SECTION 1 – BROADBAND MULTI–NUCLEAR FUNCTIONAL TESTS

Note

This Section applies to M1040FF and M1040FK.

Description

This section tests the Signa Advantage Multi–Nuclear Spectroscopy hardware and software using the resonant frequency of phosphorus (^{31}P). Initially, the basic Signa Advantage will be verified to be operating properly. Then the proper operation of Spectroscopy specific hardware is checked.

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

The data obtained during the Phosphorus Signal to Noise – Averaging Test is stored as N12345.001 Spectroscopy raw data files in the :SYSTEM:SPECRAW directory on the MV/4000 or MV/7800 Computer (/usr/g/data/specfid or /usr/g/mrspecraw for 5.X). The N12345.001 files are transferred to a Sun workstation for analysis with the SA/GE Spectroscopy Analysis Software or to a Nicolet SDS for analysis.

Initial Conditions

- Catalog M1040FF or M1040FK, Signa Advantage Spectroscopy (BroadBand, Multi–nuclear hardware) fully operational.
- Keytape (4.X) installed or Spectroscopy Option and Research Option Keys (5.X) installed.
- Release 4.X ONLY: Catalog M1040HTS, Hydrogen Only (EPROM) installed or Release 5.X ONLY: Catalog M1090MC, Second Hard Drive and Catalog M1040HT, Hydrogen Only (hardware key, EPROM) installed.
- 4.5 (or later) Release Signa Advantage or 5.1 (or later) Release Signa Advantage 1.5T software fully operational.
- System Noise Floor Check, Direction 15300 (4.X) / Direction 15400 (5.X) has been performed and acceptance specifications met.
- Signal to Noise Check, Direction 15300 (4.X) / DIrection 15400 (5.X) has been performed and acceptance specifications met.
- Magnet has been shimmed and acceptance specifications met.

Tools Required

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

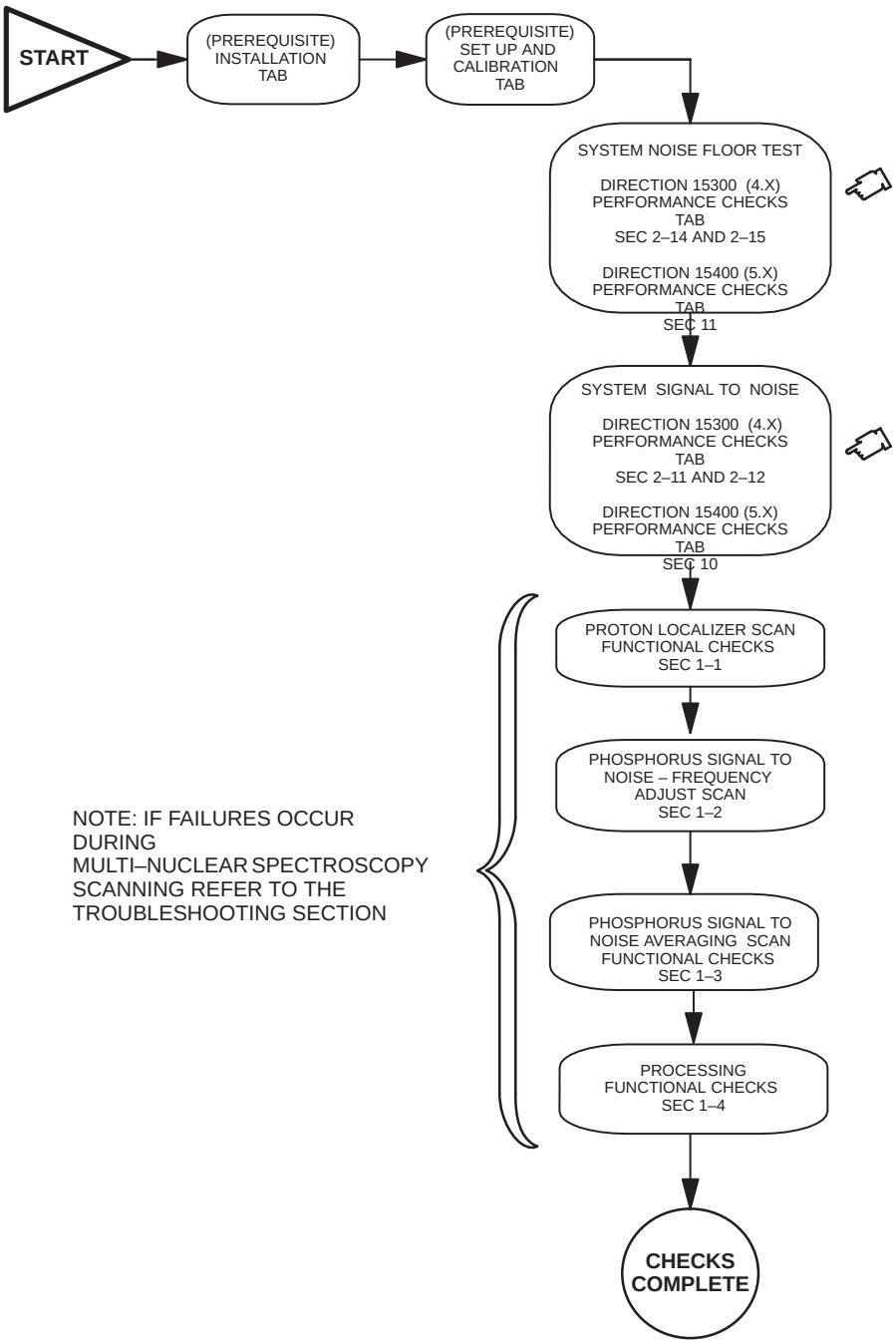
Item	Description	Part Number	Qty.
1.	8"/3" Phosphorus Spectroscopy surface coil	46–265204G3	1
2.	0.050 M Phosphoric Acid Solution MSDS #8360515	46–317299G1	1
3.	14.7 M Phosphoric Acid Solution MSDS #8360515	46–317299G2	1

