SECTION 1 – MULTI–NUCLEAR TR BIAS TROUBLESHOOTING

NOTE
This Section applies to M1040FF and M1040FK.

1–1 INTRODUCTION ––– Written Specifically for RF Cabinet

Section 1 tests require the availability of the 1.5T Spectroscopy Hardware.

FOR TROUBLESHOOTING PURPOSES ONLY:
This procedure checks Multi–Nuclear Spectroscopy related voltages at the Dynamic Disable/TR Driver Board located in the Dynamic Disable Module in the RF Cabinet. The Multi–Nuclear Spectro TR Bias is produced by the Dynamic Disable/TR Driver Board (its timing is concurrent with the unblank signal timing). It assumes the Dynamic Disable/TR Driver Board has been pre–adjusted for Multi–Nuclear Spectroscopy to an approximate positive transmit mode bias of ~4.3 VDC in the Transmit Mode. This procedure checks the bias line voltages out to the coil but does not include the coil.

The MNS Receive Bias (~15 VDC power for the 20 dB Gain Block and Spectroscopy Preamplifier) is sent out from the Receiver Board (no TNF used on Multi–Nuclear Spectroscopy). Once a MNS protocol is setup and pulsed at least once this ~15 VDC should be present on the MNS Receive Line until a non–Multi–Nuclear Spectroscopy scan is pulsed.

Transmit Line Concepts: The spectro transmit line is the path for the MNS RF XMIT Signal. This line also is the path for the Spectro TR Bias. This TR Bias has 2 (two) modes {transmit or receive} associated with it. The Transmit Mode is understood to be a positive bias which occurs when the scanner is pulsing (concurrent with the unblank signals timing), or the system is forced to the Transmit Mode via the JP3 jumper placed in **“Test Mode C”** (Transmit Simulation Mode). The Receive Mode is understood to be a negative bias which occurs when the scanner is not pulsing, or the system is forced to the Receive Mode via the JP3 jumper placed in **“Test Mode B”** (Receive Simulation Mode).

Section 1 tests are performed when the normal Set–UP and Calibration procedure (dynamic testing) has failed. This Section will help enable the user to determine the source (board, cable, box) of the Transmit Line TR Bias path problem statically.

After completing this Section the associated Set–Up and Calibration tests must be performed.

Set up scan using protocol provided before attempting the following measurements. The system must be pulsed in the Multi–Nuclear Spectroscopy mode

NOTE
TR Bias is always sent out for Head, Body, and Spectro (BB Spectro TR errors are ignored when a MNS scan protocol is not selected). Additionally, the Spectro TR Bias will not be present in the magnet room due to the filter relay until a MNS scan protocol is started/pulsed at least once. The Receive Bias will not be present on the AUX receive line until a Multi–Nuclear Spectroscopy scan protocol is started/pulsed at least once.

CAUTION

CARE MUST BE TAKEN WHEN USING A VOLT–METER AND METER LEADS IN THE MAGNET ROOM NEAR THE BORE DUE TO THE MAGNETIC FIELD.

1–2 RF Cabinet ONLY––DYNAMIC DISABLE/TR DRIVER BOARD JP3 JUMPER POSITIONS

The Dynamic Disable/TR Driver Board is located in the Dynamic Disable Module in the RF Cabinet. Jumper JP3 on the Dynamic Disable/TR Driver Board has three positions (A, B, C – indicated on the board near jumper); each represents a different mode. JP3, shown in Illustration 1–1, has a Normal Mode A (Software Control Mode), a Test Mode B (Receive Simulation Mode), and a Test Mode C (Transmit Simulation Mode). Specific to Multi–Nuclear Spectroscopy: this voltage is sent out of the DD/TR Driver Board as Spectro TR Bias and is applied to the Transmit Heliax Cable via the 3 Band Low Pass Filter and activation of the proper relay circuitry.

NOTE

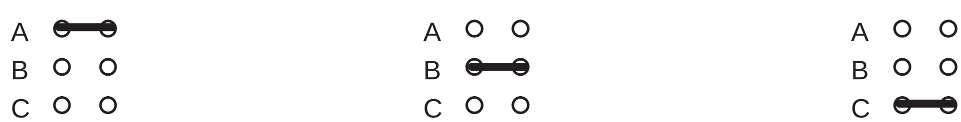
When JP3 is placed in Normal Mode A (Software Control Mode) a negative/positive TR bias is timed concurrently with the unblank/blank pulse. In the Software Control Mode the TR Bias outputs are dependent, therefore, on the presence and switching of the unblank/blank pulse. The TR Bias is then sent out to the respective Transmit Line input (to the Head TR Switch, the Body Hybrid Splitter, or the Spectroscopy TR Module) if the path is good.

When JP3 is placed in Test Mode B (Receive Simulation Mode) a negative bias is forced continuously at the specific Transmit Line input to the Head TR Switch, the Body Hybrid Splitter, and the Spectroscopy TR Module.

When JP3 is placed in Test Mode C (Transmit Simulation Mode) a positive bias is forced continuously at the specific Transmit Line input to the Head TR Switch, the Body Hybrid Splitter, and the Spectroscopy TR Module.

CAUTION

For JP3, do not leave the DD/TR Driver Board jumper JP3 in position "TEST MODE C" for any extended period of time. Damage to the Phosphorus Spectroscopy TR Module will result. Damage to the Head TR Switch and Body Hybrid Splitter may result as well if their Bias Lines are connected



SOFTWARE CONTROL MODE
"NORMAL MODE A"

RECEIVE SIMULATION MODE
"TEST MODE B"
(Negative Bias)

TRANSMIT SIMULATION MODE
"TEST MODE C"
(Positive Bias–**CHAR MODE**)

JUMPER JP3 MODE POSITIONS
ILLUSTRATION 1–1

1–3 INITIAL CONDITIONS – RF CABINET ONLY

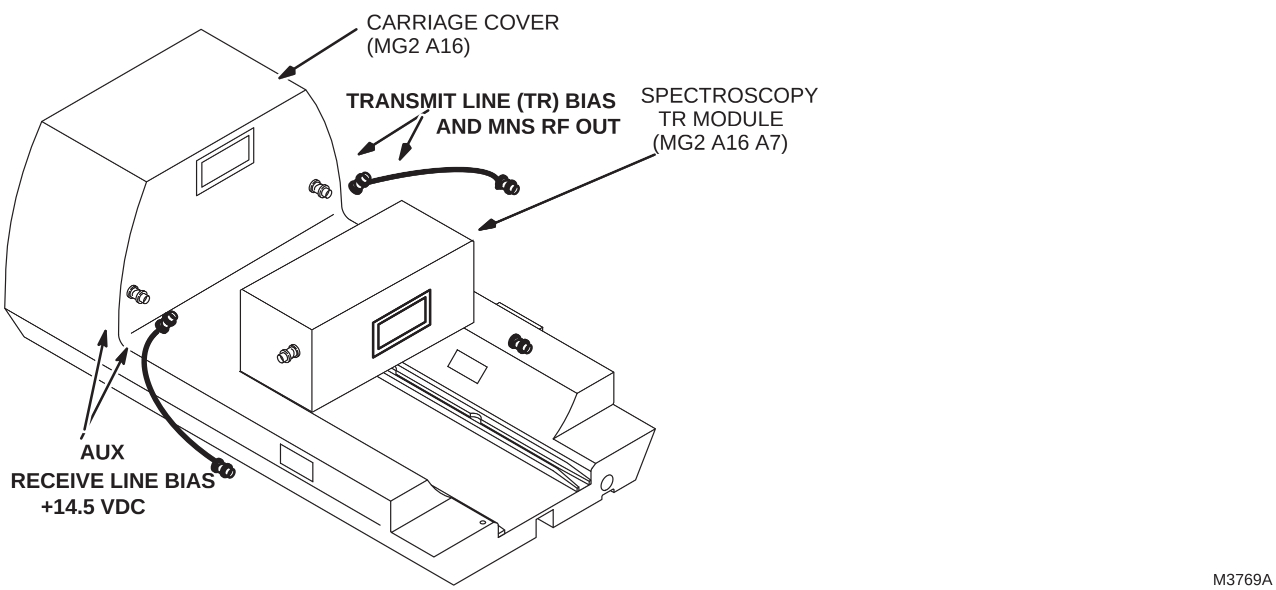
- Place JP2 located on the DD/TR Driver Board to Disable "B" error reporting (service/bypass mode).
- Verify JP3 on Dynamic Disable/TR Driver Board is in Position "Normal Mode A" (Software Control Mode).
- Disconnect cables on Dynamic Disable Module Rear Panel:

  MR1 A9 J2 (TR Bias to Spectro TR Switch) cable is disconnected.

  MR1 A9 J4 (TR Bias to Body Hybrid) cable is disconnected.

  MR1 A9 J3 (TR Bias to Head TR Switch) cable is disconnected.
- Position Phosphorus Spectroscopy TR Module (MG2A16A7) on Carriage Cover (MG2A16) as shown in Illustration 1–2.
- Verify the Spectroscopy TR Module lemo to lemo cables are not connected at this time.
- Set up scan using the applicable protocol in the Tables provided.
- Pulse the Multi–Nuclear Spectroscopy system once with the TG set to 0 (zero) (to activate the AUX Receive Line Bias and select the proper relay path for TR Bias on the MNS Transmit Line).

NOTE
DO NOT connect the Lemo cables to the ^{31}P Spectroscopy TR Module at this time.



SET UP FOR Initial BIAS CHECKS TO VERIFY CABLES ARE NOT SWAPPED
ILLUSTRATION 1–2

1–3 INITIAL CONDITIONS – RF CABINET ONLY (Continued)

TABLE 1–1
4.X PHOSPHORUS SIGNAL TO NOISE – FREQUENCY ADJUST SCAN PROTOCOL

SCAN PROTOCOL (4.X)

MAIN MENU		
	[NEW SERIES]	
PATIENT POSITION		
Patient Entry	**[Head First]**	
Patient Position	**[Supine]**	
Coil Type	**[Other Coil]**	
Axial/Sag. Landmark	**[Nasion]**	
	[NEXT PAGE]	
SURFACE COIL PAGE		
Trans/Rec	**[Extrem]**	
	[NEXT PAGE]	
IMAGING PARAMETERS		
Image Mode	**[Single Scan]**	
Scan Plane	**[Coronal]**	
Pulse Sequence	**[Multiple Echo]**	
Enter PSD Filename	**SPECFID.PSD**	*(Rel. 4.7)*
or	**BBCAL.PSD**	*(Rel. 4.8)*
	[NEXT PAGE]	
USER CV		
SPEC_WIDTH	**[2000]**	
NUM_PTS	**[1024]**	
NUC	**[31]**	
NAV	**[16]**	
	[NEXT PAGE]	
SCAN TIMING		
Number of Echoes	**[1]**	
Echo Time (TE)	**[20 msec]**	
Rep Time (TR)	**[2000 msec]**	
	[NEXT PAGE]	
SCANNING RANGE		
Field of View	**[24 cm]**	
Scan Thickness	**[10 mm]**	
	[NEXT PAGE]	
ACQUISITION TIME		
Acquisition Matrix	**[256 x 256]**	
Imaging Time	**[1 NEX 0:00]**	
Frequency Direction	**[default]**	
	[NEXT PAGE]	
AUTO CENTER FREQUENCY		
	[Water]	
	[NEXT PAGE]	
REVIEW PAGE		
	[NEXT PAGE]	
SCAN OPERATIONS		
	[SPECTROSCOPY]	
SPECTROSCOPY		
	[MOD ACQ PARAMS]	
Use AX to set the ^{31}P frequency		
Type:	**R1 7 R2 3**0 **TG 0**	
	[EXIT PAGE]	
	[START SINGLE]	
	[STOP ACQUISIT]	

NOTE

If no TR Bias is present in the magnet room it may be the Relay Assembly paths are not engaged properly. The Control Variable pibbandfilt may be changed to 2 (download) and then back to 1 (download). The relays will click when the download occurs.

1–3 INITIAL CONDITIONS – RF CABINET ONLY (Continued)

TABLE 1–2
5.X PHOSPHORUS SIGNAL TO NOISE – FREQUENCY ADJUST SCAN PROTOCOL

SCAN PROTOCOL (5.X)

MAIN MENU	
	[New Series]
PATIENT POSITION	
Patient Entry	**[Head First]**
Patient Position	**[Supine]**
Axial/Sag. Landmark	**[Nasion]**
Coil Type	**[Other Coils]**
Other Coils Selection screen appears	
	[EXTREM]
	[Backup]
Scan Plane	**[Coronal]**
	[Imaging Params]
IMAGING PARAMETERS	
Image Mode	**[Spectro]**
(K *SAR must be "On"* K)	**[Monitor SAR]**
Pulse Sequence	**[Spin Echo]**
or enter PSD Filename	**fidcsi**
Monitor SAR?	**[No]**
	[Next Screen]
USER CVs	
spectral width	**2000**
number of points	**1024**
nucleus	**31**
Scan Mode	**1**
Total # of Scans	**16**
rl resolution for CSI scans	**1**
ap resolution for CSI scans	**1**
si resolution for CSI scans	**1**
rfpulse	**1** (selects soft/sinc pulse)
	[Scan Timing]
SCAN TIMING	
Rep Time (TR)	**[2000 msec]**
	[Scan Set–Up]
SCAN SET–UP	
Prescan Options	None *if applicable*
Auto CF	**[Water]**
	[Scanning Range]
SCANNING RANGE	
Field of View	**[24 cm]**
Scan Thickness	**[10 mm]**
Interscan Spacing	**don't care**
	[start][end]
	[Spectro]
SPECTROSCOPY	
	R1 7 R2 30 TG 0
	press enter
	[START SINGLE]
	[BACKUP]
	[STOP ACQUISIT]

NOTE

If no TR Bias is present in the magnet room it may be the Relay Assembly paths are not engaged properly. The Control Variable pibbandfilt may be changed to 2 (download) and then back to 1 (download). The relays will click when the download occurs.

