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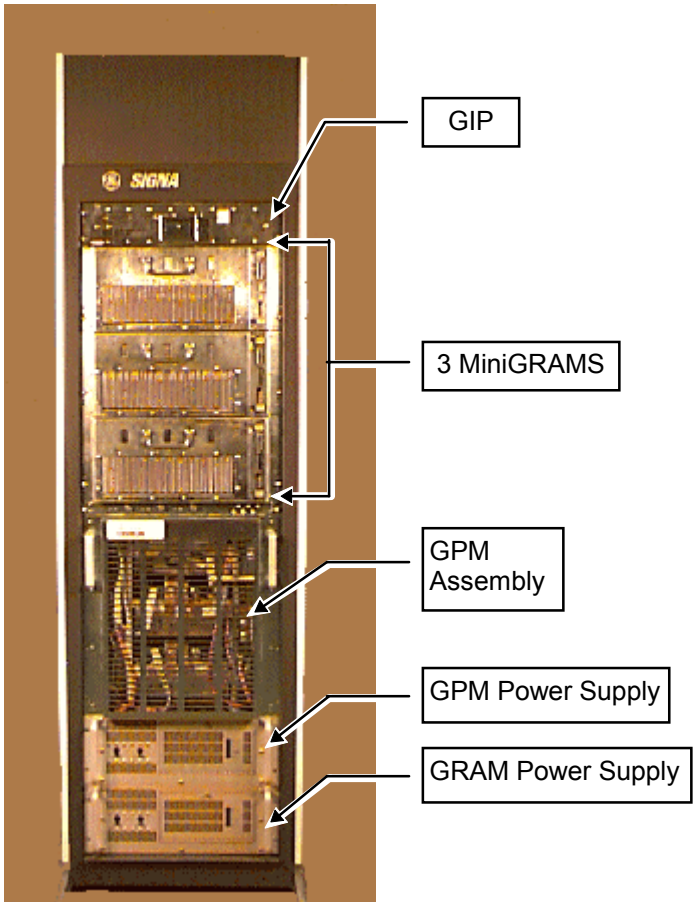
SGD HI SLEW - PROBLEM ISOLATION

1- DESCRIPTION

There are some problems in the gradient driver system that cannot be isolated to a particular axis by diagnostics or symptom analysis. Isolating to a replaceable FRU may require swapping of hardware between axes and regenerating the problem. The following procedures give instructions on how to swap the various FRU's between axes.



SGD - HI SLEW CABINET POWER SUPPLIES
ILLUSTRATION 1-1

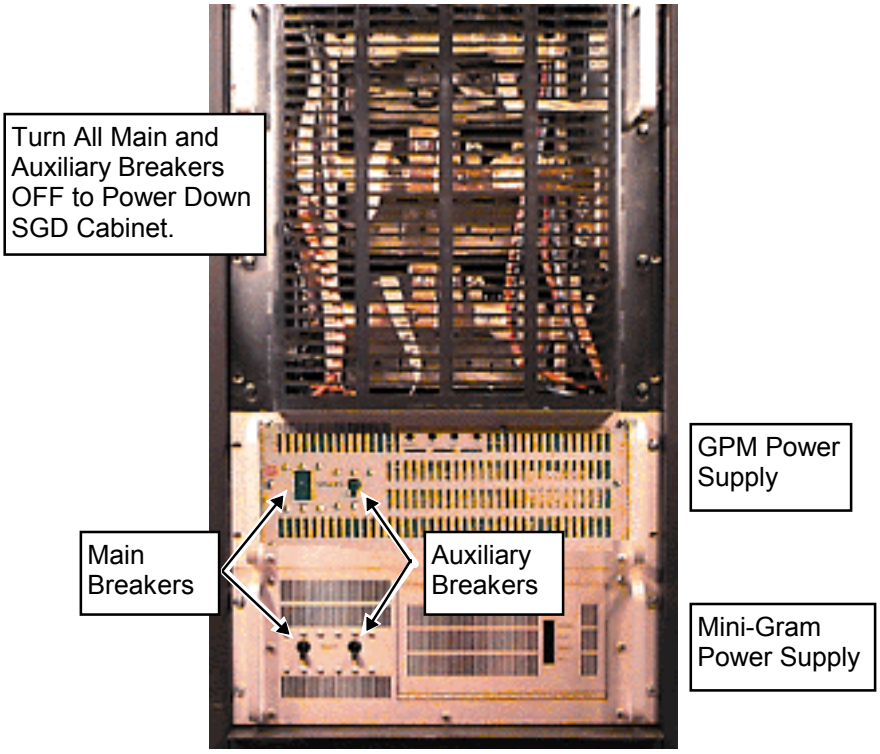
1-1 Preliminary Set Up Procedure

Proper Lockout and Tagout procedures must be followed while troubleshooting to isolate a problem in the gradient driver system. Follow the steps below to safely remove power to the Hi Slew Cabinet before troubleshooting.

