GE Medical Systems

Technical Publications

Direction 2151387

Revision 4

Signa® Horizon™ (5.8 Release) Multi−Nuclear Spectroscopy Subsystem

Operating Documentation

DAMAGE IN TRANSPORTATION

All packages should be closely examined at time of delivery. If damage is apparent, have notation "**damage in shipment**" written on **all** copies of the freight or express bill **before** delivery is accepted or "signed for" by a General Electric representative or a hospital receiving agent. Whether noted or concealed, damage **MUST** be reported to the carrier **immediately** upon discovery, or in any event, within **14** days after receipt, and the contents and containers held for inspection by the carrier. A transportation company will not pay a claim for damage if an inspection is not requested within this **14** day period.

Call Traffic and Transportation, Milwaukee, WI (414) 785−5052/8*323−5052 **immediately** after damage is found. At this time be ready to supply name of carrier, delivery date, consignee name, freight or express bill number, item damaged and extent of damage.

Complete instructions regarding claim procedure are found in Section "S" of the Policy & Procedure Bulletins.

3/12/92

GE Medical Systems

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REVISION HISTORY

REV	DATE	PRIMARY REASON FOR CHANGE
A+	Dec. 21, 1995	First preliminary release.
0	Jan. 8, 1995	Not released.
1	October, 1996	Updates and Corrections
2	August 1, 1997	Updates and Corrections
3	March 31, 1998	Updates, Corrections and Additions
4	April 29, 2003	Updates, Corrections and Additions

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SECTION 1 – SPECTROSCOPY SUBSYSTEM MANUAL ORGANIZATION

The Spectroscopy Subsystem manual consist of tabs with the following titles. Each section includes information for Signa Horizon 1.5T (5.5 Release).

INTRODUCTION

The introduction contains a brief description of system and subsystem documentation structure, manual organization, component organization, and explanation of the reference designator system.

INSTALLATION

Installation of 1.5T Signa Horizon (5.5 Release) Multi–Nuclear Spectroscopy Option {M1040JB, New Spectro Installation} or {M1090JZ, Horizon Spectro Upgrades} is provided. A cable interconnect diagram for this subsystem is located at end of this section. Additionally, instructions for installing the PROBE/SV key and EPROM are included.

Note

PROBE/SV Calibration is required, however, this procedure is not referenced in this manual.

SET UP AND CALIBRATION

This section contains set up and calibration procedures required for the subsystem.

FUNCTIONAL CHECKS

Procedures required to perform BroadBand Spectroscopy Subsystem Function and Performance checks are included. An additional section is provided to aid in maintaining quality performance.

REPLACEMENT/MAINTENANCE

This section contains procedures for replacement of FRUs. In addition, it contains or directs you to any functional check or calibration procedures required as a result replacement.

SCHEMATICS/INTERCONNECTS

Schematics for circuit boards are included here. Interconnects of subsystem and cabinets are also provided.

RENEWAL PARTS

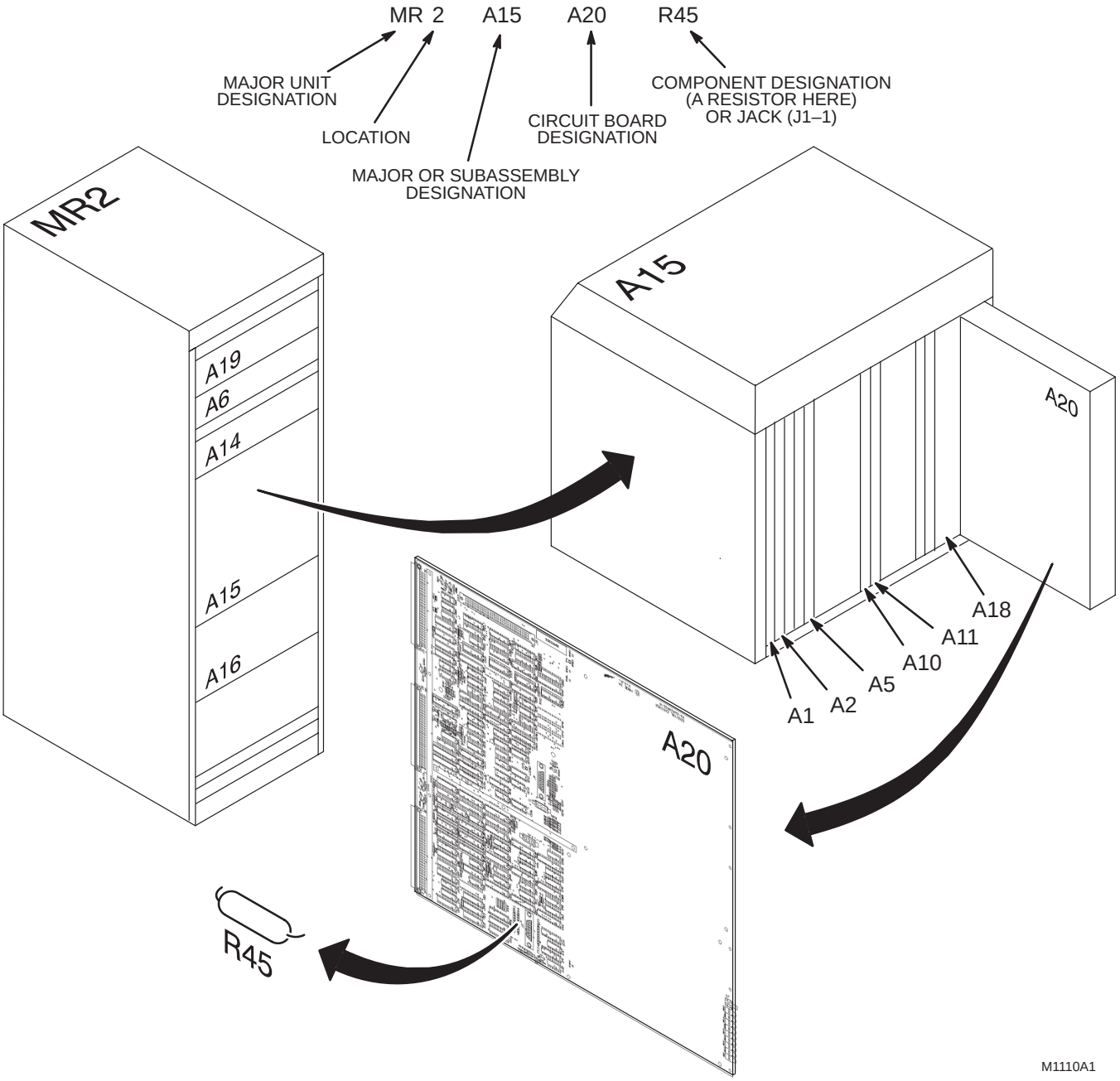
This section contains an exploded view and parts list for each assembly and part list for each kit delivered with 1.5T Signa Horizon (5.5 Release) Multi–Nuclear Spectroscopy acquisition Option, Catalog M1040JB (New) or M1090JZ (5.5 Upgrades).

Note

Please note that the Omission Error Report (Direction 15028) is no longer issued with MR Directions. Should you find any errors in this manual, or should you like to suggest additional material, the approved procedure for handling complaints/suggested improvements to MR Service Directions is the CQA process as defined in the Field Service Procedures Manual.

SECTION 2 – EXPLANATION OF DESIGNATOR SYSTEM

The Component Designator System is a means of identifying all system components in a consistent way. This system is used to identify components throughout this manual. See Illustration 2–1 for an explanation of the Component Designator System.



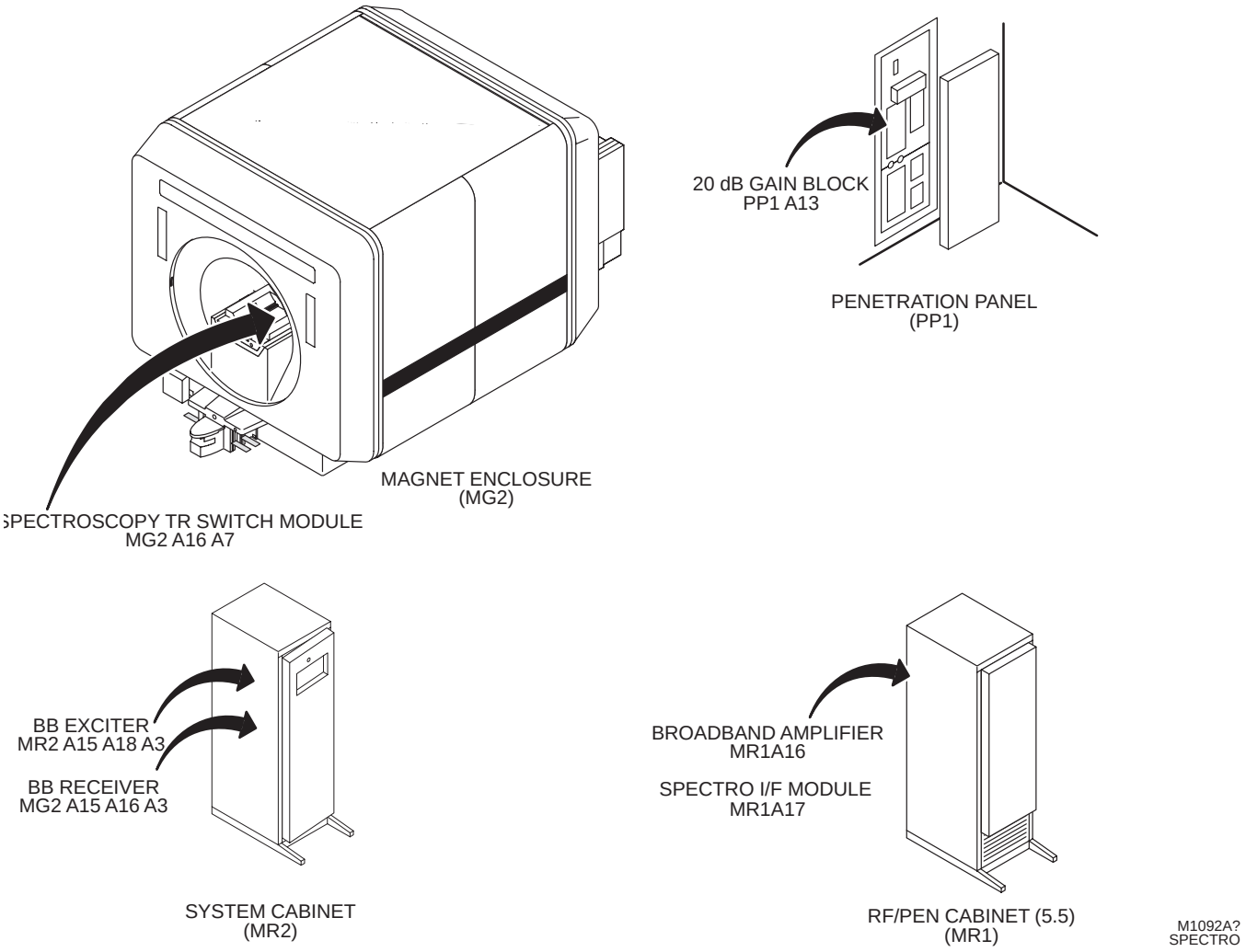
COMPONENT DESIGNATOR SYSTEM
ILLUSTRATION 2–1

SECTION 3 – COMPONENT IDENTIFICATION

Refer to Table 3–1 for 1.5T Signa Horizon (5.5 Release) Multi–Nuclear Spectroscopy Subsystem designators for all Signa systems. Refer to Illustration 3–1 for Signa Horizon (5.5 Release) components.

TABLE 3–1
1.5T SIGNA HORIZON (5.5 Release) MULTI–NUCLEAR SPECTROSCOPY SUBSYSTEM DESIGNATOR/HARDWARE

DESIGNATOR	DESCRIPTION	DESIGNATOR	DESCRIPTION
MG2 MR1 MR2	MAGNET ENCLOSURE RF/PEN CABINET SYSTEM CONTROL CABINET	PP1	PENETRATION PANEL



SIGNA HORIZON SPECTROSCOPY SUBSYSTEM COMPONENTS (5.5)
ILLUSTRATION 3–1

INSTALLATION

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INSTALLATION (Continued)

SECTION 1 – GETTING STARTED

Note

This section applies to M1040JB and M1090JZ, Multi–Nuclear (BroadBand) Signa Horizon (5.5 Release). Multi–Nuclear Spectroscopy hardware is housed in the RF/Pen Cabinet.

1–1 INTRODUCTION

With the 1.5T Signa Horizon (5.5 Release) the RF Cabinet has been changed. The new RF/Pen Cabinet has a RF System Control Module (RFSC), Magnet Enclosure Power Supply Module (MEPS), and room to house the Multi–Nuclear RF Amplifier, new Spectro Module Assembly (2109930–10) and associated interconnecting cables.

Both Signa Horizon 5.5 hardware Spectroscopy options, as delivered by Catalog M1040JB (New Spectro Installations) or M1090JZ (5.5 Spectro Upgrades) are installed by this Section. The M1040JB option may be installed on a Signa Horizon 1.5T System (5.5 Release). The M1090JZ option may be installed on a Signa Horizon 1.5T System (Release 5.5) to upgrade the existing Spectroscopy option, i.e., the BroadBand RF Cabinet (MR6). The installation procedure indicates which option(s) pertains.

In addition, another RF/Pen Cabinet has been released. The RF/Pen 2 Cabinet contains a SSM [combination of the RF System Control Module (RFSC) and Magnet Enclosure Power Supply Module (MEPS)]. This has changed the Spectroscopy Kit which is supplied via a vendor. The new Spectro Kit contains longer internal interconnecting cables to accommodate the RF/Pen 2 Cabinet. It also has a Spectro Attenuator and an additional 2 foot BNC coaxial cable. The SSM in the RF/Pen 2 Cabinet houses 3 micro's. Please check the minimum board levels, and new Spectro Module Assembly (2109930–11) and associated interconnecting cables.

Note

This option is not for field installation in Signa Mobile sites.

1–2 PREREQUISITE UPGRADES AND RELATED OPTIONS

Signa Horizon (5.5 Release) Spectroscopy Option may be added to any 1.5T Signa Horizon fixed site configuration shipped since September 1985 providing prerequisite upgrades are installed. To determine if upgrades and/or options are required, use the procedure below.

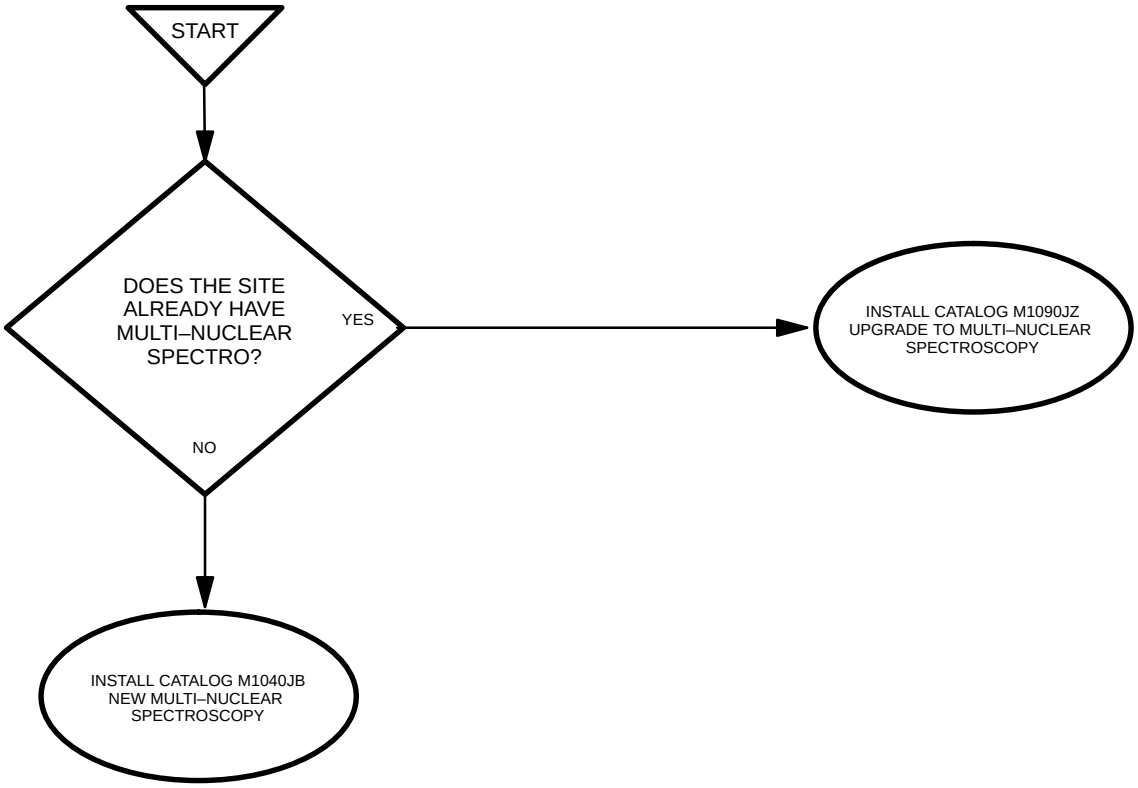
1. Refer to Table 1–1 and Table 1–2.
2. Determine which configuration is applicable to your site. For Signa Horizon 1.5T (5.5 Release) Systems, use the flowchart in Illustration 1–1 to inspect to help determine upgrade status or new status.
3. Install any prerequisite upgrades.
4. Refer to Table 1–2 to ensure all required related options have been ordered.
5. Install M1040JB or M1090JZ. Refer to installation instructions in the remainder of this Direction. The installation procedure indicates which option(s) pertain.
6. Install required related options. Table 1–2 shows where installation instructions are found for each option.

The system is to be operating at Software Release 5.5.2 or higher.

1–2 PREREQUISITE UPGRADES AND RELATED OPTIONS (Continued)

TABLE 1–1
REQUIRED UPGRADE SUMMARY [1.5T SIGNA HORIZON (5.5 RELEASE)]

SYSTEM CAT# DELIVERED	SYSTEM CONFIGURATION AS DELIVERED	PREREQUISITE UPGRADES
Signa Horizon M1000MA, M1000MB, M1000MC, M1000MD, M1000ME, or M1000MF	ERBTEC RF/Pen Cabinet (Model 2109930, 2109930–3, 2109930–5)	M1090MC, Additional Magnetic Disk



NEW OR UPGRADE FLOW CHART (5.5 RELEASE)
ILLUSTRATION 1–1

1–2 PREREQUISITE UPGRADES AND RELATED OPTIONS (Continued)

TABLE 1–2
RELATED OPTIONS

CAT #	SIGNA HORIZON 1.5T (5.5) SYSTEMS	
	NEED?	DOCUMENTED IN:
M1040HT 5.X Option Key	Yes	*Direction 2124201, MR Release 5.x Signa Service Methods* (CD–ROM) and this manual Section 9, 5.X RELATED OPTIONS
Workstation	Yes; type determined and supplied by customer.	
M1040BJ SAGE Software	Maybe	*Direction 15309, Analysis Workstation Software* (Delivered with Catalog Option) [Alternate outside sources are available]
Peripherals (printer, etc)	Determined and supplied by customer.	
M1090PP MRS PHANTOM	Maybe	Customer Catalog: FE can use this for PROBE/SV SNR (and Calibration). Customers can use this for PROBE/SV Daily Quality Assurance of SNR. Cannot be used for decoupling experiments.
M1040CC, CF ^{31}P Surface Coils	No	Operator Manuals [Alternate outside sources are available] M1040CC=8"T,5"R ^{31}P Surface Coil M1040CF=8"T,3"R ^{31}P Surface Coil **DISCONTINUED** The GE Service Coil may still be available for FE Use.
M1040BH Resistive Shim for GE Magnets	Not required	*Direction 15144, Resistive Shim Option for S–I, S–II & S–III Magnets* (Delivered with Catalog Option)
M1040CH Resistive Shim for GE SIV Magnets	Not required	*Direction 2112362, Resistive Shim Option for S–IV Magnets* (Delivered with Catalog Option)
M1040BK High Speed Ethernet	No	—

1–3 CONTENTS OF M1040JB/M1090JZ SIGNA HORIZON SPECTROSCOPY OPTION

M1040JB consists of the Multi–Nuclear RF Amplifier and kits as listed in Table 1–3. Items 1 through 6 appear in Illustration 1–2. M1090JZ consists of items 4 and 10.

TABLE 1–3
M1040JB SIGNA MULTI–NUCLEAR SPECTROSCOPY CONTENTS

ITEM	PART NUMBER	DESCRIPTION	SECTION INSTALLED
1	46–301464P2	Analogic RF Amplifier & power linecord (MR1A16)	Section 4
2	46–301824G2	Spectroscopy Subsystem Cable Interconnect Kit	Section 2
3	46–301825G1	System Cabinet Kit	Section 6
4	2109930–10	Spectro Module Assembly (MR1A17)	Section 5
5	2136365	Adapter Plate Assembly Kit (Penetration Panel)	Section 7
6	46–301548G1	Magnet Enclosure Kit (Phosphorus)	Section 8
7	46–317286G1	^{31}P Service Coil and Phantom Kit	Not “installed”
10	2151387	Signa HORIZON Spectroscopy Subsystem Manual	Not “installed”

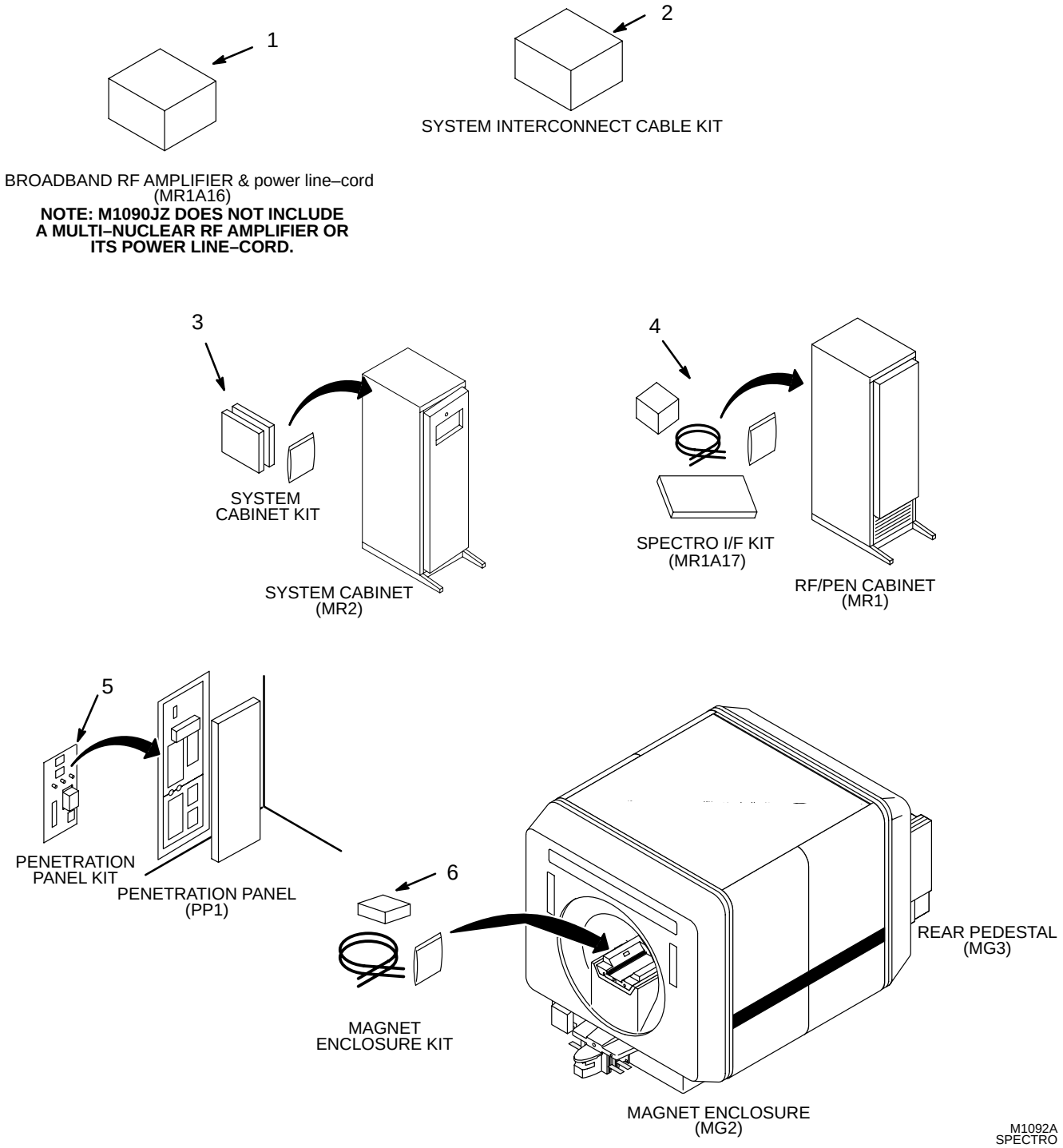
Note

Item 1 is an Analogic Amplifier. This part number may be replaced with a compatible Amplifier.

The **power line–cord** is part of the Multi–Nuclear RF Amplifier and must remain with the Multi–Nuclear RF Amplifier in the case of exchange/replacement.

When installing the **Analogic Amplifier** into a cabinet if the filtered front **cabinet cover cannot be installed**, it is necessary to remove the two (2) handles, the four (4) front cover screws, and the front filter grill and filter from the Analogic Amplifier. These parts must be retained and reinstalled on the amplifier prior to return to Analogic for repair/replacement. This approach is only applicable for cabinets equipped with air inlet filters.

1–3 CONTENTS OF M1040JB/M1090JZ SIGNA HORIZON SPECTROSCOPY OPTION (Continued)



SIGNA SPECTROSCOPY SUBSYSTEM COMPONENTS (M1040JB)
ILLUSTRATION 1–2

1–4 M1040JB PREINSTALLATION CHECK

The following checks are to be performed at the site to insure that longer cables (if any) are ordered and received prior to Spectroscopy option installation. These items are to be ordered in advance and available prior to starting.

☐ 1. This option provides 14 new system cables as listed in Table 1–4. Is the length of new cables sufficient for the intended routing at the site?

TABLE 1–4
NEW SYSTEM CABLES PROVIDED WITH THIS UPGRADE

CABLE ROUTE	RUN(S)	LENGTH	TYPE
Magnet Enclosure (MG3 A17) to Penetration Panel (PP1)	472, 473	80 Feet (28 m)	RG223/U and Heliax
RF/PEN Cabinet (MR1) to System Cabinet (MR2) Not needed——keep RUN 229.	466	50 Feet (16 m)	RG223/U Coax
System Cabinet (MR2) to Penetration Panel (PP1)	469	50 Feet (16 m)	RG223/U Coax
RF/PEN Cabinet (MR1) to Penetration Panel (PP1)	468	50 Feet (16 M)	Heliax coax

1–5 REQUIRED TOOLS, SUPPLIES, AND TEST EQUIPMENT

Standard hand tools and non–magnetic tools are used for the hardware installation.

Other service software, tools, and phantoms used during Set–up and Calibration or system performance testing are listed in the applicable service manuals.

Phantom Kit includes two (2) empty bottles. **The Phosphorus solutions must be procured locally.** MSDS #8360515.

1–6 INSTALLATION SCHEDULE CONSIDERATIONS

Manpower needed for heavy lifting during the hardware installation phase includes two persons for installing Multi–Nuclear RF Amplifier. The amplifiers weigh upwards to 130 pounds.

System power off during the hardware installation phase can be as short as one long day if two installers are used efficiently. System non–availability during Set–up, Calibration, and Functional Checks is about 12 total hours.

Performing FMIs, periodic maintenance, installation of prerequisite upgrades etc. will directly add to the man–hour and system down–time total. Be sure that all planned activity is considered when predicting return of system to customer.

1–7 SHIPPING DOCUMENT, PACKING LISTS, AND PRODUCT DELIVERY INSTRUCTIONS

"Shipping Documents" lists catalog numbers delivered to the site. Review these to confirm that ordered configuration is delivered complete. Packing Lists and "Product Delivery Instructions" (PDI) specify box contents, part numbers, and shipping procedure. The PDI is numbered by catalog number. For example, PDI–M1040JB is for SIGNA (5.5 Release) Horizon 1.5T Multi–Nuclear Spectroscopy.

Refer to the delivered PDI to verify box contents and identify shortages that are known at time of shipment and may be shipped later. Refer to Table 1–5 for a summary of box contents as detailed in PDI–M1040JB (packed in Box 1). Refer to Table 1–6 for a summary of box contents as detailed in PDI–M1090JZ (packed in Box 1) for information specific to your shipment.

Note

The packing box numbers and contents are subject to change without notice. Always refer to copy of PDI delivered with shipment.

TABLE 1–5
PDI SUMMARY FOR M1040JB SHIPPING BOXES

BOX #	CONTENTS
1	Service Manual, System Cabinet Kit, Magnet Enclosure Kit, Penetration Panel Kit, Cable Kit, Spectro I/F Kit
2	Multi–Nuclear RF Amplifier & power linecord.
3	8"T, 3"R ^{31}P Service Coil and Phantom Kit. NOTE: **Phantom solutions must be procured locally!!!!** MSDS #8360515.

TABLE 1–6
PDI SUMMARY FOR M1090JZ SHIPPING BOX

BOX #	CONTENTS
1	Multi–Nuclear Spectro I/F Kit (Spectro Module Assembly and cables) [w/out Spectro RF Amplifier], Service Manual

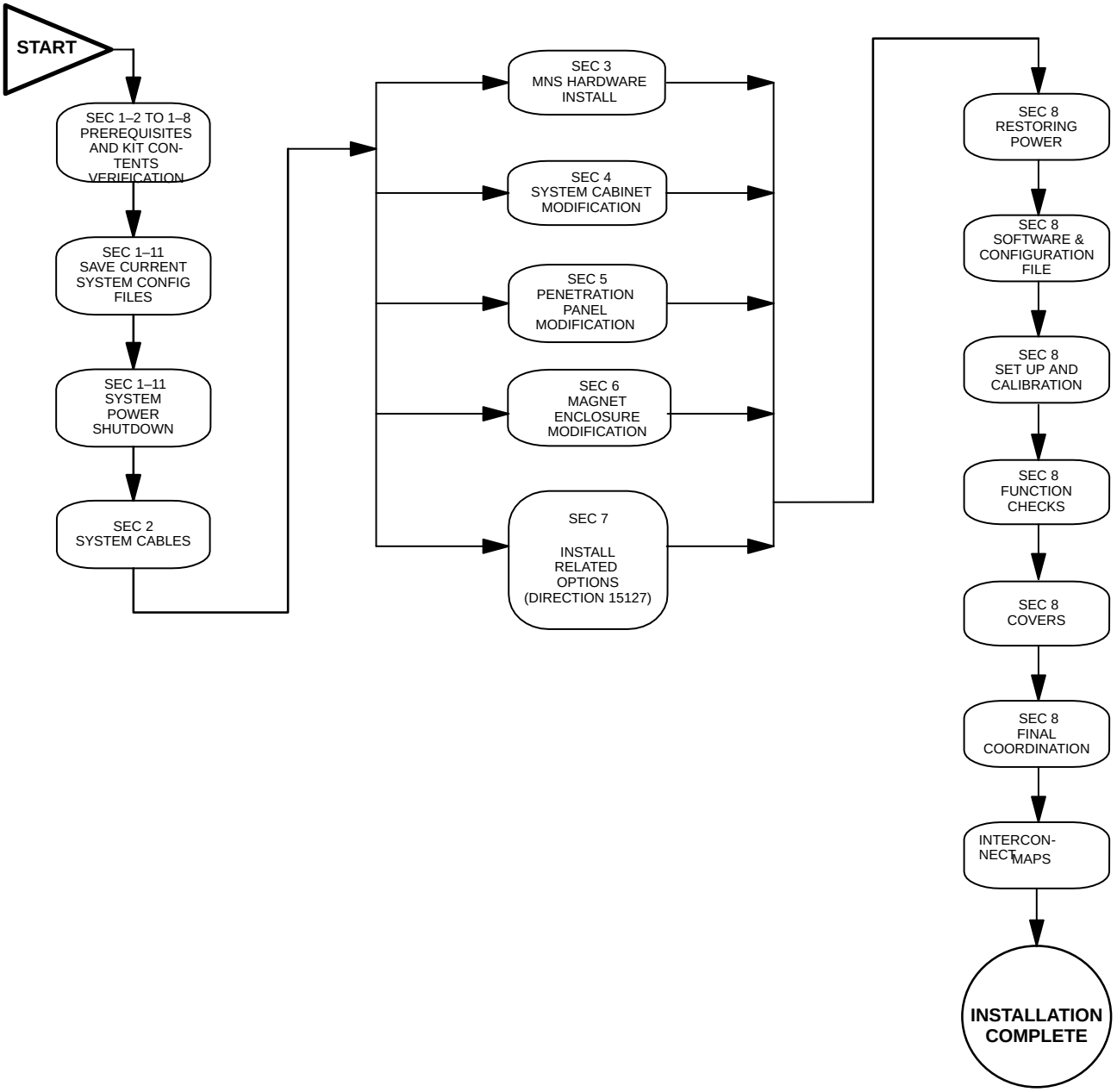
1–8 ICD, SHIPPING, AND INSTALLATION PRODUCT LOCATOR CARDS

The Product Locator System tracks creation, shipment and field location of serialized major models. A set of 3 Product Locator Cards (PLC) are used; the "ICD" (Inspection Control Document) card is completed after the serial number nameplate is attached, the "Shipping Card" is completed when shipped, and the "Installation Card" is attached for shipment according to the PDI.

Kit added rating plates are furnished with the various cabinet modification kits. They signify that the Signa model numbers on the cabinet have changed function and compatibility. These rating plates do not have ICD cards since serial numbers are not assigned.

1–9 INSTALLATION FLOW CHART

The flow chart in Illustration 1–3 shows sequence for an orderly and efficient installation of the Spectroscopy Subsystem. Note that many procedures are performed in parallel. All sections referred to in this chart are contained in this Direction.



INSTALLATION FLOW CHART
ILLUSTRATION 1–3

1–10 CONVENTIONS

The following conventions are used in this Direction:.

- Front, rear, left, and right are defined as follows: the patient entrance end of the magnet is the front; the opposite end is the rear; left and right are in respect to a person's left and right while facing the patient entrance end of the magnet.
- Fastening hardware (ie. screws, bolts, and nuts) is dimensioned in inches unless otherwise specified.

1–11 SYSTEM POWER SHUTDOWN

FATAL ELECTRIC SHOCK HAZARD!! LETHAL VOLTAGES ARE PRESENT WITHIN THE PDU EVEN IF ALL PDU BREAKERS ARE OFF. TO PREVENT POSSIBLE FATAL ELECTRIC SHOCK, DISCONNECT POWER TO THE PDU BY PERFORMING THE FOLLOWING PROCEDURE.

1. If adding this option to an existing 5.5 Horizon system, remember to save configuration files before powering down the system. Place tape in drive and type **saveINFO** (ENTER) at the command prompt. Refer to MR CD–ROM *Direction 2124201, MR Release 5.x Signa Service Methods,* navigate to Computer Subsystem (look for saveINFO command) for details.
2. Notify users, field service and installation personnel that are working on the system that power to the system is to be shut down and locked out.
3. Refer to MR CD–ROM *Direction 2124201, MR Release 5.x Signa Service Methods,* navigate to Computer: Set Up & Calibration, and perform BRINGING THE SYSTEM DOWN to shut down the computer before removing power.
4. For standard PDU, press the FULL OFF button on front control panel of PDU.
   For compact PDU, open front panel of PDU, find and press the POWER OFF button inside PDU.
5. Locate and shut off main disconnect supplying power to the PDU.
6. Perform lock out of main disconnect. Tag main disconnect to prevent inadvertent power restoration.

Note

Lock out and tag procedures for GE Service personnel are detailed in MR CD–ROM *Direction 2124201, MR Release 5.x Signa Service Methods,* navigate to System, SAFETY.

1–11 SYSTEM POWER SHUTDOWN (Continued)

7. Verify power is off in each type of PDU. If not, find source of power and disconnect. Below are suggestions, but not the only possibilities to check that power is removed from either type of PDU.

   - FOR COMPACT PDU:

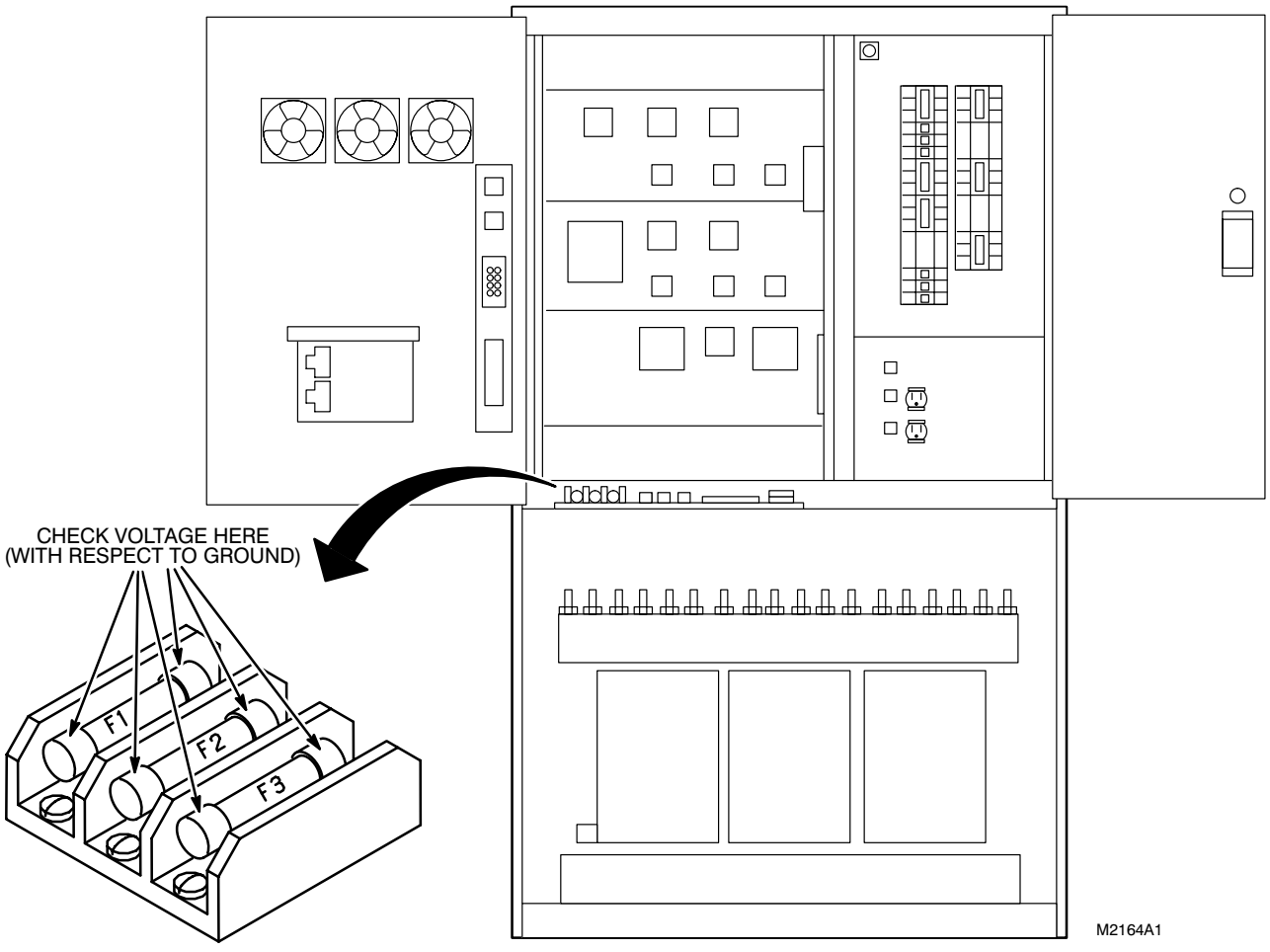
   – Check lights on panel next to POWER OFF button. If these lights are not lit, and they were previously, power has been removed.

   - FOR STANDARD PDU:

   – Remove screws from left front door.

   – Swing open left front door.

   – Check for 0 volts, with respect to ground, on both ends of each fuse located inside standard PDU. Refer to Illustration 1–4 for 3.X/4.X PDU. If 120 VAC power is present, find source and disconnect.



POWER OFF VERIFICATION
ILLUSTRATION 1–4

SECTION 2 – SPECTROSCOPY SUBSYSTEM CABLES

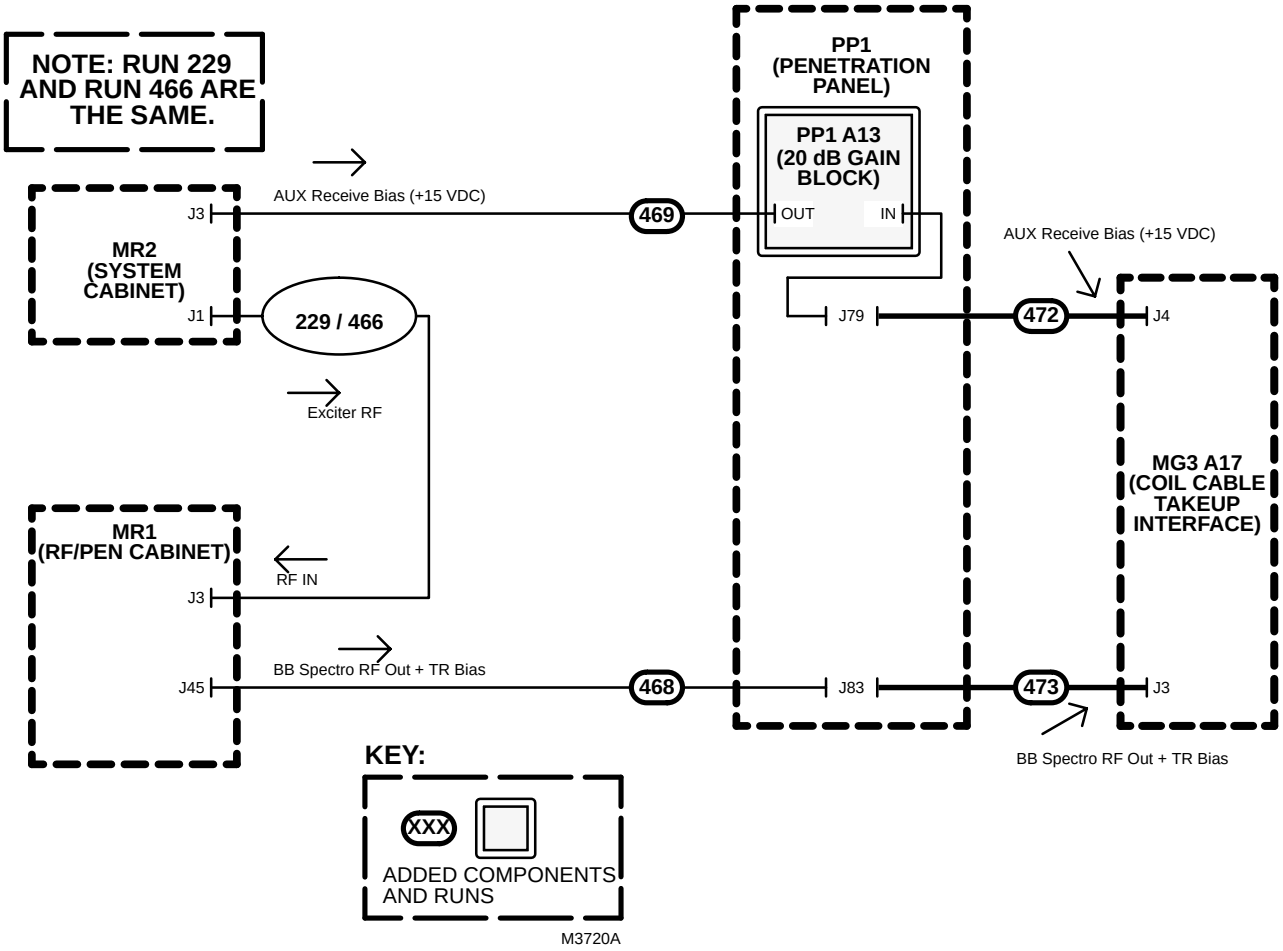
Note
This section applies to M1040JB.

2–1 UNPACKING CABLE KIT

The five new Spectroscopy Subsystem Cables are shipped in Box 1.

TABLE 2–1
SPECTROSCOPY SUBSYSTEM CABLES

RUN	"FROM"	"TO"	DESCRIPTION	REMARKS
468	PP1–J83	MR1–A7–J45	Heliax Coax, 50 foot Cable	Heliax Coax, SC to N
469	PP1–A13–OUT	MR2–A11–J3	RG223 Coax, 50 foot Cable	RG223 Coax, BNC
472	MG3–A17–J4	PP1–J79	RG223 Coax, 80 foot Cable	RG223 Coax, BNC
473	MG3–A17–J3	PP1–J83	Heliax Coax, 80 foot Cable	Heliax Coax, SC to N



NEW CABLE KIT ROUTE MAP (5.5 Release)
ILLUSTRATION 2–1

2–2 CABLE REMOVAL

If the Multi–Nuclear Spectroscopy Option is being added to a previously installed system, remove the cables listed in Table 2–2.

TABLE 2–2
INTERCONNECTING CABLE

RUN	"FROM"	"TO"	DESCRIPTION	RUN 466
229	MR2 A11 J1	MR1–A7–J3	RG223/U Coax Cable	NOTE: RUN 229 can be kept. RUN 466 is the same as RUN 229. There is no need to remove RUN 229. There is no need to route RUN 466. This is due to the removal of the MR6 Spectro Cabinet.

2–3 ROUTE NEW CABLES

TABLE 2–3
ROUTING NEW CABLES

RUN(S)	FROM	TO	LENGTH	TYPE
MAGNET ROOM CABLES				
472	Magnet Enclosure	Penetration Panel	80 Feet (26 m)	**RG223 Coax, BNC**
473	Magnet Enclosure	Penetration Panel	80 Feet (26 m)	**Heliax Coax, SC to N**
EQUIPMENT ROOM CABLES				
466	System Cabinet	BroadBand RF Cabinet	50 Feet (16 m)	**RG223 Coax, BNC**
468	Penetration Panel	BroadBand RF Cabinet	50 Feet (16 m)	**Heliax Coax, SC to N**
469	System Cabinet	Penetration Panel	50 Feet (16 m)	**RG223 Coax, BNC**

1. Route cables listed in Table 2–3. See Illustration 2–1.
2. Remove twists and kinks from cabling.
3. Allow:
   – three feet (one meter) of slack at entrance to Cabinets
   – six feet (two meters) of slack at the Penetration Panel
   – sufficient slack to connect to Coil Cable Takeup Interface (MG3 A17)

SECTION 3 – RF/PEN CABINET (1 or 2) MNS HARDWARE INSTALL

(HORIZON 5.5 RELEASE)

Note

This section applies to M1040JB or M1090JZ.

Note

This section applies to the newest Spectro Kit which contains the MR1A18 Spectro Attenuator.

3–1 MNS CABLE LIST FOR RF/PEN 1 OR 2 CABINET

1. The RF Signal IN from the System Cabinet is as follows:

RF/PEN1	**RF/PEN2**
RF Signal In on RUN 229	RF Signal In on RUN 229
MR1A7J3 I/F Panel (to RFSC, MR1A15J105)	MR1A20A1J3 SSM

2. Relabel the necessary cables (bolded) for RF/PEN 2 as follows using the supplied labels:

MR1A15J104	MR1A18J1	540009	**MR1A20A1J104**	MR1A18J1
MR1A18J2	MR1A16J3	540031	MR1A18J2	MR1A16J3
MR1A16J2	MR1A17J1	540005	MR1A16J2	MR1A17J1
MR1A17J5	MR1A7J45	540004	MR1A17J5	MR1A7J45
MR1A15J507	MR1A17J7	540015	**MR1A20J507**	MR1A17J7
MR1A16J7	MR1A17J6	540016	MR1A16J7	MR1A17J6
MR1A15J407	MR1A17J4	540008	**MR1A20A2J407**	MR1A17J4
MR1A15J101	MR1A17J2	540006	**MR1A20A1J101**	MR1A17J2
MR1A15J102	MR1A17J3	540007	**MR1A20A1J102**	MR1A17J3
MR1A17	Erbtec RF Amp (GND Studs)	540018	MR1A17	Erbtec RF Amp (GND Studs)

Note

Refer to Illustrations 3–1, 3–2, and 3–3 when installing the Multi–Nuclear Spectroscopy Option.

3–2 INITIAL READINESS FOR RF/PEN 1 OR 2 CABINET

NOTE

Anti–tip legs must be on the RF/PEN Cabinet before beginning this procedure.

1. Verify ERBTEC RF Amplifier is NOT EXTENDED OUT on its rails.
2. Verify the Spectro Circuit Breaker located at the rear bottom of the RF/PEN Cabinet is in the OFF position.
3. Remove the RF/PEN Cabinet front cover.
4. Viewed from the front of the cabinet, remove the left side panel:
   - Remove the phillips head screw that secures the side panel cover. This is located at the bottom of the side cover above the anti–tip leg.
   - Using a large straight blade screwdriver, pry the side panel upwards. Use the anti–tip leg for leverage.

NOTE

If the side panel cannot be removed it is possible to install the Spectro Kit

3–3 SHELF INSTALLATION FOR RF/PEN 1 OR 2 CABINET

NOTE

Before installing the shelf, check to see if the four phillips panhead 10–32 screws, which will mount the Spectro Module Assembly (silver box), will actually fit through the four holes on the rear of the shelf. If the holes are too small, use a drill and drill bit to enlarge them before installing the shelf.

1. Count down from the top of each of the four (front and back) rails and mark hole #22.
2. Place the shelf into the cabinet with the lip edge oriented toward the front and down. The four holes on the shelf should be oriented toward the rear of the cabinet.
3. Install the shelf into the cabinet using the four 1/4–20 bolts and nuts.
4. Place the bolts through the shelf. The nut will directly contact the side rail.

NOTE

If the bolts/nut hardware is installed incorrectly they will interfere with the installation of the Spectro RF Amplifier.

5. Verify the shelf position does not extend beyond the front and rear mounting rails. Tighten nuts to secure the shelf. Verify back door will close properly.
6. **Check rear door:** Before tightening the bolts holding the shelf, make sure you have selected the correct holes on the shelf. There are two shelf holes at each side rail location. Use the front set of holes. The shelf should sit as far towards the rear of the RF/PEN Cabinet as possible without interfering with the ability to close the door. Once you are sure the shelf is installed in the correct position, tighten each bolt/nut.

3–4 SPECTRO I/F BRACKET CONNECTOR INSTALLATION FOR RF/PEN 2 CABINET ONLY

1. RF/PEN 2 ONLY: Install the Spectro I/F Bracket's N and BNC panel mount connectors
   - Place the panel mount N connector through the back–side of the Spectro I/F Bracket at MR1 A7 J45. Attach the lock washer and nut to the N connector. Tighten appropriately—Do Not overtighten.
   - Place the panel mount BNC connector through the back–side of the Spectro I/F Bracket at MR1 A7 J50. Attach the lock washer and nut to the BNC connector. Tighten appropriately—Do Not overtighten.

3–5 SPECTRO I/F BRACKET INSTALLATION FOR RF/PEN 2 CABINET ONLY

1. RF/PEN 2 ONLY: Install the Spectro I/F Bracket (MR1A7)
   - Count up from the bottom right rear rail. Mark hole #5 and hole #8.
   - Place a clip nut at each of the two above hole positions.
   - Install the Spectro I/F Bracket onto the cabinet using the two #10–32x1/2" screws and flat washers. Tighten the screws.

3–6 SPECTRO RF AMPLIFIER INSTALLATION FOR RF/PEN 1 OR 2 CABINET

1. Anti–tip legs must be on the RF/Pen Cabinet before beginning this procedure.

CAUTION
The installation of the Spectro RF Amplifier requires two persons.
The ENI Amplifier weighs ~77 lbs. and the Analogic Amplifier weighs ~ 130 lbs.

2. Attach the four 10–32 self–locking clips onto the vertical cabinet front rails to line up with the Spectro Amplifier's front cover mounting holes. The Spectroscopy Amplifier will be held in with four 10–32x1/2" screws and flat washers. Verify the 4 screws are properly tightened.

NOTE
The power linecord is part of the Spectroscopy RF Amplifier

NOTE
ANALOGIC AMPLIFIER
The handles and filter/grill assembly must be removed so the RF/PEN Cabinet Front Cover can be installed. All parts must be placed in a plastic bag and retained. These parts must be sent back with the Analogic Amplifier in the case of FRU. These parts may be required for future upgrades.

3–7 SPECTRO RF AMPLIFIER LABELING VERIFICATION FOR RF/PEN 1 OR 2 CABINET

1. **Verify Equipment Connection Labels for all Spectro Kits:**

BNC	RF IN at BroadBand Amplifier	**J3**
N Cable	RF OUT at BroadBand Amplifier	**J2**
Sub–D Cable	Remote Control In/Out	**J7**

The Multi–Nuclear Spectroscopy RF Amplifier connections may need to be relabeled at the Amplifier. Only three connections are made: a BNC cable to RF IN, a N cable to RF OUT, and a Sub–D cable to the Remote Control IN/OUT.

