BRX

YOUR AUTOMATION FOUNDATION!

PLC HARDWARE USER MANUAL

Do-more DRIVEN

AUTOMATIONDIRECT.com

BX-USER-M

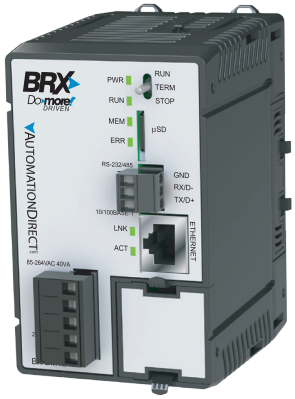
Sales: 1-800-633-0405
Tech Support: 770-844-4200
Tech Fax: 770-886-3199
www.automationdirect.com

Manual Number: BX-USER-M

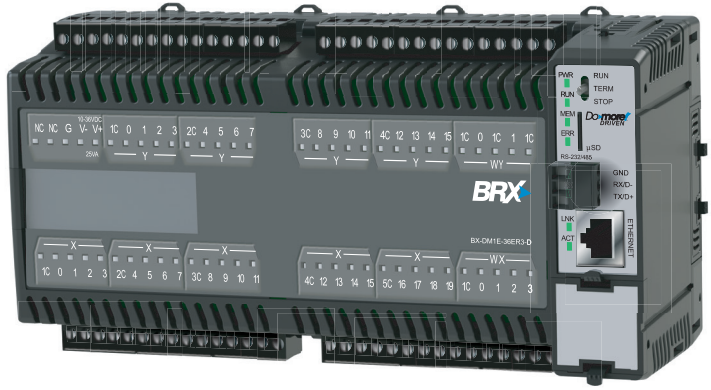
BRX Do-more! Platform

10-Point Unit

18-Point Unit



No Onboard I/O Unit



36-Point Unit

WARNING

Thank you for purchasing automation equipment from **Automationdirect.com®**, doing business as, **AutomationDirect**. We want your new automation equipment to operate safely. Anyone who installs or uses this equipment should read this publication (and any other relevant publications) before installing or operating the equipment.

To minimize the risk of potential safety problems, you should follow all applicable local and national codes that regulate the installation and operation of your equipment. These codes vary from area to area and usually change with time. It is your responsibility to determine which codes should be followed, and to verify that the equipment, installation, and operation is in compliance with the latest revision of these codes.

At a minimum, you should follow all applicable sections of the National Fire Code, National Electrical Code, and the codes of the National Electrical Manufacturer's Association (NEMA). There may be local regulatory or government offices that can also help determine which codes and standards are necessary for safe installation and operation.

Equipment damage or serious injury to personnel can result from the failure to follow all applicable codes and standards. We do not guarantee the products described in this publication are suitable for your particular application, nor do we assume any responsibility for your product design, installation, or operation.

Our products are not fault-tolerant and are not designed, manufactured or intended for use or resale as on-line control equipment in hazardous environments requiring fail-safe performance, such as in the operation of nuclear facilities, aircraft navigation or communication systems, air traffic control, direct life support machines, or weapons systems, in which the failure of the product could lead directly to death, personal injury, or severe physical or environmental damage ("High Risk Activities"). **AutomationDirect** specifically disclaims any expressed or implied warranty of fitness for High Risk Activities.

For additional warranty and safety information, see the Terms and Conditions section of our catalog. If you have any questions concerning the installation or operation of this equipment, or if you need additional information, please call us at 770-844-4200.

This publication is based on information that was available at the time it was printed. At **AutomationDirect** we constantly strive to improve our products and services, so we reserve the right to make changes to the products and/or publications at any time without notice and without any obligation. This publication may also discuss features that may not be available in certain revisions of the product.

Trademarks

This publication may contain references to products produced and/or offered by other companies. The product and company names may be trademarked and are the sole property of their respective owners. **AutomationDirect** disclaims any proprietary interest in the marks and names of others.

Copyright 2017, Automationdirect.com® Incorporated
All Rights Reserved

No part of this manual shall be copied, reproduced, or transmitted in any way without the prior, written consent of **Automationdirect.com® Incorporated**. **AutomationDirect** retains the exclusive rights to all information included in this document.

ADVERTENCIA

Gracias por comprar equipo de automatización de **Automationdirect.com**®. Deseamos que su nuevo equipo de automatización opere de manera segura. Cualquier persona que instale o use este equipo debe leer esta publicación (y cualquier otra publicación pertinente) antes de instalar u operar el equipo.

Para reducir al mínimo el riesgo debido a problemas de seguridad, debe seguir todos los códigos de seguridad locales o nacionales aplicables que regulan la instalación y operación de su equipo. Estos códigos varian de área en área y usualmente cambian con el tiempo. Es su responsabilidad determinar cuales códigos deben ser seguidos y verificar que el equipo, instalación y operación estén en cumplimiento con la revisión mas reciente de estos códigos.

Como mínimo, debe seguir las secciones aplicables del Código Nacional de Incendio, Código Nacional Eléctrico, y los códigos de (NEMA) la Asociación Nacional de Fabricantes Eléctricos de USA. Puede haber oficinas de normas locales o del gobierno que pueden ayudar a determinar cuales códigos y normas son necesarios para una instalación y operación segura.

Si no se siguen todos los códigos y normas aplicables, puede resultar en daños al equipo o lesiones serias a personas. No garantizamos los productos descritos en esta publicación para ser adecuados para su aplicación en particular, ni asumimos ninguna responsabilidad por el diseño de su producto, la instalación u operación.

Nuestros productos no son tolerantes a fallas y no han sido diseñados, fabricados o intencionados para uso o reventa como equipo de control en línea en ambientes peligrosos que requieren una ejecución sin fallas, tales como operación en instalaciones nucleares, sistemas de navegación aérea, o de comunicación, control de tráfico aéreo, máquinas de soporte de vida o sistemas de armamentos en las cuales la falla del producto puede resultar directamente en muerte, heridas personales, o daños físicos o ambientales severos ("Actividades de Alto Riesgo"). **Automationdirect.com** específicamente rechaza cualquier garantía ya sea expresada o implicada para actividades de alto riesgo.

Para información adicional acerca de garantía e información de seguridad, vea la sección de Términos y Condiciones de nuestro catálogo. Si tiene alguna pregunta sobre instalación u operación de este equipo, o si necesita información adicional, por favor llámenos al número 770-844-4200 en Estados Unidos.
Esta publicación está basada en la información disponible al momento de impresión. En **Automationdirect.com** nos esforzamos constantemente para mejorar nuestros productos y servicios, así que nos reservamos el derecho de hacer cambios al producto y/o a las publicaciones en cualquier momento sin notificación y sin ninguna obligación. Esta publicación también puede discutir características que no estén disponibles en ciertas revisiones del producto.

Marcas Registradas

Esta publicación puede contener referencias a productos producidos y/u ofrecidos por otras compañías. Los nombres de las compañías y productos pueden tener marcas registradas y son propiedad única de sus respectivos dueños. Automationdirect.com, renuncia cualquier interés propietario en las marcas y nombres de otros.

PROPIEDAD LITERARIA 2017, AUTOMATIONDIRECT.COM® INCORPORATED
Todos los derechos reservados

No se permite copiar, reproducir, o transmitir de ninguna forma ninguna parte de este manual sin previo consentimiento por escrito de **Automationdirect.com® Incorprated**. **Automationdirect.com** retiene los derechos exclusivos a toda la información incluida en este documento. Los usuarios de este equipo pueden copiar este documento solamente para instalar, configurar y mantener el equipo correspondiente. También las instituciones de enseñanza pueden usar este manual para propósitos educativos.

AVERTISSEMENT

Nous vous remercions d'avoir acheté l'équipement d'automatisation de **Automationdirect.com®**, en faisant des affaires comme, **AutomationDirect**. Nous tenons à ce que votre nouvel équipement d'automatisation fonctionne en toute sécurité. Toute personne qui installe ou utilise cet équipement doit lire la présente publication (et toutes les autres publications pertinentes) avant de l'installer ou de l'utiliser.

Afin de réduire au minimum le risque d'éventuels problèmes de sécurité, vous devez respecter tous les codes locaux et nationaux applicables régissant l'installation et le fonctionnement de votre équipement. Ces codes diffèrent d'une région à l'autre et, habituellement, évoluent au fil du temps. Il vous incombe de déterminer les codes à respecter et de vous assurer que l'équipement, l'installation et le fonctionnement sont conformes aux exigences de la version la plus récente de ces codes.

Vous devez, à tout le moins, respecter toutes les sections applicables du Code national de prévention des incendies, du Code national de l'électricité et des codes de la National Electrical Manufacturer's Association (NEMA). Des organismes de réglementation ou des services gouvernementaux locaux peuvent également vous aider à déterminer les codes ainsi que les normes à respecter pour assurer une installation et un fonctionnement sûrs.

L'omission de respecter la totalité des codes et des normes applicables peut entraîner des dommages à l'équipement ou causer de graves blessures au personnel. Nous ne garantissons pas que les produits décrits dans cette publication conviennent à votre application particulière et nous n'assumons aucune responsabilité à l'égard de la conception, de l'installation ou du fonctionnement de votre produit.

Nos produits ne sont pas insensibles aux défaillances et ne sont ni conçus ni fabriqués pour l'utilisation ou la revente en tant qu'équipement de commande en ligne dans des environnements dangereux nécessitant une sécurité absolue, par exemple, l'exploitation d'installations nucléaires, les systèmes de navigation aérienne ou de communication, le contrôle de la circulation aérienne, les équipements de survie ou les systèmes d'armes, pour lesquels la défaillance du produit peut provoquer la mort, des blessures corporelles ou de graves dommages matériels ou environnementaux («activités à risque élevé»). La société **AutomationDirect** nie toute garantie expresse ou implicite d'aptitude à l'emploi en ce qui a trait aux activités à risque élevé.

Pour des renseignements additionnels touchant la garantie et la sécurité, veuillez consulter la section Modalités et conditions de notre documentation. Si vous avez des questions au sujet de l'installation ou du fonctionnement de cet équipement, ou encore si vous avez besoin de renseignements supplémentaires, n'hésitez pas à nous téléphoner au 770-844-4200.

Cette publication s'appuie sur l'information qui était disponible au moment de l'impression. À la société **AutomationDirect**, nous nous efforçons constamment d'améliorer nos produits et services. C'est pourquoi nous nous réservons le droit d'apporter des modifications aux produits ou aux publications en tout temps, sans préavis ni quelque obligation que ce soit. La présente publication peut aussi porter sur des caractéristiques susceptibles de ne pas être offertes dans certaines versions révisées du produit.

Marques de commerce

La présente publication peut contenir des références à des produits fabriqués ou offerts par d'autres entreprises. Les désignations des produits et des entreprises peuvent être des marques de commerce et appartiennent exclusivement à leurs propriétaires respectifs. **AutomationDirect** nie tout intérêt dans les autres marques et désignations.

Copyright 2017, Automationdirect.com® Incorporated
Tous droits réservés

Nulle partie de ce manuel ne doit être copiée, reproduite ou transmise de quelque façon que ce soit sans le consentement préalable écrit de la société **Automationdirect.com® Incorporated**. **AutomationDirect** conserve les droits exclusifs à l'égard de tous les renseignements contenus dans le présent document.

Notes

Do-more! BRX Hardware Manual

AUTOMATIONDIRECT.com

Please include the Manual Number and the Manual Issue, both shown below, when communicating with Technical Support regarding this publication.

Manual Number: BX-USER-M
Issue: 2nd Edition
Issue Date: 9/17

Publication History		
Issue	**Date**	**Description of Changes**
1st Edition	02/17	Original
Rev A	03/17	Made minor corrections throughout the manual.
2nd Edition	09/17	Added Analog I/O Expansion Modules. Updated BX-P-ECOMLT specifications. Made minor corrections throughout the manual.

Notes

TABLE OF CONTENTS

Introduction

Chapter 1: General Installation and Wiring Guidelines

Safety Guidelines 1-2
Introduction to the BRX Mechanical Design 1-5
Dimensions and Installation 1-6
Mounting Guidelines 1-9
Wiring Guidelines 1-14
I/O Module Wiring Options 1-21
System Wiring Strategies 1-23

Chapter 2: BX ME Wiring

Overview 2-2
BX-DM1E-M Wiring 2-4
BX-DM1E-M-D Wiring 2-6

Chapter 3: BX 10/10E Wiring

BX 10/10E Micro PLC Units (MPUs) 3-2
Overview 3-2
BX 10/10E MPUs 3-2
BX 10/10E Wiring Termination Selection 3-5
Terminal Block Connectors 3-5
ZIPLink Prewired Cable Solutions 3-6
ZIPLink System Examples 3-7
BX 10 Micro PLC Units (MPUs) 3-8
BX-DM1-10ED1-D Wiring 3-8
BX-DM1-10ED2-D Wiring 3-14
BX-DM1-10ER-D Wiring 3-20

BX-DM1-10AR-D Wiring 3-26
BX 10E Micro PLC Units (MPUs) 3-32
BX-DM1E-10ED13-D Wiring 3-32
BX-DM1E-10ED23-D Wiring 3-40
BX-DM1E-10ER3-D Wiring 3-48
BX-DM1E-10AR3-D Wiring 3-56

Chapter 4: BX 18/18E Wiring

Overview 4-2
BX 18/18E MPUs 4-2
General Specifications 4-3
BX 18/18E MPU Wiring Termination Selection 4-5
Terminal Block Connectors 4-5
ZIPLink Pre-Wired Cable Solutions 4-7
ZIPLink System Examples 4-9
BX 18 Micro PLC Units (MPUs) 4-10
BX-DM1-18ED1 Wiring 4-10
BX-DM1-18ED1-D Wiring 4-16
BX-DM1-18ED2 Wiring 4-22
BX-DM1-18ED2-D Wiring 4-28
BX-DM1-18ER Wiring 4-34
BX-DM1-18ER-D Wiring 4-40
BX-DM1-18AR Wiring 4-46
BX 18E Micro PLC Units (MPUs) 4-52
BX-DM1E-18ED13 Wiring 4-52
BX-DM1E-18ED13-D Wiring 4-61
BX-DM1E-18ED23 Wiring 4-70
BX-DM1E-18ED23-D Wiring 4-79
BX-DM1E-18ER3 Wiring 4-88
BX-DM1E-18ER3-D Wiring 4-97
BX-DM1E-18AR3 Wiring 4-106

Chapter 5: BX 36/36E Wiring

Overview 5-2
BX 36/36E MPUs 5-2
BX 36/36E Wiring Termination Selection 5-5

Terminal Block Connectors 5-5
ZIPLink Pre-Wired Cable Solutions 5-7
ZIPLink System Examples 5-9
BRX 36 Micro PLU Units (MPUs) 5-10
BX-DM1-36ED1 Wiring 5-10
BX-DM1-36ED1-D Wiring 5-16
BX-DM1-36ED2 Wiring 5-22
BX-DM1-36ED2-D Wiring 5-28
BX-DM1-36ER Wiring 5-34
BX-DM1-36ER-D Wiring 5-40
BX-DM1-36AR Wiring 5-46
BX 36E Micro PLC Units (MPUs) 5-52
BX-DM1E-36ED13 Wiring 5-52
BX-DM1E-36ED13-D Wiring 5-61
BX-DM1E-36ED23 Wiring 5-70
BX-DM1E-36ED23-D Wiring 5-79
BX-DM1E-36ER3 Wiring 5-88
BX-DM1E-36ER3-D Wiring 5-97
BX-DM1E-36AR3 Wiring 5-106

Chapter 6: BRX Pluggable Option Module (POM)

Overview 6-2
General Specifications 6-2
Module Installation 6-3
BX-P-SER2-TERM 6-4
BX-P-SER4-TERM 6-6
BX-P-SER2-RJ12 6-8
BX-P-ECOMLT 6-9
BX-P-USB-B 6-10

Chapter 7: BRX Digital I/O Expansion Modules

Overview 7-2
Module Types 7-3
Discrete Input Modules 7-3
Discrete Output Modules 7-3
Discrete Combo Input/Output Modules 7-4

Wiring Termination Options 7-5
Terminal Block Connectors 7-5
ZIPLink Wiring System 7-6
General Specifications 7-8
Module Installation 7-9
BX-08NF3 Sinking/Sourcing 3–5 VDC Input 7-10
BX-xxND3 Sinking/Sourcing 12–24 VDC Input 7-11
BX-xxNB 12–24 VAC Input 7-13
BX-xxNA 120–240 VAC Input 7-15
BX-xxTD1 Sinking 12–24 VDC Output 7-17
BX-xxTD2 Sourcing 12–24 VDC Output 7-19
BX-xxTR Relay Output 7-21
BX-05TRS Relay Output 7-23
BX-xxTA 120–240 VAC Output 7-24
BX-08CD3R Combination DC Input/Relay Output 7-26
BX-xxCD3D1 Combination DC Input/Sinking DC Output 7-29
BX-xxCD3D2 Combination DC Input/Sourcing DC Output 7-32

Chapter 8: BRX Analog I/O Expansion Modules

Overview 8-2
Module Types 8-2
Wiring Termination Options 8-4
General Specifications 8-6
Dimensional Information 8-6
Module Installation 8-7
Module Configuration 8-8
Analog Tips and Troubleshooting 8-9
BX-08AD-1 Analog Current Sinking Input 8-16
BX-08AD-2B Analog Voltage Input 8-21
BX-04THM Thermocouple Input 8-26
BX-08DA-1 Analog Current Source Output 8-32
BX-08DA-2B Analog Voltage Output 8-37

Chapter 9: Future Release of BRX Specialty Expansion Modules

Chapter 10: BRX Do-more! Designer Getting Started

Overview 10-2
Before You Begin 10-3
BRX Do-more! Designer System Requirements 10-4
Step 1: Install Do-more! Designer Software 10-5
Step 2: Launch the Do-more! Designer Software 10-8
Step 3: Prepare the Hardware 10-11
Step 4: Apply Power to the PLC 10-14
Step 5: Establish PC to BRX MPU Communications 10-15
Step 6: Verify Hardware Configuration 10-20
Step 7: Create a Ladder Logic Program 10-23
Step 8: Save Project 10-33
Step 9: Write Project to the BRX MPU 10-34
Step 10: Testing Project Using Data View 10-37
Do-more Designer Software and Firmware Updates 10-41
Updating the Firmware 10-42
Live Update 10-45
Update Operating System 10-46
Update Gate Array and Loader 10-48
Dashboard 10-50
Help File 10-53

Chapter 11: BRX Do-more! CPU Specifications

The BRX Platform 11-2
BRX Do-more! CPU Common Specifications 11-3
Memory Features 11-5
CPU Status Indicators 11-7
Mode Switch Functions 11-8
DIP Switch Specifications 11-9
Battery Replacement 11-12
microSD Slot 11-13
Customizing the Logo Window 11-14
RS-232/485 Port Specifications 11-15
Ethernet Port Specifications 11-17

POM Slot 11-17

Chapter 12: BRX Do-more! Onboard Motion Control and Highspeed I/O

Overview 12-2
Unsuitable Applications 12-3
BRX Wiring Examples: High-Speed Inputs 12-4
BRX Wiring Examples: High-Speed Outputs, continued 12-8
Available High-Speed Input and Output Features 12-11
1. Input Filters 12-12
2. Interrupt Setup 12-14
3. High-Speed I/O 12-23
BRX High-Speed Examples 12-34
BRX High-speed Instructions 12-56
AXCAM 12-57
AXCONFIG 12-63
AXFOLLOW 12-67
AXGEAR 12-71
AXHOME 12-75
AXJOG 12-82
AXPOSSCRV 12-84
AXPOSTRAP 12-89
AXRSTFAULT 12-94
AXSETPROP 12-96
AXVEL 12-99
TDODECFG 12-102
TDOPLS 12-104
TDOPRESET 12-114

Chapter 13: BRX Do-more! Communications

Overview 13-3
Terminology 13-3
General Concepts 13-4
USB Communications 13-5
Serial Communications 13-6
RS-232 13-6
RS-485 13-8

Serial Port Settings 13-10
Serial Protocols 13-13
MRX Instruction 13-16
MWX Instruction 13-18
K-Sequence 13-20
ASCII 13-21
STREAMIN Instruction 13-22
STREAMOUT Instruction 13-24
Ethernet 13-26
Wiring 13-27
IP Addressing and Subnets 13-27
Port Numbers 13-28
Ethernet Protocols 13-29
PEERLINK Instruction 13-29
Do-more! Protocol 13-30
RX 13-30
WX 13-34
Modbus TCP/IP 13-38
MRX Instruction 13-40
MWX Instruction 13-42
HOST Ethernet Protocol 13-44
DLRX 13-45
DLWX 13-47
EtherNet/IP (Explicit Messaging) 13-49
EtherNet/IP Client (Master) 13-52
SMTP – EMAIL 13-57
EMAIL 13-60

Chapter 14: Future Release of BRX Remote I/O

Chapter 15: BRX Do-more! Maintenance and Troubleshooting

Hardware Maintenance 15-2
Diagnostics 15-3
CPU Indicators 15-5
PWR Indicator 15-6
RUN Indicator 15-7

ERR Indicator 15-7
Communications Problems 15-7
I/O Troubleshooting 15-8
Noise Troubleshooting 15-10

Appendix A: EU Directives (CE)

European Union (EU) Directives A-2
Basic EMC Installation Guidelines A-5

Appendix B: BRX MPU Power Budgeting

Power Budget Form B-2
Power Budget Worksheet B-3
BRX MPU Available Expansion Power B-4
BRX MPU POM Power Consumed B-5
BRX MPU Expansion Module Power Consumed B-6
Power Budget Examples B-9

INTRODUCTION: BRX PLATFORM

BRX Introduction ii

Conventions Used iii

BRX Overview iv

BRX Platform v

User Manual Layout vi

BRX Introduction

Purpose of this Manual

The hardware user manual provides information that will help you install, set up, program, troubleshoot, and maintain your BRX platform. The user manual also includes information that is critical to the safety of the personnel who will install and use the controller, and to the integrity of machinery, processes, and equipment controlled by the BRX Micro PLC Unit (MPU).

The manual also includes important information about power and signal wiring, mounting of the BRX MPU, and configuring the BRX MPU system.

About Getting Started

If you are familiar with programmable controllers in general, then following the simple steps in this manual may be all you require to start being productive using a BRX Do-more MPU system. After you have completed the steps, your BRX MPU will be running the ladder logic project that you programmed.

Online Help Files and Other Documentation

BRX Do-more! Designer programming software is available as a download from our website.

See http://support.automationdirect.com/products/domore.html.

The Do-more! Designer software includes researchable online help topics covering all aspects of the software, instruction set, module setup, and communications.

In addition, each BRX MPU, I/O expansion module and Pluggable Option Module (POM) module ships with an insert document containing technical data and installation instructions.

Technical Support

We have an extensive library of free online videos that cover a vast array of technical topics. Follow this link: https://www.automationdirect.com/videos/tutorials, and chose the "In-depth Product Tutorials" tab for product specific videos.

If you cannot find the solution to your particular situation, or, if for any reason you need additional technical assistance, our technical support group is glad to work with you in answering your questions. Please contact us at:

By Telephone: 770-844-4200

(Mon.-Fri., 9:00 a.m. to 6:00 p.m. E.T.)

On the Web: **support.automationdirect.com**

We also encourage you to visit our web site where you can find technical and non-technical information about our products and our company.

Visit us at **www.automationdirect.com**

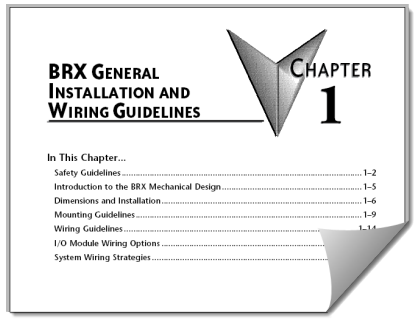
Conventions Used

When you see the "note pad" icon in the left-hand margin, the paragraph to its immediate right will be a special note. Notes represent information that may make your work quicker or more efficient. The word ***NOTE:*** *in boldface will mark the beginning of the text.*

When you see the "exclamation point" icon in the left-hand margin, the paragraph to its immediate right will be a warning. This information could prevent injury, loss of property, or even death in extreme cases. Any warning in this manual should be regarded as critical information that should be read in its entirety. The word WARNING in boldface will mark the beginning of the text.

Key Topics for Each Chapter

The beginning of each chapter will list the key topics that can be found in that chapter.


BRX General Installation and Wiring Guidelines

Chapter 1

In This Chapter...

Safety Guidelines 1–2
Introduction to the BRX Mechanical Design 1–5
Dimensions and Installation 1–6
Mounting Guidelines 1–9
Wiring Guidelines 1–14
I/O Module Wiring Options 1–14
System Wiring Strategies 1–14

BRX Overview

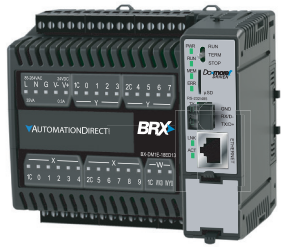
The BRX platform is a very versatile modular Micro PLC system that combines powerful features in a compact, standalone footprint. The BRX platform is designed to be used as a stand-alone controller or can be expanded using a wide variety of expansion modules that easily snap onto the side of any BRX Micro PLC Unit (MPU) creating a sturdy and rugged PLC platform. The foundation of the platform consists of 4 unique MPU form factors that provide for a strong system design to fit your application requirements precisely while keeping the cost of the system to a minimum. Shown below are the four unique Micro PLC form factors.

BX ME
No Built-In I/O
Ethernet Port

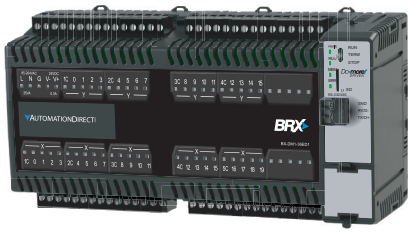
BX 10
10 Discrete I/O
No Analog I/O
No Ethernet Port

BX 10E
10 Discrete I/O
2 Analog I/O
Ethernet Port

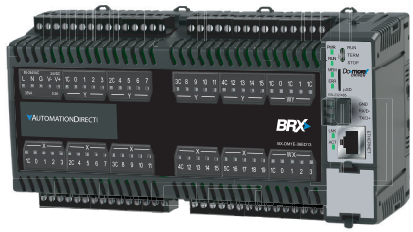
BX 18
18 Discrete I/O
No Analog I/O
No Ethernet Port



BX 18E
18 Discrete I/O
2 Analog I/O
Ethernet Port



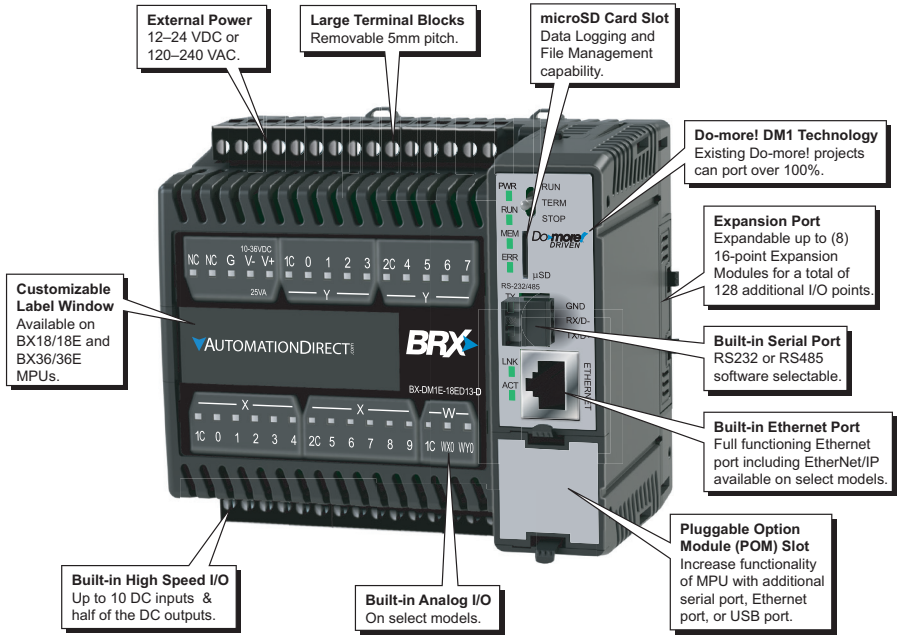
BX 36
36 Discrete I/O
No Analog I/O
No Ethernet Port



BX 36E
36 Discrete I/O
6 Analog I/O
Ethernet Port

BRX Platform

Below is a quick look at some of the standard features available on the BRX Platform.



The BRX platform allows you to choose from various communications ports. All BRX MPU models have a built-in RS232C/485 (software-selectable) serial port. However, an RJ45 Ethernet port (10/100Mbps) is provided on select units. With support for EtherNet/IP, Modbus TCP, Modbus RTU, ASCII, K-sequence (DirectLOGIC users) and custom protocols, the BRX MPU platform provides supreme versatility for any application. In addition, all BRX MPUs have an extra plug-in slot that allows for additional user-selected communications port. These optional communications ports are called Pluggable Option Modules (POMs) and are available in 3-pin serial RS232, RJ12 serial RS232, 3-pin serial RS485, USB and Ethernet versions. Simply choose the extra port you want, plug it in and go.

BRX hardware is built to last and is engineered, assembled and supported right here in America; designed and fabricated by industrial automation veterans with hardware facilities in Tennessee and Florida. The compact modular architecture results in an outstanding controller package, with high performance, a small footprint, at a very low cost. The BRX platform is an extremely versatile modular system that you can customize to your specific controller needs. BRX has four distinct form factors, built-in high-speed I/O, motion control, an interchangeable communications port, on-board analog I/O, and many I/O expansion modules from which to choose. The BRX MPU platform allows you to build the ideal controller for your application that delivers the quality and reliability you expect at an unexpectedly lower cost.

BRX Platform, Continued

FREE, fully-functional Do-more! Designer programming software was developed to be powerful, flexible and easy to use. The user-friendly, fill-in-the-blank software design makes complex operations like PID and motion control a cinch. It is available to download online whenever you choose, as often as you'd like. Take it for a spin or start your project immediately, there are never any licensing fees or service charges.

User Manual Layout

This BRX user manual is intended to be used as a reference manual for the BRX hardware. It is laid out into 3 sections as follows:

Installation, Wiring and Specifications

- Chapter 1: Hardware Installation, General Wiring Guidelines and Strategies
- Chapter 2: BX ME Wiring
- Chapter 3: BX 10/10E Wiring
- Chapter 4: BX 18/18E Wiring
- Chapter 5: BX 36/36E Wiring
- Chapter 6: Pluggable Option Module (POM)
- Chapter 7: Digital I/O Expansion Modules
- Chapter 8: Analog Expansion Modules (For Future Release)
- Chapter 9: Specialty Expansion Modules (For Future Release)

Programming and Software

- Chapter 10: BRX Do-more! Designer Getting Started
- Chapter 11: BRX Do-more! CPU Specifications
- Chapter 12: High Speed I/O and Motion Control
- Chapter 13: Communications
- Chapter 14: Remote I/O (For Future Release)

Maintenance and Troubleshooting

- Chapter 15: Maintenance and Troubleshooting
- Appendix A: EU Directive
- Appendix B: Power Budgeting

General Installation and Wiring Guidelines

In This Chapter...

Safety Guidelines 1-2
Introduction to the BRX Mechanical Design 1-5
Dimensions and Installation 1-6
Mounting Guidelines 1-9
Wiring Guidelines 1-14
I/O Module Wiring Options 1-21
System Wiring Strategies 1-23

1 Safety Guidelines

NOTE: *Products with CE marks perform their required functions safely and adhere to relevant standards as specified by CE directives provided they are used according to their intended purpose and that the instructions in this manual are adhered to. The protection provided by the equipment may be impaired if this equipment is used in a manner not specified in this manual. A listing of our international affiliates is available on our Web site at http://www.automationdirect.com.*

WARNING: Providing a safe operating environment for personnel and equipment is your responsibility and should be your primary goal during system planning and installation. Automation systems can fail and may result in situations that can cause serious injury to personnel or damage to equipment. Do not rely on the automation system alone to provide a safe operating environment. You should use external electromechanical devices, such as relays or limit switches, that are independent of the MPU application to provide protection for any part of the system that may cause personal injury or damage. Every automation application is different, so there may be special requirements for your particular application. Make sure you follow all national, state, and local government requirements for the proper installation and use of your equipment.

Plan for Safety

The best way to provide a safe operating environment is to make personnel and equipment safety part of the planning process. You should examine every aspect of the system to determine which areas are critical to operator or machine safety. If you are not familiar with PLC system installation practices, or your company does not have established installation guidelines, you should obtain additional information from the following sources.

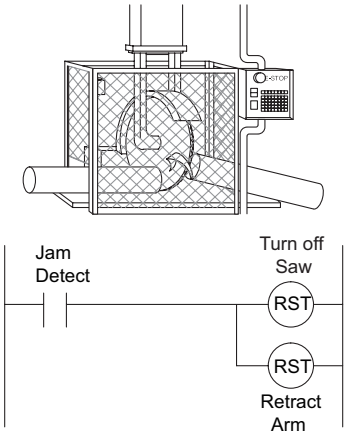
- NEMA — The National Electrical Manufacturers Association, located in Washington, D.C., publishes many different documents that discuss standards for industrial control systems. You can order these publications directly from NEMA. Some of these include:
  ICS 1, General Standards for Industrial Control and Systems
  ICS 3, Industrial Systems
  ICS 6, Enclosures for Industrial Control Systems
- NEC — The National Electrical Code provides regulations concerning the installation and use of various types of electrical equipment. Copies of the NEC Handbook can often be obtained from your local electrical equipment distributor or your local library.
- Local and State Agencies — many local governments and state governments have additional requirements above and beyond those described in the NEC Handbook. Check with your local Electrical Inspector or Fire Marshall office for information.

Three Levels of Protection

WARNING: The control program must not be the only form of protection for any problems that may result in a risk of personal injury or equipment damage.

The publications mentioned provide many ideas and requirements for system safety. At a minimum, you should follow these regulations. Also, you should use the following techniques, which provide three levels of system control.

1. Orderly system shutdown sequence in the MPU control program.
2. Mechanical disconnect for output module power.
3. Emergency stop switch for disconnecting system power.



Orderly System Shutdown

The first level of fault detection is ideally the MPU control program in which you would identify any likely problems. Certain shutdown sequences should be performed. Some types of problems that are likely to occur are issues such as jammed parts or other process failures, that may not pose a risk of personal injury or equipment damage however, would need to be cleared prior to restarting the MPU control program.

System Power Disconnect

You should also use electromechanical devices, such as master control relays and/or limit switches, to prevent accidental equipment startup at an unexpected time. These safety devices should be installed in a manner that will prevent any machine operations from occurring where there maybe a possibility of injury to personnel or equipment.

For example, if the machine in the illustration above has a jammed part, the MPU control program can turn off the saw blade and retract the arbor. If the operator must open the guard to remove the part, you should also include a bypass switch that disconnects all system power any time the guard is opened.

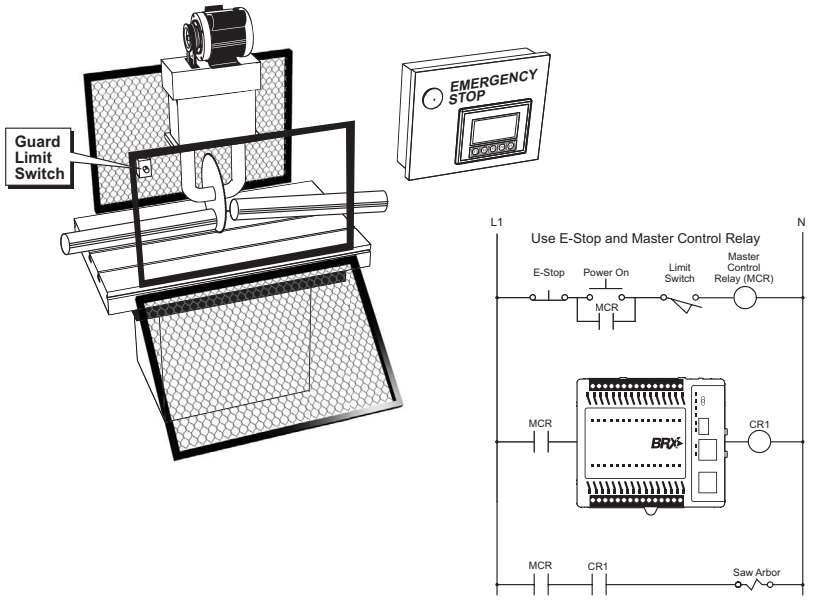
Emergency Stop Circuits

Emergency stop (E-Stop) circuits are a critical part of automation safety. For each machine controlled by an MPU, provide an E-Stop device that is hardwired external to the MPU and easily accessed by the machine operator.

E-stop devices are commonly hardwired through a master control relay (MCR) or a safety control relay (SCR) that will isolate power from the MPU I/O system in an emergency.

MCRs and SCRs provide a convenient means for removing power from the I/O system during an emergency situation. By de-energizing an MCR (or SCR) coil, power to the input (optional) and output devices is removed. This event occurs when any emergency stop switch opens. However, the MPU continues to receive power and operate even though all its inputs and outputs are disabled.

The MCR circuit could be extended by placing an MPU fault relay (closed during normal MPU operation) in series with any other emergency stop conditions. This would cause the MCR circuit to drop the MPU I/O power in case of an MPU failure (memory error, I/O communications error, etc.).

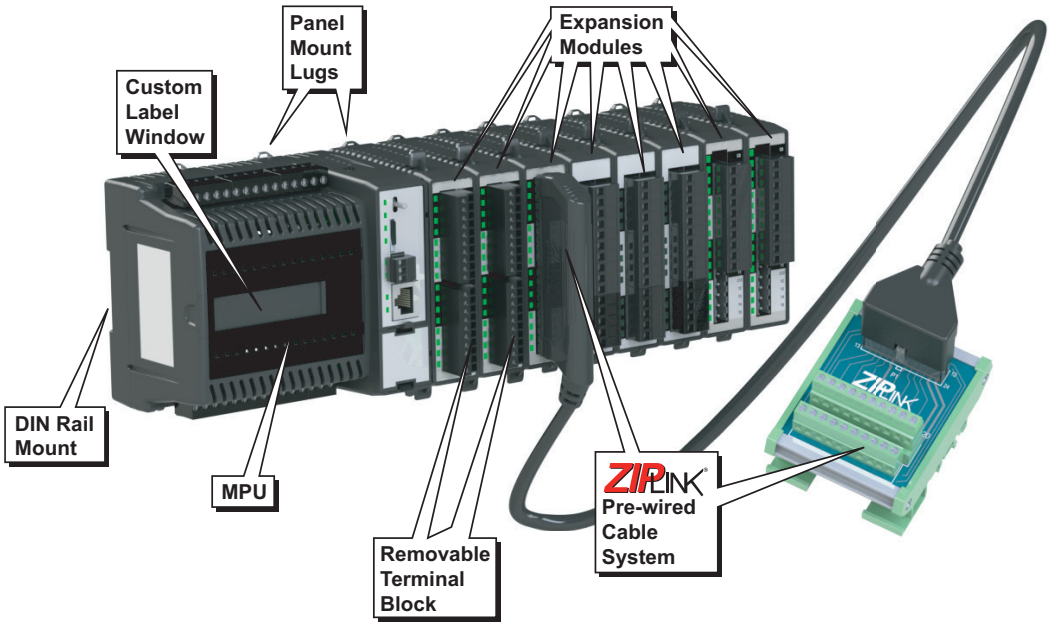


WARNING: For some applications, field device power may still be present on the terminal block even though the MPU is turned off. To minimize the risk of electrical shock, remove all field device power before you expose or remove MPU wiring.

Introduction to the BRX Mechanical Design

The BRX platform is designed to be used as a stand-alone controller or can be expanded. Using a combination of expansion modules, that simply snap on, you can create a sturdy and rugged PLC platform that can handle all your automation control applications.

Typical BRX Do-more Platform System



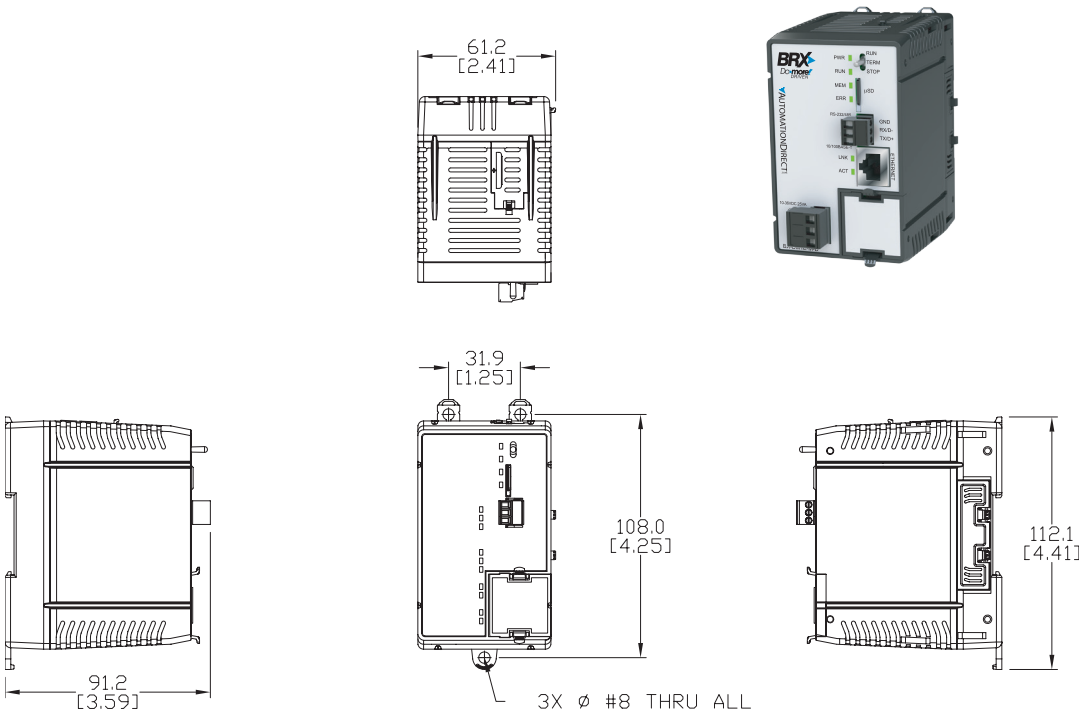
1 Dimensions and Installation

Before installing the BRX Micro PLC Unit (MPU) you will need to know the dimensions of the components considered. The diagrams on the following pages provide the nominal dimensions of each MPU series and Expansion modules, which you can use when designing your enclosure. Remember to leave room for potential expansion to the right of the MPU.

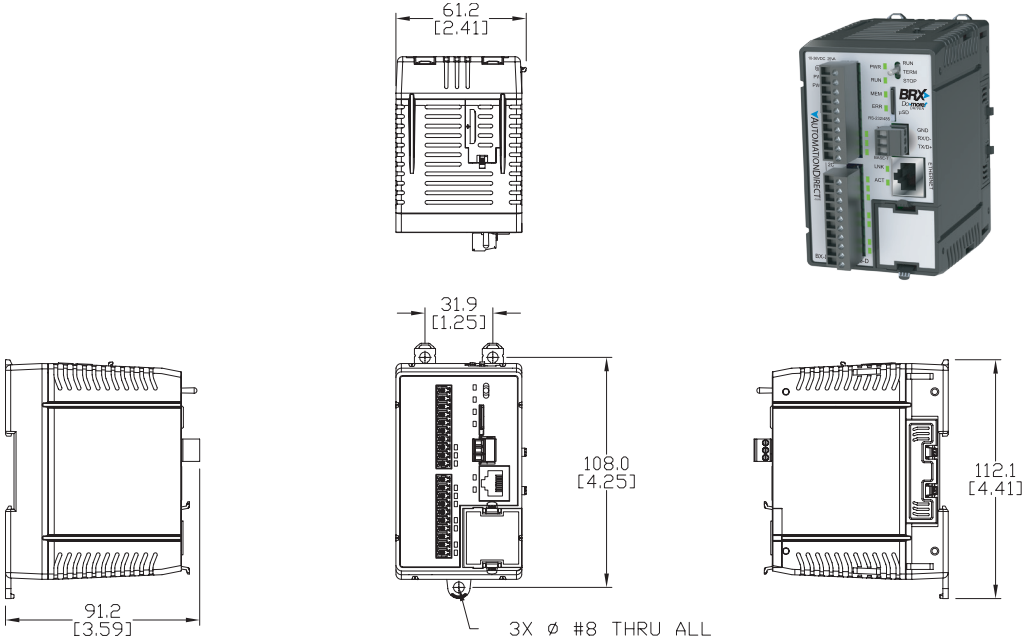
The height is the same for all components. The width varies depending on your choice of MPU and expansion modules. Allow adequate space to the right of MPU for mounting and dismounting additional Expansion modules. The BRX platform is designed to be mounted on standard 35mm DIN rail, or it can be surface mounted. Make sure you follow the installation guidelines for proper unit spacing.

NOTE: *Downloadable Dimensional drawings for MPUs and Expansion modules are available at AutomationDirect.com.*

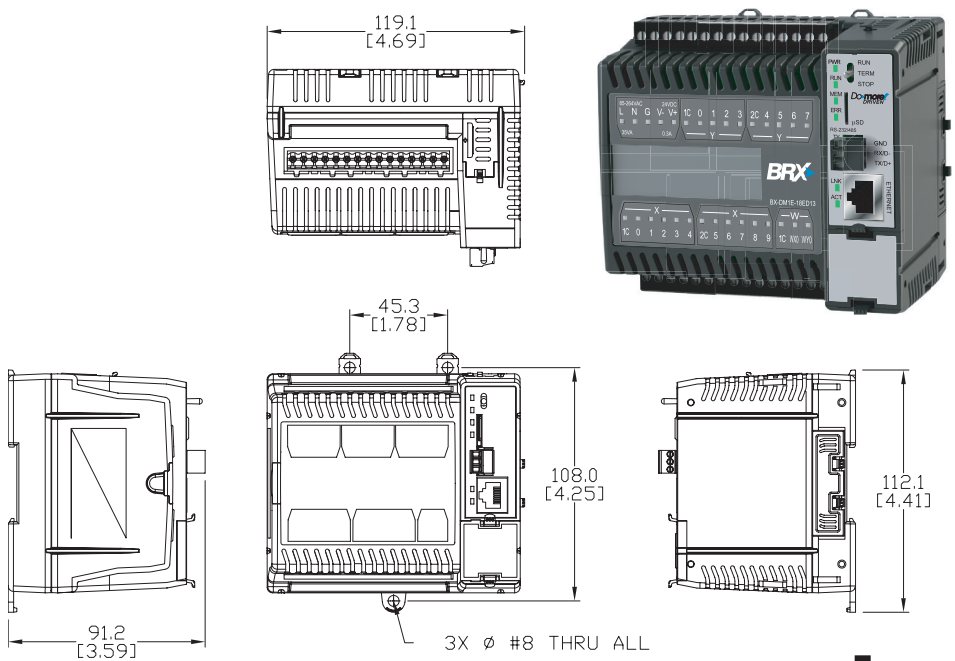
BX ME MPU Dimensions, mm[inch]



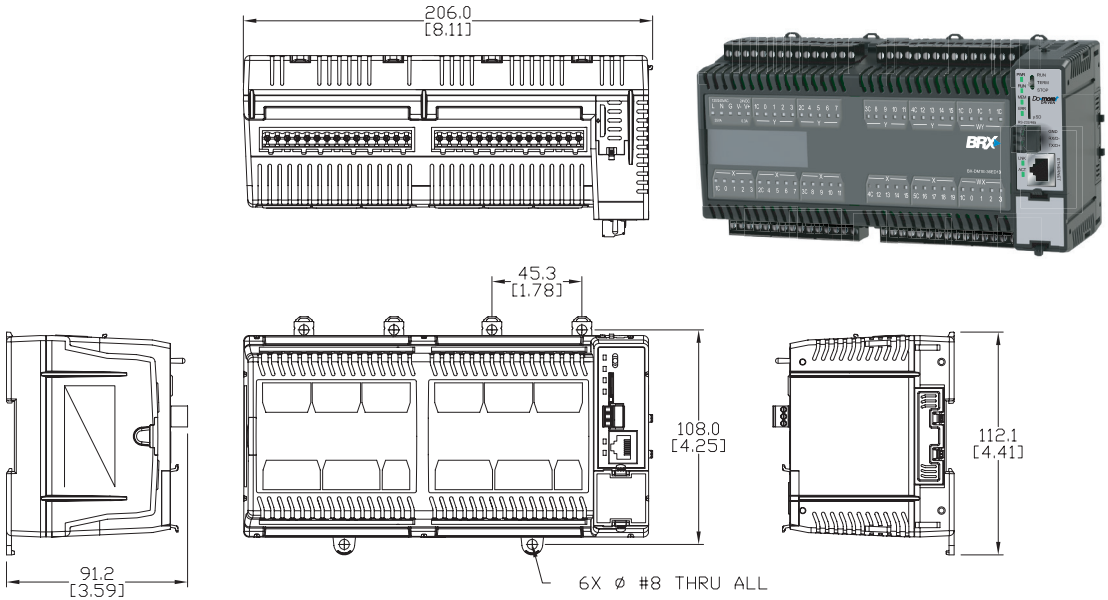
BX 10/10E MPU Dimensions, mm[inch]



BX 18/18E MPU Dimensions, mm[inch]

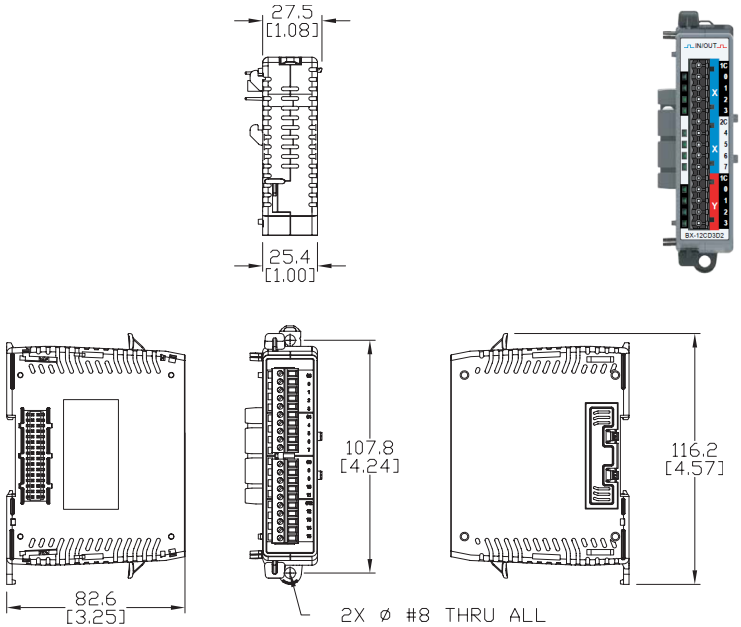


BX 36/36E Modules Dimensions, mm[inch]



BRX Expansion Modules Dimensions, mm[inch]

NOTE: *Allow a minimum of 45mm (1.75 in) to the right of MPU chassis for mounting and dismounting Expansion modules.*



Mounting Guidelines

Enclosures

Your selection of a proper enclosure is important to ensure safe and proper operation of your BRX platform system. Applications for the BRX platform can vary and may require additional hardware considerations. The minimum considerations for enclosures include:

- Conformance to electrical standards
- Protection from the elements in an industrial environment
- Common ground reference
- Maintaining specified ambient temperature
- Access to the equipment
- Security or restricted access
- Sufficient space for proper installation and maintenance of the equipment

Mounting Position

Mount the BRX MPU horizontally, as shown in the illustration on the following page, to provide proper ventilation. Do not mount the BRX MPU vertically, upside down, or on a flat horizontal surface.

Mounting Clearances

Provide a minimum clearance of 2 inches (50mm) on all sides of the BRX MPU:

- Between the MPU and all sides of the enclosure.
- Between the MPU and enclosure door mounted operator panels and other door mounted items.
- Between the MPU and any wire duct.

Grounding

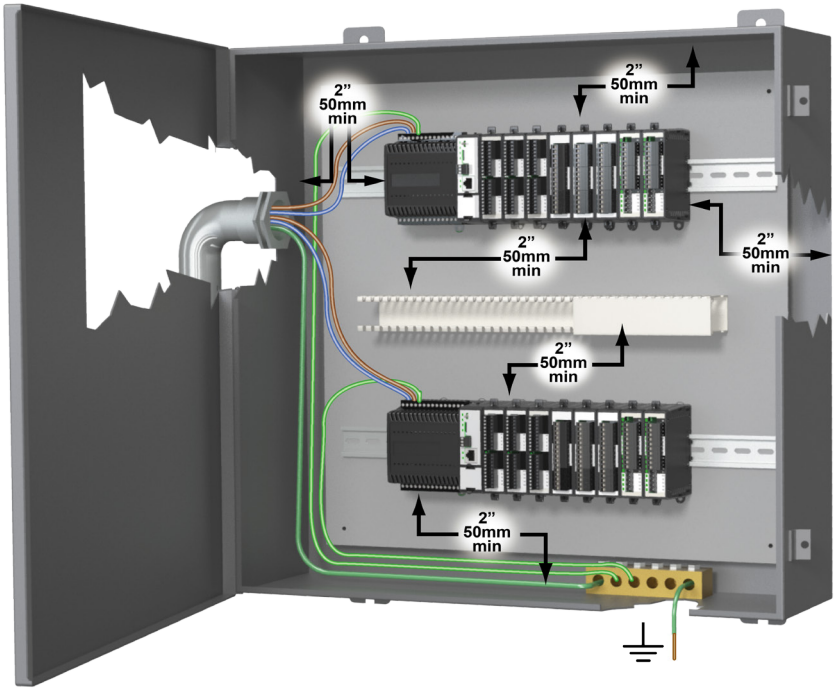
A good common ground reference (earth ground) is essential for proper operation of the BRX platform. One side of all control circuits, power circuits and the ground lead must be properly connected to earth ground by either installing a ground rod in close proximity to the enclosure or by connecting to the incoming power system ground. There must be a single-point ground (i.e. copper bus bar) for all devices in the enclosure that require an earth ground.

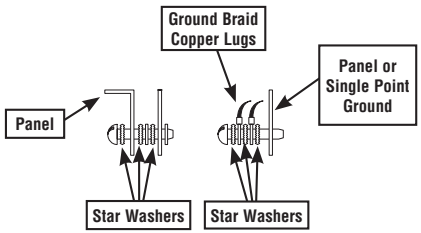
Temperature Considerations

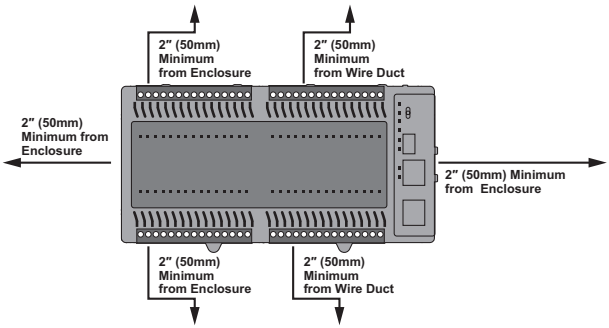
The BRX platform should be installed in an operating environment that complies with the equipment temperature specifications (Please review Chapter 11 for information about environmental specifications). If the enclosure temperature has the potential to fluctuate above or below the specifications, cooling or heating the enclosure should be considered.

Power Considerations

The BRX platform units have a wide range of DC or AC power supply options. Some require a 12–24 VDC power supply where others are capable of using 120–240 VAC power supply. The BRX platform requires the use of EMF/RFI line noise filters on the AC power supply to achieved CE certification. Please review the European Union (CE) material in Appendix A for more information.

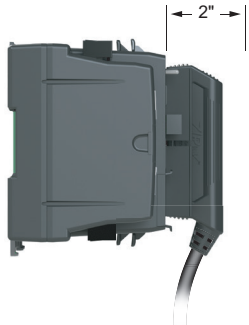






NOTE: Removable terminal block kits and ***ZIP***Link wiring systems are sold separately. Detailed information is available in the BRX MPU Wiring chapters.

NOTE: Add 2" to mounting depth when using ***ZIP***Link cable.



In addition to the panel layout guidelines, other specifications can affect the installation of an MPU. Always consider the following:

- Environmental Specifications
- Power Requirements
- Agency Approvals
- Enclosure Selection and Component Dimensions

WARNING: Do not disconnect equipment unless power has been switched off or the area is known to be non–hazardous.

Agency Approvals

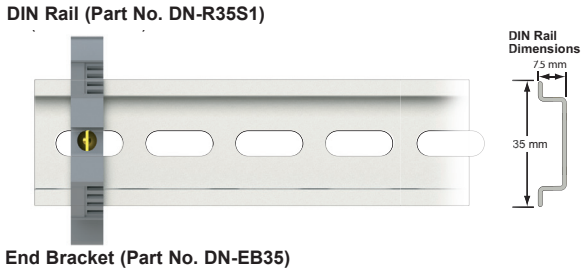
Some applications require agency approvals for particular components. The BRX platform agency approvals are listed below:

- UL (Underwriters' Laboratories, Inc.)
- CUL (Canadian Underwriters' Laboratories, Inc.)
- CE (European Economic Union)

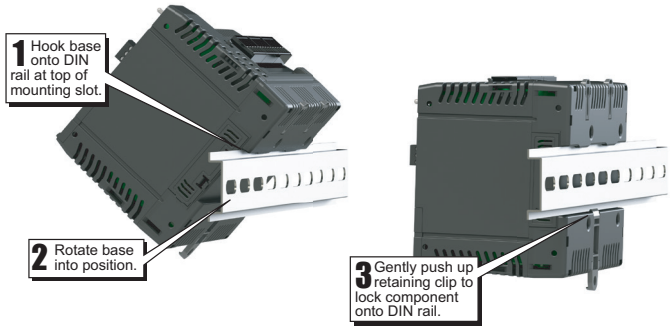
NOTE: *See the "EU Directives(CE)" in Appendix A in this manual for more information.*

Using DIN Rail Mounts

The BRX platform can be secured to the cabinet using DIN rails. Use DIN rail that conforms to DIN EN standard 50022. We offer a complete line of DIN rail and DIN rail mounted apparatus. These rails are approximately 35mm high, with a depth of 7.5 mm. If you mount the BRX MPU on a rail, you should also consider using end brackets on each side. The end brackets keep the BRX MPU from sliding horizontally along the rail. This minimizes the possibility of accidentally pulling connecting circuit wiring loose.

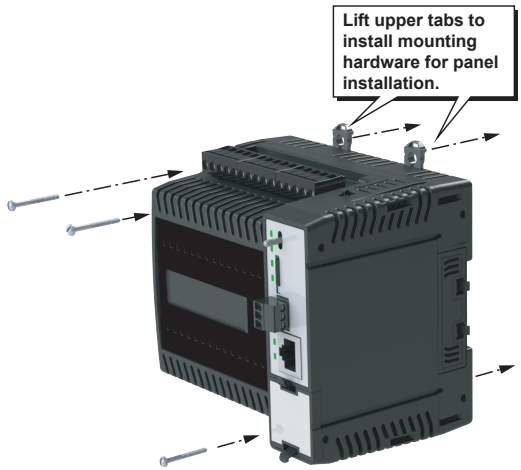


If you examine the bottom of the BRX MPU, you'll notice retaining clips. To secure to a DIN rail, hook the unit on to the DIN rail at the top of the mounting slot and gently press on the bottom of the unit until the unit snaps on to the DIN rail. The clips lock the BRX MPU onto the rail. To remove, pull down on the bottom retaining clips, slightly rotate the unit away from the DIN rail, lift the unit up off the DIN rail and pull it away from the rail.



Direct Panel Mount

The BRX MPU can be surface mounted directly to a panel. Along the back, top and bottom, of the BRX MPU you will find tabs with holes. Pull these out revealing mounting holes through which to screw down the BRX MPU to a panel, without the need for a DIN rail.



Installing the Expansion I/O Modules

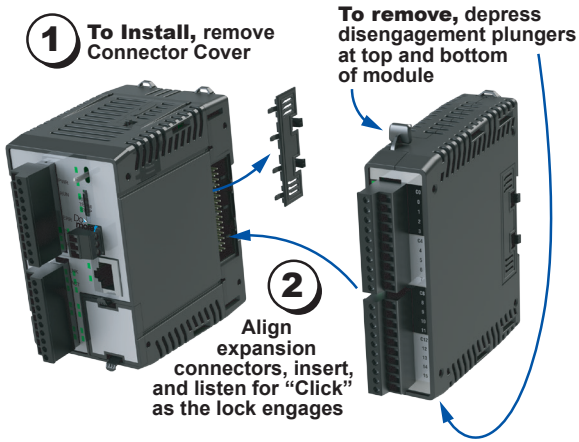
You can add additional I/O points to the BRX MPU by installing expansion I/O modules. Information on how many expansion modules are supported is found in the chapter associated with each of the BRX MPUs.

NOTE: *Allow a minimum of 45mm (1.75 in) to the right of MPU chassis or Expansion Modules for mounting and dismounting Expansion modules.*

Expansion modules are installed to the right of the BRX MPU. Before installing the module, be sure the expansion connector cover is removed.

When adding Expansion modules to a DIN rail mounted BRX MPU, the Expansion Module must be mounted to the rail first then connected to the BRX MPU. To install the expansion module on DIN rail, place the module onto the top of the rail and gently push the bottom down and in towards the rail. The spring loaded retaining clips will snap into the rail keeping the module on the rail. Slide the module to the left until it locks into the BRX MPU.

To install the expansion module to a panel mounted BRX MPU, align the expansion module connector with the MPU expansion slot and insert into the BRX MPU until it locks into place. Pull out the top and bottom screw mount tabs and screw the expansion module into the panel.



IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

1

Wiring Guidelines

Power Wiring Connection

Connect the power source wiring for the BRX MPU as shown. Observe the precautions stated in this manual.

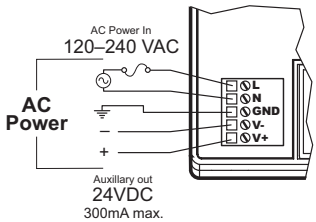
See the appropriate BRX MPU wiring chapter in this manual for technical specifications on wire size and screw torque recommendations on various terminal block connections available.

NOTE: *With external power supply off, terminal block may be removed for ease of wiring and then reinserted prior to applying power to the MPU.*

BX ME MPUs

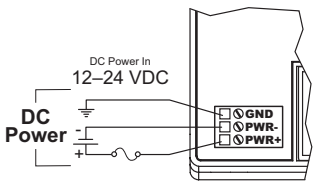
Power Supply Connections

AC Powered Units	
Part Number	**External Power**
BX-DM1E-M	120–240 VAC



BX-DM1E-M
120–240 VAC

DC Powered Units	
Part Number	**External Power**
BX-DM1E-M-D	12–24 VDC



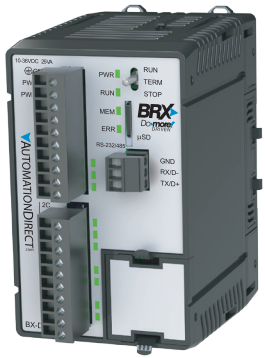
BX-DM1E-M-D
12–24 VDC

BRX 10/10E MPUs

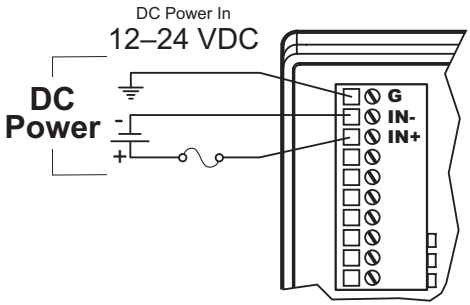
Power Supply Connections

All BX 10/10E MPUs require 12–24 VDC external power supply. With power supply off, the terminal block may be removed for ease in wiring and then reinserted prior to applying power to the MPU. Follow the wiring termination diagram below for proper power supply connections.

DC Powered Units	
Part Number	**External Power**
BX 10 MPUs	12–24 VDC
BX-DM1-10ED1-D	
BX-DM1-10ED2-D	
BX-DM1-10ER-D	
BX-DM1-10AR-D	
BX 10E MPUs	
BX-DM1E-10ED13-D	
BX-DM1E-10ED23-D	
BX-DM1E-10ER3-D	
BX-DM1E-10AR3-D	



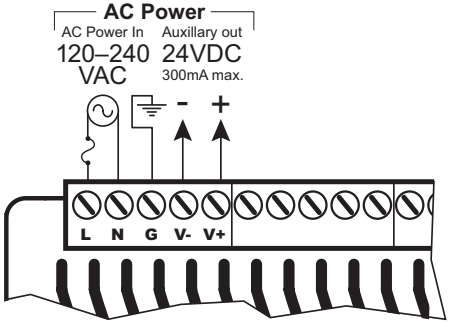
BX 10 Micro PLC Unit (MPU)
No Built-in Analog or Ethernet



BX 18/18E MPUs

Power Supply Connections, 120–240 VAC

AC Powered Units	
Part Number	**External Power**
BX 18 MPUs	120–240 VAC
BX-DM1-18ED1	
BX-DM1-18ED2	
BX-DM1-18ER	
BX-DM1-18AR	
BX 18E MPUs	
BX-DM1E-18ED13	
BX-DM1E-18ED23	
BX-DM1E-18ER3	
BX-DM1E-18AR3	

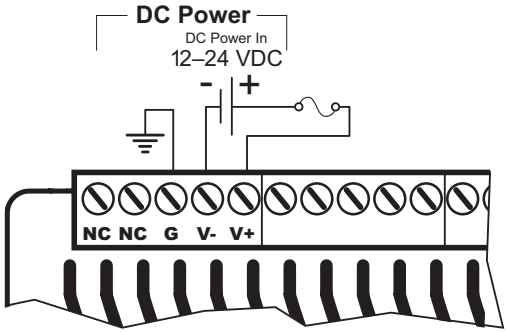


WARNING: **Do not exceed the 24VDC auxiliary power supply load limit of 300mA**

BX 18/18E MPUs, Continued

Power Supply Connections, 12–24 VDC

DC Powered Units	
Part Number	**External Power**
BX 18 MPUs	12–24 VDC
BX-DM1-18ED1-D	
BX-DM1-18ED2-D	
BX-DM1-18ER-D	
BX 18E MPUs	
BX-DM1E-18ED13-D	
BX-DM1E-18ED23-D	
BX-DM1E-18ER3-D	

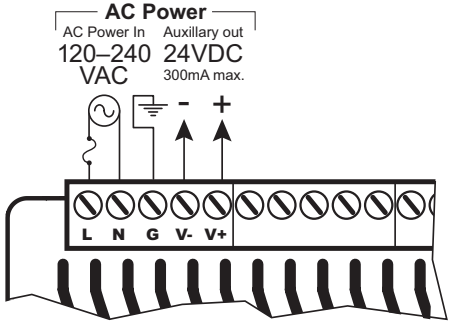


WARNING: **No External AC power supply needed on this unit. The two terminals marked "NC" are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!**

BX 36/36E MPUs

Power Supply Connections, 120–240 VAC

AC Powered Units	
Part Number	**External Power**
BX 36 MPUs	120–240 VAC
BX-DM1-36ED1	
BX-DM1-36ED2	
BX-DM1-36ER	
BX-DM1-36AR	
BX 36E MPUs	
BX-DM1E-36ED13	
BX-DM1E-36ED23	
BX-DM1E-36ER3	
BX-DM1E-36AR3	

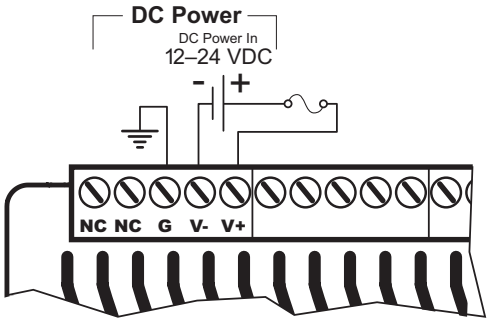


WARNING: **Do not exceed the 24VDC auxiliary power supply load limit of 300mA**

BX 36/36E MPUs, Continued

Power Supply Connections, 12–24 VDC

DC Powered Units	
Part Number	**External Power**
BX 36 MPUs	12–24 VDC
BX-DM1-36ED1-D	
BX-DM1-36ED2-D	
BX-DM1-36ER-D	
BX 36E MPUs	
BX-DM1E-36ED13-D	
BX-DM1E-36ED23-D	
BX-DM1E-36ER3-D	



WARNING: **No External AC power supply needed on this unit. The two terminals marked "NC" are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!**

Grounding

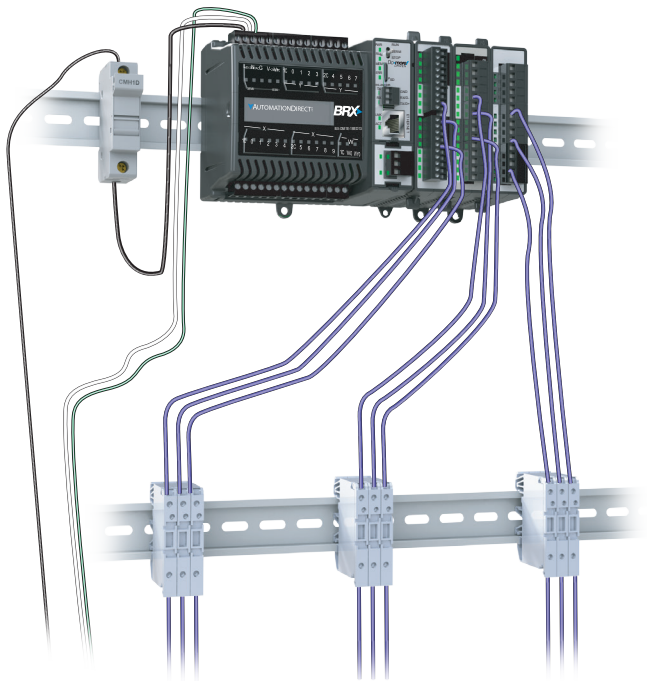
A good common ground reference (earth ground) is essential for proper operation of the BRX MPU. One side of all control circuits, power circuits and the ground lead must be properly connected to a common earth ground by either installing a ground rod in close proximity to the enclosure or by connecting to the incoming power system ground. There must be a single-point ground (i.e. copper bus bar) for all devices in the enclosure that require an earth ground.

WARNING! Do not operate the BRX MPU without proper earth grounding.

Fuse Protection

The BRX MPU I/O circuits do not have internal fuses. In order to protect the MPU, we suggest you add external fuses to your I/O wiring. A fast-blow fuse with a lower current rating than the I/O bank common current rating can be wired to each common; or a fuse with a rating of slightly less than the maximum current per output point can be added to each output. Refer to the BRX MPU specifications for the model you are working with to find the maximum current per output point or per output common. Adding the external fuse does not guarantee the prevention of MPU damage, but it will provide added protection.

The image below shows a BRX platform MPU with Expansion Modules, where an external power supply is wired through a fused terminal block. Various other I/O is wired to DIN rail mounted fused terminal blocks.



I/O Module Wiring Options

There are two available methods for wiring BRX MPUs and expansion modules: hand wiring to the optional removable terminal blocks or using the *ZIP*Link wiring system (recommended). Refer to the appropriate BRX MPU chapter to review detailed information on the wiring options.

***ZIP*Link Wiring System**

***ZIP*Link Pre-Wired Cable**

***ZIP*Link Remote Feedthrough Terminal Block Module**

Planning the I/O Wiring Routes

The following guidelines provide general information on how to wire the I/O connections to the BRX platform. For specific information on wiring a particular component of the BRX platform, refer to the wiring specifications in Chapters 2 through 5 for BRX MPUs and Chapter 7 for I/O expansion modules.

1. If using removable terminal blocks or *ZIP*Link connector blocks, follow the wire size given for the connection method.
2. Always use a continuous length of wire from BRX MPU to I/O connections or junction panel terminations. Do not splice wires to attain a needed length.
3. Use the shortest run possible between devices.
4. Use conduit or wire trays for routing where possible.
5. Avoid running low voltage control wires near high voltage wiring.
6. Avoid confusion by separating input wiring runs from output wiring runs where possible.
7. To minimize voltage drops when wires must run long distances, consider using multiple wires for the return line.
8. Avoid running DC wiring in close proximity to AC wiring where possible.
9. Avoid creating sharp bends in wire runs; follow accepted Electrical Code standards.
10. Route communications wiring separately from control and power wiring.

Auxiliary DC Power Supply

On AC powered BRX MPUs an integral auxiliary isolated 24VDC power supply with its own isolation boundary is included. Since this is isolated it can be used to power input and/or output circuits.

In some cases using the built-in auxiliary 24VDC supply can result in a cost savings for your control system precluding the purchase of an addition external DC power source. It can power combined loads up to 300mA. Be careful not to exceed the current rating of the supply. As a system designer, you may be able to design or select field devices which can take advantage of the 24VDC auxiliary supply.

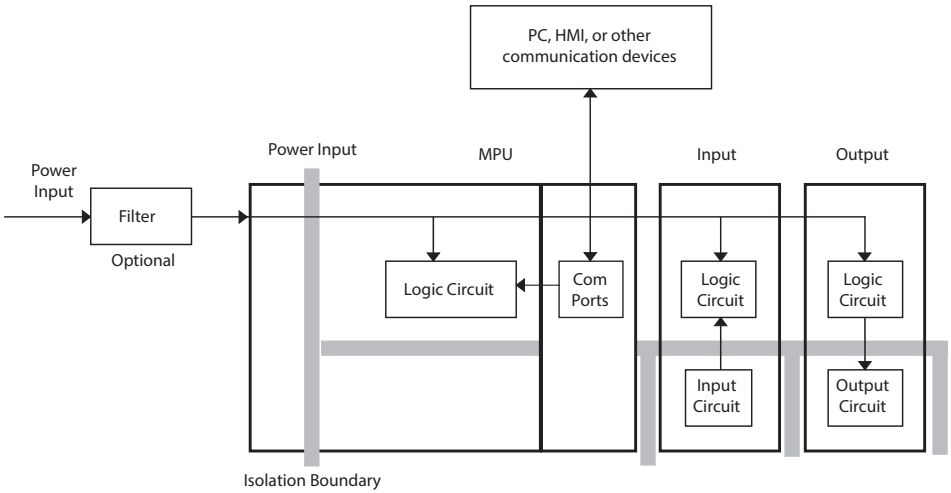
WARNING: **Do not exceed the 24VDC auxiliary power supply load limit of 300mA.**

System Wiring Strategies

The BRX platform is very flexible and will work in many different wiring configurations. By studying this section before actual installation, you can find the best wiring strategy for your application. This will help to lower system cost and wiring errors, while avoiding potential safety problems.

MPU Isolation Boundaries

MPU circuitry is divided into three main regions separated by isolation boundaries, shown in the drawing below. Electrical isolation provides safety, such that a fault in one area does not damage another. The transformer in the power supply provides magnetic isolation between the primary and secondary sides. Optical isolators provide isolation in Input and Output circuits. This isolates logic circuitry from the field side I/O. The discrete inputs are isolated from the discrete outputs because each is isolated from the logic side. Isolation boundaries protect the devices which are connected to the communication ports, such as PCs and HMIs, from power input faults or field wiring faults. When wiring a BRX MPU, it is extremely important to avoid making external connections that connect logic side circuits to any other.



Logical Representation of Isolation Boundaries

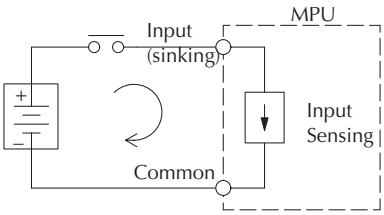
Sinking/Sourcing Concepts

Before wiring field devices to the BRX MPU I/O, it's necessary to have a basic understanding of "sinking" and "sourcing" concepts. Use of these terms occurs frequently in input or output circuit discussions. The purpose of this section is to explain the terms. The short definitions are as follows:

Sinking = Path to supply ground (–) or switching ground

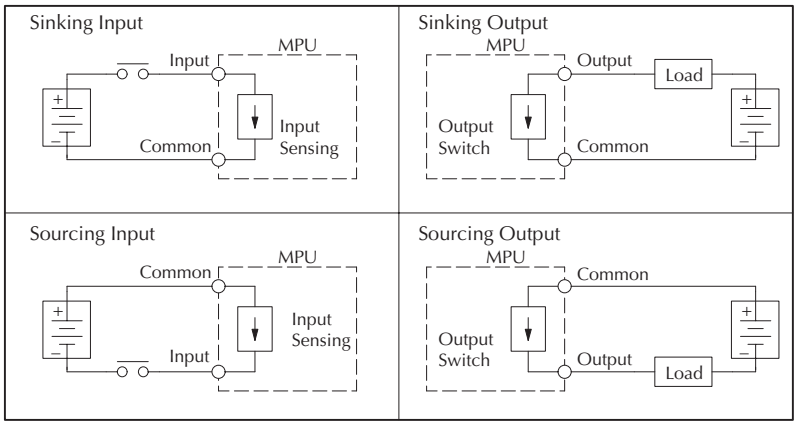
Sourcing = Path to supply source (+) or switching +V

These terms only apply to DC circuits, not AC circuits. Input and output points that are either sinking or sourcing can conduct current in only one direction. This means it is possible to wire the external supply and field device to the I/O point with current trying to flow in the wrong direction, in which case the circuit will not operate.



The diagram on the left shows a "sinking" MPU input. To properly connect the external supply, connect it so that the input provides a path to ground (–). Start at the MPU input terminal, follow through the input sensing circuit, exit at the common terminal, and connect the supply (–) to the common terminal.

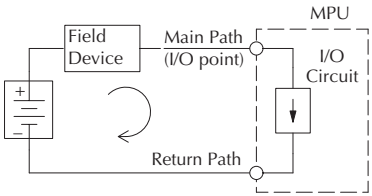
The switch between the supply (+) and the input completes the circuit. Current flows in the direction of the arrow when the switch is closed. By applying the circuit principle above to the four possible combinations of input/output sinking/sourcing types, we have the four circuits as shown below.



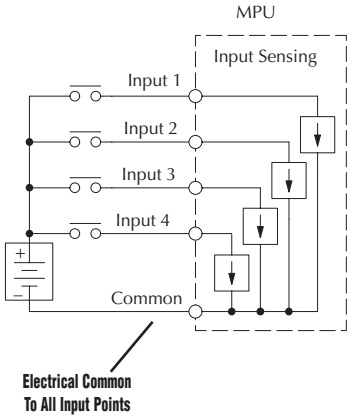
I/O "Common Terminal" Concepts

In order for a BRX MPU I/O circuit to operate, current must enter at one terminal and exit at another. This means at least two terminals are associated with every I/O point. In the figure below, the input or output terminal is the main path for the current. One additional terminal must provide the return path to the power supply.

If there was unlimited space then every I/O point could have two dedicated terminals as the figure below shows. Providing this level of flexibility is not practical or necessary for most applications.

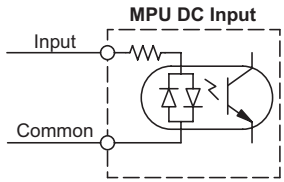


Most I/O point groups share the return path (common) among two or more I/O points. The figure below shows a group (or bank) of four input points which share a common return path. In this way, the four inputs require only five terminals instead of eight.



NOTE: *In the circuit above, the current in the common path is equal to the sum of the energized channels. This is especially important in output circuits, where larger gauge wire is sometimes needed for the commons.*

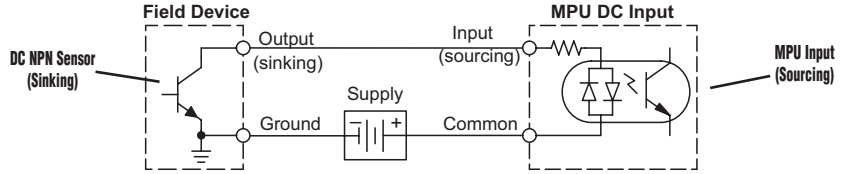
DC Input Wiring Methods



DC inputs can be wired as either sinking or sourcing inputs. The dual diodes (shown in this diagram) allow current to flow in either direction. Inputs grouped by a common point must be either all sinking or all sourcing. DC inputs typically operate in the range of 12–24 VDC.

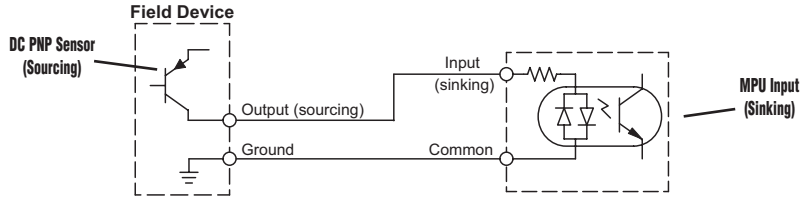
Sinking Input Sensor (NPN Type) to BRX MPU Sourcing Input

In the following example, a field device has an open-collector NPN transistor output. When energized, it sinks current to ground from the DC input point. The input current is sourced from the common terminal connected to power supply (+).



Sourcing Input Sensor (PNP Type) to BRX MPU Sinking Input

In the following example, a field device has an open-emitter PNP transistor output. When energized, it sources current to the input point, which sinks the current to ground. Since the field device loop is sourcing current, no additional power supply is required for the module.



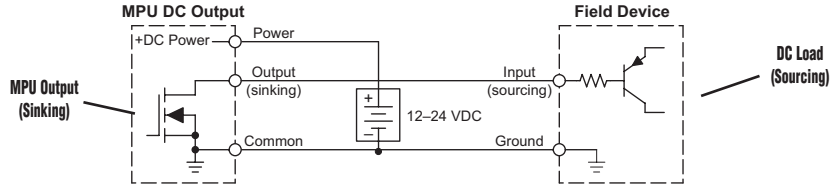
DC Output Wiring Methods

DC output circuits are wired as all current sinking or all current sourcing depending on which output module part number is used. DC outputs typically operate in the range of 12–24 VDC.

MPU Sinking Output to Sourcing Load Device

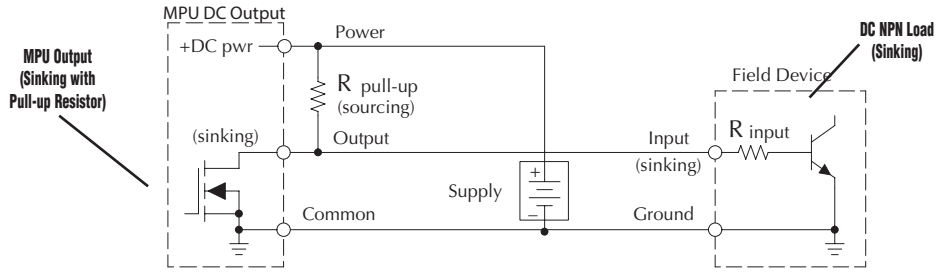
Many applications require connecting a MPU output point to a DC input on a field device load. This type of connection is made to carry a low-level DC signal.

In the following example, the MPU output point sinks current to ground (common) when energized. The output is connected to a field device load with a sourcing input.



MPUs DC Sinking Output to Sinking Load Device

In the example below, a sinking output point is connected to the sinking input of a field device load. In this case, both the MPU output and field device input are sinking type. Since the circuit must have one sourcing and one sinking device, we add sourcing capability to the MPU output by using a pull-up resistor. In the circuit below, we connect $R_{pull\text{-}up}$ from the output to the DC output circuit power input.



NOTE: *DO NOT attempt to drive a heavy load (>25mA) with this pull-up method.*

NOTE: *Using the pull-up resistor to implement a sourcing output has the effect of inverting the output point logic. In other words, the field device input is energized when the MPU output is OFF, from a ladder logic point-of-view. Your ladder program must take this into consideration and generate an inverted output. Or, you may choose to cancel the effect of the inversion elsewhere, such as in the field device.*

It is important to choose the correct value of $R_{pull\text{-}up}$. In order to do so, we need to know the nominal input current to the field device (I_{input}) when the input is energized. If this value is not known, it can be calculated as shown (a typical value is 15mA). Then use I_{input} and the voltage of the external supply to compute $R_{pull\text{-}up}$. Then calculate the power $P_{pull\text{-}up}$ (in watts), in order to size $R_{pull\text{-}up}$ properly.

$$I_{input} = \frac{V_{input\ \ (turn\text{–}on)}}{R_{input}}$$

$$R_{pull\text{-}up} = \frac{V_{supply} - 0.7}{I_{input}} - R_{input}$$

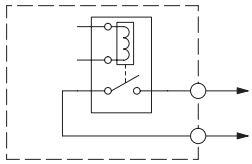
$$P_{pull\text{-}up} = \frac{V^2_{supply}}{R_{pull\text{-}up}}$$

Relay Outputs - Wiring Methods

Relays are best for the following applications:

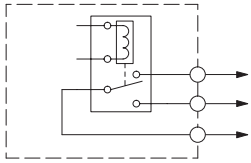
- Loads that require higher currents than the solid-state outputs can deliver
- Cost-sensitive applications
- Some output channels need isolation from other outputs (such as when some loads require different voltages than other loads)

Relay with Form A contacts



Relay outputs are available in two contact arrangements. Form A type, or SPST (single pole, single throw) type. They are normally open and are the simplest to use. The Form C, or SPDT (single pole, double throw) type has a center contact which moves and a stationary contact on either side. This provides a normally closed contact and a normally open contact.

Relay with Form C contacts



The relays in some relay output modules share common terminals, which connect to the wiper contact in each relay of the bank. Other relay modules have relays which are completely isolated from each other. In all cases, the module drives the relay coil when the corresponding output point is on.

Some applications where relays would NOT be used:

- Loads that require currents under 10mA
- Loads which must be switched at high speed or heavy duty cycle.

Relay Outputs – Transient Suppression for Inductive Loads in a Control System

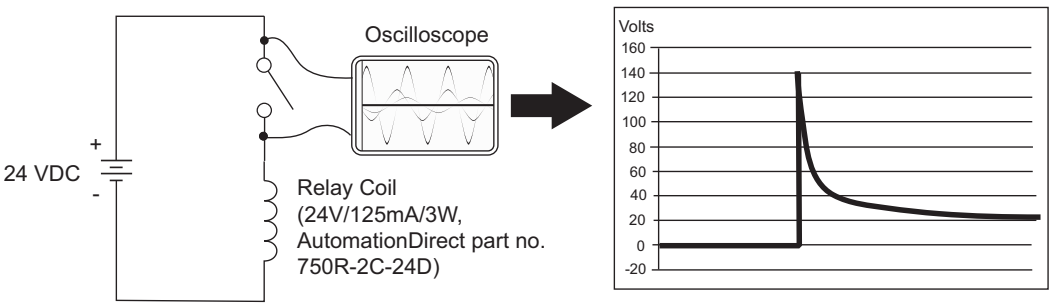
The following pages are intended to give a quick overview of the negative effects of transient voltages on a control system and provide some simple advice on how to effectively minimize them (Transient Voltage Suppression or TVS). The need for transient voltage suppression is often not apparent to the newcomers in the automation world. Many mysterious errors that can afflict an installation can be traced back to a lack of transient suppression.

What is a Transient Voltage and Why is it Bad?

Inductive loads (devices with a coil) generate transient voltages as they transition from being energized to being de-energized. If not suppressed, the transient can be many times greater than the voltage applied to the coil. These transient voltages can damage the BRX MPU outputs or other sensitive electronic devices connected to the circuit, and cause unreliable operation of adjacent electronics. Transients must be managed with suppressors (TVS) for longer component life while sustaining reliable operation of the control system.

Examples of coil driven devices include: Relays, Contactors, Solenoids, Motor starters, Motors, and Welders. This example shows a simple circuit with a small 24V/125mA/3W relay. As you can see, when the switch is opened, thereby de-energizing the coil, the transient voltage generated across the switch contacts peaks at 140V.

Example: Circuit with no Suppression



In the same circuit, replacing the relay with a larger 24V/290mA/7W relay will generate a transient voltage exceeding 800V (not shown). Transient voltages like this can cause many problems, including:

- Relay contacts driving the coil may experience arcing, which can pit the contacts and reduce the relay's lifespan.
- Solid state (transistor) outputs driving the coil can be damaged if the transient voltage exceeds the transistor's ratings. In extreme cases, complete failure of the output can occur the very first time a coil is de-energized.
- Input circuits, which might be connected to monitor the coil or the output driver, can also be damaged by the transient voltage.

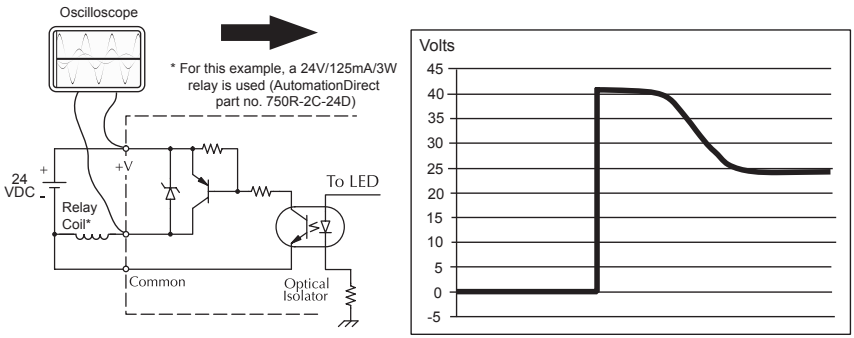
A very destructive side-effect of the arcing across relay contacts is the electromagnetic interference (EMI) it can cause. This occurs because the arcing causes a current surge, which releases RF energy. The entire length of wire between the relay contacts, the coil, and the power source carries the current surge and becomes an antenna that radiates the RF energy. It will readily couple into parallel wiring and may disrupt the MPU and other electronics in the area. This EMI can make an otherwise stable control system behave unpredictably at times.

MPU's Integrated Transient Suppressors

Although the BRX MPU outputs have integrated suppressors to protect against transients, they are not capable of handling them all. It is usually necessary to have some additional transient suppression for an inductive load.

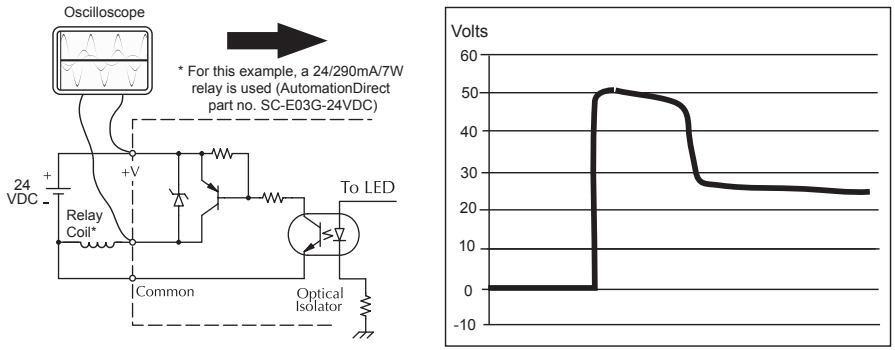
Here is another example using the same 24V/125mA/3W relay used earlier. This example measures the PNP transistor output of a typical MPU, which incorporates an integrated Zener diode for transient suppression. Instead of the 140V peak in the first example, the transient voltage here is limited to about 40V by the Zener diode. While the MPU will probably tolerate repeated transients in this range for some time, the 40V is still beyond the module's peak output voltage rating of 30V.

Example: Small Inductive Load with Only Integrated Suppression



The next example uses the same circuit as above, but with a larger 24V/290mA/7W relay, thereby creating a larger inductive load. As you can see, the transient voltage generated is much worse, peaking at over 50V, yet considerably below the 800V mentioned earlier. Driving an inductive load of this size(66% above rate voltage) without additional transient suppression is very likely to permanently damage the MPU output.

Example: Larger Inductive Load with Only Integrated Suppression

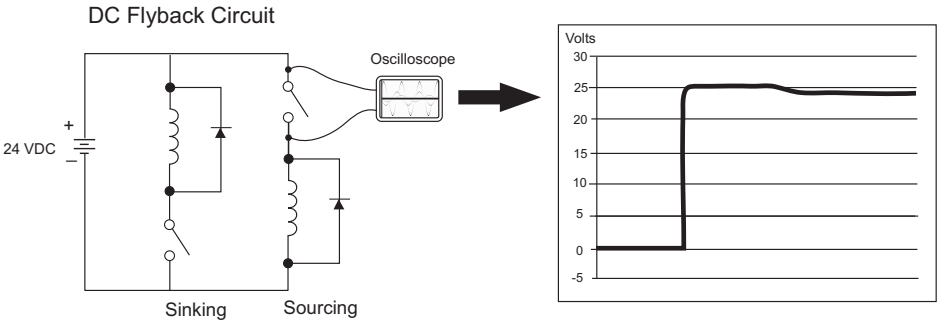


Additional transient suppression should be used in both these examples. If you are unable to measure the transients generated by the connected loads of your control system, using additional transient suppression on all inductive loads would be the safest practice.

Types of Additional Transient Protection

DC Coils:

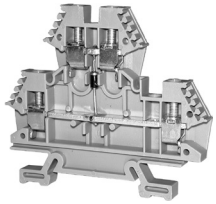
The most effective protection against transients from a DC coil is a flyback diode. A flyback diode can reduce the transient to roughly 1V over the supply voltage, as shown in this example.



Many AutomationDirect socketed relays and motor starters have add-on flyback diodes that plug or screw into the base, such as the AD-ASMD-250 protection diode module and 784-4C-SKT-1 socket module shown below. If an add-on flyback diode is not available for your inductive load, an easy way to add one is to use AutomationDirect's DN-D10DR-A diode terminal block, a 600VDC power diode mounted in a slim DIN rail housing.

AD-ASMD-250
Protection Diode Module

784-4C-SKT-1
Relay Socket



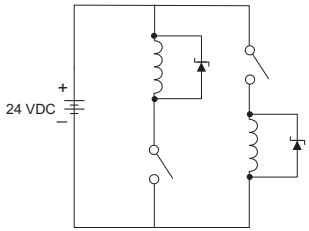
DN-D10DR-A
Diode Terminal Block

Two more common options for DC coils are Metal Oxide Varistors (MOV) or TVS diodes. These devices should be connected across the coil for best protection as shown below. The optimum voltage rating is the lowest rated voltage available for the suppressor that will NOT conduct at the supply voltage, while still allowing a safe margin.

AutomationDirect's ZL-TSD8-24 transorb module is a good choice for 24VDC circuits. It is a bank of 8 uni-directional 30V TVS diodes. Since they are uni-directional, be sure to observe the polarity during installation. MOVs or bi-directional TVS diodes would install at the same location, but have no polarity concerns.

ZL-TSD8-24
Transorb Module

DC MOV or TVS Diode Circuit



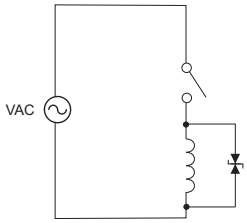
AC Coils:

Two options for AC coils are MOVs or bi-directional TVS diodes. These devices are most effective at protecting the driver from a transient voltage when connected across the coil. The optimum voltage rating for the suppressor is the lowest rated voltage available that will NOT conduct at the supply voltage, while still allowing a safe margin.

AutomationDirect's ZL-TSD8-120 transorb module is a good choice for 120VAC circuits. It is a bank of eight bi-directional 180V TVS diodes.

ZL-TSD8-120
Transorb Module

AC MOV or Bi-Directional Diode Circuit



NOTE: *Manufacturers of devices with coils frequently offer MOV or TVS diode suppressors as an add-on option that mount conveniently across the coil. Before using them, carefully check the suppressor ratings. Just because the suppressor is made specifically for that part does not mean it will reduce the transient voltages to an acceptable level for your application.*

For example, a MOV or TVS diode rated for use on 24–48 VDC coils would need to have a high enough voltage rating to NOT conduct at 48V. That suppressor might typically start conducting at roughly 60VDC. If it were mounted across a 24V coil, transients of roughly 84V (if sinking output) or -60V (if sourcing output) could reach the MPU output. Many semiconductor MPU outputs cannot tolerate such levels.

BX ME WIRING

In This Chapter...

Overview 2-2
BX-DM1E-M Wiring 2-4
BX-DM1E-M-D Wiring 2-6

BX ME Micro PLC Unit (MPU)

Overview

The BX ME Micro PLC Unit (MPUs) includes two different versions. Both have the same appearance and basic features, the only difference being that one unit is externally powered with 12–24 VDC and the other unit is externally powered with 120–240 VAC.

The units have no built-in I/O points. This allows use as a standalone controller unit with no I/O or you can customize the I/O to meet the needs of your application by adding BRX Expansion Modules. All MPUs can expand their capacity with the addition of as many as eight (8) BRX Expansion Modules, allowing more flexibility while keeping control cost down.

BX-DM1E-M
120–240 VAC

BX-DM1E-M-D
12–24 VDC

General Specifications

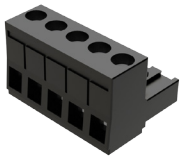
- Support for 8 additional Expansion Modules (See Chapter 7).
- No built-in discrete I/O points
- No built-in analog I/O points
- Serial port for RS232/485 communications
- RJ45 port for Ethernet communications
- MicroSD slot
- Pluggable Option Module (POM) for an additional communications port

Power Supply Connector

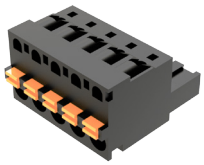
The power supply terminal block connectors are included with this MPU. The power supply connectors are a screw type, removable terminal block. Replacement connectors and specifications are listed in the tables that follow.

BX-DM1E-M AC Power Supply Connector Specifications

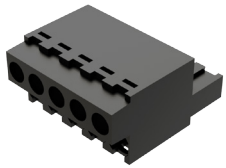
Part Number	BX-RTB05 (Included w/Unit)	BX-RTB05-1	BX-RTB05-2
Connector Type	Screw Type-90 deg	Spring Clamp Type-180 deg	Screw Type-180 deg
Wire Exit	180 deg	180 deg	180 deg
Pitch	5.0 mm	5.0 mm	5.0 mm
Screw Size	M2.5	N/A	M2.5
Recommended Screw Torque	< 3.98 lb·in (0.45 N·m)	N/A	< 3.98 lb·in (0.45 N·m)
Screwdriver Blade Width	3.5 mm	3.5 mm	3.5 mm
Wire Gauge (Single wire)	28–12 AWG	28–14 AWG	28–14 AWG
Wire Gauge (Two wire)	28–16 AWG	28–16 AWG (Dual Wire Ferrule Required)	28–16 AWG (Dual Wire Ferrule Required)
Wire Strip Length	0.3 in (7.5 mm)	0.37 in (9.5 mm)	0.37 in (9.5 mm)
Equiv. Dinkle P/N	5ESDV-05P-BK	5ESDSR-05P-BK	5ESDSR-05P-BK



BX-RTB05



BX-RTB05-1

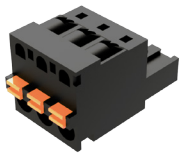


BX-RTB05-2

BX-DM1E-M-D DC Power Supply Connector Specifications

Part Number	BX-RTB03 (Included w/Unit)	BX-RTB03-1
Connector Type	Screw Type-90 deg	Spring Clamp Type-180 deg
Wire Exit	180 deg	180 deg
Pitch	5.0 mm	5.0 mm
Screw Size	M2.5	N/A
Recommended Screw Torque	< 3.98 lb·in (0.45 N·m)	N/A
Screwdriver Blade Width	3.5 mm	3.5 mm
Wire Gauge (Single wire)	28–12 AWG	28-14 AWG
Wire Gauge (Two wires)	28–16 AWG	28-16 AWG (Dual Wire Ferrule Required)
Wire Strip Length	0.3 in (7.5 mm)	0.37 in (9.5 mm)
Equiv. Dinkle P/N	5ESDV-03P-BK	5ESDSR-03P-BK

BX-RTB03



BX-RTB03-1

BX-DM1E-M Wiring

- Serial port for RS232/485 communications
- RJ45 port for Ethernet communications
- MicroSD slot
- Pluggable Option Module (POM) for an additional communications port
- No built-in discrete I/O
- No built-in analog I/O
- Requires an external 120–240 VAC external power supply.
- Includes an integral 24VDC auxiliary output power supply.

BX-DM1E-M

NOTE: *Eight (8) Expansion Modules can be connected to add I/O capability.*

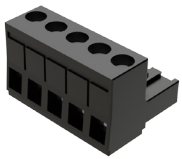
Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Rating	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Efficiency	80%
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Output Protection for Over Current, Over Voltage, and Over Temperature	Self resetting
Heat Dissipation	8W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Operating Design Life	10 years at full load at 40°C ambient, 5 years at 60°C ambient
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

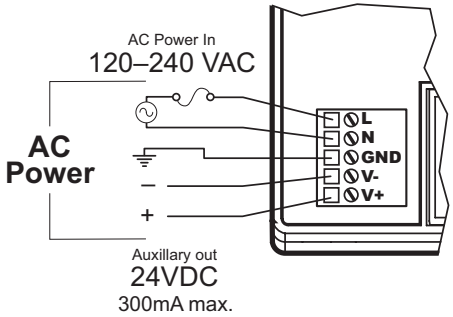
BX-DM1E-M Wiring, Continued

Power Supply Connections, 120–240 VAC

Pin	Connection
1	L
2	N
3	GND
4	V–
5	V+



Removable Connector Included
ADC Part # BX-RTB05



WARNING: **Do not exceed the 24VDC auxiliary power supply load limit of 300mA**

BX-DM1E-M-D Wiring

- Serial port for RS232/485 communications
- RJ45 port for Ethernet communications
- MicroSD slot
- Pluggable Option Module (POM) for an additional communications port
- No built-in discrete I/O
- No built-in analog I/O
- Requires an external 12–24 VDC external power supply.
- No integral 24VDC auxiliary output power supply.

BX-DM1E-M-D

NOTE: *Eight (8) Expansion Modules can be connected to add I/O capability.*

Power Supply Specifications

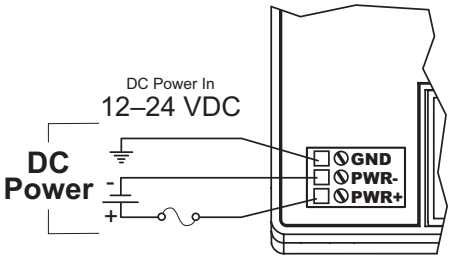
Power Supply Specifications	
Nominal Voltage Range	12–24 VDC
Input Voltage Range (Tolerance)	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	30W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Efficiency	85%
Under Input Voltage Lock-out	<9VDC
Output Protection for Over Current, Over Voltage, and Over Temperature	Self resetting
Heat Dissipation	3.2 W Max
Isolated User 24VDC Output	None
Operating Design Life	10 years at full load at 40°C ambient, 5 years at 60°C ambient
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

BX-DM1E-M-D Wiring, Continued

Power Supply Connections, 12–24 VDC

Pin	Connection
1	GND
2	In –
3	In +

Removable Connector Included
ADC Part # BX-RTB03



Notes:

BX 10/10E Wiring

In This Chapter...

BX 10/10E Micro PLC Units (MPUs) 3-2
Overview 3-2
BX 10/10E MPUs 3-2
BX 10/10E Wiring Termination Selection 3-5
Terminal Block Connectors 3-5
*ZIP*Link Prewired Cable Solutions 3-6
*ZIP*Link System Examples 3-7
BX 10 Micro PLC Units (MPUs) 3-8
BX-DM1-10ED1-D Wiring 3-8
BX-DM1-10ED2-D Wiring 3-14
BX-DM1-10ER-D Wiring 3-20
BX-DM1-10AR-D Wiring 3-26
BX 10E Micro PLC Units (MPUs) 3-32
BX-DM1E-10ED13-D Wiring 3-32
BX-DM1E-10ED23-D Wiring 3-40
BX-DM1E-10ER3-D Wiring 3-48
BX-DM1E-10AR3-D Wiring 3-56

BX 10/10E Micro PLC Units (MPUs)

Overview

The BX 10/10E Micro PLC Unit (MPU) includes eight different versions. All have the same appearance and basic features. All units have six (6) discrete input points, and four (4) discrete output points built-in. Units with DC inputs have six (6) selectable high-speed inputs and units with DC outputs have two (2) selectable high-speed outputs. All MPUs can expand their capacity with the BRX Expansion Modules to allow for more flexibility while keeping control cost down. BX 10E units have an additional one (1) analog input and one (1) analog output built-in that are current/voltage selectable within the software.

The units ship without wiring terminals. This allows you to select the terminal block type that best fits your application. There are several wiring options available, including screw terminal connectors, spring clamp terminal connectors and prewired *ZIP*Link cable solutions.

BX 10/10E MPUs

BX 10/10E MPUs can be divided into two distinct groups, BX 10 and BX 10E. The BX 10 MPUs have no built-in analog I/O or Ethernet port. The BX 10E MPUs have the same features of the BX 10, plus built-in analog I/O and an Ethernet port.

BX 10 MPUs

General Specifications

10 discrete I/O points: 6 inputs, 4 outputs
No built-in analog I/O points
All units are externally powered by a nominal 12–24 VDC
Models with DC inputs have 6 high speed inputs up to 250kHz
Models with DC inputs can accept 12–24 nominal voltages AC or DC
Models with DC inputs can be wired as sinking or sourcing
Models with AC inputs can accept 120–240 nominal voltages
Output types available are DC sinking, DC sourcing, and relay
Models with DC outputs have 2 high speed outputs up to 250kHz
Support for 2 additional Expansion Modules

BX 10
Micro PLC Unit (MPU)
No Built-in Analog or Ethernet

The following table shows the available MPUs with the BX 10 feature set.

BX 10 MPUs

Part Number	External Power	Discrete Input	Discrete Output	Expansion Modules
BX-DM1-10ED1-D	12–24 VDC	6 High-Speed, Sinking or Sourcing	2 High-Speed 2 Standard DC Sinking	2
BX-DM1-10ED2-D			2 High-Speed 2 Standard DC Sourcing	
BX-DM1-10ER-D			4 Form A Relay	
BX-DM1-10AR-D		6 Standard AC		

BX 10E MPUs

General Specifications

10 discrete I/O points: 6 in/4 out

All units are externally powered by a nominal 12–24 VDC

Models with DC inputs:

- have 6 high speed inputs up to 250kHz
- accept 12–24 nominal voltages AC or DC
- can be wired as sinking or sourcing.

Models with AC inputs can accept 120–240 nominal voltages

All units have a built-in RJ-45 Ethernet port, 10/100 Mbps

All units have 1 analog input (current/voltage software selectable)

Output types available are DC sinking, DC sourcing, and relay

Models with DC outputs have 2 high speed outputs up to 250kHz

Support for 2 additional Expansion Modules

BX 10E
Micro PLC Unit (MPU)
Built-in Analog or Ethernet

The following table shows the available MPUs with the BX 10E feature set.

BX 10E MPUs

Part Number	External Power	Discrete Inputs	Discrete Output	Analog*		Expansion Modules
				Input	Output	
BX-DM1E-10ED13-D	12–24 VDC	6 High-Speed, Sinking or Sourcing	2 High-Speed 2 Standard DC Sinking	1 Current or Voltage	1 Current or Voltage	2
BX-DM1E-10ED23-D			2 High-Speed 2 Standard DC Sourcing			
BX-DM1E-10ER3-D			4 Form A Relay			
BX-DM1E-10AR3-D		6 Standard AC				

* Analog can be current or voltage software selectable per channel.

BX 10/10E Wiring Termination Selection

The BX 10/10E MPUs ship without wiring terminals. This allows you to select the terminal block type that best fits your application. There are several wiring options available, including removable screw terminal connectors, removable spring clamp terminal connectors and prewired *ZIP*Link cable solutions.

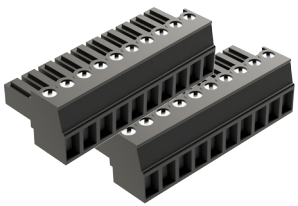
Terminal Block Connectors

The terminal block connectors are provided in kits and can be easily ordered as a single part number to receive all the terminal block connectors needed. Each kit for the BX 10/10E MPU comes with two (2) 10-pin, 3.8 mm terminal blocks. On the BX 10/10E MPUs the terminals are organized into groups consisting of 3 inputs with an isolated common and 2 outputs with an isolated common, e.g., Inputs X0-X2 are in a group with their common terminal.

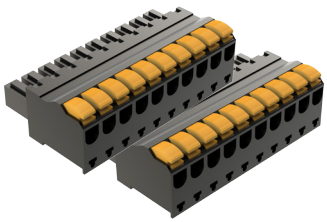
The terminal block connector kit part numbers and connector specifications are listed in the table below.

Terminal Block Connector Specifications

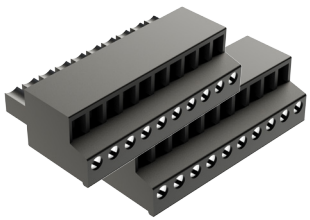
Kit Part Number	BX-RTB10	BX-RTB10-1	BX-RTB10-2
Connector Type	Screw Type-90 degree	Spring Clamp Type-180 degree	Screw Type-180 degree
Wire Exit	180 degree	180 degree	180 degree
Pitch	3.81 mm	3.81 mm	3.81 mm
Screw Size	M2	N/A	M2
Recommended Screw Torque	<1.77 lb·in (0.2 N·m)	N/A	<1.77 lb·in (0.2 N·m)
Screwdriver Blade Width	2.5 mm	2.5 mm	2.5 mm
Wire Gauge (Single Wire)	28–16 AWG	28–18 AWG	30–16 AWG
Wire Gauge (Dual Wire)	28–16 AWG	30–20 AWG (Dual Wire Ferrule Required)	30–18 AWG
Wire Strip Length	0.24 in (6mm)	0.35 in (9mm)	0.26 in (6.5 mm)
Equiv. Dinkle part #	EC381V-10P-BK	ESC381V-10-BK	EC381F-10P-BK



BX-RTB10



BX-RTB10-1



BX-RTB10-2

NOTE: *For replacement terminal blocks, the appropriate part number in the table above should be ordered.*

*ZIP*Link Prewired Cable Solutions

ZIPLinks eliminate the normally tedious process of wiring between devices by utilizing prewired cables and DIN rail mount connector modules. It's as simple as plugging in a cable connector at either end or terminating wires at only one end. Prewired cables keep installation clean and efficient, using less space at a fraction of the cost of standard terminal blocks. ***ZIP***Link prewired cables can connect directly to a ***ZIP***link remote terminal block module or with the pigtail option they can allow for a convenient solution to wire the BRX platform to 3rd party devices. For the BX 10/10E MPUs, one cable and one feedthrough module is needed to connect to onboard wiring termination points. There are two feedthrough module options available, the ZL-RTB20 and the ZL-RTB20-1. The ZL-RTB20 is a standard feedthrough terminal module and the ZL-RTB20-1 is a compact feedthrough terminal block module and has a compact footprint which takes up less space in the control cabinet.

The ***ZIP***Link system options for the BX 10/10E MPUs are listed in the table below.

BX 10/10E ZIPLink Selector

MPU Part Number	Component	Module Part No.	Cable Part No.*
BX-DM1-10ED1-D	Feedthrough	ZL-RTB20 (Standard) OR ZL-RTB20-1 (Compact)	ZL-BX-CBL20 ZL-BX-CBL20-1 ZL-BX-CBL20-2
BX-DM1-10ED2-D			
BX-DM1-10ER-D			
BX-DM1-10AR-D			
BX-DM1E-10ED13-D			
BX-DM1E-10ED23-D			
BX-DM1E-10ER3-D			
BX-DM1E-10AR3-D			

**** Select the cable length: Blank = 0.5 m, -1 = 1.0 m, -2 = 2.0 m.***
Available pigtail cables: ZL-BX-CBL20-1P = 1.0 m, ZL-BX-CBL20-2P = 2.0 m.

*ZIP*Link Prewired Cables

Custom molded ***ZIP***Link prewired cables allow for fast and easy connection of field wiring and remote I/O to the BRX platform. The prewired cables are available in 0.5 meter, 1 meter and 2 meter lengths. Pigtail cables are used to connect the BRX platform directly to third-party devices, lowering your wiring cost and time. The pigtail cables are available in 1 meter and 2 meter lengths.

ZL-BX-CBL20
***ZIP*Link Prewired Cable**

ZL-BX-CBL20-1P
***ZIP*Link Pigtail Cable**

*ZIP*Link Remote Feedthrough Modules

Feedthrough modules provide low-cost and compact field wiring screw termination solutions for quickly connecting with the BRX platform. There are 2 modules available for use with the BRX platform. The ZL-RTB20 and the ZL-RTB20-1. The ZL-RTB20 is a standard 2 row, 20-pin, DIN rail mountable feedthrough module. The ZL-RTB20-1 is a compact 3 row, 24-pin DIN rail mountable feedthrough module with a smaller footprint design.

The *ZIP*Link remote feedthrough module specifications are listed in the table below.

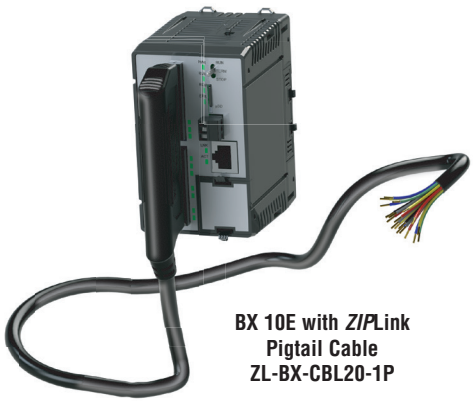
*ZIP*Link Module Specifications		
Part Number	**ZL-RTB20 (Maximum of 2 Needed)**	**ZL-RTB20-1 (Maximum of 2 Needed)**
Number of positions	20 screw terminals, 2 rows	24 screw terminals, 3 rows
Screwdriver Width	1/8 in (3.8 mm) maximum	
Screw Torque	4.4 lb·in (0.5 N·m)	

ZL-RTB20

ZL-RTB20-1

*ZIP*Link System Examples

BX 10E MPU with *ZIP*Link System pre-wired cable and feedthrough module.



BX 10E with *ZIP*Link Pigtail Cable ZL-BX-CBL20-1P

BX 10 Micro PLC Units (MPUs)

BX-DM1-10ED1-D Wiring

This MPU has 10 discrete I/O points. The connections are grouped as follows:

Six (6) discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the front left of the unit; organized into groups of 4 terminals consisting of 3 inputs and an isolated common each.

Four (4) discrete outputs - sinking; rated at 12–24 VDC. They are located along the front left of the unit. The outputs are organized into groups of 3 terminals consisting of 2 outputs and an isolated common each.

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.

WARNING: **No analog I/O is included on this unit. The three (3) terminals between the power supply and the inputs are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!**

BX-DM1-10ED1-D

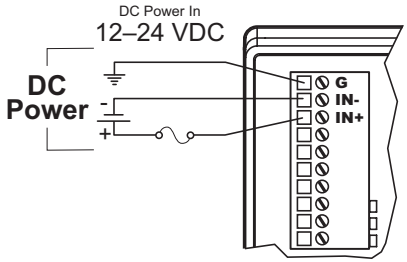
NOTE: *Two (2) Expansion modules can be connected to extend I/O capacity.*

BX-DM1-10ED1-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage	12–24 VDC
Input Voltage Range (Tolerance)	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	14W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Efficiency	85%
Under Input Voltage Lock-out	< 9VDC
Heat Dissipation	3.2 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



BX-DM1-10ED1-D Wiring, Continued

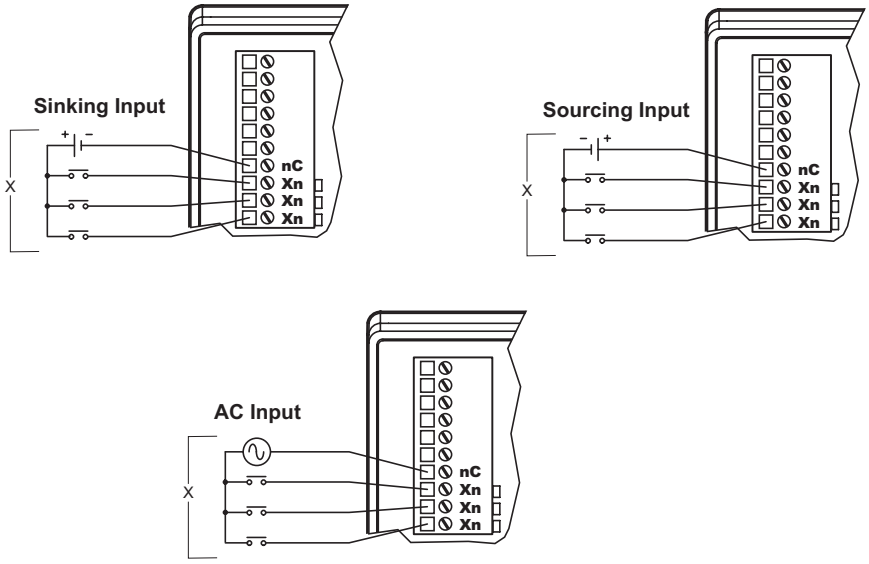
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		6	
Commons		2 (3 points/common) Isolated	
Nominal Voltage Rating		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz [2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		2.0 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard [1]
Location		X0...X5	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]

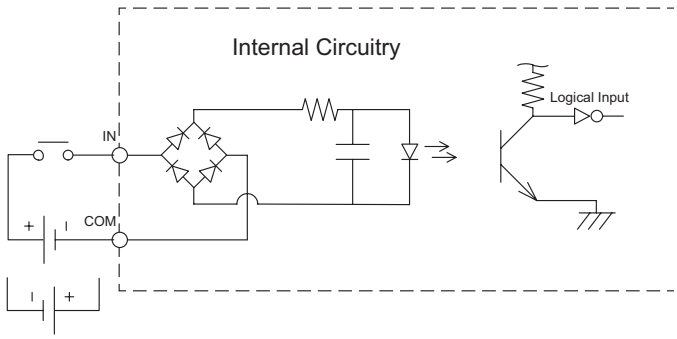
1. All Inputs may be used as standard inputs or high speed inputs independently.
2. 240Hz filter must be set in software for AC operation.

BX-DM1-10ED1-D Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

BX-DM1-10ED1-D Wiring, Continued

Discrete Output Specifications

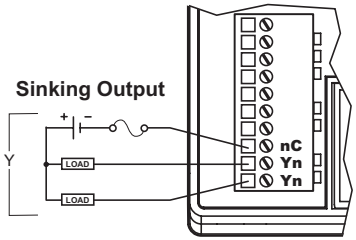
Discrete Output Specifications		
Output Type	Sinking	
Total Outputs per Module	4	
Commons	2 (2 points/common) Isolated	
Maximum Current per Common	1A	
Nominal Voltage Rating	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard [1]
Location	Y0...Y1	Y2...Y3
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	143Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level [2]	Between 4A and 8A	N/A
Fusing	External fusing recommended	

1. All outputs may be used as standard outputs. Only the first 2 outputs (Y0...Y1) are capable of high speed DC operation.

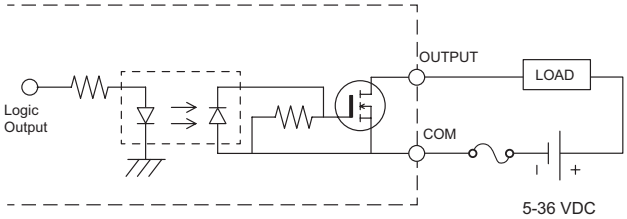
2. When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.

BX-DM1-10ED1-D Wiring, Continued

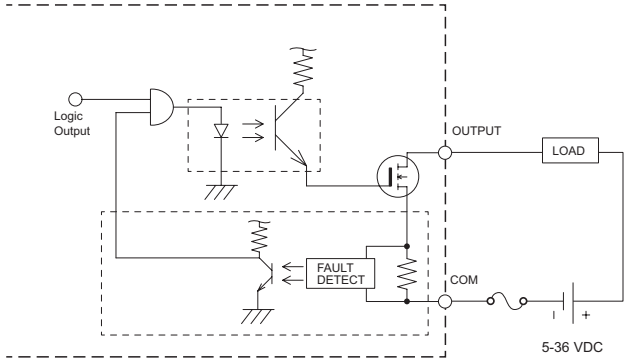
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1-10ED2-D Wiring

This MPU has 10 discrete I/O points. The connections are grouped as follows:

Six (6) discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the front left of the unit; organized into groups of 4 terminals consisting of 3 inputs and an isolated common in each group.

Four (4) discrete outputs - sourcing; rated at 12–24 VDC. They are located along the front left of the unit. The outputs are organized into groups of 3 terminals consisting of 2 outputs and an isolated common in each group.

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.

WARNING: **No analog I/O is included on this unit. The three (3) terminals between the power supply and the inputs are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS.**

BX-DM1-10ED2-D

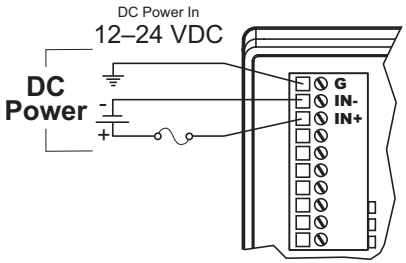
NOTE: *Two (2) Expansion Modules can be connected to extend I/O capacity.*

BX-DM1-10ED2-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage	12–24 VDC
Input Voltage Range (Tolerance)	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	14W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Efficiency	85%
Under Input Voltage Lock-out	<9VDC
Heat Dissipation	3.2 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



BX-DM1-10ED2-D Wiring, Continued

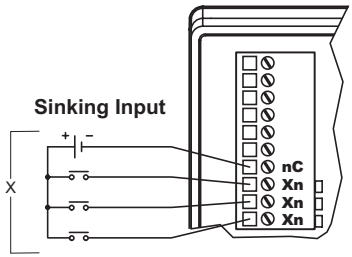
Discrete Input Specifications

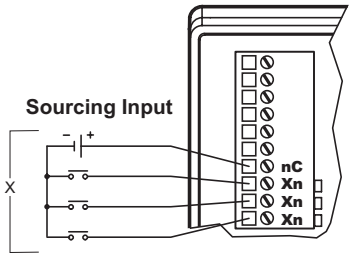
Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		6	
Commons		2 (3 points/common) Isolated	
Nominal Voltage Rating		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz [2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		2.0 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard [1]
Location		X0...X5	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]

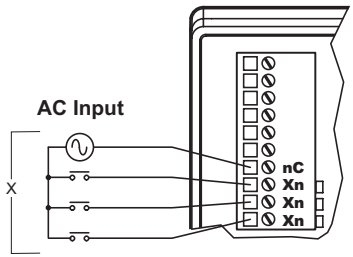
1. All Inputs may be used as standard inputs or high speed inputs independently.
2. 240Hz filter must be set in software for AC operation.

BX-DM1-10ED2-D Wiring, Continued

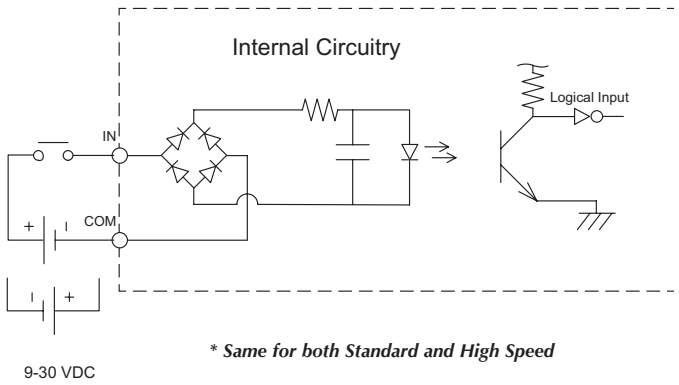
Discrete Input Connection Options







Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

BX-DM1-10ED2-D Wiring, Continued

Discrete Output Specifications

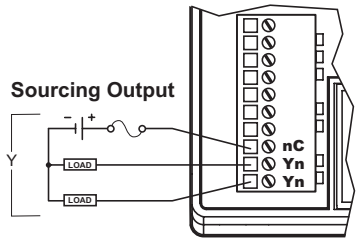
Discrete Output Specifications		
Output Type	Sourcing	
Total Outputs per Module	4	
Commons	2 (2 points/common) Isolated	
Maximum Current per Common	1A	
Nominal Voltage Rating	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard [1]
Location	Y0...Y1	Y2...Y3
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	143Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level [2]	Between 4A and 8A	N/A
Fusing	External fusing recommended	

1. All outputs may be used as standard outputs. Only the first 2 outputs (Y0...Y1) are capable of high speed DC operation.

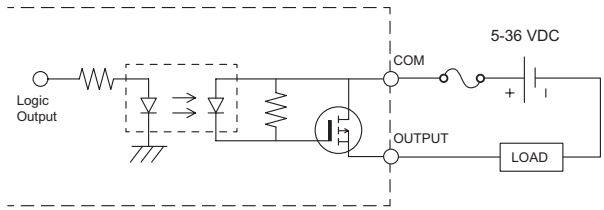
2. When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.

BX-DM1-10ED2-D Wiring, Continued

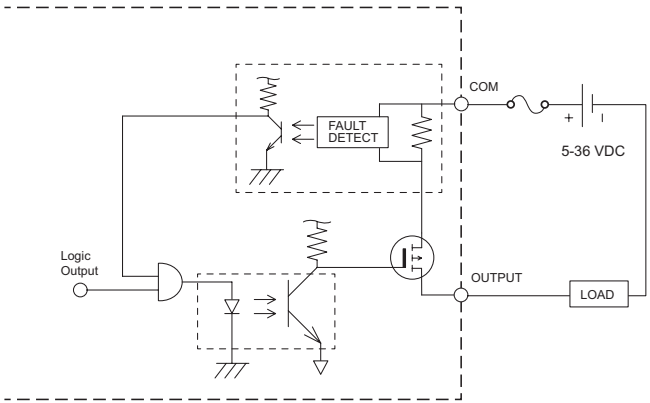
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1-10ER-D Wiring

This MPU has 10 discrete I/O points. The connections are grouped as follows:

Six (6) discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the front left of the unit; organized into groups of 4 terminals consisting of 3 inputs and an isolated common in each group.

Four (4) discrete outputs - Form A Relay (SPST); rated 5–48 VDC/ 24–240 VAC. They are located along the front left of the unit. The outputs are organized into groups of three terminals consisting of two outputs and an isolated common in each group.

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.

WARNING: **No analog I/O is included on this unit. The three (3) terminals between the power supply and the inputs are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!**

BX-DM1-10ER-D

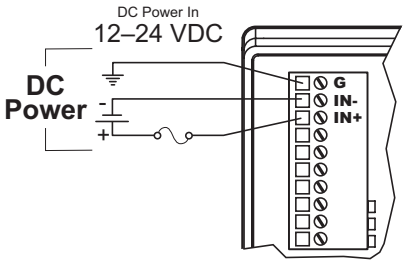
NOTE: *Two (2) Expansion modules can be connected to extend I/O capacity.*

BX-DM1-10ER-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage	12–24 VDC
Input Voltage Range (Tolerance)	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	14W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Efficiency	85%
Under Input Voltage Lock-out	<9VDC
Heat Dissipation	3.2 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



BX-DM1-10ER-D Wiring, Continued

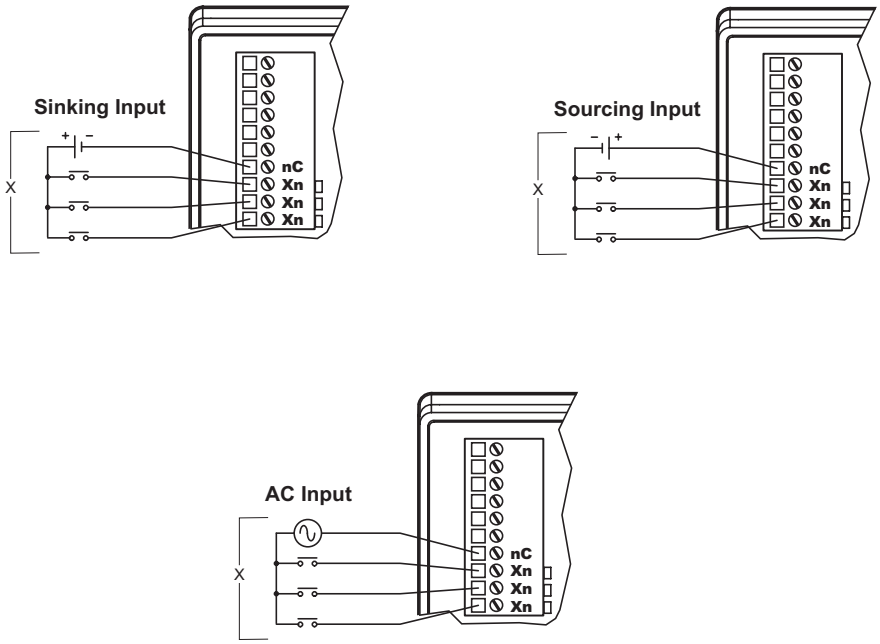
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		6	
Commons		2 (3 points/common) Isolated	
Nominal Voltage Rating		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz [2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		2.0 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard [1]
Location		X0...X5	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]

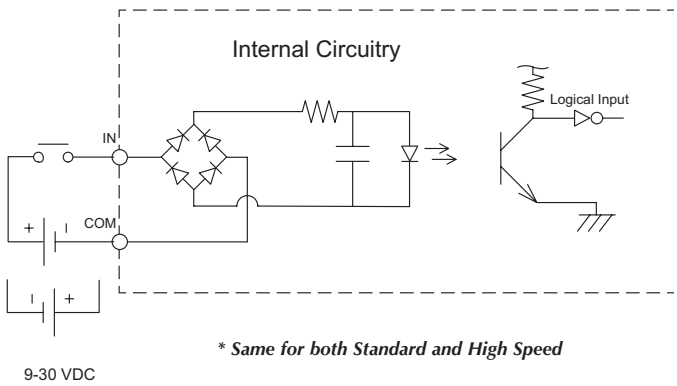
1. All Inputs may be used as standard inputs or high speed inputs independently.
2. 240Hz filter must be set in software for AC operation.

BX-DM1-10ER-D Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

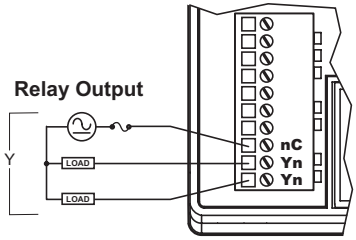
BX-DM1-10ER-D Wiring, Continued

Discrete Output Specifications

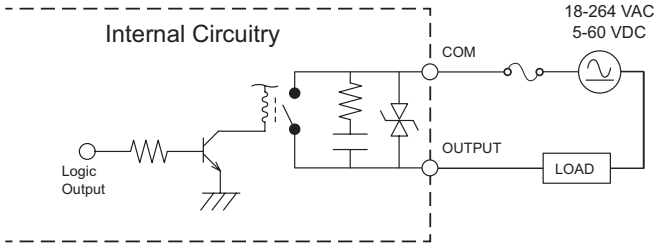
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	4
Commons	2 (2 points/common) Isolated
Maximum Current per Common	4A
Nominal Voltage Rating	5–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC 18–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA (DC), 300µA (AC) due to RC snubber circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y3
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fusing	External fusing recommended

BX-DM1-10ER-D Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



BX-DM1-10AR-D Wiring

This MPU has 10 discrete I/O points. The connections are grouped as follows:

Six (6) discrete inputs - AC rated for 120–240 VAC. They are located along the front left of the unit; organized into groups of 4 terminals consisting of 3 inputs and an isolated common in each group.

Four (4) discrete outputs - Form A Relay (SPST); rated 5–48 VDC/ 24–240 VAC. They are located along the front left of the unit. The outputs are organized into groups of 3 terminals consisting of 2 outputs and an isolated common in each group.

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.

WARNING: **No analog I/O is included on this unit. The three (3) terminals between the power supply and the inputs are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS.**

BX-DM1-10AR-D

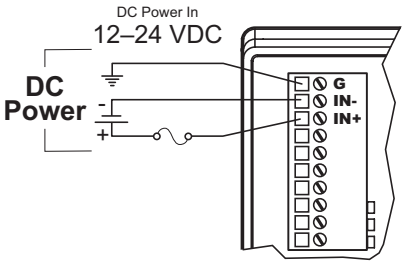
NOTE: *Two (2) Expansion modules can be connected to extend I/O capacity.*

BX-DM1-10AR-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage	12–24 VDC
Input Voltage Range (Tolerance)	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	14W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Efficiency	85%
Under Input Voltage Lock-out	<9VDC
Heat Dissipation	3.2 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



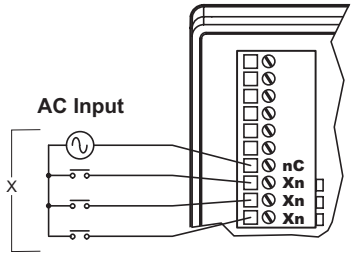
BX-DM1-10AR-D Wiring, Continued

Discrete Input Specifications

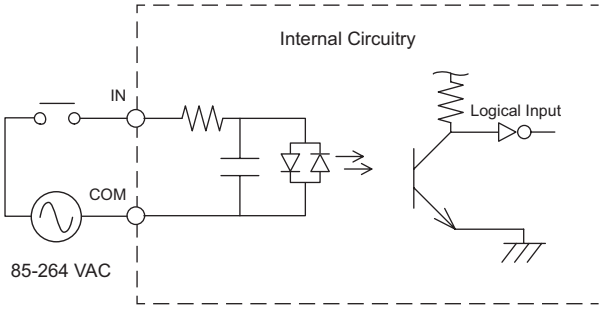
Discrete Input Specifications	
Input Type	AC
Total Inputs per Module	6
Commons	2 (3 points/common) Isolated
Nominal Voltage Rating	120–240 VAC
Input Voltage Range	85–264 VAC
Maximum Voltage	264VAC RMS
AC Frequency	47–63 Hz
Input Impedance	15kΩ
Input Current (typical)	9mA @ 120VAC, 13mA @ 220VAC
Maximum Input Current	14mA @ 120VAC, 20mA @ 220VAC
ON Voltage Level	> 85VAC
OFF Voltage Level	< 40VAC
Maximum OFF Current	2.5 mA
Status Indicators	Logic Side, Green
Input Details	
Input Type	Standard
Location	X0..X5
OFF - ON Response	10ms
ON - OFF Response	10ms

BX-DM1-10AR-D Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry



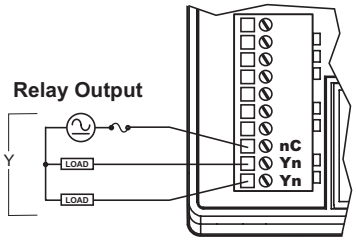
BX-DM1-10AR-D Wiring, Continued

Discrete Output Specifications

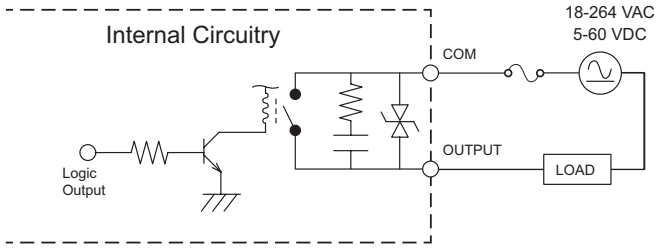
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	4
Commons	2 (3 points/common) Isolated
Maximum Current per Common	4A
Nominal Voltage Rating	5–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC 18–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA (DC), 300µA (AC) due to RC snubber circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y3
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fusing	External fusing recommended

BX-DM1-10AR-D Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



BX 10E Micro PLC Units (MPUs)

BX-DM1E-10ED13-D Wiring

This MPU has 10 discrete I/O points. The connections are grouped as follows:

Six (6) discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the front left of the unit; organized into groups of 4 terminals consisting of 3 inputs and an isolated common in each group.

Four (4) discrete outputs - sinking; rated at 12–24 VDC. They are located along the front left of the unit. The outputs are organized into groups of 3 terminals consisting of 2 outputs and an isolated common in each group.

One (1) analog input and one (1) analog output. The analog inputs and outputs are located along the front left side of the unit. The analog inputs and outputs are grouped together on 3 terminals consisting of 1 analog input, 1 analog output and a shared analog common.

current or voltage selectable through software

16-bit resolution @ ±10V, ±20mA

current signal ranges of 4–20 mA, ±20 mA

voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5VDC, ±10VDC

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.

BX-DM1E-10ED13-D

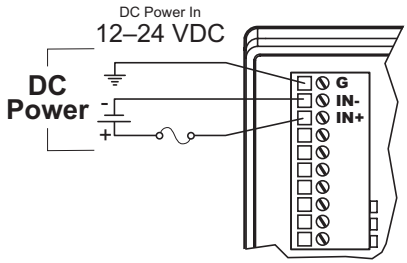
NOTE: *Two (2) Expansion modules can be connected to extend I/O capacity.*

BX-DM1E-10ED13-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage	12–24 VDC
Input Voltage Range (Tolerance)	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	14W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Efficiency	85%
Under Input Voltage Lock-out	<9VDC
Heat Dissipation	3.2 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



BX-DM1E-10ED13-D Wiring, Continued

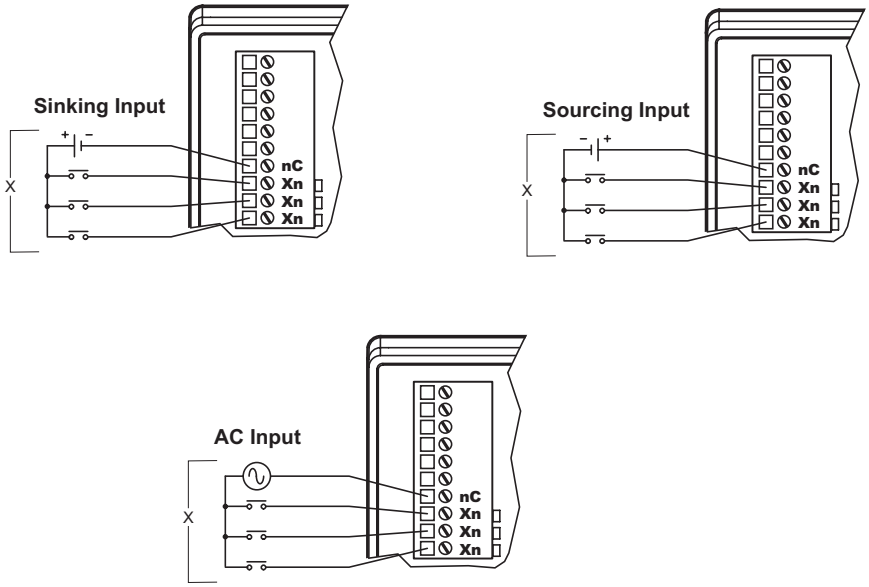
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		6	
Commons		2 (3 points/common) Isolated	
Nominal Voltage Rating		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz [2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		2.0 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard [1]
Location		X0...X5	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]

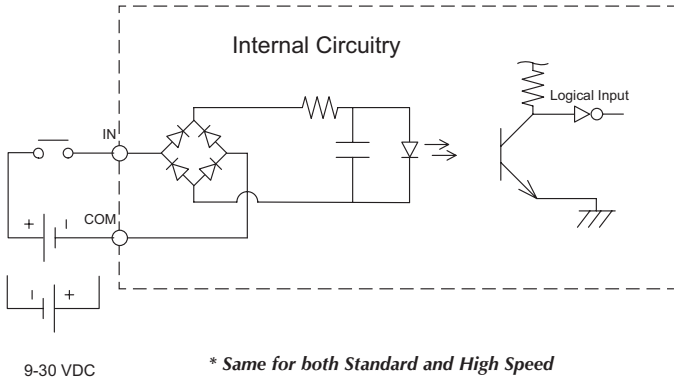
1. All Inputs may be used as standard inputs or high speed inputs independently.
2. 240Hz filter must be set in software for AC operation.

BX-DM1E-10ED13-D Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

BX-DM1E-10ED13-D Wiring, Continued

Discrete Output Specifications

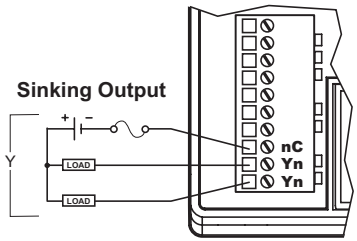
Discrete Output Specifications		
Output Type	Sinking	
Total Outputs per Module	4	
Commons	2 (2 points/common) Isolated	
Maximum Current per Common	1A	
Nominal Voltage Rating	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard [1]
Location	Y0...Y1	Y2...Y3
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	143Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level [2]	Between 4A and 8A	N/A
Fusing	External fusing recommended	

1. All outputs may be used as standard outputs. Only the first 2 outputs (Y0...Y1) are capable of high speed DC operation.

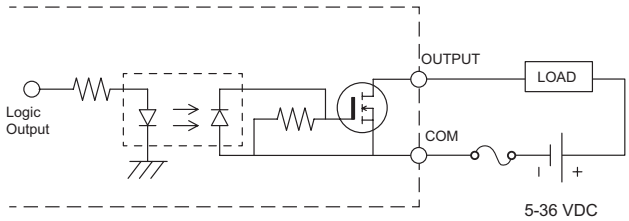
2. When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.

BX-DM1E-10ED13-D Wiring, Continued

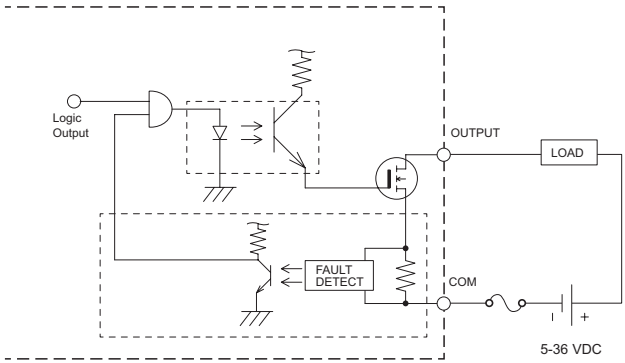
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1E-10ED13-D Wiring, Continued

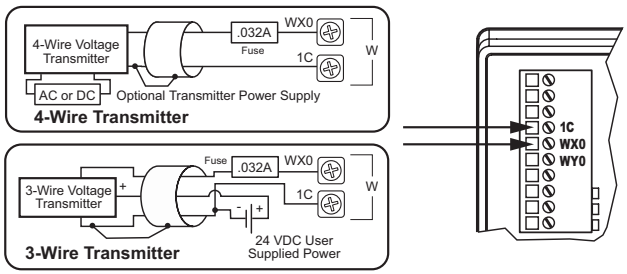
Analog Input Specifications

Analog Input Specifications	
Inputs per Module	1
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	1.2 ms
Input Impedance Voltage Modes	220kΩ
Input Impedance Current Modes	249Ω
Fusing	External fusing recommended

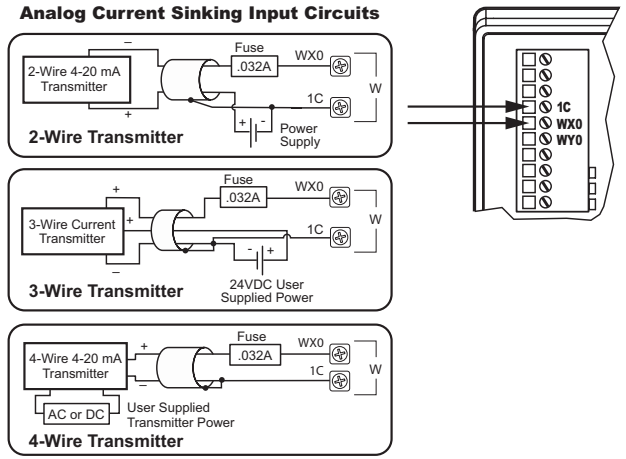
* Software selectable per channel.

Analog Input Connections Options

Analog Voltage Input Circuits



Analog Current Sinking Input Circuits



An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.

BX-DM1E-10ED13-D Wiring, Continued

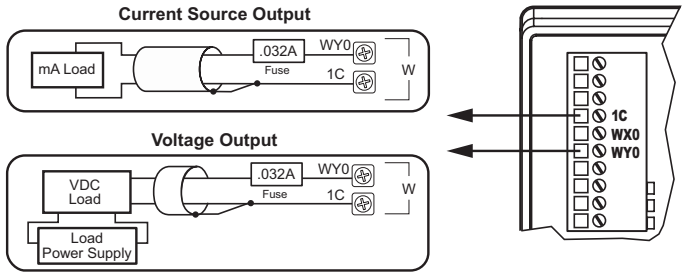
Analog Output Specifications

Analog Output Specifications	
Outputs per Module	1
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Minimum Voltage Load Impedance	1kΩ
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Maximum Current Load Impedance	500Ω
Conversion	< 1ms
Resolution	16 bit @ ±10V, ±20mA
Fusing	External fusing recommended

* Software selectable per channel.

Analog Output Connections Options

Analog Output Wiring



An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.

BX-DM1E-10ED23-D Wiring

This MPU has 10 discrete I/O points. The connections are grouped as follows:

Six (6) discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the front left of the unit; organized into groups of 4 terminals consisting of 3 inputs and an isolated common in each group.

Four (4) discrete outputs - sourcing; rated at 12–24 VDC. They are located along the front left of the unit. The outputs are organized into groups of 3 terminals consisting of 2 outputs and an isolated common in each group.

One (1) analog input and one (1) analog output. The analog inputs and outputs are located along the front left side of the unit. The analog inputs and outputs are grouped together on 3 terminals consisting of 1 analog input, 1 analog output and a shared analog common.

current or voltage selectable through software

16-bit resolution @ ±10V, ±20mA

current signal ranges of 4–20 mA, ±20 mA

voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5VDC, ±10VDC

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.

BX-DM1E-10ED23-D

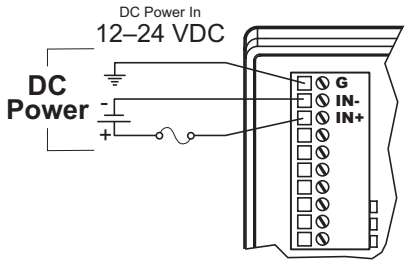
NOTE: *Two (2) Expansion modules can be connected to extend I/O capacity.*

BX-DM1E-10ED23-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage	12–24 VDC
Input Voltage Range (Tolerance)	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	14W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Efficiency	85%
Under Input Voltage Lock-out	<9VDC
Heat Dissipation	3.2 W Max
Isolated User 24VDC Output	None
Operating Design Life	10 years at full load at 40°C ambient, 5 years at 60°C ambient
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



BX-DM1E-10ED23-D Wiring, Continued

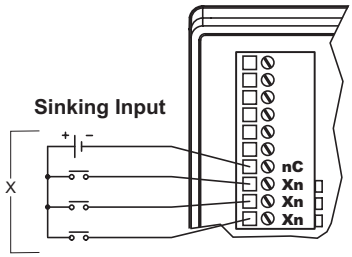
Discrete Input Specifications

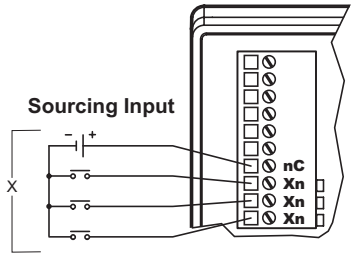
Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		6	
Commons		2 (3 points/common) Isolated	
Nominal Voltage Rating		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz [2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		2.0 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard [1]
Location		X0...X5	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]

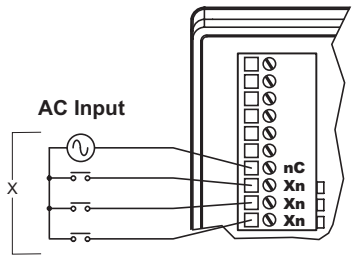
1. All Inputs may be used as standard inputs or high speed inputs independently.
2. 240Hz filter must be set in software for AC operation.

BX-DM1E-10ED23-D Wiring, Continued

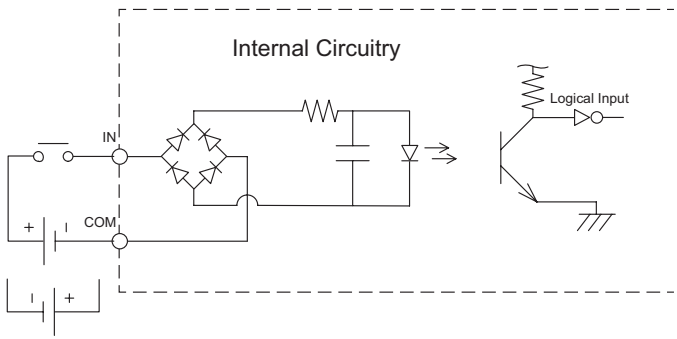
Discrete Input Connection Options







Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

BX-DM1E-10ED23-D Wiring, Continued

Discrete Output Specifications

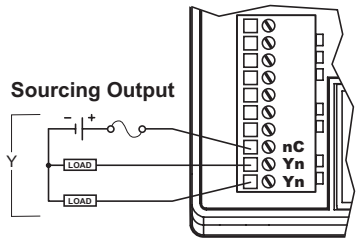
Discrete Output Specifications		
Output Type	Sourcing	
Total Outputs per Module	4	
Commons	2 (2 points/common) Isolated	
Maximum Current per Common	1A	
Nominal Voltage Rating	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard [1]
Location	Y0...Y1	Y2...Y3
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	143Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level [2]	Between 4A and 8A	N/A
Fusing	External fusing recommended	

1. All outputs may be used as standard outputs. Only the first 2 outputs (Y0...Y1) are capable of high speed DC operation.

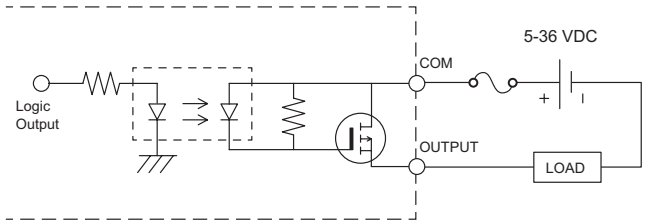
2. When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.

BX-DM1E-10ED23-D Wiring, Continued

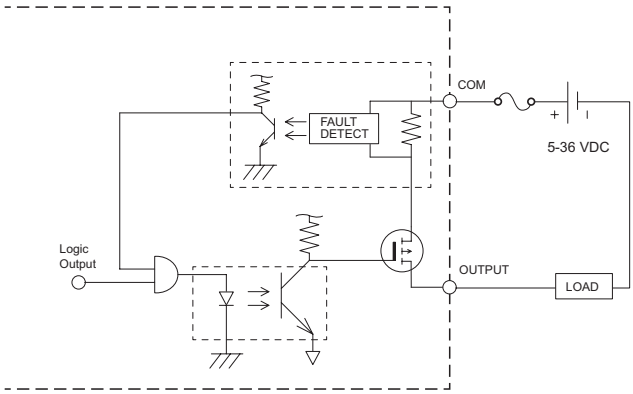
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

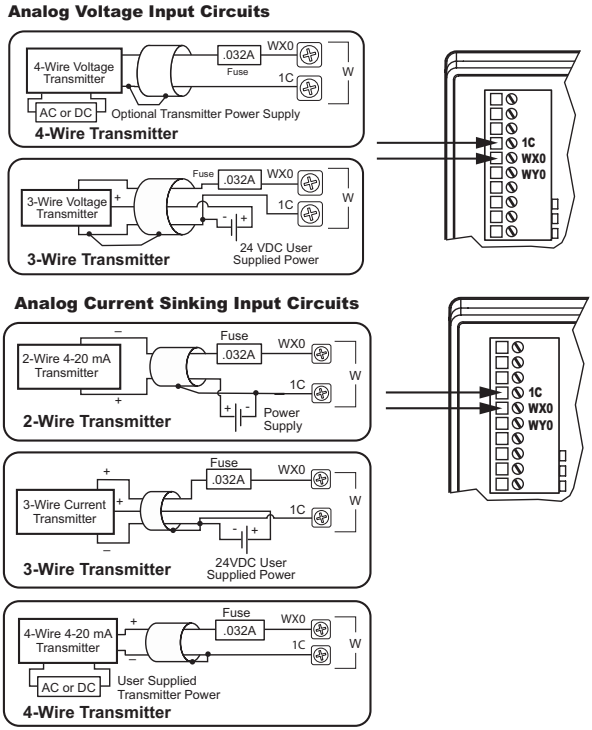
BX-DM1E-10ED23-D Wiring, Continued

Analog Input Specifications

Analog Input Specifications	
Inputs per Module	1
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	1.2 ms
Input Impedance Voltage Modes	220kΩ
Input Impedance Current Modes	249Ω
Fusing	External fusing recommended

* Software selectable per channel.

Analog Input Connections Options



An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.

BX-DM1E-10ED23-D Wiring, Continued

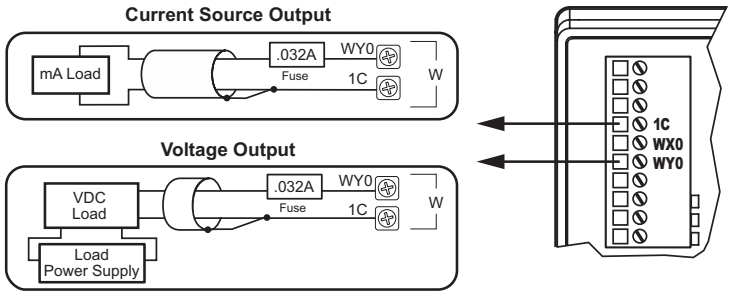
Analog Output Specifications

Analog Output Specifications	
Outputs per Module	1
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Minimum Voltage Load Impedance	1kΩ
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Maximum Current Load Impedance	500Ω
Conversion Time	< 1ms
Resolution	16 bit @ ±10V, ±20mA
Fusing	External fusing recommended

* Software selectable per channel.