DANGER!!

FATAL ELECTRIC SHOCK HAZARD!! TO PREVENT FATAL ELECTRIC SHOCK, DISCONNECT POWER FROM THE PDU BEFORE YOU PERFORM THE FOLLOWING PROCEDURES. PERFORM LOCKOUT / TAGOUT PROCEDURE PER GE OSHA LOCKOUT / TAGOUT REQUIREMENTS 29 CFR 1910.147. DO THIS BY SECURING THE PDU CIRCUIT BREAKER FOR THE SCALEABLE GRADIENT CABINET.

1. Power down the SGD Cabinet by turning off the Main Breakers and Auxiliary Breakers on the Front Panel of **both** the GRAM-PS and the GPM-PS. See Illustration 1-2



SGD HI-SLEW CABINET—LOWER HALF (FRONT COVER REMOVED)
ILLUSTRATION 1-2

2. Turn off the SGD Cabinet Breaker at the Power Distribution Unit. Lock out the Breaker and tag it.

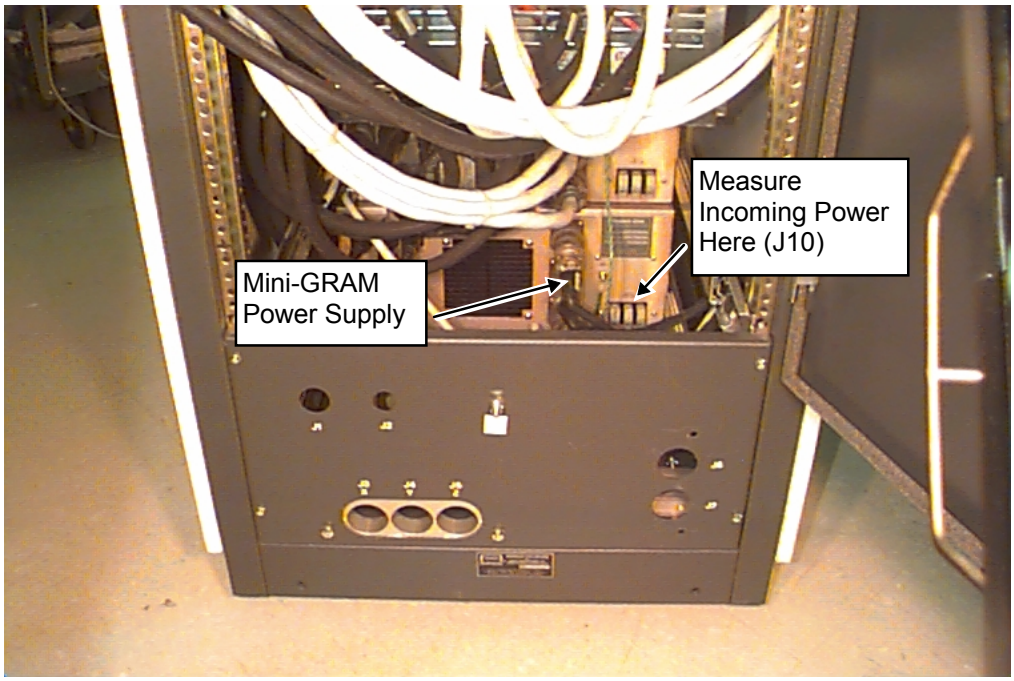
3. After power to the SGD Cabinet has had sufficient time to dissipate, take a Digital Multimeter and set it to its highest AC voltage range.

4. Verify that all energy has been dissipated by measuring incoming power to all components of the SGD Cabinet by following steps 5 & 6.

1-1 Preliminary Set Up Procedure (continued)

5. Measure incoming power to the GRAM-PS as follows:

   - Place the reference probe (black) on the SGD Cabinet Ground.
   - Locate J10. This is the 208V, 3 Phase input to the GRAM-PS.
   - Measure voltage at each of three 208 Volt input terminals. The meter should read 0 Volts AC at each of the three measuring points. See Illustration 1-3.