Note

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

Flow Chart

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



SPECTROSCOPY FUNCTION CHECK FLOW CHART
ILLUSTRATION 1–1

1–1 PROTON LOCALIZER SCAN

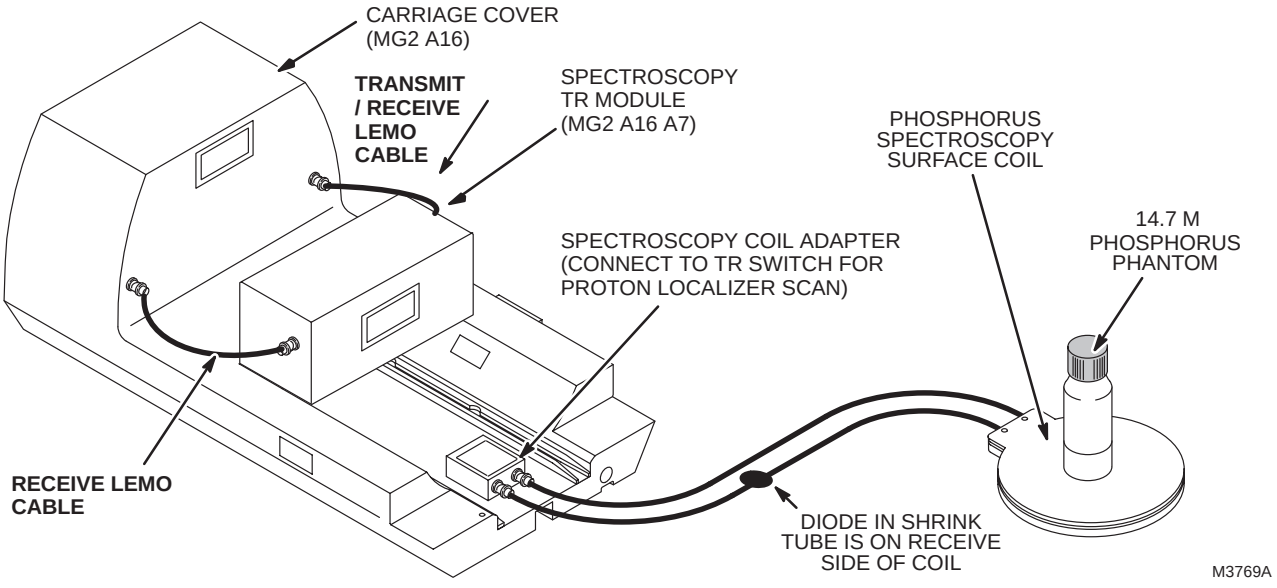
CAUTION

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

1. Position Phosphorus Spectroscopy TR Module (MG2 A16 A7) on Carriage Cover (MG2 A16) as shown in Illustration 1–2.

CAUTION

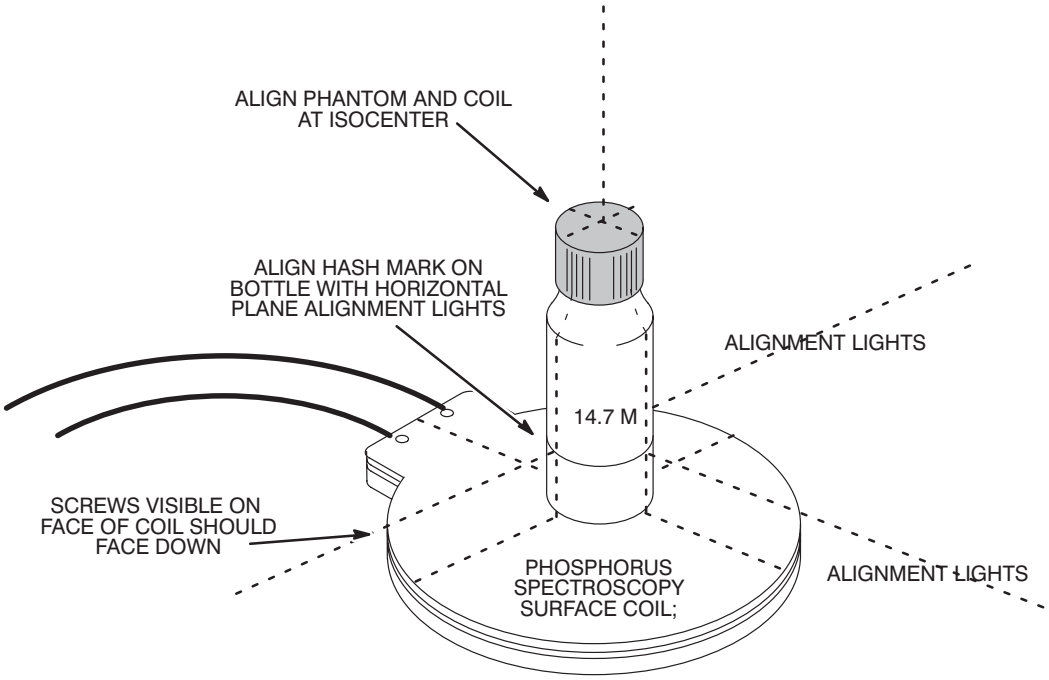
Do not leave the Spectroscopy TR Module installed (connected / disconnected) during non–spectroscopy scanning. The Spectroscopy TR Module will be installed during Proton localizer scans per this document, this is acceptable. Once the BroadBand Spectroscopy scanning has been completed and Narrowband scanning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



SET UP FOR PROTON LOCALIZER SCAN
ILLUSTRATION 1–2

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

1–1 PROTON LOCALIZER SCAN (Continued)



PHANTOM SET UP FOR PROTON LOCALIZER SCAN
ILLUSTRATION 1–3

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

Note

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

6. Acquire the localizer image according to the scan prescription given in Table 1–1 for 4.X and Table 1–2 for 5.X.

