USA Instruments, Inc.

PREMIER 7000
PHASED ARRAY CTL SPINE COIL

Service Manual

Part No. 780005 (Rev. E)

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INTRODUCTION

1. How the Coil Operates

- The block diagram of the Phased Array CTL Spine Coil is shown in *Figure 1*. It is designed for imaging the cervical, thoracic and lumbar spine. The coil contains 12 elements, which are divided into six quadrature pairs, each of which consists of a loop coil and a saddle coil. Each of the quadrature pairs is approximately 15cm in length with 1.2cm overlap between the adjacent sections. The signal from each coil pair is combined through a two-element quadrature combiner. The Phased Array CTL Spine Coil uses six signal input channels *(see Figure 2)*. A maximum of four contiguous inputs, representing four quadrature pairs (eight coil elements) can be selected at a time.

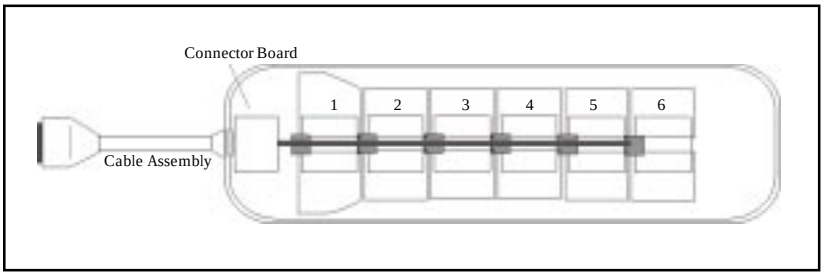

Figure 1: Block diagram of the coil.

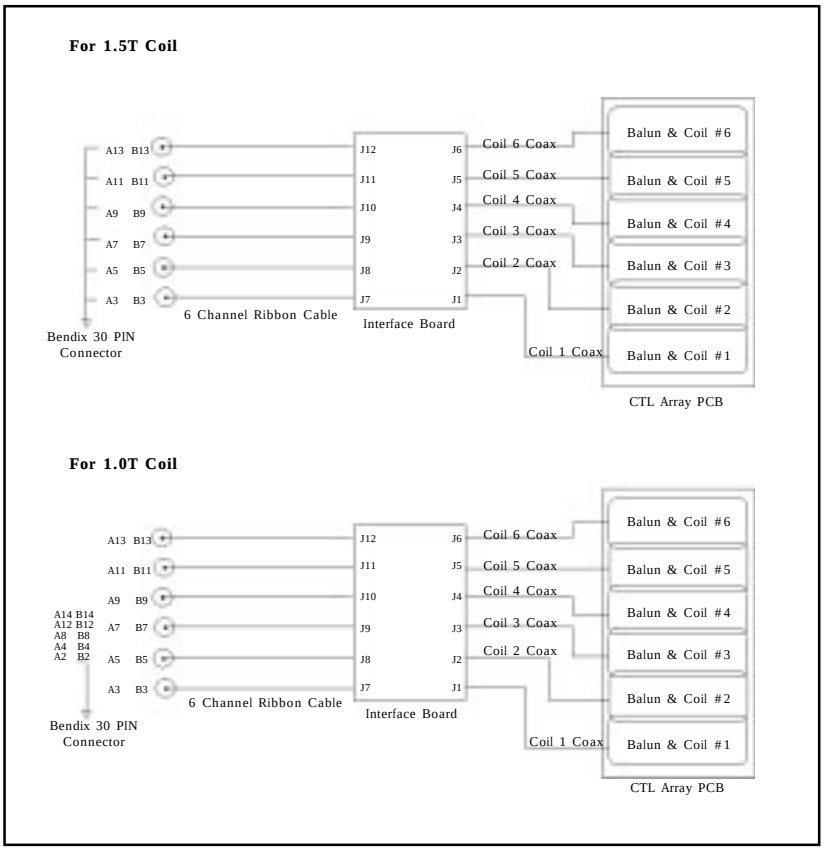

Figure 2: Block diagram of the circuit layout.

