GE Medical Systems

Technical Publications

Direction 2194610

Revision 1

Signa[R] 1.5T Release 8.X 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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WARNING

- **THIS SERVICE MANUAL IS AVAILABLE IN ENGLISH ONLY.**
- **IF A CUSTOMER'S SERVICE PROVIDER REQUIRES A LANGUAGE OTHER THAN ENGLISH, IT IS THE CUSTOMER'S RESPONSIBILITY TO PROVIDE TRANSLATION SERVICES.**
- **DO NOT ATTEMPT TO SERVICE THE EQUIPMENT UNLESS THIS SERVICE MANUAL HAS BEEN CONSULTED AND IS UNDERSTOOD.**
- **FAILURE TO HEED THIS WARNING MAY RESULT IN INJURY TO THE SERVICE PROVIDER, OPERATOR OR PATIENT FROM ELECTRIC SHOCK, MECHANICAL OR OTHER HAZARDS.**

AVERTISSEMENT

- **CE MANUEL DE MAINTENANCE N'EST DISPONIBLE QU'EN ANGLAIS.**
- **SI LE TECHNICIEN DU CLIENT A BESOIN DE CE MANUEL DANS UNE AUTRE LANGUE QUE L'ANGLAIS, C'EST AU CLIENT QU'IL INCOMBE DE LE FAIRE TRADUIRE.**
- **NE PAS TENTER D'INTERVENTION SUR LES ÉQUIPEMENTS TANT QUE LE MANUEL SERVICE N'A PAS ÉTÉ CONSULTÉ ET COMPRIS.**
- **LE NON-RESPECT DE CET AVERTISSEMENT PEUT ENTRAÎNER CHEZ LE TECHNICIEN, L'OPÉRATEUR OU LE PATIENT DES BLESSURES DUES À DES DANGERS ÉLECTRIQUES, MÉCANIQUES OU AUTRES.**

WARNUNG

- **DIESES KUNDENDIENST–HANDBUCH EXISTIERT NUR IN ENGLISCHER SPRACHE.**
- **FALLS EIN FREMDER KUNDENDIENST EINE ANDERE SPRACHE BENÖTIGT, IST ES AUFGABE DES KUNDEN FÜR EINE ENTSPRECHENDE ÜBERSETZUNG ZU SORGEN.**
- **VERSUCHEN SIE NICHT, DAS GERÄT ZU REPARIEREN, BEVOR DIESES KUNDENDIENST–HANDBUCH NICHT ZU RATE GEZOGEN UND VERSTANDEN WURDE.**
- **WIRD DIESE WARNUNG NICHT BEACHTET, SO KANN ES ZU VERLETZUNGEN DES KUNDENDIENSTTECHNIKERS, DES BEDIENERS ODER DES PATIENTEN DURCH ELEKTRISCHE SCHLÄGE, MECHANISCHE ODER SONSTIGE GEFAHREN KOMMEN.**

AVISO

- **ESTE MANUAL DE SERVICIO SÓLO EXISTE EN INGLÉS.**
- **SI ALGÚN PROVEEDOR DE SERVICIOS AJENO A GEMS SOLICITA UN IDIOMA QUE NO SEA EL INGLÉS, ES RESPONSABILIDAD DEL CLIENTE OFRECER UN SERVICIO DE TRADUCCIÓN.**
- **NO SE DEBERÁ DAR SERVICIO TÉCNICO AL EQUIPO, SIN HABER CONSULTADO Y COMPRENDIDO ESTE MANUAL DE SERVICIO.**
- **LA NO OBSERVANCIA DEL PRESENTE AVISO PUEDE DAR LUGAR A QUE EL PROVEEDOR DE SERVICIOS, EL OPERADOR O EL PACIENTE SUFRAN LESIONES PROVOCADAS POR CAUSAS ELÉCTRICAS, MECÁNICAS O DE OTRA NATURALEZA.**

ATENÇÃO

- **ESTE MANUAL DE ASSISTÊNCIA TÉCNICA SÓ SE ENCONTRA DISPONÍVEL EM INGLÊS.**
- **SE QUALQUER OUTRO SERVIÇO DE ASSISTÊNCIA TÉCNICA, QUE NÃO A GEMS, SOLICITAR ESTES MANUAIS NOUTRO IDIOMA, É DA RESPONSABILIDADE DO CLIENTE FORNECER OS SERVIÇOS DE TRADUÇÃO.**
- **NÃO TENTE REPARAR O EQUIPAMENTO SEM TER CONSULTADO E COMPREENDIDO ESTE MANUAL DE ASSISTÊNCIA TÉCNICA.**
- **O NÃO CUMPRIMENTO DESTE AVISO PODE POR EM PERIGO A SEGURANÇA DO TÉCNICO, OPERADOR OU PACIENTE DEVIDO A‘ CHOQUES ELÉTRICOS, MECÂNICOS OU OUTROS.**

AVVERTENZA

- **IL PRESENTE MANUALE DI MANUTENZIONE È DISPONIBILE SOLTANTO IN INGLESE.**
- **SE UN ADDETTO ALLA MANUTENZIONE ESTERNO ALLA GEMS RICHIEDE IL MANUALE IN UNA LINGUA DIVERSA, IL CLIENTE È TENUTO A PROVVEDERE DIRETTAMENTE ALLA TRADUZIONE.**
- **SI PROCEDA ALLA MANUTENZIONE DELL’APPARECCHIATURA SOLO DOPO AVER CONSULTATO IL PRESENTE MANUALE ED AVERNE COMPRESO IL CONTENUTO.**
- **NON TENERE CONTO DELLA PRESENTE AVVERTENZA POTREBBE FAR COMPIERE OPERAZIONI DA CUI DERIVINO LESIONI ALL’ADDETTO ALLA MANUTENZIONE, ALL’UTILIZZATORE ED AL PAZIENTE PER FOLGORAZIONE ELETTRICA, PER URTI MECCANICI OD ALTRI RISCHI.**

警告

・このサービスマニュアルには英語版しかありません。
・ＧＥＭＳ以外でサービスを担当される業者が英語以外の言語を要求される場合、翻訳作業はその業者の責任で行うものとさせていただきます。
・このサービスマニュアルを熟読し理解せずに、装置のサービスを行わないで下さい。
・この警告に従わない場合、サービスを担当される方、操作員あるいは患者さんが、感電や機械的又はその他の危険により負傷する可能性があります。

注意:

- 本维修手册仅存有英文本。
- 非 GEMS 公司的维修员要求非英文本的维修手册时，客户需自行负责翻译。
- 未详细阅读和完全了解本手册之前，不得进行维修。
- 忽略本注意事项会对维修员，操作员或病人造成触电，机械伤害或其他伤害。

REVISION HISTORY

REV	DATE	PRIMARY REASON FOR CHANGE
A	Nov. 1, 1998	8.2 Software Clinical preliminary release.
B	Dec. 1, 1998	8.2 Software Clinical preliminary release with corrections.
C	May. 1, 1999	8.2 Software Clinical preliminary release with corrections.
D	Sept. 20, 1999	8.2 Software Clinical preliminary release with corrections.
E	Nov. 17 , 1999	8.3 Software Clinical preliminary release with Power Monitor test added and corrections.
0	Aug. 25, 2000	8.3 Software Release for M1033MA, M1033MB, M1033MC and M1033MD.
1	Apr. 30, 2001	New catalogs M3090DA, M3090DB, and M3090DC.

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SECTION 1 – MULTI–NUCLEAR SPECTROSCOPY SUBSYSTEM MANUAL ORGANIZATION

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.

The 1.5T Signa Release 8.X Multi–Nuclear Spectroscopy Subsystem manual consist of tabs with the following titles. All information contained in this Manual will refer specifically to the 1.5T Signa Release 8.X Multi–Nuclear Spectroscopy Subsystem Option unless otherwise noted, however, most references throughout this Manual will be abbreviated to MNS or MNSpectroscopy. There are portions of this Manual which may refer to the proton (^{1}H) Spectroscopy Option (PROBE/SV). The term 8.3 Release (software) refers to the initial product offering of Multi–Nuclear Spectroscopy as a product within the 8.X platform.

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

Catalogs **M1033MA** and **M1033MB** are obsolete and have been replaced by catalogs **M3090DA** and **M3090DB**, respectively. Catalog **M1033MC** is obsolete and catalog **M1033MD** will effectively take its place. Catalog **M3090DC** has been introduced to provide LX systems with MN Spectroscopy compatibility with the new ACGD hardware.

Installation of the New 8.X MNSpectroscopy Option, (UCERD required):
Systems with an RF/PDU cabinet (SRFD) must re–route the RF IN cable from the System Cabinet.

Upgrade from 4.x – 5.X MNS to 8.X MNSpectroscopy Option:.
FE must verify presence (order if required) of MR1A18 Mechanical Attenuator and MR1A18J2 to MR1A16J3 BNC.

Additionally, instructions for installing the MNS Option Key (2254697) and EPROM (EPROM for PROBE only, installed in the RF/Pen 1 or 2 Cabinet but **NOT** needed for systems with an RF/PDU (SRFD) Cabinet) are included. Verify FMI 60525 done ONLY for sites with an SSM (RF/PEN2 Cabinet) (3 micros for the power monitor).

EPLD (U3) on the RF/PEN2 ONLY CPD Board must be: 540049.02, checksum C623, datecode 10/5/99.
Verify FMI 60527 done to upgrade ONLY sites with Indigo II computer to a 2nd disk and 128 Meg memory.
Verify FMI 60533 or eqivalent upgrade done ONLY for sites with Octane computer to upgrade memory to 256 Meg.

Interconnects of subsystem and cabinets are also provided.

SET UP AND CALIBRATION

This section contains Set–Up and Calibration procedures required for 1.5T MNSpectroscopy.

FUNCTIONAL CHECKS

Procedures required to perform 1.5T MNS Functional/Performance checks (SNR and Power Monitor checks).

TROUBLESHOOTING

This section contains a series of tests/checks that may help direct you toward a failed part.

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 of hardware replacement.

SCHEMATICS/INTERCONNECTS

Schematics for selected 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 MNS Option, Catalog. Information is preliminary and is subject to change:

Installation of the New 8.X MNSpectroscopy Option, UCERD required:
M1033MD, New 8.X MNS Stand–alone Cabinet Installation for sites with the RF/PEN 1, RF/PEN 2, RF/PDU, or SRF Cabinet. Erbtec amplifier needs EPROM.

Upgrade existing 4.X to 5.X MNS to 8.X MNSpectroscopy Option, UCERD required:
M3090DA, Signa Advantage 4.X to 5.4 Upgrade to 8.X MNS. RF/Pen 1, 2, RF/PDU, or SRF Cabinet. No Erbtec EPROM needed.
M3090DB, Horizon 5.5 + MNS Upgrade to 8.X MNS, RF/PEN 1, 2, RF/PDU, SRF Cabinet. No Erbtec EPROM needed.
M3090DC, Signa LX receiving ACGD upgrade with new RF/PDU or SRF Cabinet.

CERD to UCERD upgrade:
M1033MF, A UCERD is required for all sites, existing 8.X sites with a CERD must order this Catalog.

M1033MG, SAGE7 for 8.X, Key to activate 8.X SAGE 7 software. This key is not required for the MNS Option as it is included (2254697).

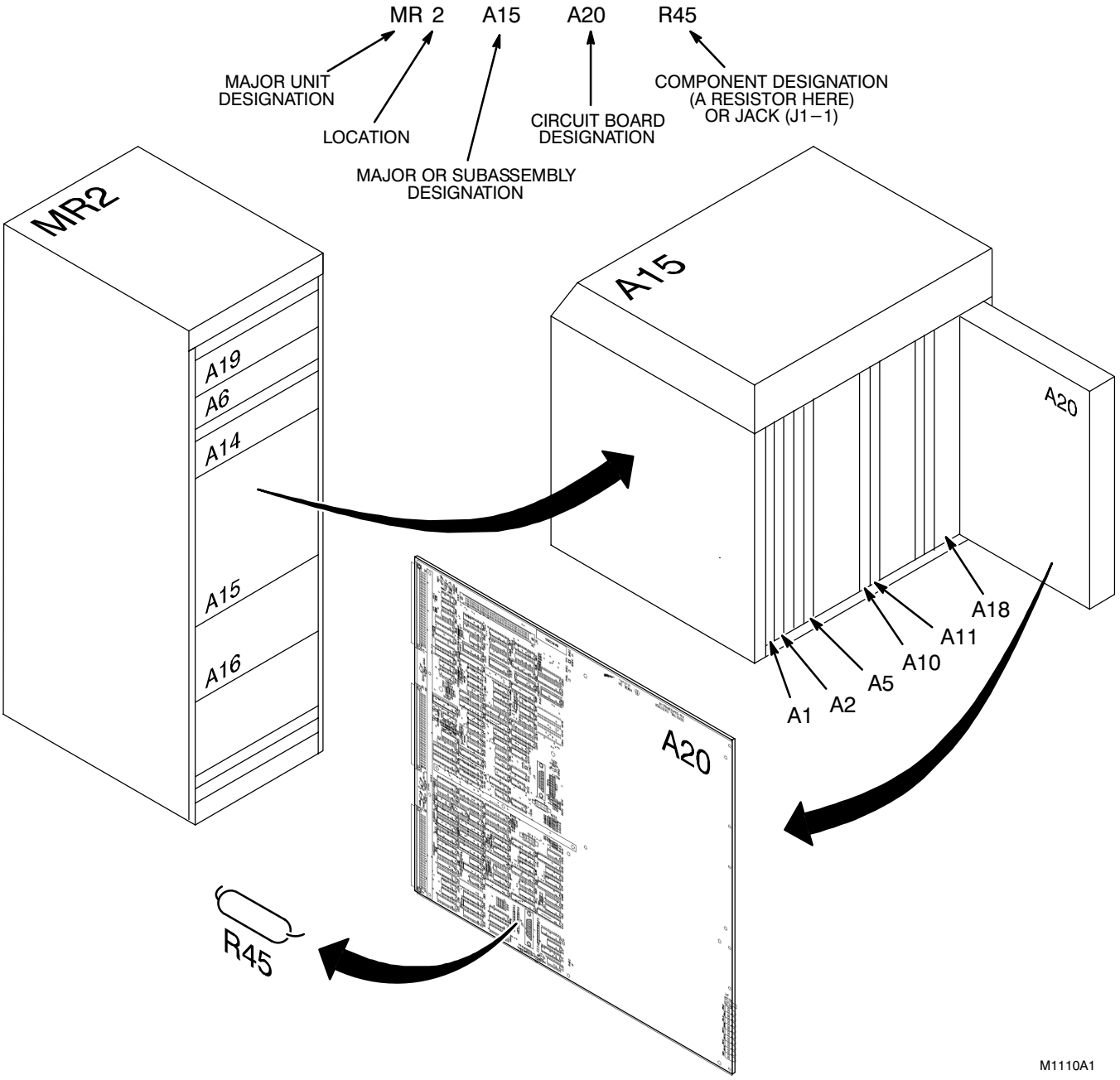
M1040PH, 1.5T Phosphorus Flex Coil Kit, includes 31P TR Flex Coil, Cable Extension, 2 wraps, and Q.D. Box. These parts already are included in the normal 8.X MNS Catalog

Additionally, instructions for installing the MNS Option Key (used for MNS) and EPROM (for PROBE only, installed in the RF/Pen 1 or 2 Cabinet ONLY) are included.

Interconnects of subsystem and cabinets are also provided.

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.



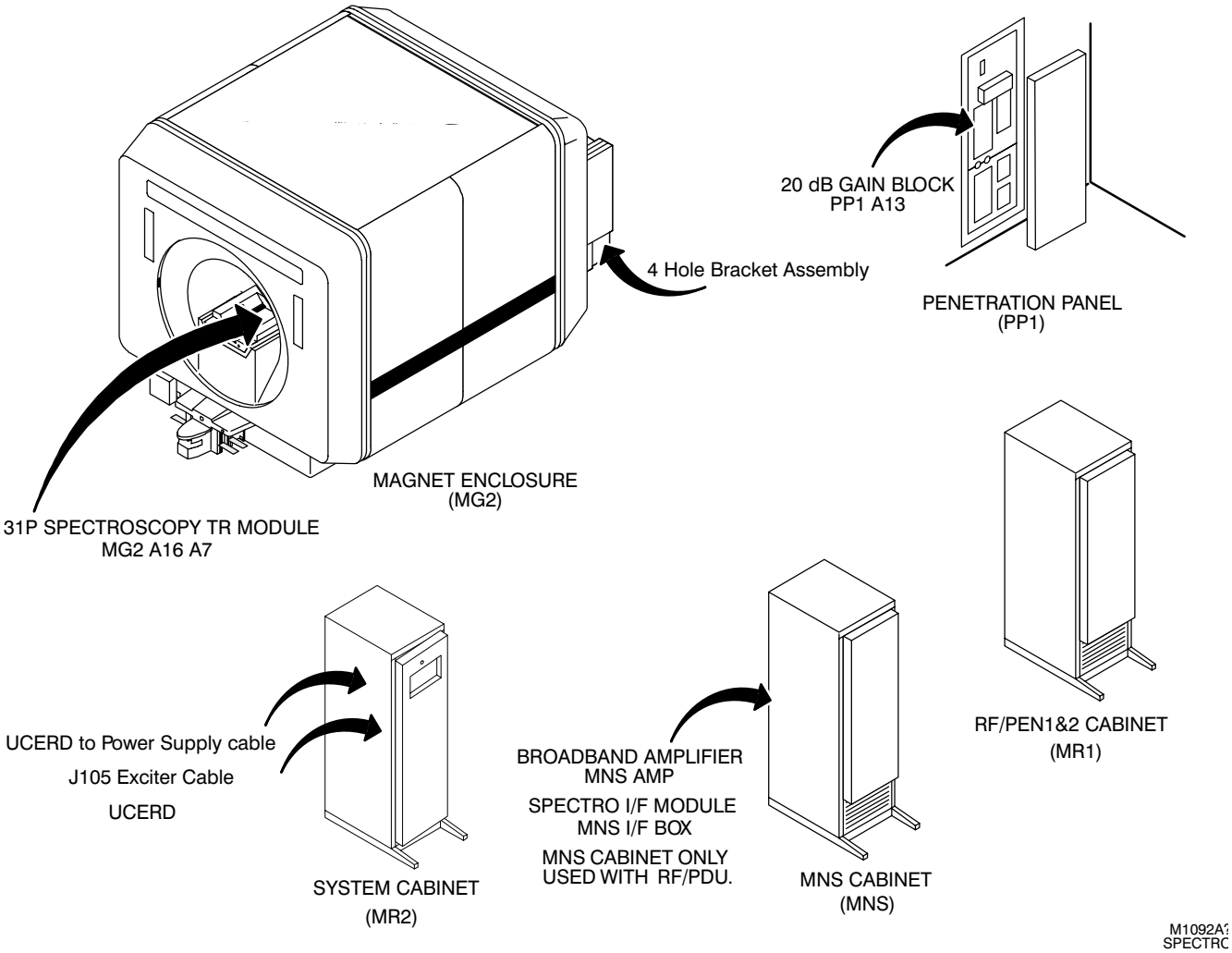
COMPONENT DESIGNATOR SYSTEM
ILLUSTRATION 2–1

SECTION 3 – COMPONENT IDENTIFICATION

Refer to Table 3–1 for Multi–Nuclear Spectroscopy Subsystem designators. Refer to Illustration 3–1 Multi–Nuclear Spectroscopy components.

TABLE 3–1
1.5T SIGNA MULTI–NUCLEAR SPECTROSCOPY SUBSYSTEM DESIGNATOR / HARDWARE

DESIGNATOR	DESCRIPTION	DESIGNATOR	DESCRIPTION
MG2 MR1 MR2	MAGNET ENCLOSURE RF/PEN CABINET SYSTEM CONTROL CABINET	PP1 MNS	PENETRATION PANEL MULTI–NUCLEAR SPECTROSCOPY CABINET



1.5T SIGNA MULTI–NUCLEAR SPECTROSCOPY SUBSYSTEM COMPONENTS
ILLUSTRATION 3–1

INSTALLATION

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SECTION 1 – GETTING STARTED

Note

This section applies Multi–Nuclear Spectroscopy hardware.

1–1 INTRODUCTION

In the past, MN Spectroscopy hardware was often included in the same cabinet with the narrowband RF amplifier hardware. Rapid improvements in MR RF (SRFD) and gradient hardware (Advanced Control Gradient Driver (ACGD)) has necessitated a change in this philosophy. Spectroscopy hardware will now be installed in a stand–alone cabinet to better accomodate future changes and improvements in MR technology. 3 new upgrade kits have been introduced and 1 install kit has been brought over from the previous catalog structure to facilitate this change.

MN Spectroscopy option upgrade kits, as delivered by Catalogs M3090DA (MRi Spectro Signa Advantage Upgrade), M3090DB (MRi Spectro Signa Horizon Upgrade), and M3090DC (MRi Spectro LX Upgrade) are installed by this Section. The MN Spectroscopy option install kit, as delivered by Catalog M1033MD (MRi MN Spectroscopy Installation), is for Horizon LX and MRi systems that do not currently have MN Spectroscopy and is also installed by this Section. Catalogs M3090DA/DB/DC provide an empty, stand–alone MNS Cabinet and put hardware at the Penetration Panel, in the System Cabinet, in the SRF or RF/PDU Cabinet, in the ACGD Cabinet, and in the Magnet Room. Catalog M1033MD provides an MNS Cabinet complete with all the hardware including a broadband RF amplifier and puts hardware at the Penetration Panel, in the System Cabinet, in the SRF or RF/PDU Cabinet, in the ACGD Cabinet, and in the Magnet Room.

Note

The MN Spectroscopy option is not for field installation in Signa Mobile sites.

1–2 PREREQUISITE UPGRADES AND RELATED OPTIONS

The Multi–Nuclear Spectroscopy Option may be added to any 1.5T Signa 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.
2. Determine which configuration is applicable to your site. Utilize the flowchart in Illustrations NO TAG and 1–2 to inspect to help determine upgrade status or new status.
3. Install any prerequisite upgrades.
4. Install MNS. Refer to installation instructions in the remainder of this Direction. The installation procedure indicates which option(s) pertain.

Note

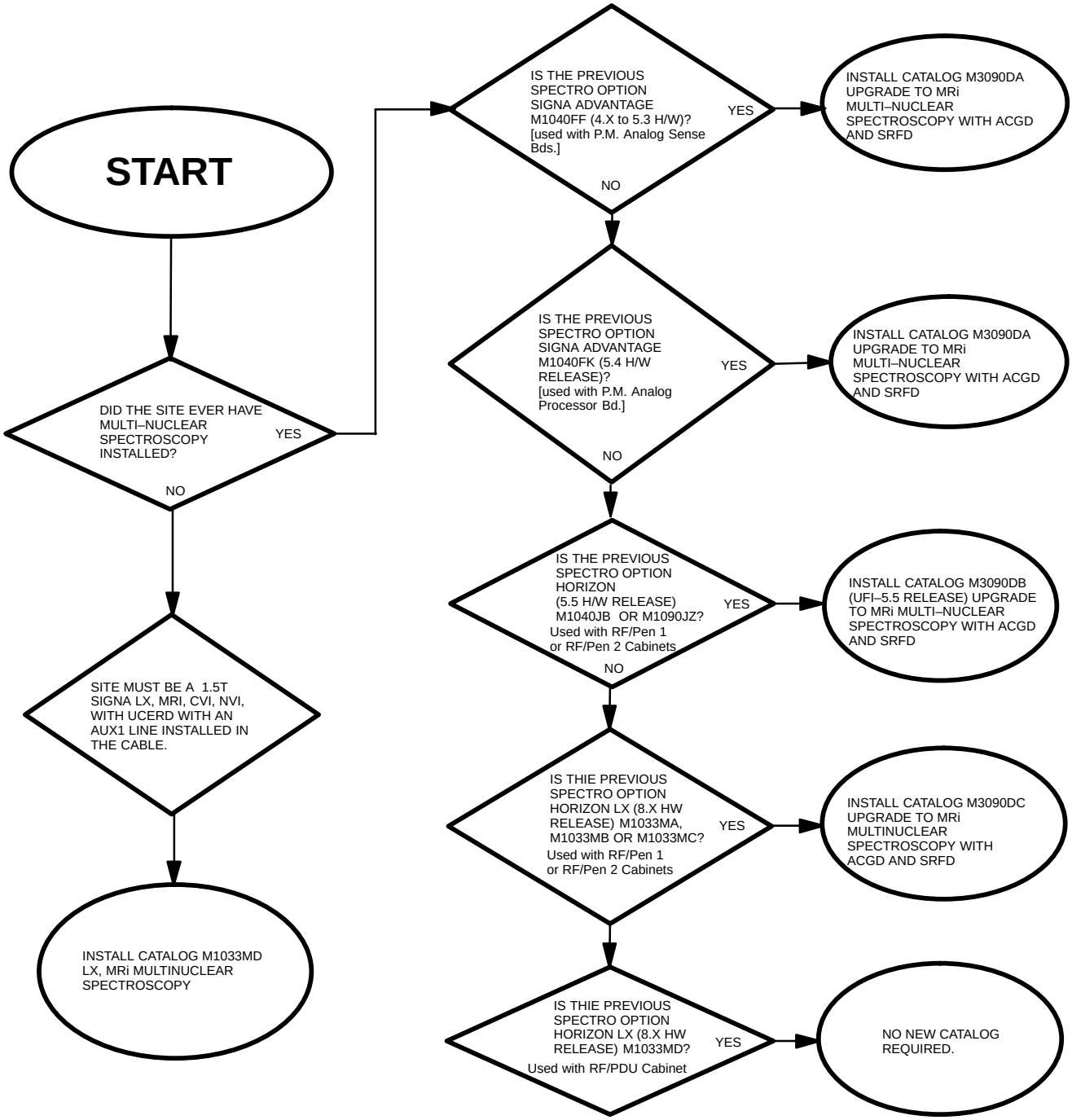
Systems with ACGD hardware are to be operating at Software Release ASP2 or 8.4ACGD or CNV3 or higher.

1–2 PREREQUISITE UPGRADES AND RELATED OPTIONS (Continued)

TABLE 1–1
REQUIRED UPGRADE SUMMARY

SYSTEM CAT# DELIVERED	SYSTEM CONFIGURATION AS DELIVERED	PREREQUISITE UPGRADES
Signa Horizon LX, MRi M1033MD	RF/Pen Cabinet 1 (Model 2109930, 2109930–3, 2109930–4, 2109930–50) or RF/Pen Cabinet 2 (Model 2160200, 2160200–2) or RF/PDU Cabinet (Model 2224560) or SRF Cabinet (Model 2174500)	None
Signa Horizon MRi M3090DA, M3090DB	SRF Cabinet (Model 2174500) and ACGD Cabinet (Model 2238915)	Signa Advantage Spectroscopy option M1040FF or Signa Advantage Spectroscopy option M1040FK or Signa Advantage Spectroscopy option M1040JB or M1090JZ
Signa Horizon MRi M3090DC	SRF Cabinet (Model 2174500) and ACGD Cabinet (Model 2238915)	Signa Horizon LX Spectroscopy option M1033MA or Signa Horizon LX Spectroscopy option M1033MB or Signa Horizon LX Spectroscopy option M1033MC

1–3 CATALOG DETERMINATION FLOW CHART



FLOW CHART FOR 1.5T SIGNA LX, MRI MULTI–NUCLEAR SPECTROSCOPY
ILLUSTRATION 1–2

1–4 CONTENTS OF THE INDIVIDUAL MNSPECTROSCOPY OPTION KITS

The major components of the M3090DA/DB/DC and M1033MD kits are listed in Table 1–2 below. Items 1 through 3 and 5 through 8, 12 and 16 appear in Illustration 1–3. Refer to Renewal part Section for specific contents of each MNS Catalog.

TABLE 1–2
M1033 MULTI–NUCLEAR SPECTROSCOPY CONTENTS

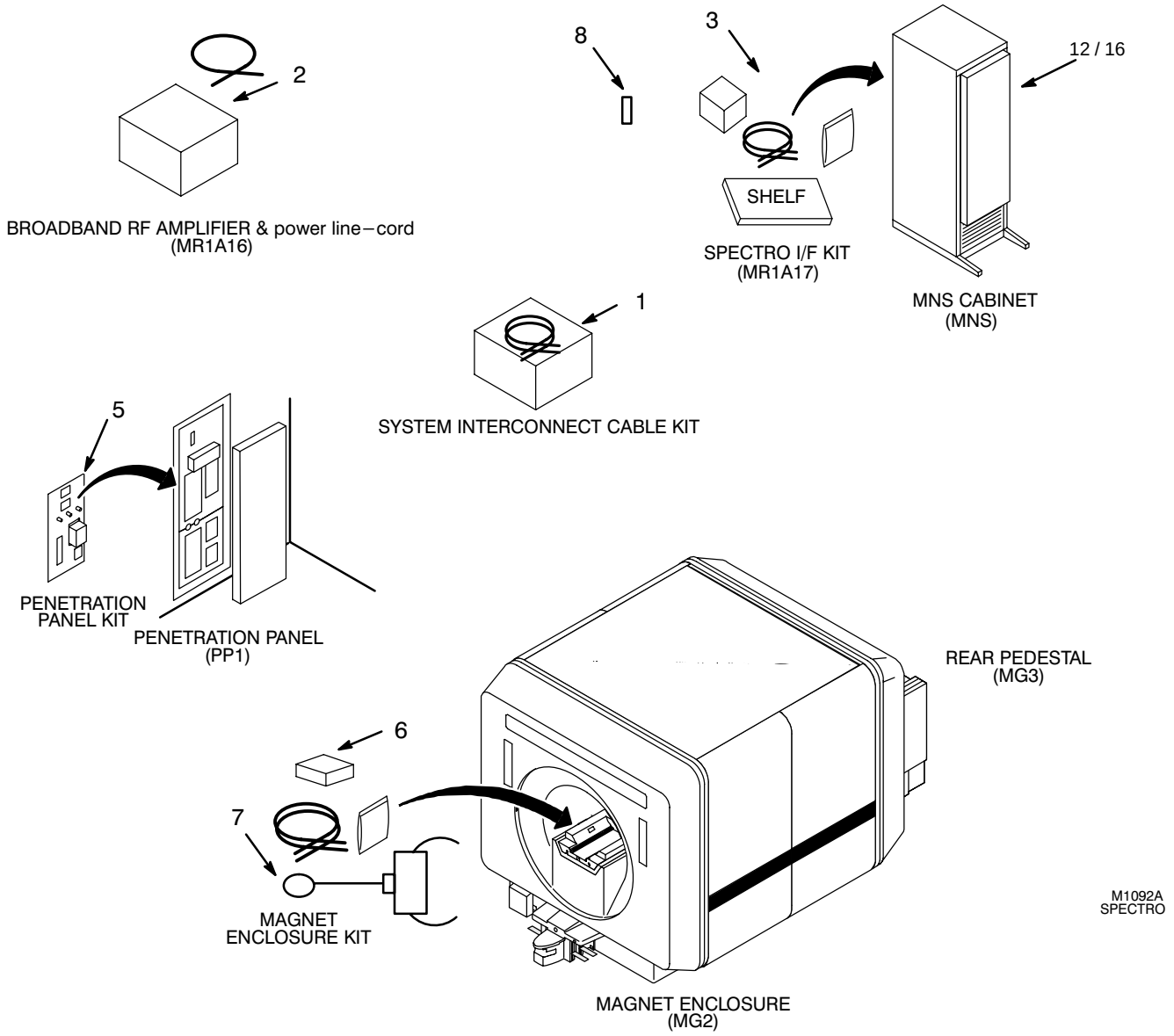
ITEM	PART NUMBER	DESCRIPTION	SECTION INSTALLED
1	46–301824G4	MNS Subsystem Cable Interconnect Kit	Section 2
2	46–301464P2	Analogic RF Amplifier & power linecord, and Vendor Manual	Section 4
3	2109930–12	Spectro Module Assembly and cables (M3090DA only)	Section 4
4	2144525–2	Sys. Cabinet: UCERD–TNS Kit (M1033MD, M3090DA/DB only)	Section 6
5	46–301548G4	LPCC Magnet Enclosure Kit (M3090DA/DB only)	Section 8
6	46–301548G5	LX Magnet Enclosure Kit For LPCC (M1033MD only)	Section 8
7	2259502	1.5T ^{31}P TR Flex Coil, Extender cable, Velcro Strap, and 1.5T ^{31}P Flex Coil Q. D. Adaptor Box (MD, DA, DB only)	Not “installed”
8	2152220	MRS Head Sphere With Solution (MD, DA, DB only)	Not “installed”
9	2229281–100	MNS Op Manual (MD, DA, DB only)	Not “installed”
10	2228585–100	SAGE 7 LX User’s Guide (MD, DA, DB only)	Not “installed”
11	2136365	Adapter Plate Assembly (M1033MD, M3090DA/DB only)	Section 7
12	2220080	MNS Cabinet Install	Section 3
13	2254697	Multinuclear Spectro (M1033MD, M3090DA/DB only)	Section 1
14	2209382	LX S/W Options (M1033MD, M3090DA/DB only)	Section 1
15	46–320103P1	RF/Pen 1 and 2 EPROM (M1033MD only)	Section 9
16	2220080–2	MNS Cabinet Assembly for ASP (M3090DA/DB only)	Section 4

NOTE concerning Spectro RF Amplifiers

The Analogic Amplifier part number may be replaced with a compatible Amplifier (ENI).

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.

1–4 GENERIC CONTENTS OF M1033MD AND M3090DA/DB/DC MNSPECTROSCOPY OPTION (Continued)



GENERIC MNSPECTROSCOPY SUBSYSTEM COMPONENTS (M1033MD AND M3090DA/DB/DC)
ILLUSTRATION 1–3

1–5 PREINSTALLATION CHECK

The following checks are to be performed at the site to insure that the cable lengths are satisfactory prior to Spectroscopy option installation. Extra cable lengths and BNC adapters to join the cables, if necessary, are to be ordered in advance and available prior to starting.

1. This option provides 4 new system cables as listed in Table 1–3.

TABLE 1–3
NEW SYSTEM CABLES PROVIDED WITH THIS UPGRADE

CABLE ROUTE	RUN(S)	LENGTH	TYPE
Magnet Enclosure (MG3 A17 J3) to Penetration Panel (PP1J83)	473	80 Feet (28 m)	Heliax, N to SC
Magnet Enclosure (MG3 A17 J4) to Penetration Panel (PP1 J79)	472	80 Feet (28 m)	RG223/U BNC Coax
System Cabinet (MR2 A11 J3) to Penetration Panel (PP1 A13 OUT)	469	50 Feet (16 m)	RG223/U BNC Coax
RF/PEN Cabinet (MR1 A7 J45) to Penetration Panel (PP1 J83)	468	50 Feet (16 M)	Heliax, N to SC

1–6 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.

MRS (MR Spectroscopy) Phantom, 2152220 (MSDS #8365823), is included with the shipment of the Proton Spectroscopy Option and the MNS Option. Other Spectroscopy Option Keys (required for Hydrogen Only Spectroscopy) are not associated with the MNS Option.

1–7 INSTALLATION SCHEDULE CONSIDERATIONS

Manpower needed for heavy lifting during the hardware installation phase includes two persons for installing Multi–Nuclear RF Amplifier. The Analogic Amplifier weighs upward to 130 pounds. The ENI Amplifier weighs upward to 77 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 16 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.

1–8 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–M1033MD in Table 1–7 is for 1.5T SIGNA Release LX, MRi 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 1–4 for a summary of box contents as detailed in PDI–M3090DA. Refer to Table 1–5 for a summary of box contents as detailed in PDI–M3090DB. Refer to Table 1–6 for a summary of box contents as detailed in PDI–M3090DC. Refer to Table 1–7 for a summary of box contents as detailed in PDI–M1033MD.

Note

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

TABLE 1–4
PDI SUMMARY FOR M3090DA SHIPPING BOXES

BOX	CONTENTS
1	Operators Documentation, MN Spectroscopy Software MOD Option Key for LX and MRi, 1.5T (^{31}P) Phosphorus TR Flex Coil Kit with Operators Manual, MNS Mag. Encl Kit, MRS Phantom, Cable set, UCERD (J109) to TNS and I/F Panel Cable, Empty Plastic Bottle
2	1.5T RF/Pen 2 Spectro Internal cable Kit
3	MNS Cabinet for ASP Upgrade

TABLE 1–5
PDI SUMMARY FOR M3090DB SHIPPING BOXES

BOX	CONTENTS
1	Operators Documentation, MN Spectroscopy Software MOD Option Key for LX and MRi, 1.5T (^{31}P) Phosphorus TR Flex Coil Kit with Operators Manual, LPCC MNS Mag. Encl Kit, MRS Phantom, Cable set, UCERD (J109) to TNS and I/F Panel Cable, Empty Plastic Bottle
2	1.5T RF/Pen 2 Spectro Internal cable Kit
3	MNS Cabinet for ASP Upgrade

TABLE 1–6
PDI SUMMARY FOR M3090DC SHIPPING BOXES

BOX	CONTENTS
1	1.5T RF/Pen 2 Spectro Internal cable Kit
2	MNS Cabinet for ASP Upgrade

TABLE 1–7
PDI SUMMARY FOR M1033MD SHIPPING BOXES

BOX	CONTENTS
1	Operators Documentation, MN Spectroscopy Software MOD Option Key for LX and MRi, 1.5T (^{31}P) Phosphorus TR Flex Coil Kit with Operators Manual, MNS Mag. Encl Kit, UCERD (J109) to TNS and I/F Panel Cable, Empty Plastic Bottle, MNS Phosphorus TR Module, U17 Erbtec Processor Board EPROM, Cable, Adapter Plate Assy.
2	MRS Phantom
3	MNS Spectroscopy RF Heliax Cable
4	MNS Spectroscopy RF Heliax Cable
5	Cable Set
6	MNS Cabinet

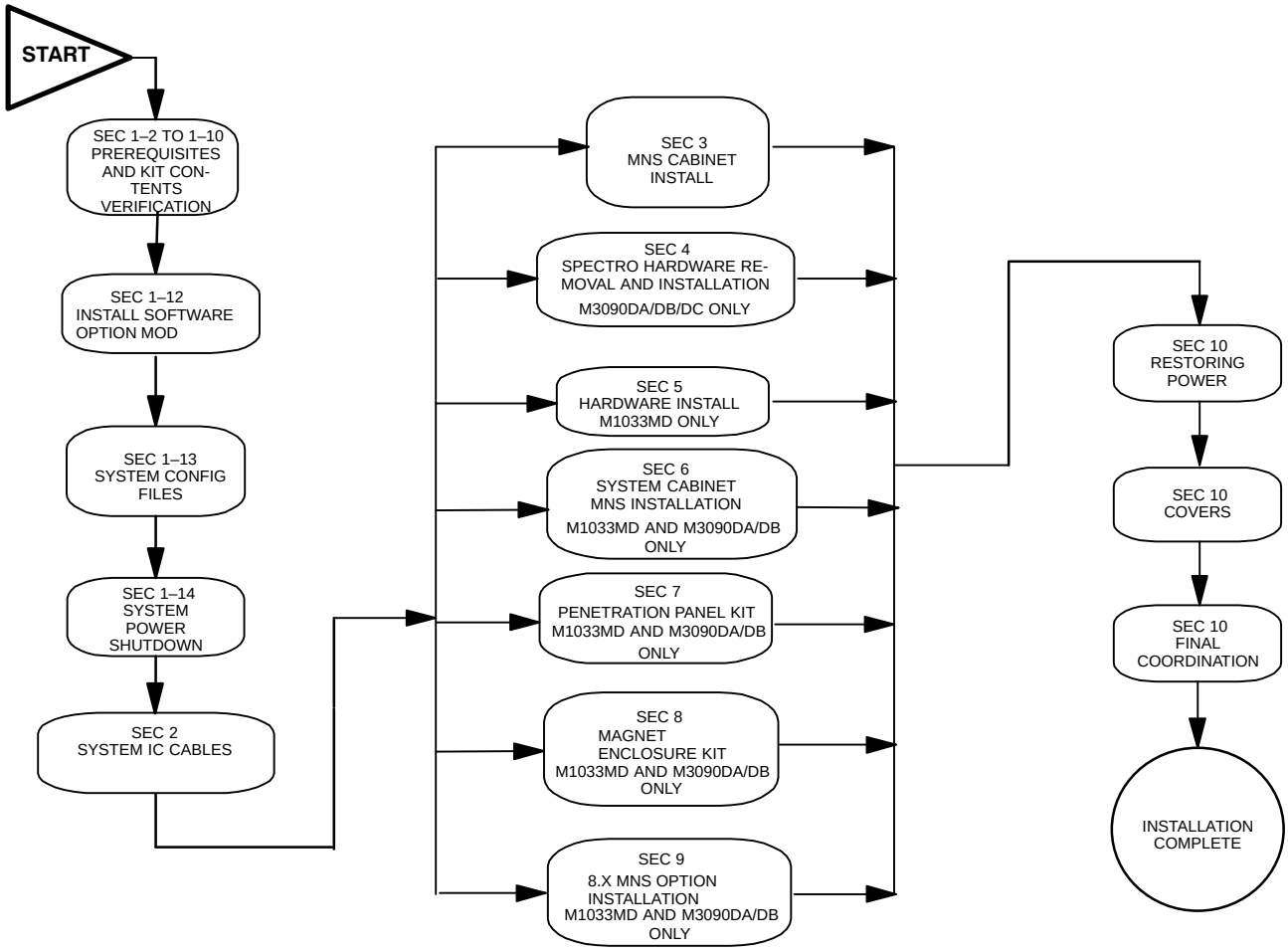
1–9 ICD, SHIPPING, AND INSTALLATION PRODUCT LOCATOR CARDS

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.

1–10 INSTALLATION FLOW CHART

The flow chart in Illustration 1–4 shows sequence for an orderly and efficient installation of the MNSpectroscopy 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 1–4

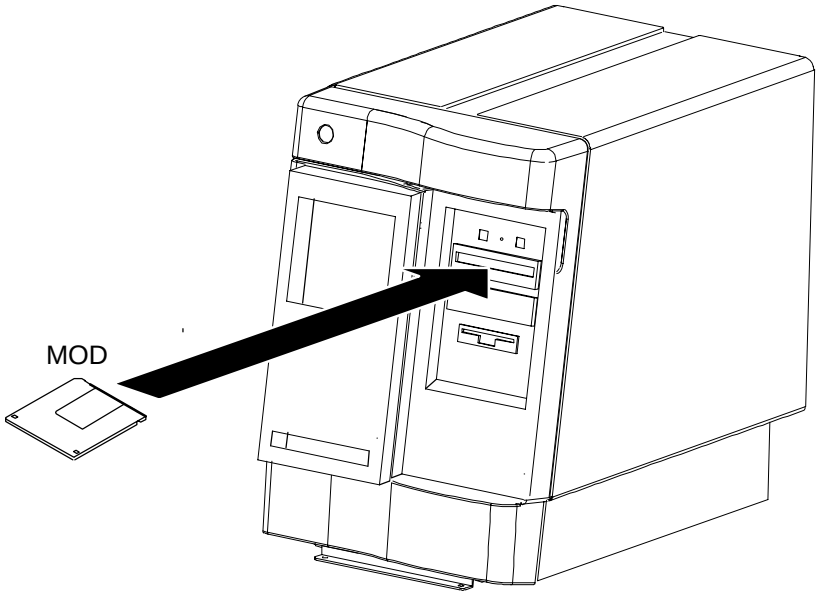
1–11 CONVENTIONS

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.

1–12 INSTALLING MRi / LX MULTI–NUCLEAR SPECTROSCOPY SOFTWARE OPTION [MOD]

1. Insert the **MOD** disk (Signa Horizon LX MNS Option, 2254697) in the SGI computer MOD drive.
2. Select the **[Service Tools Desktop]**.
3. Select **[Install...]** from the Service Desktop Manager.
4. After Type Root Password is displayed, type **operator** as the password.
5. After the Guided Install window opens, select **Option Key tab**.
6. Select **MOD** box at Install Option Key portion of the window, then select **Instal**l.
7. When the installation process is complete, either load the next MOD, or when all options have been loaded, select **File –––> Quit** to exit the Guided Install tool.
8. Remove the front panel of the computer, place the MNS Option Rating Plate on the inside panel of the Computer Duplex front panel.
9. Reboot the computer.
10. The installation is now complete.



MNS OPTION KEY INSTALLATION
ILLUSTRATION 1–5

1–13 MULTI–NUCLEAR SPECTROSCOPY CONFIGURATION FILE MANAGER

1. The Coil Config file should contain the P31_FLEX MNS coil. If it does not then perform the following steps.
2. At the **"Service Desktop Manager"** click on **[Tools] [Utilities]**. Use the mouse to highlight the **"Config File Manager"**. Click on **[Start]**. Select the **"MR Configuration File"**. Answer the following:

   Spectroscopy RF Amplifier = **yes** to configure the Multi–Nuclear Spectro RF Amplifier (amp to ready)
   Broadband Transciever = **yes** to configure the MNS BroadBand Transceiver (frequency change)
   Power Monitor Type = **1** to configure a 1.5T site with Multi–Nuclear Spectroscopy
3. Select **"Coil Configuration File" "Add a Coil"** to create a P31_FLEX Coil.
   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)
4. Save all changes before exiting.

Note

The MNSpectro Option Key delivered with the Hydrogen Only Spectroscopy Option (PROBE/SV) must 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).

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

1–14 SYSTEM POWER SHUTDOWN

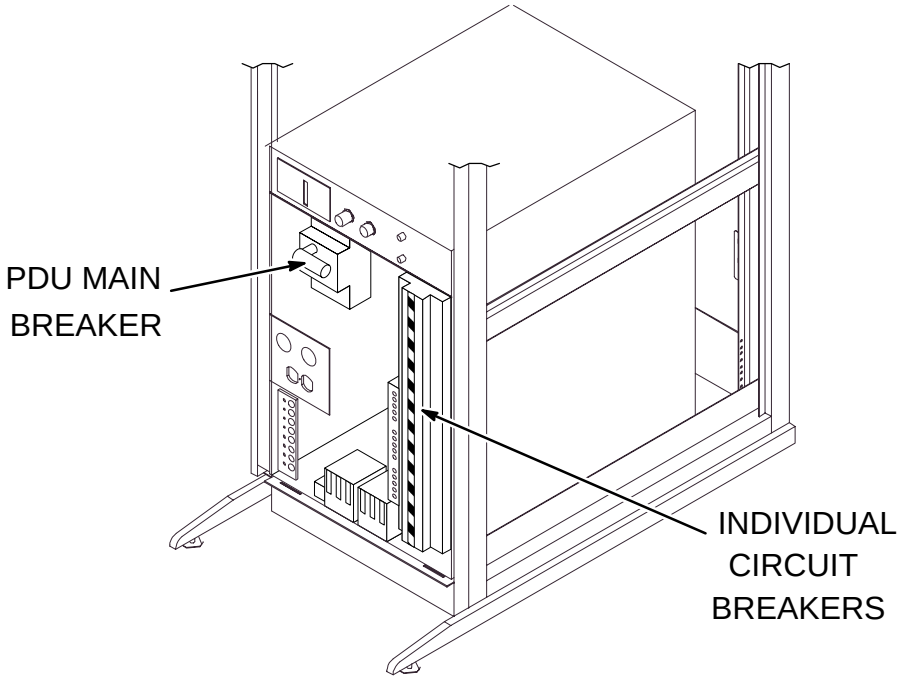
DANGER!!

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. Refer to MR 8.X Service Methods CD–ROM *Direction 2160623, Service Documentation, Safety, Section 6 – OSHA LOCKOUT / TAGOUT REQUIREMENTS.*
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. Shutdown the system software before removing power.
4. For the Standard PDU:
   – Open the hinged, right front door and find the incoming power Phase A, Phase B, and Phase C indicator lights in the lower left area of the breaker panel. All the lights should be illuminated. **Note any that are burned out**.
   – Press the FULL OFF button on the front control panel of the PDU to power it off.
5. For the Compact PDU:
   – Open front panel of the Compact PDU and find the incoming power DS1, DS2, and DS3 phase indicator lights in the upper right area of the breaker panel. All the lights should be illuminated. **Note any that are burned out**.

1–14 SYSTEM POWER SHUTDOWN (Continued)

6. For the Teal PDU mounted inside the RF/PDU cabinet:
   – Locate the incoming power Ph. A, Ph. B, and Ph. C phase indicator LEDs in the lower left area of the front panel. All the LEDs should be illuminated. **Note any that are burned out**.
   – Power off the PDU by rotating the Main Input PDU Breaker located on the front panel to the OFF position.
7. For systems with the SRF cabinet that have the Phoenix PDU mounted inside the ACGD cabinet:
   – Locate the incoming power Ø A, Ø B, and Ø C phase indicator LEDs in the center area of the front panel. All the LEDs should be illuminated. **Note any that are burned out**.
   – Power off the PDU by rotating the Main Input PDU Breaker located on the front panel to the OFF position.
8. Locate and shut off main disconnect breaker supplying power to the PDU.
9. Perform lock out of the main disconnect breaker. Tag the main disconnect breaker to prevent inadvertent power restoration.



POWER OFF BREAKERS FOR PDU IN RF/PDU AND ACGD CABINETS
ILLUSTRATION 1–6

1–14 SYSTEM POWER SHUTDOWN (Continued)

10. 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 labeled DS1, DS2, and DS3 on the panel next to POWER OFF button. If these lights are not lit, and they were previously, power has been removed. Make certain that the lights were previously in good working order and that none were burned out.

    – Open the hinged front door on the PDU and use an AC voltmeter to measure a sample of the input voltage between test inputs A–B, A–C, and B–C (each test input is scaled down to 100:1 of the corresponding incoming AC phase) and confirm that the voltage between each is zero volts AC (0 VAC).

    - FOR TEAL PDU INSIDE RF/PDU CABINET:

    – Locate the incoming power Ph. A, Ph. B, and Ph. C phase indicator LEDs in the lower left area of the front panel. If these LEDs are not lit, and they were previously, power has been removed. Make certain that the LEDs were previously in good working order and that none were burned out.

    – Measure a sample of the input voltage between test inputs A–B, A–C, and B–C (each test input is scaled down to 100:1 of the corresponding incoming AC phase) and confirm that the voltage between each is zero volts AC (0 VAC).

    - FOR PHOENIX PDU INSIDE ACGD CABINET USED WITH SRF CABINET:

    – Locate the incoming power Ø A, Ø B, and Ø C phase indicator LEDs in the center area of the front panel. If these LEDs are not lit, and they were previously, power has been removed. Make certain that the LEDs were previously in good working order and that none were burned out.

    – Measure a sample of the input voltage between test inputs A–B, A–C, and B–C (each test input is scaled down to 100:1 of the corresponding incoming AC phase) and confirm that the voltage between each is zero volts AC (0 VAC).

1–14 SYSTEM POWER SHUTDOWN (Continued)

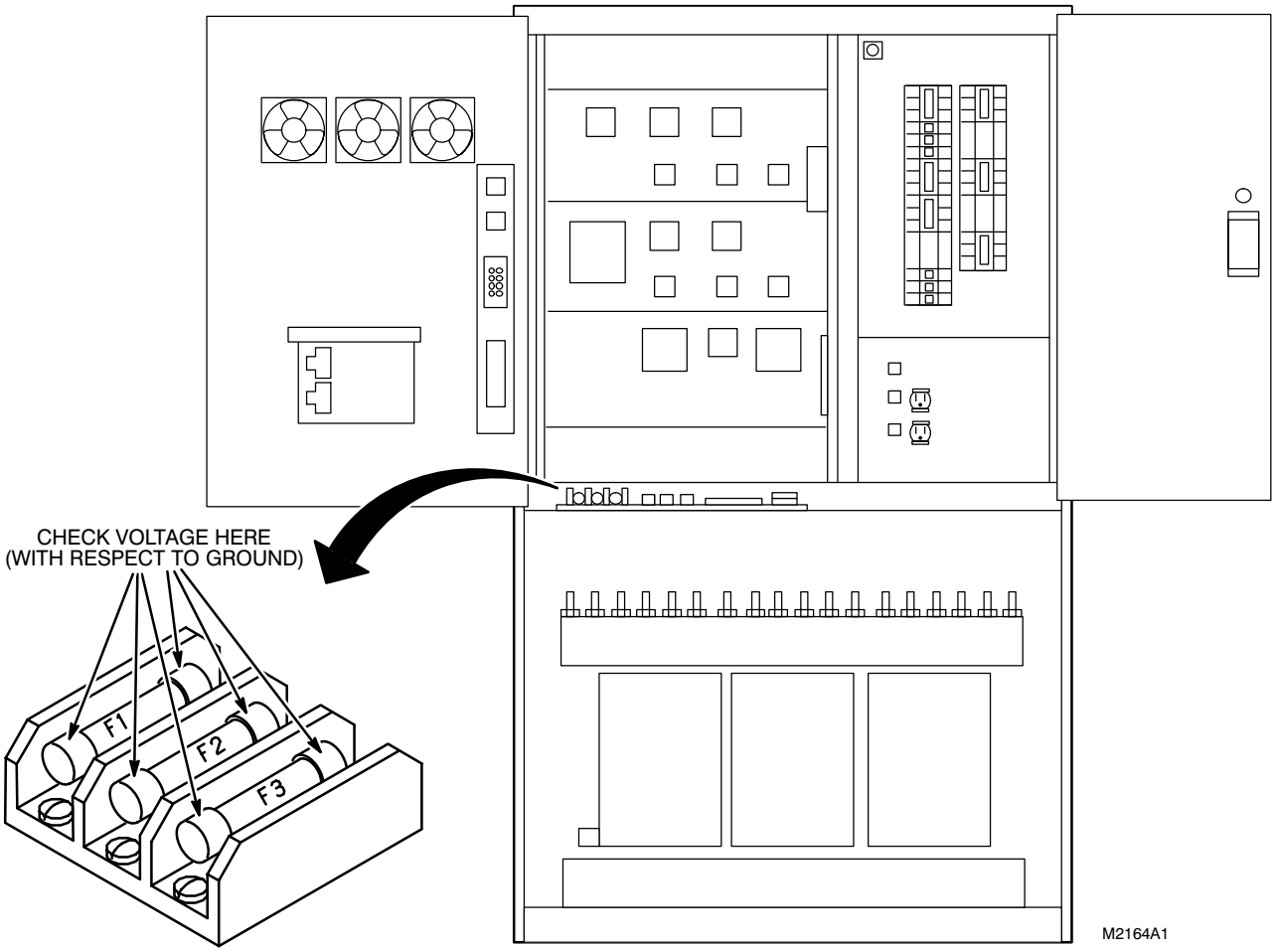
- FOR STANDARD PDU:

– Open the right, front door and locate the incoming power Phase A, Phase B, and Phase C phase indicator lights in the lower left area of the front panel. If these lights are not lit, and they were previously, power has been removed. Make certain that the lights were previously in good working order and that none were burned out.

– Remove screws from left front door.

– Swing open left front door.

– Check for 0 volts AC, with respect to ground, on both ends of each fuse located inside standard PDU. Refer to Illustration 1–7. If power is present then find the source and disconnect.



POWER OFF VERIFICATION
ILLUSTRATION 1–7

SECTION 2 – MNS SUBSYSTEM CABLE INSTALLATION

NOTE
This section applies to all catalogs.

Time: 1 hour, 1 person.

2–1 UNPACKING CABLE KIT

The 4 new MNSpectroscopy Subsystem Cables are shipped in Box 1. See Table 2–1 for a listing of the cables. Note that cable Runs 468 and 473 are only included with the M1033MD kit.

TABLE 2–1
MNSPECTROSCOPY SUBSYSTEM CABLES

RUN	"FROM"	"TO"	DESCRIPTION	REMARKS
468	PP1–J83	MNS–RF–OUT	Heliax Coax, 50 foot Cable	Heliax Coax, SC to N **(For M1033MD ONLY)**
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 **(For M1033MD ONLY)**
936	MR1–A20–PWR	MNS–J1	Power Cable, 12 foot extension	Twist–lock connectors
961	MR1–A20–J507	MNS CONTROL I/O	Multiconductor cable	25 pin sub–D connectors
962	MR1–A20–J102	MNS PMB	RG223 Coax, 15 foot cable	RG223 Coax, BNC
963	MR1–A20–J101	MNS PMA	RG223 Coax, 15 foot cable	RG223 Coax, BNC
964	MR1–A20–J407	MNS TR BIAS	RG223 Coax, 15 foot cable	RG223 Coax, BNC
965	MR1–A20–J104	MNS RF IN	RG223 Coax, 15 foot cable	RG223 Coax, BNC

2–2 ROUTE NEW CABLES

Note

The UCERD ”RF OUT” signal from the Exciter, Run 229, is part of the normal system. This cable is common for all ”RF OUT” signals.

1. Route cables listed in Table 2–2.

   See Illustration 2−1 for systems with an RF/PDU or SRF Cabinet.

   See Illustration 2−2 for systems with an RF/PEN 2 Cabinet.

   See Illustration 2−3 for systems with an RF/PEN 1 Cabinet.

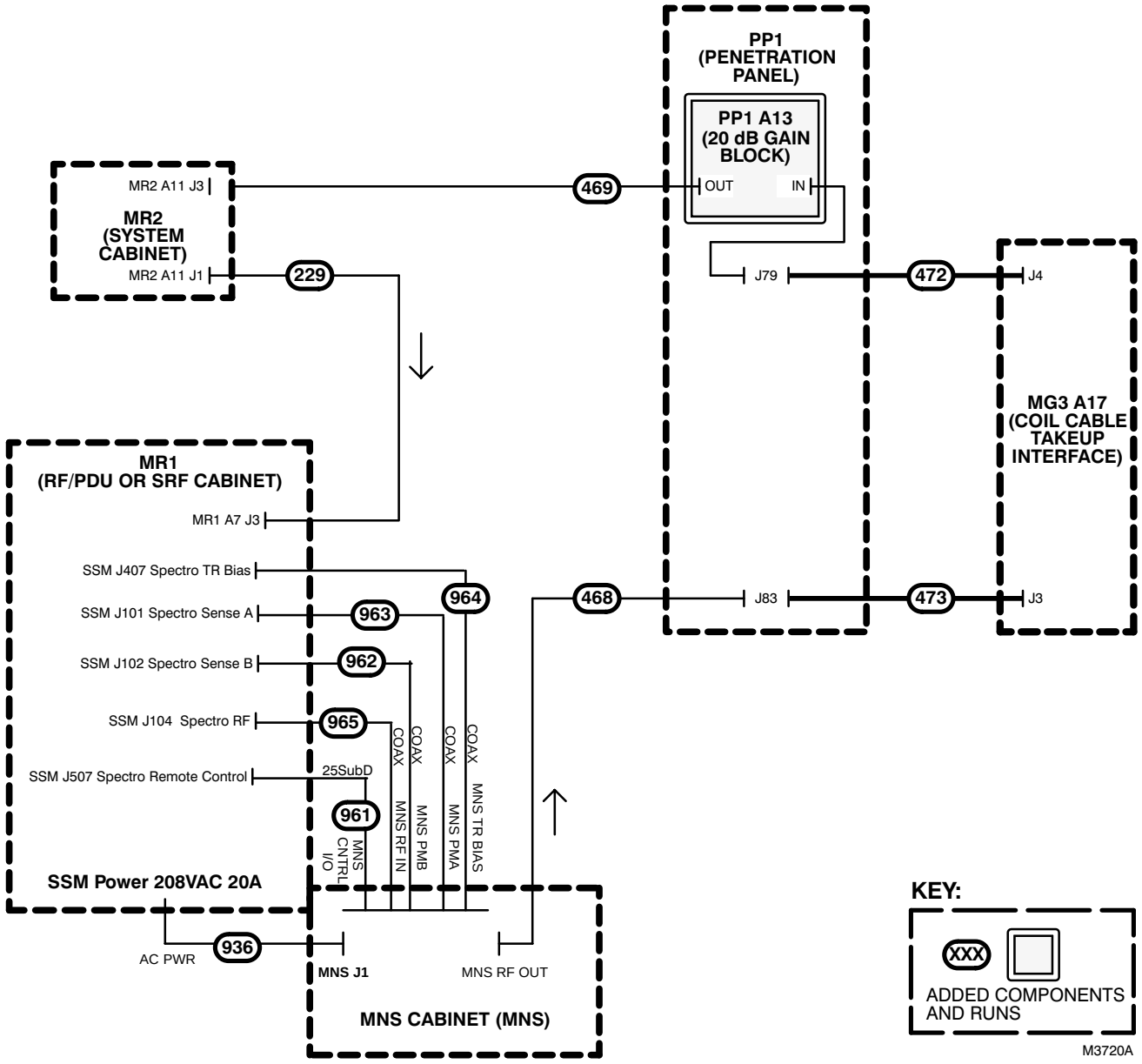
2. Remove twists and kinks from cabling. When routing cables, avoid circular loop bundles of less than 6 foot diameter.

