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1- INTRODUCTION

1-1 Application

Gradient Driver Tests are a method of testing the Gradient Driver subsystem. The tests look like diagnostics that are invoked on the screen at the operator workspace. They are more than that, however; they are a hybrid digital and analog diagnostic test. This group of tests exercise and test the entire Gradient Driver subsystem with the three non-proprietary Power-up Tests, and the proprietary Static and Dynamic Tests.

The Gradient Driver Tests are available on systems with ACGD cabinets that use the GP (Gradient Processor) to look at digital and analog signals within the Gradient Driver subsystem.

The Gradient Driver Tests are designed to isolate a problem in a FRU, or group of FRUs. The tests are easy to invoke. Errors are reported to the system error log. The system error log entries are limited in size, so in cases where additional information is required, an “extended error” may be available. System error messages with extended information will contain the symbols “->” at the end of the message. The extended error messages document is titled “Horizon 8x (LX) Extended Error Log” and is available on the Service Methods CD-ROM.

1-2 Purpose

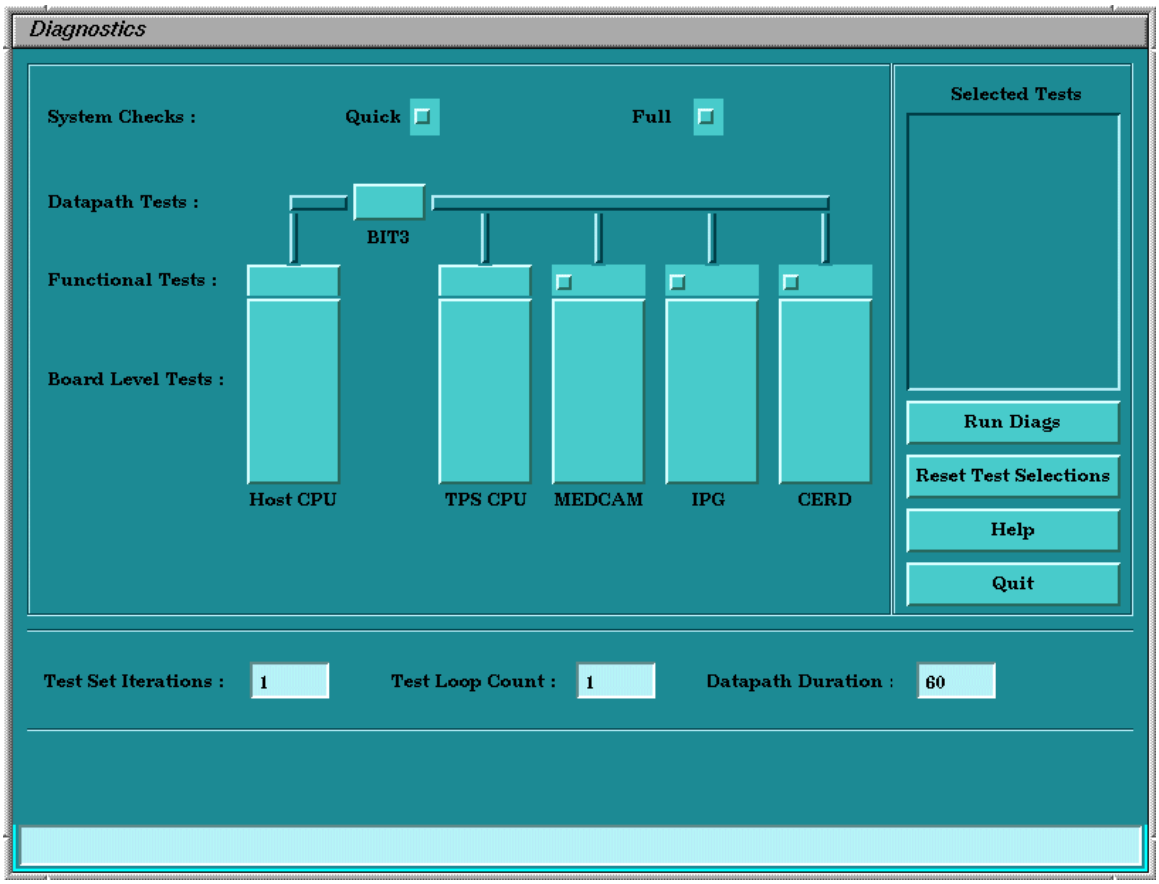
Note

A valid Service Key is required to run these Proprietary Class C Diagnostics.
A Service Key is required for Gradient Tests (Static and Dynamic Tests)