1–1 PROTON LOCALIZER SCAN (Continued)

TABLE 1–1
4.X PROTON LOCALIZER SCAN PROTOCOL

SCAN PROTOCOL (4.X)

MAIN MENU

[SCAN MODE]

SCAN MODE

[RESEARCH]
[EXECUTE]

MAIN MENU

[NEW STUDY]

PATIENT STUDY PARAMETERS

ID: **SPECFT**
Name: **FT LCL**
Monitor SAR? **N**
[NEXT PAGE] twice

PATIENT POSITION

Patient Entry **[Head First]**
Patient Position **[Supine]**
Coil Type **[Body Coil]**
Axial/Sag. Landmark **[Naison]**
[NEXT PAGE]

IMAGING PARAMETERS

Image Mode **[Single Scan]**
Scan Plane **[Axial]**
Pulse Sequence **[Multiple Echo]**
Imaging Options **[Extra Options]**
Enter PSD Filename **(default or blank)**
[NEXT PAGE]
[Extended Dyn Rang]
[NEXT PAGE]

SCAN TIMING

Number of Echoes **[1]**
Echo Time (TE) **[20 msec]**
Rep Time (TR) **[300 msec]**
[NEXT PAGE]

SCANNING RANGE

Field of View **[24 cm]**
Scan Thickness **[10 mm]**
Scan Location: (I/S) **S0**
No. of Scan Locations: **[1]**
FOV Center: (L/R) **R0** (P/A) **A0**
[NEXT PAGE]

ACQUISITION TIME

Acquisition Matrix **[256 x 128]**
Imaging Time **[1 NEX 0:42]**
Frequency Direction **[default]**
[NEXT PAGE]

AUTO CENTER FREQUENCY

[Water]
[NEXT PAGE]

REVIEW PAGE

[NEXT PAGE]

SCAN OPERATIONS

[AUTO PRESCAN]
[SCAN]
[CANCEL]

1–1 PROTON LOCALIZER SCAN (Continued)

