

SC9000 EP™ medium-voltage drives

User manual

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Safety

Definitions and symbols

WARNING

This symbol indicates high voltage. It calls your attention to items or operations that could be dangerous to you and other persons operating this equipment. Read the message and follow the instructions carefully.



This symbol is the "Safety Alert Symbol." It occurs with either of two signal words: CAUTION or WARNING, as described below.

WARNING

Indicates a potentially hazardous situation which, if not avoided, can result in serious injury or death.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, can result in minor to moderate injury, or serious damage to the product. The situation described in the CAUTION may, if not avoided, lead to serious results. Important safety measures are described in CAUTION (as well as WARNING).

Hazardous high voltage

WARNING

Motor control equipment and electronic controllers are connected to hazardous line voltages. When servicing drives and electronic controllers, there may be exposed components with housings or protrusions at or above line potential. Extreme care should be taken to protect against shock.

Stand on an insulating pad and make it a habit to use only one hand when checking components. Always work with another person in case an emergency occurs. Disconnect power before checking controllers or performing maintenance. Be sure equipment is properly grounded. Wear safety glasses whenever working on electronic controllers or rotating machinery.

Warnings and cautions

This manual contains clearly marked cautions and warnings which are intended for your personal safety and to avoid any unintentional damage to the product or connected appliances.

Please read the information included in cautions and warnings carefully.

Warnings

WARNING

Be sure to ground the unit following the instructions in this manual. Ungrounded units may cause electric shock and/or fire.

WARNING

This equipment should be installed, adjusted, and serviced by qualified electrical maintenance personnel familiar with the construction and operation of this type of equipment and the hazards involved. Failure to observe this precaution could result in death or severe injury.

WARNING

Components within the SC9000 EP power unit are live when the drive is connected to power. Contact with this voltage is extremely dangerous and may cause death or severe injury.

WARNING

Line terminals (L1, L2, L3), motor terminals (U, V, W) and the DC-link terminals (-/+ /N) are live when the drive is connected to power, even if the motor is not running. Contact with this voltage is extremely dangerous and may cause death or severe injury.

WARNING

Even though the control I/O-terminals are isolated from line voltage, the relay outputs and other I/O-terminals may have dangerous voltage present even when the drive is disconnected from power. Contact with this voltage is extremely dangerous and may cause death or severe injury.

WARNING

The SC9000 EP drive has a potential for large capacitive leakage current during operation, which can cause enclosure parts to be above ground potential. Proper grounding, as described in this manual, is required. Failure to observe this precaution could result in death or severe injury.

⚠ WARNING

An upstream disconnect/protective device must be provided as required by the National Electrical[®] Code (NEC[®]). Failure to follow this precaution may result in death or severe injury.

⚠ WARNING

Before opening the SC9000 EP drive doors:

Open main disconnect switch on the SC9000 EP drive.

Wait a minimum of 5 (five) minutes after all the lights on the keypad are off. This allows time for the DC bus capacitors to discharge.

A hazard voltage may still remain in the DC bus capacitors even if the power has been turned off. While wearing proper PPE, open the doors to the drive. Locate the yellow shorting stick and ensure metal end of stick is grounded. Discharge both halves of DC bus utilizing grounding studs on the rectifier.

Failure to follow the above precautions may cause death or severe injury.

Cautions**⚠ CAUTION**

Do not perform any meggar or voltage withstand tests on any part of the SC9000 EP drive or its components. Improper testing may result in damage.

⚠ CAUTION

Prior to any tests or measurements of the motor or the motor cable, disconnect the motor cable at the SC9000 EP output terminals (U, V, W) to avoid damaging the SC9000 EP during motor or cable testing.

⚠ CAUTION

Do not touch any components on the circuit boards. Static voltage discharge may damage the components.

⚠ CAUTION

Any electrical or mechanical modification to this equipment without prior written consent of Eaton will void all warranties and may result in a safety hazard in addition and voiding of the UL listing.

⚠ CAUTION

Prevent foreign material such as wire clippings or metal shavings from entering the drive enclosure, as this may cause arcing damage and fire.

⚠ CAUTION

Install the SC9000 EP drive in a well-ventilated room that is not subject to temperature extremes, high humidity, or condensation, and avoid locations that are directly exposed to sunlight, or have high concentrations of dust, corrosive gas, explosive gas, inflammable gas, grinding fluid mist, etc. Improper installation may result in a fire hazard.

Motor and equipment safety**⚠ CAUTION**

Before starting the motor, check that the motor is mounted properly and aligned with the driven equipment. Ensure that starting the motor will not cause personal injury or damage equipment connected to the motor.

⚠ CAUTION

Set the maximum motor speed (frequency) in the SC9000 EP drive according to the requirements of the motor and the equipment connected to it. Incorrect maximum frequency settings can cause motor or equipment damage and personal injury.

⚠ CAUTION

Before reversing the motor rotation direction, ensure that this will not cause personal injury or equipment damage.

⚠ CAUTION

Make sure that no power correction capacitors are connected to the SC9000 EP output or the motor terminals to prevent SC9000 EP malfunction and potential damage.

⚠ CAUTION

Make sure that the SC9000 EP output terminals (U, V, W) are not connected to the utility line power as severe damage to the SC9000 EP may occur.

Glossary

Many of the following terms and acronyms are used throughout the manual and on schematics. They are included to clarify verbiage.

Terms and abbreviations

24PR—24 pulse diode rectifier bridge

27/47—Undervoltage and phase reversal detection relay

Active Front End (AFE)—Refers to controllable rectification of AC to DC; makes a drive regenerative

Adjustable frequency drive—A type of motor controller that drives an electric motor by varying the frequency and voltage supplied to the electric motor

Bypass—Systems provide backup for the SC9000 EP adjustable frequency drive

Cn—DC bus capacitors (C1, C2, C3...)

COE—Custom order engineering

Constant torque (ct)—A drive whose torque rating is constant over its operational range

CPT—Control power transformer

CRn—DC bus rectifier from pre-charge transformer

CTB—Customer terminal block

CT—Current transformer

DMCR—Drive motor control rack

EP—Encapsulated powerpole

EPC—Electric pre-charge

Fieldbus—An industrial network system for real-time distributed control

ICG—Ampgard integrated control gear

Fn—24 pulse rectifier fuse (F1, F2, F3...)

IGBT—Insulated gate bipolar transistor

Inverter (INV)—An electronic device or circuitry that change direct current (DC) to alternating current (AC)

ISW—Isolation switch

ISWX—Isolation switch auxiliary relay

ITG—Integrated interface card

M—Main contactor

MBn—Main blower (MB1, MB2, MB3...)

MCO—Main cooling on

MCR—Main contactor relay

MCX—Main cooling contact

MFn—Main fan (MF1, MF2, MF3...)

MX—Main cooling interposing relay

Motor ID Run—The better way to identify a motor, requires motor shaft be disconnected from the load

MOV—Metal oxide varistor

MSn—Main blower starter (1, 2, 3...)

OCS—Output contactor status

OCX—Output contactor contact

OPTXX—SPX controller option card

PCR—Pre-charge ready relay

PFn—Primary fuse (PF1, PF2, PF3...)

PMR—Phase monitor relay

PS—ITG power supply

PT—Potential transformer

PX—Pre-charge relay

RCO—Redundant cooling on

RCX—Redundant cooling contact

Rectifier—An electrical device that converts an alternating current into a direct one by allowing current to flow through it in one direction only.

Rn—Resistor (RS1, RS2, RS3...)

RSn—Redundant blower starter (RS1, RS2, RS3...)

RTD—Resistive thermal device

RVSS—Reduced-voltage soft starter

SPX—Drive controller module

T2—Blower transformer

UPB—UPS replace battery

UPR—UPS ready

UPS—Uninterrupted power source

URTD—Universal Resistance Temperature Detector

Variable torque (vt)—A drive whose torque rating varies over its operational range

Chapter 1: Introduction

Purpose

This user manual covers the setup, configuration, maintenance, and application of the SC9000 Encapsulated Powerpole (EP) Medium-voltage Adjustable Frequency Drive (AFD). It covers the basic sequences of using the drive as well as basic maintenance and operation. It does not cover all possible contingencies, variations, and details that may arise during the handling and installation of this equipment due to the customizations that happen on a per customer basis.

Application and description

The Eaton SC9000 EP provides adjustable frequency control and protection of medium-voltage AC motors and equipment rated at 2400 V, 3300 V, and 4160 V. The SC9000 EP is typically supplied as an integrated drive that includes an integrated drive isolation transformer. It can be supplied as a stand-alone drive or it can be directly connected to other Ampgard products in a configuration known as Ampgard Integrated Control-Gear.

The drive consists of several main components mounted together in the drive enclosure(s). Incoming cable or bus is fed through an incoming section that includes a non-load break isolation switch, current limiting power fuses, and a main vacuum contactor. The isolation switch can be opened to allow access inside the drive for servicing or troubleshooting. The 24-pulse drive isolation transformer and the DC bus capacitor charging is accomplished by use of the softmag (pre-charger circuit). The DC bus capacitors are charged and the 24-pulse transformer is magnetized before application of main power, assuring proper phasing and limiting the very high damaging inrush currents to the main rectifier bridge devices. When the proper DC bus voltage is attained, the pre-charge circuit is turned off and the main contactor is closed. The transformer's output feeds into the rectifier. The rectifier powers the DC bus that in turn feeds the drive inverter. The inverter creates the adjustable frequency AC output that controls the speed of the connected motor. The inverter is a drawout truck-mounted device that can be withdrawn from the structure for repair or replacement. The inverter may feed an optional output filter that is supplied when the motor cable length is excessive.

Contact Eaton if the motor cable length is greater than what is recommended in Section 2 of Appendix D and the optional output filter has not been supplied.

Control power transformers are supplied to provide 120 V single-phase control power for the drive and 480 V three-phase power to the blowers. The CPTs are connected after the isolation switch and main fuses and are thus energized any time the isolation switch is closed.

Cooling blowers are provided to exhaust hot air from the drive enclosure. Replaceable filters are provided in the lower portion of the drive doors to minimize dust accumulation inside the enclosure.

Other standard and optional devices are supplied with the drive. Refer to the specific order drawings supplied with the drive to determine which devices have been provided with your equipment.

SC9000 EP standard features

- Delivers maximum benefits while being the smallest fully integrated medium-voltage drive in the industry
- Precise control of medium-voltage motors up to 6000 hp
- Fully integrated package with isolation switch, main contactor, 24-pulse phase shifting isolation transformer, rectifier and inverter. Current limiting fuses, contactor assembly, inverter assembly, and isolating switch assembly are easily removed from the enclosure; line and load terminals are completely accessible from the front
- Positive mechanical isolating switch with visible disconnect completely grounds and isolates the AFD from the line power with a mechanically driven isolation shutter, leaving no exposed high voltage
- Utilizes highly reliable Ampgard components such as a non-load break switch rated for 10,000 mechanical operations, an SL contactor with the highest interrupting rating in the industry at 8500A, EATON power fuses, and a low profile handle mechanism
- Utilizes the same keypad and programming software as the SPX9000 line of low-voltage drives. This standardization translates into a reliable, easy-to-use system that does not require hours of learning new software
- The SC9000 EP's keypad offers a full view of the drive's inner workings. Customers can view and change parameters and monitor actual running values right from the keypad. In addition, the keypad's built-in upload and download capability reduces startup time
- Extensively tested, manufactured, and assembled to ISO® 9001:2000 certification standards
- Designed and constructed to exacting UL® certification standards for use in the most rigorous applications
- The SC9000 EP's integrated phase shifting isolation transformer / 24 pulse converter coupled to a three-level inverter topology assures minimum component usage and reduces output harmonics, delivering sine wave power to the motor. Heat pipe technology improves cooling efficiency and allows the SC9000 EP to run at reduced noise levels. Output filters may be required in some applications
- Individual powerpoles are encapsulated, producing a harsh environment inverter.

Chapter 1: Introduction

- The SC9000 EP's specialized design and patented thermal management system yields the smallest footprint per hp in the industry as a fully integrated drive. This size benefit ensures installations in space limited electrical rooms, eliminating the need for additional cable and conduit installations, and in some cases, eliminating the need for additional feeders required by our competitors
- The SC9000 EP's modular roll-in roll-out inverter design significantly reduces Mean Time to Repair (MTTR), which means that the SC9000 EP is built for maximum uptime
- The test/burn-in procedure runs the drive for a minimum of seven hours before shipping. This allows problems to be detected and corrected before shipment. This process exceeds the new IEEE 1566 requirements of 4 hour minimum test/burn-in before shipment
- Gateway for multiple communication protocols allow easy communication with all commonly used control systems, such as Modbus®, PROFIBUS® DP, CANopen, DeviceNet™
- System bus, CAN, for the networking of drives and peripherals
- Simple programming via a PC. The 9000XDrive software allows customers to upload and download drive parameters, which can be changed, saved, and transferred back to the drive and then printed or saved to a file for future reference. These parameters can also be compared to default values to determine drive configuration. Other operator functions include the ability to set references, start and stop the drive, monitor and display signals and values and help with troubleshooting. The 9000XLoad tool gives customers the ability to upload system, application, and option card software intended for engineering, commissioning, and service personnel
- Programmable for custom applications for control and I/O functions
- Low air volume displacement
- Low electrical noise
- Volts/hertz control for single or multiple motor applications
- Open-loop vector control
- Isolation with fiber optics
- Digital synchronization
- Integrated automation interface

Documentation reference

For further information on installation and application, refer to the applicable technical data, publications, and/or industry standards. Download Eaton electronic information from www.eaton.com/SC9000.

Chapter 2: Safety

Precautions

There is a hazard of electric shock whenever working on or near electrical equipment. Turn off all power supplying the equipment before starting work. Lock out the disconnecting means in accordance with NFPA 70E® "Electrical Safety Requirements for Employee Safety In the Workplace."

Where it is not feasible to de-energize the system, take the following precautions:

1. Instruct persons working near exposed parts that are or may be energized to use practices (including appropriate apparel, equipment and tools) in accordance with NFPA 70E.
2. Require persons working on exposed parts that are or may be energized to be qualified persons who have been trained to work on energized circuits.

Only qualified electrical personnel with training and experience with medium-voltage equipment (>1000V) shall be permitted to work on this apparatus. They shall be familiar with the work to be performed, as well as industry and local safety procedures and standards.

In addition, this person should have the following qualifications:

1. Be trained and authorized to energize, de-energize, clear, ground, and tag circuits and equipment in accordance with established safety practices.
2. Be trained in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established practices.
3. Be trained in rendering first aid.
4. Be knowledgeable with respect to electrical installation codes and standards, for example, the National Electrical Code® (NEC®).

Read and understand all instructions before attempting installation, operation, or maintenance of the medium voltage drive.

Disconnect all low and medium-voltage power sources to the drive or the medium-voltage control-gear before working on the equipment. Lockout procedures must be followed. Verify that the voltage has been removed. Observe all local and national codes and standards

Safety features

The medium-voltage drive has many safety features to help ensure the safety of operators and maintenance personnel. Incoming voltage is disconnected from the downstream portion of the circuit by the isolation switch in the incoming section of the drive. The isolation switch is interlocked with the medium-voltage door in the incoming section to prevent

access to the compartment before the switch is opened. The switch is interlocked with the main contactor to prevent opening the switch under load. The switch operating mechanism is also interlocked to prevent closing the switch with the door open. A viewing window is provided to verify the switch position before entering the medium-voltage compartment. Other medium-voltage doors are also interlocked to prevent access until the switch is open as well. Distinctive marking on back of switch assembly appears when shutter barrier is in position and starter is completely isolated from the line. Grounding clips provide a positive grounding of the SC9000 EP AFD and main fuses when the isolating switch is opened. High and low-voltage circuits are compartmentalized and isolated from each other. The drawout isolation switch is easily removed by loosening two bolts in the back of the switch. The shutter remains in place when the switch is withdrawn (see **Chapter 5**). Grounding device is provided for shorting the DC bus to ground before entering the medium-voltage compartments.

The operating mechanism has provision for lockout/tagout. All local and other procedures should be followed to ensure safe operation.

DC link capacitors

WARNING

High storage device, do not enter drive until capacitors have discharged.

The DC Link consists of a large, medium-voltage capacitor bank charged to a maximum of 7500 Vdc for 4160V drives, 5940 Vdc for 3300 drives, and 4320 Vdc for 2400V drives. The capacitors require 5 minutes to discharge to 50 Vdc after the main contactor is opened. Verify on the keypad that the DC voltage has discharged before entering the compartment. Follow verification and grounding procedures before installing or servicing the equipment.

Grounding practices

WARNING

The SC9000 EP must be solidly grounded.

The inverter must be grounded in accordance with Article 250 of the National Electrical Code or Section 10 of the Canadian Electrical Code, Part I. The grounding conductor should be sized in accordance with NEC Table 250.122 or CEC, Part I Table 16. The SC9000 EP is supplied with a ground bus that runs the length of the drive. **If the drive is shipped in sections, be sure that the ground bus connection splices are installed across all shipping splits.** This ground bus must be solidly connected to the building ground grid. The ground connection is required for proper drive operation. The ground connection is required for personal safety. **THE METAL OF CONDUIT IS NOT AN ACCEPTABLE GROUND.**

Chapter 3: Programming and configuration

Medium-voltage drives application

Introduction

The Medium-Voltage Drives Application enables user-friendly operation, setup, and configuration of the drive.

Motor protection functions in the medium-voltage drive

The Medium-voltage Drives Application provides the following protection functions:

- External fault protection
- Undervoltage protection
- Output phase supervision
- Earth fault protection
- Motor thermal protection
- Fieldbus fault protection
- Slot fault protection

Keypad operation

Figure 1. Keypad and display

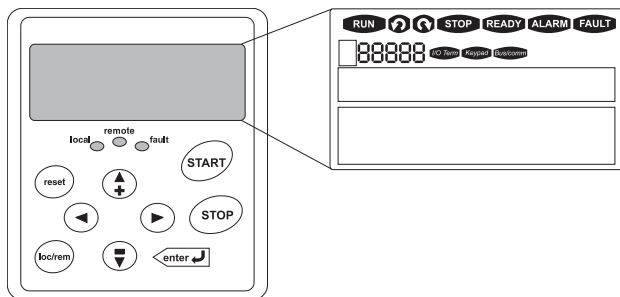










Table 1. LCD status indicators

Indicator	Description
	Run Indicates that the SC9000 EP is running and controlling the load. Blinks when a stop command has been given but the SC9000 EP is still ramping down.
	Counterclockwise operation The output phase rotation is BAC, corresponding to counterclockwise rotation of most motors.
	Clockwise operation The output phase rotation is ABC, corresponding to clockwise rotation of most motors.
	Stop Indicates that the SC9000 EP is stopped and not controlling the load.
	Ready Indicates that the SC9000 EP is ready to be started.
	Alarm Indicates that there is one or more active drive alarm(s).
	Fault Indicates that there is one or more active drive fault(s).
	I/O terminal Indicates that the I/O terminals have been chosen for control.
	Keypad Indicates that the keypad has been chosen for control.
	Bus/communications Indicates that the communications bus control has been chosen for control.

Table 2. LED status indicators

Indicator	Description
Local	Local—steady illumination Indicates that the SC9000 EP is ready to be started and operated from the Local mode. Local—flashing Indicates that the SC9000 EP is ready for operating command to select Local or Remote operation.
Remote	Remote Indicates that the SC9000 EP is operating and controlling the load remotely.
Fault	Fault Indicates that there is one or more active drive fault(s).

Table 3. Navigation buttons

Button	Description
	<p>Start This button operates as the START button for normal operation when the “Keypad” is selected as the active control.</p>
	<p>Enter This button is used in the parameter edit mode to save the parameter setting and move to the next parameter ... To reset the Fault History if pressed while in the “Fault History” menu. To confirm the acceptance of a change. To change a virtual button status while in the “Button” menu. To confirm the start-up list at the end of the Start-Up Wizard. When the “Operate” menu is active, to exit the “Operate” submenu.</p>
	<p>Stop This button has two integrated operations. The button operates as STOP button during normal operation ... Motor STOP from the keypad, which is always active unless disabled by the “StopButtonActive” parameter. Used to reset the active faults.</p>
	<p>Reset Resets the active faults.</p>
	<p>Local / remote Switches between LOCAL and REMOTE control for start, speed reference and reverse functions. The control locations corresponding to local and remote can be selected within an application.</p>
	<p>Left arrow Navigation button, movement to left. In parameter edit mode, exits mode, backs up one step. Cancels edited parameter (exit from a parameter edit mode). When in “Operate” menu will move backward through menu. At end of “Start-Up Wizard”, repeats the “Start-Up Wizard” setup menu.</p>
	<p>Right arrow Navigation button, movement to right. Enter parameter group mode. Enter parameter mode from group mode. When in “Operate” menu will move forward through menu.</p>
	<p>Up and down arrows Move either up or down a menu list to select the desired menu item. Editing a parameter/password, while the active digit/character is scrolled. Increase/decrease the reference value of the selected parameter. In the “Operate” menu, will cause the display of the current reference source and value and allow its change if the keypad is the active reference source. Used to set the password (if defined) when leaving the “Operate” menu. Scroll through the “Active Faults” menu when the SC9000 EP is stopped.</p>

Menu navigation

Navigation tips

- To navigate within one level of a menu, use the up and down arrows
- To move deeper into the menu structure and back out, use the right and left arrows
- To edit a parameter, navigate to show that parameter’s value, and press the right arrow button to enter the edit mode. In edit mode, the parameter value will flash
- When in edit mode, the parameter value can be changed by pressing the up or down arrow keys
- When in edit mode, pressing the right arrow a second time will allow you to edit the parameter value digit by digit
- To confirm the parameter change, you must press the ENTER button. *The value will not change unless the ENTER button is pushed*

Some parameters can not be changed while the SC9000 EP is running. The screen will display LOCKED if you attempt to edit these parameters while the drive is running. Stop the drive to edit these parameters. See the appropriate application manual for identification of these parameters specific to your chosen application.

Note: The following menus represent those in version 5.30C of the firmware. For information on menus for prior or subsequent versions, contact the factory.

9000XDrive

9000XDrive software allows customers another way to program and configure their drive. 9000XDrive allows the customer to monitor, control, and troubleshoot their drive. It contains tools such as monitor window and datalogger to assist customers in using their drives and adjusting parameters as needed from a safer environment. Datalogger allows a customer to capture specific data at certain times, such as a fault condition. For more information on 9000XDrive, see **Chapter 7: Troubleshooting and Fault Tracing**

SC9000 EP V5.0—Configuration menus

Compatibility

Version 5.0 and later applications are compatible with SC9000 EP drives, which include ITG style modulator boards. Version 5.0 and later applications are not intended for earlier non-EP drives. Version 5.0 and later applications require a version 761 or later SPX controller running version NXP0000V179.VCN or later system firmware.

Mappable I/O

SC9000 EP Version 5.0 Mappable I/O provides the flexibility needed to match a wide variety of field applications. The CTB I/O interface provides connection points for customer remote inputs and outputs. The type of connection is dependent on the type of I/O device. Turck output connections are power feed and relay. Customer connections are made on the CTB (Customer Terminal Block).

Module configuration is viewable and settable from the keypad or 9000XDrive. For detail on I/O, refer to **Figure 2** below and in **Chapter 5**.

Figure 2. I/O Configurations

I/O - SC9000EP VCN 5.30C Series			
LABEL	DWG ID	FUNCTION	TYPE
O1A	MCO	MainCooling	2DO-R-CO
O1B	RCX	RedunCooling (Option)	2DO-R-CO
O2A	WRN	WarningInd	2DO-R-CO
O2B	FLT	FaultInd	2DO-R-CO
O3A	RLY1	Programmable Outputs	2DO-R-CO
O3B	RLY2		2DO-R-CO
O4A	RLY3		2DO-R-CO
O4B	RLY4		2DO-R-CO
O5A	OCX		OutContMaint (Option)
O5B	-	SPARE	2DO-R-CO
O6A	STA	STSyncAck (Option)	2DO-R-CO
O6B	STB	STBypass (Option)	2DO-R-CO
O7A	EXR	SFExciterRun (Option)	2DO-R-CO
O7B	-	SPARE	2DO-R-CO
A1A	RTD5	XfmrCoil	2 AI - PT / NI
A1B	-	SPARE	2 AI - PT / NI
A2A	RTD3	Rec1Temp	2 AI - PT / NI
A2B	RTD4	Rec2Temp	2 AI - PT / NI
A3A	RTD6	Inlet2Temp	2 AI - PT / NI
A3B	RTD7	Exhau2Temp	2 AI - PT / NI
A4A	-	Analog Out	2 AO I(4-20MA)
A4B	-	Analog Out	2 AO I(4-20MA)
I1A	UPR	UPSReady	2DI 24VDC INPUT
I1B	URB	UPSReplBatt	2DI 24VDC INPUT
PF0	PF0	POWER FEED MODULE	PDF 120VAC
I2A	PMR	PhaseMonitor	2DI 120VAC INPUT
I2B	MCS	MainContStatus	2DI 120VAC INPUT
I3A	ESTA	EstopAux	2DI 120VAC INPUT
I3B	XTF	XfmrOverTempFLT	2DI 120VAC INPUT
I4A	XTA	XfmrTempAmb	2DI 120VAC INPUT
I4B	VAC	120VACPF0	2DI 120VAC INPUT
I5A	MCO	MainCoolingOn	2DI 120VAC INPUT
I5B	RTF	RectOverTempFLT (Option)	2DI 120VAC INPUT
I6A	RCC	RedunCoolingOn (Option)	2DI 120VAC INPUT
I6B	TFR	STTransferGo (Option)	2DI 120VAC INPUT
I7A	SU	STSyncUp (Option)	2DI 120VAC INPUT
I7B	SD	STSyncDown (Option)	2DI 120VAC INPUT
I8A	FTT	FilterInclOT (Option)	2DI 120VAC INPUT
I8B	FCP	FilterCapOP (Option)	2DI 120VAC INPUT
I9A	BRT	BalanceReactorOT (Option)	2DI 120VAC INPUT
I9B	OCS	OutContStatus (Option)	2DI 120VAC INPUT

Quick start

Choose a mode of operation:

Parameter P1.6.1 motor control mode

- 0 = Frequency Control
- 1 = Open Loop Speed
- 2 = Open Loop Torque
- 3 = Closed Loop Speed
- 4 = Closed Loop Torque

Frequency control

Easy to set up, does not require motor ID run, speed control least accurate, slip is not controlled, in some cases greater slip is an advantage on regenerative loads; it helps the drive avoid over-charging the bus on deceleration. Torque capability is low, less than 150%. This mode is best for pumps and fans or any non-speed critical application requiring less than 150% torque, and is the recommended starting point for most applications.

Open loop speed/torque

Setup slightly more complicated, requires a motor ID run or manual entry of magnetization current. Slip compensation possible through motor model speed estimate. Speed control more accurate than V/H mode. Torque up to 150%. This mode is good for higher torque requirements such as mixers or other loads with high static friction at start-up, and slightly more sensitive to overcharging of bus on deceleration.

Closed loop speed/torque

Setup is complex. *Motor ID run and shaft encoder required.* Tuning usually required. Extremely accurate speed control, high torque to 200%. Zero speed control at full torque.

Note that two types of motor identification runs are possible:

- ID with Run
- ID without Run

The best way to perform an ID run is 'ID with Run', and requires that the motor shaft be disconnected from the load. If this is not possible, an "ID without Run" may be substituted, but is not as accurate. See parameter P1.6.12 for details.

⚠ CAUTION

Do not perform motor ID run when the SC9000 EP drive is configured with an output SINE filter.

Basic setup

1. Map the remote I/O—this is always done at factory. Changes are sometimes required in the field.
2. **Reboot the entire control rack.** This step only needs to be performed one time. Ensure that the SPX controller does not return an FCODE 91 'CANMaster' or FCODE 92 'CANFollower' fault on power up. If these faults occur, refer to **Table 12** recommendations and check CAN wiring between SPX and modulator boards. The unpowered line impedance from CAN HI to CAN LO must be 60 to 120 ohms.
3. Verify a Green status LED on the Turck communication adapter (Bus). The LED should turn green approximately 12 seconds after power-up. If the LED does not turn green, check the parameters of the OPTD2 or OPTD6 in slot B. The CAN mode parameter should be set to 'CAN OPEN', and the BAUD rate set to 125K Baud. If the parameters are OK, check the wiring; the unpowered line impedance from CAN HI to CAN LO must be 60 to 120 ohms. The system will NOT function properly if this LED is ORANGE.
4. If the I/O system is properly configured, all faults on the SPX and controller boards should clear when the reset button on the keypad is pressed. ITG controller cards should indicate 'Stopped'.
5. Configure Basic Parameters. Use data found on motor name plate.

Parameter menus (referenced to VCN 5.30)**G1.1 Basic parameters****P1.1.1 Nominal Inverter Voltage**

Selects the nominal inverter voltage of the drive.

- 1 = 4160
- 2 = 3300
- 3 = 2400

P1.1.2 Minimum Frequency

Sets the minimum frequency at which the drive will run when given a run command. The drive will ramp to this frequency at the ramp rate given from P1.1.4 'Acceleration Time' on receipt of a run command and not go below that frequency until the run command is released.

P1.1.3 Maximum Frequency

Sets the minimum frequency at which the drive will run when given a run command under normal operating conditions (regulator or limits are not active).

P1.1.4 Acceleration Time

Sets the time in seconds for the drive to ramp from 0 Hz to maximum frequency.

P1.1.5 Deceleration Time

Set the time in seconds for the drive to ramp from maximum frequency given in P1.1.3 to 0 Hz.

P1.1.6 Current Limit

Sets the user configurable current limit. The drive will alter certain behaviors such as acceleration time based on this parameter. For example, if the current limit is reached while accelerating, the motor regulator will inhibit the ramp rate to keep the current below the limit entered for this parameter.

P1.1.7 Motor Nominal Voltage

Set the motor nominal voltage at rated speed.

P1.1.8 Motor Nominal Frequency

Sets the motor nominal frequency at rated speed.

P1.1.9 Motor Name Plate RPM

Sets the motor nominal speed at rated speed.

P1.1.10 Motor Cosine Phi

Rated power factor of the motor from nameplate.

P1.1.11 Motor Nominal Current

Rated full load motor current from nameplate.

P1.1.12 Local Control Place

Sets the control place used when drive is in local mode.

P1.1.13 Remote Control Place

Sets the control place used when drive is in remote mode.

P1.1.14 Local Reference

Sets the source of the speed reference when the drive is in local mode.

P1.1.15 Remote Reference

Sets the source of the speed reference when the drive is in remote mode.

P1.1.16 Preset Speed1

Set point for speed used when the PresetSpeed1 input is made active.

P1.1.17 Preset Speed2

Set point for speed used when the PresetSpeed2 input is made active.

P1.1.18 Preset Speed3

Set point for speed when the PreSetSpeed1 and PreSetSpeed2 input are both made active.

P1.1.19 Main Contactor Control Mode

0 = Normal

The main contactor will open immediately on a stop condition.

1 = Timed Released

The main contactor will remain closed for the number of seconds specified 'Main Contactor Holding Time' (parameter P1.1.21) on a stop condition. Note: The main contactor will open immediately on a fault condition.

P1.1.20 PreCharge Time

The minimum amount of time the SC9000 either DC pre-charges the capacitor link or AC soft-mags the system.

P1.1.21 Main Contactor Hold Time

Specifies the number of seconds the main contactor will remain closed when the main contactor mode is set to 'Timed Release'.

P1.1.22 MotorCount

Setting this parameter to a value of 2 activates a supplementary parameter menu allowing for the entry of parameters for a second motor. The second motor is selected by a digital input mapped to remote I/O or DIN3-6. Selection of the motor by digital I/O must be done when the drive is stopped. If the motor selection input is changed while the motor is running, the second set of motor parameters will become active on the next stop/run cycle.

G 1.1.21 MOTOR 2

P1.1.23.1 Minimum Frequency

Sets the minimum frequency at which the drive will run when given a run command. The drive will ramp to this frequency at the ramp rate given from P1.1.23.3 'Acceleration Time' on receipt of a run command and not go below that frequency until the run command is released.

P1.1.23.2 Maximum Frequency

Sets the minimum frequency at which the drive will run when given a run command under normal operating conditions (regulator or limits are not active).

P1.1.23.3 Acceleration Time

Sets the time in seconds for the drive to ramp from 0 Hz to maximum frequency.

P1.1.23.4 Deceleration Time

Set the time in seconds for the drive to ramp from maximum frequency given in p1.1.23.2 to 0 Hz.

P1.1.23.5 Current Limit

Sets the user configurable current limit. The drive will alter certain behaviors such as acceleration time based on this parameter. For example, if the current limit is reached while accelerating, the motor regulator will inhibit the ramp rate to keep the current below the limit entered for this parameter.

P1.1.23.6 Motor Nominal Voltage

Set the motor nominal voltage at rated speed.

P1.1.23.7 Motor Nominal Frequency

Sets the motor nominal frequency at rated speed.

P1.1.23.8 Motor Name Plate RPM

Sets the motor nominal speed at rated speed.

P1.1.23.9 Motor Nominal Current

Rated full load motor current from nameplate.

P1.1.23.10 Motor Cosine Phi

Rated power factor of the motor from nameplate.

G1.2 Input Signals**P1.2.1 Start/Stop Logic**

Selects the logic used by DIN1 and DIN2 used to start and stop the drive.

- 0 = Forward – Reverse
- 1 = Start – Reverse
- 2 = Start – Enable
- 3 = StartP – Stop Pulse
- 4 = ForwR – RevR
- 5 = StartR – Rev
- 6 = StartR = Enable

- 0 = DIN1 is forward RUN, DIN2 is reverse Run
- 1 = DIN1 is RUN, DIN2 is direction (reverse when active)
- 2 = DIN1 is RUN, DIN2 is enable (enable when active)
- 3 = DIN1 is Latched RUN, DIN2 is normally closed STOP (emulates three-wire control).
- 4 = DIN1 is Forward RUN, DIN2 is Reverse Run
- 5 = DIN1 is RUN, DIN2 is direction (reverse when active; rising edge required to start)
- 6 = DIN1 is RUN, DIN2 is enable (enable when active; rising edge required to start)

P1.2.2 DIN3 Function

Sets the function mapped to digital input 3 on the OPTA9 card in slot A.

Available functions:

- 0 = None
- 1 = External Fault Close
- 2 = External Fault Open
- 3 = Run Enable
- 4 = Acceleration/Deceleration Time
- 5 = Force Local
- 6 = Force Remote
- 7 = Reverse
- 8 = Overload Relay
- 9 = Motor Pot Up
- 10 = Motor Pot Down
- 11 = PID Control Active
- 12 = Fault Reset
- 13 = Preset Speed1
- 14 = PreSet Speed2
- 15 = SyncField
- 16 = Sync Up
- 17 = Sync Down
- 18 = Transfer Go
- 19 = Motor Select

P1.2.3 DIN4 Function

Sets the function mapped to digital input 4 on the OPTA9 card in slot A. Mapping is the same as DIN3.

P1.2.4 DIN5 Function

Sets the function mapped to digital input 5 on the OPTA9 card in slot A. Mapping is the same as DIN3.

P1.2.5 DIN6 Function

Sets the function mapped to digital input 6 on the OPTA9 card in slot A. Mapping is the same as DIN3.

P1.2.6 DIN3 Terminal Select

Parameter to connect hardware terminal to DIN3 function. Slot and index (e.g., DIN3 default is 12 for Slot A DIN3). Terminal to function programming TTF. TTF programming uses Terminal Type (DigIn, AnIn, or AnOut): Slot (A,B,C,D,E). Terminal Number (0,1..9) format. Pushing the right arrow key several times presents a single or double numeric entry coded in the same manner.

P1.2.7 DIN4 Terminal Select

Parameter to connect hardware terminal to DIN4 function. Slot and index. Terminal to function programming TTF.

P1.2.8 DIN5 Terminal Select

Parameter to connect hardware terminal to DIN5 function. Slot and index. Terminal to function programming TTF.

P1.2.9 DIN6 Terminal Select

Parameter to connect hardware terminal to DIN6 function. Slot and index. Terminal to function programming TTF.

P1.2.10 Current Reference Offset

Offset for current input. 0 = No offset: 0—20 mA, 1 = Offset 4 mA (“living zero”), provides supervision of zero level signal.

P1.2.11 Reference Scale Minimum Value

0 = scaling off. Greater than 0 sets the minimum scaling value.

P1.2.12 Reference Scale Maximum Value

Sets the maximum scaling value. Must be greater than p1.2.7

P1.2.13 Reference Invert

Inverts reference signal:
 Max. ref. signal = Min. set freq.
 Min. ref. signal = Max. set freq.
 0 = No inversion
 1 = Reference inverted

P1.2.14 Reference Filter Time

Filters out disturbances from the incoming analogue signal. Long filtering time makes regulation response slower.

P1.2.15 AI1 Signal Select

Connects the AI1 signal to the analogue input using TTF programming (Signal Type:Slot.TerminalNumber).

P1.2.16 AI2 Signal Select

Connects the AI2 signal to the analogue input with TTF programming.

P1.2.17 AI3 Signal Select

Connects the AI3 signal to the analogue input with TTF programming.

P1.2.18 Motor Potentiometer Reference Memory

- 0 = No reset
- 1 = Memory reset in stop

Note: Pot reference is reset to 0 on power-cycle of the SPX controller.

G1.3 Output Signals

P1.3.1 Iout 1 Signal

Connects the AO1 signal to the analogue output of your choice with this parameter.

P1.3.2 Iout Content

This parameter selects the desired function for the analogue output signal.

P1.3.3 Iout Filter Time

Defines the filtering time of the analogue output signal. Setting this parameter value 0 will deactivate filtering.

P1.3.4 Iout Invert

Inverts the analogue output signal:
Maximum output signal = Minimum set value
Minimum output signal = Maximum set value

P1.3.5 Iout Minimum

Defines the signal minimum to either 0 mA or 4 mA (living zero). 0 Sets the minimum value to 0 mA. 1 sets the minimum value to 4 mA.

P1.3.6 Iout Scale

Scaling factor for analogue output.

P1.3.7 Frequency Supv Lim 1

- 0 No supervision
- 1 Low limit supervision
- 2 High limit supervision

P1.3.8 Frequency Suv Val 1

Selects the frequency value supervised by p1.3.7.

P1.3.9 Iout 2 Signal

Connects the AO2 signal to the analogue output of your choice with this parameter.

P1.3.10 Iout 2 Content

This parameter selects the desired function for the analogue output signal from the following list.

Available functions:

- 0 = None
- 1 = Output Frequency
- 2 = Frequency Reference
- 3 = Motorspeed
- 4 = Motorcurrent
- 5 = Motor Torque
- 6 = Motor Power
- 7 = Motor Voltage
- 8 = DC Voltage
- 9 = Synchronous Field Reference
- 10 = Software Torque Reference

Analogue Output Descriptions:

- 0 = Nothing
Turns the channel off, mapping it to nothing.
- 1 = Output Frequency
The output frequency currently being used.
- 2 = Frequency Reference
The frequency reference currently being used.
- 3 = Motorspeed
The present motor current (based on RPM).
- 4 = Motorcurrent
The present motor current based on current scale and full scale amps.
- 5 = Motor Torque
The present motor torque based on +/-300% and full scale.
- 6 = Motor Power
The present motor power based on +/-300% and full scale.
- 7 = Motor Voltage
The present motor voltage based on 10000 full scale counts, 1 count = 1 volt.
- 8 = DC Voltage
The present DC bus voltage based on 10000 full scale counts, 1 count = 1 volt.
- 9 = Synchronous Field Reference
Field reference signal for synchronous motor excitation.
- 10 = Software Torque Reference
Used in special applications (e.g., Master/Follower drive tandems).

P1.3.11 Iout 2 Filter Time

Defines the filtering time of the analogue output signal. Setting this parameter value 0 will deactivate filtering.

P1.3.12 Iout 2 Invert

Inverts the analogue output signal:
 Maximum output signal = Minimum set value
 Minimum output signal = Maximum set value

P1.3.13 Iout 2 Minimum

Defines the signal minimum to either 0 mA or 4 mA (living zero). 0 Sets the minimum value to 0 mA. 1 sets the minimum value to 4 mA.

P1.3.14 Iout 2 Scale

Scaling factor for analogue output.

P1.3.15 Iout 3 Signal

Connects the AO3 signal to the analogue output of your choice with this parameter.

P1.3.16 Iout 3 Content

This parameter selects the desired function for the analogue output signal from analog output list above.

P1.3.17 Iout 3 Filter Time

Defines the filtering time of the analogue output signal. Setting this parameter value 0 will deactivate filtering.

P1.3.18 Iout 3 Invert

Inverts the analogue output signal:
 Maximum output signal = Minimum set value
 Minimum output signal = Maximum set value

P1.3.19 Iout 3 Minimum

Defines the signal minimum to either 0 mA or 4 mA (living zero). 0 Sets the minimum value to 0 mA. 1 sets the minimum value to 4 mA.

P1.3.20 Iout 3 Scale

Scaling factor for analogue output.

G1.4 Drive Control**P1.4.1 Ramp 1 Shape**

The start and end of acceleration and deceleration ramps can be smoothed with this parameter as well as P1.4.2 parameters. Setting value 0 gives a linear ramp shape which causes acceleration and deceleration to act immediately to the changes in the reference signal. Setting value 0.1...10 seconds for this parameter produces an S-shaped acceleration/deceleration.

P1.4.2 Ramp 2 Shape

See P1.4.1 above.

P1.4.3 Acceleration Time 2

This parameter and P1.4.4 values correspond to the time required for the output frequency to accelerate from the zero frequency to the set maximum frequency (P1.1.3). These parameters give the possibility to set two different acceleration/deceleration time sets for one application.

P1.4.4 Deceleration Time 2

See P1.4.3 above.

P1.4.5 Start Function

Ramp: 0 The frequency converter starts from 0 Hz and accelerates to the set reference frequency within the set acceleration time. (Load inertia or starting friction may cause prolonged acceleration times).

Flying start: 1 The frequency converter is able to start into a running motor by applying a small torque to motor and searching for the frequency corresponding to the speed the motor is running at. Searching starts from the maximum frequency towards the actual frequency until the correct value is detected. Thereafter, the output frequency will be increased/decreased to the set reference value according to the set acceleration/deceleration parameters. Use this mode if the motor is coasting when the start command is given. With the flying start it is possible to ride through short mains voltage interruptions.

CAUTION

Do not set P1.4.5 to 1 Flying Start when an output SINE filter is connected to SC9000 drive. However, a dv/dt output filter is compatible with this starting algorithm.

P1.4.6 Stop Function

Coasting: 0 The motor coasts to a halt without any control from the frequency converter, after the Stop command.

Ramp: 1 After the Stop command, the speed of the motor is decelerated according to the set deceleration parameters. If the regenerated energy is high it may be necessary to use an external braking resistor for faster deceleration.

Normal stop: Ramp/ Run Enable stop: coasting 2 After the Stop command, the speed of the motor is decelerated according to the set deceleration parameters. However, when Run Enable is selected, the motor coasts to a halt without any control from the frequency converter.

Normal stop: Coasting/ Run Enable stop: ramping 3 The motor coasts to a halt without any control from the frequency converter. However, when Run Enable signal is selected, the speed of the motor is decelerated according to the set deceleration parameters. If the regenerated energy is high it may be necessary to use an external braking resistor for faster deceleration.

P1.4.7 Flux Brake

Enable/Disable

P1.4.8 Flux Brake Current

Parameter to set the amount of flux braking current in amps. The 9000XDrive signals 'fluxcurrent' and 'freqout' can be monitored to demonstrate its effectiveness in slowing the machine. The resulting energy is absorbed in the machine, which requires user discretion.

P1.4.9 Fly Start Options

Word to control fly-start options, bit values as listed:
B0 – Disable movement in reverse direction.
B1 – Disable AC scanning.
B2 - Disable fly brake phase.
B3 - Use encoder data for frequency measurement.
B4 – Use frequency reference for initial guess.
B5 - Disable DC scanning for step-up application.

G1.5 Prohibit Frequency

Used to avoid certain frequencies because of mechanical resonance problems. With the following parameters it is possible to set limits for the "skip frequency" region.

P1.5.1 Range 1 High Limit

High limit for frequency range that is to be skipped.

P1.5.2 Range 1 Low Limit

Low limit for frequency range that is to be skipped.

P1.5.3 Range 2 High Limit

High limit for frequency range that is to be skipped.

P1.5.4 Range 2 Low Limit

Low limit for frequency range that is to be skipped.

P1.5.5 Range 3 High Limit

High limit for frequency range that is to be skipped.

P1.5.6 Range 3 Low Limit

Low limit for frequency range that is to be skipped.

P1.5.7 PH Acc/Dec Ramp

Defines the acceleration/deceleration time when the output frequency is between the selected prohibit frequency range limits (P1.5.1 and P1.5.6). The ramping speed (selected acceleration/ deceleration time 1 or 2) is multiplied with this factor. E.g. value 0.1 makes the acceleration time 10 times shorter than outside the prohibit frequency range limits.

G1.6 Motor Control

P1.6.1 Motor Control Mode

0 = Frequency Control
1 = Open Loop Speed
2 = Open Loop Torque
3 = Closed Loop Speed
4 = Closed Loop Torque

P1.6.2 U/f Optimization

Auto torque boost in case of open loop control operation can be enabled with parameter.

0 = None
1 = Auto torque boost (Auto torque boost is enabled).

It is recommended to enable auto torque boost only if successful ID run is performed during the commissioning.

P1.6.3 U/f Ratio Select

Select the U/f ratio in case of open loop control operation.

0 = Linear
1 = Squared
2 = Programmable

Parameters P1.6.8 U/f zero point voltage, P1.6.7 U/f mid point voltage, P1.6.6 U/f mid point frequency are required to be adjusted in this selection. If the ID run is successfully done, those parameter are set to their optimum values.

P1.6.4 Field Weakening Point

The field weakening point is the output frequency at which the motor voltage reaches the value of P1.6.5, Voltage at FWP. This parameter is applicable during open loop control of the motor. Normally this parameter is set equal to motor nominal frequency.

P1.6.5 Voltage at Field Weakening Point

Percentage value of the motor voltage at the field weakening point. Above the field weakening point frequency the voltage remains to the value set by this parameter. This parameter is applicable during open loop control of the motor. Normally this parameter is set to 100.00% of motor nominal voltage.

P1.6.6 U/f Midpoint Frequency

Mid point frequency reference in case of programmable U/f curve. This can be set as (U/f zero point voltage * Motor nominal frequency) /100.

P1.6.7 U/f Midpoint Voltage

Motor voltage as a percentage of motor nominal voltage at frequency reference equal to U/f mid point frequency. This can be set as 1.41 * U/f zero point voltage.

P1.6.8 Zero Frequency Voltage

Motor voltage as a percentage of motor nominal voltage at zero frequency reference. This can be set to produce motor current equal to 80...100% of nominal magnetizing current at zero frequency reference.

P1.6.9 Over Voltage Control

Overvoltage controller can be activated with this parameter.

0 = Off

1 = On, no ramp. Overvoltage controller is P type controller.

2 = On with ramp. Overvoltage controller is PI type controller.

The drive corrects the frequency reference internally when the DC link voltage rises above 118% of nominal. Bit 4 of 'motorregulatorstatus' goes HIGH when OV Control is active. This signal can be monitored along with the DC bus voltage in 9000XDrive. OV control is typical during certain periods of ramp stop.

P1.6.10 Under Voltage Control

Enables under voltage controller, 0= disabled, 1= enabled. Default is enabled.

P1.6.11 Load Drooping

Load drooping as a percentage of nominal speed at nominal torque. Load drooping allows the static speed error as a function of a load torque. For e.g. If Load drooping is set as 10% then for 100% motor torque the drive will allow actual speed less than 10% nominal speed of the motor. It can be used to smoothen out the load torque variation or also to share the load torque between the two drive systems when the coupling between the drive systems is not rigid.

P1.6.12 Identification

This parameter defines the different modes of the automatic motor identification run. Set the parameter and give the run command within 30 seconds to activate the identification.

The parameter is reset to zero (none) after the identification is complete. In case of failure, Alarm 57 Identification is generated.

0 = None

1 = Identification without motor running

The identification is performed with motor at standstill. In this mode motor stator resistance and parameters for U/F curve are identified. At the end of the identification, the parameter P1.6.3 U/f Ratio Select is set equal to 2 (programmable). This Identification mode is used when it is not possible to decouple the motor from the gearbox and load. The identification optimizes the performance for open loop motor control mode.

After the successful identification B0 of variable ID Run Status is Set.

2 = Identification with motor running

The identification is performed with motor running. It is recommended to decouple the motor from the gearbox and the load. In addition to the motor parameters for open loop motor control, magnetizing current (P1.6.13.1) and flux linearization curve (P1.6.14.1 through P1.6.14.15) are identified.

After the successful identification B0, B2 and B3 of variable ID Run Status is Set.

3 = Encoder ID

The motor may rotate during the identification. The function is primarily used to identify the shaft zero position for PMSM motor when absolute encoder is used.

4 = Magnetization current calculation

In this identification, the magnetization current of the motor for a given motor data (P1.6.13.1) is calculated.

Note: The motor is not subjected to any voltage or current. Giving a run command.

G1.6.13 Closed Loop**P1.6.13.1 Magnetization Current**

Sets the nominal magnetizing current for the motor corresponding to 100% flux. The value of the parameter (if not known) can be found out by performing following test on the motor. Note that the motor must be decoupled from the gearbox and the load while doing the following test.

- Set all the nameplate parameters of the motor P1.1.1 through P1.1.11.
- Set P1.6.1 Motor Ctrl Mode = 0 (Open Loop Frequency control)
- Run the motor with no load on the shaft with approx. $0.66 \times \text{Rated Frequency}$ (33 Hz for 50 Hz motor)
- Wait for 10 seconds and then note the value of signal Motor Current
- Set this value to P1.6.13.1 Magnetizing Current

P1.6.13.2 Speed Control Kp

Gain for the speed controller in closed loop motor control operation. Gain value 100 means nominal torque reference is produced at the speed controller output for the frequency error of 1 Hz.

P1.6.13.3 Speed Control Ki

Integral time constant in ms for the speed controller in closed loop motor control operation.

P1.6.13.4 Reserved

P1.6.13.5 Accel Compensation

Time constant for the acceleration compensation of the fixed inertia of the drive system in closed loop motor control operation. It can be calculated as follows.

$$\text{AccelCompensationTC} = J \frac{2\pi f_{\text{nom}}}{T_{\text{nom}}} = J \frac{(2\pi f_{\text{nom}})^2}{P_{\text{nom}}}$$

Where:

J = total system inertia in kg*m²

f_{nom} = motor nominal frequency in Hz

T_{nom} = motor nominal torque

P_{nom} = motor nominal power in kW

The final I_q reference is added with additional I_q reference P1.6.13.5 Acceleration compensation Out proportional to inertia torque during acceleration deceleration. Note that fixed inertia such as motor inertia, gear box inertia, basic roll inertia can be compensated with this parameter.

P1.6.13.6 Slip Adjust

This parameter can be tuned to compensate for inaccuracies in the motor nominal speed data on the motor nameplate. Also the Rotor time constant estimated by the motor model can be adjusted with this parameter. The rotor time constant varies with the motor temperature.

P1.6.13.7 Start Magnetization Current

Defines the current that is applied to motor when the start command is given in Closed Loop control mode. At start this parameter is used together with p1.6.13.8 to decrease the time before the motor is able to produce maximum torque.

P1.6.13.8 Start Magnetization Time

Defines the time for how long the magnetization current p1.6.13.7 is applied to the motor at start. The magnetizing current at start is used in order to premagnetize the motor before running. This will improve the torque performance at start. The time needed depends on the size of the motor. The parameter value varies from 100 ms to 3 seconds. The bigger the motor the more time is needed

P1.6.13.9 Start Zero Speed Time

After giving the start command the drive will remain at zero speed for the time defined by this parameter. The speed will be released to follow the set frequency/ speed reference after this time has elapsed from the instant where the command is given.

P1.6.13.10 Stop 0 Speed Time

The drive will remain at zero speed with controllers active for the time defined by this parameter after reaching the zero speed when a stop command is given. This parameter has no effect if the selected stop function p1.4.6 is Coasting. The zero speed time starts when the ramp time is expected to reach zero speed.

P1.6.13.11 Startup Torque

Choose here the startup torque.

0 = Not Used

1 = Torque Memory

2 = Torque Reference

3 = Torque FWD/REV

P1.6.13.12 Startup Torque FWD

Sets the start-up torque for forward direction if selected with p1.6.13.11.

P1.6.13.13 Startup Torque REV

Sets the start-up torque for reverse direction if selected with p1.6.13.11.

P1.6.13.14 Encoder1 Filter Time

Sets the filter time constant for speed measurement. The parameter can be used to eliminate encoder signal noise. Too high a filter time reduces speed control stability.

P1.6.13.15 Closed Loop Over Voltage Reference

Maximum voltage allowed before over-voltage trip when in closed loop mode.

P1.6.13.16 Closed Loop Over Voltage Protection Enabled

Enable/disable over-voltage control in closed loop mode only.

P1.6.13.17 Closed Loop Over Voltage Droop

Use this function when a balanced load is necessary for mechanically connected motors.

G1.6.14 Identification

P1.6.14.1 – P1.6.14.24 Reserved

P1.6.15 Voltage Control

Reserved.

P1.6.16 Make Flux Time

Amount of time fluxing is established on start, default 200 milliseconds.

P1.6.17 Make Flux Voltage

Amount of voltage as a percentage of nominal motor voltage applied during flux period.

P1.6.18 Make Flux Hardware Dead-Time

Reserved.

G1.7 Protections

P1.7.1 4 mA Input Fault

- 0 = No response
- 1 = Warning
- 2 = Warning, the frequency from 10 seconds back is set as reference
- 3 = Warning, the 4 mA fault frequency is set as reference as based on p1.7.2
- 4 = Fault, stop mode according to p1.4.6
- 5 = Fault, stop mode after fault always by coasting

P1.7.2 4 mA and FB Fault Frequency

If the value of parameter p1.7.1 is set to 3 and the 4 mA fault occurs then the frequency reference to the motor is the value of this parameter.

P1.7.3 External Fault

- 0 = No response
- 1 = Warning
- 2 = Fault, stop mode after fault according to p1.4.6
- 3 = Fault, stop mode after fault always by coasting

P1.7.4 External Fault Delay

0 to 2 Minute (120 Second) Delay for External Fault P1.7.3 established as DIN inputs.

P1.7.5 Input Phase Supv

- 0 = No response
- 1 = Warning
- 2 = Fault, stop acc. to p1.4.6
- 3 = Fault, stop by coasting

P1.7.6 Under Voltage Fault Response

- 0 = Fault stored in history
- 1 = Fault not stored

P1.7.7 UV Reference Select

- 0 = Programmable
- 1 = 80% of Nominal

P1.7.8 UV Ref Minimum

Minimum UV Reference (compared to nominal 685V bus).

P1.7.9 UV Ref Maximum

Maximum Reference (compared to nominal 685V bus).

P1.7.10 Output Phase Superv

- 0 = No response
- 1 = Warning
- 2 = Fault, stop acc. to p1.4.6
- 3 = Fault, stop by coasting

Output phase supervision of the motor ensures that the motor phases have an approximately equal current.

P1.7.11 Earth Fault

- 0 = No response
- 1 = Warning
- 2 = Fault, stop acc. to p1.4.6
- 3 = Fault, stop by coasting

Earth fault protection ensures that the sum of the motor phase currents is zero.

P1.7.12 Motor Therm Prot

- 0 = No response
- 1 = Warning
- 2 = Fault, stop acc. to p1.4.6
- 3 = Fault, stop by coasting

Deactivating the protection, i.e., setting parameter to 0, will reset the thermal stage of the motor to 0%.

P1.7.13 Motor Ambient Temperature Factor

The factor can be set between -100.0% — 100.0% where $-100.0\% = 0\text{ }^{\circ}\text{C}$, $0.0\% = 40\text{ }^{\circ}\text{C}$, $100.0\% = 80\text{ }^{\circ}\text{C}$

P1.7.14 MTP F0 Crrnt

Defines the cooling factor at zero speed in relation to the point where the motor is running at nominal speed without external cooling.

P1.7.15 MTP Motor T

This time can be set between 1 and 200 minutes. This is the thermal time constant of the motor. The bigger the motor, the bigger the time constant. The time constant is the time within which the calculated thermal stage has reached 63% of its final value.

P1.7.16 Motor Duty Cycle

The value can be set to 0% ...150%.

P1.7.17 Stall Protection

- 0 = No response
- 1 = Warning
- 2 = Fault, stop acc. to p1.4.6
- 3 = Fault, stop by coasting

P1.7.18 Stall Current

The current can be set to $0.0\text{...}2\text{*IH}$. For a stall stage to occur, the current must have exceeded this limit.

P1.7.19 Stall Time Limit

This time can be set between 1.0 and 120.0 s.

This is the maximum time allowed for a stall stage. The stall time is counted by an internal up/down counter. If the stall time counter value goes above this limit the protection will cause a trip.

P1.7.20 Stall Frequency Limit

The frequency can be set between 1-fmax. For a stall state to occur, the output frequency must have remained below this limit for a certain time.

P1.7.21 Underload Protec

- 0 = No response
- 1 = Warning
- 2 = Fault, stop acc. to p1.4.6
- 3 = Fault, stop by coasting

If tripping is set active the drive will stop and activate the fault stage. Deactivating the protection by setting the parameter to 0 will reset the underload time counter to zero.

P1.7.22 UP fnom Torque

The torque limit can be set between

10.0–150.0% x TnMotor. This parameter gives the value for the minimum torque allowed when the output frequency is above the field weakening point.

P1.7.23 UP f0 Torque

The torque limit can be set between 5.0–150.0% x TnMotor. This parameter gives value for the minimum torque allowed with zero frequency.

P1.7.24 UP Time Limit

This time can be set between 2.0 and 600.0 s. This is the maximum time allowed for an underload state to exist. An internal up/down counter counts the accumulated underload time. If the underload counter value goes above this limit the protection will cause a trip according to p1.7.17.

P1.7.25 Thermistor F. Response

- 0 = No response
- 1 = Warning
- 2 = Fault, stop acc. to p1.4.6
- 3 = Fault, stop by coasting

P1.7.26 Voltage Loss Delay Time

Sets the time for voltage loss from 1 second to 30 seconds.

P1.7.27 FB Comm. Fault Response

Set here the response mode for the fieldbus fault if a fieldbus board is used.

P1.7.28 Slot Com Fault Response

Set here the response mode for a board slot fault due to missing or broken board.

P1.7.29 E-Stop Stop Mode

- 0 = Coast
- 1 = Use Stop Mode P1.4.6
- 2 = Ramp

P1.7.30 Fault Inhibit Register 1

Reserved.

P1.7.31 Fault Inhibit Register 2

Reserved.

P1.7.32 Fault Inhibit Register 3

Reserved.

P1.7.33 Fault Inhibit Register 4

Reserved.

G1.8 Auto Restart

P1.8.1 Wait Time

Specifies the amount of time that will elapse between the fault condition clearing and the drive restarting.

P1.8.2 Trial Time

Specifies the amount of time allowed for auto-restart attempts, before the drive will declare a hard fault.

P1.8.3 Start Function

Specifies the method used to restart the drive, such as ramp, fly-start, or system defined.

P1.8.4 Undervoltage Fault Tries

Specifies the number of times to repeat the time the **Undervoltage** fault condition is allowed and restart attempted, within the trial time window. If the condition persists longer than the trial time and fails to clear, at hard fault occurs.

