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1- OVERVIEW

This procedure explains the functional checks from the RFI (RF Interface) module for the 0.7T (GRFD) Power Cabinet.

The RFI Functional Checks described in this document should be performed when the Maximum Power RF Output setup and Calibration procedure has failed.

The Body mode of the system is used for transmit only, with receive on Head.

Note

In the 0.7T (GRFD) Power Cabinet the RF signal from the exciter is connected via a J3 rear interface bracket. It then is routed to the RFI Module (front) J14 BNC connector RF In. The SSM connections J105 or J103 are not utilized.

1-1 General Function

The RFI is the interface between the System Support Module (SSM) and the RF Power Module (RFM). Additionally, the RFI interfaces to the Transceiver Exciter Output and to the RF Coils through the Helix Cable Interface. The RFI consists of three blocks: IF Translation, Input Conditioning, and Output Conditioning.

The RFI module performs 2 major functions:

1. The RFI is the RF interface from the Transceiver Exciter Output to the RF Amplifier, and finally to the RF Coils through the heliax cable connection(s).

The RFI provides the proper output power needed for Surface (Body), or Head mode. The Head and Body Couplers, located in the RFI, provide the redundant pick-off signals to the Power Monitoring circuitry on the APM.

2. The RFI Module also provides communication translation between the RF Amplifier and the System Support Module (SSM) which in turn communicates with the host.

The RFI functionality includes: Head/Body Switching, Test output, Serial Link decoding, error/status reporting, and unblank / RF Lock signal control.

1-2 RFI Input Conditioning Section per “Purchase Specification”

Body (front panel gain adjustment): 0 dBm nominal (± 0.1 dBm).

Head (front panel gain adjustment): -10 dB nominal, (-10 dB delta below body).

J13, Test Output: 400 mW (+26 dBm/12.619 Vp-p) with 1 mW (0 dBm/0.632 Vp-p) RF Input.

1-3 RFI Output Conditioning Section per “Purchase Specification”

J4, Body Output: 9 kW.

J3, Head Output: 900 W.

J8 & J6, Body Coupler A, B: -46 dB ± 0.25 dB.

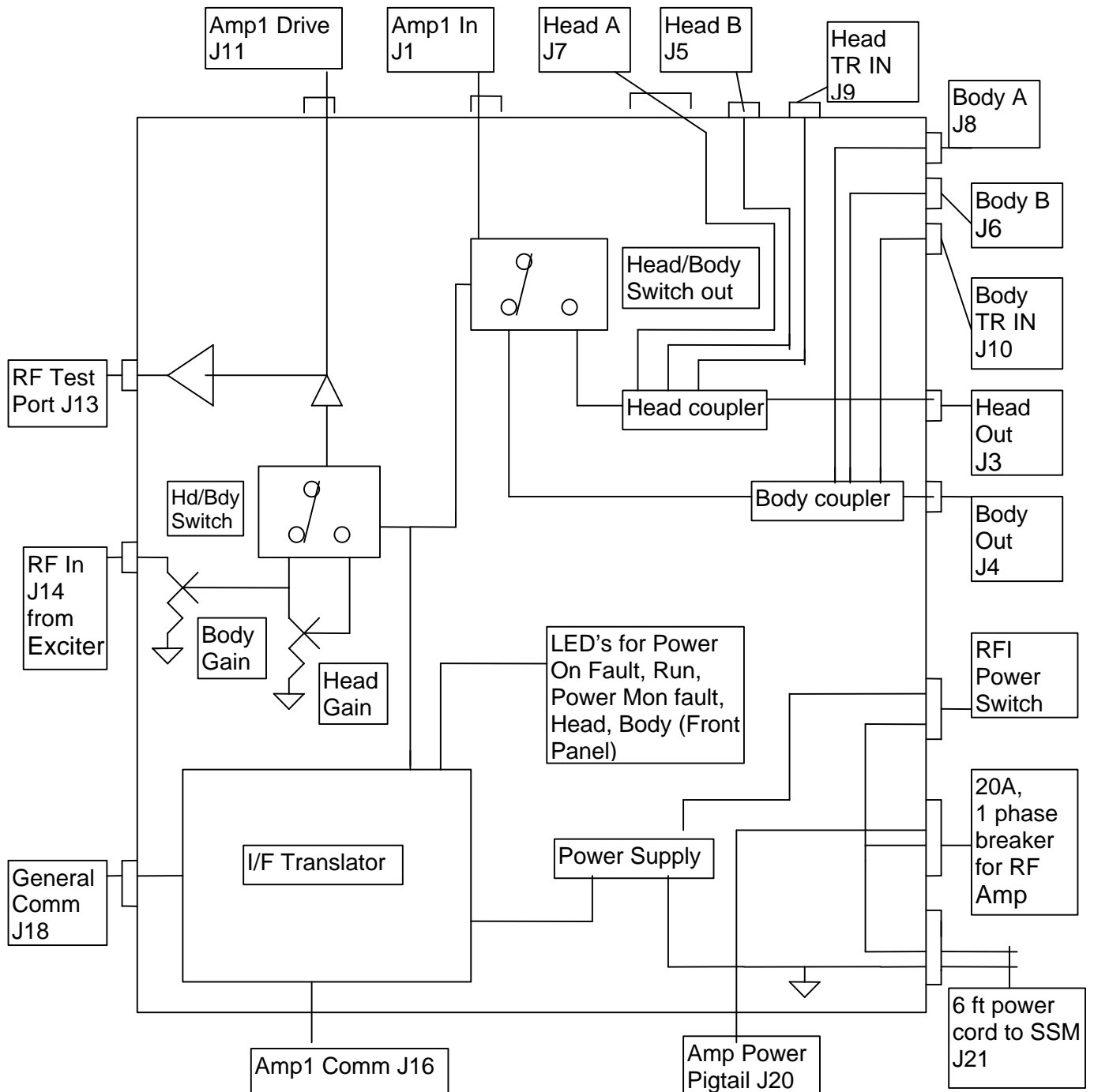
J7 & J5, Head Coupler A, B: -35 dB ± 0.25 dB.

