GE Industrial Control Systems

1000/1800 Amp IGBT Gate Driver/Shunt Feedback Board IS200DSFCG_A_ _

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 IS200DSFC 1000/1800 Amp IGBT Gate Driver/Shunt Feedback Board (DSFC) contains a current sensing circuit, a fault detection circuit, and two IGBT gate drive circuits. The driver and feedback circuits are galvanically and optically isolated. The board is designed for use with the 1000 Amp and 1800 Amp Innovation Series™ Pulse Width Modulated (PWM) source bridges and ac drives. The DSFC board interfaces to the drive control via the IS200BPIB Drive Bridge Personality Interface Board (BPIB). A 1000 A source bridge or drive will require three DSFC boards, one per phase. An 1800 A source bridge or drive will require six DSFC boards, two "daisy chained" DSFC boards per phase. The DSFC (G1) is designed for use in drive/source applications where the ac input is 600 V LL rms. The DSFC board is mounted directly to the upper and lower IGBT modules in each phase leg to keep driver output and shunt input connections as short as possible. The board is held in place by the gate, emitter and collector connections to the IGBT. Proper orientation of the board for positioning of the gate, emitter and collector mounting holes is essential. See Figure 1 for a block diagram of board circuitry and Figure 2 for a board layout diagram showing major components.

Output Phase Gate Drive

Each of the two isolated IGBT gate drive circuits drives two paralleled IGBT modules. One circuit controls the upper IGBTs of a phase leg and the other controls the lower.

These circuits drive the IGBT gate between VCC (+15 V) and VEE (–15 V) (IGBT emitter common) and have the capability to sink or source a maximum of 20 amps peak. The DSFC gate drive circuits are designed to operate at a maximum PWM chopping frequency of 6 kHz. The drive control optocoupler input diodes are connected in an anti-parallel configuration that provides upper and lower drive control from a common differential twisted pair control line. The DSFC board's gate series resistors and gate-emitter capacitors are sized specifically for the IGBT module.

Each gate driver output is monitored and the state indicated by a green and a yellow LED.

- The yellow LED will be ON when the IGBTs are driven ON.
- The green LED will be ON when the IGBTs are driven OFF.

Two types of faults can be detected by the driver circuits, Desaturation and Undervoltage. These faults are reported through one "multiplexed" differential fault line for both upper and lower IGBT circuits. (See Desaturation/Undervoltage Fault Reporting paragraph.)

- **Desaturation Fault:** When the driver is commanded to turn the IGBT ON, the voltage drop between the emitter and collector of the IGBT is monitored. If this voltage exceeds 10 V for 4 microseconds, a desaturation fault will be enunciated. An RC integrator with a 4 microsecond time constant in the desaturation monitor circuit prevents erroneous desaturation faults. When a desaturation fault occurs, the BPIB board operates the DSFC board in a "burst" mode where a 2 MHz PWM signal is used to slowly bring the gate voltage down to zero (within 2 to 5 microseconds).
- **Undervoltage Fault:** The voltage between the positive driver power supply (+15V, MLP15 & MUP15) and negative driver power supply (–15V, MLN15 & MUN15) is also monitored. If the voltage between the +15 and –15 V supplies drops below 20 V, an undervoltage fault will occur.

These two faults are logically ORed together and optically coupled to a differential driver interface to the control logic. The optocoupler in the OK state will be ON (output low).

The turn ON command signal to the gate drive is differential. Applying 5 V to the control lines will turn one of the drivers ON.

Reversing the 5V polarity will turn OFF the device that was ON and turn ON the driver that was OFF.

When the drive is initially powered-up, both control lines are held at the same potential in order to set the upper and lower gate drive circuits in the OFF state. Also, when the drive is operating, both control lines are held at the same potential for a period of time (dwell time) to assure that the upper or lower IGBTs of a phase leg have turned OFF before others are commanded to turn ON. The dwell time is controlled by the BPIB board.

Desaturation/Undervoltage Fault Reporting

Upper/Lower fault signals are multiplexed. A fault condition is represented by a 0 V differential voltage between UFMN and LFMP (U = Upper, L = Lower).

- **Fault: U On / L Off**
  UFMN = +(5)
  LFMP = +(5)
- **Fault: U Off / L On**
  UFMN = -(0)
  LFMP = -(0)
- **No Fault: U On or Off/ L On or Off**
  UFMN = -(0)
  LFMP = +(5)

Shunt Current Feedback

Output phase current is monitored by deriving a VCO output signal from the voltage dropped across the phase shunt. This voltage is amplified and then passed on to the VCO circuitry. The VCO has a range of 0–2 MHz and the circuit is biased so that at zero current the nominal output is 1 MHz. A ±200 mV shunt voltage is converted into a ±800 KHz change in the VCO output frequency. The output of the VCO is optically coupled to a differential driver interface to the control logic.