3–8 SPECTRO POWER CABLE INSTALLATION FOR RF/PEN 1 OR 2 CABINET

1. Remove the screws holding in the ERBTEC RF Amplifier, place the screws into a bag for storage.

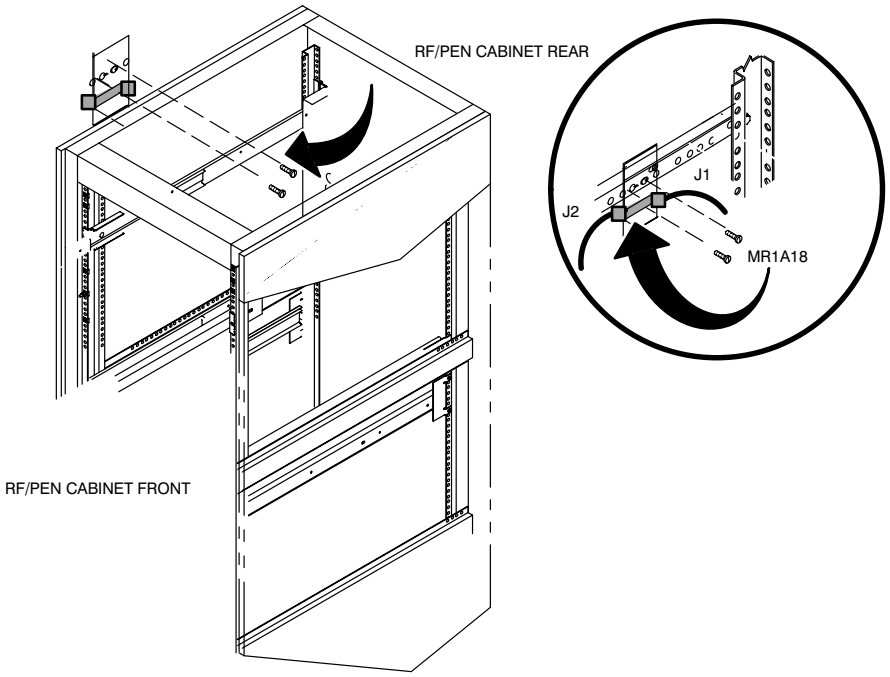
NOTE
All cables will be routed on the left side of the cabinet as viewed from the front between the side cover and horizontal cabinet rails or on the right side of the cabinet as viewed from the rear between the side cover and horizontal cabinet rails.

2. SPECTRO RF AMPLIFIER POWER LINE–CORD;
   - Connect the large male side of the Spectro power line–cord to the unused Spectro power connector located near the bottom of the cabinet on the right side of the ERBTEC Amplifier (as viewed from the rear).
   - Route the Spectro power line–cord up the side and across the shelf.
   - Connect the Spectro power line–cord to the rear of the Spectro RF Amplifier.

3. Locate the power switch or circuit breaker at the Spectroscopy Amplifier. Place the power switch or circuit breaker to the ON position.

3–9 SPECTRO ATTENUATOR INSTALLATION FOR RF/PEN 1 OR 2 CABINET

1. At the rear of the RF/PEN Cabinet locate the top horizontal rail on the right side of the cabinet.
2. On the top–most, right rear side rail —— install the Spectro Attenuator (MR1A18):



MR1A18 SPECTRO ATTENUATOR PLACEMENT
ILLUSTRATION 3–1

3. Mark holes #7 and #10 on the top rail (as viewed from the rear right).
4. Mount the Spectro Attenuator to the top rails by placing the two 1/4–20x1/2” screws through the inside rail and tightening them into the threaded MR1A18 Attenuator Bracket. The bracket is located on the outside of the rail (closest to the side cover).

NOTE

The MR1A18 Spectro Attenuator will be used to adjust the Multi–Nuclear Spectro RF Signal into the Spectro RF Amplifier for 1.55 kW Spectro RF OUT.

CAUTION

Verify the locking nut on the MR1A18 Spectro Attenuator shaft is loose before attempting any adjustments. This Spectro Attenuator is a 3/4 turn pot (CW to increase attenuation). Carefully re–tighten the locking nut on the MR1A18 Spectro Attenuator shaft after the 1.55 kW Spectro RF Output adjustment is made. Do NOT over–tighten.

3–10 MNS INTERCONNECT CABLE AND MODULE INSTALLATION FOR RF/PEN 1 OR 2 CABINET

3–10–1 RF/PEN 1 CABINET ONLY: Procure cables 540006, 540007, 540008, and 540015

1. Group all ends of the cables with the label identifier MR1A15. . . together.
2. Route the above four (4) cables between the rear right corner of the RFSC and the outside of the cabinet rails.
3. Connect the four (4) cables to the appropriate locations at the rear of the RFCS (J101, J102, J407, J507). The **J507 cable connector** may have nuts connected to the screws, remove the nuts before installing.
4. Route the other end of the four (4) cables up the side to the shelf. Tywrap cables together as necessary. Do Not tywrap the cables to any rail holes, they must remain free–moving.

3–10–2 RF/PEN 2 CABINET ONLY: Procure cables 540006, 540007, 540008, and 540015

1. Group all ends of the cables with the label identifier MR1A15. . . together.
2. Relabel the **MR1A15 . . .** cables with the appropriate **MR1A20 . . .** labels provided. The ending J# designation is the same.
3. Push the SSM slightly forward to gain routing access.
4. Route the above four (4) cables between the rear right corner rail and the SSM. They should be routed directly below the two (2) Amplifier power cables.
5. Connect the four (4) cables to the appropriate locations at the rear of the SSM (J101, J102, J407, J507). The **J507 cable connector** may have nuts connected to the screws, remove the nuts before installing.
6. Route the other end of the four (4) cables up the side to the shelf. Tywrap cables together as necessary. Do Not tywrap the cables to any rail holes, they must remain free–moving.

3–10–3 RF/PEN 1 CABINET ONLY: Procure cables 540004, and 540009

1. Procure cable 540004, *RF + TR Bias Out*;
2. Connect the (right angle connector) MR1A7J45 cable to the back–side of the N connector at the RF/PEN 1 Cabinet I/F panel. Position the right angle portion of the RF & TR OUT cable sideways so that it does not get bumped by the Directional Coupler when the Erbtec RF Amplifier is pushed back into its original position.
3. Carefully push the ERBTEC RF Amplifier back into the RF/PEN 1 Cabinet. Be careful to insure the cable bundle on the right rear side is not getting pinched.
4. Route the other end of the cable up the side to the shelf.
5. Procure cable 540009, *Spectro RF IN*;
6. Connect the MR1A15J104 cable to the BNC connector at the RFSC.
7. Route the other end of the cable up the side to the shelf.
8. Verify the RFSC slides in and out and can be opened properly without obstruction.

3–10–4 RF/PEN 2 CABINET ONLY: Procure cables 540004, and 540009

1. Procure cable 540004, *RF + TR Bias Out*;
2. Connect the (right angle connector) MR1A7J45 cable to the back–side of the N connector at the RF/PEN 2 Cabinet Spectro I/F Bracket.
3. Carefully push the SSM and the ERBTEC RF Amplifier back into the RF/PEN 2 Cabinet. Be careful to insure the cable bundle on the right rear side is not getting pinched.
4. Route the other end of the cable up the side to the shelf.
5. Procure cable 540009, *Spectro RF IN*;
6. Connect the MR1A20A1J104 cable to the BNC connector at the SSM.
7. Route the other end of the cable up the side to the shelf.
8. Verify the SSM slides in and out and can be opened properly without obstruction.

3–10–5 CONNECT CABLES AT THE SPECTRO RF AMP–––RF/PEN 1 OR 2 CABINET: Connect cables 540009, 540031, 540016, and 540005

1. Connect 540009, MR1A18J1 to the Spectro Attenuator BNC connector located towards the rear of the Cabinet.
2. Connect 540031, MR1A18J2 to the Spectro Attenuator BNC connector located towards the front of the Cabinet. Connect the other end of the cable labeled MR1A16J3 to the *RF In* BNC connector located at the rear of the Spectro RF Amplifier. Verify the Spectro Amplifier *RF In* J# designator is correctly labeled. If it is incorrect, relabel the Amplifier at this time with the proper J3 designator.
3. Connect 540016, MR1A16J7 to the Remote Control In/Out connector located at the rear of the Spectro RF Amplifier. Verify the Spectro Amplifier *Remote Control In/Out* J# designator is correctly labeled. If it is incorrect, relabel the Amplifier at this time with the proper J7 designator.
4. Connect 540005, MR1A16J2 to the *RF Out* N connector located at the rear of the Spectro RF Amplifier. Verify the Spectro Amplifier *RF Out* J# designator is correctly labeled. If it is incorrect, relabel the Amplifier at this time with the proper J2 designator.

3–10–6 CONNECT CABLES AT THE SPECTRO MODULE–––RF/PEN 1 OR 2 CABINET: Connect cables 540004, 540005, 540006, 540007, 540008, 540015, 540016,and 540018

1. Place the Spectro Module Assembly onto the shelf directly behind the Spectro RF Amplifier.
2. Position the connectors toward the right side as viewed from the rear of the cabinet.
3. Connect 540004, *RF + TR Bias Out,* to the Spectro Module Assembly's MR1A17J5 connector.
4. Connect 540005, *BB RF Out* to the Spectro Module Assembly's MR1A17J1 connector.
5. Connect 540006, *Spectro Out A,* to the Spectro Module Assembly's MR1A17J2 connector.
6. Connect 540007, *Spectro Out B,* to the Spectro Module Assembly's MR1A17J3 connector.
7. Connect 540008, *Spectro TR Bias,* to the Spectro Module Assembly's MR1A17J4 connector.
8. Connect 540015, *Spectro I/F,* to the Spectro Module Assembly's MR1A17J7 connector.
9. Connect 540016, *BB I/F,* to the Spectro Module Assembly's MR1A17J6 connector.
10. Connect 540018, *Spectro Ground,* between the Spectro Module Assembly's GROUND STUD. Route the other end along the side to the ERBTEC Narrowband Amplifier's Ground Stud located at the rear.

3–10–7 INSTALL SPECTRO MODULE ASSEMBLY–––RF/PEN 1 OR 2 CABINET

1. Secure the Spectro Module Assembly to the shelf using the four phillips panhead #10–32 screws and flat washers.

3–11 REPLACE RF/PEN CABINET SIDE PANEL COVER–––RF/PEN 1 OR 2 CABINET

1. Viewed from the front of the cabinet, replace the left side panel:
   - Replace the phillips head screw that secures the side panel cover. This is located at the bottom of the side cover above the anti–tip leg.

3–12 RF/PEN CABINET MULTI–NUCLEAR SPECTRO HELIAX CABLE–––RF/PEN 1 OR 2 CABINET

1. **Run 468 Heliax Cable installation:**
   - RF/PEN 1 ONLY:
     Connect Run 468 (Spectro RF OUT + TR BIAS) Heliax cable to MR1 A7 J45 I/F Panel.
   - RF/PEN 2 ONLY:
     Connect Run 468 (Spectro RF OUT + TR BIAS) Heliax cable to MR1 A7 J45 Spectro I/F Bracket.

3–13 RF/PEN 2 CABINET MICROPROCESSORS

Older revisions of the Circuit Boards located in the RF/Pen2 Cabinet SSM will present problems for MNS users. The revisions listed below represent the minimal acceptable board revision for Horizon LX MNS. The Circuit Board part number is listed before the board revision. Part numbers and board revisions will vary over time, however, when experiencing Multi–Nuclear Spectroscopy problems have these numbers ready to discuss.

1. Three microprocessors are supplied. The supplied CPD Board microprocessor should be used only if it is a more recent date compile code. The remaining two microprocessors are identical and should be used on the APM Board only if they are of a more recent date compile code. Any time the microprocessors are replaced with a newer version the Board revision will reflect the change.
2. CPD (Communications PIN Driver Board): 550015.**05**
   (with micro—> U8, 550061.03 checksum 2DC7 date 10/7/97).
3. APM (Analog Power Monitor Board): 550013.**05**
   (with identical micro's—> U8 and U1, 550063.01 checksum A000 date 10/3/97).

3–14 RF/PEN CABINET MULTI–NUCLEAR SPECTRO CIRCUIT BREAKER–––RF/PEN 1 OR 2 CABINET

1. Verify the Spectro Circuit Breaker located at the rear bottom of the RF/PEN Cabinet is in the ON position.
2. The MNS RF Amplifier should be powered ON. Verify fan is running in the Amplifier.

3–15 SPECTRO CHIMNEY INSTALLATION FOR RF/PEN 2 CABINET FRONT COVER ONLY

1. RF/PEN 2 ONLY: Install the Spectro Chimney onto the front cover
   - Use the four studs as a guide.
   - Secure the Spectro Chimney with the four 6–32 nuts and eight 4–40 screws.

3–16 SPECIAL USE ONLY––– BNC CONNECTION

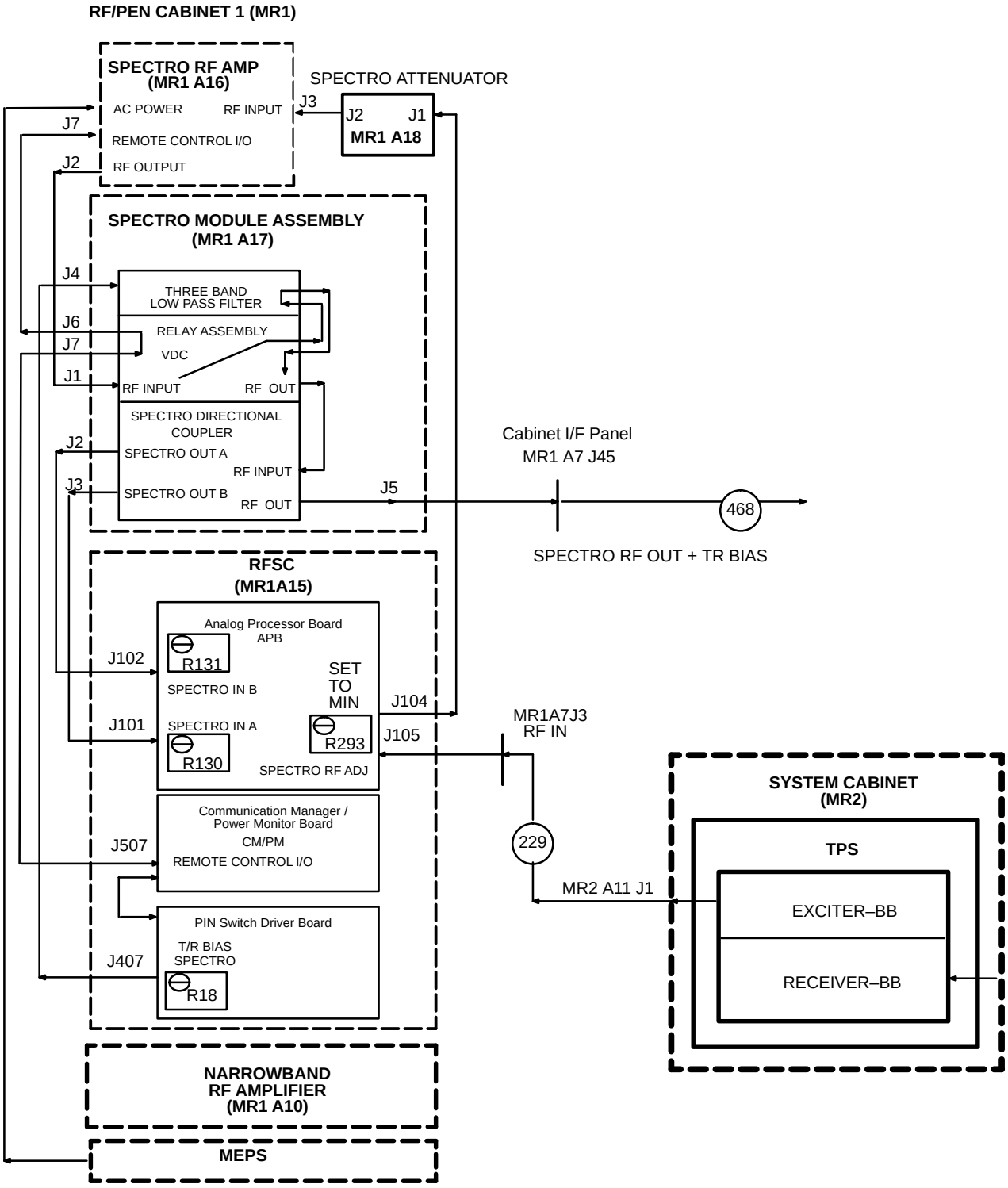
NOTE
DO NOT PERFORM THIS SECTION–––
FOR DUAL CERD FUTURE USE ONLY

Signa Horizon MR1 A7 J50 Hole Installation into a RF/PEN 1 Cabinet ONLY:

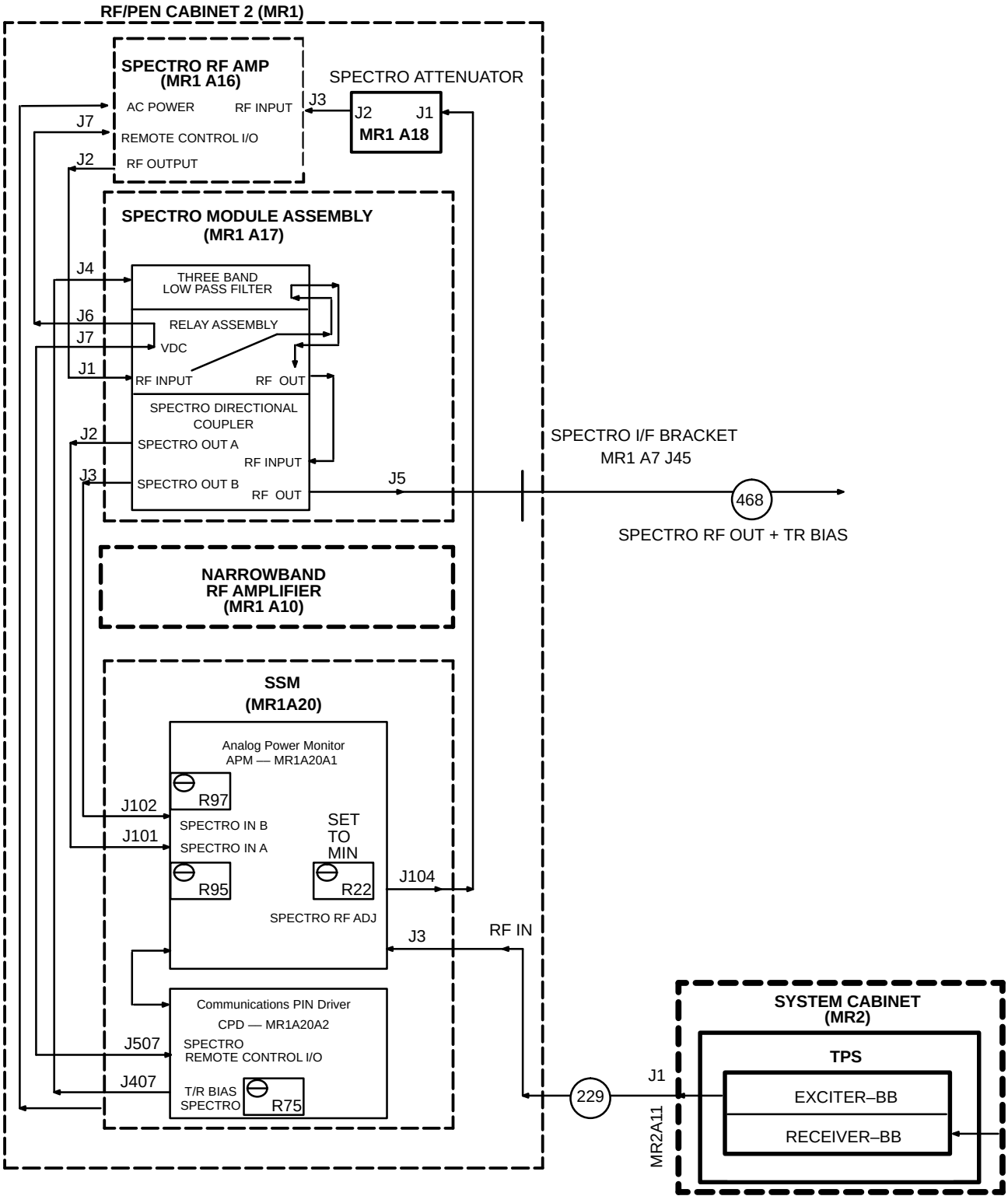
1. A hole must be made at the RF/PEN Cabinet 1 I/F Panel to install the MR1A7J50 BNC panel mount connector:
   - With the 0.0 starting point at the I/F Panel's right–most top corner, measure down 4.75 inches and over toward the left 2.3 inches.
   - Use a BNC Greenlea Punch or drill a 1/2 inch hole.
   - Place the panel mount BNC connector through the back–side of the I/F Panel at MR1 A7 J50. Attach the lock washer and nut to the N connector. Tighten appropriately—Do Not overtighten.
   - Label this connection at the I/F Panel as J50.

Signa Horizon MR1 A7 J50 BNC Connection at Spectro I/F Bracket on RF/PEN 2 Cabinet ONLY:

NOTE
No connections will be made to the MR1 A7 J50 Spectro I/F Bracket.



RF/PEN 1 CABINET WITH MULTI–NUCLEAR SPECTROSCOPY OPTION ON HORIZON (5.5 RELEASE)
ILLUSTRATION 3–2



RF/PEN 2 CABINET WITH MULTI–NUCLEAR SPECTROSCOPY OPTION ON HORIZON (5.5 RELEASE)
ILLUSTRATION 3–3

SECTION 4 – SYSTEM CABINET KIT

Note
This section applies to M1040JB.

4–1 UNPACKING SYSTEM CABINET KIT

The System Cabinet kit provides BB (BroadBand) Exciter and BB Receiver modules for Multi–Nuclear Spectroscopy acquisition at other than Proton (Hydrogen) frequency.

The System Cabinet is shipped in Box 1. Refer to Table 4–1 for contents.

TABLE 4–1
SYSTEM CABINET KIT

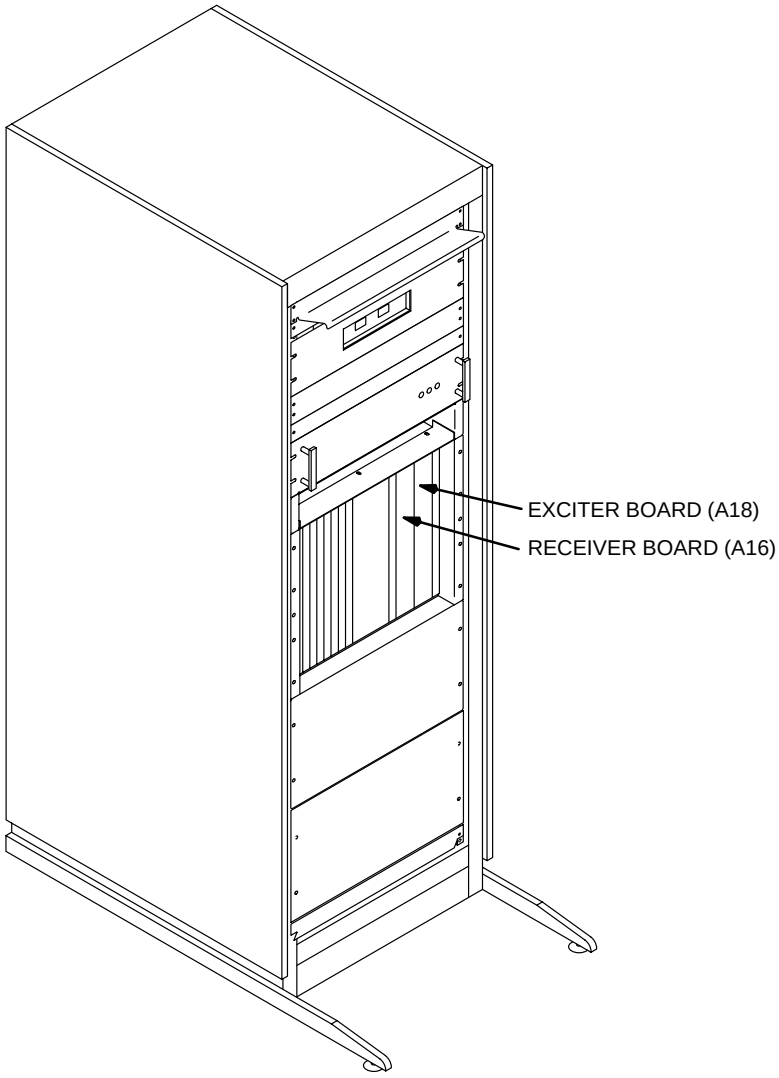
ITEM	PART NO.	QUANT.	DESCRIPTION
2	46–264232G1	1	BB RECEIVER (MR2 A15 A16 A3)
3	46–264230G2	1	BB EXCITER (MR2 A15 A18 A3)
6	46–208560P12	10	SCREW, 4–40 X 0.312 BIND HD STL
	2123273	1	TNF SPECTRO UPGRADE KIT (cable and adaptor)

4–2 RECEIVER BOARD AND EXCITER BOARD REMOVAL

Note
The Receiver Board designator is MR2 A15 A16 (5.5).
The Exciter Board designator is MR2 A15 A18 (5.5).

1. If the flow chart (Illustration 1–3) is being followed, System Cabinet power should be shut off because PDU power is shut off. Verify that PDU power is disconnected, locked out, and tagged before continuing.
2. Put on a grounded wrist band.
3. Verify cables are labeled before disconnecting. Disconnect cable from J12 connector on Receiver Board and connector J14 from Exciter Board of TPS Assembly (A15).
4. Remove four screws which secure Receiver Board and Exciter Board to TPS Assembly (A15).
5. Use ejectors to push Receiver Board and Exciter Board out from connectors at rear of TPS Assembly (A15). Refer to Illustration 4–1.
6. Slide out and remove Receiver Board and Exciter Board from TPS Assembly (A15). Refer to Illustration 4–1.
7. Put each Receiver Board and Exciter Board into individual static free bags.
8. Put static free bags onto a workbench.

4–2 RECEIVER BOARD AND EXCITER BOARD REMOVAL (Continued)



M3518A

RECEIVER BOARD AND EXCITER BOARD LOCATIONS (RELEASE 5.5)
ILLUSTRATION 4–1

4–3 BROADBAND RECEIVER MODULE INSTALLATION

Install BroadBand Receiver Module onto Narrowband Receiver Module of Receiver Board as follows:

The BroadBand Receiver Module designator is MR2 A15 A16 A3 (5.5).
The Narrowband Receiver Module designator is MR2 A15 A16 A2 (5.5).

1. Put on a grounded wrist band.
2. Remove Receiver Board (item 2) from static free bag.
3. Remove two screws and protection cover from connector J6 of Narrowband Receiver Module. Discard cover. Save the screws.

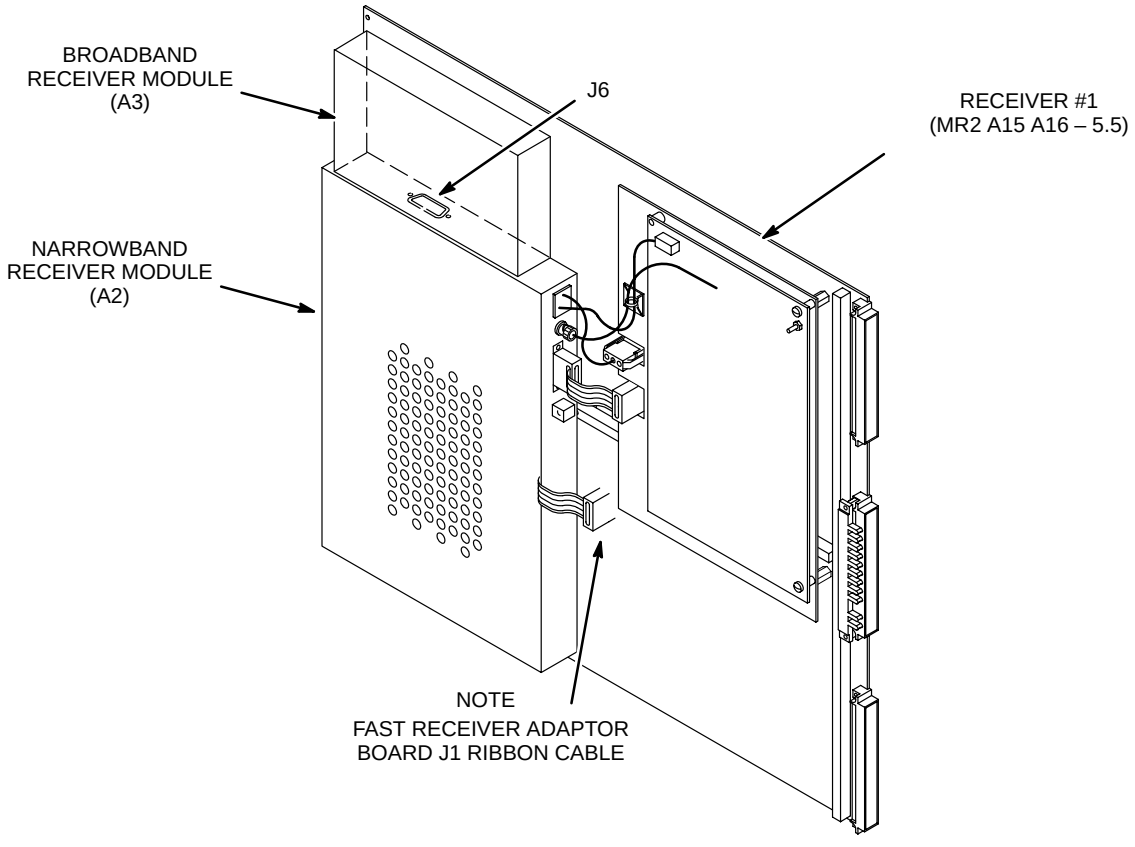
Note

Make sure the screws just removed in step 3 are re–installed to secure connector J6 in next step. If the screws are not re–installed, correlated noise may develop.

If a Fast Receiver is present in the system note the J1 connector orientation.

Failure to orient this J1 Ribbon connector pin 1 to Circuit Board pin 1 (dot on board) correctly will result in Fast Receiver issues.

4. Install two screws removed in step 3 to secure connector J6 to Narrowband Receiver Module and tighten.
5. Slide connector J6 of BroadBand Receiver Module into connector J6 of Narrowband Receiver Module.
6. Install four screws (item 6) through Receiver Board and into BroadBand Receiver Module. Tighten screws.
7. Put assembled Receiver Board into a static free bag.

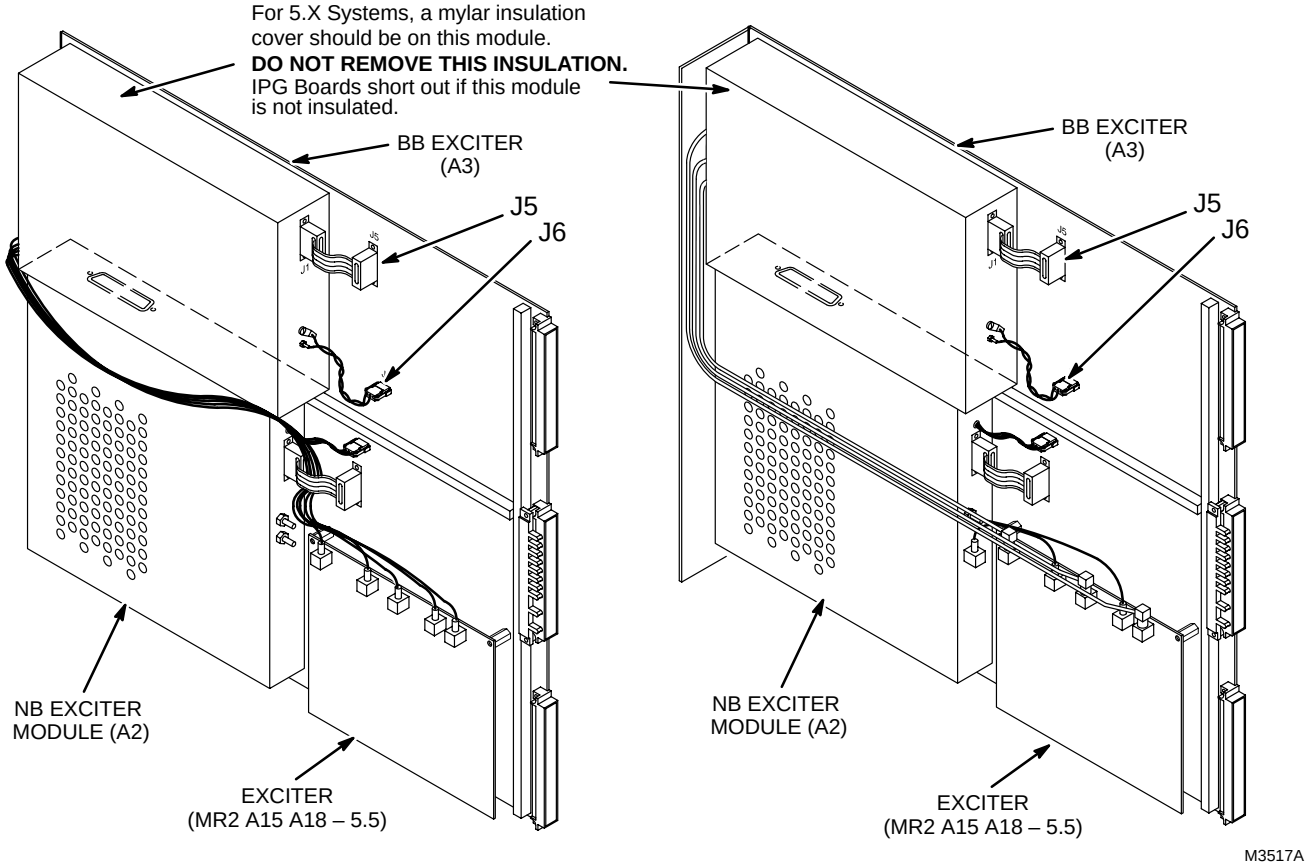


BROADBAND RECEIVER MODULE INSTALLED
ILLUSTRATION 4–2

4–4 BROADBAND EXCITER MODULE INSTALLATION

Install BroadBand Exciter Module (A3) onto Narrowband Exciter Module (A2) of Exciter Board as follows:

1. Put on a grounded wrist band.
2. Remove two screws and protection cover from connector J7 of Narrowband Exciter Module (A2). Discard cover. Save the screws.
3. Install two screws removed in step 2 to secure connector J7 to Narrowband Exciter Module (A2) and tighten.
4. Slide connector J7 of BroadBand Exciter Module (kit item 3) into connector J7 of Narrowband Exciter Module (A2).
5. Install four screws (item 6) through Exciter Board and into BroadBand Exciter Module (A3). Tighten screws. Refer to Illustration 4–3.
6. Install connector J5 into connector J5 of Exciter Board. Refer to Illustration 4–3.
7. Secure connector J5 of ribbon cable to Exciter Module with two #4–40 screws and tighten.
8. Install connector J6 of cable assembly into connector J6 of Exciter Board.
9. Put assembled Exciter Board into a static free bag.



BROADBAND EXCITER MODULE INSTALLED
ILLUSTRATION 4–3

4–5 RECEIVER BOARD AND EXCITER BOARD INSTALLATION

Install Receiver Board and Exciter Board onto TPS Assembly (A15) as follows:

1. Put on a grounded wrist band.
2. Remove Receiver Board and Exciter Board from static free bags and slide into TPS Assembly (A15) until the connector at back of chassis lock into position and ejectors move into their locked positions.
3. Install four pan head screws to secure the Receiver Board and Exciter Board to TPS Assembly (A15) and tighten.
4. Simultaneously install connector J12 to Receiver Board and connector J14 to Exciter Board.

4–6 SYSTEM CABINET CABLE CONNECTION

1. Connect previously routed cables listed in Table 4–2 to System Cabinet Interface Panel.

TABLE 4–2
NEW CABLES CONNECTED TO SYSTEM CABINET

CONNECTOR	TYPE OF CONNECTOR	RUN	REMARKS
MR2 A11 J3	RG223 BNC Coax	469	Spectroscopy Receive from 20 dB Gain Block

4–7 TRANSIENT NOISE FILTER (TNF) CABLE CONNECTION (2123272)

1. Find J2 through J5 cable bundle at rear of System Cabinet near TNF Module. Locate J3 connector inside bundle braiding. Remove connector from bundle. BB Spectroscopy does not use a TNF Module.

Note

The J3 cable is connected to MR2A16J12–7.

2. Place 5/8 inch shrink tubing, supplied in kit, on J3 cable.
3. Connect BNC to BNC adapter, supplied in kit, to J3 connector.
4. Cover cable bundle braid with shrink tubing. Use heat gun to shrink tubing on braid and connector.
5. Connect cable, 2118109–2, supplied in kit, from adapter to Interface Panel MR2 A11J3 (AUX) and tywrap cable for strain relief.

SECTION 5 – PENETRATION PANEL KIT

Note
This section applies to M1040JB.

5–1 PENETRATION PANEL KIT

The Penetration Panel kit provides a new Quad II / Roemer Body Coil Filter Panel that includes the 20 dB Gain Block (PP1 A13) and connectors for additional RF cables. The Dynamic Disable and Inductive Drive Filter (PP1 A11) is installed on the new filter panel after being removed from a previously installed Penetration Panel, or obtained from the M1040FJ Options Prerequisite Upgrade.

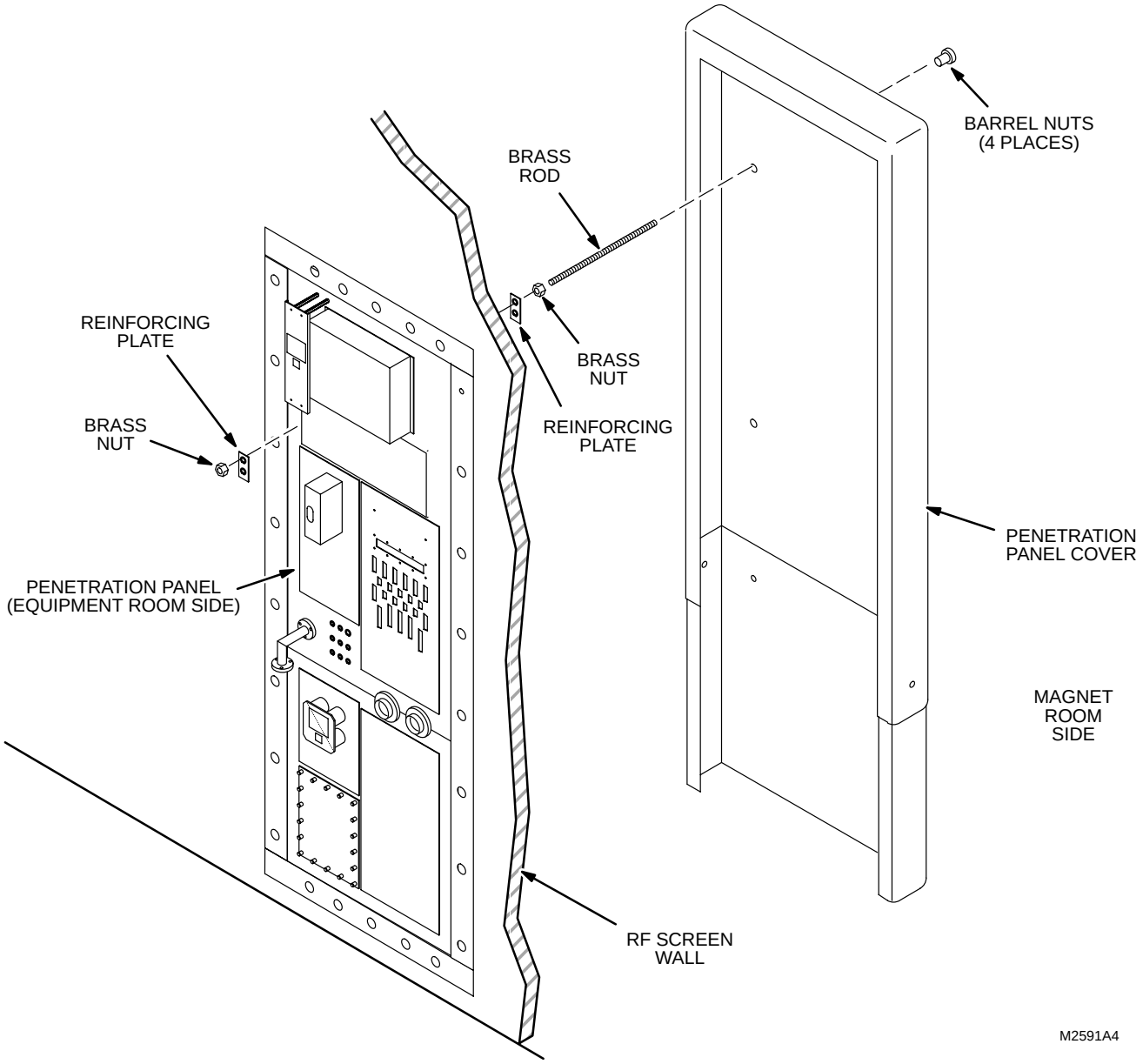
1. Unpack Penetration Panel Kit from Box 1 and verify that contents listed in Table 5–1 are complete.
2. If Signa Horizon Options Prerequisite Upgrade is also being installed, locate the Dynamic Disable and Inductive Drive Filter (PP1 A11) delivered with M1040FJ upgrade.
3. If the flow chart (Illustration 1–3) is being followed, RF/Pen Cabinet power should be shut off because PDU power is shut off. Verify that PDU power is disconnected, locked out, and tagged before continuing.

TABLE 5–1
PENETRATION PANEL KIT

ITEM	PART NUMBER	DESCRIPTION	QUANTITY
2	46–301829G1	20 dB Gain Block Plate Assembly	1
3	46–208560P123	Binding Head Screw, 10–32 x 3/8, Stainless Steel	24
4	516A770P604	BInding Head Screw, 6–32 X 1/4, Stainless Steel	8

5–2 PENETRATION PANEL COVER REMOVAL

1. Remove equipment room and magnet room covers and/or other field installed decorative enclosures for access to Penetration Panel. See Illustration 5–1.



PENETRATION PANEL COVER REMOVAL
ILLUSTRATION 5–1

5–3 FILTER PANEL REMOVAL

Note

The following procedure assumes a Signa Advantage (4.X) or Signa Advantage 1.5T (5.X) is already installed and disconnection of some cables are required.

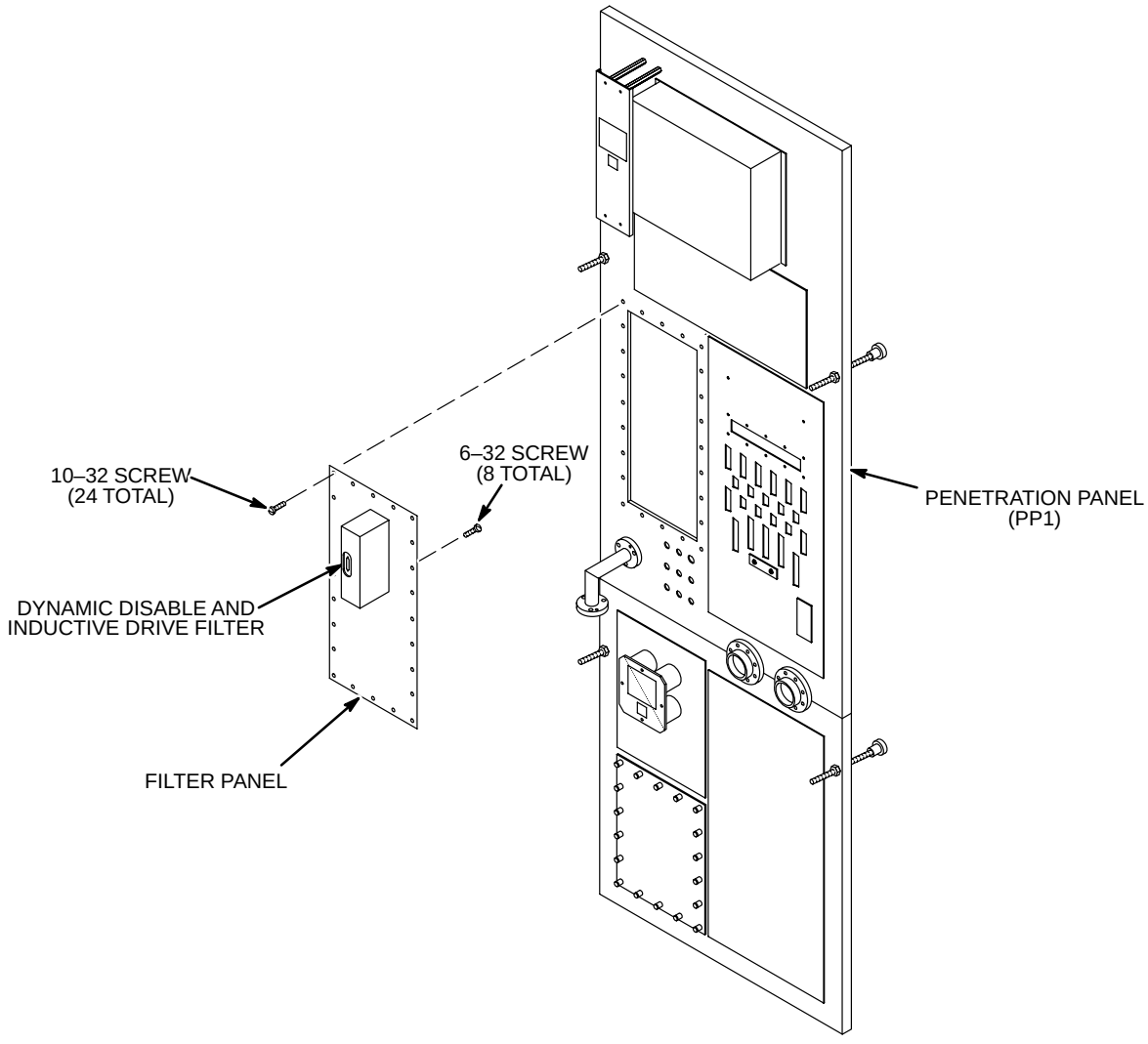
1. Disconnect cable end from Dynamic Disable and Inductive Drive Filter Module (PP1 A11). Refer to Table 5–2 cable ends to be disconnected.

TABLE 5–2
RUNS DISCONNECTED FROM FILTER PANEL

CONNECTOR	TYPE OF CONNECTOR	RUN
EQUIPMENT ROOM CABLES		
PP1–J71	**15–pin Subminature–D**	**470**
MAGNET ROOM CABLES		
PP1–J72	**BNC**	**474**
PP1–J73	**BNC**	**475**
PP1–J74	**BNC**	**476**
PP1–J75	**BNC**	**477**
PP1–J76	**BNC**	**478**

5–3 FILTER PANEL REMOVAL (Continued)

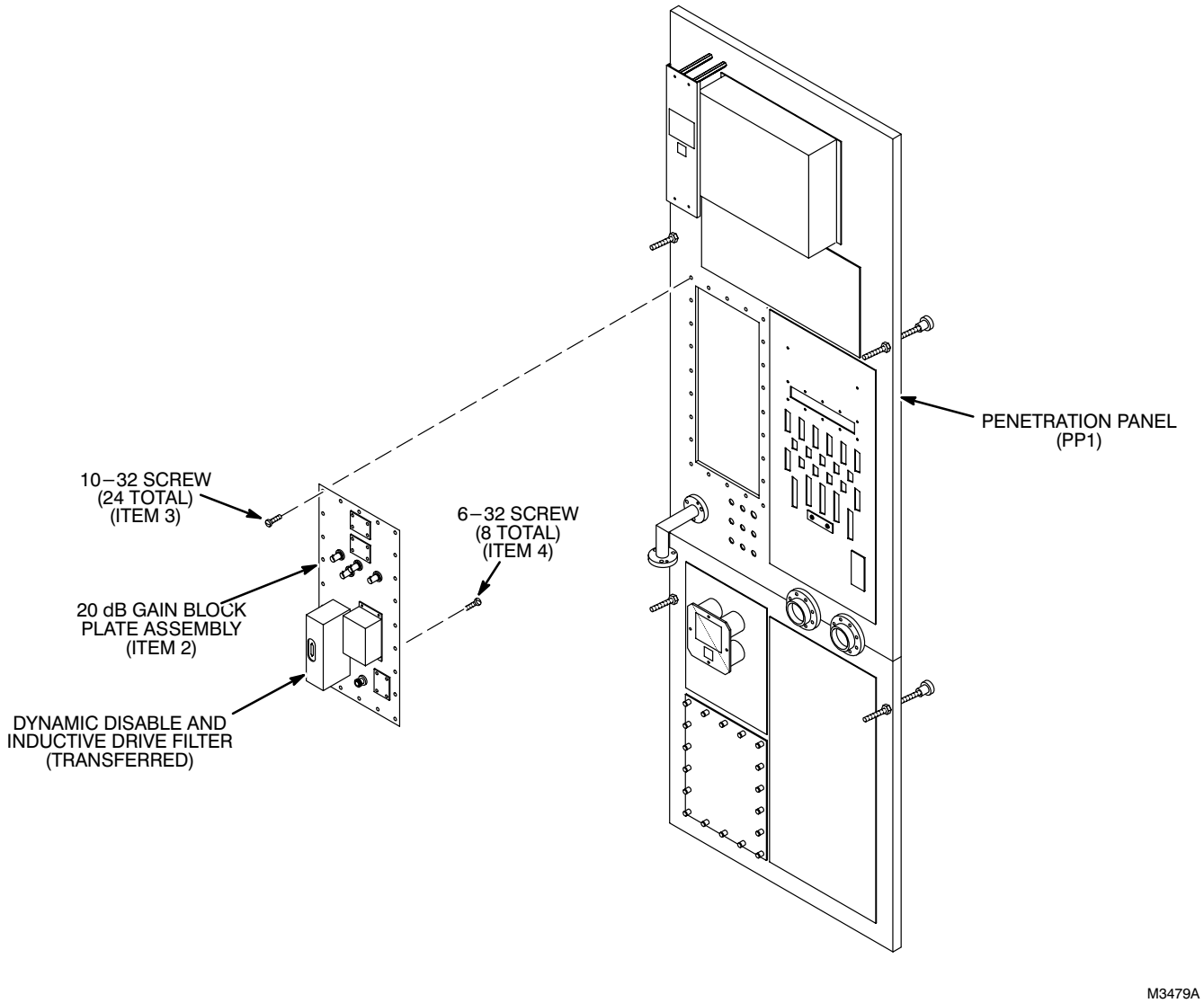
2. Unfasten and remove 24 10–32 X 3/8” screws that fasten filter panel to Penetration Panel. See Illustration 5–2.
3. Remove filter panel from Penetration Panel.
4. Unfasten and remove eight 6–32 X 3/8 screws that fasten Dynamic Disable and Inductive Drive Filter to filter panel. Save the Dynamic Disable and Inductive Drive Filter. See Illustration 5–2.
5. Place empty filter panel on discard pile.



REMOVE DYNAMIC DISABLE AND INDUCTIVE DRIVE FILTER ASSEMBLY
ILLUSTRATION 5–2

5–4 20 dB GAIN BLOCK PLATE ASSEMBLY INSTALLATION

1. Fasten Dynamic Disable and Inductive Drive Filter (J71 toward panel top) on new 20 dB Gain Block plate assembly (item 2) using six furnished 6–32 screws (item 4). See Illustration 5–3.
2. Align holes in plate of plate assembly with holes in Penetration Panel, install the 24 #10–32 screws (item 3), and tighten screws. See Illustration 5–3.



INSTALL ADAPTOR PLATE ASSEMBLY
ILLUSTRATION 5–3

5–5 CONNECT CABLES TO 20 dB GAIN BLOCK PLATE

1. Connect previously routed spectroscopy subsystem cables to both sides of the new Penetration Panel as marked. Table 5–3 lists cables that are connected to the new 20 dB Gain Block (PP1 A13) plate. Also connect cables previously disconnected from Dynamic Disable and Inductive Drive Filter (PP1 A11).

TABLE 5–3
PREVIOUS AND NEW RUNS CONNECTING TO NEW 20 dB BLOCK PLATE

CONNECTOR	TYPE OF CONNECTOR	RUN
EQUIPMENT ROOM CABLES		
PP1–J79	37–pin Subminature–D	470
PP1–J83	SC (right angle adaptor)	468
PP1–A13–OUT	BNC	469
MAGNET ROOM CABLES		
PP1–J72	BNC	474
PP1–J73	BNC	475
PP1–J74	BNC	476
PP1–J75	BNC	477
PP1–J76	BNC	478
PP1–J79	BNC	472
PP1–J83	SC	473

SECTION 6 – MAGNET ENCLOSURE KIT

Note
This section applies to M1040JB.

6–1 UNPACKING MAGNET ENCLOSURE KIT

The Magnet Enclosure Kit provides interconnect, Spectroscopy TR Module (TR Switch and Preamplifier for Phosphorus) for Spectroscopy Surface Coils operating at Phosphorus frequency.

The Magnet Enclosure Kit is shipped in Box 1. Refer to Table 6–1 for contents.