J10, Body TR Bias coupled to the RF Out.

J9, Head TR Bias coupled to the RF Out.

Insertion loss: Amp1In (J11) to Head Out (J3) / Body Out (J4): 0.15 dB maximum.

1-4 RFI Block Diagram Section



RFI BLOCK DIAGRAM

J11, J13, J14, J16, RFI power switch, 20A circuit breaker on front panel. Remainder of connectors on the rear panel.

1-4 RFI Block Diagram Section (continued)

Refer to the RFI Block Diagram:

The Exciter RF In signal enters the RFI at J14 "RF In". When the RFI is in the Body mode the RF In signal path is through the Body Gain pot, through the "Head/**Body** Switch In", and out of the RFI at "Amp1 Drive" (J11). The Body RF signal is then amplified and exits the RF Amplifier. The amplified RF re-enters the RFI at "Amp1 In" (J1), passes through the "Head/**Body** Switch Out" to the Body Coupler where the J10 Body TR Bias (from the SSM) is coupled to the Body RF Out (J4). The Body Coupler also passes the redundant Body Sense to the SSM via J8 and J6. The Body A and Body B power monitor signals are -46 dB referenced to the Body Out (J4).

When the RFI is in the Head mode the RF In signal path is through the Body Gain pot and the Head Gain pot, through the "**Head**/Body Switch In", and out of the RFI at Amp1 Drive (J11). The Head RF signal is then amplified and exits the RF Amplifier. The amplified RF re-enters the RFI at Amp1 In (J1), passes through the "**Head**/Body Switch Out" to the Head Coupler where the J9 Head TR Bias (from the SSM) is coupled to the Head RF Out (J3). The Head Coupler also passes the redundant Head Sense to the SSM via J7 and J5. The Head A and Head B power monitor signals are -35 dB referenced to the Head Out (J3).

The dB difference between the RF signal as measured at the rear of the RF Amplifier (with interconnect cable) and the output of the RFI (either Head or Body) is typically 0.15 dB.

2- UNBLANK (GATE) SIGNAL

The Unblank signal enters the RFI, from the SSM, at the J18 (General Comm) digital control and status cable. The Unblank signal is routed through the RFI to the RF Amplifier. A visual indication of the "Gate" (illumination indicates presence of the unblank when system pulses) signal is visible at the rear of the RF Amplifier.

The Head, Body, and Test blanking signals are all active high and only one is high at any point in time. The status of these signals determines which mode the RFI is operating in. The HEAD and BODY LED's in the Processor Board indicate the mode of operation, which mount on the front panel of the RFI unit. If both LED's are off the RFI is in test mode.