Two faults can be generated by the current feedback circuit, DI/DT and Instantaneous Overcurrent (IOC).

- DI/DT Fault: A 100% or greater step change of the rated shunt current will cause a DI/DT fault to be reported within 25 microseconds.
- IOC Fault: An IOC fault is reported if the current exceeds 250% rated current.

These two faults are logically ORed together and optically coupled to a differential driver interface to the control logic.

Power Supplies

The high voltage side of each of the driver/monitor circuits is powered by an isolation transformer.

- The primary of this transformer is connected to a ±17.7 volt peak (35.4 volt peak to peak), 25 kHz square wave.
- Two of the three secondaries are halfwave rectified and filtered to provide the isolated +15 V (VCC) and –15 V (VEE) required by the upper and lower IGBT driver circuits (unregulated, ±5%*, 1 A average maximum for each voltage).
- The third secondary is fullwave rectified and filtered to provide an isolated ±12 V required by the shunt current feedback VCO and fault detection circuitry (unregulated, ±10%, 100 mA average maximum for each voltage).

The shunt circuit also requires a light 5 V logic supply that is generated by a 5 V linear regulator connected to the +12 V supply (±10%, 100 mA average maximum). Only the 5 V power supply is regulated.

Maximum load is as follows:

±17.7 V 0.65 A rms
+5 V 150 mA

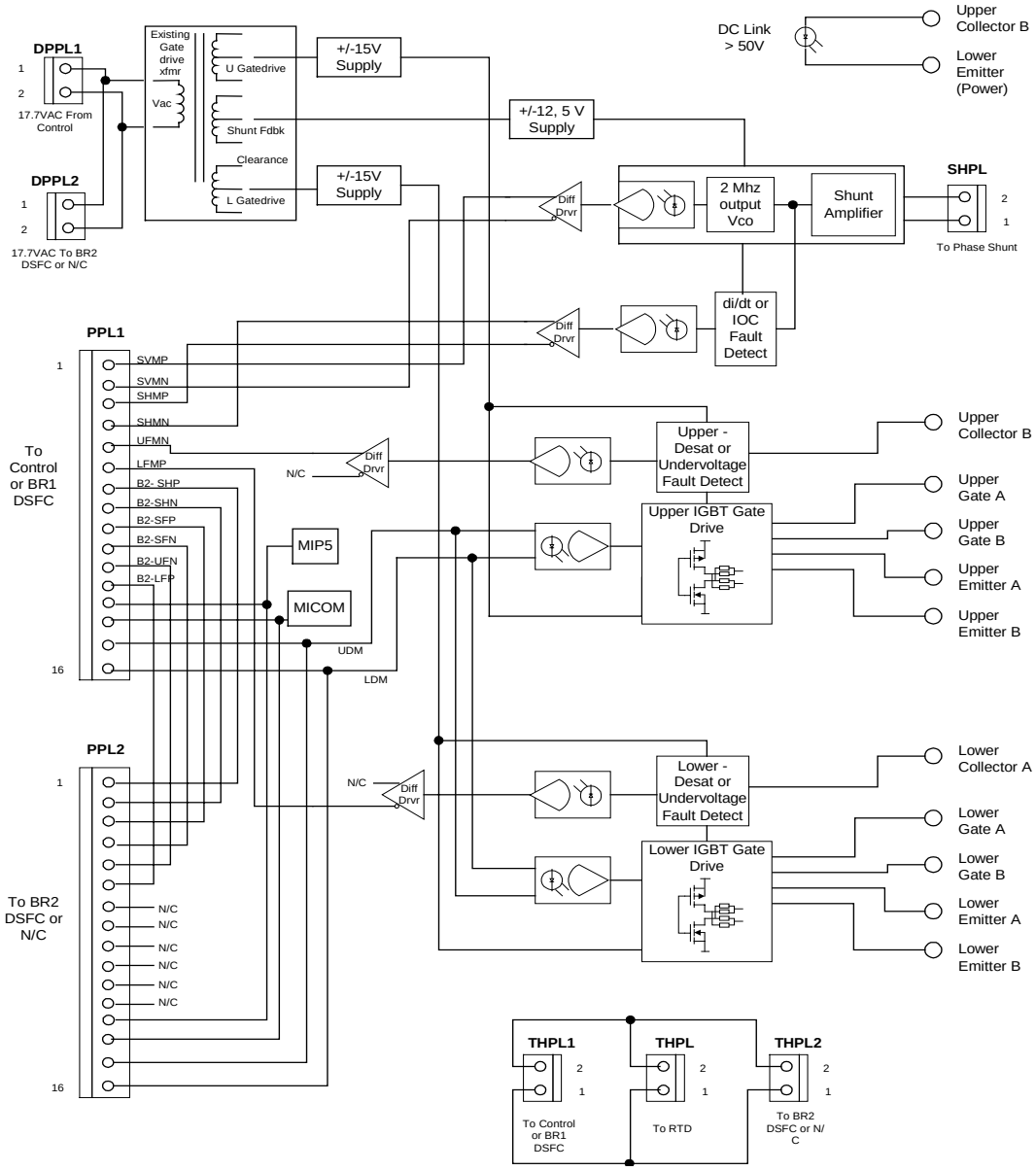

Figure 1. DSFC Board Block Diagram

Application Data

The DSFC board contains plug and stab-on connectors, mounting eyelet connectors (to the IGBT), and LED indicators, as part of the board. There are no configurable hardware items or fuses as part of the board. Refer to Figure 2 for a DSFC board layout diagram that shows the location of major board components.