TABLE 6–1
MAGNET ENCLOSURE KIT

ITEM	PART NO.	QUANT.	DESCRIPTION
3	46–301166P1	2	RECEPTACLE, PANEL FEED THROUGH, LEMO
4	46–301319P1	4	WASHER, 1/2" OD, .36 ID, .030 THICK, 300 SST
5	2100718	1	SPECTROSCOPY TR MODULE (MG2 A16 A7)
6	46–282467G4	1	SPECTROSCOPY COIL ADAPTER (MG2 A16 A7 A3)
7	46–301205P1	2	CABLE, WHITE RG58/U W/ LEMO STRAIGHT AND ELBOW CONNECTORS
8	46–301338P1	2	ADAPTOR, BNC TO LEMO
9	46–301690G1	1	CABLE ASSEMBLY, RUN NO. 456, MG3–A17–J3 TO MG2–A16–J1
10	46–243775G708	1	CABLE, RUN NO. 455, MG3–A17–J4 TO MG2–A16–J2
16	46–208990P1	1	ADAPTOR, 50 OHM IMPEDANCE, BULKHEAD/PANEL, BNC
20	46–221865P1	1	CONNECTOR, 50 OHM IMPEDANCE, JACK–JACK, N ADAPTORS
21	46–251182P229	1	RATING PLATE, MODIFICATION KIT ADDED, 46–301548G1
22	46–306506P1	1	ADAPTOR, N PLUG TO SC JACK
205	46–320405P5	1	9 COMPARTMENT BOX, FOR SMALL HARDWARE PIECES

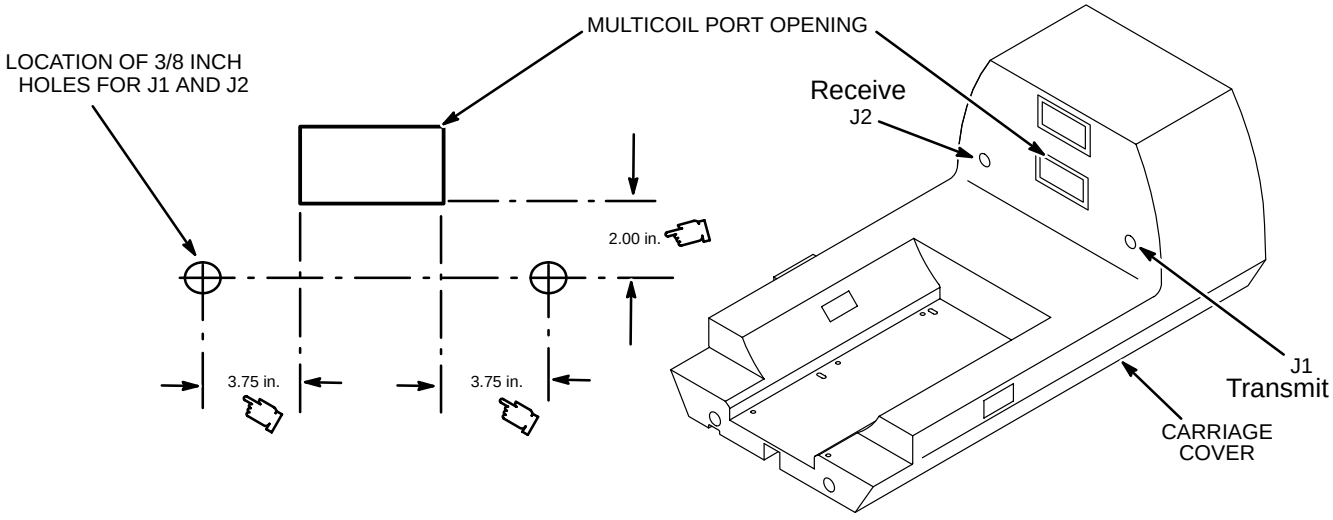
6–2 CARRIAGE COVER REMOVAL

Remove carriage cover from Carriage Cover Assembly (A16) of Magnet Enclosure (MG2) as follows:

1. Remove four screws and washers from top of carriage cover.
2. Lift up rear of carriage cover until it clears cable track.
3. Slide carriage cover forward until it clears front stops.
4. Disconnect Run 403 from Head Preamplifier (MG2 A16 A3–OUTPUT).
5. Disconnect Run 485 from from Head Coil TR Switch (MG2 A16 A5 J6).
6. Put carriage cover onto a workbench.

6–3 CARRIAGE COVER MODIFICATION

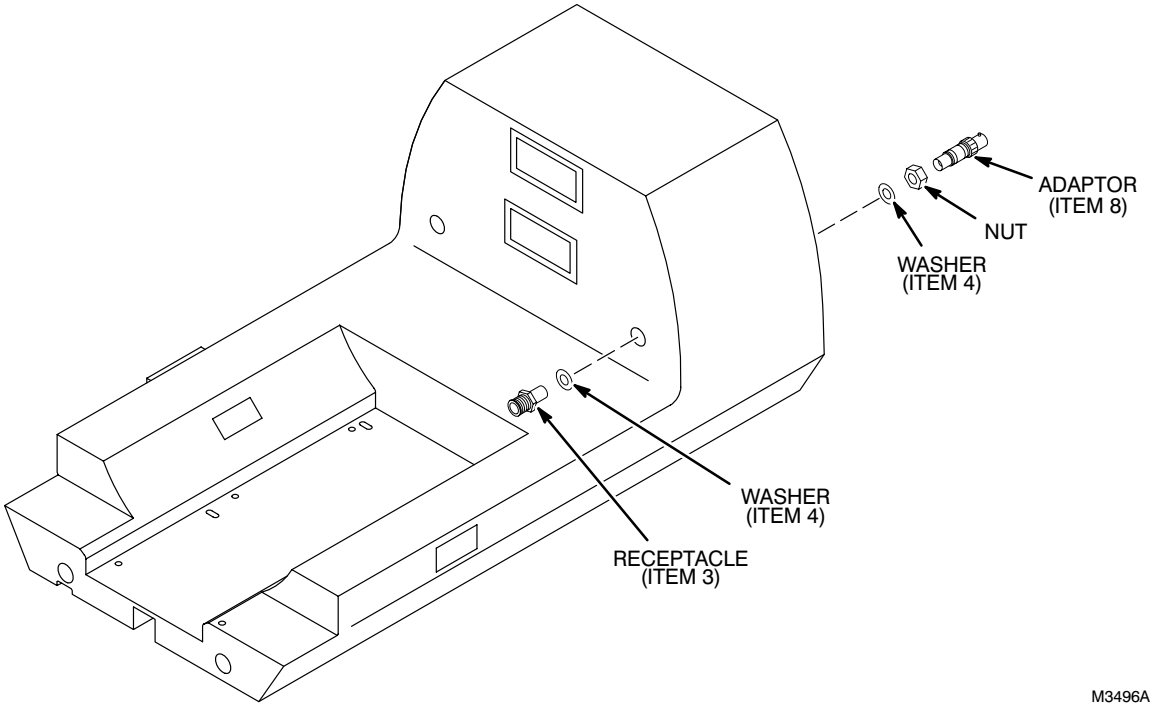
1. Locate holes to drill for J1 and J2 on carriage cover. The centers of these holes are 2.00 in. below and 3.75 in. left and right from lower corners of Multicoil port opening. Refer to Illustration 6–1.
2. Drill two 3/8 in. holes in carriage cover as located in step 1.
3. Use a permanent marking pen to label holes J1 (Transmit) and J2 (Receive) on inside of carriage cover. Refer to Illustration 6–1.



DRILL TEMPLATE FOR CARRIAGE COVER
ILLUSTRATION 6–1

6–3 CARRIAGE COVER MODIFICATION (Continued)

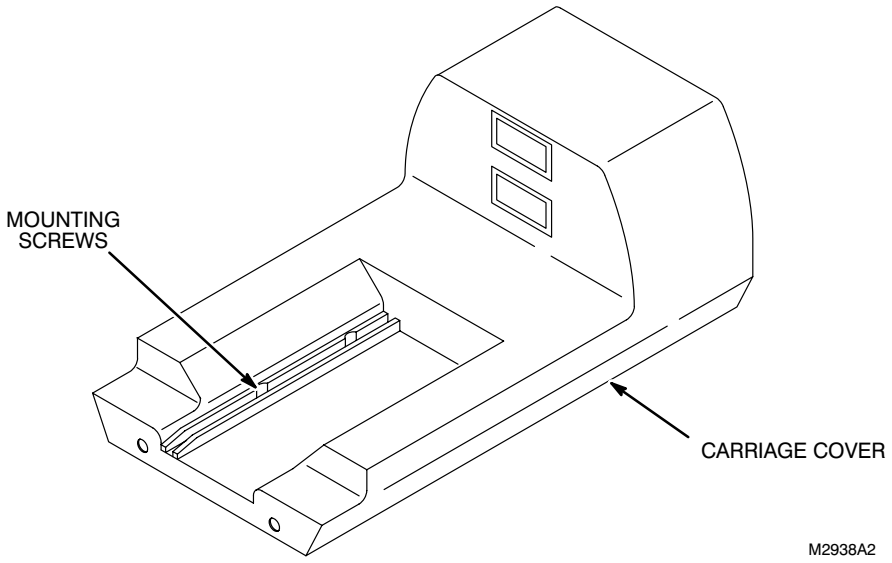
4. Remove nut from each Lemo receptacle (item 3).
5. Install washer (item 4) onto each receptacle.
6. Install assembled receptacle through hole J1 of carriage cover, install washer (item 4) and nut onto receptacle, and tighten nut. Refer to Illustration 6–2.
7. Install assembled receptacle through hole J2 of carriage cover, install washer (item 4) and nut onto receptacle, and tighten nut. Refer to Illustration 6–2.
8. Connect adaptor (item 8) onto receptacles J1 and J2. Refer to Illustration 6–2.
9. If present, remove protective covering, used for shipping, from carriage cover.



RECEPTACLE AND ADAPTOR INSTALLATION
ILLUSTRATION 6–2

6–4 CARRIAGE COVER INTERCONNECT

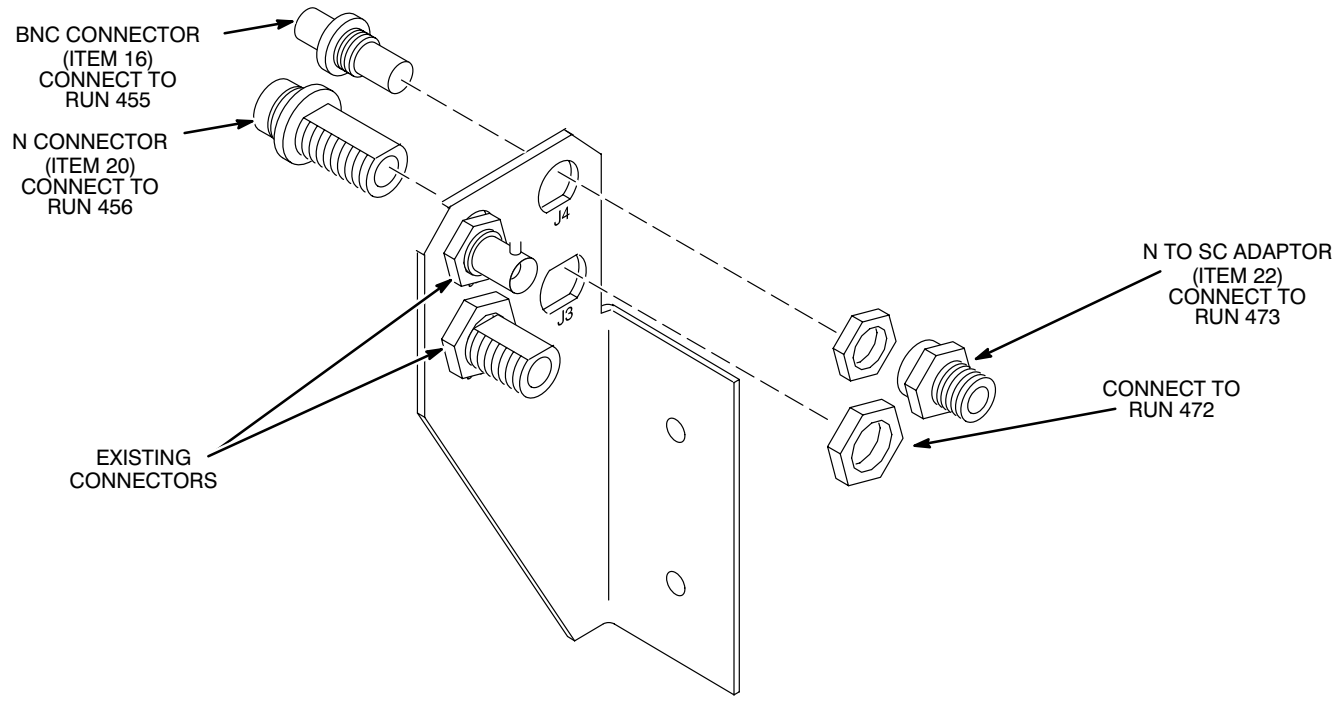
1. Feed new cables, Run 455 (item 10) and Run 456 (item 9) through cable track, down through hole in the bridge, and over to four–cable bracket on rear frame.
2. Turn carriage cover on its side and put onto the carriage.
3. Install cables onto carriage cover as follows:
   a. Install existing Run 403 (46–243775G557) connector (output) to connector (output) of Preamp (A2) in carriage cover.
   b. Install connector J6 of existing Run 485 (46–243775G757) to connector J6 of Head TR Switch (A1) in carriage cover.
   c. Install connector J1 of new Run 456 cable 46–301690G1 (item 9) to connector J1 of adaptor on carriage cover [BB Spectro RF + TR Bias Line].
   d. Install connector J2 of new Run 455 cable 46–243775G708 (item 10) to connector J2 of adaptor on carriage cover [BB Spectro AUX Receive Bias Line].
4. Align holes in front of carriage cover over front stops, slide carriage cover back onto front stops, and lower onto carriage plate.
5. Install four screws and washers onto carriage cover. Tighten screws. Refer to Illustration 6–3.



INSTALLING CARRIAGE COVER
ILLUSTRATION 6–3

6–5 CABLE INTERCONNECTION

1. Install BNC connector (item 16) through hole marked J4 on bracket (MG3 A17), install nut onto connector, and tighten nut.
2. Install “N” connector (item 20) through hole marked J3 on bracket (MG3 A17). Install nut onto connector, and tighten nut.
3. Install “N” to SC adaptor connector (item 22) on rear side of connector installed in step 2.
4. Connect end of Run 456 (marked MG3–A17–J3) to connector J3 on bracket.
5. Connect end of Run 455 (marked MG3–A17–J4) to connector J4 on bracket.



J3 AND J4 CONNECTORS
ILLUSTRATION 6–4

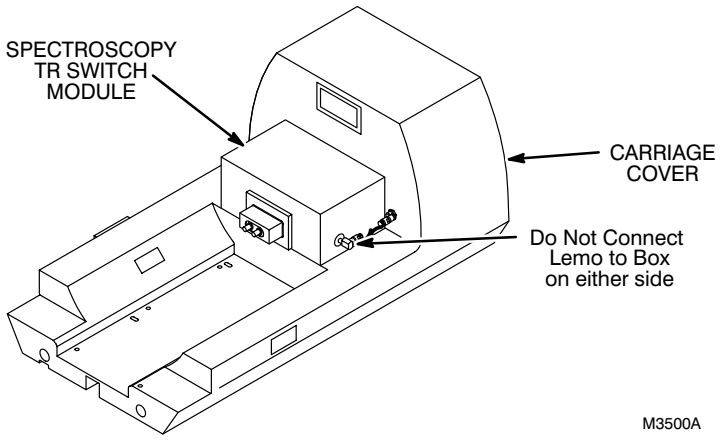
6. Connect previously routed Run 473 from Penetration Panel (PP1–J83) to N to SC Adaptor on J3 of bracket.
7. Connect previously routed Run 472 from Penetration Panel (PP1–J79) to BNC connector on J4 of bracket.

6–6 INSTALLING SPECTROSCOPY TR MODULE

CAUTION

Do not leave the Spectroscopy TR Module connected to any hardware during non–spectroscopy scanning. It has been determined that it is acceptable to perform proton localizer scans with the Spectroscopy TR Module connected due to the short duration of the Proton scan. During normal everyday SIGNA scanning–––it is recommended that the Spectroscopy TR Module be removed or the positive (transmit) bias sent out during non–BroadBand scanning may damage the Spectroscopy TR Switch and make it unusable over time.

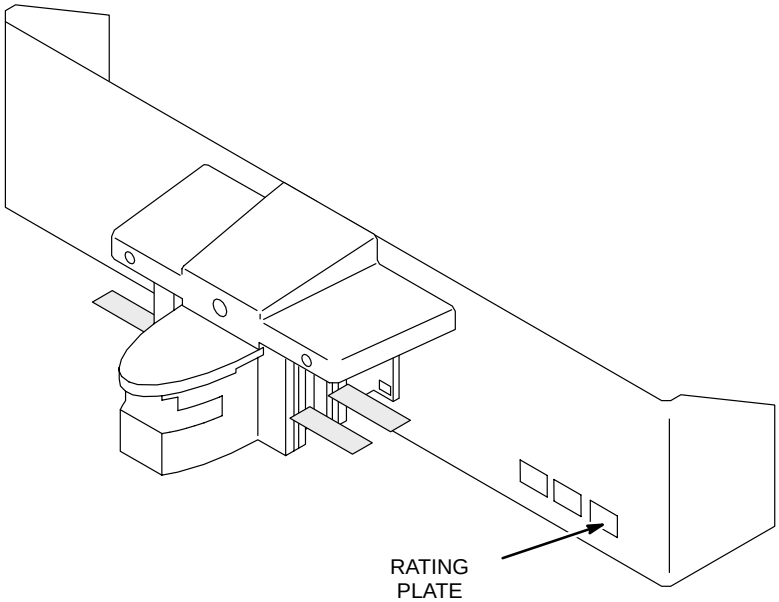
1. Make sure mating Velcro strips are properly aligned on the bottom of Spectroscopy TR Module (A7)(item 5).
2. Remove protective cover from Velcro strips.
3. Place Spectroscopy TR Module (A7) onto carriage cover of Carriage Cover Assembly (A16). Refer to Illustration 6–5.
4. Press down firmly onto Spectroscopy TR Module (A7) to secure Velcro to carriage cover.
5. Procure and install one cable (item 7) to connector J1 on carriage cover, install this side only. **DO NOT install** the connector to the Spectroscopy TR Module (A7). Refer to Illustration 6–5.
6. Procure and install second cable (item 7) to connector J2 on carriage cover, install this side only. **DO NOT install** the connector to the Spectroscopy TR Module. Refer to Illustration 6–5.
7. Install Spectroscopy Surface Coil Quick Disconnect (item 6) into bezel of Spectroscopy TR Module. Refer to Illustration 6–5.



SPECTROSCOPY TR SWITCH MODULE INSTALLATION
ILLUSTRATION 6–5

6–7 INSTALLING RATING PLATE

1. Install rating plate (item 21) on base trim on front of Magnet Enclosure. Refer to Illustration 6–6.



LOCATION OF RATING PLATE
ILLUSTRATION 6–6

SECTION 7 – 5.X SPECIFIC RELATED OPTIONS

Note

This section applies to M1040JB.

For Multi–Nuclear Spectroscopy to be fully operational, install the related options included in Table 7–1.

TABLE 7–1
RELATED OPTIONS

CAT #	SIGNA HORIZON 1.5T (5.5 RELEASE) SYSTEMS	
	NEED?	DOCUMENTED IN:
M1040BH Resistive Shim for GE Magnets	Optional	*Direction 15144, Resistive Shim Option for S1, S11 & S–III Magnets* (Delivered with Option)
M1090PP MRS PHANTOM	Maybe	Customer Catalog: FE can use this for PROBE/SV calibrations and SNR. Research Customers can use this for PROBE/SV Daily Quality Assurance.
M1040BJ SA/GE Software	Not Required	*Direction 15309, Analysis Workstation Software* (Delivered with Catalog Option) [Alternate outside sources are available]
M1040CC, CF ^{31}P Surface Coils	No	Operator Manuals [Alternate outside sources are available] M1040CC=8"T,5"R ^{31}P Surface Coil M1040CF=8"T,3"R ^{31}P Surface Coil DISCONTINUED The GE Service Coil may still be available
M1040HT 5.X Option Key	Yes	*Direction 2124201, MR Release 5.x Signa Service Methods* (CD–ROM) (5.X Specific Option)
M1090MC Additional Magnetic Disk for System Host Computer	Yes	*Direction 15416, Second Disc Drive Option Installation* (5.X Specific Option)
Workstation	Yes, type determined and supplied by customer.	
Peripherals (printer, etc)	Determined and supplied by customer.	

Refer to the Directions listed with each catalog for installation instructions for:

- M1040BH Resistive Shim for GE Magnets
- M1040CC, CF ^{31}P Spectroscopy Surface Coils
- Analysis Workstation and peripherals
- M1040BJ SA/GE software

For your convenience, this section includes installation instructions for (prerequisites) specific 5.X Option installation:

- M1090MC Additional Magnetic Disk
- M1040HT Spectroscopy Option Key (used for PROBE and MNS) and EPROM (used for PROBE)

7–1 M1090MC ADDITIONAL MAGNETIC DISK INSTALLATION

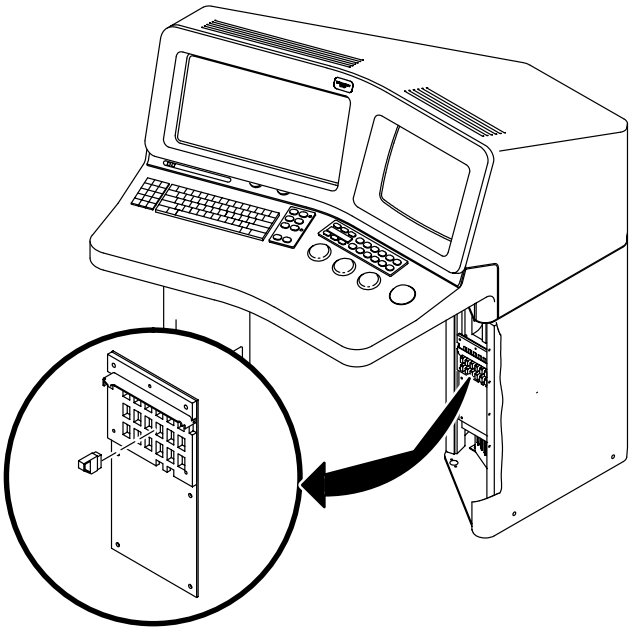
Refer to *Direction 15416, Second Disc Drive Option Installation*, for the procedure to install the second disc drive into the Genesis computer cabinet.

7–2 M1040HT SPECTRO OPTION KEY AND EPROM INSTALLATION

M1040HT includes the Spectroscopy Option Key (317350G1), Spectroscopy specific EPROM and (possibly) a Spectroscopy Surface Coil Quick Disconnect Box (46–282467G4).

7–2–1 SPECTRO OPTION KEY

To install the Spectroscopy Option Key, refer to Illustration 7–1 and Illustration 7–2. Once installed the Option Key is site specific and cannot be moved from one system to another. This key needs to be in place at all times Spectroscopy is to be used. If taken out, Spectroscopy can be reinitialized by bringing the system down, inserting the key and then bringing the system back up again.



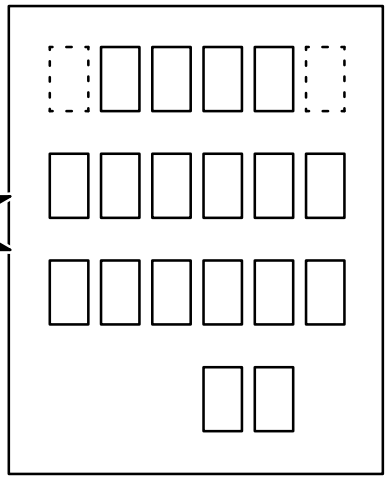
STEP 1
REMOVE FRONT COVER
OF CONSOLE PEDESTAL

STEP 2
LOCATE PROPER KEY SLOT

STEP 3
INSERT KEY INTO SOCKET
PRESS FIRMLY
BUT DO NOT DAMAGE PINS

M3724A

OPTION KEY LOCATION
ILLUSTRATION 7–1



PLACE SPECTRO OPTION KEY IN ANY OF THESE SLOTS IN ROW TWO OR THREE

ROW ONE
SERVICE PERSON KEYS ONLY
TWO OUTSIDE SLOTS
ARE NOT FOR KEYS

ROWS TWO AND THREE
OPTION KEYS (e.g. IVI, CINE)

ROW FOUR
IN–HOUSE SERVICE AND INSITE KEYS

SECURITY BOARD KEY SLOT ASSIGNMENTS
ILLUSTRATION 7–2

7–2–2 SPECTRO EPROM INSTALLATION

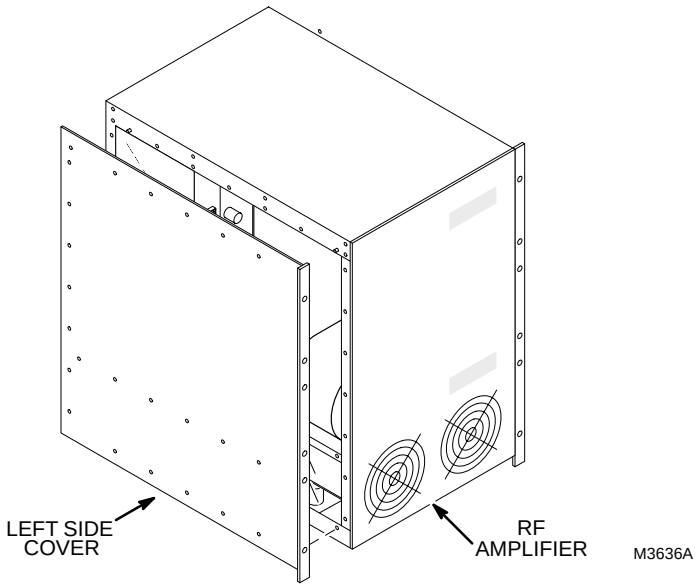
Remove RF Amplifier Covers

1. Verify the anti–tip stabilizer legs are installed on the RF/Pen Cabinet——these will prevent the Cabinet from tipping over.
1. If already ON and connected, turn OFF all RF/Pen Cabinet circuit breakers at rear of cabinet.
2. Disconnect power cable to RF/Pen Cabinet. Perform Lock–out/Tag–out procedures. (Refer to MR CD–ROM *Direction 2124201, MR Release 5.x Signa Service Methods,* navigate to System, SAFETY).
3. Remove RF/Pen Cabinet front door and open rear door.

CAUTION

Personal injury hazard. Cabinet may tip off if anti–tip legs are not in place. Make sure that anti–tip legs are installed before pulling RF Amplifier.

4. Remove securing screws and pull RF Amplifier completely forward.
5. Remove Left Side Cover. See Illustration 7–3.
6. Locate Processor Board in Processor Cavity just behind AC Switching Module (see Illustration 7–5). Place a service cloth, paper or cardboard piece over High Voltage Cavity to catch any hardware that may drop.
7. Push RF Amplifier back into the cabinet.

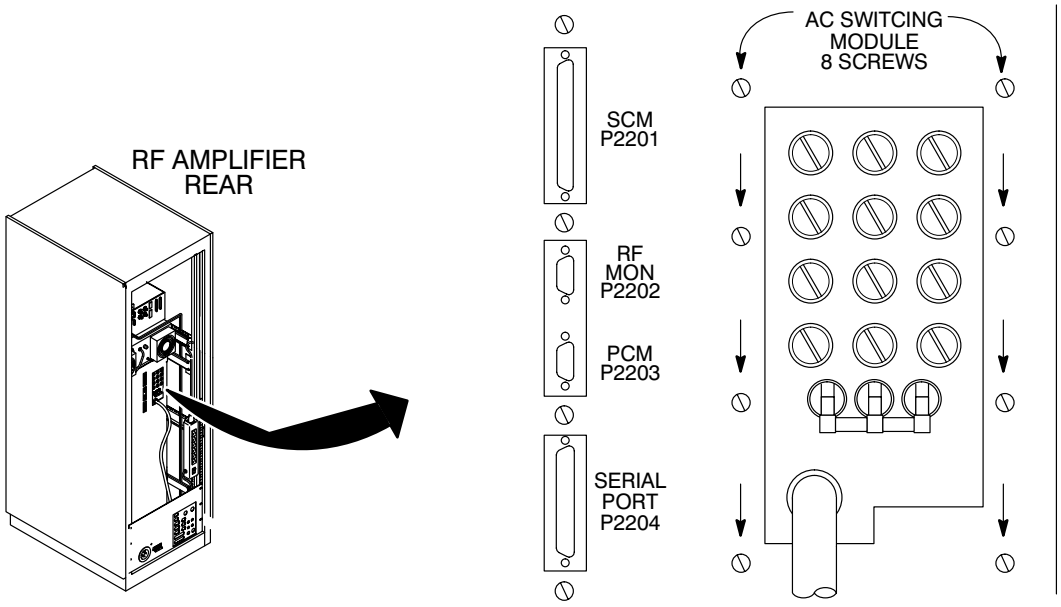


REMOVE RF AMPLIFIER COVERS
ILLUSTRATION 7–3

7–2–2 SPECTRO EPROM INSTALLATION (Continued)

Remove AC Switching Module

1. Remove eight 8–32 x 3/8 screws securing AC Switching Module from outside of rear panel of the RF Amplifier. See Illustration 7–4.

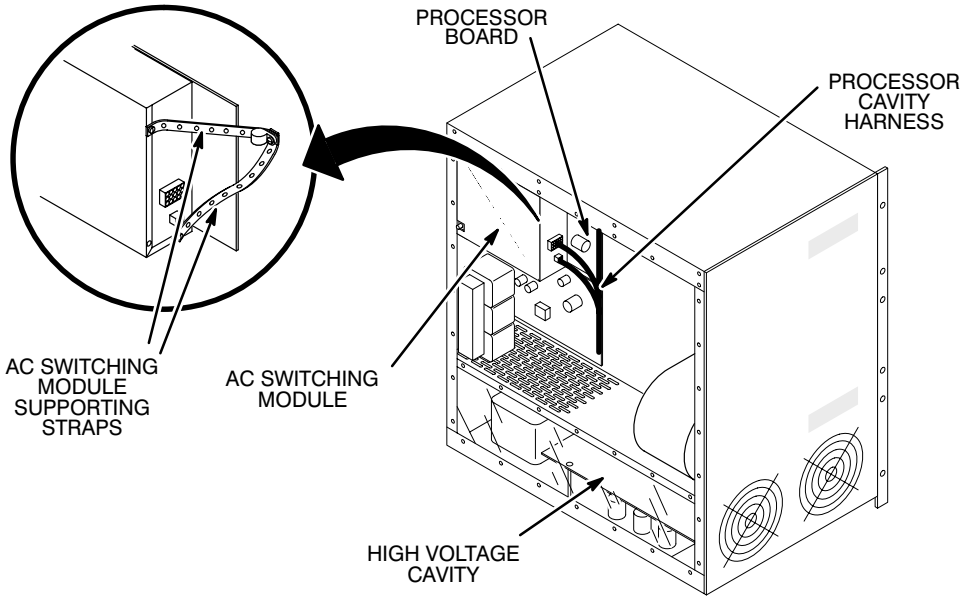


REMOVE SCREWS AND CABLES FROM REAR OF AMPLIFIER
ILLUSTRATION 7–4

2. Pull RF Amplifier completely forward and locate AC Switching Module.

7–2–2 SPECTRO EPROM INSTALLATION (Continued)

3. Support the AC Switching Module with one hand and remove supporting straps from module by removing two screws. See Illustration 7–5.



PROCESSOR AND AC SWITCHING MODULE LOCATION
ILLUSTRATION 7–5

4. Lift up slightly on module and remove it towards front of amplifier to slide off locating stud on rear panel.
5. It may be necessary to disconnect the two Processor Cavity Harness connectors (P2101 and P2102) from AC Switching Module unit by grasping connector, depressing locking tabs, and rocking connector housing while pulling gently. DO NOT PULL WIRES.
6. Feed Power cord through rectangular opening in rear panel and remove AC Switching module. Rest module on the floor.

7–2–2 SPECTRO EPROM INSTALLATION (Continued)

Install EPROM

1. Locate Processor Board (now exposed with AC switching module removed).

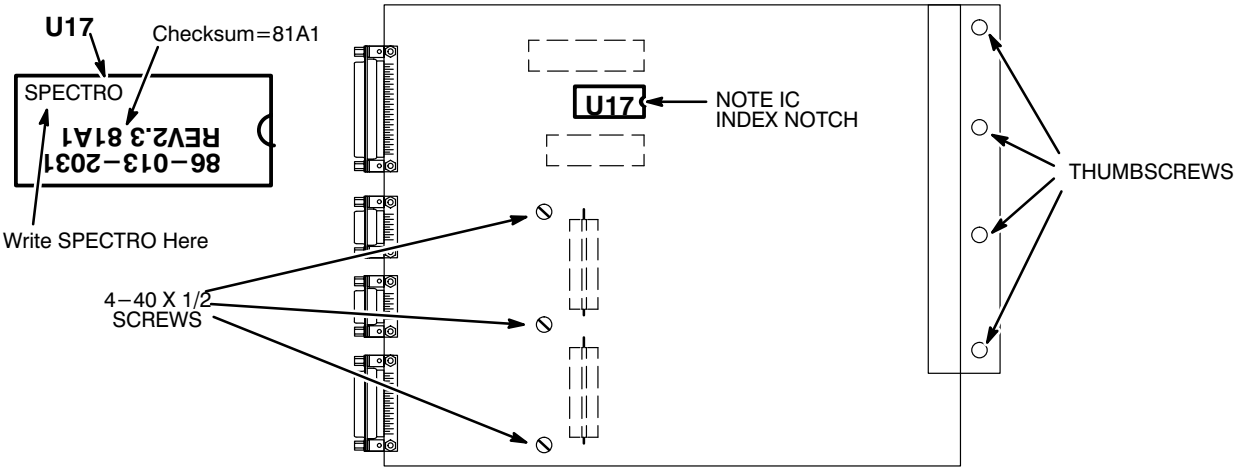
CAUTION

Processor Board and Components are static sensitive. Board components may be damaged if not handled in a static free environment. Take appropriate precautions (e.g. wear properly grounded wrist strap and use a grounding mat) when handling this board.

2. Locate and remove U17 on Processor Board. See Illustration 7–6.
3. Mark the original U17 EPROM as **original** and store it in the static bag supplied for the Proton Spectro EPROM.
4. Note that per Illustration 7–6 the label affixed to the EPROM is usually upside–down. Write the word Spectroscopy on the white label of the new EPROM. Install new EPROM (46–320103P1 from M1040HT kit) at U17 location. See Illustration 7–6. The static bag containing the original U17 EPROM must be marked as **Original Processor Board U17 EPROM** on the outside of the static bag and it should be visablly stored in the MR1 RF/Pen Cabinet by taping the static bag to the front of the Amplifier (usually it is placed near the air intake filter).

Note

This **original** EPROM must be replaced on the Processor Board and Proton Spectro EPROM must be retained if replacing the RF Amplifier or the Processor Board.



EPROM (U17) LOCATION ON PROCESSOR BOARD
ILLUSTRATION 7–6

7–2–2 SPECTRO EPROM INSTALLATION (Continued)

Re–assemble Amplifier

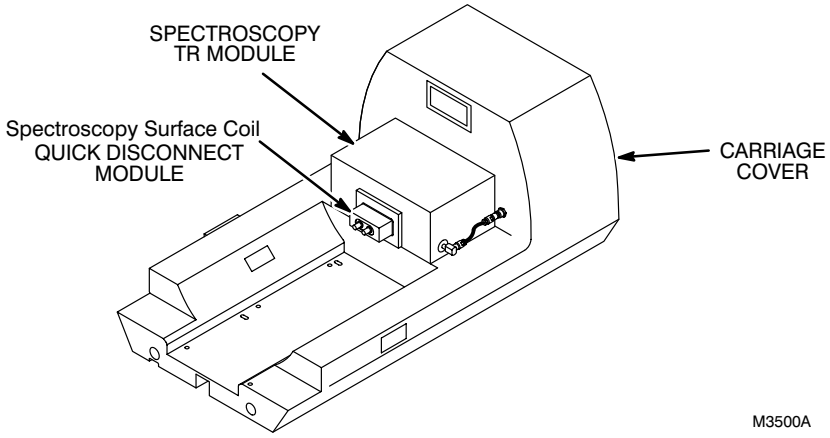
5. Position removed AC Switching Module in Processor Cavity with power cord fed through rectangular opening in rear panel. The DANGER message should be facing out.
6. Locate stud on interior side of rear panel and line it up with hole in module. The stud provides location and support while securing the unit.
7. Support module by fastening straps. See Illustration 7–5.
8. Plug in two connectors (P2102, P2101) from Processor Cavity Harness making certain orientation is correct and pins are properly seated. The connector will click when tabs have fully locked.
9. Push RF Amplifier back into the cabinet.
10. Attach module to rear panel by first loosely securing with eight 8–32 x 3/8 screws. Securely tighten all screws. See Illustration 7–4.
11. Pull RF Amplifier completely forward. Remove service cloth, cardboard or paper used to catch falling hardware.
12. Blow out unit with dry compressed air.
13. Replace left side cover with all screws and tighten properly.

7–2–3 SPECTROSCOPY SURFACE QUICK DISCONNECT MODULE

The quick disconnect module is labeled as Spectroscopy Surface Coil and is used only when scanning Multi–Nuclear Spectroscopy with a Extremity Transmit/Receive Coil. You may have received two of these modules (possibly one from this kit and one from the M1040JB kit or a previous Catalog kit). Use this second module (if received) as a spare. The Spectroscopy Surface Coil Quick Disconnect adaptor is installed in the magnet enclosure carriage cover as shown.

Note

Whenever scanning Proton Spectroscopy with the Head Coil——use the standard Quad Head Coil Quick Disconnect Adaptor Box — Forward or Reverse depending on your system configuration). **DO NOT Use** the Spectroscopy Surface Coil Quick Disconnect Adaptor when performing Proton scanning.



SPECTROSCOPY BOX INSTALLATION
ILLUSTRATION 7–7

SECTION 8 – FINAL PROCEDURES

Note
This section applies to M1040JB and M1090JZ.

8–1 RESTORING POWER

1. Notify field service and other installation personnel that are working at the site that the PDU main disconnect locks and tags will be removed so PDU power can be turned on.
2. Swing left panel closed.
3. Install three screws to secure left front panel to cabinet.
4. Swing right front panel to the closed position.
5. Remove “locks and tags” tag from main disconnect.
6. Restore power to the PDU from main disconnect.
7. Press the FULL ON button on the PDU front control panel. Turn ON circuit breaker on the rear of the RF/Pen Cabinet for the Broadband RF Amplifier, MR1A16. Verify that CB3 at the interface panel is turned on.

8–2 SPECTROSCOPY SOFTWARE AND CONFIGURATION FILE

Software for 1.5T Signa Horizon (5.5 Release) Spectroscopy Option is included in the 5.5 software tapes. The Option Key is used to activate the Spectroscopy Option resident in the load from cold tape.

Complete an entire Load From Cold found in MR CD–ROM *Direction 2124201, MR Release 5.x Signa Service Methods*, navigate to Computer:Set Up and Calibration, LOAD FROM COLD.

Items to pay close attention to while completing the load for Spectroscopy:

1. Reformat disks as a dual disk OC system.
2. When asked if this is a Spectroscopy system, answer **y** (ENTER) for yes.
3. When asked if this is a Broadband Transceiver system, answer **y** (ENTER) for yes.
4. **For 5.5 RF/Pen Cabinet with APB:** The “Amp Cal” values are always “0”.
5. **For 5.5 Release:** The MR Configuration File has several new fields that must be filled in depending on the RF Amplifier and Power Monitor types you have. Refer to MR CD–ROM *Direction 2124201, MR Release 5.x Signa Service Methods,* navigate to System:Set–up & Calibration, CONFIGURATION FILE, for details.
6. Signa must be rebooted after entering configuration file changes.

8–2–1 P31_FLEX COIL MULTI–NUCLEAR SPECTROSCOPY CONFIGURATION FILE MANAGER

1. The Coil Config file will not contain the P31_FLEX MNS coil. Add the coil with the following information:
2. **"Add a Coil"** to create a P31_FLEX Coil. This information is for 8.X release systems. Modify info as required.
   Coil Name =**P31_FLEX**
   CoilType = **3**
   Extremity Coil = **yes**
   Cable Loss = **1.3**
   CoilLoss = **0.032**
   Recon Scale Factor = **1.0**
   Linear vs. Quadrature = **0** (linear)
   Multiple Receiver Coil? = **no**
   Number of Receivers = **0**
   Starting Receiver ID = **0**
   Ending Receiver ID = **0**
   Multi–Coil Port Enable = **0**
   Multi–Coil Port Error Enable = **0**
   Additional transmit attenuation = **0**
   Number of Fast Receivers = **0**
   Starting Fast Receiver ID = **4**
   Ending Fast Receiver ID = **4**
   Fast TG Start TA = **190**
   Fast TG Start RG = **12**
   Multi Coil Recon Enable = **0**
   korecName = (enter a space here if applicable to your software revision)
3. Save all changes before exiting.

Note

The Spectro Option Key should have been previously installed. ONLY sites with an ERBTEC RF Amplifier are required to install the EPROM which allows for increased unblank time (for Hydrogen ONLY Spectroscopy).

4. Signa must be shutdown and rebooted to save any file changes.

8–3 SET UP AND CALIBRATION

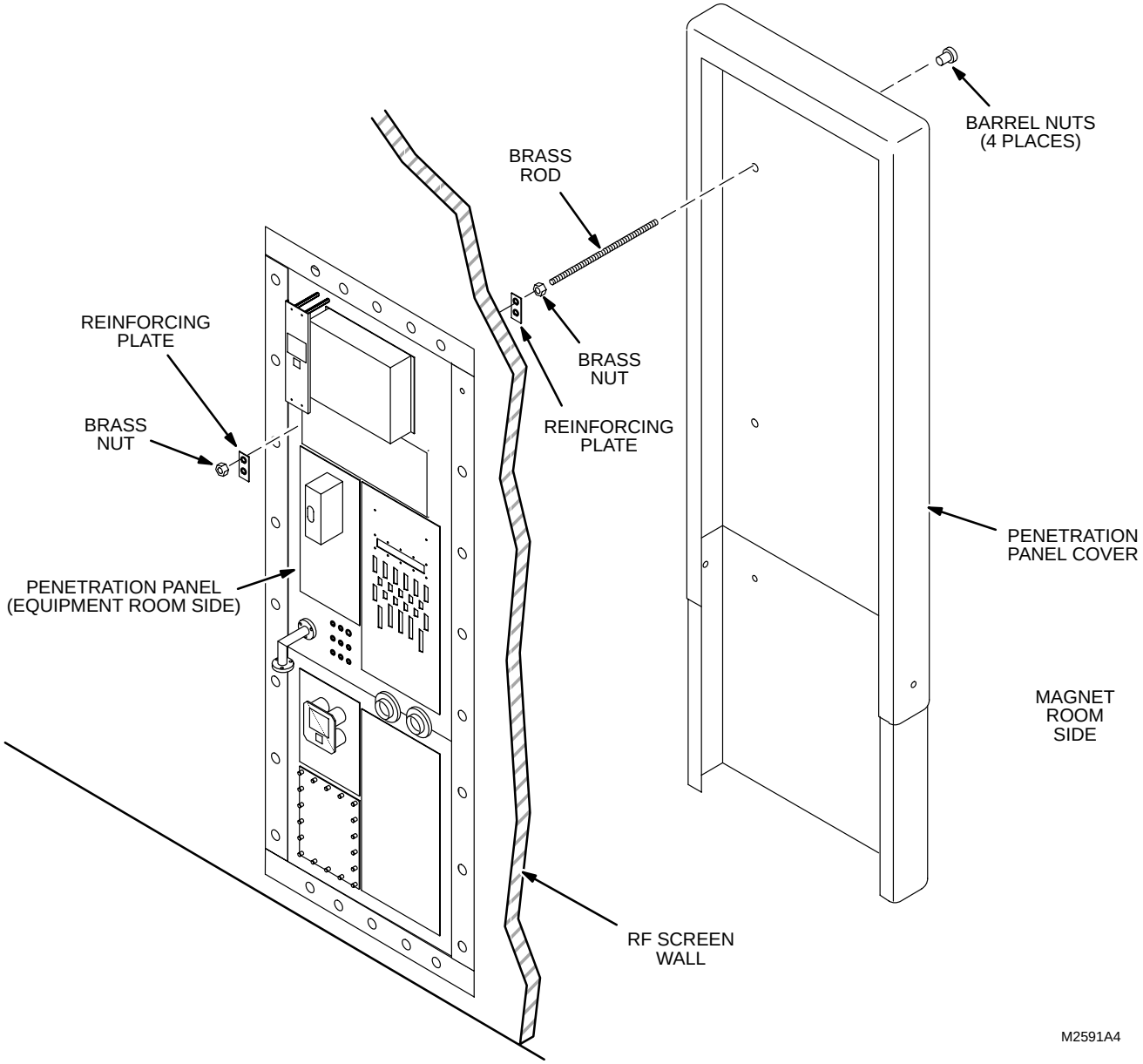
1. Perform procedures in Set Up and Calibration tab.

8–4 FUNCTIONAL CHECKS

1. Perform procedures in Functional Checks tab—Section 1.

8–5 REPLACE COVERS

1. **After all cable installation procedures are completed in magnet and equipment rooms,** install assembled telescoping covers on brass rods and secure with four barrel nuts or replace other customer supplied panel covering. See Illustration 8–1.



INSTALLATION OF PENETRATION PANEL COVER
ILLUSTRATION 8–1

8–5 REPLACE COVERS (Continued)

2. Replace all cabinet covers that have not been previously replaced.
3. Replace Magnet Enclosure covers that have not been previously replaced.
   a Replace Magnet Enclosure side covers.
   b Close front cover and check cable clearance. Position and adjust cables as required. Latch Front cover.
   c Close and latch rear cover.
   d Replace Rear Pedestal covers.

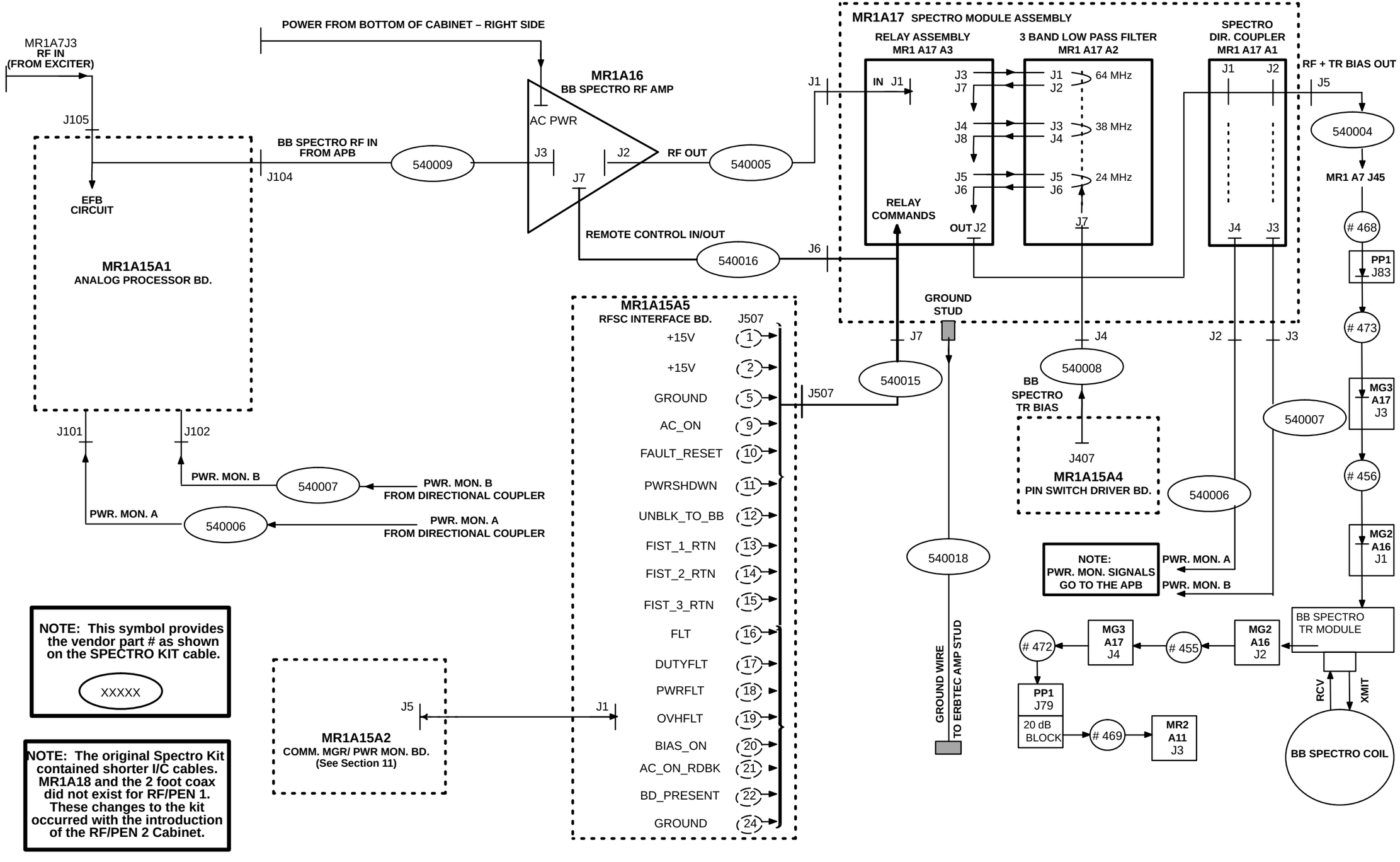
8–6 MATERIAL DISPOSAL GUIDANCE

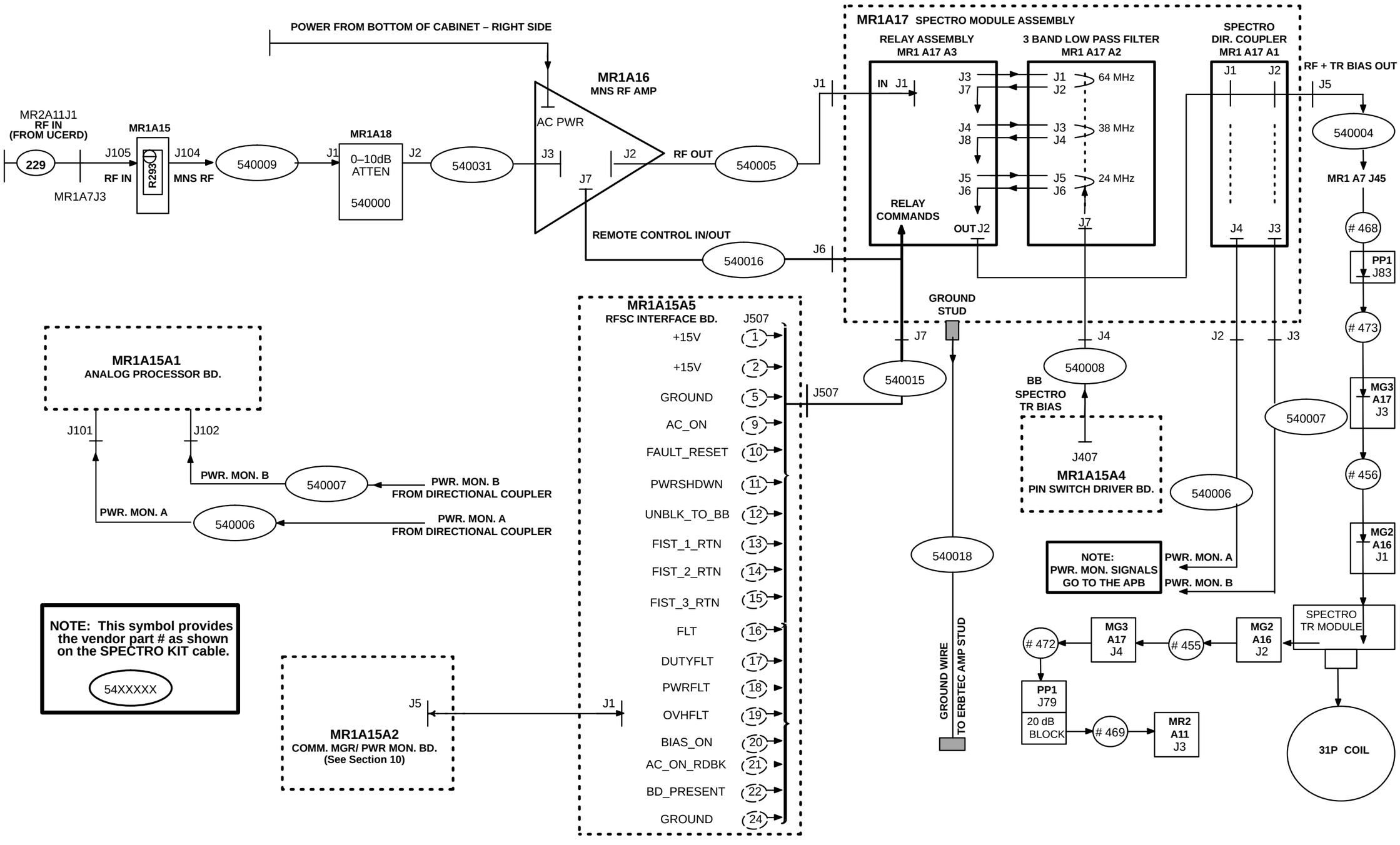
The “Return Pile” consists of items that have a potential value for service of the installed base and the disposition of such must be controlled by GE. Disposition of the return pile is per Medical Systems Marketing and Engineering Policy and Procedures: effective date – July 1, 1990; issued by – VICE PRESIDENT AND GENERAL MANAGER; Subject titled – USED AND REFURBISHED EQUIPMENT. This Policy was distributed to field personnel October 9, 1990 per cover letter signed by Vice President General Manager – Service and Vice President General Manager – Sales.