3- CALIBRATION REQUIREMENTS AFTER HARDWARE REPLACEMENT

TABLE 2-1
RE-CALIBRATION REQUIREMENTS AFTER HARDWARE REPLACEMENT

Hardware Replaced	Required Calibration
<ul style="list-style-type: none">RFI Module	<ul style="list-style-type: none">0.7T Max Power RF Out Setup & Calibration procedure.

4- RF CONVERSION CALCULATOR SEQUENCES

VP-P to dBm Calculation:

VP-P [,] 0.632 [=] [LOG] [*] 20 [=] dBm.

dBm to VP-P Calculation:

dBm [,] 20 [=] [INV LOG] [*] 0.632 [=] VP-P.

Example Conversion Below: Using 3.65 dBm, Scope Power reading listed on Kit card

3.65 [,] 20 [=] (0.1825) [INV LOG] (1.5222991) [*] 0.632 [=] (0.9620931) VP-P.

dBm to Watts Calculation:

dBm [,] 10 [=] [INV LOG] [=] [*] 0.001 [=] Total Watts.

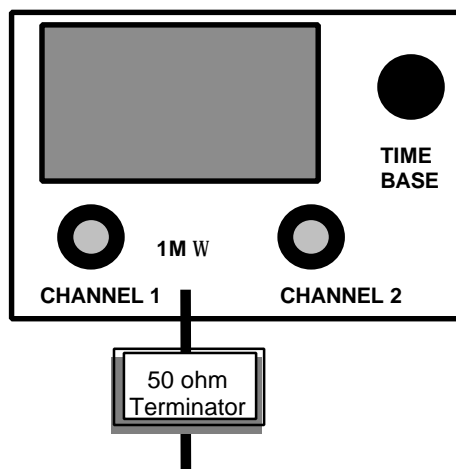
5- EQUIPMENT USE

5-1 Oscilloscope Use

0.7T sites using the RF Power Measurement Kit **should not use** the 1.5T Scope Calibrator tool to set the oscilloscope for divisions. The 1.5T Scope Calibrator can be used to verify the final 50 ohm terminated oscilloscope channel measures approximately 1.0 VPP (4 dBm).

1. Verify the Bandwidth Limit button is not selected on the oscilloscope.
2. Verify Channel 1 is set to a FINAL termination of 50 ohms. See Illustration 5-1.

100 MHz or greater OSCILLOSCOPE



The FINAL Oscilloscope Termination MUST be Equivalent to 50 ohms when measuring RF signals. If the oscilloscope has a 50 ohm selectable Terminator do not use the external 50 ohm terminator.

RF SIGNAL OSCILLOSCOPE CONNECTIONS ILLUSTRATION 5-1

5-2 Dummy Load and Cable Calibration

1. Verify attenuation value of the equipment by performing the "Dummy Load and Cables Calibration" procedure.

6- SYSTEM PREPARATION FOR BODY MODE

1. Remove all coils and phantoms from the bore.



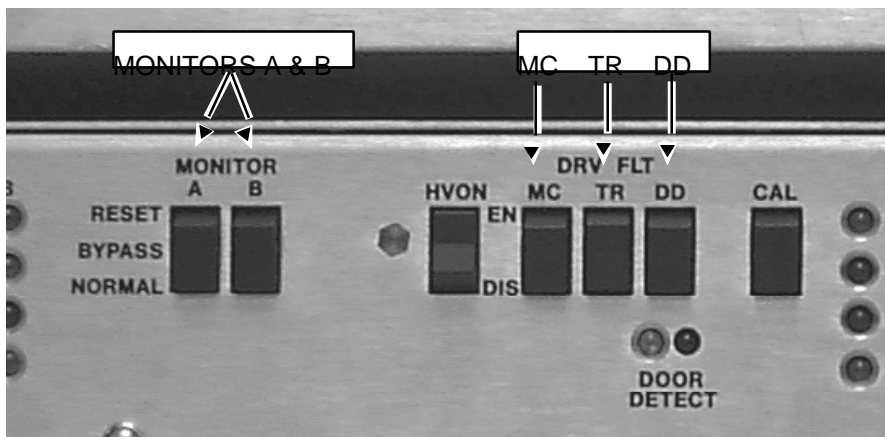
PROPERTY DAMAGE! TO PREVENT COIL AND ASSOCIATED SWITCH DAMAGE, REMOVE ALL PHANTOMS AND HARDWARE (I.E., HEAD COIL, SURFACE COIL...) FROM THE MAGNET BORE.



