



GEI-100509C

# EX2100 and EX2100e Excitation Control Exciter Attenuation Module (EXAM) Instruction Guide

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## Safety Symbol Legend

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

***Warning***

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

***Caution***

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Indicates a procedure, condition, or statement that should be strictly followed to improve these applications.

***Attention***

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**Warning**

To prevent personal injury or damage to equipment, follow all GE safety procedures, LOTO, and site safety procedures as indicated by EHS.

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**Warning**

This equipment contains a potential hazard of electric shock, burn, or death. Only personnel who are adequately trained and thoroughly familiar with the equipment and the instructions should install, operate, or maintain this equipment.

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**Warning**

Isolation of test equipment from the equipment under test presents potential electrical hazards. If the test equipment cannot be grounded to the equipment under test, the test equipment's case must be shielded to prevent contact by personnel. To minimize hazard of electrical shock or burn, approved grounding practices and procedures must be strictly followed.

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**Warning**

To prevent personal injury or equipment damage caused by equipment malfunction, only adequately trained personnel should modify any programmable machine.

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**Warning**

Always ensure that applicable standards and regulations are followed and only properly certified equipment is used as a critical component of a safety system. Never assume that the HMI or the operator will close a safety critical control loop.

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## EX2100 Excitation Control

### Functional Description

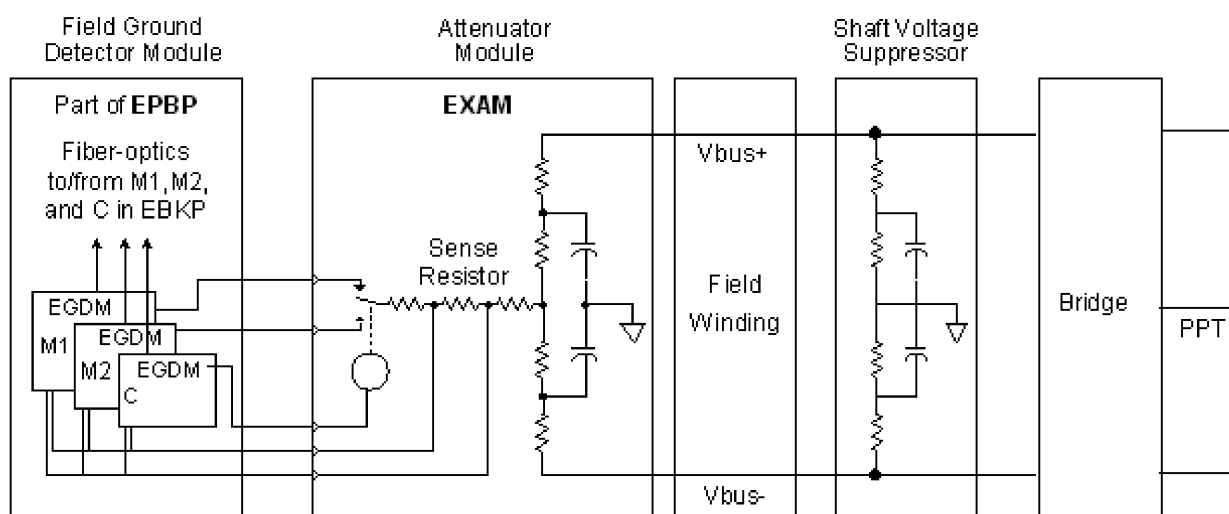
The Exciter Attenuation Module IS200EXAM (EXAM), combined with the Exciter Ground Detector Module IS200EGDM (EGDM), provides the ground detection system for the EX2100 Excitation Control. The EXAM mounts in the High Voltage Interface (HVI) module that is located in the auxiliary cabinet. It provides attenuation between the field bus and the EGDM by sensing high voltage from the bridge and scaling the voltage to a usable level.

The EXAM and EGDM(s) are connected through the Exciter Power Backplane IS200EPBP (EPBP). A single 9-pin cable connects the EXAM to the EPBP. The EGDM plugs into the EPBP through a 96-pin connector, P2.

Only one EXAM is required for simplex and triple modular redundant (TMR) applications and the interconnection is the same. The following figure displays a typical EX2100 ground detection system diagram.