Analog Output Connections Options

Analog Output Wiring



An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.

BX-DM1E-10ER3-D Wiring

This MPU has 10 discrete I/O points. The connections are grouped as follows:

Six (6) discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the front left of the unit; organized into groups of 4 terminals consisting of 3 inputs and an isolated common in each group.

Four (4) discrete outputs - Form A Relay (SPST); rated 6–48 VDC/ 24–240 VAC. They are located along the front left of the unit. The outputs are organized into groups of 3 terminals consisting of 2 outputs and an isolated common in each group.

One (1) analog input and one (1) analog output. The analog inputs and outputs are located along the front left side of the unit. The analog inputs and outputs are grouped together on 3 terminals consisting of 1 analog input, 1 analog output and a shared analog common.

current or voltage selectable through software

16-bit resolution @ ±10V, ±20mA

current signal ranges of 4–20 mA, ±20 mA

voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5VDC, ±10VDC

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.

BX-DM1E-10ER3-D

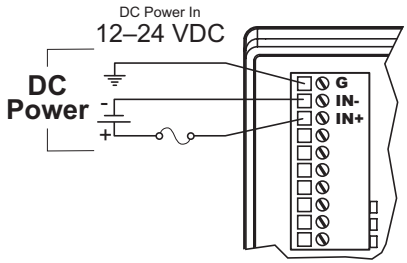
NOTE: *Two (2) Expansion modules can be connected to extend I/O capacity.*

BX-DM1E-10ER3-D Wiring, Continued

Power Supply Specification

Power Supply Specifications	
Nominal Voltage	12–24 VDC
Input Voltage Range (Tolerance)	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	14W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Efficiency	85%
Under Input Voltage Lock-out	<9VDC
Heat Dissipation	3.2 W Max
Isolated User 24VDC Output	None
Operating Design Life	10 years at full load at 40°C ambient, 5 years at 60°C ambient
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



BX-DM1E-10ER3-D Wiring, Continued

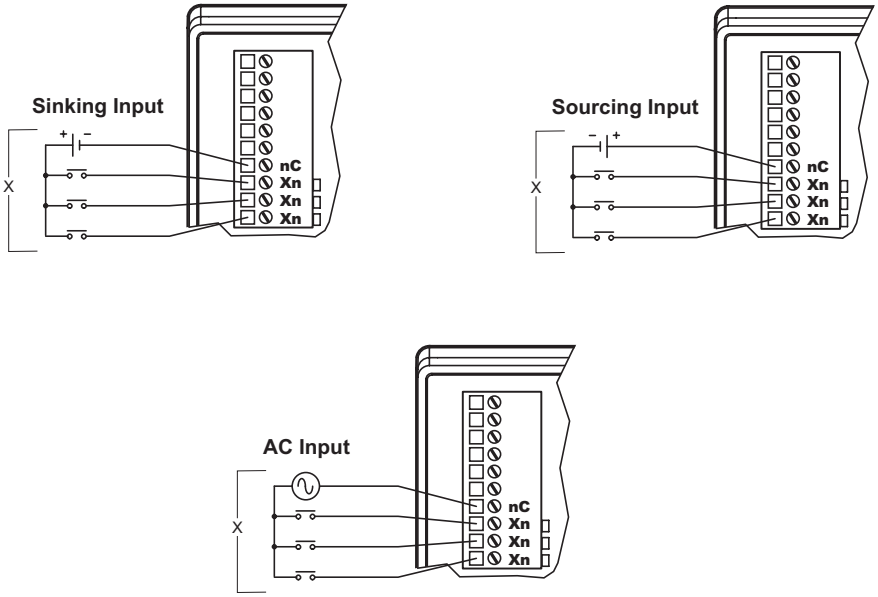
Discrete Input Specifications

Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		6	
Commons		2 (3 points/common) Isolated	
Nominal Voltage Rating		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz [2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		2.0 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard [1]
Location		X0...X5	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]

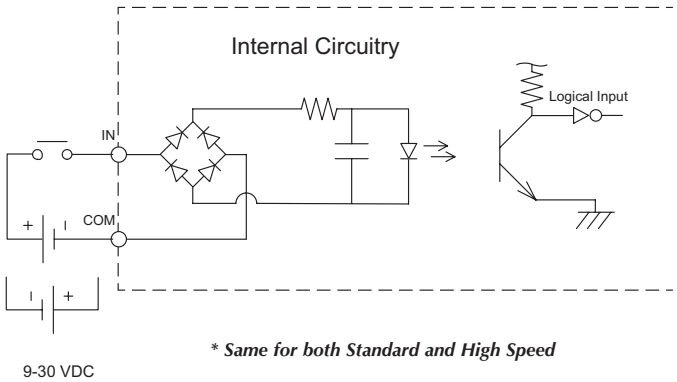
1. All Inputs may be used as standard inputs or high speed inputs independently.
2. 240Hz filter must be set in software for AC operation.

BX-DM1E-10ER3-D Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

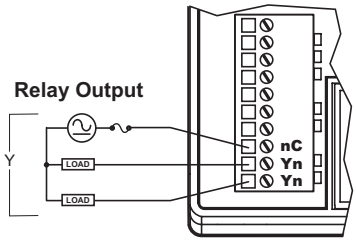
BX-DM1E-10ER3-D Wiring, Continued

Discrete Output Specifications

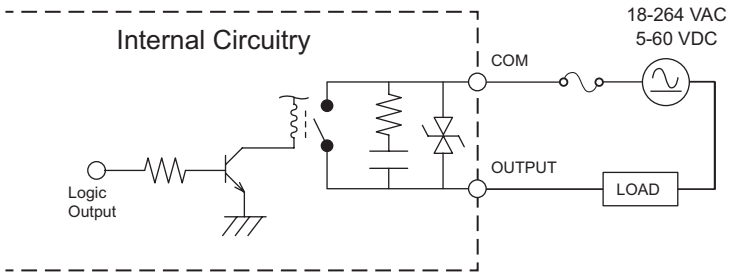
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	4
Commons	2 (2 points/common) Isolated
Maximum Current per Common	4A
Nominal Voltage Rating	5–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC 18–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1μA (DC), 300μA (AC) due to RC snubber circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y3
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fusing	External fusing recommended

BX-DM1E-10ER3-D Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



BX-DM1E-10ER3-D Wiring, Continued

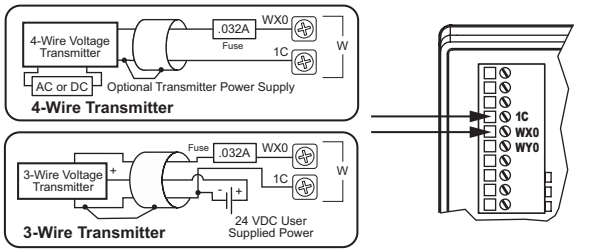
Analog Input Specifications

Analog Input Specifications	
Inputs per Module	1
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	1.2 ms
Input Impedance Voltage Modes	220kΩ
Input Impedance Current Modes	249Ω
Fusing	External fusing recommended

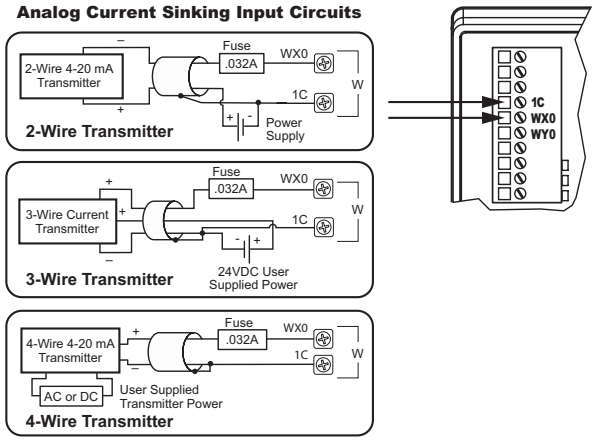
* Software selectable per channel.

Analog Input Connections Options

Analog Voltage Input Circuits



Analog Current Sinking Input Circuits



An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.

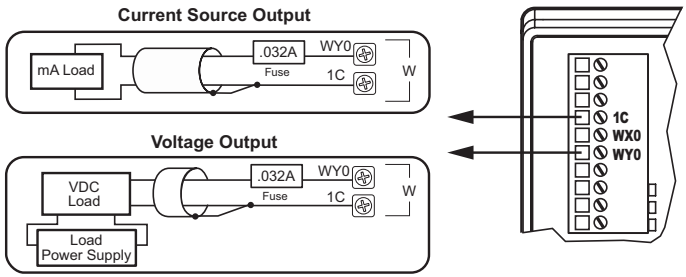
BX-DM1E-10ER3-D Wiring, Continued

Analog Output Specifications

Analog Output Specifications	
Outputs per Module	1
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Minimum Voltage Load Impedance	1kΩ
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Maximum Current Load Impedance	500Ω
Conversion Time	< 1ms
Resolution	16 bit @ ±10V, ±20mA
Fusing	External fusing recommended

* Software selectable per channel.

Analog Output Connections Options



An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.

BX-DM1E-10AR3-D Wiring

This MPU has 10 discrete I/O points. The connections are grouped as follows:

Six (6) discrete inputs - AC rated for 120–240 VAC. They are located along the front left of the unit; organized into groups of 4 terminals consisting of 3 inputs and an isolated common in each group.

Four (4) discrete outputs - Form A Relay (SPST); rated 6–48 VDC/ 24–240 VAC. They are located along the front left of the unit. The outputs are organized into groups of 3 terminals consisting of 2 outputs and an isolated common in each group.

One (1) analog input and one (1) analog output. The analog inputs and outputs are located along the front left side of the unit. The analog inputs and outputs are grouped together on 3 terminals consisting of 1 analog input, 1 analog output and a shared analog common.

current or voltage selectable through software

16-bit resolution @ ±10V, ±20mA

current signal ranges of 4–20 mA, ±20 mA

voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5VDC, ±10VDC

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.

BX-DM1E-10AR3-D

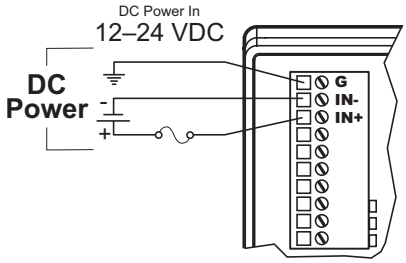
NOTE: *Two (2) Expansion modules can be connected to extend I/O capacity.*

BX-DM1E-10AR3-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage	12–24 VDC
Input Voltage Range (Tolerance)	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	14W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Efficiency	85%
Under Input Voltage Lock-out	<9VDC
Heat Dissipation	3.2 W Max
Isolated User 24VDC Output	None
Operating Design Life	10 years at full load at 40°C ambient, 5 years at 60°C ambient
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



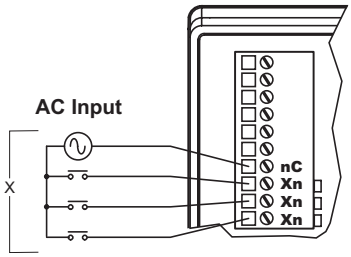
BX-DM1E-10AR3-D Wiring, Continued

Discrete Input Specifications

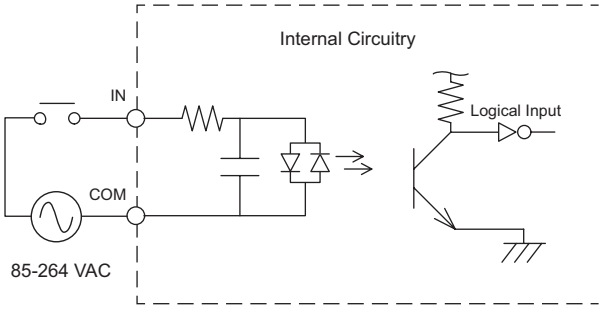
Discrete Input Specifications	
Input Type	AC
Total Inputs per Module	6
Commons	2 (3 points/common) Isolated
Nominal Voltage Rating	120–240 VAC
Input Voltage Range	85–264 VAC
Maximum Voltage	264VAC RMS
AC Frequency	47–63 Hz
Input Impedance	15kΩ
Input Current (typical)	9mA @ 120VAC, 13mA @ 220VAC
Maximum Input Current	14mA @ 120VAC, 20mA @ 220VAC
ON Voltage Level	> 85VAC
OFF Voltage Level	< 40VAC
Maximum OFF Current	2.5 mA
Status Indicators	Logic Side, Green
Input Details	
Input Type	Standard
Location	X0..X5
OFF - ON Response	10ms
ON - OFF Response	10ms

BX-DM1E-10AR3-D Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry



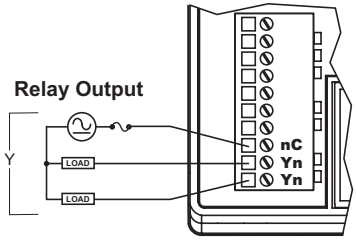
BX-DM1E-10AR3-D Wiring, Continued

Discrete Output Specifications

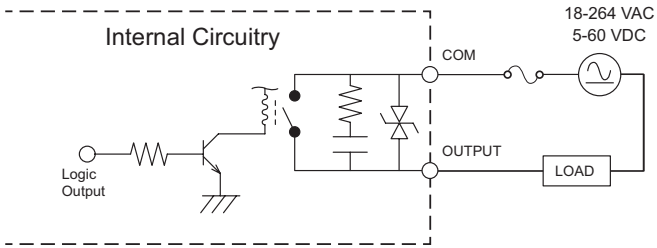
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	4
Commons	2 (2 points/common) Isolated
Maximum Current per Common	4A
Nominal Voltage Rating	5–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC 18–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA (DC), 300µA (AC) due to RC snubber circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y3
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fusing	External fusing recommended

BX-DM1E-10AR3-D Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



BX-DM1E-10AR3-D Wiring, Continued

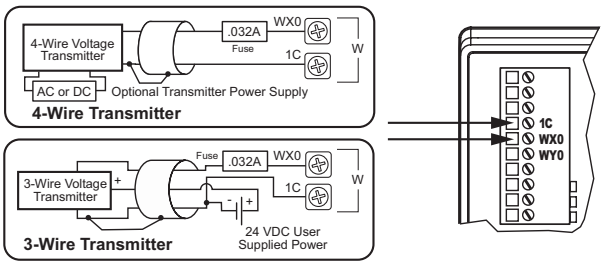
Analog Input Specifications

Analog Input Specifications	
Inputs per Module	1
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	1.2 ms
Input Impedance Voltage Modes	220kΩ
Input Impedance Current Modes	249Ω
Fusing	External fusing recommended

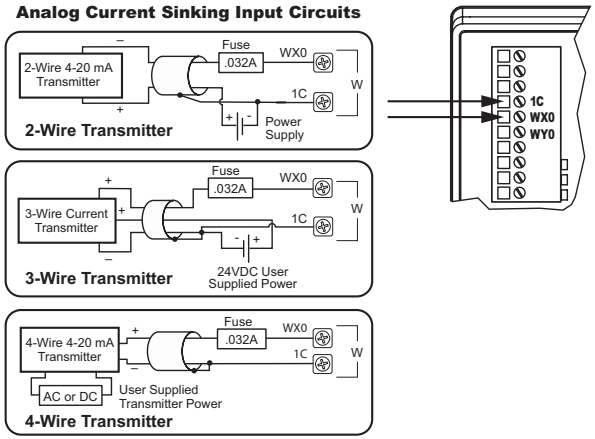
* Software selectable per channel.

Analog Input Connections Options

Analog Voltage Input Circuits



Analog Current Sinking Input Circuits



An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.

BX-DM1E-10AR3-D Wiring, Continued

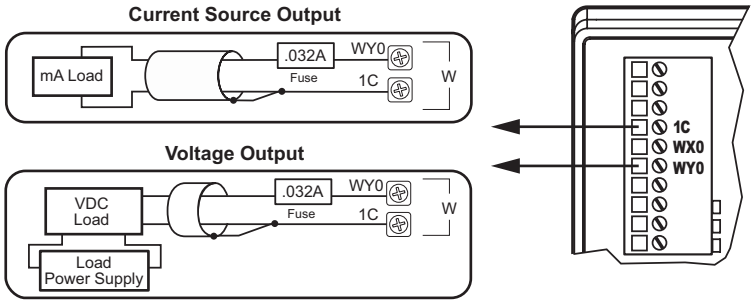
Analog Output Specifications

Analog Output Specifications	
Outputs per Module	1
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Minimum Voltage Load Impedance	1kΩ
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Maximum Current Load Impedance	500Ω
Conversion Time	< 1ms
Resolution	16 bit @ ±10V, ±20mA
Fusing	External fusing recommended

* Software selectable per channel.

Analog Output Connections Options

Analog Output Wiring



An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.

Notes:

BX 18/18E Wiring

In This Chapter...

Overview 4-2
BX 18/18E MPUs 4-2
General Specifications 4-3
BX 18/18E MPU Wiring Termination Selection 4-5
Terminal Block Connectors 4-5
*ZIP*Link Pre-Wired Cable Solutions 4-7
*ZIP*Link System Examples 4-9
BX 18 Micro PLC Units (MPUs) 4-10
BX-DM1-18ED1 Wiring 4-10
BX-DM1-18ED1-D Wiring 4-16
BX-DM1-18ED2 Wiring 4-22
BX-DM1-18ED2-D Wiring 4-28
BX-DM1-18ER Wiring 4-34
BX-DM1-18ER-D Wiring 4-40
BX-DM1-18AR Wiring 4-46
BX 18E Micro PLC Units (MPUs) 4-52
BX-DM1E-18ED13 Wiring 4-52
BX-DM1E-18ED13-D Wiring 4-61
BX-DM1E-18ED23 Wiring 4-70
BX-DM1E-18ED23-D Wiring 4-79
BX-DM1E-18ER3 Wiring 4-88
BX-DM1E-18ER3-D Wiring 4-97
BX-DM1E-18AR3 Wiring 4-106

BX 18/18E Micro PLC Units (MPUs)

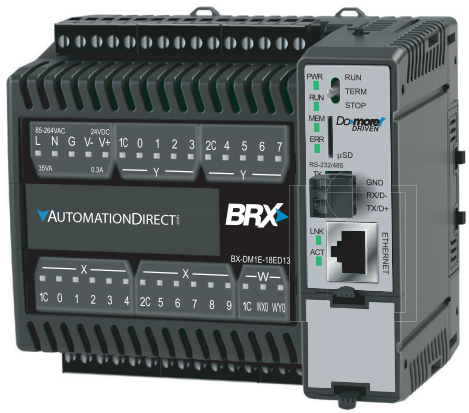
Overview

The BX 18/18E Micro PLC Unit (MPU) includes fourteen different versions having the same appearance and basic features. All units have 10 discrete input points and 8 discrete output points built-in. Units with DC inputs have 10 selectable high-speed inputs and units with DC outputs have 4 selectable high-speed outputs. All MPUs can expand their I/O capacity with the BRX Expansion Modules, allowing for more flexibility while keeping control cost down. BX 18E units additionally have 1 analog input and 1 analog output built-in that are current/voltage selectable within the software.

BX 18/18E MPUs

BX 18/18E MPUs are divided into two distinct groups, BX 18 and BX 18E. The BX 18 MPUs have no built-in analog I/O or Ethernet port. The BX 18E MPUs have all the features of the BX 18, plus built-in analog I/O and an Ethernet port.

BX 18 Micro PLC Unit (MPU) - No Built-in Analog or Ethernet



BX 18E Micro PLC Unit (MPU) with Built-in Analog and Ethernet Port

BX 18 MPUs

General Specifications

18 discrete I/O points: 10 input, 8 output

No built-in analog I/O points

Models with DC inputs:

- have 10 high-speed inputs rated up to 250kHz
- accept 12–24 nominal voltage, AC or DC
- can be wired as sinking or sourcing

Models with AC inputs can accept 120–240 nominal voltages

BX 18 Micro PLC Unit (MPU)
No Built-in Analog or Ethernet

Output types available are DC sinking, DC sourcing, and relay

Models with DC outputs have 4 high-speed outputs rated up to 250kHz

Support for 4 additional Expansion Modules

The following table shows the available BX 18 MPUs.

BX 18 MPUs

Part Number	External Power	Discrete Input	Discrete Output	Expansion Modules
BX-DM1-18ED1	120–240 VAC	10 High-Speed, DC Sinking or Sourcing	4 High-Speed 4 Standard DC Sinking	4
BX-DM1-18ED1-D	12–24 VDC			
BX-DM1-18ED2	120–240 VAC		4 High-Speed 4 Standard DC Sourcing	
BX-DM1-18ED2-D	12–24 VDC			
BX-DM1-18ER	120–240 VAC		8 Form A Relay	
BX-DM1-18ER-D	12–24 VDC			
BX-DM1-18AR	120–240 VAC	10 Standard AC		

BX 18E MPUs

General Specifications

18 Discrete I/O points: 10 inputs, 8 outputs

All units have 1 analog input and 1 analog output (current/voltage software selectable)

All units have built-in Ethernet port, 10/100 Mbps

Models with DC inputs:

- have 10 high-speed inputs rated up to 250kHz
- accept 12–24 nominal voltages, AC or DC
- can be wired as sinking or sourcing

BX 18E Micro PLC Unit (MPU) with Built-in Analog and Ethernet Port

Models with AC inputs can accept 120–240 nominal voltages

Output types available are DC sinking, DC sourcing, and relay

Models with DC outputs have 4 high-speed outputs rated up to 250kHz

Support for 8 additional Expansion Modules

The following table shows the available BX 18E MPUs.

BX 18E MPUs

Part Number	External Power	Discrete Input	Discrete Output	Analog *		Expansion Modules
				Input	Output	
BX-DM1E-18ED13	120–240 VAC	10 High-Speed, DC Sinking or Sourcing	4 High-Speed 4 Standard DC sinking	1 Current or Voltage	1 Current or Voltage	8
BX-DM1E-18ED13-D	12–24 VDC					
BX-DM1E-18ED23	120–240 VAC		4 High-Speed 4 Standard DC sourcing			
BX-DM1E-18ED23-D	12–24 VDC					
BX-DM1E-18ER3	120–240 VAC		8 Form A relay			
BX-DM1E-18ER3-D	12–24 VDC					
BX-DM1E-18AR3	120–240 VAC	10 Standard AC				

* Analog can be current or voltage software selectable per channel.

BX 18/18E MPU Wiring Termination Selection

The BX 18/18E MPUs ship without terminal blocks. This allows you to select the termination type that best suits your application. There are several wiring options available, including removable screw terminal connectors, removable spring clamp terminal connectors and pre-wired *ZIP*Link cable solutions.

Terminal Block Connectors

The terminal block connectors are provided in kits and can be ordered as a single part number. Each kit contains all the terminal block connectors required: (3) 5-pin 5mm terminal blocks (BX-RTB05), (2) 6-pin 5mm terminal blocks (BX-RTB06), and (1) 3-pin 5mm terminal block (BX-RTB03).

The BX 18/18E MPUs terminals are configured into groups of 5 inputs and 4 outputs each with an isolated common, e.g., inputs X0–X4 are grouped with their common terminal. On the BX 18E MPU the analogs are grouped as 3 terminals consisting of 1 input, 1 output and a shared isolated analog common. The I/O termination groups are isolated such that a single group connector can be removed without affecting other groups of I/O or the external power source.

The terminal block connector kit part numbers and connector specifications are listed in the table below.

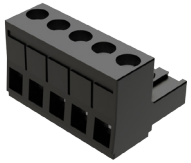
Removable Terminal Block Specifications

Kit Part Number	BX-RTB18	BX-RTB18-1
Connector Type	Screw Type-90 degree	Spring Clamp Type-180 degree
Wire Exit	180 degree	180 degree
Pitch	5.0 mm	5.0 mm
Screw Size	M2.5	N/A
Recommended Screw Torque	< 3.98 lb·in (0.45 N·m)	N/A
Screwdriver Blade Width	3.5 mm	3.5 mm
Wire Gauge (Single Wire)	28–12 AWG	28–14 AWG
Wire Gauge (Dual Wire)	28–16 AWG	28–16 AWG (Dual wire ferrule required)
Wire Strip Length	0.3 in (7.5 mm)	0.37 in (9.5 mm)
Equiv. Dinkle P/N	5ESDV-0*n*P-BK*	5ESDSR-0*n*P-BK*

* Replace n with: (3) 3-terminal, (5) 5-terminal or (6) for 6-terminal.

BX-RTB18 Screw Terminal Block Kit

This terminal block kit has 90 degree screw terminal blocks. Wire is 180 degree pass through.



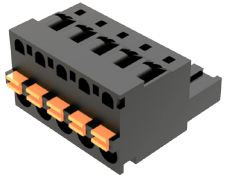
5-Pin

6-Pin

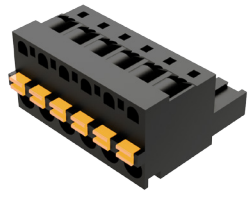
3-Pin

BX-RTB18-1 Spring Terminal Block Kit

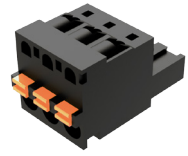
This terminal block kit has Spring Clamp wire terminal blocks with 180 degree wire pass through.



5-Pin



6-Pin



3-Pin

Replacement terminal blocks can be ordered online at:
www. automationdirect.com. Single replacement terminal blocks are listed in table below.

Replacement Terminal Blocks		
	BX-RTB18	**BX-RTB18-1**
3-pin	BX-RTB03	BX-RTB03-1
5-pin	BX-RTB05	BX-RTB05-1
6-pin	BX-RTB06	BX-RTB06-1

*ZIP*Link Pre-Wired Cable Solutions

*ZIP*Links eliminate the normally tedious process of wiring between devices by utilizing prewired cables and DIN rail mount connector modules. *ZIP*Links are as simple as plugging in a cable connector at either end or terminating wires at only one end. Prewired cables keep installation clean and efficient, using less space at a fraction of the cost of standard terminal blocks. *ZIP*Link prewired cables can connect directly to a *ZIP*link remote terminal block module or with the pigtail option, allowing for a convenient solution to wire the BRX platform to 3rd party devices. For the BX 18/18E MPUs, two (2) cables and two (2) *ZIP*link feedthrough modules are needed to connect all the wiring termination points.

There are two (2) feedthrough module options available, the ZL-RTB20 and the ZL-RTB20-1. The ZL-RTB20 is a standard feedthrough remote terminal module while the RTB20-1 is a feedthrough remote terminal block having a more compact footprint, requiring less space in the control cabinet.

The *ZIP*Link system options for the BX 18/18E MPUs are listed in the table below.

BX 18/18E ZIPLink Selector

Part Number	Module Type	Module Part No.	Max Qty Needed	Cable Part No.*	Max Qty Needed
BX-DM1-18ED1	Feedthrough	ZL-RTB20, (standard) -OR- ZL-RTB20-1 (compact)	2	ZL-BX-CBL15 ZL-BX-CBL15-1 ZL-BX-CBL15-2	2
BX-DM1-18ED1-D					
BX-DM1-18ED2					
BX-DM1-18ED2-D					
BX-DM1-18ER					
BX-DM1-18ER-D					
BX-DM1-18AR					
BX-DM1E-18ED13					
BX-DM1E-18ED13-D					
BX-DM1E-18ED23					
BX-DM1E-18ED23-D					
BX-DM1E-18ER3					
BX-DM1E-18ER3-D					
BX-DM1E-18AR3					

* Select the cable length: Blank = 0.5 m, -1 = 1.0 m, -2 = 2.0 m.
Available pigtail cables: ZL-BX-CBL15-1P = 1.0 m, ZL-BX-CBL15-2P = 2.0 m.

*ZIP*Link Prewired Cables

Custom molded *ZIP*Link prewired cables allow for fast and easy connection of field wiring and remote I/O to the BRX platform. The prewired cables are available in 0.5 meter, 1 meter and 2 meter lengths. Pigtail cables are used to connect the BRX platform directly to third-party devices, reducing your wiring time and cost. The pigtail cables are available in 1 meter and 2 meter lengths.

***ZIP*Link Prewired Cable**

***ZIP*Link Pigtail Cable**

*ZIP*Link Remote Feedthrough Modules

Remote Feedthrough modules provide low-cost and compact field wiring screw termination solutions for quickly connecting with the BRX platform. There are two (2) modules available for use with the BRX platform. The ZL-RTB20 and the ZL-RTB20-1. The ZL-RTB20 is a standard 2-row, 20-pin, DIN rail mountable feedthrough module. The ZL-RTB20-1 is a compact 3-row, 24-pin, DIN rail mountable feedthrough module with a smaller footprint design.

*ZIP*Link remote feedthrough module specifications are listed in this table.

***ZIP*Link Module Specifications**		
Part Number	**ZL-RTB20 (Maximum of 2 Needed)**	**ZL-RTB20-1 (Maximum of 2 Needed)**
Number of positions	20 screw terminals, 2 rows	24 screw terminals, 3 rows
Screwdriver Width	1/8 in (3.8 mm) maximum	
Screw Torque	4.4 lb·in (0.5 N·m)	

ZL-RTB20

ZL-RTB20-1

*ZIP*Link System Examples

BX 18 MPU with *ZIP*Link pre-wired cables and ZL-RTB20 feedthrough modules.

BX 18 MPU with *ZIP*Link pigtail cables installed.

BX 18 Micro PLC Units (MPUs)

BX-DM1-18ED1 Wiring

This MPU is made up of 18 discrete I/O points. The connections are grouped as follows:

10 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in two (2) groups of 6 terminals, each comprised of 5 inputs and an isolated common.

8 discrete outputs - sinking; rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in two (2) groups of 5 terminals, each comprised of 4 outputs and an isolated common.

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.

WARNING: **No analog I/O is included on this unit. The 3 terminals to the right of the inputs are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS.**

BX-DM1-18ED1

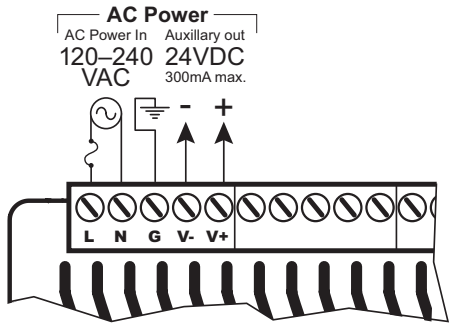
NOTE: *Four (4) Expansion Modules can be connected to extend I/O capacity.*

BX-DM1-18ED1 Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Rating	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Efficiency	80%
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	8W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



WARNING: **Do not exceed the 24VDC auxiliary power supply load limit of 300mA.**

BX-DM1-18ED1 Wiring, Continued

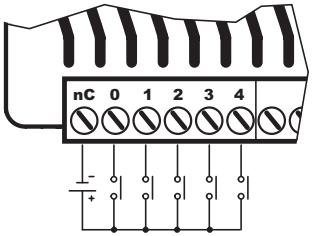
Discrete Input Specifications

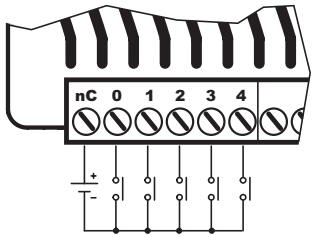
Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		10	
Commons		2 (5 points/common) Isolated	
Nominal Voltage Rating		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz [2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard [1]
Location		X0...X9	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms [2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms [2]

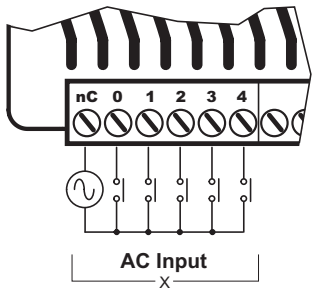
1. All Inputs may be used as standard inputs or high speed inputs independently.
2. 240Hz filter must be set in software for AC operation.

BX-DM1-18ED1 Wiring, Continued

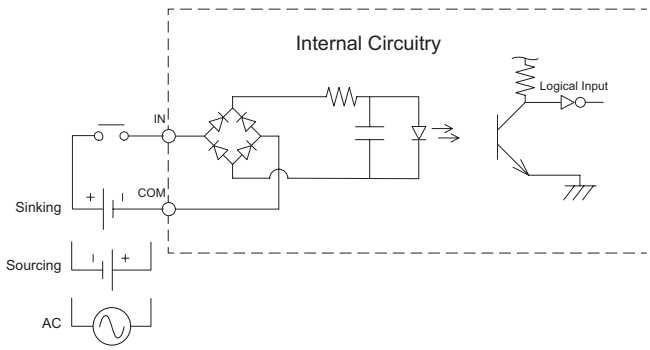
Discrete Input Connection Options







Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

BX-DM1-18ED1 Wiring, Continued

Discrete Output Specifications

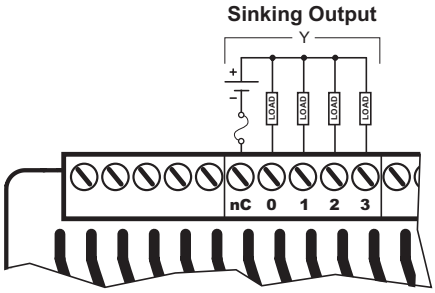
Discrete Output Specifications		
Output Type	Sinking	
Total Outputs per Module	8	
Commons	2 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Rating	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard [1]
Location	Y0...Y3	Y4...Y7
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	143Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level [2]	Between 4A and 8A	N/A
Fusing	External Fusing recommended	

1. All outputs may be used as standard outputs. Only the first 4 outputs (Y0...Y3) are capable of high speed DC operation.

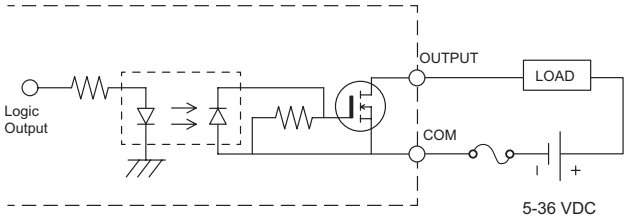
2. When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.

BX-DM1-18ED1 Wiring, continued

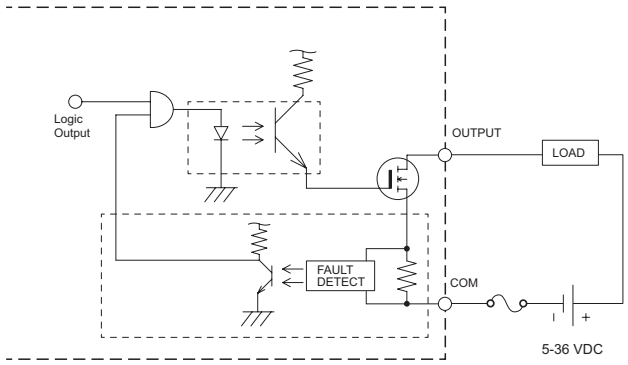
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1-18ED1-D Wiring

This MPU is made up of 18 discrete I/O points. The connections are grouped as follows:

10 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in two (2) groups of six (6) terminals, each comprised of five (5) inputs and an isolated common.

8 discrete outputs - sinking; rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC external power supply terminals. The outputs are configured in two (2) groups of five (5) terminals, each comprised of four (4) outputs and an isolated common.

The MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.

WARNING: No analog I/O is included on this unit. The three (3) terminals to the right of the inputs are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS.

BX-DM1-18ED1-D

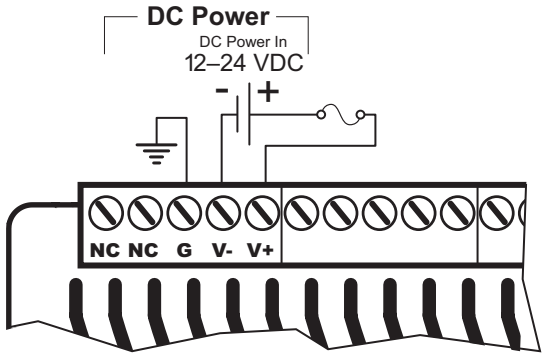
NOTE: *Four (4) Expansion Modules can be connected to extend I/O capacity.*

BX-DM1-18ED1-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range	12–24 VDC
Input Voltage Range (Tolerance)	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	30W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Efficiency	85%
Under Input Voltage Lock-out	<9VDC
Heat Dissipation	3.2 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



WARNING: No External AC power supply needed on this unit. The two terminals marked "NC" are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!

BX-DM1-18ED1-D Wiring, Continued

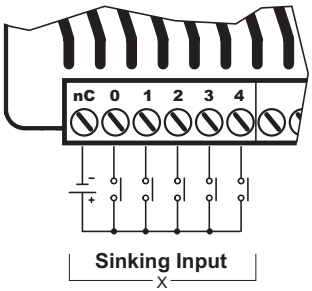
Discrete Input Specifications

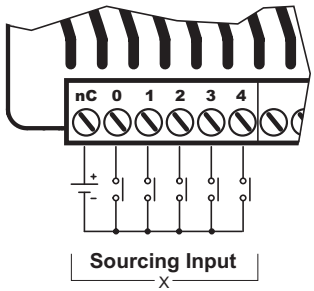
Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		10	
Commons		2 (5 points/common) Isolated	
Nominal Voltage Rating		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz [2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard [1]
Location		X0...X9	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]

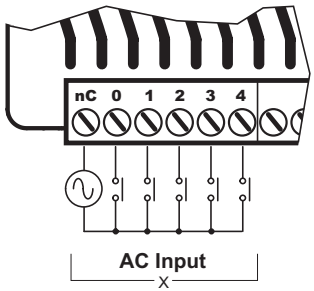
1. All Inputs may be used as standard inputs or high speed inputs independently.
2. 240Hz filter must be set in software for AC operation.

BX-DM1-18ED1-D Wiring, Continued

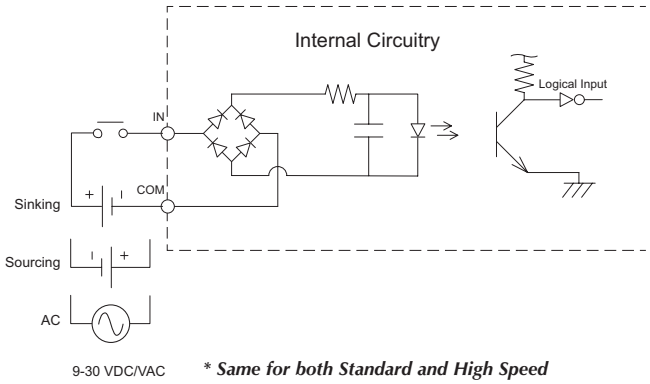
Discrete Input Connection Options







Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

BX-DM1-18ED1-D Wiring, Continued

Discrete Output Specifications

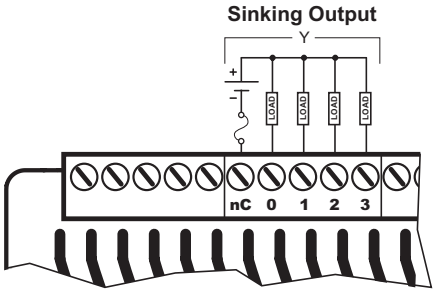
Discrete Output Specifications		
Output Type	Sinking	
Total Outputs per Module	8	
Commons	2 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Rating	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36 VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard [1]
Location	Y0...Y3	Y4...Y7
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	143Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level [2]	Between 4A and 8A	N/A
Fusing	External Fusing recommended	

1. All outputs may be used as standard outputs. Only the first 4 outputs (Y0...Y3) are capable of high speed DC operation.

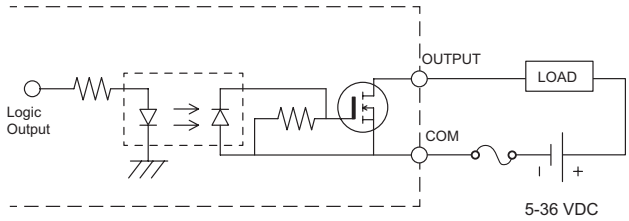
2. When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.

BX-DM1-18ED1-D Wiring, Continued

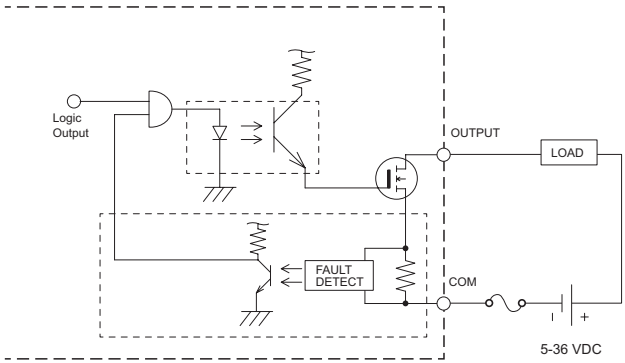
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1-18ED2 Wiring

This MPU is made up of 18 discrete I/O points. The connections are grouped as follows:

10 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in two (2) groups of 6 terminals, each comprised of 5 inputs and an isolated common.

8 discrete outputs - sourcing; rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in two (2) groups of 5 terminals, each comprised of 4 outputs and an isolated common.

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.

WARNING: **No analog I/O is included on this unit. The 3 terminals to the right of the inputs are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS.**

BX-DM1-18ED2

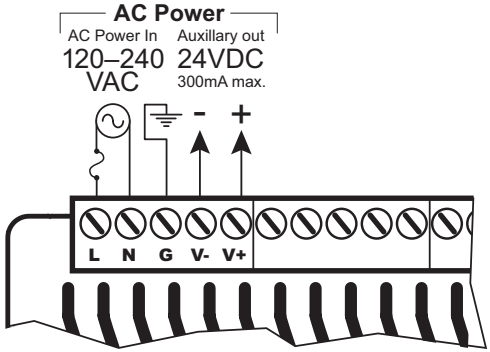
NOTE: *Four (4) Expansion Modules can be connected to extend I/O capacity.*

BX-DM1-18ED2 Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Rating	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Efficiency	80%
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	8W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



WARNING: **Do not exceed the 24VDC auxiliary power supply load limit of 300mA.**

BX-DM1-18ED2 Wiring, Continued

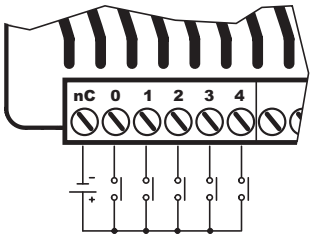
Discrete Input Specifications

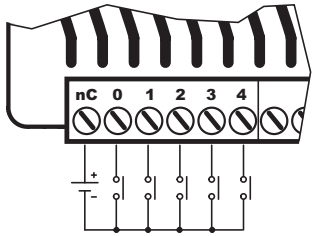
Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		10	
Commons		2 (5 points/common) Isolated	
Nominal Voltage Rating		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz [2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard [1]
Location		X0...X9	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]

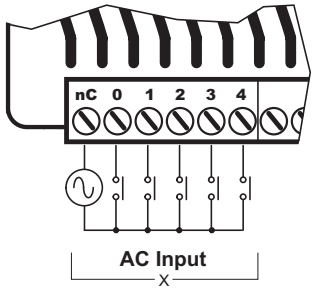
1. All Inputs may be used as standard inputs or high speed inputs independently.
2. 240Hz filter must be set in software for AC operation.

BX-DM1-18ED2 Wiring, Continued

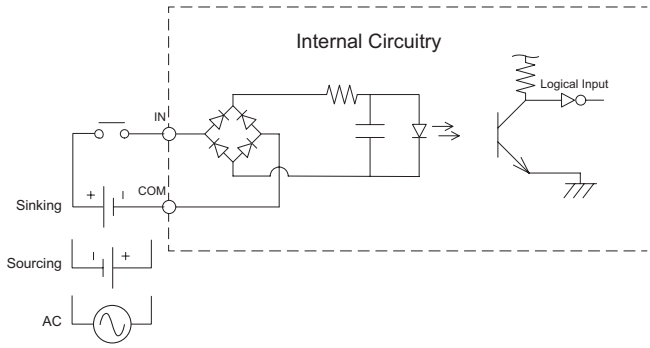
Discrete Input Connection Options







Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

BX-DM1-18ED2 Wiring, Continued

Discrete Output Specifications

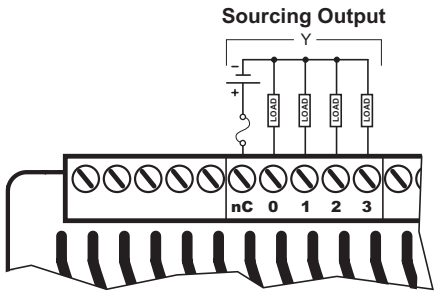
Discrete Output Specifications		
Output Type	Sourcing	
Total Outputs per Module	8	
Commons	2 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Rating	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36 VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard [1]
Location	Y0...Y3	Y4...Y7
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	143Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level [2]	Between 4A and 8A	N/A
Fusing	External Fusing recommended	

1. All outputs may be used as standard outputs. Only the first 4 outputs (Y0...Y3) are capable of high speed DC operation.

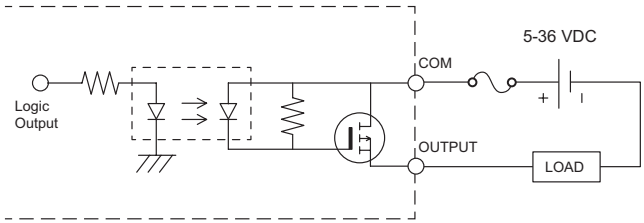
2. When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.

BX-DM1-18ED2 Wiring, Continued

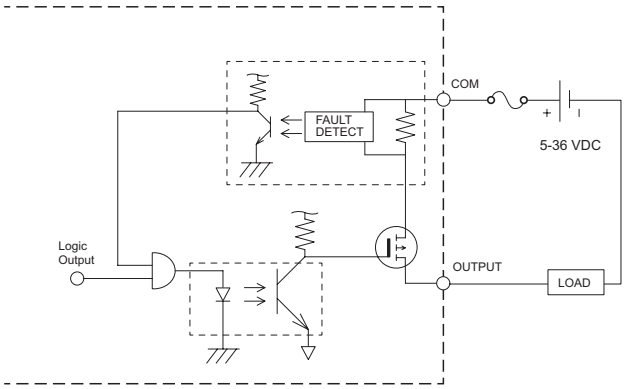
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1-18ED2-D Wiring

This MPU is made up of 18 discrete I/O points. The connections are grouped as follows:

10 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in two (2) groups of 6 terminals, each comprised of 5 inputs and an isolated common.

8 discrete outputs - sourcing; rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC external power supply terminals. The outputs are configured in two (2) groups of 5 terminals, each comprised of 4 outputs and an isolated common..

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.

WARNING: **No analog I/O is included on this unit. The 3 terminals to the right of the inputs are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS.**

BX-DM1-18ED2-D

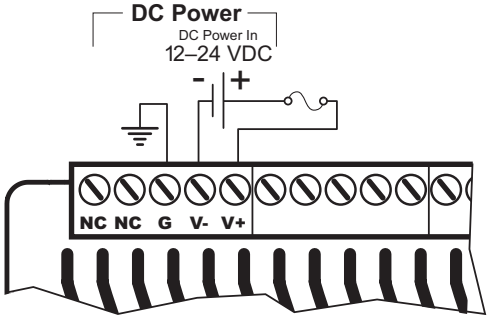
NOTE: *Four (4) Expansion Modules can be connected to extend I/O capacity.*

BX-DM1-18ED2-D, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range	12–24 VDC
Input Voltage Range (Tolerance)	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	30W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Efficiency	85%
Under Input Voltage Lock-out	<9VDC
Heat Dissipation	3.2 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



WARNING: No External AC power supply needed on this unit. The two terminals marked "NC" are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!

BX-DM1-18ED2-D Wiring, Continued

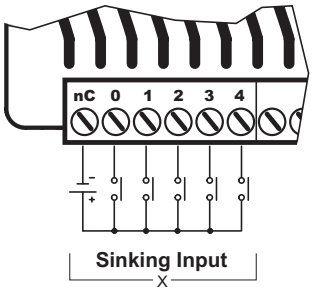
Discrete Input Specifications

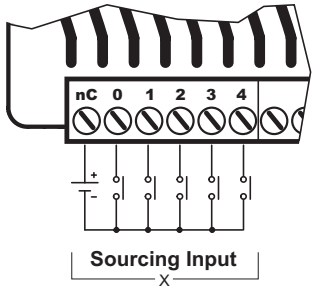
Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		10	
Commons		2 (5 points/common) Isolated	
Nominal Voltage Rating		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard [1]
Location		X0...X9	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]

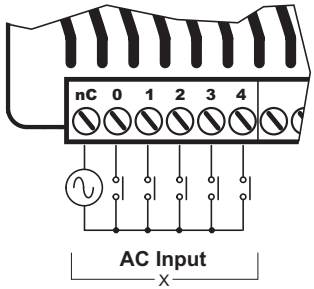
1. All Inputs are capable of high speed DC operation.
2. 240Hz filter must be set in software for AC operation..

BX-DM1-18ED2-D Wiring, Continued

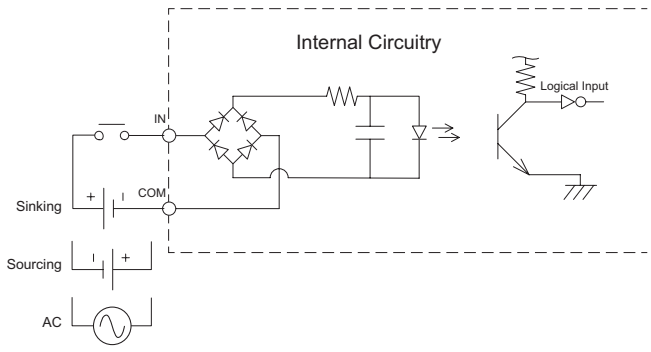
Discrete Input Connection Options







Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

BX-DM1-18ED2-D Wiring, Continued

Discrete Output Specifications

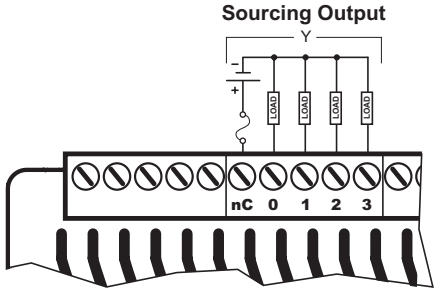
Discrete Output Specifications		
Output Type	Sourcing	
Total Outputs per Module	8	
Commons	2 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Rating	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36 VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard [1]
Location	Y0...Y3	Y4...Y7
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	143Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level [2]	Between 4A and 8A	N/A
Fusing	External Fusing recommended	

1. All outputs may be used as standard outputs. Only the first 4 outputs (Y0...Y3) are capable of high speed DC operation.

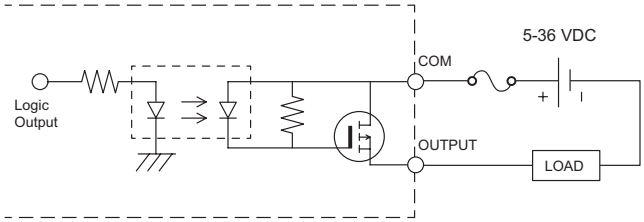
2. When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.

BX-DM1-18ED2-D Wiring, Continued

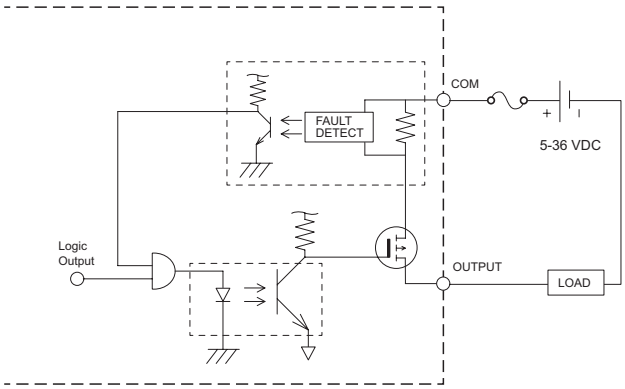
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1-18ER Wiring

This MPU is made up of 18 discrete I/O points. The connections are grouped as follows:

10 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in two (2) groups of 6 terminals, each comprised of 5 inputs and an isolated common.

8 discrete outputs - Form A Relay (SPST); rated 5–48 VDC/ 24–240 VAC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in two (2) groups of 5 terminals, each comprised of 4 outputs and an isolated common..

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.

WARNING: **No analog I/O is included on this unit. The 3 terminals to the right of the inputs are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS.**

BX-DM1-18ER

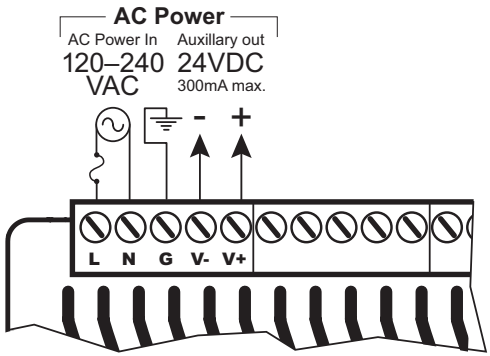
NOTE: *Four (4) Expansion Modules can be connected to extend I/O capacity.*

BX-DM1-18ER Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Rating	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Efficiency	80%
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	8W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



WARNING: **Do not exceed the 24VDC auxiliary power supply load limit of 300mA.**

BX-DM1-18ER Wiring, Continued

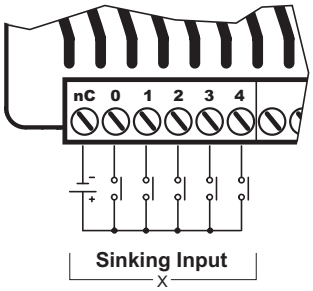
Discrete Input Specifications

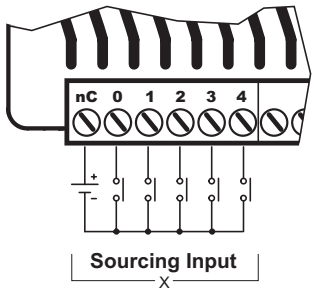
Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		10	
Commons		2 (5 points/common) Isolated	
Nominal Voltage Rating		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz [2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard [1]
Location		X0...X9	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]

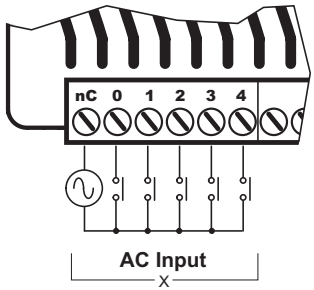
1. All Inputs may be used as standard inputs or high speed inputs independently.
2. 240Hz filter must be set in software for AC operation.

BX-DM1-18ER Wiring, Continued

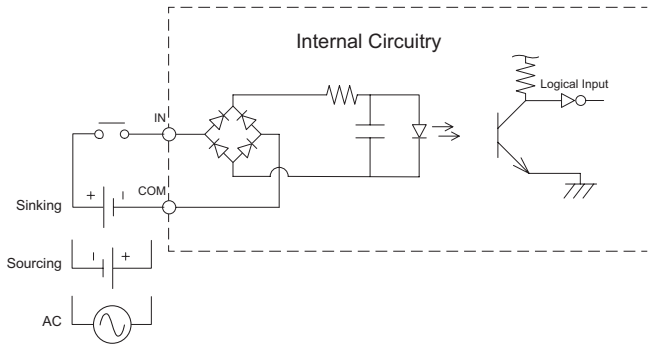
Discrete Input Connection Options







Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

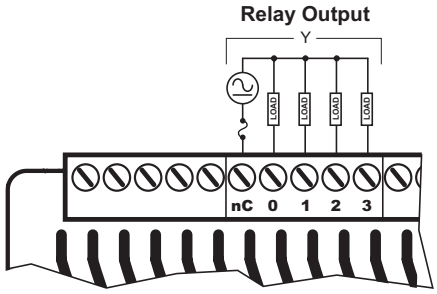
BX-DM1-18ER Wiring, Continued

Discrete Output Specifications

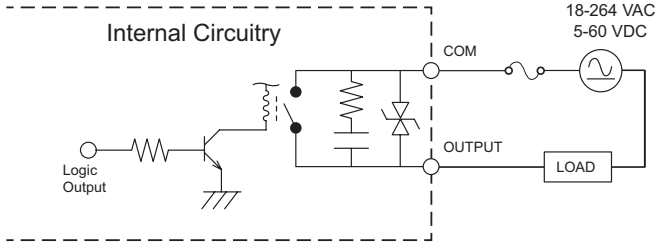
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	8
Commons	2 (4 points/common) Isolated
Maximum Current per Common	8A
Nominal Voltage Rating	5–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC, 18–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA (DC) 300µA (AC) due to RC Snubber Circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y7
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fusing	External Fusing recommended

BX-DM1-18ER Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



BX-DM1-18ER-D Wiring

This MPU is made up of 18 discrete I/O points. The connections are grouped as follows:

10 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in two (2) groups of 6 terminals, each comprised of 5 inputs and an isolated common.

8 discrete outputs - Form A Relay (SPST); rated 5–48 VDC/ 24–240 VAC. They are located along the top of the unit starting to the right of the 24VDC external power supply terminals. The outputs are configured in two (2) groups of 5 terminals, each comprised of 4 outputs and an isolated common.

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply

WARNING: **No analog I/O is included on this unit. The 3 terminals to the right of the inputs are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS.**

NOTE: *Four (4) Expansion Modules can be connected to extend I/O capacity.*

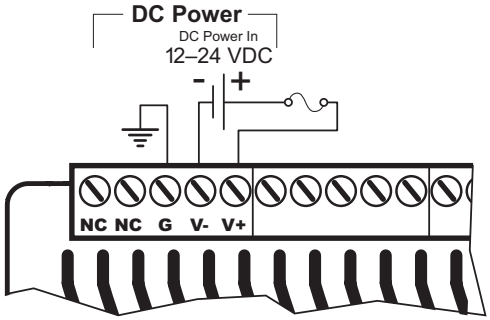
BX-DM1-18ER-D

BX-DM1-18ER-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range	12–24 VDC
Input Voltage Range (Tolerance)	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	30W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Efficiency	85%
Under Input Voltage Lock-out	<9VDC
Heat Dissipation	3.2 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



WARNING: No External AC power supply needed on this unit. The two terminals marked "NC" are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!

BX-DM1-18ER-D Wiring, Continued

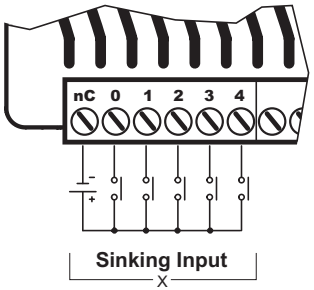
Discrete Input Specifications

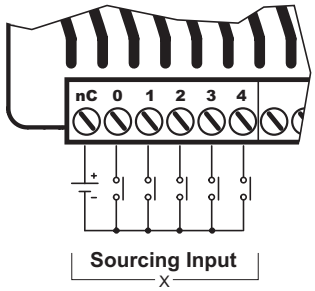
Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		10	
Commons		2 (5 points/common) Isolated	
Nominal Voltage Rating		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz [2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard [1]
Location		X0...X9	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]

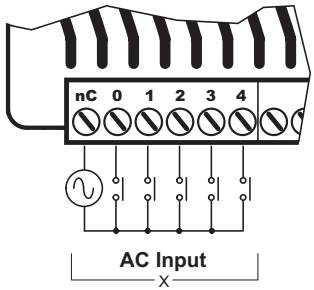
1. All Inputs may be used as standard inputs or high speed inputs independently.
2. 240Hz filter must be set in software for AC operation.

BX-DM1-18ER-D Wiring, Continued

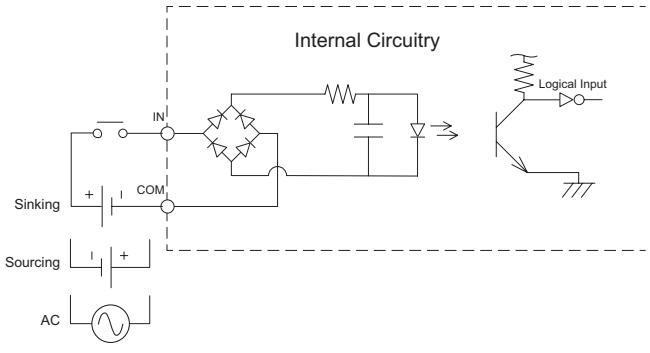
Discrete Input Connection Options







Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

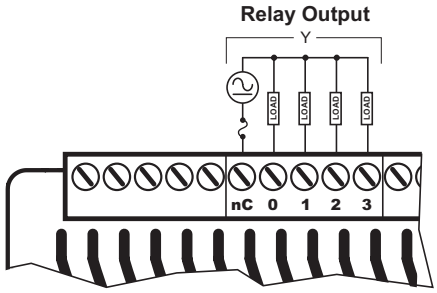
BX-DM1-18ER-D Wiring, Continued

Discrete Output Specifications

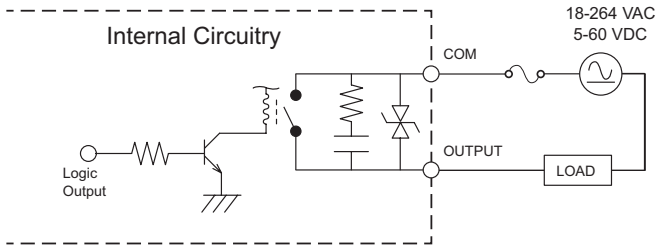
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	8
Commons	2 (4 points/common) Isolated
Maximum Current per Common	8A
Nominal Voltage Rating	5–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC, 18–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA (DC) 300µA (AC) due to RC Snubber Circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y7
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fusing	External Fusing recommended

BX-DM1-18ER-D Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



BX-DM1-18AR Wiring

This MPU is made up of 18 discrete I/O points. The connections are grouped as follows:

10 discrete inputs - AC rated for 120–240 VAC. They are located along the bottom of the unit; configured in two (2) groups of 6 terminals, each comprised of 5 inputs and an isolated common.

8 discrete outputs - Form A Relay (SPST); rated 5–48 VDC/ 24–240 VAC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in two (2) groups of 5 terminals, each comprised of 4 outputs and an isolated common..

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.

WARNING: **No analog I/O is included on this unit. The 3 terminals to the right of the inputs are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS.**

NOTE: *Four (4) Expansion Modules can be connected to extend I/O capacity.*

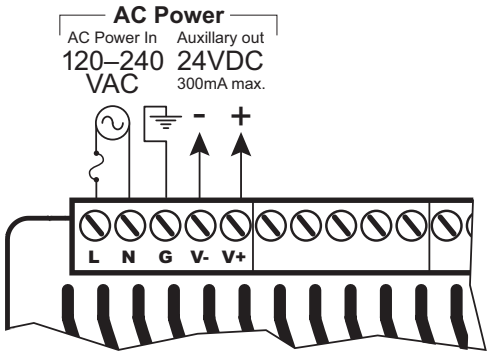
BX-DM1-18AR

BX-DM1-18AR Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Rating	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Efficiency	80%
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	8W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



WARNING: **Do not exceed the 24VDC auxiliary power supply load limit of 300mA.**

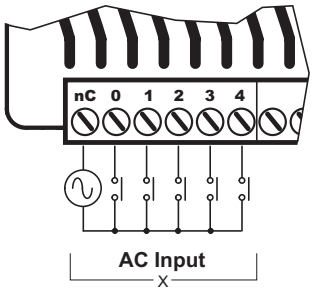
BX-DM1-18AR Wiring, Continued

Discrete Input Specifications

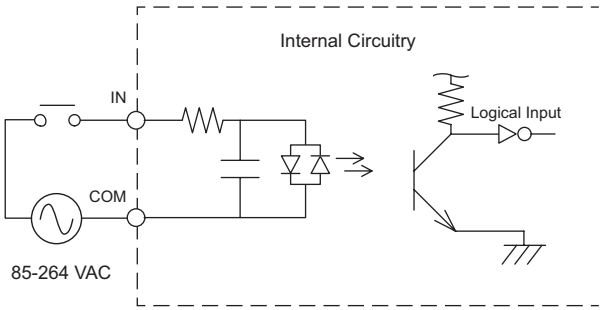
Discrete Input Specifications	
Input Type	AC
Total Inputs per Module	10
Commons	2 (5 points/common) Isolated
Nominal Voltage Rating	120–240 VAC
Input Voltage Range	85–264 VAC
Maximum Voltage	264VAC RMS
AC Frequency	47–63 Hz
Input Impedance	15kΩ
Input Current (typical)	9mA @ 120VAC, 13mA @ 220VAC
Maximum Input Current	14mA @ 120VAC, 20mA @ 220VAC
ON Voltage Level	> 85VAC
OFF Voltage Level	< 40VAC
Maximum OFF Current	2.5 mA
Status Indicators	Logic Side, Green
Input Details	
Input Type	Standard
Location	X0...X9
OFF - ON Response	10ms
ON - OFF Response	10ms

BX-DM1-18AR Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry



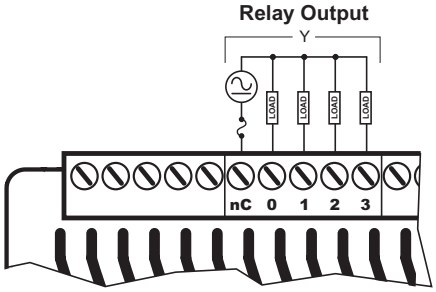
BX-DM1-18AR Wiring, Continued

Discrete Output Specifications

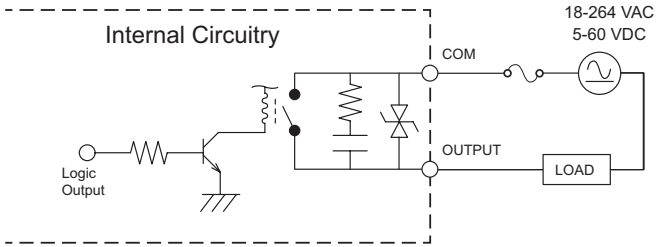
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	8
Commons	2 (4 points/common) Isolated
Maximum Current per Common	8A
Nominal Voltage Rating	5–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC, 18–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1μA (DC) 300μA (AC) due to RC Snubber Circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y7
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fusing	External Fusing recommended

BX-DM1-18AR Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



BX 18E Micro PLC Units (MPUs)

BX-DM1E-18ED13 Wiring

This MPU is made up of 18 discrete I/O points. The connections are grouped as follows:

10 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in two (2) groups of 6 terminals, each comprised of 5 inputs and an isolated common.

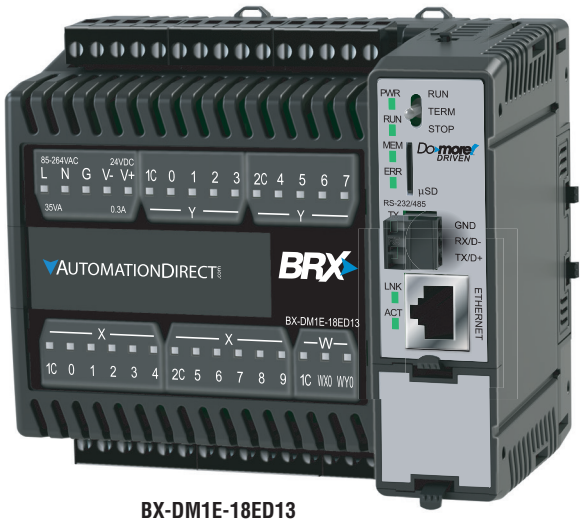
8 discrete outputs - sinking; rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in two (2) groups of 5 terminals, each comprised of 4 outputs and an isolated common..

1 analog input and 1 analog output. They are located along the bottom of the unit to the right of the discrete inputs. The analogs are a group of three (3) terminals, comprised of 1 input, 1 output and a shared isolated common.

The analogs share these common features:

- current or voltage selectable through software
- 16-bit resolution @ ±20mA, ±10VDC
- current signal ranges of 4–20 mA, ±20mA
- voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5VDC, ±10VDC.

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.



BX-DM1E-18ED13

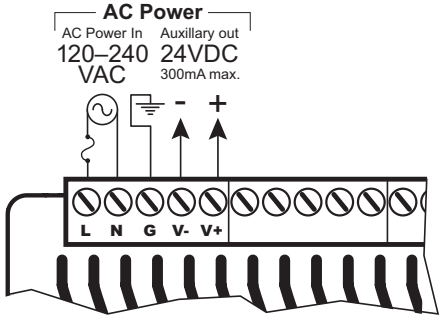
NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity.*

BX-DM1E-18ED13 Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Rating	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Efficiency	80%
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	8W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



WARNING: **Do not exceed the 24VDC auxiliary power supply load limit of 300mA.**

BX-DM1E-18ED13 Wiring, Continued

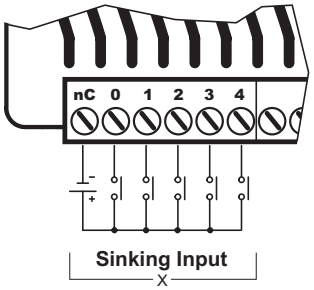
Discrete Input Specifications

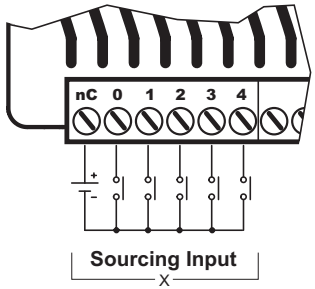
Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		10	
Commons		2 (5 points/common) Isolated	
Nominal Voltage Rating		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz [2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard [1]
Location		X0...X9	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]

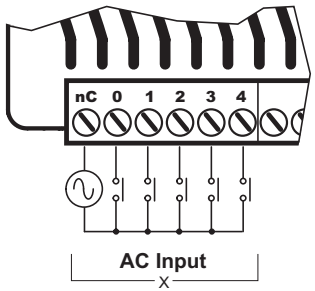
1. All Inputs may be used as standard inputs or high speed inputs independently.
2. 240Hz filter must be set in software for AC operation.

BX-DM1E-18ED13 Wiring, Continued

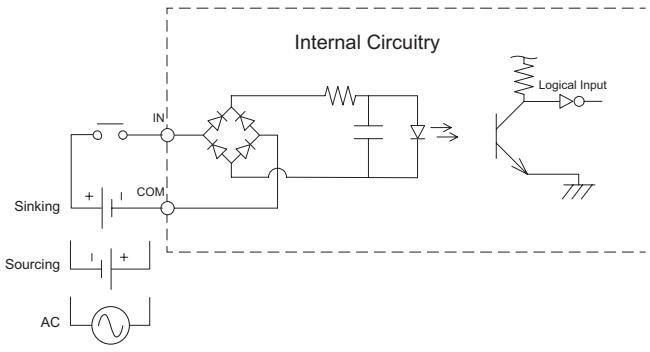
Discrete Input Connection Options







Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

BX-DM1E-18ED13 Wiring, Continued

Discrete Output Specifications

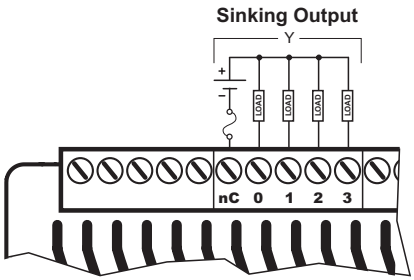
Discrete Output Specifications		
Output Type	Sinking	
Total Outputs per Module	8	
Commons	2 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Rating	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard [1]
Location	Y0...Y3	Y4...Y7
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	143 Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level [2]	Between 4A and 8A	N/A
Fusing	External Fusing recommended	

1. All outputs may be used as standard outputs. Only the first 4 outputs (Y0...Y3) are capable of high speed DC operation.

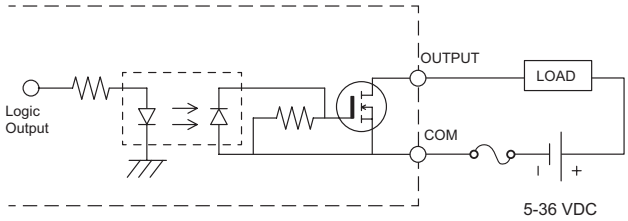
2. When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.

BX-DM1E-18ED13 Wiring, Continued

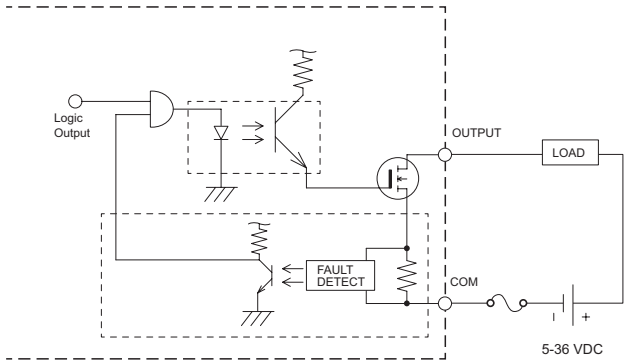
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

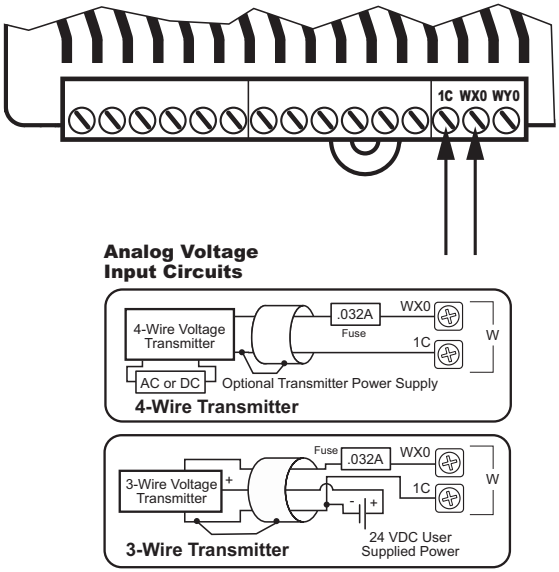
BX-DM1E-18ED13 Wiring, Continued

Analog Input Specifications

Analog Input Specifications	
Inputs per Module	1
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	1.2 ms
Input Impedance Voltage Modes	220kΩ
Input Impedance Current Modes	249Ω
Input Stability	0.02% of Full Hardware Range
Full Scale Calibration Error	0.05% of Full Hardware Range
Offset Calibration Error	0.01% of Full Hardware Range
Accuracy vs Temperature Error	0.05% of Full Hardware Range
Fusing	External fusing recommended

* Software selectable per channel.

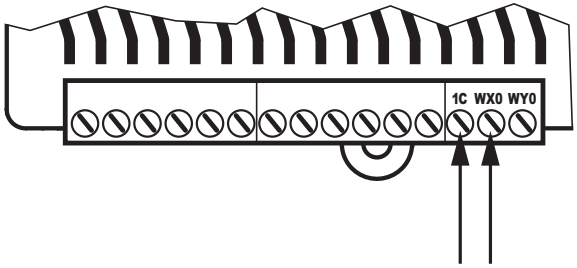
Analog Input Voltage Connection Options



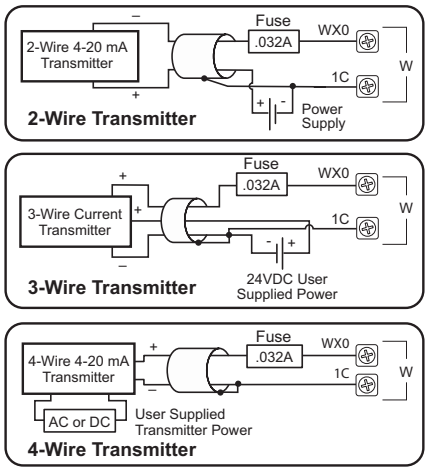
NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-18ED13 Wiring, Continued

Analog Input Current Sinking Connection Options



Analog Current Sinking Input Circuits



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

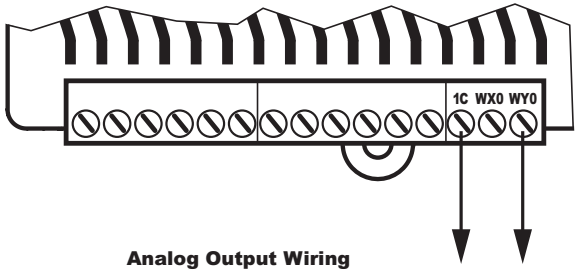
BX-DM1E-18ED13 Wiring, Continued

Analog Output Specifications

Analog Output Specifications	
Outputs per Module	1
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Minimum Voltage Load Impedance	1kΩ
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Maximum Current Load Impedance	500Ω
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	< 1ms
Output Stability	0.02% of Full Hardware Range
Full Scale Calibration Error	0.05% of Full Hardware Range
Offset Calibration Error	0.01% of Full Hardware Range
Accuracy vs Temperature Error	0.05% of Full Hardware Range
Fusing	External fusing recommended

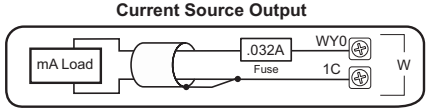
* Software selectable per channel.

Analog Output Connection Options

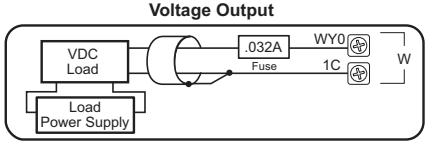


Analog Output Wiring

Current Source Output



Voltage Output



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-18ED13-D Wiring

This MPU is made up of 18 discrete I/O points. The connections are grouped as follows:

10 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in two (2) groups of 6 terminals, each comprised of 5 inputs and an isolated common.

8 discrete outputs - sinking; rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC external power supply terminals. The outputs are configured in two (2) groups of 5 terminals, each comprised of 4 outputs and an isolated common..

1 analog input and 1 analog output. They are located along the bottom of the unit to the right of the discrete inputs. The analogs are a group of three (3) terminals, comprised of 1 input, 1 output and a shared isolated common.

The analogs share these common features:

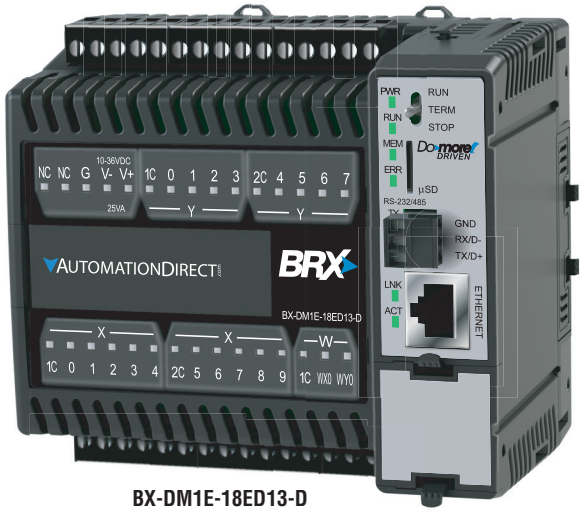
current or voltage selectable through software,

16-bit resolution @ ±20 mA, ±10 VDC

current signal ranges of 4–20 mA, ±20 mA,

voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5 VDC, ±10 VDC.

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.



BX-DM1E-18ED13-D

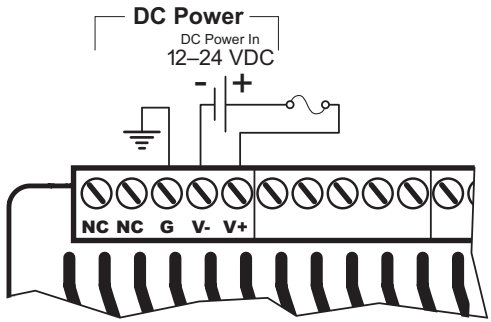
NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity.*

BX-DM1E-18ED13-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range	12–24 VDC
Input Voltage Range (Tolerance)	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	30W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Efficiency	85%
Under Input Voltage Lock-out	<9VDC
Heat Dissipation	3.2 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



WARNING: No External AC power supply needed on this unit. The two terminals marked "NC" are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!

BX-DM1E-18ED13-D Wiring, Continued

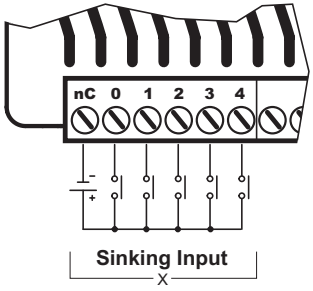
Discrete Input Specifications

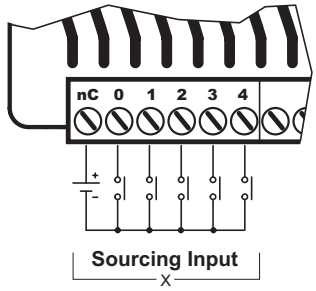
Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		10	
Commons		2 (5 points/common) Isolated	
Nominal Voltage Rating		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz [2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard [1]
Location		X0...X9	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]

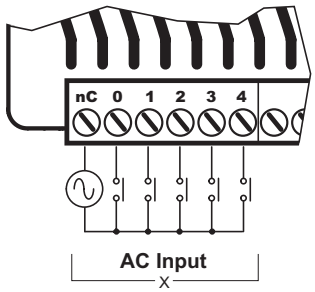
1. All Inputs may be used as standard inputs or high speed inputs independently.
2. 240Hz filter must be set in software for AC operation.

BX-DM1E-18ED13-D Wiring, Continued

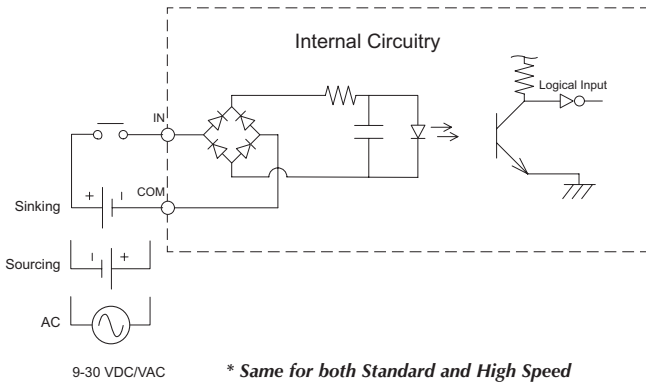
Discrete Input Connection Options







Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

BX-DM1E-18ED13-D Wiring, Continued

Discrete Output Specifications

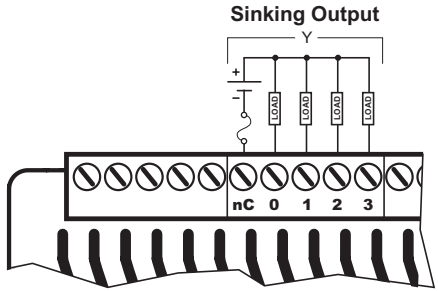
Discrete Output Specifications		
Output Type	Sinking	
Total Outputs per Module	8	
Commons	2 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Rating	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36 VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard [1]
Location	Y0...Y3	Y4...Y7
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	143Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level [2]	Between 4A and 8A	N/A
Fusing	External Fusing recommended	

1. All outputs may be used as standard outputs. Only the first 4 outputs (Y0...Y3) are capable of high speed DC operation.

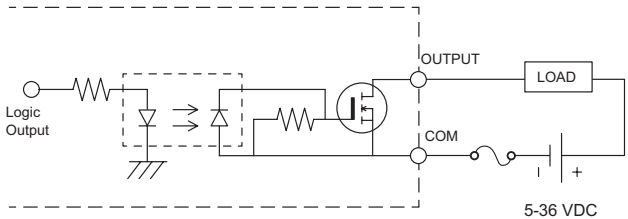
2. When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.

BX-DM1E-18ED13-D Wiring, Continued

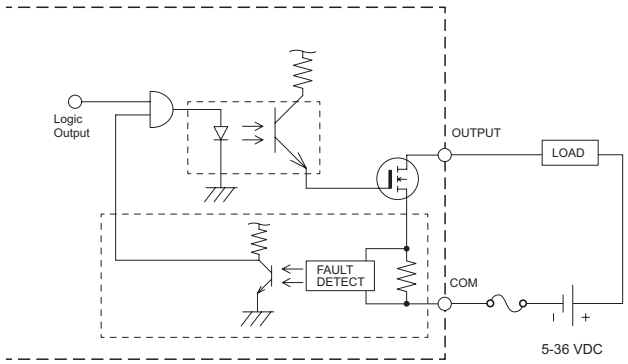
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

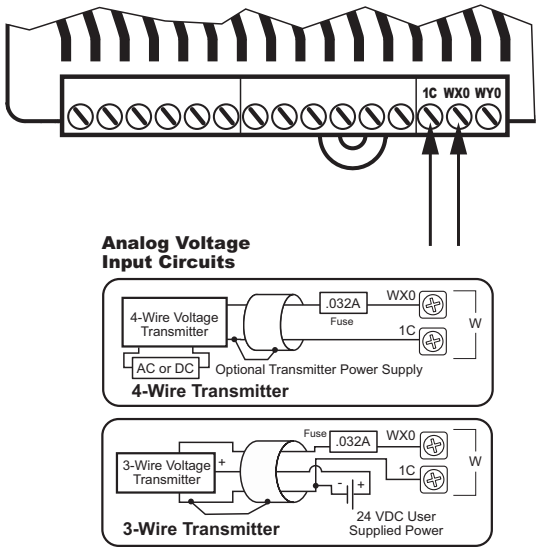
BX-DM1E-18ED13-D Wiring, Continued

Analog Input Specifications

Analog Input Specifications	
Inputs per Module	1
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	1.2 ms
Input Impedance Voltage Modes	220kΩ
Input Impedance Current Modes	249Ω
Input Stability	0.02% of Full Hardware Range
Full Scale Calibration Error	0.05% of Full Hardware Range
Offset Calibration Error	0.01% of Full Hardware Range
Accuracy vs Temperature Error	0.05% of Full Hardware Range
Fusing	External fusing recommended

* Software selectable per channel.

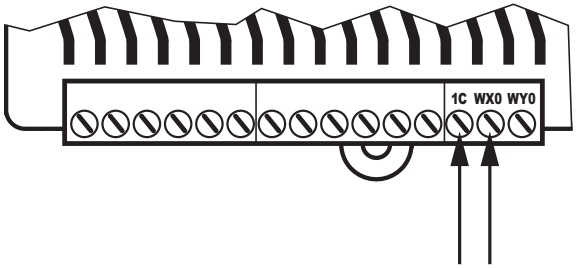
Analog Input Voltage Connection Options



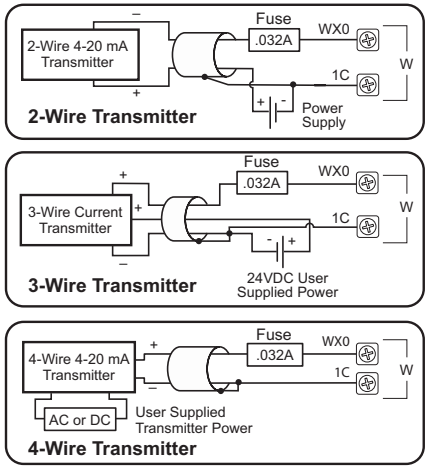
NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-18ED13-D Wiring, Continued

Analog Input Current Sinking Connection Options



Analog Current Sinking Input Circuits



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

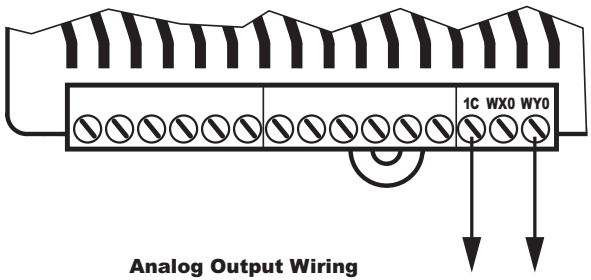
BX-DM1E-18ED13-D Wiring, Continued

Analog Output Specifications

Analog Output Specifications	
Outputs per Module	1
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Minimum Voltage Load Impedance	1kΩ
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Maximum Current Load Impedance	500Ω
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	< 1ms
Output Stability	0.02% of Full Hardware Range
Full Scale Calibration Error	0.05% of Full Hardware Range
Offset Calibration Error	0.01% of Full Hardware Range
Accuracy vs Temperature Error	0.05% of Full Hardware Range
Fusing	External fusing recommended

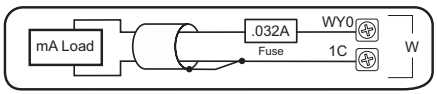
* Software selectable per channel.

Analog Output Connection Options

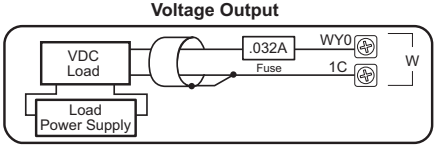


Analog Output Wiring

Current Source Output



Voltage Output



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-18ED23 Wiring

This MPU is made up of 18 discrete I/O points. The connections are grouped as follows:

10 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in two (2) groups of 6 terminals, each comprised of 5 inputs and an isolated common.

8 discrete outputs - sourcing; rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in two (2) groups of 5 terminals, each comprised of 4 outputs and an isolated common..

1 analog input and 1 analog output. They are located along the bottom of the unit to the right of the discrete inputs. The analogs are a group of three (3) terminals, comprised of 1 input, 1 output and a shared isolated common.

The analogs share these common features:

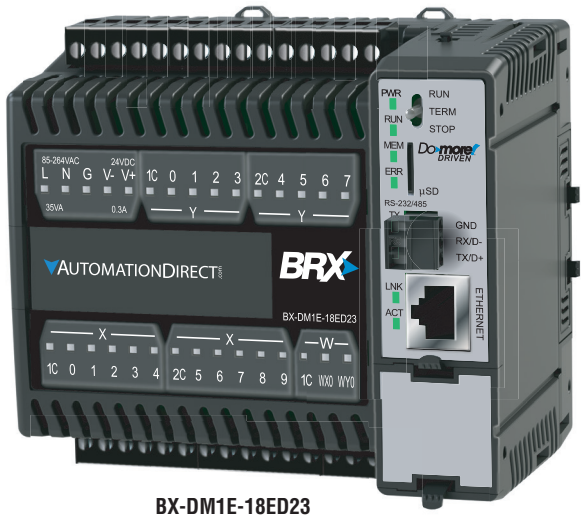
current or voltage selectable through software,

16-bit resolution @ ±20mA, ±10VDC

current signal ranges of 4–20 mA, ±20mA,

voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5VDC, ±10VDC.

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.



BX-DM1E-18ED23

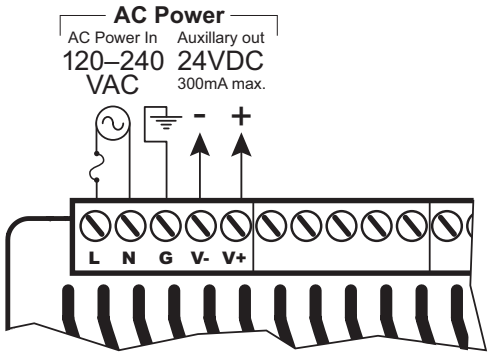
NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity.*

BX-DM1E-18ED23 Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Rating	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Efficiency	80%
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	8W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



WARNING: **Do not exceed the 24VDC auxiliary power supply load limit of 300mA..**

BX-DM1E-18ED23 Wiring, Continued

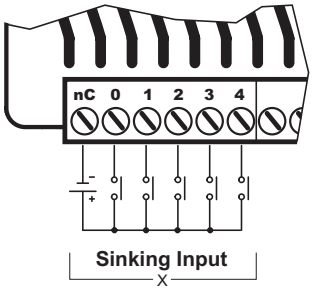
Discrete Input Specifications

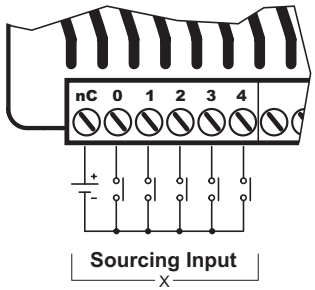
Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		10	
Commons		2 (5 points/common) Isolated	
Nominal Voltage Rating		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz [2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard [1]
Location		X0...X9	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]

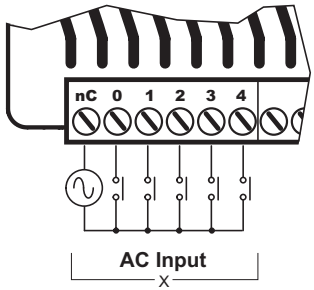
1. All Inputs may be used as standard inputs or high speed inputs independently.
2. 240Hz filter must be set in software for AC operation.

BX-DM1E-18ED23 Wiring, Continued

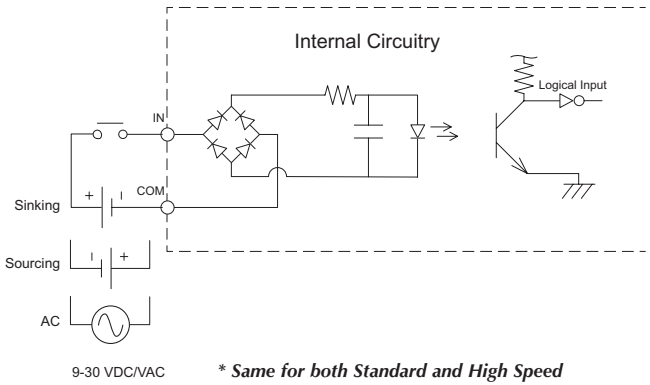
Discrete Input Connection Options







Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

BX-DM1E-18ED23 Wiring, Continued

Discrete Output Specifications

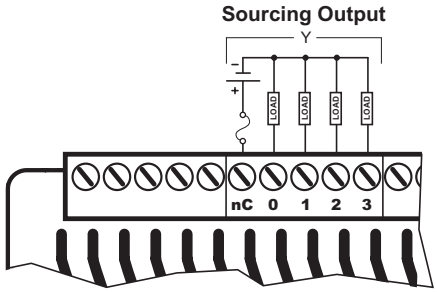
Discrete Output Specifications		
Output Type	Sourcing	
Total Outputs per Module	8	
Commons	2 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Rating	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36 VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard [1]
Location	Y0...Y3	Y4...Y7
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	143Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level [2]	Between 4A and 8A	N/A
Fusing	External Fusing recommended	

1. All outputs may be used as standard outputs. Only the first 4 outputs (Y0...Y3) are capable of high speed DC operation.

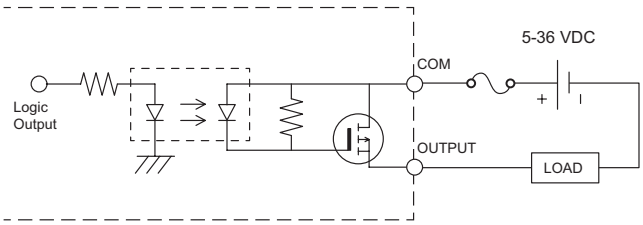
2. When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.

BX-DM1E-18ED23 Wiring, Continued

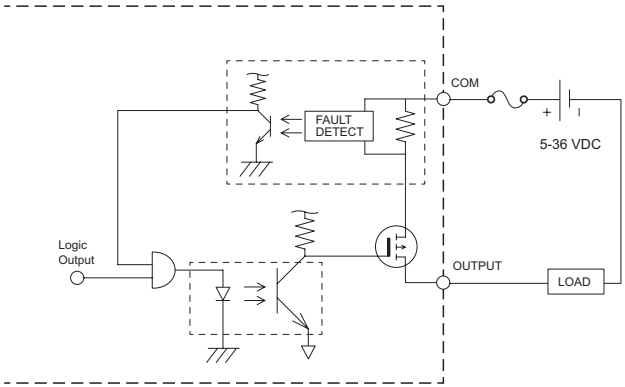
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

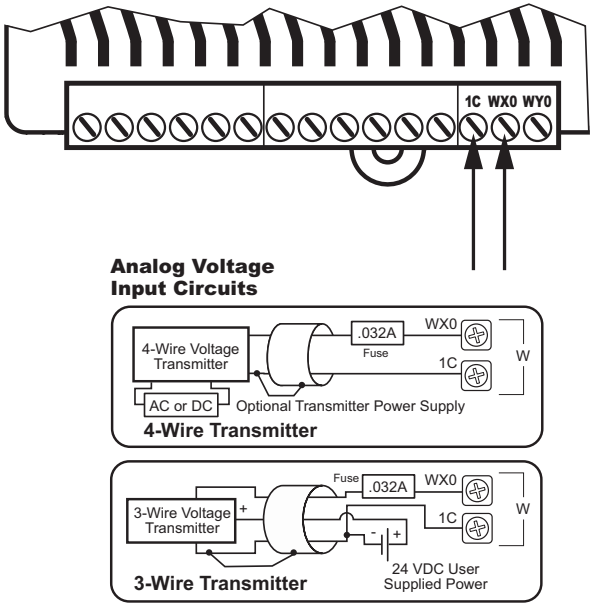
BX-DM1E-18ED23 Wiring, Continued

Analog Input Specifications

Analog Input Specifications	
Inputs per Module	1
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	1.2 ms
Input Impedance Voltage Modes	220kΩ
Input Impedance Current Modes	249Ω
Input Stability	0.02% of Full Hardware Range
Full Scale Calibration Error	0.05% of Full Hardware Range
Offset Calibration Error	0.01% of Full Hardware Range
Accuracy vs Temperature Error	0.05% of Full Hardware Range
Fusing	External fusing recommended

* Software selectable per channel.

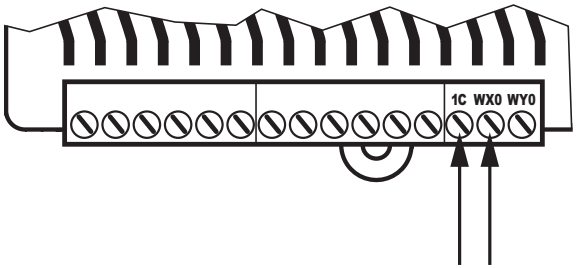
Analog Input Voltage Connection Options



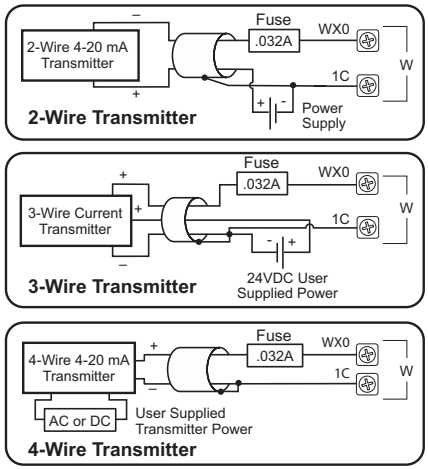
NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-18ED23 Wiring, Continued

Analog Input Current Sinking Connection Options



Analog Current Sinking Input Circuits



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

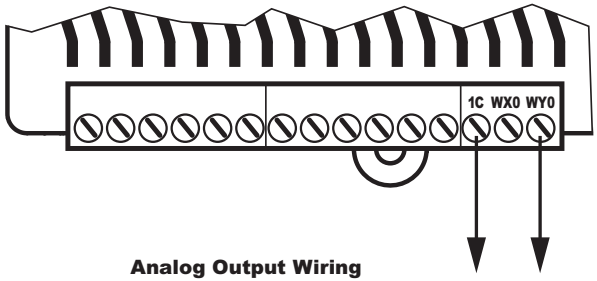
BX-DM1E-18ED23 Wiring, Continued

Analog Output Specifications

Analog Output Specifications	
Outputs per Module	1
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Minimum Voltage Load Impedance	1kΩ
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Maximum Current Load Impedance	500Ω
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	< 1ms
Output Stability	0.02% of Full Hardware Range
Full Scale Calibration Error	0.05% of Full Hardware Range
Offset Calibration Error	0.01% of Full Hardware Range
Accuracy vs Temperature Error	0.05% of Full Hardware Range
Fusing	External fusing recommended

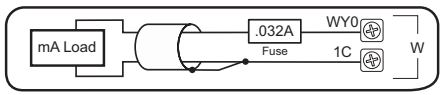
* Software selectable per channel.

Analog Output Connection Options

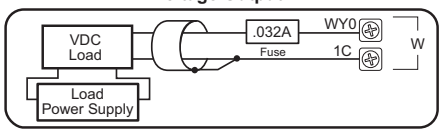


Analog Output Wiring

Current Source Output



Voltage Output



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-18ED23-D Wiring

This MPU is made up of 18 discrete I/O points. The connections are grouped as follows:

10 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in two (2) groups of 6 terminals, each comprised of 5 inputs and an isolated common.

8 discrete outputs - sourcing; rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC external power supply terminals. The outputs are configured in two (2) groups of 5 terminals, each comprised of 4 outputs and an isolated common..

1 analog input and 1 analog output. They are located along the bottom of the unit to the right of the discrete inputs. The analogs are a group of three (3) terminals, comprised of 1 input, 1 output and a shared isolated common.

The analog share these common features:

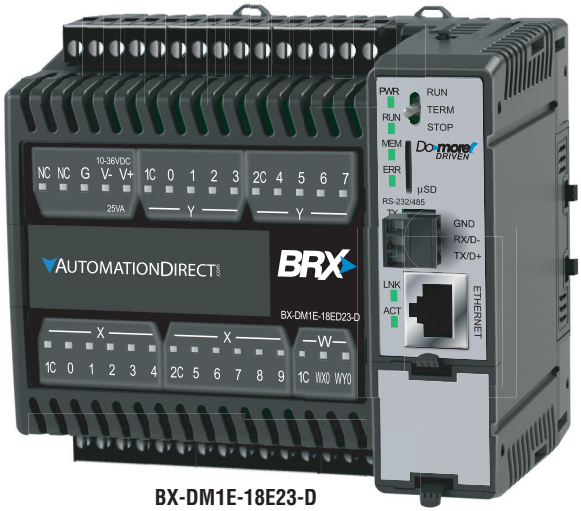
current or voltage selectable through software,

16-bit resolution @ ±20mA, ±10VDC

current signal ranges of 4–20 mA, ±20mA,

voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5VDC, ±10VDC.

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.



BX-DM1E-18E23-D

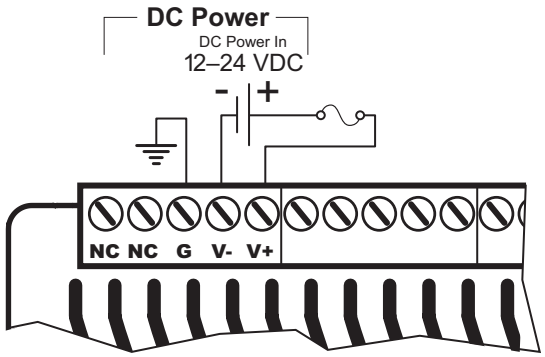
NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity.*

BX-DM1E-18ED23-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range	12–24 VDC
Input Voltage Range (Tolerance)	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	30W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Efficiency	85%
Under Input Voltage Lock-out	<9VDC
Heat Dissipation	3.2 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



WARNING: No External AC power supply needed on this unit. The two terminals marked "NC" are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!

BX-DM1E-18ED23-D Wiring, Continued

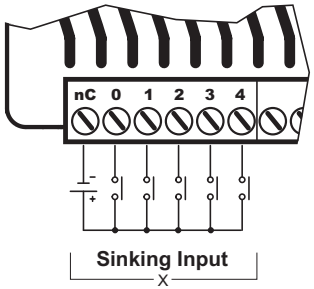
Discrete Input Specifications

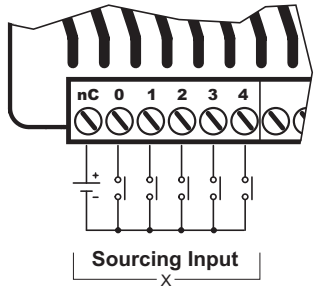
Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		10	
Commons		2 (5 points/common) Isolated	
Nominal Voltage Rating		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz [2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard [1]
Location		X0...X9	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]

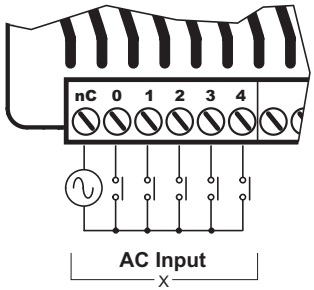
1. All Inputs may be used as standard inputs or high speed inputs independently.
2. 240Hz filter must be set in software for AC operation.

BX-DM1E-18ED23-D Wiring, Continued

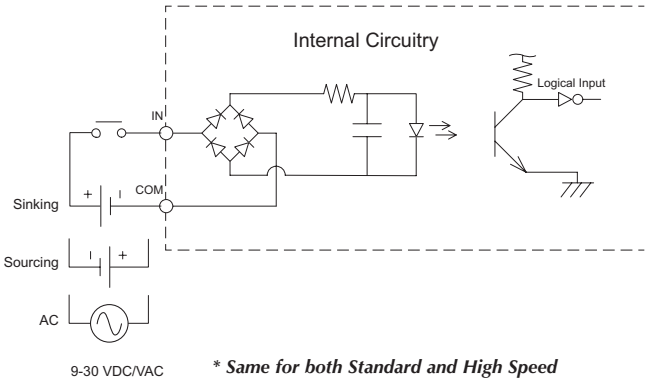
Discrete Input Connection Options







Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

BX-DM1E-18ED23-D Wiring, Continued

Discrete Output Specifications

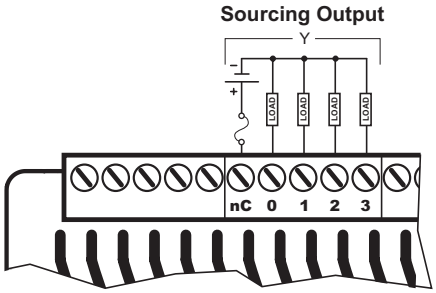
Discrete Output Specifications		
Output Type	Sourcing	
Total Outputs per Module	8	
Commons	2 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Rating	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36 VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard [1]
Location	Y0...Y3	Y4...Y7
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	143 Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level [2]	Between 4A and 8A	N/A
Fusing	External Fusing recommended	

1. All outputs may be used as standard outputs. Only the first 4 outputs (Y0...Y3) are capable of high speed DC operation.

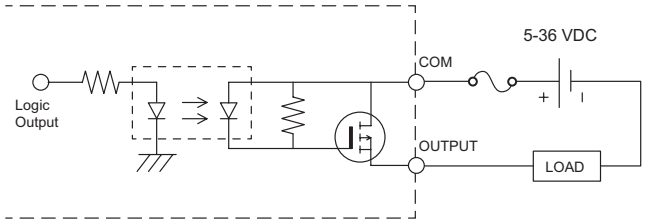
2. When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.

BX-DM1E-18ED23-D Wiring, Continued

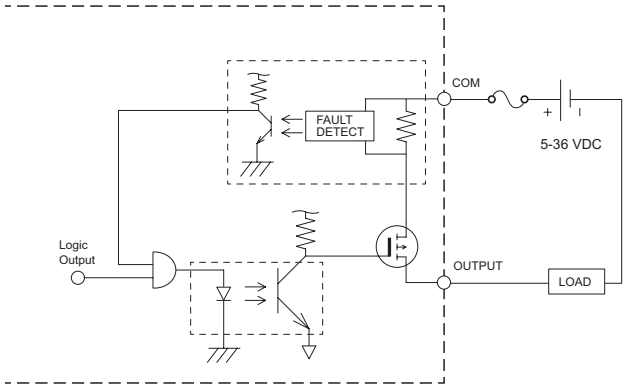
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

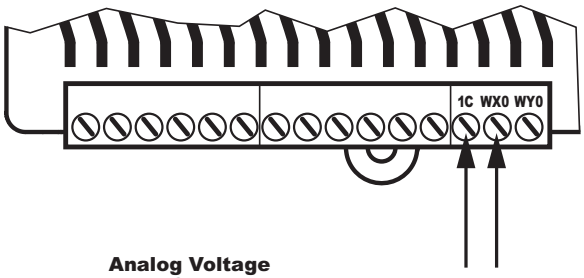
BX-DM1E-18ED23-D Wiring, Continued

Analog Input Specifications

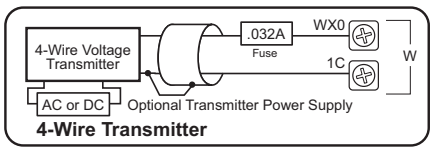
Analog Input Specifications	
Inputs per Module	1
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	1.2 ms
Input Impedance Voltage Modes	220kΩ
Input Impedance Current Modes	249Ω
Input Stability	0.02% of Full Hardware Range
Full Scale Calibration Error	0.05% of Full Hardware Range
Offset Calibration Error	0.01% of Full Hardware Range
Accuracy vs Temperature Error	0.05% of Full Hardware Range
Fusing	External fusing recommended

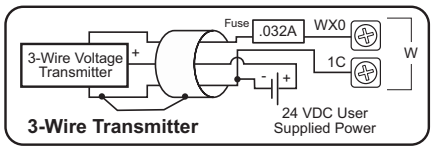
* Software selectable per channel.

Analog Input Voltage Connection Options



Analog Voltage Input Circuits

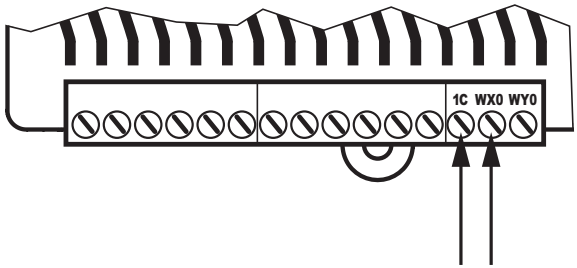




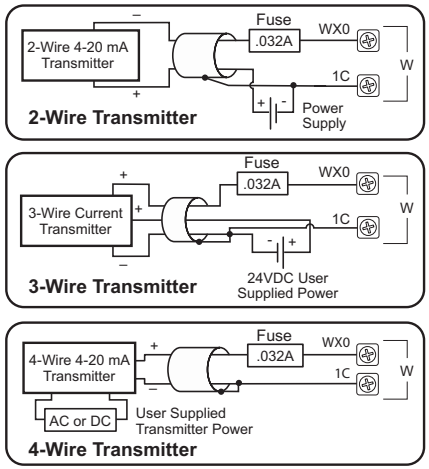
NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-18ED23-D Wiring, Continued

Analog Input Current Sinking Connection Options



Analog Current Sinking Input Circuits



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

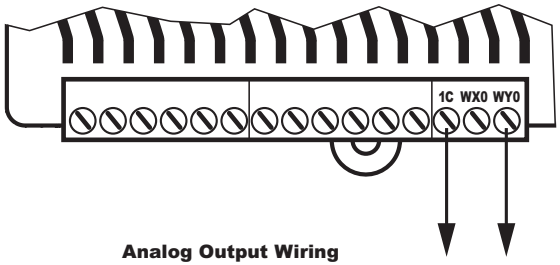
BX-DM1E-18ED23-D Wiring, Continued

Analog Output Specifications

Analog Output Specifications	
Outputs per Module	1
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Minimum Voltage Load Impedance	1kΩ
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Maximum Current Load Impedance	500Ω
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	< 1ms
Output Stability	0.02% of Full Hardware Range
Full Scale Calibration Error	0.05% of Full Hardware Range
Offset Calibration Error	0.01% of Full Hardware Range
Accuracy vs Temperature Error	0.05% of Full Hardware Range
Fusing	External fusing recommended

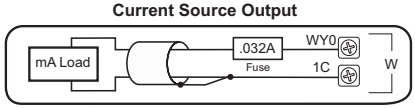
* Software selectable per channel.

Analog Output Connection Options

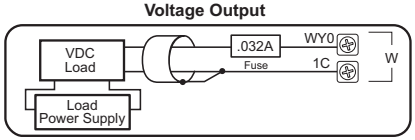


Analog Output Wiring

Current Source Output



Voltage Output



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-18ER3 Wiring

This MPU is made up of 18 discrete I/O points. The connections are grouped as follows:

10 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in two (2) groups of 6 terminals, each comprised of 5 inputs and an isolated common.

8 discrete outputs - Form A Relay (SPST); rated 5–48 VDC/ 24–240 VAC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in two (2) groups of 5 terminals, each comprised of 4 outputs and an isolated common.

1 analog input and 1 analog output. They are located along the bottom of the unit to the right of the discrete inputs. The analogs are a group of three (3) terminals, comprised of 1 input, 1 output and a shared isolated common.

The analogs share these common features:

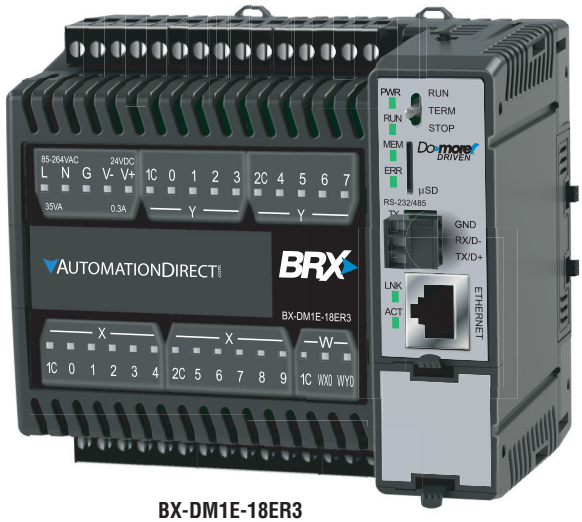
current or voltage selectable through software,

16-bit resolution @ ±20mA, ±10VDC

current signal ranges of 4–20 mA, ±20mA,

voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5 VDC, ±10VDC.

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.



BX-DM1E-18ER3

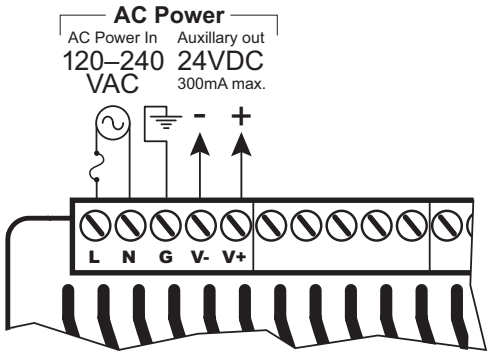
NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity.*

BX-DM1E-18ER3 Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Rating	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Efficiency	80%
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	8W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



WARNING: **Do not exceed the 24VDC auxiliary power supply load limit of 300mA.**

BX-DM1E-18ER3 Wiring, Continued

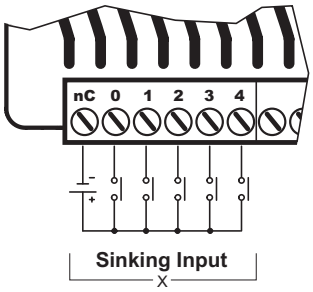
Discrete Input Specifications

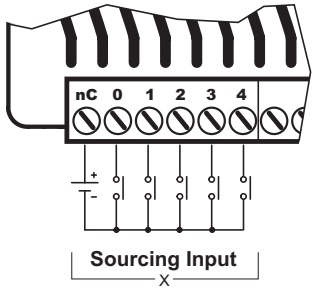
Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		10	
Commons		2 (5 points/common) Isolated	
Nominal Voltage Rating		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz [2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard [1]
Location		X0...X9	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]

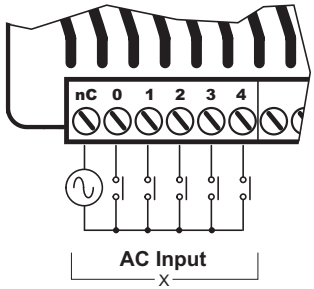
1. All Inputs may be used as standard inputs or high speed inputs independently.
2. 240Hz filter must be set in software for AC operation.

BX-DM1E-18ER3 Wiring, Continued

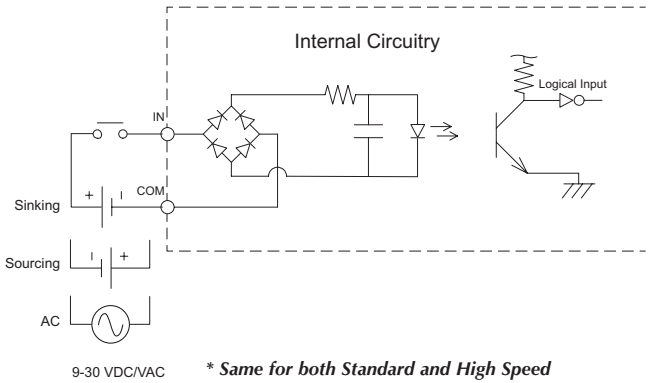
Discrete Input Connection Options







Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

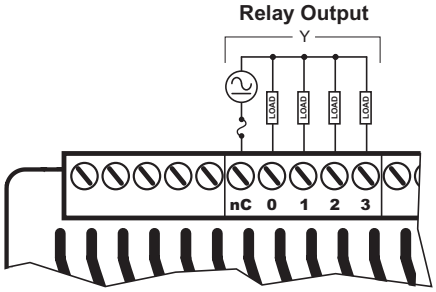
BX-DM1E-18ER3 Wiring, Continued

Discrete Output Specifications

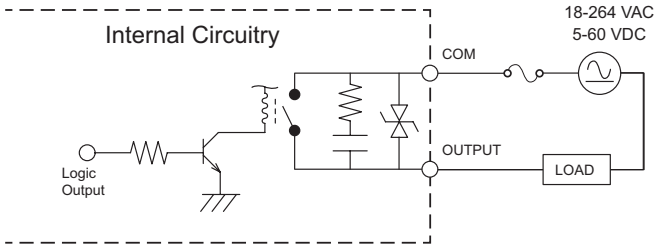
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	8
Commons	2 (4 points/common) Isolated
Maximum Current per Common	8A
Nominal Voltage Rating	5–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC, 18–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1μA (DC) 300μA (AC) due to RC Snubber Circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y7
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fusing	External Fusing recommended

BX-DM1E-18ER3 Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



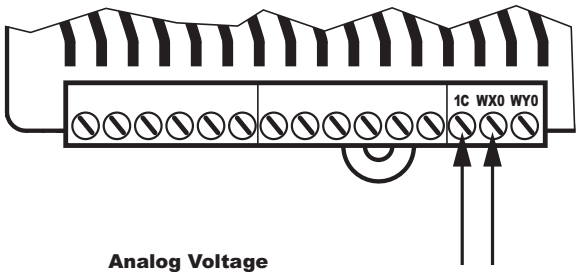
BX-DM1E-18ER3 Wiring, Continued

Analog Input Specifications

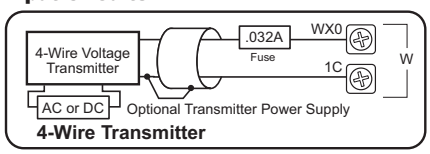
Analog Input Specifications	
Inputs per Module	1
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	1.2 ms
Input Impedance Voltage Modes	220kΩ
Input Impedance Current Modes	249Ω
Input Stability	0.02% of Full Hardware Range
Full Scale Calibration Error	0.05% of Full Hardware Range
Offset Calibration Error	0.01% of Full Hardware Range
Accuracy vs Temperature Error	0.05% of Full Hardware Range
Fusing	External fusing recommended

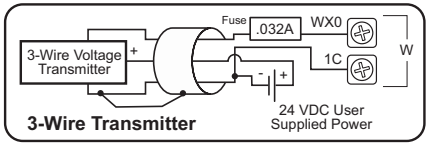
* Software selectable per channel.

Analog Input Voltage Connection Options



Analog Voltage Input Circuits

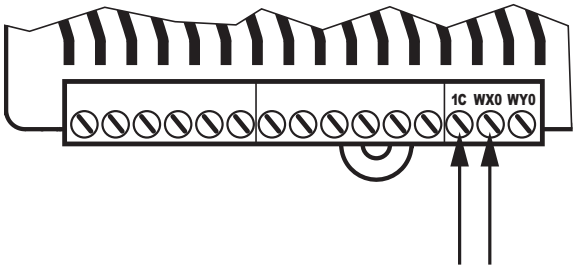




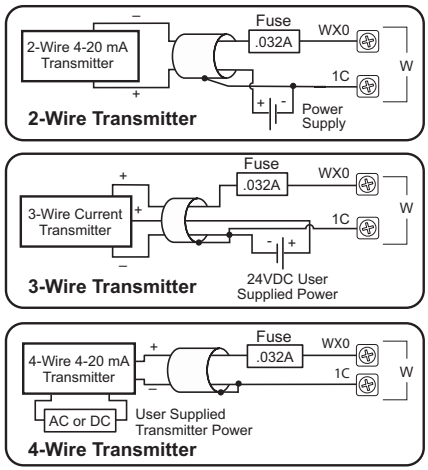
NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-18ER3 Wiring, Continued

Analog Input Current Sinking Connection Options



Analog Current Sinking Input Circuits



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

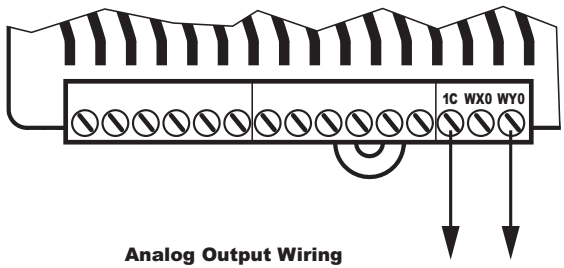
BX-DM1E-18ER3 Wiring, Continued

Analog Output Specifications

Analog Output Specifications	
Outputs per Module	1
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Minimum Voltage Load Impedance	1kΩ
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Maximum Current Load Impedance	500Ω
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	< 1ms
Output Stability	0.02% of Full Hardware Range
Full Scale Calibration Error	0.05% of Full Hardware Range
Offset Calibration Error	0.01% of Full Hardware Range
Accuracy vs Temperature Error	0.05% of Full Hardware Range
Fusing	External fusing recommended

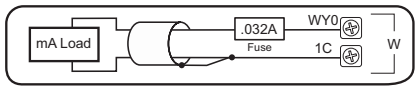
* Software selectable per channel.

Analog Output Connection Options

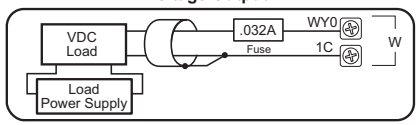


Analog Output Wiring

Current Source Output



Voltage Output



An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.

BX-DM1E-18ER3-D Wiring

This MPU is made up of 18 discrete I/O points. The connections are grouped as follows:

10 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in two (2) groups of 6 terminals, each comprised of 5 inputs and an isolated common.

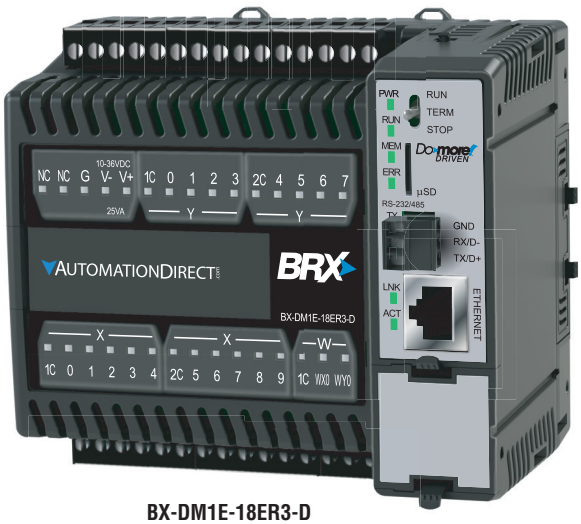
8 discrete outputs - Form A Relay (SPST); rated 5–48 VDC/ 24–240 VAC. They are located along the top of the unit starting to the right of the 24VDC external power supply terminals. The outputs are configured in two (2) groups of 5 terminals, each comprised of 4 outputs and an isolated common.

1 analog input and 1 analog output. They are located along the bottom of the unit to the right of the discrete inputs. The analogs are a group of three (3) terminals, comprised of 1 input, 1 output and a shared isolated common.

The analogs share these common features:

- current or voltage selectable through software
- 16-bit resolution @ ±20mA, ±10VDC
- current signal ranges of 4–20 mA, ±20mA
- voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5VDC, ±10VDC

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.



BX-DM1E-18ER3-D

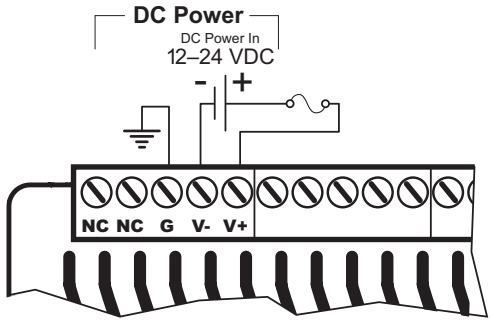
NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity.*

BX-DM1E-18ER3-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range	12–24 VDC
Input Voltage Range (Tolerance)	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	30W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Efficiency	85%
Under Input Voltage Lock-out	<9VDC
Heat Dissipation	3.2 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



WARNING: No External AC power supply needed on this unit. The two terminals marked "NC" are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!

BX-DM1E-18ER3-D Wiring, Continued

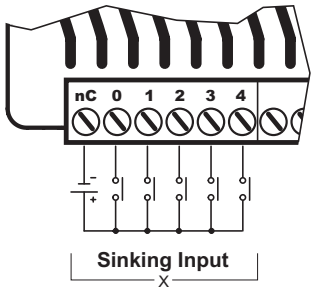
Discrete Inputs Specifications

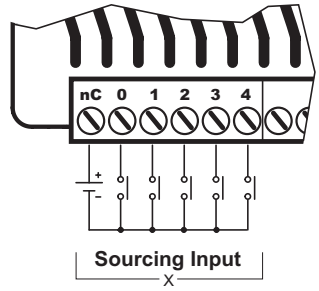
Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		10	
Commons		2 (5 points/common) Isolated	
Nominal Voltage Rating		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz [2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed DC	Standard [1]
Location		X0...X9	
OFF to ON Response	DC	< 2µs	
	AC	–	10ms[2]
ON to OFF Response	DC	< 2µs	
	AC	–	10ms[2]

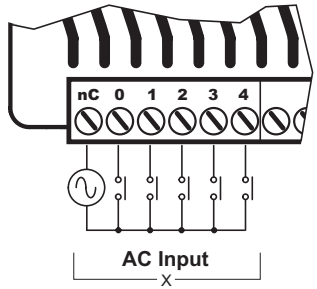
1. All Inputs may be used as standard inputs or high speed inputs independently.
2. 240Hz filter must be set in software for AC operation.

BX-DM1E-18ER3-D Wiring, Continued

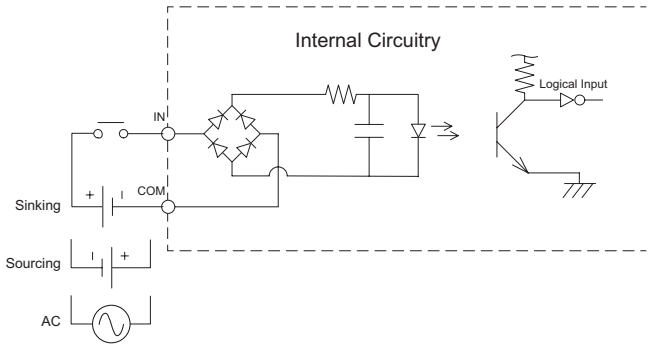
Discrete Input Connection Options







Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

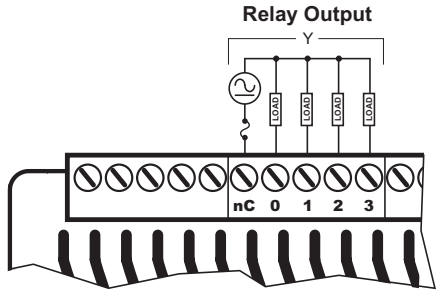
BX-DM1E-18ER3-D Wiring, Continued

Discrete Output Specifications

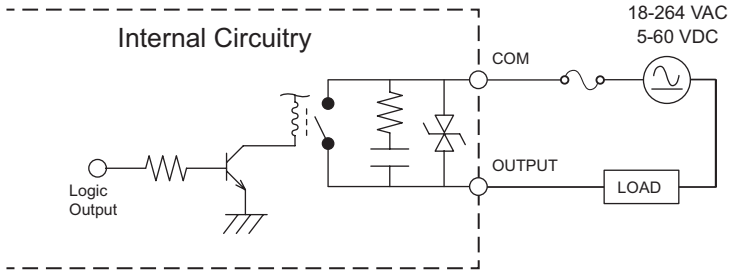
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	8
Commons	2 (4 points/common) Isolated
Maximum Current per Common	8A
Nominal Voltage Rating	5–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC, 18–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA (DC) 300µA (AC) due to RC Snubber Circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y7
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fusing	External Fusing recommended

BX-DM1E-18ER3-D Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



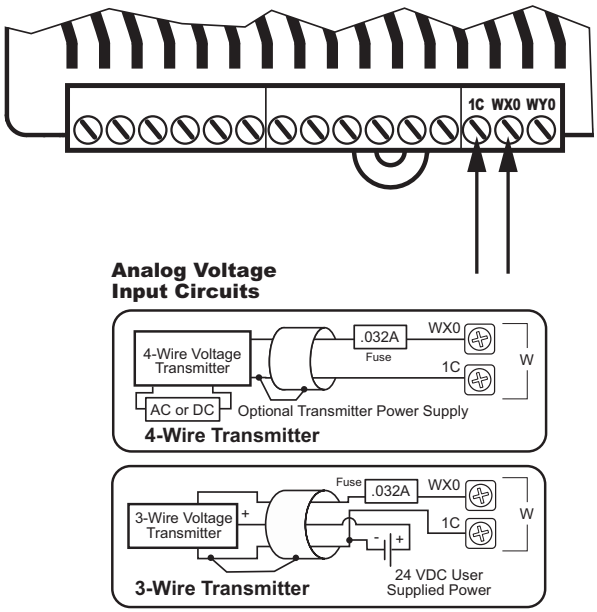
BX-DM1E-18ER3-D Wiring, Continued

Analog Input Specifications

Analog Input Specifications	
Inputs per Module	1
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	1.2 ms
Input Impedance Voltage Modes	220kΩ
Input Impedance Current Modes	249Ω
Input Stability	0.02% of Full Hardware Range
Full Scale Calibration Error	0.05% of Full Hardware Range
Offset Calibration Error	0.01% of Full Hardware Range
Accuracy vs Temperature Error	0.05% of Full Hardware Range
Fusing	External fusing recommended

* Software selectable per channel.

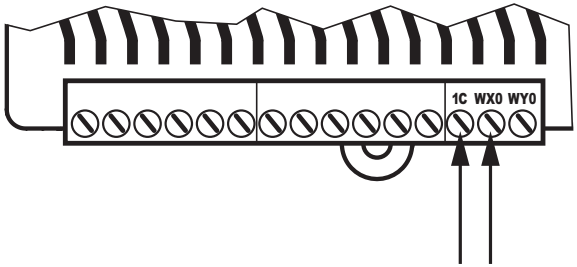
Analog Input Voltage Connection Options



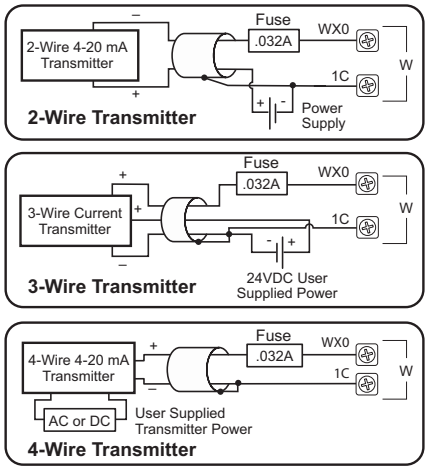
An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.

BX-DM1E-18ER3-D Wiring, Continued

Analog Input Current Sinking Connection Options



Analog Current Sinking Input Circuits



An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.

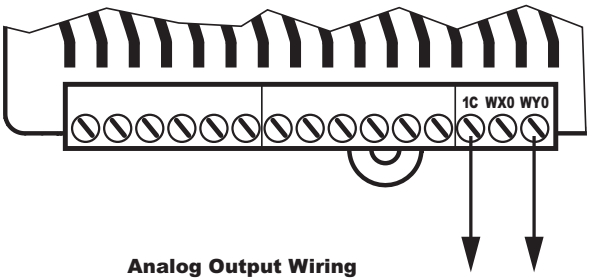
BX-DM1E-18ER3-D Wiring, Continued

Analog Output Specifications

Analog Output Specifications	
Outputs per Module	1
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Minimum Voltage Load Impedance	1kΩ
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Maximum Current Load Impedance	500Ω
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	< 1ms
Output Stability	0.02% of Full Hardware Range
Full Scale Calibration Error	0.05% of Full Hardware Range
Offset Calibration Error	0.01% of Full Hardware Range
Accuracy vs Temperature Error	0.05% of Full Hardware Range
Fusing	External fusing recommended

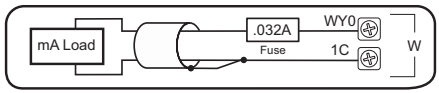
* Software selectable per channel.

Analog Output Connection Options

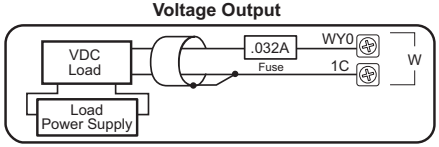


Analog Output Wiring

Current Source Output



Voltage Output



An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.

BX-DM1E-18AR3 Wiring

This MPU is made up of 18 discrete I/O points. The connections are grouped as follows:

10 discrete inputs - AC rated for 120–240 VAC. They are located along the bottom of the unit; configured in two (2) groups of 6 terminals, each comprised of 5 inputs and an isolated common.

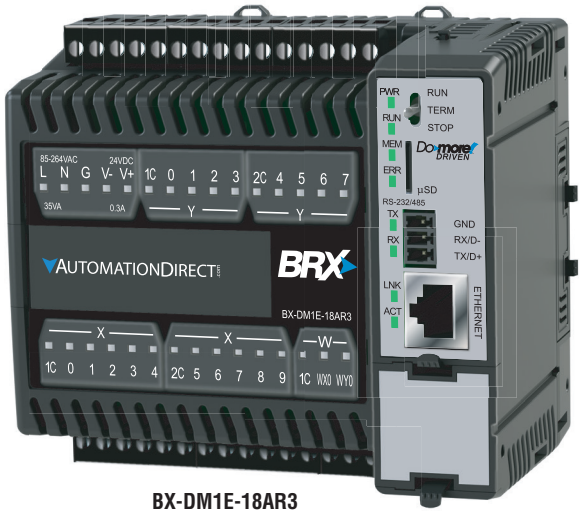
8 discrete outputs - Form A Relay (SPST); rated 5–48 VDC/ 24–240 VAC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in two (2) groups of 5 terminals, each comprised of 4 outputs and an isolated common.

1 analog input and 1 analog output. They are located along the bottom of the unit to the right of the discrete inputs. The analogs are a group of three (3) terminals, comprised of 1 input, 1 output and a shared isolated common.

The analogs share these common features:

- current or voltage selectable through software,
- 16-bit resolution @ ±20mA, ±10VDC
- current signal ranges of 4–20 mA, ±20mA,
- voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5VDC, ±10 VDC.

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.



BX-DM1E-18AR3

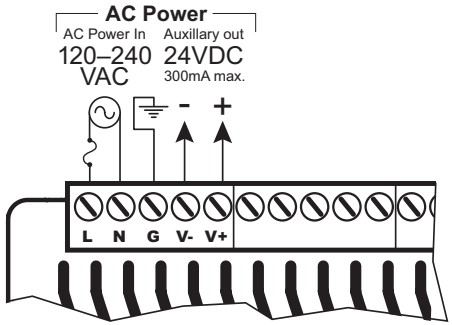
NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity.*

BX-DM1E-18AR3 Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Rating	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Efficiency	80%
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	8W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



WARNING: **Do not exceed the 24VDC auxiliary power supply load limit of 300mA.**

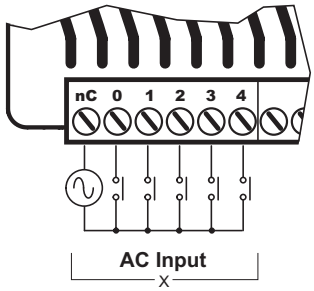
BX-DM1E-18AR3 Wiring, Continued

Discrete Inputs Specifications

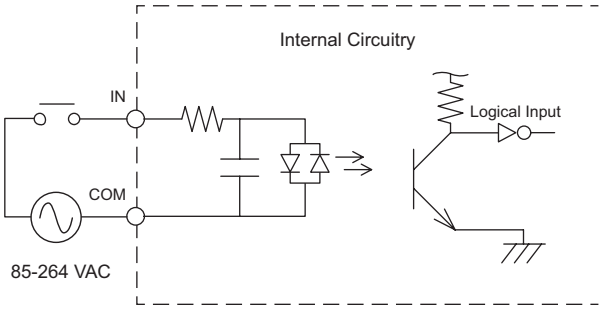
Discrete Input Specifications	
Input Type	AC
Total Inputs per Module	10
Commons	2 (5 points/common) Isolated
Nominal Voltage Rating	120–240 VAC
Input Voltage Range	85–264 VAC
Maximum Voltage	264VAC RMS
AC Frequency	47–63 Hz
Input Impedance	15kΩ
Input Current (typical)	9mA @ 120VAC, 13mA @ 240VAC
Maximum Input Current	14mA @ 120VAC, 20mA @ 240VAC
ON Voltage Level	> 85VAC
OFF Voltage Level	< 40VAC
Maximum OFF Current	2.5 mA
Status Indicators	Logic Side, Green
Input Details	
Input Type	Standard
Location	X0...X9
OFF - ON Response	10ms
ON - OFF Response	10ms

BX-DM1E-18AR3 Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry



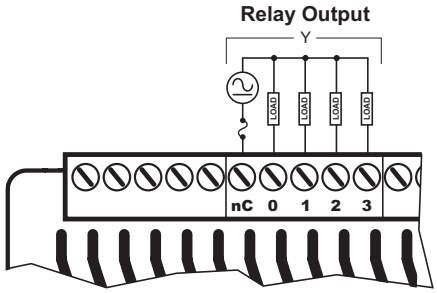
BX-DM1E-18AR3 Wiring, Continued

Discrete Output Specifications

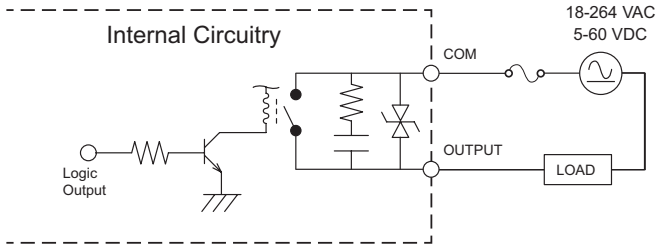
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	8
Commons	2 (4 points/common) Isolated
Maximum Current per Common	8A
Nominal Voltage Rating	5–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC, 18–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA (DC) 300µA (AC) due to RC Snubber Circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y7
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fusing	External Fusing recommended

BX-DM1E-18AR3 Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



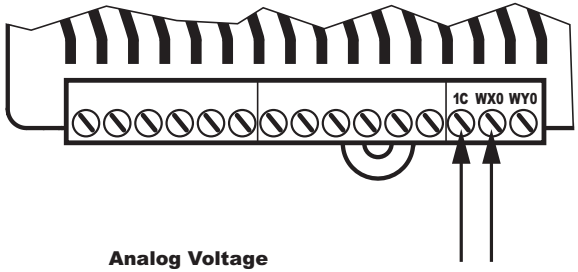
BX-DM1E-18AR3 Wiring, Continued

Analog Input Specifications

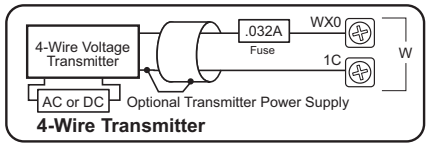
Analog Input Specifications	
Inputs per Module	1
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	1.2 ms
Input Impedance Voltage Modes	220kΩ
Input Impedance Current Modes	249Ω
Input Stability	0.02% of Full Hardware Range
Full Scale Calibration Error	0.05% of Full Hardware Range
Offset Calibration Error	0.01% of Full Hardware Range
Accuracy vs Temperature Error	0.05% of Full Hardware Range
Fusing	External fusing recommended

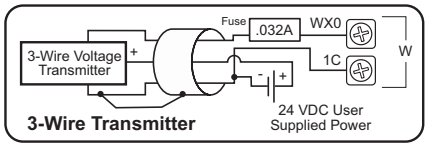
* Software selectable per channel.

Analog Input Voltage Connection Options



Analog Voltage Input Circuits

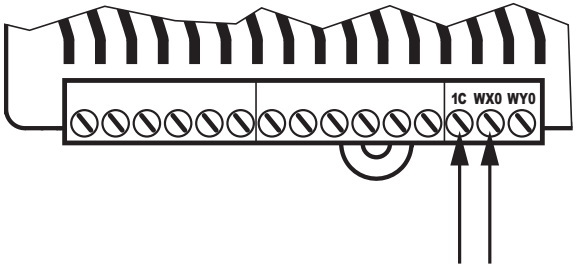




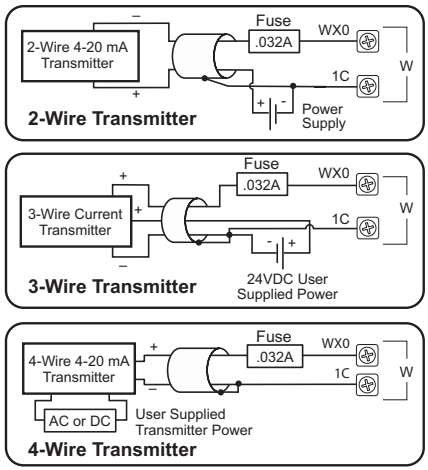
NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-18AR3 Wiring, Continued

Analog Input Current Sinking Connection Options



Analog Current Sinking Input Circuits



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

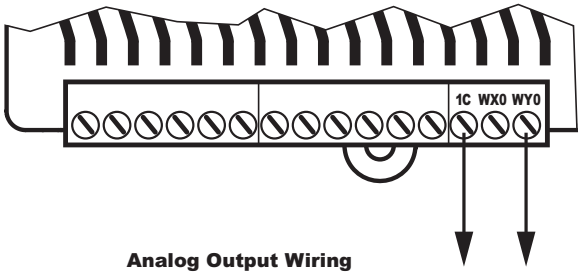
BX-DM1E-18AR3 Wiring, Continued

Analog Output Specifications

Analog Output Specifications	
Outputs per Module	1
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Minimum Voltage Load Impedance	1kΩ
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Maximum Current Load Impedance	500Ω
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	< 1ms
Output Stability	0.02% of Full Hardware Range
Full Scale Calibration Error	0.05% of Full Hardware Range
Offset Calibration Error	0.01% of Full Hardware Range
Accuracy vs Temperature Error	0.05% of Full Hardware Range
Fusing	External fusing recommended

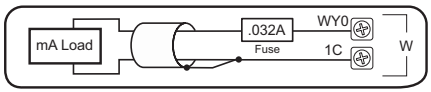
* Software selectable per channel.

Analog Output Connection Options

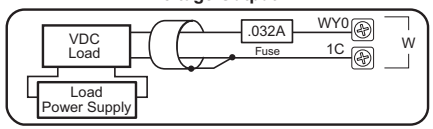


Analog Output Wiring

Current Source Output



Voltage Output



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX 36/36E Wiring

In This Chapter...

Overview 5-2
BX 36/36E MPUs 5-2
BX 36/36E Wiring Termination Selection 5-5
Terminal Block Connectors 5-5
*ZIP*Link Pre-Wired Cable Solutions 5-7
*ZIP*Link System Examples 5-9
BRX 36 Micro PLU Units (MPUs) 5-10
BX-DM1-36ED1 Wiring 5-10
BX-DM1-36ED1-D Wiring 5-16
BX-DM1-36ED2 Wiring 5-22
BX-DM1-36ED2-D Wiring 5-28
BX-DM1-36ER Wiring 5-34
BX-DM1-36ER-D Wiring 5-40
BX-DM1-36AR Wiring 5-46
BX 36E Micro PLC Units (MPUs) 5-52
BX-DM1E-36ED13 Wiring 5-52
BX-DM1E-36ED13-D Wiring 5-61
BX-DM1E-36ED23 Wiring 5-70
BX-DM1E-36ED23-D Wiring 5-79
BX-DM1E-36ER3 Wiring 5-88
BX-DM1E-36ER3-D Wiring 5-97
BX-DM1E-36AR3 Wiring 5-106

BX 36/36E Micro PLC Units

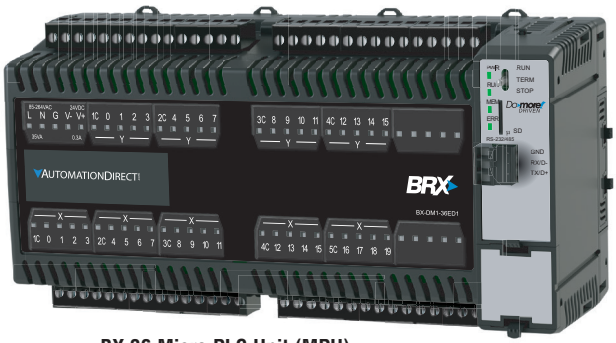
Overview

The BX 36/36E Micro PLC Unit (MPU) includes fourteen different versions. All have the same appearance and basic features. All units have 20 discrete input points and 16 discrete output points built-in. Units with DC inputs have 10 selectable high-speed inputs and units with DC outputs have 8 selectable high-speed outputs. All MPUs can expand their capacity with the BRX Expansion Modules to allow for more flexibility while keeping control cost down. BX 36E units have an additional 4 analog inputs and 2 analog outputs built-in that are current/voltage selectable within the software.

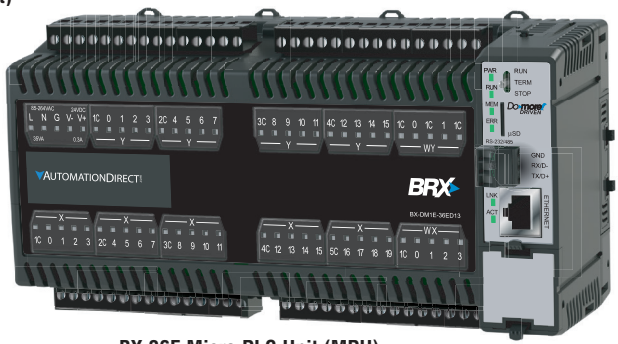
The units ship without wiring terminals. This allows you to select the termination type that best fits your application. There are several wiring options available, including screw terminal connectors, spring clamp terminal connectors and pre-wired *ZIP*Link cable solutions.

BX 36/36E MPUs

BX 36/36E MPUs are divided into two distinct groups, BX 36 and BX 36E. The BX 36 MPUs have no built-in analog I/O or Ethernet port. The BX 36E MPUs have all the features of the BX 36, plus built-in analog I/O and an Ethernet port.



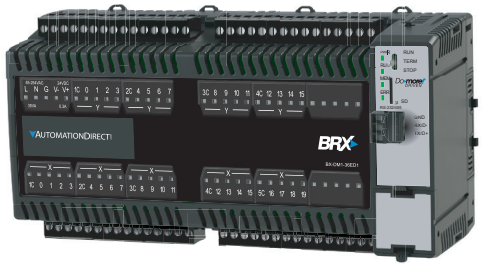
BX 36 Micro PLC Unit (MPU)
(No Built-in Analog or Ethernet Port)



BX 36E Micro PLC Unit (MPU)
(Built-in Analog and Ethernet Port)

BX 36 MPUs

General Specifications



BX 36 Micro PLC Unit (MPU)
(No Built-in Analog or Ethernet port)

36 discrete I/O points: 20 input,16 output

No analog I/O points

Models with DC inputs:

- have 10 high-speed inputs up to 250kHz
- accept 12–24 nominal voltages AC or DC
- can be wired as sinking or sourcing

Models with AC inputs can accept 120–240 nominal voltages

Output types available are DC sinking, DC sourcing, and relay

Models with DC outputs have 8 high-speed outputs rated up to 250kHz

Support for 4 additional Expansion Modules

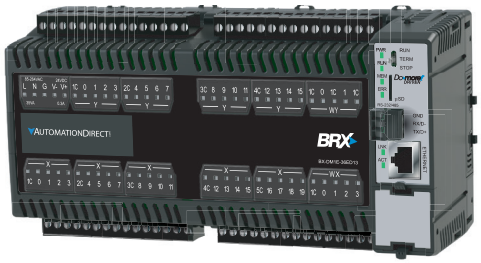
The following table shows the available BX 36 MPUs.

BX 36 MPUs

Part Number	External Power	Discrete Input	Discrete Output	Expansion Modules
BX-DM1-36ED1	120–240 VAC	10 High-speed 10 Standard DC Sinking or Sourcing	8 High-speed 8 Standard DC Sinking	4
BX-DM1-36ED1-D	12–24 VDC			
BX-DM1-36ED2	120–240 VAC		8 High-speed 8 Standard DC Sourcing	
BX-DM1-36ED2-D	12–24 VDC			
BX-DM1-36ER	120–240 VAC		16 Form A Relay	
BX-DM1-36ER-D	12–24 VDC			
BX-DM1-36AR	120–240 VAC	20 AC		

BX 36E MPUs

General Specifications



BX 36E Micro PLC Unit (MPU)
(Built-in Analog and Ethernet Port)

36 Discrete I/O points: 20 inputs, 16 outputs

All units have 4 analog inputs and 2 analog outputs (current/voltage software selectable)

All units have built-in Ethernet port, 10/100 Mbps

Models with DC inputs:

- have 10 high-speed inputs up to 250kHz
- accept 12–24 nominal voltages, AC or DC
- can be wired as sinking or sourcing

Models with AC inputs can accept 120–240 nominal voltages

Output types available are DC sinking, DC sourcing, and relay

Models with DC outputs have 8 high-speed outputs up to 250kHz

Support for 8 additional Expansion Modules

The following table shows the available BX 36E MPUs.

BX 36E MPUs

Part Number	External Power	Discrete Inputs	Discrete Output	Analog *		Expansion Modules
				Input	Output	
BX-DM1E-36ED13	120–240 VAC	10 High-speed 10 Standard DC Sinking or Sourcing	8 High-Speed 8 Standard DC Sinking	4 Current or Voltage	2 Current or Voltage	8
BX-DM1E-36ED13-D	12–24 VDC					
BX-DM1E-36ED23	120–240 VAC		8 High-Speed 8 Standard DC Sourcing			
BX-DM1E-36ED23-D	12–24 VDC					
BX-DM1E-36ER3	120–240 VAC		16 Form A Relay			
BX-DM1E-36ER3-D	12–24 VDC					
BX-DM1E-36AR3	120–240 VAC	20 Standard AC				

* Analog can be current or voltage software selectable per channel.

BX 36/36E Wiring Termination Selection

The BX 36/36E MPUs ship without wiring terminals. This allows you to select the terminal block type that best suits your application. There are several removable terminal block options available, including screw terminals, spring clamp terminals, as well as pre-wired ***ZIP***Link module and cable solutions.

Terminal Block Connectors

The terminal block connectors are provided in kits and can be easily ordered as a single part number. Each kit contains the required number of terminal blocks: (12) 5-pin 5mm terminal blocks.

The BX 36/36E MPUs terminals are configured into groups consisting of 4 inputs and 4 outputs each with an isolated common, e.g., inputs X0–X3 are grouped with a common terminal. The groups are isolated such that a single 5-pin connector can be removed without affecting another group of I/O or the external power source.

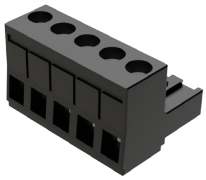
The terminal block connector kit part numbers and connector specifications are listed in the table below.

Removable Terminal Block Specifications

Kit Part Number	BX-RTB36	BX-RTB36-1
Connector Type	Screw Type-90 degree	Spring Clamp Type-180 degree
Wire Exit	180 degree	180 degree
Pitch	5.0 mm	5.0 mm
Screw Size	M2.5	N/A
Screw Torque	< 3.98 lb·in (0.45 N·m)	N/A
Screwdriver Blade Width	3.5 mm	3.5 mm
Wire Gauge (Single Wire)	28–12 AWG	28–14 AWG
Wire Gauge (Dual Wire)	28–16 AWG	28–16 AWG (Dual wire ferrule required)
Wire Strip Length	0.3 in (7.5 mm)	0.37 in (9.5 mm)
Equiv. Dinkle P/N	5ESDV-05P-BK	5ESDSR-05P-BK

BX-RTB36 Screw Terminal Block Kit

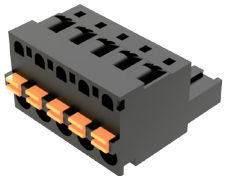
This terminal block kit has 12, 90 degree screw terminal blocks with 180 degree wire pass through.



5-Pin

BX-RTB36-1 Spring Terminal Block Kit

This terminal block kit has 12, Spring Clamp wire terminal blocks with 180 degree wire pass through.



5-Pin

Replacement terminal blocks can be ordered online at: **www.automationdirect.com.** Single replacement terminal blocks are listed in table below.

Replacement Terminal Blocks		
	BX-RTB36	**BX-RTB36-1**
5-pin	BX-RTB05	BX-RTB05-1

*ZIP*Link Pre-Wired Cable Solutions

ZIPLinks eliminate the normally tedious process of wiring between devices by utilizing prewired cables and DIN rail mount connector modules. ***ZIP***Links are as simple as plugging in a cable connector at either end or terminating wires at only one end. Pre-wired cables keep installation clean and efficient, using less space at a fraction of the cost of standard terminal blocks. ***ZIP***Link pre-wired cables connect directly from the MPU to a ***ZIP***link remote terminal block module or with the pigtail cable option, that allows for a convenient solution to wire the BRX platform to third-party devices. For the BX 36/36E MPUs, four (4) cables and four (4) ***ZIP***Link feedthrough modules are needed to connect all the wiring termination points.

There are two (2) feedthrough module options available, the ZL-RTB20 and the ZL-RTB20-1. The ZL-RTB20 is a standard feedthrough remote terminal module while the ZL-RTB20-1 is a feedthrough remote terminal block having a more compact footprint, requiring less space in the control cabinet.

The table below lists the ***ZIP***Link system options for the BX 36/36E MPUs.

