NETWORK GATEWAY SERIES

ICC

INDUSTRIAL CONTROL COMMUNICATIONS, INC.

ETH-200

ETHERNET MULTIPROTOCOL NETWORK GATEWAY

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Introduction

Thank you for purchasing the ICC ETH-200 Ethernet Multiprotocol Network Gateway. The ETH-200 allows information to be transferred seamlessly between many different fieldbus networks with minimal configuration requirements. The ETH-200 provides a 10/100BaseT Ethernet port, two RS485 ports, one RS232 port, and three common serial ports for direct connectivity to Toshiba 7-series, 9-series, 11-series or VF-nC1 Adjustable Speed Drives (ASDs). These various communication ports operate independently, and are configurable along with the unit's internal point database via a standard web browser.

The gateway currently provides support for the following protocols:

- ▸ Modbus RTU (RS485 master & slave)
- ▸ Modbus RTU (RS232 master & slave)
- ▸ Toshiba ASD (common serial master)
- ▸ Toshiba 3-series ASD (RS232 master)
- ▸ Modbus TCP/IP (slave)
- ▸ Ethernet/IP (server)
- ▸ Mitsubishi 500-series & 700-series ASD (RS485 master)
- ▸ Johnson Controls, Inc. Metasys N2 (RS485 slave) *(under development)*
- ▸ Sullair Supervisor network (RS485 master) *(under development)*

New network drivers are continuously being added, and can be downloaded for free from our web site.

Before using the ETH-200 network gateway, please familiarize yourself with the product and be sure to thoroughly read the instructions and precautions contained in this manual. In addition, please make sure that this instruction manual is delivered to the end user of the ETH-200, and keep this instruction manual in a safe place for future reference or unit inspection.

This instruction manual describes the device specifications, wiring methods, maintenance procedures, supported functions and usage methods for the ETH-200 network gateway.

For the latest information, support, firmware releases or product point files, please visit http://www.iccdesigns.com.

Before continuing, please take a moment to ensure that you have received all materials shipped with your kit. These items are:

- ETH-200 gateway
- Panel-mount standoff kit
- Documentation CD-ROM

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ETH-200 Ethernet Multiprotocol Network Gateway
User's Manual

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Notice to Users

INDUSTRIAL CONTROL COMMUNICATIONS, INC.'S PRODUCTS ARE NOT
AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE-SUPPORT
DEVICES OR SYSTEMS. Life-support devices or systems are devices or
systems intended to sustain life, and whose failure to perform, when properly
used in accordance with instructions for use provided in the labeling and user's
manual, can be reasonably expected to result in significant injury.

No complex software or hardware system is perfect. Bugs may always be
present in a system of any size. In order to prevent danger to life or property, it
is the responsibility of the system designer to incorporate redundant protective
mechanisms appropriate to the risk involved.

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Usage Precautions

Operating Environment

- Please use the gateway only when the ambient temperature of the environment into which the unit is installed is within the following specified temperature limits:

    Operation: -10 ~ +50°C (+14 ~ +122°F)
    Storage: -40 ~ +85°C (-40 ~ +185°F)

- Avoid installation locations that may be subjected to large shocks or vibrations.

- Avoid installation locations that may be subjected to rapid changes in temperature or humidity.

Installation and Wiring

- Proper ground connections are vital for both safety and signal reliability reasons. Ensure that all electrical equipment is properly grounded.

- Route all communication cables separate from high-voltage or noise-emitting cabling (such as ASD input/output power wiring).

ASD Connections

- Do not touch charged parts of the drive such as the terminal block while the drive's CHARGE lamp is lit. A charge will still be present in the drive's internal electrolytic capacitors, and therefore touching these areas may result in an electrical shock. Always turn all drive input power supplies OFF, and wait at least 5 minutes after the CHARGE lamp has gone out before connecting communication cables.

- To avoid misoperation, do not connect any gateway terminals to either the ASD's E/GND terminals, the motor, or to any other power ground.

- When making common serial connections between the gateway and Toshiba ASDs, do not use cables that exceed 5 meters in length.

- For further drive-specific precaution, safety and installation information, please refer to the appropriate documentation supplied with your drive.

- Internal ASD EEPROMs have a limited life span of write cycles. Observe all precautions contained in this manual and your ASD manual regarding which drive registers safely may and may not be repetitively written to.

- When used without an Auxiliary power source (Toshiba ASD common serial mode), the gateway derives its control power from the connected drives. Therefore, removing power to all connected drives will also cause the gateway to lose power.

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1. The Network Gateway Series Concept

The ETH-200 is a member of the ICC Network Gateway Series product family. Members of this family are designed to provide a uniform interface, configuration and application experience. This commonality reduces the user's learning curve, reducing commissioning time while simplifying support. The ETH-200 provides simultaneous support for many different communication protocols, allowing complex interchanges of data between otherwise incompatible networks.

The heart of the Network Gateway Series concept is an element called the "point database". The point database is entirely user-configurable, and provides the mapping information that allows requests from the various supported networks to be interpreted and stored in a common format. This allows data to be routed from any supported network to any other supported network.

Additionally, the point database provides the added benefit of "data mirroring", whereby current copies of point values (populated by a "source port" designation) are maintained locally within the gateway itself. This greatly reduces the request-to-response latency times on the various networks, as requests (read or write) can be entirely serviced locally, thereby eliminating the time required to execute a secondary transaction on a different network.

When properly configured, the gateway will become essentially "transparent" on the networks, and the various network devices can engage in seamless dialogs with each other.

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2. Feature Summary

Ethernet Port

IEEE 802.3 10/100BaseT Ethernet compliant. Shielded RJ45 connector accepts standard CAT5-type 8-conductor unshielded twisted-pair (UTP) patch cables. Supports multiple simultaneous protocols.

RS485 Ports

Two half-duplex 2-wire RS485 ports (A / B / Signal Ground / Shield). These ports allow a selection of various master and slave protocols.

RS232 Port

One RS232 port that can be used to configure the unit, update the internal firmware, upload/download files or act as a control protocol port.

Toshiba ASD Ports

Three common serial (aka logic level) ports for connection of Toshiba 7-series, 9-series, 11-series or VF-nC1 ASDs. ASD connections use the same standard RJ45 style 8-conductor UTP patch cables: any standard CAT5 Ethernet cable (found in most electronics stores) 5 meters or less in length can be used. ASD connections are automatically established and continuously monitored: no drive configuration needs to be performed to connect the unit to the drives. Just plug it in – it's that simple.

Power Supply

When connected to Toshiba ASDs via the ASD1 / ASD2 / ASD3 ports, can be either powered directly from the attached ASDs, or from the auxiliary power ("AUX PWR") input jack. All other non-Toshiba applications require the use of the AUX PWR input to supply power to the unit. When more than one power source is connected, the unit will draw its control power from the source with the highest supply voltage.

Supported Protocols

- ‣ Modbus RTU (RS485 master & slave)
- ‣ Modbus RTU (RS232 master & slave)
- ‣ Toshiba ASD (common serial master)
- ‣ Toshiba 3-series ASD (RS232 master)
- ‣ Modbus TCP/IP (slave)
- ‣ Ethernet/IP (server)
- ‣ Mitsubishi 500-series & 700-series ASD (RS485 master) (also used by MGI Technologies, Inc. ASDs)
- ‣ Johnson Controls, Inc. Metasys N2 (RS485 slave) *(under development)*
- ‣ Sullair Supervisor network (RS485 master) *(under development)*

New network drivers are continuously being added, and can be downloaded for free from our web site.

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Text-Based Console Configuration

Basic unit configuration is performed via a text-based console interface, available locally over the RS232 port via a standard PC terminal program such as Microsoft Windows HyperTerminal®, or over Ethernet via a Telnet session. The unit also provides initial configuration access via ICMP ("ping") configuration.

Macromedia® Flash-Enabled Embedded Web Server

Advanced unit configuration and point monitoring/control are also provided via an embedded web server using the HTTP protocol. The unit's web server feature provides direct data access and control via standard web browsers such as Microsoft Internet Explorer and Netscape Navigator. The latest version of Macromedia Flash Player browser plug-in is required.

Configuration File Upload/Download

A unit's configuration can be uploaded from / downloaded to a PC, which provides the capability for PC-based file backup and easy configuration copying to multiple units. Sample configuration files and related documentation can also be downloaded from our web site, uploaded to a unit, and custom-modified to suit a specific application.

Network Timeout Action

A per-port and per-point 2-level configurable network timeout action can be programmed that allows each internal point to have its own unique "fail-safe" condition in the event of a network interruption.

Indicators

- 1 green "LNK" LED that is on whenever a valid Ethernet connection is detected.
- 1 green "SPD" LED that is on whenever a 100BaseT Ethernet connection is established.
- 1 amber "ACT" LED that flashes whenever data is transferred across the Ethernet network.
- 1 bicolor red/green "MS" LED that indicates module status information.
- 1 bicolor red/green "NS" LED that indicates network status information.
- 1 green "TX" and 1 red "RX" LED on each RS485 port.
- 1 green and 1 red LED on each of the Toshiba common serial ASD ports.

Refer to section 8 for more detailed information about the LED indicators and their meanings.

Field-Upgradeable

As new firmware becomes available, the unit can be upgraded in the field by the end-user. Refer to section 16.5 for more information.

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Versatile Mounting Options

The unit can be panel-mounted with the included standoff kit, or snapped into existing 4" Augat SnapTrack^{TM} (6TK series or equivalent). An optional mounting kit (ICC part number 10581) is also available for DIN-rail mount applications.

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3. Installing the Gateway

The gateway's installation procedure will vary slightly depending on the chosen mounting method and the networks that will be used.

3.1 Mounting

3.1.1 Panel Mounting

The included standoff kit allows for panel mounting of the unit. The standoff kit is comprised of four 1" aluminum male/female standoffs and four #6 lock washers.

1. Remove one of the four cover standoff retention screws and its lock washer from the bottom side of the unit. DO NOT dispose of this screw and washer, as they will be used later to mount the unit to the panel.

2. Install one of the male/female standoffs and a #6 lock washer from the standoff kit through the unit's circuit board and into the bottom of the cover standoff. Refer to Figure 1.
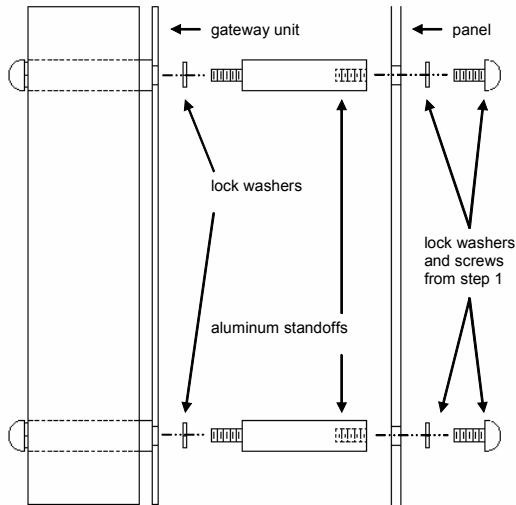
Figure 1: Standoff Kit Installation

3. Repeat steps 1 and 2 above to replace each of the three other cover standoff retention screws.

4. Using the dimensions provided in Figure 2, drill four 0.150" diameter holes at the specified locations on the panel. As a convenient pattern guide, the unit with attached mounting standoffs can be held against the panel, and the four standoff locations marked with a pencil or scribe.
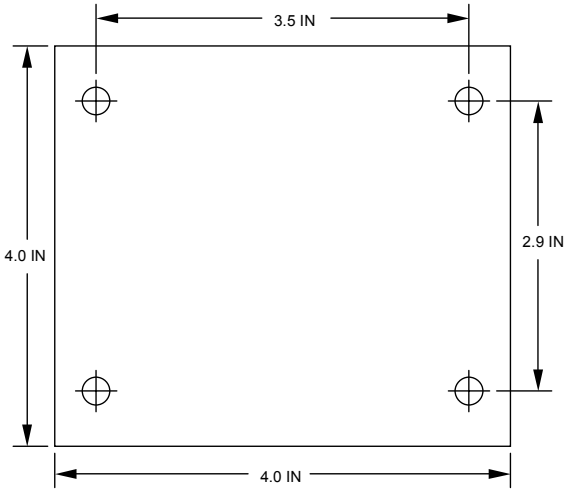
Figure 2: Standoff Hole Placement

5. As shown in Figure 1, use the four screws and lock washers from step 1 to mount the unit from the back side of the panel.

3.1.2 SnapTrack™ Mounting

The unit footprint measures 4" x 4" square, and is designed to fit directly into existing 4" Augat SnapTrack™ (6TK series or equivalent). Carefully insert the unit into the SnapTrack™ by pressing firmly on the pan head screws located at the 4 corners of the unit's cover. DO NOT press directly on the aluminum cover, as this may damage the cover.

3.1.3 DIN Rail Mounting

An optional mounting kit (ICC part number 10581) allows DIN rail mounting of the unit. The mounting kit is comprised of a 4" section of Augat 6TK SnapTrack™ and two DIN rail clips.

1. Carefully insert the unit into the SnapTrack™ by pressing firmly on the pan head screws located at the 4 corners of the unit's cover. DO NOT press directly on the aluminum cover, as this may damage the cover.

2. Install the DIN rail clips into the openings on the bottom side of the SnapTrack™. Refer to Figure 3.

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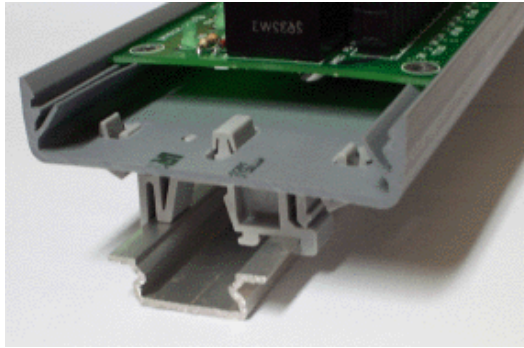
Figure 3: DIN Rail Mounting Kit Installation

3.2 Installation for Non-Toshiba ASD Networks

Note that in order to power the unit when not connecting to Toshiba ASDs via the common serial ports, the optional 120VAC/9VDC power supply (ICC part number 10456) or a user-supplied power source meeting the requirements outlined in section 10 must also be installed.

1. Mount the unit via the desired method (refer to section 3.1).

2. Connect the various networks to their respective plugs/terminal blocks. Ensure that any terminal blocks are fully seated into their respective headers, and route the network cables such that they are located well away from any electrical noise sources, such as ASD input power or motor wiring. Also take care to route all cables away from any sharp edges or positions where they may be pinched.

3. Take a moment to verify that the gateway and all network cables have sufficient clearance from electrical noise sources such as drives, motors, or power-carrying electrical wiring.

4. Connect the power supply to the gateway's "AUX PWR" jack.

3.3 Installation for Toshiba ASD Networks

The gateway connects to each drive via the drive's common serial (logic level) communication port, typically located on either the main drive control board (G7, S11), on the front of the drive enclosure under a small snap-on cover (A7, S9), on the right-hand side of the drive enclosure under a small snap-on cover (S7), or on the bottom side of the drive enclosure (VF-nC1). Although in general no drive parameters need to be configured in order to use the

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gateway, it is advantageous to check that the drive's common serial communication data rate is set to its maximum speed. Because the gateway will communicate to each drive only at the drive's configured data rate, this will provide the fastest response time for drive-to-network data transfers. For information on checking the drive's common serial communication data rate, refer to the appropriate manual supplied with your drive.

Note that the common serial communication parameters of each drive are handled independently by the gateway, which means that different drive families may be connected to different channels of the unit in any combination, and that the drives connected to each channel may simultaneously communicate to the unit at completely different baud rates, parity settings, etc.

Drives can be connected to the gateway on any ASD channel in any order or combination. When more than one drive is connected to the unit, or if the optional auxiliary power supply is used, the gateway will draw its control power from the source with the highest power supply voltage.

Installation of the gateway should only be performed by a qualified technician familiar with the maintenance and operation of the connected drives. To install the gateway, complete the steps outlined in the following sections related to your specific drive.

3.3.1 Installation for G7 ASDs

1. Mount the unit via the desired method (refer to section 3.1).

2. ⚡ **CAUTION!** Verify that all input power sources to the drives to be connected have been turned OFF and are locked and tagged out.

3. ⚠ **DANGER!** ⚡ Wait at least 5 minutes for the drive's electrolytic capacitors to discharge before proceeding to the next step. **Do not touch any internal parts with power applied to the drive, or for at least 5 minutes after power to the drive has been removed. A hazard exists temporarily for electrical shock even if the source power has been removed.** Verify that the CHARGE LED has gone out before continuing the installation process.

4. Remove the drive's front cover / open the drive's cabinet door (refer to the appropriate drive manual for instructions how to do this).

5. The drive's LCD panel (also called the "Electronic Operator Interface" or "EOI") can communicate with the drive via either the RS485/RS232 channel (CNU1/CNU1A) or the common serial channel (CNU2/CNU2A). Because the gateway uses the common serial channel, the LCD panel must be configured to use the RS485/RS232 channel. If the drive to be connected is currently using CNU2 (on the drive control board) and CNU2A (on the LCD panel), then this connection must first be switched over to CNU1 (on the drive control board) and CNU1A (on the LCD panel).

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Refer to Toshiba's documentation for any precautions or notices regarding this connection change. If the LCD panel is already connected via the RS485/RS232 channel, then no change is required.

6. Configure the drive's LCD panel to communicate via the RS485/RS232 channel by setting parameter "`Communication Setting Parameters...Communication Settings...Select LCD Port Connection`" to "`RS485/232 serial`".

7. Connect the drive's common serial communication port (CNU2) to one of the ASD channels of the gateway with the communication cable (communication cable is not included with the gateway kit). When choosing cables for this connection, standard 24 AWG category 5 (CAT5) unshielded twisted-pair (UTP) 8-conductor cables found in Ethernet networks in most office environments can be used. The maximum allowable length for these cables is 5 meters. Although there are many varieties and styles of CAT5 UTP cables available, ICC strongly recommends using only high-quality cables from reputable manufacturers to guarantee optimal noise immunity and cable longevity. Ensure that each end of the cable is fully seated into the modular connectors, and route the cable such that it is located well away from any drive input power or motor wiring. Also take care to route the cable away from any sharp edges or positions where it may be pinched.

8. Reinstall the drive's front cover / close the drive's cabinet door.

9. Repeat steps 2-8 to connect other drive(s) as needed.

10. Connect the other various networks to their respective plugs/terminal blocks. Ensure that any terminal blocks are fully seated into their respective headers, and route the network cables such that they are located well away from any electrical noise sources, such as ASD input power or motor wiring. Also take care to route all cables away from any sharp edges or positions where they may be pinched.

11. If an auxiliary power supply is going to be used, connect it to the gateway's "AUX PWR" jack.

12. Take a moment to verify that the gateway and all network cables have sufficient clearance from drives, motors, or power-carrying electrical wiring.

13. Turn the power sources to all connected drives ON, and verify that the drives function properly. If the drives do not appear to power up, or do not function properly, immediately turn power OFF. **Repeat steps 1 and 2 to remove all power from the drives.** Then, verify all connections. Contact ICC or your local Toshiba representative for assistance if the problem persists.

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3.3.2 Installation for S7, S9, S11, A7 and VF-nC1 ASDs

1. Mount the unit via the desired method (refer to the separate mounting options manual for more information).

2. ⚡ **CAUTION!** Verify that all input power sources to the drives to be connected have been turned OFF and are locked and tagged out.

3. ⚠ **DANGER!** ⚡ Wait at least 5 minutes for the drive's electrolytic capacitors to discharge before proceeding to the next step. **Do not touch any internal parts with power applied to the drive, or for at least 5 minutes after power to the drive has been removed. A hazard exists temporarily for electrical shock even if the source power has been removed.** Verify that the CHARGE LED has gone out before continuing the installation process.

4. Remove the drive's common serial communication port cover if it has one (refer to the appropriate drive manual for instructions how to do this). Do not discard this cover, as it should be reinstalled to minimize contamination of the port's electrical contacts if the gateway is ever disconnected from the drive.

5. Connect the drive's common serial communication port to one of the ASD channels of the gateway with the communication cable (communication cable is not included with the gateway kit). When choosing cables for this connection, standard 24 AWG category 5 (CAT5) unshielded twisted-pair (UTP) 8-conductor cables found in Ethernet networks in most office environments can be used. The maximum allowable length for these cables is 5 meters. Although there are many varieties and styles of CAT5 UTP cables available, ICC strongly recommends using only high-quality cables from reputable manufacturers to guarantee optimal noise immunity and cable longevity. Ensure that each end of the cable is fully seated into the modular connectors, and route the cable such that it is located well away from any drive input power or motor wiring. Also take care to route the cable away from any sharp edges or positions where it may be pinched.

6. Repeat steps 2-5 to connect other drive(s) as needed.

7. Connect the other various networks to their respective plugs/terminal blocks. Ensure that any terminal blocks are fully seated into their respective headers, and route the network cables such that they are located well away from any electrical noise sources, such as ASD input power or motor wiring. Also take care to route all cables away from any sharp edges or positions where they may be pinched.