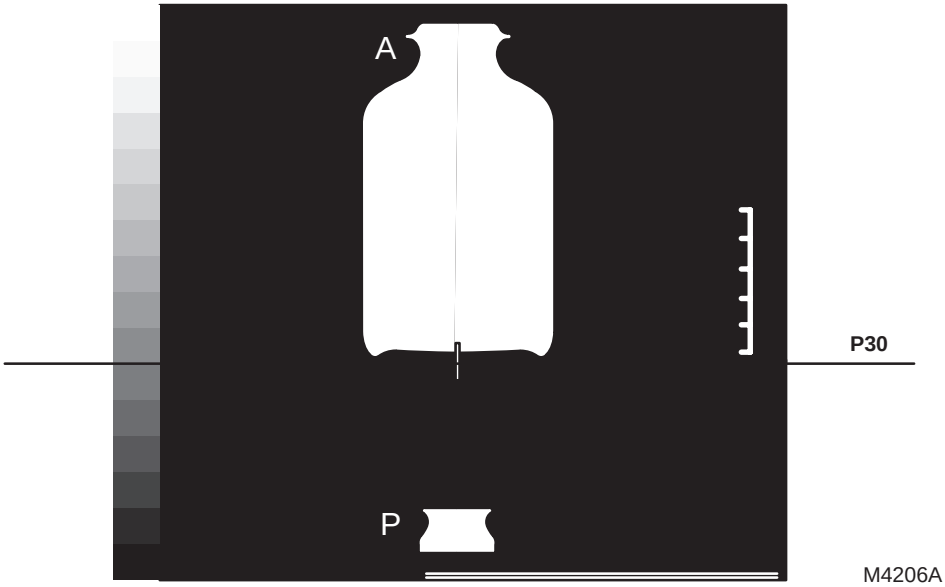
TABLE 1–2
5.X PROTON LOCALIZER SCAN PROTOCOL

SCAN PROTOCOL (5.X)	
MAIN MENU	
	[SCAN MODE]
SCAN MODE	
	[RESEARCH]
	[ACCEPT]
MAIN MENU	
	[New Exam]
PATIENT/EXAM INFORMATION	
Id:	**specft**
Name:	**ft lcl**
Patient Weight	**111**
	[Patient Position]
PATIENT POSITION	
Patient Entry	**[Head First]**
Patient Position	**[Supine]**
Axial/Sag. Landmark	**[Nasion]**
Coil Type	**[Body Coil]**
Scan Plane	**[Axial]**
	[Imaging Params]
IMAGING PARAMETERS	
Image Mode	**[2D]**
(K *SAR must be "On"* K*)*	**[Monitor SAR]**
Pulse Sequence	**[Spin Echo]**
Imaging Options	**[Extended Dyn Rang]**
or enter PSD Filename	none
SCAN TIMING	
Number of Echoes	**[1]**
Echo Time (TE)	**[20 msec]**
Rep Time (TR)	**[300 msec]**
	[Scan Set–Up]
SCAN SET–UP	
Prescan Options	None *if applicable*
Auto CF	**[Water]**
	[Scan Ops]
SCANNING RANGE	
Field of View	**[24 cm]**
Scan Thickness	**[10 mm]**
Interscan Spacing	**don't care**
Start Loc (I/S):	**0**
End Loc (I/S):	**0**
No. of Scan Locations:	1
FOV Center (L/R):	0 (P/A): 0
	[#] [Acq Time]
ACQUISITION TIME	
Acq. Matrix (freq.)	**[256]**
Acq. Matrix (phase)	**[128]**
Frequency Direction	**[R/L]**
Phase FOV	default
Imaging Time	**[1 NEX 0:44]**
Contrast	**[No]**
Table Delta:	0 mm
	[Scan Ops]
SCAN OPERATIONS	
	[Auto Prescan]
	[Scan]

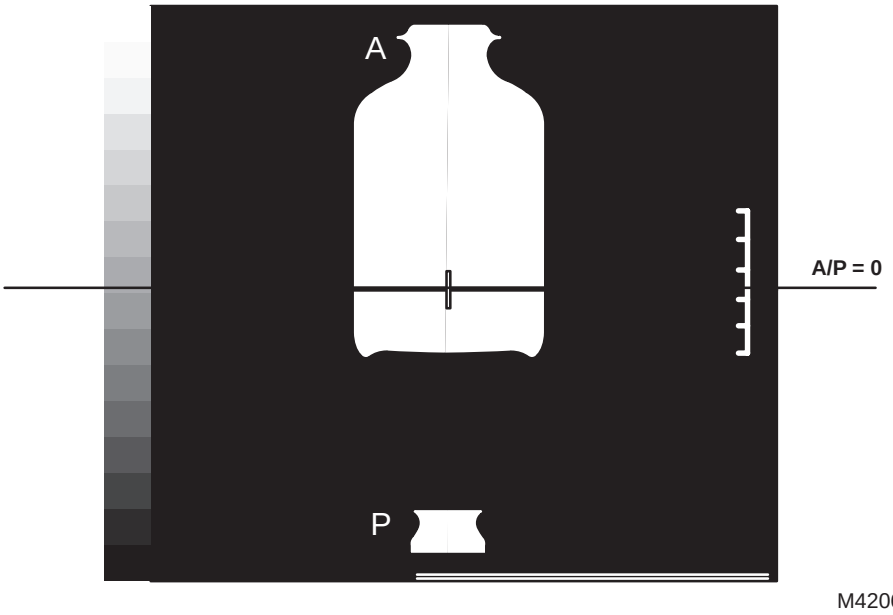
1–1 PROTON LOCALIZER SCAN (Continued)