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 Take–Up Interface (MG3 A17)

TABLE 2–2
ROUTING NEW CABLES

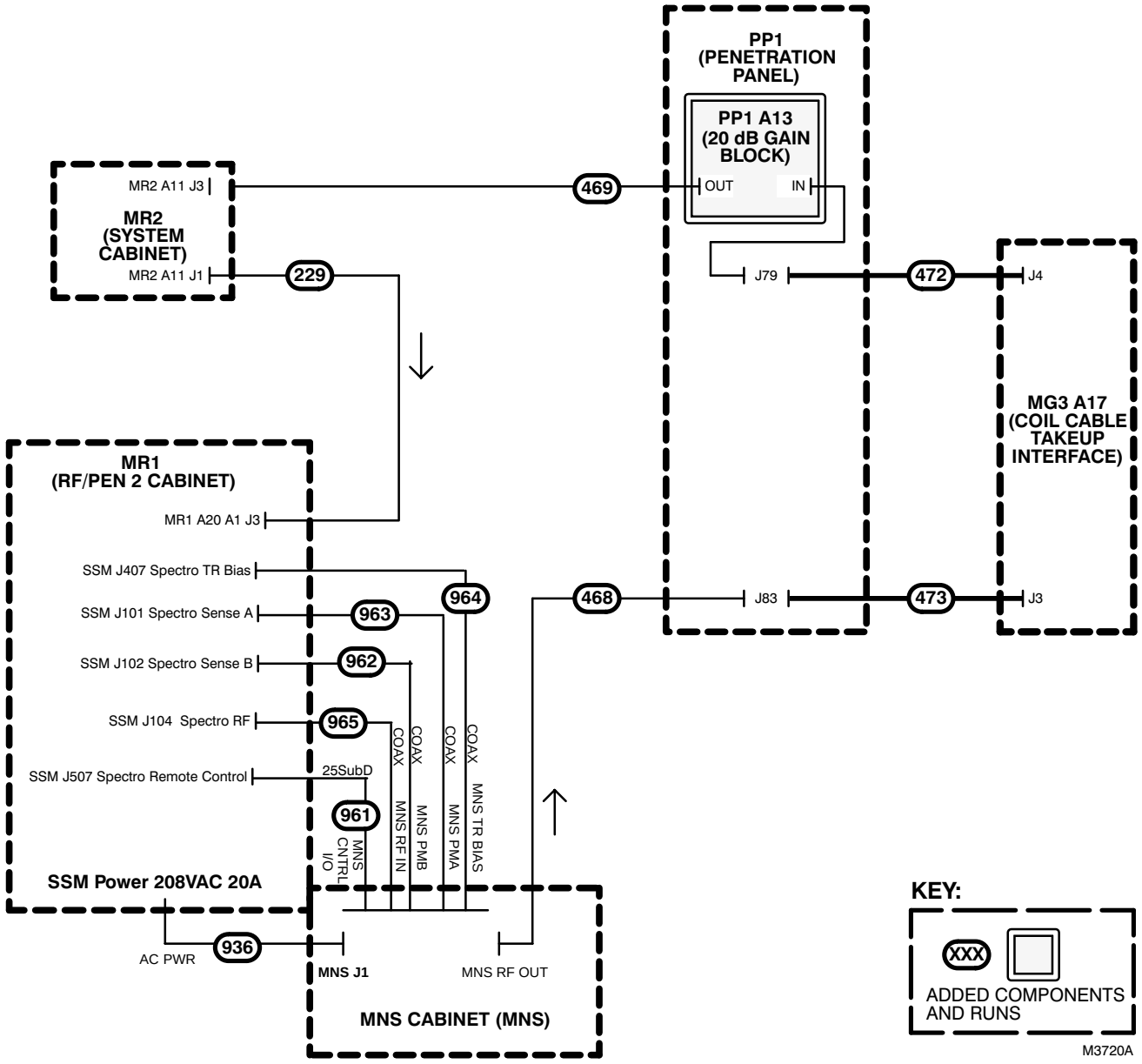
RUN(S)	FROM	TO	LENGTH	TYPE
MAGNET ROOM CABLES				
472	Magnet Enclosure	Penetration Panel	80 Feet (26 m)	RG223 Coax, BNC
473	Magnet Enclosure	Penetration Panel	80 Feet (26 m)	Heliax Coax, SC to N
EQUIPMENT ROOM CABLES				
468	Penetration Panel	MNS Cabinet	50 Feet (16 m)	Heliax Coax, SC to N
469	System Cabinet	Penetration Panel	50 Feet (16 m)	RG223 Coax, BNC
936	RF Cabinet	MNS Cabinet	12 Feet (3.6 m)	Power cable extension
961	RF Cabinet	MNS Cabinet	15 Feet (4.5 m)	25pin sub–D multicon
962	RF Cabinet	MNS Cabinet	15 Feet (4.5 m)	RG223 Coax, BNC
963	RF Cabinet	MNS Cabinet	15 Feet (4.5 m)	RG223 Coax, BNC
964	RF Cabinet	MNS Cabinet	15 Feet (4.5 m)	RG223 Coax, BNC
965	RF Cabinet	MNS Cabinet	15 Feet (4.5 m)	RG223 Coax, BNC

2−2 ROUTE NEW CABLES (Continued)



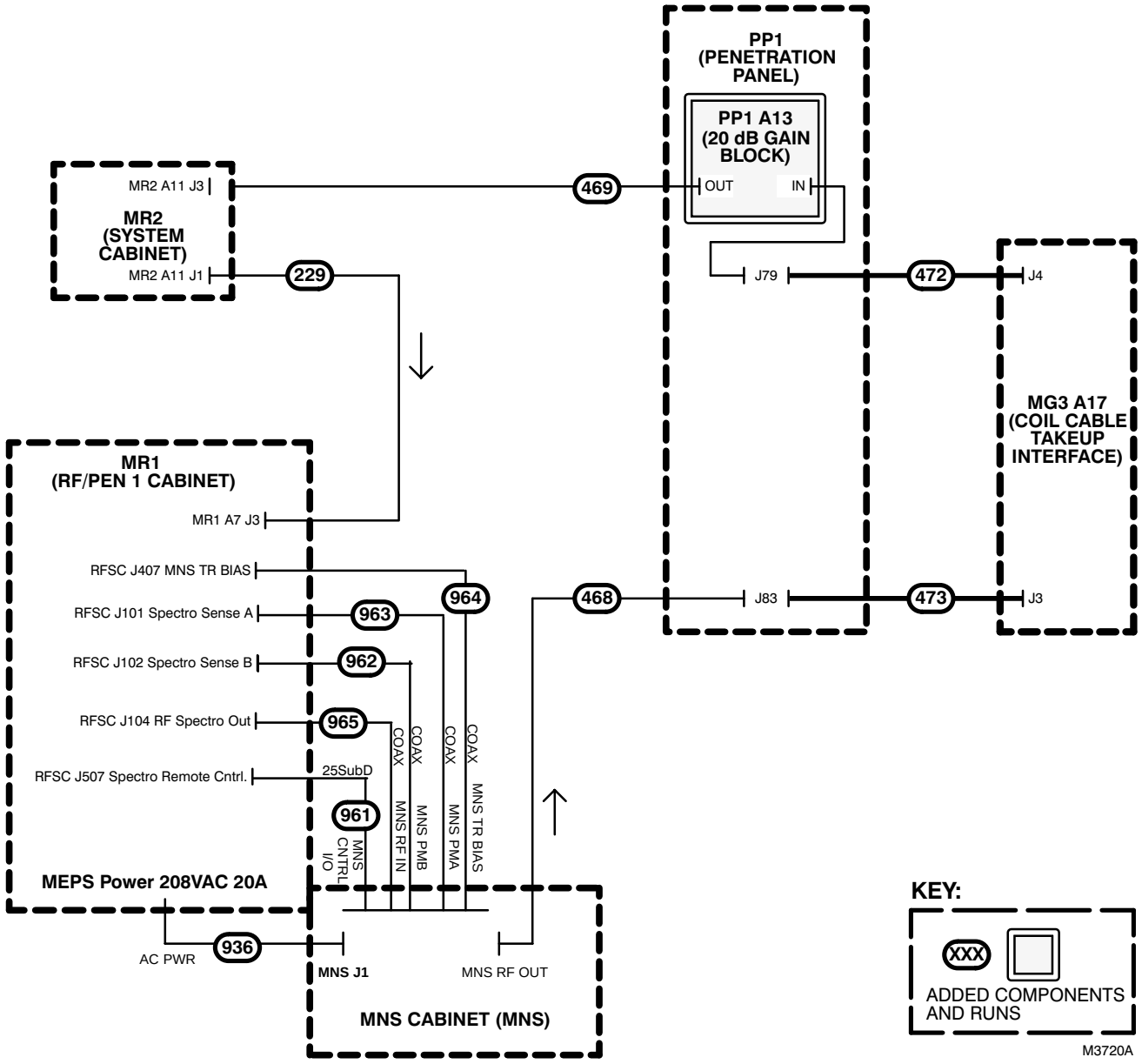
NEW CABLE KIT ROUTE MAP−−−RF/PDU OR SRF CABINET AND MNS CABINET
ILLUSTRATION 2−1

2–2 ROUTE NEW CABLES (Continued)



NEW CABLE KIT ROUTE MAP−−−RF/PEN 2 AND MNS CABINETS
ILLUSTRATION 2−2

2–2 ROUTE NEW CABLES (Continued)



NEW CABLE KIT ROUTE MAP–––RF/PEN 1 AND MNS CABINETS
ILLUSTRATION 2–3

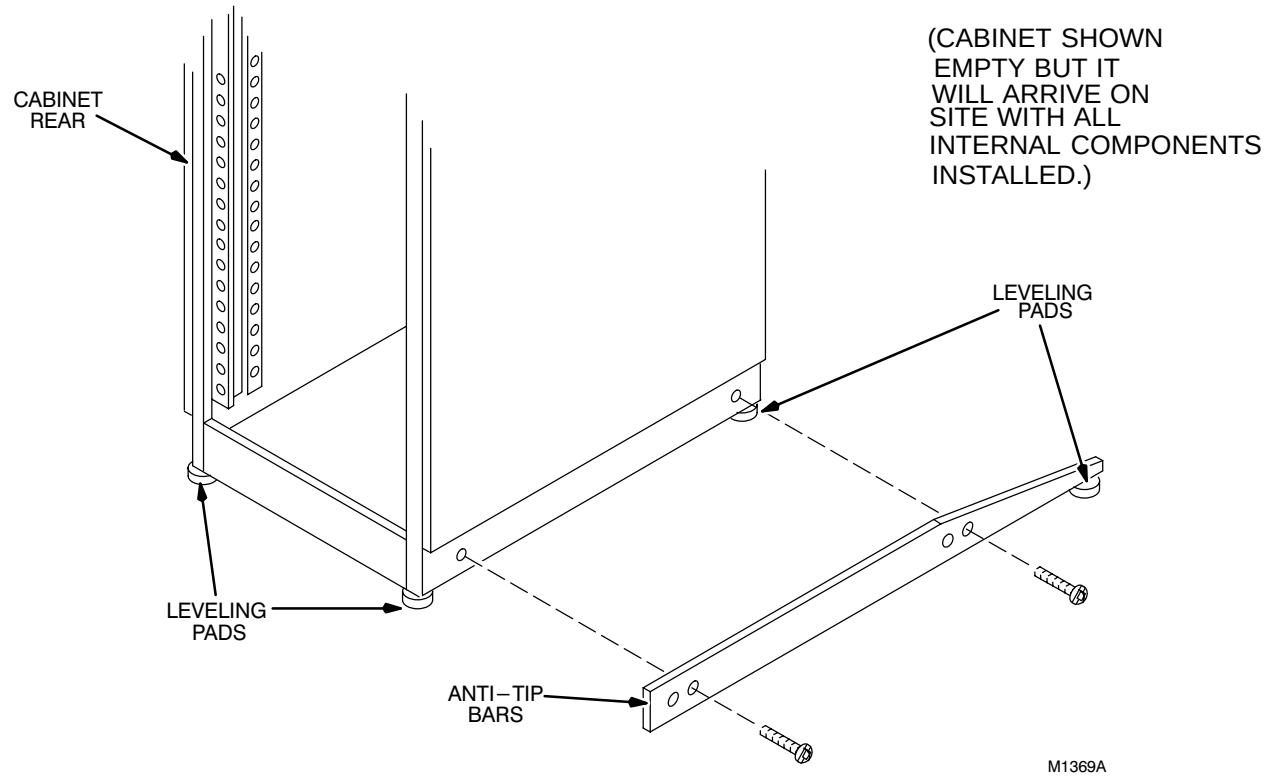
SECTION 3 – MNS CABINET INSTALLATION

3–1 INSTALL MNS CABINET (MNS)

1. Move MNS Cabinet to installation position. This should be directly beside the RF/PDU or SRF or RF/PEN 2 or RF/PEN 1 Cabinet.
2. Remove all shipping material from cabinet.
3. Position cabinet into final position so that previously routed cables can be connected.
4. Lower leveling pads of cabinet onto the floor. See Illustration 3–1.
5. If seismic anchoring is required by local codes, secure with anchoring hardware and proceed to Section 3–2, MNS CABINET CABLE CONNECTION.
6. Open rear door and remove anti–tip bars from inside of cabinet.
7. Install screws and two anti–tip bars to cabinet if it was not secured with seismic hardware to floor. Refer to Illustration 3–1. Adjust leveling pads on anti–tip bars and cabinet to remove weight from casters and level cabinet.

Note

Cabinet must be vertical and stable when finished.



CABINET LEVELING PAD ADJUSTMENT

ILLUSTRATION 3–1

3–2 MNS CABINET CABLE CONNECTIONS

1. Connect previously routed cables listed in Table 3–1.

   See Illustration 3−2 for systems with an RF/PDU or SRF Cabinet.

   See Illustration 3−3 for systems with an RF/PEN 2 Cabinet.

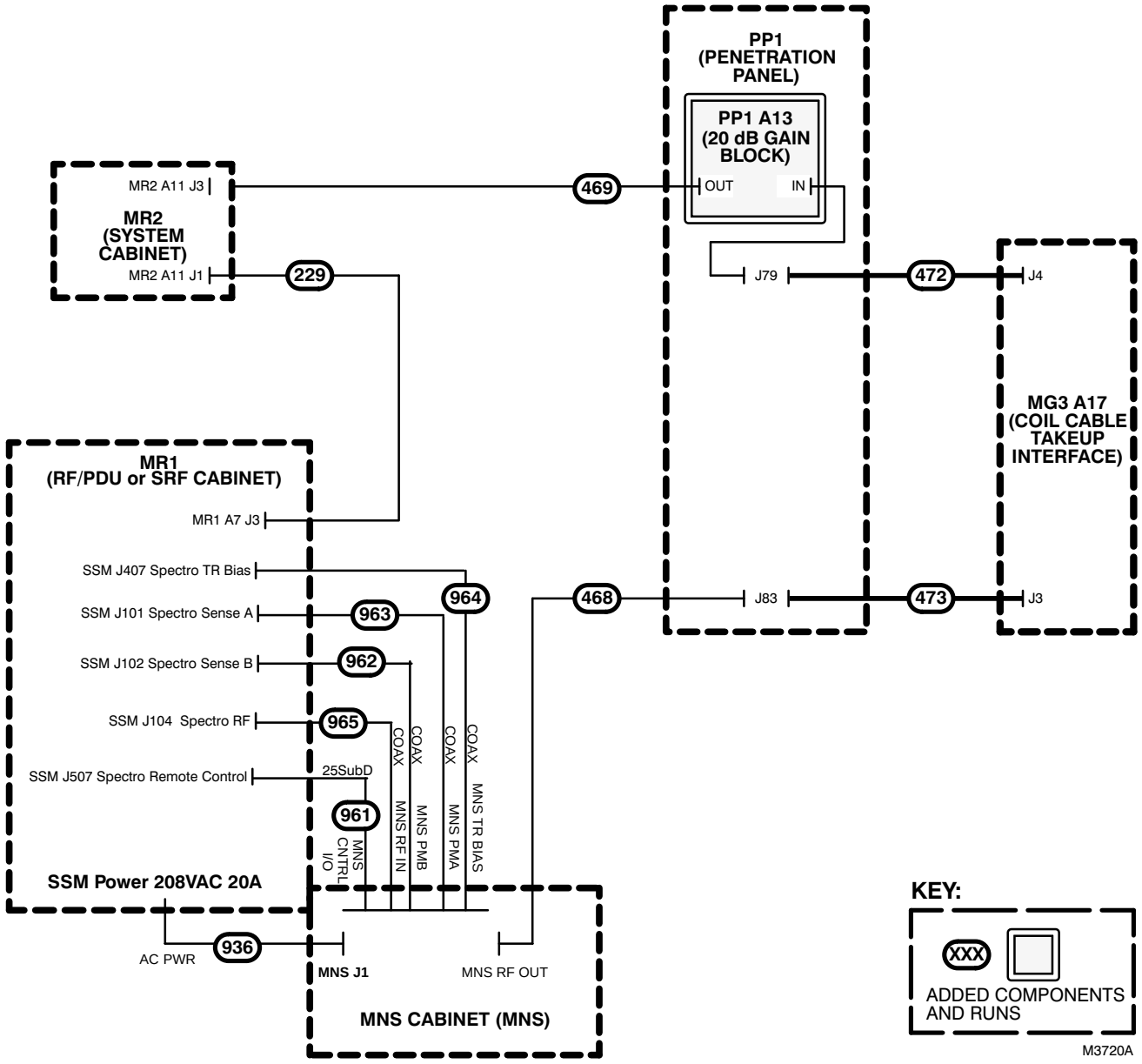
   See Illustration 3−4 for systems with an RF/PEN 1 Cabinet.

2. If required, use the furnished right–angle N adapter for Run 468 at MNS RF OUT. This 46–221865P3 connector is shipped in a plastic bag attached to inside of cabinet.

TABLE 3–1
CABLES CONNECTED TO NEW BROADBAND RF CABINET

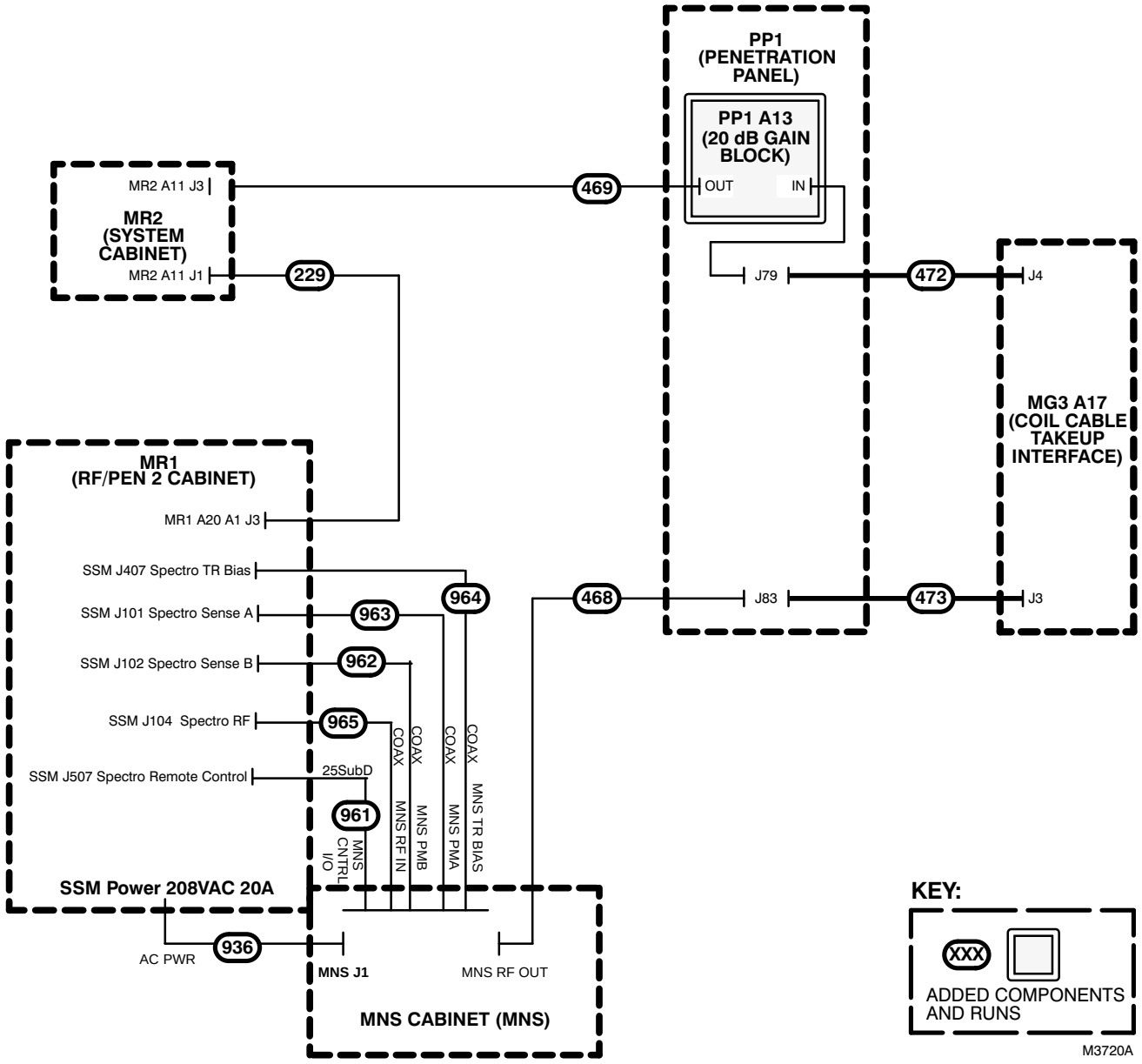
CONNECTOR	TYPE OF CONNECTOR	RUN	REMARKS
MNS J1	Twist–lock power cable plug	936	220V AC Power Input through extension cable from cable on rear of SSM
MNS CONTROL I/O	25–Pin Subminature–D	961	CONTROL I/O for amp and relay assy.
MNS PMB	RG223 BNC Coax	962	Power Monitor B signal
MNS PMA	RG223 BNC Coax	963	Power Monitor A signal
MNS TR BIAS	RG223 BNC Coax	964	TR bias input to MNS filter
MNS RF IN	RG223 BNC Coax	965	RF input from J104 on SSM (RF/PEN 2) or RFSC (RF/PEN 1)
MNS RF OUT	Male N – 1/2 in. Heliax	468	MNS Heliax (RF OUT + TR Bias)

3–2 MNS CABINET CABLE CONNECTIONS (Continued)



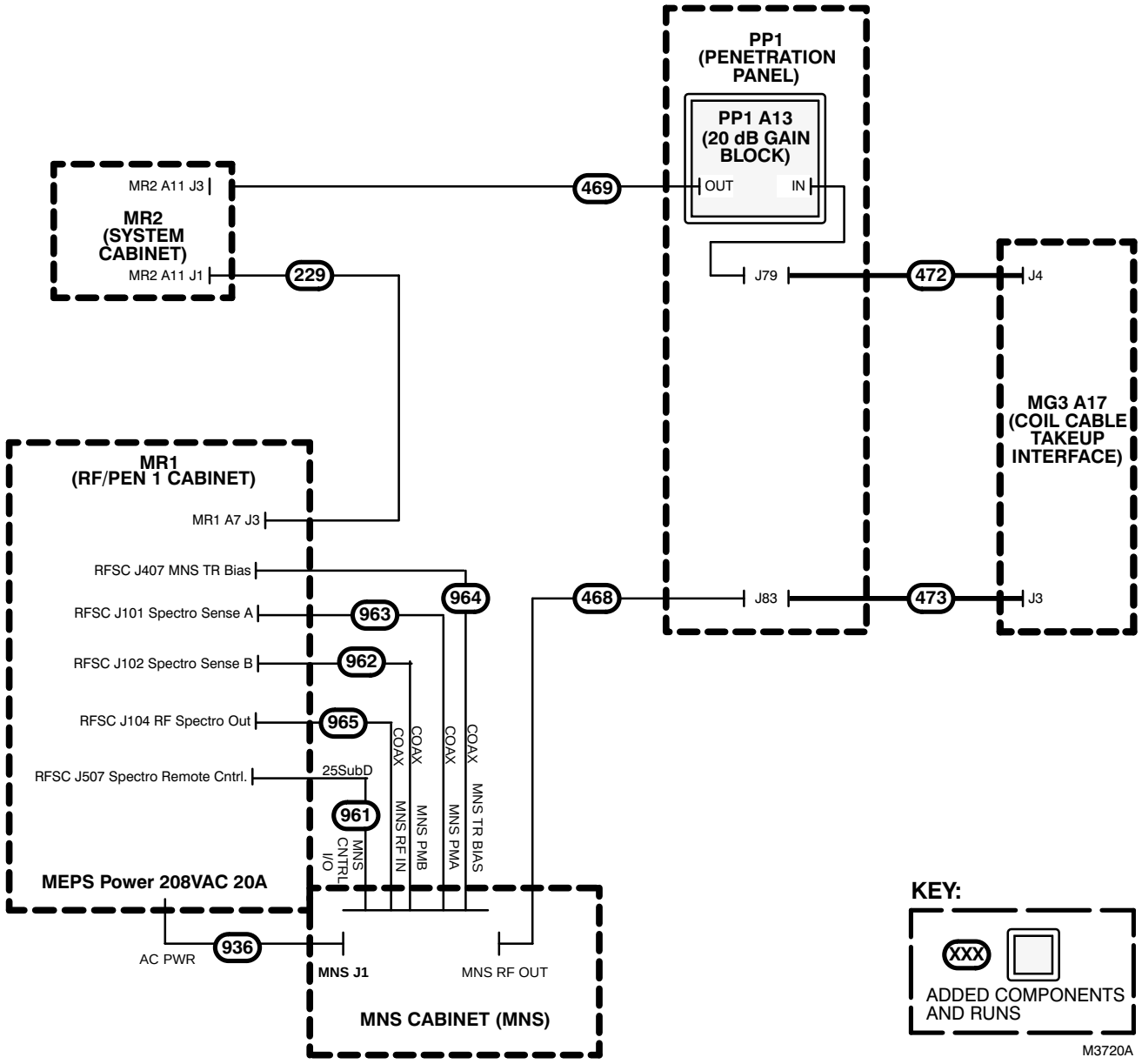
RF/PDU OR SRF TO MNS CABINET CABLE CONNECTIONS
ILLUSTRATION 3–2

3–2 MNS CABINET CABLE CONNECTIONS (Continued)



RF/PEN 2 TO MNS CABINET CABLE CONNECTIONS
ILLUSTRATION 3–3

3–2 MNS CABINET CABLE CONNECTIONS (Continued)



RF/PEN 1 TO MNS CABINET CABLE CONNECTIONS
ILLUSTRATION 3–4

SECTION 4 – SPECTRO HARDWARE REMOVAL AND INSTALLATION FOR M3090DA/DB/DC

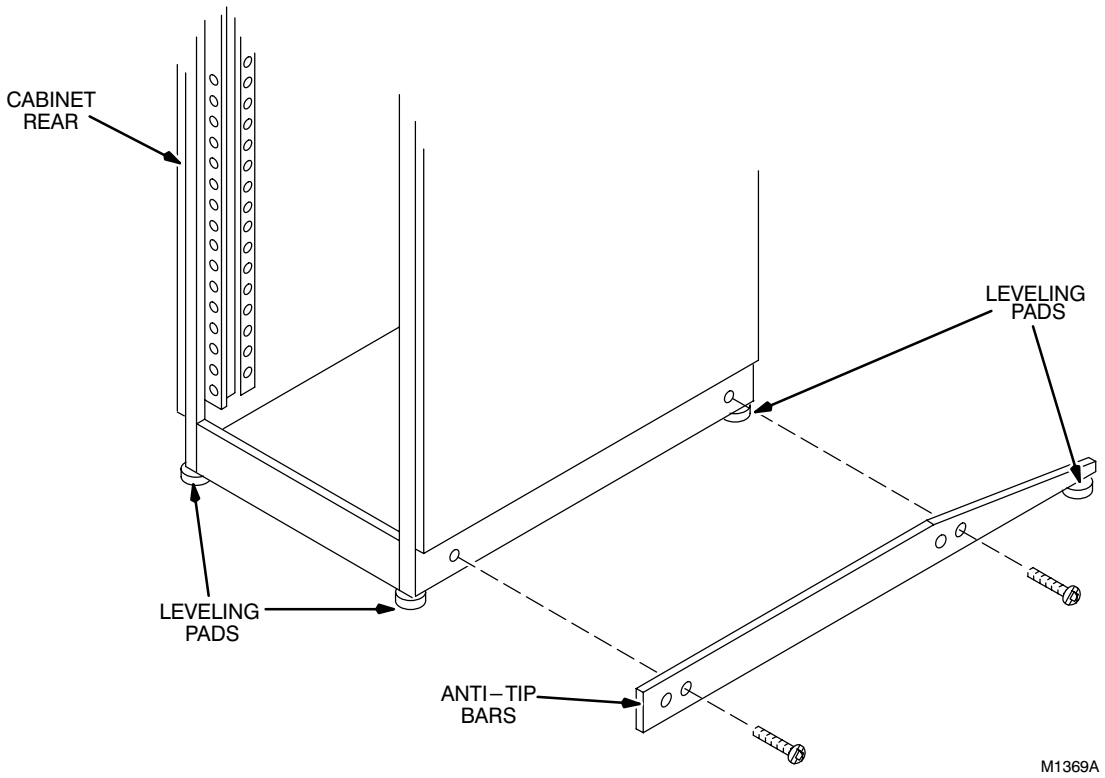
In the past, many MN Spectroscopy kits were either installed in the RF Cabinet or in a standalone cabinet. It was decided, with the release of the M3090DA/DB/DC catalogs, to include a new, empty cabinet with each of the upgrades and to move the MN Spectroscopy hardware out the RF Cabinet or older standalone cabinet and into the new MNS cabinet. This decision was made for 3 reasons. The first was to make any future RF Cabinet upgrades easier to implement. If the spectroscopy hardware is in its own cabinet, less re–work will be necessary if the old RF Cabinet is ever upgraded or replaced. The second reason was that the space above the RF amplifiers in the SRF Cabinet is already reserved for future upgrades/options. The MN Spectroscopy hardware, for this reason, cannot occupy this space. The third reason had to do with the standalone Spectroscopy cabinets that were supplied, many years ago, to systems with Signa Advantage 4.X hardware. The new MN Spectroscopy hardware requires different mounting hardware than what was supplied in the old standalone cabinet. Placing this hardware in the old cabinet would have required extensive re–work of the cabinet. Also, the style of this cabinet, because it was made many years ago, looks much different from that of the new cabinets. It was decided, since the cabinet was old, the re–work was significant, and it looked different from the other cabinets, that it would be better to replace this cabinet with a new one.

4–1 INITIAL READINESS

CAUTION

Anti–tip legs must be on the cabinet containing the spectroscopy hardware before beginning this procedure.

1. Locate the anti–tip legs and install them on each side of the cabinet containing the spectroscopy hardware. See Illustration 4–1.
2. Locate the anti–tip legs and install them on each side of the MNS Cabinet. See Illustration 4–1.



INSTALLATION OF ANTI–TIP LEGS ONTO CABINET
ILLUSTRATION 4–1

3. Verify that the power to the spectroscopy hardware is in the OFF position.

   RF/PEN 1 Cabinet: Verify that the Spectro Circuit breaker on the rear, bottom of the cabinet is in the OFF (down) position.

   RF/PEN 2 Cabinet: Verify that the CB4 circuit breaker located on the rear of the SSM in the RF/PEN 2 Cabinet is in the OFF (down) position.

   Standalone Spectroscopy Cabinet: Verify that the CB1 circuit breaker located on the rear of the cabinet is in the OFF (down) position.

4. Remove the front cover and open the rear door to the cabinet containing the spectroscopy hardware.
5. As viewed from the front of the cabinet, remove the left side panel.
6. 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.
7. 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 still possible to remove the spectroscopy hardware.

8. Repeat steps 5 through 7 for the MNS Cabinet.
9. Remove the front cover and open the rear door of the MNS Cabinet.

4–2 VERIFY SPECTRO I/F BRACKET INSTALLATION ON THE REAR OF THE MNS CABINET

1. Look on the rear of the MNS Cabinet and verify that the Spectro I/F Bracket is mounted in the bottom of the cabinet. This bracket will support the MNS RF amplifier and the Spectro Module Assembly. The cabinets should arrive with this bracket installed.
2. If the bracket is in place then proceed to the next section.
3. If the bracket is not in place then count down 76 holes from the top of each cabinet rail and mark the 76th hole on each.
4. Install the Spectro I/F Bracket onto the cabinet using the 4 #10–32X1/2" screws, flat washers, and 10–32 nuts. Tighten the screws.

4–3 SPECTRO RF AMPLIFIER REMOVAL AND INSTALLATION

CAUTION

Anti−tip legs must be installed on both the MNS and RF or Spectroscopy Cabinets before beginning this procedure.

1. Attach 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.

CAUTION

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

2. Transfer the Spectroscopy RF Amplifier from the RF/PEN 1, RF/PEN 2, or standalone Spectroscopy Cabinet and place it onto the shelf plate in the MNS Cabinet.
3. Install the 4 screws and flat washers into the amplifier front mounting holes and verify the 4 screws are properly tightened.

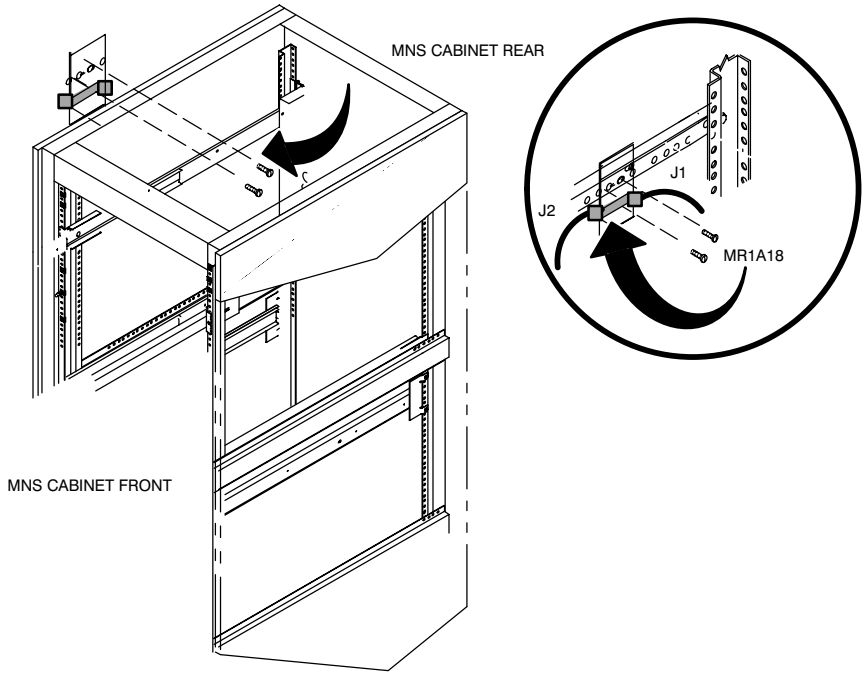
Note

The power line cord is part of the Spectroscopy RF amplifier.

4. Connect the AC power cable to the power recepticle on the rear of the MNS RF Amplfiier.
5. Route the other end of the power cable over the rail supporting the broadband RF amplifier and outside the right–side cabinet rails (the side cover was removed earlier to make this easier) and connect to the AC recepticle in the bottom of the cabinet.

4–4 SPECTRO ATTENUATOR INSTALLATION FOR M3090DA/DB ONLY

1. At the rear of the MNS 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 (MNS ATTEN). See Illustration 4–2.



MR1A18 SPECTRO ATTENUATOR PLACEMENT
ILLUSTRATION 4–2

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 MNS ATTEN Attenuator Bracket. The bracket is located on the outside of the rail (closest to the side cover).

Note

The MNS ATTEN Spectro Attenuator will be used to adjust the MN Spetro RF Signal into the Spectro RF Amplifier for 1.58kW Spectro RF Power out.

CAUTION

Verify the locking nut on the MNS ATTEN Spectro Attenuator shaft is loose. It must be loose before any adjustements are attempted.

5. Connect cable 540009, MR1A18J1, to the J1 input port on the Spectro Attenuator. Route the other end labeled **MNS RF IN** outside the right–side cabinet rails (the side cover was removed earlier to make this easier) to the bottom of the cabinet and connect it to the BNC connector on the interior of the cabinet labeled, on the exterior of the I/F panel, **MNS RF IN**.

4–5 SPECTRO ATTENUATOR INSTALLATION FOR M3090DC ONLY

1. At the rear of the RF/PEN1 or RF/PEN 2 Cabinet, locate the spectro attenuator module mounted on the top horizontal rail on the right side of the cabinet.
2. Locate cables 540009 and 540031 that are connected to each side of the attenuator and make sure that each cable end is properly labeled for later reassembly.
3. Remove cables 540009 and 540031 from the cabinet.
4. Re–label the end of cable 540009 that had been connected to J104 on the SSM (RF/PEN 2 Cabinet) or RFSC (RF/PEN 1 Cabinet) so that it now reads, "**MNS RF IN**".
5. Remove the attenuator and hardware from the RF/PEN 1 or RF/PEN 2 Cabinet and re–install it in the same location inside the MNS Cabinet. See Illustration 4–2.
6. Reconnect cable 540009, MR1A18J1, to input port J1 on the Spectro Attenuator. Route the other end labeled **MNS RF IN** outside the right–side cabinet rails (the side cover was removed earlier to make this easier) to the bottom of the cabinet and connect it to the BNC connector on the interior of the cabinet labeled **MNS RF IN**.
7. Reconnect cable 540031, MR1A18J2, to the output port J2 on the Spectro Attenuator. Move the unconnected end out of the way until the MNS RF Amplifier is installed.

4–6 SPECTROSCOPY CABLE INSTALLATION FOR M3090DA ONLY

Locate cables 540004, 540006, 540007, 540008, 540015, and 540018 in the installation kit.

1. Shown below are the cable run numbers and labels that should be seen on each end of the cable. Re–label one end of each of the cables to that shown in bold print so that the cables match what is listed:

540015	MR1A17J7	**MNS CONTROL I/O**
540008	MR1A17J4	**MNS TR BIAS**
540006	MR1A17J2	**MNS PMA**
540007	MR1A17J3	**MNS PMB**
540004	MR1A7J45	**MNS RF OUT**

2. Find the label on one end of ground cable 540018 that reads MR1A17 and re–label it to read **MNS GND.**
3. Connect cable 540004, MNS RF OUT, to **MNS RF OUT** on the interior of the MNS RF Cabinet I/F panel.
4. Connect cable 540006, MNS PMA, to **MNS PMA** on the interior of the MNS RF Cabinet I/F panel.
5. Connect cable 540007, MNS PMB, to J45 **MNS PMB** on the interior of the MNS RF Cabinet I/F panel.
6. Connect cable 540008, MNS TR BIAS, to **MNS TR BIAS** on the interior of the MNS RF Cabinet I/F panel.
7. Connect cable 540015, MNS CONTROL I/O, to **MNS CONTROL I/O** on the interior of the MNS RF Cabinet I/F panel.
8. Connect the green ground wire 540018, MNS GND, to the ground stud on the exterior of the MNS RF Cabinet I/F panel.
9. Route the 6 cables outside the right–side cabinet rails (the side cover was removed earlier to make this easier) and over the rail supporting the broadband RF amplifier. Temporarily secure the cables at this position. Do not permanently tywrap them to the rail as they must remain free–moving.

4–7 SPECTROSCOPY CABLE REMOVAL AND INSTALLATION FOR M3090DB/DC ONLY

Locate cables 540004, 540006, 540007, 540008, 540015, and 540018 inside the RF/PEN Cabinet.

1. Carefully remove cables 540004, 540006, 540007, 540008, 540015, and 540018 from the RF/PEN Cabinet.
2. Shown below are the cable run numbers and labels that should be seen on each end of the cable. Re–label one end of each of the cables to that shown in bold print so that the cables match what is listed:

540015	MR1A17J7	**MNS CONTROL I/O**
540008	MR1A17J4	**MNS TR BIAS**
540006	MR1A17J2	**MNS PMA**
540007	MR1A17J3	**MNS PMB**
540004	MR1A7J45	**MNS RF OUT**

3. Find the label on one end of ground cable 540018 that reads MR1A17 and re–label it to read **MNS GND.**
4. Connect cable 540004, MNS RF OUT, to **MNS RF OUT** on the interior of the MNS RF Cabinet I/F panel.
5. Connect cable 540006, MNS PMA, to **MNS PMA** on the interior of the MNS RF Cabinet I/F panel.
6. Connect cable 540007, MNS PMB, to J45 **MNS PMB** on the interior of the MNS RF Cabinet I/F panel.
7. Connect cable 540008, MNS TR BIAS, to **MNS TR BIAS** on the interior of the MNS RF Cabinet I/F panel.
8. Connect cable 540015, MNS CONTROL I/O, to **MNS CONTROL I/O** on the interior of the MNS RF Cabinet I/F panel.
9. Connect the green ground wire 540018, MNS GND, to the ground stud on the exterior of the MNS RF Cabinet I/F panel.
10. Route the 6 cables outside the right–side cabinet rails (the side cover was removed earlier to make this easier) and over the rail supporting the broadband RF amplifier. Temporarily secure the cables at this position. Do not permanently tywrap them to the rail as they must remain free–moving.

4–8 MNS SPECTRO MODULE ASSEMBLY INSTALLATION FOR M3090DA ONLY

Connect cables 540031, 540005, 540016, 540004, 540006, 540007, 540008, 540015, and 540018.

1. Connect cable 540005, MR1A16J2, to **RF OUT** J2 on the rear of the MNS RF Amplifier.
2. Connect cable 540016, MR1A16J7, to **REMOTE I/F** J7 on the rear of the MNS RF Amplifier.
3. Connect cable 540031, MR1A16J3, to **RF IN** J3 on the rear of the MNS RF Amplifier.
4. Install the Spectro Module Assembly directly behind the MNS RF Amplifier but do not yet secure it to the shelf.
5. Connect cable 540005, MR1A17J1, to **RF IN** J1 on the Spectro Module Assembly.
6. Connect cable 540016, MR1A17J6, to **BB I/F** J6 on the Spectro Module Assembly.
7. Connect cable 540031, MR1A18J2, to the Spectro Attenuator output J2.
8. Place the AC power switch on the rear of the MNS RF Amplifier in the up (ON) position.
9. Secure the Spectro Module Assembly to the shelf using the 4 supplied Phillips, panhead #10–32 screws and flat washers.
10. Connect cable 540004, MR1A17J5, to **RF & TR BIAS OUT** J5 on the Spectro Module Assembly.

4–8 MNS SPECTRO MODULE ASSEMBLY INSTALLATION FOR M3090DA ONLY (continued)

11. Connect cable 540006, MR1A17J2, to **SPECTRO OUT A** J2 on the Spectro Module Assembly.
12. Connect cable 540007, MR1A17J3, to **SPECTRO OUT B** J3 on the Spectro Module Assembly.
13. Connect cable 540008, MR1A17J4, to **TR BIAS** J4 on the Spectro Module Assembly.
14. Connect cable 540015, MR1A17J7, to **SPECTRO I/F** J7 on the Spectro Module Assembly.
15. Connect the green ground wire 540018, MR1A17GND, to the ground stud on the Spectro Module Assembly.

4–9 MNS SPECTRO MODULE ASSEMBLY REMOVAL AND INSTALLATION FOR M3090DB/DC ONLY

1. Disconnect cables 540005 and 540016 from the Spectro Module Assembly located in the RF/PEN 1 or RF/PEN 2 Cabinet and transfer them to the MNS Cabinet.
2. Reconnect cable 540005, MR1A17J2, to **RF OUT** J2 on the rear of the MNS RF Amplifier.
3. Reconnect cable 540016, MR1A17J7, to **REMOTE I/F** J7 on the rear of the MNS RF Amplifier.
4. Reconnect cable 540031, MR1A16J3, to **RF IN** J3 on the rear of the MNS RF Amplifier.
5. Remove the Spectro Module Assembly from the RF/PEN 1 or RF/PEN 2 Cabinet and place it behind the MNS RF Amplifier in the MNS Cabinet. Do not yet secure it to the shelf assembly.
6. Reconnect cable 540004, MR1A17J5, to **RF & TR BIAS OUT** J5 on the Spectro Module Assembly.
7. Reconnect cable 540006, MR1A17J2, to **SPECTRO OUT A** J2 on the Spectro Module Assembly.
8. Reconnect cable 540007, MR1A17J3, to **SPECTRO OUT B** J3 on the Spectro Module Assembly.
9. Reconnect cable 540008, MR1A17J4, to **TR BIAS** J4 on the Spectro Module Assembly.
10. Reconnect cable 540015, MR1A17J7, to **SPECTRO I/F** J7 on the Spectro Module Assembly.
11. Reconnect the green ground wire 540018, MR1A17GND, to the ground stud on the Spectro Module Assembly.
12. Place the AC power switch on the rear of the MNS RF Amplifier in the up (ON) position.
13. Secure the Spectro Module Assembly to the shelf directly behind the MNS RF Amplifier with the hardware that was used in the RF/PEN 1 or RF/PEN 2 Cabinet.

4–10 MNS CABINET CIRCUIT BREAKER RESET

1. Verify that the external breaker CB1 on the bottom rear of the MNS Cabinet is in the ON position.
2. Verify that the internal breakers inside the bottom of the MNS Cabinet are in the ON position.
3. Verify that the circuit breaker on the rear of the Analogic RF Amplifier is in the ON position.

SECTION 5 – M1033MD HARDWARE INSTALL

NOTE

See Illustration 1–1 for proper MCAT kit usage.

TIME: 4 Hours, 1 person (2 people required to lift the Spectro RF Amplifier).

5–1 MNS CABLE LIST

Internal MNS kit cable lengths were changed (longer) to accomodate the RF/PEN2 Cabinet.

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

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

RF/PEN2 AND RF/PDU
RF Signal In on RUN 229
MR1A7J3 I/F Panel (to SSM, MR1A20J3)

NOTE

Refer to Illustrations 5–2 (RF/PEN 1), 5–3 (RF/PEN 2), and 5–4 (RF/PDU) when installing the Multi–Nuclear Spectroscopy Option.

5–2 INSTALLATION OF M1033MD FOR RF/PDU OR SRF CABINET ONLY: Procure the 6 foot BNC to SMB cable

1. Disconnect the BNC cable connected to J14 RF INPUT on the front of the RFI Module. Re–label this cable as MR1A20J3 RF IN.
2. Cut enough of the tie–wraps securing this cable to the cabinet so that it can easily be connected to MR1A20J3 on the rear of the SSM.
3. Connect this cable to the J3 RF IN BNC connector on the rear of the SSM.
4. Connect the MR1A23J14 BNC to SMB cable (part # 2267990) supplied with the M1033MD kit to the J14 RF INPUT BNC connector on the front of the RFI.
5. Route the other end of the cable over the top of the RFI and back down to the rear of the SSM. Connect the SMB connector to RF IN TP (a recessed SMB connector) which is between J3 and J106 on the rear of the SSM.

5–3 MNS CABINET INTERCONNECTIONS CHECK

1. Refer to illustration 5–4. The MNS Cabinet should have been delivered with all internal hardware and cabling installed. Open the MNS Cabinet rear door and verify that all cables are properly routed and connected to components in the MNS Cabinet.
2. Close the MNS Cabinet rear door.

5–4 RF/PEN1 OR 2 CABINET CIRCUIT BREAKER RESET

1. Verify the Spectro Circuit Breaker located on the rear of the MEPS in the RF/PEN 1 is in the ON position.
2. Verify the System Support Module Main breaker CB4 on the rear of the SSM in the RF/PEN 2 Cabinet is in the ON position.

NOTE

The System Support Module Main breaker CB4 on the rear of the SSM <u>does not</u> control power to the Broadband RF Amplifier. Power to the BroadBand RF Amplifier is present whenever there is AC incoming power to the SSM. Power–off the RF/PEN 2 Cabinet or remove incoming power to the SSM in order to remove incoming power to the Broadband RF Amplifier.

5–5 RF/PDU OR SRF CABINET CIRCUIT BREAKER RESET

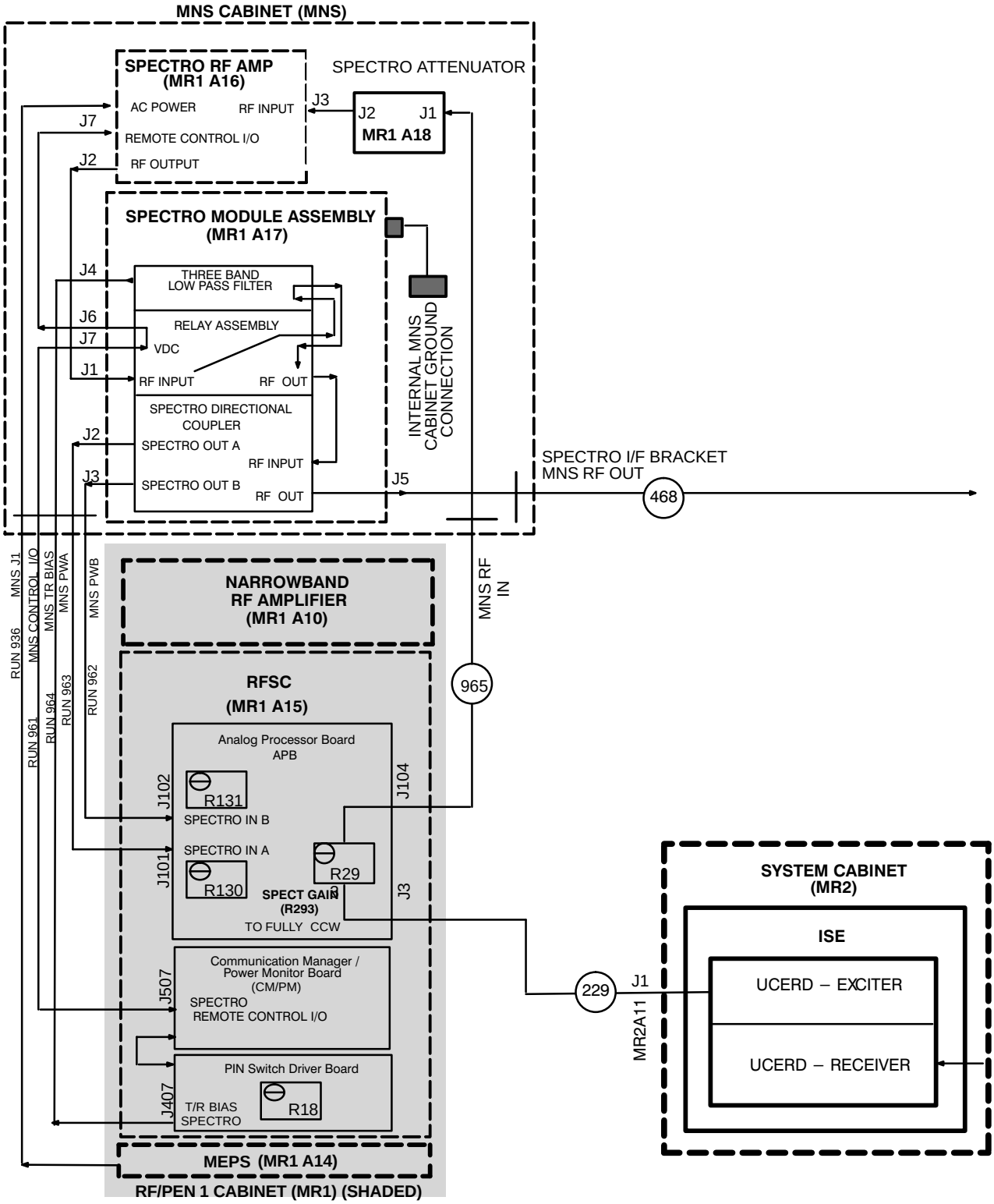
1. Verify the System Support Module Main breaker CB4 located on the rear of the SSM in the RF/PDU Cabinet is in the ON position.

NOTE

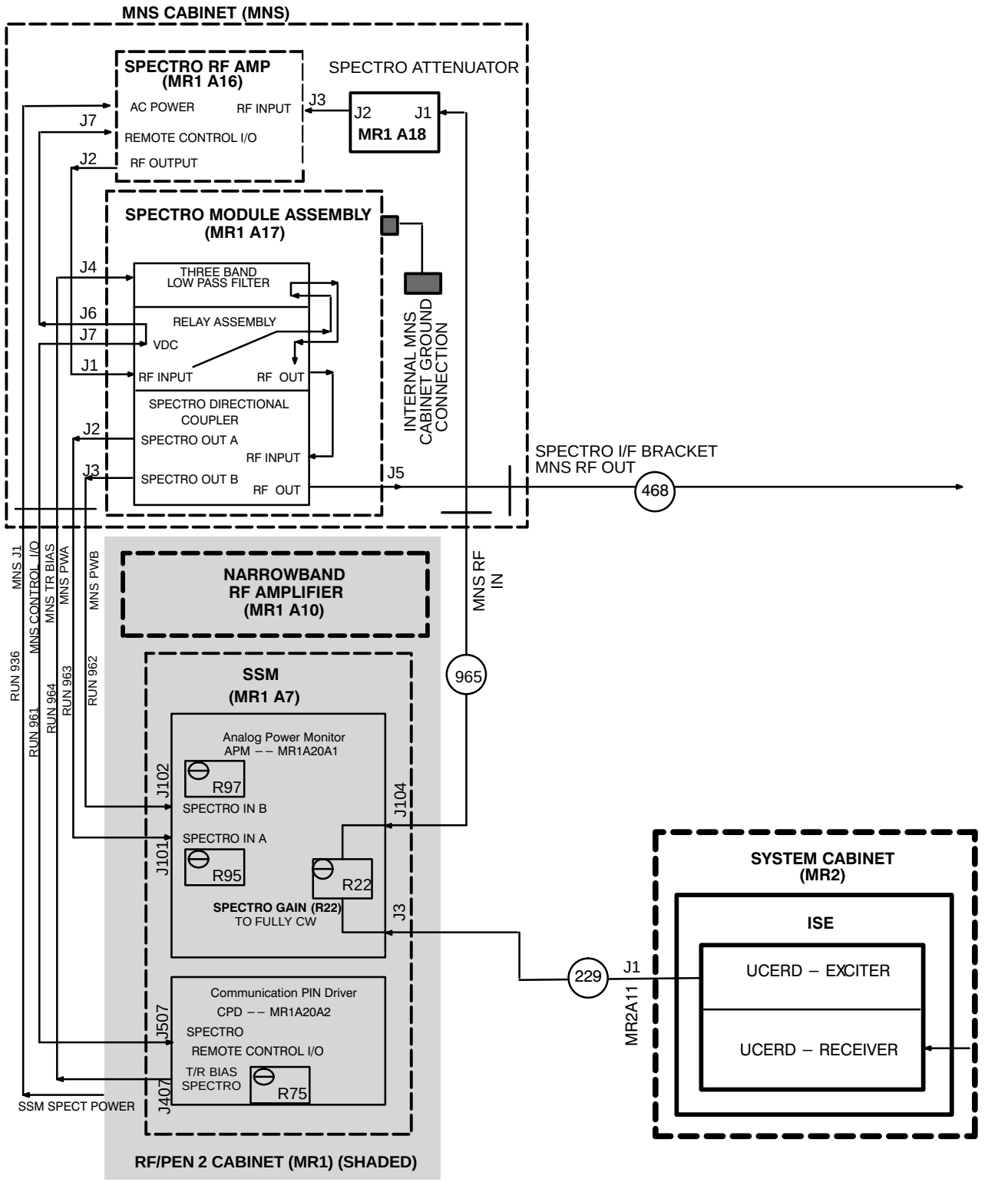
The System Support Module Main breaker CB4 on the rear of the SSM <u>does not</u> control power to the Broadband RF Amplifier. Power to the Broadband RF Amplifier is present whenever there is AC incoming power to the SSM. Power–off the external CB1 breaker on the bottom rear of the MNS Cabinet in order to remove incoming power to the Broadband RF Amplifier.

5–6 MNS CABINET CIRCUIT BREAKER RESET

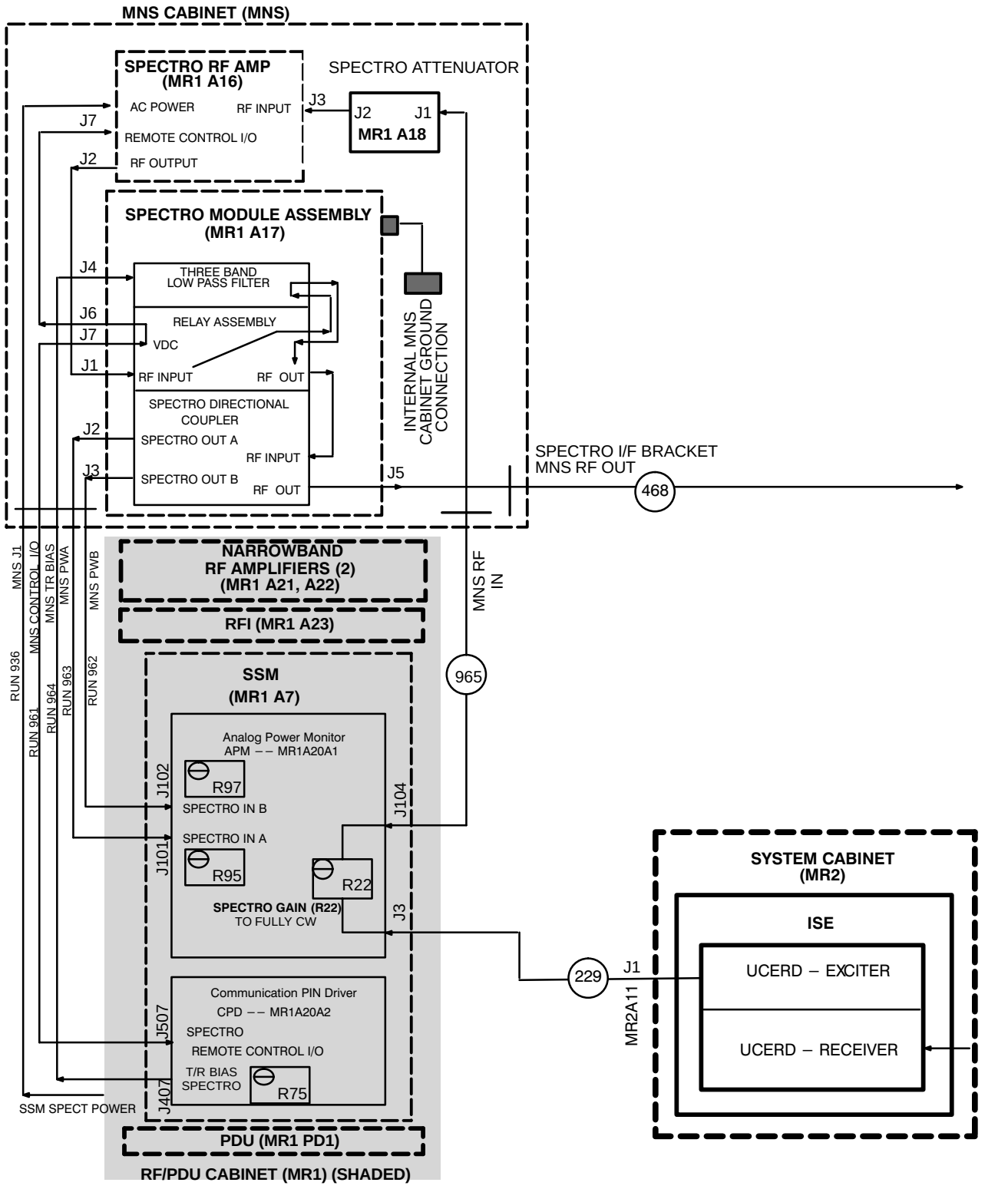
1. Verify that the external breaker CB1 on the bottom rear of the MNS Cabinet is in the ON position.
2. Verify that the internal breakers inside the bottom of the MNS Cabinet are in the ON position.
3. Verify that the circuit breaker on the rear of the Analogic RF Amplifier is in the ON position.



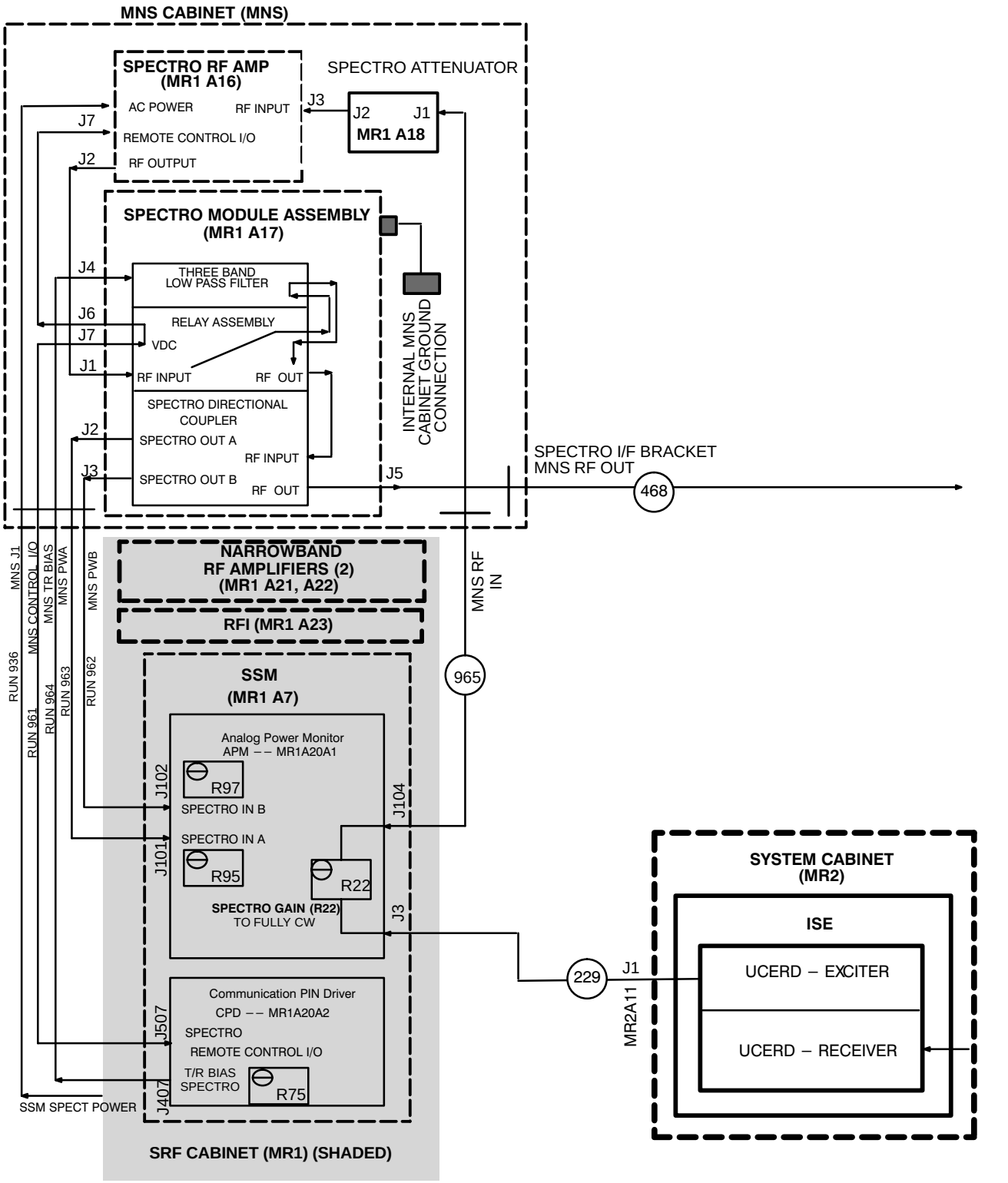
RF/PEN 1 CABINET WITH MULTI–NUCLEAR SPECTROSCOPY OPTION
ILLUSTRATION 5–2



RF/PEN 2 CABINET WITH MULTI−NUCLEAR SPECTROSCOPY OPTION
ILLUSTRATION 5–3



RF/PDU CABINET WITH MULTI–NUCLEAR SPECTROSCOPY OPTION
ILLUSTRATION 5–4



SRF CABINET WITH MULTI–NUCLEAR SPECTROSCOPY OPTION
ILLUSTRATION 5–5

SECTION 6 – SYSTEM CABINET MNS INSTALLATION FOR M3090DA/DB AND M1033MD ONLY

NOTE

This section does not apply to the M3090DC Catalog. All MNS sites for 8.X must have a UCERD (and associated J109 cable with the AUX1 line). Early 8.X sites may have not received this cable. Later 8.X sites will have this cable and installing the one provided in this kit is not necessary.

NOTE

MNS (Multi–Nuclear Spectroscopy is the same as BB (BroadBand Spectroscopy).

6–1 SYSTEM CABINET CABLE CONNECTION

1. Only one new cable, per Table 7–1, has been added for MNS to the System Cabinet Interface Panel.

TABLE 7–1
NEW INTERCONNECT CABLE CONNECTED TO SYSTEM CABINET

CONNECTOR	TYPE OF CONNECTOR	RUN	REMARKS
MR2 A11 J3	Coax	469	Spectroscopy Receive (AUX1) from 20 dB Gain Block / Preamplifier

6–2 TRANSIENT NOISE FILTER

1. A TNF is not used in the Multi–Nuclear Spectroscopy portion of the system.
2. The MNS connection between MR2 A11 J3 and the UCERD front panel connection at J109 “AUX1” serves as the System Cabinet receive path for Multi–Nuclear Spectroscopy.

Note

The UCERD J109 cable assembly must have an AUX1 receive cable installed to successfully perform MNS.

6–3 UCERD TO TNS CABLE CHECK AND INSTALLATION

1. All MNS sites must have a UCERD and the associated (longer than CERD power cable) power cable.
2. The MNS cable connection between MR2 A11 J3 and the UCERD front panel connection at J109 “AUX1” must be present.
3. Open the rear door of the System Cabinet and check to see that there is a coaxial cable connected to MR2 A11 J3 on the inside of the System Cabinet I/F panel. This cable should trace up to a bundle of cables secured in a sheath that interfaces to J109 on the front of the UCERD. Note that it is one of two cables (the other being the RF OUT to MR2 A11 J1) that does not interface with the TNS.
4. If the site already has this cable in place then no further action in this section is necessary.
5. If this cable is not present then locate the UCERD to TNS cable kit (2144525–2) from the appropriate M1033 kit.
6. Disconnect the cable connector from J109 on the CERD and remove the corresponding BNC connectors from the TNS outputs and from MR2 A11 J1 on the inside of the System Cabinet I/F panel.

6–3 UCERD TO TNS CABLE CHECK AND INSTALLATION (CONTINUED)

7. Remove the old UCERD to TNS cable and replace with the new one supplied in the M1033MD, M3090DA, or M3090DB kit. Be careful to correctly route and connect all the BNC connectors to the proper locations. Each cable is labeled. Ty–wrap where needed.

SECTION 7 – PENETRATION PANEL KIT FOR M1033MD AND M3090DA/DB

Note
Catalog M3090DC should not need this section performed.

7–1 MNS HARDWARE PEN PANEL INSTALLATION FOR SITES WITH MULTICOIL

1. Remove the Pen Panel covers (4 large barrel screw nuts). See illustration 7–1.
2. Remove and discard the nut and bolt assembly threaded through J83 on the penetration panel filter plate. See illustration 7–3.
3. Using the included nut and washer attach the SC Coax Adapter (item 9) to J83 on the penetration panel. See Illustration 7–4.
4. Refer to illustration 7–6. Perform the steps in the order shown to add hardware to the panel filter. Note that the 2 multicoil filter boxes normally seen in the upper part of the filter panel on systems equipped with multicoil (where the 2 cover plates are shown) and the multicoil select switch under the 1kV Dynamic Disable Filter (1 cover plate is shown) are not visible in this illustration.
5. Connect equipment room cable Run 469 to the 20 dB Gain Block OUT (PP1 A13 OUT).
6. Connect equipment room cable Run 468 to PP1 J83 on the penetration panel.
7. Connect magnet room cable Run 472 to PP1 J79 on the penetration panel.
8. Connect magnet room cable Run 473 to PP1 J83 on the penetration panel.

TABLE 7–1
PENETRATION PANEL KIT

ITEM	PART NUMBER	DESCRIPTION	QUANTITY
2	46–264814G1	20 dB Gain Block	1
22242	46–208921P4	Screws for 20 dB GainBlock and Panel Opening Covers	12
12	46–306507P1/2	J83 Right Angle SC to SC Adaptor	2
13	46–233422P1	Right Angle BNC to BNC Adaptor	1
11	46–243775G743	PP1–J79 to PP1A13 IN coaxial cable	1
9	46–306505P1	SC Coax Adapter Jack–Jack	1
2	2133757	Empty Filter Plate	1
6	46–301973P1	Panel Opening Cover	1
7	46–301974P1	Panel Opening Cover	1
8	46–208990P1	50 Ohm BNC Bulkhead Adapter	1

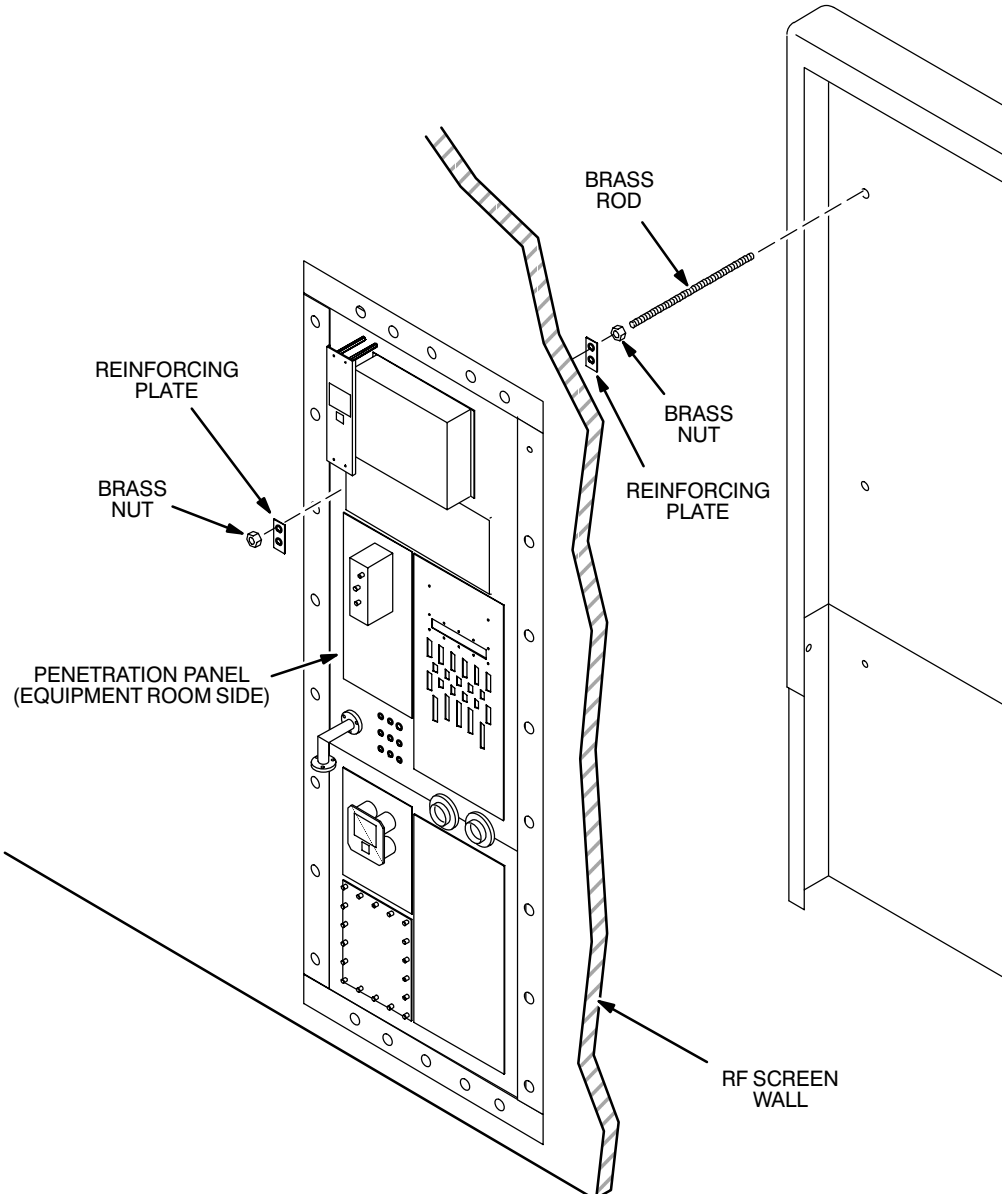
7−2 SITES WITHOUT MULTICOIL − PENETRATION PANEL KIT

The Penetration Panel kit provides a new style BRM/1kV DD Filter Panel that includes the 20 dB Gain Block (PP1 A13) and connectors for additional RF cables. The 1 kV Dynamic Disable Filter (PP1 A11) is installed on the new filter panel after being removed from the previously installed Penetration Panel. This will mainly apply to the installation of M3090DA and M1033MD kits but, in certain situations, could also apply to M3090DB kits.

