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1- OVERVIEW

Description - All of the material applies to 1.5T Signa 5x systems ONLY.
Echo Peak Location Calibration, is a tuning procedure to be used with the Spectroscopy PROBE/SV option (this is an acronym for *PROton Brain Exam, Single Voxel*). A PROBE SNR performance test can be performed if the site has a MRS Phantom (MR Spectroscopy Phantom, 2152220).
NOTE: The SNR procedure (optional if a MRS Phantom is available) can be performed ONLY if the MRS Phantom is available. The SNR procedure (optional if a MRS Phantom is available) will be performed after the Tuning procedure.

This Tuning procedure determines the six control variable (CV) values specific to your Signa system for PROBE/SV scanning. Several scans are required for the tuning: a localizer scan to ensure that your system is working properly, a probe-s (STEAM) Tuning scan and a Verification scan, a probe-p (PRESS) Tuning scan and a Verification scan.

Each tuning scan will yield twelve coordinate values: A, C, B, and D for each of the three CVs. A total of twenty-four coordinate values will be the result of probe-s and probe-p tuning. The final step will be to calculate the three CV values derived from the probe-s scan, and the three CV values derived from the probe-p tuning scan. You can do this either automatically, by using a script file, or manually, by using a calculator, and then manually entering the values into the script file. The CVs for probe-s and probe-p will be recorded and saved on the saveINFO tape.

Certain protocol menus shown may be slightly different from those on your system.

1-1 PROBE Tuning Recalibration Considerations

Probe Tuning Calibration Procedure must be performed anytime:

- The Gradient Subsystem is affected thus requiring the grafidy procedure to be performed.

1-2 Initial Conditions

- Release 5.7 software or greater.
- Fully operational 1.5T Signa 5x system with all performance specifications met.
- M1040HT (spectro option key [46-317350G1] and U17 Spectroscopy EPROM) installed in the ERBTEC RF Amplifier on the processor board (per 15501, PROBE/SV Installation).
- Magnet shimmed and acceptance specifications have been met.
- Grafidy has been performed and all acceptance specifications have been met.

1-3 Tools Required for Tuning:

- Head TLT Phantom in the Head Coil and the Patient Head Cradle (Do not use the head loader or tuning ring). The MRS Phantom may be used during the Tuning process if it is available.
- A calculator: if not using the automatic script file.
- MRS Phantom (2152220) is required for the **optional** PROBE/SV SNR performance tests.

1-4 Acronynms

APS	Auto prescan: Auto-adjustment of data acquisition (scan) parameters
AVS	Auto Voxel Shim
AWS	Automatic Water Suppression
CSI	Chemical Shift Imaging
CV	Control Variable
FID	Free Induction Decay
FOV	Field of View
GRx	Graphic Prescription
IFCC	Image file create and cleanup
MPS	Manual prescan: Manual adjustment of data acquisition (scan) parameters
MRS	Magnetic Resonance Spectroscopy
NEX	Number of Excitations in a single frame of data
PRESS	Point-resolved spectroscopy, basis for probe-p PSD
PROBE/Q	Automated analysis and display of PROBE/SV data
PROBE/SV	PROton Brain Exam Single voxel spectroscopy using automated STEAM or PRESS pulse sequence
PSD	Pulse sequence data base
RECON	Process that creates an image or spectrum from data acquired with a Signa MRI scanner.
ROI	Region of Interest
RSP	Real-time sequence control parameters
SAT	Saturation, a signal suppression technique
STEAM	Stimulated echo acquisition mode, basis for probe-s PSD
TE	Echo time
TIR	Tardis Image Receive
TPS	Transceiver and Processing subsystem
TR	Repetition time
VOI	Voxel of interest

1-5 Display Parameters, Case, Order, and Script

tw (space) 2 (space) mw (space) 1 (space) wa (space) 4 (space) mw (space) 2 wa (space) 9 <enter>

The line of letters and numbers above determine how the signal is displayed on the monitor. The translation in this case is: Total Windows: 2, Modify Window 1 to show WAveform 4, Modify Window 2 to show WAveform 9.

Note

Case important to CVs: The CV names on your screen are lower-case letters for PROBE-S, and all capitals for PROBE-P.

Note

Order of values important: Verify that you have entered the x-cursor position values (A, C, B, D) in the correct order. This is critical.

Note

Minor script problem: The current probefix1 script has a minor bug but works correctly: The message for probe-p delta values identifies them as STEAM instead of PRESS.

1-6 Definitions

Chemical Shift Imaging (CSI)

A data acquisition technique that combines phase encoding with the acquisition of a spectrum for each phase encoding step. The spatial resolution of these images depends on the number of phase encoding steps, while the frequency resolution depends on the spectral width and the number of data points in a spectrum. Images over a narrow range of frequencies can be created to show the spatial distribution of the chemical constituents of the tissue being scanned.

probe-s

One of two PROBE/SV pulse sequences. The probe-s sequence is a version of the stimulated echo acquisition mode (STEAM). It differs from the steamcsi sequence in the following areas: the spectral width and number of data points acquired are fixed to 2500 Hz and 2048, respectively; both water suppressed and non-water suppressed frames are acquired during the scan; and a special PROBE/SV reconstruction is used to create a spectrum from the data. This sequence is used for short echo time, single-voxel spectroscopy, i.e., TEs shorter than 35 milliseconds.

probe-p

One of two PROBE/SV pulse sequences. The probe-p sequence is a version of the point-resolved spectroscopy (PRESS) pulse sequence. It differs from the presscsi sequence in the following areas: the spectral width and number of data points acquired are fixed at 2500 Hz and 2048, respectively; both water-suppressed and non-water-suppressed frames are acquired during the scan; and a special PROBE/SV reconstruction is used to create a spectrum from the data. The PRESS sequence provides twice the SNR of the STEAM sequence but at the expense of slightly longer minimum TEs.

presscsi

A research version of the probe-p pulse sequence that provides more flexibility and additional capabilities such as chemical shift imaging acquisition.

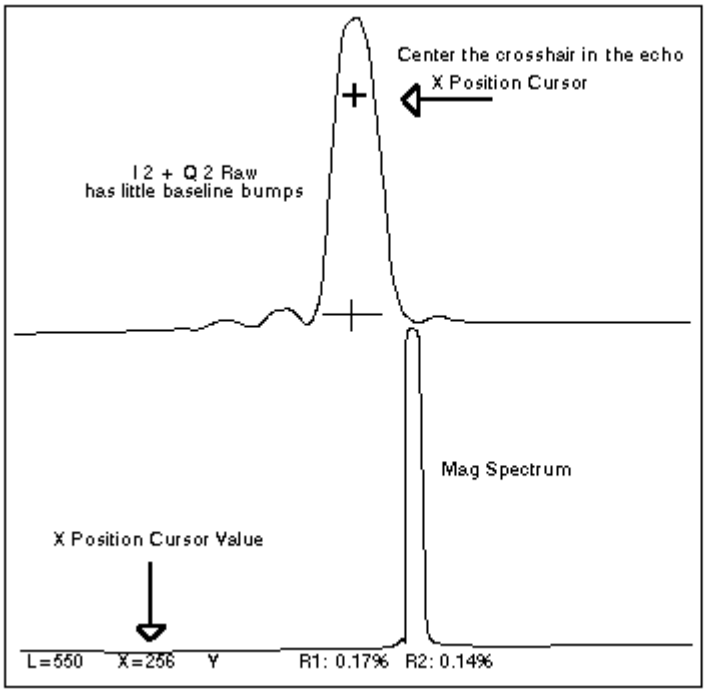
steamcsi

A research version of the probe-s pulse sequence that provides more flexibility and additional capabilities such as chemical shift imaging acquisition.

STEAM is an acronym for a standard spectroscopy pulse sequence: STimulated-Echo Acquisition Method. PRESS, another standard psd, is Point-RESolved Spectroscopy.

1-7 PROBE/SV Tuning Waveform

The following Illustrations display incorrect and correct tuning waveforms for your reference



The waveforms shown are a representation of a correct tuning waveform. The waveform may differ from system to system.