INTRODUCTION (continued)

- The Premier 7000 Phased Array CTL Spine Coil is a receive-only coil. The coil is actively decoupled from the RF transmit coil during transmit by means of a RF choking circuit. The choking circuit elements are switched on and off by pin diodes. During body coil transmission, the pin diodes are turned on with a forward bias DC source (250mA) provided by the MR system. When the pin diodes are turned on, each of the RF choking elements becomes very high in impedance (typically above 2 kilo-ohm). These high impedance elements in the coil segregate the coil circuitry into several isolated electrical segments, preventing any current flow in the coil circuit. A 30 pin Bendix connector is used to mate the coil with the system's phased array port.

2. Compatibility

- The Phased Array CTL Spine Coil (GE Part Number M1087SP) is compatible with the Signa Horizon™ 1.5T system.
- The Phased Array CTL Spine Coil (GE Part Number M1887SP) is compatible with the Signa Horizon™ 1.0T system.

3. Coil Specifications

Parameter	Characteristics
Coil Design	6 pair (12-element) quadrature phased array, receive-only coil
Tuned Frequency	63.86 MHz (factory set) for 1.5T 42.68 MHz (factory set) for 1.0T
Optimum FOV	group of four elements provides 48cm FOV
Operation and Storage Environment	operate and store the coil in the scanner room

Table 1: Coil specifications.

4. Related Documents

- Operator's Guide (USAI Part Number 770004 for 1.5T, USAI Part Number 770011 for 1.0T).
- MR System Guide (GE Part Number 2124201-3 for Signa 5.X Service Methods, GE Part Number 2160623-3 for Signa 8.X Service Methods).

SETUP AND CALIBRATION

1. Shipping List

Part Name	GE Part #	USAI Part #	Qty
Coil with Cable Assembly	2225545-6	100082	1
Adapter Block	2225545-9	150038	1
CT Phantom	2225545-4	150028	1
TL Phantom	2225545-3	150027	1
Patient Comfort Pad	E8800PD	150029	1
Wedge Pads (Set of 2)	E8800PE	150030	1
Operator's Guide	2225545-5	770004	1
Service Manual	2225545-11	780005	1

Table 2: Phased Array CTL Spine Coil (GE Part Number M1087SP) shipping list for Signa Horizon 1.5T system.

Part Name	GE Part #	USAI Part #	Qty
Coil with Cable Assembly	2225549-3	100095	1
Adapter Block	2225549-5	150039	1
CT Phantom	2225545-4	150028	1
TL Phantom	2225545-3	150027	1
Patient Comfort Pad	E8800PD	150029	1
Wedge Pads (Set of 2)	E8800PE	150030	1
Operator's Guide		770011	1
Service Manual	2225545-11	780005	1

Table 3: Phased Array CTL Spine Coil (GE Part Number M1887SP) shipping list for Signa Horizon 1.0T system.

2. Installing the Coil

- At the console, install a new soft key. This soft key will be used by the operator to select a specific coil mode as listed below in *Table 4*. Refer to the system manuals for information on installing soft keys (use the phased array and coil default values shown below).

Coil Name	Number of Receivers	Start Receiver	Stop Receiver	Recon Enable Mask	Port Enable Mask	Error Enable Mask
USCTLTOP	4	0	3	0	7	7
USCTLMID	4	0	3	0	6	6
USCTLBOT	4	0	3	0	14	14
USCS123	4	0	3	1	3	3
USCT234*	4	0	3	2	6	6
USTL345*	4	0	3	4	14	14
USLS456	4	0	3	8	12	12
USCS12	2	1	2	0	3	3
USTS23	2	2	3	0	2	2
USTL34*	4	0	3	6	6	6
USLS45	2	0	1	0	4	4
USLS56	2	1	2	0	12	12

**to be used with Signa software release 8.2.5 or later*

Table 4: Phased array values.