P1.8.5 Overvoltage Fault Tries

Specifies the number of times to repeat the time the **Overvoltage** fault condition is allowed and restart attempted, within the trial time window. If the condition persists longer than the trial time and fails to clear, at hard fault occurs.

P1.8.6 Overcurrent Fault Tries

Specifies the number of times to repeat the time the **Overcurrent** fault condition is allowed and restart attempted, within the trial time window. If the condition persists longer than the trial time and fails to clear, at hard fault occurs.

P1.8.7 4ma fault Tries

Specifies the number of times to repeat the time the **4ma fault** fault condition is allowed and restart attempted, within the trial time window. If the condition persists longer than the trial time and fails to clear, at hard fault occurs.

P1.8.8 Motor Temperature Fault Tries

Specifies the number of times to repeat the time the **Motor Temperature** fault condition is allowed and restart attempted, within the trial time window. If the condition persists longer than the trial time and fails to clear, at hard fault occurs.

P1.8.9 External Fault Tries

Specifies the number of times to repeat the time the **External Fault** fault condition is allowed and restart attempted, within the trial time window. If the condition persists longer than the trial time and fails to clear, at hard fault occurs.

P1.8.10 Underload Fault Tries

Specifies the number of times to repeat the time the **Underload** voltage fault condition is allowed and restart attempted, within the trial time window. If the condition persists longer than the trial time and fails to clear, at hard fault occurs.

G1.9 PID Control**P1.9.1 Enable PID-Ctrl**

Allows for control by the PID. 0 for No, 1 for yes.

P1.9.2 PID Units

Sets the units for the PID to use. Default is 0/ percent.

P1.9.3 PID Accuracy

Sets the accuracy for the PID Control

60 = 0
61 = 0.0
62 = 0.00
63 = 0.000

P1.9.4 PID Ref. Source

Defines which frequency reference source is selected when controlled from the PID

0 = AI1
1 = AI2
2 = Keypad
3 = Fieldbus
4 = Motor Pot

P1.9.5 PID Ref. Min.

The PID reference that agrees to the minimum value of the reference signal. Ranges from 0 to 100.

P1.9.6 PID Ref. Max.

The PID reference that agrees to the maximum value of the reference signal. Ranges from 0 to 100.

P1.9.7 PID Ref.RampTime

Sets the ramp time. Can be between 0.01 seconds and 30 seconds.

P1.9.8 PID Feedback Src

Sets the feedback source based on selection

0 = AI1
1 = AI2
2 = Fieldbus
3 = AI1/AI2 Min
4 = AI1/AI2 Max
5 = Mean AI1/AI2

P1.9.9 Sensor Min.

Ranges between -30000 and 100.

P1.9.10 AI1 Min. Value

Sets the minimum scaling point for AI1 0 to 100%.

P1.9.11 AI2 Min. Value

Sets the minimum scaling point for AI2 0 to 100%.

P1.9.12 Sensor Max.

Ranges between 0 and 30000.

P1.9.13 AI1 Max. Value

Sets the maximum scaling point for AI 1, 0 to 100%.

P1.9.14 AI2 Max. Value

Sets the maximum scaling point for AI 2 0 to 100%.

P1.9.15 PID-Contr Gain

This parameter defines the gain of the PID controller. If the value of the parameter is set to 100% a change of 10% in the error value causes the controller output to change by 10%. If the parameter value is set to 0 the PID controller operates as ID-controller.

P1.9.16 PID-Contr I Time

The parameter ID119 defines the integration time of the PID controller. If this parameter is set to 1,00 second a change of 10% in the error value causes the controller output to change by 10.00%/s. If the parameter value is set to 0.00 s the PID controller will operate as PD controller.

P1.9.17 Error Inversion

This parameter allows you to invert the error value of the PID controller

0 No inversion
1 Inverted

P1.9.18 Sleep Frequency

The frequency converter is stopped automatically if the frequency of the drive falls below the Sleep level defined with this parameter for a time greater than that determined by p1.9.19. During the Stop state, the PID controller is operating switching the frequency converter to Run state when the actual value signal either falls below or exceeds the Wake-up level determined by p1.9.20.

P1.9.19 Sleep Delay

The minimum amount of time the frequency has to remain below the Sleep level before the frequency converter is stopped.

P1.9.20 Wake Up Limit

The wake-up level defines the level below which the actual value must fall or which has to be exceeded before the Run state of the frequency converter is restored.

P1.9.21 Wake Up Action

This parameter defines whether the restoration of the Run state occurs when the actual value signal falls below or exceeds the Wake-up limit.

0 = Wake-up happens when actual value goes below the limit.

1 = Wake-up happens when actual value exceeds the limit.

P1.9.22 Wake Up Deadband

Ranges between 0 and 100.

G1.10 Torque Control

P1.10.1 Torque Limit

With this parameter you can set the torque limit control between 0.0–300.0%.

P1.10.2 Torq Lim Ctrl P

This parameter defines the gain of the torque limit controller. It is used in Open Loop control mode only.

P1.10.3 Torq Lim Ctrl I

This parameter determines the I-gain of the torque limit controller. It is used in Open Loop control mode only.

P1.10.4 Torq Ref Select

Defines the source for torque reference.

0 Not used

1 Analogue input 1

2 Analogue input 2

3 Analogue input 3

4 Analogue input 4

5 Analogue input 1 (joystick)

6 Analogue input 2 (joystick)

7 From keypad, parameter R3.5

8 Fieldbus

P1.10.5 Torq Ref Max

Scale the custom minimum and maximum levels for analog inputs within –300.0...300.0%.

P1.10.6 Torq Ref Min

See P1.10.5 above.

P1.10.7 Torq Speed Limit

With this parameter the maximum frequency for the torque control can be selected.

0 Maximum frequency, P1.1.3

1 Selected frequency reference

P1.10.8 OL TC Min Freq

Defines the frequency limit below which the frequency converter operates in frequency control mode. Because of the nominal slip of the motor, the internal torque calculation is inaccurate at low speeds where it is recommended to use the frequency control mode.

P1.10.9 OL Torq Ctrl P

Defines the P gain of the torque controller.

P1.10.10 OL Torq Ctrl I

Defines the I gain of the torque controller.

P1.10.11 Gen Torque Limit

Maximum torque allowed by regulator when motor is in generating mode. Range is 0.00 to 300.00%

P1.10.12 Mot Torque Limit

Maximum torque allowed by regulator when motor is in motoring mode. Range is 0.00 to 300.00%

G1.11 THERMAL MANAGEMENT

P1.11.1 Max Cabinet Temp Rise

Maximum temperature rise allowed before blowers are turned on. The rise is calculated by subtracting the ambient temperature from the highest internal temperature measured at several locations inside the drives enclosure.

If the result is greater than the blower rise temperature, the blowers will run.

Note: The blowers will also run if the DC bus is charged.

P1.11.2 Max Filter Rise

Temperature rise that when the drive is running results in a FCODE 79 Check Filter alarm.

P1.11.3 Max Rated Ambient

Specifies the maximum temperature for the ambient air the drive will see at its input filters. A fault will occur if the temperature exceeds this value. A warning will be indicated if the temperature exceeds the warning threshold. The warning threshold is calculated by multiplying the maximum temperature by the temperature warning percent (P1.11.9).

P1.11.4 Max Rated Ambient 2

Similar to P1.11.3 for second enclosure (e.g., Sine-Filter enclosure or Output Transformer).

P1.11.5 Max Transformer Coil Temp

Specifies the maximum temperature for the main transformer coil. A fault will occur if the temperature exceeds this value. A warning will be indicated if the temperature exceeds the warning threshold.

The warning threshold is calculated by multiplying the maximum temperature by the temperature warning percent (P1.11.9).

P1.11.6 Max Rectifier Temperature

Sets the maximum temperature allowed for the rectifier heat sink. A rectifier temperature fault will occur if the temperature exceeds this value. A warning will be indicated if the temperature exceeds the warning threshold. The warning threshold is calculated by multiplying the max temperature by the temperature warning percent.

P1.11.7 Max Inductor Temperature

Sets the maximum temperature allowed for the inductor heat sink. A inductor temperature fault will occur if the temperature exceeds this value. A warning will be indicated if the temperature exceeds the warning threshold. The warning threshold is calculated by multiplying the max temperature by the temperature warning percent (P1.11.9).

P1.11.8 Max Output Transformer Temperature

Sets the maximum temperature allowed for the output transformer. A fault will occur if the temperature exceeds this value. A warning will be indicated if the temperature exceeds the warning threshold. The warning threshold is calculated by multiplying the max temperature by the temperature warning percent (P1.11.9).

P1.11.9 Temperature Warning Percent

Percentage used by multiple parameters to determine when to give warning based on max temperatures.

P1.11.10 Blower Exchange Time

If the drive is equipped with redundant blowers, this parameter specifies the amount of hours the main blowers will run before rotating to redundant. The redundant blowers will then run for the same amount of time before rotating to main and the cycle will repeat.

G1.12 Medium-Voltage

Parameters in this group are used in open or closed loop vector mode and should not be adjusted when the drive is in Volts/Hertz mode. Some are used for advanced options and if set incorrectly, could damage the drive.

P1.12.1 Medium-Voltage Index

Reserved.

P1.12.2 Torque Stabilator Gain

Gain for the torque stabilator in open loop motor control operation. The range for the gain value is 0 to 1000.

P1.12.3 Torque Stabilator Damping

Damping rate for the torque stabilator in open loop motor control operation. The range is 0 to 1000.

P1.12.4 Torque Stabilator Limit

Frequency limit of torque stabilator output in Hertz.

P1.12.5 Torque Stabilator Gain Field Weakening Point

Gain of the torque stabilator at field weakening point in open loop motor control operation. The range is 0 to 1000.

P1.12.6 Voltage Stabilator Gain

Gain for the voltage stabilator. The range is 0 to 1000. The function of the voltage stabilator is to stabilize the variations in the DC link voltage caused due to load or incoming supply variations.

P1.12.7 Voltage Stabilator Damping

Damping rate for the voltage stabilator. The range is 0 to 1000.

P1.12.8 Voltage Stabilator Limit

Frequency limit of voltage stabilator output in Hertz.

P1.12.9 OverVolta_Kp_Add

Additional gain of the P-term of the PI type overvoltage controller at field weakening point.

P1.12.10 OverVolta_Kp

Gain of the P-term of the PI type overvoltage controller. The range is 0 to 32767.

P1.12.11 OverVolta_Ki

Gain for the I-term of the PI type overvoltage controller.

P1.12.12 UnderVoltage_Kp

Gain for the P-term of the PI type under voltage controller.

P1.12.13 UnderVoltage_Ki

Gain for the I-term of the PI type under voltage controller.

P1.12.14 Restart Delay

Delay time within which the drive cannot be restarted after the coast stop. The time can be set up to 60.000 seconds.

P1.12.15 Short Restart Delay

Delay to for modulation to restart after coast stop and new start is issued (in milliseconds, range is 0–65000).

P1.12.16 Ids Stabilator Gain Ref

Gain reference for the ID type stabilator.

P1.12.17 Ids Filter Coefficient

Filter coefficient of id-current stabilizer.

P1.12.18 FlyStart DC Magnetization Current

Reference for DC magnetization phase current used during fly-start.

P1.12.19 Flux Circle Stabilization Gain

Gain of the flux stabilator in open loop motor control operation. The range is 0 to 32000.

P1.12.20 Over Voltage Kd

Gain for the D-term of the PID type overvoltage controller.

P1.12.21 Motor Over Current Kp

Gain for the P-term of the PI type overcurrent controller.

P1.12.22 Motor Over Current Ki

Gain for the I-term of the PI type overcurrent controller.

P1.12.23 Current Control Kp

Gain for the current controller in closed loop motor control operation. Range 1 to 10000. Note that in normal cases the default value is sufficient and there is no need to change this parameter.

P1.12.24 Current Control Ti

Integral time constant for the current controller in closed loop motor control operations. Range 0 to 100.0 milliseconds. Note that in normal cases the default value is sufficient and there is no need to change this parameter.

P1.12.25 Over Modulation Limit

113% is full six-step, default 120%. Can be lowered to limit Sine-Filter and Inverter Harmonic interaction.

P1.12.26 Dead Time Compensation

Reserved.

P1.12.27 Dead Time Cont./Discont. Current Limit

Reserved.

P1.12.28 Generator Over Current Kp

Gain for the generating current controller in closed loop motor control operation. Range 1 to 10000. Please note that in normal cases the default value is sufficient and there is no need to change this parameter.

P1.12.29 Generator Over Current Ki

Integral time constant for the generating current controller in closed loop motor control operations.

Range 0 to 100.0 milliseconds. Note that in normal cases the default value is sufficient and there is no need to change this parameter.

P1.12.30 Advanced Options

Reserved.

P1.12.31 Main Hour

Hour counter for main blower run time. Retentive.

P1.12.32 Redundant Hour

Hour counter for redundant blower run time. Retentive.

P1.12.33 Test Cycle

Reserved for factory test.

P1.12.34 ITG Double Switching Frequency

Reserved.

G1.13 Fieldbus

P1.13.1 Fieldbus Data In 1 Select

Maps a parameter ID to the 'FBProcessDataIn1' variable (parameter ID). This parameter allows a value to be passed over a fieldbus interface to the application program. Use of this parameter requires that the variable being set is changeable while the drive is in run mode. Generally if the parameter can be set on the keypad when running, the parameter will work in this function.

P1.13.2 Fieldbus Data In 2 Select

Maps a parameter ID to the 'FBProcessDataIn2' variable. This parameter allows a value to be passed over a fieldbus interface to the application program. Use of this parameter requires that the variable being set is changeable while the drive is in run mode. Generally if the parameter can be set on the keypad when running, the parameter will work in this function.

P1.13.3 Fieldbus Data Out 8 Select

Maps a parameter ID to the 'FBProcessDataOUT8' variable. This parameter allows a value to be read from the SC9000 EP over any fieldbus.

P1.13.4 Fieldbus Data Out 7 Select

Maps a parameter ID to the 'FBProcessDataOUT7' variable. This parameter allows a value to be read from the SC9000 EP over any fieldbus.

P1.13.5 Fieldbus Data Out 6 Select

Maps a parameter ID to the 'FBProcessDataOUT6' variable. This parameter allows a value to be read from the SC9000 EP over any fieldbus.

P1.13.6 Fieldbus Data Out 5 Select

Maps a parameter ID to the 'FBProcessDataOUT5' variable. This parameter allows a value to be read from the SC9000 EP over any fieldbus.

P1.13.7 Fieldbus Data Out 4 Select

Maps a parameter ID to the 'FBProcessDataOUT4' variable. This parameter allows a value to be read from the SC9000 EP over any fieldbus.

P1.13.8 Fieldbus Data Out 3 Select

Maps a parameter ID to the 'FBProcessDataOUT3' variable. This parameter allows a value to be read from the SC9000 EP over any fieldbus.

P1.13.9 Fieldbus Data Out 2 Select

Maps a parameter ID to the 'FBProcessDataOUT2' variable. This parameter allows a value to be read from the SC9000 EP over any fieldbus.

P1.13.10 Fieldbus Data Out 1 Select

Maps a parameter ID to the 'FBProcessDataOUT1' variable. This parameter allows a value to be read from the SC9000 EP over any fieldbus.

P1.13.11 Fieldbus Minimum Scale

Sets the minimum scaling factor for fieldbus or analog inputs. If this parameter is set to a value other than 0, the drive will align the minimum frequency to this value. Example: Assuming the minimum frequency has been set to 45 Hz; if Fieldbus **Minimum Scale** is set to 45, then the drive will use 45 Hz as the reference value when 4 mA is present on an analog input. If it is set to zero, the frequency reference will not advance until the analog input goes over 16 mA, the point corresponding to 45 Hz.

P1.13.12 Fieldbus Maximum Scale

Sets the maximum scaling factor for fieldbus or analog inputs. If this parameter is set to a value other than 60, the drive will align the maximum frequency to this value. Example: Assuming the maximum frequency has been set to 45 Hz; if Fieldbus Maximum Scale is set to 45, then the drive will use 45 Hz as the reference value when 20 mA is present on an analog input. If it is set to 60, the frequency reference will not advance once the analog input goes over 16 mA, the point corresponding to 45 Hz.

G1.14 SINEFILTER

This parameter group configures a boost voltage transfer function to compensate for the voltage drop present when a sine-wave filter is used at the output of the drive.

P1.14.1 Voltage Boost Function

0 = Disable
1 = Enable

P1.14.2 IO Measure LOW

Minimum percent current used for scaling output boost voltage.

Parameters P1.14.2 through P1.14.5 provide for boosting inverter output voltage when a sine-filter is used. The motor current is converted to a percentage of nominal FLA, and that percentage is compared to the minimum and maximum percentages entered in P1.14.2 and P1.14.3. The output voltage from the inverter is then boosted or attenuated by the percentages entered for parameters P1.14.4 and P1.14.5.

P1.14.3 IO Measure High

Maximum percent current used for scaling output boost voltage.

P1.14.4 Voltage Gain Low

Minimum percent output boost voltage at IO Measure low.

P1.14.5 Voltage Gain High

Maximum percent output boost voltage at IO Measure high.

P1.14.6 ModIndexLimit

Maximum modulation index allowed when voltage boosting (percentage).

G1.15 Synchronous Field Control

This parameter group configures the control algorithm and interlocking when using a low-voltage drive as an exciter for synchronous field applications.

P1.15.1 SyncFieldMode

Controls the operation of Synchronous field control mode.

0 = Disable
1 = Enable

P1.15.2 Exciter Type

Sets the mode of operation for control of the exciter. Transfer function is the preferred mode for startup and roughing in a system. A typical mode of operation is to control the field current as a function of stator frequency. PID mode is most accurate but requires a reliable source of feedback for power factor.

0 = None
1 = PID
2 = Stepped
3 = Transfer Function
4 = Test Sweep

P1.15.3 Reference Source

Sets the origin of the reference source.

0 = Off
1 = Analog Input 1
2 = Analog Input 2
3 = Analog Input 3
4 = Motor Current
5 = Cosine Phi (Power Factor)
6 = Frequency Output
7 = Keypad
8 = Testmode
9 = Motor Simulation

P1.15.4 Reference Filter

Filter time in milliseconds used with reference source.

P1.15.5 Reference Input Minimum

Minimum value used for bottom end of reference input transfer function (independent variable).

P1.15.6 Reference Input Maximum

Maximum value used for top end of reference input transfer function (independent variable).

P1.15.7 Reference Output Minimum

Minimum value used for bottom end of reference input transfer function (dependent variable).

P1.15.8 Reference Output Maximum

Maximum value used for bottom end of reference input transfer function (dependent variable).

P1.15.9 Exciter Out Minimum

Minimum input voltage used to scale output of exciter reference.

Note: The exciter reference controller allows for several algorithms including fixed, linear transfer function, and PID. Parameters P1.15.9 and P1.15.10 provide a means of scaling the final output value from the reference to the 0–10000 count range used to scale the analog output of the SC9000 D/A converter.

P1.15.10 Exciter Out Maximum

Maximum input voltage used to scale output of exciter reference.

Note: The exciter reference controller allows for several algorithms including fixed, linear transfer function, and PID.

Parameters P1.15.9 and P1.15.10 provide a means of scaling the final output value from the reference to the 0–10000 count range used to scale the analog output of the SC9000 D/A converter.

G1.15.11 PID Field

P1.15.11.1 Actual Source

Selects the source of the signal used for feedback in the PID controller.

- 0 = Off
- 1 = Analog Input 1
- 2 = Analog Input 2
- 3 = Analog Input 3
- 4 = Motor Current
- 5 = Cosine Phi (Power Factor)
- 6 = Frequency Output
- 7 = Keypad
- 8 = Testmode
- 9 = Motor Simulation

P1.15.11.2 Actual Filter Time

Time constant applied to actual source (milliseconds).

P1.15.11.3 Polarity

Polarity applied to actual source. This parameter is used to set positive or negative feedback to the PID controller.

- 0 = Fixed to 1 (Non-invert)
- 1 = Fixed to –1 (invert)
- 2 = Reserved
- 3 = Reserved

P1.15.11.4 Scale

Sets the scale factor applied to the gain parameters of the PID controller.

P1.15.11.5 Proportional Gain K

Sets the proportional gain of the PID field controller.

P1.15.11.6 Integral Gain I

Sets the integral gain of the PID field controller.

P1.15.12 Stepped Field

Parameters to adjust excitation when P1.15.2 set to 2 = Stepped. See **Table 28** P1.15.12.1 through P.1.15.12.11. Consult factory where necessary.

G1.16 REMOTE I/O

G1.16.1 Digital Output Group

Selects the function used for an output module (Example: Out1AFunc selects the function of output module 1, output A). Available output functions:

- 0 = Off
- 1 = On
- 2 = Main Cooling
- 3 = Redundant Cooling
- 4 = MVD_Ready
- 5 = Start
- 6 = Run Steady
- 7 = Run Indicator Flash
- 8 = Fault Indicator
- 9 = External Fault Warning
- 10 = Reference fault Warning
- 11 = Warning
- 12 = Over Temperature Warning
- 13 = Motor Overload
- 14 = Motor General Limit Hit
- 15 = Output Contactor Maintained
- 16 = Output cOntactor Unlatched
- 17 = Output Contactor Latched
- 18 = In Remote
- 19 = In Local
- 20 = In Reverse
- 21 = At Speed
- 22 = In Preset Speed
- 23 = Exciter Run Out
- 24 = Bypass Contactor Maintained
- 25 = Bypass Unlatched
- 26 = Bypass Latched
- 27 = Sync Transfer Acknowledge
- 28 = Frequency Supervision
- 29 = 100 ms tick
- 30 = 500 ms tick
- 31 = Cooling Failure
- 32 = Motor RTD Failure
- 33 = Motor RTD Invalids
- 34 = Motor RTD Alarm Timeout
- 35 = Motor RTD Trip

Description of Output Functions

0 = Off

Forces output to an off state at all times.

1 = On

Forces output to an on state at all times.

2 = Main Cooling

Active when drive requests run of main blowers or fans. Main blowers are usually located at the front top of drive. Main fans are usually located at the top of the inverter adjacent to the inverter heat exchanger.

3 = Redundant Cooling

Active when drive requests run of redundant blowers or fans. Redundant blowers are usually located at the very top of drive, and are optional equipment. Redundant fans are usually located at the top of the inverter adjacent to the inverter heat exchanger.

4 = MVD_Ready

Output turns on when all prerequisite inputs for start are satisfied (or are un-mapped). The following input states are required:

Run Enable = ON

Mapped to DIN3 through DIN6, or Unmapped.

Isolation Switch = OFF

Mapped on remote input 1a through 7b, or Unmapped.

Phase Monitor = OFF

Mapped on remote input 1a through 7b, or Unmapped.

Motor Controller Fault = FALSE

No fault condition.

The drive will not start if any of these conditions are not met.

5 = Start

Output turns on during the start sequence of the drive. This output also covers the time during charging of the DC bus (i.e., the output transitions on at the run request and before the inverter starts to fire). The output remains on during the entire duration of run.

6 = Run Steady

Active when drive is in run mode. This output is maintained on any time the inverter is providing output frequency.

7 = Run Indicator Flash

Output used to indicate RUN and DC bus status. This output will go solid on if the drive is running (inverter is firing). The output will also flash to indicate that the DC bus is charged, and will do so even if the drive is not running (inverter is firing).

8 = Fault Indicator

Active when the drive is faulted. This output will alternate from on to off if a warning condition occurs. If the warning condition progresses to a fault, the output will transition to solid on.

9 = External Fault Warning

Output turns on during an external fault condition occurs.

10 = Reference Fault Warning

Output turns on when reference for speed is lost (4–20 mA level less than 4 mA, or field bus is lost).

11 = Warning

Output turns on during any warning condition internal to drive.

12 = Over Temperature Warning

Output turns on when the hottest internally measured temperature is higher than the warning level found in the settings group.

13 = Motor OverLoad

Output is set when a motor thermal overload (due to I^2T) has occurred.

14 = Motor General Limit Hit

Output is set when the motor regulator is active due to excessive regeneration torque or current.

15 = Output Contactor Maintained

Output is used to control a magnetically held version of output contactor (not a latch/unlatch style).

16 = Output Contactor Unlatched

Active when drive requests that the output contactor open. This output is normally used to control the unlatch coil of the medium-voltage output contactor. This is a pulsed output signal controlled by drive logic and has one second duration.

17 = Output Contactor Latched

Output turns on when drive requests that output contactor close. This output is normally used to control the latch coil of the medium-voltage output contactor. This is a pulsed output signal controlled by drive logic and has one second duration.

18 = In Remote

Output turns on when drive is in remote mode.

19 = In Local

Output turns on when drive is in local mode.

20 = In Reverse

Output turns on when drive is in reverse run mode.

21 = At Speed

Output turns on when drive output frequency is within $\pm 1\%$ of frequency reference.

22 = In Preset Speed

Output turns on when drive output frequency is within $\pm 1\%$ of preset speed.

23 = Exciter Run

Output used as a run command for external excitation system. Active only when I synchronous field motor mode (P1.15.1) is set to 'enable'.

24 = Bypass Contactor Maintained

Output turns on when drive requests that bypass contactor closes, and remains on for the entire duration of the hold time. This output is normally used to control the holding coil of the medium-voltage bypass contactor. This is a maintained output signal controlled by drive logic.

25 = Bypass Contactor Unlatch

Output turns on when drive requests that bypass contactor opens. This output is normally used to control the unlatch coil of the medium-voltage bypass contactor. This is a pulsed output signal controlled by drive logic and has one second duration.

26 = Bypass Contactor Latch

Output turns on when drive requests that bypass contactor close. This output is normally used to control the latch coil of the medium-voltage bypass contactor. This is a pulsed output signal controlled by drive logic and has one second duration.

27 = Sync Transfer Acknowledge

Indicates that drive is synchronized to the line via OPTD7.

28 = Frequency Supervision

Remote digital output used with parameters P1.3.7 and P1.3.8 HIGH or LOW accordingly.

29 = 100 Millisecond Tick

Output is forced to cycle with a 100 ms period. Useful for debugging.

30 = 500 Millisecond Tick

Output is forced to cycle with a 500 ms period. Useful for debugging.

31 = Cooling Failure

Output turns on when one or both of the blowers are failed.

32 = Motor RTD Failure

Output turns on when URTD II module fails in terms of communication loss (exclusive to URTD II for motor temperature sensing).

33 = Motor RTD Invalids

Output turns on when the number of bad channels exceed the parameter setting P1.18.3.3 (invalids determined by codes exceeding 249, includes SHORT and OPEN RTDs).

34 = Motor RTD Alarm Timeout

If one of the ten motor RTDs exceeds the warning level in P1.18.3 section, this Output turns on after the P1.18.3.6 delay time.

35 = Motor RTD Trip

Output turns on when the Trip trigger is set in the URTD II motor RTD algorithm (either voted count P1.18.3.4 exceeded, or non-voted trigger).

G1.16.2 Digital Input Group

Selects the function used for an input module (Example: In1AFunc selects the function of input module 1, input A). Available input functions:

- 0 = None
- 1 = Phase Monitor
- 2 = Aux. Estop
- 3 = Remote Estop
- 4 = Main Contactor Auxiliary
- 5 = Output Contactor Auxiliary
- 6 = Main Cooling Auxiliary
- 7 = Redundant Cooling Auxiliary
- 8 = Transformer Over Temperature Fault
- 9 = Transformer Ambient Cooling
- 10 = Sine Filter Cap Over Pressure
- 11 = Sine Filter Inductor Over Temperature
- 12 = Rectifier Over Temperature Fault
- 13 = Balancing Reactor Over Temperature
- 14 = UPS Ready
- 15 = UPS Battery Bad
- 16 = Motor Select 1
- 17 = Synchronous Transfer Go
- 18 = Synchronous Transfer Up
- 19 = Synchronous Transfer Down
- 20 = 120 V Monitor
- 21 = SC9000 GP PreCharge
- 22 = Output Transformer Over Temperature Fault
- 23 = Cabinet 2 Ambient Cooling

Description of Input Functions**0 = None****1 = Phase Monitor Relay**

The input monitors the state of the phase monitor relay. The input is normally off when the phase sequence and voltages are correct. A high state on this input will cause a warning or fault to occur.

2 = Auxiliary Emergency Stop

Monitors the auxiliary emergency stop circuit. A low state on an input mapped to this function will cause the drive to trip with an 'auxiliary emergency stop' message displayed on the keypad.

3 = Remote Emergency Stop

Monitors the remote emergency stop circuit. A low state on an input mapped to this function will cause the drive to trip with a 'remote emergency stop' message displayed on the keypad.

4 = Main Contactor Auxiliary

Monitors the state of the main contactor. A high state in this input indicates the main contactor is closed. The input must be high for the drive to run. This function must be mapped for the drive to run.

5 = Output Contactor Auxiliary

Monitors the state of the output contactor. A high state in this input indicates the output switch is open. The input must be low for the drive to run. If this function is not mapped, output contactor monitoring will be disabled, and the drive will run regardless of the state of the output contactor.

6 = Main Cooling Auxiliary

Auxiliary contact monitor for main blower starter bank 1. This input is used to monitor the state of the starters used for main blower control. The normally open auxiliary contact of all main blower starters should be wired in series, and connected to this input. If the contact is open when the main blowers are commanded to run, a fault will occur, or use of redundant blowers will be attempted.

7 = Redundant Cooling Auxiliary

Auxiliary contact monitor for redundant blower starter bank 1. This input is used to monitor the state of the starters used for redundant blower control. The normally open auxiliary contact of all redundant blower starters should be wired in series, and connected to this input. If the contact is open when the main blowers are commanded to run, a fault will occur.

8 = Transformer Over Temperature Fault

Monitors the state of the over-temperature switch used on the Transformer. When mapped to an input, an open circuit will cause the drive to trip with a transformer over temperature fault.

9 = Transformer Ambient Cooling

Input used for a clix-style thermostat switch. Temperature set to maintain blowers is run state until switch OPENS at a temperature near ambient

10 = Sine Filter Capacitor Over-Pressure

Monitors the state of the overpressure switch used on the sine filter capacitors. When mapped to an input, an open circuit will cause the drive to trip with a capacitor over-pressure fault.

11 = Sine Filter Inductor Over-Temperature

Monitors the state of the over-temperature switch used on the sine filter inductor. When mapped to an input, an open circuit will cause the drive to trip with an inductor over temperature fault.

12 = Rectifier Over Temperature Fault

Monitors the state of the over-temperature switch used on the rectifier. When mapped to an input, an open circuit will cause the drive to trip with a rectifier over temperature fault.

13 = Balancing Reactor Over Temperature

Monitors the state of the over-temperature switch used on the Balancing Reactor. When mapped to an input, an open circuit will cause the drive to trip with a reactor over temperature fault.

14 = UPS Ready

Monitors the state of the universal power supply and trips with a UPS not ready Fault.

15 = UPS Battery Bad

Monitors the state of the universal power supply's battery and trips with a UPS battery bad Fault.

16 = Motor Select 1

Input is used to select the motor number (0 or 1) for a multiple motor sync-transfer drive. The drive must be in sync-transfer mode for Motor Select bits to function. Off selects motor 1, on selects motor 2.

17 = Synchronous Transfer Go Command

The input is used to command the drive to execute a sync transfer operation. The drive and utility grid must be synced before the transfer will occur. The drive must be in sync transfer mode for this command to function.

18 = Sync Up Command

The input is used to command the drive to synchronize to the utility grid in preparation to transfer the motor from the drive to utility grid. The drive must be in sync transfer mode for this command to function.

19 = Synchronous Down Command

The input is used to command the drive to synchronize to the utility grid in preparation to transfer the motor from the utility grid to drive. The drive must be in sync transfer mode for this command to function.

20 = 120 V monitor

Monitors the 120 V control power transformer to avoid multiple faults being recorded if power is lost.

21 = GP PreCharge Command

This input is used to command a DC pre-charge on the SC9000 GP drive.

22 = Output Transformer Over Temperature Fault

Monitors the state of the over-temperature switch used on the output transformer. When mapped to an output, an open circuit will cause the drive to trip with an output transformer over temperature fault.

23 = Cabinet 2 Ambient Cooling

Input used for a clix-style thermostat switch. Temperature set to maintain blowers is run state until switch OPENS at a temperature near ambient

G1.16.3 Analog Input (Base 1)

Selects the function used for an analog input module on Turck base 1 (Example: An In1AFunc selects the function of input module 1, input A). When an input is mapped to one of the functions listed, the corresponding protection mode is automatically enabled. If a function is not mapped to an input point, the protection mode is disabled.

Available functions:

- 0 = None
- 1 = Inlet Air Temperature
- 2 = Exhaust Air Temperature
- 3 = Transformer Coil Temperature
- 4 = Rectifier 1 Temperature
- 5 = Rectifier 2 Temperature
- 6 = Inductor Temperature
- 7 = Enclosure 2 Inlet Air Temperature
- 8 = Enclosure 2 Exhaust Air Temperature
- 9 = Output Transformer Temperature

Description of analog input functions

0 = None

1 = Inlet Air Temperature

Input used to measure air temperature at air inlet.

2 = Exhaust Air Temperature

Input used to measure the exhaust temperature. When the temperature of this point exceeds 70 degree C, the drive will trip.

3 = Transformer Coil Temperature

Input used to measure the transformer coil temperature. When the temperature of this point exceeds the value of P1.11.5, "MaxTransformerCore Temp", the drive will trip on 'XfmrOTCoil'.

4 = Rectifier 1 Temperature

Input used to measure rectifier 1 heat sink temperature.

5 = Rectifier 2 Temperature

Input used to measure rectifier 2 heat sink temperature.

6 = Inductor Temperature

Input used to measure either the Balancing Reactor for dual-inverter SC9000 EP drives or the output SINE filter inductor/reactor.

7 = Enclosure 2 Inlet Air Temperature

Input used to measure second enclosure at air inlet.

8 = Enclosure 2 Exhaust Air Temperature

Input used to measure second enclosure exhaust temperature. When the temperature exceeds 70 °C, the drive will trip.

9 = Output Transformer Temperature

Input used to measure output transformer temperature. When the temperature exceeds parameter value P1.11.8, the drive will trip.

G1.16.4 Analog Output (Base 1)

Selects the function used for an analog output module on the Turckbase 1.

Available functions:

- 0 = Min Scale, Reserved
- 1 = Max Scale, Reserved
- 2 = Test Sweep, Reserved
- 3 = Output Frequency
- 4 = Frequency Reference
- 5 = Motor Speed
- 6 = Motor Current
- 7 = Motor Torque
- 8 = Motor Power
- 9 = Motor Voltage
- 10 = Medium DC Bus Voltage

G1.16.5 MP1 Analog (ITG Modulator)

Selects the function used for an analog input on the ITG modulator MP1 connector.

Available functions:

- 0 = None
- 1 = Cabinet Inlet Temperature
- 2 = Cabinet Exhaust Temperature
- 3 = Transformer Coil (reserved for factory test*)
- 4 = Rectifier 1 Temp (reserved for factory test*)
- 5 = Rectifier 2 Temp (reserved for factory test*)
- 6 = Cabinet 2 Inlet Temperature
- 7 = Cabinet 2 Exhaust Temperature

* MP1 analog input limited to 103 °C input and not recommended for magnetics temperature sensing which can range to 220.

G1.17 SYNC TRANSFER**P1.17.1 COMMON****P1.17.1.1 Sync Transfer Mode**

- 0 = Disabled
- 1 = Open Transition
- 2 = Closed Transition

P1.17.1.2 Sync Accel Time

Sets the acceleration rate used when synchronizing the AFD out to the utility grid.

P1.17.1.3 Sync Decel Time

Sets the deceleration rate used when synchronizing the AFD out to the utility grid.

P1.17.1.4 Sync Up Angle

Set the phase relationship of the drive output to utility grid for final synchronization, when transferring from the AFD to utility. Example -30 means the drive lead utility by 30 degrees when synchronization is attained.

P1.17.1.5 Sync Down Angle

Set the phase relationship of the drive output to utility grid for final synchronization, when transferring from the utility to AFD. Example -30 means the drive lead utility by 30 degrees when synchronization is attained.

P1.17.1.6 Angle Zero Adjust

Zero offset null for synchronizer PID.

P1.17.1.7 Sync Gain

Proportional gain term for phase synchronizer PID.

P1.17.1.8 Phase Dead band

Dead band used for phase lock in degrees.

P1.17.1.9 Frequency Dead band

Deadband used for frequency lock in degrees.

P1.17.2 CLOSED TRANSITION

P1.17.2.1 Sync Up Lock Stability Time

Delay for minimum sync up time.

P1.17.2.2 Sync Up Current Cutoff Threshold

Threshold of amps comparator to complete up transfer.

P1.17.2.3 Sync Down Lock Stability Time

Delay for minimum sync down time.

P1.17.2.4 Sync Down Modulation Delay

Delay for modulation to begin on sync down.

P1.17.2.5 ITG Acknowledge Time Limit

Timeout time if ITG Acknowledge is not received, results in FCODE 94.

P1.17.3 OPEN TRANSITION

Note on Bypass and Output contactor control:

There are two styles of contactor that can be used in sync transfer systems; maintained hold, and latch-unlatch. The remote I/O menu output section has options for both types of devices. For maintained hold devices, only one output is required, and that output is on as long as the contactor is supposed to be on. For latched devices, two outputs are required, one to latch the contactor, and the other to unlatch it. The synch transfer logic uses on times for the latch and unlatch signals of 1 second. The signals are output at the appropriate times to close and open latch/unlatch style devices.

P1.17.3.1 Sync-Up Inverter Stop

Time in milliseconds from the 'TransferGo' signal going active to inverter modulation stop.

P1.17.3.2 Sync up Bypass Close

Time in milliseconds from the "TransferGo" signal going active to closure of 'BypassLatch' or 'BypassMaintained'.

P1.17.3.3 Sync Up Output Open

Time in milliseconds from the "TransferGo" signal going active to closure of 'Output Unlatch' or opening of 'Output Maintained'.

P1.17.3.4 Sync Down Bypass Open

Time in milliseconds from the "TransferGo" signal going active to closure of 'BypassUnLatch' or opening of 'Bypass Maintained'.

P1.17.3.5 Sync Down Output Close

Time in milliseconds from the "TransferGo" signal going active to closure of 'Output Latch' or closing of 'Output Maintained'.

P1.17.3.6 Sequence Complete

Time in milliseconds from the "TransferGo" signal going active to the transfer sequence timer resetting. This signal can be used by the PLC to acknowledge that the transfer sequence has completed.

P1.17.3 COMMON CT/OT TIMERS

P1.17.3.7 SyncAcquireTime

Maximum time allowed for sync lock to occur after 'transferUp' or 'transferDown' input is asserted. This time includes the ramp time if the transfer go signal is given at a frequency that is lower than the utility grid.

P1.17.3.8 SyncLockTime

Minimum time required for synclock to be held before 'syncAck' output is asserted. Longer times provide a more settling time for solid phase lock.

P1.17.3.9 Frequency Dead Band On Delay

Sets the on time delay used by the debounce logic at the output of the frequency lock comparator. The comparator dead band is set by parameter P1.17.1.9 Frequency Dead band.

P1.17.3.10 Frequency Dead Band Off Delay

Sets the off time delay used by the debounce logic at the output of the frequency lock comparator. The comparator dead band is set by parameter P1.17.1.9 Frequency Dead band.

P1.17.3.11 Phase DeadBand On Delay

Sets the on time delay used by the debounce logic at the output of the frequency lock comparator. The comparator dead band is set by parameter P1.17.1.8 Phase Dead band.

P1.17.3.12 Phase DeadBand Off Delay

Sets the on time delay used by the debounce logic at the output of the frequency lock comparator. The comparator dead band is set by parameter P1.17.1.8 Phase Dead band.

G1.18 URTD GROUP

P1.18.1 MITG

P1.18.1.1 Inverter1Max

Temperature where drive trips on inverter over temperature.

P1.18.1.2 Inverter1Vote

Bit-Masked Ch1-Ch6 (B0 through B5, 0-63 equivalent) to include in voting. Default is 63, where all six temperatures are used.

P1.18.1.3 Inverter1VoteMax

Voting Count Before Trip Occurs.

P1.18.1.4 BadChannelMax1

Number of Channels Allowed to Be Invalid (Temperature shown as 250 through 255 indicates bad channel).

P1.18.2 SITG**P1.18.2.1 EnableRx2URTD**

Enable/Disable for second parallel inverter in high-horsepower applications.

P1.18.2.2 Inverter2Max

Temperature where drive trips on inverter over temperature.

P1.18.2.3 Inverter2Vote

Bit-Masked Ch1-Ch6 (B0 through B5, 0-63 equivalent) to include in voting. Default is 63, where all six temperatures are used.

P1.18.2.4 Inverter2VoteMax

Voting Count Before Trip Occurs.

P1.18.2.5 BadChannelMax2

Number of Channels Allowed to Be Invalid (Temperature shown as 250 through 255 indicates bad channel).

P1.18.3 URTD Motor**P1.18.3.1 RTDPresent**

Enable/Disable if Motor URTD II Module is used.

P1.18.3.2 Motor RTD Voting

Voting Register Count 0-1023 for ten RTD channels, see Appendix E for further details and examples.

P1.18.3.3 Bad Channel Count

Number of invalid channels as counted before Invalids alarm/fault.

P1.18.3.4 Motor RTD Vote Count

Number of channels in voting count, all other channels considered non-voting trigger for RTD trip.

P1.18.3.5 URTD Failure Response

Fault handling response if communications are lost between ITG modulator gateway and Motor URTD II module.

P1.18.3.6 Alarm Timeout Delay

Delay in Seconds 0 to 120 before alarm is annunciated. Trip level is immediate.

P1.18.3.7 URTD Invalids Response

Fault handling response if the number of bad channels is exceeded.

P1.18.3.8 Motor Winding Trip Level

Trip level setting.

P1.18.3.9 Motor Winding Alarm Level

Alarm level setting.

P1.18.3.10 Motor Bearing Trip Level

Trip level setting.

P1.18.3.11 Motor Bearing Alarm Level

Alarm level setting.

P1.18.3.12 Load Bearing Trip Level

Trip level setting.

P1.18.3.13 Load Bearing Alarm Level

Alarm level setting.

P1.18.3.14 RTD History Reset

Standby or Commit to reset history records for peak temperatures for ten channels and the number count of communications failures, invalids alarm/faults, alarm timeouts, and trips.

Note: History is susceptible to SPX controller power-loss. VCN application software is configured for retaining nonvolatile memory.

G1.19 ITG CONFIG**P1.19.1 OC Value**

ITG modulator Overcurrent Keypad setpoint, 0 to 4095 counts (default 2280).

P1.19.2 OV Value

ITG Modulator Overvoltage Keypad setpoint, 0 to 4095 counts (default 3940).

P1.19.3 Commit to FRAM

If the drive is unfaulted and stopped, the OC and OV values in P1.19.1 and P1.19.2 can be written to memory in the ITG modulator. The keypad LEDs blink at a 2 Hz rate during this process.

Special parameters

The following parameter ID's are useful for monitoring the status of the SC9000 EP drive. The parameter ID can be used with SC9000 EP fieldbus interfaces to obtain data from these parameters. Each signal is bit-masked where B0 = 1, B1 = 2, through B15 = 32768. The sum of the bits is added and displayed as a 16-bit UINT value in 9000XDrive or over Fieldbus.

Parameter ID 1995: - CSpecFaultBits1

B0 = Check Filter Alarm
B1 = Not Faulted
B2 = SPARE
B3 = Estop Fault Active
B4 = Output Contactor Fault Active
B5 = Ambient Temperature Warning
B6 = Exhaust Hot Warning
B7 = Faulted
B8 = Transformer Coil OT Fault
B9 = SPARE
B10 = Inverter Over Temperature Warning
B11 = SPARE
B12 = SPARE
B13 = Main Blower Warning
B14 = Redundant Blower Warning
B15 = Blower Lost Fault

Parameter ID 1983: V4FaultReg1

B0 = Inverter OT Fault
B1 = Inverter OT Warning
B2 = Bridge Rectifier OT Fault
B3 = Bridge Rectifier OT Warning
B4 = Redundant Blower Fault
B5 = Redundant Blower Warning
B6 = Blower Loss Fault
B7 = Blower Loss Warning
B8 = SPARE
B9 = SPARE
B10 = SPARE
B11 = Transformer Coil Fault
B12 = Transformer Coil Alarm
B13 = SPARE
B14 = SPARE
B15 = SPARE

Parameter ID 1984: V4FaultReg2

B0 = Ambient Temperature Fault
B1 = Ambient Temperature Alarm
B2 = Intake Filter Fault
B3 = Intake Filter Alarm
B4 = Filter Reactor Temperature Fault
B5 = Filter Reactor Alarm
B6 = Exhaust Temperature Fault
B7 = Exhaust Temperature Alarm
B8 = E-Stop Fault
B9 = SPARE
B10 = SPARE
B11 = SPARE
B12 = SPARE
B13 = SPARE
B14 = SPARE
B15 = SPARE

Parameter ID 1989: V4FaultReg3

B0 = Isolation Switch Fault
B1 = Main Contactor Fault
B2 = Output Contactor Fault
B4 = SPARE
B5 = Run Enable FCODE 58 Fault
B6 = SPARE
B7 = SPARE
B8 = SPARE
B9 = SPARE
B10 = SPARE
B11 = SPARE
B12 = SPARE
B13 = SPARE
B14 = SPARE
B15 = SPARE

Parameter ID 1988: RemoteInputBits1

B0 = Phase Monitor Relay
B1 = Reserved
B2 = Isolation Interlock
B3 = Auxiliary E Stop
B4 = Remote E Stop
B5 = Main Contactor Auxiliary
B6 = Bypass Contactor Auxiliary
B7 = Output Contactor Auxiliary
B8 = Sine Filter Capacitor Over Pressure
B9 = Sine Filter Inductor or Air OT
B10 = Balancing Reactor Inverter 1 Phase U Snap Switch
B11 = Balancing Reactor Inverter 1 Phase V Snap Switch
B12 = Balancing Reactor Inverter 1 Phase W Snap Switch
B13 = Balancing Reactor Inverter 2 Phase U Snap Switch
B14 = Balancing Reactor Inverter 2 Phase V Snap Switch
B15 = Balancing Reactor Inverter 2 Phase W Snap Switch

Parameter ID 1987: U_MRS Motor Regulator Status Bits

B0 = Motoring Current Limit
 B1 = Generator Current Limit
 B2 = Motoring Torque Limit
 B3 = Generator Torque Limit
 B4 = Over Voltage Limit
 B5 = Under Voltage Limit

Parameter ID 0043: General Status

B0 MVD_Ready
 B1 RunEnable
 B2 RunRequest
 B3 MC_Run
 B4 MC_Fault
 B5 MC_Warning
 B6 MC_DC_Brake Inactive in V5.00
 B7 MotorRegulatorStatus
 B8 IOTerminalControl
 B9 KeypadControl
 B10 FieldbusControl
 B11 InLocal
 B12 InRemote
 B13 SPARE
 B14 SPARE
 B15 HeartBeat (1Second)

B0 MVD_Ready

In the SC9000 EP, the DC bus does not charge until the drive is started. For this reason, the 'MC_READY' bit used in the low-voltage drives was replaced with 'MVD_Ready'. This bit indicates that the main isolation switch is closed, the status of the phase monitor relay is good, run enable is good, and that the drive is not faulted.

B1 through B12 Control Source Status Bits

In the SVX or SPX 9000 low-voltage drive, there was a disconnect between the control place and the selected keypad mode. It was possible to check whether the drive was in local or remote, but the user had to know what the local and remote control places were in advance in order to determine in control was from the keypad, I/O terminals, or fieldbus. In the SC9000 EP, there are separate bits to indicate the control place as well as the actual physical location of control.

Chapter 4: Pre-start checks

CAUTION

Prior to initial operation of the SC9000 EP, the system must be inspected, adjusted and tested by qualified personnel. Failure to properly inspect, adjust, and test the drive before initial startup can result in equipment damage that is not covered by the manufacturer's warranty.

General inspection

CAUTION

All power sources must be isolated and locked out before servicing the equipment.

Open the panels and/or doors and inspect for any physical damage or remaining installation debris on the SC9000 EP power system.

Inspect the control rack to verify that there are no loose connectors on the control cards.

Check that the SC9000 EP is wired correctly and all power connections are tight. Verify that all control wiring and plug-in terminal blocks are tight. Field wiring should be checked for clearance to live busses where necessary, physically secured to withstand the effects of fault current.

Check that there are no obstructions in the intake airway or exhaust airway.

Using an ohmmeter, check for and eliminate any grounds between the drive input and output power leads.

Verify that the emergency stop pushbutton on the low-voltage door is depressed and in the stop state. Verify that all remote start/stop signals are in the stop position to ensure that the motor does not attempt to start when the drive isolation switch is closed and the main contactor is energized.

Ensure that safety signs are not covered or obscured by paint.

All switches and other operating mechanisms should be manually exercised to make certain that they are properly aligned and operate freely.

Operating mechanisms such as interlocks, key switches, etc., should be checked for function as intended for protection of personnel and equipment.

All devices must be set to their normal or OFF position before energizing incoming power.

Motor

Verify that the motor nameplate data and load requirements correspond to SC9000 EP output ratings:

- Voltage: If motor is re-connectable, verify that the leads are configured for the correct voltage and phase rotation
- Frequency: Verify that the motor is 60 Hz and matches the SC9000 EP rating
- Duty Cycle: Verify that the duty cycle matches the load requirements
- Check that the motor is installed according to the manufacturer's instructions
- Manually rotate the motor shaft to check that the motor is not binding

Transformer

Verify that the actual input voltage being fed to the drive transformer primary is within $\pm 10\%$ of the rated voltage listed on the drive nameplate.

Grounding

Verify that the drive ground bus is properly grounded to the site ground with the proper sized conductor. Connections must be tightened to the proper torque. All grounding connections should be checked.

Verify that the shield of all shielded control and signal wires that plug into the control rack cards are grounded at the rack using the grounding clamp.

Close all panels and/or doors before energizing the SC9000 EP.

Chapter 5: Operation

Safety interlocks

The SC9000 EP is manufactured with several built-in interlock provisions and safety features to reduce hazards and provide proper operating sequences:

- Mechanical interlocks prevent opening the medium-voltage doors with the switch in the closed position. Ensure that the medium-voltage doors are fully closed and latched to prevent damage to the interlock bracket on the back of the incoming structure door
- An additional interlock prevents closing of the switch unless the medium-voltage door is closed (see Medium-voltage Door Interlock Plunger in **Figure 3**)
- Standard key interlocks on all medium-voltage doors. On SC9000 EPs that require two or more structures, the adjacent door(s) will also be interlocked with the switch operating mechanism. The adjacent door(s) must be closed before the main door is closed. All doors must be closed before the switch operator can be moved to the closed position

Note: Attempting to close the switch with the door open can cause damage to the operating mechanism.

Mechanical and electrical interlocks are provided to ensure that the non-loadbreak isolation switch cannot be opened or closed unless the main contactor is de-energized (see mechanical interlock with contactor in **Figure 3**). Do not attempt to force the switch operating mechanism with the main contactor closed. The handle mechanism is designed to fail before the isolation switch can be opened with the main contactor closed. For mechanical interlock adjustment, refer to Eaton document

CAUTION

Applying excessive force to the switch handle with the mechanical interlocks engaged will result in damage to the switch.

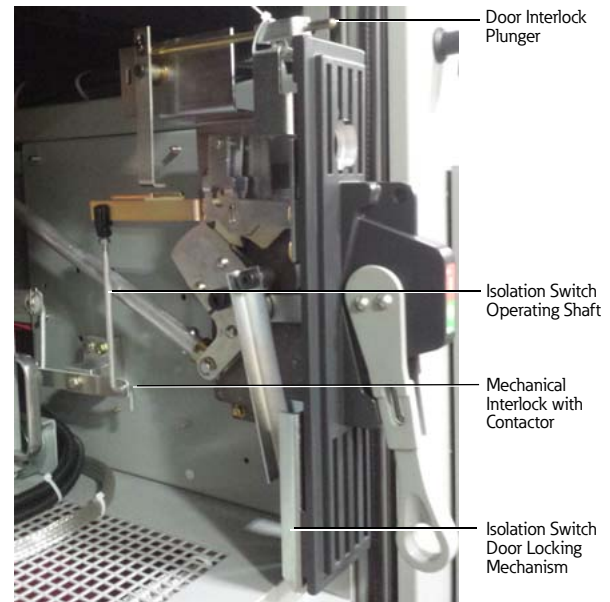
An electrical interlock is provided to disconnect the control power transformer secondary before the isolating switch stabs are disconnected from the line fingers. This interlock ensures that the switch is breaking transformer magnetizing current only. Do not connect additional loads to the isolating switch.

WARNING

If loads greater than the interrupting rating of the switch are connected to the switch, equipment damage, personal injury or death may occur.

An optional key interlock may be provided to lock the switch in the open position for special configurations. Refer to the specific order drawings to determine if key interlocks have been provided.

Figure 3. Handle mechanism with contactor and door interlocks



Isolation switch

The drive isolation switch is a non-loadbreak device. Mechanical and electrical interlocks are provided to ensure that the main contactor is de-energized before the switch can be operated. In the open position, the switch isolates medium-voltage from the main compartment, allowing access to the drive for inspection and maintenance. The isolation switch includes ground fingers that ground the line side of the power fuses when the switch is in the open position.

The switch consists of a fixed rear portion and a removable front portion. Refer to **Figures 4** and **5**. The fixed portion includes line fingers and a moveable shutter that isolates the line fingers when the switch is in the open position. The removable portion is operated by a handle mechanism that extends through the medium-voltage door. With the handle in the up position, the switch is closed and medium-voltage is available for full operation of the controller load. With the handle in the down position, the switch is open and medium-voltage is isolated from the downstream components.

An isolation switch viewing window is provided in the medium-voltage door directly in front of the isolation switch. After opening the isolation switch and before opening the medium-voltage door, the switch should be visually examined through the viewing window to verify that it is in the open position. Three green and white “barber poles” will

be visible when the switch is in the open position and the shutter assembly is in the isolating position. See **Figure 6** for location of barber poles. The use of a flashlight will help in verifying the position of the barber poles.

⚠ WARNING

Do not enter the medium-voltage drive compartment without visually verifying that the isolation switch is open and the isolating shutter is in place. Entering a compartment without the isolating shutter in place may result in severe injury or death.

Medium-voltage may still be present behind the shutter and on the main bus or incoming cables, even with the isolation switch open. The bus or incoming cable connections are barriered from the other drive components. Extreme caution must be exercised to prevent contact with these live parts. Do not remove the barriers or open the shutter unless the upstream feeder is locked out and tagged out.

⚠ WARNING

Do not contact any line side drive connection without verifying that the upstream feeder is properly locked out. Failure to lockout the upstream feeder may result in severe injury or death.

Figure 4. Isolation switch

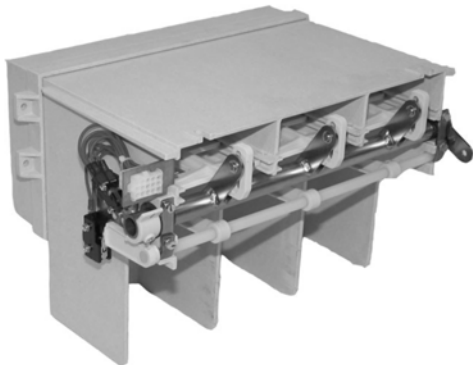


Figure 5. Shutter mechanism and finger barrier isolation of incoming line bus (shown with removable portion of isolation switch removed)

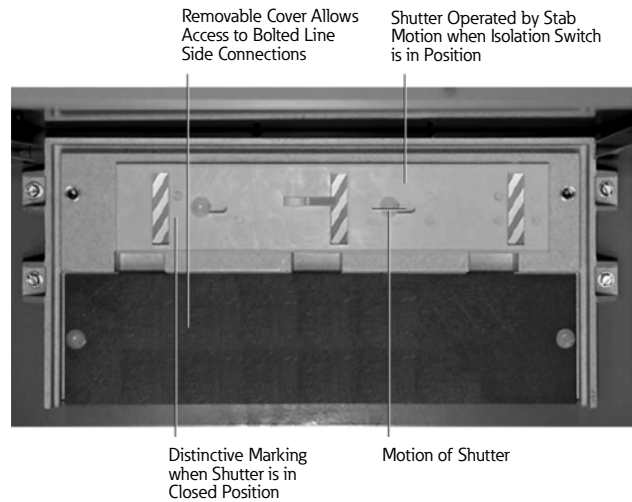
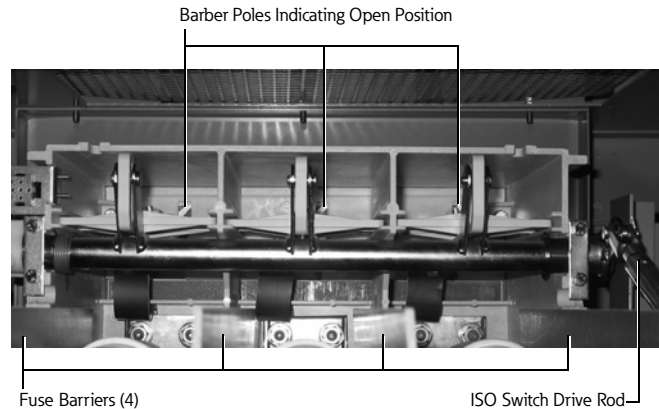


Figure 6. Shutter mechanism and finger barrier isolation of incoming line bus (shown with removable portion of isolation switch)



Main contactor assembly

400 A vacuum contactor

A stab-in version of the SL Contactor is standard. The stab-in contactor is mounted on wheels and rolls into the SC9000 EP AFD structure. Contactor line and load fingers engage cell-mounted stabs as the contactor is inserted into the SC9000 EP AFD incoming cell. The contactor is held in position by a bolt and bracket combination. It can be easily withdrawn from the SC9000 EP AFD incoming cell by removing the bolt holding the contactor against the bracket and disconnecting the isolation switch interlock. The contactor can be removed from the SC9000 EP AFD after disconnecting the medium-voltage cables going to the control transformer.

800 A vacuum contactor

The 800 A SL Contactor is available in the SC9000 EP Frames D and E AFD and is rated at 720 A enclosed.

The 800 A contactor is also stab-in. The 800 A contactor is mounted on wheels and has similar features to the stab-in 400 A contactor.