8. If an auxiliary power supply is going to be used, connect it to the gateway's "AUX PWR" jack.

9. Take a moment to verify that the gateway and all network cables have sufficient clearance from drives, motors, or power-carrying electrical wiring.

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10. Turn the power sources to all connected drives ON, and verify that the drives function properly. If the drives do not appear to power up, or do not function properly, immediately turn power OFF. **Repeat steps 1 and 2 to remove all power from the drives.** Then, verify all connections. Contact ICC or your local Toshiba representative for assistance if the problem persists.

4. RS485 Port Electrical Interfaces

In order to ensure appropriate network conditions (signal voltage levels, etc.) when using the gateway's RS485 ports, some knowledge of the network interface circuitry is required. Refer to Figure 4 for a simplified network schematic of the RS485 interface circuitry. Note that the "Shield" terminal has no internal connection: its purpose is simply to provide a cable shield chaining location between devices. The shield is then typically connected to ground at one location only.
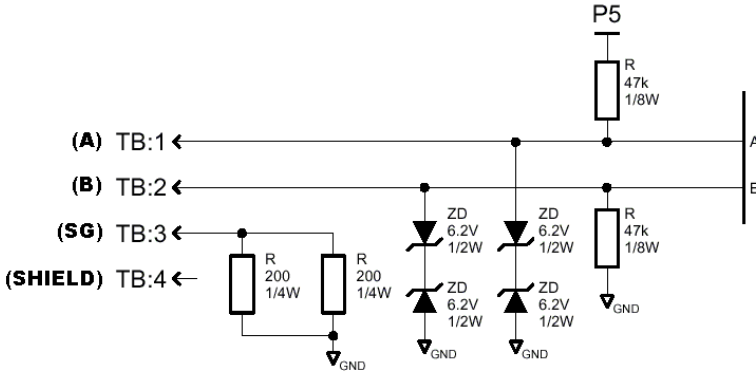
Figure 4: RS485 Interface Circuitry Schematic

Figure 5 details the specific network connections to the RS485 terminal block. This connection scheme applies equally to both RS485 ports.
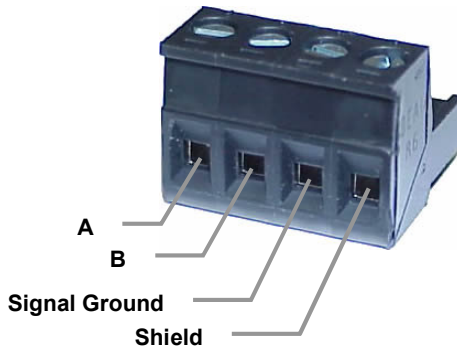
Figure 5: RS485 Terminal Block Connections

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5. Environmental Specifications

Item	Specification
Operating Environment	Indoors, less than 1000m above sea level, do not expose to direct sunlight or corrosive / explosive gasses
Operating Temperature	-10 ~ +50°C (+14 ~ +122°F)
Storage Temperature	-40 ~ +85°C (-40 ~ +185°F)
Relative Humidity	20% ~ 90% (without condensation)
Vibration	5.9m/s^2 {0.6G} or less (10 ~ 55Hz)
Grounding	Non-isolated, referenced to power source ground
Cooling Method	Self-cooled

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6. Maintenance and Inspection

Preventive maintenance and inspection is required to maintain the gateway in its optimal condition, and to ensure a long operational lifetime. Depending on usage and operating conditions, perform a periodic inspection once every three to six months. Before starting inspections, disconnect all power sources.

Inspection Points

- Check that the network cable(s) are properly terminated in the terminal block(s), and ensure that pluggable terminal blocks are fully seated in their headers. Reseat if necessary.

- Check that there are no defects in any attached wire terminal crimp points. Visually check that the crimp points are not damaged or loose.

- Visually check all wiring and cables for damage. Replace as necessary.

- Clean off any accumulated dust and dirt.

- If use of the gateway is discontinued for extended periods of time, apply power at least once every two years and confirm that the unit still functions properly.

- Do not perform hi-pot tests on the gateway, as they may damage the unit.

Please pay close attention to all periodic inspection points and maintain a good operating environment.

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7. Storage and Warranty

7.1 Storage

Observe the following points when the gateway is not used immediately after purchase or when it is not used for an extended period of time.

- Avoid storing the unit in places that are hot or humid, or that contain large quantities of dust or metallic dust. Store the unit in a well-ventilated location.

- When not using the unit for an extended period of time, apply power at least once every two years and confirm that it still functions properly.

7.2 Warranty

The gateway is covered under warranty by ICC, Inc. for a period of 12 months from the date of installation, but not to exceed 18 months from the date of shipment from the factory. For further warranty or service information, please contact Industrial Control Communications, Inc. or your local distributor.

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8. LED Indicators

The gateway contains several different LED indicators, each of which conveys important information about the status of the unit and connected networks. These LEDs and their functions are summarized here.

8.1 Toshiba ASD Common Serial Port Indicators

Each Toshiba ASD common serial port RJ45 connector has two LEDs positioned immediately above them (1 green and 1 red).

Green LED ...... Indicates "drive link". Solid green when a logical connection exists with the attached drive (i.e. the gateway is reading data from the drive).
Red LED.......... Data write. Flashes briefly when data is written to the drive from the point database.

8.2 Ethernet Port Indicators

The Ethernet Port RJ45 connector has three LEDs positioned immediately to the left of it.

SPD ...... SPeeD: solid green whenever a 100BaseT Ethernet connection is established.
LNK ...... LiNK: solid green whenever a valid Ethernet connection is detected.
ACT ...... ACTivity: flashes amber whenever network activity is detected.

8.3 RS485 Port Indicators

Each RS485 port has one red and one green LED situated next to its respective terminal block.

Green LED ...... Lights when the gateway is transmitting data on the port.
Red LED.......... Lights when the gateway is receiving data on the port (note that this does not indicate the validity of the data with respect to a particular protocol: only that data exists and is being detected.)

8.4 Ethernet/IP Status Indicators

One Module Status ("MS") LED and Network Status ("NS") LED exists. These bicolor red/green indicators conform to the prescribed behavior as dictated in the Ethernet/IP specification, Volume 2, Chapter 9.

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9. Configuration Switches

There are two configuration DIP switches (marked "CFG") located on the unit near the RS232 port.

Switch #1 ....Firmware update switch. Place in "OFF" position for normal operation, and in the "ON" position only when new firmware is to be downloaded to the unit. Refer to section 16.5 for more information.

Switch #2 ....RS232 port selection switch. When "OFF" at unit startup, the RS232 port will act as the serial console, regardless of the port's configuration as indicated on the web interface (refer to section 14.1 for more information on the serial console). When "ON" at unit startup, the RS232 port carries whatever protocol was assigned to it via the web interface. Note that the state of this switch is only detected when the gateway boots up.

10. Auxiliary Power Supply

The ICC part #10456 120VAC/9VDC power supply can be used to power the unit via the AUX PWR input. If providing your own auxiliary power supply, ensure that it adheres to the following specifications:
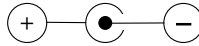
Connection diagram .... $\oplus$—$\odot$—$\ominus$
Voltage rating .... 9 - 40VDC
Current rating.......................... 500mA (@9VDC)

The gateway's AUX PWR input uses the CUI, Inc. PJ-002A (2.1mm x 5.5mm) or equivalent DC power jack, which mates with the PP-002A (2.1mm x 5.5mm) or equivalent power plug.

11. Internal Battery

The gateway has an internal coin-cell type battery that is used to backup the file system when the unit is unpowered. This battery is designed to last the lifetime of the product under normal use. However, if the gateway is left unpowered for several years, the battery may become exhausted. For this reason, always be certain to download any customized configuration files to a PC so that they will be available for uploading again if the battery fails and requires replacement. Additionally, it is recommended to record the IP address, subnet mask and gateway settings in the notes section (section 18) of this manual for future reference.

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If the battery becomes discharged, contact ICC for assistance in obtaining a replacement. Alternatively, it can be replaced by the user by removing all power sources from the gateway, removing the cover, carefully popping out the discharged battery and replacing it with a Panasonic BR1632 or equivalent component.

12. Unit Configuration Concepts

12.1 Port and Protocol Configuration

Each of the communication ports (or, in the case of the Ethernet port, the protocols) can be individually configured or enabled/disabled. It is important to note that the ports (and Ethernet protocols) function independent of one another, and can operate simultaneously. For example, a Modbus TCP/IP request, Modbus RTU slave request on RS485A, and an ASD1 request can simultaneously access the same internal point.

Although each communication port can be configured via the web interface, their configuration selections vary slightly. The Toshiba ASD common serial ports have a simple enable/disable selection. The RS232 and RS485 ports can be disabled, or can have one of a selection of control protocols assigned to them. The Ethernet port can by definition carry multiple control protocols simultaneously, and therefore each protocol it supports can be individually enabled or disabled.

Along with the protocol selection for the RS232/RS485 ports, each of these ports also has a corresponding baudrate, parity, address assignment and timeout time assignment. Note that not all assignable protocols support the same range of configuration options: therefore be sure to assign a valid entry in all cases (for example, a Modbus RTU slave's "address" assignment must be in the range 1-247 to comply with the Modbus specification). Also note that certain protocols may not make use of all available configuration options (e.g. certain protocols operate only at one specified baudrate regardless of the "baudrate" selection value). The protocol-specific sections of this manual will document these cases.

Similarly, each of the Ethernet protocols has its own unique configuration attributes, such as Ethernet/IP's assembly object member lists and Modbus TCP/IP's timeout assignments.

12.2 Timeout Configuration

The gateway's points can be configured to perform a specific set of actions when primary communications are lost on one or more of its various networks. This allows each point to have its own unique "fail-safe" condition in the event of a network interruption. There are three separate elements (four in the case of Modbus TCP/IP) that define the network timeout behavior:

- A port's network timeout time
- A point's "Timeout Enable" selection
- A point's "Timeout Value" setting
- For Modbus TCP/IP, a "Master IP" address designation

The *timeout time* adjustment range depends on the port. For the RS485 and RS232 ports, the time is adjustable in 1s increments from 0 to 500s. For the Modbus TCP/IP protocol, the time is adjustable in 1ms increments from 500ms-30000ms (0.5s-30.0s).

The default timeout time in all cases is 0, which disables network timeout handling. When nonzero, timeout processing does not begin until after a valid network packet has been received by the unit on that port. In the case of Modbus TCP/IP, a "timeout" event will only be deemed to have occurred when a communication lapse or abnormal socket error takes place with the specific client device designated by the "Master IP" address: a communication lapse or abnormal socket error with any other client will not result in a timeout event.

When the timeout time is nonzero and a communication interruption is detected, the *timeout enable* selections for each point are inspected. Those points that are found to have their timeout enable selections set to "enabled" will then have their configured *timeout values* automatically written to their assigned "source port" objects. This mechanism provides for a flexible set of device failsafe conditions to be established on a point-by-point basis.

12.3 Point Configuration

As mentioned in section 1, the Network Gateway Series concept revolves around a central "point database", containing the value and access characteristics for each network. With respect to the Network Gateway Series, a "point" is simply an object that defines some sort of network access, mapping and configuration data, as well as a single "value" attribute that can be read from or written to by various communication ports or protocols.

The only restriction placed on this "central clearinghouse" concept is that only one port can autonomously update the point's value, "mirroring" its designated object for other protocols to access. What this means is that although any protocol can read from or write to a point's internal value, most of the time that point's value will simply be mirroring a remote data object that resides on one of the gateway's subnets. The selection of what a specific point is to mirror is performed via its "source port" selection.

For example, a point may be configured to contain Toshiba ASD parameter mapping and Modbus master ID and holding register mapping information. However, because both of these protocols act as "master" protocols, only one of them can be allowed to continuously update the point's value. If both master protocols could simultaneously update the point's internal value, it would erratically alternate back and forth between the values designated by the Toshiba parameter and Modbus holding register objects. Any "slave" protocol (Modbus RTU slave, Metasys N2, Ethernet/IP etc.) can read from or write to a point at any time, but only the protocol designated by the point's "source port" assignment will autonomously update the point's value independent of any other protocol traffic.

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The "source port" designation also determines where a new point value will be written to when a "slave" protocol writes a new value to the point. For example, if an Ethernet/IP connection consumes new data that changes the value of a point, how do we know where this new value will exit the gateway to arrive at its final destination? The answer is that any new point values written by "slave" protocols will generate "write" transactions only on the "source port".

This concept may best be further explained by way of a representative scenario. For example, let's assume that the gateway's RS485A port has been designated to be a Modbus Master. Let's further assume that the "Modbus Master" portion of point #5 indicates a "Source ID" value of 8 and "Register" value of 14, and that point #5's "Source Port" selection is set to "RS485A". What this means is that independent of any other gateway traffic, point #5 will continuously attempt to update its internal value by making requests to the RS485A port. And, because the RS485A port has been designated as a Modbus Master, then the "Modbus Master" portion of point #5's configuration will be referenced by the update task, and point #5's value will therefore always be mirroring the value of holding register #14 of remote Modbus station address #8 connected to the Modbus subnet attached to the gateway's RS485A port. Perhaps holding register #14 of Modbus station address #8 is a monitor item, indicating the pressure in compressor tank. Whenever the tank's pressure changes, therefore, the value of point #5 will automatically update to reflect the new value read from the remote device. Once the tank's pressure reading has been brought into the gateway, it can then be retrieved by any protocol (or ALL the protocols) currently assigned to the gateway's other communication ports.

As a modification to the previous example, let's assume this time that holding register #14 of Modbus remote station address #8 is the speed command of a conveyor belt. In this case, point #5 of the gateway will be mirroring the current speed command of the conveyor, in a similar fashion to how it previously mirrored the compressor tank's pressure. This time, however, the speed command represents something that can also be written to. Therefore, let's assume that point #5 has been included in the output assembly member list of the Ethernet/IP protocol, and that a new data value is consumed by an Ethernet/IP connection object that causes the value of point #5 to be changed. In this case, this new point value will automatically cause a "write holding register" transaction to occur on the RS485A Modbus master port, updating the value of holding register #14 on remote Modbus station #8, causing the conveyor to accelerate (or decelerate) to the new speed.

Note that it is also perfectly acceptable to have a point's "source port" assigned to "no source". All this means that this point will not be autonomously updated (i.e. that it will not automatically mirror anything.) In a sense, it will simply be "scratchpad memory" that the various ports and protocols can use to exchange information among themselves. For example, a Modbus TCP/IP write transaction could update the value of such a point, which then can be inserted into the produced assembly data of an Ethernet/IP connection, causing the gateway to act as a Modbus TCP/IP –to- Ethernet/IP router, while simultaneously performing its other network functions.

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Although the various configuration possibilities may seem overwhelming at first, it is clear that the gateway can perform powerful and flexible routing algorithms. Through configuration experience, the "in" and "out" data flows will become more clear.

12.4 General Configuration Procedure

Now that we have had a brief tutorial on port and point configuration, we can proceed on to how these elements fit into the overall configuration procedure. The general configuration procedure steps can be summarized as follows:

1. Assign the initial Ethernet configuration via either the ARP ping method or console configuration method.
2. Access the embedded web server's configuration page via a web browser.
3. Assign (or enable/disable) the desired protocols and their characteristics to the specific communication ports.
4. Perform the desired per-protocol mapping and definition assignments for each point, including the name, timeout and "source port" assignments.
5. Submit the changes to the gateway, which will update its internal configuration file and reboot the unit.
6. Download a copy of the unit's configuration file to your PC for backup purposes

Of course, it is possible to simplify or even eliminate some of these steps by starting your configuration from a pre-existing point database file (either downloaded from the internet or previously-created by the user), and then simply modifying those elements necessary to match your application.

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13. Initial Ethernet Configuration

The gateway typically requires configuration prior to communicating on an Ethernet network. This fundamental configuration is achieved via one of two possible methods: using ICMP ("ping") configuration via the Address Resolution Protocol (ARP), or via a text-based console interface, accessible over the RS232 serial channel and a telnet interface. The following are the factory-set values of the most important Ethernet parameters:

IP Address 192.168.1.100
Subnet Mask..................... 255.255.255.0
Default Gateway 192.168.1.2

If these parameters are not compatible with your network settings, they will need to be modified.

13.1 ARP Method

The IP address can be changed remotely by using the Address Resolution Protocol (ARP). This is performed by adding a static entry into a PC's ARP cache table, which stores the associations between a device's IP and physical (MAC) addresses. The unit is then "pinged" from a command prompt (MS DOS™ window) to assign the new IP address to it. Below is an example of the commands used to change the unit's IP address:

```
arp -s <IP address> <MAC address>
ping <IP address>
arp -d <IP address>
```

The initial "arp –s" command adds a static association between the unit's MAC address and the desired IP address to the PC's ARP table. When the ping command is executed with the IP address as an argument, the PC sends this information to the unit indicated by the associated MAC address. The unit then detects that it was addressed with the correct MAC address and adopts the IP address indicated in the ICMP "ping" packet. The optional "arp –d" command then removes the static route from the PC's ARP table.

The unit's MAC address is printed on a label located to the left of the Ethernet jack on the unit's cover. An example of setting a unit's IP address to 192.168.16.110 would look like:

```
arp -s 192.168.16.110 00-90-C2-C0-29-8B
ping 192.168.16.110
arp –d 192.168.16.110
```

Forcing the unit to adopt the new IP address completes only half of the ARP configuration process. In addition to the IP address being changed, the unit also automatically configures its subnet mask to 255.255.255.255. This setting essentially allows only the computer that issued the ping command to

communicate with the unit. From this computer, then, the user must also access the unit's web page via a web browser, or its console via a telnet session, in order to assign a new subnet mask. <u>Until the new subnet mask is assigned to the unit, the IP address change is only temporary</u>. If the unit loses power or is otherwise reset prior to submitting a new subnet mask, the previous IP address and subnet mask settings will return.

Note that if the subnet mask is to be modified via the unit's web page, that network elements such as HTTP proxy servers may relay the web page request for the configuring computer. The unit, seeing the HTTP request from a computer other than that which performed the initial "ping", will ignore such a request. Therefore, be sure to bypass or disable any proxy servers at least temporarily when using this configuration method.

For security reasons, once the ARP method of configuration has been successfully completed (i.e. a new subnet mask has been entered), the ARP method of configuration will be disabled, and all future attempts at using this method will be ignored by the unit. It is possible, however, to re-enable the ARP method via a console command (refer to section 14.3).

13.2 Console Method

The console method of configuration is achieved via a text-based console interface, accessible over the RS232 port and a telnet interface. The RS232 console is accessed by connecting the port to a computer's serial (COM) port, and then running a terminal emulation program, such as Windows® HyperTerminal. If the ARP method of initial configuration is not used, then the RS232 console must be accessed. More information about the console interface and its commands can be found in section 14.

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14. Console Access

14.1 RS232

The console is accessible via an RS232 interface for direct connection to a computer's serial (COM) port. This is performed by connecting the unit's RS232 port to the computer's serial port via a standard straight-thru serial cable. Unless the ARP ping configuration method is used, this will typically be the initial configuration channel, as the telnet and web browser interfaces can only be accessed once the network parameters have already been established and the device is communicating on the Ethernet network.

14.1.1 Requirements

All that is needed is a computer with a serial (COM) port containing some sort of communications software (such as HyperTerminal, included with Microsoft Windows operating systems) and a straight-thru serial cable, such as the Belkin 6' serial extension cable (Belkin part #F2N209-06). Refer to Figure 6 for a representative example cable. Any communications software and PC will work, provided they support ASCII communications at 38.4kbaud.

Figure 6: A Typical Serial Extension Cable

14.1.2 Connection

Connect one end of the serial cable to the gateway's RS232 port, and connect the other end to the computer's serial port. Make sure that CFG DIP switch #2 is in the "OFF" (left) position to force the RS232 port to act as the serial console. If the unit is currently using the RS232 port for control protocol communication, then it must be rebooted (powered down and then back up again) with CFG switch #2 in the OFF position to enable the serial console on the RS232 port.

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14.1.3 Application Configuration

As previously mentioned, any PC communication software and PC serial port can be used. The software configuration example given here will be for Windows HyperTerminal communicating via COM1.