SETUP AND CALIBRATION (continued)

Coil Name	Coil Type	Extremity Coil	Cable Loss	Coil Loss	Recon Scale Factor	Xmit Coil Type	Multi Coil
USCTLTOP	3	no	1.05 (BRM) 1.20 (CRM)	1.72 (BRM) 0.952 (CRM)	1.00	quad	yes
USCTLMID	3	no	1.05 (BRM) 1.20 (CRM)	1.72 (BRM) 0.952 (CRM)	1.00	quad	yes
USCTLBOT	3	no	1.05 (BRM) 1.20 (CRM)	1.72 (BRM) 0.952 (CRM)	1.00	quad	yes
USCS123	3	no	1.05 (BRM) 1.20 (CRM)	1.72 (BRM) 0.952 (CRM)	1.00	quad	yes
USCT234*	3	no	1.05 (BRM) 1.20 (CRM)	1.72 (BRM) 0.952 (CRM)	1.00	quad	yes
USTL345*	3	no	1.05 (BRM) 1.20 (CRM)	1.72 (BRM) 0.952 (CRM)	1.00	quad	yes
USLS456	3	no	1.05 (BRM) 1.20 (CRM)	1.72 (BRM) 0.952 (CRM)	1.00	quad	yes
USCS12	3	no	1.05 (BRM) 1.20 (CRM)	1.72 (BRM) 0.952 (CRM)	1.00	quad	yes
USTS23	3	no	1.05 (BRM) 1.20 (CRM)	1.72 (BRM) 0.952 (CRM)	1.00	quad	yes
USTL34*	3	no	1.05 (BRM) 1.20 (CRM)	1.72 (BRM) 0.952 (CRM)	1.00	quad	yes
USLS45	3	no	1.05 (BRM) 1.20 (CRM)	1.72 (BRM) 0.952 (CRM)	1.00	quad	yes
USLS56	3	no	1.05 (BRM) 1.20 (CRM)	1.72 (BRM) 0.952 (CRM)	1.00	quad	yes

**to be used with Signa software release 8.2.5 or later*

Table 5: Coil values for Signa Horizon 1.5T.

Coil Name	Coil Type	Extremity Coil	Cable Loss	Coil Loss	Recon Scale Factor	Xmit Coil Type	Multi Coil
USCTLTOP	3	no	1.24 (BRM)	0.549 (BRM)	1.00	quad	yes
USCTLMID	3	no	1.24 (BRM)	0.549 (BRM)	1.00	quad	yes
USCTLBOT	3	no	1.24 (BRM)	0.549 (BRM)	1.00	quad	yes
USCS123	3	no	1.24 (BRM)	0.549 (BRM)	1.00	quad	yes
USCT234*	3	no	1.24 (BRM)	0.549 (BRM)	1.00	quad	yes
USTL345*	3	no	1.24 (BRM)	0.549 (BRM)	1.00	quad	yes
USLS456	3	no	1.24 (BRM)	0.549 (BRM)	1.00	quad	yes
USCS12	3	no	1.24 (BRM)	0.549 (BRM)	1.00	quad	yes
USTS23	3	no	1.24 (BRM)	0.549 (BRM)	1.00	quad	yes
USTL34*	3	no	1.24 (BRM)	0.549 (BRM)	1.00	quad	yes
USLS45	3	no	1.24 (BRM)	0.549 (BRM)	1.00	quad	yes
USLS56	3	no	1.24 (BRM)	0.549 (BRM)	1.00	quad	yes

**to be used with Signa software release 8.2.5 or later*

Table 6: Coil values for Signa Horizon 1.0T.

- The coil is ready for clinical use after proper installation of the soft key. Refer to the Operator's Guide for instructions on use of the coil.

SETUP AND CALIBRATION (continued)

3. Changing Quadrature Configuration

- The quadrature configuration can be changed in the field only if the coil is a Revision B (1.0T) or a Revision C (1.5T) or later version. Coils of Revision A (1.0T) or Revision B (1.5T) have to be sent to USAI for changing quadrature configuration. Note: For a coil which is upgraded from Revision A to Revision B (1.0T coils) or from Revision B to Revision C (1.5T coils) or later, J3 is located at the upper left side of the feeding board.