Figure 7. 400 A stab-in contactor and fuse assembly

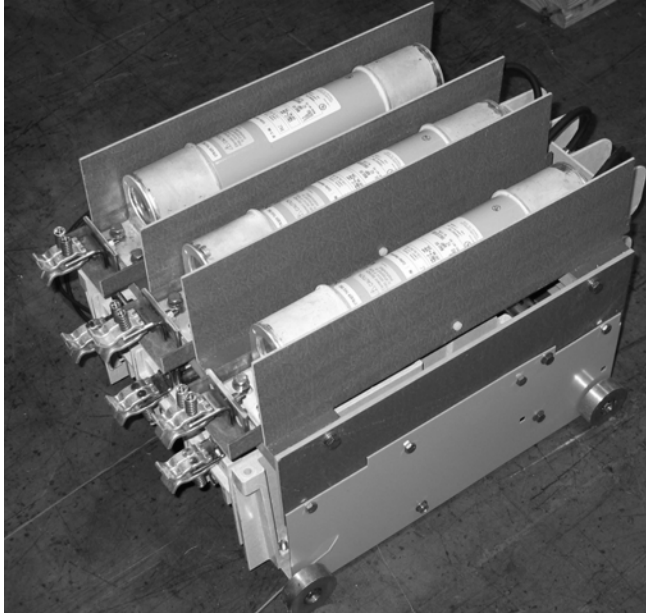


Figure 8. 800 A stab-in contactor and fuse assembly

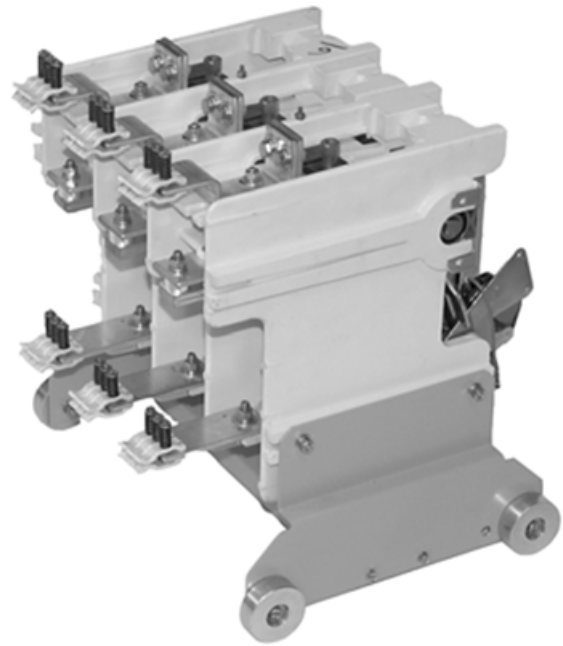
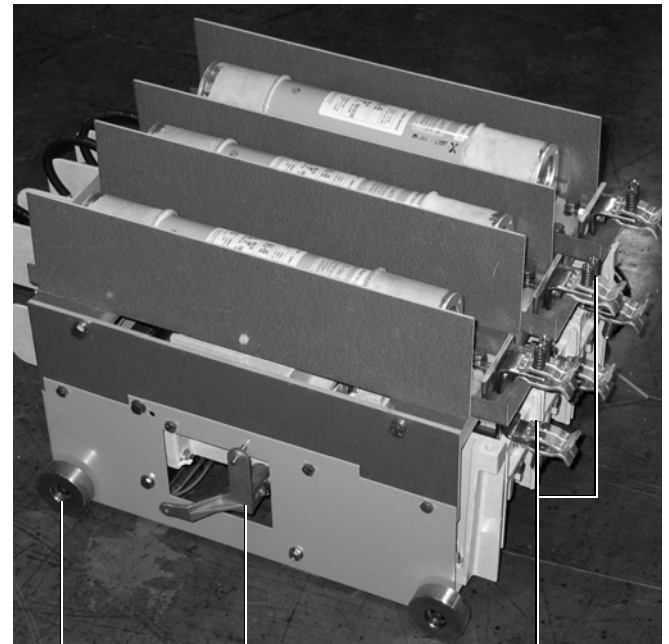


Figure 9. Stab-in contactor mechanical interlock and fingers



Rollout Wheels

Mechanical Interlock
with Isolation Switch

Self-Aligning
Contactor Line
and Load
Fingers

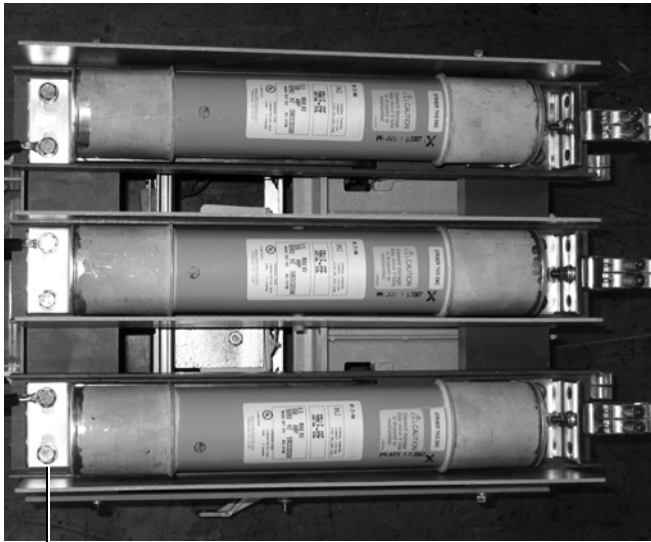
Current limiting fuses

SC9000 EP AFDs use Eaton Type HLE power fuses with special time/current characteristics. The fuse is coordinated with the contactor to provide maximum motor/transformer utilization and protection. The standard mounting method for power fuses is bolted onto the contactor assembly.

Interruption is accomplished without expulsion of gases, noise or moving parts. Type HLE fuses are mounted in a horizontal position. When a fault has been cleared, a metal pin indicator in the front of the fuse, normally depressed, pops up to give visible blown fuse indication.

The control circuit primary fuses are also current limiting.

Figure 10. Blown fuse indicating device



Fault Indicator

Isolated low-voltage control

The low-voltage door has four cutouts as standard.

Figure 11. SC9000 EP AFD low-voltage door closed



Contactor operation

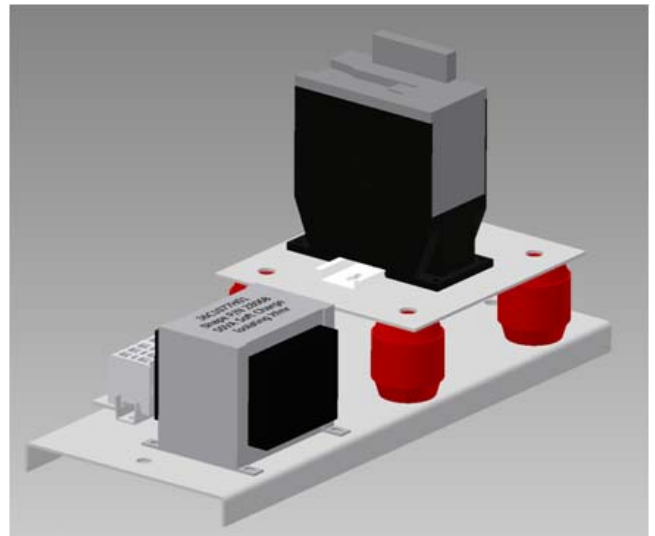
The main contactor does not need to be closed to apply pre-charge; however, the isolation switch must be closed. The main contactor must be closed to apply power to the isolation transformer and rectifier. The main contactor must be open before operating the isolation switch. Start and Stop pushbuttons are standard on the keypad, and open and close pushbuttons may also be supplied on the drive low-voltage door. The control power transformer will provide 120 Vac to power the drive control modules.

Figure 12. SC9000 EP AFD low-voltage door open

The Device Panel and optional Eaton MP Series Motor Protection Relays fit in the same size low-voltage door cutout. The standard SC9000 EP keypad can be removed for plug-in of a laptop via a serial connection. A standard viewing window in the low-voltage door allows visual verification of the SC9000 EP AFD status. The low-voltage control panel is behind the low-voltage door and is completely isolated from the medium-voltage compartment. The medium-voltage door is locked closed and interlocked with the isolation switch. A row of control terminal blocks is provided on the right side of the control compartment. Opening the low-voltage door can access them. The blocks are fixed mounted and remain in place when the medium-voltage door is opened. A test plug is supplied inside the low-voltage section. The plug is wired to the secondary of the control power transformer. Test power can be used to energize the control circuit by using a standard extension cord to energize the plug. A 15 A maximum customer convenience two-receptacle outlet is also provided for powering a laptop or other electronic devices. The low-voltage compartment swings out of the way with the medium-voltage door as it is opened, allowing access to the medium-voltage components that are mounted behind the low-voltage compartment.

Softmag (pre-charge) circuit

Unlike other pre-charge methods, the innovative Softmag (pre-charge) circuit in the SC9000 EP protects the rectifier and DC bus components from high in-rush currents. The design uses the control power circuit for DC link capacitor charging while magnetizing the 24-pulse isolation transformer assuring proper phasing. This feature eliminates the risk of component or transformer failure during the pre-charge cycle and lengthens the life of the affected components.

Figure 13. SC9000 EP Softmag (pre-charge) circuit

Modular roll-in/roll-out stab-in three-phase inverter

Figure 14. 1250 hp three-phase EP inverter



The roll-out three-phase inverter module employs an insulation and buswork system to obtain the highest power density rating in the market.

Heat pipe technology is used to cool the active power components in the inverter.

This method of heat removal from the inverter is up to 10 times more efficient than traditional air-cooling methods, resulting in less required airflow for quieter and more efficient operation. The thermal management system has been subjected to temperatures of $-50\text{ }^{\circ}\text{C}$ to model cold weather transport without the rupture of any heat pipes. It is also important to note that thermal management performance was unaffected by the extreme cold storage.

This cooling methodology and the encapsulation of the medium-voltage components result in a harsh-environment inverter that protects the active power devices and circuit boards from the environment and airborne contaminants eliminating potential causes of failures. The encapsulation system also protects other components from flying debris and collateral damage in the event of a device failure.

Figure 15. Heat pipe thermal management system

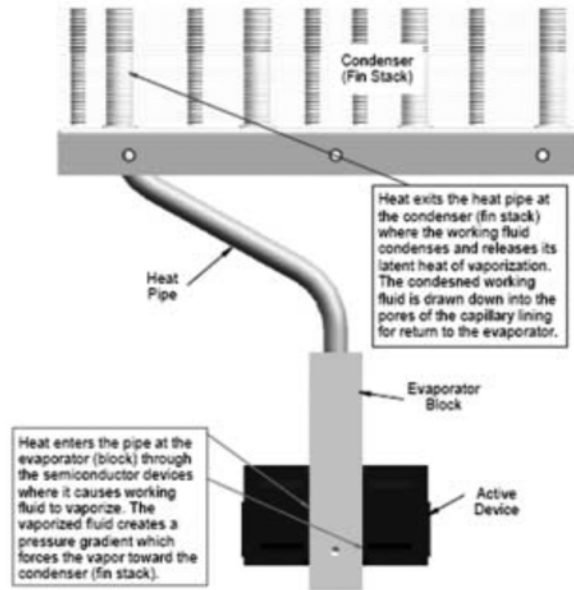
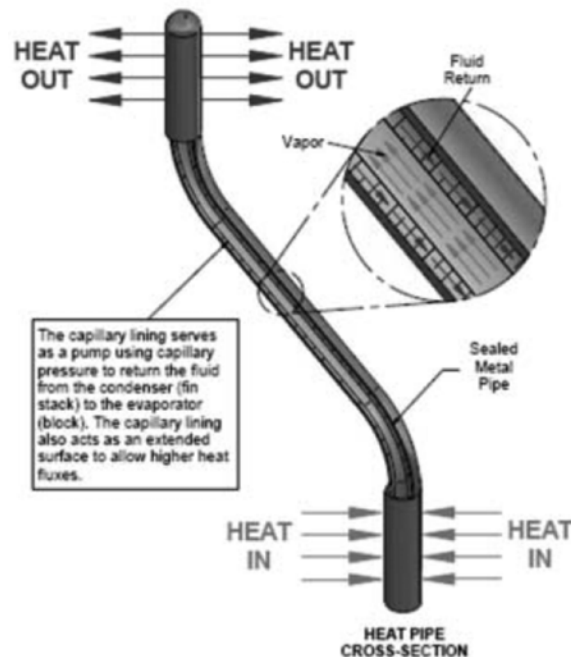


Figure 16. Heat pipe construction

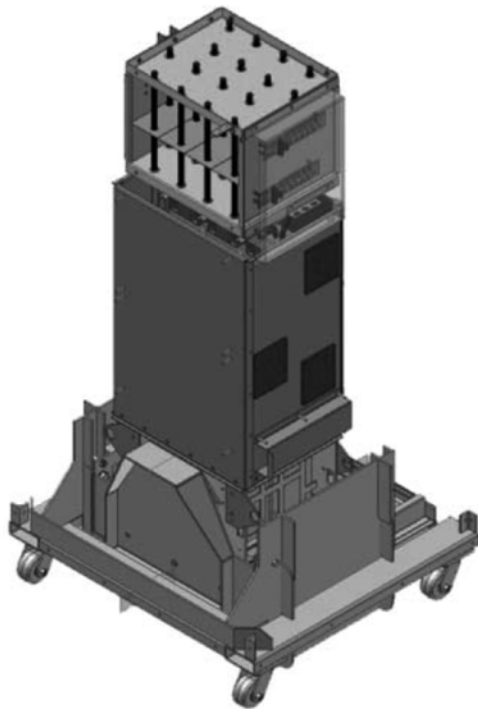


In the event of a failure, the modular roll-in/roll-out design of the inverter will minimize downtime. The SC9000 EP uses an inverter replacement system that minimizes mean-time-to-repair (MTTR) and is designed exclusively for the purposes of inverter module exchange.

The system removes the existing inverter safely and effectively and then allows for the insertion of a replacement inverter that is on-site or shipped from the factory where spare inverters are stocked.

The new and improved power pole inverter encapsulates the power electronics of each half-phase and allows each to be replaced individually rather than replacing the entire inverter.

Figure 17. Inverter replacement system



Mappable I/O specifications

The modules available to the customer for connection have been pre-wired to the CTB and configured to the controller. Refer to the job specific drawings to verify correct connection terminals. Verify I/O specs are compatible with the module, refer to **Figure 2**. Once connected, access the parameters on 9000XDrive or the keypad to map the component to the desired control.

Table 4. Terminal specifications

Turck I/O terminals (available on CTB)

Connection device	Type	Nominal voltage	Operating current
Power feed module	PDF 120 Vac	120/230 Vac	10 A (max)
Relay module	2DO-R-CO	230 Vac / 30 Vdc	3 A at 250 Vac (nominal) / 1 A at 24 Vdc (nominal)

⚠ WARNING

Do not connect test power to the starter control circuit without removing the plug from the receptacle. Failure to do so will result in a back-feed condition on the control power transformer, which will generate high voltage inside the controller with the isolation switch open. High voltage can cause severe injury or death.

Drive control

The drive can be controlled through the keypad on the drive door or by external signals. The keypad is the same unit as is supplied on Eaton's SPX line of low-voltage drives. Keypad operation is described in **Chapter 3** of this manual.

When all checks have been completed and the drive is ready to run, pull the emergency stop pushbutton on the low-voltage door to the "out" position. The drive can now be run via the keypad and/or remote signals.

SC9000 EP medium-voltage AFD sequence of operation

This document contains the sequence of operation for the SC9000 EP medium-voltage adjustable frequency drive. This is a reference document to understand how the drive operates internally.

CPT	Control Power Transformer
DIN	SPX Controller, A9 Option Card Input
DMCR	Drive Motor Control Rack
GIL	Green Indicating Light—OFF (OPEN)
ISW	Isolation Off Load Disconnect Switch
ISWX	Isolation Switch Auxiliary Relay
M	Main Contactor
MCS	Main Contactor Status
MCR	Main Contactor Relay
MP1	DC Bus Voltage Sensor Input
MP2	DC Bus Voltage Sensor Input
MP3	Current Sensor Input(s)
MRR	Master Ready Relay
MX	Main Contactor Coil
OPTA9	Option A9 card
PCR	Pre-Charge Ready
PT	Potential Transformer
PX	Pre-Charge Relay
RIL	Red Indicating Light—RUN (CLOSED)
RTD	Resistive Thermal Device
SPX	Drive Controller
T2	Blower Transformer
27/47	Undervoltage and Phase Rev. Relay

Startup

- Upon completion of the pre-start checks (see **Chapter 4**) apply line power to main bus of SC9000 EP.
- Closing Isolation switch (ISW) closes auxiliary contact ISW, and applies power to control power transformer (CPT), blower transformer and optional PTs. The Main Contactor Open green indicating light (GIL) is illuminated.
- The 27/47 relay detects the phase voltage level and phase-sequence and provides feedback to the TURCK controller (I2B). The contact is normally closed (NC) and opens when conditions are good. The relay settings range is 80% to 100%; factory set at 80%. The controller has a 1 second delay before a trip is issued to allow any transients to die out. The relay is connected to the secondary of the three-phase blower transformer at 480V. The relay is located on the blower control panel next to the blower contactors. The panel is only accessible when the ISO switch is open and the medium-voltage (MV) door is open.
- The TURCK I/O block power supply, motor controller rack power supply and TURCK power feeder modules are energized. Power supplies (PSG and U24) convert 120 Vac to 24 Vdc for the drive controller. Once energized, the controllers perform self-checks and display any errors found during boot up. The TURCK controller will close the main ready relay (MRR) if the Master controller and SPX controller are OK. The Ready light on the keypad illuminates. The Integrated Interface Card (ITG) alphanumeric display will display system status as text.
- A RESET command can be issued from the keypad, Field bus or remote customer input (DIN). This reset command is used to reset any alarms or faults that may prevent the drive from running. If the ITG board fault indications fail to clear, refer to the Troubleshooting portion of the Manual.
- A START command can be received from customer input on the CTB, the keypad or Field bus. This run command is passed from the SPX A9 card, producing a Run state that energizes PCR coil. PCR energizes an isolation transformer powering the PX contactor. This contactor powers a separate winding on the main transformer, magnetizing the transformer and charging the DC bus.
- The PCR contact energizes the pre-charge coil (PX) beginning the charge cycle. The DC bus is monitored and provides feedback to the Master card (MP3).
- The starters (main & redundant) for the blowers have auxiliary contacts that are connected to the TURCK I/O. The inlet air (ambient) and transformer (XFMR) core, inverter, and exhaust temperatures are monitored by the TURCK I/O. There are two values for transformer temperature – Alarm and Fault. Reaching the Alarm temperature will generate a drive alarm without stopping the drive. Reaching the Fault temperature will stop the drive.
- Once the DC bus voltage level is reached, the precharge timer stops; if the timer expires, a fault occurs. The main contactor is closed via main contactor relay (MCR) and MX pilot. The MCR contact is the last permissive in the MX logic rung. The MX coil energizes, energizing the main contactor coil controller. The coil controller uses a 100% duty cycle pulse width modulated (pwm) signal to pull in the DC coils of the main contactor. Once the vacuum bottles close, pwm duty drops to 10% to hold the contactor poles in. The green indicating light (GIL) turns off and red Run indicating light (RIL) illuminates.
- Inverter fans and blowers are commanded to run. The inverter heat sinks are monitored by three resistive thermal devices (RTD), one for each phase U,V, and W. RTD leads connect to a URTD module on the floating EP inverter. A fiber optic cable returns to RX2 on the master ITG board for temperature communication that passes on to the SPX controller through CAN messages.

11. The TURCK I/O block receives main contactor status feedback (MCS). When the main contactor closes, the IGBTs are gated on and the motor begins to ramp up. The PCR contactor drops out and pre-charge is ended.
12. Three current sensors monitor the output of the drive. These sensors are connected to the Master interface board at MP2. The signals are scaled internally on the ITG.

Power down

1. A stop command can be received from customer input on the keypad, fieldbus or removing the run command.
2. Upon receiving the STOP command, the drive will complete its preconfigured ramp down cycle and stop the motor. The motor should come to a complete stop.
3. Once the motor has stopped, the inverter will power off and the main contactor will open unless main contactor hold settings are active.
4. Once the main contactor is open, the DC capacitors will begin to discharge and bleed down via the capacitor bleed down resistors. It should be less than 50VDC in 5 minutes.
5. The blowers will continue to run until the preset cutoff temperature is reached or a restart command is received.
6. At this point, if any work is to be performed, refer to the POWERING-OFF PROCEDURE in **Chapter 7**.

Hardware components

Power supply

The power supply is designed to supply the power for the entire control rack. It also contains outputs to control relays for the Main Contactor, Pre-charge, Fan Blowers and 24 V Run Signal. When replacing the card on a single ITG unit be sure the jumper on the J1 header is in pin 11 and 13. On units with the a MITG and SITG remove the jumper. The control of these is from the ITG card. It is designed with 3 ounce copper outer layers and 1 ounce copper inner layers.

DC Bus Feedback 0V–GND

Figure 18. Power supply front view

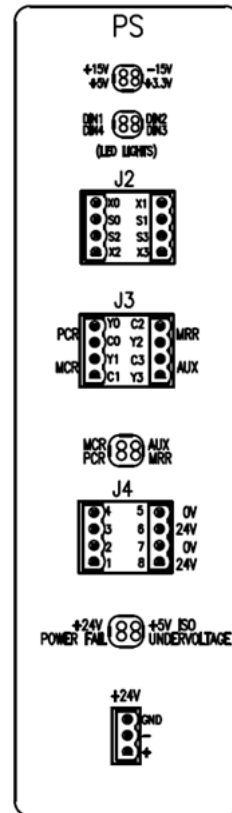


Table 5. Power supply inputs

Inputs	Description
+24 V	24 V—input
J4	24 V—output

Table 6. Relay connector outputs

Inputs	Description
J3	PCR—Pre-Charge Relay
J3	MCR—Main Contactor Relay
J3	MRR—Master Relay Ready
J3	Aux—Auxiliary
J2	24 V Output for External Boards

Motor interface card

The interface card provides the connection between the controller board via the X1 Connector and the control rack back plane. It provides the DC Voltage Feedback, +12/-12 Vdc Power and IC EPROM.

Figure 19. Motor connector PCB

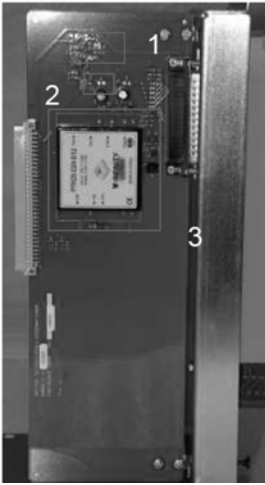


Table 7. Motor connector PCB components

Block	Description
1	DC feedback scaling
2	EEPROM
3	±12 Vdc power supply

Figure 20. Controller



ITG

ITG (Integrated Interface Card) integrates old Master and Slave Interface cards' functionality into one module. One single inverter units there is one ITG. On dual inverter units, two ITGs are needed, the first one being the MITG and the second one being the SITG. In the event of card replacement, refer to Eaton document 37C1239 for proper Dip Switch settings. On units using both MITG and SITG, remove the two post jumper on the MITG daughter card (**Figure 21**). The ITG uses fiber optic cables to communicate with the inverter. The ITG receives and processes inputs from voltage, current, and temperature sensors. It uses this information to provide commands for inverter control through the fiber optic cables.

- MP3 connector receives DC Bus Voltage.
- MP2 connector receives data from the Output Current Sensors to provide instantaneous adjustments.
- MP1 connector receives input data from RTDs for temperature measurement.

The fiber optic cables connect the ITG directly to the Inverter. They provide instantaneous communication and reduced noise. Each connector abbreviation is a direct correlation to the IGBT it connects to. The WNL connector goes to the W Phase, Negative, Lower IGBT. VPU goes to the V Phase, Positive, Upper IGBT.

- TX1,RX1 provide high-speed bus communication to the OPTD2 card in slot E
- CH,CL (CAN1&2 on dwg.) provide CANbus communication to ITG from OPTD2 slot E
- TX2/RX2 are for temperature sensors
- TX3/RX3 is used for Motor RTD II module (MITG only).

Upon startup, the ITG will display the system status in words on the display (**Figure 22**). First the power supply card will indicate power ready, then the ITG will display the software version and a wait que. Then it will display some parameter set points, followed by status STOPPED. Once the run command is sent to the SPX controller, the ITG will display PRE CHARGE during the pre-charge cycle (may be as little as one second). Then the OLED display will show running once the drive begins to run the motor.

Figure 21. Two post jumper and DIP switches



Figure 22. ITG status



Figure 23. ITG

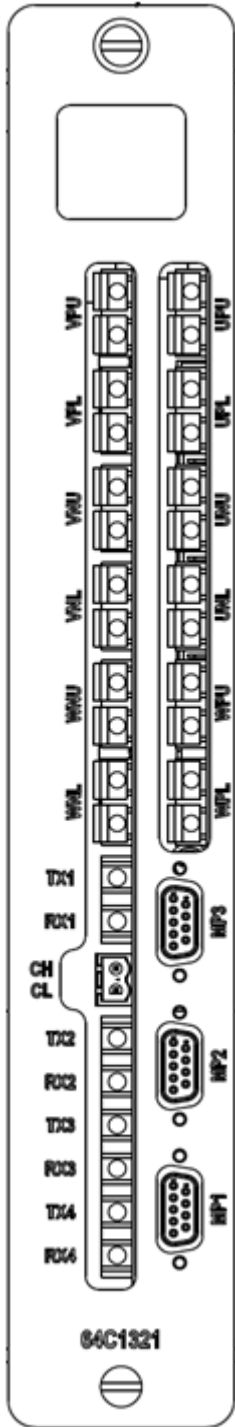


Table 8. RTD cable

Connector MP1	Pin description	
1	RTD1	RTD U Phase
2	AGND	
3	RTD2	RTD V Phase
4	AGND	
5	RTD3	RTD W Phase
6	AGND	
7	RTD4	
8	AGND	
9	AGND	

Table 9. UVW cable

Connector MP2	Pin description	
1	15	Phase U
2	IU	
3	-15 V	
4	15	Phase V
5	IV	
6	-15 V	
7	+15 V	Phase W
8	IW	
9	-15	

Table 10. DC bus cable

Connector MP3	Pin description	
With LEM voltage sensors		
1	15	VTP
2	-15 V	
3	+DC Bus	
4	AGND	
5	+15 V	VTN
6	-15 V	
7	-DC Bus	
8	AGND	
9	AGND	
With voltage monitoring board		
1	+15 V	VTP
2	-15 V	
3	+DC Bus	
4	AGND	
5	VnnRMS	VTN
6	VuvRMS	
7	-DC Bus	
8	AGND	
9	VnnAVG	

Chapter 6: Maintenance

A maintenance program should be established as soon as the drive has been installed and put into operation. After the drive has been inspected a number of times at weekly intervals and the conditions noted, the frequency of inspections can be increased or decreased to suit the conditions found.

WARNING

All incoming power must be disconnected and locked out before performing maintenance on the SC9000 EP. The DC bus voltage must be fully discharged per the “Discharging DC bus” section in Chapter 7. Failure to disconnect incoming power and verify DC bus is discharged can result in equipment damage, personal injury, or death.

Before attempting maintenance, consult the specific circuit diagrams and other documentation supplied with the drive.

Main contactor and fuse truck

Follow the steps below to remove the contactor/fuse truck from the input cell. Installation is the reverse of the removal process. Note that the mechanical interlock mechanism on the side of the contactor must be reconnected before the contactor can be closed. The mechanism is weighted in such a manner that the contactor cannot operate until the interlock rod clevis is reconnected.

- Disconnect mechanical interlock on right side of contactor
- Unplug Control Harness
- Remove two bolts that mount the front rail on the left side of the contactor to the floor panel
- Swing truck to the left while withdrawing it from cell

Inspect the contactor line and load fingers for signs of arcing or overheating. Replace as necessary. Inspect the mechanical interlock components attached to right side of the contactor main operating shaft and side sheets. Ensure the lever is secure on the shaft and that the pivoting arm moves freely. Verify that the finger assemblies are in their neutral (horizontal) position before reinserting the contactor into the cell. No lubrication is required.

Refer to IB 48018N for details of additional contactor operation and maintenance information.

For installation, reverse the order of the above procedure.

Fuses

Inspect the current limiting fuses after each relay initiated trip, because this is the most severe service to which they will be subjected. Check the fuse resistance, and compare with the value of a new fuse. A pop-up indicator on the visible end of the fuse provides a visual sign of an open fuse. If a fuse has blown due to a fault, it is likely that the other fuses experienced a similar overcurrent condition. In this case, Eaton recommends that all three fuses be replaced. Ensure that the replacement fuses are of the same rating and mounting configuration as those originally supplied.

Isolation switch

The isolation switch consists of a fixed rear portion and a removable front portion. The switch should operate smoothly in both directions, with an increase in resistance as the stabs engage the controller line fingers. Inspect for any signs of mechanical wear or overheating.

To withdraw the removable portion:

- Remove the main contactor truck assembly
- Remove the control plug
- Remove the cotter pin and clevis pin from drive rod clevis
- Remove the two bolts securing the removable portion of the switch to the fixed portion
- Pull the switch forward, then down and out of the controller

WARNING

Take care not to let the switch quickly drop down as the removable portion separates from the fixed portion or damage to the shutter can occur.

The fixed portion of the switch including the isolating shutter remains in the controller. Medium-voltage may be present at the line fingers behind this shutter. Before attempting to inspect the line fingers or do other work on the fixed portion of the switch, ensure that the controller incoming power is isolated and locked out at an upstream feeder.

With the incoming power locked out, the fingers can be inspected and the vertical bus connections checked for tightness. Remove the polyester barrier mounted immediately below the switch for access to the vertical bus connections. Verify the operation of the shutter mechanism by gently pushing it to the left. It should spring back to the closed position when released.

⚠ WARNING

Failure to lock out incoming power before servicing the fixed portion of the switch or vertical bus can result in equipment damage, severe injury, or death.

Reinstallation is the reverse of the procedure above. Make sure that the shaft of the removable portion of the switch is rotated to the fully open position before reinstallation.

⚠ WARNING

If the switch is inserted with the shaft in the closed position, the shutter may be forced open and live parts may be contacted, resulting in severe injury or death.

Operating handle and door interlock

A mechanical interlock prevents opening the medium-voltage door with the switch in the closed position. A steel plunger lowers into position as the switch is closed. This plunger engages a bracket welded to the back of door, preventing the door from opening with the switch closed. In the unlikely event the switch malfunctions and cannot be opened, it will be necessary to drill out the welds to allow access to the medium-voltage compartment. Prior to performing this work, make sure that power is disconnected upstream. Refer to **Figure 24**. Use a 1/4-inch bit and drill out the two welds that can be seen just below the handle mechanism. After repairs are made to the switch mechanism, the door should be replaced with a new factory built part to ensure the restoration of the interlock feature.

Figure 24. Drill location for emergency entrance to cabinet



Rectifier assembly

Inspect diode fuses after each relay initiated trip due to a current fault, since this is the most severe service to which they will be subjected. Check the fuse resistance, and compare with the value of a new fuse. A pop-up indicator on the visible end of the fuse provides a visual sign of an open fuse. If a fuse has blown due to a fault, Eaton recommends that all three fuses on that secondary be replaced. Ensure that the replacement fuses are of the same rating and mounting configuration as those originally supplied.

Inverter

No regular maintenance of the inverter is required.

Door filters

Door filters are washable; they should be inspected regularly and cleaned when dirty. A clogged filter will reduce the cooling efficiency of the blowers and shorten the life of the drive.

Loosening the thumbscrew on the top of the filter frame and tilting the frame out will allow removal of the filter.

Blowers and fans

Blowers on the roof of the drive are provided to exhaust hot air from the drive enclosure. Fans on the inverter heatsink are provided to cool the inverter IGBTs. The blades of the blowers and fans should be cleaned at intervals deemed necessary by routine inspection. The main contactor should be in the off position and the drive isolation switch opened before servicing the unit.

Blowers are constructed using bearings with "lifetime lubrication." The blower is maintenance free.

Fans and blowers are of the heavy-duty type with a Mean Time Between Failure (MTBF) rating of 50000 hours for long life and dependable service. Expected life could be shortened if excessive dirt or dust damages the bearings. Replacement parts are available from Eaton.

To replace a transformer blower, remove the top steel sheet from above the blower by unbolting the sheet from the rest of the case. Next unbolt the blower from the top and bottom and check that all bolts are loose and removed and the motor wires are disconnected. Remove and replace the blower and do the previous steps backward to install the new blower.

To replace an inverter fan remove the guards on the fan, then unscrew the fan from the structure. To replace the second and third fans away from the front of the cabinet, Eaton advises removing the inverter as discussed later in this manual.

Recommended spare parts

Refer to the documentation shipped with the job to see the recommended spare parts for the particular model(s) on that job.

Table 11. Spare parts

Quantity	Description
1	Transformer blower
1	Inverter fan
1	Control fuse kit
1	Main fuse kit
1	Inverter cart
1	Power pole set

SC9000 EP maintenance schedule

CAUTION

Before starting work, review appropriate ILs and Control Schematic to understand the safety issues.

WARNING

BEFORE WORKING INSIDE THE DRIVE, THE ADJUSTABLE FREQUENCY DRIVE MUST BE STOPPED.

Every month

Clean the air filter

- The air filter can be cleaned while the drive is running
- Loosen screw on the filter mounting bracket
- Remove filter from bracket
- Vacuum filter
- Install the filter back in the bracket
- Perform this on all doors with filters

Verify that the blowers are running properly

- Listen for abnormal sounds from the blowers

Review fault history through the keypad.

Every year

Stopping the adjustable frequency drive (AFD)

- STOP drive with the normal control system or use keypad STOP command
- After the input contactor has opened on the drive, monitor the DC bus voltage, wait until <50 Vdc is shown. This should take approximately 5 minutes
- Open the isolation switch on the drive and lock it out
- Open the doors to the drive. Locate the yellow shorting stick and ensure metal end of stick is grounded
- Discharge both halves of DC bus utilizing grounding studs on the rectifier
- Use a tick tracer to verify that all sources of AC control power is off

Cleaning

- Clean all cabinets with a non-static vacuum cleaner to remove any dust and debris. Do not vacuum any electronic boards or devices. Do not use canned air as this can leave a conductive film on material. Do not use compressed air as this can force particles further into the transformer

Inspect power components for signs of damage or heat stress.

Visually inspect all accessible wiring, check connections to verify snug fit, if found loose, tighten with a screwdriver.

Control wiring

- Within the control bucket, check each wire is not loose
- All control wiring into low-voltage controller and medium-voltage controller should be properly shielded and grounded. Ensure a proper ground connection. **DO NOT OVER TORQUE GROUNDING SCREWS ON SHIELD.** This can crimp the wires within the shield and short them out

24 Pulse converter

- Remove Lexan barrier
- Check for any discoloration, overheating or mechanical stress
- Check power connections on the rectifier and power transformer by rotating the connections by hand. If a loose connection is found, the connection should be torqued. Torquing of all power connections is not recommended
 - Cables from transformer labeled 1R, 1S, 1T, 2R, 2S, 2T, 3R, 3S, 3T, 4R, 4S and 4T
 - Semiconductor fast blowing fuse pins and connections F1 through F12
 - All bolted connections to the semiconductor fuses, diodes and cables
 - Dual diode pack module mounted on the heatsink
 - Positive, Negative, Neutral crimp and cable connections (POS, NEG, NEUT)
 - Voltage divider connections to the bus (POS, NEG, NEUT) and into the medium-voltage controller MP3
 - Disconnect the positive and negative discharge resistor wires and read the resistance of each wire to neutral, compare this to the job drawings
 - When replacing Lexan barrier, make sure discharge studs are properly exposed to cutout and can be easily accessed

Blower and fans

- Check main and redundant blowers (redundant if applicable)
- Check secondary 480 V blower fuse by resistance across terminals of each fuse
- Check each set of blower overload relays. Overload settings to be 3.2 A with automatic reset
- Verify that all control wiring is properly seated and not loose
- Spin inverter fans for smooth turning and healthy bearings. Access and visual check to these fans may be difficult without removal of inverter and is not recommended if inverter is healthy
- Check removable air filter in front of drive for excess debris and particles. Clean off with warm water, dry off before reinstalling filters

- When drive is ready to be turned on, go to parameters P1.12.31 and P1.12.32 to reduce the cycle time to confirm both Main and Redundant blowers operate correctly (change back to default values when finished)
- Visually inspect proper rotation of blowers and fans
- Audibly check that there is no excessive noise due to vibration in cabinets or in blower assembly

Contactors and fuse assembly visual inspection

- Remove the contactor
- Check that the phase barriers are in good condition and fit correctly. If broken or missing get new ones. The contactor will not have the Basic Impulse Level (BIL) without the barriers
- Inspect all bolted joints for signs of overheating and discoloration. Do not tighten with a wrench. If there are signs of overheating, take the joint apart and clean before reassembling
- Inspect fuses for signs of overheating, discoloration and mechanical damage
- Inspect all bolted joints, look for signs of overheating. Do not tighten to check
- Check line and load finger cluster springs. The tension should be about equal on all clusters. If springs are discolored or burned—replace. If finger clusters are burned on the contact surface—replace
- Mechanical interlock: Inspect for free movement and alignment
- Check all wiring to see if it is secure in its terminal and tighten as required
- Check the operation of the auxiliary interlocks, pin 2-3, 4-5, 6-7 and 8-9 interlocks. Refer to the order drawings for special contact configuration. Standard arrangement is 2-3 and 6-7 being NO and 4-5 and 8-9 being NC
- Check pole closing—all at the same time. Two or three light or voltmeter method is OK
- Inspect hardware securing operation plate and moving armature to the main shaft
- Inspect operating lever mechanical interlock bracket on main shaft for any cracks or breaks
- Clean the contactor
 - Dry dirt and dust may be removed by blowing off with the output of a vacuum cleaner with a non-static tip
 - Grease and dirt film may be removed by wiping with “409” cleaner, then wipe with clean water or alcohol
 - Clean carefully the front of the contactor. Do not bang or bump the interlock activators, clean gently

Isolation switch

- Remove isolation switch (if necessary)
- Inspect isolation switch line fingers. Look for discoloration and overheating
- Check all bolts and screws for tightness. Check line finger spring
- Check that ground fingers and ground bars are OK
- Clean and re-grease line fingers with DC-4 silicone grease
- Check for smooth operation of handle
- Check operation of isolation switch auxiliary interlock. Switch must change position with first 15 degrees of opening movement of the switch handle
- Check all Kirk key interlocks. Interlock scheme on outline drawings
- Cell Inspection—Visual—Tight Connections—Overheating
 - Load cables and stabs
 - Load cables
 - Load stab assembly. Look for wear and burns
 - Clean and lubricate with DC-4 silicone grease
 - Line stab assembly
 - Remove shutter mechanism from isolation switch incoming line stab assembly
 - Check for tight connection and any abnormal discoloration. Clean and re-grease stabs with DC-4 silicone grease
 - Replace barrier
 - Check operation of barrier for smooth operation
- Cable entry and or exit locations
 - Check cable entry ONLY if upstream power is disconnected feeding the drive, locked and tagged out
 - Cable exit connection either in inverter section or incoming section of a stand-alone drive

Every 5 years**Stopping the adjustable frequency drive (AFD)**

- STOP drive with the normal control system or use keypad STOP command
- After the input contactor has opened on the drive, monitor the DC bus voltage, wait until <50 Vdc is shown. This should take approximately 5 minutes
- Open the isolation switch on the drive and lock it out
- Open the doors to the drive. Locate the yellow shorting stick and ensure metal end of stick is grounded
- Discharge both halves of DC bus utilizing grounding studs on the rectifier
- Use a tick tracer to verify that all sources of AC control power is off

Remove inverter from the cabinet and inspect stab connections and power wires.**Contactor and fuse assembly**

- Replace control and power fuses
- Check the wear on vacuum bottles and high pot the bottles. Refer to Instruction Book IB48018N for further details on the operation and maintenance of the vacuum contactors

Replace fans and blower motors. These devices have a 50,000 hour life.

If the feeder to the drive lineup is locked out, the main bus compartment covers can be removed so that the power connections can be inspected. With the covers removed, inspect the surge arresters and clean the compartments with a non-static vacuum cleaner.

Instructions for the replacement of medium-voltage drive inverters

Scope

These are general instructions that apply to all frames power pole inverters of Eaton SC9000 EP medium-voltage adjustable frequency drives.

Precautions

Due to the nature of the components used within the inverter, special precautions must be taken to avoid damage to the circuitry. The person working on the equipment must wear a grounded static strap thus eliminating the static charge on that person.

Use caution to prevent pinched fingers; inverters can weigh up to 2000 lb (910 kg).

There is a hazard of electric shock whenever working on or near electrical equipment. Turn off all power supplying the equipment before starting work. Lock out the disconnecting means in accordance with NFPA 70E®, "Electrical Safety Requirements for Employee Safety In the Workplace." Discharge rectifier, inverter, and DC bus with grounding stick. Where it is not feasible to de-energize the system, take the following precautions:

1. Instruct persons working near exposed parts that are or may be energized to use practices (including appropriate apparel, equipment and tools) in accordance with NFPA 70E.
2. Require persons working on exposed parts that are or may be energized to be qualified persons who have been trained to work on energized circuits.

For the purpose of these instructions, a qualified person is one who is familiar with the installation, construction, or operation of the equipment and the hazards involved. In addition, this person should have the following qualifications:

1. Be trained and authorized to energize, de-energize, clear, ground, and tag circuits and equipment in accordance with established safety practices.
2. Be trained in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc. in accordance with established practices.
3. Be trained in rendering first aid.
4. Be knowledgeable with respect to electrical installation codes and standards, for example, the National Electrical Code® (NEC®).

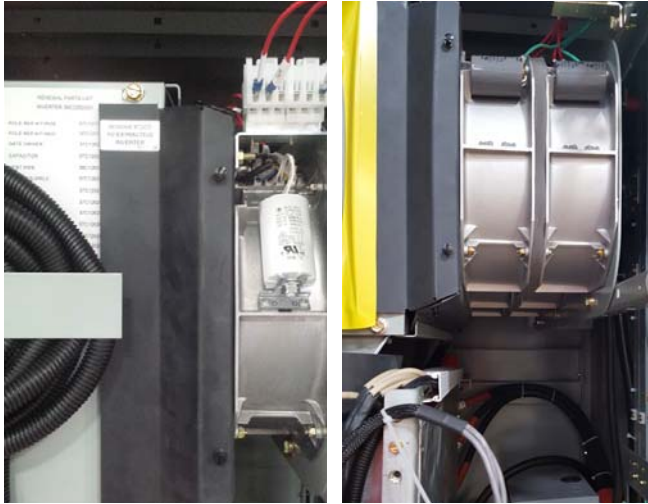
Preparation

Before removal, ensure that the structure has been properly prepared during assembly or removal of a previously installed inverter. This is a good time to check torqued connections and remove any debris. Make sure the drive is also zero energy verified.

1. Remove the support brace and metal cover from the front of the inverter and disconnect the ground cables, power supplies and RTD wiring per the applicable schematics. Remove fiber optic cables from the control bucket. Wrap the fiber optic cables around the metal mountings.



- Remove the side flange of the formex fan shroud and disconnect the fan wiring terminal blocks.



- Using a 3/8-inch drive tool, turn the racking mechanism screw counterclockwise until the inverter stabs are fully disengaged with the stab panel fingers. Perform this step with a coworker spotting you incase the inverter begins to move.



- Remove the support brace holding the inverter in place at the bottom of the drive structure. Perform this step with a coworker spotting you incase the inverter begins to move.





5. Align inverter wheels with cart or ramp and adjust cart or ramp to proper height for a smooth transition.



6. Ensure that all wiring is held or secured free from interference with the inverter. Take special care of the position of the fiber optic cables which can catch on the heat pipe radiators. Check to make sure all wires and groundings are unattached from the inverter.
7. Pull the inverter slowly towards the cart or ramp with the help of multiple coworkers.

8. Short circuit the positive, neutral, and negative DC stabs on the rear of the inverter using a shorting strap.



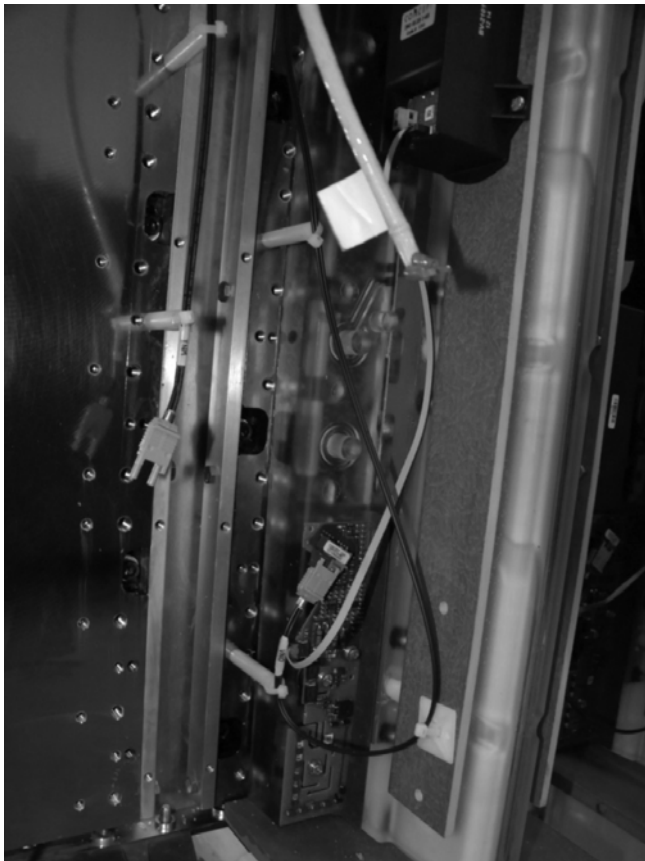
9. Reverse steps for installation.

Instructions for individual power pole removal and replacement

The power poles themselves are removable and replaceable within the rollout inverter with very little difficulty and time. The inverter shroud first be removed before performing any maintenance or replacements on the power poles.

1. After removing the inverter side sheet, remove the outer pole cover from the old pole needing replacement.
2. The old pole is then unbolted from the capacitor, AC bus, and heatsink after all fiber optic and power cables have been disconnected.

Figure 25. Disconnect power supply, fiber optic and ribbon cables



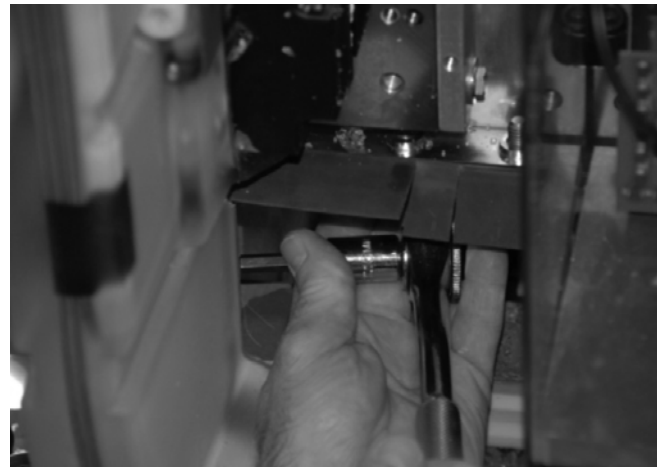
(Care must be taken with ribbon connector. Use tip of pen to push on red release button on ribbon connector before applying any force.)

3. The old pole is then unbolted from the capacitor, AC bus, and heatsink.

Figure 26. Remove bolts to capacitor



Figure 27. Unbolt electrical connections at back and bottom



4. After removal of the old pole, the heatsink is cleaned of thermal paste using mineral spirits and/or denatured alcohol.
5. A new layer of thermal paste is reapplied to the heatsink using screen.

Figure 28. Fix screen to heatpipe



Figure 29. Apply thernal paste



Figure 30. Remove screen carefully

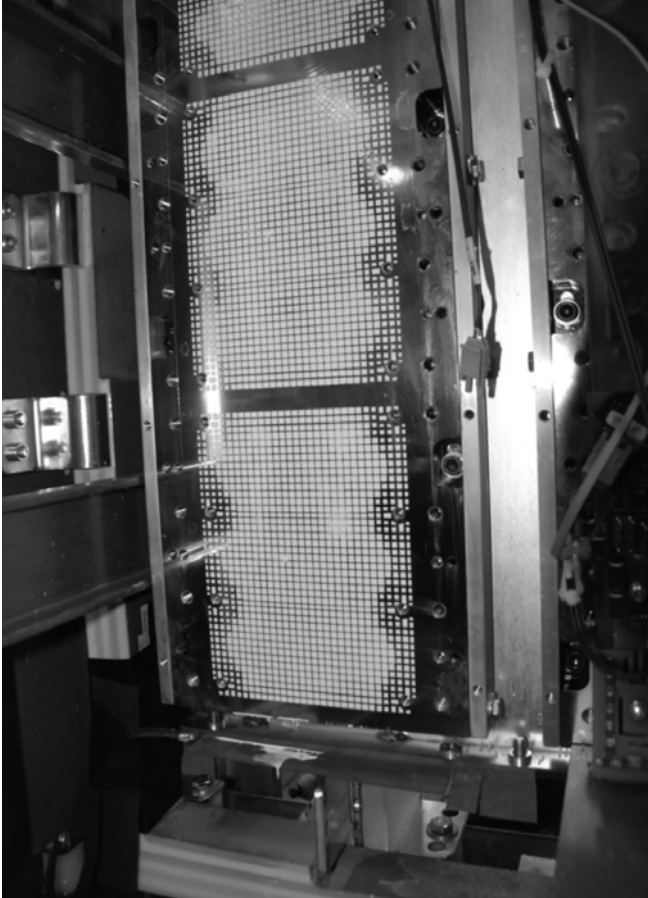


Figure 31. Install tapered pins for aligning power pole



6. Using two mounting studs, the new Power Pole is positioned into place and the M6 caphead screws are started into the mounting holes to secure the pole to the heatsink. The M6 screws mounted to the heatsink shall be torqued to 2 Nm. After waiting 30 minutes they are further torqued to 5 Nm.

Figure 32. Place power pole on heatpipe



Figure 33. Secure hardware to power pole (wait 30 minutes and torque appropriately)



7. The AC bus connection and capacitor terminal connections are then connected before anything is tightened down. The AC bus connections are to be torqued to 5 Nm and the capacitor connection to 10 Nm.

Figure 34. Secure electrical connections

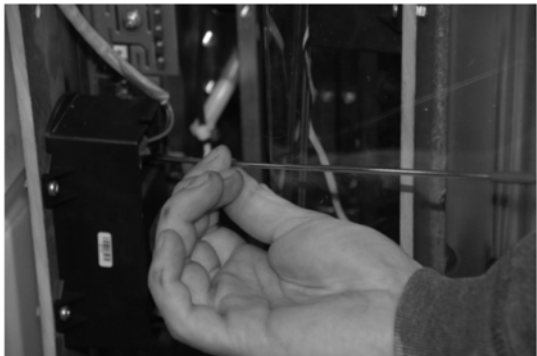


Figure 35. Mount paddles with power supplies and gate drivers (IMPORTANT: Remove bonding and use static precautions)



8. The fiber optic and power supply cables are reconnected and the outer pole cover replaced. Static straps required.

Figure 36. Reconnect power supplies and fiber optic cables



Chapter 7: Troubleshooting and fault tracing

Powering-off procedure

Before performing any task during which you must inspect, maintain, or troubleshoot the SC9000 EP power system, you must do the following:

1. Stop SC9000 EP and observe that the motor has completely stopped.
2. If control power is ON, make sure the DC bus voltage is at a safe level (wait until <50 Vdc is shown) by means of a computer or the keypad.
3. Turn OFF the incoming power to the drive by opening and grounding the disconnect switch for the circuit that feeds the drive. Follow all applicable lockout/tagout procedures.
4. Turn OFF the control power. If control power is needed, plug an extension cord from any 120 V power source into the test plug located on the control panel. This will give 120 V control power to the unit.
5. Wait for at least 5 minutes before proceeding to the next step.
6. Open the doors to the drive. Locate the yellow shorting stick and ensure metal end of stick is grounded.
7. Discharge both halves of DC bus utilizing grounding studs on the rectifier per the “Discharging DC bus” section below.
8. Proceed with the necessary inspection, troubleshooting, or maintenance.

Discharging DC bus

1. Use proper PPE, clothing, face shield, gloves, and hearing protection.
2. Remove the medium-voltage source, and verify the precharge circuit is off (GP drives).
3. After at least 5 minutes of discharge time, verify with the SPX controller keypad that the DC voltage is below 50 Vdc.
4. Open the isolation switch.
5. Open the medium-voltage drive door that gives access to the rectifier.
6. Remove and extend the shorting stick to its maximum length.
7. Stand back from the drive.
8. Place the metal end of the shorting stick on stud number 1, per the applicable following figures.

Figure 37. SC9000 Frame A discharge studs

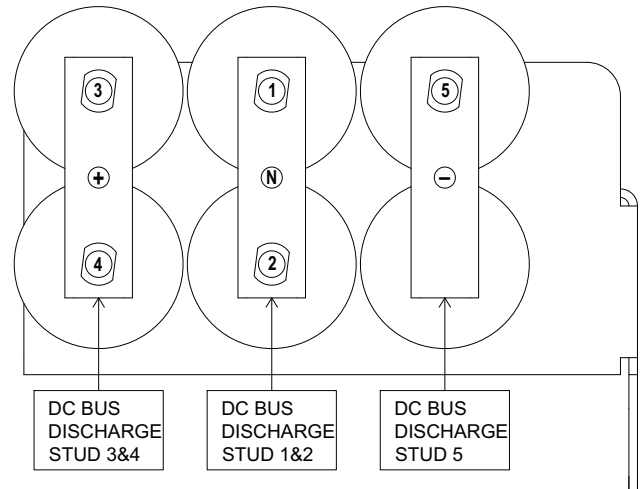


Figure 38. SC9000 Frame B/C/D discharge studs

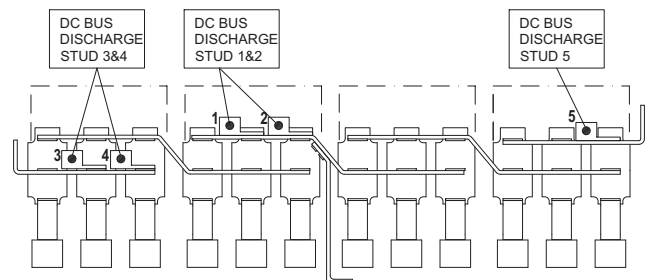
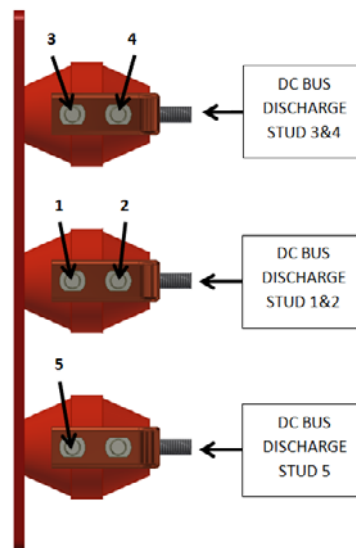


Figure 39. SC9000 GP discharge studs



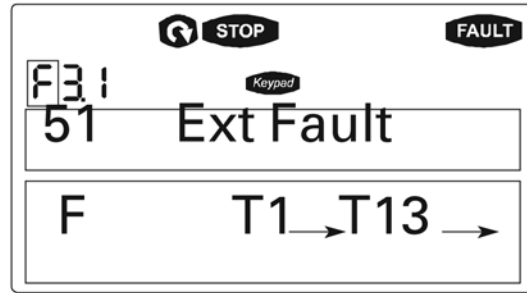
9. With the shorting stick on stud number 1, place one of the grounding cable (that is tied to the ground bus) on stud number 2.
10. Move the shorting stick from stud number 1 to stud number 3.
11. With the shorting stick on stud number 3, place the other grounding cable (that is tied to the ground bus) on stud number 4.
12. Move the sorting stick from stud number 3 to stud number 5.

Indications

When a fault other than an ALARM takes place, the SC9000 EP stops. The sequence indication F1, the fault code, a short description of the fault and the fault type symbol will appear on the display located on the control panel. In addition, the indication FAULT or ALARM is displayed and, in case of a FAULT, the red LED on the keypad starts to blink. If several faults occur simultaneously, the sequence of active faults (accessible from menu M3) can be browsed with the Browser buttons. See **Figure 40**.

The active faults memory can store a maximum of 10 faults in the sequential order of appearance, with F1 the most recent fault and F10 the oldest. The fault remains active until it is cleared with either the STOP or RESET buttons or with a reset signal from the I/O terminal. To avoid losing valuable fault data, record faults and associated data. If the memory is full, triggering another fault will erase a fault. Avoid hitting the Estop or anything thing else that may trigger a fault. Upon fault reset, the display will be cleared and will return to the same state it was before the fault trip. If the fault is still present and no remedial actions have been taken, the drive will not power on, even if the buttons STOP or RESET are pressed.

Figure 40. Active fault display example



CAUTION

Remove any external start signals or permissives before resetting the fault to prevent an unintentional restart of the SC9000 EP, which could result in personal injury or equipment damage.

Fault Type Range: A, F, AR, FT
 Fault Type
 There are four different types of faults. These faults and their definitions are given in **Table 12**.

Note: These fault codes represent those in version 5.30C of the firmware. For information on fault codes for prior or subsequent versions, contact the factory.

Table 12. SC9000 EP/SPX controller fault codes

Fault code	Item	Description	Warning text	Fault text	Possible solutions
1	Overcurrent	Current has reached four times the maximum rated FLA	Overcurrent	Overcurrent	See Table 15, Note C
2	Overvoltage	Voltage on DC bus has reached high trip threshold (nominal 118% rated RMS)	Overvoltage	Overvoltage	See Table 15, Note D
3	Earth Fault	Sum of the output phase current is not equal to zero. Potential earth fault outside the SC9000.	Earth Fault	Earth Fault	Check the motor and/or motor cables to earth ground for impedance.
9	Undervoltage	Voltage on DC bus has gone below low-voltage trip threshold (nominal 60% rated RMS)	Undervoltage	Undervoltage	See Table 15, Note E
11	Output Phase	Loss of current draw or a significant difference in current draw on the output of the SC9000. Fault occurs above 0.5 Hz if any phase is less than 1/8 the sum of all the filtered output currents when lasting for more than 2 seconds.	Output Phase	Output Phase	Disconnect the motor load and start the SC9000 open circuit. If the drive fault on FCODE 11 again there is something wrong with the current measurement circuits within the SC9000. If the open circuit voltage is observed o.k. on an oscilloscope shutdown and re-connect the machine. Monitor IUrms, IVrms, and IWrms in 9000XDrive Monitor PC tool for uneven distribution.
15	Motor Stall	Motor stall determined by SPX controller P1.7.17–P1.7.20 parameter settings.	Motor Stall	Motor Stall	Determine if parameters are set according to the application and machine ratings. Otherwise this fault is indicative of a locked rotor, is the machine rated for the load and starting torque required? Use 9000XDrive Monitor tool with firmware type signals 'motorcurrent' and 'freqout' along with 'motorregulatorstatus' statusword [bit 0 is motoring current limit status] to determine where the machine is being stalled.
16	Motor Overtemp	An SPX calculated over-temperature from motor nominal frequency and current plus parameters P1.7.12–P1.7.15.	Mot.Overtemp	Mot.Overtemp	Adjust SPX parameters per the machine and application with respect to i^2t calculations. Capture the output frequency and motor current using 9000XDrive signals firmware type 'freqout' and 'motorcurrent' either with the Monitor tool or Advanced DataLogger to determine if excessive current is being drawn near rated motor frequency.
17	Motor UnderLoad	Motor torque below minimum threshold per SPX parameters P1.7.21–P1.7.24.	MotorUnderld	MotorUnderld	Adjust SPX parameters per the machine and application.
22	Parameter Fault	A parameter value has been corrupted and/or the microprocessor failed the start up check.	Param. Fault	Param. Fault	Reset the SC9000 at keypad or other control place. If this fault repeats re-load the PAR parameter file using 9000XDrive PC tool or replace the SPX controller.
50	Analog In<4mA	Analog input link is below min of 4mA	Anlg lin<4mA	Anlg lin<4mA	Insert digital multimeter instrument in series with external current source and measure. This will determine if it is an SC9000 concern or external control signal problem.
51	External Fault	External fault input tripped	Ext Fault	Ext Fault	Check Schematic, determine which fault occurred and what is in that circuit. If the fault string has been jumpered and the fault still exists, the OPTA9 card may need replaced.