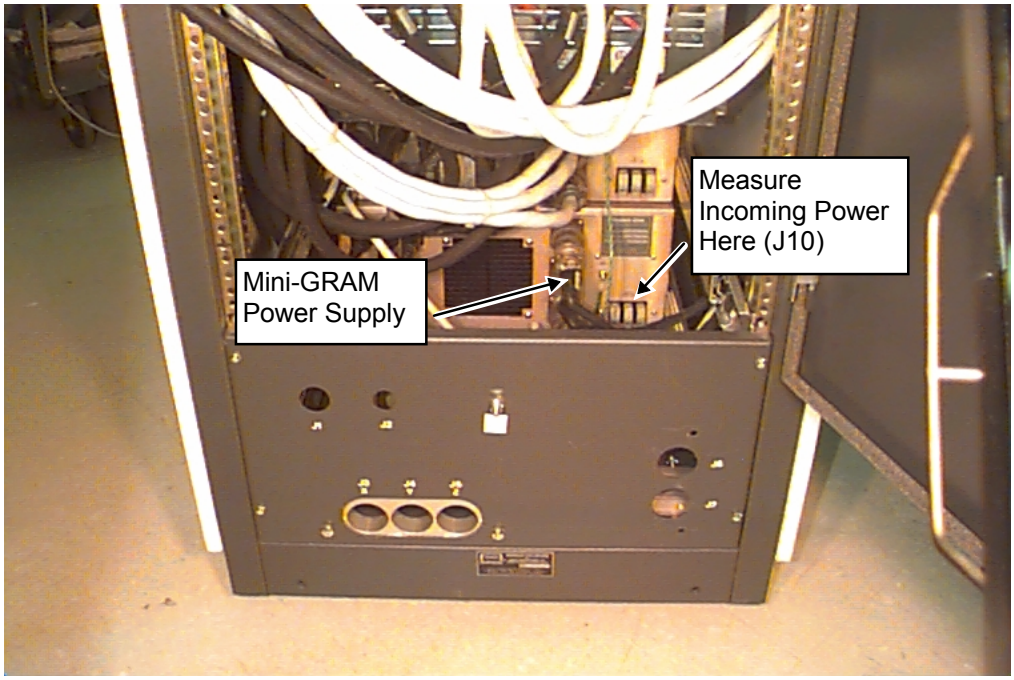


SGD CABINET—REAR VIEW: INCOMING POWER MEASUREMENT LOCATIONS
ILLUSTRATION 1-3

1-1 Preliminary Set Up Procedure (continued)

6. Measure voltage at the GPM-PS as follows:

- Place the reference probe (black) on the SGD Cabinet Ground.
- Locate J-10. This is the 208V, 3 Phase input to the GPM-PS.
- Place the red probe on each of three 208 Volt input terminals: L1, L2, and L3. The meter should read 0 Volts AC at each of the 3 measuring points. See Illustration 1-4.



SGD CABINET—REAR VIEW: INCOMING POWER MEASUREMENT LOCATIONS
ILLUSTRATION 1-4

2- SWAPPING INSTRUCTIONS

2-1 GIP Module

The Gradient Interface Processor (GIP) receives digital data from the IPG Board in the Systems Cabinet. This digital data is 3 separate channels (one per gradient axis) and is converted to analog on the GIP Board. The analog waveforms are then sent to the Main Boards of the Gradient Power Module (GPM) and to the miniGRAM's. The following table lists the inputs and outputs of the GIP. All input and output cables connect to the back of the GIP.

AXIS	INPUT FROM IPG BOARD	OUTPUTS TO GPM	OUTPUTS TO MINGRAM'S
X axis	J2	J7	J8
Y axis	J3	J9	J10
Z axis	J4	J11	J12

2-2 MINIGRAM'S

The miniGRAM's provide additional voltage to accelerate the ramps of the gradient waveforms that will be sent to drive the gradient coil. There is one miniGRAM per axis and the cables inside the cabinet have sufficient length to reach a neighboring miniGRAM. You may have to cut some tywraps that are used to dress the cables to gain enough length to swap them between miniGRAM's.