1–4 SPECTROSCOPY DD/TR DRIVER CIRCUIT ADJUSTMENTS – STEADY STATE – RF CABINET ONLY

NOTE

This Section is written as a continuous procedure. Sub–Sections should be performed in sequence.

To complete this section, you will perform the following:

- Section 1–3: INITIAL CONDITIONS – RF CABINET ONLY
- Unloaded Steady State Spectro TR Current and Voltage Measurement —– Receive Mode
- Unloaded Steady State Spectro Path Measurements —– Receive Mode
- Loaded Spectroscopy TR Module Check —– Receive Mode
- Loaded Spectro TR Switch Circuit Board Verification —– Receive Mode
- Unloaded Spectro TR Voltage Adjustment and Error Detection Verification —– Transmit Mode
- Loaded Spectro TR Switch Circuit Board Verification —– Transmit Mode
- Loaded Spectro TR Current/Voltage Verification —– Transmit Mode
- Loaded Spectro TR Voltage Verification (w/ Spectro TR Module and coil) —– Transmit Mode
- Loaded Spectro TR Current/Voltage Verification **(w/ Spectro TR Module and Spectro Coil)** —– Transmit Mode
- RECONFIGURATION – RF CABINET ONLY

Note

All test point locations in this procedure are measured with reference to ground test points.

1–4–1 Unloaded Steady State Spectro TR Current and Voltage Measurement ––– Receive Mode

This Sub–Section will verify the Unloaded DD/TR Driver Board voltages are good in the Receive Mode.

1. Place the following jumper on the DD/TR Driver Board in the correct position:
   - JP3 – Position **“Test Mode B”** (Receive Simulation Mode), this forces a negative voltage for all TR Driver circuit outputs. This Receive Mode simulation should produce the same results as when JP3 is in the Normal Mode **“A”** (Software Control Mode) and the system is not being pulsed. **DO NOT PULSE.**
2. Measure (in reference to any ground Test Point) and verify the following on DD/TR Driver Board:

STEP	FUNCTION	MEASURE AT LOCATION:	ADJUST POT.:	SPECIFICATION:	WRITE FINAL MEASURED VALUE:
2a	Unloaded Spectro TR Current Output (RCV Mode)	TP1	No Adj.	0.0 ±0.1 VDC	
2b	Unloaded Spectro TR Voltage Output (RCV Mode)	TP2	No Adj.	–13.5 ±1.0 VDC	

NOTE

If you do not get the above measurements, you will probably need to troubleshoot and replace the DD/TR Driver Board, Power Supply, or an interconnect harness.

T/S HINT: Break down the failure. Troubleshoot by measuring the Dynamic Disable Module power supply voltages at the DD/TR Driver Board, at the power supplies, and interconnect power harnesses.

3. ***If NOT proceeding*** to the next section of this procedure skip to System Reconfiguration.

1–4–2 Unloaded Steady State Spectro Path Measurements ––– Receive Mode

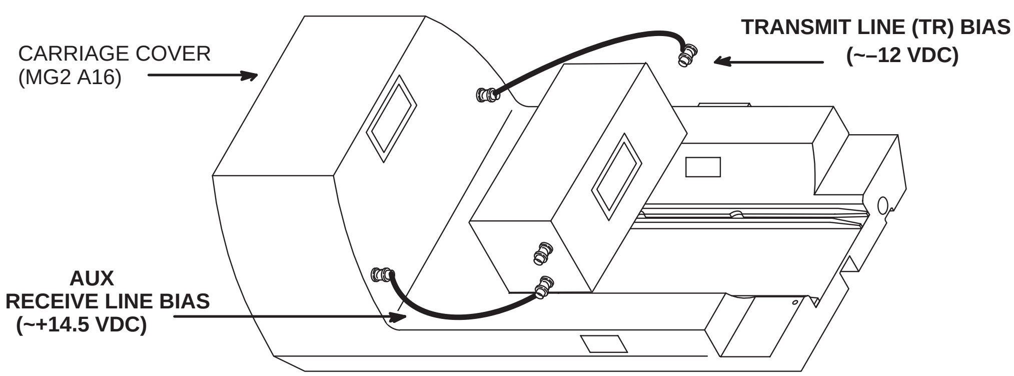
This Sub–Section will verify the coaxial cables inside the Carriage Cover are not swapped. The Lemo Cables will be checked for continuity via voltmeter measurements. Additionally, it will verify each path is good.

1. Verify the 2 (two) Lemo Cables (Receive Line and Transmit Line) are not connected to the Spectroscopy TR Module as shown in Illustration 1–2.
2. JP3 – **"Test Mode B"** (Receive Simulation Mode).
3. Connect cable on Dynamic Disable Module Rear Panel:

   MR1 A9 J2 (TR Bias to Spectro TR Switch) cable is connected.
4. Measure lemo connections located on the Carriage Cover:

   Note
   It is important to verify during these checks that the Receive Line and the Transmit Line are not
   swapped at the Carriage Cover.
   Verify the proper location of each Bias Line at the Carriage Cover per Illustration 1–2.

   - MNS Transmit Line Side should measure ~ –12 VDC (this is the T**R** Bias on the transmit line).
   - AUX Receive Line Side should measure ~ +14.5 VDC (AUX Receive Bias not present until first Multi–Nuclear Spectroscopy **pulse**).
5. If step 4. results are good continue on to next step.
6. **Lemo Cable Checks**, refer to Illustration 1–3:
   Connect the AUX Receive Line Bias side lemo cable to the Carriage Cover. Connect the other MNS Transmit Line Bias side lemo cable to the Carriage Cover. Measure lemo cables (lemo connectors have been known to fail usually resulting in low SNR or no signal):
   - AUX Receive Line Side should measure ~ +14.5 VDC (AUX Receive Bias not present until first Multi–Nuclear Spectroscopy **pulse**).
   - MNS Transmit Line Side should measure ~ –12 VDC (this is the T**R** Bias on the transmit line).



MULTI–NUCLEAR SPECTRoscopy LEMO CABLE CHECKS
ILLUSTRATION 1–3

7. ***If NOT proceeding*** to the next section of this procedure skip to System Reconfiguration.

1–4–3 Loaded Spectroscopy TR Module Check ––– Receive Mode

This Sub–Section will verify the absence of current in the Receive Mode. Additionally, it will verify the Spectro TR Switch Circuit Board paths are good (located in the Spectro TR Module).

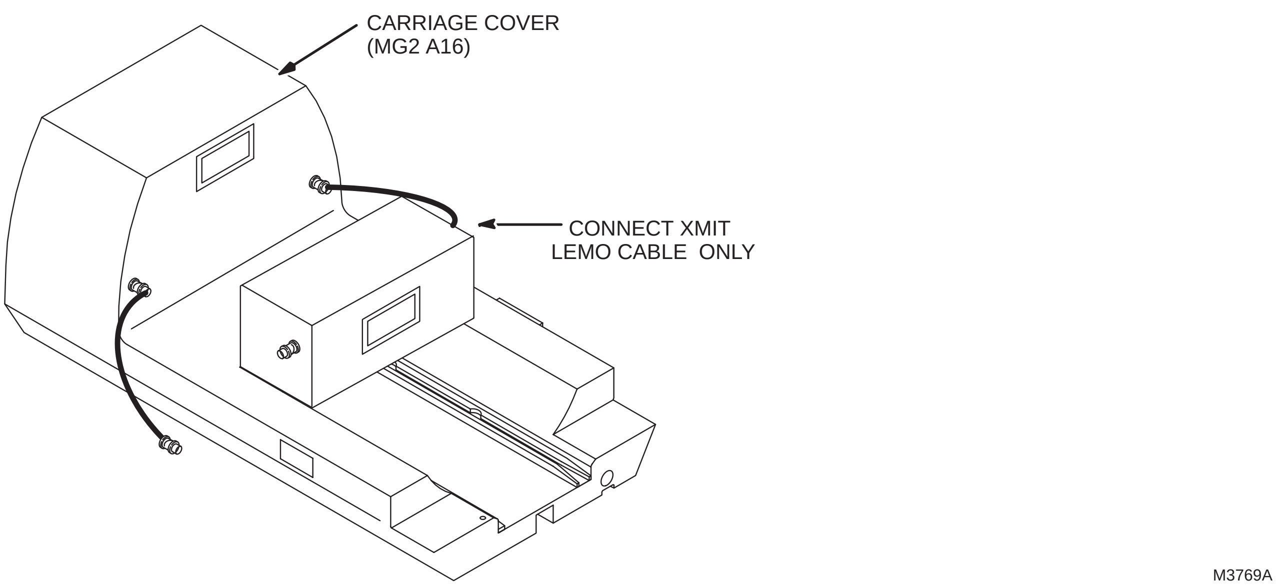
- JP3 – **“Test Mode B”** (Receive Simulation Mode).

1. Refer to Illustration 1–4. **Connect Spectroscopy TR Module** to Carriage Assembly. **DO NOT** connect a Coil.
2. Connect the Transmit Lemo Cable only, refer to Illustration 1–4.
3. Measure (in reference to any ground test point) and verify the following on DD/TR Driver Board:

STEP	FUNCTION	MEASURE AT LOCATION:	ADJUST POT.:	SPECIFICATION:	WRITE FINAL MEASURED VALUE:
4a	Loaded Spectro TR Current Output (w/ Spec. TR Module, RCV Mode)	TP1	No Adj.	0.0 VDC, ¿0.1 VDC	

NOTE

You should measure 0 VDC (Equiv. to 0 Amps $_{DC}$).



XMIT LEMO CABLE CONNECTEd to Spectro TR MODULE
ILLUSTRATION 1–4

4. ***If NOT proceeding*** to the next section of this procedure skip to System Reconfiguration.

1–4–4 Loaded Spectro TR Switch Circuit Board Verification ––– Receive Mode

This Sub–Section will verify the Spectroscopy TR Switch Circuit Board paths are good in the Transmit Mode by measuring voltages at the Spectroscopy Q.D. Box (or the Quad Head Normal Q. D. Adaptor Box for test purposes only).

- Verify JP3 on DD/TR Driver Board is in Position “Normal Mode A” (Software Control Mode).
- Disconnect cables on DD Module Rear Panel:

MR1 A9 J4 (TR Bias to Body Hybrid) cable is disconnected.

MR1 A9 J3 (TR Bias to Head TR Switch) cable is disconnected.

1. Connect cable on Dynamic Disable Module Rear Panel:

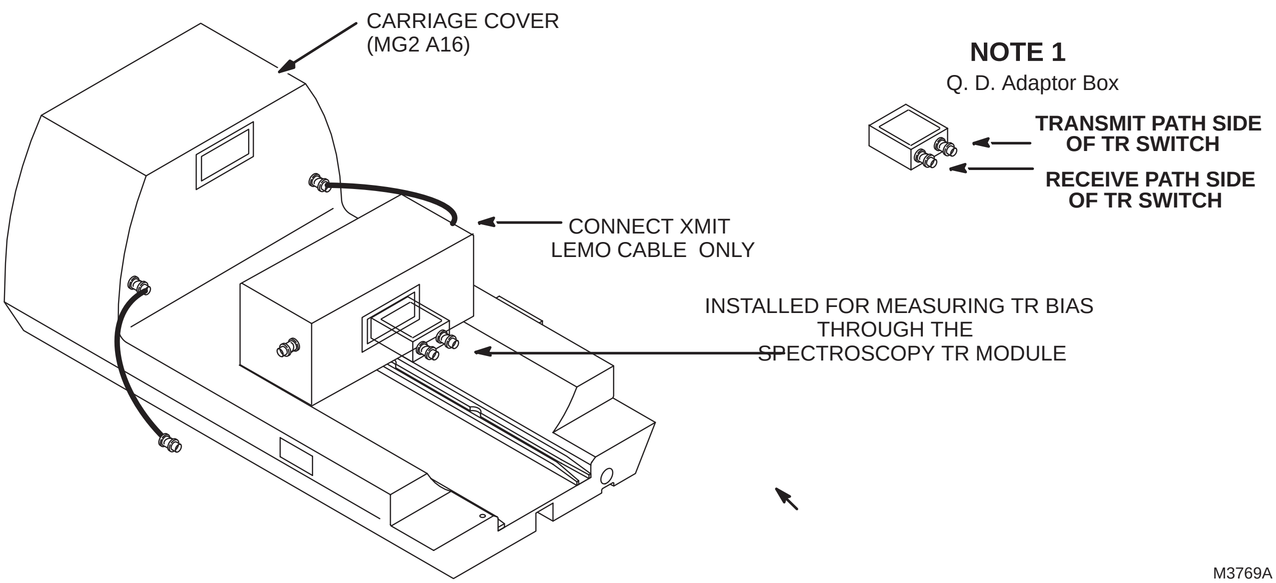
MR1 A9 J2 (TR Bias to Spectro TR Switch) cable.

2. Refer to Illustration 1–5:

- **Do Not Connect** the MNS Transmit Line Bias side lemo cable to the Spectroscopy TR Module until step
- Connect the Quad Head Normal Quick Disconnect Adaptor Box.

Note

The Quick Disconnect Adaptor Box with 2 (two) connectors allows for testing of the Spectro TR Switch circuit board paths independently.



XMIT LEMO CABLE CONNECTED AND QUAD NORMAL Q.D. ADAPTOR BOX INSTALLED
ILLUSTRATION 1–5

NOTE 1

If the site only has a Quad Head Reverse Quick Disconnect Adaptor Box be aware the voltmeter measurements may be swapped in step 4.

1–4–4 Loaded Spectro TR Switch Circuit Board Verification ––– Receive Mode (Continued)

3. Place the following jumper on the DD Module DD/TR Driver Board in the correct position:
   - JP3 – Change to Position **“Test Mode B”** (Receive Simulation Mode).
4. Measure the Quick Disconnect Adaptor Box connectors, refer to Illustration 1–5:

NOTE

There are two types of 1.5T ^{31}P Spectroscopy TR Modules (46–287918G1 or 2100718).
The original style TR Switch Circuit Board (#46–264762G1) mounted in the Spectroscopy TR Module (**46–287918G1**) has surface mount .4W resistors.
The new style TR Switch Circuit Board (#46–321316G1) mounted in the Spectroscopy TR Module (**2100718**) has axial leaded resistors.