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

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



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



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

1–2 PHOSPHORUS SIGNAL TO NOISE – FREQUENCY ADJUST SCAN

CAUTION

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

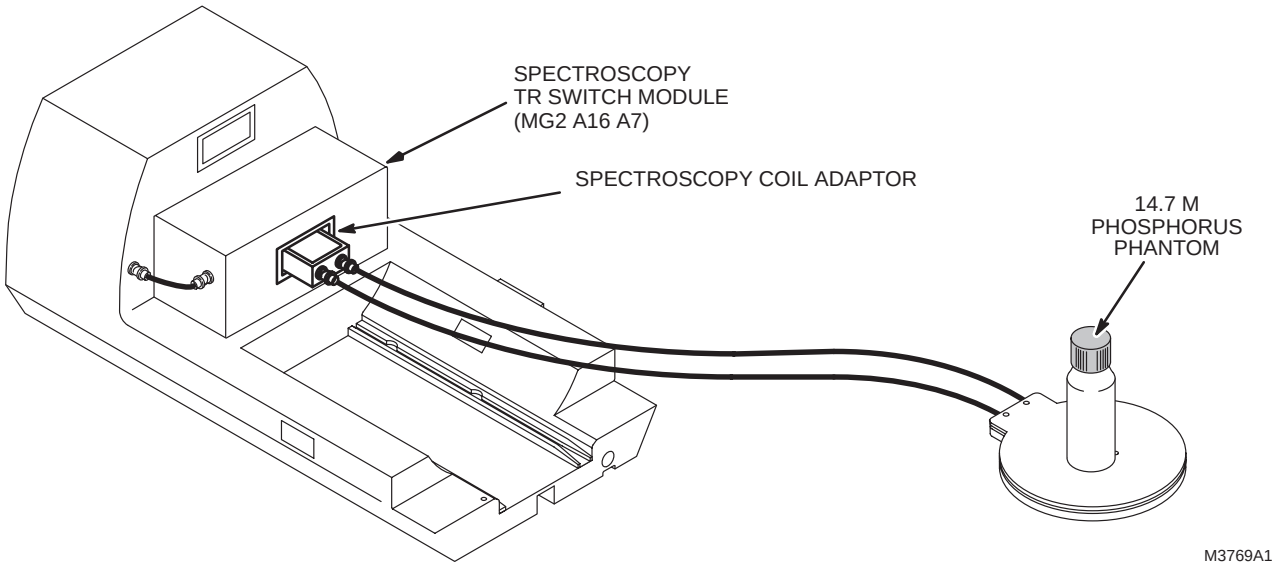
Note

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

1. Prescribe the new series. Refer to Table 1–3 for 4.X or Table 1–4 for 5.X protocols as required.

Note

For 4.5 Release software or less, the phosphorus center frequency should be determined by multiplying the proton center frequency (on the prescan page) by 0.404838.



SET UP FOR FREQUENCY ADJUST SCAN
ILLUSTRATION 1–6

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

TABLE 1–3
4.X PHOSPHORUS SIGNAL TO NOISE – FREQUENCY ADJUST SCAN PROTOCOL

SCAN PROTOCOL (4.X)

MAIN MENU
[NEW SERIES]

PATIENT POSITION
Patient Entry **[Head First]**
Patient Position **[Supine]**
Coil Type **[Other Coil]**
Axial/Sag. Landmark **[Nasion]**
[NEXT PAGE]

SURFACE COIL PAGE
Trans/Rec **[Extrem]**
[NEXT PAGE]

IMAGING PARAMETERS
Image Mode **[Single Scan]**
Scan Plane **[Coronal]**
Pulse Sequence **[Multiple Echo]**
Imaging Options **[Graphic Prescription]**
(see note below)
Enter PSD Filename **SPECFID.PSD** *(Rel. 4.7)*
or **BBCAL.PSD** *(Rel. 4.8)*
[NEXT PAGE]

USER CV
SPEC_WIDTH **[2000]**
NUM_PTS **[1024]**
NUC **[31]**
NAV **[16]**
[NEXT PAGE]

SCAN TIMING
Number of Echoes **[1]**
Echo Time (TE) **[20 msec]**
Rep Time (TR) **[2000 msec]**
[NEXT PAGE]