Figure 7 shows the "Connect To" tab of the properties window for COM1. Figure 8 shows the window that appears when "Configure" is selected in the "Connect To" tab. Figure 9 shows the "Settings" tab of the properties window. Most of these settings are their default values: usually the only change needed is the "Bits per second" setting shown in Figure 8.
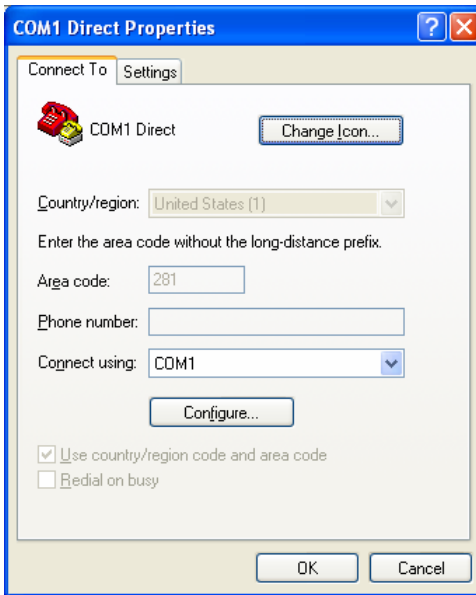
Figure 7: HyperTerminal Properties…Connect To
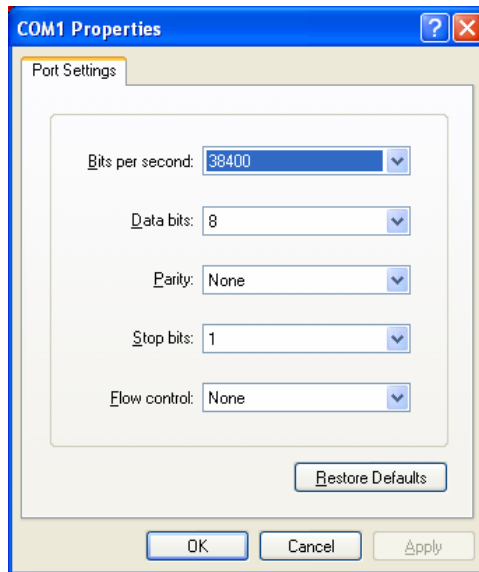
Figure 8: HyperTerminal Properties…Connect To…Configure
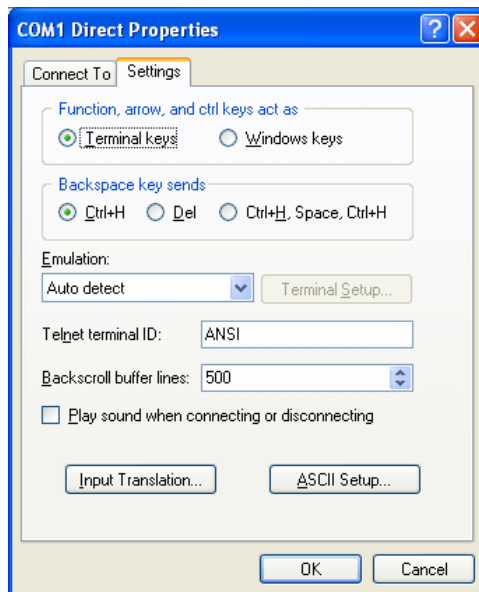
Figure 9: HyperTerminal Properties…Settings

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14.2 Telnet

The console is also accessible via a Telnet interface for remote administration over Ethernet once the unit is communicating on the network. The Telnet console uses well-known port 23. Note that although only 1 telnet console session can be active at any given time, the telnet console and RS232 console operate independently and can be used simultaneously.

14.2.1 Requirements

All that is needed is a computer with telnet software that can access the gateway over the Ethernet network. Telnet software is typically included as a standard component of Microsoft Windows and other PC operating systems.

14.2.2 Connection

No special connections are required, other than the PC running the Telnet application must be able to access the gateway to be configured.

14.2.3 Application Configuration

Although any software vendor's Telnet client application can be used, the configuration example given here will use the Microsoft Windows Telnet application. To start the Telnet application, simply type "telnet" at either a DOS (command) prompt or in the "Start…Run" window. Once the telnet client screen opens, the target device can be accessed simply by typing "open" at the Telnet prompt with the gateway's IP address as an argument. Refer to Figure 10.
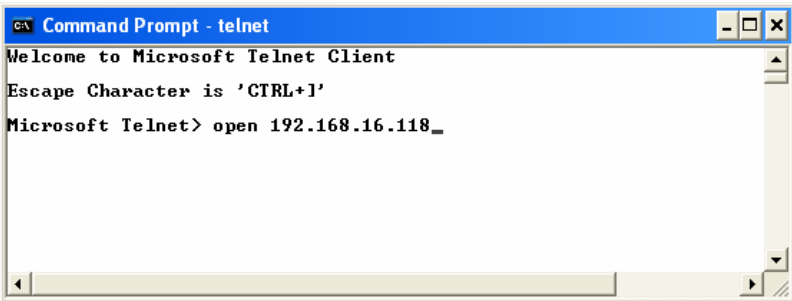
Figure 10: Telnet Menu

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14.3 Command Overview

The console provides standard access and configuration methods for the various network parameters and configurations supported by the gateway. This section will present an overview of the supported console commands.

It is important to note that unless otherwise indicated, each of these commands will become effective immediately after it has been successfully entered. This may have several repercussions; for example, if you change the IP address of the device via the Telnet console, then you will lose the telnet connection to the device (as it was a connection to the old IP address) and therefore must re-connect to the console if you wish to continue changing parameters. Also note that the console commands are not case-sensitive.

Help: This command shows the console version and an overview of all available commands. As indicated in the returned help information, typing "Help <command>" with a specific command will return help information specific to that command. Refer to Figure 11 for the help command output via Telnet. All further display screens shown in this section will be from Telnet, although they will look identical when accessed via the RS232 port.


```
help

ETH-200 Console Version 1.0

Available commands: (type "help <command>" for more info)
set               - Configure various options.
show              - Show current configuration.
xmodem            - Configuration file upload/download.
help              - This help screen.
ping config reset - Re-enable ICMP (ping) configuration.

>
```
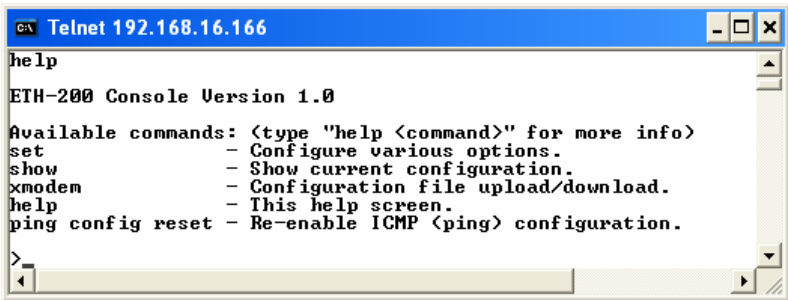
Figure 11: "Help" Command

Set: The "Set" command actually encompasses several subcommands, each of which allows setting a different configuration parameter. To set a parameter, two arguments are required: the parameter's name and the value to set it to. Figure 12 shows an example of changing the IP address of a device to 192.168.16.120. After this command is entered, the device will then reconfigure itself to allow network access via the IP address 192.168.16.120.

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```
Telnet 192.168.16.166                                    _ □ ×

help set

set:
    Usage: "set <variable> <value>"
    The following variables can be set with this command:
    ip          - The IP address of the device (ie: 192.168.16.100)
    netmask     - The subnet mask for the device (ie: 255.255.255.0)
    gateway     - The default gateway for the device (ie: 192.168.16.2)

>set ip 192.168.16.120_
```

Figure 12: "Set" Command Overview and Implementation

Show: Figure 13 shows an example of this command, which displays current configuration information. Some of this information (IP Address, Netmask and Gateway) is configurable via the "set" command. The "Firmware Version" field indicates the unit's current application firmware version. The "Ping Configuration" field indicates whether or not the ability to remotely configure the unit via the ARP method is currently allowed (refer to section 13.1).

```
Telnet 192.168.16.166                                    _ □ ×

show

Current Configuration:
         MAC Address.............00-90-C2-C5-B0-3A
         IP Address.............192.168.16.166
         Netmask................255.255.255.0
         Gateway................192.168.16.2
         Firmware Version:......1.000, Dec 13 2004
         Ping Configuration:....Allowed

>_
```

Figure 13: "Show" Command Overview

Xmodem: The "xmodem" command allows unit configuration files to be transferred between the gateway and a PC. As Xmodem is a serial protocol, the xmodem command only applies to the serial console (RS232 port).

Whenever unit configuration is completed, it is highly recommended that a backup copy of the configuration file be downloaded from the unit to a PC. One reason for this is in case it becomes necessary to restore the file to the unit's file system later (such as if the unit's internal backup battery becomes exhausted and requires replacement). Another reason is that it may be desirable to load multiple units with the same configuration. Configuration files contain all point and port settings (but not network configuration information, such as IP address). A downloaded configuration file can be uploaded to any ETH-200, allowing the user to clone multiple units with the same configuration.

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Two different variations of the Xmodem protocol are supported (CRC and Checksum) for those serial communication packages that only support one or the other. However, some programs can automatically adapt to the user's selection, making the specific Xmodem protocol selection arbitrary. The first argument of the xmodem command indicates the mode, and must be set to either "/crc" for Xmodem CRC mode, or "/cs" for Xmodem checksum mode.

As mentioned above, configuration files can be both downloaded and uploaded. The second argument in the xmodem command indicates the action to take, and must be set to either "/d" to download the configuration file from the unit, or "/u" to upload a configuration file to the unit.

Figure 14 shows an example of initiating an Xmodem download in CRC mode. Once the message "The ETH-200 is ready to send its configuration file via Xmodem…Download the file now" appears, the user has 30 seconds to start the Xmodem download. This can be performed in HyperTerminal by clicking the "receive" button (🖹) on the tool bar. Figure 15 shows the dialog box that will appear after clicking the "receive" button. Specify the folder in which to place the received file, select Xmodem as the receiving protocol, and click "Receive". One last dialog box will prompt the user to name the received file, and then the transfer will begin. This will only take several seconds to complete, and at the conclusion the console will indicate the status of the transfer and return to the entry menu.
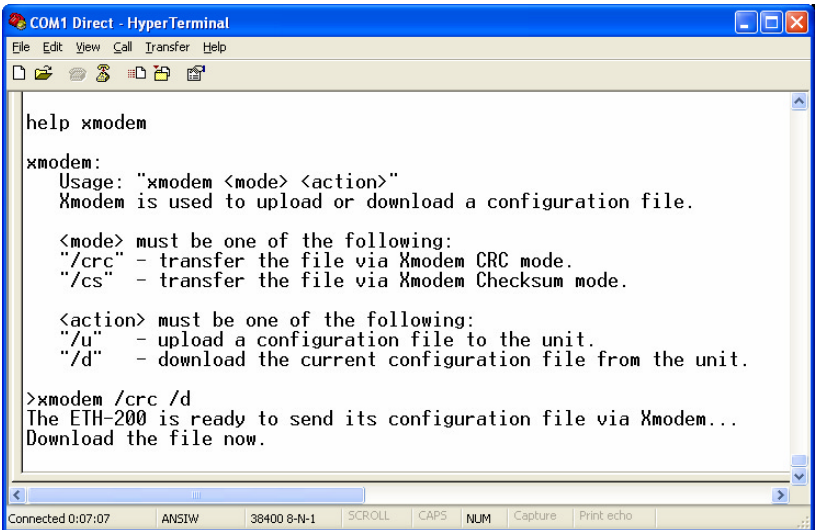
Figure 14: "Xmodem" Command Overview and Implementation
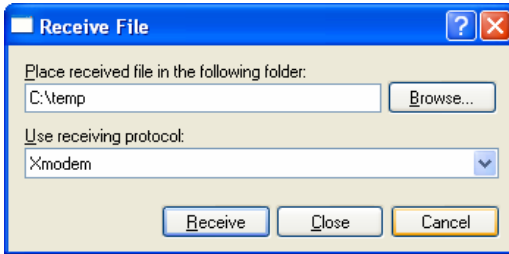
Figure 15: HyperTerminal receive file dialog box

When uploading a file, the procedure is similar to downloading. Enter "/u" instead of "/d" for the action parameter of the xmodem command. Once the xmodem upload command is entered, the user will have 30 seconds to click the "send" button (🖳) on the tool bar in HyperTerminal and initiate the Xmodem upload transaction. Upon successful completion of the Xmodem upload, the unit will reset, and the uploaded file will become the unit's active configuration. The previous configuration cannot be recovered (unless a corresponding configuration file exists, of course).

Ping config reset: This command re-enables the ability to configure the unit's IP address via the ARP method (refer to section 13.1). For security reasons, whenever the ARP method of configuration is successfully completed, the unit disables this method, and subsequent attempts at ARP configuration will be ignored. By entering the "ping config reset" console command, however, the unit will once again allow the ARP method of configuration. Refer to Figure 16. Recall that the current ARP method configuration status can always be obtained via the "show" command.
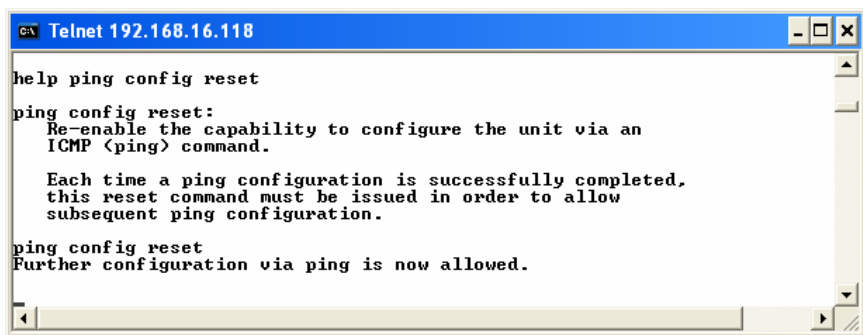
Figure 16: "Ping Config Reset" Overview and Implementation

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15. Embedded Web Server

The gateway contains an embedded web server (also known as an HTTP server), which allows users to access the unit's internal data in a graphical manner with web browsers such as Microsoft Internet Explorer or Netscape Navigator. In this way, the unit and connected devices can be monitored, configured and controlled from across the room or from across the globe.

The ETH-200's web pages are best viewed with either Internet Explorer version 5.x and later, or Netscape Navigator version 6.x and later. The free Macromedia Flash player plug-in is also required, and can be obtained at http://www.macromedia.com/go/getflash. Always ensure that you have the latest version of the Flash player installed: if some aspect of the web pages appears to be displayed unusually, installing the latest Flash player update usually resolves the problem.

To access the unit's embedded web server, just enter its configured IP address into the address (URL) field of your web browser. Accessing the ETH-200's web page is the same as surfing the Internet's world-wide web. Refer to Figure 17 for an example.
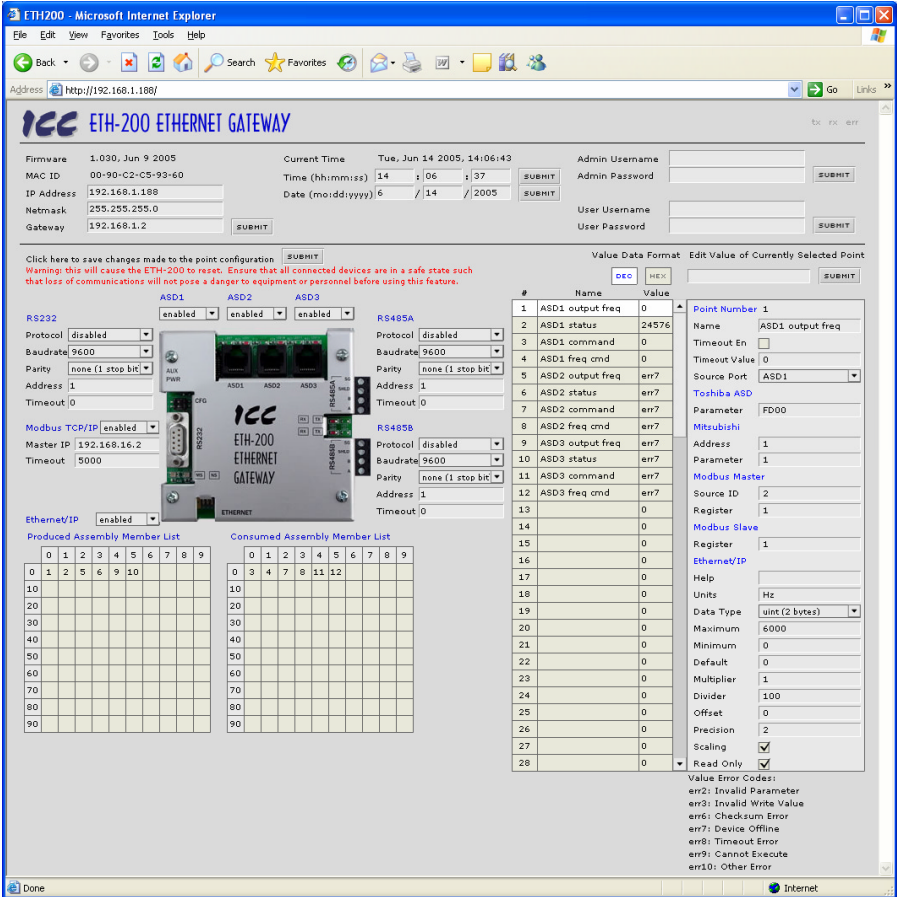
Figure 17: Embedded Web Server Interface

15.1 Authentication

For security, the ETH-200 requires valid user authentication when the web page is accessed or the point information is modified. The authentication request will appear as a browser popup box that will request entry of a user name and password. The unit contains two different security realms: an administrator realm and a user realm. Each of these realms has a different username and password, and applies to different activities. This division of authentication realms allows a device administrator to retain control of critical items (such as changing a unit's IP address or modifying point values and point definitions) while allowing a device user with appropriate authorization to monitor point values (i.e. observe the status of the attached network devices).

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Refer to Figure 18 for a screen shot of the administrator realm authentication dialog box, and Table 1 for initial factory-set authentication values. Note that the username and password are case-sensitive, and that once authenticated, the authentication will remain in effect from that point until all browser windows are closed.
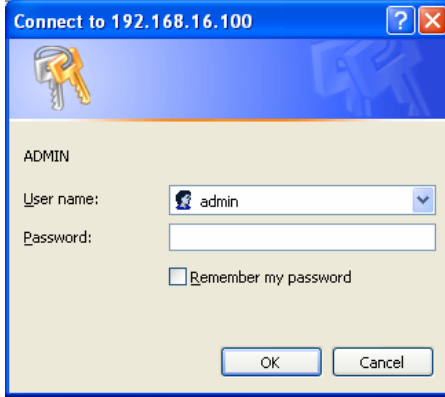
Figure 18: Administrator Authentication

Table 1: Initial factory-set authentication values

Realm	Username	Password	Realm Applies To
USER	user	Blank (i.e. do not enter a password)	Monitoring capabilities
ADMIN	admin	Blank (i.e. do not enter a password)	All change actions

15.2 Communication Status Indicators

Figure 19 shows the communication status indicators. These will blink periodically to show the status of data communication between the web browser and the unit.

Figure 19: Communication Status Indicators

15.3 Unit Status

Figure 20 shows the non-modifiable unit status information. This includes the 48-bit Ethernet MAC address, and the application firmware version information.

ICC