1. Unpack Penetration Panel Kit from Box 1 and verify that contents listed in Table 7–1 are complete.
2. If Signa Release 8.X Options Prerequisite Upgrade is also being installed, locate the 1 kV Dynamic Disable Filter (PP1 A11) delivered with the upgrade. It is otherwise already on the penetration panel filter plate.
3. If the flow chart (Illustration 1–4) 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.

7–3 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 7–1.



PENETRATION PANEL COVER REMOVAL
ILLUSTRATION 7−1

7–4 FILTER PANEL REMOVAL

Note

The following procedure assumes a Signa Horizon 8.X is already installed and disconnection of some cables are required.

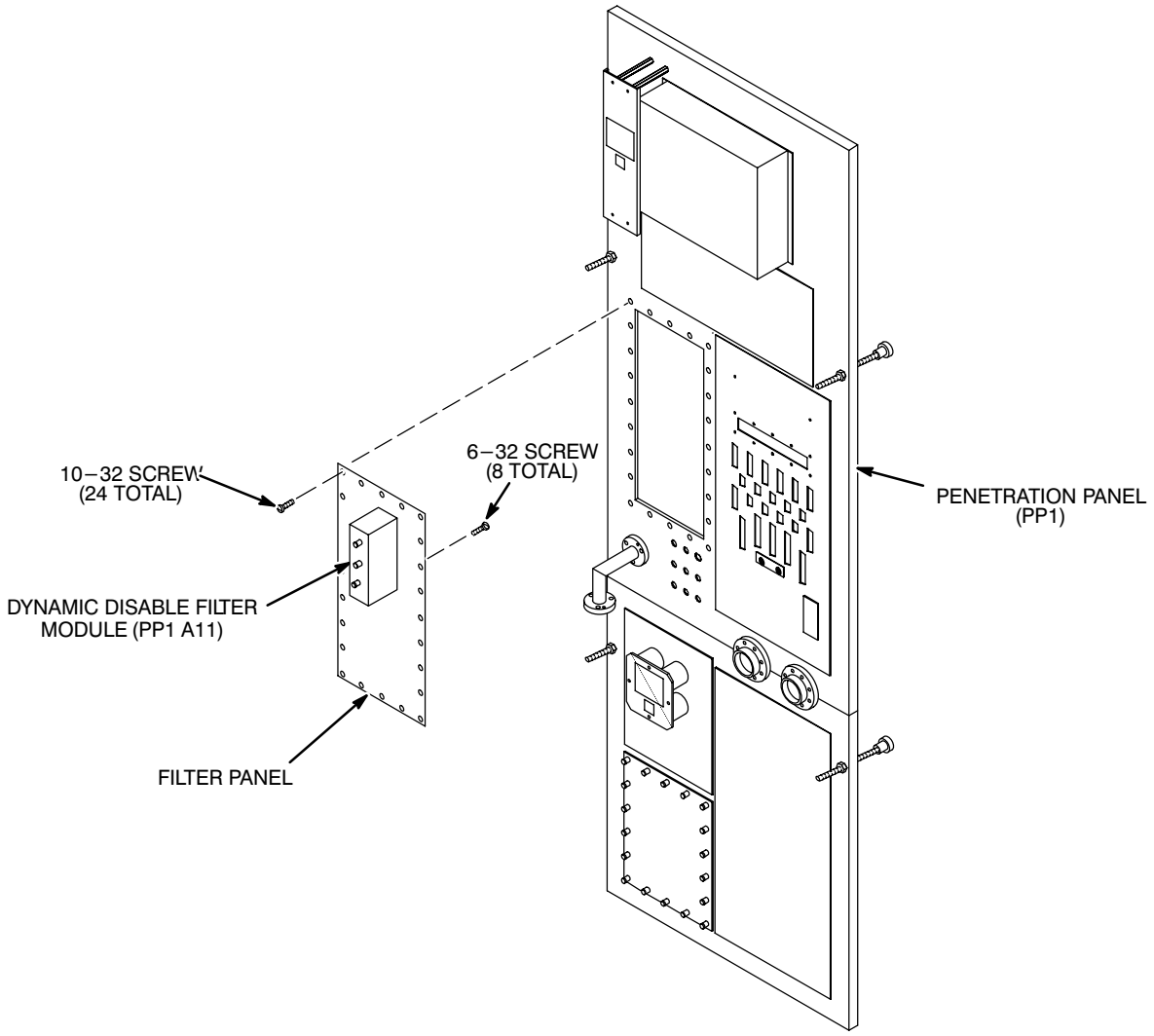
1. Disconnect cable ends from 1kV Dynamic Disable Filter Module (PP1 A11). Refer to Table 7–2 cable ends to be disconnected.

TABLE 7–2
RUNS DISCONNECTED FROM FILTER PANEL

CONNECTOR	TYPE OF CONNECTOR	RUN
EQUIPMENT ROOM CABLES		
PP1–J92	MHV	775
PP1–J93	MHV	776
PP1–J94	MHV	777
MAGNET ROOM CABLES		
PP1–J72	MHV	778
PP1–J73	MHV	779
PP1–J74	MHV	780
PP1–J75	MHV	781
PP1–J76	MHV	782

2. Unfasten and remove the 24 10–32 X 3/8” screws that fasten filter panel to Penetration Panel. Retain the screws. See Illustration 7–2.
3. Remove filter panel from Penetration Panel.
4. Remove 1kV Dynamic Disable Filter Module (PP1 A11) from filter panel. Retain 1kV Dynamic Disable Filter Module (PP1 A11) and screws. See illustration 7–2.
5. Place empty filter panel on discard pile.

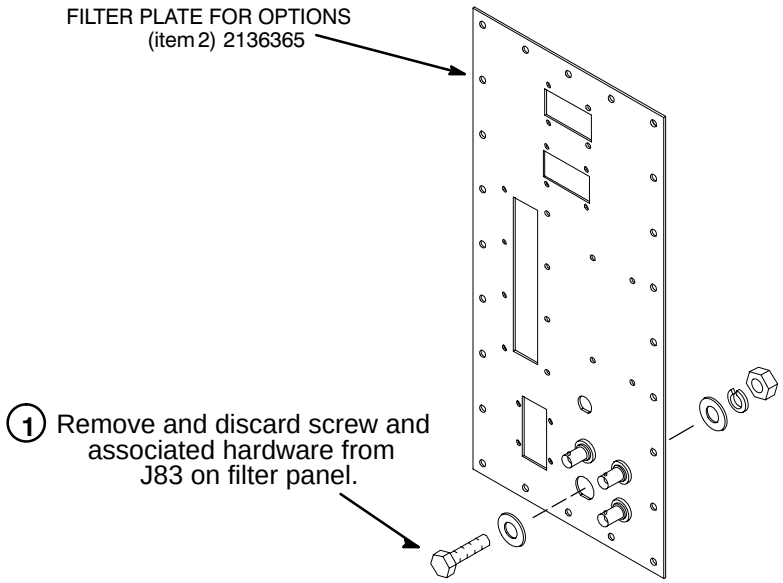
7−5 FILTER PANEL REMOVAL (Continued)



REMOVE DYNAMIC DISABLE AND INDUCTIVE DRIVE FILTER ASSEMBLY
ILLUSTRATION 7−2

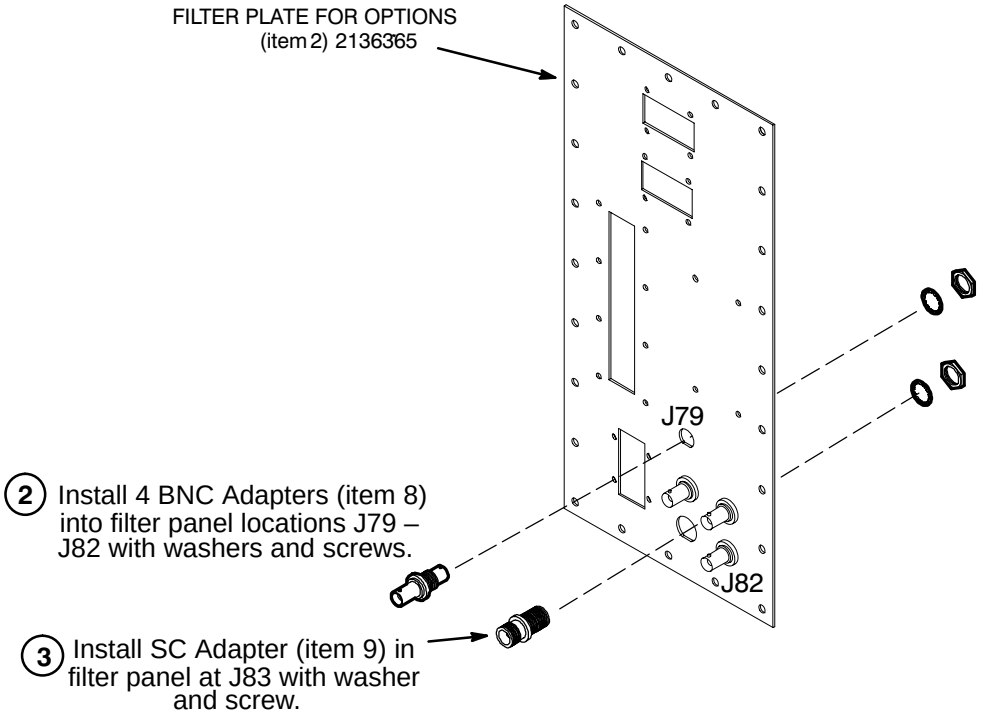
7–5 20 dB GAIN BLOCK PLATE ASSEMBLY INSTALLATION

1. Refer to illustrations 7–3 and 7–4. Prepare the filter plate and then install 4 BNC Adapters and 1 SC Coax Adapter into the new filter plate (item 2) in the order shown in the two illustrations.



FILTER PLATE PREPARATION
ILLUSTRATION 7−3

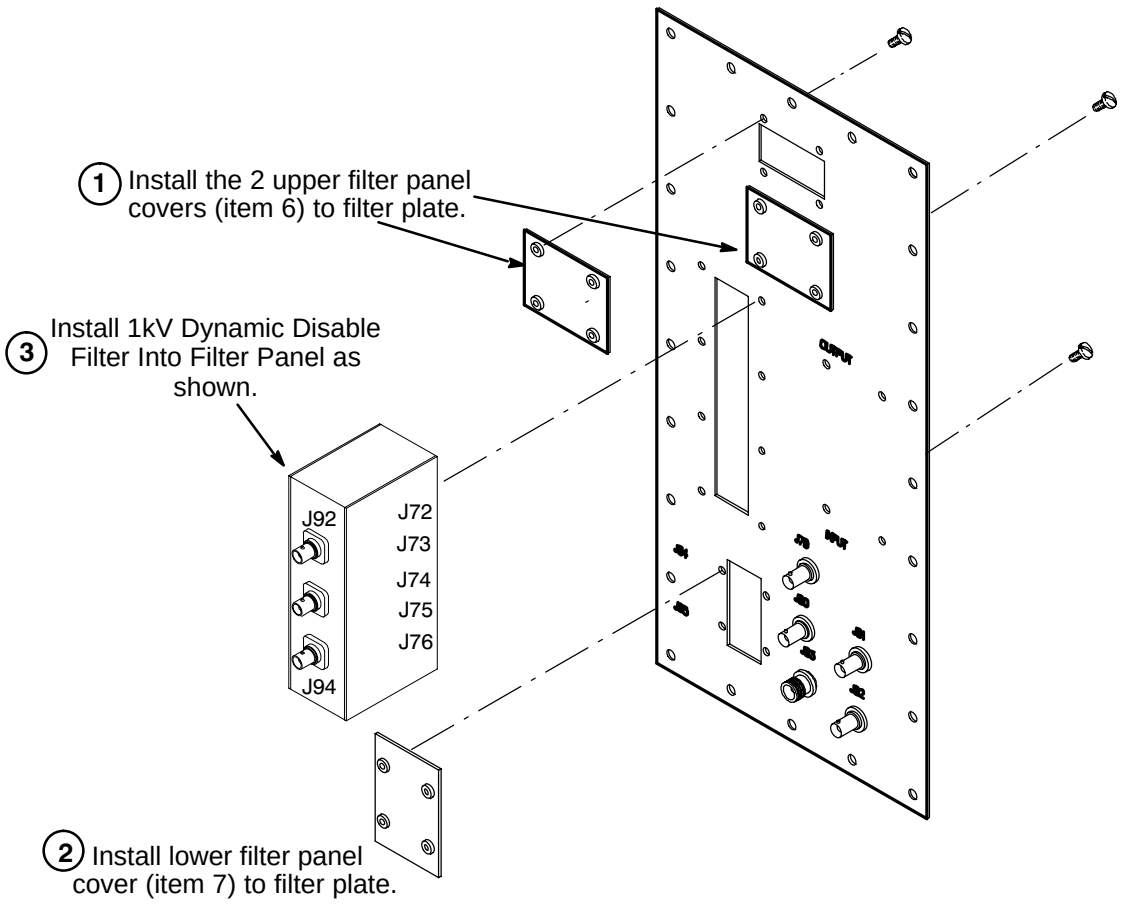
7–5 20 dB GAIN BLOCK PLATE ASSEMBLY INSTALLATION (CONTINUED)



INSTALL FILTER PLATE PANEL CONNECTORS
ILLUSTRATION 7–4

7–5 20 dB GAIN BLOCK PLATE ASSEMBLY INSTALLATION (Continued)

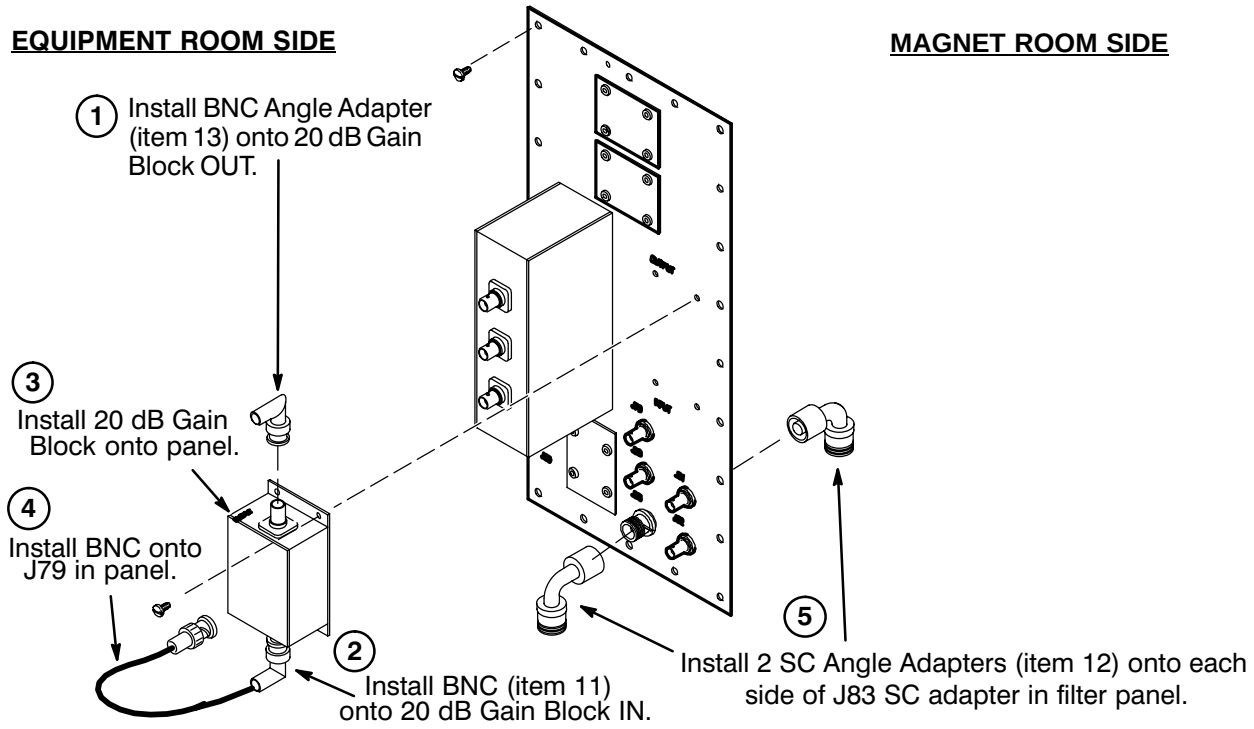
2. Refer to illustration 7–5. Fasten 1 kV Dynamic Disable Filter, 2111443, and upper and lower cover plates (items 6 and 7, respectively) on new filter plate assembly (item 2) in the order shown. Use eight 6–32 screws retained from de–install to install the 1kV Dynamic Disable Filter and eight 6–32 screws (item 24224) to install the cover plates.



INSTALLATION OF COVER PLATES AND DYNAMIC DISABLE FILTER
ILLUSTRATION 7–5

7–5 20 dB GAIN BLOCK PLATE ASSEMBLY INSTALLATION (Continued)

3. Refer to illustration 7–6 and install the adapters, cable, and 20 dB Gain Block in the order shown. Use 4 furnished 6–32 screws (item 24224) to secure the 20 dB Gain Block to the filter panel.



INSTALLING SPECTRO PARTS ON NEW FILTER PANEL
ILLUSTRATION 7–6

7–6 FILTER PANEL REPLACEMENT

1. Orient filter panel from the equipment room side so that 20 dB Gain Block OUT is up and facing the equipment room. See illustration 7–6. Align the holes in the filter panel assembly over the holes in the penetration panel. Install the 24 #10–32 screws that were retained when the old panel was removed into each of the holes. Tighten the screws after all 24 have been threaded.
2. Connect previously routed MNSpectroscopy subsystem cables to both sides of the new Penetration Panel as marked. Table 7–3 lists cables that are connected to the new 20 dB Gain Block (PP1 A13) filter panel. Also connect cables previously disconnected from 1kV Dynamic Disable Filter Module (PP1 A11).

TABLE 7–3
PREVIOUS AND NEW RUNS CONNECTING TO NEW 20 dB BLOCK PLATE

CONNECTOR	TYPE OF CONNECTOR	RUN
EQUIPMENT ROOM CABLES		
PP1–J79	BNC	N/A – Directly to Gain Block.
PP1–J83	SC (right angle adapter)	468
PP1–A13–OUT	BNC	469
PP1–J92	MHV	775
PP1–J93	MHV	776
PP1–J94	MHV	777
MAGNET ROOM CABLES		
PP1–J72	MHV	778
PP1–J73	MHV	779
PP1–J74	MHV	780
PP1–J75	MHV	781
PP1–J76	MHV	782
PP1–J79	BNC	472
PP1–J83	SC (right angle adapter)	473

SECTION 8 – MAGNET ENCLOSURE KIT FOR M1033MD AND M3090DA/DB

Note
Catalog M3090DC should not need this section performed.

TIME: 1 person, 4 Hours.

The kit received will depend on the site (upgrade or new install). It should be understood that the cable–take–up coaxial runs (transmit #456 and receive #455) will be replaced on all systems to accomodate the potential of the LPCC (Low Profile Carriage Cover) installation. This collector kit may be sent with both: two right angle Lemo style adaptors (2251522) and Clips (2254250) to be used with a LPCC or two white Lemo cables (2259728 and 2259728–2) and vaious other adaptors to be used with the original Carraige Cover Assembly.

8–1 UNPACKING MAGNET ENCLOSURE KIT

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

The Magnet Enclosure Kit is shipped in Box 1. Refer to Table 8–1 for contents. Rating Plate may be loose in the box.

TABLE 8–1
MAGNET ENCLOSURE KIT

ITEM	PART NO.	QUANT.	DESCRIPTION
3	46–301166P1	2	RECEPTACLE, PANEL FEED THROUGH, LEMO (non–LPCC)
4	46–301319P1	4	WASHER, 1/2” OD, .36 ID, .030 THICK, 300 SST (non–LPCC)
7	46–301205P1	2	CABLE, WHITE RG58/U W/ LEMO STRAIGHT AND ELBOW CONNECTORS (non–LPCC)
8	46–301338P1	2	ADAPTOR, BNC TO LEMO
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 , OR PLASTIC BAG OR BOX, FOR SMALL HARDWARE
	2100718	1	31P MNSPECTROSCOPY TR MODULE (MG2 A16 A7), (new sites ONLY)
	2257057	1	CABLE TAKE–UP, RUN NO. 456, MG3–A17–J3 TO MG2–A16–J1
	2257058	1	CABLE TAKE–UP, RUN NO. 455, MG3–A17–J4 TO MG2–A16–J2
	2254250	5	Plastic Sticky Cable Hold–down Clips (LPCC ONLY)

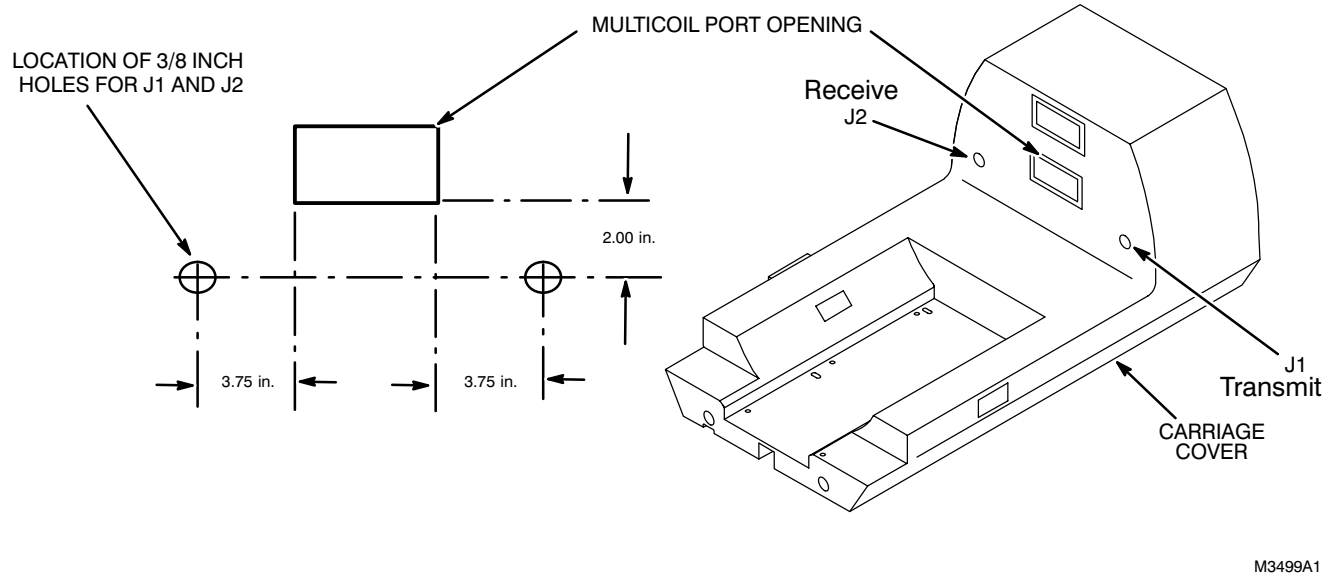
8–2 CARRIAGE COVER REMOVAL–ORIGINAL STYLE

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.

8–3 CARRIAGE COVER MODIFICATION–ORIGINAL STYLE

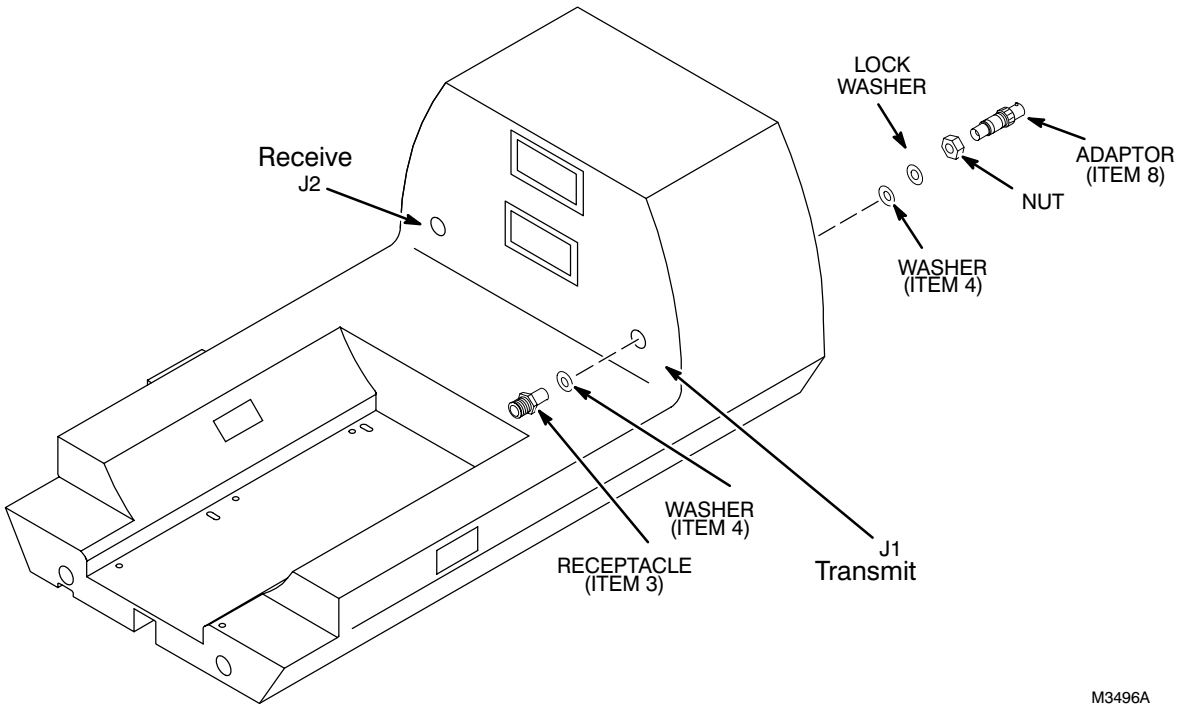
1. Locate holes to drill for J1 and J2 on carriage cover. The centers of these holes are 2.00 in. below and 3.75 in. left and right from lower corners of Multi–Coil port opening. Refer to Illustration 8–1.
2. Drill two 3/8 in. holes in carriage cover as located in step 1. If available a 23/64 drill bit is optimal.
3. Use a permanent marking pen to label holes J1 (Transmit) and J2 (Receive) on inside of carriage cover. Refer to Illustration 8–1.



DRILL LOCATIONS FOR CARRIAGE COVER
ILLUSTRATION 8–1

8−3 CARRIAGE COVER MODIFICATION−ORIGINAL STYLE (Continued)

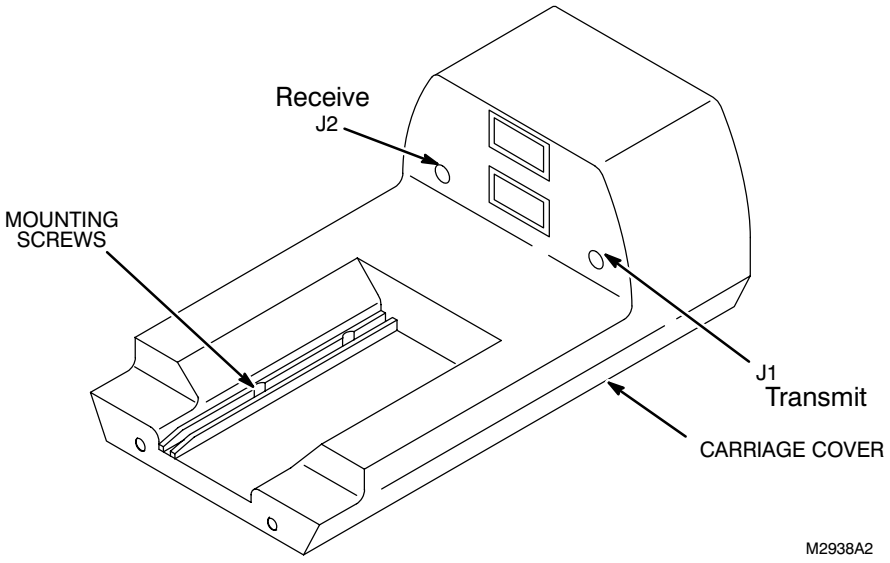
4. Remove nut from each Lemo receptacle (item 3).
5. Install washer (item 4) onto each receptacle.
6. Install assembled receptacle through hole J1 of carriage cover, install washer (item 4) and nut onto receptacle, and tighten nut. Refer to Illustration 8–2.
7. Install assembled receptacle through hole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



RECEPTACLE AND ADAPTOR INSTALLATION
ILLUSTRATION 8−2

8–4 CARRIAGE COVER INTERCONNECT–ORIGINAL STYLE

1. Feed new cables, Run 455 (2257058) and Run 456 (2257057) through cable–take–up 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 [Head Line] existing Run 403 (46–243775G557) connector (output) to connector (output) of Preamp (A2) in carriage cover.
   b. Install [Head Line] 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 (2257057) to connector J1 of adaptor on carriage cover [BB Spectro RF + TR Bias Line].
   d. Install connector J2 of new Run 455 cable (2257058) 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 8–3.

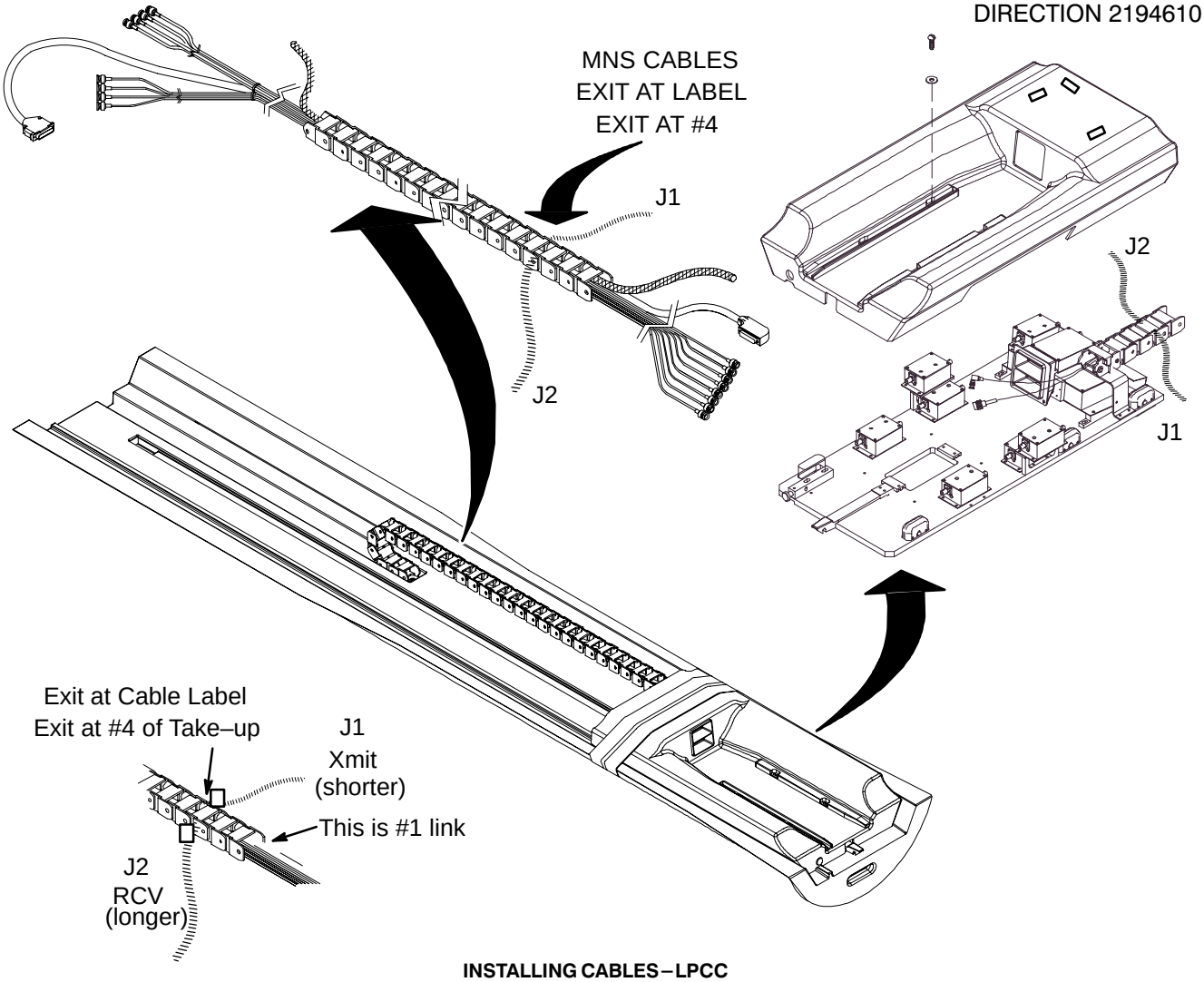


INSTALLING CARRIAGE COVER
ILLUSTRATION 8–3

8–5 CARRIAGE COVER INTERCONNECT–LPCC STYLE

1. Feed new cables, Run 455 (2257058) and Run 456 (2257057) through cable–take–up track, down through hole in the bridge, and over to four–cable bracket on rear frame, Illustration 8–5.
2. Install/verify cables (which are equal in length but will have unequal lengths at the LPCC) as follows:
   a. Install with connector J1 of new Run 456 cable (2257057) at LPCC exit end [BB Spectro RF + TR Bias Line]. This end of the cable exits the cable–take–up at link #4 (near cable label–shorter), Illustration 8–4.
   b. Install with connector J2 of new Run 455 cable (2257058) LPCC exit end [BB Spectro AUX Receive Bias Line]. This end of the cable exits the cable–take–up at link #4 (near cable label–longer), Illustration 8–4.
3. Connect the BNC to Lemo Adapters (46–301338P1) to J1 and J2. See Illustration 8–6.
4. Connect the 2 Lemo–Lemo cables (46–301205P1) to the adapters previously installed on J1 and J2.
5. Place the Spectro TR Module (white box–not shown) on top of the LPCC (flat–top area) . Do not connect to the Lemo–Lemo cables (now J1 and J2) at this time.
6. Place the cable–clips (3 are shown) on top of the LPCC and around the perimeter of the Spectro TR Module (flat–top area) to hold cables J1 and J2 in place . These are the small box–type items on the top rear of the LPCC. See Illustration 8–4.

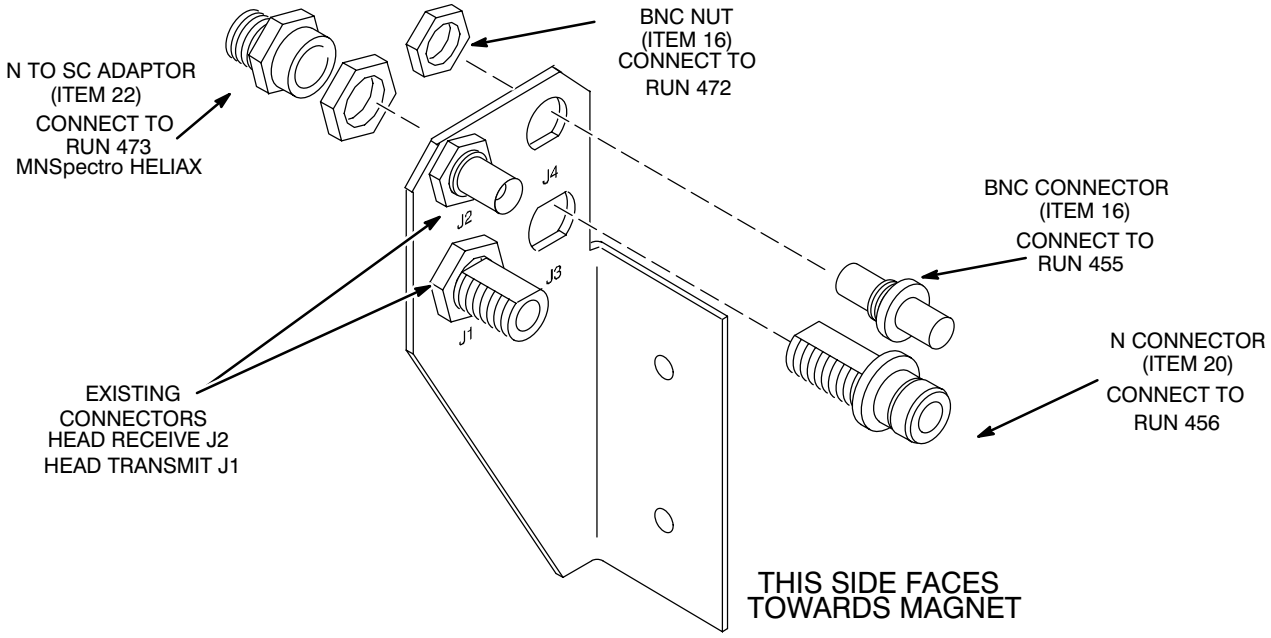
DIRECTION 2194610



INSTALLING CABLES – LPCC
ILLUSTRATION 8–4

8–6 CABLE INTERCONNECTION

1. Install BNC connector (item 16) through hole marked J4 on bracket (MG3 A17), install nut onto connector, and tighten nut.
2. **Verify "N" connector lockwasher (if present) is not magnetic, if it is do not use.** 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. Place a piece of tape or cable marker on this cable identifying it as "MNS RF OUT + TR BIAS" or **"XMIT"**.
6. Connect end of Run 455 (marked MG3–A17–J4) to connector J4 on bracket.
7. Place a piece of tape or cable marker on this cable identifying it as "MNS Receive Signal / Receive Bias" or **"RCV"**.



J3 AND J4 CONNECTORS
ILLUSTRATION 8–5

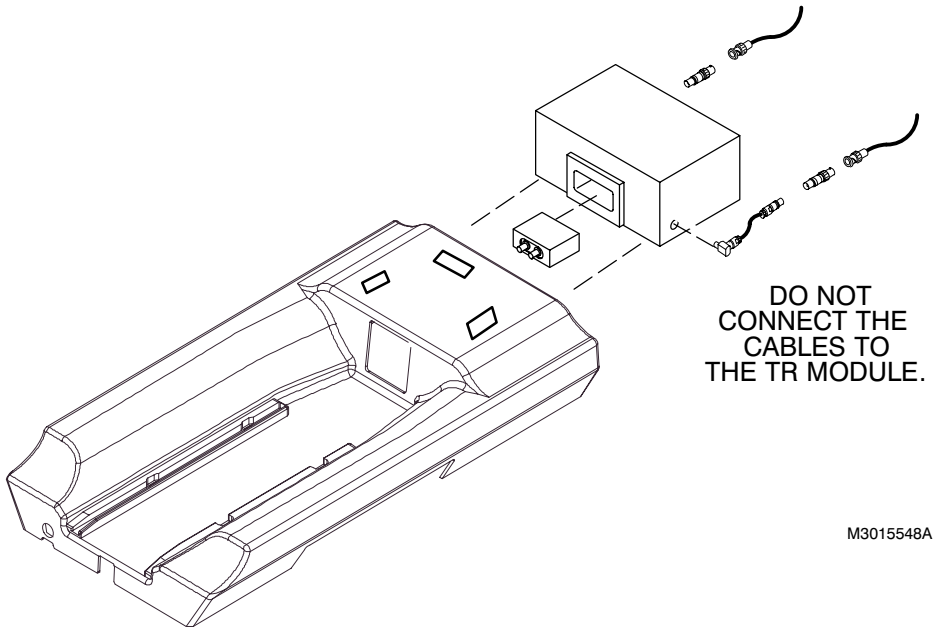
8. Connect previously routed Run 473 from Penetration Panel (PP1–J83) to N to SC Adaptor on J3 of bracket.
9. Connect previously routed Run 472 from Penetration Panel (PP1–J79) to BNC connector on J4 of bracket.

8–7 INSTALLING SPECTROSCOPY TR MODULE – LPCC STYLE

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).
2. Remove protective cover from Velcro strips.
3. Affix the Spectroscopy TR Module (A7) onto the carriage cover of the Low Profile Carriage Cover Assembly (A16). Refer to Illustration 8–6.
4. Press down firmly onto Spectroscopy TR Module (A7) to secure Velcro to carriage cover.
5. Install MNSpectroscopy Quick Disconnect into bezel of Spectroscopy TR Module. Refer to Illustration 8–6.
6. Leave cables J1 and J2 unconnected at this time. These will be connected during calibration.



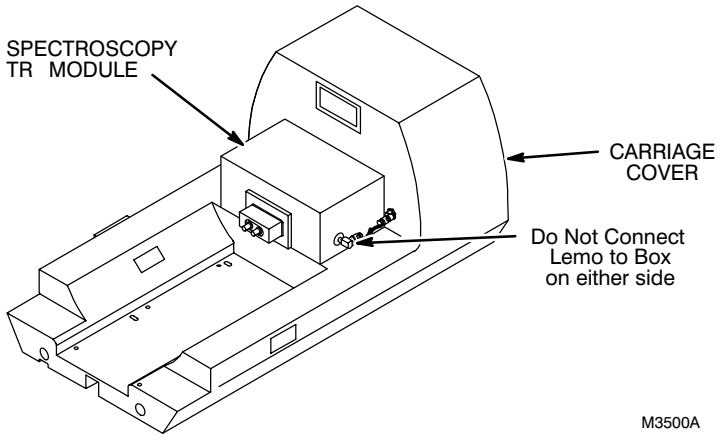
LPCC TR MODULE INSTALLATION
ILLUSTRATION 8−6

8–8 INSTALLING SPECTROSCOPY TR MODULE – ORIGINAL STYLE

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.

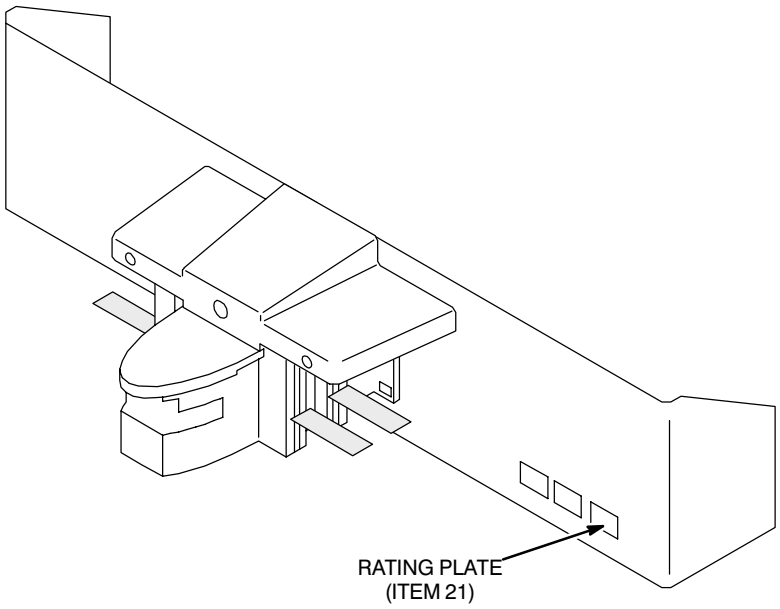
1. Make sure mating Velcro strips are properly aligned on the bottom of Spectroscopy TR Module (A7).
2. Remove protective cover from Velcro strips.
3. Place Spectroscopy TR Module (A7) onto carriage cover of Carriage Cover Assembly (A16). Refer to Illustration 8–7.
4. Press down firmly onto Spectroscopy TR Module (A7) to secure Velcro to carriage cover.
5. Procure and install one cable to connector J1 on carriage cover, install this side only. **DO NOT install** the connector to the Spectroscopy TR Module (A7). This will be connected during calibration. Refer to Illustration 8–7.
6. Procure and install second cable to connector J2 on carriage cover, install this side only. **DO NOT install** the connector to the Spectroscopy TR Module (A7). This will be connected during calibration. Refer to Illustration 8–7.
7. Install MNSpectroscopy Quick Disconnect into bezel of Spectroscopy TR Module. Refer to Illustration 8–7.



SPECTROSCOPY TR MODULE INSTALLATION
ILLUSTRATION 8−7

8–9 INSTALLING RATING PLATE

1. Install rating plate on base trim on front of Magnet Enclosure. Refer to Illustration 8–8.



LOCATION OF RATING PLATE
ILLUSTRATION 8−8

SECTION 9 – 8.X MNS OPTION INSTALLATION FOR M1033MD AND M3090DA/DB

Note
Catalog M3090DC should not need this section performed.

9–1 RELATED OPTIONS

For Multi–Nuclear Spectroscopy to be fully operational, install the related options included in Table 9–1.

TABLE 9–1
RELATED OPTIONS

	1.5T SIGNA MNSPECTROSCOPY SYSTEMS	
	NEED?	**DOCUMENTED IN:**
U17 PROBE EPROM	Maybe	RF/PEN 1 and 2 CABINETS ONLY *For use with the ERBTEC RF Amplifier* *Processor Board U17*
Disk Drive and Memory	Yes	Required for INDIGO II ONLY (128 Meg Memeory) FMI 60527
MEMORY	Yes	Required for OCTANE ONLY (256 Meg Memeory) FMI 60533

NOTE

If present, the Hydrogen ONLY Spectroscopy Option (PROBE) Tuning and SNR tests and should have been run prior to MNS installation.

9–2 8.X MNS OPTION KEY AND PROBE FILTER REMOVAL

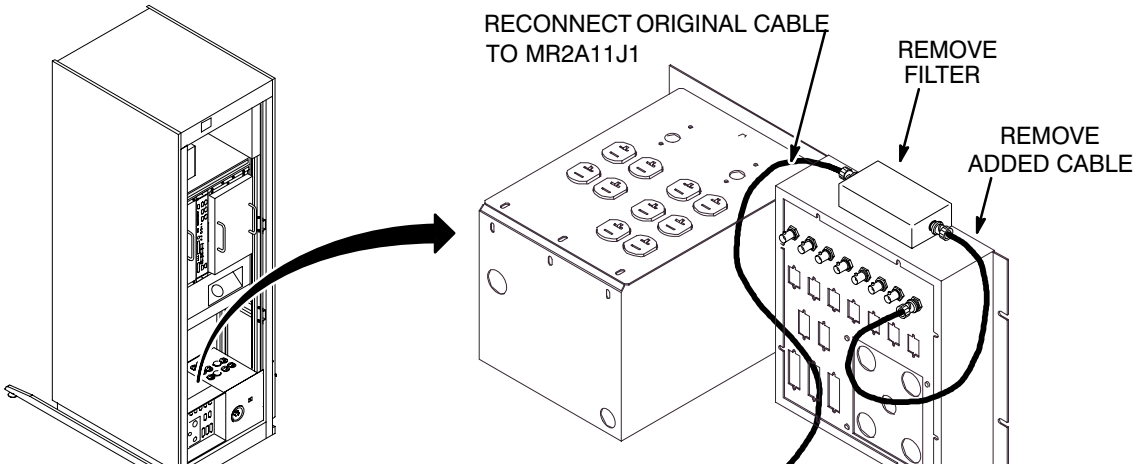
The 8.X Muti–Nuclear Spectroscopy Option Key (in some cases used to activate SAGE, Hydrogen ONLY Spectroscopy and Multi–Nuclear Spectroscopy), and the Hydrogen ONLY Spectroscopy specific EPROM for U17 (46–320103P1) (used in the Erbtec RF Amplifier ONLY) are discussd.

9–3 8.X MNS OPTION KEY INSTALLATION

The MNS Option Key should already be installed. See Installation Tab, Section 1 – GETTING STARTED.

9–4 PROBE FILTER REMOVAL

1. Disconnect the PROBE Filter assembly if present. Refer to Illustration 9–1.
2. Reconnect the original system cable to the MR2 A11 J1 connector on the Interface Panel.



PROBE FILTER LOCATION
ILLUSTRATION 9–1

NOTE

PROBE Filter adds approximately 3.5 +/– 0.5 dB of loss to the system. If present, this PROBE FILTER Kit must be removed.

9–5 RF POWER OUTPUT CALIBRATION AFTER PROBE FILTER KIT REMOVAL

The PROBE Filter Kit affected the RF Out signal. It affects the Multi–Nuclear Spectroscopy RF Out also (same line).

1. If the External Probe Filter was removed, refer to proper RF Power Out Setup and Calibration procedure listed below in Table 9–2 and perform APB, APM or RFI Calibration of the RF.

TABLE 9–2
RF CALIBRATION PROCEDURES

CABINET TYPE	RF AMPLIFIER TYPE	2160623 SERVICE CDROM PROCEDURE
RF/PEN 1	Erbtec 20kW RF Amplifier	RF/PEN 1 Max Power Out and Calibration (RC1SCA2.DOC)
RF/PEN 2	Erbtec 20kW RF Amplifier	RF/PEN 2 Max Power RF Out And Calibration (RC2SCA2.DOC)
RF/PDU	Analogic RF Amplifier	1.5T RF/PDU Max Power RF Out Setup and Calibration (RC3SCA1.DOC)
SRF	Analogic RF Amplifier	1.5T SRF Max Power RF Out Setup and Calibration (RC5SCA1.DOC)

9–6 PROTON SPECTRO EPROM INSTALLATION FOR RF/PEN 1 OR 2 CABINETS ONLY

The EPROM is not associated or required for MNSpectroscopy. The EPROM is ONLY required for Proton Spectroscopy. The EPROM can ONLY be installed at sites with a 1.5T ERBTEC RF Amplifier. It is not used if the system has an RF/PDU or SRF Cabinet (1.5T Analogic solid–state amplifiers).

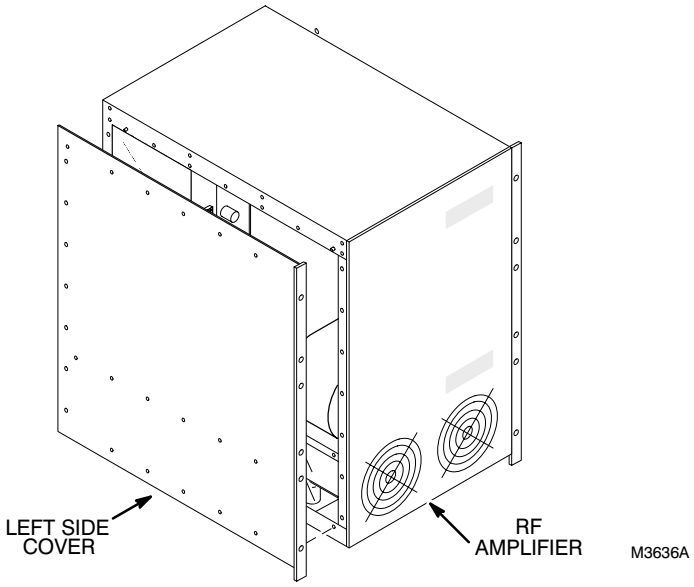
9−6−1 Remove RF Amplifier Covers

1. Verify the anti–tip stabalizer legs are installed on the RFPen Cabinet——these will prevent the Cabinet from tipping over.
2. If already ON and connected, turn OFF all RFPen Cabinet circuit breakers at rear of cabinet.
3. Disconnect power cable to RF/Pen Cabinet. Perform Lock–out/Tag–out procedures. (Refer to MR CD–ROM *Direction 2160623, MR Rlease 8.x Signa Service Methods,* navigate to System, SAFETY).
4. Remove RFPen 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.

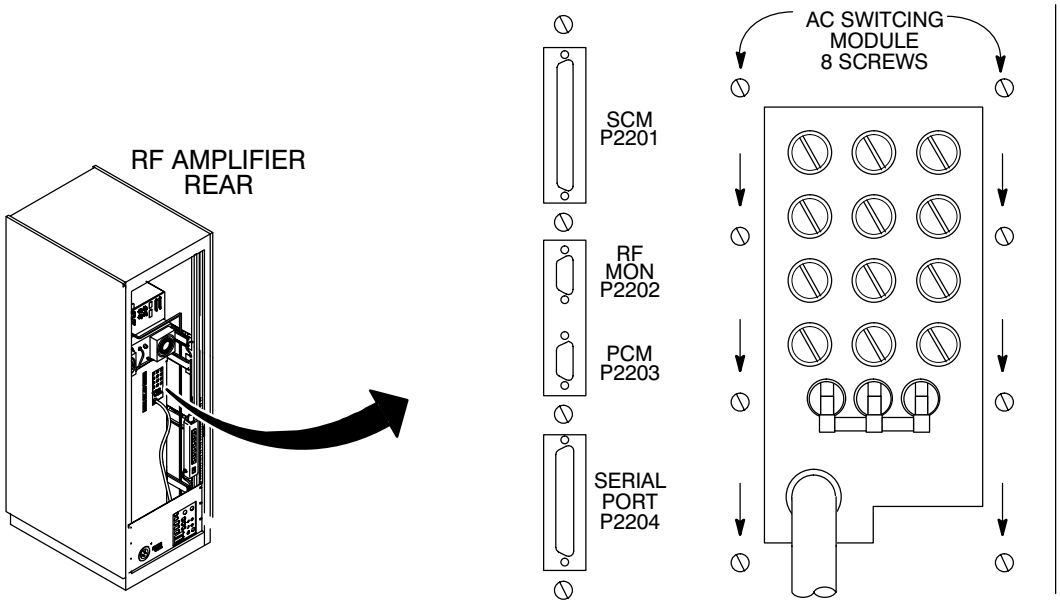
5. Remove securing screws and pull RF Amplifier completely forward.
6. Remove Left Side Cover. See Illustration 9–2.
7. Locate Processor Board in Processor Cavity just behind AC Switching Module (see Illustration 9–4). Place a service cloth, paper or cardboard piece over High Voltage Cavity to catch any hardware that may drop.
8. Push RF Amplifier back into the cabinet.



REMOVE ERBTEC RF AMPLIFIER COVERS
ILLUSTRATION 9−2

9−6−2 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 9–3.

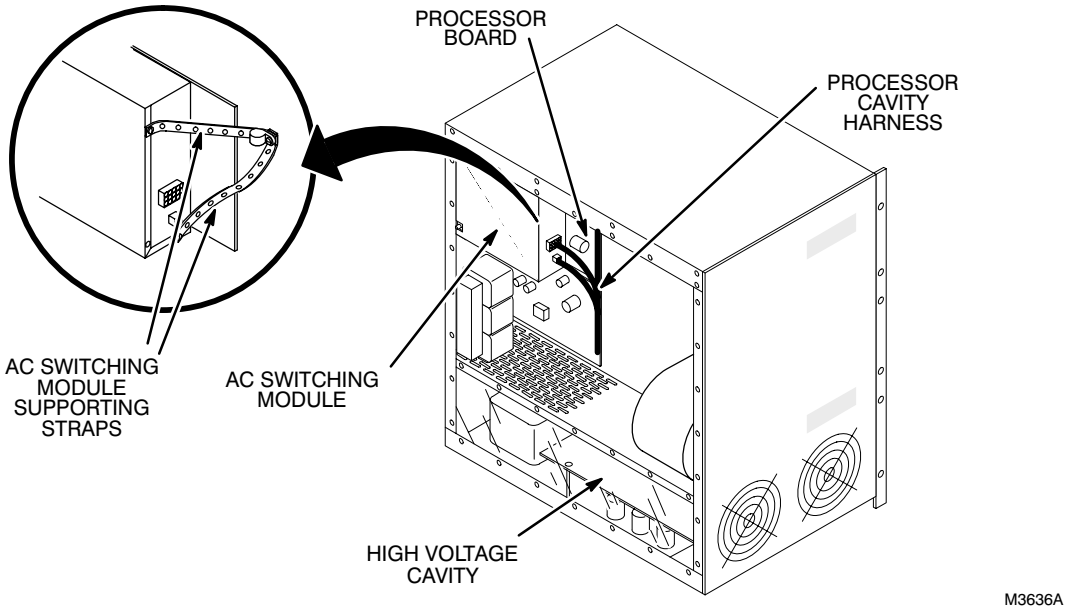


REMOVE SCREWS AND CABLES FROM REAR OF AMPLIFIER
ILLUSTRATION 9−3

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

9−6−2 Remove AC Switching Module (Continued)

3. Support the AC Switching Module with one hand and remove supporting straps from module by removing two screws. See Illustration 9–4.



PROCESSOR AND AC SWITCHING MODULE LOCATION
ILLUSTRATION 9−4

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.

9−6−3 Install EPROM

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

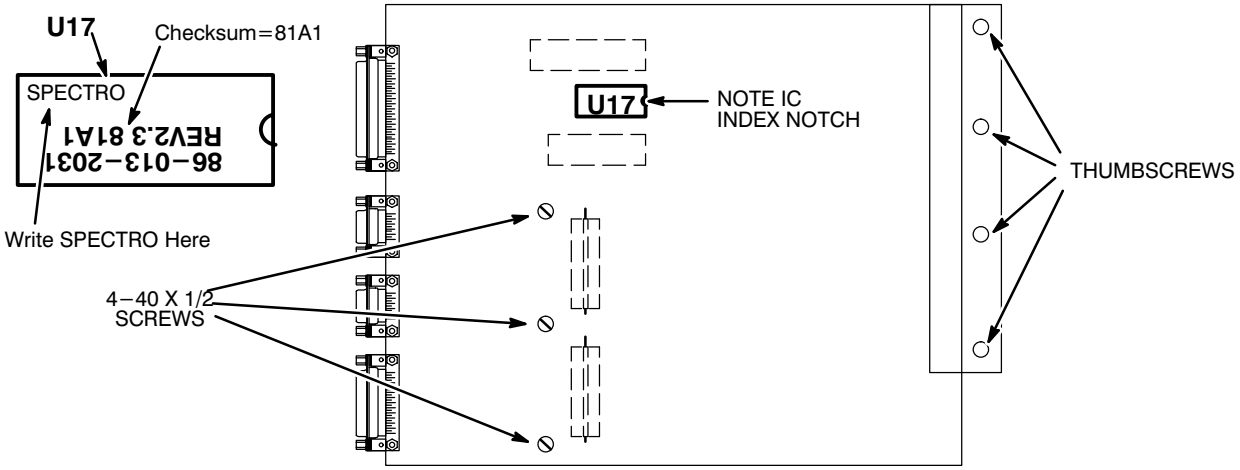
CAUTION

Processor Board and Components are static sensitive. Board components may be damaged if not handled in a static free environment. Take appropiate 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 9–5.
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 9–5 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) at U17 location. See Illustration 9–5. 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 9−5

9−6−4 Re−assemble Amplifier

1. 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.
2. Locate stud on interior side of rear panel and line it up with hole in module. The stud provides locationing and support while securing the unit.
3. Support module by fastening straps. See Illustration 9–4.
4. 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.
5. Push RF Amplifier back into the cabinet.
6. Attach module to rear panel by first loosely securing with eight 8–32 x 3/8 screws. Securely tighten all screws. See Illustration 9–3.
7. Pull RF Amplifier completely forward. Remove service cloth, cardboard or paper used to catch falling hardware.
8. Blow out unit with dry compressed air.
9. Replace left side cover with all screws and tighten properly.

SECTION 10 – FINAL PROCEDURES

10–1 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.

10–1–1 Standard PDU

1. Swing left panel closed.
2. Install three screws to secure left front panel to cabinet.
3. Swing right front panel to the closed position.
4. Remove “locks and tags” tag from main disconnect.
5. Restore power to the PDU from main disconnect.
6. 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 (RF/PEN) is turned on.

10–1–2 Compact PDU, Teal PDU, and Phoenix PDU

1. Remove “locks and tags” tag from main disconnect.
2. Restore power to the PDU from main disconnect.
3. Move PDU Main Input Breaker to the ON position.

10–2 SET UP AND CALIBRATION

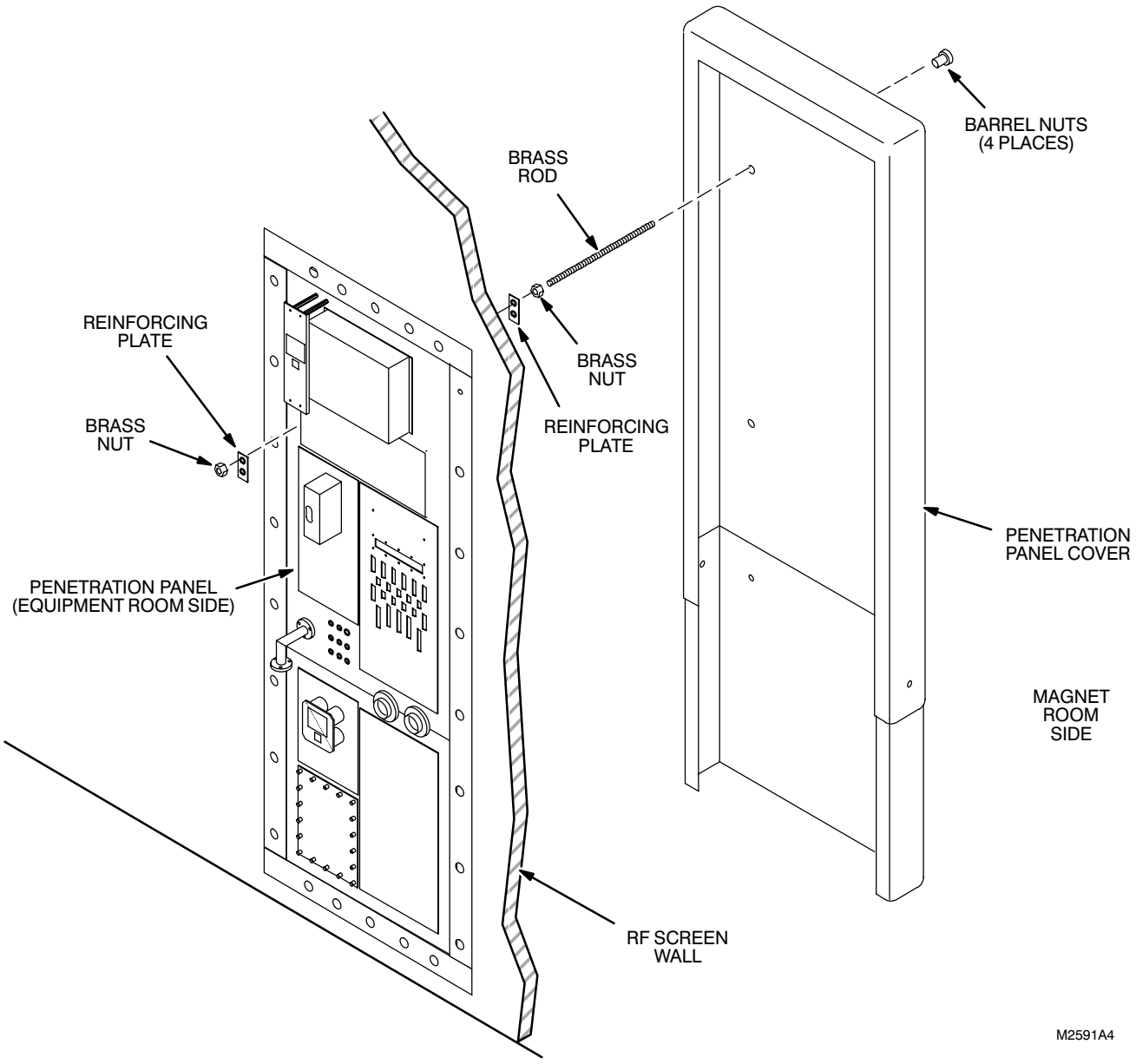
1. Perform procedures in Set Up and Calibration tab.

10–3 FUNCTIONAL CHECKS

1. Perform procedures in Functional Checks tab.

10–4 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 10–1.



INSTALLATION OF PENETRATION PANEL COVER
ILLUSTRATION 10−1

10−4 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.