GRAPHIC PRESCRIPTION
[Control P/F]

SCANNING RANGE
Field of View **[24 cm]**
Scan Thickness **[10 mm]**
Select slice 30mm above the bottom of the phantom. Use **[DEPOSIT]** button.
[NEXT PAGE]

ACQUISITION TIME
Acquisition Matrix **[256 x 256]**
Imaging Time **[1 NEX 0:00]**
Frequency Direction **[default]**
[NEXT PAGE]

AUTO CENTER FREQUENCY
[Water]
[NEXT PAGE]

REVIEW PAGE
[NEXT PAGE]

SCAN OPERATIONS
[SPECTROSCOPY]

SPECTROSCOPY
[MOD ACQ PARAMS]
Use AX to set the ^{31}P frequency
Type: **R1 7 R2 3**0 **TG 25**
[EXIT PAGE]
[MODIFY CVs]
Change the CV **DDA** **10**
[MODIFY CVs]
Set Entry Point Type: **ENT TEST**
[START SINGLE]
[MOD DISP PARAMS]
TW 2 press enter
MW 1 WA 12 press enter
MW 2 WA 9 press enter
Set VZ switch to **NO**.
Set Line Broadening to **OFF.**
[EXIT PAGE]
[MOD ACQ PARAMS]
Use DX to adjust the ^{31}P center frequency.
[EXIT PAGE]
[STOP ACQUISIT]

Note

If bottle has been properly set up with the bottom of the bottle appearing at P30 as shown in Illustration1–5, there is no need to use Graphic Rx.

A software bug workaround for gradient and thickness too small messages is to initially set FOV to 48 cm and Scan Thickness at 30 mm. The FOV and scan thickness must be changed to 24 cm and 10 mm respectively when performing the SNR Functional Checks.

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

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

SCAN PROTOCOL (5.X)

MAIN MENU

[New Series]

PATIENT POSITION

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

IMAGING PARAMETERS

Image Mode **[Spectro]**
(K SAR must be "On" K*)* **[Monitor SAR]**
Pulse Sequence **[Spin Echo]**
Imaging Options **[Extended Dyn Rang]**
[Graphic Rx]
(see note below)
or enter PSD Filename **fidcsi**
Monitor SAR? **[No]**
[Next Screen]

USER CVs

spectral width **2000**
number of points **1024**
nucleus **31**
Scan Mode **1**
Total # of Scans **16**
rl resolution for CSI scans **1**
ap resolution for CSI scans **1**
si resolution for CSI scans **1**
rfpulse **1** (selects soft/sinc pulse)
[Scan Timing]

SCAN TIMING

Rep Time (TR) **[2000 msec]**
[Scan Set–Up]

SCAN SET–UP

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

SCANNING RANGE – GRAPHIC RX

Field of View **[24 cm]**
Scan Thickness **[10 mm]**
Interscan Spacing **don't care**
position cursor line to zero location on monitor
[start][end]
[Spectro]

SPECTROSCOPY

Use AX to set the ^{31}P frequency (probably already set by software)
R1 7 R2 30 TG 25
press enter
[MODIFY CVs]
Change the CV **dda** **10**
[BACKUP]
Set Entry Point **ent single1**
[START SINGLE]
[DISPLAY PARAMS]
tw 2 press enter
mw 1 wa 1 press enter
wm 2 wa 9 press enter
Verify VZ switch is set to **NO**.
Verify FA is set to **NO**.
[BACKUP]

Use DX to adjust the ^{31}P center frequency.
[STOP ACQUISIT]

Note

If bottle has been properly set up with the bottom of the bottle appearing at P30 as shown in Illustration1–5, there is no need to use Graphic Rx.

A software bug workaround for gradient and thickness too small messages is to initially set FOV to 48 cm and Scan Thickness at 30 mm. The FOV and scan thickness must be changed to 24 cm and 10 mm respectively when performing the SNR Functional Checks.

1–3 PHOSPHORUS SIGNAL TO NOISE – AVERAGING SCAN

This procedure will determine the signal to noise levels during a spectroscopy scan. Seven scans will be completed. Data from each scan will be stored. The data will be analyzed using SA/GE software to find the level of signal to noise. All scans must be performed using a 0.05 M sample with R1 = 7, R2 = 30, TG = 25. Altering any portion of the test will invalidate the normalized SNR result. If a site is qualifying an alternate coil the normalized SNR result from the 8"/3" Phosphorus Spectroscopy surface coil will be used as a comparison.

Note

Not all SNR scans are required but the 1st, 3rd, and 5th are recommended.

