SERVICE MANUAL

USA Instruments, Inc.

Document 2375136-7

Revision 4

GE Signa® 1.5T
MARK 9000
PHASED ARRAY SHOULDER COIL

GE Catalog Part Number: M1087SE

Damage in Transportation

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

Immediately complete a "Damage Loss Claim Form", available via MS Exchange Mail, after the damage is found.

MS Exchange Path:

Outlook/Public Folder/All Public Folders/Medical Systems/!Global Initiatives/Information Management/Forms/Common Forms/DAMAGE LOSS CLAIM FORM.

Send the completed form to the email address listed in the form.

For more information about the Transportation Claim Procedure, access the GE Medical Systems Intranet and enter the following URL address (case sensitive):

ftp://3.87.40.2/globepro/qualsys/Docs/190016MF.PDF

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- 忽略本注意事项会对维修员，操作员或病人造成触电，机械伤害或其他伤害。

TABLE OF CONTENTS

SECTION 1 – INTRODUCTION

1-1 Product Identification and Shipping List

To identify the Phased Array Shoulder Coil, refer to the coil labels (as shown in *Figure 1*).

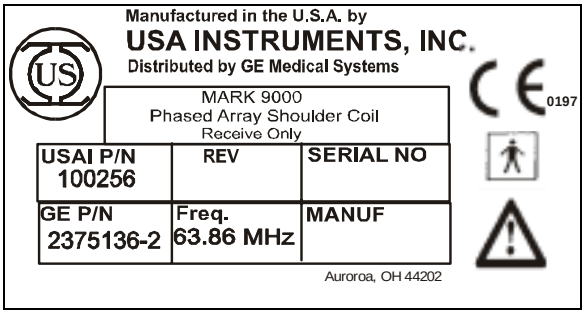


Figure 1: Coil label.

Figure 2 shows a picture of the Phased Array Shoulder Coil.

Figure 2: The Phased Array Shoulder Coil.

SHIPPING LIST – TABLE 1-1

Part Name	GE Part #	Qty
Coil	2375136-2	1
Patient Comfort Pad	2375136-5	1
Phantom Positioner	2375136-3	1
Positioning Straps (Set of 2)	2375136-4	1
Operator's Guide	2375136-6	1
Service Manual	2375136-7	1

1-2 Compatibility

This coil is compatible with the Signa® Horizon™ and LX Horizon™ 1.5T.

1-3 Related Documentation

Operator's Guide, GE Part Number 2375136-6.

Signa® LX Service Methods CD, 2160623-1.

1-4 Environmental Requirements

Storage Requirements

Coil should be stored in the scanner room.

Dimensions

8.5" L x 9.1" W x 12.4" H (21.7 cm x 23.2 cm x 31.6 cm)

Weight

7.0 lbs. (3.2 kg)

1-5 Theory of Operation

The physical layout of the Mark 9000 Phased Array Shoulder Coil is shown in *Figure 3*. The coil is designed for imaging the shoulder and surrounding regions. The sensitive region of the coil offers approximately 20cm field of view. The device consists of three quadrature receive coils.

The Phased Array Shoulder Coil is a receive-only coil as shown in the Schematic in the Appendix. 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 by pin diodes. The pin diode is turned on by a forward biasing DC current source supplied by the MRI system (active decoupling). When the pin diode is turned on, the impedance of the RF choking circuit becomes very high (typically above 2 kilo-ohm), compared to the other circuit elements (less than 25 kilo-ohm). These high impedance elements segregate the coil circuitry into two isolated electrical segments, preventing any current flow in the coil circuit.