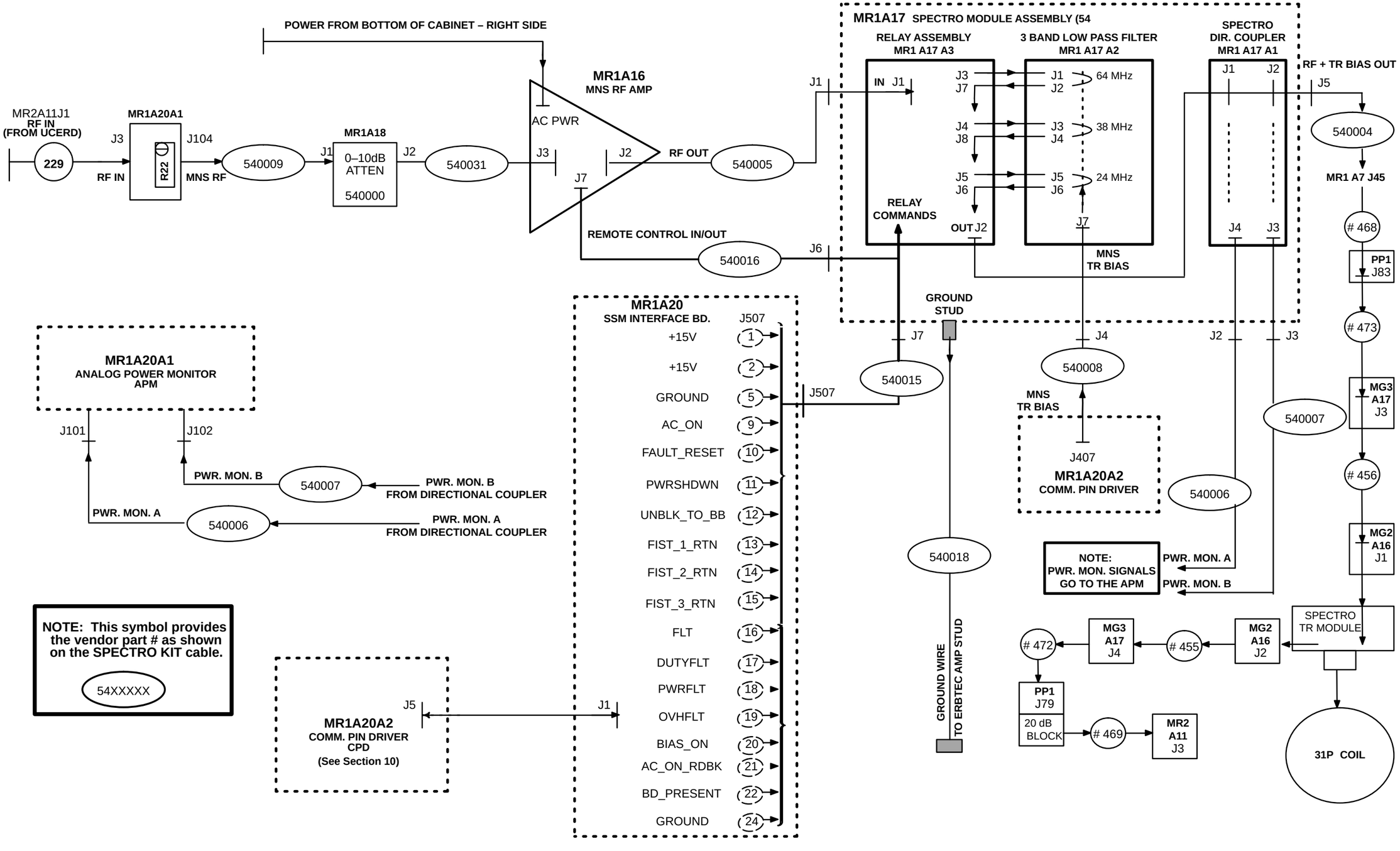
1. For coordination of return pile, refer to above policy “Exhibit A” and contact GEMS Salvage Operation: Phone (414)–747–6997 or (414)–548–2527; Dial Comm 8*320–2527 or 8*579–6997; Fax (414–747–6855); WizMail “SALVAGE”.
2. Disposition of all items in the discard (or recycle) pile per above referenced policy and procedure.

8–7 FINAL COORDINATION

1. Record and enter applicable data into applicable site configuration files and records.


MR1A7J3
RF IN
(FROM EXCITER)
J105
EFB
CIRCUIT
MR1A15A1
ANALOG PROCESSOR BD.
J101
J102
PWR. MON. B
PWR. MON. A
540007
540006
PWR. MON. B
FROM DIRECTIONAL COUPLER
PWR. MON. A
FROM DIRECTIONAL COUPLER
POWER FROM BOTTOM OF CABINET – RIGHT SIDE
BB SPECTRO RF IN
FROM APB
J104
540009
MR1A16
BB SPECTRO RF AMP
AC PWR
J3
J2
RF OUT
540005
J7
REMOTE CONTROL IN/OUT
540016
J6
J1
MR1A17 SPECTRO MODULE ASSEMBLY
RELAY ASSEMBLY
MR1 A17 A3
3 BAND LOW PASS FILTER
MR1 A17 A2
SPECTRO
DIR. COUPLER
MR1 A17 A1
IN J1
J3
J7
J4
J8
J5
J6
OUT J2
J1
J2
64 MHz
J3
J4
38 MHz
J5
J6
24 MHz
J7
J1
J2
J4
J3
RF + TR BIAS OUT
J5
RELAY
COMMANDS
GROUND
STUD
MR1A15A5
RFSC INTERFACE BD.
J507
+15V
+15V
GROUND
AC_ON
FAULT_RESET
PWRSHDWN
UNBLK_TO_BB
FIST_1_RTN
FIST_2_RTN
FIST_3_RTN
FLT
DUTYFLT
PWRFLT
OVHFLT
BIAS_ON
AC_ON_RDBK
BD_PRESENT
GROUND
1
2
5
9
10
11
12
13
14
15
16
17
18
19
20
21
22
24
J507
540015
J7
J4
J2
J3
540008
BB
SPECTRO
TR BIAS
J407
MR1A15A4
PIN SWITCH DRIVER BD.
540004
MR1 A7 J45
468
PP1
J83
473
MG3
A17
J3
540007
456
MG2
A16
J1
540006
540018
GROUND WIRE
TO ERBTEC AMP STUD
NOTE:
PWR. MON. SIGNALS
GO TO THE APB
PWR. MON. A
PWR. MON. B
472
MG3
A17
J4
455
MG2
A16
J2
BB SPECTRO
TR MODULE
RCV
XMIT
PP1
J79
20 dB
BLOCK
469
MR2
A11
J3
BB SPECTRO COIL
J5
J1
MR1A15A2
COMM. MGR/ PWR MON. BD.
(See Section 11)
NOTE: This symbol provides the vendor part # as shown on the SPECTRO KIT cable.
XXXXX
NOTE: The original Spectro Kit contained shorter I/C cables. MR1A18 and the 2 foot coax did not exist for RF/PEN 1. These changes to the kit occurred with the introduction of the RF/PEN 2 Cabinet.


POWER FROM BOTTOM OF CABINET – RIGHT SIDE
MR1A16
MNS RF AMP
AC PWR
MR2A11J1
RF IN
(FROM UCERD)
229
MR1A15
J105
RF IN
R293
J104
MNS RF
MR1A7J3
540009
MR1A18
J1
0–10dB
ATTEN
540000
J2
540031
J3
J7
J2
RF OUT
540005
J1
MR1A17 SPECTRO MODULE ASSEMBLY
RELAY ASSEMBLY
MR1 A17 A3
3 BAND LOW PASS FILTER
MR1 A17 A2
SPECTRO
DIR. COUPLER
MR1 A17 A1
IN J1
J3
J7
J1
J2
64 MHz
J4
J8
J3
J4
38 MHz
J5
J6
J5
J6
24 MHz
RELAY
COMMANDS
OUT J2
J7
J1
J2
RF + TR BIAS OUT
J5
540004
MR1 A7 J45
468
PP1
J83
473
MG3
A17
J3
REMOTE CONTROL IN/OUT
540016
J6
MR1A15A5
RFSC INTERFACE BD.
J507
+15V
1
+15V
2
GROUND
5
AC_ON
9
FAULT_RESET
10
PWRSHDWN
11
UNBLK_TO_BB
12
FIST_1_RTN
13
FIST_2_RTN
14
FIST_3_RTN
15
FLT
16
DUTYFLT
17
PWRFLT
18
OVHFLT
19
BIAS_ON
20
AC_ON_RDBK
21
BD_PRESENT
22
GROUND
24
J507
540015
GROUND
STUD
J7
J4
J2
J3
540008
BB
SPECTRO
TR BIAS
J407
MR1A15A4
PIN SWITCH DRIVER BD.
540007
MG3
A17
J3
456
540006
MG2
A16
J1
MR1A15A1
ANALOG PROCESSOR BD.
J101
J102
PWR. MON. B
540007
PWR. MON. B
FROM DIRECTIONAL COUPLER
PWR. MON. A
540006
PWR. MON. A
FROM DIRECTIONAL COUPLER
NOTE: This symbol provides the vendor part # as shown on the SPECTRO KIT cable.
54XXXXX
J5
J1
MR1A15A2
COMM. MGR/ PWR MON. BD.
(See Section 10)
540018
GROUND WIRE
TO ERBTEC AMP STUD
NOTE:
PWR. MON. SIGNALS
GO TO THE APB
PWR. MON. A
PWR. MON. B
SPECTRO
TR MODULE
472
MG3
A17
J4
455
MG2
A16
J2
PP1
J79
20 dB
BLOCK
469
MR2
A11
J3
31P COIL


POWER FROM BOTTOM OF CABINET – RIGHT SIDE
MR1A16
MNS RF AMP
AC PWR
J3
J2
RF OUT
540005
J1
J7
REMOTE CONTROL IN/OUT
540016
J6
MR2A11J1
RF IN
(FROM UCERD)
229
MR1A20A1
J3
RF IN
R22
MNS RF
J104
540009
MR1A18
J1
0–10dB
ATTEN
540000
J2
540031
MR1A17 SPECTRO MODULE ASSEMBLY (54
RELAY ASSEMBLY
MR1 A17 A3
3 BAND LOW PASS FILTER
MR1 A17 A2
SPECTRO
DIR. COUPLER
MR1 A17 A1
IN J1
J3
J7
J4
J8
J5
J6
OUT J2
J1
J2
64 MHz
J3
J4
38 MHz
J5
J6
24 MHz
J7
RELAY
COMMANDS
MNS
TR BIAS
J1
J2
J5
RF + TR BIAS OUT
540004
MR1 A7 J45
468
PP1
J83
473
MG3
A17
J3
456
MG2
A16
J1
J4
J3
J2
J3
540007
MR1A20
SSM INTERFACE BD.
J507
+15V
+15V
GROUND
AC_ON
FAULT_RESET
PWRSHDWN
UNBLK_TO_BB
FIST_1_RTN
FIST_2_RTN
FIST_3_RTN
FLT
DUTYFLT
PWRFLT
OVHFLT
BIAS_ON
AC_ON_RDBK
BD_PRESENT
GROUND
1
2
5
9
10
11
12
13
14
15
16
17
18
19
20
21
22
24
J507
GROUND
STUD
J7
540015
J4
540008
MNS
TR BIAS
J407
MR1A20A2
COMM. PIN DRIVER
540006
MR1A20A1
ANALOG POWER MONITOR
APM
J101
J102
PWR. MON. B
540007
PWR. MON. B
FROM DIRECTIONAL COUPLER
PWR. MON. A
540006
PWR. MON. A
FROM DIRECTIONAL COUPLER
NOTE: This symbol provides the vendor part # as shown on the SPECTRO KIT cable.
54XXXXX
MR1A20A2
COMM. PIN DRIVER
CPD
(See Section 10)
J5
J1
540018
GROUND WIRE
TO ERBTEC AMP STUD
NOTE:
PWR. MON. SIGNALS
GO TO THE APM
PWR. MON. A
PWR. MON. B
472
MG3
A17
J4
455
MG2
A16
J2
SPECTRO
TR MODULE
PP1
J79
20 dB
BLOCK
469
MR2
A11
J3
31P COIL

SECTION 1 – BROADBAND AND NARROWBAND RF/PEN CABINET

Note

This Service Manual does not contain PROBE Spectroscopy specific information. The term Spectro or Spectroscopy as used throughout this manual refers to Multi–Nuclear Spectroscopy unless otherwise noted.

Note

The following descriptions apply to M1040JB/M1090JZ (5.5 Release) Hardware. This Multi–Nuclear Spectroscopy hardware is located in the RF/PEN Cabinet.

Note

The term **WRT** used means with respect to or with reference to.

Note

The term **MNS** refers to Multi–Nuclear Spectroscopy. MNS is the same as BroadBand (BB) Spectroscopy. These terms will be used throughout this Service Manual.

Note

M1040HT includes a Spectro Option Key—this is required to perform PROBE and MNS Spectroscopy. The key is discussed in the Installation Section of this manual and is labeled 46–317350G1. Also included is the Spectroscopy EPROM (for PROBE/SV).

1–1 DESCRIPTION

- **Planned Maintenance: Perform RF and Power Monitor Checks when required.**

This section describes how to adjust (M1040JB/M1090JZ Only):

- Phosphorus (^{31}P) Multi–Nuclear Spectroscopy Surface Coil Verification.
- Visually verify RUN 455, Receive cable, is properly routed and mark cable as RCV. Visually verify RUN 456, Transmit cable, is properly routed and mark cable as XMIT.
- **RF/Pen Cabinet 1:** Voltage, Current,and Threshold adjustment of the Spectroscopy PIN Switch TR Driver Circuit (Dynamic Mode) located in the RFSC.
- **RF/Pen Cabinet 2:** Voltage adjustment of the Spectroscopy TR Driver Circuit (Dynamic Mode) located in the SSM.
- Spectroscopy RF Output of the MNS Exciter (with BroadBand Module) to specified Power level.
- Output of the MNS RF Amplifier Heliax Cable to specified Power level.
- **RF/Pen Cabinet 1:** Set Up of Analog Processor Board (APB) so the Communication Manager/Power Monitor Board (CM/PM) trips for MNS frequencies.
- **RF/Pen Cabinet 2:** Set Up of Analog Power Monitor (APM) so the Communication PIN Driver Board (CPD) trips for MNS frequencies.

1–2 (^{31}P) MULTI–NUCLEAR SPECTROSCOPY SURFACE COIL VERIFICATION

This procedure will:

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

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 in the Field Environment.

Note

The following checks cannot verify the prototype (^{31}P) GP Phosphorus Flex Coil (941203–##) or any Flex coil.

1. Use ohmmeter 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).

1–3 MNS CABLE VERIFICATION / LABELING IN CARRIAGE ASSEMBLY

- Procure cable label markers or tape to visually identify the 2 (two) separate cable take–up coaxial cables used for Multi–Nuclear Spectroscopy.

1. Visually verify that RUN 455 (MNS Receive Signal / Receive Bias) is connected to the right side of the Carriage Assembly as viewed from the rear of the magnet.
2. Place a piece of tape or cable marker on this cable identifying it as “MNS Receive Signal / Receive Bias” or **“RCV”**. This is for future reference and trouble–shooting.
3. Visually verify that RUN 456 (MNS RF OUT + TR BIAS) is connected to the left side of the Carriage Assembly as viewed from the rear of the magnet.
4. Place a piece of tape or cable marker on this cable identifying it as “MNS RF OUT + TR BIAS” or **“XMIT”**. This is for future reference and trouble–shooting.

1–4 INITIAL (5.5 Release) (^{31}P) MULTI–NUCLEAR SPECTROSCOPY SCAN PREPARATION

1. Install the Spectroscopy TR Module and connect to Carriage Assembly.
   DO NOT Connect RF Out + TR Bias cable to Carriage Assembly per Illustration 1–1.

   - **RF/Pen 1 Cabinet ONLY:**

   - Verify JP87 on PIN Switch Driver Board to Position “Normal Mode A” (Software Control Mode).
   - Place the CM/PM Board power monitor jumpers in the JP2 and JP6 into position B (service/bypass mode).
   - Place MR1 A15 SW2 located on the front of the RFSC Module to TR–DD Faults Disable “ON” (service/bypass mode).
   - The RFSC may contain an interlock switch that will need to be defeated by lifting/pulling to the full–up position.

   - **RF/Pen 2 Cabinet ONLY:**

   - Place the rocker switch labeled “TR” located on the front of the System Support Module (SSM) to “DIS” or the TR Fault Disable Mode (TR service/bypass mode).
   - At the front panel of the SSM place the Power Monitor A and B rocker switches in the “BYPASS” Mode.
   - The System Support Module, APM and CPD Boards, must meet the minimum revision level when used with Multi–Nuclear Spectroscopy. Currently the minimum Circuit Board revisions are located in the Trouble–Shooting Section.

Note

Three (3) microprocessors in the SSM may need to be replaced.
After replacement mark new revisions on the APM and CPD Boards.

2. Set up scan using protocol in Table 1–1.
3. Landmark on Head area of cradle (no coil or phantom needed at this time).
4. Set the TG to 0 (zero).

Note

The MNS scan protocol must be pulsed once to activate the Multi–Nuclear Spectroscopy circuitry:
This activates the AUX Receive Bias to the 20 dB Gain Block and Spectro Preamp.
This selects the proper relay and provides a path in the Spectro Module Assembly.

CAUTION

The Analogic Amplifier must have the POWER and READY LED’s located on the front panel illuminated.

The ENI Amplifier must have its POWER and GATING BUTTONS located on the front panel in the out position (under remote/system control).

1–4 INITIAL (5.5 Release) (^{31}P) MULTI–NUCLEAR SPECTROSCOPY SCAN PREPARATION (Continued)

TABLE 1–1

HORIZON SCAN PRESCRIPTION FOR (^{31}P) MULTI–NUCLEAR SPECTROSCOPY SET–UP and CAL ADJUSTMENTS

SCAN PROTOCOL (5.5 RELEASE)

MAIN MENU

[New Series]

PATIENT/EXAM INFORMATION

Id: **geservice**
Name:
Patient Weight **300 < IMPORTANT!!**
[Patient Position]

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]**
Imaging Options **[Extended Dyn Rang]**
or enter PSD Filename **fidcsi**
[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) **[Other] 600** msec
[Scan Set–Up]

SCAN SET–UP

Prescan Options None *if applicable*
Auto CF **[Water]**
[Scanning Range]

SCANNING RANGE

Field of View **[48 cm]** ——work around
Scan Thickness **[30 mm]**——work around
Interscan Spacing **[Other] 0**
Start Loc (I/S): **0**
End Loc (I/S): **0**
No. of Scan Locations: 1
FOV Center (L/R): 0 (P/A): 0

ACQ TIME

Acq Freq **256**
Acq Phase **192**
Freq Dir S/I
Nex **2**
Contrast **No**
Table Delta **0**
[Scan Ops]

[MODIFY CVs]
squeeze New Value: **0**
[BACKUP]

[Review Screen]
Field of View **[24 cm]**
Scan Thickness **[10 mm]**
[ACCEPT]

Select Soft Key **[Spectro]**

SPECTROSCOPY

Use AX to set the ^{31}P frequency (~25.85 MHz)
Type **R1 7 R2 30 TG 0** press **ENTER**

[MODIFY CVs]
Change the following CVs:
Type **dda** New Value: **10**
Type **ia_rf1** New Value: **32766**
Type **pibbandfilt** New Value:**1**
Type **spec_cal** New Value**:1**
[BACKUP]

Set Entry Point, type: **ent single1**

Note

Table 1–1 contains a software bug workaround for gradient and thickness too small messages. FOV is always set at 24 cm and Scan Thickness is always set at 10 mm for test purposes.

1–4 INITIAL (5.5 Release) (^{31}P) MULTI–NUCLEAR SPECTROSCOPY SCAN PREPARATION (Continued)

TABLE 1–1
HORIZON SCAN PRESCRIPTION FOR (^{31}P) MULTI–NUCLEAR SPECTROSCOPY SET–UP and CAL ADJUSTMENTS

SCAN PROTOCOL (5.5 RELEASE) with Phosphorus Flex Coil

MAIN MENU

[New Series]

PATIENT/EXAM INFORMATION

Id: **geservice**
Name:
Patient Weight **300 < IMPORTANT!!**
[Patient Position]

PATIENT POSITION

Patient Entry **[Head First]**
Patient Position **[Supine]**
Axial/Sag. Landmark **[Nasion]**
Coil Type **[Other Coils]**
Other Coils Selection screen appears
[P31_Flex]
[Backup]
Scan Plane **[Axial]**
[Imaging Params]

IMAGING PARAMETERS

Image Mode **[Spectro]**
(⋆ SAR must be "On" ⋆) **[Monitor SAR]**
Pulse Sequence **[SPIN Echo]**
Imaging Options **[Extended Dyn Rang]**
or enter PSD Filename **fidcsi**
[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) **[Other] 600** msec
[Scan Set–Up]

SCAN SET–UP

Prescan Options None *if applicable*
Auto CF **[Water]**
[Scanning Range]

SCANNING RANGE

Field of View **[48 cm]**——work around
Scan Thickness **[30 mm]**——work around
Interscan Spacing **[Other] 0**
Start Loc (I/S): **0**
End Loc (I/S): **0**
No. of Scan Locations: 1
FOV Center (L/R): 0 (P/A): 0

ACQ TIME

Acq Freq **256**
Acq Phase **192**
Freq Dir R/L
Nex **2**
Contrast **No**
Table Delta **0**
[Scan Ops]

[MODIFY CVs]
squeeze New Value: **0**
[BACKUP]

[Review Screen]
Field of View **[24 cm]**
Scan Thickness **[10 mm]**
[ACCEPT]

Select Soft Key **[Spectro]**

SPECTROSCOPY

Use AX to set the ^{31}P frequency (~25.85 MHz)
Type **R1 7 R2 30 TG 0** press **ENTER**

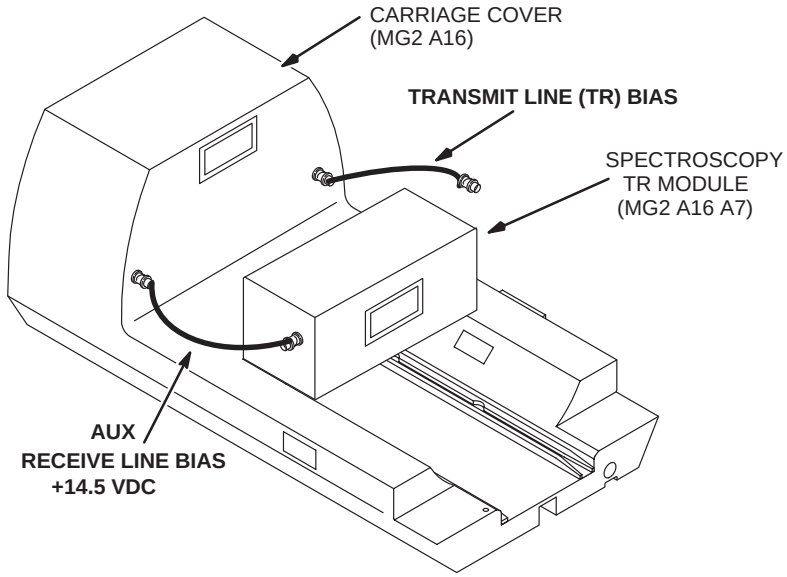
[MODIFY CVs]
Change the following CVs:
Type **dda** New Value: **10**
Type **ia_rf1** New Value: **32766**
Type **pibbandfilt** New Value:**1**
Type **spec_cal** New Value**:1**
[BACKUP]

Set Entry Point, type: **ent single1**

Note

Table 1–1 contains a software bug workaround for gradient and thickness too small messages. FOV is always set at 24 cm and Scan Thickness is always set at 10 mm for test purposes.

1–4 INITIAL (5.5 Release) (^{31}P) MULTI–NUCLEAR SPECTROSCOPY SCAN PREPARATION (Continued)



MULTI–NUCLEAR SPECTROSCOPY HARDWARE SET–UP
ILLUSTRATION 1–1

1–5 RF/PEN 1 CABINET SECTION ONLY

SPECTROSCOPY TR DRIVER CIRCUIT ADJUSTMENTS ––– DYNAMIC STATE

This section calibrates the Spectroscopy TR Driver Circuits to eliminate Multi–Nuclear Spectroscopy TR errors which occur only during Multi–Nuclear Spectroscopy scanning. To complete this section, you will perform the following:

- Dynamic State TP21 (voltage), TP18 (current), TP19 (threshold) Adjustment and Verification.

1–5–1 Initial Set Up

- Setup Initial Multi–Nuclear Spectroscopy Scan Preparation per Section 1–4.
- Set–up an oscilloscope to 1 Meg Ω termination when measuring TR and Power Monitor Signals. Set–up an oscilloscope to 50 Ω termination when measuring any RF Signal.

1–5–2 Dynamic State TP21, TP18, TP19 Adjustment and Verification

1. At “Scan Operation” screen, press **[Spectro Prescan]**.
2. Press **[Start Single]**.
3. Monitor the Spectro TR PIN Switch Driver test points TP18, TP21, and TP19.
4. Set the positive output voltage level at TP21 by adjusting R18 to +4.3 Volts as shown in Illustration 1–2 (typically this is factory set to +4.0 or +6.0 VDC). When the Spectroscopy TR Module is connected (loaded) this 4.3 value will drop and will require re–adjustment.
5. Verify TP18 (current output value) positive output level is close to, or greater than, the value in Illustration 1–3. [(TP18 divided by 101.2) divided by .10 = current]
   or
   14.5 VDC (per the Illustration) divided by 10.12 = 1.432 Amps. 1.4 Amps is the minimum.

6. Verify TP19 (threshold error detection value) is at +5 Volts as shown in Illustration 1–4 (no adjustment).

Note

When TP21 voltage setting is increased/decreased the current output value at TP18 will also increase/decrease.

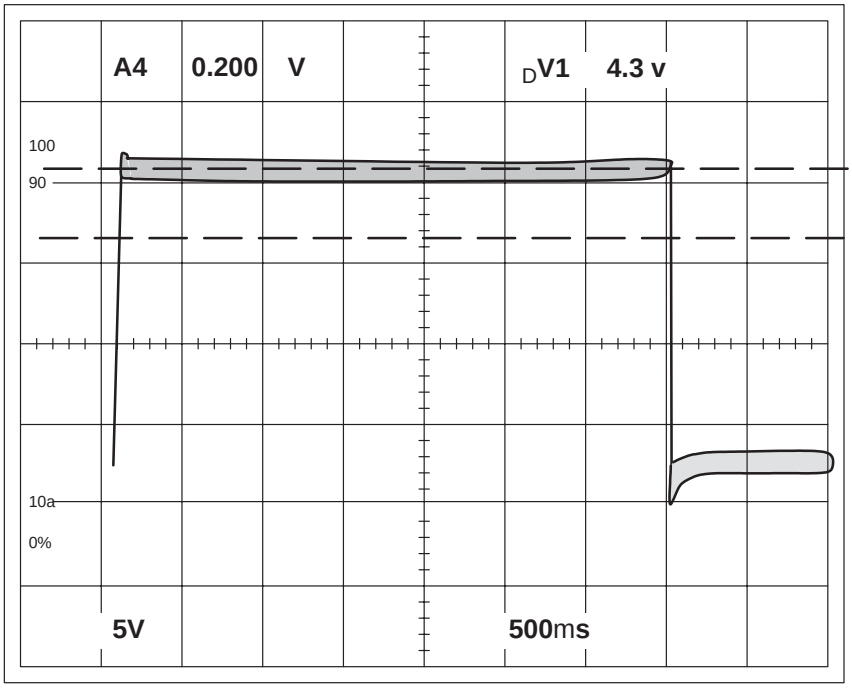
Note

The waveforms shown are worst case and may not represent those displayed on your system. Waveforms should ideally be clean and square.

Note

The measurements should be taken in near the middle to the end of the positive transmit pulse.

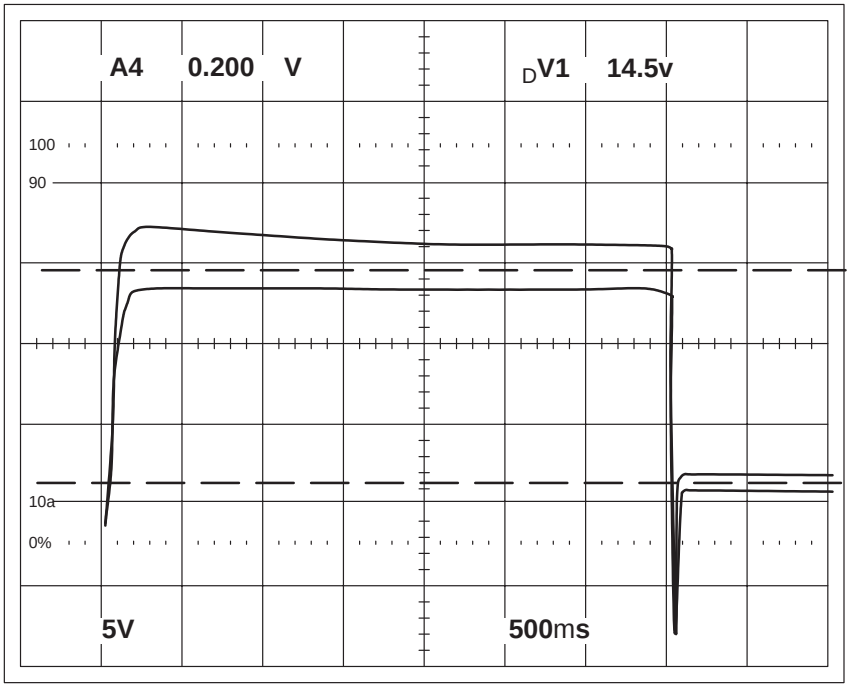
1–5–2 Dynamic State TP21, TP18, TP19 Adjustment and Verification (Continued)



USE R18 TO ADJUST THE POSITIVE VOLTAGE LEVEL

GROUND REF

SPECTRO PIN SWITCH DRIVER TR OUTPUT VOLTAGE (TP21)
ILLUSTRATION 1–2

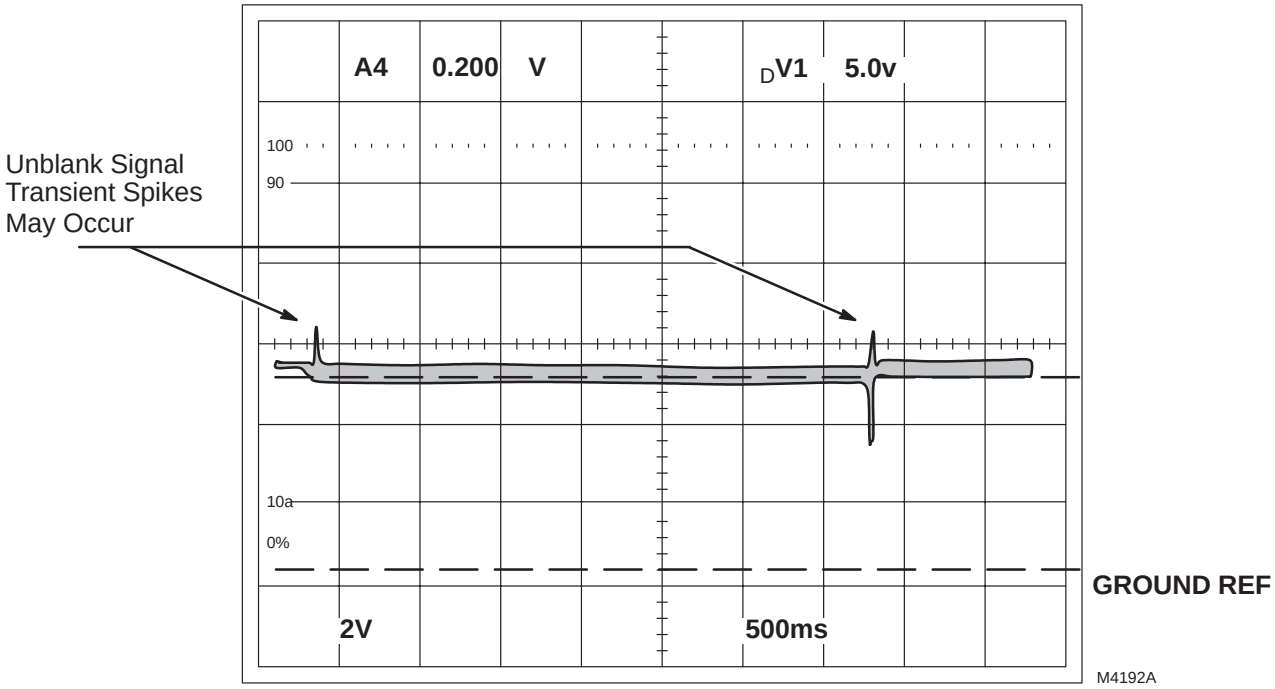


THE CURRENT WAVEFORM IS AFFECTED BY THE LOAD AND ADJUST-ING R18

GROUND REF

SPECTRO TR DRIVER CURRENT EQUIVALENT VOLTAGE DIVIDED BY 10 (TP18)
ILLUSTRATION 1–3

1–5–2 Dynamic State TP21, TP18, TP19 Adjustment and Verification (Continued)



SPECTRO TR THRESHOLD ERROR DETECTION (TP19)
ILLUSTRATION 1–4

7. When adjustments are completed, press **[Stop]** to stop the Prescan.
8. Place the following switch located on the front of the RFSC Module in the correct position:
   - MR1 A15 SW2 – TR–DD Faults Disable "OFF" (normal mode).
9. Connect the RF Out + TR Bias cable to the Spectroscopy TR Module (from the Carraige Assembly.
10. Press **[Start Single]**.

Note

If TR errors are reported check the Error Log to insure that they are related to Multi–Nuclear Spectroscopy Hardware (the Error Log will report if the problem is Head, Body or Spectro). Recheck connections to J407, J408, J409 at the rear of the RFSC Module. If Spectro TR errors are reported re–verify the dynamic calibration procedure or turn to TROUBLESHOOTING Section.

11. When operation is satisfactory, press **[Stop]** to stop the Prescan.
12. Press **[Done]** to stop the exit the Spectro Prescan page.

1–5–3 RESTORATION CHECK LIST

1. ***If NOT proceeding*** to the applicable next section of this procedure restore system per Section 1–10.

1–6 RF/PEN 2 CABINET SECTION ONLY

SPECTROSCOPY TR DRIVER CIRCUIT ADJUSTMENTS ––– DYNAMIC STATE

This section adjusts the CPD Board Spectroscopy TR Driver Voltage. Multi–Nuclear Spectro TR error reporting occurs only when Multi–Nuclear Spectroscopy scans are initiated, otherwise, they are ignored. To complete this section, you will perform the following:

- CPD Board: Dynamic State TP17, Spectro TR Voltage Out, Adjustment and Verification.

1–6–1 Initial Set Up

- Setup Initial Multi–Nuclear Spectroscopy Scan Preparation per Section 1–4.
- Set–up an oscilloscope to 1 Meg Ω termination when measuring TR and Power Monitor Signals. Set–up an oscilloscope to 50 Ω termination when measuring any RF Signal.

1–6–2 Dynamic State TP17 Spectro TR Voltage Adjustment and Verification

1. At “Scan Operation” screen, press **[Spectro Prescan]**.
1. Press **[Start Single]**.
2. Monitor the Spectro TR test point “STR–OUT” at TP17 on the CPD Board in the SSM.
3. Set the positive output voltage level at TP17 by adjusting R75 to +4.3 Volts as shown in Illustration 1–5 (typically this is factory set to +4.0 or +6.0 VDC). When the Spectroscopy TR Module is connected (loaded) this 4.3 value will drop and will require re–adjustment.

Note

When TP17 voltage setting is increased/decreased the MNS current output value (as discussed below) will also increase/decrease.

4. Verify the current output value as measured on the CPD Board in the SSM at U32 pin 3 WRT ground (positive output level) is a minimum of 1.4 Amps.
   [(The U32 pin 3 measured voltage value divided by 46.45) divided by .12 = current]
   or
   U32 pin 3 divided by 5.574 = 1.432 Amps.

Note

The waveform shown is worst case and may not represent those displayed on your system. Waveforms should ideally be clean and square.

Note

The measurement must be taken in the “dynamic state” of the transmit pulse (i.e., near the middle to the end of the positive pulse).

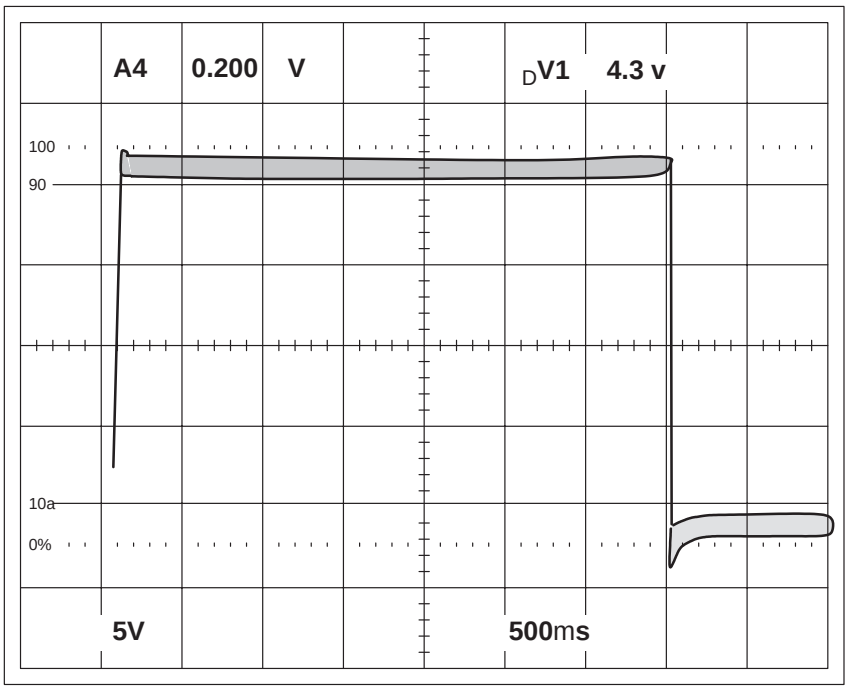
1–6–2 Dynamic State TP17 Spectro TR Voltage Adjustment and Verification (Continued)

5. When adjustments are completed, press **[Stop]** to stop the Prescan.
6. Place the TR rocker switch at the front panel of the SSM place in the correct position:
   - TR rocker switch to the “EN” position (TR Fault Enable Mode).
7. Connect the RF Out + TR Bias cable to the Spectroscopy TR Module (from the Carraige Assembly.
8. At “Scan Operation” screen, press **[Spectro Prescan]**.
9. Select **[Start Single]**.
10. Select **[Stop]**.

Note

If TR errors are reported check the Error Log to insure that they are related to Multi–Nuclear Spectroscopy Hardware (the Error Log will report if the problem is Head, Body or Spectro). Recheck connections to J407, J408, J409 at the rear of the SSM. If Spectro TR errors are reported re–verify the dynamic calibration procedure or turn to TROUBLESHOOTING Section.

11. When operation is satisfactory, press **[STOP]** to stop the Prescan.
12. Press **[Done]** to exit the Spectro Prescan page.



USE R75 TO ADJUST THE POSITIVE VOLTAGE LEVEL

GROUND REF

CPD SPECTRO TR OUTPUT VOLTAGE (TP17)
ILLUSTRATION 1–5

1–6–3 RESTORATION CHECK LIST

1. ***If NOT proceeding*** to the applicable next section of this procedure restore system per Section 1–11.

1–7 MULTI–NUCLEAR SPECTROSCOPY RF SIGNAL FROM THE EXCITER WITH BB MODULE

- Setup Initial Multi–Nuclear Scan Prescription per Section 1–4.

1. Disconnect the Coaxial Cable outside the System Cabinet at MR2 A11 J1, RF OUT Signal.
2. Set the TG to 200.
3. Set–up an oscilloscope to 50 Ω termination.
4. Connect oscilloscope to the BNC panel mount connector at the System Cabinet I/F Panel, MR2 A11 J1.
5. At “Scan Operation” screen, press **[Spectro Prescan]**.
6. Select **[Start Single]**.
7. Measure the MNS RF OUT Signal and verify it meets specification at MR2 A11 J1:
   10 dBm, ±1 dBm **(**1.6 VP–P to 2.2 VP–P)
8. Set the TG to 0 (zero).
9. Select **[Stop]**.
10. Select **[Done]**.
11. Re–connect the Coaxial Cable outside the System Cabinet at MR2 A11 J1, RF OUT Signal.

1–7–1 RESTORATION CHECK LIST

1. ***If NOT proceeding*** to the applicable next section of this procedure restore system per Section 1–10 or 1–11.

1–8 MULTI–NUCLEAR SPECTROSCOPY RF POWER OUT ADJUSTMENTS

This procedure will:

- Verify 1.55 kW maximum RF Output at TG=200 from the Multi–Nuclear Spectroscopy RF Amplifier using the scan protocol per Table 1–1.

NOTE: A calculator may be necessary.

1–8–1 Initial Set–Up For Multi–Nuclear Spectroscopy RF OUT Measurement

- Setup Initial Multi–Nuclear Spectroscopy Scan Preparation per Section 1–4.
- Set–up an oscilloscope to 50 Ω termination to measure RF Signals.

1. Initially set the RF/Pen Cabinet Spectro Attenuator, MR1A18, as follows. This 0 to10 dB mechanical attenuator attenuator is located in the rear of the RF/Pen Cabinet to the right of the Multi–Nuclear Spectroscopy RF Amplifier.

CAUTION

Loosen the locking nut on the Spectro Gain Attenuator. This is a 3/4 turn pot. DO NOT APPLY FORCE.

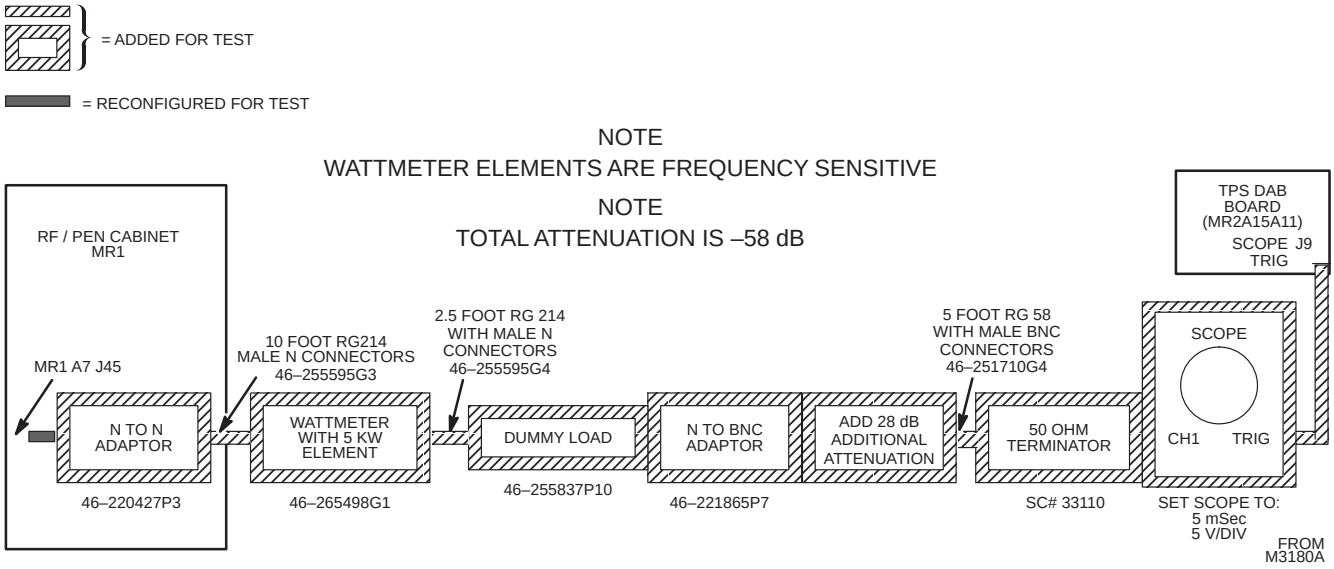
Note

If a site is unable to set the Spectro RF Out level without adding additional attenuation, please write a CQA and add in the extra attenuation as required.

2. **RF/PEN 1 Cabinet with MR1A18 Attenuator ONLY:** Initially set the RFSC Analog Processor Board (MR1 A15 A1) Spectro Gain Pot R293 to the minimum–point and then adjust for 1.55 kW. MR1A18 will be set to minimum attenuation.
3. **RF/PEN 1 Cabinet without MR1A18 Attenuator ONLY:** Initially set the RFSC Analog Processor Board (MR1 A15 A1) Spectro Gain Pot R293 to the minimum–point and then adjust for 1.55 kW.
4. **RF/PEN 2 Cabinet with MR1A18 Attenuator ONLY:** At the rear of the SSM locate the Spectro RF Adjust pot R22. Adjust R22 fully CW to minimum value. MNS RF will use this path, however, R22 will not be used to adjust the MNS RF Input Signal. MR1A18 will set the RF OUT Signal.
5. Reconfigure system hardware for MNS RF Power measurements as shown in Illustration 1–6 or 1–7. The RF Power Measurement Kit is the preferred method, however, the wattmeter method is shown.

1–8–1 Initial Set–Up For Multi–Nuclear Spectroscopy RF OUT Measurement (Continued)

FOR ILLUSTRATION 1–6 ONLY:



RECONFIGURATION FOR WATTMETER SPECTROSCOPY POWER MEASUREMENTS
ILLUSTRATION 1–6

Note

If an oscilloscope has a 50 Ω selectable termination there is no need to use the 50 Ω teminator shown in Illustration 1–6 unless selecting the oscilloscope's 1 Meg Ω selectable termination.

CAUTION

30 dB of ATTENUATION is the minimum amount required when measuring 1.55 kW into any oscilloscope. It is preferable to have a higher value of ATTENUATION to prevent damage to the oscilloscope. This procedure requests –58 dB total.

1–8–1 Initial Set–Up For Multi–Nuclear Spectroscopy RF OUT Measurement (Continued)

FOR ILLUSTRATION 1–7 ONLY:

Note

The Quick Reference Card shown was created for Multi–Nuclear Spectroscopy RF Power Measurements (only frequencies below 50 MHz) and may not be available in the RF Power Measurement Kit.

The Scope Calibrator is not to be used for frequencies below 50 MHz.

Note

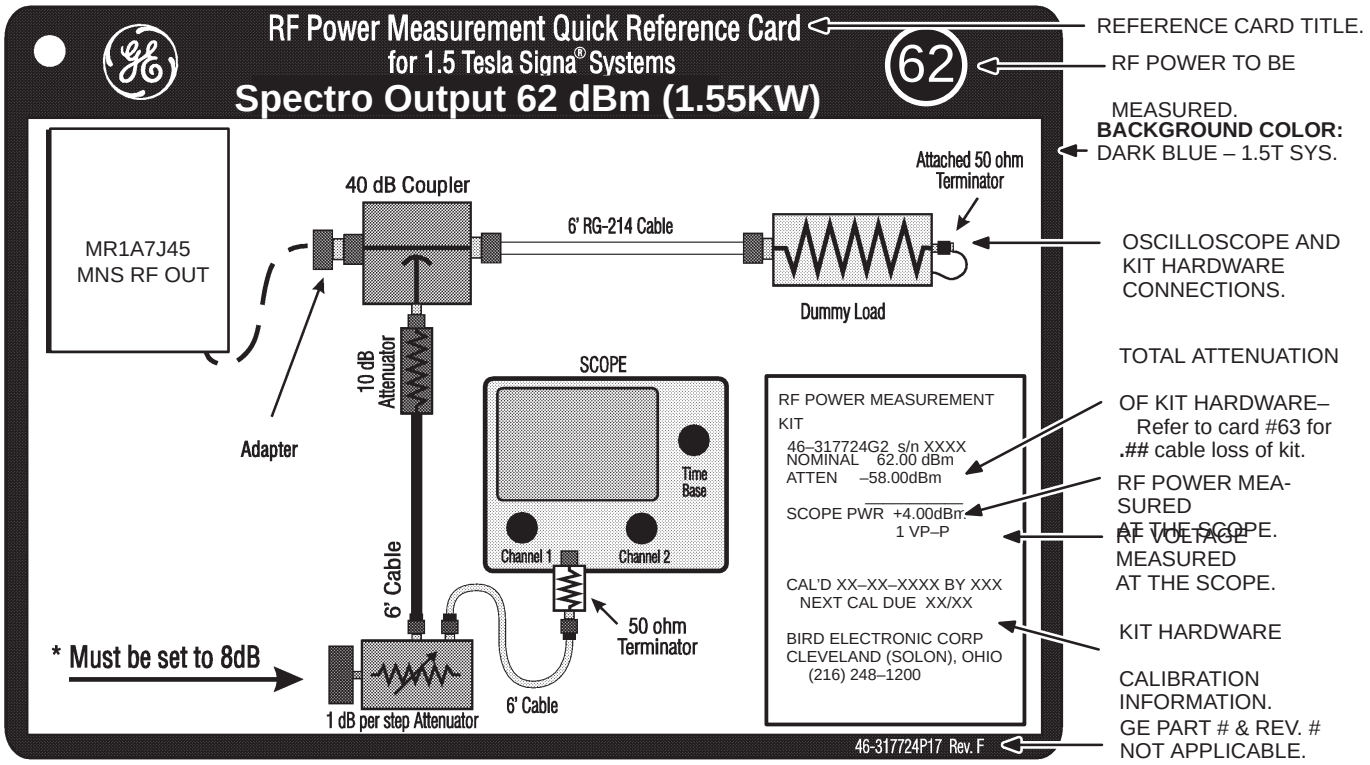
If an oscilloscope has a 50 Ω selectable termination there is no need to use the 50 Ω teminator shown in Illustration 1–7 unless selecting the oscilloscope's 1 Meg Ω selectable termination.

CAUTION

Ensure the output of the 30 dB attenuator is terminated with the 50 Ω terminator chained to the 30 dB attenuator to create a dummy load as illustrated on the reference cards. See Illustration 1–7. If the attenuator is not terminated, RF signal can be transmitted into the surrounding area and erroneous measurements will occur.

Note

Each Power Measurement Kit has a unique cable loss value. Refer to 1.5T Head RF OUT card. Look at the **ATTEN** value (–59.##). Add the **.##** shown on this card to the –58 dB of the card shown below. For example: –58.00 + –.41 = ATTEN of –58.41 dB.



RF POWER MEASUREMENT QUICK REFERENCE CARD FOR FREQUENCIES UP TO 50 MHZ
ILLUSTRATION 1–7

1–8–2 1.55 kW Multi–Nuclear Spectroscopy RF Power Output Adjustment

1. Record the Total Attenuation per selected hardware set–up:
   (**Total Attenuation**) **– _____dB**.
   (Attenuation + **cable loss** shown on Head Card #63 as 59.##)
2. **[Spectro Prescan]**.
3. Set the TG to 0 (zero).
4. **[Start Single]**.
5. Slowly increase TG setting to 200 using 20 unit increments.
6. **RF/PEN 1 Cabinet with MR1A18 Attenuator ONLY:** Initially set the RFSC Analog Processor Board (MR1 A15 A1) Spectro Gain Pot R293 to the minimum–point and then adjust for 1.55 kW. MR1A18 will be set to minimum attenuation.
7. **RF/PEN 1 Cabinet without MR1A18 Attenuator ONLY:** Initially set the RFSC Analog Processor Board (MR1 A15 A1) Spectro Gain Pot R293 to the minimum–point and then adjust for 1.55 kW.
8. **RF/PEN 2 Cabinet with MR1A18 Attenuator ONLY:** At the rear of the SSM locate the Spectro RF Adjust pot R22. Adjust R22 fully CW to minimum value. MNS RF will use this path, however, R22 will not be used to adjust the MNS RF Input Signal. MR1A18 will set the RF OUT Signal.

CAUTION

Loosen the locking nut on the Spectro Gain Attenuator. This is a 3/4 turn pot.
CW to increase attenuation
DO NOT APPLY FORCE.
Hand–tighten the locking nut on the Spectro Gain Attenuator.

9. Monitor Spectro RF Output and record volts peak–to–peak (Spectro Out+TR BIAS).
   Record in appropriate space: _____ **VP–P** or _____ **mVP–P**
   EXAMPLE: –58.00 dB + –.41 (Kit Attenuation) = ATTEN of –58.41 dB
   62.00 dB – 58.41 dB = 3.59 dB
   Refer to Trouble–Shooting Section RF Calculation and Reference Tables to calculate proper voltage level
   3.59 dB = 0.95547 VP–P or 955 mVP–P into 50 Ω terminated oscilloscope.
10. Lower TG to 0 (zero).
11. Press **[Stop].**
12. Press **[Done].**

1–8–3 RESTORATION CHECK LIST

1. ***If NOT proceeding*** to the applicable next section of this procedure restore system per Section 1–10 or 1–11.

1–9 MULTI–NUCLEAR SPECTROSCOPY POWER MONITOR ADJUSTMENT

This procedure will:

- RF/Pen 1 or RF/Pen 2 Cabinet:
  Set the Multi–Nuclear Spectroscopy redundant Power Monitor waveforms to a pre–determined Volts Peak value (oscilloscope terminated into 1 Meg Ω).

1–9–1 Initial Set–Up

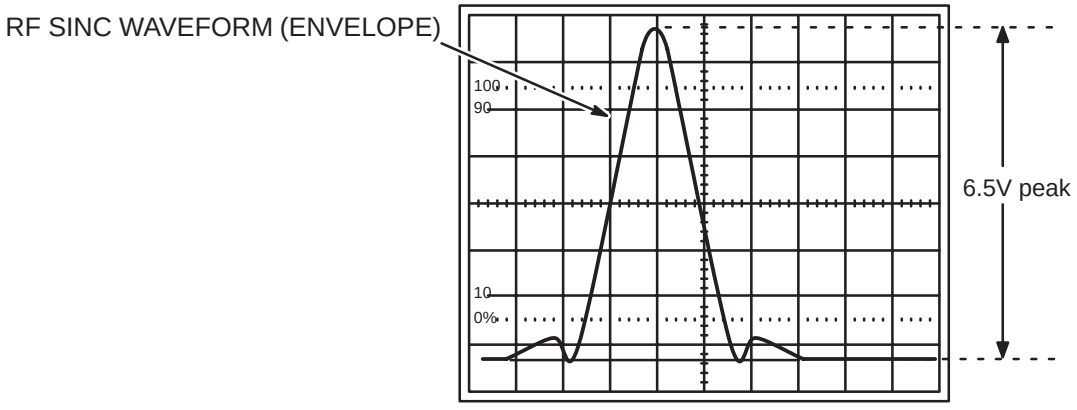
- Setup Initial Multi–Nuclear Spectroscopy Scan Preparation per Section 1–4.
- Set–up an oscilloscope to 1 Meg Ω termination to measure RF Power Monitor Signals.
- Connect hardware per in Illustration 1–6 or 1–7. Disconnect hardware at CH1 of oscilloscope. Connect this to CH2. CH1 will be used to view and set the redundant Power Monitor waveforms.