1. Verify hardware and protocols are set up as used in Section 1–2, PHOSPHORUS SIGNAL TO NOISE – FREQUENCY ADJUST SCAN.
2. Press **[Back to Landmark]** on front panel of magnet enclosure.
3. Turn alignment lights on.
4. **Remove 14.7 M** Phosphorus phantom and **replace** with the **.050 M** Phosphorus phantom.
5. Press **[Advance to Scan]** on front panel of magnet enclosure.
6. Press **[START Single].** Refer to Illustration1–7. You should see the majority of noise in Magnitude Spectrum being less than 1/4 of the signal as shown. If not, some part of the system is not working properly.
7. Adjust the frequency to center the echo.
8. Select **[Stop Acquisition**].
9. Continuing from previous protocol in Section 1–2, PHOSPHORUS SIGNAL TO NOISE – FREQUENCY ADJUST SCAN use the Averaging Protocols for 4.X or 5.X as shown in Table 1–5.
10. Select **[START Average]** per the averaging protocols after the entry point is set to average.

Note

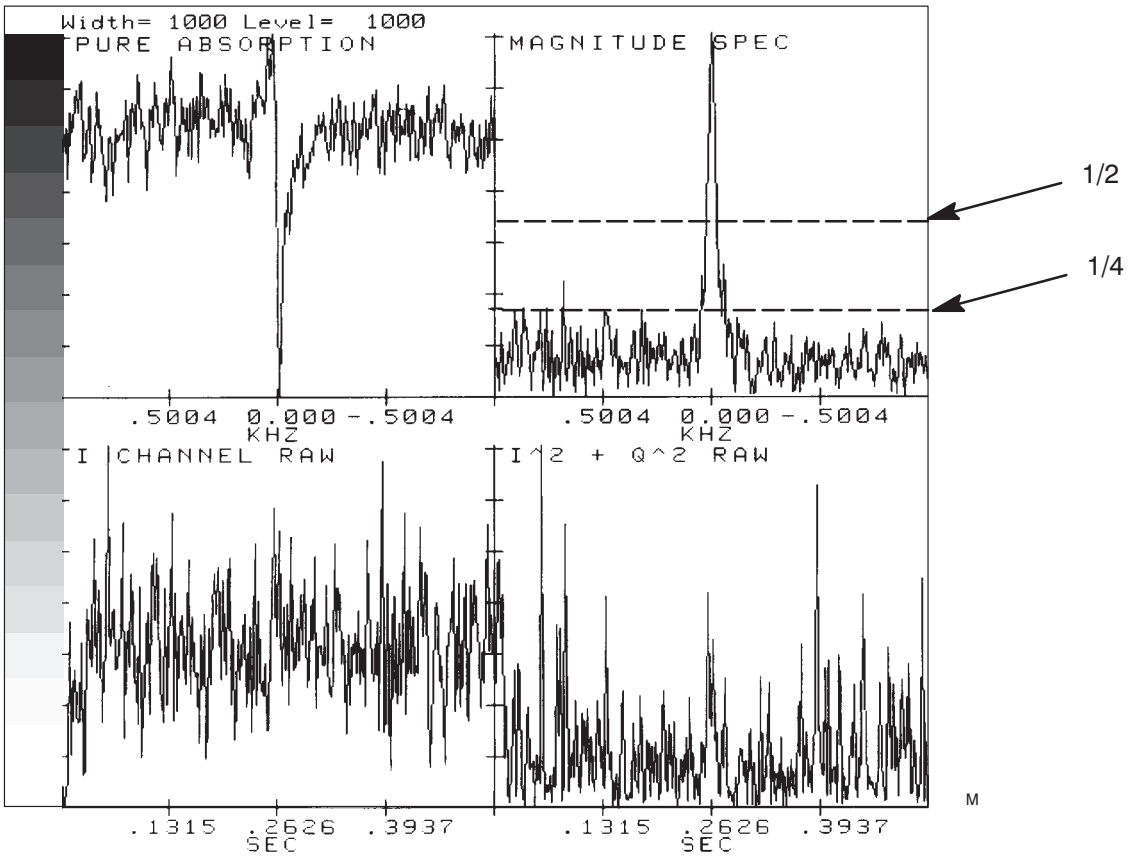
If the **[STR ACQ BUF DATA]** (4.X) or the **[STORE]** (5.X) is not pressed before beginning the next AVG SCAN, the data is **lost** and scan must be repeated.

Note

Select List Data to view the data and File Numbers stored.