1. Click on **[Diagnostics]** on the Service Desktop; then click **[Start]**.

2. Wait for the Diagnostics Main Menu to appear, as shown in Illustration 1-1.

1-2 Purpose (continued)



DIAGNOSTICS MAIN MENU SCREEN
ILLUSTRATION 1-1

3. On the Diagnostics Main Menu Screen, make sure Test Set Iterations is set to **[1]** (default).

4. Click on **IPG**.

5. On the IPG screen (IPG Board Level Tests:), click on **[MDS...]**. See Illustration 1-2.

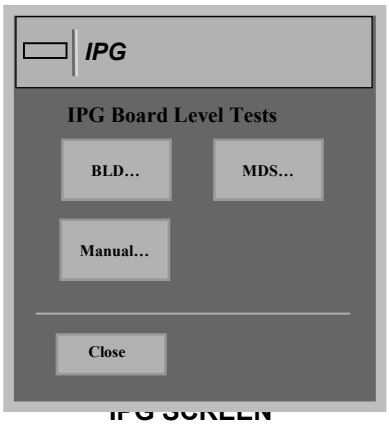
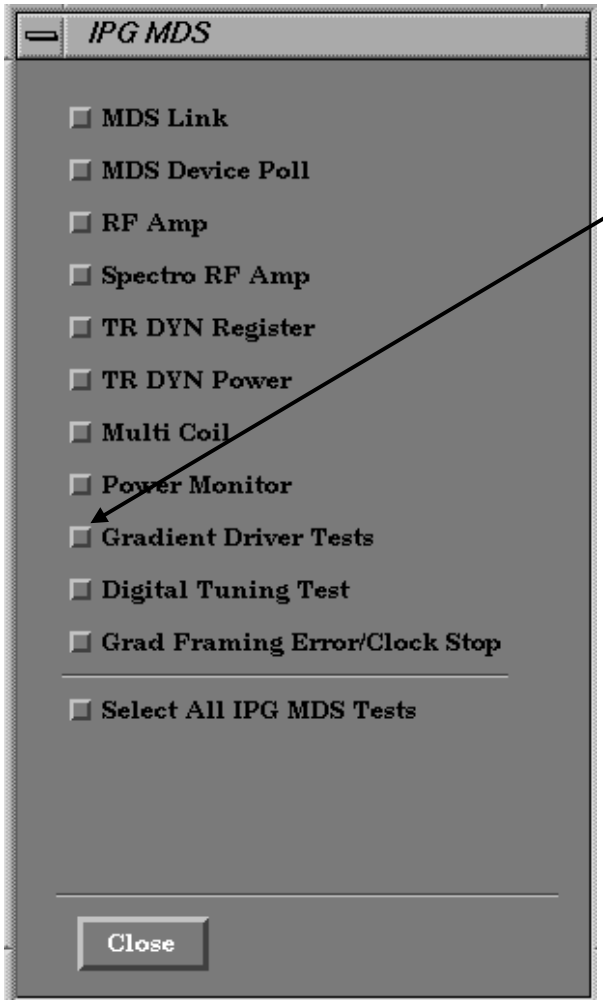


ILLUSTRATION 1-2



6. On IPG MDS screen, Select **[Gradient Driver Tests]**. Then click on **[Close]**, then **[Close]** again. See Illustration 1-3.

7. On Diagnostics Main Menu screen, 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]**.

TEST SELECTION SCREEN
ILLUSTRATION 1-3

2- POWER-UP TESTS

Power-up Tests examine GP board interrupts, memory, and register access. They run each time the system is brought up to the applications level, each time the TPS is reset, and the first time the Gradient Driver Tests are invoked from the Diagnostic menu on the Service Desktop.

When the IPG/SPI code is loaded the first time, TPS resets. All subsequent Run Diags sessions do not run Power-up Tests.