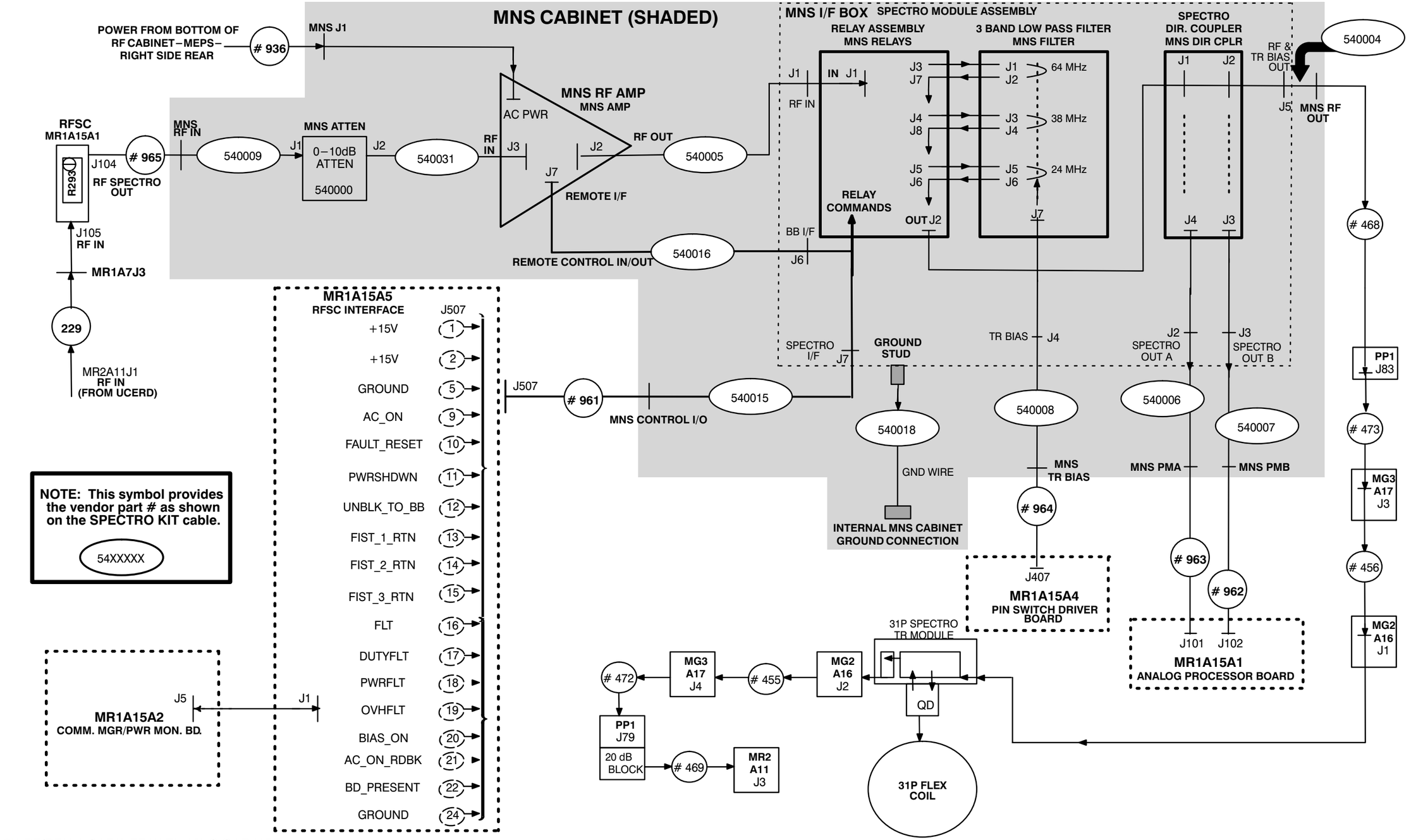
10−5 MATERIAL DISPOSAL GUIDANCE

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.

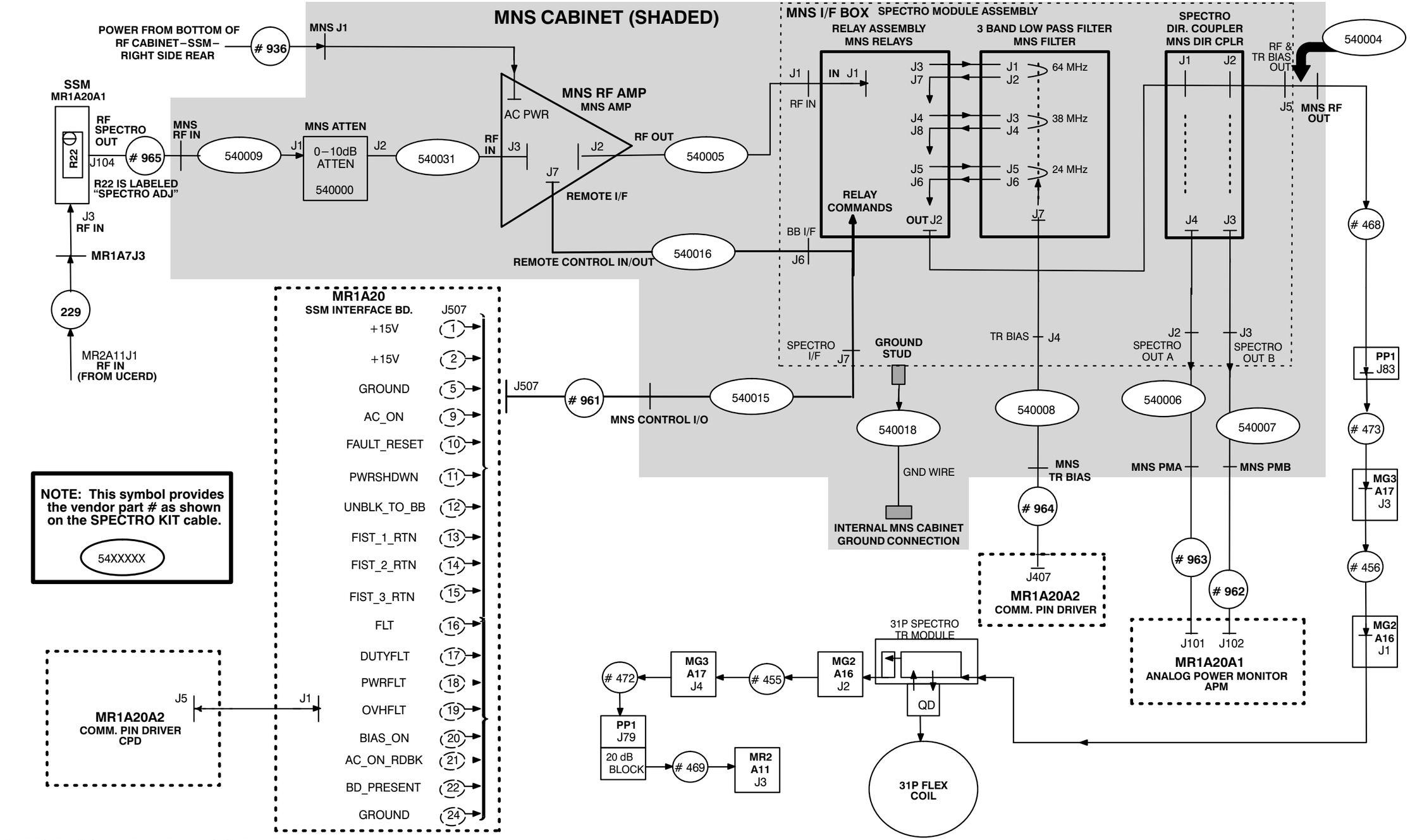
1. For coordination of return pile, refer to above policy “Exhibit A” and contact GEMS Salvage Operation directly by phone at (414)–747–6997 or (414)–548–2527. If no one answers then leave a voice mail describing generally what hardware you have to return and where you can be contacted. It is important for the Salvage Operation personnel to speak with someone on the site so that they can gather the needed details to arrange for removal of the equipment. Allow 3–5 days for removal. The Salvage Operation fax is (414)–747–6855.
2. Disposition of all items in the discard (or recycle) pile per above referenced policy and procedure.

10−6 FINAL COORDINATION

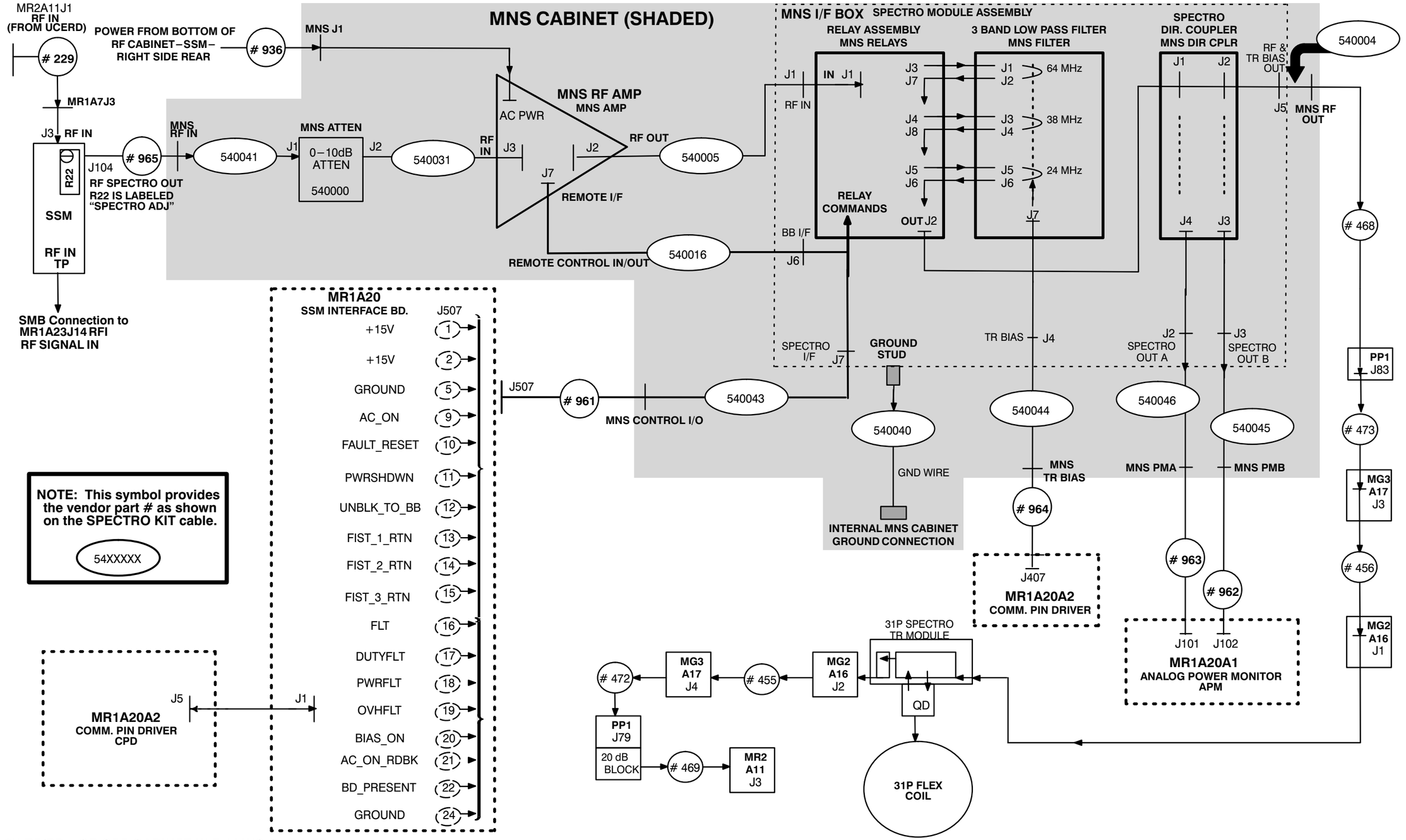
1. Record and enter applicable data into applicable site configuration files and records.
2. Complete and return all Product Locator Cards.



8X RF/PEN 1 CABINET WITH MNS CABINET



8X RF/PEN 2 CABINET WITH MNS CABINET



8X RF/PDU OR SRF CABINET WITH MNS CABINET

SET–UP AND CALIBRATION

TABLE OF CONTENTS

SECTION 1 – MULTI–NUCLEAR SPECTROSCOPY (BROADBAND)

M1033MD AND M3090DA/DB/DC

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, MNS, or BroadBand (BB) Spectroscopy unless otherwise noted.

NOTE

The Spectroscopy Erbtec RF Amplifier EPROM (46–320103P1) used specifically for PROBE Spectroscopy (Hydrogen only) applications in the ERBTEC RF Amplifier (RFPen 1 and 2 style Cabinets). Not used in RF/PDU or SRF style Cabinets (Analogic solid–state RF amplifier).

NOTE

Three (3) microprocessors in the SSM may need to be replaced due to FMI 60525, check EPLD: APM (U1, U8) EEAE date code 3/25/99. CPD (U8) FEB5 date code 4/19/99. Do not ever use any microprocessors provided in the MNS Kit. Verify the CPD Board U3 EPLD (C623, 10/5/99).

1–1 DESCRIPTION

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

This section describes how to adjust:

- Verify RUN 455, Receive cable, is properly routed.
  Verify RUN 456, Transmit cable, is properly routed.
- **RFSC:** Voltage, Current,and Threshold adjustment of the Spectroscopy PIN Switch TR Driver Circuit (Dynamic Mode) located in the **RFSC**.
- **SSM:** Voltage adjustment of the Spectroscopy TR Driver Circuit (Dynamic Mode) located in the **SSM**.
- Spectroscopy RF Output of the MNS UCERD to specified Power level.
- Output of the MNS RF Amplifier Heliax Cable to specified Power level of 1.58 kW.
- **RFSC:** Set Up of Analog Processor Board (APB) so the Communication Manager/Power Monitor Board (CM/PM) trips for MNS frequencies.
- **SSM:** Set Up of Analog Power Monitor (APM) so the Communication PIN Driver Board (CPD) trips for MNS frequencies.
- **Power Monitor: RFSC** hardware related directions will test to verify the Multi–Nuclear Spectroscopy redundant Power Monitor functions as prescribed.
  Power Monitor: SSM hardware related directions will test to verify the Multi–Nuclear Spectroscopy redundant Power Monitor functions as prescribed.

1–2 TOOLS/EQUIPMENT REQUIRED

- MRS Phantom.
- DVM and leads.
- Screwdrivers (phillips and straight blade type).
- 100 MHz or greater Oscilloscope.
- 2 Oscilloscope Probes.
- RF Power Measurement KIt.
- Pot Tweeker.

1–3 MNS CABLE DVM VERIFICATION AT CARRIAGE ASSEMBLY / CABLE–TAKE–UP CHAIN

- Visually verify the 2 (two) separate cable take–up coaxial cables used for Multi–Nuclear Spectroscopy are labeled as RCV and XMIT per the Installation section.

1. Measure ~+15 VDC on the Receive Line (AUX 1) using a DVM. Measure at Carriage Assembly (for LPCC sites measure at exit of Cable–Take–UP link) Receive Line side per Illustration 1–1.
2. Measure ~–12 VDC on the Transmit Line using a DVM. Measure at Carriage Assembly (for LPCC sites measure at exit of Cable–Take–UP link) Transmit Line side per Illustration 1–1.

1–4 INITIAL 1.5T (^{31}P) MNS SCAN PREPARATION

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

   - **RFPen 1 Cabinet ONLY (RFSC):**

   Verify JP87 on PIN Switch Driver Board to Position “Normal Mode A” (Software Control Mode).

   Place the CM/PM Board power monitor jumpers, 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.

   - **RFPen 2 And RF/PDU Cabinets ONLY (SSM):**

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

NOTE

For 8.X Release UCERD Multi–Nuclear Spectroscopy circuitry ONLY:

The AUX1 Receive Bias is ~+14.7 VDC to the 20 dB Gain Block and Spectro Preamp at all times. When not scanning MNS the (highest frequency) relay path through the Spectro Module Assembly should be engaged at all times, allowing TR Bias out to the Spectro TR Module (during the proton localizer). When the CV value is altered via the scan protocol *CV2* nucleus value a different relay path (depending on the frequency of the nuclei) may be selected. See Troubleshooting section for more detail if required.

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 1.5T (^{31}P) MNS SCAN PREPARATION (Continued)

TABLE 1–1
8.X SCAN PRESCRIPTION FOR (^{31}P) MNS SET–UP and CAL ADJUSTMENTS

SCAN PROTOCOL (8.X)

RX MANAGER

[New Series]

PATIENT INFORMATION

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

PATIENT POSITION

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

IMAGING PARAMETERS

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

ADDITIONAL PARAMETERS

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]**
CV16 CSI grid (off) **0.00 [Accept]**

SCAN TIMING

# of Echoes **1**
TE **40**
TR **550**

ACQUISITION TIMING

NEX **[2.00]**
Freq DIR [A/P]
Auto CF [Water]
Autoshim **[OFF]**

SCANNING RANGE

FOV **[24]**
Slice Thickness **[20.0]**
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: **ia_rf1** Current Value: **0**
CV Name: **ia_rf2** Current Value: **32767**
CV Name: **pibbandfilt** Current Value: **1** (for 31P)
[Accept]

[RESEARCH OPERATIONS]
DOWNLOAD

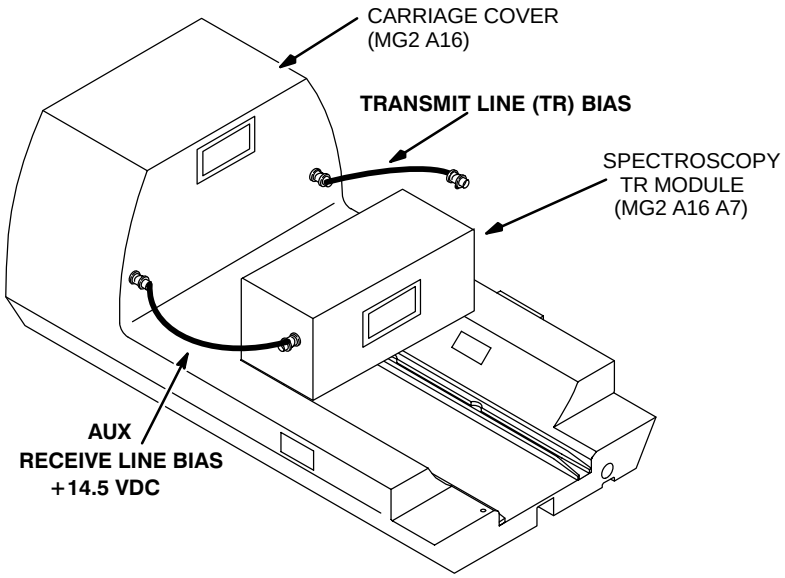
[Spectro Prescan]
Entry Point: **single1**
Nucleus: **31**
R1 **13**
R2 **30**
TG **0**
AX Default

[Start]
[Stop]
[Done]

NOTE

The User CV's Screen refers to CV14. The actual Control Variable name is opuser14. To select a hard pulse (square for trouble–shooting purposes) change the CV to zero (0) and Download.

1–4 INITIAL 1.5T (^{31}P) MNS SCAN PREPARATION (Continued)



MNS HARDWARE SET–UP: HIGH CARRAIGE COVER SHOWN
ILLUSTRATION 1–1

MNS HARDWARE COMPONENTS: COIL INTERFACED WITH SPECTRO TR MODULE
ILLUSTRATION 1–2

1–5 RFPEN 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 verification of voltage at J407 (unloaded).
- Dynamic State TP21 (voltage) Adjustment if MNS positive voltage is not within specification.

Dynamic State TP18 (current), TP19 (threshold) waveform Illustrations are provided, but not adjusted.

1–5–1 INITIAL SET UP

- Setup Initial Multi–Nuclear Spectroscopy Scan Preparation Protocol per Table 1–1, Section NO TAG.
- Set–up an oscilloscope to 1 Meg Ω termination when measuring TR and Power Monitor Signals.

1–5–2 DYNAMIC – TP21 ADJUSTMENT, TP18 AND TP19 VERIFICATION

1. At “Scan Operation” screen, press **[SPECTRO PRESCAN]**.
2. Press **[START]**.
3. Monitor the Spectro TR PIN Switch Driver output at the rear of the RFSC at J407.
4. Unloaded positive output voltage level should be set at +4.30 Volts (+/–0.10 V) above ground reference.

1–5–2 DYNAMIC – TP21 ADJUSTMENT, TP18 AND TP19 VERIFICATION (Continued)

5. If the unloaded positive output voltage level is not within the above specification reset the positive MNS voltage by monitoring TP21 and adjusting R18 to +4.30 Volts (+/–0.10 V) above ground reference as shown in Illustration1–3.

NOTE

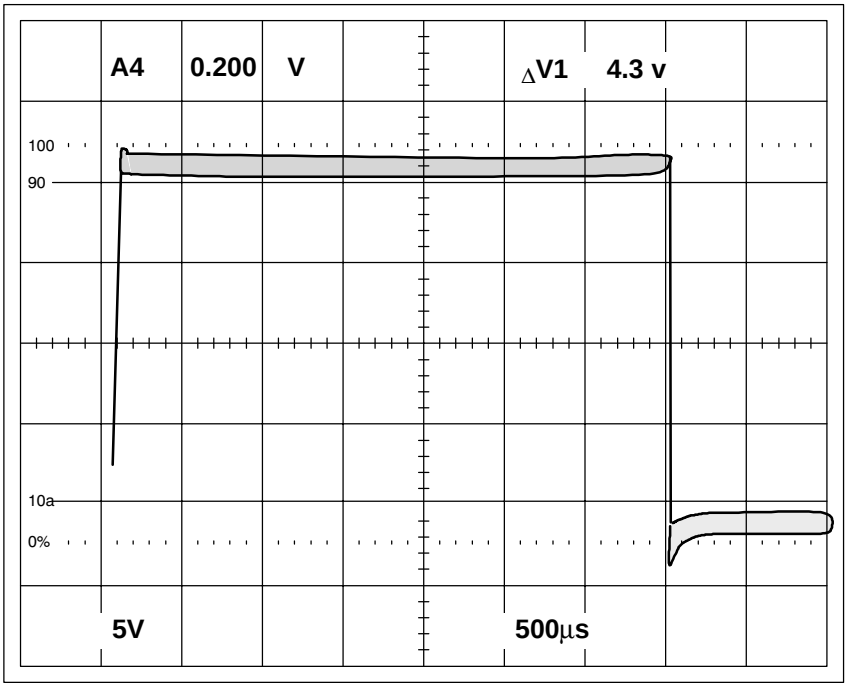
When TP21 voltage setting is increased/decreased the current output value at TP18 will also increase/decrease.

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.

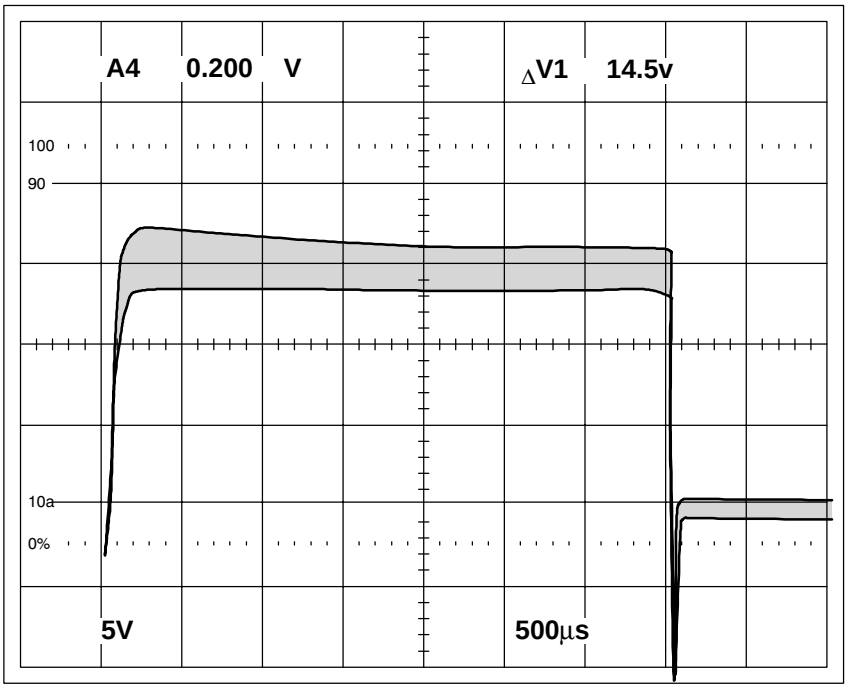


USE R18 TO ADJUST THE POSITIVE VOLTAGE LEVEL

GROUND REF

SPECTRO PIN SWITCH DRIVER TR OUTPUT VOLTAGE (TP21)
ILLUSTRATION 1–3

1–5–2 DYNAMIC – TP21 ADJUSTMENT, TP18 AND TP19 VERIFICATION (Continued)

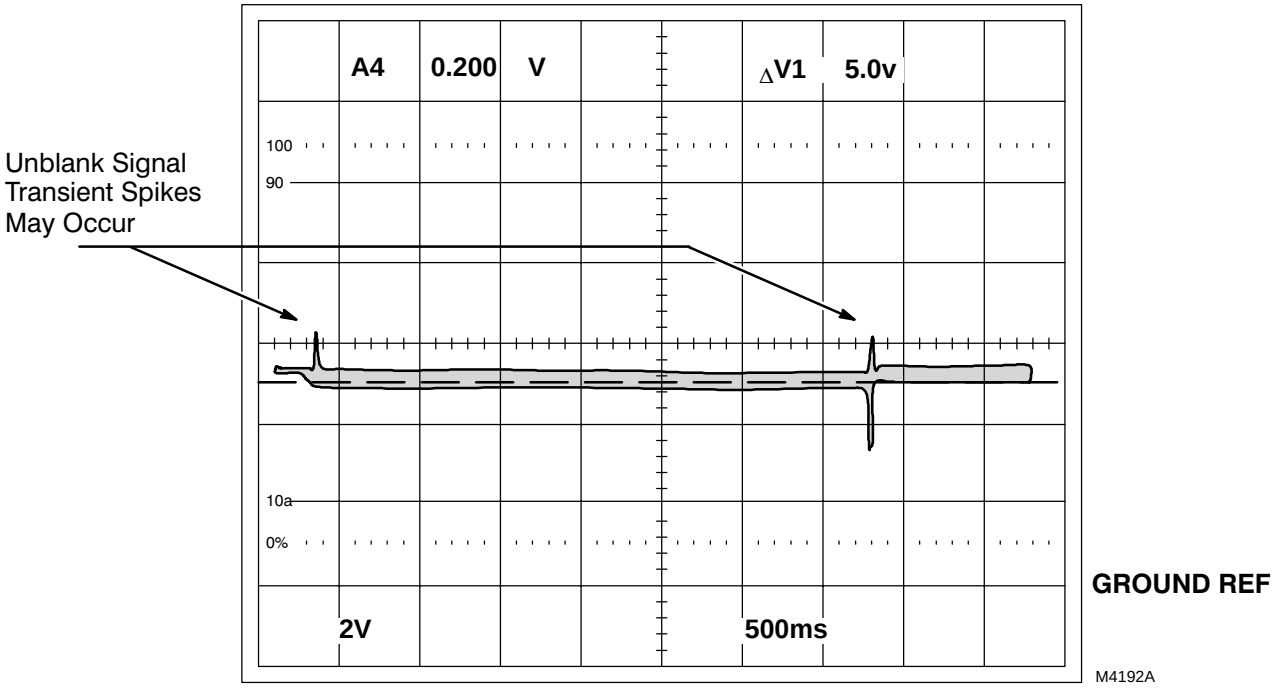


THE CURRENT WAVEFORM IS AFFECTED BY THE LOAD AND ADJUSTING R18

GROUND REF

SPECTRO TR DRIVER CURRENT EQUIVALENT VOLTAGE DIVIDED BY 10 (TP18)
ILLUSTRATION 1–4

1–5–2 DYNAMIC – TP21 ADJUSTMENT, TP18 AND TP19 VERIFICATION (Continued)



SPECTRO TR THRESHOLD ERROR DETECTION (TP19)
ILLUSTRATION 1–5

6. When adjustments are completed, press **[STOP]** to stop the Prescan.
7. Place the following switch located on the front of the RFSC Module in the correct position and verify:
   - MR1 A15 SW2 – TR–DD Faults Disable "OFF" (normal mode).
   - Verify J407 (MNSpectro TR Bias) is connected at RFSC.
8. Connect the MNSpectro RF Out + TR Bias cable to the Spectroscopy TR Module (from the Carriage Assembly).
9. Press **[START]**.

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 **MNSpectro TR errors** are reported re–verify the dynamic calibration procedure or turn to TROUBLESHOOTING TAB.

10. Re–adjust, as required, the loaded positive output voltage level at TP21 by adjusting R18 to +4.30 Volts referenced to Ground, (+4.30 Volts:–0.00, +0.10 Volts) as shown in Illustration1–3.
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 1–11.

1–6 RFPEN 2, RF/PDU, AND SRF CABINETS SECTION ONLY

MNSPECTROSCOPY 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:

- Verification of the MNSpectro TR Bias at SSM rear connection J407.
- If needed: CPD Board: Dynamic State TP17, Spectro TR Voltage Out, Adjustment and Verification.

CAUTION

DO NOT LEAVE THE SSM TOP COVER OPEN (IN HEAD OR SURFACE MODE) WHEN VERIFING TEST POINT VOLTAGES. INTERNAL IGBT CIRCUITRY IS KNOWN TO SHORT IF PROPER AIR FLOW IS INTERRUPTED (WHEN NOT IN THE BODY MODE). CONNECT TEST EQUIPMENT SECURELY AND CLOSE THE COVER WHILE PERFORMING VERIFICATION CHECKS. PREPARE TO SCAN SHOULD BE SELECTED TO INSURE PROPER MODE SELECTION.

1–6–1 INITIAL SET UP

- Setup Initial Multi–Nuclear Spectroscopy Scan Preparation per Table 1–1, Section NO TAG.
- Set–up an oscilloscope to 1 Meg Ω termination when measuring TR and Power Monitor Signals.

1–6–2 DYNAMIC – TP17 SPECTRO TR VOLTAGE VERIFICATION (AND ADJUSTMENT)

1. At “Scan Operation” screen, press **[SPECTRO PRESCAN]**.
1. Press **[START]**.
2. Monitor the Spectro TR Bias BNC connection at the rear of the SSM, J407.
3. Measure the unloaded positive output voltage level (with reference to ground). The unloaded positive MNSpectro TR output voltage level should be at the +4.30 Volts (–0.00, +0.10 Volts) value shown in Illustration 1–6.
4. If the unloaded positive output voltage level is not within the above specification it will be necessary to set–up a **BODY SCAN PROTOCAL** so that the SSM can be opened during pulsing without causing IGBT failures. Pulse in the Body mode. Change the positive MNS voltage by monitoring the unloaded positive MNSpectro TR output voltage level at TP17 on the CPD Board and adjusting R75 to +4.30 Volts as shown in Illustration 1–6.

NOTE

When TP17 voltage setting is increased/decreased the MNS current output value will also increase/decrease. The waveform shown is worst case and may not represent those displayed on your system. Waveforms should ideally be clean and square. 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).

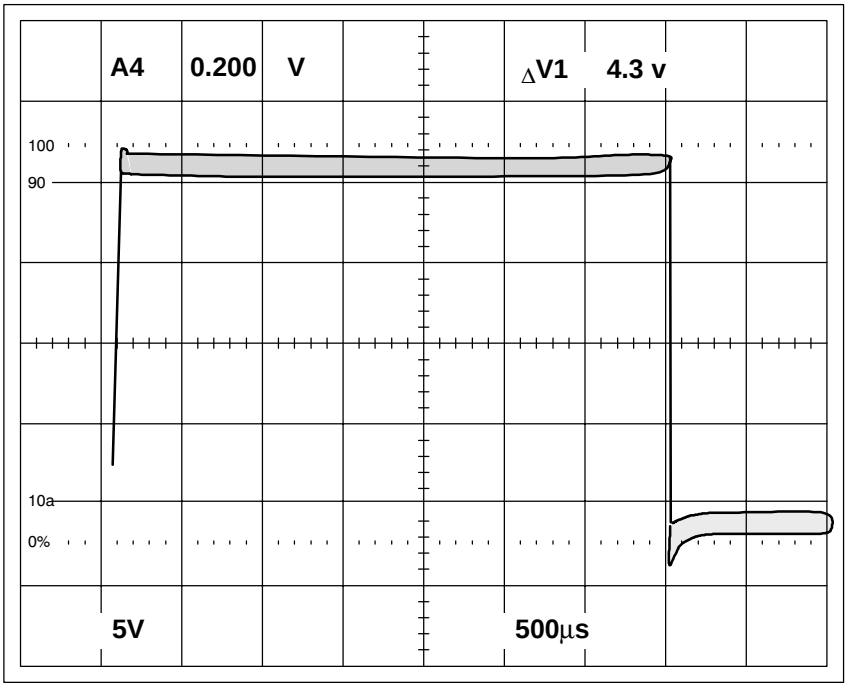
1–6–2 DYNAMIC – SPECTRO TR VOLTAGE VERIFICATION (AND ADJUSTMENT) (Continued)

5. When adjustments are completed, press **[STOP]** to stop the Prescan.
6. Reconnect J407 coax cable. Close the SSM.
7. 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).
8. Connect the RF Out + TR Bias cable to the Spectroscopy TR Module (from the Carriage Assembly).
9. At “Scan Operation” screen, press **[SPECTRO PRESCAN]**.
10. Select **[START]**.

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 **MNSpectro TR errors** are reported re–verify the dynamic calibration procedure or turn to the TROUBLESHOOTING TAB.

11. Select **[STOP]**. If needed, dynamically re–adjust the loaded positive output voltage level at TP17 by adjusting R75 to +4.30 Volts referenced to Ground, (+4.30 Volts:–0.00, +0.10 Volts) as shown in Illustration 1–6. Open SSM when system is in Body Mode ONLY (see Caution).
12. When operation is satisfactory, press **[STOP]** to stop the Prescan.
13. Press **[DONE]** to exit the Spectro Prescan page.



MNSPECTRO TR OUTPUT VOLTAGE AT SSM J407 OR CPD (TP17)
ILLUSTRATION 1–6

1–6–3 RESTORATION CHECK LIST

1. ***If NOT proceeding*** to the applicable next section of this procedure restore system per Section 1–12.

1–7 1.5T PHOSPHORUS RF SIGNAL FROM THE UNIVERSAL CERD (UCERD)

NOTE

Sub–Section 1–7 is not required. It has been included to help the FE insure that the UCERD exciter MNSpectro RF output is within specification. Do not perform this section unless it is not possible to acheive 1.58 kW RF output from the RF Amplifier (see Section 1–8) and it is suspected that the UCERD exciter is not outputting the specified level of power. If the UCERD exciter cannot be measured at the front panel then it is acceptable to measure the RF Out signal at MR1A11J1. This signal, however, may be slightly lower due to cable loss and is not specified. The RF Out signal is only specified at the UCERD front panel.

- Setup Section 1–4 and Initial MNS Scan Prescription per Table 1–1.
- Verify RF Out + TR Bias cable to the Spectroscopy TR Module (from the Carriage Assembly) is connected.
- The UCERD RF Signal can be directly measured using a 100 MHz oscilloscope (no calibrator required) because the frequency is below 50 MHz (actual frequency is approximately 25.85 MHz).

1. Disconnect the UCERD front panel J109 cable.
2. Set the TG to 200.
3. Set–up an oscilloscope (50 Ω final termination). Verify 20 MHz BW Limit button is not selected.
4. Using the TPS/RF Cable Kit procure a cannon to BNC test cable (46–301549P6).
5. Connect cannon to BNC test cable to RF OUT at J109 on UCERD.
6. Connect the BNC end of the test cable to oscilloscope.

NOTE

If an oscilloscope has a 50 Ω selectable termination port do not use the 50 Ω feed–through terminator. The 50 ohm feed–through is provided in the RF Power Measurement Kit for high Z scopes.

7. At “Scan Operation” screen, select **[SPECTRO PRESCAN]**.
8. Select **[START]**.
9. Measure the UCERD MNS RF Signal and verify it meets specification at UCERD Exciter “RF OUT” J109: 4 dBm (1.00 Volts Peak to Peak), ±1 dBm. This is roughly [893 mVolts Peak to Peak = 3 dBm] to [1.10 Volts Peak to Peak = 5 dBm]. If measuring the UCERD at MR2A11J1 (System Cabinet I/F panel) should not usually be less than 0.823 VPP.
10. Set the TG to 0 (zero).
11. Select **[STOP]**.
12. Select **[DONE]**.
13. Re–connect the UCERD J109 cable at the front panel.
14. ***If NOT proceeding*** to the applicable next section of this procedure restore system per Section 1–10 or 1–12.

1–8 1.5T PHOSPHORUS RF POWER OUT ADJUSTMENTS

This procedure will:

- Verify 1.58 kW maximum RF Output at TG=200 from the Multi–Nuclear Spectroscopy RF Amplifier using the scan protocol per Table 1–1 and referring to Illustration 1–7.

1–8–1 INITIAL SET–UP FOR 1.5T PHOSPHORUS RF OUT MEASUREMENT

- Setup Section 1–4 and Initial MNS Scan Prescription per Table 1–1.
- Set–up an oscilloscope to 50 Ω final termination to measure RF Signals.
- Verify 20 MHz BW Limit button is not selected.
- Initially set the Spectro Attenuator, MR1A18, to fully CCW maximum attenuation. This 0 to10 dB mechanical attenuator attenuator is located in the right–side rear of the cabinet housing 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.

1–8–2 1.58 kW PHOSPHORUS RF POWER OUTPUT ADJUSTMENT

1. **RFPEN 1 Cabinet ONLY:** At the rear of the **RFSC** locate the SPEC GAIN RF Adjust pot R293. Adjust R293 fully CCW to maximum value. MNS RF will use this path and R293 may or may not require re–adjustment later to successfully attain the MNS1.58 kW RF Out.
2. **RFPEN 2, RF/PDU, or SRF Cabinets ONLY:** At the rear of the **SSM** locate the SPECTRO ADJ RF pot R22. Adjust R22 fully CW to minimum value. MNS RF will use this path, however, R22 may or may not be used to adjust the MNS 1.58 kW RF Out.
3. Re–configure system hardware for MNS RF Power measurements as shown in Illustration 1–7.

1–8–2 1.58 kW PHOSPHORUS RF POWER OUTPUT ADJUSTMENT (Continued)

FOR ILLUSTRATION 1–7 ONLY:

NOTE

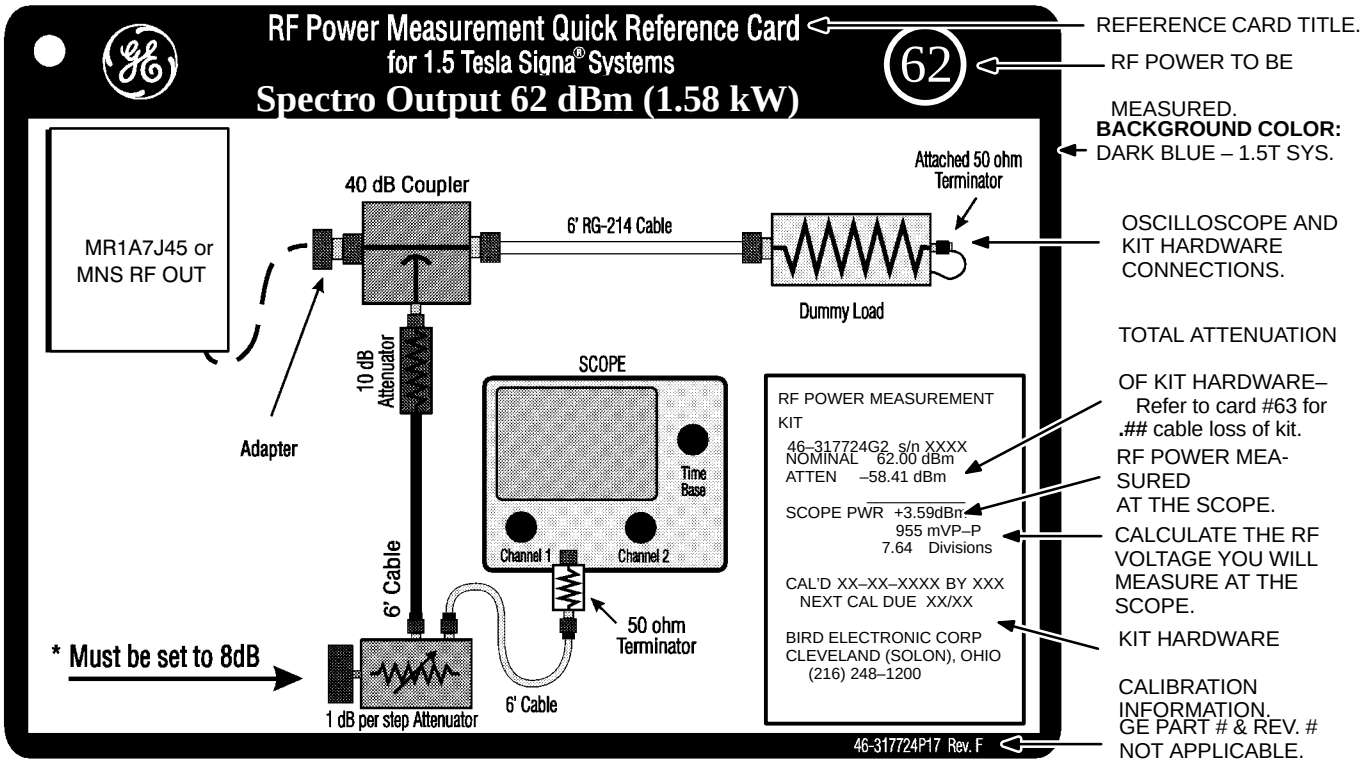
The Quick Reference Card # 62 shown below was created for Multi–Nuclear Spectroscopy RF Power Measurements. Many kits may not yet have this card. The main reason for showing this card is to provide the user with a diagram for how to configure the hardware to measure the MNS RF output power. The attenuation and scope power values that would normally come printed on the card can also be easily calculated.

NOTE

When using the RF Power Measurement Kit do not select the oscilloscope 50 Ω internal selectable termination. Use, instead, the 50 Ω feed–through terminator included in the kit. See Illustration 1–7. Select the oscilloscope's 1 Meg Ω internal selectable termination, if it permits this.

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 1.58 kW PHOSPHORUS RF POWER OUTPUT ADJUSTMENT (Continued)

4. Record the Total .## Attenuation below per selected MNS hardware set–up using RF Power Measurement Kit card #63:
   - (Total Attenuation on sticker) **58 . _____dB**
     (shown on the 1.5T Head Card #63 as 59.## dB)
   - **EXAMPLE:** 58.00 dBm + 0.41 (Kit Card #63 Attenuation) = Total ATTEN of 58.41 dB
5. Subtract the Total Attenuation (**58.##**) derived in the previous step from 62 dBm (1.58 kW) to get the desired value of power in dBm at the scope necessary to acheive 1.58 kW output from the MNS RF amplifier.
   - 62 dBm – **58.##** = Power in dBm seen at scope (this is the desired value)
   - Record in space: _____dBm (desired value to be seen at scope)
   - **EXAMPLE:** 62 dBm – 58.41 dBm = **3.59 dBm** (this is the amount of power reaching the 50 Ω terminated oscilloscope when the MNS RF amplifier output is 62 dBm (1.58 kW).
6. Use one of the two methods below to convert the desired power to be seen at the scope, expressed in dBm and calculated in the previous step, to Volts peak to peak (Vp–p):
   - Use the calculator on the MR scanner to do the conversion. Move the cursor into the background, right mouse click, select Calculator from the Root Menu. The formula below will convert from dBm to V P–P. Enter the values into the calculator using the mouse or keyboard EXACTLY as shown:

     dBm (DIVIDED BY) 20 (EQUALS) (INV LOG) (MULTIPLY) .632 (EQUALS) **(V P–P)**.

     Example calculation using *3.59* dBm:
     3.59 dBm (DIVIDED BY) 20 (EQUALS) 0.1795 (INV LOG) (MULTIPLY) .632 (EQUALS) **0.95547005** V P–P
   - Alternatively, this value can be calculated with a hand calculator (equipped with log functions) using the formula below:

     Vpp = [antilog (dBm / 20)] X 0.632

     Example calculation using 3.59 dBm: **0.955 Vp–p** = [antilog (3.59 dBm / 20)] X 0.632
   - Record in space: _____ **Vp–p** (This is the target value that will be read directly from the scope.)
7. **[SPECTRO PRESCAN]**.
8. Set the TG to 0 (zero).
9. **[START]**.
10. Slowly increase TG setting to 200 using 20 TG unit increments.
11. Adjust the Spectro Gain Attenuator, MR1A18, CW increasing the Spectro RF In signal while watching the scope face to obtain the target **Vp–p** (recorded in step 6). Adjust the RFSC Spectro Gain RF (R293) or SSM Spectro Adj RF (R22) pot on the rear of the RFSC or SSM only if absolutely necessary.

1–8–2 1.58 kW PHOSPHORUS RF POWER OUTPUT ADJUSTMENT (Continued)

CAUTION

DO NOT APPLY FORCE.
Hand–tighten the locking nut on the Spectro Gain Attenuator.

12. Hand–tighten the locking nut on the Spectro Gain Attenuator.
13. Re–verify MNSpectro RF Out is still set properly after the MR1A18 Attenuator locking nut is hand tightened.
14. Lower TG to 0 (zero).
15. Press **[STOP].**
16. Press **[DONE].**

NOTE

Once the MNS RF Out has been adjusted to 1.58 kW, it is recommended that MR1A16J3 (Spectro RF Amp input signal) value is measured at TG=200 per the above conditions and recorded in the site log book. This signal level specifically depends on the Spectro RF Amp gain (each amplifier is slightly different). It is typically between 400 and 632 mVP–P (into 50 ohm final termination). RF signal measured is directly dependent on the RF Amplifier gain and will vary from amplifier to amplifier.

1–8–3 RESTORATION CHECK LIST

1. ***If NOT proceeding*** to the applicable next section of this procedure restore system per **Section 1–11 SYSTEM WITH RFPEN 1 CABINET – RESTORATION CHECK LIST** or **Section 1–12 SYSTEM WITH RFPEN 2, RF/PDU, OR SRF CABINET – RESTORATION CHECK LIST.**

1–9 MULTI–NUCLEAR SPECTROSCOPY POWER MONITOR ADJUSTMENT

This procedure will:

- **RFPen 1** (has an RFSC)**:**
  Set the Multi–Nuclear Spectroscopy redundant Power Monitor waveforms to a pre–determined Volts Peak value (oscilloscope terminated into 1 Meg Ω).
- **RF/PEN 2, RF/PDU, or SRF Cabinet:**
  Set the Multi–Nuclear Spectroscopy redundant Power Monitor waveforms to a pre–determined Volts Peak value (oscilloscope terminated into 1 Meg Ω) in the SSM.

1–9–1 INITIAL SET–UP

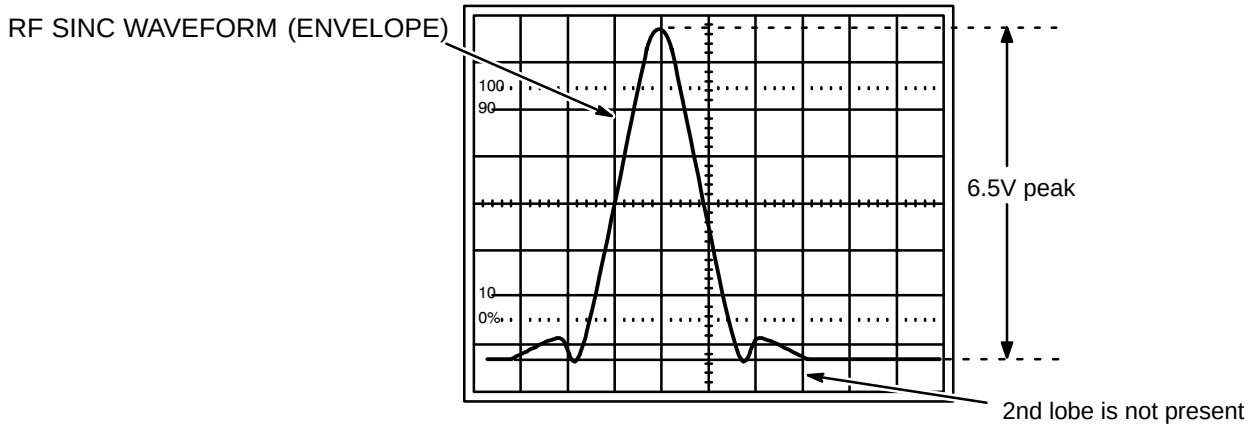
- Setup Section 1–4 and Initial MNS Scan Prescription per Table 1–1.
- Set–up an oscilloscope to 1 Meg Ω internal input impedance to measure RF Power Monitor Signals.
- Connect hardware per in Illustration 1–7. Disconnect hardware at CH1 of oscilloscope. Connect this to CH2. CH1 will be used to view and set the redundant Power Monitor waveforms.

1–9–2 RFPEN1 CABINET SUB–SECTION ONLY (RFSC Hardware)

MNS POWER MONITOR ADJUSTMENT TO APB

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

1. Open the RFPen1 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. Place JP2 and JP6 to position B (bypass) on the Communication Manager Board (CM/PM).
4. Select **[SPECTRO PRESCAN]**.
5. Select **[START]**.
6. Slowly increase TG setting until output of the dummy load is within +/– 0.2 dB of **1.58 kW** (Spectro Out + TR BIAS). If Power Monitor faults occur, adjust R130 / R131 to decrease level at the Analog Processor Board.
7. Monitor peak voltage of the waveform at TP10 of Analog Processor Board (MR1 A15 A1) and adjust R130 (CW to increase) on Analog Processor Board to obtain 6.50 +/– 0.05 V peak (1.58 kW equivalent). See Illustration 1–8. Verify RF Sense LED's are illuminated.
8. 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.
9. Monitor peak voltage of the waveform at TP11 of Analog Processor Board (MR1 A15 A1) and adjust R131 (CW to increase) on Analog Processor Board to obtain 6.50 +/– 0.05 V peak (1.58 kW equivalent). See Illustration 1–8. Verify RF Sense LED's are illuminated.
10. Lower TG to 0.
11. Select **[STOP]**.
12. Select **[DONE]**.
13. Place JP2 and JP6 to position A on the CM/PM Bd. if not running planned maintenance for Power Monitor.



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 1–11.

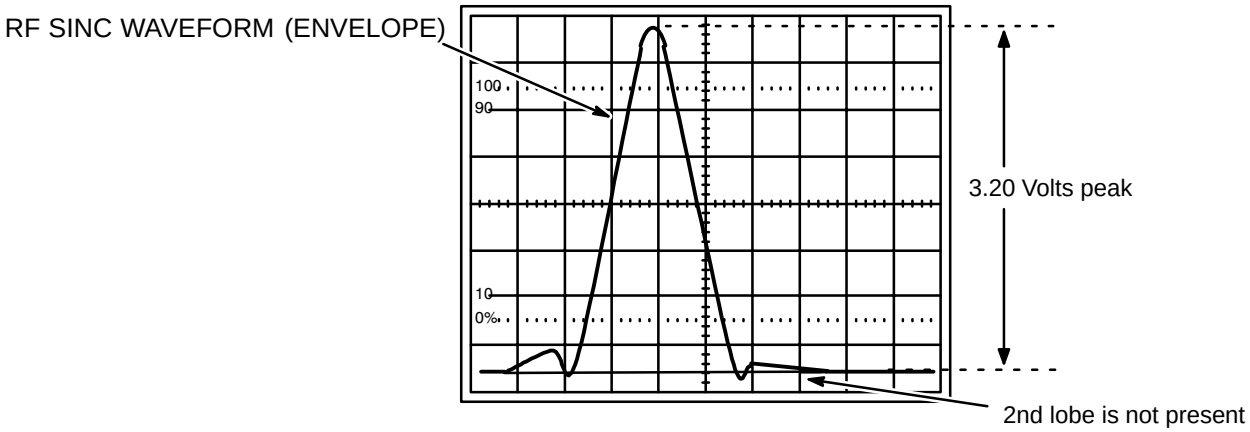
1–9–4 RFPEN 2, RF/PDU, OR SRF CABINET SUB–SECTION ONLY

MNS Power Monitor Adjustment at the APM

CAUTION

SSM cannot be opened unless the system is in the Body Mode (must also select Prepare To Scan). Interruption of the SSM airflow in Head or Surface mode will cause the IGBT's to short (these are for the 3 Dynamic Disable circuits).

1. Place the SSM power monitor rocker switches (A and B) in the bypass power monitoring position.
2. In Body Mode (1000 VDC, no current flow) open the SSM and locate the APM pots R95, and R97. A metal shield may need to be removed.
3. Connect Channel 1 scope (1 Meg ohm) to TP18 of APM (Spectro–EnvA) with respect to appropriate ground test point.
4. Connect Channel 2 scope (1 Meg ohm) to TP19 of APM (Spectro–EnvB) with respect to appropriate ground test point.
5. Close the SSM cover. Setup the MNS protocol. Select **[SPECTRO PRESCAN]**. Select **[START]**.
6. Slowly increase TG setting until output of the dummy load is within +/– 0.2 dB of **1.58 kW** (Spectro Out + TR BIAS). TG should be at 200.
7. Monitor peak voltage of the waveform at TP18 of APM and adjust R95 to obtain 3.20, +/– 0.05 V peak (1.58 kW equivalent). See Illustration 1–9. Verify the RF Sense LED's are illuminated.
8. Monitor peak voltage of the waveform at TP19 of APM and adjust R97 to obtain 3.20, +/– 0.05 V peak (1.58 kW equivalent). See Illustration 1–9. Verify the RF Sense LED's are illuminated.
9. Select **[STOP]** and **[DONE]**.



RFPEN 2 WAVEFORM FOR APM – POWER MONITOR ADJUSTMENT
ILLUSTRATION 1–9

1–9–5 RESTORATION CHECK LIST

NOTE

The Power Monitor may not fault properly if either one of the SSM Switches are left in the BYPASS position. Verify Power Monitor A and B rocker switches are set to the “NORMAL” Mode..

1. ***If NOT proceeding*** to the applicable next section of this procedure restore system per **Section 1–12 SYSTEM WITH RFPEN 2, RF/PDU, OR SRF CABINET – RESTORATION CHECK LIST**.

1–10 PLANNED MAINTENANCE FOR MNS POWER MONITOR – RFPEN 1 & 2, RF/PDU, AND SRF CABINETS

This procedure will:

- Test the **RFPen 1** Cabinet to verify the Multi–Nuclear Spectroscopy redundant Power Monitor functions as prescribed.

- Test the **RF/Pen 2, RF/PDU or SRF Cabinet** SSM redundant Power Monitor functions as prescribed. Observe SSM directions and **cautions**.

CAUTION

SSM cannot be opened unless the system is in the Body Mode (must also select Prepare To Scan). Interruption of the SSM airflow in Head or Surface mode will cause the IGBT’s to short (these are for the 3 Dynamic Disable circuits).

1–10–1 INITIAL SET–UP

- Setup Section 1–4 and Initial MNS Scan Prescription per Table 1–1.
- Set–up RF power Measurement Kit (or alternate attenuation) per **1.58 kW PHOSPHORUS RF POWER OUTPUT ADJUSTMENT** procedure, Illustration 1–7.

1–10–2 RFPEN 1 PLANNED MAINTENANCE FOR MNS POWER MONITOR

1. Open the RFSC Module. Place Communication Manager Board (CM/PM) jumpers JP2 and JP6 in the Power Monitors to position B, bypass mode.
2. With scan protocol prescribed set TG initially to 50.
3. Test MNS Power Monitor per Table 1–2.

TABLE 1–2
RFSC RELATED MNS POWER MONITOR TEST

TEST	SCAN CONDITIONS	ADJUSTMENTS	VERIFY
MNS Peak Power (Amp High)	[Research Operations] [Modify CVs] trip_amp = 0.56 [Accept] [Download] [Spectro Prescan] [Start]	Increase Transmit Gain (TG) until Power Monitor Fault LED's both illuminate.	MNS RF Amplifier is unblanking (gating). Power Monitor A and B detect RF Sense. Power Monitor Head LEDs ON. Power Monitor Faults occur (A and B) when TG is between 180 and 200. Pass _____ Fail _____
Set TG to 50. Select [STOP] and [DONE] at the Spectro Prescan Page. Place the Power Monitor Interlock (MON INTLK) switch to RESET, then to MODE1. Reset the MNS RF Amplifier is required.			
MNS Peak Power (Amp Low)	[Research Operations] [Modify CVs] trip_amp = 0.90 [Accept] [Download] [Spectro Prescan] [Start]	Increase Transmit Gain (TG) until Power Monitor Fault LED's both illuminate.	MNS RF Amplifier is unblanking (gating). Power Monitor A and B detect RF Sense. Power Monitor Head LEDs ON. Power Monitor Faults occur (A and B) when TG is between 120 and 140. Pass _____ Fail _____
Set TG to 50. Select [STOP] and [DONE] at the Spectro Prescan Page. Place the Power Monitor Interlock (MON INTLK) switch to RESET, then to MODE1. Reset the MNS RF Amplifier as required.			

1–10–2 RFPEN 1 PLANNED MAINTENANCE FOR MNS POWER MONITOR (Continued)

TABLE 1–2 (CONTINUED)
RFSC RELATED MNS POWER MONITOR TEST

TEST	SCAN CONDITIONS	ADJUSTMENTS	VERIFY
MNS Pulse Width High (Min Limit)	[Research Operations] [Modify CVs] trip_amp = 0 trip_width = 0 flip_rf2 = 180 squeeze = 1 [Accept] [Download] [Spectro Prescan] [Start]	Increase Transmit Gain (TG) until at 170.	MNS RF Amplifier is unblanking (gating). Power Monitor A and B detect RF Sense. Power Monitor Head LEDs ON. No Power Monitor Faults occur (A and B) when TG is at 170. Select [STOP] and [DONE] at the Spectro Prescan Page. Pass _____ Fail _____
MNS Pulse Width High (Max Limit)	[Research Operations] [Modify CVs] trip_width = 0.5 [Accept] [Download] [Spectro Prescan] [Start]	Do NOT change TG.	Power Monitor Faults (A and B). Pass _____ Fail _____
Select [STOP] and [DONE] at the Spectro Prescan Page. Place the Power Monitor Interlock (MON INTLK) switch to RESET, then to MODE1. Reset the MNS RF Amplifier as required.			
MNS Pulse Width Low (Min Limit)	[Research Operations] [Modify CVs] trip_width = 0 flip_rf2 = 90 squeeze = 2 [Accept] [Download] [Spectro Prescan] [Start]	Do NOT change TG.	MNS RF Amplifier is unblanking (gating). Power Monitor A and B detect RF Sense. Power Monitor Head LEDs ON. Power Monitor does NOT Fault. Pass _____ Fail _____ Select [STOP] and [DONE] at the Spectro Prescan Page.

1–10–2 RFPEN 1 PLANNED MAINTENANCE FOR MNS POWER MONITOR (Continued)

TABLE 1–2 (CONTINUED)
RFSC RELATED MNS POWER MONITOR TEST

TEST	SCAN CONDITIONS	ADJUSTMENTS	VERIFY
MNS Pulse Width Low (Max Limit)	[Research Operations] [Modify CVs] trip_width = 0.5 [Accept] [Download] [Spectro Prescan] [Start]	Do NOT change TG.	Power Monitor Faults (A and B). Pass _____ Fail _____
Select [STOP] and [DONE] at the Spectro Prescan Page. Place the Power Monitor Interlock (MON INTLK) switch to RESET, then to MODE1. Reset the MNS RF Amplifier as required.			
MNS Duty Cycle	[Research Operations] [Modify CVs] trip_width = 0 trip_cycle = 0 opuser0 = 16000 opuser1 = 256 optr = 230000 [Accept] [Download] [Spectro Prescan] [Start]	Do NOT change TG.	MNS RF Amplifier is unblanking (gating). Power Monitor A and B detect RF Sense. Power Monitor Head LEDs ON. Power Monitor does NOT Fault. Pass _____ Fail _____ Select [STOP] and [DONE] at the Spectro Prescan Page.
MNS Duty Cycle	[Research Operations] [Modify CVs] trip_cycle = 0.9 [Accept] [Download] [Spectro Prescan] [Start]	Do NOT change TG.	Power Monitor Faults (A and B).
Set TG to 0. Select [STOP] and [DONE] at the Spectro Prescan Page. Place the Power Monitor Interlock (MON INTLK) switch to RESET, then to MODE1. Reset the MNS RF Amplifier as required. Place the CM/PM Board power monitor jumpers, JP2 and JP6, into position A (Normal Mode).			

1–10–3 RFPEN 2, RF/PDU, AND SRF PLANNED MAINTENANCE FOR MNS POWER MONITOR

1. With scan protocol prescribed set TG initially to 50.
2. Test MNS Power Monitor per Table 1–3.

TABLE 1–3
SSM RELATED MNS POWER MONITOR TEST

TEST	SCAN CONDITIONS	ADJUSTMENTS	VERIFY
MNS Peak Power (Amp High)	[Research Operations] [Modify CVs] trip_amp = 0.56 [Accept] [Download] [Spectro Prescan] [Start]	Increase Transmit Gain (TG) until Power Monitor Fault LED's both illuminate.	MNS RF Amplifier is unblanking (gating). Power Monitor A and B detect RF Sense. Power Monitor Head LEDs ON. Power Monitor Faults occur (A and B) when TG is between 180 and 200. Pass _____ Fail _____
Set TG to 50. Select [STOP] and [DONE] at the Spectro Prescan Page. Reset the Power Monitor switches (A and B) at the front of the SSM. Reset the MNS RF Amplifier as required.			
MNS Peak Power (Amp Low)	[Research Operations] [Modify CVs] trip_amp = 0.90 [Accept] [Download] [Spectro Prescan] [Start]	Increase Transmit Gain (TG) until Power Monitor Fault LED's both illuminate.	MNS RF Amplifier is unblanking (gating). Power Monitor A and B detect RF Sense. Power Monitor Head LEDs ON. Power Monitor Faults occur (A and B) when TG is between 120 and 140. Pass _____ Fail _____
Set TG to 50. Select [STOP] and [DONE] at the Spectro Prescan Page. Reset the Power Monitor switches (A and B) at the front of the SSM. Reset the MNS RF Amplifier as required.			

1–10–3 RFPEN 2, RF/PDU, AND SRF PLANNED MAINTENANCE FOR MNS POWER MONITOR (Continued)

TABLE 1–3 (CONTINUED)
SSM RELATED MNS POWER MONITOR TEST

TEST	SCAN CONDITIONS	ADJUSTMENTS	VERIFY
MNS Pulse Width High (Min Limit)	[Research Operations] [Modify CVs] trip_amp = 0 trip_width = 0 flip_rf2 = 180 squeeze = 1 [Accept] [Download] [Spectro Prescan] [Start]	Increase Transmit Gain (TG) until at 170.	MNS RF Amplifier is unblanking (gating). Power Monitor A and B detect RF Sense. Power Monitor Head LEDs ON. No Power Monitor Faults occur (A and B) when TG is at 170. Select [STOP] and [DONE] at the Spectro Prescan Page. Pass _____ Fail _____
MNS Pulse Width High (Max Limit)	[Research Operations] [Modify CVs] trip_width = 0.5 [Accept] [Download] [Spectro Prescan] [Start]	Do NOT change TG.	Power Monitor Faults (A and B). Pass _____ Fail _____
Select [STOP] and [DONE] at the Spectro Prescan Page. Reset the Power Monitor switches (A and B) at the front of the SSM. Reset the MNS RF Amplifier as required.			
MNS Pulse Width Low (Min Limit)	[Research Operations] [Modify CVs] trip_width = 0 flip_rf2 = 90 squeeze = 2 [Accept] [Download] [Spectro Prescan] [Start]	Do NOT change TG.	MNS RF Amplifier is unblanking (gating). Power Monitor A and B detect RF Sense. Power Monitor Head LEDs ON. Power Monitor does NOT Fault. Pass _____ Fail _____ Select [STOP] and [DONE] at the Spectro Prescan Page.

1–10–3 RFPEN 2, RF/PDU, AND SRF PLANNED MAINTENANCE FOR MNS POWER MONITOR (Continued)

TABLE 1–3 (CONTINUED)
SSM RELATED MNS POWER MONITOR TEST

TEST	SCAN CONDITIONS	ADJUSTMENTS	VERIFY
MNS Pulse Width Low (Max Limit)	[Research Operations] [Modify CVs] trip_width = 0.5 [Accept] [Download] [Spectro Prescan] [Start]	Do NOT change TG.	Power Monitor Faults (A and B). Pass _____ Fail _____
Select [STOP] and [DONE] at the Spectro Prescan Page. Reset the Power Monitor switches (A and B) at the front of the SSM. Reset the MNS RF Amplifier as required.			
MNS Duty Cycle	[Research Operations] [Modify CVs] trip_width = 0 trip_cycle = 0 opuser0 = 16000 opuser1 = 256 optr = 230000 [Accept] [Download] [Spectro Prescan] [Start]	Do NOT change TG.	MNS RF Amplifier is unblanking (gating). Power Monitor A and B detect RF Sense. Power Monitor Head LEDs ON. Power Monitor does NOT Fault. Pass _____ Fail _____ Select [STOP] and [DONE] at the Spectro Prescan Page.
MNS Duty Cycle	[Research Operations] [Modify CVs] trip_cycle = 0.9 [Accept] [Download] [Spectro Prescan] [Start]	Do NOT change TG.	Power Monitor Faults (A and B).
Set TG to 0. Select [STOP] and [DONE] at the Spectro Prescan Page. Reset the Power Monitor switches (A and B) at the front of the SSM. Place Power Monitor switches (A and B) at the front of the SSM to Normal Position. Reset the MNS RF Amplifier as required.			

1–11 SYSTEM WITH RFPEN 1 CABINET – RESTORATION CHECK LIST

1. Perform the following:
   - Verify the System is in Idle Mode (not pulsing).
   - Disconnect all scope probes.
   - Remove test hardware.
   - Remove the Spectroscopy TR Module and associated hardware (if not continuing on).
   - Place the Communication Manager Board (CM/PM) 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, UCERD RF Signal is connected.
   - Verify the Heliax Cable outside the RFPen 1 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 RFPen 1 Cabinet front cover.

1–12 SYSTEM WITH RFPEN 2, RF/PDU, OR SRF CABINET – RESTORATION CHECK LIST

1. Perform the following:
   - Verify the System is in Idle Mode (not pulsing).
   - Disconnect all scope probes.
   - Remove test hardware.
   - Remove the Spectroscopy TR Module and associated hardware (if not continuing on).
   - Verify the Coaxial Cable outside the System Cabinet at MR2A11J1, UCERD RF Signal is connected.
   - Verify the Heliax Cable outside the RFPen 2 Cabinet at MR1A7J45, MNS RF Out + Bias is connected.
   - Verify the Heliax Cable outside the MNS Cabinet at MNS RF OUT, MNS RF Out + Bias is connected.
   - 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.
   - Replace any covers, shields, or screws removed.
   - Close the SSM cover and tighten screws.
   - Slide the SSM in place and replace screws.
   - Replace the RFPen 2, RF/PDU, SRF Cabinet front cover.
   - Replace the MNS Cabinet front cover.

1–13 RF OUTPUT POWER RECALIBRATION OF RF/PDU AND SRF CABINETS AFTER INSTALLATION

Since a new cable is added at J14 of the RFI during the MN Spectroscopy installation and the introduction of this cable into the circuit will result in a loss of signal to the RFI, it is necessary at this point to readjust the phase and gain of the RFI. Please perform the RF calibration procedure described in either the *1.5T RF/PDU Max RF Power Out Setup and Calibration* document (RC3SCA1.DOC) or *1.5T SRF Max RF Power Out Setup and Calibration* document (RC5SCA1.DOC) located on the 8.X Service Methods CDROM.

