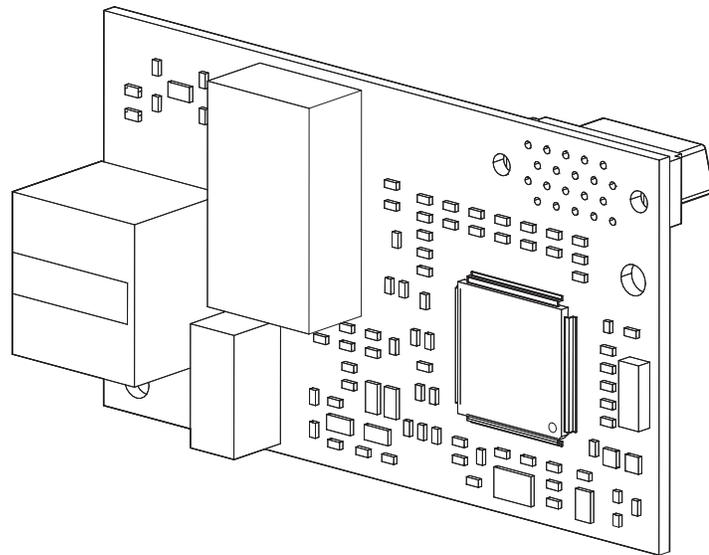


## YASKAWA Z1000 Bypass Option Modbus TCP/IP Single and Dual-Port Technical Manual

Type: SI-EM3/SI-EM3D

Applicable Products : Z1B1-

To properly use the product, read this manual thoroughly and retain for easy reference, inspection, and maintenance. Ensure the end user receives this manual.



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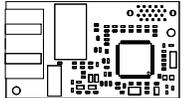
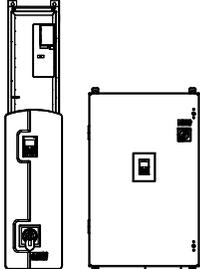
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## 1 Preface and Safety

Yaskawa manufactures products used as components in a wide variety of industrial systems and equipment. The selection and application of Yaskawa products remain the responsibility of the equipment manufacturer or end user. Yaskawa accepts no responsibility for the way its products are incorporated into the final system design. Under no circumstances should any Yaskawa product be incorporated into any product or design as the exclusive or sole safety control. Without exception, all controls should be designed to detect faults dynamically and fail safely under all circumstances. All systems or equipment designed to incorporate a product manufactured by Yaskawa must be supplied to the end user with appropriate warnings and instructions as to the safe use and operation of that part. Any warnings provided by Yaskawa must be promptly provided to the end user. Yaskawa offers an express warranty only as to the quality of its products in conforming to standards and specifications published in the Yaskawa manual. **NO OTHER WARRANTY, EXPRESS OR IMPLIED, IS OFFERED.** Yaskawa assumes no liability for any personal injury, property damage, losses, or claims arising from misapplication of its products.

### ◆ Applicable Documentation

The following manuals are available for the SI-EM3/SI-EM3D option:

	<p>Yaskawa 1000-Series Bypass Single and Dual-Port SI-EM3/SI-EM3D Modbus TCP/IP Option Technical Manual (This manual)</p> <p>The Technical Manual contains information required to install the option and set up related bypass parameters.</p>
	<p>Z1000 Bypass Technical Manual (SIEPYAIZ1B01)</p> <p>This manual provides detailed information on parameter settings and bypass functions. Use this manual to expand bypass functionality and to take advantage of higher performance features. This manual is available for download on our documentation website, <a href="http://yaskawa.com">yaskawa.com</a>.</p>

### ◆ Terms

**Note:** Indicates supplemental information that is not related to safety messages.

**Bypass:** Yaskawa Z1000 Bypass Unit

**Drive:** Yaskawa 1000-Series AC Drive

**Option:** Yaskawa 1000-Series SI-EM3 Single Port Modbus TCP/IP Option and SI-EM3D Dual-Port Modbus TCP/IP Option

### ◆ Registered Trademarks

- Modbus TCP/IP is a trademark of Modbus-IDA.
- All trademarks are the property of their respective owners.

### ◆ Supplemental Safety Information

Read and understand this manual before installing, operating, or servicing this option. The option must be installed according to this manual and local codes.

The following conventions are used to indicate safety messages in this manual. Failure to heed these messages could result in serious or possibly even fatal injury or damage to the products or to related equipment and systems.

**⚠ DANGER**

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

**⚠ WARNING**

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

**WARNING!** may also be indicated by a bold key word embedded in the text followed by an italicized safety message.

**⚠ CAUTION**

Indicates a hazardous situation, which, if not avoided, could result in minor or moderate injury.

**CAUTION!** may also be indicated by a bold key word embedded in the text followed by an italicized safety message.

**NOTICE**

Indicates a property damage message.

**NOTICE:** may also be indicated by a bold key word embedded in the text followed by an italicized safety message.

**■ General Safety****General Precautions**

- The diagrams in this manual may be indicated without covers or safety shields to show details. Replace the covers or shields before operating the drive and run the drive according to the instructions described in this manual.
- Any illustrations, photographs, or examples used in this manual are provided as examples only and may not apply to all products to which this manual is applicable.
- The products and specifications described in this manual or the content and presentation of the manual may be changed without notice to improve the product and/or the manual.
- When ordering a new copy of the manual due to damage or loss, contact your Yaskawa representative or the nearest Yaskawa sales office and provide the manual number shown on the front cover.
- If nameplate becomes worn or damaged, order a replacement from your Yaskawa representative or the nearest Yaskawa sales office.

**⚠ DANGER****Heed the safety messages in this manual.**

Failure to comply will result in death or serious injury.

The operating company is responsible for any injuries or equipment damage resulting from failure to heed the warnings in this manual.

**Electrical Shock Hazard****Do not connect or disconnect wiring while the power is on.**

Failure to comply will result in death or serious injury.

Failure to comply will result in death or serious injury. Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait for at least the time specified on the warning label once all indicators are OFF, and then measure the DC bus voltage level to confirm it has reached a safe level.

**NOTICE****Observe proper electrostatic discharge procedures (ESD) when handling the drive and circuit boards.**

Failure to comply may result in ESD damage to the drive circuitry.

**Do not perform a withstand voltage test on any part of the drive.**

Failure to comply could result in damage to the sensitive devices within the drive.

**Do not operate damaged equipment.**

Failure to comply could result in further damage to the equipment.

Do not connect or operate any equipment with visible damage or missing parts.

### NOTICE

**Do not expose the drive to halogen group disinfectants.**

Failure to comply may cause damage to the electrical components in the drive.

Do not pack the drive in wooden materials that have been fumigated or sterilized.

Do not sterilize the entire package after the product is packed.

## 2 Product Overview

### ◆ About this Product

This option provides a communications connection between the bypass and a Modbus TCP/IP network. The option connects the bypass to a Modbus TCP/IP network and facilitates the exchange of data.

This manual explains the handling, installation and specifications of this product.

The option is a communications link to connect industrial devices (such as smart motor controllers, operator interfaces, and variable frequency drives) as well as control devices (such as programmable controllers and computers) to a network. The option is a simple, networking solution that reduces the cost and time to wire and install factory automation devices, while providing interchangeability of like components from multiple vendors.

By installing the option to a bypass, it is possible to do the following from a Modbus TCP/IP master device:

- Operate the bypass
- Operate the drive
- Monitor bypass status
- Monitor drive status
- Change bypass parameter settings



### ◆ Applicable Models

The option can be used with the bypass models in [Table 1](#).

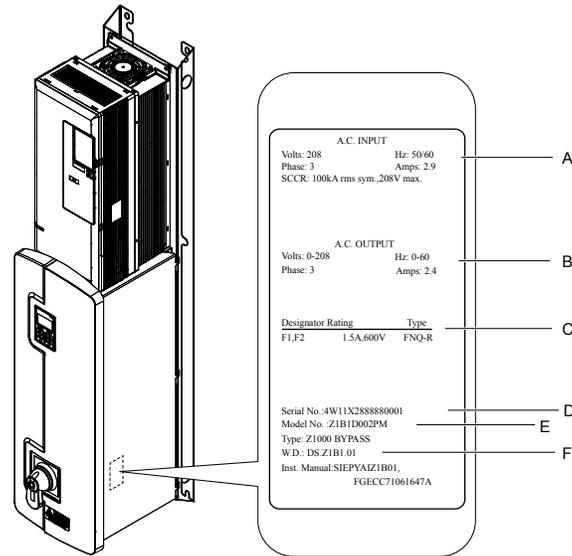
**Table 1 Applicable Models**

Drive Series	Bypass Model Z1B1	Software Version <1>
Z1000	D002 to D273	VST800298 and later
	B001 to B304	

<1> See “PRG” on the drive nameplate for the software version number.

◆ Bypass Nameplate

The nameplate is located on the inside right wall of the Z1000 bypass enclosure.

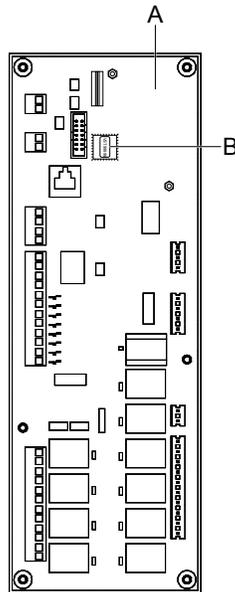


- A – Input specifications
- B – Output specifications
- C – Replacement fuse specifications
- D – Serial number
- E – Bypass model number
- F – Schematic document number

Figure 1 Bypass Nameplate Information Example

◆ Bypass Software Version Number

The software version label for the bypass is located on the bypass PCB. The bypass PCB is located on the inside left wall of the Z1000 Bypass enclosure.



- A – Bypass PCB
- B – Bypass Software Version Label

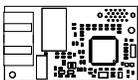
Figure 2 Bypass Software Version Label

## 3 Receiving

Perform the following tasks upon receipt of the option:

- Inspect the option for damage. Contact the shipper immediately if the option appears damaged upon receipt.
- Verify receipt of the correct model by checking the model number printed on the name plate of the option package. *Refer to Option Components on page 10.*
- Contact your supplier if you have received the wrong model or the option does not function properly.

### ◆ Option Package Contents

Description	Option	Ground Wire	Screws (M3)	LED Label	Installation Manual
-		 </>	 </>	 </>	
Quantity	1	1	3	1	1

<1> The ground wire, ground wire screw (1) and LED labels are not required for option card installation to bypass units.

### ◆ Tools Required for Installation

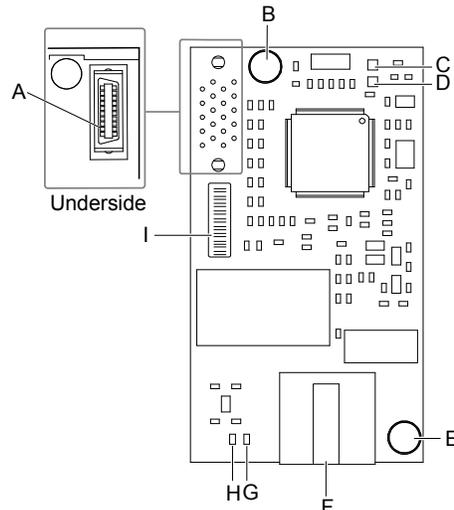
A Phillips screwdriver (M3 metric or #1, #2 U.S. standard) is required to install the option and remove bypass front covers. Screw sizes vary by drive capacity. Select a screwdriver appropriate for the bypass capacity.

Use a short-shaft, magnetic screwdriver when installing the option card into the narrow enclosure models Z1B1D002 to Z1B1D074 and Z1B1B001 to Z1B1B077.