PERSONAL INJURY! TO PREVENT POSSIBLE RF BURN WHEN DISCONNECTING HELIAX CABLES FROM J3 OR J4, VERIFY THAT THE SYSTEM IS NOT IN MANUAL PRESCAN OR SCANNING, THE SCAN DESKTOP ICON WILL DISPLAY THE "IDLE" MESSAGE.



2. See Illustration 6-1. On the front of the SSM place the:
 - 2 (two) power MONITOR switches (A and B) to the Bypass position.
 - 3 (three) DRV FLT switches to the DIS (disable faults) position.



SSM FRONT PANEL SWITCHES DISABLED
ILLUSTRATION 6-1

3. Prepare the system to scan in Body mode per the 0.7T "GRFD Max Power RF Out Setup and Calibration" Body protocol. Enter all Control Variables per the protocol.
4. Verify Body LED is illuminated on front of RFI Module.

6-1 Troubleshooting Prerequisite — RF Signal In

Minimum RF signal levels at the CERD and into the 0.7T (GRFD) Power Cabinet. Refer to the following specification Tables and Illustration 6-2 for equipment setup. Setup protocol per Section 6.

The System Cabinet 8x ISE CERD Board RF signal must meet specifications per Table 6-1. Typical RF signal output at the J109 “RF OUT” located at the front panel of the CERD/UCERD is 3.0 dBm to 5 dBm (0.893 mVPP to 1.12 VPP). Verify the RF Out switch is on/enabled.

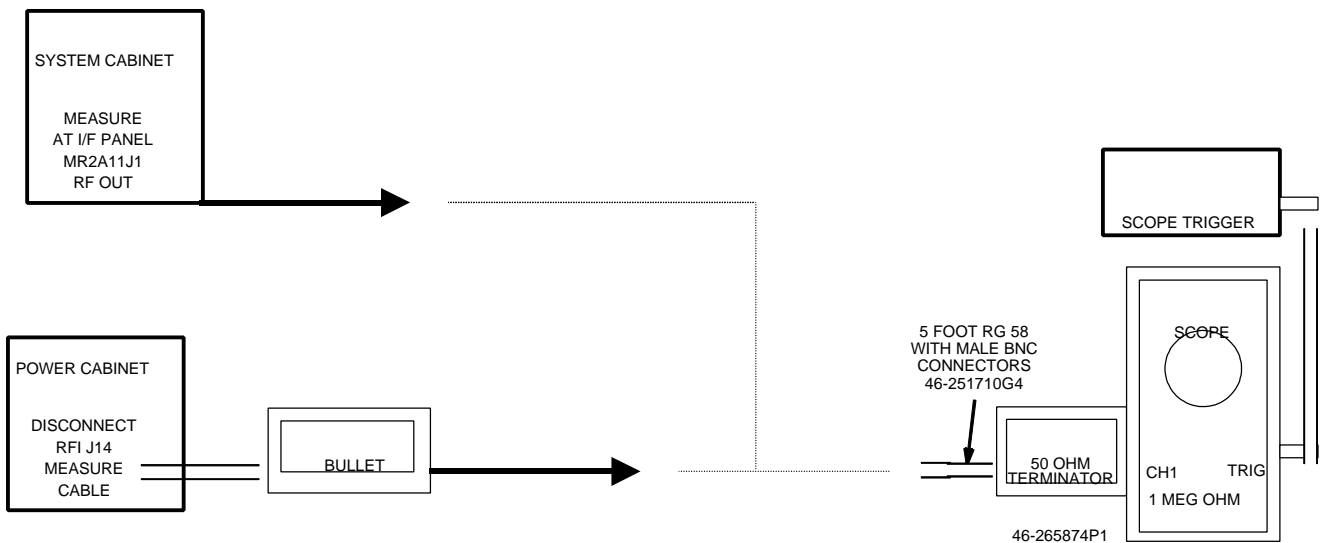
TABLE 6-1
CERD / UCERD BOARD RF SIGNAL REQUIREMENT

DESCRIPTION	SPECIFICATION AT FRONT OF ISE CHASSIS RF OUT, J109	SPECIFICATION AT MR2A11J1 SYSTEM CABINET I/F PANEL
0.7T RF In	0.893 to 1.12 VPP	0.843 to 1.12 VPP
MR2A11J1	3.0 dBm to 5.0 dBm	2.5 dBm to 5.0 dBm