   - Connect the Transmit Side lemo cable at the Spectroscopy TR Module, refer to Illustration 1–5.
   - Receive Path Side should measure ~ –12 VDC.

   - **original style**: Transmit Path Side should measure ~ 0 VDC.
   - **new style**: Transmit Path Side should measure ~ –12 VDC.

   - Disconnect the Transmit Side lemo cable at the Spectroscopy TR Module.
5. ***If NOT proceeding*** to the next section of this procedure skip to System Reconfiguration.

1–4–5 Unloaded Spectro TR Voltage and Error Detection Adjustment ––– Transmit Mode

This Sub–Section will verify the Unloaded DD/TR Driver Board voltages are good in the Transmit Mode.

- Disconnect cables on Dynamic Disable Module Rear Panel:

  MR1 A9 J2 (TR Bias to Spectro TR Switch) cable is disconnected.

  MR1 A9 J4 (TR Bias to Body Hybrid) cable is disconnected.

  MR1 A9 J3 (TR Bias to Head TR Switch) cable is disconnected.

6. Place the following jumper on the DD Module DD/TR Driver Board in the correct position:
   - JP3 – **"Test Mode C"** (Transmit Simulation Mode) sets positive voltage for TR Driver circuits.

NOTE

With all three TR Bias cables disconnected, there is no danger of damaging any of the TR Switch circuitry with the positive transmit mode voltage because there is not a path for current.

7. Measure (in reference to any ground test point) and verify the following on DD/TR Driver Board:

STEP	MEASURE:	MEASURE AT LOCATION:	ADJUST POT.:	SPECIFICATION:	WRITE FINAL MEASURED VALUE:
5a	Unloaded Spectro TR Voltage Output	TP2	R131	+4.3 VDC, –0.2/+0.3 VDC	
5b	Unloaded Spectro TR Error Detection Threshold	TP3	R149	+1.2 VDC, ±0.05 VDC	

NOTE

The TR Error Detection Threshold voltage at TP3 will fault at (+1.2 VDC) equal to 1.2 Amps of current.

T/S HINT: Break down the failure. Troubleshoot by measuring the DD Module power supply voltages at the DD/TR Driver Board, at the power supplies, and interconnect power harnesses.

8. Place the following jumper on the DD Module DD/TR Driver Board in the correct position:
   - Verify JP3 on DD/TR Driver Board is in Position **"Normal Mode A"** (Software Control Mode).
9. ***If NOT proceeding*** to the next section of this procedure skip to System Reconfiguration.

1–4–6 Loaded Spectro TR Current/Voltage Verification ––– Transmit Mode

This Sub–Section will verify the presence of current in the Transmit Mode.

- Verify JP3 on DD/TR Driver Board is in Position “Normal Mode A” (Software Control Mode).
- Disconnect cables on Dynamic Disable Module Rear Panel:

  MR1 A9 J2 (TR Bias to Spectro TR Switch) cable is disconnected.

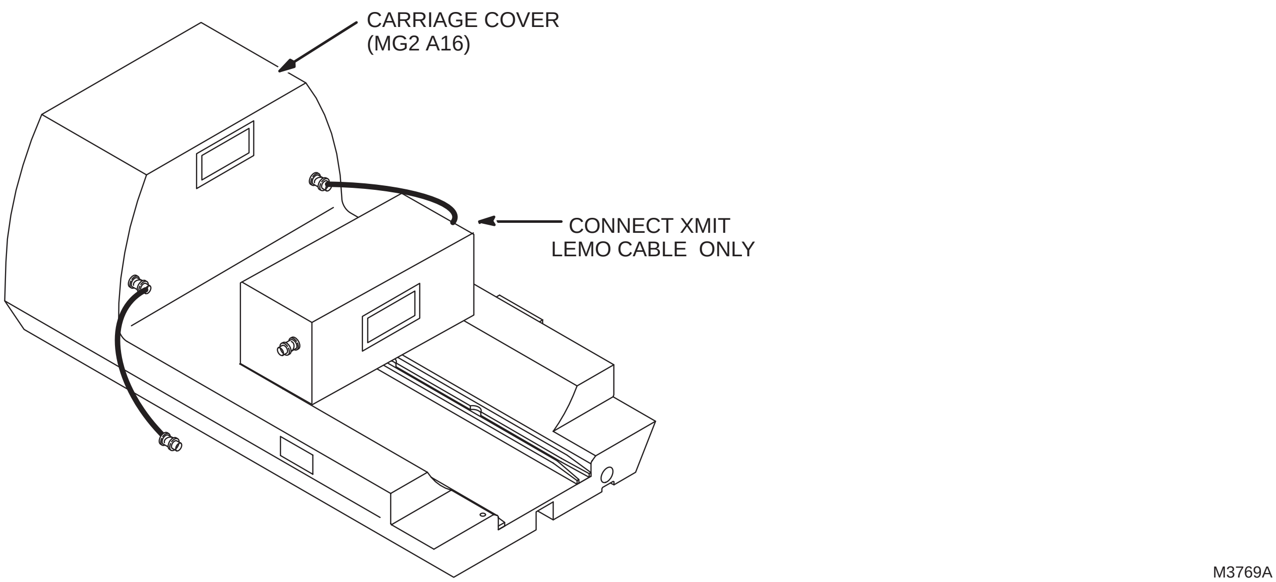
  MR1 A9 J4 (TR Bias to Body Hybrid) cable is disconnected.

  MR1 A9 J3 (TR Bias to Head TR Switch) cable is disconnected.

10. Connect a voltmeter between TP1 and any ground reference test point on the DD/TR Driver Board:
11. **Connect Spectroscopy TR Module** to Carriage Assembly. **Do NOT** attach a Coil.
12. Connect cable on DD Module Rear Panel:

    MR1 A9 J2 (TR Bias to Spectro TR Switch) cable.

13. Refer to Illustration 1–6:
    Connect the MNS Transmit Line Bias side lemo cable to the Spectroscopy TR Module.



XMIT LEMO CABLE CONNECTEd to Spectro TR MODULE
ILLUSTRATION 1–6

CAUTION

Do not leave the DD/TR Driver Board jumper JP3 in “Test Mode C” for any period of time greater than 1 minute while Spectroscopy TR Module is connected. Damage to the Spectroscopy TR Module (the Spectro TR Switch Circuit Board) will result.

1–4–6 Loaded Spectro TR Current/Voltage Verification ––– Transmit Mode (Continued)

14. Place the following jumper on the DD Module DD/TR Driver Board in the correct position:
    - JP3 – Change to Position **“Test Mode C”** (Transmit Simulation Mode) sets positive voltage for TR Driver circuits.

CAUTION

Do not leave the DD/TR Driver Board jumper JP3 in “Test Mode C” for any period of time greater than 1 minute while Spectroscopy TR Module is connected. Damage to the Spectroscopy TR Module (the Spectro TR Switch Circuit Board) will result.

STEP	FUNCTION	MEASURE AT LOCATION:	ADJUST POT.:	NO SPECIFICATION:	WRITE FINAL MEASURED VALUE:
1a	Loaded Spectro TR Current Output (Spectro TR Module, XMIT Mode)	TP1	NOTE 2	~1.6 VDC, ¿2 VDC This measurement is dependent upon the TP2 voltage value and the Spectro TR Module Assembly.	

15. Place the following jumper on the DD Module DD/TR Driver Board in the correct position:
    - JP3 – Change to Position **“Normal Mode A”** (Software Control Mode).

T/S HINT: If there is no current draw verify the path through the Spectro Hardware (relay path) is good. Next — try using the Head TR circuitry at the DD/TR Driver Board with J2 cable connected to J3 connector. To do this first adjust the Unloaded Head TR Bias to ~4.3 VDC. Connect the MR1 A9 J2 cable (TR Bias Spectro) on DD Module Rear Panel to the MR1 A9 J3 (TR Bias Head) connector. If TP1 Current can now be measured there is a Spectro TR circuitry board problem on the DD/TR Driver Board.

Remember to reset the Head TR Bias to its proper value and reroute any swapped cables properly.

NOTE

The voltage at TP1 is directly proportional to the Spectro TR Module load current:
Current (I) of Spectro TR = Voltage of TP1.

NOTE 2

If the TP2 voltage is increased the current value measured at TP1 will increase. Only the TP2 measurement has a specification, however, it is important to understand the correlation between these 2 (two) measurements. An Example has been provided below to illustrate this concept.

EXAMPLE:

The voltage at TP2 was set to 4.3 VDC.

4.3 VDC divided by ~2.7 W = ~1.6 Amps (TP1)

16. ***If NOT proceeding*** to the next section of this procedure skip to System Reconfiguration.

1–4–7 Loaded Spectro TR Switch Circuit Board Verification ––– Transmit Mode

This Sub–Section will verify the Spectroscopy TR Switch Circuit Board paths are good in the Transmit Mode by measuring voltages at the Spectro Q. D. Box if available (or Quad Normal Q. D. Adaptor Box BNC connectors for test purposes only).

- Verify JP3 on DD/TR Driver Board is in Position **"Normal Mode A"** (Software Control Mode).
- Disconnect cables on Dynamic Disable Module Rear Panel:

  MR1 A9 J4 (TR Bias to Body Hybrid) cable is disconnected.

  MR1 A9 J3 (TR Bias to Head TR Switch) cable is disconnected.

1. Connect cable on DD Module Rear Panel:

   MR1 A9 J2 (TR Bias to Spectro TR Switch) cable.

2. Refer to Illustration 1–7:

NOTE

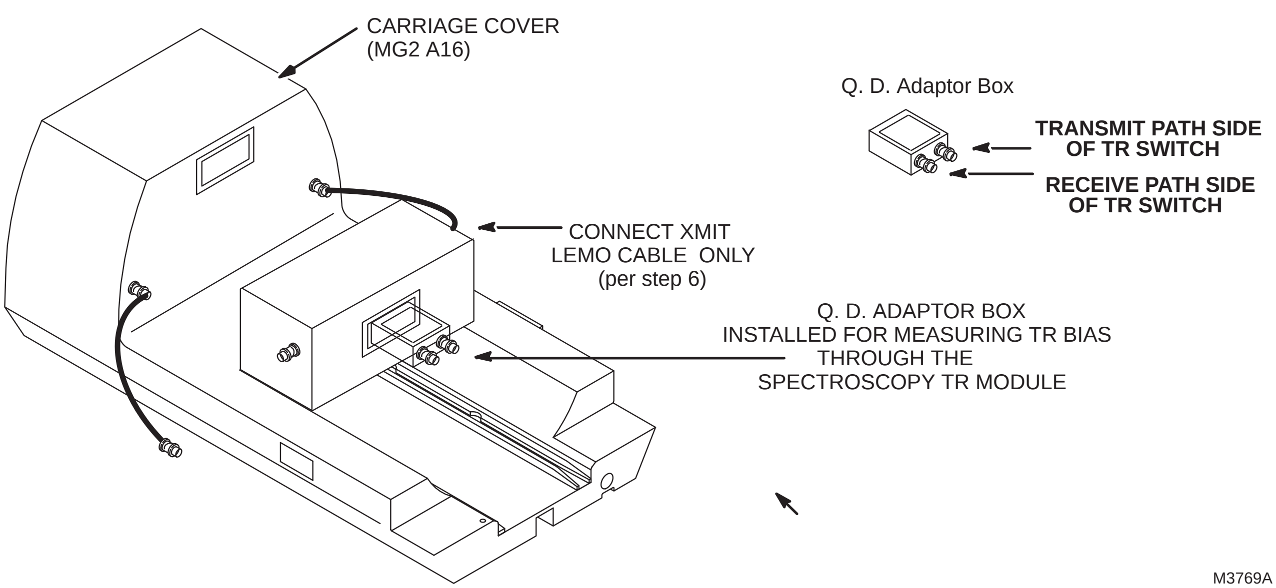
To reduce the time the positive bias is connected to the Spectro TR Module it is recommended
that the lemo cable on the transmit side is initially disconnected. Connect this lemo cable

when ready to make a measurement. Disconnect the lemo cable quickly from the Spectroscopy TR Module promptly after the measurement.

- **Do Not Connect** the XMIT side lemo cable to the Spectroscopy TR Module until step 6.
- Connect the Quick Disconnect Adaptor Box.

Note

The Quick Disconnect Adaptor Box with 2 (two) connectors allows for testing of the Spectro TR Switch circuit board paths independently.



XMIT LEMO CABLE CONNECTED AND Q.D. ADAPTOR BOX INSTALLED
ILLUSTRATION 1–7

1–4–7 Loaded Spectro TR Switch Circuit Board Verification ––– Transmit Mode (Continued)

3. Place the following jumper on the DD Module DD/TR Driver Board in the correct position:
   - JP3 – Change to Position **“Test Mode C”** (Transmit Simulation Mode) sets positive voltage for TR Driver circuits.

CAUTION

Do not leave the DD/TR Driver Board jumper JP3 in “Test Mode C” for any period of time greater than 1 minute while Spectroscopy TR Module is connected. Damage to the Spectroscopy TR Module (the Spectro TR Switch Circuit Board) will result.

4. Refer to Illustration 1–7:
   - Connect the MNS Transmit Line Bias side lemo cable to the Spectroscopy TR Module.
5. Measure the Quick Disconnect Adaptor Box connectors, refer to Illustration 1–7:

NOTE

There are two types of 1.5T ^{31}P Spectroscopy TR Modules (46–287918G1 or 2100718).
The original style TR Switch Circuit Board (#46–264762G1) mounted in the Spectroscopy TR Module (**46–287918G1**) has surface mount .4W resistors.
The new style TR Switch Circuit Board (#46–321316G1) mounted in the Spectroscopy TR Module (**2100718**) has axial leaded resistors.