BX 36/36E ZIPLink Selector

Part No.	Component Type	Module Part No.	Max Qty Needed	Cable Part No.*	Max Qty Needed
BX-DM1-36ED1	Feedthrough	ZL-RTB20 (Standard) -OR- ZL-RTB20-1 (Compact)	4	ZL-BX-CBL15 ZL-BX-CBL15-1 ZL-BX-CBL15-2	4
BX-DM1-36ED1-D					
BX-DM1-36ED2					
BX-DM1-36ED2-D					
BX-DM1-36ER					
BX-DM1-36ER-D					
BX-DM1-36AR					
BX-DM1E-36ED13					
BX-DM1E-36ED13-D					
BX-DM1E-36ED23					
BX-DM1E-36ED23-D					
BX-DM1E-36ER3					
BX-DM1E-36ER3-D					
BX-DM1E-36AR3					

* Select the cable length: Blank = 0.5 m, -1 = 1.0 m, -2 = 2.0 m.
Available pigtail cables: ZL-BX-CBL15-1P = 1.0 m, ZL-BX-CBL15-2P = 2.0 m.

*ZIP*Link Pre-wired Cables

Custom molded ***ZIP***Link pre-wired cables allow for fast and easy connection of field wiring and remote I/O to the BRX platform. The prewired cables are available in 0.5 meter, 1 meter and 2 meter lengths. Pigtail cables are used to connect the BRX platform directly to 3rd party devices, reducing your wiring time and cost. The pigtail cables are available in 1 meter and 2 meter lengths.

Pre wired *ZIP*Link Cable

***ZIP*Link Pigtail Cable**

*ZIP*Link Remote Feedthrough Modules

Feedthrough modules provide low-cost and compact field wiring screw termination solutions for quickly connecting with the BRX platform. There are two (2) modules available for use with the BRX platform. The ZL-RTB20 and the ZL-RTB20-1. The ZL-RTB20 is a standard 2-row, 20-pin, DIN rail mountable feedthrough module. The ZL-RTB20-1 is a compact 3-row, 24-pin, DIN rail mountable feedthrough module with a smaller footprint design.

The ***ZIP***Link feedthrough module specifications are listed in the table below.

***ZIP*Link Module Specifications**		
Part Number	**ZL-RTB20 (Maximum of 4 needed)**	**ZL-RTB20-1 (Maximum of 4 needed)**
Number of positions	20 screw terminals, 2 rows	24 screw terminals, 3 rows
Screwdriver Width	1/8 in (3.8 mm) maximum	
Screw Torque	4.4 lb·in (0.5 N·m)	4.4 lb·in (0.5 N·m)

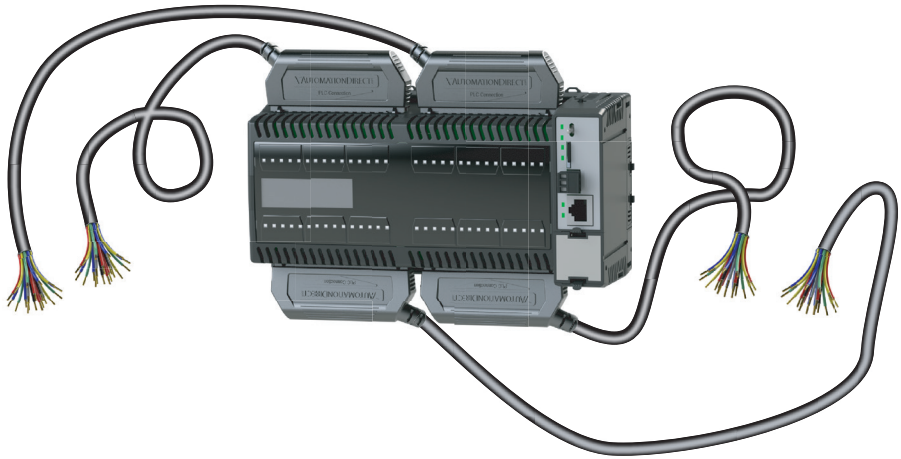
ZL-RTB20

ZL-RTB20-1

*ZIP*Link System Examples

BX 36 MPU with *ZIP*Link pre-wired cables and ZL-RTB20 feedthrough modules.

BX 36 MPU with *ZIP*Link pigtail cables installed.



BRX 36 Micro PLU Units (MPUs)

BX-DM1-36ED1 Wiring

This MPU is made up of 36 discrete I/O points. The connections are grouped as follows:

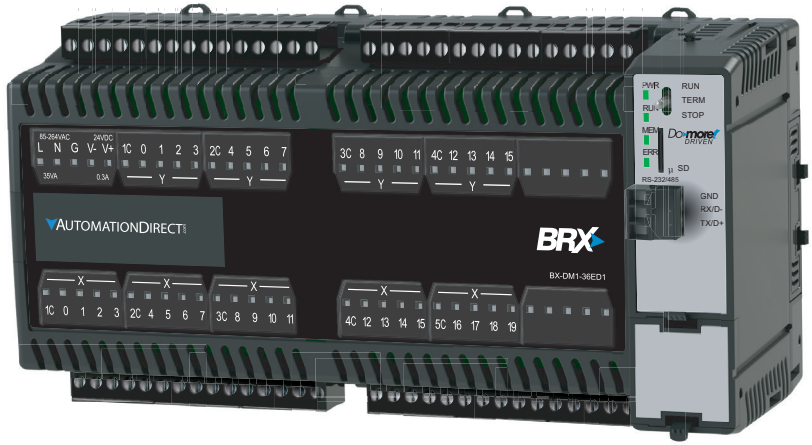
20 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in five (5) groups of 5 terminals, each comprised of 4 inputs and an isolated common.

16 discrete outputs - sinking; rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in four (4) groups of 5 terminals, each comprised of 4 outputs and an isolated common.

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.

WARNING: **No analog I/O is included on this unit. The 5 terminals to the right of the input and output rails are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS**

NOTE: *Four (4) Expansion Modules can be connected to extend I/O capacity.*



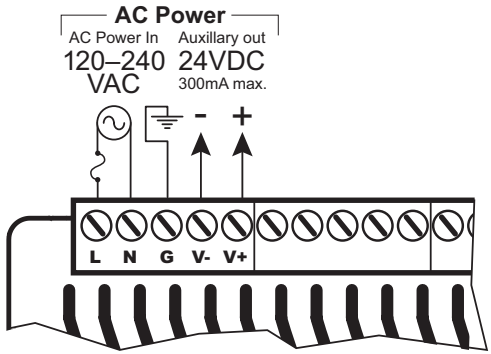
BX-DM1-36ED1

BX-DM1-36ED1 Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Rating	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Efficiency	80%
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	8W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



WARNING: **Do not exceed the 24VDC auxiliary power supply load limit of 300mA.**

BX-DM1-36ED1 Wiring, Continued

Discrete Input Specifications

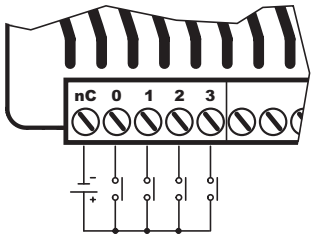
Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		20	
Commons		5 (4 points/common) Isolated	
Nominal Voltage Rating		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz [2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed	Standard [1]
Location		X0...X9	X10...X19
OFF to ON Response	DC	< 2µs	2ms
	AC	—	10ms [2]
ON to OFF Response	DC	< 2µs	2ms
	AC	—	10ms[2]

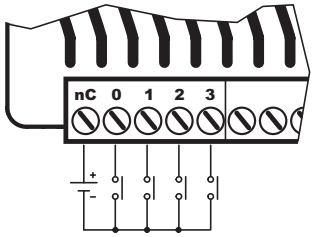
1. All inputs may be used as standard inputs. Only the first 10 inputs (X0...X9) are capable of high speed DC operation.

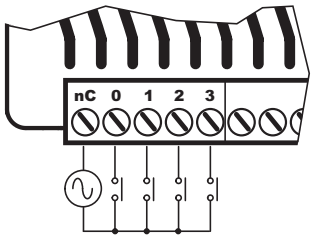
2. 240Hz filter must be set in software for AC operation.

BX-DM1-36ED1 Wiring, Continued

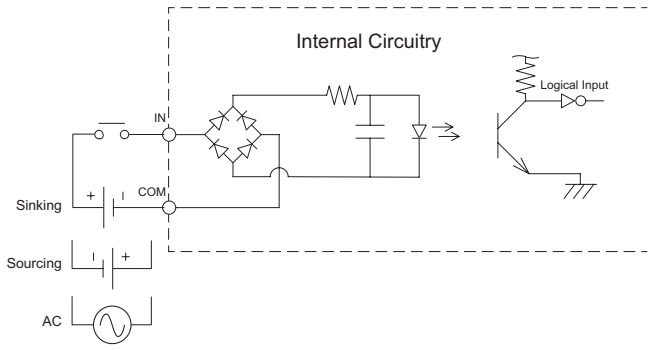
Discrete Input Connection Options







Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

BX-DM1-36ED1 Wiring, Continued

Discrete Output Specifications

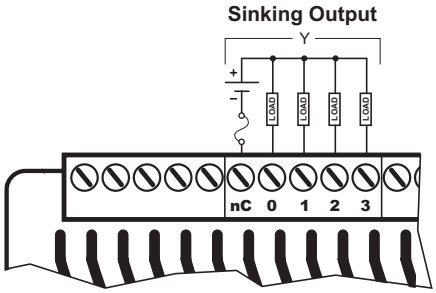
Discrete Output Specifications		
Output Type	Sinking	
Total Outputs per Module	16	
Commons	4 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Rating	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard [1]
Location	Y0...Y7	Y8...Y15
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	143Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level [2]	Between 4A and 8A	N/A
Fusing	External fusing recommended	

1. All outputs may be used as standard outputs. Only the first 8 outputs (Y0...Y7) are capable of high speed DC operation.

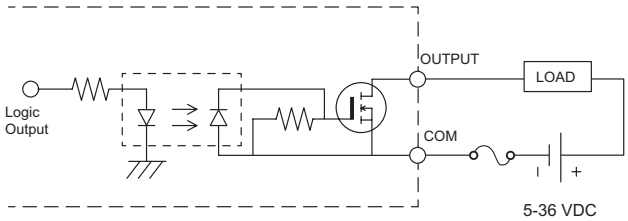
2. When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.

BX-DM1-36ED1 Wiring, Continued

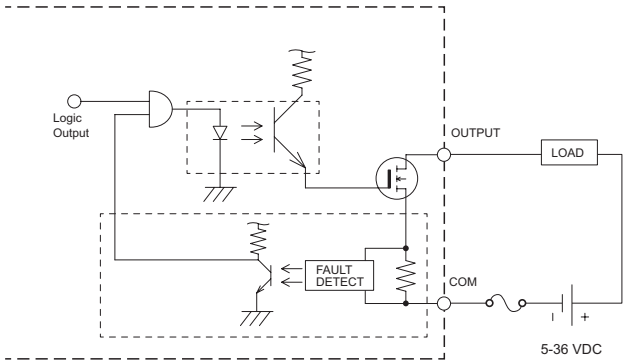
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1-36ED1-D Wiring

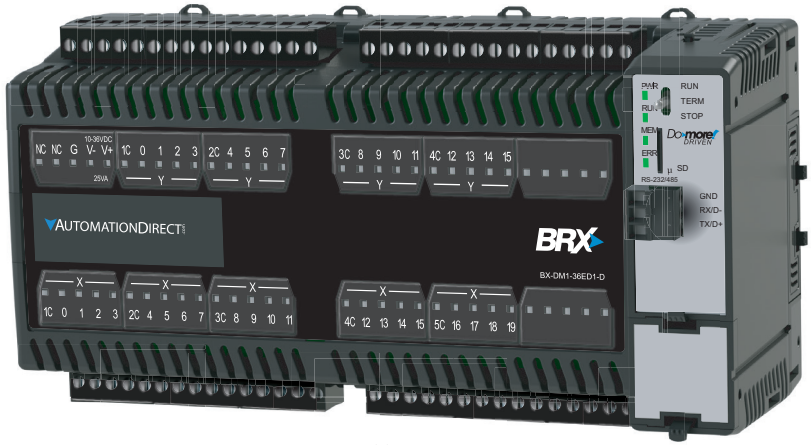
This MPU is made up of 36 discrete I/O points. The connections are grouped as follows:

20 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in five (5) groups of 5 terminals, each comprised of 4 inputs and an isolated common.

16 discrete outputs - sinking; rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC external power supply terminals. The outputs are configured in four (4) groups of 5 terminals, each comprised of 4 outputs and an isolated common.

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.

WARNING: **No analog I/O is included on this unit. The 5 terminals to the right of the input and output rails are not used. These input and output terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS**



BX-DM1-36ED1-D

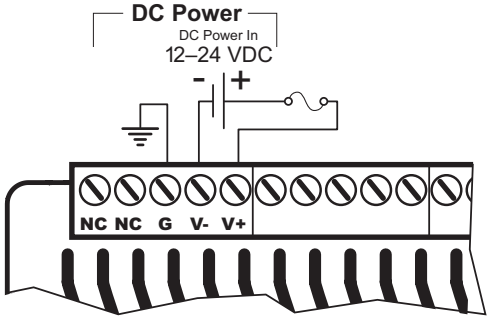
NOTE: *Four (4) Expansion Modules can be connected to extend I/O capacity.*

BX-DM1-36ED1-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range	12–24 VDC
Input Voltage Range (Tolerance)	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	30W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Efficiency	85%
Under Input Voltage Lock-out	<9VDC
Heat Dissipation	3.2 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



WARNING: No External AC power supply needed on this unit. The two terminals marked "NC" are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!

BX-DM1-36ED1-D Wiring, Continued

Discrete Input Specifications

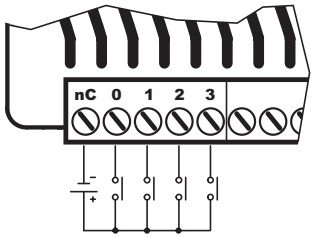
Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		20	
Commons		5 (4 points/common) Isolated	
Nominal Voltage Rating		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz [2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed	Standard [1]
Location		X0...X9	X10...X19
OFF to ON Response	DC	< 2µs	2ms
	AC	—	10ms[2]
ON to OFF Response	DC	< 2µs	2ms
	AC	—	10ms[2]

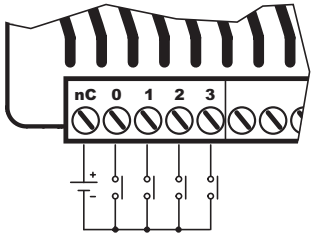
1. All inputs may be used as standard inputs. Only the first 10 inputs (X0...X9) are capable of high speed DC operation.

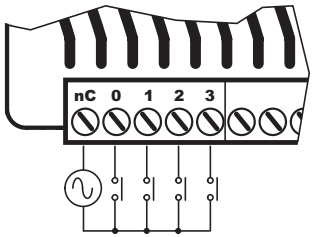
2. 240Hz filter must be set in software for AC operation.

BX-DM1-36ED1-D Wiring, Continued

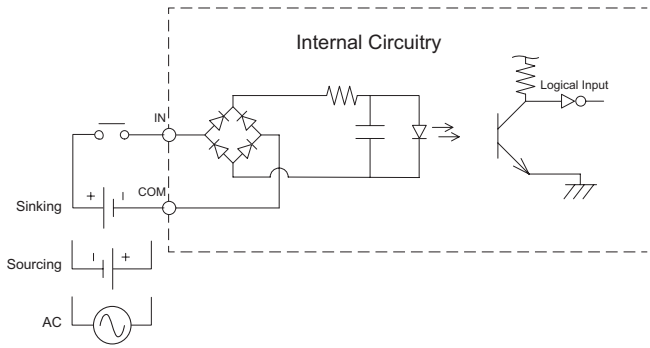
Discrete Input Connection Options







Discrete Input Internal Circuitry *



* ***Same for both Standard and High Speed***

BX-DM1-36ED1-D Wiring, Continued

Discrete Output Specifications

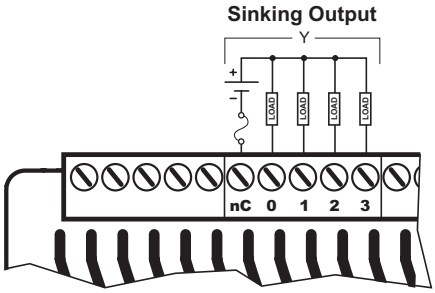
Discrete Output Specifications		
Output Type	Sinking	
Total Outputs per Module	16	
Commons	4 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Rating	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard [1]
Location	Y0...Y7	Y8...Y15
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	143Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level [2]	Between 4A and 8A	N/A
Fusing	External fusing recommended	

1. All outputs may be used as standard outputs. Only the first 8 outputs (Y0...Y7) are capable of high speed DC operation.

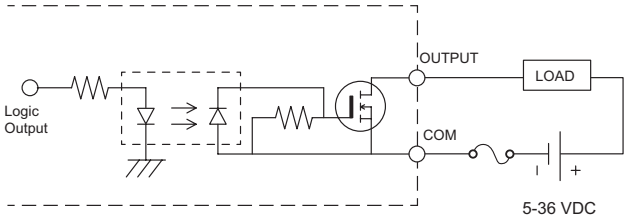
2. When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.

BX-DM1-36ED1-D Wiring, Continued

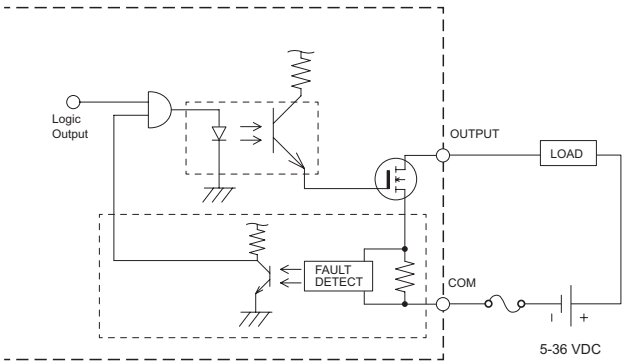
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1-36ED2 Wiring

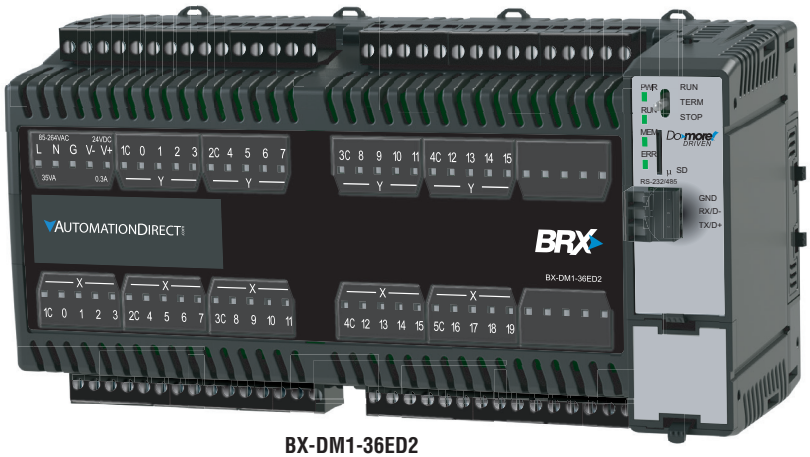
This MPU is made up of 36 discrete I/O points. The connections are grouped as follows:

20 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in five (5) groups of 5 terminals, each comprised of 4 inputs and an isolated common.

16 discrete outputs, sourcing, rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in four (4) groups of 5 terminals, each comprised of 4 outputs and an isolated common.

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.

WARNING: **No analog I/O is included on this unit. The 5 terminals to the right of the input and output rails are not used. These input and output terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS**



BX-DM1-36ED2

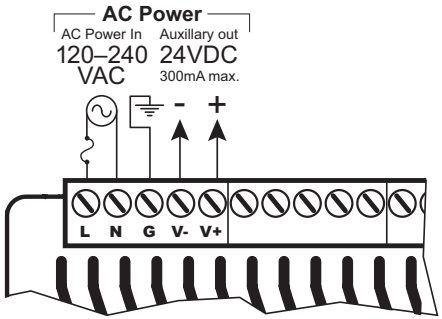
NOTE: *Four (4) Expansion Modules can be connected to extend I/O capacity.*

BX-DM1-36ED2 Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Rating	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Efficiency	80%
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	8W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



WARNING: **Do not exceed the 24VDC auxiliary power supply load limit of 300mA.**

BX-DM1-36ED2 Wiring, Continued

Discrete Input Specifications

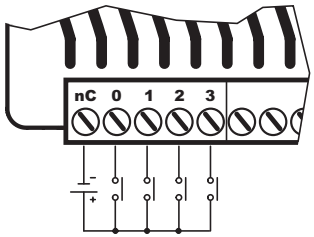
Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		20	
Commons		5 (4 points/common) Isolated	
Nominal Voltage Rating		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz [2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed	Standard [1]
Location		X0...X9	X10...X19
OFF to ON Response	DC	< 2µs	2ms
	AC	—	10ms[2]
ON to OFF Response	DC	< 2µs	2ms
	AC	—	10ms[2]

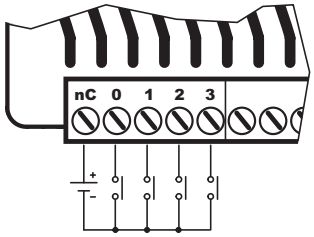
1. All inputs may be used as standard inputs. Only the first 10 inputs (X0...X9) are capable of high speed DC operation.

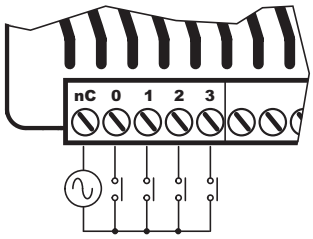
2. 240Hz filter must be set in software for AC operation.

BX-DM1-36ED2 Wiring, Continued

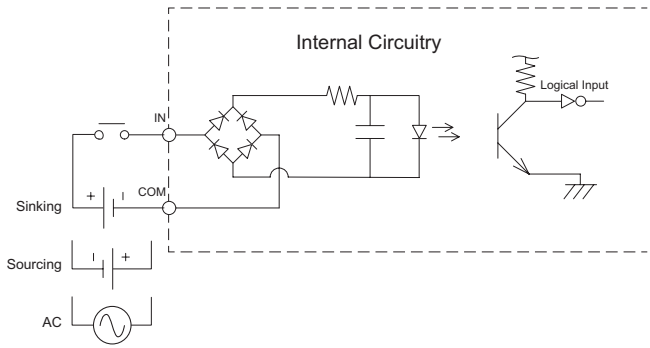
Discrete Input Connection Options







Discrete Input Internal Circuitry *



Same for both Standard and High Speed

BX-DM1-36ED2 Wiring, Continued

Discrete Output Specifications

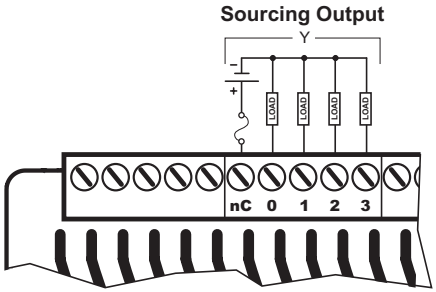
Discrete Output Specifications		
Output Type	Sourcing	
Total Outputs per Module	16	
Commons	4 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Rating	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard [1]
Location	Y0...Y7	Y8...Y15
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	143Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level [2]	Between 4A and 8A	N/A
Fusing	External fusing recommended	

1. All outputs may be used as standard outputs. Only the first 8 outputs (Y0...Y7) are capable of high speed DC operation.

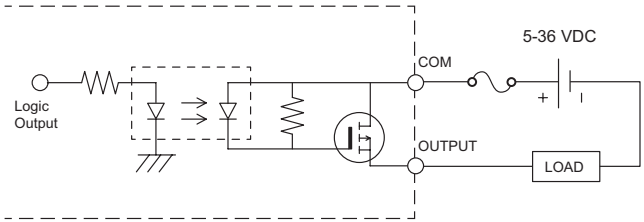
2. When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.

BX-DM1-36ED2 Wiring, Continued

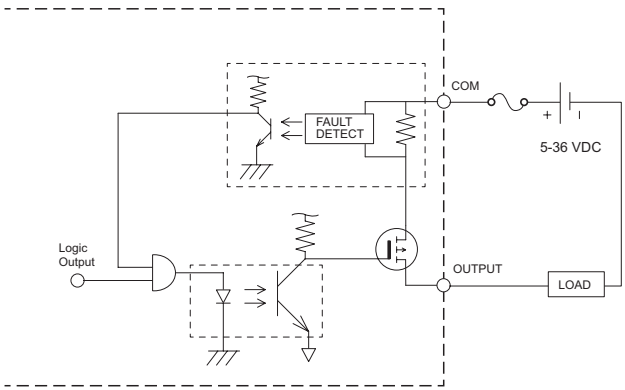
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1-36ED2-D Wiring

This MPU is made up of 36 discrete I/O points. The connections are grouped as follows:

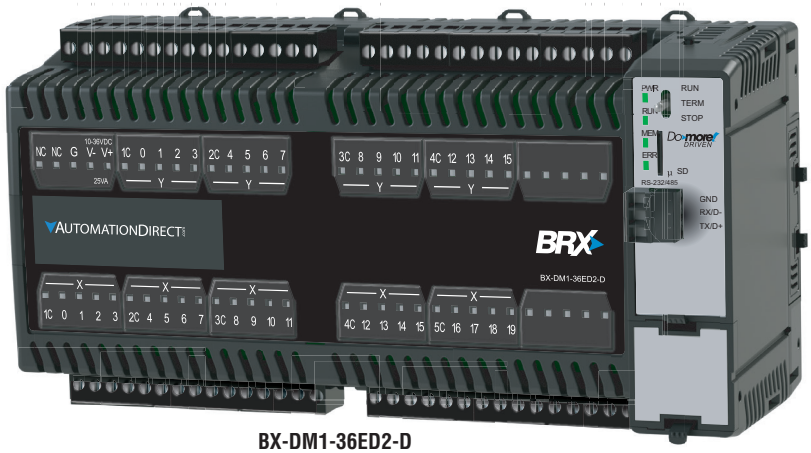
20 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in five (5) groups of 5 terminals, each comprised of 4 inputs and an isolated common.

16 discrete outputs, sourcing, rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC external power supply terminals. The outputs are configured in four (4) groups of 5 terminals, each comprised of 4 outputs and an isolated common.

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.

WARNING: **No analog I/O is included on this unit. The 5 terminals to the right of the input and output rails are not used. These input and output terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS**

NOTE: *Four (4) Expansion Modules can be connected to extend I/O capacity.*



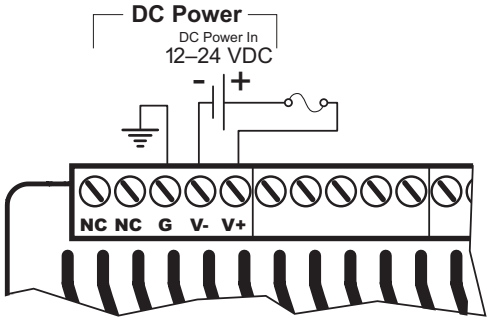
BX-DM1-36ED2-D

BX-DM1-36ED2-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range	12–24 VDC
Input Voltage Range (Tolerance)	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	30W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Efficiency	85%
Under Input Voltage Lock-out	<9VDC
Heat Dissipation	3.2 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



WARNING: **No External AC power supply needed on this unit. The two terminals marked "NC" are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!**

BX-DM1-36ED2-D Wiring, Continued

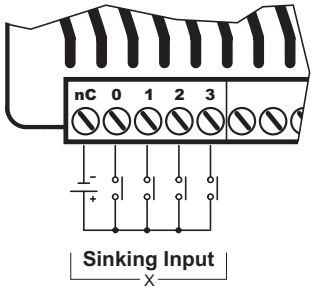
Discrete Input Specifications

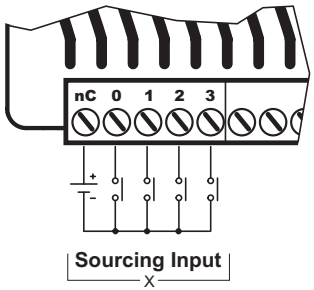
Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		20	
Commons		5 (4 points/common) Isolated	
Nominal Voltage Rating		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz [2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed	Standard [1]
Location		X0...X9	X10...X19
OFF to ON Response	DC	< 2µs	2ms
	AC	—	10ms[2]
ON to OFF Response	DC	< 2µs	2ms
	AC	—	10ms[2]

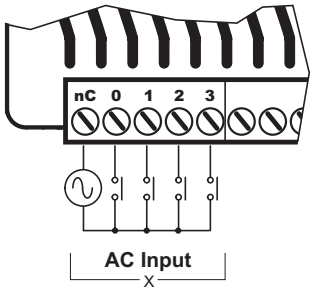
1. All inputs may be used as standard inputs. Only the first 10 inputs (X0...X9) are capable of high speed DC operation.
2. 240Hz filter must be set in software for AC operation.

BX-DM1-36ED2-D Wiring, Continued

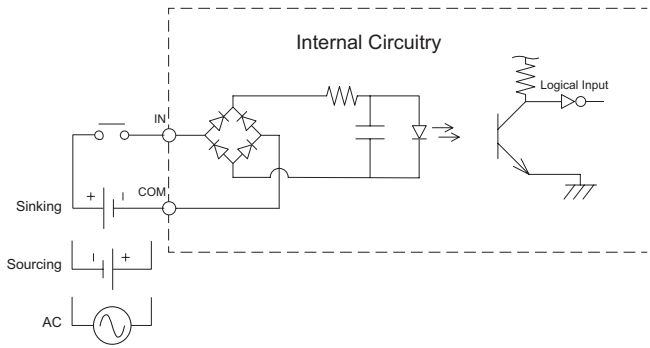
Discrete Input Connection Options







Discrete Input Internal Circuitry *



9-30 VDC/VAC ***Same for both Standard and High Speed***

BX-DM1-36ED2-D Wiring, Continued

Discrete Output Specifications

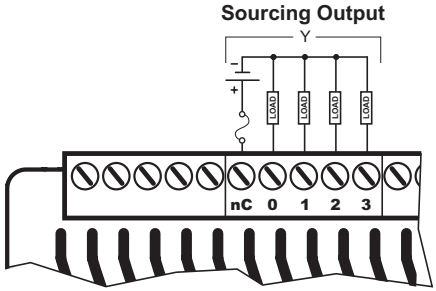
Discrete Output Specifications		
Output Type	Sourcing	
Total Outputs per Module	16	
Commons	4 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Rating	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard [1]
Location	Y0...Y7	Y8...Y15
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	143Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level [2]	Between 4A and 8A	N/A
Fusing	External fusing recommended	

1. All outputs may be used as standard outputs. Only the first 8 outputs (Y0...Y7) are capable of high speed DC operation.

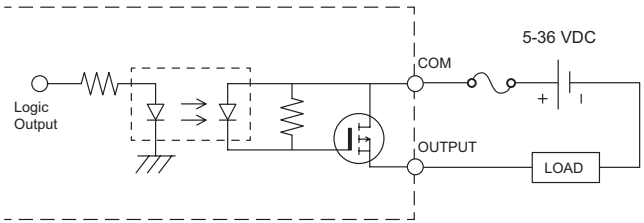
2. When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.

BX-DM1-36ED2-D Wiring, Continued

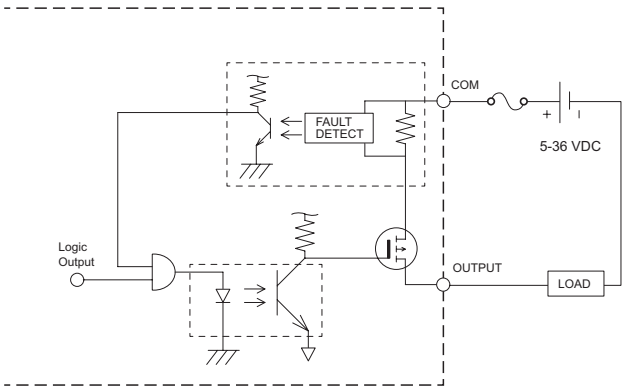
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

BX-DM1-36ER Wiring

This MPU is made up of 36 discrete I/O points. The connections are grouped as follows:

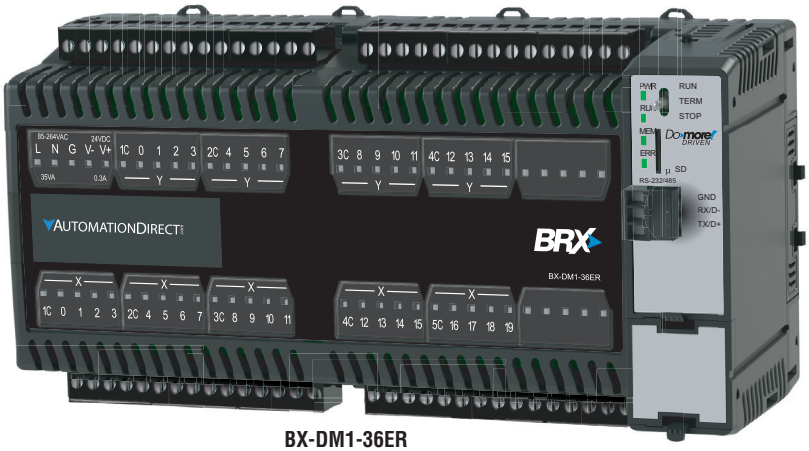
20 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in five (5) groups of 5 terminals, each comprised of 4 inputs and an isolated common.

16 discrete outputs - Form A Relay (SPST); rated 5–48 VDC/ 24–240 VAC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in four (4) groups of 5 terminals, each comprised of 4 outputs and an isolated common.

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.

WARNING: **No analog I/O is included on this unit. The 5 terminals to the right of the input and output rails are not used. These input and output terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS**

NOTE: *Four (4) Expansion Modules can be connected to extend I/O capacity.*



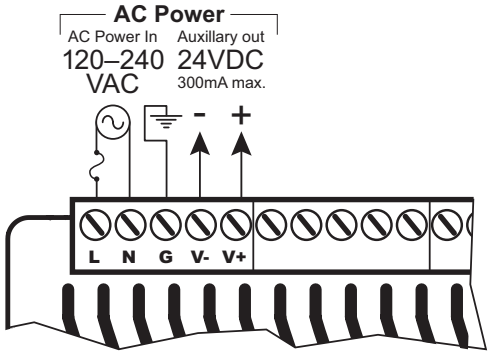
BX-DM1-36ER

BX-DM1-36ER Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Rating	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Efficiency	80%
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	8W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



WARNING: **Do not exceed the 24VDC auxiliary power supply load limit of 300mA.**

BX-DM1-36ER Wiring, Continued

Discrete Input Specifications

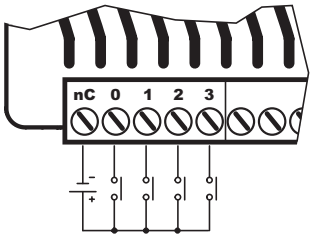
Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		20	
Commons		5 (4 points/common) Isolated	
Nominal Voltage Rating		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz [2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed	Standard [1]
Location		X0...X9	X10...X19
OFF to ON Response	DC	< 2µs	2ms
	AC	—	10ms[2]
ON` to OFF Response	DC	< 2µs	2ms
	AC	—	10ms[2]

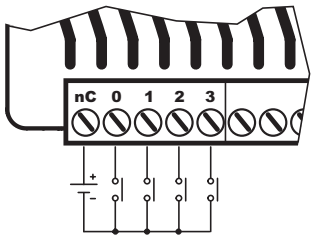
1. All inputs may be used as standard inputs. Only the first 10 inputs (X0...X9) are capable of high speed DC operation.

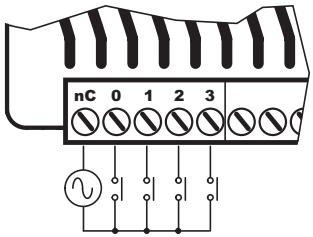
2. 240Hz filter must be set in software for AC operation.

BX-DM1-36ER Wiring, Continued

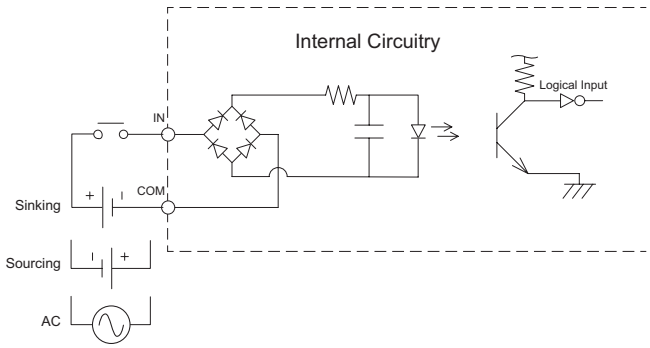
Discrete Input Connection Options







Discrete Input Internal Circuitry *



Same for both Standard and High Speed

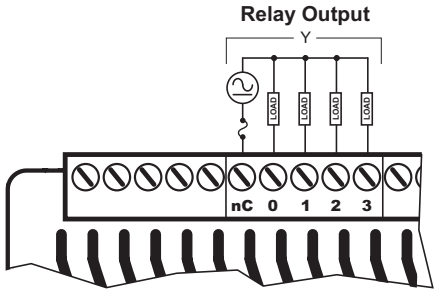
BX-DM1-36ER Wiring, Continued

Discrete Output Specifications

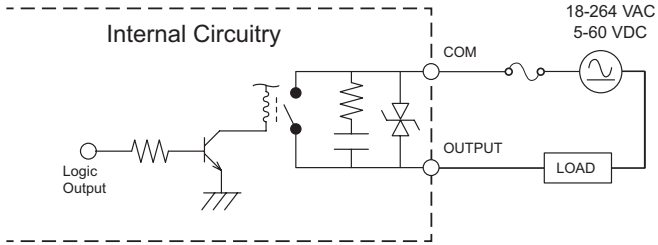
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	16
Commons	4 (4 points/common) Isolated
Maximum Current per Common	8A
Nominal Voltage Rating	5–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC, 18–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA (DC) 300µA (AC) due to RC Snubber Circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y15
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fusing	External fusing recommended

BX-DM1-36ER Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



BX-DM1-36ER-D Wiring

This MPU is made up of 36 discrete I/O points. The connections are grouped as follows:

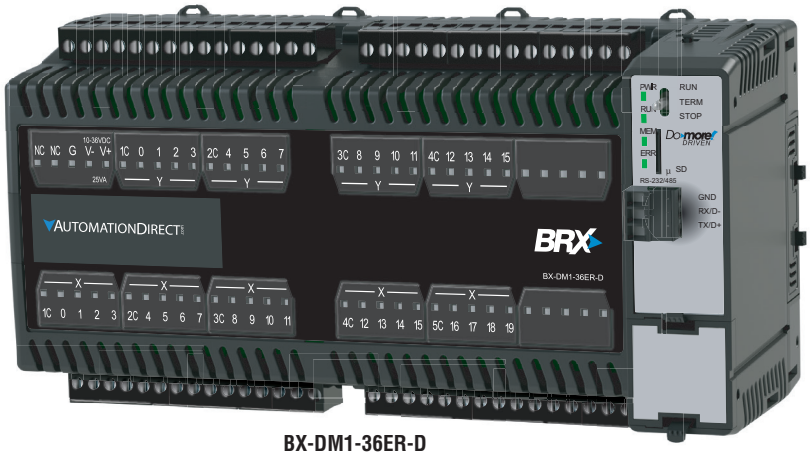
20 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in five (5) groups of 5 terminals, each comprised of 4 inputs and an isolated common.

16 discrete outputs - Form A Relay (SPST); rated 5–48 VDC/ 24–240 VAC. They are located along the top of the unit starting to the right of the 24VDC external power supply terminals. The outputs are configured in four (4) groups of 5 terminals, each comprised of 4 outputs and an isolated common.

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.

WARNING: **No analog I/O is included on this unit. The 5 terminals to the right of the input and output rails are not used. These input and output terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS**

NOTE: *Four (4) Expansion Modules can be connected to extend I/O capacity.*



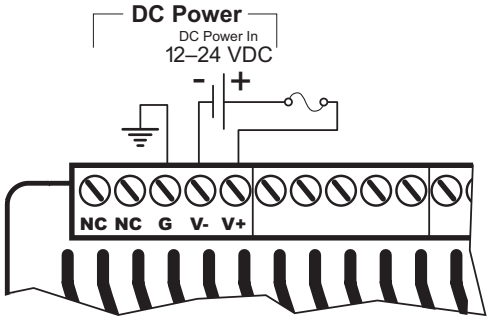
BX-DM1-36ER-D

BX-DM1-36ER-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range	12–24 VDC
Input Voltage Range (Tolerance)	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	30W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Efficiency	85%
Under Input Voltage Lock-out	<9VDC
Heat Dissipation	3.2 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



BX-DM1-36ER-D Wiring, Continued

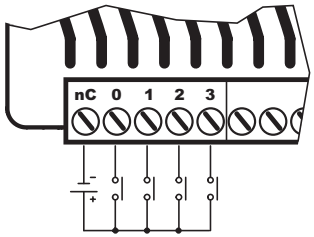
Discrete Input Specifications

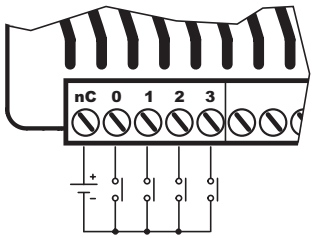
Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		20	
Commons		5 (4 points/common) Isolated	
Nominal Voltage Rating		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz [2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed	Standard [1]
Location		X0...X9	X10...X19
OFF to ON Response	DC	< 2µs	2ms
	AC	—	10ms [2]
ON to OFF Response	DC	< 2µs	2ms
	AC	—	10ms [2]

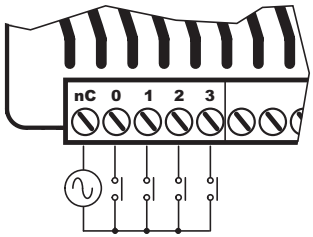
1. All inputs may be used as standard inputs. Only the first 10 inputs (X0...X9) are capable of high speed DC operation.
2. 240Hz filter must be set in software for AC operation.

BX-DM1-36ER-D Wiring, Continued

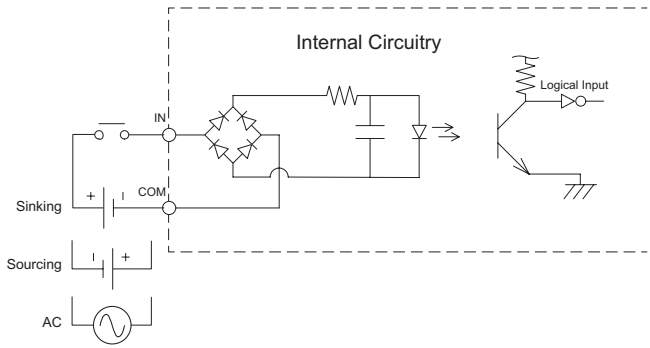
Discrete Input Connection Options







Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

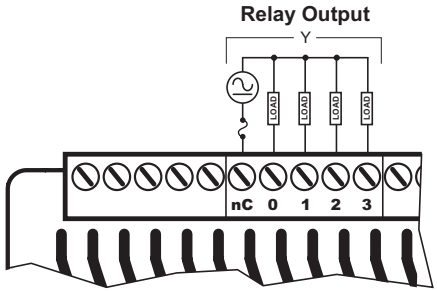
BX-DM1-36ER-D Wiring, Continued

Discrete Output Specifications

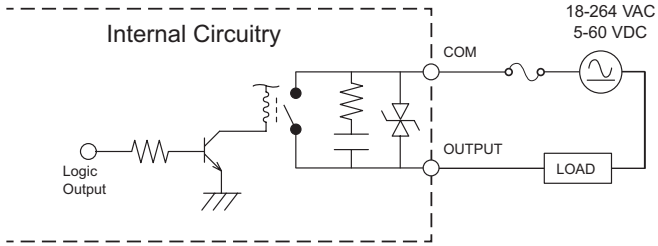
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	16
Commons	4 (4 points/common) Isolated
Maximum Current per Common	8A
Nominal Voltage Rating	5–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC, 18–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA (DC) 300µA (AC) due to RC Snubber Circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y15
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fusing	External fusing recommended

BX-DM1-36ER-D Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



BX-DM1-36AR Wiring

This MPU is made up of 36 discrete I/O points. The connections are grouped as follows:

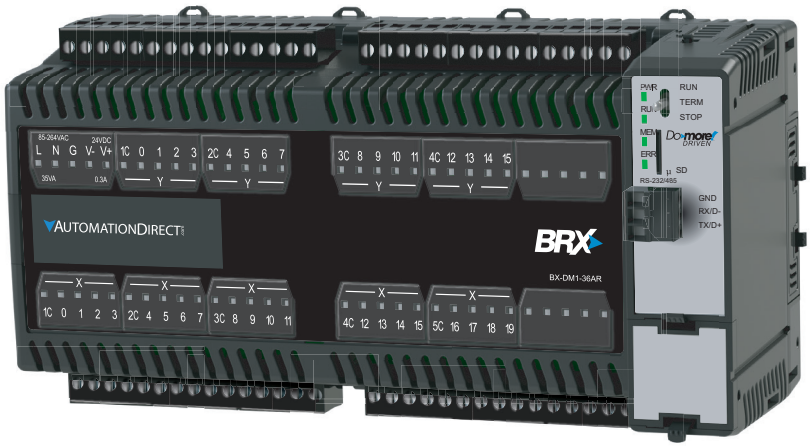
20 discrete inputs, AC, rated for 120–240 VAC. They are located along the bottom of the unit; configured in five (5) groups of 5 terminals, each comprised of 4 inputs and an isolated common.

16 discrete outputs - Form A Relay (SPST); rated 5–48 VDC/ 24–240 VAC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in four (4) groups of 5 terminals, each comprised of 4 outputs and an isolated common.

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.

WARNING: **No analog I/O is included on this unit. The 5 terminals to the right of the input and output rails are not used. These input and output terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS**

NOTE: *Four (4) Expansion Modules can be connected to extend I/O capacity.*



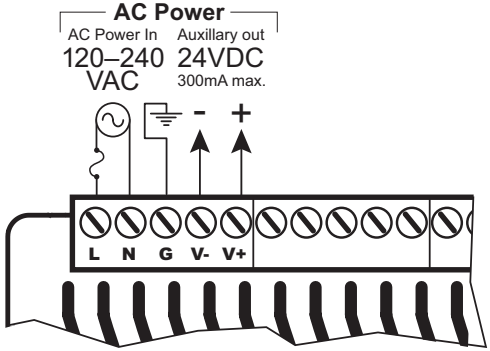
BX-DM1-36AR

BX-DM1-36AR Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Rating	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Efficiency	80%
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	8W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



WARNING: **Do not exceed the 24VDC auxiliary power supply load limit of 300mA.**

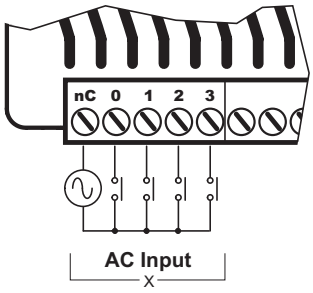
BX-DM1-36AR Wiring, Continued

Discrete Input Specifications

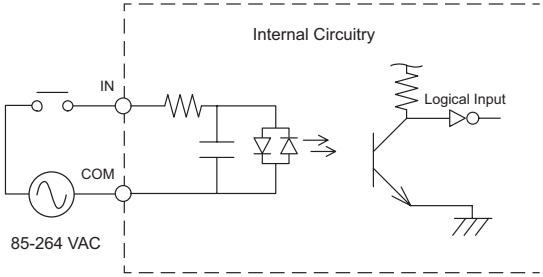
Discrete Input Specifications	
Input Type	AC
Total Inputs per Module	20
Commons	5 (4 points/common) Isolated
Nominal Voltage Rating	120–240 VAC
Input Voltage Range	85–264 VAC
Maximum Voltage	264VAC RMS
AC Frequency	47–63 Hz
Input Impedance	15kΩ
Input Current (typical)	9mA @ 120VAC, 13mA @ 220VAC
Maximum Input Current	14mA @ 120VAC, 20mA @ 220VAC
ON Voltage Level	> 85VAC
OFF Voltage Level	< 40VAC
Maximum OFF Current	2.5 mA
Status Indicators	Logic Side, Green
Input Details	
Input Type	Standard
Location	X0...X19
OFF - ON Response	10ms
ON - OFF Response	10ms

BX-DM1-36AR Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry



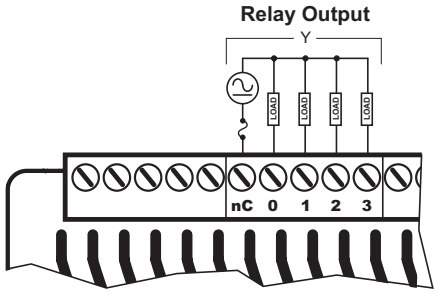
BX-DM1-36AR Wiring, Continued

Discrete Output Specifications

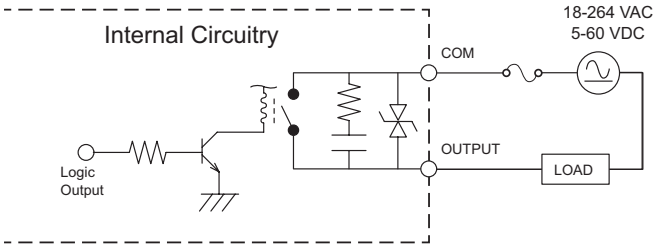
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	16
Commons	4 (4 points/common) Isolated
Maximum Current per Common	8A
Nominal Voltage Rating	5–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC, 18–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA (DC) 300µA (AC) due to RC Snubber Circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y15
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fusing	External fusing recommended

BX-DM1-36AR Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



BX 36E Micro PLC Units (MPUs)

BX-DM1E-36ED13 Wiring

This MPU is made up of 36 discrete I/O points. The connections are grouped as follows:

20 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in five (5) groups of 5 terminals, each comprised of 4 inputs and an isolated common.

16 discrete outputs - sinking; rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in four (4) groups of 5 terminals, each comprised of 4 outputs and an isolated common.

4 analog inputs and 2 analog outputs. The analog inputs are located along the bottom of the unit to the right of the discrete inputs. The analog inputs are grouped together on 5 terminals consisting of 4 input and a shared analog input common. The analog outputs are located along the top of the unit to the right of the discrete outputs. The analog outputs are grouped together on 5 terminals consisting of 2 outputs and 3 shared analog output common terminals:

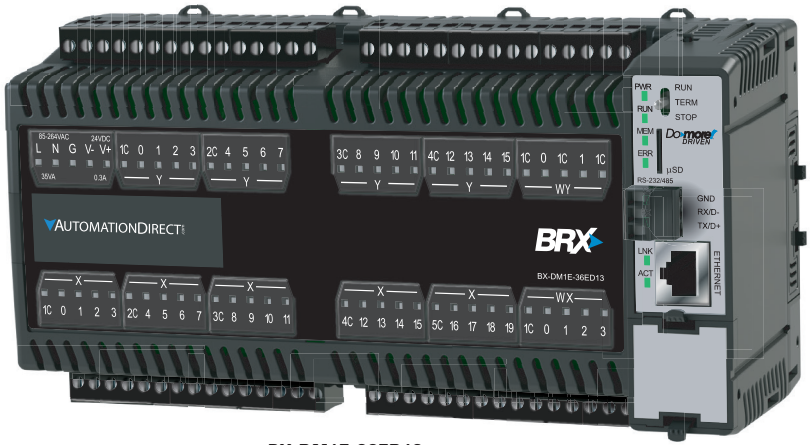
current or voltage selectable through software

16-bit resolution @ ±10V, ±20mA

current signal ranges of 4–20 mA, ±20mA

voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5VDC, ±10VDC

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.



BX-DM1E-36ED13

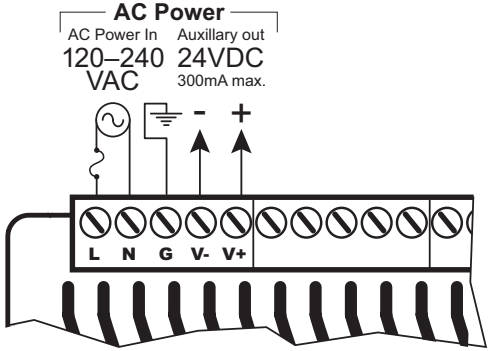
NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity.*

BX-DM1E-36ED13 Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Rating	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Efficiency	80%
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	8W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



WARNING: **Do not exceed the 24VDC auxiliary power supply load limit of 300mA.**

BX-DM1E-36ED13 Wiring, Continued

Discrete Input Specifications

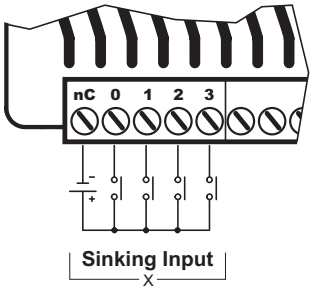
Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		20	
Commons		5 (4 points/common) Isolated	
Nominal Voltage Rating		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz [2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed	Standard [1]
Location		X0...X9	X10...X19
OFF to ON Response	DC	< 2µs	2ms
	AC	—	10ms[2]
ON to OFF Response	DC	< 2µs	2ms
	AC	—	10ms[2]

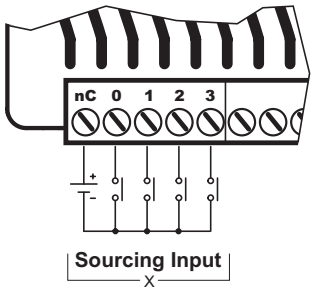
1. All inputs may be used as standard inputs. Only the first 10 inputs (X0...X9) are capable of high speed DC operation.

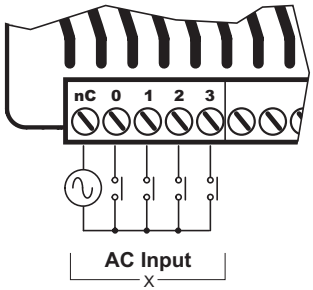
2. 240Hz filter must be set in software for AC operation.

BX-DM1E-36ED13 Wiring, Continued

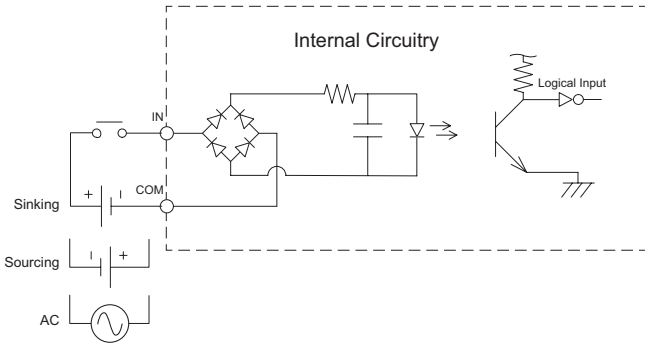
Discrete Input Connection Options







Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

BX-DM1E-36ED13 Wiring, Continued

Discrete Output Specifications

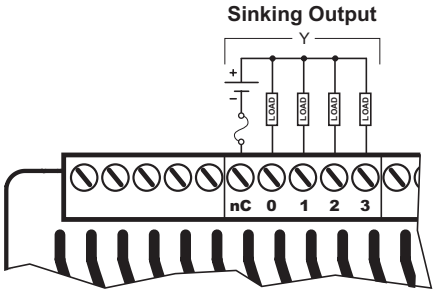
Discrete Output Specifications		
Output Type	Sinking	
Total Outputs per Module	16	
Commons	4 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Rating	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard [1]
Location	Y0...Y7	Y8...Y15
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	143Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level [2]	Between 4A and 8A	N/A
Fusing	External fusing recommended	

1. All outputs may be used as standard outputs. Only the first 8 outputs (Y0...Y7) are capable of high speed DC operation.

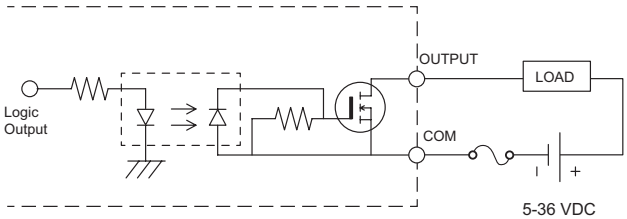
2. When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.

BX-DM1E-36ED13 Wiring, Continued

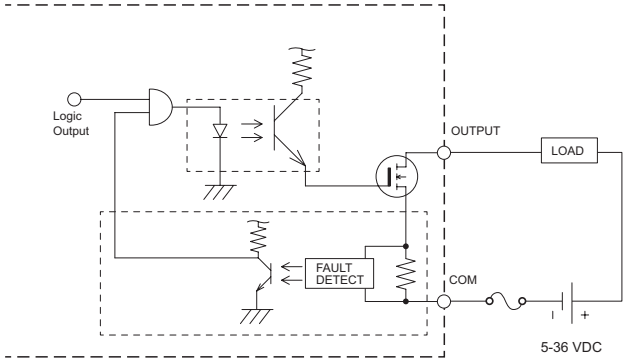
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

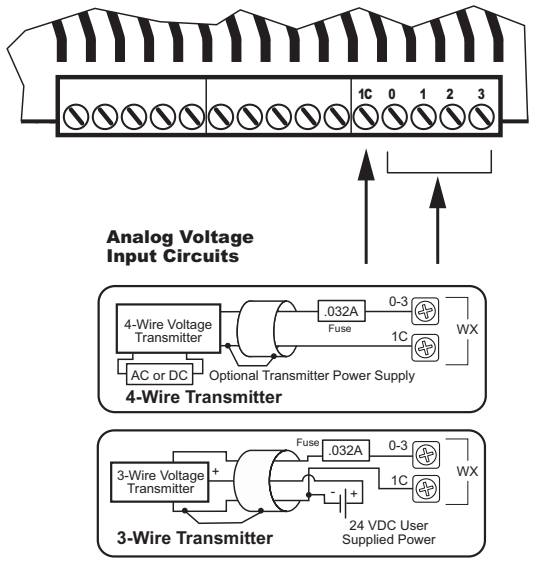
BX-DM1E-36ED13 Wiring, Continued

Analog Input Specifications

Analog Input Specifications	
Inputs per Module	4
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	1.2 ms
Input Impedance Voltage Modes	220kΩ
Input Impedance Current Modes	249Ω
Input Stability	0.02% of Full Hardware Range
Full Scale Calibration Error	0.05% of Full Hardware Range
Offset Calibration Error	0.01% of Full Hardware Range
Accuracy vs Temperature Error	0.05% of Full Hardware Range
Fusing	External fusing recommended

* Software selectable per channel.

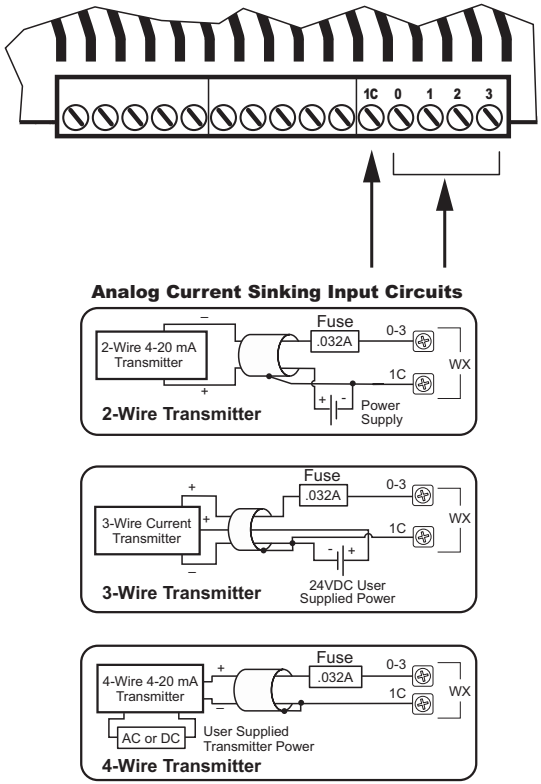
Analog Input Voltage Connection Options



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-36ED13 Wiring, Continued

Analog Input Current Sinking Connection Options



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

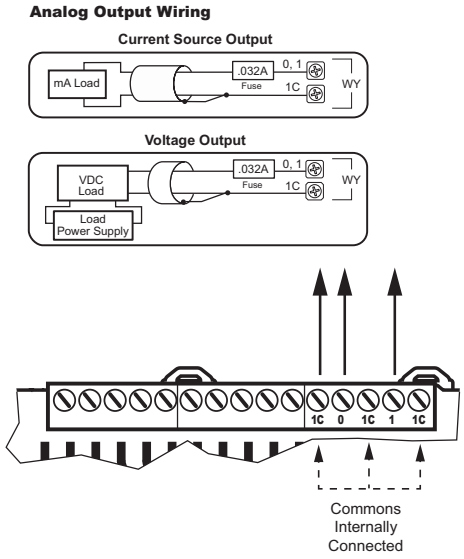
BX-DM1E-36ED13 Wiring, Continued

Analog Output Specifications

Analog Output Specifications	
Outputs per Module	2
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Minimum Voltage Load Impedance	1kΩ
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Maximum Current Load Impedance	500Ω
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	< 1ms
Output Stability	0.02% of Full Hardware Range
Full Scale Calibration Error	0.05% of Full Hardware Range
Offset Calibration Error	0.01% of Full Hardware Range
Accuracy vs Temperature Error	0.05% of Full Hardware Range
Fusing	External fusing recommended

* Software selectable per channel.

Analog Output Connection Options



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-36ED13-D Wiring

This MPU is made up of 36 discrete I/O points. The connections are grouped as follows:

20 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in five (5) groups of 5 terminals, each comprised of 4 inputs and an isolated common.

16 discrete outputs - sinking; rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC external power supply terminals. The outputs are configured in four (4) groups of 5 terminals, each comprised of 4 outputs and an isolated common.

4 analog inputs and 2 analog outputs. The analog inputs are located along the bottom of the unit to the right of the discrete inputs. The analog inputs are grouped together on 5 terminals consisting of 4 input and a shared analog input common. The analog outputs are located along the top of the unit to the right of the discrete outputs. The analog outputs are grouped together on 5 terminals consisting of 2 outputs and 3 shared analog output common terminals.

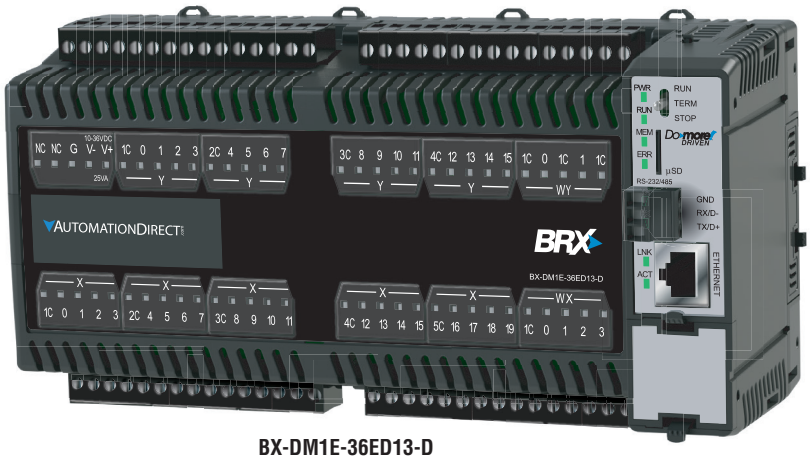
current or voltage selectable through software

16-bit resolution @ ±10V, ±20mA

current signal ranges of 4–20 mA, ±20mA

voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5VDC, ±10VDC

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.



BX-DM1E-36ED13-D

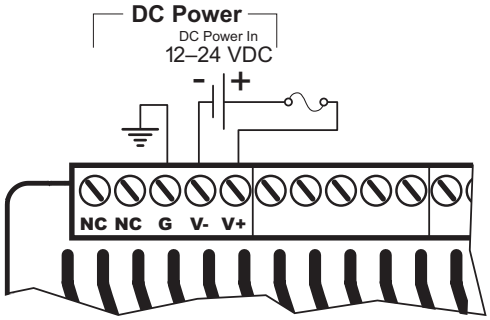
NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity.*

BX-DM1E-36ED13-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range	12–24 VDC
Input Voltage Range (Tolerance)	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	30W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Efficiency	85%
Under Input Voltage Lock-out	<9VDC
Heat Dissipation	3.2 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



WARNING: No External AC power supply needed on this unit. The two terminals marked "NC" are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!

BX-DM1E-36ED13-D Wiring, Continued

Discrete Input Specifications

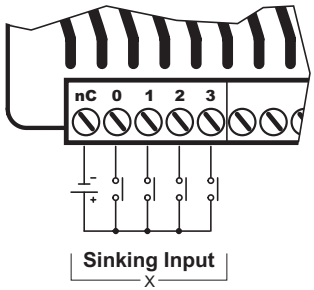
Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		20	
Commons		5 (4 points/common) Isolated	
Nominal Voltage Rating		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz [2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed	Standard [1]
Location		X0...X9	X10...X19
OFF to ON Response	DC	< 2µs	2ms
	AC	—	10ms [2]
ON to OFF Response	DC	< 2µs	2ms
	AC	—	10ms [2]

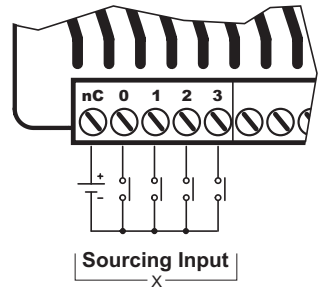
1. All inputs may be used as standard inputs. Only the first 10 inputs (X0...X9) are capable of high speed DC operation.

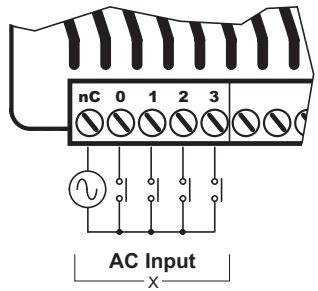
2. 240Hz filter must be set in software for AC operation.

BX-DM1E-36ED13-D Wiring, Continued

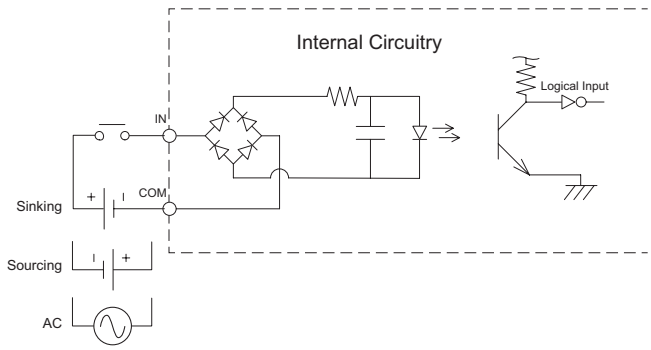
Discrete Input Connection Options







Discrete Input Internal Circuitry *



9-30 VDC/VAC ***Same for both Standard and High Speed***

BX-DM1E-36ED13-D Wiring, Continued

Discrete Output Specifications

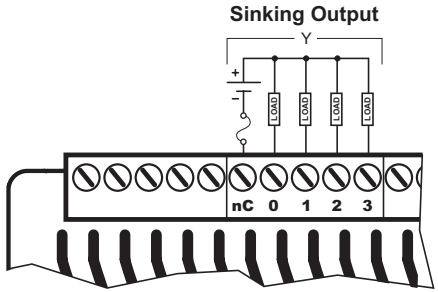
Discrete Output Specifications		
Output Type	Sinking	
Total Outputs per Module	16	
Commons	4 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Rating	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard [1]
Location	Y0...Y7	Y8...Y15
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	143Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level [2]	Between 4A and 8A	N/A
Fusing	External fusing recommended	

1. All outputs may be used as standard outputs. Only the first 8 outputs (Y0...Y7) are capable of high speed DC operation.

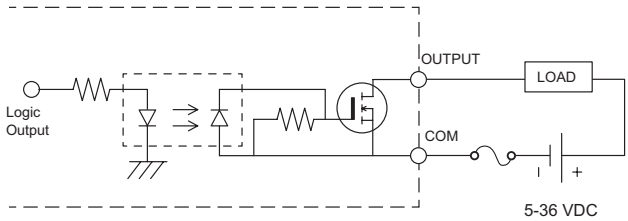
2. When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.

BX-DM1E-36ED13-D Wiring, Continued

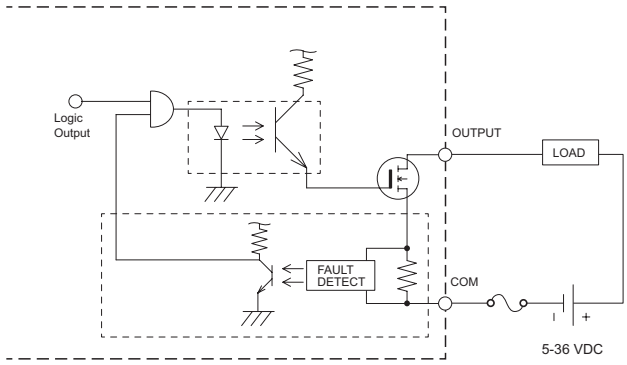
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

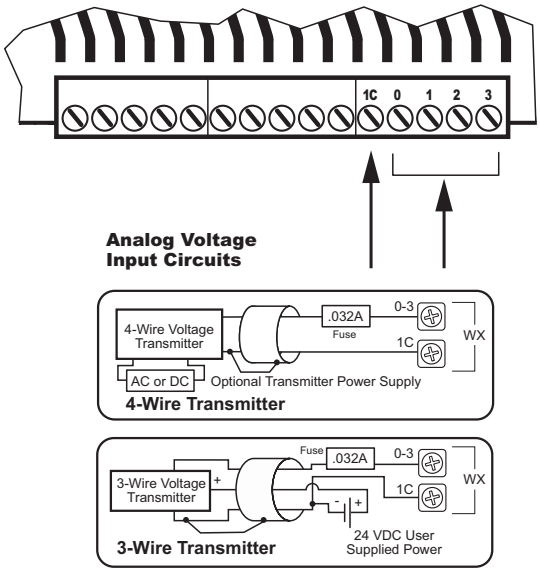
BX-DM1E-36ED13-D Wiring, Continued

Analog Input Specifications

Analog Input Specifications	
Inputs per Module	4
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	1.2 ms
Input Impedance Voltage Modes	220kΩ
Input Impedance Current Modes	249Ω
Input Stability	0.02% of Full Hardware Range
Full Scale Calibration Error	0.05% of Full Hardware Range
Offset Calibration Error	0.01% of Full Hardware Range
Accuracy vs Temperature Error	0.05% of Full Hardware Range
Fusing	External fusing recommended

* Software selectable per channel.

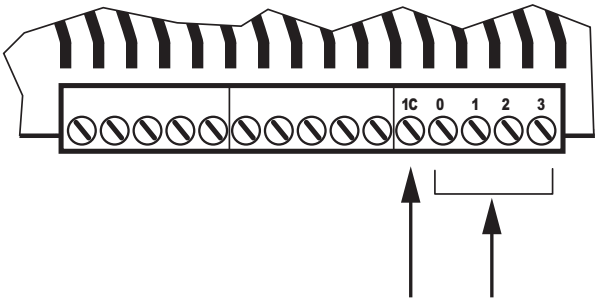
Analog Input Voltage Connection Options



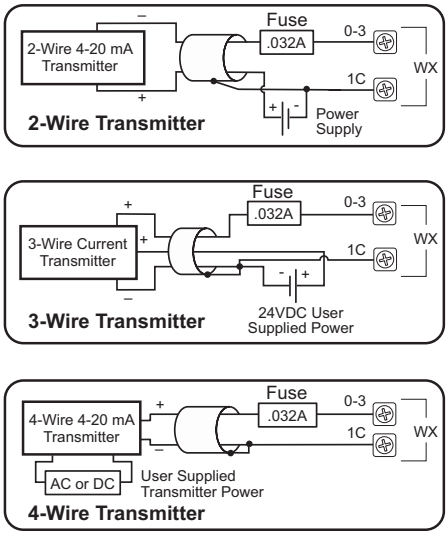
NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-36ED13-D Wiring, Continued

Analog Input Current Sinking Connection Options



Analog Current Sinking Input Circuits



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

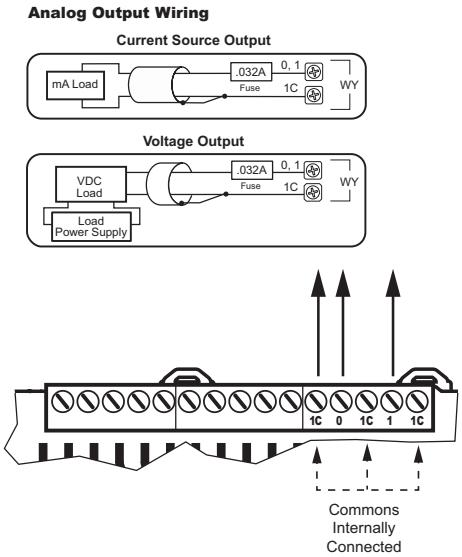
BX-DM1E-36ED13-D Wiring, Continued

Analog Output Specifications

Analog Output Specifications	
Outputs per Module	2
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Minimum Voltage Load Impedance	1kΩ
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Maximum Current Load Impedance	500Ω
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	< 1ms
Output Stability	0.02% of Full Hardware Range
Full Scale Calibration Error	0.05% of Full Hardware Range
Offset Calibration Error	0.01% of Full Hardware Range
Accuracy vs Temperature Error	0.05% of Full Hardware Range
Fusing	External fusing recommended

* Software selectable per channel.

Analog Output Connection Options



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-36ED23 Wiring

This MPU is made up of 36 discrete I/O points. The connections are grouped as follows:

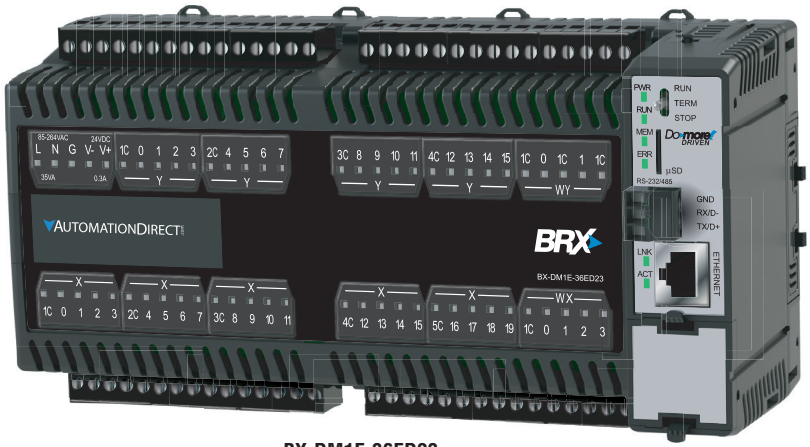
20 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in five (5) groups of 5 terminals, each comprised of 4 inputs and an isolated common.

16 discrete outputs, sourcing, rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in four (4) groups of 5 terminals, each comprised of 4 outputs and an isolated common.

4 analog inputs and 2 analog outputs. The analog inputs are located along the bottom of the unit to the right of the discrete inputs. The analog inputs are grouped together on 5 terminals consisting of 4 input and a shared analog input common. The analog outputs are located along the top of the unit to the right of the discrete outputs. The analog outputs are grouped together on 5 terminals consisting of 2 outputs and 3 shared analog output common terminals.

- current or voltage selectable through software
- 16-bit resolution @ ±10V, ±20mA
- current signal ranges of 4–20 mA, ±20mA
- voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5VDC, ±10VDC

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.



BX-DM1E-36ED23

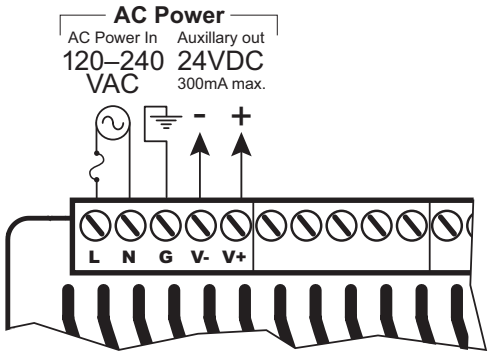
NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity.*

BX-DM1E-36ED23 Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Rating	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Efficiency	80%
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	8W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



WARNING: **Do not exceed the 24VDC auxiliary power supply load limit of 300mA.**

BX-DM1E-36ED23 Wiring, Continued

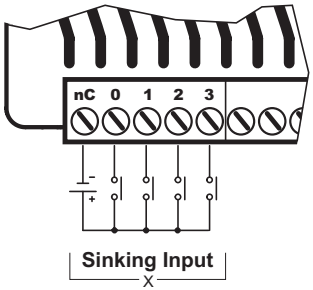
Discrete Input Specifications

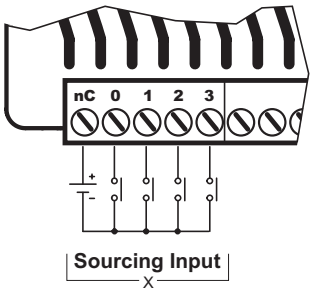
Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		20	
Commons		5 (4 points/common) Isolated	
Nominal Voltage Rating		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz [2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed	Standard [1]
Location		X0...X9	X10...X19
OFF to ON Response	DC	< 2µs	2ms
	AC	—	10ms[2]
ON to OFF Response	DC	< 2µs	2ms
	AC	—	10ms[2]

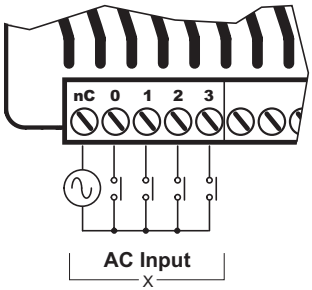
1. All inputs may be used as standard inputs. Only the first 10 inputs (X0...X9) are capable of high speed DC operation.

2. 240Hz filter must be set in software for AC operation.

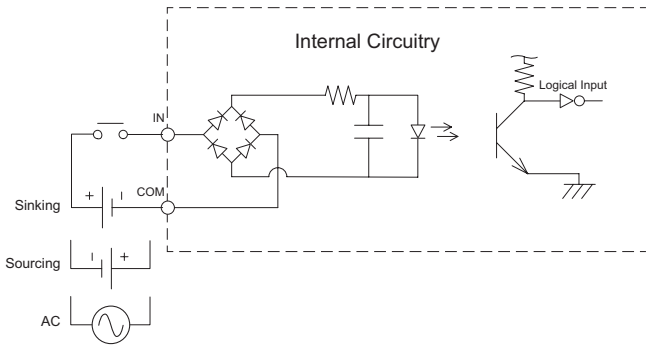
Discrete Input Connection Options







Discrete Input Internal Circuitry *



Same for both Standard and High Speed

BX-DM1E-36ED23 Wiring, Continued

Discrete Output Specifications

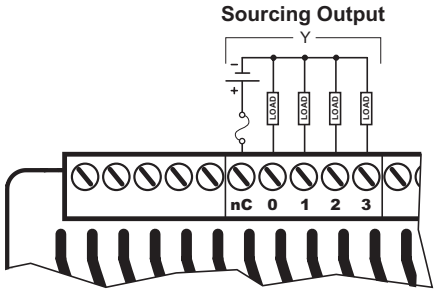
Discrete Output Specifications		
Output Type	Sourcing	
Total Outputs per Module	16	
Commons	4 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Rating	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard [1]
Location	Y0...Y7	Y8...Y15
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	143Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level [2]	Between 4A and 8A	N/A
Fusing	External fusing recommended	

1. All outputs may be used as standard outputs. Only the first 8 outputs (Y0...Y7) are capable of high speed DC operation.

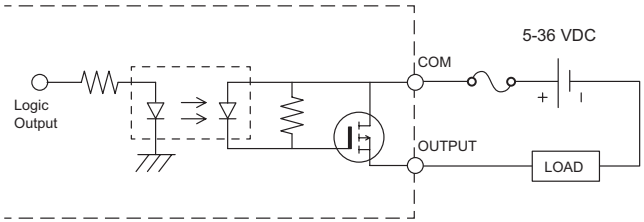
2. When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.

BX-DM1E-36ED23 Wiring, Continued

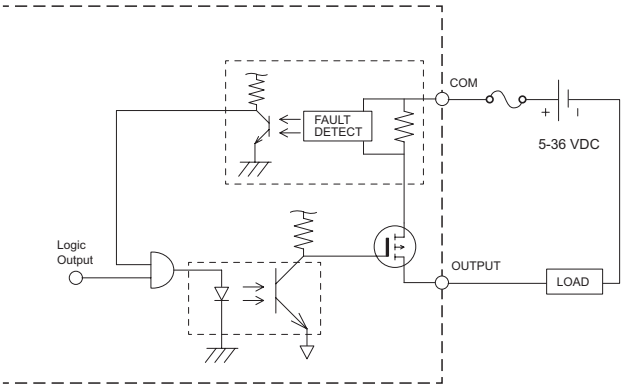
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

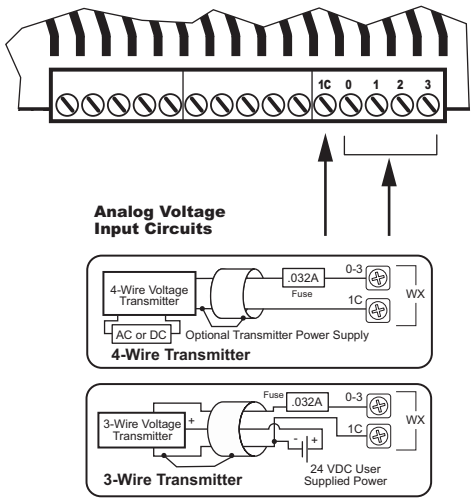
BX-DM1E-36ED23 Wiring, Continued

Analog Input Specifications

Analog Input Specifications	
Inputs per Module	4
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	1.2 ms
Input Impedance Voltage Modes	220kΩ
Input Impedance Current Modes	249Ω
Input Stability	0.02% of Full Hardware Range
Full Scale Calibration Error	0.05% of Full Hardware Range
Offset Calibration Error	0.01% of Full Hardware Range
Accuracy vs Temperature Error	0.05% of Full Hardware Range
Fusing	External fusing recommended

* Software selectable per channel.

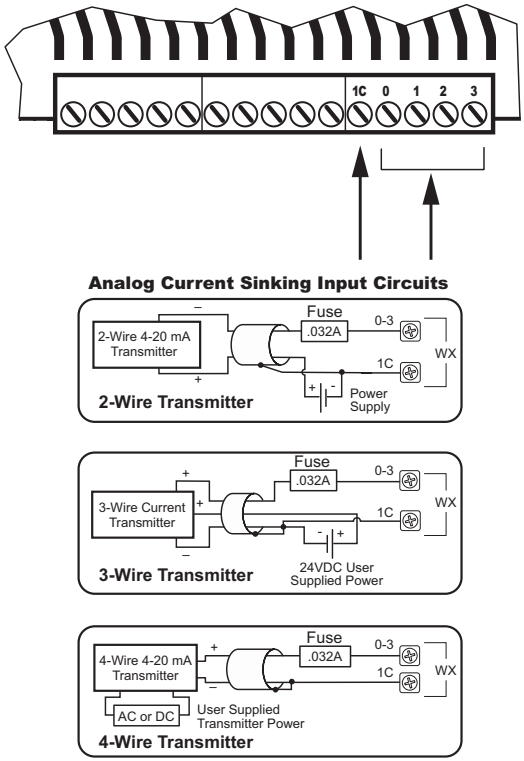
Analog Input Voltage Connection Options



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-36ED23 Wiring, Continued

Analog Input Current Sinking Connection Options



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

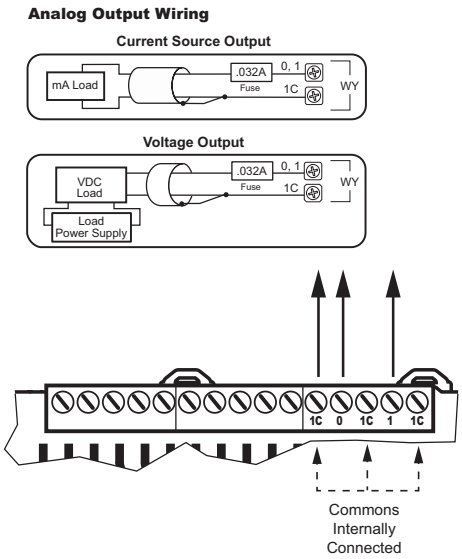
BX-DM1E-36ED23 Wiring, Continued

Analog Output Specifications

Analog Output Specifications	
Outputs per Module	2
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Minimum Voltage Load Impedance	1kΩ
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Maximum Current Load Impedance	500Ω
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	< 1ms
Output Stability	0.02% of Full Hardware Range
Full Scale Calibration Error	0.05% of Full Hardware Range
Offset Calibration Error	0.01% of Full Hardware Range
Accuracy vs Temperature Error	0.05% of Full Hardware Range
Fusing	External fusing recommended

* Software selectable per channel.

Analog Output Connection Options



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-36ED23-D Wiring

This MPU is made up of 36 discrete I/O points. The connections are grouped as follows:

20 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in five (5) groups of 5 terminals, each comprised of 4 inputs and an isolated common.

16 discrete outputs, sourcing, rated at 12–24 VDC. They are located along the top of the unit starting to the right of the 24VDC external power supply terminals. The outputs are configured in four (4) groups of 5 terminals, each comprised of 4 outputs and an isolated common.

4 analog inputs and 2 analog outputs. The analog inputs are located along the bottom of the unit to the right of the discrete inputs. The analog inputs are grouped together on 5 terminals consisting of 4 input and a shared analog input common. The analog outputs are located along the top of the unit to the right of the discrete outputs. The analog outputs are grouped together on 5 terminals consisting of 2 outputs and 3 shared analog output common terminals.

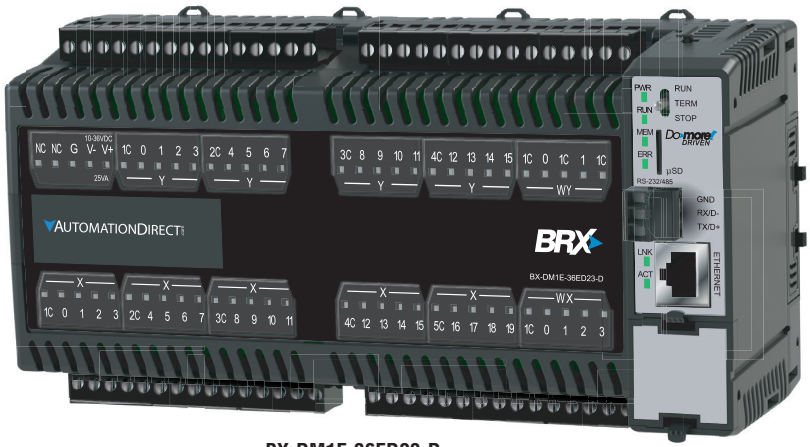
current or voltage selectable through software

16-bit resolution @ ±10V, ±20mA

current signal ranges of 4–20 mA, ±20mA

voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5VDC, ±10VDC

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply



BX-DM1E-36ED23-D

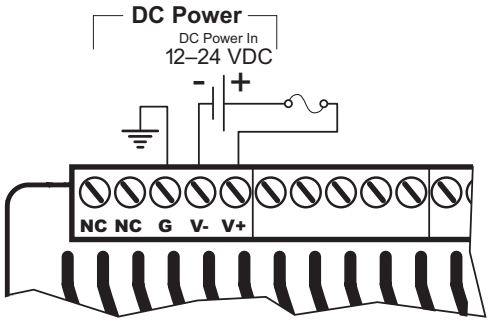
NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity.*

BX-DM1E-36ED23-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range	12–24 VDC
Input Voltage Range (Tolerance)	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	30W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Efficiency	85%
Under Input Voltage Lock-out	<9VDC
Heat Dissipation	3.2 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



WARNING: No External AC power supply needed on this unit. The two terminals marked "NC" are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!

BX-DM1E-36ED23-D Wiring, Continued

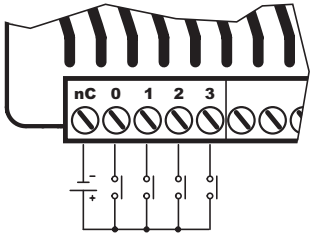
Discrete Input Specifications

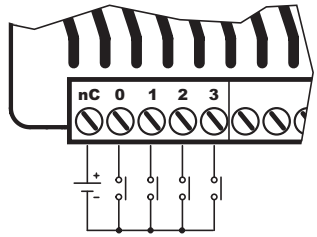
Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		20	
Commons		5 (4 points/common) Isolated	
Nominal Voltage Rating		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz [2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed	Standard [1]
Location		X0...X9	X10...X19
OFF to ON Response	DC	< 2µs	2ms
	AC	—	10ms[2]
ON to OFF Response	DC	< 2µs	2ms
	AC	—	10ms[2]

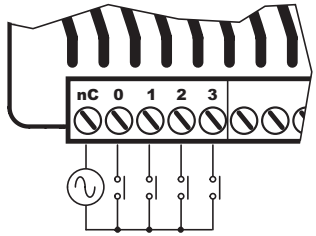
1. All inputs may be used as standard inputs. Only the first 10 inputs (X0...X9) are capable of high speed DC operation.
2. 240Hz filter must be set in software for AC operation.

BX-DM1E-36ED23-D Wiring, Continued

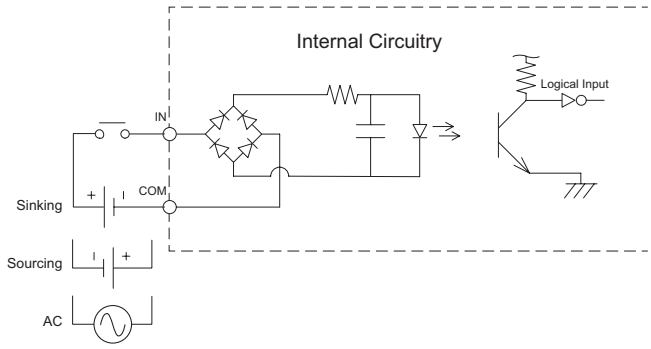
Discrete Input Connection Options







Discrete Input Internal Circuitry



** Same for both Standard and High Speed*

BX-DM1E-36ED23-D Wiring, Continued

Discrete Output Specifications

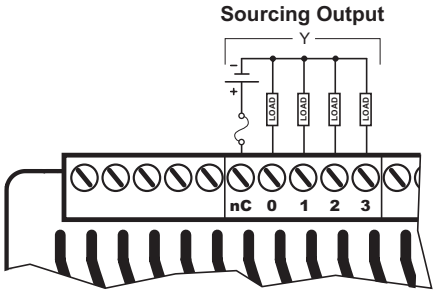
Discrete Output Specifications		
Output Type	Sourcing	
Total Outputs per Module	16	
Commons	4 (4 points/common) Isolated	
Maximum Current per Common	2A	
Nominal Voltage Rating	12–24 VDC	
Operating Voltage Range	5–36 VDC	
Maximum Voltage	36VDC	
Minimum Output Current	0.1 mA @ 24VDC	
Maximum Output Current	0.5 A per output No derating over temperature range	
Maximum Inrush Current	5A for 50ms	
Maximum Leakage Current	10µA	
ON Voltage Drop	0.05 VDC	
Status Indicators	Logic Side, Green	
Output Details		
Output Type	High-Speed	Standard [1]
Location	Y0...Y7	Y8...Y15
OFF to ON Response	< 2µs	< 5ms
ON to OFF Response	< 2µs	< 2ms
Maximum Switching Frequency	1m cable - 250kHz 10m cable - 100kHz	143Hz
Overcurrent, Short Circuit Protection and Short to Ground	Current limit by Common Group, self-resetting	N/A
Overcurrent Trip Level [2]	Between 4A and 8A	N/A
Fusing	External fusing recommended	

1. All outputs may be used as standard outputs. Only the first 8 outputs (Y0...Y7) are capable of high speed DC operation.

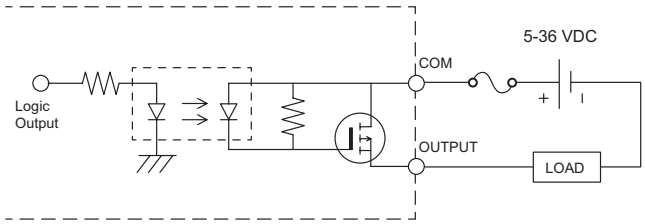
2. When the high-speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.

BX-DM1E-36ED23-D Wiring, Continued

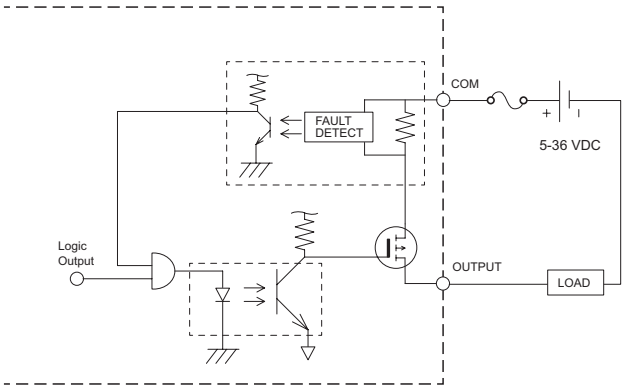
Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



Discrete High-Speed Output Internal Circuitry



NOTE: *When the high speed outputs are in an overcurrent situation, the Common terminal Red LED is on. The output LED's will remain operational even though the output circuitry is turned off and no power is flowing. This condition is not reported to the CPU.*

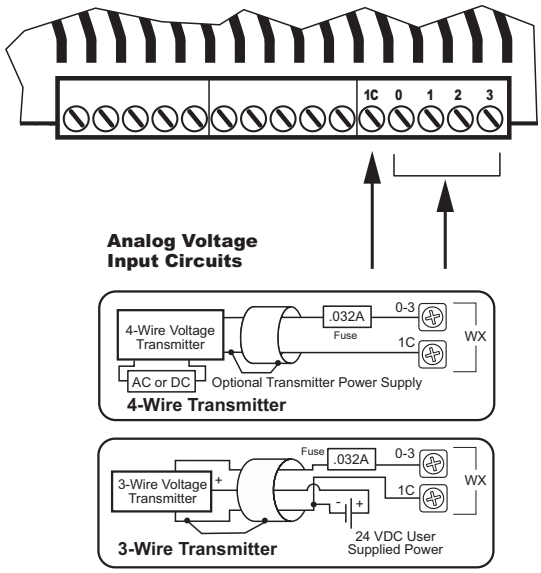
BX-DM1E-36ED23-D Wiring, Continued

Analog Input Specifications

Analog Input Specifications	
Inputs per Module	4
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	1.2 ms
Input Impedance Voltage Modes	220kΩ
Input Impedance Current Modes	249Ω
Input Stability	0.02% of Full Hardware Range
Full Scale Calibration Error	0.05% of Full Hardware Range
Offset Calibration Error	0.01% of Full Hardware Range
Accuracy vs Temperature Error	0.05% of Full Hardware Range
Fusing	External fusing recommended

* Software selectable per channel.

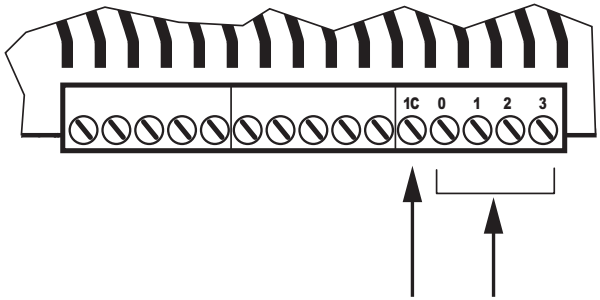
Analog Input Voltage Connection Options



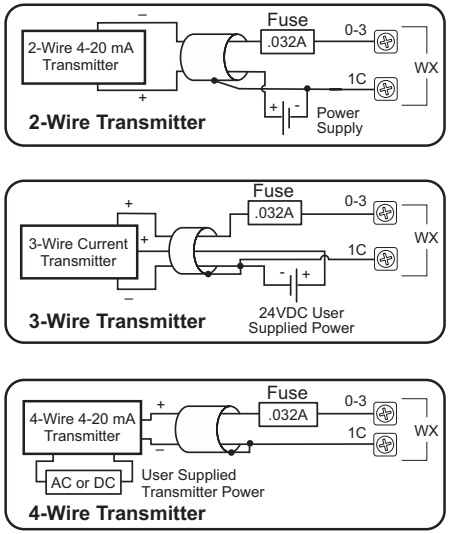
NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-36ED23-D Wiring, Continued

Analog Input Current Sinking Connection Options



Analog Current Sinking Input Circuits



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

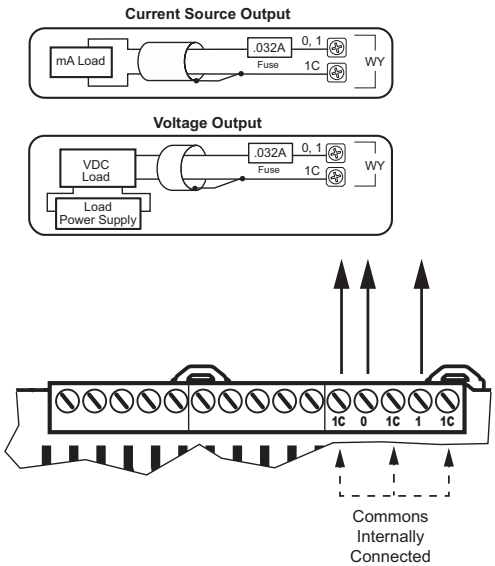
BX-DM1E-36ED23-D Wiring, Continued

Analog Output Specifications

Analog Output Specifications	
Outputs per Module	2
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Minimum Voltage Load Impedance	1kΩ
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Maximum Current Load Impedance	500Ω
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	< 1ms
Output Stability	0.02% of Full Hardware Range
Full Scale Calibration Error	0.05% of Full Hardware Range
Offset Calibration Error	0.01% of Full Hardware Range
Accuracy vs Temperature Error	0.05% of Full Hardware Range
Fusing	External fusing recommended

* Software selectable per channel.

Analog Output Connection Options



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-36ER3 Wiring

This MPU is made up of 36 discrete I/O points. The connections are grouped as follows:

20 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in five (5) groups of 5 terminals, each comprised of 4 inputs and an isolated common.

16 discrete outputs - Form A Relay (SPST); rated 5–48 VDC/ 24–240 VAC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in four (4) groups of 5 terminals, each comprised of 4 outputs and an isolated common.

4 analog inputs and 2 analog outputs. The analog inputs are located along the bottom of the unit to the right of the discrete inputs. The analog inputs are grouped together on 5 terminals consisting of 4 input and a shared analog input common. The analog outputs are located along the top of the unit to the right of the discrete outputs. The analog outputs are grouped together on 5 terminals consisting of 2 outputs and 3 shared analog output common terminals.

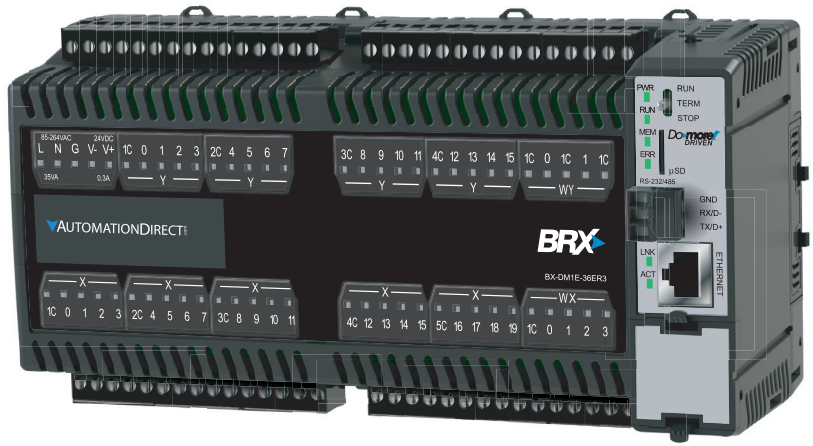
current or voltage selectable through software

16-bit resolution @ ±10V, ±20mA

current signal ranges of 4–20 mA, ±20mA

voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5VDC, ±10VDC

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.



BX-DM1E-36ER3

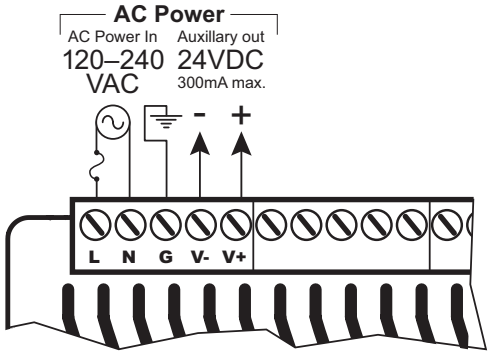
NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity.*

BX-DM1E-36ER3 Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Rating	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Efficiency	80%
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	8W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



WARNING: **Do not exceed the 24VDC auxiliary power supply load limit of 300mA.**

BX-DM1E-36ER3 Wiring, Continued

Discrete Input Specifications

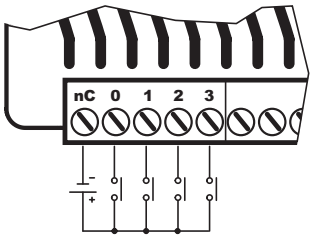
Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		20	
Commons		5 (4 points/common) Isolated	
Nominal Voltage Rating		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz [2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed	Standard [1]
Location		X0...X9	X10...X19
OFF to ON Response	DC	< 2µs	2ms
	AC	—	10ms [2]
ON to OFF Response	DC	< 2µs	2ms
	AC	—	10ms [2]

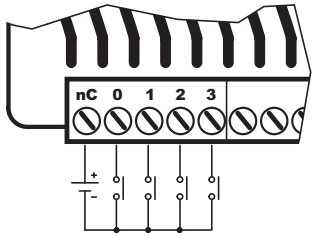
1. All inputs may be used as standard inputs. Only the first 10 inputs (X0...X9) are capable of high speed DC operation.

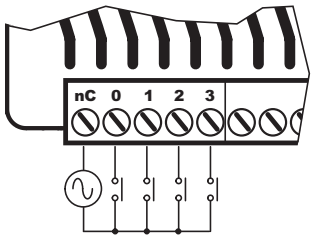
2. 240Hz filter must be set in software for AC operation.

BX-DM1E-36ER3 Wiring, Continued

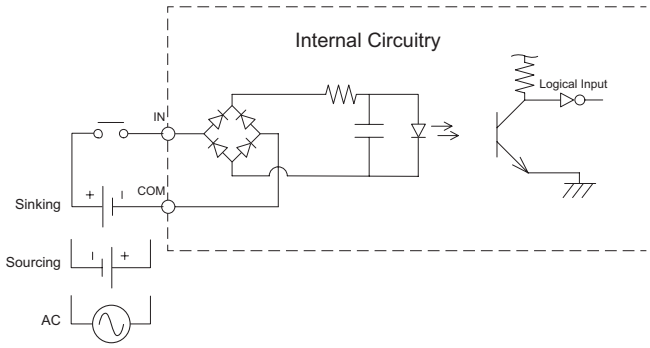
Discrete Input Connection Options







Discrete Input Internal Circuitry *



9-30 VDC/VAC ***Same for both Standard and High Speed***

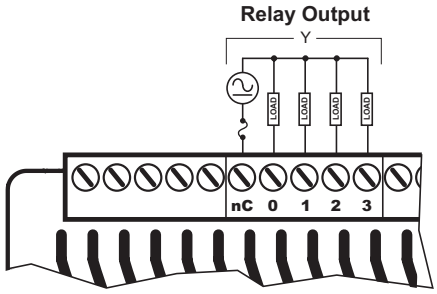
BX-DM1E-36ER3 Wiring, Continued

Discrete Output Specifications

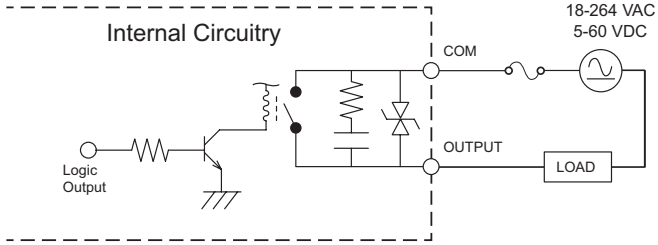
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	16
Commons	4 (4 points/common) Isolated
Maximum Current per Common	8A
Nominal Voltage Rating	5–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC 18–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA (DC) 300µA (AC) due to RC Snubber Circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y15
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fusing	External fusing recommended

BX-DM1E-36ER3 Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry



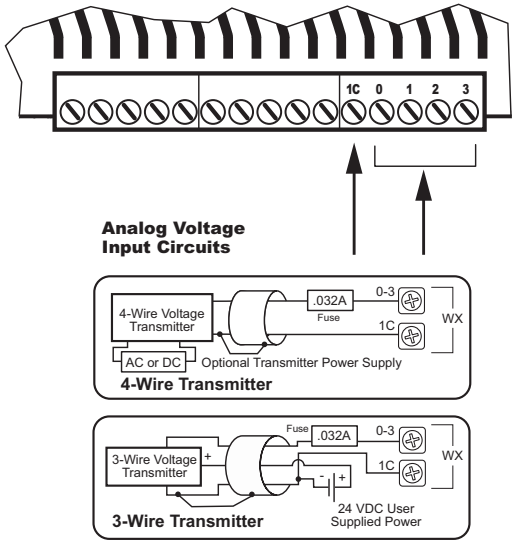
BX-DM1E-36ER3 Wiring, Continued

Analog Input Specifications

Analog Input Specifications	
Inputs per Module	4
Input Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range *	Software Selectable ±20mA, 4–20 mA
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	1.2 ms
Input Impedance Voltage Modes	220kΩ
Input Impedance Current Modes	249Ω
Input Stability	0.02% of Full Hardware Range
Full Scale Calibration Error	0.05% of Full Hardware Range
Offset Calibration Error	0.01% of Full Hardware Range
Accuracy vs Temperature Error	0.05% of Full Hardware Range
Fusing	External fusing recommended

* Software selectable per channel.

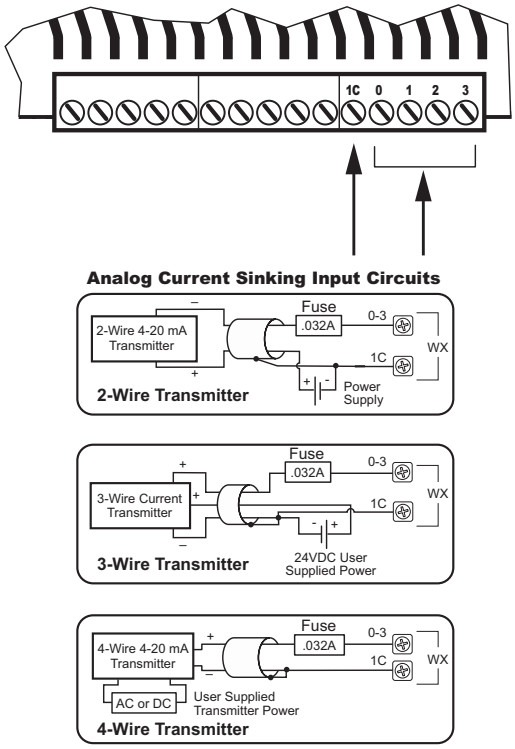
Analog Input Voltage Connection Options



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-36ER3 Wiring, Continued

Analog Input Current Sinking Connection Options



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-36ER3 Wiring, Continued

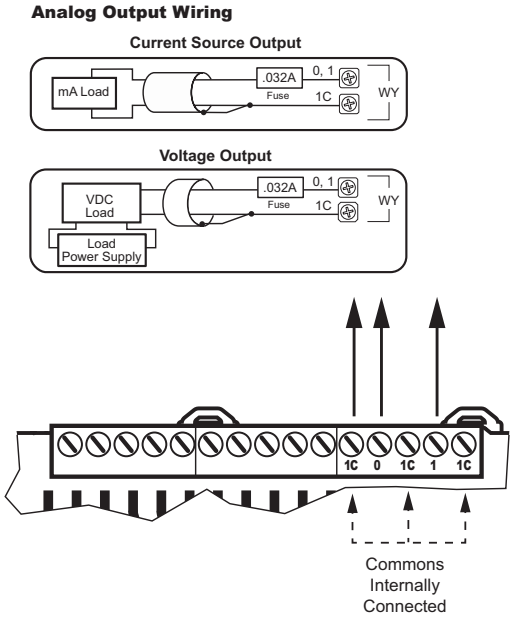
Analog Output Specifications

Analog Output Specifications	
Outputs per Module	2
Output Voltage Range *	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Minimum Voltage Load Impedance	1kΩ
Output Current Range *	Software Selectable ±20mA, 4–20 mA
Maximum Current Load Impedance	500Ω
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	< 1ms
Output Stability	0.02% of Full Hardware Range
Full Scale Calibration Error	0.05% of Full Hardware Range
Offset Calibration Error	0.01% of Full Hardware Range
Accuracy vs Temperature Error	0.05% of Full Hardware Range
Fusing	External fusing recommended

* Software selectable per channel.

Analog Output Connection Options

Analog Output Wiring



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-36ER3-D Wiring

This MPU is made up of 36 discrete I/O points. The connections are grouped as follows:

20 discrete inputs - sinking/sourcing; rated for 12–24 VAC/VDC. They are located along the bottom of the unit; configured in five (5) groups of 5 terminals, each comprised of 4 inputs and an isolated common.

16 discrete outputs - Form A Relay (SPST); rated 5–48 VDC/ 24–240 VAC. They are located along the top of the unit starting to the right of the 24VDC external power supply terminals. The outputs are configured in four (4) groups of 5 terminals, each comprised of 4 outputs and an isolated common.

4 analog inputs and 2 analog outputs. The analog inputs are located along the bottom of the unit to the right of the discrete inputs. The analog inputs are grouped together on 5 terminals consisting of 4 input and a shared analog input common. The analog outputs are located along the top of the unit to the right of the discrete outputs. The analog outputs are grouped together on 5 terminals consisting of 2 outputs and 3 shared analog output common terminals.

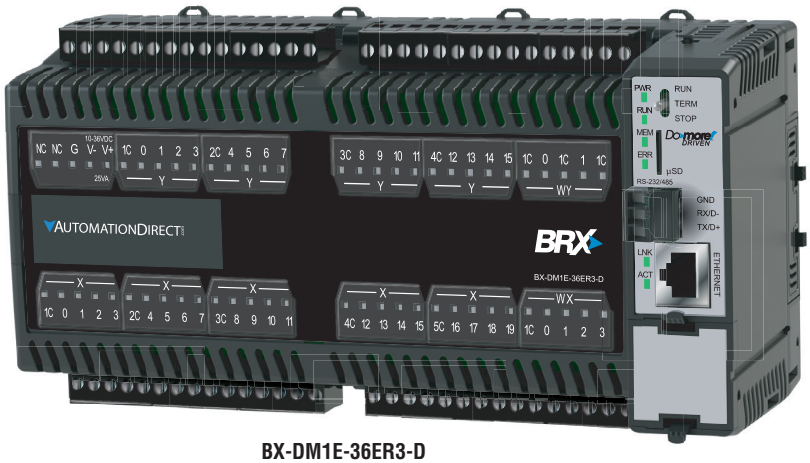
current or voltage selectable through software

16-bit resolution @ ±10V, ±20mA

current signal ranges of 4–20 mA, ±20mA

voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5VDC, ±10VDC

This MPU requires an external 12–24 VDC power supply. The DC power supply connection is located on the top left side of the unit. There is no 24VDC auxiliary output supply.



BX-DM1E-36ER3-D

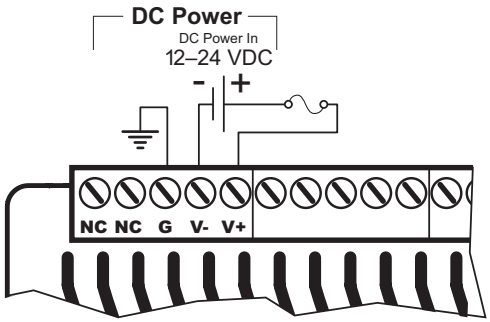
NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity.*

BX-DM1E-36ER3-D Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Range	12–24 VDC
Input Voltage Range (Tolerance)	10–36 VDC
Maximum Input Voltage Ripple	< ±10%
Maximum Input Power	30W
Cold Start Inrush Current	5A, 2ms
Maximum Inrush Current (Hot Start)	5A, 2ms
Internal Input Protection	Reverse polarity protection and undervoltage lockout via transistor circuit
Acceptable External Power Drop Time	10ms
Efficiency	85%
Under Input Voltage Lock-out	<9VDC
Heat Dissipation	3.2 W Max
Isolated User 24VDC Output	None
Voltage Withstand (dielectric)	1500VAC power Inputs to ground applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



WARNING: No External AC power supply needed on this unit. The two terminals marked "NC" are not used. These terminals are not internally connected. DO NOT CONNECT ANYTHING TO THESE TERMINALS!

BX-DM1E-36ER3-D Wiring, Continued

Discrete Input Specifications

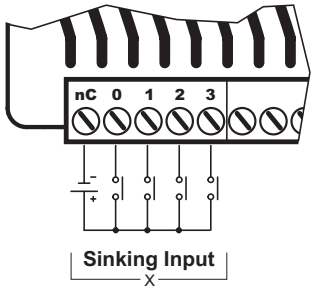
Discrete Input Specifications			
Input Type		Sink/Source	
Total Inputs per Module		20	
Commons		5 (4 points/common) Isolated	
Nominal Voltage Rating		12–24 VAC/VDC	
Input Voltage Range		9–30 VAC/VDC	
Maximum Voltage		30 VAC/VDC	
DC Frequency		0–250 kHz - High-speed	
Minimum Pulse Width		0.5 µs - High-speed	
AC Frequency		47–63 Hz[2]	
Input Impedance		3kΩ @ 24VDC	
Input Current (typical)		6mA @ 24 VAC/VDC	
Maximum Input Current		12mA @ 30 VAC/VDC	
ON Voltage Level		> 9.0 VAC/VDC	
OFF Voltage Level		< 2.0 VAC/VDC	
Maximum OFF Current		1.5 mA	
Status Indicators		Logic Side, Green	
Input Details			
Input Type		High-Speed	Standard[1]
Location		X0...X9	X10...X19
OFF to ON Response	DC	< 2µs	2ms
	AC	—	10ms[2]
ON to OFF Response	DC	< 2µs	2ms
	AC	—	10ms[2]

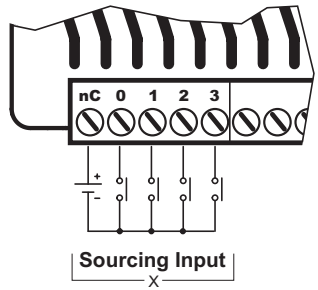
1. All inputs may be used as standard inputs. Only the first 10 inputs (X0...X9) are capable of high speed DC operation.

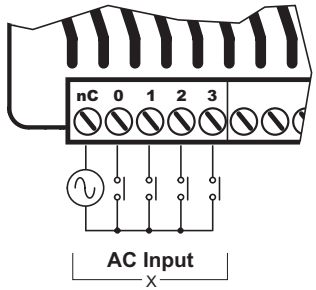
2. 240Hz filter must be set in software for AC operation.

BX-DM1E-36ER3-D Wiring, Continued

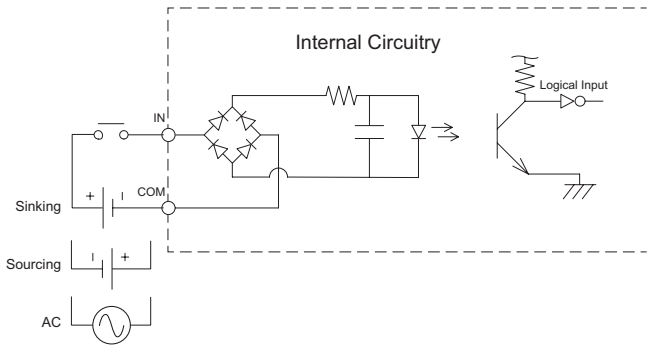
Discrete Input Connection Options







Discrete Input Internal Circuitry *



** Same for both Standard and High Speed*

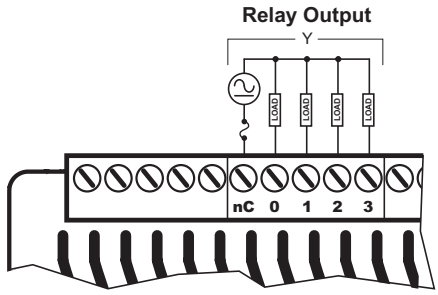
BX-DM1E-36ER3-D Wiring, Continued

Discrete Output Specifications

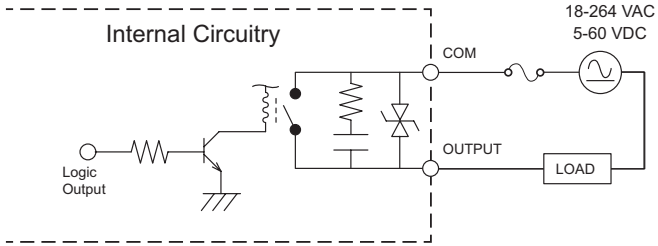
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	16
Commons	4 (4 points/common) Isolated
Maximum Current per Common	8A
Nominal Voltage Rating	5–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC 18–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA (DC) 300µA (AC) due to RC Snubber Circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y15
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fusing	External fusing recommended

BX-DM1E-36ER3-D Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry

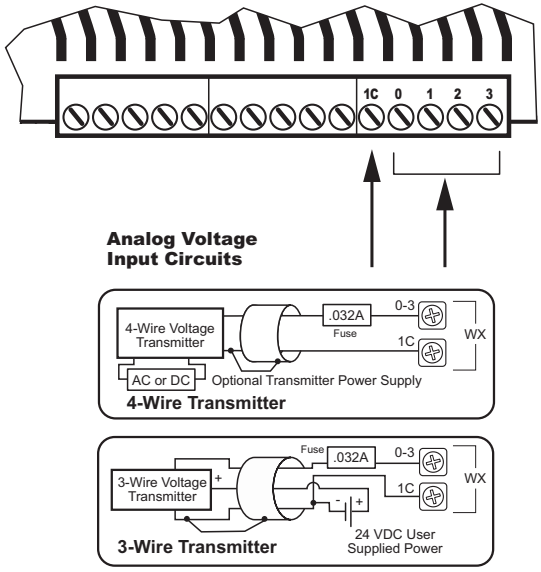


BX-DM1E-36ER3-D Wiring, Continued

Analog Input Specifications

Analog Input Specifications	
Inputs per Module	4
Input Voltage Range	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range	Software Selectable ±20mA, 4–20 mA
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	1.2 ms
Input Impedance Voltage Modes	220kΩ
Input Impedance Current Modes	249Ω
Input Stability	0.02% of Full Hardware Range
Full Scale Calibration Error	0.05% of Full Hardware Range
Offset Calibration Error	0.01% of Full Hardware Range
Accuracy vs Temperature Error	0.05% of Full Hardware Range
Fusing	External fusing recommended

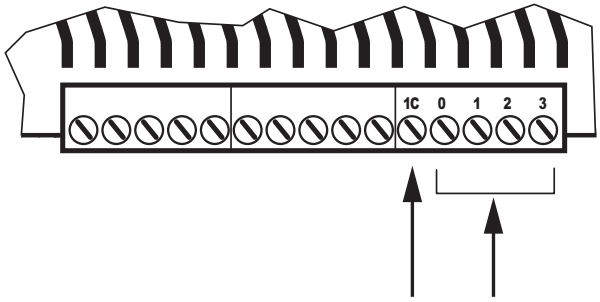
Analog Input Voltage Connection Options



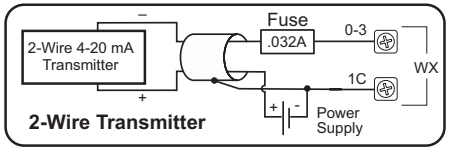
NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

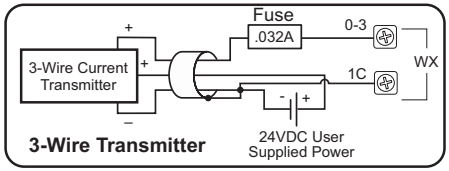
BX-DM1E-36ER3-D Wiring, Continued

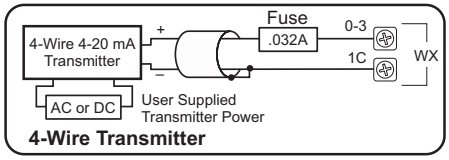
Analog Input Current Sinking Connection Options



Analog Current Sinking Input Circuits







NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

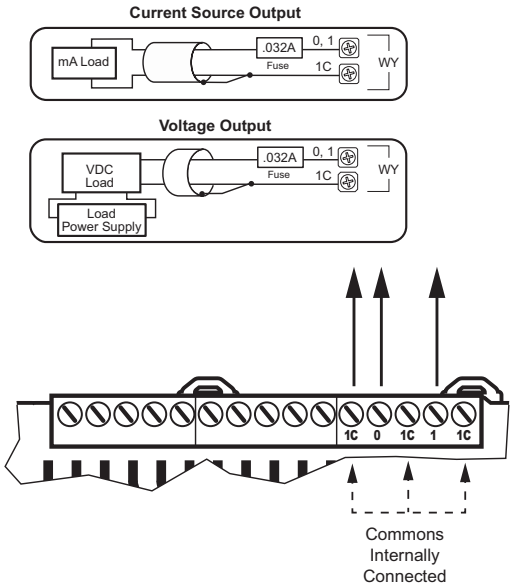
BX-DM1E-36ER3-D Wiring, Continued

Analog Output Specifications

Analog Output Specifications	
Outputs per Module	2
Output Voltage Range	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Minimum Voltage Load Impedance	1kΩ
Output Current Range	Software Selectable ±20mA, 4–20 mA
Maximum Current Load Impedance	500Ω
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	< 1ms
Output Stability	0.02% of Full Hardware Range
Full Scale Calibration Error	0.05% of Full Hardware Range
Offset Calibration Error	0.01% of Full Hardware Range
Accuracy vs Temperature Error	0.05% of Full Hardware Range
Fusing	External fusing recommended

Analog Output Connection Options

Analog Output Wiring



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-36AR3 Wiring

This MPU is made up of 36 discrete I/O points. The connections are grouped as follows:

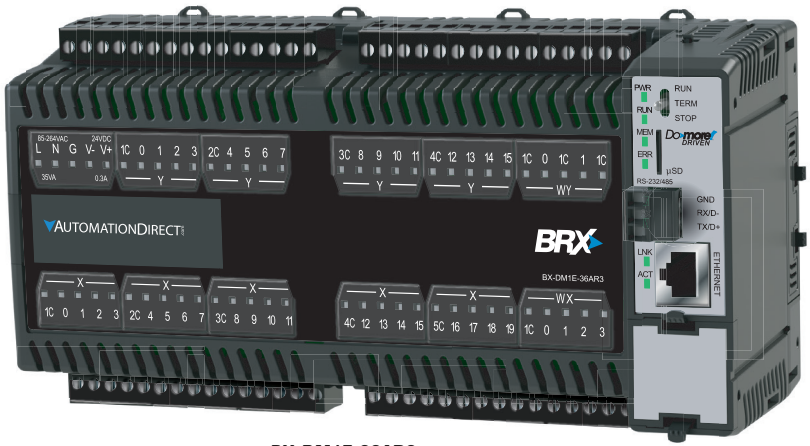
20 discrete inputs - AC rated for 120–240 VAC. They are located along the bottom of the unit; configured in five (5) groups of 5 terminals, each comprised of 4 inputs and an isolated common.

16 discrete outputs - Form A Relay (SPST); rated 5–48 VDC/ 24–240 VAC. They are located along the top of the unit starting to the right of the 24VDC auxiliary output terminals. The outputs are configured in four (4) groups of 5 terminals, each comprised of 4 outputs and an isolated common.

4 analog inputs and 2 analog outputs. The analog inputs are located along the bottom of the unit to the right of the discrete inputs. The analog inputs are grouped together on 5 terminals consisting of 4 input and a shared analog input common. The analog outputs are located along the top of the unit to the right of the discrete outputs. The analog outputs are grouped together on 5 terminals consisting of 2 outputs and 3 shared analog output common terminals.

- current or voltage selectable through software
- 16-bit resolution @ ±10V, ±20mA
- current signal ranges of 4–20 mA, ±20mA
- voltage signal ranges of 0–5 VDC, 0–10 VDC, ±5VDC, ±10VDC

This MPU requires an external 120–240 VAC power supply. The AC power supply connection and the 24VDC auxiliary output supply terminals are located on the top left side of the unit.



BX-DM1E-36AR3

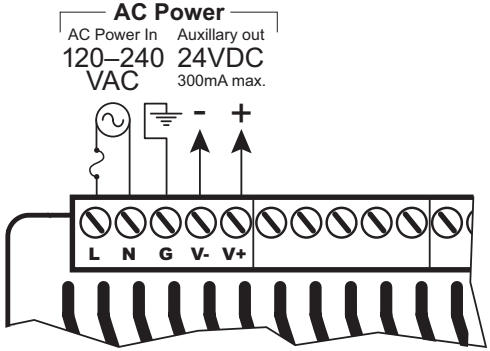
NOTE: *Eight (8) Expansion Modules can be connected to extend I/O capacity.*

BX-DM1E-36AR3 Wiring, Continued

Power Supply Specifications

Power Supply Specifications	
Nominal Voltage Rating	120–240 VAC
Input Voltage Range (Tolerance)	85–264 VAC
Rated Operating Frequency	47–63 Hz
Maximum Input Power	40VA
Cold Start Inrush Current	1.5 A, 2ms
Maximum Inrush Current (Hot Start)	1.5 A, 2ms
Internal Input Fuse Protection	Micro fuse 250V, 2A Non-replaceable
Acceptable External Power Drop Time	10ms
Efficiency	80%
Under Input Voltage Lock-out	80VAC
Input Transient Protection	Input choke and line filter
Heat Dissipation	8W Max
Isolated User 24VDC Output	24VDC @ 0.3 A max, <1V P-P Ripple, Integrated self-resetting short circuit protection
Voltage Withstand (dielectric)	1500VAC Power Inputs to Ground applied for 1 minute 1500VAC Ground to 24VDC Output applied for 1 minute
Insulation Resistance	>10MΩ @ 500VDC

Power Supply Connections



WARNING: **Do not exceed the 24VDC auxiliary power supply load limit of 300mA.**

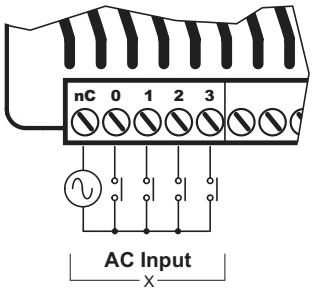
BX-DM1E-36AR3 Wiring, Continued

Discrete Input Specifications

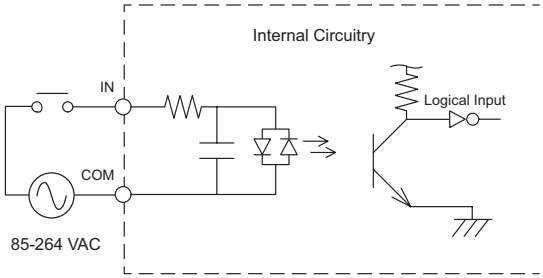
Discrete Input Specifications	
Input Type	AC
Total Inputs per Module	20
Commons	5 (4 points/common) Isolated
Nominal Voltage Rating	120–240 VAC
Input Voltage Range	85–264 VAC
Maximum Voltage	264VAC RMS
AC Frequency	47–63 Hz
Input Impedance	15kΩ
Input Current (typical)	9mA @ 120VAC, 13mA @ 220VAC
Maximum Input Current	14mA @ 120VAC, 20mA @ 220VAC
ON Voltage Level	> 85VAC
OFF Voltage Level	< 40VAC
Maximum OFF Current	2.5 mA
Status Indicators	Logic Side, Green
Input Details	
Input Type	Standard
Location	X0...X19
OFF - ON Response	10ms
ON - OFF Response	10ms

BX-DM1E-36AR3 Wiring, Continued

Discrete Input Connection Options



Discrete Input Internal Circuitry



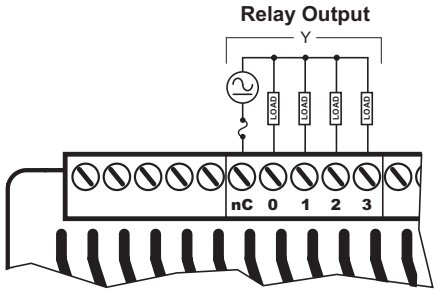
BX-DM1E-36AR3 Wiring, Continued

Discrete Output Specifications

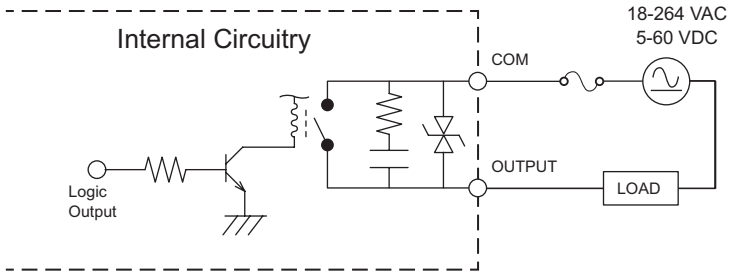
Discrete Output Specifications	
Output Type	Relay Form A (SPST)
Total Outputs per Module	16
Commons	4 (4 points/common) Isolated
Maximum Current per Common	8A
Nominal Voltage Rating	5–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC, 18–264 VAC
Maximum Voltage	60VDC 264VAC
Minimum Output Current	0.1 mA @ 24VDC 0.1 mA @ 24VAC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA (DC) 300µA (AC) due to RC Snubber Circuit
ON Voltage Drop	0.2 V Max
Status Indicators	Logic Side, Green
Output Details	
Output Type	Standard
Location	Y0...Y15
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Maximum Switching Frequency	10Hz
Relay Cycle Life Mechanical Endurance Electrical Endurance	 5 million operations 120,000 operations
Fusing	External fusing recommended

BX-DM1E-36AR3 Wiring, Continued

Discrete Output Connection Options



Discrete Standard Output Internal Circuitry

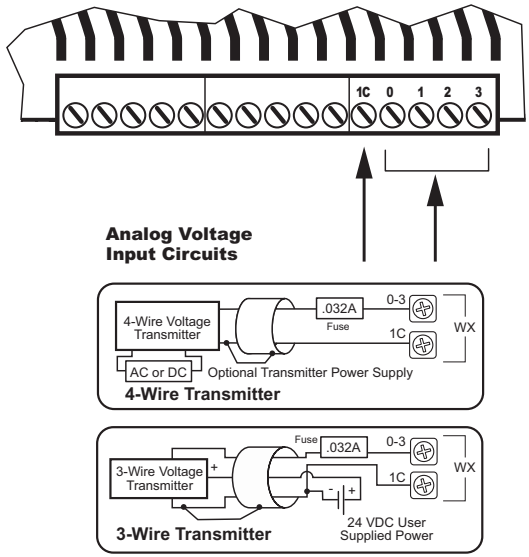


BX-DM1E-36AR3 Wiring, Continued

Analog Input Specifications

Analog Input Specifications	
Inputs per Module	4
Input Voltage Range	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Input Current Range	Software Selectable ±20mA, 4–20 mA
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	1.2 ms
Input Impedance Voltage Modes	220kΩ
Input Impedance Current Modes	249Ω
Input Stability	0.02% of Full Hardware Range
Full Scale Calibration Error	0.05% of Full Hardware Range
Offset Calibration Error	0.01% of Full Hardware Range
Accuracy vs Temperature Error	0.05% of Full Hardware Range
Fusing	External fusing recommended

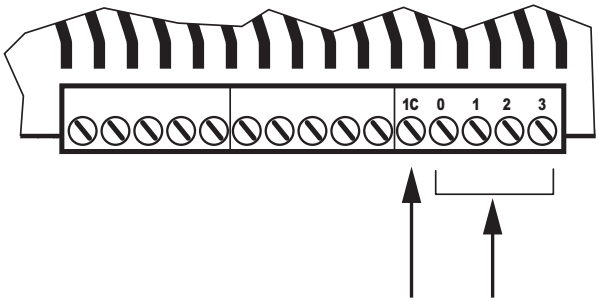
Analog Input Voltage Connection Options



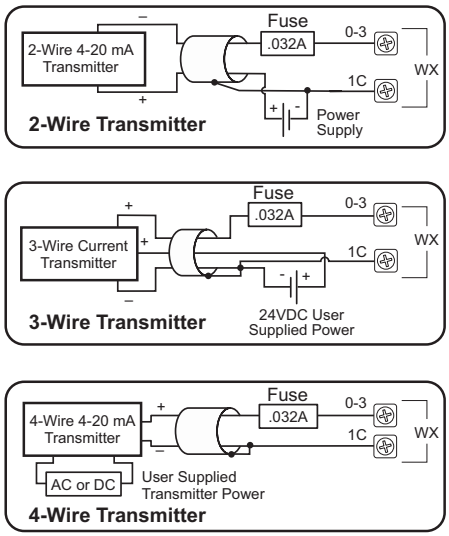
NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-36AR3 Wiring, Continued

Analog Input Current Sinking Connection Options



Analog Current Sinking Input Circuits



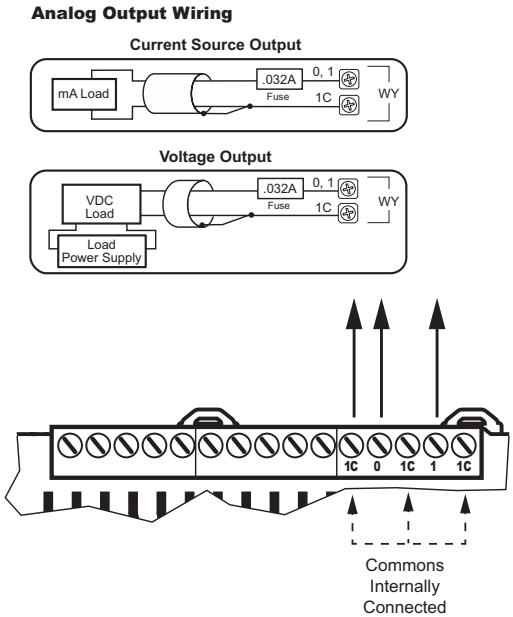
NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BX-DM1E-36AR3 Wiring, Continued

Analog Output Specifications

Analog Output Specifications	
Outputs per Module	2
Output Voltage Range	Software Selectable ±10V, ±5V, 0–10 V, 0–5 V
Minimum Voltage Load Impedance	1kΩ
Output Current Range	Software Selectable ±20mA, 4–20 mA
Maximum Current Load Impedance	500Ω
Resolution	16 bit @ ±10V, ±20mA
Conversion Time	< 1ms
Output Stability	0.02% of Full Hardware Range
Full Scale Calibration Error	0.05% of Full Hardware Range
Offset Calibration Error	0.01% of Full Hardware Range
Accuracy vs Temperature Error	0.05% of Full Hardware Range
Fusing	External fusing recommended

Analog Output Connection Options



NOTE: *An Edison S500-32-R 0.032A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.*

BRX Pluggable Option Module (POM)

In This Chapter...

Overview 6-2
General Specifications 6-2
Module Installation 6-3
BX-P-SER2-TERM 6-4
BX-P-SER4-TERM 6-6
BX-P-SER2-RJ12 6-8
BX-P-ECOMLT 6-9
BX-P-USB-B 6-10

Overview

BRX Do-more MPUs have a slot available for the addition of a single BRX Pluggable Option Module (POM). The POM slot can be used to add a serial port, Ethernet port, USB port or any other POM modules that are available.

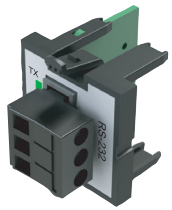
POM modules are hot swappable; this allows you to interchange different communication options while the system is running. For example you can configure the system to use the RJ45 Ethernet port POM to talk with a C-more panel. Then you can hot swap to the USB POM for programming. When you are done programming you can hot swap back to the Ethernet POM without needing to power cycle or reconfigure the system.

General Specifications

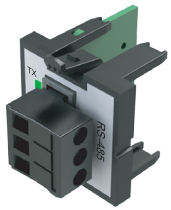
General specifications common to the POM modules are listed in the table below.

General Specifications	
Operating Temperature	0° to 60°C (32° to 140°F)
Storage Temperature	-20° to 85°C (-4° to 185°F)
Humidity	5 to 95% (non-condensing)
Environmental Air	No corrosive gases permitted
Vibration	IEC60068-2-6 (Test Fc)
Shock	IEC60068-2-27 (Test Ea)
Enclosure Type	Open equipment
Agency Approvals	UL 61010-2 - UL File # E185989 Canada and USA CE Compliant E185989*
Noise Immunity	NEMA ICS3-304
EU Directive	See the “EU Directive” in Appendix A or topic DMD0331 in the Do-more! Designer software Help file.
Weight	7g (0.25 oz)

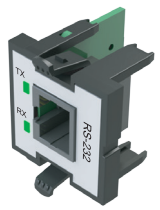
*Meets EMC and Safety requirements. See the D.O.C. for details.



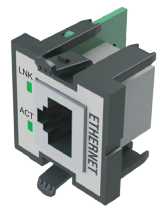
BX-P-SER2-TERM
RS-232 Port



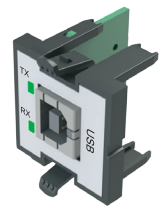
BX-P-SER4-TERM
RS-485 Port



BX-P-SER2-RJ12
RS-232 Port (RJ12)



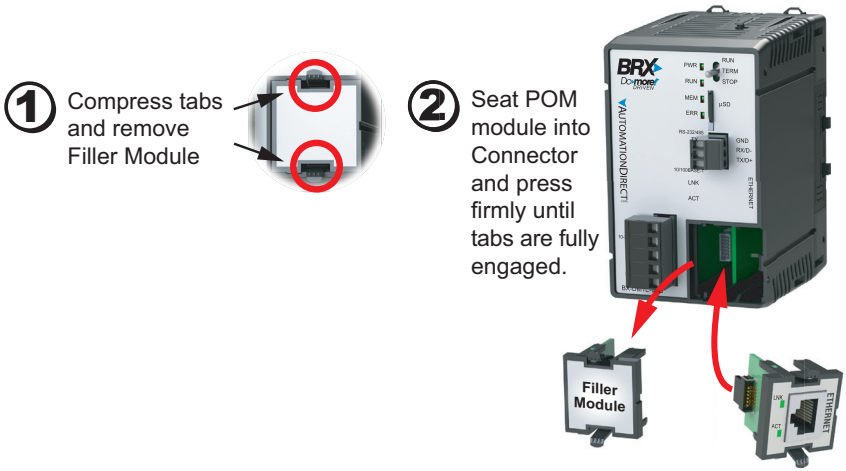
BX-P-ECOMLT
Ethernet Port



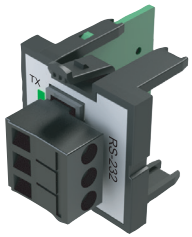
BX-P-USB-B
USB Type B Port

Module Installation

The blank filler plate can be removed by compressing the top and bottom tabs and pulling the module forward away from the unit. To install the POM, orient the module so that the connector on the rear is on the left side, aligning the locking tabs on the top and bottom of the module. Gently guide the module into the opening until you hear it click, locking the module into place.

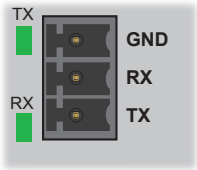


BX-P-SER2-TERM



Removable Connector Included

The RS-232 POM can be connected to the Do-more! Designer programming software, Modbus RTU master or slave devices, DirectLogic PLCs via K-Sequence protocol, as well as devices that send or receive non-sequenced ASCII strings or characters.



Pinout	RS232
1	GND
2	RX
3	TX

6

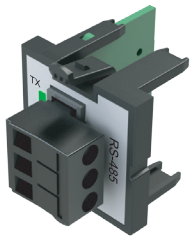
BX-P-SER2-TERM Specifications	
Description	Non-isolated Serial port that can communicate via RS-232. Includes ESD protection and built-in surge protection.
Supported Protocols	Do-more!™ Protocol (Default) Modbus RTU (Master & Slave) K-Sequence (Slave) ASCII (In & Out)
Data Rates	1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200 Baud
Default Settings	115200bps, No Parity, 8 Data Bits, 1 Stop Bit, Station #1
Port Status LED	Green LED is illuminated when active for TXD and RXD
Port Type	Removable 3-pin terminal strip 3.5 mm pitch
RS-232 TX	RS-232 Transmit output
RS-232 RX	RS-232 Receive input
RS-232 GND	Logic ground
RS-232 Maximum Output Load (TXD/RTS)	3kΩ, 1000pf
RS-232 Minimum Output Voltage Swing	±5V
RS-232 Output Short Circuit Protection	±15mA
Cable Requirements	RS-232 use P/N L19772-XXX from automationdirect.com
Maximum Distance	6 meters (20 foot) recommended maximum
Replacement Connector	ADC Part # BX-RTB03S
Hot Swappable	Yes

BX-P-SER2-TERM, continued

BX-RTB03S Connector Specifications	
Part Number	BX-RTB03S
Connector Type	Screw type
Wire Exit	180 degree
Pitch	3.5 mm
Screw Size	M2
Recommended Screw Torque	<1.77 lb·in (0.2 N·m)
Screwdriver Blade Width	2.5 mm
Wire Gauge (Single Wire)	28–16 AWG
Wire Gauge (Two Wires)	28–16 AWG
Wire Strip Length	0.24 in (6mm)
Equiv. Dinkle part #	EC350V-03P-BK

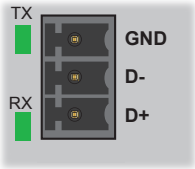
Removable Connector Included

BX-P-SER4-TERM



Removable Connector Included

The RS-485 POM can be connected to the Do-more! Designer programming software, Modbus RTU master or slave devices, DirectLogic PLCs via K-Sequence protocol, as well as devices that send or receive non-sequenced ASCII strings or characters.



Pinout	RS485
1	GND
2	D-
3	D+

6

BX-P-SER4-TERM Specifications

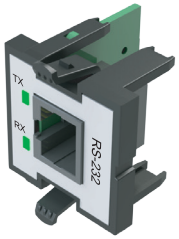
Description	Non-isolated Serial port that can communicate via RS-485. Includes ESD protection and built-in surge protection.	
Supported Protocols	Do-more!™ Protocol (Default) Modbus RTU (Master & Slave) K-Sequence (Slave) ASCII (In & Out)	
Data Rates	1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200 baud	
Default Settings	115200bps, No Parity, 8 Data Bits, 1 Stop Bit, Station #1, Termination resistor OFF	
Port Status LED	Green LED is illuminated when active for TXD and RXD	
Port Type	Removable 3-pin terminal strip, 3.5 mm pitch	
RS-485 Station Addresses	1–247	
RS-485 D+	RS-485 transceiver high	
RS-485 D-	RS-485 transceiver low	
RS-485 GND	Logic ground	
RS-485 Input Impedance	19kΩ	
RS-485 Maximum Load	50 transceivers, 19kΩ each,	
	DIP Switch	Selectable 120Ω termination resistor
RS-485 Output Short Circuit Protection	±250mA, thermal shut-down protection	
RS-485 Electrostatic Discharge Protection	±8kV per IEC1000-4-2	
RS-485 Electrical Fast Transient Protection	±2kV per IEC1000-4-4	
RS-485 Minimum Differential Output Voltage	1.5 V with 60Ω load	
RS-485 Fail Safe Inputs	Logic high input state if inputs are unconnected	
RS-485 Maximum Common Mode Voltage	-7.5 V to 12.5 V	
Cable Requirements	RS-485 use P/N L19827-XXX from automationdirect.com	
Maximum Distance	1000 meters (3280 feet)	
Replacement Connector	ADC Part # BX-RTB03S	
Hot Swappable	Yes	

BX-P-SER4-TERM, continued

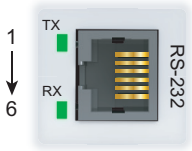
BX-RTB03S Connector Specifications	
Part Number	BX-RTB03S
Connector Type	Screw Type
Wire Exit	180 degree
Pitch	3.5 mm
Screw Size	M2
Recommended Screw Torque	<1.77 lb·in (0.2 N·m)
Screwdriver Blade Width	2.5 mm
Wire Gauge (Single Wire)	28–16 AWG
Wire Gauge (Two Wires)	28–16 AWG
Wire Strip Length	0.24 in (6mm)
Equiv. Dinkle part #	EC350V-03P-BK

Removable Connector Included

BX-P-SER2-RJ12



The RS-232 RJ12 POM can be connected to the Do-more! Designer programming software, Modbus RTU master or slave devices, DirectLogic PLCs via K-Sequence protocol, as well as devices that send or receive non-sequenced ASCII strings or characters.



6-pin RJ12 Female Modular Connector

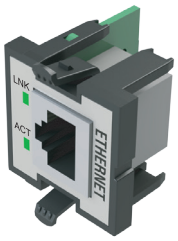
Pin #	Signal	
1	0V	Power (-) connection (GND)
2	5V	Power (+) connection (220mA max)
3	RXD	Receive Data (RS-232)
4	TXD	Transmit Data (RS-232)
5	RTS	Request to Send (RS-232)
6	CTS	Clear to Send (RS-232)

6

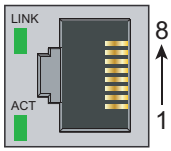
BX-P-SER2-RJ12 Specifications

Description	Non-isolated Serial port that can communicate via RS-232. Includes ESD protection and built-in surge protection.
Supported Protocols	Do-more!™ Protocol (Default) Modbus RTU (Master & Slave) K-Sequence (Slave) ASCII (In & Out)
Data Rates	1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200 Baud
Default Settings	115200bps, No Parity, 8 Data Bits, 1 Stop Bit, Station #1
Port Status LED	Green LED is illuminated when active for TXD and RXD
Port Type	RJ12 - 6P6C
RS-232 Maximum Output Load (TXD/RTS)	3kΩ, 1000pf
RS-232 Minimum Output Voltage Swing	±5V
RS-232 Output Short Circuit Protection	±15mA
Cable Requirements	Recommend AutomationDirect.com cable D2-DSCBL (with USB-RS232) or EA-MG-PGM-CBL
Maximum Distance	6 meters (20 feet), maximum recommended distance
Replacement Connector	N/A
Hot Swappable	Yes

BX-P-ECOMLT



The Ethernet LT POM can be connected to the Do-more! Designer programming software or HMI's that support the Do-more!, Modbus, or K-sequence protocol. This POM functions only as a server device.

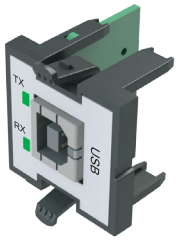


Pin #	Signal
1	TXD+ Transmit Data
2	TXD- Transmit Data
3	RXD+ Receive Data
4	N/C
5	N/C
6	RXD- Receive Data
7	N/C
8	N/C

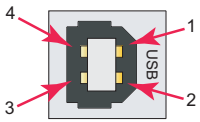
BX-P-ECOMLT Specifications

Description	Standard transformer isolated Ethernet port with built-in surge protection.
Transfer Rate	1 Mbps throughput max
Port Status LED	LINK LED is solid when network link is established. ACT LED flashes when port is active.
Supported Protocols	Do-more! Protocol (Server) Modbus (Server) K-sequence (Server) Programming/Monitoring
Cable Recommendation	C5E-STxxx-xx from AutomationDirect.com
Maximum Distance	100 meters (328 feet)
Port Type	RJ45, Category 5, Auto Crossover
Ethernet Port Numbers: Do-more! Protocol Modbus K-sequence Programming/Monitoring	 28784, UDP 502, TCP 28784, UDP 28784, UDP
Hot Swappable	Yes

BX-P-USB-B



The USB POM can only be connected to the Do-more! Designer programming software.



Mating face of USB type B female

Pin #	Signal
1	+5
2	-Data
3	+Data
4	GND

6

BX-P-USB-B Specifications	
Description	USB Type B Port that can be utilized for programming.
USB Specification Version	USB 2.0
Port Status LED	LED flashes when port is active
Cable Recommendation	USB-CBL-ABxx from AutomationDirect.com
Hot Swappable	Yes

BRX Digital I/O Expansion Modules

In This Chapter...

Overview 7-2
Module Types 7-3
Discrete Input Modules 7-3
Discrete Output Modules 7-3
Discrete Combo Input/Output Modules 7-4
Wiring Termination Options 7-5
Terminal Block Connectors 7-5
*ZIP*Link Wiring System 7-6
General Specifications 7-8
Module Installation 7-9
BX-08NF3 Sinking/Sourcing 3–5 VDC Input 7-10
BX-xxND3 Sinking/Sourcing 12–24 VDC Input 7-11
BX-xxNB 12–24 VAC Input 7-13
BX-xxNA 120–240 VAC Input 7-15
BX-xxTD1 Sinking 12–24 VDC Output 7-17
BX-xxTD2 Sourcing 12–24 VDC Output 7-19
BX-xxTR Relay Output 7-21
BX-05TRS Relay Output 7-23
BX-xxTA 120–240 VAC Output 7-24
BX-08CD3R Combination DC Input/Relay Output 7-26
BX-xxCD3D1 Combination DC Input/Sinking DC Output 7-29
BX-xxCD3D2 Combination DC Input/Sourcing DC Output 7-32

Overview

One of the unique features of the BRX platform is its ability to expand its capability to fit your application solution. One of the ways the BRX platform can do this is by using expansion modules that conveniently "Snap-on" to the side of any BRX MPU. Once the expansion module has snapped in place and is added to the project it instantly adds additional I/O and features to the MPU with little to no additional setup required.

NOTE: *To learn more about adding expansion units to the project go to Chapter 1, "Installing the Expansion I/O Modules".*

The digital expansion modules give you the ability to add additional discrete I/O as needed and are identified as an input module, output module or combination input/output module. On the front panel of the digital I/O expansion modules a color scheme and a symbol are used to denote the module type.

Most modules are available in 5, 8, 12 or 16 point variations consisting of sink/source DC inputs/outputs, AC inputs/outputs, relay outputs and combination modules.

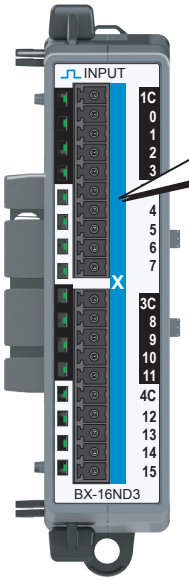
The modules ship without wiring terminal blocks. This allows you to select the termination style that best fits your application. There are several wiring options available, including screw terminal connectors, spring clamp terminal connectors and pre-wired ***ZIP***Link cable solutions.

More detailed information about the digital expansion modules along with specifications and wiring diagrams follow in this chapter.

NOTE: When using relay expansion modules, adding more than 32 relay points requires you to perform a power budget calculation. See Appendix B for more information.

Module Types

Discrete Input Modules

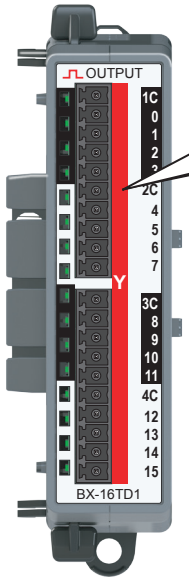


Ten (10) discrete input modules are available in various DC and AC voltage ranges. Input module faceplates have a blue terminal bar and symbol ⎍ for easy distinction from other module types. Listed in the table below are the four different types of input modules available.

Discrete Input Modules

Identifier	Type	8-Point	12-Point	16-Point
NF3	3–5 VDC Sink/Source	BX-08NF3	N/A	N/A
ND3	12–24 VDC Sink/Source	BX-08ND3	BX-12ND3	BX-16ND3
NB	24VAC	BX-08NB	BX-12NB	BX-16NB
NA	120VAC	BX-08NA	BX-12NA	BX-16NA

Discrete Output Modules



Twelve (12) discrete output modules are available in DC sinking, DC sourcing, AC voltage and Relay type outputs. Output module faceplates have a red terminal bar and symbol ⎍ for easy distinction from other module types. Listed in the table below are the five different types of output modules available.

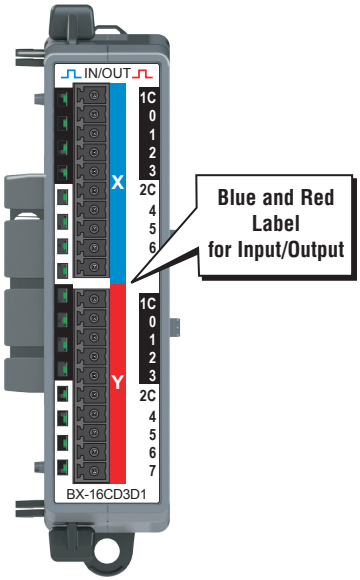
Discrete Output Modules

Identifier	Type	5-Point	8-Point	12-Point	16-Point
TD1	12–24 VDC Sinking	N/A	BX-08TD1	BX-12TD1	BX-16TD1
TD2	12–24 VDC Sourcing	N/A	BX-08TD2	BX-12TD2	BX-16TD2
TR	Relay Form A (SPST)	N/A	BX-08TR	BX-12TR	BX-16TR
TRS	Relay Form C (SPDT)	BX-05TRS	N/A	N/A	N/A
TA	120–240 VAC Triac	N/A	BX-08TA	BX-12TA	N/A

Module Types, Continued

Discrete Combo Input/Output Modules

Five discrete input/output combo modules are available with DC sink/source inputs and sink/source/relay outputs. The Input/Output faceplate terminal bar is in blue and red, making it easy to distinguish between inputs and outputs and from other module types.