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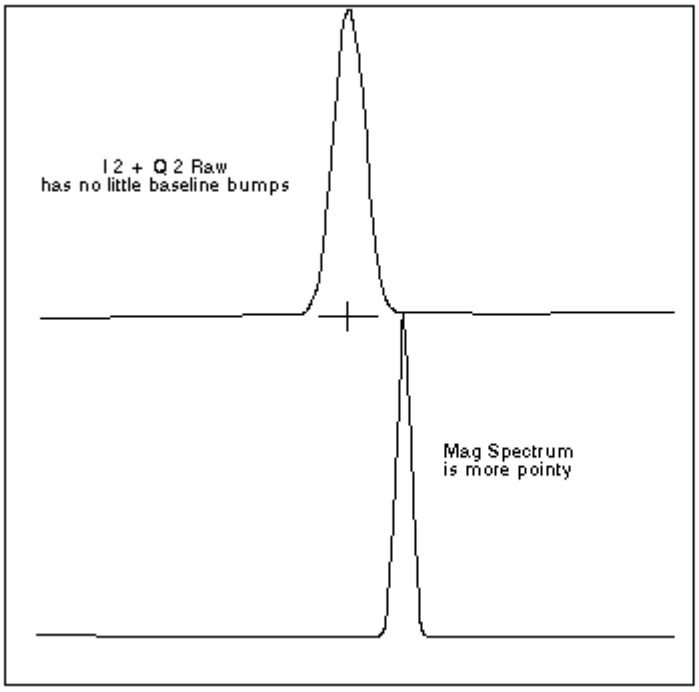
CORRECT TUNING
ILLUSTRATION 1-1



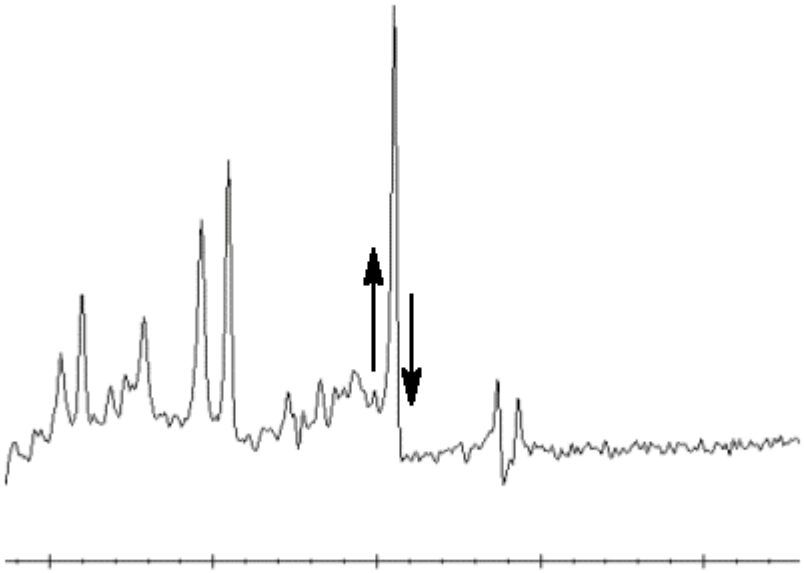
These waveforms may be result of two gradient shim values being perturbed at the same time, or of more than one delta value being improperly entered during tuning.

L4874B

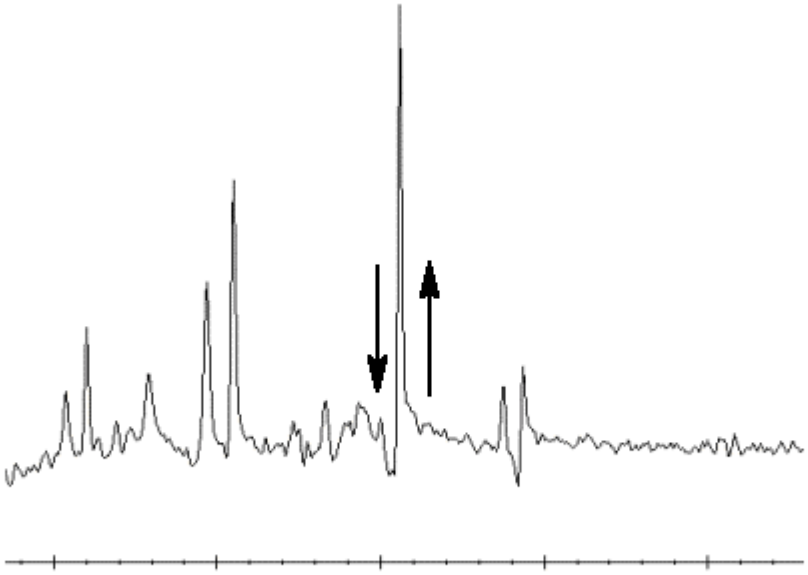
INCORRECT TUNING
ILLUSTRATION 1-2

1-8 PROBE/SV SNR Results

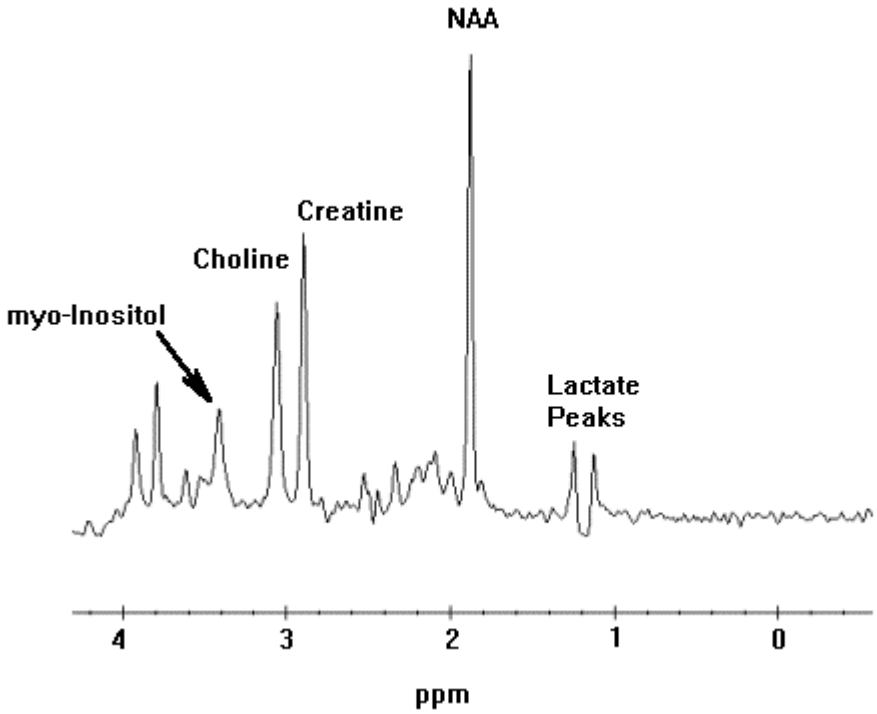
The following Illustrations display (2) incorrect SNR resultant waveforms and (1) correct SNR resultant waveform (labeled) for your reference. The MRS Phantom is required to perform the optional SNR procedure.



INCORRECT SNR RESULT
ILLUSTRATION 1-3



INCORRECT SNR RESULT
ILLUSTRATION 1-4



CORRECT SNR RESULT
ILLUSTRATION 1-5

2- PROTON LOCALIZER SCAN

1. Position the Head TLT phantom on the Head Support in the Head Coil. Do not use the tuning ring or head loader. Use foam padding as necessary to center phantom in Head Coil.
2. If performing the full tuning procedure it is possible to zero all tuning values, see Table 3-1.
3. Setup the proton localizer protocol per Table 2-1. Centering is critical.