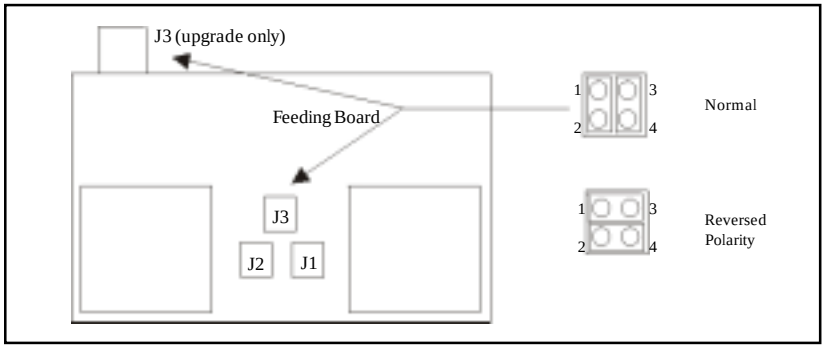

Figure 3: Feeding board layout.

- To change the quadrature configuration for magnets with reversed polarity, follow these steps: (1) locate J3 on the feeding board; (2) the normal position for the jumper should be 1-2, 3-4; (3) remove both jumpers and reposition them as 1-3, 2-4; (4) all six feeding boards need to be modified.

4. Quality Assurance Procedure

- Tuning -- The Premier 7000 Phased Array CTL Spine Coil does not require matching or tuning on a per patient basis. The coil is initially tuned to the system frequency by USA Instruments' service engineers and requires no additional tuning.

- QA Check -- It is recommended that the clinical user conduct a QA check on the Premier 7000 Phased Array CTL Spine Coil on a weekly basis. The QA check consists of a QA scan, a calculation of the signal-to-noise ratio (SNR) and a visual inspection of the coil phantom image.

- QA Setup -- Select [New Study], [New Exam] or [New Pt] to set a new landmark. Remove the Quad Head Coil or any other surface coil (if present) from the cradle. Caution! The Quad Head Coil must be completely removed from the cradle before performing a body scan. Failure to do this may result in damage to the Quad Head Coil. Place the Phased Array CTL Spine Coil at the center of the cradle. Place the CTL phantom set directly on the coil; do not use the pads *(see Figure 4)*. The set consists of the CT phantom (GE Part 2225545-4, USAI Part 150028) and the TL phantom (GE Part 2225545-3, USAI Part 150027). Make sure the ears of the CT phantom are positioned firmly against the coil sides. Place the TL phantom so that it is positioned face to face against the CT phantom *(see Figure 4)*. Minimize spacing between the coils by pushing the TL phantom against the CT phantom. Connect the Phased Array CTL Spine Coil connector to the phased array port.

SETUP AND CALIBRATION (continued)

- The QA check for the Phased Array CTL Spine Coil requires two scans. The coil consists of six individual coil (pairs). The first scan measures SNR over the top three coils (coil mode USCS123) and should be landmarked at the 22cm mark (center of the top three coils) on the scale attached to the side of the coil. The second scan measures SNR over the bottom three coils (coil mode USLS456) and should be landmarked at the 57cm mark (center of the bottom three coils) on the scale attached to the side of the coil. The critical parameters for the QA scan protocol are listed below.

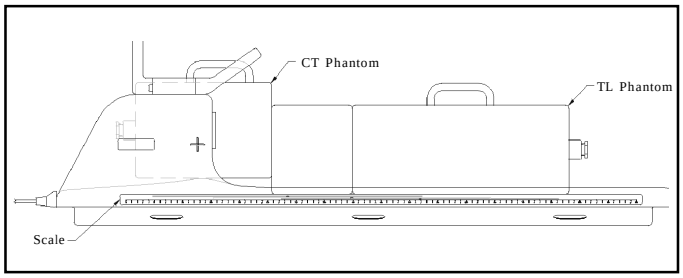

Figure 4: Positioning the phantom set.