FUNCTIONAL CHECKS

TABLE OF CONTENTS

SECTION 1 – 1.5T ^{31}P FUNCTIONAL TESTS

1–1 DESCRIPTION

Description Perform the ^{31}P Functional SNR Test. The Functional Test includes a visual inspection of the coil (and associated cable), hardware set–up, a proton localizer scan, the ^{31}P scan, and analysis to calculate the signal-to-noise ratio, and a Phosphorus System Noise Floor Check.

Background

The 1.5T Phosphorus (^{31}P) Transmit/Receive Flex Coil should never be used if any metallic components of the coil are visible or exposed when the coil is bent or flexed. Inspect the foam covering (before and after each use) for cracks or breaks. Always inspect the coil cable, particularly where the cable connects to the main body of the coil. Inspect the foam covering (before and after each use) for foreign fluids or residue. **GE service engineers should repair or replace all defective hardware.**

Use the straps provided to secure the coil and phantom for these tests. Phosphorus spectra are acquired from a MRS Phantom (MR Spectroscopy).

The basic imaging system must be verified to be operating properly (System Health must pass). Then the Multi–Nuclear Spectroscopy specific hardware can be tested.

A proton localizer scan is performed. The Auto–Prescan portion of the proton localizer scan must complete successfully before continuing to the ^{31}P tests. The ^{31}P SNR Spectro Prescan may require minor adjustment to the shim. The user should utilize the zoom tool and verify that only one peak is present before scanning.

The data obtained during the Phosphorus Signal–to-Noise Test Scan is transferred to SAGE Version 7.0 and pre–processed. The SNR is obtained from the pre–processed data using the *secsi_snr* tool. Record the SNR values on the Functional Test Data Sheet which can be used as a system performance baseline for future reference.

The Phosphorus System Noise Floor Check will enable the user to isolate a noisy 20 dB Gain Block and verify if the site meets acceptable noise specifications. The results of this noise test may be effected by future hardware / software system changes.

1–2 INITIAL CONDITIONS

- Magnet has been shimmed and acceptance specifications met.
- Grafidy has been run and acceptance specifications met.
- 1.5T Signa Release 8.X software (8.3 or later) fully operational.
- Full pass of SPT has been performed and acceptance specifications met.
- PROBE SNR tests have been performed and acceptance specifications met.
- System Health Tests must pass (possibly excluding the EPI portion).
- All related MNSpectroscopy Option Key (8.X) installed/activated.
- Configuration file entries (BB Transciever and MNSpectro RF Amplifier to yes) have been set.
- 1.5T Signa Multi–Nuclear Spectroscopy ^{31}P hardware is fully calibrated and operational.

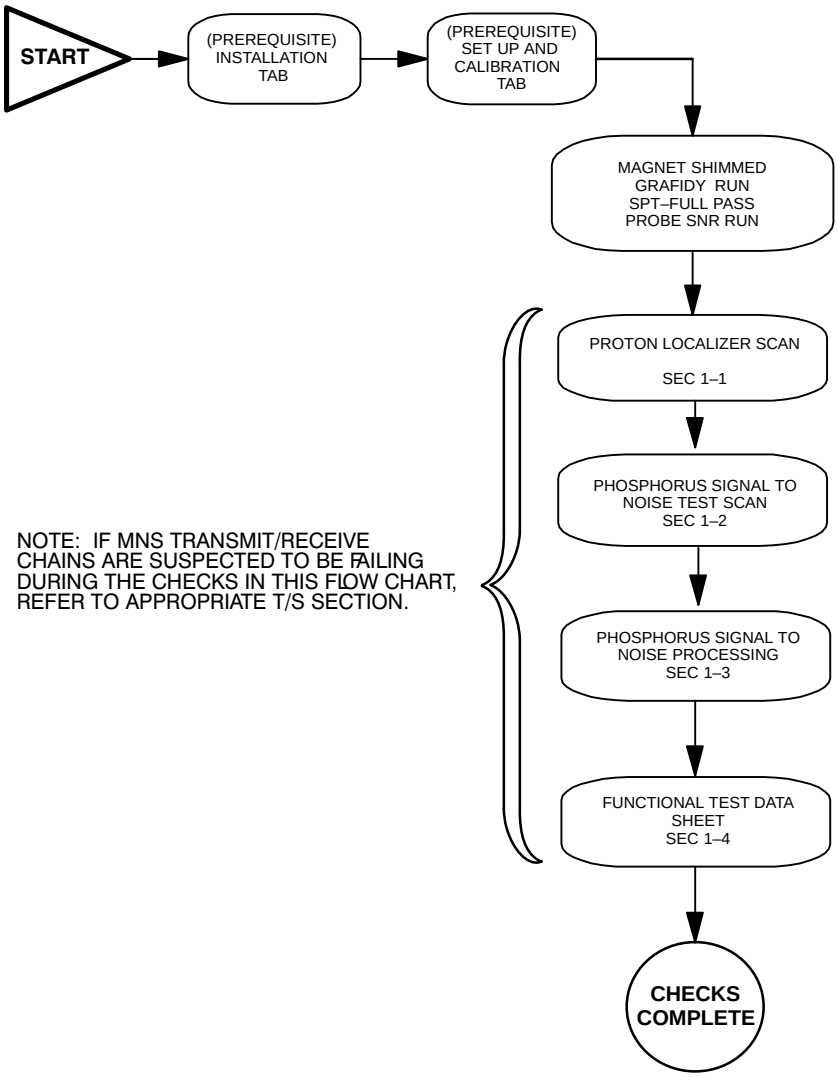
1–3 TOOLS REQUIRED

Description	Part Number	Qty.
1.5T (^{31}P) Phosphorus Transmit/Receive Flex Coil	2219090	1
1.5T MNS ^{31}P Flex Coil Quick Disconnect Adaptor Box	46–282468G4	1
Short Wrap (not shown)	2248047	1
MRS Phantom (MR Spectroscopy) — MSDS # 8365823 (not shown)	2152220	1
Phosphorus Spectroscopy TR Module	2100718 or 46–264762G1	1

(^{31}P) Phosphorus Transmit/Receive Flex Coil, MNS Q.D. BOX, and (^{31}P) Spectroscopy TR Module
ILLUSTRATION 1–1

1–4 FLOW CHART

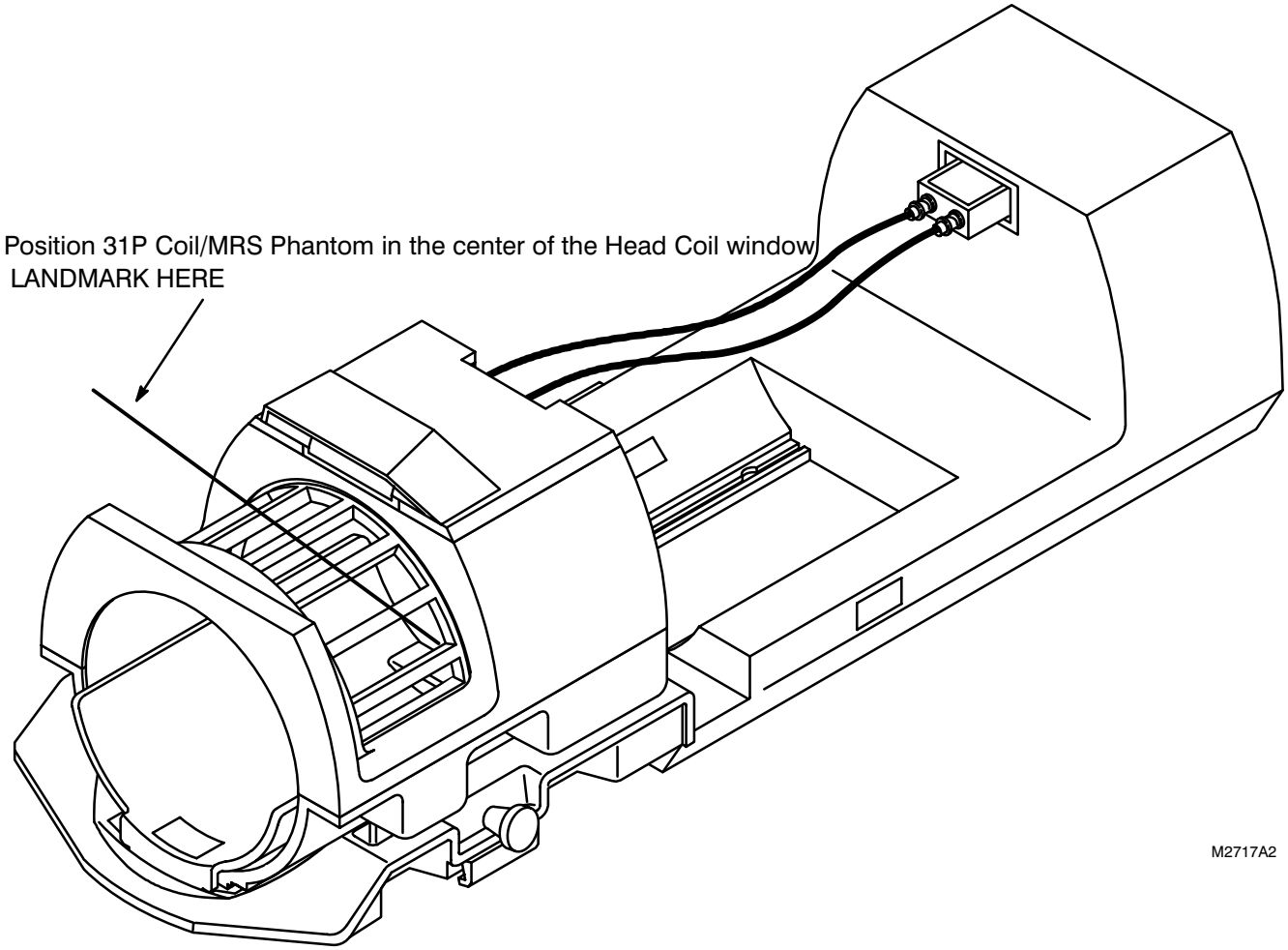
The flow chart in Illustration 1–2 shows sequence for Functional Checks of the (MNS) Multi–Nuclear Spectroscopy Subsystem. Sections and tabs referred to in this chart are contained in this Direction unless otherwise left empty. Note that Narrowband system performance checks must be performed and acceptance specifications must be verified. All Narrowband system performance problems must be resolved before Multi–Nuclear (MNS) Spectroscopy functional checks are performed.



MULTI–NUCLEAR SPECTROSCOPY FUNCTION CHECK FLOW CHART
ILLUSTRATION 1–2

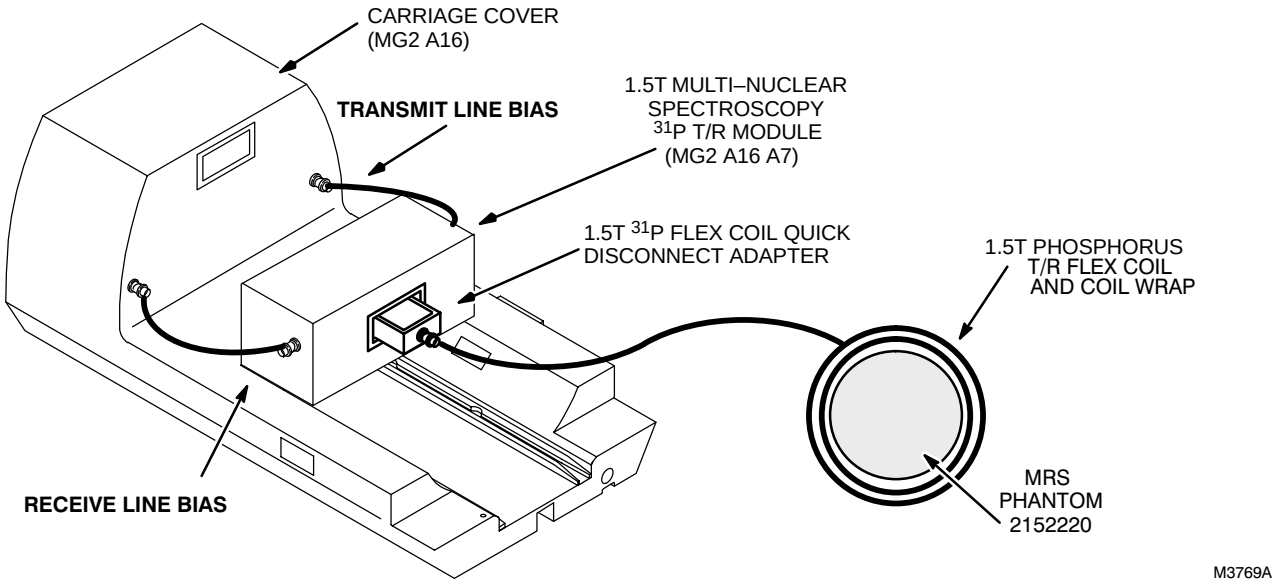
1–5 PROTON LOCALIZER SCAN

1. Place the Head Coil in the bore on the cradle. Connect the Head Coil Quick Disconnect Adaptor Box per normal operation. Refer to Illustration 1–3.



HEAD COIL PLACEMENT (HIGH PROFILE CARRAIGE COVER SHOWN)
ILLUSTRATION 1–3

1–5 PROTON LOCALIZER SCAN (Continued)



SET UP FOR FUNCTIONAL TEST SCAN –– IN HEAD COIL (NOT SHOWN)
ILLUSTRATION 1–4

2. Position 1.5T Phosphorus Spectroscopy TR Module (MG2A16A7) on Carriage Cover (MG2A16) as shown in Illustration 1–4.
3. Verify the two (2) Lemo Cables (Receive Line and Transmit Line) are connected as shown in Illustration 1–4.
4. Procure the MRS Phantom (2152220). Tightly wrap the 1.5T Phosphorus T/R Flex Coil around the MRS Phantom using the Short Coil Wrap. Center the MRS Phantom in the 1.5T ^{31}P T/R Flex Coil.
5. Verify the 1.5T ^{31}P T/R Flex Coil and 1.5T MNS ^{31}P Flex Coil Q. D. Adaptor Box are connected as shown in Illustration 1–4. DO NOT USE the extender Cable for Head Applications (looping is unacceptable).
6. Place the 1.5T ^{31}P T/R Flex Coil and MRS Phantom inside the Head Coil. Position for landmarking per Illustration 1–3. Connect 1.5T ^{31}P Flex Coil Q. D. Adaptor Box to the ^{31}P Spectroscopy TR Module.

CAUTION

Do not leave the Spectroscopy TR Module installed (connected / disconnected) during non–spectroscopy scanning. The Spectroscopy TR Module will be installed during Proton localizer and Functional Test scans per this document using the 1.5T MNS ^{31}P T/R Flex Coil and 1.5T MNS ^{31}P Flex Coil 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.

1–5 PROTON LOCALIZER SCAN (Continued)

7. Refer to Table 1–1. Set–up the Proton Localizer Head scan prescription.

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. **[Landmark]** on the center of the MRS Phantom (in the 1.5T ^{31}P T/R Flex Coil) positioned in center of the Head Coil window opening per Illustration 1–3. Pad as required (A/P=0, R/L=0).
9. Select **[Advance to Scan]**.
10. Acquire the localizer image according to the scan prescription given in Table 1–1. Use the cross–hair function to verify phantom placement is at isocenter (A/P at 0, R/L at 0, S/I at 0).

CAUTION

Look at the front of the ENI Amplifier in the RF/PEN or MNS Cabinet. If the Gating Button LED is continuously ON, press button to toggle LED OFF. This LED should only light when RF pulses (coincident with unblank) 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.

CAUTION

Look at the front of the ANALOGIC Amplifier in the RF/PEN or MNS Cabinet. If the Power LED and Ready LED are not illuminated the system is not ready to scan. This Unblank LED should only light when RF pulses (coincident with unblank) occur during scanning. Do Not pulse the MNS system unless the Power and Ready LED's are ON, otherwise, damage to the MNS hardware may occur.

1–5 PROTON LOCALIZER SCAN (Continued)

NOTE

At the Workstation Monitor click on the magnet scanner icon.
The ENTER key may need to be selected after directly entering a value when setting up protocols.
Otherwise, the Accept button may be selected within the sub–menu box.
(Sub–menu boxes are indicated with a ...).

NOTE

It is acceptable to use the **Service protocol** O.58–31P Setup and Cal Series 1 localizer.

TABLE 1–1
8.X PROTON LOCALIZER SCAN PROTOCOL (OR USE SERVICE PROTOCOL)

SCAN PROTOCOL (8.3)

RX MANAGER

[End Exam] CONFIRM
Enter the following or select the Service protocol.

NEW PATIENT

[PATIENT INFO]

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

PATIENT POSITION — PLEASE Landmark

Patient Position	**Supine**
Patient Entry	**Head First**
Landmark	**Nasion**
Coil—Coil Type	**Head Accept**

IMAGING PARAMETERS

	Plane	**Axial**
	Mode	**2D**
Pulse Seq	P. Seq.	**SPGR Accept**
Imaging Opt	Im. Op.	**NONE Accept**
	PSD Name	none

SCAN TIMING

# of Echoes	**1**
TE	**Min Full**
TR	**18**
Flip Angle	**20**
Bandwidth	**31.25**

ACQUISITION TIMING

Freq	**256**
Phase	**160**
NEX	**1.00**
Phase FOV	1.00
Freq DIR	**A/P**
Auto CF	Water
Autoshim	**[Select]**

SCANNING RANGE

FOV	**24**
Slice Thickness	**20**
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]
[Scan]
[RESEARCH OPERATIONS]
[Setup Params]
Record:
R1:_____ R2:_____ TG:_____ AX:_____
Gradient Shim Values:
X:_____ Y:_____ Z:_____
[DONE]

1–6 PHOSPHORUS SIGNAL TO NOISE TEST SCAN

1. Setup the scan prescription per Table 1–2.

NOTE

Do not select Auto Prescan or Manual Prescan during MNSpectro scanning. This will result in a false (low) signal display. If APS or MPS is accidentally selected re–prescibe the Proton Localizer to correct the problem.

It is acceptable to use the **Service protocol** O.58–31P Setup and Cal Series 2. Verify all selections are correct. The Display CV dda=10 must always be entered.

TABLE 1–2
8.X PHOSPHORUS SIGNAL TO NOISE TEST SCAN PROTOCOL

RX MANAGER

[New Series]
Enter the following or select the Service protocol.

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 **Extended Dynamic Range [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

NEX **[2.00]**
Freq DIR **[R/L]**
Auto CF **[Water]**
Autoshim **[OFF]**

SCANNING RANGE

FOV **[24]**
Slice Thickness **[20.0]**
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:
may need to select <enter> after the entries are made.
CV Name: **dda**
Current Value: **10**
[Accept]

[RESEARCH OPERATIONS]
DOWNLOAD

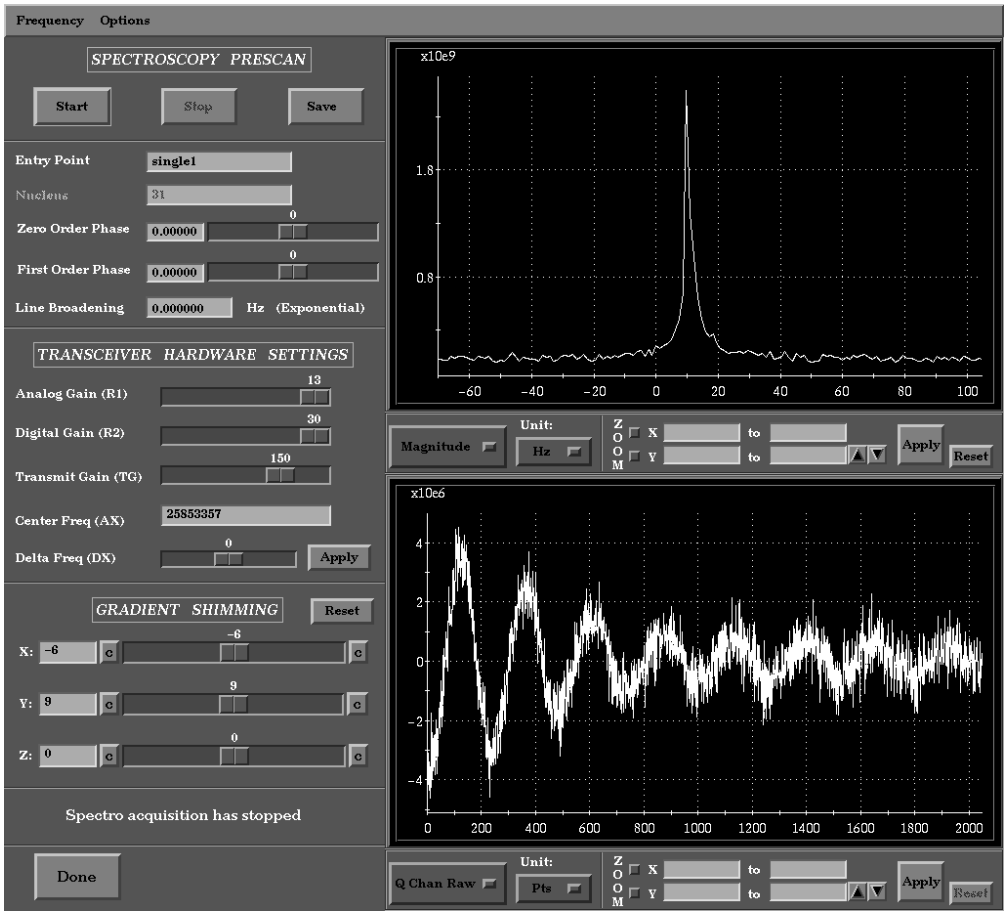
[Spectro Prescan]
Entry Point: **single1**
Nucleus: **31**
R1 **13**
R2 **30**
TG **0**
AX Default
Top Screen **[Magnitude] [Hz]**
Bottom Screen **[Q Chan Raw] [Pts]**
[Start]
Adjust TG to 20, 40, 80, 100, 120, 140, **150**

Refer to the 2 displays and instructions provided to check the quality of the spectral data. Verify that the shim (free induction decay waveform) oscillates and decreases smoothly on the bottom screen. Verify a single peak is present in the top screen by utilizing the horizontal zoom function. Adjust shim as required per instructions.

[Stop]
[Done]
[Scan]

1–6 PHOSPHORUS SIGNAL TO NOISE TEST SCAN (Continued)

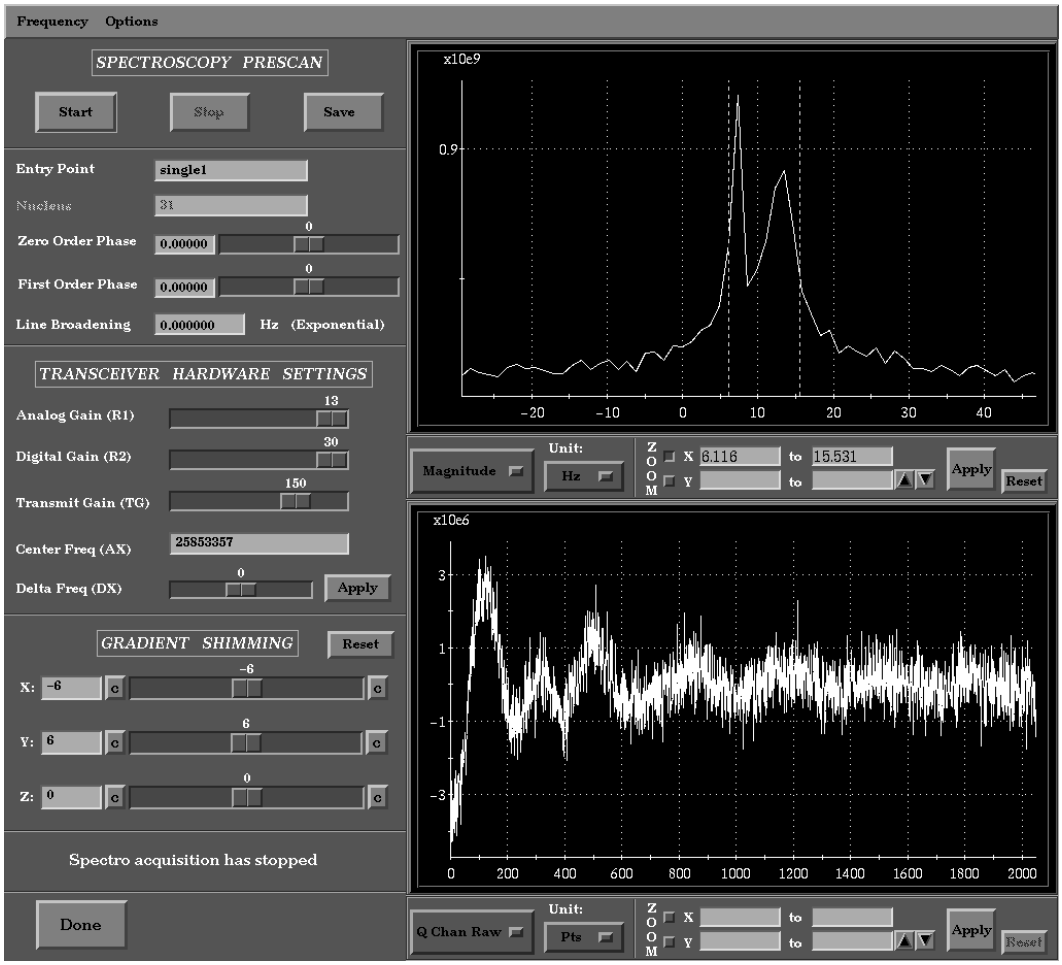
2. After selecting **[Start]**.
   Verify the Top Screen is set to **[Magnitude] [Hz]**
   Verify the Bottom Screen is set to [**Q Chan Raw] [Pts]**
3. Verify TG is set at 150.
4. Use the two displays on the Spectroscopy Screen to check the quality of the spectral data. The free induction decay waveform displayed on the bottom screen, “Q Channel Raw,” should oscillate and decrease smoothly. A single peak should be displayed on the top screen, “Magnitude.” The single peak should smoothly increase and decrease with no distortion at the top of the peak and a minimum of distortion around the bottom of the peak. The goal is a single narrow, undistorted peak with maximum intensity. Typical Magnitude and Q Channel Raw displays from the phosphorus phantom are shown below.



INITIAL PHOSPHORUS SPECTROSCOPY SCREEN
ILLUSTRATION 1–5

1–6 PHOSPHORUS SIGNAL TO NOISE TEST SCAN (Continued)

5. Screen Adjustments: Examine the peak on the Magnitude display more closely, locate the X Zoom control on the control panel just below the center of the top display screen, and click on the [X] button. Use the mouse to select and drag the left and right cursors that appear on the screen to define a “zoom” region around the peak. Select [Apply] to zoom to the selected region. Repeat this process as necessary to obtain a clear view of the peak. An example of a zoomed peak with distortion is shown below. A distorted peak may affect the results of the SNR test.



DUAL PEAK – POOR SHIM
ILLUSTRATION 1–6

1–6 PHOSPHORUS SIGNAL TO NOISE TEST SCAN (Continued)

6. If the peak is distorted or split in the zoomed view, it may be possible to eliminate or decrease the distortion by manually adjusting the gradient shim settings. Start with the X Shim value; use the mouse to increase the X Shim value by one (1) unit (*for example if the original value is 15, increase to 16*). View the peak in the Magnitude display screen. There are three possible effects of the change in a shim value: 1 – the peak shape and intensity remain unchanged; 2 – the peak shape improves and the peak intensity increases; or 3 – the peak distortion increases and the peak intensity decreases. Obviously, you want to improve the shape and intensity of the peak (maximize the height of the peak by checking the numeric values at the left of the screen). Make the peak as narrow as possible. Your next step depends on which of the three effects that you see:

    - If the peak shape improves, increase the X Shim value by one (1) unit (*in the example from 16 to 17*) and repeat the examination of the peak shape.
    - If there is no change OR if the peak distortion increases, change the X Shim value to one (1) unit less than the original value (*in the example from 16 to 14*) and repeat the examination of the peak shape.

The idea is to improve the peak shape and peak intensity. Change the X Shim value to improve the peak shape, or leave the X Shim value unchanged if any change leaves the peak shape unchanged or increases the distortion. Once the X Shim value has been checked, change the Y Shim value in the same manner, and then change the Z Shim. If the one (1) unit changes have no effect on the peak shape, stop. If you have improved the peak shape repeat these steps starting with the X Shim again until any further changes have no effect or increase the distortion of the peak.

7.Select **[Stop]** and **[Done]**.

8.Select **[Scan]**.

1–7 PHOSPHORUS SIGNAL TO NOISE PROCESSING–MANUAL OR QUICK SCRIPT METHOD

Pre–8.3 sites will need to perform the Manual (8.2 clinical version) Script Method. Sites with Release 8.3 or greater may use the Quick Script Method or the 8.3 Software (or greater) Manual Method.

1–7–1 PHOSPHORUS SIGNAL TO NOISE PROCESSING–QUICK SCRIPT METHOD

1. Select the **[Tools]** icon. If analysis is ongoing begin at step 3 with sage entry.
2. Select the **[CShell...]** and move the mouse to the open CShell window.
3. Type in: **sage<Enter>**

***SAGE* WINDOW**

4. Select:
   [File] [Load] [Raw Data]

***RAW LOAD* WINDOW**

5. Select **[Update List]**
6. Select/Highlight the most recent raw–file (P#####.7)
7. Record the raw–file number in space provided at step 15 in this section: P_____ .7
8. Select **[Load]**
   The data will load and the *Active Dataset* window will appear.
   Move this window over to the top right–most portion of the screen.
9. Select **[Dismiss]** at the Raw Load Window.

***SAGE* WINDOW**

10. Select:
    [Macros] [Func Tests] [1.5T 31P SNR]

***CShell Winterm* WINDOW**

11. Record the 1.5T ^{31}P SNR results:

AT THE *SAGE* WINDOW

12. If not continuing with other SNR testing then exit sage by selecting:
    [File] [Exit SAGE]

***CONFIRM* WINDOW**

13. Select:
    [Exit] to confirm exit from SAGE.

1–7–2 PHOSPHORUS SNR PROCESSING–8.2 SOFTWARE MANUAL SCRIPT METHOD

This 6 to 7 minute procedure (8.2 clinical version) will determine the signal to noise levels during a Multi–Nuclear Spectroscopy scan. One scan was completed. Data from the scan will be loaded into SAGE and pre–processed. The pre–processed data will be analyzed using the SNR tool (secsi_snr) to find the signal to noise ratio.
During this process it is acceptable to move the pop up windows as required.

1. Select the **[Tools]** icon. If analysis is ongoing begin at step 3 with sage entry.
2. Move the mouse to the background (brick area) screen and select:
   [Root Menu] [Service Tools] [Command Window]
3. Type in:
   source /usr/g/spectro/rsi/idl_5.1/bin/idl_setup<Enter>
   sage<Enter>

***SAGE VERSION 7.0* WINDOW**

4. Select:
   [File] [Load] [Raw Data]

***RAW LOAD* WINDOW**

5. Select **[Update List]**
6. Select/Highlight the most recent raw–file (P#####.7)
7. Record the raw–file number in space provided at step 15 in this section: P_____ .7
8. Select **[Load]**
   The data will load and the *Active Dataset* window will appear.
   Move this window over to the top right–most portion of the screen.

***SAGE VERSION 7.0* WINDOW**

9. Select:
   [Processing] [Spectral Apodize ...]
   Utilize [Delete] at the keyboard to remove the current LB entry. Change this from 1.2500 Hz to 3 Hz.
   [Delete] (as necessary) **3<enter>**
   [Dismiss]

***SAGE VERSION 7.0* WINDOW**

10. Select:
    [Recons] [Spectrum ...]

1–7–2 PHOSPHORUS SIGNAL TO NOISE PROCESSING–MANUAL SCRIPT METHOD (Continued)

***SPECTRUM RECONSTRUCTION* WINDOW**

11. Verify the Spectrum Reconstruction window now has the following selections:
    Apodize: Yes
    Function: Gaussian
    Echo Offset: 0%
    LB: 3.0000 Hz (Verify this value is now correct)
    ZEROFILL*: Yes
    Zerofill: 1 times
    Place Zeros: Right
12. Select:
    [Reconstruct]

NOTE

Verify the *Active Dataset* window data changes from a FID looking waveform to a spectrum–like waveform.

***SAGE VERSION 7.0* WINDOW**

13. Select:
    [Processing] [Phase ...]

***PHASING* WINDOW**

14. In the **Zero Order Auto Phase panel** select:
    In the Auto Application area click on upper left corner of the “selection box” and select **[Global]**
    In the Auto Method area click on upper left corner of the “selection box” and select **[Simplex]**
    select **[Auto Phase]**

NOTE

The peak displayed will point up–wards.

[Dismiss] the *Phasing* window.

AT THE *SAGE VERSION 7.0* WINDOW

15. Select:
    [File] [Save] [Data ...]

1−7−2 PHOSPHORUS SIGNAL TO NOISE PROCESSING−MANUAL SCRIPT METHOD (Continued)

***LOAD/SAVE* WINDOW**

16. Record the following information:

		site specific information:
Site: _____	**Example:**	**Site: bay3a**
Study: _____		**Study: 50886**
Series: _____		**Series: 2**
File: P_____ .7_pro		**File: P03584.7_pro**

17. Select:
[Save Data]
[Dismiss] the *Load/Save* window.

***SAGE VERSION 7.0* WINDOW**

18. Select:
[File] [Exit SAGE]

***CONFIRM* WINDOW**

19. Select:
[Exit] to confirm exit from SAGE.

***COMMAND* WINDOW (labeled Terminal)**

20. Refer to the recorded information for your system.
Type the following:

```
cd /usr/g/spectro/sage/func_test<enter>
idl -rt=secsi_snr.sav<enter>
```

AT THE PROMPT

NOTE

Refer to the recorded information from the Load/Save window in step 16. **[Site, Study, Series, File] Replace the bolded site specific information with actual site information.**

21. `Enter Transformed Data Filename:` Type in the following:
`/usr/g/spectro/data/` **`bay3a`**`/geservice/` **`50886/2/P03584.7`**`_pro.sdf` **<enter>**

1–7–3 PHOSPHORUS SIGNAL TO NOISE PROCESSING–8.3 SOFTWARE MANUAL SCRIPT METHOD

This 6 to 7 minute procedure (8.3 software or greater) will determine the signal to noise levels during a Multi–Nuclear Spectroscopy scan. One scan was completed. Data from the scan will be loaded into SAGE and pre–processed. The pre–processed data will be analyzed using the SNR tool (secsi_snr) to find the signal to noise ratio.
During this process it is acceptable to move the pop up windows as required.

1. Select the **[Tools]** icon. If analysis is ongoing begin at step 3 with sage entry.
2. Select the **[CShell...]** and move the mouse to the open CShell window.
3. Type in: **sage<Enter>**

***SAGE* WINDOW**

4. Select:**[File] [Load] [Raw Data]**

***RAW LOAD* WINDOW**

5. Select: **[Update List]**
6. Select/Highlight the most recent raw–file (P#####.7)
7. Record the raw–file number in space provided at step 15 in this section: P_____ .7
8. Select: **[Load]**
   The data will load and the *Active Dataset* window will appear.
   Move this window over to the top right–most portion of the screen.

***SAGE* WINDOW**

9. Select: **[Processing] [Spectral Apodize ...]**
   Utilize [Delete] at the keyboard to remove the current LB entry. Change this from 1.2500 Hz to 3 Hz.
   [Delete] (as necessary) **3<enter>**

***SAGE* WINDOW**

10. Select: **[Recons] [Spectrum ...]**
    [Dismiss]

***SPECTRUM RECONSTRUCTION* WINDOW**

11. Verify the Spectrum Reconstruction window now has the following selections:
    Apodize: Yes
    Function: Gaussian
    Echo Offset: 0%
    LB: 3.0000 Hz (Verify this value is now correct)
    ZEROFILL*: Yes
    Zerofill: 1 times
    Place Zeros: Right
12. Select: **[Reconstruct]**

NOTE

Verify the *Active Dataset* window data changes from a FID looking waveform to a spectrum–like waveform.

1−7−3 PHOSPHORUS SIGNAL TO NOISE PROCESSING−8.3 SOFTWARE MANUAL SCRIPT METHOD (Continued)

***SAGE VERSION 7.0* WINDOW**

13. Select: **[Processing] [Phase ...]**

***PHASING* WINDOW**

14. In the **Zero Order Auto Phase panel** select:
    In the Auto Application area click on upper left corner of the “selection box” and select **[Global]**
    In the Auto Method area click on upper left corner of the “selection box” and select **[Simplex]**
    select **[Auto Phase]**

NOTE

The peak displayed will point up−wards.

[Dismiss] the *Phasing* window.

***SAGE VERSION 7.0* WINDOW**

15. Select:
    [File] [Save] [Data ...]

***LOAD/SAVE* WINDOW**

16. Record the following information:

		site specific information:
Site: _____	**Example:**	**Site: bay3a**
Study: _____		**Study: 50886**
Series: _____		**Series: 2**
File: P_____ .7_pro		**File: P03584.7_pro**

17. Select:
    [Save Data]
    [Dismiss] the *Load/Save* window.

***SAGE* WINDOW**

18. Select:
    [Macros] [Func Tests] [1.5T 31P SNR]

***CShell Winterm* WINDOW**

19. Record the 1.5T ^{31}P SNR results:

AT THE *SAGE* WINDOW

20. If not continuing with other SNR testing then exit sage by selecting:
    [File] [Exit SAGE]

***CONFIRM* WINDOW**

21. Select:
    [Exit] to confirm exit from SAGE.

1–8 FUNCTIONAL TEST DATA SHEET

The SNR value using the 1.5T ^{31}P T/R Flex Coil should be at least TBD for n=1, and at least TBD for n=64. Record SNR results below. It is recommended that Spectroscopy related SNR tests are performed at least 3 times to get a good system performance average.

NOTE

The results of the ^{31}P SNR tests will vary from run to run (by approxiamately 30 counts as referenced to the first specification listed). It is advisable to save all of the results of the ^{31}P SNR test for future reference.

Coil Type: **1.5T ^{31}P TR FLEX COIL**	Coil S/N: _____ Date of Test: _____ Study/Series/Image: _____ P#: **P** _____ **.7_pro.sdf** **TEST:** In the Head Coil, No Extender Cable—pad up to center—run localizer.					
n#	**Area** **~5.e+06**	**Amp** **~1.0e+06**	**Noise**	**AreaSNR**	**AmpSNR**	**AmpSNR (preliminary spec.)**
1						**≥ 130**
2						**≥ 184**
4						**≥ 260**
8						**≥ 368**
16						**≥ 520**
32						**≥ 736**
64						**≥ 1040**

1–9 SHORT FUNCTIONAL TEST – FOR TROUBLESHOOTING ONLY

1. Enter the ”User CVs Screen.
2. Change CV4 ”total # of scans” value to 4. Four is the lowest acceptable value which can be entered and be analyzed successfully. Scan time for troubleshooting is reduced to approximately 1 minute.

1–10 BODY FUNCTIONAL TEST – FOR TROUBLESHOOTING ONLY

1. Remove the Head Coil from the bore.
2. Connect the 1.5T ^{31}P T/R Flex Coil and Q.D. Adaptor Box to the Spectroscopy TR Module.
3. The MRS Phantom should be used with the short wrap. Pad up to isocenter as required.
4. Setup a Body proton Localizer scan protocol. Verify the phantom is properly centered. Select APS and Scan.
5. Immediately setup the **8.X PHOSPHORUS SIGNAL TO NOISE TEST SCAN PROTOCOL**. Do not select the APS Softkey.
6. **[Spectro Prescan]**. **[Start**]. Manual Shim as required. Verify only 1 peak is present. **[Stop]**. **[Scan]**.
7. Analyze the SNR results. If the Body Functional Test passes the SNR specification with significantly higher values than the SNR test run in the Head Coil the site may be experiencing some type of Head Coil interaction.

NOTE

The results of the ^{31}P SNR tests will vary from run to run (by approxiamately 30 counts as referenced to the first specification listed).

1–11 PHOSPHORUS SYSTEM NOISE FLOOR CHECK

Description The Phosphorus Noise Floor Check Test is performed using the 1.5T ^{31}P T/R Flex Coil and Q.D. Adaptor Box connected to the Spectroscopy TR Module. The 1.5T ^{31}P T/R Flex Coil is positioned inside the Head Coil. No phantom or RF is used. The results of this noise test may be effected by future hardware / software system changes.

- RF Output switch on the front of the System Cabinet UCERD is moved from RF Out Normal to RF Out Disable.
- 1.5T ^{31}P T/R Flex Coil and Q.D. Adaptor Box connected to the Spectroscopy TR Module. The 1.5T ^{31}P T/R Flex Coil is positioned inside the Head Coil. Landmark on center of coils.

1. Disable the RF Out on the UCERD front panel.
2. Remove all phantoms from the patient table. This is an empty bore test.
3. Connect the 1.5T ^{31}P T/R Flex Coil and Q.D. Adaptor Box to the Spectroscopy TR Module.
4. Position the 1.5T ^{31}P T/R Flex Coil inside the Head Coil.
5. Landmark on the center of both coils, then press Move to Scan.
6. At the operator work space, prepare the system for a Phophorus Noise Floor scan. Setup the scan prescription per Table 1–3.

1–11 PHOSPHORUS SYSTEM NOISE FLOOR CHECK (Continued)

TABLE 1–3
8.X PHOSPHORUS NOISE FLOOR CHECK PROTOCOL

RX MANAGER

[New Series]
Enter the following:

PATIENT INFORMATION

	Patient ID:	geservice
	Patient Name:	31noise
	Patient Weight	111

PATIENT POSITION

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

IMAGING PARAMETERS

	Plane	Coronal
	Mode	**2D**
Pulse Seq	P. Seq	**Fid CSI (MRS) [Accept]**
Imaging Opt	Im Opt	**Extended Dynamic Range [Accept]**
	PSD Name	

ADDITIONAL PARAMETERS

USER CVs SCREEN

CV0	spectral width	**16000**
CV1	number of points	**2048**
CV2	nucleus	**31**
CV3	scan mode	**0.00**
CV4	total #of scans	**1.00**
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]**
CV16	CSI grid: (acq.)	**2.00 [Accept]**

SCAN TIMING

# of Echoes	**1**
TR	3**00**

ACQUISITION TIMING

Freq	**[256]**
Phase	**[192]**
NEX	**[1.00]**
Freq DIR	**[S/I]**
Auto Center Freq	**[Water]**
Select	**[Autoshim]**

SCANNING RANGE

FOV	**[24]**
Slice Thickness	**[10.0]**
Spacing	**[1.5]**
Start (A/P):	**0**
End (A/P):	**0**
# Slices:	1
S/I Center:	0
R/L Center:	0
Table Delta	0.00

[Save Series]

[Prepare to Scan]

[Research Operations] **[Download]**

[Spectro Prescan]

Entry Point:	**single1**
Nucleus:	**31**
R1	**13**
R2	**30**
TG	**0**
AX	Default
Top Screen	**[Magnitude] [Hz]**
Bottom Screen	**[Q Chan Raw] [Pts]**

[Start]
[Done]
[Scan]

Scan time is approximately 1 minute.
When scan is complete proceed to Analysis section.

1–12 PHOSPHORUS SYSTEM NOISE FLOOR IMAGE ANALYSIS

Description The Phosphorus Noise Floor Check Test is a preliminary test re–introduced with 8.3 Release software. It is performed using the 1.5T ^{31}P T/R Flex Coil and Q.D. Adaptor Box connected to the Spectroscopy TR Module. The 1.5T ^{31}P T/R Flex Coil is positioned inside the Head Coil. No phantom or RF is used. The results of this noise test may be effected by future hardware / software system changes.

1. Go to the Image Management Desk Top (looks like a terminal with images displayed).
2. Locate the **[Browser]** selection. Select by clicking on **[Browser]**.
3. Locate and select the proper Exam, Series, and Image.
4. After the Noise Floor Image has been selected, click on **[Viewer]**. The Noise Floor Image will pop up.
5. Locate the **[Measure]** selection. Select by clicking on **[Measure]**. Select the round cursor.
6. Create a round cursor to cover a ROI area between 30000 and 40000 mm^2.
   - To size the circle select the small box with the mouse and drag.
   - To position the circle select the circle with the mouse and drag to center the circle in the Noise Floor Image.
7. Record the ROI, mean value, and sd (standard deviation) value in Table 1–4.

TABLE 1–4
8.X PHOSPHORUS SYSTEM NOISE FLOOR DATA SHEET

ROI (mm$^{2)}$	ROI between 30000 and 40000 mm^2
mean	Mean Noise approximately ~ 40.7
sd	No specification. ~ 20.7

8. Proceed to next section or System Restoration.

1–12–1 Phosphorus System Noise Floor Check with 20 dB Gain Block Bypassed

1. At the Penetration Panel. bypass the 20 dB Gain Block.
2. Perform the Phosphorus System Noise Floor Check section.
3. Perform the Phosphorus System Noise Floor Image Analysis section, however, use Table 1–5.

TABLE 1–5
8.X PHOSPHORUS SYSTEM NOISE FLOOR DATA SHEET (BYPASS 20 dB GAIN BLOCK)

ROI ($mm^{2)}$	ROI between 30000 and 40000 mm^2
mean	Mean Noise approximately ~ 2.7
sd	No specification. ~ 1.4

4. If all the values pass then consider replacing the 20 dB Gain Block and running the test again.
5. Try the following, in order, if still not passing the noise floor test after bypassing the 20 dB Gain Block:
   - Swap the head heliax line and the MNS heliax line input and output connections at the rear of the System Cabinet and in the rear pedestal.
   - Swap the head receive cabling and the MNS receive cabling input and output connections at the rear of the System Cabinet and in the rear pedestal.
   - Verify and record the grafidy and shim calibration numbers.
   - Try swapping out the J109 cable that connects to the front of the UCERD.
   - Try swapping out the UCERD Exciter.
   - If the above actions have not yielded results then contact the OLC for support.
6. Proceed to System Restoration.

1–12–2 System Restoration

- RF Output switch on the front of the System Cabinet UCERD is moved from RF Out Disable to RF Out Normal.
- Remove hardware: 1.5T ^{31}P T/R Flex Coil, Q.D. Adaptor Box, Spectroscopy TR Module, and the Head Coil.

TROUBLESHOOTING

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TROUBLESHOOTING (CONTINUED)

TABLE OF CONTENTS

SECTION 1 – MNSPECTRO TR BIAS T/S––RFPen1 ONLY

1–1 INTRODUCTION ––– RF/PEN 1 Cabinet ONLY

Section 1 tests require the availability of the 1.5T MNSpectroscopy 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 RFPen 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 ~4.30 VDC in the Transmit Mode. This procedure checks the bias line voltages out to the ^{31}P TR Flex 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). This ~15 VDC should be present on the MNS Receive Line.

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 (Multi–Nuclear Spectro TR errors are ignored when a MNS scan protocol is not selected).

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 RFPen 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 RFPen 1 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

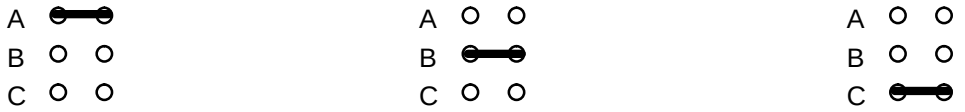
When JP87 is placed in Normal Mode A (Software Control Mode) a negative/positive TR bias is timed concurrently with the unblank/blank pulse. In the Software Control Mode the TR Bias outputs are dependent, therefore, on the presence and switching of the unblank/blank pulse. The TR Bias is then sent out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

CAUTION

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 – RFPen 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:

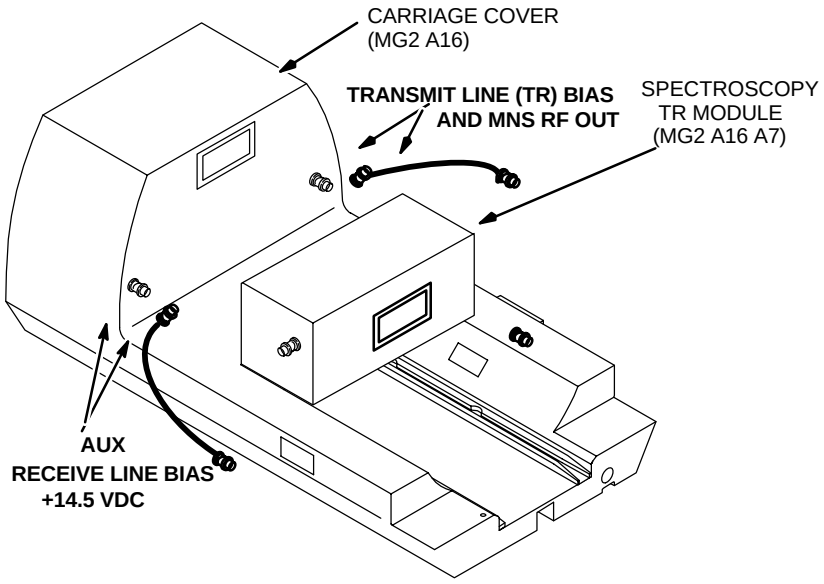
  MR1 A15 J407 (TR Bias to Spectro TR Switch) cable is disconnected.

  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.

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 – RFPen 1 CABINET ONLY (Continued)

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

SCAN PROTOCOL (8.3)

RX MANAGER

[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 **[OFF]**

SCANNING RANGE

FOV **[24]**
Slice Thickness **[20.0]**
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:
may need to select <enter> after the entries are made.
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]
Adjust TG to 20, 40, 80, 100, 120, 140, **150**

Verify Peak is present.

[Stop]
[Done]
[Scan]

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 – RFPen 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 – RFPen 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 **Section 1–5 System Reconfiguration – RF/PEN 1 Cabinet ONLY.**

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.

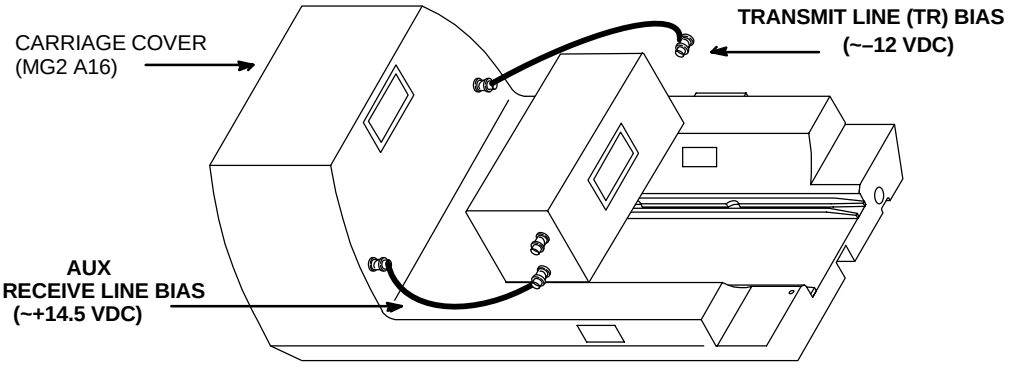
1. Verify the 2 (two) Lemo Cables (Receive Line and Transmit Line) are not connected to the Spectroscopy TR Module as shown in Illustration 1–2.
2. JP87 – **"Test Mode B"** (Receive Simulation Mode).
3. Connect cable on RFSC Module Rear Panel:

   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.
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.
   - 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).

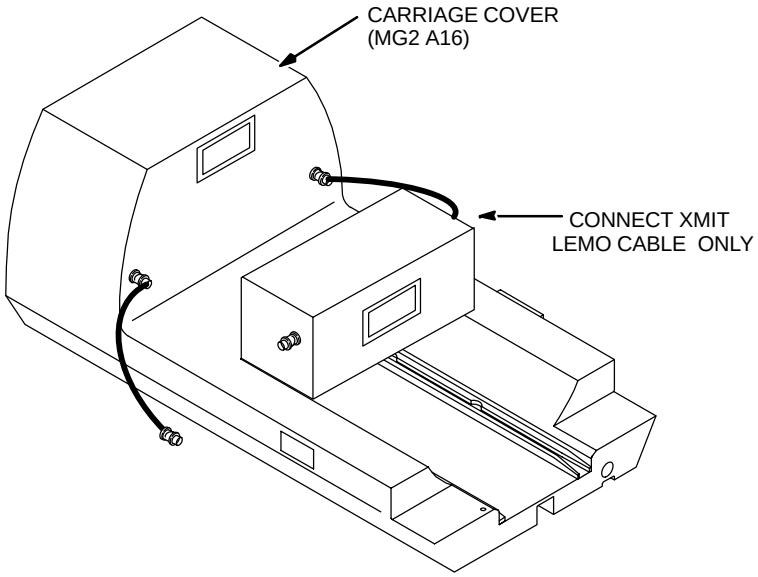
- JP87 – **"Test Mode B"** (Receive Simulation Mode).

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/ 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 **Section 1–5 System Reconfiguration – RF/ PEN 1 Cabinet ONLY.**

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.

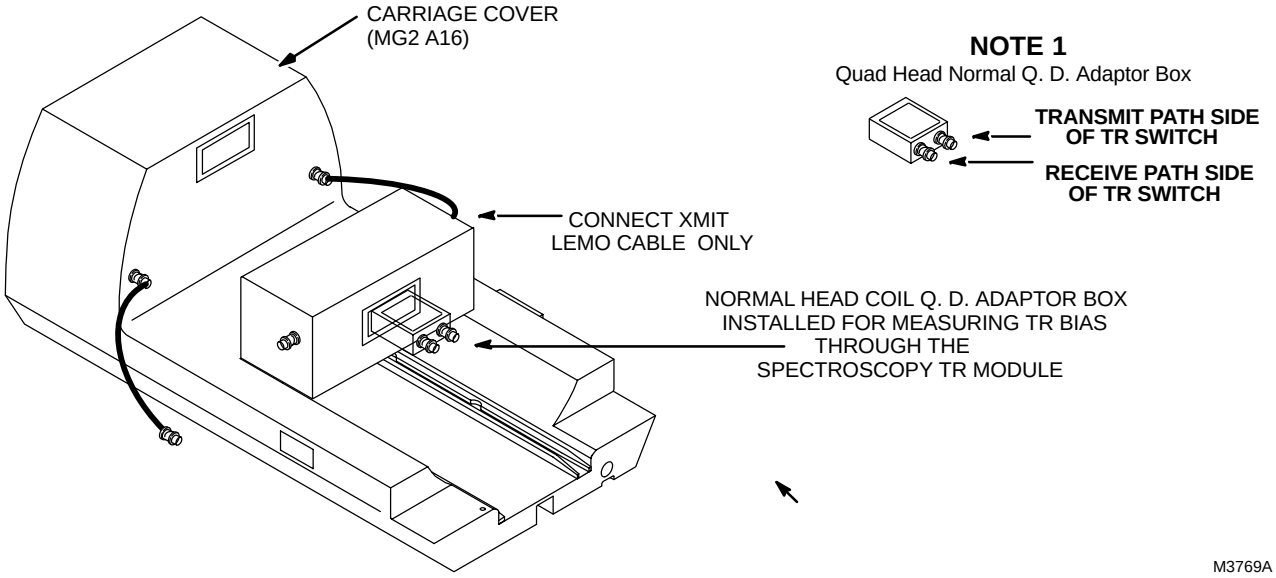
1. Connect cable on RFSC Module Rear Panel:

   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 **Section 1–5 System Reconfiguration – RF/ PEN 1 Cabinet ONLY.**

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 **Section 1–5 System Reconfiguration – RF/ PEN 1 Cabinet ONLY.**

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.

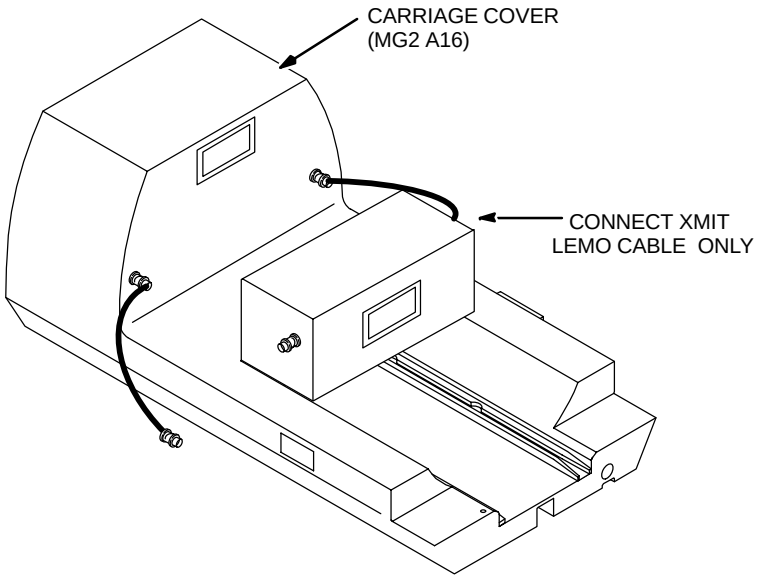
  MR1 A15 J408 (TR Bias to Body Hybrid) cable is disconnected.

  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.



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 ~4.30 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 **Section 1–5 System Reconfiguration – RF/ PEN 1 Cabinet ONLY.**

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 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:

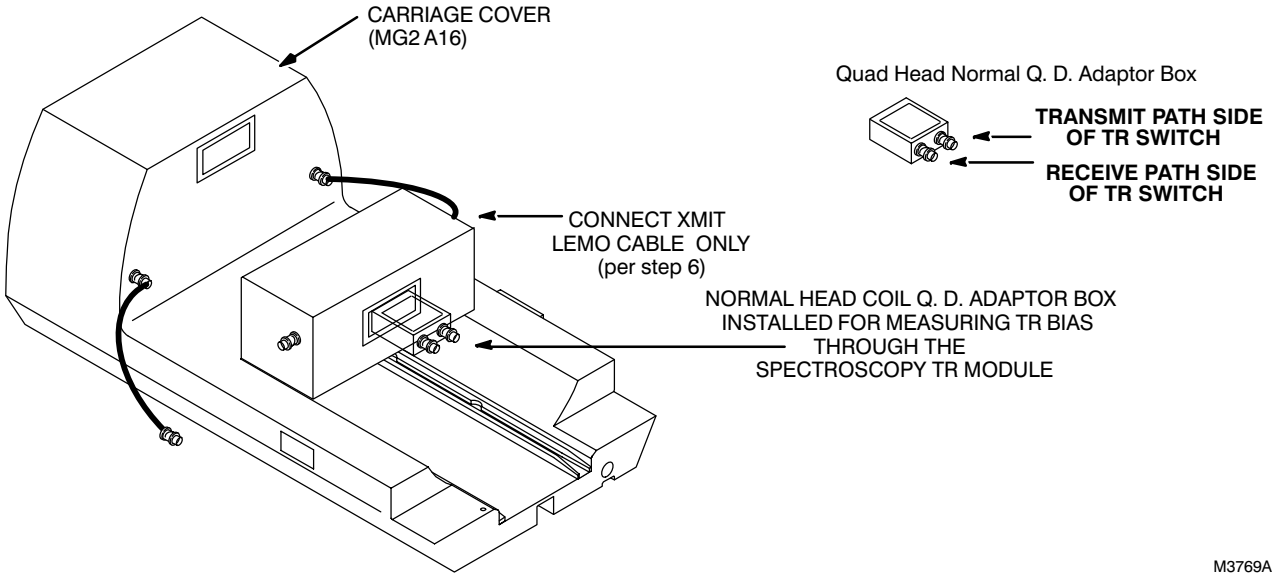
NOTE

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 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 HEAD NORMAL 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 Quad Head Normal 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 Quad Head Normal 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 **Section 1–5 System Reconfiguration – RF/ PEN 1 Cabinet ONLY.**

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

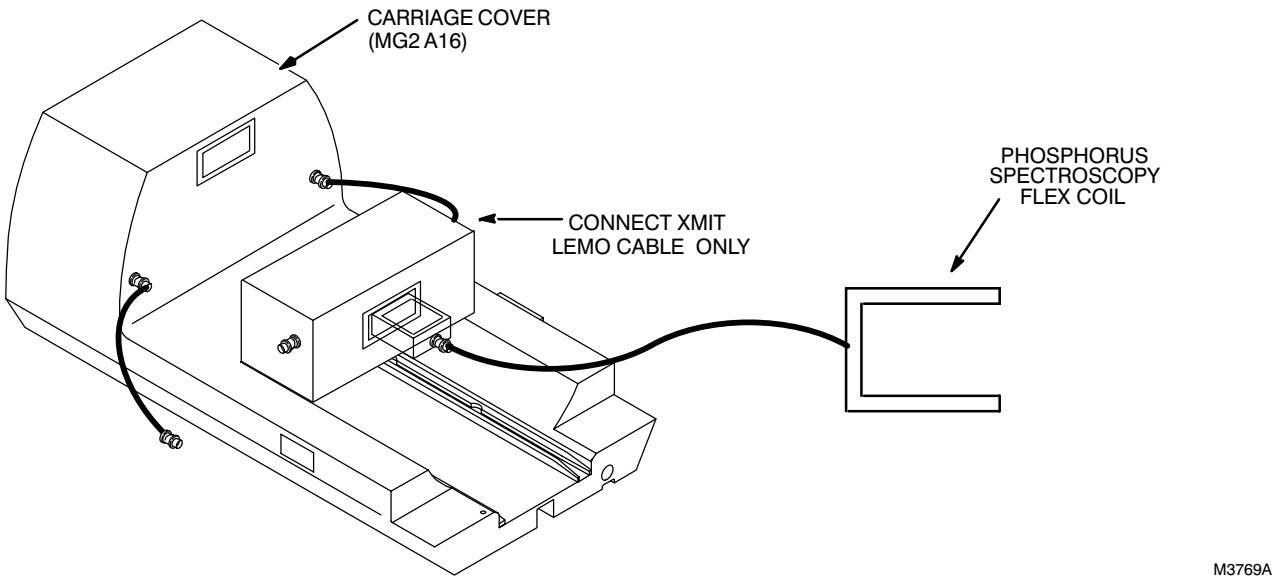
This Sub–Section will verify the Spectroscopy ^{31}P TR Flex Coil is not shorted at its input connection. An alternate method would be to use an ohmmeter across the Flex Coil's BNC Connector and measure a high impedance. This test does not completely verify the coil is good (for example it cannot check tuning).

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.
2. Connect cable on RFSC Module Rear Panel:

   MR1 A15 J407 (TR Bias to Spectro TR Switch) cable.
3. Use voltmeter to measure between TP18 and TP58 GND reference on the PIN Switch Driver Board:
4. Attach the (^{31}P) Phosphorus Multi–Nuclear Spectroscopy Flex Coil (using the Spectroscopy Flex Coil Quick Disconnect Adaptor Box) to the Spectroscopy TR Module.



XMIT LEMO CABLE CONNECTED AND MNS FLEX COIL Q.D. ADAPTOR BOX INSTALLED

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

5. 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 Flex 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 Flex Coil may be damaged. Verify the coil is not shorted by measuring a high impedance across the TR Flex Coil’s BNC cable connector (the coil has a capacitor at the input to block DC).

6. 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).
7. Proceed to the next section of this procedure —— **Section 1–5 System Reconfiguration – RF/PEN 1 Cabinet ONLY.**

1–5 SYSTEM RECONFIGURATION – RFPen 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 Flex 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

Tests located in the TROUBLESHOOTING TAB are performed when the normal Set–Up and Calibration procedure (dynamic testing) has failed. After completing this Tab the associated Set–Up and Calibration tests must be performed.

CAUTION

Do not leave the Spectroscopy TR Module installed (connected / disconnected) during prolonged periods of 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 Flex Coil and MNS Flex Coil 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 – MNSPECTRO MODULE ASSEMBLY CHECKS

2–1 INTRODUCTION

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

The Spectro Module Assembly (MR1A17) is used specifically for Multi–Nuclear Spectroscopy. It 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 used specifically for Multi–Nuclear Spectroscopy. It 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 specifically for Multi–Nuclear Spectroscopy. It 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.

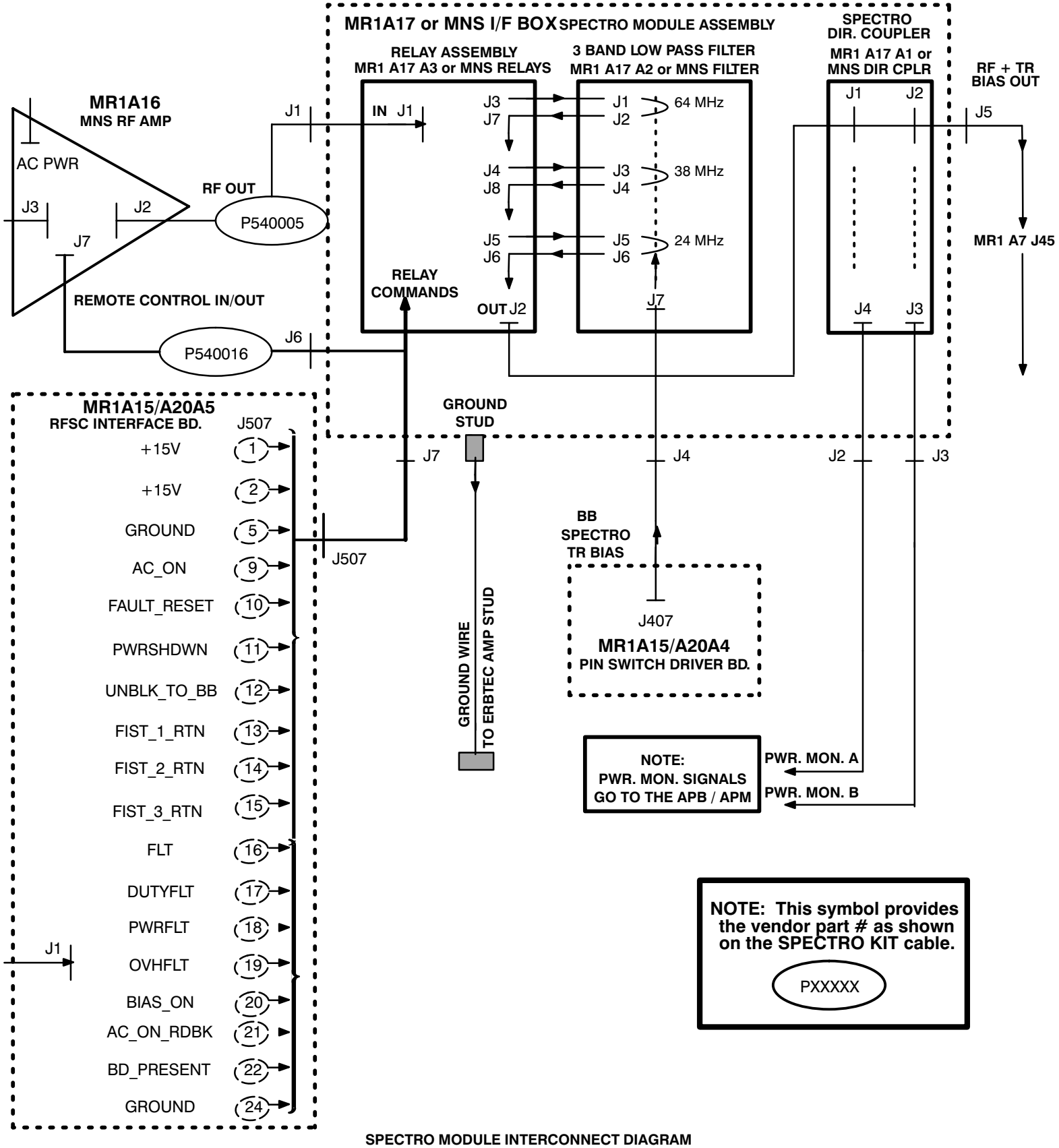
The second band (40 MHz) has input J3 and output J4. The loss within the pass–band (DC to 38 MHz) is $\leq$ 0.25 dB. The stop–band has a minimum attenuation of 40 dB for frequencies greater than 80 MHz.