```
Firmware     1.030, Jun 9 2005
MAC ID       00-90-C2-C5-93-60
```

Figure 20: Unit Status

15.4 Set Date and Time

Figure 21 shows the submission boxes in which new date and time information can be entered. Note that the hours are entered in military time format (0-23 = 12AM – 11PM).

Figure 21: Set Date and Time

15.5 Network Configuration

Figure 22 shows the submission boxes in which network configuration information can be entered. Note that changing the subnet mask or default gateway will immediately result in a momentary loss of communications: just wait for a moment, or use the "refresh" button on your browser to re-establish communications. Changing the unit's IP address, however, will result in a complete loss of communications, as the unit's IP address will immediately be changed from that of the page you are viewing to the new value. To reconnect, therefore, requires transitioning to the new IP address via the browser's "Address" (URL) field.

Figure 22: Network Configuration

15.6 Authentication Configuration

Figure 23 shows the submission boxes used to change the user-level and administrator-level usernames and passwords.

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Figure 23: Authentication Configuration

To change, enter your desired username and password (max 11 characters each), then click "Submit". Contact ICC if you have forgotten your username or password for instructions on how to reset them.

15.7 Port Configuration

The ETH-200 has eight ports (the Ethernet port actually acts like two independent "ports", as the control protocols it supports can be used simultaneously). There are three Toshiba ASD common serial connections, two RS485 connections, one RS232 connection, one Modbus TCP/IP connection, and one Ethernet/IP connection. These various connections are configured using the interface shown in Figure 24.
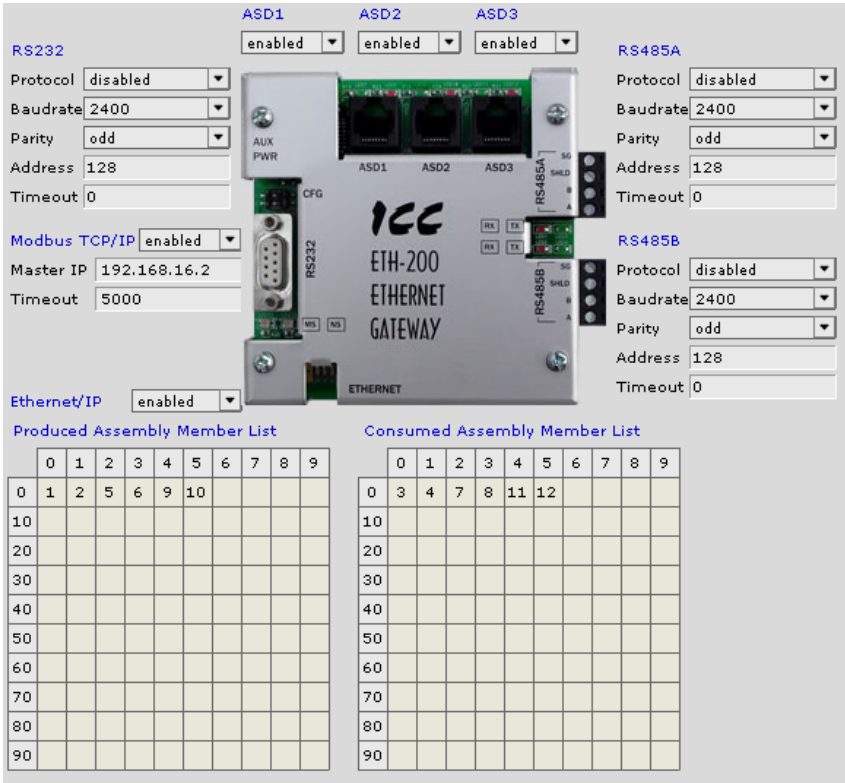
Figure 24: Port Configuration Interface

15.7.1 Toshiba ASD Common Serial Port Configuration

The Toshiba ASD common serial connection ports are configured by selecting either "enabled" or "disabled" from the drop-down box. It is recommended to disable those ports that will not have drives connected to them.

15.7.2 RS232 and RS485 Port Configuration

The RS232 and RS485 ports have the following configuration parameters:

- Protocol: Use the drop-down box to select the desired protocol to be attached to this port.

- Baudrate: Use the drop-down box to select the desired network baudrate (note that some protocols have a fixed baudrate and ignore this selection).

- Parity: Use the drop-down box to select the desired network parity (note that some protocols have a fixed parity and ignore this selection).

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- Address: This assigns this port a network address for the selected protocol.

- Timeout: Defines a timeout time (in seconds) that the port uses to identify a network timeout.

15.7.3 Modbus TCP/IP Configuration

The Modbus TCP/IP protocol has the following configuration parameters:

- Enable/Disable: Enables or disables this protocol.

- Master IP: Defines the IP address that the Modbus TCP/IP driver will consider as its "master" for timeout purposes.

- Timeout: Defines a timeout time (in milliseconds). This network timeout only applies to network traffic originating from the configured "master IP" address. Valid timeout times are 500ms-30000ms (0.5s-30.0s).

Because the socket timeout determination is performed on a per-socket duration basis, note that a certain degree of caution must be exercised when using the network timeout feature to avoid "nuisance" timeouts from occurring. Specifically, do not perform inadvisable behavior such as sending a request from the master device to an ETH-200, and then closing the socket prior to successfully receiving the unit's response. The reason for this is because the ETH-200 will then experience an error when attempting to respond via the now-closed socket, which will immediately trigger the timeout action. Always be sure to manage socket life cycles "gracefully", and do not abandon outstanding requests.

Modbus TCP/IP sockets initiated from devices other than the "master" device use a fixed 30s timeout time, and do not perform timeout processing. This allows devices other than the designated "master" to access the unit for monitoring or other non-critical access purposes.

15.7.4 Ethernet/IP Port Configuration

The Ethernet/IP port has the following configuration parameters:

- Enable/Disable: Enables or disables this protocol.

- Produced/Consumed Assembly Member Lists: These arrays allow the creation of custom-built assembly instances. Each box in the array is capable of containing a point number. Because the "value" attributes of each point are 16-bit data elements, each box represents two bytes of consumed or produced data.

  Up to 100 points can be assigned to each member list (for a total of 200 bytes of produced and/or consumed data). The array locations are numbered 0-99, and traverse from left to right across each row, and then increment to the left-most position on the next row. Clicking on a box in an array toggles the point that will be referenced when class 1 connected data is produced or consumed at that corresponding location. A blank

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array entry indicates that no point is referenced at that location, which will cause corresponding consumed data to be ignored and produced data to be a default value of 0.

As an example, looking at the member list definitions shown in Figure 24, we can see that each member list contains 6 defined points. Therefore, up to 12 "meaningful" bytes of data can be both consumed and produced via class 1 connected messages (the qualifier "meaningful" is used here because a client may configure a class 1 connection that indicates larger produced and/or consumed data sizes, but all unreferenced consumed data (data after byte #12) will be ignored, and all unreferenced produced data (also data after byte #12) will be dummy "0" values). The first word (two bytes) of consumed data will be written to the "value" attribute of point #3, the next two bytes to point #4 and so on. If points #3 and #4 etc. have a "Source Port" selection defined, then this command data will subsequently also propagate to that port and down to the point's configured remote device.

This example works similarly when describing the behavior of the produced member list in Figure 24. In this case, the first 2 bytes of the produced data will be the value of point #1, the next two bytes will be the value of point #2 and so on.

15.8 Point Configuration

The ETH-200 supports 100 total points. The configuration of these points determines what data is available from attached network devices. Points are configured using the interface shown in Figure 25.

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Figure 25: Point Configuration Interface

The list on the left displays the point number, name and current value for each available point. Clicking on one of these locations will load the point's current configuration into the interface on the right, where the configuration may be edited.

Each point contains the following configuration attributes:

- Name: This is a user description of the point, up to 16 characters.

- Timeout En: Checking this box will allow the point to participate in timeout processing when a port network timeout event is detected.

- Timeout Value: This determines the value this point will default to upon the occurrence of a network timeout. If a "Source Port" has been designated (see below), then this value will also propagate to the configured remote device connected to the designated port.

- Source Port: This determines the ETH-200 port that this point will obtain its value from and write values to.

- Toshiba ASD:

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- o   Parameter: The Toshiba ASD parameter (in hex, 0000-FFFF) that this point refers to.

- Mitsubishi:
  - o   Address: The address of the Mitsubishi or MGI drive that this point refers to.
  - o   Parameter: The parameter within that drive that this point refers to.

- Modbus Master:
  - o   Source ID: The ID (station address) of the Modbus slave that this point refers to.
  - o   Register: The holding register within that slave that this point refers to.

- Modbus Slave:
  - o   Register: The holding register number assigned to this point.

- Ethernet/IP: Note that these entry fields are only necessary for support of the custom Electronic Data Sheet (EDS) download function, which will be supported on an upcoming firmware version. They will then allow explicit messaging access to points as CIP parameter objects.
  - o   Help: User defined help text, up to 24 chars.
  - o   Units: User defined engineering units text, up to 5 chars.
  - o   Data Type: The data type of this point.
  - o   Maximum: The max value of this point.
  - o   Minimum: The min value of this point.
  - o   Default: The default value of this point.
  - o   Multiplier: The multiplier of this point.
  - o   Divider: The divider of this point.
  - o   Offset: The offset of this point.
  - o   Precision: The precision, in decimal places, of this point.
  - o   Scaling: Checking this box tells this point to use (value x multiplier)/divider + offset to determine its actual value.
  - o   Read only: Defines this point as read only when checked.

15.9 Upload Port and Point Configuration

Once all desired changes have been made to the port and point configurations, this data must be uploaded to the ETH-200. This is performed by clicking the "SUBMIT" button shown in Figure 26.
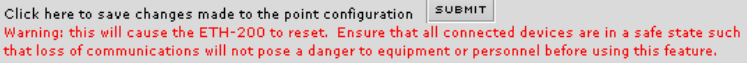
Figure 26: Port and Point Configuration Upload

Submitting the port and point configuration may require up to 1 minute to complete, during which time a "please wait" graphic will be displayed. Once the upload completes, the interface will return to its normal screen. However, clicking your browser's refresh button may be required to reestablish communications with the ETH-200.

This process will also result in the loss of communications with all devices connected to the ETH-200. It is important to ensure that all connected devices are in a safe state such that loss of communications will not pose a danger to equipment or personnel before using this feature.

15.10 Radix Selection

Figure 27 shows the radix selection buttons. These selection buttons allow changing the point value data display and entry radix between decimal and hexadecimal formats.
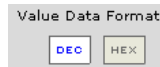
Figure 27: Radix Selection

15.11 Editing Point Values

The value of the currently selected point can be modified using the interface shown in Figure 28. The radix of the value entered here is determined by the radix selection described in section 15.10. Editing the point value in this interface and selecting "SUBMIT" immediately updates the point's value in the unit, which will result in a write to the point's configured "Source Port" if one is assigned.
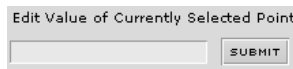
Figure 28: Edit Point Value Interface

15.12 Error Code Reference

Figure 29 shows the error code reference table. These error codes may appear in certain situations in the point "Value" fields.