6. Measure the Quick Disconnect Adaptor Box, refer to Illustration 1–7:
   - Reconnect the Transmit Side lemo cable at the Spectroscopy TR Module.
   - Receive Path Side should measure ~ some positive **T**R Bias voltage——less than 4 VDC.
   - Transmit Path Side should measure ~ some positive **T**R Bias voltage——less than 4 VDC.
7. Disconnect the Transmit Side lemo cable from the Spectroscopy TR Module.
8. Place the following jumper on the DD Module DD/TR Driver Board in the correct position:
   - JP3 – Change to Position **“Normal Mode A”** (Software Control Mode).
9. ***If NOT proceeding*** to the next section of this procedure skip to System Reconfiguration.

1–4–8 Loaded Spectro TR Current/Voltage Verification (w/ Spectro TR Module and Spectro Coil) ––– Transmit Mode

This Sub–Section will verify the Spectroscopy Coil is not shorted at its input connection. This test does not completely verify the coil is good.

1. Verify DD/TR Driver Board jumper position as follows:
   - Verify JP3 on DD/TR Driver Board is in Position **“Normal Mode A”** (Software Control Mode).
   - Disconnect cables on Dynamic Disable Module Rear Panel:

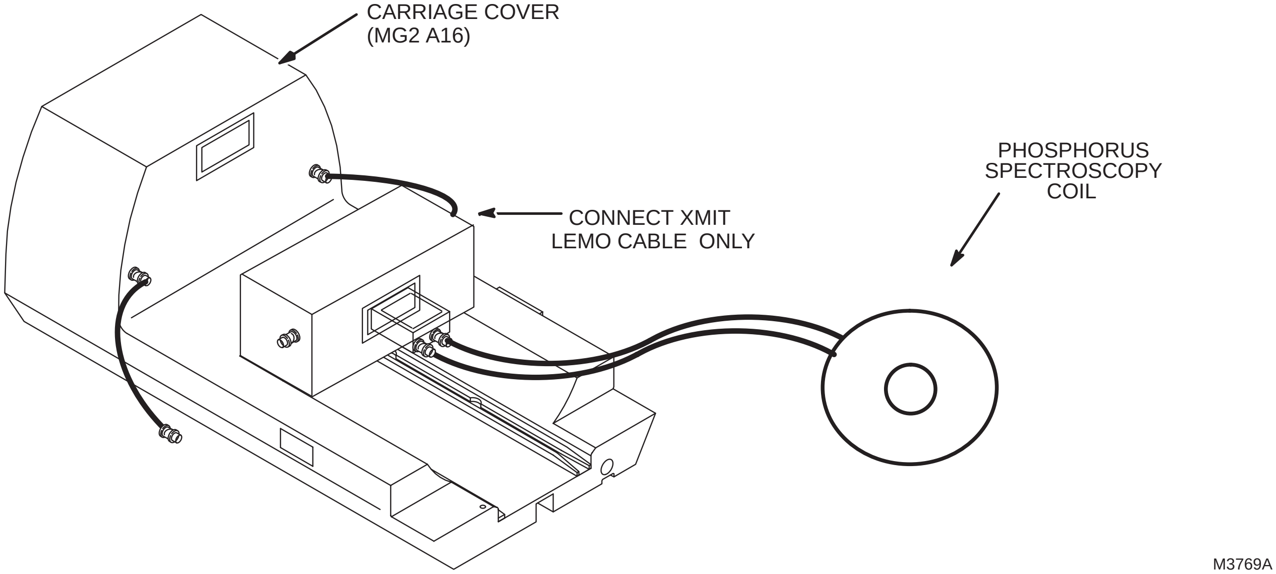
     MR1 A9 J4 (TR Bias to Body Hybrid) cable is disconnected.

     MR1 A9 J3 (TR Bias to Head TR Switch) cable is disconnected.

1. Connect cable on DD Module Rear Panel:

   MR1 A9 J2 (TR Bias to Spectro TR Switch) cable.

2. Use voltmeter to measure between TP1 and any ground test point reference on the DD/TR Driver Board:
3. Attach the (^{31}P) Phosphorus Multi–Nuclear Spectroscopy Coil to the Spectroscopy TR Module.



XMIT LEMO CABLE CONNECTED AND Q.D. ADAPTOR BOX INSTALLED

1–4–8 Loaded Spectro TR Current/Voltage Verification (w/ Spectro TR Module and Spectro Coil)
––– Transmit Mode (Continued)

4. Place the following jumper on the DD Module DD/TR Driver Board in the correct position:
   - JP3 – Change to Position “Test Mode C” (Transmit Simulation Mode) sets **positive voltage** for TR Driver circuits.

CAUTION

Do not leave the DD/TR Driver Board jumper JP3 in “Test Mode C” for any extended period of time while Spectroscopy TR Module is connected. Damage to the Spectroscopy TR Module will result.

STEP	FUNCTION	MEASURE AT LOCATION:	ADJUST POT.:	NO SPECIFICATION:	WRITE FINAL MEASURED VALUE:
3a	Loaded Spectro TR Current Output (Spectro TR Module and Coil, XMIT Mode)	TP1	See NOTE	~1.6 VDC, ¿2 VDC This measurement is dependent upon the TP2 voltage value and the Spectro TR Switch Module Assembly.	

NOTE

The voltage measured at TP1 with the Spectroscopy Coil attached should be approximately the same as Section 1–4–6 step14.–1a TP1 value when only the Spectro TR Module was connected.

T/S HINT: If the Loaded Spectro current is not very close to the value measured previously the Spectroscopy Coil may be damaged. With the coil attached there may be a 100 mA current increase.

5. Place the following jumper on the DD Module DD/TR Driver Board in the correct position:
   - Verify JP3 on DD/TR Driver Board is in Position **“Normal Mode A”** (Software Control Mode).
6. Proceed to the next section of this procedure —– System Reconfiguration.

1–5 RECONFIGURATION – RF CABINET ONLY

- Verify JP3 on DD Module DD/TR Driver Board is in Position **“Normal Mode A”** (Software Control Mode).
- Verify JP2 located on the DD/TR Driver Board to Enable “A” error reporting (normal mode).
- Verify all the TR Bias cables at MR1 A9 (J2, J3, J4) are connected correctly. TR Faults will occur if there is a miscabling issue. The Error Log will report on the specific TR paths that are failing when pulsing MNS protocols.
- Disconnect the Multi–Nuclear Spectroscopy (MNS) Coil.
- Disconnect the Q. D. Adaptor Box from the Spectroscopy TR Module.
- Disconnect the MNS lemo cables from the Spectroscopy TR Module.
- Verify the Spectroscopy TR Module and associated MNS hardware is removed from Magnet Bore.

NOTE

Section 1 tests are performed when the normal Set–UP and Calibration procedure (dynamic testing) has failed. After completing this Section the associated Set–Up and Calibration tests must be performed.

CAUTION

Do not leave the Spectroscopy TR Module installed (connected / disconnected) during non–spectroscopy scanning. The Spectroscopy TR Module will be installed during Proton localizer and Functional Test scans per this manual using the MNS ^{31}P Coil and MNS Q. D. Adaptor Box, this is acceptable. Once the Multi–Nuclear Spectroscopy scanning has been completed and Narrowband scanning is resumed the Spectroscopy TR Module and associated hardware should be removed from the bore of the magnet.

SECTION 2 – SPECTRO HARDWARE CHECKS

NOTE
This Section applies to M1040FF and M1040FK.

2–1 INTRODUCTION

Description ––– MULTI–NUCLEAR SPECTRO HARDWARE OVERVIEW

The BroadBand Cabinet houses the Relay Assembly, 3 Band Low Pass Filter, and the Spectroscopy Directional Coupler, plus interconnect cabling. **This Hardware is a FRU** and does not require that the specific failing component in the box is determined, however, if the need arises this Section may help when troubleshooting. The MR Config File contains 2 questions concerning Multi–Nuclear Spectroscopy, answer Yes to both. MNS does not utilize the EPROM, PROton Brain Exam/Single Voxel Spectroscopy does (PROBE/SV).

Description ––– FILTER RELAY ASSEMBLY (46–301704)

The Filter Relay Assembly is controlled through the software selection of the frequency and/or nuclei. The RF enters into the Assembly at a common point and exits the Assembly at a common point. Three sets of relays are available which directly correspond to three frequency sensitive 3 Band Low–Pass Filter networks. The Filter Relay Assembly essentially steers the Multi–Nuclear Spectroscopy RF signal to the proper frequency sensitive circuitry (3 Band Low–Pass Filter). It is used to reduce the higher harmonics that accompany the intended frequency.

Description ––– THREE BAND LOW PASS FILTER (46–264866G1)

The Three Band Low Pass Filter is used to remove the harmonics (high order, specifically the third order) at the output of the Multi–Nuclear Spectroscopy RF amplifier. The Three Band Low Pass Filter has three independent low pass filters. A set of relay switches select which of the three frequency bands the RF will pass through.

The Three Band Low Pass Filter introduces the DC Bias which is used for switching (between transmit and receive mode) the Spectroscopy TR Module and some coils. This DC bias originates in the RF Cabinet as the Spectro TR Bias signal and is controlled by the unblank signal (System Cabinet).

Description ––– SPECTROSCOPY DIRECTIONAL COUPLER (2104697–2)

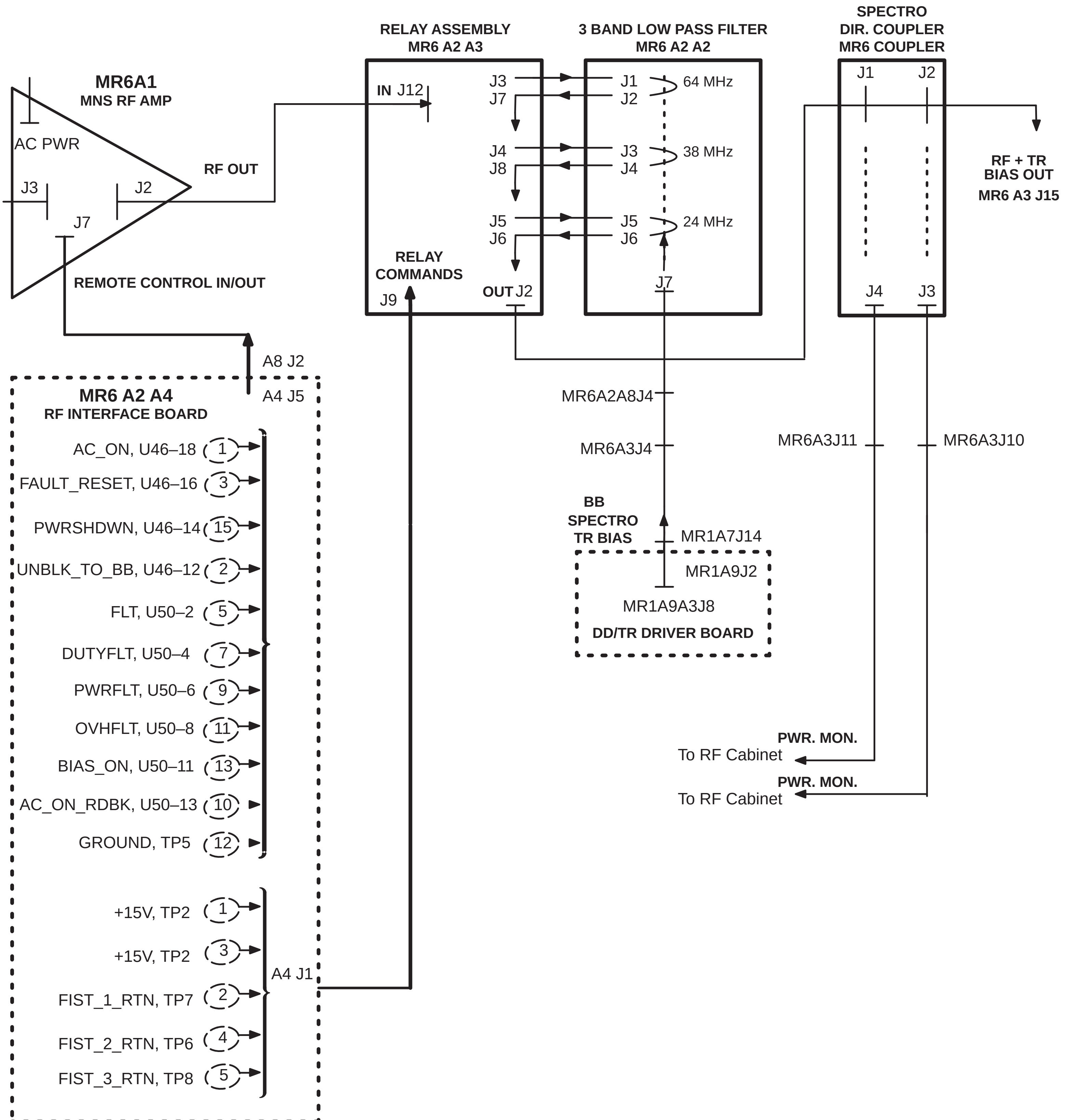
The Spectroscopy Directional Coupler samples the forward power wave which travels from the Spectro RF Amplifier. The redundantly sampled wave (–53 dB coupling ratio) is then returned via coaxial cables to the power monitor for signal processing. These sampled waves will be processed in such a way as to determine the amount of power that is being sent to the Spectroscopy Coil.

Description ––– RF INTERFACE BOARD (46–264818G1)

The RF Interface Board connects to a bi–directional communication (Bicycle) link via connector J6. The RF Interface Board serves as an interface that controls/monitors the Spectroscopy amplifier when commanded by the host computer and it links up with the power monitor to inhibit the Spectroscopy amplifier output in the event an unsafe condition is detected. This board communicates with the power monitor by sending an echo of the Unblank signal. If the unsafe condition is detected an Rflock signal is transmitted to the RF Interface Board which in turn generates a shutdown signal to inhibit the amplifier output. As long as the shutdown signal is not cleared, the Unblank signal will remain inhibited from being applied to the Multi–Nuclear RF Amplifier.

Description ––– BYPASSING THE BROADBAND MULTI–NUCLEAR SPECTRO CABINET (MR6)

See Sub–section for instructions.