1–9–2 RF/PEN 1 CABINET SUB–SECTION ONLY

MNS Power Monitor Adjustment at the APB

- Place the CM/PM Board power monitor jumpers in the JP2 and JP6 into position B (Bypass Mode).

1. Open the RF/PEN1 RFSC and locate the APB pots R130, and R131.
2. Connect Channel 1 scope to TP10 of Analog Processor Board (Head_AD_A) (MR1 A15 A1) located in the RFSC, with ground to appropriate ground test point.
3. Select **[Spectro Prescan]**.
4. Select **[Start Single]**.
5. Slowly increase TG setting until output of the dummy load is within +/– 0.2 dB of **1.55 kW** (Spectro Out + TR BIAS). If Power Monitor faults occur, adjust R130 / R131 to decrease level at the Analog Processor Board.
6. Monitor peak voltage of the waveform at TP10 of Analog Processor Board (MR1 A15 A1) and adjust R130 on Analog Processor Board to obtain 6.50 ¿0.1 V peak (1.55 kW equivalent). See Illustration 1–8. Verify RF Sense LED's are illuminated.
7. Connect Channel 1 scope to TP11 of Analog Processor Board (Head_AD_B) (MR1 A15 A1) located in the RFSC, with ground to appropriate ground test point.
8. Monitor peak voltage of the waveform at TP11 of Analog Processor Board (MR1 A15 A1) and adjust R131 on Analog Processor Board to obtain 6.50 ¿0.1 V peak (1.55 kW equivalent). See Illustration 1–8. Verify RF Sense LED's are illuminated.
9. Lower TG to 0 (zero).
10. Select **[Stop]**.
11. Select **[Done]**.



RF/PEN1 WAVEFORM FOR APB – POWER MONITOR ADJUSTMENT
ILLUSTRATION 1–8

1–9–3 RESTORATION CHECK LIST

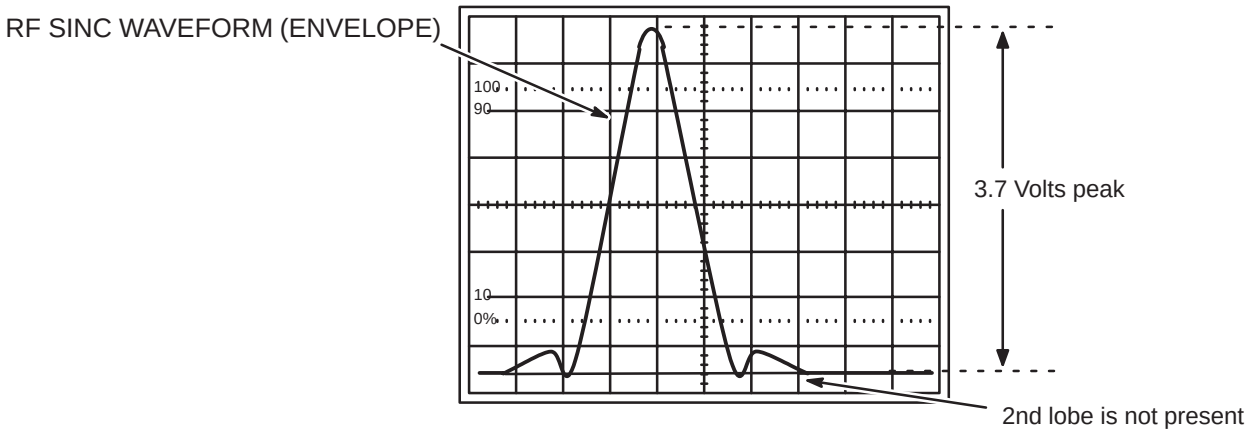
1. ***If NOT proceeding*** to the applicable next section of this procedure restore system per Section 1–10.

1–9–4 RF/PEN 2 CABINET SUB–SECTION ONLY

MNS Power Monitor Adjustment at the APM

- Place the SSM power monitor rocker switches in the bypass power monitoring position.

1. Open the RF/PEN2 SSM and locate the APM pots R95, and R97. A metal shield may need to be removed.
2. Connect Channel 1 scope to TP18 of APM (Spectro–EnvA) with ground to appropriate ground test point.
3. Select **[Spectro Prescan]**.
4. Select **[Start Single]**.
5. Slowly increase TG setting until output of the dummy load is within ¿0.2 dB of **1.55 kW** (Spectro Out + TR BIAS).
6. Adjust R95 counter–clockwise to decrease (CCW) level at the APM.
7. Monitor peak voltage of the waveform at TP18 of APM and adjust R95 to obtain 3.70, ¿0.05 V peak (1.55 kW equivalent). See Illustration 1–9. Verify RF Sense LED's are illuminated.
8. Move the scope probe to TP19 of the APM.
9. Adjust R97 clockwise to decrease (CW) level at the APM.
10. Monitor peak voltage of the waveform at TP19 of APM and adjust R97 to obtain 3.70, ¿0.05 V peak (1.55 kW equivalent). See Illustration 1–9. Verify RF Sense LED's are illuminated.
11. Lower TG to 0 (zero).
12. Select **[Stop]**.
13. Select **[Done]**.



RF/PEN 2 WAVEFORM FOR APM – POWER MONITOR ADJUSTMENT
ILLUSTRATION 1–9

1–9–5 RESTORATION CHECK LIST

1. ***If NOT proceeding*** to the applicable next section of this procedure restore system per Section 1–11.

1–10 SYSTEM WITH RF/PEN 1 CABINET–RESTORATION CHECK LIST

1. Perform the following:
   - Disconnect all scope probes.
   - Remove test hardware.
   - Remove the Spectroscopy TR Module and associated hardware.
   - Place the CM/PM Board power monitor jumpers in the JP2 and JP6 into position A (Normal Mode).
   - Verify MR1 A15 SW2 – TR–DD Faults Disable "OFF" (normal mode).
   - Verify JP87 on PIN Switch Driver Board is in Position "Normal Mode A" (Software Control Mode).
   - Verify the Coaxial Cable outside the System Cabinet at MR2A11J1 is connected.
   - Verify the Heliax Cable outside the RF/Pen 2 Cabinet at MR1A7J45, MNS RF Out + Bias is connected.
   - At the front of the RFSC reset any Power Monitor faults using the key provided.
   - Replace any covers, shields, or screws removed.
   - Close the RFSC cover and tighten screws.
   - Slide the RFSC Module in place and replace screws.
   - Replace the RF/Pen 1 Cabinet front cover.

1–11 SYSTEM WITH RF/PEN 2 CABINET– RESTORATION CHECK LIST

1. Perform the following:
   - Disconnect all scope probes.
   - Remove test hardware.
   - Remove the Spectroscopy TR Module and associated hardware.
   - Verify the front panel SSM TR rocker switch is in the "EN" position (TR Fault Enable Mode).
   - Verify the front panel SSM Power Monitor A and B rocker switches are in the "NORMAL" Mode.
   - Verify the Coaxial Cable outside the System Cabinet at MR2A11J1 is connected.
   - Verify the Heliax Cable outside the RF/Pen 2 Cabinet at MR1A7J45, MNS RF Out + Bias is connected.
   - Replace any covers, shields, or screws removed.
   - Close the SSM cover and tighten screws.
   - Slide the SSM in place and replace screws.
   - Replace the RF/Pen 2 Cabinet front cover.

SECTION 1 – BROADBAND MULTI–NUCLEAR FUNCTIONAL TESTS

Note

This Section applies to M1040JB and M1090JZ.

Description

This section tests the 1.5T HORIZON (5.5 Release) Multi–Nuclear Spectroscopy hardware and software using the resonant frequency of phosphorous (^{31}P). Initially, the basic 1.5T HORIZON (5.5 Release) SIGNA system will be verified to be operating properly. Then the proper operation of Multi–Nuclear Spectroscopy specific hardware is checked.

All tests require the 8"Transmit/3"Receive Phosphorus *Service* Spectroscopy Surface Coil. Phosphorus spectra are acquired from a 14.7 Molar Phosphoric Acid Phantom in the Phosphorus Signal to Noise – Non–Averaging Frequency Adjust Scan Test to verify signal is present.

All tests require the 8"Transmit/3"Receive Phosphorus *Service* Spectroscopy Surface Coil. Phosphorus spectra are acquired from a 0.050 Molar (50 mM) Phosphoric Acid Phantom in the Phosphorus Signal to Noise – Averaging Test.

The data obtained during the Phosphorus Signal to Noise – Averaging Test are stored as N12345.001 Spectroscopy raw data files in the :SYSTEM:SPECRAW directory on the MV/7800 Computer /usr/g/mrspecraw for 5.X). The N12345.001 files are transferred to a Sun workstation for analysis with the SA/GE Spectroscopy Analysis Software or to a Nicolet SDS for analysis.

Initial Conditions

- ☐ Catalog M1040JB or M1090JZ, 1.5T Signa Horizon (5.5 Release) Spectroscopy (BroadBand/Multi–nuclear hardware) fully operational.
- ☐ Spectroscopy Option Key (5.X) installed (and if applicable—Research Option Key).
- ☐ Catalog M1090MC, Second Hard Drive and Catalog M1040HT, Hydrogen Only (Spectroscopy Option Key (5.X), EPROM) installed.
- ☐ 5.5 (or later) Release Signa Horizon 1.5T software fully operational.
- ☐ System Noise Floor Check, Direction 2124201–3 (5.X) has been performed and acceptance specifications met.
- ☐ Signal to Noise Check, Direction 2124201–3 (5.X) has been performed and acceptance specifications met.
- ☐ Magnet has been shimmed and acceptance specifications met.

Tools Required

Spectroscopy Quality Assurance/Service Coil and Phantom Kit, 46–317286G1, consists of the following:

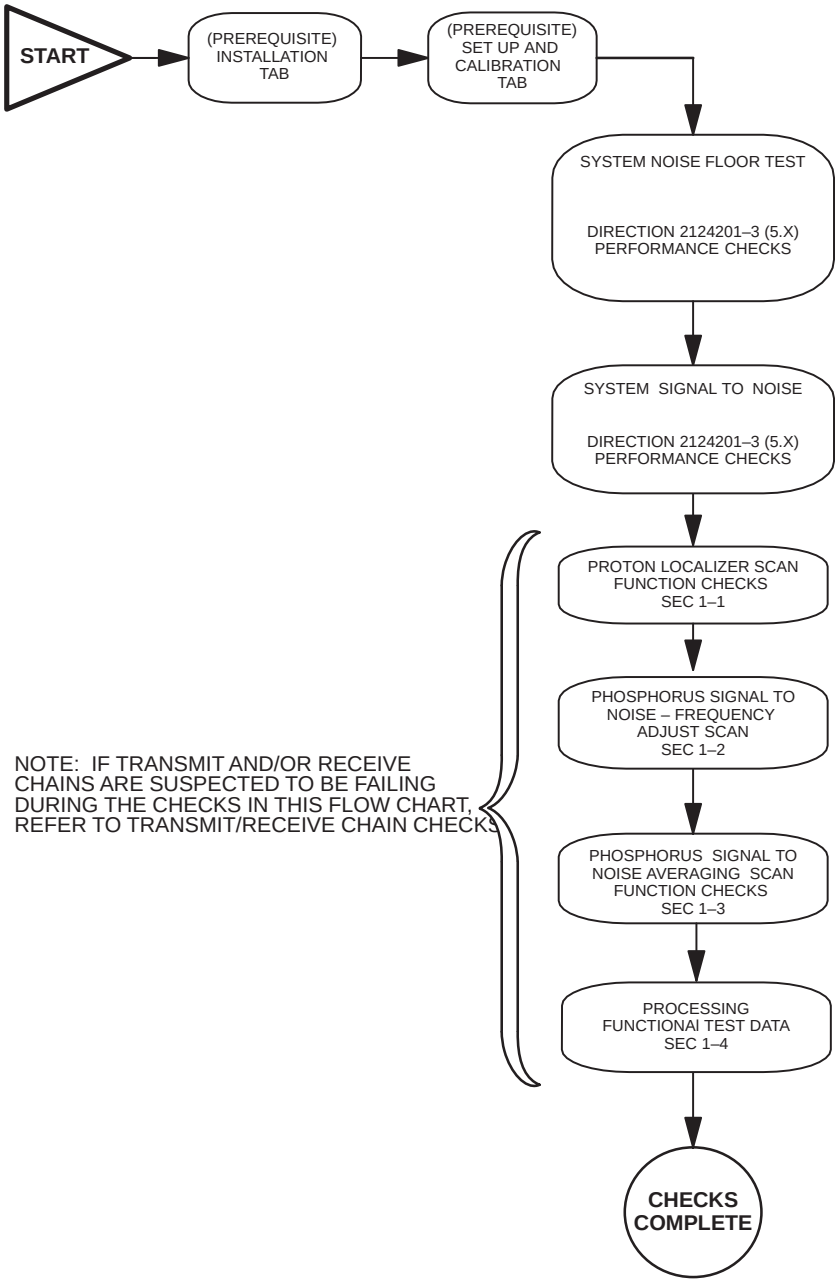
Item	Description	Part Number	Qty.
1.	8"/3" Phosphorus Spectroscopy surface coil	46–265204G3	1
2.	0.050 M Phosphoric Acid Solution — MSDS # 8360515	46–317299G1	1
3.	14.7 M Phosphoric Acid Solution — MSDS # 8360515	46–317299G2	1

Note

The Phantom Kit Phosphoric Acid Solution must be procured locally. Store away from open flame or heat sources. If a spill occurs use rubber gloves and flush area afflicted with plenty of water for 15 minutes. Refer to MSDS #8360515 for more specific information.

Flow Chart

The flow chart in Illustration 1–1 shows sequence for functional check of the (MNS) Multi–Nuclear Spectroscopy Subsystem. Sections and tabs referred to in this chart are contained in this Direction unless otherwise noted. Note that narrowband system performance checks for signal to noise and noise floor must be performed and acceptance specifications must be verified. Narrowband system performance problems must be resolved before (MNS) Spectroscopy functional checks are performed.



MULTI–NUCLEAR SPECTROSCOPY FUNCTION CHECK FLOW CHART
ILLUSTRATION 1–1

1–1 PROTON LOCALIZER SCAN

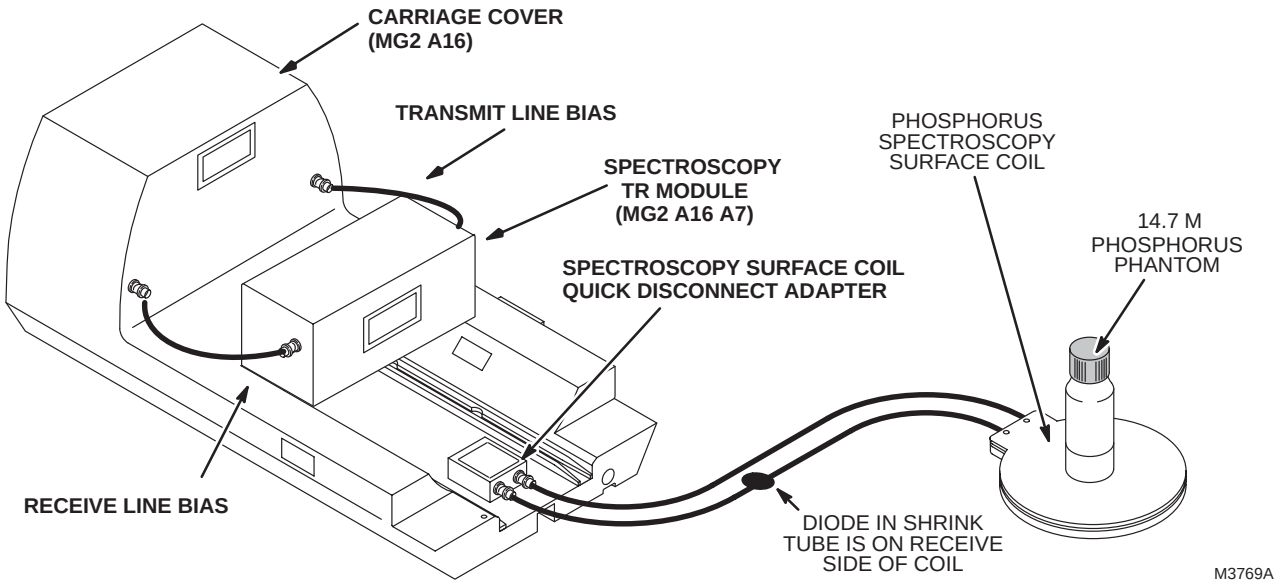
CAUTION

The Quad Head Coil must be completely removed from the cradle before performing any body scans. Failure to do this may result in damage to the Head Coil/TR Network.

1. Position Phosphorus Spectroscopy TR Module (MG2 A16 A7) on Carriage Cover (MG2 A16) as shown in Illustration 1–2.
2. Verify the two (2) Lemo Cables (Receive Line and Transmit Line) are connected as shown in Illustration 1–2.

CAUTION

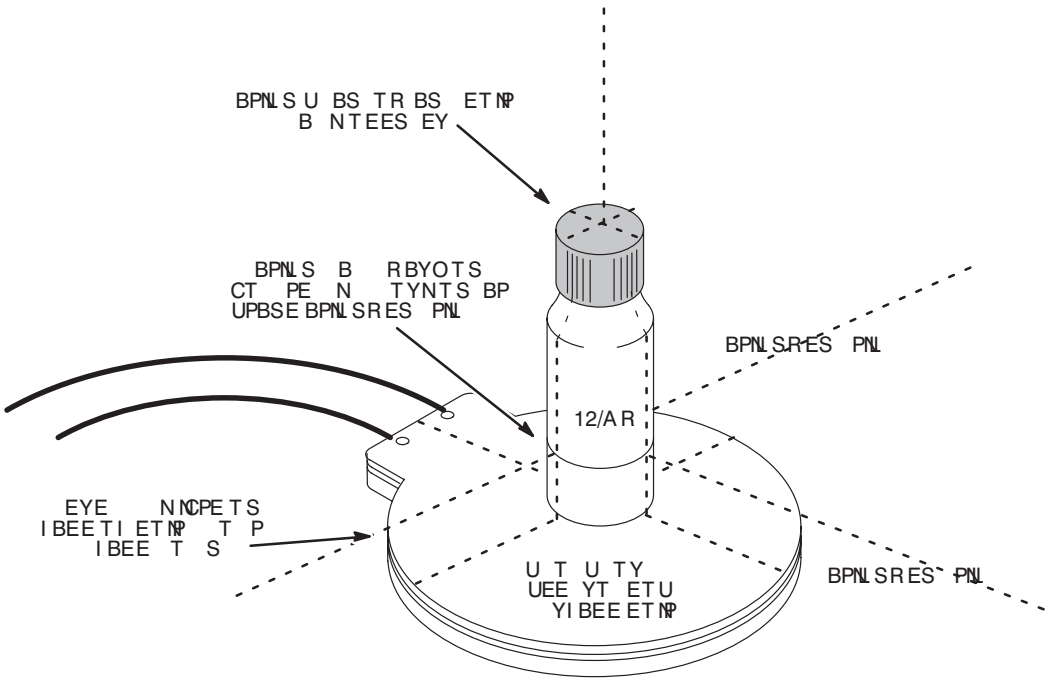
Do not leave the Spectroscopy TR Module installed (connected / disconnected) during non–spectroscopy scanning. The Spectroscopy TR Module will be installed during Proton localizer scans per this document, this is acceptable. Once the Multi–Nuclear Spectroscopy scanning has been completed and Narrowband scanning is resumed the Spectroscopy TR Module should be removed from the bore of the magnet.



SET UP FOR PROTON LOCALIZER SCAN
ILLUSTRATION 1–2

3. Connect the Phosphorus Spectroscopy Surface Coil to the Spectroscopy Coil Adapter (MR2 A16 A7 A3). Place surface coil on the cradle. Connect Spectroscopy Surface Coil Adaptor Quick Disconnect Box to Spectroscopy TR Module and place the 14.7 M Phosphorus Phantom on the coil as show in Illustration 1–2.

1–1 PROTON LOCALIZER SCAN (Continued)



PHANTOM SET UP FOR PROTON LOCALIZER SCAN
ILLUSTRATION 1–3

4. Attach the Spectroscopy Surface Coil Quick Disconnect Adapter (connected to 8"–3" Phosphorus Surface Coil) to the Spectroscopy TR Module. See Illustration 1–6.
5. Place phantom bottle on center of coil. The center of the phantom bottle should be at isocenter with vertical alignment lights crossing bottle at hash mark as shown in Illustration 1–3.
6. Verify that the Spectroscopy TR Module is attached to the Carriage Cover. See Illustration 1–6.
7. Place phantom bottle on center of coil. The center of the phantom bottle should be at isocenter with vertical alignment lights crossing bottle at hash mark as shown in Illustration 1–3.

Note

All Multi–Nuclear Spectroscopy users should be made aware that the foam pads contain a phosphorus flame retardant chemical. When scanning, the foam pads can be detected as a very small but broad peak. This could present a difficulty if you are scanning *in vivo* or if the user is trying to initially locate the phosphorus peak.

8. Acquire the localizer image according to the scan prescription given in Table 1–1.

1–1 PROTON LOCALIZER SCAN (Continued)

TABLE 1–1
5.X PROTON LOCALIZER SCAN PROTOCOL

SCAN PROTOCOL (5.X)

MAIN MENU

[SCAN MODE]

SCAN MODE

[RESEARCH]
[ACCEPT]

MAIN MENU

[New Exam]

PATIENT/EXAM INFORMATION

Id: **specft**
Name: **ft lcl**
Patient Weight **300**
[Patient Position]

PATIENT POSITION

Patient Entry **[Head First]**
Patient Position **[Supine]**
Axial/Sag. Landmark **[Nasion]**
Coil Type **[Body Coil]**
Scan Plane **[Axial]**
[Imaging Params]

IMAGING PARAMETERS

Image Mode **[2D]**
(*SAR must be "On"* **)** **[Monitor SAR]**
Pulse Sequence **[Spin Echo]**
Imaging Options **[Extended Dyn Rang]**
or enter PSD Filename none

SCAN TIMING

Number of Echoes **[1]**
Echo Time (TE) **[20 msec]**
Rep Time (TR) **[300 msec]**
[Scan Set–Up]

SCAN SET–UP

Prescan Options None
Auto CF **[Water]**
[Scan Ops]

SCANNING RANGE

Field of View **[24 cm]**
Scan Thickness **[10 mm]**
Interscan Spacing **[1.5 mm]**
Start Loc (I/S): **0**
End Loc (I/S): **0**
No. of Scan Locations: 1
FOV Center (L/R): 0 (P/A): 0
[⇐] [Acq Time]

ACQUISITION TIME

Acq. Matrix (freq.) **[256]**
Acq. Matrix (phase) **[128]**
Frequency Direction **[R/L]**
Phase FOV default
Imaging Time **[1 NEX 0:44]**
Contrast **[No]**
Table Delta: 0 mm
[Scan Ops]

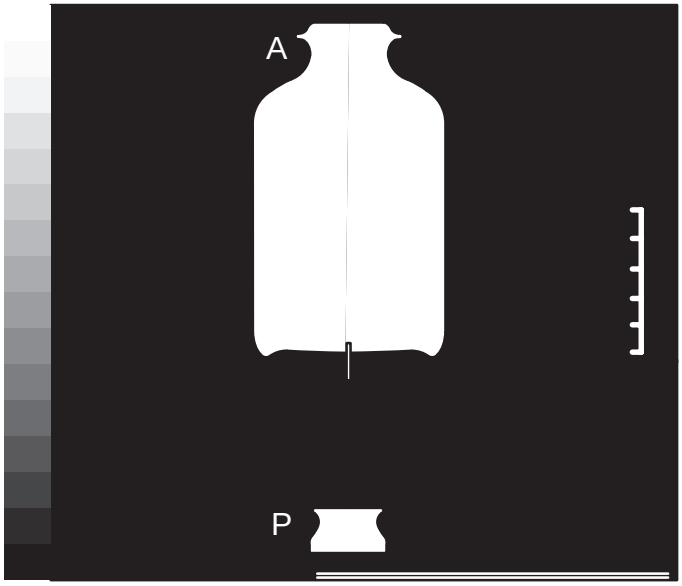
SCAN OPERATIONS

[Auto Prescan]
[Scan]

1–1 PROTON LOCALIZER SCAN (Continued)

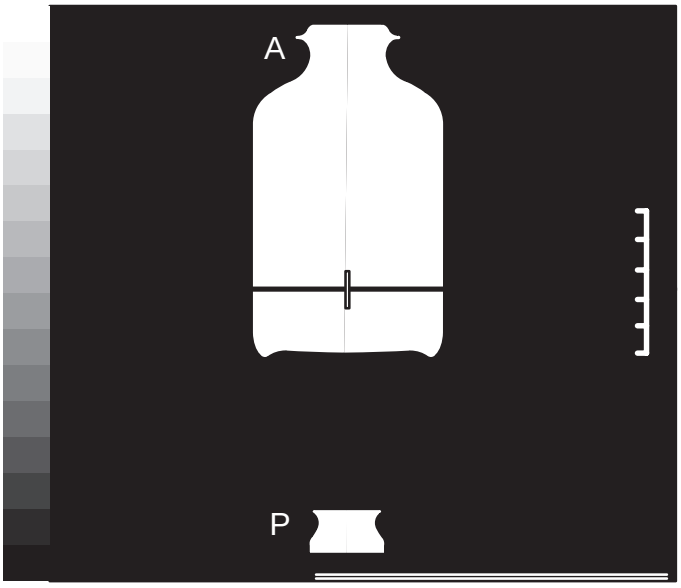
9. If the scan image does not appear as shown in Illustration 1–4. Adjust placement of coil using pads so that bottom of bottle is close to P30 shown in Illustration 1–4. Do **not** place pads between the coil and phantom bottle.

10. Illustration 1–5 shows that the bottom of the bottle is ~30 mm below 0. The landmark line on the bottle and 0 isocenter coincide. Center of the bottle should also be centered left to right making R/L ~ 0.



M4206A

SCAN SHOWING ALIGNMENT OF PHANTOM BOTTOM CLOSE TO P30
ILLUSTRATION 1–4



M4206A

SCAN SHOWING HASH MARK ON ACTUAL PHANTOM AND ISOCENTER MATCHING AT ZERO
ILLUSTRATION 1–5

1–2 PHOSPHORUS SIGNAL TO NOISE – FREQUENCY ADJUST SCAN

CAUTION

Look at the front of the ENI Amplifier in the RF/Pen Cabinet. If the Gating Button LED is continuously ON, press button to toggle LED OFF. This LED should only light when RF pulses occur during scanning. If this Gating Button LED is always ON, the ENI Amplifier may be damaged and Multi–Nuclear Spectroscopy scanning can not occur.

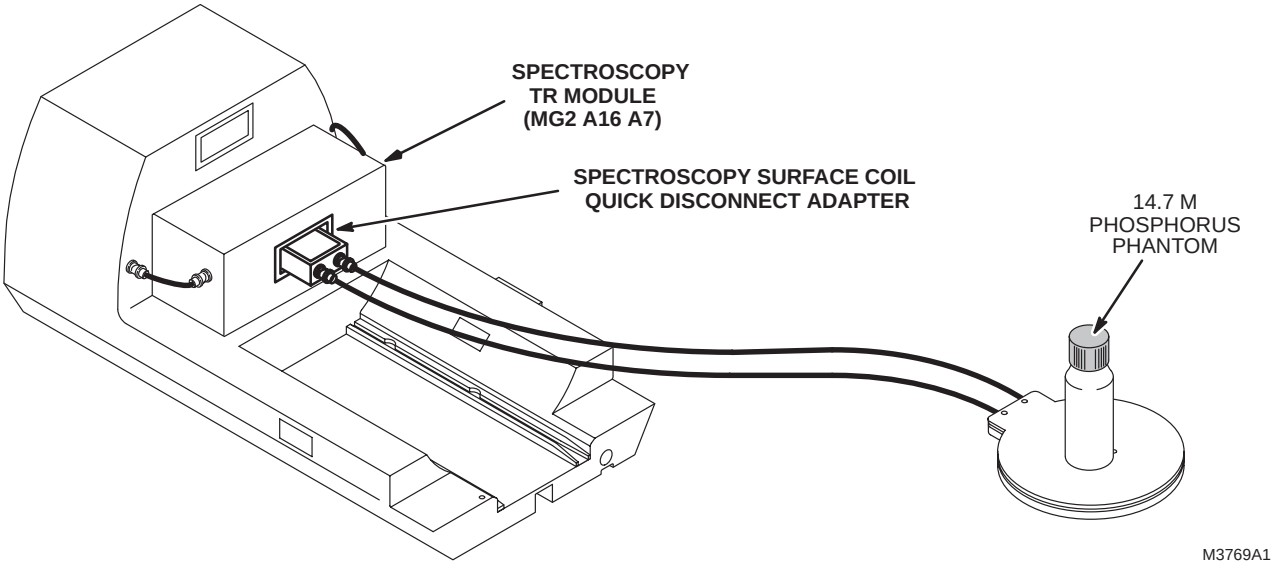
Note

All Multi–Nuclear Spectroscopy users should be made aware that the foam pads contain a phosphorus flame retardant chemical. When scanning, the foam pads can be detected as a very small but broad peak. This could present a difficulty if you are scanning *in vivo* or if the user is trying to initially locate the phosphorus peak.

1. Attach the Spectroscopy Surface Coil Adapter (connected to 8"–3" Phosphorus Surface Coil) to the Spectroscopy TR Module. See Illustration 1–6.
2. Attach the Spectroscopy TR Module to the Carriage Cover. See Illustration 1–6.
3. Prescribe the new series. Refer to Table 1–2 for 5.X protocols as required.

Note

The phosphorus center frequency can be approximately determined by multiplying the proton center frequency (on the prescan page) by 0.404838.



SET UP FOR FREQUENCY ADJUST SCAN
ILLUSTRATION 1–6

1–2 PHOSPHORUS SIGNAL TO NOISE – FREQUENCY ADJUST SCAN (Continued)

TABLE 1–2
5.5 PHOSPHORUS SIGNAL TO NOISE – FREQUENCY ADJUST SCAN PROTOCOL

SCAN PROTOCOL (5.5)

MAIN MENU

[New Series]

PATIENT/EXAM INFORMATION

Id: **geservice**
Name:
Patient Weight **300 < IMPORTANT!!**
[Patient Position]

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]**
(*SAR must be "On"*) **[Monitor SAR]**
Pulse Sequence **[Spin Echo]**
Imaging Options **[Extended Dyn Rang]**
or enter PSD Filename **fidcsi**
[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) **[Other] 2000** msec
[Scan Set–Up]

SCAN SET–UP

Prescan Options None *if applicable*
Auto CF **[Water]**
[Scanning Range]

SCANNING RANGE

Field of View **[48 cm]** —workaround
Scan Thickness **[30 mm]**—workaround
Interscan Spacing **[Other] 0**
Start Loc (I/S): **0**
End Loc (I/S): **0**
No. of Scan Locations: 1
FOV Center (L/R): 0 (P/A): 0

ACQ TIME

Acq Freq 256
Acq Phase 192
Freq Dir R/L
Nex 2
Contrast No
Table Delta 0
[Scan Ops]

[MODIFY CVs]
squeeze Check Value: **0**
[BACKUP]

[Review Screen]
Field of View **[24 cm]**
Scan Thickness **[10 mm]**
[ACCEPT]

Select Soft Key **[Spectro]**

SPECTROSCOPY

Use AX to set the ^{31}P frequency,
Type: **R1 7 R2 30 TG 25** press **ENTER**

[MODIFY CVs]
Change the following CVs:
dda New Value: **10**
pibbandfilt Check Value: **1**
opuser4 Check Value: **16**
[BACKUP]

[Mod Disp Params]
TW 2 MW 1 WA 1 MW 2 WA 9
[Backup]

Set Entry Point, type: **ent single1**

Note

If bottle has been properly set up with the bottom of the bottle appearing at P30 as shown in Illustration 1–5, there is no need to use Graphic Rx.

1–3 PHOSPHORUS SIGNAL TO NOISE – AVERAGING SCAN

This procedure will determine the signal to noise levels during a Multi–Nuclear Spectroscopy scan. Seven scans will be completed. Data from each scan will be stored. The data will be analyzed using SA/GE software to find the level of signal to noise.

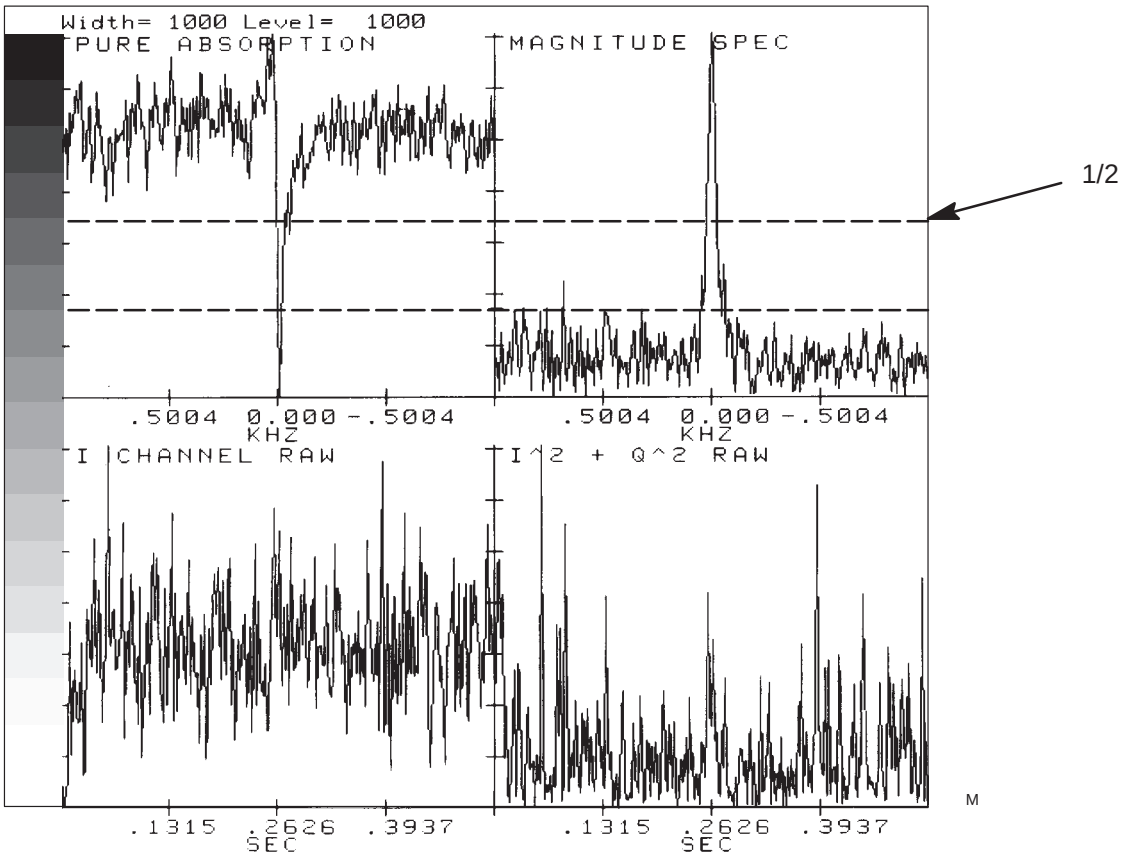
1. Verify hardware and protocols are set up as used in Section 1–2, PHOSPHORUS SIGNAL TO NOISE – FREQUENCY ADJUST SCAN.
2. **[Start Single]**.
3. Achieve proper center frequency for Phosphorus by adjusting dx per Magnitude Spectrum Illustration 1–7. (A peak must be located to continue on to SNR scans).
4. **[Stop Acq.]**.
5. Press **[Back to Landmark]** on front panel of magnet enclosure.
6. Turn alignment lights on.
7. **Remove** 14.7 M Phosphorus phantom and **replace** with the .050 M Phosphorus phantom.
8. Press **[Advance to Scan]** on front panel of magnet enclosure.
9. Press **[START SINGLE]**. Refer to Illustration 1–7. You should see the majority of noise in Magnitude Spectrum being less than 1/4 of the signal as shown. If not, some part of the system is not working properly.
10. Adjust the frequency to center the echo.
11. Press **[STOP ACQ]**.
12. Continuing from previous protocol in Section 1–2, PHOSPHORUS SIGNAL TO NOISE – FREQUENCY ADJUST SCAN use the Averaging Protocols for 5.5 as shown in Table 1–3.
13. Select **[START AVERAGE]** per the averaging protocols after the entry point is set to average..

Note

If the **[STORE]** is not pressed before beginning the next AVG SCAN, the data is **lost** and scan must be repeated. **[List Data]** will display information similar to List Exams does in normal scanning.

1–3 PHOSPHORUS SIGNAL TO NOISE – AVERAGING SCAN (Continued)

Illustration 1–7 shows results of a 0.05 M sample with **R1 = 7**, **R2 = 30**, **TG = 25**. This illustration shows the first pulse of a START AVERAGE or a typical pulse of START SINGLE. Typically, the noise in Magnitude Spectrum quadrant is less than 1/2 and most noise should occur below 1/4 of the quadrant.



TYPICAL 0.05M SAMPLE PULSE WAVE FORMS
ILLUSTRATION 1–7

Note

All BroadBand Spectroscopy users should be made aware that the foam pads contain a phosphorus flame retardant chemical. When scanning, the foam pads can be detected as a very small but broad peak. This could present a difficulty if you are scanning *in vivo* or if the user is trying to initially locate the phosphorus peak.

1–3 PHOSPHORUS SIGNAL TO NOISE – AVERAGING SCAN (Continued)

TABLE 1–3
5.5 AVERAGING PROTOCOLS

NOTE: The Control Variable *specnavs* is not an equivelant CV to *opuser4*. The CV *specnav*s can only be used with 4.

NOTE: Verify that "START AVERAGE" has been selected with an Entry Point of "single 1".

AVERAGING PROTOCOL (5.5)	
Set Entry Point	**ent avg** press enter
	[MODIFY CVs]
Change CV **opuser4**	**16**
	[BACKUP]
	[START AVERAGE]
Wait for scans to be complete.	**[STORE]**
Enter Site Name, 16, and date.	Press **ENTER**.
Record File Number on data sheet.	
	[MODIFY CVs]
Change CV **opuser4**	**32**
	[BACKUP]
	[START AVERAGE]
Wait for scans to be complete.	**[STORE]**
Enter Site Name, 32, and date.	Press **ENTER**.
Record File Number on data sheet.	
	[MODIFY CVs]
Change CV **opuser4**	**64**
	[BACKUP]
	[START AVERAGE]
Wait for scans to be complete.	**[STORE]**
Enter Site Name, 64, and date.	Press **ENTER**.
Record File Number on data sheet.	
	[MODIFY CVs]
Change CV **opuser4**	**128**
	[BACKUP]
	[START AVERAGE]
Wait for scans to be complete.	**[STORE]**
Enter Site Name, 128, and date.	Press **ENTER**.
Record File Number on data sheet.	
	[MODIFY CVs]
Change CV **opuser4**	**256**
	[BACKUP]
	[START AVERAGE]
Wait for scans to be complete.	**[STORE]**
Enter Site Name, 256, and date.	Press **ENTER**.
Record File Number on data sheet.	
	[MODIFY CVs]
Change CV **opuser4**	**512**
	[BACKUP]
	[START AVERAGE]
Wait for scans to be complete.	**[STORE]**
Enter Site Name, 512, and date.	Press **ENTER**.
Record File Number on data sheet.	
	[MODIFY CVs]
Change CV **opuser4**	**1024**
	[BACKUP]
	[START AVERAGE]
Wait for scans to be complete.	**[STORE]**
Enter Site Name,1024 and date.	Press **ENTER**.
Record File Number on data sheet.	

Note

If the **[STORE]** is not pressed before beginning the next AVG SCAN, the data is **lost** and scan must be repeated. **[List Data]** will display information similar to List Exams does in normal scanning.

1–4 PROCESSING

1. Refer to *Direction 15309, Analysis Workstation Software.*
2. Perform file transfer from the System Computer to the Spectroscopy Analysis Workstation.
3. Analyze the Spectroscopy Data to determine the Signal to Noise Ratio. Remember to use the data sheet provided in Section 1–5, FUNCTIONAL TEST DATA SHEET.

1–5 FUNCTIONAL TEST DATA SHEET

Use the following data sheet while performing the Phosphorus Signal To Noise – Averaging Scan and during the analysis of the data using the SA/GE software. The NORMALIZED SNR value should be between 6 and 10 for the 8"Transmit/3"Receive Phosphorus Spectroscopy *Service* Surface Coil only. This NORMALIZED SNR value should remain consistent for the BroadBand Spectro system for each successive NAV. If a site has an alternate Coil, the site will be responsible for qualifying that coil, the NORMALIZED SNR value may or may not be between 6 and 10.

Coil Type:			**Coil S/N:**		
n# (4.X) or g# (5.X)	**NAV**	**NAV SQUARE ROOT**	**PEAK NUMBER**	**SNR**	**NORMALIZED SNR** **Divide SNR by NAV SQUARE ROOT**
	16	**4**	**1**		
	32	**5.66**	**2**		
	64	**8**	**3**		
	128	**11.3**	**4**		
	256	**16**	**5**		
	512	**22.6**	**6**		
	1024	**32**	**7**		

SECTION 1 – MULTI–NUCLEAR TR BIAS TROUBLESHOOTING

NOTE

This Section applies to M1040JC and M1090ST.

1–1 INTRODUCTION ––– Written Specifically for RF/Pen 1 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 PIN Switch Driver Board located in the RF System Controller (RFSC) in the RF/Pen 1 Cabinet. The Multi–Nuclear Spectro TR Bias is produced by the PIN Switch Driver Board (its timing is concurrent with the unblank signal timing). It assumes the PIN Switch 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 JP87 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 JP87 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 in Table 1–1 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/Pen 1 Cabinet ONLY––PIN SWITCH DRIVER BOARD (MR1 A15 A4) JP87 JUMPER POSITIONS

The PIN Switch Driver Board is located in the RF System Controller (RFSC) in the RF/Pen Cabinet. Jumper JP87 on the PIN Switch Driver Board has three positions (A, B, C – indicated on the board near jumper); each represents a different mode. JP87, 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 RFSC 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

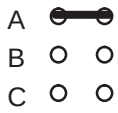
When JP87 is placed in Normal Mode A (Software Control Mode) a negative/positive TR bias is timed concurrently with the unblank/blank pulse. In the Software Control Mode the TR Bias outputs are dependent, therefore, on the presence and switching of the unblank/blank pulse. The TR Bias is then sent out 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 JP87 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.

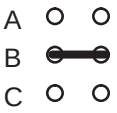
When JP87 is placed in Test Mode C (Transmit Simulation Mode) a positive bias is forced continuously at the specific Transmit Line input to the Head TR Switch, the Body Hybrid Splitter, and the Spectroscopy TR Module.

CANI DGE

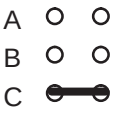
For JP87, do not leave the PIN Switch Driver Board jumper JP87 in position "TEST MODE C" for any extended period of time. Damage to the Phosphorus Spectroscopy TR Module will result. Damage to the Head TR Switch and Body Hybrid Splitter may result as well if their Bias Lines are connected



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 JP87 MODE POSITIONS
ILLUSTRATION 1–1

1–3 INITIAL CONDITIONS – RF/PEN 1 CABINET ONLY

- Place MR1 A15 SW2 located on the front of the RFSC Module to TR–DD Faults Disable "ON" (service/by-pass mode).
- Verify JP87 on PIN Switch Driver Board is in Position "Normal Mode A" (Software Control Mode).
- Disconnect cables on RFSC Module Rear Panel:

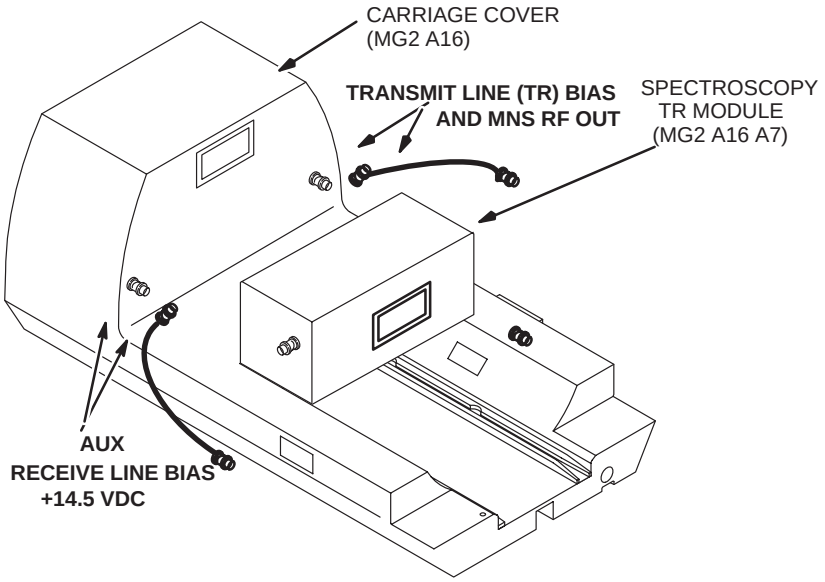
  MR1 A15 J407 (TR Bias to Spectro TR Switch) cable is disconnected.

  MR1 A15 J408 (TR Bias to Body Hybrid) cable is disconnected.

  MR1 A15 J409 (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 protocol in Table 1–1.
- 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/PEN 1 CABINET ONLY (Continued)

TABLE 1–1
8.X PHOSPHORUS SIGNAL TO NOISE TEST SCAN PROTOCOL

SCAN PROTOCOL (8.X)

RX MANAGER

PATIENT REGISTER

[New Series]

PATIENT INFORMATION

Patient ID: geservice
Patient Name: 31flex
Patient Weight 300

PATIENT POSITION

Patient Position Supine
Patient Entry Head First
Coil Coil Type **[Surface] P31_FLEX [Accept]**

IMAGING PARAMETERS

Plane **Axial**
Mode **2D**
Pulse Seq P. Seq **Spin Echo(MRS) [Accept]**
Imaging Opt Im Opt **EDR [Accept]**
PSD Name

ADDITIONAL PARAMETERS

SCAN TIMING

# of Echoes **1**
TR **4000**
Flip Angle **60**

USER CVs SCREEN

CV0 spectral width **2500**
CV1 number of points **1024**
CV2 nucleus **31**
CV3 scan mode **1.00**
CV4 total #of scans **128.00**
CV5 rl resolution for csi scans **1.00**
CV6 ap resolution for csi scans **1.00**
*CV7*si resolution for csi scans **1.00**
CV14 rfpulse (soft) **1.00 [Accept]**

ACQUISITION TIMING

Freq **[256]**
Phase **[160]**

NEX **[2.00]**

ACQUISITION TIMING

Freq DIR [R/L]
Auto CF [Water]
Autoshim **[selected]**

SCANNING RANGE

FOV **[24]**
Scan Thickness **[20.0]**
Interscan Spacing **[1.5]**
Start (S/I): **0**
End (S/I): **0**
Slices: 1
L/R Center: 0
P/A Center: 0
Table Delta 0.00

[Save Series]

[Prepare to Scan]

[Research Operations]
DISPLAY CV's:
CV Name: **dda**
Current Value: **10**
CV Name: **pibbandfilt**
Current Value: **1**
[Accept]

[RESEARCH OPERATIONS]
DOWNLOAD

[Spectro Prescan]
Entry Point: **single1**
Nucleus: **31**
R1 **13**
R2 **30**
TG **0**
AX Default
Top Screen **[Magnitude]**
Bottom Screen **[Q Chan Raw]**
[Start]
Verify TG is **0**

[Stop]

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 TR PIN SWITCH DRIVER CIRCUIT ADJUSTMENTS – STEADY STATE – RF/PEN 1 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/PEN 1 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 Flex Coil)** —– Transmit Mode
- RECONFIGURATION – RF/PEN 1 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 PIN Switch Driver Board voltages are good in the Receive Mode.

1. Place the following jumper on the RFSC PIN Switch Driver Board in the correct position:
   - JP87 – 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 JP87 is in the Normal Mode **"A"** (Software Control Mode) and the system is not being pulsed. **DO NOT PULSE.**
2. Measure (in reference to TP58 GND) and verify the following on PIN Switch Driver Board:

STEP	FUNCTION	MEASURE AT LOCATION:	ADJUST POT.:	SPECIFICATION:	WRITE FINAL MEASURED VALUE:
2a	Unloaded Spectro TR Current Output (RCV Mode)	TP18	No Adj.	0.0 ¿0.1 VDC	
2b	Unloaded Spectro TR Voltage Output (RCV Mode)	TP21	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 PIN Switch Driver Board, Power Supply, or an interconnect harness.

T/S HINT: Break down the failure. Troubleshoot by measuring the RFSC power supply voltages at the PIN Switch 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. JP87 – **"Test Mode B"** (Receive Simulation Mode).
3. Connect cable on RFSC Module Rear Panel:

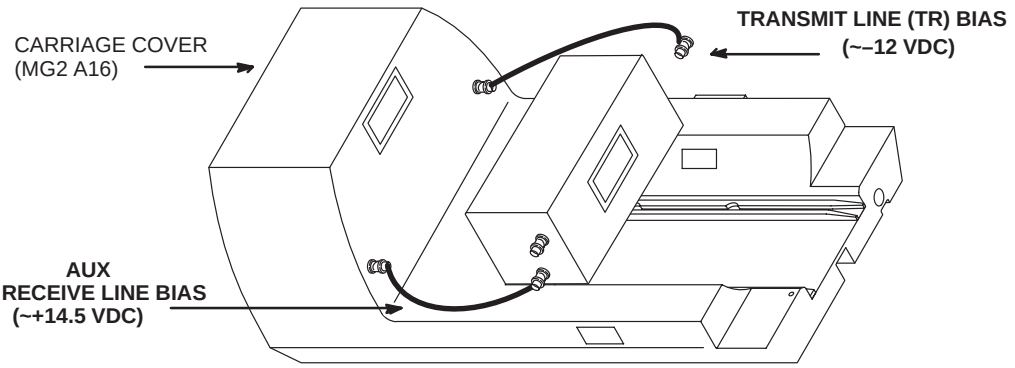
   MR1 A15 J407 (TR Bias to Spectro TR Switch) cable is connected.
4. Measure lemo connections located on the Carriage Cover:

   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).

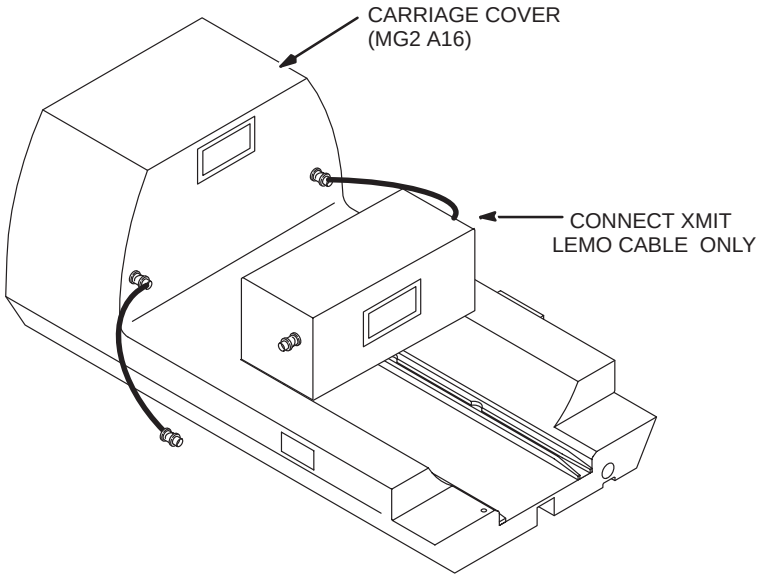
- JP87 – **"Test Mode B"** (Receive Simulation Mode).

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 TP58 GND) and verify the following on PIN Switch 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)	TP18	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 Quad Head Normal Q. D. Adaptor Box (for test purposes only).

- Verify JP87 on PIN Switch Driver Board is in Position “Normal Mode A” (Software Control Mode).
- Disconnect cables on RFSC Module Rear Panel:

  MR1 A15 J408 (TR Bias to Body Hybrid) cable is disconnected.

  MR1 A15 J409 (TR Bias to Head TR Switch) cable is disconnected.