For a complete description of the Power-up Tests, see the procedure for Gradient Driver Power-up Diags.

3- STATIC TESTS

These diagnostics test for three possible hardware configurations and operating modes. They exercise the Gradient Driver subsystem in the most comprehensive manner, and also in the same modes used in product. Together with the Power-up Tests, these Static Tests establish confidence in the following areas of the subsystem.

- Digital portions of the GP Board
- The entire MDS Link
- The analog signals on the SGA.
- The analog signals on the SGA Power Supply
- The analog signals on the GP
- The entire power chain of the gradient subsystem.

Prior to starting the Static Tests, a comparison is made between the hardware configuration specified in the `MRconfig.cfg` file, and the actual hardware sensed by the GP Board. If the two do not match, the Gradient Driver Tests are aborted. It is critical that the MR configuration file and the hardware present match exactly for these tests to operate. If they do not match, Gradient Driver Tests are not executed for any axis.

3-1 Static Fault Checking

Prior to beginning the Static Tests, all fault registers on the GP are checked. Section 6 of this document lists the signals tested.

If any of the faults are set, an error is logged, and NO Tests are performed.

Faults are also monitored during the operation of the test. If a fault occurs, an error is logged and the test is aborted on that axis.

3-2 Static Tests Modes

There are two modes in which the Static Tests run:

- Standby Static Mode
- Ready Static Mode

3-3 Static Data Collection

Each Static Test consists of forcing DAC values and measuring a set of signals. All tests sequence through two passes. The first uses a small range of DAC values to catch any overcurrent conditions before damaging hardware. The second pass uses the full scale range from -320A to 320A, with steps every 16A. If any signals are out of range in the first pass, an error is logged and the test is aborted.

3-4 Static Data Analysis

Throughout the Static Tests, signals are generated and data are collected. To determine the relative health of the hardware, transfer functions are calculated using the data collected to determine if those data are within range. This is the method that these tests use to predict where a problem is in the subsystem.

3-5 Static Tests Error Handling

Each axis of the Gradient Driver subsystem is tested independently. If an error occurs on one axis, the error is logged, the axis is taken to Standby, and the test on that axis aborts; however, all other axes, continue with the rest of the Static and Dynamic Tests.

3-6 Static Tests Error Reporting

Every error message that could be generated by the Static Tests has been reviewed for technical accuracy and service relevance. In all cases, if there were more information that could be added to the error message, an extended error message has been created.