**Note:** Tools required to prepare the option cables for wiring are not listed in this manual.

## 4 Option Components

### ◆ SI-EM3 Single Port Modbus TCP/IP Option



- |   |   |
|---|---|
| <b>A – Option Connector (CN5)</b>               | <b>F – Communication connector CN1 (RJ45)</b> |
| <b>B – Installation hole</b>                    | <b>G – LED (LINK/ACT) &lt;2&gt;</b>           |
| <b>C – LED (MS) &lt;2&gt;</b>                   | <b>H – LED (10/100) &lt;2&gt;</b>             |
| <b>D – LED (NS) &lt;2&gt;</b>                   | <b>I – Option Nameplate</b>                   |
| <b>E – Grounded installation hole &lt;1&gt;</b> |   |

**Figure 3 Option Components (Single Port)**

- <1> The ground wire packaged loose in the option shipping package is not required for installation to Z1000 bypass units.
- <2> The LEDs are not visible when used in a bypass configuration. Use parameters U6-80 through U6-99 to monitor operation status. [Refer to Option Monitors on page 24.](#)

## ◆ SI-EM3D Dual-Port Modbus TCP/IP Option

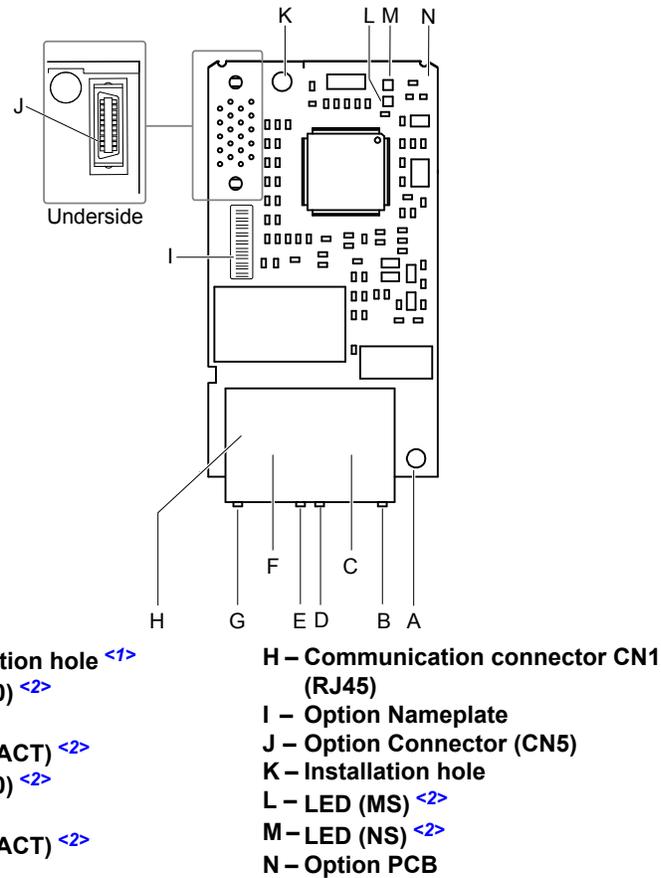


Figure 4 Option Components (Dual-Port)

- <1> The ground wire packaged loose in the option shipping package is not required for installation to Z1000 bypass units.
- <2> The LEDs are not visible when used in a bypass configuration. Use parameters U6-80 through U6-99 to monitor operation status. [Refer to Option Monitors on page 24.](#)

# 5 Installation Procedure

This section explains how to properly mount and install the communication option card to the Z1000 Bypass.

### ◆ Section Safety

#### DANGER

##### Electrical Shock Hazard

**Do not connect or disconnect wiring while the power is on.**

Failure to comply will result in death or serious injury.

Disconnect all power to the bypass and wait at least the amount of time specified on the bypass front cover safety label. After all indicators are off, measure the DC bus voltage to confirm safe level, and check for unsafe voltages before servicing. The internal capacitor remains charged after the power supply is turned off.

#### WARNING

##### Electrical Shock Hazard

**Do not remove the front covers of the bypass while the power is on.**

Failure to comply could result in death or serious injury.

The diagrams in this section may include options and bypass units without covers or safety shields to show details. Be sure to reinstall covers or shields before operating any devices. The option should be used according to the instructions described in this manual.

**Do not allow unqualified personnel to use equipment.**

Failure to comply could result in death or serious injury.

Maintenance, inspection, and replacement of parts must be performed only by authorized personnel familiar with installation, adjustment, and maintenance of this product.

**Do not touch circuit boards while the power is on.**

Failure to comply could result in death or serious injury.

**Do not use damaged wires, stress the wiring, or damage the wire insulation.**

Failure to comply could result in death or serious injury.

**Do not use damaged wires, place excessive stress on wiring, or damage the wire insulation.**

Failure to comply could result in death or serious injury.

##### Fire Hazard

**Tighten all terminal screws to the specified tightening torque.**

Loose electrical connections could result in death or serious injury by fire due to overheating of electrical connections.

#### NOTICE

**Observe proper electrostatic discharge procedures (ESD) when handling the bypass and circuit boards.**

Failure to comply may result in ESD damage to the bypass circuitry.

**Never shut the power off while the bypass is outputting voltage.**

Failure to comply may cause the application to operate incorrectly or damage the bypass.

**Do not operate damaged equipment.**

Failure to comply may cause further damage to the equipment.

Do not connect or operate any equipment with visible damage or missing parts.

## NOTICE

**Do not use unshielded cable for control wiring.**

Failure to comply may cause electrical interference resulting in poor system performance.

Use shielded twisted-pair wires and ground the shield to the ground terminal of the bypass.

**Properly connect all pins and connectors.**

Failure to comply may prevent proper operation and possibly damage equipment.

**Check wiring to ensure that all connections are correct after installing the option and connecting any other devices.**

Failure to comply could result in damage to the option.

◆ **Prior to Installing the Option**

**NOTICE:** *Install communications options on the bypass control PCB. Do not install communications options on the Z1000 drive PCB. Improperly connected communications options will cause erroneous operation.*

■ **Verify Bypass Operation**

Verify that the bypass functions normally without the option installed. Refer to the Z1000 Bypass Technical Manual (SIEPYAIZ1B01) for information on wiring and connecting the bypass unit.

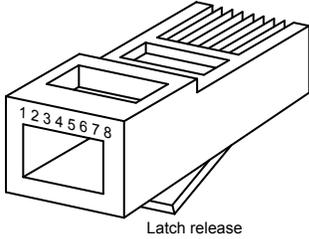
■ **Prepare Network Cables**

Determine the length of cable required to connect from the option to a network device and attach all connectors to network cables before installing the option. Refer to [Table 3 Communication Cable Specifications](#) for details.

The communication connection point on the option is designated CN1. CN1 may have 2 ports depending on the option type.

CN1 is the connection point for a customer-supplied network communication cable with a modular RJ45 connector.

**Table 2 8-Way Modular Connector (Customer-Supplied)**

Male 8-Way Modular Connector	Pin	Description
	1 (Pair 2)	Transmit data (TXD) +
	2 (Pair 2)	Transmit data (TXD) -
	3 (Pair 3)	Receive data (RXD) +
	4 (Pair 1)	Not used <1>
	5 (Pair 1)	Not used <1>
	6 (Pair 3)	Receive data (RXD) -
	7 (Pair 4)	Not used <1>
	8 (Pair 4)	Not used <1>

<1> Not used for 10 Mbps and 100 Mbps networks.

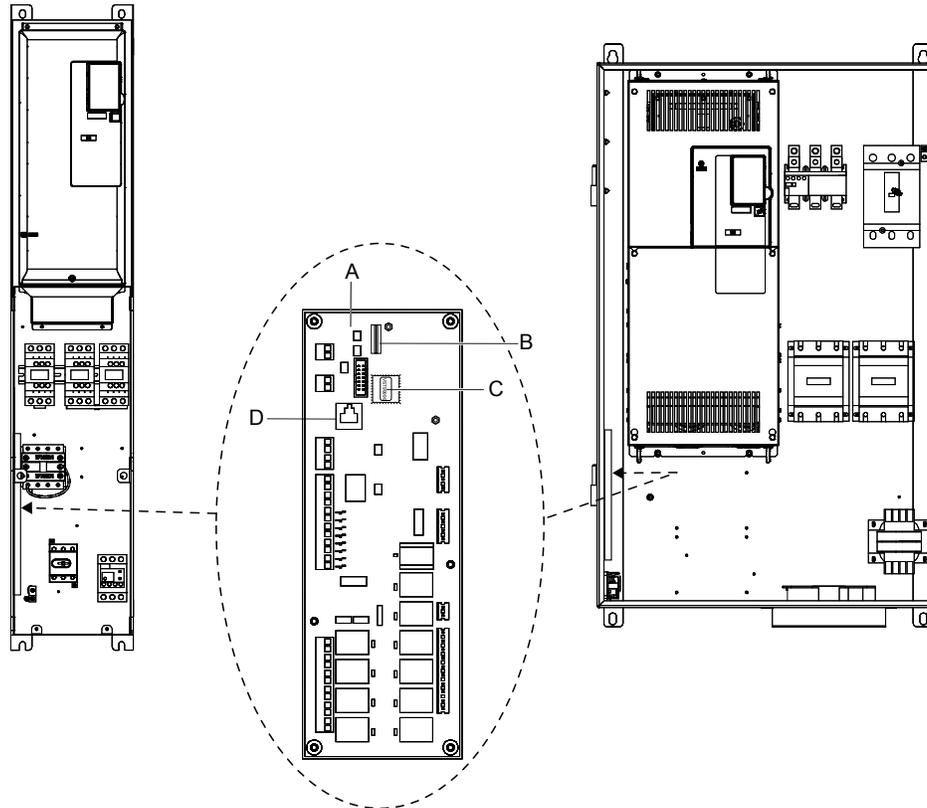
**Table 3 Communication Cable Specifications**

Communication Protocol	Description
Modbus TCP/IP	Only use cable recommended for Modbus TCP/IP. Using a cable not specifically recommended may cause the option or bypass to malfunction. Refer to the Modbus-IDA website for more information on network cabling (modbus.org).

### ■ Bypass Unit Components

*Figure 5* shows a front view of the bypass control board with the option connection terminals and related components for reference.

**Note:** Bypass PCB location varies by model.



**A – Bypass PCB**

**B – Option card connector (CN5)**

**C – Bypass software version number**

**D – Communications port CN2**

**Figure 5 Front View of Bypass PCB**

## ◆ Remove the Bypass Front Cover

**WARNING!** *Electrical Shock Hazard. Do not open the front cover of the bypass while the power is on. Failure to comply may result in death or serious injury. Make sure that the disconnect handle is in the “OFF” position before attempting to open the front cover.*

### ■ Models Z1B1D002 to D074 and Z1B1B001 to B077

1. Turn the disconnect handle to the “OFF” position and wait the appropriate amount of time for voltage to dissipate. Verify using a multimeter and follow all appropriate lockout/tagout procedures.

**NOTICE:** *Damage to Equipment. Observe proper electrostatic discharge procedures (ESD) when handling the option, bypass, and circuit boards. Failure to comply may result in ESD damage to circuitry.*

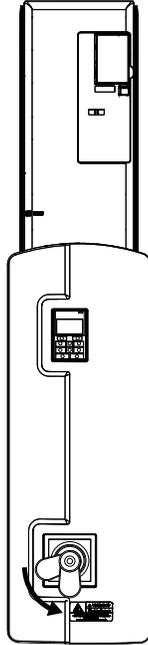


Figure 6 Disconnect Power

## 5 Installation Procedure

2. Remove the two front cover screws using a #2 Phillips screwdriver.

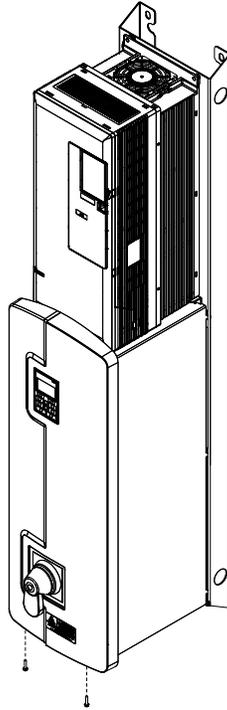


Figure 7 Remove Front Cover Screws

3. Lift the cover up and gently pull forward to remove the front cover.

**NOTICE:** Do not damage the Cat5e cable that connects the keypad to the bypass control PCB when removing the front cover. Failure to comply may cause erroneous operation.

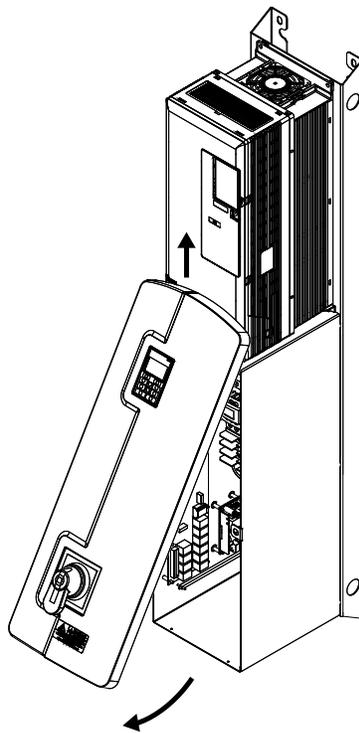
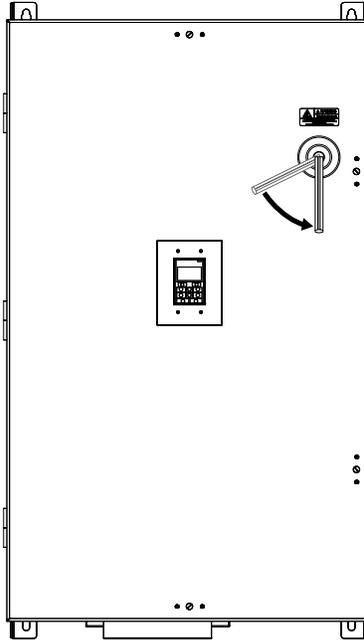


Figure 8 Lift and Remove Front Cover

**Models Z1B1D088 to D273 and Z1B1B096 to B302**

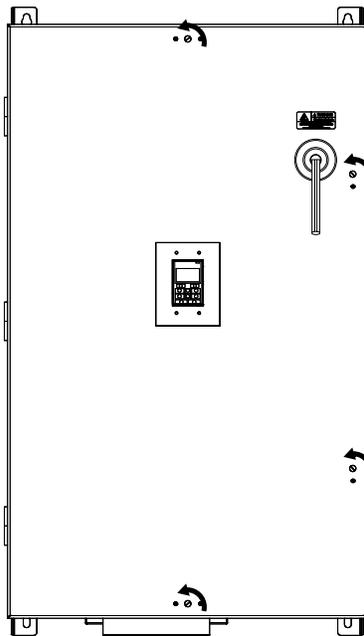
1. Turn the disconnect handle to the “OFF” position and wait the appropriate amount of time for voltage to dissipate. Verify using a multimeter and follow all appropriate lockout/tagout procedures.