```
Value Error Codes:
err2: Invalid Parameter
err3: Invalid Write Value
err6: Checksum Error
err7: Device Offline
err8: Timeout Error
err9: Cannot Execute
err10: Other Error
```

Figure 29: Error Code Reference

16. Protocol-Specific Information

This section will discuss topics that are specific to each of the available network selections.

16.1 Modbus

The gateway supports Modbus slave functionality via both Modbus RTU and Modbus TCP/IP, and Modbus master functionality via Modbus RTU. The slave implementations share common access methods, which is to say they support the same functions and reference the internal points via a common "Modbus Slave" holding register assignment. Other notes of interest are:

- Points are addressed by their assigned holding register (4X reference).

- Supported Modbus slave functions are indicated in Table 2.

Table 2: Supported Modbus Slave Functions

Function Code	Function	Modbus TCP/IP Class
1	Read coils	1
3	Read multiple registers	0
5	Write coil	1
6	Write single register	1
15	Force multiple coils	2
16	Write multiple registers	0

- Holding register number entry radix is decimal (e.g. $10 = 10_{10}$)

- Configuration tip: Improved network utilization may be obtained by appropriately grouping points into blocks having contiguous holding register assignments. In this way, the "read multiple registers" and "write multiple registers" functions can be used to perform transfers of larger blocks of registers using fewer Modbus transactions compared to a situation where the read/write registers were arranged in an alternating or scattered fashion.

- Because the transaction is handled locally within the gateway, write data checking is not available. For example, if a write is performed to a register with a data value that is out-of-range of the corresponding "source port" object, no Modbus exception will be immediately returned. However, the point will always reflect the "source port" status and object value. In other words, if such an out-of-range write attempt is performed, the

unsuccessful "source port" network write can be observed by reading the current (unchanged) value of the point during a subsequent Modbus transaction.

16.1.1 Coil Mappings

The Modbus slave implementations provide read/write support for coils (0X references). Accessing coils does not reference any new physical data: coils are simply indexes into various bits of Modbus holding registers. What this means is that when a coil is accessed, that coil is resolved by the gateway into a specific holding register, and a specific bit within that holding register. The pattern of coil-to-register/bit relationships can be described as follows:

Coils 1...16 map to holding register #1, bit0...bit15 (bit0=LSB, bit15=MSB)
Coils 17...32 map to holding register #2, bit0...bit15, and so on.

Arithmetically, the coil-to-register/bit relationship can be described as follows: For any given coil, the holding register in which that coil resides can be determined by:

$$holding\ register = \left\lfloor \frac{coil + 15}{16} \right\rfloor \qquad ...Equation\ 1$$

Where the bracket symbols "$\lfloor\ \rfloor$" indicate the "floor" function, which means that any fractional result (or "remainder") is to be discarded, with only the integer value being retained.

Also, for any given coil, the targeted bit in the holding register in which that coil resides can be determined by:

$$bit = (coil - 1)\ \%\ 16 \qquad ...Equation\ 2$$

Where "coil" $\in [1...65535]$, "bit" $\in [0...15]$, and "%" is the modulus operator, which means that any fractional result (or "remainder") is to be retained, with the integer value being discarded (i.e. it is the opposite of the "floor" function).

From these equations, it can be seen that the largest holding register number that can be accessed via this coil-to-register mapping method is 4096 (which contains coil 65535).

For clarity, let's use Equation 1 and Equation 2 in a calculation example. Say, for instance, that we are going to read coil #34. Using Equation 1, we can determine that coil #34 resides in holding register #3, as $\lfloor 3.0625 \rfloor = \lfloor 3\ r1 \rfloor = 3$. Then, using Equation 2, we can determine that the bit within holding register #3 that coil #34 targets is (34-1)%16 = 1, as 33%16 = mod(3 r1) = 1. Therefore, reading coil #34 will return the value of holding register #3, bit #1.

Note that this coil-to-register/bit relationship holds true regardless of whether or not holding register #3 is assigned to a point. If holding register #3 is not

assigned to a point, then a Modbus exception will be returned. Either way, coil #34 will <u>always</u> access holding register #3, bit #1.

16.1.2 Modbus RTU Slave

- Broadcast (for functions 5, 6, 15 and 16) is supported.

- Network characteristics selections
  - o Baud rate: 2400 / 4800 / 9600 / 19200 / 38400 bps
  - o Parity: odd / even / none (1 stop bit) / none (2 stop bits)

16.1.3 Modbus RTU Master

- Supported Modbus master functions are indicated in Table 3. These functions are automatically invoked by the gateway in response to point read or write requests.

Table 3: Supported Modbus Master Functions

Function Code	Function
3	Read multiple registers
16	Write multiple registers

- The slave response timeout (in seconds) is assigned via the designated port's "Timeout" selection. If "0" is chosen (an invalid timeout time), the gateway will use a 2s timeout by default.

- Network characteristics selections
  - o Baud rate: 2400 / 4800 / 9600 / 19200 / 38400 bps
  - o Parity: odd / even / none (1 stop bit) / none (2 stop bits)

16.1.4 Modbus TCP/IP Slave

The gateway supports Schneider Electric's Modbus TCP/IP protocol, release 1.0. The unit is conformance class 0 and partial class 1 and class 2 compliant, and allows up to 4 simultaneous Modbus TCP/IP client connections (sockets).

- The "unit identifier" (UI) field of the request packets is ignored.

- Standard socket timeouts are set to 30s, which means that if a particular open socket experiences no activity for more than 30s, then the gateway assumes that the client or network has experienced some sort of unexpected problem, and the gateway will close that socket.

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- A "master" IP address and timeout time can be assigned to the unit. Each point defined in the point database has the capability to be assigned an optional failsafe timeout value. When an unexpected socket failure from the "master" client occurs, all points with timeout processing enabled will be written with their failsafe values. This provides an additional level of process security in the event of a network or master device disturbance.

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16.2 Ethernet/IP

The gateway supports the Ethernet/IP protocol (release 1.0), administered by the Open DeviceNet Vendor Association (ODVA).

- This product has been self-tested by ICC, Inc. and found to comply with ODVA Ethernet/IP Conformance Test Software Version A3.7.3.

- Supports unconnected messages (UCMM), and up to 16 simultaneous class 1 or class 3 connections.

- Supports CIP point-to-point transport types in the originator-to-target direction, and both point-to-point and multicast transport types in the target-to-originator direction.

- Supports only CIP "cyclic" transport triggers.

- Connection sizes are adjustable between 0 and 200 bytes (100 points @ 2 bytes per point = 200 bytes). Because point "value" attributes are 16-bit elements, however, connection sizes cannot be odd (i.e. 1, 3, 5 etc.)

- When data is consumed via a class 1 connection, if the actual consumed data size is less than or equal to the connection's configured consumed connection size, then all received data will be consumed. If the actual consumed data size is larger than the connection's configured consumed connection size, however, the consumed data will be ignored.

- If a parameter entry in the consumed assembly member list is empty (i.e. no parameter has been assigned to that location), then any consumed data that corresponds to that location will be ignored. Conversely, if a parameter entry in the produced assembly member list is empty, then any produced data that corresponds to that location will be a default value of 0. Refer to section 15.7.4 for further information on the assembly object member lists.

- The 32-bit run/idle header is required in the originator-to-target direction. When using an originator that does not support the run/idle header, then just send dummy data as the 1st two words, as the ETH-200 ignores the contents of the run/idle header. The ETH-200 does not send a run/idle header in the target-to-originator direction.

- Point-to-point class 1 connected messages will be produced targeting the IP address of the device that instantiated the connection, port 0x08AE (port 2222).

- If a class 1 connection's consuming half (O=>T) times out, then the producing half (T=>O) will also time-out and will stop producing.

- Once instantiated, class 1 connections act independently of the encapsulation protocol sessions over which they were established. The

client may therefore terminate the encapsulated session at any time with no ill affects on the class 1 transport mechanism.

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16.3 Toshiba Common Serial ASD Protocol

- The gateway can act as a Toshiba ASD master via the dedicated common serial port connections. All Toshiba ASDs that include a common serial port are supported.

- No configuration is necessary, as the gateway automatically adapts to the ASD's configured characteristics.

- All parameter writes use the drive's RAM / EEPROM data write ("W") command. For all writes that target the drive's EEPROM, be sure to follow Toshiba's guidelines regarding the number of times a specific parameter can be written without risk of EEPROM damage.

- Point parameter number entry radix is hexadecimal (e.g. 10 = 0x0010 or 16_{10})

16.4 Mitsubishi ASD Protocol

- The gateway acts as a Mitsubishi protocol master via its RS-485 ports. Adjustable speed drives such as the FR-A500/E500/F500 series and F700-series that support the Mitsubishi protocol can be accessed. Also supported are MGI Technologies, Inc. M3000, M4000 and M5000-series drives that support the Mitsubishi protocol.

- For 500-series drives, the gateway can connect to the ASD via either the PU (panel) connector, or via an optional FR-A5NR computer link board. Because the ASDs externally present a 4-wire RS-485 network, connecting them to the gateway requires jumpering the network wires for 2-wire format (i.e. connecting SDA-RDA and SDB-RDB).

When Using an FR-A5NR Card

Connect as shown in Figure 30.
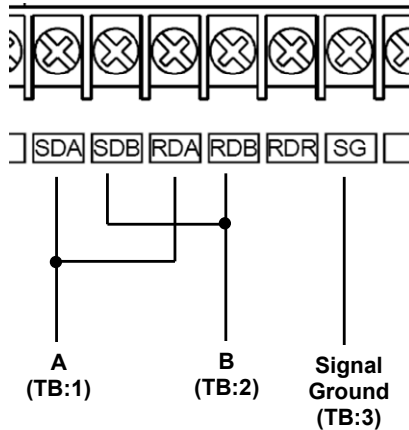
Figure 30: FR-A5NR Connections

When Using the PU Port

Connecting to the drive's RJ-45 PU port will likely require building a custom cable. For simplicity, a standard 8-conductor Ethernet patch cable can be used as a starting point. There are two standard color schemes for the wire pairs in such cables as defined by the Electronic Industry Association / Telecommunications Industry Association (EIA-TIA). These two standards are called T-568B and T-568A (refer to Figure 31). The most common color scheme is T-568B, and will therefore be the one used for this example connection. If starting with a cable wired according to the T-568A specification, just interchange the colors to achieve the same pin connections.

Connect as shown in Figure 32.
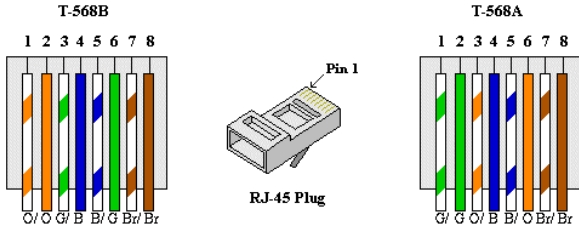
Figure 31: EIA/TIA Wiring Standards
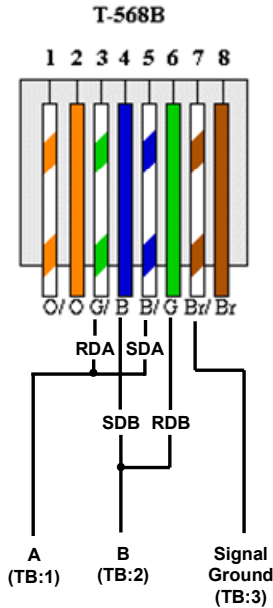
Figure 32: PU Port Connections

- For 700-series drives, the gateway can connect to the ASD via either the PU (panel) connector as indicated in Figure 32, or via the on-board RS-485 terminals. Because both of these ports externally present a 4-wire RS-485 network, connecting them to the gateway requires jumpering the network wires for 2-wire format (i.e. connecting SDA-RDA and SDB-RDB). When using the on-board RS-485 terminals, connect as shown in Figure 33.

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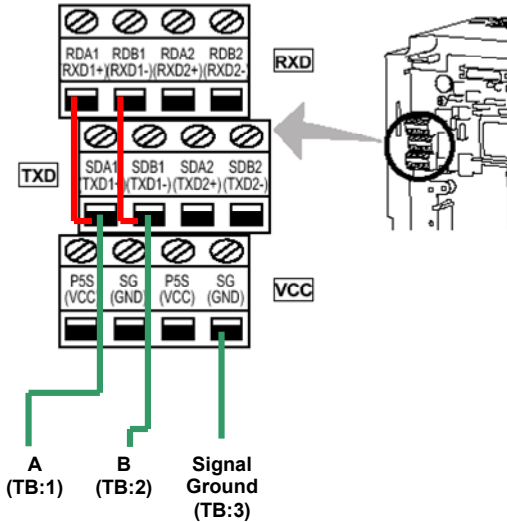
Figure 33: 700-Series ASD Connections

- Note that although the 700-series ASD also supports the Modbus RTU protocol, it does not currently support the Modbus RTU protocol in 2-wire format. Therefore, using the Mitsubishi protocol is currently the only available method to communicate with the gateway (ASD parameter 549 must be "0").

- The slave response timeout is determined via the gateway's RS-485 port timeout value setting. If the timeout value is set to 0, a default timeout time of 2s is used.

- ASD communication characteristics are dictated by parameters 117-124 (PU port) and 331-341 (RS-485 port). Most of these parameters can be set as desired by the user. However, the following parameters must be set as indicated to successfully connect to the gateway:

  Parameter 119/333 (stop bits/data bits).........*Must be set for 8 data bits*
  Parameter 123/337 (wait time setting)...........*Must be set to 9999*
  Parameter 124/341 (CR/LF selection)...........*Must be set to 1 (CR only)*

- ASD parameter number entry radix is decimal (e.g. $10 = 10_{10}$)

- Any numerically-addressed parameter defined by the Mitsubishi protocol reference manual is directly accessible (base frequency = parameter #3, etc.). However, some ASD data objects do not have parameter numbers assigned by Mitsubishi. For these data objects, the additional parameter numbers indicated in Table 4 have been assigned. For further information

on these parameters, please refer to the relevant Mitsubishi documentation.

Table 4: Additional Mitsubishi Parameter Assignments

Parameter Number	Item
1000	Second parameter switch-over
1001	Frequency command (RAM)
1002	Frequency command (EEPROM)
1003	Frequency monitor
1004	Output current monitor
1005	Output voltage monitor
1006	Special monitor
1007	Special monitor selection number
1008	Most recent #1 and #2 alarms / alarm clear
1009	Most recent #3 and #4 alarms
1010	Most recent #5 and #6 alarms
1011	Most recent #7 and #8 alarms
1014	Inverter status monitor / operation command
1015	Operation mode acquisition
1016	All parameter clear
1017	Inverter reset

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16.5 Toshiba 3-Series ASD Protocol

- The gateway can act as an RS232 master for Toshiba 3-series ASDs (G3, H3, E3 etc.) Use of the ICC "*Toshiba 3-Series ASD Interface Cable*" (ICC part #10603) or an equivalent cable is required to connect the gateway's RS232 port to the drive's on-board RS232 port.

- The following ASD parameters (in GROUP:COMMUNICATION SETTING PARAMETERS) must be set as indicated:

    RS232 BAUD RATE .... 2 (9600 baud)
    NUMBER OF DATA BITS .... 1 (8 bits)
    PARITY SETTING .... 0 (even parity)

    Remember that the drive must be reset whenever communication-related parameters are changed in order to activate the change.

- All parameter writes use the drive's RAM / EEPROM data write ("W") command. For all writes that target the drive's EEPROM, be sure to follow Toshiba's guidelines regarding the number of times a specific parameter can be written without risk of EEPROM damage.

- Point parameter number entry radix is hexadecimal (e.g. 10 = 0x0010 or 16_{10}).

- The available ASD parameters are as indicated in the tables starting in section 16.5.1. For further details on how to interpret these tables, please refer to the *Toshiba G3 RS232C Communications Manual* (Toshiba part number 42709) or the *Toshiba INV3-MODBUS-RTU Communications Manual* (ICC part number 10028).

16.5.1 Command Parameters

Parameter	Bit	Function	Bank	Mask	Adjustment Range	Multiplier
0001	word	Frequency command	0	FFFF	0.00 ~ 400.00Hz Actual frequency will be limited by LL, UL and Fmax.	0.01
0002	0	RUN command	0	—	0: Stop 1: Run	—
	1	STOP Command (has priority over RUN command)			0: run enabled 1: stop	
	2	Forward • reverse run selection			0: reverse 1: forward	
	3	Acc/dec #1 / #2 selection			0: Acc / dec #1 1: Acc / dec #2	
	4	Reserved			—	
	5	Reserved			—	
	6	Reserved			—	
	7	Jog mode selection			0: Normal (acc/dec mode) 1: Jog mode	
	8	Feedback control			0: Feedback valid 1: Feedback invalid	
	9	Compulsory DC injection braking mode			0: No compulsory DC injection braking 1: Compulsory DC injection below DC INJECTION START FREQUENCY	
	A	Fundamental parameter switching			0: V/F #1 1: V/F #2	
	B	Gate block command (coast stop command)			0: Normal 1: Gate block	
	C	Emergency off command			0: Does nothing 1: Emergency off	
	D	Reset command (trip clear)			0: Does nothing 1: Reset	
	E	Reserved			—	
	F	Reserved			—	
0003	word	RS232 command / frequency selection	0	0003	0000: FREQUENCY MODE SELECTION, COMMAND MODE SELECTION settings 0001: RS232C commands valid 0002: RS232C frequency valid 0003: RS232C commands and frequency valid	—
0004	word	Preset speed run command	0	000F	0000: Output frequency selected by FREQUENCY MODE SELECTION 0001 ~ 000F: speeds 1 ~ 15	—