Table 12. SC9000 EP/SPX controller fault codes, continued

Fault code	Item	Description	Warning text	Fault text	Possible solutions
52	Keypad Comm	Keypad communications lost	Keypad Comm	Keypad Comm	Check the cable between the ITG rack SPX controller and the door mounted keypad bezel. Ensure the keypad is properly seated in the door mounted bezel. Install keypad in ITG rack control module. Replace keypad. If the fault persists, the SPX controller may need replaced (capture the PAR parameter file and drive service info file from the controller before doing so).
53	Fieldbus Comm	Fieldbus communications lost	FBCommunicat	FBCommunicat	Check with the operator/systems-integrator to ensure the communication protocol is correct. Ensure the option card is correct and is recognized by the SPX controller in 9000XDrive. Check the parameters to ensure the correct slot is used for communications.
54	Slot Comm	Adapter board in slot communication fault	Slot Communic	Slot Communic	Check SC9000 SPX controller drive menu to ensure card is recognized (Slot E will not be recognized). Change option card with known good card, if fault continues change SPX controller module [see note above concerning PAR and service info file capture].
55	UPS Battery Bad	Bad battery digital input.	UPSBatteryBad	UPSBatteryBad	Check the installed UPS connection per the schematic. Check the UPS battery. Replace UPS or battery as necessary.
56		SC9000 GP Run Enable not mapped.	MapRunEnabGP	MapRunEnabGP	Check digital inputs in parameters (including remote I/O) to verify Run Enable is mapped.
57	Identification	Motor identification run failed. See parameters P1.6.12, P1.6.13.1	Identificatio	Identificatio	Consult the factory.
58	RunEnableLost	Run enable DIN lost (dropped after running)	RunEnableLost	RunEnableLost	Check Schematic, determine what is in that circuit. If the run enable has been jumpered and the fault still exists, OPTA9 card may need replaced.
59	BypassContactorClosed	Run disabled due to bypass contactor closed	BypassLost	BypassContOpen	Check the output contactor auxiliary contact wiring to the SC9000 I/O rack. Verify the remote digital input is mapped correctly. Listen to the output contactor audibly to see if it is closing or no.
60	FilterCapOP	Pressure in Filter Capacitor is high	FilterCapOP	FilterCapOP	Check the status of the Sine Filter Caps, if normal check the wiring to the Turck I/O. Check mapping in the parameters to ensure it matches the input.
61	FilterIndOT	Temperature of Filter Inductor is high	FilterIndOT	FilterIndOT	Check the status of the Sine Filter inductors, if normal check the wiring to the Turck I/O. Check mapping in the parameters to ensure it matches the input. Check the AC fan cooling the Sine Filter inductor, check input filter to see if it is clogged.
62	ExciterFieldLoss	Feedback from 'exciter OK' input lost	ExcFieldLoss	ExcFieldLoss	Verify connection between external exciter controller and SC9000. Troubleshoot exciter controller.
63	Output Transformer Coil	Output Transformer is hot	AutoXfmrOT	AutoXfmrOT	Check the status of the output transformer, if normal check the wiring to the Turck I/O. Check mapping in the parameters to ensure it matches the input. Check air-flow and filters.

Table 12. SC9000 EP/SPX controller fault codes, continued

Fault code	Item	Description	Warning text	Fault text	Possible solutions
64	Rectifier Overtemperature	Rectifier heatsink too hot	RectifierOT	RectifierOT	Check the fan operations. Check the rectifier heatsink for blockage and contamination. Check the ambient temperature. Check the RTD
65	Inverter Overtemperature	Inverter heatsink too hot	InverterOT	InverterOT	Check the fan operations. Check the heat pipe for blockage and contamination. Check the ambient temperature. Check the RTD and the wires to the Turck I/O or URTD module mounted to the inverter after the DC bus is discharged.
66	Reactor OT	Inductor too hot	ReactorOT	ReactorOT	Check the status of the reactor, if normal check the wiring to the Turck I/O. Check mapping in the parameters to ensure it matches the input. Check air-flow and filters.
67	Exhaust Hot	Exhaust hot	ExhaustHot	ExhaustHot	Ambient temperature above unit specs. Air filters may be clogged, require cleaning or replacement. Check wiring to the Turck module and ensure the parameters match the device.
70	UPSNotReady	UPSNotReady	UPSNotReady	UPSNotReady	Check the wiring from the UPS to the Turck I/O. Check parameter mapping. Check UPS. Consider replacing the UPS.
71	LineVoltLoss	Three phase medium-voltage to drive lost at 24/47 relay	LineVoltLoss	LineVoltLoss	Check the upstream power for amplitude and phase sequence ABC (if SC9000 blowers spin in reverse direction this is an indication of incorrect phase sequence). Check the main fuses and CPT fuses. Check fuses to the 27/47 relay. Inspect wiring to the I/O module and ensure the relay is properly mapped in the parameters.
72	E-Stop	Emergency stop pulled	E - Stop	E - Stop	Check if SC9000 E-Stop is open. Check if there is more than one E-stop in the string. Check Turck I/O mapping. Compare parameter to location on Turck I/O wiring.
73	IsoSwitchOpen	Main power isolation switch is open	IsoSwitchOpen	IsoSwitchOpen	Check Turck I/O parameter mapping compare to wired location. Not typically used on later SC9000 EP drives. If not the I/O, check wiring and aux. contact on the Amgard ISO switch.
74	E-Stop Remote	Auxiliary E-Stop pulled	E-Stop Remote	E-Stop Remote	Similar to FCODE 72. Check plant E-Stop wiring similarly or Turck I/O and parameter mapping.
75	RTD Bad Channels	The number of RTD Motor Bad Channels is exceeded	RTDBadChannls	RTDBadChannls	Refer to Appendix E Table 25
76	RTD Motor Alarm Timeout	The motor is hot longer than the alarm delay	RTDMtrAlarmTO	RTDMtrAlarmTO	Refer to Appendix E Table 25
77	XFMR Core Hot	Transformer core is hot	XFMR Coil Hot	XFMR Coil Hot	Check the status of the transformer, if normal check the wiring to the Turck I/O. Check mapping in the parameters to ensure it matches the input. Check air-flow and filters.
78	Hi Ambient	Ambient air temperature is too high	Hi Ambient	Hi Ambient	Ambient temperature above unit specs. Air filters may be clogged, require cleaning or replacement. Check wiring to the Turck module and ensure the 9000Xdrive or Keypad G1.11 parameters are set correctly.
79	Check Filter	Possible filter clogged, temperature difference between inlet and exhaust is high	CheckFilter	CheckFilter	Check, clean or replace the filter. Check the wiring and the Turck mapping.
80	Trin Timeout	ITG Fault HW	TRIN Timeout	TRIN Timeout	Check ITG oLED fault screens MITG and SITG. If they are not fault consider replacing ITG modulator card if fault persists.

Table 12. SC9000 EP/SPX controller fault codes, continued

Fault code	Item	Description	Warning text	Fault text	Possible solutions
81	MITG Fault	Failure in master board or MITG, observe sub-code shown on LED text on ITG modulator MITG	MITG Fault	MITG Fault	Refer to Table 14
82	SITG Fault	Failure in follower board or SITG, observe sub-code shown on oLED text on ITG modulator SITG	SITG Fault	SITG Fault	Refer to Table 14
83	ExtPrechrgeLost	GP mode precharge fail	GPPreChrgLost	GPPreChrgLost	Verify external digital input signal does not go low at any ITG state per Figure 118 of Appendix G.
84	URTDMissing	URTD subsystem missing	InvURTDComms	InvURTDComms	Check for pinched or broken fiber between MITG/SITG and inverter URTD module(s). Verify connection is firm and latched with simplex connector. Check URTD input power is ok. Consider replacing fiber or URTD module if problem persists.
85	Bad RTD URTD	One or more RTDs on URTD have failed	InvURTDBadChn	InvURTDBadChn	Observe RTD inputs on inverter URTD module(s), verify they measure near 100 to 109 ohms at room temperature. Use 9000XDrive to monitor inverter temperatures, if values exceed 249 this is an indication of bad channels. 250 is outside of range, 253 is RTD shorted, 254 is RTD open, 255 is RTD invalid. Use signals 'inv11_rtd through inv16_rtd' for Inverter 1 and 'inv21_rtd through inv26_rtd' for Inverter 2 in 9000XDrive.
86	Precharge	Problem with precharge circuit	PreCharge	PreCharge	Use 9000XDrive signal 'MediumDCVoltage' to observe DC voltage with PC tool. Or Keypad Monitor value DC Voltage. Voltage should rise in less than 10 seconds for successful DC type pre-charge or 3 seconds with AC soft-mag start. If problem persists change out PX sub-assembly panel.
87	MainBlower	Main blower starter loss	MainBlower	MainBlower	Verify digital input is mapped correctly from blower starter in parameters. Verify rotation. Check wiring. Check for thermal overload trip on starter.
88	RedunBlower	Redundant blower starter loss	Redund.Blower	Redund.Blower	Verify digital input is mapped correctly from blower starter in parameters. Verify rotation. Check wiring. Check for thermal overload trip on starter.
89	BlowerLoss	Blower failure	Blower Loss	Blower Loss	In single or redundant systems check wiring and overloads per FCODEs 87 and 88 above. If redundant system both blowers are lost.
90	OutputOpen	Output contactor is open when expected closed, or closed when expected open	OutContOpen	OutContOpen	Determine if the contactor is in the correct state. If not check the control schematics for the contactor. If it is in the correct state, ensure it is wired to the correct auxiliary contacts and the Turck is properly wired and the parameters
91	CAN Master	Failure in CAN communications to Master or MITG	CANMaster	CANMaster	Check CAN harness between SPX controller and MITG. Check to see if RED/BLACK is swapped. Checked for loose wiring. Check to see if SPX controller option card is seated correctly.
92	CANFollower	CANFollower	CANFollower	CANFollower	Same as above for FCODE 92 but for SITG card connection.
93	120VAC_REMIO	120 VAC missing at remote I/O feed	120VACPFDLost	120VACPFDLost	Check power feed to Turck I/O module of interest. Check GREEN lights indicating power is ok. Consider replacing module.
94	Sync Transfer Timeout	Timer timed out during synchronous transfer algorithm	STConfTimeout	STConfTimeout	Refer to Appendix F for state diagrams against 9000XDrive signal of interest. Consult with factory and Eaton EESS.

Table 12. SC9000 EP/SPX controller fault codes, continued

Fault code	Item	Description	Warning text	Fault text	Possible solutions
95	ITGTimeOut	ITGTimeOut	LM3STimeout	LM3STimeout	Check ITG modulator card seating into rack and CAN connection. Consult factory and Table 14.
96	Turck	Problem with Turck I/O controller or comms to Turck bus coupler	Turck	Turck	Verify GREEN lights on CAN GWBR module on Turck I/O modules. Re-boot power to Turck and verify the UPS power goes to zero. If problem persists consult factory. Inspect wiring between Turck module and OPTD2 card in slot B. Check baud rate and mapping in parameters. Refer to Turck BL20 manual page 3-27 to 3-31. Using a paperclip, hold the set button down until all the module LEDs come on.
97	Motor RTD Failure	Loss of communications to the URTD II module for Motor Temperature sensing	RTDMtrFAILURE	RTDMtrFAILURE	Refer to Appendix E Table 25.
98	MainOpened	Main contactor is open when expected closed	MainOpened	MainOpened	Check that the main contactor is closing. If not, check mechanical interlock on ISO switch and contactor control circuit. If contactor is closing check wiring to Turck and mapping of devices. Input Ampgard contactor is opening while SC9000 is running. Check digital input wire routing to avoid power cables. Consult factory.

Fault Code Range: 1–99
 Fault codes indicate the cause of the fault. See **Table 12** for further explanation.

Fault Time Range: T.1–T.13

Data Record In this menu, important data recorded at the time of the fault is available. This feature is intended to help the user or the service person to determine the cause of fault. **Table 13** indicates the information that is recorded.

Table 13. Fault time data

Data	Units	Description
T.1	D	Counted Operation Days (Fault 43: Additional Code)
T.2	hh:mm:ss (d)	Counted Operation Hours (Fault 43: Counted Operational Days)
T.3	Hz hh:mm:ss	Output Frequency (Fault 43: Counted Operational Hours)
T.4	A	Motor Current
T.5	V	Motor Voltage
T.6	%	Motor Power
T.7	%	Motor Torque
T.8	V	DC Bus Voltage
T.9	°C	Unit Temperature
T.10	—	Ruin Status
T.11	—	Direction
T.12	—	Warnings
T.13	—	Zero Speed

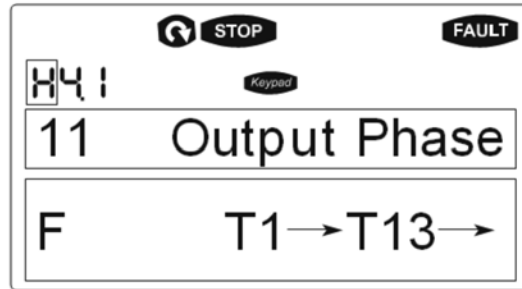
Note

① Real time record. If read time is set, T.1 and T.2 will appear as follows:

T.1	yyyy-mm-dd	Counted Operation Days (Fault 43: Additional Code)
T.2	hh:mm:ss.sss	Counted Operation Hours (Fault 43: Counted Operation Days)

The SC9000 EP's memory can store a maximum of 30 faults (accessible from menu M4), in the order of appearance. If there are 30 uncleared faults in the memory, the next occurring fault will erase the oldest fault from the memory. Use 9000XDrive to clear the fault history.

Figure 41. Sample fault history display



If fault codes such as 81 or 82, in conjunction with (MITG or SITG boards) their inherent description are shown on the display located on the control panel, an additional step has to be performed. Examine the Master ITG interface LED indication and the SITG interface LED indication. These will be two digit numeric codes that together give more detailed information about the fault. See **Tables 14** and **15** for the correlation between the numbers and the specific faults.

Record this information for future reference.

If there is an active fault of this type, the drive will rapidly flash one of the error codes from the **Tables 12** and **13**. Hitting reset will attempt to reset the drive as usual. If the fault is still present, the rack will not reset. If the fault has been cleared, the rack will reset and the LED display will no longer rapidly blink.

Figure 42. LED indications



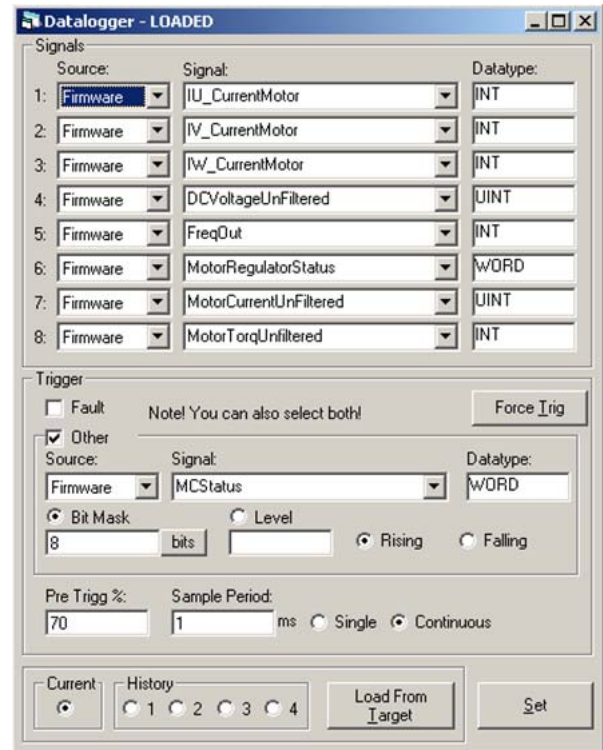
ITG LED Indication

SC9000 EP Keypad

Datalogger

The SC9000 EP Drive Controller (SPX) Datalogger is a drive tool to capture operational data during an event, such as a fault condition. Event data is stored in the SPX Controller memory and must be retrieved with the 9000XDrive access tool. Data is sampled at a high resolution similar to an oscilloscope. Data sampling can be set to 1 ms and larger (smaller values produce greater resolution). The controller can be configured with a single or a four memory buffer (single is default). Single memory data is over-written on the next event capture and is lost forever. To configure Datalogger, select options on the tools tab in 9000XDrive; it must be enabled before an event occurs. To access Datalogger select Datalogger in the options menu. Select the recommended eight basic signals to monitor as seen in **Figure 43**. After selecting the desired signals and trigger and any other desired criteria, click SET and verify WAITING TRIGGER message. It is important to be familiar with correct data prior to an important fault event. Understand the workings of Datalogger prior to it being needed to maximize its effectiveness.

Figure 43. Datalogger signals



Note: These fault codes represent those in version 5.0 (or later) of the application VCN software. For information on fault codes for prior or subsequent versions, contact the factory.

Table 14. ITG fault codes (V3.3.0)

Fault code	Item in ITG color display	Recommended action
2	2 VPU DESATURATION	Note A
3	3 WNU FO LOSS	Note B
4	4 UNU FO LOSS	Note B
5	5 OVERVOLTAGE	Note D
6	6 W OVERCURRENT	Note C
7	7 VPU NACK	Note B
8	8 UPU NACK	Note B
10	10 ITG SYSTEM	Replace the ITG
12	12 VPL DESATURATION	Note A
13	13 WNL FO LOSS	Note B
14	14 UNL FO LOSS	Note B
15	15 OVERVOLTAGE	Note D
16	16 V OVERCURRENT	Note C
17	17 VPL NACK	Note B
18	18 UPL NACK	Note B
20	20 ITG SYSTEM	Replace the ITG
22	22 VNU DESATURATION	Note A
23	23 UPU DESATURATION	Note A
24	24 WPU FO LOSS	Note B
25	25 OVERVOLTAGE	Note D
26	26 U OVERCURRENT	Note C
27	27 VNU NACK	Note B
28	28 UNU NACK	Note B
30	30 ITG SYSTEM	Replace the ITG
32	32 VNL DESATURATION	Note A
33	33 UPL DESATURATION	Note A
34	34 WPL FO LOSS	Note B
35	35 OVERVOLTAGE	Note D
37	37 VNL NACK	Note B
38	38 UNL NACK	Note B
40	40 ITG SYSTEM	Replace the ITG
41	41 UNDERVOLTAGE	Note E
42	42 WNU DESATURATION	Note A
43	43 UNU DESATURATION	Note A
47	47 WNU NACK	Note B
48	48 WPU NACK	Note B
50	50 ITG SYSTEM	Replace the ITG
51	51 DC BUS UNBAL POS	With drive in a zero energy state, check the connections of the LEM voltage sensor on both the low-voltage and medium-voltage sides. Check the rectifiers and fuses. Check the discharge resistors
52	52 WNL DESATURATION	Note A

Table 14. ITG fault codes (V3.3.0), continued

Fault code	Item in ITG color display	Recommended action
53	53 UNL DESATURATION	Note A
57	57 WNL NACK	Note B
58	58 WPL NACK	Note B
60	60 ITG SYSTEM	Replace the ITG
61	61 DC BUS UNBAL NEG	With drive in a zero energy state, check the connections of the LEM voltage sensor on both the low-voltage and medium-voltage sides. Check the rectifiers and fuses. Check the discharge resistors
62	62 VPU FO LOSS	Note B
63	63 WPU DESATURATION	Note A
70	70 ITG SYSTEM	Replace the ITG
72	72 VPL FO LOSS	Note B
73	73 WPL DESATURATION	Note A
82	82 VNU FO LOSS	Note B
83	83 UPU FO LOSS	Note B
91	91 ITG SYSTEM	Replace the ITG
92	92 VNL FO LOSS	Note B
93	93 UPL FO LOSS	Note B
97	97 System Bus	Ensure there is CAN communication between Control module and ITG. Check the F/O and CAN wiring. Check status of OPTD2 card. Check parameters 6.5.1.1.1 (7) and .2 (6).
101	101 CAN Fault	Check interconnect between ITG and Control module. Check status of OPTD2 card. Check parameters 6.5.1.1.1 (7) and .2 (6).
102	102 ITG SYSTEM	Replace the ITG
103	103 ITG SYSTEM	Replace the ITG
104	104 ITG SYSTEM	Replace the ITG
106	106 Power Supply	Check power supply, UPS and battery for correct voltages. If voltages are correct check power supply connection to backplane and the backplane
107	107 CAN Fault	Check interconnect between ITG and Control module. Check status of OPTD2 card. Check parameters 6.5.1.1.1 and .2 for correct settings.
108	108 ITG SYSTEM	Replace the ITG
109	109 CPU COMM FAULT	Replace the ITG
110	110 CPU COMM FAULT	Replace the ITG
111	111 CPU COMM FAULT	Replace the ITG
112	112 CPU COMPATIBILITY	Replace the ITG
113	113 CPU COMPATIBILITY	Replace the ITG
114	114 CPU COMPATIBILITY	Replace the ITG
115	115 CPU COMM FAULT	Replace the ITG
116	116 CPU COMM FAULT	Replace the ITG
117	117 CPU COMM FAULT	Replace the ITG
120	120 CPU COMM FAULT	Replace the ITG
121	121 CPU COMM FAULT	Replace the ITG
122	122 CPU COMM FAULT	Replace the ITG
123	123 CPU COMM FAULT	Replace the ITG
124	124 CPU COMM FAULT	Replace the ITG
125	125 CPU COMM FAULT	Replace the ITG
127	127 ITG SYSTEM	Replace the ITG

Table 14. ITG fault codes (V3.3.0), continued

Fault code	Item in ITG color display	Recommended action
128	128 CPU COMM FAULT	Replace the ITG
129	129 CPU COMPATIBILITY	Replace the ITG
130	130 CPU COMM FAULT	Replace the ITG
131	131 CPU COMM FAULT	Replace the ITG
132	132 CPU COMM FAULT	Replace the ITG
133	133 CPU COMM FAULT	Replace the ITG
134	133 AC GND FLT	Verify the three-phase output is not grounded
135	135 DC POS GND FLT	Verify the DC Bus positive is not grounded
136	136 DC NEU GND FLT	Consult with the Eaton Customer Solution Center using the telephone number shown on page ii
137	137 DC NEG GND FLT	Verify the DC Bus negative is not grounded

Hazardous high voltage**⚠ WARNING**

Motor control equipment and electronic controllers are connected to hazardous line voltages. When servicing drives and electronic controllers, there may be exposed components with housings or protrusions at or above line potential. Extreme care should be taken to protect against shock.

Stand on an insulating pad and make it a habit to use only one hand when checking components. Always work with another person in case an emergency occurs. Disconnect power before checking controllers or performing maintenance. Be sure equipment is properly grounded. Wear safety glasses whenever working on electronic controllers or rotating machinery.

Table 15. General troubleshooting procedure for desaturation faults

Description	Possible solutions
Note A	
A desaturation fault can occur as a result of an IGBT not entering full conduction, excessive current, or destruction of an IGBT. There are also a number of hardware issues that can lead to a false indication of a desaturation fault. The following list provides some items to check.	
1 Do not reset the fault if there is a known motor wiring issue or motor problem, until all problems have been corrected (such as water infiltration or suspected failure of a winding). Once this step is verified proceed to step2.	Inspect the cables, sine filters and motor to ensure no damage. Replace faulty parts necessary
2 Attempt a reset of the drive to see if the desaturation fault repeats. Proceed to the next item if it does.	
3 Remove the fiber optic connector for the gate indicated in the original fault message. There should be a bright visible red light in the top fiber of the connector. If there is, check the bottom connection on the ITG. There should be light emitting from that terminal.	If there is no light coming from the ITG, replace the card.
4 If there is no light on the fiber optic cable, perform a visual inspection on the fiber optic run. Ensure all medium-voltage is locked out, the DC bus at 0 volts and grounded. Examine the fiber optics for breaks, cuts, melting, or excessive bends.	Determine what damaged the fiber optics and repair that problem. Replace the damaged fiber optic set.
5 If there is no light on the fiber optic cable, check the other sets of fiber optics if no light, the power supply on the inverter must be inspected. Ensure all medium-voltage is locked out, the DC bus at 0 volts and grounded. Power the LV compartment with 120VAC and inspect the power supply, there should be 24 volts entering the power supply and regulated 15 volts out. If the voltages are correct, there is a problem with the power supply and gate driver within the inverter.	Replace voltage regulator if faulty. If voltages are correct replace power supply and gate driver on faulty pole.
6 Static check of the inverter: Ensure all sources of electricity have been removed and locked out, the DC bus is at 0 volts and has been grounded. With the DMM on diode scale, place the negative lead on the positive terminal and there should be approximately .685 volt drop on all three phases. Switch leads and the DMM should read OL on all three phases. Place the positive lead on the negative terminal and there should be approximately .685 volt drop on all three phases. Switch leads and the DMM should read OL on all three phases. The DMM should read OL on all three phases to neutral both directions. If any of the readings are 0 volts or approximately .35 volts, one or both IGBTs on that phase failed and need to be replaced.	Replace the failed pole

Table 15. General troubleshooting procedure for desaturation faults, continued

Description	Possible solutions
Note B	
A fiber optic fault results when the fiber optic signal does not reach the gate drive board in the inverter.	
1 Attempt a reset of the drive to see if the fiber optic fault repeats. Proceed to the next item if it does.	
2 Remove the fiber optic connector for the gate indicated in the original fault message. There should be a bright visible red light in the top fiber of the connector. If there is, check the bottom connection on the ITG. There should be light emitting from that terminal.	If there is no light coming from the ITG, replace the card.
3 If there is no light on the fiber optic cable, perform a visual inspection on the fiber optic run. Ensure all medium-voltage is locked out, the DC bus at 0 volts and grounded. Examine the fiber optics for breaks, cuts, melting, or excessive bends.	Determine what damaged the fiber optics and repair that problem. Replace the damaged fiber optic set.
4 If there is no light on the fiber optic cable, check the other sets of fiber optics if no light, the power supply on the inverter must be inspected. Ensure all medium-voltage is locked out, the DC bus at 0 volts and grounded. Power the LV compartment with 120VAC and inspect the power supply, there should be 24 volts entering the power supply and regulated 15 volts out. If the voltages are correct, there is a problem with the power supply and gate driver within the inverter.	Replace voltage regulator if faulty. If voltages are correct replace power supply and gate driver on faulty pole.
Note C	
An overcurrent fault can occur as a result of more current being drawn than the drive was designed to supply. This current can be drawn by the motor, cables and poor connections. The overcurrent can also be caused by faulty measuring devices or incorrect settings.	
1 Do not reset the fault if there is a known motor wiring issue or motor problem, until all problems have been corrected. This includes poor connections, damage to insulation, corona discharge on the cables or at the motor.	Inspect the cables, sine filters and motor to ensure no damage. Replace faulty parts necessary. Check cable connections for signs of arcing or excessive heat, replace or repair as needed.
2 Ensure all sources of electricity have been removed and locked out, the DC bus is at 0 volts and has been grounded. Remove the output leads to the motor. Power up drive, start and monitor for overcurrent failure. If the fault continues, the problem is in the drive and not the load.	
3 Check the settings on the drive. Ensure the settings have not been changed. If the ITG card had been replaced, ensure it is set to the correct horsepower.	Change settings to match the drives original settings and ensure they are compatible with the motors nameplate rating
4 Check the connections to the current sensors. Ensure all sources of electricity have been removed and locked out, the DC bus is at 0 volts and has been grounded. Inspect the cables and the plug at each sensor. Check the connection at the each CT and at the ITG board	Repair connections and / or replace the cable to the CTs. If connections are correct and the part is available, replace the ITG to determine if the issue is in the DMCR.
5 Static check of the inverter: Ensure all sources of electricity have been removed and locked out, the DC bus is at 0 volts and has been grounded. With the DMM on diode scale, place the negative lead on the positive terminal and there should be approximately .685 volt drop on all three phases. Switch leads and the DMM should read OL on all three phases. Place the positive lead on the negative terminal and there should be approximately .685 volt drop on all three phases. Switch leads and the DMM should read OL on all three phases. The DMM should read OL on all three phases to neutral both directions. If any of the readings are 0 volts or approximately .35 volts, one or both IGBTs on that phase failed and need to be replaced.	Replace the failed pole

Table 15. General troubleshooting procedure for desaturation faults, continued

Description	Possible solutions
Note D	
An overvoltage fault results from the DC bus being above its maximum. This can be caused by a high line voltage, regeneration from the motor, or inaccurate and faulty sensors.	
1 Determine when the overvoltage fault occurs. Is it at startup, shut down, normal running conditions or at a particular time.	
2 Overvoltage occurs at startup	
3 Overvoltage occurs at shut down. Monitor the voltage at shut down. Does the DC bus increase when the drive is stopped but the load is still turning? Regeneration may be causing the bus voltage to rise.	Monitor the voltage at shut down. Does the DC bus increase when the drive is stopped but the load is still turning? Regeneration may be causing the bus voltage to rise. If coasting, could be caused by sine filter caps. Increase deceleration time to reduce the chance of overvoltage.
4 Overvoltage occurs during normal operation. Often the result of monitoring devices and power supplies. Ensure all sources of electricity have been removed and locked out, the DC bus is at 0 volts and has been grounded. Inspect the LEM voltage devices, check the cabling and connections. Check the power supply to ensure the devices are getting 15 vdc. Check the connections to ensure they are not damaged and the plugs are secure.	Replace any damaged cables. If the LEM is not getting the proper voltage, replace the power supply. If the LEM is drawing the voltage down or has a damaged connector, replace the device.
5 Overvoltage occurs at a particular time or interval on a regular basis. Could be a voltage spike caused by external sources.	Check external sources. See if an application starts or stops at the same time as the fault occurrence.
6 Overvoltage fault is a result of noise on the cables.	Ensure the shielding is grounded at the control section. Install ferrite beads on the cables at the sensor end.
Note E	
An undervoltage fault results from the DC bus being below its minimum (60%). This can be caused by a low line voltage, failed rectifiers, or inaccurate and faulty sensors.	
1 Determine when the undervoltage fault occurs. Is it at startup, shut down, normal running conditions or at a particular time.	
2 Undervoltage occurs at startup could be the result of an unstable DC bus. This could be caused by a weak line, the rectifier section, the bus capacitors or the monitoring system.	Monitor the line voltage when starting the drive, see if it drops. Check rectifiers and fuses to ensure none have failed. Check the voltage measuring devices, ensure the connections are tight and the cable plugs are properly inserted.
3 Undervoltage occurs at shut down. Monitor the voltage at shut down. Does the DC bus decrease when the drive is stopped?	Monitor the voltage at shut down. Does the DC bus increase when the drive is stopped but the load is still turning? Regeneration may be causing the bus voltage to rise. If coasting, could be caused by sine filter caps. Increase deceleration time to reduce the chance of overvoltage.
4 Undervoltage occurs during normal operation. Often the result of monitoring devices and power supplies. Ensure all sources of electricity have been removed and locked out, the DC bus is at 0 volts and has been grounded. Inspect the LEM voltage devices, check the cabling and connections. Check the power supply to ensure the devices are getting 15 vdc. Check the connections to ensure they are not damaged and the plugs are secure.	Replace any damaged cables. If the LEM is not getting the proper voltage, replace the power supply. If the LEM is drawing the voltage down or has a damaged connector, replace the device.
5 Undervoltage occurs at a particular time or interval on a regular basis. Could be a voltage dip caused by external sources.	Check external sources. See if an application starts or stops at the same time as the fault occurrence.
6 Undervoltage fault is a result of noise on the cables.	Ensure the shielding is grounded at the control section. Install ferrite beads on the cables at the sensor end.

Appendix A: Typical SC9000 EP configurations

Table 16. SC9000 EP AFD configuration matrix

The SC9000 EP model number can be configured by using the table below. For options or requirements outside this table, please consult factory. The example below, SC 93C100-VT-E is a SC9000 EP, 4160V input, 4160V output, 1000 hp, VT, without Bypass.

SC9	3		C		100–						V	E	—	—	
Series	Input voltage		Output voltage		2400 V Output	3300 V output	4160 V output	6600 V output	6900V output ①	Duty rating	Style	Options			
Code	Code	Volt	Code	Volt	Code	hp	hp	hp	hp	hp	Code	Code			
SC9	1	2400, 60 Hz	A	2400	030	300	300	300	300	300	V VT	E No bypass	Consult factory		
	2	3300, 60 Hz	B	3300	035	350	350	350	350	350	C CT ②	F FVNR bypass	Consult factory		
	3	4160, 60 Hz	C	4160	040	400	400	400	400	400		G RVAT bypass	Consult factory		
	4	4800, 60 Hz	D	4800	045	450	450	450	450	450		H RVR bypass	Consult factory		
	5	6600, 60 Hz	E	6600	050	500	500	500	500	500		I RVSS bypass	Consult factory		
	6	6900, 60 Hz	F	6900	060	600	600	600	600	600		J FVR bypass			
	7	12,470, 60 Hz	G	12,470	070	700	700	700	700	700		K RVATR bypass			
	8	13,200, 60 Hz	H	13,200	080	800	800	800	800	800		L RVRB bypass			
	9	13,800, 60 Hz	I	13,800	090	900	900	900	900	900		M RVSSR bypass			
	10	2400, 50 Hz			100	1000	1000	1000	1000	1000					
	11	3300, 50 Hz			125	1250	1250	1250	1250	1250					
	12	4160, 50 Hz			150	1500	1500	1500	1500	1500					
	13	4800, 50 Hz			175	1750	1750	1750	1750	1750					
	14	6000, 50 Hz			200	2000	2000	2000	2000	2000					
	15	6600, 50 Hz			225	2250	2250	2250	2250	2250					
	16	6900, 50 Hz			250	2500	2500	2500	2500	2500					
	17	10,000, 50 Hz			275		2750	2750	2750	2750					
	18	11,000, 50 Hz			300		3000	3000	3000	3000					
	19	12,000, 50 Hz			325		3250	3250	3250	3250					
					350		3500	3500	3500	3500					
					375		3750	3750	3750	3750					
					400		4000	4000	4000	4000					
					425			4250	4250	4250					
					450			4500	4500	4500					
					475			4750	4750	4750					
					500			5000	5000	5000					
					525			5250	5250	5250					
					550			5500	5500	5500					
					575			5750	5750	5750					
					600			6000	6000	6000					
					650			6500	6500	6500					
					700			7000	7000	7000					
					750			7500	7500	7500					
					800			8000	8000	8000					
					850			8500	8500	8500					
					900			9000	9000	9000					
					950			9500	9500	9500					
					1000			10,000	10,000	10,000					
					1200			12,000	12,000	12,000					

Notes

- ① Consult factory.
- ② For CT applications, consult factory.

VT = Variable torque 110% for 1 minute.
 Shaded area indicates no availability at this time.

