8645/GRAM TROUBLESHOOTING

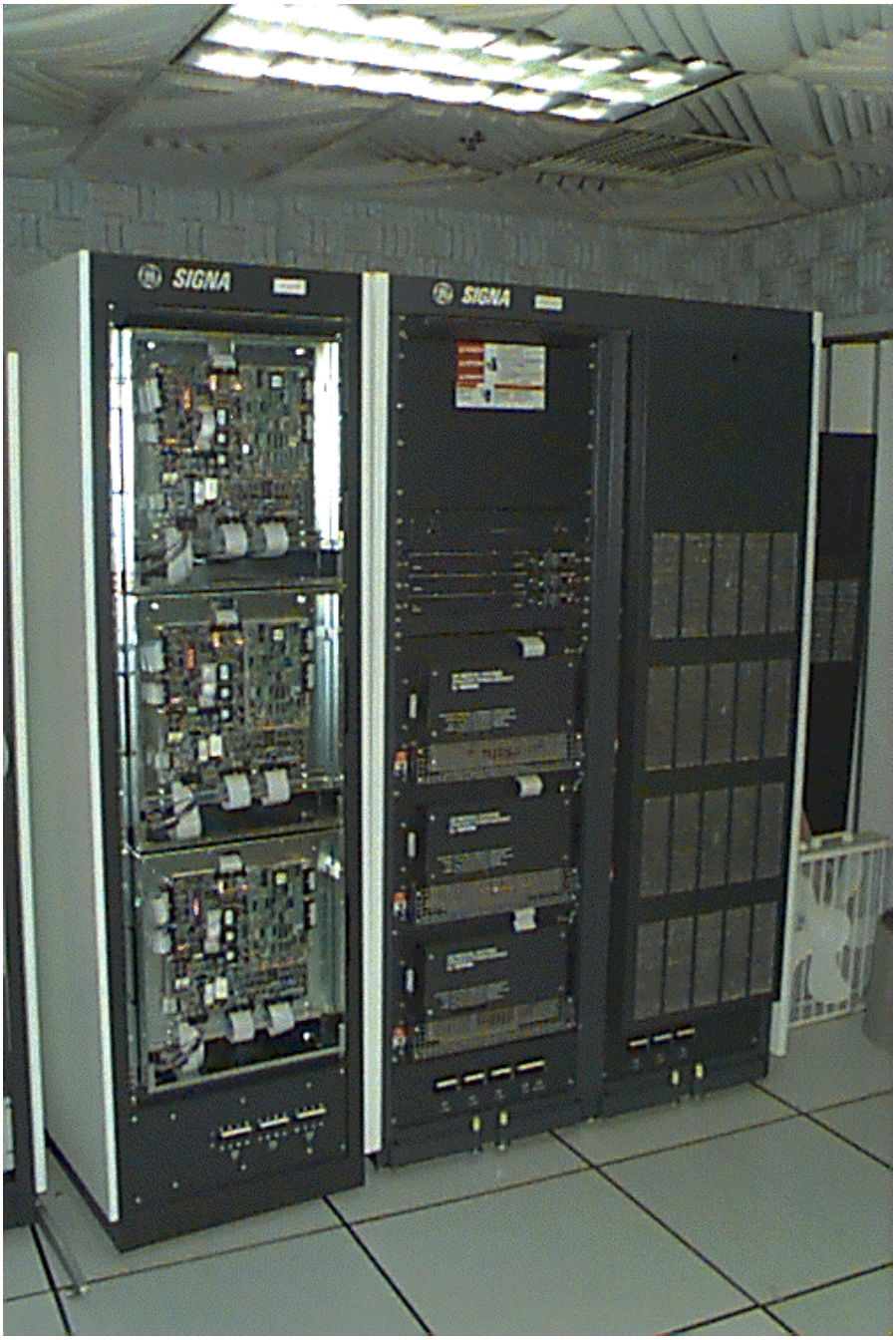


TABLE OF CONTENTS

1- HOW TO USE THIS TROUBLESHOOTING GUIDE

This troubleshooting guide is structured for an experienced MR Field Engineer to troubleshoot based on symptoms typical of gradient driver problems. This guide can be used for 8645/GRAM hardware on either Signa 8.x Lightning or 5.x Horizon Systems.

The Section titles are symptom descriptions. The rest of the section describes possible additional symptoms, definition of the failure where necessary, and how to troubleshoot and repair the problem. **The Field Engineer should match the problem with the scanner to a symptom listed in the Table of Contents**. The Initial Check - Any Symptom Fault is a list of some of the common causes of problems seen on 8645/GRAM hardware.

Please follow the Lock Out / Tag Out instruction as listed in the next section whenever powering down the system to ensure your personal safety.

2- POWER LOCK OUT / TAG OUT

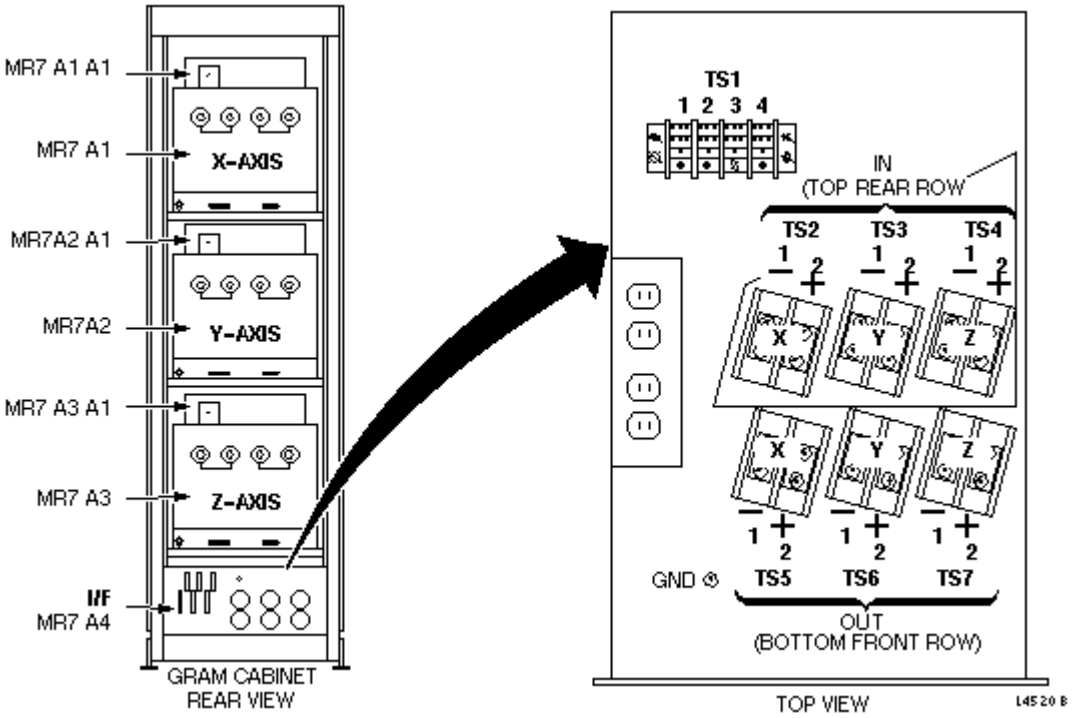
Description - This material is to be applied to all replacement procedures that involve the 8645 Gradient Cabinet modules.

DANGER!!

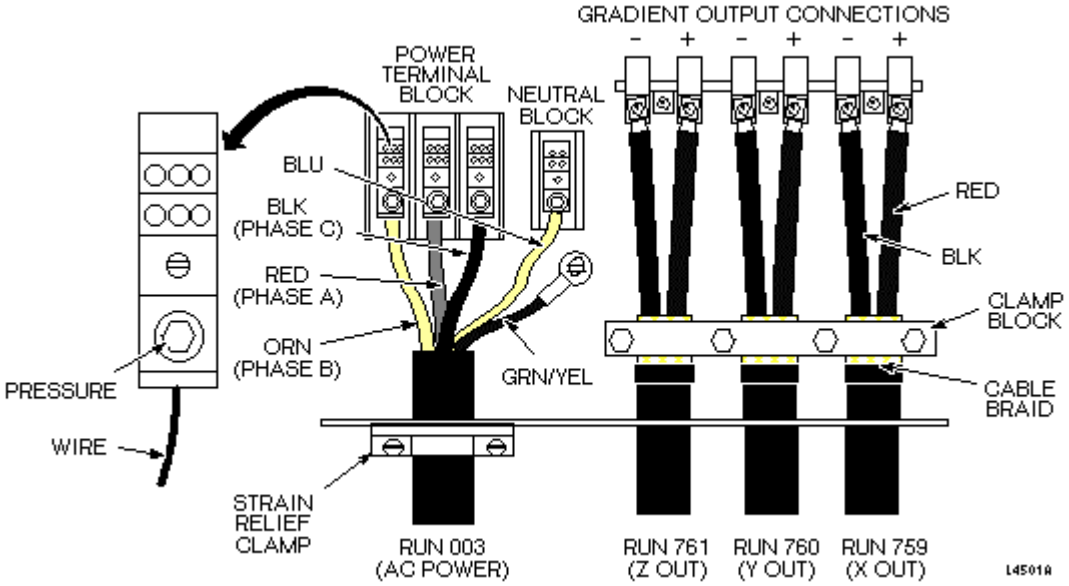
FATAL ELECTRIC SHOCK HAZARD!! THE GRADIENT AMPLIFIERS (AND GRAM, IF PRESENT) ACT AS CONSTANT LOAD SOURCES, AND WILL SEND MAXIMUM CURRENT TO ANY LOAD (INCLUDING YOU!). TO PREVENT FATAL ELECTRIC SHOCK, ENSURE THAT POWER IS OFF TO BOTH CABINETS BEFORE STARTING THIS PROCEDURE.

1. Perform lockout / tagout procedure per GE OSHA Lockout / Tagout Requirements 29 CFR 1910.147. Do this by securing the PDU circuit breaker for the 8645 Gradient Amplifier Cabinet, and for the GRAM Cabinet (if present), with the required devices. (Refer to *Procedure For Safety: Section 6*.)

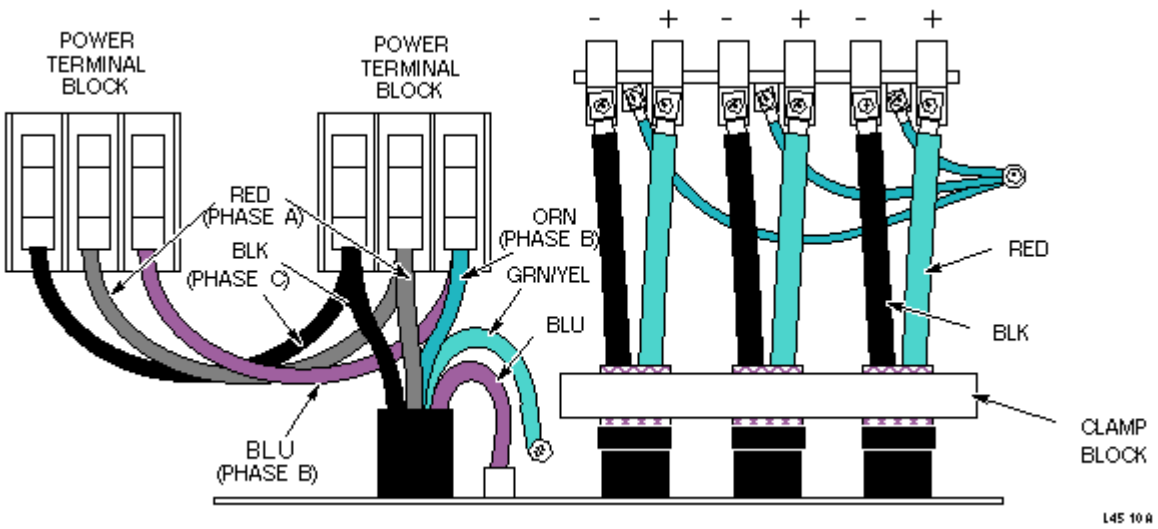
2. Verify that all energy has been dissipated by measuring incoming power to the GRAM Cabinet at TS1 (see Illustration 1-1). Verify that all energy has been dissipated for the 8645 Gradient Amplifier Cabinet by measuring power at TS1. Also see Illustration 1-2 for Signa Horizon HiSpeed system, or Illustration 1-3 for Signa Horizon or Horizon EchoSpeed systems.



GRAM CABINET, REAR VIEW – BOTTOM PANEL AND TS1
ILLUSTRATION 1-1



8645 CABINET POWER AND OUTPUT CABLE CONNECTIONS
ILLUSTRATION 1-2



INCOMING POWER TO A DOUBLE-BAY 8645 GRADIENT CABINET
ILLUSTRATION 1-3

3- INITIAL CHECKS-ANY SYMPTOM FAULT

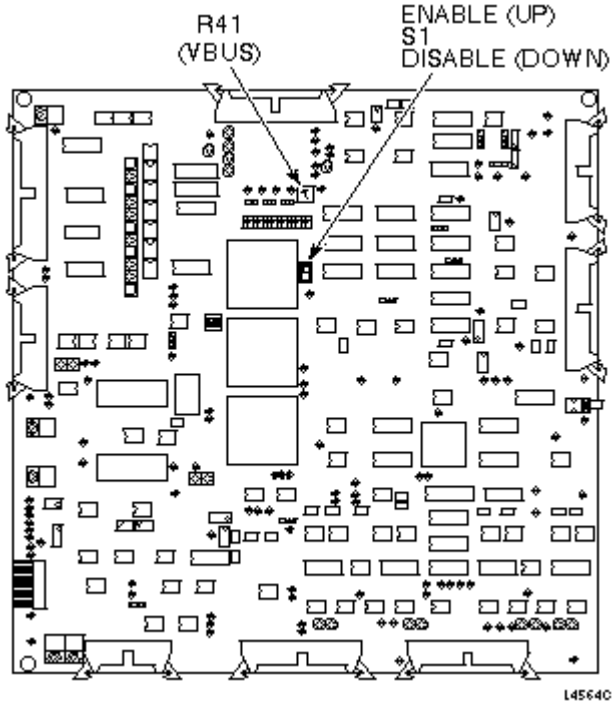
3-1 Power OFF

The following preliminary checks may be performed for any Gradient Driver System error. The first of these checks are done with the power to the GRAM Cabinet and Gradient Cabinet OFF.

CAUTION

Equipment Damage Potential! Power Cycling the GRAM (turning GRAM breaker on/off quickly) can burn up a regulator on the GRAM Power Supply Board. Always wait one minute between power down/power up of the GRAM Cabinet.