Patient/Exam Information	
ID	QA
Name	CTL Spine
Patient Weight	111 lbs / 50 Kgs
Patient Position	
Patient Entry	Head First
Patient Position	Supine
Axial/Sag Landmark	
Coil Type	USCS123 / USLS456
Scan Plane	Sagittal
Imaging Parameters	
Image Mode	2D
Pulse Sequence	Spin Echo
Imaging Options	None
Scan Timing	
Number of Echoes	1
Echo Time (TE)	30 msec
Rep Time (TR)	300 msec
Scan Time	1m:23s
Scanning Range	
Field of View (FOV)	48 cm
Scan Thickness	3 mm
Interscan Spacing	0 mm
Start Loc	0
End Loc	0
Number of Scan Locations	1
FOV Center	0 LR, 0 AP
Acquisition Time	
Acq Matrix (Frequency)	256
Acq Matrix (Phase)	256
Frequency Direction	A/P
NEX	1
Phase FOV	48 cm
Autoshim	On
Auto CF	Peak

Table 7: QA scan parameters.

SETUP AND CALIBRATION (continued)

- Select [Scan]. Scan the CT phantom with the top three coils (coil mode USCS123) with landmark at the 22cm mark on the scale. Observe the resulting image of the phantom which should be similar to *Figure 5*. Check to see that there are no artifacts in the image. This image will be used for determination of the SNR of the top three coils.

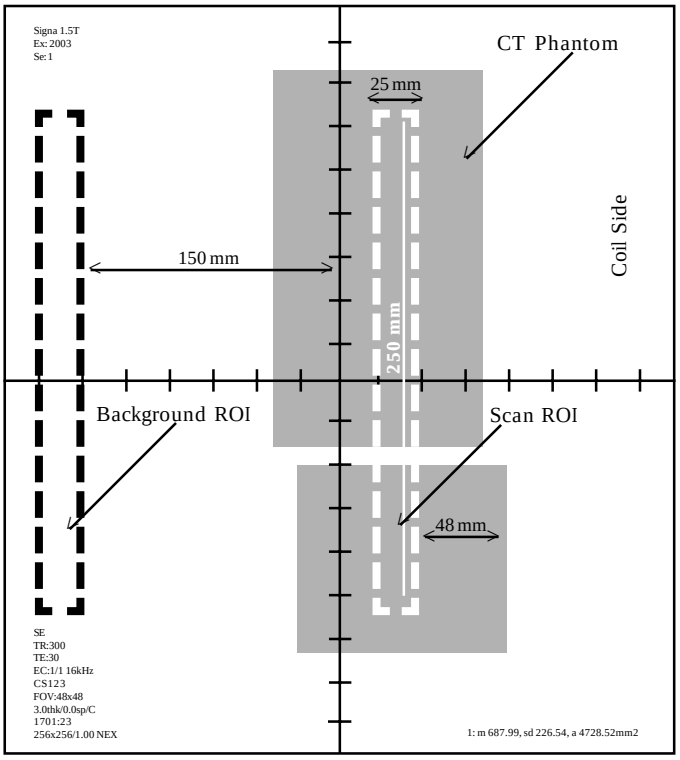

Figure 5: SNR measurement for top three coils (coil mode USCS123).

- Select [Scan]. Scan the TL phantom with the bottom three coils (coil mode USLS456) with landmark at the 57cm mark on the scale. Observe the resulting image of the phantom which should be similar to *Figure 6*. Check to see that there are no artifacts in the image. This image will be used for determination of the SNR of the bottom three coils.