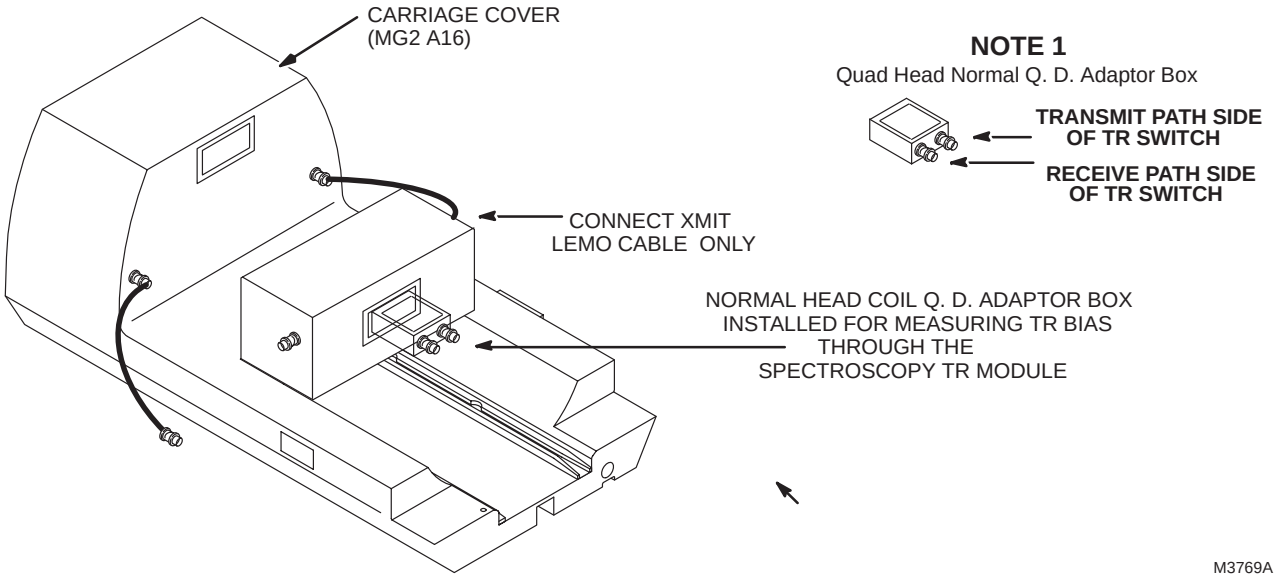
1. Connect cable on RFSC Module Rear Panel:

   MR1 A15 J407 (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 will 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 RFSC PIN Switch Driver Board in the correct position:
   - JP87 – Change to Position **"Test Mode B"** (Receive Simulation Mode).
4. Measure the Quad Head Normal Quick Disconnect Adaptor Box connectors, refer to Illustration 1–5, (see NOTE 1):

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 PIN Switch Driver Board voltages are good in the Transmit Mode.

- Disconnect cables on RFSC Module Rear Panel:

  MR1 A15 J407 (TR Bias to Spectro TR Switch) cable is disconnected.

  MR1 A15 J408 (TR Bias to Body Hybrid) cable is disconnected.

  MR1 A15 J409 (TR Bias to Head TR Switch) cable is disconnected.

6. Place the following jumper on the RFSC PIN Switch Driver Board in the correct position:
   - JP87 – **"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 TP58 GND) and verify the following on PIN Switch Driver Board:

STEP	MEASURE:	MEASURE AT LOCATION:	ADJUST POT.:	SPECIFICATION:	WRITE FINAL MEASURED VALUE:
5a	Unloaded Spectro TR Voltage Output	TP21	R18	+4.3 VDC, –0.2/+0.3 VDC	
5b	Unloaded Spectro TR Error Detection Threshold	TP19	No Adj.	+5.0 VDC, ⍰0.5 VDC	

NOTE

The TR Error Detection Threshold voltage at TP19 will fault at (+5 VDC ÷ 10 =) less than 0.5 Amps of current draw. This Error Detection circuitry is not adjustable.

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

8. Place the following jumper on the RFSC PIN Switch Driver Board in the correct position:
   - Verify JP87 on PIN Switch 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 JP87 on PIN Switch Driver Board is in Position “Normal Mode A” (Software Control Mode).
- Disconnect cables on RFSC Module Rear Panel:

  MR1 A15 J407 (TR Bias to Spectro TR Switch) cable is disconnected.

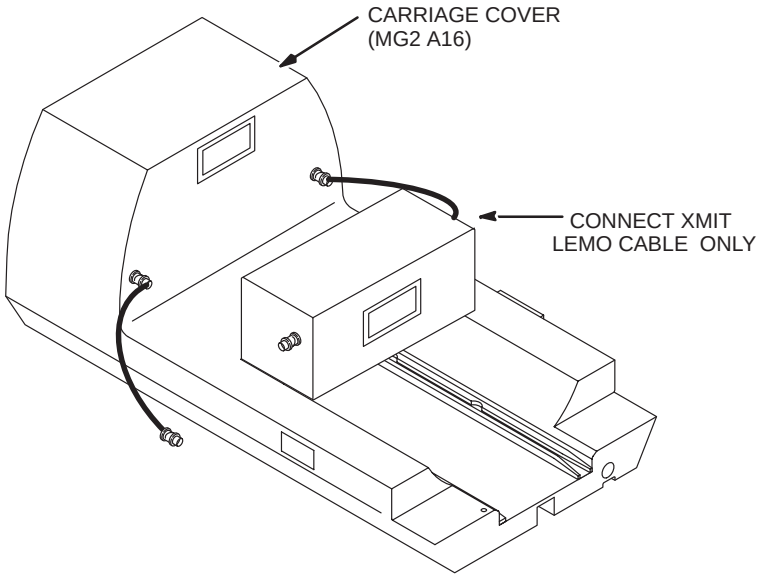
  MR1 A15 J408 (TR Bias to Body Hybrid) cable is disconnected.

  MR1 A15 J409 (TR Bias to Head TR Switch) cable is disconnected.

10. Connect a voltmeter between TP18 and TP58 GND reference on the PIN Switch Driver Board:
11. **Connect Spectroscopy TR Module** to Carriage Assembly. **Do NOT** attach a Coil.
12. Connect cable on RFSC Module Rear Panel:

    MR1 A15 J407 (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.



M3769A

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

CAUTION

Do not leave the PIN Switch Driver Board jumper JP87 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 RFSC PIN Switch Driver Board in the correct position:
    - JP87 – Change to Position **"Test Mode C"** (Transmit Simulation Mode) sets positive voltage for TR Driver circuits.

CAUTION

Do not leave the PIN Switch Driver Board jumper JP87 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)	TP18	NOTE 2	~16.0 VDC, ⍰2 VDC This measurement is dependent upon the TP21 voltage value and the Spectro TR Module Assembly.	

15. Place the following jumper on the RFSC PIN Switch Driver Board in the correct position:
    - JP87 – Change to Position **"Normal Mode A"** (Software Control Mode).

T/S HINT: If there is no current draw verify the path through the MR1A17 Spectro Assembly (relay path) is good. Next –– try using the Head TR circuitry at the PIN Switch Driver Board with J407 cable connected to J409 connector. To do this first adjust the Unloaded Head TR Bias to ~4.3 VDC. Connect the MR1 A15 J407 cable (TR Bias Spectro) on RFSC Module Rear Panel to the MR1 A15 J409 (TR Bias Head) connector. If TP18 Current can now be measured there is a Spectro TR circuitry board problem on the PIN Switch Driver Board.

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

NOTE

The voltage at TP18 is directly proportional to the Spectro TR Module load current:
Current (I) of Spectro TR = Voltage of TP18 ÷ 10.

NOTE 2

If the TP21 voltage is increased the current value measured at TP18 will increase. Only the TP21 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 TP21 was set to 4.3 VDC.

4.3 VDC divided by ~2.7 Ω (load) = ~1.6 Amps (TP18)

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 JP87 on PIN Switch Driver Board is in Position **"Normal Mode A"** (Software Control Mode).
- Disconnect cables on RFSC Module Rear Panel:

  MR1 A15 J408 (TR Bias to Body Hybrid) cable is disconnected.

  MR1 A15 J409 (TR Bias to Head TR Switch) cable is disconnected.

1. Connect cable on RFSC Module Rear Panel:

   MR1 A15 J407 (TR Bias to Spectro TR Switch) cable.

2. Refer to Illustration 1–7:

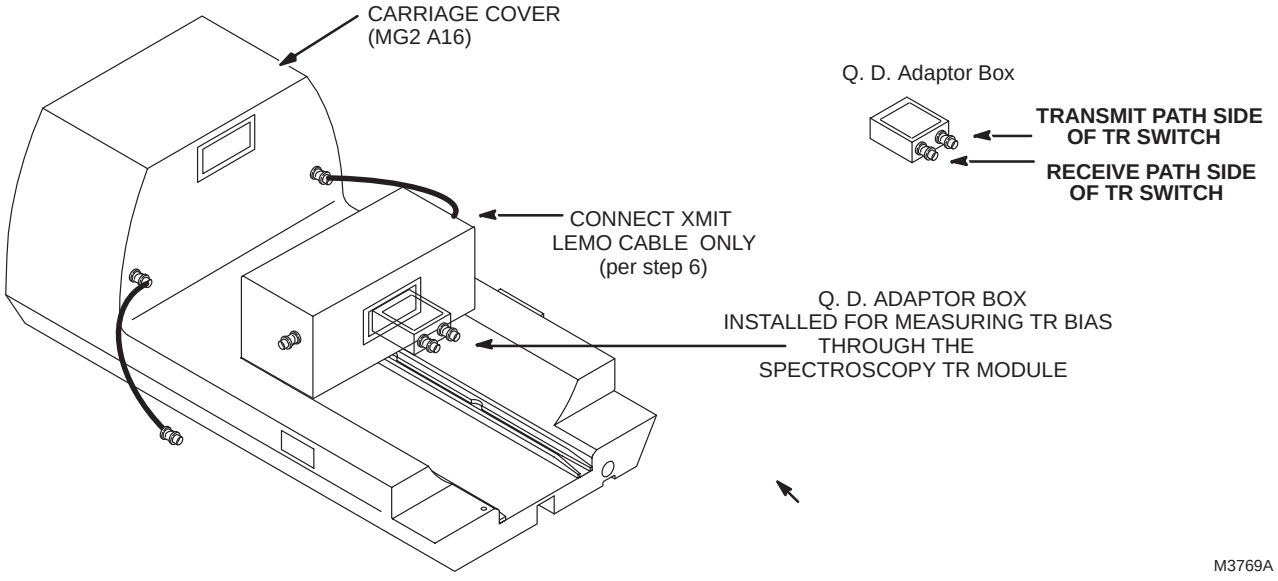
NOTE

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 RFSC PIN Switch Driver Board in the correct position:
   - JP87 – Change to Position **"Test Mode C"** (Transmit Simulation Mode) sets positive voltage for TR Driver circuits.

CAUTION

Do not leave the PIN Switch Driver Board jumper JP87 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 RFSC PIN Switch Driver Board in the correct position:
   - JP87 – 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

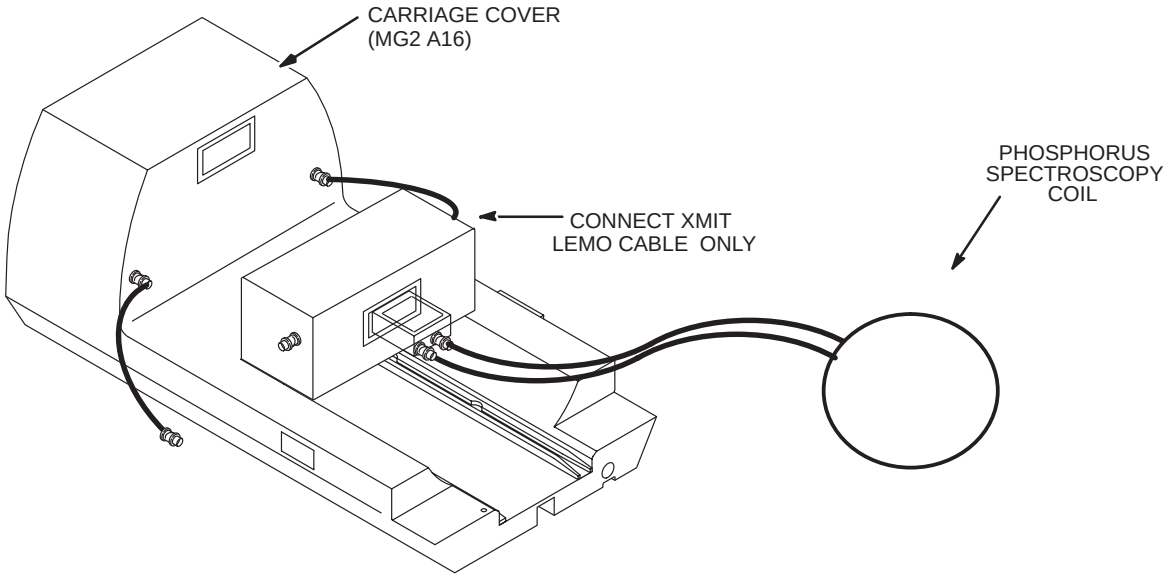
This Sub–Section will verify the Spectroscopy Coil is not shorted at its input connection. This test does not completely verify the coil is good.

1. Verify PIN Switch Driver Board jumper position as follows:
   - Verify JP87 on PIN Switch Driver Board is in Position **"Normal Mode A"** (Software Control Mode).
   - Disconnect cables on RFSC Module Rear Panel:

     MR1 A15 J408 (TR Bias to Body Hybrid) cable is disconnected.

     MR1 A15 J409 (TR Bias to Head TR Switch) cable is disconnected.
1. Connect cable on RFSC Module Rear Panel:

   MR1 A15 J407 (TR Bias to Spectro TR Switch) cable.
2. Use voltmeter to measure between TP18 and TP58 GND reference on the PIN Switch 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 RFSC PIN Switch Driver Board in the correct position:
   - JP87 – Change to Position "Test Mode C" (Transmit Simulation Mode) sets **positive voltage** for TR Driver circuits.

CAUTION

Do not leave the PIN Switch Driver Board jumper JP87 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)	TP18	See NOTE	~16.0 VDC, ±2 VDC This measurement is dependent upon the TP21 voltage value and the Spectro TR Switch Module Assembly.	

NOTE

The voltage measured at TP18 with the Spectroscopy Coil attached should be approximately the same as Section 1–4–6 step14.–1a TP18 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.

5. Place the following jumper on the RFSC PIN Switch Driver Board in the correct position:
   - Verify JP87 on PIN Switch 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/PEN 1 CABINET ONLY

- Verify JP87 on PIN Switch Driver Board is in Position **"Normal Mode A"** (Software Control Mode).
- Verify MR1 A15 SW2 – TR–DD Faults Disable "OFF" (normal mode).
- Verify all the TR Bias cables at MR1 A15 (J407, J408, J409) 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 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.

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 MODULE ASSEMBLY CHECKS

NOTE
This Section applies to M1040JB and M1090JZ.

2–1 INTRODUCTION

Description ––– Spectro Module Assembly (2124498–27) Overview

The Spectro Module Assembly (MR1A17) houses the Relay Assembly, 3 Band Low Pass Filter, and the Spectroscopy Directional Coupler, plus interconnect cabling. **This Module 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.

Description ––– Filter Relay Assembly

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 ––– 3 Band Low Pass Filter (46–264866G1)

The Three Band Low Pass Filter is used to remove the harmonics at the output of the 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 first band (25 MHz) has input J5 and output J6. The loss within the pass–band (DC to 24 MHz) is $\leq$ 0.25 dB. The stop–band has a minimum attenuation of 40 dB for frequencies greater than 50 MHz.

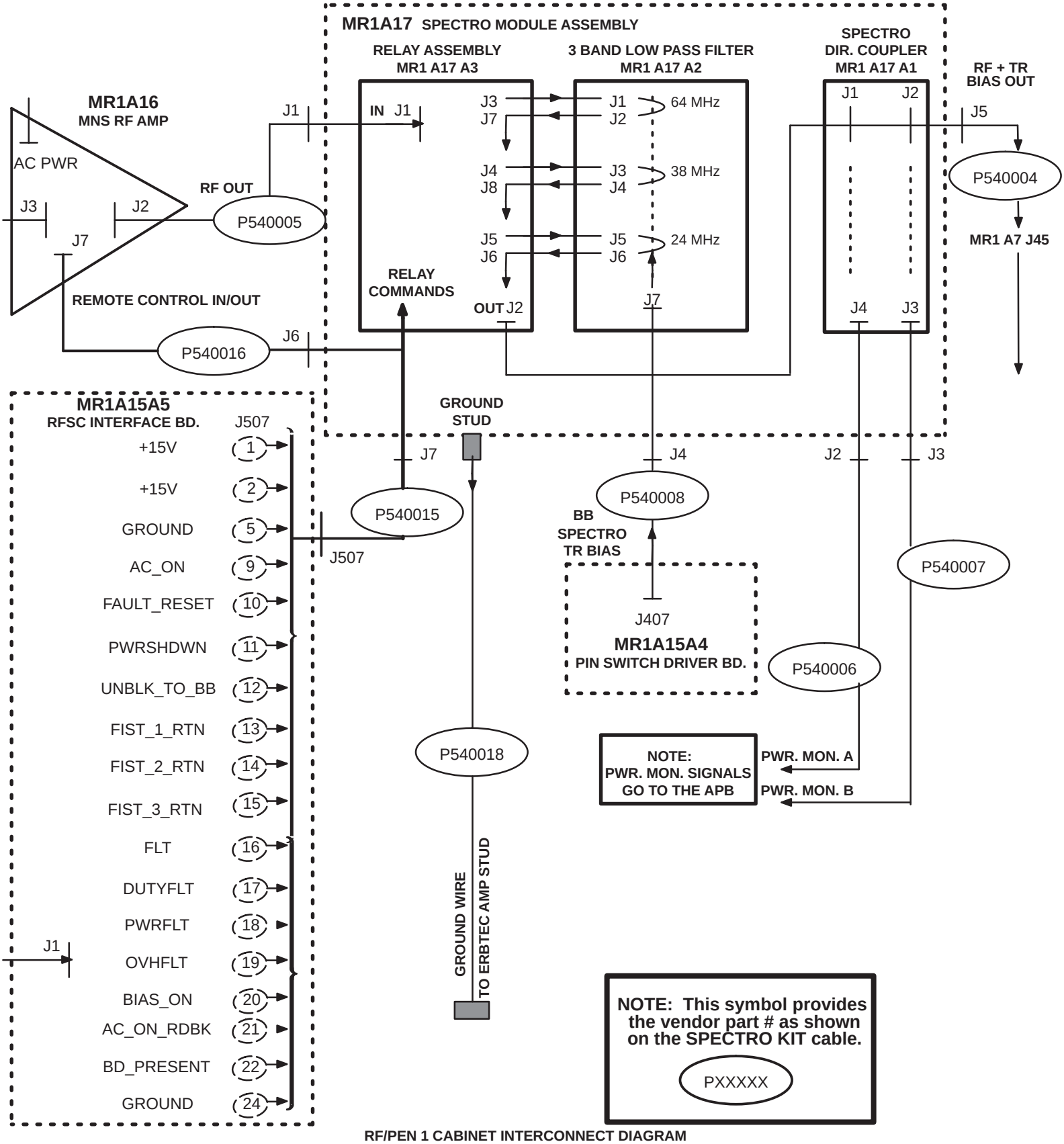
The second band (40 MHz) has input J3 and output J4. The loss within the pass–band (DC to 38 MHz) is $\leq$ 0.25 dB. The stop–band has a minimum attenuation of 40 dB for frequencies greater than 80 MHz.

The third band (64 MHz) has input J1 and output J2. The loss within the pass–band (DC to 64 MHz) is $\leq$ 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.

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.



RF/PEN 1 CABINET INTERCONNECT DIAGRAM
ILLUSTRATION 2–1

2–2 FILTER RELAY ASSEMBLY

Refer to Illustrations 2–1 and 2–2:

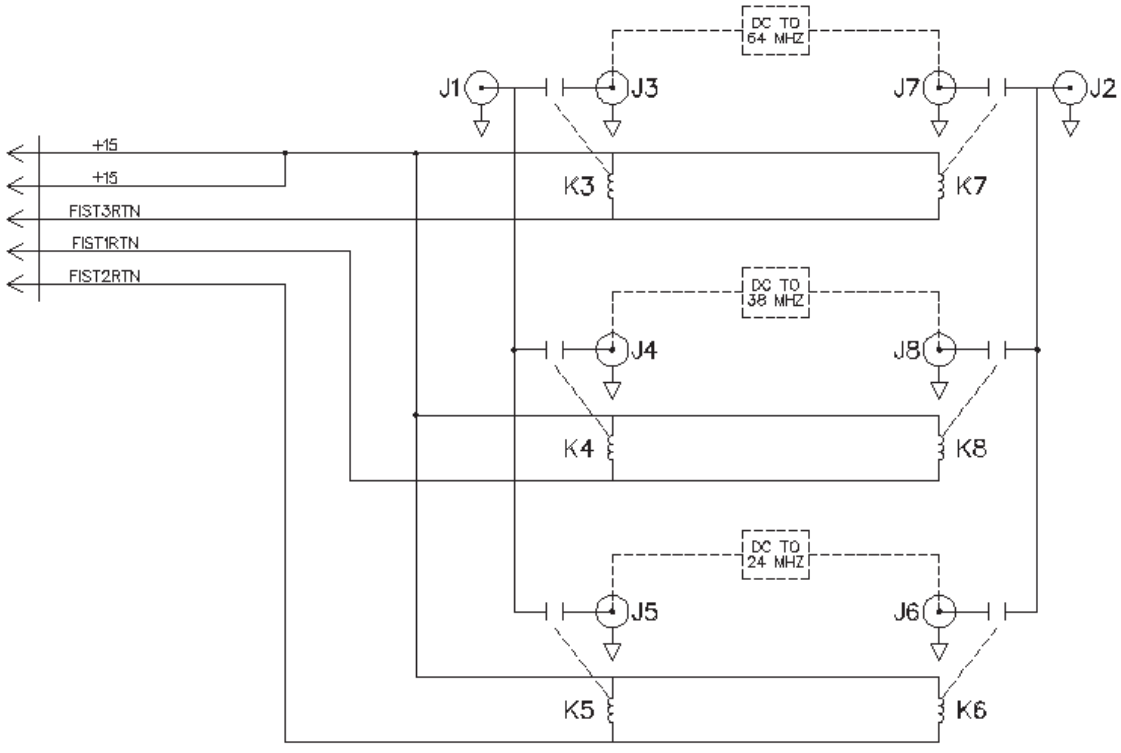
If the Filter Relay Assembly is suspected to be failing, use the following procedure to check out the assembly's functionality. Be aware that one coaxial connection and corresponding relay on each side of the Filter Relay Assembly is left open/unused. Be sure to note the location of any coaxial cables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

1. Remove cover from Spectroscopy Module Assembly MR1A17.
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

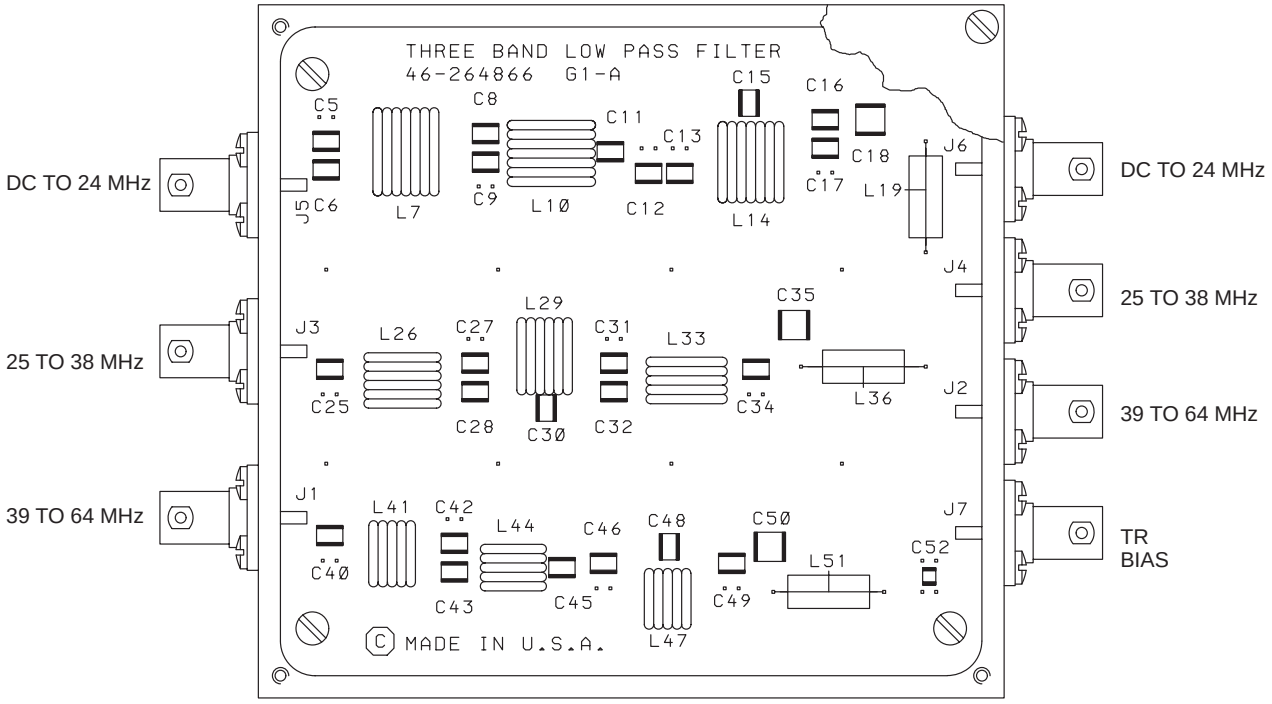
All non–selected relay wires should equal 15 VDC.

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

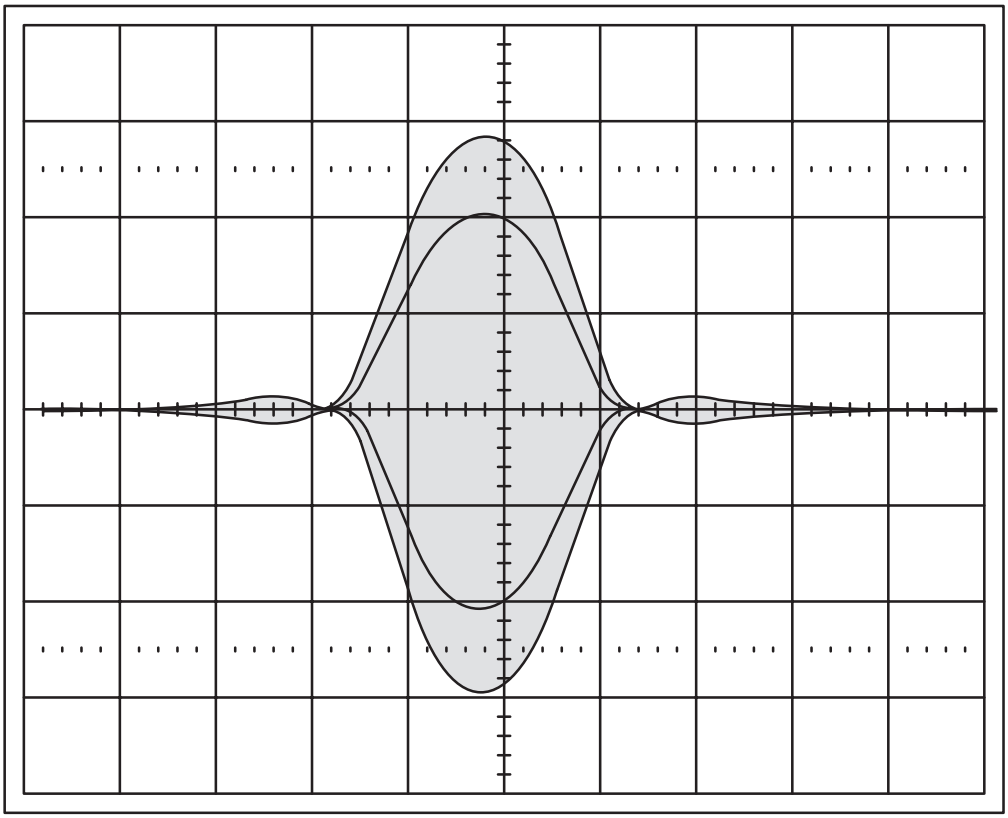
Refer to Illustrations 2–1 and 2–3:

1. Remove cover from Spectroscopy Module Assembly MR1A17.
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 (MR1 A16 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

NI IT S

D RO G EGC

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 Module Assembly MR1A17.
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).

SECTION 3 – TRANSMIT CHAIN RF OUT CHECKS

NOTE
This Section applies to M1040JB and M1090JZ.

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.

Circuit Analysis: Spectro Gain Adjust pot range assuming 8 dBm (1.5887 VP–P) RF In (no cable losses accounted for or other hardware)

RF/PEN 1, RFSC, Spectro RF OUT at J104
J105 RF IN value 8 dBm – 6 dB = 2 dBm (.796 VP–P)
Analysis: {1.875 gain stage value (R293 minimum) to 11.99 gain stage value (R293 maximum)}
(.796 VP–P) * 1.875 = 1.492 VP–P or 7.46 dBm to (.796 VP–P) * 11.99 = 9.54 VP–P or 23.58 dBm
– 9.266 dB at output =
J104: (R293 min. is –1.8 dBm, .513 VP–P) to (R293 max. is 14.3 dBm, 3.28 VP–P)

RF/PEN 2, SSM, Spectro RF OUT at J104
J3 RF IN value 8 dBm – 9.5 dB = –1.5 dBm (.53176 VP–P)
Analysis: {1.465 gain stage value (R22 minimum) to 24.7 gain stage value (R22 maximum)}
(.5317 VP–P) * 1.465 = .77903 VP–P or 1.8167 dBm to (.5317 VP–P) * 24.7 = 13.134 VP–P or 26.35 dBm
J104: (R22 min. is 1.8167 dBm, .779 VP–P) to (R22 max. is above 10 VP–P and the op amp is saturated)

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. Tables 3–1 and 3–2 show 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: Check MR1A18 and the Spectro Gain Adjust pot:
RF/PEN 1 —— RFSC —— R293
RF/PEN 2 —— SSM ——R22

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 3–1 shows, our example voltage should be around 250 mV peak–to–peak.
7. Verify TG = 200 (if necessary).
8. Measure voltage.
9. Record voltage.

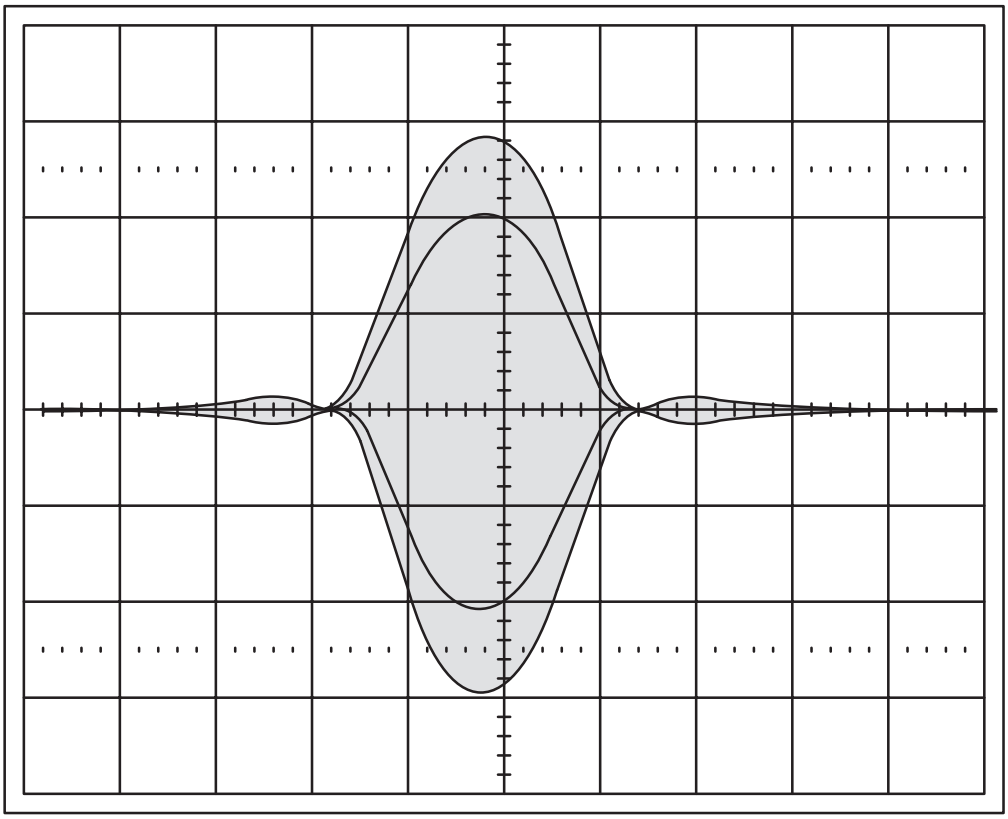
   As table 3–1 shows, our example voltage should be around 2 V peak–to–peak.
10. Verify TG = 0.
11. Press **[Stop Acquisition].**
12. Reconnect cabling.
13. Move to next logical connection point to determine failure(s).

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 (MR1 A16 J2, RF OUT) and output of Filter Relay Assembly, the RF may look distorted due to higher harmonics. Illustration 3–1 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). #1 and #2 refer to RF/Pen 1 or RF/Pen 2 Cabinet.			
MR2 A15 A18 J12 (5.X)	**.2 – .3**	**1.6 – 2.2**	**Measure TPS Exciter Board's SMB connector**
MR2 A11 J1 (without PROBE FILTER)	**.2 – .3**	**1.6 – 2.2**	**Measure MR2 I/F Panel BNC connector (Cable loss can be –1 dB)**
MR1 A7 J3 – #1	**.2 – .3**	**1.6 – 2.2**	**Measure cable's BNC connector––Run 229 (Cable loss can be –1 dB to –2 dB)**
MR1 A20 A1 J3 – #2	**.2 – .3**	**1.6 – 2.2**	**Measure cable's BNC connector––Run 229 (cable loss can be –1 dB to –2 dB)**
MR1 A15 J105 – #1	**.2 – .3**	**1.6 – 2.2**	**Measure cable's BNC connector**
MR1 A15 J104 – #1	**.2 – .3**	**1.6 – 2.2**	**Measure RFSC Panel's BNC connector (from APB)**
MR1 A20 A1 J104 – #2	**.2 – .3**	**1.6 – 2.2**	**Measure SSM Panel's BNC connector (from APM)**
MR1 A18 J1	**.2 – .3**	**1.6 – 2.2**	**Measure cable's BNC connector**
All measurements represent the MNS RF Signal after Spectro Gain Adjustment pot and MR1A18 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).			
MR1 A18 J2	**.067 – .084**	**.447 –.632**	**Measure attenuator BNC connector**
MR1 A16 J3	**.067 – .084**	**.447 –.632**	**Measure cable's BNC connector (RF IN to MNS AMP)**

3–4 TRANSMIT CHAIN CONNECTION POINTS, VOLTAGES AND COMMENTS (Continued)

TABLE 3–2
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**.
Verify the RFSC front Switch is in the service/bypass position 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).			
MR1 A16 J2	**.945 – 1.065**	**7.09 – 7.96**	**Measure N connector of MNS Amplifier**
MR1 A17 J1	**.945 – 1.065**	**7.09 – 7.96**	**Measure cable's N connector**
MR1 A17 Internal J1	**.945 – 1.065**	**7.09 – 7.96**	**Measure cable's N connector (center relay input)**
MR1 A17 Internal J4	**.945 – 1.065**	**7.09 – 7.96**	**Measure BNC relay connector (from ^{31}P relay)**
MR1 A17 Internal J3	**.945 – 1.065**	**7.09 – 7.96**	**Measure cable's connector (to ^{31}P 3BLP Filter)**
MR1 A17 Internal J4	**.945 – 1.065**	**7.09 – 7.96**	**Measure 3BLP Filter BNC connector (exiting ^{31}P 3BLP Filter)**
MR1 A17 Internal J8	**.945 – 1.065**	**7.09 – 7.96**	**Measure BNC cable's connector (from ^{31}P 3BLP Filter)**
MR1 A17 Internal J2	**.945 – 1.065**	**7.09 – 7.96**	**Measure relay N connector (center relay output)**
MR1 A17 Internal J1	**.945 – 1.065**	**7.09 – 7.96**	**Measure cable's N connector (input to coupler)**
MR1 A17 Internal J2	**.945 – 1.065**	**7.09 – 7.96**	**Measure coupler's N connector (output of coupler)**
MR1 A17 J5	**.945 – 1.065**	**7.09 – 7.96**	**Measure Spectro Module Assembly N connector**
MR1 A7 J45	**.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 – MNS COMPONENT / PIN SIGNAL LOCATIONS

(FOR RF/PEN 1 and RF/PEN 2CABINETS)

Note

This section applies to M1040JC and M1090ST.

4–1 MULTI–NUCLEAR SIGNALS ON THE CM/PM BOARD IN THE RFSC of the RF/Pen1 Cabinet

(located near ribbon cables at bottom——all cables must be connected when making measurements)

1.	U16,	PIN 18	AC_ON	High
2.	U16,	PIN 16	FAULT_RESET	Low
3.	U16,	PIN 14	POWER_SHUTDOWN	Low
4.	U16,	PIN 12	UNBLANK_TO_BB	Unblank Signal when pulsing BB
5.	U48,	PIN 15	FIST_1_RTN (^{phosphorus})	($^{DC–38MHz}$) relay selected will be low (pibbandfilt=1)
6.	U48,	PIN 16	FIST_2_RTN($^{carbon/sodium/lithium}$)	($^{DC–24MHz}$) relay selected will be low (pibbandfilt=2)
7.	U48,	PIN 17	FIST_3_RTN (^{fluorine})	($^{DC–64MHz}$) relay selected will be low (pibbandfilt=0)
8.	U59,	PIN 2	FAULT	Low
9.	U59,	PIN 4	DUTY_FAULT	Low
10.	U59,	PIN 6	POWER_FAULT	Low
11.	U59,	PIN 8	OVERHEAT_FAULT	Low
12.	U59,	PIN 13	AC_ON_READBACK	High
13.	U59,	PIN 17	BOARD_PRESENT	Low

4–2 SPECTROSCOPY BOARD PART NUMBER AND REVISIONS (RF/Pen1)

Older revisions of the Circuit Boards located in the RFSC may present a problems. The revisions listed below represent the minimal acceptable board revision for Horizon LX MNS. The Circuit Board part number is listed before the board revision. Part numbers and board revisions will vary, however, when experiencing Multi–Nuclear Spectroscopy problems have these numbers ready.

1. CM/PM Board (Communication Manager / Power Monitor Board): 450003.07
2. APB (Analog Processor Board): 450002.05
3. Pin Switch Driver Board: 450158.06

4–3 ASSOCIATED MULTI–NUCLEAR SPECTROSCOPY REVISIONS (RF/Pen1)

1. EPROM U42, located on the CM/PM Board in the RFSC, should be at least 1.8 Revision.
2. PAL U40, located on the CM/PM Board in the RFSC, should be 6D04.
3. Spectro RF Out Adjust Circuitry, adjust MNS RF Out using MR1A18 Mechanical Attenuator (+possibly R293).
4. Processor Board requires a special EPROM for Spectroscopy users.

4–4 MULTI–NUCLEAR SIGNALS ON THE J507 CABLE and the REAR INTERFACE BOARD IN THE SSM of the RF/Pen2 Cabinet (all cables must be connected when making measurements)

	MR1A20 REAR I/F BOARD J507	ROW, PIN	Signal Name	Status
1.	1	B10, 42	+15 VDC	+15 VDC
2.	2	C10, 74	+15 VDC	+15 VDC
3.	5	A2, 2	GROUND	Low
4.	9	C13, 77	AC_ON	High
5.	10	C15, 79	FAULT_RESET	Low
6.	11	A16, 16	POWER_SHUTDOWN	Low
7.	12	C16, 80	UNBLANK_TO_BB	Unblank Signal to Spectro Amp when pulsing MNS
		C11, 75	S–UNBLK–N	Unblank Signal when pulsing MNS
		C12, 76	S–UNBLK–P	Unblank Signal when pulsing MNS
8.	13	A9, 9	FIST_1_RTN (^{phosphorus})	($^{DC–38MHz}$) relay selected will be low (pibbandfilt=1)
9.	14	B7, 39	FIST_2_RTN($^{carbon/sodium/lithium}$)	($^{DC–24MHz}$) relay selected will be low (pibbandfilt=2)
10.	15	C9, 73	FIST_3_RTN (^{fluorine})	($^{DC–64MHz}$) relay selected will be low (pibbandfilt=0)
11.	16	C6, 70	FAULT	Low
12.	17	B13, 45	DUTY_FAULT	Low
13.	18	B19, 51	POWER_FAULT	Low
14.	19	A7, 7	OVERHEAT_FAULT	Low
15.	20	B16, 48	BIASON	High
16.	21	C18, 82	AC_ON_READBACK	High
17.	22	B8, 40	BOARD_PRESENT	Low

4–5 SPECTROSCOPY BOARD PART NUMBER AND REVISIONS (RF/Pen2)

Older revisions of the Circuit Boards located in the RF/Pen2 Cabinet SSM will present problems for MNS users. The revisions listed below represent the minimal acceptable board revision for Horizon LX MNS. The Circuit Board part number is listed before the board revision. Part numbers and board revisions will vary over time, however, when experiencing Multi–Nuclear Spectroscopy problems have these numbers ready to discuss.

1. CPD (Communications PIN Driver Board): 550015.05
   (with micro—> U8, 550061.03 checksum 2DC7 date 10/7/97).
2. APM (Analog Power Monitor Board): 550013.05
   (with identical micro's—> U8 and U1, 550063.01 checksum A000 date 10/3/97).

4–6 ASSOCIATED MULTI–NUCLEAR SPECTROSCOPY REVISIONS (RF/Pen2)

1. Microprocessors: 3 Total.
2. Spectro RF Out Adjust Circuitry, adjust MNS RF Out using Mechanical MR1A18 Attenuator (+possibly R22).
3. Processor Board requires a special EPROM for Spectroscopy users.

SECTION 5 – 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.

5–1 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).*

5–1–1 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

5–1–1 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 6 – 8T/3R ^{31}P SPECTROSCOPY SURFACE COIL CHECKS

Note
This section applies to M1040JB and M1090JZ.

6–1 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).

6–2 (^{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 7 – SPECTROSCOPY AMPLIFIER CHECKS

NOTE
This Section applies to M1040JB and M1090JZ.

7–1 INTRODUCTION

Description

For Troubleshooting Purposes ONLY

All Section 7 tests 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 5 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.

7–2 ANALOGIC AMPLIFIER (AN8063G)
Weight: Greater than 130 lbs
Greater than 59 kgs

7–2–1 ANALOGIC AMPLIFIER (AN8063G)––DETERMINE VISUAL FAILURE

Verify AN8063G Front Panel LED Status Function per Table 7–1:

TABLE 7–1
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.

7–2–2 ANALOGIC AMP, (AN8063G)––FRONT PANEL DIAGNOSTIC LED STATUS FUNCTION, Table 7–2

TABLE 7–2
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.

7–2–3 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 Section 5 Trouble–shooting signal pin locations for J507 Spectro Connection. The Spectro Module Assembly (MR1A17) 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.

7–2–4 ANALOGIC AMPLIFIER (AN8063G), UNBLANK LED NOT ON DURING MNS SCANNING

1. Section 5 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 AN8063G Vendor Manual for 15 position D cable connection pin location. Also, this signal can be easily accessed at MR1A17 internal Sub D connection.

7–2–5 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.

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.

7–2–6 ANALOGIC AMPLIFIER (AN8063G), FORWARD POWER SAMPLE

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

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

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

7–2–8 ANALOGIC AMPLIFIER CONTROL BOARD JUMPERS

1. Dev Fail —— IN. AC On Reset —— OUT. Auto Reset —— OUT.

7–3 ENI AMPLIFIER (MRI–2000)

Weight: 77 lbs
34.9 kgs

7–3–1 ENI AMPLIFIER (MRI–2000)––DETERMINE VISUAL FAILURE

Verify ENI Front Panel Function per Table 7–1:

TABLE 7–3
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.

7–3–2 ENI AMP, (MRI–2000)––CABLE CONNECTIONS, Table 7–2

TABLE 7–4
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.**

7–3–3 ENI AMP, (MRI–2000)––FRONT PANEL FUNCTION, Table 7–5

TABLE 7–5
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.

7–3–4 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 5 Trouble–shooting signal pin locations for J507 Spectro Connection. The Spectro Module Assembly (MR1A17) 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)

7–3–5 ENI AMPLIFIER (MRI–2000), UNBLANK LED NOT ON DURING MNS SCANNING

1. Section 5 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 MR1A17 internal Sub D connection.

7–3–6 ENI AMP, (MRI–2000)––TROUBLESHOOTING GUIDE, Table 7–6

TABLE 7–6
ENI TROUBLESHOOTING GUIDE

AC on light does not light	Circuit Breaker open	Turn on Circuit Breaker
	Blown fuse	Replace fuse (2A, Slo–Blo)
	Defective Power Supply	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	Visually inspect connectors for broken pins.
	Defective input or output cables	Visually inspect cables
	Bias not gated	Check for proper on gating signal level (TTL)
Low RF Output	Defective cables	Visually inspect or change cables
	Faulty Power Supply voltage	Check power supply with front panel meter
	Defective RF Amplifier module	FRU
Excessive Distortion	Defective RF Amplifier module	FRU
Amplifier Overheating	Defective fan	Check that fan is operating

7–4 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:**

CANI DGE

––– 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 ÷ .02 Ω = ~1.2 Amps, ± 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.

7–4 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.

SECTION 1 – BROADBAND RF AMPLIFIER (MR1A16)

Note
This Section applies to M1040JB and M1090JZ.

1–1 BROADBAND RF AMPLIFIER REPLACEMENT (MR1A16)

Remove BroadBand RF Amplifier (A16) from RF/PEN Cabinet (MR1) as follows:

1. Disconnect power to the BroadBand Amplifier at the BroadBand Circuit Breaker. The Erbtec Amplifier power is not affected at this time.
2. Tag power source to leave switch/circuit breaker in off position due to “cabinet in service”.
3. Remove four pan head screws/washers from rear of cabinet below shelf to move Spectro Module Assembly to the side to access rear of BroadBand RF Amplifier.
4. Remove AC power plug at the rear of the BroadBand RF Amplifier.
5. Tag and remove cables J2 (RF OUT), J3 (Spectro RF IN), and J7 (Remote Control In/Out) from rear panel of BroadBand RF Amplifier.
6. Remove four screws from front panel (these hold the BroadBand RF Amplifier in the cabinet).

CAUTION

Two people are required to lift the MULTI–NUCLEAR Spectroscopy RF Amplifier off the shelf.

7. The Power line–cord is part of the BroadBand Amplifier and **must be retained** with it. See NOTE.
8. Slide amplifier off of shelf and out the front of the MR1 cabinet. The BroadBand RF Amplifiers can weigh up to 130 pounds, at least two people are required to lift this equipment. Verify all parts of the Amplifier are being returned as there is a charge for incomplete returns.

Note

The Analogic RF Amplifier may have a **filtered front grill** and **side handles** that interfere with the installation of the Cabinets front cover, however, this has only been reported as an issue on Horizon Systems. The Horizon Based System’s front cover of the cabinet has a filter incorporated into it. In this case it is acceptable to remove the Analogic RF Amplifiers filtered front grill and side handles. This hardware **must be retained/reinstalled** in the case of exchange/return.

The **power line–cord** is part of the BroadBand RF Amplifier. The power line–cord must be returned with the Amplifier. A new power line–cord must be received with the exchange/replacement. This is important because all power line–cords are **not compatible** with the different styles of BroadBand Amplifiers.

1–1 RF AMPLIFIER REPLACEMENT (Continued)

Install BroadBand RF Amplifier (A16) into RF/PEN Cabinet (MR1) as follows:

9. Slide amplifier on to shelf and into the front of the MR1 cabinet.
10. Install four screws into front panel of the BroadBand Rf Amplifier.
11. Route the new power line–cord.
12. Install cables J2, J3, and J7 onto rear panel of BroadBand RF Amplifier. Refer to the IC Illustrations at the end of the Installation Section.
13. Install AC power plug into BroadBand RF Amplifier. Connect it to the extension power cable located on the right side of the cabinet.
14. Verify BroadBand RF Amplifier circuit breaker at front (ENI) or rear (Analogic) of the Spectro Amplifier is on.
15. Install four pan head screws/washers in rear of cabinet below shelf to install (silver) Spectro Module Assembly [MR1 A17].
16. Turn MR1 I/F panel BroadBand switch/circuit breaker to the on position and remove “cabinet in service” tag.

SECTION 2 – SPECTRO MODULE ASSEMBLY (MR1A17)

Note
This Section applies to M1040JB and M1090JZ.

2–1 SPECTRO MODULE ASSEMBLY REPLACEMENT (MR1A17

Remove Spectro Module Assembly (A17) as follows:

1. Make sure all circuit breakers on the RF/PEN Cabinet (MR1) have been turned OFF.
2. Make sure power to RF/PEN Cabinet (MR1) has been disconnected.
3. Tag power source to leave switch/circuit breaker in off position due to “cabinet in service”.
4. Put on a grounded wrist band.
5. Tag and remove cables from Spectro Module Assembly:
   MR1A17J1 2 kW RF IN
   MR1A17J2 Power Monitor Spectro Sense A
   MR1A17J3 Power Monitor Spectro Sense B
   MR1A17J4 Spectro TR Bias
   MR1A17J5 2 kW RF OUT
   MR1A17J6 Remote Control In/Out
   MR1A17J7 Spectro Relay Control
   Ground Wire Connects to the Ground Stud
6. Remove four #10–32 screws/washers which secure the Spectro Module Assembly to shelf at rear of RF/PEN Cabinet.
7. Remove Spectro Module Assembly from RF/PEN Cabinet.

2–2 SPECTRO MODULE ASSEMBLY INSTALLATION

Install Spectro Module Assembly (A17) as follows:

1. Put on a grounded wrist band.
2. Connect the following cables to the Spectro Module Assembly:
   MR1A17J1 2 kW RF IN
   MR1A17J2 Power Monitor Spectro Sense A
   MR1A17J3 Power Monitor Spectro Sense B
   MR1A17J4 Spectro TR Bias
   MR1A17J5 2 kW RF OUT
   MR1A17J6 Remote Control In/Out
   MR1A17J7 Spectro Relay Control
   Ground Wire Connects to the Erbtec RF Amplifier
3. Remove the grounded wrist band.
4. Remove “cabinet in service” tag from switch/circuit breaker.
5. Install AC power plug into RF/PEN cabinet.
6. Make sure all circuit breakers on the RF/PEN Cabinet (MR1) have been turned ON.

SECTION 3 – SYSTEM CABINET (MR2)

Note
This Section applies to M1040JB and M1090JZ.

3–1 BROADBAND RECEIVER MODULE REPLACEMENT

Remove BroadBand Receiver Module (A3) as follows:

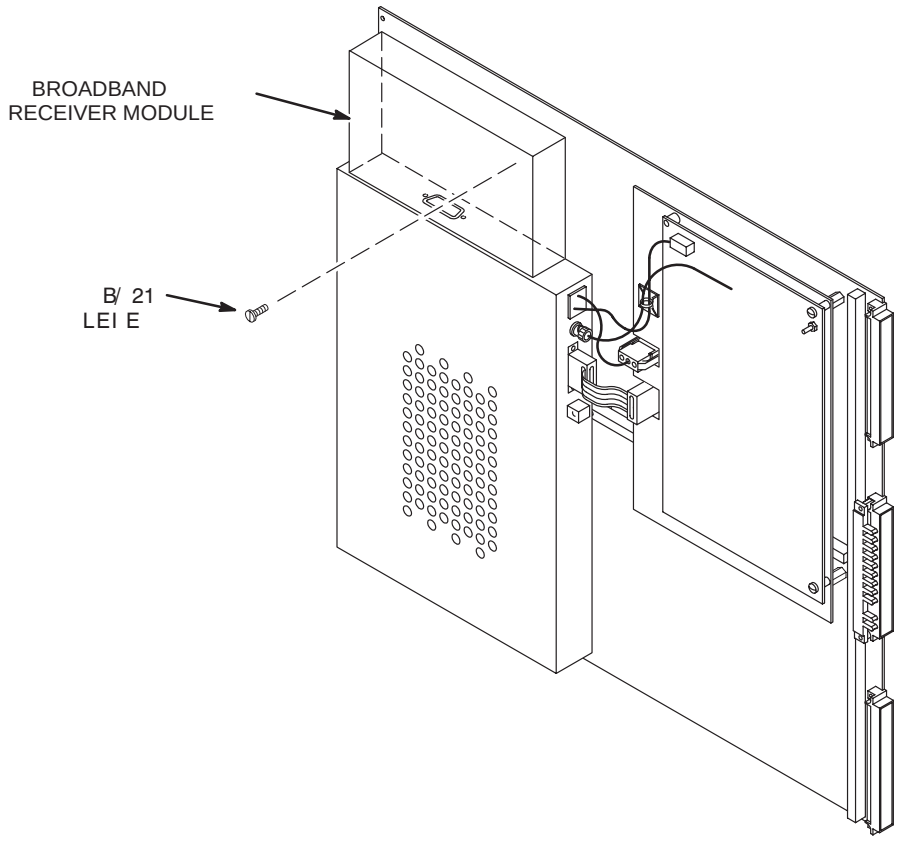
1. Make sure power to Gradient (MR3) and Systems Cabinet (MR2) have been disconnected.
2. Put on a grounded wrist band.
3. Tag and simultaneously disconnect connector J12 from Receiver Board and connector J14 from Exciter Board.
4. Remove two screws securing Receiver Board to cabinet.
5. Use ejector clips to push Receiver Board out from connector at rear of chassis.
6. Remove Receiver Board out from chassis.
7. Put Receiver Board in a static free bag.
8. Put static free bag with Receiver Board onto a work bench.
9. Make sure grounded wrist band is on.
10. Remove Receiver Board from static free bag.
11. Remove four #6–32 screws and BroadBand Receiver Module from Receiver Board. Refer to Illustration 3–1.

TABLE 3–1
POWER SUPPLY REQUIREMENTS

NOMINAL VOLTAGE	TOLERANCE	RIPPLE	CURRENT (max)
+ 18VDC	**+3%**	**5% p–p**	**100 milliamp**

Note
Whenever possible, measure power supplies using an oscilloscope to determine if ripple is present and problematic.