1. Check V Bus: Measure resistance at TP 22. Adjust R-41 on the GRAM Control Board. For SR 120 Systems, adjust R-41 to 1k Ohms. For SR-77 Systems, adjust R-41 to 300 Ohms. Power must be **OFF** for this test.



GRAM CONTROL BOARD WITH LOCATION OF VBUS (R-41) AND SWITCH 1
ILLUSTRATION 3-1

2. Check all gradient coil axes. Measuring the resistance between J3 (+OUT) and J4 (-OUT) at rear of each GRAM module will give the gradient coil resistance for each axis.

3. Check the switch positions on the GRAM Control board. See Table 3-1.

TABLE 3-1
SWITCH POSITIONS AND SETTINGS FOR THE GRAM CONTROL BOARD

NUMBER	POSITION	SETTING	SWITCH NAME AND POSITION DEFINITION
S1	N/A	Up	GRAM Enabled – When S1 is down, the GRAM is disabled
S2	1	Down	(RES) Reserved – not used
S2	2	Down	(HV) High Voltage Enable – Under software control
S2	3	Down	(FW) Free Wheel – Enables PWM mode under software control. Up is Freewheel mode, no PWM
S2	4	Down	(MAN) Manual Ready – This is controlled by GAP. Up is Troubleshooting, it forces the GRAM to Manual Ready. (S1 must also be up, or enabled when MAN is up.)

4. Check the jumper positions of the GRAM Control Board. Refer to Table 3-2.

TABLE 3-2
JUMPER POSITIONS AND SETTINGS FOR THE GRAM CONTROL BOARD

NAME	POSITION	SETTING
JP1	2&3	
JP2	2&3	
JP3	2&3	
JP4	2&3	(V/D) Voltage or Digital to Analog converter – DAC selected
JP5	2&3	(AN/DIG) Analog or Digital – Digital selected
JP6	2&3	(DIS/EN) Disable or Enable – Enable selected
JP13	2&3	(AN/DIG) Charge mode
JP8	2&3	(TST/NRM) Test or Normal – Normal selected
JP9	2&3	Sets up one current sensor. JP9 is located under the tuning board

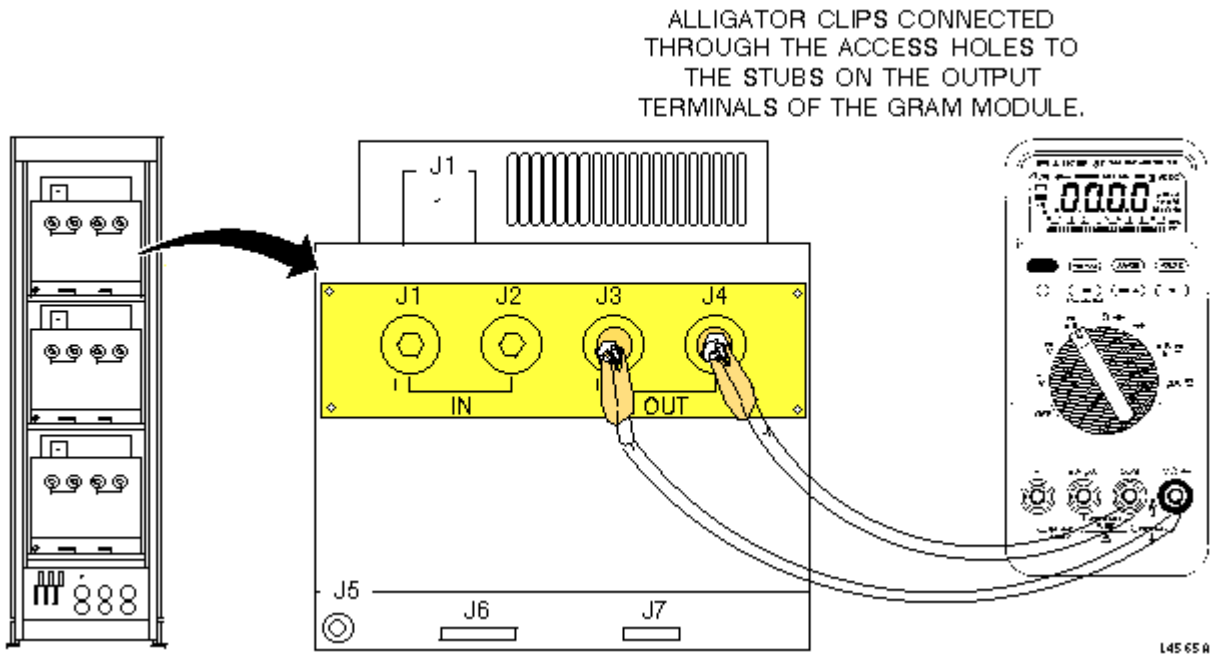
5. Check jumper positions on the GRAM Power Supply Board. See Table 3-3.

TABLE 3-3
JUMPER POSITIONS AND SETTINGS FOR THE GRAM POWER SUPPLY BOARD

NUMBER	POSITION JP2 present	POSITION JP2 not present	SETTING Note: A dot on the circuit board indicates pin 1 location.
JP1	2 & 3	2 & 3	Triangle Enable
JP2	1 & 2	–	Connects LGND to AGND
JP3	1 & 2	2 & 3	High Voltage Enable
JP4	2 & 3	2 & 3	Under Voltage Enable
JP5	1 & 2	2 & 3	High Voltage Enable
JP6	1 & 2	2 & 3	NORM – Normal Mode

3-2 Power ON

1. Check that GRAM Module DC Offsets as follows. Set the Gradshims to 0. The Gradshim settings are accessible after setting up any scan, then selecting **[SetUp Parameters]** and setting X, Y & Z gradshims to 0**.** Then using long voltmeter leads with alligator clips, connect a voltmeter at the rear of the GRAM chassis across J3 (+OUT) and J4 (–OUT). The voltmeter should be set to DC milivolts. J3 (+OUT) and J4 (-OUT) should measure 0 mVDC ±10mVDC. See Illustration 3-2.



MEASURING DC OFFSETS AT THE REAR OF THE GRAM MODULE
ILLUSTRATION 3-2

2. If the measurement across J3 (+OUT) and J4 (-OUT) is **>5 VDC** on any axis, turn OFF power to the gradient cabinets by following Section 2 - Power Lock Out / Tag Out. Measure the coil resistance for the failing axis. Measuring the resistance between GRAM In and GRAM Out at rear of each GRAM module will give the gradient coil resistance for each axis.

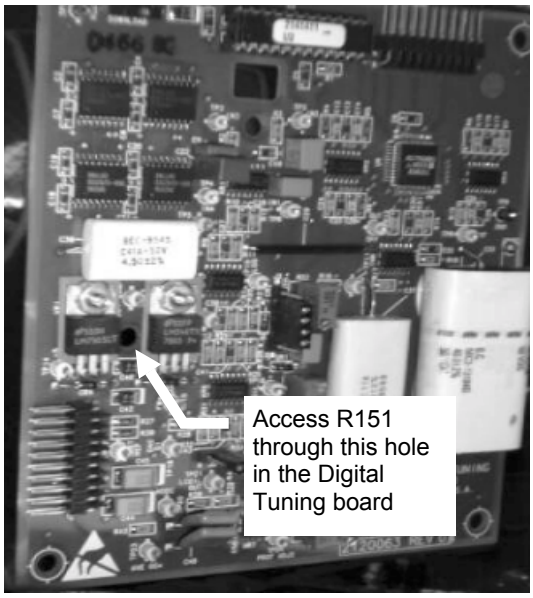
   a) If coil resistance is greater than one Ohm, replace the Gradient Coil.

   b) If coil resistance is less than one Ohm, suspect connections and Gradient Filter Box on Penetration Panel .

3. If the measurement across J3 (+OUT) and J4 (-OUT) is not 0 mVDC $\pm$10 mVDC, make the following adjustments: On the GRAM Control Board, locate and adjust R151 (Offset Null), so that the voltmeter reads 0 mVDC $\pm$10 mVDC. R151 is accessible through a hole in the digital tuning board (located between two voltage regulators in T0-220 packages). See Illustration 3-3.

Note:

Be aware, that in high magnetic fields the DC Offsets will change as the cabinet rear door position changes.



LOCATION OF THE R151 ACCESS HOLE ON THE DIGITAL TUNING BOARD
ILLUSTRATION 3-3

Note

These adjustments must be done while the 8645 Power Modules are in the READY state. Signa software will automatically switch the Power Modules to StandBy after several minutes of waiting without scanning. Select **[Download]** to put the Power Modules back into the READY state for the adjustment. For SR120 systems and some of the earlier SR77 systems the cabinet fan had 2 speeds, thus an indication that the Power Modules switched to STANDBY was and if the cabinet fan would switch to the slower speed (audibly noticeable).

3. Ensure that Eddy Current Compensation files are downloaded.

   a) **Systems Without a GRAM**: The ecccoeff.dat file is the coefficient file that is downloaded to the WARP on IPG when TPS Reset is performed, and every time the Grafidy analysis tool is run. This file contains the B0 (zeroth order) coefficients, and the eddy current (first order) coefficients for systems without a GRAM.

   b) **Systems with a GRAM**: The ecccoeff.dat file is also used to store the B_0 coefficients or systems **with** a GRAM and works in conjunction with the gram_tune.dat file. The gram_tune.dat file is downloaded every time the GAP Board is reset, i.e., on a TPS Reset, a power cycle to the GAP Chassis, or every time the Grafidy analysis tool is run. This file contains the eddy current (first order) coefficients for systems **with** a GRAM. The gram_tune.dat file is located in the directory */usr/g/caldir*. See Illustration 3-4.

Short Time Constants			Long Time Constants				
105	76	0	54	10	2	8	65
1638	205	0	0	02	2544	720	3483
105	76	0	94	131	43	10	65
1638	205	0	1	2608	231	135	3151
105	246	0	111	29	8	28	65
1638	205	0	515	1	87	0	3145

TYPICAL GRAM_TUNE.DAT FILE WITH EDDY CURRENT COMPENSATION VALUES DOWNLOADED
ILLUSTRATION 3-4

If several columns in the gram_tune.dat file contain all zeros, some Eddy Current Compensation values have not been downloaded, or have been disabled.

4- CURRENT DISTORTION FAULTS

4-1 Definition

A Current Distortion Fault occurs when the Output Current and the Input Current command differ by +/-20 A.

4-2 Symptoms

1. Scanner pauses

2. Gradient Power Modules will not go to READY.

3. Gradient Power Modules cycle constantly between READY & STANDBY

4-3 Test

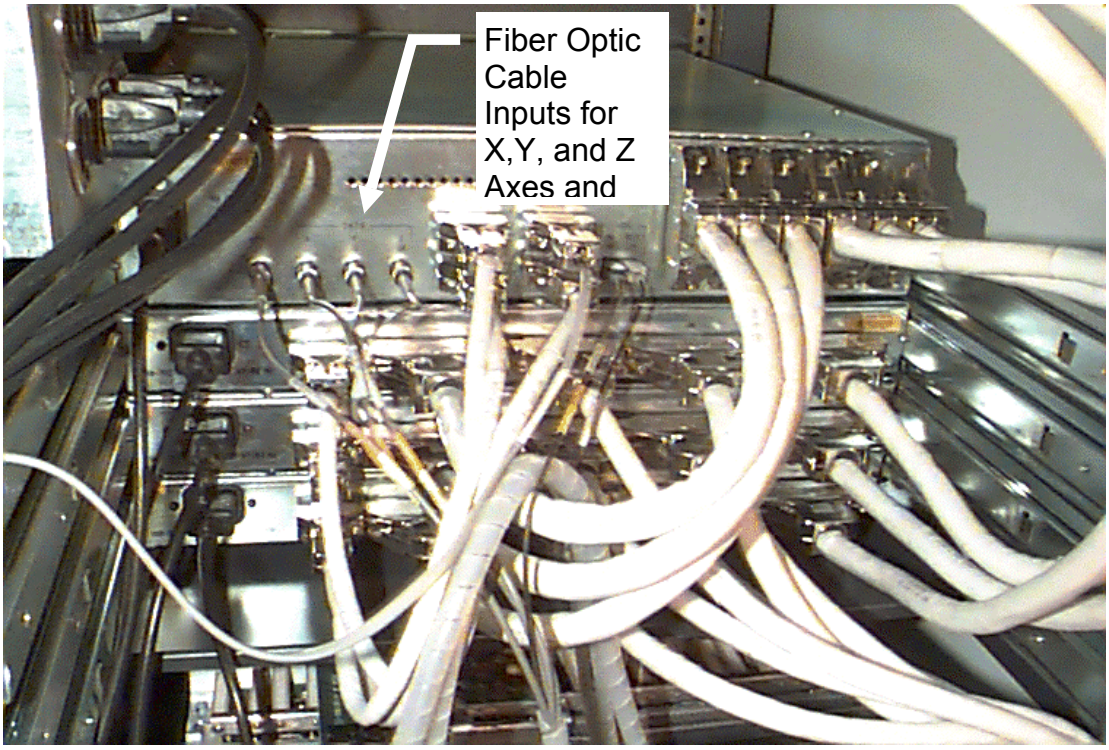
4-3-1 Check System Error Log

1. If single Current Distortion Fault error, then run Gradient Driver and Digital Tuning Board Diagnostics.

2. If a Current Distortion Fault error is combined with other errors—a distortion fault may be a symptom of another fault in the Gradient Driver chain. A distortion fault could be a waveform halting due to an IPG command.

4-3-2 Determine Source

1. Swap fiber optic cables at GAP. At the rear of the GAP the data F/O cables are labeled J2 -XDATA, J3-YDATA, J4-ZDATA. See Illustration 4-1.