Appendix A: Typical Frames A, B, C

Figure 44. Typical schematic for SC9000 EP—sheet 1

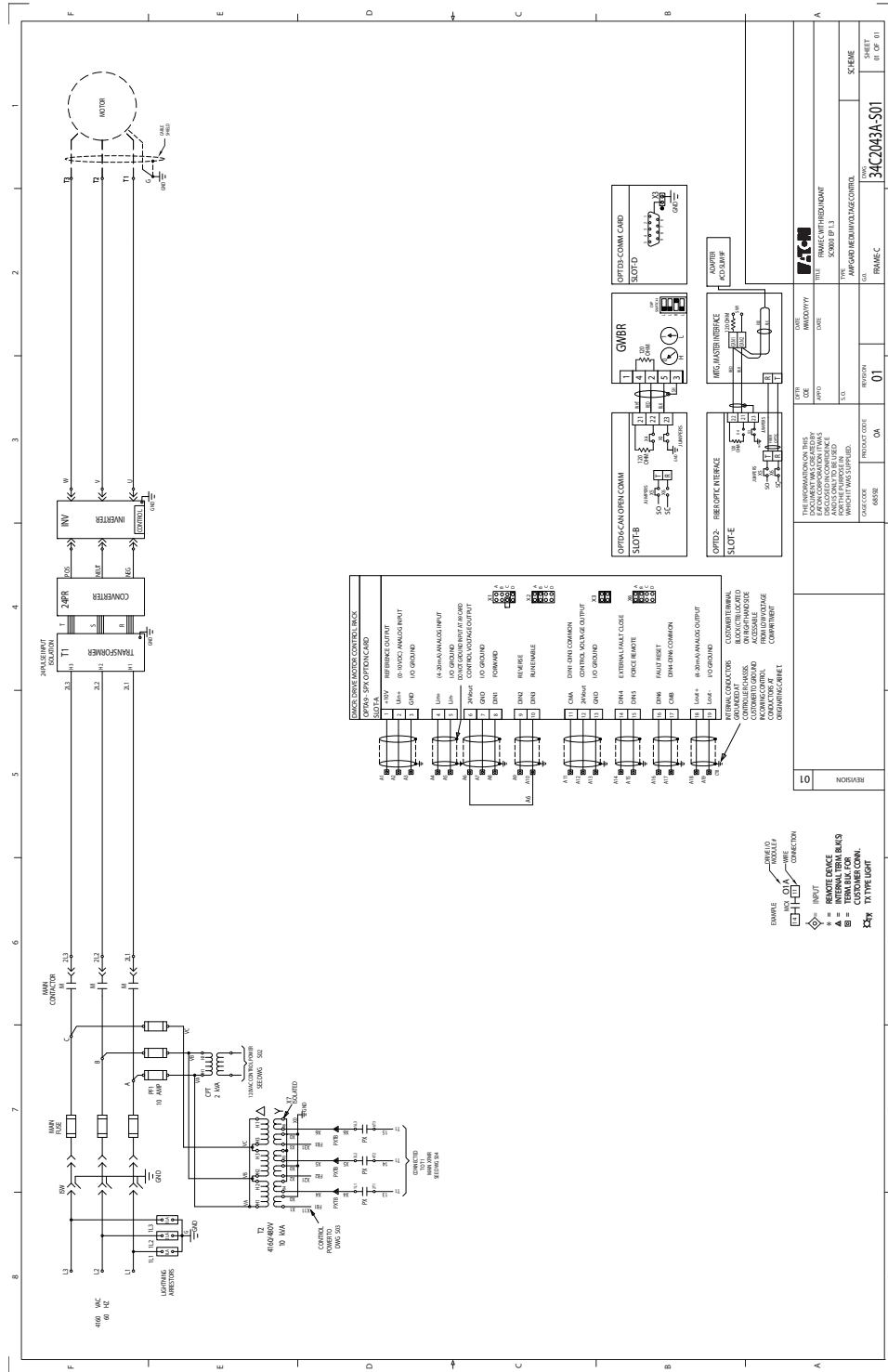


Figure 45. Typical schematic for SC9000 EP—sheet 2

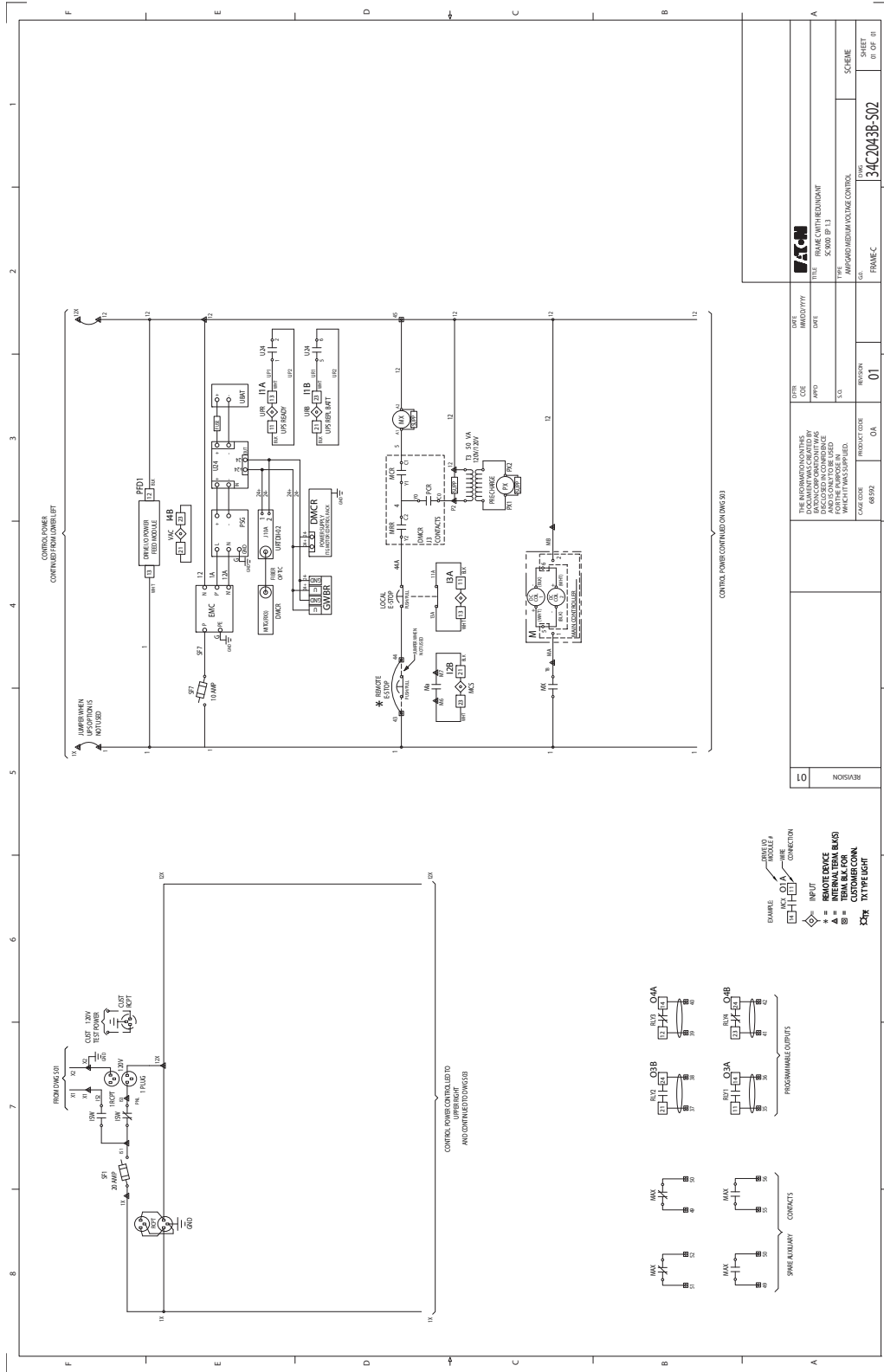


Figure 46. Typical schematic for SC9000 EP—sheet 3

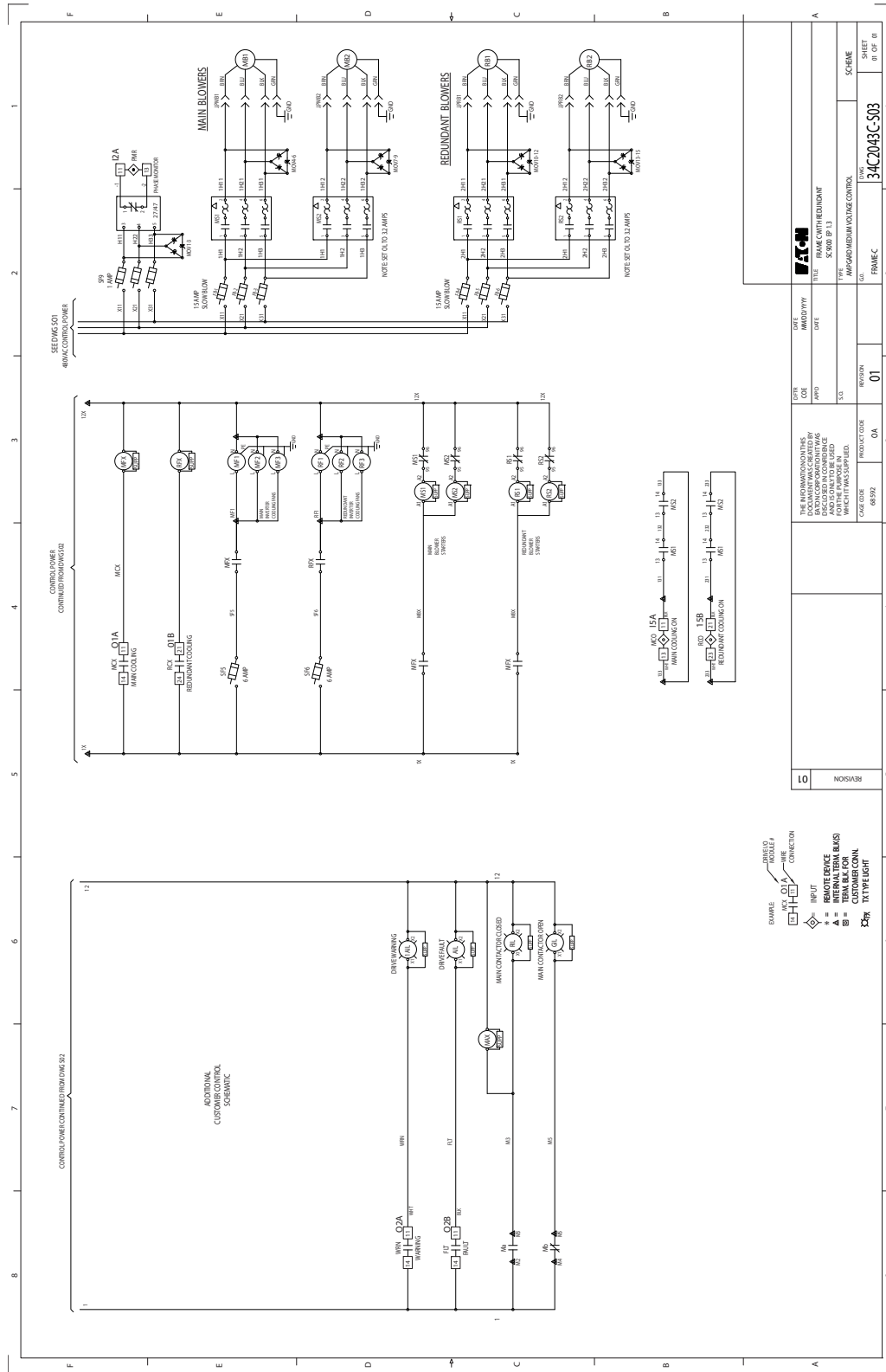


Figure 47. Typical schematic for SC9000 EP—sheet 4

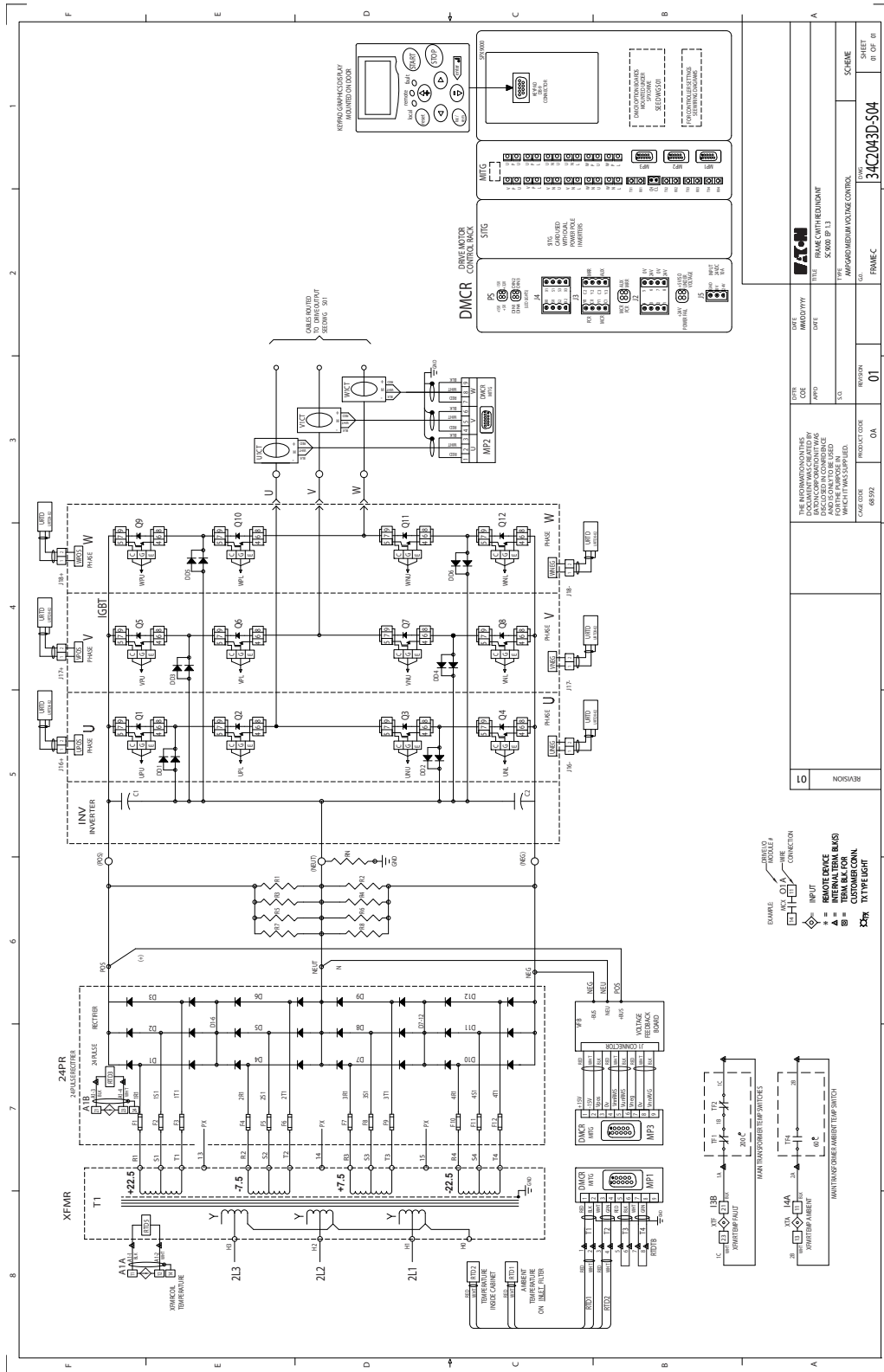


Figure 49. Frame A parts layout—SC9000 EP

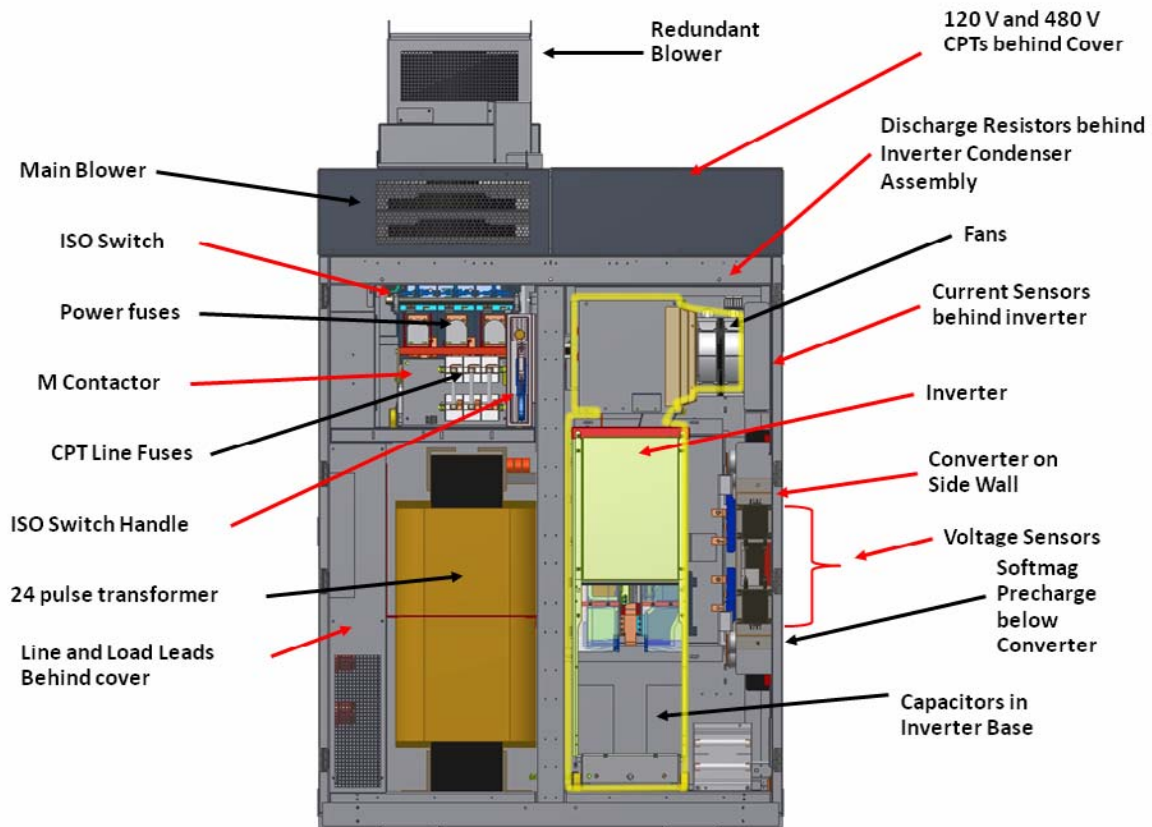


Figure 50. Frame A configuration—SC9000 EP

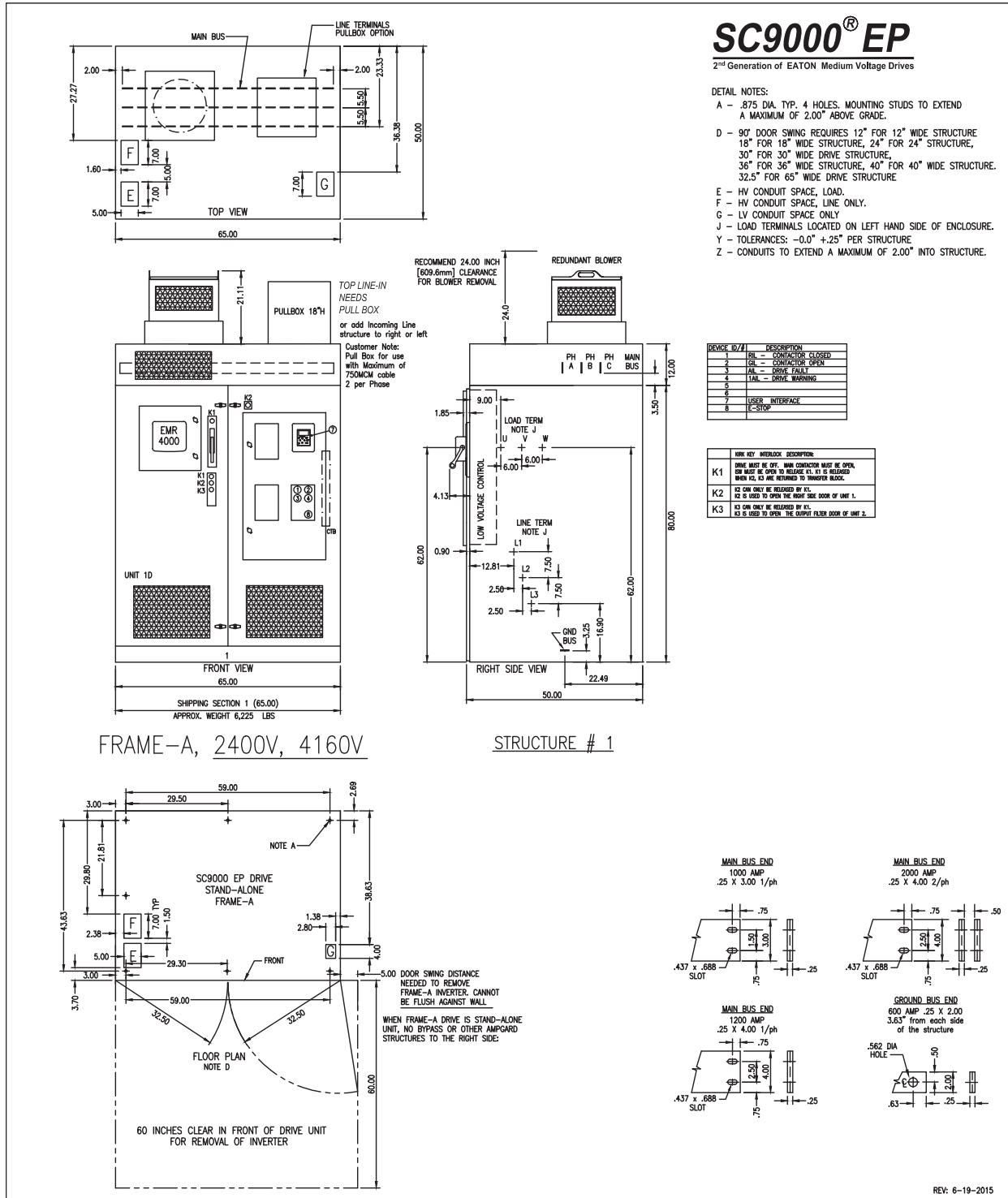


Figure 51. Frame B parts layout—SC9000 EP

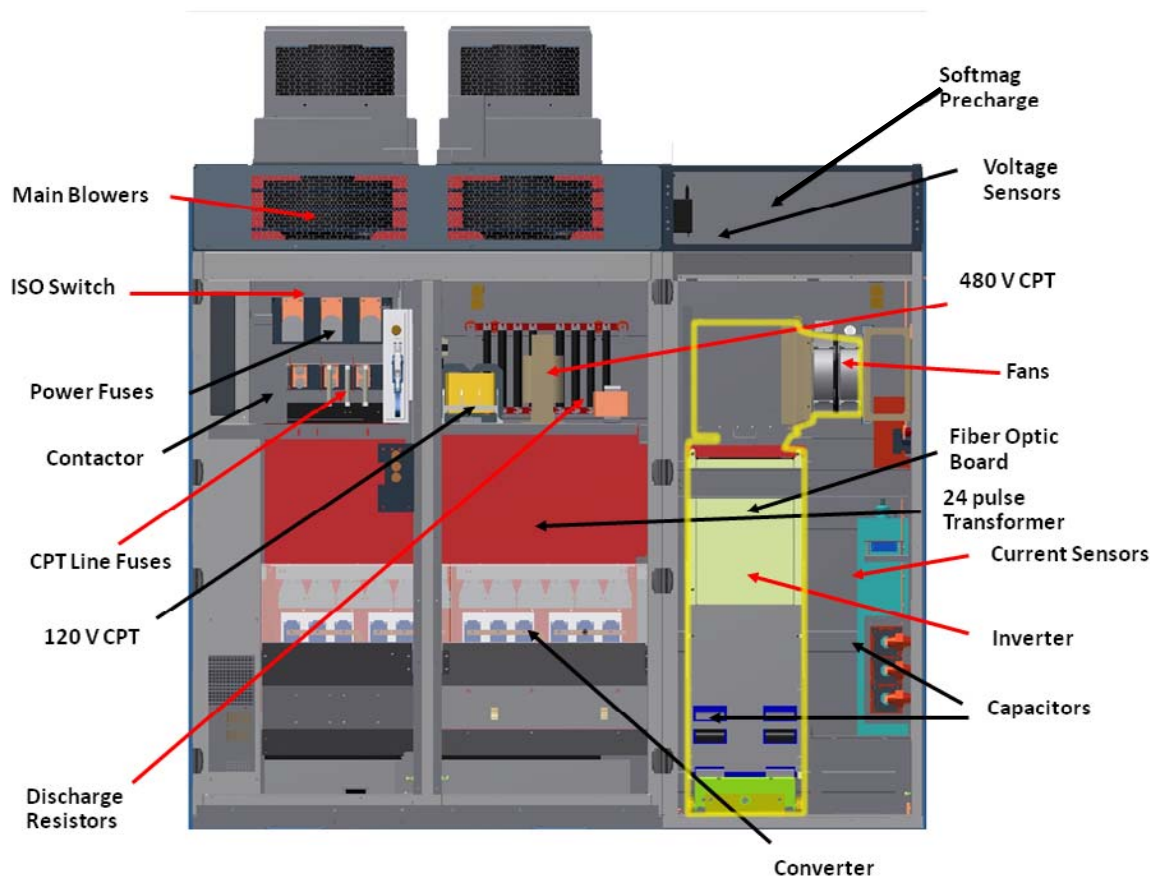


Figure 52. Frame B configuration—SC9000 EP

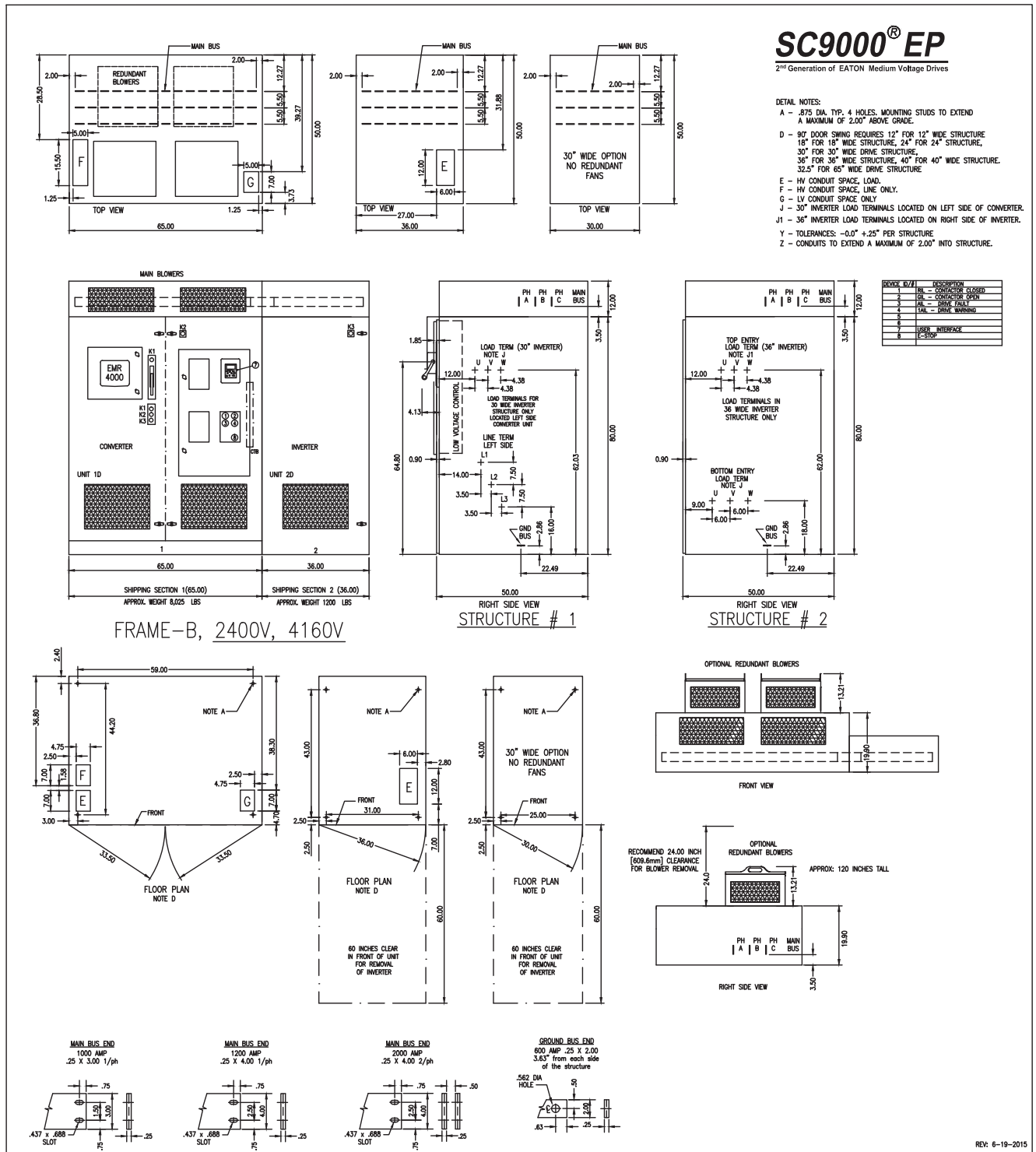


Figure 53. Frame C parts layout—SC9000 EP

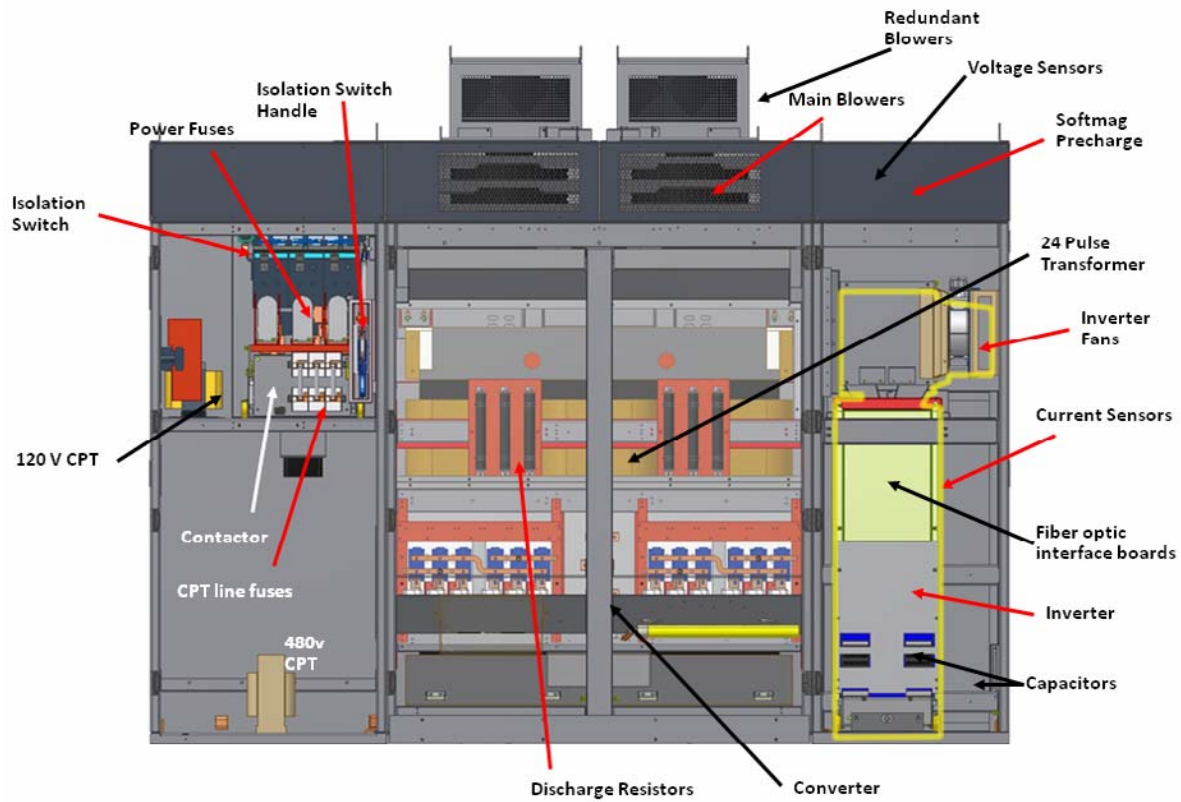
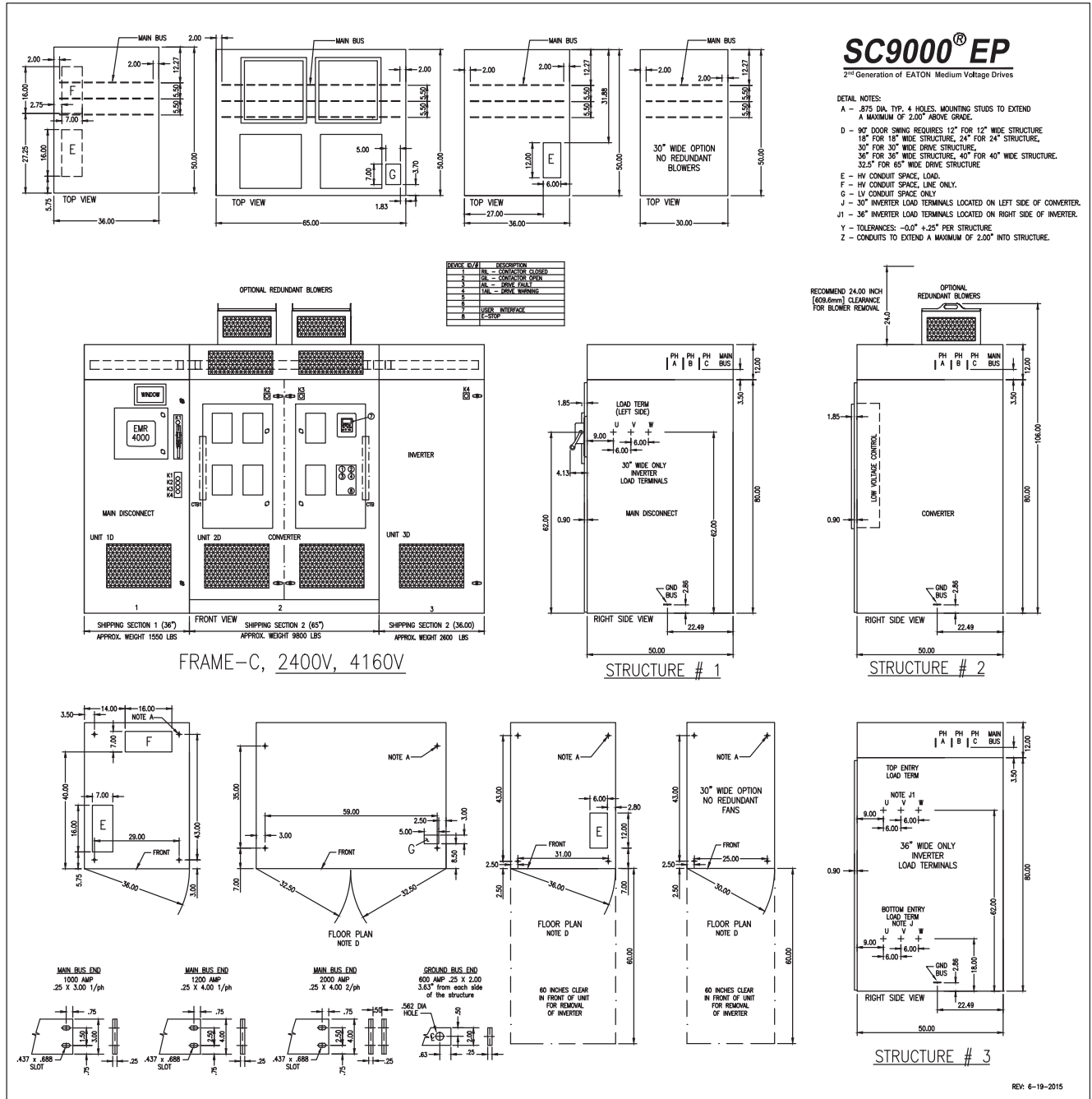


Figure 54. Frame C configuration—SC9000 EP



Appendix B: Typical Frames D, E

Figure 55. Typical schematic for SC9000 EP—sheet 1

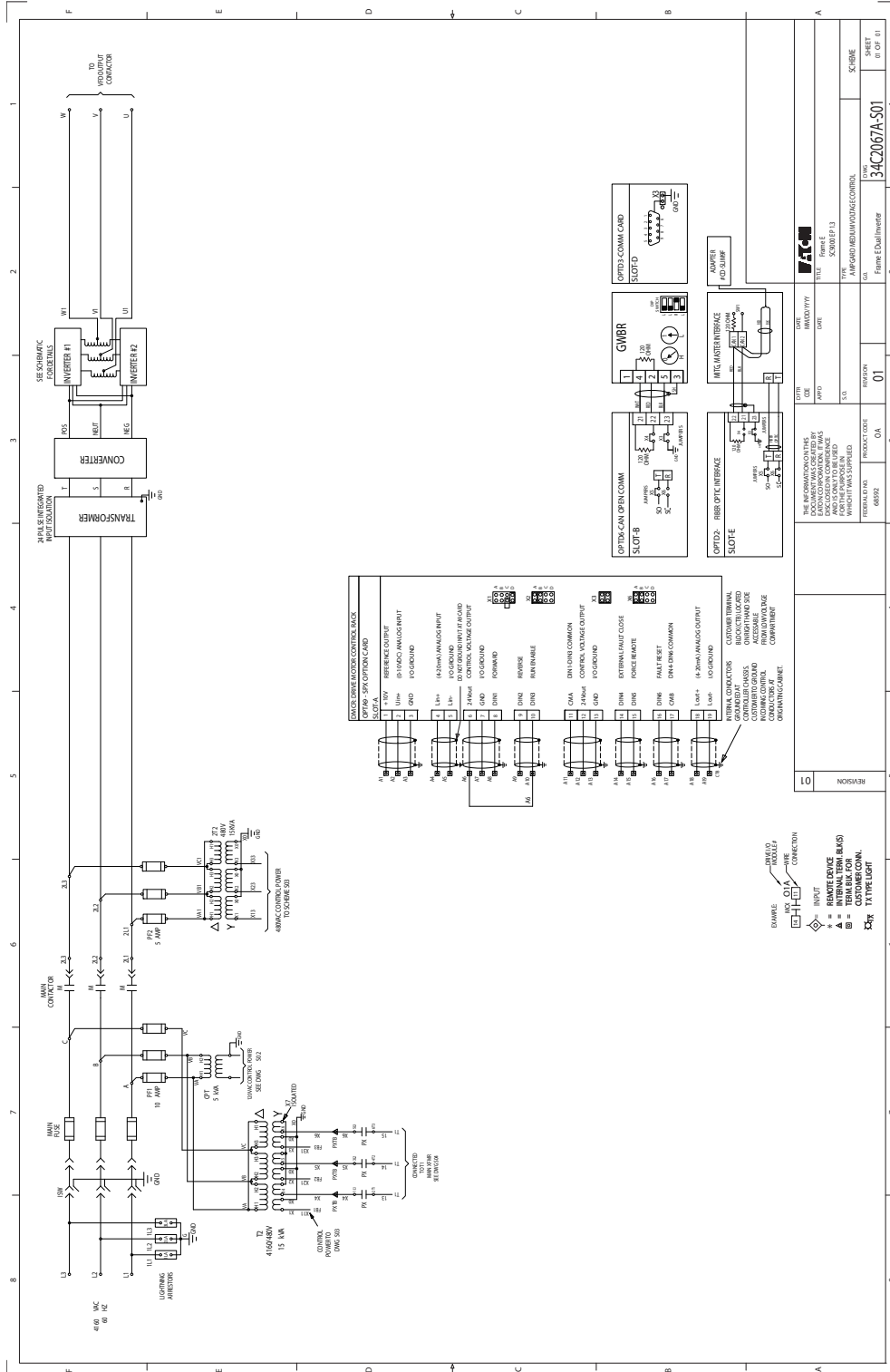
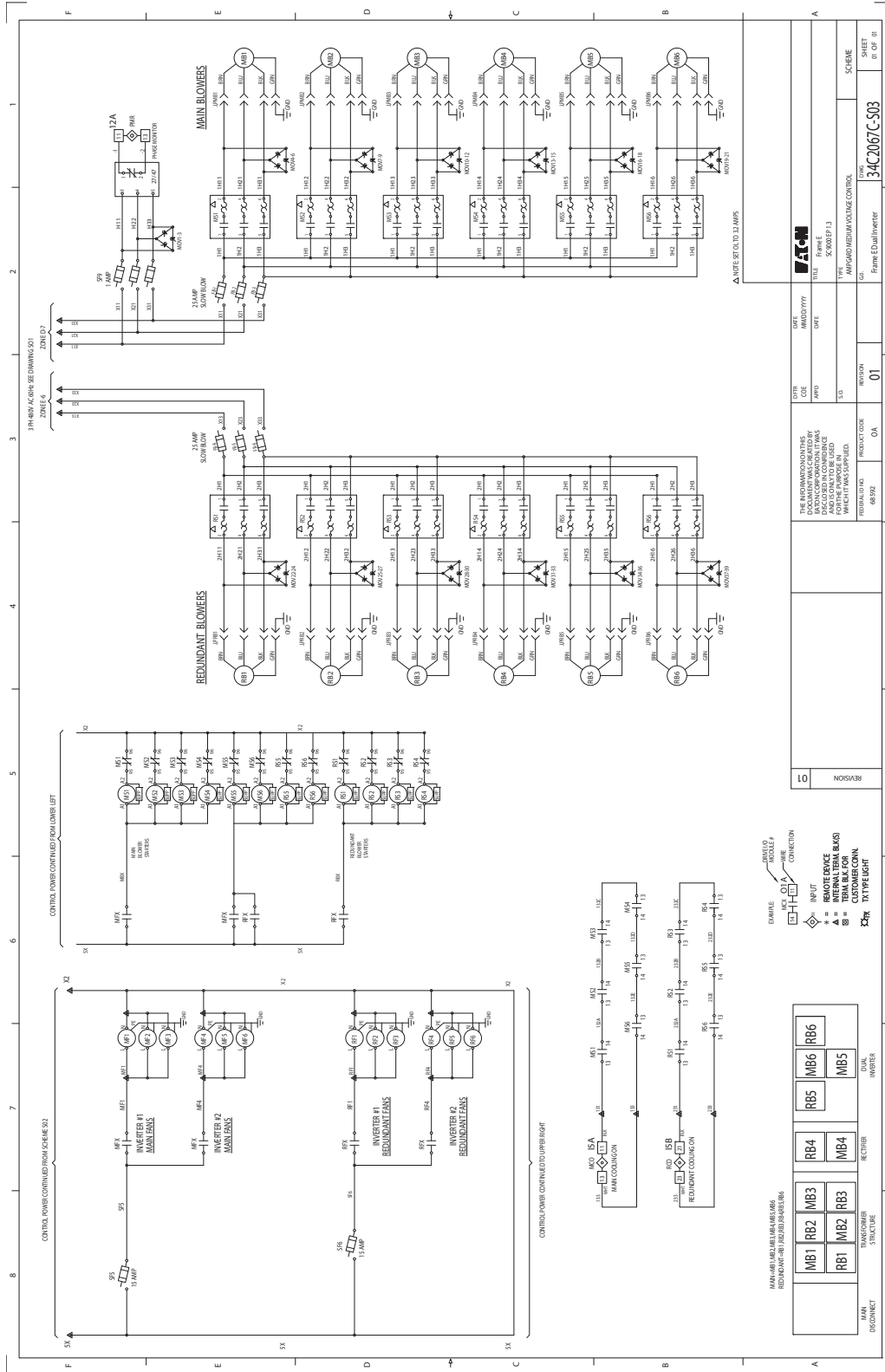


Figure 57. Typical schematic for SC9000 EP—sheet 3



THE INFORMATION CONTAINED HEREIN IS THE PROPERTY OF EATON CORPORATION. IT IS TO BE USED ONLY FOR THE PURPOSES AND CONDITIONS SPECIFIED IN THE AGREEMENT WHICH IT WAS SUPPLIED.		FEDERAL ID: 68592	PRODUCT CODE: 0A	REVISION: 01	DATE: 01	DRAWING NO.: 34C2067C-503	SHEET: 01 OF 01
TITLE: SC9000 EP 3	FRAME: E	FRAME: E	FRAME: E	FRAME: E	FRAME: E	FRAME: E	FRAME: E
USER CODE: AMPD	USER CODE: AMPD	USER CODE: AMPD	USER CODE: AMPD	USER CODE: AMPD	USER CODE: AMPD	USER CODE: AMPD	USER CODE: AMPD
DATE:	DATE:	DATE:	DATE:	DATE:	DATE:	DATE:	DATE:
PRODUCT CODE:	PRODUCT CODE:	PRODUCT CODE:	PRODUCT CODE:	PRODUCT CODE:	PRODUCT CODE:	PRODUCT CODE:	PRODUCT CODE:
REVISION:	REVISION:	REVISION:	REVISION:	REVISION:	REVISION:	REVISION:	REVISION:
DRAWING NO.:	DRAWING NO.:	DRAWING NO.:	DRAWING NO.:	DRAWING NO.:	DRAWING NO.:	DRAWING NO.:	DRAWING NO.:
SHEET:	SHEET:	SHEET:	SHEET:	SHEET:	SHEET:	SHEET:	SHEET:

Figure 58. Typical schematic for SC9000 EP—sheet 4

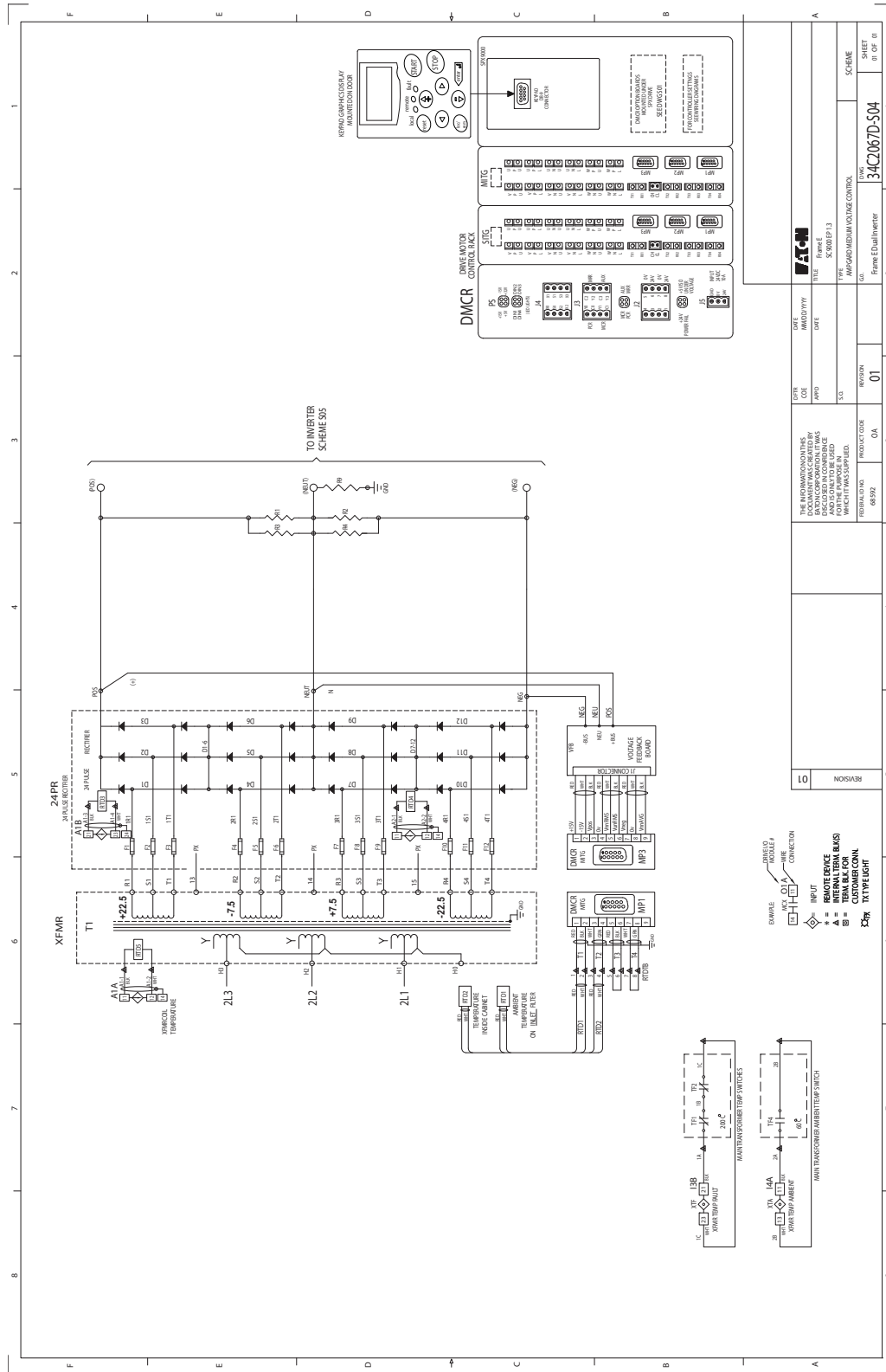


Figure 59. Typical schematic for SC9000 EP—sheet 5

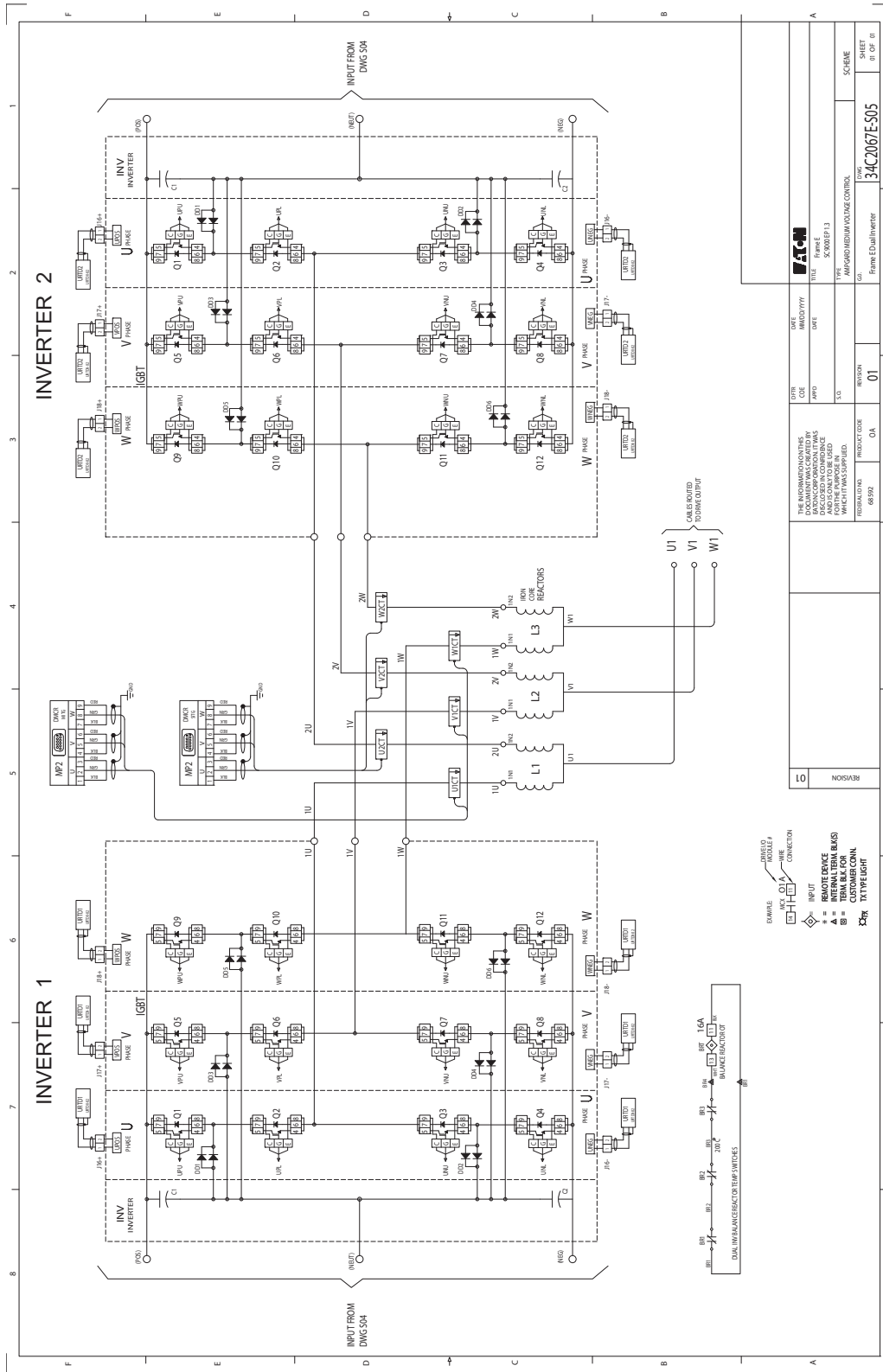


Figure 60. Typical schematic for SC9000 EP—sheet 6

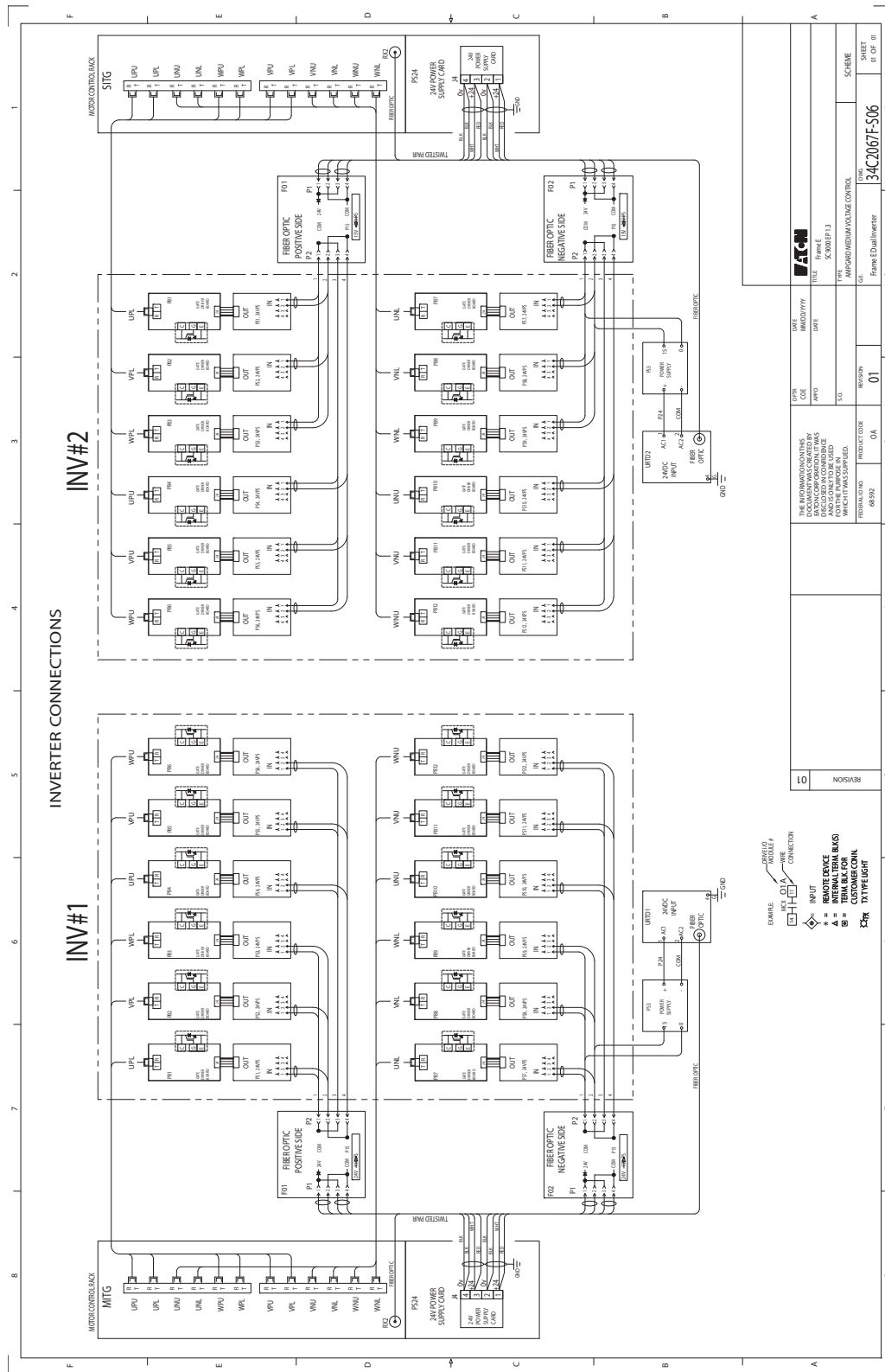


Figure 61. Typical schematic for SC9000 EP—sheet 7

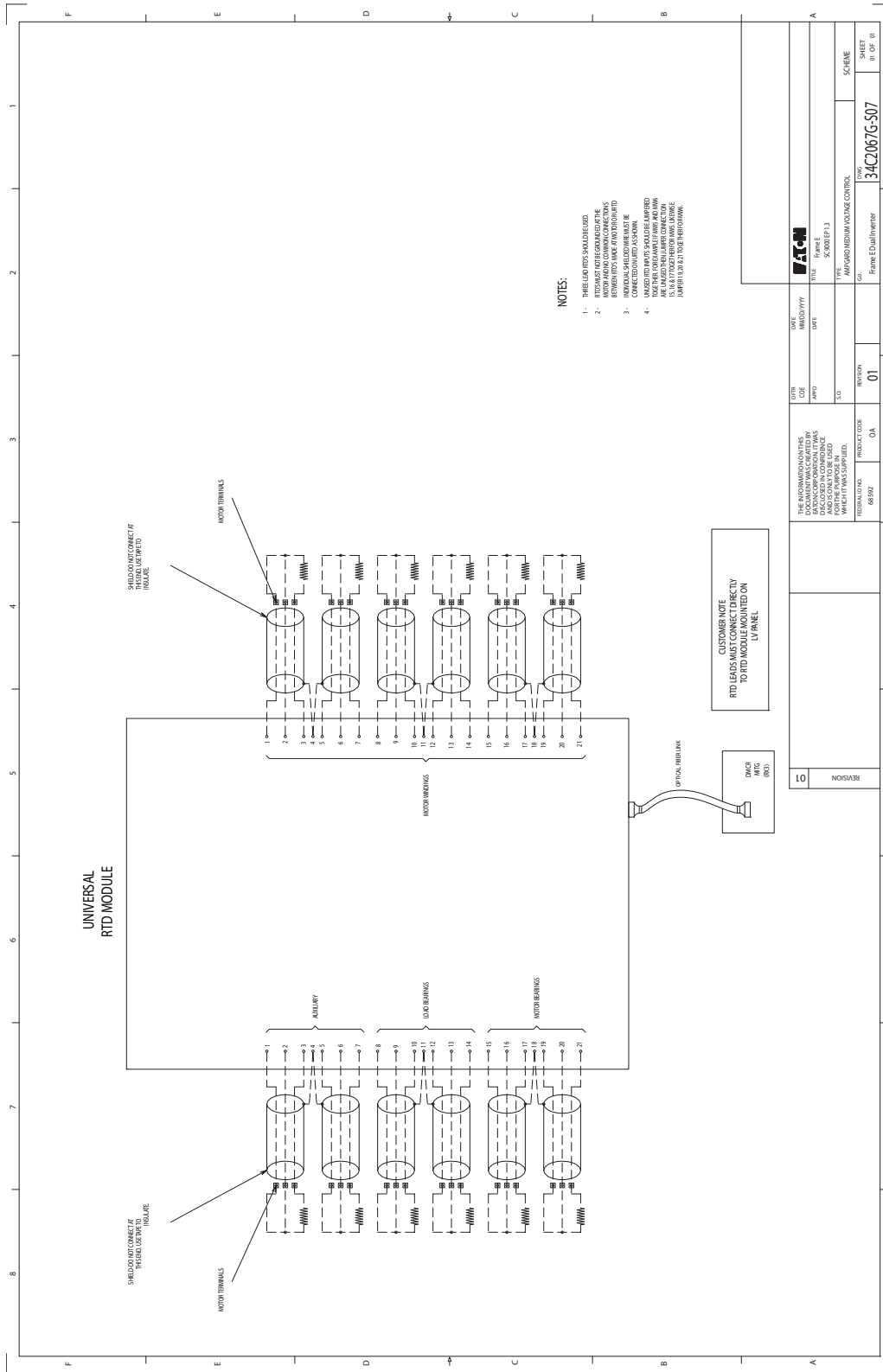


Figure 62. Frame D parts layout—SC9000 EP

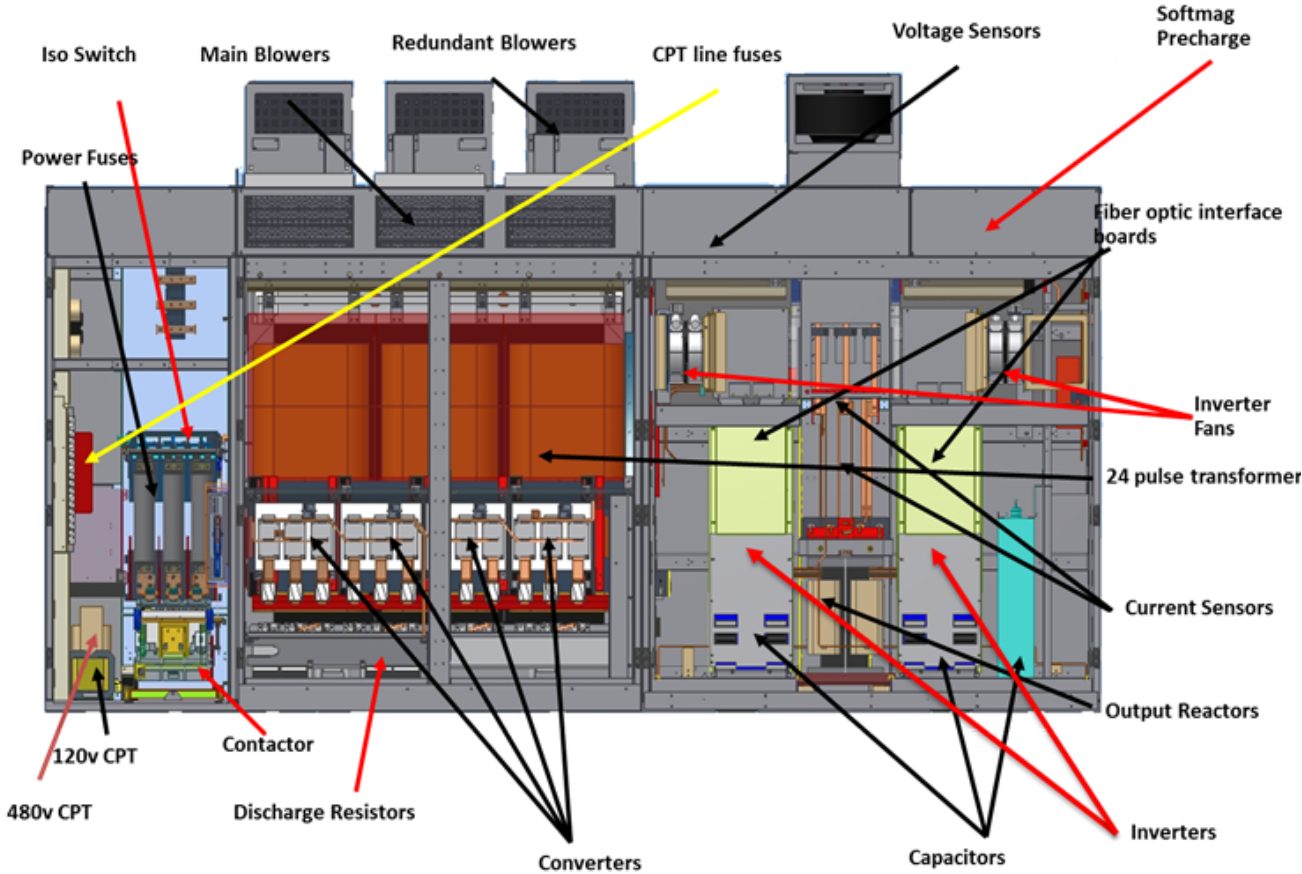


Figure 63. Frame D configuration—SC9000 EP—2400 V

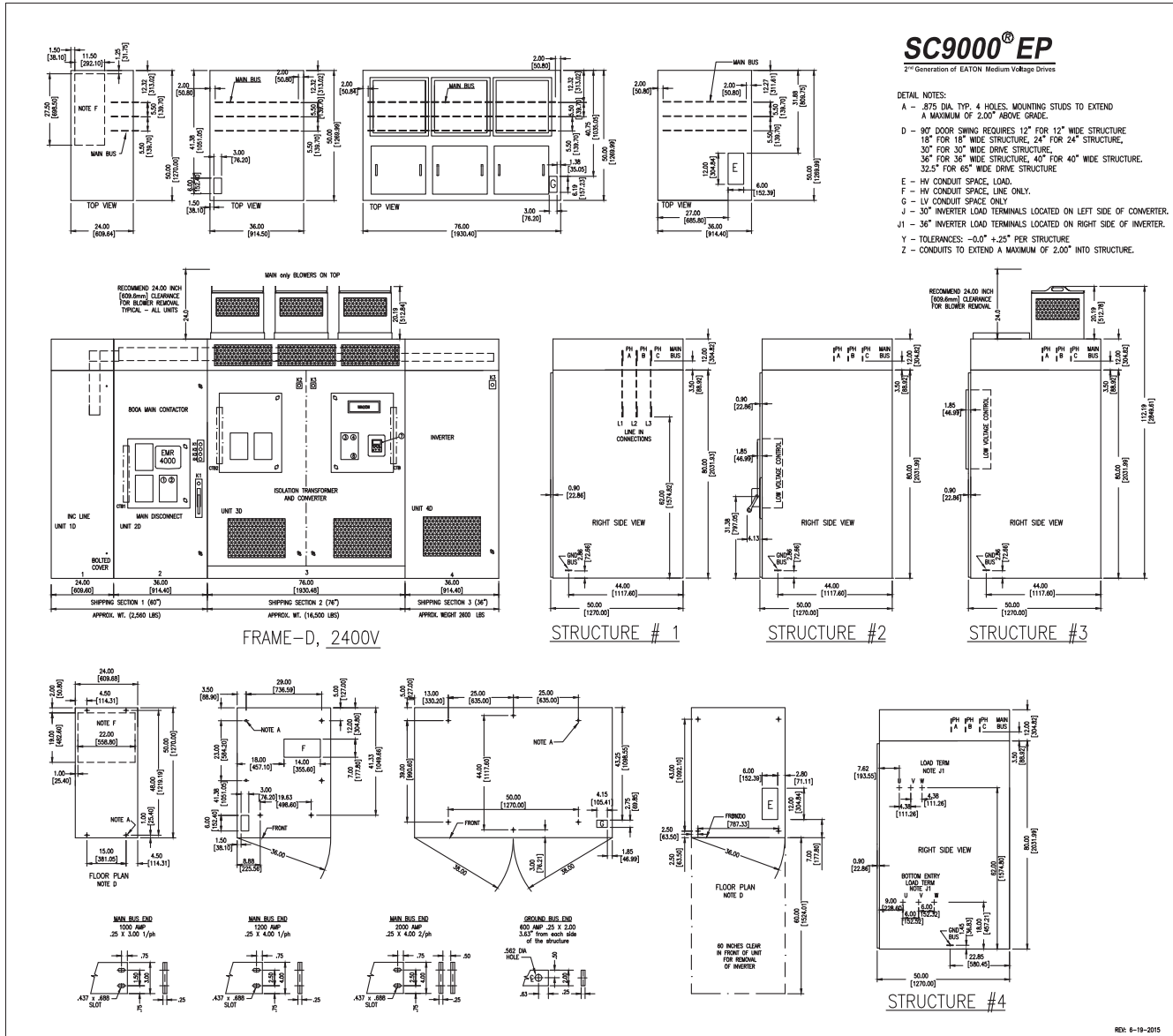


Figure 64. Frame D configuration—SC9000 EP—4160 V

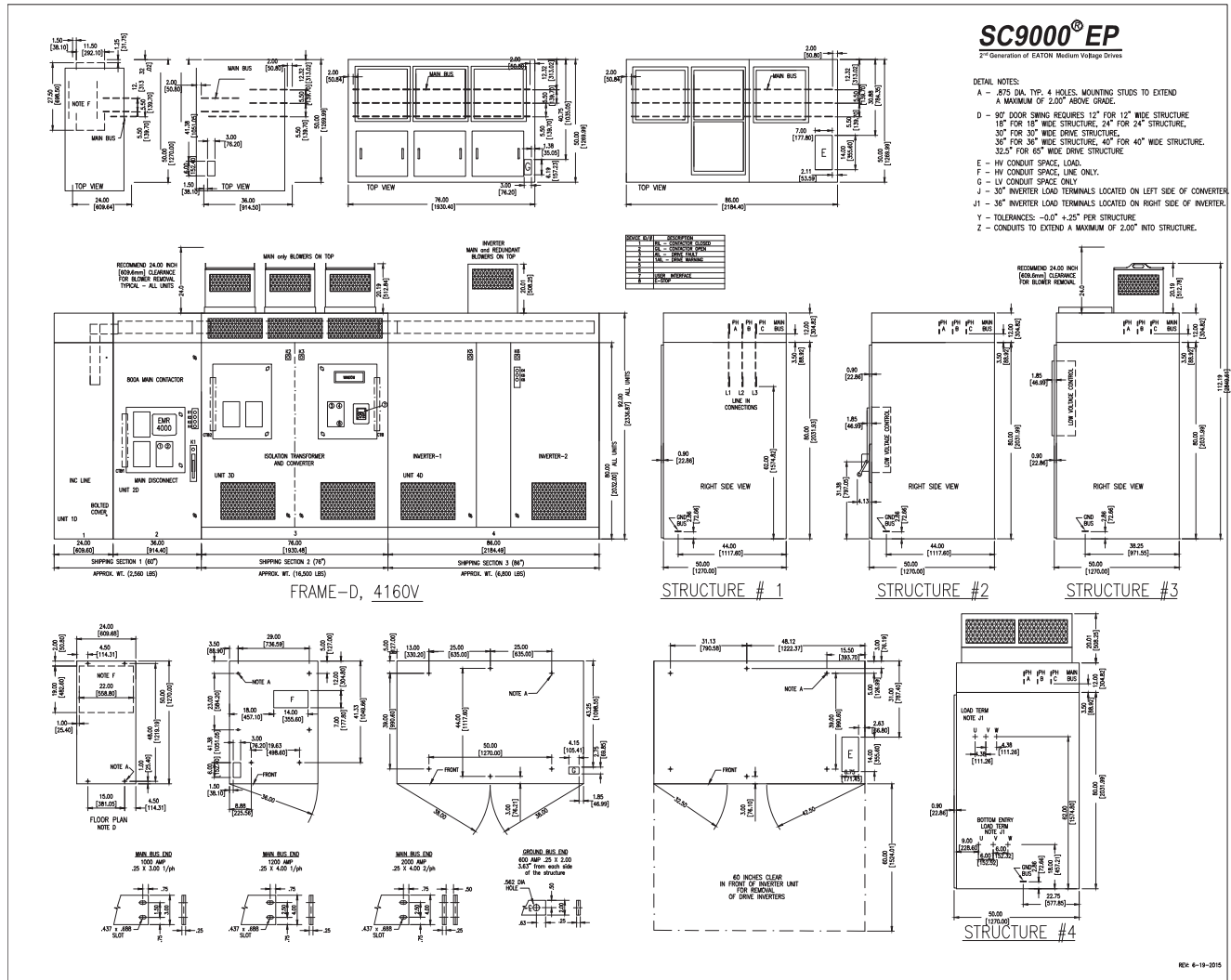


Figure 65. Frame E parts layout—SC9000 EP

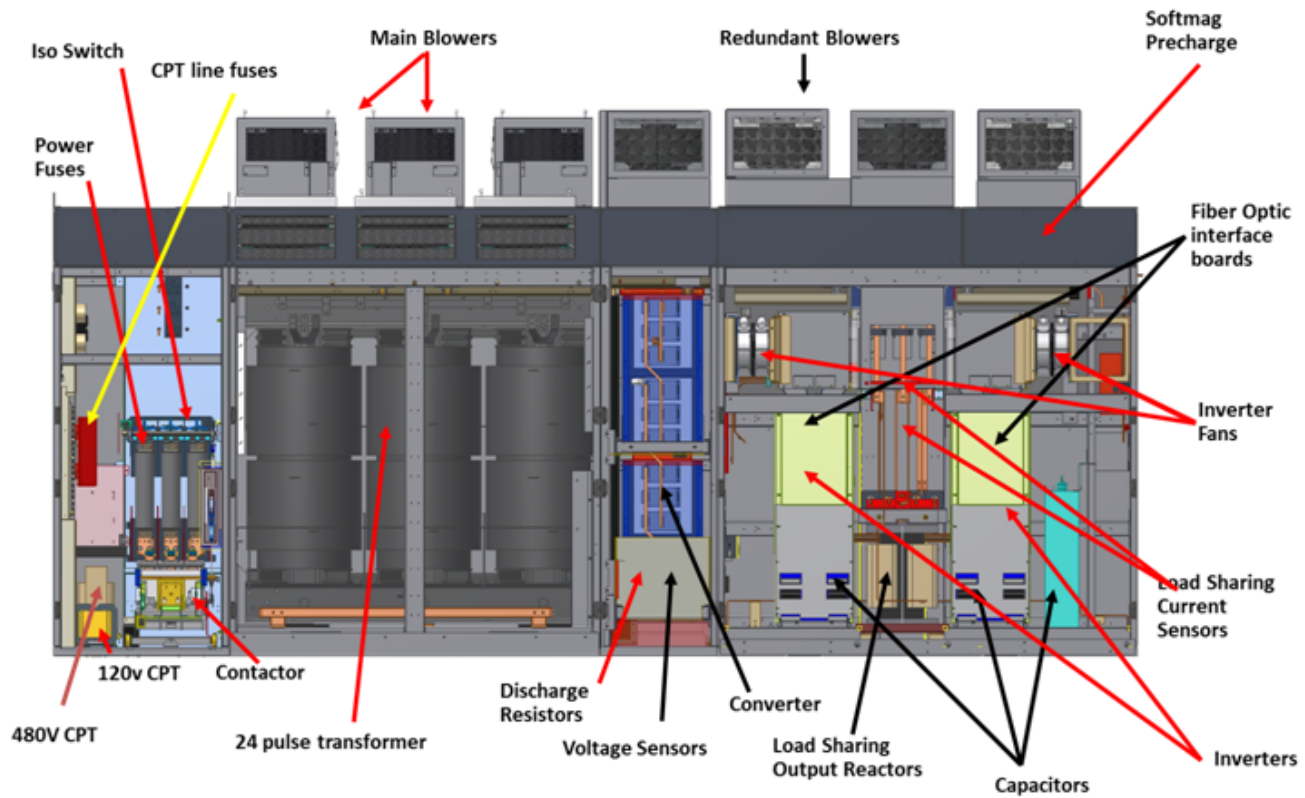


Figure 66. Frame E configuration—SC9000 EP

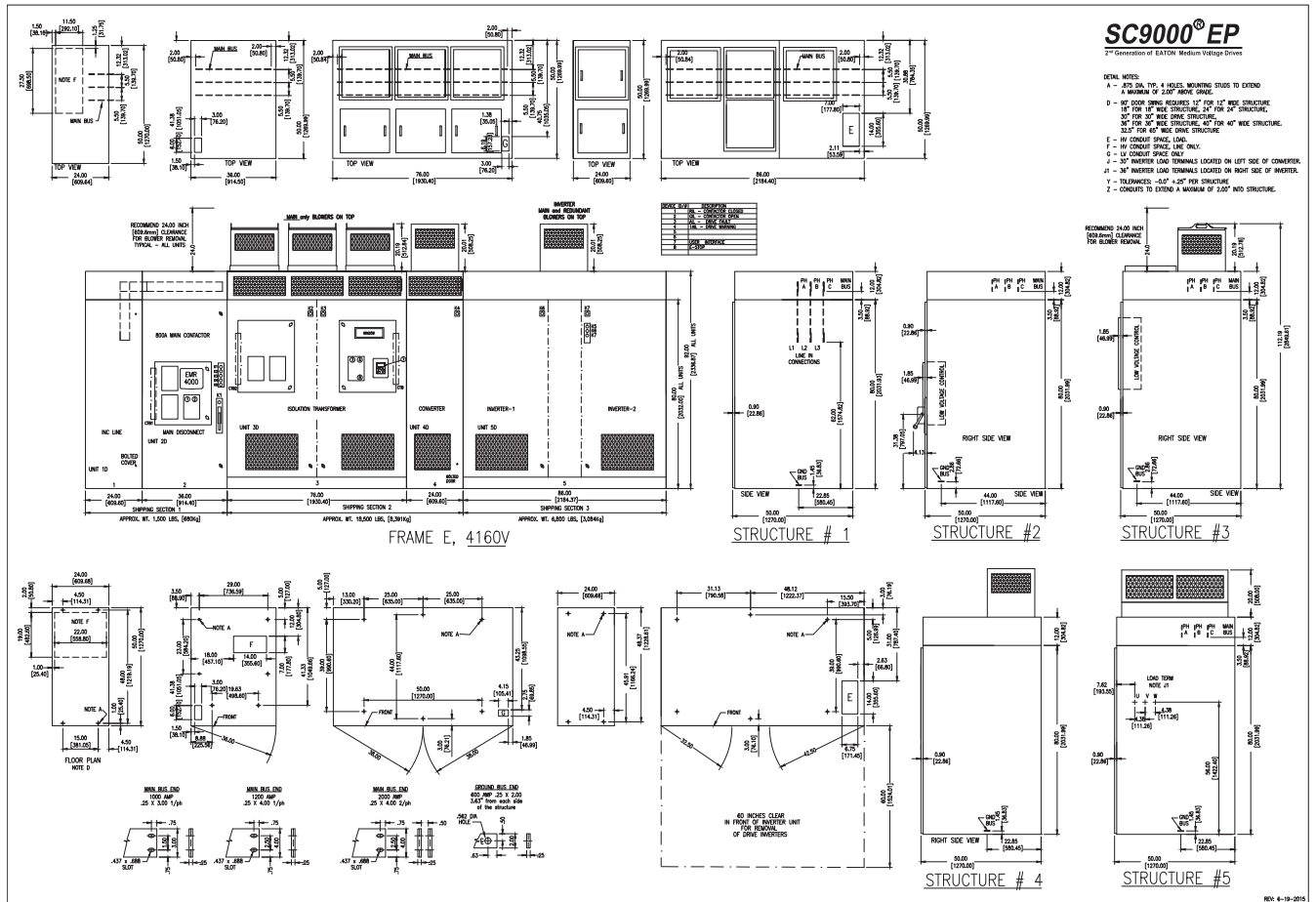


Figure 67. ARC parts layout—SC9000 EP

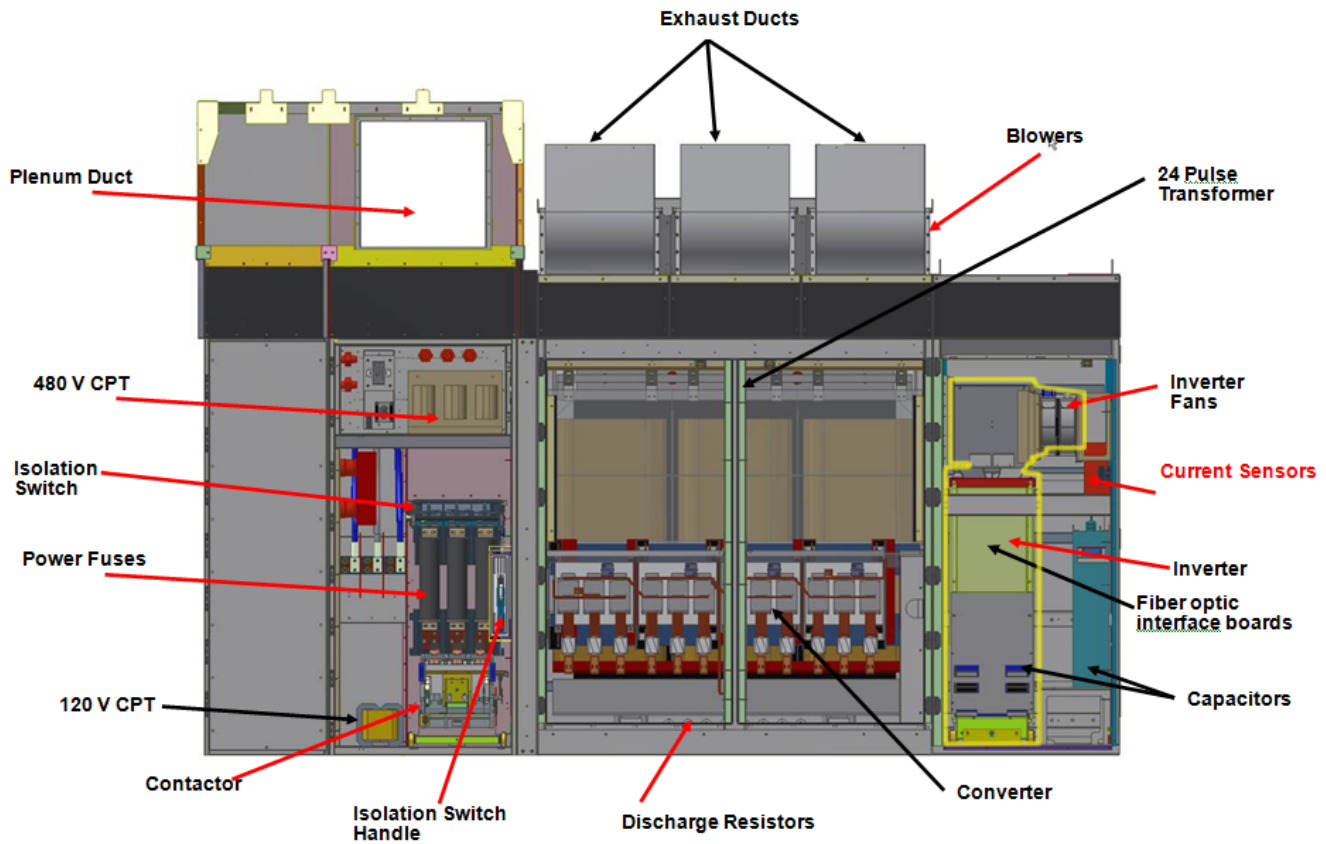
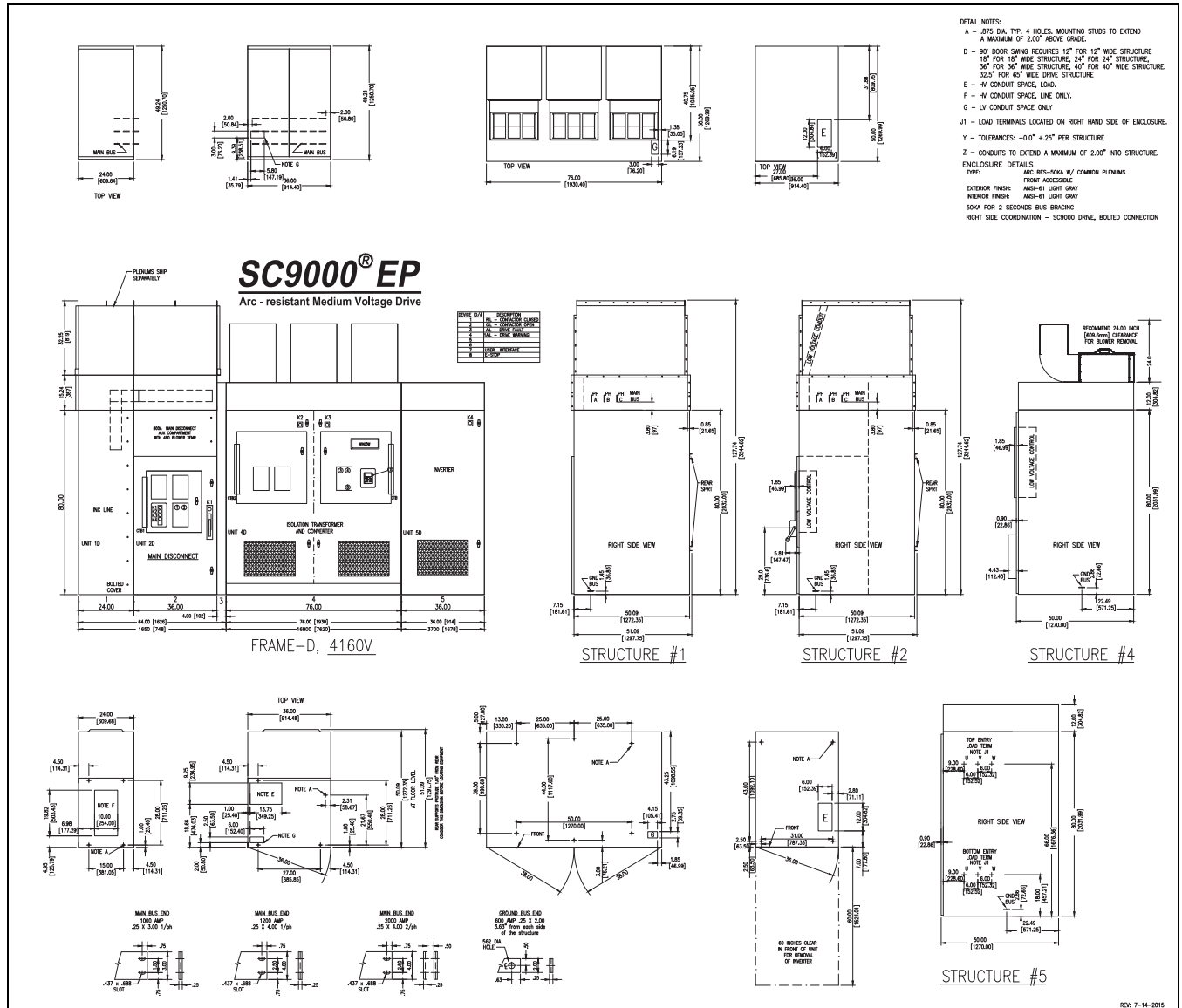