**NOTICE:** *Damage to Equipment. Observe proper electrostatic discharge procedures (ESD) when handling the option, bypass, and circuit boards. Failure to comply may result in ESD damage to circuitry.*



**Figure 9 Disconnect Power**

2. Turn the flat head screw fasteners on the front cover 1/2 turn counter-clockwise.



**Figure 10 Turn Front Cover Fasteners**

## 5 Installation Procedure

---

3. Carefully swing open the bypass front cover door.

**NOTICE:** Do not damage the Cat5e cable that connects the keypad to the bypass control PCB when removing the front cover. Failure to comply may cause erroneous operation.

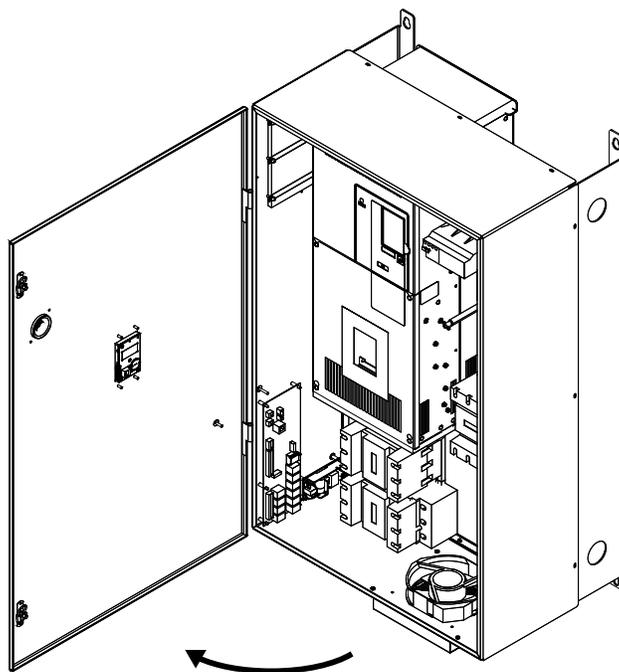


Figure 11 Swing Open Door

## ◆ Install the Option

**DANGER!** *Electrical Shock Hazard. Do not connect or disconnect wiring while the power is on. Failure to comply could result in death or serious injury. Before installing the option, disconnect all power to the bypass and wait at least the amount of time specified on the bypass front cover safety label. After all indicators are off, measure the DC bus voltage to confirm safe level, and check for unsafe voltages before servicing. The internal capacitor remains charged after the power supply is turned off.*

1. Fasten the option card to the metal standoffs on the bypass PCB using two screws included in the option kit. Use a short-shaft, magnetic screwdriver for narrow enclosure models Z1B1D002 to Z1B1D074 and Z1B1B001 to Z1B1B077. Tighten each screw to 0.5 to 0.6 N•m (4.4 to 5.3 in lbs).

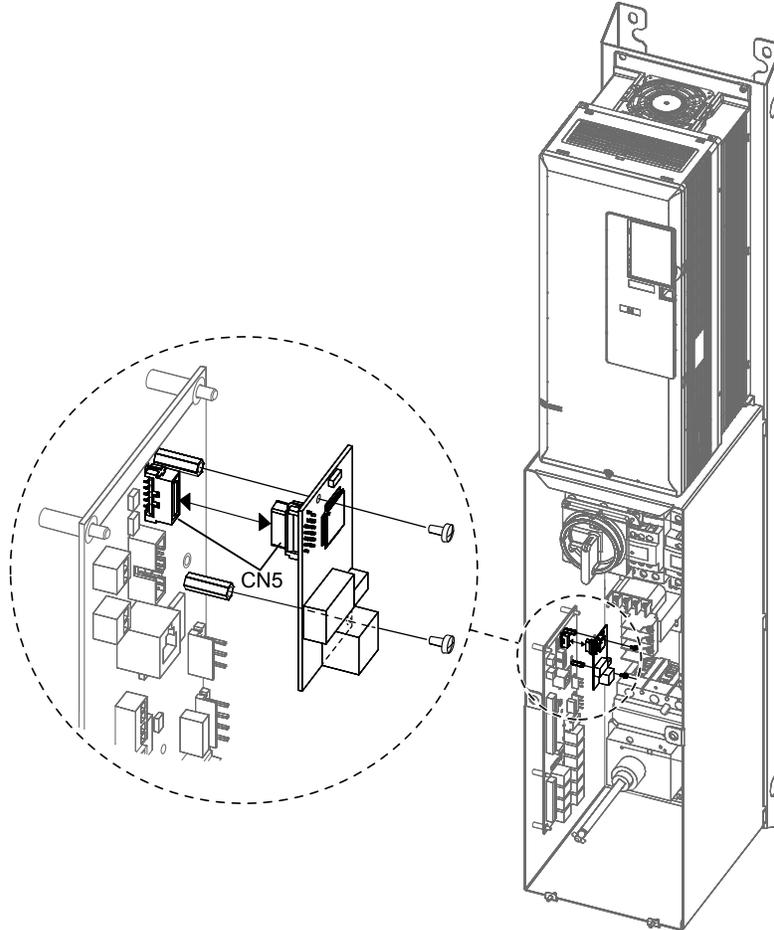


Figure 12 Insert Option into Bypass PCB CN5 Connector Port - Model Z1B1D002

## 5 Installation Procedure

- For single-port connections using SI-EM3, connect the customer-supplied Cat5e network cable to the option by firmly inserting the RJ45 8-pin connector into the CN1 modular connector port on the option board. For dual-port connections using SI-EM3D, skip to Step 3.

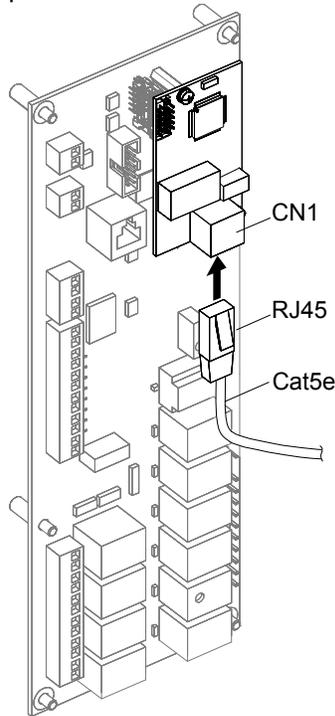


Figure 13 Connect Network Cable to Option

**NOTICE:** Separate control circuit wiring from main circuit wiring and other high-power lines. Improper wiring practices could result in bypass malfunction due to electrical interference.

### IGMP Snooping

Switches implementing IGMP Snooping are strongly recommended to limit devices to only receive the multicast packets in which they are interested.

### Option Connection Diagram

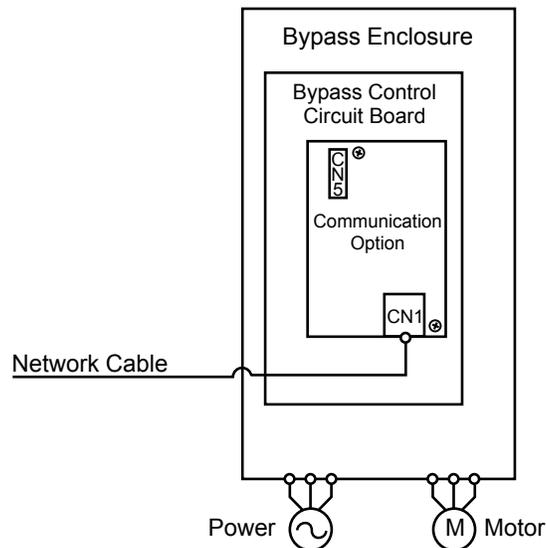


Figure 14 Option Connection Diagram (Single Port CN1 Connection)

- For dual-port connections using SI-EM3D, connect the customer-supplied Cat5e network cables to the option by firmly inserting the RJ45 8-pin connectors into the CN1 modular connector ports on the option board.

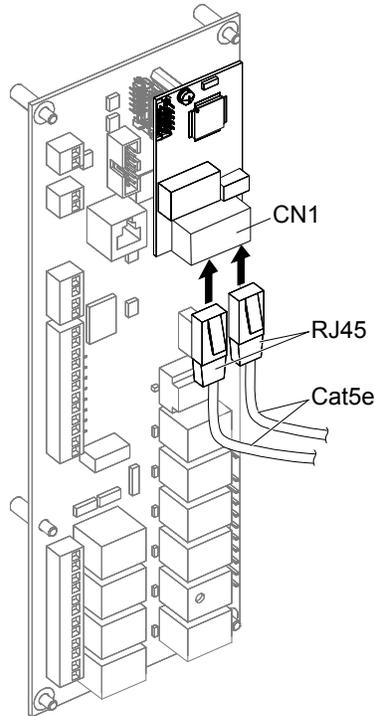


Figure 15 Connect Network Cables to Option (Dual-Port CN1 Connection)

**NOTICE:** Separate control circuit wiring from main circuit wiring and other high-power lines. Improper wiring practices could result in bypass malfunction due to electrical interference.

### IGMP Snooping

Switches implementing IGMP Snooping are strongly recommended to limit devices to only receive the multicast packets in which they are interested.

### Option Connection Diagram

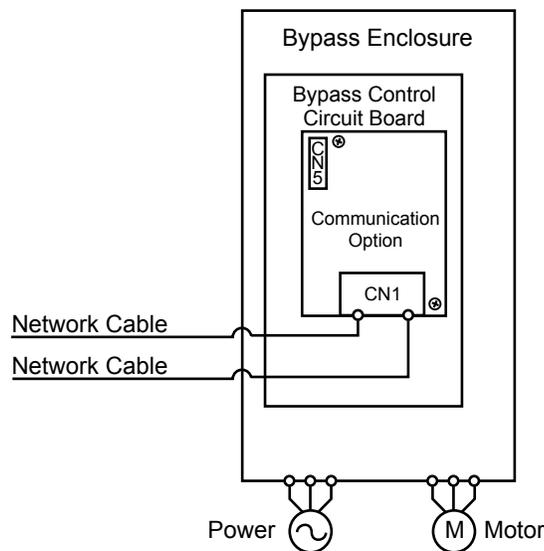


Figure 16 Option Connection Diagram (Dual-Port CN1 Connection)

## 5 Installation Procedure

### Dual-Port CN1 Connection

The dual CN1 network ports on the option board act as a switch to allow for flexibility in cabling topology. For example, a traditional star network topology may be employed by using a single port on the option board. Alternatively, a daisy-chained approach may be employed by using both CN1 ports. The daisy-chained approach reduces the requirements of central switch ports. A ring topology is also possible.

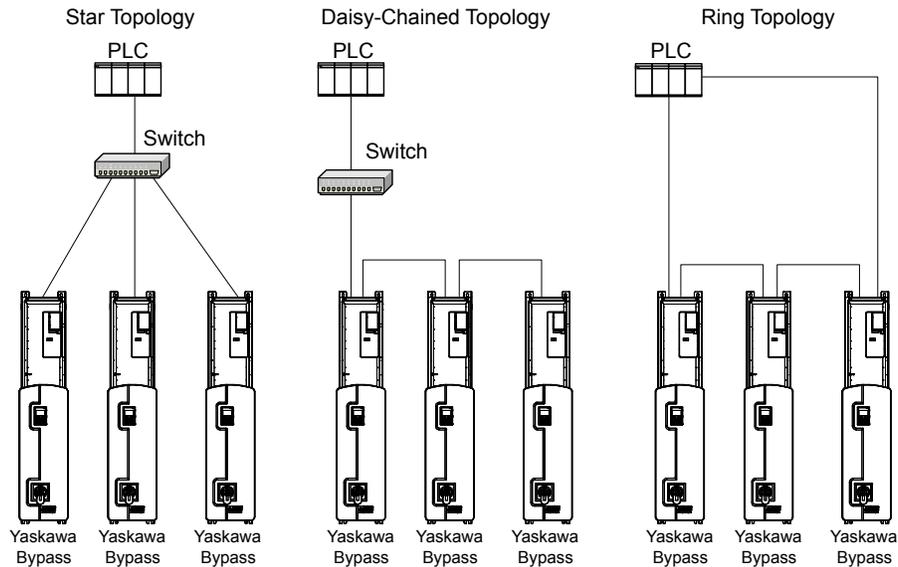


Figure 17 Topology Options

4. Replace and secure the bypass front cover.
5. Make sure no cables are pinched between the front covers and the bypass when replacing the covers.
6. Set bypass parameters according to Section [6 Related Bypass Parameters](#) on page [23](#).