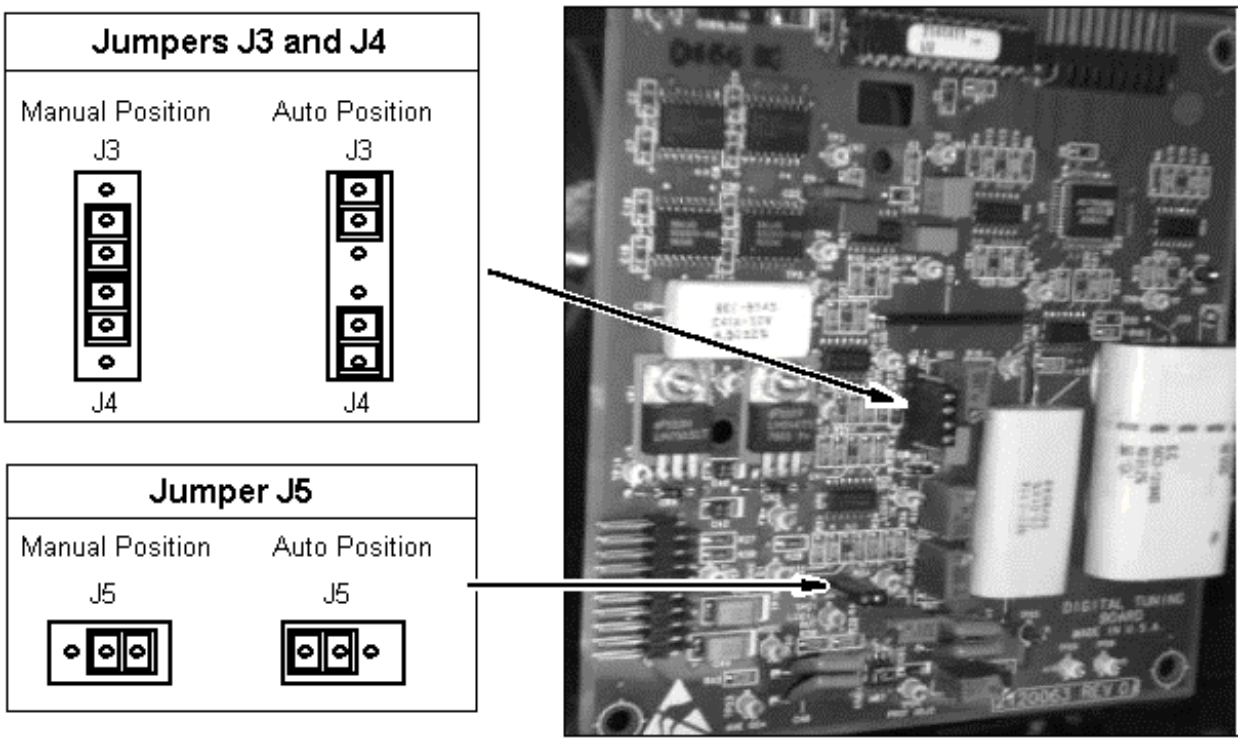
REAR VIEW OF GAP ENCLOSURE AND FIBER OPTIC CABLE INPUTS
ILLUSTRATION 4-1

2. Repeat the scan or diagnostic that produces the error. If error (problem) follows F/0 cable change, the problem is before the input to the GAP module.

3. Verify the all Digital Tuning Board jumpers are in **Auto Position** and the jumpers are the correct type as described below.

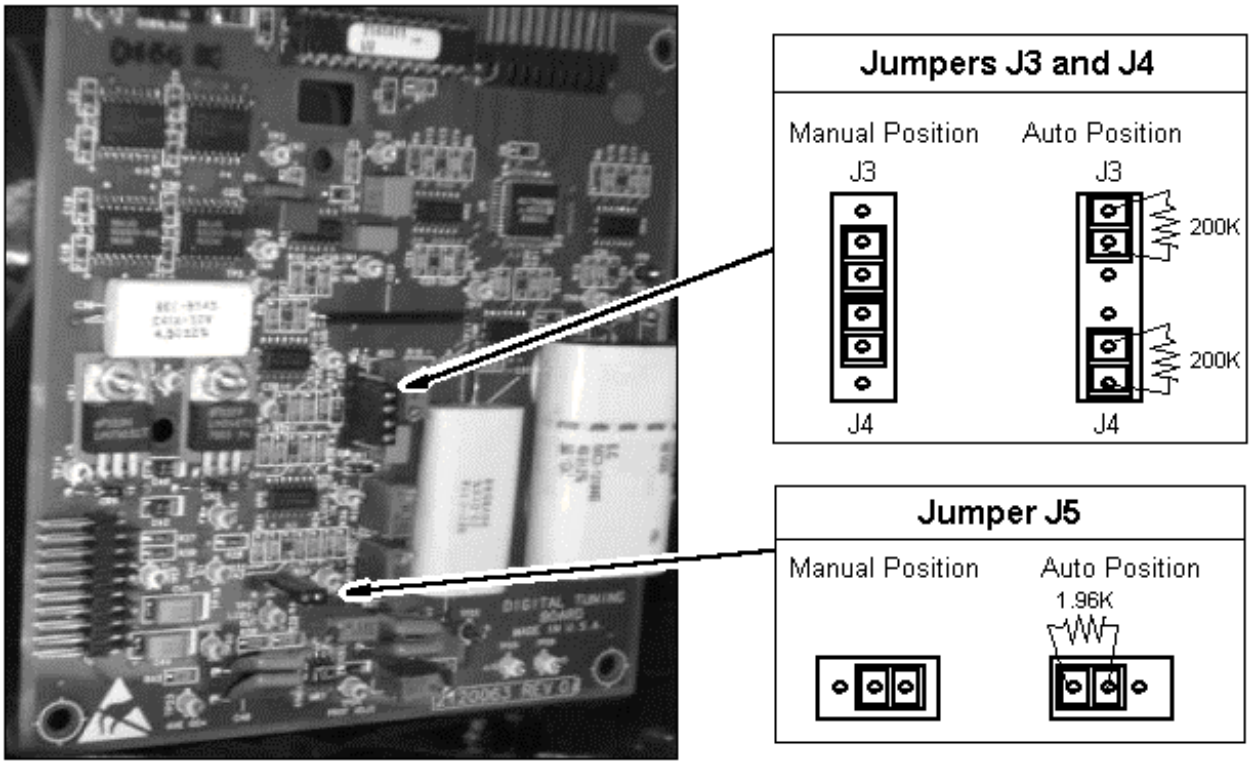
   a) See Illustration 4-2 for Rev E Boards (no resistors)

   b) See Illustration 4-3 for Rev D Boards (needs resistors on jumpers).



c)

DIGITAL TUNING BOARD (REV E) JUMPER LOCATIONS / SETTINGS
ILLUSTRATION 4-2



DIGITAL TUNING BOARD (REV D) JUMPER LOCATIONS / SETTINGS
ILLUSTRATION 4-3

4. Next, try swapping Digital Tuning Boards between axes to see if the problem follows this board.
5. If error does not follow F/O change, disable Eddy Current Compensation and rescan. Access the Grafidy Eddy Current Analysis screen. For 5.x systems, select **[Utilities], [MR Tools], [Grafidy].** For 8.X systems, locate **[Cal/Checks]** in the Service Desktop Manager**.** Select **[Grafidy],** then **[Start].** The following choices will appear:

```
GRAFIDY - Eddy Current Analysis
1 - Read and Process Raw Data
2 - Fit
3 - Initialize Parameters
4 - System Status
    S or Q - Exit to Tools Menu

   Enter Choice: (0..4) [1] : ..............          4<Enter>

System Status

This Software was created 9/18/97 -10:34:41

1 - Display System Configuration
2 - Display Calibration Settings
3 - Enable/Disable Software Control Compensation

S or Q - Exit Status Menu

   Enter Choice: (1..3) [1] : ..............          3<Enter>
```

The Grafidy Program then gives the user the choice to Toggle ON or OFF B0 compensation, Long Time Constants, and Short Time Constants for the X, Y, and Z axes. If the user exits the Grafidy Program, any disabled values will be re-enabled automatically. After turning OFF, all compensation, verify that the */usr/g/caldir/gram_tune.dat* file contains zeroes in the first seven columns.

4. If the system scans without error, re-enable Long Time Constants and rescan.

   a) If errors occur: Check the Digital Tuning Board to see if all ribbon connectors are secure. Re-calibrate Long Time Constants by running Grafidy. See MR Release 5.X or 8.X, Service Methods CD-ROM, Direction 2187583-1, Gram Tuning & Grafidy Release 8.2 (or 8.25)

   b) If no errors occur:

      Perform manual gram tuning. See MR Release 5.X or 8.X Service Methods CD-ROM, Direction 2187583-1, Gram Tuning Manual Method.

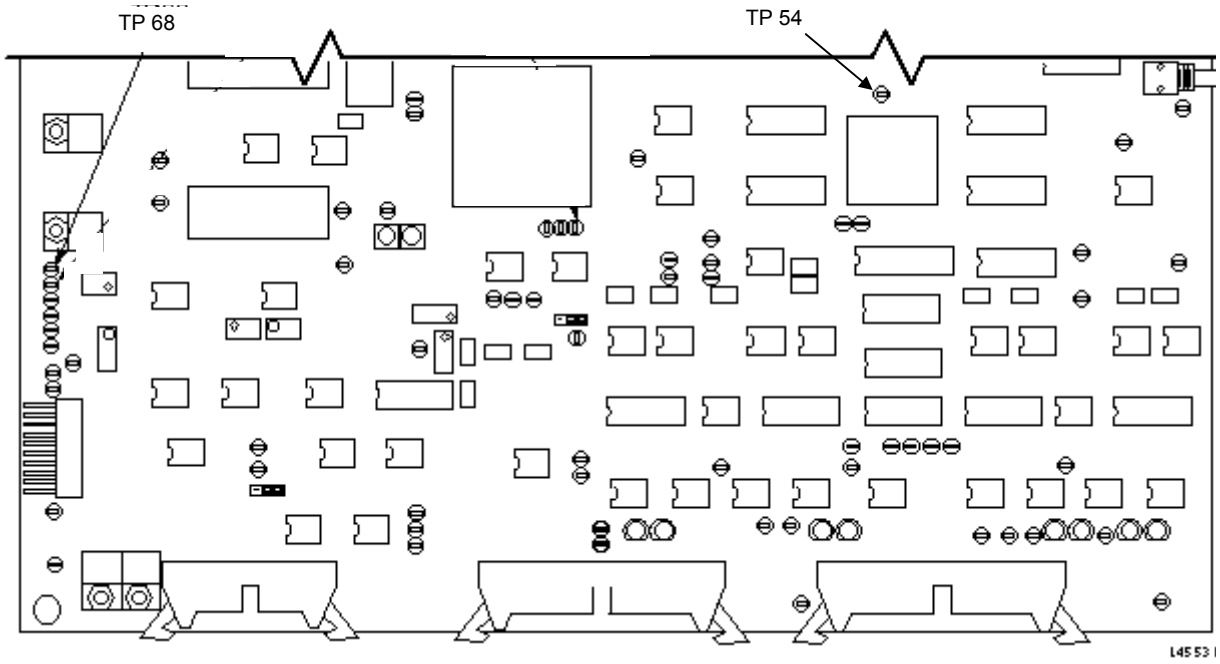
      Run Digital Tuning Board Diagnostics. See MR Release 5.X or 8.X ,Signa Horizon Service Methods CD-ROM Direction 2187583-1, Diagnostics.

4-3-3 If Distortion Fault Source Is Not Yet Found

1. Perform oscilloscope test:

   a) Set channel 1 to 2V/Div and connect probe to TP 54 on GRAM Control Board (TP 54 is located behind the GASM Board). It is part of the Gradient Coil Current Regulator circuitry, and it is labeled DIST for Current Distortion. See Illustration 4-4.

   b) Set channel 2 to 2V/Div and connect probe to TP 68 on GRAM Control Board (located behind the Digital Tuning Board). It is part of the Reference Waveform DAC circuitry and it is labeled DAC_I. See Illustration 4-4.



GRAM CONTROL BOARD—LOWER HALF-- SHOWING TP54 AND TP68
ILLUSTRATION 4-4

   c) If the transition from HI to LO on Channel 1 occurs during the ramp on Channel 2, then suspect GRAM or GRAM cables.

   d) If the transition from HI to LO on Channel 1 occurs on the flattop on Channel 2, suspect 8645 or its cables.

2. Turn OFF power to the gradient cabinets by following Section 2 - Power Lock Out / Tag Out . Swap 8645 Power Cables to other axis.

   a) Swap the red power cable J1-1, black power cable J1-3, and 37 Pin connectors (J5 Status Control).

   b) If error follows isolate problem to HI or LO Power Module and then to a FRU within the Power Module. Or else, check GRAM Cabling, Master Interface (MIF), Digital Tuning Board.

5- OVERLOADS ERRORS IN LOG

5-1 Definition

An Overload occurs when Vout from the 8645 is greater than Vsupply from PolyPhase Buck Module. An Overload occurs when the HIGH ERROR signal on the Power Module Main Board exceeds +/- 12 VDC for greater than 5 microseconds. A Long Overload occurs when this signal exceeds the +/- 12 VDC limit for more than 35 milliseconds.

5-2 Symptom

Overload single message in error log.