Figure 68. ARC, EP Frame D configuration—SC9000 EP



Appendix C: Typical Frame GP

Figure 69. Typical schematic for SC9000 GP—sheet 1

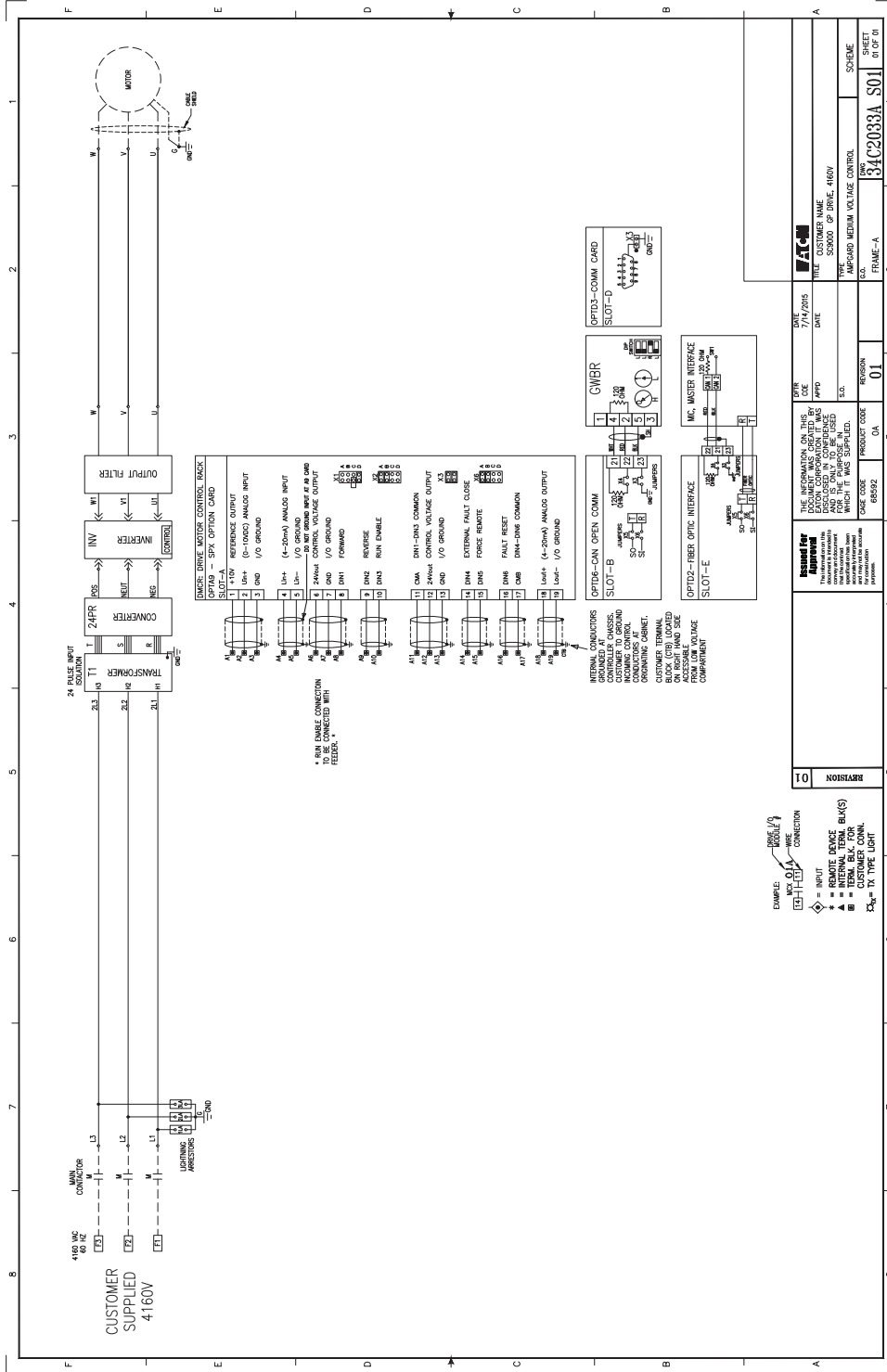


Figure 70. Typical schematic for SC9000 GP—sheet 2

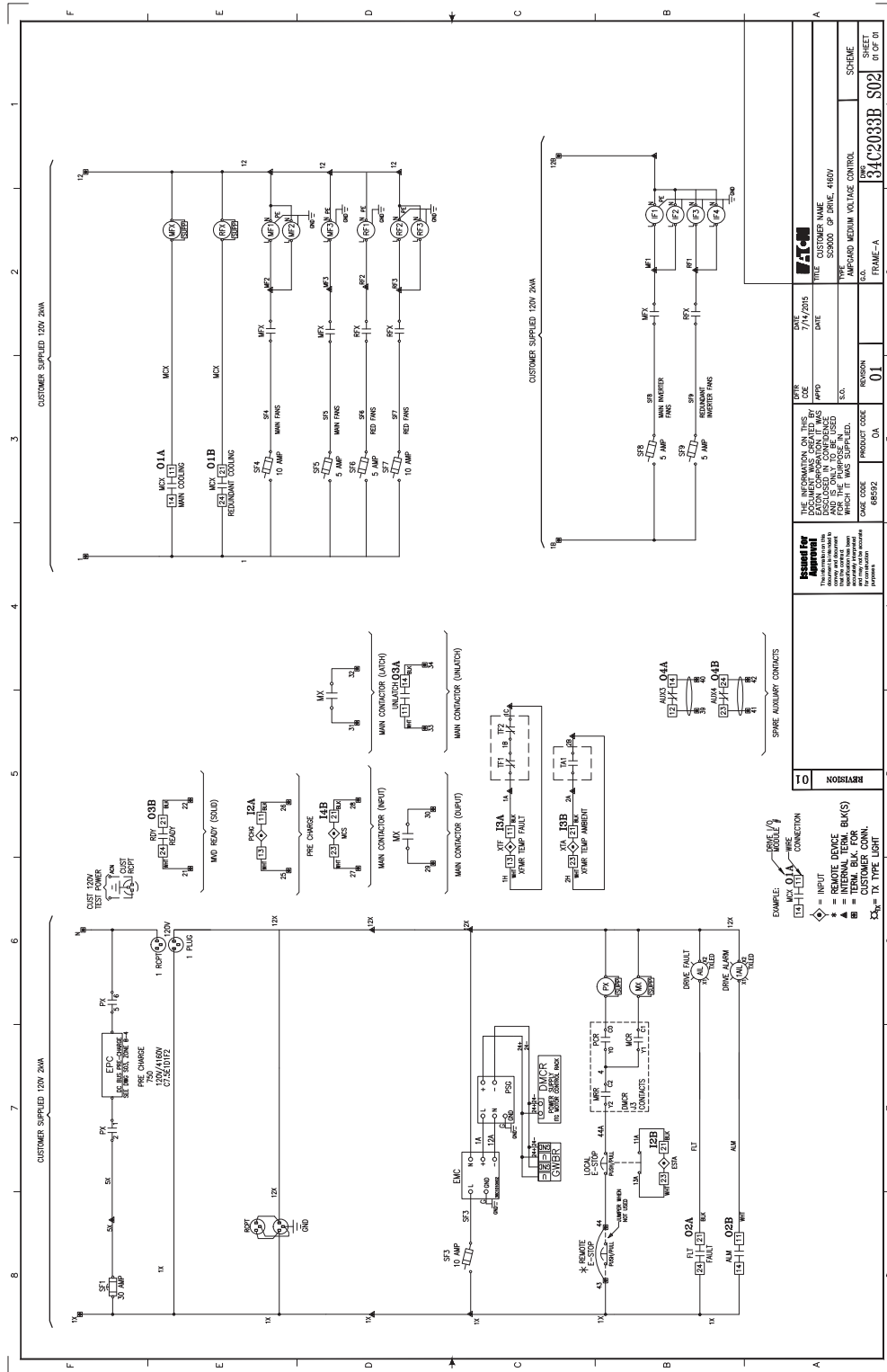


Figure 72. Typical schematic for SC9000 GP — sheet 4

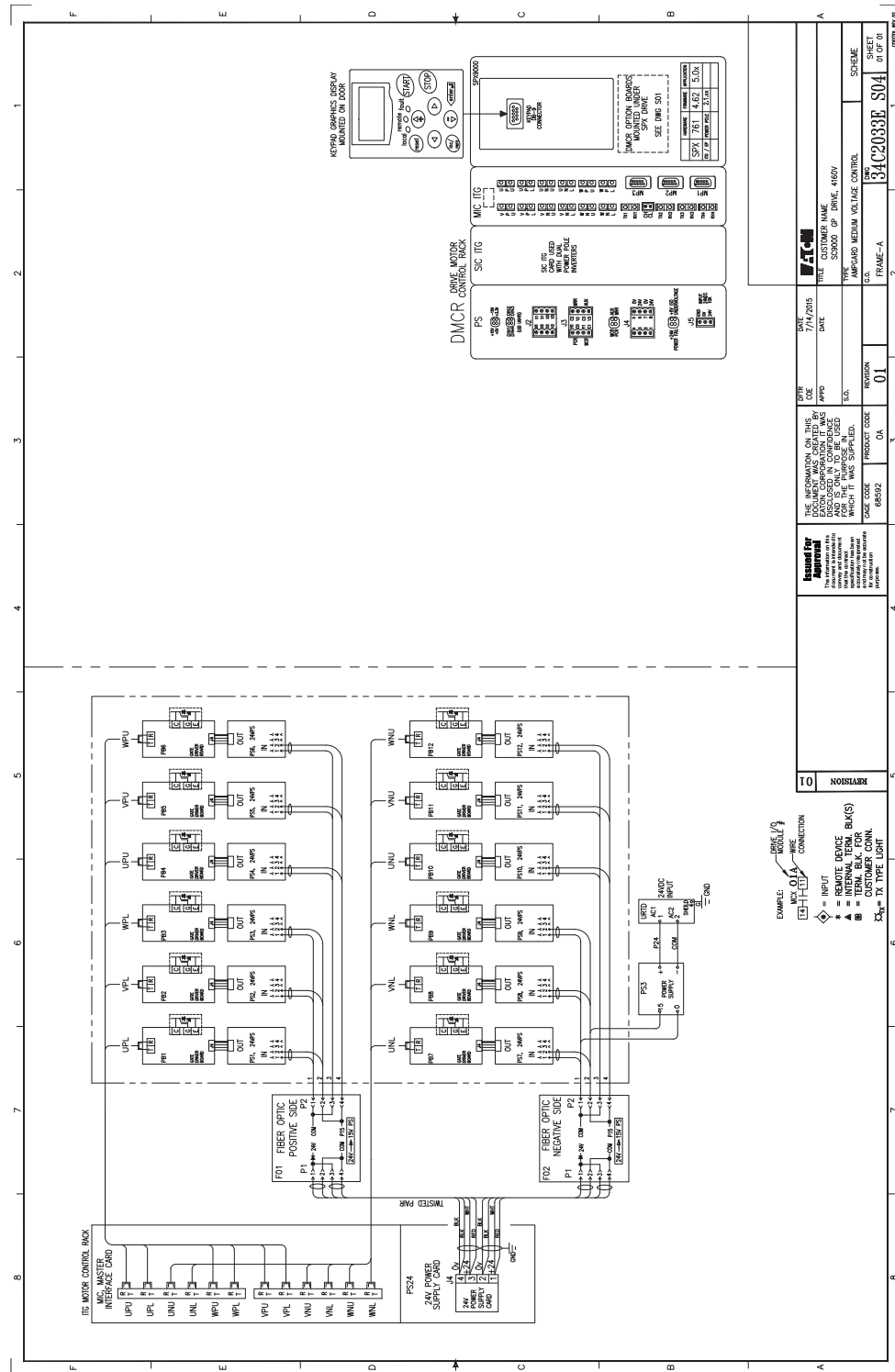


Figure 73. Typical schematic for SC9000 GP—sheet 5

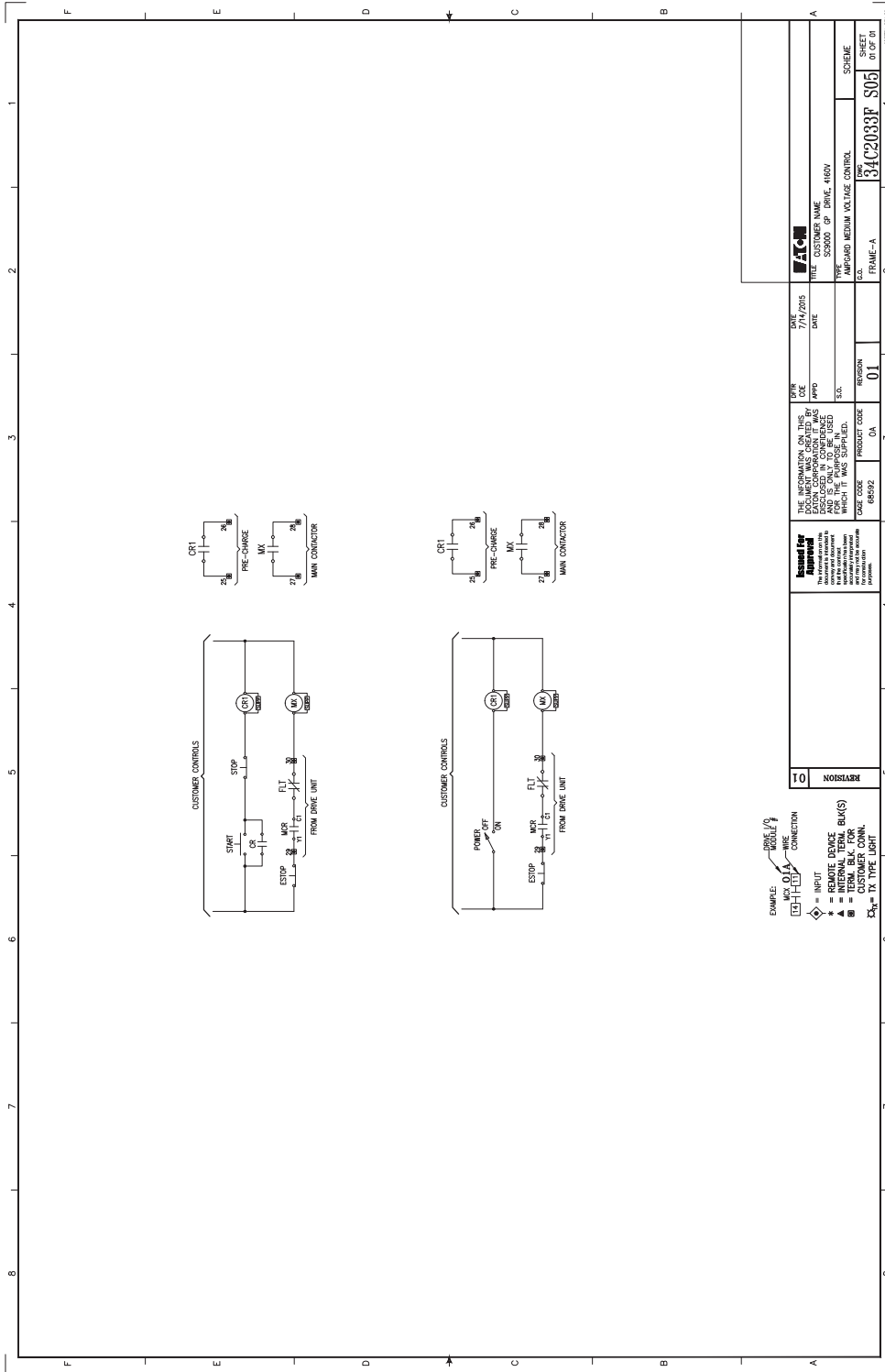


Figure 74. SC9000 GP parts layout

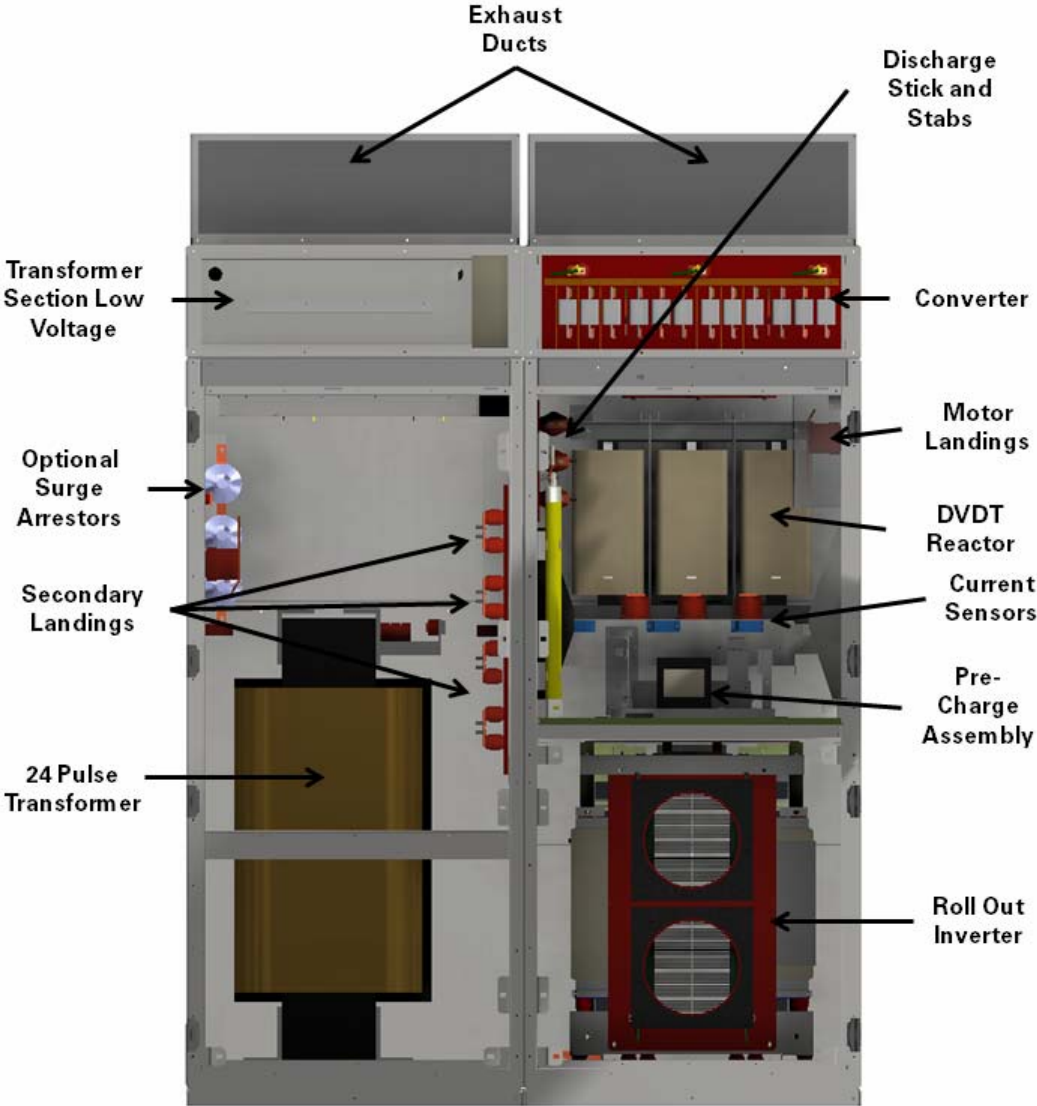
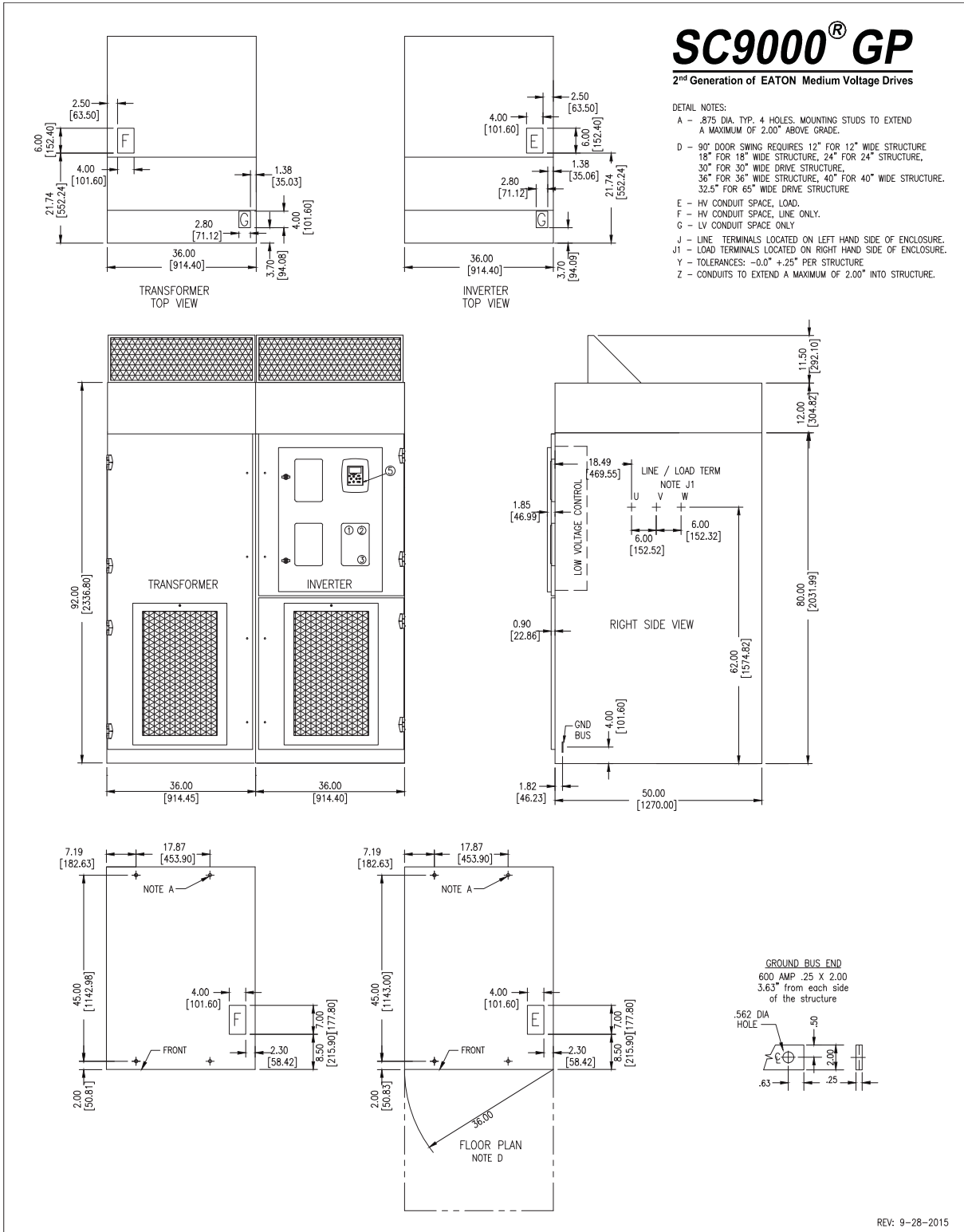


Figure 75. SC9000 GP configuration



Appendix D: Optional equipment

Section 1: Introduction

Purpose

This user manual addendum covers the installation, operation, and maintenance of selected SC9000 EP medium-voltage adjustable frequency drive optional equipment. It does not cover all possible contingencies, variations, and details that may arise during installation, operation, and maintenance of this equipment.

The SC9000 EP can be equipped with several optional features. This addendum addresses these features:

- dV/dt filter
- Sine filter
- Synchronous transfer
- Synchronous motor control
- High voltage input
- Bypass control

Optional features summary

dV/dt filter

Standard induction motors driven by adjustable frequency drives can experience excessive induced voltages at the motor under certain cable length conditions. An SC9000 EP dV/dt filter, selected for the motor's ratings and cable length, reduces these voltages, and makes longer cable runs possible with satisfactory operation.

Inverter-duty motors driven by adjustable frequency drives also can experience excessive induced voltages at the motor if cable length is excessive. For inverter-duty motors, the circumstances when these voltages occur are different, but an SC9000 EP dV/dt filter also addresses these conditions.

Sine filter

Total Harmonic Distortion, or THD, is a measurement of the amount the addition of other frequency waves corrupts a wave shape.

The SC9000 EP sine filter design reduces the drive output THD to less than 5% on both output voltage and current. Although its purpose is harmonic distortion reduction, the sine filter will also reduce the drive output dV/dt to less than 10 volts per microsecond.

Synchronous transfer system

With additional equipment, the SC9000 EP can provide synchronous transfer control to a multiple-motor system. For any number of motors, this system individually starts and

accelerates each motor, matches its voltage, frequency and phase angle to a utility power bus, and transfers the motor from the SC9000 EP to the utility bus. In addition, the synchronous transfer system can transfer any connected motor's power source from the utility bus back to the SC9000 EP and run or stop it.

Synchronous motor control

The SC9000 EP adjustable frequency drive can power synchronous motors. Additional power and control components power the motor's rotor field.

While the Ampgard motor control product line offers four different versions of synchronous motor field excitation for motor starters, the SC9000 EP offers synchronous motor field control for AC brushless and DC brush fields.

High voltage input

The SC9000 EP can deliver 2400 V, 3300 V or 4160 V output voltages, and can accommodate input voltages between 2.4 kV and 13.8 kV. When input voltages above 6.9 kV are required, the SC9000 EP is equipped with an additional 72-inch wide cabinet to incorporate a 95 kV BIL incoming line and a 15 kV input contactor.

Bypass system

The Ampgard system offers two systems for bypass control: full voltage bypass and **Reduced Voltage Solid State** bypass.

Full voltage bypass serves as a backup to the SC9000 EP AFD and can run a connected using a full voltage starter while the AFD is down.

RVSS bypass starts the connected motor using a reduced-voltage solid-state starter technology while the AFD is down.

Refer to the specific order drawings supplied with your drive system for details on which devices are part of your equipment.

Documentation reference

For further information on installation and application, refer to the applicable technical data, publications, and/or industry standards. Download Eaton electronic information from www.eaton.com.

Eaton contact information

For the location of your nearest Eaton sales office or distributor, call toll-free 1-800-525-2000 or log on to www.eaton.com. Eaton's Engineering Services & Systems (EESS) can be reached at 1-800-498-2678.

Section 2: dV/dt filter

The SC9000 EP dV/dt filter is a combination of reactors, capacitors and resistors that reduces the sharp change in voltages due to IGBT switching. Smoothing the voltage spikes reduces the high frequency ringing, lowers the voltage added to the drive output and reduces the effects on motor insulation and bearings when cable lengths are excessive.

The dV/dt filter reduces high frequency ringing on the SC9000 EP output. It does not reduce drive output Total Harmonic Distortion. The SC9000 EP Sine Filter serves that purpose.

When to use a dV/dt filter

For motors used with SC9000 EP drives, the decision to apply a dV/dt filter depends upon the motor used and the connecting cable lengths between the SC9000 EP and the motor.

Longer cable runs are possible with a dV/dt filter present. Permissible lengths depend upon the type of motor used.

dV/dt use on a standard motor

If a standard (non-inverter rated) motor is used,

- Apply a dV/dt filter to a 2400 V motor whenever the connecting cable lengths are greater than 60 feet
- Apply a dV/dt filter to a 4160 V motor whenever the connecting cable lengths are greater than 120 feet
- Apply **only** a sine filter (see Chapter 3) whenever the cable length is greater than 1250 feet

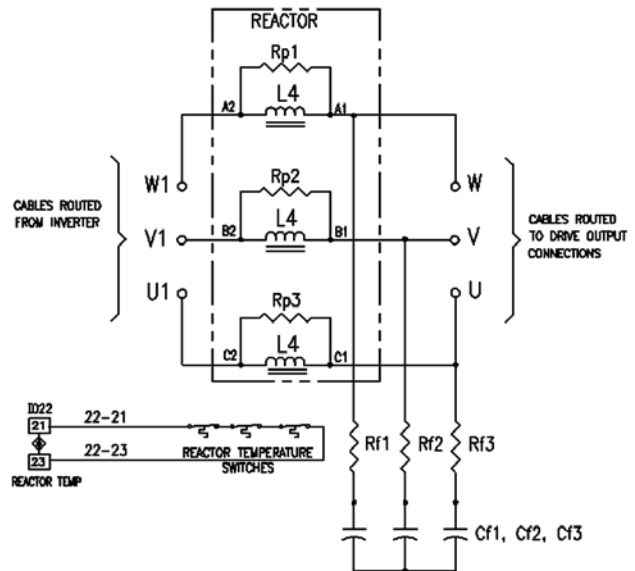
dV/dt use on an inverter duty motor

- Apply a dV/dt filter to a 2400 V motor whenever the connecting cable lengths are greater than 150 feet
- Apply a dV/dt filter to a 4160 V motor whenever the connecting cable lengths are greater than 300 feet
- Apply **only** a sine filter (see Chapter 3) whenever the cable length is greater than 1250 feet

Contact Eaton if the motor cable length is greater than what is recommended above and the optional output filter has not been supplied.

Figure 76 shows a representative dV/dt elementary diagram.

Figure 76. Typical dV/dt filter



Example showing the effects of a dV/dt filter

Figure 77 shows a representative SC9000 EP voltage step output (in green) with a corresponding dV/dt filter voltage output (in purple). In this example, the rate of change of drive output voltage (dV/dt) has decreased by about 23 times.

Figure 77. dV/dt filter effect on drive output

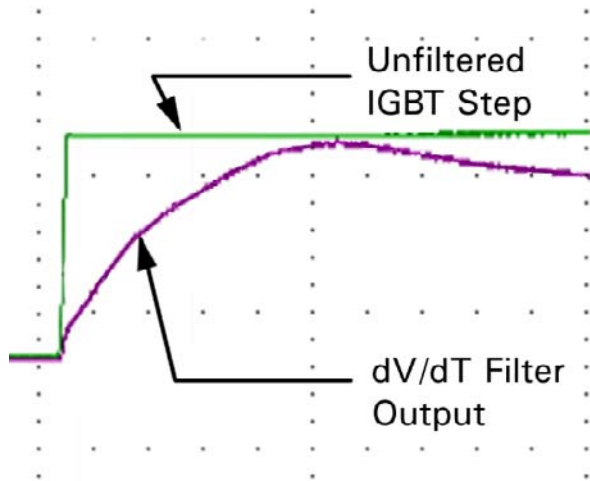


Figure 78 shows an example dV/dt filter in its cabinet.

Figure 78. dV/dt filter in cabinet



Appendix D: Optional equipment

SC9000 EP dV/dt filters and ratings

SC9000 EP dV/dt Filter designs are based upon drive rated voltage and current. Eaton application engineers select a filter during the project design process. **Tables 17** and **18** show SC9000 EP dV/dt filter models.

Table 17. 2300 V dV/dt filters

Catalog number 39C2078	Drive power (hp)	Filter rating (A)	Cabinet size (H x W x D)	Watts loss (W)
G43	300	71	92 x 24 x 50	1024
G44	400	93	92 x 24 x 50	1084
G45	500	116	92 x 24 x 50	1102
G46	600	136	92 x 36 x 50	1383
G48	800	180	92 x 36 x 50	1440
G410	1000	225	92 x 36 x 50	1514
G412	1250	279	92 x 36 x 50	1658
G415	1500	335	92 x 36 x 50	1802
G420	2000	446	92 x 36 x 50	2129
G425	2500	558	92 x 36 x 50	2226

Table 18. 4160 V dV/dt filters

Catalog number 39C2028	Drive power (hp)	Filter rating (A)	Cabinet size (H x W x D)	Watts loss (W)
G43	300	44.7	92 x 24 x 50	1282
G44	400	57.0	92 x 24 x 50	1360
G45	500	65.1	92 x 24 x 50	1357
G46	600	81.5	92 x 36 x 50	1674
G48	800	101	92 x 36 x 50	2029
G410	1000	125	92 x 36 x 50	2011
G412	1250	159	92 x 36 x 50	2163
G415	1500	186	92 x 36 x 50	3348
G420	2000	248	92 x 36 x 50	3444
G425	2500	310	92 x 36 x 50	3592
G430	3000	373	92 x 40 x 50	4843
G435	3500	434	92 x 40 x 50	4632
G442	4250	527	92 x 40 x 50	6731
G450	5000	633	92 x 40 x 50	7892
G460	6000	760	92 x 40 x 50	8033

dV/dt filter as part of the SC9000 EP lineup

During the project application and design process, the intended cable lengths and motor type selected will determine whether to apply a dV/dt filter. If your project needs a dV/dt filter, Eaton application engineers will select a filter for the intended drive, motor and installation.

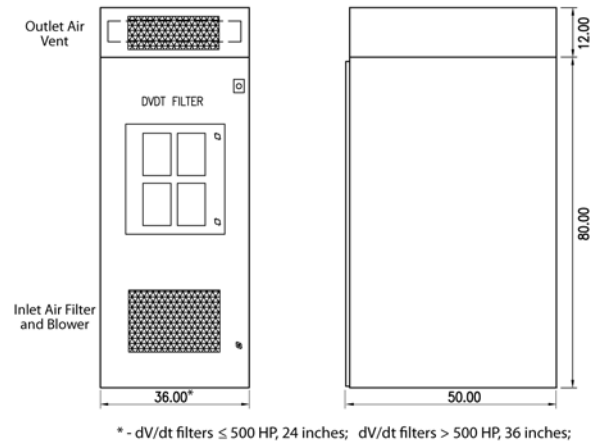
Physical location in SC9000 EP drive

The SC9000 EP dV/dt filter, when present, is typically located in the SC9000 EP panel lineup, adjacent to and downstream of the inverter cabinet. However, it can be located remotely depending on the application and installation constraints.

Filter cabinet outline

Figure 79 shows a typical cabinet outline for a dV/dt filter.

Figure 79. dV/dt representative cabinet outlines



Figures 80 and 81 show the dV/dt filter cabinet location and power flow position in the SC9000 EP.

Figure 80. dV/dt filter cabinet in SC9000 EP lineup

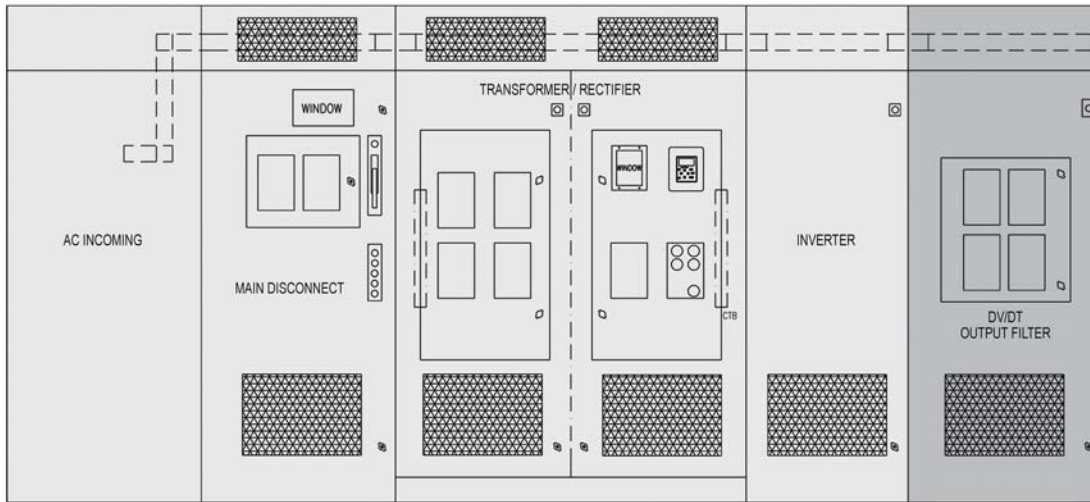
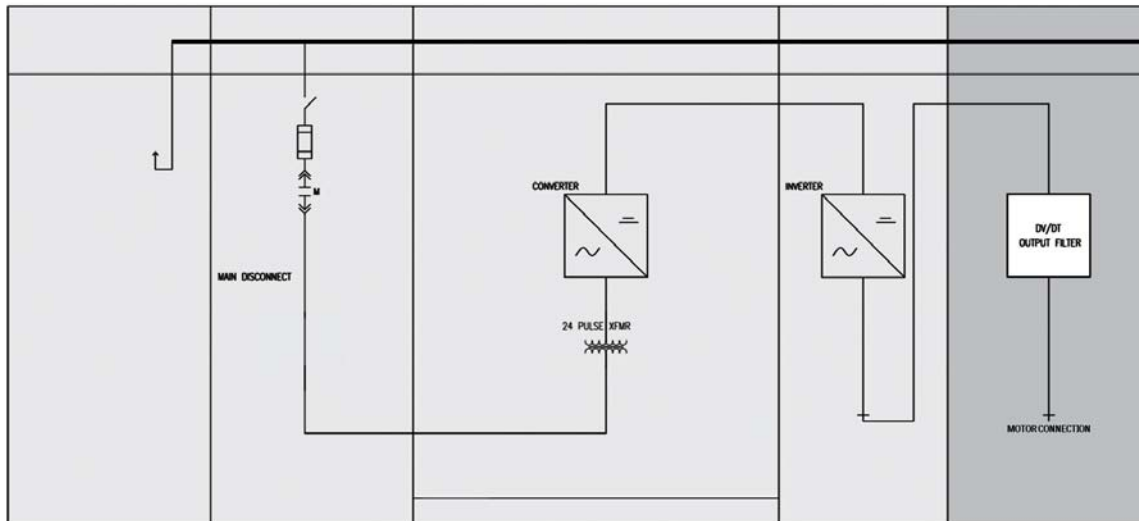


Figure 81. dV/dt filter power flow



dV/dt cooling requirements

The installed filter's cabinet cooling system provides its required cooling. This system consists of an inlet air filter and outlet air fan, located in the cabinet door, and an air outlet vent on top of the control cabinet. The filter and fan require periodic maintenance for maximum efficiency.

Maintenance

Inspect the dV/dt filter cabinet cooling system periodically to assure maximum uptime and effectiveness. Inspect the cooling fan and inlet air filter at least once every three months. Clean the filters with an air jet and dust the fan to prevent dust buildup in the fan motor and bearings. Replace the fan every three to five years.

Appendix D: Optional equipment

Troubleshooting

The dV/dt filter includes reactor thermal switches. When a dV/dt Filter is included in the SC9000 EP, these sensors connect to the SC9000 EP I/O and the drive application is programmed to monitor them. Detection of a thermal switch opening causes a drive shutdown and a fault message to be displayed and recorded.

Replacement parts

Table 19 shows replacement part numbers.

Table 19. Replacement parts

Part number	Description
W2E250-HJ32-0	Fan, WE250, 1P, 115V, 60HZ, 50C C
478C779H01	Intake filter
Contact Eaton for project-specific part	Reactor (includes thermal switch and thermal sensor)

O&M technical references

For additional information about the SC9000 EP, refer to this SC9000 EP User Manual, IB02004001E.

Section 3: Sine filter

Sine filter definition

A sine filter is an SC9000 EP system element designed to reduce Total Harmonic Distortion of the output. Total Harmonic Distortion, or THD, is a measurement of the amount the addition of other frequency waves corrupts a wave shape. THD measures the power quality of electric power systems.

Unlike the dV/dt filter, which works to reduce high-frequency drive output components, the sine filter reduces specific lower-frequency harmonics to produce a more sinusoidal drive output voltage and current.

Reducing Total Harmonic Distortion of the voltage and current delivered to a motor can decrease heating and increase efficiency. Harmonics, if present, will increase the electrical losses, and increase motor heating.

Sine filter purpose

The SC9000 EP sine filter design reduces the drive output THD to less than 5% on both output voltage and current, for loads above 30% of rated. Although its purpose is harmonic distortion reduction, the sine filter will also reduce the drive output dV/dt.

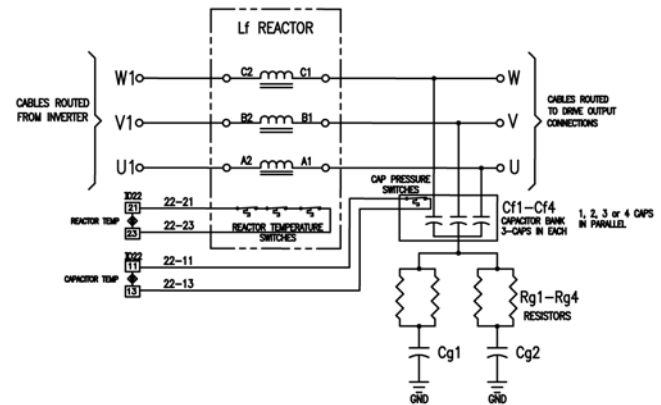
With the sine filter applied, the only limitation on connecting cable lengths is the voltage drop between the drive and the motor.

Sine filter design

The SC9000 EP sine filter is composed of inductors, capacitors and resistors. The inductors and capacitors assemblies include protective sensing devices.

Figure 82 shows a representative sine filter diagram.

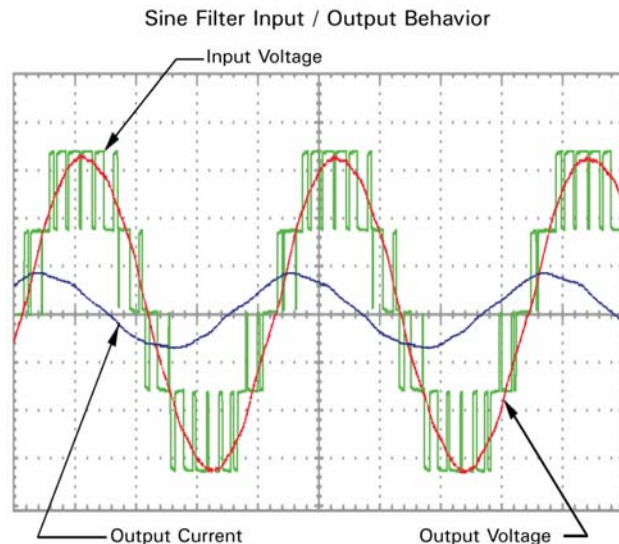
Figure 82. Typical sine filter elementary diagram



Representative sine filter performance

Figure 83 shows an example of SC9000 EP output performance without and with the Sine Filter.

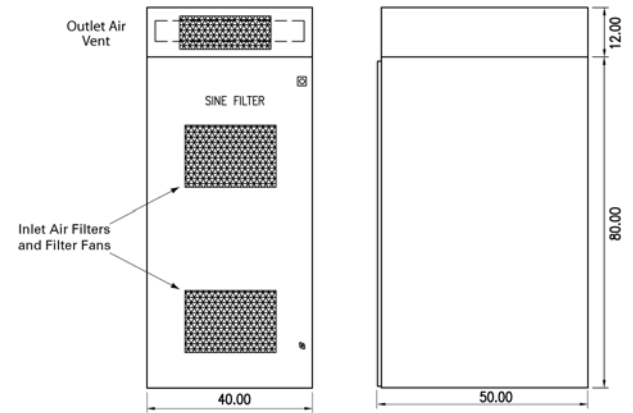
Figure 83. Example before and after sine filter output



Sine filter location in the SC9000 EP drive

Sine filters mount in their own cabinets, and come with cabinet cooling fans and inlet air filters. Due to their weight, sine filter inductors mount in the cabinet bottom, with the resistors and capacitors on a shelf above them.

Figure 84. Sine filter panel layout



Figures 85 and 86 show a typical SC9000 EP lineup with a sine filter included. The sine filter mounts adjacent to the inverter cabinet in an SC9000 EP lineup.

Figure 85. Sine filter added to SC9000 EP lineup

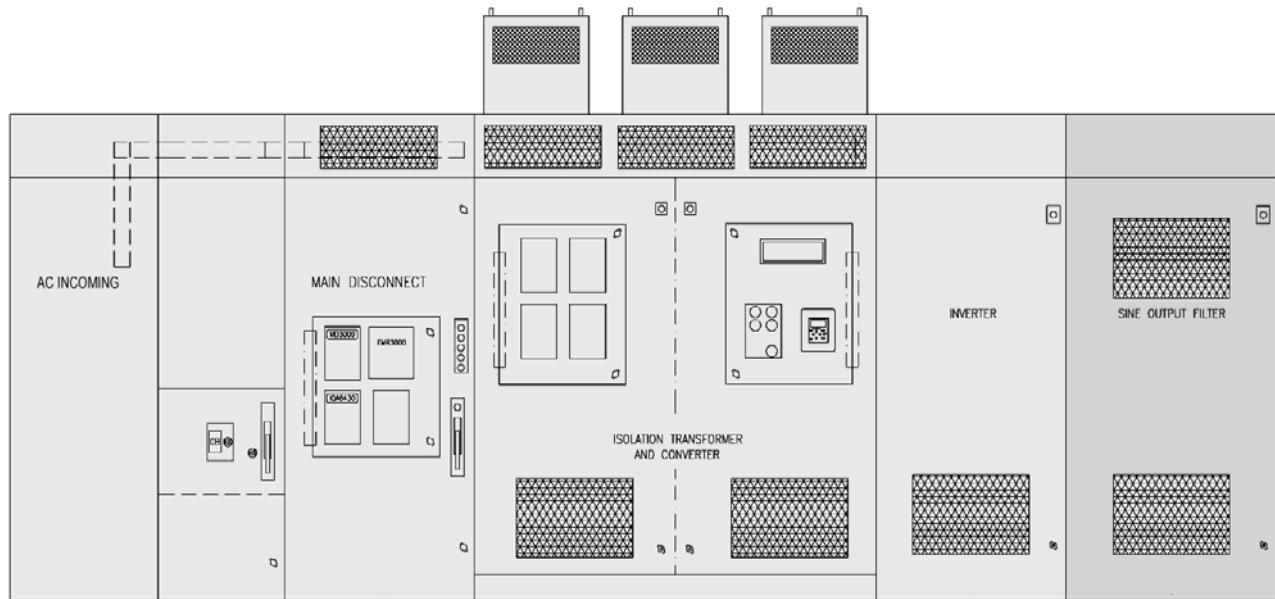
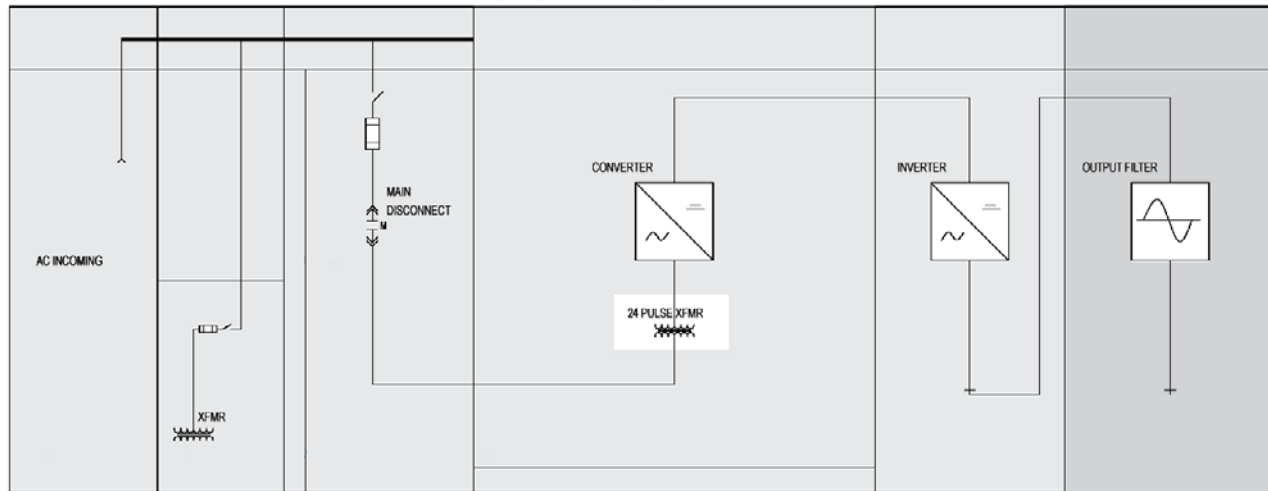


Figure 86. Sine filter power flow one-line diagram



Figures 87 and 88 show installed Sine Filters in two frame sizes.

Figure 87. Sine filter with filter fans shown



Figure 88. Frame D sine filter



When to apply a sine filter

Deciding to apply a sine filter depends upon several design factors. The length of the cable between the drive and motor; whether there is concern for motor heating due to additional harmonics; the motor design (inverter duty versus non-inverter duty), all play a role in the application decision. If the cable length from drive to a standard motor **or** to an inverter duty motor is greater than 1250 feet, apply a Sine Filter.

Sine filter ratings

The connected motor horsepower and current determine which SC9000 EP sine filter to apply. **Tables 20** and **21** show the filter catalogue numbers along with corresponding induction motor ratings. Contact the factory for synchronous motor applications.

Table 20. 2400 V sine filters for induction motors

Catalog number 39C2022	Motor power (hp)	Filter output (A)	Cabinet size (H x W x D)	Watts loss (W)
G02	350	82	92 x 40 x 50	1492
G04	450	104	92 x 40 x 50	1759
G06	600	135	92 x 40 x 50	2151
G08	800	178	92 x 40 x 50	2628
G10	1000	223	92 x 40 x 50	3142
G11	1250	279	92 x 40 x 50	3720
G12	1500	335	92 x 40 x 50	4013
G14	2000	446	92 x 40 x 50	5043
G16	2500	558	92 x 40 x 50	6327

Table 21. 4160 V Sine filters for induction motors

Catalog number 39C2022	Motor power (hp)	Filter output (A)	Cabinet size (H x W x D)	Watts loss (W)
G22	350	47	92 x 40 x 50	1530
G24	450	60	92 x 40 x 50	1792
G26	600	77	92 x 40 x 50	2199
G28	800	103	92 x 40 x 50	2708
G30	1000	128	92 x 40 x 50	3245
G31	1250	162	92 x 40 x 50	3860
G32	1500	186	92 x 40 x 50	4123
G34	2000	250	92 x 40 x 50	5204
G36	2500	312	92 x 40 x 50	6495
G38	3000	380	92 x 40 x 50	8375
G39	3500	434	92 x 40 x 50	9152
G40	4250	533	92 x 40 x 50	11315
G41	5000	624	90 x 56 x 50	13131
G42	6000	747	90 x 56 x 50	15212

Cooling requirements and filter monitoring

Sine filters are power components and require cooling to operate properly. Each sine filter cabinet is equipped with cooling fans and inlet air filters to provide satisfactory cooling. The sine filter reactors are also equipped with over-temperature switches and the capacitors have over-pressure switches to detect adverse conditions.

Maintenance

Sine Filter maintenance consists of periodic inspections of the cooling air fans and inlet air filters, and periodic checks of the oil-filled capacitors.

Inspect the cooling fans and inlet air filters at least once every three months. Clean the filters with an air jet and dust the fans to prevent dust buildup in the fan motor and bearings. Replace fans every three to five years.

Check the capacitors annually.

SC9000 EP application programming

⚠ CAUTION

Do not attempt to perform an SC9000 EP motor characteristics identification procedure with the sine filter connected between the SC9000 EP and the motor. this could damage to the SC9000 EP and require repair.

⚠ CAUTION

Do not use the Open Loop Vector Control mode with a sine filter installed. The Sine Filter will interfere with the SC9000 EP motor model calculations, resulting in improper operation.

Applying a sine filter to the SC9000 EP requires programming the medium-voltage drives application. The sine filter introduces a voltage drop in the output to the motor. The SC9000 EP application programming raises the drive output voltage to restore full voltage performance at the motor.

Refer to Chapter 5, Parameter Group G1.14 for detailed information about the Sine Filter parameters.

The sine filter affects the choice of SC9000 EP operating modes. Refer to the Caution messages above for important restrictions.

Troubleshooting

The sine filter includes reactor thermal and capacitor pressure switches. When a sine filter is included in the SC9000 EP, these sensors connect to the SC9000 EP I/O and the drive application is programmed to monitor them. Detection of a thermal switch or capacitor pressure switch opening causes a drive shutdown and a fault message to be displayed and recorded.

Replacement parts

Table 22 shows replacement part.

Table 22. Replacement parts

Part number	Description
W2E250-HJ32-0	Fan, WE250, 1P, 115V, 60HZ, 50C C
478C779H01	Intake filter
Contact Eaton for project-specific part	Capacitor assembly (overttemperature, overpressure switches included)

O&M technical references

For additional information about the SC9000 EP, refer to this SC9000 EP User Manual, IB02004001E.

Section 4: Synchronous transfer

Purpose

With additional equipment, the SC9000 EP can provide synchronous transfer control to a multi-motor system. (This excludes SC9000 GP, which is not capable of synchronous transfer). For any number of motors, this system individually starts and accelerates each motor and runs it at any desired speed. Or, it can start a motor, match the motor’s voltage, frequency and phase angle to a utility power bus, and transfer the motor from the SC9000 EP to the utility bus. The Synchronous Transfer system can also transfer any connected motor’s power from the utility bus back to the SC9000 EP and individually control its speed or stop it.

Components

To perform this function, the Synchronous Transfer System must have an SC9000 EP output damping reactor, a PLC control system to receive customer commands, and bypass and motor select contactors for each motor. Customer commands include Start or Stop, Sync Up or Sync Down, for each system motor. The SC9000 EP can also include an optional AFD feeder bus contactor.

SC9000 EP output reactor

Sized for the SC9000 EP drive and motors’ rating, the output reactor dampens current transients during the bypass contactor and motor select contactor switching.

Bypass contactor

This Ampgard medium-voltage starter assembly connects a selected motor to the utility feed line upon command. There is one bypass contactor module for each connected motor.

Motor select contactor

This Ampgard medium-voltage starter assembly connects a selected motor to the AFD feeder bus upon command. There is one motor select contactor module for each connected motor. Unlike the bypass contactor module, this module does not include motor starter fuses, since the SC9000 EP provides overload protection.

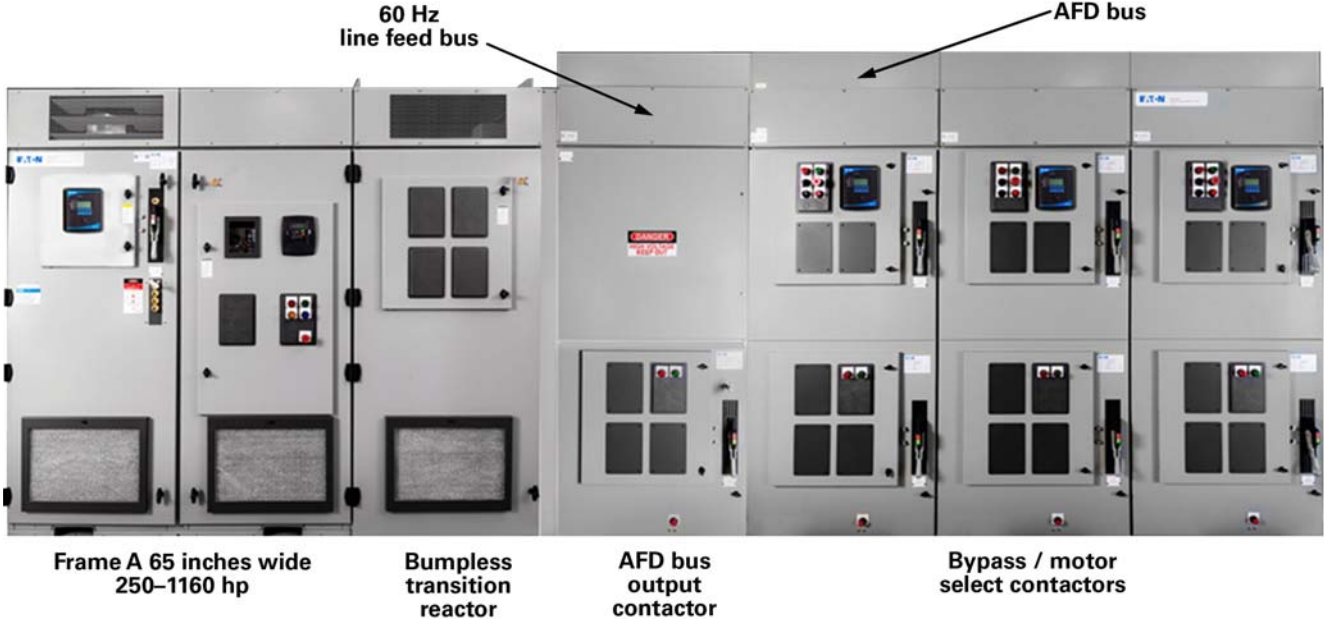
PLC system

The SC9000 EP Synchronous Transfer system includes programmable controllers to receive command inputs from the customer’s supervisory control and sequence the SC9000 EP, the motor select and bypass contactors. A Drive master PLC mounts behind a low-voltage door in an SC9000 EP cabinet. Smaller PLCs for each motor in the system provide system scalability plus status monitoring for each system motor.

The Drive master PLC receives requests from individual motor PLCs for transfer operations. The master PLC checks system permissives and system status before initiating a transfer sequence.

The master PLC sequences and monitors each motor's bypass contactor, motor select contactor and motor status to assure that proper execution of drive operation and contactor switching take place. Since a successful transfer includes voltage, frequency and phase synchronization between the SC9000 EP and the utility bus, the drive times each transfer step to the millisecond.