TABLE 2-1
SCAN PROTOCOL: PROTON LOCALIZER

A. Main Menu:
[New Exam]

B. Patient/Exam Information:
Id: **geservice<ENTER>**
Name: **probetune**
Weight (Lb.): **111<ENTER>**
Set Patient Protocols to **Service**.
[Patient Position]

C. At front enclosure:
Landmark on the phantom in the Head Coil.
press **LANDMARK**.
press **MOVE TO SCAN**.

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

E. Imaging Parameters:
Image Mode: **[2D]**
(*SAR must be ON*): **[Monitor SAR]**
Pulse Sequence: **[Gradient Echo]**
Imaging Options: none (default)
or enter PSD Filename: (should be blank)
[Scan Timing] or **[Next Screen]**

F. Scan Timing:
Flip Angle: **[20]**
Number of Echoes: **[1]**
Echo Time: **[Minimum]**
Rep Time: **[100 msec]**
[Scan Set-Up]

G. Scan Set-Up:
Prescan Options: **[Autoshim]**
Auto CF: **[Water]**
[<=] [Scanning Range]

H. Scanning Range:
Field of View: **[24 cm]**
Scan Thickness: **[4 mm]**
Interscan Spacing: (default)
Start Loc (I/S): **0<Enter>**
End Loc (I/S): **0<Enter>**
No. Of Scan Locations: 1
FOV Center (L/R): 0 (P/A): 0
[<=] [Acq Time]

I. Acquisition Time:
Acq. Matrix (freq): **[256]**
Acq. Matrix (phase): **[160]**
Frequency Direction: **[A/P]**
Phase FOV: **[1:00 / 24 cm]**
Imaging Time: **[1NEX]**
Contrast: **[No]**
Table Delta: 0 mm
[Scan Ops]

J. Scan Operations:
[Auto Prescan]

Record APS Values:
R1_____ R2 _____ TG _____
AX _____

L. Record Gradient Shim Values:
Select: **[Gradient Shim]**
X_____ Y _____ Z _____
Select: **[Backup]**

M. Select: **[Scan]**

N. When Completed Select: **[Cancel]**

3- PROBE-S TUNING

3-1 Probe-s Protocol

1. Setup the proton probe-s tuning protocol per Table 3-1.

TABLE 3-1
SCAN PROTOCOL: PROBE-S TUNING

A. Main Menu:
[New Series]
B. Patient Position:
Patient Entry: **[Head First]**
Patient Position: **[Supine]**
Axial/Sag Landmark: **[Nasion]**
Coil Type: **[Head Coil]**
Scan Plane: **[Axial]**
[Imaging Params]
C. Imaging Parameters:
Image Mode: **[Spectro]**
(*SAR must be ON*): **[Monitor SAR]**
Pulse Sequence: **[Spin Echo]**
Imaging Options: **[Extended Dynamic Range]**
or enter PSD Filename: **[probe-s]**
[User CVs] or **[Next Screen]**
D. User CVs:
Scan Mode: **[0]**
Total Number of Scans: **[32]**
rl voxel length in mm: **[20]**
ap voxel length in mm: **[20]**
rl voxel position in mm: **[0]**
ap voxel position in mm: **[0]**
[Scan Timing] or **[Next Screen]**
E. Scan Timing:
Echo Time: **[288]**
Rep Time: **[2000]**
[Scan Set-Up]
F. Scan Set-Up:
Prescan Options: **[Autoshim]**
Auto CF: **[Water]**
[<=] [Scanning Range]
G. Scanning Range:
Field of View: **[24 cm]**
Scan Thickness: **[20 mm]**
Interscan Spacing: (default)
Start Loc (I/S): **0<Enter>**
End Loc (I/S): **0<Enter>**
No. Of Scan Locations: 1
FOV Center (L/R): 0 (P/A): 0
[<=] [Acq Time]

H. Acquisition Time:
Acq. Matrix (freq): **[256]**
Acq. Matrix (phase): **[160]**
Frequency Direction: **[A/P]**
Imaging Time: **[2NEX]**
Contrast: **[No]**
Table Delta: 0 mm
[Scan Ops]

I. Scan Operations:
[Auto Prescan]
Record (successful) APS Values:
R1_____ R2 _____ TG _____
AX _____

J. Select: **[Modify CVs]**
opuser 1: **[512]**
opuser3: **[1]**
deltax: **[0.0]**
deltay: **[0.0]**
deltaz: **[0.0]**
echomode: **[2]**
suppress: **[0]**
Zeroing Note: If performing the full tuning procedure for probe-s and probe-p, it is possible to zero (0) the coordinate values via a [G Shell] by typing **probefix1 c** before the scan is prescribed. Select the **[Download]** soft key before prescanning.

K. Record Gradient Shim Values:
Select: **[Gradient Shim]**

X_____ Y _____ Z _____
Select: **[Backup]**

L. Select: **[Spectro]**
Type: **tw 2 mw 1 wa 4 mw 2 wa 9 <enter>**

3-2 Probe-s Tuning

Perform tuning. Refer to Illustrations in Sub-section 1-7. Record all A, C, B, and D coordinate values for the deltay, deltaz, and deltax CVs.

DELTAY Tuning

Select: **[MODIFY CVs]**
Type: **deltay <Enter>**
Type: **-1 <Enter>**
Select: **[Backup]**
Type or Select: **sin <Enter>** or **[Start Single]**
Select: **[GRADIENT SHIM]**
Type delta value: **xd 100 <Enter>**

The echo should be present in the upper Raw window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. -1 / 100: **A =**_____

Type: **-200 <Enter>**

The echo should be present in the upper Raw window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. -1 / -100: **C =**_____

Type: **100 <Enter>**(back to starting *x* Autoshim value)
Select: **[Backup]**
Type or Select: **sto <Enter>** or **[Stop Acq]**
Select: **[MODIFY CVs]**
Type: **deltay <Enter>**
Type: **1 <Enter>**
Select: **[Backup]**
Type or Select: **sin <Enter>** or **[Start Single]**
Select: **[GRADIENT SHIM]**
Type delta value: **xd 100 <Enter>**

The echo should be present in the upper Raw window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. 1 / 100: **B =**_____

Type: **-200 <Enter>**

The echo should be present in the upper Raw window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. 1 / -100: **D =**_____

Type: **100 <Enter>** (back to starting *x* Autoshim value)
Select: **[Backup]**
Type or Select: **sto <Enter>** or **[Stop Acq]**
****

DELTAZ Tuning

Select: **[MODIFY CVs]**
Verify: deltay = 0
Type: **deltaz <Enter>**
Type: **-1 <Enter>**
Select: **[Backup]**
Type or Select: **sin <Enter>** or **[Start Single]**
Select: **[GRADIENT SHIM]**
Enter delta value: **zd 100 <Enter>**

The echo should be present in the upper Raw window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. -1 / 100: **A =**_____

Type: **-200 <Enter>**

The echo should be present in the upper Raw window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. -1 / -100: **C =**_____

Type: **100 <Enter>** (back to starting *z* Autoshim value)
Select: **[Backup]**
Type or Select: **sto <Enter>** or **[Stop Acq]**
Select: **[MODIFY CVs]**
Type: **deltaz <Enter>**
Type: **1 <Enter>**
Select: **[Backup]**
Type or Select: **sin <Enter>** or **[Start Single]**
Select: **[GRADIENT SHIM]**
Type: **zd 100 <Enter>**

The echo should be present in the upper Raw window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. 1 / 100: **B =**_____

Type: **-200 <Enter>**

The echo should be present in the upper Raw window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. 1 / -100: **D =**_____

Type: **100 <Enter>** (back to starting *z* Autoshim value)
Select: **[Backup]**
Type or Select: **sto <Enter>** or **[Stop Acq]**
****

DELTAX Tuning

Select: **[MODIFY CVs]**
Verify deltaz = 0
Type: **deltax <Enter>**
Type: **-1 <Enter>**
Select: **[Backup]**
Type or Select:: **sin <Enter>** or **[Start Single]**
Select: **[GRADIENT SHIM]**
Enter delta value: **yd 100 <Enter>**

The echo should be present in the upper Raw window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. -1 / 100: **A =**_____

Type: **-200 <Enter>**

The echo should be present in the upper Raw window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. -1 / -100: **C =**_____

Type: **100 <Enter>** (back to starting *y* Autoshim value)
Select: **[Backup]**
Type or Select: **sto <Enter>** or **[Stop Acq]**
Select: **[MODIFY CVs]**
Type: **deltax <Enter>**
Type: **1 <Enter>**
Select: **[Backup]**
Type or Select: **sin <Enter>** or **[Start Single]**
Select: **[GRADIENT SHIM]**
Type: **yd 100 <Enter>**

The echo should be present in the upper Raw window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. 1 / 100: **B =**_____

Type: **-200 <Enter>**

The echo should be present in the upper Raw window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. 1 / -100: **D =**_____

Type: **100 <Enter>** (back to starting *y* Autoshim value)
Select: **[Backup]**
Select: **[Modify CVs]**
Type: **deltax <Enter>**
Type: **0 <Enter>**
Select: **[Backup]**
Type or Select: **sto <Enter>** or **[Stop Acq]**
****

3-3 Probe-s Script File

Perform Script File entry, using either the automatic script file or the manual method. Record all CV values for deltay, deltaz, and deltax.