MULTI–NUCLEAR SPECTRO INTERCONNECT DIAGRAM
ILLUSTRATION 2–1

2–2 FILTER RELAY ASSEMBLY (46–301704)

Refer to Illustrations 2–1 and 2–2:

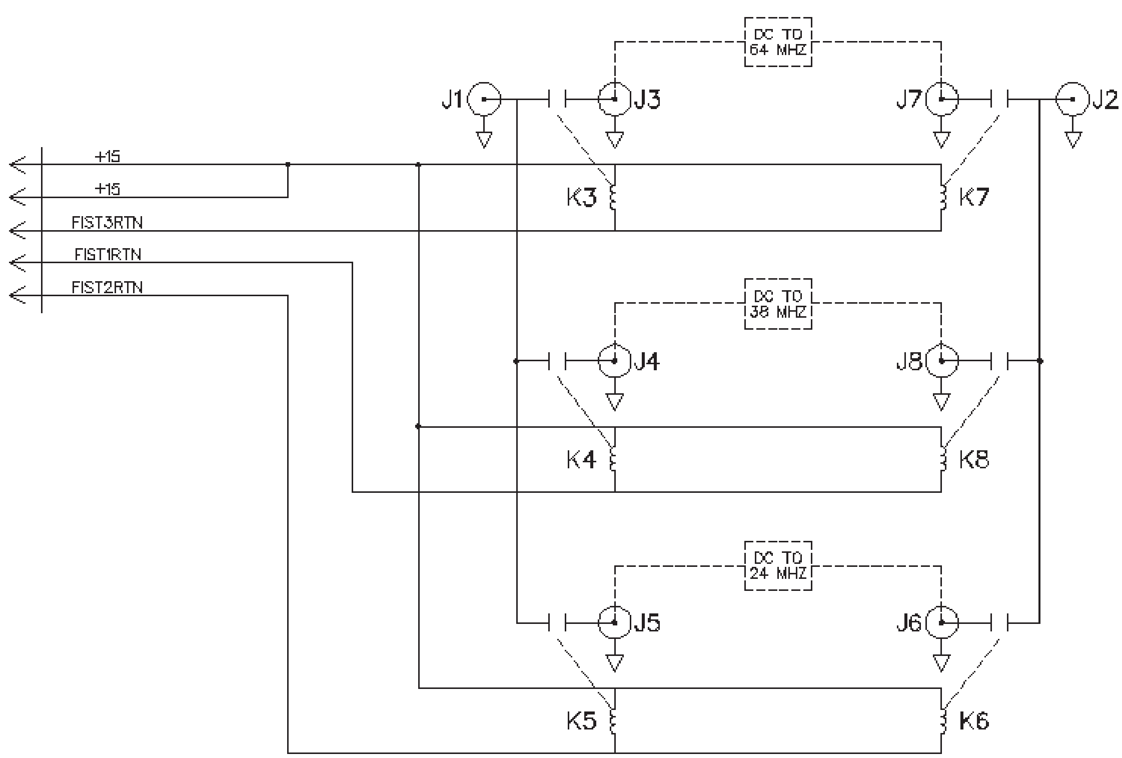
If the Filter Relay Assembly is suspected to be failing, use the following procedure to check out the assembly's functionality. Be aware that one coaxial connection and corresponding relay on each side of the Filter Relay Assembly is left open/unused. Be sure to note the location of any coaxial cables before ever disconnecting them from the Relay Assembly.

1. Remove cover from Spectroscopy hardware at rear of MR6.
2. Look for relays marked 38 MHz (two exist). Many relays are no longer marked.
3. Software select the 38 MHz relays by setting up a scan protocol similar to that in FUNCTIONAL CHECKS, Section 1, Phosphorus Signal To Noise Test Scan Protocol.
4. Verify the TG is set to 0 (zero).
5. Pulse the system once to engage the Relay Assembly. Do not continue pulsing the system.
6. Using a digital voltmeter, referenced to chassis ground, measure one of the wires of these software selected relays. This should equal 15 VDC. Measure the other wire which should equal ~ 0.8 VDC.

Note

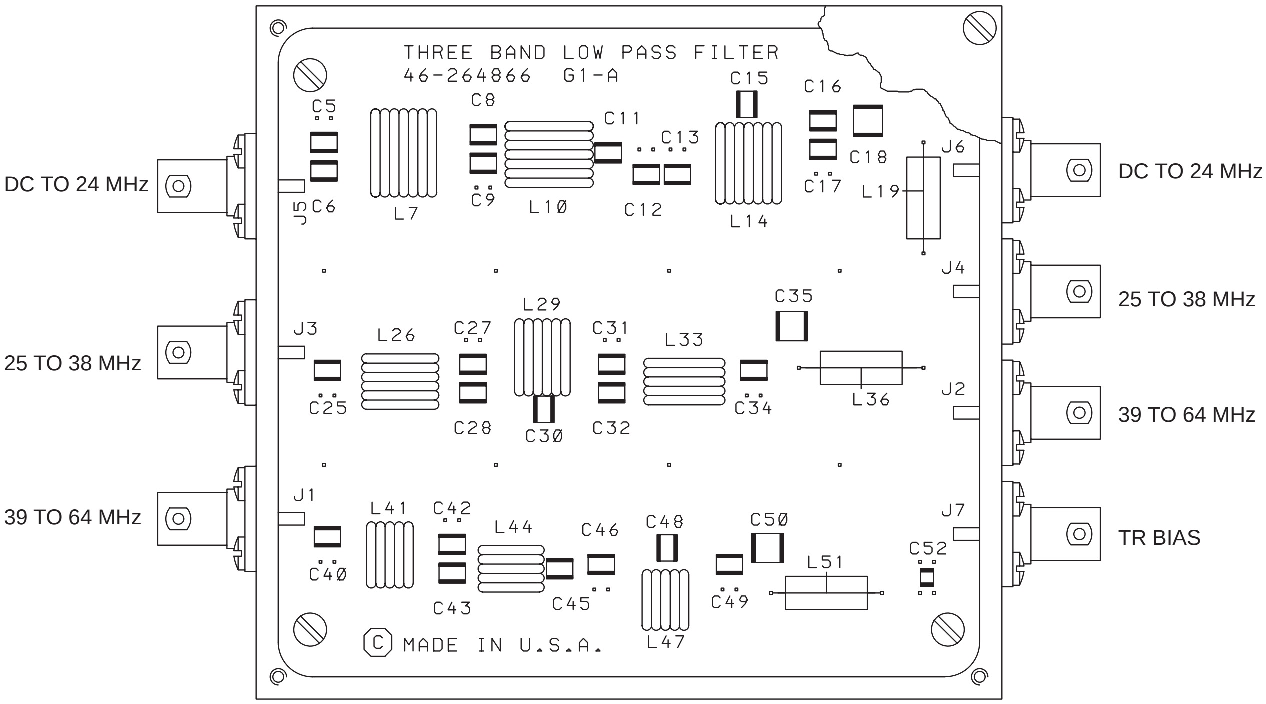
All non–selected relay wires should equal 15 VDC.

7. Visually check that when the relay contact closes, it pushes a clear plastic reference pin.



FILTER RELAY ASSEMBLY/3 BAND LOW PASS FILTER
ILLUSTRATION 2–2

2–3 THREE BAND LOW PASS FILTER (46–264866G1)



3 BAND LOW PASS FILTER
ILLUSTRATION 2–3

Description:

Refer to Illustrations 2–1 and 2–3:

The first band (25 MHz) has input J5 and output J6. The loss within the pass–band (DC to 24 MHz) is ≤ 0.25 dB. The stop–band has a minimum attenuation of 40 dB for frequencies greater than 50 MHz.

The second band (40 MHz) has input J3 and output J4. The loss within the pass–band (DC to 38 MHz) is ≤ 0.25 dB. The stop–band has a minimum attenuation of 40 dB for frequencies greater than 80 MHz.

The third band (64 MHz) has input J1 and output J2. The loss within the pass–band (DC to 64 MHz) is ≤ 0.25 dB. The stop–band has a minimum attenuation of 40 dB for frequencies greater than 130 MHz.

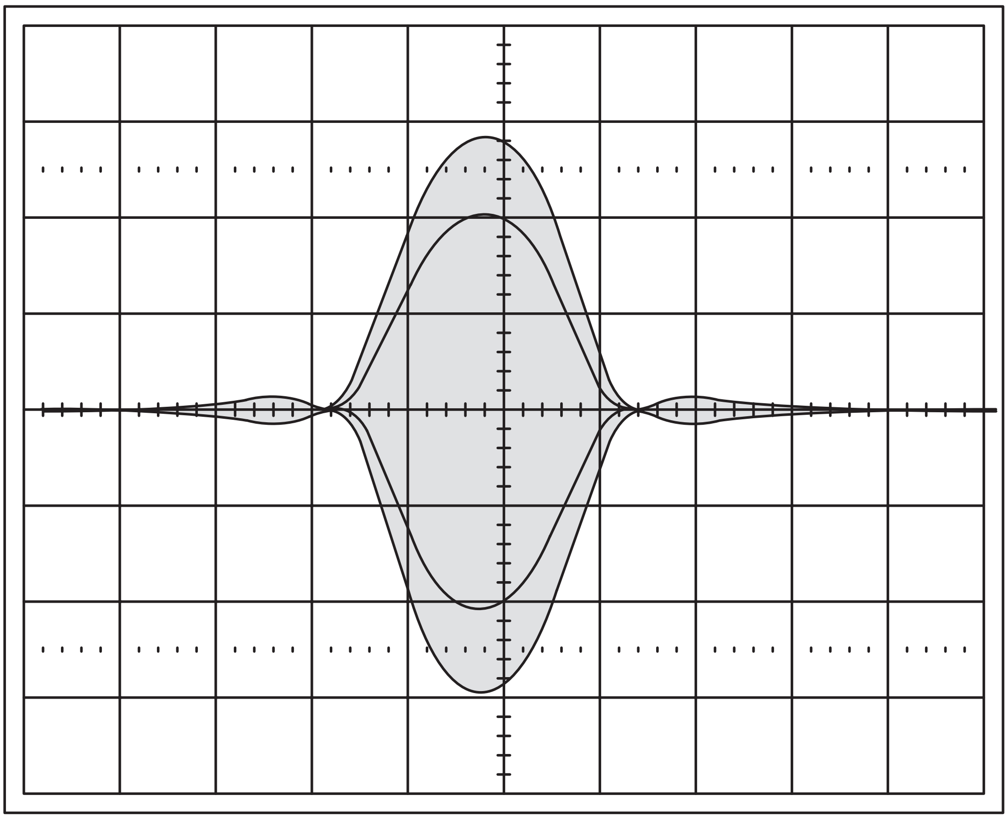
The remaining connector J7 is used to introduce the DC bias for the Spectroscopy TR Switch Module. This DC bias originates in the RF Cabinet as the Spectro TR Bias signal and is controlled by the unblank signal.

1. Remove cover from Spectroscopy hardware at rear of MR6.
2. Software select the 38 MHz relays by setting up a scan protocol similar to that in FUNCTIONAL CHECKS, Section 1, Phosphorus Signal To Noise Test Scan Protocol.
3. Verify the TG is set to 0 (zero).
4. Pulse the system once to engage the Relay Assembly. Do not continue pulsing the system.
5. Verify the appropriate Relays for 38 MHz have been selected. Look for a miswire.
6. Using a digital voltmeter measure the coaxial cable connected to J7 of the 3 Band Low Pass Filter. This should measure ~ –12 VDC when not pulsing the Spectro System.

2–3 THREE BAND LOW PASS FILTER (46–264866G1) (Continued)

7. Refer to the RF Power Out Section for assistance in troubleshooting a no RF problem.

After the output of the Spectro RF Amp (MR6 A1 J2, RF OUT) and output of Filter Relay Assembly, the RF may look distorted due to harmonics. Illustration 2–4 shows harmonics on the scope. The 3–Band Low Pass Filter is designed to eliminate higher (third) order harmonics. RF OUT measurements after the filter should NOT show the effects of these harmonics.



EFFECT OF HARMONICS
ILLUSTRATION 2–4

CAUTION

When T/S RF paths it is usually adequate to set the TG at 25.

8. Refer to the MNS Component / Signal Locations Section for assistance in selecting a higher band Relay and its associated portion of the 3 Band Low Pass Filter to help determine the failure. Always attempt to select a filter band higher than the original band determined by the system. For troubleshooting ^{19}F (60.08138 MHz), or ^{3}HE (48.65288 MHz) problems it is acceptable to select the lower band during troubleshooting, however, it must be understood that the RF Signal at these higher frequencies passing through the lower filter will be attenuated. Do not set the TG at 200 during these troubleshooting exercises because maximum power could damage the 3 Band Low Pass Filter.

2–4 SPECTROSCOPY DIRECTIONAL COUPLER (2104697–2)

Refer to Illustration 2–1:

1. Remove cover from Spectroscopy hardware at rear of MR6.
2. Software select the 38 MHz relays by setting up a scan protocol similar to that in FUNCTIONAL CHECKS, Section 1, Phosphorus Signal To Noise Test Scan Protocol.
3. Verify the TG is set to 0 (zero).
4. Pulse the system once to engage the Relay Assembly. Do not continue pulsing the system.
5. Verify the appropriate Relays for 38 MHz have been selected. Look for a miswire.
6. Verify there are no broken cables or connections that are visibly obvious within the Module.
7. If the Spectroscopy System was previously scanning (with RF Power), verify the RF cables are not hot to the touch.
8. Refer to the RF Power Out Section for assistance in troubleshooting a no RF problem.
9. If troubleshooting a thru RF Power issue:
   - Determine the RF OUT dBm value at the RF Input connection to the Coupler.
   - From the RF Input connector to the output connector, the loss must be less than 0.3 dB (this value is negligible).
10. If troubleshooting a power monitor sense issue:
    - Determine the RF OUT dBm value at the RF Output connection.
    - Calculate using the RF Reference Tables what the sense values should be.