Discrete Combo Input/Output Modules I/O Type

Discrete Combo Input/Output Type						
Identifier	Identifier	Input Type	Output Type	8-Point	12-Point	16-Point
CD3	D1	12–24 VDC Sink/Source	12–24 VDC Sinking	N/A	BX-12CD3D1	BX-16CD3D1
	D2		12–24 VDC Sourcing		BX-12CD3D2	BX-16CD3D2
	R		Relay Form A (SPST)	BX-08CD3R	N/A	N/A

Wiring Termination Options

The BRX digital expansion modules ship without wiring terminals blocks. This allows you to select the termination style that best fits your application. There are several wiring options available, including removable screw terminal connectors, removable spring clamp terminal connectors and pre-wired ***ZIP***Link cable solutions.

Terminal Block Connectors

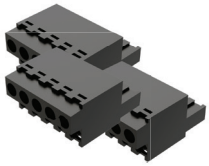
The terminal block connectors are provided in kits of multiple connectors that are easily ordered as a single part number. There are 2 different types of kits to choose from; one kit for the five, eight and 12-point modules and one kit for the 16-point modules. The five, eight and 12-point module kit includes (3) 5-pin 5mm connectors. The 8-point modules will use only 2 of the 5-pin connectors, one (1) will not be used. The 5 and 12-point modules will use all three connectors. The 16-point module kits include (2) 10-pin 3.81 mm connectors.

Terminal block kit part numbers and connector specifications are listed in the following tables.

Terminal Block Connectors, 5-Point, 8-Point & 12-Point Modules

BX-RTB08 Kit

BX-RTB08-1 Kit

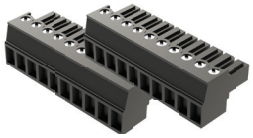


BX-RTB08-2 Kit

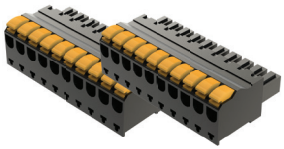
Terminal Block Specifications 5, 8 & 12-point Type

Kit Part Number	BX-RTB08	BX-RTB08-1	BX-RTB08-2
Connector Type	Screw Type - 90 degree	Spring Clamp Type - 180 degree	Screw Type - 180 degree
Wire Exit	180 degree	180 degree	180 degree
Pitch	5.0 mm	5.0 mm	5.0 mm
Screw Size	M2.5	N/A	M2.5
Screw Torque Recommended	< 3.98 lb·in (0.45 N·m)	N/A	< 3.98 lb·in (0.45 N·m)
Screwdriver Blade Width	3.5 mm	3.5 mm	3.5 mm
Wire Gauge (Single Wire)	28–12 AWG	28–14 AWG	28–12 AWG
Wire Gauge (Dual Wire)	28–16 AWG	28–16 AWG (Dual Wire Ferrule Required)	28–16 AWG
Wire Strip Length	0.3 in (7.5 mm)	0.37 in (9.5 mm)	0.3 in (7.5 mm)
Equiv. Dinkle P/N	5ESDV-05P-BK	5ESDSR-05P-BK	5ESDF-05P-BK

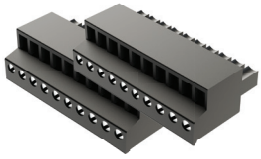
Terminal Block Connectors, 16-Point Modules



BX-RTB10 Kit



BX-RTB10-1 Kit



BX-RTB10-2 Kit

Terminal Block Specifications 16-point

Part Number	BX-RTB10	BX-RTB10-1	BX-RTB10-2
Connector Type	Screw Type 90 degree	Spring Clamp Type 180 degree	Screw Type 180 degree
Wire Exit	180 degree	180 degree	180 degree
Pitch	3.81 mm	3.81 mm	3.81 mm
Screw Size	M2	N/A	M2
Screw Torque Recommended	<1.77 lb·in (0.2 N·m)	N/A	<1.77 lb·in (0.2 N·m)
Screwdriver Blade Width	2.5 mm	2.5 mm	2.5 mm
Wire Gauge (Single Wire)	28–16 AWG	26–18 AWG	30–16 AWG
Wire Gauge (Dual Wire)	28–18 AWG	30–20 AWG (Dual Wire Ferrule Required)	30–18 AWG
Wire Strip Length	0.24 in (6mm)	0.35 in (9mm)	0.26 in (6.5 mm)
Equiv. Dinkle P/N	EC381V-10P-BK	ESC381V-10-BK	EC381F-10P-BK

7

*ZIP*Link Wiring System

BRX digital expansion modules can be quickly connected to convenient *ZIP*Link remote terminal blocks for ease of wiring remote I/O devices. Your *ZIP*Link selection is dependent on the number of expansion module terminal points. The following tables list the connector options.

8-Point BRX Digital Expansion Module ZIPLink Selector

Expansion Module Part No.	*ZIP*Link Module	*ZIP*Link Module Part No.	Qty Needed	*ZIP*Link Cable Part No.*	Qty Needed
BX-08ND3	Feedthrough	ZL-RTB20, (standard) -OR- ZL-RTB20-1 (compact)	1	ZL-BXEM-CBL10 ZL-BXEM-CBL10-1 ZL-BXEM-CBL10-2	1
BX-08NF3					
BX-08NA					
BX-08NB					
BX-08TD1					
BX-08TD2					
BX-08TR					
BX-08TA					
BX-08CD3R					

** Select the cable length: Blank = 0.5 m, -1 = 1.0 m, -2 = 2.0 m.*
Available pigtail cables: ZL-BXEM-CBL10-1P = 1.0 m, ZL-BXEM-CBL10-2P = 2.0 m.

12 & 5-Point BRX Digital Expansion Module ZIPLink Selector					
Expansion Module Part No.	***ZIP*Link Module**	***ZIP*Link Module Part No.**	**Qty Needed**	***ZIP*Link Cable Part No.***	**Qty Needed**
BX-12ND3	Feedthrough	ZL-RTB20, (standard) -OR- ZL-RTB20-1 (compact)	1	ZL-BXEM-CBL15 ZL-BXEM-CBL15-1 ZL-BXEM-CBL15-2	1
BX-12NA					
BX-12NB					
BX-12TD1					
BX-12TD2					
BX-12TR					
BX-05TRS					
BX-12TA					
BX-12CD3D1					
BX-12CD3D2					

** Select the cable length: Blank = 0.5 m, -1 = 1.0 m, -2 = 2.0 m.*
Available pigtail cables: ZL-BXEM-CBL15-1P = 1.0 m, ZL-BXEM-CBL15-2P = 2.0 m.

16-Point BRX Digital Expansion Module ZIPLink Selector					
Expansion Module Part No.	***ZIP*Link Module**	***ZIP*Link Module Part No.**	**Qty Needed**	***ZIP*Link Cable Part No.***	**Qty Needed**
BX-16ND3	Feedthrough	ZL-RTB20, (standard) -OR- ZL-RTB20-1 (compact)	1	ZL-BXEM-CBL20 ZL-BXEM-CBL20-1 ZL-BXEM-CBL20-2	1
BX-16NA					
BX-16NB					
BX-16TD1					
BX-16TD2					
BX-16TR					
BX-16CD3D1					
BX-16CD3D2					

** Select the cable length: Blank = 0.5 m, -1 = 1.0 m, -2 = 2.0 m.*
Available pigtail cables: ZL-BXEM-CBL20-1P = 1.0 m, ZL-BXEM-CBL20-2P = 2.0 m.

General Specifications

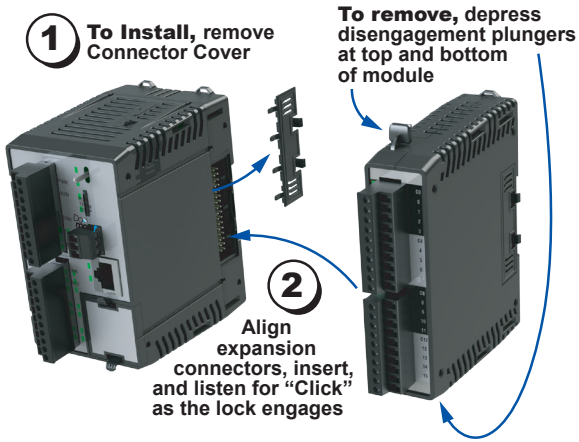
All BRX digital expansion modules have the same general specifications listed in the table below.

General Specifications	
Operating Temperature	0° to 60°C (32° to 140°F)
Storage Temperature	-20° to 85°C (-4° to 185°F)
Humidity	5 to 95% (non-condensing)
Environmental Air	No corrosive gases permitted
Vibration	IEC60068-2–6 (Test Fc)
Shock	IEC60068-2-27 (Test Ea)
Enclosure Type	Open Equipment
Noise Immunity	NEMA ICS3-304
EU Directive	See the “EU Directive” topic in the Help File
Agency Approvals	UL 61010-2 - UL File # E185989 Canada and USA CE Compliant EN61131-2

Module Installation

WARNING: Do not apply field power until the following steps are completed. The BRX expansion modules are NOT hot swappable.

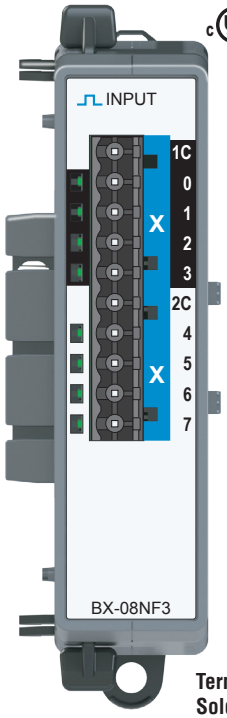
To install an expansion module, remove the connector cover on the right side of the MPU or expansion module the new module is to be connected to. Align the expansion connectors, insert the module until you hear a "click", indicating the module expansion connectors have engaged.



To remove an expansion module locate the two disengagement plungers. One is located at the top of the of the expansion module and a second one at the bottom of the expansion module. Depressing both plungers at the same time will release the locking mechanism and disengage the unit from the system.

Note: *Allow a minimum of 45mm (1.75 in) to the right of MPU chassis and any subsequent expansion modules for mounting and dismounting of the modules.*

BX-08NF3 Sinking/Sourcing 3–5 VDC Input



Terminal Blocks Sold Separately

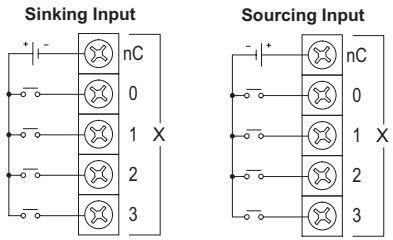
Discrete Input Specifications	
Input Type	Sink/Source
Inputs per Module	8
Commons	2 (4 points/common) Isolated
Nominal Voltage Rating	3–5 VDC
Input Voltage Range	2–6 VDC
Maximum Voltage	6VDC
Input Impedance	870Ω @ 5VDC
Input Current (typical)	6mA @ 5VDC
Maximum Input Current	8mA @ 6VDC
ON Voltage Level	> 2.0 VDC
OFF Voltage Level	< 0.8 VDC
Minimum ON Current	1.2 mA (2V required-guarantee ON state)
Maximum OFF Current	0.5 mA
OFF-ON Response	2ms
ON-OFF Response	2ms
Status Indicators	Logic Side, Green

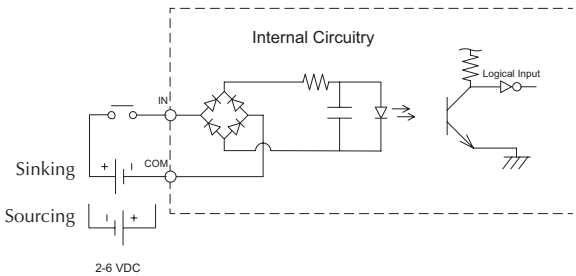
IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

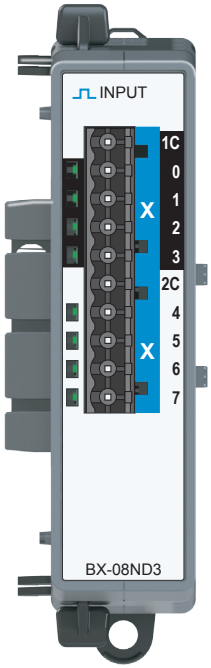
We recommend using prewired ***ZIP***Link cables and connection modules. If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

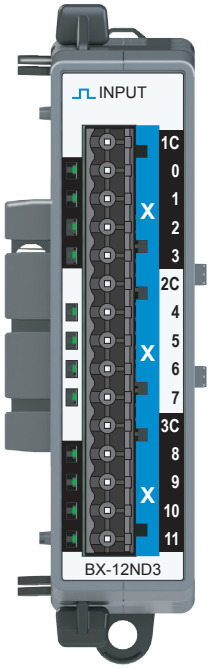
Discrete Input Wiring Diagrams

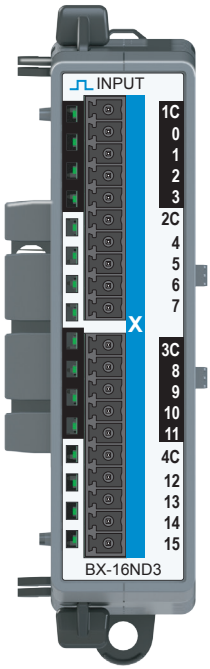




BX-xxND3 Sinking/Sourcing 12–24 VDC Input







Terminal Blocks Sold Separately

BX-08ND3

Input Module
8-pt, 12–24 VDC
Sink/Source

BX-12ND3

Input Module
12-pt, 12–24 VDC
Sink/Source

BX-16ND3

Input Module
16-pt, 12–24 VDC
Sink/Source

We recommend using prewired ***ZIP***Link cables and connection modules.
If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

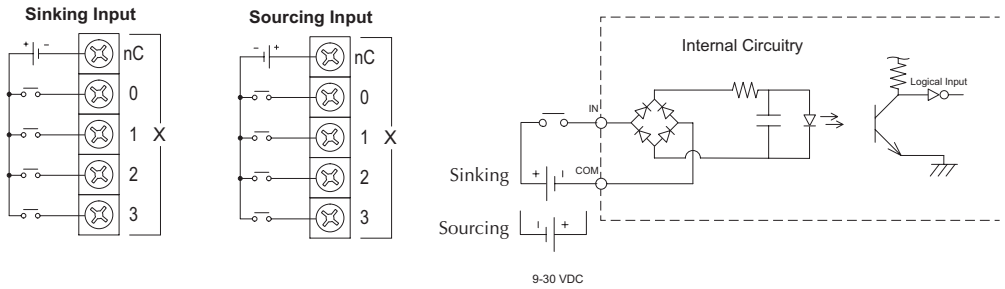
IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

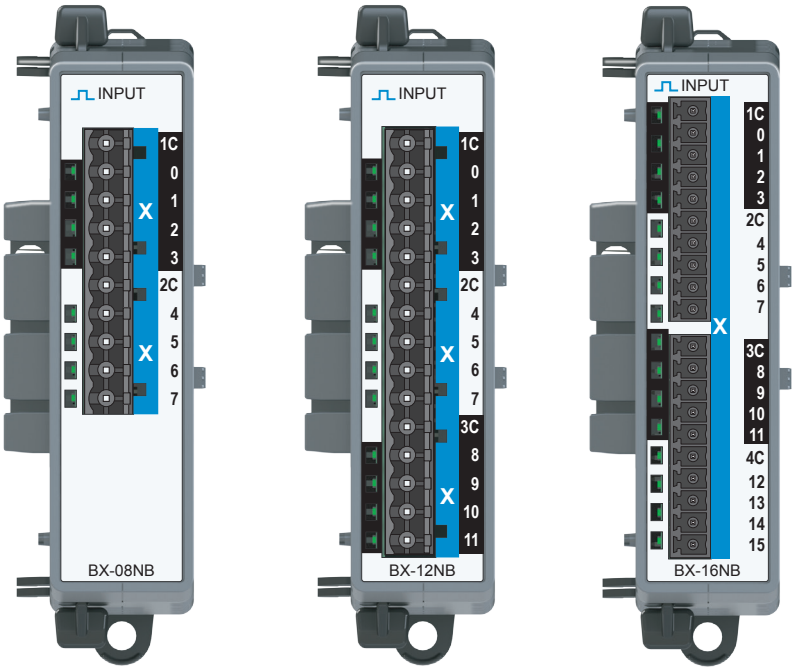
BX-xxND3 Sinking/Sourcing 12–24 VDC Input, continued

Discrete Input Specifications		
Input Type		Sink/Source
Inputs per Module	BX-08ND3	8
	BX-12ND3	12
	BX-16ND3	16
Commons	BX-08ND3	2 (4 points/common) Isolated
	BX-12ND3	3 (4 points/common) Isolated
	BX-16ND3	4 (4 points/common) Isolated
Nominal Voltage Rating		12–24 VDC
Input Voltage Range		9–30 VDC
Maximum Voltage		30VDC
Input Impedance		3kΩ @ 24VDC
Input Current (typical)		8mA @ 24VDC
Maximum Input Current		12mA @ 30VDC
ON Voltage Level		> 9.0 VDC
OFF Voltage Level		< 2.0 VDC
OFF-ON Response		2ms
ON-OFF Response		2ms
Status Indicators		Logic Side, Green

Discrete Input Wiring Diagrams



BX-xxNB 12–24 VAC Input



Terminal Blocks Sold Separately

7

BX-08NB
Input Module
8-pt, 12–24 VAC

BX-12NB
Input Module
12-pt, 12–24 VAC

BX-16NB
Input Module
16-pt, 12–24 VAC

We recommend using prewired ***ZIP***Link cables and connection modules.
If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

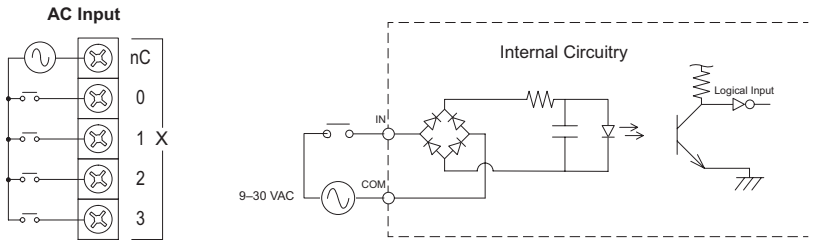
IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

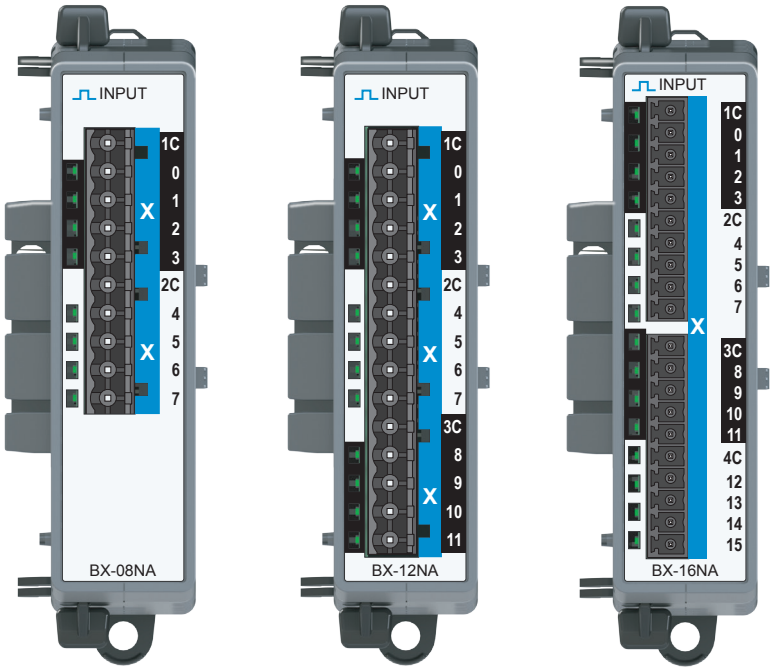
BX-xxNB 12–24 VAC Input, continued

Discrete Input Specifications		
Input Type		AC
Inputs per Module	BX-08NB	8
	BX-12NB	12
	BX-16NB	16
Commons	BX-08NB	2 (4pts / common) Isolated
	BX-12NB	3 (4pts / common) Isolated
	BX-16NB	4 (4pts / common) Isolated
Nominal Voltage Rating		12–24 VAC
Input Voltage Range		9–30 VAC
Maximum Voltage		30VAC RMS
AC Frequency		47–63 Hz
Input Impedance		3kΩ @ 24VAC
Input Current (typical)		8mA @ 24VAC
Maximum Input Current		12mA @ 30VAC
ON Voltage Level		> 9.0 VAC
OFF Voltage Level		< 2.0 VAC
Minimum ON Current		5.0 mA (9V required-guarantee ON state)
Maximum OFF Current		2.0 mA
OFF-ON Response		10ms
ON-OFF Response		10ms
Status Indicators		Logic Side, Green

Discrete Input Wiring Diagram



BX-xxNA 120–240 VAC Input



Terminal Blocks Sold Separately

7

BX-08NA
Input Module
8-pt, 120–240 VAC

BX-12NA
Input Module
12-pt, 120–240 VAC

BX-16NA
Input Module
16-pt, 120–240 VAC

We recommend using prewired ***ZIP***Link cables and connection modules.
If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

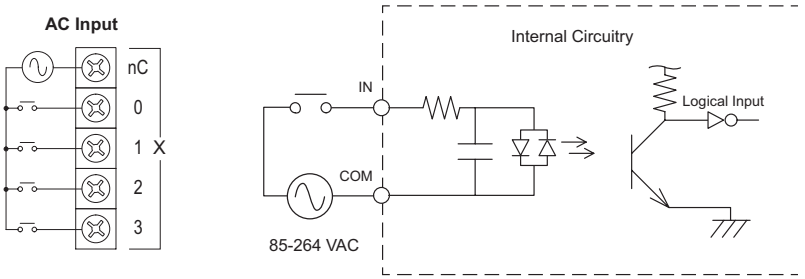
IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

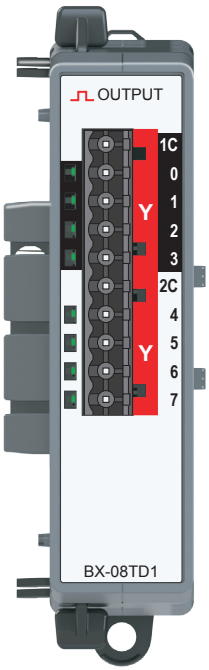
BX-xxNA 120–240 VAC Input, continued

Discrete Input Specifications		
Input Type		AC
Inputs per Module	BX-08NA	8
	BX-12NA	12
	BX-16NA	16
Commons	BX-08NA	2 (4pts / common) Isolated
	BX-12NA	3 (4pts / common) Isolated
	BX-16NA	4 (4pts / common) Isolated
Nominal Voltage Rating		120–240 VAC
Input Voltage Range		85–264 VAC
Maximum Voltage		264VAC RMS
AC Frequency		47–63 Hz
Input Impedance		15kΩ
Input Current (typical)		9mA @ 120VAC, 13mA @ 220VAC
Maximum Input Current		14mA @ 120VAC, 20mA @ 220VAC
ON Voltage Level		> 85VAC
OFF Voltage Level		< 40VAC
Maximum OFF Current		2.5 mA
OFF-ON Response		10ms
ON-OFF Response		10ms
Status Indicators		Logic Side, Green

Discrete Input Wiring Diagram

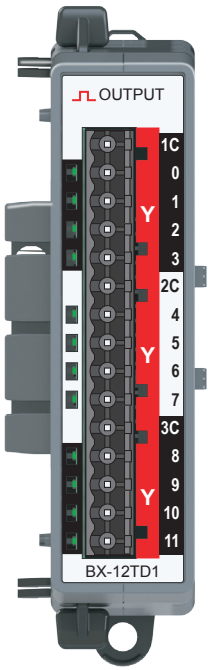


BX-xxTD1 Sinking 12–24 VDC Output



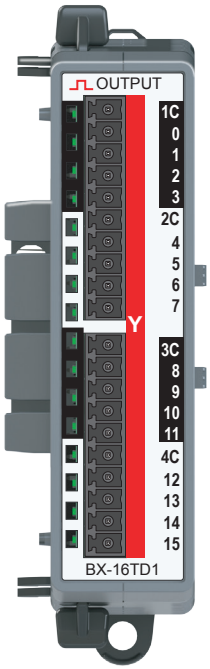
BX-08TD1

Output Module 8-pt,
12–24 VDC, Sinking



BX-12TD1

Output Module 12-pt,
12–24 VDC, Sinking



BX-16TD1

Output Module 16-pt,
12–24 VDC, Sinking

Terminal Blocks Sold Separately

7

We recommend using prewired ***ZIP***Link cables and connection modules.
If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

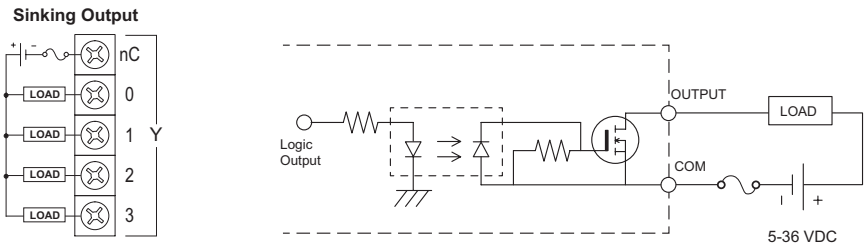
IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

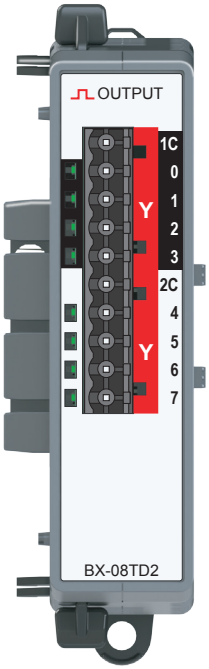
BX-xxTD1 Sinking 12–24 VDC Output, continued

Discrete Output Specifications		
Output Type		Sinking
Outputs per Module	BX-08TD1	8
	BX-12TD1	12
	BX-16TD1	16
Commons	BX-08TD1	2 (4pts / common) Isolated
	BX-12TD1	3 (4pts / common) Isolated
	BX-16TD1	4 (4pts / common) Isolated
Maximum Current per Common		2A
Nominal Voltage Rating		12–24 VDC
Input Voltage Range		5–36 VDC
Maximum Voltage		36VDC
Minimum Output Current		0.1 mA 24VDC
Maximum Output Current		0.5 A per output, no derating over temperature range
Maximum Inrush Current		5A for 50ms
Maximum Leakage Current		10µA
ON Voltage Drop		> 0.05 VDC
Fuses, Overcurrent Protection		N/A
OFF-ON Response		<5ms
ON-OFF Response		<2ms
Status Indicators		Logic Side, Green

Discrete Output Wiring Diagram

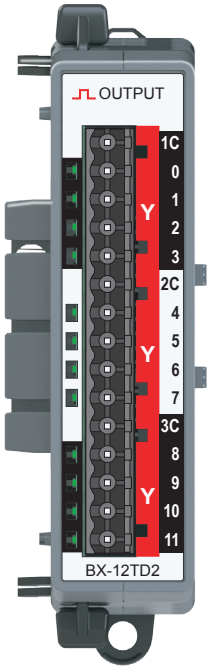


BX-xxTD2 Sourcing 12–24 VDC Output



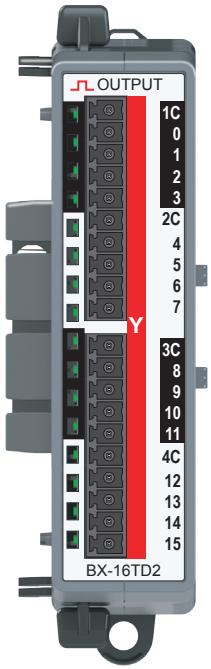
BX-08TD2

Output Module 8-pt,
12–24 VDC, Sourcing



BX-12TD2

Output Module 12-pt,
12–24 VDC, Sourcing



BX-16TD2

Output Module 16-pt,
12–24 VDC, Sourcing

Terminal Blocks Sold Separately

We recommend using prewired ***ZIP***Link cables and connection modules.
If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

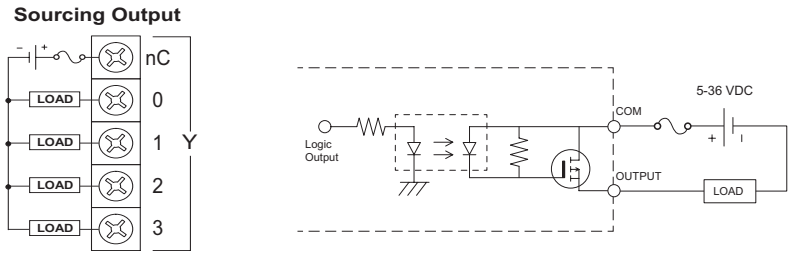
IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

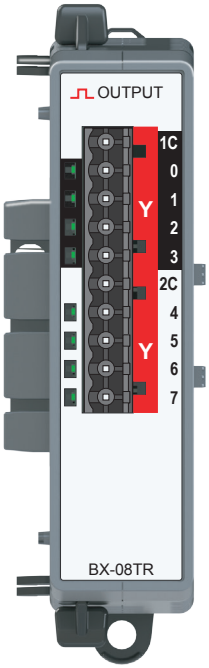
BX-xxTD2 Sourcing 12–24 VDC Output, continued

Discrete Output Specifications		
Output Type		Sourcing
Outputs per Module	BX-08TD2	8
	BX-12TD2	12
	BX-16TD2	16
Commons	BX-08TD2	2 (4pts / common) Isolated
	BX-12TD2	3 (4pts / common) Isolated
	BX-16TD2	4 (4pts / common) Isolated
Maximum Current per Common		2A
Nominal Voltage Rating		12–24 VDC
Input Voltage Range		5–36 VDC
Maximum Voltage		36VDC
Minimum Output Current		0.1 mA 24VDC
Maximum Output Current		0.5 A per output, no derating over temperature range
Maximum Inrush Current		5A for 50ms
Maximum Leakage Current		10µA
ON Voltage Drop		> 0.05 VDC
Fuses, Overcurrent Protection		N/A
OFF-ON Response		<5ms
ON-OFF Response		<2ms
Status Indicators		Logic Side, Green

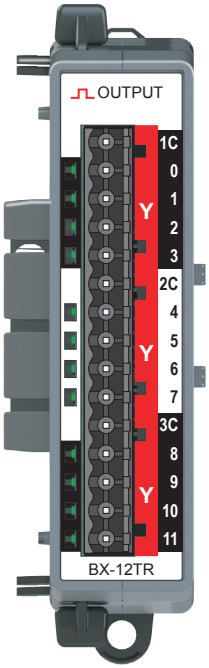
Discrete Output Wiring Diagram



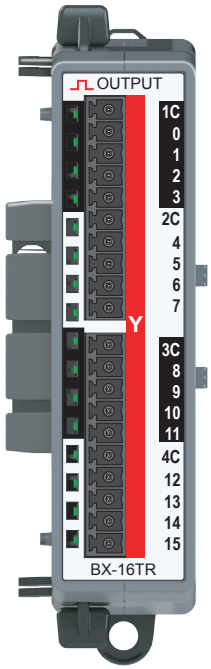
BX-xxTR Relay Output



BX-08TR
Output Module 8-pt,
Relay Form A (SPST)



BX-12TR
Output Module 12-pt,
Relay Form A (SPST)



BX-16TR
Output Module 16-pt,
Relay Form A (SPST)

Terminal Blocks Sold Separately

We recommend using prewired ***ZIP***Link cables and connection modules.
If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

IMPORTANT!

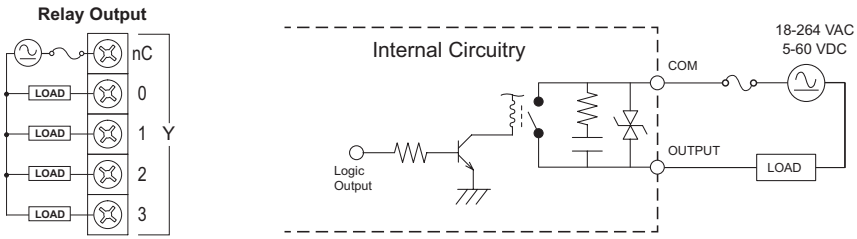
Hot-Swapping Information
Note: This device cannot be Hot Swapped.

NOTE: When using relay expansion modules, adding more than 32 relay points requires you to perform a power budget calculation. See Appendix B for more information.

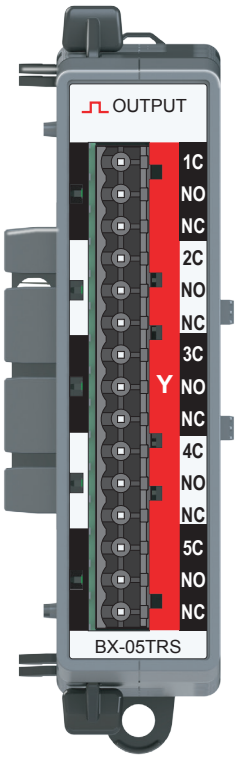
BX-xxTR Relay Output, continued

Discrete Output Specifications		
Output Type		Relay, Form A (SPST)
Outputs per Module	BX-08TR	8
	BX-12TR	12
	BX-16TR	16
Commons	BX-08TR	2 (4pts / common) Isolated
	BX-12TR	3 (4pts / common) Isolated
	BX-16TR	4 (4pts / common) Isolated
Maximum Current per Common		8A
Nominal Voltage		5–48 VDC 24–240 VAC
Operating Voltage Range		5–60 VDC, 18–264 VAC
Maximum Voltage		60VDC, 264VAC
Minimum Output Current		0.1 mA 24VDC
Maximum Output Current		2A
Maximum Inrush Current		5A for 50ms
Maximum Leakage Current		1µA (DC), 300µA (AC) due to RC snubber circuit
ON Voltage Drop		> 0.2 Vmax
Fuses, Overcurrent Protection		N/A
Maximum Switching Frequency		10Hz
Relay Cycle Life		
Mechanical Endurance		5 Million Operations
Electrical Endurance		120,000 Operations
Status Indicators		Logic Side, Green

Relay Output Wiring Diagram



BX-05TRS Relay Output



Terminal Blocks Sold Separately

We recommend using prewired ***ZIP***Link cables and connection modules.
If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

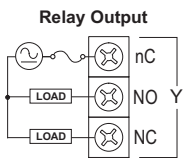
Discrete Output Specifications	
Output Type	Relay, Form C (SPDT)
Outputs per Module	5
Commons	5 Isolated
Maximum Current per Common	2A
Nominal Voltage	5–48 VDC 24–240 VAC
Operating Voltage Range	5–60 VDC, 18–264 VAC
Maximum Voltage	60VDC, 264VAC
Minimum Output Current	0.1 mA 24VDC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1µA (DC), 300µA (AC) due to RC snubber circuit
ON Voltage Drop	> 0.2 Vmax
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Fuses, Overcurrent Protection	N/A
Maximum Switching Frequency	10Hz
Relay Cycle Life	
Mechanical Endurance	10 Million Operations
Electrical Endurance	50,000 Operations
Status Indicators	Logic Side, Green

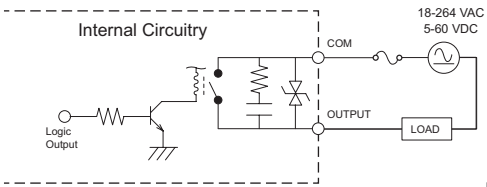
IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

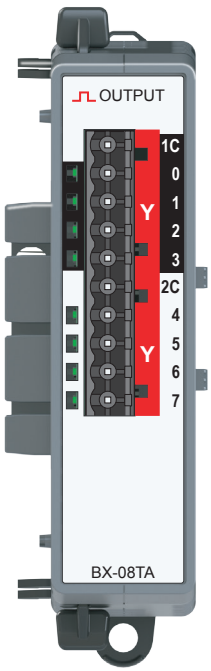
NOTE: When using relay expansion modules, adding more than 32 relay points requires you to perform a power budget calculation. See Appendix B for more information.

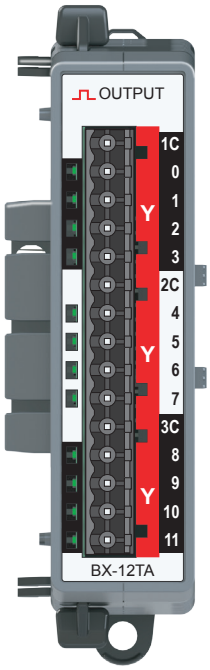
Relay Output Wiring Diagram





BX-xxTA 120–240 VAC Output





Terminal Blocks Sold Separately

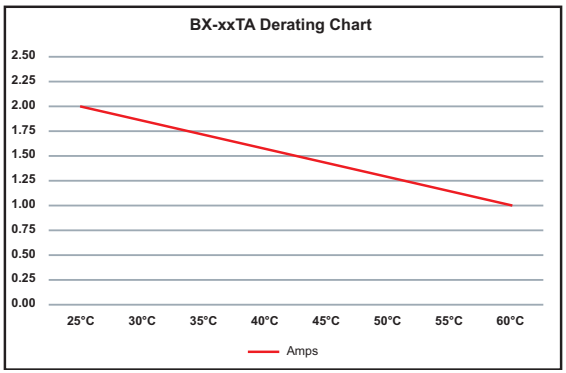
BX-08TA
Output Module
8-pt, 120–240 VAC

BX-12TA
Output Module
12-pt, 120–240 VAC

We recommend using prewired ***ZIP***Link cables and connection modules.
If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

IMPORTANT!

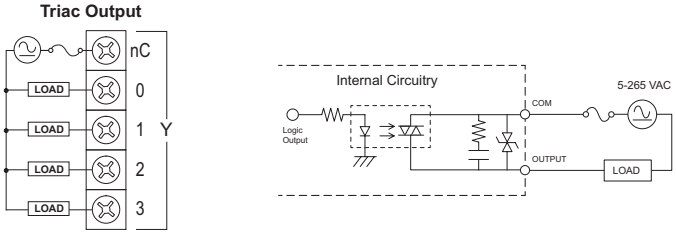
Hot-Swapping Information
Note: This device cannot be Hot Swapped.



BX-xxTA 120–240 VAC Output, continued

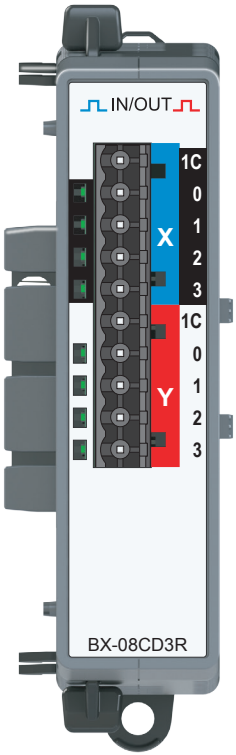
Discrete Output Specifications		
Output Type		Triac
Outputs per Module	BX-08TA	8
	BX-12TA	12
Commons	BX-08TA	2 (4 points/common) Isolated
	BX-12TA	3 (4 points/common) Isolated
Maximum Current per Common		2A
Nominal Voltage		120–240 VAC
Operating Voltage Range		5–265 VAC
Maximum Voltage		265VAC
Maximum Output Current		0.5 A across temp range
Current Derating		Linear by Common: 2A @ 25°C - 1A @ 60°C
Maximum Inrush Current		5A for 50ms
Maximum Leakage Current		1µA
ON Voltage Drop		2.5 Vmax
ON-OFF Response		<10ms
OFF-ON Response		<10ms
Fuses		N/A
Status Indicators		Logic Side, Green

Triac Output Wiring Diagram



BX-08CD3R Combination DC Input/Relay Output

The BX-08CD3R Combination DC Input/Relay Output Expansion Module provides a total of eight (8) points; four (4) 12–24 VDC sink/source inputs and four (4) Form A (SPST) relay outputs.



IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

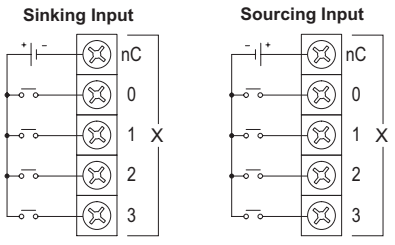
Terminal Blocks Sold Separately

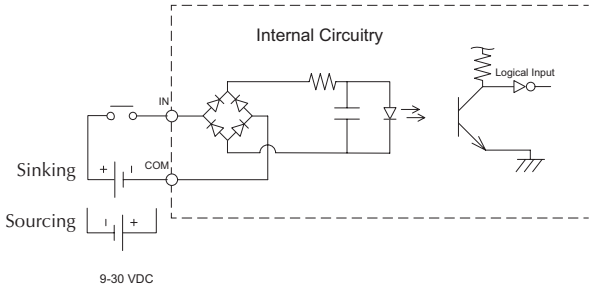
We recommend using prewired ***ZIP***Link cables and connection modules.
If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

BX-08CD3R Combination DC Input/Relay Output, continued

Discrete Input Specifications	
Input Type	Sink/Source
Inputs per Module	4
Nominal Voltage Rating	12–24 VDC
Input Voltage Range	9–30 VDC
Maximum Voltage	30VDC
Commons	1 (4 points/common)
Input Current (typical)	8mA @ 24VDC
Maximum Input Current	12mA @ 30VDC
Input Impedance	3kΩ @ 24VDC
ON Voltage Level	> 9.0 VDC
OFF Voltage Level	< 2.0 VDC
Minimum ON Current	5.0 mA (9V required-guarantee ON state)
Maximum OFF Current	2.0 mA
OFF-ON Response	2ms
ON-OFF Response	2ms
Status Indicators	Logic Side, Green

Discrete Input Wiring Diagrams

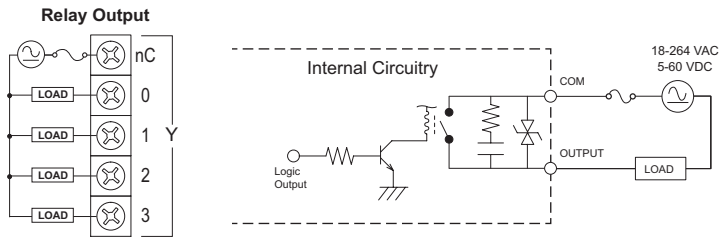




BX-08CD3R Combination DC Input/Relay Output, continued

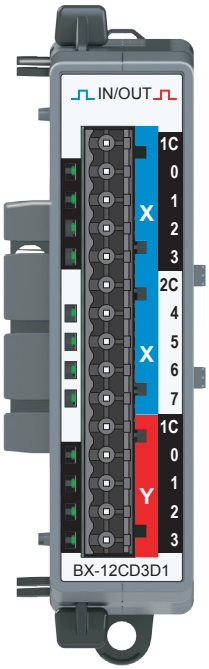
Discrete Output Specifications	
Output Type	Relay, Form A (SPST)
Outputs per Module	4
Commons	1 (4 points/common)
Maximum Current per Common	8A
Nominal Voltage	5–48 VDC, 24–240 VAC
Operating Voltage Range	5–60 VDC, 18–264 VAC
Maximum Voltage	60VDC, 264VAC
Minimum Output Current	0.1 mA @24VDC
Maximum Output Current	2A
Maximum Inrush Current	5A for 50ms
Maximum Leakage Current	1μA
ON Voltage Drop	0.2 Vmax
ON-OFF Response	<10ms
OFF-ON Response	<10ms
Fuses	N/A
Maximum Switching Frequency	10Hz
Relay Cycle Life	
Mechanical Endurance	5 Million Operations
Electrical Endurance	120,000 Operations
Status Indicators	Logic Side, Green

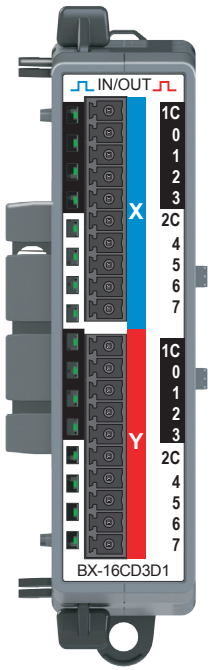
Relay Output Wiring Diagrams



BX-xxCD3D1 Combination DC Input/Sinking DC Output

The BX-xxCD3D1 Combination DC Input/Sourcing Output Expansion Modules provides a total of twelve (12) or sixteen (16) points; eight (8) 12–24 VDC sink/source inputs and either four (4) or eight (8) 12-24 VDC sinking outputs.





Terminal Blocks Sold Separately

BX-12CD3D1

Combination Discrete Module
Input: 8-pt, 12–24 VDC, Sink/Source,
Output: 4-pt, 12–24 VDC, Sinking

BX-16CD3D1

Combination Discrete Module
Input: 8-pt, 12–24 VDC, Sink/Source,
Output: 8-pt, 12–24 VDC, Sinking

We recommend using prewired ***ZIP***Link cables and connection modules.
If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

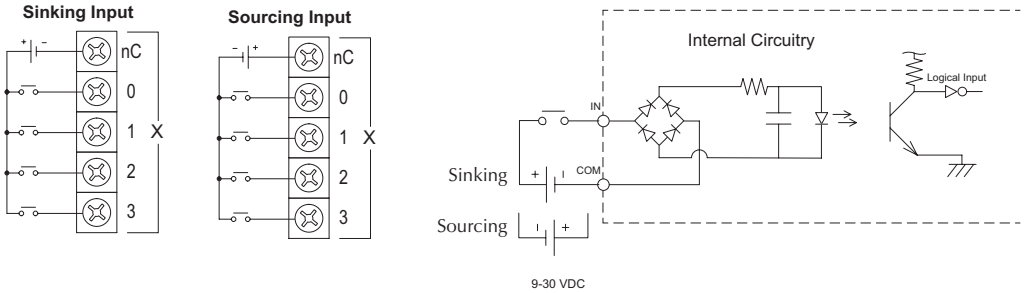
IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

BX-xxCD3D1 Combination DC Input/Sinking DC Output, continued

Discrete Input Specifications		
Input Type		Sink/Source
Inputs per Module		8
Commons	BX-12CD3D1	2 (4 points/common) Isolated
	BX-16CD3D1	2 (4 points/common) Isolated
Nominal Voltage Rating		12–24 VDC
Input Voltage Range		9–30 VDC
Maximum Voltage		30VDC
Input Impedance		3kΩ @ 24VDC
Input Current (typical)		8mA @ 24VDC
Maximum Input Current		12mA @ 30VDC
ON Voltage Level		> 9.0 VDC
OFF Voltage Level		< 2.0 VDC
Minimum ON Current		5.0 mA (9V required-guarantee ON state)
Maximum OFF Current		2.0 mA
OFF-ON Response		2ms
ON-OFF Response		2ms
Status Indicators		Logic Side, Green

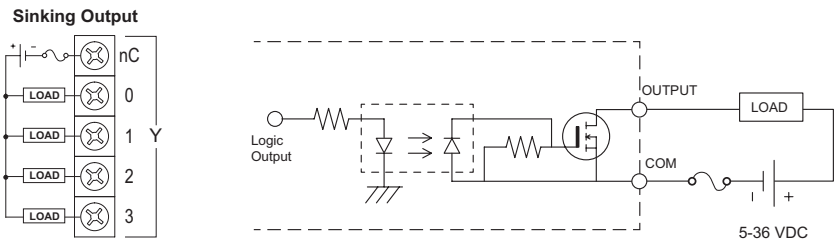
Discrete Input Wiring Diagrams



BX-xxCD3D1 Combination DC Input/DC Sinking Output, continued

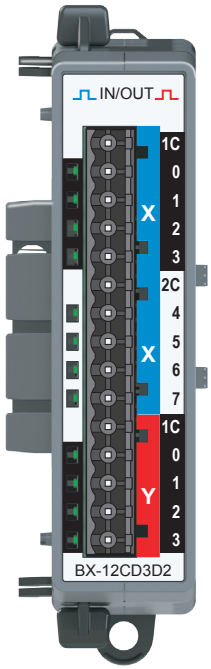
Discrete Output Specifications		
Output Type		Sinking
Outputs per Module	BX-12CD3D1	4
	BX-16CD3D1	8
Commons	BX-12CD3D1	1 (4 points/common)
	BX-16CD3D1	2 (4 points/common) Isolated
Maximum Current per Common		2A
Nominal Voltage		12–24 VDC
Operating Voltage Range		5–36 VDC
Maximum Voltage		36VDC
Minimum Output Current		0.1 mA @ 24VDC
Maximum Output Current		0.5 A per output, no derating over temperature range
Maximum Inrush Current		5A for 50ms
Maximum Leakage Current		10µA
ON Voltage Drop		0.05 VDC
Fuses, Overcurrent Protection		N/A
Status Indicators		Logic Side, Green
OFF-ON Response		< 5ms
ON-OFF Response		< 2ms
Status Indicators		Logic Side, Green

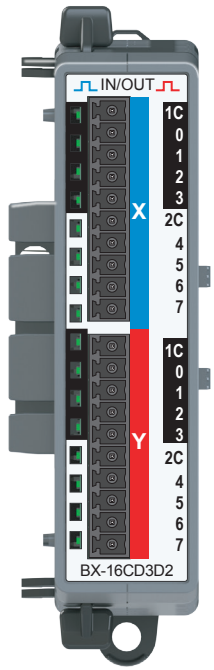
Discrete Output Wiring Diagrams



BX-xxCD3D2 Combination DC Input/Sourcing DC Output

The BX-xxCD3D2 Combination Input/Output Expansion Modules provides a total of twelve (12) or sixteen (16) points; eight (8) 12–24 VDC sink/source inputs and either four (4) or eight (8) 12-24 VDC sourcing outputs.





Terminal Blocks Sold Separately

BX-12CD3D2

Combination Discrete Module
Input: 8-pt, 12–24 VDC, Sink/Source
Output: 4-pt, 12–24 VDC, Sourcing

BX-16CD3D2

Combination Discrete Module
Input: 8-pt, 12–24 VDC, Sink/Source,
Output: 8-pt, 12–24 VDC, Sourcing

We recommend using prewired ***ZIP***Link cables and connection modules.
If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

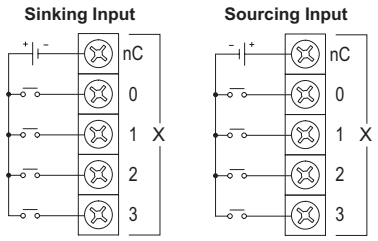
IMPORTANT!

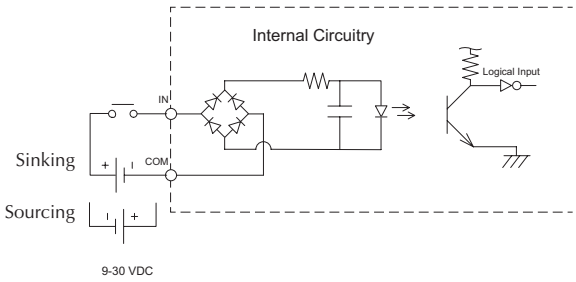
Hot-Swapping Information
Note: This device cannot be Hot Swapped.

BX-xxCD3D2 Combination DC Input/Sourcing DC Output, continued

Discrete Input Specifications		
Input Type		Sink/Source
Inputs per Module		8
Commons	BX-12CD3D2	2 (4 points/common) Isolated
	BX-16CD3D2	2 (4 points/common) Isolated
Nominal Voltage Rating		12–24 VDC
Input Voltage Range		9–30 VDC
Maximum Voltage		30VDC
Input Impedance		3kΩ @ 24VDC
Input Current (typical)		8mA @ 24VDC
Maximum Input Current		12mA @ 30VDC
ON Voltage Level		> 9.0 VDC
OFF Voltage Level		< 2.0 VDC
Minimum ON Current		5.0 mA (9V required-guarantee ON state)
Maximum OFF Current		2.0 mA
OFF-ON Response		2ms
ON-OFF Response		2ms
Status Indicators		Logic Side, Green

Discrete Input Wiring Diagrams

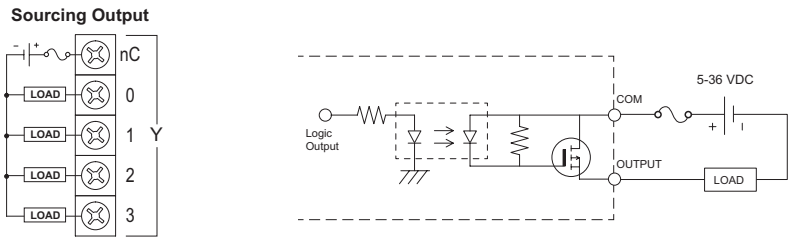




BX-xxCD3D2 Combination DC Input/DC Sourcing Output, continued

Discrete Output Specifications		
Output Type		Sourcing
Outputs per Module	BX-12CD3D2	4
	BX-16CD3D2	8
Commons	BX-12CD3D2	1 (4 points/common)
	BX-16CD3D2	2 (4 points/common) Isolated
Maximum Current per Common		2A
Nominal Voltage		12–24 VDC
Operating Voltage Range		5–36 VDC
Maximum Voltage		36VDC
Minimum Output Current		0.1 mA @ 24VDC
Maximum Output Current		0.5 A per output, no derating over temperature range
Maximum Inrush Current		5A for 50ms
Maximum Leakage Current		10µA
ON Voltage Drop		0.05 VDC
Fuses, Overcurrent Protection		N/A
OFF-ON Response		< 5ms
ON-OFF Response		< 2ms
Status Indicators		Logic Side, Green

Discrete Output Wiring Diagrams



BRX Analog I/O Expansion Modules

In This Chapter...

Overview 8-2
Module Types 8-2
Wiring Termination Options 8-4
Terminal Block Connectors 8-4
*ZIP*Link Wiring System 8-5
General Specifications 8-6
Dimensional Information 8-6
Module Installation 8-7
Module Configuration 8-8
Analog Tips and Troubleshooting 8-9
General Tips for Analog Circuits 8-9
Reducing Electrical Noise 8-10
Current Module Tips and Troubleshooting 8-12
Voltage Module Tips and Troubleshooting 8-14
Temperature (Thermocouple) Module Tips and Troubleshooting 8-15
BX-08AD-1 Analog Current Sinking Input 8-16
BX-08AD-2B Analog Voltage Input 8-21
BX-04THM Thermocouple Input 8-26
BX-08DA-1 Analog Current Source Output 8-32
BX-08DA-2B Analog Voltage Output 8-37

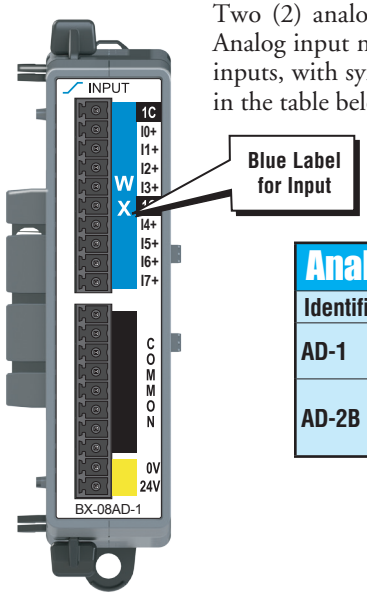
Overview

One of the unique features of the BRX platform is its ability to easily expand its capability to fit your application solution. One of the ways the BRX platform can do this is by using expansion modules that conveniently "snap-on" to the side of any BRX MPU.

The analog expansion modules give you the ability to add additional analog I/O as needed and are identified as an input module, output module or temperature input module. On the front panel of the analog I/O expansion modules a color scheme and a symbol are used to denote the module type. Analog modules are available in 8-point current inputs/outputs, 8-point unipolar or bipolar voltage inputs/outputs, and 4-point thermocouple input modules.

Module Types

Analog Input Modules

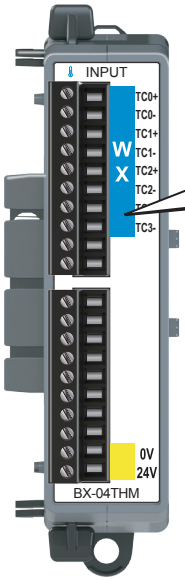


Two (2) analog input modules are available, with current or voltage inputs. Analog input module faceplates have a blue terminal bar to distinguish them as inputs, with symbols ⟋ or ◢ to signify current or voltage, respectively. Listed in the table below are the different types of input modules available.

Analog Input Modules

Identifier	Input Type	8-Point
AD-1	Current Sink 0–20mA, 4–20mA	BX-08AD-1
AD-2B	Voltage ±10VDC, ±5VDC, 0–5VDC, 0–10VDC	BX-08AD-2B

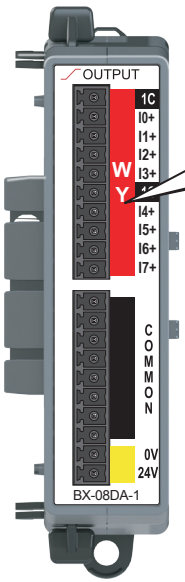
Temperature Input Module



A temperature input module is available with thermocouple inputs. The temperature input module can also be configured for millivolt-level voltage inputs. Temperature module faceplates have a blue terminal bar and symbol for easy distinction from other module types. The table below shows the temperature input module and its input type.

Temperature Input Module		
Identifier	**Type**	**4-Point**
THM	Thermocouple	BX-04THM

Analog Output Modules



Two (2) analog output modules are available, in current and voltage outputs. Analog output module faceplates have a red terminal bar to distinguish them as outputs, with symbols or to signify current or voltage, respectively. Listed in the table below are the different types of output modules available.

Analog Output Modules		
Identifier	**Type**	**8-Point**
DA-1	Current Source 0–20mA, 4–20mA	BX-08DA-1
DA-2B	Voltage ±10VDC, ±5VDC, 0–5VDC, 0–10VDC	BX-08DA-2B

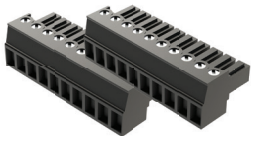
Wiring Termination Options

The BRX analog expansion modules ship without wiring terminals blocks. This allows you to select the termination style that best fits your application. There are several wiring options available, including removable screw terminal connectors, removable spring clamp terminal connectors and pre-wired ***ZIP***Link cable solutions. The BRX Temperature Input Modules include the BX-RTB10 kit. The BX-RTB10-1 or BX-RTB10-2 can also be used and can be purchased separately.

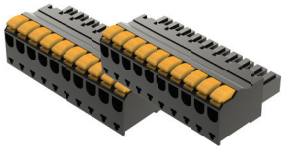
Terminal Block Connectors

The terminal block connectors are provided in kits of multiple connectors that are easily ordered as a single part number. The kits for the 8-point modules and for the 4-point thermocouple module include (2) 10-pin 3.81-mm connectors.

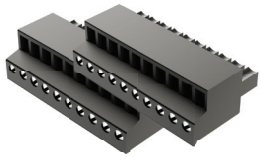
Terminal block kit part numbers and connector specifications are listed in the following table.



BX-RTB10 Kit



BX-RTB10-1 Kit



BX-RTB10-2 Kit

Terminal Block Specifications

Part Number	BX-RTB10	BX-RTB10-1	BX-RTB10-2
Connector Type	Screw Type 90 degree	Spring Clamp Type 180 degree	Screw Type 180 degree
Wire Exit	180 degree	180 degree	180 degree
Pitch	3.81 mm	3.81 mm	3.81 mm
Screw Size	M2	N/A	M2
Screw Torque Recommended	<1.77 lb·in (0.2 N·m)	N/A	<1.77 lb·in (0.2 N·m)
Screwdriver Blade Width	2.5 mm	2.5 mm	2.5 mm
Wire Gauge (Single Wire)	28–16 AWG	26–18 AWG	30–16 AWG
Wire Gauge (Dual Wire)	28–18 AWG	30–20 AWG (Dual Wire Ferrule Required)	30–18 AWG
Wire Strip Length	0.24 in (6mm)	0.35 in (9mm)	0.26 in (6.5 mm)
Equiv. Dinkle P/N	EC381V-10P-BK	ESC381V-10-BK	EC381F-10P-BK

NOTE: *BX-RTB10 terminal blocks are included with Temperature Input modules.*

*ZIP*Link Wiring System

BRX analog expansion modules can be quickly connected to convenient ***ZIP***Link remote terminal blocks for ease of wiring remote I/O devices. The following table lists the connector options. The ***ZIP***Link wiring system is not available for use with the BRX Temperature Input Module.

8-Point BRX Analog Expansion Module ZIPLink Selector

Expansion Module Part No.	*ZIP*Link Module	*ZIP*Link Module Part No.	Qty Needed	*ZIP*Link Cable Part No.*	Qty Needed
BX-08AD-1	Feedthrough	ZL-RTB20 (standard) OR ZL-RTB20-1 (compact)	1	ZL-BXEM-CBL20 ZL-BXEM-CBL20-1 ZL-BXEM-CBL20-2	1
BX-08AD-2B					
BX-08DA-1					
BX-08DA-2B					

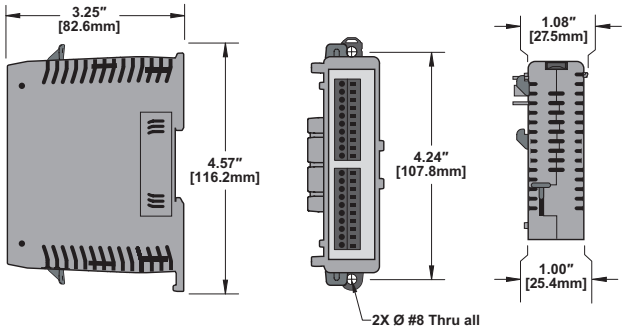
** Select the cable length: Blank = 0.5 m, -1 = 1.0 m, -2 = 2.0 m.*
Available pigtail cables: ZL-BXEM-CBL20-1P = 1.0 m, ZL-BXEM-CBL20-2P = 2.0 m.

General Specifications

All BRX analog expansion modules and temperature input modules have the same general specifications listed in the table below.

General Specifications	
Operating Temperature	0° to 45°C (32° to 113°F)
Storage Temperature	−20° to 70°C (−4° to 158°F)
Humidity	5 to 95% (non-condensing)
Environmental Air	No corrosive gases permitted
Vibration	IEC60068-2-6 (Test Fc)
Shock	IEC60068-2-27 (Test Ea)
Enclosure Type	Open Equipment
Agency Approvals	UL 61010-2-201 File # E139594 Canada and USA CE (Safety: EN61010-2-201 and Immunity: EN61131-2: 2007)
Noise Immunity	NEMA ICS3-304
EU Directive	See the “EU Directive” topic in the BRX Help File.

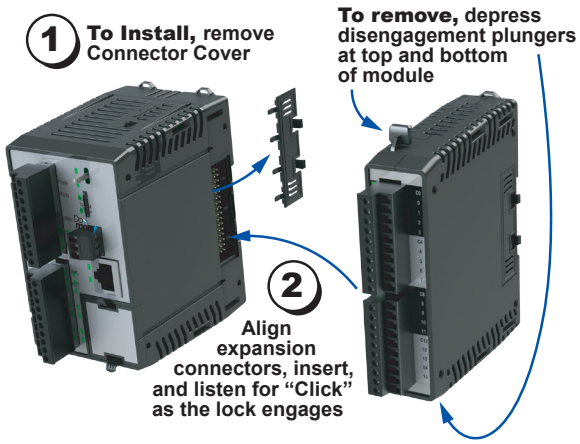
Dimensional Information



Module Installation

WARNING: Do not apply field power until the following steps are completed. The BRX expansion modules are NOT hot swappable.

To install an expansion module, remove the connector cover on the right side of the MPU or expansion module to which the new module is to be connected. Align the expansion connectors and insert the module until you hear a "click", indicating the module expansion connectors have engaged.



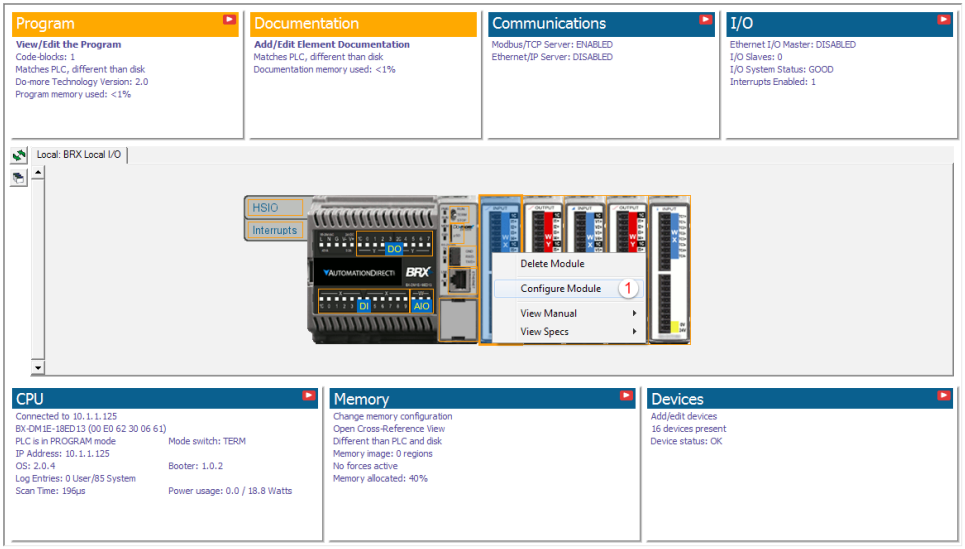
To remove an expansion module locate the two disengagement plungers. One is located at the top of the of the expansion module and a second one at the bottom of the expansion module. Depressing both plungers at the same time will release the locking mechanism and disengage the unit from the system.

NOTE: *Allow a minimum of 45mm (1.75in) to the right of MPU chassis and any subsequent expansion modules for mounting and dismounting of the modules.*

Module Configuration

Once the expansion module has snapped in place and is added to the project it instantly adds additional I/O and features to the MPU with minimal additional setup required.

To configure a newly attached module, load the Do-more! Designer software and connect to the BRX MPU, as discussed in Chapter 10. A graphical representation of the BRX unit with its attached modules is displayed in the Dashboard of the software.



To access the module configuration dialogs, left-click or right-click on the module in the Dashboard and select (1) **Configure Module**. The configuration dialogs for each module are discussed in the corresponding section of this chapter.

Analog Tips and Troubleshooting

This subsection presents common tips on selection and installation of analog hardware, as well as basic troubleshooting techniques, to maximize the performance of your analog input/output circuits.

General Tips for Analog Circuits

When selecting and installing analog devices there are a few things to consider:

- Current devices are much more tolerant to noise than voltage devices.
- Current devices can handle much longer runs of wire without signal loss.
- Shielded twisted pair wire should always be used. Analog signals are typically low power and the better your isolation the less noise you will have degrading the signal.
- If the analog signal is from a thermocouple, the appropriate thermocouple extension wire and terminal blocks must be used if needed to extend wire lengths.
- Use the shortest wiring route whenever possible.
- Do not run analog signal wiring in the same conduit or wire way as AC wiring.
- Do not run analog signal wiring next to large motors, high current switches, or transformers.
- Route the wiring through an approved cable housing to minimize the risk of accidental damage.
- Shields should be connected only at one end, to ground at the source device. Connecting both ends of a shield will create a ground loop which can increase the noise in a circuit.
- Bonding of the DC negative to ground should be considered, with the exception of Class II power supplies which should never be bonded to ground. This can help with reducing noise induced into analog circuits. Please note that consideration should be given to all devices that will utilize the power supply to insure that bonding of the negative will not cause damage or interference.
- AC power should be checked from neutral to ground. This voltage should be less than 0.1 VAC.

NOTE: *Your company may have guidelines for wiring and cable installation. If so, you should check those before you begin the installation.*

NOTE: *Check local and national codes to choose the correct method for your application.*

Reducing Electrical Noise

Electrical noise is one of the most difficult problems to diagnose. It can enter the system from a wide range of conducted or radiated sources.

Conducted noise is when the electrical interference is introduced into the system by way of an attached wire, panel connection, etc. It may enter through an I/O point, a power supply connection, the communication ground connection, or the chassis ground connection.

Radiated noise is when electrical interference is introduced into the system without a direct electrical connection, such as via radio waves.

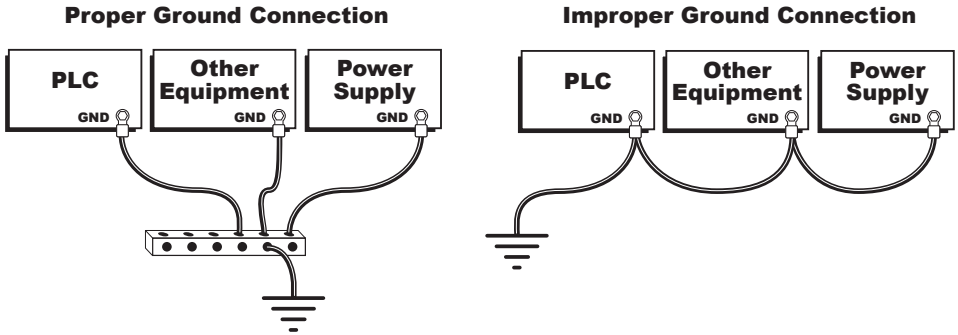
It may be difficult to determine how electrical noise is entering the system, but the corrective actions for either type of noise problem are similar.

While electrical noise cannot be eliminated completely, it can be reduced to a level that will not affect system function. Proper grounding of components and signal wiring along with proper isolation of voltages can minimize noise in the system.

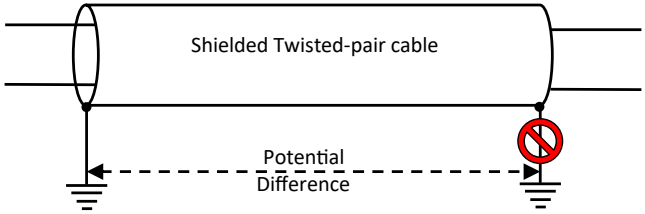
Grounding

Most noise problems result from improper grounding of the system. A good earth ground can be the single most effective way to correct noise problems. If a ground is not available, install a ground rod as close to the system as possible.

Ensure all ground wires are single point grounds and are not daisy chained from one device to another. Ground metal enclosures around the system. Loose ground wires on your devices are more susceptible to noise than the other wires in your system. A loose wire is no more than a large antenna waiting to introduce noise into the system; therefore, you should tighten all connections in your system. Review Chapter 1, "General Installation and Wiring Guidelines", if you have questions regarding how to ground your system.



Cables with shields should be grounded on only one end of the shield. This prevents ground loops and allows for any radiated noise collected by the shield to properly drain to a single ground point.



Isolation

Electrical noise can enter the system through the power source for the MPU and I/O. Installing an isolation transformer for all AC sources can correct this problem.

DC power sources should be properly grounded, except for Class II power supplies which should never be bonded to ground. Switching DC power supplies commonly generate more noise than linear supplies. Typically switching type supplies work well for analog circuits, but for some circuits where noise can be a factor, linear type supplies may be needed.

Analog wiring should be placed in separate wire ways or wiring bundles. Keep AC and DC wiring separated. Never run analog signal or communications wiring in parallel or in close proximity to high voltage wiring.

Transformers, inductors, VFDs, DC drives, welders, static generators, ultrasonic devices, radio transmitters, receivers, wiring and antennas, along with similar types of devices, generate large amounts of RF interference. DC wiring, analog wiring and communications wiring should be kept as far away from these sorts of devices and their associated input and output wiring as possible.

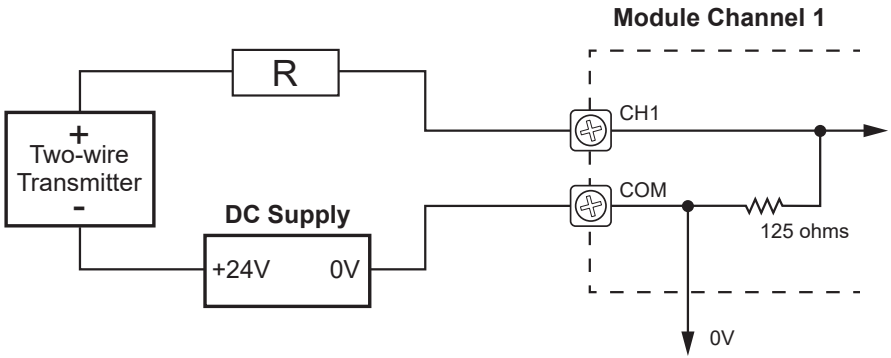
Devices that generate noise such as those listed above, along with coil driven devices such as relays, contactors, solenoids, etc., should be placed on a separate power supply from analog circuits. If this is not possible, then great care should be taken to properly suppress the transient voltage spikes from these devices turning on and off. See Chapter 1, "BRX General Installation and Wiring Guidelines" for more information on this subject.

Current Module Tips and Troubleshooting

- Use shielded twisted pair wire. Suggested ADC cables are PLTC3-18-xS-xxxx or PLTC3-18-xSS-xxxx
- Analog circuits follow Ohm's Law. As such it is important to follow the specifications for impedance in the circuit. If you allow the impedance values to go outside of the specification, damage to the module will occur.
- If your transmitter requires a load resistance higher than 125Ω, you may need to add a resistor in series with the module. Consider the following example for a transmitter being operated from a 24VDC supply with a recommended load resistance of 750 ohms. Since the module has a 125-ohm resistance, you need to add an additional resistor.

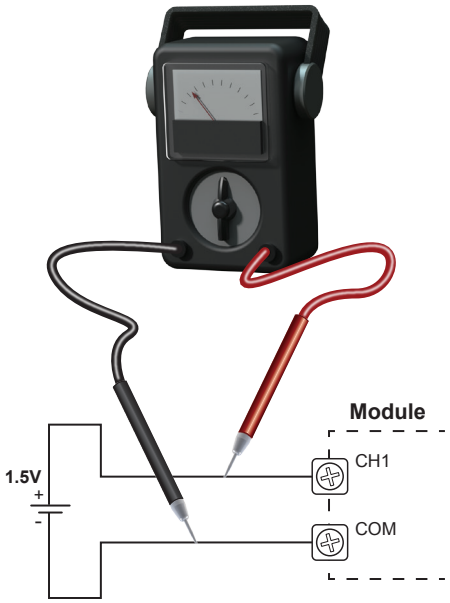
R = Tr – Mr
R = 750 – 125
R ≥ 625

R = Resistor to add
Tr = Termination Requirement
Mr = Module resistance (Internal 125 ohms)



- If you suspect an I/O error, there are several things that could be causing the problem:
  - A blown fuse.
  - A loose terminal block.
  - The 24VDC supply has failed or 24VDC has not been supplied to the I/O common.
  - The I/O point has failed.
- The DC power supply that powers the module should be checked for the negative side to ground voltage being under 0.1 V for both AC and DC. If this voltage is floating, it can cause errors and/or damage to the circuit.

- To test a current input module, use a 1.5 V battery wired across the positive and negative terminals of the channel to check for current. When applied across a current analog input point, a reading of approximately 30% of the full scale value should result.

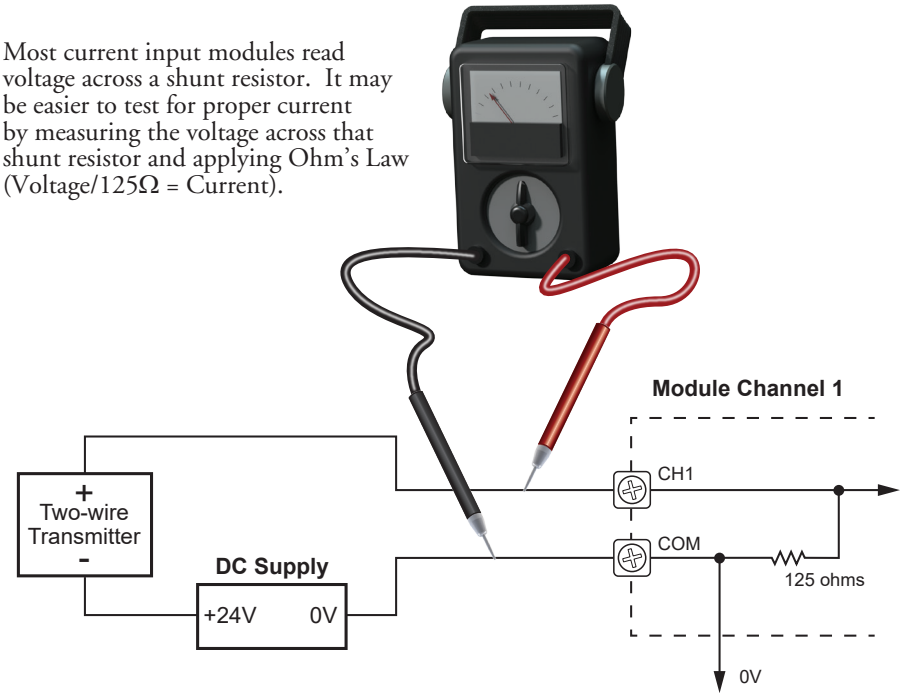


0–20mA is 0–5VDC across the input resistor

1.5V/5V=0.3

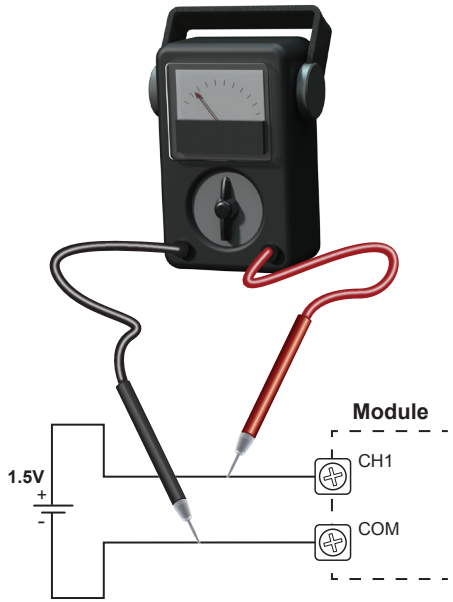
0.3*65535 = ~19660 counts or
0.3*32767=~9830 counts

- Most current input modules read voltage across a shunt resistor. It may be easier to test for proper current by measuring the voltage across that shunt resistor and applying Ohm's Law (Voltage/125Ω = Current).



Voltage Module Tips and Troubleshooting

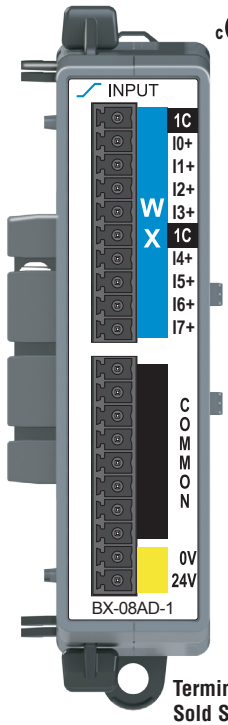
- Use shielded twisted pair wire. Suggested ADC cables are PLTC3-18-xS-xxxx or PLTC3-18-xSS-xxxx.
- Jumper the positive and negative terminals together on unused voltage input channels.
- Analog circuits follow Ohm's Law. As such it is important to follow the specifications for impedance in the circuit. If you allow the impedance values to go outside of the specification, damage to the module will occur.
- If you suspect an I/O error, there are several things that could be causing the problem:
  - A blown fuse
  - A loose terminal block
  - The 24VDC supply has failed or 24VDC has not been supplied to the I/O common.
  - The I/O point has failed.
- The DC power supply that powers the module should be checked for the negative side to ground voltage being under 0.1 V for both AC and DC. If this voltage is floating, it can cause errors and/or damage to the circuit.
- To test the voltage input module, use a 1.5 V battery wired across the positive and negative terminals of the input channel to check for voltage. When applied across a voltage analog input point, a reading of approximately 1.5 V should result.



Temperature (Thermocouple) Module Tips and Troubleshooting

- Use shielded thermocouple extension wire of the same type as the thermocouple.
- Do not use terminal blocks that are not designed for thermocouple extension wire.
- Thermocouple wires that have just been twisted to form a junction will inherently be less accurate than factory made thermocouples. The use of twist junction thermocouples is not recommended.
- Jumper each of the channel +/- connections together on the module with a short piece of copper wire. This will cause the module to return the measured terminal block temperature for that channel. Does it read the correct ambient temperature of the thermocouple module? If so there probably isn't anything wrong with the module. This temperature will be several degrees higher than the ambient air temperature of the enclosure.
- With a thermocouple simulator, you have to disable the burnout detection for the module using the module setup in the Do-more! Designer software and download the program to the PLC. This will disable the burnout circuitry, which will cause incorrect readings if left enabled. Even then, it is likely that the module will not read exactly what the simulator is putting out due to the wire differences and the terminal block on the module causing some cold junction error.
- It is possible that the module may be damaged from exceeding the common mode voltage spec which is 5 Volts. The voltage needs to be measured between each channel on both plus and minus terminals of the module on both AC and DC scales and make sure that it is under 5 Volts maximum. Preferably the voltage should be less than 0.1V.
- AC power should be checked from neutral to ground. This voltage should be less than 0.1 VAC.
- With grounded thermocouples, take precautions to prevent having a voltage potential between thermocouple tips. A voltage of 1V or greater between tips will skew measurements. For grounded thermocouples, the equipment and thermocouples must be bonded with large-gauge braided wire to the same ground as the PLC.
- The DC power supply that powers the module should be checked for the negative side to ground voltage being under 0.1V for both AC and DC. If this voltage is floating, it can cause errors and/or damage to the circuit.

BX-08AD-1 Analog Current Sinking Input



Terminal Blocks Sold Separately

We recommend using prewired ***ZIP***Link cables and connection modules. If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

Analog Current Sinking Input Specifications	
Inputs per Module	8
Commons	1
Module Signal Input Range	0–20mA, 4–20mA (Default)
Signal Resolution	16-bit, 15-bit (Default)
Input Impedance	125Ω±0.1%, 1/10th watt
All Channel Update Rate	45ms (8 channels)
Over Current Circuit Detection Time	< 1second
Maximum Continuous Overload (Voltage)	0.5 Watts (e.g. ±100V @ 5mA)
Sample Duration Time	5µs per channel
Hardware Filter Characteristics	Low Pass 1st order, −3dB @ 144Hz
Conversion Method	Successive approximation
Linearity Error (end to end)	±0.01% of range
Input Stability and Repeatability	±0.035% of range (after 10 min. warmup)
Full Scale Calibration Error	±0.02% of range
Offset Calibration Error	±0.02% of range
Accuracy vs. Temperature	±25PPM / ºC maximum
Maximum Inaccuracy	0.1% of range (incl. Temperature Drift)
Maximum Crosstalk	−96dB, 1 LSB
Channel to Backplane Isolation	1800VAC applied for one second
Channel to Channel Isolation	None
Loop Fusing (External)	Fast-acting 0.032A recommended
Backplane Power Consumption	0.1 W
External DC Power Required	Class 2 or LPS power supply 24VDC (±20%) 25mA
Heat Dissipation	2.5 W
Weight	100g (3.5 oz)
Software Version	Do-more! Designer Programming Software version 2.1 or later

IMPORTANT!

Hot-Swapping Information
NOTE: This device cannot be Hot Swapped.

BX-08AD-1 Analog Current Sinking Input, continued

Data Range Specifications

Selection	Description	Enable 16 bit Unchecked (15 bit Resolution, Default)			Enable 16 bit Checked (16 bit Resolution)		
		Raw Counts	Casting*	µA Per Count	Raw Counts	Casting*	µA Per Count
0–20mA	unipolar 0–20mA	0–32767	–	0.61	0–65535	WXn:U	0.31
4–20mA	unipolar 4–20mA	0–32767	–	0.49	0–65535	WXn:U	0.24

** For more information on Casting refer to Help topic DMD0309 in the Do-more! Designer Software.*

The module reserves the first 24 bits of unused contiguous space in the X register, aligned to an 8-bit word boundary, for status reporting. Error flags for this module are laid out within its status register space as described in the following table.

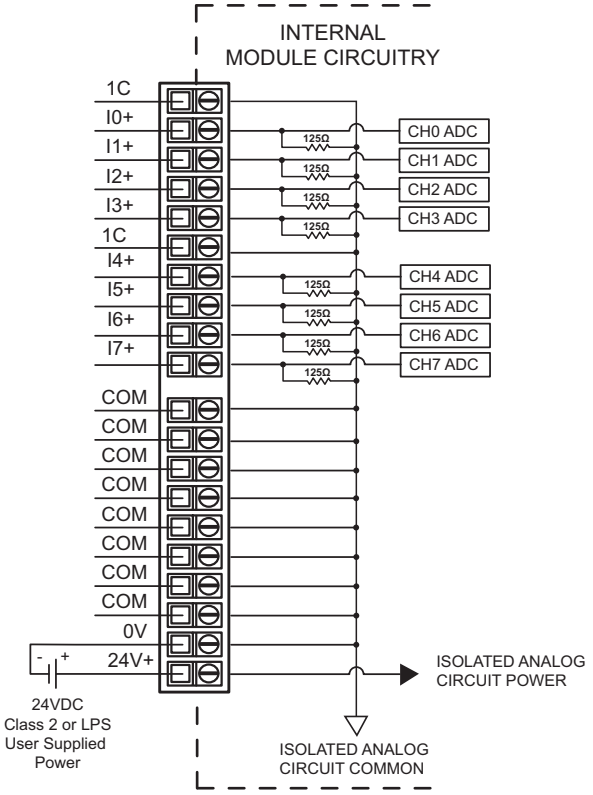
Error Flag Specifications

	MSB							LSB
1st Byte of unused X Registers								
Module Status	-	-	-	-	-	Data Not Valid	Missing 24VDC	Self Test Failed
2nd Byte of unused X Registers								
Channel Open (Broken Transmitter)*	Channel 8	Channel 7	Channel 6	Channel 5	Channel 4	Channel 3	Channel 2	Channel 1
3rd Byte of unused X Registers								
Unused	-	-	-	-	-	-	-	-

** Broken Transmitter bits will turn on below ~3.75 mA.*

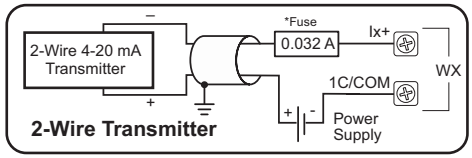
BX-08AD-1 Analog Current Sinking Input, continued

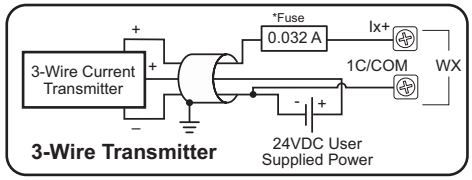
Analog Current Input Wiring

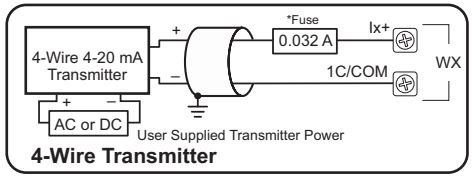


Analog Current Sinking Input Circuits

*An Edison S500-32-R 0.032 A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.





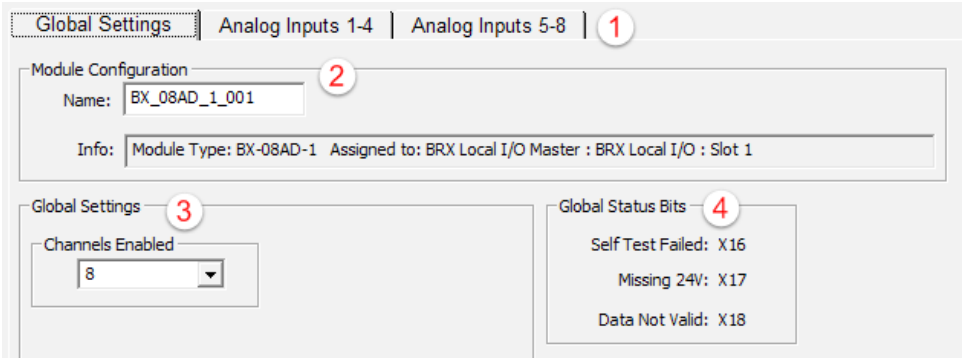


NOTE: Shield should be connected only at one end, to ground at the source device.

BX-08AD-1 Analog Current Sinking Input, continued

Software Setup

After the module is installed, open the Do-more! Designer programming software version 2.1 or later, connect to the BRX MPU and open the **Configure Module** dialog as described at the beginning of this chapter.



(1) The module options are divided into subsets across multiple tabs. Click the appropriate tab to edit the configuration.

(2) *Module Configuration*

Name – Each module comes with a default name. This may be changed by the user to better identify the module if desired.

Info – This is the system description of the module. It is static and may not be changed.

(3) *Global Settings*

Channels Enabled – Select how many channels will be used. The default is all channels. Selecting fewer channels may increase the update frequency. See the module specifications for details.

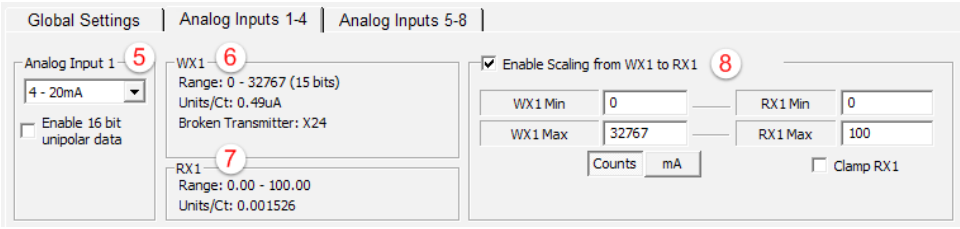
(4) *Global Status Bits*

Self Test Failed – This bit will be On if the module has failed its internal self-test. In this case the module is likely bad and should be replaced.

Missing 24V – This bit will be On if the external 24VDC power is missing. Check the 24VDC power connection on the module terminal block.

Data Not Valid – This bit will be On if the module does not have the latest configuration parameters or the module has not been configured at all. Reload the program into the CPU and power cycle.

BX-08AD-1 Analog Current Sinking Input, continued



(5) ***Analog Input x***

These settings are for each channel of the analog module.

Drop Down menu - Select the range of the analog input here.

Enable 16 bit unipolar data – Check this box to change the raw count range from a signed decimal bipolar data format to an unsigned decimal data format. This may require that Casting be used in the program in order to properly access the data. Refer to the chart of Data Range Specifications earlier in this chapter to see if the registers must be accessed with Casting.

(6) ***WXx***

Range – The number of Raw counts for the selected channel on the module

Units/Ct – The amount of current that will equal 1 raw count.

Broken Transmitter – The input register that when On will indicate that the loop is broken.

(7) ***RXx***

Range – The engineering units to which the raw counts are scaled.

Units/Ct – The number of raw counts that will equal 1 scaled engineering unit.

(8) ***Enable Scaling from WXx to RXx***

WXx Min – The minimum value of the raw counts to scale.

WXx Max – The maximum value of the raw counts to scale.

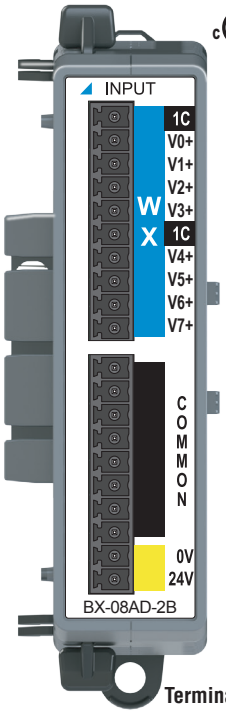
RXx Min – The minimum value of the engineering units for scaling.

RXx Max – The maximum value of the engineering units for scaling.

Counts/mA – Use these buttons to change the raw scaling to counts or milliamps.

Clamp RXx – If this box is checked, RXx will clamp at the minimum and maximum scaled values.

BX-08AD-2B Analog Voltage Input



Terminal Blocks Sold Separately

Analog Voltage Input Specifications	
Inputs per Module	8
Commons	1
Module Signal Input Range	±10 VDC, ±5 VDC, 0–5 VDC, 0–10 VDC (default)
Signal Resolution	16-bit, 15 bit (Default)
Input Impedance	>10MΩ
All Channel Update Rate	45ms (8 channels)
Sample Duration Time	5µs per channel
Hardware Filter Characteristics	Low Pass 2nd order, −3dB @ 15kHz
Conversion Method	Successive approximation
Accuracy vs. Temperature	±25PPM / °C maximum
Maximum Inaccuracy	0.15% of full range (over temp)
Linearity Error (end to end)	±0.03%
Input Stability and Repeatability	±0.06% of range (after 10 min. warmup)
Full Scale Calibration Error	±0.08% of range
Offset Calibration Error	±0.08% of range
Maximum Crosstalk	−96dB, 1 LSB
Channel to Backplane Isolation	1800VAC applied for one second
Channel to Channel Isolation	None
Loop Fusing (External)	Fast-acting 0.032A recommended
Backplane Power Consumption	0.1 W
External DC Power Required	Class 2 or LPS power supply 24VDC (±20%) 25mA
Heat Dissipation	2.5 W
Weight	100g (3.5 oz)
Software Version	Do-more! Designer Programming Software version 2.1 or later

We recommend using prewired ***ZIP***Link cables and connection modules.
If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

IMPORTANT!

Hot-Swapping Information
NOTE: This device cannot be Hot Swapped.

BX-08AD-2B Analog Voltage Input, continued

Data Range Specifications

Selection	Description	Enable 16 bit Unchecked (15 bit Resolution, Default)[1]			Enable 16 bit Checked (16 bit Resolution)		
		Raw Counts	Casting[2]	µV Per Count	Raw Counts	Casting[2]	µV Per Count
0–10V	unipolar 10VDC	0–32767	-	305	0–65535	WXn:U	152
0–5V	unipolar 5VDC	0–32767	-	152	0–65535	WXn:U	76
±10V	bipolar 10VDC	-	-	-	−32768 to 32767	-	305
±5V	bipolar 5VDC	-	-	-	−32768 to 32767	-	152

1. Bipolar ranges default to 16-bit resolution.

2. For more information on Casting refer to Help topic DMD0309 in the Do-more! Designer Software.

8

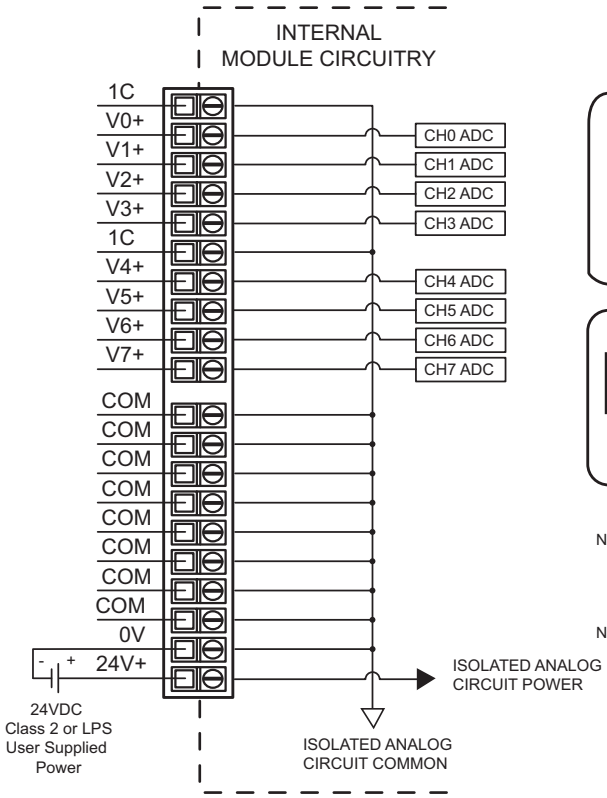
The module reserves the first 24 bits of unused contiguous space in the X register, aligned to an 8-bit word boundary, for status reporting. Error flags for this module are laid out within its status register space as described in the following table.

Error Flag Specifications

	MSB							LSB
1st Byte of unused X Registers								
Module Status	-	-	-	-	-	Data Not Valid	Missing 24VDC	Self Test Failed
2nd Byte of unused X Registers								
Channel Out of Range	Channel 8	Channel 7	Channel 6	Channel 5	Channel 4	Channel 3	Channel 2	Channel 1
3rd Byte of unused X Registers								
Unused	-	-	-	-	-	-	-	-

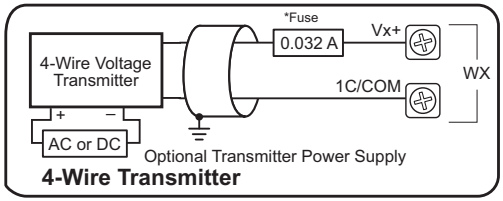
BX-08AD-2B Analog Voltage Input, continued

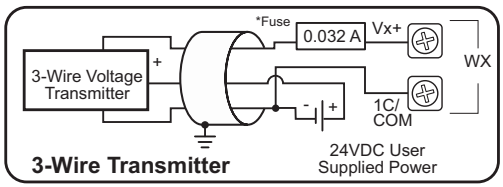
Analog Voltage Input Wiring



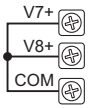
Analog Voltage Input Circuits

*An Edison S500-32-R 0.032 A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.





NOTE: For maximum accuracy: Jumper unused inputs to common.

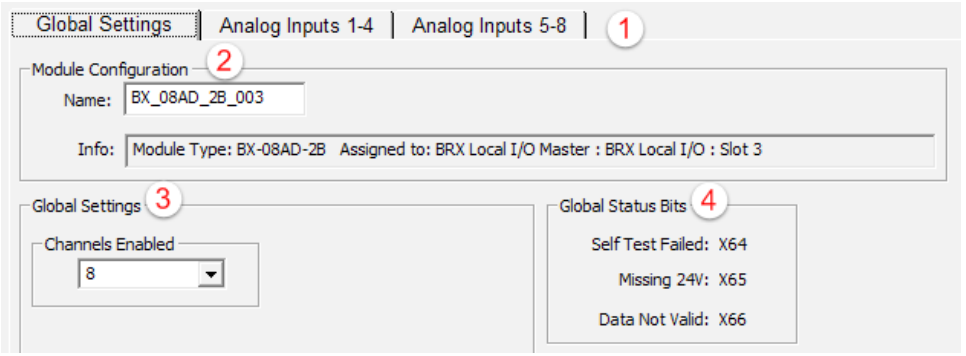


NOTE: Shield should be connected only at one end, to ground at the source device.

BX-08AD-2B Analog Voltage Input, continued

Software Setup

After the module is installed, open the Do-more! Designer programming software version 2.1 or later, connect to the BRX MPU and open the **Configure Module** dialog as described at the beginning of this chapter..



(1) The module options are divided into subsets across multiple tabs. Click the appropriate tab to edit the configuration.

(2) *Module Configuration*

Name – Each module comes with a default name. This may be changed by the user to better identify the module if desired.

Info – This is the system description of the module. This is static and may not be changed.

(3) *Global Settings*

Channels Enabled – Select how many channels will be used. The default is all channels. Selecting fewer channels may increase the update frequency. See the module specifications for details.

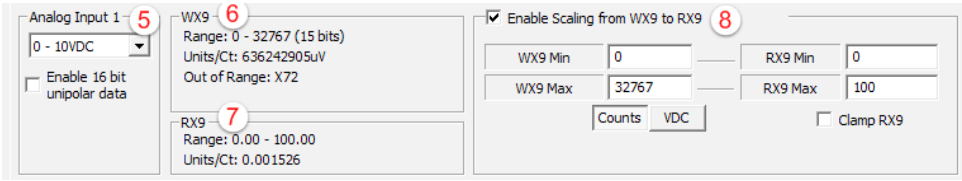
(4) *Global Status Bits*

Self Test Failed – This bit will be On if the module has failed its internal self-test. In this case the module is likely bad and should be replaced.

Missing 24V – This bit will be On if the external 24VDC power is missing. Check the 24VDC power connection on the module terminal block.

Data Not Valid – This bit will be On if the module does not have the latest configuration parameters or the module has not been configured at all. Reload the program into the CPU and power cycle.

BX-08AD-2B Analog Voltage Input, continued



(5) ***Analog Input*** x

These settings are for each channel of the analog module.

Drop Down menu - Select the range of the analog input here.

Enable 16 bit unipolar data – Check this box to change the raw count range from a signed decimal bipolar data format to an unsigned decimal data format. This may require that Casting be used in the program in order to properly access the data. Refer to the chart of Data Range Specifications earlier in this chapter to see if the registers must be accessed with Casting.

(6) ***WXx***

Range – The number of Raw counts for the selected channel on the module

Units/Ct – The amount of voltage that will equal 1 raw count.

Out of Range – The input register that when On will indicate that the voltage is outside of the selected range.

(7) ***RXx***

Range – The engineering units to which the raw counts are scaled.

Units/Ct – The number of raw counts that will equal 1 scaled engineering unit.

(8) ***Enable Scaling from WXx to RXx***

WXx Min – The minimum value of the raw counts to scale.

WXx Max – The maximum value of the raw counts to scale.

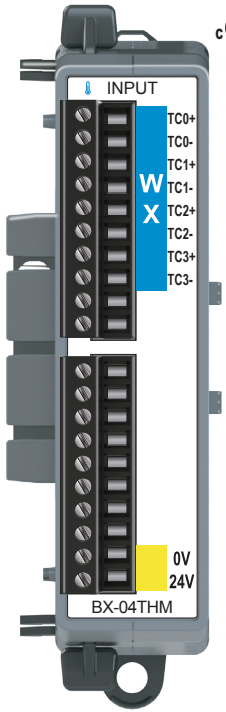
RXx Min – The minimum value of the engineering units for scaling.

RXx Max – The maximum value of the engineering units for scaling.

Counts/VDC – Use these buttons to change the raw scaling to counts or volts.

Clamp RXx – If this box is checked, RXx will clamp at the minimum and maximum scaled values.

BX-04THM Thermocouple Input



BX-RTB10 Terminal Blocks Included

8

NOTE: *This device does not support ZIPLink Wiring Systems*

IMPORTANT!

Hot-Swapping Information

NOTE: This device cannot be Hot Swapped.

Thermocouple Input Specifications

Input Channels	4 Differential
Commons	0
Input Impedance	>5MΩ
Resolution	16-bit, 0.1°(C or F)
Thermocouple Input Ranges	Type J: −190° to 760°C (−310° to 1400°F) (default) Type E: −210° to 1000°C (−346° to 1832°F) Type K: −150° to 1372°C (−238° to 2502°F) Type R: 65° to 1768°C (149° to 3214°F) Type S: 65° to 1768°C (149° to 3214°F) Type T: −230° to 400°C (−382° to 752°F) Type B: 529° to 1820°C (984° to 3308°F) Type N: −70° to 1300°C (−94° to 2372°F) Type C: 65° to 2320°C (149° to 4208°F)
Cold Junction Compensation	Automatic
Thermocouple Linearization	Automatic
Accuracy vs. Temperature	±50PPM per °C (maximum)
Linearity Error	±1°C maximum (±0.5°C typical) Monotonic with no missing codes
Maximum Inaccuracy–Temperature	±3°C maximum (excluding thermocouple error) (including temperature drift)
Linear Voltage Input Ranges	0–39mV ±39mV ±78mV 0–156mV ±156mV 0–1.25 V
Maximum Inaccuracy–Voltage	0.06% @ 25°C, 0.10% @ 0–60°C
All Channel Update Rate	2.16 s
Sample Duration Time	270ms
Open Circuit Detection Time	Within 2s
Maximum Ratings	Fault protected inputs to ±50V
Common Mode Range	0.6 V (@ 16-bit Resolution)
Common Mode Rejection	100dB @ DC and 130dB @ 60Hz
Conversion Method	Sigma-Delta
Backplane Power Consumption	0.1 W
External DC Power Required	Class 2 or LPS power supply 24VDC (±20%) 25mA
Heat Dissipation	2.5 W
Weight	100g (3.5 oz)
Software Version	Do-more! Designer Programming Software version 2.1 or later

BX-04THM Thermocouple Input, continued

Data Range Specifications

Selection	Description	Enable 16 bit Unchecked (15 bit Resolution, Default)[1]			Enable 16 bit Checked (16 bit Resolution)		
		Raw Counts	Casting[2]	µV Per Count	Raw Counts[3]	Casting[2]	µV Per Count
Type J	Type J	-	-		°C: −1900 to 7600 °F: −3100 to 14000	-	-
Type K	Type K	-	-		°C: −2100 to 10000 °F: −3460 to 18320	-	-
Type E	Type E	-	-		°C: −1500 to 13720 °F: −2380 to 25020	-	-
Type R	Type R	-	-		°C: 650 to 17680 °F: 1490 to 32140	-	-
Type S	Type S	-	-		°C: 650 to 17680 °F: 1490 to 32140	-	-
Type T	Type T	-	-		°C: −2300 to 4000 °F: −380 to 7520	-	-
Type B	Type B	-	-		°C: 5290 to 18200 °F: 9840 to 33080	- WXn:U	-
Type N	Type N	-	-		°C: −700 to 13000 °F: −940 to 23720	-	-
Type C	Type C	-	-		°C: 650 to 23200 °F: 1490 to 42080	- WXn:U	-
0–39 mVDC	Unipolar 39 mVDC	0–32767	-	1.2	0–65535	WXn:U	0.6
−39–39 mVDC	Bipolar 39 mVDC	-	-		−32768 to 32767	-	1.2
−78–78 mVDC	Bipolar 78 mVDC	-	-		−32768 to 32767	-	2.4
0–156 mVDC	Unipolar 156 mVDC	0–32767	-	4.8	0–65535	WXn:U	2.4
−156–156 mVDC	Bipolar 156 mVDC	-	-		−32768 to 32767	-	4.8
0–1.25 VDC	Unipolar 1.25 VDC	0–32767	-	38.1	0–65535	WXn:U	19.1

1. Thermocouple and bipolar ranges default to 16-bit resolution.
2. For more information on Casting refer to Help topic DMD0309 in the Do-more! Designer Software.
3. Temperatures have one implied decimal place (e.g., raw count of -1900 is -190.0°).

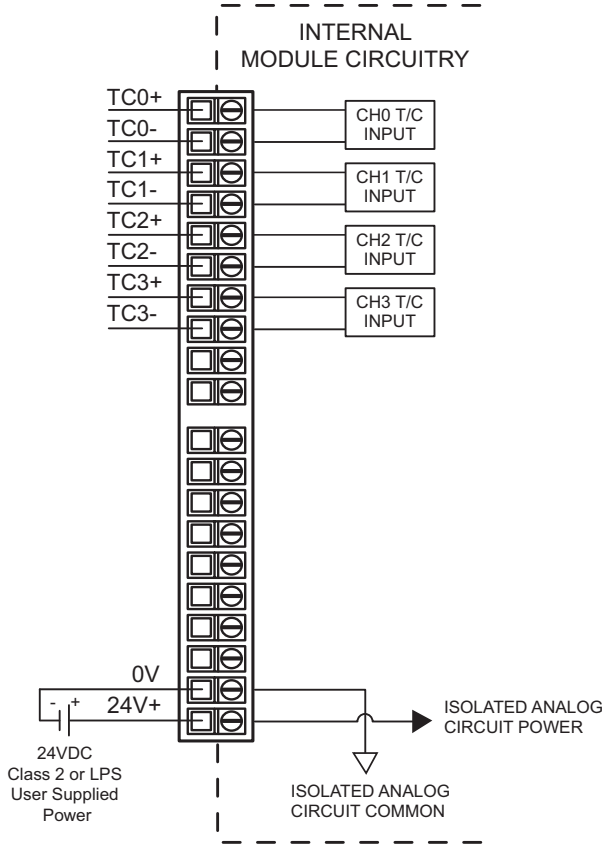
The module reserves the first 24 bits of unused contiguous space in the X register, aligned to an 8-bit word boundary, for status reporting. Error flags for this module are laid out within its status register space as described in the following table.

Error Flag Specifications

	MSB							LSB
1st Byte of unused X Registers								
Module Status	-	-	-	-	-	Data Not Valid	Missing 24VDC	Self Test Failed
2nd Byte of unused X Registers								
Channel Out of Range	-	-	-	-	Channel 4	Channel 3	Channel 2	Channel 1
3rd Byte of unused X Registers								
Channel Open (Burn Out)	-	-	-	-	Channel 4	Channel 3	Channel 2	Channel 1

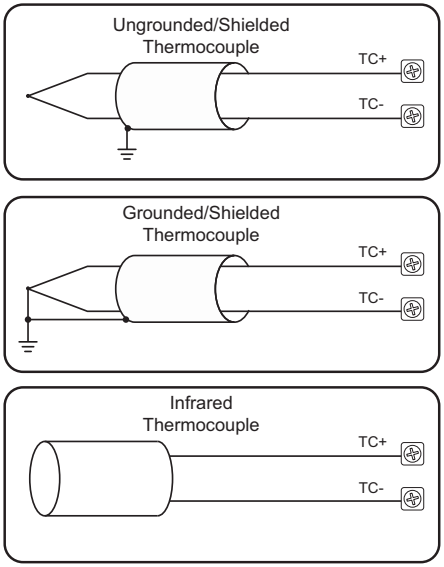
BX-04THM Thermocouple Input, continued

Analog Thermocouple/Voltage Input Wiring



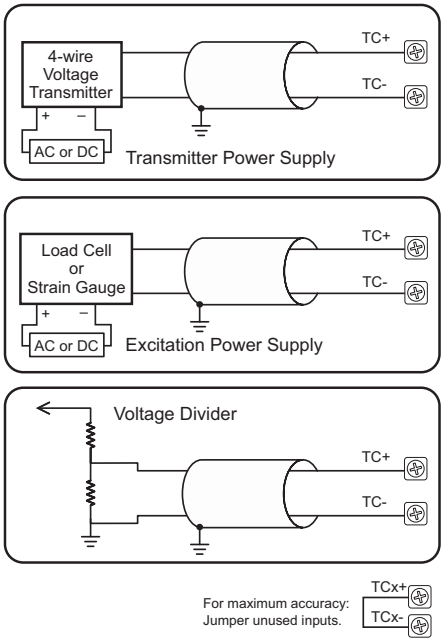
BX-04THM Thermocouple Input, continued

Thermocouple Input Circuits



NOTE: Thermocouple extension wire and proper thermocouple terminal blocks must be used to extend thermocouples. AutomationDirect thermocouple wire is recommended.

Analog Voltage Input Circuits



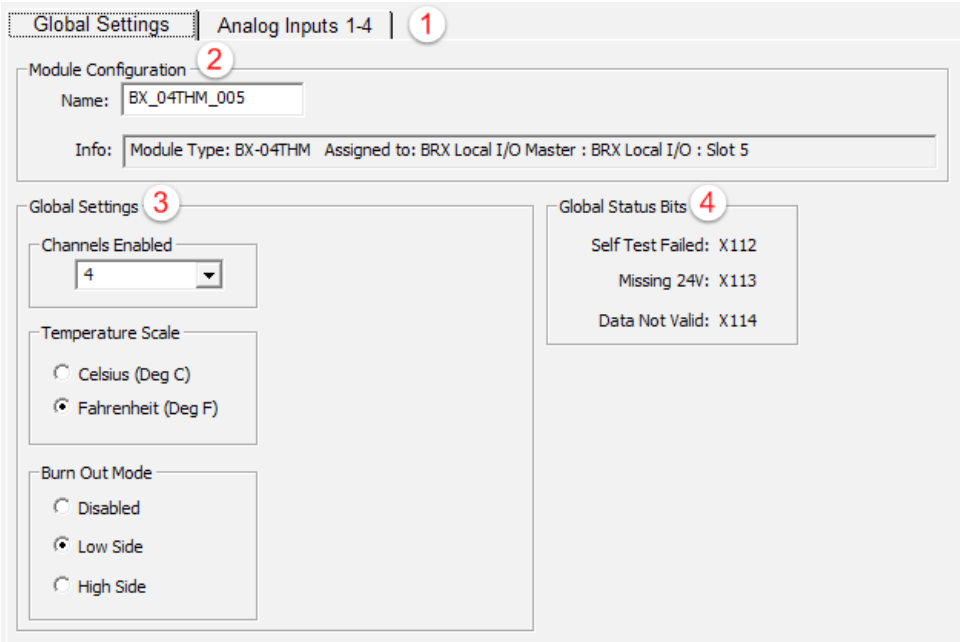
For maximum accuracy:
Jumper unused inputs.

NOTE: Shield should be connected only at one end, to ground at the source device.

BX-04THM Thermocouple Input, continued

Software Setup

After the module is installed, open the Do-more! Designer programming software version 2.1 or later, connect to the BRX MPU and open the **Configure Module** dialog as described at the beginning of this chapter..



(1) The module options are divided into subsets across multiple tabs. Click the appropriate tab to edit the configuration.

(2) *Module Configuration*

Name – Each module comes with a default name. This may be changed by the user to better identify the module if desired.

Info – This is the system description of the module. This is static and may not be changed.

(3) *Global Settings*

Channels Enabled – Select how many channels will be used. The default is all channels. Selecting fewer channels may increase the update frequency. See the module specifications for details.

Temperature Scale – Select either Celcius or Fahrenheit.

Burn Out Mode – Select if the Input register should read Low or High on burn out or if burn out detection should be disabled. Note: *Burn Out Mode* must be set to Disabled in order to use a Thermocouple Calibrator.

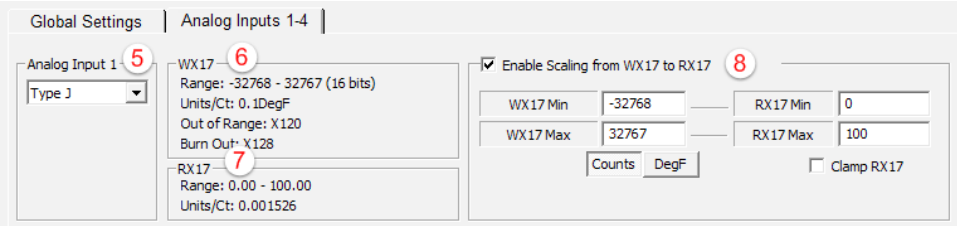
BX-04THM Thermocouple Input, continued

(4) *Global Status Bits*

Self Test Failed – This bit will be On if the module has failed its internal self-test. In this case the module is likely bad and should be replaced.

Missing 24V – This bit will be on if the external 24VDC power is missing. Check the 24VDC power connection on the module terminal block.

Data Not Valid – This bit will be on if the module does not have the latest configuration parameters or the module has not been configured at all. Reload the program into the CPU and power cycle.



(5) *Analog Input* x

These settings are for each channel of the analog module.

Drop Down menu - Select the range of the analog input here.

(6) *WXx*

Range – The number of Raw counts for the selected channel on the module

Units/Ct – The amount of temperature or voltage that will equal 1 raw count.

Out of Range – The input register that when On will indicate that the input is outside of the range selected.

Burn Out – If burn out is enabled, this register will be On when the loop is broken.

(7) *RXx*

Range – The engineering units to which the raw counts are scaled.

Units/Ct – The number of raw counts that will equal 1 scaled engineering unit.

(8) *Enable Scaling from WXx to RXx*

WXx Min – The minimum value of the raw counts to scale.

WXx Max – The maximum value of the raw counts to scale.

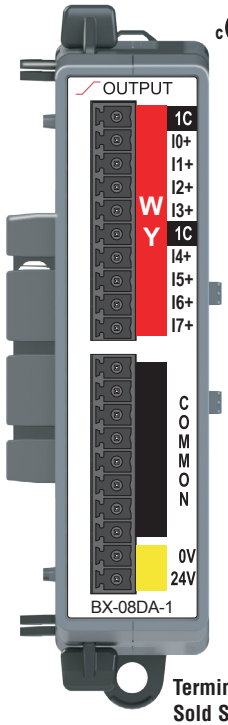
RXx Min – The minimum value of the engineering units for scaling.

RXx Max – The maximum value of the engineering units for scaling.

Counts/DegF – Use these buttons to change the raw scaling to counts or degrees (C or F).

Clamp RXx – If this box is checked, RXx will clamp at the minimum and maximum scaled values.

BX-08DA-1 Analog Current Source Output



Terminal Blocks Sold Separately

We recommend using prewired ***ZIP***Link cables and connection modules. If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

IMPORTANT!

Hot-Swapping Information

NOTE: This device cannot be Hot Swapped.

Analog Current Source Ouput Specifications	
Outputs per Module	8
Commons	1
Module Signal Output Range	0–20mA, 4–20mA (Default)
Signal Resolution	16-bit, 15-bit (Default)
Output Type	Current Sourcing up to 22mA
Output Value in Fault Mode	~0mA
Maximum Load Impedance	700Ω
Maximum Capacitive Load	1000pF
Allowed Load Type	Grounded
Maximum Continuous Overload	30mA
All Channel Update Rate	1.5 ms per enabled channel
Maximum Inaccuracy	±0.15% of range
Maximum Full Scale Calibration Error	±0.08% of range
Maximum Offset Calibration Error	±0.06% of range
Conversion Method	Successive approximation
Accuracy vs. Temperature	±25PPM / °C maximum
Maximum Crosstalk	+10µV
Linearity Error (end to end)	±0.06% of range
Output Stability and Repeatability	±0.02% of full range after 10 minute warmup (typical)
Output Ripple	±0.01% of range/mA
Output Settling Time	200µs
Channel to Backplane Isolation	1800VAC applied for one second
Channel to Channel Isolation	None
Loop Fusing (External)	Fast-acting 0.032A recommended
Backplane Power Consumption	0.1 W
External DC Power Required	Class 2 or LPS power supply 24VDC (±20%) 250mA
Heat Dissipation	8.1 W
Weight	100g (3.5 oz)
Software Version	Do-more! Designer Programming Software version 2.1 or later

BX-08DA-1 Analog Current Source Output, continued

Data Range Specifications

Selection	Description	Enable 16 bit Unchecked (15 bit Resolution, Default)			Enable 16 bit Checked (16 bit Resolution)		
		Raw Counts	Casting*	µA Per Count	Raw Counts	Casting*	µA Per Count
0–20mA	unipolar 0–20mA	0–32767	-	0.61	0–65535	WYn:U	0.31
4–20mA	unipolar 4–20mA	0–32767	-	0.49	0–65535	WYn:U	0.24

** For more information on Casting refer to Help topic DMD0309 in the Do-more! Designer Software.*

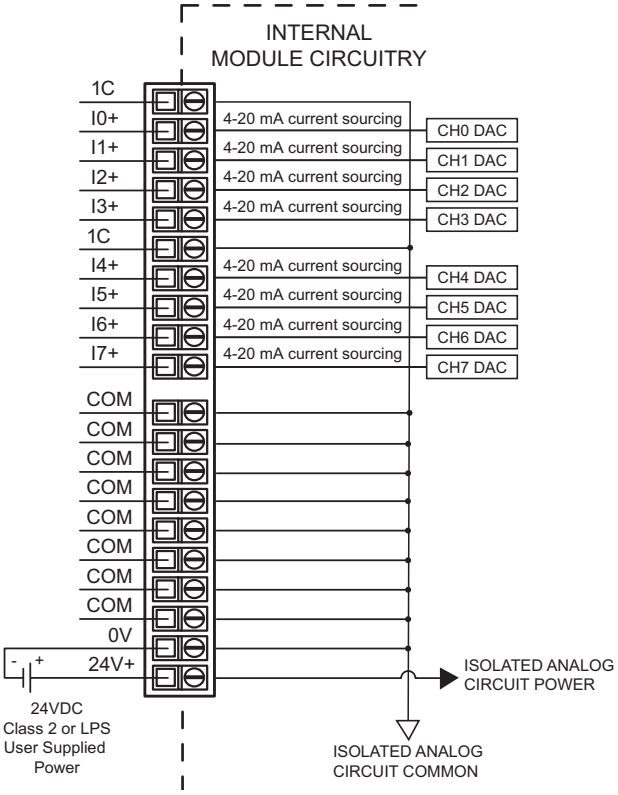
The module reserves the first 24 bits of unused contiguous space in the X register, aligned to an 8-bit word boundary, for status reporting. Error flags for this module are laid out within its status register space as described in the following table.

Error Flag Specifications

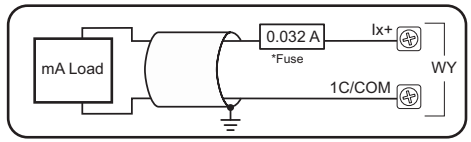
	MSB							LSB
1st Byte of unused X Registers								
Module Status	-	-	-	-	-	Data Not Valid	Missing 24VDC	Self Test Failed
2nd Byte of unused X Registers								
Unused	-	-	-	-	-	-	-	-
3rd Byte of unused X Registers								
Unused	-	-	-	-	-	-	-	-

BX-08DA-1 Analog Current Source Output, continued

Analog Current Ouput Wiring



Analog Current Source Output



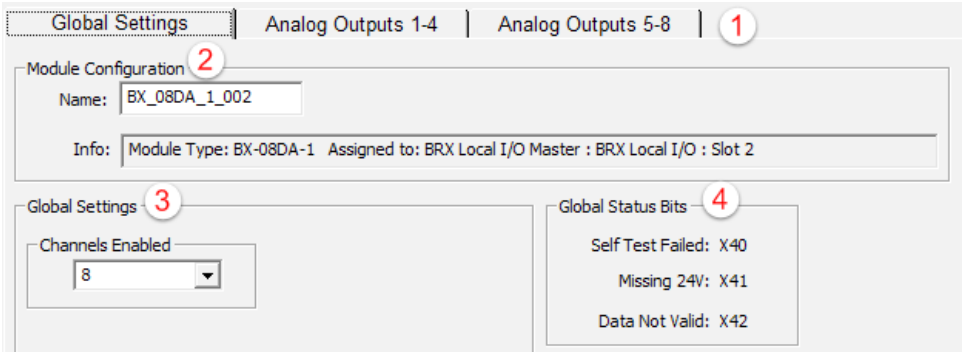
*An Edison S500-32-R 0.032 A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.

NOTE: Shield should be connected only at one end, to ground at the source device.

BX-08DA-1 Analog Current Source Output, continued

Software Setup

After the module is installed, open the Do-more! Designer programming software version 2.1 or later, connect to the BRX MPU and open the **Configure Module** dialog as described at the beginning of this chapter..



(1) The module options are divided into subsets across multiple tabs. Click the appropriate tab to edit the configuration.

(2) *Module Configuration*

Name – Each module comes with a default name. This may be changed by the user to better identify the module if desired.

Info – This is the system description of the module. This is static and may not be changed.

(3) *Global Settings*

Channels Enabled – Select how many channels will be used. The default is all channels. Selecting fewer channels may increase the update frequency. See the module specifications for details.

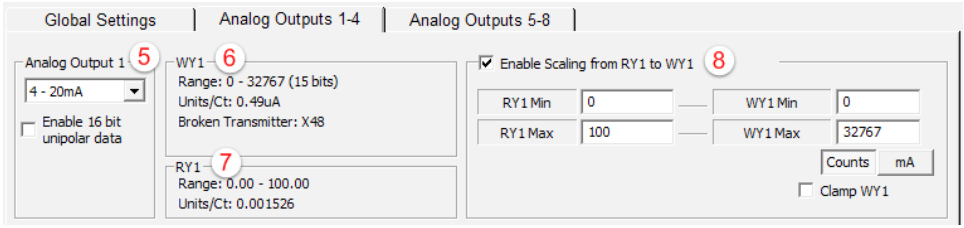
(4) *Global Status Bits*

Self Test Failed – This bit will be On if the module has failed its internal self-test. In this case the module is likely bad and should be replaced.

Missing 24V – This bit will be On if the external 24VDC power is missing. Check the 24VDC power connection on the module terminal block.

Data Not Valid – This bit will be On if the module does not have the latest configuration parameters or the module has not been configured at all. Reload the program into the CPU and power cycle.

BX-08DA-1 Analog Current Source Output, continued



(5) ***Analog Output x***

These settings are for each channel of the analog module.

Drop Down menu – Select the range of the analog output here.

Enable 16 bit unipolar data – Check this box to change the raw count range from a signed decimal bipolar data format to an unsigned decimal data format. This may require that Casting be used in the program in order to properly access the data. Refer to the chart of Data Range Specifications earlier in this chapter to see if the registers must be accessed with Casting.

(6) ***WYx***

Range – The number of Raw counts for the selected channel on the module

Units/Ct – The amount of current that will equal 1 raw count.

Broken Transmitter – The input register that when On will indicate that the loop is broken.

(7) ***RYx***

Range – The engineering units to which the raw counts are scaled.

Units/Ct – The number of raw counts that will equal 1 scaled engineering unit.

(8) ***Enable Scaling from RYx to WYx***

RYx Min – The minimum value of the engineering units for scaling.

RYx Max – The maximum value of the engineering units for scaling.

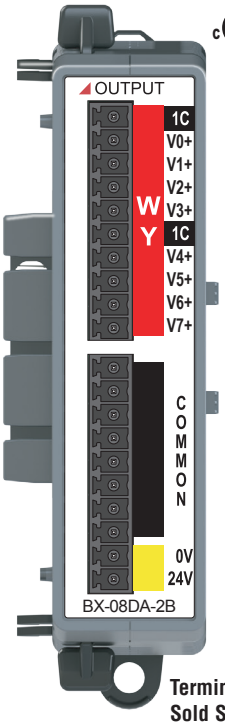
WYx Min – The minimum value of the raw counts to scale.

WYx Max – The maximum value of the raw counts to scale.

Counts/mA – Use these buttons to change the raw scaling to counts or milliamps.

Clamp WYx – If this box is checked, WYx will clamp at the minimum and maximum scaled values.

BX-08DA-2B Analog Voltage Output



Terminal Blocks Sold Separately

Do-more! Designer version 2.1 or higher required.

We recommend using prewired ***ZIP***Link cables and connection modules.
If you wish to hand-wire your module, a removable terminal block is available. See Wiring Termination Selection in this chapter for all options.

Analog Voltage Output Specifications

Outputs per Module	8
Commons	1
Module Signal Input Range	±10 VDC, ±5 VDC, 0–5 VDC, 0–10 VDC (Default)
Signal Resolution	16-bit, 15-bit (Default)
Output Type	Voltage outputs sourcing/sinking at 10mA (example 10V @ 1kΩ load).
Output Value in Fault Mode	Voltage outputs 0V (Unipolar or Bipolar)
Minimum Load Impedance	1kΩ
Maximum Capacitive Load	1000pF
Allowed Load Type	Grounded
Maximum Continuous Overload	15mA
All Channel Update Rate	3ms
Maximum Inaccuracy	0.2% of range
Maximum Full Scale Calibration Error	±0.08% of range
Maximum Offset Calibration Error	±0.04% of range
Accuracy vs. Temperature	±25PPM / °C maximum
Maximum Crosstalk	+3µV
Linearity Error (end to end)	±0.01% of range
Output Stability and Repeatability	±0.02% of full range after 10 min. warmup (typical)
Output Ripple	150 µV/mA
Output Settling Time	200µs
Channel to Backplane Isolation	1800VAC applied for one second
Channel to Channel Isolation	None
Loop Fusing (External)	Fast-acting 0.032A recommended
Backplane Power Consumption	0.1 W
External DC Power Required	Class 2 or LPS power supply 24VDC (±20%) 100mA
Heat Dissipation	3.1 W
Weight	100g (3.5 oz)
Software Version	Do-more! Designer Programming Software version 2.1 or later

IMPORTANT!

Hot-Swapping Information

NOTE: This device cannot be Hot Swapped.

BX-08DA-2B Analog Voltage Output, continued

Data Range Specifications

Selection	Description	Enable 16 bit Unchecked (15 bit Resolution, Default)[1]			Enable 16 bit Checked (16 bit Resolution)		
		Raw Counts	Casting[2]	µV Per Count	Raw Counts	Casting[2]	µV Per Count
0–10V	unipolar 10VDC	0–32767	-	305	0–65535	WYn:U	152
0–5V	unipolar 5VDC	0–32767	-	152	0–65535	WYn:U	76
±10V	bipolar 10VDC	-	-		−32768 to 32767	-	305
±5V	bipolar 5VDC	-	-		−32768 to 32767	-	152

1. Bipolar ranges default to 16-bit resolution.
2. For more information on Casting refer to Help topic DMD0309 in the Do-more! Designer Software.

8

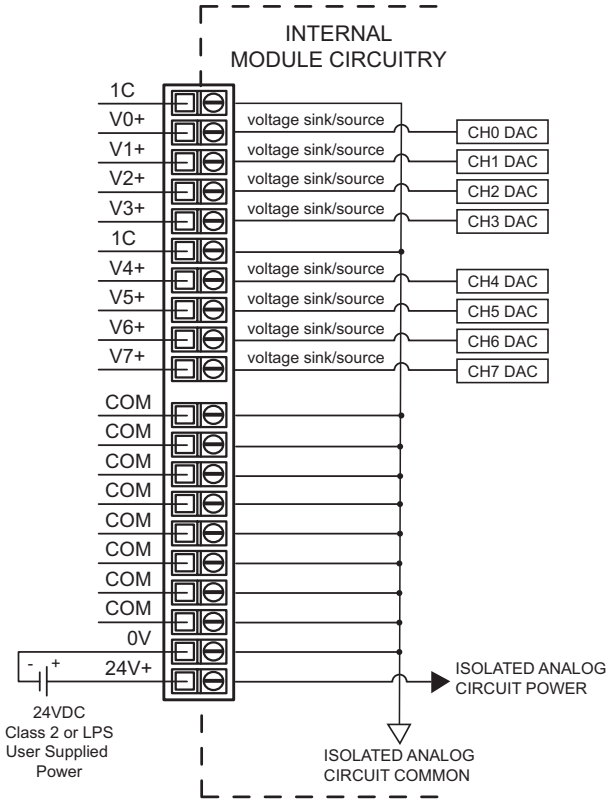
The module reserves the first 24 bits of unused contiguous space in the X register, aligned to an 8-bit word boundary, for status reporting. Error flags for this module are laid out within its status register space as described in the following table.

Error Flag Specifications

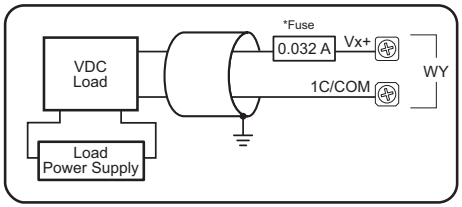
	MSB							LSB
1st Byte of unused X Registers								
Module Status	-	-	-	-	-	Data Not Valid	Missing 24VDC	Self Test Failed
2nd Byte of unused X Registers								
Unused	-	-	-	-	-	-	-	-
3rd Byte of unused X Registers								
Unused	-	-	-	-	-	-	-	-

BX-08DA-2B Analog Voltage Output, continued

Analog Voltage Output Wiring



Analog Voltage Output Circuit



*An Edison S500-32-R 0.032 A fast-acting fuse is recommended for all analog voltage inputs, analog outputs, and current loops.

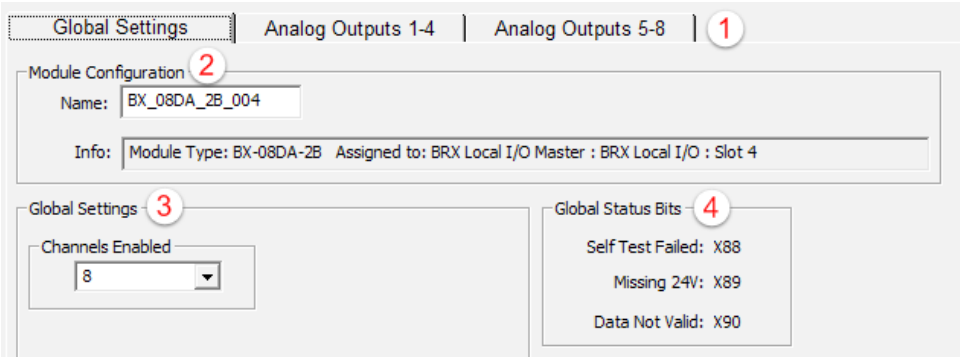
NOTE: Shield should be connected only at one end, to ground at the source device.

8

BX-08DA-2B Analog Voltage Output, continued

Software Setup

After the module is installed, open the Do-more! Designer programming software version 2.1 or later, connect to the BRX MPU and open the **Configure Module** dialog as described at the beginning of this chapter..



(1) The module options are divided into subsets across multiple tabs. Click the appropriate tab to edit the configuration.

(2) *Module Configuration*

Name – Each module comes with a default name. This may be changed by the user to better identify the module if desired.

Info – This is the system description of the module. This is static and may not be changed.

(3) *Global Settings*

Channels Enabled – Select how many channels will be used. The default is all channels. Selecting fewer channels may increase the update frequency. See the module specifications for details.

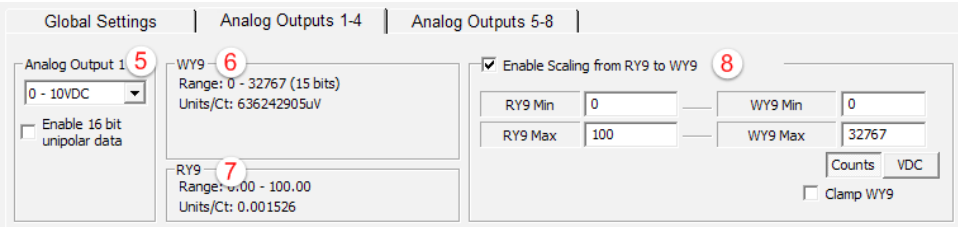
(4) *Global Status Bits*

Self Test Failed – This bit will be On if the module has failed its internal self-test. In this case the module is likely bad and should be replaced.

Missing 24V – This bit will be On if the external 24VDC power is missing. Check the 24VDC power connection on the module terminal block.

Data Not Valid – This bit will be On if the module does not have the latest configuration parameters or the module has not been configured at all. Reload the program into the CPU and power cycle.

BX-08DA-2B Analog Voltage Output, continued



(5) ***Analog Output x***

These settings are for each channel of the analog module.

Drop Down menu - Select the range of the analog output here.

Enable 16 bit unipolar data – Check this box to change the raw count range from a signed decimal bipolar data format to an unsigned decimal data format. This may require that Casting be used in the program in order to properly access the data. Refer to the chart of Data Range Specifications earlier in this chapter to see if the registers must be accessed with Casting.

(6) ***WYx***

Range – The number of Raw counts for the selected channel on the module

Units/Ct – The amount of voltage that will equal 1 raw count.

(7) ***RYx***

Range – The engineering units to which the raw counts are scaled.

Units/Ct – The number of raw counts that will equal 1 scaled engineering unit.

(8) ***Enable Scaling from RYx to WYx***

RYx Min – The minimum value of the engineering units for scaling.

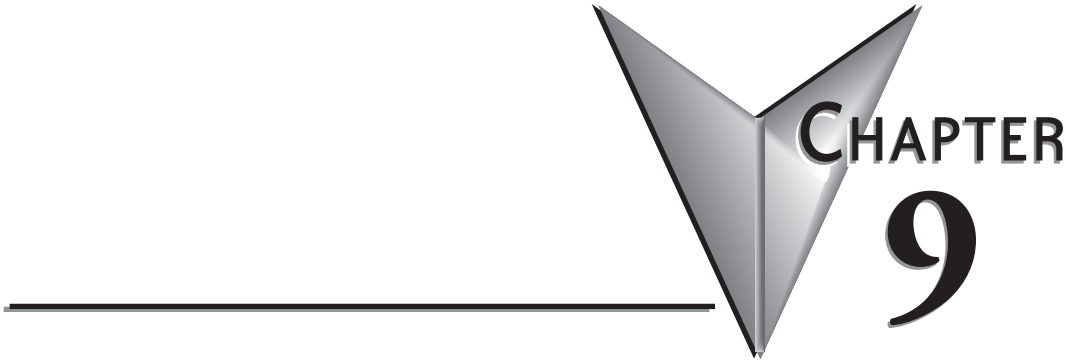
RYx Max – The maximum value of the engineering units for scaling.

WYx Min – The minimum value of the raw counts to scale.

WYx Max – The maximum value of the raw counts to scale.

Counts/VDC – Use these buttons to change the raw scaling to counts or volts.

Clamp WYx – If this box is checked, WYx will clamp at the minimum and maximum scaled values.



FUTURE RELEASE OF BRX SPECIALTY EXPANSION MODULES

For Future Use

BRX Do-more! Designer Getting Started

In This Chapter...

Overview 10-2
Before You Begin... 10-3
BRX Do-more! Designer System Requirements 10-4
Step 1: Install Do-more! Designer Software 10-5
Step 2: Launch the Do-more! Designer Software 10-8
Step 3: Prepare the Hardware 10-11
Step 4: Apply Power to the PLC 10-14
Step 5: Establish PC to BRX MPU Communications 10-15
Step 6: Verify Hardware Configuration 10-20
Step 7: Create a Ladder Logic Program 10-23
Step 8: Save Project 10-33
Step 9: Write Project to the BRX MPU 10-34
Step 10: Testing Project Using Data View 10-37
Do-more Designer Software and Firmware Updates 10-41
Updating the Firmware 10-42
Live Update 10-45
Update Operating System 10-46
Update Gate Array and Loader 10-48
Dashboard 10-50
Help File 10-53

Overview

The BRX Platform is a Micro PLC system that uses the Do-more! Designer Software version 2.0 or newer (ADC part number DM-PGMSW). The Do-more! Designer programming software package (downloadable for free) was developed as a powerful, flexible and easy to use controls design tool.

The programming GUI features a user-friendly fill-in-the-blank design for editing ladder logic, making complex operations such as PID and motion control easy to setup while minimizing programming time. A built-in simulator allows testing of your program design without requiring any additional external hardware. This will help to reduce programming errors prior to critical live application startups.

Easy to use troubleshooting tools allow you to actually see what is going on in your logic, from single stepping through the program one scan at a time to monitoring multiple elements during verification of correct program execution.

For the DirectLOGIC users that want to use the BRX Do-more! MPU for projects originally written in DirectSOFT, Do-more! Designer software has a built-in DirectLOGIC migration tool that will greatly reduce the time to migrate a DirectSOFT program into Do-more! Designer.

This chapter focuses on installing the Do-more! Designer software, establishing a connection to a BRX MPU, writing a simple ladder logic program and downloading it to the MPU. This should help get you familiarized with the software and get started utilizing one of the most powerful PLC's on the market.

Before You Begin...

Wiring Tools and Hardware

The tools and hardware shown below may be required to connect your power supply to your BRX MPU

Screwdriver
TW-SD-MSL-3

Wire Strippers
DN-WS

Electrical and Signal Wire

AC Power Cord
(Not available from Automationdirect.com)

Programming Connection Options

The BRX MPU allows several built-in programming interface options. Choose from one of the following suggested communication methods for this short step-by-step introduction to the BRX platform. You should have at least one of these programming options ready and available.

Ethernet port (built-in), just connect a cable

Serial port: Using the 3-pin serial connection on the MPU

Ethernet Cable

Serial Cable
ZL-DB9F-CBL-2P

POM Slot Programming Options

USB POM and cable assembly(below)

Ethernet POM and cable (right)

RS-232 serial POM (RJ12 or 3-pin) (lower right)

Ethernet POM Module with Cable

BX-PGM-CBL Programming Cable Assembly

RS-232 Serial POM (RJ12) Module with Cable

RS-232 Serial POM (3-pin) Module with Cable

BRX Do-more! Designer System Requirements

Do-more! Designer Windows-based programming software (CD-ROM or web download) works with a variety of Windows® operating systems listed below.

Do-more! Designer software can connect to the BRX system using one of the following specifications. More detailed specifications and options are listed later in this chapter.

BRX Do-more is compatible with any of these PC operating systems:

- Windows® 10
- Windows® 8.1 - 64 bit
- Windows® 8.1 - 32 bit
- Windows® 8 - 64 bit
- Windows® 8 - 32 bit
- Windows® 7 - 64 bit
- Windows® 7 - 32 bit
- Windows® Vista - 64 bit
- Windows® Vista - 32 bit

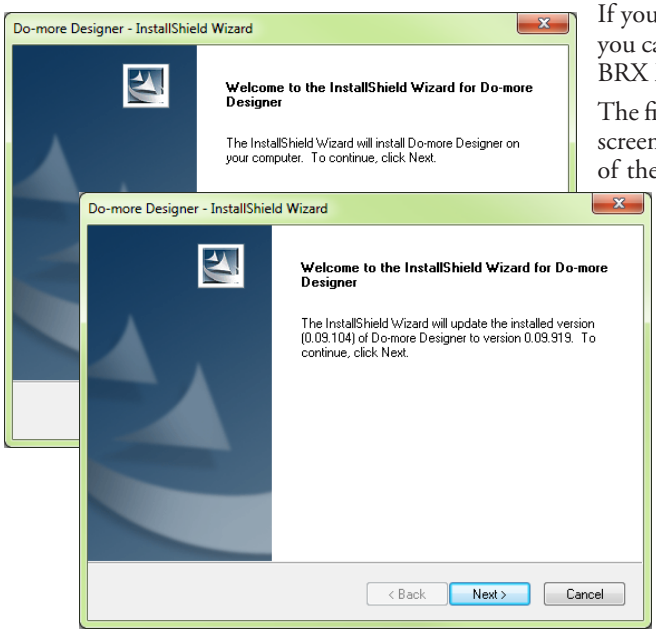
Hardware Requirements:

- HD Space: 140Mb
- Video: 1024x768 256 color
  (1280x720 true color recommended)
- 1GHz , single core CPU (2GHz, multi-core recommended)
- 1GB RAM (3GB recommended)
- Other: Windows® 8 RT Edition is not supported.

NOTE: *Ethernet POMs, USB and Serial Cables are sold separately. USB or Ethernet cable is also required for communications between PC and CPU.*

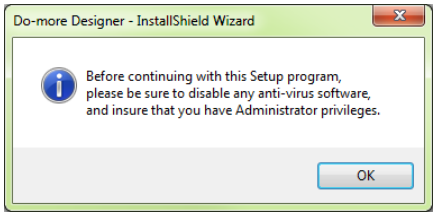
Step 1: Install Do-more! Designer Software

Download the Do-more! Designer programming software (DM-PGMSW) from our website at **http://support.automationdirect.com/products/domore.html**, and launch the install procedure. If you already have Do-more! Designer installed, you can just update to version 2.0 or newer to get BRX MPU support.



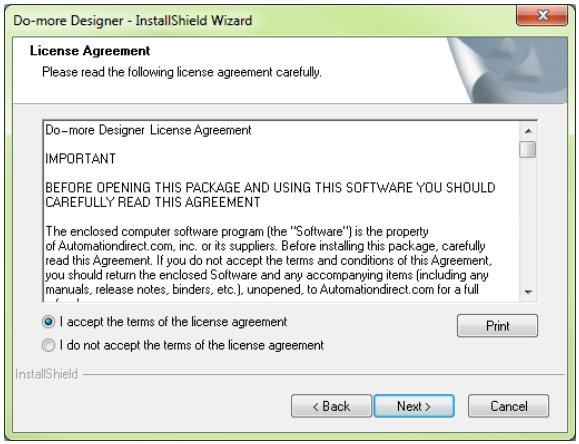
The first window that opens displays the *Welcome* screen seen here. If there are previous versions of the software already installed, this screen will show the version number of the software being replaced as well as the one being installed. Click **Next** to continue.

An alert window will appear requesting that all anti-virus software be disabled and also reminding the user that administrative restrictions may exist.

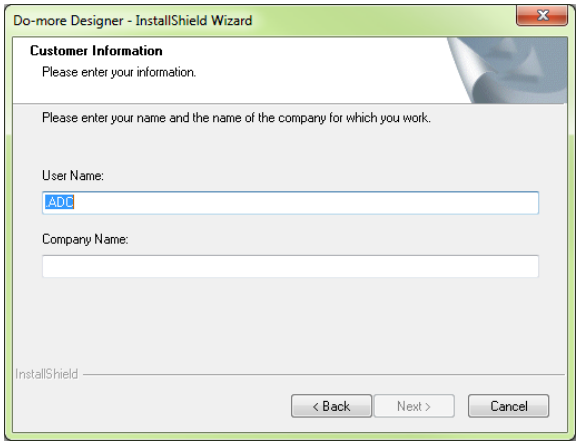


The *License Agreement* window will be displayed next. Read over the agreement, select **I accept the terms of the license agreement** and click the **Next** button to continue.

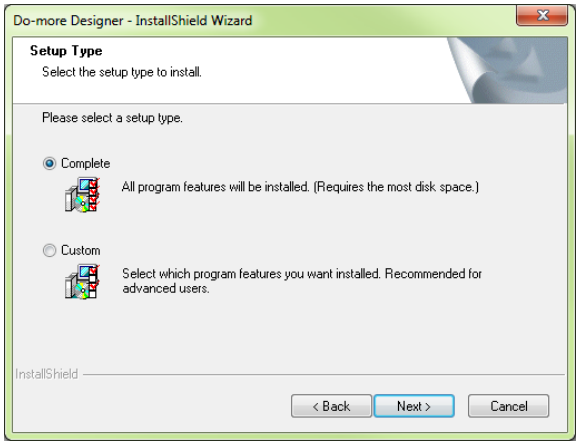
The license agreement may be printed if desired. The **Print** function will print a pdf of the **License Agreement** document to your default printer.



At this point the software will ask a little about you. Please fill in the user information requested on the ***Customer Information*** screen and click **Next** to continue.



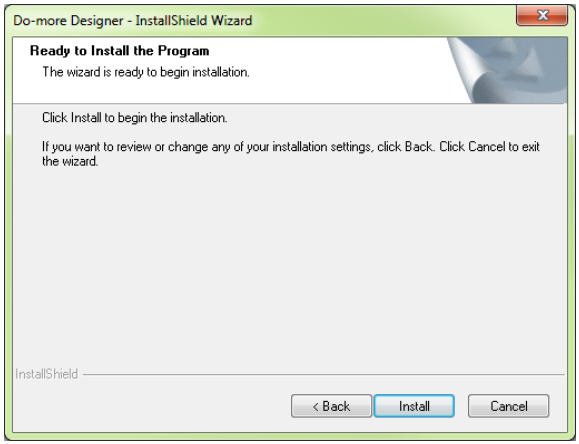
At this stage, the software will ask which type of install you would like to perform. The ***Setup Type*** window seen below gives two options for installation type: **Complete** and **Custom**.

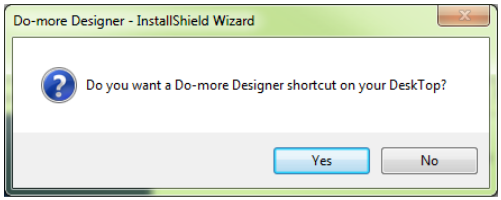


Custom installation allows you to choose which program features to install, whereas **Complete** installation installs all of the program features available. The **Complete** installation is selected by default and is recommended for first-time users and for purposes of this primer. Click **Next** to continue.

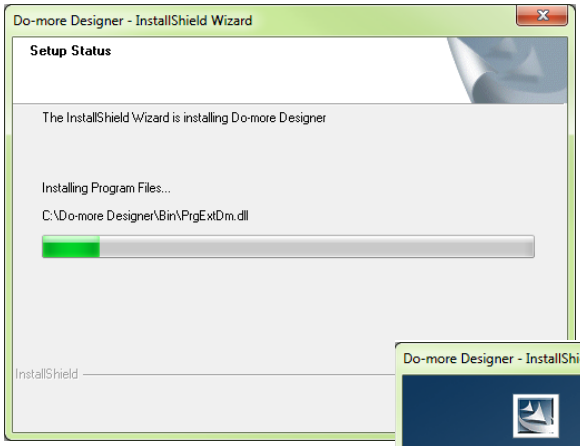
The next window to appear is the ***Ready to Install the Program*** window. This window is an alert window, cautioning you that the program is about to be installed. If there are any changes that need to be made to the install settings do them now before continuing.

To review or change any of the previous installation selections, click **Back** to return to the appropriate window and make the change. If no changes are necessary click **Install** to begin the installation.



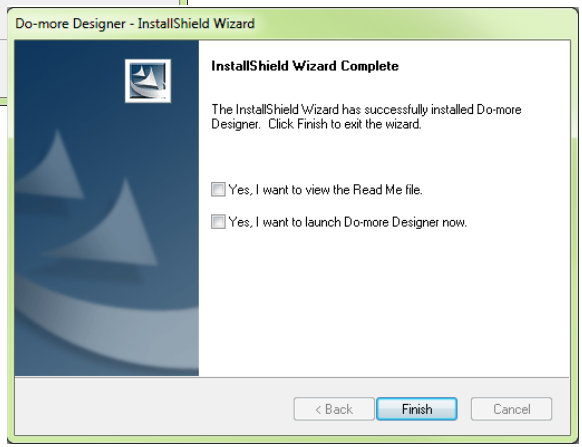


The pop-up shown here will allow you to choose to install a Do-more! Designer software desktop shortcut on your PC. Click **Yes** or **No** and continue with the installation.



The software will now install the needed folders and files while the *Setup Status* window displays the installation progress status.

Once the installation has been successfully completed, the *InstallShield Wizard Complete* window below will open.



Your software is now installed and ready to use. The installation wizard can now be closed by clicking **Finish**.

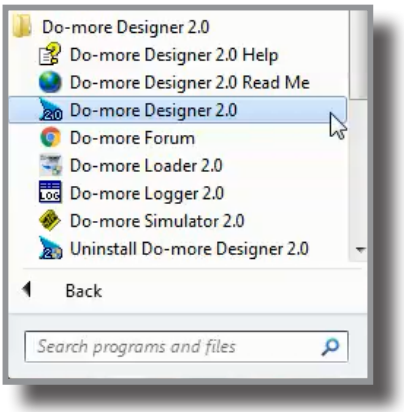
NOTE: *By default the* **Read Me File** *and* **Launch Do-more! Designer now** *boxes are checked. Un-check either box should you choose not to view the Read Me file and not launch the software at this time.*

Step 2: Launch the Do-more! Designer Software

NOTE: *For this step, ensure the BRX MPU is not powered up. Connection to your PC is in Step 3.*

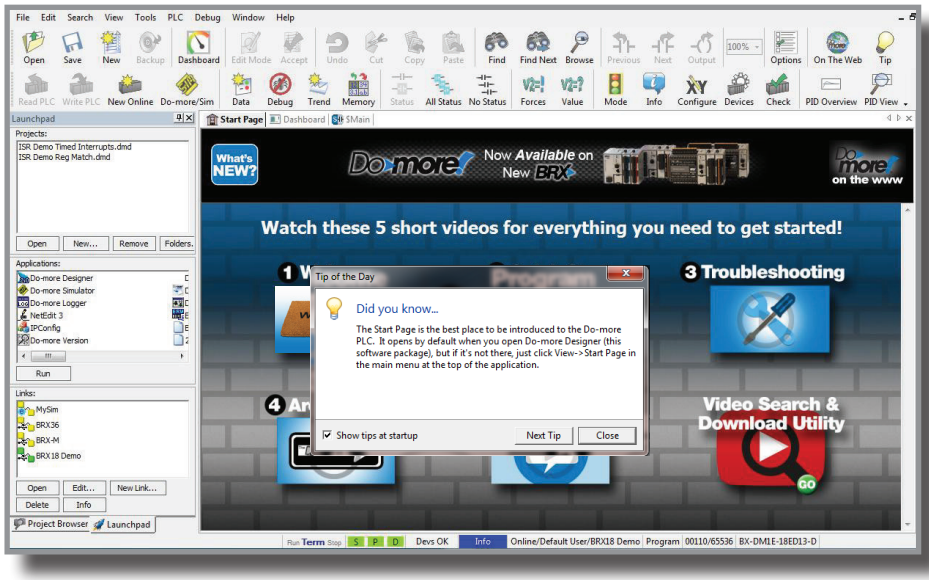
NOTE: *There are many keyboard shortcuts available in the Do-more! Designer software. For a list of available short cuts (hot keys), view Help topic DMD0361.*

After installing the Do-more! Designer software, launch the software by double clicking the desktop Do-more! Designer icon.

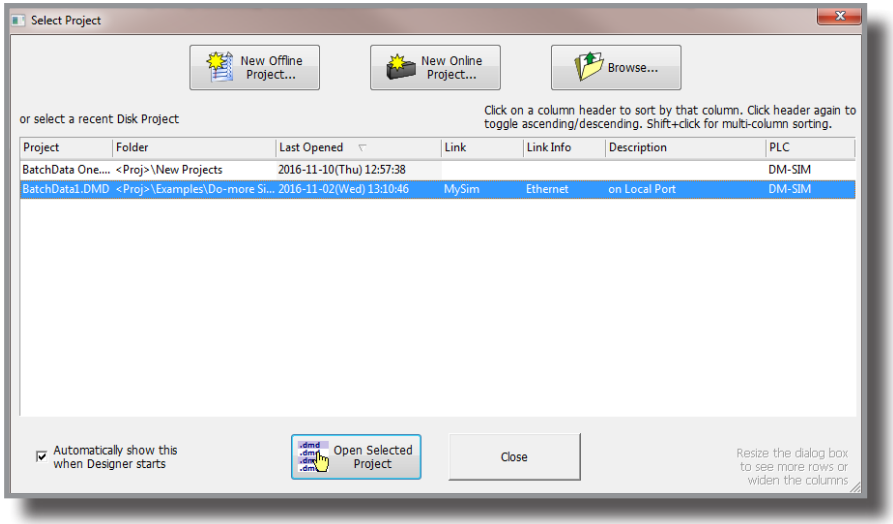


You can also launch the software from your PC ***Start*** menu or ***All Programs*** menu. If the software link is not embedded in the ***Start*** menu, use the path: **Start > All Programs > Do-more > Designer x.x > Do-more! Designer x.x** to launch the software.