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 is used specifically for Multi–Nuclear Spectroscopy. It 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.



SPECTRO MODULE INTERCONNECT DIAGRAM
ILLUSTRATION 2−1

2–2 FILTER RELAY ASSEMBLY

Refer to Illustrations 2–1 and 2–2:

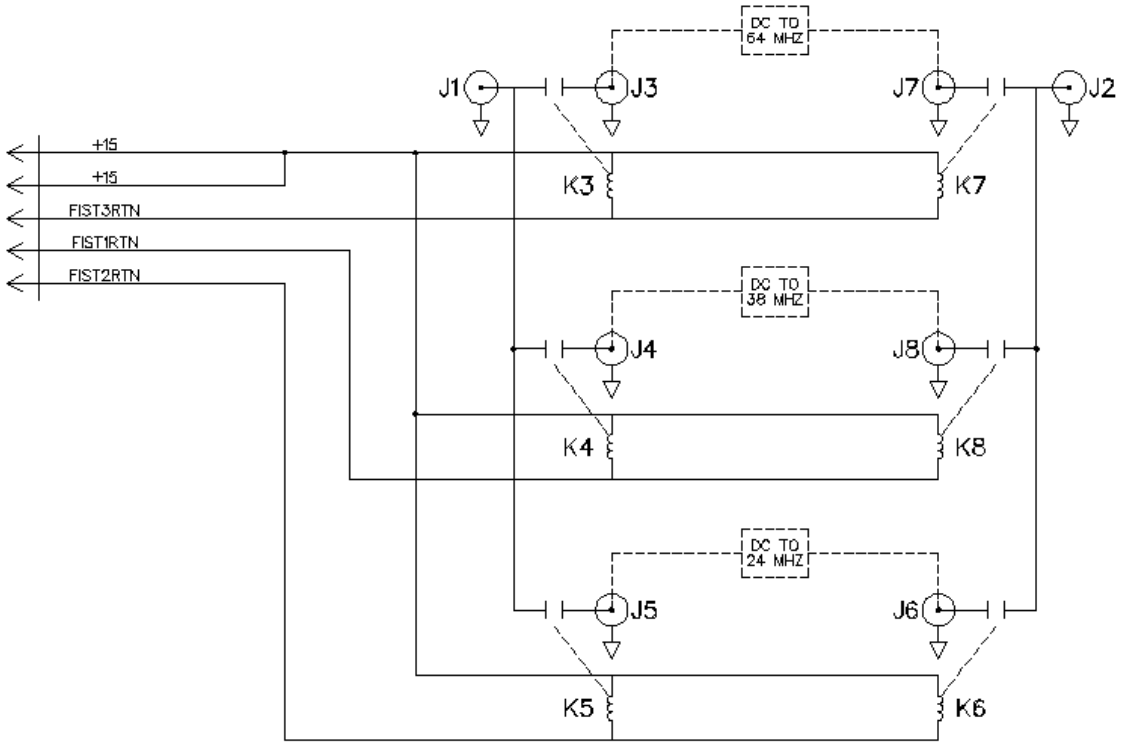
If the Filter Relay Assembly is suspected to be failing, use the following procedure to check out the assembly's functionality. Be aware that one coaxial connection and corresponding relay on each side of the Filter Relay Assembly is left open/unused. Be sure to note the location of any coaxial cables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

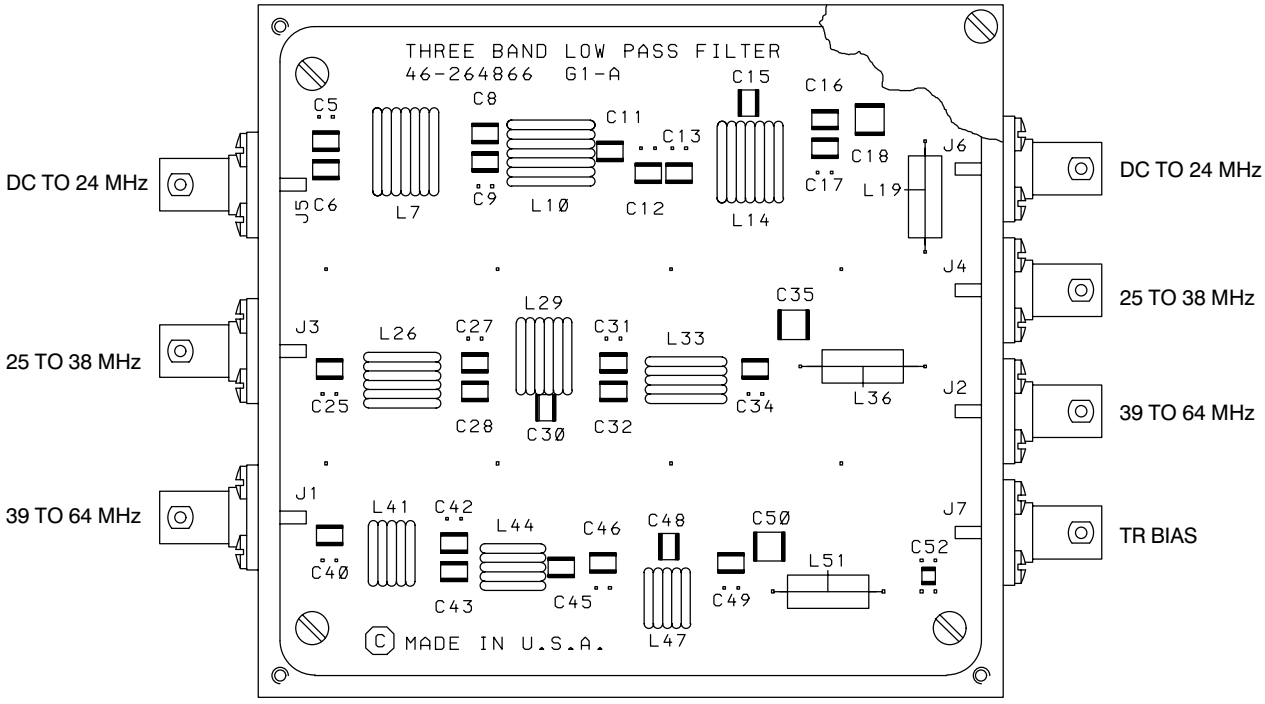
All non–selected relay wires should equal 15 VDC.

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

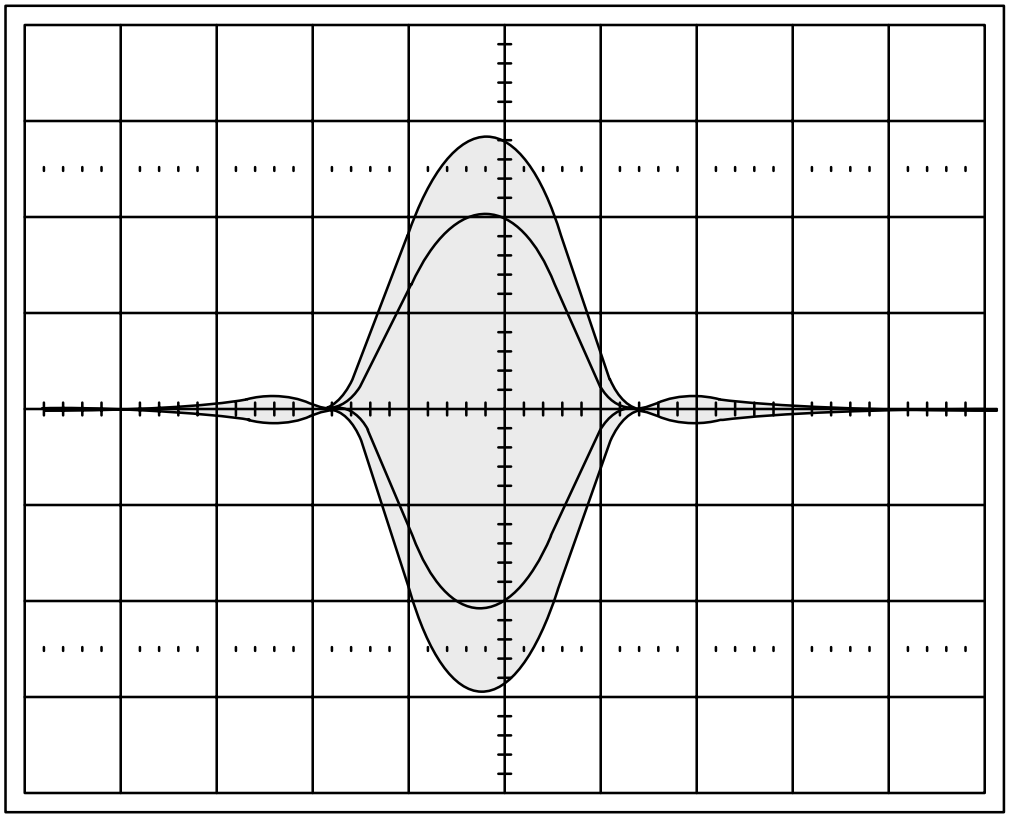
Refer to Illustrations 2–1 and 2–3:

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

CAUTION

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

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

2–4 SPECTROSCOPY DIRECTIONAL COUPLER (2104697–2)

Refer to Illustration 2–1:

1. Remove cover from Spectroscopy 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 = 1.58 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

3−1 INTRODUCTION

This Section is used for Multi−Nuclear Spectroscopy troubleshooting ONLY:
Refer to the Set−Up and Calibration Tab to prescribe the MNS 1.58 kW RF Power Out scan protocol. Normally, it is acceptable to troubleshoot at TG = 25 per the Table 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 to −3 dB, ±0.5 dB.

DESCRIPTION

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

1.5T MNS FREQUENCIES

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

3−2 TRANSMIT CHAIN CHECKS

Checking the Transmit chain is simply verifying voltages at different connection points. Table 3−1 shows most connection points available for checks throughout the transmit chain and the approximate expected voltages at each point using a TG = 25 (commonly used in Spectroscopy) and TG =200. The 100/300/400 MHz 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.

Verify the Spectro Gain Adjust pot is set correctly to the normal operating position:
RF/PEN 1 −−− RFSC −−− R293 (SPEC GAIN) −− MAXIMUM (CCW)
RF/PEN 2 −−− SSM −−− R22 (SPECTRO ADJ) −− MINIMUM (CW)
RF/PDU −−− SSM −−− R22 (SPECTRO ADJ) −− MINIMUM (CW)
SRF −−−−−−−SSM −−−R22 (SPECTRO ADJ) −− MINIMUM (CW)

3−2−1 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, (1.58 kW MNS RF Power Out).
2. Connect 50 Ω terminated scope to connection point.

   For example: ***UCERD 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 134 mV peak−to−peak.
7. Verify TG = 200 (if necessary).
8. Measure voltage.
9. Record voltage.

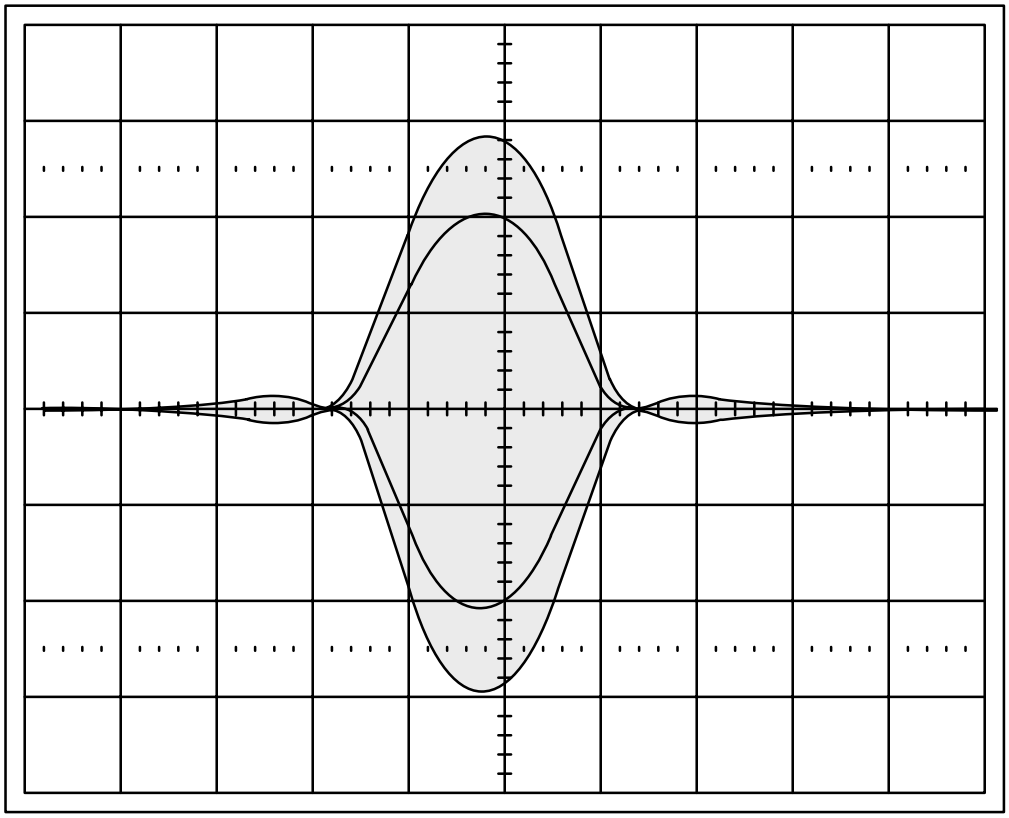
   As table 3−1 shows, our example voltage should be around 1 V peak−to−peak.
10. Verify TG = 0.
11. Press **[Stop Acquisition].**
12. Reconnect cabling.
13. Move to next logical connection point to determine failure(s).

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.

3−2−1 EXAMPLE MEASUREMENT (Continued)

After the output of the MNSpectro BroadBand Amplifier (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

3–2–2 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)	COMMENTS (300 MHZ OR < SCOPE) Prescribe the 1.58 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 –14.5 dBm (~119 mVP–P) and –12.5 dBm (~150 mVP–P). Measurements taken at TG=200 should fall between +3 dBm (~893 mVP–P) and +5 dBm (~1.12 VP–P).			
UCERD Exciter J109	.119 – .15	.893 – 1.12	Measure front panel RF OUT using TPS RF Kit BNC–N cable
MR2 A11 J1 (Run 229)	.119 – .15	.893 – 1.12	Measure MR2 I/F Panel BNC connector (Cable loss is –1 dB)
MR1 A7 J3 (Run 229)	.119 – .15	.893 – 1.12	Measure cable's BNC connector
MR1A15J105 (RF/PEN 1) or MR1A20J104 (RF/PEN 2 or RF/PDU)	.119 – .15	.893 – 1.12	Measure cable's BNC connector (Cable loss is –1 to –2 dB)
MR1 A18 J1	.119 – .15	.893 – 1.12	Measure cable's BNC connector
All measurements represent the MNS UCERD RF Signal after it MR1A18 has been adjusted (assumed at –5 dB for chart). 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 or MNS RF AMP	.067 – .084	.447 –.632	Measure cable's BNC connector (RF IN to MNS AMP)
Verify the RFSC/SSM 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 or MNS RF AMP J2	.945 – 1.065	7.09 – 7.96	Measure N connector of MNS Amplifier
MR1 A17 J1 or MNS I/F BOX J1	.945 – 1.065	7.09 – 7.96	Measure cable's N connector
MR1 A17 Internal J1 or MNS I/F BOX J1	.945 – 1.065	7.09 – 7.96	Measure cable's N connector (center relay input)
MR1 A17 A3 J4 or MNS RELAYS J4	.945 – 1.065	7.09 – 7.96	Measure BNC relay connector (from ^{31}P relay)
MR1 A17 A2 J3 or MNS FILTER J3	.945 – 1.065	7.09 – 7.96	Measure cable's connector (to ^{31}P 3BLP Filter)
MR1 A17 A2 J4 or MNS FILTER J4	.945 – 1.065	7.09 – 7.96	Measure 3BLP Filter BNC connector (exiting ^{31}P 3BLP Filter)
MR1 A17 A3 J8 or MNS RELAYS J8	.945 – 1.065	7.09 – 7.96	Measure BNC cable's connector (from ^{31}P 3BLP Filter)
MR1 A17 A3 J2 or MNS RELAYS J2	.945 – 1.065	7.09 – 7.96	Measure relay N connector (center relay output)

TABLE 3–2 (CONTINUED)
TRANSMIT CHAIN CONNECTION POINTS, VOLTAGES AND COMMENTS

MR1 A17 A1 J1 or MNS DIR CPLR J1	.945 – 1.065	7.09 – 7.96	Measure cable's N connector (input to coupler)
MR1 A17 A1 J2 or MNS DIR CPLR J2	.945 – 1.065	7.09 – 7.96	Measure coupler's N connector (output of coupler)
MR1 A17 J5 or MNS I/F BOX J5	.945 – 1.065	7.09 – 7.96	Measure Spectro Module Assembly N connector
MR1 A7 J45 or MNS RF OUT	.945 – 1.065	7.09 – 7.96	Measure MR1 Cabinet's I/F Panel 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 is –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 – TRANSMIT/RECEIVE CHAIN FUNCTIONAL CHECKS

4–1 INTRODUCTION

Description

For Multi–Nuclear Spectroscopy Troubleshooting Purposes ONLY

All Section 4 tests require the Spectroscopy Phosphorus Flex Coil and MNS Flex Coil Quick Disconnect Adaptor Box. In severe troubleshooting cases, the concentrated (14.7 M) samples work best, if it is available. The 14.7 Molar bottle must be filled locally. It must be understood that the tests contained in this section have not been verified and are to be used as a guide when troubleshooting is required.

Protocol Selection

Refer to Functional Checks Tab to prescribe the Proton Localizer Scan Protocol and the Phosphorus Signal To Noise Test Scan Protocol. SNR protocol TR time should be changed to 500 (500000) for testing.

These tests only check for gain, not noise.

Refer to Installation Tab IC, Interconnect Block Diagrams.

Tools Required

- Empty Bottle with label: 14.7 Molar (46–317299G2).
- Test Cable: Octane Computer Cable Kit (2154392–2), BNC (male) to Cannon (female).

Note

This 14.7 Molar Phosphoric Acid solution must be procured locally. MSDS # 8360515.
It is almost impossible to troubleshoot a receive line problem without this solution if a signal generator (PTS or similar tool) is not available.

Alternate Tool

- Signal Generator (PTS) — set up as soon as the generator is determined to be needed
  This equipment needs to be plugged in and turned on for at least 30 minutes prior to use to warm up and stabilize

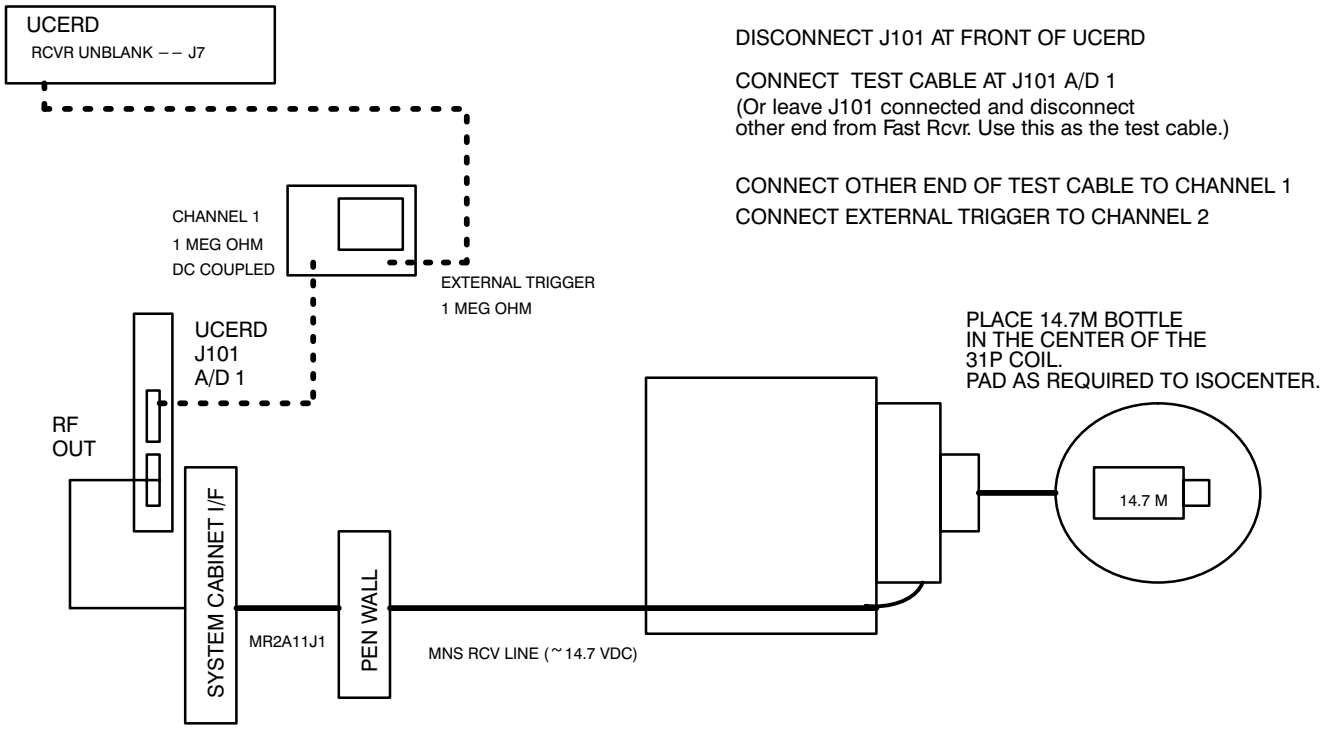
4–2 DETERMINE RECEIVE FAILURE––this section is not complete––waiting for T/S tool.

The receive signal does not show a strong receive peak. It is difficult to determine if is being received properly without the use of an external signal generator or sine–wave oscillator at the frequency of interest.

Before attempting the following procedure please verify DX is adjusted to phosphorus frequency. Attempt to locate the signal ± 2000 Hz. Wait for the system to pulse several times between each adjustment of frequency.

Two troubleshooting locations have been provided in this Section.

1. To determine if the receive line is failing, follow this procedure:

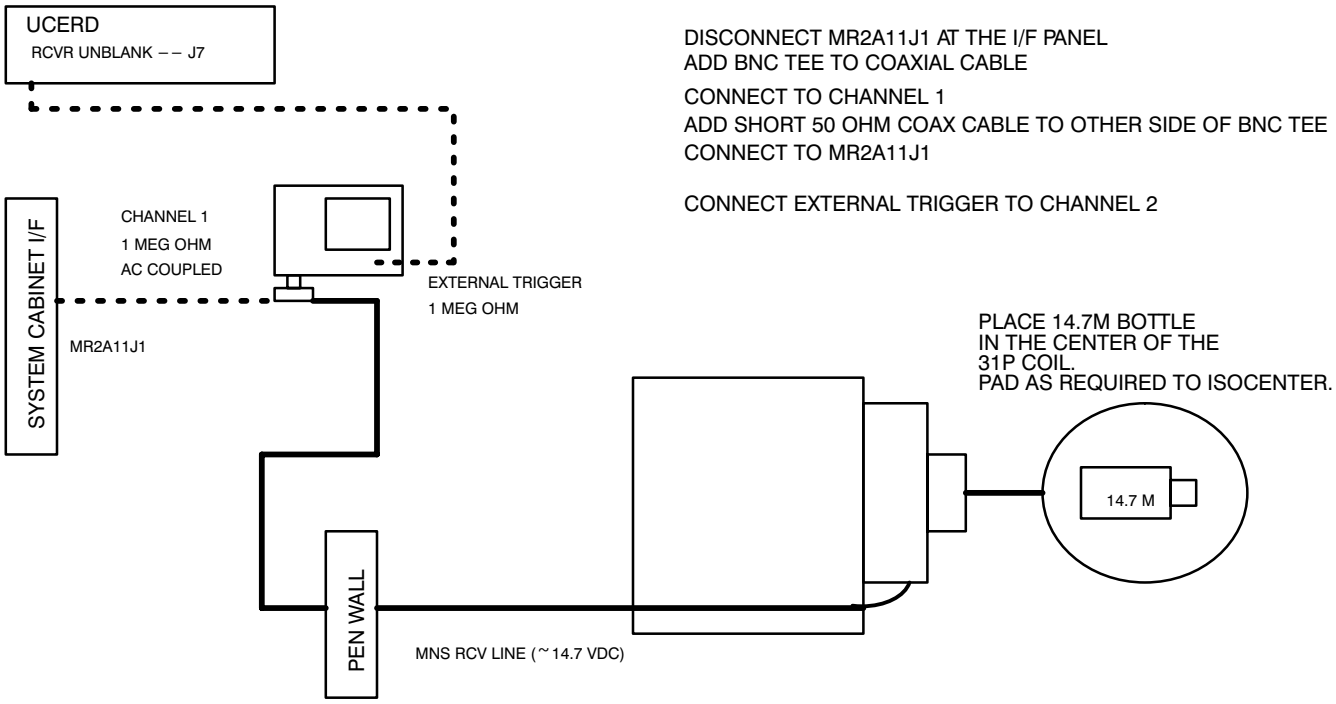


MNS HARDWARE SET–UP TO DETECT IF UCERD RECEIVER SIGNAL IS PRESENT
ILLUSTRATION 4–1

2. Select **[SPECTRO PRESCAN]**.
3. Select **[START SINGLE]**.
4. Set the TG to:
   - 100 Our test bay measured 306 mVP–P
   - 150 Our test bay measured 464 mVP–P
   - 200 Our test bay measured 580 mVP–P
5. Select **[STOP]** or **[DONE]**.

4−2 DETERMINE RECEIVE FAILURE (Continued)

6. To determine if the Receiver is failing, follow this procedure:



MNS HARDWARE SET−UP TO DETECT IF RECEIVE LINE SIGNAL IS PRESENT
ILLUSTRATION 4−2

7. Select **[SPECTRO PRESCAN]**.
8. Select **[START SINGLE]**.
9. Currently there are not any available values for this step.
10. Select **[STOP]** or **[DONE]**.

4–3 PTS SET UP INSTRUCTIONS

If injecting RF into either chain, remember to plug in and turn on signal generator at least 30 minutes before use. This time period allows the generator to warm up and stabilize signal output.

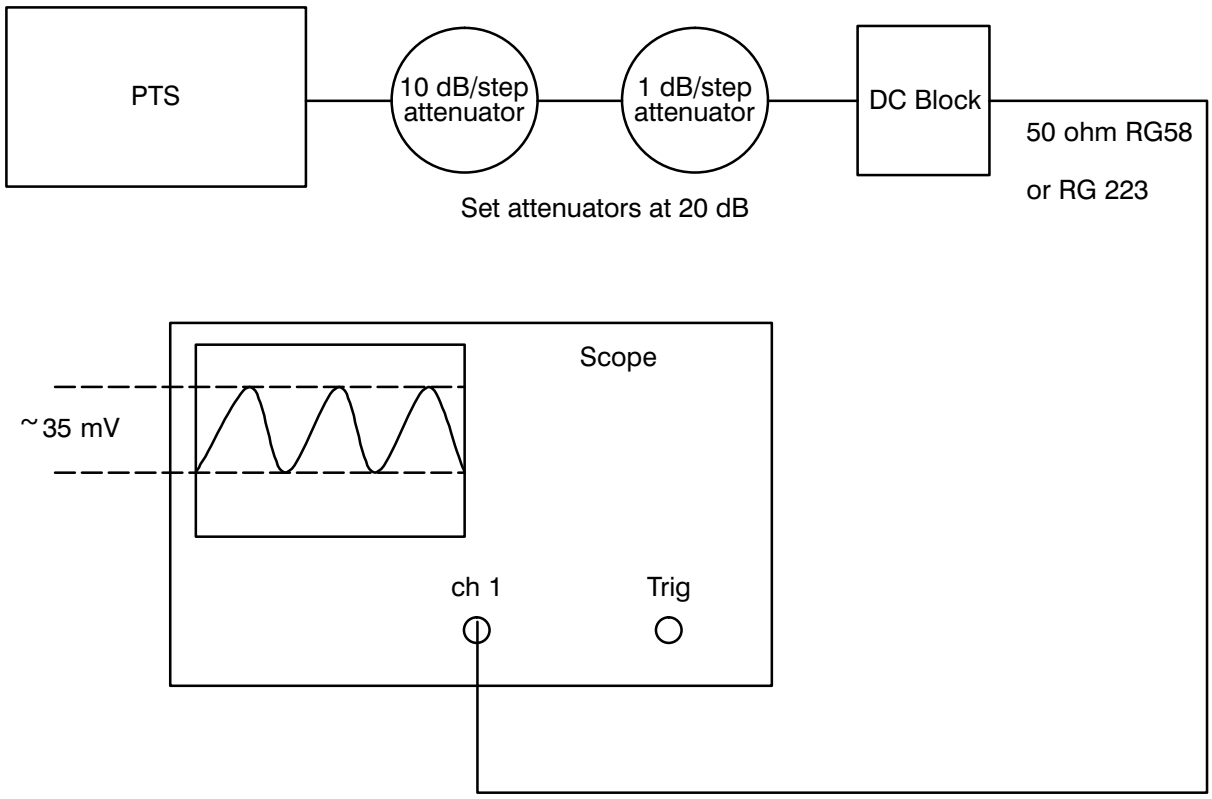
Just before use, remember to calibrate the signal generator. To do this:

1. Adjust the frequency dials on PTS to match the system frequency for ^{31}P (~25854256 Hz).

Note

PTS Frequency is +/– 100 Hz from Operator's Console Frequency. The PTS may need adjustment to produce a smooth sine wave on the Operator's Console. See Illustration 4–3.

2. Adjust the PTS level to 35 mv p–p on the scope.



SET–UP TO CALIBRATE PTS OUTPUT
ILLUSTRATION 4–3

Tools Required

- 50 Ω coax cables (RG223 or RG58), various lengths
- BNC Bullets (2)
- Sense Loop
- Dummy Load 50Ω , 30 dB, or RF Power Measurement Kit
- TPS Cable Kit (46–301549G1)
- Oscilloscope

4–3–1 RECEIVE CHAIN CHECK INJECTIONS

All injections will use the following:

- PTS set up value
- Scan protocol (verify R1 = 7, R2 = 30, TG = 0, and DX is at phosphorous frequency)
- Scope set up. Use 1 Meg Ω termination.
- RF OUT is removed

Use Table 4–2 to check different parts of the receive chain. This table shows the injection points, attenuation set up values and expected values at various points in the receive chain. Below is an explanation of each column.

1. Connect PTS at the injection point in INJECTION POINT column.
2. Set up attenuators shown in Column A, START ATTEN. VALUE.
   In this case we raise the attenuation from the original starting value of 20 dB to 50 dB. This is done because the injected signal from the PTS will be amplified by the gain block by approximately 18 to 24 dB. If the gain of the 20 dB Gain Block is 19 dB then the Final Atten Value would be set at 39 dB {Original starting value of 20 dB + *19 dB GAIN* = 39 dB}.
3. Press **[START SINGLE].**
4. The injected voltage in Column B, VOLTAGE, is 35 mVp–p (always 35 mVp–p at 20 dB of attenuation).
5. Adjust attenuators to match or come very close to the voltage value referred to as the **Receiver T/S Value** (Example Value is 6.7 Vp–p) on scope at the Receiver Board. Record value actually measured in Column C. (Original Column C value is established in Section NO TAG, MEASURE RECEIVER MODULE GAIN).
6. Write down final attenuator value in Column D, FINAL ATTEN. VALUE.
7. Press **[STOP ACQUISITION]**.
8. Make calculations and compare to expected values. If values are extremely off, troubleshoot.
9. Example below is explained:

TABLE 4–1
RECEIVE CHAIN INJECTION POINTS, VALUES, CALCULATIONS

INJECTION POINT	START ATTEN. VALUE	INJECTION VOLTAGE	RECVR T/S VALUE (J13)	FINAL ATTEN. VALUE	CALCULATION FOR GAIN VALUE
PP1 A13 IN Inject into BNC connector on 20 dB Gain Block	50 dB	35 mVp–p	**6.3Vp–p**	**39 dB**	Gain Block Value = 19 dB Should be around 40 dB (gain of 20 dB Gain Block + 20 original).

10. Connect PTS at the injection point PP1 A13 IN. Adjust the Attenuators to set the J13 A/D Sample to the Reciever T/S Value of approximately 7 Vp–p. This check will eliminate the magnet room hardware and the short BNC coaxial cable at the Pen Wall. If R1=7 and 35 mVp–p is injected into the 20 dB Gain Block then the Final Atten Value should equal approximately 40 dB (this relates directly to the gain of Gain Block + 20 dB original).
11. If no signal is received at J13 it is possible to isolate each item being checked. For example, the injection point could remain the same for this check (input of the 20 dB Gain Block), but the scope could be moved to view the output of the 20 dB Gain Block, either at the Pen Wall or at the I/F Panel of the Systems Cabinet. The scope would need to be AC Coupled and 1 Meg Ω terminated. A BNC TEE and a 12.5 foot (RG58 or RG223) cable or a cable less than 1 foot (RG58 or RG223) can be used to view the Aux Receive line while still supplying +15 VDC to the 20 dB Gain Block. The result should be that the attenuators would be set at 18 to 24 dB so that the scope signal is approximately equal (as close as possible to PTS injection value) to 35 mVp–p. This check would show that the 20 dB Gain Block was good.

4–3–1 RECEIVE CHAIN CHECK INJECTIONS (Continued)

- RG58 or RG223 cable length (inches)=11808 (velocity factor) / (frequency) 2
  150 inches (12.5 feet)= 11808 * .66 / 25.85 * 2
  This calculation is for a 1/2 lambda cable (acts like an open). A shorter cable, 75 inches, would act like a short, this would not be good to use! A cable of 1 foot or less can be used.

Note

Table 4–2 reflects values using a 1 Meg Ω scope.

TABLE 4–2
RECEIVE CHAIN INJECTION POINTS, VALUES, CALCULATIONS

	A	B	C	D	
INJECTION POINT	**START ATTEN. VALUE**	**VOLTAGE**	**RECVR T/S VALUE (J13)**	**FINAL ATTEN. VALUE**	**CALCULATION FOR GAIN VALUE**
PP1 A13 OUT Inject 35 mVp–p into Run 469 cable out of 20 dB Gain Block	20 dB	35 mVp–p			Col. D value = Final Atten Value should be 0 dB or slightly less. This indicates no gain but possibly some cable loss.
The next calculation will produce the GAIN BLOCK VALUE. Gain Block Value = Col. D.					
PP1 A13 IN Inject into BNC connector on 20 dB Gain Block	50 dB	35 mVp–p			Gain Block Value = Attenuators should be around 38 to 44 dB (original 20 dB + gain of 20 dB Gain Block).
The next calculation will produce a Gain Value. Gain Value = Col. D – 20 dB original (should be same as Gain Block Value).					
PP1 J79 Inject into short BNC cable	50 dB	35 mVp–p			Gain Value = Attenuators should be around 38 to 44 dB (original 20 dB + gain of 20 dB Gain Block).
The next calculation will produce a Cable Loss Value. Cable Loss Value$_1$ = Col. D – 20 dB original – Gain Block Value.					
MG3 A17 J4 Inject into Head Coil Take Up I/F Adaptor/Connector, Run 455	50 dB	35 mVp–p			Cable Loss Value$_1$ = Attenuators should be around 36 to 42 dB (original 20 dB + gain of 20 dB Gain Block – cable loss).
The next calculation will produce a Cable Loss Value. Cable Loss Value$_2$ = Col. D – 20 dB original – Gain Block Value.					
MG2 A16 J2 (RCV Port) Inject into Carriage Cover Assy. BNC cable, Run 455. (disconnect lemo)	50 dB	35 mVp–p			Cable Loss Value$_2$ = Attenuators should be around 36 to 42 dB (original 20 dB + gain of 20 dB Gain Block – cable loss).
The next calculation will produce a TR Switch Box Gain Value. TR Switch Box Gain Value = Col. D – 20 dB original – Gain Block Value + |Cable Loss Value$_2$ | (Note: the "| |" require you to take the absolute value. In other words, if a negative number, drop the negative sign.					
MG2 A16 A7 A3 J19 Inject into **receive** side of Extrem quick disconnect adaptor box.	80 dB	35 mVp–p			TR Switch Box Gain Value = Attenuators should be around 70 to 76 dB (original 20 dB + gain of 20 dB Gain Block + 34 dB preamp gain – any cable loss).

SECTION 5 – MNS COMPONENT / PIN SIGNAL LOCATIONS

(FOR ALL RF CABINETS)

5–1 MULTI–NUCLEAR SIGNALS ON THE CM/PM BOARD IN THE RFSC of the RFPen1 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

5–2 SPECTROSCOPY BOARD PART NUMBER AND REVISIONS (RFPen1)

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

5–3 ASSOCIATED MULTI–NUCLEAR SPECTROSCOPY REVISIONS (RFPen1)

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 (R293 CCW).
4. Processor Board requires a special EPROM for PROBE Spectroscopy users (Erbtec RF Amplifier type ONLY).

5–4 MULTI–NUCLEAR SIGNALS ON THE J507 CABLE and the REAR INTERFACE BOARD IN THE SSM of the RF/Pen2, RF/PDU, and SRF Cabinet (all cables must be connected when making measurements)

	MR1A20 J507	REAR I/F BOARD 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

5–5 SPECTROSCOPY BOARD PART NUMBER AND REVISIONS (SSM)

Older revisions of the Circuit Boards located in the RFPen2 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).
2. APM (Analog Power Monitor Board): 550013.05 (with micro's—> U8, U1).
3. CPD (Communications PIN Driver Board): with EPLD—> U3 (see Introduction Tab).

5–6 ASSOCIATED MULTI–NUCLEAR SPECTROSCOPY REVISIONS (RF/PEN 2, RF/PDU, SRF)

1. Microprocessors: 3 Total. With the introduction of FMI 60525: APM=EEAE, 3/25/99. CPD=FEB5, 4/19/99.

5−6 ASSOCIATED MULTI–NUCLEAR SPECTROSCOPY REVISIONS (RF/PEN 2, RF/PDU, SRF) (continued)

2. Spectro RF Out Adjust Circuitry—adjust MNS RF Out using Mechanical MR1A18 Attenuator (R22 CW).
3. Erbtec Processor Board requires a special EPROM for PROBE Spectroscopy users (Erbtec RF Amplifier type ONLY).

SECTION 6 – 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.

6–1 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).*

6–1–1 REFERENCE TABLE (dBm, WATTS, VOLTAGE P–P, and RMS CURRENT)

0 dBm = 1 mW into 50 Ω's.

TABLE 6–1
REFERENCE TABLE (TABLE CONTINUES ONTO NEXT PAGE)

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

6–1–1 REFERENCE TABLE (dBm, WATTS, VOLTAGE P–P, and RMS CURRENT) (Continued)

TABLE 6–1
REFERENCE TABLE (Continued)

POWER dBm	POWER WATTS	VOLTAGE Volts P–P	CURRENT RMS amps	POWER dBm	POWER WATTS	VOLTAGE Volts P–P	CURRENT RMS amps
0	1.00 E–3	0.632455532	4.5 E–3	54	2.51 E+2	316.98	2.2
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 7 – 8" T / 3" R ^{31}P SPECTROSCOPY SURFACE COIL CHECKS

Note

This section applies to old style platter (Extremity, Transmit/Receive type) coils. These coils were not proton blocked and may be considered a potential safety hazard if used on patients.

7–1 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) TR Flex Coil.
The single line Phosphorus TR Flex Coil often will have Spectro TR Shorted error messages if a special (has a capacitor inside) MNS Flex Coil Quick Disconnect Box is not used (specifically when using the older style Spectro TR Module).

7–2 (^{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 8 – SPECTROSCOPY AMPLIFIER STAND–ALONE CHECK

8–1 INTRODUCTION

Description

For Multi–Nuclear Spectroscopy Troubleshooting Purposes ONLY

All Section 8 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.

NOTE

All sites with a SSM must verify that FMI 60525 (3 micro's for Power Monitor) was installed. The U3 EPLD on the CPD Board must be current revision or the RF Amplifier will continue to pulse after a Fault ocurrs. See Introduction Tab for details.

8–2 ANALOGIC AMPLIFIER (AN8063G)

Weight: Greater than 130 lbs
Greater than 59 kgs

8–2–1 ANALOGIC AMPLIFIER (AN8063G)––DETERMINE VISUAL FAILURE

Verify AN8063G Front Panel LED Status Function per Table 8–1:

TABLE 8–1
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	**Red**	**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	**Red**	**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.

8–2–2 ANALOGIC AMP, (AN8063G)––FRONT PANEL DIAGNOSTIC LED STATUS FUNCTION, Table 8–2

TABLE 8–2
AN8063G FRONT PANEL DIAGNOSTIC LED's

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

8–2–3 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 cable / connection is verified good continue to next Step to attempt to isolate the Amplifier from remote system control.

8–2–4 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.

8–2–5 ANALOGIC AMPLIFIER (AN8063G), STAND–ALONE START–UP (Circuit Breaker AC ON Mode)

1. Procure a jumper (a jumper may not be present).
2. Remove power to the AN8063G at the Amplifier rear circuit breaker.
3. Disconnect power cable connected at the rear panel of the Amplifier.
4. Disconnect Remote Control Interface cable connected at the rear panel of the Amplifier.

CAUTION

VERIFY POWER IS REMOVED BEFORE CONTINUING TO AVOID ELECTRICAL SHOCK. DO NOT OPEN TOP COVER FOR 5 MINUTES AFTER REMOVING POWER.

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 (across) 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 interconnect (Spectro Remote Control In/Out) is 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 across the two pins (not installed). Leave on 1 pin only.
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.

8–2–6 ANALOGIC AMPLIFIER (AN8063G), FORWARD POWER SAMPLE

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

8–2–7 ANALOGIC AMPLIFIER (AN8063G), FUSE REPLACEMENT

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

8–2–8 ANALOGIC AMPLIFIER CONTROL BOARD JUMPERS

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

8–3 ENI AMPLIFIER (MRI–2000)

Weight: 77 lbs
34.9 kgs

8–3–1 ENI AMPLIFIER (MRI–2000)––DETERMINE VISUAL FAILURE

Verify ENI Front Panel Function per Table 8–1:

TABLE 8–3
ENI FRONT PANEL EXTERNAL SWITCHES / INDICATORS

POSITION	FUNCTION
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.

8–3–2 ENI AMP, (MRI–2000)––CABLE CONNECTIONS, Table 8–2

TABLE 8–4
ENI CONNECTIONS

NAME	TYPE	FUNCTION
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.

8–3–3 ENI AMP, (MRI–2000)––FRONT PANEL FUNCTION, Table 8–5

TABLE 8–5
ENI FRONT PANEL FUNCTION

NAME	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.

8–3–4 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 cable / 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)

8–3–5 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.

8–3–6 ENI AMP, (MRI–2000)––TROUBLESHOOTING GUIDE, Table 8–6

TABLE 8–6
ENI TROUBLESHOOTING GUIDE

SYMPTOM	FAULT	ANALYSIS
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

8–4 ENI AMPLIFIER (MRI–2000), STAND–ALONE START–UP (Circuit Breaker AC ON Mode)

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

CAUTION

––– LESS THAN 30 SECONDS–––

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

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

Circuit Value is approximately: 24 mVolts ÷ .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

Release the Gating Switch. Verify the Gating LED is not illuminated.

CAUTION

VERIFY GATING SWITCH IS NO LONGER DEPRESSED AND GATING LED IS NOT ILLUMINATED BEFORE CONTINUING.

8–4 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.

REPLACEMENT/MAINTENANCE

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SECTION 1 – BROADBAND RF AMPLIFIER (MR1A16)/(MNS AMP)

1–1 BROADBAND RF AMPLIFIER REPLACEMENT (MR1A16) OR (MNS AMP)

Remove BroadBand RF Amplifier (A16) from RFPen 1 or 2 (MR1) or MNS Cabinet (MNS) as follows:

1. Disconnect power to the BroadBand RF Amplifier.
   - **RF/PEN 1 and RF/PEN 2:** Place the RF AMPLIFIER CABINET circuit breaker in the PDU cabinet in the down (OFF) position and then lock and tag out the PDU front door so that the breaker is inaccessable.
   - **RF/PDU:** Shutdown the system software and then place the Main Input breaker on the front of the Teal PDU into the down (OFF) position. Log and tagout the handle of the Main Input breaker so that it is fixed into the "OFF" position.
   - **SRF:** Place the SSM breaker on the front of the Phoenix PDU (located in the ACGD cabinet) into the down (OFF) position. Move the plastic breaker guard over the top of the breakers and then lock and tag it out so that none of the breaker positions can be changed.

   NOTE

   The System Support Module Main breaker CB4 on the rear of the SSM <u>does not</u> control power to the Broadband RF Amplifier. Power to the Broadband RF Amplifier is present whenever there is AC incoming power to the SSM. Remove power from the SSM to remove power from the Broadband RF Amplifier.
2. Ensure power is removed to the MNS Cabinet by placing the CB1 breaker on the rear of the MNS Cabinet in the down (OFF) position.
3. Install anti–tip legs to cabinet if it is not seismically secured to the floor and if the anti–tip legs were not already secured to the cabinet at installation.
4. Remove four pan head screws/washers from rear of cabinet below shelf to move Spectro Module Assembly (silver box) to the side to access rear of BroadBand RF Amplifier.
5. Remove AC power plug at the rear of the BroadBand RF Amplifier.
6. Tag and remove cables J2 (RF Power Out), J3 (Spectro RF IN), and J7 (Remote Control In/Out) from rear panel of BroadBand RF Amplifier.
7. Remove four screws from front panel (these hold the BroadBand RF Amplifier in the cabinet).

CAUTION

Two people are required to lift the BroadBand Spectroscopy RF Amplifier off the shelf.

8. The Power line–cord is part of the BroadBand Amplifier and **must be retained** with it. See NOTE.

1–1 IBROADBAND RF AMPLIFIER REPLACEMENT (MR1A16) OR (MNS AMP) (continued)

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 **compatible** with the different styles of BroadBand Amplifiers.

9. Slide amplifier off of shelf and out the front of the 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.

Install BroadBand RF Amplifier (A16) into RFPen (MR1) or MNS Cabinet (MNS) as follows:

10. Slide amplifier on to shelf and into the front of the RFPen (MR1) or MNS Cabinet (MNS).
11. Install four screws into front panel of the BroadBand Rf Amplifier.
12. Route the new power line–cord.
13. 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.
14. Install AC power plug into BroadBand RF Amplifier. Connect it to the extension power cable located on the right side of the cabinet.
15. Verify BroadBand RF Amplifier circuit breaker (located at the rear of BB RF Amplifier) is on.
16. Install four pan head screws/washers in rear of cabinet below shelf to install (silver) Spectro Module Assembly [MR1 A17].
17. Remove "cabinet in service" tag.
18. Re–apply power to the BroadBand RF Amplifier.
    - **RF/PEN 1:** Put the BroadBand Circuit Breaker located on the rear of the MEPS in the RF/PEN 1 Cabinet into the up (ON) position
    - **RF/PEN 2, RF/PDU, SRF:** On the front of the PDU put the RF Amplifier circuit breaker into the up (ON) position.
    - **MNS CABINET:** On the bottom rear of the MNS Cabinet put the CB1 breaker into the up (ON) position.
19. Check the indicator lights on the front and verify that the BroadBand RF Amplifier is receiving power.
20. Reset the TPS on systems with an RF/PEN 2 Cabinet.

SECTION 2 – SPECTRO MODULE ASSEMBLY (MR1A17) / (MNS I/F BOX)

2–1 SPECTRO MODULE ASSEMBLY REPLACEMENT (MR1A17) / (MNS I/F BOX)

Remove Multi–Nuclear Spectroscopy Module Assembly (A17, silver box) as follows:
2124498–27, Spectro Module Assembly, P540001.02

1. Disconnect power to the BroadBand RF Amplifier and associated hardware:
   - **RF/PEN 1 and RF/PEN 2:** Place the RF AMPLIFIER CABINET circuit breaker in the PDU cabinet in the down (OFF) position and then lock and tag out the PDU front door so that the breaker is inaccessable.
   - **SRF:** Place the SSM breaker on the front of the Phoenix PDU (located in the ACGD cabinet) into the down (OFF) position. Move the plastic breaker guard over the top of the breakers and then lock and tag it out so that none of the breaker positions can be changed.
   - **RF/PDU:** Shutdown the system software and then place the Main Input breaker on the front of the Teal PDU into the down (OFF) position. Log and tagout the handle of the Main Input breaker so that it is fixed into the “OFF” position.
   - **MNS Cabinet:** Place the CB1 breaker on the outside rear of the cabinet into the down (OFF) position.
2. Tag power source to leave switch/circuit breaker in off position due to “cabinet in service”.
3. Tag and remove cables from MNSpectro Module Assembly:

MR1A17J1	2 kW RF IN
MR1A17J2	Power Monitor Spectro Sense A
MR1A17J3	Power Monitor Spectro Sense B
MR1A17J4	Spectro TR Bias
MR1A17J6	Remote Control In/Out
MR1A17J7	Spectro Relay Control
Ground Wire	Connects to the Erbtec RF Amplifier

4. Remove four #10–32 screws/washers which secure the MNSpectro Module Assembly to shelf at rear of RFPen 1 or 2 Cabinet.
5. Remove MNSpectro Module Assembly from RFPEN 1, RF/PEN 2, or MNS Cabinet.

2–2 MNSPECTRO MODULE ASSEMBLY INSTALLATION

Install MNSpectro Module Assembly (A17) as follows:

1. Connect the following cables to the MNSpectro Module Assembly:

MR1A17J1	2 kW RF IN (from BroadBand RF Amp)
MR1A17J2	Power Monitor Spectro Sense A
MR1A17J3	Power Monitor Spectro Sense B
MR1A17J4	Spectro TR Bias
MR1A17J6	Remote Control In/Out
MR1A17J7	Spectro Relay Control
Ground Wire	Connects to the Erbtec RF Amplifier (or grounded source)

2. Remove “cabinet in service” tag from switch/circuit breaker.
3. Re–apply power to the BroadBand RF Amplifier.
   - **RF/PEN 1 or RF/PEN 2:** Remove the lockout/tagout hardware from the PDU and put the breaker back into the up (ON) position
   - **MNS CABINET:** On the bottom rear of the MNS Cabinet put the CB1 breaker into the up (ON) position.

2−2 MNSPECTRO MODULE ASSEMBLY INSTALLATION (continued)

4. Reset the TPS on systems with an RF/PEN 2 Cabinet.

SECTION 3 – PENETRATION PANEL (PP1)

3–1 20 dB GAIN BLOCK

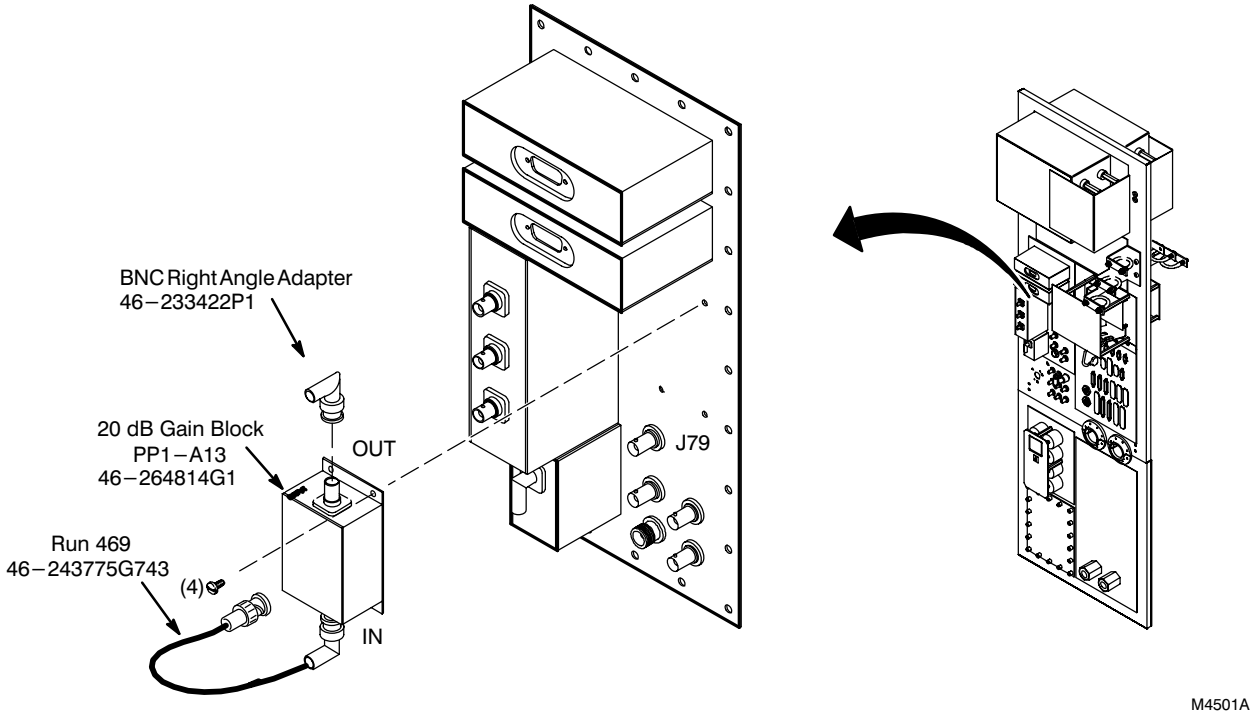
Remove 20 dB Gain Block (A13) from Penetration Panel (PP1) as follows referring to Illustration 3–1:

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). [out is the signal going back to the UCERD receiver module]
3. Disconnect connector (IN) of cable on connector J79 of Penetration Panel (PP1) from connector (IN) of 20 dB Gain Block (A13). [in is the signal from the coil and the preamplifier]
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 referring to Illustration 3–1:

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).

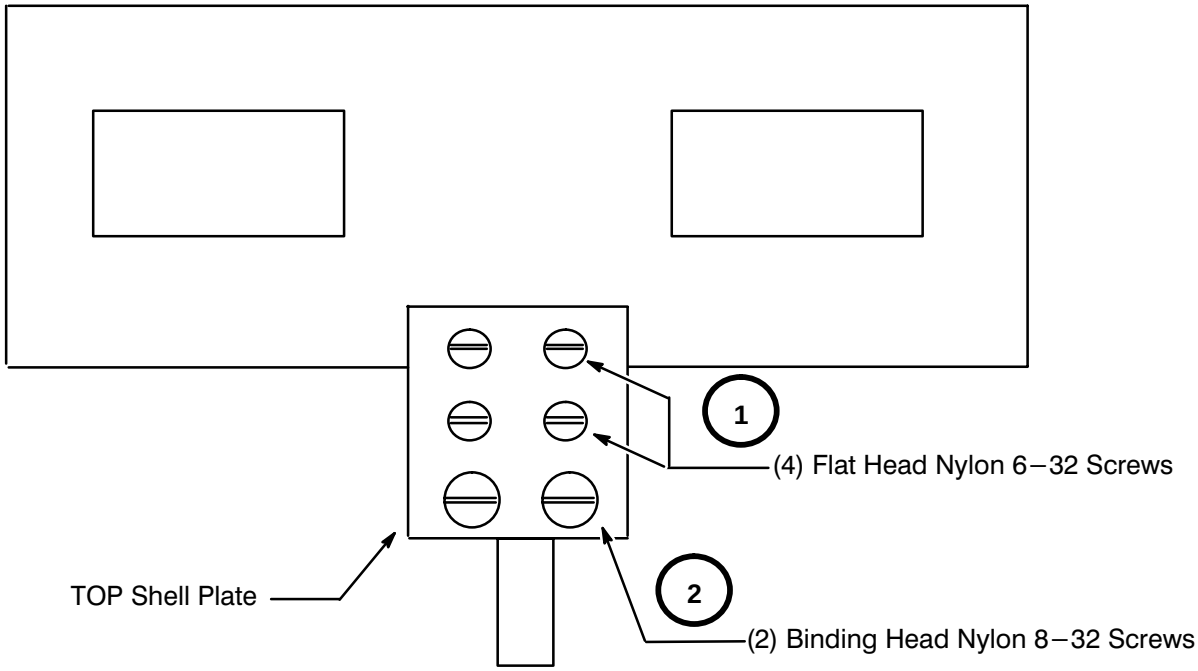
3−1 20 dB GAIN BLOCK (CONTINUED)



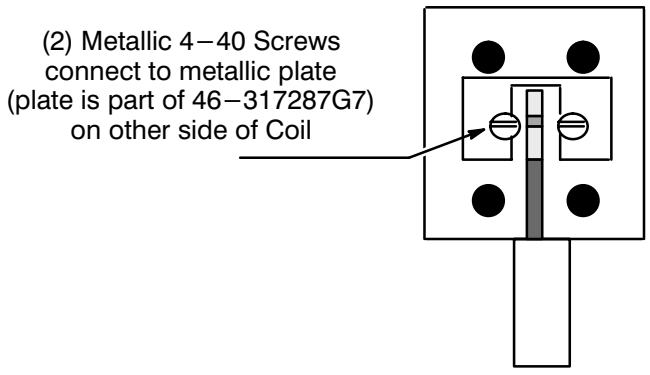
20DB GAIN BLOCK REMOVAL AND INSTALLATION ON FILTER PANEL PLATE
ILLUSTRATION 3–1

SECTION 4 – ^{31}P FLEX COIL CABLE REPLACEMENT

4–1 ^{31}P FLEX COIL (2219090) CABLE REPLACEMENT (46–317287G7)

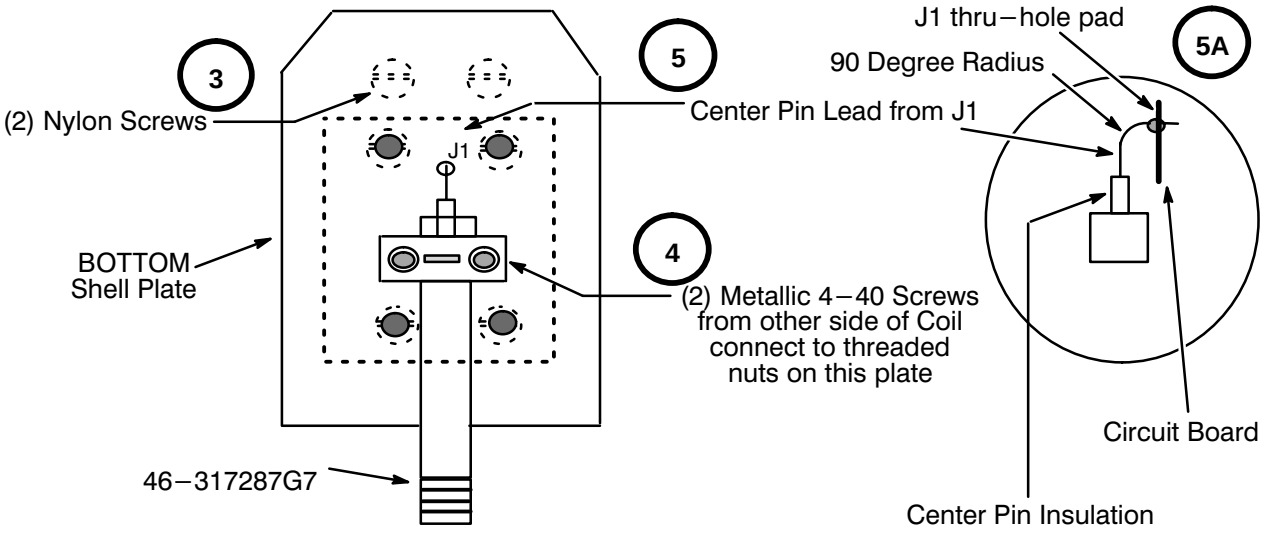


TOP SIDE OF COIL WITH TOP SHELL PLATE ATTACHED
ILLUSTRATION 4–1



TOP SIDE OF COIL WITH TOP SHELL PLATE REMOVED
ILLUSTRATION 4–2

4–1 ^{31}P FLEX COIL (2219090) CABLE REPLACEMENT (46–317287G7) (CONTINUED)



BOTTOM SIDE OF COIL
ILLUSTRATION 4–3

4–1–1 REMOVE ^{31}P FLEX COIL CABLE (46–317287G7) AS FOLLOWS: REFER TO ILLUSTRATIONS 4–1, 4–2 AND 4–3:

1. Disconnect (and retain) 6 (six) nylon screws on Top Side per Illustration 4–1, (circles #1 and 2). This side of the Flex Coil has a smaller plastic SHELL PLATE.
2. Remove (and retain) TOP plastic SHELL PLATE and screws.
3. Turn ^{31}P Flex Coil over to Bottom Side.
4. Disconnect (and retain) the top 2 (two) nylon screws per Illustration 4–3, (circle #3).
5. Remove (and retain) BOTTOM plastic SHELL PLATE and screws.
6. Turn ^{31}P Flex Coil over to Top Side.
7. Disconnect (and retain) 2 (two) metallic screws per Illustration 4–2. Illustration 4–3 shows the cable plate connection, (circle #4).
8. Turn ^{31}P Flex Coil over to Bottom Side.
9. Unsolder the center pin at J1 thru–hole per Illustration 4–3, (circle #5).
10. Remove ^{31}P Flex Coil Cable (46–317287G7).
11. Remove any excess solder build up at J1. Clean the pad/thru–hole area with alcohol.

4–1–2 REPLACE ^{31}P FLEX COIL CABLE (46–317287G7) AS FOLLOWS: REFER TO ILLUSTRATIONS 4–1, 4–2 AND 4–3:

1. Procure replacement ^{31}P Flex Coil Cable (46–317287G7).
2. Per Bottom Side Illustration 4–3 the J1 thru–hole/pad area should be solder free and cleaned with alcohol.
3. Clean the replacement cable center pin with alcohol.
4. Pre–tin the center pin of the replacement ^{31}P Flex Coil Cable using solder. Do not touch the solder iron to the center pin insulating dielectric material.

NOTE

When tinning the center pin use a small amount of solder. Using too much solder will cause solder to wick under the center pin insulating dielectric material. This is undesirable.

5. Place the replacement cable on the Flex Coil per Illustration 4–3.
6. Position the replacement cable so the metallic nut plate lines up with the metallic screw holes per Illustrations 4–2 and 4–3.
7. Using round nose pliers bend the replacement cable center pin so that it protrudes through the J1 hole extending slightly past the circuit board (no more than 0.100 inches) per Illustration 4–3, (circle #5A).

NOTE

It is important that the bend is not a sharp bend (having a radius). Do not compress (crush) or create a sharp 90 degree bend at the center pin conductor.

8. Re–verify positioning of the replacement cable so the metallic nut plate lines up with the metallic screw holes.
9. Install 2 (two) metallic screws (Top Side) per Illustrations 4–2 and 4–3. **Do Not overtighten**.
10. Solder the center pin at J1 (Bottom Side) per Illustration 4–3.

NOTE

Re–clean center pin before soldering if it has been handled/touched.

11. Position and replace BOTTOM plastic SHELL PLATE per Illustration 4–3.
12. Install 2 (two) nylon screws (circle #3) per Illustration 4–3. **Do Not overtighten**.
13. Turn ^{31}P Flex Coil over to Top Side.
14. Position and replace TOP plastic SHELL PLATE.
15. Install 6 (six) nylon screws per Illustration 4–1, (circles #1 and 2). **Do Not overtighten**.