16.5.2 Monitor Parameters

Parameter	Bit	Function	Bank	Mask	Adjustment Range	Multiplier
0005	word	Output frequency monitor	0	FFFF	0.00 ~ 400.00Hz	0.01
0006	0	Run • stop status	0	—	0: Stopped 1: Running	—
	1	Run enable			0: Run enabled 1: Stopped	
	2	Forward • reverse status			0: Reverse 1: Forward	
	3	Accel / decel #1 / #2 selection status			0: Accel / decel #1 1: Accel / decel #2	
	4	Reserved			—	
	5	Fault status			0: Faulted 1: Not faulted	
	6	Reserved			—	
	7	Jog mode status			0: Normal (accel / decel mode) 1: Jog mode	
	8	Feedback enable status			0: Feedback invalid 1: Feedback valid	
	9	Compulsory DC injection braking mode			0: DC injection braking inactive 1: DC injection braking active	
	A	Fundamental parameter switching			0: V/F #1 1: V/F #2	
	B	Coast stop command status			0: Normal 1: Coast to stop	
	C	Emergency off command			0: Normal 1: Emergency off	
	D	Reserved			—	
	E	Main Circuit Undervoltage			0: Normal 1: Undervoltage	
	F	Reserved			—	
0007	word	Output current monitor	0	00FF	0 ~ 255%	1
0008	word	Output voltage monitor *(Note 1)*	0	FFFF	0 ~ 232%	0.1
0009	word	IV terminal analog input value	0	FFFF	0000 ~ FFFF (0% ~ 100%)	1
000A	word	RX terminal analog input value	0	FFFF	0000 ~ 7FFF (-100% ~ 0%), 7FFF ~ FFFF (0% ~ 100%)	1
000B	word	Frequency command monitor	0	FFFF	0000 ~ 9C40 (0.00 ~ 400.00 Hz)	0.01
000C	word	Input voltage monitor *(Note 1)*	0	FFFF	0 ~ 255%	0.1
000D	word	Input terminal status monitor	0	FFFF	Refer to Table 5 (page 66)	—
000E	low byte	Output terminal status monitor	0	00FF	Refer to Table 6 (page 66)	—
	high byte	Inverter Status 2		FF00		
000F	word	Inverter Status 1	0	FFFF	Refer to Table 7 (page 67)	—
0010	word	Present trip	0	00FF		—

Parameter	Bit	Function	Bank	Mask	Adjustment Range	Multiplier
0011	high byte	4th Past trip (most recent)	0	7F00	Refer to section 16.5.16 for fault codes	—
	low byte	3rd past trip		007F		
0012	high byte	2nd past trip	0	7F00		—
	low byte	1st past trip (oldest)		007F		
0013	word	Pre-compensation output frequency	0	FFFF	0000 ~ 9C40 (0.00 ~ 400.00 Hz)	0.01
0014	word	Post-compensation output frequency	0	FFFF	0000 ~ 9C40 (0.00 ~ 400.00 Hz)	0.01
0015	word	Torque current monitor	0	FFFF	*(Note 2)*	0.01
0016	low byte	Excitation current monitor	0	00FF	00 ~ FF (0 ~ 255%)	1
	high byte	Reserved	—	—	—	—
0017	word	PID feedback value	0	FFFF	*(Note 2)*	0.02
0018	word	Motor overload ratio	0	FFFF	0 ~ 65535	100/65535
0019	word	Inverter overload ratio	0	FFFF	0 ~ 65535	100/65535
001A	word	DBR overload ratio	0	FFFF	0 ~ 65535	100/65535
001B	word	Input power (%)	0	FFFF	0 ~ 6553.5	0.1
001C	word	Input power (kW)	0	FFFF	*(Note 3)*	
001D	word	Output power (%)	0	FFFF	*(Note 2)*	0.1
001E	word	Output power (kW)	0	FFFF	*(Note 2, Note 3)*	
001F	word	RR input	0	FFFF	0 ~ 65535	100/65535
0020	—	Reserved	—	—	—	—
0021	—	Reserved	—	—	—	—
0022	—	Reserved	—	—	—	—
0023	low byte	Inverter typeform monitor	0	00FF	Refer to Table 8 (page 67)	—
	8	Input / output power units	0	0100	0: 0.01kW 1: 0.1kW	—
	9,A	Command mode status	0	0600	00: terminal 01: panel 10: option 11: RS232C	—
	B,C	Frequency mode selection status	0	1800	00: terminal 01: panel 10: option 11: RS232C	—
	D,E,F	Reserved	—	—	—	—
0024	—	Reserved	—	—	—	—
0025	—	Reserved	—	—	—	—

(**Note 1**) .... These monitor voltage units are not affected by the setting of VOLTAGE UNITS SELECTION in GROUP:UTILITY PARAMETERS; they are always in units of %.

(**Note 2**) .... These parameters use signed data (data values larger than 7FFFH are negative). If the parameter data is 8000H or larger, the actual value can be obtained by: **actual value = - [FFFFH - (parameter data) + 1]**.

(**Note 3**) .... If the input / output power units data is 0, the monitored data is in 0.01kW units, and the multiplier is 0.01. If the input / output power units data is 1, the monitored data is in 0.1kW units, and the multiplier is 0.1. These values are automatically set according to the inverter's capacity.

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Table 5: Input Terminal Status Monitor (parameter 000D)

	Bit	Input Terminal	0	1	Single-Bit Read Mask
Lower Byte	bit 0	F	terminal - CC open	terminal - CC shorted	0001
	bit 1	R	terminal - CC open	terminal - CC shorted	0002
	bit 2	S1	terminal - CC open	terminal - CC shorted	0004
	bit 3	S2	terminal - CC open	terminal - CC shorted	0008
	bit 4	S3	terminal - CC open	terminal - CC shorted	0010
	bit 5	S4	terminal - CC open	terminal - CC shorted	0020
	bit 6	S5 (option)	terminal - CC open	terminal - CC shorted	0040
	bit 7	S6 (option)	terminal - CC open	terminal - CC shorted	0080

	Bit	Input Terminal	0	1	Single-Bit Read Mask
Upper Byte	bit 0	unused (always 0)	—	—	—
	bit 1	unused (always 0)	—	—	—
	bit 2	unused (always 0)	—	—	—
	bit 3	unused (always 0)	—	—	—
	bit 4	unused (always 0)	—	—	—
	bit 5	S7 (option)	terminal - CC open	terminal - CC shorted	0020
	bit 6	RES	terminal - CC open	terminal - CC shorted	0040
	bit 7	ST	terminal - CC open	terminal - CC shorted	0080

Table 6: Output Terminal Status Monitor / Inverter Status 2 (parameter 000E)

	Bit	Output Terminal	0	1	Single-Bit Read Mask
Lower Byte	bit 0	unused (always 0)	—	—	—
	bit 1	unused (always 0)	—	—	—
	bit 2	FAN	OFF	ON	0004
	bit 3	FL	FLB-FLC shorted	FLA-FLC shorted	0008
	bit 4	MS relay	OFF	ON	0010
	bit 5	OUT (option)	OUTB-OUTC shorted	OUTA-OUTC shorted	0020
	bit 6	RCH	RCHA-RCHC open	RCHA-RCHC shorted	0040
	bit 7	LOW	LOWA-LOWC open	LOWA-LOWC shorted	0080

	Bit	Inverter Status	0	1	Single-Bit Read Mask
Upper Byte	bit 0	accelerating	not accelerating	accelerating	0001
	bit 1	decelerating	not decelerating	decelerating	0002
	bit 2	for inverter use	—	—	—
	bit 3	retry	not retrying	retrying	0008
	bit 4	running (including DC injection braking)	stopped	running	0010
	bit 5	for inverter use	—	—	—
	bit 6	for inverter use	—	—	—
	bit 7	tripped	not tripped	tripped	0080

Table 7: Inverter Status 1 (parameter 000F)

	Bit	Inverter Status	0	1	Single-Bit Read Mask
Lower Byte	bit 0	running (accel/decel)	—	running	0001
	bit 1	unused (always 0)	—	—	—
	bit 2	forward / reverse	reverse	forward	0004
	bit 3	accel/decel #1/#2	accel/decel #1	accel/decel #2	0008
	bit 4	for inverter use	—	—	—
	bit 5	for inverter use	—	—	—
	bit 6	for inverter use	—	—	—
	bit 7	jog/normal mode	normal (accel/decel)	jog mode	0080

	Bit	Inverter Status	0	1	Single-Bit Read Mask
Upper Byte	bit 0	feedback ON/OFF	OFF	feedback active	0001
	bit 1	DC injection braking	OFF	DC inj. braking active	0002
	bit 2	V/F #1/#2	V/F #1	V/F #2	0004
	bit 3	coasting	not coasting	coasting	0008
	bit 4	emergency off	not in emergency off	in emergency off	0010
	bit 5	for inverter use	—	—	—
	bit 6	for inverter use	—	—	—
	bit 7	for inverter use	—	—	—

Table 8: Inverter Typeform Codes

230v Class		460v Class		575v Class	
Inverter Model	Typeform Data (Hex)	Inverter Model	Typeform Data (Hex)	Inverter Model	Typeform Data (Hex)
G3-2010	××21	G3-4015	××42	G3-6060	××65
G3-2015	××22	G3-4025	××43	G3-6120	××67
G3-2025	××23	G3-4035	××44	G3-6160	××68
G3-2035	××24	G3-4055	××45	G3-6220	××69
G3-2055	××25	G3-4080	××46	G3-6270	××6A
G3-2080	××26	G3-4110	××47	G3-6330	××6B
G3-2110	××27	G3-4160	××48	G3-6400	××6C
G3-2160	××28	G3-4220	××49	G3-6500	××6D
G3-2220	××29	G3-4270	××4A	G3-6600	××6E
G3-2270	××2A	G3-4330	××4B	G3-6750	××6F
G3-2330	××2B	G3-4400	××4C	G3-610K	××70
G3-2400	××2C	G3-4500	××4D	G3-612K	××71
		G3-4600	××4E	G3-615K	××72
		G3-4750	××4F	G3-620K	××73
		G3-410K	××50		
		G3-412K	××51		
		G3-415K	××52		
		G3-420K	××53		
		G3-425K	××54		
		G3-430K	××55		

16.5.3 Fundamental Parameters #1

Parameter	Function / Title	Bank	Mask	Adjustment Range	Multiplier
0026	MAXIMUM OUTPUT FREQUENCY (*)	0 / 1	FFFF	0BB8 ~ 9C40 (30.00~400.00)	0.01
0027	BASE FREQUENCY #1	0 / 1	FFFF	09C4 ~ 9C40 (25.00~400.00)	0.01
0028	BASE FREQUENCY VOLTAGE SELECT (*)	0 / 1	0030	0000: Input voltage level (0) 0020: Automatic setting (1) 0030: Stationary setting (2)	—
0029	MAXIMUM OUTPUT VOLTAGE #1	0 / 1	FFFF	0000 ~ 0258 (0 ~ 600)	1
002A	REVERSE OPERATION DISABLE SELECT	0 / 1	0020	0000: Reverse allowed (0) 0020: Reverse not allowed (1)	—
002B	UPPER LIMIT FREQUENCY	0 / 1	FFFF	0000 ~ Fmax	0.01
002C	LOWER LIMIT FREQUENCY	0 / 1	FFFF	0000 ~ UL, Fmax	0.01
002D	VOLTS PER HERTZ PATTERN (*)	0 / 1	000F	0000: Constant torque (1) 0001: Variable torque (2) 0002: Auto. torque boost (3) 0006: #3 w/ auto. energy savings (4) 000A: Vector control (5) 000E: #5 w/ auto. energy savings (6)	—
002E	1, 2 VOLTAGE BOOST #1	0 / 1	FFFF	0000 ~ 012C (0.0 ~ 30.0)	0.1
002F	ACCELERATION TIME #1	0 / 1	FFFF	0001 ~ EA60 (0.01~ 600.00) 0001 ~ EA60 (0.1~ 6000.0)	0.01 0.1
0030	DECELERATION TIME #1	0 / 1	FFFF	0001 ~ EA60 (0.01~ 600.00) 0001 ~ EA60 (0.1~ 6000.0)	0.01 0.1
0031	ACC/DEC PATTERN #1 SELECTION	0 / 1	0030	0000: Linear (0) 0010: Self-adjusting (1) 0020: S-Pattern #1 (2) 0030: S-Pattern #2 (3)	—
0032	ACCEL/DECEL PATTERN ADJUST LOW	0 / 1	00FF	0003 ~ 00FD (0 ~ 50) *(Note 1)*	1
0033	ACCEL/DECEL PATTERN ADJUST HIGH	0 / 1	00FF	0003 ~ 00FD (0 ~ 50) *(Note 1)*	1

Note 1: Parameter data = (desired setting x 5 + 3), converted to hexadecimal

16.5.4 Fundamental Parameters #2

Parameter	Function / Title	Bank	Mask	Adjustment Range		Multiplier
0034	BASE FREQUENCY #2	0 / 1	FFFF	09C4 ~ 9C40 (25.00 ~ 400.00)		0.01
0035	MAXIMUM OUTPUT VOLTAGE #2	0 / 1	FFFF	0000 ~ 0258 (0 ~ 600)		1
0036	VOLTAGE BOOST #2	0 / 1	FFFF	0000 ~ 012C (0.0 ~ 30.0)		0.1
0037	ELECTRONIC THERMAL PROTECT LVL #2	0 / 1	00FF	000A ~ 0064 (10 ~ 100)		1
0038	STALL PROTECTION SELECTION #2	0 / 1	0040	0000: ON 0040: OFF	(0) (1)	—
0039	0 STALL PROTECTION LEVEL #2	0 / 1	00FF	000A ~ 00D7 (10 ~ 215)		1
003A	ACCELERATION TIME #2	0 / 1	FFFF	0001 ~ EA60 (0.1~ 6000.0) 0001 ~ EA60 (0.01~ 600.00)		0.1 0.01
003B	DECELERATION TIME #2	0 / 1	FFFF	0001 ~ EA60 (0.1~ 6000.0) 0001 ~ EA60 (0.01~ 600.00)		0.1 0.01
003C	ACC/DEC PATTERN #2 SELECTION	0 / 1	0030	0000: Linear 0010: Self-adjusting 0020: S-Pattern #1 0030: S-Pattern #2	(0) (1) (2) (3)	—
003D	ACC/DEC #1/#2 SWITCH FREQUENCY	0 / 1	FFFF	0000 ~ Fmax		0.01

16.5.5 Panel Control Parameters

Parameter	Function / Title	Bank	Mask	Adjustment Range		Multiplier
003E	DIRECTION SELECTION (FORWARD/REV)	0 / 1	0004	0000: Reverse 0004: Forward	(0) (1)	—
003F	STOP PATTERN SELECTION	0 / 1	0040	0000: Decelerated stop 0040: Coast stop	(0) (1)	—
0040	FUNDAMENTAL PARAM SWITCHING	0 / 1	0004	0000: V/F #1 0004: V/F #2	(1) (2)	—
0041	ACCEL/DECEL #1/#2 SELECTION	0 / 1	0008	0000: Accel / decel #1 0008: Accel / decel #2	(1) (2)	—
0042	PANEL RESET SELECTION	0 / 1	0030	0000: All possible 0010: OL only 0020: OL, OC only	(0) (1) (2)	—
0043	PANEL FEEDBACK CONTROL	0 / 1	0001	0000: Feedback valid 0001: Feedback invalid	(0) (1)	—

16.5.6 Terminal Selection Parameters

Parameter		Function / Title	Bank	Mask	Adjustment Range	Multiplier
0044		INPUT TERMINAL SELECTION	0 / 1	0001	0000: Standard functions (0) 0001: Individual selections (1)	—
0045		"R" INPUT TERMINAL FUNCTION	0 / 1	FFFF	0000 ~ FFFF (0 ~ 54) Refer to Table 9 (page 72)	—
0046		"S1" INPUT TERMINAL FUNCTION				
0047		"S2" INPUT TERMINAL FUNCTION				
0048		"S3" INPUT TERMINAL FUNCTION				
0049		"S4" INPUT TERMINAL FUNCTION				
004A	1	"F" INPUT TERMINAL FUNCTION				
004B		"RES" INPUT TERMINAL FUNCTION				
004C		"ST" INPUT TERMINAL FUNCTION				
004D		"S5" INPUT TERMINAL FUNCTION				
004E		"S6" INPUT TERMINAL FUNCTION				
004F		"S7" INPUT TERMINAL FUNCTION				
0050		POTENTIAL TERMINAL FUNCTION				
0051		R,S1-S7 TERMINAL RESPONSE TIME	0 / 1	00FF	0001 ~ 0064 (1 ~ 100)	1
0052		F INPUT TERMINAL RESPONSE TIME	0 / 1	00FF	0001 ~ 0064 (1 ~ 100)	1
0053		RES INPUT TERMINAL RESPONSE TIME	0 / 1	00FF	0001 ~ 0064 (1 ~ 100)	1
0054		ST INPUT TERMINAL RESPONSE TIME	0 / 1	00FF	0001 ~ 0064 (1 ~ 100)	1
0055		"RCH" CONTACTS FUNCTION	0 / 1	FFFF	0 ~ FFFF (0 ~ 63) Refer to Table 10 (page 73)	—
0056		"RCH" CONTACTS DELAY TIME	0 / 1	00FF	0001 ~ 0064 (1 ~ 100)	1
0057		"RCH" CONTACTS HOLD TIME	0 / 1	00FF	0001 ~ 0064 (1 ~ 100)	1
0058		"LOW" CONTACTS FUNCTION	0 / 1	FFFF	0 ~ FFFF (0 ~ 63) Refer to Table 10 (page 73)	—
0059		"LOW" CONTACTS DELAY TIME	0 / 1	00FF	0001 ~ 0064 (1 ~ 100)	1
005A		"LOW" CONTACTS HOLD TIME	0 / 1	00FF	0001 ~ 0064 (1 ~ 100)	1
005B		"FL" CONTACTS FUNCTION	0 / 1	FFFF	0 ~ FFFF (0 ~ 63) Refer to Table 10 (page 73)	—
005C		"FL" CONTACTS DELAY TIME	0 / 1	00FF	0001 ~ 0064 (1 ~ 100)	1
005D		"FL" CONTACTS HOLD TIME	0 / 1	00FF	0001 ~ 0064 (1 ~ 100)	1
005E		"OUT" CONTACTS FUNCTION	0 / 1	FFFF	0 ~ FFFF (0 ~ 63) Refer to Table 10 (page 73)	—
005F		"OUT" CONTACTS DELAY TIME	0 / 1	00FF	0001 ~ 0064 (1 ~ 100)	1
0060		"OUT" CONTACTS HOLD TIME	0 / 1	00FF	0001 ~ 0064 (1 ~ 100)	1
0061		LOW SPEED SIGNAL OUTPUT FREQ	0 / 1	FFFF	0 ~ Fmax	0.01

Parameter	Function / Title		Bank	Mask	Adjustment Range		Multiplier
0062	ACC/DEC COMPLETE DETECT BAND		0 / 1	FFFF	0 ~ Fmax		0.01
0063	SPEED REACH MAXIMUM FREQUENCY		0 / 1	FFFF	0 ~ Fmax		0.01
0064	SPEED REACH MINIMUM FREQUENCY		0 / 1	FFFF	0 ~ Fmax		0.01
0065	COMMERCIAL POWER/INV SWITCHING OUTPUT		0 / 1	00C0	0000: OFF (0) 0040: Auto switch on trip (1) 0080: At COMMERCIAL POWER/ INV SWITCH FREQ (2) 00C0: Both (1) and (2) (3)		—
0066	2, 3	COMMERCIAL POWER/INV SWITCH FREQ	0 / 1	FFFF	0 ~ Fmax		0.01
0067	"FP" OUTPUT TERMINAL PULSE FREQUENCY		0 / 1	0003	0000: 48f (0) 0001: 96f (1) 0002: 360f (2)		—
0068	RR INPUT SPECIAL FUNCTION SELECT		0 / 1	00E0	0000: Standard (0) 0040: Fmax (1) 0080: TACC/TDEC multiplier (2) 00C0: VB multiplication factor (3) 0020: CL multiplication factor (4)		—

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Table 9: Input Terminal Selections

Setting Value	Data (Hex)	Function	Setting Value	Data (Hex)	Function
0	10C8	R (reverse run)	28	04AF	Binary bit #6
1	011C	SS1 (preset speed selection)	29	08AF	Binary bit #7
2	021C	SS2 (preset speed selection)	30	10AF	Binary bit #8
3	041C	SS3 (preset speed selection)	31	20AF	Binary bit #9
4	081C	SS4 (preset speed selection)	32	40AF	Binary bit #10
5	20C8	F (forward run)	33	04CE	No effect
6	201B	RES (fault reset)	34	01C7	UP/DOWN frequency setting (UP)
7	C0C9	ST (gate ON/OFF)	35	02C7	UP/DOWN frequency setting (DOWN)
8	0CC8	JOG selection	36	04C7	UP/DOWN frequency clear
9	081A	Accel / decel #1/#2 selection	37	08C7	PUSH-type RUN key
10	101B	Emergency off	38	10C7	PUSH-type STOP key
11	021B	DC injection braking ON/OFF	39	02B9	No effect
12	041B	Fundamental parameter switching (V/F #2)	40	C0C8	Forward/reverse run selection
13	011B	Feedback control ON/OFF	41	20C7	RUN
14	10CE	Pattern run selection #1	42	30C9	Binary data write
15	20CE	Pattern run selection #2	43	0198	[LOCAL/REMOTE] key
16	40CE	Pattern run selection #3	44	0298	[MON] key
17	80CE	Pattern run selection #4	45	0498	[PRG] key
18	02CE	Pattern run continue signal	46	0898	[UP] key
19	01CE	Pattern run step trigger signal	47	1098	[DOWN] key
20	0AC9	JOG forward run	48	2098	[READ/WRITE] key
21	06C9	JOG reverse run	49	4098	[RUN] key
22	10AE	Binary bit #0	50	8098	[STOP/CLEAR] key
23	20AE	Binary bit #1	51	08CE	Commercial power / inverter switching signal
24	40AE	Binary bit #2	52	40C7	Reserved for option use
25	80AE	Binary bit #3	53	10CB	RR frequency switching input
26	01AF	Binary bit #4	54	20CB	IV frequency switching input
27	02AF	Binary bit #5			

Note: In order for binary bit #0 ~ #10 (setting values 22 ~ 32) and UP/DOWN frequency setting (setting values 34 & 35) inputs to be valid, parameter FREQUENCY PRIORITY SELECTION #1 or FREQUENCY PRIORITY SELECTION #2 in GROUP:FREQUENCY SETTING PARAMETERS must be set to 5 (BIN (binary setting or UP/DOWN setting)).

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Table 10: Output Terminal Selections (RCH, LOW, FL, OUT relay contacts)

Setting Value	Data (Hex)	Function	Setting Value	Data (Hex)	Function
0	0000	Lower limit frequency	32	C5B7	Executing emergency off
1	0100	/Lower limit frequency	33	CDB7	/Executing emergency off
2	0200	Upper limit frequency	34	B5BB	Executing retry
3	0300	/Upper limit frequency	35	BDBB	/Executing retry
4	0400	Low speed signal	36	D5CF	Pattern run switching output
5	0500	/Low speed signal	37	DDCF	/Pattern run switching output
6	0600	Accel/decel complete	38	D5D8	PID deviation limit
7	0700	/Accel/decel complete	39	DDD8	/PID deviation limit
8	0800	Selected speed reach signal	40	C5BB	Run/stop
9	0900	/Selected speed reach signal	41	CDBB	/Run/stop
10	0A00	Fault	42	1400	Severe fault (armature short, load-end short, open phase, output error, earth fault)
11	0B00	/Fault	43	1500	/Severe fault (armature short, load-end short, open phase, output error, earth fault)
12	0C00	Fault other than earth fault or load-end overcurrent	44	1600	Non-severe fault (overload, overcurrent, overvoltage)
13	0D00	/Fault other than earth fault or load-end overcurrent	45	1700	/Non-severe fault (overload, overcurrent, overvoltage)
14	95B5	Overcurrent pre-alarm	46	E5D8	Commercial power / inverter switching output #1
15	9DB5	/Overcurrent pre-alarm	47	EDD8	/Commercial power / inverter switching output #1
16	85C5	Inverter overload pre-alarm	48	F5D8	Commercial power / inverter switching output #2
17	8DC5	/Inverter overload pre-alarm	49	FDD8	/Commercial power / inverter switching output #2
18	95C5	Motor overload pre-alarm	50	85C0	Fan ON/OFF