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

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



TYPICAL 0.05M SAMPLE PULSE WAVE FORMS
ILLUSTRATION 1–7

Note

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

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

TABLE 1–5
4.X AND 5.X AVERAGING PROTOCOLS

AVERAGING PROTOCOL (4.X)	
Set Entry Point	**ENT AVG** press enter
	[MODIFY CVs]
Change CV **NAV**	**16**
	[MODIFY CVs]
	[START AVERAGE]
Wait for scans to be complete.	**[STR ACQ BUF DATA]**
Enter Site Name, 16, and date.	Press **ENTER**.
Record File Number on data sheet.	
	[MODIFY CVs]
Change CV **NAV** (See Note)	**32**
	[MODIFY CVs]
	[START AVERAGE]
Wait for scans to be complete.	**[STR ACQ BUF DATA]**
Enter Site Name, 32, and date.	Press **ENTER**.
Record File Number on data sheet.	
	[MODIFY CVs]
Change CV **NAV** (See Note)	**64**
	[MODIFY CVs]
	[START AVERAGE]
Wait for scans to be complete.	**[STR ACQ BUF DATA]**
Enter Site Name, 64, and date.	Press **ENTER**.
Record File Number on data sheet.	
	[MODIFY CVs]
Change CV **NAV** (See Note)	**128**
	[MODIFY CVs]
	[START AVERAGE]
Wait for scans to be complete.	**[STR ACQ BUF DATA]**
Enter Site Name, 128, and date.	Press **ENTER**.
Record File Number on data sheet.	
	[MODIFY CVs]
Change CV **NAV** (See Note)	**256**
	[MODIFY CVs]
	[START AVERAGE]
Wait for scans to be complete.	**[STR ACQ BUF DATA]**
Enter Site Name, 256, and date.	Press **ENTER**.
Record File Number on data sheet.	
	[MODIFY CVs]
Change CV **NAV** (See Note)	512
	[MODIFY CVs]
	[START AVERAGE]
Wait for scans to be complete.	**[STR ACQ BUF DATA]**
Enter Site Name, 512, and date.	Press **ENTER**.
Record File Number on data sheet.	
	[MODIFY CVs]
Change CV **NAV** (See Note)	1024
	[MODIFY CVs]
	[START AVERAGE]
Wait for scans to be complete.	**[STR ACQ BUF DATA]**
Enter Site Name,1024 and date.	Press **ENTER**.
Record File Number on data sheet.	
	[CANCEL]

NOTE: After typing **NAV** and **ENTER.** Answer the following question: (Y/N) Return this variable to a dependent state? Answer "**N**" for no. Then type the NAV number.

AVERAGING PROTOCOL (5.X)	
Set Entry Point	**ent avg** press enter
	[MODIFY CVs]
Change CV **opuser4**	**16**
	[BACKUP]
	[START AVERAGE]
Wait for scans to be complete.	**[STORE]**
Enter Site Name, 16, and date.	Press **ENTER**.
Record File Number on data sheet.	
	[MODIFY CVs]
Change CV **opuser4**	**32**
	[BACKUP]
	[START AVERAGE]
Wait for scans to be complete.	**[STORE]**
Enter Site Name, 32, and date.	Press **ENTER**.
Record File Number on data sheet.	
	[MODIFY CVs]
Change CV **opuser4**	**64**
	[BACKUP]
	[START AVERAGE]
Wait for scans to be complete.	**[STORE]**
Enter Site Name, 64, and date.	Press **ENTER**.
Record File Number on data sheet.	
	[MODIFY CVs]
Change CV **opuser4**	**128**
	[BACKUP]
	[START AVERAGE]
Wait for scans to be complete.	**[STORE]**
Enter Site Name, 128, and date.	Press **ENTER**.
Record File Number on data sheet.	
	[MODIFY CVs]
Change CV **opuser4**	**256**
	[BACKUP]
	[START AVERAGE]
Wait for scans to be complete.	**[STORE]**
Enter Site Name, 256, and date.	Press **ENTER**.
Record File Number on data sheet.	
	[MODIFY CVs]
Change CV **opuser4**	512
	[BACKUP]
	[START AVERAGE]
Wait for scans to be complete.	**[STORE]**
Enter Site Name, 512, and date.	Press **ENTER**.
Record File Number on data sheet.	
	[MODIFY CVs]
Change CV **opuser4**	1024
	[BACKUP]
	[START AVERAGE]
Wait for scans to be complete.	**[STORE]**
Enter Site Name,1024 and date.	Press **ENTER**.
Record File Number on data sheet.	
	[CANCEL]

Note

If the **[STR ACQ BUF DATA]** (4.X) or the **[STORE]** (5.X) is not pressed before beginning the next AVG SCAN, the data is **lost** and scan must be repeated. Select List Data to view data stored.

1–4 PROCESSING

1. Refer to *Direction 15309, Analysis Workstation Software.*
2. Perform file transfer from the System Computer to the Spectroscopy Analysis Workstation.
3. Analyze the spectroscopy data to determine the signal to noise ratio. Remember to use the data sheet provided in Section 1–5, FUNCTIONAL TEST DATA SHEET.
4. Remove all Multi–Nuclear Spectro hardware when tests have been completed.

1–5 FUNCTIONAL TEST DATA SHEET

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

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