SETUP AND CALIBRATION (continued)

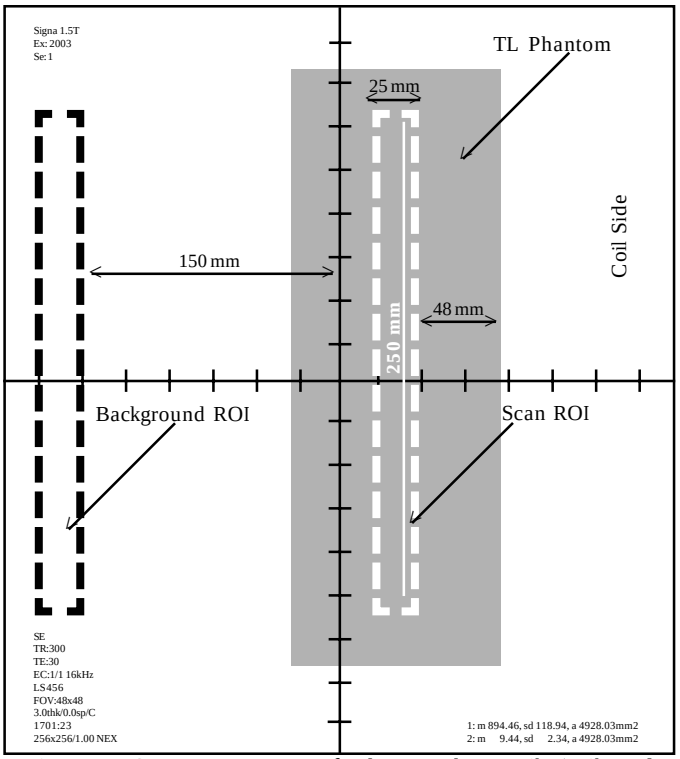

Figure 6: SNR measurement for bottom three coils (coil mode USLS456).

- SNR Measurement of Top Three Coils -- Select the phantom image. Select the rectangular cursor or box. Size the box so that it represents a rectangular region of interest (ROI) of 25mm x 250mm (approximate). Position the edge of this rectangle at 48mm **from the edge of the phantom closest to the coil, with the center of the rectangle in line with FOV isocenter** *(see Figure 5).*

SETUP AND CALIBRATION (continued)

- Record the phantom ROI's mean pixel value and standard deviation. Reposition or recreate the same rectangular ROI in the background region at exactly 150mm from the **center of the FOV** *(see Figure 5)*. Check to see that the background is free of any artifact.

- Record the phantom mean pixel value and standard deviation.

- Calculate the image's signal-to-noise ratio (SNR = phantom mean pixel divided by background standard deviation). SNR should be greater than 230 (for 1.5T) or 185 (for 1.0T). Example:

	Mean Pixel	Standard Deviation
Phantom ROI	500	12.5
Background ROI	10	2

- SNR Measurement of Bottom Three Coils -- Repeat previous steps with the phantom image (see Figure 6) obtained from the bottom three coils (coil mode USLS456). The measured SNR should be greater than 200 (for 1.5T) and 155 (for 1.0T).

- Visual Check of Phantom Images -- The user should study the sagittal images of the phantoms that were obtained for the SNR analysis to spot any large signal voids or significant signal non-uniformity. Signal voids and signal non-uniformity may indicate potential problems with an individual coil or coils. Contact your service engineer for troubleshooting.

REPLACEMENT AND MAINTENANCE

1. Checking the Protection Pin Diodes and Output Cable with DMM

- Select the DIODE TEST function on the DMM. Connect the negative lead to the connector pin on Row A. Connect the positive lead to the pin on Row B. Refer to the table and illustration above. A reading of 0.90 volts to 1.20 volts should be observed. If a reading below 0.90 volts is observed, either the output cable is shorted or one of the pin diodes on the feeding board is defective. If a reading above 1.20 is observed, either the output cable or the jumper is open.

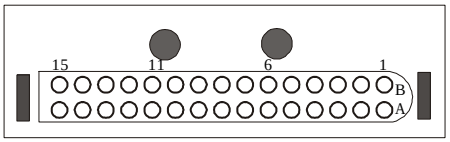

Figure 7: Pin locations for Bendix 30 pin phased array connector.