Note

Refer to Section 1: Order of values (A, C, B, D) is important. Minor script problem.

3-3-1 The Automatic Process

You can use the script *probefix1* to automatically calculate the final delta value at the end of the probe-s tuning procedure. Once all the A, C, B, and D values are entered, you must perform the Verification Checks to ensure that the final CVs are correct.

1. Select **[UTILITIES]** then **[MR Tools]**. Open a **[G Shell]** and move it to the right.
2. Type: **probefix1 <Enter>**
3. For probe-s / steamcsi: Enter the twelve coordinate values for probe-s in **A**, **C**, **B**, and **D** order (**not** A, B, C, and D). This entry order is VERY IMPORTANT! There will be four values for the deltay CV, four values for deltaz, and four values for deltax. The brackets contain the coordinate values entered previously.

Note

Refer to Section 1: Order of values is important. Minor script problem.

4. For probe-p / presscsi: If probe-p tuning has been performed previously, and will not be rerun at this time, you should accept the existing coordinate values displayed in the brackets [ ] by pressing the **<Enter>** key. If probe-p tuning has **not** been performed previously, or **will** be run at this time, enter zeros (0) for the twelve coordinate values.
5. To display the current delta CVs, type: **probefix1 l** *(that's a lower-case L)*.

Note

Minor script problem: The current probefix1 script has a minor bug but works correctly: The message for probe-p delta values identifies them as STEAM instead of PRESS.

6. Select **<Enter>** as needed to view the CVs. Record the CV values; they require the entry of ±**n.nnnn** digits.
   a) Record deltax value _____
   b) Record deltay value _____
   c) Record deltaz value _____

Specification Criteria (absolute value):

- single delta parameter, l < .5 l
- sum of all delta parameters, l < .8 l

7. Close the **[G Shell]** when done.
8. **Important:** Select **[Download]** before going to Tuning Verification.

3-3-2 The Manual Process

The CV delta value is initially 0. To manually calculate the new delta (*x*, *y*, or *z*) CV value, use the formula below.

$$\frac{\frac{512\text{-}A\text{-}B}{B\text{-}A} + \frac{512\text{-}C\text{-}D}{D\text{-}C}}{2}$$

1. Accordingly, enter your calculations like this:

$$\frac{512\text{-} \quad - \quad + \quad 512\text{-} \quad -}{- \qquad\qquad\qquad -}$$

divided by 2

2. Record the CV values; they require the entry of ±**n.nnnn** digits.
   a) Record deltax value _____
   b) Record deltay value _____
   c) Record deltaz value _____
3. Select **[UTILITIES]** then **[MR Tools]**. Open a **[G Shell]**.
4. Type: **probefix <Enter>**
5. For probe-s / steamcsi: Enter the manually calculated delta values into the probefix script.
6. For probe-p / presscsi: If probe-p tuning has been performed previously, and will **not** be rerun at this time, enter the previous delta values. The existing CV values can be found by electing to display the CVs that contain the word *delta* when a probe-p scan protocol is set up.
7. To display the current delta CVs, type: **probefix1 l <*Enter*>***(that's a lower-case L).*

Note

Minor script problem: The current probefix1 script has a minor bug but works correctly: The message for probe-p delta values identifies them as STEAM instead of PRESS.

8. Select **<Enter>** as needed to view the CVs. Record the CV values; they require the entry of ±**n.nnnn** digits.
   a) Record deltax value _____
   b) Record deltay value _____
   c) Record deltaz value _____

Specification Criteria (absolute value):

- single delta parameter, l < .5 l
- sum of all delta parameters, l < .8 l

7. Close the **[G Shell]** when done.
8. **Important:** Select **[Download]** before going to Tuning Verification.
9. Select **[CANCEL]**, or type and type **exit** to remove the G Shell.

3-4 Probe-s Tuning Verification

DELTAY Verification

Verify that the CV deltay is set to the calculated value.
Select: **[Modify CVs]**
Type: **deltay <Enter>**
Type: **<U> <Enter>** to unlock the CV, then ±**n.nnnn <Enter>**
Select: **[Backup]**
Type or Select: **sin** or **[Start Single]**
Select: **[Gradient Shim]**
Type: **xd 100 <Enter>**

The echo should be present in the upper RAW window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. 100 offset =_____

Type: **–200 <Enter>**

The echo should be present in the upper RAW window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. –100 offset =_____

The +/– 100 offset echoes should be at the same *x*-crosshair position. If they are not, check calculations first, then continue modifying the CV deltay until they are within 0–3 x crosshair position units of one another.

Record Final deltay value _____

Select: **[GRADIENT SHIM]**
Type: **xd 100 <Enter>** (back to starting *x* Autoshim value)
Select: **[Backup]**
Type or Select: **sto <Enter>** or **[Stop Acq]**
****

DELTAZ Verification

Verify that the CV deltaz is set to the calculated value.
Select: **Modify CVs]**
Type: **deltaz <Enter>**
Type: **<U> <Enter>** to unlock the CV, then **±n.nnnn <Enter>**
Select:**[Backup]**
Type or Select: **sin <Enter>** or **[Start Single]**
Select:**[Gradient Shim]**
Type: **zd 100 <Enter>**

The echo should be present in the upper RAW window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. 100 offset =_____

Type: **–200 <Enter>**

The echo should be present in the upper RAW window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. –100 offset =_____

The +/– 100 offset echoes should be at the same *x*-crosshair position. If they are not, check calculations first, then continue modifying the CV deltay until they are within 0–3 x crosshair position units of one another.

Record Final deltaz value _____

Select: **[GRADIENT SHIM]**
Type: **zd 100 <Enter>** (back to starting *z* Autoshim value)
Select: **[Backup]**
Type or Select: **sto <Enter>** or **[Stop Acq]**
****

DELTAX Verification

Verify that the CV deltax is set to the calculated value.

Select: **[Modify CVs]**
Type: **deltax <Enter>**
Type: **U <Enter>** to unlock the CV, then ±**n.nnnn <Enter>**
Select: **[Backup]**
Type or Select: **sin <Enter>** or **[Start Single]**
Select: **[Gradient Shim]**
Type: **yd 100 <Enter>**

The echo should be present in the upper RAW window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. 100 offset =_____

Type: **–200 <Enter>**

The echo should be present in the upper RAW window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. –100 offset =_____

The +/– 100 offset echoes should be at the same *x*-crosshair position. If they are not, check calculations first, then continue modifying the CV deltax until they are within 0–3 crosshair position units of one another.

Record Final deltay value _____

Select: **[GRADIENT SHIM]**
Type: **yd 100 <Enter>** (back to starting *y* Autoshim value)
Select: **[Backup]**
Type or Select: **sto <Enter>** or **[Stop Acq]**
Select: **[Modify CVs]**
Type: **suppress <Enter>**
Type: **U <Enter>**
Select: **[Backup]**
Select: **[Backup]**
Select: **[Cancel]**

Specification Criteria (absolute value):

- single delta parameter, I < .5 I
- sum of all delta parameters, I < .8 I

3-5 Removing PROBE/SV Processes

1. If you are not proceeding to the probe-p tuning procedure:
   In a [G Shell], slay the probe processes by typing **slay<spacebar>probe<Enter>** (or restart Signa).
   Answer *yes* to all questions.
2. Press **[Cancel]** or type **exit** to remove the G Shell.
3. Probe-s Tuning changes **must be saved** on the saveINFO tape **if not continuing** on to the probe-p tuning procedure.