In some EX2100e applications, the EXAM board interfaces to the exciter/regulator options board (ERO) instead of to the EGDM board. The ERO and EGDM provide equivalent ground detector functionality. Computational power for the EX2100 ground detector is provided by the Digital Signal Processor Control Board (DSPX).

The EXAM board is also applied in a stand-alone simplex ground detector product, PGDM. The PGDM contains a processor board BPPB, an acquisition board BFGD, and interfaces to the ground detector terminal board BGTB. These boards provide similar functionality to the EX2100-based boards.



EX2100 Ground Detection System

The field voltage ( $V_{bus+}$  and  $V_{bus-}$ ) varies from 125 V dc to 1000 V dc and the ac line-to-line voltages power potential transformer (PPT) vary from 120 to 1300 V ac rms.

The EXAM has two variations of filter capacitance that are selectable through jumpers JP1 and JP2:

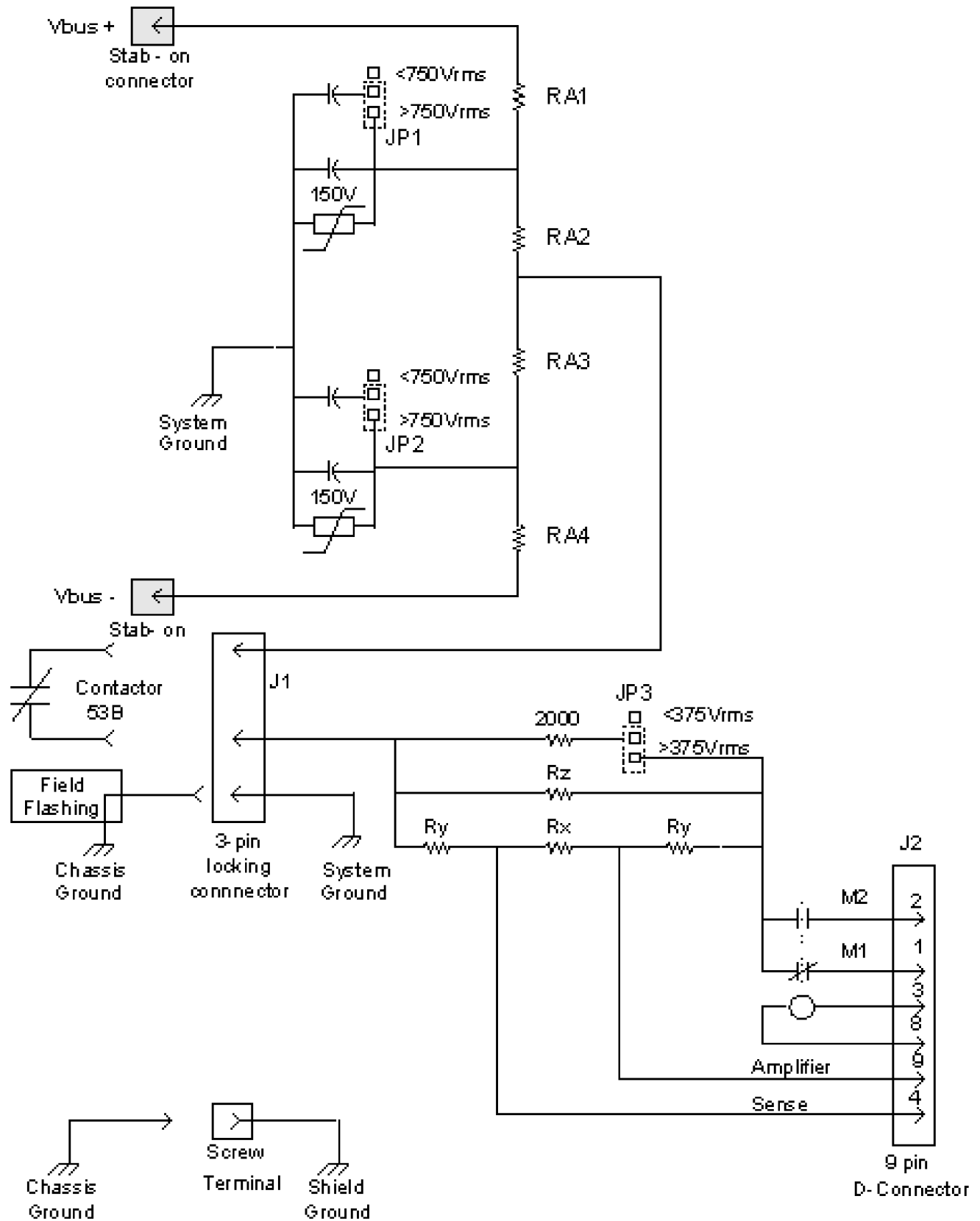
- PPT voltages less than 750 V rms
- PPT voltages greater than 750 V rms