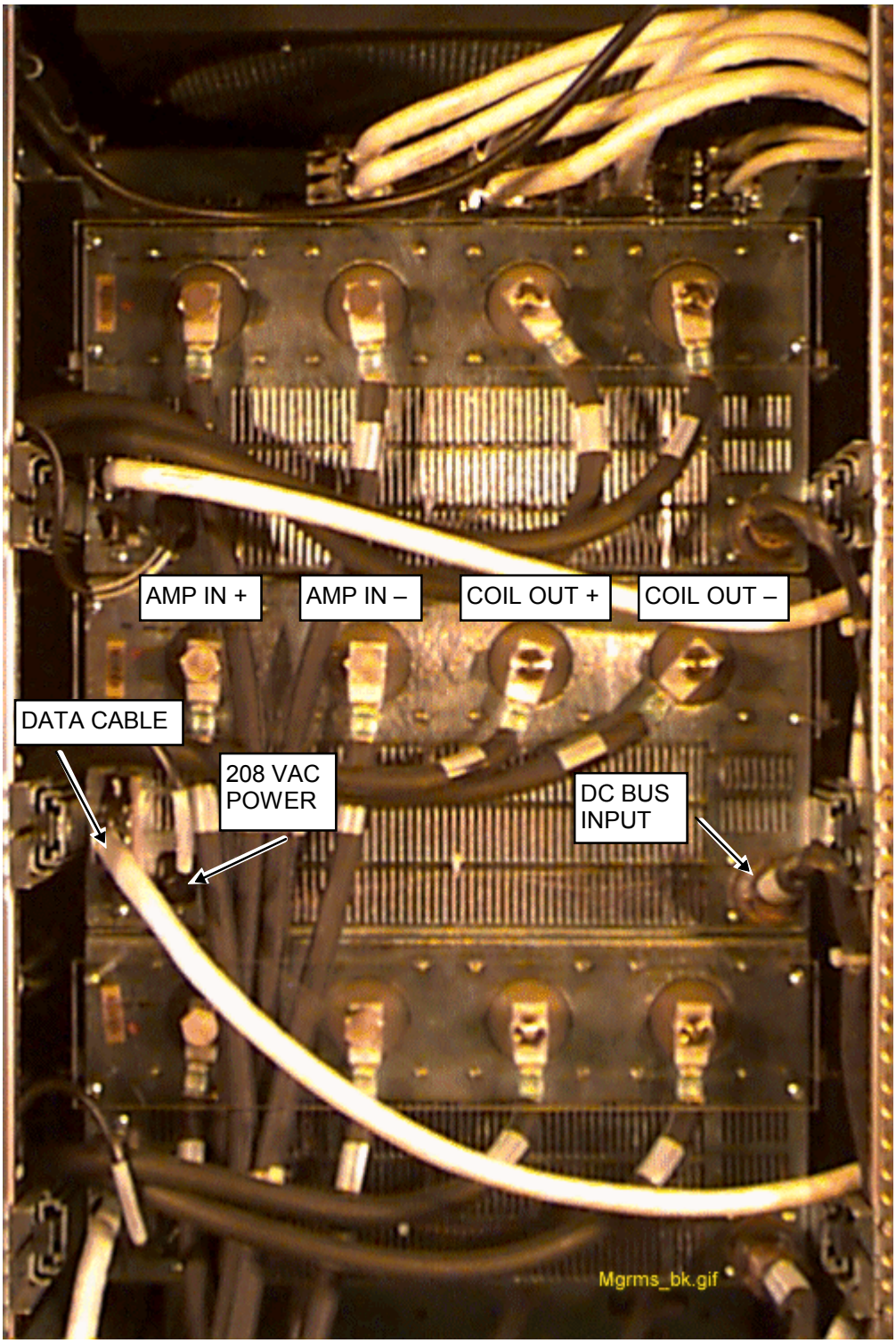
Note

The X (top-most) and Z (bottom-most) miniGRAM's cannot be swapped because the Z output cables are not long enough to reach the X miniGRAM.

The input, output, and power cables should be swapped between miniGRAM's. **Important: When swapping GRAM's between axes, all cables must be swapped.** See Illustration 2-1 for picture of the miniGRAM cabling.

The Control Boards and Gate Driver Boards are also FRU's within the miniGRAM. If a problem is isolated to a miniGRAM, these boards can be swapped between miniGRAM's to verify a possible failure to one of the boards.