The RF signal (J14, RF In — front of RFI module in the 0.7T Power Cabinet) must meet specifications per Table 6-2:

TABLE 6-2
J14 RFI RF SIGNAL REQUIREMENT

DESCRIPTION	SPECIFICATION
0.7T RF In	≥ 0.597 VPP
RFI — J14	-0.50 dBm minimum



RF SIGNAL MEASUREMENTS
 ILLUSTRATION 6-2

5. Disconnect the Exciter RF Interconnect cable, Run 229, at MR2A11 J1 System Cabinet I/F Panel.
6. Connect a BNC cable to measure MR2A11J1 per Illustration 6-2.
7. **[Manual Prescan]**. Set TG = 200. Measure the Exciter output at the System Cabinet Interface Panel, MR2A11J1, to make sure its peak RF power is within specification (using a 100 MHz or greater oscilloscope with final oscilloscope termination of 50 ohms).
8. Stop the **[Manual Prescan]**.
9. Reconnect the Exciter RF cable to MR2A11 J1 System Cabinet I/F Panel.
- A. If the exciter output is not in the specified range, refer to the *CERD or UCERD Board Replacement* procedure for exciter functional checks. Verify the internal cable from Exciter J109 "RF OUT" to MR2A11J1 is good.
10. Disconnect the Exciter RF In signal at the 0.7T (GRFD) Power Cabinet RFI Module front panel J14.
11. Using a bullet connect the J14 BNC cable per Illustration 6-2.
12. **[Manual Prescan]**. Set TG = 200. Measure the Exciter "RF IN" signal at the RFI J14 cable to make sure its peak RF power is within specification (using a 100 MHz or greater oscilloscope with final oscilloscope termination of 50 ohms).
13. Stop the **[Manual Prescan]**.
14. Reconnect the Exciter "RF IN" cable to the front panel of the RFI Module J14.
- A. If the exciter "RF IN" signal to the RFI Module is not in the specified range verify Interconnect Cable Run 229 and/or the internal BNC cable between the rear J3 bracket to J14 of the RFI Module is good.

6-2 Troubleshooting — RF Amp Drive out of the RFI, Body Mode

1. Refer to Section 1-4 RFI Block Diagram. Disconnect the J3 “RF IN” signal at the rear of the Analogic RF Power Amplifier Module located in the 0.7T (GRFD) Power Cabinet.
2. Using a bullet connect the J3 “RF IN” BNC cable to the oscilloscope (using a 100 MHz or greater oscilloscope with final oscilloscope termination of 50 ohms).
3. **[Manual Prescan]**. Set TG = 200. Measure the J3 “RF IN” BNC cable to make sure its peak RF power is within specification (using a 100 MHz or greater oscilloscope with final oscilloscope termination of 50 ohms).
4. Stop the **[Manual Prescan]**.
5. Reconnect the J3 “RF IN” BNC cable at the rear of the Analogic RF Power Amplifier Module located in the 0.7T (GRFD) Power Cabinet.
 - A. If the J3 “RF IN” BNC cable is not in the specified range verify the internal BNC cable between the front panel of the RFI Module (J11, Amp I Drive) and the Analogic RF Power Amplifier Module (J3, RF IN) is good.
 - 0.563 millivolts peak-peak is –1.00 dBm (minimum)
 - 0.632 millivolts peak-peak is 0.00 dBm (nominal)
 - 0.709 millivolts peak-peak is +1.00 dBm (maximum)
 - B. It may be necessary to calibrate the RFI Module “Body Gain” adjust pot to achieve the Analogic RF Power Amplifier Module specified nominal input value.
 - C. If the J3 “RF IN” measurement at the rear of the Analogic RF Power Amplifier Module during Body Mode is between 0.563 millivolts peak-peak and 0.709 millivolts peak-peak and then measure the J4 “RF Out” Power at the rear of the RF Power Amplifier Module.