EXAMPLE:
MNS RF OUT = 1.55 kW or ~62 dBm
sense values are expected to be ~ –40 dB down from the above value
62 dBm – 40 dBm =22 dBm or 7.9621 V P–P (into a 50 Ω terminated scope)

11. If troubleshooting a thru RF Power issue:
    - Determine the RF OUT dBm value at the RF Input connection to the Coupler.
    - From the RF Input connector to the output connector, the loss must be less than 0.3 dB (this value is negligible).

2–5 RF INTERFACE BOARD (MR6 A2 A4) (46–264818G1)

Refer to Illustration 2–1:

1. Helpful Hints:

J1 — connects to the band selectable filter (Fist1rtn, Fist2rtn, Fist3rtn, +15 VDC)
J2 — connects to the Power Monitor (Ublks*–p/n, Rflck–p/n, Rflck*–p/n)
J3 — connects to the Dynamic Disable TR Driver Board (UBLNS*–P/N)
J4 — connects to the power supply (+5 VDC, +15 VDC, Common)
J5 — connects to the BroadBand RF Amplifier
J6 — connects to the bi–directional Bicycle link

- Signals enter and exit via the Bicycle Link. Verify this is connected.
- Verify the RFLock: measure a low (~.4 VDC) between U37–3 and TP5 (low to go).
  measure a low (~.4 VDC) between U37–13 and TP5 (low to go).
  If a RFLock (high) occurs the Shutdown signal at U46–6 and U50–15 will be high.
- The Spectro Unblank (gating) signal can be measured at U37–5, or TP3, or U46–8, or U46–12 WRT to TP5 (Lground).
- Verify +5 VDC is present between TP4 and TP5.

2–5–1 BYPASSING THE BROADBAND MULTI–NUCLEAR SPECTRO CABINET (MR6)

NOTE: It is important to verify a failure is due to the Multi–Nuclear Spectro Hardware. MNS is often suspected of causing system problems. Often MNS hardware is not at fault and the failure could have been solved easily by paying close attention to the error log messages.

If the BroadBand Cabinet is suspected to be failing and cannot be fixed promptly it may be necessary to bypass the BB Hardware. The RF and Bicycle link will most likely need to be bypassed. Use the following procedure to bypass Spectro BroadBand Cabinet (MR6). Verify all cables are marked properly before disconnecting them.

1. Disconnect the BroadBand Cabinet I/F Panel's RF IN (the RF OUT from the System Cabinet Exciter Board) coaxial cable at MR6 A3 J3 Run # 466.
2. Disconnect the BroadBand Cabinet I/F Panel's RF OUT (the RF to the ERBTEC RF AMP) coaxial cable at MR6 A3 J5 Run # 461.
3. Connect Run # 461 and Run # 466 together using a BNC Bullit (the RF is now bypassing the MR6 Cabinet)
4. Disconnect the BroadBand Cabinet Bicycle Link at the RF Interface Board MR6 A2 A4 J6.
5. Disconnect the BroadBand Cabinet I/F Panel's Power Monitor #1 coaxial cable at MR6 A3 J10 Run # 464.
6. Disconnect the BroadBand Cabinet I/F Panel's Power Monitor #2 coaxial cable at MR6 A3 J11 Run # 465.
7. If needed, disconnect the BroadBand Cabinet I/F Panel's Unblank In and RF Lock cables at MR6 A3 J7 (Run # 462) and MR6 A3 J2 (Run # 459) respectively.
8. MR Configuration File: BroadBand Spectro Amp—NO.
   BroadBand Transceiver—NO.
   ReSigna.

SECTION 3 – TRANSMIT CHAIN RF OUT CHECKS

NOTE
This Section applies to M1040FF and M1040FK.

3–1 INTRODUCTION

This Section is used for troubleshooting ONLY:
Refer to the Set–Up and Calibration Tab to prescribe the MNS 1.55kW RF Power Out scan protocol. Normally, it is acceptable to troubleshoot at TG = 25 per the Table 3–1 supplied.

Checking the Transmit chain is simply verifying voltages at different connection points. The Table supplied does not compensate for cable loss. Generally, a heliax cable will be approximately –1 dB, ± 0.5 dB. The loss of a coaxial cable will vary depending upon its properties and length. Generally, the loss of a coaxial cable should not exceed –2 dB, ± 0.5 dB.

Description

- These tests only check for gain (or loss) only, not noise.

1.5T MNS FREQUENCIES

• ^{1}H	63.864 MHz	^{17}O	8.660625 MHz
• ^{2}H	9.803625 MHz	^{19}F	60.08138 MHz
• ^{3}He	48.65288 MHz	^{23}Na	16.90238 MHz
• ^{7}Li	24.80213 MHz	^{29}Si	12.68663 MHz
• ^{11}B	20.49338 MHz	^{31}P	25.85288 MHz
• ^{13}C	16.05788 MHz	^{129}Xe	17.66475 MHz

3–2 TRANSMIT CHAIN CHECKS

Checking the Transmit chain is simply verifying voltages at different connection points. Table3–1 shows most connection points available for checks throughout the transmit chain and the approximate expected voltages at each point using a TG = 25 (commonly used in Spectroscopy) and TG =200. The scope is set at 50 Ω termination when measuring RF.

NOTE

A Sense Loop may be used to verify the system is transmitting, however, the placement of the sense loop is an uncontrolled variable. Troubleshooting with a sense loop can be misleading. It is a best practice to follow the Table provided verifying the presence of a RF Signal at TG=25.

PROBLEMS: Verify gold BroadBand Modules are present in System Cabinet.
Check MR6 RF Input Board Spectro Gain Adjust AT25.
Verify BNC coaxial cable is connected to Multi–Nuclear RF Amplifier RF IN connector.

3–6 EXAMPLE MEASUREMENT

Below is an example connection point being checked and showing approximate voltages:

1. Set up scope and verify scan protocol is same as Set–Up & Calibration Tab, (1.55 kW MNS RF Power Out).
2. Connect 50 Ω scope to connection point.

   For example: ***EXCITER RF OUT***

3. Press **[Start Single].**
4. Verify TG = 25.
5. Measure voltage.
6. Record voltage.

   As table NO TAG shows, our example voltage should be around 250 mV peak–to–peak.

7. Verify TG = 200 (if necessary).
8. Measure voltage.
9. Record voltage.

   As table NO TAG shows, our example voltage should be around 2 V peak–to–peak.

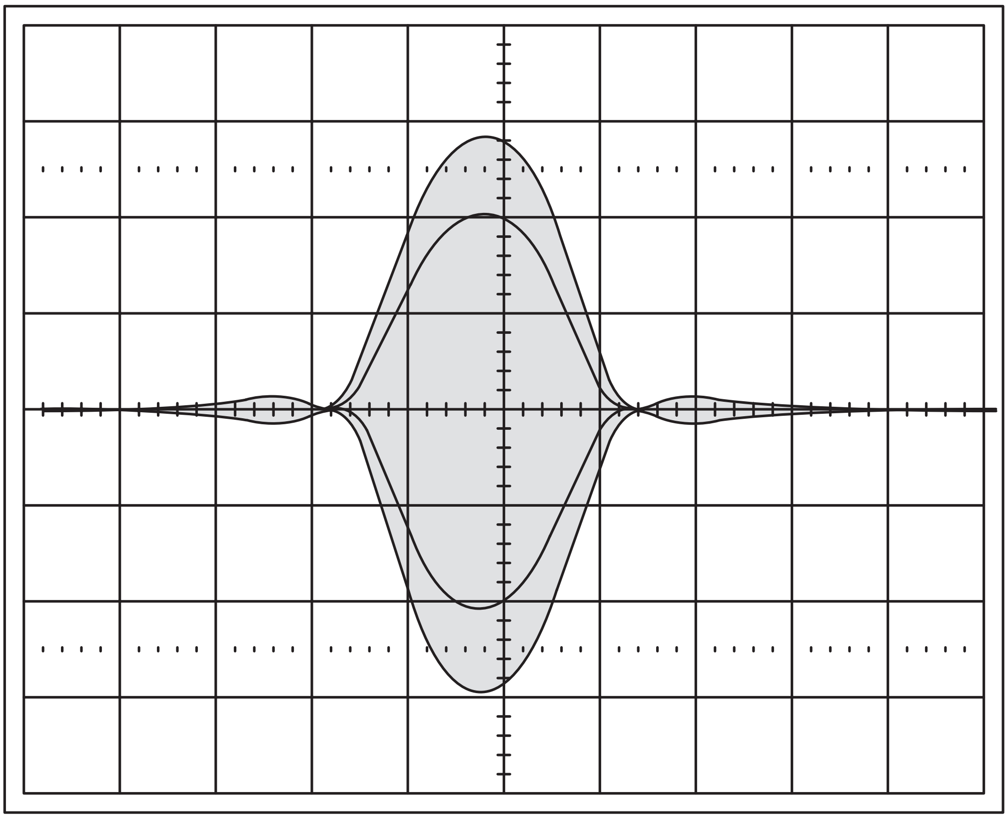
10. Verify TG = 0.
11. Press **[Stop Acquisition].**
12. Reconnect cabling.
13. Move to next logical connection point to determine failure(s).

Note

Multi–Nuclear Spectroscopy may be difficult to troubleshoot. More than one item in the TR chain may fail. Therefore, check all accessible items before ordering new parts.

3–3 SPECTRO RF OUTPUT

After the output of the Spectro BB Amplifier (J2, RF OUT) and output of Filter Relay Assembly, the RF may look distorted due to higher harmonics. Illustration3–1 shows harmonics on the scope. The 3–Band Low Pass Filter is designed to eliminate higher order harmonics. RF Power measurements after the filter should NOT show the effects of the higher harmonics.



HARMONICS BEFORE FILTERING
ILLUSTRATION 3–1

3–4 TRANSMIT CHAIN CONNECTION POINTS, VOLTAGES AND COMMENTS

TABLE 3–1
TRANSMIT CHAIN CONNECTION POINTS, VOLTAGES AND COMMENTS

CONNECTION POINT	APPROX. VOLTAGE AT TG = 25 (V p–p)	APPROX. VOLTAGE AT TG = 200 (V p–p) 1.55 kW max	COMMENTS Prescribe the 1.55 kW MNS RF Power Output Protocol located in the Set–Up and Calibration Tab. This Table does not take cable loss into consideration.
Measurements taken at TG=25 should fall between –9.5 dBm (~211 mVP–P) and –6.5 dBm (~299 mVP–P). Measurements taken at TG=200 should fall between +8 dBm (~1.6 VP–P) and +11 dBm (~2.2 VP–P).			
MR2 A15 A20 J12 (4.X) MR2 A15 A18 J12 (5.X)	.2 – .3	1.6 – 2.2	Measure TPS Exciter Board’s SMB connector
MR2 A11 J1	.2 – .3	1.6 – 2.2	Measure MR2 I/F Panel BNC connector (common line) (Cable loss can be –1 dB)
MR6 A3 J3	.2 – .3	1.6 – 2.2	Measure cable’s BNC connector (common line) (Cable loss can be –1 dB)
MR6 A2 A7 J1	.2 – .3	1.6 – 2.2	Measure cable’s SMB connector (common line)
All measurements represent the MNS RF Signal after Spectro Gain Adjustment AT25 has been adjusted Measurements taken at TG=25 should fall between –19.5 dBm (~67 mVP–P) and –17.5 dBm (~84 mVP–P). Measurements taken at TG=200 should fall between –3 dBm (~447 mVP–P) and 0 dBm (~632 mVP–P).			
MR6 A2 A7 J2	.067 – .084	.447 – .632	Measure RF Input Bd’s SMB connector
MR6 A2 A8 J9	.067 – .084	.447 – .632	Measure I/C Panel lower BNC connector
MR6 A1 J3	.067 – .084	.447 – .632	Measure cable’s BNC connector
Verify the DD/TR Driver Board JP2 is in the service/bypass position (B) for measurements below. **Utilize a total of –40 dB when measuring RF Amplifier Output Power** All measurements below at TG=200 should be about 62 dB (or 61 dB) —>62 dB –30 dB load – 10 dB pad=22 dBm). TG of 200 = 20 dB. TG of 25 = 2.5 dB. 20–2.5=17.5 dB All measurements below at TG=25 should be about 62 dB – 17.5 = 44.5—>44.5 – 30 dB load – 10 dB pad=4.5 dBm).			
MR6 A1 J2	.945 – 1.065	7.09 – 7.96	Measure N connector of MNS Amplifier
MR6 A7 A3 J12	.945 – 1.065	7.09 – 7.96	Measure cable’s N connector
MR6 A2 A3 J4	.945 – 1.065	7.09 – 7.96	Measure BNC relay connector (from ^{31}P relay)
MR6 A2 A2 J3	.945 – 1.065	7.09 – 7.96	Measure cable’s connector (into ^{31}P 3BLP Filter)
MR6 A2 A2 J4	.945 – 1.065	7.09 – 7.96	Measure 3BLP Filter BNC connector (exiting ^{31}P 3BLP Filter)
MR6 A2 A3 J8	.945 – 1.065	7.09 – 7.96	Measure BNC cable’s connector (from ^{31}P 3BLP Filter)
MR6 A2 A3 J2	.945 – 1.065	7.09 – 7.96	Measure relay N connector (center relay output)
MR6 coupler J1	.945 – 1.065	7.09 – 7.96	Measure cable’s N connector (input to coupler)
MR6 coupler J2	.945 – 1.065	7.09 – 7.96	Measure coupler’s N connector (output of coupler)
MR6 A3 J15	.945 – 1.065	7.09 – 7.96	Measure MR1 Cabinet’s SPECTRO N connector
PP1 A11 J83	.945 – 1.065	7.09 – 7.96	Measure cable’s SC connector
MG3 A17 J3	.945 – 1.065	7.09 – 7.96	Measure other side of adaptor at rear pedestal—Run 456
MG2 A16 A7 A1 J3	.945 – 1.065	7.09 – 7.96	Measure Spectro TR Module Transmit Lemo cable (Heliax cable loss and hardware can be –1 dB to –1.5 dB)
MG2 A16 A7 A3 J18	.945 – 1.065	< 7.09 – 7.96	Measure Quick Disconnect Box’s Transmit side (slight Switch Loss will occur, however, no distortion)

SECTION 4 – RF CALCULATION and REFERENCE TABLE

Description

A Sample Calculation has been provided for users who require more exact conversion values, however, cannot recall the sequence/formula.