Coil Number	Positive Lead Connection	Negative Lead Connection	Voltage Reading
1	3B	3A	1.10 (+.10 / -.20)
2	5B	5A	1.10 (+.10 / -.20)
3	7B	7A	1.10 (+.10 / -.20)
4	9B	9A	1.10 (+.10 / -.20)
5	11B	11A	1.10 (+.10 / -.20)
6	13B	13A	1.10 (+.10 / -.20)

Table 8: Pin diodes and output cable with DMM for Signa Horizon 1.5T.

Coil Number	Positive Lead Connection	Negative Lead Connection	Voltage Reading
1	3B, 3A	2B, 2A	1.10 (+.10 / -.20)
2	5B, 5A	4B, 4A	1.10 (+.10 / -.20)
3	7B, 7A	8B, 8A	1.10 (+.10 / -.20)
4	9B, 9A	8B, 8A	1.10 (+.10 / -.20)
5	11B, 11A	12B, 12A	1.10 (+.10 / -.20)
6	13B, 13A	14B, 14A	1.10 (+.10 / -.20)

Table 9: Pin diodes and output cable with DMM for Signa Horizon 1.0T.

REPLACEMENT AND MAINTENANCE (continued)

2. Field Replaceable Units

Part Name	GE Part #	USAI Part #
Coil	2225545-6	100082
Cable Assembly	2225545-2	110040
Bridge	2225545-8	110004
Adapter Block	2225545-9	150038
CT Phantom	2225545-4	150028
TL Phantom	2225545-3	150027

Table 10: Field replaceable units for Signa Horizon 1.5T.

Part Name	GE Part #	USAI Part #
Coil	2225549-3	100095
Cable Assembly	2225549-2	110041
Bridge	2225549-4	110005
Adapter Block	2225549-9	150039
CT Phantom	2225545-4	150028
TL Phantom	2225545-3	150027

Table 11: Field replaceable units for Signa Horizon 1.0T.

3. Replaceable Accessories

Part Name	GE Part #	USAI Part #
Patient Comfort Pad	E8800PD	150029
Wedge Pads (set of 2)	E8800PE	150030
Coil Shipping Container Set		150207
Phantom Shipping Container Set		150208

Table 12: Replaceable accessories for Signa Horizon 1.5T and 1.0T.

4. Replacing the External Cable

- Remove coil cover. Remove the two screws that hold down the cable assembly (as shown above). Disconnect SMB plugs on the cable end from the interface boards. Remove the old cable assembly. Use two screws to fix a new cable assembly on the CTL coil. Connect all six SMB plugs to the corresponding receptacles on the interface board. Close the coil cover.

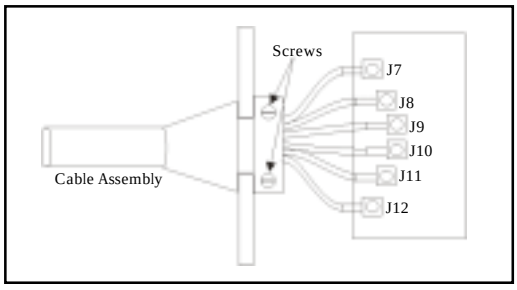

Figure 8: Cable assembly.

REPLACEMENT AND MAINTENANCE (continued)

5. Replacing the Anterior Bridge Assembly

- The anterior bridge assembly is a field replaceable unit and can be simply interchanged with the original assembly. However, to ensure correct fit and ease of engagement of the anterior assembly to the coil, it is strongly recommended that the service engineer follow the following procedure (see *Figure 9* for guidance).

- Step 1 -- Unscrew the top cover from the bridge assembly and loosen (using an 11/32 inch nut driver) both nuts that secure the connector pins.

- Step 2 -- Place the bottom portion of the bridge assembly on the C-Spine section of the coil. Then tighten both nuts.