5-3 Error Log numbers

1. 2238410 through 2238415
2. 2239284 through 2239286

5-4 Possible Causes

1. The most likely cause is that the PolyPhase Buck Controller is not tracking its input.

2. HSS Data could be requesting large swings in current. Source could be eddy currents or the IPG.

3. The Master Interface (MIF) DAC may be unstable (SR20 only).

4. The MIF feedback loop may be unstable (SR20 only).

5. The current sense circuit is intermittent from the Main Board or Shunt.

6. Power Module Main Board integration circuits may be unstable.

7. The output shelf may be intermittent.

8. The coil load and cabling may be intermittent.

9. The input power may be outside the requirements.

5-5 Test

1. Run Gradient Driver Diagnostics.

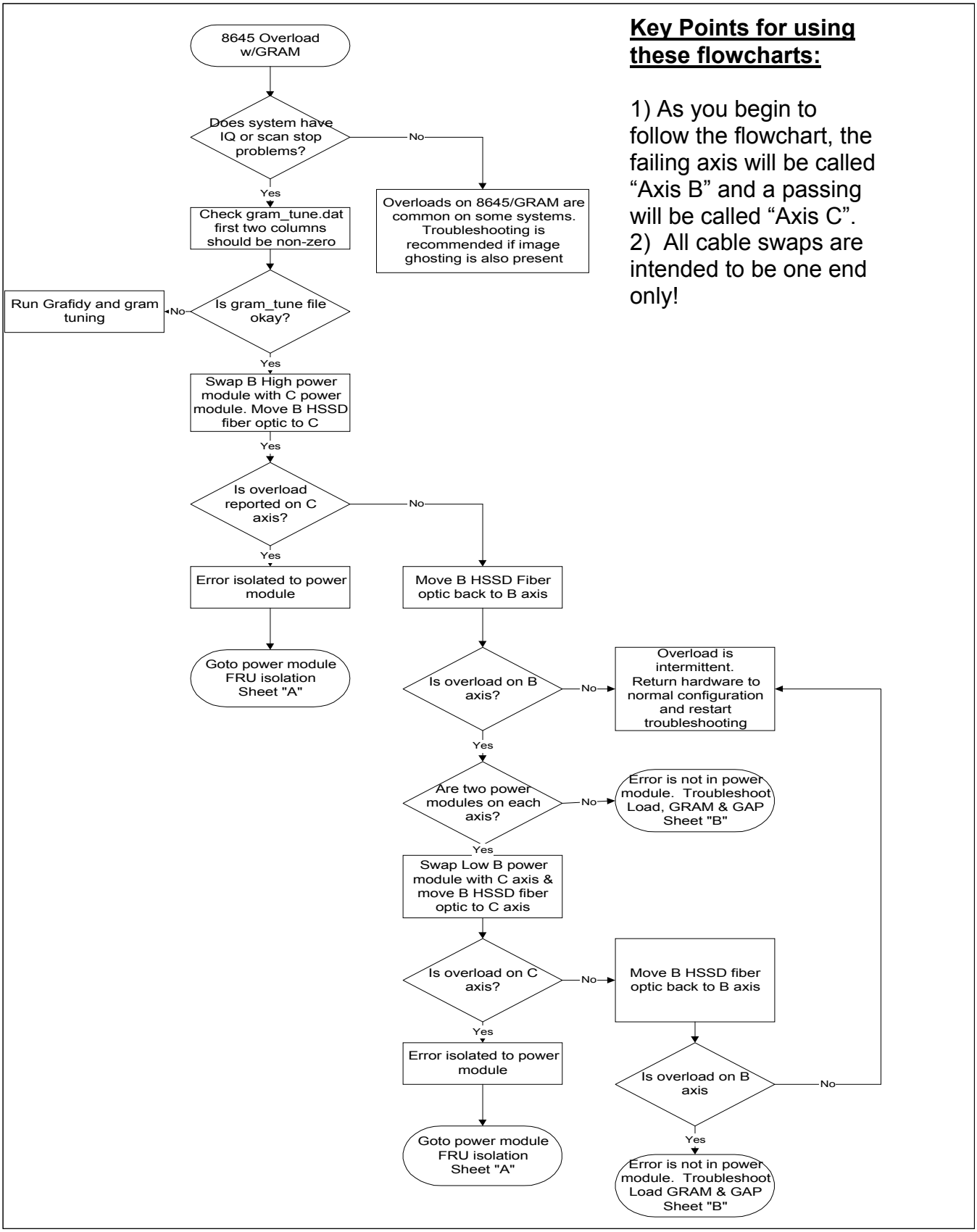
2. Check cabling.

Note

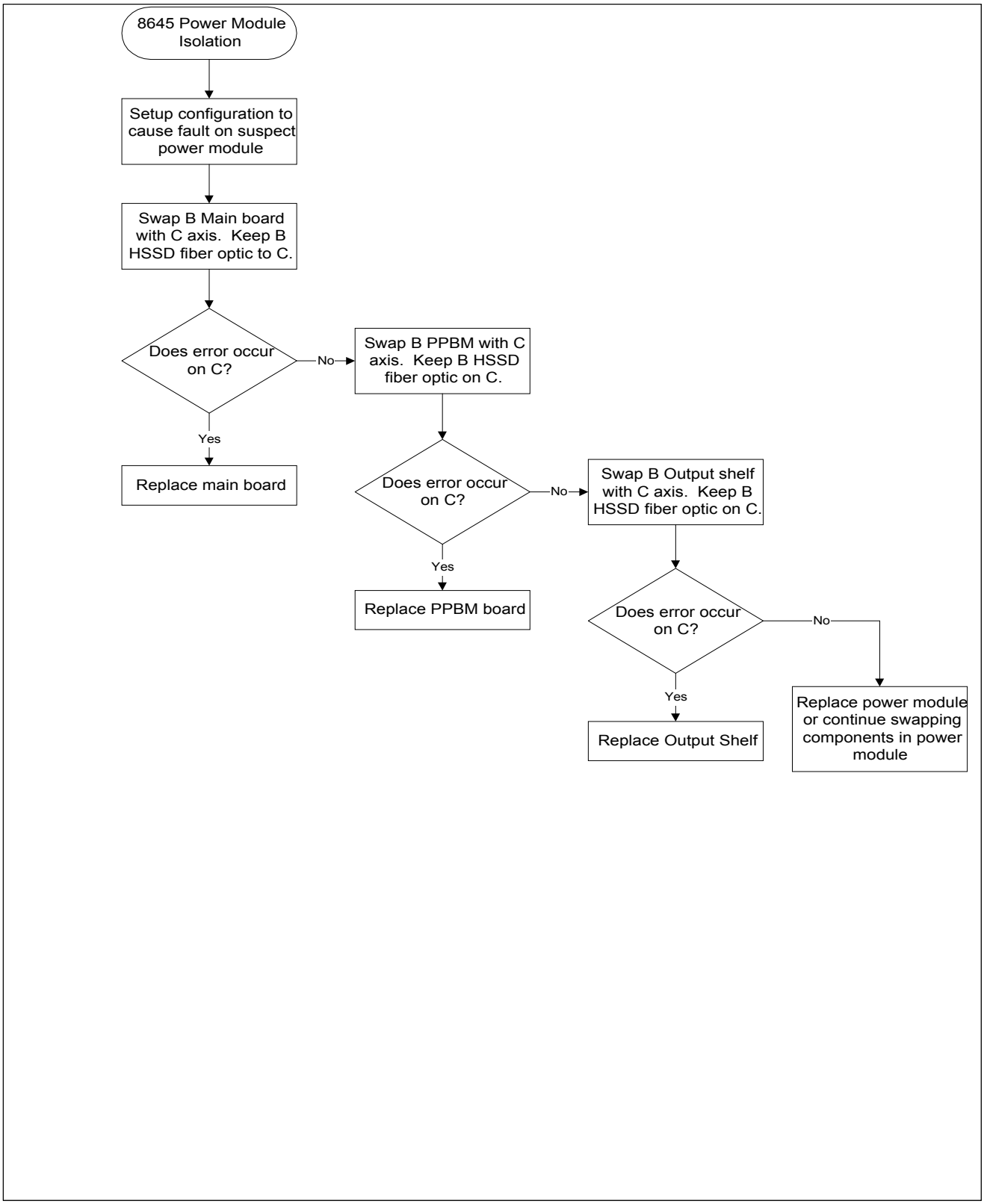
Some overloads can occur on a normal system and not affect imaging. Examples, high duty cycle, EPI, DWEPI, and large output scans.

3. Otherwise, troubleshoot 8645 using the following flowcharts.

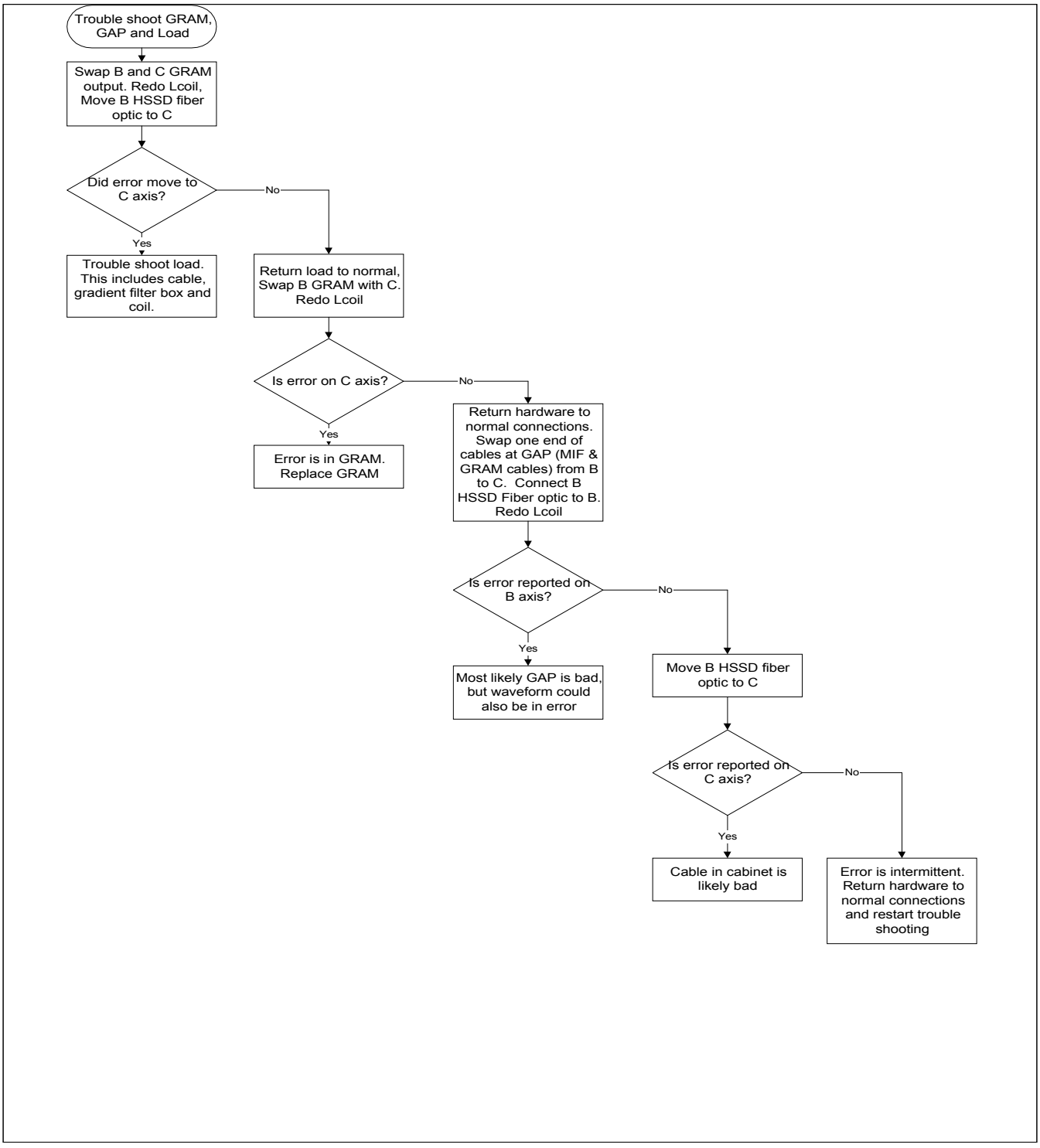
5-6 Overload Troubleshooting Flowchart



OVERLOAD - TROUBLESHOOTING 8645 POWER MODULE (SHEET 'A')



OVERLOAD - TROUBLESHOOTING LOAD, GRAM, & GAP (SHEET 'B')



6- TOROID TRANSFORMER OVERTEMP

6-1 Definition

The Transformer Overtemp LED will turn on (and the 8645 will go into STANDBY) when any of the three sensed transformer temperatures exceed approximately 175 degrees C.

6-2 Symptoms

1. Gradient Power Modules do not go to READY.

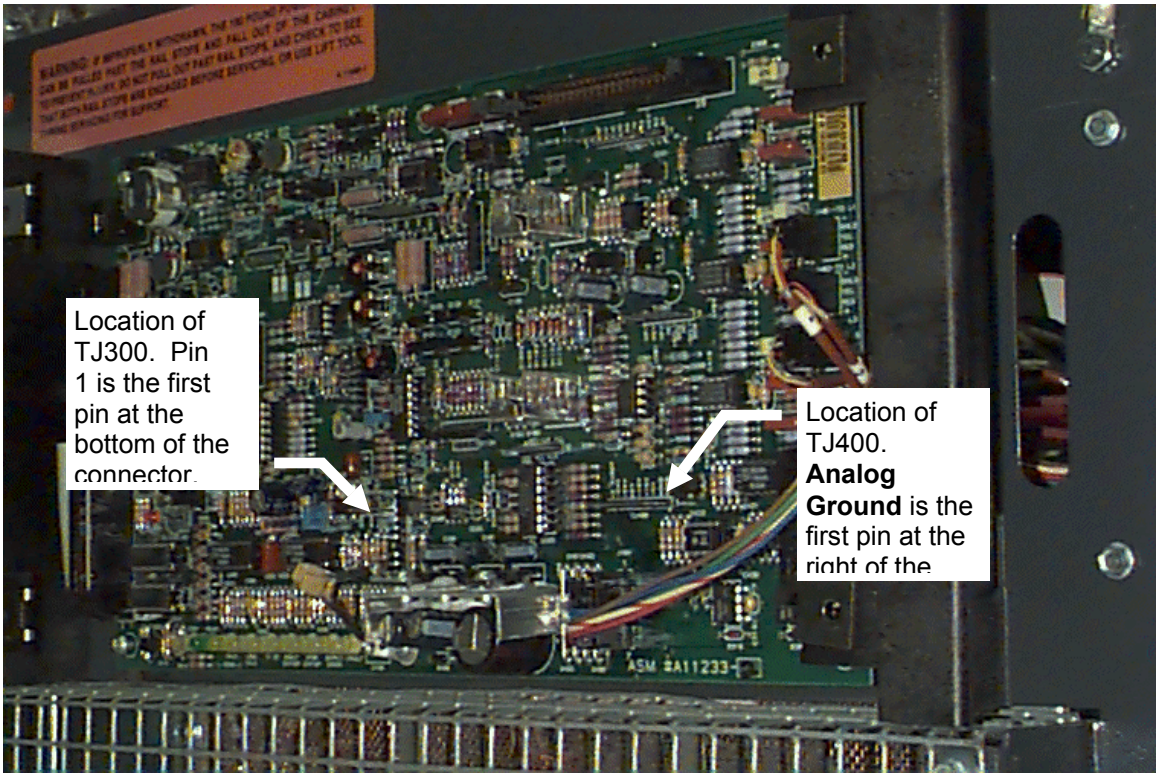
2. Transformer Overtemp LED is lit on the front of the Power Module.

6-3 Error Log numbers

1. 2238437 X High
2. 2238438 Y High
3. 2238439 Z High
4. 2238440 X Low
5. 2238441 Y Low
6. 2238442 Z Low

6-4 Test

1. Check test point voltage value. These test points exist on the Main Board: TJ300, pins1,2, or 3 will measure 1.45V with respect to analog ground (labeled AGND on TJ400). See Illustration 6-1.