A Reference Table has been provided to enable the user to quickly reference values between dBm, Watts, and Volt Peak–Peak when troubleshooting RF. It can serve the user whenever attempting to determine approximate gain and losses throughout the system.

4–1 SAMPLE CALCULATION for VOLTAGE to dBm to WATTS CONVERSION

To convert from dBm to V P–P, use the example calculation below:
dBm [DIVIDED BY] 20 [EQUALS] [INV LOG] [MULTIPLY] .632 [EQUALS] (V P–P).

For example, use the *32.5* dBm:
(32.5 dBm) [DIVIDED BY] 20 [EQUALS] *(1.625)* [INV LOG] [MULTIPLY] .632 [EQUALS] *(26.651219 V P–P)*

To convert from Voltage to dBm, use the example calculation shown below:
V p–p [DIVIDED BY] .632 [EQUALS] [LOG] [MULTIPLY] 20 [EQUALS] (dBm)
To get true dBm value, you need to add any attenuation put into the line while measuring.
(above dBm value) [PLUS] *(attenuation value inserted in the line)* [EQUALS] *(true dBm)*

For example, using a base voltage of 24.9 VP–P and having a 30 dB dummy load:
24.9 (V p–p) [DIVIDED BY] .632 [EQUALS] *(39.398734)* [LOG] [MULTIPLY] **20** [EQUALS] *(31.909645 dBm)*
[PLUS] 30 *(– 30 dB dummy load)* [EQUALS] *(61.909645 dBm)*

To convert from dBm to Watts, use the example calculation below:
dBm [DIVIDED BY] 10 [EQUALS] [INV LOG] [EQUALS] *(total mW)*
[MULTIPLY] .001 [EQUALS] *(total Watts).*

For example, use the *61.909645* dBm:
(61.909645 dBm) [DIVIDED BY] 10 [EQUALS] *(6.1909645)* [INV LOG] [EQUALS] *(1552260.3 mW)*
[MULTIPLY] .001 [EQUALS] *(1552 Watts or 1.55 kW).*

4–1–1 REFERENCE TABLE (dBm, WATTS, VOLTAGE P–P, and RMS CURRENT)

0 dBm = 1 mW into 50 Ω's.

POWER dBm	POWER WATTS	VOLTAGE Volts P–P	CURRENT RMS amps	POWER dBm	POWER WATTS	VOLTAGE Volts P–P	CURRENT RMS amps
–30	1.00 E–6	0.0200	141 E–6	24	2.51 E–1	10.024	7.1 E–2
–29	1.26 E–6	0.0224	159 E–6	25	3.16 E–1	11.247	8.0 E–2
–28	1.58 E–6	0.0224	178 E–6	26	3.98 E–1	12.619	8.9 E–2
–27	2.00 E–6	0.0252	200 E–6	27	5.01 E–1	14.159	1.0 E–1
–26	2.51 E–6	0.0283	224 E–6	28	6.31 E–1	15.887	1.1 E–1
–25	3.16 E–6	0.0317	251 E–6	29	7.94 E–1	17.825	1.3 E–1
–24	3.98 E–6	0.0356	282 E–6	30	1.00 E+0	20.000	1.4 E–1
–23	5.01 E–6	0.0399	317 E–6	31	1.26 E+0	22.440	1.6 E–1
–22	6.31 E–6	0.0448	355 E–6	32	1.58 E+0	25.179	1.8 E–1
–21	7.94 E–6	0.0502	398 E–6	33	2.00 E+0	28.251	2.0 E–1
–20	1.00 E–5	0.0632	447 E–6	34	2.51 E+0	31.698	2.2 E–1
–19	1.26 E–5	0.0710	502 E–6	35	3.16 E+0	35.566	2.5 E–1
–18	1.58 E–5	0.0796	562 E–6	36	3.98 E+0	39/905	2.8 E–1
–17	2.00 E–5	0.0893	632 E–6	37	5.01 E+0	44.774	3.2 E–1
–16	2.51 E–5	0.1002	709 E–6	38	6.31 E+0	50.238	3.6 E–1
–15	3.16 E–5	0.1125	795 E–6	39	7.94 E+0	56.368	4.0 E–1
–14	3.98 E–5	0.1262	892 E–6	40	1.00 E+1	63.246	4.5 E–1
–13	5.01 E–5	0.1416	1.0 E–3	41	1.26 E+1	70.963	5.0 E–1
–12	6.31 E–5	0.1589	1.1 E–3	42	1.58 E+1	79.621	5.6 E–1
–11	7.94 E–5	0.1783	1.3 E–3	43	2.00 E+1	89.337	6.3 E–1
–10	1.00 E–4	0.2000	1.4 E–3	44	2.51 E+1	100.24	7.1 E–1
–9	1.26 E–4	0.2244	1.6 E–3	45	3.16 E+1	112.47	8.0 E–1
–8	1.58 E–4	0.2518	1.8 E–3	46	3.98 E+1	126.19	8.9 E–1
–7	2.00 E–4	0.2825	2.0 E–3	47	5.01 E+1	141.59	1.0
–6	2.51 E–4	0.3170	2.2 E–3	48	6.31 E+1	158.87	1.1
–5	3.16 E–4	0.3557	2.5 E–3	49	7.94 E+1	178.25	1.3
–4	3.98 E–4	0.3991	2.8 E–3	50	1.00 E+2	200.00	1.4
–3	5.01 E–4	0.4477	3.2 E–3	51	1.26 E+2	224.40	1.6
–2	6.31 E–4	0.5024	3.6 E–3	52	1.58 E+2	251.79	1.8
–1	7.94 E–4	0.5637	4.0 E–3	53	2.00 E+2	282.51	2.0
0	1.00 E–3	0.632455532	4.5 E–3	54	2.51 E+2	316.98	2.2

4–1–1 REFERENCE TABLE (dBm, WATTS, VOLTAGE P–P, and RMS CURRENT) (Continued)

POWER dBm	POWER WATTS	VOLTAGE Volts P–P	CURRENT RMS amps	POWER dBm	POWER WATTS	VOLTAGE Volts P–P	CURRENT RMS amps
1	1.26 E–3	0.7096	5.0 E–3	55	3.16 E+2	355.66	2.5
2	1.58 E–3	0.7962	5.6 E–3	56	3.98 E+2	399.05	2.8
3	2.00 E–3	0.8934	6.3 E–3	57	5.01 E+2	447.74	3.2
4	2.51 E–3	1.0024	7.1 E–3	58	6.31 E+2	502.38	3.6
5	3.16 E–3	1.1247	8.0 E–3	59	7.94 E+2	563.68	4.0
6	3.98 E–3	1.2619	8.9 E–3	60	1.00 E+3	632.46	4.5
7	5.01 E–3	1.4159	1.0 E–2	61	1.26 E+3	709.63	5.0
8	6.31 E–3	1.5887	1.1 E–2	62	1.58 E+3	796.21	5.6
9	7.94 E–3	1.7825	1.3 E–2	63	2.00 E+3	893.37	6.3
10	1.00 E–2	2.0000	1.4 E–2	64	2.51 E+3	1002.4	7.1
11	1.26 E–2	2.2440	1.6 E–2	65	3.16 E+3	1124.7	8.0
12	1.58 E–2	2.5179	1.8 E–2	66	3.98 E+3	1261.9	8.9
13	2.00 E–2	2.8251	2.0 E–2	67	5.01 E+3	1415.9	10
14	2.51 E–2	3.1698	2.2 E–2	68	6.31 E+3	1588.7	11
15	3.16 E–2	3.5566	2.5 E–2	69	7.98 E+3	1782.5	13
16	3.98 E–2	3.9905	2.8 E–2	70	1.00 E+4	2000.0	14
17	5.01 E–2	4.4774	3.2 E–2	71	1.26 E+4	2244.0	16
18	6.31 E–2	5.0238	3.6 E–2	72	1.58 E+4	2517.9	18
19	7.98 E–2	5.6368	4.0 E–2	73	2.00 E+4	2825.1	20
20	1.00 E–1	6.3246	4.5 E–2	74	2.51 E+4	3169.8	22
21	1.26 E–1	7.0963	5.0 E–2	75	3.16 E+4	3556.6	25
22	1.58 E–1	7.9621	5.6 E–2	76	3.98 E+4	3990.5	28
23	2.00 E–1	8.9337	6.3 E–2	77	5.01 E+4	4477.4	32

SECTION 5 – 8T/3R ^{31}P SPECTROSCOPY SURFACE COIL CHECKS

Note
This section applies to M1040FF and M1040FK.

5–1 OVERVIEW

This procedure will:

- Verify using a multimeter the three diodes and their path in the (^{31}P) 8"Transmit/3"Receive Phosphorus Multi–Nuclear Spectroscopy Surface *Service* Coil are not damaged.

NOTE
This type of Coil is currently no longer available in product because it is not Proton blocked and can present a potential hazard when using UFI PSD's to acquire spectroscopy data on humans.

This procedure will not:

- Verify the (^{31}P) Phosphorus Multi–Nuclear Spectroscopy Surface *Service* Coil is properly tuned or damaged due to other components which can not be easily measured.
- Verify the source of a noise problem with the MNS system.

NOTE
The following checks cannot verify the prototype (^{31}P) GP Phosphorus Flex Coil (941203–##) or any other (^{31}P) Flex Coil.
The single line Phosphorus Flex Coil often will have Spectro TR Shorted error messages if a special Quick Disconnect Box is not used (specifically when using the older style Spectro TR Module).

5–2 (^{31}P) MULTI–NUCLEAR SPECTROSCOPY SURFACE COIL VERIFICATION

1. Use Digital Volt Meter on the diode scale.
2. Place either lead on transmit line shield (GND) and other lead on receive line side shield (GND). Should measure an open (high impedance). If your coil is not a product coil (Product style coils have a visable diode in the receive line cable), this high impedance will not appear.
3. Forward Check —– Measure *receive* line side of coil. Red lead to center PIN, black lead to shield (GND). Should measure ~0.7V (1 diode drop).
4. Reverse Check —– Measure *receive* line side of coil. Red lead to shield (GND), black lead to center PIN. Should measure an open (high impedance).
5. Forward Check —– Measure *transmit* line side of coil. Red lead to center PIN, black lead to shield (GND). Should measure ~0.7V (1 diode drop).
6. Reverse Check —– Measure *transmit* line side of coil. Red lead to shield (GND), black lead to center PIN. Should measure an open (high impedance).

SECTION 6 – SPECTROSCOPY AMPLIFIER CHECKS

NOTE
This Section applies to M1040FF and M1040FK.

6–1 INTRODUCTION

Description

For Troubleshooting Purposes ONLY

All tests in this Section require the product style Spectroscopy Amplifier, Analogic or ENI. The Amplifier's Remote Control Interface signal cable will be disconnected at the Amplifier. The Amplifier will then be tested in a stand–alone fashion to attempt to detect if it is faulting due to an interconnect cable or associated board. It will be used to help isolate which FRU may be failing. Section 2 Troubleshooting should be checked initially to determine what signal is not in the correct state. The FIST_#_RTN signals for the relay assembly do not enter the Spectroscopy Amplifier and are not considered.
The checks do not test RF Power Out.

6–2 ANALOGIC AMPLIFIER (AN8063G)

Weight: Greater than 130 lbs
Greater than 59 kgs

6–2–1 ANALOGIC AMPLIFIER (AN8063G)––DETERMINE VISUAL FAILURE

Verify AN8063G Front Panel LED Status Function per Table 6–1:

TABLE 6–1
AN8063G FRONT PANEL STATUS LED's

LED LABEL	COLOR	FUNCTION
PWR	Green	AC power supplied to unit. Check line voltage and cord, circuit breaker, fuses.
RDY	Green	Amplifier start–up completed and ready to use. Blinks while sequency up power. Check interface or cable connection.
UNBNK	Yellow	Lights when a gating (unblank) pulse is applied to the Multi–Nuclear Amplifier. Check UNBLNK signal and cable connection.
OVL	Yellow	Overload condition, usually by overdriving input. Must be RESET manually, via Remote Interface or by automatic control (J3––AUTO RESET). Check diagnostic LEDs for fault condition.
FLT	Yellow	Equipment fault condition. Shuts down internal circuitry until RESET manually or through the Remote Interface. Cannot be reset automatically. Check diagnostic LEDs for fault condition.

Note
The PWR and RDY LED's must be illuminated. Attempt to RESET the Signa System and manually RESET the AN8063G before continuing on. During MNS scanning the UNBNK LED must pulse.

6–2–2 ANALOGIC AMP, (AN8063G)––FRONT PANEL DIAGNOSTIC LED STATUS FUNCTION, Table 6–2

TABLE 6–2
AN8063G FRONT PANEL DIAGNOSTIC LED's

LED LABEL	COLOR	FUNCTION
FWD PWR	Green	Peak forward power too high. Triggers OVLD condition. Check input level. RESET amplifier.
RFD PWR	Green	Peak reflected power too high. Triggers OVLD condition. Check input level and output termination. RESET amplifier.
JCT TMP	Yellow	Junction temperature of FET's is too high. Triggers OVLD or FLT condition. Check fans for cooling, duty cycle, pulse width. Check VDC HI/LOW LEDs.
RF TMP	Yellow	RF heatsink temperature too high. Triggers SHTDWN condition. Check fans for cooling, duty cycle, pulse width. Check PS TMP LED.
PS TMP	Yellow	Power supply heatsink temperature too high. Triggers FLT condition. Check fans for cooling, duty cycle, pulse width.
VDC HI	Yellow	Power supply voltage too high. Triggers SHTDWN condition. RESET System.
VDC LO	Yellow	Power supply voltage too low. Triggers OVLD or FLT condition. Check for low line voltage.
DEV FLT	Yellow	Device failure. Active when one or more output FET's fails. Triggers FLT condition.