19	9DC5	/Motor overload pre-alarm	51	8DC0	/Fan ON/OFF
20	D5C5	Overheat pre-alarm	52	F5B6	Executing JOG
21	DDC5	/Overheat pre-alarm	53	FDB6	/Executing JOG
22	A5B4	Overvoltage pre-alarm	54	1800	Local/remote operation
23	ADB4	/Overvoltage pre-alarm	55	1900	/Local/remote operation
24	E5B4	Undervoltage alarm	56	A5D1	Cumulative timer alarm
25	EDB4	/Undervoltage alarm	57	ADD1	/Cumulative timer alarm
26	85B5	Undercurrent alarm	58	1A00	Communication error alarm
27	8DB5	/Undercurrent alarm	59	1B00	/Communication error alarm
28	85D1	Overtorque alarm	60	A5B6	F/R
29	8DD1	/Overtorque alarm	61	ADB6	/F/R
30	E5BB	Braking resistor OL pre-alarm	62	1E00	Run preparation complete
31	EDBB	/Braking resistor OL pre-alarm	63	1F00	/Run preparation complete

16.5.7 Special Control Parameters

Parameter	Function / Title		Bank	Mask	Adjustment Range	Multiplier
0069	START-UP FREQUENCY		0 / 1	FFFF	0000 ~ 03E8 (0.00 ~ 10.00)	0.01
006A ~ 006F	Reserved		—	—	—	—
0070	END FREQUENCY		0 / 1	FFFF	0000 ~ 0BB8 (0.00 ~ 30.00)	0.01
0071	RUN FREQUENCY		0 / 1	FFFF	0000 ~ Fmax	0.01
0072	RUN FREQUENCY HYSTERESIS		0 / 1	FFFF	0000 ~ 0BB8 (0.00 ~ 30.00)	0.01
0073	ENABLE JUMP FREQUENCIES		0 / 1	0080	0000: Function OFF (0) 0080: Function ON (1)	—
0074		JUMP FREQUENCY #1	0 / 1	FFFF	0000 ~ Fmax	0.01
0075		JUMP FREQUENCY #1 BANDWIDTH	0 / 1	FFFF	0000 ~ 0BB8 (0.00 ~ 30.00)	0.01
0076		JUMP FREQUENCY #2	0 / 1	FFFF	0000 ~ Fmax	0.01
0077	1	JUMP FREQUENCY #2 BANDWIDTH	0 / 1	FFFF	0000 ~ 0BB8 (0.00 ~ 30.00)	0.01
0078		JUMP FREQUENCY #3	0 / 1	FFFF	0000 ~ Fmax	0.01
0079		JUMP FREQUENCY #3 BANDWIDTH	0 / 1	FFFF	0000 ~ 0BB8 (0.00 ~ 30.00)	0.01
007A ~ 007F	Reserved		—	—	—	—
0080	PWM CARRIER FREQUENCY *(Note 1)*		0 / 1	00FF	0005 ~ 0064 (0.5 ~ 10.0)	0.1

Note 1: Actual adjustment range depends on inverter rating.

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16.5.8 Frequency Setting Parameters

Parameter	Function / Title		Bank	Mask	Adjustment Range		Multiplier
0081	FREQUENCY PRIORITY SELECTION #1		0 / 1	0007	0001: RR 0002: IV 0003: RX 0004: PG 0005: BIN	(1) (2) (3) (4) (5)	—
0082	FREQUENCY PRIORITY SELECTION #2		0 / 1	0038	0008: RR 0010: IV 0018: RX 0020: PG 0028: BIN	(1) (2) (3) (4) (5)	—
0083	ANALOG INPUT FILTER		0 / 1	0003	0000: No filter 0001: Small filter 0002: Medium filter 0003: Large filter	(0) (1) (2) (3)	—
0084	RR TERMINAL STANDARD OR ADJUSTABLE		0 / 1	0002	0000: Standard 0002: Adjustable	(0) (1)	—
0085		RR REFERENCE SETTING POINT #1	0 / 1	00FF	0000 ~ 0064 (0 ~ 100)		1
0086	1	RR REF POINT #1 FREQUENCY	0 / 1	FFFF	0000 ~ Fmax		0.01
0087		RR REFERENCE SETTING POINT #2	0 / 1	00FF	0000 ~ 0064 (0 ~ 100)		1
0088		RR REF POINT #2 FREQUENCY	0 / 1	FFFF	0000 ~ Fmax		0.01
0089	IV TERMINAL STANDARD OR ADJUSTABLE		0 / 1	0004	0000: Standard 0004: Adjustable	(0) (1)	—
008A		IV REFERENCE SETTING POINT #1	0 / 1	00FF	0000 ~ 0064 (0 ~ 100)		1
008B	1	IV REF POINT #1 FREQUENCY	0 / 1	FFFF	0000 ~ Fmax		0.01
008C		IV REFERENCE SETTING POINT #2	0 / 1	00FF	0000 ~ 0064 (0 ~ 100)		1
008D		IV REF POINT #2 FREQUENCY	0 / 1	FFFF	0000 ~ Fmax		0.01
008E	RX TERMINAL STANDARD OR ADJUSTABLE		0 / 1	0008	0000: Standard 0008: Adjustable	(0) (1)	—
008F		RX REFERENCE SETTING POINT #1	0 / 1	00FF	009C ~ 00FF, 0000 ~ 0064 (-100 ~ -1, 0 ~ 100)		1
0090	1	RX REF POINT #1 FREQUENCY	0 / 1	FFFF	-Fmax ~ Fmax		0.02
0091		RX REFERENCE SETTING POINT #2	0 / 1	00FF	009C ~ 00FF, 0000 ~ 0064 (-100 ~ -1, 0 ~ 100)		1
0092		RX REF POINT #2 FREQUENCY	0 / 1	FFFF	-Fmax ~ Fmax		0.02
0093	PG TERMINAL STANDARD OR ADJUSTABLE		0 / 1	0010	0000: Standard 0010: Adjustable	(0) (1)	—
0094		PG REFERENCE SETTING POINT #1	0 / 1	00FF	009C ~ 00FF, 0000 ~ 0064 (-100 ~ -1, 0 ~ 100)		1
0095	1	PG REF POINT #1 FREQUENCY	0 / 1	FFFF	-Fmax ~ Fmax		0.02
0096		PG REFERENCE SETTING POINT #2	0 / 1	00FF	009C ~ 00FF, 0000 ~ 0064 (-100 ~ -1, 0 ~ 100)		1
0097		PG REF POINT #2 FREQUENCY	0 / 1	FFFF	-Fmax ~ Fmax		0.02
0098	BINARY INPUT STD OR ADJUSTABLE		0 / 1	0001	0000: Standard 0001: Adjustable	(0) (1)	—

Parameter	Function / Title		Bank	Mask	Adjustment Range	Multiplier
0099	1	BINARY REF SETTING POINT #1	0 / 1	00FF	0000 ~ 0064 (0 ~ 100)	1
009A		BINARY REF POINT #1 FREQUENCY	0 / 1	FFFF	-Fmax ~ Fmax	0.02
009B		BINARY REF SETTING POINT #2	0 / 1	00FF	0000 ~ 0064 (0 ~ 100)	1
009C		BINARY REF POINT #2 FREQUENCY	0 / 1	FFFF	-Fmax ~ Fmax	0.02
009D		JOG RUN FREQUENCY	0 / 1	FFFF	0000 ~ 07D0 (0.00 ~ 20.00)	0.01
009E	Other than 0	JOG STOP METHOD	0 / 1	00C0	0000: Decelerated stop (0) 0040: Coast stop (1) 0080: DC injection stop (2)	—
009F		PRESET SPEED SELECTION	0 / 1	000F	0000 ~ 000F (0 ~ 15)	1
00A0 ~ 00FF		Reserved	—	—	—	—
0100	Other than 0	PRESET SPEED MODE ACTIVATION	0 / 1	0004	0000: Deactivated (0) 0004: Activated (1)	—
0101		PRESET SPEED #1 FREQUENCY	1	FFFF	LL ~ UL	0.01
0102		PRESET SPEED #1 OPERATING MODE	1	040C	0004: (0) 0000: (1) 000C: (2) 0008: (3) 0404: (4) 0400: (5) 040C: (6) 0408: (7)	1
0103	2 or higher	PRESET SPEED #2 FREQUENCY	1	FFFF	LL ~ UL	0.01
0104		PRESET SPEED #2 OPERATING MODE	1	040C	Same as PRESET SPEED #1 OPERATING MODE	1
0105	3 or higher	PRESET SPEED #3 FREQUENCY	1	FFFF	LL ~ UL	0.01
0106		PRESET SPEED #3 OPERATING MODE	1	040C	Same as PRESET SPEED #1 OPERATING MODE	1
0107	4 or higher	PRESET SPEED #4 FREQUENCY	1	FFFF	LL ~ UL	0.01
0108		PRESET SPEED #4 OPERATING MODE	1	040C	Same as PRESET SPEED #1 OPERATING MODE	1
0109	5 or higher	PRESET SPEED #5 FREQUENCY	1	FFFF	LL ~ UL	0.01
010A		PRESET SPEED #5 OPERATING MODE	1	040C	Same as PRESET SPEED #1 OPERATING MODE	1
010B	6 or higher	PRESET SPEED #6 FREQUENCY	1	FFFF	LL ~ UL	0.01
010C		PRESET SPEED #6 OPERATING MODE	1	040C	Same as PRESET SPEED #1 OPERATING MODE	1
010D	7 or higher	PRESET SPEED #7 FREQUENCY	1	FFFF	LL ~ UL	0.01
010E		PRESET SPEED #7 OPERATING MODE	1	040C	Same as PRESET SPEED #1 OPERATING MODE	1
010F	8 or higher	PRESET SPEED #8 FREQUENCY	1	FFFF	LL ~ UL	0.01
0110		PRESET SPEED #8 OPERATING MODE	1	040C	Same as PRESET SPEED #1 OPERATING MODE	1

Parameter	Function / Title		Bank	Mask	Adjustment Range	Multiplier
0111	9 or higher	PRESET SPEED #9 FREQUENCY	1	FFFF	LL ~ UL	0.01
0112		PRESET SPEED #9 OPERATING MODE	1	040C	Same as PRESET SPEED #1 OPERATING MODE	1
0113	10 or higher	PRESET SPEED #10 FREQUENCY	1	FFFF	LL ~ UL	0.01
0114		PRESET SPEED #10 OPERATING MODE	1	040C	Same as PRESET SPEED #1 OPERATING MODE	1
0115	11 or higher	PRESET SPEED #11 FREQUENCY	1	FFFF	LL ~ UL	0.01
0116		PRESET SPEED #11 OPERATING MODE	1	040C	Same as PRESET SPEED #1 OPERATING MODE	1
0117	12 or higher	PRESET SPEED #12 FREQUENCY	1	FFFF	LL ~ UL	0.01
0118		PRESET SPEED #12 OPERATING MODE	1	040C	Same as PRESET SPEED #1 OPERATING MODE	1
0119	13 or higher	PRESET SPEED #13 FREQUENCY	1	FFFF	LL ~ UL	0.01
011A		PRESET SPEED #13 OPERATING MODE	1	040C	Same as PRESET SPEED #1 OPERATING MODE	1
011B	14 or higher	PRESET SPEED #14 FREQUENCY	1	FFFF	LL ~ UL	0.01
011C		PRESET SPEED #14 OPERATING MODE	1	040C	Same as PRESET SPEED #1 OPERATING MODE	1
011D	15	PRESET SPEED #15 FREQUENCY	1	FFFF	LL ~ UL	0.01
011E		PRESET SPEED #15 OPERATING MODE	1	040C	Same as PRESET SPEED #1 OPERATING MODE	1

16.5.9 Protection Function Parameters

Parameter	Function / Title		Bank	Mask	Adjustment Range	Multiplier
011F	DYNAMIC BRAKING SELECTION		0 / 1	0003	0000: no dynamic braking (0) 0001: with dynamic braking, no DBR overload trip (1) 0003: with dynamic braking and DBR overload trip (2)	—
0120	2	BRAKING RESISTOR VALUE	0 / 1	FFFF	000A ~ 2710 (1.0 ~ 1000)	0.1
0121		BRAKING RESISTOR POWER RATING	0 / 1	FFFF	0001 ~ EA60 (0.01 ~ 600.00)	0.01
0122	OVERVOLTAGE STALL PROTECTION		0 / 1	0004	0000: ON (0) 0004: OFF (1)	—
0123	DC INJECTION START FREQUENCY		0 / 1	FFFF	0000 ~ 2EE0 (0.00 ~ 120.00)	0.01
0124	Other than 0	DC INJECTION CURRENT MAGNITUDE	0 / 1	00FF	0000 ~ 0064 (0 ~ 100)	1
0125		DC INJECTION TIME	0 / 1	00FF	0000 ~ 0064 (0.0 ~ 10.0)	0.1
0126	FWD/REV DC INJECTION PRIORITY CTRL		0 / 1	0040	0000: OFF (0) 0040: ON (1)	—
0127	MOTOR SHAFT STATIONARY CTRL		0 / 1	0080	0000: OFF (0) 0080: ON (1)	—
0128	EMERGENCY OFF MODE SELECTION		0 / 1	0030	0000: Coast stop (0) 0010: Decelerated stop (1) 0020: DC injection stop (2)	—
0129	2	EMERGENCY OFF DC INJECTION TIME	0 / 1	00FF	0000 ~ 0064 (0.0 ~ 10.0)	0.1
012A	NUMBER OF RETRY ATTEMPTS		0 / 1	00FF	0000 ~ 000A (0 ~ 10)	1
012B	Other than 0	TIME BETWEEN RETRY ATTEMPTS	0 / 1	00FF	0000 ~ 0064 (0.0 ~ 10.0)	0.1
012C	REGENERATION POWER RIDE-THROUGH		0 / 1	0008	0000: OFF (0) 0008: ON (1)	—
012D	1	REGENERATION RIDE-THROUGH TIME	0 / 1	00FF	0000 ~ 00FA (0.0 ~ 25.0)	0.1
012E	AUTO-RESTART (MOTOR SPEED SEARCH)		0 / 1	0018	0000: OFF (0) 0008: On power failure (1) 0010: On ST make/break (2) 0018: Both (1) and (2) (3)	—
012F	ELECTRONIC THERMAL PROTECT LVL #1		0 / 1	00FF	000A ~ 0064 (10 ~ 100)	1
0130	OVERLOAD REDUCTION START FREQ		0 / 1	FFFF	0000 ~ 0BB8 (0.00 ~ 30.00)	0.01
0131	MOTOR 150% OVERLOAD TIME LIMIT		0 / 1	00FF	0001 ~ 00F0 (10 ~ 2400)	10
0132	OVERLOAD SELECTION		0 / 1	0030	0000: with motor overload trip, without soft-stall (0) 0010: with motor overload trip and soft-stall (1) 0020: without soft-stall or motor overload trip (2) 0030: with soft-stall, without motor overload trip (3)	—

Parameter	Function / Title	Bank	Mask	Adjustment Range	Multiplier
0133	STALL PROTECTION ENABLE	0 / 1	0040	0000: ON (0) 0040: OFF (1)	—
0134	0 STALL PROTECTION CURRENT LEVEL	0 / 1	00FF	000A ~ 00D7 (10 ~ 215)	1
0135	UNDERVOLTAGE TRIP SELECTION	0 / 1	0080	0000: Trip disabled (0) 0080: Trip (during run) (1)	—
0136	UNDERVOLTAGE DETECT TIME	0 / 1	FFFF	0000 ~ 03E8 (0.00 ~ 10.00)	0.01
0137	LOW CURRENT DETECT SELECTION	0 / 1	0008	0000: Trip disabled (0) 0008: Trip on detection (1)	—
0138	LOW CURRENT DETECT LEVEL	0 / 1	00FF	0000 ~ 0064 (0 ~ 100)	1
0139	LOW CURRENT DETECTION TIME	0 / 1	00FF	0000 ~ 00FF (0 ~ 255)	1
0140	OUTPUT SHORT-CIRCUIT DETECTION SELECT	0 / 1	0003	0000: Standard motor (0) 0001: High-speed motor (1) 0002: Positioning use (standard motor) (2) 0003: Positioning use (high-speed motor) (3)	—
0141	OVERTORQUE TRIP SELECTION	0 / 1	0040	0000: Trip disabled (0) 0040: Trip enabled (1)	—
0142	OVERTORQUE TRIP LEVEL	0 / 1	00FF	0000 ~ 00C8 (0 ~ 200)	1
0143	FAULT TRIP EEPROM SAVE ENABLE	0 / 1	0002	0000: Data cleared when powered OFF (0) 0002: Data retained when powered OFF (1)	—
0144	COOLING FAN CONTROL SELECTION	0 / 1	0004	0000: Automatic (temperature detection) (0) 0004: Always ON (1)	—
0145	CUMULATIVE RUN TIMER ALARM SETTING	0 / 1	FFFF	0000 ~ C34B (0.00 ~ 999.90)	0.02

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16.5.10 Pattern Run Control Parameters

Parameter		Function / Title	Bank	Mask	Adjustment Range		Multiplier
0146		PATTERN RUN SELECTION	0 / 1	0008	0000: OFF 0008: ON	(0) (1)	—
0147	1	PATTERN RUN CONTINUE MODE	0 / 1	0001	0000: reset on stop 0001: switch when done	(0) (1)	—
0148		PATTERN GROUP #1 SPEED #0	1	00FF	0000: Skip 0001 ~ 000F: Speeds 1 ~ 15	(0)	1
0149		PATTERN GROUP #1 SPEED #1					
0150		PATTERN GROUP #1 SPEED #2					
0151		PATTERN GROUP #1 SPEED #3					
0152		PATTERN GROUP #1 SPEED #4					
0153		PATTERN GROUP #1 SPEED #5					
0154		PATTERN GROUP #1 SPEED #6					
0155		PATTERN GROUP #1 SPEED #7					
0156		PATTERN GROUP #1 NUMBER OF CYCLES	0 / 1	00FF	0001 ~ 00FF: 1 ~ 255		1
0157		PATTERN GROUP #2 SPEED #0	1	00FF	0000: Skip 0001 ~ 000F: Speeds 1 ~ 15	(0)	1
0158		PATTERN GROUP #2 SPEED #1					
0159		PATTERN GROUP #2 SPEED #2					
015A		PATTERN GROUP #2 SPEED #3					
015B		PATTERN GROUP #2 SPEED #4					
015C		PATTERN GROUP #2 SPEED #5					
015D		PATTERN GROUP #2 SPEED #6					
015E		PATTERN GROUP #2 SPEED #7					
015F		PATTERN GROUP #2 NUMBER OF CYCLES	0 / 1	00FF	0001 ~ 00FF: 1 ~ 255		1
0160		PATTERN GROUP #3 SPEED #0	1	00FF	0000: Skip 0001 ~ 000F: Speeds 1 ~ 15	(0)	1
0161		PATTERN GROUP #3 SPEED #1					
0162		PATTERN GROUP #3 SPEED #2					
0163		PATTERN GROUP #3 SPEED #3					
0164		PATTERN GROUP #3 SPEED #4					
0165		PATTERN GROUP #3 SPEED #5					
0166		PATTERN GROUP #3 SPEED #6					
0167		PATTERN GROUP #3 SPEED #7					
0168		PATTERN GROUP #3 NUMBER OF CYCLES	0 / 1	00FF	0001 ~ 00FF: 1 ~ 255		1
0169		PATTERN GROUP #4 SPEED #0	1	00FF	0000: Skip	(0)	1

Parameter	Function / Title		Bank	Mask	Adjustment Range	Multiplier
016A	PATTERN GROUP #4 SPEED #1				0001 ~ 000F: Speeds 1 ~ 15	
016B	PATTERN GROUP #4 SPEED #2					
016C	PATTERN GROUP #4 SPEED #3					
016D	PATTERN GROUP #4 SPEED #4					
016E	PATTERN GROUP #4 SPEED #5					
016F	PATTERN GROUP #4 SPEED #6					
0170	PATTERN GROUP #4 SPEED #7					
0171	PATTERN GROUP #4 NUMBER OF CYCLES		0 / 1	00FF	0001 ~ 00FF: 1 ~ 255	1
0172	SPEED #1 CONTINUE MODE		1	00FF	0000: Count in seconds from time of activation (0) 0001: Count in minutes from time of activation (1) 0002: Count in seconds from speed reach (2) 0003: Count in minutes from speed reach (3) 0004: Non-stop (continue until STOP command) (4) 0005: Continue until next step command (5)	—
0173	< 4	SPEED #1 DRIVE TIME	1	FFFF	0000 ~ 1F40 (0 ~ 8000)	1
0174	SPEED #2 CONTINUE MODE		1	00FF	Same as SPEED #1 CONTINUE MODE	—
0175	< 4	SPEED #2 DRIVE TIME	1	FFFF	0000 ~ 1F40 (0 ~ 8000)	1
0176	SPEED #3 CONTINUE MODE		1	00FF	Same as SPEED #1 CONTINUE MODE	—
0177	< 4	SPEED #3 DRIVE TIME	1	FFFF	0000 ~ 1F40 (0 ~ 8000)	1
0178	SPEED #4 CONTINUE MODE		1	00FF	Same as SPEED #1 CONTINUE MODE	—
0179	< 4	SPEED #4 DRIVE TIME	1	FFFF	0000 ~ 1F40 (0 ~ 8000)	1
017A	SPEED #5 CONTINUE MODE		1	00FF	Same as SPEED #1 CONTINUE MODE	—
017B	< 4	SPEED #5 DRIVE TIME	1	FFFF	0000 ~ 1F40 (0 ~ 8000)	1
017C	SPEED #6 CONTINUE MODE		1	00FF	Same as SPEED #1 CONTINUE MODE	—
017D	< 4	SPEED #6 DRIVE TIME	1	FFFF	0000 ~ 1F40 (0 ~ 8000)	1
017E	SPEED #7 CONTINUE MODE		1	00FF	Same as SPEED #1 CONTINUE MODE	—
017F	< 4	SPEED #7 DRIVE TIME	1	FFFF	0000 ~ 1F40 (0 ~ 8000)	1
0180	SPEED #8 CONTINUE MODE		1	00FF	Same as SPEED #1 CONTINUE MODE	—
0181	< 4	SPEED #8 DRIVE TIME	1	FFFF	0000 ~ 1F40 (0 ~ 8000)	1
0182	SPEED #9 CONTINUE MODE		1	00FF	Same as SPEED #1 CONTINUE MODE	—
0183	< 4	SPEED #9 DRIVE TIME	1	FFFF	0000 ~ 1F40 (0 ~ 8000)	1
0184	SPEED #10 CONTINUE MODE		1	00FF	Same as SPEED #1 CONTINUE MODE	—

Parameter	Function / Title		Bank	Mask	Adjustment Range	Multiplier
0185	< 4	SPEED #10 DRIVE TIME	1	FFFF	0000 ~ 1F40 (0 ~ 8000)	1
0186	SPEED #11 CONTINUE MODE		1	00FF	Same as SPEED #1 CONTINUE MODE	—
0187	< 4	SPEED #11 DRIVE TIME	1	FFFF	0000 ~ 1F40 (0 ~ 8000)	1
0188	SPEED #12 CONTINUE MODE		1	00FF	Same as SPEED #1 CONTINUE MODE	—
0189	< 4	SPEED #12 DRIVE TIME	1	FFFF	0000 ~ 1F40 (0 ~ 8000)	1
018A	SPEED #13 CONTINUE MODE		1	00FF	Same as SPEED #1 CONTINUE MODE	—
018B	< 4	SPEED #13 DRIVE TIME	1	FFFF	0000 ~ 1F40 (0 ~ 8000)	1
018C	SPEED #14 CONTINUE MODE		1	00FF	Same as SPEED #1 CONTINUE MODE	—
018D	< 4	SPEED #14 DRIVE TIME	1	FFFF	0000 ~ 1F40 (0 ~ 8000)	1
018E	SPEED #15 CONTINUE MODE		1	00FF	Same as SPEED #1 CONTINUE MODE	—
018F	< 4	SPEED #15 DRIVE TIME	1	FFFF	0000 ~ 1F40 (0 ~ 8000)	1

16.5.11 Feedback Control Parameters

Parameter	Function / Title		Bank	Mask	Adjustment Range		Multiplier
0190	FEEDBACK CONTROL SELECTION		0 / 1	0060	0020: No feedback	(0)	—
					0040: PID control	(1)	
					0060: Speed feedback	(2)	
0191		FEEDBACK INPUT SIGNAL SELECTION	0 / 1	001C	0004: RR input	(1)	—
					0008: IV input	(2)	
					000C: RX input	(3)	
					0010: PG feedback	(4)	
					0014: RS232C input	(5)	
					0018: Communication/12-bit binary interface board	(6)	
	1, 2				001C: BIN input	(7)	
0192		PROPORTIONAL GAIN	0 / 1	00FF	0001 ~ 00FF (0.01 ~ 2.55)		0.01
0193		INTEGRAL GAIN	0 / 1	FFFF	0001 ~ 8CA0 (0.01 ~ 360.00)		0.01
0194		ANTI-HUNTING GAIN	0 / 1	00FF	0000 ~ 00FF (0.0 ~ 25.5)		0.1
0195		LAG TIME CONSTANT	0 / 1	00FF	0000 ~ 00FF (0 ~ 255)		1
0196		PID LOWER LIMIT FREQUENCY	0 / 1	FFFF	0 ~ Fmax		0.01
0197	PID DEVIATION LIMIT SELECTION		0 / 1	0080	0000: No PID deviation limit	(0)	—
					0080: PID deviation limited	(1)	
0198	1	PID DEVIATION UPPER LIMIT	0 / 1	00FF	0000 ~ 0032 (0 ~ 50)		1
0199		PID DEVIATION LOWER LIMIT	0 / 1	00FF	0000 ~ 0032 (0 ~ 50)		1
019A	PG INPUT: NUMBER OF PULSES		0 / 1	FFFF	0001 ~ 270F (1 ~ 9999)		1
019B	PG INPUT: NUMBER OF PHASES		0 / 1	0001	0000: Single-phase input	(1)	—
					0001: Two-phase input	(2)	
019C	DROOPING CONTROL ENABLE		0 / 1	0002	0000: OFF	(0)	—
					0002: ON	(1)	
019D	1	DROOPING CONTROL AMOUNT	0 / 1	00FF	0000 ~ 0064 (0 ~ 10.0)		0.1
019E	OVERRIDE CONTROL SELECTION		0 / 1	0007	0000: OFF	(0)	—
					0001: FCRR	(1)	
					0002: FCIV	(2)	
					0003: FCRX	(3)	
					0004: FCPG	(4)	
					0005: FCPNL	(5)	
					0006: FCOPT	(6)	
					0007: FCMLT	(7)	
019F		OVERRIDE MULTIPLIER INPUT SELECTION	0 / 1	0038	0000: Reference	(0)	—
					0008: KRR	(1)	
					0010: KIV	(2)	
	7				0018: KRX	(3)	
					0020: KBIN	(4)	
01A0		OVERRIDE CHANGE MULTIPLIER	0 / 1	FFFF	FC18 ~ 03E8 (-100.0 ~ 100.0)		0.1
01A1 ~ 0203	Reserved		—	—	—		—

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16.5.12 Communication Setting Parameters

Parameter		Function / Title	Bank	Mask	Adjustment Range	Multiplier
0204		INVERTER ID NUMBER	1	00FF	0000 ~ 00FF (0 ~ 255)	1
0205		COMMUNICATION SELECTION	1	0007	0000: OFF (0) 0001: RS485 (1) 0002: Modbus, F10, DeviceNet (2) 0003: TOSLINE S-20 (3) 0004: 12 bit binary input (4) 0005: 3-digit BCD (0.1Hz) (5) 0006: 3-digit BCD (1Hz) (6)	—
0206	1	MASTER/SLAVE SELECTION	1	0018	0000: Slave (0) 0008: Master (freq. command) (1) 0010: Master (output frequency)(2)	—