Connectors

Dc link voltages and the output phase voltage sensing line are connected to stab-on terminals. See Table 1 for stab-on terminal descriptions.

All connections to the IGBTs are made with the mounting hardware through the mounting eyelets in the DSFC board. See Table 2 for mounting eyelet connection descriptions.

All other inputs/outputs (I/O) for the DSFC board are made at eight plug connectors, PPL1, PPL2, SHPL, THPL, THPL1, THPL2, DPPL1 and DPPL2. See Figure 2 for connector locations and Tables 3 thru 7 for connector pin descriptions.

- Table 3 PPL1 Connector
- Table 4 PPL2 Connector
- Table 5 SHPL Connector
- Table 6 THPL, THPL1, THPL2 Connectors
- Table 7 DPPL1 and DPPL2 Connectors

LED Indicators

There are five LED indicators on the DSFC board, DS1, DS2, DS3, DS4, and DS5. These LEDs indicate status of the dc link (DS1) and upper and lower IGBT driver status (DS2 – DS5). See Figure 2 for the locations of the LEDs and Table 9 for descriptions.

Table 1. Stab Connections

Stab	Nomenclature	Description
E1	MVFB	Output phase voltage sensing line
E17	DCLP	Dc link voltage, positive
E18	DCLN	Dc link voltage, negative

Table 2. DSFC Board Eyelet Connections To IGBTs

Board Eyelet	Description
UC	Upper Collector Link Positive
UGA	Upper A Device Gate (captive fastener)
UEA	Upper A Device Emitter (captive fastener)
UGB	Upper B Device Gate (captive fastener)
UEB	Upper B Device Emitter (captive fastener)
LGA	Lower A Device Gate (captive fastener)
LEA	Lower A Device Emitter (captive fastener)
LGB	Lower B Device Gate (captive fastener)
LEB	Lower B Device Emitter (captive fastener)
LE	Lower Emitter Link Negative