3–1 BROADBAND RECEIVER MODULE REPLACEMENT (Continued)



BROADBAND RECEIVER MODULE REMOVAL/INSTALLATION
ILLUSTRATION 3–1

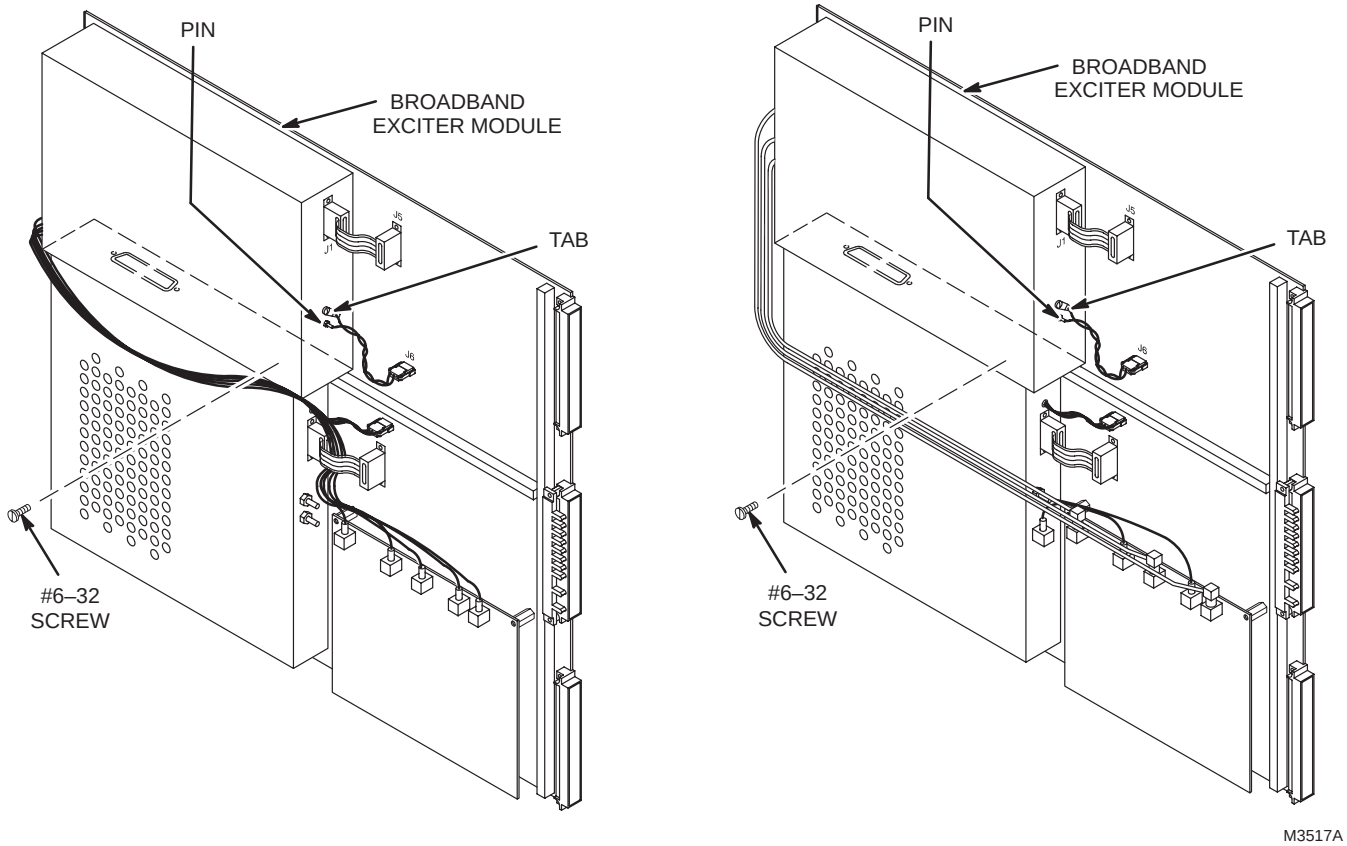
Install BroadBand Receiver Module (A3) as follows:

1. Put on a grounded wrist band.
2. Install four #6–32 screws and Broadband Receiver Module onto Receiver Board. Refer to Illustration 3–1. Tighten screws.
3. Put Receiver Board in a static free bag.
4. Move static free bag with Receiver Board to Systems cabinet.
5. Make sure grounded wrist band is on.
6. Remove Receiver Board from static free bag.
7. Slide Receiver Board into chassis until connector seats firmly at back of chassis.
8. Install two screws to secure Receiver Board to cabinet.
9. Simultaneously install connector J12 onto Receiver Board and connector J14 onto Exciter Board.

3–2 BROADBAND EXCITER MODULE REPLACEMENT

Remove BroadBand Exciter Module (A3) as follows:

1. Make sure power to Systems Cabinet has been disconnected.
2. Put on a grounded wrist band.
3. Tag and simultaneously disconnect connector J12 from Receiver Board and connector J14 from Exciter Board.
4. Remove two screws securing Exciter Board to cabinet.
5. Use ejector clips to push Exciter Board out from connector at rear of chassis.
6. Remove Exciter Board out from chassis.
7. Put Exciter Board in a static free bag.
8. Put static free bag with Exciter Board onto a work bench.
9. Make sure grounded wrist band is on.
10. Remove Exciter Board from static free bag.
11. Tag and disconnect connectors J5 and J6 from Exciter Board. Refer to Illustration 3–2.
12. Remove four pan head screws and BroadBand Exciter Module from Exciter Board. Refer to Illustration 3–2.



BROADBAND EXCITER REMOVAL/INSTALLATION
ILLUSTRATION 3–2

3–2 BROADBAND EXCITER MODULE INSTALLATION (Continued)

Install BroadBand Exciter Module (A3) as follows:

1. Put on a grounded wrist band.
2. Install four pan head screws and Broadband Exciter Module onto Exciter Board. Refer to Illustration 3–2. Tighten screws.
3. Connect connectors J5 and J6 onto Exciter Board. Refer to Illustration 3–2.
4. Put Exciter Board in a static free bag.
5. Move static free bag with Exciter Board to Systems cabinet.
6. Make sure grounded wrist band is on.
7. Remove Exciter Board from static free bag.
8. Slide Exciter Board into chassis until connector seats firmly at back of chassis.
9. Install two screws to secure Exciter Board to cabinet.
10. Simultaneously install connector J12 onto Receiver Board and connector J14 onto Exciter Board.
11. Connect power to Systems Cabinet.

SECTION 4 – PENETRATION PANEL (PP1)

Note
This Section applies to M1040JB and M1090JZ.

4–1 20 dB GAIN BLOCK

Remove 20 dB Gain Block (A13) from Penetration Panel (PP1) as follows:

1. Put on a grounded wrist band.
2. Disconnect connector (OUT) of cable (Run 469) from connector (OUT) of 20 dB Gain Block (A13) on outside of Penetration Panel (PP1).
3. Disconnect connector (IN) of cable on connector J79 of Penetration Panel (PP1) from connector (IN) of 20 dB Gain Block (A13).
4. Remove four screws and 20 dB Gain Block from Penetration Panel (PP1).
5. Put 20 dB Gain Block (A13) in a static free bag.
6. Put static free bag with 20 dB Gain Block (A13) onto a work bench.

Install 20 dB Gain Block (A13) onto Penetration Panel (PP1) as follows:

1. Put on a grounded wrist band.
2. Remove 20 dB Gain Block (A13) from static free bag.
3. Install four screws and 20 dB Gain Block (A13) onto Penetration Panel (PP1). Tighten screws.
4. Install connector (IN) of cable on connector J79 of Penetration Panel (PP1) onto connector (IN) of 20 dB Gain Block (A13).
5. Install connector (OUT) of cable (Run 469) onto connector (OUT) of 20 dB Gain Block (A13) on Penetration Panel (PP1).

SECTION 1 – INTERCONNECTS

Interconnect diagrams show cable connections within the RF/PEN CABINET (MR1). Interconnection diagrams of the equipment room and magnet room are also provided for the Spectroscopy Subsystem.

Run 466 may still be delivered with M1040JB, however, this cable is not necessary as Run 229 (MR2A11J1 to MR1A7J3) already exists.

Total cable interconnections for a forward production Signa Horizon system (5.5 Release) with Spectroscopy Option are located in the Installation tab. Interconnect cables that are specific to the M1040JB Spectroscopy Option are listed in Table 1–1. Table 1–2 applies to M1040JB and M1090JZ.

M1090JZ is an existing BroadBand Spectroscopy upgraded to (5.5 Release) Horizon. The Spectro Heliax Cable (Run 468), and the Exciter RF OUT Cable (Run 466) will both need to be re–routed for M1090JZ upgrades. Additionally, Run # 459, 460, 461, 462, 463, 464, 465, and 467 will be removed with the M1090JZ upgrade. Table 1–2 applies to M1040JB and M1090JZ Options delivered before the introduction of the RF/Pen 2 Cabinet.

Table 1–3 and 1–4 apply to M1040JB and M1090JZ Options delivered after the introduction of the RF/Pen 2 Cabinet.

TABLE 1–1
SIGNA HORIZON (5.5 RELEASE in the RF/Pen 1 Cabinet) SPECTROSCOPY OPTION CABLES

RUN	"FROM"	"TO"	DESCRIPTION	DELIVERED WITH CAT#	REMARKS
466	MR2 A11 J1	MR1 A7 J3	50 ft RG223/U Coax (BNC)	maybe JB	Run 229 already exists here
468	MR1 A7 J45	PP1 J83	50 ft Heliax Coax (N to SC)	M1040JB	SPECTRO OUT + TR BIAS
469	PP1 A13 OUT	MR2 A11 J3	50 ft RG223/U Coax (BNC)	M1040JB	Spectro Receive (+ 15 VDC RCV Bias)
472	MG3 A11 J3	PP1 A17 J4	80 ft RG223/U Coax (BNC)	M1040JB	Spectro Receive (+ 15 VDC RCV Bias)
473	PP1 J83	MG3 A11 J3	80 ft Heliax Coax (SC TO N)	M1040JB	SPECTRO OUT + TR BIAS

NOTE: The coaxial cable between MR2 A11 J1 and MR1 A7 J3 (Exciter RF) already exists as Run 229. An additional coaxial cable may be delivered, however, this Run 466 is not needed and should not be installed. It has not been required since the MR6 BroadBand Cabinet was removed.

SECTION 1 – INTERCONNECTS (Continued)

TABLE 1–2
SIGNA HORIZON (5.5 RELEASE RF/Pen 1 Cabinet ONLY) SPECTROSCOPY SPECTRO KIT––ORIGINAL KIT, 2109930–10

"FROM"	"TO"	GE #	VENDOR #	REMARKS
MR1A15J104	MR1A16J3	2124497–51	540009	SPECTRO RF IN
MR1A16J2	MR1A17J1	2124497–48	540005	2 kW RF IN
MR1A17J5	MR1A7J45	2124497–47	540004	SPECTRO RF OUT + TR BIAS
MR1A15J507	MR1A17J7	2124497–49	540015	I/F CABLE ASSEMBLY
MR1A17J6	MR1A16J7	2124497–50	540016	BB–I/F CABLE ASSEMBLY
MR1A15J407	MR1A17J4	2124497–55	540008	SPECTRO TR BIAS
MR1A17J2	MR1A15J101	2124497–53	540006	POWER MONITOR SENSE A
MR1A17J3	MR1A15J102	2124497–54	540007	POWER MONITOR SENSE B
MR1A17 Ground	ERBTEC Ground	2124497–52	540018	SPECTRO GROUND WIRE
——	——	2124498–27	540001	SPECTRO MODULE ASSEMBLY
——	——	2124498–28	510132	SPECTRO SHEETMETAL SHELF
——	——	46–221806P2	215–2287	PHILLIPS PANHEAD SS 10–32 X 1/2
——	——	2124498–29	216–0010	SS FLAT WASHER #10
——	——		300–7009	N BULKHEAD ADAPTOR,F–F,UG–30/U

TABLE 1–3
SIGNA HORIZON (5.5 RELEASE RF/Pen 1/2 Cabinet) SPECTROSCOPY SPECTRO KIT, 21309930–11

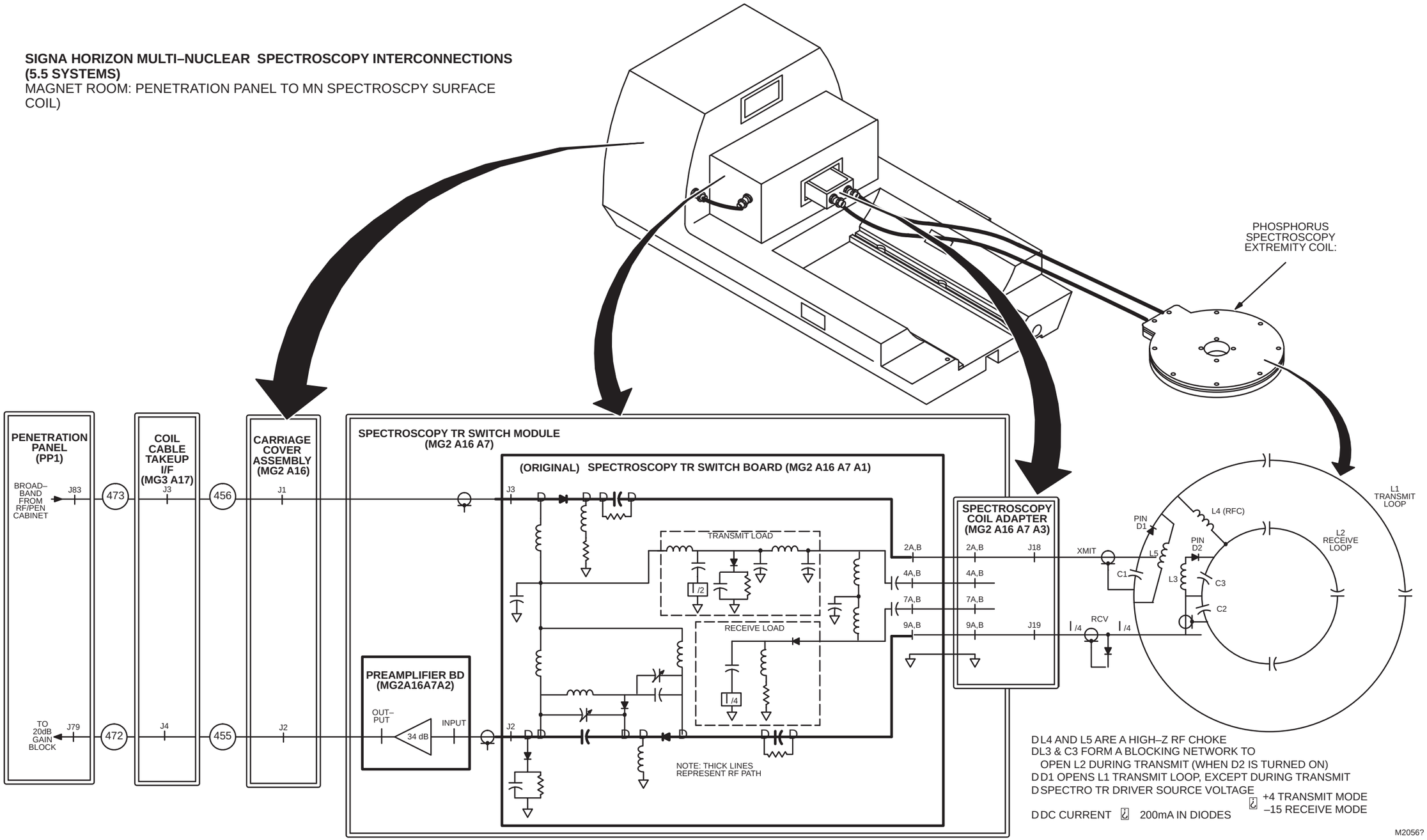
"FROM"	"TO"	GE #	VENDOR #	REMARKS
MR1A17 Ground	ERBTEC Ground	2124497–52	540018	SPECTRO GROUND WIRE (to ground studs)
MR1A15J104 MR1A20A1J104	MR1A18J1	2124497–51	540009	SPECTRO RF IN to ATTENUATOR IN
MR1A18J2	MR1A16J3		540031	ATTENUATOR OUT to Spectro Amp RF IN
MR1A17J5	MR1A7J45	2124497–47	540004	SPECTRO RF OUT + TR BIAS
MR1A15J507 MR1A20J507	MR1A17J7	2124497–49	540015	SPECTRO I/F CABLE ASSEMBLY (main cable)
MR1A15J407 MR1A20A1J407	MR1A17J4	2124497–55	540008	SPECTRO TR BIAS
MR1A17J3	MR1A15J102 MR1A20A1J102	2124497–54	540007	SPECTRO POWER MONITOR SENSE B
MR1A17J2	MR1A15J101 MR1A20A1J101	2124497–53	540006	SPECTRO POWER MONITOR SENSE A
MR1A17J6	MR1A16J7	2124497–50	540016	BB–I/F CABLE ASSEMBLY (control signals to Spectro Amplifier)
MR1A16J2	MR1A17J1	2124497–48	540005	2 kW RF IN from Spectro Amplifier to Spectro Module Asm.

SECTION 1 – INTERCONNECTS (Continued)

TABLE 1–4
SIGNA HORIZON (5.5 RELEASE RF/Pen 1/2 Cabinet) SPECTROSCOPY SPECTRO KIT, 2109930–11

"FROM"	"TO"	GE #	VENDOR #	REMARKS
——	——	2124498–27 46–221806P2 2124498–29	540001 214–2104 215–2287 216–0010	Spectro Module Asm. MR1A17 includes: (1) 10–32 nylon insert nut, (4) #10 SS Flat Washer (4) 10–32 x 1/2 Phillips Panhead Screw
——	——	 46–221806P2	# 214–9903 215–2287	Amplifier Hardware Kit includes: (4) rail clips for Amplifier (4) Phillips Panhead SS Screw 10–32 X 1/2
——	——	2124498–28	# 510132 **215–2529** 214–0215	Shelf Assembly includes: (1) SPECTRO SHEETMETAL SHELF (4) Screw, HexHeadCap, 1/4–20 (4) Nut, Hex keps zinc/steel, 1/4–20
——	——		# 510198 214–2101 215–2260	RF/PEN2 Chimney Kit includes: (1) Multi–Nuclear Spectro Front Cabinet Cover Chimney. (4) 6–32 nylon insert nuts (8) 4–40 x 3/8 phillips screws
——	——	 46–221806P2 2124498–29	# 540029 300–7009 300–70091 300–0511 215–2287 216–0010 214–9903	Spectro I/F Bracket MR1A7 includes: (1) Spectro I/F Bracket (1) N Bulkhead Adaptor, F–F,UG–30/U (1) N Lockwasher (1) BNC 50 ohm Pnl Mnt Adapt, D Style & BNC Lockwasher (2) Phillips Panhead SS Screw 10–32 X 1/2 (2) SS Flat Washer #10 (2) rail clips
——	——		# 379–0006 550061 550063	SSM Micro Kit includes: (1) chip puller (1) RF/PEN 2 Only, micro for CPD (U8) (2) RF/PEN 2 Only, micro for APM (U8 and U1)
——	——		401–2007	RF/Pen 2 Cable Label Kit includes: **RF/PEN2 Only**—always bagged (1) MR1A20A1J104 (1) MR1A20J507 (1) MR1A20A2J407 (1) MR1A20A1J102 (1) MR1A20A1J101
——	——	46–221806P2	215–2287	PHILLIPS PANHEAD SS 10–32 X 1/2
——	——	2124498–29	216–0010	SS FLAT WASHER #10
——	——		300–7009	N BULKHEAD ADAPTOR,F–F,UG–30/U

SIGNA HORIZON MULTI–NUCLEAR SPECTROSCOPY INTERCONNECTIONS (5.5 SYSTEMS)
MAGNET ROOM: PENETRATION PANEL TO MN SPECTROSCPY SURFACE COIL)

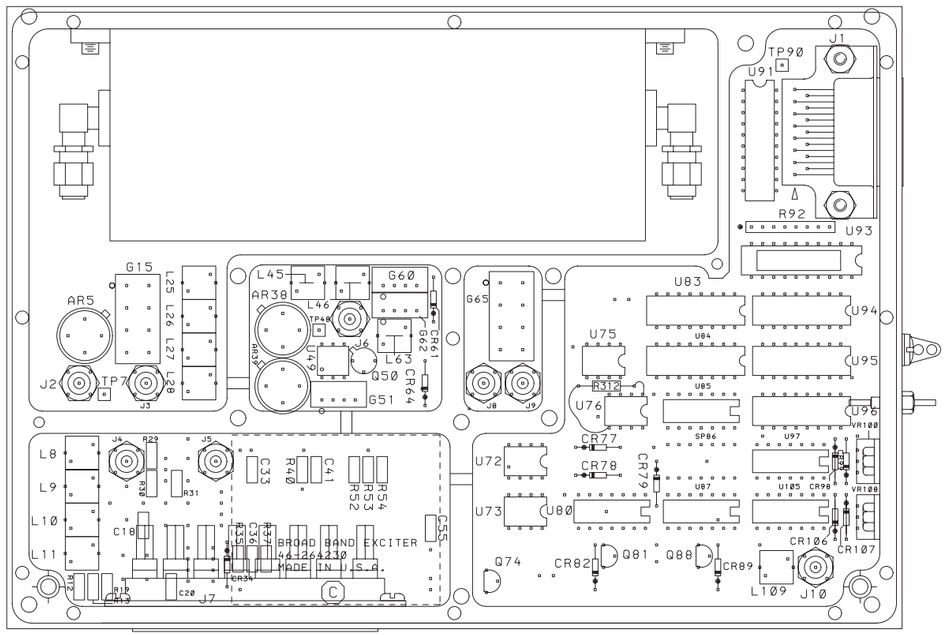


D L4 AND L5 ARE A HIGH–Z RF CHOKE
D L3 & C3 FORM A BLOCKING NETWORK TO
OPEN L2 DURING TRANSMIT (WHEN D2 IS TURNED ON)
D D1 OPENS L1 TRANSMIT LOOP, EXCEPT DURING TRANSMIT
D SPECTRO TR DRIVER SOURCE VOLTAGE +4 TRANSMIT MODE –15 RECEIVE MODE
D DC CURRENT 200mA IN DIODES

M2056?

MR2 A15 A20 A3
BROADBAND EXCITER

46–264230G1–D, G2–E



Description

GENERAL ELECTRIC

46-264230-S
CONT ON SHEET 2 SH NO. 1

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING : -
APPLIED PRACTICES: 46-200600 | SURFACES: √ | TOLERANCES ON DIMENSIONS: DECIMALS (2 PLACES) | DECIMALS (3 PLACES) | ANGLES ±

REV AF
46-264230-S
CONT ON SHEET 2 SH NO. 1

TITLE SCHEMATIC DIAGRAM
BROADBAND EXCITER
FIRST MADE FOR MRSPEC_4.5

P/L ISSUED
46-264230G1-D
46-264230G2-E

THE REVISION NUMBER OF THIS SHEET IS THE CONTROL NUMBER OF THIS ENTIRE DOCUMENT. THIS REVISION NUMBER MUST INCREASE WHENEVER ANY SHEET IS CHANGED.

PCN #	171751	-	158733	158952	171127	171496
DATE / SHT	1JUN91	9FEB90	9MAR90	21JUN90	12SEP90	6MAR91
2	AE	AA	AB	AC	AC	AD

SINE/TTL CONVERTER
MA2 A15 A20 A3
10:1 DIVIDER
2:1 FREQ. DIVIDER
FREF 1 MHZ [2-B1]
FREF 0.5MHZ
190-270 MHZ VCO COURSE TUNE
FINE TUNE MIXER
6dB DIRECTIONAL COUPLER
LOOP AMPLIFIER AND FILTER
210 MHZ LP FILTER/66 MHZ NOTCH
FREQUENCY/PHASE COMPARATOR
DIVIDE BY N (N = 380 TO 570)
+28dB GAIN BLOCK
+14dB GAIN BLOCK
2dB ATTENUATOR
16dB DIRECTIONAL COUPLERS
LOOP LOCK AMPLITUDE DETECT

10 MHZ IN
66MHZ IN
TO DIGITAL EXCITER BOARD
BROADBAND SYNTH (L04)
HL0 [2-F8]
(+24dbm)

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
ALL RESISTORS SURFACE MOUNT 1/8W, 5% AND ARE IN OHMS
CAPS-ALL FRACTIONAL VALUES - UF, ALL OTHERS-PF
ALL INDUCTORS ARE IN NH.
ALL DIODES ARE 1N4148
2. *INDICATES AN ACTIVE LOW.

REVISIONS				PRINTS TO	
AE	GT_6MAR91	AB	DLW_9MAR90	748	
PCN_171496		PCN_158733			
AF	DPB_1JUN91	AC	FEP_21JUN90		
PCN_171751		PCN_158952			
		AD	FEP_12SEP90		
		PCN_171127			

MADE BY F.PIERCE_16OCT89
ISSUED R.WEBB 8FEB90
APPROVALS RCR 9FEB90
MEDICAL SYSTEMS MILWAUKEE, WISCONSIN
46-264230-S CONT ON SHEET 2 SH NO. 1

MR2 A15 A20 A3

GENERAL ELECTRIC

46-264230-S
CONT ON SHEET - SH NO. 2

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING : -
APPLIED PRACTICES: 46-280680 | SURFACES: √ | TOLERANCES ON DIMENSIONS: DECIMALS (2 PLACES) | DECIMALS (3 PLACES) | ANGLES ±

REV AE
46-264230-S
CONT ON SHEET - SH NO. 2

TITLE SCHEMATIC DIAGRAM
BROADBAND EXCITER
FIRST MADE FOR MRSPEC_4.5

P/L ISSUED

LOOP AMPLIFIER AND FILTER

120 MHZ VCO

10dB DIRECTIONAL COUPLER

6dB ATTENUATOR

DEVICES SHOWN TOP VIEW

LM393

MC4018 MC12014 74LS193

C302 ,C303, C320,C325

74HCT244 27S29

C300,C319

MC12013

C309

74LS90 74LS92

C298,C315

C285 ,C304, C310

MC4044 74HCT04

MC12019

7805 7815

U310

+DC AR2 UTO561 UTO222 PA2

MD110 MD138

T9-1

TDC6-1 TDC10-1 TSC2-1

Z-COMM
1 GND
2 +15
3 VC
4 FR OUT
5 +15
6 +5VDC
7 GND
8 GND

78L05

2N3906

HCT04

UNUSED GATE

12dB GAIN BLOCK

10dB GAIN BLOCK

[1-A8] FREF 1 MHZ

U87 74LS92 DIVIDE BY 6

U85 MC4044 FREQUENCY/PHASE COMPARATOR

U75 OPA-22

U49 T9-1

G51 TDC 10-1

AR39 PA2

AR38 UTO 561

U76 MC12019 DIVIDE BY 20 ECL

Q81 2N3906

CR82

CR84 MV104

Q50

U310

L63 85

CR79

R280 1K

ECL TO TTL CONVERTER

120 MHZ BANDPASS FILTER

L45 110

L46 110

10dB DIRECTIONAL COUPLER G60 TDC 10-1

J6 120MHZ(L03) (+21dbm)

FOR G1: 46-301880P1
FOR G2: 46-301880P2

117.5 BANDPASS FILTER
K&L 4C20-117.4/1.25-EO/EO
G353

J9 J2

G65 MD 110

AR5 A82

G15 2,4,5,6 MD138

22dB GAIN BLOCK

J8 2.5MHZ IN

86MHZ LO-PASS FILTER

J3 9-86 MHZ OUT

L03-PRES

J1 TO DIGITAL EXCITER BOARD

U80

U73 LM393

SCHOTTKY CR61 HSCH-3486

G62 TSC 2-1

3dB SPLITTER

LLO

[1-F10] HLO

LOOP LOCK AND AMPLITUDE DETECT

LOW LOCAL OSCILLATOR MIXER

HIGH LOCAL OSCILLATOR MIXER

10dB ATTENUATOR

REVISIONS				PRINTS TO	
AE	DPB_1JUN91	AB	DLW_9MAR90	740	
PCN_171751			PCN_158733		
		AC	FEP_21JUN90		
			PCN_158952		
		AD	GT_6MAR91		
			PCN_171496		

MADE BY F.PIERCE_16OCT89
ISSUED R.WEBB_8FEB90

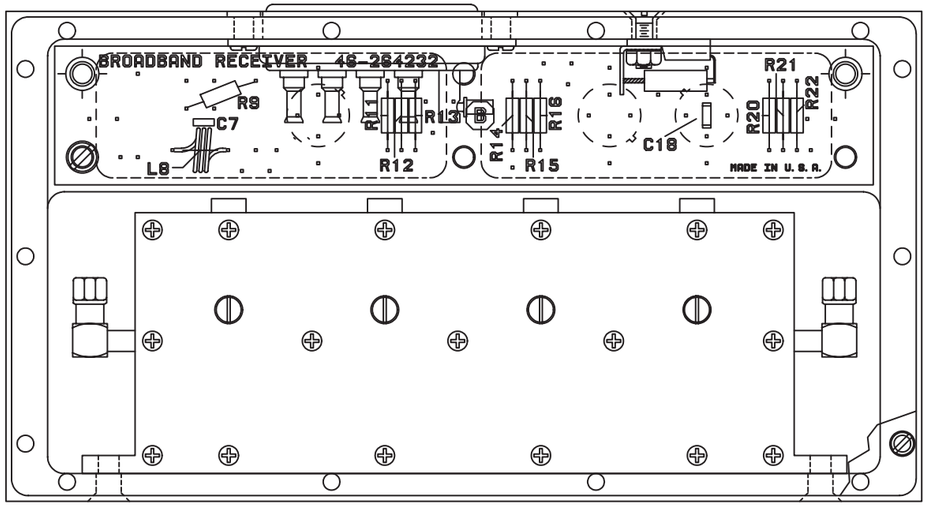
APPROVALS RCR 9FEB90

MEDICAL SYSTEMS — MILWAUKEE, WISCONSIN

46-264230-S
CONT ON SHEET - SH NO. 2

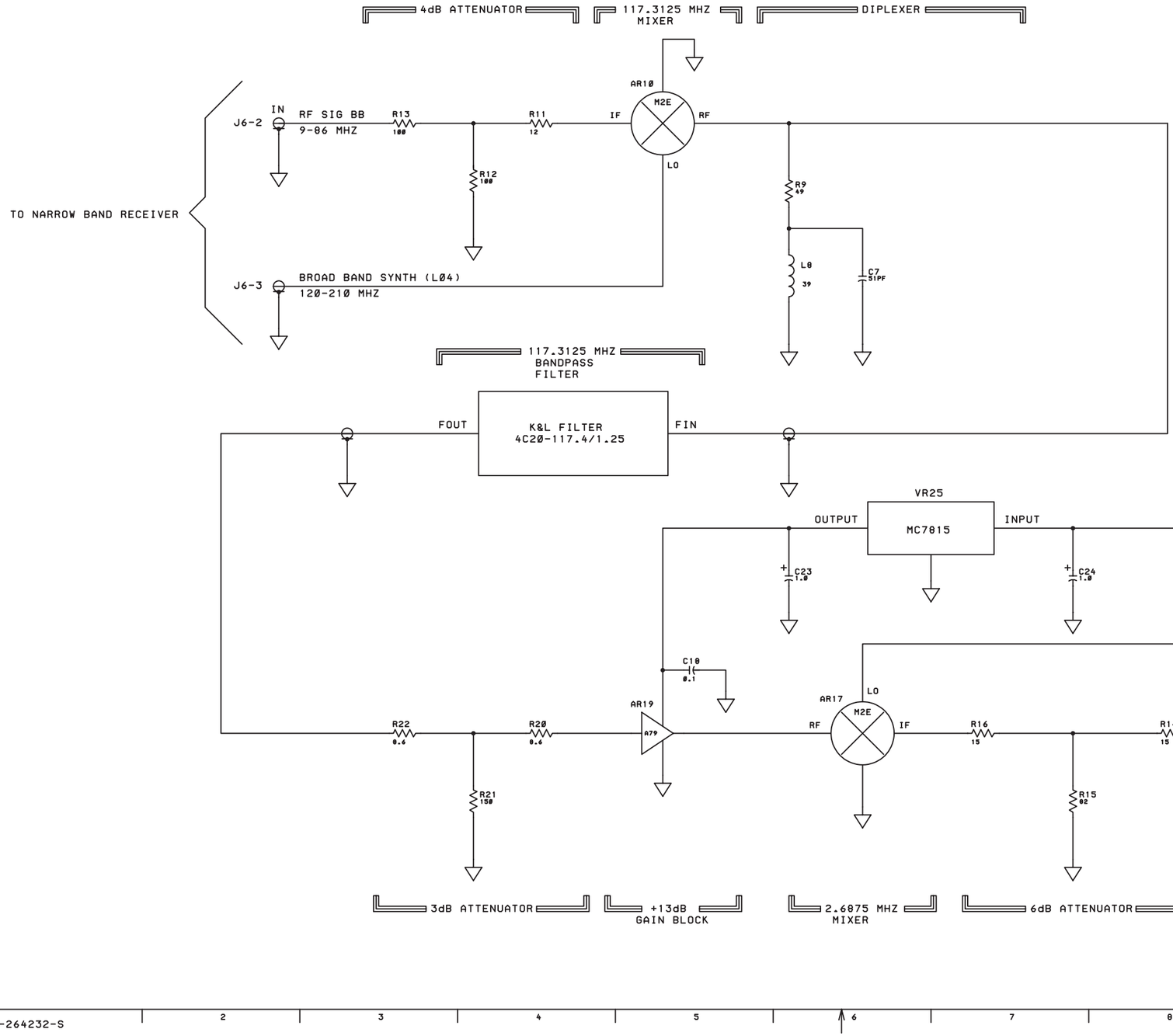
MR2 A15 A18 A3
BROADBAND RECEIVER

46–264232G1–B, G2–B



Description

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING:-
APPLIED PRACTICES
46-208600
REV AB
46-264232-S
CONT ON SHEET - SHT NO. 1
TITLE
SCHEMATIC DIAGRAM
BROADBAND RECEIVER
FIRST MADE FOR MR SYS CA4
46-264232-S
CONT ON SHEET - SHT NO 1
46-26423261-B
46-26423262-B



GAIN ADJUSTMENT CHART			
ATTENUATION -dB	R20	R21	R22
0	JUMPER	OPEN	JUMPER
1	JUMPER	470 OHMS	6.2 OHMS
2	6.2 OHMS	220	6.2
3	9.1	150	9.1
4	12	100	12
5	12	82	15
6	15	68	18
7	18	56	22
8	22	47	22
9	24	39	24
10	27	36	27

DEVICES SHOWN TOP VIEW:

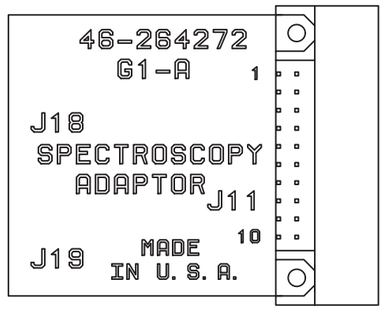
NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE 0.25W, 1%
   AND ARE IN OHMS.
   ALL CAPACITORS ARE IN MFD.
   ALL INDUCTORS ARE IN nH.

REVISIONS			PRINTS TO
NR	DLW 19JAN90		740
	ADDED G2		
AB	DLW 30MAR90		
	PCN 158784		

MADE BY	APPROVALS	DIV OR DEPT	
D.WALK 5OCT89	RCR 14DEC89	MEDICAL SYSTEMS	46-264232-S
ISSUED R.WEBB 7DEC89		MILWAUKEE, WI. LOCATION	CONT ON SHEET - SHT NO. 1

MG2 A16 A6
MG2 A16 A7 A3
SPECTROSCOPY ADAPTOR

46–264272G1–A



Description

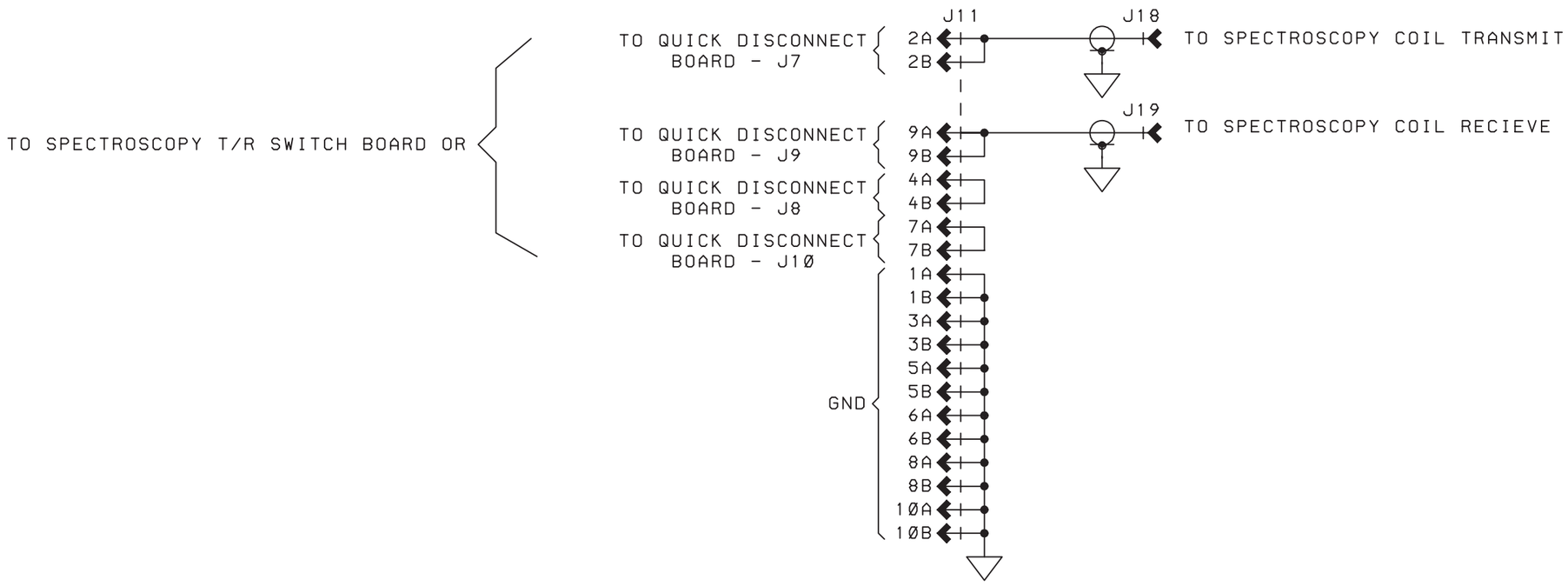
DRAWING NO. 46-264272-S SHT NO. 1 CONT ON SHEET -

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING:-	REV AB	TITLE
APPLIED PRACTICES 46-208600	46-264272-S CONT ON SHEET - SHT NO. 1	SCHEMATIC DIAGRAM SPECTROSCOPY ADAPTOR FIRST MADE FOR SPECTROSCOPY COIL QUICK DISCONNECT

46-264272-S
CONT ON SHEET - SHT NO 1

MG2A16A6
MG2A16A7A3

46-264272G1-A



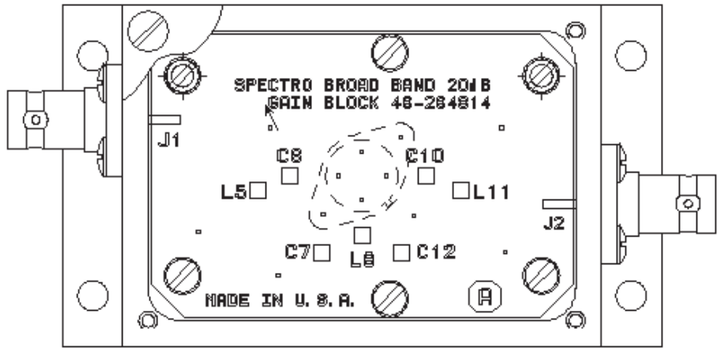
REVISIONS		PRINTS TO	
	AB DPB 240CT90	740	
	PCN 171248		

MADE BY	APPROVALS	DIV OR DEPT	
R. LISOWSKI 10JUN87	RCR 27JUL87	MEDICAL SYSTEMS	46-264272-S
ISSUED B. AHONEN 14JUL87		MILWAUKEE, WI LOCATION	CONT ON SHEET - SHT NO. 1

46-264272-S

PP1 A13
SPECTRO BROADBAND 20dB GAIN BLOCK

46–264814G1–A

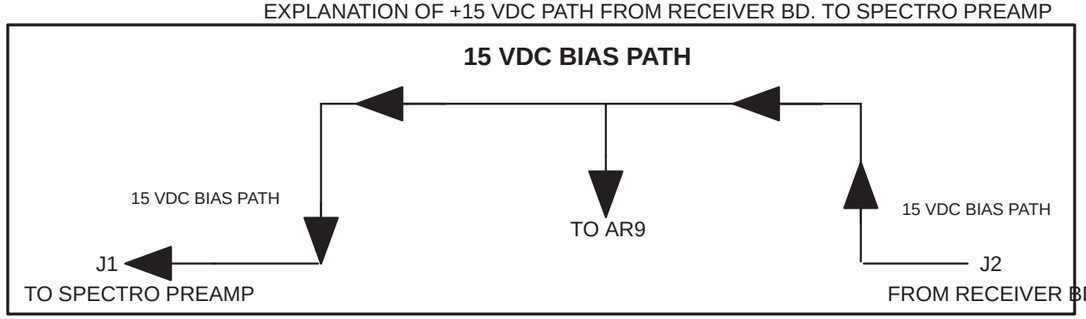


Description

The Spectroscopy BroadBand 20 dB Gain Block was designed to augment receive channel gain from the RF Preamp to the RF Receiver. Located at the Penetration Panel it provides roughly 20 dB of signal amplification at all frequencies of Multi–Nuclear interest while ensuring a total noise figure of less than 1 dB for the composite receive channel. In general, the +15 VDC bias applied to port J2 (Output) enables the active device for proper RF operation over the frequency range. Capacitors C6 and C10 accomplish DC blocking at the input and output of the device while inductors L5, L8, and L11 act as RF chokes. Capacitors C7 and C12 route any residual RF in the DC bypass path to ground. This configuration bridges the DC supply from ports J2 (Output) to J1 (Input) so as to supply DC current to the preamp.

As a continuity check with no bias applied, the DC resistance at ports J1 and J2 to Ground (common) should be observed infinite (1 to 10 Megaohms). The resistance measured through the device, J1 center conductor to J2 center conductor, should be observed at 4 to 6 ohms.

EXPLANATION OF +15 VDC PATH FROM RECEIVER BD. TO SPECTRO PREAMP



DRAWING NO. 46-264814-S SHT NO. 1 CONT ON SHEET -

PP1 A13

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING:-

APPLIED PRACTICES

REV A AA

46-264814-S

CONT ON SHEET - SHT NO. 1

GENERAL ELECTRIC

46-264814-S

CONT ON SHEET - SHT NO 1

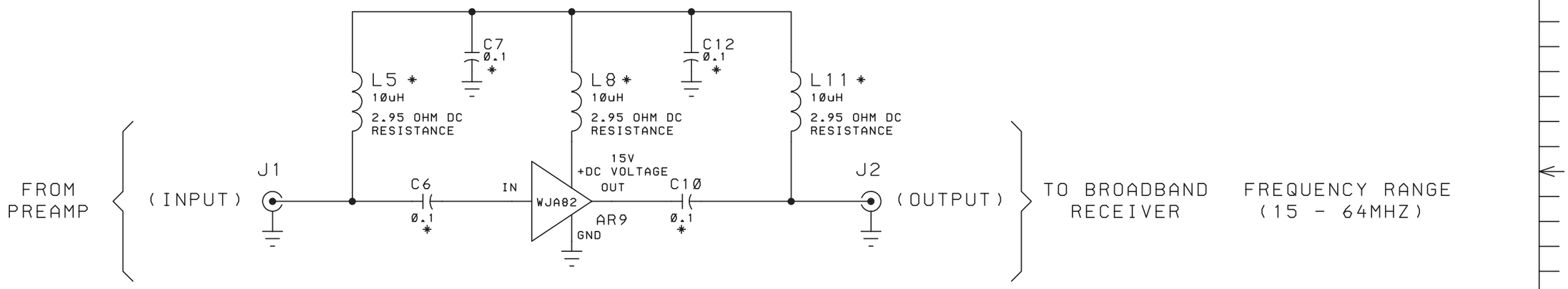
TITLE

SCHEMATIC DIAGRAM
SPECTRO BROAD BAND 20dB GAIN BLOCK

FIRST MADE FOR MR

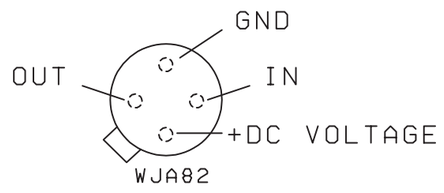
P/L ISSUED

46-264814G1-A



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   ALL CAPACITORS ARE IN MFD.
2. "*" INDICATES SURFACE MOUNTED
   COMPONENT.

ALL DEVICES SHOWN TOP VIEW

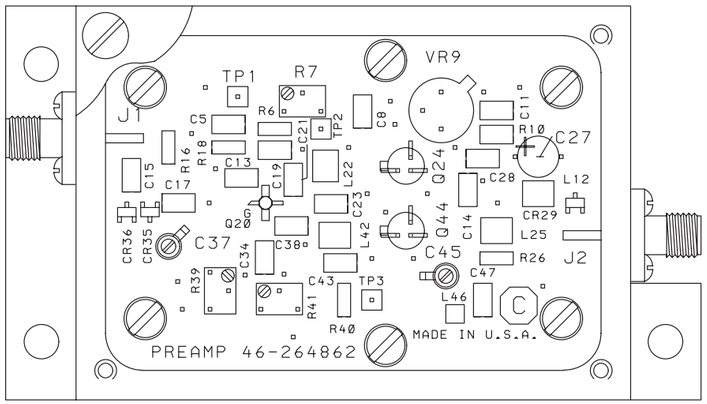


REVISIONS	PRINTS TO	
	740	

MADE BY	APPROVALS	DIV OR DEPT	
G. TESKE 18MAR89		MEDICAL SYSTEMS	46-264814-S
ISSUED		MILWAUKEE, WI. LOCATION	CONT ON SHEET - SHT NO. 1

MG2 A16 A7 A2
SPECTROSCOPY PREAMP (Phosphorus)

46–264862G1–B



Description

The preamp provides the first stage of amplification for the MR signal in the receive path. The preamp is part of the Spectroscopy TR Module which is placed at the front of the head carriage slide trolley when Multinuclear BroadBand scanning is selected. The J2 RF output port of the preamp requires +15 VDC, +/– 10% @ 100 mAmps. The +15 VDC preamp bias originates in the Systems Cabinet TPS Power Supply and is supplied to the Receiver Board and BB Receiver Module via the backplane. The Spectroscopy AUX port preamp bias will measure +15 VDC after a Broad-Band Spectroscopy protocol is selected and pulsed once. The spectroscopy preamp bias is sent down the selected AUX receive coaxial cable to power the 20 dB gain block and the preamp. The total nominal gain of the preamp is +35 dB, +/– 3 dB, this gain can be measured by injecting an RF signal at the specified frequency with a maximum level of –10 dBm (nominally this is –30 dBm). The noise figure should be less than 0.5 dB.

DRAWING NO. 46-264862-S SHT NO. 1 CONT ON SHEET -

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING:-

APPLIED PRACTICES
46-208600

REV AB
46-264862-S
CONT ON SHEET - SHT NO. 1

TITLE
SCHEMATIC DIAGRAM
SPECTROSCOPY PREAMP (PHOSPHORUS)
FIRST MADE FOR MR

46-264862-S
CONT ON SHEET - SHT NO 1

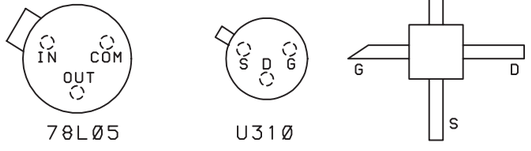
MG2A16A7 A2

46-264862G1-B

0.35 TO 0.4 VDC
V_D ADJUST
TP2
TP1
V_D ADJUST
R6 10 *
R7 200 0.5W
VR9 78L05
R10 100 400MW
C5 0.01 *
C8 0.01 *
C11 0.01 *
C28 0.01 *
C27 10 25V
L12 10uH *
MAXIMUM RESISTANCE DC - 8.1 OHMS
L22 10uH *
MAXIMUM RESISTANCE DC - 8.1 OHMS
OPERATING FREQUENCY (25.8 MHZ)
I_D
Q24 U310 *
MAXIMUM RESISTANCE DC - 8.1 OHMS
L25 10uH *
R26 910 *
CR29 MMBD201 *
J2 OUTPUT
TO 20 DB GAIN BLOCK
V_D
C23 0.01
C21 120PF *
I_{DT}
L46 1.2uH * 2 OHM DC RESISTANCE
C47 0.01 *
C45 0.8-8PF 500V * OUTPUT TUNING
C14 20PF *
Q44 U310 *
J1 INPUT
FROM T/R SWITCH
C15 0.01 *
INPUT TUNING
C17 20PF *
C37 0.8-8PF 500V *
Q20 FSC10LF/FA *
R16 51K *
CR35 MMBD201 *
CR36 MMBD201 *
L48 1.5uH * 0.01 OHM DC RESISTANCE
C13 0.01 *
C19 0.01 *
R18 100 *
I_D ADJUST
R39 200 0.5W
C34 0.01 *
C38 0.01 *
L42 10uH *
MAXIMUM RESISTANCE DC - 8.1 OHMS
I_{DT} ADJUST CW
R41 200 0.5W
C43 0.01 *
TP3
0.3 VDC
I_{DT} ADJUST
R40 10 *

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE IN OHMS AND ARE 0.125W, 5%.
   ALL CAPACITORS ARE IN MFD AND ARE 50V, 10%.
2. "*" INDICATES SURFACE MOUNTED COMPONENT.

ALL DEVICES SHOWN TOP VIEW



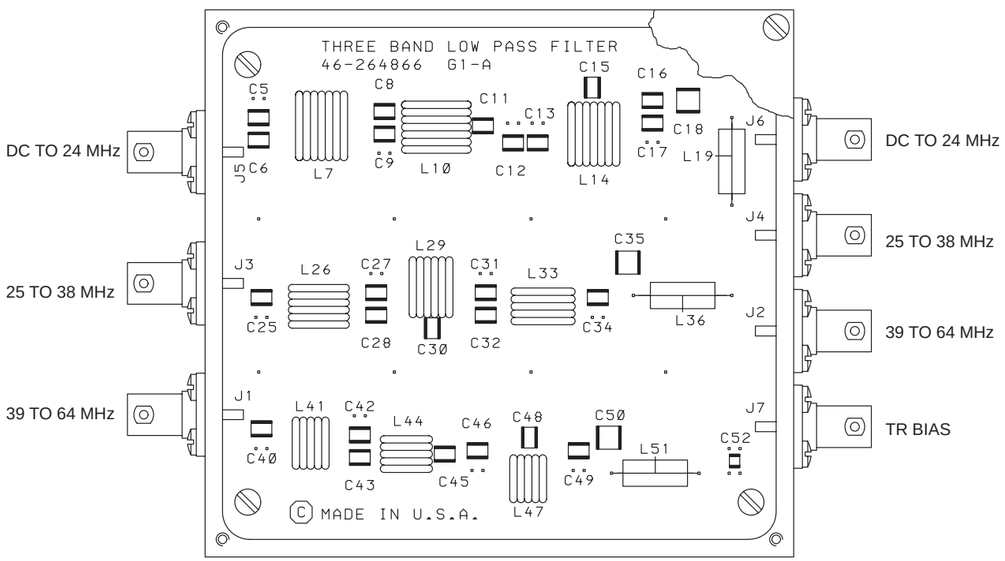
REVISIONS		PRINTS TO	
AB DLW 16FEB90		740	
PCN 158690			

MADE BY	APPROVALS	DIV OR DEPT	
G.TESKE 7MAR89	RCR 4MAY89	MEDICAL SYSTEMS	46-264862-S
ISSUED R.BECERRA 2MAY89		MILWAUKEE, WI. LOCATION	CONT ON SHEET - SHT NO. 1

46-264862-S

MR6 A2 A2
THREE BAND LOW PASS FILTER

46–264866G1–B



Description

The Three Band Low Pass Filter is used to remove the harmonics at the output of the 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 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.

DRAWING NO. 46-264866-S
CONT. ON SHEET - SH NO. 1

MAG A2 A2

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING : -					REV AC
APPLIED PRACTICES	SURFACES	TOLERANCES ON DIMENSIONS			46-264866-S
46-280600	√	DECIMALS (2 PLACES) ±	DECIMALS (3 PLACES) ±	ANGLES ±	CONT. ON SHEET - SH NO. 1

GENERAL ELECTRIC

TITLE SCHEMATIC DIAGRAM
THREE_BAND_LOW_PASS_FILTER
FIRST MADE FOR RF_CABINET

46-264866-S
CONT. ON SHEET - SH NO.1

P/L ISSUED
46-264866G1-B

FROM FILTER RELAY ASSEMBLY

J5 L7 448nH C5 180PF 300V C6 330PF 500V C8 390pF 300V C9 470pF 500V L10 448nH C11 18pf 1000V C12 100pF 1000V C13 100pF 1000V L14 383nH C15 18pf 1000V C16 150pF 500V C17 270pF 300V C18 0.15uF 50V J6

L19 4.7uH

L36 4.7uH

J3 L26 238nH C25 62pF 1000V C27 220pF 300V C28 220pF 300V L29 238nH C30 5.6pF 1000V C31 220pF 500V C32 100pF 300V L33 238nH C34 62pF 1000V C35 0.15uF 50V J4

TO FILTER RELAY ASSEMBLY

J1 L41 158nH C40 27pf 1000V C42 100pF 1000V C43 100pF 500V L44 158nH C45 6.2pF 1000V C46 62pF 1000V L47 126nH C48 6.8pF 1000V C49 39pf 1000V C50 0.15uF 50V J2

L51 4.7uH

J7 BIAS TO RF AMP

C52 0.015uF 50V

REVISIONS		PRINTS TO
	AB DPB_220CT90	740
	PCN_171257	
	AC DPB_24MAY91	
	PCN_171761	

MADE BY F.PIERCE_13JUL89
TRACED B.BRIER_19OCT89
APPROVALS RCR 30OCT89
MEDICAL SYSTEMS MILWAUKEE, WISCONSIN DRAWING DEPT.