2-2 MINIGRAM'S (continued)



MINIGRAM CABLING
ILLUSTRATION 2-1

2-3 GPM

The GPM is a 3 channel voltage amplifier that amplifies the analog waveforms from the GIP. There are voltage monitor BNC jacks that can be scoped to view the analog output voltage waveforms on the front of the GPM. There are several FRU's within the GPM that can be replaced.

Cables at the rear of the GPM can be swapped to verify a problem follows the GPM. After isolating a problem to the GPM follow these instructions to isolate to a sub-FRU within the GPM. The GPM can be pulled completely out of the cabinet on slide rails to accommodate troubleshooting.

Equipment Damage Caution! Do not run the SGD cabinet with the GPM pulled out. The cabinet cooling is not effective unless all modules are fully installed. It is essential that the back door is closed.

2-3-1 GPM Power Supply

The GPM Power Supply supplies the high voltage power to the GPM. There are 3 identical outputs (one per GPM axis). These can easily be swapped at the back of the GPM-PS to try and isolate a power supply problem. See table following for output power connections from the GPM-PS to the GPM.

AXIS	CONNECTION
X	J7
Y	J8
Z	J9

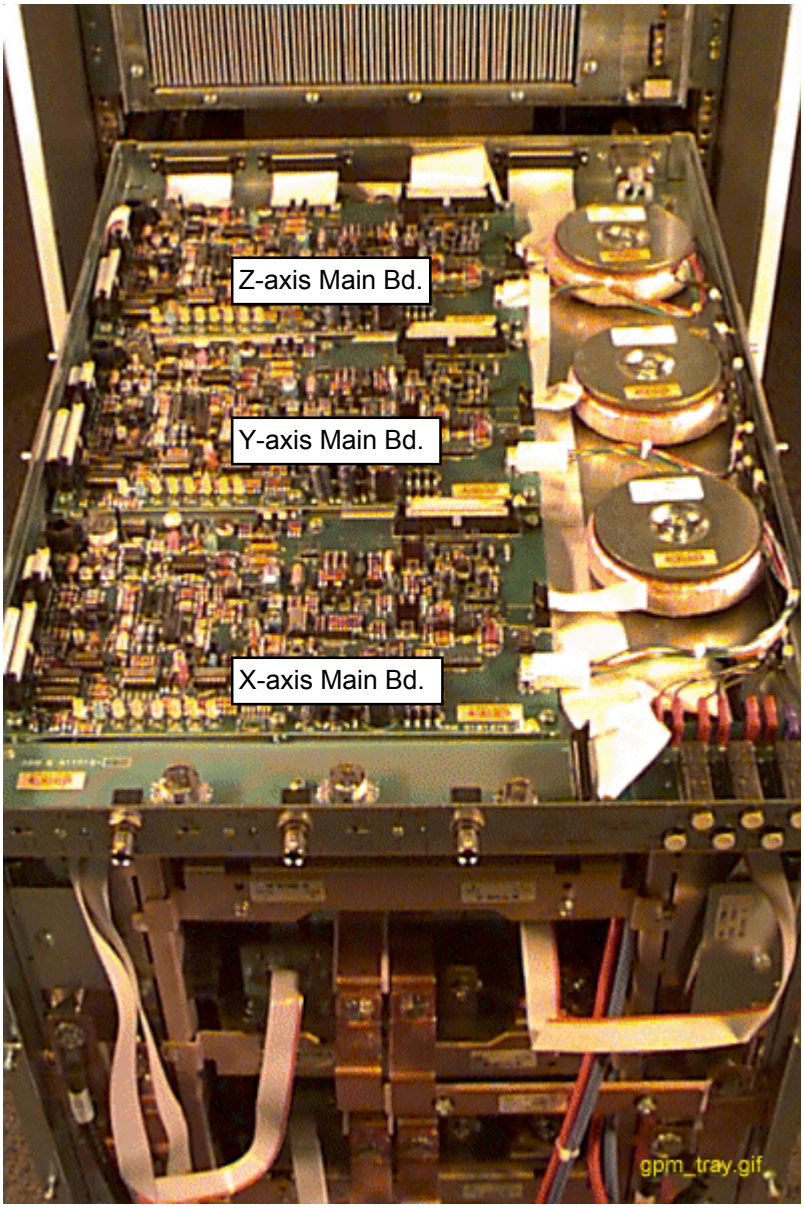
2-3-2 Swapping Main Boards

Each axis Main Board receives the analog waveform from the GIP. The Main Board contains the first stage input amplifier and subsequent error amplifier and feedback circuitry of the GPM.