6–2–3 ANALOGIC AMPLIFIER (AN8063G), NORMAL START–UP (Remote AC ON Mode)

1. If necessary, insure proper AC line voltage set–up per Analogic Amplifier Vendor Manual.
2. Verify power to the AN8063G is present and properly connected. Verify power source breaker is on.
3. Verify Remote Control Interface cable connection is present and properly connected.
4. Turn the Amplifier on by switching the breaker located at the rear panel. The PWR LED on the front panel will light.
5. RDY status LED on the front panel will blink until the thyristor–controlled softstart is completed, at which time the RDY LED will light continuously.

Note

If the Normal start–up sequence is unsuccessful the Amplifier may be faulty.
Verify cable interconnects are good using the AN8063G Manual (for 15 position D connector to Customer Interface Board) and Section2 Trouble–shooting signal pin locations. The MR6 Spectro hardware connections must be checked also. If cables / connection is verified good continue to next Step to attempt to isolate the Amplifier from remote system control.

6–2–4 ANALOGIC AMPLIFIER (AN8063G), UNBLANK LED NOT ON DURING MNS SCANNING

1. Section 2 Troubleshooting should be checked initially to determine if the unblank signal is present in conjunction with the RF Cabinet unblank signal. Refer to the AN8063G Vendor Manual for 15 position D cable connection pin location. Also, this signal can be easily accessed at the MR6 RF Interface Board, TP3.

6–2–5 ANALOGIC AMPLIFIER (AN8063G), STAND–ALONE START–UP (Circuit Breaker AC ON Mode)

1. Procure a jumper.
2. Remove power to the AN8063G at the Amplifier rear circuit breaker.
3. Disconnect power cable connected at the rear panel of the Amplifier.
4. Disconnect Remote Control Interface cable connected at the rear panel of the Amplifier.

CAUTION

VERIFY POWER IS REMOVED BEFORE CONTINUING TO AVOID ELECTRICAL SHOCK.

5. Remove and retain all top cover screws (14 screws).
6. Remove Amplifier top cover.
7. Locate the Customer Interface Board (located at Remote Control Interface connection). Locate the jumper (not installed) labeled BREAKER AC_ON. Place a jumper on the two pins (installed).
8. Replace the Amplifier top cover, only one screw is needed for safety.
9. Reconnect power cable connected at the rear panel of the Amplifier.
10. Power on the AN8063G at the Amplifier rear circuit breaker.
11. The Amplifier PWR LED on the front panel will light.
12. The Amplifier RDY status LED on the front panel will blink (approximately 5 seconds) until the thyristor–controlled softstart is completed, at which time the RDY LED will light continuously.

Note

If the Stand–alone start–up sequence is successful the Amplifier may not be faulty. Verify cable interconnects are good. Check control signal source (Circuit Board).

Reconfigure Amplifier:

13. Remove power to the AN8063G at the Amplifier rear circuit breaker.
14. Remove Amplifier top cover.
15. Locate the Customer Interface Board (located at Remote Control Interface connection). Locate the jumper (installed) labeled BREAKER AC_ON. Remove the jumper from the two pins (not installed).
16. Replace the Amplifier top cover using14 screws.
17. Reconnect Remote Control Interface cable connected at the rear panel of the Amplifier.
18. Reconnect power cable connected at the rear panel of the Amplifier.
19. Power on the AN8063G at the Amplifier rear circuit breaker.

6–2–6 ANALOGIC AMPLIFIER (AN8063G), FORWARD POWER SAMPLE

1. The FWR PWR value is ~40 dB (into 50 Ω termination) down from the RF Output value.

6–2–7 ANALOGIC AMPLIFIER (AN8063G), FUSE REPLACEMENT

1. Fuse replacement: 0.25 amp, 250 volt, Slo–Blo.

6–3 ENI AMPLIFIER (MRI–2000)

Weight: 77 lbs
34.9 kgs

6–3–1 ENI AMPLIFIER (MRI–2000)––DETERMINE VISUAL FAILURE

Verify ENI Front Panel Function per Table 6–1:

TABLE 6–3
ENI FRONT PANEL EXTERNAL SWITCHES / INDICATORS

Standby	The Standby switch turns on the AC power when depressed. The internal LED indicates that power is on.
Gating	The Gating switch enables continuous bias when depressed. This switch should not be depressed when used with a SIGNA System. The indicator lights whenever bias is on. Do not leave this in the constant gating mode.
Fault Reset	Pressing this switch resets pulse width and duty cycle faults. The indicator LED lights for any fault condition. All other faults are self resetting except for overvoltage fault.

Note

The Standby LED represents that power is applied and the amplifier is ready. During MNS scanning the UNBNK LED must pulse.

6–3–2 ENI AMP, (MRI–2000)––CABLE CONNECTIONS, Table 6–2

TABLE 6–4
ENI CONNECTIONS

RF Output Connector	N style Connector	Always used–delivers Amplifier RF Output.
RF Sample Connector	BNC style Connector	Used only to view the low–level sample output of the RF Output. This value is ~47.75 dB (into 50 Ω termination) down from the RF Output value. The vendor states that this is frequency sensitive and when at 25.85 MHz the RF Sample is actually closer to 52 dB down.
RF Input Connector	BNC style Connector	Always used–accepts drive from signal source (exciter) at 0 dBm maximum for 2kW output.
Gating input Connector	BNC style Connector	Factory Use Only: >3.5V=PA Bias ON <0.7V=Bias OFF
AC Mains	ENI supplied 3 prong power cord	Always used–provides power to the ENI Amplifier. This line–cord is part of the ENI Amplifier FRU.
Remote Control I/O	15 position D Connector	Always used–provides communication to / from the ENI Amplifier.
HPA and System Interface Connector	D Connector	Factory Use Only.

6–3–3 ENI AMP, (MRI–2000)––FRONT PANEL FUNCTION, Table 6–5

TABLE 6–5
ENI FRONT PANEL FUNCTION

Circuit Breaker	**Removes all power from the MRI–2000 and must be manually reset. This is a single–phase, 2–pole, 15A circuit breaker. Resetting the circuit breaker also resets the over voltage fault condition.**
Fault Defeat	**Defeats the pulse width and duty cycle fault protection. This switch also lights the fault indicator lamp and sends a fault signal to external control via the rear panel connector.**
Power Meter FWD / REFL PWR	**Selects either forward or reflected peak power metering when the Meter Select switch is set to read Peak Power.**
Meter Select	**The switch allows monitoring of:** **Current, PA1 thru PA4 measures the average DC current into each PA module. The meter reading is 7.5A full scale.** **Peak Power measures the peak forward and peak reflected output power when used in conjunction with the Fwd/Refl switch. The meter reading is 3000W full scale.** **Voltage measurements allow monitoring of internal power supply voltages. The meter readings are 75V full scale.** **Bias measures the DC voltage of the gate bias to the FET RF power transistors.**
Fuse F1 and F2	**Used to protect the+15V power supply, the +5V power supply and the cooling fan.**
Fuse Indicators	**Pulse width indicates excessive pulse width and is reset with the Fault Reset switch. Operating the fault defeat switch will light the front panel Fault LED.** **Duty cycle indicates excessive pulse duty cycle and is reset with the Fault Reset switch. Operating the fault defeat switch will light the front panel Fault LED.** **Overheat indicates excessive amplifier heatsink temperature and is self–resetting.** **Overvoltage indicates a failure in the +60V power supply. It must be reset by turning the circuit breaker OFF then ON. Do not reset this fault unless the +60V supply has been checked. The Fault LED will light at the front panel.** **PA Current indicates excessive power amplifier current. This fault is self–resetting.**

6–3–4 ENI AMPLIFIER (MRI–2000), NORMAL START–UP (Remote AC ON Mode)

1. If necessary, insure proper AC line voltage set–up per ENI Amplifier MRI–2000 Vendor Manual.
2. Verify power to the MRI–2000 is present and properly connected. Verify power source breaker is on.
3. Verify Remote Control Interface cable connection is present and properly connected.
4. Turn the Amplifier on by switching the breaker located at the lower front drop panel.
5. Depress the STANDBY Switch on the front panel to activate the AC Power to the MNS Amplifier. The LED located in the center of the STANDBY Switch (internal LED) is a visual indicator that AC Power is ON.
6. Verify the GATING Switch is not depressed. Verify the Gating LED is not illuminated. The LED located in the center of the GATING Switch (internal LED) is a visual indicator that the MNS Amplifier is being constantly gated. This GATING LED should be controlled by the SIGNA System and pulse in conjunction with the unblank signal.

Note

If the Normal start–up sequence is unsuccessful the Amplifier may be faulty. Verify cable interconnects are good using the MRI–2000 Manual (for 15 position D connector to Customer Interface Board) and Section 2 Trouble–shooting signal pin locations. The MR6 Spectro hardware connections must be checked also. If cables / connection is verified good continue to next Step to attempt to isolate the Amplifier from remote system control.

7. Verify that +60V is present on the meter select switch located at the lower front drop panel.
8. Verify that the following Voltages are present on the meter select switch located at the lower front drop panel:
   +33 VDC
   +25 VDC
   +15 VDC
   –15 VDC
   +5 VDC (standby bias)

6–3–5 ENI AMPLIFIER (MRI–2000), UNBLANK LED NOT ON DURING MNS SCANNING

1. Section 2 Troubleshooting should be checked initially to determine if the unblank signal is present in conjunction with the RF/Pen Cabinet unblank signal. Refer to the ENI Vendor Manual for 15 position D cable connection pin location. Also, this signal can be easily accessed at the MR6 RF Interface Board, TP3.

6–3–6 ENI AMP, (MRI–2000)––TROUBLESHOOTING GUIDE, Table 6–6

TABLE 6–6
ENI TROUBLESHOOTING GUIDE

AC on light does not light	Circuit Breaker open Blown fuse Defective Power Supply	Turn on Circuit Breaker Replace fuse (2A, Slo–Blo) FRU
Fault light on	Internal protection circuits operating. Check for specific fault indicator light behind lower front drop panel.	For overvoltage fault, turn circuit breaker OFF then ON. Press reset switch for all other faults.
No RF Output or no RF Gain	Broken input or output connectors Defective input or output cables Bias not gated	Visually inspect connectors for broken pins. Visually inspect cables Check for proper on gating signal level (TTL)
Low RF Output	Defective cables Faulty Power Supply voltage Defective RF Amplifier module	Visually inspect or change cables Check power supply with front panel meter FRU
Excessive Distortion	Defective RF Amplifier module	FRU
Amplifier Overheating	Defective fan	Check that fan is operating

6–4 ENI AMPLIFIER (MRI–2000), STAND–ALONE START–UP (Circuit Breaker AC ON Mode)

1. Turn the Amplifier OFF by switching the circuit breaker located at the lower front drop panel.
2. Disconnect Remote Control Interface cable connected at the rear panel of the Amplifier.
3. Verify power to the MRI–2000 is present and properly connected. Verify power source breaker is on.
4. Turn the Amplifier ON by switching the circuit breaker located at the lower front drop panel.
5. Depress the STANDBY Switch on the front panel to activate the AC Power to the MNS Amplifier. The LED located in the center of the STANDBY Switch (internal LED) is a visual indicator that AC Power is ON.
6. Verify that +60V is present at the meter display via the meter select switch located at the lower front drop panel. The presence of +60V indicates that the ENI Amplifier is READY.
7. Verify that the following Voltages are present on the meter select switch located at the lower front drop panel:
   +33 VDC
   +25 VDC
   +15 VDC
   –15 VDC
   +5 VDC (standby bias)
8. **Gating Switch Test:**

CAUTION

––– LESS THAN 30 SECONDS–––

ACTIVATING THE GATING SWITCH CAN DEGRADE OR DAMAGE THE DRIVER BOARD AND PA BOARD TRANSISTORS IF LEFT ON FOR GREATER THAN 30 SECONDS.

Depress (select) the GATING Switch. Verify the Gating LED is illuminated. The LED located in the center of the GATING Switch (internal LED) is a visual indicator that the MNS Amplifier is being constantly gated.

Circuit Value is approximately: 24 mVolts $\div$ .02 Ω = ~1.2 Amps, $\pm$ 0.3 Amps.
~1.05 to 1.4 Amps is the nominal value, however, per the vendor the currents can be slightly higher.

Quickly verify that the following Currents are present at the meter display via the meter select switch located at the lower front drop panel:
PA1
PA2
PA3
PA4

Verify the GATING Switch is not depressed. Verify the Gating LED is not illuminated.

CAUTION

VERIFY GATING SWITCH IS NO LONGER DEPRESSED AND ILLUMINATED BEFORE CONTINUING.

6–4 ENI AMPLIFIER (MRI–2000), STAND–ALONE START–UP (Circuit Breaker AC ON Mode) (Continued)

CAUTION

VERIFY GATING SWITCH IS NO LONGER DEPRESSED AND ILLUMINATED BEFORE CONTINUING.

9. **Normal Position for Gating Switch:**
Verify the GATING Switch is not depressed. Verify the Gating LED is not illuminated. The LED located in the center of the GATING Switch (internal LED) is a visual indicator that the MNS Amplifier is being constantly gated. This GATING LED should be controlled by the SIGNA System and pulse in conjunction with the unblank signal.

Note

If the Stand–alone start–up sequence is successful the Amplifier may not be faulty. Verify cable interconnects are good. Check control signal source (Circuit Board).

Reconfigure Amplifier:

10. Turn the Amplifier OFF by switching the circuit breaker located at the lower front drop panel.
11. Reconnect Remote Control Interface cable connected at the rear panel of the Amplifier.
12. Verify power to the MRI–2000 ENI Amplifier is present and properly connected.
13. Verify power source breaker is ON.
14. Reconnect power cable connected at the rear panel of the Amplifier.
15. Turn the Amplifier ON by switching the circuit breaker located at the lower front drop panel.