0207		RS485 BAUD RATE	1	0004	0000: Normal mode (0) 0004: High-speed mode (1)	—
0208		TOSLINE-F10 COMMAND INPUT	1	0003	0000: OFF (0) 0001: Frequency command (1) 0002: Command input (2) 0003: Both (1) and (2) (3)	—
0209	2	TOSLINE-F10 MONITOR OUTPUT	1	003C	0000: (0) 0020: (8) 0004: (1) 0024: (9) 0008: (2) 0028: (10) 000C: (3) 002C: (11) 0010: (4) 0030: (12) 0014: (5) 0034: (13) 0018: (6) 0038: (14) 001C: (7) 003C: (15)	—
020A		TOSLINE-F10 COMM ERROR MODE	1	0080	0000: Data cleared (0) 0080: Data retained (1)	—
020B		TOSLINE-S20 RECEIVE ADDRESS	1	FFFF	0000 ~ 03FF (0 ~ 1023)	1
020C		TOSLINE-S20 TRANSMIT ADDRESS	1	FFFF	0000 ~ 03FF (0 ~ 1023)	1
020D		TOSLINE-S20 COMMAND INPUT	1	001F	0000 ~ 001F (0 ~ 31)	1
020E		TOSLINE-S20 MONITOR OUTPUT	1	001F	0000 ~ 001F (0 ~ 31)	1
020F	3	TOSLINE-S20 FREQ REF ADDR SELECT	1	0001	0000: Disable (0) 0001: Enable (1)	1
0210		1 TOSLINE-S20 FREQ REFERENCE ADDR	1	FFFF	0000 ~ 03FF (0 ~ 1023)	1
0211		TOSLINE-S20 COMM ERROR MODE	1	0002	0000: Data cleared (0) 0002: Data retained (1)	1
0212		TOSLINE-S20 COMM OPTION RESET	1	0004	0000: No effect (0) 0004: Reset (1)	1
0213		RS485/12-BIT BINARY BIAS,GAIN	0 / 1	0020	0000: OFF (0) 0020: ON (1)	—
0214	1	RS485/12-BIT BINARY POINT #1	0 / 1	00FF	0000 ~ 0064 (0 ~ 100)	1
0215		RS485/12-BIT BINARY PT. #1 FREQ	0 / 1	FFFF	0000 ~ Fmax (0 ~ Fmax)	0.01
0216		RS485/12-BIT BINARY POINT #2	0 / 1	00FF	0000 ~ 0064 (0 ~ 100)	1
0217		RS485/12-BIT BINARY PT. #2 FREQ	0 / 1	FFFF	0000 ~ Fmax (0 ~ Fmax)	0.01

16.5.13 AM/FM Terminal Adjustment Parameters

Parameter	Function / Title	Bank	Mask	Adjustment Range	Multiplier
0218	FM TERMINAL FUNCTION SELECTION	0 / 1	FFFF	1194: Pre-comp ref. frequency (0) 6686: Post-comp output freq. (1) 1500: Frequency setting (2) 2576: Output current (3) 2689: DC voltage (4) 5668: Output voltage (5) 3684: Torque current (6) 2688: Excitation current (7) 7506: PID feedback value (8) 0584: Motor overload ratio (9) 0586: Inverter overload ratio (10) 0588: DBR overload ratio (11) 835C: Input power (12) 835E: Output power (13) A000: Fixed output (14) 2304: Peak output current (15) 8302: Peak input voltage (16)	—
0219	FREQUENCY METER ADJUSTMENT	0 / 1	FFFF	0000 ~ FFFF	1
021A	AM TERMINAL FUNCTION SELECTION	0 / 1	FFFF	Same as FM TERMINAL FUNCTION SELECTION	—
021B	CURRENT METER ADJUSTMENT	0 / 1	FFFF	0000 ~ FFFF	1

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16.5.14 Utility Parameters

Parameter	Function / Title	Bank	Mask	Adjustment Range	Multiplier
021C	INDUSTRIAL APPLICATIONS (previous setting monitor for read use only)	0 / 1	00FF	0000: Standard shipment setting (0) 0001: Pump application (1) 0002: Fan application (2) 0003: Conveyor application (3) 0004: Hoist application (4) 0005: Textiles application (5) 0006: Machine tools application (6)	—
021D	INDUSTRIAL APPLICATIONS (for write use) (*)	0 / 1	00FF	0000: Does nothing (0) 0011: Pump application (1) 0012: Fan application (2) 0013: Conveyor application (3) 0014: Hoist application (4) 0015: Textiles application (5) 0016: Machine tools application (6)	—
021E	STANDARD SETTING MODE SELECTION (*)	0 / 1	00FF	0000: Does nothing (0) 0001: 50Hz standard settings (1) 0002: 60Hz standard settings (2) 0003: Factory settings (3) 0004: Trip clear (4) 0005: Save user-set parameters (5) 0006: TYPE 5 reset (6) 0007: Initialize typeform (7)	—
021F	COMMAND MODE SELECTION	0 / 1	0007	0000: Only RS232C valid (0) 0001: Terminal input valid (1) 0002: Panel input valid (2) 0003: Communication interface input valid (3) 0004: local/remote valid (4)	—
0220	FREQUENCY MODE SELECTION	0 / 1	0038	0000: Only RS232C valid (0) 0008: Terminal input valid (1) 0010: Panel input valid (2) 0018: Communication/12-bit binary interface input valid (3) 0020: local/remote valid (4)	—
0221	PANEL OPERATION MODE SELECTION	0 / 1	00FB	0000 ~ 003F (0 ~ 63) (except 0004, 0008, 000C....)	1
0222	PASS NUMBER	0 / 1	00FF	0000 ~ 0063 (0 ~ 99)	1
0223	CPU VERSION	2	FFFF	(Monitor only)	—
0224	ROM VERSION	3	FFFF	(Monitor only)	—
0225	EEPROM VERSION	1	FFFF	(Monitor only)	—
0226	INVERTER TYPEFORM	0	00FF	(Monitor only)	—
0227	STATUS MONITOR #1 DISPLAY SELECT	0 / 1	FFFF	0001 ~ 0010 (1 ~ 16)	1
0228	STATUS MONITOR #2 DISPLAY SELECT	0 / 1	FFFF	0001 ~ 0010 (1 ~ 16)	1
0229	STATUS MONITOR #3 DISPLAY SELECT	0 / 1	FFFF	0001 ~ 0010 (1 ~ 16)	1
022A	STATUS MONITOR #4 DISPLAY SELECT	0 / 1	FFFF	0001 ~ 0010 (1 ~ 16)	1
022B	FREQUENCY UNITS SCALE FACTOR	0 / 1	FFFF	0000 ~ 4E20 (0.00 ~ 200.00)	0.01
022C	FREQUENCY DISPLAY RESOLUTION	0 / 1	0003	0000: 1Hz (0) 0001: 0.1Hz (1) 0002: 0.01Hz (2)	—

Parameter	Function / Title	Bank	Mask	Adjustment Range		Multiplier
022D	ACC/DEC TIME UNITS SELECTION	0 / 1	0004	0000: 0.1 sec.	(0)	—
				0004: 0.01 sec.	(1)	
022E	CURRENT UNITS SELECTION	0 / 1	0008	0000: %	(0)	—
				0008: A	(1)	
022F	VOLTAGE UNITS SELECTION	0 / 1	0010	0000: %	(0)	—
				0010: V	(1)	
0230	BLIND FUNCTION SELECTION	0 / 1	0001	0000: Blind	(0)	—
				0001: Selective unblinding	(1)	
0231	FUNDAMENTAL PARAMS #2 BLIND	0 / 1	0040	0000: Blind	(0)	—
				0040: Unblind	(1)	
0232	PANEL CONTROL PARAMS BLIND	0 / 1	0080	0000: Blind	(0)	—
				0080: Unblind	(1)	
0233	TERMINAL SELECTION PARAMS BLIND	0 / 1	0001	0000: Blind	(0)	—
				0001: Unblind	(1)	
0234	SPECIAL CONTROL PARAMS BLIND	0 / 1	0002	0000: Blind	(0)	—
				0002: Unblind	(1)	
0235	FREQUENCY SETTING PARAMS BLIND	0 / 1	0004	0000: Blind	(0)	—
				0004: Unblind	(1)	
0236	PROTECTION FUNCTION PARAMS BLIND	0 / 1	0008	0000: Blind	(0)	—
				0008: Unblind	(1)	
0237	PATTERN RUN CONTROL PARAMS BLIND	0 / 1	0010	0000: Blind	(0)	—
				0010: Unblind	(1)	
0238	FEEDBACK CONTROL PARAMS BLIND	0 / 1	0020	0000: Blind	(0)	—
				0020: Unblind	(1)	
0239	1 COMMUNICATION PARAMS BLIND	0 / 1	0040	0000: Blind	(0)	—
				0040: Unblind	(1)	
023A	INDUSTRIAL APPL:PUMP PARAMS BLIND	0 / 1	0080	0000: Blind	(0)	—
				0080: Unblind	(1)	
023B	INDUSTRIAL APPL:FAN PARAMS BLIND	0 / 1	0001	0000: Blind	(0)	—
				0001: Unblind	(1)	
023C	INDUSTRIAL APPL: CONVEYOR BLIND	0 / 1	0002	0000: Blind	(0)	—
				0002: Unblind	(1)	
023D	INDUSTRIAL APPL: HOIST BLIND	0 / 1	0004	0000: Blind	(0)	—
				0004: Unblind	(1)	
023E	INDUSTRIAL APPL: TEXTILES BLIND	0 / 1	0008	0000: Blind	(0)	—
				0008: Unblind	(1)	
023F	INDUST APPL:MACHINE TOOLS BLIND	0 / 1	0010	0000: Blind	(0)	—
				0010: Unblind	(1)	
0240	AM/FM ADJUSTMENT PARAMS BLIND	0 / 1	0001	0000: Blind	(0)	—
				0001: Unblind	(1)	
0241	MOTOR PARAMETERS BLIND	0 / 1	0004	0000: Blind	(0)	—
				0004: Unblind	(1)	

16.5.15 Motor Rating Parameters

Parameter	Function / Title		Bank	Mask	Adjustment Range		Multiplier
0242	NUMBER OF MOTOR POLES		0 / 1	00FF	0001: (2) 0002: (4) 0003: (6) 0004: (8) 0005: (10) 0006: (12) 0007: (14) 0008: (16)		2
0243	MOTOR RATED CAPACITY		0 / 1	FFFF	0001 ~ 270F (0.1 ~ 999.9)		0.1
0244	MOTOR TYPE		0 / 1	0030	0000:Toshiba EQPIII motor	(0)	—
					0010:Toshiba STD motor	(1)	
					0020:Other	(2)	
0245	2	MOTOR RATED VOLTAGE （230 / 460v units)	0 / 1	00FF	0012 ~ 0078 (90 ~ 600)		5
0246		(575v units)			001A ~ 00AC (130 ~ 860)		
0247		MOTOR RATED FREQUENCY	0 / 1	00FF	0000 ~ 00C8 (0 ~ 400)		2
0248		MOTOR RATED RPM	0 / 1	FFFF	0000 ~ 270F (0 ~ 9999)		1
0249		AUTO-TUNING ENABLE	0	0008	0000: Auto-tuning disabled	(0)	—
					0008: Auto-tuning enabled	(1)	
024A	LOAD MOMENT OF INERTIA		0 / 1	00C0	0000: Small	(0)	—
					0040: Medium	(1)	
					0080: Large	(2)	
					00C0: Very large	(3)	

16.5.16 Inverter Fault Codes

LCD Display Message	Data (Hex)	Explanation
NO ERROR	××00	No error has been recorded since the last inverter reset or trip clear
OVERCURRENT (ACCEL) (PRESS CLEAR)	××01	Overcurrent during acceleration
OVERCURRENT (DECEL) (PRESS CLEAR)	××02	Overcurrent during deceleration
OVERCURRENT (RUN) (PRESS CLEAR)	××03	Overcurrent during constant-speed run
LOAD-END OVERCURRENT (PRESS CLEAR)	××04	Load-end overcurrent detected at start-up (output terminals, motor wiring etc.)
U-PHASE SHORT CKT (PRESS CLEAR)	××05	U-phase armature short circuit
V-PHASE SHORT CKT (PRESS CLEAR)	××06	V-phase armature short circuit
W-PHASE SHORT CKT (PRESS CLEAR)	××07	W-phase armature short circuit
LOST INPUT PHASE (PRESS CLEAR)	××08	Lost input phase (option)
LOST OUTPUT PHASE (PRESS CLEAR)	××09	Lost output phase (option)
OVERVOLTAGE (ACCEL) (PRESS CLEAR)	××0A	Overvoltage during acceleration
OVERVOLTAGE (DECEL) (PRESS CLEAR)	××0B	Overvoltage during deceleration
OVERVOLTAGE (RUN) (PRESS CLEAR)	××0C	Overvoltage during constant-speed run
INVERTER OVERLOAD (PRESS CLEAR)	××0D	Inverter overload
MOTOR OVERLOAD (PRESS CLEAR)	××0E	Motor overload
DBR OVERLOAD TRIP (PRESS CLEAR)	××0F	Dynamic braking resistor overload
OVERHEAT TRIP (PRESS CLEAR)	××10	Inverter overheat
EMERGENCY OFF (PRESS CLEAR)	××11	Emergency off
EEPROM WRITE FAILURE (PRESS CLEAR)	××12	EEPROM failure during write
EEPROM READ FAILURE (PRESS CLEAR)	××13	EEPROM failure during initial read
—	××14	Unused
RAM ERROR (PRESS CLEAR)	××15	RAM error
ROM ERROR (PRESS CLEAR)	××16	ROM error
CPU ERROR (PRESS CLEAR)	××17	CPU error
COMMUNICATION ERROR (PRESS CLEAR)	××18	RS232C timer time-out
GATE ARRAY FAULT (PRESS CLEAR)	××19	Gate array error
CURRENT DETECT ERROR (PRESS CLEAR)	××1A	Output current detection circuit error

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LCD Display Message	Data (Hex)	Explanation
OPTION PCB ERROR (PRESS CLEAR)	××1B	Option PCB error
OPTION ROM ERROR	××1C	Option ROM error
LOW CURRENT TRIP (PRESS CLEAR)	××1D	Low current
UNDERVOLTAGE TRIP (PRESS CLEAR)	××1E	Main circuit undervoltage
—	××1F	Unused
OVERTORQUE TRIP (PRESS CLEAR)	××20	Overtorque
EARTH FAULT (SOFT) (PRESS CLEAR)	××21	Earth fault (software)
EARTH FAULT (HARD) (PRESS CLEAR)	××22	Earth fault (hardware)
OPEN FUSE TRIP (PRESS CLEAR)	××23	Open fuse
DBR OVERCURRENT TRIP (PRESS CLEAR)	××24	Dynamic braking resistor overcurrent
DC OVERCURRENT (ACC) (PRESS CLEAR)	××25	Overcurrent in DC section during acceleration
DC OVERCURRENT (DEC) (PRESS CLEAR)	××26	Overcurrent in DC section during deceleration
DC OVERCURRENT (RUN) (PRESS CLEAR)	××27	Overcurrent in DC section during constant-speed run
AUTO-TUNING ERROR (PRESS CLEAR)	××28	Auto-tuning error
INV TYPEFORM ERROR (PRESS READ/WRITE)	××29	Inverter typeform error

17. Firmware Updates

The gateway's embedded firmware resides in flash memory that can be updated in the field. Firmware updates may be released for a variety of reasons, such as custom firmware implementations, firmware improvements and added functionality as a result of user requests.

ICC is continually striving to enhance the functionality and flexibility of our products, and we therefore periodically release new embedded firmware to achieve these goals and meet customer requests. Flash firmware files and all related documentation (such as updated user manuals) can be downloaded as complete board support packages (referred to as BSPs) from http://www.iccdesigns.com. It is suggested that users check this Internet site prior to installation, and then periodically afterwards to determine if new support packages have been released and are available to upgrade their units.

17.1 Requirements

Besides the new firmware file, firmware updates require a PC with a Windows operating system (Windows 95 or newer) and a serial port, the RFU PC application (refer to section 17.3), and an appropriate cable to connect the RS232 port of the unit to the PC.

Please be sure to read the firmware release notes and updated user's manual (included with the BSP) for any important notices, behavior precautions or configuration requirements prior to updating your firmware. For example, upgrading to a new firmware version may affect user-defined configuration files: prior to starting an update procedure always back up your configuration file to a PC for later recovery if necessary.

17.2 Connection

⚠ **IMPORTANT:** Note that the gateway will not be operating its system control and communication tasks while its internal firmware is being updated. Therefore, be sure to shut down the system to a known safe state prior to initiating the firmware update procedure.

Connect the serial port cable between the RS232 port of the gateway and the computer's serial port. Move "CFG" switch #1 to the "ON" (right-hand) position: this will place the gateway into the "firmware download" mode. Whenever "CFG" switch #1 is "ON", the gateway can only download firmware to its flash memory: all other application functions (such as communications, console access etc.) will be disabled.

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17.3 Using the RFU Utility

Support for downloading new application firmware to the gateway is provided by the free Rabbit Field Utility (RFU), which is a 32-bit application that runs on Microsoft Windows platforms. The RFU utility can be downloaded from ICC's home page at http://www.iccdesigns.com. When downloading a new gateway application BSP, always confirm that you also have the latest version of RFU, as new .BIN firmware files contained in BSPs may require functionality found only in the most recent RFU versions for successful downloading.

The remainder of this section will detail the RFU utility configuration and firmware download procedures.

17.3.1 Required Files

When first downloaded, the RFU utility files are compressed into one self-extracting .EXE distribution file. Create a folder (such as c:\RFU), place the distribution file in this folder, and then execute it. This will extract the compressed files into that same folder. The distribution file is then unneeded and can be deleted if desired. To run the RFU utility, double-click on the RFU.EXE file icon.

17.3.2 First-Time Configuration

The first time the RFU utility is run on a computer, several configuration items need to be confirmed. These configuration items are retained in the computer's registry from that point on, so reconfiguration is not required unless certain parameters (such as which serial port to use on the computer) are changed.

The two configuration items that need to be confirmed are the communications and bootstrap loaders path. First, select the "Setup…Communications" menu item (refer to Figure 34).
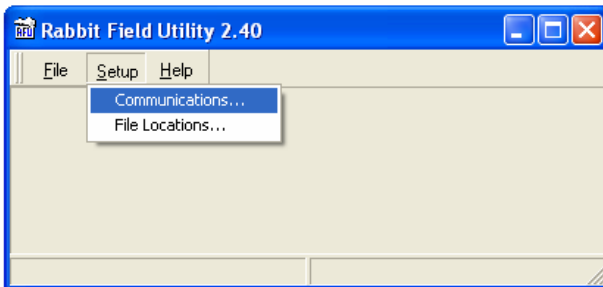
Figure 34: RFU Main Screen

The Communications Options window shown in Figure 35 then appears. Confirm that the settings are as shown, with the possible exception of the

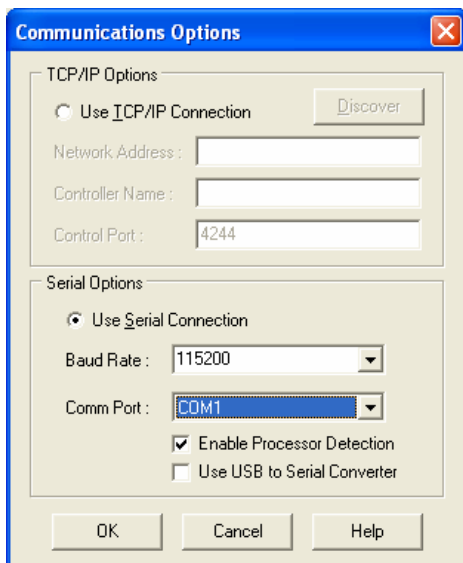"Comm Port" settings, which depends on the COM port you are using. Click "OK" when complete.

Figure 35: Communications Options Window

Next, select the "Setup…File Locations" menu item from the main screen. The "Choose File Locations" window shown in Figure 36 then appears. Confirm that the correct paths to the referenced files are entered. Enter the correct paths if necessary.
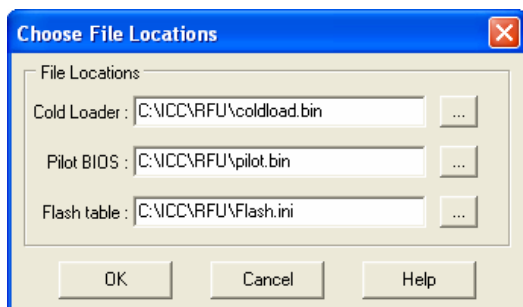

Figure 36: Choose File Locations Window

17.3.3 Transmitting Firmware Files

When a board support package (BSP) has been downloaded and unzipped, the flash firmware file will be the one with ".BIN" as its file name extension.

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Once the RFU utility has been configured, the flash firmware files can be downloaded to the gateway by two different methods. The simplest way is to drag the application firmware .BIN file's icon and drop it onto the RFU utility's main screen. This will automatically initiate the download process.

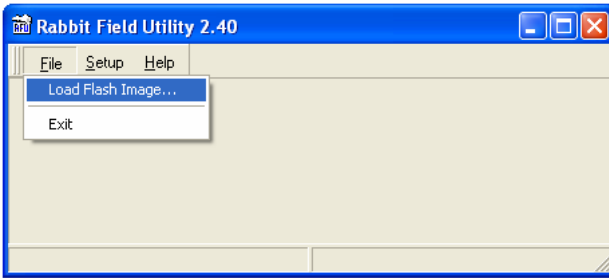Alternatively, select the "File…Load Flash Image" menu item (refer to Figure 37).

Figure 37: Load Flash Image Menu Selection

The flash image (.BIN file) selection window will then appear (refer to Figure 38). Browse to the location of the flash image file and select it. Clicking "OK" will then initiate the download process.
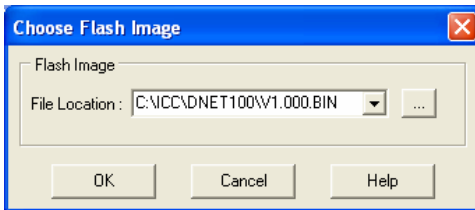
Figure 38: Flash File Selection Window

While downloading, the RFU utility will indicate the download status. Once complete, summary information will be displayed in the bottom status bar (see Figure 39).
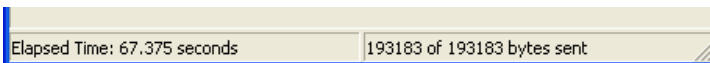

Figure 39: Summary Information

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17.4 Wrap-Up

Once downloading is complete, close the RFU utility, move "CFG" switch #1 back to the "OFF" (left-hand) position to exit "firmware download" mode, and cycle power momentarily to the unit by either disconnecting the auxiliary power supply and/or powering down all connected drives or momentarily removing all drive communication cables from the unit.

When the unit powers up again, it will be running the new application firmware. If the new firmware version release notes indicated that the configuration file might need to be reloaded, then do so at this point.

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18. Notes

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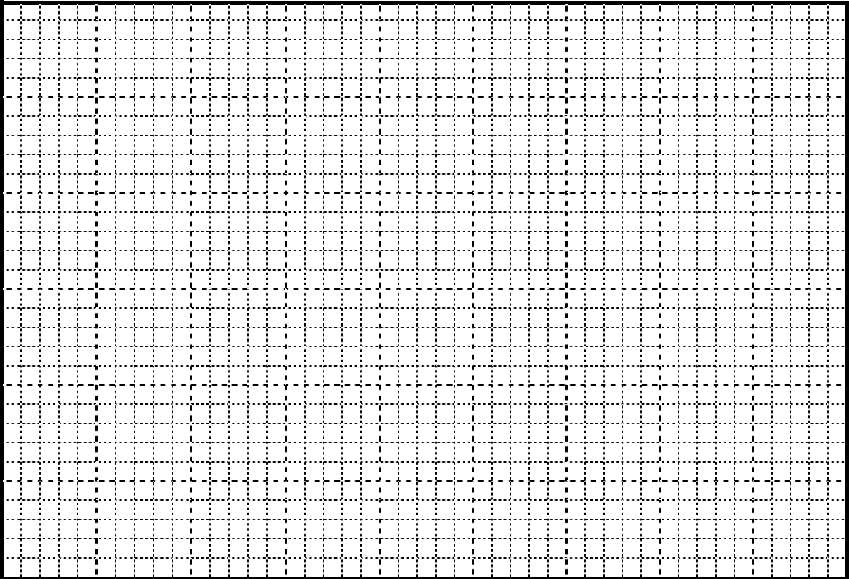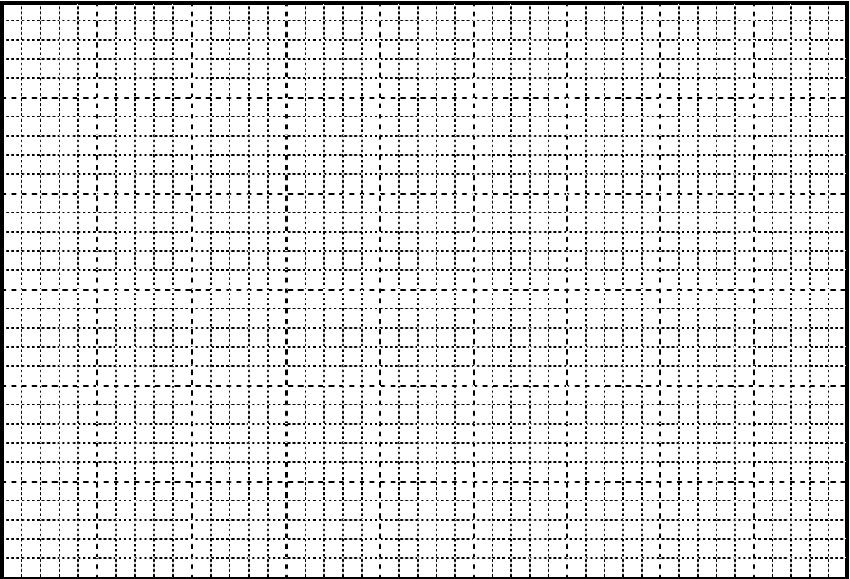
INDUSTRIAL CONTROL COMMUNICATIONS, INC.

2204 Timberloch Place, Suite 250
The Woodlands, TX USA 77380-1049
Tel: [281] 292-0555 Fax: [281] 292-0564
World Wide Web http://www.iccdesigns.com