### ◆ Option LED Display

The LEDs are not visible when used in a bypass configuration. Use parameters U6-80 through U6-99 to monitor operation status. [Refer to Option Monitors on page 24](#) for details.

## 6 Related Bypass Parameters

The following parameters are used to set up the bypass for operation with the option. Parameter setting instructions can be found in the drive manual.

Confirm proper setting of the parameters in [Table 4](#) before starting network communications. After changing parameter settings, cycle power to the bypass for the new settings to take effect.

**Table 4 Related Parameters**

No. (Addr. Hex)	Name	Description	Values
F6-02 (03A3)	External Fault from Comm. Option Detection Selection	0: Always detected 1: Detection during run only	Default: 0 Range: 0, 1
F6-03 (03A4)	External Fault from Comm. Option Operation Selection	0: Ramp to stop. Decelerate to stop using the deceleration time in C1-02. 1: Coast to stop 2: Fast Stop. Decelerate to stop using the deceleration time in C1-09. 3: Alarm only <I>	Default: 1 Range: 0 to 3
Z1-07 (85CC)	Speed Reference Select <I>	0: Operator 1: Analog Input 2: Bypass Serial 3: Option Board (CN5)	Default: 1 Range: 0 to 3
Z1-08 (85CD)	Run Command Select <I>	0: Operator 1: Bypass Controller Digital Input 2: Bypass Serial 3: Option Board (CN5)	Default: 1 Range: 0 to 3
Z1-38 (85EB)	HOA Source Select	0: Operator 1: Digital Inputs 2: Ser Comm & Opt	Default: 0 Range: 0 to 2
Z1-39 (85EC)	Drive/Bypass Source Select	0: Operator 1: Digital Inputs 2: Serial Communications	Default: 0 Range: 0 to 2
Z4-01 (8700)	IP Address 1	Sets the most significant octet of network static IP address.	Default: 192 Range: 0 to 255
Z4-02 (8701)	IP Address 2	Sets the second most significant octet of network static IP address.	Default: 168 Range: 0 to 255
Z4-03 (8702)	IP Address 3	Sets the third most significant octet of network static IP address.	Default: 1 Range: 0 to 255
Z4-04 (8703)	IP Address 4	Sets the fourth most significant octet of network static IP address.	Default: 20 Range: 0 to 255
Z4-05 (8704)	Subnet Mask 1	Sets the most significant octet of network static subnet mask.	Default: 255 Range: 0 to 255
Z4-06 (8705)	Subnet Mask 2	Sets the second most significant octet of network static subnet mask.	Default: 255 Range: 0 to 255
Z4-07 (8706)	Subnet Mask 3	Sets the third most significant octet of network static subnet mask.	Default: 255 Range: 0 to 255
Z4-08 (8707)	Subnet Mask 4	Sets the fourth most significant octet of network static subnet mask.	Default: 0 Range: 0 to 255
Z4-09 (8708)	Gateway IP Address 1	Sets the most significant octet of network gateway address.	Default: 192 Range: 0 to 255
Z4-10 (8709)	Gateway IP Address 2	Sets the second most significant octet of network gateway address.	Default: 168 Range: 0 to 255
Z4-11 (870A)	Gateway IP Address 3	Sets the third most significant octet of network gateway address.	Default: 1 Range: 0 to 255
Z4-13 (870C)	IP Address Mode Select	0: User-Defined (Static IP) 1: BOOTP Setting 2: DHCP	Default: 2 Range: 0 to 2
Z4-12 (870B)	Gateway IP Address 4	Sets the fourth most significant octet of network gateway address.	Default: 1 Range: 0 to 255
Z4-14 (870D)	Duplex Select	0: Forced Half Duplex 1: Auto Negotiate Duplex Mode and Communication Speed 2: Forced Full Duplex	Default: 1 Range: 0 to 2
Z4-15 (870E)	Speed Mode Setting	10: 10 Mbps 100: 100 Mbps	Default: 10 Range: 10, 100

## 6 Related Bypass Parameters

No. (Addr. Hex)	Name	Description	Values
Z4-16 (870F)	Communication Loss Timeout	Control connection timeout value for detection of communication loss.	Default: 0 s Min.: 0 Max.: 300

- <1> When set to 3, the drive will continue to operate when a fault is detected. Take safety measures, such as installing an emergency stop switch.
- <2> Available in bypass controller software versions VST800400 and later.

**Table 5 Option Monitors**

No.	Name	Description	Value Range
U6-80 to U6-83	Online IP Address	IP Address currently available; U6-80 is the most significant octet	0 to 255
U6-84 to U6-87	Online Subnet	Subnet currently available; U6-84 is the most significant octet	0 to 255
U6-88 to U6-91	Online Gateway	Gateway currently available; U6-88 is the most significant octet	0 to 255
U6-92	Online Speed	Link Speed	10: 10 Mbps 100: 100 Mbps
U6-93	Online Duplex	Duplex Setting	0: Half, 1: Full
U6-94	Port 2 Speed	Port 2 Link Speed	10: 10 Mbps 100: 100 Mbps
U6-95	Port 2 Duplex	Port 2 Duplex Setting	0: Half, 1: Full
U6-97	Option Software Version	Option Software Version	–
U6-98	First Fault	First Option Fault	–
U6-99	Current Fault	Current Option Fault	–

## 7 Common Tasks

This section describes common tasks when using an SI-EM3 or SI-EM3D option kit on a Z1000 bypass.

### ◆ Accessing Drive and Bypass Monitors and Parameters

A list of register addresses can be found in the Z1000 Bypass Technical Manual, SIEPYAIZ1B01. Details of how to access these through Modbus TCP/IP can be found in Section [8 Modbus TCP/IP Messaging](#) on page 26.

### ◆ Monitor Statuses

Monitor various statuses using Modbus TCP/IP Read Commands (FC 03 or FC 23)

**Table 6 Monitor Various Statuses**

Status	Description	Drive Mode	Bypass Mode
Run	Read this status explicitly through drive register 0x4B.	x	-
	Read this status using address 8785H (bit 1).	-	x
Fault	Read this status using address 8785H (bit 2).	x	x
Output Frequency	Read this status using register 0041H (scaling = 0.1A).	x	-
Output Current	Read this status using address 0026H (scaling = 0.1A).	x	x <1>
	Read this status using address 8780H (scaling = 0.1A).	-	x <2>
Other Drive-specific Statuses	Refer to Z1000 Bypass Technical Manual (SIEPYAIZ1B01 ) for a list of monitors and their register addresses. Drive-specific addresses are valid only when the drive is energized. The drive may not be energized when in Bypass mode or when the service disconnect switch is OFF.	x	-
Other Bypass-specific Statuses	All other bypass-specific statuses and monitors (8440H to 8442H and UB-01 to UB-96) can be read. Refer to Z1000 Bypass Technical Manual (SIEPYAIZ1B01) for a list of monitors and their register addresses.	-	x

<1> Available in bypass controller software versions VST800400 and later.

<2> Available in bypass controller software versions VST800299 and earlier.

**Table 7 Fault Status Bit**

Software Version	Pre-defined IO Assembly Bits	Bypass Address 8785 (bit 2)
VST800299 and earlier	Drive faults only	Drive or bypass faults
VST800400	Drive or bypass faults	Drive or bypass faults

### ◆ Issuing Bypass Commands

Write bypass commands using a Modbus TCP/IP Write Commands (FC6, FC16 or FC23).

**Table 8 Issue Various Commands**

Command	Description
Frequency Reference	Set parameter Z1-07 to 3. Frequency reference is written using address 0002H (scaling determined by o1-03).
Run/Stop	Set parameter Z1-08 to 3. Run/Stop command is written using address 0001H. <b>Note:</b> Bits 0 and 1 of BypCmd (8400H) are not valid for option cards.
Fault Reset	Fault Reset is written using address 8400H (bit D).
Other Bypass Commands	Other bypass commands are written to addresses 8400H to 8407H. Refer to Z1000 Bypass Technical Manual (SIEPYAIZ1B01 ).

## 8 Modbus TCP/IP Messaging

### ◆ Modbus TCP/IP Overview

The Modbus TCP/IP protocol is essentially the Modbus protocol over an Modbus TCP/IP network. A master controller (typically a PLC) sends commands to slave devices, which then perform the specified functions and send a response to the master. The drive using the option has slave functionality.

### ■ Supported Modbus TCP/IP Commands

Table 9 Supported Modbus TCP/IP Commands

Function Code	Function Name
03H	Read Multiple Registers
06H	Write Single Register
10H	Write Multiple Registers
17H	Read/Write Multiple Registers

### ■ Drive Modbus TCP/IP Option Registers

All of the command registers, monitor registers, and parameters documented in the drive Technical Manual are accessible via the option.

### ■ High Speed Access Drive Modbus TCP/IP Option Registers

Many of the registers required for control have been specially mapped to provide higher speed access to increase network performance. Use these registers for the best response times.

All drive command registers have been mapped to this high speed access area (Modbus TCP/IP registers 01H to 01FH) as shown in [Table 10](#). In addition, the monitors shown in [Table 11](#) are mapped for high speed access.

It is possible to both read and write command data.

**Note:** Bits that are not used should be set to 0. Refrain from writing to reserved registers.

Table 10 Command Register Data

Register No.	Contents	
0000H	Reserved	
0001H	Operation Commands and Multi-function Inputs	
	bit 0	H5-12 = 0: Forward Run Command (0 = Stop, 1 = Forward Run) H5-12 = 1: Run Command (0 = Stop, 1 = Run)
	bit 1	H5-12 = 0: Reverse Run Command (0 = Stop, 1 = Reverse Run) H5-12 = 1: Forward/Reverse (0 = Forward, 1 = Reverse)
	bit 2	External Fault (EF0)
	bit 3	Fault Reset
	bit 4	Multi-Function Input 1 Function is ComRef when H1-01 = 40 (Forward/Stop). <b>Note:</b> When the bit at ComCtrl is turned on, commands from MEMOBUS/Modbus communications take control of the operation. However, when a communications option card is connected, that option card is given priority.
	bit 5	Multi-Function Input 2 Function is ComCtrl when H1-02 = 41 (Reverse/Stop).
	bit 6	Multi-Function Input 3
	bit 7	Multi-Function Input 4
	bit 8	Multi-Function Input 5
	bit 9	Multi-Function Input 6
	bit A	Multi-Function Input 7
	bit B	Multi-Function Input 8
	bit C to F	Reserved
0002H	Frequency Reference	Units are determined by parameter o1-03.