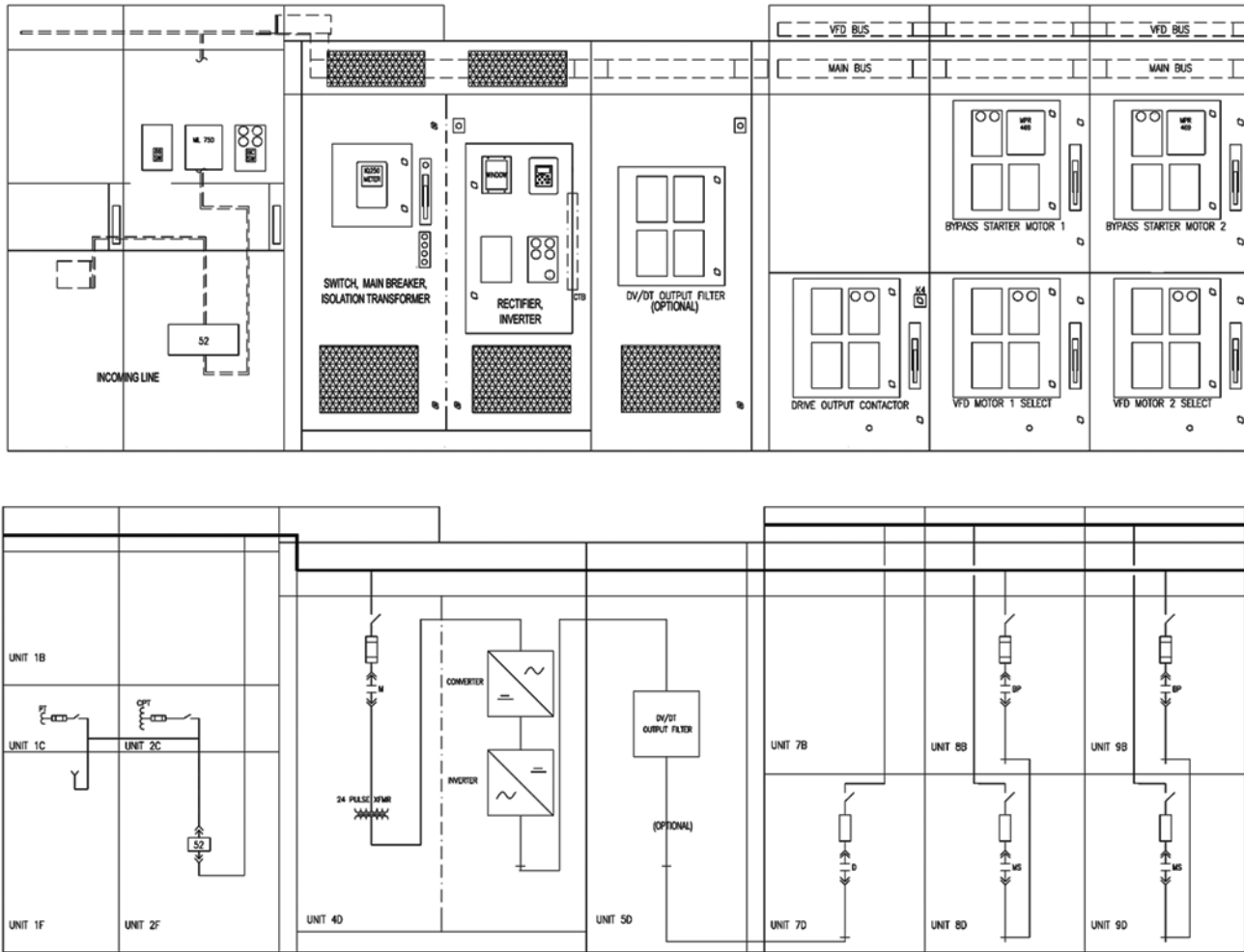
Figure 89. Synchronous transfer



Synch transfer panel layout and power flow

Figure 90 shows a typical synchronous transfer system panel layout and power flow.

Figure 90. Synchronous transfer panel layout



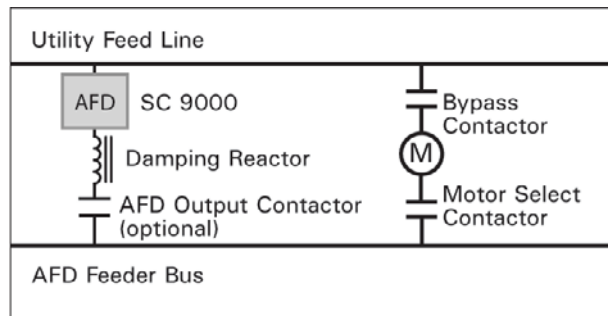
Transfer control operation

Following is a description of the synchronous transfer system operation. **Figure 91** shows the elements that make up an SC9000 EP Synchronous Transfer system.

Control elements colors and symbols

■ = de-energized	■ = energized feeder bus
■ = energized AFD bus	⊗ = contactor energized and closed

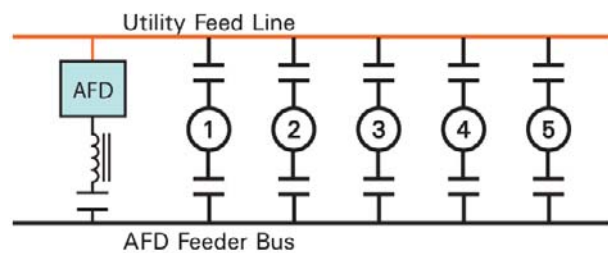
Figure 91. Synchronous transfer elements



Sequence of operation

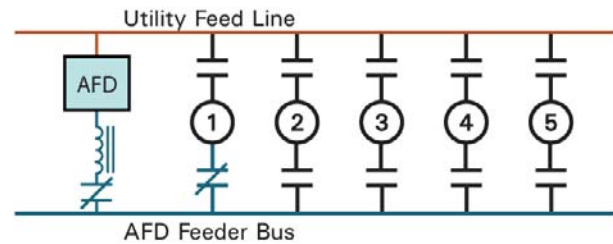
1. The AFD and feeder bus are energized (**Figure 92**).

Figure 92. AFD and feeder bus energized



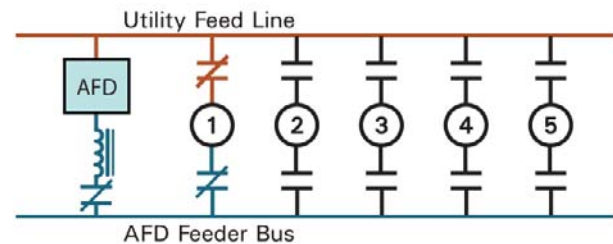
2. The PLC receives a Start Command from the supervisory control system.
 - The PLC closes the appropriate motor select contactor
 - When the motor select contactor is closed, the PLC starts the AFD. The AFD accelerates and operates the selected motor at either a preset speed or a reference speed (**Figure 93**)

Figure 93. AFD runs selected motor at speed



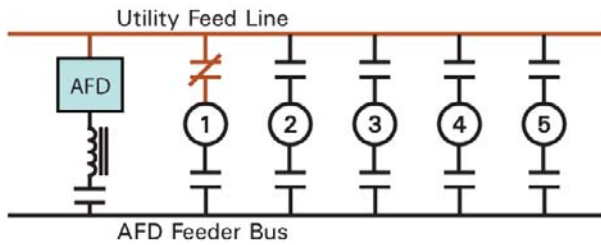
3. Sync UP
 - When the motor is required to transfer to the utility line, the supervisory control instructs the PLC to send a "Sync Up" command to the AFD
 - The AFD adjusts its output to match the utility line voltage, frequency and phase angle
 - Once the AFD is synchronized with the utility line, the selected motor's bypass contactor closes, connecting the motor to the utility line, and the selected motor's select contactor opens, disconnecting the motor from the AFD bus (**Figure 94**)

Figure 94. Selected motor contactors switching



- The AFD output reactor dampens any transient currents that may occur during the transition
- Once the transition is complete, the AFD shuts down and waits for another Start command from the PLC
- Now only the utility bus feeds the selected motor (**Figure 95**)

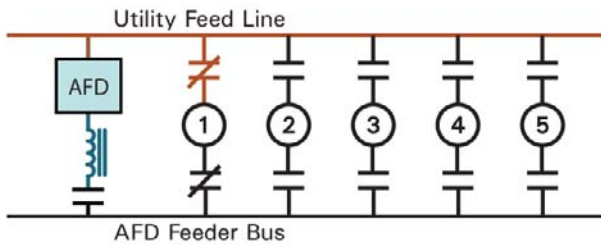
Figure 95. Selected motor on utility bus



4. Sync Down

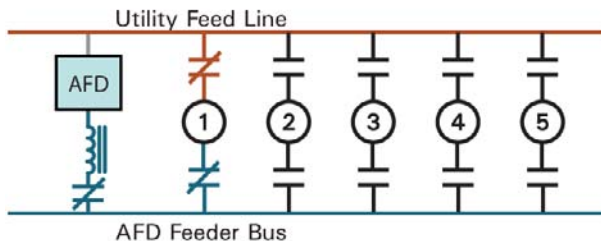
- When instructed by the supervisory control, the PLC sends a command to the AFD to “Sync Down”
- The PLC commands the AFD to start
- With the AFD output contactor open and the selected motor’s bypass contactor closed, the PLC closes the selected motor’s motor select contactor (**Figure 96**)

Figure 96. Motor select contactor closes



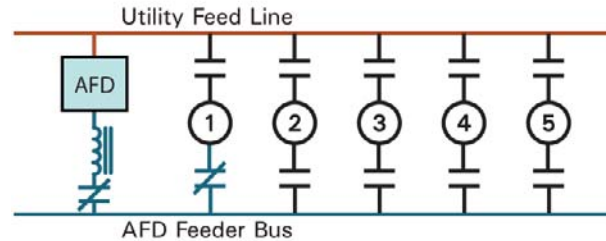
- The AFD is commanded to match the utility’s voltage, frequency and phase angle; once this is completed, the AFD output contactor closes and the selected motor’s utility’s bypass contactor opens. The AFD output reactor dampens any transient currents that may occur during the transition (**Figure 97**)

Figure 97. AFD contactor closes, bypass opens



- The AFD, now connected to the selected motor, operates at a set speed or follows a reference speed (**Figure 98**)

Figure 98. Selected motor runs on AFD bus



Control interface

Customer commands for each motor include Start, Stop, Sync Up, Sync Down, and Run Speed. Motor and Contactor status are available for supervisory control.

Control options

The SC9000 EP Synchronous Transfer system comes standard with Eaton Programmable Controllers. Other controllers can be furnished as an option.

Control application configuration

The SC9000 EP medium-voltage drives application has programming parameters for use with Synchronous Transfer systems. Refer to Chapter 5, Parameter Group G1.17 for detailed information on these parameters.

Fault conditions / alarm states

The SC9000 EP monitors fault conditions and alarm states for all Synchronous Transfer system elements. Individual motor PLCs monitor motor and contactors’ status and coordinate with the Drive master PLC at all times. Drive status and alarm conditions are available through the SC9000 EP operator interface and remote supervisory control interface provisions.

O&M technical references

For additional information about the Synchronous Transfer system elements, refer to Appendix F of this SC9000 EP User Manual, IB02004001E and your project reference drawings:

AD02004001E Synchronous Transfer Control with SC9000 EP

Section 5: Synchronous motor system

Synchronous motors

Synchronous motors are like other induction motors in that they have stator windings that induce currents and magnetic fields in rotor squirrel cage bars. In the synchronous motor, these squirrel cage bars, or *amortisseur* windings, are short-time rated, for starting duty. The synchronous motor also has externally-powered wound rotor magnets. How the wound rotor magnets receive their power defines the two synchronous motor types.

Synchronous motors come in two varieties: brush-type and brushless. The brush-type motor uses slip rings and brushes to conduct DC excitation current to the rotor wound electromagnets. The brushless type uses a separate set of stator windings and rotor bars to transmit AC to rotor-mounted hardware for conversion to DC.

Synchronous motor components

Figure 99, Figure 100 and Figure 101 show the essential rotor DC excitation components of brush-type and brushless synchronous motors.

Figure 99. Brush-type synchronous motor elements

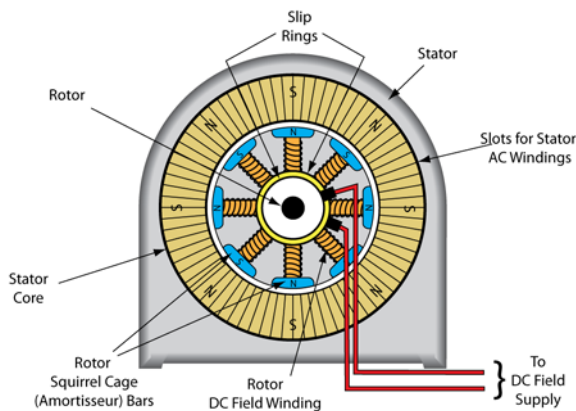


Figure 100. Brush-type motor slip rings

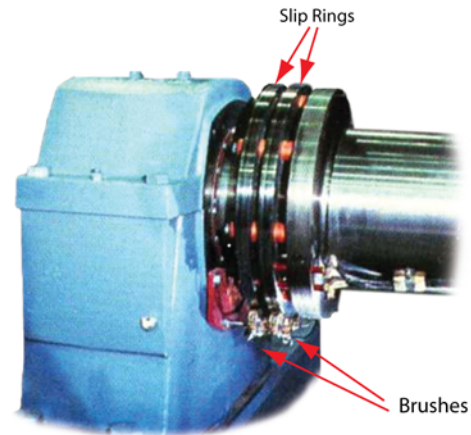
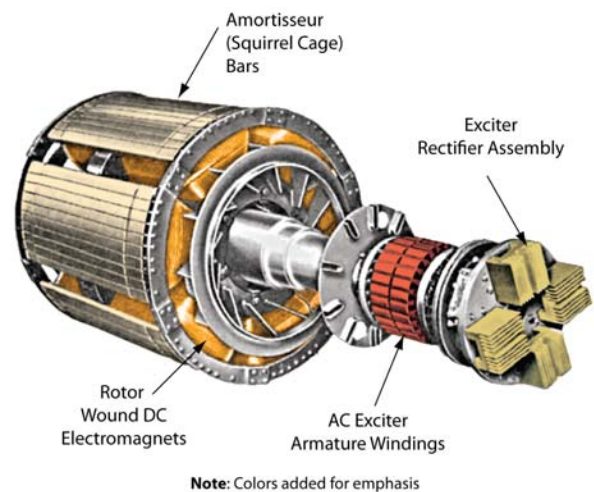


Figure 101. Brushless synchronous motor elements



A synchronous motor starts like a conventional induction motor, using a motor starter or VFD and relying on the torque produced by the stator magnets and squirrel cage bar magnets for acceleration. As the motor speed approaches its synchronous speed, an external control system detects this and energizes the rotor's separate-excitation windings, the wound electromagnets, pulling the rotor up to synchronous, or rated speed. Once at synchronous speed, the amortisseur windings act as damping windings to discourage motor speed variation, or hunting.

Appendix D: Optional equipment

The brushless type synchronous motor has distinct advantages over the brush-type. Maintenance of the brushless type is considerably simpler. The brushless type does not require cleaning the slip ring collector, repairing damaged or corroded slip rings, inspecting and replacing worn brushes, etc. In addition, brush particles abraded from the brushes and loose in the motor frame can deposit on the motor windings, affecting insulation life.

In addition, the brushless type is more suitable for use in adverse environmental conditions. Maintaining slip rings and brushes under conditions like those found in chemical plants, where steam, oil or corrosive gases are present, is very difficult. Brushless motor designs for pressurized or explosion-proof requirements are much simpler than with slip rings and brushes.

The SC9000 EP drive system can include control and excitation for brushless synchronous motors.

SC9000 EP synchronous motor control

The SC9000 EP Synchronous Motor control system provides both stator and rotor control and power. The SC9000 EP Adjustable Frequency Drive powers and protects the synchronous motor's stator windings, while the separate power and protection system provides the rotor windings excitation. **Figure 102** shows the SC9000 EP functional block diagram for brushless synchronous motors.

The SC9000 EP directs the field exciter, based upon configuration and settings parameters established in the drive application software. For more information about the application parameters, see Chapter 5, Parameter Group G1.15, which includes parameters for enabling or disabling the control, choosing control modes, setting control loop constants, and so on.

Brush-type synchronous motor control

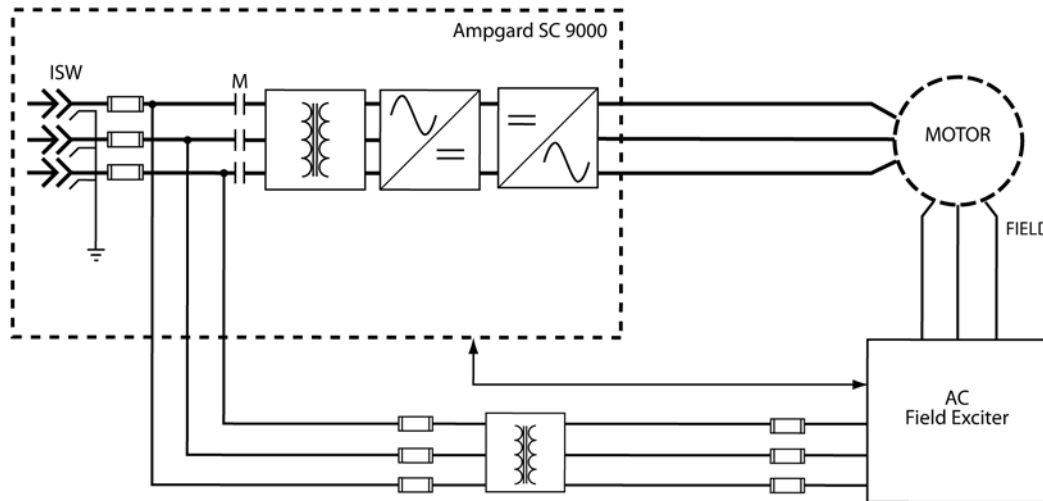
Although the SC9000 EP Synchronous Motor Control system is designed for brushless synchronous motors, Eaton also offers control systems for brush-type motors, powered by Ampgard Medium-Voltage Starters. For more information about these systems, refer to Eaton IB 48045, Instructions for Mark VI Solid-State, Brush-Type, Synchronous Motor Controllers.

O&M technical references

For detailed information on your Synchronous Motor control system, refer to the O&M manual, publications:

IB48045 Instructions For Ampgard® Mark 5.5 Solid-State, Brush-Type, Synchronous Motor Controllers

Figure 102. SC9000 EP brushless synchronous motor control



Section 6: High voltage input

Purpose

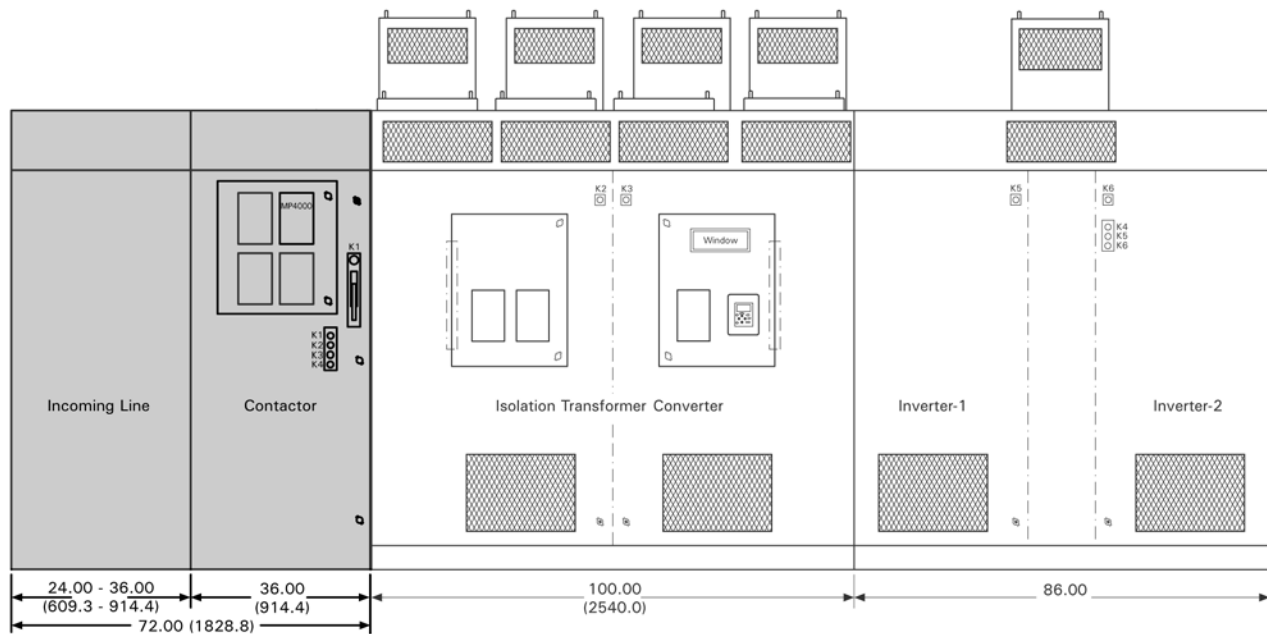
The SC9000 EP can deliver 2400 V, 3300 V or 4160 V output voltages, and can accept input voltages between 2.4 kV and 13.8 kV. When the source voltage is above 6.9 kV, the SC9000 EP must include an additional 72-inch wide cabinet grouping. This grouping houses a 95 kV BIL incoming line termination array and a 15 kV input vacuum contactor starter. The SC9000 EP 24 pulse isolation transformer primary and secondary windings are also chosen according to the project input and output voltage requirements.

Contactor

The Ampgard Type SL, 300A, 15 kV vacuum contactor can be applied at voltages up to 13,800V and is rated to drive up to a 7500 hp induction motor (300 AFL).

Representative mechanical diagrams

Figure 103. 15 kV input voltage panel layout



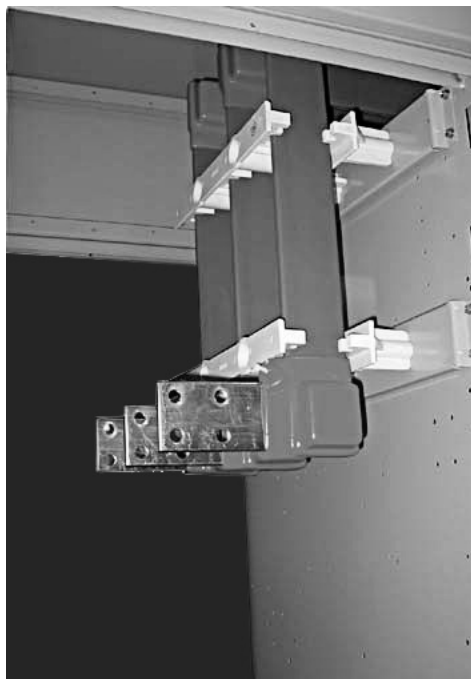
Representative photos

Figure 104 shows a high voltage input incoming compartment. **Figure 105** shows a detail of the incoming cable termination points.

Figure 104. High voltage incoming compartment



Figure 105. Incoming cable terminations



O&M technical references

For additional information about the high voltage Input system elements, refer to your project O&M manual references:

- IB 48050 Instructions for Installation, Operation, and Maintenance of the AMPGARD 15 kV, 300 A Vacuum Starter
- IB 48051 Instructions for Installation, Operation, and Maintenance of the SL 15 kV, 300 A Vacuum Contactor

Section 7: Bypass system

Purpose

Bypass control provides for those times when an SC9000 EP AFD is taken offline and the connected motor must run. This chapter addresses the Eaton SC9000 EP bypass control products.

Types of SC9000 EP bypass

There are two types of bypass control generally applied with SC9000 EP products:

- Full voltage bypass
- RVSS Bypass

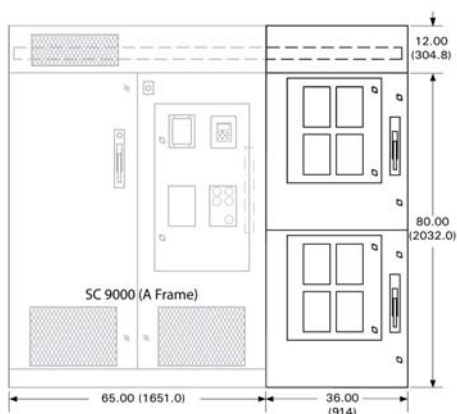
Full voltage bypass

This system switches an induction motor's power source between two sources: a utility source and an SC9000 EP AFD. Use Full voltage bypass when the AFD requires maintenance or troubleshooting. It allows the motor to connect to the incoming line, bypassing the AFD and performing a full-voltage start.

The motor and connected equipment must be able to tolerate an across-the-line start without mechanical or electrical damage. Fan or pump applications are examples of systems where a full-voltage start can work without connected equipment damage.

Representative panel layout diagram

Figure 106. Representative full voltage bypass panel layout



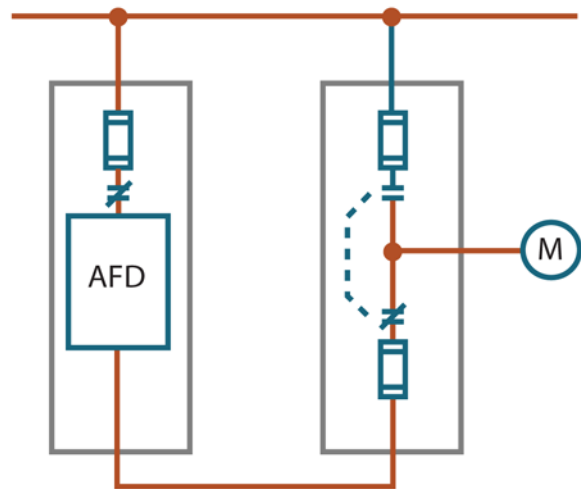
Sequence of operation

Control Elements colors and symbols

- = de-energized
- = energized feeder bus
- = contactor closed

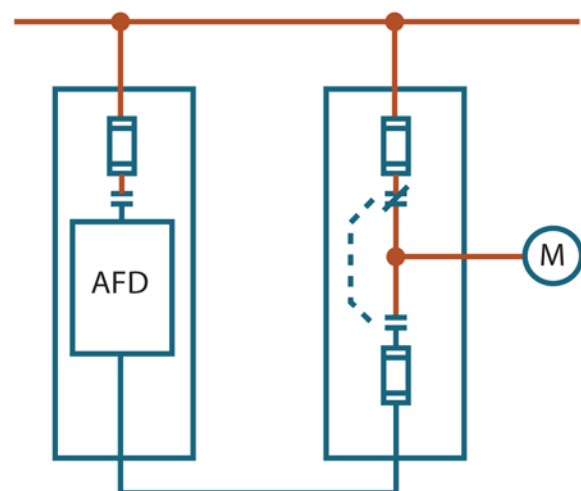
Under normal conditions, the SC9000 EP powers the motor, and the bypass contactor is open, isolating the motor from the AC power feed bus.

Figure 107. Normal operation using SC9000 EP AFD



When the AFD is not available, the AFD input contactor is open, the bypass contactor AC line feeder contactor closes, the AFD output contactor opens, and the AC line feeds the motor.

Figure 108. Full voltage bypass operation



RVSS bypass

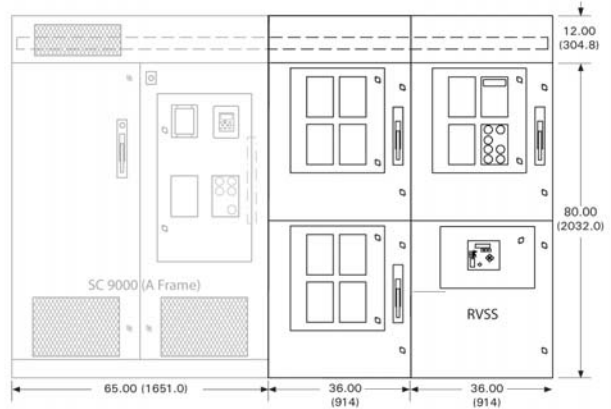
When the connected mechanical equipment cannot tolerate a full-voltage bypass start, reduced voltage solid state bypass can provide bypass functionality while delivering a smoother, softer motor start. This can eliminate high motor inrush currents and connected load mechanical stresses. In addition, RVSS is easier on the electrical supply system, softening the burden during the motor start.

This bypass method works well on conveyors, PD pumps or systems where supplied voltage is limited. **Figure 109** shows a typical RVSS cabinet.

Figure 109. Typical RVSS cabinet



Figure 110. Representative RVSS bypass panel layout



Sequence of operation

Control elements colors and symbols

- = de-energized
- = energized bus
- \neq = energized contactor closed

Under normal operation, the SC9000 EP is operating and providing power to the connected motor. The bypass contactor is in the non-bypass position, with power from the reduced voltage soft start system not connected to the motor through the bypass contactor.

Figure 111. RVSS bypass normal operation

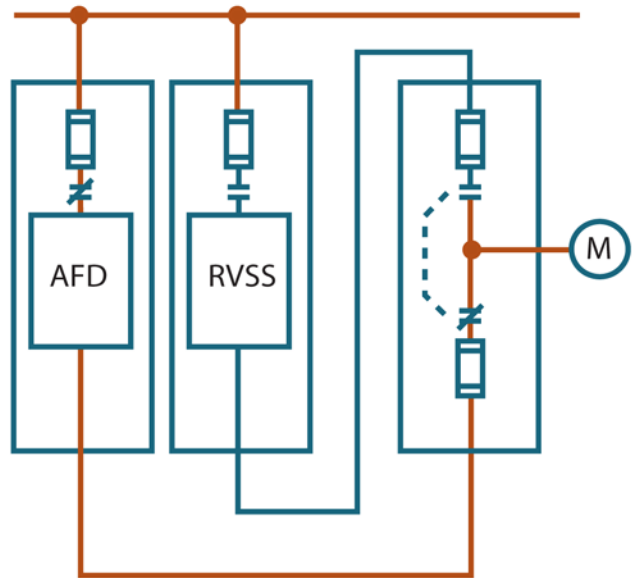
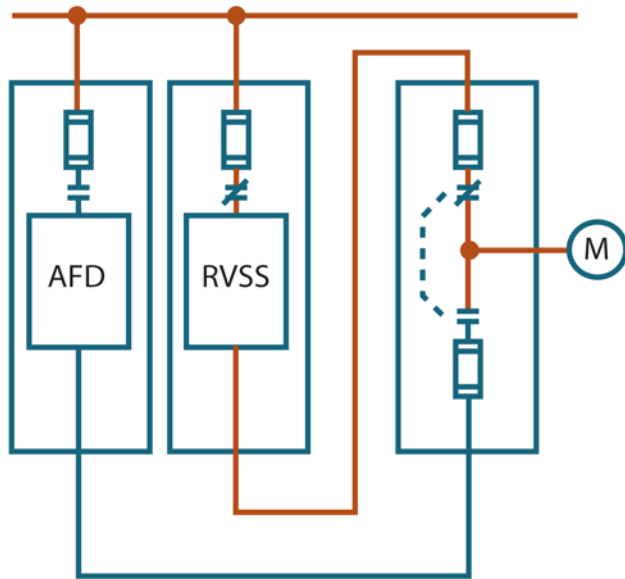


Figure 112. RVSS bypass system bypassed



O&M technical references

For detailed information on your bypass control system, refer to the O&M manual, publications:

- DEH41021 Medium-Voltage Solid State OEM Soft Starter Installation and Operation Manual
- IB 48041 Instructions for AMPGARD 400 A Medium Voltage Starter

Appendix E: URTD II module integration

The purpose of this Quick Start Guide is to guide the user through the essential steps required to commission an URTD II module. For wiring instructions and complete descriptions of the URTD II module or SC9000EP MVD, please consult those instruction manuals. Otherwise refer to the project specific wiring diagrams and schemes.

Suggested references

[1] Universal Resistance Temperature Detector (URTD) Module II, IL02602013E

[2] 9000XDrive Software User's Manual, available on www.Eaton.com

Features

- Motor protection with 10 RTD inputs; six winding, two motor bearing, two load bearing. An additional two AUX RTDs and URTD II case temperature for added monitoring use
- Twelve user configurable menu options, see **Table 23**
- Three SC9000EP MVD panel fault codes; FAILURE, Invalids/Bad Chan., and TRIP (see **Table 25**). These three fault codes have four mapping possibilities in the digital outputs, see **Table 24**
- Hottest winding, motor bearing, load bearing data viewable from panel Keypad under Monitor menu (see HottestWind, HottestMB, HottestLB from **Table 26**)
- Thirty-nine data values available over Fieldbus and 9000XDrive.exe Monitor PC tool, see **Table 26**
- Operational history with maximum temperatures and counters, see **Table 26**

Benefits

- Same User interface as SC9000EP MVD, 9000XDrive.exe PC tool
- Access of the data Values shown in **Table 26** via the SC9000 SPX controller supported fieldbuses

Communications capabilities

- Modbus®
- PROFIBUS® DP
- CANopen
- DeviceNet™
- Modbus TCP
- EtherNet/IP
- BACnet

Section 1: Keypad navigation

Step 1: Navigate the <- OR -> buttons several times to enter programming, push Enter.



Step 2: Navigate Up/Down to find M1 parameters, press right button.



Step 3: Navigate Up/Down to G1.18 URTD, press right button.



Step 4: Navigate Up/Down to M1.18.3 URTD Motor, press right button.



Step 5 through 18: Press Right to get flashing value and Up/Down to set value followed by ENTER. Configure URTD Motor Parameters P1.18.3.1 through P1.18.3.14 referencing **Table 23**.



Section 2: Computer navigation

Step 1: Download and Install 9000XDrive.exe from Eaton software web-site.

Step 2: Connect serial DB9 cable between PC com port and SPX controller interface.

Step 3: Go Online with 9000XDrive PC tool.

Step 4: Open Menu Parameters and Configure indexes P1.18.3.1 through P1.18.3.14, reference **Table 23**.

Figure 113. Online 9000XDrive screen with SC9000EP MVD and UR TD II Module parameterization

The screenshot displays the 9000XDrive software interface. The title bar shows the file path: C:\NCEngine\Applications\All_in_One\SC9000\NXP530C.wcn (SC9_V530C). The interface is divided into several sections:

- Parameter Window:** A tree view on the left side shows the navigation structure. The 'UR TD' folder is expanded, showing sub-folders like 'G 1.18 UR TD' and 'M 1.18.3 UR TD Motor'. The 'M 1.18.3 UR TD Motor' folder is selected, and its parameters are listed in the table.
- Table:** A table titled 'LOADED' displays the parameters for the selected folder. The columns are Index, Variable Text, Value, Unit, Min, Max, and ID.
- Status Bar:** At the bottom, there is a status bar with indicators for 'Com4', 'Keypad', 'Waiting Trigger', 'Ready', 'Run', 'Fault', and 'Alarm'.

Index	Variable Text	Value	Unit	Min	Max	ID
P.1.18.3.1	RTDPresent	1 / Enable		0	1	1756
P.1.18.3.2	MtrRTDVoting	1023		0	1023	1799
P.1.18.3.3	BadChannelCnt	1		0	10	1898
P.1.18.3.4	MtrRTDVoteCnt	1		0	10	1798
P.1.18.3.5	URTDFailResp	2 / Fault		0	2	1791
P.1.18.3.6	AlarmsTOsDelay	5	sec	0	120	1977
P.1.18.3.7	URTDInvalidsResp	2 / Fault		0	2	1761
P.1.18.3.8	MotorWindTripLev	155	°C	135	249	1590
P.1.18.3.9	MotorWindAlmLev	135	°C	0	249	1764
P.1.18.3.10	MotBearTripLev	95	°C	80	249	1765
P.1.18.3.11	MotBearAlmLev	80	°C	0	249	1796
P.1.18.3.12	LoadBearTripLev	95	°C	80	249	1767
P.1.18.3.13	LoadBearAlmLev	80	°C	0	249	1797
P.1.18.3.14	RTDHistoryReset	0 / Standby		0	1	1976

Table 23. M1.18.3 URTD motor parameters

Code	Text	Min.	Max.	Unit	Default	ID	Note
P1.18.3.1	RTDPresent	0	1	Text	0	1756	0 = Disable, 1 = Enable
P1.18.3.2	MtrRTDVoting	0	1023	Bit-Masked Word	1023	1799	B0 = 1 = Winding 1 B1 = 2 = Winding 2 B2 = 4 = Winding 3 B3 = 8 = Winding 4 B4 = 16 = Winding 5 B5 = 32 = Winding 6 B6 = 64 = Motor Bearing 1 B7 = 128 = Motor Bearing 2 B8 = 256 = Load Bearing 1 B9 = 512 = Load Bearing 2 (e.g., Voting Winding 4 with Motor Bearing 2 along with Load Bearing 1, enter 392. i.e., Add each bit value and enter.) ^①
P1.18.3.3	BadChannelCnt	0	10	Value	0	1898	
P1.18.3.4	MtrRTDVoteCnt	0	10	Value	0	1798	
P1.18.3.5	URTDFailResp	0	2	Text	2	1791	0 = NoAction, 1 = Alarm, 2 = Fault
P1.18.3.6	AlarmsTOsDelay	0	120	Secs.	5	1977	Delays FCODE 76 Alarm
P1.18.3.7	URTDInvalidsResp	0	2	Text	2	1761	0 = NoAction, 1 = Alarm, 2 = Fault
P1.18.3.8	MotorWindTripLev	0*	249	Deg.C	155	1590	See Note 2
P1.18.3.9	MotorWindAlmLev	0	249	Deg.C	135	1764	
P1.18.3.10	MotBearTripLev	0*	249	Deg.C	95	1765	^②
P1.18.3.11	MotBearAlmLev	0	249	Deg.C	80	1796	
P1.18.3.12	LoadBearTripLev	0*	249	Deg.C	95	1767	^②
P1.18.3.13	LoadBearAlmLev	0	249	Deg.C	80	1797	
P1.18.3.14	RTDHistoryReset	0	1	Text	0	1976	Peak History & Counts Reset

^① Voting provides redundancy for increased reliability with embedded thermal protectors. Combining P1.18.3.2 Voting Word with P1.18.3.4 Voting Count when any channel that is voted exceeds the respective trip level the Counted Level increases. If the SPX controller scan accumulated count exceeds the voting count a FCODE 76 trip occurs. Else, if any non-voted channel exceeds the trip level the FCODE 76 trip occurs (e.g., the other bit-masked channels).

^② The trip level for the winding, motor bearing, and load bearing must be equal or greater than its alarm level.

Appendix E: URTD II module integration

Table 24. Remote digital output signals P16.1.1 Out1AFunc through P16.1.14 Out7AFunc

Code	Parameter	Min.	Max.	ID	Note
P16.1.1	Out1AFunc	0	35	1851	0 = Off, 1 = On, 2 = Main Cooling . . . 32 = MtrRTDFail 33 = MtrRTDInvlds 34 = MtrRTDALmTO 35 = MtrRTDTrip
P16.1.2	Out1BFunc	0	35	1852	Same mapping options as above
P16.1.3	Out2AFunc	0	35	1853	Same mapping options as above
.
P16.1.14	Out7BFunc	0	35	1864	Same mapping options as above

Table 25. SC9000EP MVD, fault code messages

FCODE	Warning text	Fault text	Possible cause	Corrective action
75	RTDBadChannls	RTDBadChannls	Bad connection, short or open RTD. Temperature outside of measuring range. Unused channel.	Monitor Channel Data Value, 250 is outside of range, 253 is RTD shorted. 254 is RTD open. 255 is RTD invalid. Check RTD for three-wire connection at URTD II terminal block and/or loose connections.
76	RTDMtrAlarmTO	RTDMtrTrip	Motor or bearing thermal excessive temperatures.	Check alarm and trip levels against motor manufacturer recommended settings. Monitor data temperatures over FieldBus or 9000XDrive.
97	RTDMtrFAILURE	RTDMtrFAILURE	Bad Communications on Fiber between URTD and SC9000EP (ITG card, RX3 port). Bad URTD II module, broken or pinched fiber.	Pull the fiber at SC9000EP MVD ITG RX3 port and see if light beam is present, re-insert and push fault RESET in attempt to clear FCODE.

Table 26. Fieldbus mapping, ID variables

ID	Variable ①	Text	Format	R/W	Retain	Min	Max	Unit	Comment
1553	WD1	MtrRTDWind1	USINT	R		0	255	Deg.C	②
1554	WD2	MtrRTDWind2	USINT	R		0	255	Deg.C	②
1555	WD3	MtrRTDWind3	USINT	R		0	255	Deg.C	②
1556	WD4	MtrRTDWind4	USINT	R		0	255	Deg.C	②
1557	WD5	MtrRTDWind5	USINT	R		0	255	Deg.C	②
1558	WD6	MtrRTDWind6	USINT	R		0	255	Deg.C	②
1559	MB1	MtrRTDMtrBear1	USINT	R		0	255	Deg.C	②
1560	MB2	MtrRTDMtrBear2	USINT	R		0	255	Deg.C	②
1561	LB1	MtrRTDLoadBear1	USINT	R		0	255	Deg.C	②
1562	LB2	MtrRTDLoadBear2	USINT	R		0	255	Deg.C	②
1563	WD1_M	PeakHistWD1	USINT	R	Y	0	255	Deg.C	Reset history with P1.18.3.14
1564	WD2_M	PeakHistWD2	USINT	R	Y	0	255	Deg.C	Reset history with P1.18.3.14
1565	WD3_M	PeakHistWD3	USINT	R	Y	0	255	Deg.C	Reset history with P1.18.3.14
1566	WD4_M	PeakHistWD4	USINT	R	Y	0	255	Deg.C	Reset history with P1.18.3.14
1567	WD5_M	PeakHistWD5	USINT	R	Y	0	255	Deg.C	Reset history with P1.18.3.14
1568	WD6_M	PeakHistWD6	USINT	R	Y	0	255	Deg.C	Reset history with P1.18.3.14
1792	MB1_M	PeakHistMB1	USINT	R	Y	0	255	Deg.C	Reset history with P1.18.3.14
1793	MB2_M	PeakHistMB2	USINT	R	Y	0	255	Deg.C	Reset history with P1.18.3.14
1794	LB1_M	PeakHistLB1	USINT	R	Y	0	255	Deg.C	Reset history with P1.18.3.14
1795	LB2_M	PeakHistLB2	USINT	R	Y	0	255	Deg.C	Reset history with P1.18.3.14
1826	WD_H	HottestWind	USINT	R		0	255	Deg.C	Viewable on Panel Keypad, Monitor menu
1827	MB_H	HottestMB	USINT	R		0	255	Deg.C	Viewable on Panel Keypad, Monitor menu
1828	LB_H	HottestLB	USINT	R		0	255	Deg.C	Viewable on Panel Keypad, Monitor menu
1829	AX_H	HottestAux	USINT	R		0	255	Deg.C	Viewable on Panel Keypad, Monitor menu
1830	AX1	RTDAux1Mtr	USINT	R		0	255	Deg.C	
1831	AX2	RTDAux2Mtr	USINT	R		0	255	Deg.C	
1832	CSE	RTDCaseMtr	USINT	R		0	255	Deg.C	
1833	AX1_M	PeakHistAX1	USINT	R	Y	0	255	Deg.C	Reset history with P1.18.3.14
1834	AX2_M	PeakHistAX2	USINT	R	Y	0	255	Deg.C	Reset history with P1.18.3.14
1835	CSE_M	PeakHistCSE	USINT	R	Y	0	255	Deg.C	Reset history with P1.18.3.14
1836	nTrips	RTDOTTrips	USINT	R	Y	0	255	Counts	Reset history with P1.18.3.14
1837	nAlarmTOs	RTDAlarmTOs	USINT	R	Y	0	255	Counts	Reset history with P1.18.3.14
1838	nInvalids	RTDInvalids	USINT	R	Y	0	255	Counts	Reset history with P1.18.3.14
1839	nFAILs	RTDFAILs	USINT	R	Y	0	255	Counts	Reset history with P1.18.3.14
1582	GroupAlarmInstSW	MtrRTDWarnBits	UINT	R		0	1023	Status Word	B0 = 1 = Winding 1 B1 = 2 = Winding 2 B2 = 4 = Winding 3 B3 = 8 = Winding 4 B4 = 16 = Winding 5 B5 = 32 = Winding 6 B6 = 64 = Motor Bearing 1 B7 = 128 = Motor Bearing 2 B8 = 256 = Load Bearing 1 B9 = 512 = Load Bearing 2
1583	VotedCnt	MotorRTDVotCnt	USINT	R		0	10	Count	
1584	GroupTripSW	MotorRTDFtBits	UINT	R		0	1023	Status Word	Same Bit Mapping as ID 1582 above ③
1585	GroupBadChanSW	MotorRTDChanBits	UINT	R		0	1023	Status Word	Same Bit Mapping as ID 1582 and 1584 above ③
1586	BadChanCnt	MotorRTDChanCnt	USINT	R		0	10	Count	

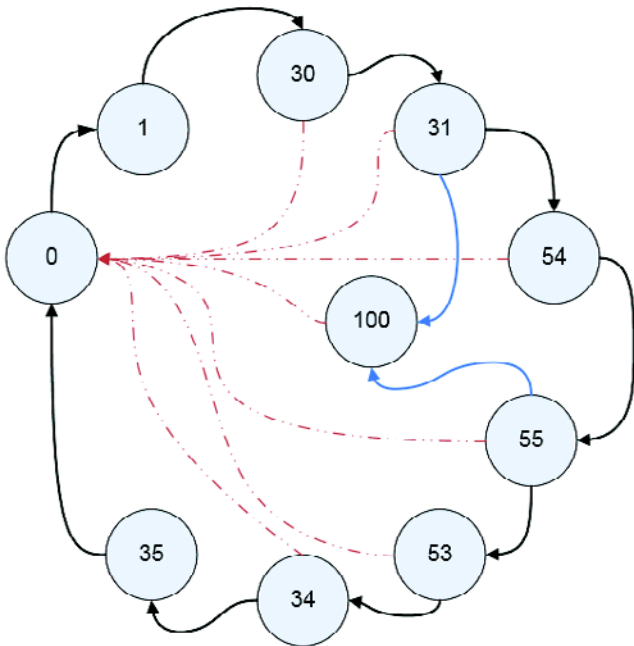
① Variable column above indicates the 9000XDrive Monitor signal name.

② Applicable temperature range 0 to 249 degrees Celsius. See Table 25 FCODE 75 for descriptions of values in excess of 249 which indicate RTD concerns.

③ Example for ID 1582/1584/1585 bit-Masked StatusWord. B2, B6, and B9 are active. Then the respective ID variable will display or transmit 580.

Appendix F: Synchronous transfer state diagrams

Figure 114. Ampgard SC90000 EP, Closed Transition Synchronous Up Transfer, Sequence of Operation, 9000XDrive Monitor signal 'st_syncState' P1.17.1.1 SynCTransMode = 2 = ClosedTrans



st_syncState = 0 (STOPPED/INIT STATE)

SPX CONTROLLER INITIALIZES CLOSED TRANSITION SYNC VARIABLES, CURRENT CUTOFF MODE IS DISABLED

st_syncState = 1 (READY FOR SYNC START)

SPX AWAITS SYNCH UP OR SYNCH DOWN COMMAND, IF SYNCH UP GOES TRUE THEN SYNCH FLAG IS SET AND ITG LCD SCREEN DISPLAYS SYNCH TO GRID TEXT

st_syncState = 30* (SYNCING UP AND WAITING FOR LOCK)

IF VFD VOLTAGE ANGLE AND FREQUENCY ARE IN SYNC WITH UTILITY THEN PROCEED AND SPX SENDS ITG MODULATOR CURRENT THRESHOLD

st_syncState = 31* (ITG MODULATOR ECHO TEST)

SPX TESTS ITG ECHO FOR CURRENT THRESHOLD, ELSE IF ECHO NOT RECEIVED WITHIN P1.17.2.5 ACK TIME JUMP TO STATE 100

st_syncState = 54* (CURRENT STABILIZATION PERIOD)

IF DRIVE REMAINS IN SYNC AFTER P1.17.2.1 DELAY THEN CURRENT CUTOFF MODE IS ENABLED AND FORCE COAST STOP IS EXECUTED

st_syncState = 55* (VERIFY CURRENT CUTOFF ECHO)

SPX TESTS ITG ECHO TO SEE IF CURRENT CUTOFF MODE IS ENABLED, IF SO SEND st_SyncAck DIGITAL OUTPUT HIGH TO PLC, ELSE IF ECHO TIME EXCEEDS P1.17.2.5 ACK TIME JUMP TO STATE 100

st_syncState = 53* (WAIT FOR ITG TRANSFER ACK) [PLC CLOSES BYPASS CONTACTOR]

SPX TESTS ITG MODULATOR CLOSE TRANSITION COMPLETE FEEDBACK WHERE THRESHOLD CURRENT IS EXCEEDED, IF SO st_SyncAck DIGITAL OUTPUT GOES LOW, THE VFD PWM MODULATION IS HALTED, AND ITG LCD SCREEN SYNC TO GRID TEXT IS REMOVED

st_syncState = 34* (WAIT FOR PLC HANDSHAKE)

TEST FOR PLC SYNCH UP SIGNAL TO GO FALSE, THE PLC REMOVES RUN COMMAND AS WELL WHICH RESULTS IN THE VFD OUTPUT CONTACTOR OPENING (STOPPED STATE)

st_syncState = 35 (WAIT AND REST SYNCH TIMERS)

RETURN TO STATE 0 AFTER 2 SECONDS, RESET TIMERS

st_syncState = 100 (NON-RECOVERABLE ECHO FAULT TIMEOUT)

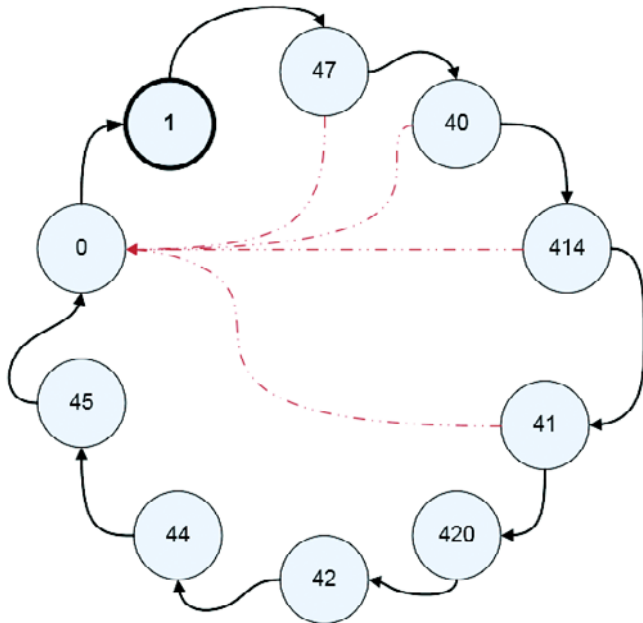
SPX FAULT FCODE 94 'SYNC TRANSFER TIMEOUT'

Note: Stop command will shut down the VFD and st_syncState will return to state 0.

Note: If synch up signal is lost in states 30, 31, 54, 55, 53, or 34 then st_syncState returns to state 0 denoted by dashed line(s).

Note: 9000XDRIVE monitor application signal 'st_syncState' can be monitored for troubleshooting purposes.

Figure 115. Ampgard SC90000 EP, Closed Transition Synchronous Down Transfer, Sequence of Operation, 9000XDrive Monitor signal 'st_syncState' P1.17.1.1 SynCTransMode = 2 = ClosedTrans



st_syncState = 0 (INIT STATE)

SPX CONTROLLER INITIALIZES CLOSED TRANSITION SYNC VARIABLES

st_syncState = 1 (IDLE/RUNNING, READY FOR SYNC START),[ON-BYPASS OR RUNNING ON VFD]

SPX AWAITS SYNCH UP OR SYNCH DOWN COMMAND, IF SYNCH DOWN GOES TRUE THEN SYNCH FLAG IS SET AND ITG LCD SCREEN DISPLAYS SYNCH TO GRID TEXT, FOR SYNCH DOWN VFD PWM MODULATION IS INITIALLY INHIBITED

st_syncState = 47* (FAST SYNC TO LINE)

IF VFD REFERENCE VOLTAGE IS NEAR LINE FREQUENCY (~2Hz DIFFERENCE) REMOVE FAST RAMP RATE

st_syncState = 40* (SYNC LOCK)

IF VFD PWM REFERENCE FREQUENCY AND PHASE ANGLE ARE IN SYNC WITH UTILITY THEN CLOSE OUTPUT VFD CONTACTOR

st_syncState = 414* (WAIT)

DELAY 500mSEC TO ALLOW PLC TO CLOSE MOTOR SELECT CONTACTOR

st_syncState = 41* (DELAY)

IF VFD REMAINS IN SYNC DELAY FOR TIME ESTABLISHED BY P1.17.2.3, THEN SEND PLC st_SyncAck

st_syncState = 420 (WAIT FOR PLC HANDSHAKE)

PLC INITIATES BYPASS CONTACTOR OPENING AND REMOVES SYNCH DOWN REQUEST SIGNAL

st_syncState = 42 (LCD TEXT)

VFD ITG LCD SYNCH TO GRID TEXT REMOVED, TIMER RESET

st_syncState = 44 (SYNCH DOWN DELAY)

WAIT UNTIL TIMER EXCEEDS P1.17.2.4 SETPOINT THEN ENABLE PWM MODULATION AND REMOVE st_SyncAck FROM PLC, BY NOW BYPASS CONTACTOR IS OPEN

st_syncState = 45 (LOCK HOLD)

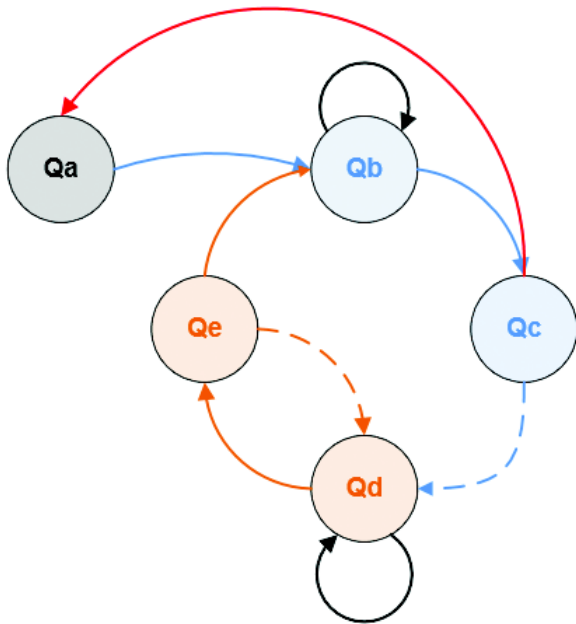
WAIT THREE SECONDS THEN RETURN TO st_syncState 0

Note: Stop command will shut down the VFD and st_syncState WILL return to State 0.

Note: If synch down signal is lost in states 47, 40, 414, or 41 then st_syncState returns to State 0 denoted by dashed line(s).

Note: 9000XDRIVE monitor application signal 'st_syncState' can be monitored for troubleshooting purposes.

Figure 116. Ampgard SC90000 EP, Closed Transition Synchronous Up/Down Transfer, Sequence of Operation, PLC State Diagram



STATE Qa

STOPPED STATE
 PLC WAITS FOR START MOTOR n COMMAND
 PLC CLOSES MOTOR SELECT n
 PLC COMMANDS VFD TO RUN
 VFD PRE-CHARGES, MAIN & OUTPUT CONTACTOR CLOSES

STATE Qb

VFD RUNS ON REFERENCE FREQUENCY (KEYPAD OR ANALOG INPUT)
 PLC WAITS FOR SYNC UP OR STOP MOTOR n COMMAND

STATE Qc

PLC RECEIVES SYNC UP MOTOR n COMMAND AND PASSES SIGNAL TO VFD
 VFD IGNORES SPEED REFERENCE AND RAMPS TO LINE FREQUENCY
 VFD PWM OUTPUT LOCKS WITH PHASE, MAGNITUDE AND FREQUENCY OF LINE
 VFD SENDS SYNC ACKNOWLEDGE TO PLC
 PLC CLOSES BYPASS n
 VFD SYNC ACKNOWLEDGE GOES LOW, PLC REMOVES SYNC UP SIGNAL
 PLC REMOVES RUN COMMAND SIGNAL TO VFD, VFD OPENS OUTPUT CONTACTOR
 PLC OPENS MOTOR SELECT CONTACTOR

Note: If VFD does not lock within programmed time, VFD will fault on FCODE 94 timeout and return to STATE Qa.

STATE Qd

PLC MAINTAINS BYPASS CLOSURE
 PLC WAITS FOR A SYNC DOWN OR STOP MOTOR n COMMAND

STATE Qe

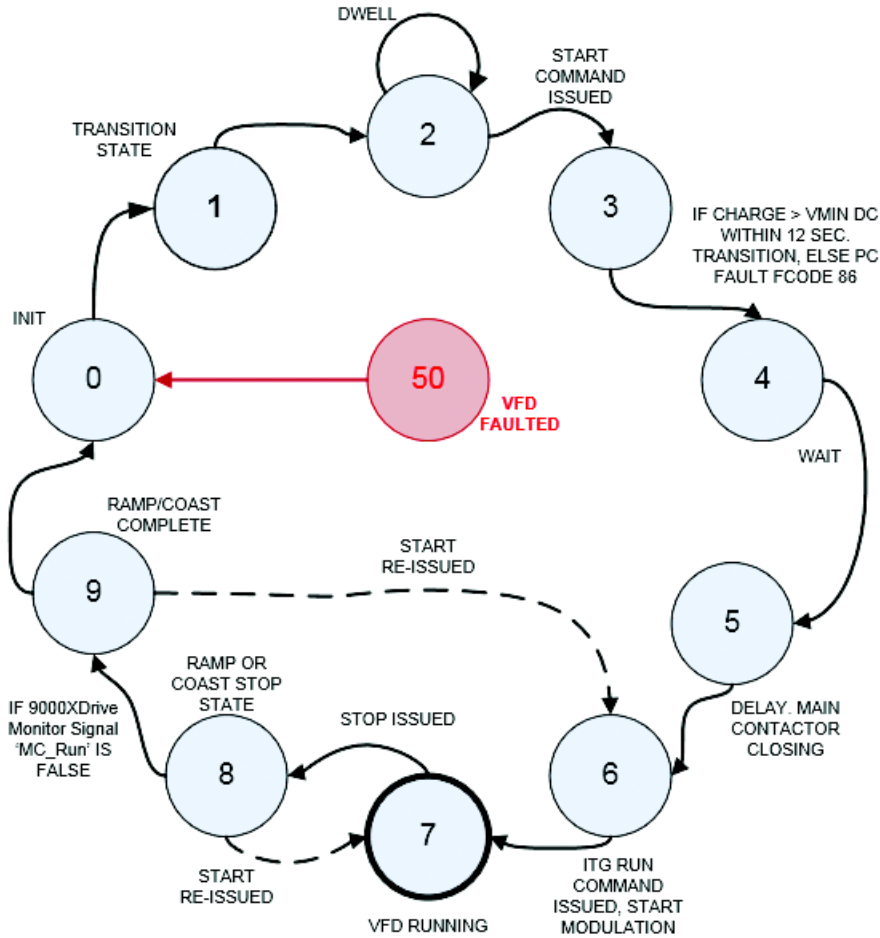
PLC RECEIVES SYNC DOWN MOTOR n COMMAND
 PLC COMMANDS VFD TO RUN
 VFD PRE-CHARGES, MAIN CONTACTOR CLOSES
 VFD IGNORES SPEED REFERENCE AND FAST VECTOR RAMPS TO LINE FREQUENCY
 VFD PWM REFERENCE VECTOR PHASE LOCKS WITH LINE, BUT PWM IS INHIBITED
 VFD CLOSES OUTPUT CONTACTOR
 VFD SENDS SYNC ACKNOWLEDGE TO PLC, PLC CLOSES MOTOR SELECT n, PWM MODULATION IS ENABLED
 VFD SYNC ACKNOWLEDGE GOES LOW, PLC OPENS BYPASS CONTACTOR
 VFD AND PLC JUMPT TO STATE Qb

Note: If VFD does not lock within programmed time on synch down, motor will maintain on bypass re-apply sync command then remove to try again.

Note: PLC stop command in any state will shut down the motor and VFD, PLC state returns to Qa.