46-264866-S
CONT. ON SHEET - SH. NO. 1

46-264866-S

2 1 NBECMACIBN/II CCRBLI I CBON

FILTER RELAY

46–301704S

Description

The Filter Relay Assembly is controlled through the software selection of the frequency and/or nuclei (the NUC Control Vartiable ultimately overrides any frequency selection). 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 Low–Pass Filter networks. The Filter Relay Assembly essentially steers the BroadBand RF frequency to the proper frequency sensitive circuitry (3 Band Low–Pass Filter).

GE Medical Systems

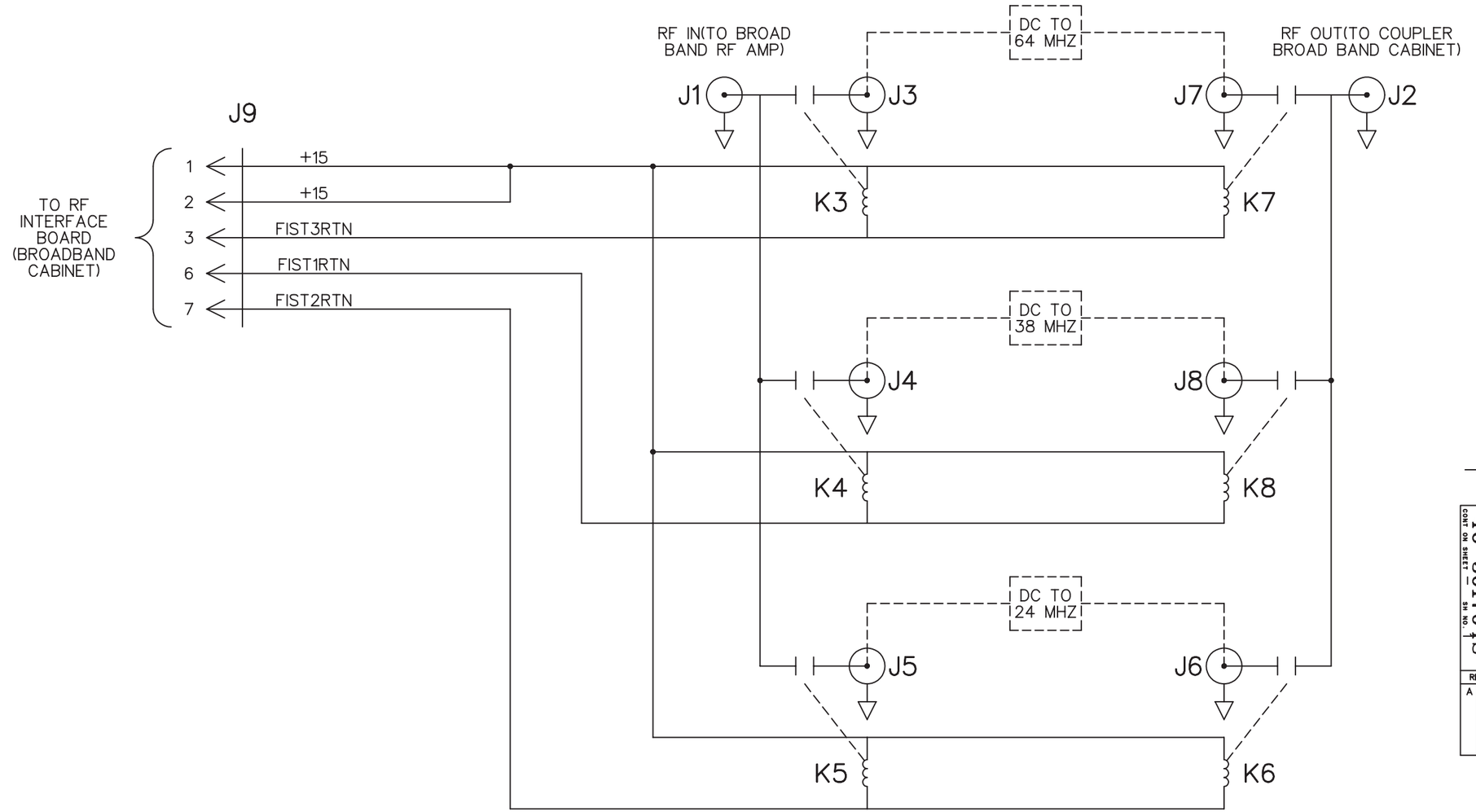
46-301704S CONT ON SHEET — SH NO. 1

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING:-
APPLIED PRACTICES | SURFACES | TOLERANCES ON DIMENSIONS: DECIMALS (2 PLACES) ± | DECIMALS (3 PLACES) ± | ANGLES ±

TITLE
FILTER, RELAY

FIRST MADE FOR MRSPECT4.5



APPROVALS	NAME	DATE
TECH		
DES		
ENG		
MFG		

REVISIONS

PRINTS TO: 740

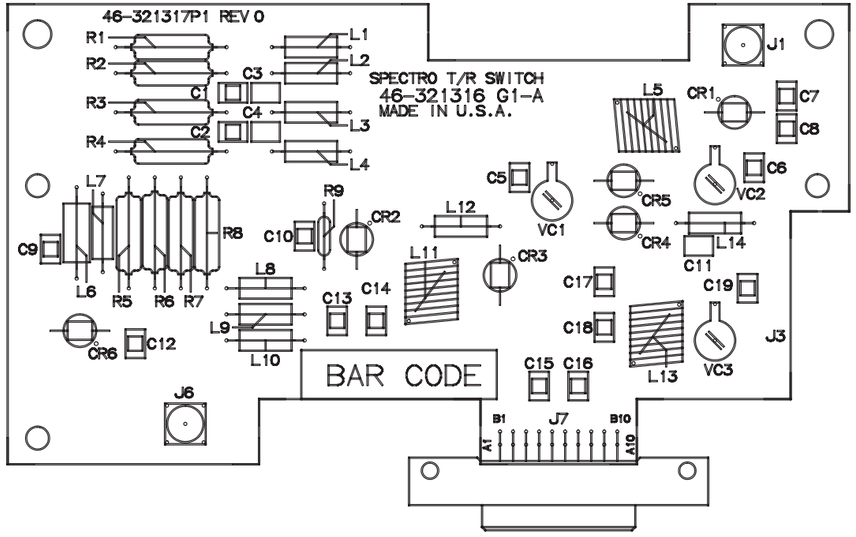
MADE BY A. GRULKE 89NOV30
ISSUED
APPROVALS
GE MEDICAL SYSTEMS — DIV OR DEPT.
MILWAUKEE, WISCONSIN — LOCATION
46-301704S —CONT ON SHEET — SH NO. 1

DRAWING NO. 46-301704S CONT ON SHEET — SH NO. 1

REV. A

MG2 A16 A7 A2
SPECTRO TR SWITCH

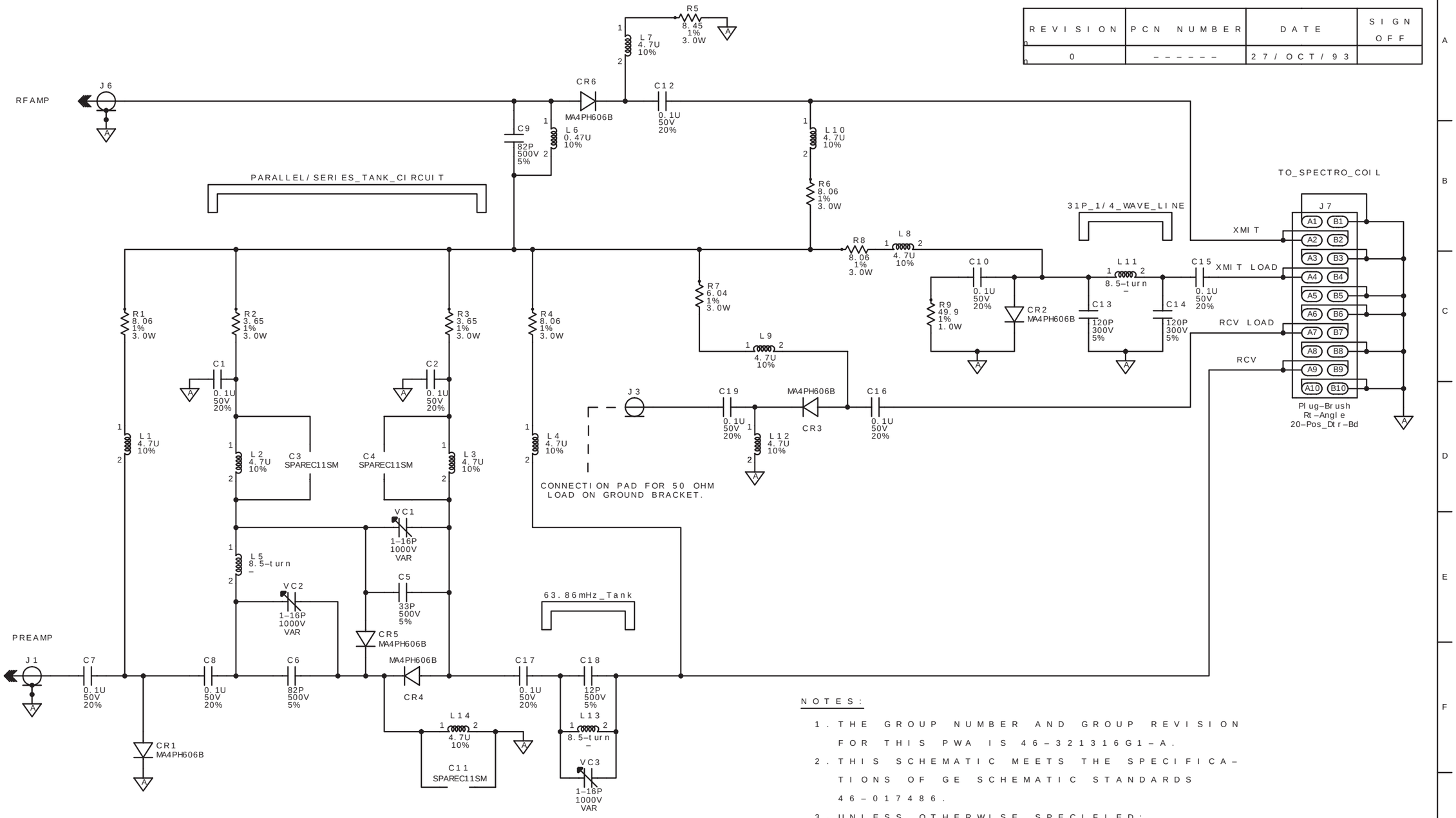
46–321316G1–B



Description

Located in the Multi–Nuclear Spectroscopy TR Module the New Spectroscopy TR Switch is used to switch the between the transmit and receive modes. The UNBLANK signal drives the TR Bias voltage mode. A bias voltage that originates from the TR Driver circuitry (under UNBLANK control) in the RF Amplifier Cabinet is used to either forward or reverse bias PIN diodes. When transmitting, a positive voltage is supplied via the transmit heliax. This forward biases the PIN diodes which in turn connect the transmitter to the coil. It also shorts the input to the preamplifier, which protects it from being damaged by the high level of RF present during the transmit cycle. When receiving, a negative voltage is supplied is supplied via the transmit heliax. This reverse biases the PIN diodes which in turn disconnects the transmit heliax from the coil and connects the preamplifier to the coil.

REVISION	PCN NUMBER	DATE	SIGN OFF
0	------	27/OCT/93	



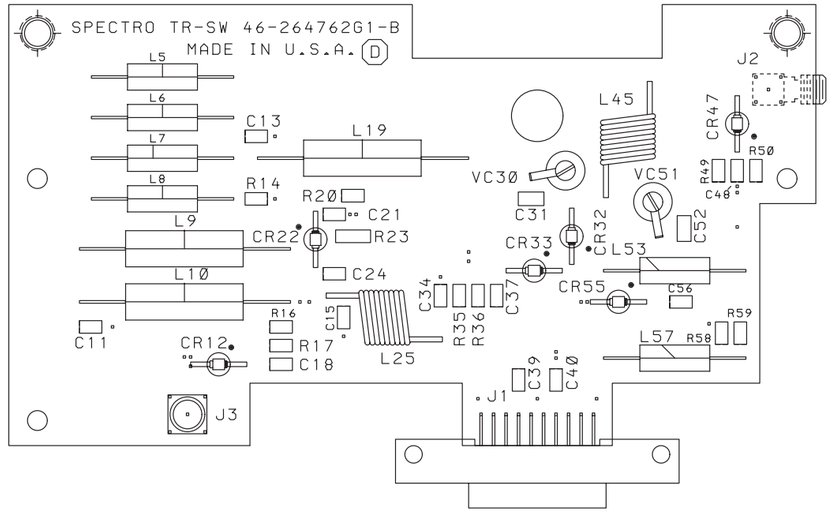
NOTES:

1. THE GROUP NUMBER AND GROUP REVISION FOR THIS PWA IS 46-321316G1-A.
2. THIS SCHEMATIC MEETS THE SPECIFICATIONS OF GE SCHEMATIC STANDARDS 46-017486.
3. UNLESS OTHERWISE SPECIFIED:
   RESISTORS ARE IN OHMS
   CAPACITORS ARE IN FARADS.
   INDUCTORS ARE IN HENRIES.

BLOCK PATHNAME	/user/body_hyb/spectr_sw SHEET 1 OF 1				
REV 0	SPECTRO T/R SWITCH	LOCATION CODE MG2-A16-A7-A1	APPROVALS	GE MEDICAL SYSTEMS MILWAUKEE WI	REVISIONS
DRAWING NO. 46-321316-S	FIRST MADE FOR MRSPECT4.5 (31P)				
SHT. NO. 1 CONT. ON SHT. NO. -	MADE BY Bill Kostolni DATE 27-OCT-93	ISSUED DATE	PRINTS TO 740		

MG2 A16 A7 A2
SPECTRO TR SWITCH

46–264762G1–B



Description

Located in the Spectroscopy TR Module the Original Multi–Nuclear Spectroscopy TR Switch is used to switch the between the transmit and receive modes. The UNBLANK signal drives the TR Bias voltage mode. A bias voltage that originates from the TR Driver circuitry (under UNBLANK control) in the RF/Pen Cabinet is used to either forward or reverse bias PIN diodes. When transmitting, a positive voltage is supplied via the transmit heliax. This forward biases the PIN diodes which in turn connect the transmitter to the coil. It also shorts the input to the preamplifier, which protects it from being damaged by the high level of RF present during the transmit cycle. When receiving, a negative voltage is supplied is supplied via the transmit heliax. This reverse biases the PIN diodes which in turn disconnects the transmit heliax from the coil and connects the preamplifier to the coil.

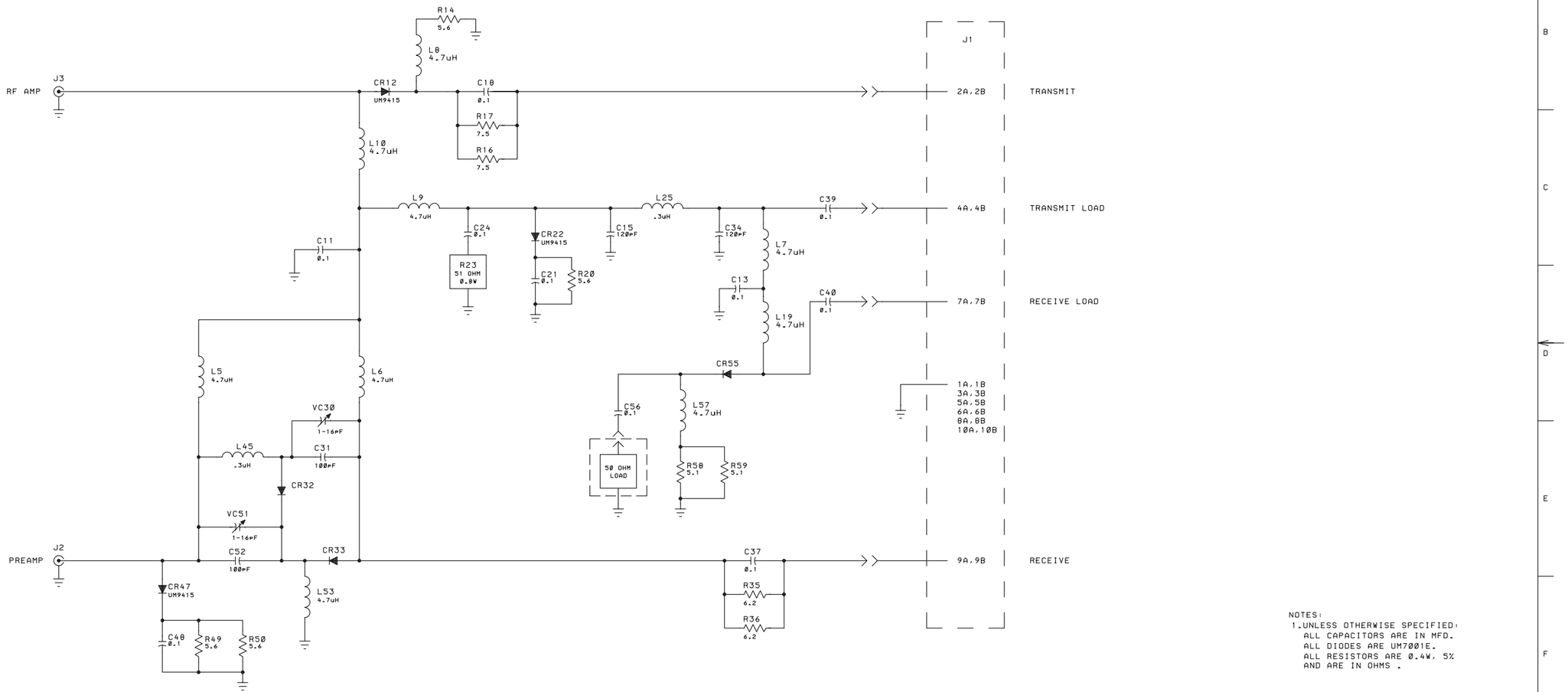
DRAWING NO. 46-264762-S CONT ON SHEET - SHT NO. 1

MG2 A16 A7 A2

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING:-	REV AC	TITLE
APPLIED PRACTICES 46-208600	46-264762-S CONT ON SHEET - SHT NO. 1	SCHEMATIC DIAGRAM SPECTRO T/R SWITCH
		FIRST MADE FOR MR SPECT 4.5

46-264762-S CONT ON SHEET - SHT NO 1

46-264762G1-B

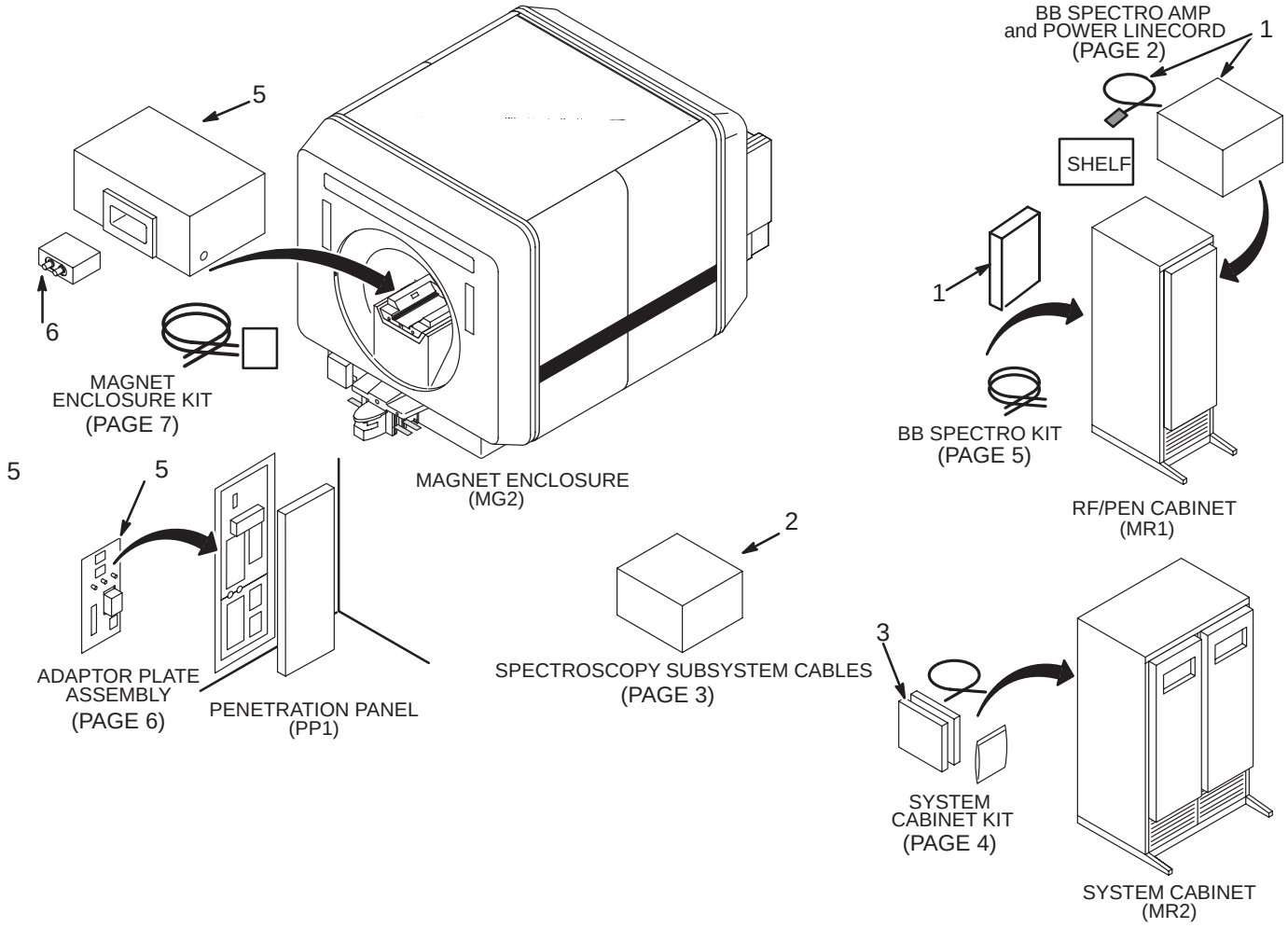


NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   ALL CAPACITORS ARE IN MFD.
   ALL DIODES ARE UM7001E.
   ALL RESISTORS ARE 0.4W, 5%
   AND ARE IN OHMS .

REVISIONS		PRINTS TO
B	DLW 12JUN89	740
	GEN. CHNGS.	
AB	DLW 20FEB90	
	PCN 158677	
AC	FEP 12FEB91	
	PCN 171522	

MADE BY G.TESKE 17MAY89	APPROVALS RCA 20OCT89	DIV OR DEPT MEDICAL SYSTEMS 46-264762-S
ISSUED R.BECERRA 18OCT89		LOCATION MILWAUKEE, WI. CONT ON SHEET - SHT NO. 1

RENEWAL PARTS – M1040JB/M1090JZ SPECTROSCOPY



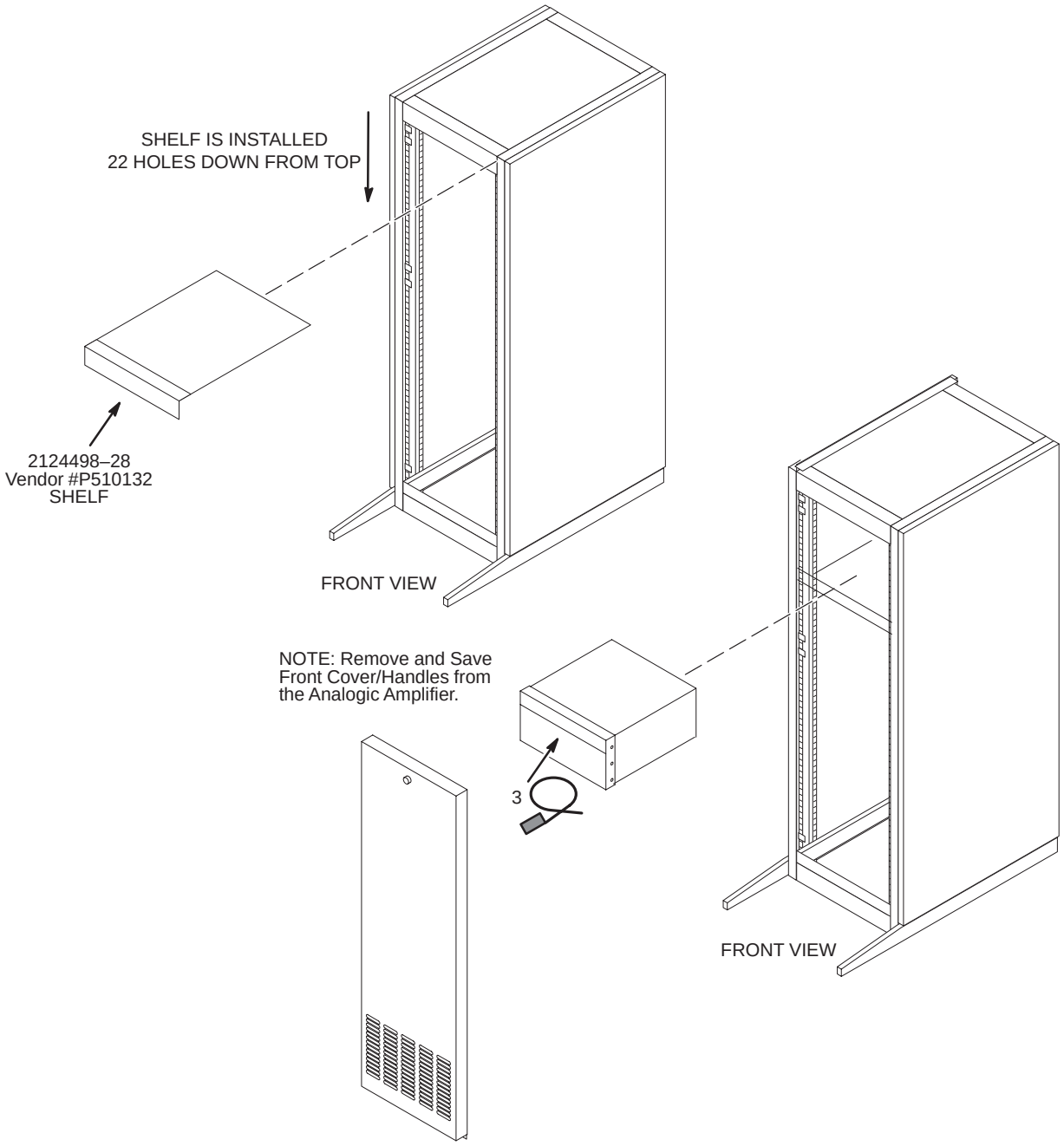
ITEM	PART NUMBER	DESCRIPTION OF M1040JB REV 0 CONTENTS	PAGE NUMBER
1	46–301464P2 OR P1	BROADBAND RF AMPLIFIER & Linecord (MR1A16)	PAGE 2
2	46–301824G2	SPECTROSCOPY SUBSYSTEM INTERCONNECT CABLES	PAGE 3
3	46–301825G1	SYSTEM CABINET KIT	PAGE 4
4	2109930–11	SPECTRO KIT (5.5 Release) (MR1A17)	PAGE 5
5	2136365	PENETRATION PANEL KIT (ADAPTOR PLATE ASM)	PAGE 7
6	46–301548G1	MAGNET ENCLOSURE KIT (PHOS)	PAGE 8
7	46–317286G1	SPECTROSCOPY ^{31}P QA/SERVICE COIL	PAGE 9

M1092A
SPECTRO

ITEM	PART NUMBER	DESCRIPTION OF M1090JZ REV 0 CONTENTS	PAGE NUMBER
1	2109930–11	SPECTRO KIT (5.5 Release) (MR1A17)	PAGE 5

CATALOG			M1040BJ	FRU	N	SA/GE SOFTWARE ASSEMBLY
1	2108873	2	ASSEMBLY		1	SA/GE SOFTWARE (FLOPPY DISK FORMAT)
2	46–307392G2	2	ASSEMBLY		1	SA/GE SOFTWARE (CARTRIDGE TAPE FORMAT)

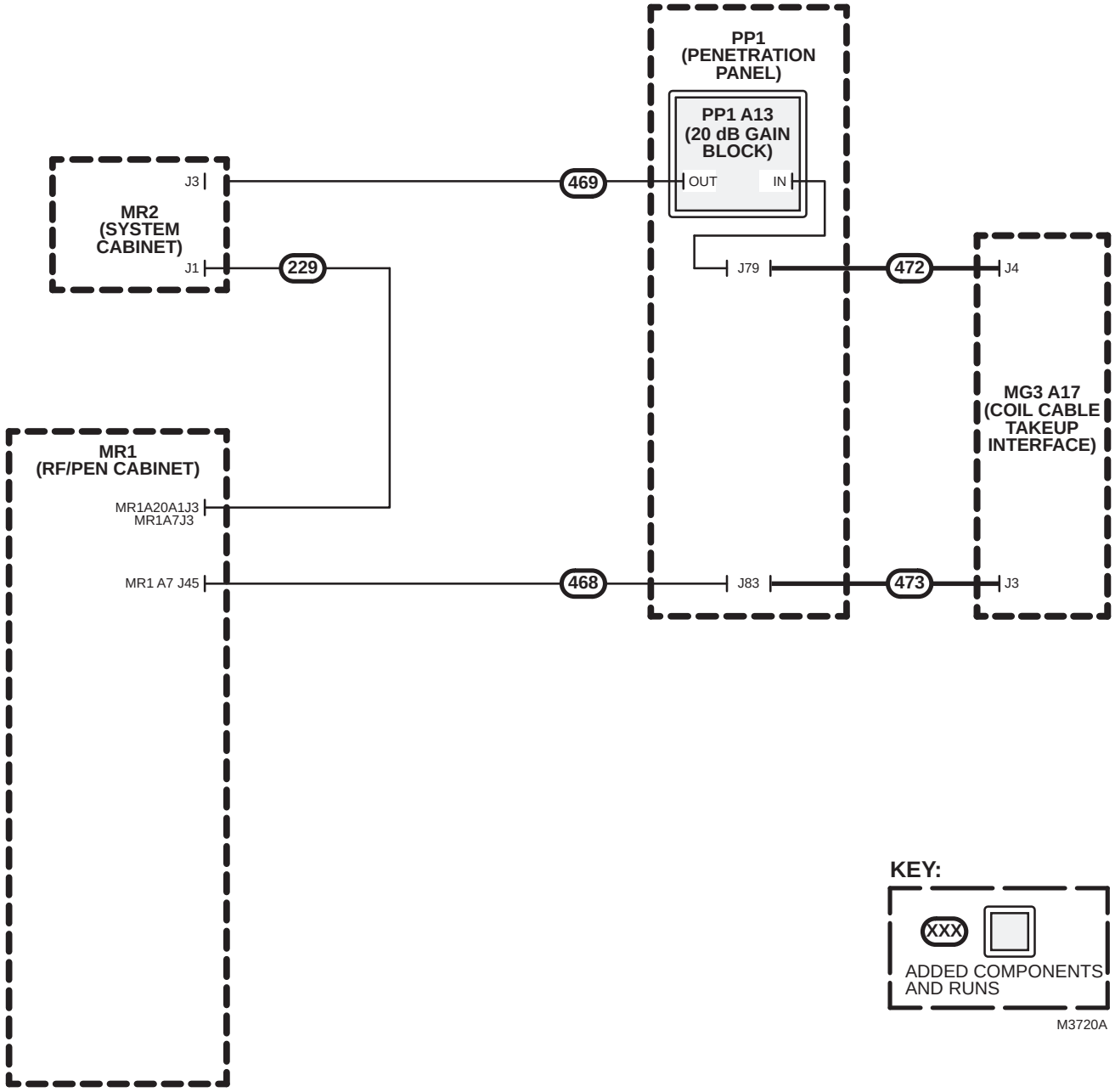
BROADBAND RF AMPLIFIER **MR1A16**



BB RF CABINET **PART OF M1040JB**

Item	Part Number	FRU	Name	Quantity	Description (Remarks)
					M301697A (G2)
3	46–301464P1	1	BROADBAND AMP	1	ENI MRI–2000 RF AMPLIFIER & Linecord, MR1A16
3A	46–301464P2	1	BROADBAND AMP	ALT	ANALOGIC RF AMPLIFIER & Linecord, MR1A16

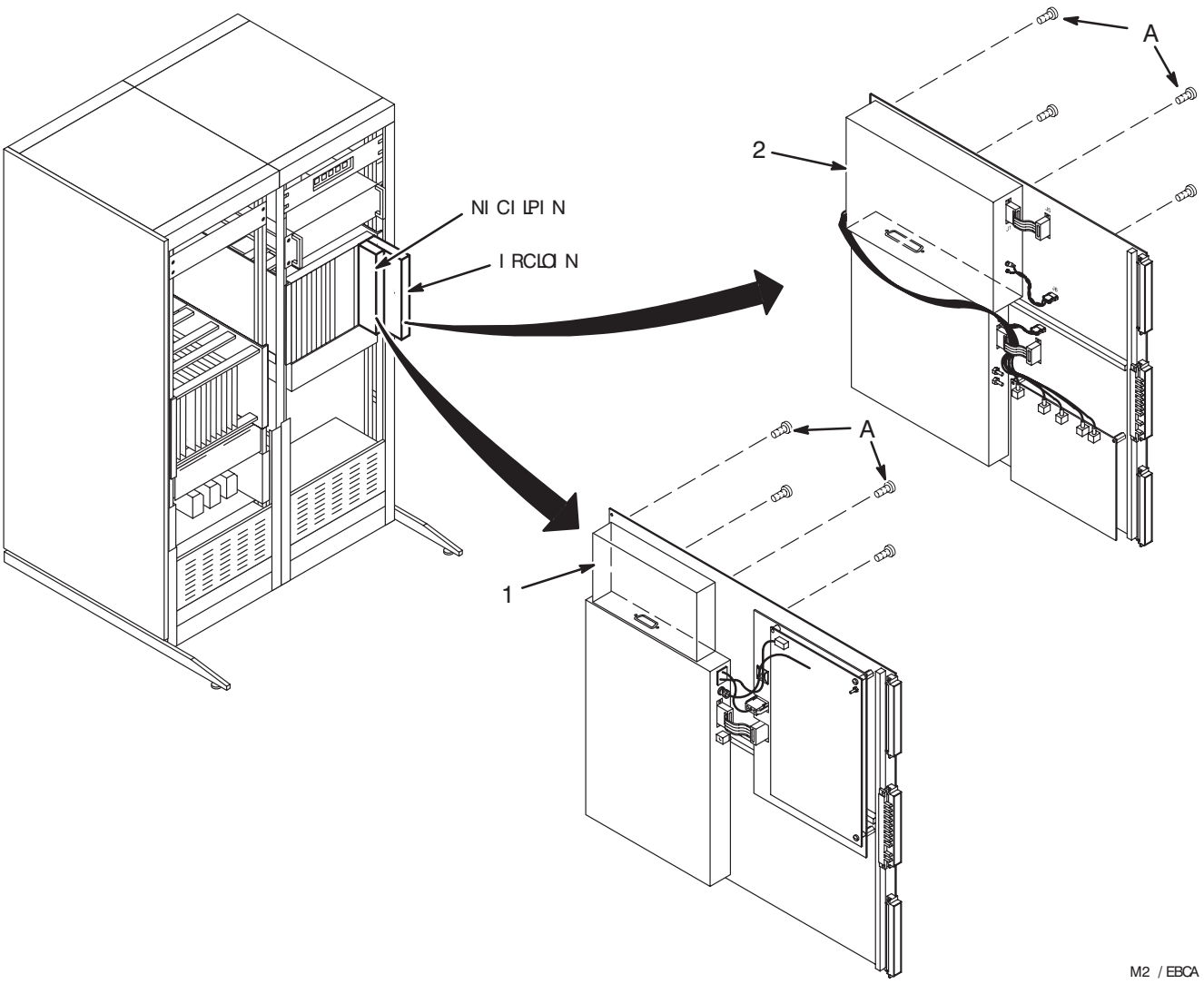
SPECTROSCOPY SUBSYSTEM CABLES 46–301824G2 FOR 5.5 RELEASE



CABLE KIT 46–301824G2 REV 0 PART OF M1040JB

Item	Part Number	FRU	Name	Quantity	Description (Remarks)
7	46–328000G933	2	CABLE	1	RUN 466 MR2–A11–J1 TO MR1–A7–J3, 50':not needed
12	46–243775G734	2	CABLE	1	RUN 469 PP1–A13–OUT TO MR2–A11–J3
18	46–243775G740	2	CABLE	1	RUN 472 MG3–A17–J4 TO PP1–J79, 80'
19	46–301837P2	2	CABLE	1	RUN 468, PP1–J83 TO MR6–A3–J45
20	46–301838P1	2	CABLE	1	RUN 473, MG3–A17–J3 TO PP1–J83

SYSTEM CABINET KIT 46–301825G1



SYS CAB KIT 46–301825G1 REV AH PART OF M1040JB

Item	Part Number	FRU	Name	Quantity	Description (Remarks)
2	46–264232G1	1	CIRCUIT BD	1	BB RECEIVER (MR2 A15 A18 A3)
3	46–264230G2	1	CIRCUIT BD	1	BB EXCITER (MR2 A15 A20 A3)
6	46–208560P12	2	SCREW,MACH	10	004–40 X 0.312 LG BIND HD STL F70B5A
7	46–208785P2	2	TAPE	.002	KAPTON PLASTIC FILM 0.88 W X 36 YD
8	46–320574P1	2	CABLE GUIDE	2	GUIDE FOR NON–RIGID EXCITER CABLE
9	2123273	1	TNS CABLE KIT	1	TNS SPECTROSCOPY ADAPTER KIT (Cable/Adaptor)

BB SPECTRO KIT W/O AMP, 2109930–11 (540000) PART OF M1040JB & M1090JZ

The 2109930–10 Spectro Kit was upgraded with the introduction of the RF/PEN 2 Cabinet. Most cables have been modified in length to accomodate the RF/PEN 2 Cabinet. All items for RF/PEN 2 ONLY have been added. The 2124497–56 cable and the MR1A18 Attenuator are now part of all 2109930–11 Spectro Kits. RF/PEN 1 MNS Systems (M1040JB & M1090JZ) do not require these additional parts. **All items are a FRU 2 unless otherwise noted. Power line–cords are not specifically set up as a FRU.**

"FROM"	"TO"	GE #	VENDOR #	REMARKS
MR1A17 Ground	ERBTEC Ground	2124497–52	540018	SPECTRO GROUND WIRE (to ground studs)
MR1A15J104 **MR1A20A1J104**	MR1A18J1	2124497–51	540009	SPECTRO RF IN to ATTENUATOR IN
MR1A18J2	MR1A16J3	2124497–56	540031	ATTENUATOR OUT to Spectro Amp RF IN (added with 2109930–11 Kit introduction)
MR1A17J5	MR1A7J45	2124497–47	540004	SPECTRO RF OUT + TR BIAS
MR1A15J507 **MR1A20J507**	MR1A17J7	2124497–49	540015	SPECTRO I/F CABLE ASSEMBLY (main cable)
MR1A15J407 **MR1A20A2J407**	MR1A17J4	2124497–55	540008	SPECTRO TR BIAS
MR1A17J3	MR1A15J102 **MR1A20A1J102**	2124497–54	540007	SPECTRO POWER MONITOR SENSE B
MR1A17J2	MR1A15J101 **MR1A20A1J101**	2124497–53	540006	SPECTRO POWER MONITOR SENSE A
MR1A17J6	MR1A16J7	2124497–50	540016	BB–I/F CABLE ASSEMBLY (control signals to Spectro Amplifier)
MR1A16J2	MR1A17J1	2124497–48	540005	2 kW RF IN from Spectro Amplifier to Spectro Module Asm.
RF/PEN 2 ONLY All RF/PEN 2 sites will need to adhere the proper label to its associated cable.		2124498–36	401–2007	RF/PEN2 CABLE LABEL KIT (1) MR1A20A1J104 (1) MR1A20J507 (1) MR1A20A2J407 (1) MR1A20A1J102 (1) MR1A20A1J101
RF/PEN 2 ONLY Many RF/PEN2 Cabinets have the proper Rev. See the T/S Tab for details		2124498–37	540034 379–0006 550061 550063	RF/PEN 2 SSM Micro Kit (1) chip puller (1) RF/PEN 2 Only, micro for CPD (U8) (2) RF/PEN 2 Only, micro for APM (U8 and U1)
RF/PEN 2 ONLY Mount Spectro Chimney into RF/Pen 2 Front Cabinet Cover		2124498–38	540035 510198 214–2101 215–2260	RF/PEN2 Chimney Kit (1) Multi–Nuclear Spectro Front Cabinet Cover Chimney. (4) 6–32 nylon insert nuts (8) 4–40 x 3/8 phillips screws
RF/PEN 2 ONLY Mount I/F Bracket at the rear of the Cabinet on right side vertical rail at the bottom		2124498–39	540036 540029 300–7009 300–70091 300–0511 215–2287 216–0010 214–9903	MR1A7, RF/PEN2 SPECTRO I/F ASM (1) Spectro I/F Bracket (1) N Bulkhead Adaptor, F–F,UG–30/U (1) N Lockwasher (1) BNC 50 ohm Pnl Mnt Adapt, D Style & BNC Lockwasher (2) Phillips Panhead SS Screw 10–32 X 1/2 (2) SS Flat Washer #10 (2) rail clips

BB SPECTRO KIT W/O AMP, 2109930–11 (540000) (Continued) **PART OF M1040JB & M1090JZ**

"FROM"	"TO"	GE #	VENDOR #	REMARKS
ALL MR1A18 is mounted on the top right horizontal rail as viewed from the rear		2124498–40	540033 179–2010 540032 215–2243 215–2290	MR1A18, ATTENUATOR KIT (1) 0–10 dB Adjustable Mechanical Attenuator (1) Attenuator Mounting Bracket (2) Atten to bracket mounting screws 6–32 x 1/4 Screw (2) Bracket to side rail mounting screws 1/4–20x 1/2
ALL Amplifier Shelf		2124498–41	540037 510132 215–2529 214–0215	Shelf Assembly (1) SPECTRO SHEETMETAL SHELF (4) Screw, HexHeadCap, 1/4–20 (4) Nut, Hex keps zinc/steel, 1/4–20
ALL Amplifier HWR FRU – NO		2124498–42	540038 214–9903 215–2287	Amplifier Hardware Kit (4) rail clips for Amplifier (4) Phillips Panhead SS Screw 10–32 X 1/2
ALL Silver Box **FRU – 1**		2124498–27	540001 214–2104 215–2287 216–0010	SPECTRO MODULE ASSEMBLY (MR1A17) (1) 10–32 nylon insert Nut for Ground stud (4) 10–32 X 1/2 screws (4) SS Flat Washer #10

MULTI–NUCLEAR / BROADBAND SPECTRO POWER LINE–CORD

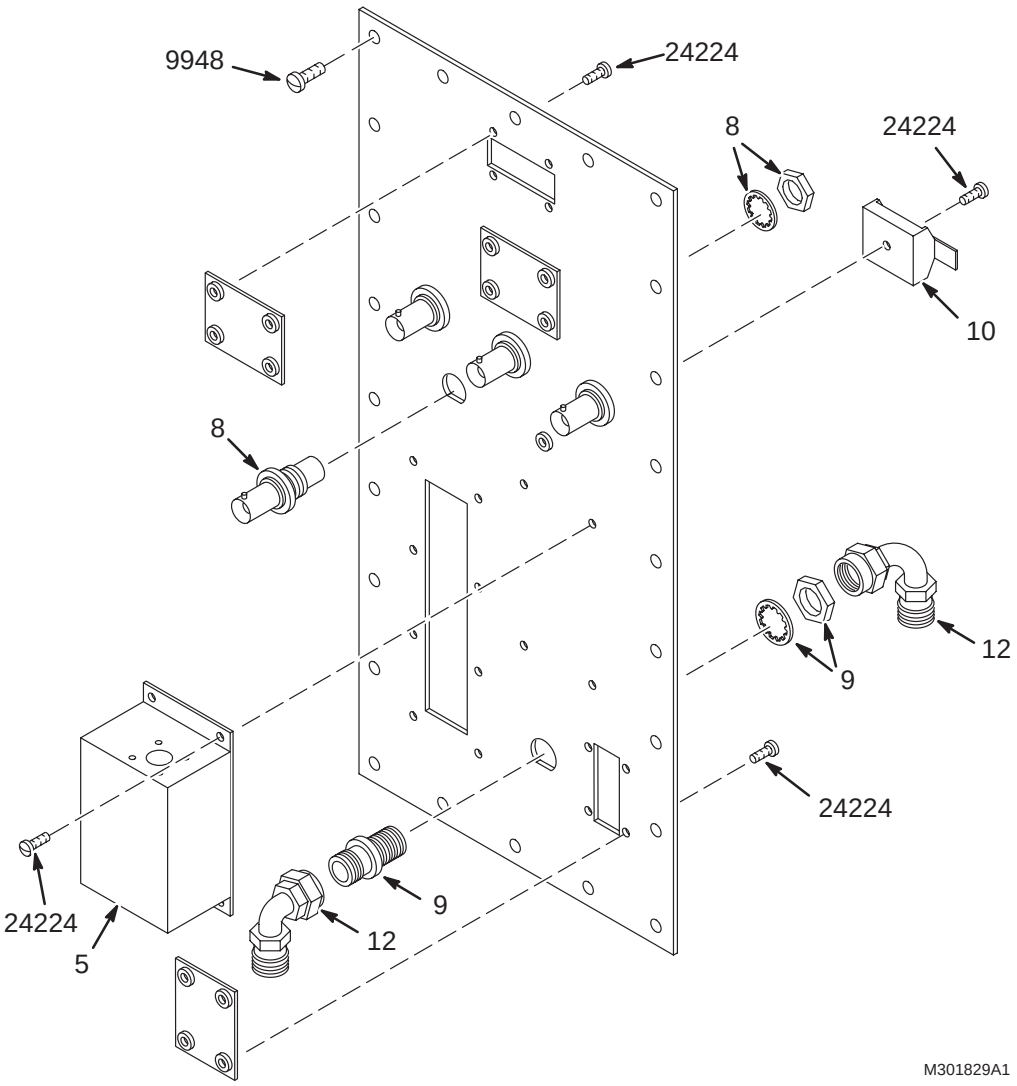
ENI Vendor Part

MR5K–PK–900–50	2	Power Linecord	1	Power Linecord for ENI RF Amplifier, (D. A. Linecord)

ANALOGIC Vendor Part

21–51546	2	Power Linecord	1	Power Linecord for ANALOGIC RF Amplifier

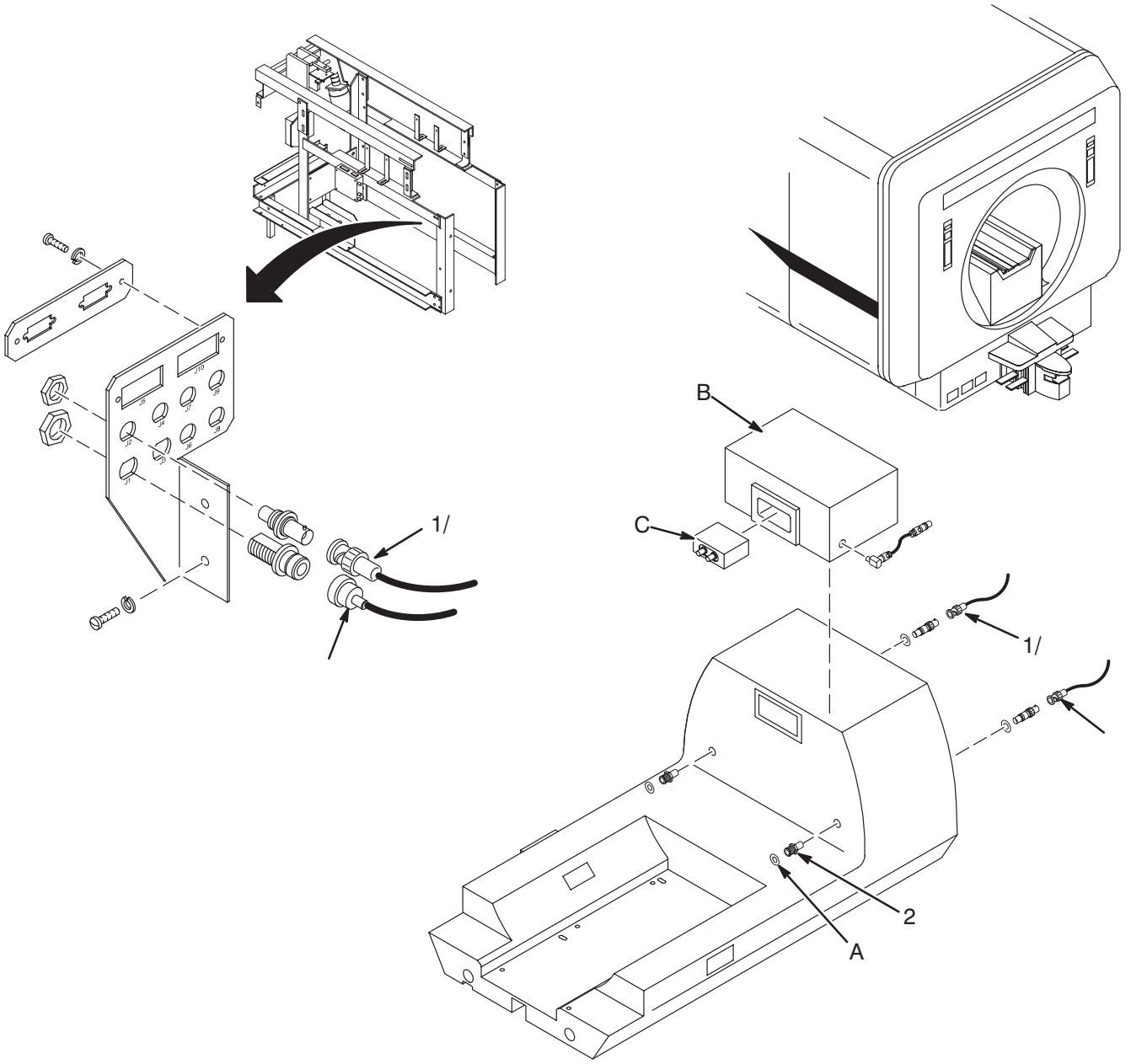
20 dB GAIN BLOCK (PP1 A13) PLATE ASM 2136365



ADPT PLT ASM **2136365** **REV 0** **PART OF M1040JB**

Item	Part Number	FRU	Name	Quantity	Description (Remarks)
2	2133757	2	PLATE	1	SIGNA ADVANTAGE OPTION ADAPTER PLATE
5	46–264814G1	1	CIRCUIT BD	1	20 dB GAIN BLOCK (PP1 A13)
	46–301973P1		PLATE	2	PANEL OPENING COVER
	46–301974P1		PLATE	1	PANEL OPENING COVER
8	46–208990P1	2	ADAPTER	4	BNC BULKHEAD ADAPTER (JACK–JACK).
9	46–306505P1	2	ADAPTER	1	SC COAX ADAPTER JACK–JACK, PANEL MT.
11	46–243775G743	2	CABLE	1	PP1–J79 TO PP1–A13–IN, 8” BNC COAX
12A	46–306507P1	2	ADAPTER	2	90 DEG. SC JACK TO SC PLUG ADAPTOR.
12B	46–306507P2	N	ADAPTER	ALT	USE 46–306507P1 FOR REPLACEMENTS
	46–233422P1	2	BNC ANG AD	1	BNC JACK–PLUG, RIGHT ANGLE ADAPTER.
24224	46–208921P4	2	SCREW,MACH	16	006–32 X 0.250 LG BIND HD BRASS

MAGNET ENCLOSURE KIT (PHOSPHORUS) 46–301548G1 FOR MG2 AND MG3



M2/1BBAEA

SPECTRO COLL 46–301548G1 REV AH PART OF M1040JB

Item	Part Number	FRU	Name	Quantity	Description (Remarks)
5	2100718 (–1)	1	SPECT BOX	1	^{31}P SPECTROSCOPY TR MODULE (MG2 A16 A7)
6	46–282467G4	1	Q D PLUG ASM	1	SPECTRO SURFACE COIL Q.D. ADAPTER (MG2 A16 A7 A3)
9	46–301690G1	2	CABLE ASM	1	(456) MG3 A17 J3 TO MG2 A16 J1
10	46–243775G708	2	CABLE	1	(455) MG3–A17–J4 TO MG2–A16–J2
	46–251182P229		RATING PLATE	1	
	2113568		BOX OF PARTS	1	

SPECTRO ^{31}P QA/SERVICE COIL KIT 46–317286G1

COIL/PHANTOM KIT 46–317286G1 REV 0 PART OF M1040BJ

Item	Part Number	FRU	Name	Quantity	Description (Remarks)
1	46–265204G3	2	8”T 3”R SPECT PHOS	1	^{31}P **SERVICE** SURFACE COIL
2	46–317299G1	2	BOTTLE W/LABEL	1	EMPTY PLASTIC BOTTLE
3	46–317299G2	2	BOTTLE W/LABEL	1	EMPTY PLASTIC BOTTLE