4- PROBE-P TUNING

4-1 Probe-p Protocol

1. Setup the proton probe-p tuning protocol per Table 4-1. Centering is critical.

TABLE 4-1
SCAN PROTOCOL: PROBE-P TUNING

A. Main Menu:
[New Series]
B. Patient Position:
Patient Entry: **[Head First]**
Patient Position: **[Supine]**
Axial/Sag Landmark: **[Nasion]**
Coil Type: **[Head Coil]**
Scan Plane: **[Axial]**
[Imaging Params]
C. Imaging Parameters:
Image Mode: **[Spectro]**
(*SAR must be ON*): **[Monitor SAR]**
Pulse Sequence: **[Spin Echo]**
Imaging Options: **[Extended Dynamic Range]**
or enter PSD Filename: **[probe-p]**
[User CVs] or **[Next Screen]**
D. User CVs:
Scan Mode: **[0]**
Total Number of Scans: **[32]**
rl voxel length in mm: **[20]**
ap voxel length in mm: **[20]**
rl voxel position in mm: **[0]**
ap voxel position in mm: **[0]**
[Scan Timing] or **[Next Screen]**
E. Scan Timing:
Echo Time: **[288]**
Rep Time: **[2000]**
[Scan Set-Up]
F. Scan Set-Up:
Prescan Options: **[Autoshim]**
Auto CF: **[Water]**
[<=] [Scanning Range]
G. Scanning Range:
Field of View: **[24 cm]**
Scan Thickness: **[20 mm]**
Interscan Spacing: (default)
Start Loc (I/S): **0<Enter>**
End Loc (I/S): **0<Enter>**
No. Of Scan Locations: 1
FOV Center (L/R): 0 (P/A): 0
[<=] [Acq Time]

H. Acquisition Time:
Acq. Matrix (freq): **[256]**
Acq. Matrix (phase): **[160]**
Frequency Direction: **[A/P]**
Imaging Time: **[2NEX]**
Contrast: **[No]**
Table Delta: 0 mm
[Scan Ops]

I. Scan Operations:
[Auto Prescan]
Record (successful) APS Values:
R1_____ R2 _____ TG _____
AX _____

J. Select: **[Modify CVs]**
opuser 1: **[512]**
opuser3: **[1]**
deltax: **[0.0]**
deltay: **[0.0]**
deltaz: **[0.0]**
echomode: **[2]**
suppress: **[0]**

Zeroing Note: If performing the full tuning procedure for probe-s and probe-p, it is possible to zero (0) the coordinate values via a [G Shell] by typing **probefix1 c** before the scan is prescribed. Do not do this if you have just performed the probe-s tuning and want to retain the values. Select the **[Download]** soft key before prescanning.

K. Record Gradient Shim Values:
Select: **[Gradient Shim]**

X_____ Y _____ Z _____
Select: **[Backup]**

L. Select: **[Spectro]**
Type: **tw 2 mw 1 wa 4 mw 2 wa 9 <enter>**

4-2 Probe-p Tuning

Perform tuning. Refer to Illustrations in Sub-section 1-7. Record all A, C, B, and D coordinate values for the deltay, deltaz, and deltax CVs.

DELTAY Tuning

Select: **[MODIFY CVs]**
Type: **deltay <Enter>**
Type: **-1 <Enter>**
Select: **[Backup]**
Type or Select: **sin <Enter>** or **[Start Single]**
Select: **[GRADIENT SHIM]**
Type delta value: **zd 100 <Enter>**

The echo should be present in the upper Raw window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. -1 / 100: **A =**_____

Type: **-200 <Enter>**

The echo should be present in the upper Raw window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. -1 / -100: **C =**_____

Type: **100 <Enter>**(back to starting *z* Autoshim value)
Select: **[Backup]**
Type or Select: **sto <Enter>** or **[Stop Acq]**
Select: **[MODIFY CVs]**
Type: **deltay <Enter>**
Type: **1 <Enter>**
Select: **[Backup]**
Type or Select: **sin <Enter>** or **[Start Single]**
Select: **[GRADIENT SHIM]**
Type delta value: **zd 100 <Enter>**

The echo should be present in the upper Raw window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. 1 / 100: **B =**_____

Type: **-200 <Enter>**

The echo should be present in the upper Raw window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. 1 / -100: **D =**_____

Type: **100 <Enter>** (back to starting z Autoshim value)
Select: **[Backup]**
Type or Select: **sto <Enter>** or **[Stop Acq]**
****

DELTAZ Tuning

Select: **[MODIFY CVs]**
Verify: deltay = 0
Type: **deltaz <Enter>**
Type: **-1 <Enter>**
Select: **[Backup]**
Type or Select: **sin <Enter>** or **[Start Single]**
Select: **[GRADIENT SHIM]**
Enter delta value: **xd 100 <Enter>**

The echo should be present in the upper Raw window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. -1 / 100: **A =**_____

Type: **-200 <Enter>**

The echo should be present in the upper Raw window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. -1 / -100: **C =**_____

Type: **100 <Enter>** (back to starting *x* Autoshim value)
Select: **[Backup]**
Type or Select: **sto <Enter>** or **[Stop Acq]**
Select: **[MODIFY CVs]**
Type: **deltaz <Enter>**
Type: **1 <Enter>**
Select: **[Backup]**
Type or Select: **sin <Enter>** or **[Start Single]**
Select: **[GRADIENT SHIM]**
Type: **xd 100 <Enter>**

The echo should be present in the upper Raw window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. 1 / 100: **B =**_____

Type: **-200 <Enter>**

The echo should be present in the upper Raw window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. 1 / -100: **D =**_____

Type: **100 <Enter>** (back to starting *x* Autoshim value)
Select: **[Backup]**
Type or Select: **sto <Enter>** or **[Stop Acq]**
****

DELTAX Tuning

Select: **[MODIFY CVs]**
Verify deltaz = 0
Type: **deltax <Enter>**
Type: **-1 <Enter>**
Select: **[Backup]**
Type or Select: **sin <Enter>** or **[Start Single]**
Select: **[GRADIENT SHIM]**
Enter delta value: **yd 100 <Enter>**

The echo should be present in the upper Raw window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. -1 / 100: **A =**_____

Type: **-200 <Enter>**

The echo should be present in the upper Raw window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. -1 / -100: **C =**_____

Type: **100 <Enter>** (back to starting *y* Autoshim value)
Select: **[Backup]**
Type or Select: **sto <Enter>** or **[Stop Acq]**
Select: **[MODIFY CVs]**
Type: **deltax <Enter>**
Type: **1 <Enter>**
Select: **[Backup]**
Type or Select: **sin <Enter>** or **[Start Single]**
Select: **[GRADIENT SHIM]**
Type: **yd 100 <Enter>**

The echo should be present in the upper Raw window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. 1 / 100: **B =**_____

Type: **-200 <Enter>**

The echo should be present in the upper Raw window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. 1 / -100: **D =**_____

Type: **100 <Enter>** (back to starting *y* Autoshim value)
Select: **[Backup]**
Select: **[Modify CVs]**
Type: **deltax <Enter>**
Type: **0 <Enter>**
Select: **[Backup]**
Type or Select: **sto <Enter>** or **[Stop Acq]**
****

4-3 Probe-p Script File

Perform Script File entry, using either the automatic script file or the manual method. Record all CV values for deltay, deltaz, and deltax.

NOTE

Refer to Section 1: Order of values (A, C, B, D) is important. Minor script problem.

4-3-1 The Automatic Process

You can use the script *probefix1* to automatically calculate the final delta value at the end of the probe-p tuning procedure. Once the A, C, B, and D values are entered, you must perform the Verification Checks to ensure that the final CVs are correct.