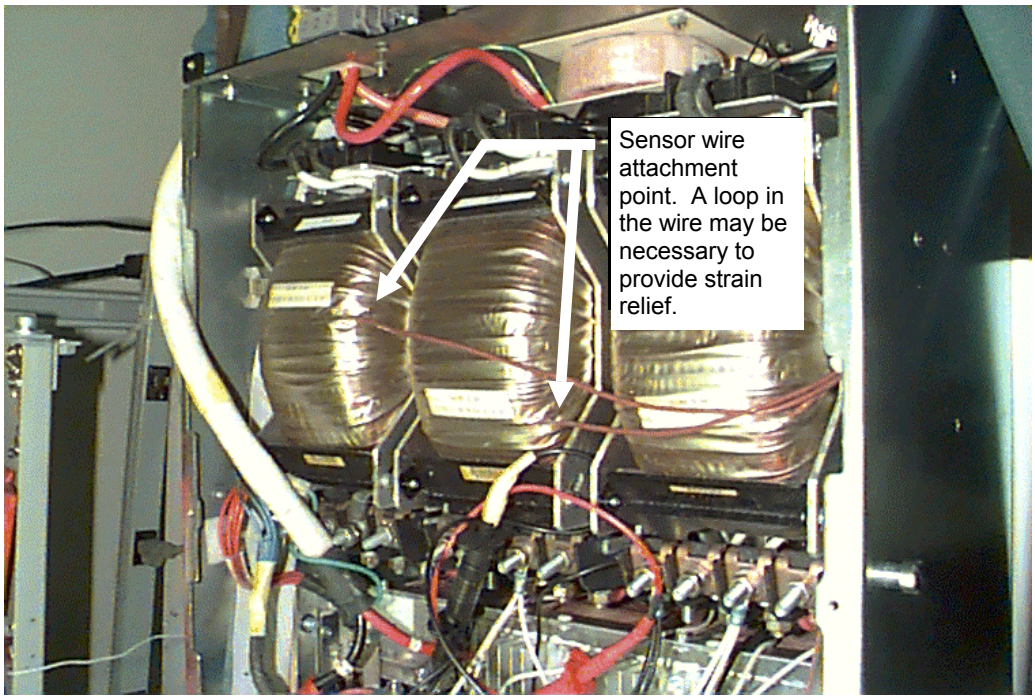
8645 POWER MODULE SHOWING LOCATION OF TJ300 & TJ400
ILLUSTRATION 6-1

2. Turn OFF power to the gradient cabinets by following Section 2 - Power Lock Out / Tag Out.

3. Swap Gradient Power Module Main Board to see if trouble moves. If trouble does not move, suspect Toroid. Otherwise, suspect Main Board.

4. Repair: Replace one Toroid or Main Board.

5. Check for adequate strain relief on temperature sensor wires. If necessary, cut tie wraps and form a small loop with the wire to allow adequate slack at connection points. See Illustration 6-2.



LOCATION OF TEMPERATURE SENSOR WIRES ON TOROID TRANSFORMERS
ILLUSTRATION 6-2

7- POWER MODULE CIRCUIT BREAKER TRIP - BURNING SMELL

7-1 Symptoms

1. Power Module circuit breaker trip (unless fails open).

2. Signa system will not go into READY.

3. Smoking or Burning Smell.

7-2 Error Log numbers

1. 2238497 X High
2. 2238498 Y High
3. 2238499 Z High
4. 2238500 X Low
5. 2238501 Y Low
6. 2238502 Z Low

7-3 Test

1. Perform visual inspection of rectifiers and wiring.

2. There are two ways to check for a shorted Bridge Rectifier:

    - Measuring for diode drops across the Red and Blue VSS wires (which connect the Bridge Rectifiers with the PPBM), or

    - Removing a suspected Bridge Rectifier and taking diode drop measurements directly across its terminals.

If a short is measured using the first method, presume a short exists in at least one Bridge Rectifier. When one Rectifier shorts, another generally shorts along with it. The second method may be utilized to check the integrity of individual Bridge Rectifiers.

Vss is the input supply voltage for the PPBM. To access the Red and Blue VSS wires, the Power Module of the affected axis must be partially disassembled. Follow these steps:

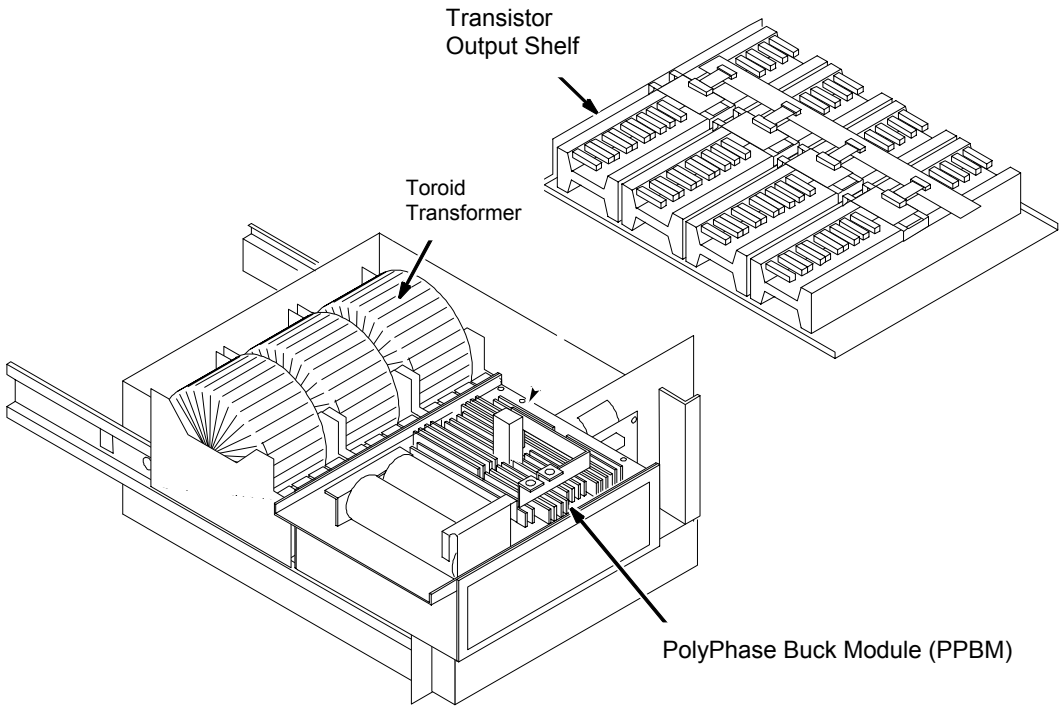
a) Turn OFF power to the gradient cabinets by following Section 2 - Power Lock Out / Tag Out. Shut off circuit breakers to Gradient Amplifier and GRAM Cabinet if present.

b) Ensure 8645 Cabinet anti-tip bars are fully extended.

c) Unscrew the Power Module front panel fastening screws.

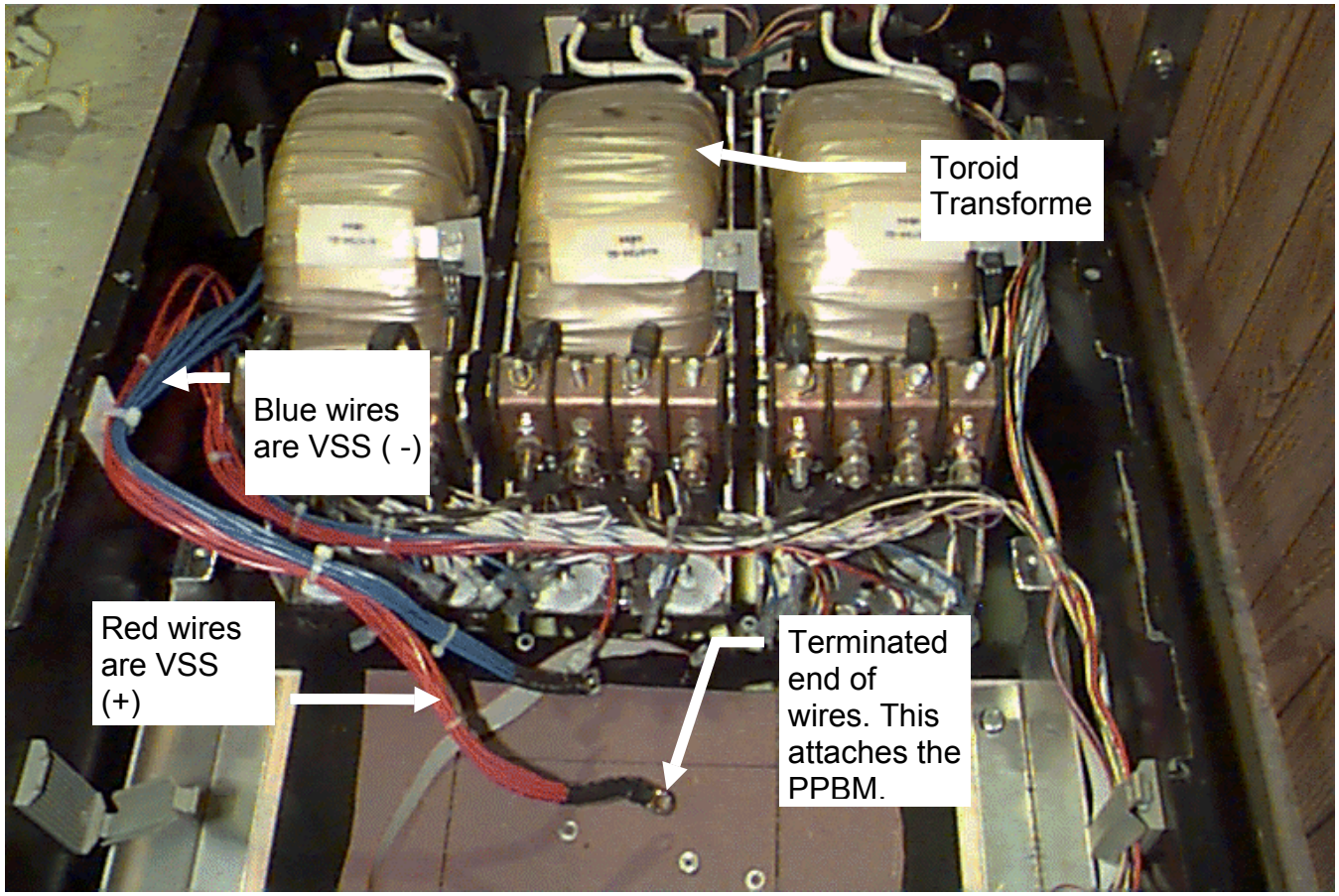
d) Pull out the Power Module for the suspected axis.

e) Remove the Transistor Output Shelves and PPBM. See Illustration 7-1.



INSIDE VIEW OF POWER MODULE SHOWING TOROID TRANSFORMERS, PPBM AND OUTPUT SHELF
ILLUSTRATION 7-1

g) Locate the Red and Blue VSS wires which connect the Bridge Rectifiers to the PolyPhase Buck Module. These wires are identified in Illustration 7-2.

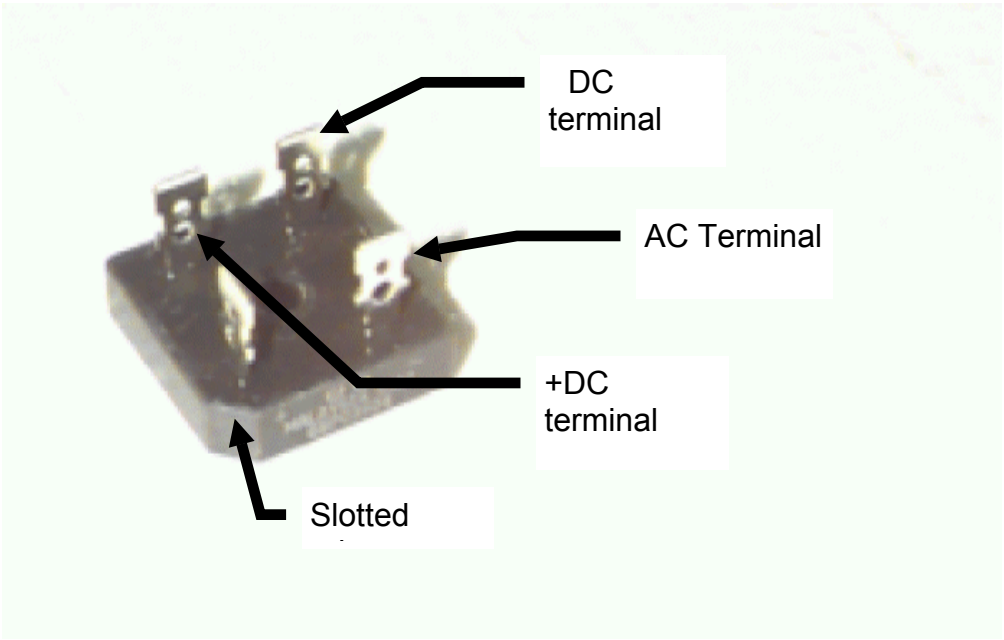


INSIDE VIEW OF POWER MODULE SHOWING LOCATION OF VSS WIRES AND TOROIDS (BRIDGE RECTIFIERS AND PPBM HAVE BEEN REMOVED)
ILLUSTRATION 7-2

h) Attach DMM probes to the terminated ends of the Red and Blue VSS wire groups. Expect a reading of 0.90V in one direction, and an open (infinity Ohms) in the other direction. These measurements indicate that the rectifiers are probably good. A shorted diode measurement will indicate that at least one Bridge Rectifier is shorted.

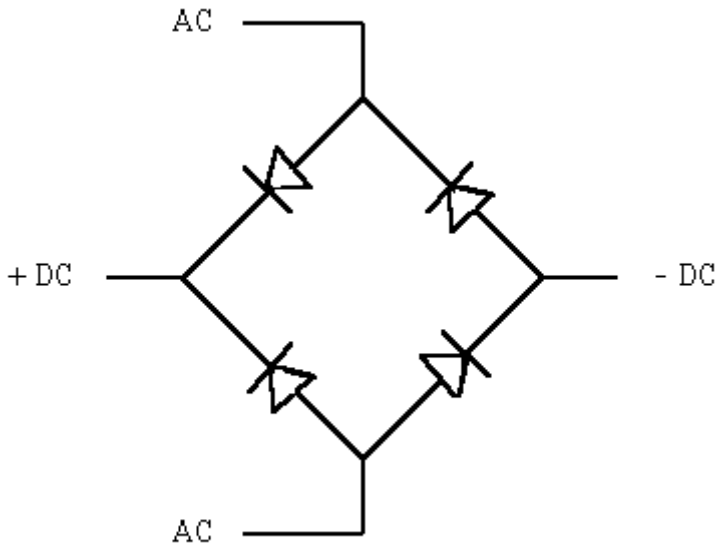
i) Determine if it is more practical to replace the entire Power Module at this point, or perform further tests to locate the particular damaged rectifiers.

j) To measure a particular Bridge Rectifier, detach all wires from terminals of the suspected Bridge Rectifier. Terminal names are given in Illustration 7-3.