Register No.	Contents	
0003H	Output voltage gain Unit: 0.1% Range: 20 (2.0%) to 2000 (200.0%), Default when power on: 1000 (100.0%)	
0004H	Torque Reference/Torque Limit, 0.1% units, signed (Usable only if Torque Control is enabled)	
0005H	Torque Compensation, 0.1% units, signed (Usable only if Torque Control is enabled)	
0006H	PID Target, 0.01% units, signed	
0007H	Analog Output Terminal FM Setting (10 V / 4000 H)	
0008H	Analog Output Terminal AM Setting (10 V / 4000 H)	
0009H	Settings for Multi-Function Digital Outputs	
	bit 0	Multi-Function Contact Output 1 (terminal M1-M2)
	bit 1	Multi-Function Contact Output 2 (terminal M3-M4)
	bit 2	Multi-Function Contact Output 3 (terminal M5-M6)
	bit 3 to 5	Reserved
	bit 6	Enables the function in bit 7
	bit 7	Fault Contact Output (terminal MA/MB-MC)
bit 8 to F	Reserved	
000AH	Pulse Output Terminal MP Setting, 1 Hz units, Setting Range: 0 to 32000	
000BH to 000EH	Reserved	
000FH	Control Selection Setting	
	bit 0	Reserved
	bit 1	PID Setpoint Input
	bit 2	Torque reference / torque limit input (enables the setting from MEMOBUS/Modbus)
	bit 3	Torque compensation input (enables the setting from MEMOBUS/Modbus)
	bit 4 to B	Reserved
	bit C	Enable Terminal S5 Input for Broadcast Data
	bit D	Enable Terminal S6 Input for Broadcast Data
	bit E	Enable Terminal S7 Input for Broadcast Data
bit F	Enable Terminal S8 Input for Broadcast Data	
0010H to 001AH	Reserved	
001BH	Analog Monitor Option AO-A3 Analog Output 1 (10 V/4000 H)	
001CH	Analog Monitor Option AO-A3 Analog Output 2 (10 V/4000 H)	
001DH	Digital Output Option DO-A3 Output (Binary)	
001EH to 001FH	Reserved	

Table 11 Drive Registers

Address (hex)	Drive Register (hex)	Description	Bit	Description
2000	4B	Status Word (U1-12)	0	During Run
			1	During Zero Speed
			2	During Reverse Direction
			3	During Fault Reset Signal Input
			4	During Speed Agree
			5	Drive Ready
			6	Alarm
			7	Fault
			8	During Operation Error (oPE□□)
			9	During Momentary Power Loss
			A	Motor 2 Selected
			B	Reserved
			C	Reserved
			D	Reserved
			E	ComRef Status, NetRef Status
F	ComCtrl Status, NetCtrl Status			
2001	44	Motor Speed Monitor (U1-05)		
2002	48	Torque Reference Monitor (U1-09)		
2003	F0	PG Count Channel 1		
2004	40	Frequency Reference Monitor (U1-01)		
2005	41	Output Frequency Monitor (U1-02)		
2006	26	Output Current (U1-03) 0.1 A		
2007	4F	Terminal A2 Input Level Monitor (U1-14)		
2008	46	DC Bus Voltage Monitor (U1-07)		
2009	C0	Error Signal 1	0	Reserved
			1	Undervoltage (Uv1)
			2	Control Power Supply Undervoltage (Uv2)
			3	Soft Charge Circuit Fault (Uv3)
			4	Reserved
			5	Ground Fault (GF)
			6	Overcurrent (oC)
			7	Overvoltage (ov)
			8	Heatsink Overheat (oH)
			9	Heatsink Overheat (oH1)
			A	Motor Overload (oL1)
			B	Drive Overload (oL2)
			C	Overtorque Detection 1 (oL3)
			D	Overtorque Detection 2 (oL4)
			E	Dynamic Braking Transistor Fault (rr)
F	Braking Resister Overheat (rH)			

Address (hex)	Drive Register (hex)	Description	Bit	Description
200A	C1	Error Signal 2	0	External Fault at input terminal S3 (EF3)
			1	External Fault at input terminal S4 (EF4)
			2	External Fault at input terminal S5 (EF5)
			3	External Fault at input terminal S6 (EF6)
			4	External Fault at input terminal S7 (EF7)
			5	External Fault at input terminal S8 (EF8)
			6	Cooling fan Error (FAn)
			5	Reserved
			6	Reserved
			7	Overspeed (os)
			8	Excessive Speed Deviation (dEv)
			9	PG Disconnected (PGo)
			A	Input Phase Loss (PF)
			B	Output Phase Loss (LF)
			C	Motor Overheat (PTC input) (oH3)
			D	Digital Operator Connection Fault (oPr)
			E	EEPROM Write Error (Err)
F	Motor Overheat Fault (PTC input) (oH4)			
200B	C2	Error Signal 3	0	MEMOBUS/Modbus Communication Error (CE)
			1	Option Communication Error (bUS)
			2	Reserved
			3	Reserved
			4	Control Fault (CF)
			5	Zero Servo Fault (SvE)
			5	Reserved
			6	Option External Fault (EF0)
			7	PID Feedback Loss (FbL)
			8	Undertorque Detection 1 (UL3)
			9	UL4 Undertorque Detection 2 (UL4)
			A	High Slip Braking Overload (oL7)
			B	Reserved
			C	Reserved
			D	Reserved
E	Reserved			
F	Hardware Fault (includes oFo)			
200C	4E	Terminal A1 Input Level Monitor (U1-13)		
200D	49	Digital Input Terminal Status (U1-10)		
200E	50	Terminal A3 Input Level Monitor (U1-15)		
200F	F1	PG Count Channel 2		
2010	4D	Drive Software Number (Flash) (U1-25)		

### ◆ Enter Command Types

The drive supports two types of Enter commands as shown in [Table 12](#). An Enter command is enabled by writing 0 to register number 0900H or 0910H. These registers can be written to only. An error will occur if the user attempts to read from these registers.

**Table 12 Enter Command Types**

Register No.	Description
0900H	Writes data into the EEPROM (non-volatile memory) of the drive and enables the data in RAM at the same time. Parameter changes remain even if the power supply is cycled.
0910H	Writes data in the RAM only. Parameter changes are lost when the drive is shut off.

- Note:**
1. Because the EEPROM can be written to a maximum of 100,000 times, refrain from writing to the EEPROM too often. The Enter command registers are write-only. Consequently, if these registers are read, then the register address will be invalid (Error code: 02H). An Enter command is not required if reference or broadcast data are sent to the drive.
  2. Parameter data cannot be written to EEPROM during undervoltage, even using 0900H.
  3. If undervoltage occurs when a making several parameter changes issued with a single ENTER command, the writing process may be aborted before all of the new changes have been written. Because all of the data has not yet been written, the EEPROM data error “CPF06” will be displayed the next time power to the drive is cycled. To prevent this problem, wait approximately 5 seconds after issuing the ENTER command before shutting off drive power.

### ◆ Enter Command Settings when Upgrading the Drive

When replacing earlier Yaskawa drive models with a 1000-series drive and keeping the MEMOBUS/Modbus communications settings, parameter H5-11 needs to be set in accordance with how the Enter command functions in the older drive. H5-11 determines if an Enter command is needed to activate parameter changes in the drive.

- Set parameter H5-11 to 0 when upgrading from a G7 or F7 series drive to 1000-series drive.
- Set parameter H5-11 to 1 when upgrading from a V7 series drive to 1000-series drive.

#### ■ H5-11 and the Enter Command

H5-11 Settings	H5-11 = 0	H5-11 = 1
Drive being replaced	G7, F7	V7
How parameter settings are enabled	When the Enter command is received from the master.	As soon as the value is changed.
Upper/lower limit check	Upper/lower limit check takes the settings of related parameters into account.	The upper/lower limit of the changed parameter is checked only.
Default value of related parameters	Not affected. The settings of related parameters remain unchanged. They must be changed manually if needed.	The default settings of related parameters are changed automatically.
Error handling when setting multiple parameters	Data is accepted even if one setting is invalid. The invalid setting will be discarded. No error message occurs.	Error occurs if only one setting is invalid. All data sent are discarded.

### ◆ Message Content

The data section of the Modbus packet contains the Modbus message. In this data section, the master sends commands to the slave, and the slave responds. The message format is configured for both sending and receiving as shown below, and the length of data packets depends on the command (function) content.

SLAVE ADDRESS
FUNCTION CODE
DATA
ERROR CHECK

#### ■ Unit Identifier

This field is used for intra-system routing purposes. It is typically used to communicate to a Modbus+ or a Modbus serial line slave through a gateway between an Modbus TCP/IP network and a Modbus serial line. This field is set by the Modbus master in the command and must be returned with the same value in the response by the slave. This is sometimes referred to as the Unit ID. A drive using the option has no gateway functionality.

#### ■ Function Code

When sent by the master, this field identifies the command to be undertaken by the slave. It also identifies the format for the DATA section of the message. The slave normally echoes this command back to the master in its response message. When the most significant bit of this field is set in the response message, it signals an error condition has occurred.

## ■ Data

This field contains multiple bytes of varying length based upon the Function Code for commands and based upon the results of the command in the response. When sent by the master, this field contains details of the command that the slave will require to carry out the function. When sent by the slave, this field contains details of the response and sometimes error information.

## ◆ Modbus TCP/IP Option Function Details

### ■ Read Multiple Registers 03 (03 H)

This function code is used to read the contents of a contiguous block of registers. The command specifies the starting register and the number of registers. The normal response packs two bytes per register. For each register in the response, the first byte contains the most significant bits and the second byte contains the least significant bits.

**Table 13 Read Multiple Registers Command**

Description	Byte	Data (Hex)
Slave Address	1	00 to FF
Function Code	1	03
Starting Register	2	0000 to FFFF
Quantity of Registers	2	N <I>

<I> N = Quantity of Registers (range is 1 - 16)

**Table 14 Read Multiple Registers Response**

Description	Byte	Data (Hex)
Slave Address	1	00 to FF
Function Code	1	03
Number of Data Bytes	1	2 x N <I>
Register Values	N <I> x 2	Values contained in slave registers.

<I> N = Quantity of Registers

**Table 15 Read Multiple Registers Error Response**

Description	Byte	Data (Hex)
Slave Address	1	00 to FF
Error Code	1	83
Exception Code	1	<i>Refer to Modbus TCP/IP Exception Codes on page 36 for details.</i>

### Examples of Fault Response, Read Response, and Read Multiple Registers Command

**Note:** In option software version VST800380, any invalid register in the range will return an error response. In option versions VST800381 and later, invalid registers in the range will not return an error response provided at least 1 register is valid. Invalid registers will be set to 0 in the response.

**Table 16** lists command examples to read register contents (register addresses 0020H to 0023H) from a drive with the slave address (unit identifier) 02H.

**Table 17** shows examples of responses indicating that multiple registers have been read successfully. The contents read from 0020H are 1770H, 1770H, 0109H, and 0000H.

**Table 18** shows examples of an error response when reading multiple registers. The exception code is 02H (indicating a register number error).

**Table 16 Example Read Multiple Registers Command**

Description		Data (Hex)
Slave Address		02
Function Code		03
Starting Register	Upper	00
	Lower	20
Quantity of Registers	Upper	00
	Lower	04

**Table 17 Example Read Multiple Registers Response**

Description		Data (Hex)
Slave Address		02
Function Code		03
Number of Data Bytes		08
Starting Register	Upper	17
	Lower	70
Next Register	Upper	17
	Lower	70
Next Register	Upper	01
	Lower	09
Last Register	Upper	00
	Lower	00

**Table 18 Example Read Multiple Registers Error Response**

Description	Data (Hex)
Slave Address	02
Error Code	83
Exception Code	02

### ■ Write Single Register 06 (06 H)

This function code is used to write to a single register in the drive. The command specifies the address of the register to be written and the value to write. The normal response is an echo of the request, returned after the register contents have been written.

**Table 19 Table 19 Write Single Register Command**

Description	Byte	Data (Hex)
Slave Address	1	00 to FF
Function Code	1	06
Register Address	2	0000 to FFFF
Register Value	2	0000 to FFFF

**Table 20 Write Single Register Response**

Description	Byte	Data (Hex)
Slave Address	1	00 to FF
Function Code	1	06
Register Address	2	0000 to FFFF
Register Value	2	0000 to FFFF

**Table 21 Write Single Register Error Response**

Description	Byte	Data (Hex)
Slave Address	1	00 to FF
Error Code	1	86
Exception Code	1	<i>Refer to Modbus TCP/IP Exception Codes on page 36 for details.</i>

### Examples of Register Write Command

**Table 22** lists command examples when writing register value 0003H to register address 0001H in a drive with the slave address (unit identifier) 01H.

**Table 23** shows examples of responses indicating that the write command has been executed successfully. The command specifies the value and the register address to write to.

**Table 24** shows examples of an error response when writing to a register. The exception code is 21H (indicating an invalid value).

Table 22 Example Write Single Registers Command

Description		Data (Hex)
Slave Address		01
Function Code		03
Register Address	Upper	00
	Lower	01
Register Value	Upper	00
	Lower	03

Table 23 Example Write Single Register Response

Description		Data (Hex)
Slave Address		01
Function Code		06
Register Address	Upper	00
	Lower	01
Register Value	Upper	00
	Lower	03

Table 24 Example Write Single Register Error Response

Description	Data (Hex)
Slave Address	01
Error Code	86
Exception Code	21

## ■ Write Multiple Registers 16 (10 H)

This function code is used to write to a contiguous block of registers in the drive. The command specifies the starting register address, the number of registers and the values to be written. The command packs two bytes per register. For each register in the command the first byte contains the most significant bits and the second byte contains the least significant bits. The normal response returns the function code, starting address and quantity of registers written.

Table 25 Write Multiple Registers Command

Description	Byte	Data (Hex)
Slave Address	1	00 to FF
Function Code	1	10
Starting Register	2	0000 to FFFF
Quantity of Registers	2	N </>
Number of Data Bytes	1	N </> x 2
Register Values	N </> x 2	0000 to FFFF

<1> N = Quantity of Registers (range is 1 - 16)

Table 26 Write Multiple Registers Response

Description	Byte	Data (Hex)
Slave Address	1	00 to FF
Function Code	1	10
Starting Register	2	0000 to FFFF
Quantity of Registers	2	N </>

<1> N = Quantity of Registers

Table 27 Write Multiple Registers Error Response

Description	Byte	Data (Hex)
Slave Address	1	01
Error Code	1	90
Exception Code	1	<i>Refer to Modbus TCP/IP Exception Codes on page 36 for details.</i>

## 8 Modbus TCP/IP Messaging

### Examples of Multiple Registers Write Command

**Table 28** lists command examples when writing register values 0001H and 0258H to register addresses 0001H and 0002H in a drive with the slave address (unit identifier) 01H.