With the field ground test activated, the bus voltage is distributed across the attenuation resistors (RA1 – RA4) and sense resistors (Rx, Ry, Rz). The test can last up to 10 seconds. With an ac bus dead short to ground, the entire bus voltage will be present across a single section of the attenuation resistors. In the event of a dead short, a fault is generated and the exciter is shut down within 10 seconds.

The activation for the field ground test and master selection is controlled by the EGDM. The EGDM controls a relay located on the EXAM. The relay has a 24 V dc coil with diode suppression and requires less than 20 mA to operate. The default state for the relay is de-energized and feeds back to the *M1* section in the TMR control, or to the only control in a simplex application. An energized relay will feed back to the *M2* section of the TMR control.

In TMR applications, a set of three EGDMs are configured as controller (C), Master 1 (M1), and Master 2 (M2). Each EGDM is automatically configured through the program pins of the 96-pin P2 connector in the EPBP. Information on which master provides the 50 V dc square-wave signal to the sense resistor in the EXAM is sent from the DSPX board to the EGDM C. The EGDM C then either powers the relay in the EXAM if *M2* is the master, or leaves it unpowered if *M1* is the master. At the same time a differential signal is sent to *M1* and *M2* that indicates the chosen master. This signal enables the signal generator on the active master and selects the test command source on each EGDM (*M1*, *M2* and *C*). The active master sends a positive or negative 50 V ac square-wave signal to the EXAM, which is applied to one end of the sense resistor (Rx).

A block diagram of the EXAM is displayed in the following figure. Connector J2 carries the square wave signal to the EXAM and the sense resistor signals back to the EGDM. The square wave signal is removed during field flashing.



EXAM Board Block Diagram



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## Application Data

The EXAM module does not include any testpoints, fuses, or LED indicators. The module includes two plug connectors, two stab-on connectors, a ground connection terminal, and three adjustable jumpers as follows:

- Connector J2 is a 9-pin D connector for the test signal, relay control, and leakage current
- Connector J1 is a 3-pin locking connector for the cable to the field flashing relay auxiliary contact
- Stab-on connectors E1 and E2 connect the field bus voltages to the attenuator module
- Terminal TB1 is the connection point for the EXAM board shield ground to the chassis ground in the cabinet
- Jumpers JP1, JP2, and JP3 configure the module for the various PPT secondary voltages that can be applied

Refer to the following tables for connector pin signal and jumper placement information:

| Pin Number | Description                  |
|------------|------------------------------|
| 1          | Connector J2                 |
| 2          | Connector J1                 |
| 3          | Stab-on connectors E1 and E2 |
| 4          | Jumper positions             |

*J2 Ground Detect Connector*

| Pin | Signal                            |
|-----|-----------------------------------|
| 1   | M1 +/-50 V dc                     |
| 2   | M2 +/-50 V dc                     |
| 3   | Relay Power                       |
| 4   | Sense attenuator                  |
| 5   | N/C                               |
| 6   | N/C                               |
| 7   | Test Relay (EX2100e control only) |
| 8   | Select Relay                      |
| 9   | Sense amplifier                   |