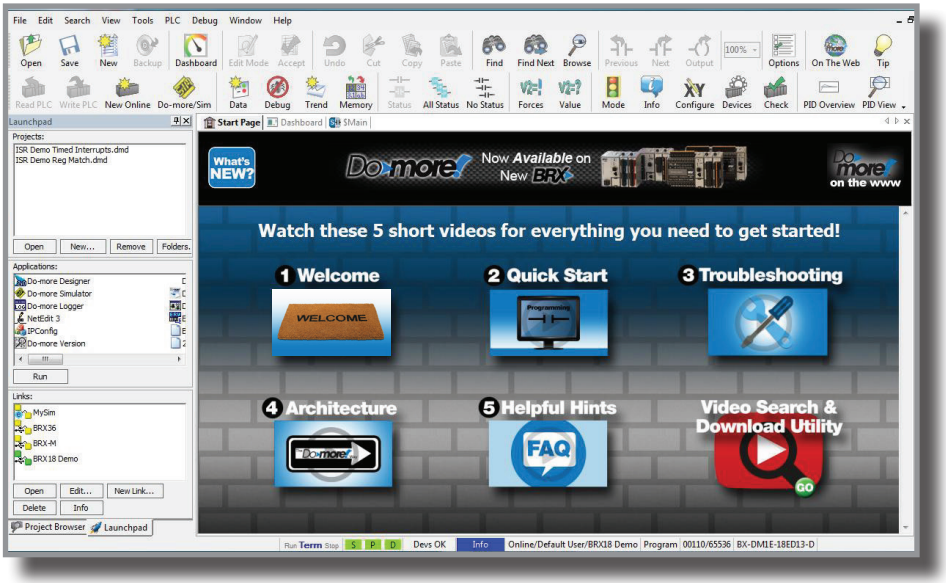
When Do-more! Designer runs for the first time it goes to the ***Start Page*** (area with 'brick' wallpaper) and the ***Tip of the Day*** pop-up comes up by default. This feature can be disabled by un-checking the ***Show tips at startup*** box in the lower left corner. Select **Close** on the ***Tip of the Day*** pop-up when you are finished viewing the tips.



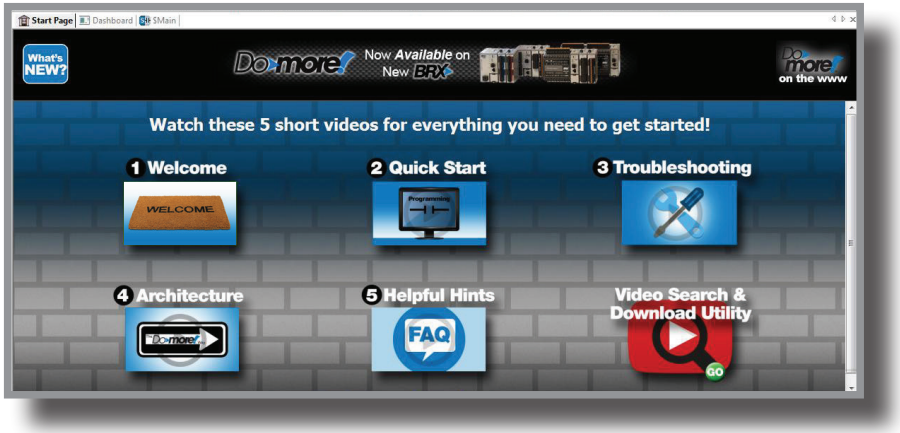
When the **Close** button on the ***Tip of the Day*** pop-up is pressed, the ***Select Project*** window comes up. Here you will select which project to work with - New Offline Project, New Online Project, or Browse (for a project not listed). If you have worked on current projects, they will appear below in the ***Recent Project*** list. As this is your initial install your window will be empty.



Press the **Close** button. The ***Launchpad*** area (on left side of window) is displayed with the ***Startup Page*** selected.



From the Start Page, you can select from any of 5 short videos that demonstrate how to use the software and explain how the Do-more! technology works.



Video 1: "Welcome", welcomes you to the Do-more! Designer Software. This video familiarizes you with the BRX environment showing you how to connect to a BRX MPU, open a project, etc.

Video 2: "Quick Start", walks you through writing and documenting a simple program and downloading it to the BRX MPU.

Video 3: "Troubleshooting", introduces you to and shows you how to use the troubleshooting and debugging tools built in to the Do-more! Designer software.

Video 4: "Architecture", explains how the Do-more ! Technology works. Understanding the Do-more Technology allows you to take advantage of the built-in features allowing you to create projects easier and decreasing the amount of programming time needed.

Video 5: "Helpful Hints", covers some of the most common BRX MPU programming challenges and explains how easily Do-more! Designer can help with these challenges.

The **Video Search & Download Utility** opens a search window and download screen.

Step 3: Prepare the Hardware

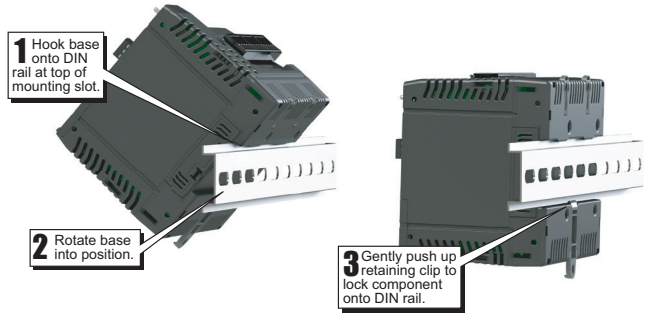
The "Installation and Wiring" chapter for the BRX MPU contains detailed information for your specific model.

The following summary explains the basic steps needed to get the BRX MPU ready to establish a link so you can program and run a project.

1. Installing the BRX MPU on DIN rail:

   A. Hook rear upper tabs over flange of DIN rail.

   B. Rotate the unit down toward the DIN rail, pressing firmly until the BRX MPU snaps securely to the DIN rail.



2. There are three ways to connect to the BRX MPU for programming:

   A. Using the USB POM with a USB programming cable.

   B. Using Ethernet cable with built-in Ethernet port.

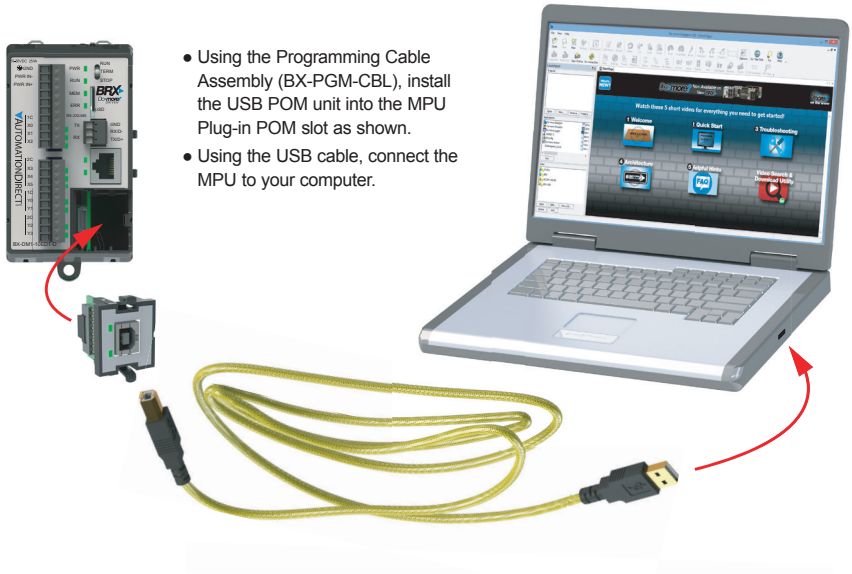
   C. Using RJ12 Serial POM module and RJ12 programming cable or via the built-in 3-pin serial port connector with user supplied cabling.

Examples of each connection type are shown on the following pages.

NOTE: *All communication connections between the BRX MPU and PC should be completed prior to launching Do-more! Designer software.*

A. Connect BRX USB to Computer Using Programming Cable

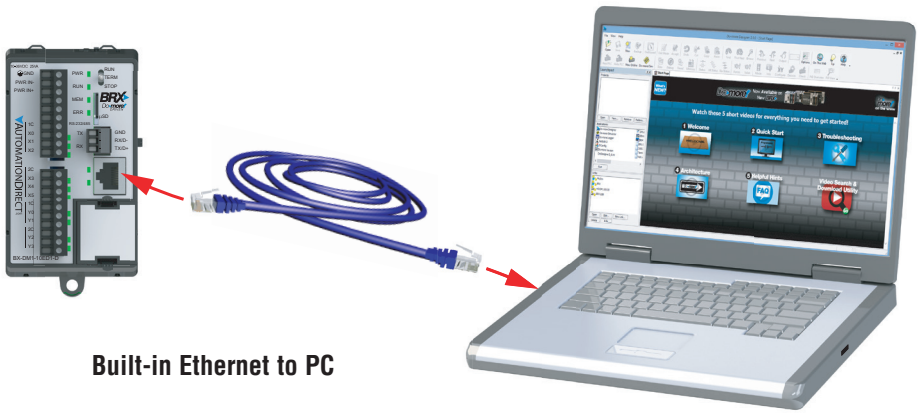
For USB connectivity the BX-PGM-CBL assembly is required. This assembly includes one USB POM module (BX-P-USB-B) and one 6ft USB-A to USB-B cable (USB-CBL-AB6).



- Using the Programming Cable Assembly (BX-PGM-CBL), install the USB POM unit into the MPU Plug-in POM slot as shown.
- Using the USB cable, connect the MPU to your computer.

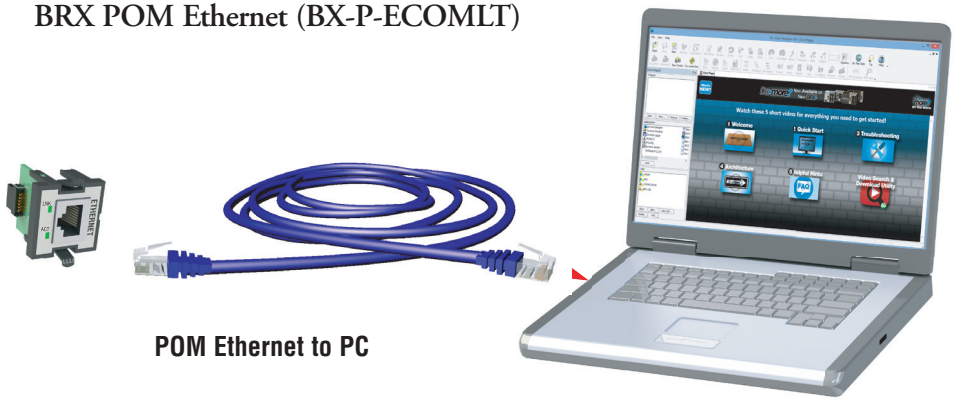
B. Connect BRX Ethernet to Computer Ethernet

There are two options for connecting the BRX via Ethernet to a PC. One option is to use the built-in Ethernet port and connect to the PC via a Cat5 Ethernet cable. An alternate connection is available by using the optional Ethernet POM (BX-P-ECOMLT) module that plugs into the POM slot on the MPU. Both Ethernet options support 10/100Base-T via the RJ45 port. The Ethernet port supports Auto-Crossover, which allows the use of a Cat5 patch or crossover cable.



Built-in Ethernet to PC

BRX POM Ethernet (BX-P-ECOMLT)



POM Ethernet to PC

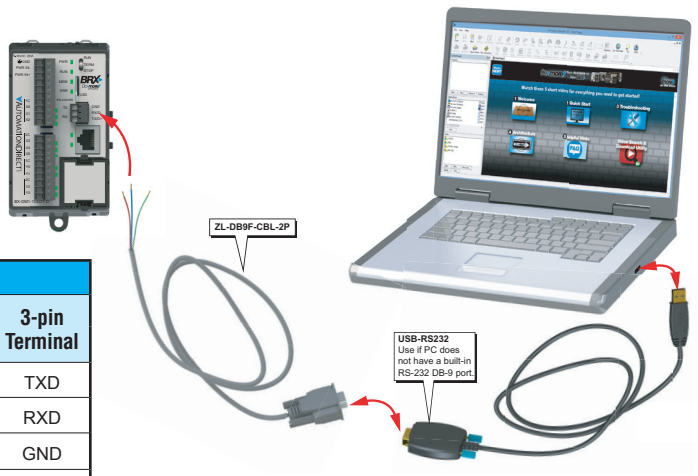
C. Connect BRX Built-in Serial Port BRX POM serial port to Computer Serial or USB Port

It is possible to connect to the BRX using the CPUs built-in serial port or by installing the BRX POM serial port, BX-P-SER2-RJ12.

BRX Built-in Serial Port.

There are two options to consider for connecting the BRX built-in serial port to a PC. The first option uses a ZL-DB9F-CBL-2P to a PC USB port using a USB to Serial adapter (USB-RS232, as shown below). If the PC has a 9-pin serial port connection, you don't need to use the USB to Serial adapter. The second option (not shown) is to use a user built cable to connect the built-in 3-pin serial port to the PC serial port or USB to Serial adapter.

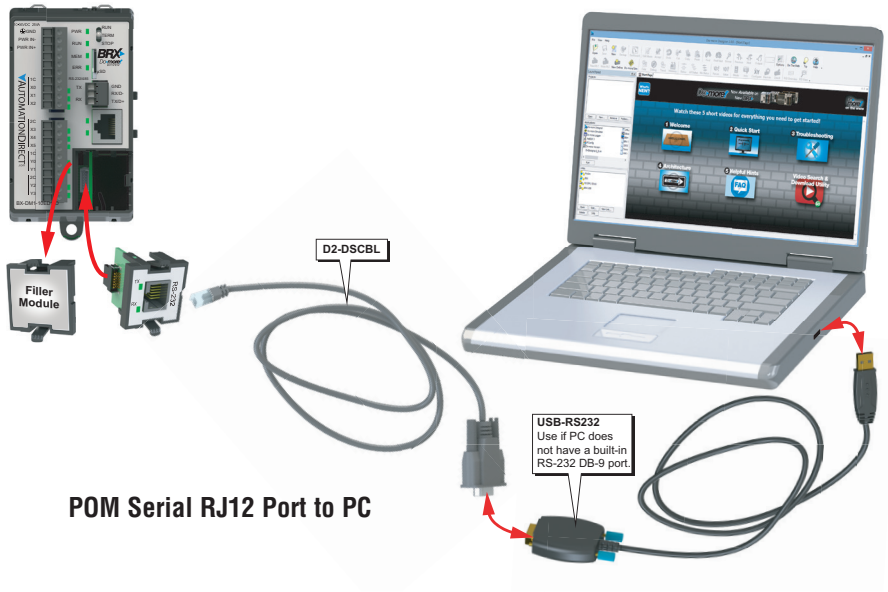
Serial RS-232 to PC



BRX 3-Pin Serial Port				
ZL-DB9F-CBL-2P			To	3-pin Terminal
Pin #	Term	Color		
2	RXD	Brown	.....	TXD
3	TXD	Red	.....	RXD
5	GND	Yellow	.....	GND
7	RTS	Blue	Jumper	
8	CTS	Violet		

BRX POM Serial Port

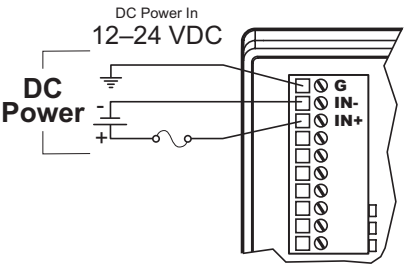
The BRX Serial POM (BX-P-SER2-RJ12) can connect to a PC by using the D2-DSCBL programming cable. The 9-pin connection of the D2-DSCBL cable can be connected to a serial port on a PC or to a USB to Serial adapter (USB-RS232, as shown below).



POM Serial RJ12 Port to PC

Step 4: Apply Power to the PLC

WARNING: Minimize the risk of electrical shock, personal injury, or equipment damage. Always disconnect the system power before installing or removing any system component.



Once all of the power wiring has been completed and verified, connect the appropriate voltage source to the power supply and power up the system. The BRX MPU will perform a self-evaluation once power is applied.

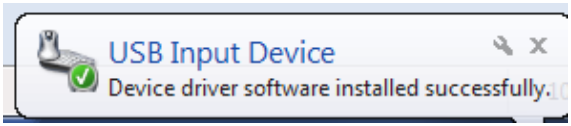
The following summary explains the basic steps needed to get the BRX MPU ready to establish a link for programming and running a project.

NOTE: *Please see Chapter 1 for the power wiring diagram corresponding to your specific BRX MPU.*

Step 5: Establish PC to BRX MPU Communications

The BRX MPU should now be powered up and the programming cable connected.

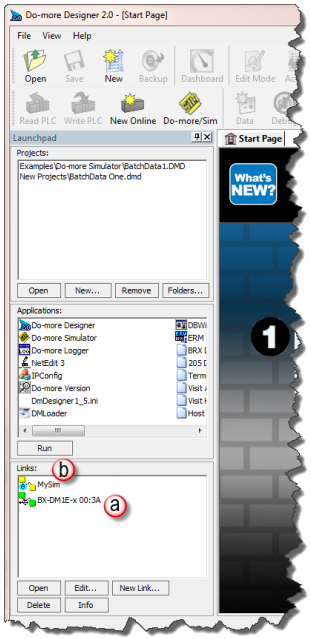
NOTE: *The following example assumes that you are using the USB POM.*



The first time the BRX USB POM is connected to your PC, you should see a message on your PC indicating that the driver for the USB device was successfully loaded:

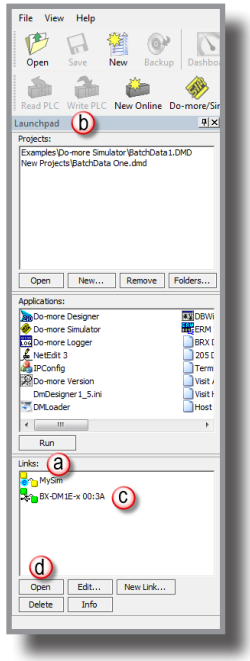
When the USB connection is made, Do-more! Designer detects the USB POM and (**a**) creates a new link, shown in the (**b**) ***Links*** window of ***Launchpad*** area.

From the ***Links*** window (b) you can open, edit, or create a new link manually. You can also delete a link or get link information. For this exercise, we will work with the link that was generated automatically when the USB POM was inserted.



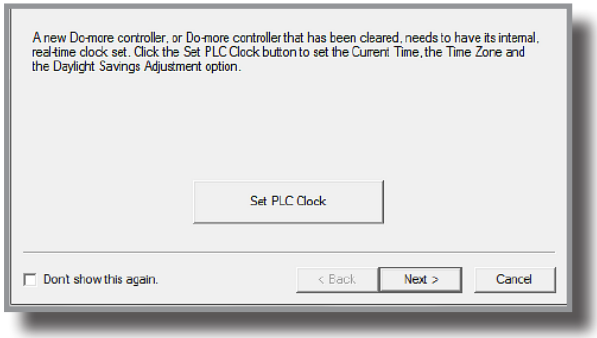
10

1. We are now ready to go online with the MPU. In the (**a**) ***Links*** section of the (**b**) ***Launchpad***, select the (**c**) USB link; in this example it is called BX-DM1E-X 00:3A. Click on (**d**) **Open** button.

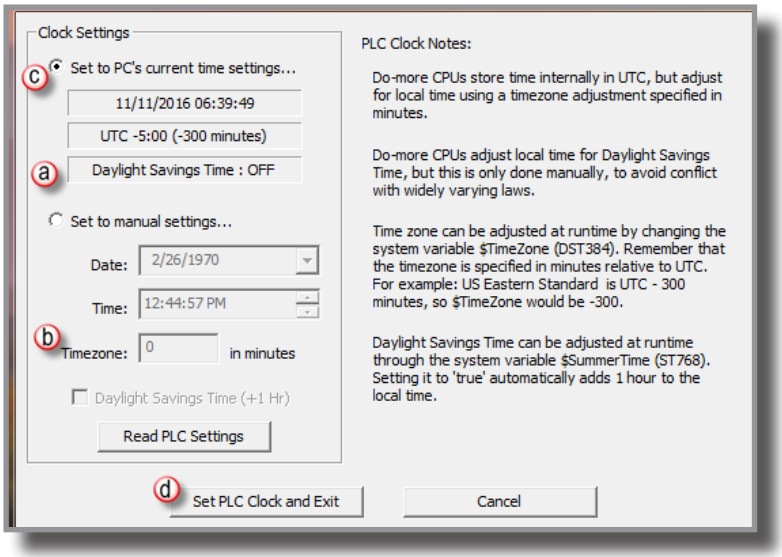


2. Once connected to the MPU, you may encounter the initialization screen shown below. This will appear on first initialization of a new MPU. Select **Set PLC Clock** to set the clock in the new MPU to be synchronized with your PC clock.

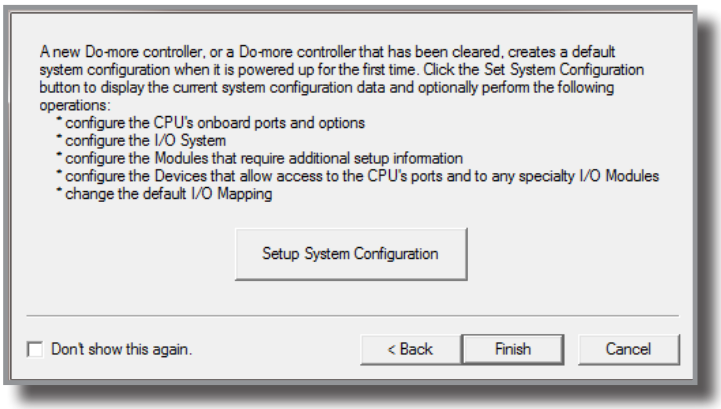
3. The ***Set PLC Clock*** option allows you to set the internal, real-time clock of the BRX MPU. The ***Set PLC Clock*** window has options for (**b**) *Timezone* and (**a**) *Daylight Saving Time* adjustments. Select (c) **Set to PC's current time settings…** then select (d) **Set PLC Clock and Exit**.



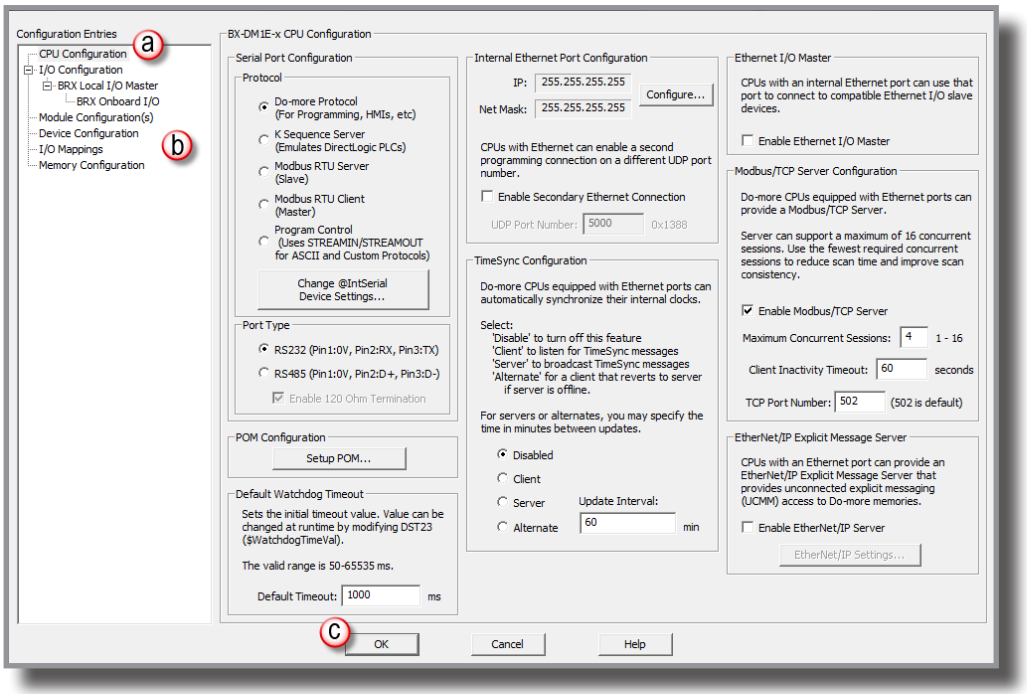
4. The option for **Setup System Configuration** appears next (below). This allows



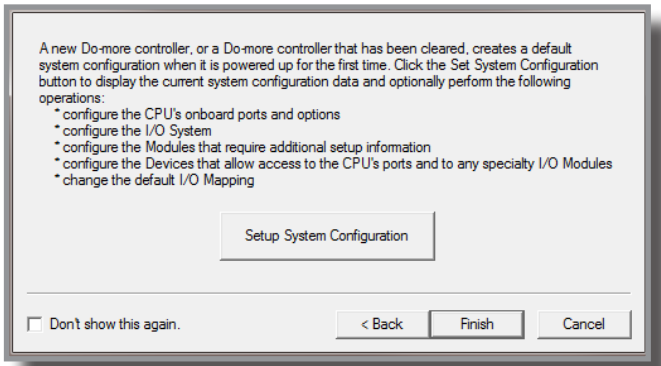
you to configure parameters of the BRX MPU, such as onboard communication port configuration, I/O configuration (i.e. high-speed), and mapping. Select **Setup System Configuration**.



5. The ***System Configuration*** window appears next with the (**a**) ***CPU Configuration*** selected by default. This window and those indexed in the (**b**) ***Configuration Entries*** tree on left, expose many of the system operating parameters for your MPU. For purposes of this introduction we will accept the

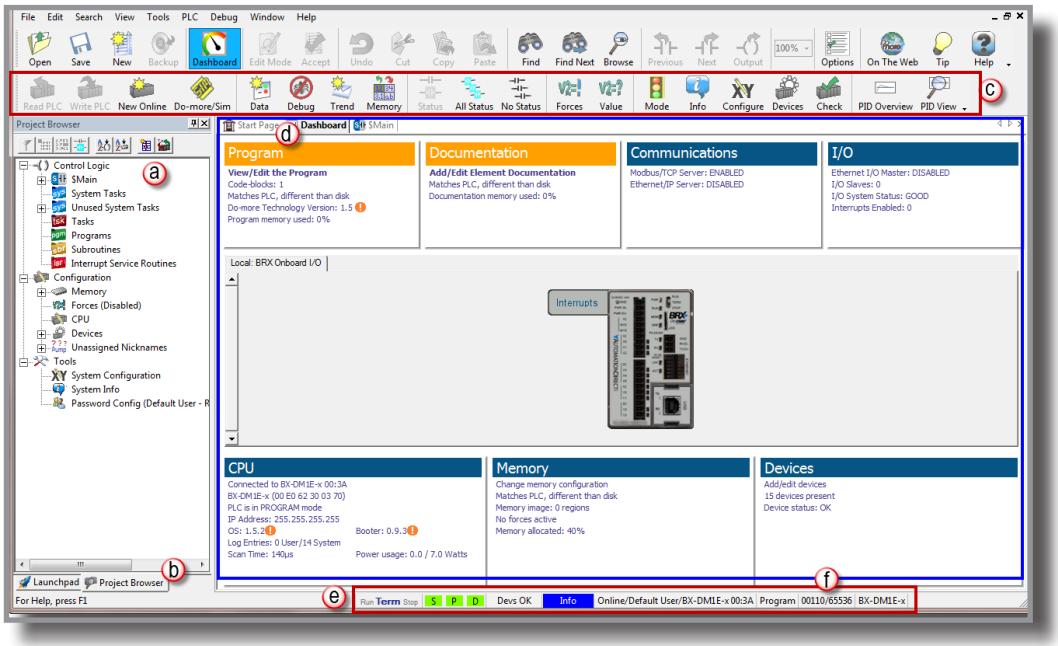


default settings. Click (c) **OK**.

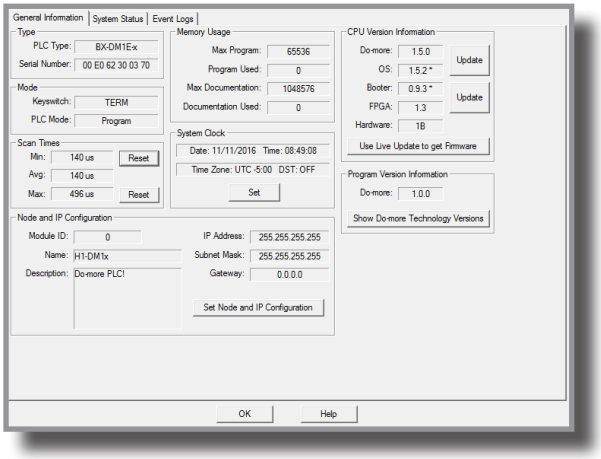


The **Setup System Configuration** box reappears. Select **Finish** button to move to next step.

6. The ***Project Browser*** (**a**, **b**), including the ***Dashboard*** (**d**), will open with the online toolbar (**c**) active. Notice the status bar indications (**e, bottom of window**) show the MPU type, memory usage, communication status, errors, and mode, etc. Hovering your mouse over the status bar (**e**) will highlight the items that are selectable. If you select one of the items, a new window will open with real-time data and available options.



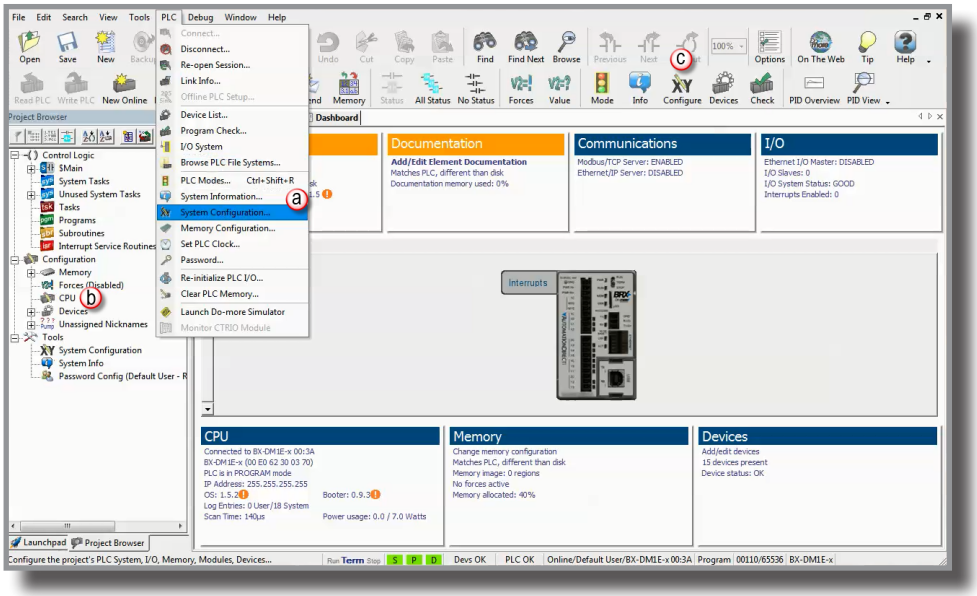
For example, the System Information window seen below, opens after selecting the memory usage values (**f**) in the status bar. This information and much more can be accessed by way of the Dashboard, a new addition to the Do-more! Designer software.



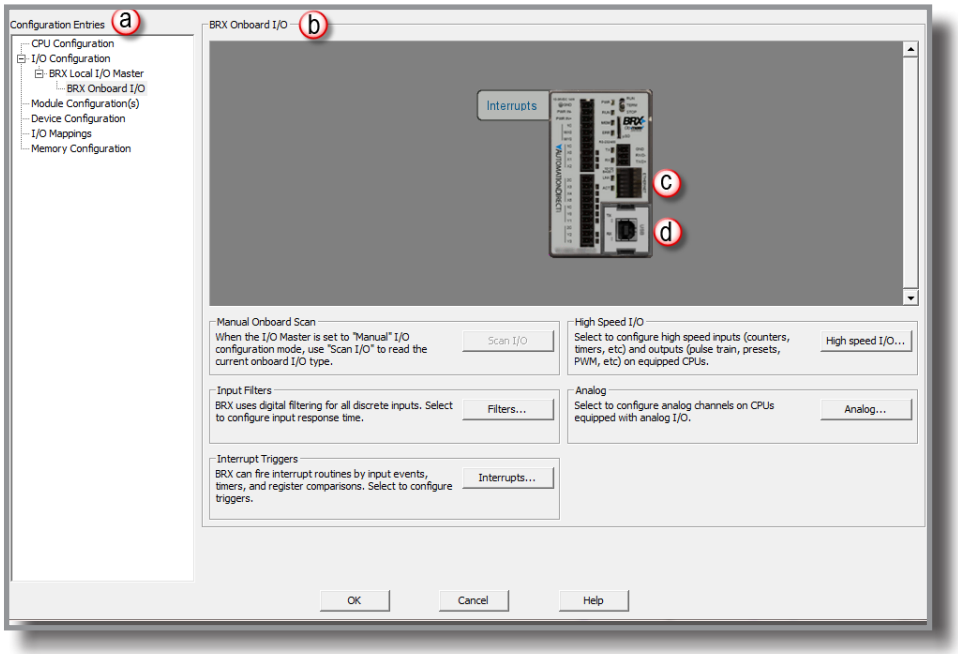
Step 6: Verify Hardware Configuration

Next we will verify the hardware configuration. The BRX series has an auto discover feature that will automatically detect installed I/O modules. You can access the System Configuration in three ways:

1. By selecting (a) *PLC* > *System Configuration*
2. By double clicking on the (b) *CPU* link under the *Configuration* tab in the *Project Browser*
3. By clicking the (c) *X/Y Configure* icon on the project toolbar.

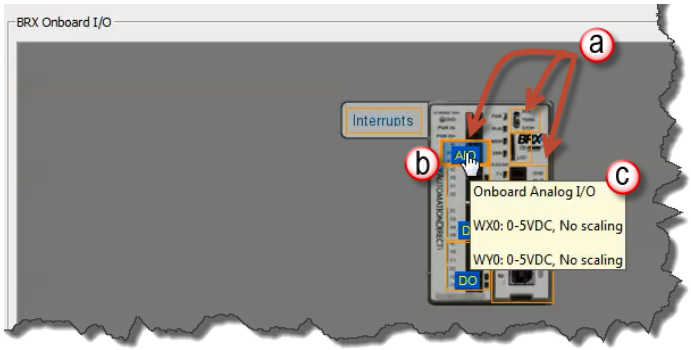


On the left side of the System Configuration window is an index of topics titled (**a**) ***Configuration Entries***. The (**b**) ***BRX Onboard I/O*** allows you to view the modules the software has detected. For this example, we are working with a BX-DM1E-10ER3 MPU and no expansion I/O. This unit has a built-in (**c**) Ethernet port and a (**d**) USB POM plugged in which show up in the overview graphic.

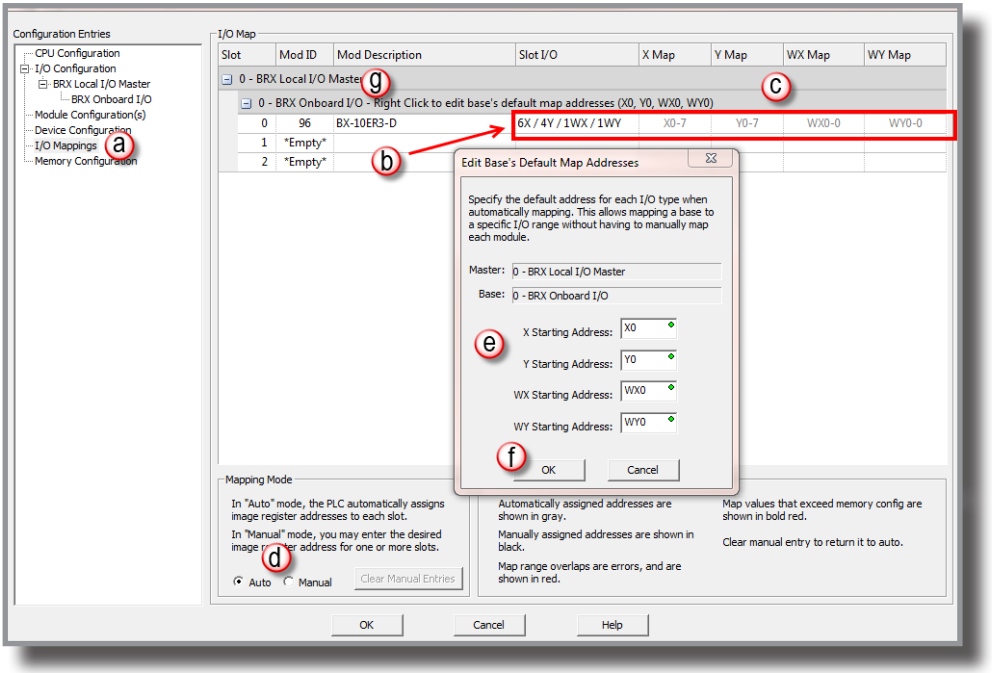


The (**a**) BRX Onboard I/O graphic area is interactive, like the system ***Dashboard***, and as you hover and move across the image (**b**) "orange" boxes will appear and display information about the highlighted section.

Also if the highlighted section can be configured you can click in the highlighted area and a configuration screen will pop up. For example hovering over (b) the built-in analog I/O hot spot, a pop up will display information on how the analog I/O is configured.

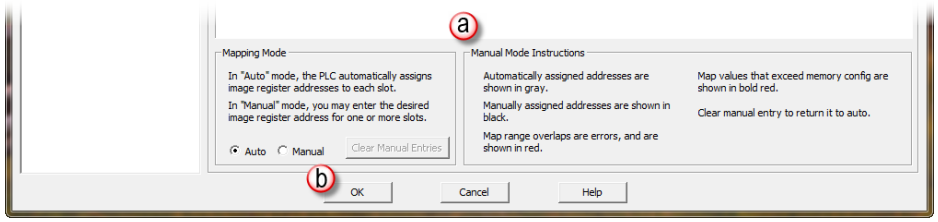


After the hardware configuration is verified, select (**a**) the ***I/O Mappings*** option in the ***Configuration Entries*** index. This option will display (**b**) the assigned addresses for the available I/O, as seen below.



These (**c**) X (discrete input), Y (discrete output), WX (analog input) and WY (analog output) addresses are automatically assigned by Do-more! Designer. You have the option to manually configure these addresses by selecting (**d**) ***Manual*** in the Mapping Mode section at the bottom of the window or by right clicking (**g**) ***BRX Onboard I/O.*** Change default starting address in (e) ***Edit Base's Default Map Addresses*** dialog box. Click (f) **OK** when completed to close ***Edit Base's Default Map Addresses*** dialog box.

The (**a**) ***Manual Mode Instructions*** section, also found at the bottom of the window, details the various color indications associated with this mode.



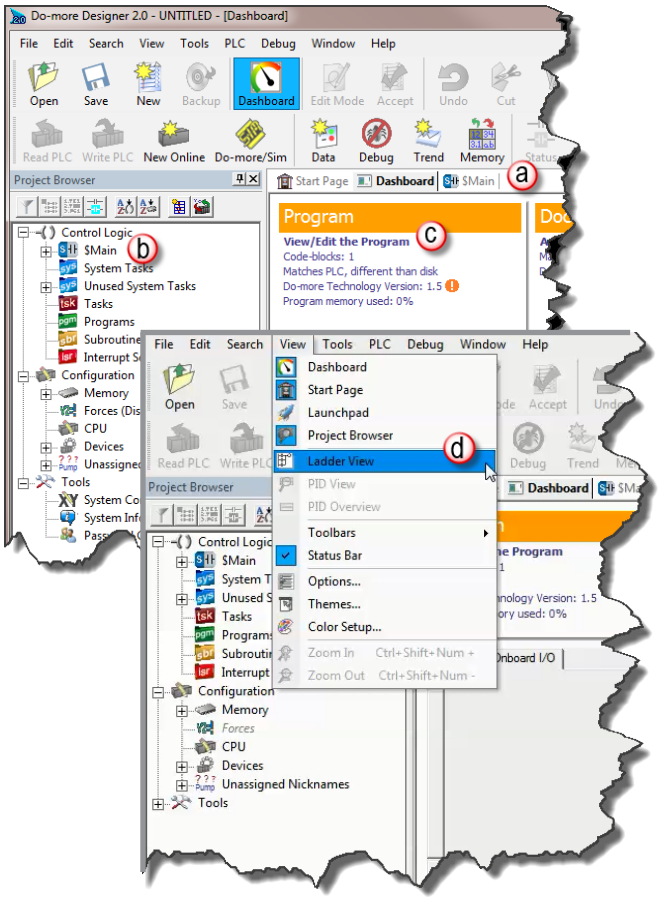
Once the hardware and mapping is configured and verified, click (**b**) **OK** to return to the main screen, displaying the ***Dashboard*** and the ***Project Browser***.

Step 7: Create a Ladder Logic Program

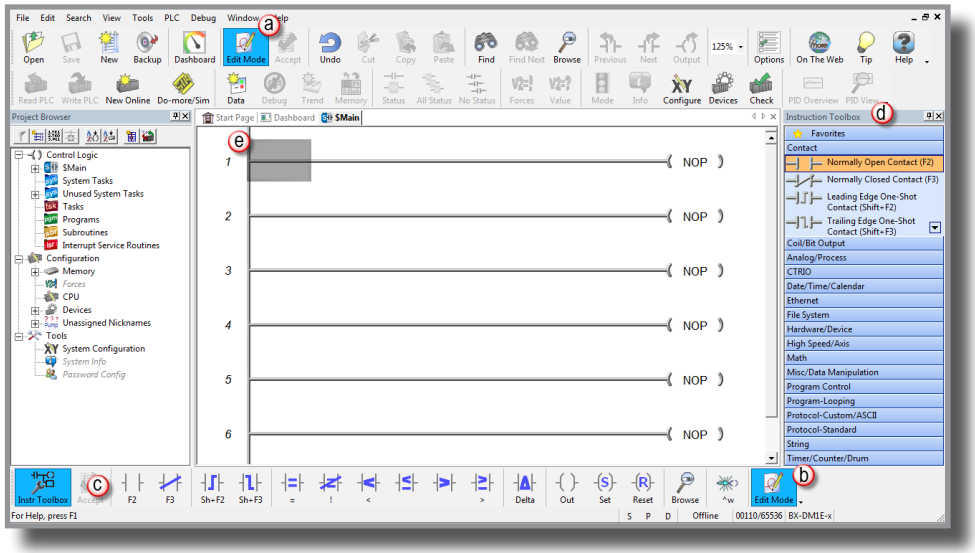
In order to create a ladder logic program, you will need to be in **Edit Mode**. All programs start with a default *$Main* code block. We will be adding our ladder logic to this code block.

We can get to the *$Main* code block four different ways:

1. By selecting the (**a**) *$Main* navigation tab.
2. By double clicking on the (**b**) *$Main* option under the *Control Logic* section of the *Project Browser.*
3. By selecting (**c**) *View/Edit the Program* under the **Program** section of the **Dashboard.**
4. By using the drop-down menu (**d**) *View* > *Ladder View*, as seen below.

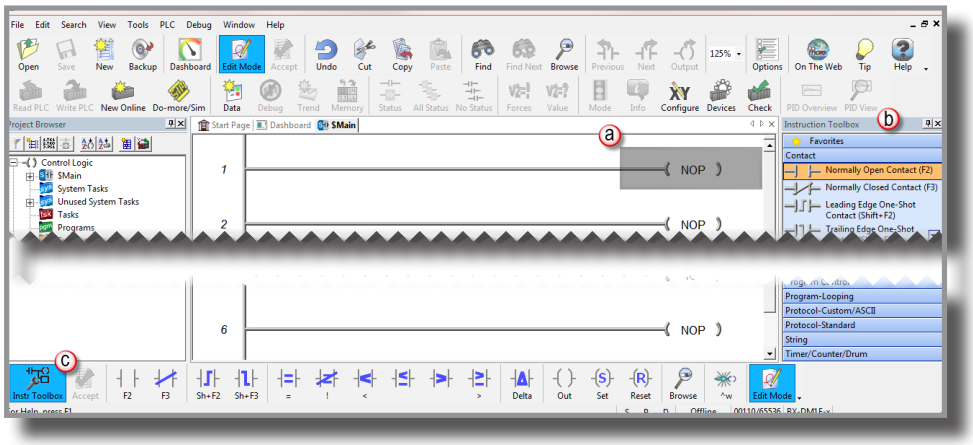


When in (**a, b**) ***Edit Mode***, the ladder palette toolbar (**c**) **and** all of the ladder (**d**) ***Instruction Toolbox*** options will become active. The cursor will be positioned on (**e**) Rung #1 and highlighted.



Rung #1

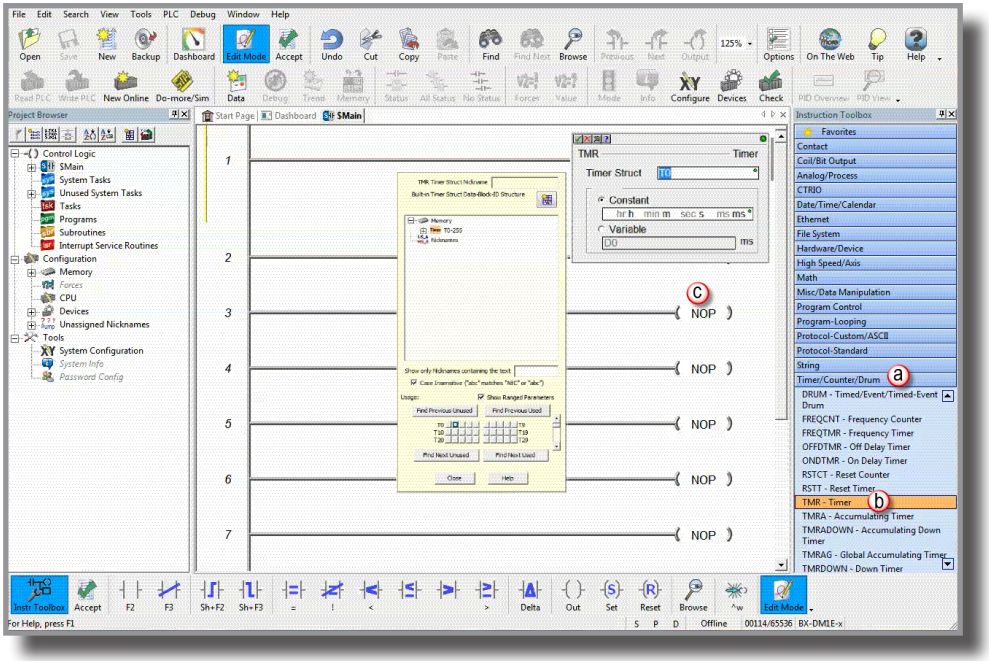
Place the cursor box in the (**a**) NOP position on Rung #1. If the (**b**) ***Instruction Toolbox*** is not open, click on the (**c**) ***Instruction Toolbox*** button from the ladder palette toolbar.



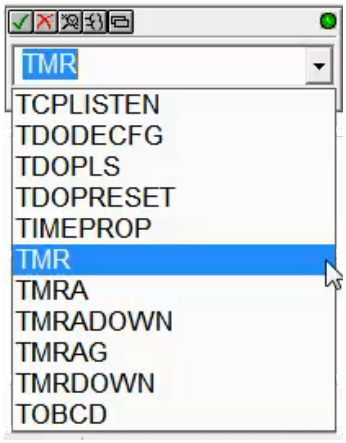
Rung #1, Continued

Now, you are ready to begin entering the example ladder logic.

Click on the section heading (**a**) Timers/Counters/Drums and (**b**) double click or drag/drop the TMR instruction.



Or you can type "T" while the cursor is on the (**c**) NOP position and select TMR from the drop down menu, then press **Enter**.

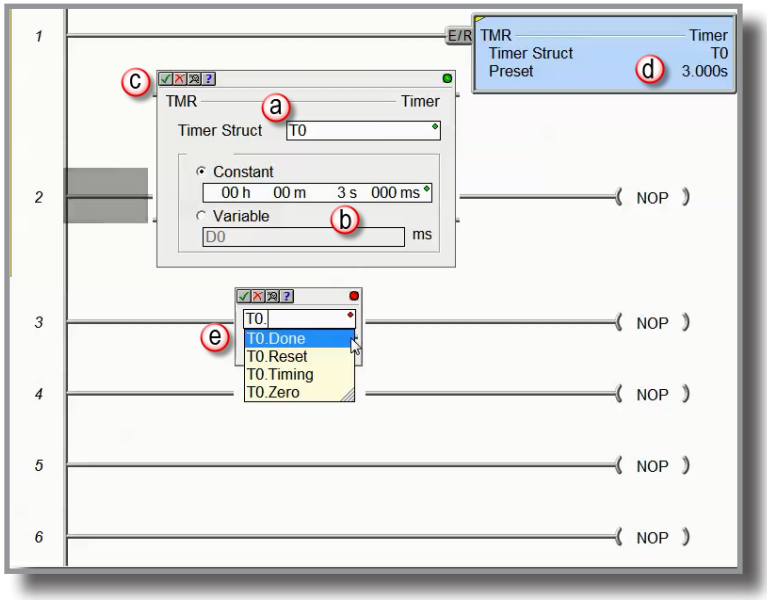


Rung #1, Continued

Once the TMR is selected, a Timer dialog box appears.

1. Set the (**a**) ***Timer Struct*** to **T0**
2. Enter 03 into the (**b**) Preset Constant Value for the seconds (s) preset.
3. Click on the (**c**) green checkmark in the upper left corner to accept.

After clicking the checkmark, Rung #1 should show the (**d**) T0 timer (TMR) instruction with a **Preset** of 3.000 seconds. A user variable can be assigned to the **Preset** value if needed, to allow the timer preset to be set from an external source.



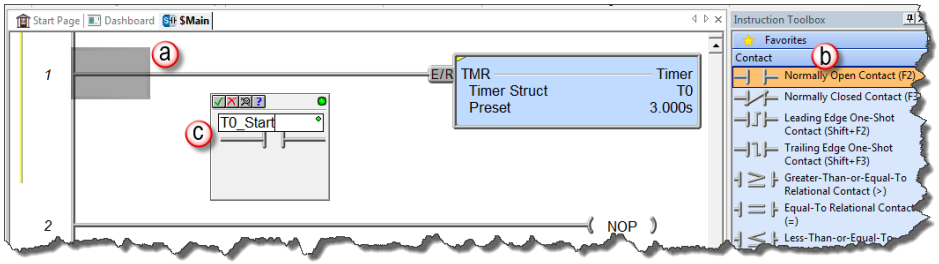
Since a Timer is a structure, it has predefined elements associated with it, such as “Tx.Acc” (accumulated time), “Tx.Done” (the completion bit) and "Tx.Timing" (the timer is enabled and timing).

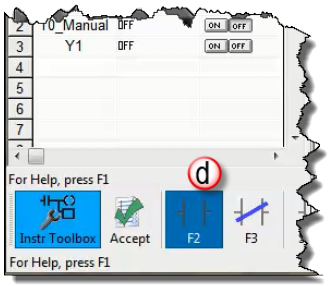
Therefore, if **T0.** (the "period" must be used to open drop-down list) is entered into any contact name, the Auto-Complete feature of Do-more! Designer will display all applicable bit (Boolean) selections available for that structure. Selecting (**e**) the ***T0.Done*** element, as seen above, will assign this element to the contact and the contact name will be **T0.Done**.

This feature works for all structures including: timers, counters, PID loops and strings. Many system data types such as, $Main and $FirstScan, as well as user-created devices like ECOM, CTRIO, or SERIO modules also use the Auto-Complete feature. See the Do-more! Designer Help file topic DMD0327 for more information on structure members.

Rung #1, Continued

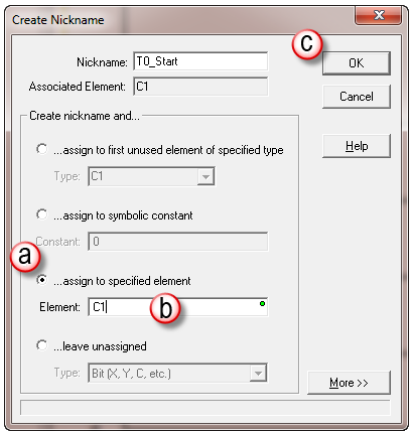
Place the cursor in the (**a**) leftmost column of rung #1. Type the nickname ***T0_Start*** at the (**a**) cursor position. The (**c**) Normally Open contact instruction (**b**) will be used by default as the nickname is entered. Press Enter.



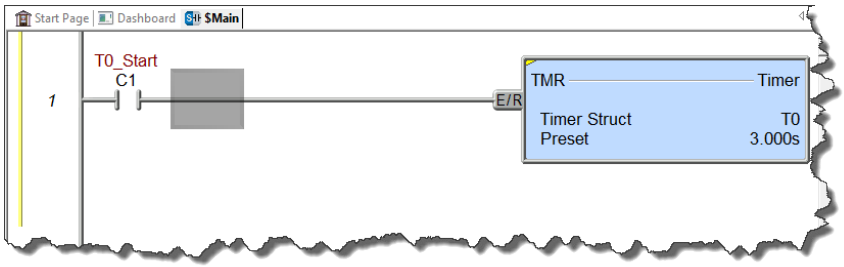


Another option is to select the (**d**) Normally Open Contact instruction from the Ladder Palette Bar (F2 Hot Key) or (**b**) double-clicking or drag/drop from the Instruction Toolbox, enter ***T0_Start*** for the name, and click the (**c**) green checkmark in the upper left corner.

Either method will open the Create Nickname dialog seen here (Right). Select (**a**) the option … ***assign to specified element***, (**b**) type the desired memory bit for this contact (C1), and select (**c**) **OK** to accept.

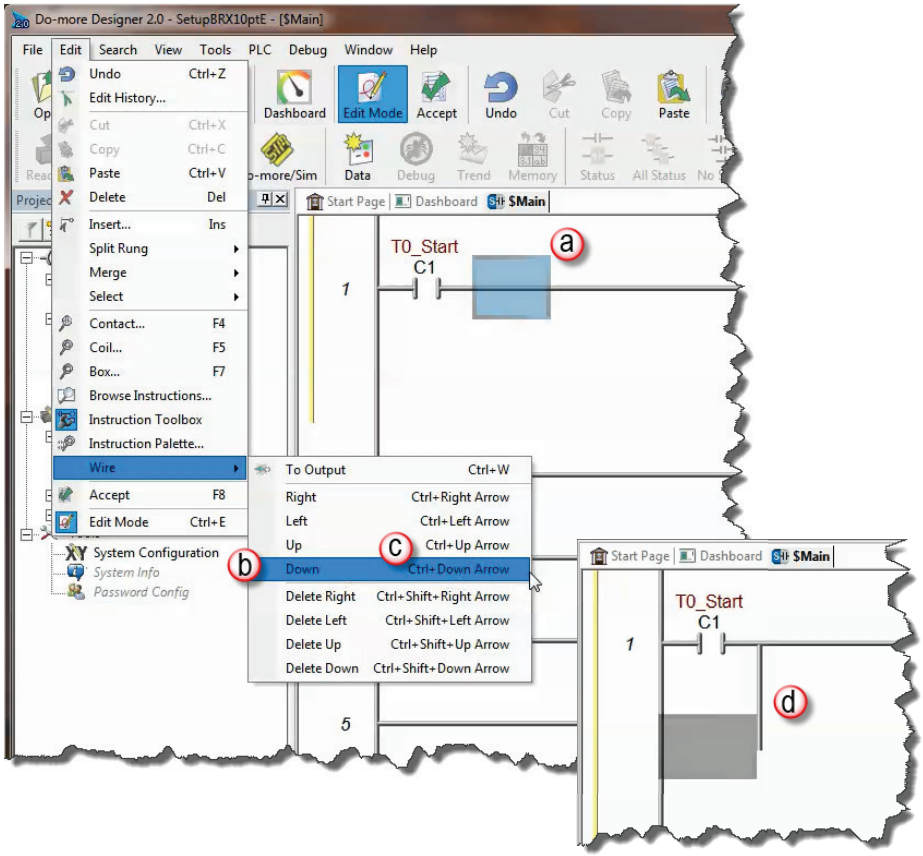


Rung #1 should appear as shown below.



Rung #1, Continued

With the cursor in the position to the (**a**) right of contact **T0_Start**, begin drawing a branch circuit. Under the ***Edit*** drop-down menu, select ***Wire***, then select (**b**) ***Down***. Notice the shortcuts that are available for wire drawing. The wire could also be drawn using the shortcut: (**c**) ***Ctrl+Down Arrow***. The (**d**) wire should now appear in your ladder.

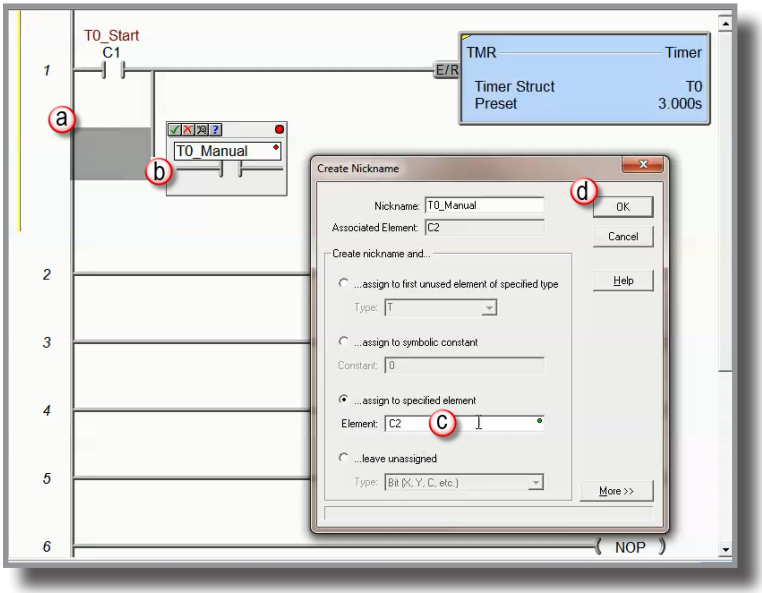


NOTE: *There are also Delete Wire options in the Edit drop down menu that are used to erase any wires not needed.*

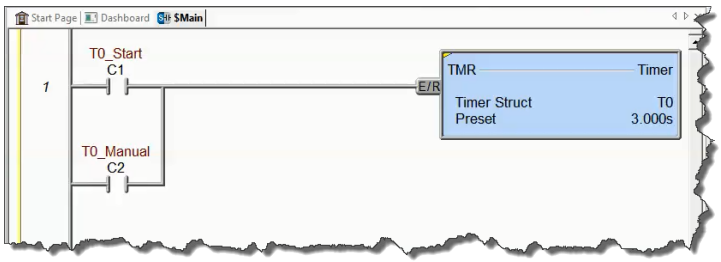
Rung #1, Continued

Place the (**a**) cursor in the space to the left of the new line and select another normally open contact.

Type in the nickname (**b**) **T0_Manual** and (**c**) assign bit C2. Select (**d**) OK to accept.

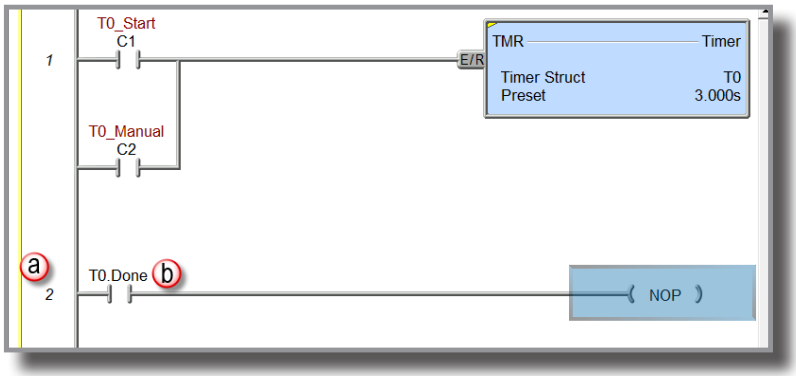


Rung #1 should look like this:



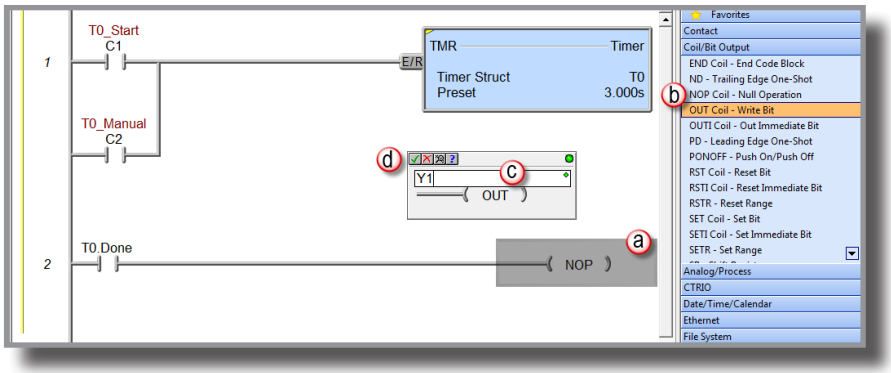
Rung #2

Place a normally open contact in the first position of (**a**) Rung #2. This contact will be tied to the Done bit of timer T0. Therefore, the name for this (**b**) contact should be entered as "T0. Done". There should be no Create Nickname dialog box as seen with the earlier normally open contacts.

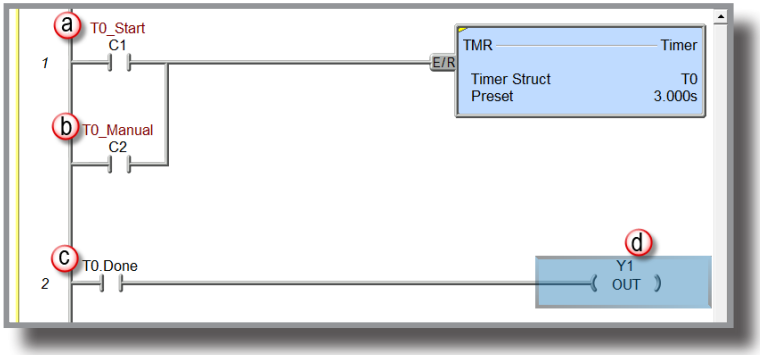


Lastly, you will need to add an **Out** coil to the end of Rung #2. Place the (**a**) cursor at the end of the rung highlighting NOP and either select **Out** from the Ladder Palette Bar, or type "OUT" and select the OUT instruction from the drop down menu. Another option is to (**b**) select the OUT instruction from the Instruction Toolbox under the Coil/Bit Output section.

Next, choose which bit will be tied to this coil. Tie this (**c**) coil to the physical output Y1 by typing "Y1" and clicking the (**d**) checkmark.

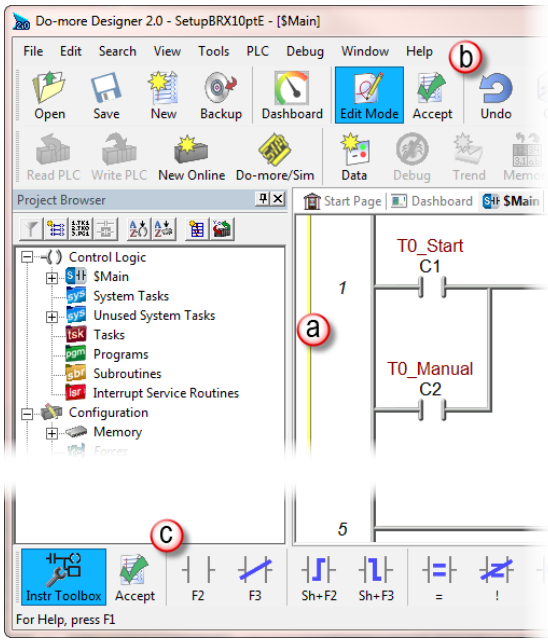


The ladder program should now look like this:

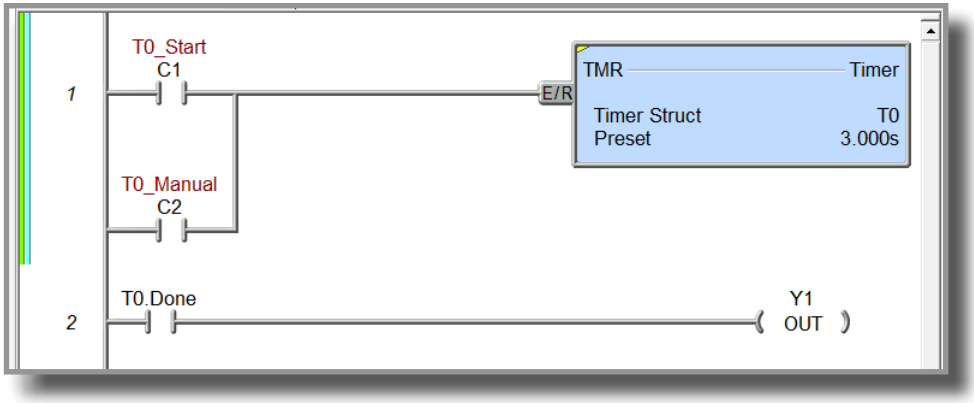


When either the (a) **T0_Start** or (b) **T0_Manual** contact is energized, the timer will begin timing. When it times out, contact (c) **T0_Done** will energize and the (d) output coil **Y1** will turn on. Note that an END instruction is not required.

The (a) yellow bar in the left margin signifies logic that has not been accepted. So once you have verified your logic, click the (b) **Accept** button in the *Project Toolbar* or the (c) *Ladder Palette Bar* to accept the changes.



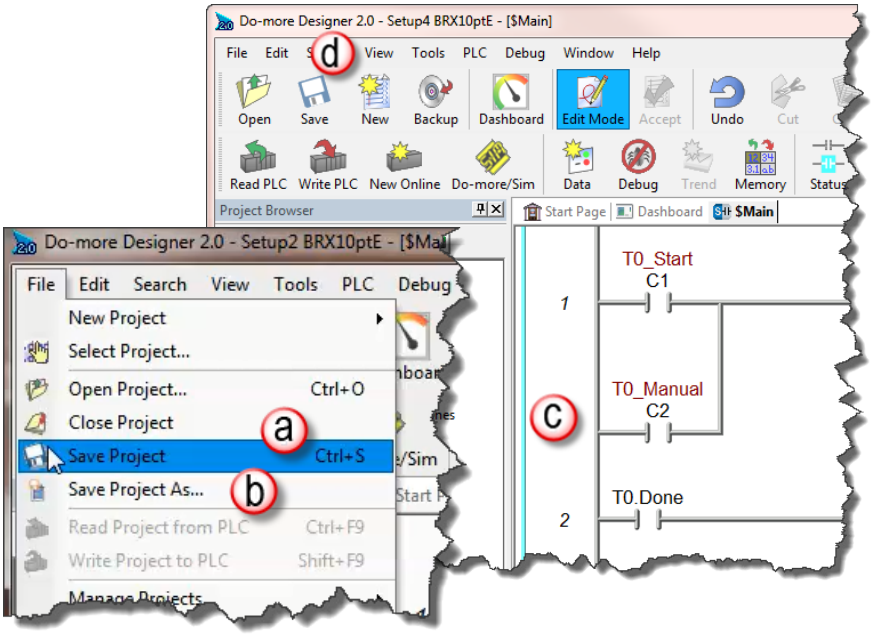
After selecting "Accept", the yellow bar should be replaced by green and blue bars (left margin). The green bar means the project has been accepted but not saved. The blue bar (only appears when online) means the project has not been downloaded to the MPU.



Step 8: Save Project

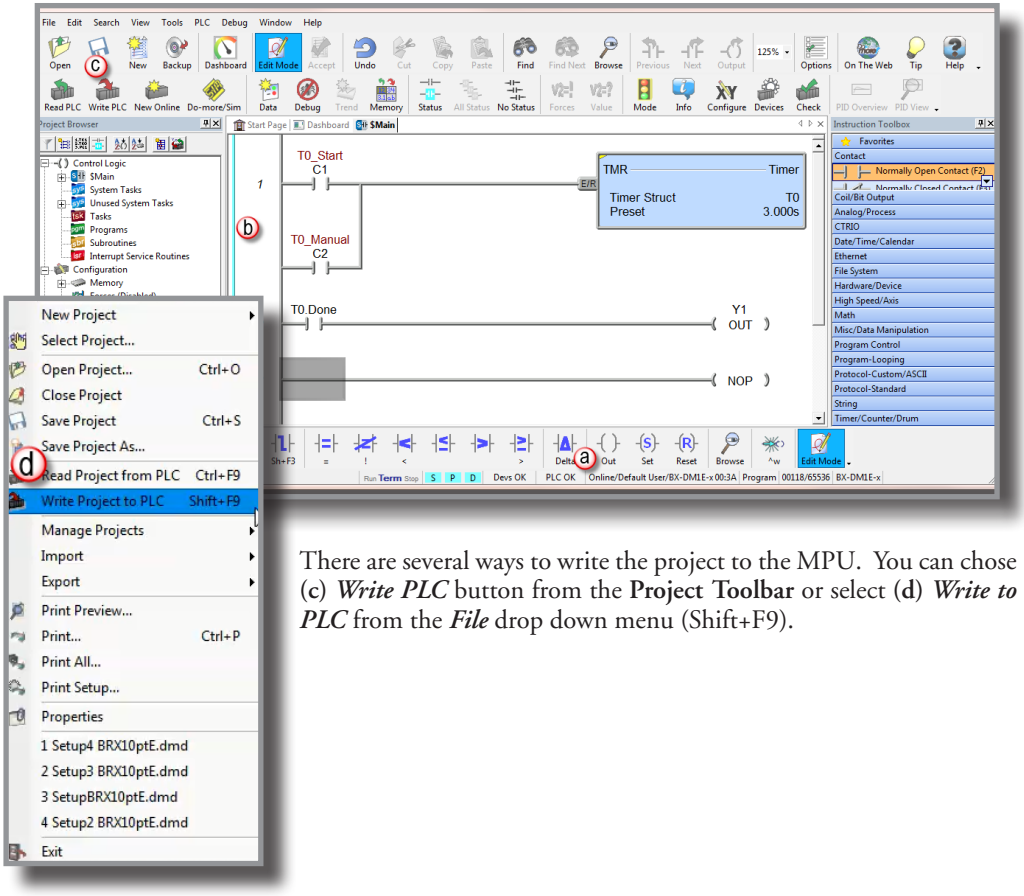
Save the project by selecting (a) **Save Project** from the **File** drop down menu (**Ctrl+S**), or save the file under a different name or in a different location by selecting the (b) **Save Project As…** option. You can also save the project by selecting the (d) **SAVE** icon on the **Project Toolbar**.

Once you save the project, the green bar on the left side of the ladder will disappear and the blue bar (c) will remain, meaning you have successfully saved the project to disk, but not yet downloaded to the MPU.



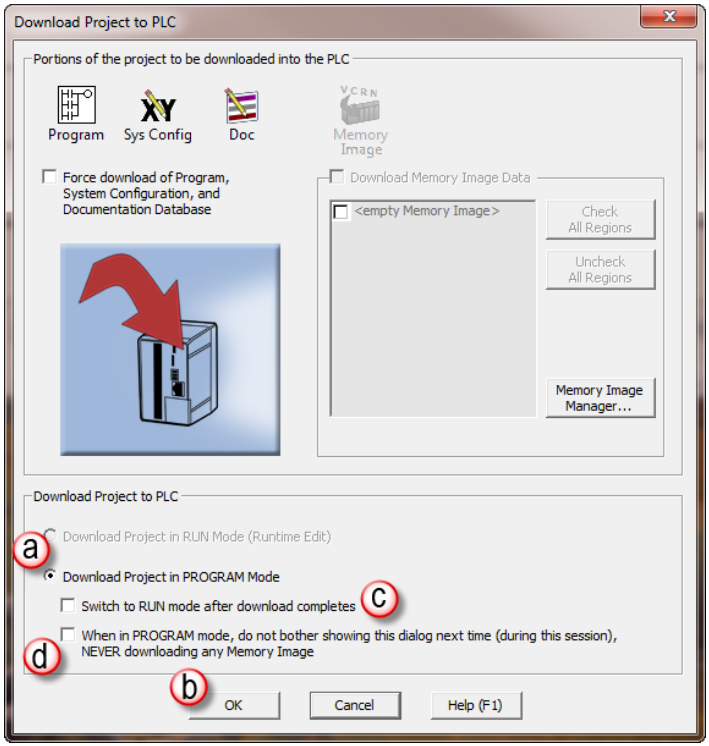
Step 9: Write Project to the BRX MPU

Now that you have created the example ladder logic program, you can write the program to the MPU. As a quick review, (**a**) check the status bar at the bottom of $Main window to verify you are Online with the MPU. Also notice the (**b**) blue bar to the left of the ladder logic program signifying that your project has been **Accepted** and **Saved** and you are online with the MPU.



There are several ways to write the project to the MPU. You can chose (**c**) ***Write PLC*** button from the **Project Toolbar** or select (**d**) ***Write to PLC*** from the ***File*** drop down menu (Shift+F9).

When the **Write PLC** button is selected and the MPU is in program mode, the ***Download Project to PLC*** pop-up window seen here appears.



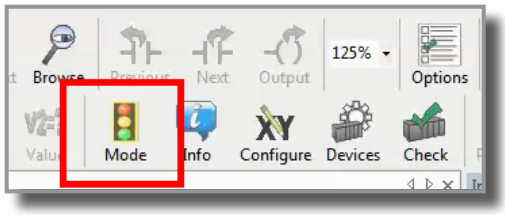
When the BRX MPU is in (**a**) Program mode and you click on the (**b**) **OK** button, the project is written to the MPU. When the download is complete, the MPU remains in program mode. In this window, you can select (**c**) to switch the MPU to **RUN** mode after the download is complete.

You can also select (**d**) not to display the ***Download Project to PLC*** window if the MPU is in program mode, keeping in mind that selecting this option will not download any Memory Image. Please view the Do-more! Designer HELP topics for details on the features available in the ***Download Project to PLC*** window.

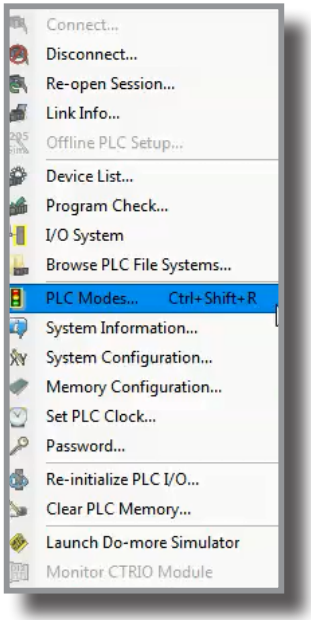
NOTE: *It is good practice to verify that the process you are controlling can be interrupted before downloading a project to the MPU.*

If you do not select the option to ***Switch to RUN mode after the download completes***, you can switch to RUN mode manually several ways:

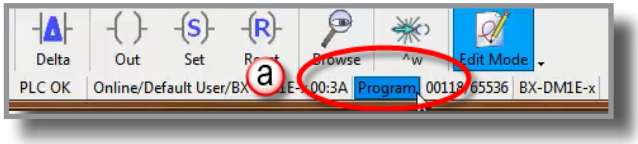
Click on the MODE icon on the Project Toolbar

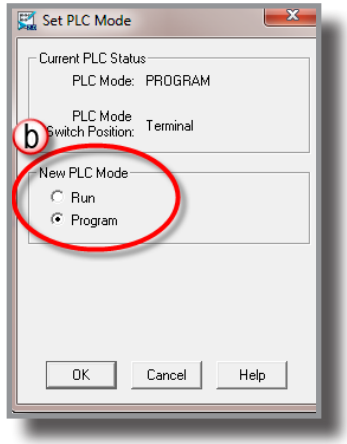


Select **PLC Modes** from the PLC drop down menu or use the shortcut, Ctrl+Shift+R.



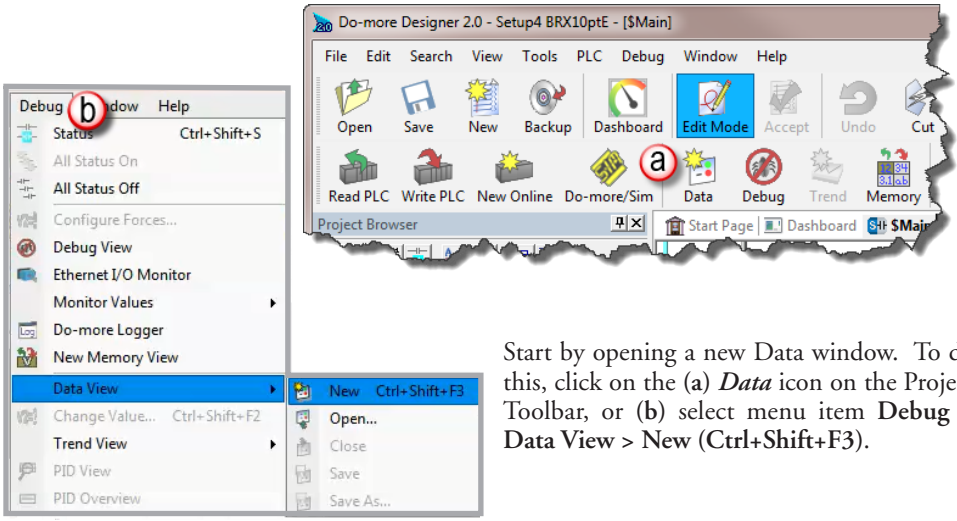
Click on (a) ***Program*** in the Status bar. This will bring up the ***Select PLC Mode*** pop-up where you can change the PLC mode by selecting the (b) **Run** radio button.





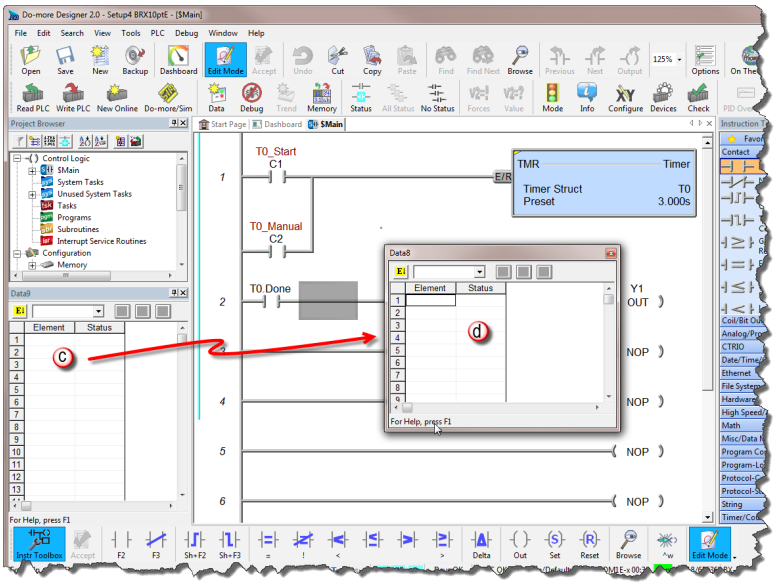
Step 10: Testing Project Using Data View

With the project successfully downloaded to the MPU and the unit in RUN mode, you can now test the function of the ladder program using the Data View tool.

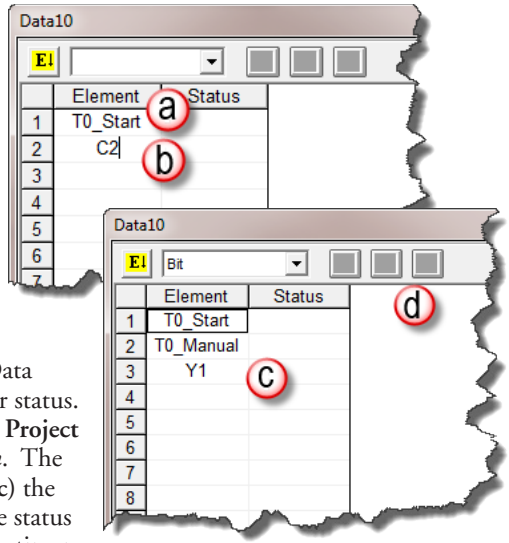


Start by opening a new Data window. To do this, click on the (**a**) *Data* icon on the Project Toolbar, or (**b**) select menu item **Debug > Data View > New (Ctrl+Shift+F3)**.

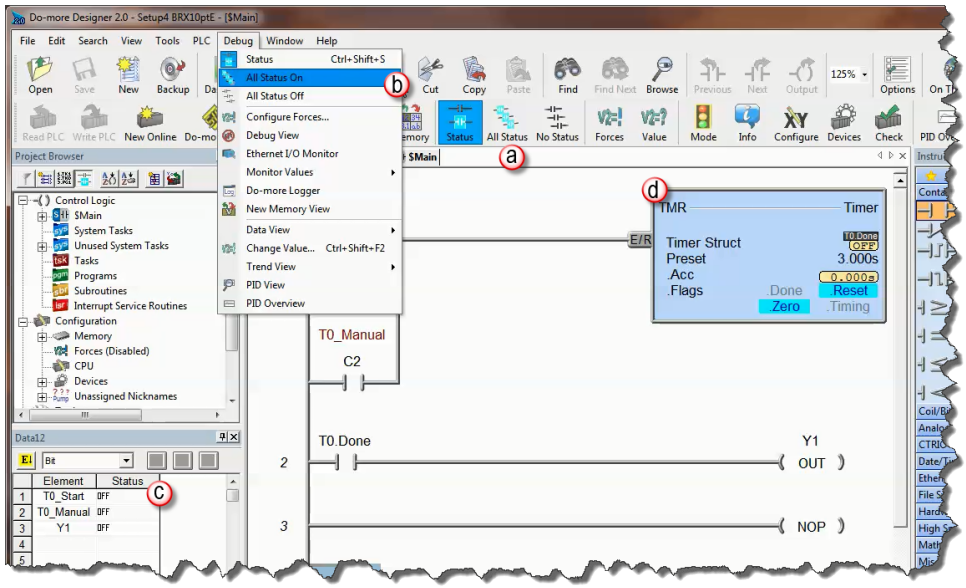
The **Data View** window shown below (**c**) will open. This window will open in the project browser section of the programming window but it can be (**d**) relocated anywhere on the screen by clicking the title bar and dragging it to a new location.



Now enter the elements that you wish to monitor. On line one type "C1" under the **Element** column and press Enter. You will see the C1 change to the (**a**) nickname associated with it, **T0_Start**. On line two (**b**) type the element "C2" (**T0_Manual**) and on line three (**c**) type "Y1". Notice the three icons (**d**) at the top right in the data window are grayed out. This will change in the next step.

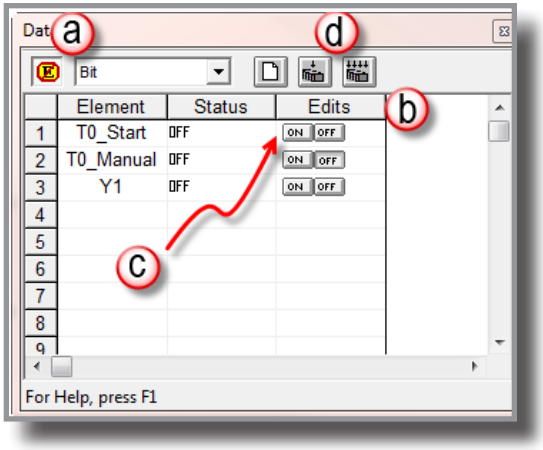


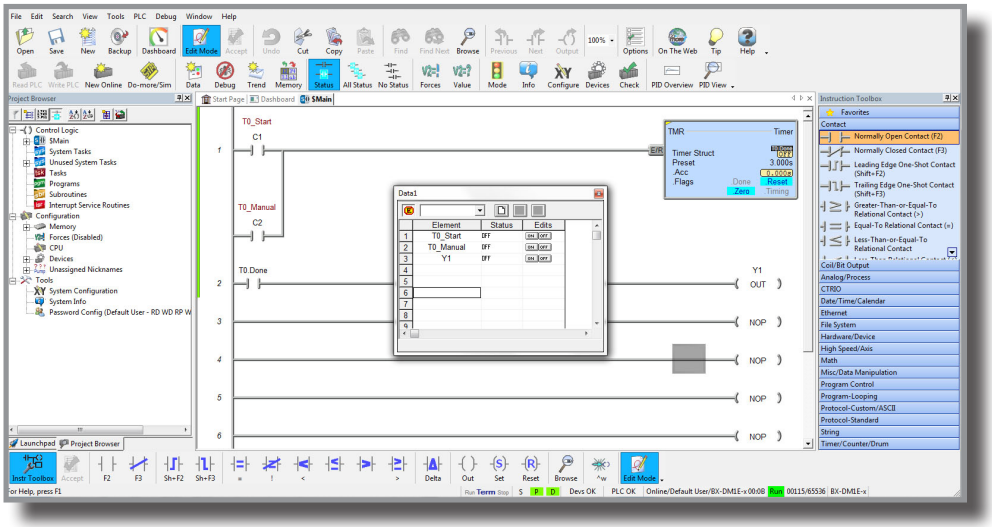
With the ladder elements entered into the Data View window, you now need to activate their status. To do so, (**a**) click the ***All Status*** icon on the **Project Toolbar**, or (**b**) select ***Debug > All Status On***. The ***All Status On*** option will not only activate (**c**) the ***Status*** of the **Data View** window but also the status of the (**d**) ladder program as seen below. The timer structure now shows the status of its structure elements, including the accumulated value.



The next step is to enable edits within the Data View window. To do this, click the (**a**) yellow box with the *E* found in the top left corner of the Data View window. The (**b**) **Edits** column is now added to the **Data View** window.

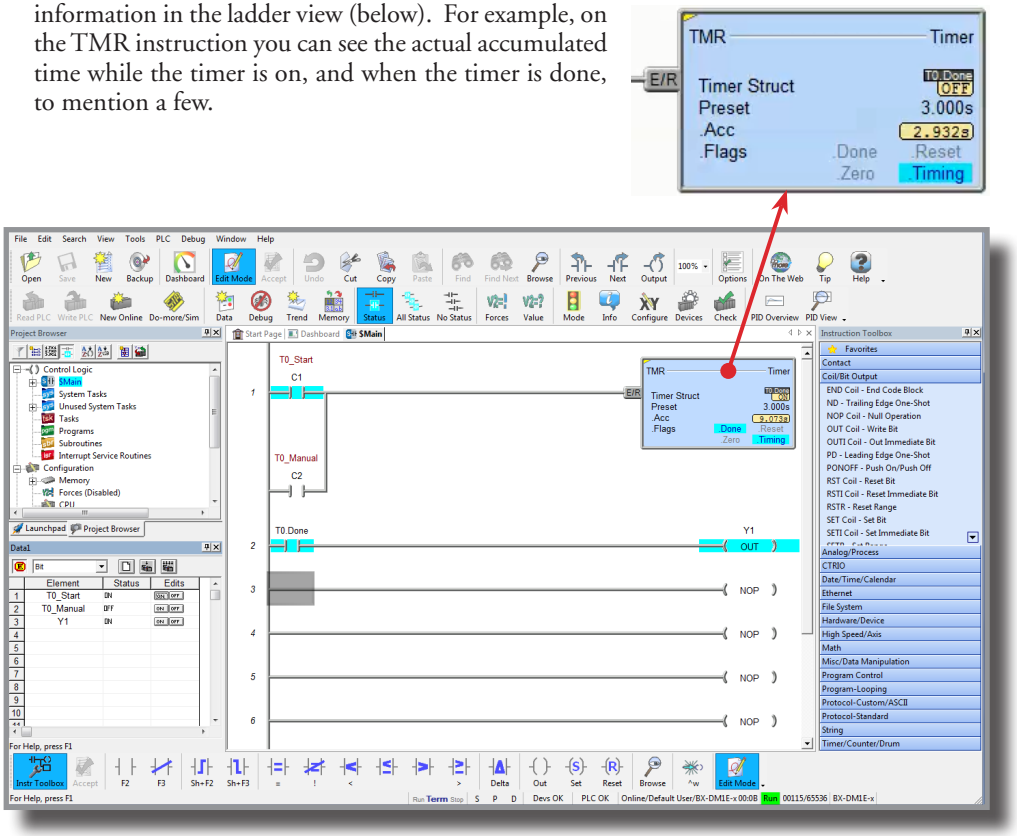
The **Edits** column allows you to make changes to the current values of the elements listed. T0_Start's current value is **OFF**. Double-click the (**c**) **ON** button under the **Edits** column. The (**d**) ***Write Current Edit*** and the ***Writes All Edits*** buttons will appear at the top of the window. The buttons will write individual or all edits, respectively, made in the **Data View** window to the MPU.





Click the ***Write Current Edit*** to PLC button and confirm it. This will write the new value to T0_Start. Once T0_Start changes to an ON state, the timer (T0) will begin to time and quickly reach the preset. As soon as the preset has been met the done bit, T0.Done, will turn ON causing output Y1 to also turn ON, as seen on the following page. Now write an OFF to T0_Start and watch as the timer and Y1 reset.

With *All Status* ON, you can view instruction information in the ladder view (below). For example, on the TMR instruction you can see the actual accumulated time while the timer is on, and when the timer is done, to mention a few.



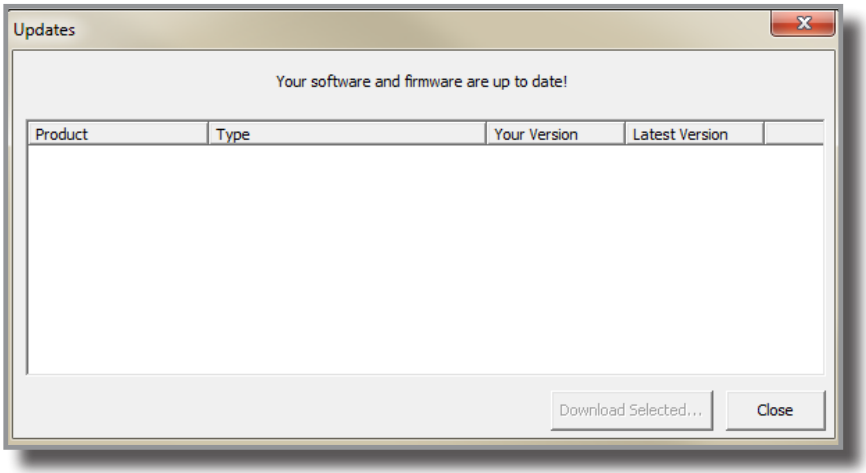
Congratulations, you have now programmed, downloaded, and tested a ladder logic program for the BRX Do-more MPU. Feel free to experiment with a program of your own and please remember that the software Help file is an essential tool to use when programming your controller.

Do-more Designer Software and Firmware Updates

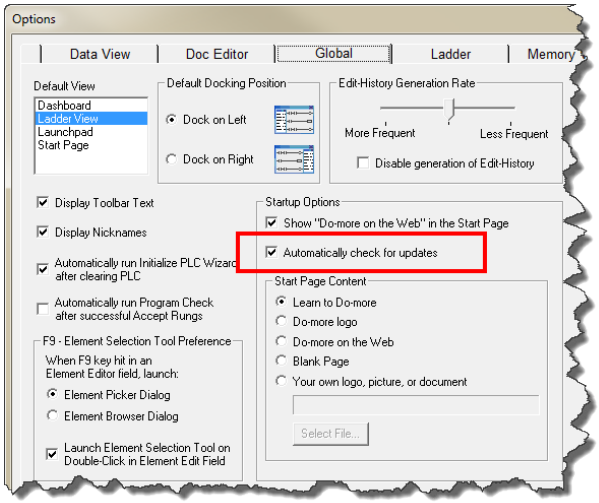
There will be times when an update is available for the BRX firmware or the Do-more Designer programming software. The Do-more! Designer software makes it very easy to download the updated files.

By default, checking for updates is done automatically each time Do-more! Designer is started. Do-more! Designer will check for updates to the programming software, the Help file content, Start Page content, new firmware for BRX Do-more and Do-more! controllers and new firmware for CTRIO(2) modules. An Internet connection is required to perform the check and to download the updates.

When updates are available, the user is notified through this dialog:



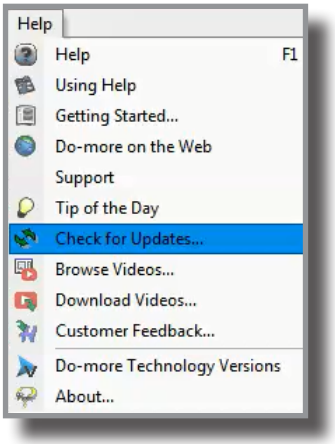
The automatic check can be disabled by opening the View -> Options menu, select the Global tab and uncheck the "Automatically Check for Updates on Startup" selection.



Do-more Designer Software and Firmware Updates, continued

To manually check for software or firmware updates, go to HELP -> Check for Updates.

Do-more Designer Help Topic DMD0310 provides detailed information on downloading the programming software updates, firmware updates, Do-more Designer Help System updates, and HTML/Documentation updates.

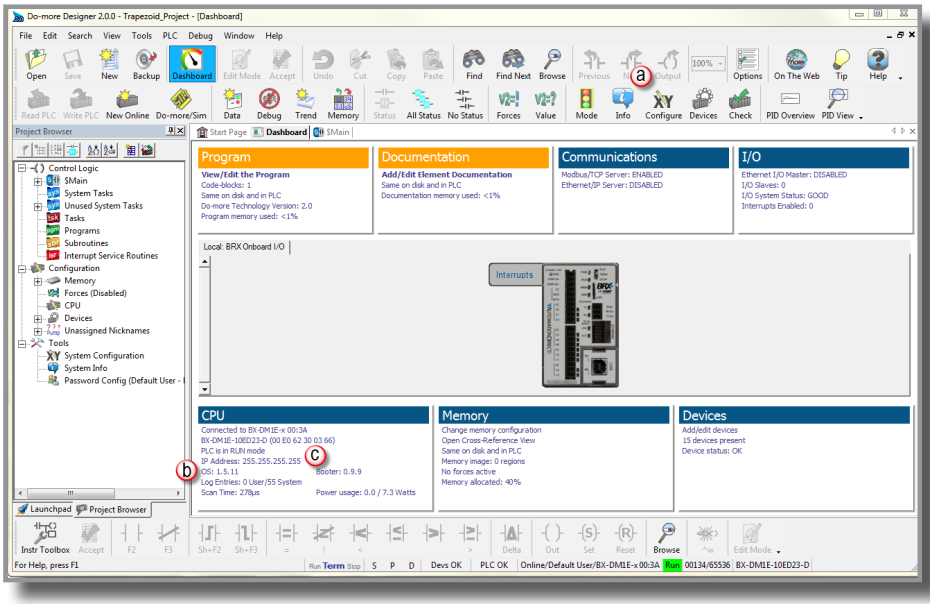


Updating the Firmware

NOTE: *Downloading the firmware files does not automatically update the firmware of the connected BRX PLC. You must use the available tools to update the Operating System and the Gate Array and Loader. The available tools will indicate when the firmware is not up to date in the controller.*

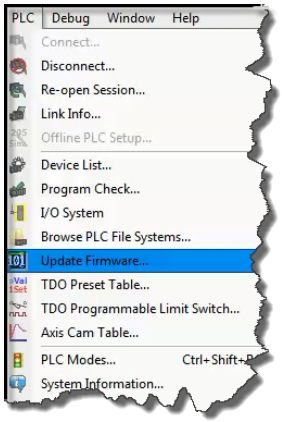
There are three ways to access the dialogs needed to update the Operating System and the Booter/Loader.

The first method is by using the (**a**) **Info** icon on the online toolbar. A second method is by selecting the (**b**) OS or (**c**) Booter links under the CPU section of the Dashboard.



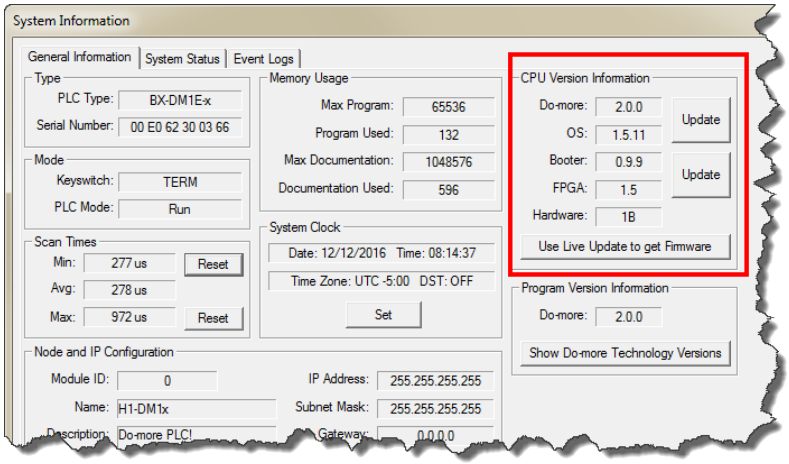
Do-more Designer Software and Firmware Updates, continued

The third method is through the menu, PLC -> Update Firmware.



When you select the **Info** icon on the online toolbar, the ***System Information*** utility (below) comes up. To update the controller firmware, use the section under ***CPU Version Information***.

The CPU section displays the following information:



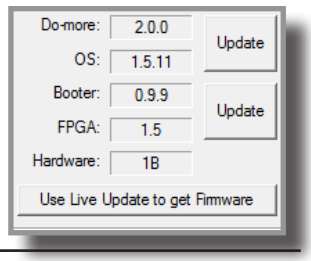
Do-more: The current version of the instruction set in the controller.

OS: The current version of the operation system in the controller.

Booter: The current version of boot loader in the controller.

FPGA: The current version of the Gate Array code in the controller.

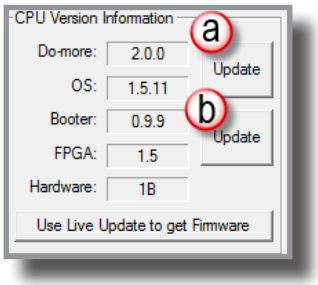
Hardware: The current revision of the controller hardware.



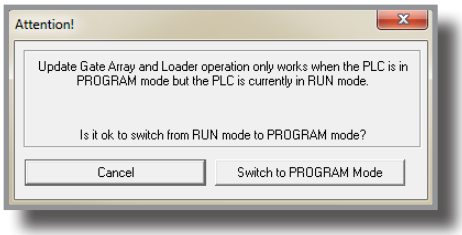
NOTE: *An Asterisk (*) next to any of the numbers means that there is an update available for that particular portion of the firmware.*

Do-more Designer Software and Firmware Updates, continued

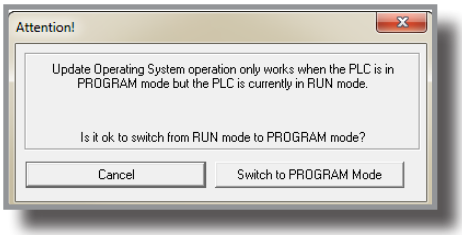
Click the **Update** button (**a**) adjacent to the Do-more & OS display to open the Update Operating System dialog.



Click the **Update** button (**b**) adjacent to the Booter & FPGA



display to open the Update Gate Array and Loader dialog.



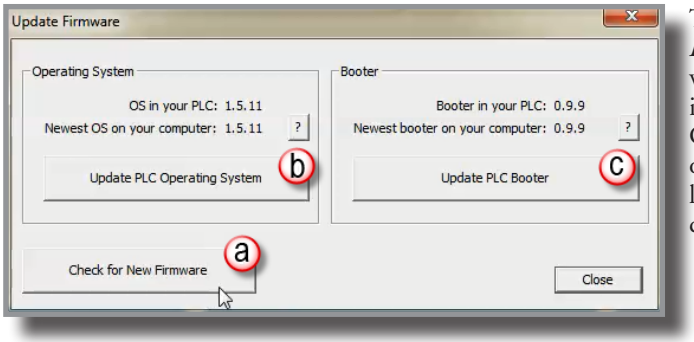
10

NOTE: *If both the Booter and OS need updating, it is recommended to do both updates.*

NOTE: *DIP switch #3 (on MPU) is used to Enable/Disable the ability to update the firmware in the controller. This DIP switch must be OFF to allow Do-more Designer to update the operating system or the gate array. Please review Do-more Designer Help topic DMD0266 for information on the on-board dipswitches.*

The dialog shown below is displayed when you use the OS or Booter link under the CPU section of the Dashboard or you use the menu PLC -> Update Firmware.

The ***Update Firmware*** dialog has the necessary tools to download new firmware files from the Web and update the connected Do-more CPU.



The ***Operating System*** and ***Booter*** sections show the version currently running in the attached Do-more CPU and the latest versions of the firmware and boot loader files that have been downloaded to this PC.

Do-more Designer Software and Firmware Updates, continued

Click (**a**) **Check for New Firmware** (previous graphic). The ***Live Update*** tool comes up, which allows you to see if there is a newer firmware available, and if so to download the updated files. The ***Live Update*** tool is discussed later in this chapter.

Clicking (**b**) **Update PLC Operating System** (previous graphic) opens the ***Update Operating System*** dialog that shows detailed information about the attached CPU's operating system and Do-more Technology versions and selects the latest Operating System firmware file based on the connected Do-more CPU. The ***Update Operating System*** dialog is discussed later in this chapter.

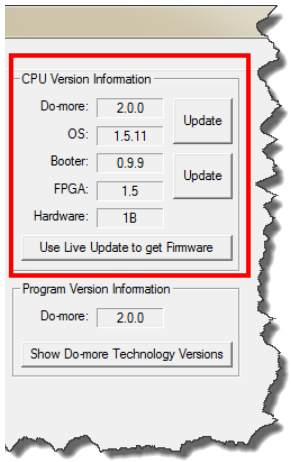
Clicking (**c**) **Update PLC Booter** (previous graphic) opens the ***Update Gate Array and Loader*** dialog that shows detailed information about the attached CPU's Gate Array and Boot Loader versions and selects the latest Boot Loader firmware file based on the connected Do-more CPU. The ***Update Gate Array and Loader*** dialog is discussed later in this chapter.

NOTE: *If both the Booter and OS need updating, it is recommended to do both updates.*

Live Update

NOTE: *DIP switch #3 (on MPU) is used to Enable/Disable the ability to update the firmware in the controller. This DIP switch must be OFF to allow Do-more Designer to update the operating system or the gate array. Please review Do-more Designer Help topic DMD0266 for information on the on-board dipswitches.*

Click the **Use Live Update to get Firmware** button to open the Live Update dialog. Live Update will utilize the Internet connection to check for new firmware files for the Do-more controllers and the CTRIO modules, then download any new files to the appropriate Bin\Images\< Device > folders.

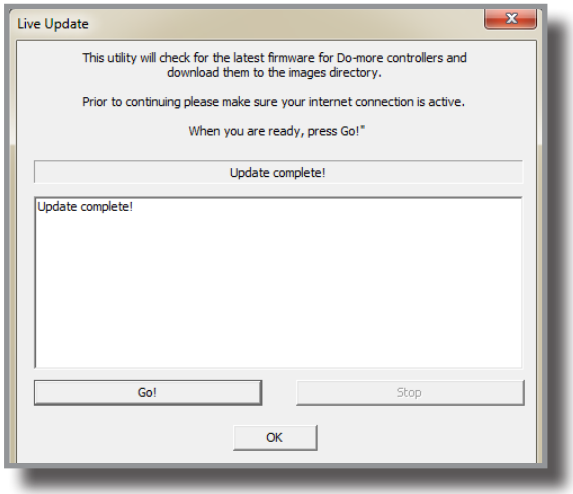


Do-more Designer Software and Firmware Updates, continued

Click the **Go!** button to check for updated firmware files.

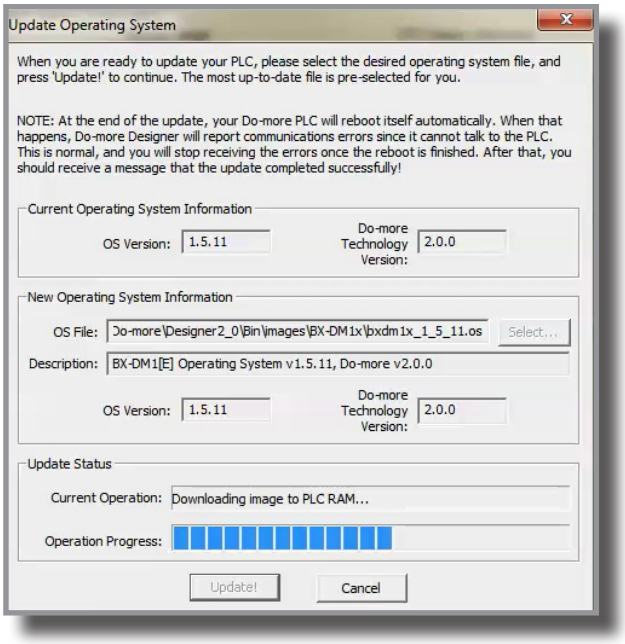
Click the **OK** button to close the Live Update dialog.

NOTE: *Live Update requires a functional Internet connection to work. Make sure the Internet connection is active before running Live Update.*



Update Operating System

When the dialog opens it will read the OS Version and Do-more versions from the currently connected controller, and from the latest operating system firmware file.



Do-more Designer Software and Firmware Updates, continued

Current Operating System Information

OS Version - the current version of the operation system in the controller

Do-more Version - the current version of the instruction set in the controller

New Operating System Information

OS File - the most up-to-date operating system firmware file in the default firmware folder

Select... - opens a ***File Open*** dialog to select an operating system firmware file. Operating System firmware files typically have the following form: "H2DM1x_<major>_<minor>_<build>.os"

Description - the current version information from the selected file

OS Version - the current version of the operation system in the selected file

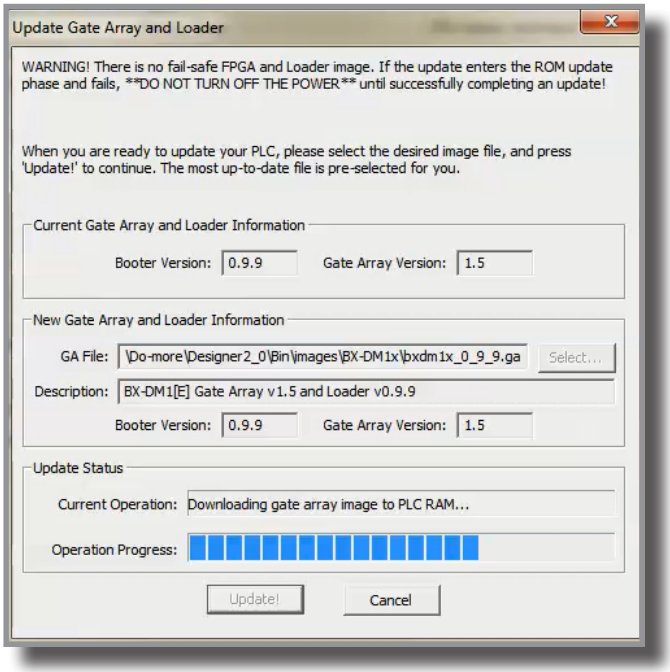
Do-more Version - the current version of the instruction set in the selected file

Click the **Update!** button to begin the update progress. The last phase of updating the operating system is a reboot of the Do-more controller. While the controller is rebooting, the normal communication updates will fail, and the Link indicator on the Status bar will turn red. Once the controller has successfully rebooted, normal communication updates will automatically resume, and the Link indicator will return to normal.

Click the **Cancel** button to exit without updating the operating system.

Update Gate Array and Loader

WARNING! There is no fail-safe for the Gate Array and Loader update, which means, if the update process begins and then fails, ** DO NOT TURN OFF THE POWER, keep trying the update process until it is successful. If you turn off the power without a successful update the controller must be sent back to the factory for repair (use the 'H/W Repair (RMA)' link at www.hosteng.com to request an RMA number for a Do-more CPU that fails to update the Gate Array and Loader).**



When the dialog opens it will read the Gate Array Version and Boot Loader version from the currently connected controller and from the latest Gate Array firmware file.

Current Gate Array and Loader Information

Booter Version - the current version of Boot Loader in the controller

Gate Array Version - the current version of the Gate Array code in the controller

New Gate Array and Loader Information

GA File - the most up-to-date Gate Array firmware file in the default firmware folder

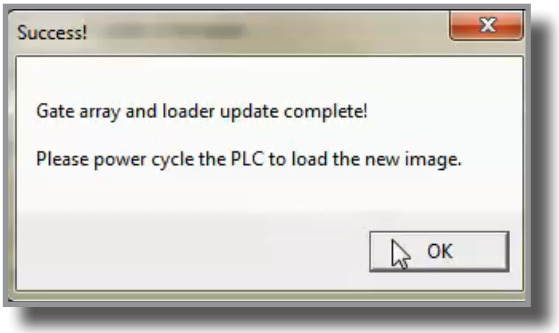
Select... - opens a ***File Open*** dialog to select a Gate Array firmware file. Gate Array files firmware file typically have the following form: "H2DM1x_<major>_<minor>_<build>.ga"

Description - the current version information from the selected file

Booter Version - the current version of Boot Loader in the selected file

Gate Array Version - the current version of the Gate Array code in the selected file

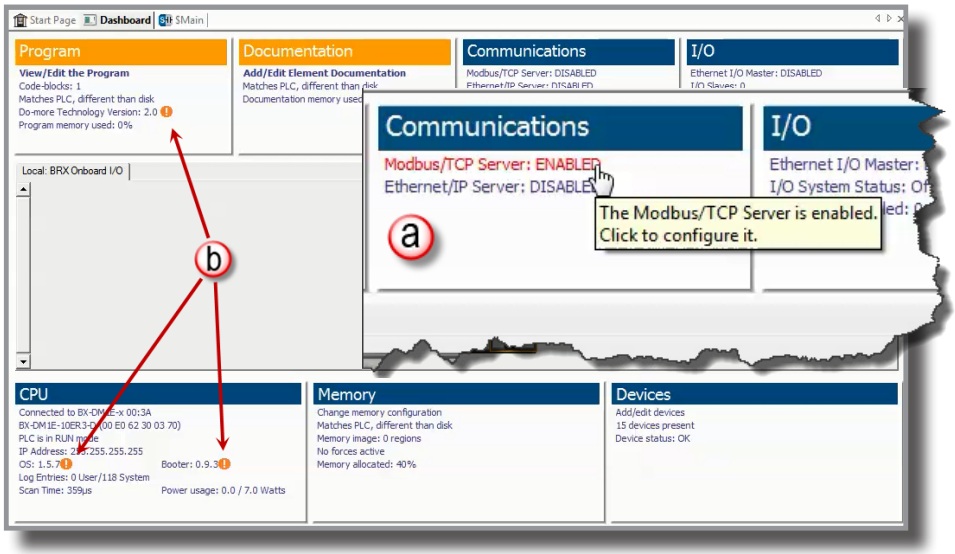
Click the **Update!** button to begin the update progress. When the Gate Array and Loader update is complete, you will see the following window with instructions to power cycle the PLC.



Click the **Cancel** (previous graphic) button to exit without updating the Gate Array and Loader.

Dashboard

The Do-more Designer Dashboard is a graphical representation of the PLC system. It is used to assist in the configuration of the various components of the system as well as for monitoring and troubleshooting after it is up and running. The following pages will be a quick overview on how to use the Dashboard. Please reference Do-more Designer Help topic DMD0415 for more detailed information.



The dashboard is divided horizontally into three sections, top, center and bottom sections. The top and bottom sections consist of distinct panes each of which contain related items with current status of each. These entries (**a**) are also mouse-over links; as you move your mouse over an entry it will highlight in red and a pop-up text box will appear with more detailed information. Left click a link to open a dialog that addresses the configuration of that entry, or opens a monitor tool for that entry.

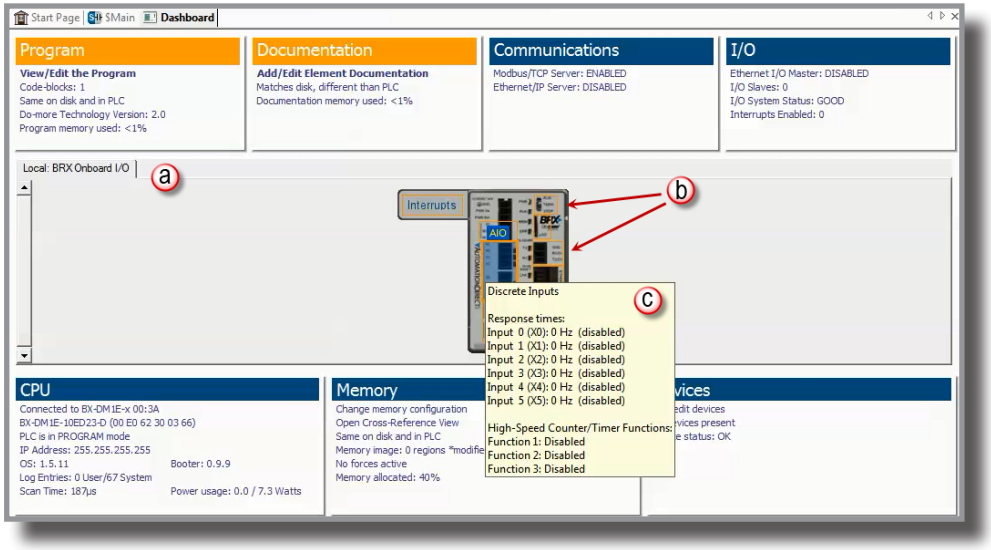
Entries (**b**) that have an orange (**!**) next to them indicate items that need your attention. For example, an orange (!) adjacent to the "OS: x.y.z" item in the CPU section indicates the firmware in the CPU is older than the firmware you have downloaded to this PC. Click the link to open the firmware update tool.

Some entries will have their text displayed with a yellow background to indicate the item is generating a warning message that may need your attention. For example, if you have Forces enabled and one or more items are currently being Forced to a value, the Memory section will display the "x forces active" text with a yellow background. Click this link to open the Configure Forces dialog to see what elements are being forced.

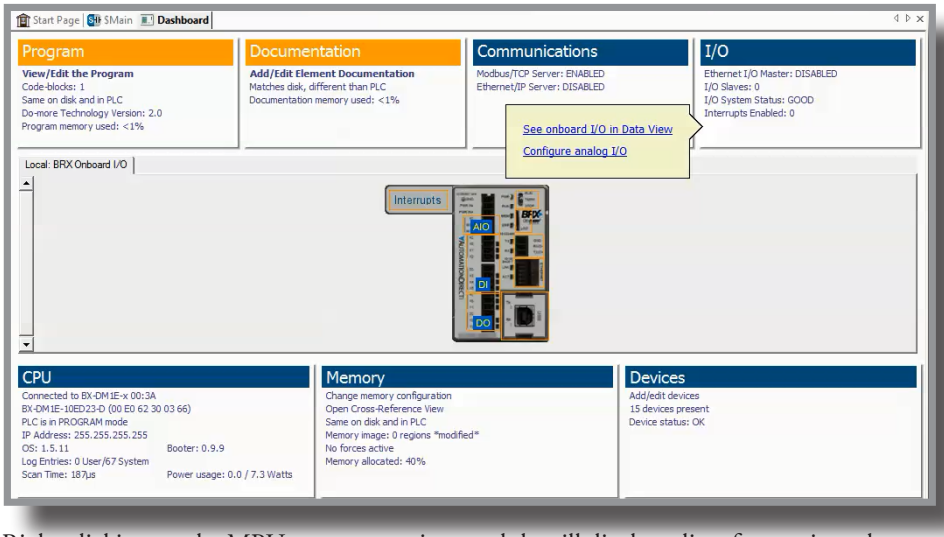
Some entries will have their text displayed with a red background to indicate the item is generating a warning message that may need your attention. For example, if an I/O module is reporting an error, the I/O section will display the "I/O System Status" text with a red background. Click this link to open the I/O System View to see an overview of the entire I/O system and locate the module that is reporting an error.

The center section contains a series of tabbed (**a**) graphical representations of the PLC system components. The leftmost (top) selection is the local CPU. There is an additional tab created for each Ethernet Remote I/O Slave. Any time the mouse cursor is in the center section (**b**) orange outlines (known as hotspots) will appear on the sections of the PLC system to indicate there is status information available for that area or configuration that can be performed.

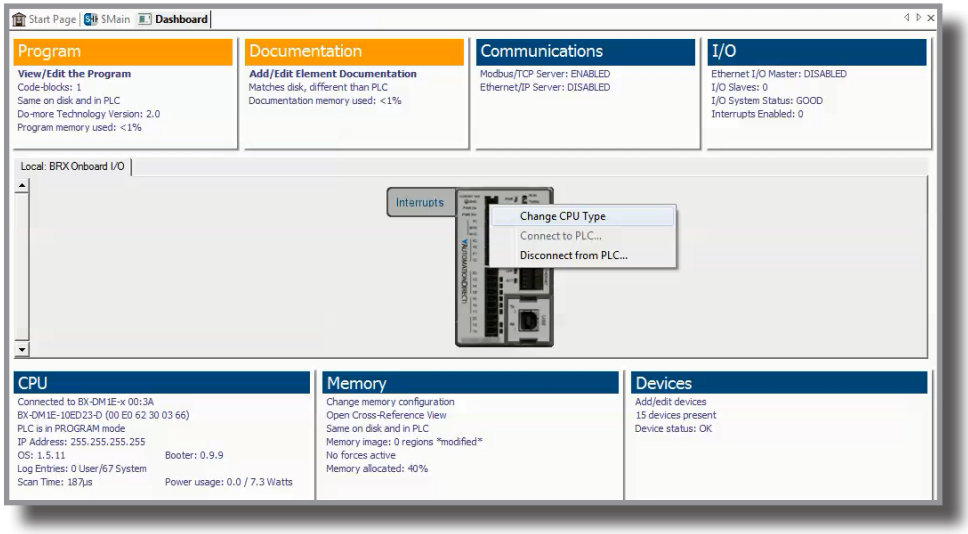
Hovering the mouse cursor over any of the hot spots will display a popup that shows the current status of the item in that hotspot. For example, hovering over the DI hotspot (**c**) will display information on the response times configured for the discrete inputs and, if the unit supports high speed inputs, it will display how the high speed Counter/Timer functions are configured.



Left-clicking on the hot spot will display a popup menu that contains links specific to the configuration tools and information displays for that item. For example, left clicking on the **AIO** (analog I/O) hotspot, displays links to view onboard analog I/O values in Data View and a link to configure the analog I/O, as shown below.



Right-clicking on the MPU or an expansion module will display a list of operations that can be performed on that module. For example, right-clicking on the MPU (below) gives the option to Change CPU Type, Connect to PLC, or Disconnect from PLC. The options will vary depending on the MPU family and module type.



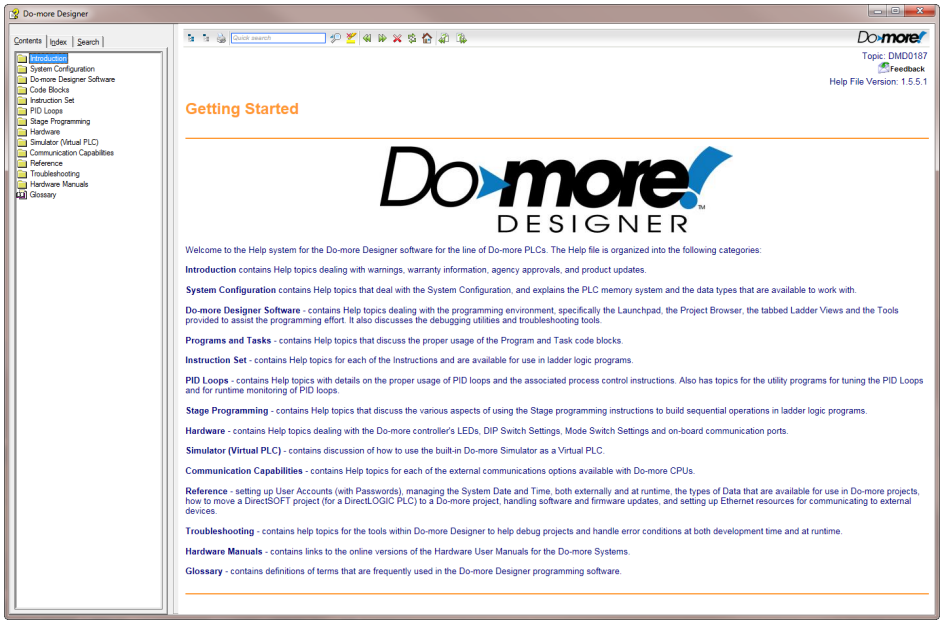
Help File

Accessing the Help File

The software Help file is available as a quick reference or detailed guide to the many features and capabilities of the Do-more! Designer software. This provides comprehensive support for you as a user of not only the BRX Platform but also the whole Do-more product family.

There are three ways to access the Help File:

1. Select the Help File icon from the Project Toolbar.
2. Choose Help from the Help menu drop down.
3. Use the shortcut F1 or press the (?) button or the Help button on the dialog that you need help with.



Notes:

BRX Do-more! CPU Specifications

In This Chapter...

The BRX Platform 11-2
BRX Do-more! CPU Common Specifications 11-3
Memory Features 11-5
CPU Status Indicators 11-7
Mode Switch Functions 11-8
DIP Switch Specifications 11-9
Battery Replacement 11-12
microSD Slot 11-13
Customizing the Logo Window 11-14
RS-232/485 Port Specifications 11-15
Ethernet Port Specifications 11-17
POM Slot 11-17

The BRX Platform

The BRX Platform is a very versatile modular Micro PLC system that combines powerful features in a compact standalone footprint. One of the many features that the BRX platform has is the ability to utilize the Do-more! DM1 Technology. This allows the BRX platform to leverage the power of the Do-more! DM1 technology resulting in shorter development time and cost. For example you are able to take an existing Do-more project that was created using the proven H2-DM1(E) or T1H-DM1(E) CPUs and port the program right into the BRX-DM1(E) CPUs.

The foundation of the platform consists of 4 unique Micro PLC unit (MPU) form factors that incorporates the Do-more DM1 technology. Shown below are the four unique Micro PLC form factors.

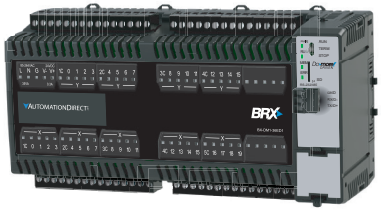
BX ME
No Built-In I/O
Ethernet Port

BX 10
10 Discrete I/O
No Analog I/O
No Ethernet Port

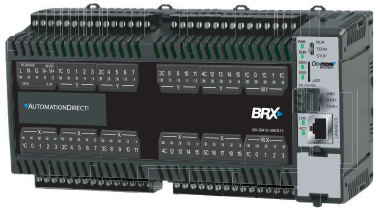
BX 10E
10 Discrete I/O
2 Analog I/O
Ethernet Port

BX 18
18 Discrete I/O
No Analog I/O
No Ethernet Port

BX 18E
18 Discrete I/O
2 Analog I/O
Ethernet Port



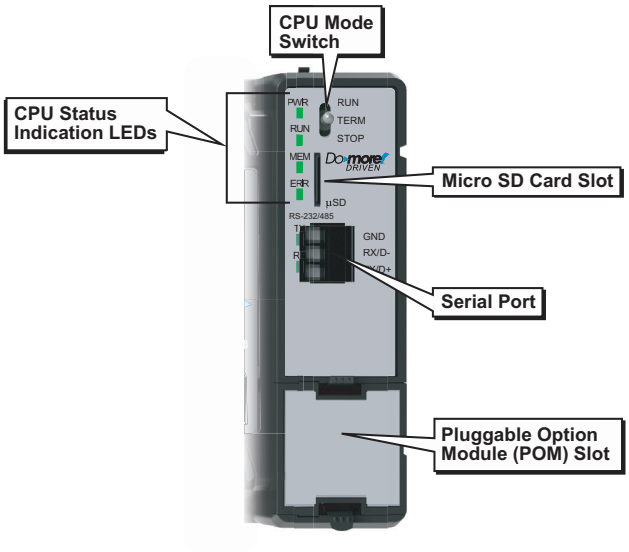
BX 36
36 Discrete I/O
No Analog I/O
No Ethernet Port



BX 36E
36 Discrete I/O
6 Analog I/O
Ethernet Port

BRX Do-more! CPU Common Specifications

The BRX Do-more! CPUs have standard built-in features such as CPU status indication, a CPU mode selection switch, microSD card slot and a CPU Pluggable Option Module (POM) slot.



General Specifications	
Operating Temperature	0° to 60°C (32° to 140°F)
Storage Temperature	-20° to 85°C (-4° to 185°F)
Humidity	5 to 95% (non-condensing)
Environmental Air	No corrosive gases permitted
Vibration	IEC60068-2-6 (Test Fc)
Shock	IEC60068-2-27 (Test Ea)
Enclosure Type	Open Equipment
Noise Immunity	NEMA ICS3-304
EU Directive	See the "EU Directive" in Appendix A or topic DMD0331 in the Help File.
Agency Approvals*	UL 61010-2 - UL File # E185989 Canada and USA CE Compliant EN61131-2

*Meets EMC and Safety requirements. See the Declaration of Conformity for details.

BRX Do-more! CPU Common Specifications, Continued

CPU Specifications	
Program Memory Type	FLASH memory
User Data Memory Type	Battery Backed RAM, user configurable
Program Memory	1MB (Includes program, data and documentation)
User Data Memory	256kB
Retentive Memory	256kB max. By default all User Data Memory is set to Retentive
Scan Time	50µs 1K Boolean
Serial Port	RS-232/485, 3-Pin, Software configurable
Pluggable Option Module	RS-232, RS-485, Ethernet 10/100, USB 2.0 Type B
Data Logging	microSD card slot (32G max)
Expansion Modules [1] (Allowed per BX MPU model)	BX ME - 8 expansion modules BX 10/10E - 2 expansion modules BX 18 - 4 expansion modules BX 18E - 8 expansion modules BX 36 - 4 expansion modules BX 36E - 8 expansion modules
Expansion Module Density	5 ,8, 12 or 16 points/module
Expansion I/O Limits	128 I/O points
Remote Ethernet Slaves	16 slave units
Remote Ethernet Slave Discrete	4096 maximum
Remote Ethernet Slave Analog	4096 maximum
Real Time Clock Accuracy	±2.6 sec per day typical at 25°C ±8s per day max at 60°C
Programming Software	Do-more Designer – Ver. 2.0 or higher
Programming Cable Options [2]	BX-PGM-CBL
Custom Label Window Size	0.75 in x 2.25 in (19mm x 57.2 mm) (18 & 36 point units only)

[1] When using more than 32 points of expansion relay output points, a power budget must be done to insure that the system can handle all of the expansion IO. Please review Appendix B for power budget information.

[2] Can be programmed from any available Serial, Ethernet or USB communications port. Optional programming cable assembly BX-PGM-CBL, includes the BX-USB-P USB POM module and a USB cable which allows programming from the CPU POM option slot.

Memory Features

BRX Do-more! CPU		
Feature	**BX-DM1-XXX**	**BX-DM1E-XXX**
Total Memory (bytes)	262,144	
Ladder Memory (instruction words)	65,536	
V-Memory (words)	Configurable up to 65536 (4096 default)	
Non-volatile V Memory (words)	Configurable up to 65536 (4096 default)	
D-memory (DWORDs)	Configurable up to 65536 (4096 default)	
Non-volatile D-Memory (DWORDs)	Configurable up to 65536 (4096 default)	
R-memory (REAL DWORDs)	Configurable up to 65536 (4096 default)	
Non-volatile R-Memory (REAL DWORDs)	Configurable up to 65536 (4096 default)	
Stage Programming	Yes	
Number of Stages	128 per program code-block; number of code-blocks configurable to memory limit	
Handheld Programmer	No	
Built-In Communications Ports	RS-232/485	RS-232/485
		Ethernet (10/100 Base-T)
Pluggable Option Module Slot (POM)	1	
Program Memory	Flash ROM	
Total I/O points available	X, Y, each configurable up to 65536 (2048 default); WX, WY (analog in/out) each configurable up to 65536 (256 default)	
Number of Instructions Available	>170	>190

Memory Features, (cont'd)

BRX Do-more! CPU		
Feature	**BX-DM1-XXX**	**BX-DM1E-XXX**
Control Relays	Configurable up to 65536 (2048 default)	
Special Relays (system defined)	1024	
Special Registers (system defined)	512	
Timers	Configurable up to 65536 (256 default)	
Counters	Configurable up to 65536 (256 default)	
System Date/Time Structures	8	
User Date/Time Structures	Configurable up to 65536 (32 default)	
Ascii String/Byte Buffer Structures	Configurable up to memory limit (192 default)	
MODBUS Client Memory	Configurable up to memory limit, default 1024 input bits, 1024 coil bits, 2048 input registers, 2048 holding registers	
DL Classic Client Memory	Up to memory limit, default 512 X, 512 Y, 512 C, 2048 V	
Immediate I/O	Yes	
Interrupt Input (hardware / timed)	Yes	
Subroutines	Program, Task, Subroutine Code-blocks, up to memory limit	
Drum Timers	Yes, up to memory limit	
Table Instructions	Yes	
Loops	FOR/NEXT, WHILE/WEND, REPEAT/UNTIL loops	
Math	>60 operators and functions: Integer, Floating Point, Trigonometric, Statistical, Logical, Bitwise, Timing	
ASCII	Yes, IN/OUT, Serial, Ethernet TCP and UDP; 11 output script commands	
PID Loop Control, Built-in	Yes, configurable to memory limit (over 2,000)	
microSD Slot	Several instructions are available to perform data logging and file management interaction on the microSD card.	
Time of Day Clock/Calendar	Yes	
Run Time Edits	Yes	
Supports True Force	Yes	
Internal Diagnostics	Yes	
Password Security	Multi-user, credentialed, session-based security	
System Error Log	Yes	
User Error Log	Yes	
Battery Backup	Yes (Battery included)	

CPU Status Indicators

CPU Status Indicators		
Indicator	**Status**	**Description**
PWR	OFF	Base power OFF
	Green	Base power ON
	Yellow	Low battery
RUN	OFF	CPU is in STOP mode
	Green	CPU is in RUN mode
	Yellow	Forces are Active
SD/ROM	OFF	No ROM activity, No SD card
	Yellow	ROM activity (Flash or SD card)
	Green	SD Card installed and mounted*
	Red	SD Card installed and not mounted*
ERR	OFF	CPU is functioning normally
	Red	CPU Fatal Hardware Error or Software Watchdog Error

*A microSD card will become "mounted" to the MPU once the MPU recognizes the microSD card and renders it accessible for use.

In addition to the individual definition of each LED, there are times when the controller will use combinations of the LED ON/OFF states and colors to convey status information. The following list describes the possible LED combinations:

ERR LED is blinking RED for (15 seconds) - Do-more! Designer can blink the ERR LED for 15 seconds to verify that a communication link is targeting the correct controller.

All eight (8) of the LEDs are ON and the color of each LED is GREEN - indicates the operating system has started running.

All eight (8) of the LEDs are cycling through RED, GREEN and YELLOW, in a serial 'chase' pattern - indicates the operating system is initializing.

The top-most four (4) LEDs are cycling through RED and GREEN, in a 'bouncing ball' pattern, this indicates the controller is running only the boot loader and is NOT going to load and run the operating system. The most likely cause is having DIP switch #1 in the ON position.

All eight (8) of the LEDs are ON and the color of each LED is RED - indicates the hardware watchdog timer has expired because the controller's operating system has stopped running.

Mode Switch Functions

The mode switch on the BRX Do-more! CPU allows the user to externally select the different modes of operation. There are three modes available: RUN, TERM and STOP

CPU Mode Switch Functions

Position	Function
RUN	CPU is forced into RUN mode if no errors are encountered.
TERM	Allows changing modes (RUN and PROGRAM) using the Do-more! Designer software.
STOP	CPU is forced into STOP mode

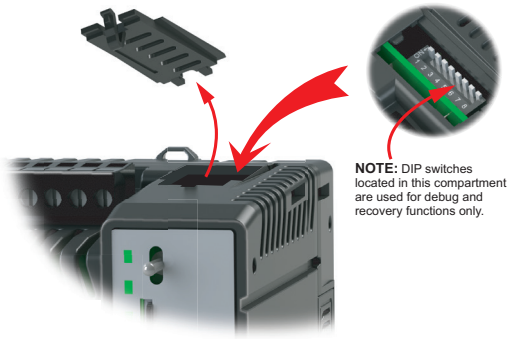
The CPU mode can also be changed through the programming software if the mode switch is placed in the TERM position. In this position, the CPU can be changed remotely between the Run and Program modes. For more information on changing CPU modes through the software, see the *Step 9: Write Project to the BRX MPU* section of Chapter 10 "BRX Do-more! Designer Getting Started". When power is applied to the system, the controller will go through its power-up sequence. Then it will either, stay in Program mode if the mode switch is in the STOP position, or attempt to go to Run mode if the mode switch is in the RUN position. If the mode switch is in the TERM position, the CPU will return to the last operational mode before power was lost. For example, if the CPU was in Run mode when power was lost, when power is restored and the mode switch is in the TERM position, the CPU will attempt to return to Run mode.

DIP Switch Specifications

The BRX Do-more! CPU has a block of DIP switches, located on the top of the chassis, that are used to perform various debug and reset operations. The DIP switch settings are only read when the system is first powered up. The default position for all of the DIP switches is OFF.

***WARNING*: CPU must be powered down prior to changing DIP switch settings!**

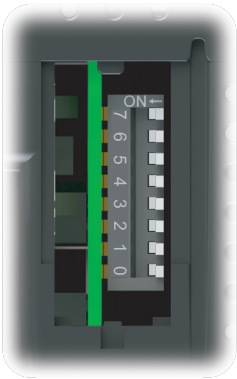
The following table describes the position and function associated with each DIP switch. BRX Do-more!



CPUs make use of combinations of DIP switch settings and the Mode switch on the front of the controller to perform two reset functions. These reset functions can only be performed when the CPU is in the Boot Loader portion of the power-up sequence.

DIP Switch Settings

DIP#	Switch Position	Function
7	ON	Reset the TCP/IP Network Settings to factory default values - Must be used with DIP #1
6	ON	Reserved
5	ON	Reserved
4	ON	Force the Serial port into RS-232 mode with default settings (Programming mode for recovery purposes).
3	ON	Disable ability to update the firmware and/or gate array.
2	ON	Disable the hardware watchdog timer - the hardware watchdog is always enabled, but this switch allows the user to override the ability of the Force Watchdog Error (WATCHDOG) and Debug mode to generate a Watchdog condition.
1	ON	Do not load an Operating System, stay in the Boot Loader.
0	ON	Load the oldest copy of the operating system.



DIP Switch Functions

The following sequence describes the steps necessary to perform one of the reset operations. This combination of DIP switch settings and mode switch manipulation is purposely complex to prevent these reset operations from being accidentally executed.

Clear Only the Network Settings

This reset function will clear ONLY the Network settings, which consists of the Module ID, Module Name, Module Description, IP Address, Subnet Mask and Gateway Address.

Begin by powering down the MPU.

Record the current DIP switch positions (so they can be set back to their original position after the manual reset is finished).

Set ONLY DIP #1 and #7 to ON position to perform the Clear Only the Network Settings operation. Ensure all other DIP switches are in OFF position.

Set the CPU mode switch to TERM (the center location) and power up the CPU.

At this point the top 4 LEDs should be blinking the 'stay in the boot loader sequence', that is, they should be blinking in sequence, from top to bottom then back to the top, alternating between red and green.

Move the CPU mode switch to RUN (to the top).

Move the CPU mode switch to TERM (to the center).

Move the CPU mode switch to RUN (to the top).

Move the CPU mode switch to TERM (to the center).

Move the CPU mode switch to STOP (to the bottom).

Move the CPU mode switch to TERM (to the center) - the top 4 LEDs should now be ON.

NOTE: *If you want to terminate the reset at this point you can do so by moving switch to RUN instead of STOP or power down the MPU.*

Move the CPU mode switch to STOP (to the bottom) - the bottom 4 LEDs should now be ON.

Move the CPU mode switch to TERM (to the center) - the top 4 LEDs begin flashing the power up sequence, and the ROM led should briefly be ON indicating that the data in the ROM is being rewritten. The LEDs will then begin flashing the 'staying in boot loader' sequence indicating the reset is complete.

Power down the MPU.

Return the DIP switches to their original positions.

Set the CPU mode switch to TERM (in the center location).

Reset to Factory Defaults

This reset function will clear everything from the CPU, including the Network Settings as described previously, and the System Configuration, Memory Configuration, all control logic, all Documentation, and all of the User Accounts and Passwords.

Begin by powering down the MPU.

Record the location of the DIP switches (so they can be set back to their original position after the manual reset is finished).

Next, set all eight of the DIP switches ON to perform a Reset to Factory Defaults.

Set the CPU mode switch to TERM (the center location) and power up the MPU.

At this point the top 4 LEDs should be blinking the 'stay in the boot loader sequence', that is, they should be blinking in sequence, from top to bottom then back to the top, alternating between red and green.

Move the CPU mode switch to RUN (to the top).

Move the CPU mode switch to TERM (to the center).

Move the CPU mode switch to RUN (to the top).

Move the CPU mode switch to TERM (to the center).

Move the CPU mode switch to STOP (to the bottom).

Move the CPU mode switch to TERM (to the center) - the top 4 LEDs should now be ON.

NOTE: *If you want to terminate the reset at this point you can do so by moving the CPU mode switch to RUN instead of STOP or power down the MPU.*

Move the CPU mode switch to STOP (to the bottom) - the bottom 4 LEDs should now be ON.

Move the CPU mode switch to TERM (to the center) - the top 4 LEDs begin flashing the power up sequence, and the ROM led should briefly be ON indicating that the data in the ROM is being rewritten. The LEDs will then begin flashing the 'staying in boot loader' sequence indicating the reset is complete.

Power down the MPU.

Return the DIP switches to their original positions.

Set the CPU mode switch to TERM (in the center location).

Battery Replacement

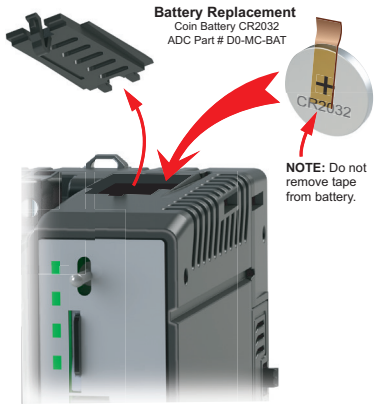
All BRX MPUs have an onboard battery that maintains the contents of the retentive memory any time the power to the controller is lost. The battery has an expected lifespan of three years; after which the battery will need to be replaced. The battery is a standard CR2032, coin cell battery (AutomationDirect P/N: D0-MC-BAT).

When the controller detects that the battery voltage is too low, and needs to be replaced, the PWR LED will be YELLOW instead of its normal GREEN color. When Do-more! Designer is online with the controller, the system-defined location $BatteryLow will be ON as well.

NOTE: *Retentive memory is not saved automatically when a Do-more! Designer project is saved to disk. Use the Memory Image Manager to create and manage retentive memory data images. Detailed information can be found in Do-more! Designer software help topic DMD0282. It is good practice to make backups of your projects and memory images to recover from unexpected circumstances.*

Power down the MPU.

Remove the battery from it's holder located on top of the MPU. Take note of how the battery is aligned in the holder. The battery is removed by pulling on the tape attached to the battery to begin sliding it out of the holder, then grasp the top edge to complete the removal of the battery.



NOTE: *The MPU has an onboard capacitor that will maintain the retentive memory contents while the battery is being replaced. The capacitor has a two-hour runtime, which should be more than enough to replace the battery.*

Insert the new battery into the holder, making sure the alignment is correct.

Power up the MPU.

Verify that the PWR LED is now GREEN instead of YELLOW and the system-defined location **$BatteryLow** will be OFF.

microSD Slot

The BRX Do-more CPU has data logging and file management instructions that allow a microSD card to be used for data logging and other file storage capabilities. The microSD card must be formatted to FAT32 and a maximum size of 32GB can be used. All card speeds are currently supported.

NOTE: *Card not included with unit. Optional 16G microSD card available (AutomationDirect P/N MICSD-16G)*

11

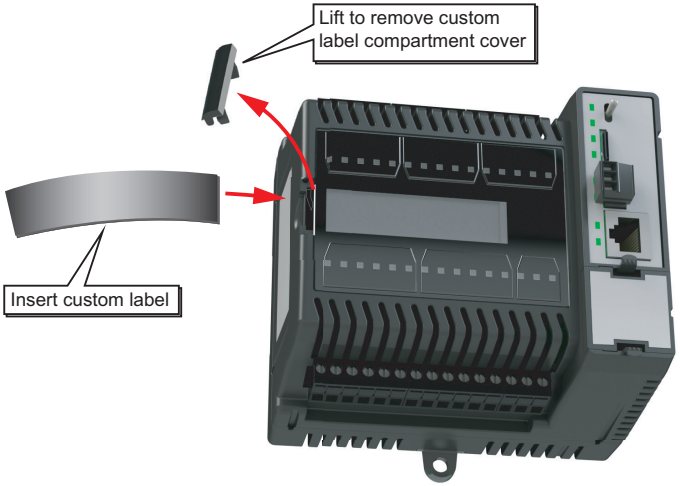
microSD Specifications				
Port Name	**microSD**			
Description	Standard microSD socket for data logging or file storage.			
Maximum Card Capacity	32GB			
Transfer Rate (ADATA microSDHC Class 4 memory card)	Mbps	Minimum	Typical	Maximum
	Read	14.3	14.4	14.6
	Write	4.8	4.9	5.1
Port Status LED	Green LED is illuminated when card is inserted/detected.			
Optional microSD Card	ADC Part# MICSD-16G			

Pin	SD
1	DAT2
2	CD/DAT3
3	CMD
4	VDD
5	CLK
6	VSS
7	DAT0
8	DAT1

Customizing the Logo Window

NOTE: *The Logo Window feature is only available on the BX 18/18E and BX 36/36E units.*

A custom label may be placed in the logo window. The logo window can accommodate label sizes up to 2 1/4" x 3/4".



Follow the steps below to add a custom logo/label:

1. Remove the small gray clip at the left edge of the clear plastic window by pulling upward, away from the unit.
2. Insert custom label.
3. Reinstall the small gray plastic clip.

The custom logo window can be used to display a company's logo, or a system identification tag, identifying the BRX MPU location and function within your system.

RS-232/485 Port Specifications

The RS-232/485 port utilizes a removable three-pin screw terminal block and is located on the front of the CPU. This port is software selectable to communicate as RS-232 or as RS-485. In the RS-485 mode you can also enable a 120 ohm termination resistor if needed.

The RS-232/485 port can be connected to the Do-more! Designer programming software, Modbus RTU master or slave devices, DirectLogic PLCs via K-Sequence protocol, as well as devices that output non-sequenced ASCII strings or characters.

Built-in RS-232 Specifications

Port Name	RS-232/RS-485
Description *	Non-isolated Serial port that can communicate via RS-232 or RS-485 (software selectable). Includes ESD protection and built-in surge protection.
Supported Protocols	Do-more!™ Protocol (Default) Modbus RTU (Master & Slave) K-Sequence (Slave) ASCII (In & Out)
Data Rates	1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200 Baud
Default Settings	RS-232, 115200bps, No Parity, 8 Data Bits, 1 Stop Bit, Station #1, Termination resistor OFF
Port Status LED	Green LED is illuminated when active for TXD and RXD
Port Type	Removable 3-pin terminal strip 3.5 mm pitch
RS-232 TXD	RS-232 Transmit output
RS-232 RXD	RS-232 Receive input
RS-232 GND	Logic ground
RS-232 Maximum Output Load (TXD/RTS)	3kΩ, 1000pf
RS-232 Minimum Output Voltage Swing	±5V
RS-232 Output Short Circuit Protection	±15mA
Cable Requirements	RS-232 use P/N L19772-XXX from automationdirect.com
Maximum Distance	30 meters (100 feet); 6 meters (20 foot) recommended maximum
Replacement Connector	ADC Part # BX-RTB03S

* When using RS-485 a termination resistor is available and is software selectable.

RS-232/485 Port Specifications, continued

Built-in RS-485 Specifications	
Port Name	RS-232/RS-485
Description *	Non-isolated Serial port that can communicate via RS-232 or RS-485 (software selectable). Includes ESD protection and built-in surge protection.
Supported Protocols	Do-more!™ Protocol (Default) Modbus RTU (Master & Slave) K-Sequence (Slave) ASCII (In & Out)
Data Rates	1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200 Baud
Default Settings	RS-232, 115200bps, No Parity, 8 Data Bits, 1 Stop Bit, Station #1, Termination resistor OFF
Port Status LED	Green LED is illuminated when active for TXD and RXD
Port Type	Removable 3-pin terminal strip 3.5 mm pitch
RS-485 Station Addresses	1–247
TXD-/RXD-	RS-485 transceiver low
TXD+/RXD+	RS-485 transceiver high
RS-485 GND	Logic ground
RS-485 Input Impedance	19kΩ
RS-485 Maximum Load	50 transceivers, 19kΩ each, 120Ω termination
RS-485 Output Short Circuit Protection	±250mA, thermal shut-down protection
RS-485 Electrostatic Discharge Protection	±8kV per IEC1000-4-2
RS-485 Electrical Fast Transient Protection	±2kV per IEC1000-4-4
RS-485 Minimum Differential Output Voltage	1.5 V with 60Ω load
RS-485 Fail Safe Inputs	Logic high input state if inputs are unconnected
RS-485 Maximum Common Mode Voltage	-7.5 V to 12.5 V
Cable Requirements Maximum Distance	RS-485 use P/N L19827-XXX from automationdirect.com 1000 meters (3280 feet)
Replacement Connector	ADC Part # BX-RTB03S

* When using RS-485 a termination resistor is available and is software selectable.

Ethernet Port Specifications

NOTE: *This section applies only to the units with the Built-in Ethernet port. These models include all BRX CPUs with the DM1E technology which includes BX ME, BX 10E, BX 18E and BX 36E.*

The Ethernet port utilizes a standard RJ-45 connector and is located on the front of the CPU just below the serial port. This port uses the 10/100BASE-T standard and has built-in auto-crossover capability allowing the use of any standard patch cable or crossover cable.

Ethernet Port Specifications	
Port Name	ETHERNET
Ethernet Port Type	RJ45, Category 5, 10/100 BASE-T, Auto Crossover
Description	Standard transformer isolated Ethernet port with built-in surge protection
Transfer Rate	10 Mbps (Orange LED) and 100 Mbps (Green LED)
Port Status LED	LED is solid when network LINK is established. LED flashes when port is active (ACT).
Supported Protocols	Do-more! Protocol Ethernet Remote I/O Modbus TCP/IP (Client & Server) EtherNet/IP (Explicit Messaging) HOST ECOM (DirectLogic) SMTP (Email), SNTP (Time Server) TCP/IP, UDP/IP (Raw packet)
Cable Recommendation	C5E-STxxx-xx from AutomationDirect.com
Ethernet Port Numbers	
MODBUS TCP/IP	502, TCP (Configurable)
EtherNet I/P (Explicit Messaging)	44818, UDP (Configurable)
HOST ECOM	28784, UDP (Configurable)
Do-more! Protocol	28784, UDP (Configurable)

POM Slot

The POM slot allows for an additional communication port, as an Ethernet, USB or serial protocol. See Chapter 6: BRX Pluggable Option Module (POM) for port options.

Notes:

BRX Do-more! Onboard Motion Control and Highspeed I/O

In This Chapter...

Overview **12-2**

Unsuitable Applications **12-3**

BRX Wiring Examples: High-Speed Inputs **12-4**

BRX Wiring Examples: High-Speed Outputs, continued **12-8**

Available High-Speed Input and Output Features **12-11**

1. Input Filters 12-12
2. Interrupt Setup 12-14
3. High-Speed I/O 12-23

BRX High-Speed Examples **12-34**

BRX High-speed Instructions **12-56**

AXCAM 12-57
AXCONFIG 12-63
AXFOLLOW 12-67
AXGEAR 12-71
AXHOME 12-75
AXJOG 12-82
AXPOSSCRV 12-84
AXPOSTRAP 12-89
AXRSTFAULT 12-94
AXSETPROP 12-96
AXVEL 12-99
TDODECFG 12-102
TDOPLS 12-104
TDOPRESET 12-114

Overview

The purpose of this chapter is to help the user understand the capabilities and the flexibility of the BRX built-in motion control and high-speed input and output (HSIO). This section will show the user the steps needed to setup the I/O for use with the High-Speed functions, provide various wiring examples, detailed programming examples and explain the available high-speed instructions.

All inputs and outputs can be selected for use in an HSIO application. However, the standard I/O will work at a lower response time. This flexibility frees up the high-speed inputs and outputs. For example, in a BRX 18/18E MPU, when setting up a pulse train output (PTO) as Step/Direction control to a stepper motor, it is possible to select a high-speed output for the STEP signal and a standard output for the Direction signal. By doing this, a high speed output is made available that can be used for another high speed output function, such as PWM.

The High-Speed inputs (as fast as 250kHz) can be used as High-Speed counters, as triggers for Interrupt Service Routines (ISR), and as edge timers. The High-Speed counter values can be used as accurate position feedback and engineered values for rate and position. The Interrupt Service Routine (ISRs) can be used to run through logic based on events that are too fast for standard input triggers and normal PLC logic scan.

With the high-speed outputs (as fast as 250kHz), it is possible to perform homing moves, trapezoid and s-curve moves, jog and velocity moves, and pulse width modulation (PWM).

Also available are electronic camming and gearing instructions, providing additional ways to handle follower type moves.

The following table shows the BRX platform HSI specifications.

HSI Specifications

Item	10/10E	18/18E	36/36E
Input Type	Sink/Source		
Total Inputs *	6	10	20**
High-Speed Inputs	6	10	10
Location	X0–X5	X0–X9	X0–X9
Frequency	0 to 250kHz		
Minimum Pulse width for HSI	0.5 µs		
Off to On Response	< 2µs		
On to Off Response	< 2µs		

* Refer to the specific wiring chapter for the discrete input specs of the specific model you are using.
** Standard inputs may be used with high-speed functions, but at lower response frequencies of approximately 120Hz.

Overview, continued

The following table shows the BRX platform HSO specifications.

HSO Specifications			
Parameter	**10/10E**	**18/18E**	**36/36E**
Output Type	High-Speed		
Total Outputs *	4	8	16**
High-Speed Outputs	2	4	8
Location	Y0–Y1	Y0–Y3	Y0–Y7
Off to On Response	< 2µs		
On to Off Response	< 2µs		
Max Switching Frequency	1m cable; 250kHz 10m cable; 100kHz		

* Refer to the specific wiring chapter for the discrete output specs of the specific model you are using.
** Standard outputs may be used with high-speed functions, but at lower response frequencies of approximately 110Hz.

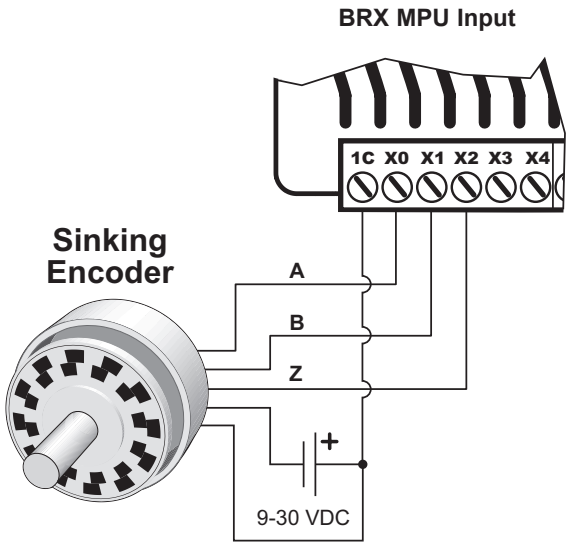
Unsuitable Applications

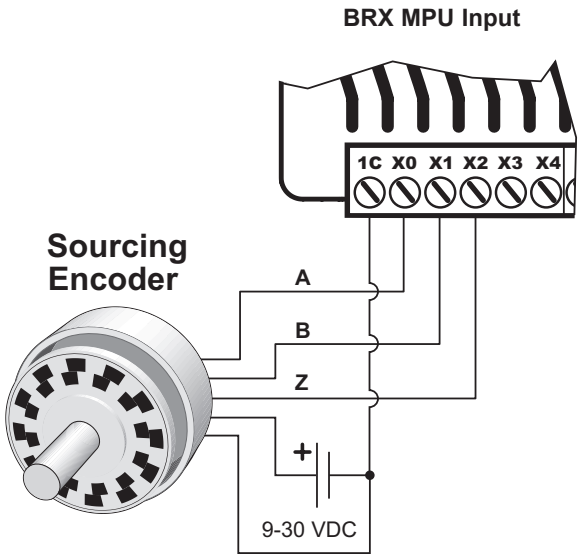
There are situations where HSIO is not an appropriate control choice:

- Mechanical contacts used as counter or encoder inputs: Reliable readings are not possible using mechanical contacts. The bounce of mechanical contacts will cause the BRX MPU input to see more edges than intended.
- Direct connection to TTL, line driver or differential encoders: A BRX MPU input cannot accept these low voltage inputs directly. (Consider using the FC-ISO-C signal conditioner to be able to input these signal types.)
- Absolute encoders are not suitable for use with the high speed inputs of the BRX MPU.