**Table 29** shows examples of responses indicating that the write command has been executed successfully. The command specifies the beginning of the register address and the number of registers.

**Table 30** shows examples of an error response when writing to a register. The exception code is 02H (indicating a register number error).

**Table 28 Example Write Multiple Registers Command**

Description		Data (Hex)
Slave Address		01
Function Code		10
Starting Register	Upper	00
	Lower	01
Quantity of Registers	Upper	00
	Lower	02
Number of Data Bytes		04
First Register Data	Upper	00
	Lower	01
Next Register Data	Upper	02
	Lower	58

**Table 29 Example Write Multiple Registers Response**

Description		Data (Hex)
Slave Address		01
Function Code		10
Starting Register	Upper	00
	Lower	01
Quantity of Registers	Upper	00
	Lower	02

**Table 30 Example Write Multiple Registers Error Response**

Description	Data (Hex)
Slave Address	01
Error Code	90
Exception Code	02

### ■ Read/Write Multiple Registers 23 (17 H)

This function code performs a combination of one read operation and one write operation in a single Modbus TCP/IP transaction. The write operation is performed before the read. The command specifies the starting read address, quantity of contiguous registers to read, starting write address, quantity of contiguous registers to write and the values to be written. The normal response contains the values of the registers that were read.

For both the address and the values, the first byte contains the most significant bits and the second byte contains the least significant bits.

**Note:** In option software version VST800380, any invalid register in the range will return an error response. In option versions VST800381 and later, invalid registers in the range will not return an error response provided at least 1 register is valid. Invalid registers will be set to 0 in the response.

**Table 31 Read/Write Multiple Registers Command**

Description	Byte	Data (Hex)
Slave Address	1	00 to FF
Function Code	1	17
Read Starting Register	2	0000 to FFFF
Quantity of Registers to Read	2	M </>
Write Starting Register	2	0000 to FFFF

Description	Byte	Data (Hex)
Quantity of Registers to Write	2	N <2>
Write Byte Count	1	N <2> X 2
Write Register Values	N <2> X 2	0000 to FFFF

<1> M = Quantity of Registers to Read (range is 1 - 16)

<2> N = Quantity of Registers to Write (range is 1 - 16)

**Table 32 Read/Write Multiple Registers Response**

Description	Byte	Data (Hex)
Slave Address	1	00 to FF
Function Code	1	17
Number of Data Bytes	1	M <1> x 2
Read Register Values	2	Values contained in slave registers

<1> M = Quantity of Registers

**Table 33 Read/Write Multiple Registers Error Response**

Description	Byte	Data (Hex)
Slave Address	1	00 to FF
Error Code	1	97
Exception Code	1	<i>Refer to Modbus TCP/IP Exception Codes on page 36 for details.</i>

### Read/Write Multiple Registers

**Table 34** lists command examples when reading registers 0001H and 0002H and then writing register values 0103H and 0258H to register addresses 0102H and 0103H in a drive with the slave address (unit identifier) 01H.

**Table 35** shows examples of responses indicating that the read/write multiple registers command has been executed successfully. Read data 1 contains the value of register address 0001H (0001H). Read data 2 contains the value of the register address 0002H (0002H).

**Table 36** shows examples of an error response when the command to read and write to multiple registers has failed. The exception code is 02H (indicating a register number error).

**Table 34 Example Read/Write Multiple Registers Command**

Description		Data (Hex)
Slave Address		01
Function Code		17
Read Starting Register	Upper	00
	Lower	01
Quantity of Registers to Read	Upper	00
	Lower	02
Write Starting Register	Upper	01
	Lower	02
Quantity of Registers to Write	Upper	00
	Lower	02
Number of Data Bytes		04
First Write Register Data	Upper	01
	Lower	03
Next Write Register Data	Upper	02
	Lower	58

**Table 35 Example Read/Write Multiple Registers Response**

Description	Data (Hex)
Slave Address	01
Function Code	17

## 8 Modbus TCP/IP Messaging

Description		Data (Hex)
Number of Data Bytes		04
Read Data 1	Upper	00
	Lower	01
Read Data 2	Upper	00
	Lower	02

**Table 36 Example Read/Write Multiple Registers Error Response**

Description	Data (Hex)
Slave Address	01
Error Code	97
Exception Code	02

### ◆ Modbus TCP/IP Exception Codes

When an error occurs, remove the cause and restart communications.

Error Code	Error Name
	Cause
01H	Function Code Error
	<ul style="list-style-type: none"> <li>Attempted to set a function code from a PLC other than 03H, 06H, 10H, and 17H.</li> </ul>
02H	Register Number Error
	<ul style="list-style-type: none"> <li>A register number specified in the command message does not exist.</li> <li>Attempted to send a broadcast message using other register numbers than 0001H or 0002H.</li> </ul>
03H	Byte Count Error
	<ul style="list-style-type: none"> <li>Read data or write data is greater than 16 bytes. Invalid command message quantity.</li> <li>In a write message, the “Number of Data Items” contained within the message does not equal twice the amount of data words (i.e., the total of Data 1+ Data 2, etc.).</li> </ul>
21H	Data Setting Error
	<ul style="list-style-type: none"> <li>Control data or parameter write data is outside the allowable setting range.</li> <li>Attempted to write a contradictory parameter setting.</li> </ul>
22H	Write Mode Error
	<ul style="list-style-type: none"> <li>Attempted to write while the drive was operating to a parameter that cannot be written to during run.</li> <li>During an EEPROM data error (CPF06), the master attempted to write to a parameter other than A1-00 to -05, E1-03, or o2-04.</li> <li>Attempted to write to read-only data.</li> </ul>
23H	DC Bus Undervoltage Write Error
	<ul style="list-style-type: none"> <li>Attempted to write from the master during an undervoltage fault (Uv1).</li> <li>Attempted to execute and Enter command during Uv1.</li> </ul>
24H	Write Error During Parameter Process
	<ul style="list-style-type: none"> <li>Master attempted writing to the drive while the drive was processing parameter data.</li> </ul>

### ◆ Control Connection Timeout

The option has a safety feature that declares a fault if communications between the master and drive is lost after the master commanded the drive to run.

A controlled connection is defined as one in which a master commands the drive by writing to register 01H. After this write, the option will begin a timer. The timer will be reset upon subsequent writes to register 01H. If the timer exceeds the value programmed in drive parameter F7-16, the option will declare a BUS ERROR if the option card has an active run command to the drive. A value of 0 in F7-16 means that the timeout is disabled.

## 9 Web Interface

The option contains a series of web pages that allow for viewing of status and diagnostic information through a standard web browser.

The web page is accessed through a self-contained web server at port 80. Access the home page by typing the IP address of the option in a web browser. Example: "http://192.168.1.20"

The IP address of the option can be read using monitors U6-80 to U6-83 on the digital operator if it is unknown. *Refer to [Option Monitors on page 24](#)* for details.

The home page is an HTML-based page providing basic drive and option data and a link to an enhanced web page requiring a Java© enabled web browser.

Enhanced Web Page Notes:

- The Enhanced Web Pages use a series of Java© applets.
- PCs must have Java SE 6 Update 14 or later installed to view the enhanced web pages.
- The Java© applets require an internet connection to check the revocation status.
- When no internet connection is available, disable the revocation check by changing a Java setting in the PC: All Programs / Java / Configure Java / Advanced Tab. Set "Perform certificate checks on" to "Do not check".

Enhanced Web Page Tab	Page
Main Tab	<a href="#">39</a>
Drive Status Tab	<a href="#">39</a>
Network Tab	<a href="#">40</a>
Email Alerts Tab <1>	<a href="#">41</a>
Parameter Access Tab <1> <2>	<a href="#">42</a>
Configuration Tab <1> <2>	<a href="#">43</a>
Custom Tab <1>	<a href="#">44</a>

<1> Available on SI-EM3D Dual-port only.

<2> Accessible after entering a valid password.

## ◆ HTML Home Page (SI-EM3D Dual-port)

The main HTML home page provides basic drive and option data and a link to an enhanced web page. The RSTP enabled home page provides Rapid Spanning Tree Protocol data. *Refer to Rapid Spanning Tree Protocol on page 45* for details on RSTP.

### ■ Main HTML Home Page

The screenshot shows the 'Main' page of the YASKAWA web interface. At the top, there is a 'YASKAWA' logo and a 'Refresh the page to update values.' prompt. Below this are two tabs: 'MAIN' (selected) and 'RSTP'. The main content area is titled 'Main' and contains two side-by-side panels: 'Device Information' and 'Network Status'. Below these panels is a 'Launch Enhanced Website' link and a small disclaimer.

Device Information		Network Status	
Protocol	Modbus-TCP	Msg Tx OK	13
IP Address	192.168.1.20	Msg Rx Ok	80
MAC ID	00:20:B5:88:31:6B	Msg Tx Dropped	0
Serial Number	123001227	Msg Rx Dropped	0
Product Name	SI-EM3D	Msg Tx Errors	1
Option Firmware Version	VST800380	Msg Rx Errors	1
Drive Model	CIMR-AA2A0004	Current Connections	0
Drive Firmware Version	01021	Collisions	0
Profinet Station Name	N/A	Tx Retry	0

[Launch Enhanced Website](#)

To run the "Enhanced Website", Java ® must be enabled in your browser. If a connection to the internet is not available, a change in the Java configuration is required. set "All Programs / Java / Configure Java / Advanced Tab / Perform certificate checks on" to "Do not check"

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Figure 18 Main HTML Home Page (Dual-Port)

### ■ RSTP Enabled HTML Home Page

The screenshot shows the 'RSTP' page of the YASKAWA web interface. At the top, there is a 'YASKAWA' logo and a 'Refresh the page to update values.' prompt. Below this are two tabs: 'MAIN' and 'RSTP' (selected). The main content area is titled 'Rapid Spanning Tree Protocol' and contains two side-by-side panels: 'General' and 'Port Information'. Below these panels is a 'Save Changes' button and a small disclaimer.

General		Port Information	
STP / RSTP	ENABLED	Port 1 Role	Root
Priority	61440	Port 1 State	Forwarding
Root Bridge	00:80:F4:09:32:4E	Port 1 Version	RSTP
Hello Time (secs)	2	Port 1 BPDU Rx Count	490
Forward Delay (secs)	21	Port 2 Role	Designated
Max Age (secs)	40	Port 2 State	Forwarding
	<input type="button" value="Save Changes"/>	Port 2 Version	RSTP
		Port 2 BPDU Rx Count	39

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Figure 19 RSTP Enabled HTML Home Page (Dual-Port)

## ◆ Main Tab

The Main tab shows basic option information such as IP address, MAC address, and firmware version.

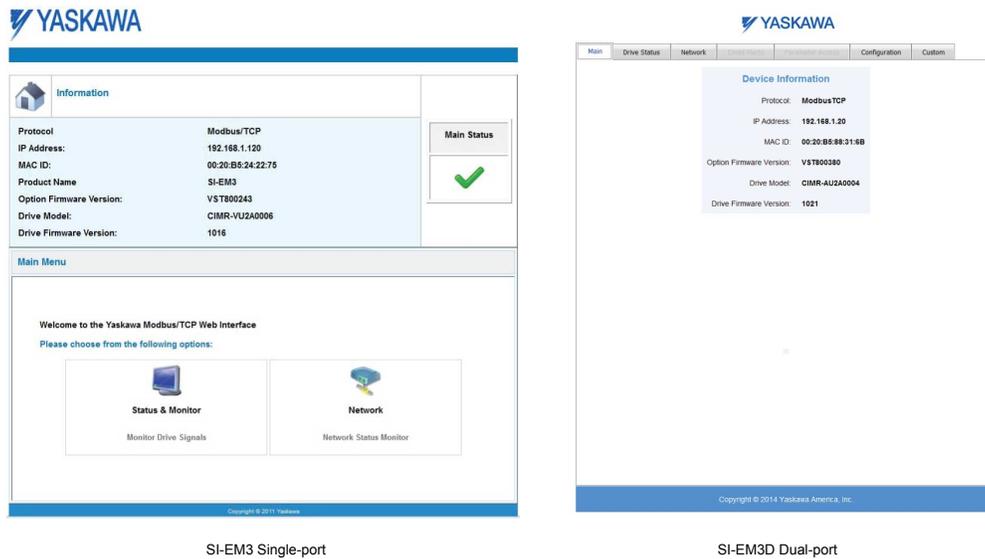


Figure 20 Main Tab View

## ◆ Drive Status Tab

The Drive Status tab shows basic I/O information and drive state information.