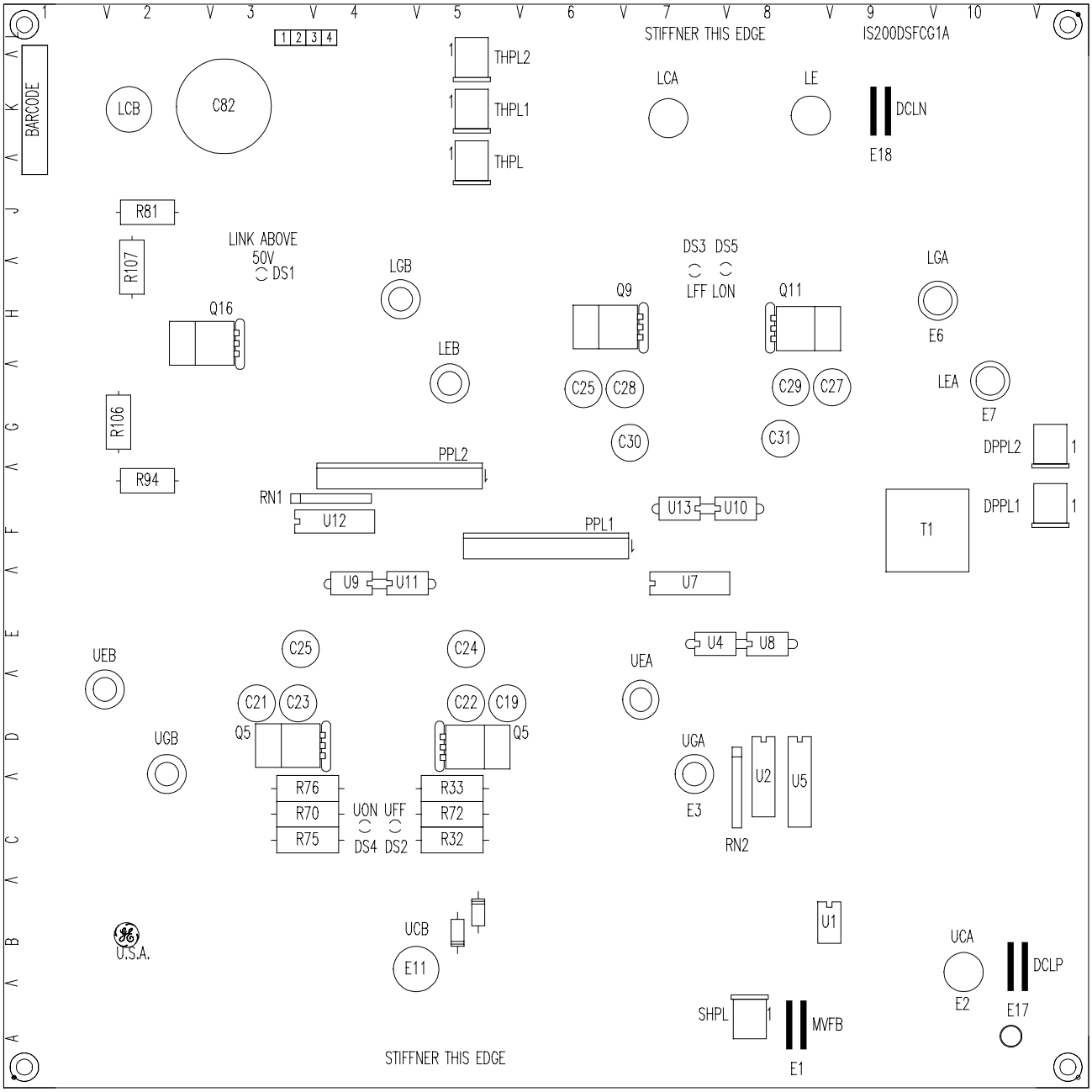

Figure 2. DSFC Board Layout Diagram

Table 3. PPL1 Connector, Phase Interface I/O With IS200BPIB Drive Bridge Personality Interface Board (BPIB)

Pin	Description
1	SVMP, Shunt VCO Positive BR1
2	SVMN, Shunt VCO Negative BR1
3	SHMP, Shunt Fault Positive BR1
4	SHMN, Shunt Fault Negative BR1
5	UFMN, Upper Fault Negative BR1
6	LFMP, Lower Fault Positive BR1
7	Shunt VCO Positive BR2 (from "daisy chained" DSFC - PPL2)
8	Shunt VCO Negative BR2 (from "daisy chained" DSFC - PPL2)
9	Shunt Fault Positive BR2 (from "daisy chained" DSFC - PPL2)
10	Shunt Fault Negative BR2 (from "daisy chained" DSFC - PPL2)
11	Upper Fault Negative BR2 (from "daisy chained" DSFC - PPL2)
12	Lower Fault Positive BR2 (from "daisy chained" DSFC - PPL2)
13	MIP5, Interface +5 V
14	MICOM, Interface Common
15	UDM, Upper Drive Signal
16	LDM, Lower Drive Signal

Table 4. PPL2 Connector, Phase Interface I/O With "Daisy Chained" DSFC Board

Pin	Description
1	SVMP, Shunt VCO Positive BR2
2	SVMN, Shunt VCO Negative BR2
3	SHMP, Shunt Fault Positive BR2
4	SHMN, Shunt Fault Negative BR2
5	UFMN, Upper Fault Negative BR2
6	LFMP, Lower Fault Positive BR2
7	Not Connected
8	Not Connected
9	Not Connected
10	Not Connected
11	Not Connected
12	Not Connected
13	MIP5, Interface +5 V
14	MICOM, Interface Common
15	UDM, Upper Drive Signal
16	LDM, Lower Drive Signal