BRX Wiring Examples: High-Speed Inputs

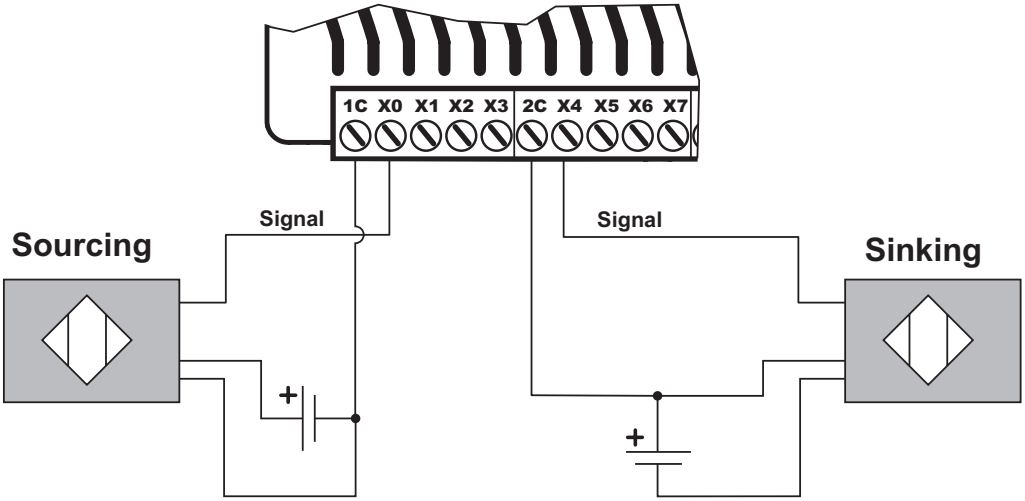
Quadrature Encoder Input





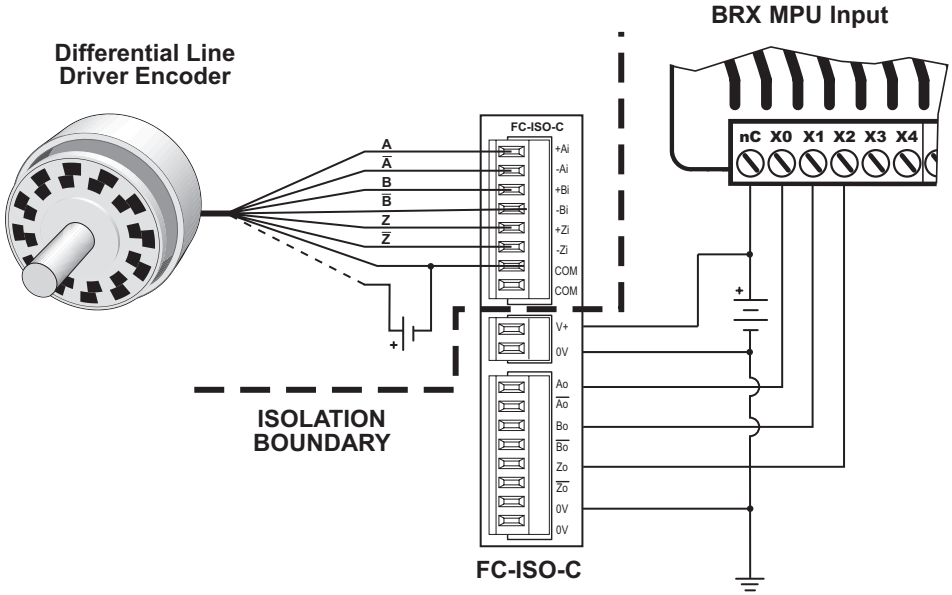
BRX Wiring Examples: High-speed Inputs, continued

NPN/PNP Input Example

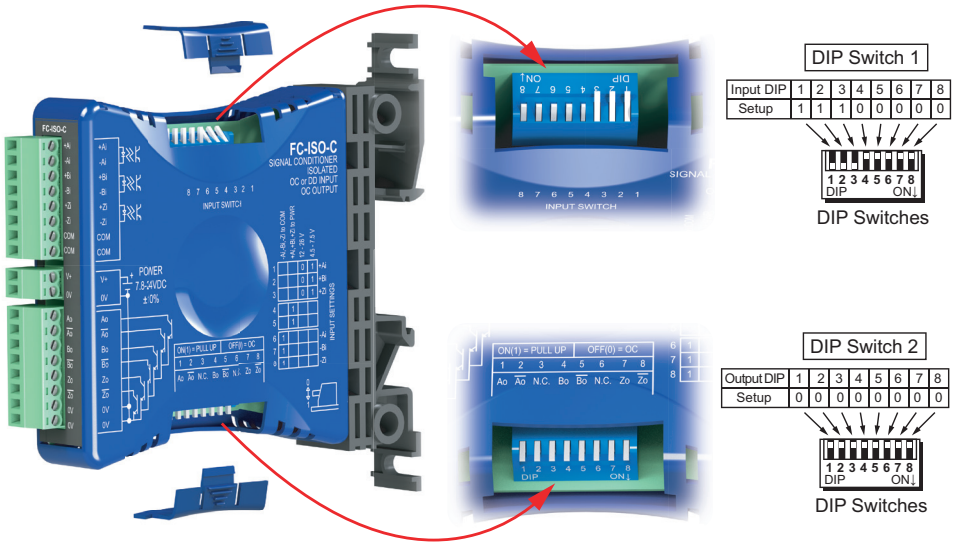


BRX Wiring Examples: High-speed Inputs, continued

Differential Line Driver Encoder Input

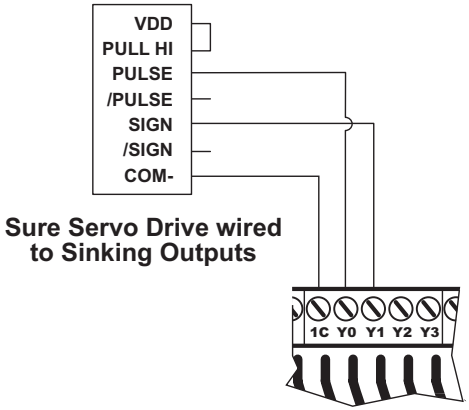


FC-ISO-C Dipswitch Settings

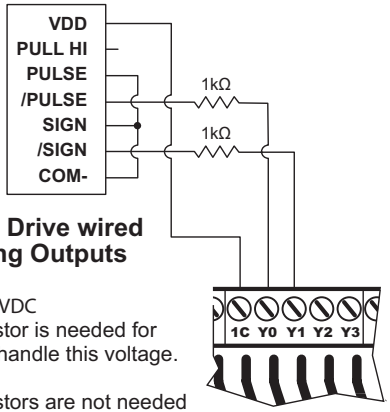


BRX Wiring Examples: High-speed Outputs

SureServo Driver Wiring Example



Sure Servo Drive wired to Sinking Outputs



Sure Servo Drive wired to Sourcing Outputs

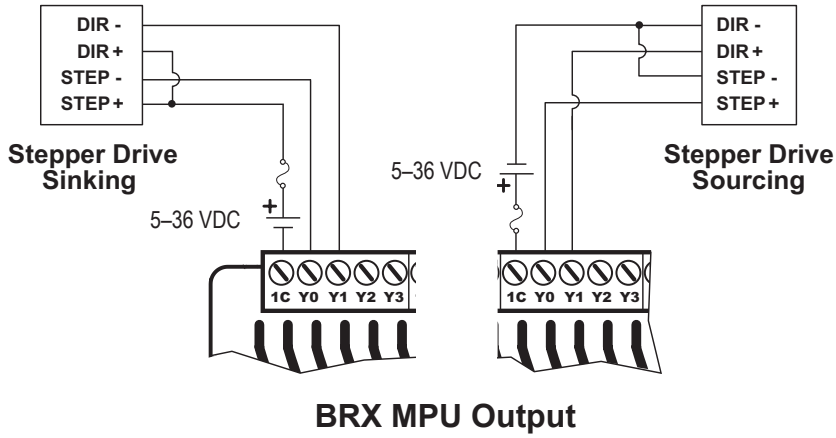
Note:
VDD = 24VDC
1kΩ resistor is needed for servo to handle this voltage.

1kΩ resistors are not needed if a 5VDC source is used.

NOTE: *Customer must consult SureServo documentation for specific details on the servo drive.*

BRX Wiring Examples: High-Speed Outputs, continued

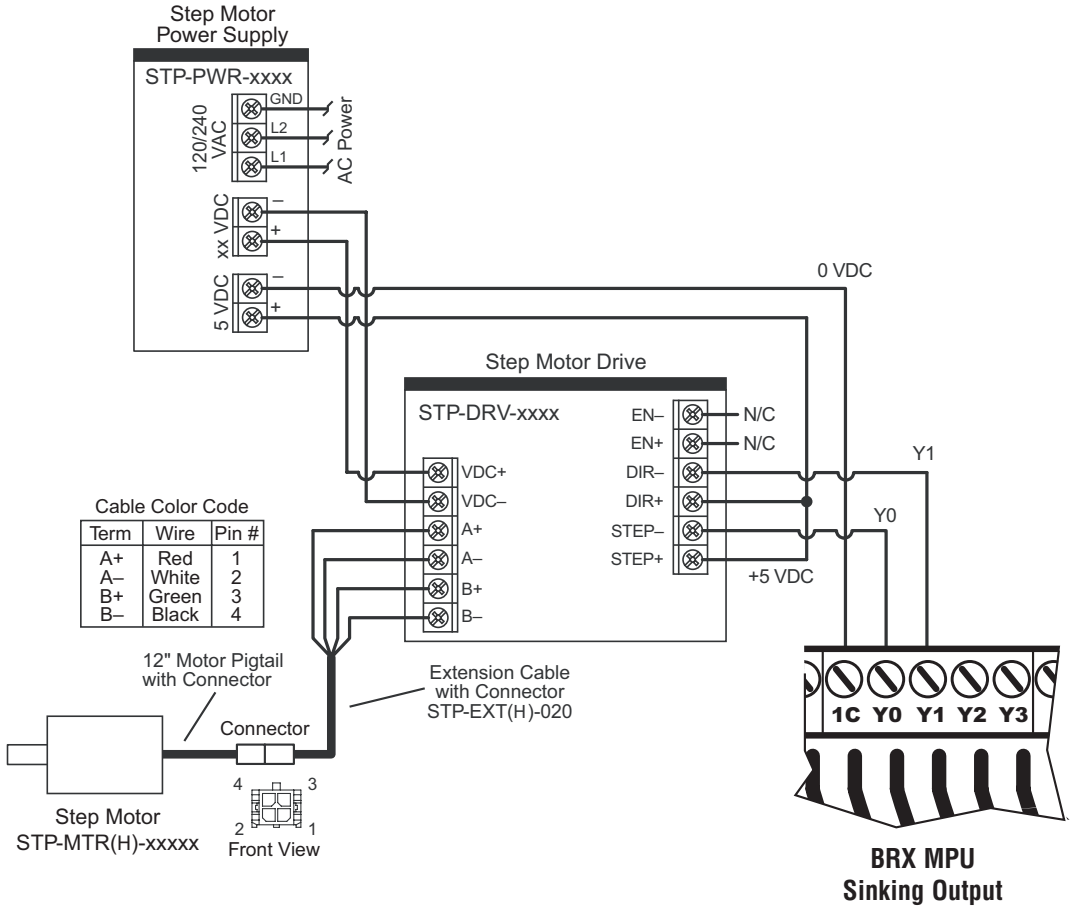
Stepper Drive Output



BRX Wiring Examples: High-speed Outputs, continued

BRX MPU to Stepper/Servo Drive Output

Detailed output wiring example between a BRX MPU and the SureStep Stepping System components.

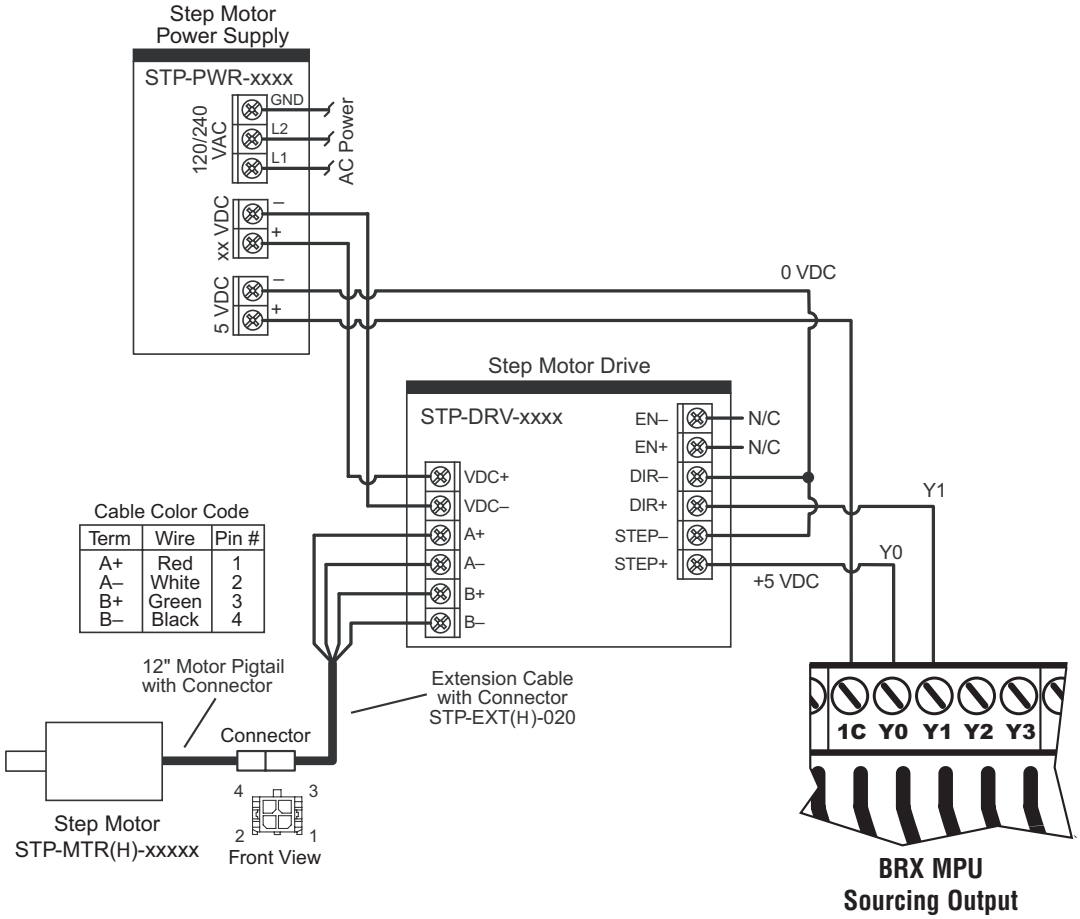


Wiring Diagram for a BRX MPU Using the SureStep Stepping System Components.

BRX Wiring Examples: High-speed Outputs, continued

BRX MPU to Stepper/Servo Drive Output

Detailed output wiring example between a BRX MPU and the SureStep Stepping System components.



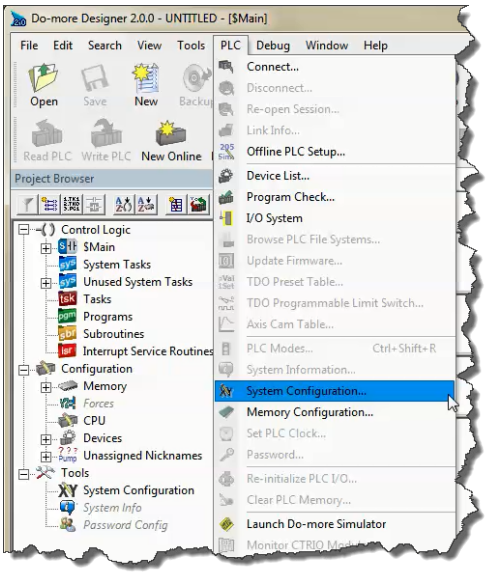
Wiring Diagram for a BRX MPU Using SureStep Stepping System Components.

Available High-Speed Input and Output Features

The following High-Speed input and output features are available on the BRX Do-more! MPUs. Reference the specific numbered topic listed below for directions on configuring that particular feature.

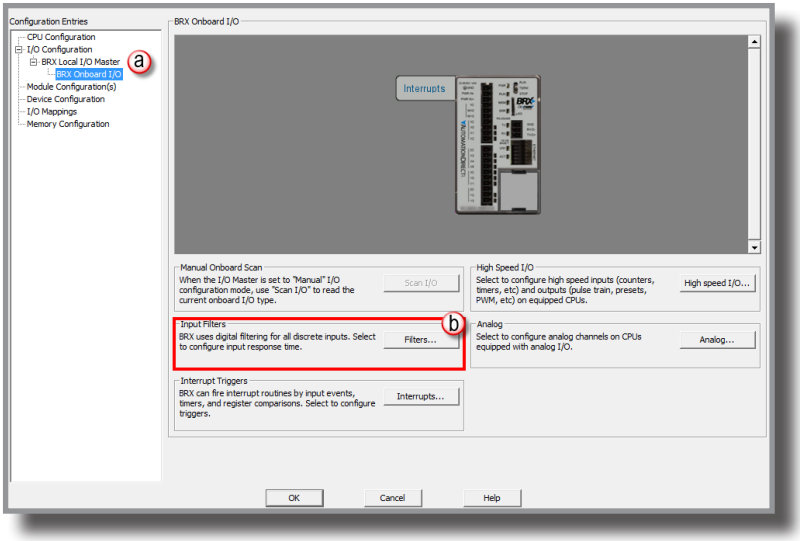
1. Input Filters
2. Interrupt Setup
    a. Setup Input Interrupts
    b. Setup Timer Interrupts
    c. Setup Match Register Interrupts
    d. Interrupt Instructions
3. High-Speed I/O (Counters, Timers, Pulse outputs, PWM and Table driven outputs)
    a. Counters
    b. Timers
        – Interval Scaling
    c. Axis/Pulse Outputs
    d. PWM (Pulse Width Modulation)
    e. Table Driven Outputs
        – Preset Tables
        – Programmable Limit Switch (PLS)

To access all of the High-Speed input and output setup, go to Do-more! Designer menu - PLC>System Configuration:

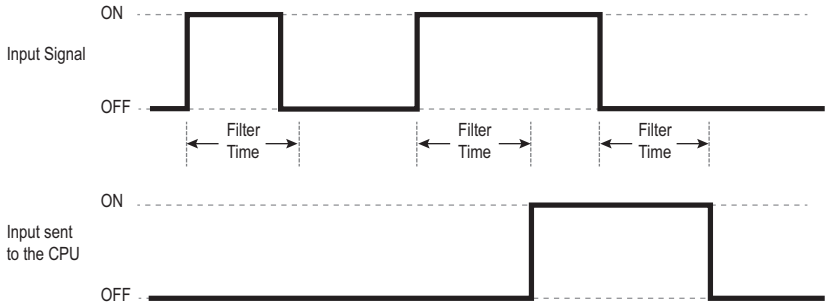


1. Input Filters

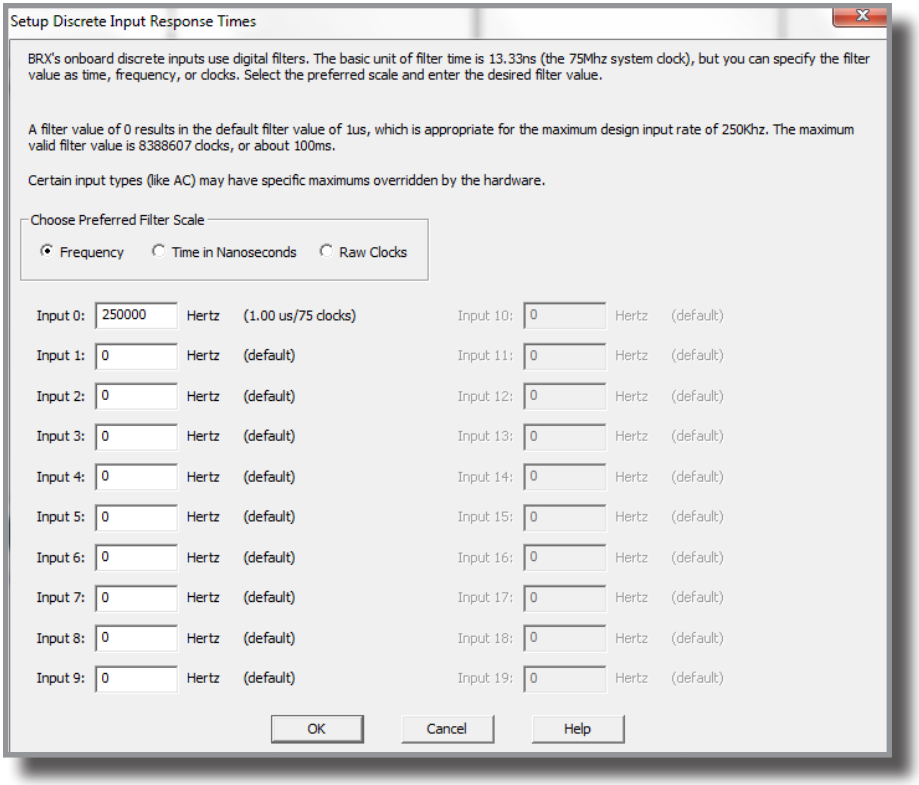
In the ***System Configuration*** window, select (**a**) the ***BRX Onboard I/O*** option under the ***Configuration Entries*** panel.



The on-board discrete inputs on all of the BRX hardware platforms can be configured to use (**b**) input filtering. Filters are typically used on inputs that are operating in electrically noisy environments to remove "false positives". This is accomplished by requiring the input signal remain above the input hardware threshold level longer than the filter time so the CPU will see that input as ON. Once ON, it must be OFF for more than the filter time before the CPU will see that input as OFF.



Clicking on (**b**) **Filters...** opens the *Setup Discrete Input Response Times* dialog box (below).



Choose Preferred Filter Scale – Sets format for all of the Inputs values entered in the form.

NOTE: *Be sure to select the Filter Scale before entering values in fields. If you change the Preferred Filter Scale after entering values then any values that are not valid in that scale will be set to 0.*

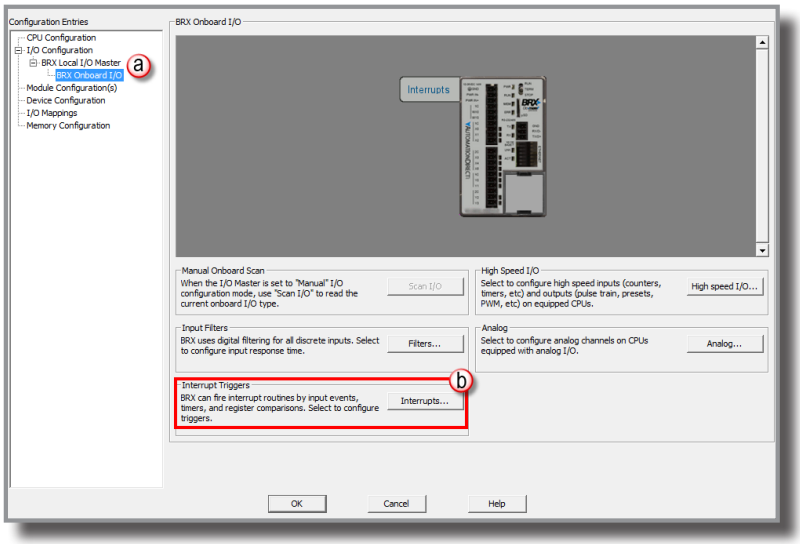
The Filter Scale can be specified in the following formats:

- A frequency in the range of 0–250000 Hz.
- A time value in milliseconds in the range of 0–112, microseconds in the range of 0 - 111848, or nanoseconds in the range of 0–111848093.
- The number of 13.33 nanosecond clocks in the range of 0–8388607.

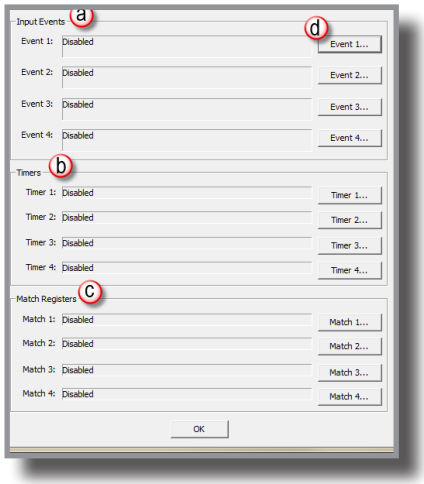
An input filter value of 0 will use the default filter value of 1 microsecond. Selecting one format to specify the filter value will automatically show the filter value in the other two formats.

2. Interrupt Setup

In the ***System Configuration*** window, select (a) the ***BRX Onboard I/O*** option under the ***Configuration Entries*** panel.



Clicking on (b) **Interrupts...** opens the ***Setup Interrupt Triggers*** dialog box (below).



A PLC normally reads inputs at the top of the scan and writes outputs at the bottom of the scan. The ladder logic is solved after the inputs are read and after the ladder is solved the outputs are written. Because the PLC can change the amount of work it does from scan to scan, the PLC scan time will also change accordingly, which will directly affect how frequently inputs will be read and outputs will be written. Interrupts are a method of triggering an action or code segment immediately after the qualifying condition(s) becomes true, regardless of variations in the PLC scan time. In the BRX PLC, this can be accomplished by using hardware (a) ***Input Events***, (b) ***Timers*** or (c) ***Match Registers***, (matching a register count). There are 12 Interrupt triggers available: 4 Input Interrupts, 4 Timer Interrupts and 4 Match Register Interrupts.

Click on (d) **Event 1...** to bring up the ***Setup Input Event*** dialog box.

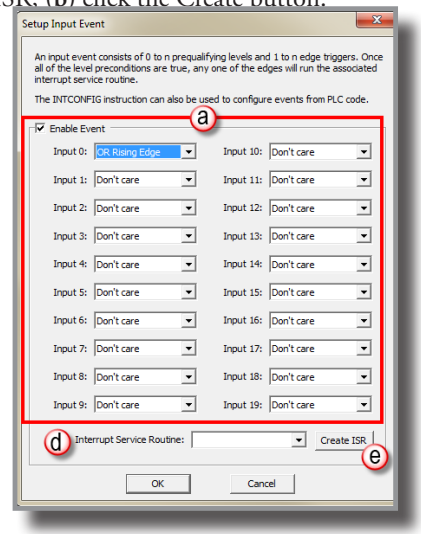
2a. Setup Input Interrupts:

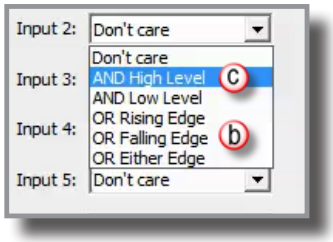
Input Interrupts can be used to respond to transitions of discrete inputs that occur during a PLC scan. Input Interrupts can be triggered in several different ways:

- Any (**a**) of the on-board discrete inputs
- Single Input (**b, dropdown menu at right**) (OR Rising Edge, OR Falling Edge or OR Either)
- Combinations of Inputs (**c, dropdown menu at right**) (AND High Level or AND Low Level)

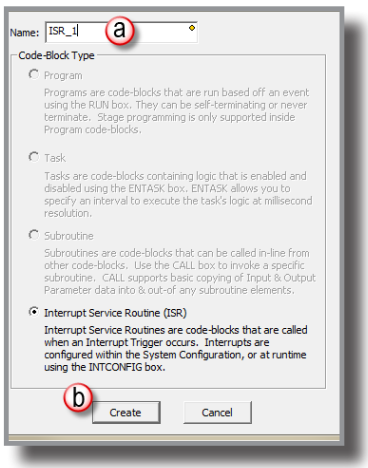
Next, choose to assign the input event to (**d**) an existing **Interrupt Service Routine** (**ISR**) or (**e**) create a new ISR.

For this exercise we will click on (**e, above**) to create a new ISR (**a, below**) and enter a name for the ISR, (**b**) click the Create button.



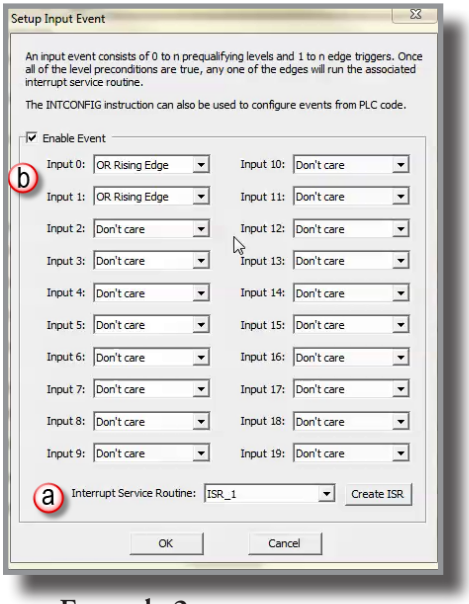


Dropdown Menu Interrupt Selections



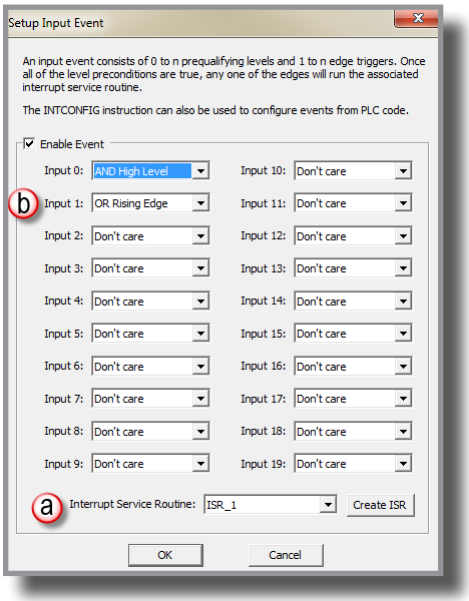
Input Interrupt Example 1

In the configuration below (**a**) of ISR_1, if (**b**) EITHER **Input 0** or **Input 1** goes from false to true, the Interrupt Service Routine **ISR_1** will run.



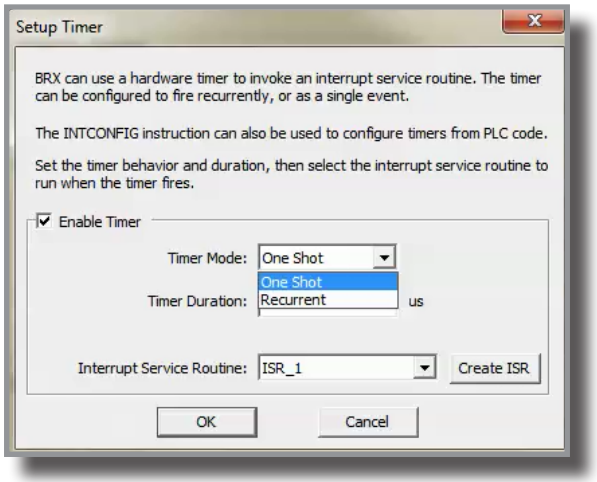
Input Interrupt Example 2

In the configuration below of (**a**) **ISR_1**, **Input 0** must be true and when (**b**) Input 1 goes from false to true, the Interrupt Service Routine **ISR_1** will run.

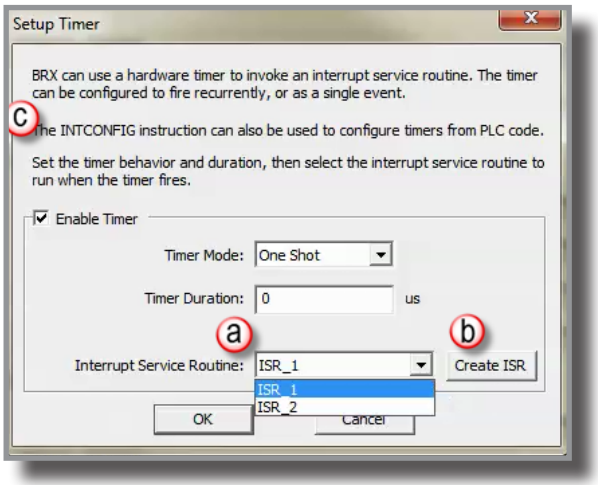


2b. Setup Timer Interrupts

Timer Interrupts use a hardware timer to run an Interrupt Service Routine in situations where you need an action to occur at regular intervals that are not affected by variations in the PLC scan time. This can be situations that require actions to occur at exact repeating intervals (Recurrent), or actions that occur after a precise amount of delay time (One Shot).



Timer Interrupts are fairly simple to setup. There are two modes: One Shot or Recurrent. The Timer Duration is in microseconds resolution. As with the Input Interrupt setup, an existing (a) ISR can be specified or a new one can be created from this dialog by clicking on (b) **Create ISR** button.

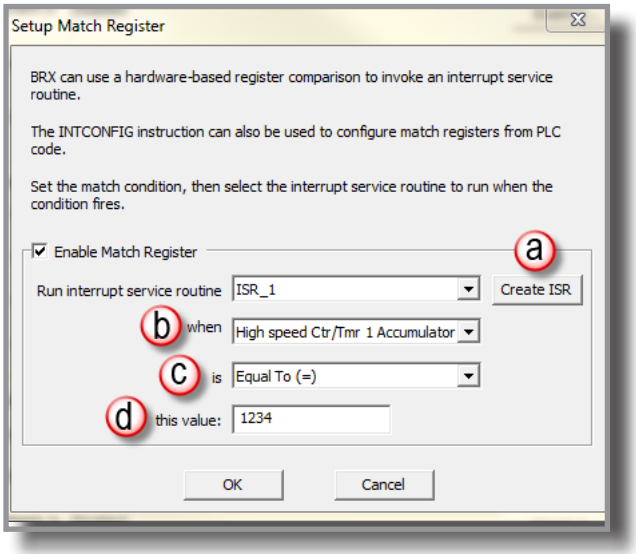


One Shot – The ISR will run only once at the time period specified after putting the PLC into Run. In order for this Interrupt to run again, the PLC will need to transition from Stop/Program to Run or you can use the (c) INTCONFIG instruction in ladder logic to trigger it again. The INTCONFIG instruction is very useful and will be discussed in more detail later.

Recurrent – the ISR will run continuously at the time period specified after putting the PLC in Run mode or it can be controlled (turned on or off) by using the INTCONFIG instruction.

NOTE: *The Timer Interrupt will be triggered when the PLC goes from Stop/Program mode to Run mode. To stop this from taking place, you can use the ISRname.Inhibit bit to disable the ISR from triggering when the PLC first goes into Run mode.*

2c. Setup Match Register



The Match Register function allows you to compare one of the hardware based registers to a value. When that condition is met, the specified Interrupt Service Routine will run. As with the other Interrupt functions, you can pick from a previously created ISR or you can create one from this dialog (**a**).

(**b**) ...**when** – specifies which of the High-Speed input or output locations to use in the comparison.

Choose from the following:

- High-Speed Ctr / Tmr 1 Accumulator
- High-Speed Ctr / Tmr 2 Accumulator
- High-Speed Ctr / Tmr 3 Accumulator
- Pulse Output 1 Position
- Pulse Output 2 Position
- Pulse Output 3 Position

(**c**) ...**is** – specifies the math operator to use when performing the comparison.
Choose from the following:

- Equal To
- Not Equal To
- Greater Than
- Greater Than or Equal To
- Less Than
- Less Than or Equal To

(**d**) ...**this value** - specifies the 32-bit signed decimal constant value to compare to the register contents. This can be any constant value between -2147483648 and 2147483647.

The specified ISR will run once when the operand condition is met. For example: In the case of Greater than, the ISR will run when the High-Speed Ctr/Tmr or Pulse Output position is above the set point. It will not run again until the value has gone below the set point and then back above it again. The same is true for Not Equal to - the ISR will run the very first time after going into Run Mode if the High-Speed Ctr/Tmr or Pulse Output position is not equal to the set point. It will not run again until the High-Speed Ctr/Tmr or Pulse Output position becomes equal to the set point and then moves off of that value.

2d. Interrupt instructions

There are four Interrupt instructions:

- INTCONFIG (Configure Interrupt)
- INTDECONFIG (Deconfigure Interrupt)
- INTSUSPEND (Suspend Interrupts)
- INTRESUME (Resume Interrupts)

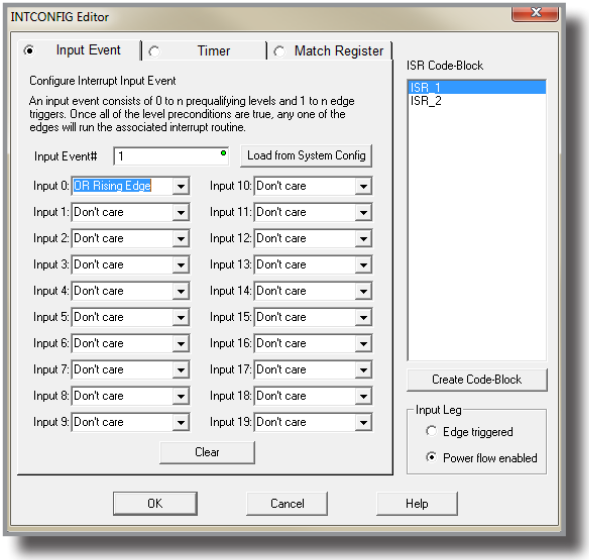
NOTE: *If you are doing ISRs, you should use one or more of the Immediate Output instructions:*
OUTI (Out Immediate)
SETI (Set Immediate)
RSTI (Reset Immediate).
These will help get a faster response from a Y in the ISRs.

A brief explanation of the use of these instructions will be given here. For full details on these instructions, refer to the help file.

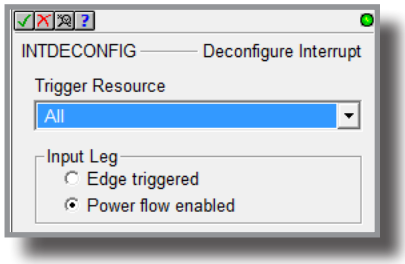
For each instruction, there is an **Input Leg** action selection: **Power flow enabled** or **Edge triggered**. A **Power flow enabled** will lock the instruction on. So if an INTCONFIG instruction was configured as **Power flow enabled**, the rung became true and an INTDECONFIG instruction was enabled, the Interrupts would still occur. Choosing **Edge triggered** will invoke the action once and other instructions may change the current behavior.

NOTE: *If an Interrupt Trigger was created using the Interrupt Triggers setup in System Configuration, be aware that these instructions DO NOT change that configuration. The Interrupt Trigger configuration will return each time the BRX CPU transitions from PROGRAM to RUN mode.*

INTCONFIG



The INTCONFIG instruction performs the same Interrupt setup located within the System Configuration. The instruction allows you to dynamically change the setup in applications where this may be required. One example is to calculate a Match Register value in Ladder Logic using the MATH instruction to D100, then use D100 in an INTCONFIG. If the INTDECONFIG instruction is used to disable Interrupts, this instruction is required to re-enable them.

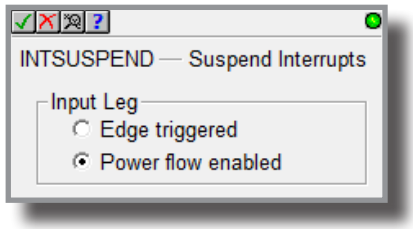


INTDECONFIG

This instruction disables the Interrupt(s) selected. Individual Interrupts may be selected as well as choosing to disable all of them. To re-enable Interrupts, the PLC must transition from Program to Run or the INTCONFIG instruction must be used. To temporarily disable Interrupts, use the INTSUSPEND instruction.

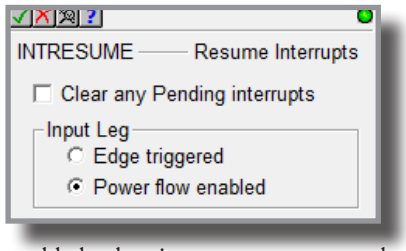
INTSUSPEND

The INTSUSPEND instruction temporarily suspends the interrupts and does not allow the ISRs to run. To enable the interrupts to function again, use the INTRESUME instruction. When interrupts are suspended using the INTSUSPEND instruction and one or more triggers take place, only one iteration of the interrupt will be available to be triggered after it is no longer suspended.



INTRESUME

The INTRESUME instruction resumes the normal processing of suspended interrupts. When the INTRESUME instruction is enabled, if one or more than one trigger took place while suspended, only one will be triggered when it resumes.



Clear any Pending interrupts: When enabled, it resets the trigger that took place while suspended. For example, if one or more triggers take place while suspended and the Clear any Pending Interrupts was not enabled, when interrupts are resumed, it will immediately execute the interrupt routine one time. If, however, the Clear any Pending Interrupts was enabled, any trigger that took place while suspended would be reset and when interrupts resume, it would start the normal processing of the interrupts.

Interrupt Service Routines

Only a brief explanation will be given of the ***Interrupt Service Routine.*** This topic is defined in the help file as well.

When an ***Interrupt Service Routine*** (ISR) is created, a structure is created. The members of the structure are as follows:

- **.ExecutionTime** – Time, in microseconds, it took to run the ISR the last time it ran.
- **.HasRun** – Should be on if the ISR has run at least once since the last Program to Run transition.
- **.Inhibit** – Enabling this bit will prevent the ISR from running. The actions do NOT get queued when this bit is enabled and the hardware interrupt becomes true for this ISR.
- **.Latency** – Time in microseconds elapsed between when the hardware Interrupt occurred and when the ISR execution began.
- **.RunCounter** – Indicates how many times the ISR has run since the past Program to Run transition.

These structure members may be helpful in troubleshooting the process when using Interrupts.

3. High-Speed I/O

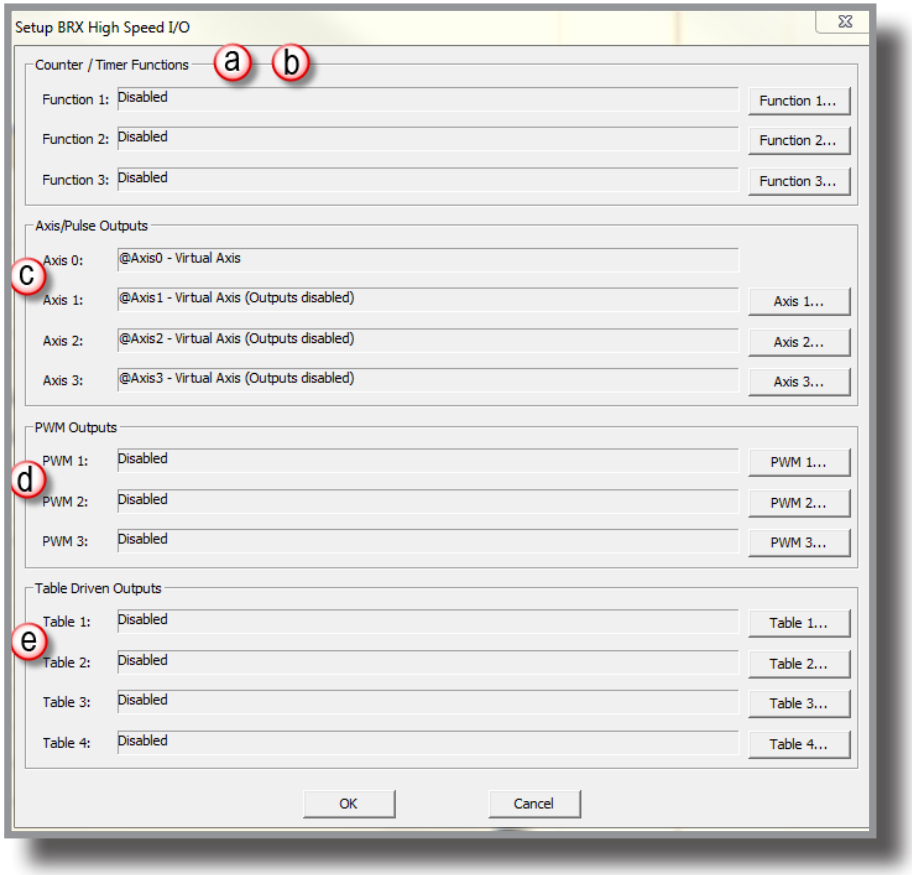
(a) Counters

(b) Timers

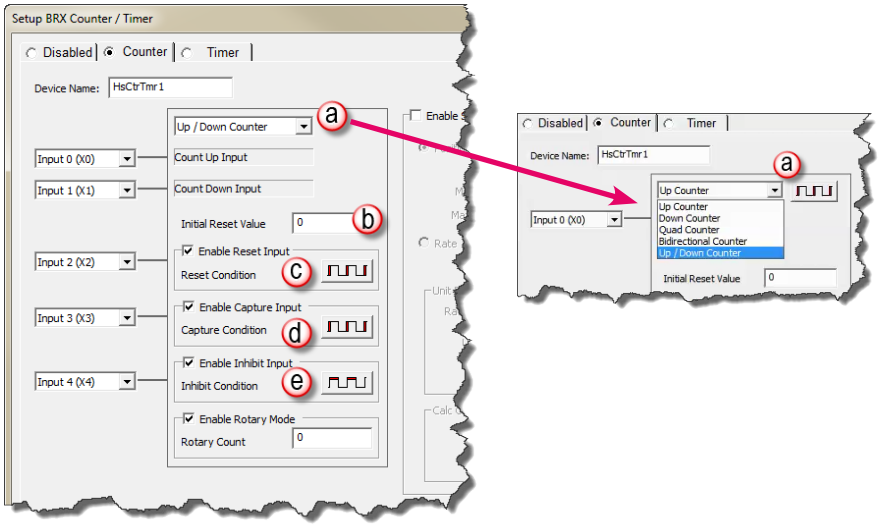
(c) Axis/Pulse Outputs

(d) Pulse Width Modulation (PWM) Outputs

(e) Table Driven Outputs



3a. Counters



A structure is created when this function is used. The name of the structure is configurable in the **Device Name** field. For the description of this function we will use the default name *HsCtrTmr1*.

(a) The BRX PLC allows for either 3 High-Speed Counters or 3 High-Speed Timers. Counters may be used in 5 different configurations with different options for the "Edge" to count:

Up Counter (Rising Edge, Trailing Edge or Both): Uses a single input and increments the count in the **$HsCtrTmr1.Acc** register.

Down Counter (Rising Edge, Trailing Edge or Both): Uses a single input and decrements the count in the **$HsCtrTmr1.Acc** register.

Quad Counter (1X, 2X or 4X): Uses 2 inputs and counts in both positive and negative directions based upon which of the inputs is 'leading'.

Bidirectional Counter: Uses 2 inputs. The first input is the count input. The second input determines whether the count is incrementing (when input is low) or decrementing (when input is high).

Up/Down Counter: Uses 2 inputs. The first input increments the count. The second input decrements the count.

(b) **Initial Reset Value:** The **$HsCtrTmr1.Acc** register will be loaded with the value configured in this field when the Reset Input goes true.

(c) **Reset Input:** When this condition is met, the **$HsCtrTmr1.Acc** register will be loaded with the value specified in the (b) ***Initial Reset Value*** field. The Input can be configured to indicate a true condition when the Rising Edge occurs, the Falling Edge, High Level or Low Level.

(d) **Enable Capture Input:** When this condition is met AND when ***$HsCtrTmr1.EnableCapture*** is

true, the current value that is in the *$HsCtrTmr1.Acc* register will be loaded into the *$HsCtrTmr1.CapturedValue* register. When this occurs, the structure member, *$HsCtrTmr1.CountCaptured* will be true. To capture again, the *$HsCtrTmr1.EnableCapture* bit must be turned off and back on. This Input can be configured to indicate a true condition on Rising Edge or Falling Edge.

(e) **Inhibit Input:** When this condition is met, the *$HsCtrTmr1.Acc* register will cease to increment or decrement. The Input can be configured to indicate a true condition on High Level or Low Level.

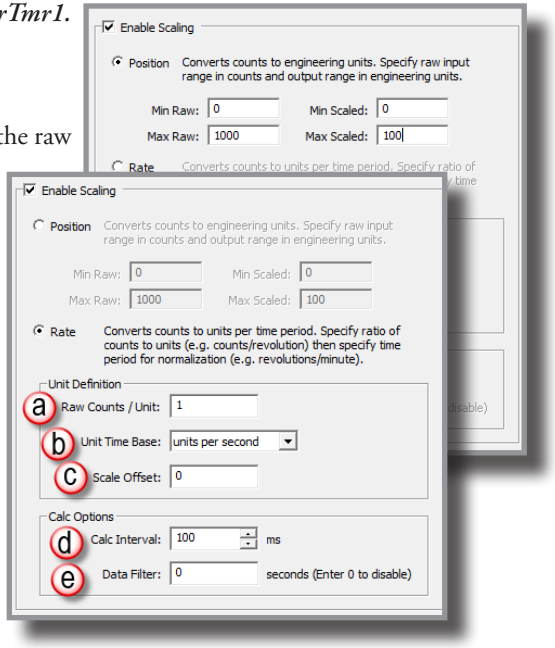
Counter Scaling

Position

Configure the **Min Raw**, **Max Raw**, **Min Scaled** and **Max Scaled** values for a linear interpolated result. That result will be placed in the *$HsCtrTmr1* structure member *$HsCtrTmr1.ScaledValue* .

Rate

The scaling feature allows you to convert the raw input pulse count to engineering units more appropriate to the process that the PLC is running. The scaled value will be placed in the structure member: *$HsCtrTmr1.ScaledValue*.



NOTE: *The raw value is used for Match Register functionality. However, the Preset Command table and PLS table can use the scaled value.*

Rate scaling is a measurement of distance over time. The following parameters are used in calculating the *.ScaledValue*:

(a) **Raw Counts / Unit:** The raw count value that would comprise 1 scaled unit value. So for calculated RPMs of an encoder, this might be the Pulses Per Revolution of the encoder.

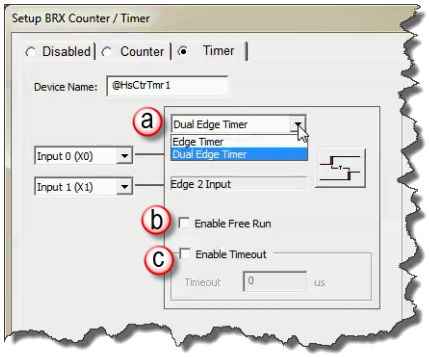
(b) **Unit Time Base:** A time base for the scaled unit value. In the example of calculating RPMs, this value would be units per minute.

(c) **Scale Offset:** Simply a value added to the resulting .ScaledValue.

(d) **Calc Interval:** Specifies how often (in milliseconds) the rate calculation is performed. The higher the value, the lower the impact on performance to the system. The calculation should be performed no faster than the process requires. If the application generates very slow pulse signals, consider using the Interval Scaling, discussed later in this chapter.

(e) **Data Filter:** Entering a value into this field will apply a time constant filter to a rolling average resulting in a 'smoother' value.

3b. Timers



There are 2 types (**a**) of High-Speed Timers for the BRX PLC: **Edge Timer** (1 Input) and **Dual Edge Timer** (2 Inputs).

Edge Timer: With the Edge Timer, measurements can be taken in 4 possible ways:

- From rising edge of one pulse to the rising edge of the next pulse
- From rising edge to falling edge of the same pulse
- From falling edge of one pulse to the rising edge of the next pulse
- From falling edge of one pulse to the falling edge of the next pulse

Dual Edge Timer: With the Dual Edge Timer, measurements can be taken in 4 possible ways:

- From the rising edge of input 1 to the rising edge of the subsequent pulse of Input 2
- From the rising edge of input 1 to the falling edge of the subsequent pulse of Input 2
- From the falling edge of input 1 to the rising edge of the subsequent pulse of Input 2
- From the falling edge of input 1 to the falling edge of the subsequent pulse of Input 2

When a High-Speed Timer is configured, a structure is created. To use the timer, the ***$HsCtrTmr1.EnableTimer*** bit must be enabled. The BRX PLC will then look for the first pulse. When the first pulse is read, the timer begins. The current time value (in microseconds) can be seen in the ***$HsCtrTmr1.Acc*** register. When the second pulse has been read, the time value is moved into the ***$HsCtrTmr1.LastTime*** register and the timer stops. To run again, disable the ***$HsCtrTmr1.EnableTimer*** bit and re-enable. There are 2 other bits to indicate the state that the timer is in. The ***$HsCtrTmr1.TimerStarted*** indicates that the timer is active. The ***$HsCtrTmr1.TimerComplete*** bit indicates that the timer has completed.

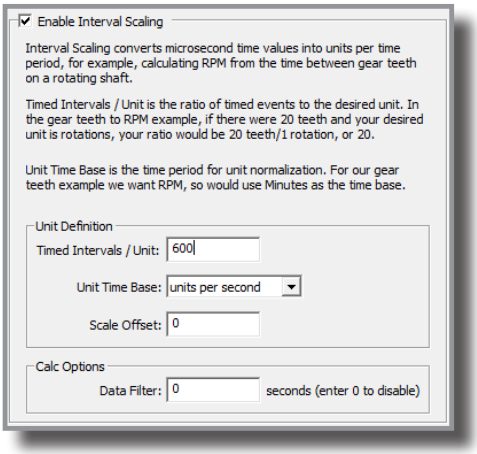
Enable Free Run: When the (**b**) **Enable Free Run** checkbox is selected, the timer will continue on subsequent pulses and the ***$HsCtrTmr1.EnableTimer*** bit only needs to be enabled once and not re-enabled for subsequent timer measurements.

NOTE: *The timer will 'free run' and will not stop in between pulses. The BRX PLC is just grabbing snapshots of the configured pulse timing.*

Enable Timeout: The **Enable Timeout** (**c**) feature gives an indication that the first pulse has been received but the second has not been received within the time period specified (in microseconds). When the timeout occurs, it will not successfully complete the timer even though the second pulse may eventually arrive. The ***$HsCtrTmr1.EnableTimer*** bit must be disabled and re-enabled.

Interval Scaling

The Scaling Interval feature (right) allows you to convert the raw input pulse count to engineering units more appropriate to the process that the PLC is running. The scaled value will be placed in the structure member: *$HsCtrTmr1.ScaledValue*.



NOTE: *The raw value is used for Match Register functionality. However, the Preset Command table and PLS table can use the scaled value.*

Interval scaling measures the time between pulses to calculate the frequency. The result is a measurement of unit movement over time. The following parameters are used in calculating the ***.ScaledValue***:

Raw Counts / Unit: This is the raw count value that would comprise 1 scaled unit value. So for calculated RPMs of an encoder, this might be the Pulses Per Revolution of the encoder.

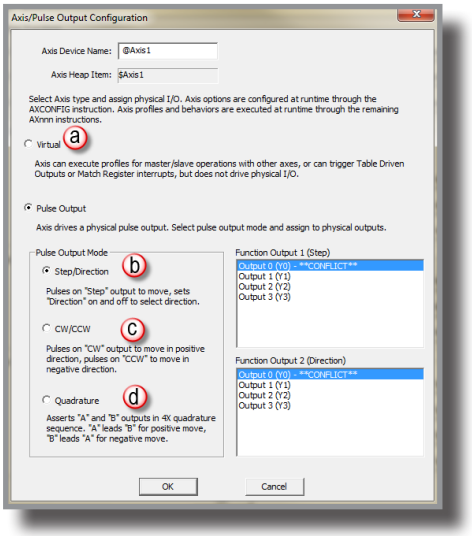
Unit Time Base: This is the time base for the scaled unit value. In the example of calculating RPMs, this value would be units per minute.

Scale Offset: This is simply a value added to the resulting **.ScaledValue**.

Data Filter: Entering a value into this field will apply a time constant filter to a rolling average resulting in a 'smoother' value.

3c. Axis/Pulse Outputs

The Axis/Pulse Output Configuration window allows you to specify the type of pulse train (mode) to output as well as the physical output points to use for this Axis. The software will indicate and warn if there are conflicts specified for the output points selected in this or other axis configurations.



There are four **Pulse Output Modes**:

1. **Virtual** (a): Axis can execute profiles for master/slave operations with other axes, or can trigger Table Driven Outputs or Match Register interrupts, but does not drive physical I/O.

NOTE: *A* ***Virtual*** *axis will not generate pulses to physical outputs of the PLC. Convenient for testing.*

2. **Step/Direction** (b): The output specified for **Function Output 1** will pulse at the speed and/or amount (Position) specified. The output specified for **Function Output 2** will be low for a positive position value move or high for a negative position value move.

3. **CW/CCW** (c): The output specified for "**Function Output 1**" will pulse at the speed and/or amount (Position) specified when the Position value is positive. The output specified for **Function Output 2** will pulse at the speed and/or amount (Position) specified when the Position value is negative.

4. **Quadrature** (d): In Quadrature mode, both outputs specified will pulse at the speed and/or amount (Position) specified in 4X fashion (both leading and trailing edges are considered a pulse). If the position value specified is a positive value, the output specified for **Function Output 1** will lead. If the position value specified is a negative value, the output specified for **Function Output 2** will lead.

3c. Axis/Pulse Outputs, continued

When an Axis is created, a structure is available for use in control and monitoring. Each member takes the form of $Axis***n.member***, where "***n***" is the Axis number (0 to 3) and "***member***" is the element word or bit referenced. Each member and an explanation of that structure are listed below.

.TargetVelocity (Signed DWord): When using an AXVEL instruction, this is the target Velocity (When using an AXPOSTRAP or AXPOSSCRV instruction, the velocity configured in the AXCONFIG instruction is the velocity that is used).

.TargetPosition (Signed DWord, Read Only): This is the target position that has been configured successfully by an AXPOSTRAP or AXPOSSCRV instruction.

.CurrentVelocity (Signed DWord, Read Only): This is velocity that the axis is currently running at.

.CurrentPosition (Signed DWord, Read Only): This is the pulse count where the Axis is currently located.

.FollowingError (Signed DWord, Read Only): When an Axis is configured to use encoder feedback as the Axis position, the FollowingError is the difference between the output pulse count (TargetPosition) and the encoder input value (Current Position). This value is always reported in pulse counts, not in encoder count values.

.MstSlvCoordError (Signed DWord, Read Only): This error is the difference between the position of the Master Axis and the projected location of the Slave Axis when using the AXGEAR, AXFOLLOW and AXCAM instruction.

.Suspend (Bit): Enabling the Suspend bit will halt the axis motion where it is at (honoring the accel and decel parameters). Disabling the bit will resume the axis motion.

.MasterEnable (Bit): This must be enabled for an axis instruction to function. It gets enabled automatically after the AXCONFIG has completed successfully.

.Configured (Bit, Read Only): This bit is true when the axis has been successfully configured by the AXCONFIG instruction.

.Active (Bit, Read Only): This bit is true when the axis is in motion (pulses are being generated).

.AtVelocity (Bit, Read Only): This bit is true when the axis is generating the pulses at the frequency specified by an AXPOSTRAP or AXPOSSCRV , an AXVEL or other axis instructions (TargetVelocity = CurrentVelocity).

.AtPosition (Bit, Read Only): This bit is true when the position specified by an AXPOSTRAP or AXPOSSCRV has been achieved (TargetPosition = CurrentPosition).

.ScriptBusy (Bit, Read Only): Reserved

.Fault (Bit, Read Only): Will be SET when either Fault Limit for an Axis is ON, or when the Axis' MasterEnable has been manually turned OFF. A Reset Axis Limit Fault (AXRSTFAULT) or an Axis Configuration (AXCONFIG) instruction must be executed to clear the Fault in the Axis before the Axis will operate again.

3d. PWM (Pulse Width Modulation)

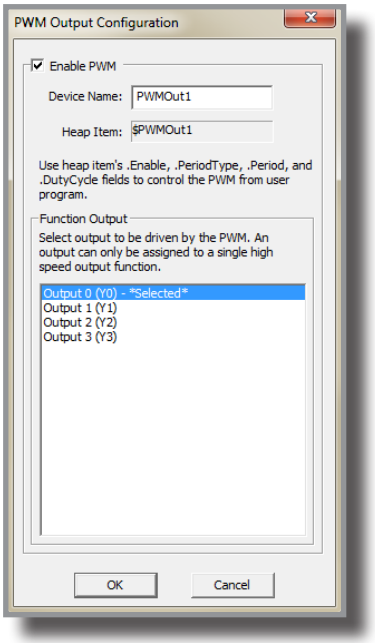
The PWM function has no associated instructions. In the "PWM Output Configuration",

specify the output to control. Once this function has been configured, a structure is created. The function is used by manipulating the members of that structure. The structure members are defined below:

.EnableOutput (Bit): Set this bit ON to generate output pulses, set the bit OFF to stop generating output pulses.

.PeriodScale (Bit): This specifies the time base for the output pulses. OFF = Microseconds (µs), ON = Milliseconds (mS).

.Period (Unsigned Word): Specifies the amount of time (in microseconds or milliseconds) for one complete pulse. This can be any positive constant value from 0–65535.



NOTE: *Remember, this value is NOT a frequency specified in Hz, this is the duration (milliseconds or microseconds) of one pulse. Because Frequency and Period are reciprocals of each other, the following formulas can be used to convert a value specified in Hz to a Period value in milliseconds or microseconds:*

*Converting Hz to millisecond period = (1/ Hz) * 1000. For example: 60Hz = (1 / 60) * 1000 = 17 milliseconds.*

*Converting Hz to microsecond period = (1/ Hz) * 1000000. For example: 60Hz = (1 / 60) * 1000000 = 16667 microseconds.*

.DutyCycle (Real): The DutyCycle determines the percentage of time that the output is high versus low. 10% Duty Cycle would mean that the output is high for 10% of the Period (or cycle) and low for 90% of the Period. This can be any Real value between 0.0 and 100.0.

3e. Table Driven Outputs

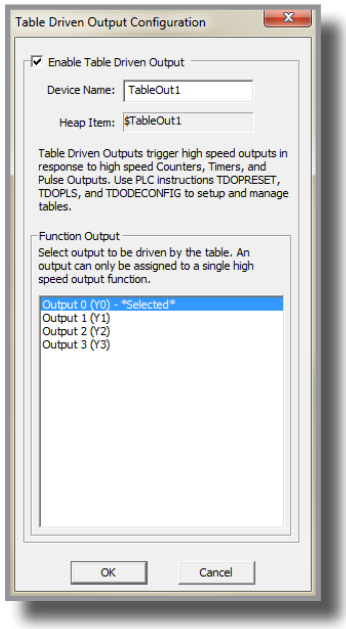


Table Driven Outputs are a method to control outputs at High-Speed based upon set points from a High-Speed counter, timer or axis position. Typically, controlling outputs from a set point in ladder would incur 'jitter' delays from one scan to the next. When controlling outputs at High-Speed, the ladder scan variation may produce undesired changes in response from one scan to the next. Using table driven outputs will eliminate this ladder scan variation.

There are 2 methods of controlling table driven outputs: Preset Tables or Programmable Limit Switch (PLS). The **TDOPRESET** instruction is used for **Preset Tables** and the **TDOPLS** instruction is used for PLS.

Preset Tables

Preset Tables will always run in order from first to last. This means that it must always be known whether the count will increment or decrement and at what point it will do this. If unexpected direction changes in count may occur, the Programmable Limit Switch function may be a better choice for that application.

As mentioned above, the table will always run from first (top of table) to last (bottom of table). In order to restart the table from the top, the **Reset Table & Acc** function should be used as one of the steps in the table.

There are 6 Preset functions to choose from in the table:

Set: This function will turn the Table Driven Output ON. A Reset must be used to turn the output OFF.

Reset: This function will turn the Table Driven Output OFF.

Pulse ON: This function will turn the Table Driven Output ON for the specified "Pulse Time" (in microseconds). At the end of the specified Pulse Time, the output will turn OFF.

Pulse OFF: If the output is ON, this function will turn the Table Driven Output OFF for the specified "Pulse Time" (in microseconds). At the end of the specified Pulse Time, the output will return to ON.

Toggle: This function will set the Table Driven Output to the opposite state from what it is currently at. If the output was ON, this function will turn it OFF. If the output was OFF, this function will turn it ON.

Reset Table & Acc: Performs a reset of the Master Register which sets its current count value to the Initial Reset Value specified in the Timer/Counter Function setup, and sets the current step in the Preset Table to **Step 0**.

3e. Table Driven Outputs, continued

When a Preset Table is configured, a structure becomes available for use in control and monitoring. The members of the structure are as follows:

.EnableOutput (Bit): This Bit is automatically set ON when the Preset Table is first loaded, and automatically turned OFF when the Table Driven Output is deconfigured. The ladder logic program can manually turn this Bit OFF to stop the table from writing it's state data to the Table Driven Output without having to use the TDODECFG instruction. While this bit is ON, the Preset Table updates the Table Driven Output.

.OutputState (Bit, Read Only): This bit is ON when the Table Driven Output is ON.

.StepNumber (Signed Byte): The zero-based step number from the table that is currently active. A step number of -1 indicates the Preset Table is either in Level Reset or is unconfigured.

.InputValOffset (Signed DWord): The current count value from the Master Register can be adjusted by a fixed amount before the comparison in the step is performed by entering that offset value here.

.ResetEdge (Bit): Turn this Bit ON to reset the Preset Table to **Step 0**, the PLC will automatically turn this bit back off.

.ResetLevel (Bit): Turn this Bit ON to reset the Preset Table to **Step** 0. Leaving the Bit ON will hold the Table in Reset until this Bit is turned OFF.

For more information on using the TDOPRESET instruction and the Preset Table function, reference the help file.

Programmable Limit Switch (PLS)

Unlike the Preset Table, the PLS (Programmable Limit Switch) will act upon the output whenever the High-Speed I/O Source Register is within the configured entry points no matter the direction it may have entered the range specified.

The entry requires specifying the low range (**ON when Greater Than or Equal to**) and high range (**and Less Than**) fields.

The **On when Greater than or equal to** field must always be a lower value than the **and Less Than** field.

Multiple entries can be configured to control the output at different ranges but they cannot overlap each other.

The PLS can control the output so that its default state is ON and the entries configured will turn the output OFF within those ranges.

3e. Table Driven Outputs, continued

The same structure that is used for the Preset Table is used for the PLS Table with a few minor changes in behavior. The explanations are given below:

.EnableOutput (Bit): This Bit is automatically set ON when the PLS Table is first loaded, and automatically turned OFF when the Table Driven Output is deconfigured. The ladder logic program can manually turn this Bit OFF to stop the table from writing it's state data to the Table Driven Output without having to use a TDODECFG instruction. If this Bit is ON the PLS Table will update the Table Driven Output.

.OutputState (Bit, Read Only): This bit is true when the Table Driven Output being controlled by the PLS is currently true.

.StepNumber (Signed Byte): The zero-based step number from the table that is currently active. A step number of -1 indicates the PLS Table is between ON positions or is unconfigured.

.InputValOffset (Signed DWord): The current count value from the Master Register can be adjusted by a fixed amount before the comparison in the step is performed by entering that offset value here.

.ResetEdge and .ResetLevel: Not used with the PLS function.

For more information on using the TDOPLS and PLS function, reference the Help file.

BRX High-Speed Examples

This section includes brief descriptions of how to implement some common motion control solutions. The information provided should give the user a good understanding of what basic steps are required to implement the desired function.

Later in the chapter, we will present detailed examples that will guide you step by step, on how to read a quadrature encoder value and how to generate a trapezoid profile using High-Speed outputs.

Get Position Using an Encoder

To read the position of an encoder, follow these basic steps in the Do-more! Designer software:

1. From the Dashboard page – Select High-Speed I/O.
2. Counter/Timer Functions – Select Function 1.
3. Select Counter – Configure the counter for Quad Counter and select X0 and X1 as your inputs.
4. Optional – Setup scaling or enable rotary mode.
5. Download the configuration to the BRX CPU and set it to RUN.
6. While connected with the CPU, verify that the encoder counts are appearing in a DataView window. Use the address ***$HsCtrTmr1.acc*** to monitor the accumulated encoder pulses.

Get Rate Using an Encoder

To read the rate of an encoder, follow these basic steps in the Do-more! Designer software:

1. From the Dashboard page – Select High-Speed I/O.
2. Counter/Timer Functions – Select Function 1.
3. Select Counter – Configure the counter for Quad Counter and select X0 and X1 as your inputs.
4. Enable Scaling – Select Rate.
5. Enter the conversion parameters.
6. Download the configuration and verify the CPU is in RUN mode.
7. While connected with the CPU, verify the encoder rate values are appearing in a DataView window. Use the address $HsCtrTmr1.scaledvalue to monitor the rate value.

Measure Timing Between Pulse Edges

To measure the time between edges of a pulse, follow these basic steps in the Do-more! Designer software:

1. From the Dashboard page – Select High-Speed I/O.
2. Counter/Timer Functions – Select Function 2.
3. Select Timer – Keep the default device name, **@HsCtrTmr2**. Select Edge Timer function. For this test, use one of the encoder inputs, i.e. X0. Select appropriate options (Free-run is suggested for testing since it does not require any ladder programming to function).
4. Optionally, setup scaling if needed.
5. Download the configuration and verify the CPU is in RUN mode.
6. While connected with the CPU, verify that the pulse measurements are showing up in a DataView

window. Use the address *$HsCtrTmr2.LastTime* to monitor the previous amount of time between pulses.

Pulse Train Output – Move to a Specific Position

The following steps will explain what is needed for the BRX CPU to prompt a stepper motor, for example, to move an absolute number of steps:

1. From the Dashboard page – Select High-Speed I/O.
2. Axis/Pulse Outputs – Select Axis 1.
3. Axis 1 Configuration – Keep the default Device name, **@Axis1**. Select Pulse Output. Select the Output Type required by your controller. For this example, we are using Step/Direction with a SureStep stepper drive. Select Y0 for Step and Y1 for Direction.
4. Download the configuration to the CPU.
5. AXCONFIG ladder rung – Configure the AXCONFIG instruction for Device @AXIS1. Use the defaults for all the fields. The move instructions use the Accel/Decel and Min/Max frequencies configured in this instruction.
6. AXPOSTRAP ladder rung – Configure the AXPOSTRAP for Device **@Axis1**. For Move Type, select Single Move and Power Flow Enabled. For Target Type, select Relative and for Position Value use the default of 1000. For Linear vs Rotary, select Linear.
7. Download program and verify the CPU is in RUN mode.
8. Trigger the AXCONFIG ladder rung – When the AXCONFIG instruction is triggered, the MasterEnable and the EnableOutput heap items will be ON. The success bit will be ON.
9. Turn on the AXPOSTRAP ladder rung – Every time the rung is powered on and left on, the instruction will send out a pulse train that matches the target position value. The CurrentPosition will increase from 0 to 1000 the first time the rung is turned on. The target position will display 1000. AtPosition turns on when the target position is reached. If you turn the rung off and back on, the CurrentPosition will increase from 1000 to 2000.
10. A detailed example using the AXPOSTRAP will be provided later in this chapter. For detailed information of the instructions, review the Do-more! Designer Help topics.

Pulse Train Output – To Home an Output

The following steps will explain what is needed for the BRX CPU to prompt a stepper motor, for example, to find a Home position:

1. From the Dashboard page – Select High-Speed I/O.
2. Axis/Pulse Outputs – Select Axis 1.
3. Axis 1 Configuration – Keep the default Device name, **@Axis1**. Select Pulse Output. Select the Output Type required by your controller. For this example, we are using Step/Direction with a SureStep stepper drive. Select Y0 for Step and Y1 for Direction.
4. Download the configuration to the CPU.
5. AXCONFIG ladder rung – Configure the AXCONFIG instruction for Device @AXIS1. Use the defaults for all the fields. The move instructions use the Accel/Decel and Min/Max frequencies configured in this instruction.
6. AXHOME ladder rung – Configure the AXHOME for Device @Axis1. For this example, we

use X2 as our Discrete Input Limit 1. Enter a value for **Homing Velocity**. Select the Discrete input and event type. Select the **Homing Termination**. For this example, we will use Decelerate to 0 after reaching input limit 1 and zero out the position value when Home is reached. Edge-triggered is selected for the input leg.

7. Download program and verify the CPU is in RUN mode.

8. Trigger the AXCONFIG ladder rung – When the AXCONFIG instruction is triggered, the MasterEnable and the **EnableOutput** heap items will be ON. The AXCONFIG success bit will be ON.

9. Trigger the AXHOME ladder rung – Turning on the input to the AXHOME rung, will trigger the HOME move. The input does not have to remain on for the HOME move to continue when the edge-triggered input is selected. Pulse outputs will be generated while the discrete input limit 1 is not reached. Once the discrete input limit 1 is reached, the pulse output will decelerate to 0, as configured for this example. During the HOME move, the **CurrentPosition** will increase. Once the HOME position is reached, the **CurrentPosition** is reset to 0.

Output Pulse Width Modulated (PWM) Pulses

To generate PWM outputs, follow these basic steps:

1. From the Dashboard page – Select High-Speed I/O.

2. PWM Outputs – Select PWM 1.

3. PWM 1 Configuration – Enable PWM. Keep the default Device name, **@PWMOut1**. Select output Y2, for example.

4. Download the program (no ladder instructions need to be added for this test) and verify the CPU is in Run.

5. Use Data View to control the PWM 1 output. Use heap items **.EnableOutput**, **.PeriodScale**, **.Period** and **.DutyCycle**.

6. $PWMOut1.DutyCycle – Specifies the percentage of one period where the output is ON, during the remaining portion the output will be OFF. This can be any Real value between 0.0 and 100.0.

7. $PWMOut1.PeriodScale – Selects the time base for the output pulses, OFF = microseconds (µs), ON = milliseconds (ms).

8. $PWMOut1.Period – Specifies the amount of time (in microseconds or milliseconds) for one complete pulse. This can be any positive constant value from 0–65535.

NOTE: *Remember, this value is NOT a frequency specified in Hz, this is the duration (in microseconds or milliseconds) of one pulse. Because Frequency and Period are reciprocals of each other, the following formulas can be used to convert a value specified in Hz to a Period value in milliseconds or microseconds:*
a. *Converting Hz to millisecond period = (1/ Hz) * 1000. For example: 60Hz = (1 / 60) * 1000 = 17 milliseconds.*
b. *Converting Hz to microsecond period = (1/ Hz) * 1000000. For example: 60Hz = (1 / 60) * 1000000 = 16667 microseconds.*

9. **$PWMOut1.EnableOutput** - Set this ON to generate output pulses, set OFF to stop generating output pulses.

Table Driven Output using a Preset Table

1. Configure a High-Speed input to read encoder values. See section on "Get Position using an Encoder".

2. From the Dashboard page – Select High-Speed I/O.

3. Table Driven Output – Select Table 1.
4. Table Driven Output Configuration – Enable Table Driven Output.

    a. This is used to trigger High-Speed outputs in response to High-Speed counters, timers and pulse outputs.

    b. Use ladder instructions TDOPRESET, TDOPLS and TDODECFG to setup and manage tables.
5. Select output Y3.
6. Download changes to the CPU.
7. Add a rung with the instruction TDOPRESET and a rung with the instruction TDODECFG.
8. Once the TDOPRESET is running, it takes over the discrete output assigned to Table1.
9. To release the discrete output from being controlled by Table 1, use TDODECFG.

Detailed Example: Configure and Test a Quadrature Input

This example walks through the steps required to get the counts from a quadrature encoder. Phase A of the encoder is wired to input X0 and Phase B of the encoder is wired to input X1.

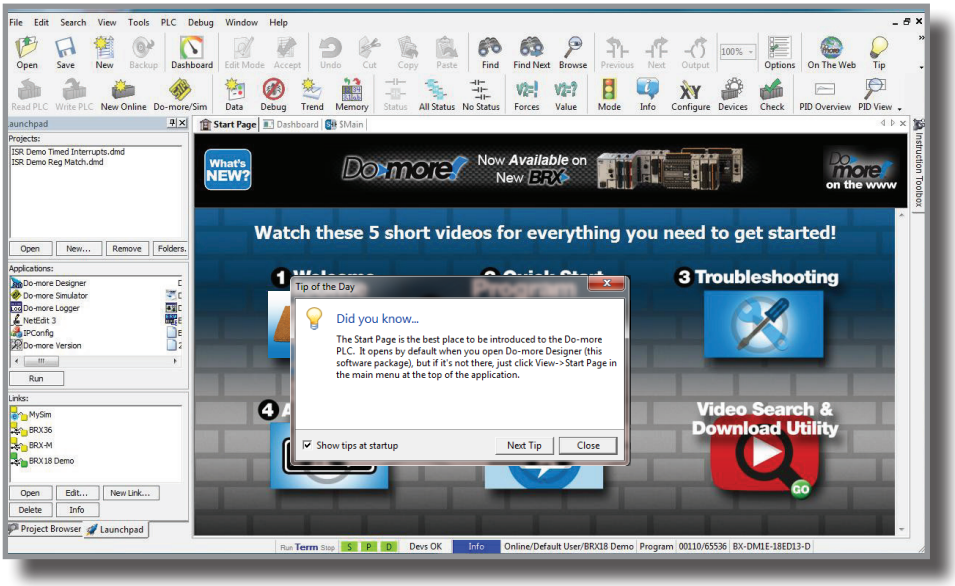
The Basic Steps

1. Wire the encoder and connect Do-more! Designer to the BRX CPU.
2. Configure a High-Speed Input as a quadrature counter.
3. Download the program changes to the CPU and place the CPU in Run.
4. Use DataView and Trend View to verify the encoder values are being read correctly by the BRX CPU.

Equipment Used

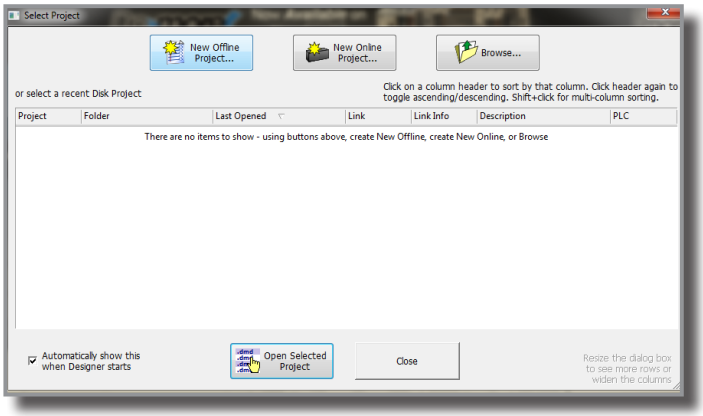
BRX MPU with DC inputs. A quadrature encoder (Open collector or Totem Pole) properly powered and connected to inputs X0 and X1 of the BRX.

Launch Do-more! Designer. By default, the Tip of the Day will pop up. Close it.



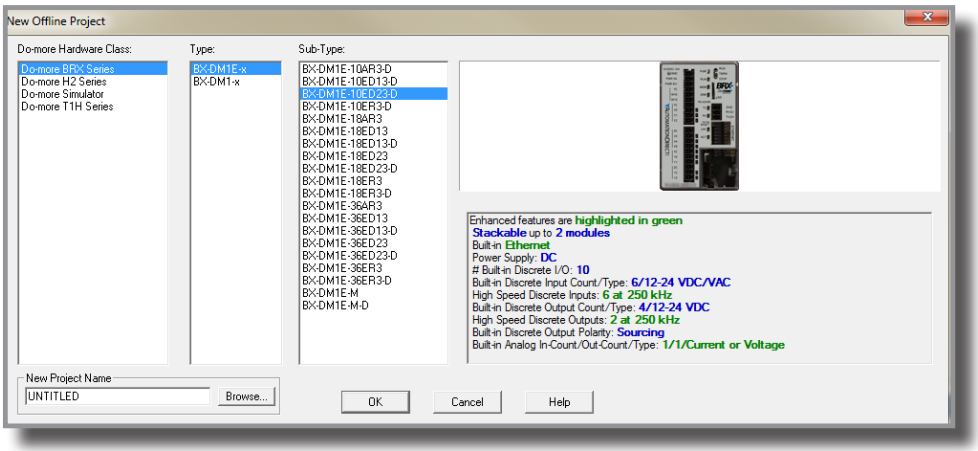
Detailed Example: Configure and Test a Quadrature Input, continued

The *Select Project* window will be displayed next. Select **New Offline Project**. Launch the



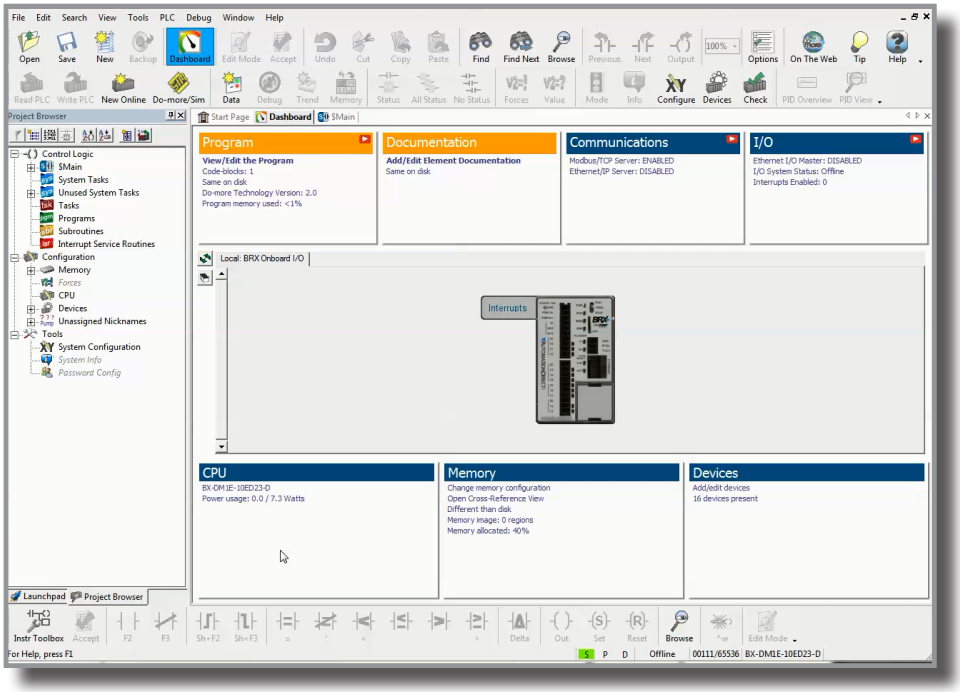
Do-more! Designer Software.

In the *New Offline Project* window select the BRX MPU model you are working with. Rename the project as Quad Encoder in the **New Project Name** field (bottom left). Press the **OK** button to accept the selections.

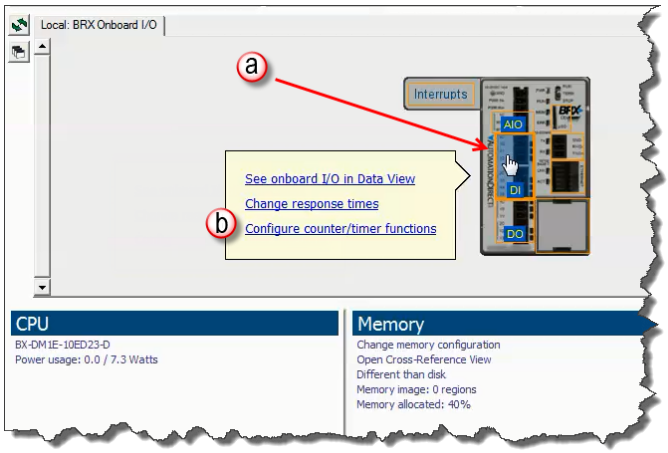


Detailed Example: Configure and Test a Quadrature Input, continued

The Dashboard page is displayed and the screen will look as follows:

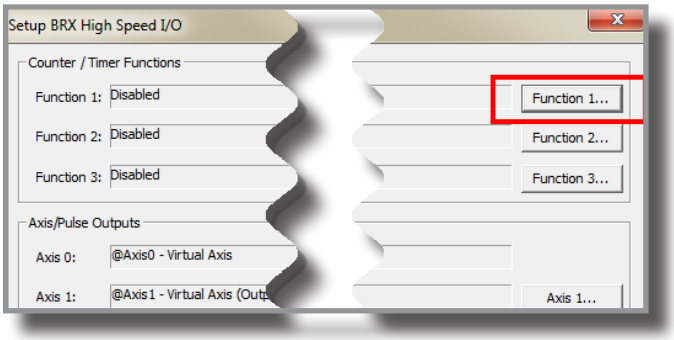


Mouse over the BRX MPU in the Dashboard BRX Onboard I/O view, orange blocks will appear around the various built-in MPU features. Select the inputs orange block (**a**). Select **Configure counter/timer functions** (**b**) to access the Setup BRX High-speed I/O page.

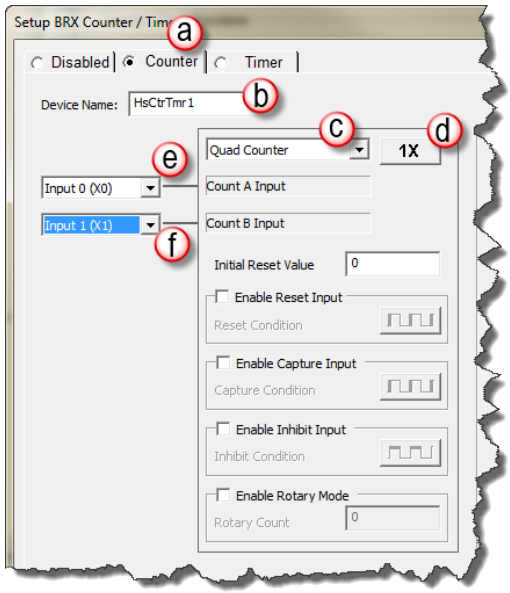


Detailed Example: Configure and Test a Quadrature Input, continued

From the **Setup BRX High-speed I/O** page, select **Function 1** under the **Counter/Timer Functions** section.



Selecting (**a**) **Counter** from the **Setup BRX Counter/Timer** dialog box. The dialog box will fill in with counter parameters. For this example, we will keep the default (**b**) **Device Name** of *HsCtrTmr1*. Select (**c**) **Quad Counter** from the dropdown menu, leaving it at (**d**) 1X counting resolution and select input (**e**) X0 (Phase A) and input (**f**) X1 (Phase B).



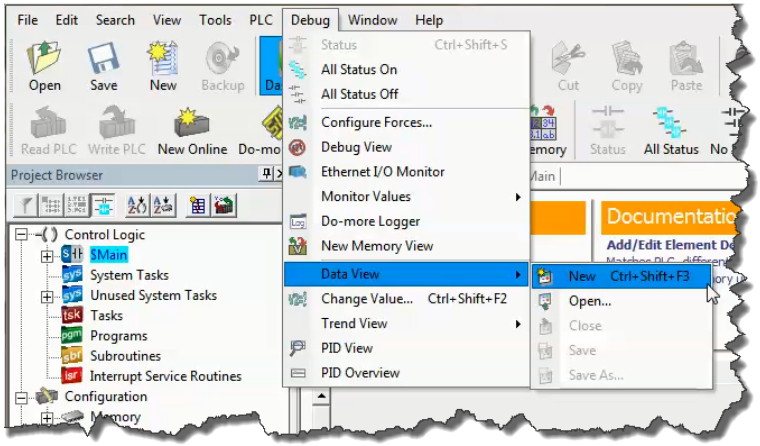
Click OK to return to the Dashboard screen. **Write** the changes to the PLC and verify you are in **Run** mode.

At this point, we have configured inputs X0 and X1 for quadrature counter high-speed inputs. No ladder is needed to monitor the counts from the encoder.

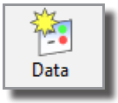
Detailed Example: Configure and Test a Quadrature Input, continued

Displaying Encoder Values via Data View

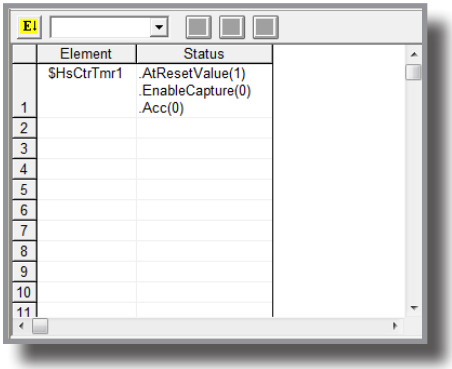
Create a **New Data View** window. From the menu select **Debug -> Data View** and **New**.



Alternately, you can use the **Data** icon (right) on the toolbar to open a new *Data View* window.



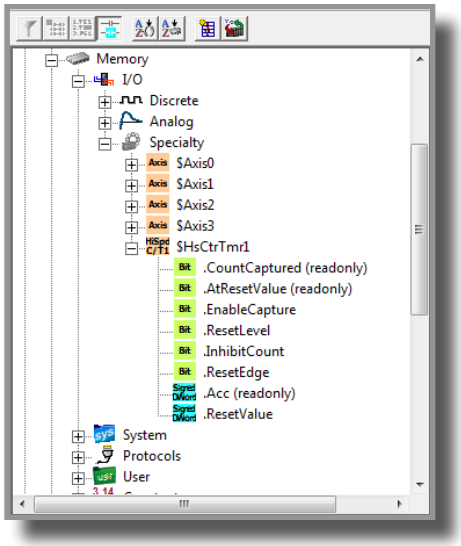
The **Data1** window is displayed. Start by typing **$HsCtrTmr1** on row 1 under the **Element** column. Make this **Data1** window wider by placing the mouse on the right edge of the window, left clicking and dragging to the right.



As you can see at right under **Status**, the Heap items **.AtResetValue**, **.EnableCapture**, and "**.Acc**". The value in parenthesis is the current value. As you turn your encoder, the value for "**.Acc**" will change. If you move the encoder in the clockwise direction the values will increase. When the encoder moves in the counter-clockwise direction, the value decreases. (The reverse maybe true depending on the wiring of the encoder phase A and phase B).

Detailed Example: Configure and Test a Quadrature Input, continued

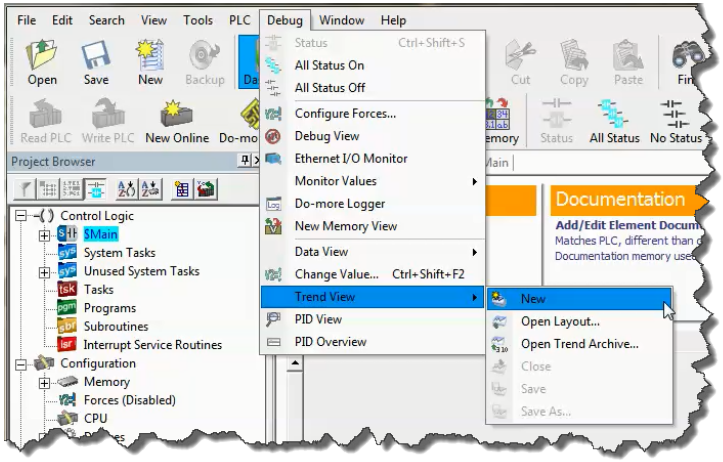
It is possible to view one Heap item per Data View row. The available Heap items for the **$HsCtrTmr1** can be found under the **Project Browser -> Configuration -> Memory -> I/O -> Specialty -> $HsCtrTmr1** as shown at right.

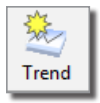


Displaying Encoder values using Trend View

Trend View is a very powerful utility, one that can be used to troubleshoot the control system. We highly recommend you use this tool to the fullest.

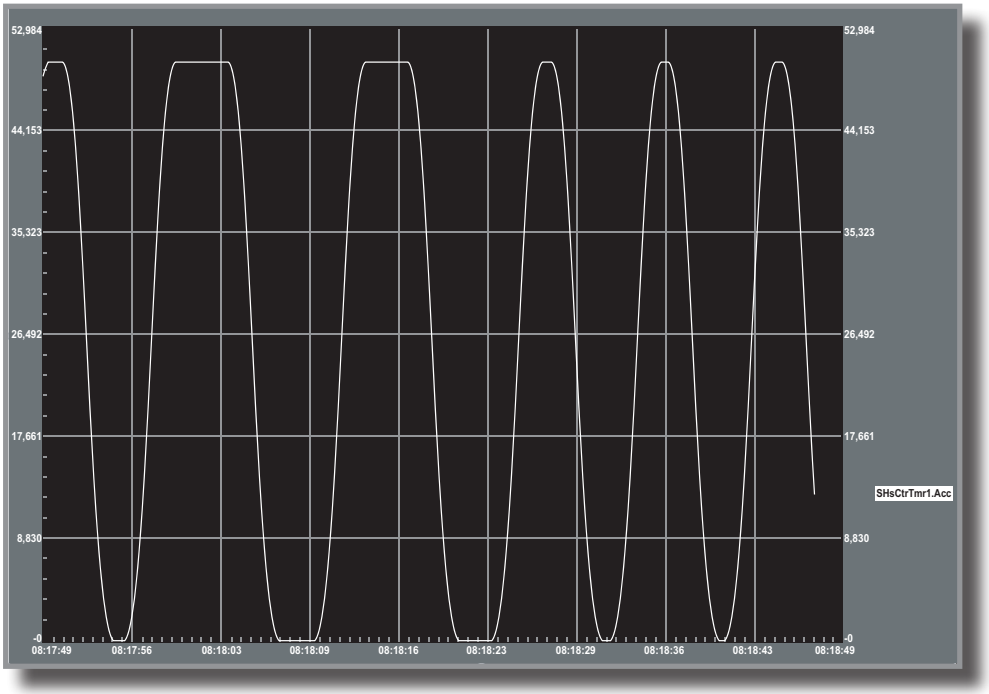
Create a new **Trend View** from the **Debug Menu** or the **Trend** icon (below, right) on the toolbar, as shown below.





Detailed Example: Configure and Test a Quadrature Input, continued

In **Trend View**, using a single pane, add the accumulated value of the high-speed counter, ***$HsCtrTmr1.Acc***. As the encoder is turned, you can see the accumulated value changing on the Trend View pane.



Detailed Example: Configure and Test a High-Speed Pulse Output with a Trapezoid Profile

This example walks through the steps required to use a BRX MPU to generate a pulsed output with a trapezoid profile using the built-in high-speed outputs.

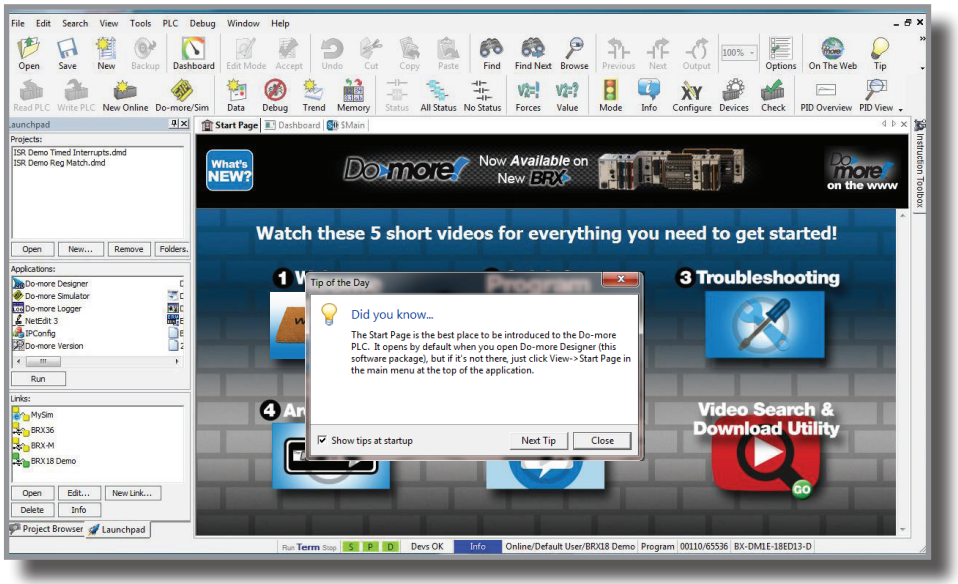
The Basic Steps

1. Gather and wire up the hardware (not covered here).
2. Launch the Do-more! Designer software and connect to a BRX MPU with DC sinking or sourcing outputs.
3. Configure Axis 1 to use Y0 for Step and Y1 for Direction.
4. Write the necessary ladder program to generate the trapezoid profile.
5. Download and run the program.
6. Show how Data View and Trend View can be used to monitor and control the profile.

Equipment Needed

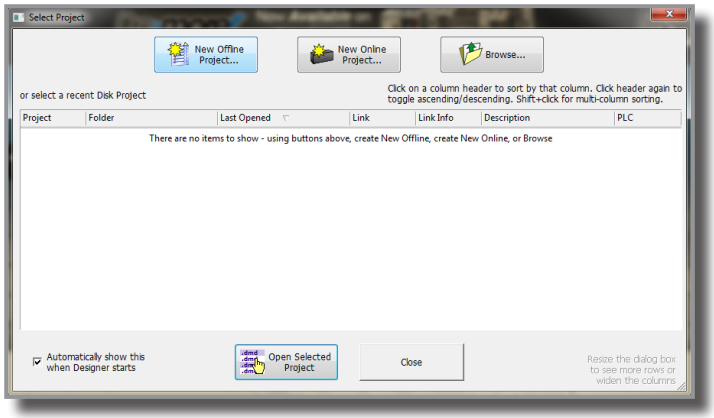
A BRX MPU with DC sinking or sourcing outputs, i.e. BX-DM1E-10ED23-D. A stepper drive and motor properly powered and wired to the BRX MPU outputs. Alternately, the output activity can be monitored in Data View or in Trend View, encase a stepper or similar hardware is not available.

Launch the Do-more! Designer Software. By default, the Tip of the Day will pop up. Close it.

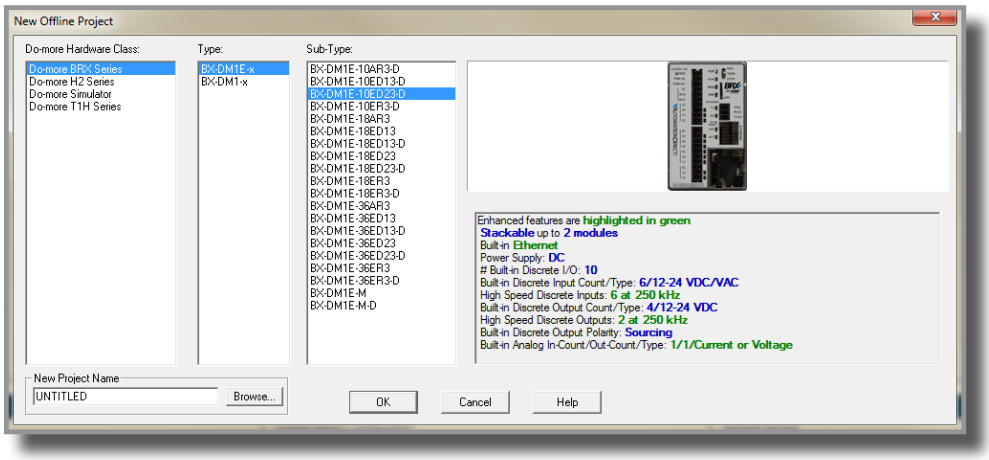


Detailed Example: Configure and Test a High-Speed Pulse Output with a Trapezoid Profile, continued

The *Select Project* window will be displayed next. Select **New Offline Project**.

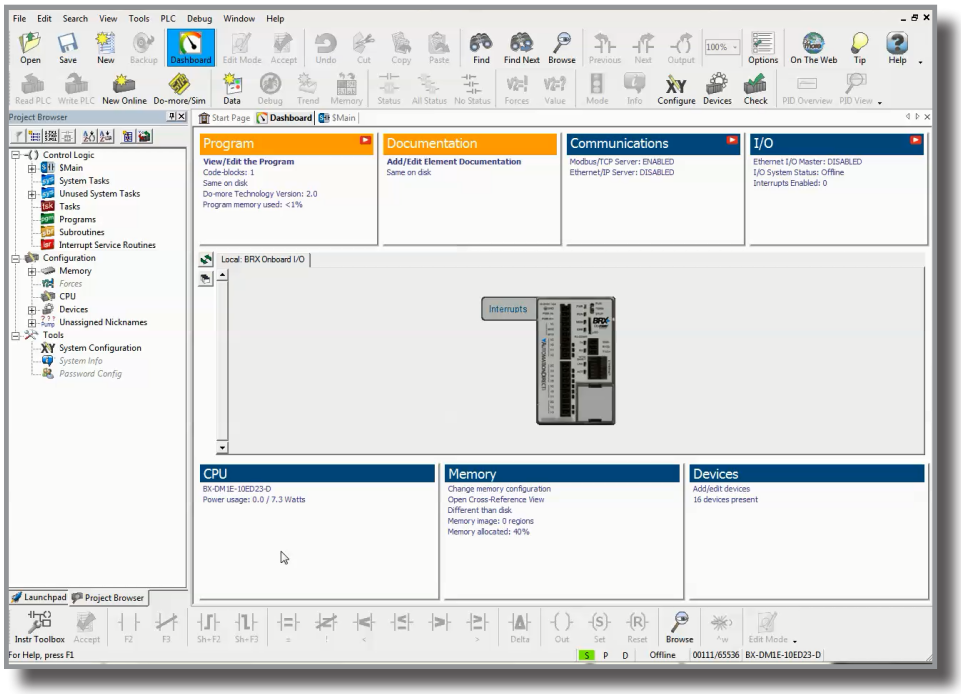


In the *New Offline Project* windows select the BRX MPU model you are working with. Rename the project as Trapezoid, in the New Project Name field. Press the OK button to accept the selections.

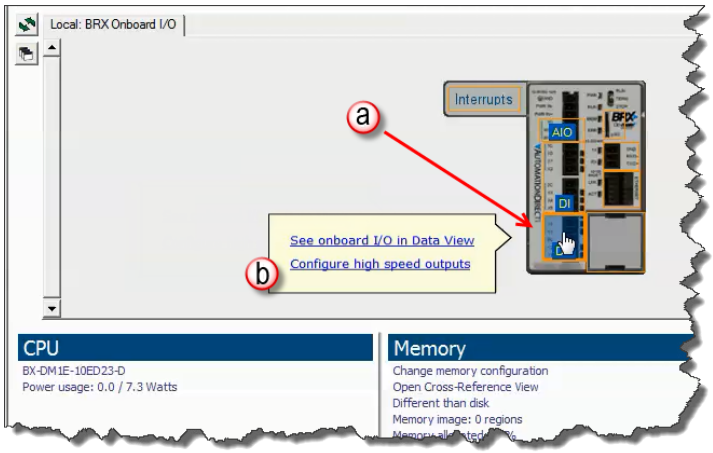


Detailed Example: Configure and Test a High-Speed Pulse Output with a Trapezoid Profile, continued

The Dashboard page is displayed and the screen will look as follows:

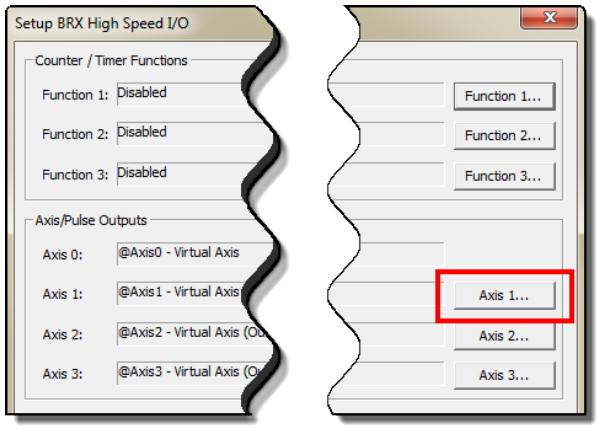


Mouse over the BRX MPU in the *Local BRX Onboard I/O* view. Select (**a**) the outputs orange block. Select **Configure high-speed outputs** (**b**) to access the *Setup BRX High-speed I/O* page.



Detailed Example: Configure and Test a High-Speed Pulse Output with a Trapezoid Profile, continued

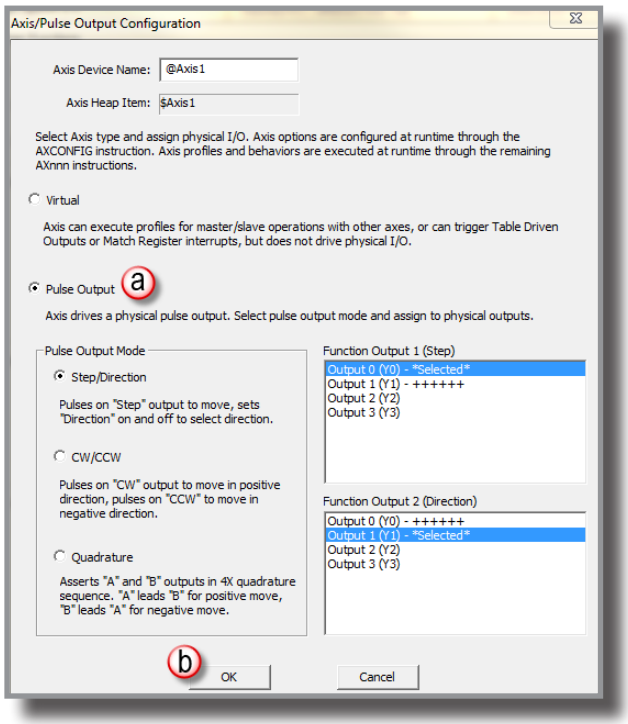
From the *Setup BRX High-speed I/O* page, select **Axis 1** under the Axis/Pulse Outputs section.



The *Axis/Pulse Output Configuration* window comes up. Select (a) **Pulse Output**. Use the default device name, **$Axis 1**. For this exercise, select Pulse Output, Step/Direction, Y0 for Step and Y1 for Direction, as shown below.

Press (b) OK to return to the *Setup BRX High-Speed I/O* window. Press OK again to return to the Dashboard screen. Save the project at this time.

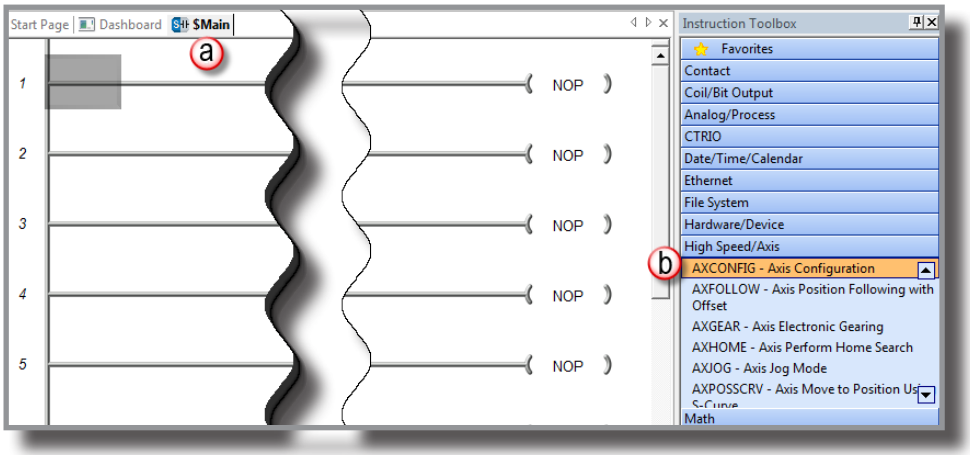
At this point, we have configured outputs Y0 and Y1 for Step and Direction high-speed outputs. Next, we will write the necessary ladder to generate a trapezoid profile with the configured high-speed outputs.



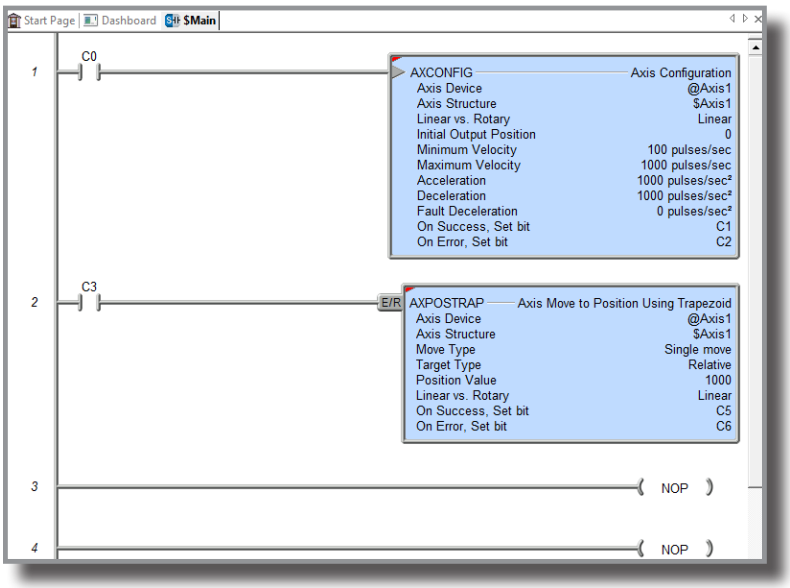
Detailed Example: Configure and Test a High-Speed Pulse Output with a Trapezoid Profile, continued

Ladder Program for Trapezoid Profile

Start by opening the **$Main** code block (**a**), as shown below.

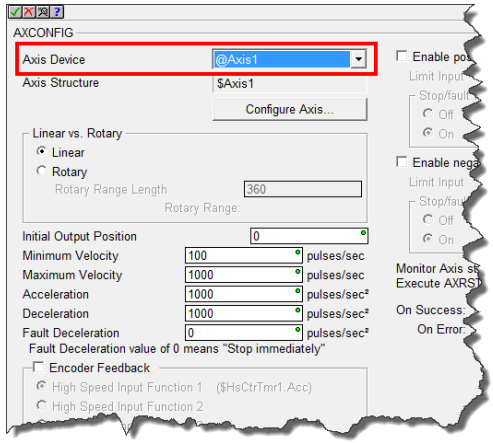


We will add two rungs to the ladder diagram by selecting two instructions from the Instruction Toolbox in the (**b**) **High-Speed/Axis** section. The ladder will look like the one shown below. On rung 1 we will place the AXCONFIG instruction and on rung 2 we will place the AXPOSTRAP instruction. The following page discusses setting the instruction parameters when placing these instructions.



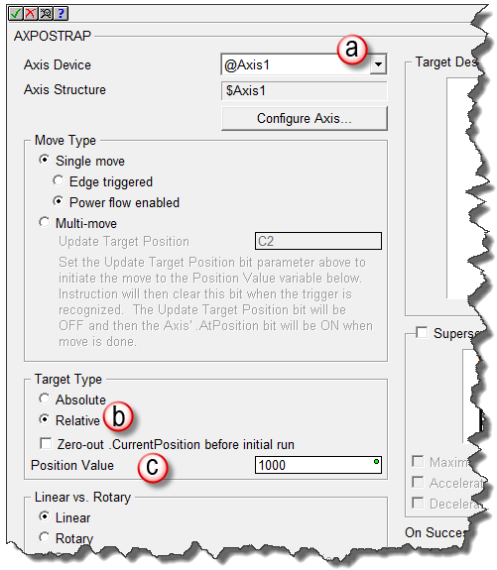
Detailed Example: Configure and Test a High-Speed Pulse Output with a Trapezoid Profile, continued

With the cursor on rung 1, Select AXCONFIG from the tool palette. AXCONFIG is needed to setup the runtime parameters for an Axis. An Axis has no default values and must be configured before it can be used. For this example, we will configure the AXCONFIG with the values as shown in the dialog box on the right. Since we have configured Axis 1 for **Step/ Direction**, change the AXCONFIG Axis Device field to **@Axis 1**. For the purpose of our example, leave all other fields at their default values.



Move cursor to rung 2 and select AXPOSTRAP from the tool palette. AXPOSTRAP is used to move an Axis from its current position to a specified target position using the configured parameters to generate a trapezoid move profile.

For the purpose of this example, change the (a) **Axis Device** to **@Axis 1** and change the (b) **Target Type** to **Relative**, leaving the other parameters at their default values. You can change the (c) **Position Value** if your setup requires additional steps to approximate the trapezoid move. When you use the **Relative** target type, the profile will move the number of steps indicated by the (c) **Position Value** each time the AXPOSTRAP instruction is triggered.

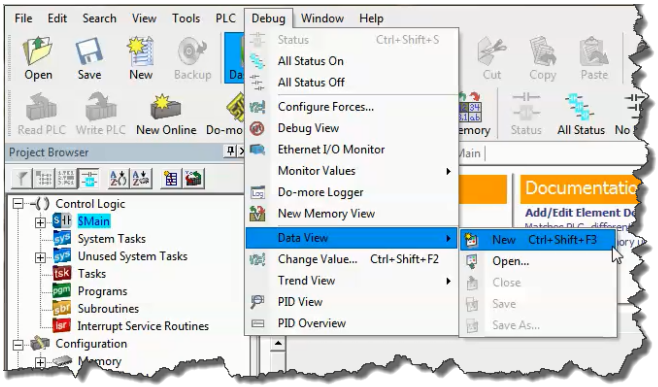


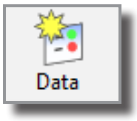
Write the program to the BRX CPU and verify it is in **RUN** mode.

Detailed Example: Configure and Test a High-Speed Pulse Output with a Trapezoid Profile, continued

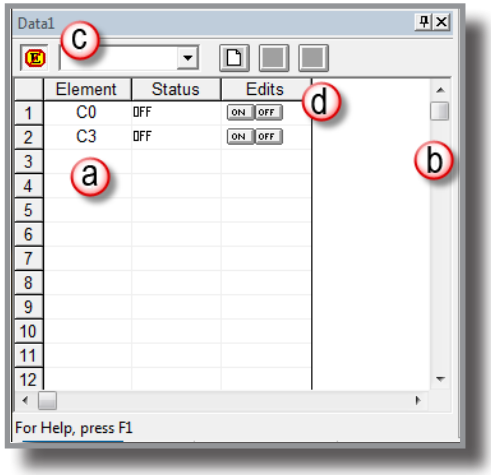
Displaying and controlling the trapezoid profile move using Data View

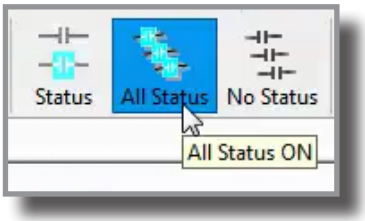
From the menu select a new Data View under the **Debug -> Data View** menu. Alternately, you can use the **Data** icon (shown on right) on the toolbar ribbon to open a new **Data View** window.





The *Data1* window is displayed (right). Start by typing C0 on row 1 and C3 on row 2, under the (**a**) **Element** column. Make the *Data1* window wider by placing the mouse on the right edge of the window (**b**), left clicking and dragging to the right. Select (**c**) the yellow **E** icon in order to display (**d**) the **Edits** column. Be sure **All Status On** (toolbar ribbon) is selected.



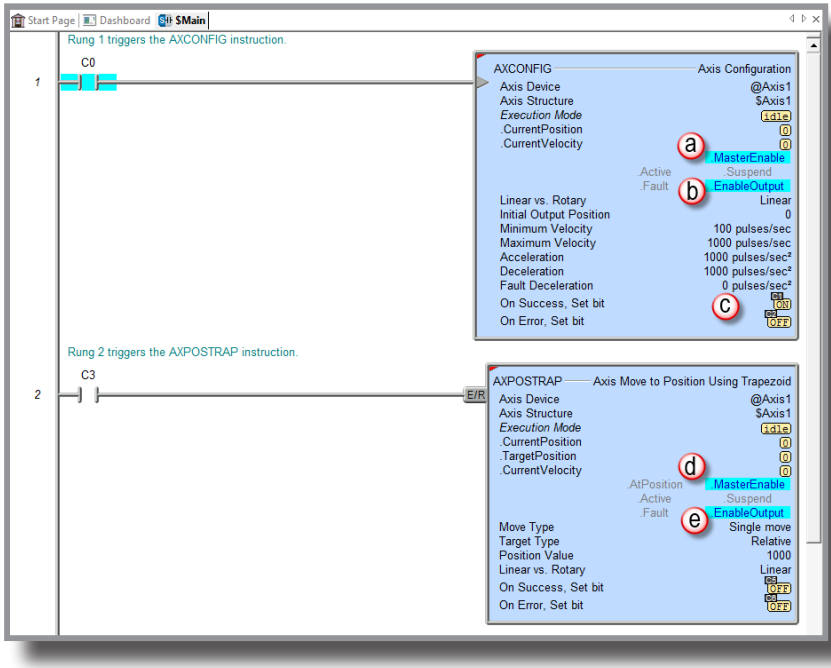


Under the **Edits** column (**d**), you will see **ON** and **OFF** buttons adjacent to C0 and C3. We will use these to trigger our two rungs of instructions. In Data View, to configure AXIS1 parameters, double-left click the ON button for C0 element.

NOTE: *The first time you use this feature, the program will ask you to confirm the writes. If you prefer check the box so that it will not ask you again.*

Detailed Example: Configure and Test a High-Speed Pulse Output with a Trapezoid Profile, continued

After triggering C0, the ladder will display the following status as shown below.



In the AXCONFIG instruction, we see (**a**) **.MasterEnable** and (**b**) **.EnableOutput** are highlighted in blue and C1 is set to ON. These indicate that Axis1 is configured and ready to be used.

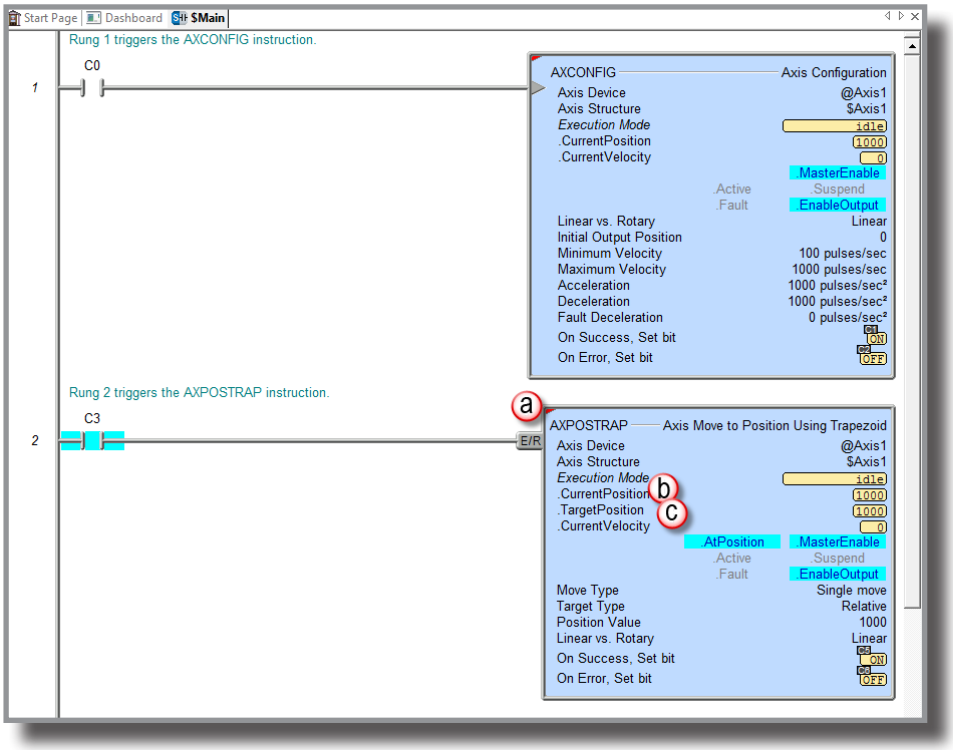
The AXPOSTRAP instruction in Rung 2 shows Axis 1 parameters have been configured (**d**) (.MasterEnable is highlighted) and it is ready to start sending pulses (e) (.EnableOutput is highlighted).

C0 can be turned off once the On Success bit (**c**), of the AXCONFIG turns on.

We are now ready to initiate our trapezoid move.

Detailed Example: Configure and Test a High-Speed Pulse Output with a Trapezoid Profile, continued

Double-left click on the C3 ON button in Data View. The trapezoid move will begin. Status indicators on (**a**) the AXPOSTRAP instruction will provide feedback about the move. The following graphic shows its status after the move is complete. Notice (**b**) the **Current Position** is now 1000 and the (**c**) **Target Position** is 1000. The field device should have moved 1000 steps.

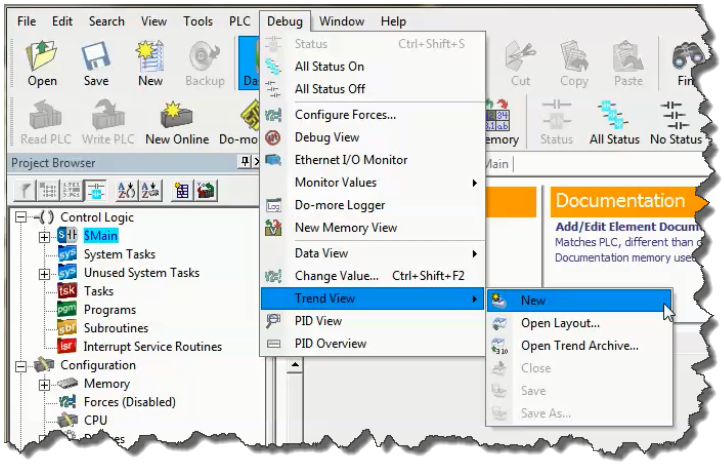


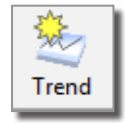
Detailed Example: Configure and Test a High-Speed Pulse Output with a Trapezoid Profile, continued

Displaying $Axis1 Current and Target values using Trend View

As mentioned before, Trend View is a very powerful utility, one that can be used to troubleshoot the control system.

Open **Trend View** from the **Debug Menu** or the **Trend** icon (right) on the toolbar, as shown below.

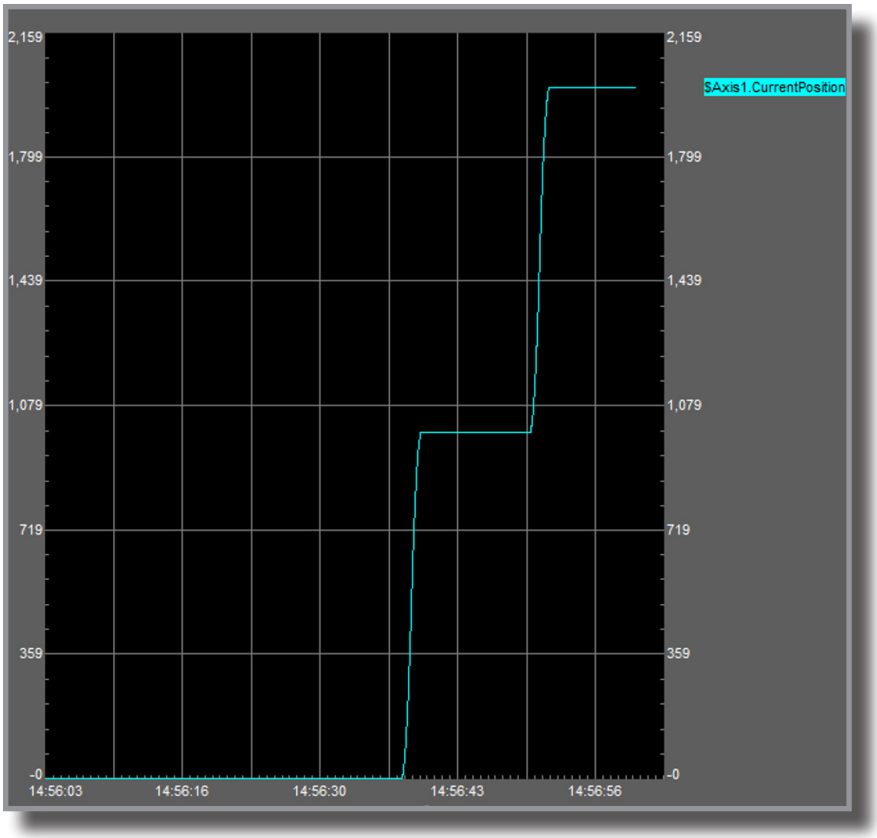




Detailed Example: Configure and Test a High-Speed Pulse Output with a Trapezoid Profile, continued

In Trend View, using a single pane, add **$Axis1.CurrentPosition** to a pane.

Every time the AXPOSTRAP instruction is triggered, 1000 pulses are generated. In the Trend View snapshot that follows, we can see the instruction was triggered twice. It started at 0 counts and reached 1000 counts the first trigger. On the second trigger, it started at 1000 and reached 2000 counts.



There are many settings available that allow the user to meet application needs. Please review the Do-more! Designer High-speed Instruction Help topics for detailed information.

BRX High-speed Instructions

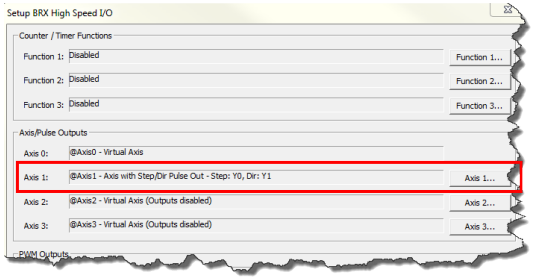
In this section we will give an overview of the high-speed instructions available to the BRX Do-more! CPU. They will be presented in this section as in the **Instruction Toolbox**, in alphabetical order.

1. AXCAM – Axis Electronic Camming
2. AXCONFIG – Axis Configuration
3. AXFOLLOW – Axis Position Following with Offset
4. AXGEAR – Axis Electronic Gearing
5. AXHOME – Axis Perform Home Search
6. AXJOG – Axis Jog Mode
7. AXPOSSCRV – Axis Move to Position Using S-Curve
8. AXPOSTRAP – Axis Move to Position Using Trapezoid
9. AXRSTFAULT – Reset Axis Limit Fault
10. AXSETPROP – Set Axis Properties
11. AXVEL – Axis Set Velocity Mode
12. TDODECFG – Deconfigure Table Driven Output
13. TDOPLS – Load Programmable Limit Switch Table for Table Driven Output
14. TDOPRESET – Load Preset Table for Table Driven Output

An expanded discussion of each of these instructions can be found in the Do-more! Designer online Help files under the High-Speed/Axis topic.

AXCAM

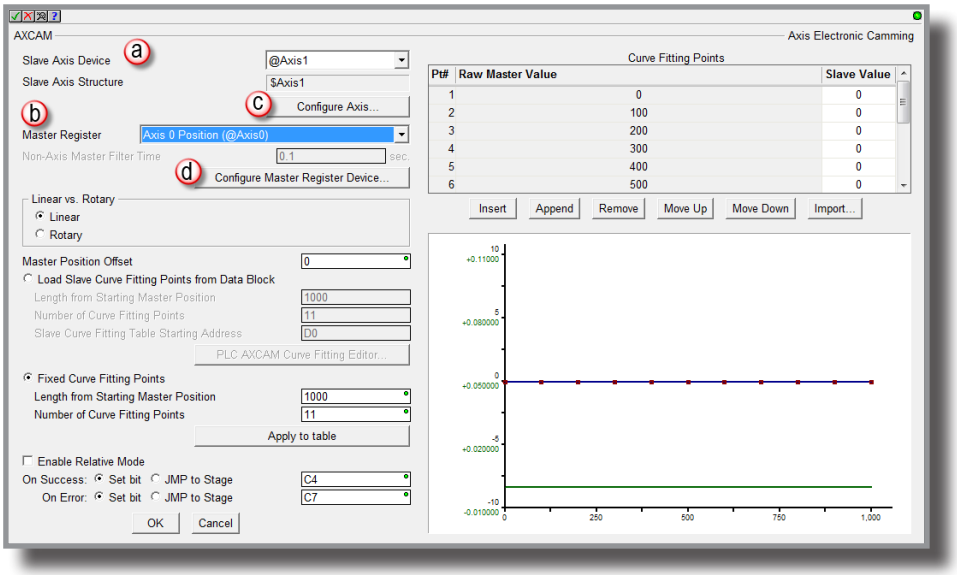
The Axis Electronic Camming (AXCAM) instruction is used to establish a Master/Slave connection for an Axis so that its movement is synchronized to another Axis or to a High-Speed Counter/Timer. The Slave Axis (**Axis 1**, below) position is derived from the Master position. Any time the Master Axis moves to a new position the Slave Axis will also move to a corresponding position as directed by the Cam Table. Pulse Outputs for a given **Axis** cannot be commanded until the AXCONFIG instruction has been configured and run successfully.



An (**a**) Axis Device (the slave axis) and either a (**b**) Master Axis, High-speed Counter or Timer must be configured before the AXCAM instruction can be used. This is setup in the "***Setup BRX High-speed I/O***" dialog in the **BRX Onboard I/O** section of the System Configuration. This dialog box can be opened directly from the AXCAM instruction by clicking on the (**c**) **Configure Axis...** button and (**d**) **Configure Master Register Device...** button (see AXCAM graphic below).

NOTE: *Axis0 is a 'virtual axis' and will not generate pulses to physical outputs of the PLC. Axis0 can be used for generating pulse output profile register values to be used for Table Driven Outputs (TDOPRESET or TDOPLS) or as the master for other axes in following-type applications (AXCAM, AXFOLLOW or AXGEAR).*

After the Axis has been configured, the AXCAM instruction may now be used (For more details see the High-speed I/O Hardware Configuration section).



AXCAM, continued

Points and segments:

A Cam Table describes a motion profile that clearly assigns a slave position for each master position of a specific master position range.

Cam tables are entered as a series of up to 64 segments. All of the segments are the same size in that they are equal divisions of the total span of the Master Axis travel.

A segment describes the distance traveled and the position of the axis. It is equal to the difference between the previous and current positions. Each segment is executed over a defined distance traveled for the Master Axis. When executing these segments, the profiling software in the controller will fit a smooth curve to the data with an updated velocity profile every millisecond.

Curve Fitting

The Cubic Interpolation method fits a cubic trajectory between each pair (segment) of cam table entries.

All segment transitions are curved, even for a linear progression between the segments. The only exception is on the last 2 table segments. The last 2 segments will be a linear progression unless **Rotary** mode has been selected. In **Rotary** mode, there will be curves on the last position of the table to the first position of the table.

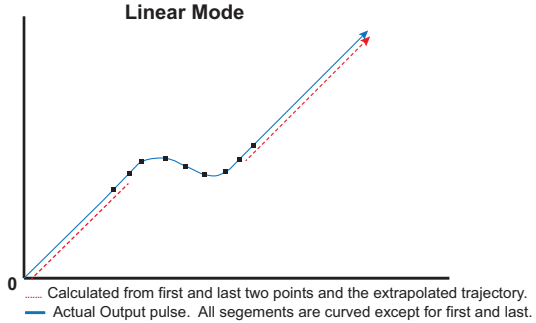
Master Register: This is the Axis, High-Speed Counter or Timer that provides the position source value. This can be any of the Axes or High-Speed Counter/Timers.

Non-Axis Master Filter Time: This parameter is only enabled if the Master Register is a High-Speed Counter/Timer. This value is the Filter Time Constant which specifies how often (in Seconds) the Slave's position is calculated. This can be any constant value or any numeric location.

Configure Master Register Device: This button will open the BRX High-Speed Input or Axis/Pulse Output dialog in the System Configuration.

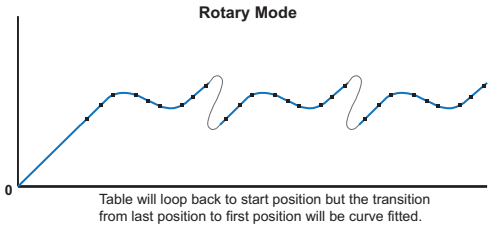
Linear vs. Rotary: This setting selects the behavior that will occur when the end of the table has been reached.

- **Linear:** The first two and the last two table positions are used to calculate a linear trajectory (from 0 at the start of the table) and the CPU will continue to output pulses until the instruction is terminated.



AXCAM, continued

- **Rotary:** This selection will 'loop' the table to start at the beginning. The modulus of the Master Register is used as the table Master Value.



Master Position Offset: A pulse count value that is added to the Master Axis position before the associated Slave position value is calculated. This can be any constant value or any numeric location. If this value is a numeric location the value is read from that location only when the instruction is first enabled.

Load Slave Curve Fitting Points from Data Block: The data for the curve is located in PLC memory.

- **Length from Starting Master Position:** The total number of pulse counts the Master will move.
- **Number of Curve Fitting Points:** The number of segments to divide the Length from Master Position into. There must be at least 3 curve fitting points in the table with a maximum of 64.
- **Slave Curve Fitting Table Starting Address:** The beginning address in PLC memory where the curve data is stored.

Fixed Curve Fitting Points: The data for the curve is in the instruction table.

- **Length from Starting Master Position:** The total number of pulse counts the Master will move.
- **Number of Curve Fitting Points:** The number of segments to divide the **Length from Master Position** into. There must be at least 3 curve fitting points in the table with a maximum of 64.

Enable Relative Mode: If selected, the function is enabled. The Slave Axis' current position is stored internally and that position becomes the new 0 for the Slave Axis. As the Master Axis moves, the Slave position values are now relative to this stored position.

On Success:

- **Set Bit:** The bit will become FALSE when the instruction is enabled and will remain FALSE until the enable leg goes back OFF. Once the enable leg turns OFF, if the instruction's device/parameters were valid, this bit will turn ON once the .CurrentVelocity reaches 0.
- **JMP to Stage:** Similarly, the JMP will not occur until after the instruction is enabled, then disabled, and all the instruction device/parameters were valid and the .CurrentVelocity reaches 0.

On Error:

- **Set Bit:** The bit will become FALSE when the instruction is enabled and will become TRUE if there was a problem with the parameters configured in the instruction, with the devices specified or if the AXCAM move was interrupted before completion.
- **JMP to Stage:** If there was a problem with the parameters configured in the instruction, with the devices specified or the AXCAM move was interrupted before completion, the PLC will jump to that stage.

AXCAM, continued

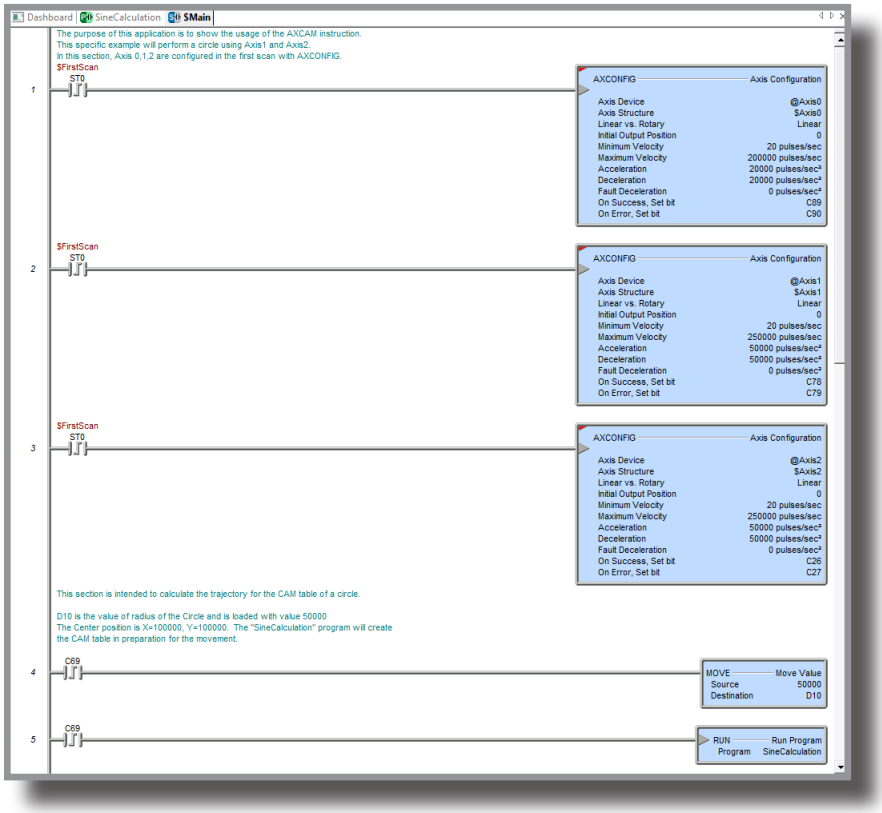
Example AXCAM

In this example we will demonstrate the use of the AXCAM instruction in conjunction with the AXCONFIG instruction to create a circular path output using multiple axes.

The radius of the circle (50000) is loaded into D10. The center position is: X=100000, Y=100000. The path followed is defined in the program **SineCalculation**.

Axes 0,1 & 2 are defined with the AXCONFIG instruction. The AXCAM instruction creates the movement of the Axes to define the path traveled. The program **SineCalculation** is called to perform the necessary math calculations to create a circular path output. The **SineCalculation** is called for each segment in the camming table (61 segments).

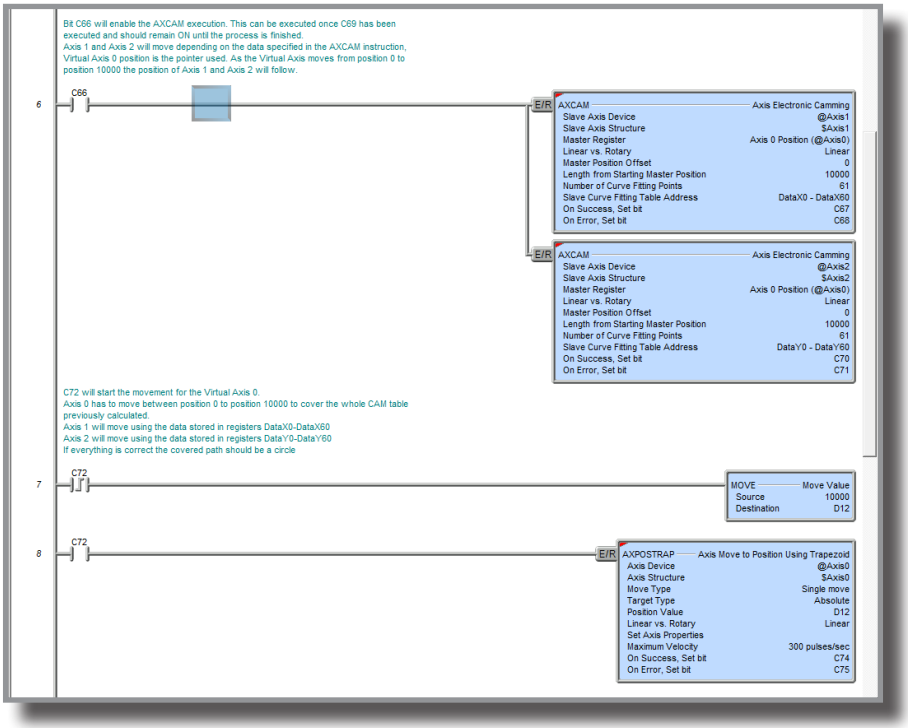
The following pages show the ladder program that defines this operation.



(Ladder continued on next page.)

AXCAM, continued

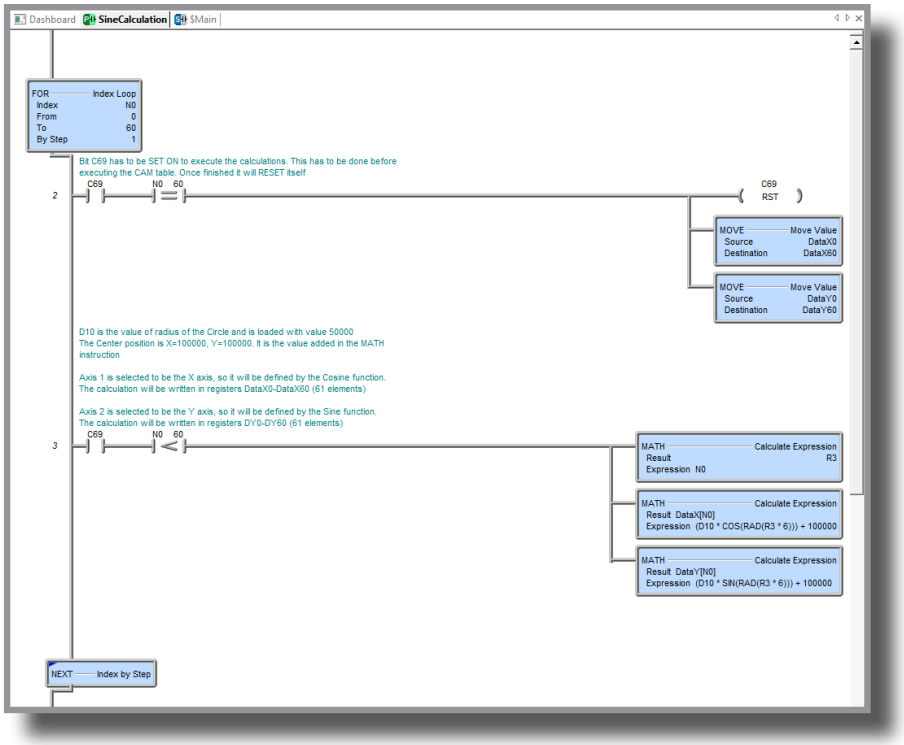
(Ladder continued from previous page.)



AXCAM, continued

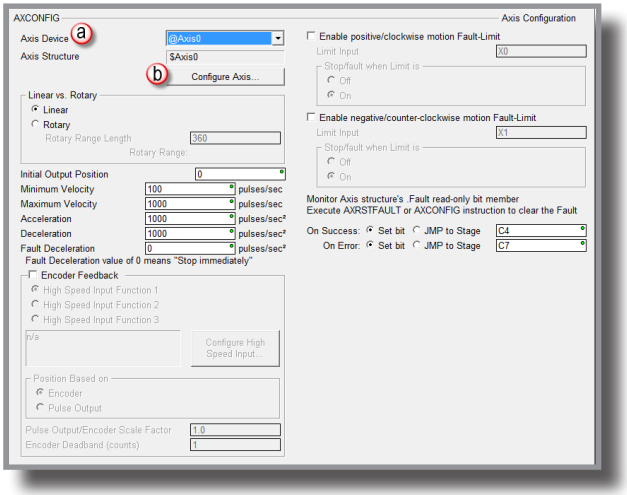
Program: SineCalculation

A program is written to perform a separate calculation to create a circular path output.



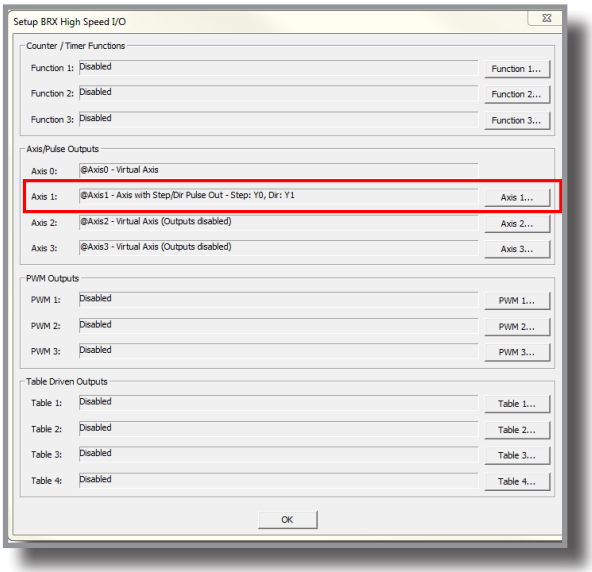
AXCONFIG

The Axis Configuration (AXCONFIG) instruction configures the parameters for a specific Axis so that it may be used for all of the other AXIS commands. Pulse Outputs for a given AXIS cannot be commanded until the AXCONFIG instruction has been run successfully. When the AXCONFIG instruction has been successfully created and initiated, the **.MasterEnable** structure member for that AXIS will become true and the AXIS may be commanded by other Axis instructions.



An (**a, above and Axis 1 below**) Axis Device must be configured before the AXCONFIG instruction can be used. This is setup in the ***Setup BRX High-speed I/O*** dialog found in the **BRX Onboard I/O** section of the System Configuration. This dialog can be opened directly in the instruction from the (**b**) **Configure Axis…** button (see AXCONFIG graphic above).

After the Axis has been configured (see the High-speed I/O Hardware Configuration section for more details), the AXCONFIG instruction may now be used.



NOTE: *Axis0 is a 'virtual axis' and will not generate pulses to physical outputs of the PLC. Axis0 can be used for generating pulse output profile register values to be used for Table Driven Outputs (TDOPRESET or TDOPLS) or as the master for other axes in following-type applications (AXCAM, AXFOLLOW or AXGEAR).*

AXCONFIG, continued

Linear vs Rotary: This setting selects the behavior that will occur when the end of the table has been reached.

- **Linear:** Linear actuators move forward or backward on a fixed linear path. The movement of linear actuators are defined in linear units such as inches or millimeters. Since linear actuators only move in two directions on a fixed path, linear actuators are defined as finite, meaning they have a set distance that they can travel in either direction before they must stop.
- **Rotary:** Rotary actuators produce rotary motion, meaning that the actuator revolves on a circular path. Movement from this type of actuator is defined in rotary units, typically degrees. A rotary table doesn't have a fixed distance it can travel; it can keep spinning in the same direction indefinitely. The count for a rotary input is kept within a defined range (Rotary Range Length). Once the count has exceeded the high limit of the specified **Rotary Range Length**, it will reset to 0. If the Axis position is decreasing (negative velocity value), when it falls below 0, it will go to the high value specified in the **Rotary Range Length**.

Initial Output Position: The current count will be set to this value when the Axis is first enabled and any time the Axis is reset. This can be any constant value or any numeric location.

Minimum Velocity (pulses/sec): The slowest frequency of output pulses that will be generated when the output is enabled. This can be any positive constant from 10 to 250000 or any numeric location with a value in that range.

Maximum Velocity (pulses/sec): The fastest frequency of output pulses that will be generated when the output is enabled. This can be any positive constant from 10 to 250000 or any numeric location with a value in that range.

Acceleration Rate (pulses/sec^2): The rate at which the pulses will be generated when the axis is ramping up from a slower pulse rate to a higher pulse rate. This can be any positive constant or any numeric location with a value in that range.

Deceleration Rate (pulses/sec^2): The rate at which the pulses will be generated when the axis is ramping down from a faster pulse rate to a slower pulse rate. This can be any positive constant or any numeric location with a value in that range.

Fault Deceleration Rate (pulses/sec^2): Any time a Fault Limit is reached or the Axis .MasterEnable is turned OFF, the Axis will decelerate to 0 at this specified rate. A value of 0 will cause the Axis to immediately stop moving. This can be any positive constant or any numeric location with a value in that range.

Encoder Feedback: Enable this option if an incremental encoder is being used to provide the speed reference feedback. The Axis structure contains a **.FollowingError** that indicates the difference in the commanded position and the encoder feedback. This can indicate a stalled motor, mechanical slippage or other problem in the application.

AXCONFIG, continued

- **High-speed Input Function 1/High-speed Input Function 2/High-speed Input Function 3:** Choose one of these options for the encoder feedback. The High-speed Counters must be setup in the **Setup BRX Counter/Timer** section of the ***BRX Onboard I/O>High-speed I/O…*** section in the System Configuration. Click on the **Configure High-speed Input…** button to access this directly.
- **Position Based on**:

  Encoder: This option will place the specified High-speed Input Function into the **.CurrentPosition** member of the Axis configured in this instruction. The difference in the specified High-speed Input Function and the actual pulse output count of the Axis configured in this instruction will be indicated in the **.FollowingError**.

  Pulse Output: This option will indicate the actual pulse output count of the Axis configured in this instruction into the **.CurrentPosition** member and the **.FollowingError** will indicate the difference between **.CurrentPosition** and the High-speed Input Function that has been specified.

- **Pulse Output/Encoder Scale:** If the motor and the encoder have different pulse-per-revolution values, enter the scale value required to bring them into alignment.
- **Encoder Deadband (counts):** Having some deadband value around the encoder current position can prevent the pulse output from generating alternating small pulses trying to get the input value to an exact number. This value is applied both above and below the encoder value. For example: A value of 2 will be a deadband of 2 above and 2 below for a span of 4 counts.

Enable Positive/Clockwise Motion Fault-Limit: Enable this option to use a physical input that will cause the Axis to Fault (Stop) if the input becomes true or false (based on the setting below) when moving in the Clockwise or Positive direction. This is typically used as an over-travel limit switch.

If a Fault-Limit is tripped, use the Axis Reset Fault (AXRSTFLT) instruction or re-trigger the Axis Config (AXCONFIG) instruction to clear the fault. Any attempt to move in the same direction that caused the fault will immediately generate another fault condition. Movement of the Axis in the opposite direction is permitted.

Limit Input: This needs to be one of the onboard X discrete input elements. This is where the over travel limit switch would be wired to.

Stop/fault when Limit is: Choose OFF to cause the Axis to fault (stop) when the specified input goes from True to False. Choose ON to cause the Axis to fault (stop) when the specified input goes from False to True.

Enable Negative/Counter-Clockwise Motion Fault-Limit: Enable this option to use a physical input that will cause the Axis to Fault (Stop) if the input becomes true or false (based on the setting below) when moving in the Counter-Clockwise or Negative direction. This is typically used as an over-travel

AXCONFIG, continued

limit switch.

If a Fault-Limit is tripped, use the Axis Reset Fault (AXRSTFLT) instruction or re-trigger the Axis Config (AXCONFIG) instruction to clear the fault. Any attempt to move in the same direction that caused the fault will immediately generate another fault condition. Movement of the Axis in the opposite direction is permitted.

Limit Input: This needs to be one of the onboard "X" discrete input elements. This is where the over travel limit switch would be wired to.

Stop/fault when Limit is: Choose OFF to cause the Axis to fault (stop) when the specified input goes from True to False. Choose ON to cause the Axis to fault (stop) when the specified input goes from False to True.

On Success:

- **Set Bit:** The bit will become FALSE when the instruction is enabled and will become TRUE if the parameters configured in the instruction and proper devices were specified.
- **JMP to Stage:** If the parameters configured in the instruction and proper devices were specified, the PLC will jump to that stage.

On Error:

- **Set Bit:** The bit will become FALSE when the instruction is enabled and will become TRUE if there was a problem with the parameters configured in the instruction or with the devices specified.
- **JMP to Stage:** If there was a problem with the parameters configured in the instruction or with the devices specified, the PLC will jump to that stage.

AXFOLLOW

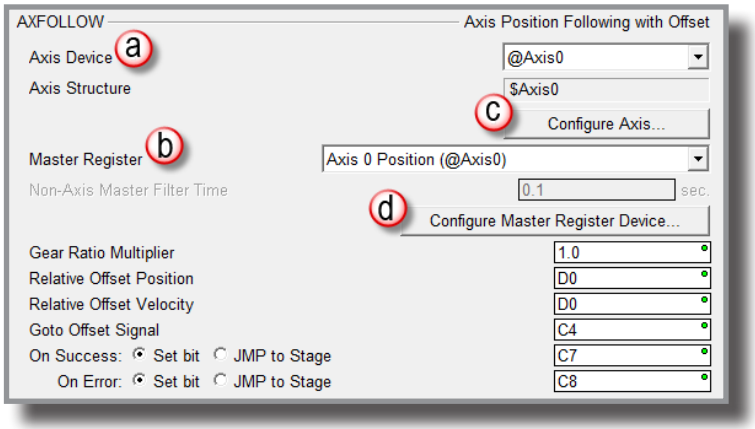
The Axis Position Following with Offset (AXFOLLOW) instruction is used to establish a Master/Follower connection for an Axis so that the Follower's movement is synchronized to the Master's movement. The Master can be another Axis or a High-Speed Counter/Timer. Pulse Outputs for a given AXIS cannot be commanded until the AXCONFIG instruction has been configured and run successfully.

Because the Follower Axis will need the ability to overtake the Master Axis during a Goto Relative Offset operation, ensure that the Maximum Velocity and Acceleration parameters of the Master and Follower Axes have been configured with enough capacity to allow this. The Follower Axis can be made more responsive by configuring it with higher Maximum Velocity or a faster Acceleration or both.

If the instruction is enabled with the Goto Offset Signal OFF, the Axis will behave in a Velocity-following manner. As soon as the Goto Offset Signal turns ON, the Axis will now behave in a Position-following manner and will remain so until the instruction is terminated. If the instruction is enabled with the Goto Offset Signal ON, the Axis will behave in a Position-following manner until the instruction is terminated.

To help keep track of the Axes movement relative to each other, any time the Axis is in Position Following mode the Follower Axis associated structure member, **.MstSlvCoordError**, will contain the difference (in pulse counts) between the Master Axis position and the Follower Axis' position.

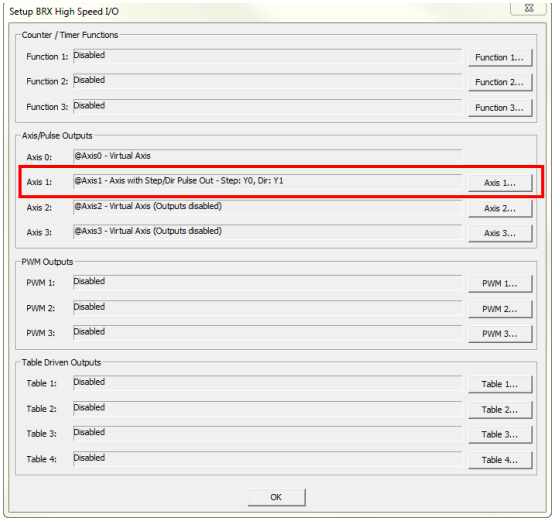
An (**a**) Axis Device (the slave axis) and either a (**b**) Master Axis, High-speed Counter or Timer must be configured before the AXFOLLOW instruction can be used. This is setup in the **Setup BRX High-speed I/O** dialog that is in the ***BRX Onboard I/O*** section of the System Configuration. This dialog can be opened directly in the instruction from the (**c**) **Configure Axis…** button and (**d**) **Configure Master Register Device...** button.



After the Axis has been configured (see the High-speed I/O Hardware Configuration section for more details), the AXFOLLOW instruction may now be used.

AXFOLLOW, continued

NOTE: *Axis0 is a 'virtual axis' and will not generate pulses to physical outputs of the PLC. Axis0 can be used for generating pulse output profile register values to be used for Table Driven Outputs (TDOPRESET or TDOPLS) or as the master for other axes in following-type applications (AXCAM, AXFOLLOW or AXGEAR).*



Master Register: This is the Axis, High-Speed Counter or Timer that provides the position source value. This can be any of the Axes or High-Speed Counter/Timers.

Non-Axis Master Filter Time: This parameter is only enabled if the Master Register is a High-Speed Counter/Timer. This value is the Filter Time Constant which specifies how often (in Seconds) the Slave's position is calculated. This can be any constant value or any numeric location.

Configure Master Register Device: This button will open the BRX High-Speed Input or Axis/Pulse Output dialog in the System Configuration.

Gear Ratio Multiplier: A multiplier that will be applied when the Follower's position is calculated. This can be any constant value or any numeric location. Unlike the similar parameter in the Electronic Gearing (AXGEAR) instruction, this value cannot be adjusted while the instruction is enabled.