1. Select **[UTILITIES]** then **[MR Tools]**. Open a **[G Shell]** and move it to the right.
2. Type: **probefix1 <Enter>**
3. For probe-s / steamcsi: If probe-s tuning has been performed previously, and will not be rerun at this time, you should accept the existing coordinate values displayed in the brackets [ ] by pressing the **<Enter>** key. If probe-s tuning has **not** been performed previously, or **will** be run at this time, enter zeros (0) for the twelve coordinate values.
4. For probe-p / presscsi: Enter the twelve coordinate values for probe-p in **A**, **C**, **B**, and **D** order (**not** A, B, C, and D). This entry order is VERY IMPORTANT! There will be four values for the deltay CV, four values for deltaz, and four values for deltax. The brackets contain the coordinate values entered previously.

NOTE

Refer to Section 1: Order of values is important. Minor script problem.

5. To display the current delta CVs, type: **probefix1 l** *(that's a lower-case L)*.

Note

Minor script problem: The current probefix1 script has a minor bug but works correctly: The message for probe-p delta values identifies them as STEAM instead of PRESS.

6. Select **<Enter>** as needed to view the CVs. Record the CV values; they require the entry of ±**n.nnnn** digits.
   a) Record deltax value _____
   b) Record deltay value _____
   c) Record deltaz value _____

Specification Criteria (absolute value):

- single delta parameter, l < .5 l
- sum of all delta parameters, l < .8 l

7. Close the **[G Shell]** when done.
8. **Important:** Select **[Download]** before going to Tuning Verification.

4-3-2 The Manual Process

The CV delta value is initially 0. To manually calculate the new delta (*x*, *y*, or *z*) CV value, use the formula below.

$$\frac{\frac{512\text{-}A\text{-}B}{B\text{-}A} + \frac{512\text{-}C\text{-}D}{D\text{-}C}}{2}$$

1. Accordingly, enter your calculations like this:

$$\frac{512\text{-} \quad - \quad + \quad 512\text{-} \quad -}{- \qquad\qquad\qquad -}$$

divided by 2

2. Record the CV values; they require the entry of ±**n.nnnn** digits.
   a) Record deltax value _____
   b) Record deltay value _____
   c) Record deltaz value _____
3. Select **[UTILITIES]** then **[MR Tools]**. Open a **[G Shell]**.
4. Type: **probefix <Enter>**
5. <u>For probe-s / steamcsi:</u> If probe-s tuning has been performed previously, and will **not** be rerun at this time, enter the previous delta values. The existing CV values can be found by displaying the CVs that contain the word *delta* when a probe-s scan protocol is set up.
6. <u>For probe-p / presscsi:</u> Enter the manually calculated delta values into the probefix script.
7. To display the current delta CVs, type: **probefix1 l <*Enter*>***(that's a lower-case L).*

Note

Minor script problem: The current probefix1 script has a minor bug but works correctly: The message for probe-p delta values identifies them as STEAM instead of PRESS.

8. Select **<Enter>** as needed to view the CVs. Record the CV values; they require the entry of ±**n.nnnn** digits.
   a) Record deltax value _____
   b) Record deltay value _____
   c) Record deltaz value _____

Specification Criteria (absolute value):

- single delta parameter, l < .5 l
- sum of all delta parameters, l < .8 l

7. Close the **[G Shell]** when done.
8. **Important:** Select **[Download]** before going to Tuning Verification.
9. Select **[CANCEL]**, or type and type **exit** to remove the G Shell.

4-4 Probe-p Tuning Verification

DELTAY Verification

Verify that the CV deltay is set to the calculated value.
Select: **[Modify CVs]**
Type: **deltay <Enter>**
Type: **U <Enter>** to unlock the CV, then ±**n.nnnn**
Select: **[Backup]**
Type or Select: **sin <Enter>** or **[Start Single]**
Select: **[Gradient Shim]**
Type: **zd 100 <Enter>**

The echo should be present in the upper RAW window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. 100 offset =_____

Type: **-200 <Enter>**
The echo should be present in the upper RAW window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. –100 =_____

The +/– 100 offset echoes should be at the same *x*-crosshair position. If they are not, check calculations first, then continue modifying the CV deltay until they are within 0–3 x crosshair position units of one another.

Record Final deltay value _____

Select: **[GRADIENT SHIM]**
Type: **zd 100 <Enter>** (back to starting *z* Autoshim value)
Select: **[Backup]**
Type or Select: **sto <Enter>** or **[Stop Acq]**
****

DELTAZ Verification

Verify that the CV deltaz is set to the calculated value.

Select: **[Modify CVs]**
Type: **deltaz <Enter>**
Type: **U <Enter>** to unlock the CV, then ±**n.nnnn**
Select: **[Backup]**
Type or Select: **sin <Enter>** or **[Start Single]**
Select: **[Gradient Shim]**
Type: **xd 100 <Enter>**

The echo should be present in the upper RAW window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. 100 offset =_____

Type: **-200 <Enter>**
The echo should be present in the upper RAW window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. –100 offset =_____

The +/– 100 offset echoes should be at the same *x*-crosshair position. If they are not, check calculations first, then continue modifying the CV deltaz until they are within 0–3 x crosshair position units of one another.

Record Final deltaz value _____

Select: **[GRADIENT SHIM]**
Type: **xd 100 <Enter>** (back to starting *x* Autoshim value)
Select: **[Backup]**
Type or Select: **sto <Enter>** or **[Stop Acq]**
****

DELTAX Verification

Verify that the CV deltax is set to the calculated value.

Select: **[Modify CVs]**
Type: **deltax <Enter>**
Type: **U <Enter>** to unlock the CV, then ±**n.nnnn**
Select: **[Backup]**
Type or Select: **sto <Enter>** or **[Stop Acq]**
Select: **[Gradient Shim]**
Type: **yd 100 <Enter>**

The echo should be present in the upper RAW window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. 100 offset =_____

Type: **–200 <Enter>**

The echo should be present in the upper RAW window. Use the crosshair cursor centered in the displayed echo as a position marker, and record the *x*-position of the crosshair as seen at the bottom of the monitor. –100 offset =_____

The +/– 100 offset echoes should be at the same *x*-crosshair position. If they are not, check calculations first, then continue modifying the CV deltax until they are within 0–3 x crosshair position units of one another.

Record Final deltax value _____

Select: **[GRADIENT SHIM]**
Type: **yd 100 <Enter>** (back to starting *y* Autoshim value)
Select: **[Backup]**
Type or Select: **sto <Enter>** or **[Stop Acq]**
Select: **[Modify CVs]**
Type: **suppress <Enter>**
Type: **U <Enter>**
Select: **[Backup]**
Select: **[Backup]**
Select: **[Cancel]**

Specification Criteria (absolute value):

- single delta parameter, I < .5 I
- sum of all delta parameters, I < .8 I

4-5 Removing PROBE/SV Processes

1. If you are not proceeding to the probe-s tuning procedure (or you did it prior to this):
   In a G Shell, slay the probe processes by typing (or restart Signa):
   slay<spacebar>probe<Enter>
   Answer *yes* to all questions.
2. Press **[Cancel]** or type **exit** to remove the G Shell.
3. All Tuning changes **must** be saved on the saveINFO tape.

5- PROBE/SV SNR PROCEDURE (OPTIONAL)

The MRS Phantom (without the loader or tuning ring) must be used for each SNR procedure.

5-1- PROTON LOCALIZER SCAN

1. Position the Head TLT phantom on the Head Support in the Head Coil. Do not use the tuning ring or head loader. Use foam padding as necessary to center phantom in Head Coil.
2. Setup the proton localizer protocol per Table 5-1. Centering is critical.