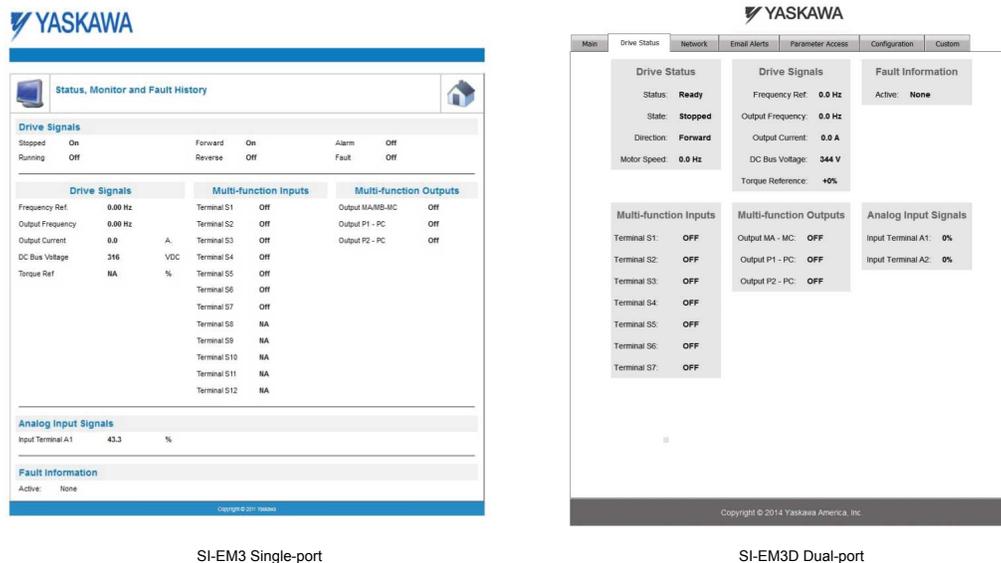


Figure 21 Drive Status Tab View

◆ Network Tab

The Network tab shows the status of the option network traffic and the status of open I/O connections.

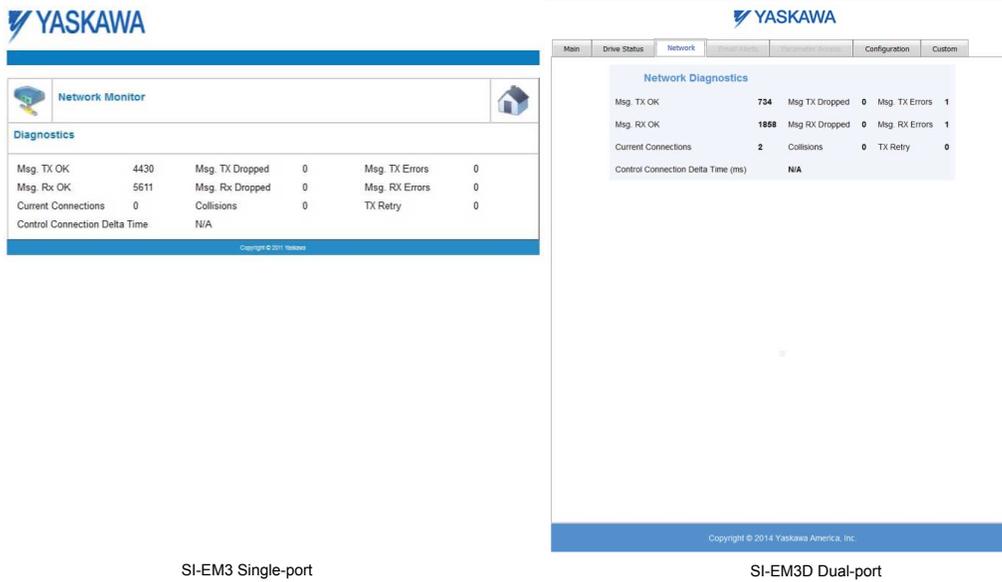


Figure 22 Network Tab View

Table 37 Network Monitor Descriptions

Network Monitor	Explanation
Msg Tx OK	Cumulative number of messages transmitted successfully from the option.
Msg Rx OK	Cumulative number of messages received successfully to the option.
Current Connections	Current number of open connections.
Control Connection Delta Time	The time between the last two writes to the Control register, MEMOBUS/Modbus address 0001H.
Msg Tx Dropped	Cumulative number of messages dropped due to output network buffer being full and unable to hold the new message.
Msg Rx Dropped	Cumulative number of messages dropped due to input network buffer being full and unable to hold the new message.
Collisions	Cumulative number of collisions (half duplex only) reported by the MAC/PHY (Media Access Control/Physical Connection).
Msg Tx Errors	Cumulative number of transmit underruns and transmit stops reported by the MAC/PHY.
Msg Rx Errors	Cumulative number of receive overruns, receive stops, and receive error frames reported by the MAC/PHY.
Tx Retry	Cumulative number of transmits in which the 1st attempt was delayed due to busy medium reported by the MAC/PHY.

## ◆ Email Alerts Tab (SI-EM3D Dual-port)

The Email Alerts tab allows the user to configure four Email Fault/Alarm conditions. When the condition is true, one email will be sent to the provided email address. Another email will not be sent until the condition becomes false and then true again. A 30-second timer prevents emails from being sent when conditions reoccur immediately after being removed. The timer helps limit the amount of emails sent regarding the same intermittent condition and helps to reduce network traffic by reducing emails about reoccurring errors.

Figure 23 Email Alerts Tab View (Dual-Port)

### ■ Conditional Email Set-up

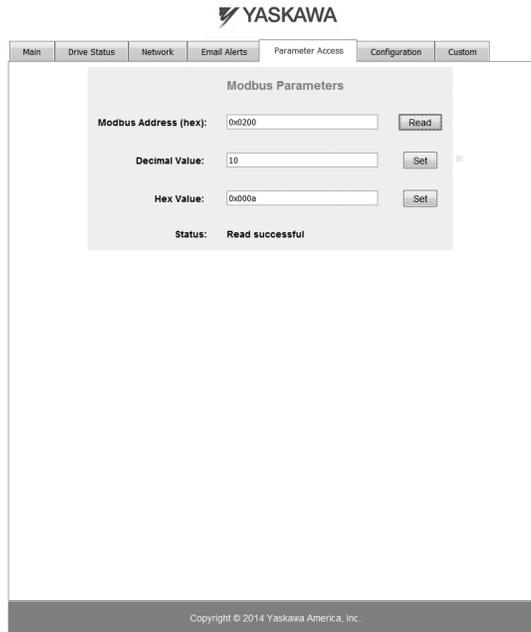
1. Define the condition that will trigger the email by selecting a monitor parameter, a comparator, and a value. Set up comparator values for the range of values to check in the chosen condition. If choosing only one condition and no OR or AND are needed, set the “OR/AND” drop-down selection to “NotUsed”.
2. Enter the email address where the alert will be sent.
3. Enter the message that will appear in the email contents.
4. Enter the email subject.
5. Click the “Email Active” check box to enable the alert.

Clicking “Save to device” will save the entered information into the option memory.

Clicking “Cancel and reload” will cancel any pending edits and display the most recently saved settings from the option board.

### ◆ Parameter Access Tab (SI-EM3D Dual-port)

The Parameter Access tab allows the user to read and write parameters from the drive. Write access is restricted until a valid password is entered.



**Figure 24 Parameter Access Tab View (Dual-Port)**

The MEMOBUS/Modbus address for the drive parameter being accessed must be entered in hexadecimal. The number must begin with “0x” to signify hexadecimal. Clicking “Read” will load and display the current value of the given MEMOBUS/Modbus Address.

Clicking “Set” will save the given value to the given MEMOBUS/Modbus address.

After a “Read” or “Set” command is given, Status will display “Waiting” while the action is being carried out, then “Complete” is displayed when finished.

## ◆ Configuration Tab (SI-EM3D Dual-port)

The Configuration tab sets web page behavior parameters. Access is restricted unless a valid password is entered.

Figure 25 Configuration Tab View (Dual-Port)

### ■ Security Login

Enter a valid password and click “Log in”. The button text changes to “Log out” and the status changes to “Logged in”.

**Note:** The default security password is “yaskawa”.

This password can be changed in the “Change Password” section of the tab. Entering a valid password allows access to the settings in the Configuration tab, Email Alerts tab, and the Parameter Access tab.

### ■ Change Password

To change the password, enter the new password in the “New Password:” and “Confirm Password:” text boxes then click “Change password”. The Status display will change to “Idle” then “Changing Password” then “Password Changed”. If the passwords in the two text boxes do not match, the Status will display “Passwords don’t match”.

### ■ Option Card

The values displayed in the various tabs are refreshed at the rate defined in the “Applet Refresh Rate (ms)” text box. Enter values in the range of 1000 ms to 65.535 seconds.

Parameter Security can be enabled or disabled by clicking one of the radio buttons. When “Disabled” is selected, no password is necessary and all functions in the web pages will be available. When “Enabled” is selected, a valid password must be entered to edit email settings and to write parameters.

### ■ Email Settings

The “Email Server IP” text box must contain the IP address of the email server. The subnet address is configured in drive parameters F7-05 through F7-08. The configured email alerts will use the server at this address when sending emails.

Enter the email server port in the “Email Port” text box.

The value in the “From Email Address” text box identifies the origin of the email alerts to the recipient.

Click “Submit Email Parameters” to save the email settings to the option.

Click “Save Configuration Parameters to Flash” to save the entered values from this tab into non-volatile memory. These values will then be remembered after cycling power.

### ■ General Settings

Click “Save Options Card Parameters” to save the Applet Refresh Rate and the Parameter Security settings to the option.

◆ Custom Tab (SI-EM3D Dual-port)

The Custom tab displays a selection of quick setting parameters.

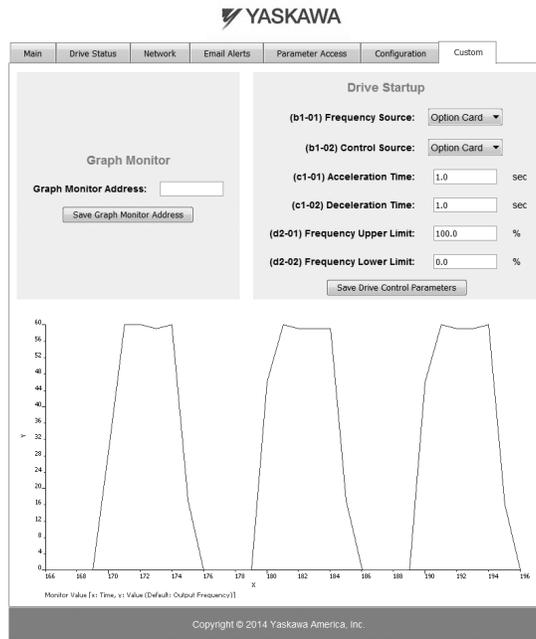


Figure 26 Custom Tab View (Dual-Port)

## 10 Rapid Spanning Tree Protocol

Rapid Spanning Tree Protocol (RSTP) is a mechanism that allows an Ethernet network to be configured as a ring or other topology that may have more than one pathway to each node. The RSTP protocol automatically determines the most efficient pathway to each node and disables any redundant pathways.

If one path fails, RSTP activates another pathway to keep the network traffic flowing. After restoring the failed path, RSTP disables any redundant paths without disrupting network traffic.

### ◆ Convergence Time

Convergence is the process that RSTP performs to identify the root node and which pathways to disable. Convergence occurs on power up and when the network changes (e.g., path failures and restorations).

Take special care when using parameter F7-16, Communication Timeout Loss, and be sure to give RSTP enough time for convergence. When F7-16 is set too short, convergence will not be able to complete before it expires. The complexity of the network and the number of drives on the network will both factor into the value of the timeout.

RSTP is unnecessary and should be disabled when using star or line topology network configurations (RSTP is disabled by default).

### ◆ Topology

The option is ideal for use in ring topologies. With RSTP enabled, a ring topology provides redundancy to the network. RSTP determines the fastest paths to each node on the network and virtually splits the ring by disabling one port on one node to prevent data from being transmitted endlessly around the ring. If a path on the ring fails, RSTP re-enables the disabled port and reconnects the split. All nodes on the network remain accessible without any interruptions.

RSTP is unnecessary and should be disabled when using star or line topology network configurations (RSTP is disabled by default).

### ◆ Enabling RSTP

RSTP is enabled from the webpage on the option.

The IP address of the option card is necessary to access the webpage. Use the operator to read the IP address values from monitors U6-80, U6-81, U6-82, and U6-83.

These monitors display the IP address whether the card is configured to receive its IP address from a master controller (BOOTP or DHCP) or if it is configured statically.

Refer to [Table 38](#) for example values of the monitors for an option IP address of 192.168.1.20.