Relative Offset Position: The Follower's position value will be adjusted by this pulse count value each time the Goto Offset Signal turns ON. This can be any constant value or any numeric location.

Relative Offset Velocity: The additional velocity the Follower Axis will use when moving to the Relative Offset Position. This value specifies how much faster (in pulses/second) the Follower Axis can move than the Master Axis when attempting to move to the Relative Offset Position. This value can be any constant between 0 and 250,000 or any numeric location containing a value in that range.

Goto Offset Signal: Each time this Bit transitions from OFF to ON, the Follower Axis will attempt to move to the Relative Offset Position using the Relative Offset Velocity. If the Relative Offset Position is reached the instruction will turn this Bit OFF. This can be any Bit memory address.

AXFOLLOW, continued

NOTE: *If the Bit assigned to the Goto Offset Signal stays ON, it indicates the Follower Axis does not have the capacity to overtake the Master Axis. Make the Follower Axis more responsive by configuring it with higher Maximum Velocity or a faster Acceleration, or both.*

On Success:

- **Set Bit:** The bit will become FALSE when the instruction is enabled and will remain FALSE until the enable leg goes back OFF. Once the enable leg turns OFF, if the instruction's device/parameters were valid, this bit will turn ON once the .CurrentVelocity reaches 0.
- **JMP to Stage:** Similarly, the JMP will not occur until after the instruction is enabled, then disabled, and all the instruction's device/parameters were valid and the .CurrentVelocity reaches 0.

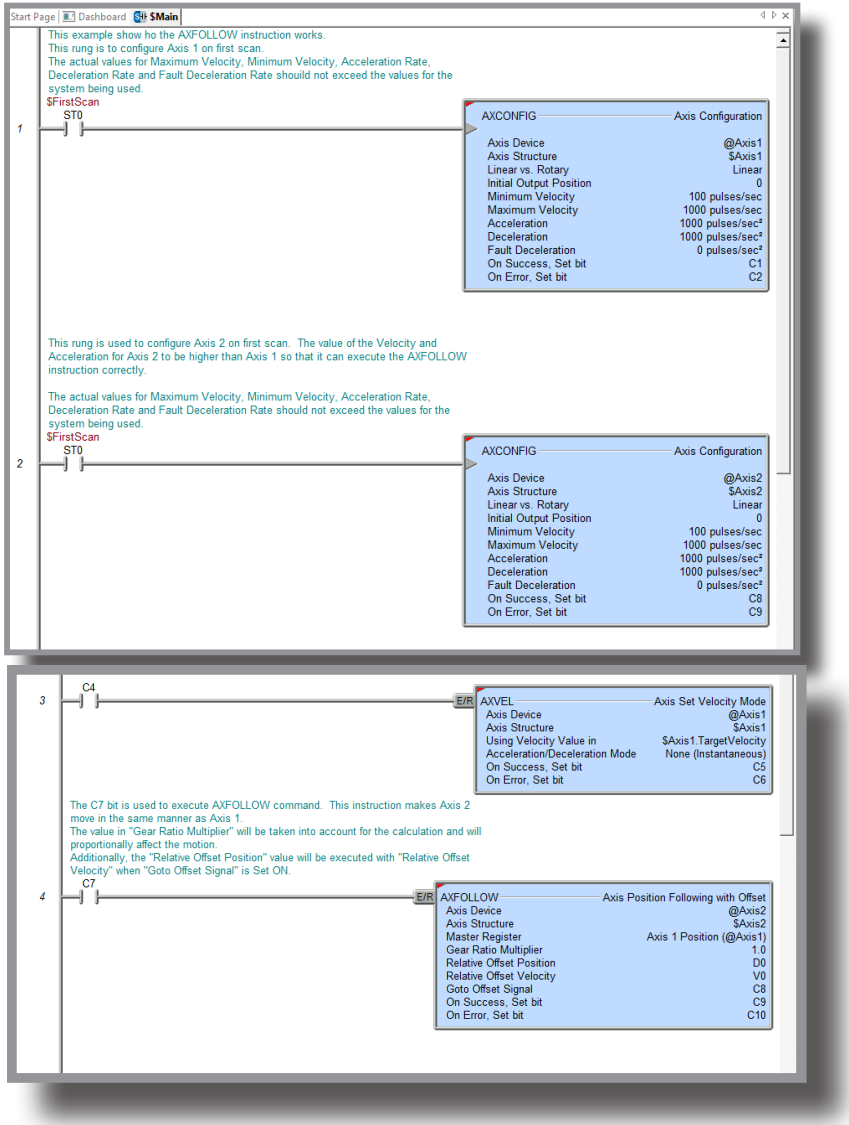
On Error:

- **Set Bit:** The bit will become FALSE when the instruction is enabled and will become TRUE if there was a problem with the parameters configured in the instruction, with the devices specified or if the AXFOLLOW move was interrupted before completion.
- **JMP to Stage:** If there was a problem with the parameters configured in the instruction, with the devices specified or the AXFOLLOW move was interrupted before completion, the PLC will jump to that stage.

AXFOLLOW, continued

Example AXFOLLOW ladder.

Rung 1 configures Axis 1 parameters. Rung 2 configures Axis 2 parameters. Rung 3 uses the AXVEL instruction to set the velocity structure. Rung 4 sets the AXFOLLOW instruction that will describe the motion of both axes.



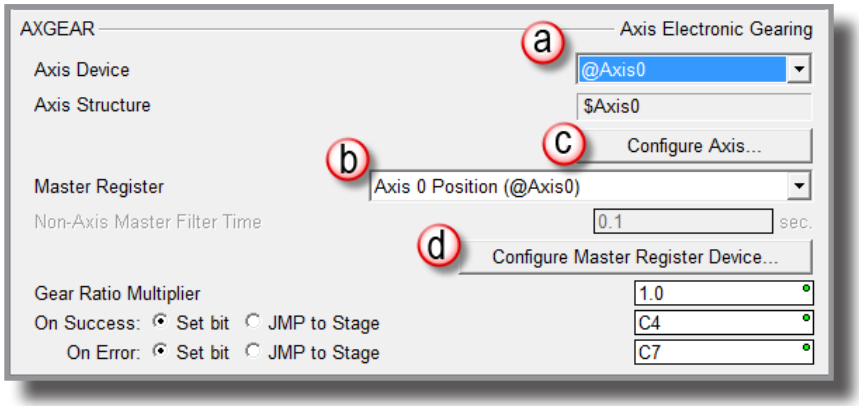
AXGEAR

The **Axis Electronic Gearing** (AXGEAR) instruction is used to create a type of Master/Slave connection that will synchronize the movement of one axis relative to another axis or a High-Speed Counter/Timer. Pulse Outputs for a given AXIS cannot be commanded until the AXCONFIG instruction has been configured and run successfully.

AXGEAR always behaves in a Position-Following mode. The Slave axis position is derived from the Master position so that any time the position of the Master Axis changes, the position of the Slave Axis will move to a position that has been modified by the user-supplied gear ratio. When the move to position operation is enabled, the AXGEAR instruction will use the current values of the Gear Ratio, the Axis Maximum Velocity, Accel, Decel and the Master's Target Position to calculate the move profile. Any changes to the Gear Ratio and Target Position will result in a trajectory change of the AXGEAR Axis.

To help keep track of the Axes movement relative to each other, any time the Axis is in Electronic Gearing mode the Slave Axis associated structure member, **.MstSlvCoordError**, will contain the difference (in pulse counts) between the Master Axis position and the Slave Axis position.

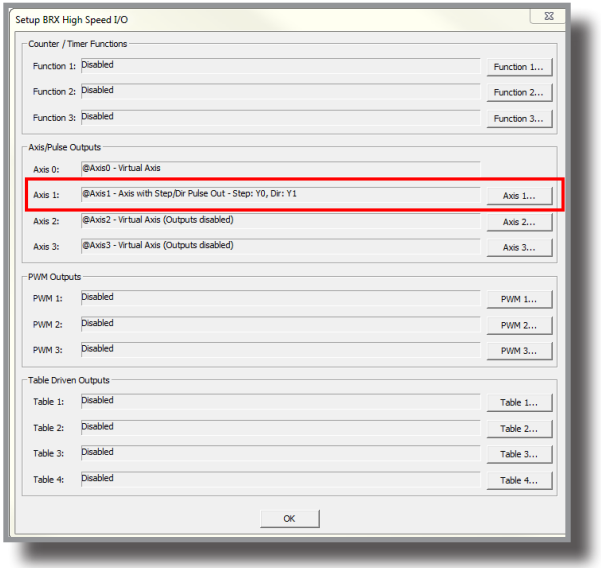
An (**a**) Axis Device (the slave axis) and either a (**b**) Master Axis, High-speed Counter or Timer must be configured before the AXGEAR instruction can be used. This is setup in the ***Setup BRX High-speed I/O*** dialog that is in the **BRX Onboard I/O** section of the System Configuration. This dialog can be opened directly in the instruction from the (**c**) **Configure Axis…** button and (**d**) **Configure Master Register Device...** button.



After the Axis has been configured (For more details, see the High-speed I/O Hardware Configuration section), the AXGEAR instruction may now be used.

AXGEAR, continued

NOTE: *Axis0 is a 'virtual axis' and will not generate pulses to physical outputs of the PLC. Axis0 can be used for generating pulse output profile register values to be used for Table Driven Outputs (TDOPRESET or TDOPLS) or as the master for other axes in following-type applications (AXCAM, AXFOLLOW or AXGEAR).*



Master Register: This is the Axis, High-Speed Counter or Timer that the Slave Axis will be electronically geared to. This can be any of the Axes or High-Speed Counter/Timers.

Non-Axis Master Filter Time: This parameter is only enabled if the Master Register is a High-Speed Counter/Timer. This value is the Filter Time Constant which specifies how often (in Seconds) the Slave's position is calculated. This can be any constant value or any numeric location.

Configure Master Register Device: This button will open the BRX High-Speed Input or Axis/Pulse Output dialog in the System Configuration.

Gear Ratio Multiplier: A multiplier that will be applied each time the Slave's position is calculated. A value of 0 will cause the Slave Axis to stop. This can be any constant value or any numeric location.

On Success:

- **Set Bit:** The bit will become FALSE when the instruction is enabled and will remain FALSE until the enable leg goes back OFF. Once the enable leg turns OFF, if the instruction's device/parameters were valid, this bit will turn ON once the .CurrentVelocity reaches 0.
- **JMP to Stage:** Similarly, the JMP will not occur until after the instruction is enabled, then disabled, and all the instruction's device/parameters were valid and the .CurrentVelocity reaches 0.

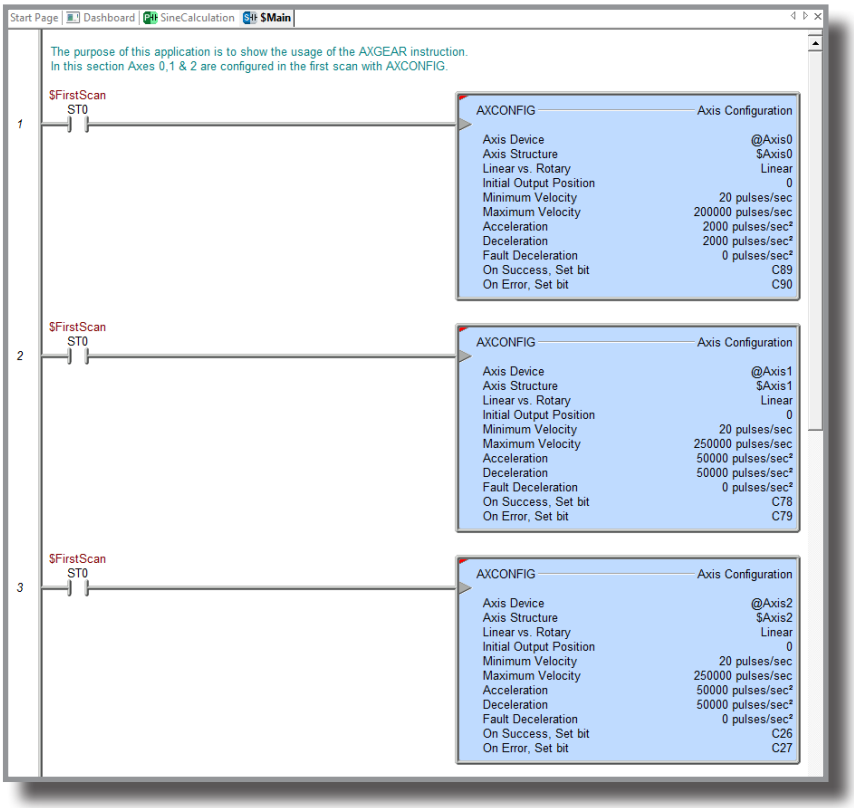
On Error:

- **Set Bit:** The bit will become FALSE when the instruction is enabled and will become TRUE if there was a problem with the parameters configured in the instruction, with the devices specified or if the AXGEAR move was interrupted before completion.
- **JMP to Stage:** If there was a problem with the parameters configured in the instruction, with the devices specified or the AXGEAR move was interrupted before completion, the PLC will jump to that stage.

AXGEAR, continued

Example AXCAM ladder.

This example demonstrates the usage of the AXGEAR instruction. Axes 0, 1& 2 are configured in the first scan with AXCONFIG.

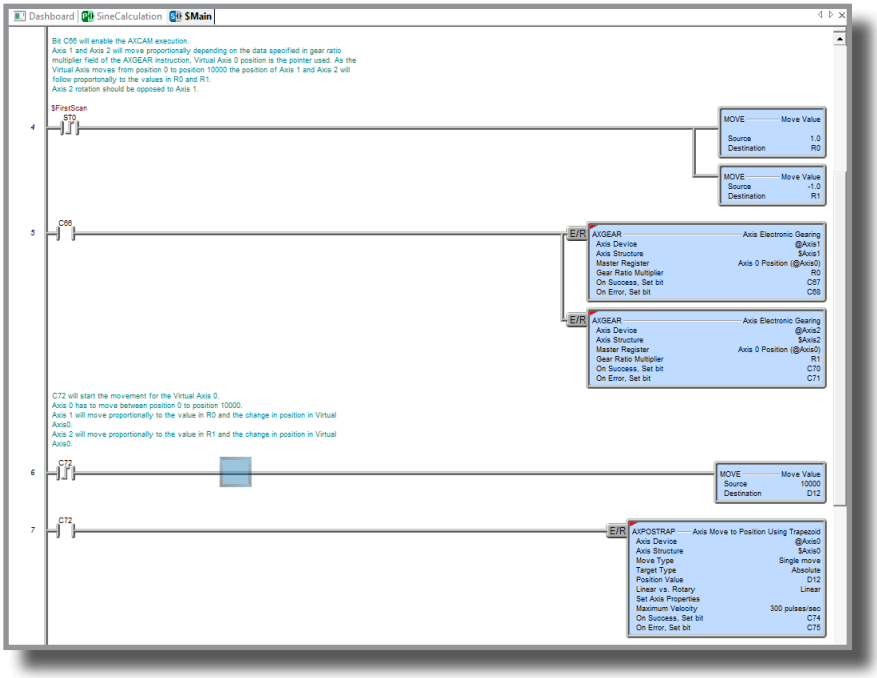


(Ladder continued on next page.)

AXGEAR, continued

In this section when C66 goes high AXCAM is executed. Axis 1 and Axis 2 will move proportionally depending on the data specified in gear ratio multiplier field of the AXGEAR instruction. Virtual Axis 0 position is the pointer used. As the Virtual Aixs 0 moves from position 0 to position 10000 the position of Axis 1 and Axis 2 will follow proportionally to the values in R0 and R1. Axis 2 rotation should be opposed to Axis 1.

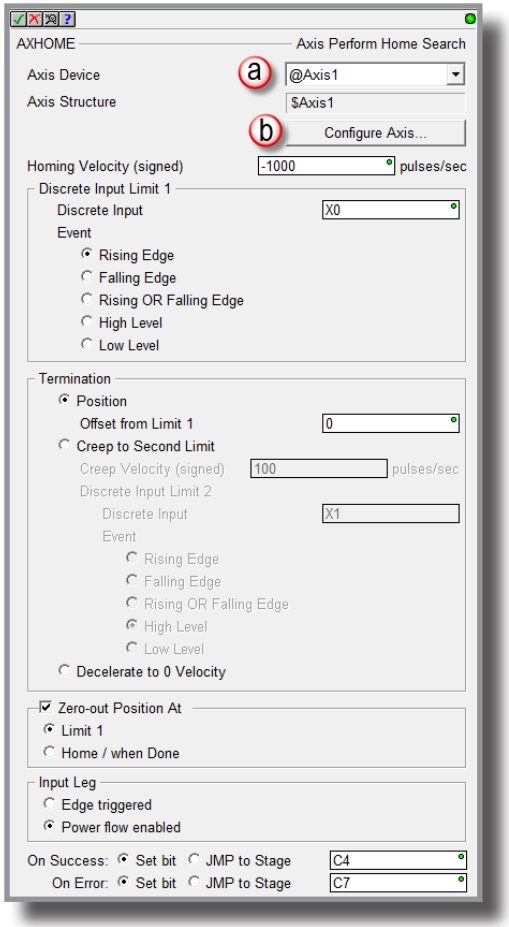
(Ladder continued from previous page.)



AXHOME

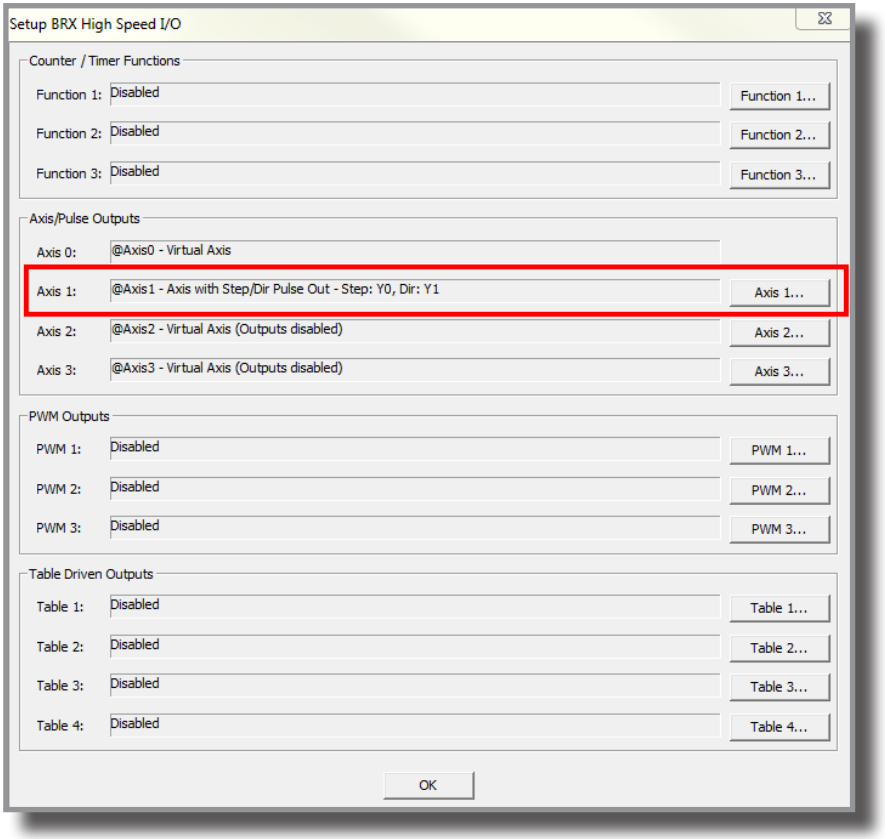
The Axis Perform Home Search (AXHOME) instruction is used to perform the necessary steps to move the specified Axis to a known starting position. Pulse Outputs for a given AXIS cannot be commanded until the AXCONFIG instruction has been configured and run successfully.

An (**a**) **Axis Device** must be configured before the AXHOME instruction can be used. This is setup in the "Setup BRX High-speed I/O" dialog that is in the "BRX Onboard I/O" section of the System Configuration. You can link directly with the (**b**) **Configure Axis…** button in the AXHOME instruction.



AXHOME, continued

After the Axis has been configured (see the High-speed I/O Hardware Configuration section for more details), the AXHOME instruction may now be used.



NOTE: Axis 0 *is a 'virtual axis' and will not generate pulses to physical outputs of the PLC. Axis0 can be used for generating pulse output profile register values to be used for Table Driven Outputs (TDOPRESET or TDOPLS) or as the master for other axes in following-type applications (AXFOLLOW or AXGEAR).*

Homing Velocity (Signed): The maximum velocity the Axis will ramp up to when moving toward Discrete Input Limit 1. The Axis will ramp up and down using the Axis current Acceleration and Deceleration settings. This can be any constant value from -250000 to -10, 0, and 10 to 250000 or any numeric location containing a value in that range. The sign of the value will indicate the direction of travel. Positive numbers will move the Axis clockwise, negative numbers will move the Axis counter-clockwise.

AXHOME, continued

Discrete Input Limit 1: The Home Search operation requires at least one discrete input.

- Discrete Input: The discrete input where the **Home** limit switch is connected. This must be one of the on-board discrete inputs.
- Event: Selects which of the following conditions will indicate the **Home** switch has been reached:

1. Rising Edge
2. Falling Edge
3. Rising OR Falling Edge
4. High Level
5. Low Level

Termination: Specifies what action to take after reaching the **Home** switch (Input Limit 1)

- **Position:** Use the Axis current positioning configuration to move the Axis to an absolute pulse count relative to the position of Discrete Input Limit 1.

  Offset from Limit 1: When **Discrete Input Limit 1** is reached, the Axis marks the position of the switch and will then move the Axis toward the specified Position.

- **Creep to Second Position:** Move the Axis to a second discrete Input Limit switch.

1. **Creep Velocity (Signed):** The maximum frequency the Axis will ramp up to when moving toward Discrete Input Limit 2. The Axis will ramp up and down using the Axis current Acceleration and Deceleration settings. This can be any constant value between -250000 to -10, 0, and 10 to 250000 or any numeric location containing a value in that range. The sign of the value will indicate the direction of travel: positive numbers will move the Axis clockwise, negative numbers will move the Axis counter-clockwise.
2. **Discrete Input Limit 2:** Use a discrete input for Limit 2. This could be a second discrete input or the same input as Discrete Input Limit 1.

   Discrete Input: The discrete input where the Discrete Input Limit 2 switch is connected. This must be one of the on-board discrete inputs.

   Event: Selects which of the following conditions will indicate the Home switch has been reached:

   - Rising Edge
   - Falling Edge
   - Rising OR Falling Edge
   - High Level
   - Low Level
3. Decelerate to 0 Velocity: The Axis will decelerate from the Homing Velocity to 0.

AXHOME, continued

Zero Position At: Enable this option to have the Axis set its Current Position to 0 after the following step of the Home Search operation:

- Limit 1: Set the Current Position to 0 when the Discrete Input Limit 1 switch is reached. Any additional movement of the Axis during the Termination phase will be reflected in the Axis Current Position value.
- Home/When Done: Set the Current Position to 0 when all phases of the Home Search operation is complete.

Input Leg: Specifies how the instruction will be enabled to run:

- Edge Triggered: Each time the input logic transitions from OFF to ON this instruction will run to completion. This selection does not allow the Home Search operation to be interrupted once it has started except by manually turning OFF the .MasterEnable for the Axis, which will put the Axis into a fault condition that must be cleared before the Axis will be permitted to move. Use the AXRSTFAULT (Reset Axis Limit Fault) instruction to clear an Axis Fault.
- Power Flow Enabled: When the Input logic transitions from OFF to ON the instruction will begin to execute and will continue executing as long as the input logic remains ON. This selection allows the Home Search operation to be interrupted by turning the input logic OFF. This is an error condition but it does not put the Axis into a Fault condition.

On Success:

- **Set Bit:** The bit will become FALSE when the instruction is enabled and will become TRUE if the parameters configured in the instruction and proper devices were specified and the Home operation completes uninterrupted.
- **JMP to Stage:** If the parameters configured in the instruction and proper devices were specified, the PLC will jump to that stage once the Home operation completes.

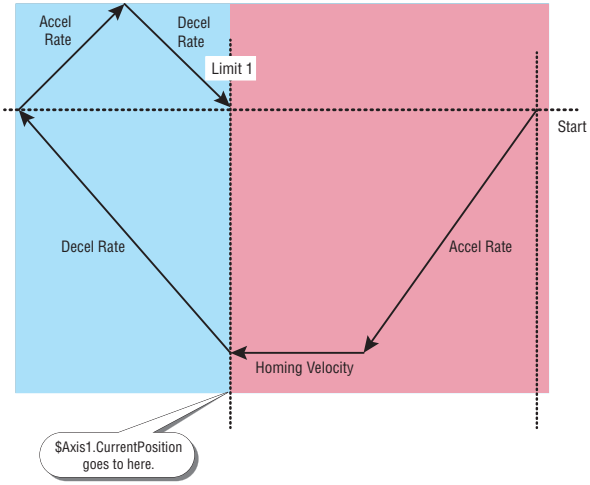
On Error:

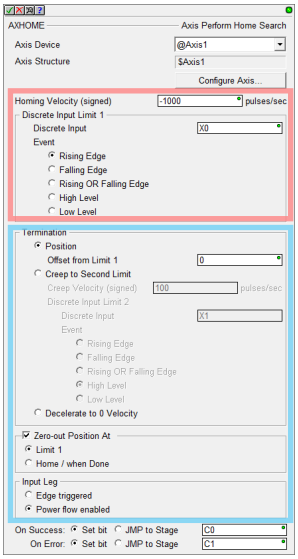
- **Set Bit:** The bit will become FALSE when the instruction is enabled and will become TRUE if there was a problem with the parameters configured in the instruction, with the devices specified or if the Home operation was interrupted before completion.
- **JMP to Stage:** If there was a problem with the parameters configured in the instruction, with the devices specified or the Home operation was interrupted before completion, the PLC will jump to that stage.

AXHOME, continued

Examples of various AXHOME configurations are considered on the following pages.

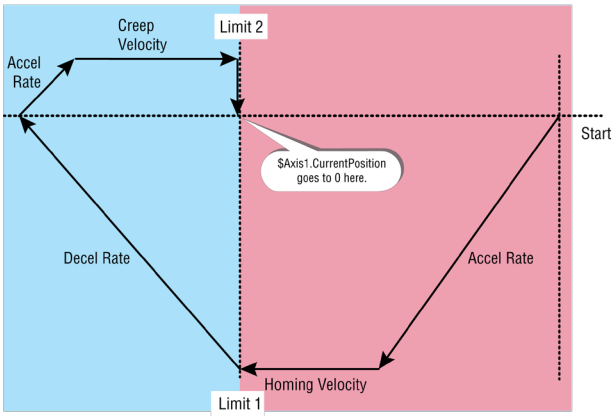
Example 1: Termination at Position of Limit 1

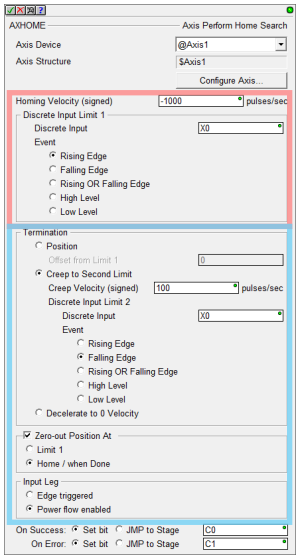




The Axis decelerates, changes direction and goes back to **$Axis.CurrentPosition** = 0 (Not looking at Limit 1 anymore).

Example 2: Termination Using Creep to Limit 2.

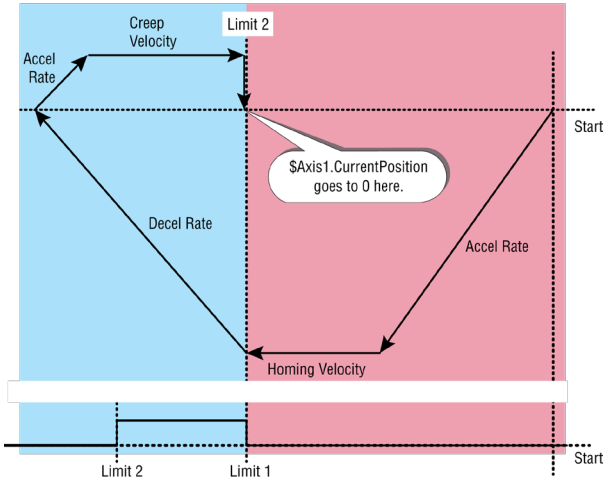


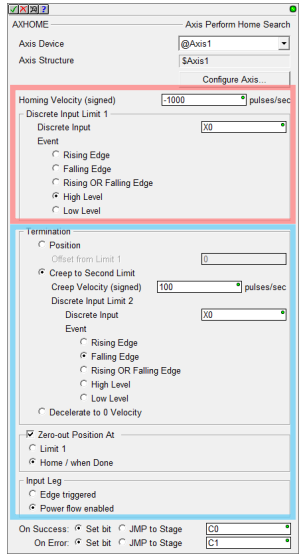


The Axis decelerates, changes direction and goes back to the falling edge of Limit 2 and the **$Axis.CurrentPosition** goes to 0 Take note that Limit 2 is the same physical switch in this situation. It could be a different one if it would make better sense for the application.

AXHOME, continued

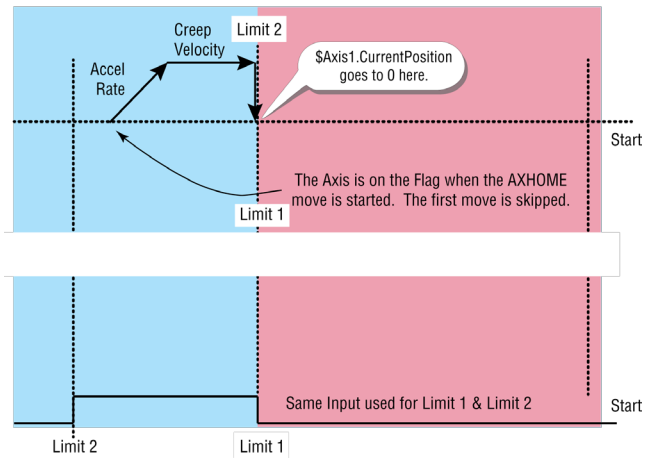
Example 3: Using Level and Edge Limits, Sharing the Same Input.

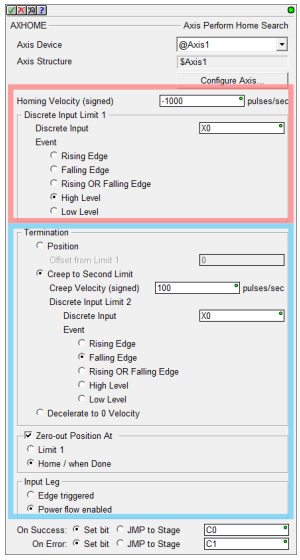




The Axis decelerates, changes direction and goes back to the Falling Edge of Limit 2 and the **$Axis.CurrentPosition** goes to 0. Take note that Limit 2 is the same physical switch in this situation. It could be a different one if it would make better sense for the application.

Example 4: Using Level and Edge Limits, Sharing the Same Input.

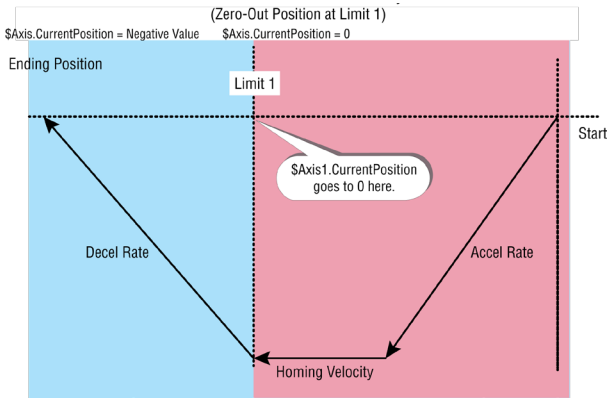


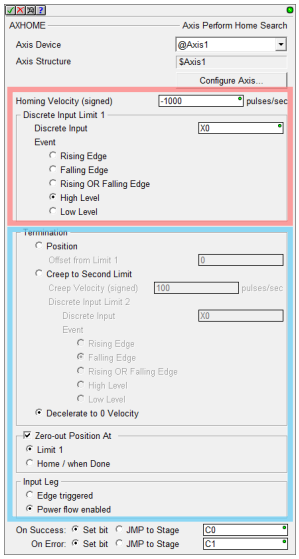


This is the same setup as the prior example but the Input for limit 1 on ON at the time of enabling the AXHOME instruction. The first movement does not occur in this case and the Axis creeps back to the Falling Edge of the switch.

AXHOME, continued

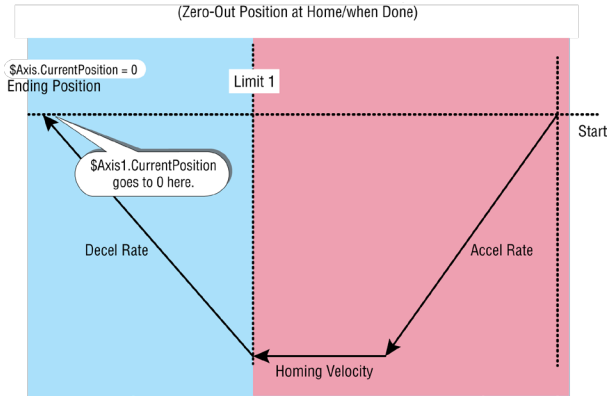
Example 5: Termination Decelerate to 0 Velocity.

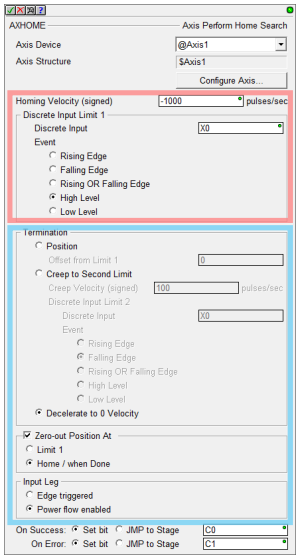




In this case, when the AXHOME operation is complete, the **$Axis1.CurrentPosition** will contain a negative value.

Example 6: Termination Decelerate to 0 Velocity.



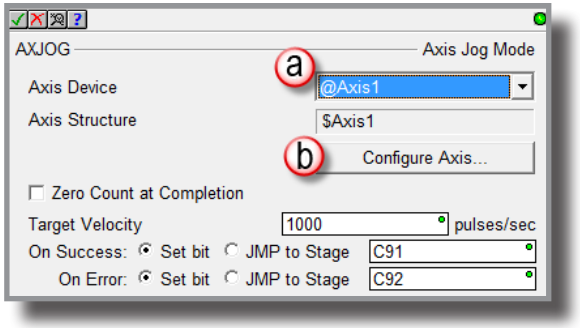


In this case, when the AXHOME operation is complete, the **$Axis1.CurrentPosition** will go to a 0 value.

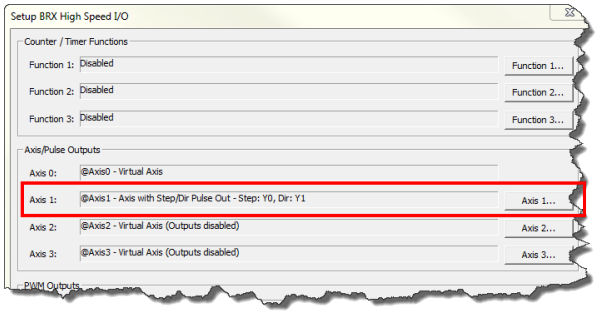
AXJOG

The Axis Jog (AXJOG) instruction sets an Axis into a mode where its position can be manually adjusted by moving the Axis in the forward or reverse direction. Jogging is a simple velocity move that uses the Acceleration and Deceleration parameters specified in the Axis Configuration to ramp up to and ramp down from the Target Velocity specified in the AXJOG instruction or the Maximum Velocity specified in the Axis Configuration, whichever is lower.

An (a) **Axis Device** must be configured before the AXJOG instruction can be used. This is done in the **Setup BRX High-speed I/O** dialog that is in the "***BRX Onboard I/O***" section of the System Configuration. You can open this dialog directly with the (b) **Configure Axis…** button.



After the Axis has been configured (below) the AXJOG instruction may now be used (See the High-speed I/O Hardware Configuration section for more details).



NOTE: *Axis0 is a 'virtual axis' and will not generate pulses to physical outputs of the PLC. Axis0 can be used for generating pulse output profile register values to be used for Table Driven Outputs (TDOPRESET or TDOPLS) or as the master for other axes in following-type applications (AXCAM, AXFOLLOW or AXGEAR).*

AXJOG, continued

Zero Count at Completion: When this option is enabled the Current Position of the Axis will be set to 0 when the Enable/Reset input transitions from ON to OFF. If this option is not enabled, the Axis will retain the contents of the Current Position after the Jog is complete.

Target Velocity: Specifies the speed that the Axis will output pulses when the Enable Leg of the AXJOG is ON and either the Forward or Reverse Leg is ON. If this value is higher than the Maximum Velocity specified in the Axis Configuration, the Axis Configuration value will be used. Forward and Reverse moves will use the Axis Configuration's Acceleration and Deceleration values when ramping up to and ramping down from the Maximum Velocity allowed.

On Success:

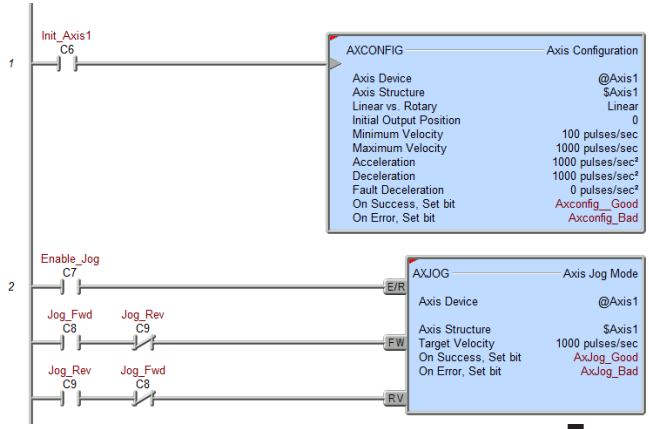
- **Set Bit:** The bit will become FALSE when the instruction is enabled and will remain FALSE until the enable leg goes back OFF. Once the enable leg turns OFF, if the instruction's device/parameters were valid, this bit will turn ON once the .CurrentVelocity reaches 0.
- **JMP to Stage:** Similarly, the JMP will not occur until after the instruction is enabled, then disabled, and all the instruction's device/parameters were valid and the .CurrentVelocity reaches 0.

On Error:

- **Set Bit:** The bit will become FALSE when the instruction is enabled and will become TRUE when proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully. The specified bit is enabled with a SET operation, not an OUT operation. The **On Error** bit will remain ON even if the instruction input logic goes OFF.
- **JMP to Stage:** when proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully, the PLC will jump to that stage.

NOTE: *Because this instruction puts the Axis into an operational mode (as opposed to performing a single operation), On Success is defined as getting the Axis into Jog mode with no errors. This means that the On Success indication will turn ON after the Enable/Reset input logic transitions from ON to OFF and the Axis' Current Velocity is at 0. When these conditions are met the Axis' Mode is "Idle". You should wait until the On Success indication turns ON before attempting to execute any other Axis instruction.*

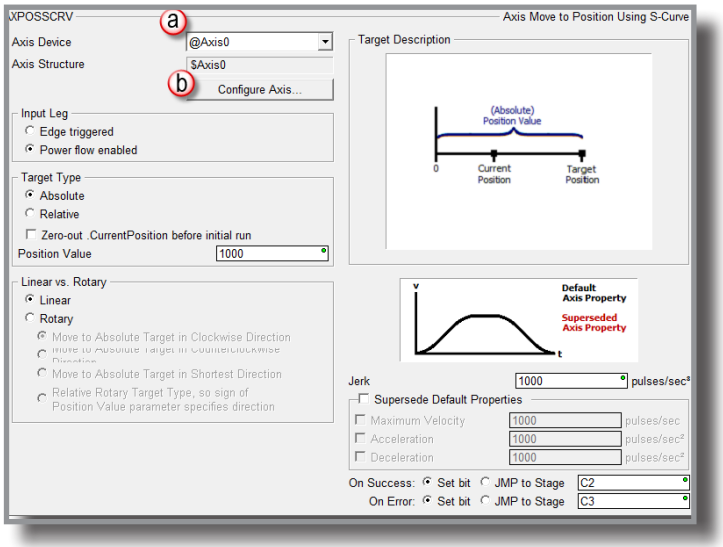
Example Ladder Logic:



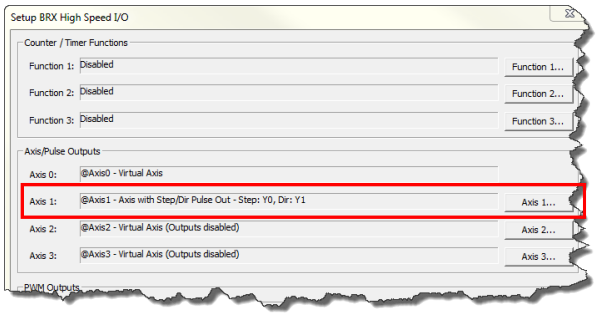
AXPOSSCRV

The Axis Move to Position Using S-Curve (AXPOSSCRV) instruction is used to move an Axis from its current position to a specified target position using the Axis configured parameters and the specified Jerk parameter which will yield an s-curve velocity profile. Pulse Outputs for a given Axis Device cannot be commanded until the AXCONFIG instruction has been configured and run successfully.

An (**a**) Axis Device must be configured befo**re the AXPOSSCRV instruction can be used. This is setup in the** Setup **BRX High-speed I/O** dialog that is in the ***BRX Onboard I/O*** section of the System Configuration. You can open this dialog directly with the (**b**) **Configure Axis…** button.



After the Axis has been configured (see the High-speed I/O Hardware Configuration section for more details), the AXPOSSCRV instruction may now be used.



NOTE: ***Axis0*** *is a 'virtual axis' and will not generate pulses to physical outputs of the PLC.* ***Axis0*** *can be used for generating pulse output profile register values to be used for Table Driven Outputs (TDOPRESET or TDOPLS) or as the Master for other axes in following-type applications (AXCAM, AXFOLLOW or AXGEAR).*

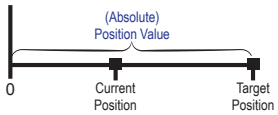
AXPOSSCRV, continued

Input Leg

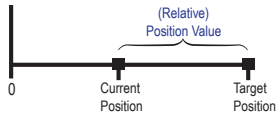
- **Edge Triggered:** The move to position operation will be performed each time the input transitions from OFF to ON. Once a move to position operation is in progress it can only be stopped by manually setting the axis .MasterEnable member to OFF, which will put the axis into a Fault state.
- **Power flow Enabled:** The move to position operation will begin when the input transitions from OFF to ON and will continue to completion as long as the input remains ON. This selection has the benefit of being able to interrupt a move to position operation by setting the input state to OFF and NOT putting the Axis into a Fault state.

Target Type

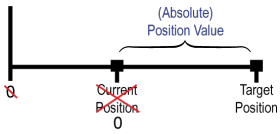
- **Absolute:** Absolute moves are measured from the axis zero position. When an axis is initialized, its current position is set to 0. An absolute move to 10000 will generate 10000 pulses to move the axis forward 10000 pulses. A subsequent absolute move to -10000 will generate 20000 pulses to move the axis backward past 0 to the -10000 position. If you execute an absolute move with a Position Value that is the same as the **Axis Current Position** the axis will not move as the absolute position is already reached.



- **Relative:** Relative moves are measured from the Axis' current position. When an axis is initialized, its current position is set to 0. A relative move to 10000 will generate 10000 pulses to move the axis forward 10000 pulses. A subsequent relative move of -10000 will generate 10000 pulses to move the axis backward to that 0 pos**ition.**



- **Zero-out Current Position Before Initial Move:** Enable this option to have the axis set its Current Position value to 0 before any move operation.
- **Position Value:** The target position (pulse count) to move the axis to. This can be any constant value, or any numeric location with a value in that range.



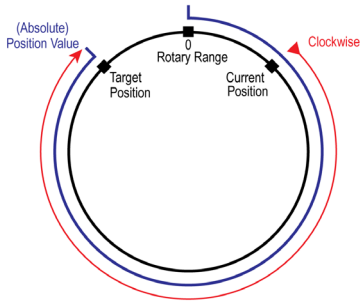
AXPOSSCRV, continued

Linear vs. Rotary

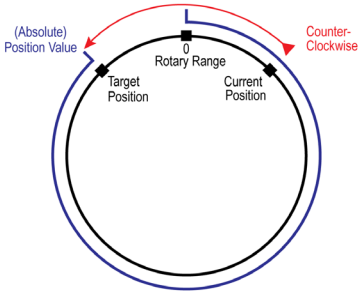
- **Linear:** The series of pulses will produce forward or backwards motion along a fixed linear path. If the Target Position value is a higher value than the Current Position value, the resulting move will be in the positive (increasing) direction. If the Target Position value is a lower value than the Current Position, the resulting move will be in the negative (decreasing) direction.

- **Rotary:** The series of pulses will produce Clockwise or CounterClockwise motion along a fixed circular path either as an absolute position value or relative position as noted in the discussion below.

Move to Absolute Target in Clockwise Direction: Taking into account the Rotary Range specified in the AXCONFIG and the Target Position Value, the PLC will always generate pulses in an increasing (positive) direction. So if the Target Position value is lower than the Current Position, the PLC will 'roll over' in the clockwise direction to achieve the position. If the Target Position Value specified exceeds the Rotary Range, the Axis will move to the modulus result. For example: If the Rotary Range is 0–359 (360 degrees) and a Target Position Value of 500 was specified, the Axis will output 140 pulses.

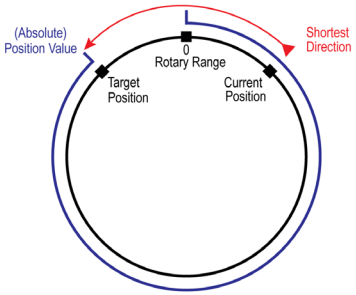


Move to Absolute Target in Counterclockwise Direction: Taking into account the Rotary Range specified in the AXCONFIG and the Target Position Value, the PLC will always generate pulses in a decreasing (negative) direction. So if the Target Position value is higher than the Current Position value, the PLC will 'roll over' in the Counter clockwise direction to achieve the position. If the Target Position Value specified exceeds the Rotary Range, the Axis will move to the modulus result. For example: If the Rotary Range is 0–359 (360 degrees) and a Target Position Value of 500 was specified, the Axis will output 220 pulses.

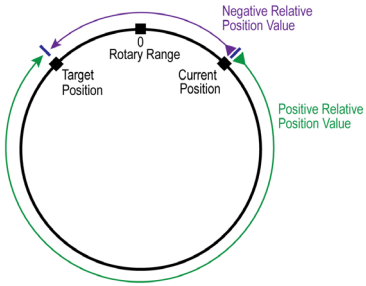


AXPOSSCRV, continued

Move to Absolute Target in Shortest Direction: Taking into account the Rotary Range specified in the AXCONFIG and the Target Position Value, the PLC will calculate the shortest distance between the Target Position Value and the Current Position value and go in either Clockwise or Counter Clockwise direction to achieve the target. If the Target Position Value specified exceeds the Rotary Range, the Axis will move to the modulus result. For example: If the Rotary Range is 0–359 (360 degrees) and a Target Position Value of 500 was specified, the Axis will output 140 pulses.



Relative Rotary Target Type, so sign of Position Value parameter specifies direction: A positive Position Value will move the Axis in a Clockwise direction and a negative Position Value will move the Axis in a Counter Clockwise direction. If the Target Position Value specified exceeds the Rotary Range, the Axis will move to the modulus result. For example: If the Rotary Range is 0–359 (360 degrees) and a Target Position Value of 500 was specified, the Axis will output 140 pulses.



Jerk: The Jerk term specifies how quickly the Axis is allowed to achieve maximum Acceleration and Deceleration on its way to reaching maximum Velocity. This value is specified in pulses/sec^3.

Supersede Default Properties: These parameters allow this AXPOSSCRV instruction to override the values specified in the AXCONFIG instruction. They only temporarily change the values in the AXCONFIG for this movement. To permanently change the parameters in the AXCONFIG, use the Set Axis Properties (AXSETPROP) instruction.

- **Maximum Velocity (pulses/sec):** The fastest frequency of output pulses that will be generated during the move to position operation. This can be any positive constant from 10 to 250000, or any numeric location with a value in that range.
- **Acceleration Rate (pulses/sec^2):** The rate at which the pulses will be generated when the axis is ramping up from a slower pulse rate to a higher pulse rate. This can be any positive constant or any numeric location with a value in that range.
- **Deceleration Rate (pulses/sec^2):** The rate at which the pulses will be generated when the axis is ramping down from a higher pulse rate to a slower pulse rate. This can be any positive constant or any numeric location with a value in that range.

AXPOSSCRV, continued

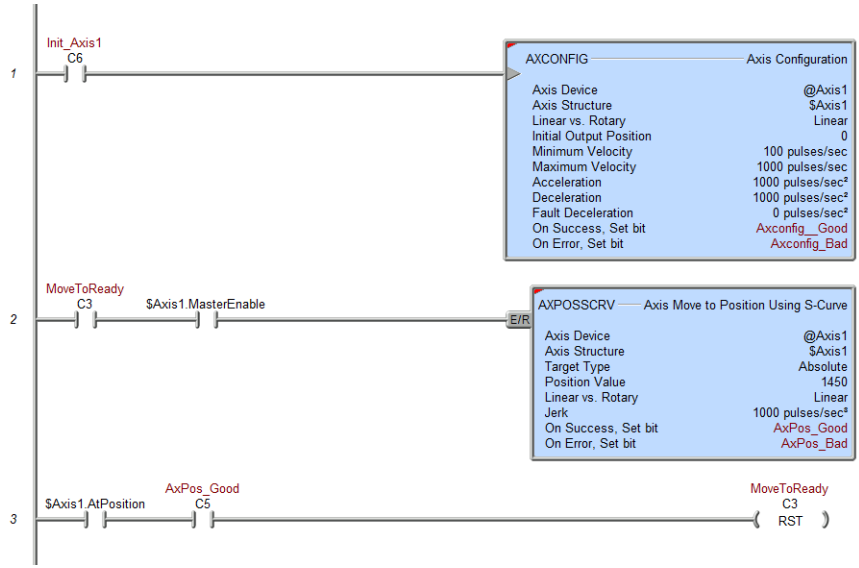
On Success:

- **Set Bit:** The bit will become FALSE when the instruction is enabled and will become TRUE when instruction parameters are properly entered and the instruction completes successfully. The specified bit is enabled with a SET operation, not an OUT operation. The On Success bit will remain ON even if the instruction input logic goes OFF.
- **JMP to Stage:** When instruction parameters are properly entered and the instruction completes successfully, the PLC will jump to that stage.

On Error:

- **Set Bit:** The bit will become FALSE when the instruction is enabled and will become TRUE when proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully. The specified bit is enabled with a SET operation, not an OUT operation. The On Error bit will remain ON even if the instruction input logic goes OFF
- **JMP to Stage:** When proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully, the PLC will jump to that stage.

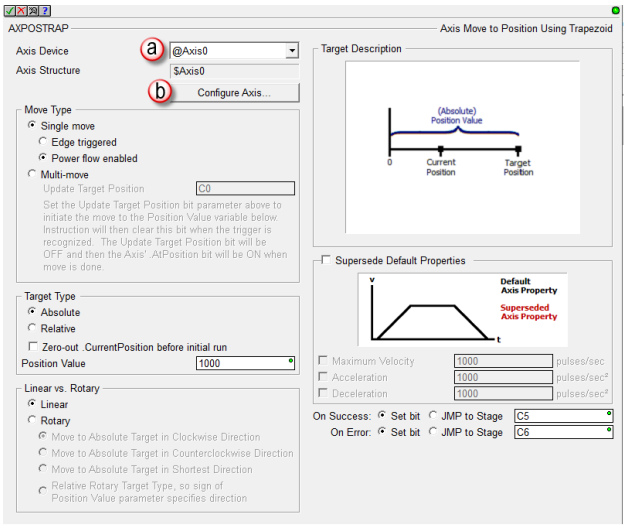
Example Usage:



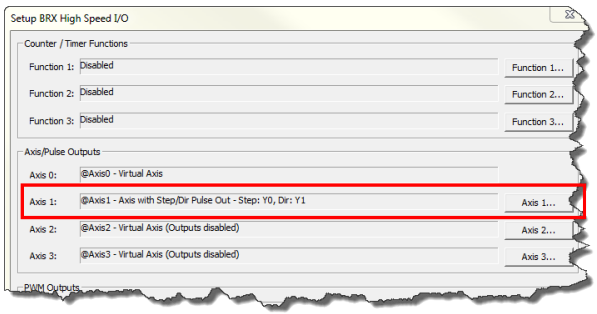
AXPOSTRAP

The Axis Move to Position Using Trapezoid (AXPOSTRAP) instruction is used to move an Axis from its current position to a specified target position using the Axis' configured parameters which will yield a trapezoid velocity profile (linear acceleration and deceleration). Pulse Outputs for a given AXIS cannot be commanded until the AXCONFIG instruction has been configured and run successfully.

An (**a**) **Axis Device** must be configured before the AXPOSTRAP instruction can be used. This is setup in the **Setup BRX High-speed I/O** dialog that is in the ***BRX Onboard I/O*** section of the System Configuration. This dialog can be opened directly in the instruction from the (**b**) **Configure Axis…**" button.



After the Axis has been configured (below), the AXPOSTRAP instruction may now be used (See the High-speed I/O Hardware Configuration section for more details).



NOTE: Axis0 is a 'virtual axis' and will not generate pulses to physical outputs of the PLC. Axis0 can be used for generating pulse output profile register values to be used for Table Driven Outputs (TDOPRESET or TDOPLS) or as the Master for other axes in following-type applications (AXCAM, AXFOLLOW or AXGEAR).

AXPOSTRAP, continued

Move Type

- **Single move:** The axis will perform 1 move to the specified position.

  Edge Triggered: The move to position operation will be performed each time the input transitions from OFF to ON. Once a move to position operation is in progress it can only be stopped by manually setting the axis .MasterEnable member to OFF, which will put the axis into a Fault state.

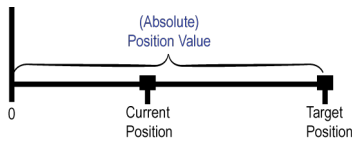
  Power flow Enabled: The move to position operation will begin when the input transitions from OFF to ON and will continue to completion as long as the input remains ON. This selection has the benefit of being able to interrupt a move to position operation by setting the input state to OFF and NOT putting the axis into a Fault state.

- **Multi-move:** The axis can perform multiple moves by changing the "Position Value" register and triggering the "Update Target Position" bit.

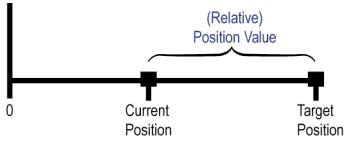
- **Trigger Target Position:** Specify an internal bit for this field. Changing this bit from OFF to ON will result in the PLC changing its Target Position (without stopping) to the value loaded into the "Position Value" register. The PLC will automatically turn the "Update Target Position" bit back OFF after changing its target position. The .AtPosition bit member of the Axis structure can be monitored to ensure completion.

Target Type

- **Absolute:** Absolute moves are measured from the axis zero position. When an axis is initialized, its current position is set to 0. An absolute move to 10000 will generate 10000 pulses to move the Axis forward 10000 pulses. A subsequent absolute move to -10000 will generate 20000 pulses to move the Axis backward past 0 to the -10000 position. If you execute an absolute move with a Position Value that is the same as the axis Current Position the axis will not move as the absolute position is already reached.



- **Relative:** Relative moves are measured from the axis current position. When an axis is initialized, its current position is set to 0. A relative move to 10000 will generate 10000 pulses to move the axis forward 10000 pulses. A subsequent relative move of -10000 will generate 10000 pulses to move the Axis backward to that 0 position.

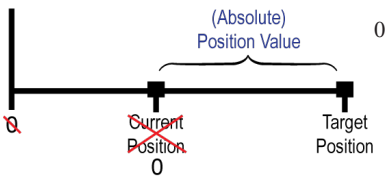


AXPOSTRAP, continued

- **Zero Current Position Before Initial Move:** Enable this option to have the Axis set its Current Position value to before any move operation.

  Single Move: Current Position is set to 0 before the move to position operation begins.

  Multi-Move: Current Position is set to 0 before the first move to position but does not happen on subsequent OFF to ON transitions of the Trigger Target Position.



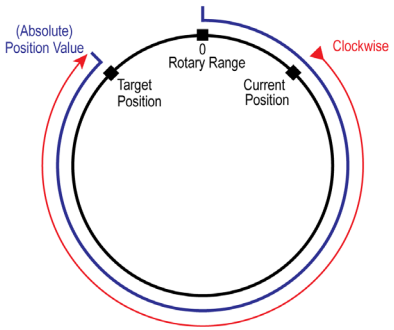
- **Position Value:** The target position (pulse count) to move the Axis to. This can be any constant value, or any numeric location with a value in that range.

Linear vs. Rotary:

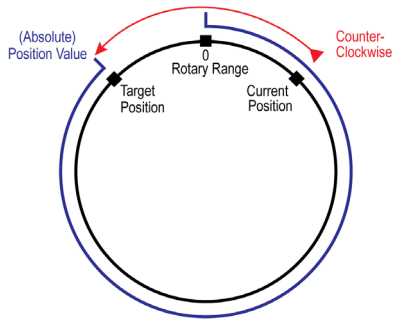
- **Linear:** The series of pulses will produce forward or backwards motion along a fixed linear path. If the Target Position value is a higher value than the Current Position value, the resulting move will be in the positive (increasing) direction. If the Target Position value is a lower value than the Current Position, the resulting move will be in the negative (decreasing) direction.

- **Rotary**

  Move to Absolute Target in Clockwise Direction: Taking into account the Rotary Range specified in the AXCONFIG and the Target Position Value, the PLC will always generate pulses in an increasing (positive) direction. So if the Target Position value is lower than the Current Position, the PLC will 'roll over' in the clockwise direction to achieve the position. If the Target Position Value specified exceeds the Rotary Range, the Axis will move to the modulus result. For example: If the Rotary Range is 0–359 (360 degrees) and a Target Position Value of 500 was specified, the Axis will output 140 pulses.

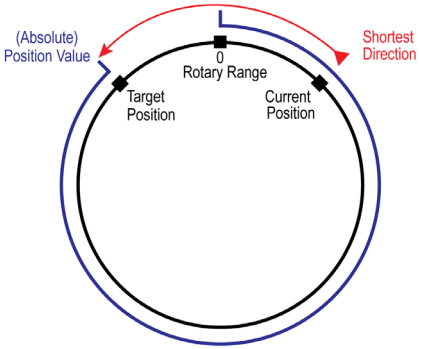


  Move to Absolute Target in Counterclockwise Direction: Taking into account the Rotary Range specified in the AXCONFIG and the Target Position Value, the PLC will always generate pulses in a decreasing (negative) direction. So if the Target Position value is higher than the Current Position value, the PLC will 'roll over' in the Counter clockwise direction to achieve the position. If the Target Position Value specified exceeds the Rotary Range, the Axis will move to the modulus result. For example: If the Rotary Range is 0–359 (360 degrees) and a Target Position Value of 500 was specified, the Axis will output 220 pulses.

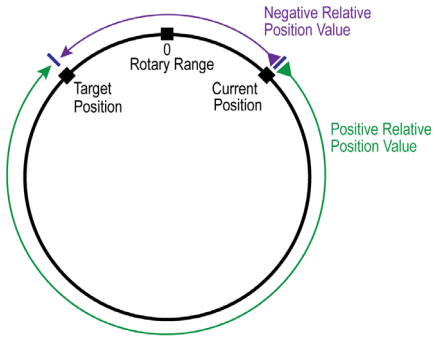


AXPOSTRAP, continued

Move to Absolute Target in Shortest Direction: Taking into account the Rotary Range specified in the AXCONFIG and the Target Position Value, the PLC will calculate the shortest distance between the Target Position Value and the Current Position value and go in either Clockwise or Counter Clockwise direction to achieve the target. If the Target Position Value specified exceeds the Rotary Range, the Axis will move to the modulus result. For example: If the Rotary Range is 0–359 (360 degrees) and a Target Position Value of 500 was specified, the Axis will output 140 pulses.



Relative Rotary Target Type, so sign of Position Value parameter specifies direction: A positive Position Value will move the Axis in a Clockwise direction and a negative Position Value will move the Axis in a Counter Clockwise direction. If the Target Position Value specified exceeds the Rotary Range, the Axis will move to the modulus result. For example: If the Rotary Range is 0–359 (360 degrees) and a Target Position Value of 500 was specified, the Axis will output 140 pulses.



12

Supersede Default Properties

Selecting these parameters allows the AXPOSTRAP instruction to override the values specified in the AXCONFIG instruction. They only temporarily change the values in the AXCONFIG for this movement. To permanently change the parameters in the AXCONFIG, use the Set Axis Properties (AXSETPROP) instruction.

- Maximum Velocity (pulses/sec): The fastest frequency of output pulses that will be generated during the move to position operation. This can be any positive constant from 10 to 250000, or any numeric location with a value in that range.
- Acceleration Rate (pulses/sec^2): The rate at which the pulses will be generated when the axis is ramping up from a slower pulse rate to a higher pulse rate. This can be any positive constant or any numeric location with a value in that range.
- Deceleration Rate (pulses/sec^2): The rate at which the pulses will be generated when the axis is ramping down from a higher pulse rate to a slower pulse rate. This can be any positive constant or any numeric location with a value in that range.

AXPOSTRAP, continued

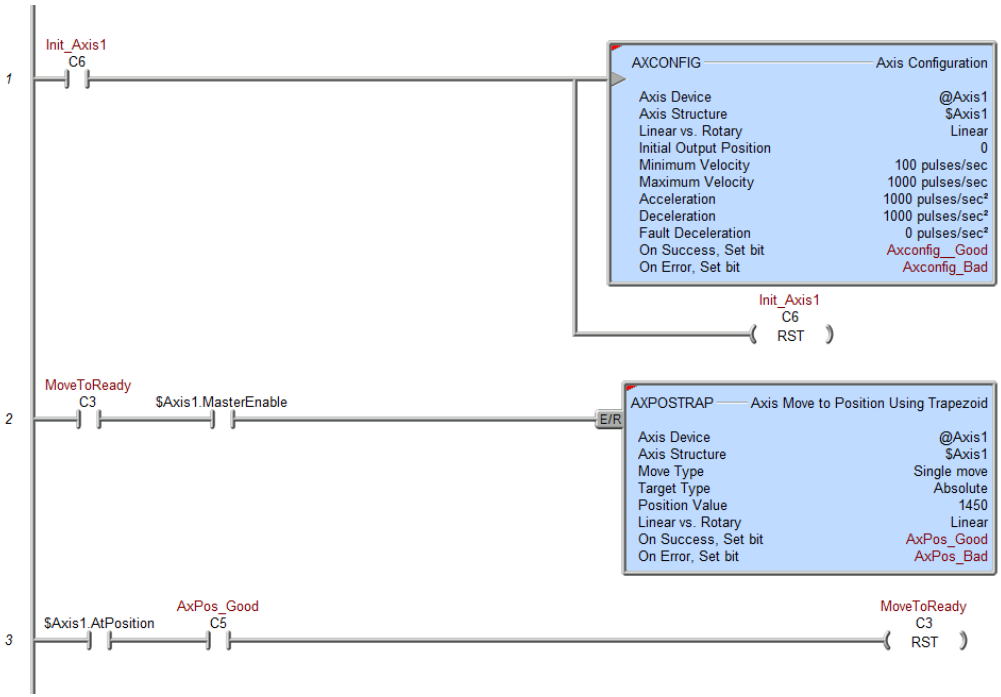
On Success:

- **Set Bit:** The bit will become FALSE when the instruction is enabled and will become TRUE when instruction parameters are properly entered and the instruction completes successfully. The specified bit is enabled with a SET operation, not an OUT operation. The On Success bit will remain ON even if the instruction input logic goes OFF.
- **JMP to Stage:** When instruction parameters are properly entered and the instruction completes successfully, the PLC will jump to that stage.

On Error:

- **Set Bit:** The bit will become FALSE when the instruction is enabled and will become TRUE when proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully. The specified bit is enabled with a SET operation, not an OUT operation. The On Error bit will remain ON even if the instruction input logic goes OFF.
- **JMP to Stage:** When proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully, the PLC will jump to that stage.

Example Usage:



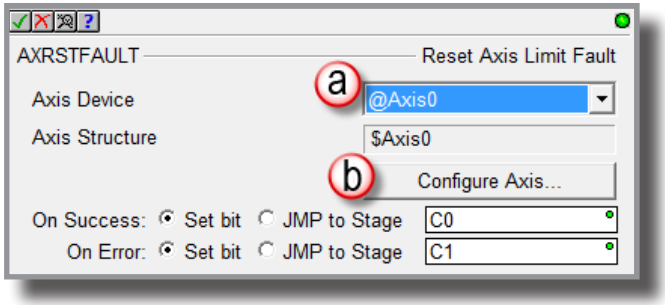
AXRSTFAULT

The Reset Axis Limit Fault (AXRSTFAULT) instruction is used to clear the fault in an axis that has either reached one of the configured Fault Limits while it was moving or has had its **.MasterEnable** manually reset.

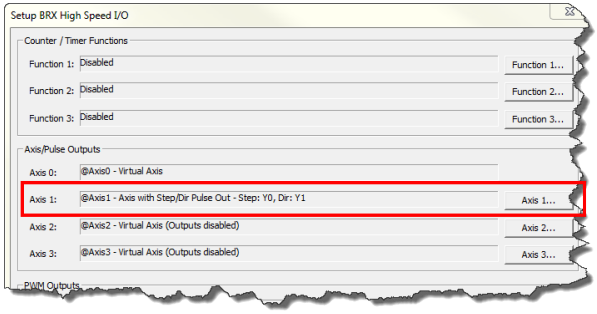
After the instruction has cleared the fault state in an axis fault, any attempt to move the Axis in the same direction that caused the fault will immediately generate another fault condition. Movement of the axis in the opposite direction that caused the fault is permitted.

The AXCONFIG (Axis Configuration) instruction will also reset an Axis that is in a fault state.

An (**a**) Axis Device must be configured before the AXRSTFAULT instruction can be used. This is setup in the **Setup BRX High-speed I/O** dialog that is in the ***BRX Onboard I/O*** section of the System Configuration. This dialog can be opened directly in the instruction from the (b) **Configure Axis…** button.



After the axis has been configured (see the High-speed I/O Hardware Configuration section for more details), the AXRSTFAULT instruction may now be used.



NOTE: *Axis0 is a 'virtual axis' and will not generate pulses to physical outputs of the PLC. Axis0 can be used for generating pulse output profile register values to be used for Table Driven Outputs (TDOPRESET or TDOPLS) or as the Master for other axes in following-type applications (AXCAM, AXFOLLOW or AXGEAR).*

AXRSTFAULT, continued

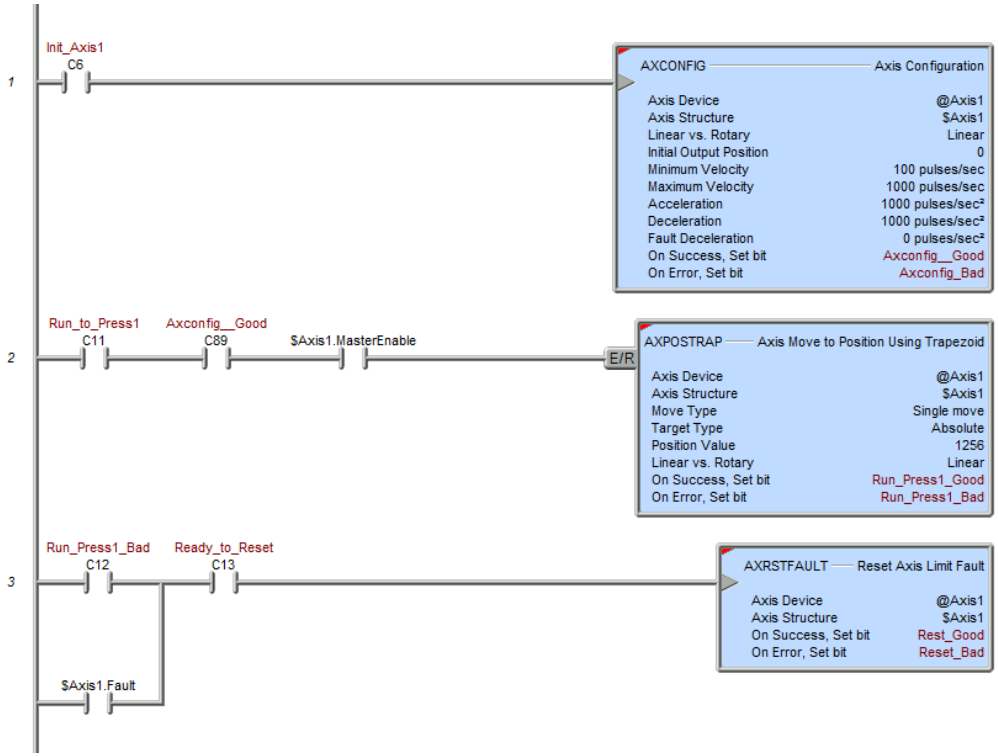
On Success:

- **Set Bit:** The bit will become FALSE when the instruction is enabled and will become TRUE when instruction parameters are properly entered and the instruction completes successfully. The specified bit is enabled with a SET operation, not an OUT operation. The On Success bit will remain ON even if the instruction input logic goes OFF.
- **JMP to Stage:** When instruction parameters are properly entered and the instruction completes successfully, the PLC will jump to that stage.

On Error:

- **Set Bit:** The bit will become FALSE when the instruction is enabled and will become TRUEwhen proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully. The specified bit is enabled with a SET operation, not an OUT operation. The On Error bit will remain ON even if the instruction input logic goes OFF.
- **JMP to Stage:** When proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully, the PLC will jump to that stage.

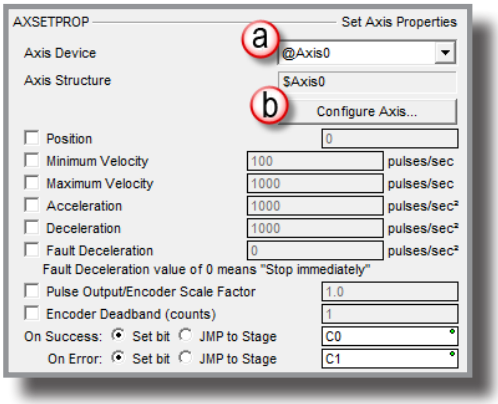
Example Usage



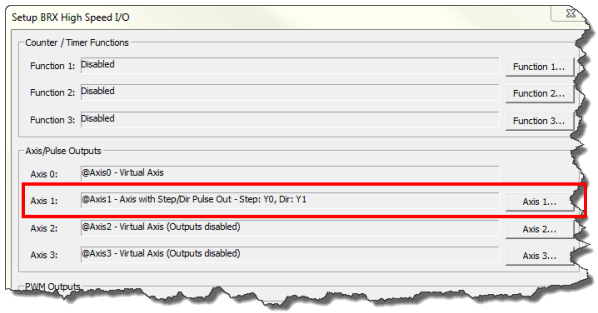
AXSETPROP

The Set Axis Properties (AXSETPROP) instruction is used to make runtime changes to the configured parameters of an Axis.

An (**a**) Axis Device must be configured before the AXSETPROP instruction can be used. This is setup in the **Setup BRX High-speed I/O** dialog that is in the ***BRX Onboard I/O*** section of the System Configuration. This dialog can be opened directly in the instruction from the (**b**) **Configure Axis…** button.



After the Axis has been configured (below) the AXSETPROP instruction may now be used (see the High-speed I/O Hardware Configuration section for more details).



NOTE: *Axis0 is a 'virtual axis' and will not generate pulses to physical outputs of the PLC. Axis0 can be used for generating pulse output profile register values to be used for Table Driven Outputs (TDOPRESET or TDOPLS) or as the master for other axes in following-type applications (AXCAM, AXFOLLOW or AXGEAR).*

AXSETPROP, continued

Position: The current count will be set to this value when this instruction is enabled. This can be any constant value or any numeric location.

Minimum Velocity (pulses/sec): The slowest frequency of output pulses that will be generated when the output is enabled. This can be any positive constant from 10 to 250000 or any numeric location with a value in that range.

Maximum Velocity (pulses per second): The fastest frequency of output pulses that will be generated when the output is enabled. This can be any positive constant from 10 to 250000 or any numeric location with a value in that range.

Acceleration Rate (pulses/sec^2): The rate at which the pulses will be generated when the axis is ramping up from a slower pulse rate to a higher pulse rate. This can be any positive constant or any numeric location with a value in that range.

Deceleration Rate (pulses/sec^2): The rate at which the pulses will be generated when the axis is ramping down from a faster pulse rate to a slower pulse rate. This can be any positive constant or any numeric location with a value in that range.

Fault Deceleration Rate (pulses/sec^2): Any time a Fault Limit is reached or the Axis .MasterEnable is turned OFF, the axis will decelerate to a velocity of 0 pulses/sec at this specified rate. A value of 0 will cause the Axis to immediately stop moving. This can be any positive constant or any numeric location with a value in that range.

Pulse Output/Encoder Scale: If the motor and the encoder have different pulse-per-revolution values, enter the scale value required to bring them into alignment.

Encoder Deadband (counts): Having some deadband value around the encoder current position can prevent the pulse output from generating alternating small pulses trying to get the input value to an exact number. This value is applied both above and below the encoder value. For example: A value of 2 will be a deadband of 2 above and 2 below for a span of 4 counts.

On Success:

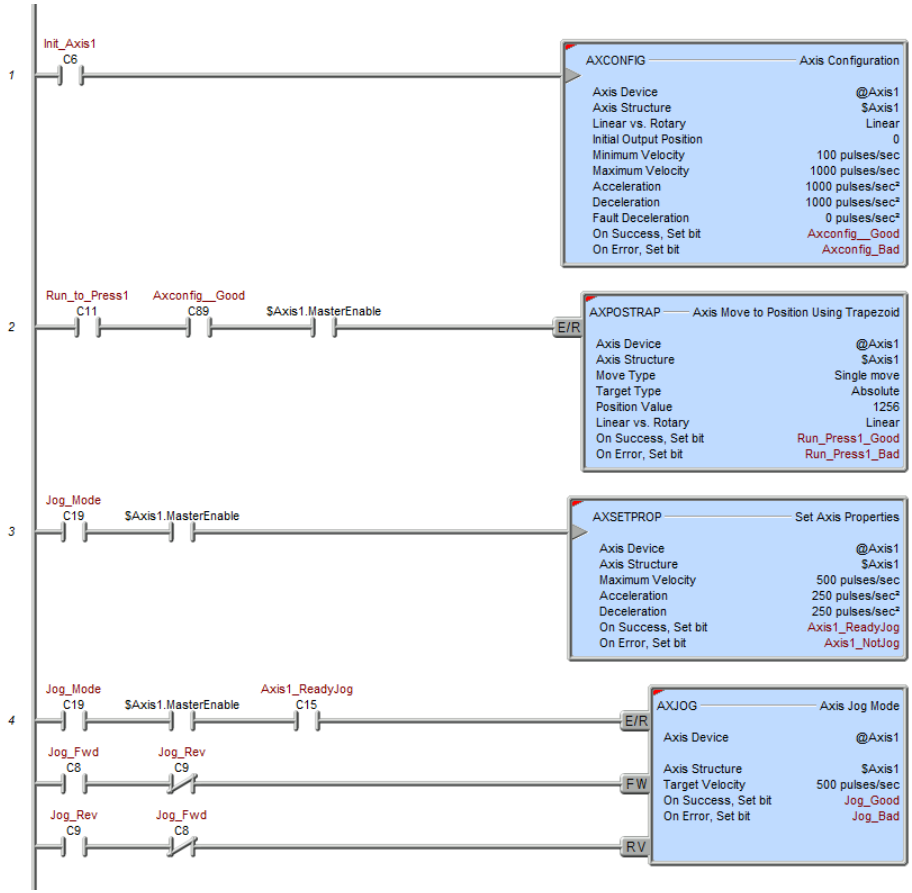
- **Set Bit:** The bit will become FALSE when the instruction is enabled and will become TRUE when instruction parameters are properly entered and the instruction completes successfully. The specified bit is enabled with a SET operation, not an OUT operation. The On Success bit will remain ON even if the instruction input logic goes OFF.
- **JMP to Stage:** When instruction parameters are properly entered and the instruction completes successfully, the PLC will jump to that stage.

On Error:

- **Set Bit:** The bit will become FALSE when the instruction is enabled and will become TRUE when proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully. The specified bit is enabled with a SET operation, not an OUT operation. The On Error bit will remain ON even if the instruction input logic goes OFF.
- **JMP to Stage:** When proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully, the PLC will jump to that stage.

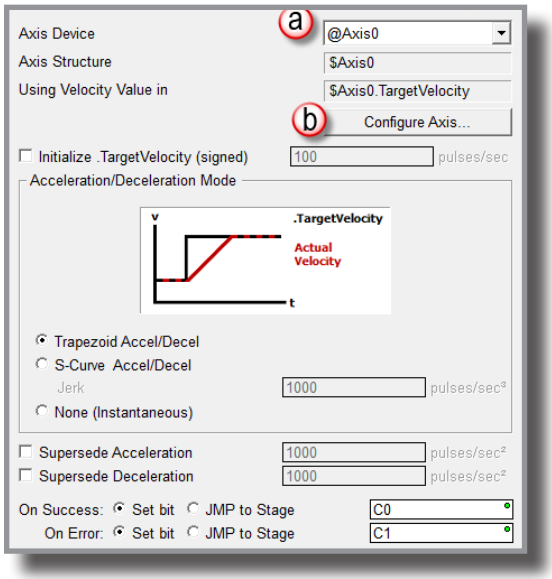
AXSETPROP, continued

Example Usage



AXVEL

The Axis Set Velocity Mode (AXVEL) instruction is used to put an axis into an operation mode where its movement is controlled by velocity rather than position. Pulse Outputs for a given axis cannot be commanded until the AXCONFIG instruction has been configured and run successfully.

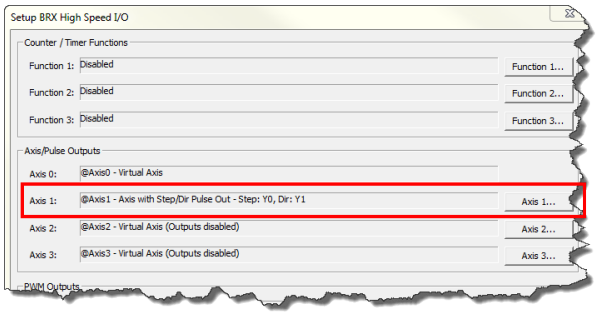


The ladder logic input to this instruction is an Enable/Reset, which means that when the Input logic turns ON the axis will ramp up to the axis structure's **.TargetVelocity** value, and when the Input logic turns OFF the axis will ramp down to a velocity of 0 and the instruction will end.

While the instruction is enabled, changing the axis associated structure member **.TargetVelocity** will dynamically change the output pulse frequency and will follow the specified Acceleration/Deceleration Mode of the instruction to achieve the speed change.

An (**a**) Axis Device must be configured before the AXVEL instruction can be used. This is setup in the **Setup BRX High-speed I/O** dialog that is in the ***BRX Onboard I/O*** section of the System Configuration. This dialog can be opened directly in the instruction from the (**b**) **Configure Axis…** button.

After the axis has been configured (below), the AXVEL instruction may now be used (See the High-speed I/O Hardware Configuration section for more details).



NOTE: *Axis0 is a 'virtual axis' and will not generate pulses to physical outputs of the PLC. Axis0 can be used for generating pulse output profile register values to be used for Table Driven Outputs (TDOPRESET or TDOPLS) or as the Master for other axes in following-type applications (AXCAM, AXFOLLOW or AXGEAR).*

AXVEL, continued

Using Velocity Value in: This field indicates the proper axis structure member to use for the desired Velocity.

Initialize .TargetVelocity (signed): Enable this option to set the velocity of the axis when this instruction is enabled. A non-zero value will cause the axis to begin moving at the specified velocity as soon as this instruction is enabled. This value can be any constant between -250000 to -10, 0, and 10 to 250000 or any numeric location containing a value in that range. The sign of the value will indicate the direction of travel: positive numbers will cause the axis to move clockwise, negative numbers will cause the axis to move counter-clockwise. Any value that is below the axis **Configured Minimum Velocity** will result in the **Axis Minimum Velocity** being used.

Acceleration/Deceleration Mode:

Specifies what level of Acceleration / Deceleration to use when the axis is changing to a new Target Velocity. The graphic will change with the selection to display what the velocity curve will look like for that selection.

- **Trapezoid Accel / Decel:** The axis will ramp from the Current Velocity to the new Target Velocity value using the axis currently configured Acceleration and Deceleration values which results in a trapezoid velocity path.
- **S-Curve Accel / Decel:** The axis will ramp from the Current Velocity to the new Target Velocity value using the axis currently configured Acceleration and Deceleration values in addition to the following Jerk parameter which results in an s-curve velocity path.
- **Apply Jerk to Accel / Decel (pulses / sec^3):** This selection is only available for S-Curve Accel / Decel. Whereas the Acceleration and Deceleration values specify how quickly the Axis is allowed to reach maximum velocity, the Jerk parameter specifies how quickly the Axis is allowed to achieve maximum Acceleration and Deceleration. This can be any positive constant greater than 0 or any numeric location with a value in that range.
- **None (Instantaneous):** The axis will immediately begin moving at the specified Target Velocity value; there is no ramp up or ramp down to the new velocity.

Supersede Acceleration Rate (pulses/sec^2): When the axis is ramping up from a slower velocity to a higher velocity use the specified rate instead of the axis configured acceleration rate. This can be any positive constant or any numeric location with a value in that range.

Supersede Deceleration Rate (pulses/sec^2): When the axis is ramping down from a faster velocity to a slower velocity use the specified rate instead of the axis configured deceleration rate. This can be any positive constant or any numeric location with a value in that range.

On Success:

- **Set Bit:** The bit will become FALSE when the instruction is enabled and will remain FALSE until the enable leg goes back OFF. Once the enable leg turns OFF, if the instruction device/parameters were valid, this bit will turn ON once the .CurrentVelocity reaches 0.
- **JMP to Stage:** Similarly, the JMP will not occur until after the instruction is enabled, then disabled, and all the instruction device/parameters were valid and the .CurrentVelocity reaches 0.

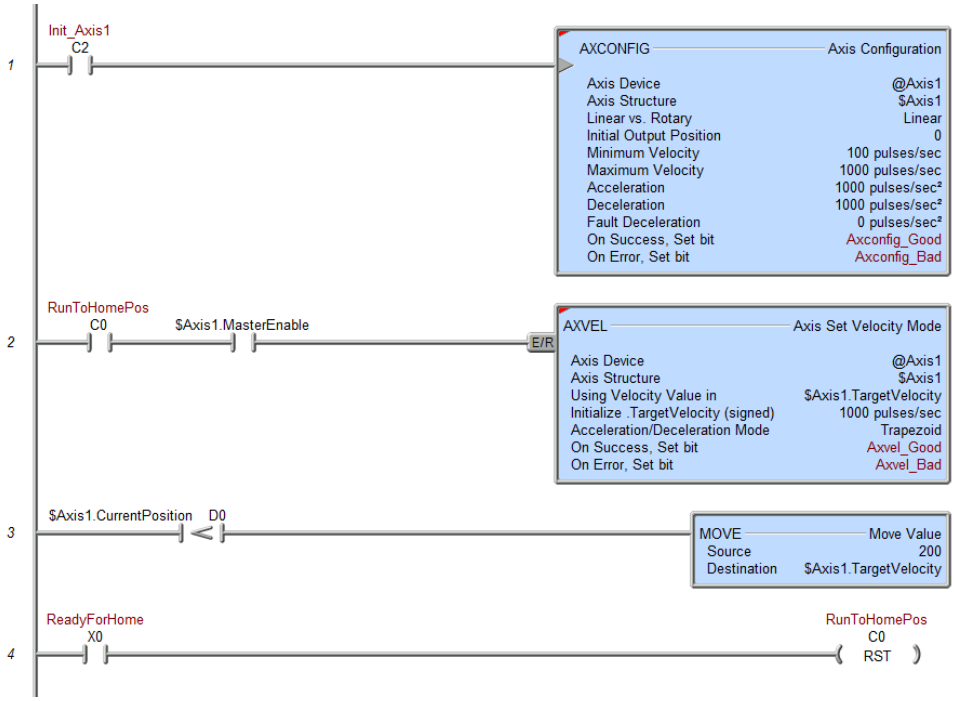
AXVEL, continued

On Error:

- **Set Bit:** The bit will become FALSE when the instruction is enabled and will become TRUE when proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully. The specified bit is enabled with a SET operation, not an OUT operation. The On Error bit will remain ON even if the instruction input logic goes OFF.
- **JMP to Stage:** When proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully, the PLC will jump to that stage.

NOTE: *Because this instruction puts the Axis into an operational model (as opposed to performing a single operation), On Success is defined as getting the Axis into Velocity mode with no errors. This means that the On Success indication will turn ON after the Enable/Reset input logic transitions from ON to OFF and the Axis' Current Velocity is at 0. When these conditions are met the Axis' Mode is "Idle". You should wait until the On Success indication turns ON before attempting to execute any other Axis instruction.*

Example Usage

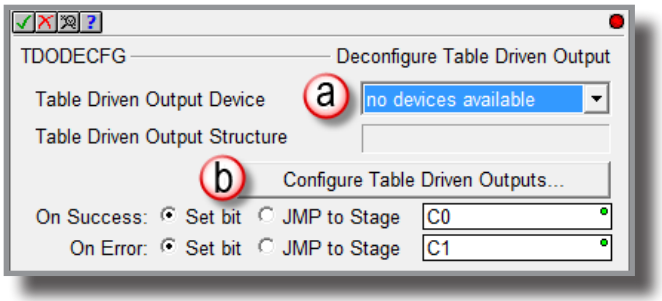


TDODECFG

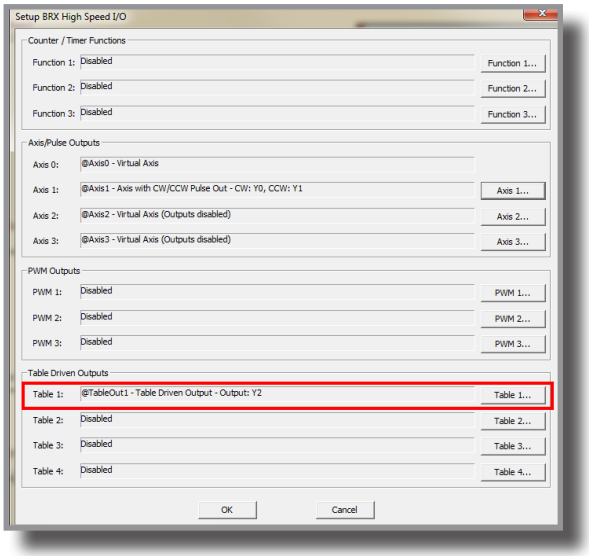
Once a TDOPLS-Load Programmable Limit Switch Table for Table Driven Output or TDOPRESET-Load Preset Table for Table Driven Output has been enabled it will continue to control that output even if the input logic is no longer ON. Use the Deconfigure Table Driven Output (TDODECFG) instruction to stop the Preset Table or PLS table from controlling the Table Driven Output.

This instruction is useful for situations when the application may require changing control of the Table Driven Output from one instruction, such as a TDOPRESET, to another.

There is one item that must be configured externally to the instruction in order to use the TDODECFG function: (**a**)Table Driven Output Device. This item is setup in the **Setup BRX High-speed I/O** dialog that is in the ***BRX Onboard I/O*** section of the System Configuration. This dialog can be opened directly in the instruction from the (**b**) **Configure Table Driven Outputs…**" button.



After the Table Driven Output has been configured (below), the TDODECFG instruction may now be used (see the High-speed I/O Hardware Configuration section for more details).



TDODECFG, continued

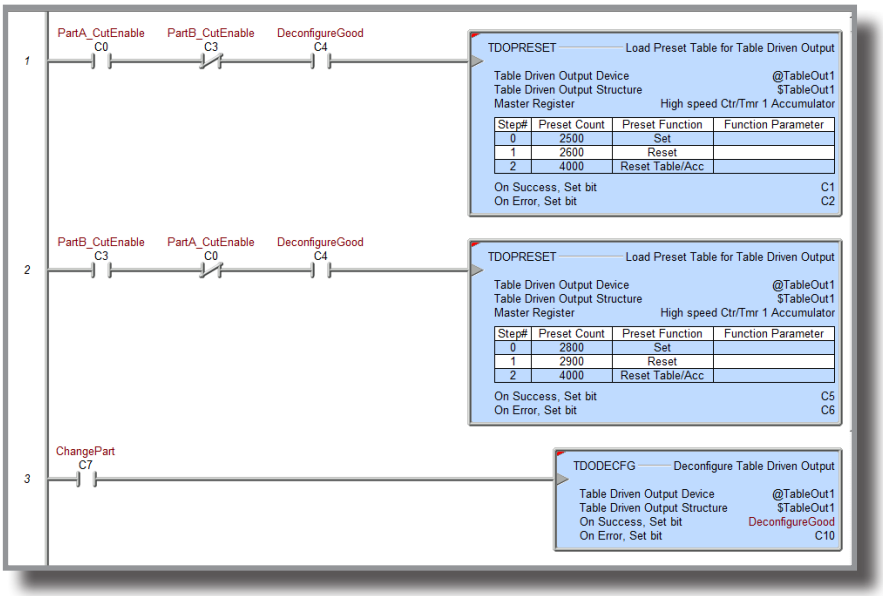
On Success:

- **Set Bit:** The bit will become FALSE when the instruction is enabled and will become TRUE when instruction parameters are properly entered and the instruction completes successfully. The specified bit is enabled with a SET operation, not an OUT operation. The On Success bit will remain ON even if the instruction input logic goes OFF.
- **JMP to Stage:** When instruction parameters are properly entered and the instruction completes successfully, the PLC will jump to that stage.

On Error:

- **Set Bit:** The bit will become FALSE when the instruction is enabled and will become TRUE when proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully. The specified bit is enabled with a SET operation, not an OUT operation. The On Error bit will remain ON even if the instruction input logic goes OFF..
- **JMP to Stage:** When proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully, the PLC will jump to that stage.

Example Usage

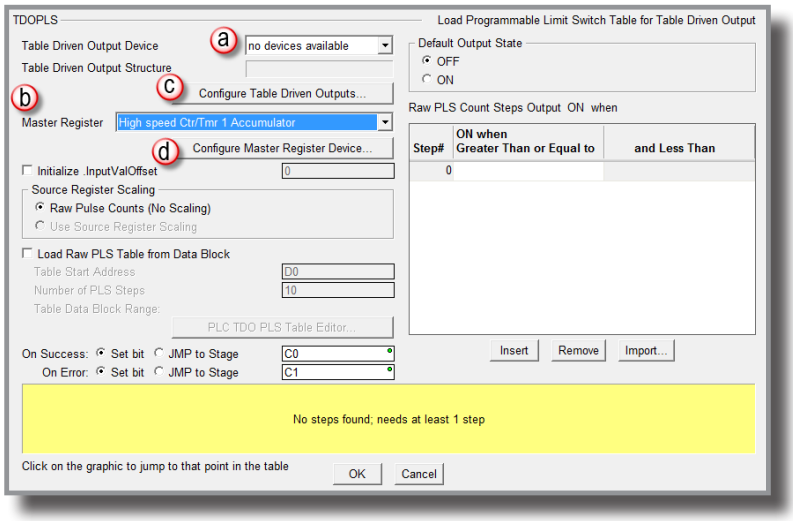


TDOPLS

A Load Programmable Limit Switch Table for Table Driven Output (TDOPLS) contains a table with a series of start and stop positions similar to the cams on a shaft. These cam positions are compared to the current count value of the specified Master Register, which can be a High-speed Counter, Timer or AXIS Current position value. When the count value falls between any of the positions in the table, the discrete output that is specified is turned ON or OFF according to the table configuration. Each table can have up to 64 cam positions. Each PLS table compares the count value of one Master Register counter and can drive one High-speed I/O discrete output.

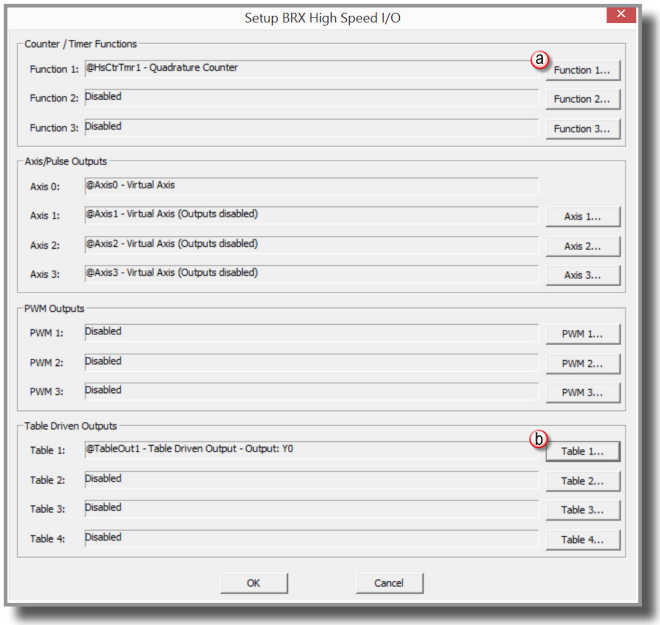
Once a PLS table has been enabled for a Table Driven Output it will continue to control that output even if the input logic is no longer ON. Use the De-configure Table Driven Output (TDODECFG) instruction to stop the PLS table from controlling the Table Driven Output.

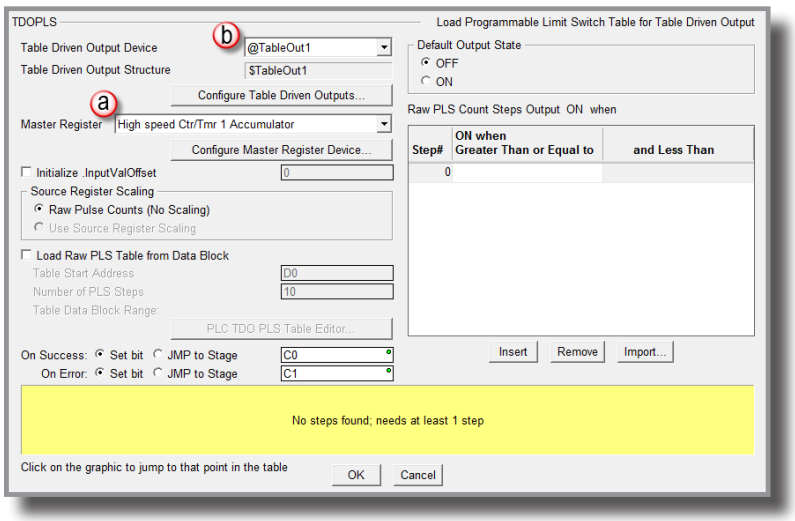
There are two items that must be configured externally to the instruction in order to use the PLS feature: (**a**) a Table Driven Output Device and (**b**) a Master Register. Both of these items are setup in the **Setup BRX High-speed I/O** dialog that is in the ***BRX Onboard I/O*** section of the System Configuration. This dialog can be opened directly in the instruction from the (**c**) **Configure Table Driven Outputs…** and (**d**) **Configure Master Register Device…** buttons.



TDOPLS, continued

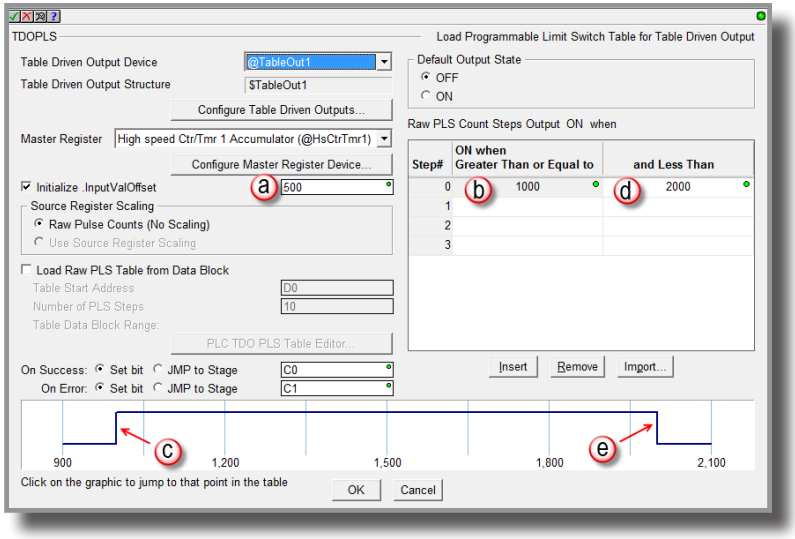
Refer to both graphics below. After the (**b**) Table Driven Output Device and (**a**) Master Register Device have been configured (see the High-speed I/O Hardware Configuration section for more details), the TDOPLS instruction may now be used.





TDOPLS, continued

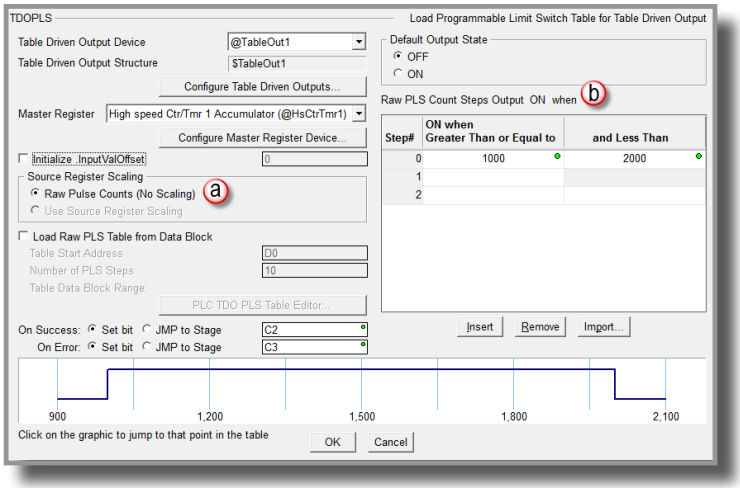
Initialize **.InputValOffset:** A positive value in this field (**a**) means that the entries will act at a lower value than shown. A negative value means that the entries will act at a higher value than shown. For example: An offset of 500 is configured in the .InputValOffset field (**a**). The first entry (**b, c**) is configured to turn ON the output at 1000 and (**d, e**) turn OFF at 2000. When the table runs, the output will actually turn ON at a value of 500 and turn OFF at 1500. If the .InputValOffset was configured for -500, the first output would have turned ON at a value of 1500 and OFF at 2500.



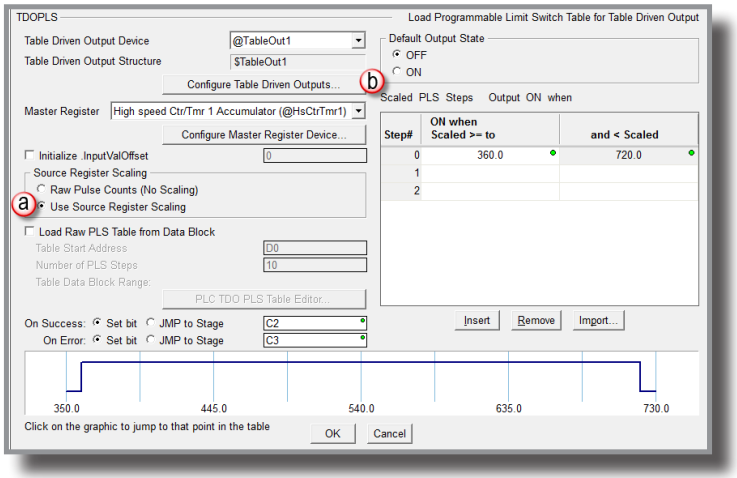
TDOPLS, continued

Source Register Scaling: The TDOPLS instruction can use the raw count value from the specified Master Register or, if scaling was enabled in the ***High-speed I/O*** setup, the scaled value to do its comparisons.

- **Raw Pulse Counts (No Scaling)** – Select this option to enter the Preset Count values in the Table as raw count values. The image below shows (**a**) **Raw Pulse Counts (No Scaling** selected, indicating the Master Register scaling was not enabled. The (**b**) table entry shows that the values entered are based on raw counts.



- **Use Source Register Scaling** – If the Master Register has been configured to scale the current count value you can use the scaled values in the table by selecting this option and entering values that are scaled the same as the Master Register. The image below shows (**a**) Use Source Register Scaling selected, indicating the Master Register scaling was enabled. The (**b**) table entry shows that the entries are based on the scaled values.



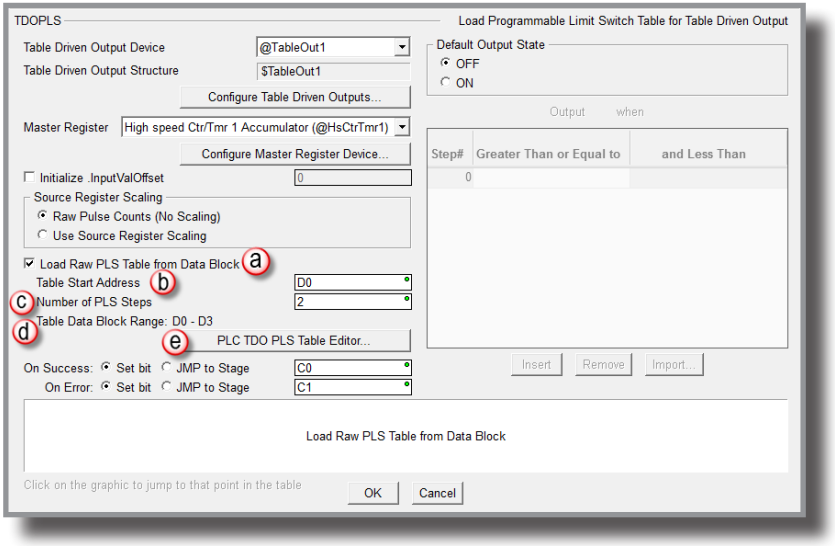
TDOPLS, continued

Load Raw PLS Table from Data Block (a): When enabled, the values used by the PLS Table come from the values stored in the specified memory range. This allows for more dynamic control of the PLS function.

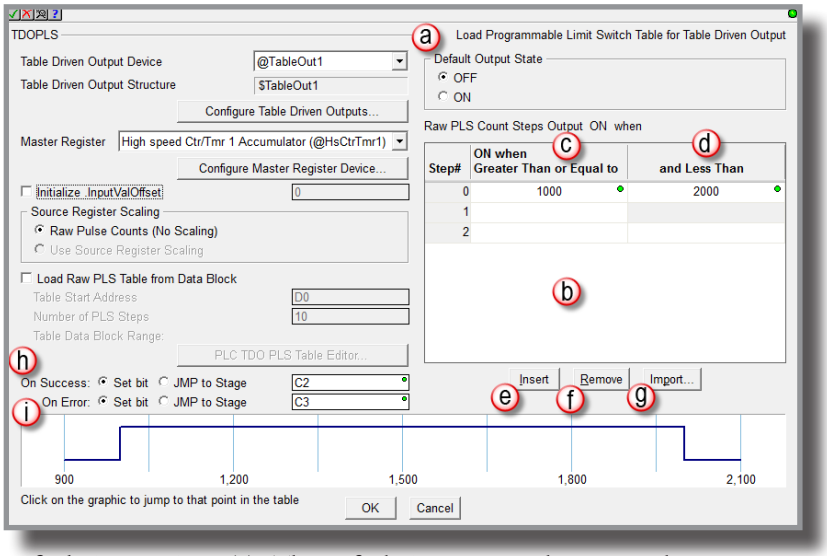
- **Table Start Address (b):** The beginning address in PLC memory where the PLS table data is stored.
- **Number of PLS Steps (c):** The number of steps in the PLS table that are stored in PLC memory. A PLS Table can have up to 64 steps.
- **Table Data Block Range (d):** Using the two values above, this shows the range of PLC memory that will be used as the PLS data table. With a starting address of D0 and a total of 2 steps, the memory range is D0 to D3.

NOTE: *The PLC TDO PLS Table Editor button is available only when the Do-more! Designer software is connected and Online with the BRX CPU.*

- **PLC TDO PLS Table Editor button (e):** Click this to open the **PLS Table Editor**. The editor allows you to edit the data values in the specified Data Block. The data configuration options on this dialog (Default Output State, value for "Greater Than or Equal", value for "Less Than") are the same as the main dialog. Detailed information of the PLC TDO PLS Table Editor dialog screen is discussed later in this section.



TDOPLS, continued



Default Output State (a): The Default Output state determines the starting state of the Output when the PLS instruction is enabled and the state that the Output is in when the count is NOT within the Entry comparisons. If the Default Output State is OFF, the Output will be ON when the count is within the Entry comparison values. If the Default Output State is ON, the Output will be OFF when the count is within the Entry comparison values.

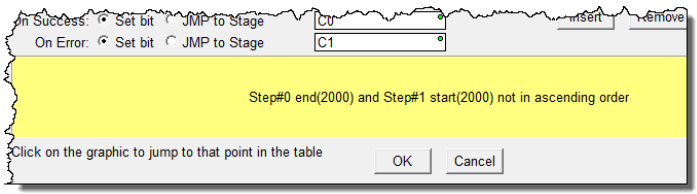
Raw (or Scaled) PLS Count Steps Output ON when (b): A table of entries that determines the Output state when the TDOPLS is running.

- The entries in the table (**b**) can be constants or variables. If variables are used, the instruction must be disabled and re-enabled after the variable value has been changed. The values in the entry table cannot be overlapping.
- The values must be increasing with the Entry numbers. In other words, the values in (**c**) **And Less Than** must be larger than the value in (**d**) **Greater Than or Equal to**.

  Output On/Off when Greater Than or Equal to: The value that represents the lower edge of the cam position. This can be any value between -2,147,483,648 and 2,147,483,647.

  And Less Than: The value that represents the upper edge of the cam position. This can be any value between -2,147,483,648 and 2,147,483,647.

If invalid entry values are used when specifying constant values, the Do-more! Designer programming software will indicate an error (below) and not allow the instruction configuration to be completed.



TDOPLS, continued

If variables are used and invalid entry values are specified, the "On Error" state will become true (**Set Bit** or **JMP to Stage**).

If the Scaling was configured for the Master Register counter and the **Use Source Register Scaling** option was specified, the entry values will be the scaled values and no conversion will be necessary.

Insert (**e**): Add an empty Step above the currently highlighted Step in the table.

Remove (**f**): Delete the currently highlighted Step from the table.

Import (**g**): Import the contents of the PLS Table from a CSV file. The format of the import file is two numbers per line, separated by a comma or whitespace, all numbers must be in ascending order, and a maximum of 64 lines. Please review CSV file formatting information later in this TDOPLS instruction section, under the section explaining the PLC TDO PLS Table Editor dialog.

On Success (**h**):

- **Set Bit:** The bit will become FALSE when the instruction is enabled and will become TRUE when instruction parameters are properly entered and the instruction completes successfully. The specified bit is enabled with a SET operation, not an OUT operation. The On Success bit will remain ON even if the instruction input logic goes OFF.
- **JMP to Stage:** If the parameters configured in the instruction and proper devices were specified, the PLC will jump to that stage.

On Error (**i**):

- **Set Bit:** The bit will become FALSE when the instruction is enabled and will become TRUE if there was a problem with the parameters configured in the instruction or with the devices specified.
- **JMP to Stage:** If there was a problem with the parameters configured in the instruction or with the devices specified, the PLC will jump to that stage.

TDOPLS, continued

PLC TDO PLS Table Editor: Allows you to edit the data values in the specified Data Block. The data configuration options on this dialog (Default Output State, value for "Greater Than or Equal", value for "Less Than") are the same as the main dialog.

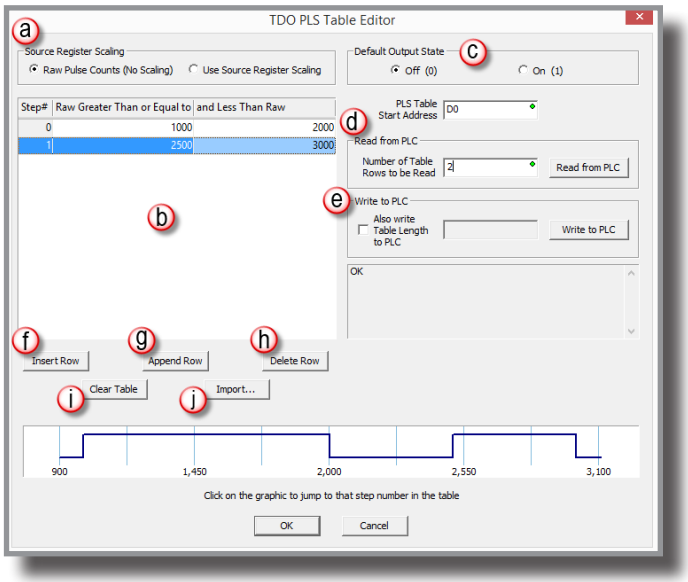
NOTE: *Initial values for Default Output State, PLS Table Start Address, and Number of PLS Entries come from the main instruction editor. If these values are changed while editing the table data with this dialog those values will be updated on the main instruction editor when this dialog is closed.*

NOTE: *If the PLC TDO PLS Table Editor dialog is opened when the Number of PLS Entries is a variable (memory address), the value in that location is read and the data in that number of rows will be read from the PLC to prefill the table. The Also Write Table Length to PLC selection will be enabled and that variable location will be prefilled here so that when the table data is written back to the PLC this location will be updated as well.*

NOTE: *A graph of the current PLS Table configuration is displayed at the bottom of the editor which shows each of the entries. Clicking on the graph will place the cursor on the table entry that contains that location. If incorrect data values are entered, i.e. overlapping data, a message will be displayed instead of the graph.*

- PLC TDO PLS Table Editor Dialog:

  Source Register Scaling (a): Same as the main dialog. The TDOPLS instruction can use the raw count value from the specified Master Register or, if scaling was enabled in the High-speed I/O setup, it can use the scaled value to do its comparisons.



  PLS Data Entry (b): Same as main dialog. Entries must be unique within the Table, the lower and upper positions of a step cannot overlap the other cam positions. The data has to be incremental.

TDOPLS, continued

Output On/Off when Greater Than or Equal to: The value that represents the lower edge of the cam position. This can be any value between -2,147,483,648 and 2,147,483,647.

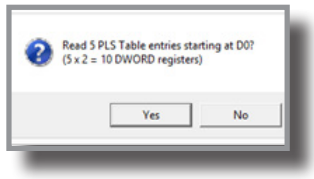
And Less Than: The value that represents the upper edge of the cam position. This can be any value between -2,147,483,648 and 2,147,483,647.

Default Output State (c): Same as main dialog. Specifies the state of the first entry in the table.

OFF (default): The output is OFF to start with. The first entry in the table will be a point which the output turns ON and subsequent entries will flip between OFF / ON / OFF / etc.

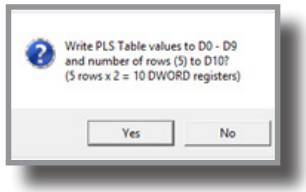
ON: The output is ON to start with. The first entry in the table will be a point which the output turns OFF and subsequent entries will flip between ON / OFF / ON / etc.

Read from PLC button (d): Overwrite the contents of the table with values from the PLC memory location specified in the Load Raw PLS Table from Data Block section.



Confirmation is requested before reading the PLC data. In this example the starting data block is D0, D10 holds a value of 5, which indicates 10 DWords will be read:

Write to PLC (e): Overwrite the contents of PLC memory at the location specified in the Load Raw PLS Table from Data Block section with the current contents of the table.



Confirmation is requested before writing data to the PLC. In this example, there are 5 rows of data. A 5 is written o D10 and the 10 DWords of data is written to D0 to D9.

Insert Row button (f): (**Insert** button in main dialog) add an empty **Step** above the currently highlighted **Step** in the table.

Append Row (g): Add a new row after the current last step in the table.

Delete Row button (h): (**Remove** button in main dialog) delete the currently highlighted Step from the table.

Clear Table button (i): Will display a confirmation dialog explaining it will delete all rows and the table will end up with a single row with values of 0 for the **Greater Than or Equal to** and 0 for **and Less Than**.

Import button (j): (**Import** button in main dialog) Import the contents of the PLS Table from a CSV file. The format of the import file is two numbers per line, separated by a comma or whitespace, all numbers must be in ascending order, and a maximum of 64 lines.

TDOPLS, continued

NOTE: *Any available text editor or an Excel worksheet can be used to create a CSV file. Just save the file as a .CSV file type.*

Example of how data should be formatted in the CSV file:

a. Two integer values per row separated by comma (surrounded by any amount of white space) or just white space.

	A	B	C	D
1	1000	1200 // Step 1		
2	2000	2300 //Step 2		
3	3000	3400 //Step 3		

b. You can also have empty rows.

c. You can also use a line comment starting with two forward slashes: // This is a comment

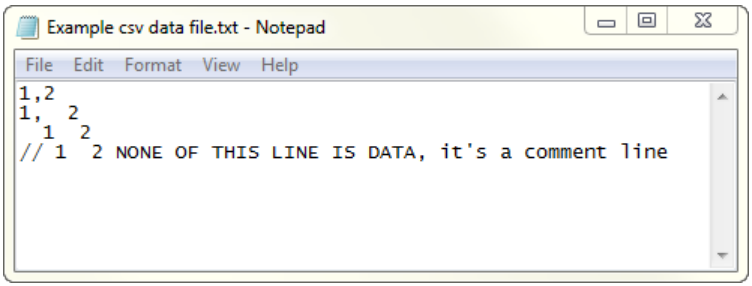
Example on how to format the data per line in the CSV file:

a. Simple comma separated values 1 and 2. (See line one below.)

b. Some white space before and/or after the comma is OK (see line two below).

c. Whitespace before, between, and after is OK also (i.e. comma is optional, see line three below).

d. Comment line (no data allowed). (see line four below.)

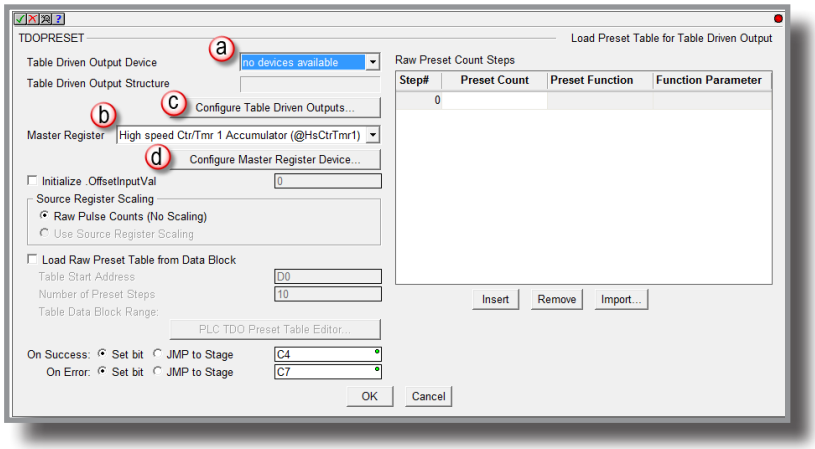


TDOPRESET

A Load Preset Table for Table Driven Output (TDOPRESET) instruction contains a series of steps that are processed in the order they appear in the table. These steps compare the current count value of the specified Master Register, which can be a High-speed Counter, Timer or AXIS Current position value, to the Preset Count in the Step, and when the count values match, the step action is performed on the selected discrete output and the next step in the table becomes the active step. Each Preset Table can have up to 64 steps. Each Preset Table compares the count value of one Master Register counter and can drive one High-speed I/O discrete output.

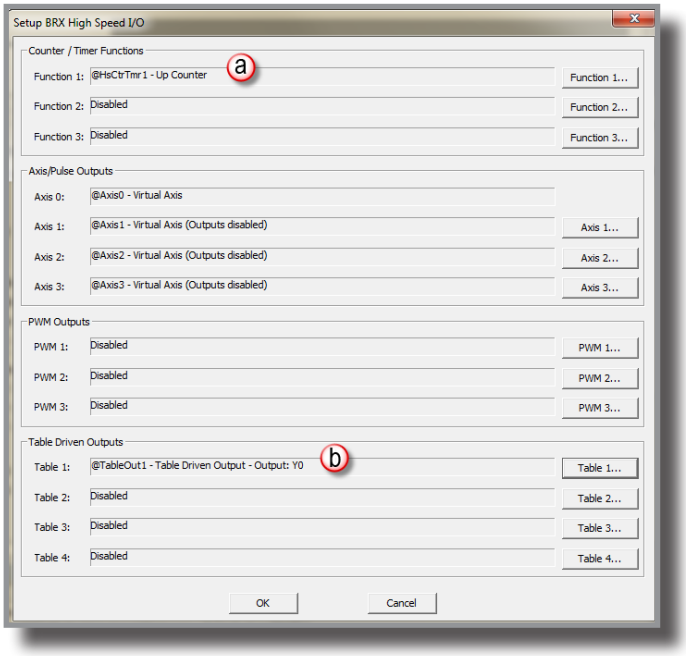
Once a Preset table has been enabled for a Table Driven Output, it will continue to control that output even if the input logic is no longer ON. Use the Deconfigure Table Driven Output (TDODECFG) instruction to stop the Preset table from controlling the Table Driven Output.

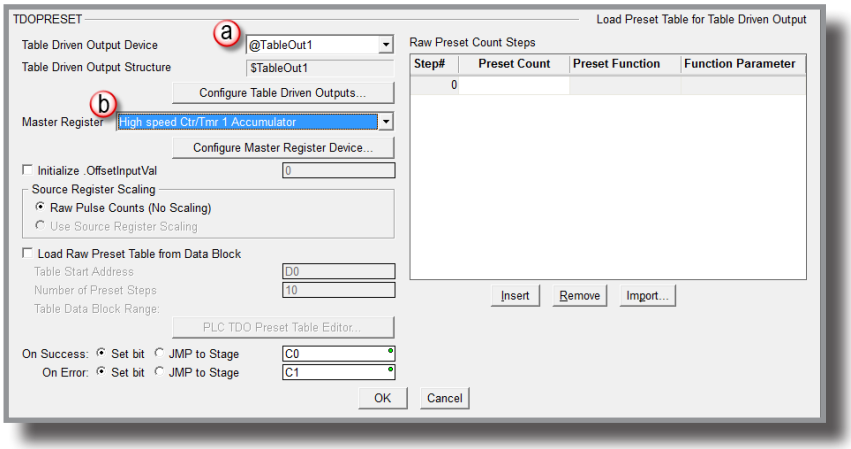
There are two items that must be configured externally to the instruction in order to use the Preset feature: (a) A **Table Driven Output Device** and (b) a **Master Register Device**. Both of these items are setup in the **Setup BRX High-speed I/O** dialog that is in the ***BRX Onboard I/O*** section of the System Configuration. This dialog can be opened directly in the instruction from the (c) **Configure Table Driven Outputs…** and (d) **Configure Master Register Device…**buttons.



TDOPRESET, continued

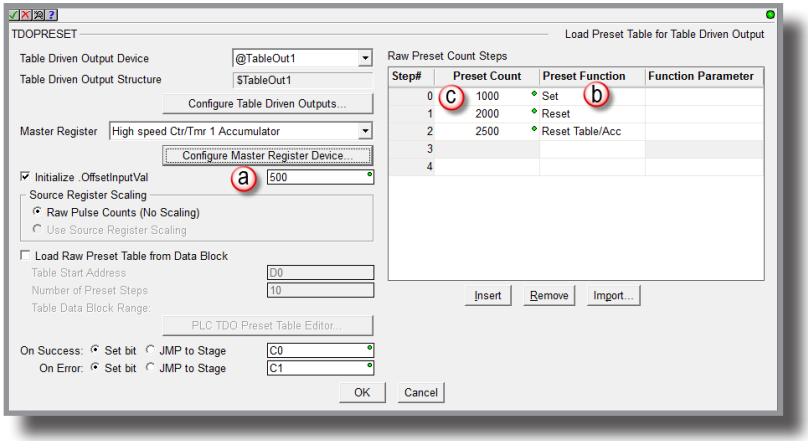
After the (**a**) Table Driven Output Device and (**b**) Master Register Device have been configured (see the High-speed I/O Hardware Configuration section for more details), the TDOPRESET instruction may now be used.



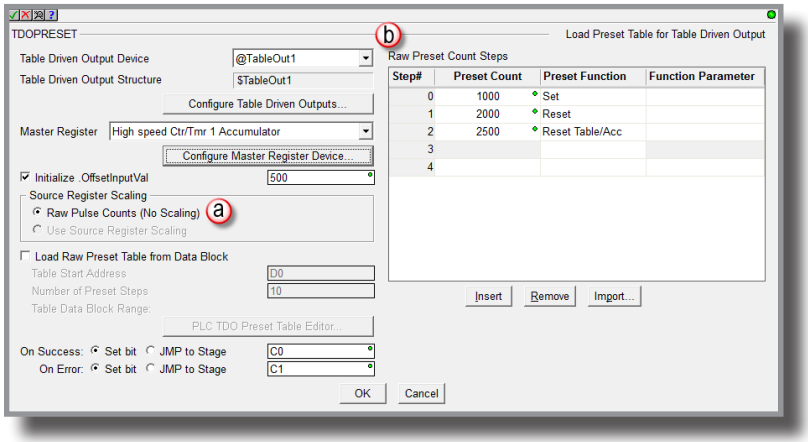


TDOPRESET, continued

Initialize .InputValOffset: A positive value in this field means that the entries will act at a lower value than shown. A negative value means that the entries will act at a higher value than shown. For example: An offset of 500 is configured in the .InputValOffset field. The first entry is configured to SET the output at 1000. When the table runs, the output will actually SET at a value of 500. In the .InputValOffset was configured for -500, the first output would have SET at a value of 1500.



Source Register Scaling: The TDOPRESET instruction can use the raw count value from the specified Master Register or, if scaling was enabled in the High-speed I/O setup, the scaled value to do its comparisons.

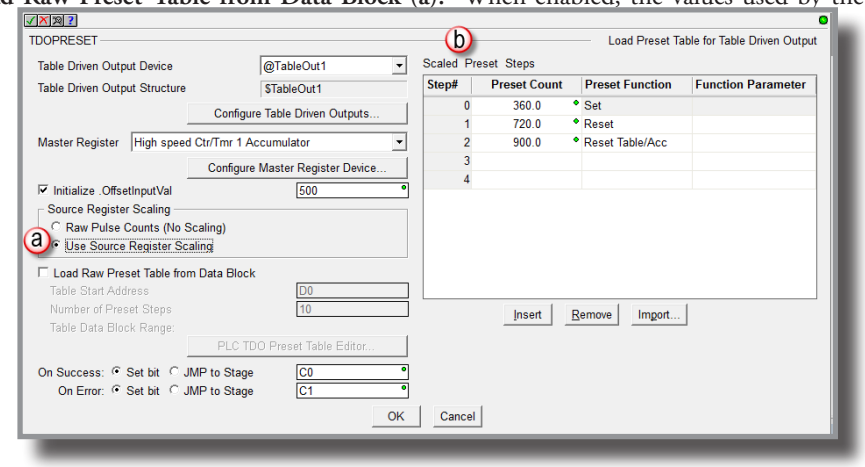


- **Raw Pulse Counts (No Scaling) (a):** Select this option to enter the Preset Count values in the Table as raw count values. The image above shows (a) **Raw Pulse Counts (No Scaling)** selected, indicating the Master Register scaling was not enabled. The **(b) Raw Preset Count Steps** table entry shows that the values entered are based on raw counts.

TDOPRESET, continued

- **Use Source Register Scaling:** If the Master Register has been configured to scale the current count value you can use the scaled values in the table by selecting this option and entering values that are scaled the same as the Master Register. The image below shows (**a**) **Use Source Register Scaling** selected, indicating the Master Register scaling was enabled. The (**b**) **Scaled Preset Steps** table entry shows that the entries are based on the scaled values.

Load Raw Preset Table from Data Block (a): When enabled, the values used by the Preset



TDOPRESET, continued

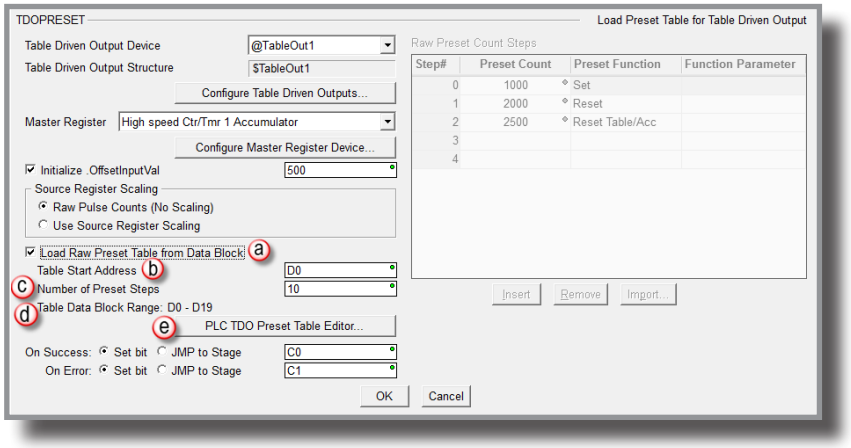
Table come from the values stored in the specified memory range. This allows for a more dynamic control of the Preset function.

- **Table Start Address (b):** The beginning address in PLC memory where the Preset table data is stored. This must be a block of Signed DWords.
- **Number of Preset Steps (c):** The number of steps in the Preset table that are stored in PLC memory. A Preset Table can have up to 64 steps.
- **Table Data Block Range (d):** Using the two values above, this shows the range of PLC memory that will be used as the Preset data table. With a starting address of D0 and a total of 10 steps, the memory range is D0 to D19. Data formatting will be discussed in the PLC TDO Preset Table Editor section found later in this section.

NOTE: *The PLC TDO Preset Table Editor button is available only when the Do-more! Designer software is connected and Online with the BRX CPU.*

- **PLC TDO Preset Table Editor button (e):** Click to open the **PLC TDO Preset Table Editor** which allows you to edit the data values in the specified Data Block. The data configuration options on this dialog (Preset Count, Preset Function, Function Parameter) are the same as the main dialog. Detailed information of the PLC TDO Preset Table Editor dialog screen is discussed later in this section.

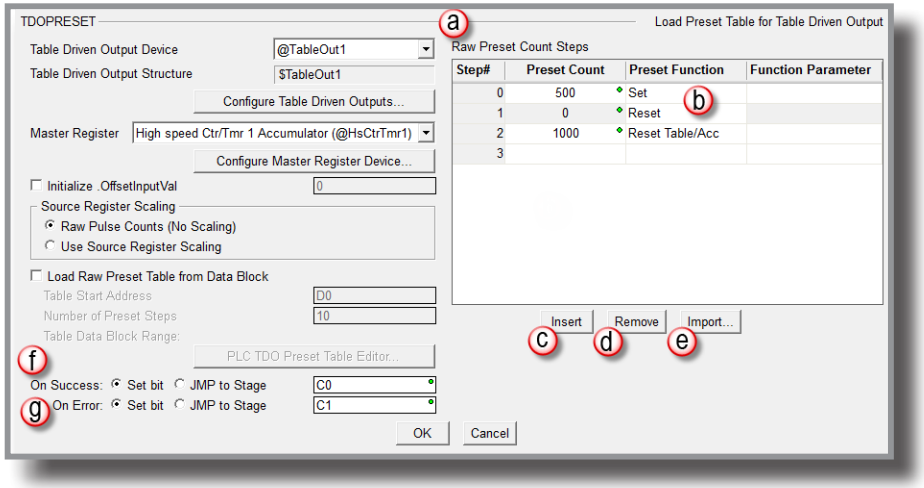
Raw (or Scaled) Preset Count Entries Output xx when: This is the table of entries for **Raw**



TDOPRESET, continued

(or Scaled) Preset Count Steps (a): This is the list of steps that determines the Table Driven Output state when the TDOPRESET is running.

- **Preset count:** The pulse count values in the table can be constants or variables. If variables are



used, the instruction must be disabled and re-enabled after the variable value has been changed. This can be any value in the range of -2,147,483,648 and 2,147,483,647.

- **Preset Function (b):** Select the action to perform on the Table Driven Output when the Step is triggered.

1. **Set:** Turns ON the Table Driven Output.
2. **Reset:** Turns OFF the Table Driven Output.
3. **Reset Table/Acc:** Performs a reset of the Master Register which sets its current count value to the Initial Reset Value specified in the Timer/Counter Function setup, and sets the current step in the Preset Table to Step 0.
4. Pulse On: Turns ON the Table Driven Output for the amount of time specified in the Function Parameter, which is the duration of the output pulse in microseconds (1 to 16,777,215).
5. Pulse Off: Turns OFF the Table Driven Output for the amount of time specified in the Function Parameter, which is the duration of the output pulse in microseconds (1 to 16,777,215).
6. Toggle: Inverts the state of the Table Driven Output. If the Table Driven Output is currently ON, it is turned OFF, or it is turned ON if it is currently turned OFF.

- Several things to consider when using this instruction:

1. Unlike the TDOPLS instruction, the values in the entry table do not have to be increasing with the Entry numbers. The table runs step by step in order of entry. Therefore, if the value in a higher entry is lower than a previous entry, the current count value must be decreasing in order for the step to be

TDOPRESET, continued

completed. For example, if Step 0 is configured as Set at 500 and Step 1 is configured as Reset at 0, the Output will be Set ON when the current counts reach 500 or more and the Output will be Reset to OFF when the current counts decrease to 0 or less.

2. In order for the table to run continuously, the final entry function must be to (X) Reset Count. After the step with the Reset Count function is complete, the table will start over at Step 0. When the TDOPRESET instruction is disabled and re-enabled, it will start over at Step 0.
3. If the Scaling was configured for the Master Register counter and the "Use Source Register Scaling" option was specified, the Step values will be entered as scaled values and no conversion will be necessary.

- **Insert button (c):** add an empty Step above the currently highlighted Step in the table.
- **Remove button (d):** delete the currently highlighted Step from the table.
- **Import button (e):** Import the contents of the Preset table from a CSV file. The format of the import file is two or three numbers per line, separated by a comma or whitespace, and a maximum of 64 lines. Please review the CSV file formatting information later in this TDOPRESET instruction section, under the section explaining the PLC TDO Preset Table Editor dialog.

On Success (**f**):

- **Set Bit:** The bit will become FALSE when the instruction is enabled and will become TRUE when instruction parameters are properly entered and the instruction completes successfully. The specified bit is enabled with a SET operation, not an OUT operation. The On Success bit will remain ON even if the instruction input logic goes OFF.
- **JMP to Stage:** When instruction parameters are properly entered and the instruction completes successfully, the PLC will jump to that stage.

On Error (**g**):

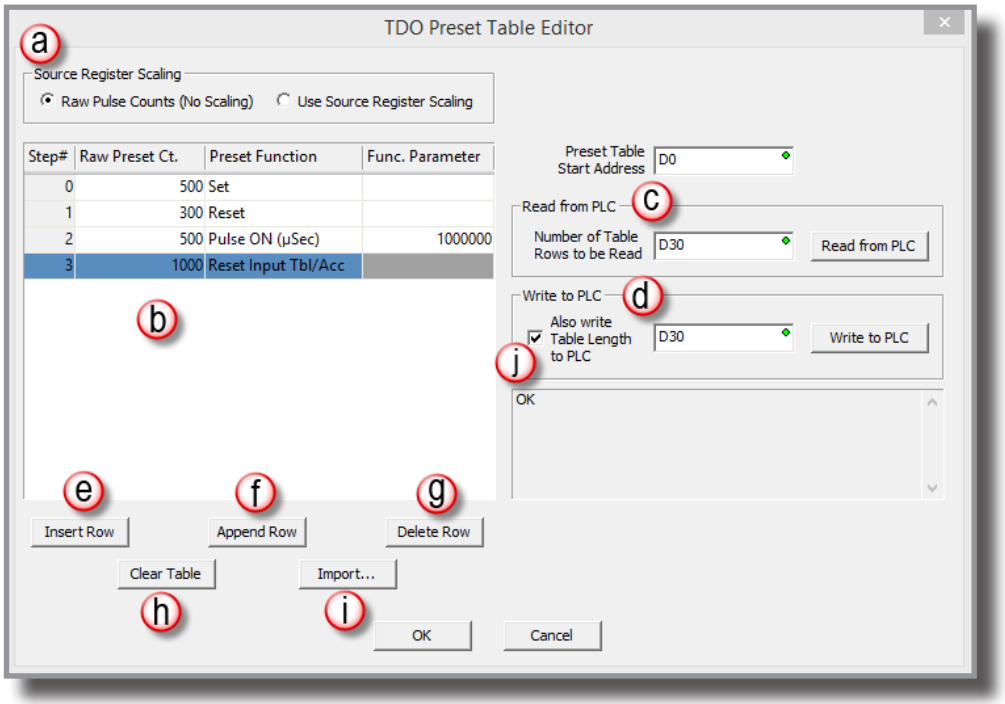
- **Set Bit:** The bit will become FALSE when the instruction is enabled and will become when proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully. The specified bit is enabled with a SET operation, not an OUT operation. The On Error bit will remain ON even if the instruction input logic goes OFF.
- **JMP to Stage:** When proper instruction parameters are NOT properly entered or the instruction IS NOT completed successfully, the PLC will jump to that stage.

NOTE: *Initial values for Preset Table Start Address, and Number of Table Rows to be Read (or Number of Preset Steps) come from the main instruction editor. If these values are changed while editing the table data with this dialog, those values will be updated on the main instruction editor when this dialog is closed.*

NOTE: *If the Number of Preset Steps is a variable (memory address), the value in that location is read and the data in that number of rows will be read from the PLC to prefill the table. The* ***Also Write Table Length to PLC*** *selection will be enabled and that variable location will be prefilled here so that when the table data is written back to the PLC this location will be updated as well.*

TDOPRESET, continued

PLC TDO Preset Table Editor

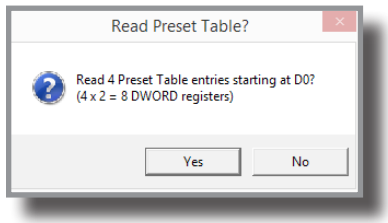


- **Source Register Scaling (a):** Same as the main dialog. The TDOPRESET instruction can use the raw count value from the specified Master Register or, if scaling was enabled in the High-speed I/O setup, it can use the scaled value to do its comparisons.
- **Raw (or Scaled) Preset Count Steps (b):** Same as main dialog. This is the list of steps that determines the Table Driven Output state when the TDOPRESET is running.
    1. **Preset count:** The PLC TDO Preset Table Editor is reading a block of D memory, it is editing the values that go into that block. The Preset Count in the PLC TDO Preset Table Editor can only be contant values. This value can be in the range of -2,147,483,648 and 2,147,483,647.
    2. **Preset Functions:** Select the action to perform on the Table Driven Output when the Step is triggered.
        - **Set:** Turns ON the Table Driven Output.
        - **Reset:** Turns OFF the Table Driven Output.
        - **Reset Table/Acc:** Performs a reset of the Master Register which sets its current count value to the Initial Reset Value specified in the Timer/Counter Function setup, and sets the current step in the Preset Table to Step 0.

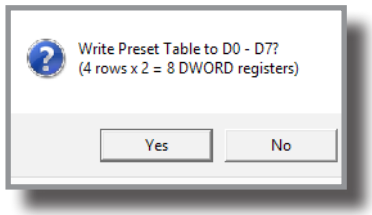
TDOPRESET, continued

- **Pulse On:** Turns ON the Table Driven Output for the amount of time specified in the Function Parameter, which is the duration of the output pulse in microseconds (1 to 16,777,215).
- **Pulse Off:** Turns OFF the Table Driven Output for the amount of time specified in the Function Parameter, which is the duration of the output pulse in microseconds (1 to 16,777,215).
- **Toggle:** Inverts the state of the Table Driven Output. If the Table Driven Output is currently ON, it is turned OFF, or it is turned ON if it is currently turned OFF.

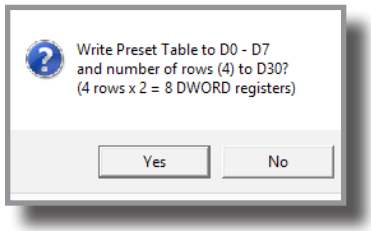
3. **Read from PLC button (c):** Overwrite the contents of the table with values from the PLC memory location specified in the Load Raw Preset Table from Data Block section.
   - Confirmation is requested before reading the PLC data. In this example the starting data block is D0, D30 is the memory address that stores the Number of Preset Steps. This has a value of 4. Eight DWords will be read from the PLC starting at D0:



4. **Write to PLC (d):** overwrite the contents of PLC memory at the location specified in the Load Raw Preset Table from Data Block section with the current contents of the table.
   - Confirmation is requested before writing data to the PLC. The four rows of data are stored in D0 to D7



   - Confirmation request before writing data to the PLC with the **Also write Table Length to PLC** enabled. In this example, there are 4 rows of data. A 4 is written to D30 and the 8 DWords of data is written to D0 to D7.



TDOPRESET, continued

5. **Format of the Preset Data Read from PLC or Written to the PLC memory addresses:** When using the PLC TDO Preset Table Editor, the data values in the specified memory locations must be formatted properly. Improperly formatted data will generate a warning message. The following example shows a range of D0 to D7, which corresponds to a starting Preset Data Table address of D0 and 4 steps. Each step is comprised of two DWords. Each Preset table entry consists of 2 signed DWord locations:

   - The first DWord location corresponds to the Preset Count where the specified command will take place. This can be any value between -2,147,483,648 and 2,147,483,647.
   - The second DWord location contains the Function Code for the command to be performed and the additional data required by a command code.
     - The upper BYTE (Byte 0) contains one of the following values to indicate the action:

       0: Set

       1: Reset

       2: Pulse ON

       3: Pulse OFF

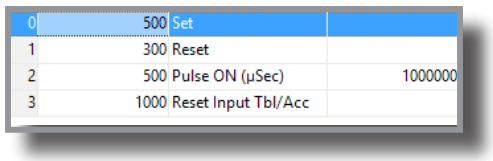
       4: Toggle

       5: Reset Table & Acc
     - When using the Pulse ON or Pulse OFF command, the lower 3 BYTEs of the second DWord location will contain the amount of time (in microseconds) the pulse will be ON or OFF respectively.
   - Example: This shows the Preset Table filled in with the desired values:

     Line 1 Step 0: Preset Count of 500. Set = Code 0.

     Line 2 Step 1: Preset Count of 300. Reset = Code 1.

     Line 3 Step 2: Preset Count of 500. Pulse ON = Code 2. Function Parameter of 1,000,000.

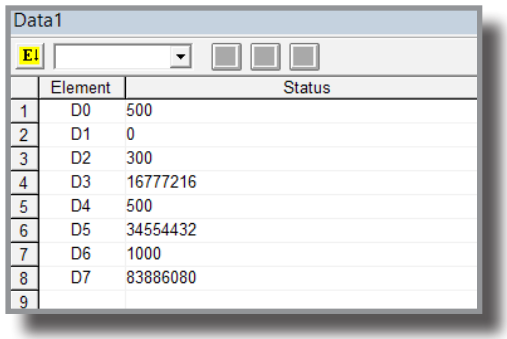


0	500	Set	
1	300	Reset	
2	500	Pulse ON (µSec)	1000000
3	1000	Reset Input Tbl/Acc	

TDOPRESET, continued

Line 4 Step 3: Preset Count of 1000. Reset Table/Acc = Code 5.

- The following Data View shows the Native values for the Data Block range of D0 to D7 associated with our example:



	Element	Status
1	D0	500
2	D1	0
3	D2	300
4	D3	16777216
5	D4	500
6	D5	34554432
7	D6	1000
8	D7	83886080
9		

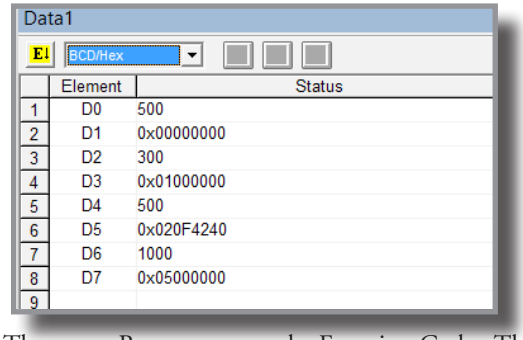
- The following Data View shows the second DWord of each step in BCD/HEX data type:

  D1 corresponds to SET (code 0) of Step 0.

  D3 corresponds to RESET (code 1) of Step 1.

  D5 corresponds to Pulse ON (code 2) of Step 2.

  D7 corresponds to Reset Table/Acc (code 5) of Step 3.



	Element	Status
1	D0	500
2	D1	0x00000000
3	D2	300
4	D3	0x01000000
5	D4	500
6	D5	0x020F4240
7	D6	1000
8	D7	0x05000000
9		

- The upper Byte represents the Function Code. The lower three Bytes represent the Function Parameter value. 0Xuullllll.

  For Step 0, function code 0 (Set) is uu = 00.

  For Step 1, function code 1 (Reset) is uu = 01.

  For Step 2, function code 2 (Pulse ON) is uu = 02. Pulse ON has a function parameter of time in microseconds, which is llllll = 0F4240. Converting Hex 0F4240 to Decimal is 1,000,000.

  For Step 3, function code 5 (Reset Table/Acc) is uu = 05.

- If, for example, we want to change the Pulse ON to last 2,500,000 microseconds, D5 would have a BCD/HEX value = 0X022625A0.

TDOPRESET, continued

- **Insert Row button (e):** (Insert button in main dialog) add an empty Step above the currently highlighted Step in the table.
- **Append Row (f):** Add a new row after the current last step in the table.
- **Delete Row button (g):** (Remove button in main dialog) delete the currently highlighted Step from the table.
- **Clear Table button (h):** Will display a confirmation dialog explaining it will delete all rows and the table will end up with a single row to Set at a Preset Value of 0.
- **Import button (i):** (Import button in main dialog) Import the contents of the PLS Table from a CSV file. The format of the import file is two or three numbers per line, separated by a comma or whitespace, with a maximum of 64 lines.

Below is an example of how data should be formatted in the CSV file.

	A	B	C	D
1	1000	0		//Set ON @ 1000
2	2000	1		// Set OFF @ 2000
3	3000	2	1000000	//Pulse ON @ 3000 for 1,000,000 microseconds
4	4000	0		// Set ON @ 4000
5	5000	3	1500000	//Pulse OFF @ 5000 for 1,500,000 microseconds
6	6000	4		//Toggle @6000
7	7000	5		//Reset Count & Table @ 7000

Column A holds the Preset Count. This can be any value between -2,147,483,648 and 2,147,483,647

Column B holds the Preset Function code. The following table shows the available function codes.

Preset Function Codes		
0	SET	No function parameter needed
1	RESET	No function parameter needed
2	PULSE ON	Requires function parameter. Time in microseconds: 1 to 16,777,215
3	PULSE OFF	Requires function parameter. Time in microseconds: 1 to 16,777,215
4	TOGGLE	No function parameter needed
5	RESET TABLE & COUNT	No function parameter needed

Column C holds the Function Parameter, which is the amount of time (in microseconds) the pulse will be ON or OFF. This is required for the PULSE ON and PULSE OFF function codes.

Column D holds the comments, which is indicated by the "//" before the text.

BRX Do-more! Communications

In This Chapter...

Overview 13-3
Terminology 13-3
General Concepts 13-4
USB Communications 13-5
Serial Communications 13-6
RS-232 13-6
RS-485 13-8
Serial Port Settings 13-10
Serial Protocols 13-13
MRX Instruction 13-16
MWX Instruction 13-18
K-Sequence 13-20
ASCII 13-21
STREAMIN Instruction 13-22
STREAMOUT Instruction 13-24
Ethernet 13-26
Wiring 13-27
IP Addressing and Subnets 13-27
Port Numbers 13-28
Ethernet Protocols 13-29
PEERLINK Instruction 13-29
Do-more! Protocol 13-30

RX 13-30
WX 13-34
Modbus TCP/IP 13-38
MRX Instruction 13-40
MWX Instruction 13-42
HOST Ethernet Protocol 13-44
DLRX 13-45
DLWX 13-47
EtherNet/IP (Explicit Messaging) 13-49
EtherNet/IP Client (Master) 13-52
SMTP – EMAIL 13-57
EMAIL 13-60

Communications

Overview

The purpose of this chapter is to help the user gain an understanding of the communications capabilities of the BRX MPU.

The BRX MPU is capable of both serial and Ethernet communications using a wide variety of protocols. Listed in the table below are the supported methods and protocols.

Communications	
Serial RS-232/RS-485	**Ethernet**
Do-more! Protocol (Server)	Do-more! Protocol (Client, Server)
Modbus RTU (Client, Server)	Modbus TCP (Client, Server)
K-Sequence (Server)	HOST ECOM Protocol (Client, Server)
ASCII (In & Out)	EtherNet/IP (Explicit Messaging (Client, Server))
	Ethernet Remote I/O
	SMTP (Email)
	SNTP (Time Server)
	TCP Raw Packet
	UDP Raw Packet

Terminology

During the course of this chapter we will use terminology and phrases that are specific to a Protocol or Physical Medium the user should understand. By way of explanation we have included some common terms and definitions in this section. Definitions and explanations of specific parameters particular to each Protocol will be discussed later in this chapter.

Physical Medium – Wires, radios, cellular service, or satellite link. The physical method (hardware) on which the data is being transmitted or received. The physical medium contains no data information. Examples of a physical medium are: RS-232, RS-485 and Ethernet 10/100 Base T.

Protocol – A Protocol is the specification for the formatting of the data (bits, bytes and words) being transmitted through the physical medium. Examples of some common industry protocols are: Modbus RTU, Modbus TCP, K-Sequence, DirectNet and EtherNet/IP.

One way to think of the Physical Medium and the Protocol is to liken them to placing a phone call. The phone call is being placed over wires, cellular service or even perhaps a satellite link. This is the physical medium. Now if the call was to China, you would say “Hello” in English. If the person on the other end understands English, they will respond with “Hello”. If the person on the other end only understands Mandarin Chinese they might respond “Ni Hao”. If you do not understand Chinese, you will be confused as to what they are saying. This is the same for a Protocol. If your PLC uses Modbus TCP/IP and you try to talk to a PLC that only understands EtherNet/IP, then you will not be able to communicate with it. The Protocols must match in order to communicate.

Client (Master) – A Client is a Master device that requests data from a Server (Slave) device.

Server (Slave) – A Server is a Slave device that responds to a request from a Client (Master) device.

UDP – User Datagram Protocol (UDP) is part of the Transport Layer of the Internet Protocol Suite. The Transport Layer is Layer 6. UDP is a simple connectionless transport mechanism for Ethernet packets. Checksums are used for data integrity, however it has no error correction or guarantee of delivery. It is considerably faster than TCP/IP due to these factors. It is widely used when data is time sensitive because dropped packets may be preferable to retries and delays.

TCP – TCP or TCP/IP is part of the Transport Layer of the Internet Protocol Suite. The Transport Layer is Layer 6. TCP is defined as a reliable, ordered and an error checked delivery method. TCP/IP is most often used when the data integrity is more important than raw speed.

Field Device – A device external to the BRX MPU.

General Concepts

The BRX Do-more! MPU is capable of both serial and Ethernet communications to a wide variety of field devices such as HMIs, SCADA systems, PLCs, barcode readers and scales. The following sections of this chapter will be of significant help to you when connecting and communicating with the various protocols needed for these types of devices. For advanced users it is possible to write custom protocols using the raw commands provided in the Do-more! Designer software. So a thorough working knowledge of the protocol is required to accomplish this.

The BRX Do-more! MPU has tightly coupled security features incorporated into it to protect your installation. See the manual section for each protocol and also the Do-more! Designer software help file for more information on password protection and Protocol Specific Memory.

Multiple user accounts are supported and logged when accessed. When programming, session based communication with unique IDs is utilized to prevent unauthorized access.

The Do-more! Protocol can access the full memory structure and is capable of utilizing a security account to protect the data. Some HMIs and SCADA software such as C-more, C-more Micro and Point of View, can utilize the Do-more! Protocol for enhanced security while accessing the full memory area.

Protocol Specific memory areas are blocked out of the User Memory when using Modbus RTU, Modbus TCP/IP, HOST ECOM and K-Sequence protocols. These memory areas are only accessible externally by using the specific protocol that corresponds to the type of memory being accessed. They are usable by the programmer to pass data externally when using third party devices. This is discussed in more detail in each Protocol section later in this chapter.

USB Communications

The POM slot USB port is useful for programming the BRX Do-more! MPU. It is compatible with Desktop PCs and Laptops utilizing USB 2.0 or higher, communicating through USB Type A to USB Type B cable. It does not support connections to other USB devices such as printers.

The POM slot USB port relies on drivers included with Windows, so there are no drivers to download. It truly is plug and play.

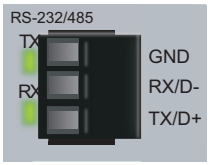
Serial Communications

The RS-232/485 port is a removable three-pin screw terminal block located on the front of the CPU. This port is software selectable to communicate as RS-232 or as RS-485. In the RS-485 mode you can also enable a 120 Ohm termination resistor if needed.

The RS-232/485 port can be connected to the Do-more! Designer programming software, Modbus RTU master or slave devices, DirectLogic PLCs via K-Sequence protocol, as well as devices that send or receive non-sequenced ASCII strings or characters.

RS-232

RS-232 is a single point wiring standard that can be used to connect external devices to the PLC.



Pinout	RS232
1	GND
2	RXD
3	TXD

Built-in RS-232 Specifications	
Port Name	RS-232/RS-485
Description	Non-isolated Serial port that can communicate via RS-232 or RS-485 (software selectable). Includes ESD protection and built-in surge protection.
Supported Protocols	Do-more!™ Protocol (Default) Modbus RTU (Client & Server) K-Sequence (Slave) ASCII (In & Out)
Data Rates	1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200 Baud
Default Settings	RS-232, 115200bps, No Parity, 8 Data Bits, 1 Stop Bit, Station #1
Port Status LED	Green LED is illuminated when active for TXD and RXD
Port Type	Removable 3-pin terminal strip 3.5 mm pitch
RS-232 TXD	RS-232 Transmit output
RS-232 RXD	RS-232 Receive input
RS-232 GND	Logic ground
RS-232 Maximum Output Load (TXD/RTS)	3kΩ, 1000pf
RS-232 Minimum Output Voltage Swing	±5V
RS-232 Output Short Circuit Protection	±15mA
Cable Requirements	RS-232 use P/N L19772-XXX from automationdirect.com
Maximum Distance	30 meters (100 feet); 6 meters (20 foot) recommended maximum
Replacement Connector	ADC Part # BX-RTB03S

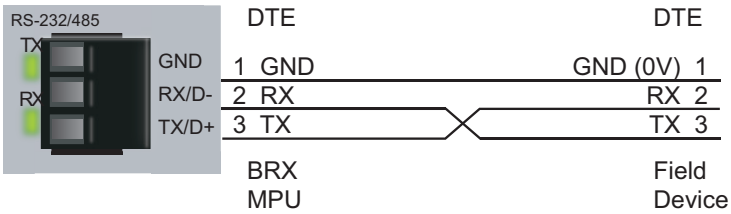
Serial Communications, continued

The manner in which external devices are wired to the CPU depend on whether the device is considered to be Data Terminal Equipment (DTE) or Data Communications Equipment (DCE). The CPU is considered a DTE device. Most Modbus or ASCII devices being connected to the CPU will also be considered a DTE device and will need to swap TX and RX (as shown below), but you should always consult the documentation of that device to verify.

If a device such as a Modem, which is a DCE device, is placed between the CPU and another Modbus or ASCII device it will most likely require connecting the signals straight across (TX to TX and RX to RX). Again, this can differ from manufacturer to manufacturer so always consult the documentation before wiring the devices together.

RS-232 is a ground referenced signal and as such it is susceptible to noise and ground differentials which may make it unsuitable for use in some circumstances.

The wiring for RS-232 is shown below. Please note that there are no connections for RTS (Ready To Send), CTS (Clear To Send) or for port powered devices (+5VDC).



NOTE: *Recommended distance between RS-232 devices is less than 6 meters (20 feet) in industrial environments. For longer distances, please consider using RS-485 or Ethernet.*

RS-485

RS-485 is a multi-point wiring standard that can be used to connect external devices to the PLC.