- Step 3 -- Remove the bottom portion of the bridge assembly from the coil. Then tighten down the connector pin and nut assembly by using the 11/32 inch driver to torque the nut and a 1/4 inch driver to keep the connector pin from rotating.

- Step 4 -- Place the bottom portion of the bridge assembly back on the coil to check that the alignment of the connector pins is correct. If the bridge does not install smoothly on the coil, loosen the nuts and pin assemblies. Repeat Steps 2 and 3 to realign the pins. If the assembly of the bridge and coil continues to be a problem after repeating the procedures, return the coil for evaluation.

- Step 5 -- If the bridge engages correctly, then reassemble the top and bottom portions of the bridge.

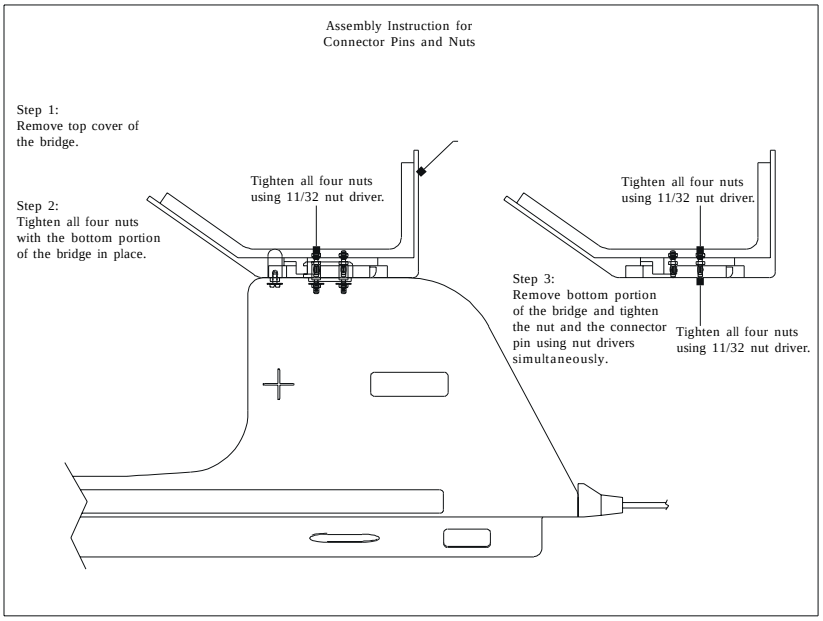

Figure 9: Replacing the anterior bridge assembly.

REPLACEMENT AND MAINTENANCE (continued)

6. Coil Care

- Before Cleaning -- Detach the coil connector from the scanner before attempting to clean. Prevent touching the connectors with bare fingers. Prevent pressing a sharp object against the surface of the connector.

- Caution! Do not pour or spray cleaning liquid directly onto the coil or cable. Do not allow any moisture to come in contact with the connector or cable. Do not immerse the coil in any cleaning liquid.

- Cleaning -- The following solutions are recommended for the coil and pad surfaces: (1) warm water, (2) one ounce commercial dishwashing liquid mixed with one gallon water or (3) a ten percent bleach solution (some discoloration may occur). Apply cleaning solution to a soft cotton cloth and proceed to clean. It is recommended that the user place a cotton sheet over the coil before positioning the patient to prevent soiling of the coil. In the event the coil is soiled, clean the coil as described above.

- Carrying the Coil -- The coil should be supported from underneath using both hands. The coil should never be lifted by the anterior section (permanent damage to the anterior bridge may result).

REVISION HISTORY

Revision	Date	Changes	Changed Pages
Revision A	05/98	First Issue	
Revision B	06/99	General Modifications	All
Revision C	09/99	Modified QA Setup, Shipping List; Added Replaceable Accessories List General Modifications	Pages 7, 9, 13 All
Revision D	09/01	Modified QA Setup, Added Revision History	Pages 7, 16
Revision E	10/01	Modified GE Part Numbers for Pads, FRU Tables, and Accessories Table	Pages 5, 13