CLOSE UP VIEW OF BRIDGE RECTIFIER
ILLUSTRATION 7-3

k) For a list of expected diode drop values taken across an individual bridge rectifier (with bridge rectifier out of the circuit), refer to Table 7-1. Also Illustration 7-4 shows the functional view of the bridge rectifier circuit.



FUNCTIONAL VIEW OF BRIDGE RECTIFIER
ILLUSTRATION 7-4

TABLE 7-1
BRIDGE RECTIFIER DIODE DROP MEASUREMENTS

(MEASUREMENTS TAKEN WITH BRIDGE RECTIFIER OUT OF CIRCUIT)

Positive Lead to:	Negative Lead to:	Expected Measurement
Positive DC terminal	AC terminal (either one)	open
Negative DC terminal	AC terminal (either one)	0.45V +/- 0.05v
AC terminal (either one)	Positive DC terminal	0.45V +/- 0.05v
AC terminal (either one)	Negative DC terminal	open

7-4 Repair

1. Replace all Toroid Transformers with damaged bridge rectifiers. See Illustration 7-2 for Toroid Location in Power Module.

2. If Vss wires are damaged, replace complete Power Module.

3. Check for adequate strain relief on temperature sensor wires. If necessary, cut tie wraps and form a small loop with the wire to allow adequate slack at connection points. See Section 4-4 in this procedure.

8- POWER MODULE CIRCUIT BREAKER TRIPS - NO BURNING SMELL

8-1 Symptoms

1. Circuit Breaker on front of 8645 cabinet trips.

2. Error log shows MDS link time out.

3. Gradient Cabinet Fan not running; 8645 Cabinet is quiet.

4. Signa system will not go into READY (if occurs typically at or soon after installation).

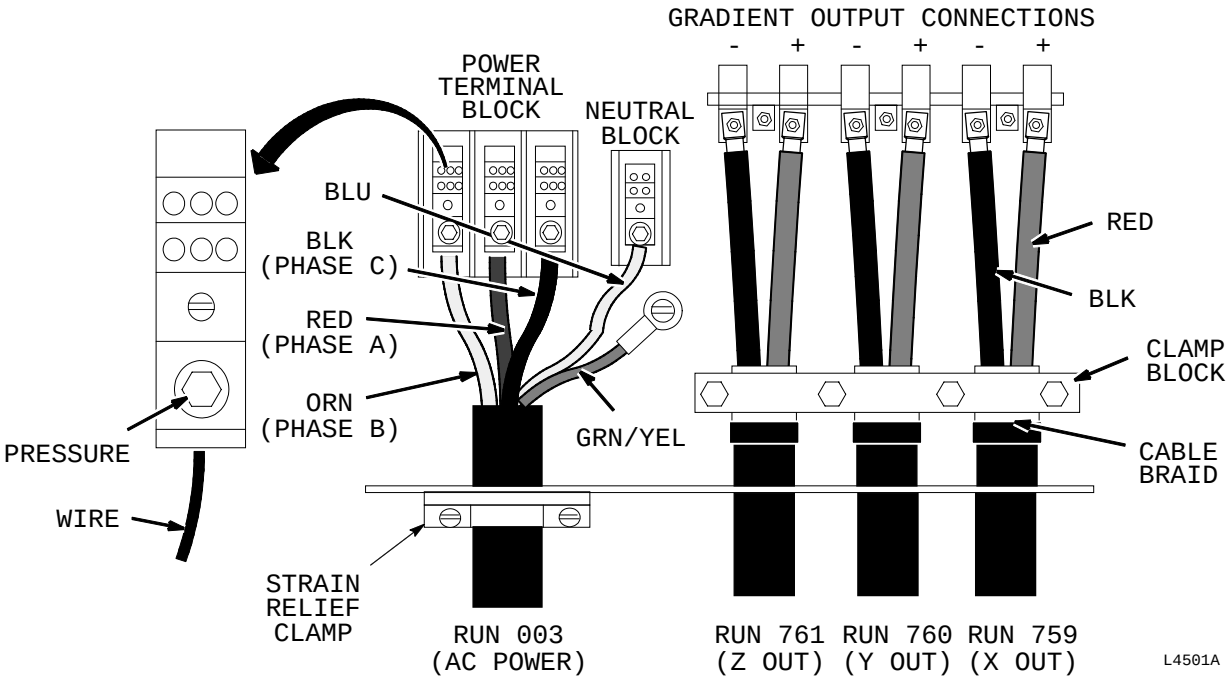
5. Gradient Cabinet Fan runs backwards.

8-2 Test

1. Rear door test: if phase is correct, vacuum from fan should pull rear door shut from half open position. If fan is going in wrong direction, there is a rumbling sound and even though there is a little resistance, the rear door can easily be opened.

2. If the fan is running in the wrong direction, turn OFF power to the gradient cabinets by following Section 2 - Power Lock Out / Tag Out. Change Incoming power phase by swapping any 2 of the orange, red, or black leads at the power terminal block at the rear of the 8645 Cabinet. See Illustration 8-1.

3. Inspect Fan Control Board for physical damage. Remove the Fan Control Board cover which is located in the upper right hand section of the rear of the 8645 Cabinet as viewed from the rear.



8645 CABINET WIRING SHOWING POWER IN AND GRADIENT OUTPUT CONNECTIONS
ILLUSTRATION 8-1

9- UNDERFLOW/OVERFLOW ERROR MESSAGES

9-1 Symptoms

1. Signa system will not go into READY.
2. Message Log reports errors: Underflow, Overflow, Current Distortion.
3. Scanner pauses.
4. GRAM Power may be OFF.
5. All LED's are OFF except GAP and Power Module LED's.

9-2 Error Log numbers

1. 2238610 through 2238615
2. 2241534 through 2241536
3. 2242056

9-3 Test

1. Verify data signals from the TPS are OK as follows:

   a) Digital Gradient Data and a Gradient Clock Signal originate in the Integrated Pulse Generator (IPG).

   b) The Digital Gradient Data and Clock Signal are sent to the TYME or the TYME II Board.

   c) In a 5.X system, the Digital Gradient Data and Clock Signal can be accessed at the following test points on the TYME Board:

   - TP22, GDATX (Gradient Data for the X Axis)
   - TP20, GDATY (Gradient Data for the Y Axis)
   - TP19, GDATZ (Gradient Data for the Z Axis)
   - TP2, GDCLK (Gradient Data Clock Signal)

   Note

   Test points TP19 through TP22 are not accessible on the TYME II Board in 8.X systems, so these signals can only be checked at the GRAM Control Boards.

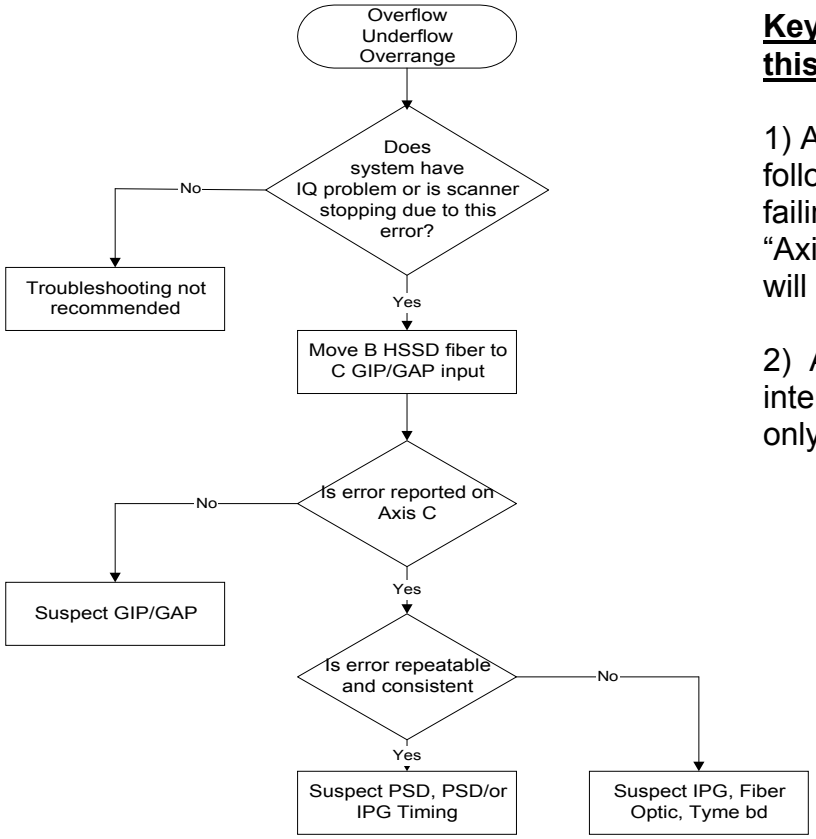
   d) On an oscilloscope, this data appears as a series of several rectangular pulses making a high to low transition from 5 Volts to 0 Volts DC. The signal remains high for about 2 microseconds, and then another series of rectangular pulses appear.

   e) These signals are converted to light pulses and sent to the GAP by Fiber Optic Cable. At the rear of the GAP the data F/O cables are labeled J2 -XDATA, J3-YDATA, J4-ZDATA. See Illustration 9-1.

   f) At the GAP the light signals are converted back to electrical waveforms. They are then sent to the GRAM Control Board. The exact same signals that were scoped at the TYME Board (TP19 through TP22) can be found at TP35 HSSD (High Speed Serial Data) on each GRAM Control Board (X, Y, or Z Axis). TP34 is the clock signal, HSSCLK.

   g) If the Digital Gradient Data does not appear at both the TYME Board and the GRAM Control Board, search for breaks in the data chain.

9-4 Overflow, Underflow, Overrange Troubleshooting Flowchart

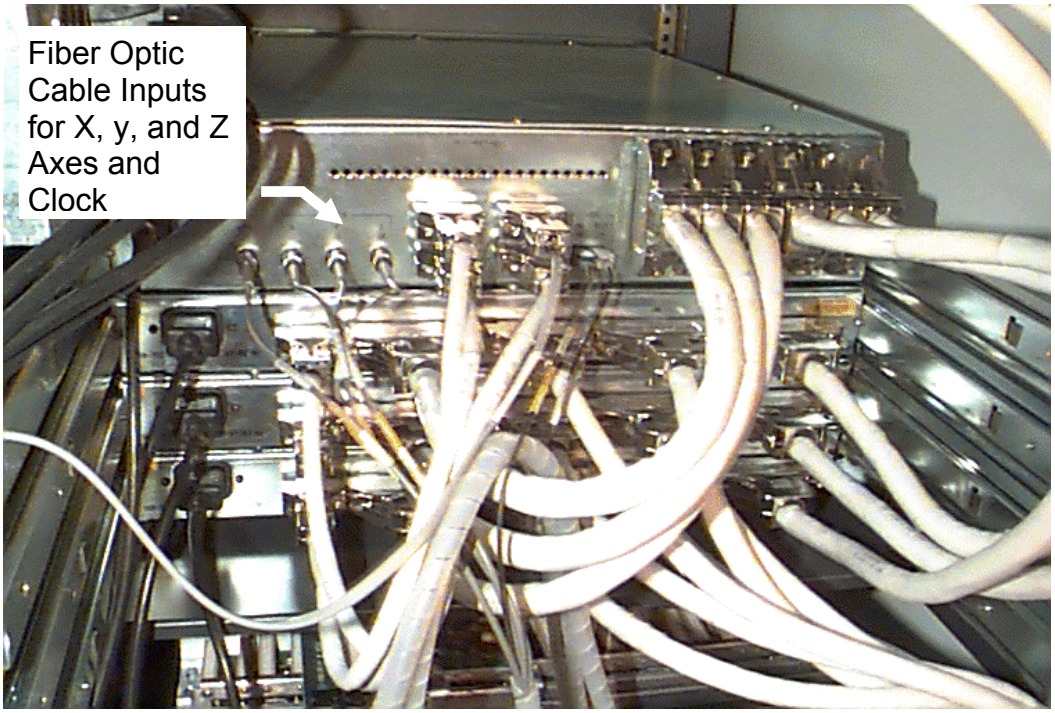


Key Points for using this flowchart:

1) As you begin to follow the flowchart, the failing axis will be called "Axis B" and a passing will be called "Axis C".

2) All cable swaps are intended to be one end only!

See Illustration 9-1 for the location of the Fiber Optic Cables at the GAP.



REAR VIEW OF GAP AND MIF CABLE CONNECTION AREAS
ILLUSTRATION 9-1

3. Run TPS Data Path Tests. See MR Release 5.X or 8.X Service Methods CD-ROM, Diagnostics, System Cabinet, TPS Data Path Tests.

4. These tests may identify a faulty TYME or TYME II Board. To isolate a problem to board level, run TPS/RF Board Level Diagnostics. Intermittent IPG problems may take some time to fail Diagnostics. 95% of the time the IPG has been the cause of the Overflow/Underflow instead of the GAP or GRAM Modules.

10- CURRENT DISTORTION FAULT ON Y-AXIS

10-1 Symptoms

1. Signa system will not scan.

2. Current distortion faults will typically occur on the Y-Axis.

10-2 Test

1. Review error log.

2. Measure DC offsets at J3 and J4 at rear of GRAM Module. J3 (+OUT) and J4 (-OUT) should measure 0mVdc + /- 10mVdc.

   a) If DC offsets measure greater than 5 VDC on any axis, TURN OFF POWER. Measure the coil resistance for the failing axis. Measuring the resistance between GRAM In and GRAM Out at rear of each GRAM module will give the gradient coil resistance for each axis.

   b) If coil resistance is greater than one Ohm, replace the Gradient Coil.

   c) If coil resistance is less than one Ohm, suspect connections and Gradient Filter Box on Penetration Panel .