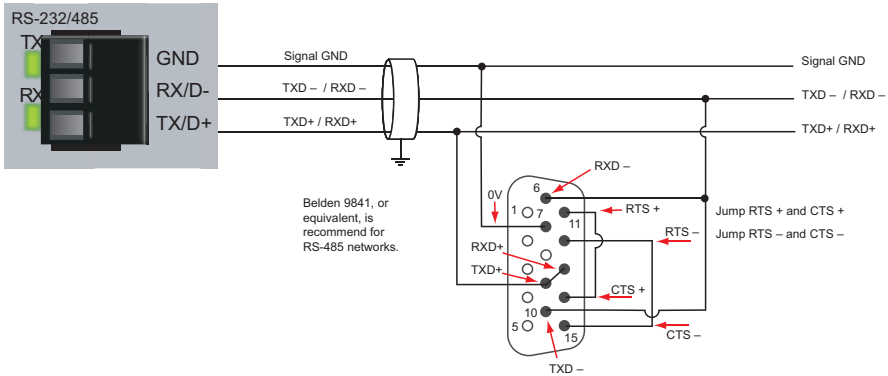
Built-in RS-485 Specifications	
Port Name	RS-232/RS-485
Description	Non-isolated Serial port that can communicate via RS-232 or RS-485 (software selectable). Includes ESD protection and built-in surge protection.
Supported Protocols	Do-more!™ Protocol (Default) Modbus RTU (Client & Server) K-Sequence (Slave) ASCII (In & Out)
Data Rates	1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200 Baud
Default Settings	RS-232, 115200bps, No Parity, 8 Data Bits, 1 Stop Bit, Station #1
Port Status LED	Green LED is illuminated when active for TXD and RXD
Port Type	Removable 3-pin terminal strip 3.5 mm pitch
RS-485 Station Addresses	1–247
RS-485 TXD-/RXD-	RS-485 transceiver low
RS-485 TXD+/RXD+	RS-485 transceiver High
RS-485 GND	Logic ground
RS-485 Input Impedance	19kΩ
RS-485 Maximum Load	50 transceivers, 19kΩ each, 120Ω termination
RS-485 Output Short Circuit Protection	±250mA, thermal shut-down protection
RS-485 Electrostatic Discharge Protection	±8kV per IEC1000-4-2
RS-485 Electrical Fast Transient Protection	±2kV per IEC1000-4-4
RS-485 Minimum Differential Output Voltage	1.5 V with 60Ω load
RS-485 Fail Safe Inputs	Logic high input state if inputs are unconnected
RS-485 Maximum Common Mode Voltage	-7.5 V to 12.5 V
Cable Requirements	RS-485 use P/N L19827-XXX from automationdirect.com
Maximum Distance	1000 meters (3280 feet)
Replacement Connector	ADC Part # BX-RTB03S

The RS-485 port is useful for connecting multiple devices on one network and/or connecting devices to the CPU at much longer distances than RS-232. The RS-485 standard supports distances of up to 1000 meters without requiring a repeater. The distance can be increased by placing an RS-485 repeater on the network, if necessary. The RS-485 Port on the CPU can support up to 50 devices, depending on the load of each device (assuming a 19kΩ load for each device).

RS-485 utilizes a differential signal which makes it much more immune to noise and grounding issues than RS-232 and is therefore a much better choice when available for communications.

This port only supports RS-485, 2-wire connections. For 4-wire RS-485 or RS-422, a converter, such as an FA-ISOCON must be used.

The wiring for RS-485 is shown below. Please note that there are no connections for RTS (Ready To Send), CTS (Clear To Send) or for port powered devices (+5VDC).



DL06 CPU Port 2

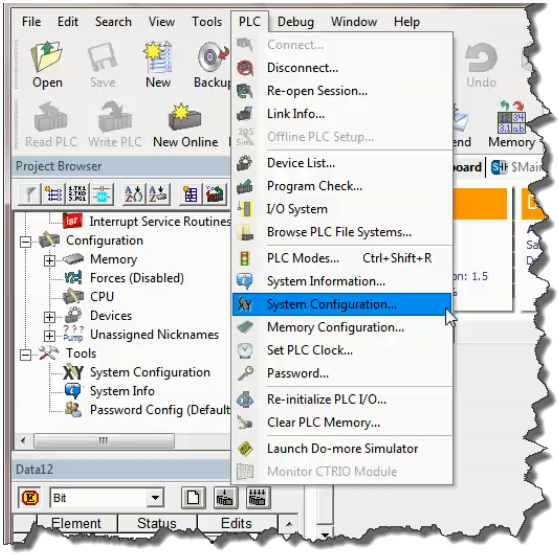
13

Serial Port Settings

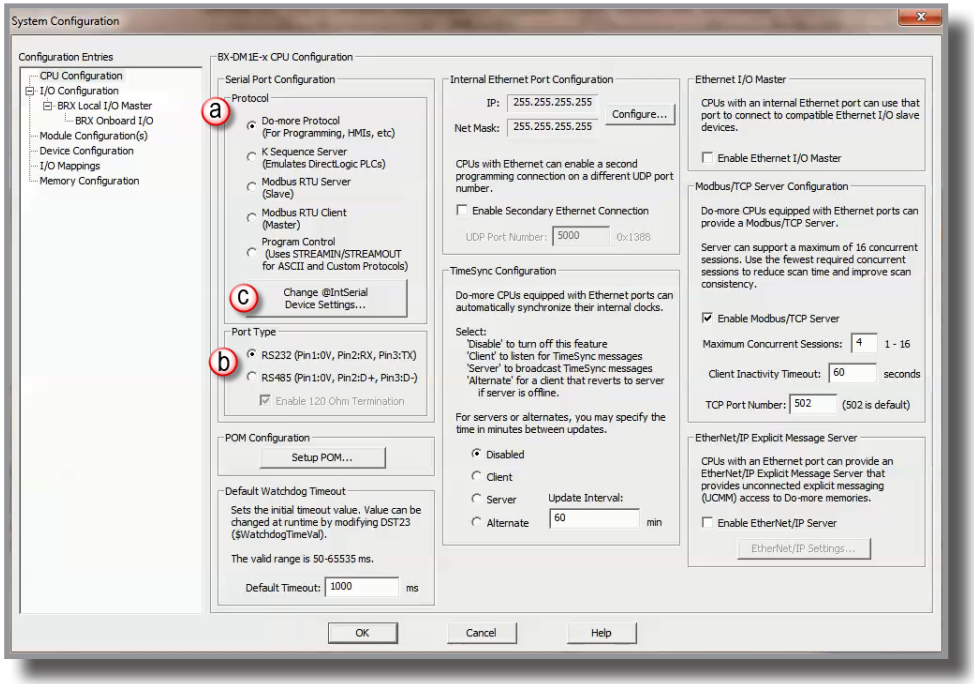
Setting up your serial port is straightforward. Follow the simple steps below.

1. You must know what physical medium your connecting device uses.
2. Establish which protocol your device supports.
3. Wire the physical medium using the wiring diagrams for either RS-232 or RS-485 on the previous pages.
4. Select supported protocol from the configuration list in the Do-more! Designer software.
5. Select baud rate, data bits, stop bits and parity for your device.
6. Set the baud, data bits, stop bits and parity to match your device and Do-more! Designer software.
7. If your device is a Client device such as an HMI, then your setup is completed.
8. If your device is a Server device and the BRX Do-more! MPU will be requesting data from it, then some ladder logic must be written. Please refer to the specific section for your chosen protocol. The Do-more! Designer software help file is also a good resource for setting up communications.

To set up your serial communications port in Do-more! Designer, from the PLC drop-down menu at the top of the screen, select **System Configuration**.

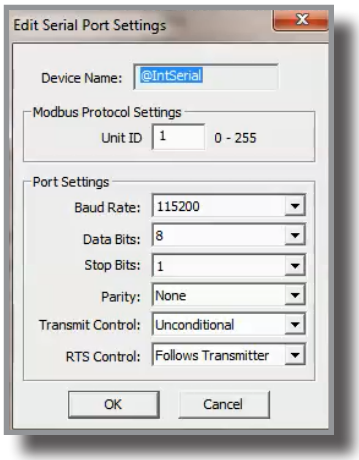


The ***System Configuration*** dialog will appear. Within this dialog box you can (**a**) pick the ***Protocol*** and (**b**) ***Port Type***, whether the port should be used for RS-232 or RS-485.



Once you have selected the desired Protocol and Port Type, click (**c**) the button labeled **Change @IntSerial Device Settings**.

The ***Edit Serial Port Settings*** dialog (right) will appear. Here you will configure the serial port settings to match any additional device(s) settings. These settings must match exactly in order for the devices to communicate properly.



Unit ID – This is the Modbus protocol identification number when the BRX Do-more! MPU functions as a server device. For RS-232 this value should always be set to 1. For RS-485, this value will depend on how many other devices are present on the network and how they are to be numbered.

Baud Rate – The rate at which the data is transmitted. The higher the number the faster the data will be transmitted. Choosing a lower value can help with issues when the data is not being received reliably.

Available Baud Rate choices: 115200, 57600, 38400, 19200, 9600, 4800, 2400, 1200

Data Bits – The number of bits in each character.

Available choices: 7 or 8.

Edit Serial Port Settings Parameters, continued

Stop Bits – The number of bits sent to denote the end of each character.

Available choices: 1 or 2.

Parity – The method of error detection used during transmission.

Available choices: None, Odd, Even

Transmit Control – Designates when data will be transmitted.

Available choices include:

- Unconditional – Data will be transmitted as soon as it reaches the output buffer
- Wait for CTS – Data will be transmitted when the CTS line is asserted.
- Delayed 5ms, delayed 50ms, delayed 250ms, delayed 500ms – After data reaches the output buffer, the RTS line will be asserted, and the transmitting of the data will be delayed by the selected number of milliseconds.

RTS Control – This setting is unused in BRX Do-more! MPUs and should always be set to **Follows Transmitter**.

Timeout – how many milliseconds should the instruction wait for the remote Modbus RTU Server to respond, this can be any constant from 0 to 32767.

Retries – how many times should the instruction retry the communication with the remote Modbus RTU Server, this can be any constant from 0 to 255.

Inter-packet Delay – the amount of time (in microseconds) the Modbus/RTU Client will place between packets as they are sent, this can be any be any constant value between 0 and 65535.

Serial Protocols

The BRX Do-more! MPU has several Protocol choices for communicating to external devices. In this section we will go over the choices and describe each choice.

Serial RS-232/RS-485
Do-more! Protocol (Server)
Modbus RTU (Client, Server)
K-Sequence (Server)
ASCII (In & Out)

Do-more! Protocol

The Do-more! protocol is a proprietary protocol that is used exclusively by the Do-more! family of controllers. This is a very feature rich and secure protocol that is used to communicate between the Do-more! Designer software and Do-more! controllers. It can also be used to communicate between multiple Do-more! controllers or to other devices such as the C-more HMI, and some SCADA systems such as Point of View support the Do-more! Protocol.

Modbus RTU

Modbus RTU is a protocol overseen by Modbus.org. This is an open standard, meaning that anyone can utilize it freely.

Modbus RTU can be utilized as either a client or server configuration. It supports multiple server (slave) devices on RS-485 and a single server (slave) device on RS-232.

Modbus RTU Server (Slave)

As a Modbus RTU Server (Slave), the BRX MPU is functioning as a listening/replying device. When an external Client (Master) device requests data from the BRX MPU, the MPU will reply with the appropriate data.

All Modbus data is stored in four sets of registers in the BRX MPU. This memory area is blocked off specifically for Modbus communications. You must place data in these registers in order for a Modbus device to be able to access it.

The Modbus data area is loosely data typed and casting or other instructions such as PUBLISH and SUBSCRIBE can be utilized to convert data in this area to the correct data type required.

Modbus		
Register Type	**Register Name**	**Range**
Holding Coil	MC	00000–01023
Input Coil	MI	10000–11023
Holding Register	MHR	30000–31047
Input Register	MIR	40000–42047

Please reference the Help file on casting, PUBLISH and SUBSCRIBE.

NOTE: *Ranges can be expanded in the Memory Configuration section of the Do-more! Designer software as needed.*

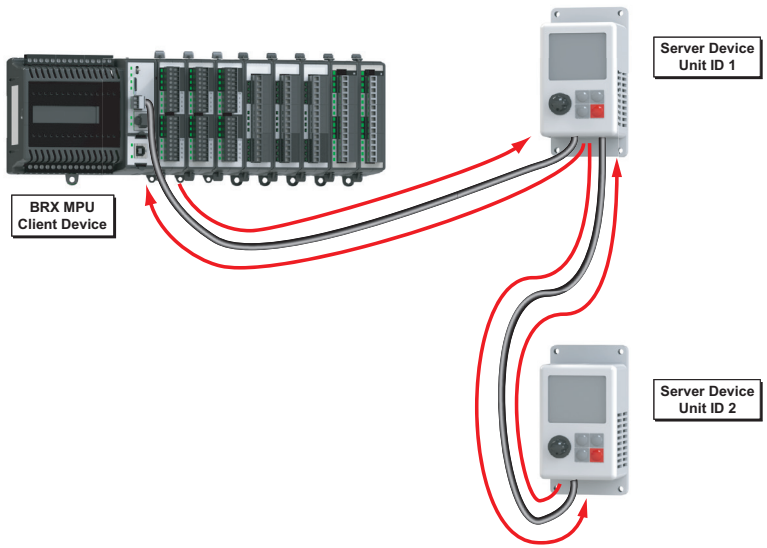
Serial Protocols, continued

The Modbus RTU Server (Slave) supports the following function codes:

Modbus	
Function Code	**Description**
1	Read coil
2	Read discrete inputs
3	Read holding registers
4	Read input registers
5	Write single coil
6	Write single registers
7	Read exception status
15	Write multiple coils
16	Write multiple registers
22	Mask write registers

Modbus RTU Client (Master)

As a Modbus RTU Client (Master), the BRX MPU is requesting data from a Modbus RTU Server (Slave) device. In order for this to work, you need to know quite a few things about your Server device such as the function codes that it supports, the data registers that are accessible and possibly the Unit ID or Slave Address.

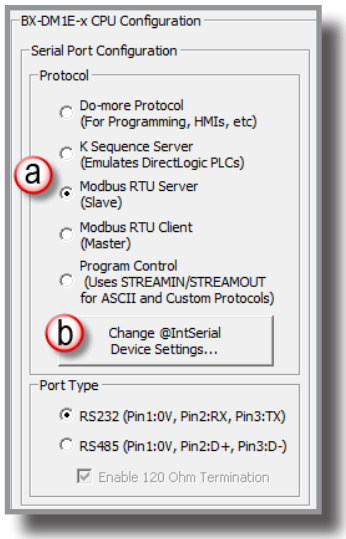


BRX MPU used as a Modbus RTU Client (Master) Example

Serial Protocols, continued

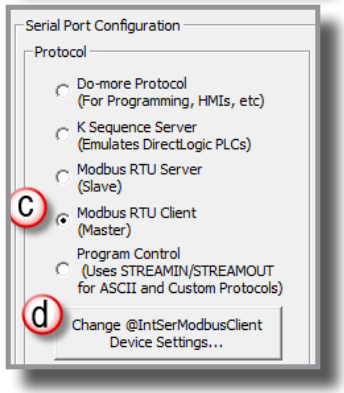
NOTE: *Only one Modbus RTU Client (Master) can be on a network.*

Opening the ***System Configuration*** dialog box you will find the **Serial Port Configuration** section where you can select the required protocol. Setting the serial port as (**a**) Modbus RTU Server (Slave), select (**b**) to create a the device @IntSerialDevice. This device will handle all of the communications with the external Modbus Servers (Slaves) through the serial port on the front of the BRX MPU.



As a Modbus RTU Client (Master), you do not have to sequence the MRX read and MWX write instructions. You can just drop them into your program and they will work in a round robin manner. However, sequencing the instructions will give you better control and allow you to build complex communication patterns to optimally communicate with your devices.

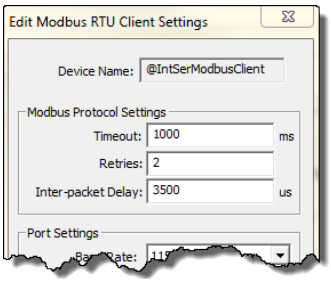
Selecting (**c**) **Modbus RTU Client (Master)** creates the device @IntSerModbusClient. Clicking on (**d**) brings up the ***EditModbus RTU Client Settings*** dialog box (below). Here you can configure Modbus Protocol Settings.



Timeout – Time in milliseconds that the instruction waits for the remote Modbus RTU Server to respond, this can be any constant from 0 to 32767.

Retries – The number of retries of the instruction to communicate with the remote Modbus RTU Server, this can be any constant from 0 to 255.

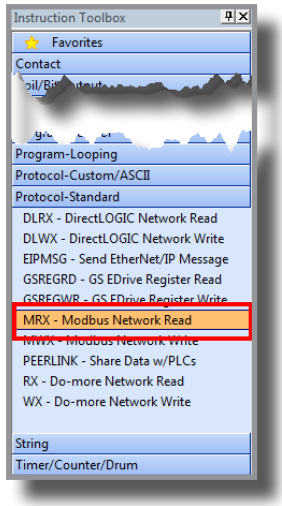
Inter-packet Delay – Time, in microseconds, that the Modbus/RTU Client will place between packets as they are sent, this can be any be any constant value between 0 and 65535.

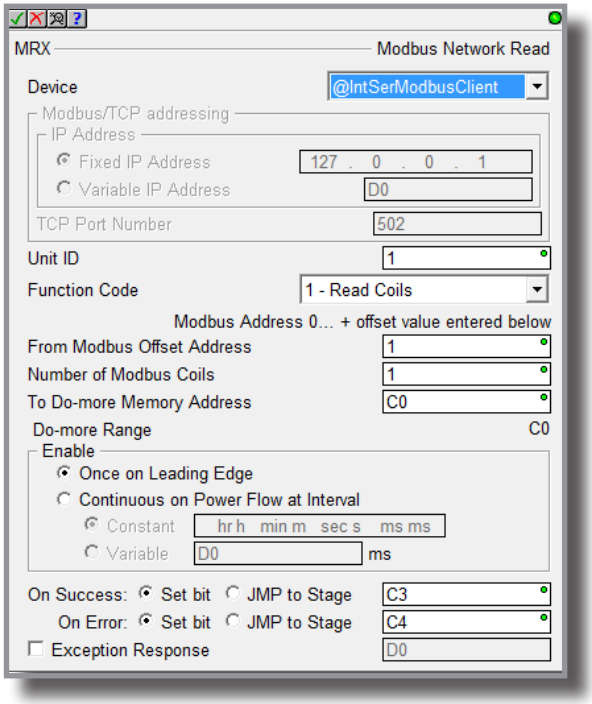


Communication instructions in Do-more! Designer have **Success** and **Error** feedback built in so that you can either set a bit or move to a Stage if you are doing stage style programming. There are examples of using Stage (state) programming in the software Help file that show how you could use this to implement a complex communications routine.

MRX Instruction

The MRX instruction, found in the ***Instruction Tool Box*** under the ***Protocol-Standard*** tab (right and below), is used to read from a Modbus RTU Server (Slave). (For more detailed information please refer to the Do-more! Designer Help files.)





Device – The device associated with the physical port that you want to communicate from. ***@IntSerModbusClient*** is the name of the device associated with the built in serial port when set as a Modbus Client (Master).

Unit ID – The ID number of the Server (Slave) device that the BRX MPU will talk to. Typically this is 1 for RS-232. For RS-485, this number could change depending on which device number you are talking to on the network.

Function Code – Select from the drop-down list one of the following Modbus function codes to use:

1 - Read Coils

2 - Read Discrete Inputs

3 - Read Holding Registers

4 - Read Input Registers

7 - Read Exception Status

MRX Instruction, continued

Modbus Address 0... + offset value entered below:

From Modbus Offset Address – The address in the Modbus Server (Slave) that you will be reading from. This address may be offset by a value of +1 depending on how the manufacturer followed the Modbus standard..

Number of Modbus Coils/ Registers – Based on the Function Code selected, this selection specifies how many consecutive elements to read. For example, if using function code 3, read holding registers, with an offset of 1, your request starts with MHR1, which corresponds to Modbus address 400001.

To Do-more Memory Address – Specifies the beginning address of a range of bits or numeric locations in the MPU where the data that is read will be stored. This data type (bit or register) must match the type expected by the Function Code.

Do-more Range – This is the ending register where the data will be stored at, calculated by taking the To Do-more Memory address and adding the Number of Modbus Coils/Registers value to it.

Enable – Designates how this instruction will operate. Select from one of the following:

Once on Leading Edge – Select this option to have this instruction run to completion exactly one time. Typically, this instruction will take more than one controller scan to complete. Configured this way the instruction is Edge Triggered.

Continuous on Power Flow at Interval – Select this option to have this instruction run as long as the instruction has power flow. After the instruction has initially run, if the instruction still has power flow, the instruction will remain enabled and will wait the specified amount of time before running again. The following options select how much time (in milliseconds) to wait between successive runs. A value of zero milliseconds (0ms) means the instruction will re-run immediately.

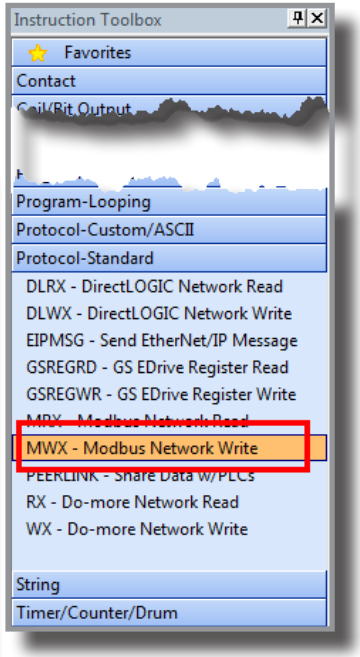
On Success – When the instruction completes successfully this action will be performed.

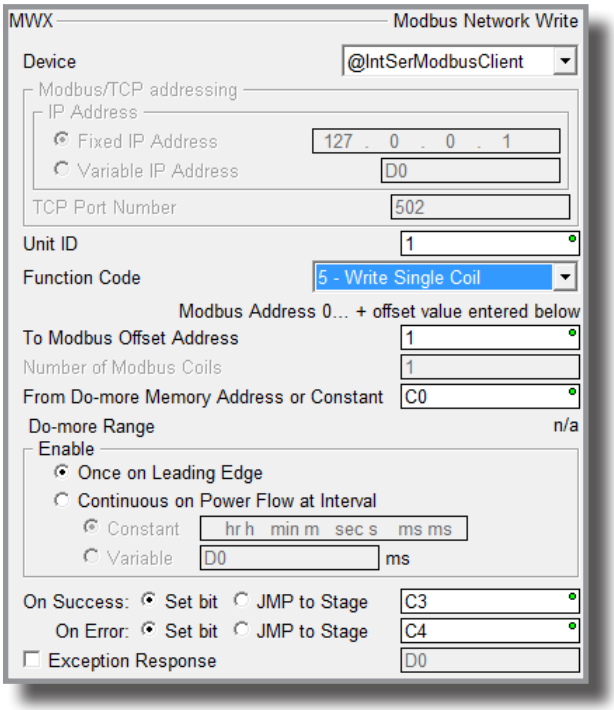
On Error – When the instruction does not successfully complete, this action will be performed.

Exception Response – For errors where the message was received properly by the Server (Slave) device, this will contain a value to indicate why the Server rejected the message. This can aid in troubleshooting the issue.

MWX Instruction

The MWX instruction, found in the ***Instruction Tool Box*** under ***Protocol - Standard*** (right and below), is used to write to a Modbus RTU Server (Slave). (For specific information please refer to the Do-more! Designer help files.)





Device – The device associated with the physical port that you want to communicate from. ***@IntSerModbusClient*** is the name of the device associated with the built in serial port when set as a Modbus Client (Master).

Unit ID – The ID number of the Server (Slave) device the BRX MPU is talking to. Typically this is 1 unless there are multiple devices on the network..

Function Code – Select from the drop-down list one of the following Modbus function codes to use:

5 - Write Single Coil

6 - Write Single Register

15 - Write Multiple Coils

16 - Write Multiple Registers

Modbus Address 0... + offset value entered below:

To Modbus Offset Address – The starting register to which you will be writing data. This address may be offset by a value of +1 depending on how the manufacturer followed the Modbus standard.

Number of Modbus Coils/ Registers – This selection specifies how many consecutive elements to write from the Modbus Offset Address. For example, if using function code 6,write a single register, with an offset of 1, it would write a value to Modbus address 400001.

From Do-more Memory Address – specifies the beginning address of a range of bits or numeric locations in the MPU to where the data will be written. This data type (bit or register) must match the type expected by the Function Code.

Do-more Range – This is the ending register from where the data will be written, calculated by taking the From Do-more! Memory address and adding the Number of Modbus Coils/ Registers value to it.

Enable – Designates how this instruction will operate. Select from one of the following:

Once on Leading Edge - Select this option to have this instruction run to completion exactly one time. Typically, this instruction will take more than one controller scan to complete. Configured this way the instruction is Edge Triggered.

Continuous on Power Flow at Interval - Select this option to have this instruction run as long as the instruction has power flow. After the instruction has initially run, if the instruction still has power flow, the instruction will remain enabled and will wait the specified amount of time before running again. The following options select how much time (in milliseconds) to wait between successive runs. A value of 0ms means the instruction will re-run immediately.

On Success – When the instruction completes successfully this action will be performed.

On Error – When the instruction does not complete successfully this action will be performed

Exception Response – For errors where the message was received properly by the Server (Slave) device, this will contain a value to indicate why the Server rejected the message. This can aid in troubleshooting the error issue.

K-Sequence

Server

The BRX Do-more! MPU can serve as a K-Sequence server to communicate to legacy devices that utilize the K-Sequence protocol such as DirectLogic PLC's, C-more HMI, SCADA systems, etc.

All K-Sequence data is stored in four sets of registers in the BRX Do-more! MPU. The memory area is blocked off specifically for K-Sequence communications. You must place data in these registers in order for a K-Sequence Client device to be able to access it.

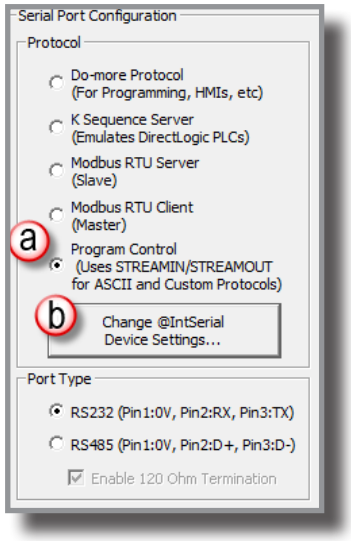
The K-Sequence data area is loosely data typed. Instructions such as Publish and Subscribe are used to communicate with a K-Sequence Client and then casting can be utilized to convert data in this area to the proper data type needed as well. Please see the Help file for more information on Casting, PUBLISH and SUBSCRIBE.

K-Sequence		
Register Type	**Register Name**	**Range**
Input Register	DLX	0–777
Output Register	DLY	0–777
Internal Coil Register	DLC	0–777
Internal Word Register	DLV	0–3777

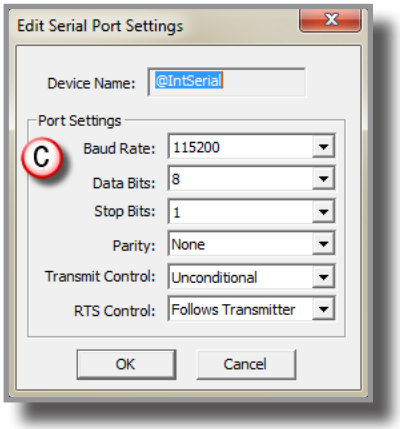
NOTE: *Ranges can be expanded in the Memory Configuration section of the Do-more! Designer software as needed.*

ASCII

The BRX Do-more! MPU can communicate with devices that utilize a non-sequenced or a custom protocol. When using ASCII messaging it is important to know how the external device communicates. This will require knowledge of how the external device expects to send and receive the data. Most ASCII devices have specification guidelines in the user manual that explain the methods needed to facilitate communications. Having this reference handy can be invaluable, saving time while programming instead of struggling with getting the communications working.

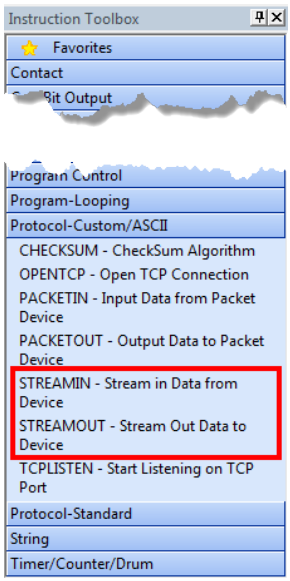


Utilizing ASCII as a messaging medium requires that the serial port (**a**) be set to **Program Control**. To configure the port settings select (**b**) the **Change @IntSerial Device Settings** button. This will bring up the (**c**) Edit Serial Port Settings dialog. **The communications settings here need to match those of the device you are communicating with.**



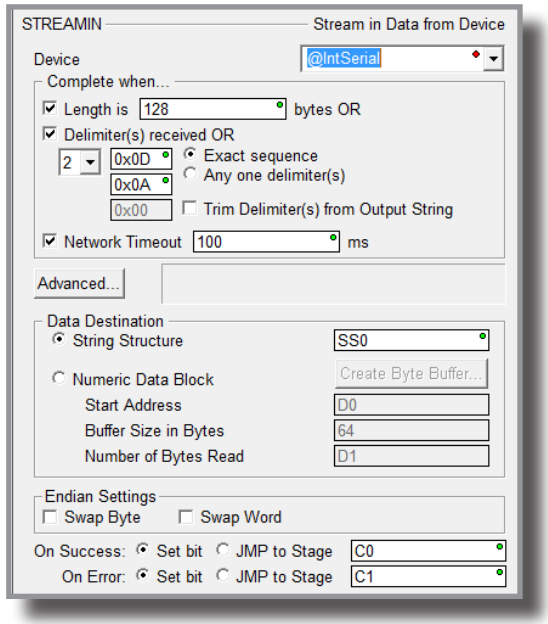
Once set, the STREAMIN and STREAMOUT instructions (right) can be utilized.

One beneficial feature of the BRX Do-more! MPU is that the serial ports are buffered so that bi-directional data transfer is possible without needing the external device to pause between sending and receiving.



STREAMIN Instruction

The STREAMIN instruction is found in the Instruction Tool Box under the Protocol-Custom/ASCII tab.



Device – The device name associated with the physical port to which you want to communicate. @IntSerial is the name of the device associated with the built in serial port for ASCII control.

Complete when...

Length is...bytes OR – Specifies the number of characters received that will signal the completion of the instruction. The OR is used if **Delimiter(s) received OR** is selected.

Delimiter(s) received OR – Message characters that once received will signal the completion of the instruction. The OR implements:

Exact sequence –
The specified characters must be receive in the order specified

Any one delimiter(s) – Receipt of any of the specified characters will signal completion.

Trim Delimiter(s) from Output String – Removes the delimiter characters from the Data Destination.

Network Timeout – The maximum amount of time that the instruction waits for completion.

Advanced – When selected a text box opens on the right. Allows the backspace character to remove characters from the received string before being placed into the Data Destination.

Data Destination

String Structure – The String memory location for the incoming data to be stored.

Numeric Data Block

Start Address – The offset into the Byte Buffer Data Block to store the incoming data.

Create Byte Buffer – Creates a data block of bytes to store the incoming data.

Buffer Size in Bytes – The maximum number of bytes that will be placed in the Byte Buffer Data Block.

Number of Bytes Read – Stores the number of bytes that were read into the Byte Buffer Data Block.

Endian Settings

Swap Byte – Swaps the bytes in each word of incoming data.

STREAMIN Instruction, Continued

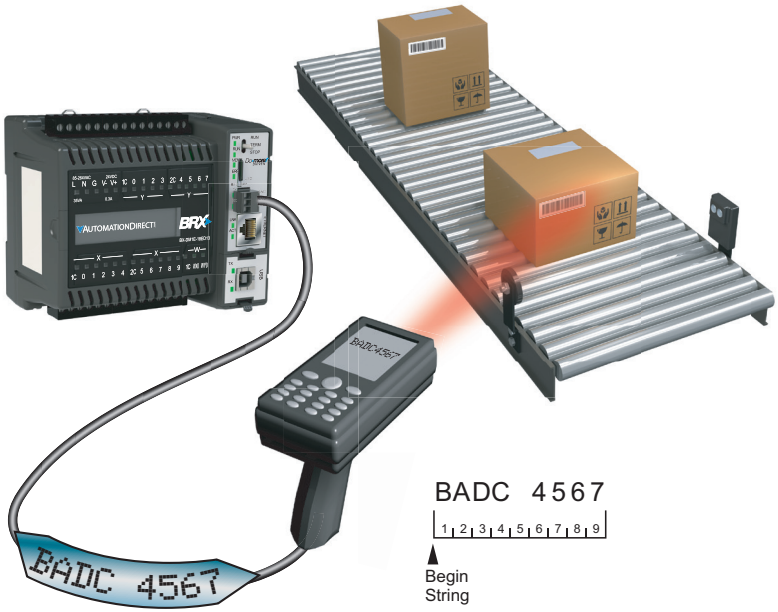
Swap Word – Swaps the words in each Double Word of incoming data.

On Success – When the instruction completes successfully this action will be performed.

On Error – When the instruction does not complete successfully this action will be performed.

Example using STREAMIN instruction.

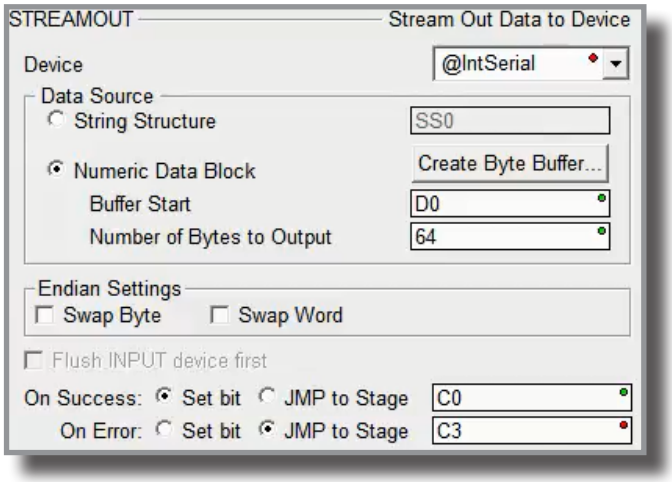
A barcode reader is an example of using STREAMIN and ASCII messaging. The string "BADC 4567" represented by the barcode is transmitted to the MPU as ASCII text with the use of the STREAMIN instruction.



NOTE: *Using @IntSerial.InQueue > 0 is the best way to trigger the STREAMIN function.*

STREAMOUT Instruction

The STREAMOUT instruction is found in the Instruction Tool Box under the Protocol-Custom/ASCII tab.

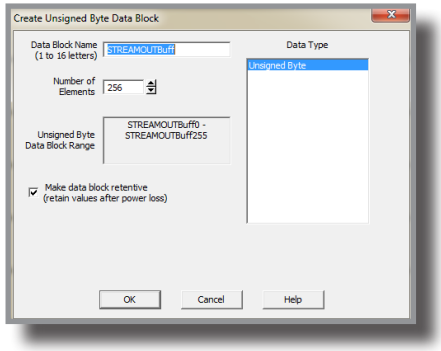


Device – The device associated with the physical port from which you want to communicate. ***@IntSerial*** is the name of the device associated with the built in serial port for ASCII control.

Data Source

String Structure – The String memory location that contains the data to be transmitted.

Numeric Data Block



- **Create Byte Buffer...** – Only available when **Numeric Data Block** is selected. Clicking this button opens ***Create Unsigned Byte Data Block*** box (right). Here you will name and create a data block of bytes to store the data to be transmitted.
- **Buffer Start** – The offset into the Byte Buffer Data Block for the data to be transmitted.
- **Number of Bytes to Output** – The number of bytes that will be transmitted.

Endian Settings

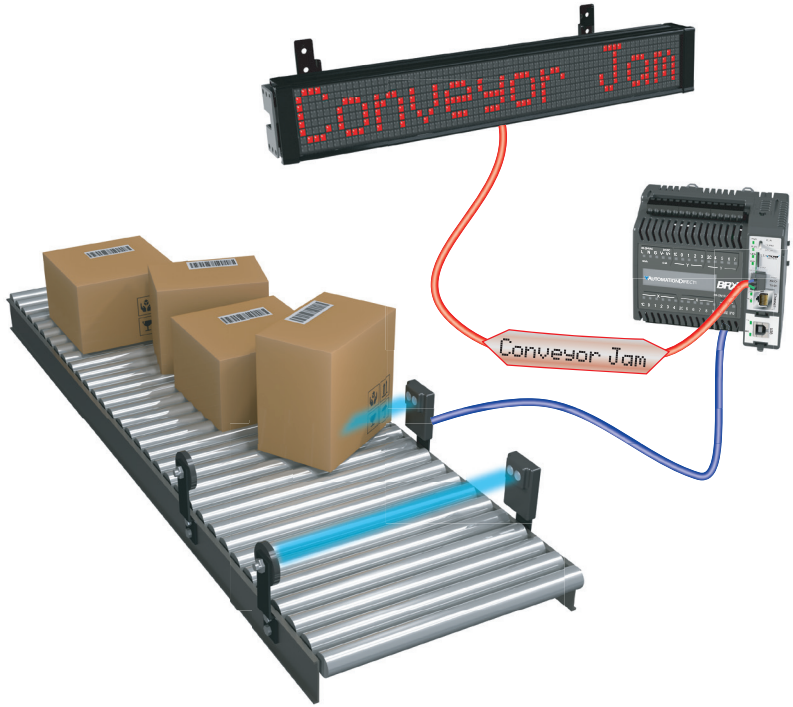
- **Swap Byte** – Swaps the bytes in each word of incoming data.
- **Swap Word** – Swaps the words in each Double Word of incoming data.

Flush INPUT device first – Clears the input buffer to ready it for a return response.

Example using STREAMOUT Instruction.

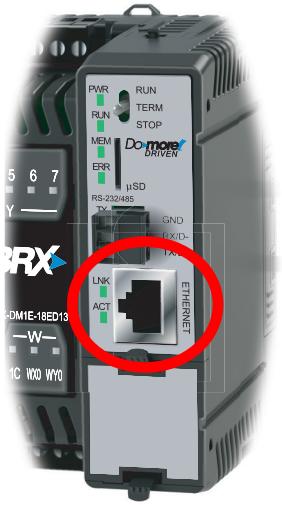
The example below uses the STREAMOUT instruction and ASCII messaging.

A sensor on the conveyor triggers a conveyor jam event in the program. The string "Conveyor Jam" is transmitted as ASCII text with the use of the STREAMOUT instruction.



Ethernet

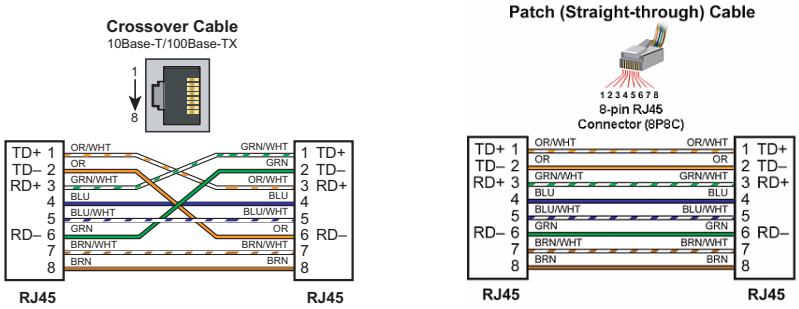
The RJ-45 Ethernet port connector is located on the CPU faceplate. Rated at 10/100 Mbps, it accepts standard CAT5e cable and has built-in auto-crossover capability; no crossover cable is required.



Ethernet Port Specifications	
Port Name	ETHERNET
Ethernet Port Type	RJ45, CAT5e, 10/100 BASE-T, Auto Crossover
Description	Standard transformer isolated Ethernet port with built-in surge protection
Transfer Rate	10 Mbps (Orange LED) and 100 Mbps (Green LED)
Port Status LED	LED is solid when network LINK is established. LED flashes when port is active (ACT).
Supported Protocols	Do-more! Protocol Ethernet Remote I/O Modbus TCP/IP (Client & Server) EtherNet/IP (Explicit Messaging) HOST ECOM (DirectLogic) SMTP (Email), SNTP (Time Server) TCP/IP, UDP/IP (Raw packet)
Cable Recommendation	C5E-STxxx-xx from AutomationDirect.com
Ethernet Port Numbers	
Modbus TCP/IP	502 (configurable), TCP
EtherNet I/P (Explicit Messaging)	44818 (configurable), UDP
HOST ECOM	28784, UDP
Do-more! Protocol	28784, UDP

Wiring

The Ethernet port on the BRX Do-more! CPU's utilizes standard networking cables and devices. Category 5e cabling is preferred. Cables can be either patch (straight through) or crossover as the BRX Do-more! CPU Ethernet port has Auto MDI detection.



IP Addressing and Subnets

IP Addresses (used in conjunction with the Subnet Mask and Default Gateway address) are used for network routing. This allows for easy and logical separation of networks. It is outside of the scope of this user manual to explain how IP Addresses and Subnet masks are configured for actual usage. There are many books, documents and tools (Subnet calculators) on the Internet that provide this information. Each facility and network will incorporate their own rules and guidelines for how their networks are to be configured.

We suggest that users maintain their IP addressing and Subnets according to common networking practices by using private network addressing when at all possible. Examples of private addressing IP ranges can be found in the table below.

IP Addressing and Subnets

IP Address Range	Typical Subnet	Classful Description
192.168.0.0–192.168.255.255	255.255.0.0	Class C Network
172.16.0.0–172.31.255.255	255.240.0.0	Class B Network
10.0.0.0–10.255.255.255	255.0.0.0	Class A Network

NOTE: *Notice that the IP range of 169.254.0.1 – 169.254.255.254 is not listed above. This range is reserved for APIPA addressing and is not recommended for use with most networks.*

Port Numbers

When doing TCP and UDP/IP communications, there is a Source Port number and Destination Port number for every message. The Client device must be aware of the Destination Port Number(s) the Server device is expecting to see, while the Server device must listen for this Destination Port number. After the Server device has received the message with the Destination Port Number on which it is listening, it will formulate the return message (if the applications require this) with the Source Port Number from the message sent as its Destination Port Number.

It is important to understand a little about the Port numbering concept because many Ethernet devices, such as routers with firewalls, will block messages with Destination Port numbers that are not configured for that device. Listed below are the default Port Numbers used in the BRX Do-more! platform. Some of the Port Numbers are configurable, allowing more flexibility when going through many different router applications.

Default Port Numbers

Ethernet	Port Numbers	TCP or UDP	Configurable
Peerlink	28784	UDP	No
Do-more! Protocol (Client, Server)	28784	UDP	Yes[1]
Modbus TCP (Client, Server)	502	TCP	Yes
HOST ECOM Protocol (Client, Server)	28784	UDP	No
EtherNet/IP (Explicit Messaging (Client, Server))	44818	TCP	Yes
Ethernet Remote I/O	28784	UDP	No
SMTP (Email)	25	TCP	Yes
SNTP (Time Server)	123	TCP	No
TCP Raw Packet	--	TCP	Yes
UDP Raw Packet	--	UDP	Yes

[1] Secondary Ethernet Connection can be enabled for the built-in Ethernet port of a BRX MPU. By default it has a UDP Port Number of 5000. It can be configured to any decimal number between 5000 and 65535, except for 28784.

While all of these protocols can be enabled on the BRX Do-more! CPU Ethernet port, it should be noted that Ethernet has a finite amount of traffic that can be handled. The amount of traffic load on the Ethernet port should be considered and polling times for Clients and Servers adjusted accordingly to allow ample time for the BRX Do-more! CPU to respond to and create requests for other devices.

NOTE: *Care should be taken when adding a BRX Do-more! MPU to an existing network as some protocols can create a significant traffic load.*

Ethernet Protocols

The BRX Do-more! MPU has several Ethernet Protocol choices for communicating to external devices. In this section we will go over the choices and describe each choice.

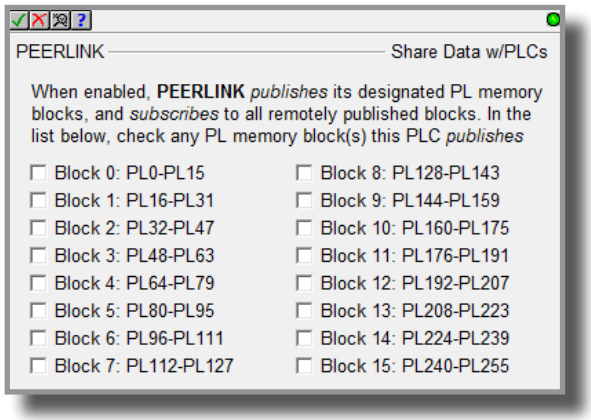
Ethernet Protocols
Peerlink
Do-more! Protocol (Client, Server)
Modbus TCP (Client, Server)
HOST ECOM Protocol (Client, Server)
EtherNet/IP (Explicit Messaging (Client, Server))
SMTP (Email)
SNTP (Time Server)
TCP Raw Packet
UDP Raw Packet

PEERLINK Instruction

The PEERLINK instruction allows easy data sharing across any PLC that is running Do-more! technology.

To set this instruction up, place your data into the appropriate PL (PEERLINK) registers that you wish this PLC to share to other Do-more! PLCs. Then check the box that corresponds to that memory area.

When this instruction is enabled, it will then automatically broadcast this information to all other Do-more! PLC's that are listening with a PEERLINK instruction.



To listen for broadcasts from other Do-more! PLC's, all you have to do is place the instruction in your ladder code. If this PLC is not sharing data, do not check any boxes. Incoming data will automatically be placed into the same register area that the broadcasting PLC has checked.

Using PUBLISH and SUBSCRIBE instructions can help to get data into and out of the PL memory area as the PL memory area is untyped data. See the Do-more! Designer help file for more information on PEERLINK, PUBLISH and SUBSCRIBE instructions.

NOTE: *Keep in mind that multiple Do-more! PLC's cannot broadcast to the same memory area. This will cause an error.*

Do-more! Protocol

The Do-more! protocol is a proprietary protocol that is used exclusively by the Do-more! family of controllers. This is a very feature rich and secure protocol for communication with the Do-more! Designer software and between Do-more! controllers. It can also be used to communicate between multiple Do-more! controllers or between some brands of HMI's, such as C-more, to a Do-more! controller. Some SCADA systems such as POV also support the Do-more! Protocol.

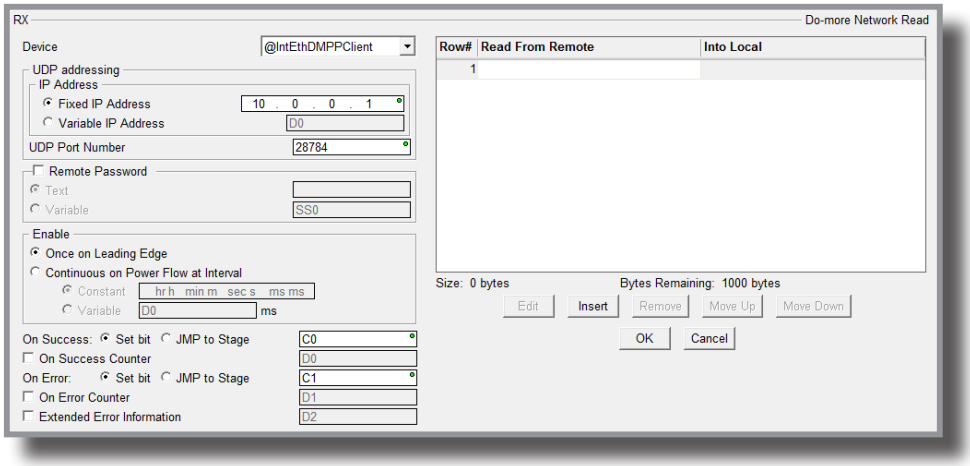
RX

The Do-more! Network Read (RX) instruction uses the Do-more! proprietary protocol to read incoming data on the on-board Ethernet port from another Ethernet-equipped Do-more! CPU. RX uses UDP (not TCP) protocol to communicate with the remote Do-more! CPU.

Each RX instruction can contain up to 50 individual read requests for a total of up to 1000 bytes of data. The RX instruction can read from all of the built-in memory blocks, all of the built-in structures, and any user-created memory blocks from the remote PLC. RX does NOT support reading a Heap Item from a remote Do-more! CPU.

In contrast to DirectLOGIC (DLRX / DLWX) and Modbus/TCP (MRX / MWX) network communication which only has access to the protocol-specific memory blocks in the remote CPUs, Do-more! RX has direct access to nearly all of the memory in the remote Do-more! CPU - including direct access to the CPU I/O memory.

The RX instruction establishes a session with the remote Do-more! CPU. The session is established using one of the User Accounts on the remote Do-more! CPU. It is through that User Account (System Security) that any access restrictions on what can be accessed can be enforced. By default it will use the Default User account (no password required).



RX, continued

IP Address – The IP Address of the Do-more! CPU to read the data from. This can be either a Fixed (static) IP Address or a Variable (dynamic) value.

Fixed IP Address – The TCP Address assigned to the Do-more! CPU. IP addresses are canonically represented in dot-decimal notation, consisting of four decimal numbers, each ranging from 0 to 255, separated by dots.

Variable IP Address – The IP Address resides in the specified memory location. This can be any readable DWord numeric location.

UDP Port Number – The port number of the Do-more! CPU) to read the data from. The default value of 28784 (0x7070) is typically the correct number for Do-more! protocol. It is possible to use a different UDP Port Number if the Enable Secondary Ethernet Connection is turned on under the CPU Configuration settings. This secondary UDP Port Number defaults to 5000. This UDP Port Number can be any decimal value between 5000 and 65535, except for 28784 (the port number used by Do-more Designer)..

Remote Password – The RX instruction requires that a communication session be established with the remote Do-more! CPU before the data read operations can be processed. Depending on how the remote system is configured, this may require the user to enter the password for the User Account to allow the session to be established. If no remote password is selected, the connection will be established using the Default User account.

Enable – Designates how this instruction is enabled. Select from one of the following:

Once on Leading Edge – Select this option to have this instruction run to completion exactly one time. Typically, this will take more than one controller scan. Configured this way the Do-more! Network Read (RX) instruction is Edge Triggered.

Continuous on Power Flow at Interval – Select this option to have this instruction run as long as the instruction has power flow. After the Do-more! Network Read (RX) has initially run, if the instruction still has power flow, the instruction will remain enabled and will wait the specified amount of time before running again. The following options select how much time (in milliseconds) to wait between successive runs.

- **Constant** – specifies the interval time in Hours / Minutes / Seconds / Milliseconds.
- **Variable** – This can be any readable numeric location that contains a value between 0 and 2,147,483,647 which represents the number of milliseconds to wait before running again. A value of 0 ms means this instruction will be set to run on the next scan.

On Success – Selects which of the following actions to perform if the Network Read operation is successful:

Set Bit – Enable this selection then specify any writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code-block.

On Success Counter – Enable this option and select a DWord location to store the total number of times the RX completed successfully. This can be any DWord location.

On Error – Selects which of the following actions to perform if the Network Read operation

RX, continued

is unsuccessful:

Set Bit – Enable this selection then specify writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code-block.

On Error Counter – Enable this option and select a DWord location to store the total number of times the RX failed to complete. This can be any DWord location.

Extended Error Information – Enable this selection then enter a memory location to store any error codes returned for this instruction. This can be any writable numeric location. The list following is of the Extended error responses and their meaning:

-1 = Protocol Error occurred. The value in LastProtoError (DST38) contains the protocol error code as follows:

2 (**0x02**) = Out Of Sessions: the remote PLC currently has 32 concurrent connections and cannot accept any more.

3 (**0x03**) = Illegal Operation: the User Account for the password in the instruction does not have Write Data privilege.

4 (**0x04**) = Invalid Session: an error occurred with the session to the remote PLC, for example the remote PLC lost power during the session.

6 (**0x06**) = Invalid Argument: the write requests are not formed properly (you should never see this).

14 (**0x0E**) = Invalid Password: the password in the instruction does not match any User Account in the remote PLC,

20 (**0x14**) = Bad DMPP Request: one or more of the write requests cannot be processed, most likely the request is for a location that is out of range on the remote PLC or the memory block doesn't exist on the remote PLC. The Extended Error location will contain the entry number of the write request that is causing the error.

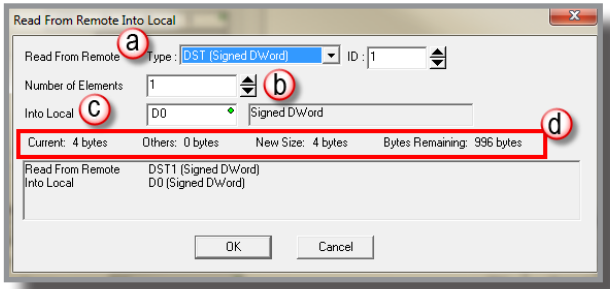
0 = No Extended Error

1 – 50 = row number of the bad read request if the Last Protocol Error Code was 20 (0x14).

Insert – Select Insert to open ***Read From Remote Into Local*** setup dialog box (See page following).

RX, continued

Read From Remote Into Local



Read From Remote – The first location in the remote PLC to begin reading data:

Type (**a**) – The Block Name of the remote memory location to read. This drop-down list contains an entry for all of the built-in memory data blocks, all of the built-in structures, and an entry for a User Block that exists on the remote PLC.

Number of Elements (**b**) – The number of consecutive elements to read.

Into Local (**c**) – The beginning location in the PLC to store the data from the read operation. The Into Local location must be the same data type and have the same element size as the specified Read From Remote data location. For example you can read from WY (Signed Word) into N (Signed Word) but you cannot read from WY (Signed Word) into V (Unsigned Word).

The remaining fields (**d**) are to help you maintain the size limitations. Fields validate immediately as you make changes in the editor.

Current – The number of bytes in the read request currently being edited.

Others – The number of bytes in the read requests already in this instruction.

New Size – The total number of bytes of all the read requests in the instructions, including the one currently being edited.

Bytes Remaining – The number of bytes of the 1000 byte limit remaining for read requests.

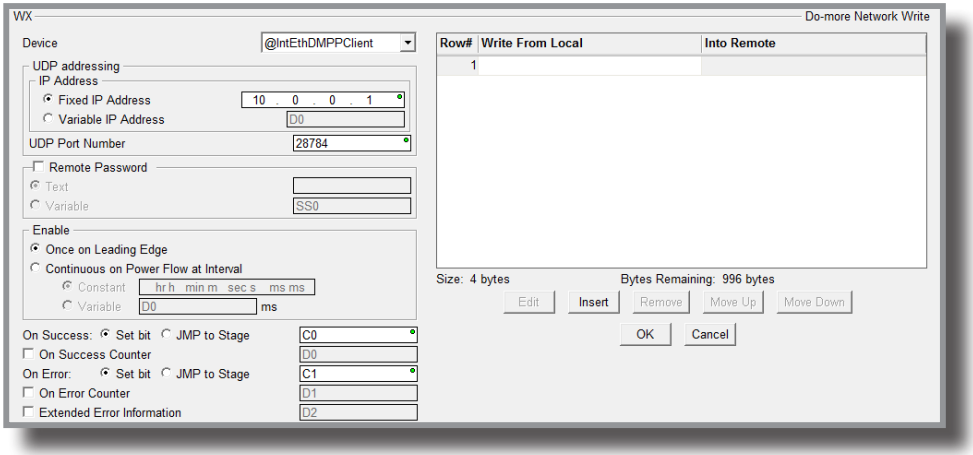
WX

The Do-more! Network Write (WX) instruction uses the Do-more! proprietary protocol to write data over the on-board Ethernet port to another Ethernet-equipped Do-more! CPU. WX uses UDP (not TCP) protocol to communicate with the remote Do-more! CPU.

Each WX instruction can contain up to 50 individual write requests for a total of up to 1000 bytes of data. The WX instruction can write to all of the built-in memory blocks, all of the built-in structures, and any user-created memory blocks in the remote PLC. WX does NOT support writing to a Heap Item in the remote Do-more! CPU.

In contrast to DirectLOGIC (DLRX / DLWX) and Modbus/TCP (MRX / MWX) network communication which only has access to the protocol-specific memory blocks in the remote CPUs, Do-more! WX has direct access to nearly all of the memory in the remote Do-more! CPU – including direct access to the PLC's I/O memory.

The WX instruction establishes a session with the remote Do-more! CPU. The session is established using one of the User Accounts on the remote Do-more! CPU. It is through that User Account (System Security) that any access restrictions on what can be accessed can be enforced. By default it will use the Default User account (no password required).



IP Address – The IP Address of the Do-more! CPU to write the data to. This can be either a Fixed (static) IP Address or a Variable (dynamic) value.

Fixed IP Address – The TCP Address assigned to the Do-more! CPU. IP addresses are canonically represented in dot-decimal notation, consisting of four decimal numbers, each ranging from 0 to 255, separated by dots.

Variable IP Address – The IP Address resides in the specified memory location. This can be any readable DWord numeric location.

UDP Port Number – The port number of the Do-more! CPU) to write the data to. The default value of 28784 (0x7070) is typically the correct number for Do-more! protocol. It is possible to use a different UDP Port Number if the Enable Secondary Ethernet Connection is turned on under the CPU Configuration settings. This secondary UDP Port Number defaults

WX, continued

to 5000. This UDP Port Number can be any decimal value between 5000 and 65535, except for 28784 (the port number used by Do-more Designer).

Remote Password – The WX instruction requires that a communication session be established with the remote Do-more! CPU before the data write operations can be processed. Depending on how the remote system is configured, this may require the user to enter the password for the User Account to allow the session to be established. If no remote password is selected, the connection will be established using the Default User account.

Enable – Designates how this instruction is enabled. Select from one of the following:

Once on Leading Edge – Select this option to have this instruction run to completion exactly one time. Typically, this will take more than one controller scan. Configured this way the Do-more Network Write (WX) instruction is Edge Triggered.

Continuous on Power Flow at Interval – select this option to have this instruction run as long as the instruction has power flow. After the Do-more! Network Write (WX) has initially run, if the instruction still has power flow, the instruction will remain enabled and will wait the specified amount of time before running again. The following options select the time (in milliseconds) delay between successive runs.

Constant - specifies the interval time in Hours / Minutes / Seconds / Milliseconds.

Variable - This can be any readable numeric location that contains a value between 0 and 2,147,483,647 which represents the number of milliseconds to wait before running again. A value of 0 ms means this instruction will be set to run on the next scan.

On Success – Selects which of the following actions to perform if the Network Write operation is successful:

Set Bit – Enable this selection then specify any writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code-block.

On Success Counter – Enable this option and select a DWord location to store the total number of times the WX completed successfully. This can be any DWord location.

WX, continued

On Error – Selects which of the following actions to perform if the Network Write operation is unsuccessful:

Set Bit – Enable this selection then specify writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code-block.

On Error Counter – Enable this option and select a DWord location to store the total number of times the RX failed to complete. This can be and DWord location.

Extended Error Information – Enable this selection then enter a memory location to store any error codes returned for this instruction. This can be any writable numeric location. The following lists the Extended error responses and their meaning:

-1 = Protocol Error occurred. The value in LastProtoError (DST38) contains the protocol error code as follows:

2 (**0x02**) = Out Of Sessions: the remote PLC currently has 32 concurrent connections and cannot accept any more.

3 (**0x03**) = Illegal Operation: the User Account for the password in the instruction does not have Write Data privilege.

4 (**0x04**) = Invalid Session: an error occurred with the session to the remote PLC, for example the remote PLC lost power during the session.

6 (**0x06**) = Invalid Argument: the write requests are not formed properly (you should never see this).

14 (**0x0E**) = Invalid Password: the password in the instruction does not match any User Account in the remote PLC.

20 (**0x14**) = Bad DMPP Request: one or more of the write requests cannot be processed, most likely the request is for a location that is out of range on the remote PLC or the memory block doesn't exist on the remote PLC. The Extended Error location will contain the entry number of the write request that is causing the error.

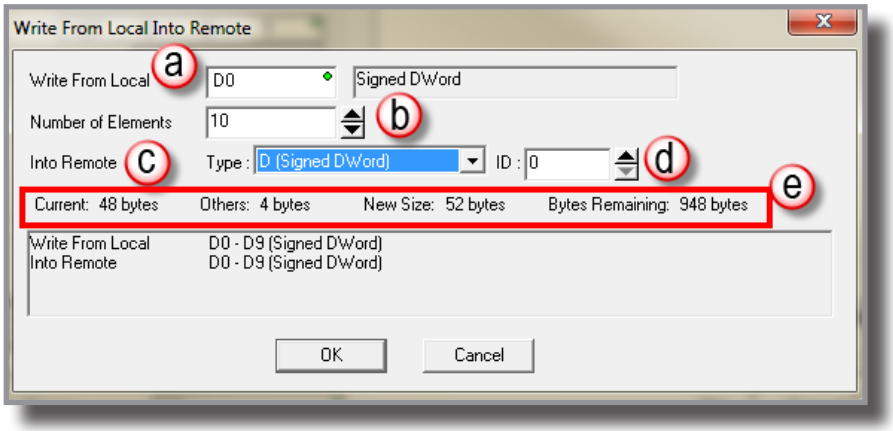
0 = No Extended Error

1 – 50 = Row number of the bad read request if the Last Protocol Error Code was 20 (0x14).

Insert – Select Insert to open Write From Local Into Remote dialog box.

WX, continued

Write From Local Into Remote



Write from Local (**a**) – The first location of the source data in the Local PLC:

Number of Elements (**b**) – The number of consecutive elements to write.

Into Remote (**c**) – The beginning location in the remote PLC to store the data from the write operation. The Into Remote location must be the same data type and have the same element size as the specified Write From Local data location. For example you can write from WY (Signed Word) into N (Signed Word) but you cannot write from WY (Signed Word) into V (Unsigned Word).

ID (**d**) – The beginning offset to write the data.

The remaining fields (**e**) are to help you maintain the size limitations. These fields validate immediately as you make changes in the editor.

Current – The number of bytes in the read request currently being edited.

Others – The number of bytes in the read requests already in this instruction.

New Size – The total number of bytes of all the read requests in the instructions, including the one currently being edited.

Bytes Remaining – The number of bytes of the 1000 byte limit remaining for read requests.

Modbus TCP/IP

Modbus TCP is a protocol overseen by Modbus.org. This standard is an open standard meaning that anyone can utilize it freely.

Modbus TCP can be utilized as either a client or server configuration. It supports Clients and Servers in a Peer to Peer fashion.

Server

As a Modbus TCP Server (Slave), the BRX Do-more MPU is functioning as a listening/replying device. The external Client (Master) device will request data registers from the BRX Do-more! and the BRX Do-more! will reply with the appropriate data.

All Modbus Client data is stored in four sets of registers in the BRX Do-more!. This memory area is blocked off specifically for Modbus communications. You must place data in these registers in order for a Modbus Client device to be able to access it.

Modbus Data Registers

Register Type	Register Name	Range
Holding Coil	MC	00000–01023
Input Coil	MI	10000–11023
Holding Register	MHR	30000–32047
Input Register	MIR	40000–42047

The Modbus data area is loosely data typed and casting or other instructions such as PUBLISH and SUBSCRIBE can be utilized to convert data in this area to the proper data type needed as well. Please see the help file for more information on casting, PUBLISH and SUBSCRIBE.

NOTE: *Ranges can be expanded in the Memory Configuration section of the Do-more! Designer software as needed.*

The Modbus TCP Server (Slave) supports the following function codes:

Function Code	Description
1	Read Coils
2	Read Discrete Inputs
3	Read Holding Registers
4	Read Input Registers
5	Write Single Coils
6	Write Single Registers
7	Read Exception Status
15	Write Multiple Coils
16	Write Multiple Registers
22	Mask Write Register

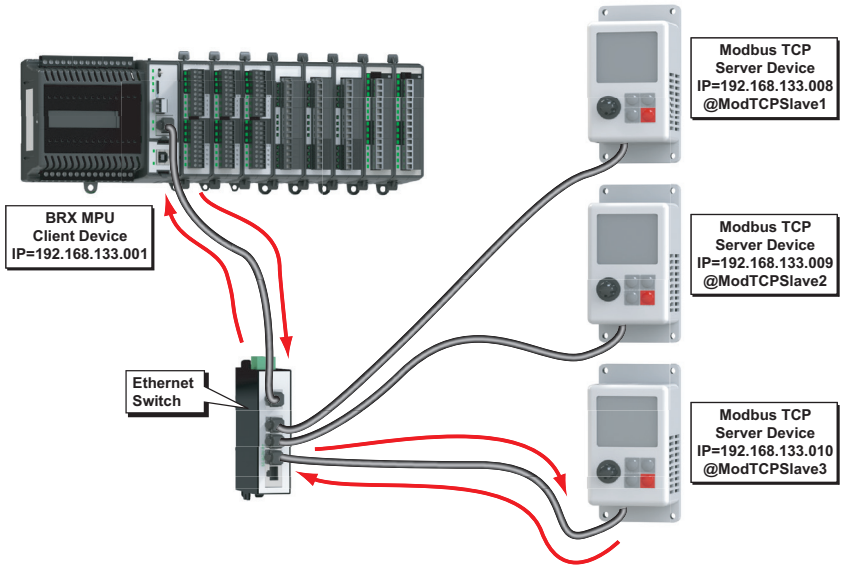
Modbus TCP Client (Master)

As a Modbus TCP Client (Master), the BRX Do-more! MPU is requesting data from a Modbus TCP Server (Slave) device.

In order for this to work, you need to know quite a few things about your Server (Slave) device such as the function codes that it supports, the data registers that are accessible and possibly the Unit ID or Slave Address.

In order to utilize the BRX Do-more! as a Modbus TCP Client you will need to create a Modbus TCP Client Device. This device will handle all of the communications with the external Modbus servers by using the Ethernet port on the front of the BRX MPU.

Note that there is a default @IntMODTCPClient device created automatically. You can choose to use this device, however we strongly recommend that you make a new Device for each Modbus TCP server that you will be communicating with. This will allow simultaneous communications to flow uninterrupted if one of the Modbus TCP servers goes offline.

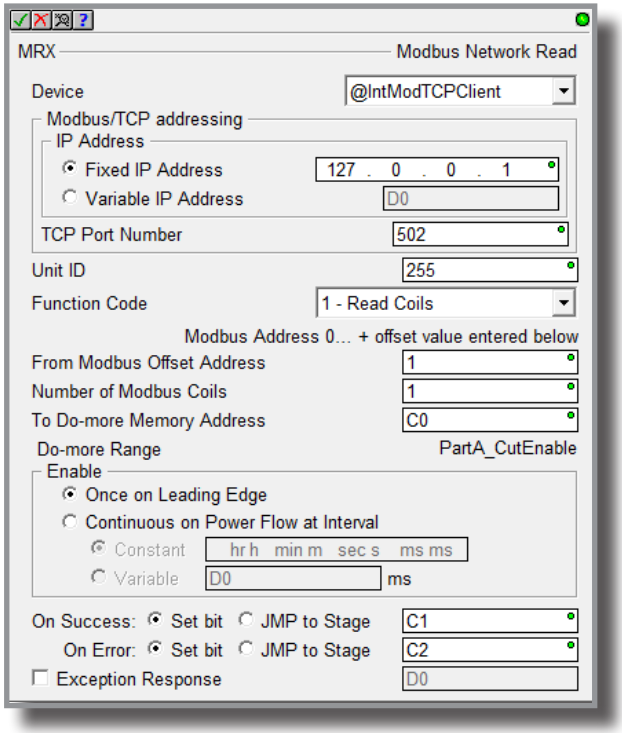


As a Modbus TCP Client, you do not have to sequence the MRX read and MRX write instructions. If you are so inclined, you can just drop them into your program and they will work in a round robin manner. However, sequencing the instructions will give you better control and allow you to build complex communication patterns to optimally communicate with your devices.

The communications instructions in Do-more! Designer have Success and Error built into the instructions so that you can either set a bit or move to a Stage if you are doing state style programming. There are examples of using Stage (state) programming in the software help file to show how you could use this to implement a complex communications routine.

MRX Instruction

The MRX instruction is used to read from a Modbus TCP Server. Following is a brief description of the MRX instruction parameters. For more detailed information please refer to the Do-more! Designer help files.



Device – The device associated with the physical port that you want to communicate from. @IntModTCPClient is the name of the device associated with the built in Ethernet port when set as a Modbus TCP Client. We strongly recommend that you make a new Device for each Modbus TCP server that you will be communicating with. This will allow simultaneous communications to flow uninterrupted if one of the Modbus TCP servers goes offline.

IP Address – The IP Address of the Modbus TCP Server (Slave) to read the data from. This can be either a Fixed (static) IP Address or a Variable (dynamic) value.

Fixed IP Address – The TCP Address assigned to the Modbus TCP Server (Slave). IP addresses are canonically represented in dot-decimal notation, consisting of four decimal numbers, each ranging from 0 to 255, separated by dots.

Variable IP Address – The IP Address resides in the specified memory location. This can be any readable DWord numeric location.

TCP Port Number – This should normally be set to 502 unless the end device has had the default port number changed.

Unit ID – The ID number of the Server (Slave) device. Typically this is 255 unless you are talking to a Modbus Serial Gateway style of device.

Function Code – selects which of the following Modbus function codes to use:

1 - Read Coils

2 - Read Discrete Inputs

3 - Read Holding Registers

4 - Read Input Registers

7 - Read Exception Status

MRX Instruction, continued

From Modbus Offset Address – The address in the Modbus Server (Slave) that you will be reading from. This address may be offset by a value of +1 depending on how the manufacturer followed the Modbus standard.

Number of Modbus Coils/ Registers – Based on the Function Code selected, this selection specifies how many consecutive elements to read.

To Do-more Memory Address – Specifies the beginning address of a range of bits or numeric locations in the CPU where the data that is read will be stored. This data type (bit or register) must match the type expected by the Function Code.

Do-more Range – This is the ending register where the data will be stored at, calculated by taking the **To Do-more Memory** address and adding the **Number of Modbus Coils/Registers** value to it.

Enable – Designates how this instruction will operate. Select from one of the following:

Once on Leading Edge - Select this option to have this instruction run to completion exactly one time. Typically, this instruction will take more than one controller scan to complete. Configured this way the instruction is Edge Triggered.

Continuous on Power Flow at Interval - Select this option to have this instruction run as long as the instruction has power flow. After the instruction has initially run, if the instruction still has power flow, the instruction will remain enabled and will wait the specified amount of time before running again. The following options select how much time (in milliseconds) to wait between successive runs. A value of 0ms means the instruction will re-run immediately.

On Success – When the instruction completes successfully this action will be performed.

Set Bit – Enable this selection then specify any writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code-block.

On Error – When the instruction does not complete successfully this action will be performed.

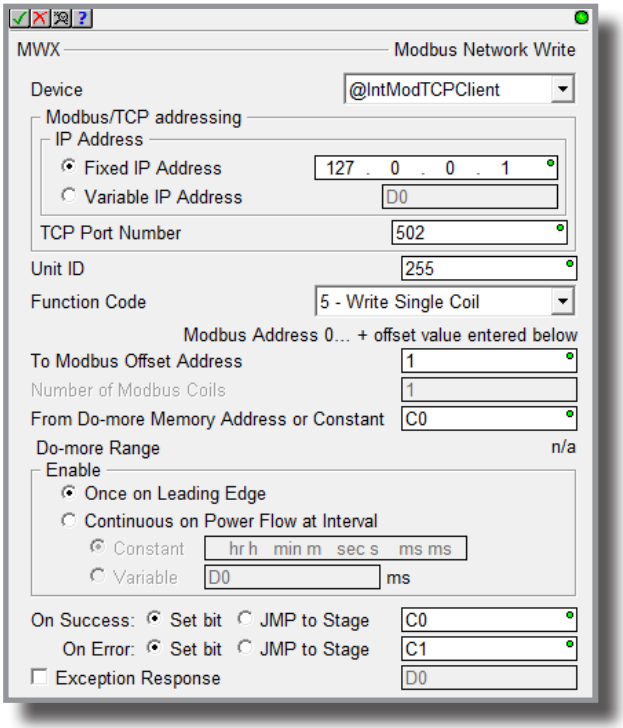
Set Bit – Enable this selection then specify any writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code-block.

Exception Response – For errors where the message was received properly by the Server (Slave) device, this will contain a value to indicate why the Server rejected the message. This can aid in troubleshooting the issue with the message.

MWX Instruction

The MWX instruction is used to write to a Modbus TCP Server. For specific information please refer to the Do-more! Designer help files.



Device – The device associated with the physical port that you want to communicate from. @IntModTCPClient is the name of the device associated with the built in Ethernet port when set as a Modbus TCP Client. We strongly recommend that you make a new Device for each Modbus TCP Server (Slave) that you will be communicating with. This will allow simultaneous communications to flow uninterrupted if one of the Modbus TCP servers goes offline.

IP Address – The IP Address of the Modbus TCP Server (Slave) to read the data from. This can be either a Fixed (static) IP Address or a Variable (dynamic) value.

Fixed IP Address – The TCP Address assigned to the Modbus TCP Server (Slave). IP addresses are canonically represented in dot-decimal notation, consisting of four decimal numbers, each ranging from 0 to 255, separated by dots.

Variable IP Address – The IP Address resides in the specified memory location. This can be any readable DWord numeric location.

MWX Instruction, continued

TCP Port Number – This should normally be set to 502 unless the end device has had the default port number changed.

Unit ID – The ID number of the Modbus TCP Server (Slave) device. Typically this is 255 unless you are talking to a Modbus Serial Gateway style of device.

Function Code – Selects which of the following Modbus function codes to use:

5 - Write Single Coil

6 - Write Single Register

15 - Write Multiple Coils

16 - Write Multiple Registers

To Modbus Offset Address – The starting register that you will be writing to. This address may be offset by a value of +1 depending on how the manufacturer followed the Modbus standard.

Number of Modbus Coils/ Registers – This selection specifies how many consecutive elements to write from the **Modbus Offset Address**.

From Do-more Memory Address – Specifies the beginning address of a range of bits or numeric locations in the CPU where the data that will be written from. This data type (bit or register) must match the type expected by the Function Code.

Do-more Range – This is the ending register where the data will be written from, calculated by taking the To Do-more Memory address and adding the Number of Modbus Coils/Registers value to it.

Enable – Designates how this instruction will operate. Select from one of the following:

Once on Leading Edge – Select this option to have this instruction run to completion exactly one time. Typically, this instruction will take more than one controller scan to complete. Configured this way the instruction is Edge Triggered.

Continuous on Power Flow at Interval – Select this option to have this instruction run as long as the instruction has power flow. After the instruction has initially run, if the instruction still has Power Flow, the instruction will remain enabled and will wait the specified amount of time before running again. The following options select how much time (milliseconds) to wait between successive runs. A value of 0ms means the instruction will re-run immediately.

On Success – When the instruction completes successfully this action will be performed.

Set Bit – Enable this selection then specify any writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code-block.

On Error – When the instruction does not complete successfully this action will be performed.

Set Bit – Enable this selection then specify any writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code-block.

Exception Response – For errors where the message was received properly by the Server (Slave) device, this will contain a value to indicate why the Server rejected the message. This can aid in troubleshooting the issue with the message.

HOST Ethernet Protocol

Server

The BRX Do-more! MPU can serve as a HOST Ethernet Protocol server to communicate to legacy devices that utilize the HOST Ethernet protocol such as DirectLogic PLC's, C-more HMI, SCADA systems, etc.

All data is stored in four sets of registers in the BRX Do-more!. This memory area is blocked off specifically for HOST Ethernet Protocol communications. You must place data in these registers so that a HOST Ethernet Protocol Client device will be able to access it.

HOST Data Registers

DirectLogic Type	Do-more Block Name	Default Octal Range
Discrete Input (X)	DLX	0–777
Discrete Output (Y)	DLY	0–777
Control Relay (C)	DLC	0–777
16-Bit Data (V)	DLV	0–3777

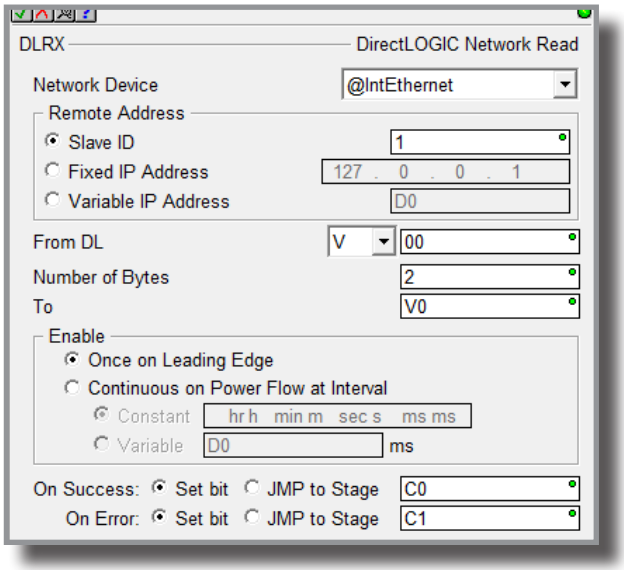
The HOST Ethernet Protocol data area is loosely data typed and casting or other instructions such as PUBLISH and SUBSCRIBE can be utilized to convert data in this area to the proper data type needed as well. Please see the help file for more information on casting, PUBLISH and SUBSCRIBE.

NOTE: *Ranges can be expanded as needed in the Memory Configuration section of the Do-more! Designer software.*

DirectLogic Client (Master)

The BRX Do-more! MPU can be a HOST Ethernet Protocol Client to communicate to legacy devices that utilize the HOST Ethernet protocol such as DirectLogic PLC's.

DLRX



Network Device – The device associated with the physical port that you want to communicate from. @IntEthernet is the name of the device associated with the built in Ethernet port.

Remote Address – specifies which of the following addressing modes to use:

Slave ID - Selects the Slave ID (Module ID) of the remote DirectLOGIC slave. The Slave ID can be any constant value in the range of 1 to 90, or any readable numeric location that contains a value in that range. If Slave ID is selected, a TCP/IP broadcast is used to perform the network read operation. This means that both the Do-more! controller and the remote ECOM module must be in the same Broadcast Domain.

Fixed IP Address – Specifies the IP Address assigned to the remote slave ECOM module. IP addresses are canonically represented in dot-decimal notation, consisting of four decimal numbers, each ranging from 0 to 255, separated by dots.

Variable IP Address – The IP Address resides in a memory location in the PLC, allowing the IP Address to be changed at runtime. This can be any readable DWord numeric location. Each octet of the IP Address is stored in one byte of the Variable Address location.

DLRX Instruction, continued

From DL - Designates the data type and the address of the data to read from the DirectLOGIC controller.

V-Memory – Locations in a DirectLOGIC controller are unsigned 16-bit values. Each V-Memory location is 2 bytes in length, so reading V-Memory requires the length be in 2-byte increments. The memory address value must begin on a byte boundary. Single Bit locations in the DirectLOGIC controllers cannot be read individually, you must read the byte that contains the desired bit.

Number of Bytes – Designates the number of elements of the selected type to read.
X, Y, C, S, T, CT, GX, GY, SP – Bit locations must be read in 1-byte increments

Enable – designates how this instruction will operate. Select from one of the following:

Once on Leading Edge - select this option to have this instruction run to completion exactly one time. Typically, this instruction will take more than one controller scan to complete. Configured this way the instruction is Edge Triggered.

Continuous on Power Flow at Interval - Select this option to have this instruction run as long as the instruction has power flow. After the instruction has initially run, if the instruction still has power flow, the instruction will remain enabled and will wait the specified amount of time before running again. The following options select how much time (in milliseconds) to wait between successive runs. A value of 0ms means the instruction will re-run immediately.

On Success – When the instruction completes successfully this action will be performed.

Set Bit – Enable this selection then specify any writable bit location.

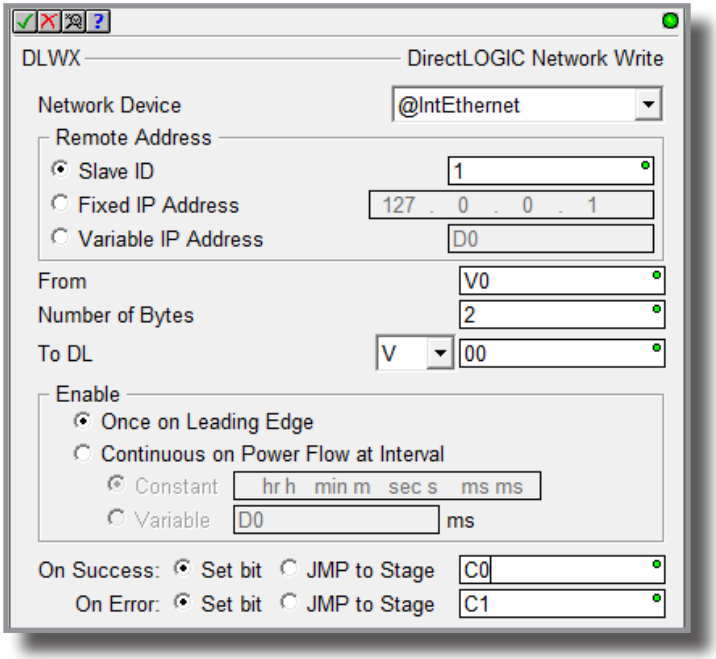
JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code-block.

On Error – When the instruction does not complete successfully this action will be performed.

Set Bit – Enable this selection then specify any writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code-block.

DLWX



Network Device – The device associated with the physical port that you want to communicate from. **@IntEthernet** is the name of the device associated with the built in Ethernet port.

Remote Address - Specifies which of the following addressing modes to use:

Slave ID – Selects the Slave ID (Module ID) of the remote DirectLOGIC slave. This can be any constant value in the range of 1 to 90, or any readable numeric location that contains a value in that range. If Slave ID is selected, the a TCP/IP broadcast is used to perform the network read operation, this means that both the Do-more controller and the remote ECOM module must be in the same Broadcast Domain.

Fixed IP Address – Specifies the IP Address assigned to the remote slave ECOM module. IP addresses are canonically represented in dot-decimal notation, consisting of four decimal numbers, each ranging from 0 to 255, separated by dots.

Variable IP Address – The IP Address resides in a memory location in the PLC. This allows the IP Address to be changed at runtime. This can be any readable DWord numeric location. Each octet of the IP Address is stored in one byte of the Variable Address location.

DLWX Instruction, continued

From – Specifies the beginning memory address in the Do-more controller of the data to send to the remote slave. This value can be any readable numeric location.

To DL – Designates the data type and the address of the data to Write to the DirectLOGIC controller.

V-Memory locations in a DirectLOGIC controller are unsigned 16-bit values. Each V-Memory location is 2 bytes in length, so reading V-Memory requires the length be in 2-Byte increments. The memory address value must begin on a Byte boundary. Single Bit locations in the DirectLOGIC controllers cannot be read individually, you must read the Byte that contains the desired Bit.

Number of Bytes – Designates the number of elements of the selected type to read.
X, Y, C, S, T, CT, GX, GY, SP – Bit locations must be read in 1-Byte increments.

Enable – designates how this instruction will operate. Select from one of the following:

Once on Leading Edge – Select this option to have this instruction run to completion exactly one time. Typically, this instruction will take more than one controller scan to complete. Configured this way the instruction is Edge Triggered.

Continuous on Power Flow at Interval – Select this option to have this instruction run as long as the instruction has power flow. After the instruction has initially run, if the instruction still has **Power Flow**, the instruction will remain enabled and will wait the specified amount of time before running again. The following options select how much time (in milliseconds) to wait between successive runs. A value of 0ms means the instruction will re-run immediately.

On Success – When the instruction completes successfully this action will be performed.

Set Bit – Enable this selection then specify any writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code-block.

On Error – When the instruction does not complete successfully this action will be performed.

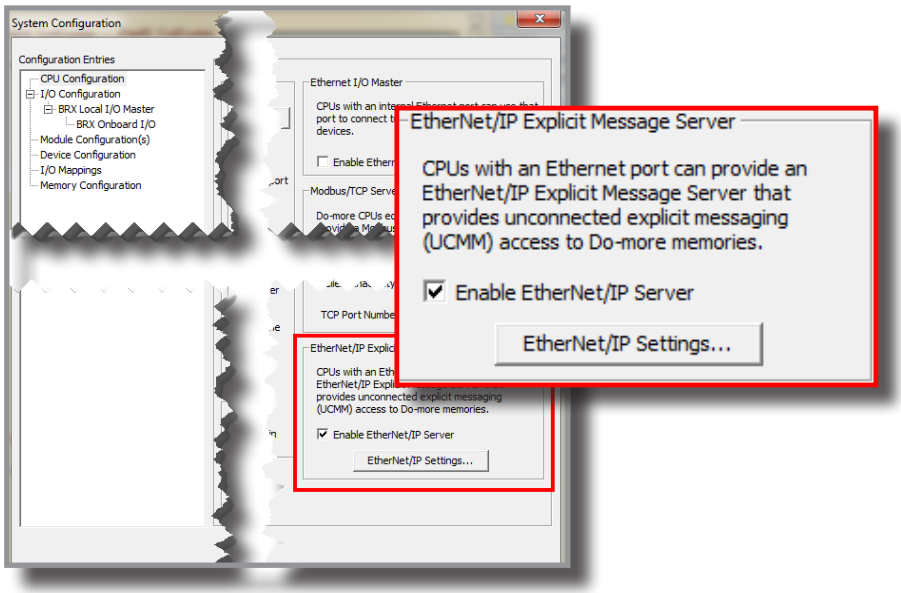
Set Bit – Enable this selection then specify any writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code-block.

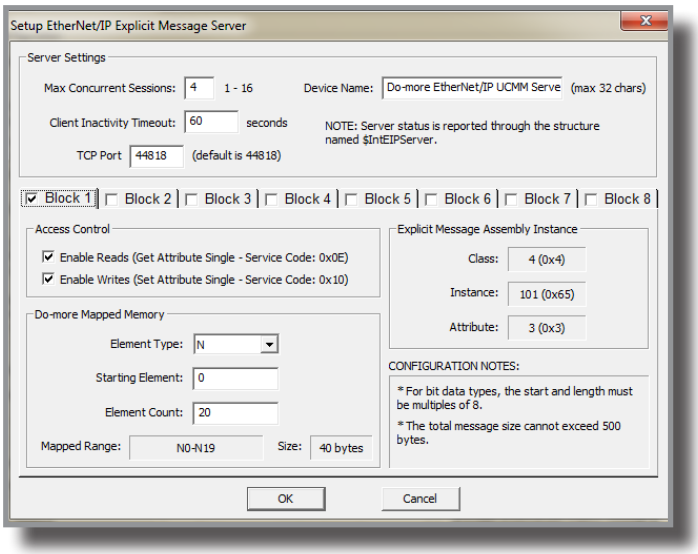
EtherNet/IP (Explicit Messaging)

Server

The EtherNet/IP Explicit Message Server must be enabled in the *System Configuration* dialog box.



Once this is enabled, you must click the EtherNet/IP Settings button to set the data blocks that will be served to outside EtherNet/IP Clients.



EtherNet/IP (Explicit Messaging), continued

TCP Port Number (44818 is default) – Designates the TCP port number on which the EtherNet/IP Explicit Message Server will accept connections. The default value of 44818 is the industry standard and will rarely need to be changed. However, this can be any constant value between 0 and 65535.

Device Name – Up to 32 characters that will be returned in requests for the Identity Class.

NOTE: Runtime status of the EtherNet/IP Server is accessed through the built-in structure $IntEIPServer which has the following members:

.ActiveSessions (read-only) – The number of concurrent open connections to EtherNet/IP clients.

.LastError – Last error reported to an EtherNet/IP client.

.Errors – Total number of errors returned to all EtherNet/IP clients.

.Transactions – Total number or completed client requests to EtherNet/IP clients.

Select the quantity of Data Blocks (up to 8 data blocks - Block 1 to Block 8) that will be made available to EtherNet/IP Clients. You can specify how many data blocks will be used and then configure each of the blocks in the sections below.

Access Control – Specify external access ability.

Enable Reads (Get Single Attribute – Service Code: 0x0E) – Allows EtherNet/IP Clients to read from this data block using Get Single Attribute.

Enable Writes (Set Single Attribute – Service Code: 0x10) – Allows EtherNet/IP Clients to write to this data block using Set Single Attribute.

Do-more Mapped Memory – Specifies the first location in a data block in the Do-more PLC memory that will be accessed when requests with this Class/Instance/Attribute are received.

Element Type – Select the memory block to use from the drop-down list of available numeric memory blocks.

Starting Element – Specify the first element in the memory block to use.

Element Count – The number of successive Elements in the Do-more memory block to use. The maximum total size on an EtherNet/IP request is 500 bytes, so the maximum number of elements per block will depend on the size of the individual elements. Refer to the chart below:

Mapped Range – Displays the currently selected range of Elements.

Size – Displays the size of the selected Element range in Bytes.

Explicit Messaging Assembly Instance – Displays the Path (class / instance / attribute) of the data block being configured.

Element Count

Element Type	Maximum Number of This Type per Data Block
Bit	4000
Byte	500
Word	250
DWord	125
Real	125

EtherNet/IP (Explicit Messaging), continued

Class – The Class of all the data blocks is fixed at 0x04 (assembly class).

Instance – Each of the 8 blocks is assigned a unique Instance as shown in this table.

Attribute – The Attribute of each of these data blocks is fixed at 0x03.

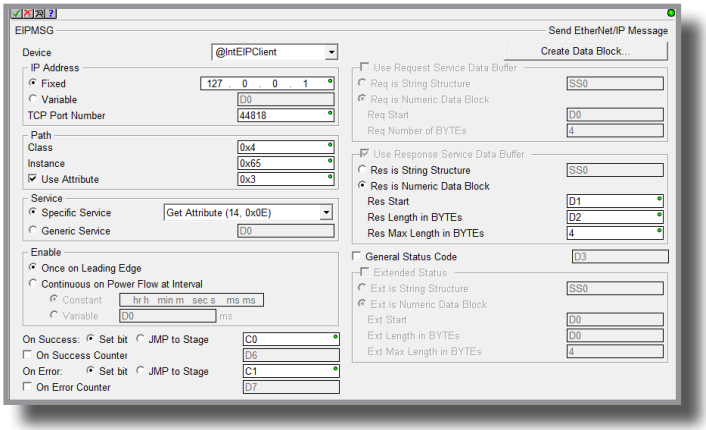
CONFIGURATION NOTES: – This area contains information pertinent to the configuration selections being made.

Instance Blocks

Block Number	Instance ID
0	101 (0x65)
1	102 (0x66)
2	103 (0x67)
3	104 (0x68)
4	105 (0x69)
5	106 (0x6A)
6	107 (0x6B)
7	108 (0x6C)

EtherNet/IP Client (Master)

EIPMSG Instruction – The Send EtherNet/IP Message instruction implements an Explicit Unconnected EtherNet/IP Client using the on-board Ethernet port of a Do-more! CPU. An explicit message client initiates request/response oriented communications with EtherNet/IP servers. Message rates and latency requirements should not be too demanding. Examples of other explicit message servers you can talk to are barcode scanners, scales, drives, or other intelligent devices.



Device – Designates which of the pre-configured EtherNet/IP Client devices to use when sending the message. Part of the configuration for a device is assigning a name to the device. It is that name which will show up in the Device selection drop-down menu. For more information on configuring devices go to the Help file.

IP Address – The IP Address of the EtherNet/IP Server (Slave) to send the message to. This can be either a Fixed (static) IP Address or a Variable (dynamic) value as described below:

Fixed Address – The TCP/IP Address assigned to the EtherNet/IP Server (Slave). IP addresses are canonically represented in dot-decimal notation, consisting of four decimal numbers, each ranging from 0 to 255, separated by dots.

NOTE: *Invoking the Element Browser (F9) for this field will bring up the IP Address Lookup utility that can find the IP Address for a given name.*

Variable IP Address – The IP Address resides in the specified memory location. This can be any readable DWord numeric location.

TCP Port Number – The port number of the EtherNet/IP Server (Slave) to send the message to. The default value of 44818 is typically the correct port number for EtherNet/IP protocol. This can be any constant value between 0 and 65535, or any readable numeric location containing a value in that range.

EtherNet/IP Client (Master), continued

Path – Specifies the parameters for the request. The specific values needed for the fields will be provided by the manufacturer of the EtherNet/IP server that you are talking to.

Class – The Class ID value (defined by the EtherNet/IP Server). This can be any positive integer value or any readable numeric location.

Instance – The Instance ID value (defined by the EtherNet/IP Server). This can be any positive integer value or any readable numeric location.

Use Attribute – Enable this option to specify the Attribute value (defined by the EtherNet/IP Server). This can be any positive integer value or any readable numeric location.

Service - Specifies the operation to perform on the set of objects. Choose from the following list of predefined Services, or select Generic and enter the Service number.

Specific Service – Select one of the predefined Service Requests below:

Get Single Attribute (14, 0x0E) - request a single attribute

Set Single Attribute (16, 0x10) - write a single attribute

Get All Attributes (1, 0x01) - request all of the attributes

Set All Attributes (2, 0x02) - write to all of the attributes

Generic Service – Specify a Service that is NOT one of the predefined Service Requests. This can be any constant integer value or readable memory location.

Create Data Block – If an appropriate data block does not already exist, or if you want to create an additional data block for use in this instruction, then click this button to open a dialog where you can create a new data block of the required type.

Use Request Service Data Buffer – This selection will be automatically enabled when any Set Attribute service is selected and automatically disabled when any Get Attribute service is selected. This buffer can be enabled any time the Generic Service is selected.

Req is String Structure – Select this option if the data for the Set Attribute service or any Generic service is contained in a String, then enter the String element to use. This can be any of the system-defined Short Strings, or system-defined Long Strings, or any of the user-defined Strings. The maximum length of the String to send is 500 bytes.

Req is Numeric Data Block – Select this option if the data for the Set Attribute service or any Generic service is contained in a numeric memory block. The maximum size of the data block that can be sent in a single service request 500 bytes (250 Words, 125 DWords, 125 Reals).

Req Start – Specify the first element of the memory block that is the data for the Set Attribute or Generic service.

Req Number of Bytes - The number of consecutive BYTEs of data for the Set Attribute or Generic service (Words = 2 Bytes, DWord = 4 Bytes, Real = 4 Bytes).

EtherNet/IP Client (Master), continued

Use Response Service Data Buffer – This selection will be automatically enabled when any Get Attribute service or any Generic service is selected and automatically disabled when any Set Attribute service is selected. This buffer can be enabled any time the Generic Service is selected.

Res is String Structure – Select this option to store the data from the Get Attribute service or any Generic service in a String, then enter the String element to use. This can be any of the system-defined Short Strings, or system-defined Long Strings, or any of the user-defined Strings. The maximum length of the String that could potentially be received is 500 bytes, so make sure the String can handle the maximum response for the desired service.

Res is Numeric Data Block – Select this option to store the data from the Get service or any Generic service in a numeric memory block. The maximum size of the data block that can be read in a single service request 500 bytes (250 Words, 125 DWords, 125 Reals).

Res Start – Specify the first element in the numeric data block to store the data that was returned by the Get Attribute or Generic service. This can be any writable numeric location.

Res Length in BYTEs – Specify a memory location to store the actual number of Bytes of data that was returned by the Get Attribute or Generic service. This can be any writable numeric location.

Res Max Length in BYTEs – Specify the maximum number of BYTEs of the returned data to retain to store in the data block. This can be any positive integer constant between 1 and 500 or any readable numeric location.

NOTE: *The byte length value should be a multiple of the number of BYTEs in a single element in the numeric memory block. For example, if the memory block consists of DWords or Reals, this value should be a multiple of 4, as there are 4 BYTEs per DWord or Real.*

General Status Code – enable this option to store the value returned from the EtherNet/IP Server in response to processing the Service Request; enter the numeric location to store the value. This can be any writable numeric location. This value could indicate success or be an error code. Consult the documentation for the EtherNet/IP Server for information on how to interpret General Status Code values.

Extended Status – Enable this option to store any extended status value returned from the EtherNet/IP Server in response to processing the Service Request.

Ext is String Structure – Select this option to store the extended status information in a String, then enter the destination String element. This can be any of the system-defined Short Strings, or system-defined Long Strings, or any of the user-defined Strings.

Ext is Numeric Data Block – Select this option to store the Extended Status data in a numeric data block.

Ext Start – Specify the first element in the numeric data block to store the Extended Status data. This can be any writable numeric location.

Ext Length in BYTEs – Specify a memory location to store the actual number of Bytes of Extended Status data. This can be any writable numeric location.

Ext Max Length in BYTEs – Specify the maximum number of BYTEs of Extended Status data to store in the data block. This can be any positive integer constant between 1 and 500, or any readable numeric location.

EtherNet/IP Client (Master), continued

NOTE: *The byte length value should be a multiple of the number of BYTEs in a single element in the numeric memory block. For example, if the memory block consists of DWords or Reals, this value should be a multiple of 4, as there are 4 BYTEs per DWord or Real.*

Enable – Designates how this instruction will operate. Select from one of the following:

Once on Leading Edge - Select this option to have this instruction run to completion exactly one time. Typically, this instruction will take more than one controller scan to complete. Configured this way the instruction is Edge Triggered.

Continuous on Power Flow at Interval - Select this option to have this instruction run as long as the instruction has power flow. After the instruction has initially run, if the instruction still has power flow, the instruction will remain enabled and will wait the specified amount of time before running again. The following options select how much time (in milliseconds) to wait between successive runs. A value of zero milliseconds (0ms) means the instruction will re-run immediately.

On Success – When the instruction completes successfully this action will be performed.

Set Bit – Enable this selection then specify writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code-block.

On Error Counter – Enable this option and select a DWord location to store the total number of times the RX failed to complete. This can be any DWord location.

On Error – When the instruction does not complete successfully this action will be performed.

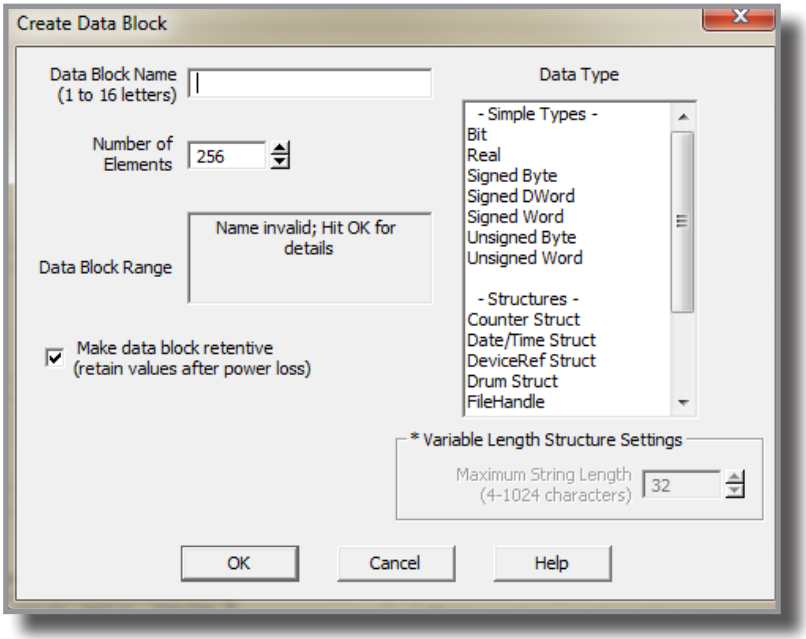
Set Bit – Enable this selection then specify writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code-block.

On Error Counter – Enable this option and select a DWord location to store the total number of times the RX failed to complete. This can be any DWord location.

EtherNet/IP Client (Master), continued

Create Data Block – If an appropriate data block does not already exist, or if you want to create an additional data block for use in this instruction, then click this button to open a dialog where you can create a new data block of the required type.



Data Block Name (1 to 16 letters) – Block names must be unique, and consist of 1 to 16 characters (A-Z, a-z; no numbers, no spaces).

Number of Elements – Specifies the number of bytes in the data block. The data blocks must be created on a DWord (4-byte) boundary. The maximum number of Bytes that can be received from a single packet is 1024.

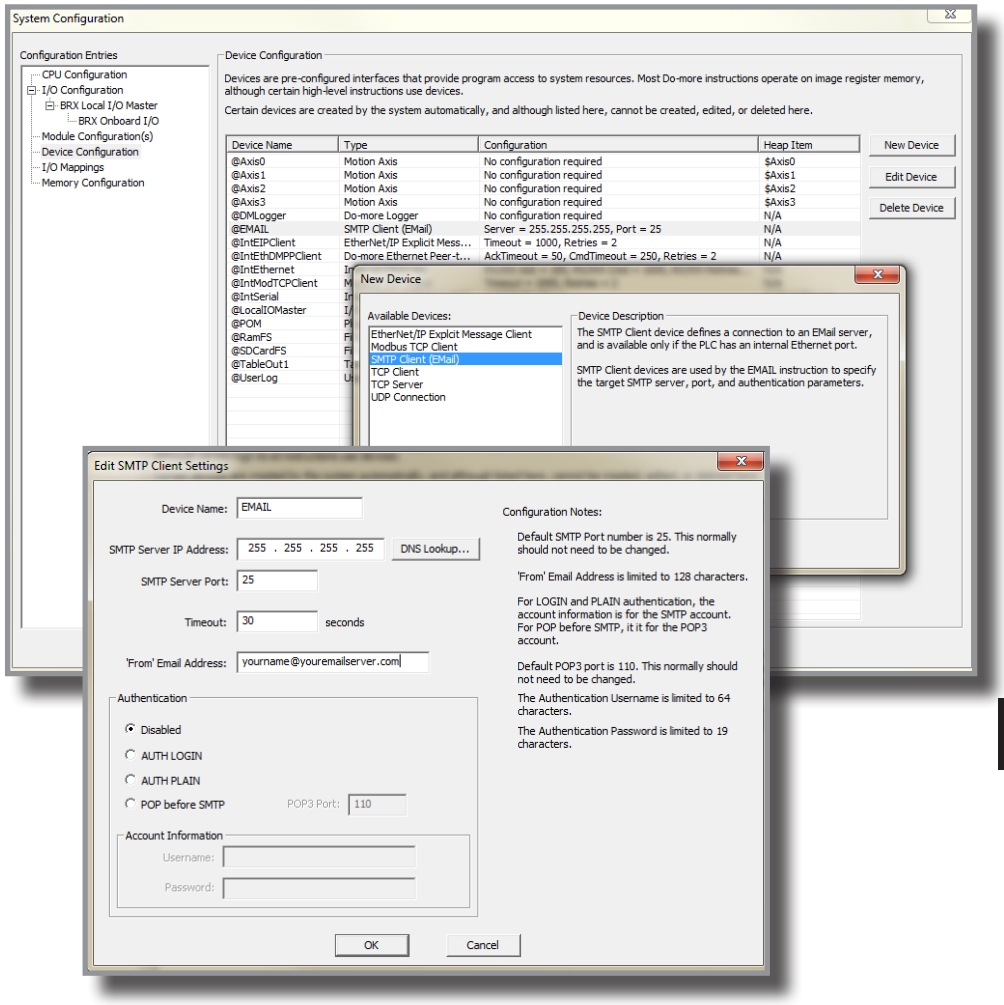
Data Block Range – Displays the first and last element of the block that will be created based on the current entries for Data Block Name and Number of Elements.

Data Type – The data block will consist of Unsigned Bytes.

Make Data Block Retentive (retain values after power loss) – A data block marked as retentive will hold its state through a power cycle or a Program-to-Run mode transition. The status of memory NOT marked as retentive will be cleared at power up and during a Program-to-Run mode transition.

SMTP – EMAIL

The Edit SMTP Client Settings dialog is used to configure an SMTP connection from the Do-more! controller to an SMTP server in order for the controller to send Email. The information that is required to configure an SMTP connection is always going to be specific to the installation. It is up to the programmer to locate the required information.



SMTP – EMAIL, continued

Device Name – The name given to the SMTP Client. This is the name that will be referenced in the Send Email (EMAIL) instructions. Device Names can consists of 1 to 16 alphanumeric characters. Device names must follow Nickname rules.

SMTP Server IP Address – The IP address of the SMTP server that will process the Email sent from the controller. If the IP Address of your SMTP Server is not static, you can use the DNSLOOKUP and DEVWRITE instructions to determine it at runtime before executing an EMAIL instruction. See the example in the EMAIL Help Topic DMD0068. If this is the case, just fill in a dummy IP Address in the SMTP Configuration.

Clicking the DNS Loopkup button will open the IP Address Lookup utility so that Do-more! Designer can search for the IP Address assigned to a given SMTP Server name. This requires a functional connection to a DNS Server.

NOTE: *The IP Address of the SMTP Server can be resolved at runtime by using the Name to IP Address (DNSLOOKUP) instruction to find the IP Address associated with a Server's name, then use the Write Device Register (DEVWRITE) instruction to set the SMTP Client Device to use the IP Address that was found.*

SMTP Server Port – The default value of 25 is the standard IP port number that is used by SMTP servers. The SMTP Server Port number can be examined at runtime with the Read Device Register (DEVREAD) instruction, and changed at runtime through the Write Device Register (DEVWRITE) instruction.

Timeout –This is the amount of time (in seconds) the SMTP Client will attempt to connect to the specified SMTP server before reporting an error. The default value of 30 seconds should be sufficient in most instances. Be aware that it is quite normal for communications with SMTP servers to take several seconds of time; setting this value too low will only cause needless problems.

From Email Address – Specifies the Email address that all Emails using this SMTP Client will use in the 'From' field. Email addresses must be in the form of X@Y.Z. SMTP servers typically require that the 'From' address be configured as a recipient address on that SMTP server before they will accept Emails from that address.

Authentication – If the SMTP server requires authentication before it will accept an Email from the controller, select one of the following three methods:

Disabled – If the SMTP server does not require authentication

AUTH LOGIN – Authenticate by logging into the SMTP Server with the Username and Password specified below

AUTH PLAIN – Authenticate by logging into the SMTP Server with the Username and Password specified below

POP before SMTP – An authentication that attempts to get Email before attempting to send an Email, the premise being that if an Email client can log in and read Email the Client must be legitimate

Pop3 Port – The default port number of 110 is the standard IP port number for POP3 requests and should not need to be change. The Pop3 Port number can be examined at runtime with the Read Device Register (DEVREAD) instruction, and changed at runtime through the Write Device Register (DEVWRITE) instruction.

SMTP – EMAIL, continued

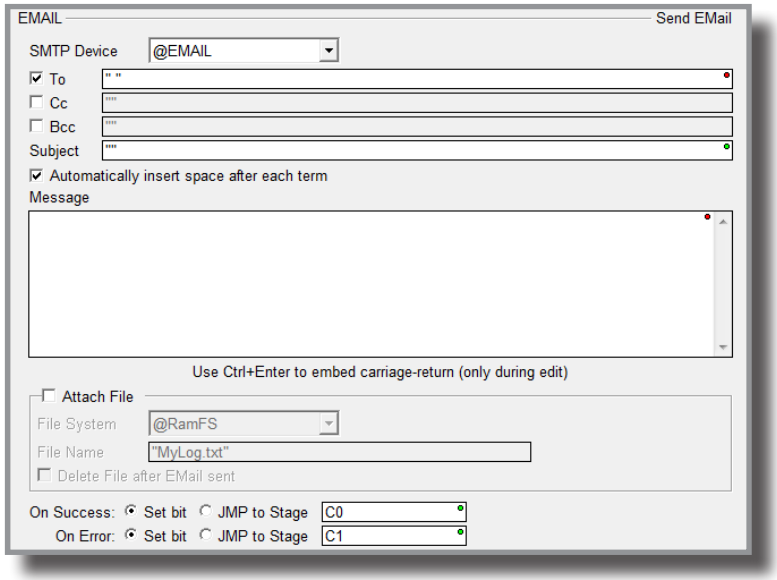
Account Information – The three authentication methods above require a UserID and Password. For 'AUTH LOGIN' and 'AUTH PLAIN', the account information is for the SMTP account, for 'POP before SMTP' method, the account information is for the POP3 account.

Username - 1 to 64 characters

Password - 1 to 19 characters

EMAIL

The Send Email (EMAIL) instruction is used to send an Email message. This instruction is only valid for Do-more! controllers that have an on-board Ethernet port. The message portion of the Email can be any combination of text and data elements from the controller. An Email can also send an attachment which can be any file on any of the built-in file systems.



SMTP Device – Designates the SMTP Client device to use to send the Email. An SMTP Client device must be configured before the Send Email instruction can be added to a program.

To – One or more primary audience Email addresses separated by semicolons. This can be a string literal (text in double quotes), or any String element.

Cc (optional) – One or more Courtesy Copy (or Carbon Copy) Email addresses separated by semicolons. This can be a string literal (text in double quotes), or any String element.

Bcc (optional) – One or more Blind Carbon Copy Email addresses separated by semicolons. This can be a string literal (text in double quotes), or any String element.

Subject – The Total number of characters in Subject line is limited to 1024 characters. This can be a string literal (text in double quotes), or any readable String element.

Automatically insert space after each term – Will insert a space between the terms when the instruction is processed. This is most useful when the Message Field contains only a list of elements that would otherwise require a manually entered space character to separate the items.

EMAIL, continued

Message – Text box in which to place the body of the Email message. There can be up to 1023 characters of data in a Message field. This data can consist of any combination of the following:

String Literal (text in double quotes).

Control characters.

Any readable String element.

Controller data elements (V0, D0, T0.Acc, etc.).

Data formatting functions (FmtInt, FmtReal, etc.).

String selection function (Lookup).

For a complete description of the available data options provided by the scripting language for use in the Text Field, see the Help file.

Attach File – Enable this option to send an existing file from one of the file Systems in the Do-more CPU along with the Message text.

File System – Specifies which of the available file systems contains the file.

@RamFS – The 1 MB file system in the Do-more CPU's system RAM. All Do-more CPUs will have this file system available.

@SDCardFS – On PLC systems that have the microSD card slot, this selection is the file system on the removable media in that slot.

File Name – The full path (including any directories) of the file on the specified file system. This can be text enclosed in double quotes, or any system or user-defined string. The File Name allows a maximum length of 255 characters including spaces and non-alphanumeric characters, excluding the following characters which have special meaning to the file system * ? " : < >. The File Name is not case sensitive.

Delete File After Email Sent – Enable this option to delete the specified file AFTER the Email has been successfully sent to the specified SMTP Server.

On Success – When the instruction completes successfully this action will be performed.

Set Bit – Enable this selection then specify writable bit location.

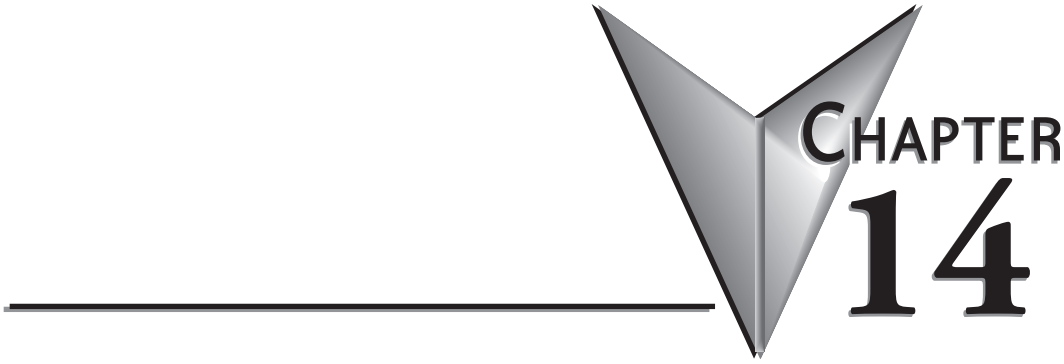
JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code-block.

On Error – When the instruction does not complete successfully this action will be performed

Set Bit – Enable this selection then specify writable bit location.

JMP to Stage – Enable this selection then specify any Stage number from S0 to S127 in the current Program code-block.

Notes:



FUTURE RELEASE OF BRX REMOTE I/O

For Future Use

BRX Do-more! Maintenance and Troubleshooting

In This Chapter...

Hardware Maintenance 15-2
Diagnostics 15-3
CPU Indicators 15-5
PWR Indicator 15-6
RUN Indicator 15-7
ERR Indicator 15-7
Communications Problems 15-7
I/O Troubleshooting 15-8
Noise Troubleshooting 15-10

Hardware Maintenance

Standard Maintenance

The BRX Platform is a low maintenance system requiring only a few periodic checks to help reduce the risks of problems. Routine maintenance checks should be made regarding two key items.

Air quality (cabinet temperature, airflow, etc.)

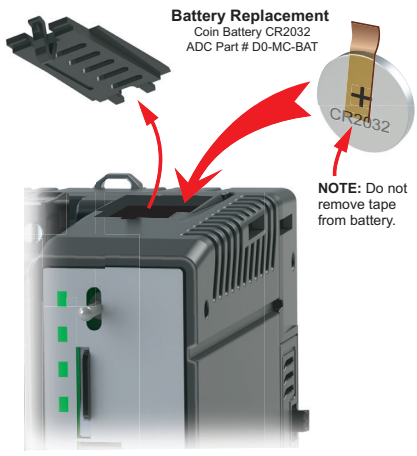
CPU battery

Air Quality Maintenance

The quality of the air your system is exposed to can affect system performance. If you have placed your system in an enclosure, check to see that the ambient temperature is not exceeding the operating specifications. If there are filters in the enclosure, clean or replace them as necessary to ensure adequate airflow. A good rule of thumb is to check your system environment every one to two months. Make sure the BRX Platform is operating within the system operating specifications.

CPU Battery Replacement

A battery is included with the CPU. When installed, the time and date along with retentive memory values will be retained. The battery is not needed for program backup. It is recommended that the battery be replaced annually.



Battery (Optional)	
D0-MC-BAT	Coin type, 3.0 V Lithium battery, 190mAh, battery number CR2032

NOTE: *Proper orientation of battery is with the "+" symbol facing left when viewed from front of MPU.*

Diagnostics

Diagnostics

Your BRX MPU performs many predefined diagnostic routines with every CPU scan. The diagnostics have been designed to detect various types of failures for the CPU and I/O modules. There are two primary error classes, critical and non-critical.

Critical Errors

Critical errors are errors the CPU has detected that present a risk of the system not functioning safely or properly. If the CPU is in Run Mode when the critical error occurs, the CPU will switch to Stop Mode (Remember, in Stop Mode all outputs are turned off). If the critical error is detected while the CPU is in Stop Mode, the CPU will not enter Run Mode until the error has been corrected. Here are some examples of critical errors:

Power supply failure

Parity error or CPU malfunction

I/O configuration errors

Certain programming errors.

Non-Critical Errors

Non-critical errors are flagged by the CPU as requiring attention. They can neither cause the CPU to change from Run Mode to Stop Mode, nor do they prevent the CPU from entering Run Mode. There are system memory addresses that the application program references to detect if a non-critical error has occurred. The application program can be used to take the system to an orderly shutdown or to switch the CPU to Stop Mode if necessary.

Some examples of non-fatal errors are:

Backup battery voltage low

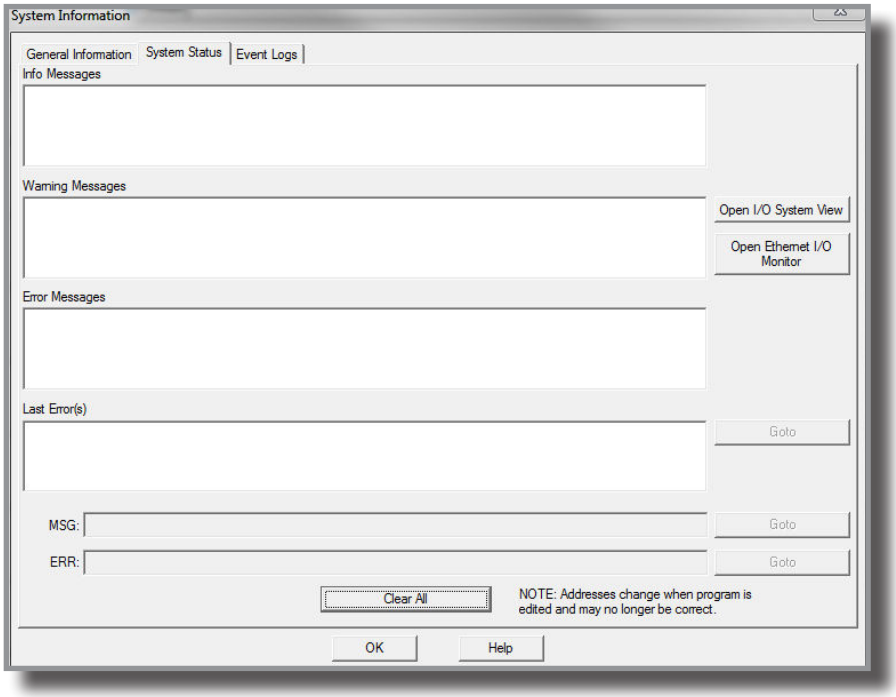
Certain programming errors

Finding Diagnostic Information

The CPU automatically logs critical and non-critical error codes. Logged errors can be found in the following places marked with a time and date stamp:

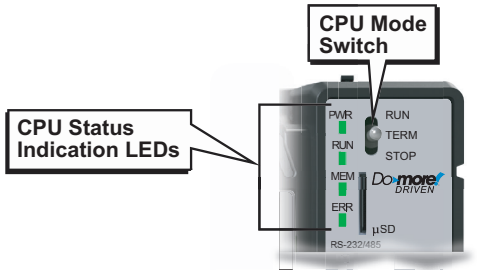
Under the PLC menu item, select System Information and then pick the System Status tab. All errors and messages are shown here.

Also check the Event Log tab for further system status.



CPU Indicators

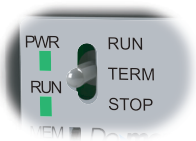
The BRX MPU has indicators on the faceplate to help diagnose problems with the system. The table below gives a quick reference of potential problems associated with each status indicator. The pages following the table contain a detailed analysis of each of these problems.



CPU Status Indicators

Indicator	Status	Description
PWR	OFF	Base power OFF
	Green	Base power ON
	Yellow	Low battery
RUN	OFF	CPU is in STOP (Program) mode
	Green	CPU is in RUN mode
	Yellow	Forces are active
MEM	OFF	No ROM activity, No SD card
	Green	SD Card installed and mounted*
	Yellow	ROM activity (Flash or SD card)
	Red	microSD Card installed and not mounted*
ERR	OFF	CPU is functioning normally
	Red	CPU fatal hardware error or software watchdog error

*A microSD card will become "mounted" once the MPU recognizes the microSD card and renders it accessible for use.



CPU Mode Switch

Position	Description
RUN	Puts the CPU into RUN mode - assuming there are no issues that prevent it from happening, like errors in the project currently loaded in the CPU, or a problem with the hardware.
TERM	Allows the Do-more Designer programming software to set the CPU's mode using the "Set PLC Mode" utility.
STOP	Puts the CPU into Stop (Program) mode which stops running the currently loaded project.

PWR Indicator

There are three general reasons for the CPU power status LED (PWR) to be OFF:

1. Power to the MPU is incorrect or is not applied.
2. MPU power supply is faulty.
3. Other component(s) have the power supply shut down.

Incorrect MPU Power

If the voltage to the power supply is not correct, the MPU may not operate properly or may not operate at all. Use the following guidelines to correct the problem.

WARNING: To minimize the risk of electrical shock, always disconnect the system power before inspecting the physical wiring.

1. First, disconnect the system power and check all incoming wiring for loose connections.
2. If you are using a separate termination panel, check those connections to make sure the wiring is connected to the proper location.
3. If the connections are acceptable, reconnect the system power and measure the voltage at the power supply connection terminal block to ensure it is within specification. If the voltage is not correct, shut down the system and correct the problem.
4. If all wiring is connected correctly and the incoming power is within the specifications required, the MPU should be replaced.

Faulty MPU

There is no simple test for a faulty MPU other than substituting a known good one to see if this corrects the problem. If you have experienced major power surges, it is possible the MPU has been damaged. If you suspect this is the cause, a line conditioner should be installed on the incoming line. This will keep damaging voltage spikes from reaching the MPU.

External Device or Module Causes the Power Supply to Shutdown

Module:

If the Power LED is not lit, remove all modules including a POM module (if present) from the BRX Platform and reapply power. If the Power LED is still unlit, then the BRX unit has sustained damage and will need to be replaced.

External Device:

External influence from a communications port.

Test as follows:

1. Turn off power to the BRX Platform.
2. Disconnect all external devices (i.e., communication cables) from the BRX Platform.
3. Reapply power.
4. If power supply operates normally then check for a shorted device or shorted cable.

RUN Indicator

If the CPU will not enter the Run mode (the RUN indicator is off), the problem is usually in the application program, unless the CPU has a critical error. If a critical error has occurred, the ERR LED should be on. You can use Do-more! Designer Software to determine the cause of the error.

When the RUN LED is yellow it indicates the CPU has one or more memory locations with Forced values.

ERR Indicator

If the ERR indicator is OFF, it means the CPU is functioning normally. If the ERR indicator is ON, the CPU has experienced one or more of the following conditions:

A Fatal Hardware Error.

A Software Watchdog Error has occurred.

An I/O module has been removed while the CPU is in RUN mode.

An I/O module in an Ethernet I/O Slave drop is not present.

If rebooting the BRX Platform clears the error, you should monitor the system and determine what caused the problem. You will find this problem is sometimes caused by high frequency electrical noise introduced into the MPU from an outside source. Check your system grounding and install electrical noise filters if the grounding is suspected. If power cycling the system does not reset the error, or if the problem returns, you should replace the MPU.

The ERR indicator can be made to BLINK from the Edit Link dialog in order to help identify the CPU. This is helpful where you may have multiple MPUs in a cabinet.

Communications Problems

If you cannot establish communications with the MPU, check these items:

The cable is disconnected.

The cable has a broken wire or has been wired incorrectly.

The cable is improperly terminated or grounded.

The device connected is not operating at the correct baud rate.

The device connected to the port is sending data incorrectly.

A grounding difference exists between the two devices.

Electrical noise is causing intermittent errors.

If it is determined that a built-in CPU communications port is bad, the MPU should be replaced. If it is a POM communications port, just replace the POM port.

I/O Troubleshooting

Things to Check

If you suspect an I/O error, there are several things that could be causing the problem:

A blown fuse

A loose terminal block

The 24VDC supply has failed or 24VDC has not been supplied to the I/O common.

The I/O point has failed.

Error Codes

Also, in the Do-more! Designer software, you can go to the PLC menu item, select System Information and then pick the System Status tab.

All errors and messages are shown here. Also check the Event Log for further information on system status such as rebooting.

Some Quick Steps

When troubleshooting the BRX Platform I/O there are a few facts you should be aware of which may assist you in quickly correcting an I/O problem:

The CPU cannot detect shorted or open output points. If you suspect one or more points on an output module to be faulty, you should measure the voltage drop from the common to the suspect point. Remember, when using a Digital Volt Meter, leakage current from an output device, such as a triac or a transistor, must be considered. A point which is off may appear to be ON if no load is connected to the point.

The I/O point status indicators on the modules are logic side indicators. This means the LED which indicates the ON or OFF status reflects the status of the point in respect to the CPU. For an output module, the status indicators could be operating normally, while the actual output device (transistor, Triac etc.) could be damaged. With an input module, if the indicator LED is ON, the input circuitry should be operating properly. To verify proper functionality, check to see that the LED goes off when the input signal is removed.

Leakage current can be a problem when connecting field devices to I/O points. False input signals can be generated when the leakage current of an output device is great enough to turn on the connected input device. To correct this, install a resistor in parallel with the input or output of the circuit. The value of this resistor will depend on the amount of leakage current and the voltage applied but usually a 10kΩ to 20kΩ resistor will work. Verify that the wattage rating of the resistor is correct for your application.

The easiest method to determine if an I/O point has failed is to replace the MPU or the expansion module if you have a spare. However, if you suspect another device to have caused the failure in the MPU or the expansion module, that device may cause the same failure in the replacement as well. As a point of caution, you may want to check devices or power supplies connected to the failed MPU or expansion module before replacing it with a spare.

Testing Output Points

Output points can be set ON or OFF using the force function to override a point even while the program is running. However, this is not a recommended method to test the output points.

NOTE: *RUN LED will turn Yellow when one or more outputs are forced.*

WARNING: Depending on your application, forcing I/O points may cause unpredictable machine operation that can result in a risk of personal injury or equipment damage. Make sure you have taken all appropriate safety precautions prior to testing any I/O points.

If you want to do an I/O check independent of the application program, follow the procedure in the table below:

Step	Action
1.	Use Do-more! Designer software to communicate on-line to the CPU.
2.	Change to Program Mode.
3.	Go to the first rung of $Main. All System Tasks should be disabled by following Step 4 as well.
4.	Insert a rung with an "END" statement. (This will cause program execution to occur only at address 0 and prevent the application program from turning the I/O points on or off).
5.	Change to Run Mode.
6.	Use the programming device to set (turn) on or off the points you wish to test.
7.	When you finish testing I/O points delete the "END" statement at the first rung.

Noise Troubleshooting

Electrical Noise Problems

Noise is one of the most difficult problems to diagnose. Electrical noise, whether conducted or radiated, can enter a system in many different ways. It may be difficult to determine how the noise is entering the system but the corrective actions for either type of noise problem are similar.

Conducted noise is when the electrical interference is introduced into the system by way of an attached wire, panel connection, etc. It may enter through an I/O point, a power supply connection, the communication ground connection, or the chassis ground connection.

Radiated noise is when electrical interference is introduced into the system without a direct electrical connection such as radio waves.

Reducing Electrical Noise

While electrical noise cannot be eliminated completely, it can be reduced to a level that will not affect system function. Proper grounding of components and signal wiring along with proper isolation of voltages can minimize noise in the system.

1. Grounding:

   Most noise problems result from improper grounding of the system. A good earth ground can be the single most effective way to correct noise problems. If a ground is not available, install a ground rod as close to the system as possible.

   Ensure all ground wires are single point grounds and are not daisy chained from one device to another. Ground metal enclosures around the system. A loose wire is no more than a large antenna waiting to introduce noise into the system; therefore, you should tighten all connections in your system. Loose ground wires are more susceptible to noise than the other wires in your system. Review Chapter 1, "General Installation and Wiring Guidelines", if you have questions regarding how to ground your system.

2. Isolation:

   Electrical noise can enter the system through the power source for the MPU and I/O. Installing an isolation transformer for all AC sources can correct this problem.

   DC power sources should be properly grounded, except for Class II power supplies. Switching DC power supplies commonly generate more noise than linear supplies.

   Place input and output wiring in separate wireways or wiring bundles. Keep AC and DC wiring separated as well. Never run I/O wiring parallel or close proximity to high voltage wiring.

EU Directives (CE)

In This Appendix...

European Union (EU) Directives A-2
Basic EMC Installation Guidelines A-5

European Union (EU) Directives

NOTE: *The information contained in this section is intended as a guideline and is based on our interpretation of the various standards and requirements. Since the actual standards are issued by other parties, and in some cases governmental agencies, the requirements can change over time without advance warning or notice. Changes or additions to the standards can possibly invalidate any part of the information provided in this section.*

This area of certification and approval is absolutely vital to anyone who wants to do business in Europe. One of the key tasks that faced the EU member countries and the European Economic Area (EEA) was the requirement to bring several similar yet distinct standards together into one common standard for all members. The primary purpose of a single standard was to make it easier to sell and transport goods between the various countries and to maintain a safe working and living environment. The Directives that resulted from this merging of standards are now legal requirements for doing business in Europe. Products that meet these Directives are required to have a CE mark to signify compliance.

Member Countries

As of January 1, 2015, the members of the EU are Austria, Belgium, Bulgaria, Croatia, Republic of Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and United Kingdom. Iceland, Liechtenstein, and Norway together with the EU members make up the European Economic Area (EEA) and all are covered by the Directives.

Applicable Directives

There are several Directives that apply to our products. Directives may be amended, or added, as required.

- **Electromagnetic Compatibility (EMC) Directive** — this Directive attempts to ensure that devices, equipment, and systems have the ability to function satisfactorily in an electromagnetic environment without introducing intolerable electromagnetic disturbance to anything in that environment.
- **Machinery Safety Directive** — this Directive covers the safety aspects of the equipment, installation, etc. There are several areas involved, including testing standards covering both electrical noise immunity and noise generation.
- **Low Voltage Directive (LVD)** — this Directive is also safety related and covers electrical equipment that has voltage ranges of 50–1000VAC and/or 75–1500VDC.
- **Battery Directive** — this Directive covers the production, recycling, and disposal of batteries.

A

Compliance

NOTE: *As of July 22, 2017 ROHS has been added as an additional requirement for CE Compliance per Directive 2011/65/EU. All products bearing the CE mark must be ROHS compliant.*

Certain standards within each Directive already require mandatory compliance. The EMC Directive, which has gained the most attention, became mandatory as of January 1, 1996. The Low Voltage Directive became mandatory as of January 1, 1997.

Ultimately, we are all responsible for our various pieces of the puzzle. As manufacturers, we must test our products and document any test results and/or installation procedures that are necessary to comply with the Directives. As an end user, you are responsible for installing the products applying "good engineering practices" and in a manner which will ensure compliance is maintained. You are also responsible for testing any combinations of products that may (or may not) comply with the Directives when used together. The end user of the products must comply with any Directives that may cover maintenance, disposal, etc. of equipment or various components. *Although we strive to provide the best assistance available, it is impossible for us to test all possible configurations of our products with respect to any specific Directive. Because of this, it is ultimately your responsibility to ensure that your machinery (as a whole) complies with these Directives and to keep up with applicable Directives and/or practices that are required for compliance.*

This then is the product specific standard for CPUs and covers the low voltage and EMC directives as required for European CE certification. This standard has many tests together with test procedures and limits, but also references the below standards for some tests.

IEC 60068	IEC 60417	IEC 60664	IEC 60695	IEC 60707	IEC 60947	IEC 60950	IEC 61000	IEC 61010
-2-1:1990 Part 2 Test A	All Parts	-1:1992 Part 1	-2-1 (all sheets) Part 2	:1999	-5-1:1997 Part 5-1	-1:2001 Part 1	-4-2:1995 Part 4-2	-1:2001 Part 1
-2-2:1974 Part 2 Test B		-3:1992			-7-1:2002 Part 7-1		-4-3:2002 Part 4-3	
-2-6:1995 Part 2: Test Fc							-4-4:1995	
-2-6:1995 Part 2: Test Fc		CISPR 11:1999					-4-5:1995 Part 4-5	
-2-14:1984 Part 2 Test N		CISPR 16-1:1999 Part 1					-4-6:1996 Part 4-6	
-2-27:1987 Part 2 Test Ea		CISPR 16-2:1999 Part 2					-4-8:1993 Part 4-8	
-2-30:1980 Part 2 Test Db							-4-12:1995 Part 4-12	
-2-31:1969 Part 2 Test Ec	For undated references, the latest edition of the referenced document (including any amendments) applies.							
-2-32:1975 Part 2 Test Ed								

The BRX system, manufactured by HOST Engineering, when properly installed and used, conforms to the Electromagnetic Compatibility (EMC), Low Voltage Directive, and Machinery Directive requirements of the following standards:

- **Product Specific Standard for Programmable Controllers**
  EN61131–2:2003 Programmable controllers, equipment requirements and tests.
- **Warning on Electrostatic Discharge (ESD)**
  We recommend that all personnel take necessary precautions to avoid the risk of transferring static charges within the control cabinet and provide clear warnings and instructions on the cabinet exterior. Such precautions may include the use of earth straps, grounding mats and similar static-control devices, or the powering off of the equipment inside the enclosure before the door is opened.

- **Warning on Radio Interference (RFI)**
  This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate preventative measures.

General Safety

- External switches, circuit breaker or external fusing are required for these devices.
- The switch or circuit breaker should be mounted near the programmable controller equipment.

Special Installation Manual

The installation requirements to comply with the requirements of the Machinery Directive, EMC Directive and Low Voltage Directive are slightly more complex than the normal installation requirements found in the United States. To help with this, we have published a special manual which you can order or download from our website:

- **DA–EU–M** – EU Installation Manual that covers special installation requirements to meet the EU Directive requirements. Refer to this manual for updated information.

Other Sources of Information

Although the EMC Directive gets the most attention, other basic Directives such as the Machinery Directive and the Low Voltage Directive, also place restrictions on the control panel builder. Because of these additional requirements it is recommended that the following publications be purchased and used as guidelines:

- BSI publication BS TH 42073: November 2000 – covers the safety and electrical aspects of the Machinery Directive
- EN 60204–1:2006 – Safety of Machinery; General electrical requirements for machinery, including Low Voltage and EMC considerations
- IEC 61000–5–2: EMC earthing and cabling requirements
- IEC 61000–5–1: EMC general considerations

It may be possible for you to obtain this information locally; however, the official source of applicable Directives and related standards is:

Publications Office
2, rue Mercier
2985 Luxembourg
LUXEMBOURG

Quickest contact is via the web at:
http://ec.europa.eu/growth/single-market/european-standards/harmonised-standards.

Another source is the British Standards Institution at:

British Standards Institution – Sales Department, Linford Wood:

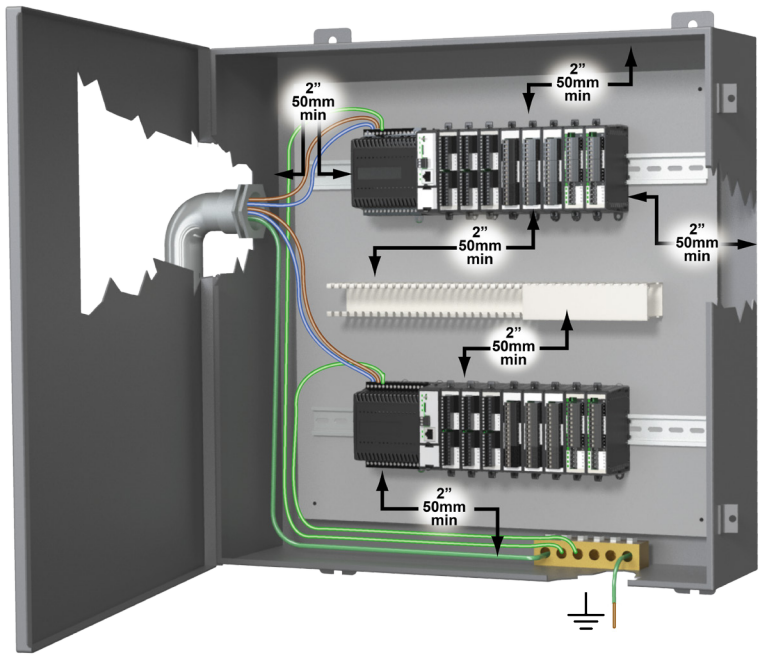
Milton Keynes, MK14 6LE, United Kingdom.

The quickest contact is via the web at www.bsigroup.com

Basic EMC Installation Guidelines

Enclosures

The simplest way to meet the safety requirements of the Machinery and Low Voltage Directives is to house all control equipment in an industry standard lockable steel enclosure. This normally has an added benefit because it will also help to reduce EMC emissions. Although the RF emissions from the programmable controller equipment, when measured in the open air, are well below the EMC Directive limits, certain configurations can increase emission levels. Holes in the enclosure, for the passage of cables or to mount operator interfaces, can increase emissions.



Mains Filters

All AC powered BRX units must be wired through an in line mains filter of type Schaffner FN 2010-1-06, or similar design. The equipment must be properly installed while adhering to the guidelines of the BRX user guide, the BRX installation manual and the installation standards IEC 1000-5-1, IEC 1000-5-2 and IEC 1131-4. It is a requirement that all PLC equipment be housed in a protective steel enclosure, which limits access to operators by a lock and power breaker and that all cables which exit the enclosure, do so through metallic conduit. If access is required by operators or untrained personnel, the PLC equipment must be installed inside an internal cover or secondary enclosure. It should be noted that the safety requirements of the machinery directive standard EN60204-1 state that all PLC power circuits must be wired through isolation transformers or isolating power supplies, and that one side of all AC or DC control circuits must be earthed. Both power input connections to the PLC equipment must be separately fused using 3 amp T-type anti-surge fuses, and a transient suppressor fitted to limit supply over voltages.

Suppression and Fusing

In order to comply with the fire risk requirements of the Low Voltage and Machinery Directive standards EN 61010–1 and EN 60204–1, it is necessary to fuse both sides of the power inputs (on both AC and DC units).

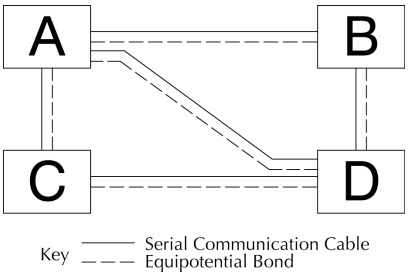
Transient suppressors must be protected by fuses and the capacity of the transient suppressor must be greater than the blow characteristics of the fuses or circuit breakers to avoid a fire risk. A recommended AC supply input arrangement for the BRX is to use twin 3 amp TT fused terminals with fuse blown indication, such as DINnectors DN–F10L terminals, or twin circuit breakers.

Internal Enclosure Grounding

A heavy-duty star earth terminal block should be provided in every cubicle for the connection of all earth ground straps, protective earth ground connections, mains filter earth ground wires, and mechanical assembly earth ground connections. This should be installed to comply with safety and EMC requirements, local standards, and the requirements found in IEC 61000–5–2. The Machinery Directive also requires that the common terminals of the programmable controller input modules, and common supply side of loads driven from programmable controller output modules should be connected to the protective earth ground terminal.

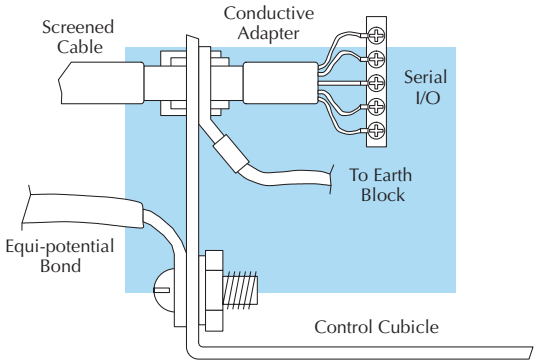
Equipotential Grounding

Adequate site earth grounding must be provided for equipment containing modern electronic circuitry. The use of isolated earth electrodes for electronic systems is forbidden in some countries. Make sure you check any requirements for your particular destination. IEC 61000–5–2 covers equipotential bonding of earth grids adequately, but special attention should be given to apparatus and control cubicles that contain I/O devices, remote I/O racks, or have inter-system communications with the primary CPU system enclosure.



An equipotential bond wire must be provided alongside all serial communications cables, and to any separate items of the plant which contain I/O devices connected to the programmable controller. The diagram above shows an example of four physical locations connected by a communications cable.

Communications and Shielded Cables



Good quality 24AWG minimum twisted-pair shielded cables, with overall foil and braid shields are recommended for analog cabling and communications cabling outside of the programmable controller enclosure. To date it has been a common practice to only provide an earth ground for one end of the cable shield in order to minimize the risk of noise caused by earth ground loop currents between apparatus. The procedure of only grounding one end, which primarily originated as a result of trying to reduce hum in audio systems, is no longer applicable to the complex industrial environment. Shielded cables are also efficient emitters of RF noise from the CPU system, and can interact in a parasitic manner in networks and between multiple sources of interference.

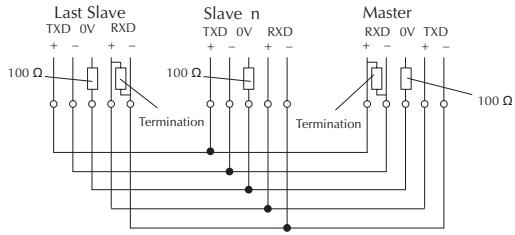
The recommendation is to use shielded cables as electrostatic "pipes" between apparatus and systems, and to run heavy gauge equipotential bond wires alongside all shielded cables. When a shielded cable runs through the metallic wall of an enclosure or machine, it is recommended in IEC 61000–5–2 that the shield should be connected over its full perimeter to the wall, preferably using a conducting adapter, and not via a pigtail wire connection to an earth ground bolt. Shields must be connected to every enclosure wall or machine cover that they pass through.

Analog and RS232 Cables

Providing an earth ground for both ends of the shield for analog circuits provides the perfect electrical environment for the twisted pair cable as the loop consists of signal and return, in a perfectly balanced circuit arrangement, with connection to the common of the input circuitry made at the module terminals. RS232 cables are handled in the same way.

Multi-drop Cables

RS422 twin twisted pair, and RS485 single twisted pair cables also require a 0V link, which has often been provided in the past by the cable shield. It is now recommended that you use triple twisted pair cabling for RS422 links, and twin twisted pair cable for RS485 links. This is because the extra pair can be used as the 0V inter-system link. With loop DC power supplies earth grounded in both systems, earth loops are created in this manner via the inter-system 0v link. The installation guides encourage earth loops, which are maintained at a low impedance by using heavy equipotential bond wires. To account for non–European installations using single-end earth grounds, and sites with far from ideal earth ground characteristics, we recommend the addition of 100 ohm resistors at each 0V link connection in network and communications cables.



Shielded Cables Within Enclosures

When you run cables between programmable controller items within an enclosure which also contains susceptible electronic equipment from other manufacturers, remember that these cables may be a source of RF emissions. There are ways to minimize this risk. Standard data cables connecting CPUs and/or operator interfaces should be routed well away from other equipment and their associated cabling. You can make special serial cables where the cable shield is connected to the enclosure's earth ground at both ends, the same way as external cables are connected.

Analog I/O and RF Interference

The readings from all analog I/O will be affected by the use of devices that exhibit high field strengths, such as mobile phones and motor drives.

All AutomationDirect products are tested to withstand field strength levels up to 10V/m, which is the maximum required by the relevant EU standards. While all products pass this test, analog I/O will typically exhibit deviations of their readings. This is quite normal, however, systems designers should be aware of this and plan accordingly.

When assembling a control system using analog I/O, these issues must be adhered to and should be integrated into the system design. This is the responsibility of the system builder/commissioner.

Network Isolation

For safety reasons, it is a specific requirement of the Machinery Directive that a keyed switch must be provided that isolates any network input signal during maintenance, so that remote commands cannot be received that could result in the operation of the machinery. To avoid the introduction of noise into the system, any keyed switch assembly should be housed in its own earth grounded steel box and the integrity of the shielded cable must be maintained.

Again, for further information on EU directives we recommend that you get a copy of our EU Installation Manual (DA–EU–M) on-line. Also, you can check the EU Commission's official web site at:

http://ec.europa.eu/growth/single-market/european-standards/harmonised-standards.

It is good Engineering practice to install toroid inductors on the I/O wiring and the communications cables such as listed in the table below.

Toroid Inductors				
Manufacturer	**Mfg. Part Number**	**Outside Diameter**	**Inside Diameter**	**Length**
RS Online	2606795	17.5 mm	9.5 mm	28.5 mm
Fair-Rite	2643665702	17.45 mm	9.5 mm	28.6 mm
Wurth Elektronick	7427009	17.5 mm	9.5 mm	28.5 mm

Items Specific to BRX

- The rating between all circuits in this product are rated **as basic insulation only**, as appropriate for single fault conditions.
- It is the responsibility of the system designer to earth one side of all control and power circuits, and to earth the braid of screened cables.
- This equipment must be properly installed while adhering to the guidelines of the in house CPU installation manual DA–EU–M, and the installation standards IEC 61000–5–1, IEC 61000–5–2 and IEC 61131–4.
- It is a requirement that all CPU equipment must be housed in a protective steel enclosure, which limits access to operators by a lock and power breaker. If access is required by operators or untrained personnel, the equipment must be installed inside an internal cover or secondary enclosure.
- It should be noted that the safety requirements of the machinery directive standard EN60204–1 state that all equipment power circuits must be wired through isolation transformers or isolating power supplies, and that one side of all AC or DC control circuits must be earthed.
- Both power input connections to the programmable controller must be separately fused using three (3) amp T-type anti–surge fuses, and a transient suppressor fitted to limit supply over-voltages.
- If the equipment is used in a manner not specified by the manufacturer the protection provided by the equipment may be impaired.

NOTES:

BRX MPU Power Budgeting

In This Appendix...

Power Budget Form B-2
Power Budget Worksheet B-3
BRX MPU Available Expansion Power B-4
BRX MPU POM Power Consumed B-5
BRX MPU Expansion Module Power Consumed B-6
Power Budget Examples B-9

BRX MPU Power Budget

The BRX MPU has a limited amount of power available to supply the expansion modules. When designing a BRX system the power budget should be taken into account to be sure that your system will perform as expected.

A general rule of thumb is that when there are 32 or more points of relay expansion modules in a system, a power budget calculation must be performed to ensure that there is enough available power to accommodate all expected modules.

On the following pages you will find a worksheet and power budget tables to help you determine your system total power budget requirement. If the calculations exceeds the total available power, you may need to consider using an additional MPU or using a Remote I/O solution to satisfy the system requirements.

Examples are also included to help show how the calculations should be performed.

WARNING: **It is extremely important to calculate the power budget. If you exceed the power budget, the system may operate in an unpredictable manner which may result in a risk of personal injury or equipment damage.**

Power Budget Form

1. Find the Watts available for the BRX MPU that you will be using. Put this value in line 1 - MPU section of the worksheet.

2. If you are using a POM (Pluggable Option Module), find the watts consumed and put this value in line 2 - POM section of the worksheet.

3. For each Expansion Module that you will be using, find the watts consumed and put this value in the appropriate slot that the module will reside in, lines 3 through 10.

4. Add the values located in the POM Watts and Slot 1 through 8, lines 2 through 10. Write the value of this sum in line 11 - Total Watts Consumed.

5. Subtract line 11 - Total Watts Consumed from line 1 - MPU Watts Available. Write this value in line 12 - Watts Remaining.

6. If the value in line 12 - Watts Remaining is a negative number, your system is consuming more Watts than the MPU is capable of providing. This system would be unsafe as designed. You will need to reconsider your design. If the remaining wattage is zero or more than zero, the system design is good.

Power Budget Worksheet

Power Budget Worksheet			
Line	Item	Part #	Watts
1	MPU		
2	POM		
3	Slot 1		
4	Slot 2		
5	Slot 3		
6	Slot 4		
7	Slot 5		
8	Slot 6		
9	Slot 7		
10	Slot 8		
11	Total Watts Consumed (Add lines 2 thru 10)		
12	Watts Remaining (Line 1 - line 11)		

WARNING: It is extremely important to calculate the power budget. If you exceed the power budget, the system may operate in an unpredictable manner which may result in a risk of personal injury or equipment damage.

BRX MPU Available Expansion Power

The following tables show the available power for each of the BRX MPU's. Use the wattages shown as the total available power when calculating the power budget.

MPU Total Power Available			
Model	**# Built-in Inputs**	**# Built-in Outputs**	**Total Available Power (W)**
BX-DM1E-M	0	0	21.3
BX-DM1E-M-D	0	0	21.3
BX 10			
BX-DM1-10ED1-D	6	4	8.5
BX-DM1-10ED2-D	6	4	8.5
BX-DM1-10ER-D	6	4	8.3
BX-DM1-10AR-D	6	4	8.3
BX 10E			
BX-DM1E-10ED13-D	6	4	7.3
BX-DM1E-10ED23-D	6	4	7.3
BX-DM1E-10ER3-D	6	4	7.0
BX-DM1E-10AR3-D	6	4	7.0
BX 18			
BX-DM1-18ED1	10	8	20.2
BX-DM1-18ED2	10	8	20.2
BX-DM1-18ER	10	8	19.6
BX-DM1-18AR	10	8	19.6
BX-DM1-18ED1-D	10	8	20.2
BX-DM1-18ED2-D	10	8	20.2
BX-DM1-18ER-D	10	8	19.6
BX 18E			
BX-DM1E-18ED13	10	8	18.8
BX-DM1E-18ED23	10	8	18.8
BX-DM1E-18ER3	10	8	17.9
BX-DM1E-18AR3	10	8	17.9
BX-DM1E-18ED13-D	10	8	18.8
BX-DM1E-18ED23-D	10	8	18.8
BX-DM1E-18ER3-D	10	8	17.9

MPU Total Power Available, continued

Total MPU Power Available			
Model	**# Built-in Inputs**	**# Built-in Outputs**	**Total Available Power (W)**
BX 36			
BX-DM1-36ED1	20	16	18.7
BX-DM1-36ED2	20	16	18.7
BX-DM1-36ER	20	16	17.6
BX-DM1-36AR	20	16	17.6
BX-DM1-36ED1-D	20	16	18.7
BX-DM1-36ED2-D	20	16	18.7
BX-DM1-36ER-D	20	16	17.6
BX 36E			
BX-DM1E-36ED13	20	16	16.4
BX-DM1E-36ED23	20	16	16.4
BX-DM1E-36ER3	20	16	15.3
BX-DM1E-36AR3	20	16	15.3
BX-DM1E-36ED13-D	20	16	16.5
BX-DM1E-36ED23-D	20	16	16.5
BX-DM1E-36ER3-D	20	16	15.3

BRX MPU POM Power Consumed

The following chart shows the power consumed by each of the BRX POMs. Use the wattages shown as the amount to be subtracted from the total available wattage when calculating the power budget.

POM Power Consumption	
Model	**Consumption (W)**
BX-P-SER2-RJ12	0.2
BX-P-SER2-TERM	0.2
BX-P-SER4-TERM	0.2
BX-P-USB-B	0.1
BX-P-ECOMLT	0.4

BRX MPU Expansion Module Power Consumed

The following tables show the power consumed by each of the BRX Expansion Modules. Use the wattages shown as the total amount to be subtracted from the available wattage when calculating the power budget.

BRX Discrete Input Expansion Modules

BRX Input Expansion Modules Power Consumption

Model	Inputs/ Module	Outputs/ Module	Consumption (W)
BX-08NA	8	0	0.2
BX-08NB	8	0	0.2
BX-08ND3	8	0	0.2
BX-08NF3	8	0	0.2
BX-12NA	12	0	0.3
BX-12NB	12	0	0.3
BX-12ND3	12	0	0.3
BX-16NA	16	0	0.3
BX-16NB	16	0	0.3
BX-16ND3	16	0	0.3

BRX Discrete Output Expansion Modules

BRX Output Expansion Modules Power Consumption

Model	Inputs/ Module	Outputs/ Module	Consumption (W)
BX-05TRS	0	5	1.8
BX-08TA	0	8	0.4
BX-08TD1	0	8	0.4
BX-08TD2	0	8	0.4
BX-08TR	0	8	1.7
BX-12TA	0	12	0.5
BX-12TD1	0	12	0.5
BX-12TD2	0	12	0.5
BX-12TR	0	12	2.5
BX-16TD1	0	16	0.5
BX-16TD2	0	16	0.5
BX-16TR	0	16	3.4

BRX Discrete Input/Output Combination Expansion Modules

BRX Combination Expansion Modules Power Consumption			
Model	Inputs/ Module	Outputs/ Module	Consumption (W)
BX-08CD3R	4	4	1.0
BX-12CD3D1	8	4	0.3
BX-12CD3D2	8	4	0.3
BX-16CD3D1	8	8	0.4
BX-16CD3D2	8	8	0.4

BRX Analog Input/Output Expansion Modules

BRX Analog Expansion Modules Power Consumption				
Type	Model	Inputs/ Module	Outputs/ Module	Consumption (W)
In	BX-08AD-1	8	0	0.1
In	BX-08AD-2B	8	0	0.1
In	BX-04THM	4	0	0.1
Out	BX-08DA-1	0	8	0.1
Out	BX-08DA-2B	0	8	0.1

Power Budget Examples

Example 1

Power Budget Worksheet			
Line	Item	Part #	Watts
1	MPU	BX-DM1-18ED1	20.20
2	POM		
3	Slot 1	BX-08ND3	0.20
4	Slot 2	BX-16ND3	0.30
5	Slot 3	BX-16TR	3.40
6	Slot 4	BX-16TR	3.40
7	Slot 5		
8	Slot 6		
9	Slot 7		
10	Slot 8		
11	Total Watts Consumed (Add lines 2 thru 10)		7.30
12	Watts Remaining (Line 1 - line 11)		12.90

This example shows that the selected configuration is within the power budget. This is a sound configuration and will work as designed.

WARNING: It is extremely important to calculate the power budget. If you exceed the power budget, the system may operate in an unpredictable manner which may result in a risk of personal injury or equipment damage.

Example 2

Power Budget Worksheet			
Line	Item	Part #	Watts
1	MPU	BX-DM1E-36ER3	15.30
2	POM	BX-P-ECOMLT	0.40
3	Slot 1	BX-08NA	0.20
4	Slot 2	BX-16ND3	0.30
5	Slot 3	BX-16ND3	0.30
6	Slot 4	BX-16TD1	0.50
7	Slot 5	BX-16TD1	0.50
8	Slot 6	BX-16TR	3.40
9	Slot 7	BX-05TRS	1.80
10	Slot 8	BX-05TRS	1.80
11	Total Watts Consumed (Add lines 2 thru 10)		9.20
12	Watts Remaining (Line 1 - line 11)		6.10

This example shows that the selected configuration is within the power budget. This is a sound configuration and will work as designed.

WARNING: It is extremely important to calculate the power budget. If you exceed the power budget, the system may operate in an unpredictable manner which may result in a risk of personal injury or equipment damage.

Example 3

Power Budget Worksheet			
Line	Item	Part #	Watts
1	MPU	BX-DM1E-36ER3	15.30
2	POM	BX-P-SER2-TERM	0.20
3	Slot 1	BX-16NA	0.30
4	Slot 2	BX-16NA	0.30
5	Slot 3	BX-16NA	0.30
6	Slot 4	BX-16TR	3.40
7	Slot 5	BX-16TR	3.40
8	Slot 6	BX-16TR	3.40
9	Slot 7	BX-16TR	3.40
10	Slot 8	BX-16TR	3.40
11	Total Watts Consumed (Add lines 2 thru 10)		18.10
12	Watts Remaining (Line 1 - line 11)		**-2.80**

This example shows that the selected configuration will exceed the power budget. This is an unsafe configuration and will not work as designed. One way to correct this is to add Remote I/O to this system for additional I/O capability.

WARNING: It is extremely important to calculate the power budget. If you exceed the power budget, the system may operate in an unpredictable manner which could result in a risk of personal injury or equipment damage.

NOTES: