GE Industrial Control Systems

LCI Control and Gating–Exciter Board
IS200FCGEH1A_ _

Safety Symbol Legend

WARNING Indicates a procedure, practice, condition, or statement that, if not strictly observed, could result in personal injury or death.

CAUTION Indicates a procedure, practice, condition, or statement that, if not strictly observed, could result in damage to or destruction of equipment.

Note Indicates an essential or important procedure, practice, condition, or statement.

Contents

Functional Description

The IS200FCGE board (FCGE) provides signal interfacing between the Load Commutated Inverter (LCI) drive and the motor field exciter. The FCGE's main functions are to:

- Relay cell gating commands from the LCI's processor board to the exciter
- Condition voltage and current feedback signals from the exciter bridge to the LCI processor board

The FCGE resides in a VMEbus rack inside the LCI's control cabinet.

VMEbus Interface

The FCGE environment consists of an FCGE board and a VMEbus host processor. The FCGE is compatible with the VME (A24/D16) specification both electrically and physically. (See the *ANSI/VITA 1-94* manual for VMEbus guidelines.)

All standard VMEbus signals are through the **P1 connector** to the VMEbus backplane (see *Application Data*, Table 3). The FCGE decodes most of the 24 address bits for internal addressing.

The FCGE interfaces with the host processor, other LCI boards, and the exciter through the **P2 connector** (see *Application Data*, Table 4). The exciter connects directly to the VMEbus backplane through a 34-pin ribbon connector.

System Functions

Timing

The FCGE has a system clock register to generate firing commands and time stamping feedback values. This circuit is an up counter clocked at 1/16 the VMEbus clock rate.

Reset

The VMEbus system reset signal 0SYSRST (pin P1-C12) sets all of the FCGE's registers to their initial values during powerup or hardware reset.

Heartbeat

Onboard "heartbeat" circuitry is enabled when the VMEbus host first writes to the FCGE. If the heartbeat is within design limits, the board's green *Active* LED is on (see *Application Data*, Figure 1). If this heartbeat check fails, gating is disabled and this LED turns off.

Board Selftest

Most of the board functions can be tested on command from the VMEbus host processor. The selftests include loopback tests and the injection of test signals into analog signal paths.

Firing Commands

The FCGE includes drivers for six firing command outputs to the exciter (see *Application Data*, Table 4). Each output corresponds to one of the six SCR (silicon-controlled rectifier) cell strings in the exciter bridge. These drivers are controlled by the LCI processor, which can turn on up to six at one time.

Exciter Feedback/Status

Current Feedback

The FCGE receives a current feedback signal that is a composite of output from current transformers on the power bridge's input phases A and C. The FCGE senses this signal differentially and conditions it at an onboard VCI (voltage-controlled oscillator), producing current feedback.

Voltage Feedback

The FCGE receives six analog voltage inputs on its P2 connector (see Table 4). These signals are attenuated in the exciter's power bridge, which has different connections for the ac switch and dc bridge configurations (see Table 1). The FCGE's six VCOs condition these inputs to produce voltage feedback.

Table 1. Exciter Connections for Voltage Feedback to the FCGE

FCGE's P2 Connector Pin	AC Bridge Connection	DC Bridge Connection
A20	Input Phase A	Input Phase A
A25	Input Phase B	Input Phase B
A22	Input Phase C	Input Phase C
A21	Output Phase A	DC + Output
A24	Output Phase B	DC – Output
A23	Output Phase C	Not connected

Cell Conduction Status

The FCGE detects cell conduction using a simple voltage-based comparator. The board differentially senses input of the voltage across each cell. It compares this voltage feedback (see Table 1) to a nominal value, and sets a latch if voltage is detected.

Shorted/Open Cell Detection

The FCGE detects if a cell in the ac exciter bridge is either shorted or open by checking current feedback input. If a component of current is at fundamental frequency, the FCGE sets a protective signal.

Ground Fault Detection

The FCGE detects ground faults from the dc exciter by checking whether the dc voltage is centered on ground potential. If detected, the FCGE sets a protective signal.

Ribbon Cable Status

When the ribbon cable between VMEbus backplane and the exciter is connected, FCGE pin P2-A11 is low (at logic 0). The FCGE monitors this input. If the voltage is above common, the FCGE sets the status feedback signal to the host processor, indicating that the cable is disconnected.

Application Data

Gating Disable

Any of the following signals disables gate firing:

- VMEbus system reset signal low (pin P1-C12)
- Kill gating signal low (pin P2-C4)
- VMEbus signal 0SYSFAIL low (pin P1-C10)
- Open collector signal 0TRIPFLT low (pin P2-C3)
- Heartbeat times out and pulls 0KILL_O low (pin P2-C4)
- Power removed from the customer CTLN1 line (see *Note*)

Note

Existing drive products have a 24 V dc hardware loop CTLN1 to block gating of cells, independent of the host processor. The FCGE receives this voltage as a 5 V dc input signal CTRLN2 (pin P2-A4.)

Indicators

The board front (see Figures 1 and 2) contains two green LEDs:

- IMOK (DS1) blinks to indicate "I am okay" – it has passed selftest and is functioning correctly.
- ACTIVE (DS2) is on solid when communicating with the LCI processor board.

Testpoints

The FCGE includes the testpoints listed and defined in Table 2. Most of these can be accessed from the board front (see Figure 1)

I/O Connectors

The FCGE contains two 96-pin VMEbus connectors (see Figure 2):

- P1 for standard VMEbus I/O (see Table 3)
- P2 for I/O interfacing with the host processor, other LCI boards, and the exciter (see Table 4).

Two 20-pin ribbon cable connectors, TSTP1 and TSP2, are for factory test only.

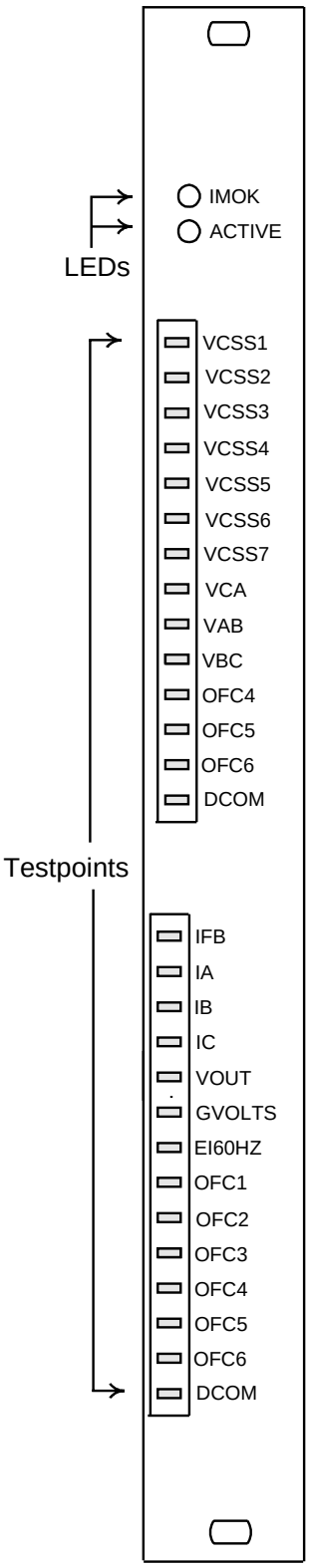

Figure 1. FCGE Board Front Panel

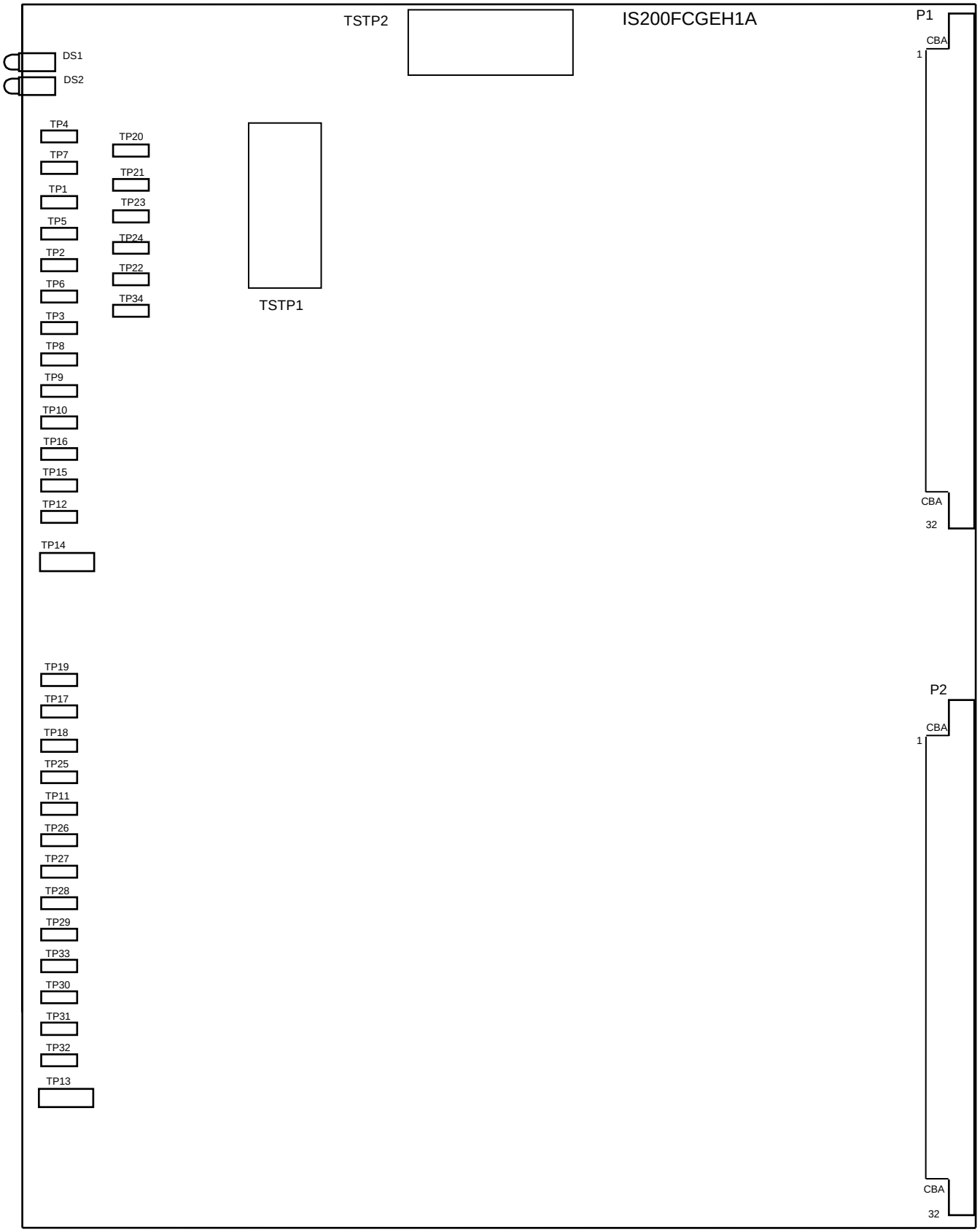

Figure 2. FCGE Board Layout

Table 2. Testpoints

Name	Nomenclature	Description
TP1	VCSS3	Cell state sensor #3: 0 for blocking (attenuated 6-to-1).
TP2	VCSS5	Cell state sensor #5: 0 for blocking (attenuated 2-to-1).
TP3	VCSS7	Cell state sensor #7: 0 for blocking (attenuated 2-to-5).
TP4	VCSS1	Cell state sensor #1: 0 for blocking (attenuated 4-to-1).
TP5	VCSS4	Cell state sensor #4: 0 for blocking (attenuated 4-to-3).
TP6	VCSS6	Cell state sensor #6: 0 for blocking (attenuated 6-to-3).
TP7	VCSS2	Cell state sensor #2: 0 for blocking (attenuated 2-to-3).
TP8	VCA	Bridge line-to-line source voltage, attenuated.
TP9	VAB	Bridge line-to-line source voltage, attenuated.
TP10	VBC	Bridge line-to-line source voltage, attenuated.
TP11	VOUT	Dc exciter: bridge dc link voltage, attenuated. Ac exciter: bridge line-to-line load voltage, attenuated.
TP12	VCBR	Vbc with reconstruction.
TP13	DCOM	Power digital common (return for P5 & P28).
TP14	ACOM	Power analog common (return for P15 and N15).
TP15	VBAR	Vab with reconstruction.
TP16	VACR	Vca with reconstruction.
TP17	IA	Exciter current feedback, scaled.
TP18	IC	Not used.
TP19	IFB	Rectified exciter phase current feedback, scaled.
TP20*	0TRIPFLT	0 indicates trip breaker command (from exciter or LCI's cell gating driver boards).
TP21*	0KILLG	0 indicates kill gating requested (from exciter or LCI's cell gating driver boards).
TP22*	0SYSRST	0 resets rack.
TP23*	0SYSFAIL	0 causes system failure indication.
TP24*	0SWRRST	0 resets selected board functions via hardware control register.
TP25	IB	Phase B current (constructed from Ia & Ic).
TP26	GVOLTS	Ground fault level.
TP27	EI60HZ	Current unbalance level.
TP28	0FC1	0 indicate firing bridge leg 1.
TP29	0FC2	0 indicates firing bridge leg 2.
TP30	0FC4	0 indicates firing bridge leg 4.
TP31	0FC5	0 indicates firing bridge leg 5.
TP32	0FC6	0 indicates firing bridge leg 6.
TP33	0FC3	0 indicates firing bridge leg 3.
TP34*	PU4	0 disables gating at hardware level.

* Not accessible from board front.

Table 3. Connector P1, Standard VMEbus I/O

Pin No.	I/O	Nomenclature	Definition
A1 – A8	Bidir.	D0 – D7	Data bus lines 0 through 7.
A9, A11, A15, A17, A19	Power	DCOM	Digital common.
A10	——-	SYSCLK	System clock (not connected).
A12	Input	0DS1	Data strobe 0.
A13	Input	0DS0	Data strobe 1.
A14	Input	0WRITE	Logic high indicates a read operation; logic low indicates a write.
A16	Output	0DTACK	Data transfer acknowledge.
A18	——-	0AS	Address strobe (not connected).
A20	Input	0IACK	Interrupt acknowledge.
A21, A22	——-	0IACKI_O	Interrupt acknowledge in/out. (Tied together, not connected.)
A23	Input	AM4	Address modifier bit 4.
A24 – A30	Bidir.	A7 – A1	Address lines 7 through.
A31	——	N12	Power –12 V dc (not connected).
A32	Power	P5	+ 5 V dc.
B1	——	0BBSY	Bus busy (not connected).
B2	——	0BCLR	Bus clear (not connected).
B3	——	0ACFAIL	Ac power failure (not connected).
B4, B5	——-	0BG0I_O	Bus grant 0 in/out. (Tied together, not connected.)
B6, B7	——-	0BG1I_O	Bus grant 1 in/out. (Tied together, not connected.)
B8, B9	——-	0BG2I_O	Bus grant 2 in/out. (Tied together, not connected.)
B10, B11	——-	0BG3I_O	Bus grant 3 in/out. (Tied together, not connected.)
B12 – B15	——-	0BR0 – 0BR3	Bus request (not connected).
B16 – B19	Input	AM0 – AM3	Address modifier, lines 0 through 3.
B20, B23	Power	DCOM	Digital common.
B21	——-	SERCLK	Serial clock (not connected).
B22	——-	SERDAT	Serial data (not connected).
B24 – B30	——-	IRQ7 – IRQ1	Interrupt request lines 7 through 1 (not connected).
B31	——-	P5STDBY	+5 V dc line for battery-backup needs (not connected).
B32	Power	P5	+ 5 V dc.
C1 – C8	Bidir.	D8 – D15	Data bus lines 8 through 15.
C9	Power	DCOM	Digital common.
C10	Input	0SYSFAIL	System failure detection – disables firing.
C11	——-	0BERR	Bus error (not connected).
C12	Input	0SYSRST	VME system reset.
C13	Input	0LWORD	Long word signal for data selection.
C14	Input	0AM5	Address modifier bit 5.
C15 – C30	Bidir.	A23 – A8	Address bus lines 23 through 8.
C31	——-	P12	+12 V dc power (not connected).
C32	Power	P5	+ 5 V dc.

Table 4. Connector P2, I/O with LCI Boards and Exciter

Pin No.	I/O	Nomenclature	Definition
A1, A2, A7	Power	DCOM	Digital common (P5 and P24 return).
A3, A8, A9, A12, A14, A15, A26 – A28	——-	——-	Not connected.
A4	Input	CTRLN2	Indicates removal of power – disables firing.
A5	Input	SLOTID1	Slot identification 1.
A6	Input	SLOTID2	Slot identification 2.
A10	Power	ACOM	Analog common.
A11	Input	JV1_CHK	0 = cable plugged-in check.
A13	Power	P15	+15 V dc.
A16	Power	N15	–15 V dc.
A17, A18	Output	DA1, DA2	Digital-to-analog no. 1 and 2 outputs.
A19	Output	MASKCHG	0 = firing mask change.
A20	Input	ATT1	Attenuated voltage signal 1, from exciter.
A21	Input	ATT4	Attenuated voltage signal 4, from exciter.
A22	Input	ATT3	Attenuated voltage signal 3, from exciter.
A23	Input	ATT6	Attenuated voltage signal 6, from exciter.
A24	Input	ATT5	Attenuated voltage signal 5, from exciter.
A25	Input	ATT2	Attenuated voltage signal 2, from exciter.
A29	Input	EIFBKP	Exciter current feedback, phase positive.
A30	Input	EIFBKN	Exciter current feedback, phase negative.
A31	Input	ICP	Exciter current feedback, phase positive.
A32	Input	ICN	Exciter current feedback, phase negative.
B1, B13, 32	Power	P5	+ 5 V dc.
B2, B12, B22, B31	Power	DCOM	Digital common.
B3 – B11, B14 – B21, B23 – B30	——-	——-	Not connected.
C1	Bidir.	ID_DATA	Board identification.
C2	Input	16MHZP	16 MHz clock signal.
C3	Output	0TRIPFLT	0 = trip fault (trips load contactor).
C4	Bidir.	0KILLG	0 = kill gating (disables firing).
C5	Power	DCOM	Digital common.
C6	Input	SLOTID3	Slot 3 identification.
C7	Input	SLOTID4	Slot 4 identification.
C8	Input	SLOTID5	Slot 5 identification.
C9, C11, C12, C14, C15, C32	——-	——-	Not connected.
C10, C16	Power	ACOM	Analog common.
C13	Power	P24	24 V dc.

Table 4. Connector P2, I/O with LCI Boards and Exciter – Continued

Pin No.	I/O	Nomenclature	Definition
C17, C18	Output	DA3, DA4	Digital-to-analog no. 3 and 4 outputs.
C19	Output	NZFM	1 = non-zero firing mask.
C20, C24, C26, C28, C30	Power	ECOM	Common to exciter for P28/SIG1 – 6.
C21	Output	SIG1	Firing pulse signal 1, to exciter.
C23	Output	SIG4	Firing pulse signal 4, to exciter.
C25	Output	SIG3	Firing pulse signal 3, to exciter.
C27	Output	SIG6	Firing pulse signal 6, to exciter.
C29	Output	SIG2	Firing pulse signal 2, to exciter.
C31	Output	SIG5	Firing pulse signal 5, to exciter.

Renewal/Warranty Replacement

How to Order a Board

When ordering a replacement board for a GE drive, you need to know:

- How to accurately identify the part
- If the part is under warranty
- How to place the order

This information helps ensure that GE can process the order accurately and as soon as possible.

Board Identification

A printed wiring board is identified by an alphanumeric **part (catalog) number** located near its edge. Figure 3 explains the structure of the part number.

The board's functional acronym, shown in Figure 3, normally is based on the **board description**, or name. For example, the *FCGE* board is described as the *LCI Control and Gating-Exciter* board.

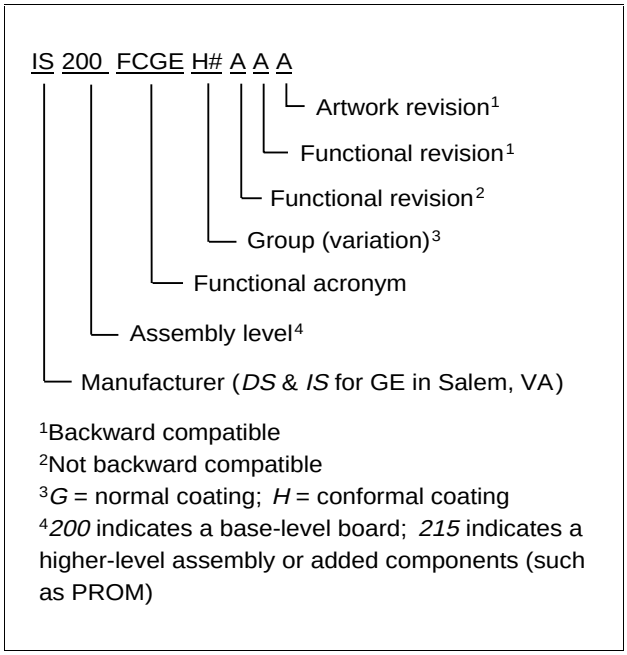

Figure 3. Board Part Number Conventions

Warranty Terms

The GE *Terms and Conditions* brochure details product warranty information, including **warranty period** and **parts and service coverage**. The brochure is included with customer documentation. It may be obtained separately from the nearest GE Sales Office or authorized GE Sales Representative.

Placing the Order

Parts still under **warranty** may be obtained directly from the factory:

GE Industrial Control Systems
Product Service Engineering
1501 Roanoke Blvd.
Salem, VA 24153-6492 USA
Phone: 001-540-387-7595
Fax: 001-540-387-8606

Renewals (spares or those not under warranty) should be ordered by contacting the nearest GE Sales or Service Office. Be sure to include:

- Complete part number and description
- Drive serial number
- Drive Material List number

Note

All digits are important when ordering or replacing any board.

The factory may substitute later versions of boards based on availability and design enhancements. However, GE Industrial Control Systems ensures backward compatibility of replacement boards.

Onboard Firmware

Each new FCGE board is shipped with the applicable firmware already installed. The onboard EEPROM containing this firmware is not intended for removal or programming in the field. If the FCGE fails because of firmware or EEPROM problems, or if an upgrade is needed, the board must be replaced.

How to Replace the Board

Handling Precautions

CAUTION

To prevent component damage caused by static electricity, treat all boards with static sensitive handling techniques.

Printed wiring boards may contain static-sensitive components. Therefore, GE ships all replacement boards in antistatic bags. Use the following guidelines when handling boards:

1. Store boards in antistatic bags or boxes.
2. Use a grounding strap when handling boards or board components.

Replacement Procedures

WARNING

To prevent electric shock, turn off power to the board, then test to verify that no power exists in the board before touching it or any connected circuits.

CAUTION

To prevent equipment damage, do not remove, insert, or adjust board connections while power is applied to the equipment.

Remove the board from the VME rack as follows:

1. Make sure that the drive in which the board resides has been deenergized.
2. Open the drive's cabinet door. Using equipment designed for high voltages, test any electrical circuits **before touching them** to ensure that power is off.
3. Carefully remove the board from the rack, as follows:
   a. Loosen the screws at the top and bottom of the board, near the board ejector tabs. (The screws are captive in the board front and should not be removed.)
   b. Unseat the board by raising the ejector tab.
   c. Using both hands, gently pull the board from the VMEbus rack.

Install the new (replacement) board in the rack as follows:

1. Slide the board into the **correct slot** in the rack.

CAUTION

Because VME boards are keyed for specific rack slots, inserting the FCGE into the wrong slot can damage the electronics.

2. Begin seating the board by firmly pressing the top and bottom of the board at the same time with your thumbs.
3. Finish seating the board in the slot by starting and then tightening the screws at the top and bottom of the board. **Tighten the screws evenly** to ensure that the board is seated squarely.

GE Industrial Control Systems

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