Appendix G: ITG control state diagrams EP/GP

Figure 117. Ampgard SC9000 EP, ITG Modulator Control, EP State Machine, "itgState"



itgState = 0 (RESET)

SoftMag/Pre-Charge = FALSE, MainContactor = FALSE, ITGRunCommand = FALSE, LCD BLINKS

itgState = 1 (STOPPED]

SoftMag/Pre-Charge = FALSE, MainContactor = FALSE, ITGRunCommand = FALSE, LCD='STOPPED'

itgState = 2 (WAITING FOR Pre-Charge)

SoftMag/Pre-Charge = FALSE, MainContactor = FALSE, ITGRunCommand = FALSE, LCD='STOPPED'

itgState = 3 (PRE-CHARGING / Soft-Mag)

SoftMag/Pre-Charge = TRUE, MainContactor = FALSE, ITGRunCommand = FALSE, LCD='PRE CHARGE'

itgState = 8 (RUN COMMAND REMOVED, HOLD

itgState = 4 (WAITING FOR Main Contactor)

SoftMag/Pre-Charge = TRUE, MainContactor = TRUE, ITGRunCommand = FALSE, LCD='PRE CHARGE'

itgState = 5 (DELAY)

SoftMag = TRUE, Pre-Charge = FALSE, MainContactor = TRUE, ITGRunCommand = FALSE, LCD='PRE CHARGE'

itgState = 6 (SEND ITG RUN COMMAND)

SoftMag/Pre-Charge = FALSE, MainContactor = TRUE, ITGRunCommand = TRUE, LCD='RUNNING'

itgState = 7 (VFD RUNNING)

SoftMag/Pre-Charge = FALSE, MainContactor = TRUE, ITGRunCommand = TRUE, LCD='RUNNING'

CONTACTOR AND LCD TEXT IF RAMP STOP)

Appendix G: ITG control state diagrams EP/GP

SoftMag/Pre-Charge = FALSE, MainContactor = TRUE,
ITGRunCommand = FALSE, LCD='RUNNING'

itgState = 9 (RAMP STOP COMPLETE, MAIN CONTACTOR
HOLD DWELL)

SoftMag/Pre-Charge = FALSE, MainContactor = TRUE,
ITGRunCommand = FALSE, LCD='STOPPED', MCR LED
INDICATOR ON ITG PS CARD REMAINS LIT DURING HOLD
PERIOD

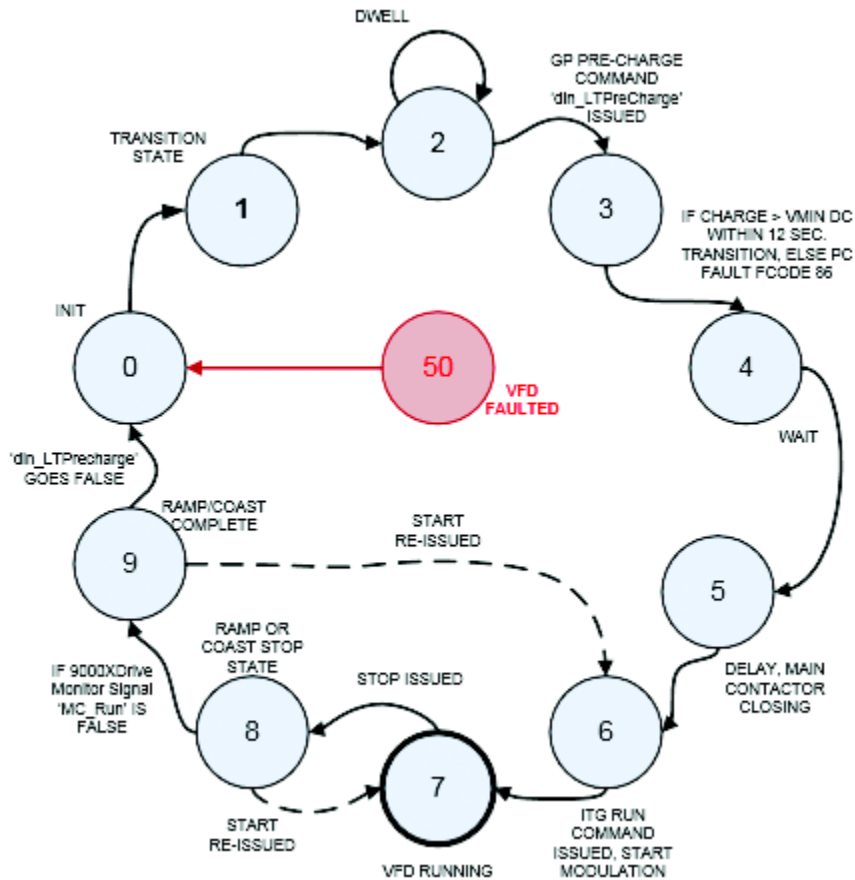
itgState = 50 (VFD IS FAULTED)

JUMP TO itgState 0

Note: Stop command will shut down the VFD and itgState
will return to State 2 from States 2, 3, 4, and 5
(not shown to left for clarity purposes).

Note: 9000XDRIVE monitor application signal 'itgState' can
be monitored for troubleshooting purposes.

Figure 118. Ampgard SC9000 GP, ITG Modulator Control, 'dinLTPCMapped' = TRUE

**itgState = 0** (RESET)

SoftMag/Pre-Charge = FALSE, MainContactor = FALSE, ITGRunCommand = FALSE, LCD BLINKS

itgState = 1 (STOPPED)

SoftMag/Pre-Charge = FALSE, MainContactor = FALSE, ITGRunCommand = FALSE, LCD='STOPPED'

itgState = 2 (WAITING FOR Pre-Charge)

SoftMag/Pre-Charge = FALSE, MainContactor = FALSE, ITGRunCommand = FALSE, LCD='STOPPED'

itgState = 3 (PRE-CHARGING / Soft-Mag)

SoftMag/Pre-Charge = TRUE, MainContactor = FALSE, ITGRunCommand = FALSE, LCD='PRE CHARGE'

itgState = 4 (WAITING FOR Main Contactor)

SoftMag/Pre-Charge = TRUE, MainContactor = TRUE, ITGRunCommand = FALSE, LCD='PRE CHARGE'

itgState = 9 (RAMP STOP COMPLETE, MAIN CONTACTOR HOLD DWELL)**itgState = 5** (DELAY)

SoftMag = TRUE, Pre-Charge = FALSE, MainContactor = TRUE, ITGRunCommand = FALSE, LCD='PRE CHARGE'

itgState = 6 (SEND ITG RUN COMMAND)

SoftMag/Pre-Charge = FALSE, MainContactor = TRUE, ITGRunCommand = TRUE, LCD='RUNNING'

itgState = 7 (VFD RUNNING)

SoftMag/Pre-Charge = FALSE, MainContactor = TRUE, ITGRunCommand = TRUE, LCD='RUNNING'

itgState = 8 (RUN COMMAND REMOVED, HOLD CONTACTOR AND LCD TEXT IF RAMP STOP)

SoftMag/Pre-Charge = FALSE, MainContactor = TRUE, ITGRunCommand = FALSE, LCD='RUNNING'

Appendix G: ITG control state diagrams EP/GP

SoftMag/Pre-Charge = FALSE, MainContactor = TRUE,
ITGRunCommand = FALSE, LCD='STOPPED', MCR LED
INDICATOR ON ITG PS CARD REMAINS LIT DURING HOLD
PERIOD

itgState = 50 (VFD IS FAULTED)

JUMP TO itgState 0

Note: Loss of RunEnable or 'din_LTPrecharge' digital input will shut down the VFD and itgState will return to STATE 2 from STATES 3, 4, and 5 (not shown to left for clarity purposes). ITG/SPX-VCN 'LT' or 'GP' signal naming convention used interchangeably.

Note: If 'din_LTPrecharge' goes false in STATE 6, 7, or 8 then FCODE 83 'GPPreChargeLost' occurs.

Note: 9000XDRIVE monitor application signal 'itgState' can be monitored for troubleshooting purposes.

Appendix H: SPX Parameters and IDs

Purpose

This user manual addendum covers the SPX controller value/parameter IDs along with their 9000XDrive signal name. The IDs can be used as described in the 9000X option communication cards to send/receive data over the associated Fieldbuses.

Table 27. SPX 5.30C VCN, Value IDs (Read Only)

ID	9000XDrive signal name	Keypad text	Units	Min.	Max.
1	FreqOut	Output Frequency	Hz	-32000	32000 ^①
2	MotorSpeed	Motor Speed Rpm		-32000	32000 ^①
3	MotorCurrent_1D	Motor Current	A	0	MotorCurrentMax
4	MotorTorque	Motor Torque	%	-3000	3000 ^②
5	MotorPower	Motor Power	%	-3000	3000 ^②
8	UnitTemperature	Unit Temperature	°C	0	300
9	MotorCalcTemperature	MotorTemperature	%	0	10000
13	AI1_Mon2	Analogue Input 1		-1000	2000
14	AI2_Mon2	Analogue Input 2		-1000	2000
15	DIN123_Status	DIN1, DIN2, DIN3		0	7
16	DIN456_Status	DIN4, DIN5, DIN6		0	7
17	DO_and_R12_Status	DO1, RO1, RO2		0	7
20	PI_SETPOINT	PID Reference		-32000	32000 ^①
21	PI_FEEDBACK	PID Feedback		-32000	32000
22	PIC_ERROR	PID Error Value		-32000	32000
23	PIC_OUTPUT	PID Output	Hz	-32000	32000
25	FreqRef	FreqReference	Hz	-32000	32000
26	AOA1_Monitor	Analog Iout	mA	0	2000
37	FaultREG37	FaultCode		0	255 ^③
39	IU_CurrentMotorDisplay	U Phase Current	A	0	30000
40	IV_CurrentMotorDisplay	V Phase Current	A	0	30000
41	IW_CurrentMotorDisplay	W Phase Current	A	0	30000
42	PowerOnTimeTripCounter	Run Time Hours	h	0	65535
43	Status_Word	StatusWord		0	65535 ^④
60	MediumDCvoltage	DC Voltage	V	0	10000
61	MediumMotorVoltage	Motor Voltage	V	0	9000
96	SineFilterFanFlow	SinFilterFanFlo	lfpm	0	10000
358	ShaftFrequency	ShaftFreq		-32767	32767
569	ActiveFault_1	ActiveFault1		0	255 ^③
570	ActiveFault_2	ActiveFault2		0	255 ^③
571	ActiveFault_3	ActiveFault3		0	255 ^③
573	ActiveFault_4	ActiveFault4		0	255 ^③
574	ActiveFault_5	ActiveFault5		0	255 ^③

^① Divide by 100.

^② Divide by 10.

^③ See **Table 12** for SPX fault code descriptions.

^④ See special parameter description at the end of Chapter 3 for bit map of each signal.

Appendix H: SPX Parameters and IDs

Table 27. SPX 5.30C VCN, Value IDs (Read Only), continued

ID	9000XDrive signal name	Keypad text	Units	Min.	Max.
1163	ActiveWarning	ActiveWarning	Days	0	255 ^①
1525	MITG_DACConfigCurrent	DAC_OC		0	4095
1526	MITG_DACConfigVoltage	DAC_OV		0	4095
1559	MB1	MtrRTDMtrBear1	°C	0	255
1560	MB2	MtrRTDMtrBear2	°C	0	255
1561	LB1	MtrRTDLoadBear1	°C	0	255
1562	LB2	MtrRTDLoadBear2	°C	0	255
1563	WD1_M	PeakHistWD1	°C	0	255
1564	WD2_M	PeakHistWD2	°C	0	255
1565	WD3_M	PeakHistWD3	°C	0	255
1566	WD4_M	PeakHistWD4	°C	0	255
1567	WD5_M	PeakHistWD5	°C	0	255
1568	WD6_M	PeakHistWD6	°C	0	255
1570	inv11_rtd	inv11_rtd	°C	0	4000 ^②
1571	inv12_rtd	inv12_rtd	°C	0	4000 ^②
1572	inv13_rtd	inv13_rtd	°C	0	4000 ^②
1573	inv14_rtd	inv14_rtd	°C	0	4000 ^②
1574	inv15_rtd	inv15_rtd	°C	0	4000 ^②
1575	inv16_rtd	inv16_rtd	°C	0	4000 ^②
1576	inv21_rtd	inv21_rtd	°C	0	4000 ^②
1577	inv22_rtd	inv22_rtd	°C	0	4000 ^②
1578	inv23_rtd	inv23_rtd	°C	0	4000 ^②
1579	inv24_rtd	inv24_rtd	°C	0	4000 ^②
1580	inv25_rtd	inv25_rtd	°C	0	4000 ^②
1581	inv26_rtd	inv26_rtd	°C	0	4000 ^②
1582	GroupAlarmInstSW	MtrRTDWarnBits		0	1023
1583	VotedCnt	MotorRTDVotCnt		0	10
1584	GroupTripSW	MotorRTDFitBits		0	1023
1585	GroupBadChanSW	MotorRTDChanBits		0	1023
1586	BadChanCnt	MotorRTDChanCnt		0	10
1690	ForceLocalRemoteHook	ForceLocalRemote		0	65535
1700	MaxUnitTemp2	Inverter2 Temp	°C	0	4000
1703	MasterDCBusHigh	DC Bus Positive	V	0	6000
1704	MasterDCBusLow	DC Bus Negative	V	0	6000
1792	MB1_M	PeakHistMB1	°C	0	255
1793	MB2_M	PeakHistMB2	°C	0	255
1794	LB1_M	PeakHistLB1	°C	0	255
1795	LB2_M	PeakHistLB2	°C	0	255
1826	WD_H	HottestWind	°C	0	255
1827	MB_H	HottestMB	°C	0	255
1828	LB_H	HottestLB	°C	0	255

^① See **Table 12** for SPX fault code descriptions.

^② Divide by 10.

Table 27. SPX 5.30C VCN, Value IDs (Read Only), continued

ID	9000XDrive signal name	Keypad text	Units	Min.	Max.
1829	AX_H	HottestAux	°C	0	255
1830	AX1	RTDAux1Mtr	°C	0	255
1831	AX2	RTDAux2Mtr	°C	0	255
1832	CSE	RTDCaseMtr	°C	0	255
1833	AX1_M	PeakHistAX1	°C	0	255
1834	AX2_M	PeakHistAX2	°C	0	255
1835	CSE_M	PeakHistCSE	°C	0	255
1836	nTrips	RTDOTTrips	°C	0	255
1837	nAlarmTOs	RTDAAlarmTOs	°C	0	255
1838	nInvalids	RTDInvalids	°C	0	255
1839	nFAILs	RTDFAILs	°C	0	255
1884	MasterBoardFaultNumber	masterFaultCode		0	65535 ^①
1887	SlaveBoardFaultNumber1	slave1FaultCode		0	65535 ^①
1940	IPX1u	Inv1BalReactU	°C	0	4000 ^②
1941	IPX1v	Inv1BalReactV	°C	0	4000 ^②
1942	IPX1w	Inv1BalReactW	°C	0	4000 ^②
1943	IPX2u	Inv2BalReactU	°C	0	4000 ^②
1944	IPX2v	Inv2BalReactV	°C	0	4000 ^②
1945	IPX2w	Inv2BalReactW	°C	0	4000 ^②
1946	Rectifier1Temp	Rectifier1Temp	°C	0	4000 ^②
1947	Rectifier2temp	Rectifier2Temp	°C	0	4000 ^②
1949	RpmForDisp	EncoderRPM	rpm	0	9999
1950	MaxUnitTemp	Inverter1 Temp	°C	0	4000 ^②
1983	V4FaultReg1	V4FaultReg1		0	65535 ^③
1984	V4FaultReg2	V4FaultReg2		0	65535 ^③
1985	rtd_coil3	XFMRTemp	°C	0	9999
1986	Scaled_KWH	Scaled_KWH		0	65535
1987	U_MRS	MotorRegStatBits		0	65535 ^③
1988	RemotInputBits1	RemotInputBits1		0	65535 ^③
1989	V4FaultReg3	V4FaultReg3		0	65535 ^③
1995	CSpecFaultBits1	CustSpecFault1		0	65535 ^③

^① See **Table 14** for ITG fault code descriptions.

^② Divide by 10.

^③ See special parameter description at the end of Chapter 3 for bit map of each signal.

Appendix H: SPX Parameters and IDs

Table 28. SPX 5.30C VCN, Parameter IDs (Read/Write)

Parameter	Keypad text	9000XDrive signal name	Min.	Max.	Units	Initial	ID
P1.1.1	NomInverterVolts	nominalLineVoltage	1	3		1	1701
P1.1.2	Min Frequency	M1_Min_Frequency	0.00	FreqMax_HighLimit	Hz	0.00	1300
P1.1.3	Max Frequency	M1_FreqMax	FreqMin	FreqMax_HighLimit	Hz	60.00	1301
P1.1.4	Accel Time	M1_Accel_Time_1	0.1	3000.0	s	60.0	1302
P1.1.5	Decel Time	M1_Decel_Time_1	0.1	3000.0	s	60.0	1303
P1.1.6	Current Limit	M1_MotorCurrentLimitPanel	MotorCurrentMin	MotorCurrentMax	A	0.00	1304
P1.1.7	Motor Nom Voltg	M1_MediumMotorNomVoltage	690	8000	V	4160	1305
P1.1.8	Motor Nom Freq	M1_MotorNomFreq	0.00	FreqMax_HighLimit	Hz	60.00	1306
P1.1.9	Motor NP Rpm	M1_MotorNomSpeed	0	65000	rpm	1780	1307
P1.1.10	Motor Cos Phi	M1_MotorCosPhii	0.30	1.00		0.85	1309
P1.1.11	Motor Nom Currnt	M1_MotorNomCurrent	MotorCurrentMin	MotorCurrentMax	A	0.00	1308
P1.1.12	Loc. Ctrl. Place	Local_Ref_Sel	1	3		1	171
P1.1.13	Rem. Ctrl. Place	Remote_Ref_Sel	1	3		1	172
P1.1.14	Local Reference	Local_Ref_Source	0	4		2	173
P1.1.15	Remote Reference	Remote_Ref_Source	0	4		0	174
P1.1.16	Preset Speed 1	MSS_1_Frequency	0.00	FreqMax_HighLimit	Hz	0.00	105
P1.1.17	Preset Speed 2	MSS_2_Frequency	0.00	FreqMax_HighLimit	Hz	0.00	106
P1.1.18	Preset Speed 3	MSS_3_Frequency	0.00	FreqMax_HighLimit	Hz	0.00	126
P1.1.19	MainContactMode	mainContactorMode	0	1		0	1990
P1.1.20	PrechargeTime	itg_minPrechargeTime	0.001	20.000	s	3.000	1755
P1.1.21	MainHoldTime	MainHoldingTime	0	32000	Sec	3600	1991
P1.1.22	MotorParamCount	MotorParamCount	1	2		1	1953
P1.1.23.1	Min Frequency	M2_Min_Frequency	0.00	FreqMax_HighLimit	Hz	0.00	1744
P1.1.23.2	Max Frequency	M2_FreqMax	FreqMin	FreqMax_HighLimit	Hz	60.00	1742
P1.1.23.3	Accel Time 1	M2_Accel_Time_1	0.1	3000.0	s	60.0	1740
P1.1.23.4	Decel Time1	M2_Decel_Time_1	0.1	3000.0	s	60.0	1741
P1.1.23.5	Current Limit	M2_MotorCurrentLimitPanel	MotorCurrentMin	MotorCurrentMax	A	0.00	1745
P1.1.23.6	Motor Nom Voltg	M2_MediumMotorNomVoltage	690	8000	V	4160	1743
P1.1.23.7	Motor Nom Freq	M2_MotorNomFreq	0.00	FreqMax_HighLimit	Hz	60.00	1747
P1.1.23.8	Motor NP Rpm	M2_MotorNomSpeed	0	65000		1780	1748
P1.1.23.9	Motor Nom Currnt	M2_MotorNomCurrent	MotorCurrentMin	MotorCurrentMax	A	0.00	1746
P1.1.23.10	Motor Cos Phi	M2_MotorCosPhii	0.30	1.00		0.85	1749
P1.2.1	Start/Stop Logic	Start_Stop_Logic	0	7		0	300
P1.2.2	DIN3 Function	DIN3_Function	0	19		0	1501
P1.2.3	DIN4 Function	DIN4_Function	0	19		0	1503
P1.2.4	DIN5 Function	DIN5_Function	0	19		0	1505
P1.2.5	DIN6 Function	DIN6_Function	0	19		0	1507
P1.2.6	DIN3 Term.Sel.	DIN3_TerminalSel	0	59		12	1502
P1.2.7	DIN4 Term.Sel.	DIN4_TerminalSel	0	59		13	1504
P1.2.8	DIN5 Term.Sel.	DIN5_TerminalSel	0	59		14	1506
P1.2.9	DIN6 Term.Sel.	DIN6_TerminalSel	0	59		15	1508
P1.2.10	Curr Ref Offset	AIA2_Offset	0	1		1	302

Table 28. SPX 5.30C VCN, Parameter IDs (Read/Write), continued

Parameter	Keypad text	9000XDrive signal name	Min.	Max.	Units	Initial	ID
P1.2.11	Ref Scal Min Val	AI_Ref_Scale_Min	0.00	Max_Frequency	Hz	0.00	303
P1.2.12	Ref Scal Max Val	AI_Ref_Scale_Max	0.00	Max_Frequency	Hz	0.00	304
P1.2.13	Ref Invert	AI_Ref_Invert	0	1		0	305
P1.2.14	Ref Filter Time	AI_Ref_Filter_Time	0.00	10.00	s	0.10	306
P1.2.15	AI1 Signal Sel	Sel_AI1_Input	0	CrossCon_Max		10	377
P1.2.16	AI2 Signal Sel	Sel_AI2_Input	0	CrossCon_Max		11	388
P1.2.17	AI3 Signal Sel	Sel_AI3_Input	0	CrossCon_Max		30	389
P1.2.18	MotPot RefMemory	ResetReference	0	1		0	367
P1.3.1	Iout 1 signal	Sel_Analog_Out1	0	59		10	464
P1.3.2	Iout Content	Analog_Output_Function	0	10		0	307
P1.3.3	Iout Filter Time	Analog_Output_Filter_Time	0.00	10.00	s	1.00	308
P1.3.4	Iout Invert	Analog_Output_Inversion	0	1		0	309
P1.3.5	Iout Minimum	Analog_Output_Min	0	1		1	310
P1.3.6	Iout Scale	Analog_Output_Scale	10	1000	%	100	311
P1.3.7	Freq Supv Lim 1	Fout_Lim_Superv_Func	0	2		0	315
P1.3.8	Freq Supv Val 1	Fout_Lim_Superv_Value	0.00	Max_Frequency	Hz	0.00	316
P1.3.9	Iout 2 Signal	Sel_Analog_Out2	0	59		0	471
P1.3.10	Iout 2 Content	Analog_Output_Function2	0	10		0	472
P1.3.11	Iout 2 Filter T	Analog_Output_Filter_Time2	0.00	10.00	s	1.00	473
P1.3.12	Iout 2 Invert	Analog_Output_Inversion2	0	1		0	474
P1.3.13	Iout 2 Minimum	Analog_Output_Min2	0	1		1	475
P1.3.14	Iout 2 Scale	Analog_Output_Scale2	10	1000	%	100	476
P1.3.15	Iout 3 signal	Sel_Analog_Out3	0	59		0	1770
P1.3.16	Iout 3 Content	Analog_Output_Function3	0	10		0	1771
P1.3.17	Iout 3 Filter T	Analog_Output_Filter_Time3	0.00	10.00	s	1.00	1772
P1.3.18	Iout 3 Invert	Analog_Output_Inversion3	0	1		0	1773
P1.3.19	Iout 3 Minimum	Analog_Output_Min3	0	1		0	1774
P1.3.20	Iout 3 Scale	Analog_Output_Scale3	10	10000	%	100	1775
P1.4.1	Ramp 1 Shape	SmoothRatio	0.0	10.0	s	2.0	500
P1.4.2	Ramp 2 Shape	SmoothRatio2	0.0	10.0	s	2.0	501
P1.4.3	Accel Time 2	Accel_Time_2	0.1	3000.0	s	10.0	502
P1.4.4	Decel Time 2	Decel_Time_2	0.1	3000.0	s	10.0	503
P1.4.5	Start Function	Start_Mode	0	1		0	505
P1.4.6	Stop Function	Stop_Mode	0	3		0	506
P1.4.7	Flux Brake	FluxBrakeEnable	0	1		0	520
P1.4.8	FluxBrakeCurrent	FluxBrakeCurrent	0.00	UnitVTCcurrent	A	5.40	519
P1.4.9	FlyStartOptions	FlyStOptions	0	65535		0	1110
P1.5.1	Range 1 High Lim	PH_Freq_Range_HighLimit_1	PH_Freq_Range_LowLimit_1	FreqMax_HighLimit	Hz	0.00	510
P1.5.2	Range 1 Low Lim	PH_Freq_Range_LowLimit_1	0.00	PH_Freq_Range_HighLimit_1	Hz	0.00	509
P1.5.3	Range 2 High Lim	PH_Freq_Range_HLim_2	PH_Freq_Range_LLim_2	FreqMax_HighLimit	Hz	0.00	512
P1.5.4	Range 2 Low Lim	PH_Freq_Range_LLim_2	0.00	PH_Freq_Range_HLim_2	Hz	0.00	511
P1.5.5	Range 3 High Lim	PH_Freq_Range_HLim_3	PH_Freq_Range_LLim_3	FreqMax_HighLimit	Hz	0.00	514

Appendix H: SPX Parameters and IDs

Table 28. SPX 5.30C VCN, Parameter IDs (Read/Write), continued

Parameter	Keypad text	9000XDrive signal name	Min.	Max.	Units	Initial	ID
P1.5.6	Range 3 Low Lim	PH_Freq_Range_LLim_3	0.00	PH_Freq_Range_HLim_3	Hz	0.00	513
P1.5.7	PH Acc/Dec Ramp	Prohibit_Range_AccDec	0.1	10.0	x	1.0	518
P1.6.1	Motor Ctrl Mode	MotorControlMode	0	ControlModeMax		0	600
P1.6.2	U/f Optimization	UFOptimization	0	1		0	109
P1.6.3	U/f Ratio Select	UFRatio	0	3		0	108
P1.6.4	Field WeakngPnt	FieldWeakeningPoint	0.00	650.00	Hz	60.00	602
P1.6.5	Voltage at FWP	FieldWeakeningPointVoltage	10.00	200.00	%	100.00	603
P1.6.6	U/f Mid Freq	UFMidPoint	0.00	FieldWeakeningPoint	Hz	60.00	604
P1.6.7	U/f Mid Voltg	UFMidPointVoltage	0.00	100.00	%	100.00	605
P1.6.8	Zero Freq Voltg	UFZeroPointVoltage	0.00	40.00	%	0.00	606
P1.6.9	Overvolt Contr	OVCntrMode	0	2		2	607
P1.6.10	Undervolt Contr	UVConrMode	0	1		1	608
P1.6.11	Load Drooping	LoadDrooping	0.00	100.00	%	0.00	620
P1.6.12	Identification	Identification_Start	0	Ident_Limit		0	631
P1.6.13.1	MagnCurrent	MagnetizingCurrent	0.00	MotorCurrentMax	A	0.00	612
P1.6.13.2	Speed Control Kp	SpeedControl_Kp	1	1000		30	613
P1.6.13.3	Speed Control Ti	SpeedControl_Ti	0.0	3200.0	ms	30.0	614
P1.6.13.4	Reserved	Temp_CL_Param	-320.00	320.00	x	0.00	1499
P1.6.13.5	Accel.Compens.	AccelCompensationTC	0.00	300.00	s	0.00	626
P1.6.13.6	Slip Adjust	SlipAdjust	0	500	%	100	619
P1.6.13.7	Start Magn Curr	DC_Brake_Current_CL	0.00	UnitVTCurrent	A	0.00	627
P1.6.13.8	Start Magn Time	DC_Brake_Start_Time_CL	0	60000	ms	0	628
P1.6.13.9	Start 0SpeedTime	StartZeroSpeedTime	0	32000	ms	100	615
P1.6.13.10	Stop 0 SpeedTime	StopZeroSpeedTime	0	32000	ms	100	616
P1.6.13.11	Startup Torque	StartupTorqueSelect	0	3		0	621
P1.6.13.12	StartupTorq FWD	StartupTorqueFWD	-300.0	300.0	%	0.0	633
P1.6.13.13	StartupTorq REV	StartupTorqueREV	-300.0	300.0	%	0.0	634
P1.6.13.14	Encoder1FiltTime	Encoder1FiltTime	0.0	100.0	ms	0.0	618
P1.6.13.15	CL_OVReference	CLOverVoltContRef	0.00	125.00	%	118.00	4290
P1.6.13.16	CL_OVProtEnable	CLOverVoltContEnable	0	1		1	1643
P1.6.13.17	CL_OVDroop	CLOverVoltContDroop	0.00	100.00	%	0.00	4436
P1.6.14.1	Reserved	FluxCurve_a	0.0	250.0	%	10.0	1355
P1.6.14.2	Reserved	FluxCurve_b	0.0	250.0	%	20.0	1356
P1.6.14.3	Reserved	FluxCurve_c	0.0	250.0	%	30.0	1357
P1.6.14.4	Reserved	FluxCurve_d	0.0	250.0	%	40.0	1358
P1.6.14.5	Reserved	FluxCurve_e	0.0	250.0	%	50.0	1359
P1.6.14.6	Reserved	FluxCurve_f	0.0	250.0	%	60.0	1360
P1.6.14.7	Reserved	FluxCurve_g	0.0	250.0	%	70.0	1361
P1.6.14.8	Reserved	FluxCurve_h	0.0	250.0	%	80.0	1362
P1.6.14.9	Reserved	FluxCurve_i	0.0	250.0	%	90.0	1363
P1.6.14.10	Reserved	FluxCurve_j	0.0	250.0	%	100.0	1364
P1.6.14.11	Reserved	FluxCurve_k	0.0	250.0	%	110.0	1365

Table 28. SPX 5.30C VCN, Parameter IDs (Read/Write), continued

Parameter	Keypad text	9000XDrive signal name	Min.	Max.	Units	Initial	ID
P1.6.14.12	Reserved	FluxCurve_l	0.0	250.0	%	120.0	1366
P1.6.14.13	Reserved	FluxCurve_m	0.0	250.0	%	130.0	1367
P1.6.14.14	Reserved	FluxCurve_n	0.0	250.0	%	140.0	1368
P1.6.14.15	Reserved	FluxCurve_o	0.0	250.0	%	150.0	1369
P1.6.14.16	Reserved	MeasRsVoltageDrop	0	30000		0	662
P1.6.14.17	Reserved	IrAddZeroPointVoltage	0	30000		0	664
P1.6.14.18	Reserved	IrAddGeneScale	0	30000		0	665
P1.6.14.19	Reserved	IrAddMotorScale	0	30000		100	667
P1.6.14.20	Reserved	LSVoltageDrop	0	3000		512	673
P1.6.14.21	Reserved	IUoffset	-32000	32000		10000	668
P1.6.14.22	Reserved	IVoffset	-32000	32000		0	669
P1.6.14.23	Reserved	IWoffset	-32000	32000		0	670
P1.6.14.24	holdSS	Speed_Step	-500	500		0	1252
P1.6.15.1	VoltControlSelec	VoltControlSel	0	1		0	1708
P1.6.15.2	MotorVoltAlm	MedMotVoltAlmLVL	0	60000	V	46000	1709
P1.6.15.3	MotorVoltFlt	MedMotVoltFltLVL	0	60000	V	52000	1710
P1.6.15.4	MotorVoltageUppe	MotorVoltageUpper	0	6000	V	4160	1711
P1.6.16	MakeFluxTime	MakeFluxTime	0	2000	ms	200	660
P1.6.17	MakeFluxVoltage	MakeFluxVoltage	0	10000	V	201	661
P1.6.18	MakeFluxVHWDT	MakeFluxVoltageHwDtComp	0	10000	V	140	663
P1.7.1	4mA Input Fault	_4mA_Fault_Response	0	5		0	700
P1.7.2	4ma+FBFaultFreq	_4mA_Fault_Freq	0.00	Max_Frequency	Hz	0.00	728
P1.7.3	External Fault	Ext_Fault_Response	0	3		3	701
P1.7.4	ExtFaultDelay	extFaultDelayTime	0.0	120.0	s	1.0	1768
P1.7.5	Input Phase Supv	Input_Phase_Supv_F	0	3		0	730
P1.7.6	UVolt Fault Resp	UV_Fault_Response	0	1		0	727
P1.7.7	UVRefSelect	UnderVoltageRefSelect	0	1		0	582
P1.7.8	UVRefMin	UnderVoltageRefMin	0	1000	V	410	746
P1.7.9	UVRefMax	UnderVoltageRefMax	0	1000	V	540	747
P1.7.10	OutputPh. Superv	Phase_Supv_F	0	3		2	702
P1.7.11	Earth Fault	Earth_Prot_F	0	3		2	703
P1.7.12	Motor Therm Prot	Therm_Prot_F	0	3		0	704
P1.7.13	MotAmbTempFactor	MotorAmbTempFactor	-100.0	100.0	%	0.0	705
P1.7.14	MTP f0 Current	MotThermZeroSpeedCool	0.0	150.0	%	40.0	706
P1.7.15	MTP Motor T	MotorThermTimeConst	1	200	min	45	707
P1.7.16	Motor Duty Cycle	MotorDutyCycle	0	150	%	100	708
P1.7.17	Stall Protection	Stall_Protect_F	0	3		0	709
P1.7.18	Stall Current	StallCurrentLimit	0.00	55.00	A	1.00	710
P1.7.19	Stall Time Lim	StallTime	1.00	120.00	s	15.00	711
P1.7.20	Stall Freq Lim	StallFrequency	0.00	Max_Frequency	Hz	0.00	712
P1.7.21	Underload Protec	ULoad_Protect_F	0	3		0	713
P1.7.22	UP from Torque	UnderloadTorqNomi	10.0	150.0	%	50.0	714

Appendix H: SPX Parameters and IDs

Table 28. SPX 5.30C VCN, Parameter IDs (Read/Write), continued

Parameter	Keypad text	9000XDrive signal name	Min.	Max.	Units	Initial	ID
P1.7.23	UP f0 Torque	UnderloadTorqZero	5.0	150.0	%	10.0	715
P1.7.24	UP Time Limit	UnderloadStateTime	2.00	600.00	s	20.00	716
P1.7.25	ThermistorF.Resp	Thermistor_Protect_F	0	3		2	732
P1.7.26	VoltLossDlyTime	VoltLossDelayTime	1	30	s	5	1936
P1.7.27	FBComm.FaultResp	FB_Fault_Response	0	5		2	733
P1.7.28	SlotComFaultResp	SPI_Fault_Response	0	3		2	734
P1.7.29	EstopSMode	fault72SMODE	0	2		0	1644
P1.7.30	FaultInhibReg1	kp_faultInhibitReg1	0	65535		0	1776
P1.7.31	FaultInhibReg2	kp_faultInhibitReg2	0	65535		0	1777
P1.7.32	FaultInhibReg3	kp_faultInhibitReg3	0	65535		0	1778
P1.7.33	FaultInhibReg4	kp_faultInhibitReg4	0	65535		0	1779
P1.8.1	Wait Time	Auto_Rst_Wait	0.10	10.00	s	0.50	717
P1.8.2	Trial Time	Auto_Rst_SVTime	0.00	60.00	s	30.00	718
P1.8.3	Start Function	Auto_Rst_StartM	0	2		0	719
P1.8.4	Undervolt. Tries	Auto_Rst_UV_Trials	0	10		0	720
P1.8.5	Overvolt. Tries	Auto_Rst_OV_Trials	0	10		0	721
P1.8.6	Overcurr. Tries	Auto_Rst_OCurr_Trials	0	3		0	722
P1.8.7	4mA Fault Tries	Auto_Rst_Ref_Trials	0	10		0	723
P1.8.8	MotTempF Tries	Auto_Rst_MotOTemp_Trials	0	10		0	726
P1.8.9	Ext.Fault Tries	Auto_Rst_ExtF_Trials	0	10		0	725
P1.8.10	Underload tries	Auto_Rst_ULoad_Trials	0	10		0	738
P1.9.1	Enable PID-Ctrl	Enable_PID_Control	0	1		0	1530
P1.9.2	PID Units	UnitSelection	0	31		0	1531
P1.9.3	PID Accuracy	UnitFormat	60	63		60	1532
P1.9.4	PID Ref. Source	PID_Ref_Source	0	4		2	1533
P1.9.5	PID Ref. Min.	PI_Setpoint_Min	Sensor_Min	PI_Setpoint_Max		(0)	1534
P1.9.6	PID Ref. Max.	PI_Setpoint_Max	PI_Setpoint_Min	Sensor_Max		(100)	1535
P1.9.7	PID Ref.RampTime	PI_StPt_RampTime	0.01	30.00	s	0.10	1536
P1.9.8	PID Feedback Src	PI_Input_Source	0	5		0	1537
P1.9.9	Sensor Min.	Sensor_Min	(-30000)	Sensor_Max		(0)	1538
P1.9.10	AI1 Min. Value	AI1_Min_Value	0.00	100.00	%	0.00	1539
P1.9.11	AI2 Min. Value	AI2_Min_Value	0.00	100.00	%	20.00	1540
P1.9.12	Sensor Max.	Sensor_Max	Sensor_Min	(30000)		(100)	1541
P1.9.13	AI1 Max. Value	AI1_Max_Value	0.00	100.00	%	100.00	1542
P1.9.14	AI2 Max. Value	AI2_Max_Value	0.00	100.00	%	100.00	1543
P1.9.15	PID-Contr Gain	PIC_GAIN	0.0	1000.0	%	100.0	1544
P1.9.16	PID-Contr I Time	PIC_INTEG_TIME	0.00	320.00	s	1.00	1545
P1.9.17	Error Inversion	PID_Acting_Mode	0	1		0	1546
P1.9.18	Sleep Frequency	Sleep_Frequency	0.00	Max_Frequency	Hz	0.00	1547
P1.9.19	Sleep Delay	Sleep_Delay	0.0	3000.0	s	0.0	1548
P1.9.20	Wake Up Limit	Sleep_Wake_Up_Level	Sensor_Min	Sensor_Max		(0)	1549
P1.9.21	Wake Up Action	Sleep_Wake_Up_Function	0	1		0	1550

Table 28. SPX 5.30C VCN, Parameter IDs (Read/Write), continued

Parameter	Keypad text	9000XDrive signal name	Min.	Max.	Units	Initial	ID
P1.9.22	Wake Up Deadband	WakeUpLevel_Deadband	Sensor_Min	Sensor_Max		(0)	1551
P1.10.1	Torque Limit	TorqueLimit	0.0	300.0	%	300.0	609
P1.10.2	TorqLimCtrl P	TorqueLimControl_Kp	0	32000		3000	610
P1.10.3	TorqLimCtrl I	TorqueLimControl_Ki	0	32000		200	611
P1.10.4	Torq Ref Select	Torque_Ref_Sel	0	4		0	641
P1.10.5	Torq Ref Max	Torque_Ref_Max	-300.0	300.0	%	100.0	642
P1.10.6	Torq Ref Min	Torque_Ref_Min	-300.0	300.0	%	0.0	643
P1.10.7	Torq Speed Limit	Torq_ContSpeed_Lim	0	2		0	644
P1.10.8	OL TC Min Freq	MinFreqTorqueControl	0.00	50.00	Hz	3.00	636
P1.10.9	OL TorqCtrl P	TorqueControl_Kp	0	32000		150	639
P1.10.10	OL TorqCtrl I	TorqueControl_Ki	0	32000		10	640
P1.10.11	GenTorqueLimit	GeneratorTorqueLim	0.0	300.0	%	300.0	168
P1.10.12	MotTorqueLimit	MotoringTorqueLim	0.0	300.0	%	300.0	169
P1.11.1	DeltaCoolLevel	DeltaCoolLVL	0.0	60.0	°C	40.0	1656
P1.11.2	MaxFilterRise	Maxrise	0.0	50.0	°C	30.0	1659
P1.11.3	MaxAmbient1	fltLevAmb	0.0	70.0	°C	40.0	1657
P1.11.4	MaxAmbient2	fltLevAmb2	0.0	70.0	°C	40.0	1669
P1.11.5	MaxTransCoil	fltLevCoil	0.0	250.0	°C	160.0	1667
P1.11.6	MaxRectifier	fltLevRect	0.0	250.0	°C	105.0	1896
P1.11.7	MaxInductor	fltLevReact	20.0	250.0	°C	160.0	1677
P1.11.8	MaxAutoCoil	fltLevAuto	0.0	250.0	°C	160.0	1661
P1.11.9	WarningPercent	p_tWarn	1	100	%	95	1894
P1.11.10	BlowerExchTime	ExchangeTime	12	720	h	720	1653
P1.12.1	MediumVoltageInd	MediumVoltageIndex	0	10000	V	0	1600
P1.12.2	TorqStabGain	TorqStabGain	0	1000		100	1412
P1.12.3	TorqStabDamp	TorqStabDamp	0	1000		0	1413
P1.12.4	TorqStabLimit	TorqStabLimit	0	300	Hz	150	1640
P1.12.5	TorqStabGainFWP	TorqStabGainFWP	0	1000		50	1414
P1.12.6	VoltStabGain	VoltStabGain	0	1000		0	1602
P1.12.7	VoltStabDamp	VoltStabDamp	0	1000		600	1601
P1.12.8	VoltStabLimit	VoltStabLimit	0	300	Hz	150	1641
P1.12.9	OverVolta_Kp_Add	OverVoltage_Kp_Add	0	32767		2000	1603
P1.12.10	OverVoltage_Kp	OverVoltage_Kp	0	32767		2000	1604
P1.12.11	OverVoltage_Ki	OverVoltage_Ki	0	32767		200	1605
P1.12.12	UnderVoltage_Kp	UnderVoltage_Kp	0	32767		4000	1606
P1.12.13	UnderVoltage_Ki	UnderVoltage_Ki	0	32767		400	1607
P1.12.14	RestartDelay	RestartDelay	0	65000	ms	100	1608
P1.12.15	ShortRestartDela	ShortRestartDelay	0	65535	ms	100	1609
P1.12.16	IdsStabGainRef	IdsStabGainRef	0	32000		800	1610
P1.12.17	IdsFiltCoeff	IdsFiltCoeff	0	32767		64	1611
P1.12.18	FlyStDCMagnCurre	FlyStDCMagnCurrent	0	32000		700	1612
P1.12.19	FluxCircleStabGa	FluxCircleStabGain	0	32767		0	1613

Appendix H: SPX Parameters and IDs

Table 28. SPX 5.30C VCN, Parameter IDs (Read/Write), continued

Parameter	Keypad text	9000XDrive signal name	Min.	Max.	Units	Initial	ID
P1.12.20	OverVoltage_Kd	OverVoltage_Kd	0	32767		250	1614
P1.12.21	MotoOverCurr_Kp	MotoOverCurr_Kp	0	32767		10000	1615
P1.12.22	MotoOverCurr_Ki	MotoOverCurr_Ki	0	32767		300	1616
P1.12.23	CurrentControlKp	CurrentControl_Kp	0.00	100.00	%	20.00	617
P1.12.24	CurrentControlTi	CurrentControl_Ti	0.0	3200.0	ms	5.0	657
P1.12.25	Over Mod Limit	OvermodulationLimit	50	120	%	120	1620
P1.12.26	DeadTimeCompens	DeadTimeCompensation	0	5000		1	1621
P1.12.27	DeadTimeConCurrL	DeadTimeContCurrLim	0	5000		100	1622
P1.12.28	GeneOverCurr_Kp	GeneOverCurr_Kp	0	32767		2000	1751
P1.12.29	GeneOverCurr_Ki	GeneOverCurr_Ki	0	32767		400	1750
P1.12.30	AdvancedOptions	AdvancedOptions	0	65535		0	1109
P1.12.31	MainHour	MainHour	0	65535	Hour	0	1630
P1.12.32	RedundantHour	RedundantHour	0	65535	Hour	0	1631
P1.12.34	ITGDoubSwFrq	kp_ITG_doubleFreq	0	1		0	1850
P1.12.33.1	TestCycleActive	TestCycleActive	0	1		0	1625
P1.12.33.2	TestTime1	TestTime1	0	1000	s	540	1626
P1.12.33.3	TestTime2	TestTime2	0	1000	s	60	1627
P1.12.33.4	TestCurrent1	TestCycle1	MotorCurrentMin	MotorCurrentMax	A	0.00	1628
P1.12.33.5	TestCurrent2	TestCycle2	MotorCurrentMin	MotorCurrentMax	A	0.00	1629
P1.12.33.6	FastBlowerSched	FastBlowerTestTime	0	1		0	1960
P1.12.33.7	MainBlowerMode	Bt_MainBlowerMode	0	2		0	1970
P1.12.33.8	RedunBlowerMode	Bt_RedunBlowerMode	0	2		0	1971
P1.13.1	FB Data In 2	FBInput1	1	2000		0	1962
P1.13.2	FB Data In 1	FBInput0	1	2000		0	1961
P1.13.3	FB Data Out8 Sel	FB_PDDataOUT8_SEL	0	10000		37	859
P1.13.4	FB Data Out7 Sel	FB_PDDataOUT7_SEL	0	10000		7	858
P1.13.5	FB Data Out6 Sel	FB_PDDataOUT6_SEL	0	10000		6	857
P1.13.6	FB Data Out5 Sel	FB_PDDataOUT5_SEL	0	10000		5	856
P1.13.7	FB Data Out4 Sel	FB_PDDataOUT4_SEL	0	10000		4	855
P1.13.8	FB Data Out3 Sel	FB_PDDataOUT3_SEL	0	10000		3	854
P1.13.9	FB Data Out2 Sel	FB_PDDataOUT2_SEL	0	10000		2	853
P1.13.10	FB Data Out1 Sel	FB_PDDataOUT1_SEL	0	10000		1	852
P1.13.11	FB Min Scale	FB_Min_Scale	0.00	320.00	Hz	0.00	850
P1.13.12	FB Max Scale	FB_Max_Scale	0.01	320.00	Hz	60.00	851
P1.14.1	VoltageBoostFunc	VB_BoostEnable	0	1		0	1930
P1.14.2	IoMeasureLow	Vb_PercentPowerMin	0	100	%	55	1931
P1.14.3	IoMeasureHigh	Vb_PercentPowerMax	Vb_PercentPowerMin	100	%	88	1932
P1.14.4	VoGainLow	VB_BoostPercentMin	0	130	%	99	1933
P1.14.5	VoGainHigh	VB_BoostPercentMax	VB_BoostPercentMin	140	%	104	1934
P1.14.6	ModIndexLimit	ModIndexLimit	0	200	%	200	655
P1.15.1	SyncFieldMode	Sf_ModeEnable	0	1		0	1906
P1.15.2	ExcType	sf_fldRefType	0	4		0	1929

Table 28. SPX 5.30C VCN, Parameter IDs (Read/Write), continued

Parameter	Keypad text	9000XDrive signal name	Min.	Max.	Units	Initial	ID
P1.15.3	RefSource	Sf_KP_PIDRefSource	0	9		0	1928
P1.15.4	RefFilter	sf_PIDRefFilterTime	60	255	ms	60	1921
P1.15.5	RefInMin	Sf_RefInMin	0	10000		0	1925
P1.15.6	RefInMax	Sf_RefInMax	0	10000		0	1926
P1.15.7	RefOutMin	Sf_RefOutMin	0	10000		0	1632
P1.15.8	RefOutMax	Sf_RefOutMax	0	10000		0	1633
P1.15.9	ExcOutMin	Sf_ExOutMin	0	10000		0	1634
P1.15.10	ExcOutMax	Sf_ExOutMax	0	10000		0	1635
P1.15.11.1	ActSource	Sf_KP_PIDActualSource	0	9		0	1636
P1.15.11.2	ActFilter	sf_Kp_PIDActFilterTime	60	10000	ms	60	1920
P1.15.11.3	Polarity	Sf_PIDPolaritySource	0	3		1	1914
P1.15.11.4	Scale	Sf_PID_Scale	-2000	2000		1	1637
P1.15.11.5	GainK	Sf_Kp_PropGain	0.000	90.000		1.000	1918
P1.15.11.6	GainI	Sf_Kp_IntGain	0.000	6.000		0.010	1919
P1.15.12.1	MeasureDly	MeasureDelay	0.0	30.0	s	2.0	1978
P1.15.12.2	CoarseDeadBand	CoarseDeadBand	0.0	20.0	A	20.0	1979
P1.15.12.3	CoarseAdjCurrent	CoarseFieldAdjustI	0.0	20.0		1.0	1982
P1.15.12.4	FineDeadBand	FineDeadBand	0.0	20.0	A	5.0	1935
P1.15.12.5	FineAdjCurrent	FineFieldAdjustI	0.0	20.0		1.0	1981
P1.15.12.6	FieldRefAmps	kp_fRefAmps	0	3000	A	1000	1655
P1.15.12.7	DCBusRef	kp_refDCBus	0	8000	V	6000	1660
P1.15.12.8	AVGain	avGain	0	200	%	200	1672
P1.15.12.9	FreqLimHigh	kp_freqHigh	0.00	70.00	Hz	60.00	1673
P1.15.12.10	FreqLimLow	kp_freqLow	0.00	60.00	Hz	18.00	1674
P1.15.12.11	DivLot	kp_DivLot	0.00	60.00	Hz	18.00	1675
P1.16.1.1	Out1AFunc	Out1AFunction	0	35		2	1851
P1.16.1.2	Out1BFunc	Out1BFunction	0	35		0	1852
P1.16.1.3	Out2AFunc	Out2AFunction	0	35		11	1853
P1.16.1.4	Out2BFunc	Out2BFunction	0	35		8	1854
P1.16.1.5	Out3AFunc	Out3AFunction	0	35		8	1855
P1.16.1.6	Out3BFunc	Out3BFunction	0	35		0	1856
P1.16.1.7	Out4AFunc	Out4AFunction	0	35		0	1857
P1.16.1.8	Out4BFunc	Out4BFunction	0	35		0	1858
P1.16.1.9	Out5AFunc	Out5AFunction	0	35		0	1859
P1.16.1.10	Out5BFunc	Out5BFunction	0	35		0	1860
P1.16.1.11	Out6AFunc	Out6AFunction	0	35		0	1861
P1.16.1.12	Out6BFunc	Out6BFunction	0	35		0	1862
P1.16.1.13	Out7AFunc	Out7AFunction	0	35		0	1863
P1.16.1.14	Out7BFunc	Out7BFunction	0	35		0	1864
P1.16.2.1	In1AFunc	Rem11AFunc	0	23		14	1805
P1.16.2.2	In1BFunc	Rem11bFunc	0	23		15	1806
P1.16.2.3	In2AFunc	Rem12aFunc	0	23		1	1807

Appendix H: SPX Parameters and IDs

Table 28. SPX 5.30C VCN, Parameter IDs (Read/Write), continued

Parameter	Keypad text	9000XDrive signal name	Min.	Max.	Units	Initial	ID
P1.16.2.4	In2BFunc	RemI2bFunc	0	23		4	1808
P1.16.2.5	In3AFunc	RemI3aFunc	0	23		2	1809
P1.16.2.6	In3BFunc	RemI3bFunc	0	23		8	1810
P1.16.2.7	In4AFunc	RemI4AFunc	0	23		9	1811
P1.16.2.8	In4BFunc	RemI4bFunc	0	23		20	1812
P1.16.2.9	In5AFunc	RemI5aFunc	0	23		6	1813
P1.16.2.10	In5BFunc	RemI5bFunc	0	23		0	1814
P1.16.2.11	In6AFunc	RemI6aFunc	0	23		0	1815
P1.16.2.12	In6BFunc	RemI6bFunc	0	23		0	1816
P1.16.2.13	In7AFunc	RemI7AFunc	0	23		0	1817
P1.16.2.14	In7BFunc	RemI7bFunc	0	23		0	1818
P1.16.2.15	In8AFunc	RemI8AFunc	0	23		0	1819
P1.16.2.16	In8BFunc	RemI8bFunc	0	23		0	1801
P1.16.2.17	In9AFunc	RemI9AFunc	0	23		0	1802
P1.16.2.18	In9BFunc	RemI9bFunc	0	23		0	1803
P1.16.3.1	Base1Ana1A	RemAI1AFunc	0	9		3	1820
P1.16.3.2	Base1Ana1B	RemAI1BFunc	0	9		0	1821
P1.16.3.3	Base1Ana2A	RemAI2AFunc	0	9		0	1822
P1.16.3.4	Base1Ana2B	RemAI2BFunc	0	9		0	1823
P1.16.3.5	Base1Ana3A	RemAI3AFunc	0	9		0	1824
P1.16.3.6	Base1Ana3B	RemAI3bFunc	0	9		0	1825
P1.16.4.1	Base1AnOut1A	rAO_1aF	0	10		0	1684
P1.16.4.2	Base1AnOut1B	rAO_1bF	0	10		0	1685
P1.16.4.3	Base1AnOut2A	rAO_2aF	0	10		0	1686
P1.16.4.4	Base1AnOut2B	rAO_2bF	0	10		0	1687
P1.16.4.5	Base1AnOut3A	rAO_3aF	0	10		0	1688
P1.16.4.6	Base1AnOut3B	rAO_3bF	0	10		0	1689
P1.16.4.7	Base1AnOut4A	rAO_4aF	0	10		0	1691
P1.16.4.8	Base1AnOut4B	rAO_4bF	0	10		0	1692
P1.16.5.1	MP1Channel1	MP1Ch1Func	0	7		1	1680
P1.16.5.2	MP1Channel2	MP1Ch2Func	0	7		2	1681
P1.16.5.3	MP1Channel3	MP1Ch3Func	0	7		0	1682
P1.16.5.4	MP1Channel4	MP1Ch4Func	0	7		0	1683
P1.17.1.1	SyncTransMode	sTransMode	0	2		0	1790
P1.17.1.2	SyncAccelTime	Ph_ProcessPIAccelTime	1	100	s	20	1715
P1.17.1.3	SyncDecelTime	Ph_ProcessPIDecelTime	1	100	s	20	1716
P1.17.1.4	SyncUpAngle	PhaseDiffOffsetToNet	-180.0	180.0	Deg	-30.0	1717
P1.17.1.5	SyncDownAngle	PhaseDiffOffsetToFC	-180.0	180.0	Deg	-30.0	1718
P1.17.1.6	AngleZeroAdjust	Ph_ProcessPITrimRefBias	-180.0	180.0	Deg	0.0	1719
P1.17.1.7	SyncGain	Ph_ProcessPITrimGain	0.0	100.0		5.0	1720
P1.17.1.8	FreqDeadband	LineVoltageFreqHyst	0.00	10.00	Hz	1.00	1723
P1.17.1.9	PhaseDeadband	PhaseDifferenceHyst	0.00	10.00	Deg	4.00	1722

Table 28. SPX 5.30C VCN, Parameter IDs (Read/Write), continued

Parameter	Keypad text	9000XDrive signal name	Min.	Max.	Units	Initial	ID
P1.17.2.1	SULockStabTime	kp_ct_currentStabTime	0.100	10.000	s	2.000	1350
P1.17.2.2	SyncUpCurThresh	p_ITG_currentThreshold	1	300	%	150	1511
P1.17.2.3	SDLockStabTime	kp_ct_sd_modulationDelay	0.100	30.000	s	2.000	1353
P1.17.2.4	SDModulatDelay	syncDownDelay	0.001	30.000	s	5.000	1462
P1.17.2.5	ITGAckTimelimit	kp_ct_echoTime	100	30000	ms	10000	1351
P1.17.3.1	SyncUpInvStop	mstimeStopInverter	0	500	ms	135	1724
P1.17.3.2	SyncUpBPassClose	mstimeBypass	0	500		64	1725
P1.17.3.3	SyncUpOutOpen	mstimeStopOutputContactor	0	1000	ms	104	1726
P1.17.3.4	SyncDwnBPassOpen	down_mstimeBypass	0	500	ms	30	1727
P1.17.3.5	SynDwnOutClose	down_mstimeStopOutputContactor	0	500	ms	121	1728
P1.17.3.6	SequenceComplete	mstimeSyncComplete	0	2000	ms	1000	1729
P1.17.3.7	SyncAcquireTime	SyncAcquireTimer	0.00	200.00	s	60.00	1730
P1.17.3.8	SyncLockTime	SyncLockTimer	0.00	200.00	s	5.00	1731
P1.17.3.9	FreqDeadBOnDel	LineVoltFreqOnDelay	0.00	40.00	s	1.00	1732
P1.17.3.10	FreqDeadBOffDel	LineVoltFreqOffDelay	0.00	40.00	s	2.00	1733
P1.17.3.11	PhseDeadBOnDel	PhaseDiffOnDelay	0.00	40.00	s	1.00	1734
P1.17.3.12	PhseDeadBOffDel	PhaseDiffOffDelay	0.00	40.00	s	2.00	1735
P1.18.1.1	Inverter1Max	KP_mitg_invFaultLvl	0	90	°C	80	1705
P1.18.1.2	Inverter1Vote	KP_mitg_urtd_rx2_votingBits	0	63		63	1757
P1.18.1.3	Inverter1VoteMax	KP_mitg_urtd_rx2_votedCount	0	6		0	1980
P1.18.1.4	BadChannelMax1	KP_mitg_urtd_rx2_badChanCnt	0	6		0	1903
P1.18.2.1	EnableRx2URTD	KP_sitg_enable_rx2	0	1		0	1769
P1.18.2.2	Inverter2Max	KP_sitg_invFaultLvl	0	90	°C	80	1897
P1.18.2.3	Inverter2Vote	KP_sitg_urtd_rx2_votingBits	0	63		63	1899
P1.18.2.4	Inverter2VoteMax	KP_sitg_urtd_rx2_votedCount	0	6		0	1900
P1.18.2.5	BadChannelMax2	KP_sitg_urtd_rx2_badChanCnt	0	6		0	1901
P1.18.3.1	RTDPresent	RTDPresent	0	1		0	1756
P1.18.3.2	MtrRTDVoting	VotingCW	0	1023		1023	1799
P1.18.3.3	BadChannelCnt	KP_BadChanCount	0	10		0	1898
P1.18.3.4	MtrRTDVoteCnt	KP_VotedCount	0	10		0	1798
P1.18.3.5	URTDFailResp	URTDMode	0	2		2	1791
P1.18.3.6	AlarmsTOsDelay	KP_motorRTDhot	0	120	sec	5	1977
P1.18.3.7	URTDInvalidsResp	invalidsFMODE	0	2		2	1761
P1.18.3.8	MotorWindTripLev	WDTrip	WDAalarm	249	°C	155	1590
P1.18.3.9	MotorWindAlmLev	WDAalarm	0	249	°C	135	1764
P1.18.3.10	MotBearTripLev	MBTrip	MBAalarm	249	°C	95	1765
P1.18.3.11	MotBearAlmLev	MBAalarm	0	249	°C	80	1796
P1.18.3.12	LoadBearTripLev	LBTrip	LBAalarm	249	°C	95	1767
P1.18.3.13	LoadBearAlmLev	LBAalarm	0	249	°C	80	1797
P1.18.3.14	RTDHistoryReset	kp_RTDDHisRst	0	1		0	1976
P1.19.1	OC Value	kp_ITGOverCurrentValue	0	4095		2280	1890
P1.19.2	OV Value	kp_ITGOverVoltageValue	0	4095		3940	1891

Table 28. SPX 5.30C VCN, Parameter IDs (Read/Write), continued

Parameter	Keypad text	9000XDrive signal name	Min.	Max.	Units	Initial	ID
P1.19.3	CommitToFRAM	requestITGParamChange	0	1		0	1645
P2.2	Keypad Direction	Panel_Reverse_Request	0	1		0	123
P2.3	StopButtonActive	Stop_B_Active	0	1		1	114

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