TABLE 5-1
SCAN PROTOCOL: PROTON LOCALIZER-REQUIRED

A. Main Menu:
[New Exam]
Patient/Exam Information:
Id: **geservice<ENTER>**
Name: **probesnr**
Weight (Lb.): **111<ENTER>**
Set Patient Protocols to **Service**.
[Patient Position]

B. At front enclosure:
Landmark on the phantom in the Head Coil.
press **LANDMARK**.
press **MOVE TO SCAN**.

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

D. Imaging Parameters:
Image Mode: **[2D]**
(*SAR must be ON*): **[Monitor SAR]**
Pulse Sequence: **[Gradient Echo]**
Imaging Options: none (default)
or enter PSD Filename: (should be blank)
[Scan Timing] or **[Next Screen]**

E. Scan Timing:
Flip Angle: **[20]**
Number of Echoes: **[1]**
Echo Time: **[Minimum]**
Rep Time: **[100 msec]**
[Scan Set-Up]

F. Scan Set-Up:
Prescan Options: **[Autoshim]**
Auto CF: **[Water]**
[<=] [Scanning Range]

G. Scanning Range:
Field of View: **[24 cm]**
Scan Thickness: **[4 mm]**
Interscan Spacing: (default)
Start Loc (I/S): **0<Enter>**
End Loc (I/S): **0<Enter>**
No. Of Scan Locations: 1
FOV Center (L/R): 0 (P/A): 0
[<=] [Acq Time]

H. Acquisition Time:
Acq. Matrix (freq): **[256]**
Acq. Matrix (phase): **[160]**
Frequency Direction: **[A/P]**
Phase FOV: **[1:00 / 24 cm]**
Imaging Time: **[1NEX]**
Contrast: **[No]**
Table Delta: 0 mm
[Scan Ops]

I. Scan Operations:
[Auto Prescan]

Record (successful) APS Values:
R1_____ R2 _____ TG _____
AX _____

J. Record Gradient Shim Values:
Select: **[Gradient Shim]**
X_____ Y _____ Z _____
Select: **[Backup]**

K. Select: **[Scan]**

L. When Completed Select: **[Cancel]**

5-2 Probe-s SNR Procedure

1. Setup the (optional) probe-s SNR protocol per Table 5-2. The MRS Phantom (without loader or tuning ring) must be used.
2. Position the MRS Phantom (Customer Catalog M1090PP) on the Head Support in the Head Coil with the temperature strip visible. Do not use the Tuning Ring or Head Loader. Use foam padding as necessary to center phantom in Head Coil. Centering (up/down/left/right/in/out) is important.
3. Make NOTE of the Temperature (greenest value) at this time for protocol entry use.

TABLE 5-2
SCAN PROTOCOL: PROBE-S SNR

A. Main Menu:
[New Series]

B. Patient/Exam Information: (if applicable)
Id: **geservice<ENTER>**
Name: **probesnr**
Weight (Lb.): **111<ENTER>**
Set Patient Protocols to **Service**.
[Patient Position]

C. At front enclosure: (if applicable)
Landmark on the phantom in the Head Coil.
press **MOVE TO SCAN**.

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

E. Imaging Parameters:
Image Mode: **[Spectro]**
(*SAR must be ON*): **[Monitor SAR]**
Pulse Sequence: **[Spin Echo]**
Imaging Options: **[Extended Dynamic Range]**
or enter PSD Filename: **[probe-s]**
[User CV's] or **[Next Screen]**

F. User CVs:
Scan Mode: **[1]**
Total Number of Scans: **[32]**
rl voxel length in mm: **[20]**
ap voxel length in mm: **[20]**
rl voxel position in mm: **[0]**
ap voxel position in mm: **[0]**
[Scan Timing] or [Next Screen]

G. Scan Timing:
# of Echoes: (1)
Echo Time (TE): **[30]**
Rep Time (TR): **[2000]**
[Scan Set-Up] or [Next Screen]

H. ScanSet-Up:
Prescan Options: **[Autoshim]**
Auto CF: **[Water]**
[<=] [Scanning Range]] or [Next Screen]

I. Scanning Range:
Field of View: **[24 cm]**
Scan Thickness: **[20 mm]**
Interscan Spacing: (default)
Start Loc (S/I): **0<Enter>**
End Loc (S/I): **0<Enter>**
No. of Scan Locations: 1
FOV Center (L/R): 0 (P/A): 0
[<=] [Acq Time]] or [Next Screen]

J. Acquisition Time:
Acq. Matrix (freq): **[256]**
Acq. Matrix (phase): **[160]**
Frequency Direction: **[A/P]**
Imaging Time: **[2NEX]**
Contrast: **[No]**
Table Delta: 0 mm
[Scan Ops] **[Save Series]**

K. [Research Operations]
[Display CVs]
Verify delta values from tuning:
deltax <Enter> _____
deltay <Enter> _____
deltaz <Enter> _____
[Modify CVs]
tempC <Enter> ____ (green temp strip value)
[Research Operations] [Download]

L. Select: **[Backup]**

M. Select: **[AutoPrescan]**
(APS must be successful to continue)

N. Select: **[Scan]**

O. Select the **Message Window** and Record:
R1, R2,TG, AX, FWHM, WS Angle, WS%
Close Message Window.

5-2 Probe-s SNR Analysis

1. SNR is not annotated on the auto viewer, you must access the image from the Browser on the **[Display (Advantage Windows) Desktop]**. On this desktop, click on **[Sort]**, **[Sort examinations by date]**. Once you have done this, the most current exams will be displayed in the upper window. Select the most current Image from the most current Series from the lower window, and click on **[Viewer]**. Select **[Format]**, click on the **[1 on 1 box]** (upper left corner).
2. Record the displayed results on the Data Sheet for Probe SNR.
3. Retain (hardcopy) the Probe SNR image for reference. This can be used to make a comparison of the Cr SNR from these most recent probe-s and probe-p scans with the Cr SNR previous/future scans.

Note

It is important to understand that a minimum of three scans should be performed (back to back) to get an estimated average Probe-S SNR.

Note

Improper temperature entry may cause a SNR failure.

5-3 Probe-p SNR Procedure

1. Setup the (optional) probe-p SNR protocol per Table 5-3. The MRS Phantom (without loader or tuning ring) must be used.
2. Position the MRS Phantom on the Head Support in the Head Coil with the temperature strip visible. Do not use the Tuning Ring or Head Loader. Use foam padding as necessary to center phantom in Head Coil. Centering (up/down/left/right/in/out) is important.
3. Make NOTE of the Temperature (greenest value) at this time for protocol entry use.

TABLE 5-3
SCAN PROTOCOL: PROBE-P SNR

A. Main Menu:
[New Series]

B. Patient/Exam Information: (if applicable)
Id: **geservice<ENTER>**
Name: **probe-snr**
Weight (Lb.): **111<ENTER>**
Set Patient Protocols to **Service**.
[Patient Position]

C. At front enclosure: (if applicable)
Landmark on the phantom in the Head Coil.
press **MOVE TO SCAN**.

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

E. Imaging Parameters:
Image Mode: **[Spectro]**
(*SAR must be ON*): **[Monitor SAR]**
Pulse Sequence: **[Spin Echo]**
Imaging Options: **[Extended Dynamic Range]**
or enter PSD Filename: **[probe-p]**
[User CV's] or **[Next Screen]**

F. User CVs:
Scan Mode: **[1]**
Total Number of Scans: **[32]**
rl voxel length in mm: **[20]**
ap voxel length in mm: **[20]**
rl voxel position in mm: **[0]**
ap voxel position in mm: **[0]**
[Scan Timing] or [Next Screen]

G. Scan Timing:
# of Echoes: (1)
Echo Time (TE): **[37]**
Repitition Time (TR): **[2000]**
[Scan Set-Up] or [Next Screen]

H. ScanSet-Up:
Precsan Options: **[Autoshim]**
Auto CF: **[Water]**
[<=] [Scanning Range]] or [Next Screen]

I. Scanning Range:
Field of View: **[24 cm]**
Scan Thickness: **[20 mm]**
Interscan Spacing: (default)
Start Loc (S/I): **0<Enter>**
End Loc (S/I): **0<Enter>**
No. of Scan Locations: 1
FOV Center (L/R): 0 (P/A): 0
[<=] [Acq Time]] or [Next Screen]

J. Acquisition Time:
Acq. Matrix (freq): **[256]**
Acq. Matrix (phase): **[160]**
Frequency Direction: **[A/P]**
Imaging Time: **[2NEX]**
Contrast: **[No]**
Table Delta: 0 mm
[Scan Ops] **[Save Series]**