6-3 Troubleshooting — RF OUT of RF Power Amplifier Module, Body Mode

1. Refer to Section 1-4 RFI Block Diagram. Disconnect the J4 “RF OUT” signal at the rear of the Analogic RF Power Amplifier Module located in the 0.7T (GRFD) Power Cabinet.
 2. Connect the RF Power Measurement Kit to J4 “RF OUT” per the procedure “0.7T GRFD Max Power RF Out Setup and Calibration” Body RF Out.
 3. **[Manual Prescan]**. Set TG = 200. Measure the J4 “RF OUT”. Verify measured RF power is within specification (using a 100 MHz or greater oscilloscope with final oscilloscope termination of 50 ohms).
 4. Stop the **[Manual Prescan]**.
 5. Reconnect the J4 “RF OUT” N cable at the rear of the Analogic RF Power Amplifier Module located in the 0.7T (GRFD) Power Cabinet.
- A. If the J4 “RF OUT” of the Analogic RF Power Amplifier Module is not 9 kW (69.54 dBm) or slightly greater, refer to the *RF Power Amplifier Replacement* procedure.
- 69.54 dBm (minimum), 9 kW or 9000 Watts
 - 69.69 dBm (maximum), 9311 Watts [this value is derived from 9 kW (out of cabinet) plus 0.15 dB (maximum specified insertion loss of the RFI OUT path) equals 69.69 dBm out of the Analogic RF Power Amplifier Module].

6-4 Troubleshooting — RF OUT of RFI Module, Body Mode

1. Refer to Section 1-4 RFI Block Diagram. Disconnect the J4 “BODY RF OUT” signal at the rear of the RFI Module located in the 0.7T (GRFD) Power Cabinet.
2. Connect the RF Power Measurement Kit to J4 “BODY RF OUT” per the procedure “0.7T GRFD Max Power RF Out Setup and Calibration” Body RF Out.
3. **[Manual Prescan]**. Set TG = 200. Measure the J4 “BODY RF OUT”. Verify measured RF power is within specification (using a 100 MHz or greater oscilloscope with final oscilloscope termination of 50 ohms).
 - A. J8 & J6, Body Coupler A, B: -46 dB \pm 0.25 dB (to Power Monitor referenced to Body RF Out dBm value).
4. Stop the **[Manual Prescan]**.
5. Reconnect the J4 “BODY RF OUT” cable at the rear of the RFI Module located in the 0.7T (GRFD) Power Cabinet.
 - A. If the J4 “RF OUT” of the RFI Module is not in the specified range, refer to the *RFI Module Replacement* procedure.

7- SYSTEM PREPARATION FOR HEAD MODE

1. Remove all coils and phantoms from the bore.



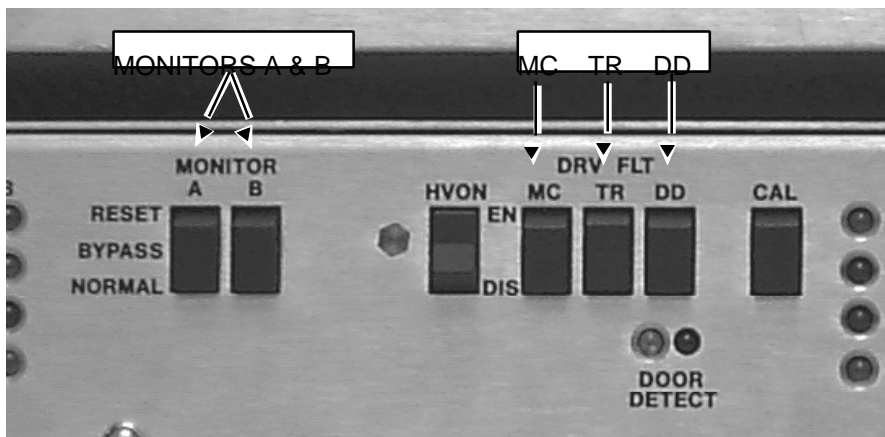
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2. See Illustration 7-1. On the front of the SSM place the:
 - 2 (two) power MONITOR switches (A and B) to the Bypass position.
 - 3 (three) DRV FLT switches to the DIS (disable faults) position.