*J1 Connector Pin Description*

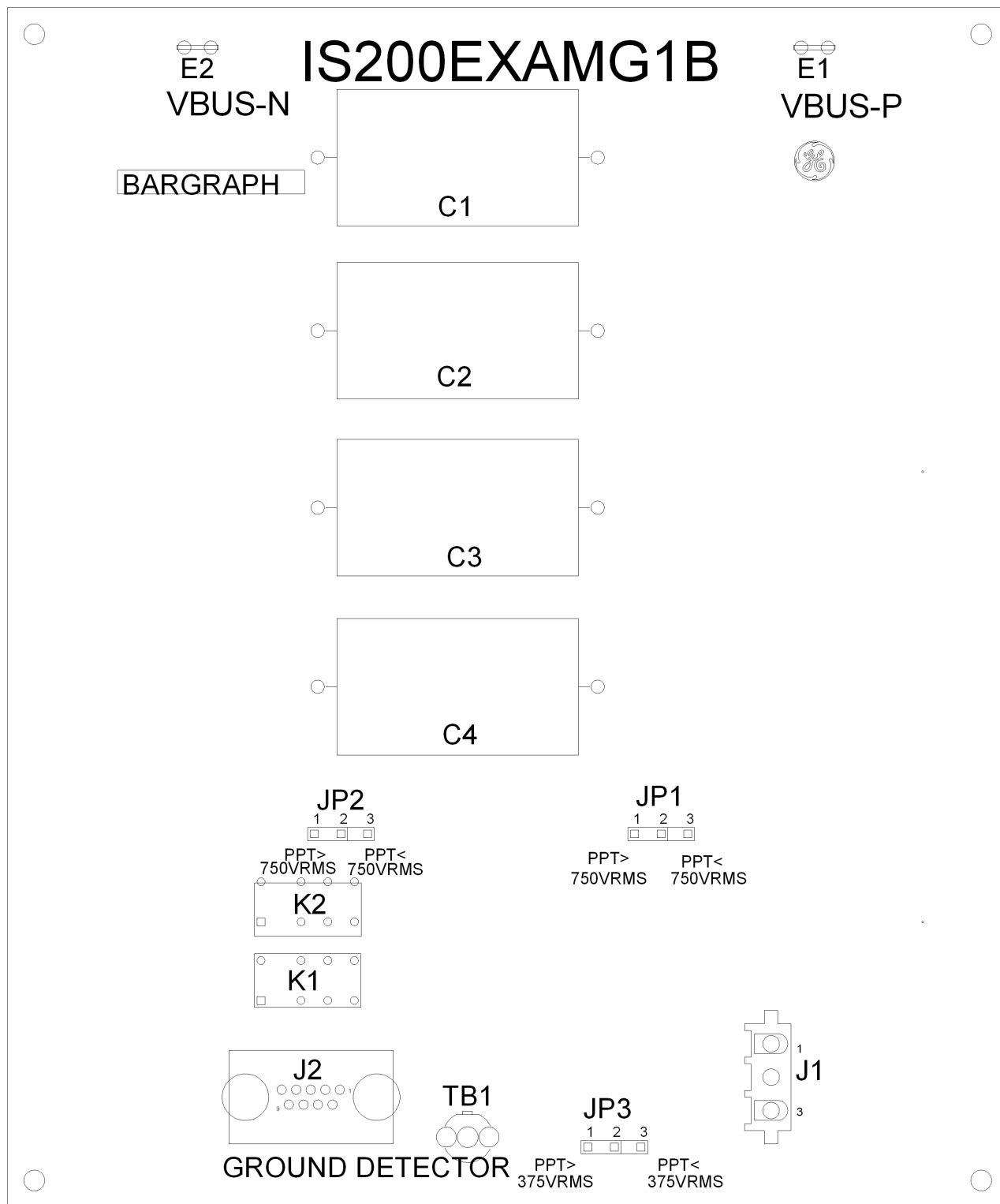
| Pin Number | Nomenclature     | Description                                                          |
|------------|------------------|----------------------------------------------------------------------|
| 1          | 53B Contact High | Voltage from field bus resistors to flashing relay auxiliary contact |
| 2          | 53B Contact Low  | Voltage from flashing relay auxiliary contact to sense resistor      |
| 3          | System Ground    | System Ground                                                        |

*E1 and E2 Stab-on Connector Descriptions*

| Connector | Nomenclature | Description                     |
|-----------|--------------|---------------------------------|
| E1        | VBUS-P       | Positive voltage from field bus |
| E2        | VBUS-N       | Negative voltage from field bus |

*JP1 — JP3 Jumper Position Descriptions*

| Jumper   | Nomenclature                       | Description                                              |
|----------|------------------------------------|----------------------------------------------------------|
| JP1, JP2 | PPT > 750 V rms<br>PPT < 750 V rms | Jumper across pins 1 and 2<br>Jumper across pins 2 and 3 |
| JP3      | PPT > 375 V rms<br>PPT < 375 V rms | Jumper across pins 1 and 2<br>Jumper across pins 2 and 3 |



EXAM Board Layout Diagram

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## Board Replacement

Replacement parts may contain static-sensitive components. Therefore, GE ships replacement parts in anti-static bags. When handling electronics, make sure to store them in anti-static bags or boxes and use a grounding strap (per the following Caution criteria).