**Table 38 Example IP Address Monitor Values**

Monitor	Value
U6-80	192
U6-81	168
U6-82	1
U6-83	20

Enter the IP address to address bar of your web browser (Ex. <http://192.168.1.20>) and hit enter to load the main page for the option. Refer to [Figure 18](#) for an example of the main page.

At the top of the page, click the RSTP button. The RSTP webpage will be displayed with “N/A” values.



Refresh the page to update values.

MAIN
RSTP

**Rapid Spanning Tree Protocol**

**General**

STP / RSTP DISABLED

Priority 61440

Root Bridge N/A

Hello Time (secs) N/A

Forward Delay (secs) N/A

Max Age (secs) N/A

**Port Information**

Port 1 Role N/A

Port 1 State N/A

Port 1 Version N/A

Port 1 BPDU Rx Count N/A

Port 2 Role N/A

Port 2 State N/A

Port 2 Version N/A

Port 2 BPDU Rx Count N/A

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**Figure 27 RSTP Page Initial View**

Change the select box labeled “STP / RSTP” from “DISABLED” to “ENABLED” then click “Save Changes”. The webpage will automatically refresh and enable RSTP. Refer to [Figure 19](#) for an example of an RSTP enabled home page.

## ◆ Rapid Spanning Tree Protocol Webpage

There are two groups of data displayed on the RSTP webpage: General and Port Information.

### ■ General

#### STP / RSTP Enable

To enable RSTP, Change this setting to “ENABLED” and click “Save Changes” to enable RSTP.

#### Priority

The RSTP Priority controls which bridge in the network becomes the root bridge. For most installations, the PLC or controller should be configured as the root bridge. A lower value in the “Priority” field indicates a higher priority. The priority ranges from 0 to 61440 in increments of 4096. The option defaults to the lowest priority, 61440. [Table 39](#) lists the possible priorities.

**Table 39 Priority Values**

0	16384	32678	49152
4096	20480	36864	53248
8192	24576	40960	57344
12288	28672	45056	61440

To change the priority, select the desired priority from the list and click “Save Changes”.

#### Root Bridge

This field displays the MAC address of the root bridge on the network.

#### Hello Time (secs)

The Hello Time is displayed in seconds. This value is set by the root bridge and indicates how often bridge packets will be sent out.

#### Forward Delay (secs)

The Forward Delay is displayed in seconds. This value is set by the root bridge. When the port is using STP and not RSTP, the Forward Delay is the length of time the bridge will wait before transitioning between states.

**Max Age (secs)**

The Max Age is displayed in seconds. This value is set by the root bridge and indicates how long a message can be passed along before being discarded.

**■ Port Information****Port Role**

The Port Role identifies how the port is being used. The seven possible values for Port Role are described in [Table 40](#).

**Table 40 Port Role Values**

Port Role	Description
Unknown	An unknown error has occurred within RSTP.
Root	This port leads to the root bridge.
Designated	This port leads away from the root bridge.
Alternate	This port is an alternate path to the root bridge.
Backup	This port is an alternate path away from the root bridge.
Disabled	This port does not have an active link.
N/A	RSTP is disabled.

**Port State**

The Port State indicates if the port is accepting and sending messages. The four possible values for Port State and the features of each state are shown in [Table 41](#).

**Table 41 Port State Values**

Port State	Accept Packets	Forward Packets	Learn MAC Addresses
Discarding	NO	NO	NO
Learning	NO	NO	YES
Forwarding	YES	YES	YES
N/A	RSTP is disabled.		

**Port Version**

RSTP can operate in normal RSTP mode or support STP mode. When an STP-only node is detected on the network, this port operates in STP mode and displays “STP”. “RSTP” will be displayed in all other cases.

**Port BPDU Rx Count**

The Port BPDU Rx Count shows the number of BPDU packets received on that port. In general, root ports receive far more BPDU packets than designated ports.

### ◆ RSTP Monitor U6-96

Monitor U6-96 is dedicated to RSTP. U6-96 shows the role and state for each port.

The displayed value has four digits. The first two digits belong to port 1 and the last two digits belong to port 2. The first and third digits represent port role while the second and fourth digits represent port state.

The possible port role and state values are shown in [Figure 28](#).

3
2
2
2

Port 1 Role		Port 1 State		Port 2 Role		Port 2 State	
0	Unknown	0	Discarding	0	Unknown	0	Discarding
2	Root	1	Learning	2	Root	1	Learning
3	Designated	2	Forwarding	3	Designated	2	Forwarding
4	Alternate			4	Alternate		
5	Backup			5	Backup		
6	Disabled			6	Disabled		
9	RSTP Disabled			9	RSTP Disabled		

**Figure 28 U6-96 Monitor Values**

Refer to [Table 40](#) for descriptions of the port role values.

Refer to [Table 41](#) for descriptions of the port state values.

Below are a few examples:

- 9292 = RSTP is disabled and both ports are forwarding.
- 3222 = Port 1 is forwarding and is the designated port. Port 2 is forwarding and is the root port.
- 2232 = Port 1 is forwarding and is the root port. Port 2 is forwarding and is the designated port.
- 3232 = Both ports are forwarding and are designated ports. This only occurs when the option is the root bridge.
- 4022 = Port 1 is discarding and is the alternate port. Port 2 is forwarding and is the root port.
- 2260 = Port 1 is forwarding and is the root port. Port 2 is discarding and is the disabled port.

## 11 Troubleshooting

### ◆ Drive-Side Error Codes

Drive-side error codes appear on the drive digital operator. Causes of the errors and corrective actions are listed below. Refer to the drive manual for additional error codes that may appear on the drive digital operator.

### ■ Faults

Both FB12 (option communication fault) and EF0 (option external fault) can appear as a fault. When a fault occurs, the digital operator ALM LED remains lit. When an alarm occurs, the ALM LED flashes.

If communication stops while the drive is running, use the following questions as a guide to help remedy the fault:

- Is the option properly installed?
- Are the communication lines properly connected to the option? Are the wires loose?
- Is the controller program working? Has the controller/PLC CPU stopped?
- Did a momentary power loss interrupt communications?

Digital Operator Display		Fault Name
<i>EF0</i>	EF0	Option Card External Fault
Cause		Possible Solutions
An external fault was received from the PLC and F6-03 is set to a value other than 3.		<ul style="list-style-type: none"> <li>• Remove the cause of the external fault.</li> <li>• Remove the external fault input from the PLC.</li> </ul>

Digital Operator Display		Fault Name
<i>Fb12</i>	Fb12	Option Communication Error
Cause		Possible Solution
Master controller (PLC) has stopped communicating		<ul style="list-style-type: none"> <li>• Check that power is supplied to the PLC</li> <li>• Check that PLC is not in program mode</li> </ul>
Communication cable is not connected properly		<ul style="list-style-type: none"> <li>• Check for faulty wiring</li> <li>• Correct any wiring problems</li> </ul>
A data error occurred due to noise		<ul style="list-style-type: none"> <li>• Check the various options available to minimize the effects of noise</li> <li>• Counteract noise in the control circuit, main circuit, and ground wiring</li> <li>• If a magnetic contactor is identified as a source of noise, install a surge absorber to the contactor coil</li> <li>• Make sure the cable used meets requirements</li> <li>• Make sure the option ground wire is connected between option FE terminal and the drive ground terminal connected to earth ground</li> </ul>
The option is not properly connected to the drive.		Reinstall the option.
Option is damaged		If there are no problems with the wiring and the error continues to occur, replace the option.
Connection Time-out		<ul style="list-style-type: none"> <li>• The option Requested Packet Interval (RPI) timer timed out.</li> <li>• Make sure that RPI time is set properly.</li> </ul>
Duplicate IP Address		Check if the option shares IP Address with at least one other node. Check the setting values of F7-01 to F7-04 (IP Address).

## Minor Faults and Alarms

Digital Operator Display		Minor Fault Name	
[ 4Po	CyPo	Cycle Power to Active Parameters	
		Comm. Option Parameter Not Upgraded	
Cause		Possible Solutions	Minor Fault (H2-□□ = 10)
Drive is not compatible with the option software version.		Turn off the power and upgrade the communication option parameters. <b>Note:</b> An alarm is triggered when the option software version is earlier or an incompatible option is installed to the drive.	YES

## bUS Fault Tolerance

### bUS Fault Auto-Restart

Parameter F6-14, bUS Fault Auto Reset Select, will appear when the option is installed.

Setting F6-14 = 0 (Disabled) or F6-01 = 3 or greater (Alarm only) will not affect standard default drive behavior.

Setting F6-14 = 1 (Enabled) AND F6-01 < 3 (Fault) will cause the following operation: The bUS fault occurs after the F7-16 delay and the Run command is removed from the drive. Then the option throws a bUS fault to the drive. When the condition is removed, the option commands a fault reset and returns control of the drive to the Modbus TCP/IP network.

**Note:** The option will only read parameter F6-01 and F6-14 from the drive during power-up.

### bUS Fault Delay

Parameter F7-16, Communications Loss Detection Time Delay, will appear when the option is installed.

The setting value of F7-16 is the length of time that the option will delay sending the bUS fault to the drive.

The status LEDs on the option are not affected by the delay time set in F7-16; the LEDs will indicate the bUS condition immediately.

**Note:** The option will only read parameter F7-16 from the drive during power-up.

## Option Error Codes

### Option Fault Monitors U6-98 and U6-99

The option can declare error/warning conditions via drive monitor parameters on the drive digital operator as shown in [Table 42](#).

**Table 42 Option Fault Monitor Descriptions**

Fault Condition	Fault Declared	Status Value (U6-98/U6-99)	Description
No Fault	n/a	0	No faults
Force Fault	EF0	3	Network sent a message to force this node to the fault state.
Connection Timeout	BUS ERROR	1101	The control connection timed out.
Duplicate IP Address	BUS ERROR	1102	This node and at least one other node have the same IP Address.
Default MAC Address	None	1103	Factory default MAC Address programmed into the option. Return for reprogramming.
Network Link Down	BUS ERROR	1104	No network link to option.
Hardware Error	BUS ERROR	1105	Option card hardware has stopped functioning. Cycle power to the drive.

Two drive monitor parameters, U6-98 and U6-99 assist the user in network troubleshooting.

- U6-98 displays the first declared fault since the last power cycle. U6-98 is only cleared upon drive power-up.
- U6-99 displays the present option status. U6-99 is cleared upon a network-issued fault reset and upon power-up.

If another fault occurs while the original fault is still active, parameter U6-98 retains the original fault value and U6-99 stores the new fault status value.

## 12 Specifications

**Table 43 Option Specifications**

Item	Specification
<b>Model</b>	SI-EM3/SI-EM3D
<b>Supported Messages</b>	<ul style="list-style-type: none"> <li>• Read Multiple Registers (03H)</li> <li>• Write Single Register (06H)</li> <li>• Write Multiple Registers (10H)</li> <li>• Read and Write Registers (17H)</li> </ul> Commands that support multiple registers have a maximum Read and Write size of 16 registers.
<b>Option Conformance</b>	Modbus-IDA Passed
<b>Connector Type</b>	RJ45 8-pin Shielded Twisted Pair Cat5e cable
<b>Physical Layer Type</b>	Isolated Physical Layer
<b>IP Address Setting</b>	Programmable from drive keypad or network
<b>Communication Speed</b>	Programmable from drive keypad or network: 10/100 Mbps, auto-negotiate
<b>Number of Connections</b>	Modbus TCP/IP: 10 Web Page Access: 2
<b>Duplex Mode</b>	Half-forced, Auto-negotiate, Full-forced
<b>Address Startup Mode</b>	Static, BOOTP, DHCP
<b>Ambient Temperature</b>	-10 °C to +50 °C (14 °F to 122 °F)
<b>Humidity</b>	95% RH or lower with no condensation
<b>Storage Temperature</b>	-20 °C to +60 °C (-4 °F to +140 °F) allowed for short-term transport of the product
<b>Area of Use</b>	Indoor (free of corrosive gas, airborne particles, etc.)
<b>Altitude</b>	1000 m (3280 ft.) or lower

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## Revision History

The revision dates and the numbers of the revised manuals appear on the bottom of the back cover.

Example:  
MANUAL NO. SIEPYAICOM23 Rev: A0  
Published in U.S.A. August 2016 16-8

Revision number  
Date of publication  
Date of original publication

Date of Publication	Revision Number	Section	Revised Content
August 2016	-	-	First Edition



# YASKAWA Z1000 Bypass Option Modbus TCP/IP Single and Dual-Port Technical Manual

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## YASKAWA

### YASKAWA AMERICA, INC.

In the event that the end user of this product is to be the military and said product is to be employed in any weapons systems or the manufacture thereof, the export will fall under the relevant regulations as stipulated in the Foreign Exchange and Foreign Trade Regulations. Therefore, be sure to follow all procedures and submit all relevant documentation according to any and all rules, regulations and laws that may apply.

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SIEPYAICOM23

MANUAL NO. SIEPYAICOM23 Rev: A0

Published in USA August 2016 16-8