11- "MDS LINK BROKEN" OR "GAP NOT RESPONDING" ERRORS

11-1 Symptoms

1. Error log reports MDS link broken between the System and RF Cabinets.

2. Signa system will not scan. Scan will pause.

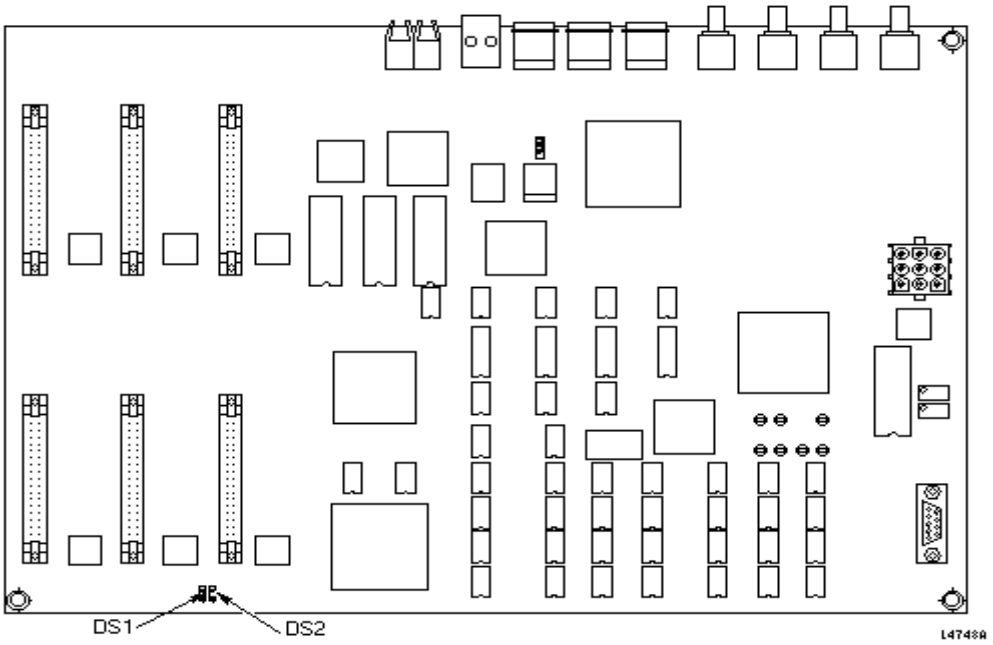
3. GAP does not respond.

11-2 Test

1. Review log for "GAP not responding" or "MDS link broken" messages.

2. Check power to GAP. The power switch is on front of the cabinet. The circuit breaker is CB-4-5 at the bottom of the 8645 Cabinet.

3. Look into the GAP to view heartbeat LED (DS2). See Illustration 11-1 for GAP status LED locations on the GAP board.



GAP STATUS LED LOCATIONS ON THE GAP BOARD
ILLUSTRATION 11-1

4. Refer to Table 11-1 for GAP Status LED flash sequences.

TABLE 11-1
GAP STATUS LED FLASH SEQUENCES

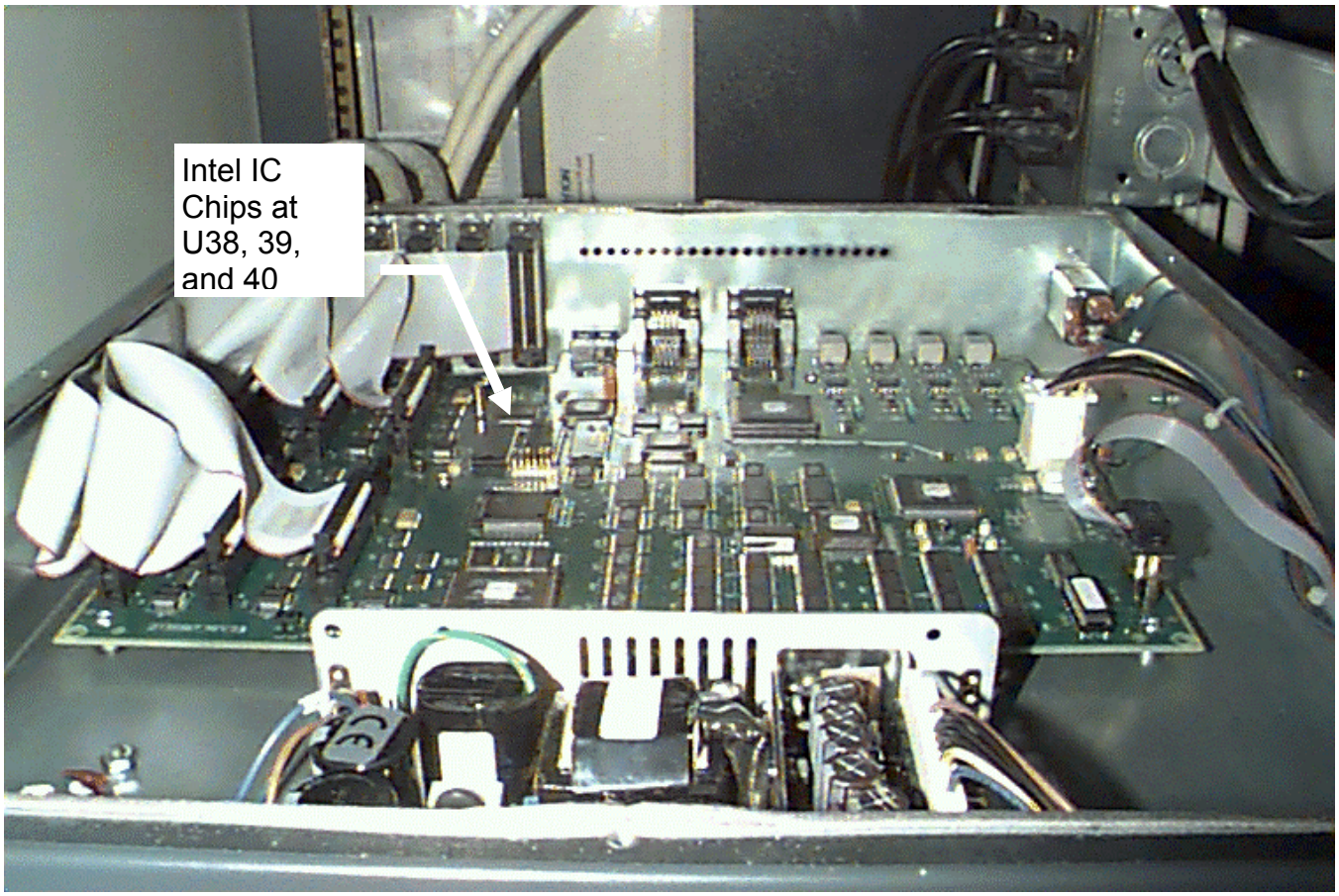
DS2 (Heartbeat LED)	System is OK	Single flash On/Single flash Off with a period of 5 seconds and a 50% duty cycle.
DS2 (Heartbeat LED)	Boot code DUART Test Failure	Single flash On/Single flash Off, 50% duty cycle.
DS2 (Heartbeat LED)	Boot code External Static RAM Test Failure	Double flash On/Single flash Off, 50% duty cycle.
DS2 (Heartbeat LED)	Power-up Interrupt Test Failure	Triple flash On/Single flash Off, 50% duty cycle.
DS1	+5V Indicator	When lit, this indicates that +5V is present. If it is not lit, +5V is not getting to the GAP.

5. Run MDS link diagnostics to identify break.

6. Use light meter test kit to test light power. Run manual diagnostics and look in end of cable.

7. Open GAP to view OKI chips (three total). Verify OKI chips have been replaced with Intel chips at U38, 39, and 40. Illustration 11-3 shows the inside of a GAP module.

8. Replace the GAP.



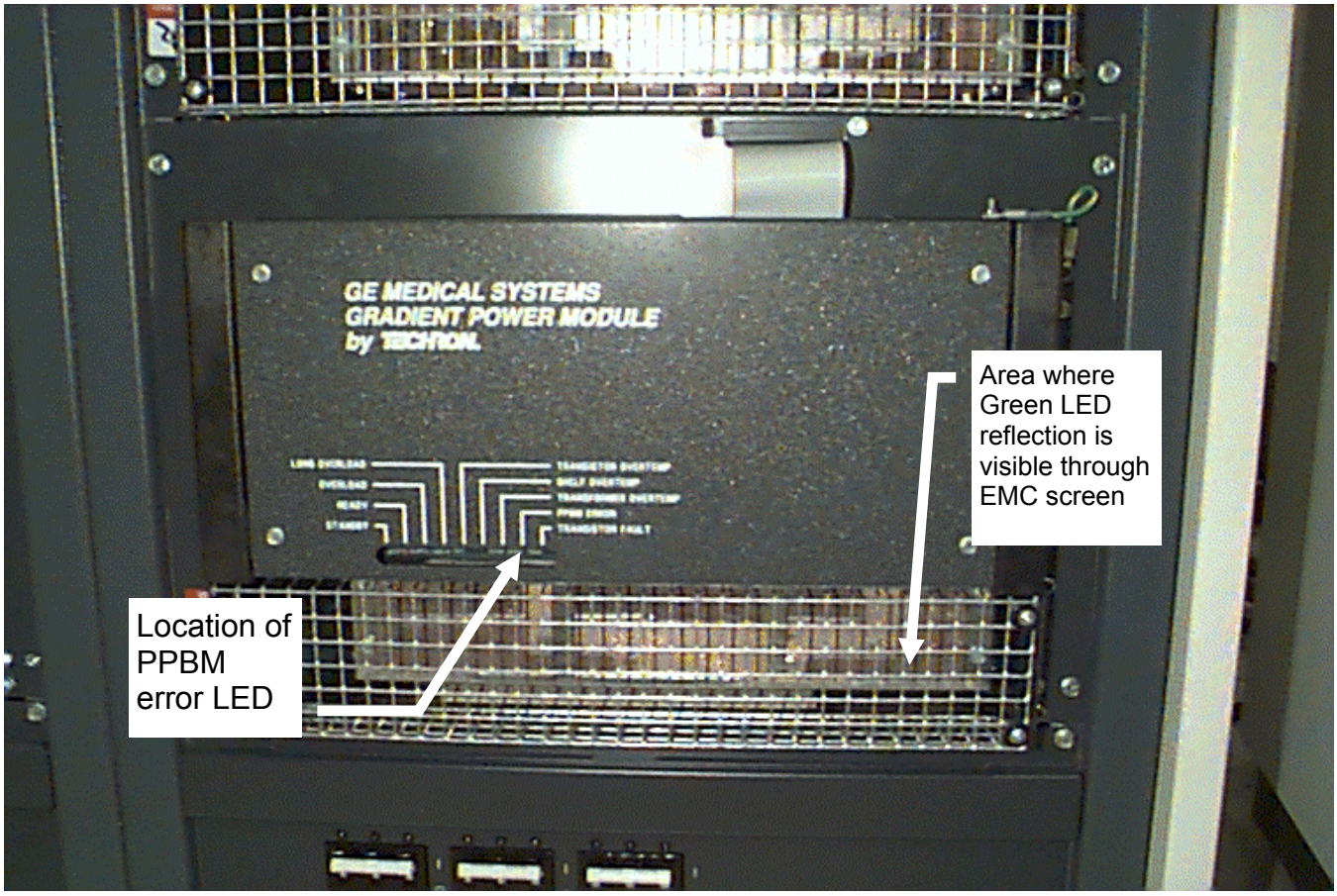
INSIDE OF GAP MODULE, VIEWED FROM THE FRONT, COVER LID REMOVED
ILLUSTRATION 11-3

12- GRADIENTS WILL NOT GO TO READY

12-1 Symptoms

1. Scanner will not go into READY.

2. PolyPhase Buck Module Error LED is lit on Gradient Power Module Main Board. See Illustration 12-1 for the location of the PPBM Error LED.



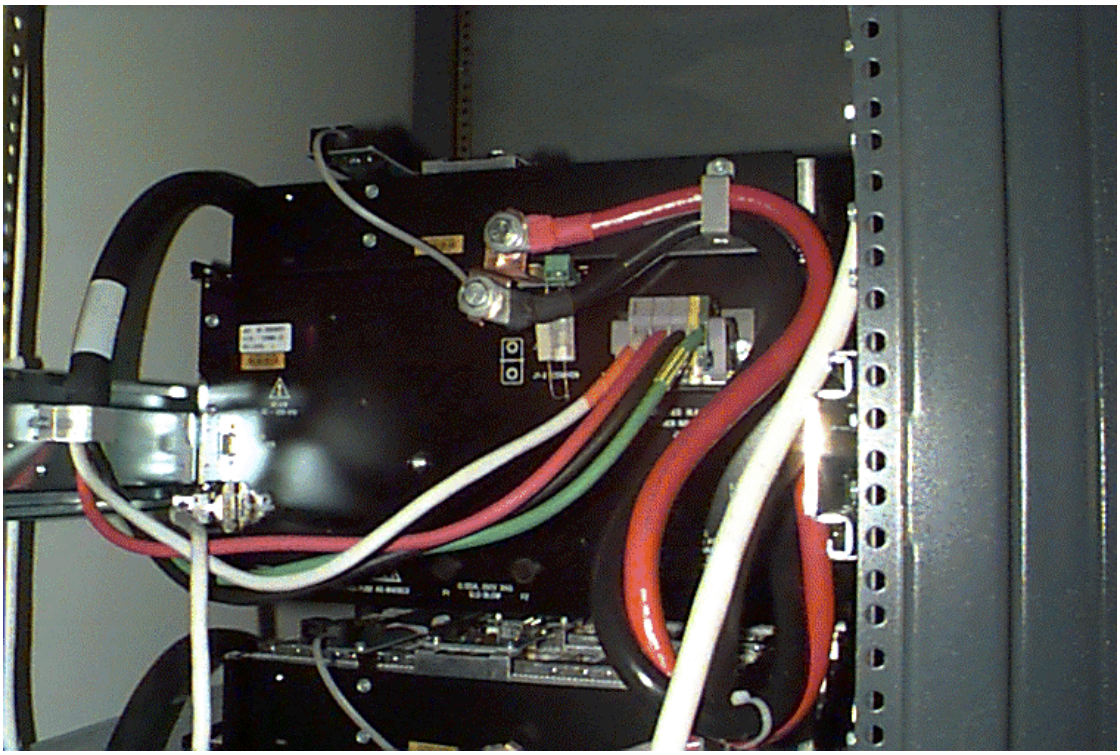
8645 POWER MODULE FRONT PANEL SHOWING LED LOCATIONS
ILLUSTRATION 12-1

12-2 Error log

1. 2238449 X High
2. 2238450 Y High
3. 2238451 Z High
4. 2238452 X Low
5. 2238453 Y Low
6. 2238454 Z Low

12-3 Test

1. Measure 208 VAC incoming to each Gradient Power Module. The spec is 208 VAC +/ 10%. If out of spec, check incoming power. See Illustration 12-2.



REAR VIEW OF 208V POWER INPUT TO POWER MODULE
ILLUSTRATION 12-2

2. Run 5 minutes in STANDBY. Check if cooled and recovered. If recovered, check the following items:

   a) 8645 Cabinet cover filter: is it clean?

   b) Are doors closed?

   c) Is fan turning in proper direction?

3. Check PPBM Power Supply Board through EMC screen. Look into the lower right-hand corner of the EMC screen. (This is easier to do in a darkened room). Look for a reflection of a green LED. The LED itself is not in direct view. If the green LED reflection is visible and yet the amber “PPBM Error” LED is lit, the Power Module Main Board is probably defective. See Illustration 12-1.