SSM FRONT PANEL SWITCHES DISABLED
ILLUSTRATION 7-1

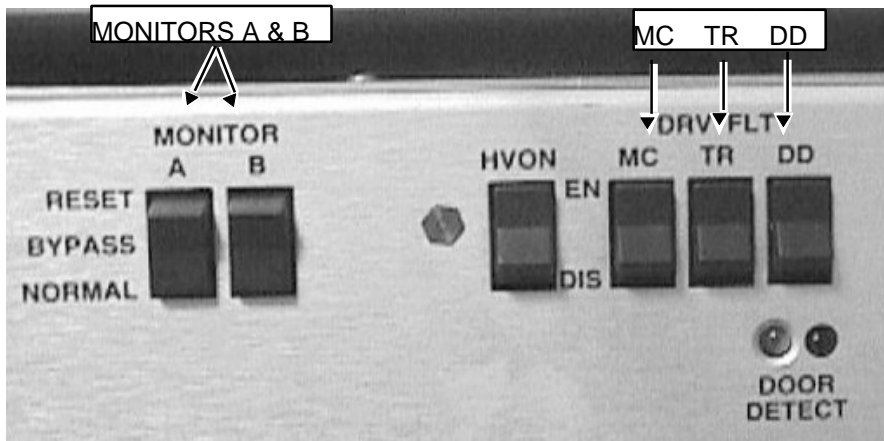
3. Prepare the system to scan in Body mode per the 0.7T "GRFD Max Power RF Out Setup and Calibration" Head protocol. Enter all Control Variables per the protocol.
4. Verify Head LED is illuminated on front of RFI Module.

7-1 Troubleshooting — RF Amp Drive out of the RFI, Head Mode

1. Refer to Section 1-4 RFI Block Diagram. Disconnect the J3 “RF IN” signal at the rear of the Analogic RF Power Amplifier Module located in the 0.7T (GRFD) Power Cabinet.
2. Using a bullet connect the J3 “RF IN” BNC cable to the oscilloscope (using a 100 MHz or greater oscilloscope with final oscilloscope termination of 50 ohms).
3. **[Manual Prescan]**. Set TG = 200. Measure the J3 “RF IN” BNC cable to make sure its peak RF power is within specification (using a 100 MHz or greater oscilloscope with final oscilloscope termination of 50 ohms).
4. Stop the **[Manual Prescan]**.
5. Reconnect the J3 “RF IN” BNC cable at the rear of the Analogic RF Power Amplifier Module located in the 0.7T (GRFD) Power Cabinet.
 - A. If the J3 “RF IN” BNC cable is not in the specified range verify the internal BNC cable between the front panel of the RFI Module (J11, Amp I Drive) and the Analogic RF Power Amplifier Module (J3, RF IN) is good.
 - 0.178 millivolts peak-peak is -11.00 dBm (minimum)
 - 0.200 millivolts peak-peak is -10.00 dBm (nominal)
 - 0.224 millivolts peak-peak is -9.00 dBm (maximum)
 - B. It may be necessary to calibrate the RFI Module “Head Gain” adjust pot to achieve the Analogic RF Power Amplifier Module specified nominal input value.
 - C. If the J3 “RF IN” measurement at the rear of the Analogic RF Power Amplifier Module during Head Mode is between 0.178 millivolts peak-peak and 0.224 millivolts peak-peak and then measure the J3 “RF Out” Power at the rear of the RF Power Amplifier Module.
 - D. J7 & J5, Head Coupler A, B: -35 dB \pm 0.25 dB (to Power Monitor referenced to Head RF Out dBm value).

8- SYSTEM RESTORATION

1. Verify scan desktop icon is displaying the "Idle" message.
2. See Illustration 8-1. On the front panel of the SSM place the:
 - 2 (two) power MONITOR switches (A and B) to the Normal position.
 - 3 (three) DRV FLT switches to the EN (enable faults) position.



SSM FRONT PANEL SWITCHES ENABLED
ILLUSTRATION 8-1

2. Remove all test equipment.
3. Verify the Head and Body Heliac cables are re-connected.
4. Verify all RFI module cables are re-connected.
5. Verify all Analogic Power Amplifier Module cables are re-connected.
6. Verify the rear bracket J3 cable is re-connected.
7. Verify the MR2A11J1 System Cabinet I/F Panel cable is re-connected.
8. Replace the cabinet covers.
9. Successfully complete one head scan, if applicable.
10. Successfully complete one body scan, if applicable.

REVISION HISTORY

REV	DATE	AUTHOR	PRIMARY REASONS FOR CHANGE
A	Apr 12, 1999	Resa Lambert	Preliminary version.
B	Nov 15, 1999	Resa Lambert	Updated to 0.7T particulars.
C	Nov 17, 1999	Resa Lambert	Added Power Monitor pick-off measurements.
0	Dec 6, 1999	Resa Lambert	Initial Release