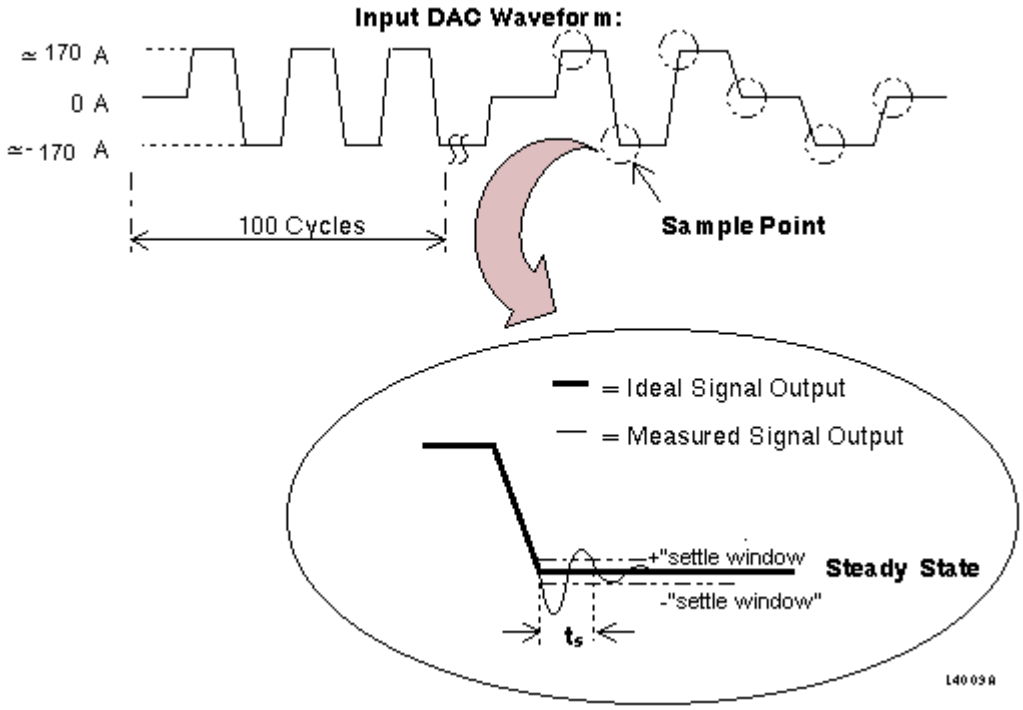
4- DYNAMIC TESTS

The Dynamic Tests are executed sequentially after a successful run of the Static Tests. This group of tests uses EPI-type waveforms. This means that voltages and currents are generated and played out using the Gradient Driver subsystem circuitry, and the epoxy-filled Gradient Coil. This digital and analog test uses a waveform that is played out to provide a unique look at analog information for diagnostic purposes.

The test that is run during the Dynamic Tests portion of the Gradient Driver Tests is called the *Settling Time Test*.

4-1 Settling Time Test

This Dynamic Test verifies that a measured gradient signal settles into its steady state value within a predefined settling time. Settling time is defined, as *the time required for a signal to reach and remain in a "predefined" window of the ideal steady state voltage or current*.



SETTLING TIME TEST WAVEFORMS
ILLUSTRATION 4-1

Illustration 4-1 shows the Settling Time Test waveforms and sample times. The upper portion of the illustration shows the overall waveform used during the test. The DAC Input is cycled through several swings of current. After loading down the system with 100 cycles, the sample phase is entered. In this phase, the DAC signal is taken from 0A to approximately 170A to approximately –170A to approximately 170A to 0A to approximately –170A to 0A, to explore each of the major transition points of the waveform. A dashed circle indicates each transition point in the illustration.

At a transition point, the resultant output signal exhibits an overshoot and damped oscillation to its steady-state value (as shown in the exploded view in the illustration). The Settling Time Test verifies that the output signal enters the "pre-defined" window within the defined settling time (t_S).

4-2 Dynamic Fault Checking

Prior to beginning the Settling Time Tests, all fault registers on the GP are checked. Section 6 of this document lists the signals tested.

If any of the faults are set, an error is logged and no Dynamic Tests are performed.

4-3 Dynamic Data Collection

The GP generates the Input DAC Waveform for this test. At transition points, the GP begins collecting output signal samples every 4 µsec. Depending on the settling time, samples are collected until it is guaranteed that the output signal must be in the "predefined" window. If the output signal is not within the window, the test fails and an error is logged.

4-4 Dynamic Data Analysis

Throughout the Dynamic Tests, signals are generated, and data are collected. This is how these tests predict where a problem is in the subsystem. The entire process is automated, and is performed within the Dynamic Tests software.

4-5 Dynamic Tests Error Reporting

Every error message that could be generated by the Static Tests has been reviewed for technical accuracy and service relevance. In all cases, if there were more information that could be added to the error message, an extended error message is created.

5- MDS LINK DEPENDENCY

The Gradient Driver Tests depend on the MDS Link being able to communicate between the Systems Cabinet and Gradient Cabinet. The GP performs the Analog Service Module "ASM" functions of monitoring the gradient driver hardware for all axes.

6- FAULT REGISTERS

The following ACGD Faults are checked:

Framing Error	Clock Stop Error
Overrange Error	Rollover Error
Current Distortion Error	SGA Cable Off
SGA Wiring/Internal Power Supply Undervoltage Fault	SGA Over Temperature
SGA Over Current	SGA Over Voltage
SGA Under Voltage	SGA-PS Cable Off
SGA-PS Power Off	SGA-PS Wiring/Internal Power Supply Under Voltage Fault
SGA-PS Over Temperature	SGA-PS Over Current
SGA-PS Over Voltage	SGA-PS Under Voltage

REVISION HISTORY

REV	DATE	AUTHOR	PRIMARY REASONS FOR CHANGE
A	Sept. 19, 2000	K. Keshena	Preliminary release.
0	Oct. 20, 2000	K. Keshena	Initial release.