SCHEMATICS/INTERCONNECTS

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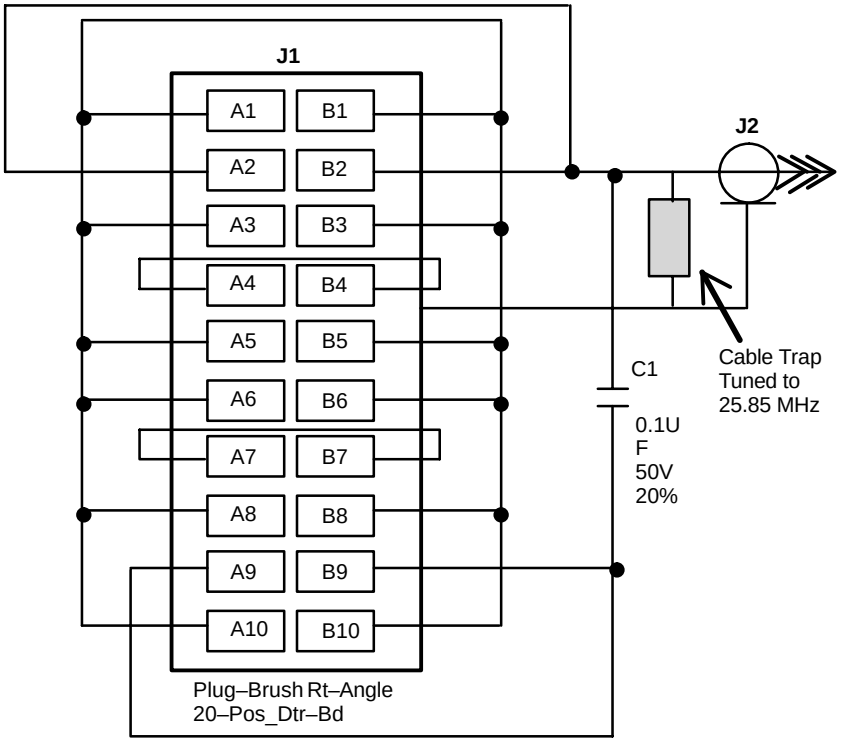
MG2 A16 A6
MG2 A16 A7 A3
1.5T (^{31}P) MNSPECTROSCOPY FLEX COIL Q. D. BOX ADAPTOR

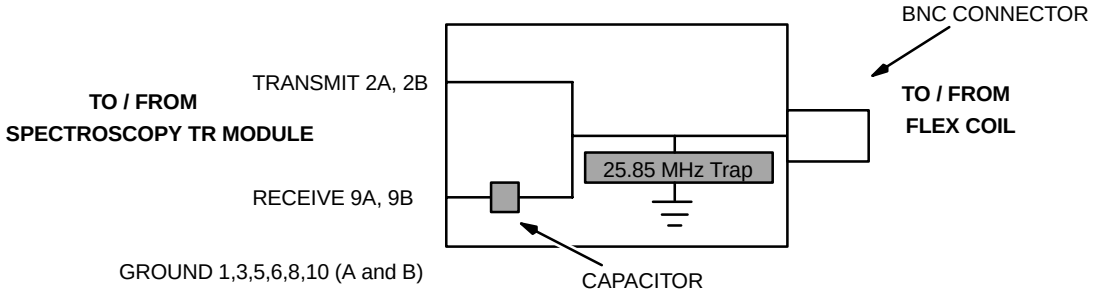
46–282468G4



1.5T ^{31}P MULTI–NUCLEAR SPECTROSCOPY TR FLEX COIL Q.D. CIRCUIT BOARD

Description

The 1.5T (^{31}P) Phosphorus Multi–Nuclear Spectroscopy (MNS) Flex Coil Quick Disconnect Adapter box provides an obvious safety function in an emergency. This adaptor box is provided for use with the 1.5T (^{31}P) Phosphorus Multi–Nuclear Spectroscopy Flex Transmit/Receive Coil. There are two paths from/to the TR Switch (receive and transmit). There are no TR Switch load paths (transmit or receive) to the TR Switch Circuit Board from this adapter circuit board. A capacitor exists to open the DC Path (TR Bias) back to the Spectroscopy TR Module, otherwise, a Spectro TR Short error may be detected. A 25.85 MHz Cable Trap (not specifically shown in detail) has been added due to Head Coil Coupling issues.

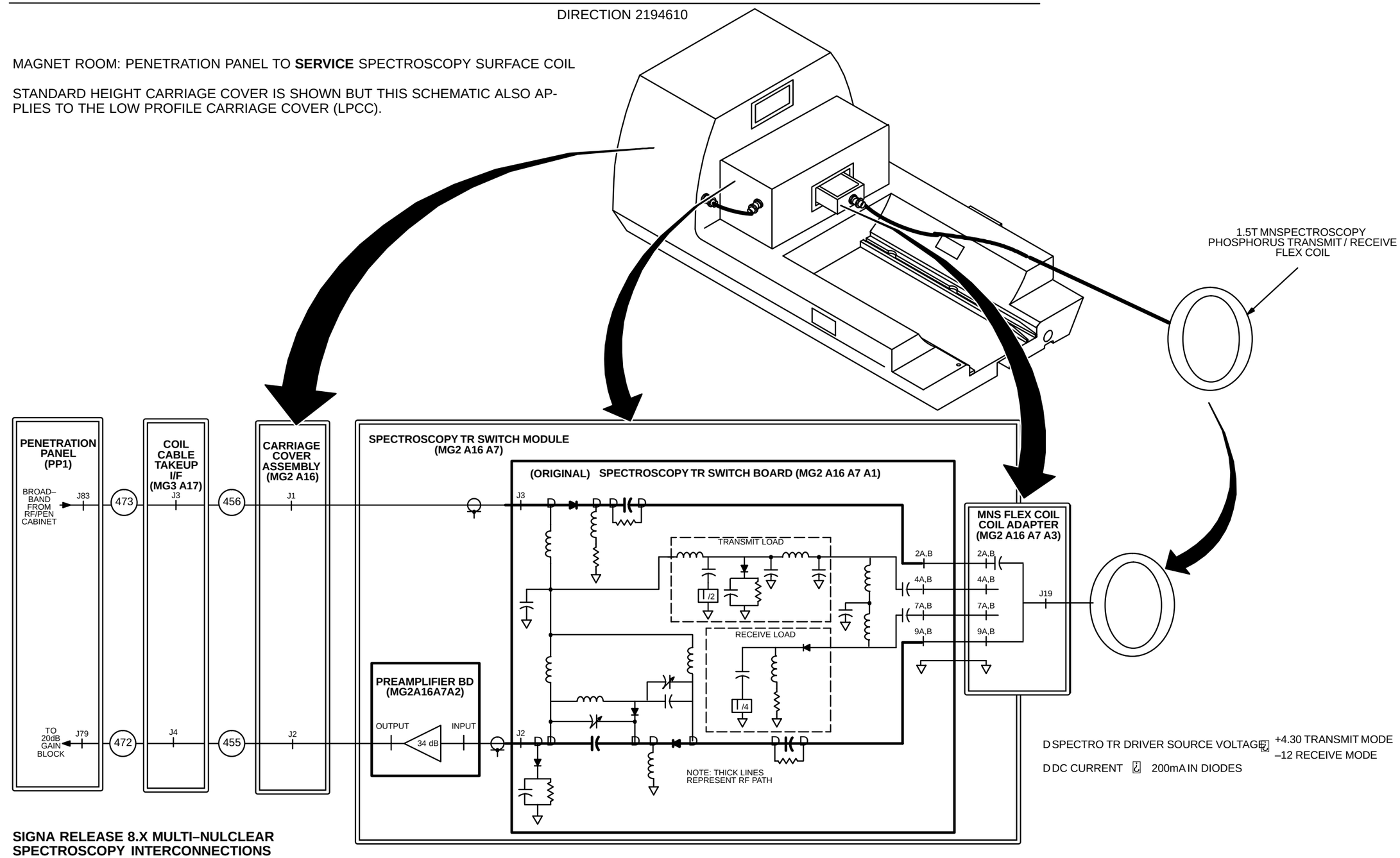


1.5T ^{31}P MULTI–NUCLEAR SPECTROSCOPY TR FLEX COIL Q.D. BOX

DIRECTION 2194610

MAGNET ROOM: PENETRATION PANEL TO **SERVICE** SPECTROSCOPY SURFACE COIL

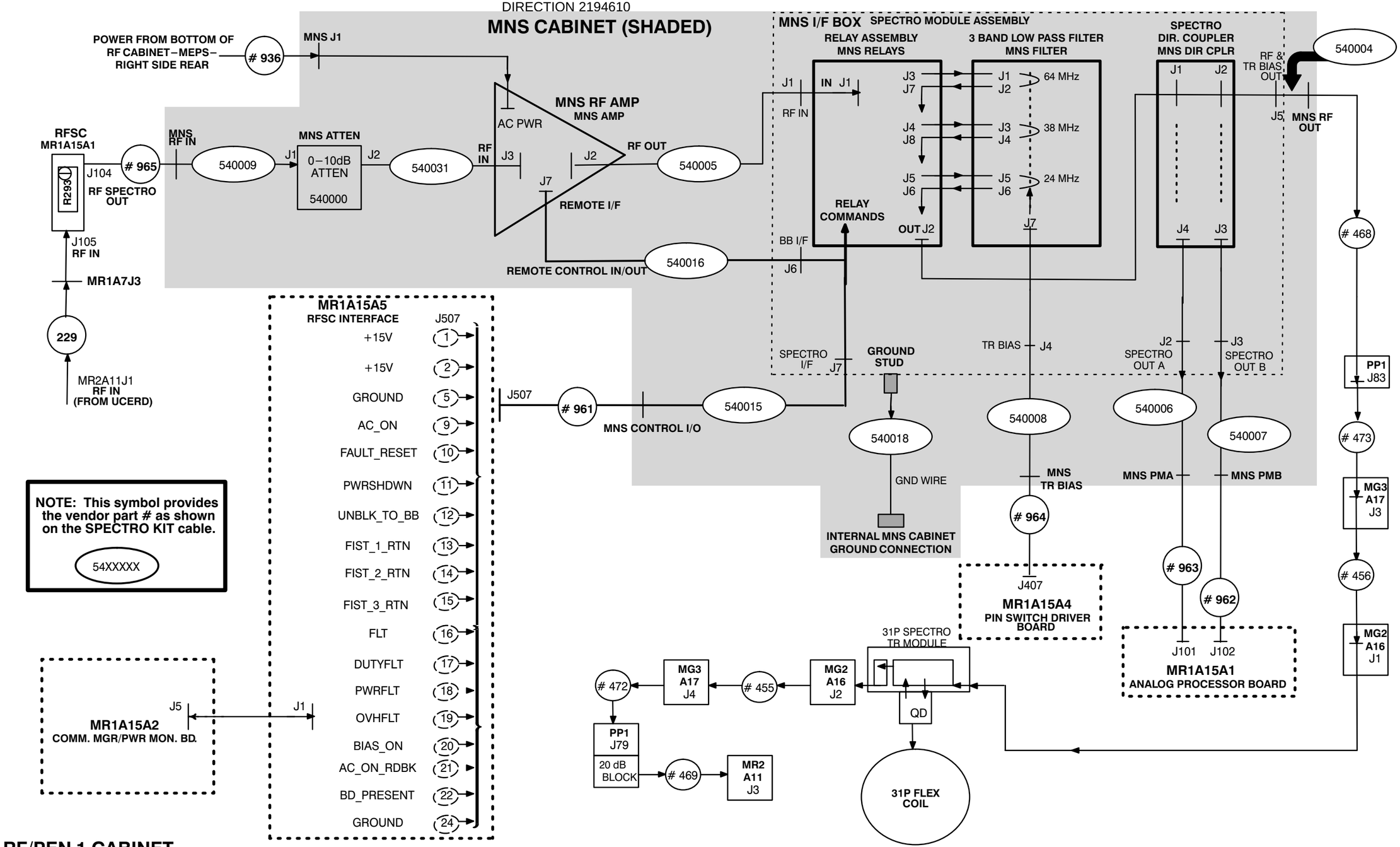
STANDARD HEIGHT CARRIAGE COVER IS SHOWN BUT THIS SCHEMATIC ALSO APPLIES TO THE LOW PROFILE CARRIAGE COVER (LPCC).



SIGNA RELEASE 8.X MULTI–NULCLEAR SPECTROSCOPY INTERCONNECTIONS

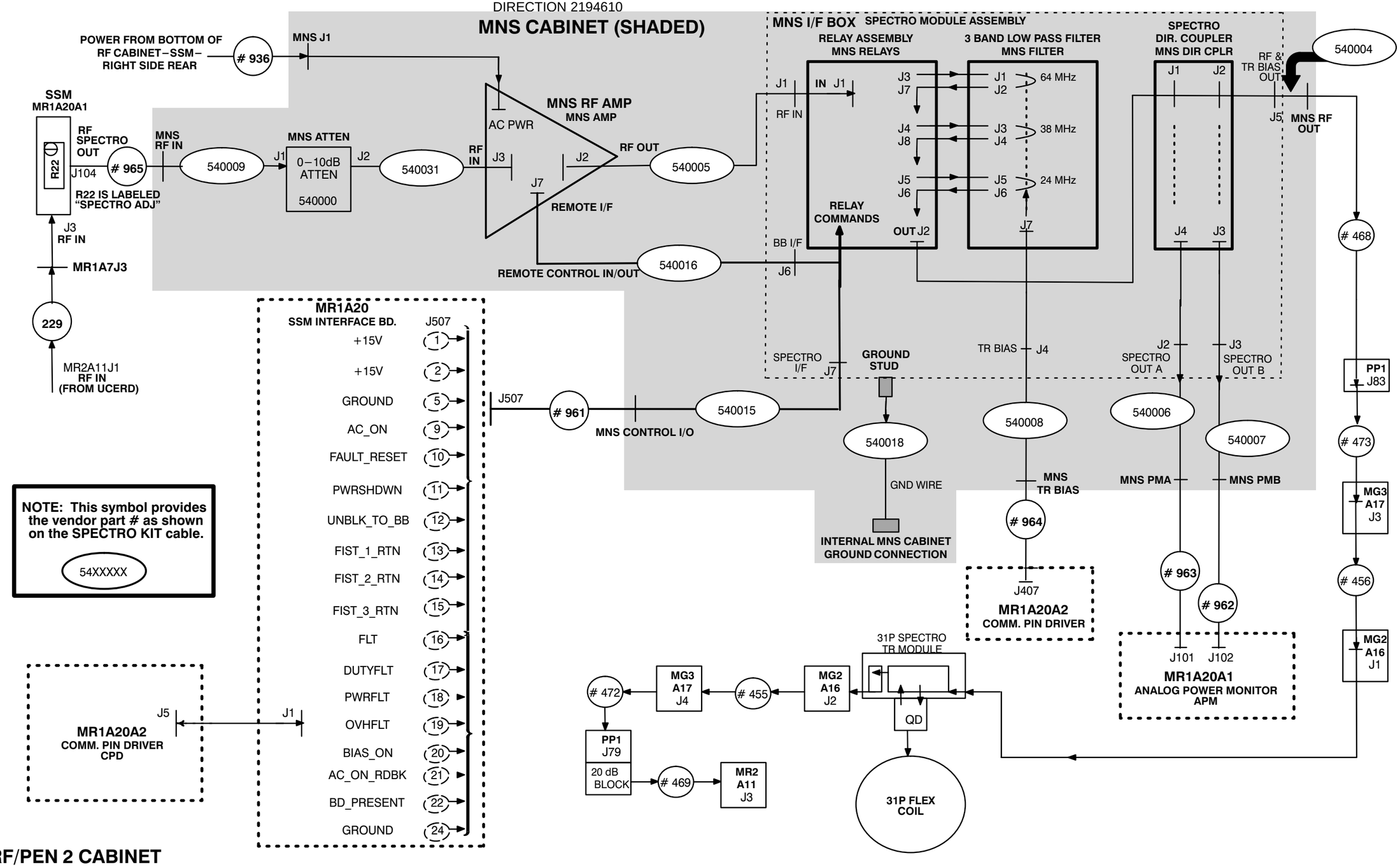
M2056?

DIRECTION 2194610

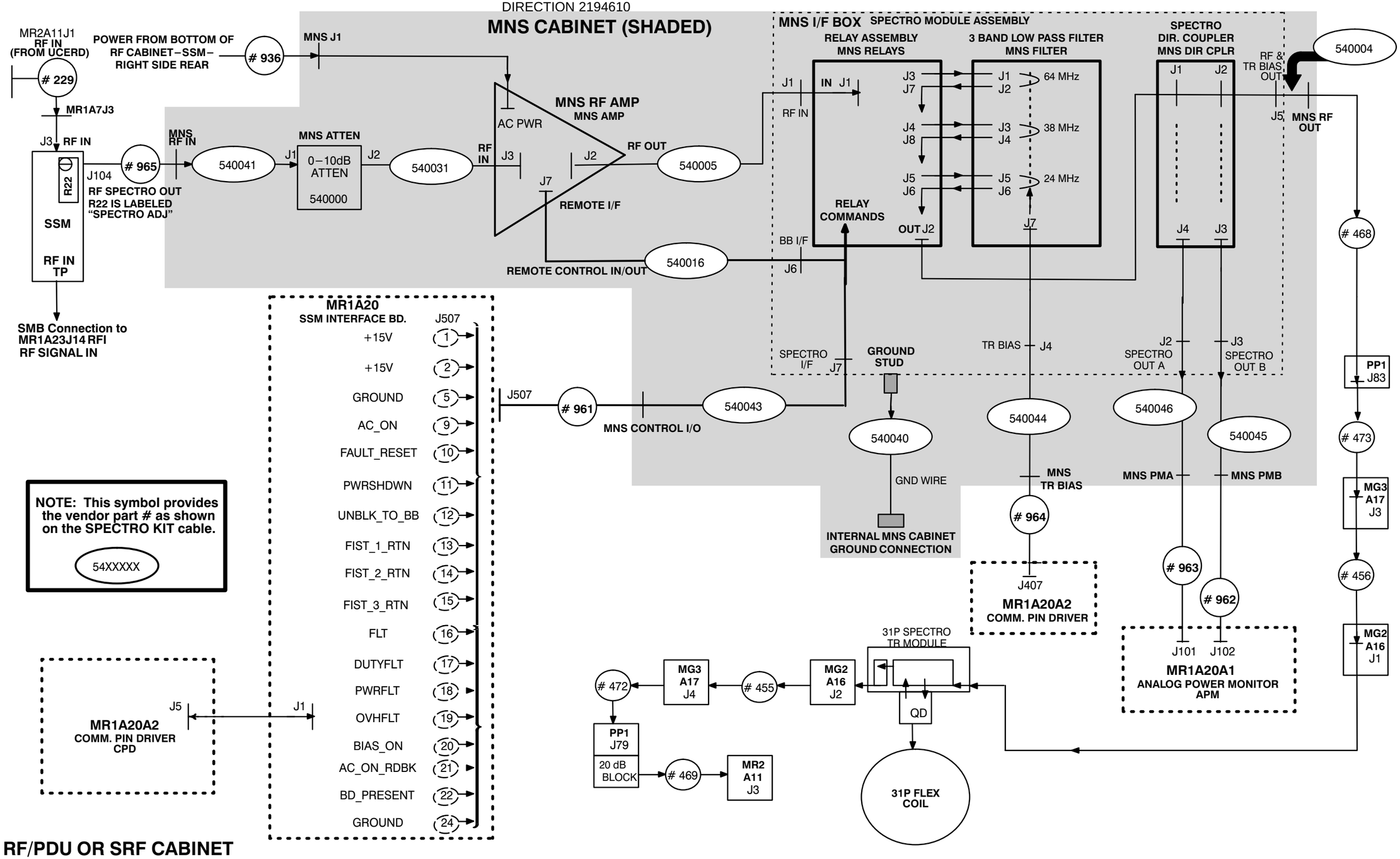


RF/PEN 1 CABINET

DIRECTION 2194610

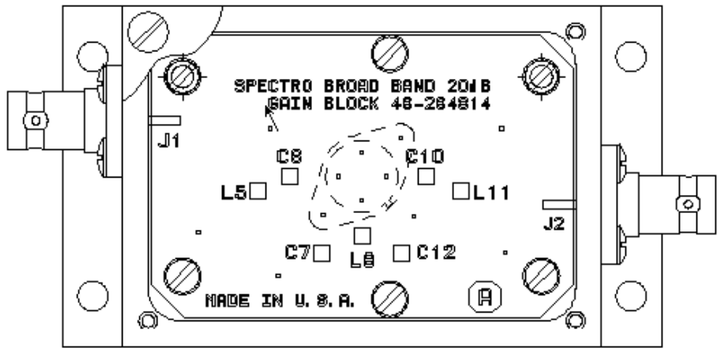


DIRECTION 2194610



PP1 A13
SPECTRO BROADBAND 20dB GAIN BLOCK

46–264814G1–A

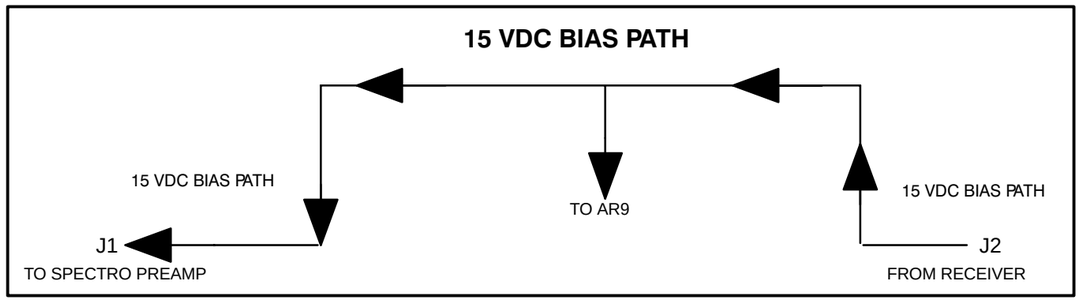


Description

The 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 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

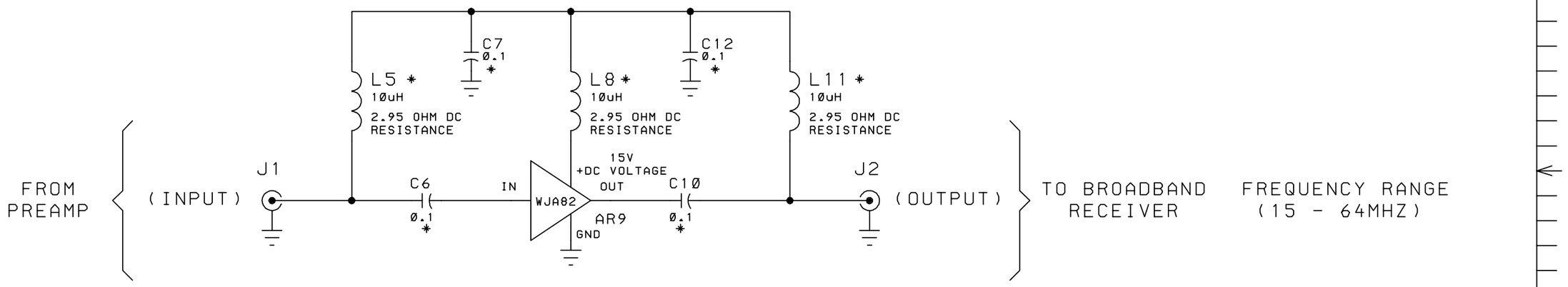
46-264814-S
CONT ON SHEET - SHT NO 1

TITLE
SCHEMATIC DIAGRAM
SPECTRO BROAD BAND 20dB GAIN BLOCK

FIRST MADE FOR MR

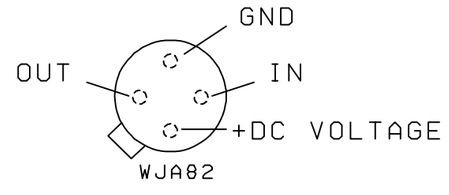
P/L ISSUED

46-264814G1-A



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

ALL DEVICES SHOWN TOP VIEW

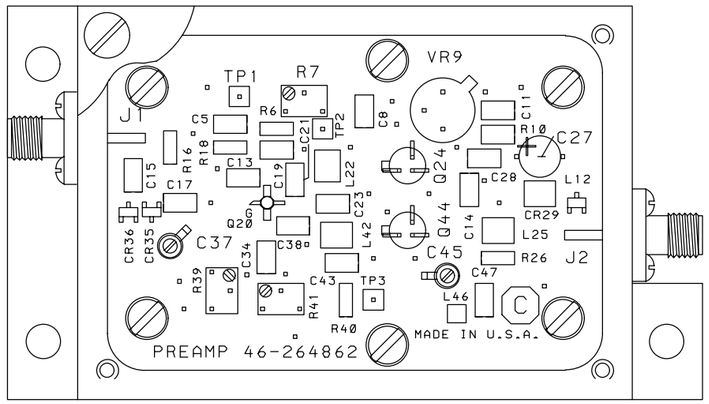


REVISIONS	PRINTS TO
	740

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 contained in the Spectroscopy TR Module which is placed on the Head Carriage Cover when Multi–Nuclear Spectroscopy 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 Power Supply and is supplied via the UCERD Power Supply cable. The MNSpectroscopy AUX port preamp bias will measure +15 VDC. This MNSpectroscopy preamp bias is sent down the selected AUX receive coaxial cable to power the BroadBand 20 dB gain block and the MNSpectroscopy preamp. The total nominal gain of the preamp is +35 dB, ± 3 dB.

It must be understood that the TR Switch and the Preamplifier are tuned to a specific frequency range of interest. They are not BroadBand.

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

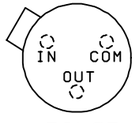
46-264862G1-B

MG2A16A7 A2

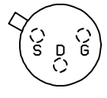
0.35 TO 0.4 VDC
V_D ADJUST
TP2
TP1
V_D ADJUST
R6 10 *
R7 200 0.5W
CW
VR9 78L05
OUT
IN
COM
R10 100 400MW *
C5 0.01 *
C8 0.01 *
C11 0.01 *
C28 0.01 *
C27 10 25V
L12 10uH *
MAXIMUM RESISTANCE DC = 8.1 OHMS
L22 10uH *
MAXIMUM RESISTANCE DC = 8.1 OHMS
OPERATING FREQUENCY (25.8 MHZ)
I_D
V_D
Q24 U310 *
G
S
D
I_{DT}
MAXIMUM RESISTANCE DC = 8.1 OHMS
L25 10uH *
R26 910 *
CR29 MMBD201 *
J2 OUTPUT
TO 20 DB GAIN BLOCK
C23 0.01
C21 120PF *
C17 20PF *
C37 0.8-8PF 500V *
Q20 FSC10LF/FA *
J1 INPUT
FROM T/R SWITCH
C15 0.01 *
INPUT TUNING
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
Q44 U310 *
C45 0.8-8PF 500V *
OUTPUT TUNING
C14 20PF *
L46 1.2uH * 2 OHM DC RESISTANCE
C47 0.01 *

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.

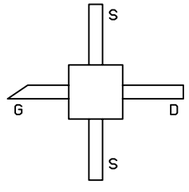
ALL DEVICES SHOWN TOP VIEW



78L05



U310



FSC10LF/FA

I_{DT} ADJUST CW
R41 200 0.5W
C43 0.01 *
TP3
0.3 VDC I_{DT} ADJUST
R40 10 *

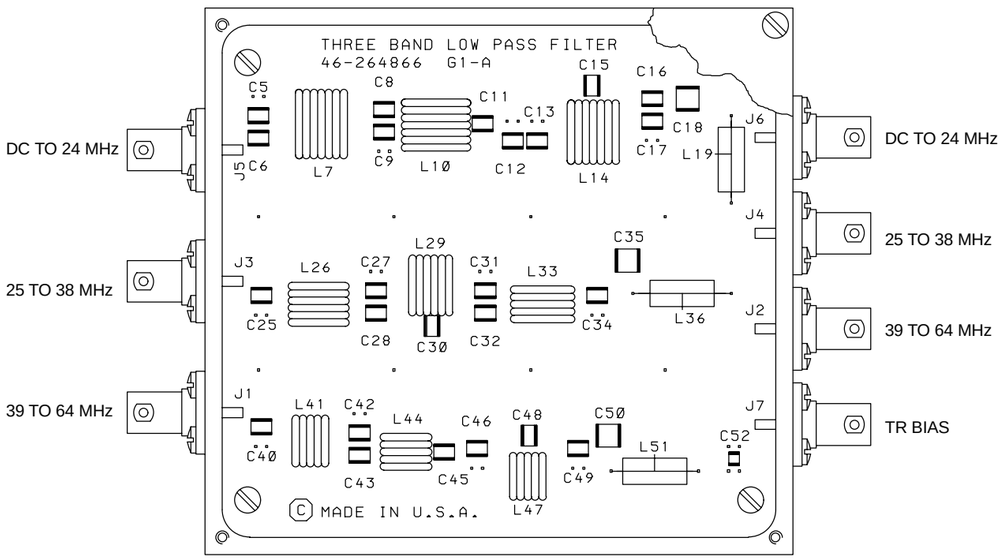
REVISIONS		PRINTS TO	
AB DLW 16FEB90		740	
PCN 158690			

MADE BY G.TESKE 7MAR89
ISSUED R.BECERRA 2MAY89
APPROVALS RCR 4MAY89
DIV OR DEPT MEDICAL SYSTEMS
LOCATION MILWAUKEE, WI.
46-264862-S
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.

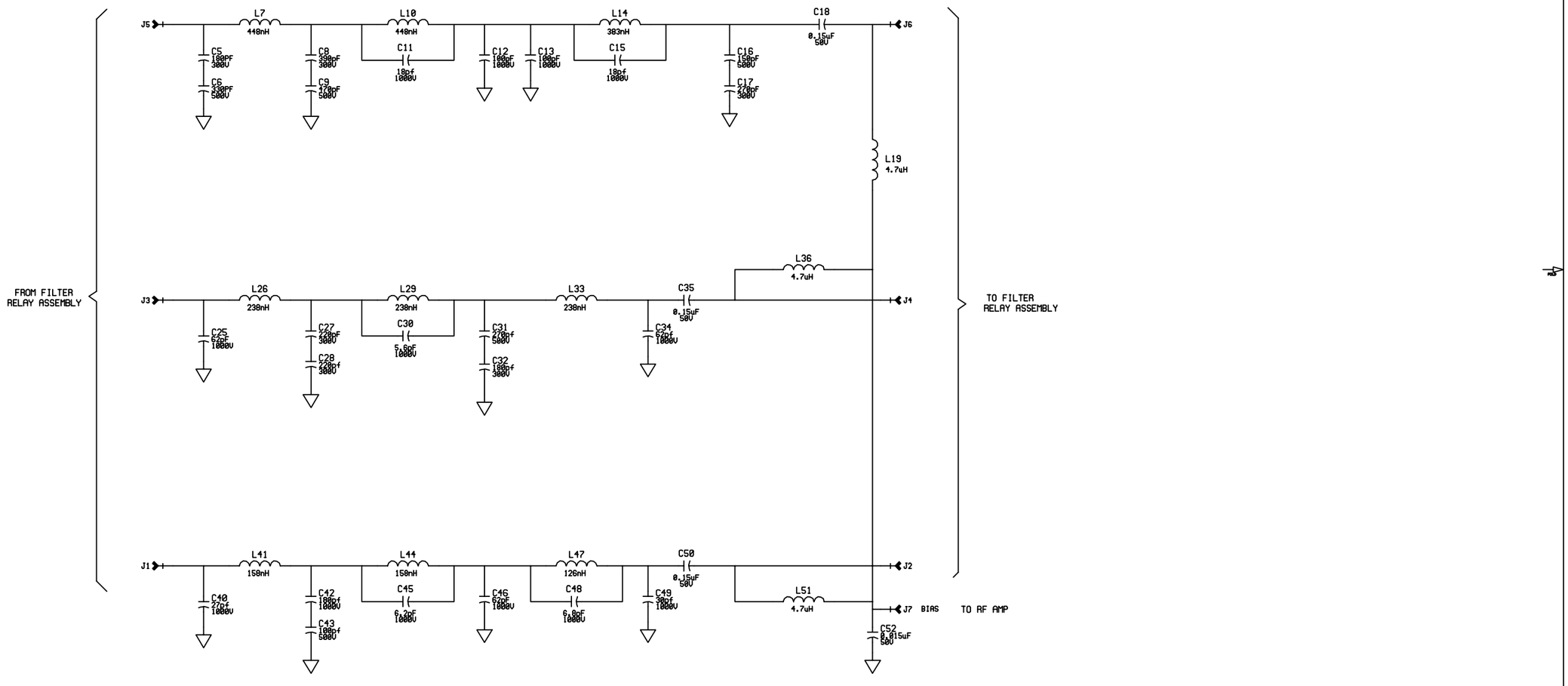
The third band (64 MHz) has input J1 and output J2. The loss within the pass–band (DC to 64 MHz) is ≤ 0.25 dB. The stop–band has a minimum attenuation of 40 dB for frequencies greater than 130 MHz.

The remaining connector J7 is used to introduce the DC TR bias for the Spectroscopy TR Switch Module. This DC bias originates in the RF Cabinet (RFSC or SSM) as the Spectro TR Bias signal and is controlled by the unblank signal. The TR bias is approximately –12 VDC in the receive mode and 4.30 VDC in the transmit mode.

MAG A2 A2

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING : -					REV AC	TITLE SCHEMATIC DIAGRAM	46-264866-S
APPLIED PRACTICES	SURFACES	TOLERANCES ON DIMENSIONS			46-264866-S	THREE_BAND_LOW_PASS_FILTER	CONT. ON SHEET - SH NO. 1
46-200680	√	DECIMALS (2 PLACES) ±	DECIMALS (3 PLACES) ±	ANGLES ±	CONT. ON SHEET - SH NO. 1	FIRST MADE FOR RF_CABINET	
						P/L ISSUED	
						46-264866G1-B	

GENERAL ELECTRIC



REVISIONS		PRINTS TO
	AB DPB_22OCT90	740
	PCN_171257	
	AC DPB_24MAY91	
	PCN_171761	

MADE BY F.PIERCE_13JUL89	APPROVALS RCR 30OCT89	MEDICAL SYSTEMS MILWAUKEE, WISCONSIN	46-264866-S
ISSUED B.BRIER_19OCT89			CONT. ON SHEET - SH. NO. 1

FILTER RELAY

46–301704S

Description

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 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).

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

In the silver box– these signals originate via the J507 SPECTRO SUB–D Connection

J9

TO RF INTERFACE BOARD (BROADBAND CABINET)

1 +15
2 +15
3 FIST3RTN
6 FIST1RTN
7 FIST2RTN

RF IN(TO BROAD BAND RF AMP) J1

DC TO 64 MHZ
J3
K3
K7
J7
RF OUT(TO COUPLER BROAD BAND CABINET) J2

DC TO 38 MHZ
J4
K4
K8
J8

DC TO 24 MHZ
J5
K5
K6
J6

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

APPROVALS	NAME	DATE
TECH		
DES		
ENG		
MFG		

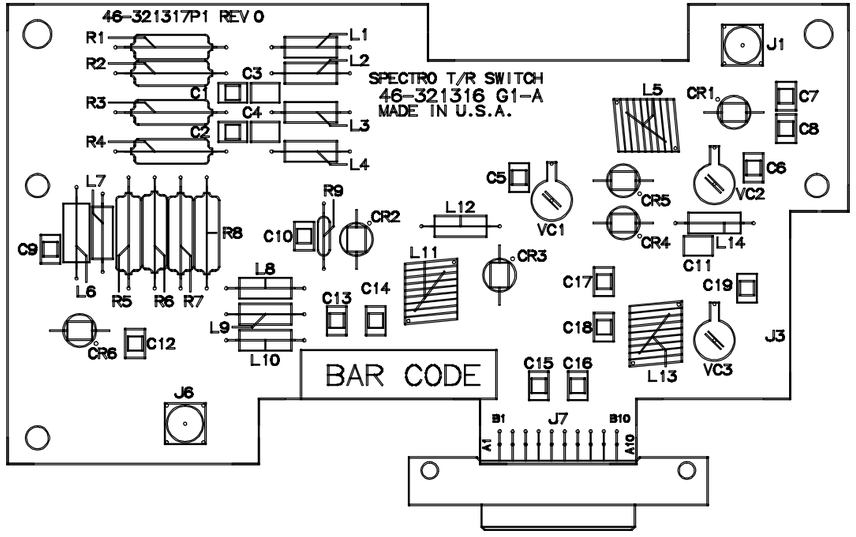
REVISIONS

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

MG2 A16 A7 A2
SPECTRO TR SWITCH

46–321316G1–B

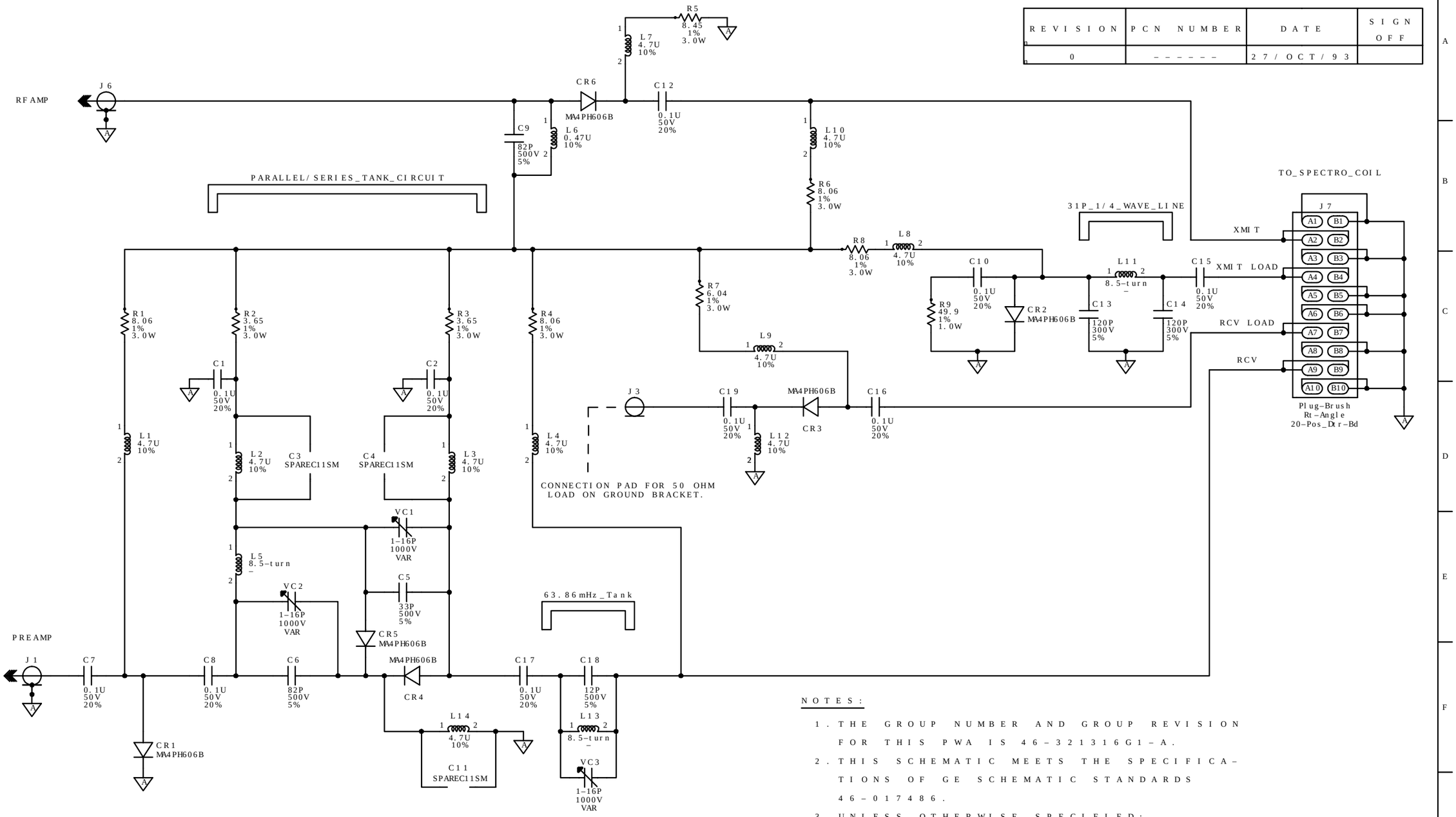


Description

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 (Mult–Nuclear Spectro TR, monitored by the system only when MNS scanning is activated) that originates from the TR Driver circuitry (under UNBLANK control) 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.

It must be understood that the TR Switch and the Preamplifier are tuned to a specific frequency range of interest. The Spectroscopy TR Module is not BroadBand.

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



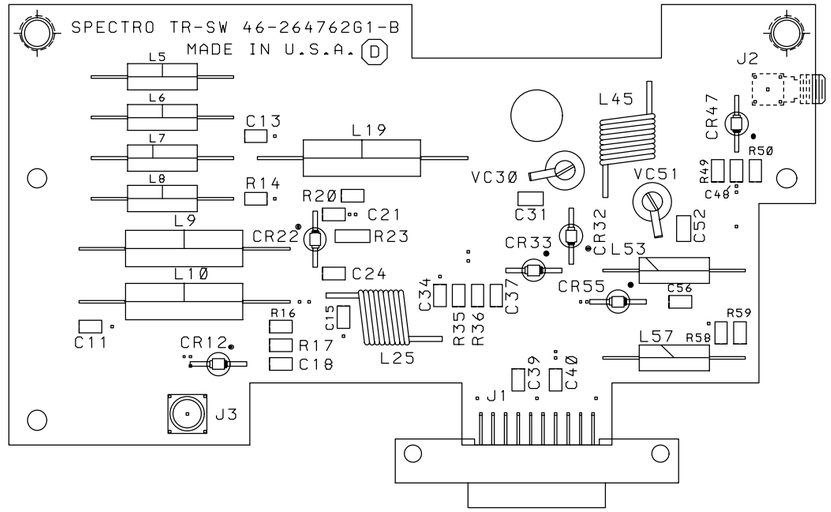
NOTES:

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	APPROVALS	GE MEDICAL SYSTEMS	REVISIONS
DRAWING NO. 46-321316-S	FIRST MADE FOR MRSPECT4.5 (31P)	MG2-A16-A7-A1		MILWAUKEE WI	
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 (Multi–Nuclear Spectro TR, only monitored by the system when MNS is actively used) that originates from the TR Driver circuitry (under UNBLANK control) 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.

It must be understood that the TR Switch and the Preamplifier are tuned to a specific frequency range of interest. They are not BroadBand.

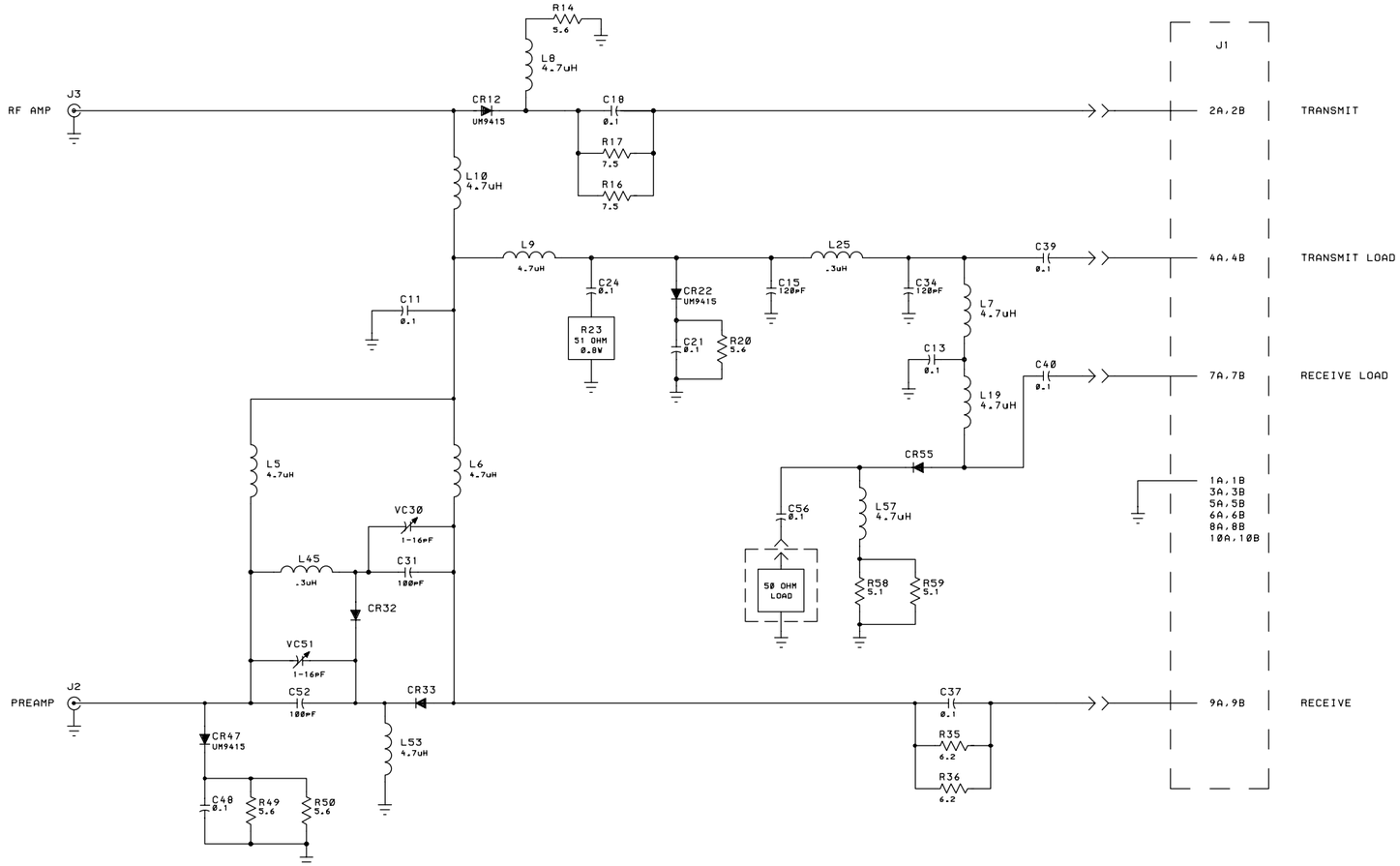
Sites with this TR Switch Board style may experience MNSpectroscopy TR Driver SHORT errors if the correct capacitivelt blocked Quick Disconnect Box is not used.

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING:-
APPLIED PRACTICES 46-208600
REV AC
46-264762-S
CONT ON SHEET - SHT NO. 1

TITLE
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



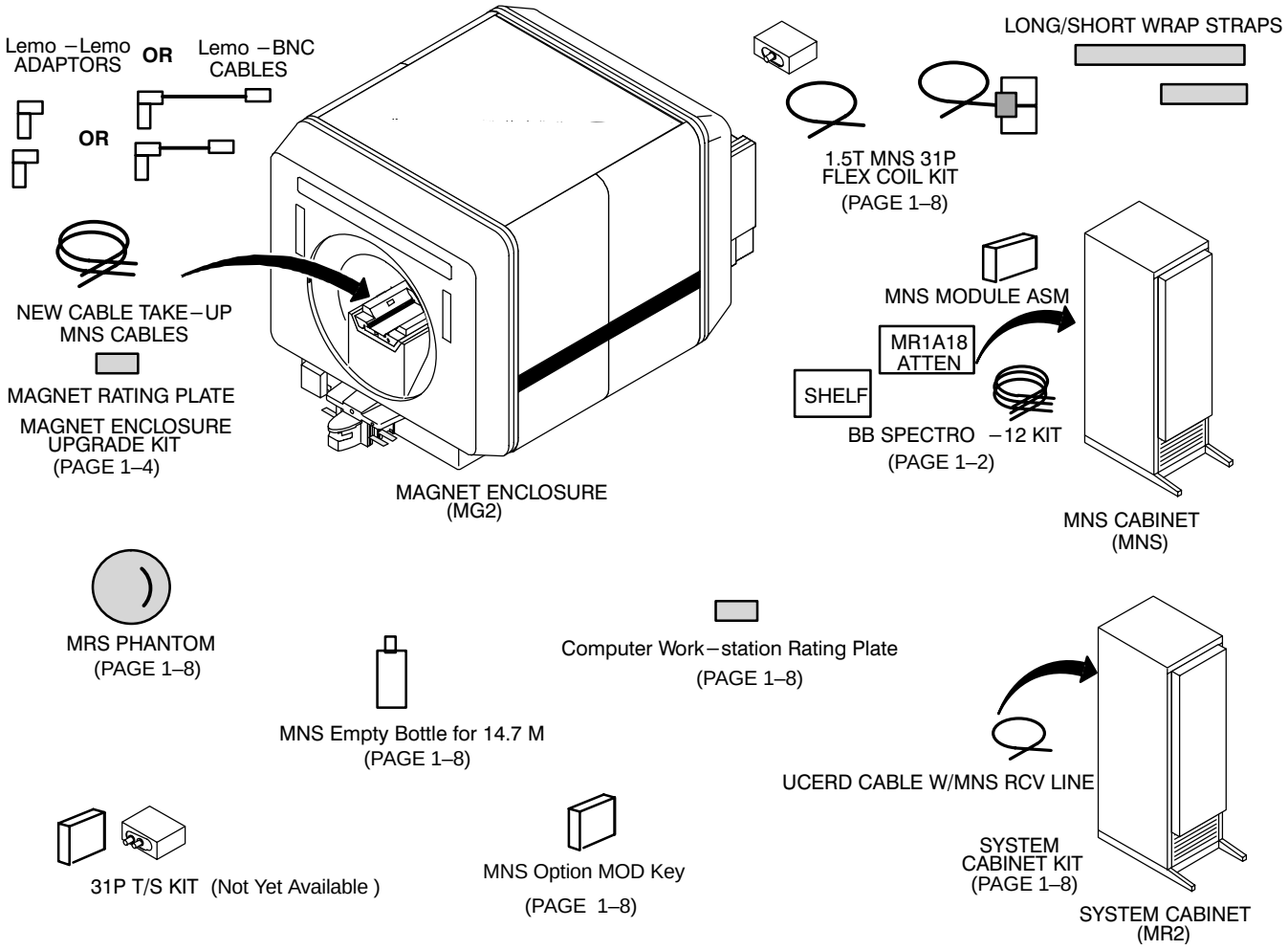
NOTES:
1.UNLESS OTHERWISE SPECIFIED:
ALL CAPACITORS ARE IN MFD.
ALL DIODES ARE UM7001E.
ALL RESISTORS ARE 0.4W, 5%
AND ARE IN OHMS .

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

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

RENEWAL PARTS

SECTION 1 – M3090DA RENEWAL PARTS



ITEM	PART NUMBER	DESCRIPTION OF M3090DA REV 1 CONTENTS	PAGE NUMBER
1	2254697	1.5T MNSpectro MOD Option Key: (2254697DDW)	PAGE 1–8
2	2209382	Service Methods Document/Direction: Install S/W Options MOD	PAGE 1–8
3	2109930–12	MNSpectro Internal Cable / Hardware Kit (w/out BB RF Amp)	PAGE 1–2
5	46–301548G4	Magnet Enclosure Upgrade Kit (1.5T ^{31}P hardware)	PAGE 1–4
6	2259502	MNSpectro 1.5T ^{31}P TR Flex Coil Kit (+ Coil Op. Manual)	PAGE 1–8
7	2152220	MRS (MRSpectroscopy) Phantom	PAGE 1–8
8	2229281–100	MNS Operator Manual	PAGE 1–8
10	2228585–100	SA/GE 7 (8.X / LX) User's Guide	PAGE 1–8
11	46–317299G2	Empty Plastic Bottle for T/S (site fills w/ 14.7M conc. Phos. Acid)	PAGE 1–8
12	2144525–2	System Cabinet: UCERD to TNS Cable Kit	PAGE 1–8
13	2220080–2	MNS Cabinet Assembly for ASP Upgrade	PAGE 1–5
14	2263077	MNS Cabinet Interconnect Cabling	PAGE 1–6
15	46–302200P3	Kit Added Rating Plate: Serial #, Model #	PAGE 1–8

1.5T MNSPECTRO RF/PEN 1 & 2, RF/PDU, AND SRF KIT W/O AMP, 2109930–12 PART OF M3090DA

The 2109930–10 Spectro Kit was upgraded with the introduction of the RFPen 2 Cabinet. Most cables have been modified in length to accomodate the RFPEN 1, RF/PEN 2, RF/PDU, and SRF Cabinet. The 2124497–56 cable and the MR1A18 Attenuator are now part of all 2109930–11 Spectro Kits.

RFPen 2 ONLY: The –12 kit no longer contains the (2124498–37) SSM micro's/chip puller. These (3) micro's were sent out as FMI 60525 to the field. The EPLD (U3) on the CPD Board must be checked: datecode 10/5/99, checksum C623 (Vendor part number 550049.02). This EPLD will stop the BroadBand RF Amplifier from continuing to pulse after a fault ocurrs.

All items are a FRU 2 unless otherwise noted.

TABLE 1–1

1.5T MNSPECTRO RF/PEN 1 & 2, RF/PDU, AND SRF KIT W/O AMP

"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 Mount Spectro Chimney into RF/Pen 2 Front Cabinet Cover	NOTE: Chimney must have a hole to accomodate Analogic Amp re-set switch.	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

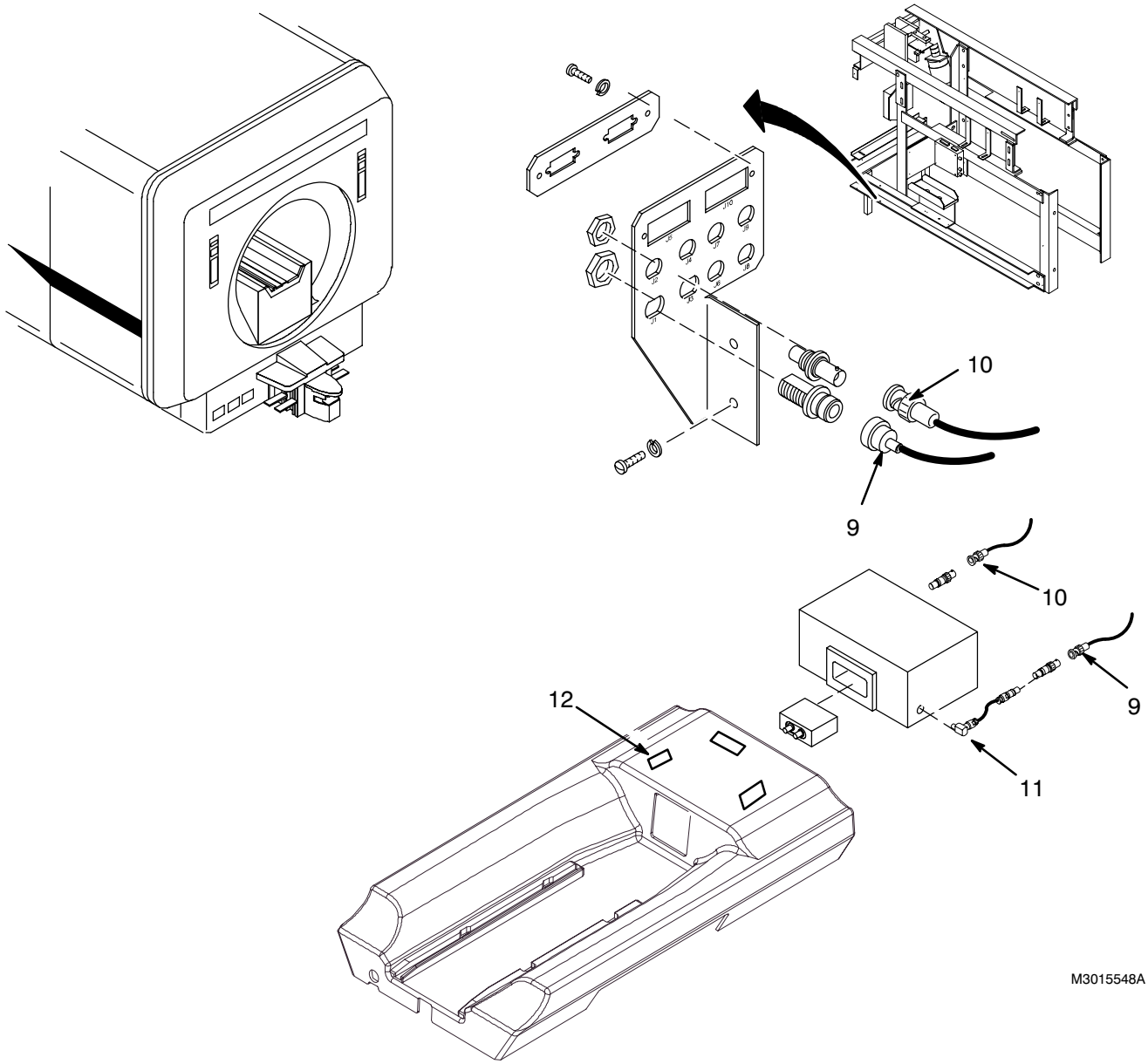
1.5T MNSPECTRO RF/PEN 1 & 2, RF/PDU, AND SRF KIT W/O AMP, 2109930–12 PART OF M3090DA (Continued)

TABLE 1–1 (Continued)

1.5T MNSPECTRO RF/PEN 1 & 2, RF/PDU, AND SRF KIT W/O AMP

"FROM"	"TO"	GE #	VENDOR #	REMARKS
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, RFPen 2 SPECTRO I/F Bracket ASSEMBLY (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
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

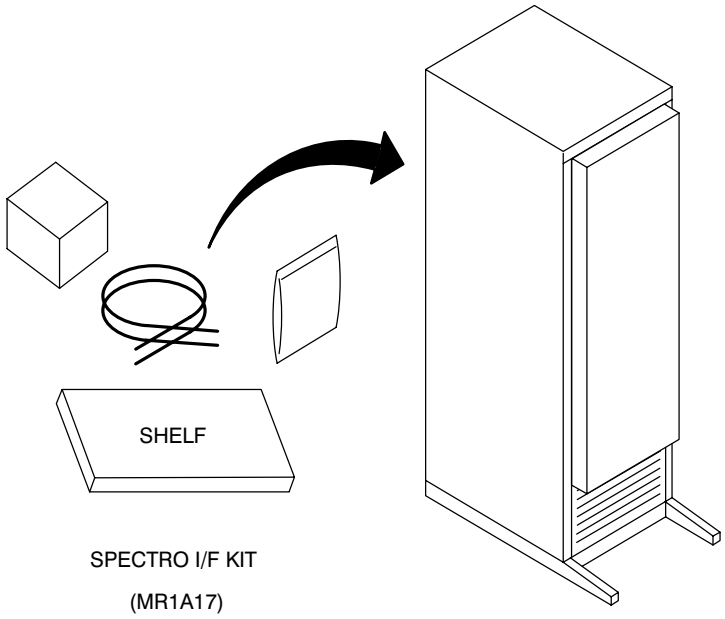
MAGNET ENCLOSURE KIT (PHOSPHORUS) 46–301548G4 FOR MG2 AND MG3



MNSPECTRO COLL 46–301548G4 REV 0 PART OF M1033MA

Item	Part Number	FRU	Name	Quantity	Description (Remarks)
9	2257057	2	CABLE	1	(456), (Xmit Coax) MG3 A17 J3 TO MG2 A16 J1
10	2257058	2	CABLE	1	(455), (Rcv Coax) MG3–A17–J4 TO MG2–A16–J2
11	2251522	2	LPCC Kit	2	Right Angle 90 degree Lemo Adaptors (FTR.OS.250.CTA)
11ALT	2259731–2	2	Alternate– LPCC Kit	1	2259728, Xmit lemo–BNC white H.S. cable & 2259728–2 Rcv lemo–BNC white H.S. cable
12	2254250	2	CLIP	5	LPCC Cable Clips for Run 455 and 456

MNS CABINET KIT FOR ASP UPGRADE 2220080–2 FOR M3090DA



SPECTRO I/F KIT

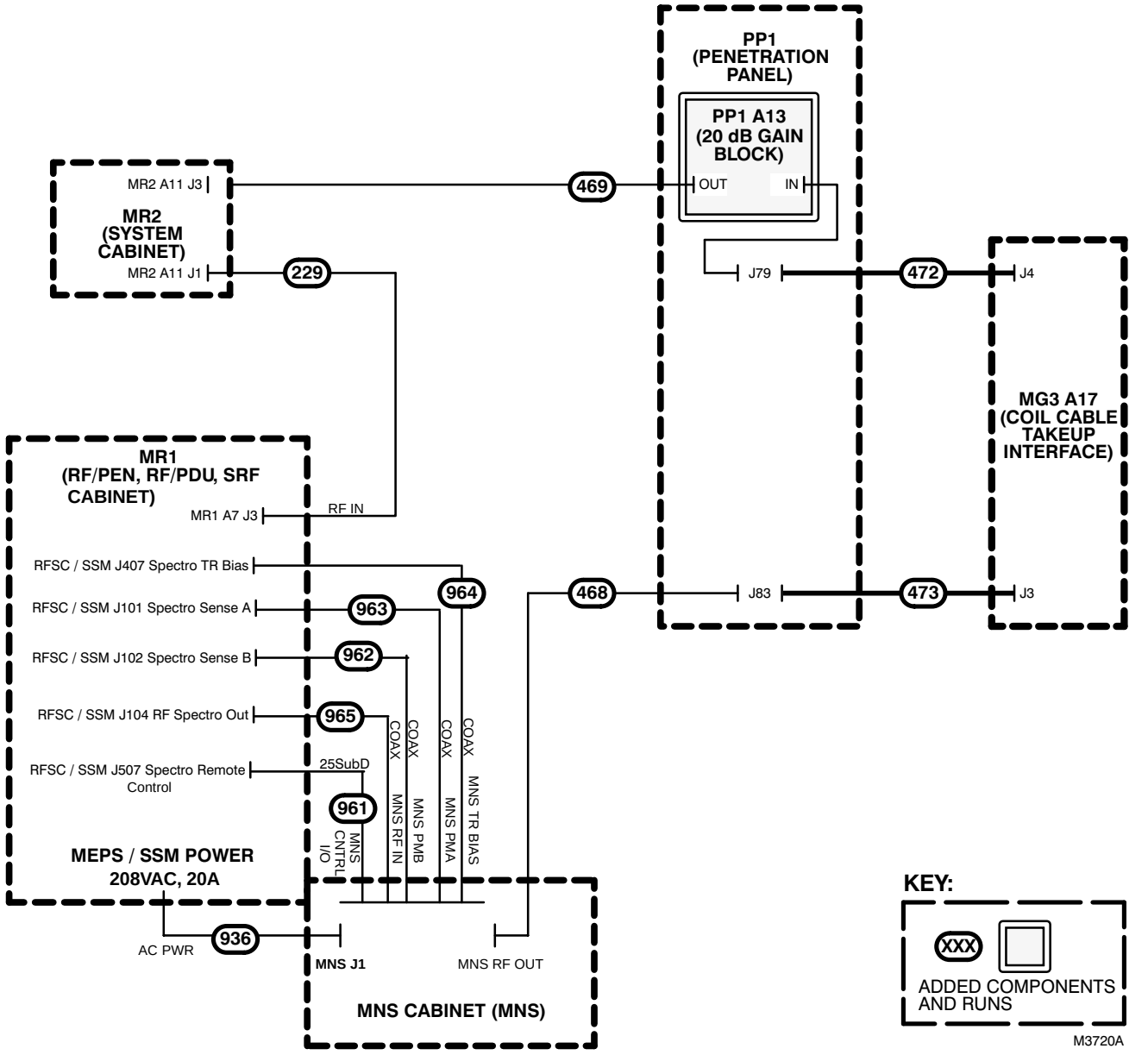
(MR1A17)

MNS CABINET FOR ASP UPGRADE (MNS)

MNS CABINET FOR ASP REV 1 PART OF M3090DA

Item	Part Number	FRU	Name	Quantity	Description (Remarks)
	46–307544P1	2	Circuit Breaker	2	20A, 2 Pole, 250V Circuit Breaker
	46–221865P1	2	N–connector	2	Bulkhead, 50 ohm, N–connector
	46–208990P1	2	BNC Adapter	6	50 ohm, bulkhead adapter
	2275785	1	3–prong socket, 208VAC	1	3–prong, 208VAC socket
	46–271382P29	2	20 amp Circuit Breaker	3	20 amps, 240VAC
	46–271110P1	1	GND Label	1	Protective Earth label
	46–208761P1	2	Cable tie	2	Nylon cable tie
	46–271110P5	2	Label	1	Label, old
	2271171	2	I/F Power Panel Data	1	I/F Power Panel Lead Data
	46–170015P10	2	Screw	16	Screw 05322
	46–170015P19	2	Screw	17	Screw 05792
	46–170012P36	2	Nut	7	6–32 Hex 5/16 nut 7/64 Thck
	46–208935P8	2	Nut	2	1/4–20, 7/16” Hex X 3/16 Thck
	46–208599P5	2	Screw	3	1/4” Screw Size External
	46–220184P54	2	Screw	1	Screw 17882
	46–170012P39	2	Nut	4	Nut, KEPS 10–32, 3/8” Hex
	46–265067P1	2	Cable Screwlock	2	I/F Panel cable screwlock
	46–170015P21	2	Screw	18	Screw 06333
	46–220288P1	2	Nut	14	Self–locking 10–32

MNSPECTROSCOPY SYSTEM IC CABLE KIT 2263077 PART OF M3090DC

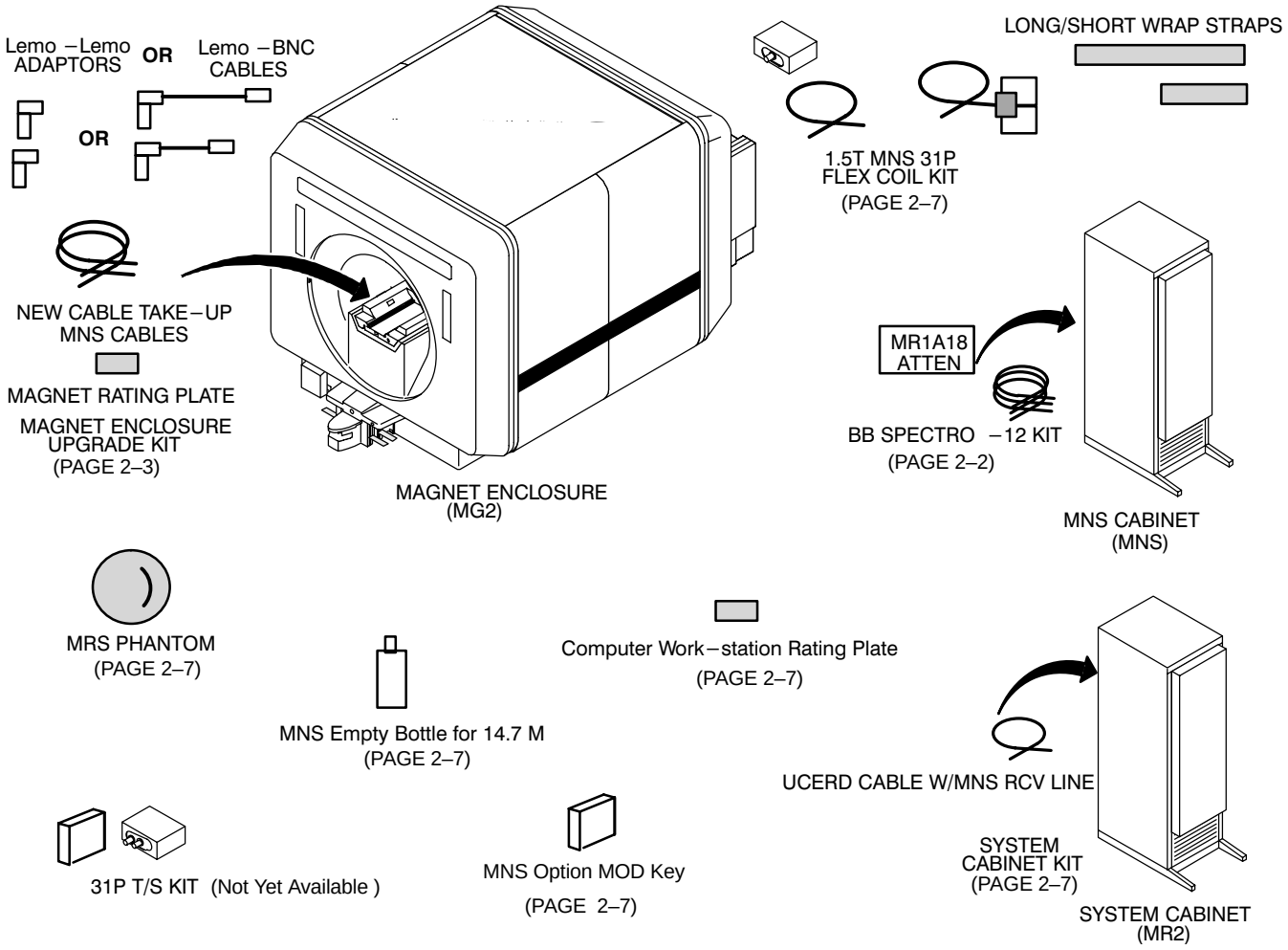


MNS INTERCONNECT CABLE KIT 2263077 PART OF KIT M3090DA

Item	Part Number	FRU	Name	Quantity	Description (Remarks)
1	46–243775G734	2	CABLE	1	RUN 469, (Rcv Coax) PP1–A13–OUT TO MR2–A11–J3
2	46–243775G740	2	CABLE	1	RUN 472, (Rcv Coax) MG3–A17–J4 TO PP1–J79, 80’
3	2269777	1	CABLE	1	RUN 936, (MNS Cab. Pwr Cable) SSM TO MNS J1
4	2267990	N	CABLE	1	6’ SMB To BNC Cable For MNS
5	2263200–53	N	CABLE	1	RUN 961, (I/O Cable) MR1A20J507 TO MNS CNTRL I/O
6	2263200–54	N	CABLE	1	RUN 962, (PMB Cable) MR1A20A1J102 TO MNS PMB
7	2263200–55	N	CABLE	1	RUN 963, (PMA Cable) MR1A20A1J101 TO MNS PMA
8	2263200–56	N	CABLE	1	RUN 964, (TR Bias Cable) MR1A20A2J407 TO MNS TR BIAS
9	2263200–57	N	CABLE	1	RUN 965, (RF in) MR1A20J104 TO MNS RF IN

Item	Part Number	FRU	Name	Quantity	Description (Remarks)
LX S/W MNS Option Key (MOD)				**2254697**	**REV 1 PART OF M3090DA**
1	2254697	2	MOD	1	MOD (8.X MNS Key forSAGE, MNS & PROBE 2000 Software)
LX S/W Options Install (Direction)				**2209382**	**REV 1 PART OF M3090DA**
1	2209382	2	Document	1	MOD S/W Key Installation Document
^{31}P TR FLEX COIL KIT				**2259502**	**REV 1 PART OF M3090DA**
1	2219090	1	$^{1.5T\ 31}$P FLEX COIL	1	1.5T (^{31}P) MNS TRANSMIT/RECEIVE FLEX COIL
2	2224905	1	EXTENSION CABLE	1	EXTENSION CABLE FOR (^{31}P) MNS FLEX COIL
3	2241998	1	1.5T (^{31}P) QD PLUG ASM	1	1.5T (^{31}P) MNS FLEX COIL Q.D. ADAPTER (WITH TRAP) (MG2 A16 A7 A3)
4	2211425	1	COIL STRAP–LONG	1	6 INCH WIDE X 60 INCH LONG POLYNAP STRAP / WRAP
5	2248047	1	COIL STRAP–SHORT	1	203.8 mm WIDE X 444.5 mm LONG POLYNAP STRAP / WRAP
101	2263377–100	1	Oper. MANUAL	1	1.5T MNS (^{31}P) T/R FLEX COIL Operator Manual
For FE Service Replacement of Attached Flex Coil Cable ONLY					
A	46–317287G7	2	REPLACEMENT CABLE	1	FIELD REPLACEMENT CABLE FOR FLEX COIL (2219090)
MRS PHANTOM				**2152220**	**REV 1 PART OF M3090DA**
1	2152220	2	MRS PHANTOM	1	MRS HEAD PHANTOM
MNSPECTRO LX / 8.X OPERATOR MANUAL				**2229281–100**	**REV 1 PART OF M3090DA**
1	2229281–100	N	Oper. MANUAL	1	LX Release 8.3 MNS Features Operator Manual
SA/GE 7 LX / 8.X USER GUIDE				**2228585–100**	**REV 1 PART OF M3090DA**
1	2228585–100	N	SA/GE 7 Users Doc	1	LX Release 8.3 MNS SA/GE 7 User Guide Manual
EMPTY BOTTLE (for Phosphoric Acid)				**46–317299G2**	**REV 1 PART OF M3090DA**
1	46–317299G2	2	EMPTY PLASTIC BOTTLE	1	14.7 MOLAR EMPTY PLASTIC BOTTLE WITH LABEL (for T/S)
System Cabinet MNS Cable				**2144525–2**	**REV 1 PART OF M3090DA**
1	2144525–2	2	cable	1	UCERD (J109) to TNS and I/F Panel Cable (with MNS RCV LINE)
COMPUTER DUPLEX RATING PLATE				**46–302200P3**	**REV 1 PART OF M3090DA**
1	46–302200P3	2	Rating Plate	1	8.X MNS Option Rating Plate: Install on inside panel
MNSPECTRO ^{31}P T/S KIT				**Not Available**	**REV 1 PART OF M3090DA**
1	2259838	2	MNS 25.85 MHz T/S Kit	1	25.85 MHz Sine Wave Oscillator T/S Kit (V/N: 4300A650) Carrying Case with Label (V/N: 4300A655) (GE# 2259838–3) 1.5T ^{31}P Sine Wave Oscillator (50 Ohm, 4 dBm, 25.85 MHz**)** (V/N: 4300A652) (GE# 2259838–2) AC Voltage Converter (V/N: 4300A603) (GE# 46–317724P3) DC Block (V/N 5297 (GE# 46–301549P15)
2	46–282467G1	2	Q.D PLUG ASM	1	$^{1.5T\ 31}$P MNS SERVICE Tool Q.D. ADAPTER (for T/S) (MG2 A16 A7 A3) (box labeled 4.5 Spectroscopy Surface Coil)

SECTION 2 – M3090DB RENEWAL PARTS



ITEM	PART NUMBER	DESCRIPTION OF M3090DB REV 1 CONTENTS	PAGE NUMBER
1	2254697	1.5T MNSpectro MOD Option Key: (2254697DDW)	PAGE 2–7
1	2209382	Service Methods Document/Direction: Install S/W Options MOD	PAGE 2–7
1	2109930–13	MNS RFPen Kit Upgrade(w/out BB RF Amp)	PAGE 2–2
2	46–301548G4	LPCC Magnet Enclosure Upgrade Kit (1.5T ^{31}P hardware)	PAGE 2–3
3	2259502	MNSpectro 1.5T ^{31}P TR Flex Coil Kit (+ Coil Op. Manual)	PAGE 2–7
4	2152220	MRS (MRSpectroscopy) Phantom	PAGE 2–7
5	2229281–100	MNS Operator Manual	PAGE 2–7
6	2228585–100	SA/GE 7 (8.X / LX) User's Guide	PAGE 2–7
7	46–317299G2	Empty Plastic Bottle for T/S (site fills w/ 14.7M conc. Phos. Acid)	PAGE 2–7
8	2144525–2	System Cabinet: UCERD to TNS Cable Kit	PAGE 2–7
1	2220800–2	MNS Cabinet for ASP Upgrade	PAGE 2–4
1	2263077	MNS Cabinet Inteconnect Cables	PAGE 2–5
9	46–302200P3	Kit Added Rating Plate: Serial #, Model #	PAGE 2–7

1.5T MNSPECTRO UPGRADE KIT, PART OF M3090DB

The 2109930–10 Spectro Kit was upgraded to 2109930–11 with the introduction of the RF/PEN 2 Cabinet. Most cables were modified in length to accomodate the RF/PEN 2 Cabinet.