Swapping Main Boards is a quick procedure.

1. Remove 8 screws holding the front of GPM to the cabinet
2. Pull out the GPM to fully extended position on its slides.
3. Remove top cover of Main Board tray.
4. Remove all cables and mounting screws to swap Main Boards.

See Illustration 2-2 for location of Main Boards:

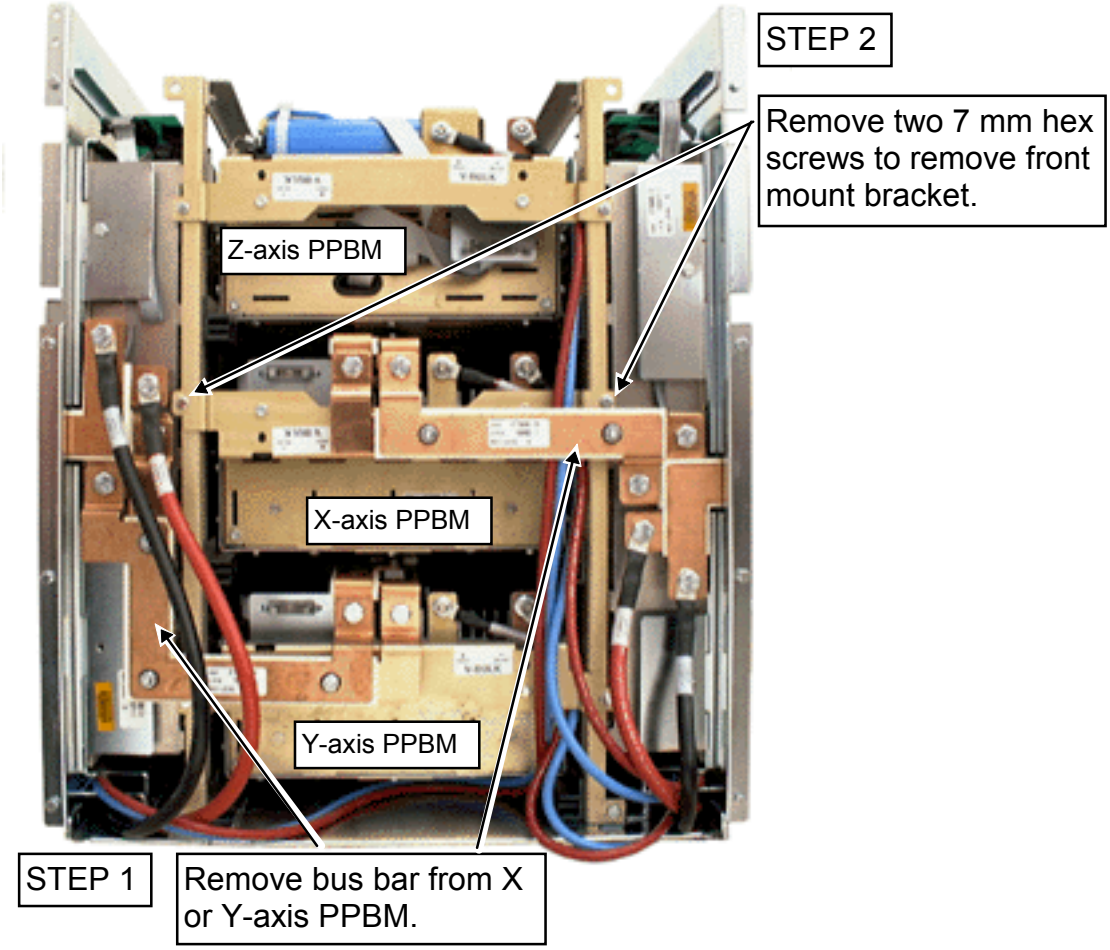


MAIN BOARD TRAY - COVER REMOVED
ILLUSTRATION 2-2

2-3-3 Swapping PPBM's

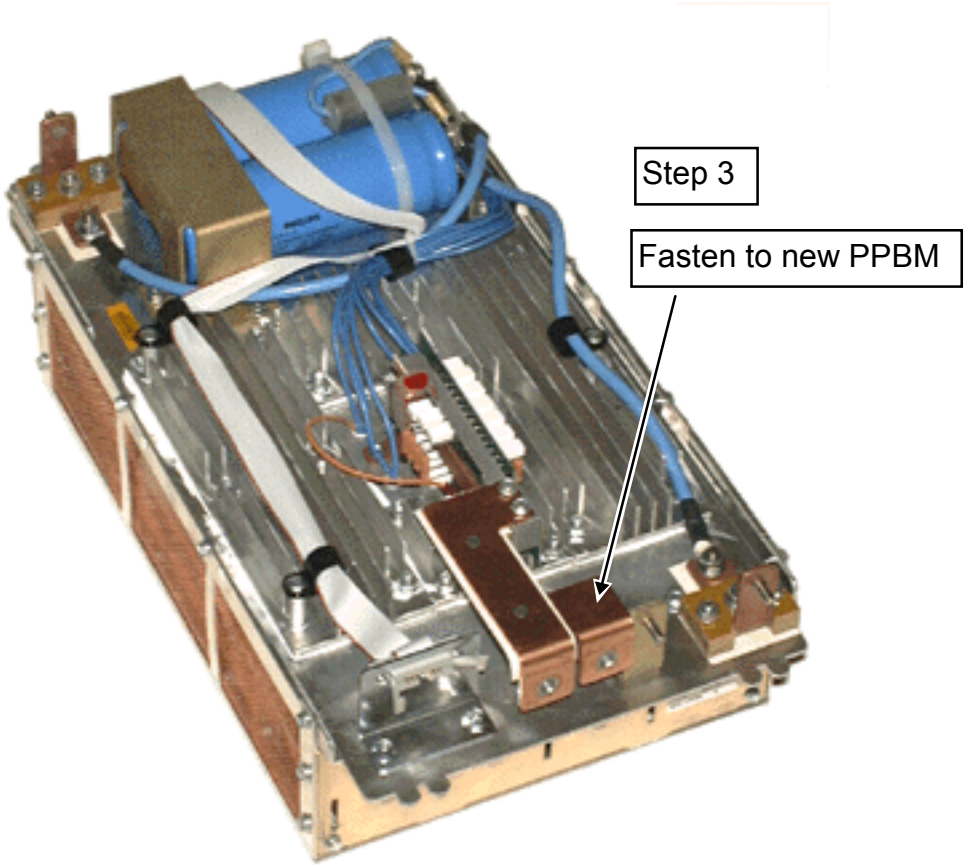
Each axis of the GPM has a Polyphase Buck Module (PPBM). The PPBM is a switch-mode, pulse-width modulated DC/DC regulator. The PPBM functions as a high-power quick-response power supply.

If a problem has been isolated to the GPM and the problem did not change axes when the GPM-PS outputs or Main Boards were swapped, try swapping PPBM's between axes. The PPBM's are stacked as shown in Illustration 7. If the problem is in the X or Y axis, swapping the X PPBM with the Y PPBM is recommended since the Z PPBM is more difficult to remove, (Z Bus Bar is harder to access). Follow the three steps shown in Illustration 2-3 & 2-4.



SWAPPING X & Y-AXIS PPBM'S
ILLUSTRATION 2-3

2-3-3 Swapping PPBM's (continued)



SWAP BUS BARS FROM EACH PPBM
ILLUSTRATION 2-4

2-3-4 Swapping Output Shelves

The Output Shelves (one per axis) are the power stage of the GPM. Swapping of the output shelves should only be done as a last measure to verify a GPM problem since this procedure requires more time and is the most involved of the GPM sub-FRU's (swap main boards or PPBM's first to try to isolate a GPM problem).

Only the X and Y output shelves could be swapped; the Z output shelf has a different bus bar configuration from X or Y. To access the Output Shelves the Main Board Tray must be removed, followed by removal of the PPBM Tower (framework that holds all 3 PPBM's). Refer to the procedure *Gradient/GRAM: SGD Gradient/GRAM Subsystem: Replacements and Maintenance: SGD GPM FRU Replacements.* Then from the outline in this procedure select; Output Shelf Replacements for instructions on removal/replacement.

REVISION HISTORY

REV	DATE	AUTHOR	PRIMARY REASONS FOR CHANGE
0	10/12/97	J. Wolak	Initial release for SGD production
1	12/02/97	J. Wolak	Minor corrections
2	4/17/98	J. Wolak	Added some additional detail for clarification
3	5/20/99	S.M.Atladottir	Updated Procedure References for New GUI
4	10/13/99	K. Keshena	Changed to use a Proprietary header.