Table 5. SHPL Connector, Shunt Input Connection To Current Shunt

Pin	Description
1	MSHM, Shunt Motor Side Connection
2	MSCOM, Shunt Bridge Side Connection

Table 6. THPL, THPL1, and THPL2 Connectors, Resistance Thermal Detector (RTD) Connections To RTD Or Pass-Through Connection To BPIB For "Daisy Chained" DSFC Board Or Connection To "Daisy Chained" DSFC Board

Pin	Description
1	MTD, RTD Source
2	MTR, RTD Return

Table 8. DPPL1 and DPPL2 Connectors, 18.4 V AC Peak Squarewave Power Connection From BPIB Or Pass-Through Connection From BPIB For "Daisy Chained" DSFC Board

Pin	Description
1	MVAC1
2	MVAC2

Table 9. DSFC LED Indicators

LED	Nomenclature	Description
DS1	LINK ABOVE 50V	Link Monitor Red LED ON: DC Link greater than 50 V OFF: DC Link less than 50 V
DS2	UFF	Upper Driver Monitor Green LED ON: Upper IGBTs driven OFF OFF: Upper IGBTs driven ON
DS3	LFF	Lower Driver Monitor Green LED ON: Lower IGBTs driven OFF OFF: Lower IGBTs driven ON
DS4	UON	Upper Driver Monitor Yellow LED ON: Upper IGBTs driven ON OFF: Upper IGBTs driven OFF
DS5	LON	Lower Driver Monitor Yellow LED ON: Lower IGBTs driven ON OFF: Lower IGBTs driven OFF

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 *DSFC* board is described as the *IGBT Gate Driver/Shunt Feedback* board.

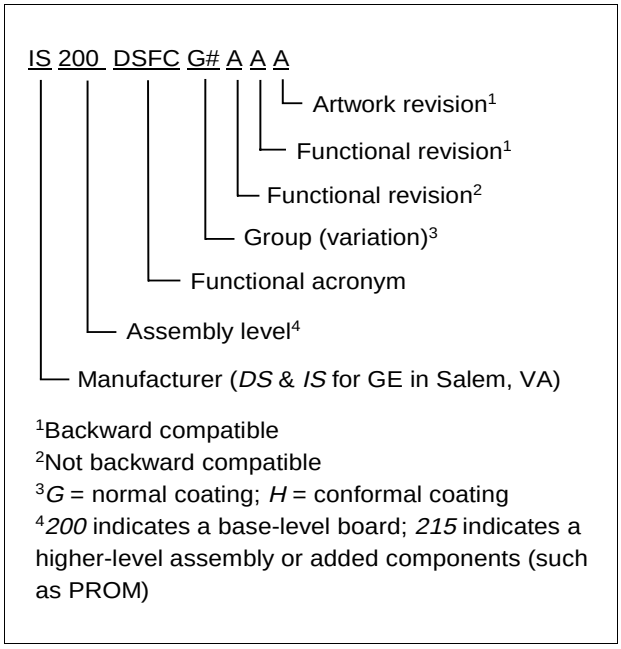

Figure 3. Board Part Number Conventions

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: + 1 540 387 7595
Fax: + 1 540 387 8606
("+" indicates the international access code required when calling from outside of the USA.)

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 (ML) 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.

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:

- Store boards in antistatic bags or boxes.
- 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.

To replace a DSFC board:

1. **Turn off the power to the drive**, then wait several minutes for all the capacitors to discharge. Test any electrical circuits before touching them to ensure the power is off.
2. Open the appropriate drive cabinet door to access the DSFC boards.
3. Carefully disconnect all cables from the DSFC board to be replaced as follows:
   - Verify cables are labeled with the correct connector name (as marked on the board) to simplify reconnection.
   - For ribbon cables, grasp each side of the cable connector that mates with the board connector and gently pull the cable connector loose.
   - For cables with pull tabs, carefully pull the tab.
4. Remove the ten nuts at the eyelet connections that secure the DSFC board to the IGBTs. (See Figure 2 for eyelet connection/nut locations.)

CAUTION

Avoid dropping mounting hardware into the unit, which could cause damage.

5. Remove the old DSFC board from the mounting studs of the IGBTs.
6. Orient the new DSFC board in the same position as the one removed, install it onto the mounting studs of the IGBTs, and secure with the ten nuts removed in step 4. Torque these nuts to 70 inch lbs.
7. Reconnect all cables to DSFC board as labeled and ensure that cables are properly seated at both ends.
8. Close all drive and equipment cabinet doors.

Notes:

GE Industrial Control Systems

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