Th M3090DB Catalog provides 2124497–56 and 2124498–40 because many MNS Horizon sites did not receive them in the earlier –10 or –11 Kits.

RF/PEN2 ONLY: SSM (3) micro's are required and were sent out as FMI 60525 to the field. The CPD Board EPLD (U3: new checksumC623, new datecode 10/5/99) must be changed to stop the BroadBand Amplifier from continuing to pulse after a fault has ocurred.

EPLD Vendor Part Number: 5500049.02 (.02 means rev 2).
If the site received a –10 kit and internal cables are too short for the RF/PEN2 cabinet refer to the M1033MA structure for these part numbers.

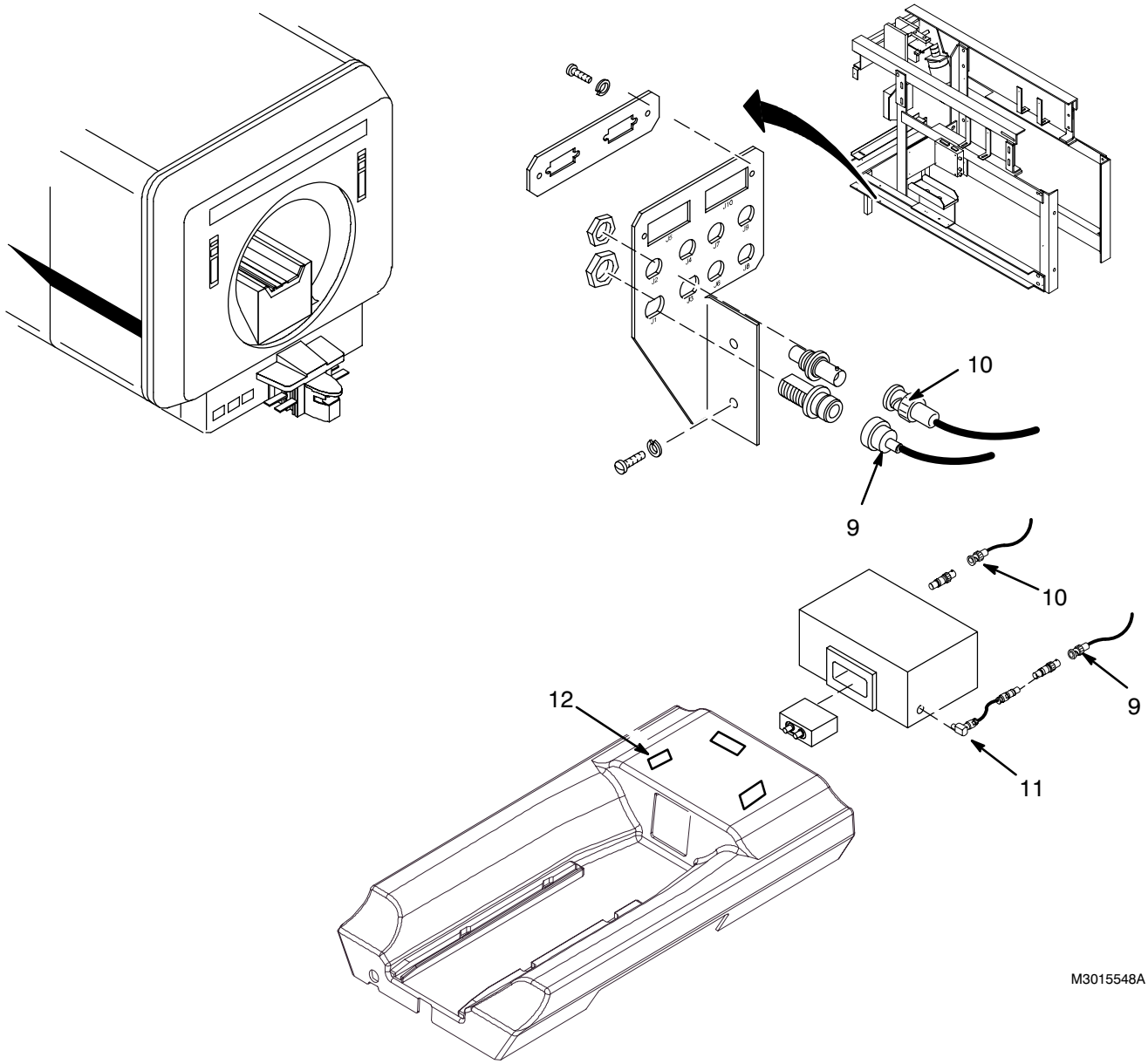
All items are a FRU 2 unless otherwise noted.

TABLE 1–1

1.5T MNSPECTRO KIT UPGRADE

"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
MR1A18J2	MR1A16J3	2124497−56	540031	ATTENUATOR OUT to Spectro Amp RF IN

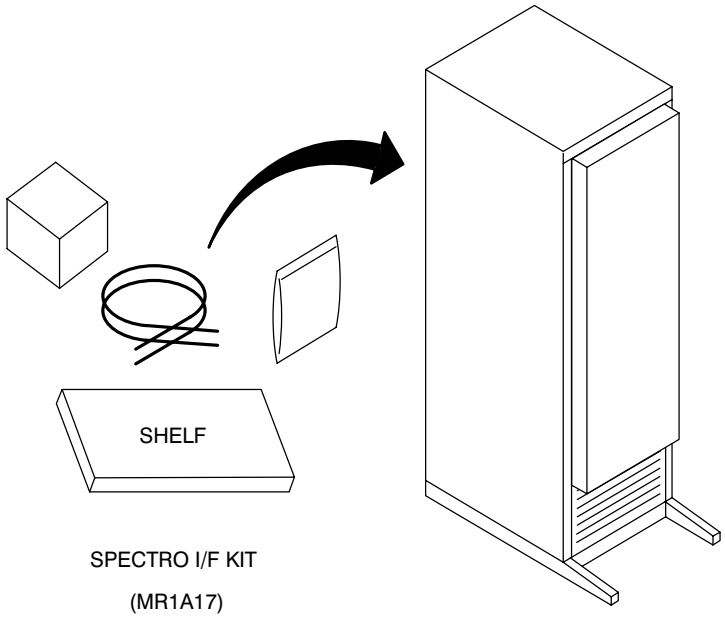
LPCC MAGNET ENCLOSURE KIT (PHOSPHORUS) 46–301548G4 **FOR MG2 AND MG3**



MNSPECTRO COLL 46–301548G4 REV 1 **PART OF M3090DB**

Item	Part Number	FRU	Name	Quantity	Description (Remarks)
9	2257057	2	CABLE	1	(456), (Xmit Coax) MG3 A17 J3 TO MG2 A16 J1
10	2257058	2	CABLE	1	(455), (Rcv Coax) MG3–A17–J4 TO MG2–A16–J2
11	2251522	2	LPCC Kit	2	Right Angle 90 degree Lemo Adaptors (FTR.OS.250.CTA)
11ALT	2259731–2	2	Alternate– LPCC Kit	1	2259728, Xmit lemo–BNC white H.S. cable & 2259728–2 Rcv lemo–BNC white H.S. cable
12	2254250	2	CLIP	5	LPCC Cable Clips for Run 455 and 456

MNS CABINET KIT FOR ASP UPGRADE 2220080–2 FOR M3090DB



SPECTRO I/F KIT

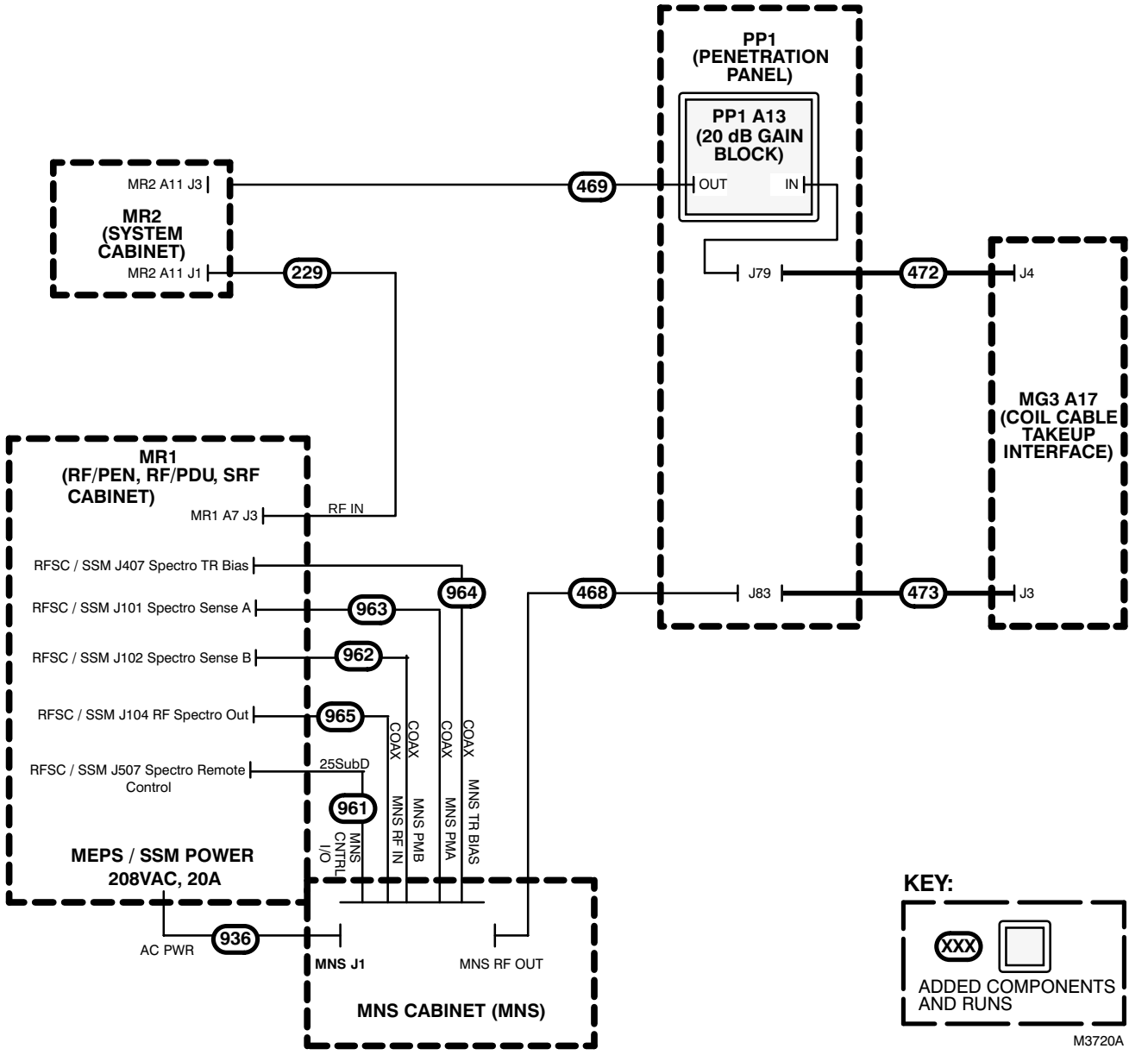
(MR1A17)

MNS CABINET FOR ASP UPGRADE (MNS)

MNS CABINET FOR ASP REV 1 PART OF M3090DB

Item	Part Number	FRU	Name	Quantity	Description (Remarks)
	46–307544P1	2	Circuit Breaker	2	20A, 2 Pole, 250V Circuit Breaker
	46–221865P1	2	N–connector	2	Bulkhead, 50 ohm, N–connector
	46–208990P1	2	BNC Adapter	6	50 ohm, bulkhead adapter
	2275785	1	3–prong socket, 208VAC	1	3–prong, 208VAC socket
	46–271382P29	2	20 amp Circuit Breaker	3	20 amps, 240VAC
	46–271110P1	1	GND Label	1	Protective Earth label
	46–208761P1	2	Cable tie	2	Nylon cable tie
	46–271110P5	2	Label	1	Label, old
	2271171	2	I/F Power Panel Data	1	I/F Power Panel Lead Data
	46–170015P10	2	Screw	16	Screw 05322
	46–170015P19	2	Screw	17	Screw 05792
	46–170012P36	2	Nut	7	6–32 Hex 5/16 nut 7/64 Thck
	46–208935P8	2	Nut	2	1/4–20, 7/16” Hex X 3/16 Thck
	46–208599P5	2	Screw	3	1/4” Screw Size External
	46–220184P54	2	Screw	1	Screw 17882
	46–170012P39	2	Nut	4	Nut, KEPS 10–32, 3/8” Hex
	46–265067P1	2	Cable Screwlock	2	I/F Panel cable screwlock
	46–170015P21	2	Screw	18	Screw 06333
	46–220288P1	2	Nut	14	Self–locking 10–32

MNSPECTROSCOPY SYSTEM IC CABLE KIT 2263077 PART OF M3090DC

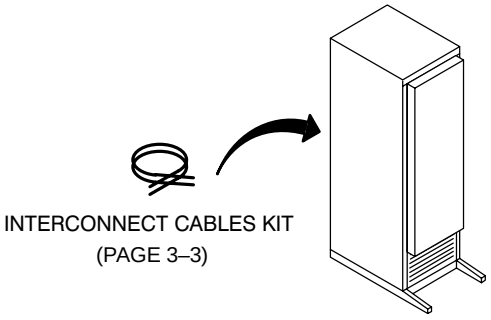


MNS INTERCONNECT CABLE KIT 2263077 PART OF KIT M3090DB

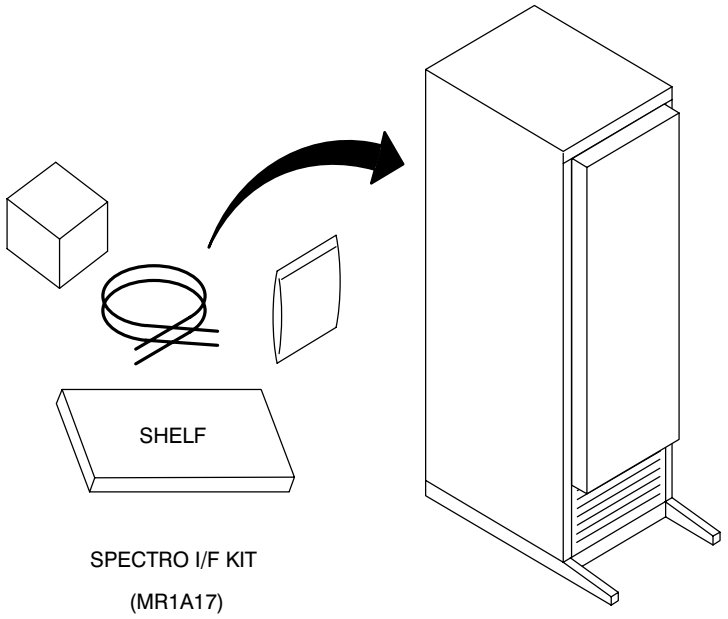
Item	Part Number	FRU	Name	Quantity	Description (Remarks)
1	46–243775G734	2	CABLE	1	RUN 469, (Rcv Coax) PP1–A13–OUT TO MR2–A11–J3
2	46–243775G740	2	CABLE	1	RUN 472, (Rcv Coax) MG3–A17–J4 TO PP1–J79, 80’
3	2269777	1	CABLE	1	RUN 936, (MNS Cab. Pwr Cable) SSM TO MNS J1
4	2267990	N	CABLE	1	6’ SMB To BNC Cable For MNS
5	2263200–53	N	CABLE	1	RUN 961, (I/O Cable) MR1A20J507 TO MNS CNTRL I/O
6	2263200–54	N	CABLE	1	RUN 962, (PMB Cable) MR1A20A1J102 TO MNS PMB
7	2263200–55	N	CABLE	1	RUN 963, (PMA Cable) MR1A20A1J101 TO MNS PMA
8	2263200–56	N	CABLE	1	RUN 964, (TR Bias Cable) MR1A20A2J407 TO MNS TR BIAS
9	2263200–57	N	CABLE	1	RUN 965, (RF in) MR1A20J104 TO MNS RF IN

Item	Part Number	FRU	Name	Quantity	Description (Remarks)
LX S/W MNS Option Key (MOD)				**2254697**	**REV 1 PART OF M3090DB**
1	2254697	2	MOD	1	MOD (8.X MNS Key forSAGE, MNS & PROBE 2000 Software)
LX S/W Options Install (Direction)				**2209382**	**REV 1 PART OF M3090DB**
1	2209382	2	Document	1	MOD S/W Key Installation Document
^{31}P TR FLEX COIL KIT				**2259502**	**REV 1 PART OF M3090DB**
1	2219090	1	$^{1.5T\ 31}$P FLEX COIL	1	1.5T (^{31}P) MNS TRANSMIT/RECEIVE FLEX COIL
2	2224905	1	EXTENSION CABLE	1	EXTENSION CABLE FOR (^{31}P) MNS FLEX COIL
3	2241998	1	1.5T (^{31}P) QD PLUG ASM	1	1.5T (^{31}P) MNS FLEX COIL Q.D. ADAPTER (WITH TRAP) (MG2 A16 A7 A3)
4	2211425	1	COIL STRAP–LONG	1	6 INCH WIDE X 60 INCH LONG POLYNAP STRAP / WRAP
5	2248047	1	COIL STRAP–SHORT	1	203.8 mm WIDE X 444.5 mm LONG POLYNAP STRAP / WRAP
101	2263377–100	1	Oper. MANUAL	1	1.5T MNS (^{31}P) T/R FLEX COIL Operator Manual
For FE Service Replacement of Attached Flex Coil Cable ONLY					
A	46–317287G7	2	REPLACEMENT CABLE	1	FIELD REPLACEMENT CABLE FOR FLEX COIL (2219090)
MRS PHANTOM				**2152220**	**REV 1 PART OF M3090DB**
1	2152220	2	MRS PHANTOM	1	MRS HEAD PHANTOM
MNSPECTRO LX / 8.X OPERATOR MANUAL				**2229281–100**	**REV 1 PART OF M3090DB**
1	2229281–100	N	Oper. MANUAL	1	LX Release 8.3 MNS Features Operator Manual
SA/GE 7 LX / 8.X USER GUIDE				**2228585–100**	**REV 1 PART OF M3090DB**
1	2228585–100	N	SA/GE 7 Users Doc	1	LX Release 8.3 MNS SA/GE 7 User Guide Manual
EMPTY BOTTLE (for Phosphoric Acid)				**46–317299G2**	**REV 1 PART OF M3090DB**
1	46–317299G2	2	EMPTY PLASTIC BOTTLE	1	14.7 MOLAR EMPTY PLASTIC BOTTLE WITH LABEL (for T/S)
System Cabinet MNS Cable				**2144525–2**	**REV 1 PART OF M3090DB**
1	2144525–2	2	cable	1	UCERD (J109) to TNS and I/F Panel Cable (with MNS RCV LINE)
COMPUTER DUPLEX RATING PLATE				**46–302200P3**	**REV 1 PART OF M3090DB**
1	46–302200P3	2	Rating Plate	1	8.X MNS Option Rating Plate: Install on inside panel
MNSPECTRO ^{31}P T/S KIT				**Not Available**	**REV 1 PART OF M3090DB**
1	2259838	2	MNS 25.85 MHz T/S Kit	1	25.85 MHz Sine Wave Oscillator T/S Kit (V/N: 4300A650) Carrying Case with Label (V/N: 4300A655) (GE# 2259838–3) 1.5T ^{31}P Sine Wave Oscillator (50 Ohm, 4 dBm, 25.85 MHz**)** (V/N: 4300A652) (GE# 2259838–2) AC Voltage Converter (V/N: 4300A603) (GE# 46–317724P3) DC Block (V/N 5297 (GE# 46–301549P15)
2	46–282467G1	2	Q.D PLUG ASM	1	$^{1.5T\ 31}$P MNS SERVICE Tool Q.D. ADAPTER (for T/S) (MG2 A16 A7 A3) (box labeled 4.5 Spectroscopy Surface Coil)

SECTION 3 – RENEWAL PARTS FOR M3090DC



MNS CABINET KIT FOR ASP UPGRADE 2220080–2 FOR M3090DC



SPECTRO I/F KIT

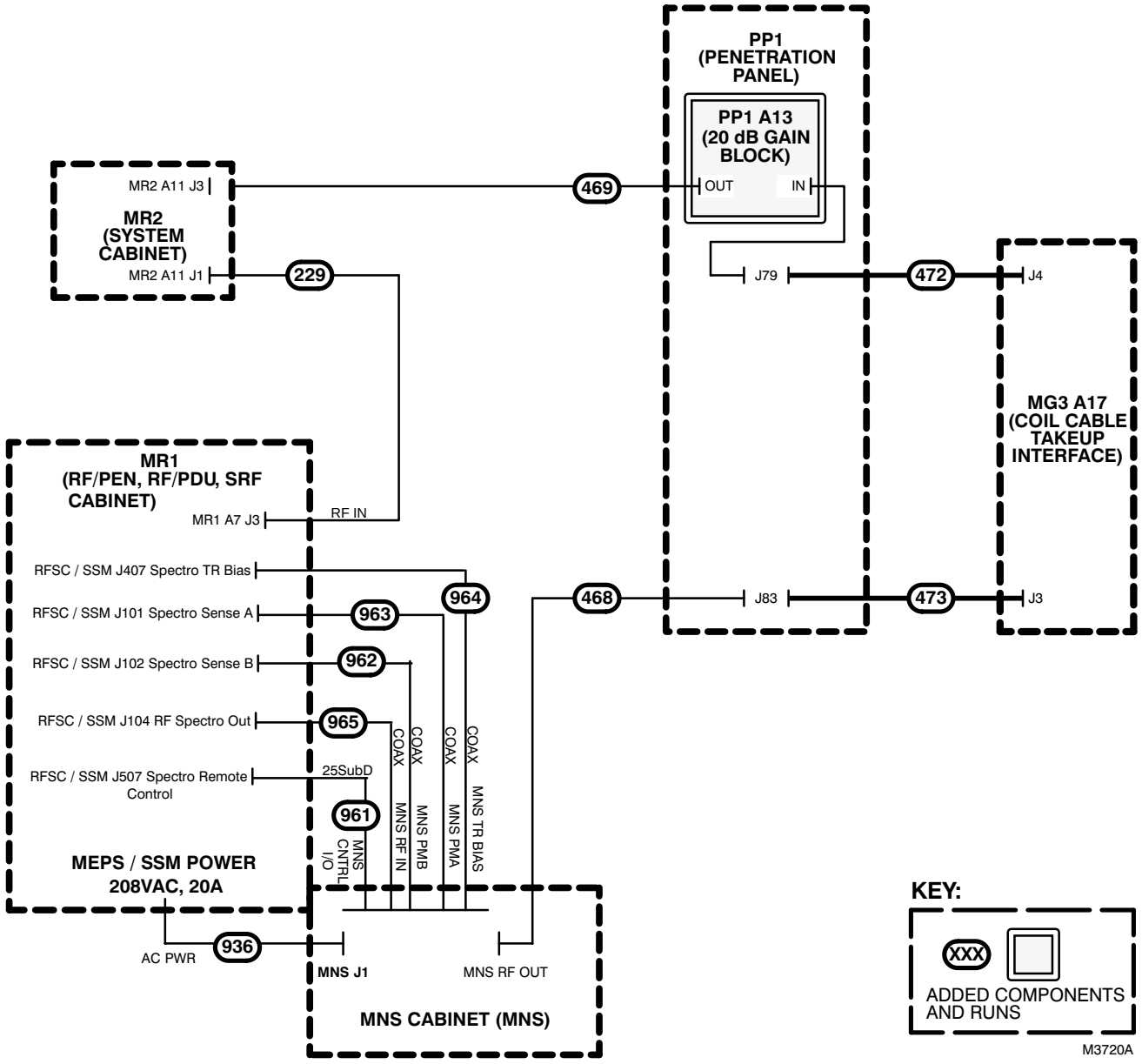
(MR1A17)

MNS CABINET FOR ASP UPGRADE (MNS)

MNS CABINET FOR ASP REV 1 PART OF M3090DB

Item	Part Number	FRU	Name	Quantity	Description (Remarks)
	46–307544P1	2	Circuit Breaker	2	20A, 2 Pole, 250V Circuit Breaker
	46–221865P1	2	N–connector	2	Bulkhead, 50 ohm, N–connector
	46–208990P1	2	BNC Adapter	6	50 ohm, bulkhead adapter
	2275785	1	3–prong socket, 208VAC	1	3–prong, 208VAC socket
	46–271382P29	2	20 amp Circuit Breaker	3	20 amps, 240VAC
	46–271110P1	1	GND Label	1	Protective Earth label
	46–208761P1	2	Cable tie	2	Nylon cable tie
	46–271110P5	2	Label	1	Label, old
	2271171	2	I/F Power Panel Data	1	I/F Power Panel Lead Data
	46–170015P10	2	Screw	16	Screw 05322
	46–170015P19	2	Screw	17	Screw 05792
	46–170012P36	2	Nut	7	6–32 Hex 5/16 nut 7/64 Thck
	46–208935P8	2	Nut	2	1/4–20, 7/16” Hex X 3/16 Thck
	46–208599P5	2	Screw	3	1/4” Screw Size External
	46–220184P54	2	Screw	1	Screw 17882
	46–170012P39	2	Nut	4	Nut, KEPS 10–32, 3/8” Hex
	46–265067P1	2	Cable Screwlock	2	I/F Panel cable screwlock
	46–170015P21	2	Screw	18	Screw 06333
	46–220288P1	2	Nut	14	Self–locking 10–32

MNSPECTROSCOPY SYSTEM IC CABLE KIT 2263077 PART OF M3090DC

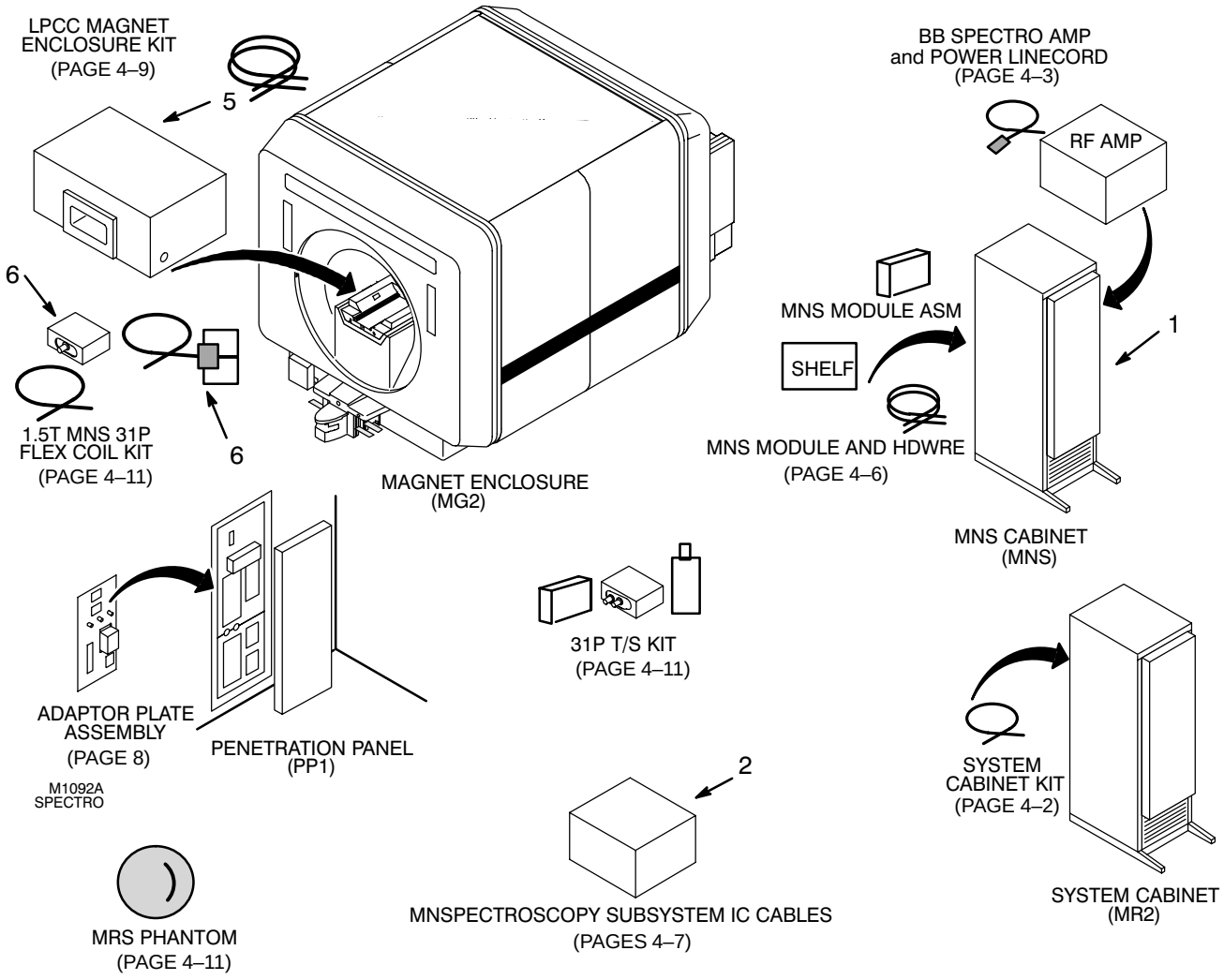


MNS INTERCONNECT CABLE KIT 2263077 PART OF KIT M3090DC

Item	Part Number	FRU	Name	Quantity	Description (Remarks)
1	46–243775G734	2	CABLE	1	RUN 469, (Rcv Coax) PP1–A13–OUT TO MR2–A11–J3
2	46–243775G740	2	CABLE	1	RUN 472, (Rcv Coax) MG3–A17–J4 TO PP1–J79, 80’
3	2269777	1	CABLE	1	RUN 936, (MNS Cab. Pwr Cable) SSM TO MNS J1
4	2267990	N	CABLE	1	6’ SMB To BNC Cable For MNS
5	2263200–53	N	CABLE	1	RUN 961, (I/O Cable) MR1A20J507 TO MNS CNTRL I/O
6	2263200–54	N	CABLE	1	RUN 962, (PMB Cable) MR1A20A1J102 TO MNS PMB
7	2263200–55	N	CABLE	1	RUN 963, (PMA Cable) MR1A20A1J101 TO MNS PMA
8	2263200–56	N	CABLE	1	RUN 964, (TR Bias Cable) MR1A20A2J407 TO MNS TR BIAS
9	2263200–57	N	CABLE	1	RUN 965, (RF in) MR1A20J104 TO MNS RF IN

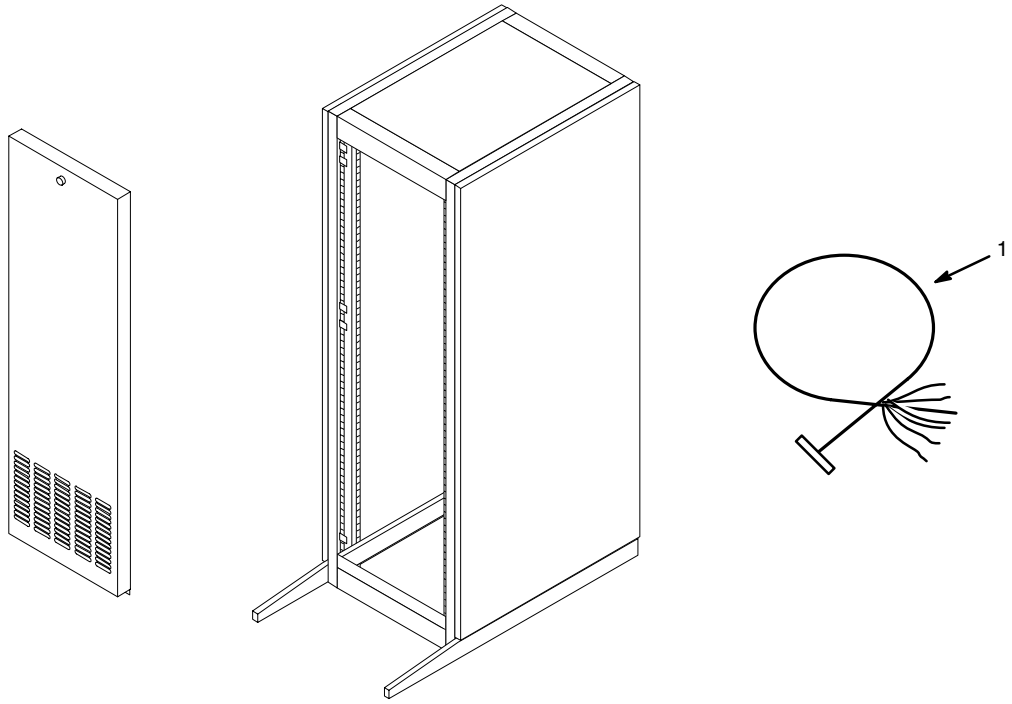
Item	Part Number	FRU	Name	Quantity	Description (Remarks)
COMPUTER DUPLEX RATING PLATE				**46–302200P3**	**REV 1 PART OF M3090DC**
1	46–302200P3	2	Rating Plate	1	8.X MNS Option Rating Plate: Install on inside panel

SECTION 4 – RENEWAL PARTS FOR M1033MD



ITEM	PART NUMBER	DESCRIPTION OF M1033MD REV 0 CONTENTS	PAGE NUMBER
1	2220080	MNS Cabinet Assembly (MNS)	PAGE 4–3
2	46–301824G4	MNSpectroscopy Subsystem Interconnect Cable Kit	PAGE 4–7
3	2229281–100	MNS Operators Manual	PAGE 4–11
4	2136365	Pen. Panel Kit (Adaptor Plate Asm.)	PAGE 4–8
5	46–301548G5	LPCC Magnet Enclosure Kit (1.5T ^{31}P hardware)	PAGE 4–9
6	2259502	MNSpectro ^{31}P TR Flex Coil Kit (1.5T ^{31}P specific hardware)	PAGE 4–11
7	2152220	MRS Phantom	PAGE 4–11
8	Pending	MNS 1.5T ^{31}P Trouble–Shooting Kit	PAGE 4–11
9	2228585–100	SA/GE 7 LX User's Guide	PAGE 4–11
10	2259873	MNS Option Key/Rating Plate/Install Sheet	PAGE 4–11
11	46–317299G2	Empty Plastic Bottle for T/S: fill with concentrated Phosphoric Acid	PAGE 4–11
12	2144525–2	System Cabinet: UCERD to TNS Cable Kit	PAGE 4–2
13	46–302200P3	Kit Added Rating Plate–No S/N	PAGE 4–11

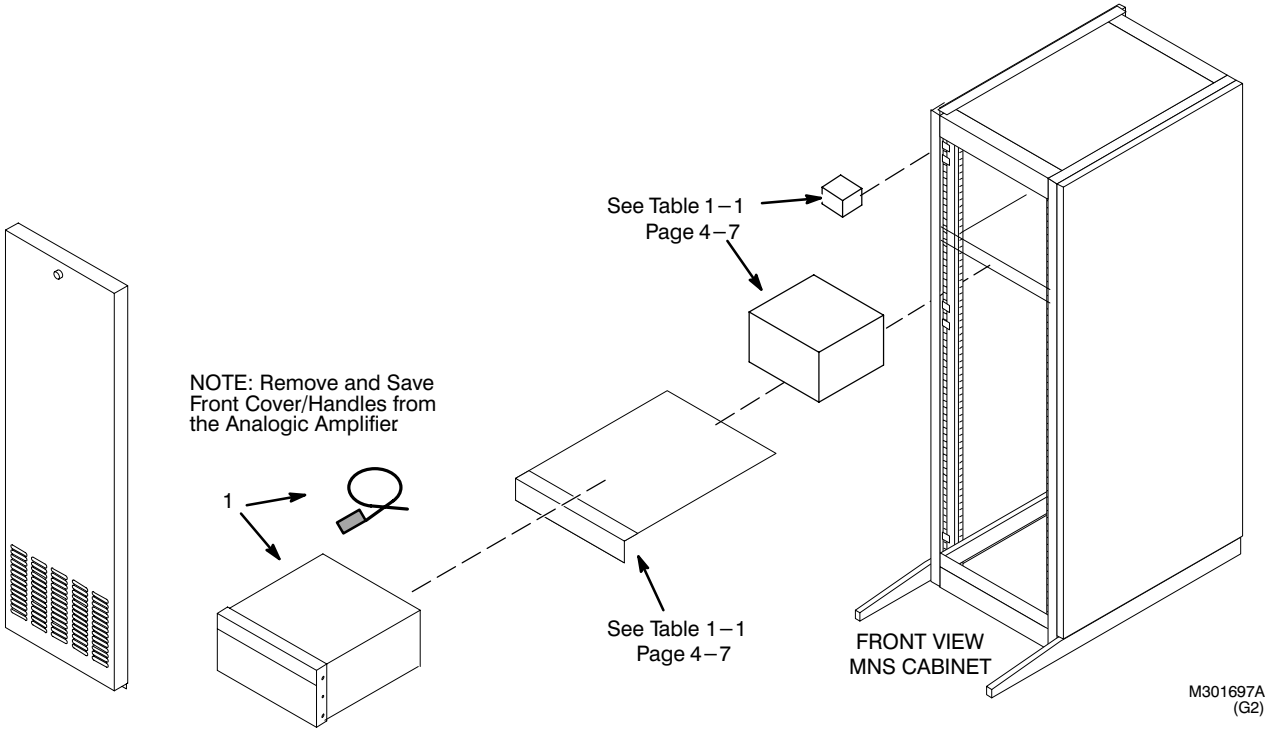
SYSTEM CABINET KIT 2144525–2



SYS CAB KIT 2144525–2 REV 0 PART OF M1033MD

Item	Part Number	FRU	Name	Quantity	Description (Remarks)
1	2144525–2	1	Cable	1	UCERD (J109) to TNS and I/F Panel Cable

MNS CABINET ASSEMBLY **2220080** **PART OF M1033MD**



MNS CABINET **2204799** **PART OF M1033MD**

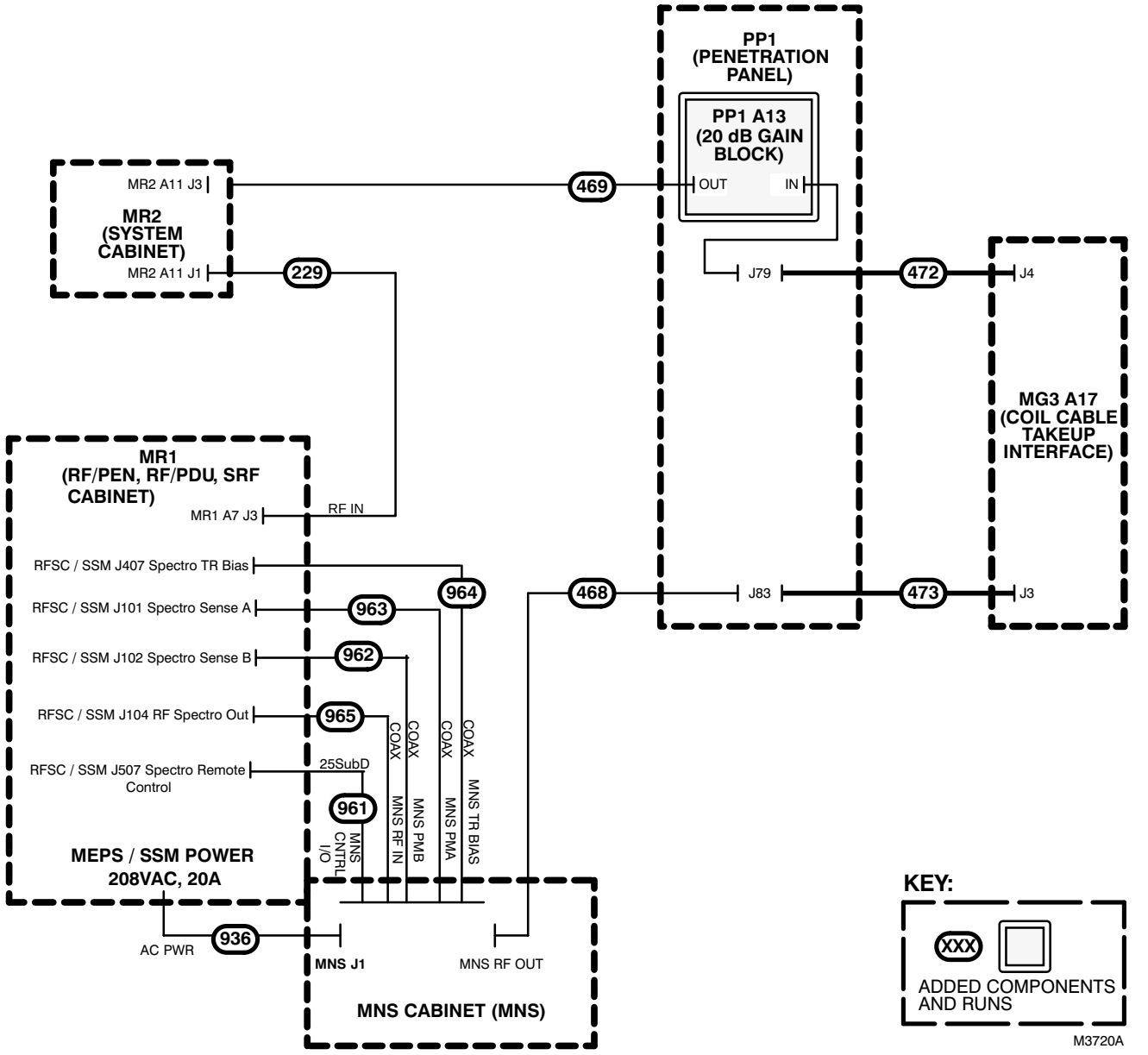
Item	Part Number	FRU	Name	Quantity	Description (Remarks)
	2204799	N	Broadband Cab.	1	MNS Broadband Cabinet
1	46–301464P2	1	BROADBAND AMP	1	ANALOGIC RF AMPLIFIER & Linecord, MR1A16

Linecord Only––Vendor Number

ANALOGIC BROADBAND AMP Vendor Part

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

MNSPECTROSCOPY SYSTEM IC CABLE KIT 46−301824G4 PART OF M1033MD



MNS INTERCONNECT CABLE KIT 46−301824G4 PART OF KIT M1033MD

Item	Part Number	FRU	Name	Quantity	Description (Remarks)
1	46−243775G734	2	CABLE	1	RUN 469, (Rcv Coax) PP1−A13−OUT TO MR2−A11−J3
2	46−243775G740	2	CABLE	1	RUN 472, (Rcv Coax) MG3−A17−J4 TO PP1−J79, 80’
19	46−301837P2	2	CABLE	1	RUN 468, (Xmit Heliax) PP1−J83 TO MR1−A7−J45
20	46−301838P1	2	CABLE	1	RUN 473, (SC Xmit Heliax) MG3−A17−J3 TO PP1−J83
3	2269777	1	CABLE	1	RUN 936, (MNS Cab. Pwr Cable) SSM TO MNS J1
5	2263200−53	N	CABLE	1	RUN 961, (I/O Cable) MR1A20J507 TO MNS CNTRL I/O
6	2263200−54	N	CABLE	1	RUN 962, (PMB Cable) MR1A20A1J102 TO MNS PMB
7	2263200−55	N	CABLE	1	RUN 963, (PMA Cable) MR1A20A1J101 TO MNS PMA
8	2263200−56	N	CABLE	1	RUN 964, (TR Bias Cable) MR1A20A2J407 TO MNS TR BIAS
9	2263200−57	N	CABLE	1	RUN 965, (RF in) MR1A20J104 TO MNS RF IN

1.5T MNSPECTRO HARDWARE LISTING **PART OF M1033MD**

All items are a FRU 2 unless otherwise noted.

TABLE 1–1

1.5T MNS CABINET CABLES AND HARDWARE

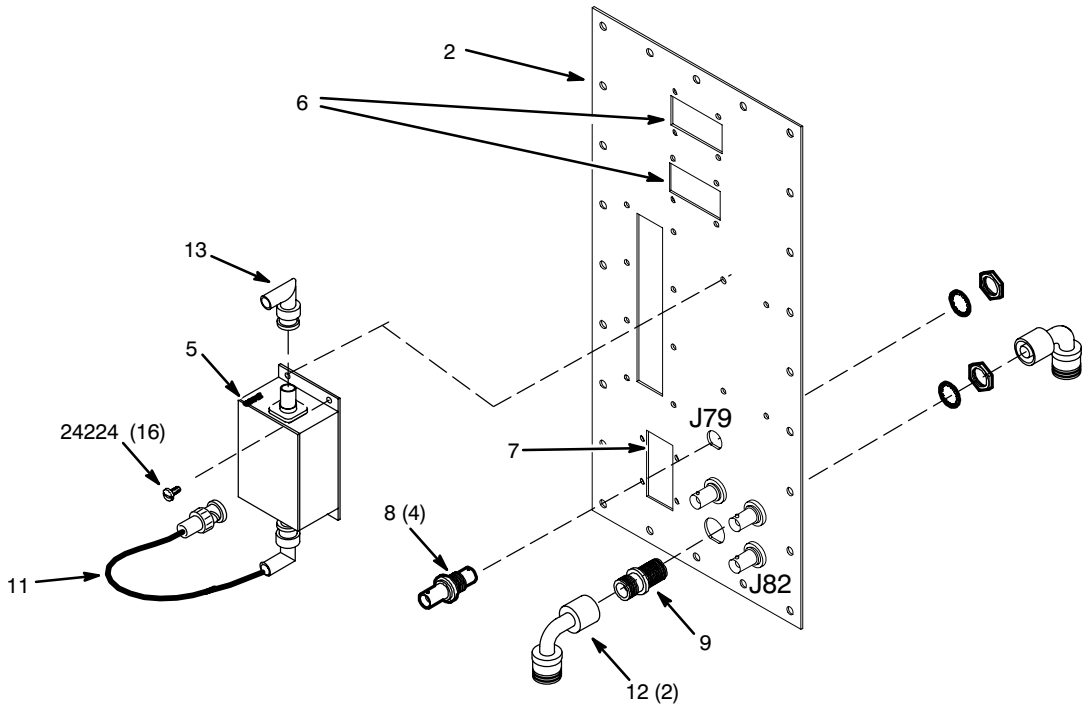
"FROM"	"TO"	GE #	VENDOR #	REMARKS
MR1A17 Ground	MNS Cabinet Chassis	2275299	540040	SPECTRO GROUND WIRE (to ground studs)
MR1A15J104 **MR1A20A1J104**	MR1A18J1	2275299–2	540041	SPECTRO RF IN to ATTENUATOR IN
MR1A18J2	MR1A16J3	2124497–56	540031	ATTENUATOR OUT to Spectro Amp RF IN
MR1A17J5	MR1A7J45	2275299–3	540004	SPECTRO RF OUT + TR BIAS
MR1A15J507 **MR1A20J507**	MR1A17J7	2275299–4	540043	SPECTRO I/F CABLE ASSEMBLY (main cable)
MR1A15J407 **MR1A20A2J407**	MR1A17J4	2275299–5	540044	SPECTRO TR BIAS
MR1A17J3	MR1A15J102 **MR1A20A1J102**	2275299–6	540045	SPECTRO POWER MONITOR SENSE B
MR1A17J2	MR1A15J101 **MR1A20A1J101**	2275299–7	540046	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/PDU sites may need to adhere the proper label to its associated cable.		2124498–36	401–2007	CABLE LABEL KIT (1) MR1A20A1J104 (1) MR1A20J507 (1) MR1A20A2J407 (1) MR1A20A1J102 (1) MR1A20A1J101

TABLE 1–1 (Continued)

1.5T MNS CABINET CABLES AND HARDWARE

"FROM"	"TO"	GE #	VENDOR #	REMARKS
ALL MR1A18 is mounted on the top right horizontal rail as viewed from the rear	N/A	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	N/A	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**	N/A	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**	N/A	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

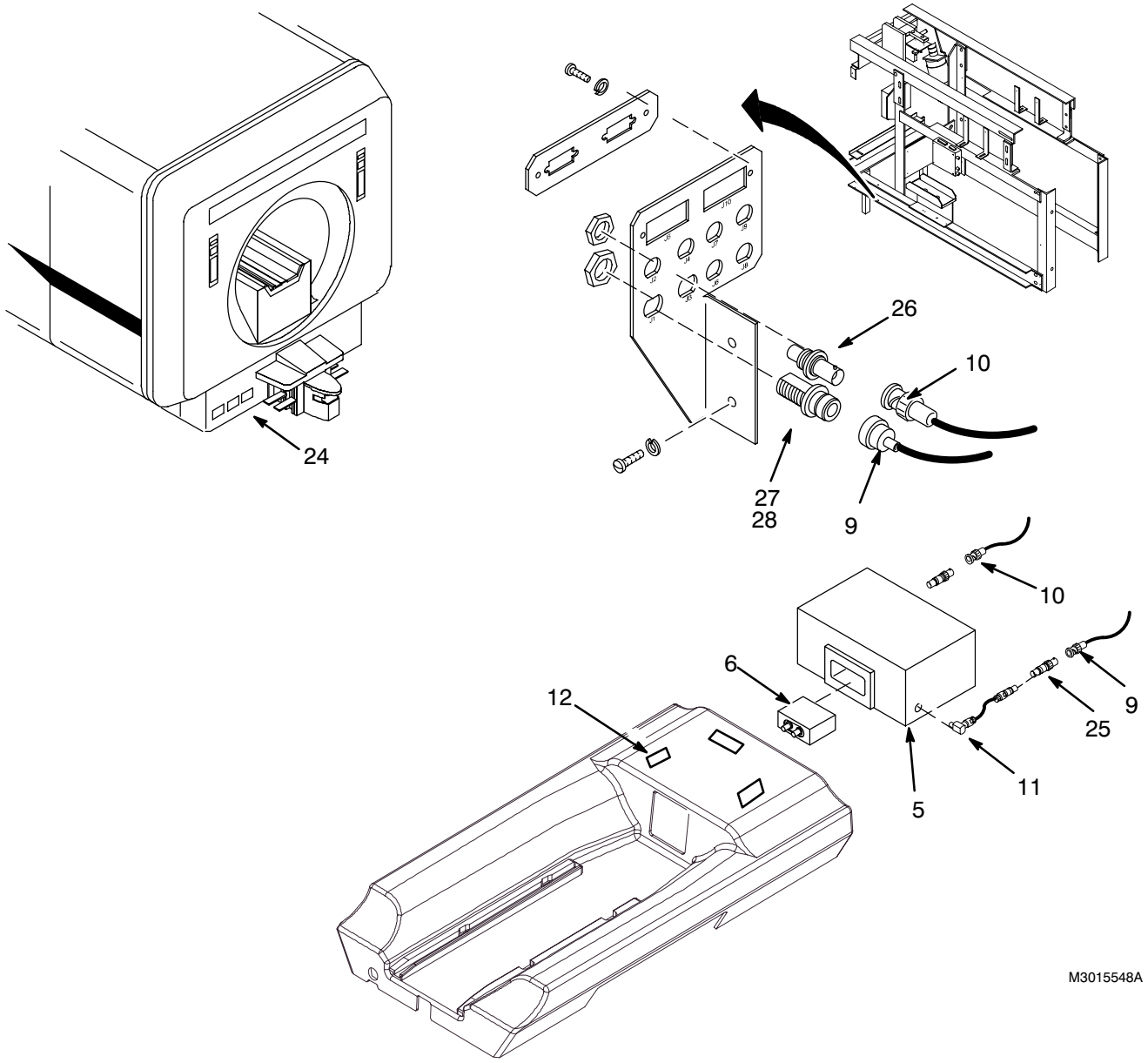
20 dB GAIN BLOCK (PP1 A13) PLATE ASM 2136365 **PART OF M1033MD**



ADAPTOR PLATE ASM 2136365 REV 0 **PART OF M1033MD**

Item	Part Number	FRU	Name	Quantity	Description (Remarks)
1	2136365ADW	N	DRAWING	0	ADAPTER PLATE ASEMBLY DRAWING
2	2133757	2	PLATE	1	EMPTY FILTER PLATE FOR MULTICOIL/SPECT.
5	46–264814G1	1	CIRCUIT BD	1	20 dB GAIN BLOCK (PP1 A13)
6	46–301973P1	2	PLATE	2	PANEL OPENING COVER
7	46–301974P1	2	PLATE	1	PANEL OPENING COVER (S/C 58977)
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
13	46–233422P1	2	BNC ANG AD	1	BNC JACK–PLUG, RIGHT ANGLE ADAPTER (S/C 40062)
14	46–208921P4	N	DRAWING	0	MNSPECTRO INSTALLATION DRAWING
24224	46–208921P4	2	SCREW,MACH	16	006–32 X 0.250 LG BIND HD BRASS SCREW

LPCC MAG ENCL KIT (PHOSPHORUS) 46–301548G5 FOR MG2 AND MG3



LPCC SPECTRO COLL 46–301548G5 REV 0 PART OF M1033MD

Item	Part Number	FRU	Name	Quantity	Description (Remarks)
1	46–301511	N	Install Drawing	0	Installation Drawing
2	46–301600	N	Drill Hole Drawing	1	Drill Hole Location Drawing
5	2100718	1	SPECT BOX	1	1.5T ^{31}P MNSPECTROSCOPY TR MODULE (MG2 A16 A7)
6	46–282467G4	1	SPECT COIL ADPTR	1	SPECTRO COIL ADAPTER (MG2 A16 A7 A3)
9	2257057	2	CABLE	1	(456), (Xmit Coax with white H.S.) MG3 A17 J3 TO MG2 A16 J1
10	2257058	2	CABLE	1	(455), (Rcv Coax with white H.S.) MG3–A17–J4 TO MG2–A16–J2
11	46–301205P1	2	LEMO–LEMO CABLE	2	Lemo to Lemo Cable
12	2254250	2	CABLE CLIP	5	Cable Clips for Runs 455 and 456

LPCC SPECTRO COLL 46–301548G5 REV 0 PART OF M1033MD (CONTINUED)

Item	Part Number	FRU	Name	Quantity	Description (Remarks)
24	46–302200P12	N	RATING PLATE	1	MNS Modification Kit Added (magnet enclosure)
25	46–301338P1	2	BNC ADAPTER	2	BNC–Lemo Adaptor
26	46–208990P1	2	BNC ADAPTER	1	BNC Bulkhead Adapter
27	46–221865P1	2	N ADAPTER	1	UG–30, N Bulkhead Adapter, 50–ohm
28	46–306506P1	2	N STRAIGHT ADPTR	1	SC–N Adapter
	2259731 (–1)	2	LPCC Kit	2	2251522, Lemo Rt. Angle Adaptor (FTR.OS.250.CTA)
ALT	2259731–2	2	ALT LPCC Kit	2	2259728, Xmit lemo–BNC white H.S. & 2259728–2 Rcv lemo–BNC white H.S.

^{31}P TR FLEX COIL KIT 2259502 REV 0 PART OF M1033MD

Item	Part Number	FRU	Name	Quantity	Description (Remarks)
1	2219090	1	$^{1.5T\ 31}$P FLEX COIL	1	1.5T (^{31}P) PHOSPHORUS TRANSMIT/RECEIVE FLEX COIL
2	2241998	1	1.5T (^{31}P) QD PLUG ASM	1	1.5T (^{31}P) PHOSPHORUS FLEX COIL Q.D. ADAPTER (WITH TRAP) (MG2 A16 A7 A3)
3	2224905	1	EXTENSION CABLE	1	EXTENSION CABLE FOR TRANSMIT/RECEIVE FLEX COIL
4	2211425	1	COIL STRAP–LONG	1	6 INCH WIDE X 60 INCH LONG POLYNAP STRAP / WRAP
5	2248047	1	COIL STRAP–SHORT	1	203.8 mm WIDE X 444.5 mm LONG POLYNAP STRAP / WRAP
6	2263377–100	N	Oper. MANUAL	1	1.5T MNS (^{31}P) PHOSPHORUS T/R FLEX COIL Operator Manual
7	2257047	1	DOCUMENT	1	1.5T MNS & PHOSPHORUS T/R FLEX COIL INSTALL DOC.

For FE Service Replacement of Attached Flex Coil Cable ONLY

A	46–317287G7	2	REPLACEMENT CABLE	1	FIELD REPLACEMENT CABLE FOR FLEX COIL (2219090)

MNSPECTRO ^{31}P T/S KIT 2259838 REV 0 PART OF M1033MD

1	**TBD**	2	MNS 25.85 MHz T/S Kit	1	25.85 MHz Sine Wave Oscillator T/S Kit (V/N: 4300A650) Carrying Case with Label (V/N: 4300A655) (GE# XXXX) 1.5T ^{31}P Sine Wave Oscillator (50 Ohm, 4 dBm, 25.85 MHz**)** (V/N: 4300A652) (GE# XXXX) AC Voltage Converter (V/N: 4300A603) (GE# 46–317724P3)
2	46–282467G1	2	Q.D PLUG ASM	1	$^{1.5T\ 31}$P MNS SERVICE Tool Q.D. ADAPTER (for T/S) (MG2 A16 A7 A3) (box labeled 4.5 Spectroscopy Surface Coil)
3	46–317299G2	2	EMPTY PLASTIC BOTTLE	1	14.7 MOLAR EMPTY PLASTIC BOTTLE WITH LABEL (for T/S)

MNSPECTRO OPTION KEY 2259873 REV 0 PART OF M1033MD

1	2254697	2	8.X MNS KEY	1	8.X MNS Key (SAGE, MNS & PROBE 2000 Software) [MOD]
2	2209382	N	DOCUMENT	1	LX Release SW KEY INSTALL DOCUMENT
3	46–302200P3	2	Rating Plate	1	8.X MNS Option Rating Plate (ICD) at Workstation Cover
4	2229281–100	N	Oper. MANUAL	1	LX Release 8.3 MNS Features Operator Manual
5	2257047	N	DOCUMENT	1	1.5T MNS & PHOSPHORUS T/R FLEX COIL INSTALL DOC.
6	2228585–100	N	DOCUMENT	1	SA/GE 7 LX Users Guide

MRS PHANTOM 2152220 REV 0 PART OF M1033MD

1	2152220	2	MRS PHANTOM	1	MRS HEAD PHANTOM

RATING PLATE 46–301548G5 REV 0 PART OF M1033MD

24	46–302200P12	N	RATING PLATE	1	MNS Modification Kit Added (magnet enclosure)

EMPTY BOTTLE (for Phosphoric Acid) 46–317299G2 REV 0 PART OF M1033MD

11	46–317299G2	2	EMPTY PLASTIC BOTTLE	1	14.7 Molar Empty Plastic Bottle with Label (For T/S)