4. To verify, swap the Power Module Main Board with another axis.

5. At the time of PPBM replacement check two things:
   a) If the PPBM is equipped with a crowbar circuit (see Illustration 13-1) check the F1 fuse to see if the fuse opened

   b) Check the rectifiers. If the Bridge Rectifier tests bad, replace the whole power module. Do not replace PPBM without checking the rectifiers. See Section 7-3 of this procedure to check the rectifiers.

6. If system goes into READY and scans, try to reproduce trip conditions. If it fails again, swap failing Power Module with adjacent unit. Otherwise, consider it a nuisance trip. Otherwise, replace Power Module.

13- PPBM CATASTROPHIC FAILURE

13-1 Symptoms

1. Signa system will not scan.

2. Gradient Power Module components are smoking or burning.

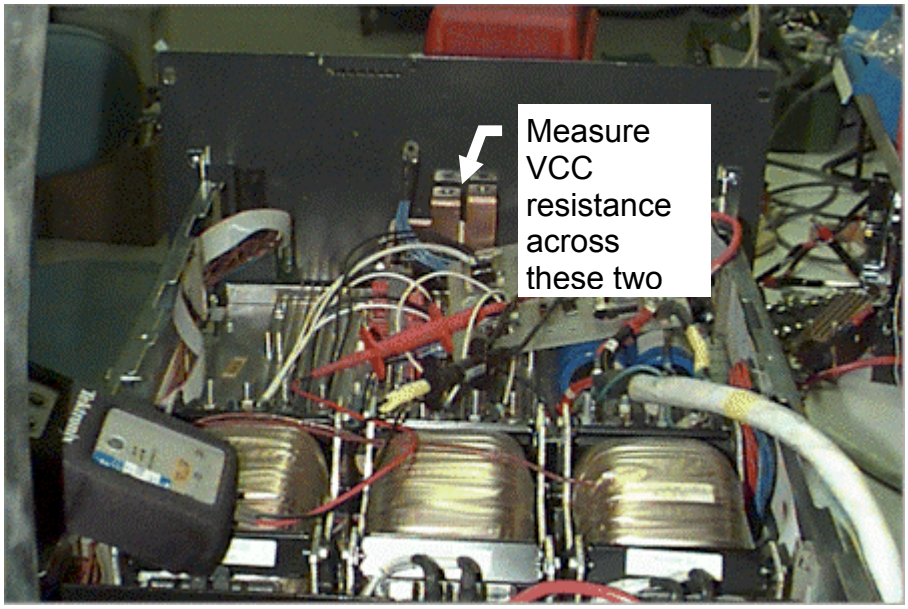
13-2 Error log

1. 2238497 X High
2. 2238498 Y High
3. 2238499 Z High
4. 2238500 X Low
5. 2238501 Y Low
6. 2238502 Z Low

13-3 Test

1. Turn OFF 8645 Gradient Cabinet AND GRAM Cabinet circuit breakers at PDU.

2. With power OFF, perform a resistance check of VCC. The VCC Busbar is located at the front end of the Power Module. See Illustration 13-1 for the VCC Busbar location.



INSIDE 8645 POWER MODULE (VIEWED FROM REAR) SHOWING VCC BUSBAR
ILLUSTRATION 13-1

3. Measure VCC Busbar resistance according to Table 13-1. There are two projections of the Busbar. Place a meter probe on each projection. If the measurements are within range, go to next step. If they are not within range, perform bridge rectifier check. See Section 7-3 of this procedure.

TABLE 13-1
VCC BUSBAR RESISTANCE MEASUREMENT CONDITIONS

Polarity	Hardware	Expected Reading
Forward	Transistor Shelf Removed or PPBM stand alone	125K ohms +/- 30K ohms
Reverse	Transistor Shelf Removed or PPBM stand alone	20K ohms +/10K ohms

13-4 Preventing Future Catastrophic Failures

Two different PPBM's exist. There is a PPBM without a crowbar circuit and a PPBM with a crowbar circuit. All replacement PPBM's will have the crowbar circuit. An example of a PPBM with crowbar circuit is shown in Illustration 13-1.

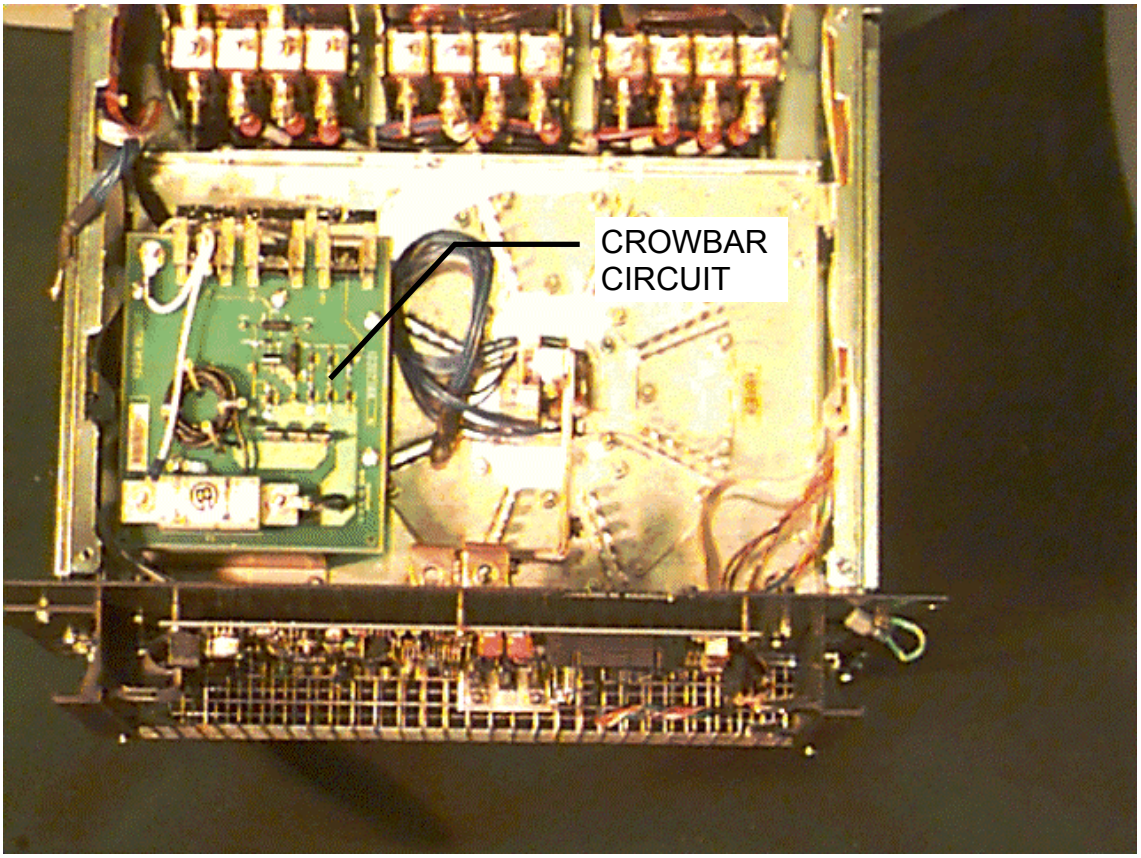


ILLUSTRATION 13-1
PPBM WITH CROWBAR CIRCUIT

By adding a crowbar circuit to the PPBM the smoking/burning catastrophic type failure is limited in the vast majority of cases. The crowbar circuit acts as a fuse that shuts down the PPBM. The PPBM may or may not experience damage.

If your 8645 Gradients do not have the crowbar circuit, and your site typically exceeds the Signa Systems siting specs for Non-condensing humidity > 60%, order and install the following.

FMI 60474 - 8645 Double-bay Gradient Crowbar Circuit Upgrade
FMI 60475 - 8645 Single-bay Gradient Crowbar Circuit Upgrade

14- PPBM OUTPUT VOLTAGE OUT-OF-RANGE IN STANDBY

14-1 Symptom

The error reads that the 8645 PPBM VCC is out of range in Standby. It is related to premature aging of a capacitor in the PPBM. This error prevents you from running the dynamic portion of the gradient driver diagnostics. It also occurs during round robin monitoring that monitors gradient cabinet status when the system is not scanning. It does not, however, prevent the system from scanning or affect the performance of the scanner.

14-2 Solution

a. Modify the *gdt_tolerances.cfg* file and *asm.cfg* file using the vi editor by selecting:
For 5.x systems: select **[Utilities]** and **[C Shell]**
For 8.x systems: select **[Service Desktop] ,** then **[C Shell]**
In the C shell window type as follows:

```
genesis @ XXXX: su root <ENTER>

Password: #bigguy <ENTER> (Release 5.x)     operator <ENTER>       (Release 8.x)

root @ XXXX: cd /w/config <ENTER>

root @ XXXX: chmod 777 gdt_tolerances.cfg <ENTER>            (gives you permission to edit)
root @ XXXX: chmod 777 asm.cfg <ENTER>

root @ XXXX: cp gdt_tolerances.cfg gdt_tolerances.org <ENTER>  (makes backup copy)
root @ XXXX: cp asm.cfg asm.cfg.org <ENTER>
```

b. Refer to Table 14-1 for the commands to change the gradient tolerance file.
Refer to Table 14-2 for the commands to edit the round robin monitoring file.
Refer to Table 14-3 for basic vi editor commands.

TABLE 14-1
GRADIENT DRIVER TOLERANCES FILE

Tolerance file	Comments
vi gdt_tolerances.cfg <ENTER>	(opens vi editor session)
/019 <ENTER>	(goes to line 019 which is VCC_STDBY_MAX)
$	(goes to end of line)
a	(append after cursor)
<SPACE> 200.0	(enter new value, it must have the decimal point)
<ESC>	(ends edit session)
:wq	(saves changes made and exits)

Note
All parameters in this file will be blank except for the VCC_STDBY_MAX value that you will add.

TABLE 14-2
ROUND ROBIN MONITORING FILE

Round Robin Monitoring file	Comments
vi asm.cfg <ENTER>	(opens vi editor session)
/VCC_H <ENTER>	(goes to line containing VCC_H)
$	(goes to end of line)
a	(append after cursor)
<SPACE> -0.5000	(enter new value, it must have a decimal point and
<SPACE> 200.00	follow the format example. All four values must be
<SPACE> 2.0000	entered even though only one is changing)
<SPACE> 200.00	
<ESC>	(ends edit session)
/VCC_L <ENTER>	(goes to line containing VCC_L)
$	(goes to end of line)
a	(append after cursor)
<SPACE> -0.5000	(enter new value, it must have a decimal point and
<SPACE> 200.00	follow the format example. All four values must be
<SPACE> 2.0000	entered even though only one is changing)
<SPACE> 200.00	
<ESC>	(ends edit session)
:wq	(saves changes made and exits)

c. Upon completion of step b, verify the change made by typing:
more gdt_tolerances.cfg <ENTER> (Press space bar to display next page of tolerance file)

```
019 VCC_STDBY_MAX  200.0
```

Type: **<CTRL> <C>**

Verify that the change was also made in the round robin monitoring file by typing:
more asm.cfg <ENTER> (Press space bar to display next page of round robin monitoring file)

You should see the following:

```
VCC_H    -0.5000   200.00    2.0000    200.00
IOUT_L
VOUT_L
VCC_L    -0.5000   200.00    2.0000    200.00
```

Type: **<CTRL> <C>**

d. `root @ XXXX:` **chmod 444 gdt_tolerances.cfg <ENTER>** (changes permissions back)
`root @ XXXX:` **chmod 444 asm.cfg <ENTER>**

e. `root @ XXXX:` **exit <ENTER>** (exits root)
exit <ENTER>

f. In order for the changes in the tolerances file to take effect the gradient driver diagnostics must be run again. This will ensure that the changes do mask the nuisance error.

Running the Diags: (For 5.x System)

1. Select **[Diags]** from the UTILITIES menu

2. Toggle Off all selected buttons.

3. At submenu selection (bottom portion of screen) select **[TPS Periph], [MDS], [Gradient Tests].**

4. Click on **[Run Diags]**. A *Results* window will appear along with a status message indicating the TPS is resetting. Once the TPS reset is complete, the selected diagnostic test will automatically commence. To halt the test, click on **[Stop Diags]**.

Running the Diags: (For the 8.x System)

1. Select the Diags Main Menu from the **[Diagnostics]** menu on the Service Desktop, then click **[Start]**.

2. Wait for the Diagnostics Main Menu to appear.

3. Select iteration count: **[1]** (default), **[5]**, or **[Cont]** (continuous).

4. Click on **IPG**, then **[MDS...]**.

5. Select **[Grad Driver Tests]**. Then click on **[Close]**, then **[Close]** again.

6. Click on **[Run Diags]**. A *Results* window will appear along with a status message indicating the TPS is resetting.
Once the TPS reset is complete, the selected diagnostic test will automatically commence. To halt the test, click on **[Stop Diags]**.

g. In order for the changes in the round robin monitoring file to take effect you must do a TPS reset. Do this by downloading TPS.

TABLE 14-3
BASIC VI EDITOR COMMANDS

COMMANDS TYPES	COMMAND	DESCRIPTION
Search for string	/<string>	Searches for the specified string throughout the file
Input Mode Commands	i	Inserts text immediately before the cursor location
	a	Appends text immediately following the cursor location
Exit Input Mode	**<ESC>**	Places *vi* in Command Mode
Cursor Positioning	$	Moves cursor to end of the line
	h	Moves cursor one character to the left
	l	Moves cursor one character to right
	j	Moves cursor down one line
	k	Moves cursor up one line
Modifying Text	x	Delete the current character
	r	Replaces current character with character typed next
	u	Undo most recent delete or change
	U	Undo all changes on current line
Saving and Exiting *vi*	:w	Save the changes to the current file
	:wq	Save the changes to the current file and quit *vi*
	:q!	Quit *vi* without saving changes

REVISION HISTORY

REV	DATE	AUTHOR	PRIMARY REASONS FOR CHANGE
A	10/22/97	F. Fiore	Initial Draft
B	11/19/97	F. Fiore	Convert document to Word Style, incorporate revisions
C	12/10/97	F. Fiore	Preparation for internal evaluation
D	1/10/98	F. Fiore	Incorporate photos, tables.
E	1/22/98	F. Fiore	Release for field evaluation
0	5/14/99	J. Wolak	Incorporated field feedback
1	5/21/99	S.M.Atladottir	Updated Procedure References for New GUI
2	10/13/99	K. Keshena	Changed to use a proprietary header.