K. [Research Operations]
[Display CVs]
Verify delta values from tuning:
deltax <Enter> _____
deltay <Enter> _____
deltaz <Enter> _____
[Modify CVs]
tempC <Enter> ____ (green temp strip value)
[Research Operations] [Download]

L. Select: **[Backup]**

M. Select: **[AutoPrescan]**
(APS must be successful to continue)

N. Select: **[Scan]**

O. Select the **Message Window** and Record:
R1, R2,TG, AX, FWHM, WS Angle, WS%
Close Message Window.

5-4 Probe-p SNR Analysis

1. SNR is not annotated on the auto viewer, you must access the image from the Browser on the **[Display (Advantage Windows) Desktop]**. On this desktop, click on **[Sort]**, **[Sort examinations by date]**. Once you have done this, the most current exams will be displayed in the upper window. Select the most current Image from the most current Series from the lower window, and click on **[Viewer]**. Select **[Format]**, click on the **[1 on 1 box]** (upper left corner).
2. Record the displayed results on the Data Sheet for Probe SNR.
3. Retain (hardcopy) the Probe SNR image for reference. This can be used to make a comparison of the Cr SNR from these most recent probe-s and probe-p scans with the Cr SNR previous/future scans.

Note

It is important to understand that a minimum of three scans should be performed (back to back) to get an estimated average Probe-P SNR.

Note

Improper temperature entry may cause a SNR failure.

5-5 Probe SNR Data Sheet

Record:
PROBE/SV Scan Protocol type: probe-___ (s or p)
X _____, Y _____, Z _____ Shim Values.
R1 _____, R2 _____, TG _____, AX _____ APS Values.
Line Width (FWHM) _____, Angle _____, Suppression Level _____

	Machine #	**Ratio**
NA	_____	_____
Cr	_____	REFERENCE
Ch	_____	_____
ml	_____	_____
H2O	_____	_____
RMS Noise		**Cr SNR**
_____		_____

Record:
PROBE/SV Scan Protocol type: probe-____ (s or p)
X _____, Y _____, Z _____ Shim Values.
R1 _____, R2 _____, TG _____, AX _____ APS Values.
Line Width (FWHM) _____, Angle _____, Suppression Level _____

	Machine #	**Ratio**
NA	_____	_____
Cr	_____	REFERENCE
Ch	_____	_____
ml	_____	_____
H2O	_____	_____
RMS Noise		**Cr SNR**
_____		_____

Record:
PROBE/SV Scan Protocol type: probe-___ (s or p)
X _____, Y _____, Z _____ Shim Values.
R1 _____, R2 _____, TG _____, AX _____ APS Values.
Line Width (FWHM) _____, Angle _____, Suppression Level _____

	Machine #	**Ratio**
NA	_____	_____
Cr	_____	REFERENCE
Ch	_____	_____
ml	_____	_____
H2O	_____	_____
RMS Noise		**Cr SNR**
_____		_____

6- HELP

Refers to Section 1 Illustrations of PROBE Tuning results and PROBE Spectra, both incorrectly Tuned and correctly Tuned, to enable the user to become familiar with what a good phantom spectrum looks like.
Additional information can be obtained concerning the cause of an AWS (Auto-Water Suppression) failure by logging the messages generated during the PROBE APS.
A site may be required to send PROBE SNR raw data to an expert for review. This section explains the P raw file location process and how to transfer it.

6-1 EXAMPLE SNR SPECTRA (optional procedure)

Errors in the PROBE Calibration Procedure (Tuning) can introduce changes in the appearance of the resulting PROBE spectra. Section 1 contains example spectra from a Probe-P SNR protocol using the MRS Phantom. Refer to Section 1 to view spectra with an un-calibrated tuning parameter (a delta was deliberately offset + or - from the correct value by 0.5 units). Compare these to the correctly tuned spectra paying particular attention to the base (left and right) of the NAA (NA) peak (this is the largest peak located at the center of the spectrum).

6-2 Logging PROBE APS (and / or Scan)

Additional information can be obtained concerning the cause of an AWS (Auto-Water Suppression) failure by logging the messages generated during the PROBE APS (and the PROBE SNR Scan). This works similarly on 5.X and LX (although the Softkeys are slightly different).

6-2-1 Directory Creation

Select Utilities, click on [G Shell] and move the [G Shell] to the right.
Per the following create a directory to hold the log file:
cd /usr/g<Enter>
mkdir probe_data<Enter>
cd probe_data<Enter>

6-2-2 Login Setup

Login to the TPS and direct the output to a file as well as the screen. Use the grav key (`) and the pipe key (|) as identified below. Local is the lower case L key.
Type in the following:
rlogin `hostname` -tps | tee tps_log <Enter>
Log onto local (l) or remote (r) vxWorks console . . . ? **l<Enter>**
VxWorkslogin: **tps<Enter>**
Password: **tpsservice<Enter>**
At this point the logging is running. DO NOT type anything in the TPS window. Watch the TPS messages appear on the screen, everything will be logged into the file entered after the tee command **(tee tps_log)**. This file will be overwritten each time.

6-2-3 APS and / or Scan

Select and run APS and / or the SNR scan.
Re-select by touching the screen the [G Shell] to review the APS log (and scan if applicable) using the scroll bar.
When done, type **logout** in the TPS window. This will disconnect the TPS from the [G Shell].
A message will appear confirming *logoutConnection closed*.

6-2-4 Viewing the Log File

To view the log file created verify the current directory is cd /usr/g/probe_data.
Type: **more tps_log<Enter>**
Close the [G Shell] if done.
The log file can be sent to the OLC, or email'd to whomever the site is working with to resolve problems.

6-3 PROBE Raw Data Files

During the troubleshooting process the site may be required to identify the P raw data files generated when PROBE SNR was performed. These files may be helpful in determining a reason for failing SNR.

6-3-1 P Raw Data File Location

This portion of the procedure should be performed after running a PROBE SNR protocol so that P Raw File identification will be straightforward.
Select Utilities.
Click on the [G Shell].
Type in the following:
cd /usr/g/mrraw<Enter>
ls -lt P* | head<Enter>
The most recent P files will be displayed by date and time. Record the PROBE raw data file (P######*). The PROBE SNR P file size is ~449580.
Close the [G Shell] if done.

6-3-2 Transfer the "mrraw" P File

Note

The OLC can be contacted and will perform this transfer for the site after a modem connection is made.

A second alternative is to ftp the P raw file to the FE laptop. Then the file may be able to be transferred from the laptop to globe (if available).

A third alternative is to ftp the P raw file to the FE laptop. Then the file may be able to be attached to an email and sent from the laptop.

Most sites will not be able to perform the following, however, if an internal MR Building site is connected to the "GE Intranet":

While still in the mrraw directory type the following:
ftp 3.87.40.2<Enter>
OR
ftp globe<Enter>
Connected to globe.med.ge.com
ready.
Name (some name):**anonymous<Enter>**
Password:**anonymous<Enter>**
ftp>**bin<Enter>**
Example--> cd l
ftp>**cd (first letter of some name)<Enter>**
Example--> mkdir raidy
ftp>**mkdir (enter some name)<Enter>**
Example--> cd raidy
ftp>**cd (enter some name)<Enter>**
ftp>**put P#####*<Enter>**
ftp>**bye<Enter>**
exit<Enter>
Now write an e-mail or call whoever is helping with this site issue that the P#####* is on globe under whatever significant name you chose.

Note

If still available, files will remain on globe for a very limited amount of time.

REVISION HISTORY

REV	DATE	AUTHOR	PRIMARY REASONS FOR CHANGE
0	Oct 24, 1995	Resa Lambert	Initial Release in Toolbook.
1	Dec 20, 1995	J. Saperstein	Initial conversion from Toolbook to Word.
2	July 1, 1998	Resa Lambert	Updated procedure to reflect FMI Release. Added SNR tests and Help Section.
3	Aug 3, 1998	Resa Lambert	Removed 5.6 references. Minor text changes.
4	Sept 30, 1999	Resa Lambert	Initial conversion to Word. Specification change to single delta value (changed from .8 to .5).