### Caution

To prevent component damage caused by static electricity, treat all boards with static sensitive handling techniques. Wear a wrist grounding strap when handling boards or components, but only after boards or components have been removed from potentially energized equipment and are at a normally grounded workstation.

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### Warning

To prevent personal injury or damage to equipment, follow all GE safety procedures, LOTO, and site safety procedures as indicated by EHS.

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### Warning

This equipment contains a potential hazard of electric shock, burn, or death. Only personnel who are adequately trained and thoroughly familiar with the equipment and the instructions should install, operate, or maintain this equipment.

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## Replacement Procedures

*The failed board should be returned to GE for repair. Do not attempt to repair it on site.*

The EXAM board is located in the auxiliary cabinet. It cannot be maintained online.

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### Warning

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

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### Caution

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

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➤ **To replace the board in an EX2100 or EX2100e excitation control**

1. Make sure that the exciter has been de-energized. Refer to *GEH-6631, EX2100 Installation and Startup Guide* and *GEH-6780, EX2100eThyristor Control Installation and Startup Guide*, for complete de-energizing procedures and follow all local practices of lockout/tagout).
2. Open the auxiliary cabinet door, and using equipment designed for high voltages, test any electrical circuits **before touching them** to ensure that power is off.
3. Carefully disconnect all cables from the EXAM board as follows:
  - a. Verify all cables are labeled with the correct connector name (as marked on the board) to simplify reconnection.
  - b. Disconnect the two stab-on connectors, the J1 and J2 connectors, and the wire to TB1.



**Avoid dropping any mounting hardware into the equipment as this could cause damage or personal injury when power is reapplied.**

***Warning***

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4. Carefully unseat the board from the mounting pins and remove the board from the Glastic® bracket
5. Check that the jumpers JP1 – JP3 on the new EXAM module are set correctly, the same as the original board.
6. Seat the replacement board firmly onto the Glastic bracket.
7. Reconnect the cables that were disconnected in step 3 and tighten.
8. Close the auxiliary cabinet door.

➤ **To replace the board in a PGDM module**

1. Be sure all sources of power including both the PGDM and the protected excitation equipment have been de-energized.
2. Follow steps 2-7 above.

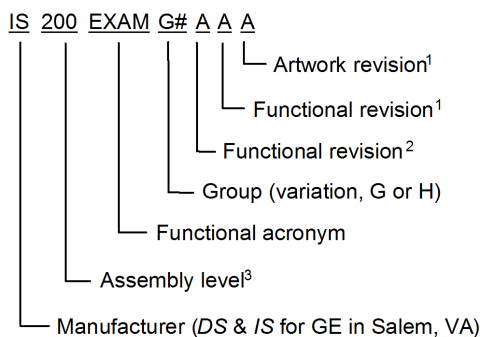
## Ordering Board

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

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

### Board Identification

A printed wiring board is identified by an alphanumeric **part (catalog) number** located near its edge. The board's functional acronym, displayed below, is normally based on the **board description**, or name.



<sup>1</sup>Backward compatible

<sup>2</sup>Not backward compatible

<sup>3</sup>200 indicates a base-level board; 215 indicates a higher-level assembly or added components (such as PROM)

#### Board Part Number Conventions

### Placing the Order

When ordering, be sure to include the following items:

- Complete part number and description
- Serial number
- Material List (ML) number

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**Note** All digits are important when ordering or replacing any board. The factory may substitute newer board versions based on availability and design enhancements, however, GE Energy ensures backward compatibility of replacement boards.

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*Renewals/spares (or those not under warranty) should be ordered by contacting the nearest GE Sales or Service Office, or an authorized GE Sales Representative.*



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