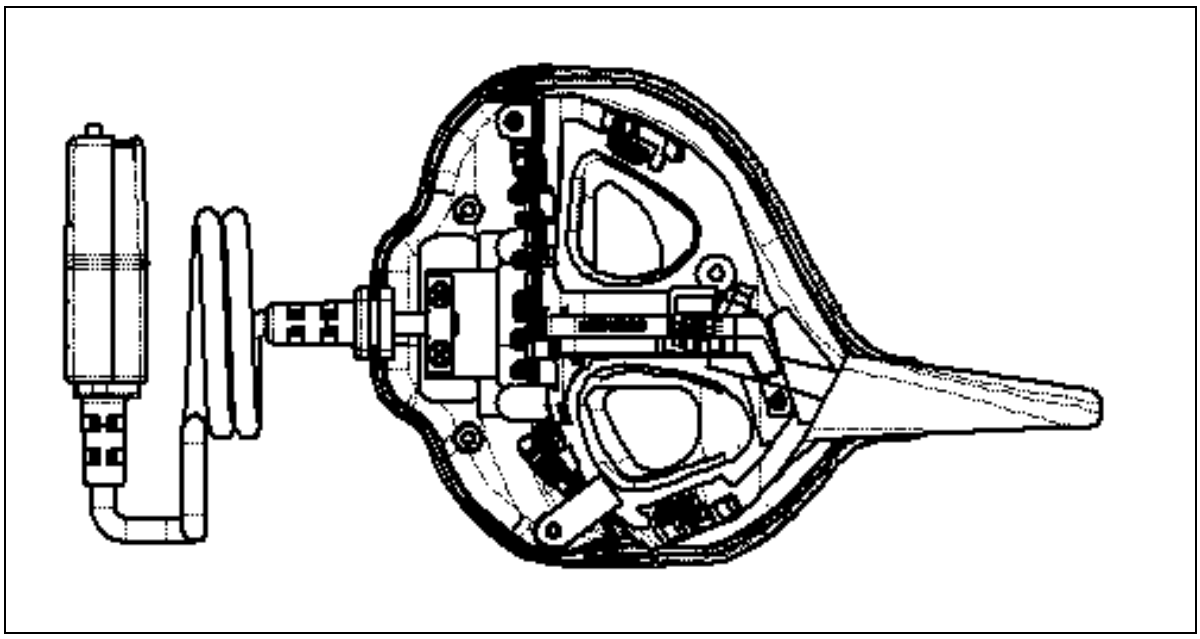


Figure 3: Coil physical layout.

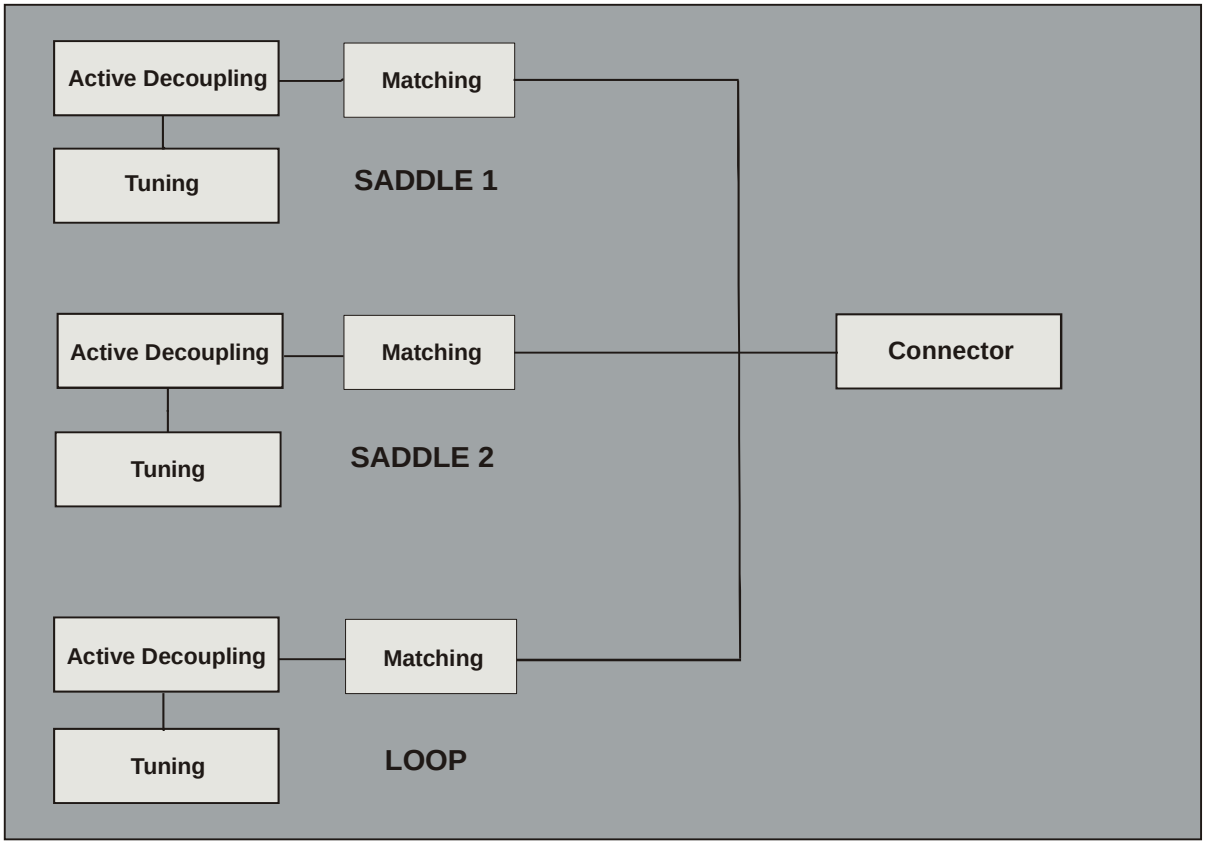


Figure 4: Block diagram of the coil.

SECTION 2 – SETUP AND CALIBRATION

2-1 Coil Installation

2-1-1 Special Install Notes

None.

2-1-2 Installing the Coil

The system will automatically recognize the coil using the Coil ID feature.

Add the coil using the Configuration File Manager. Refer to Service Methods CD; System Level Procedures; Software Utilities.

If the coil does not exist in the Coil Config File refer to the Adding New Coils to Config File Manager procedure and use the coil configuration information in Section 7-1 of this manual.

COIL CONFIGURATION NAME – TABLE 2-1-2

US SHOULDER PA

2-2 Installation Functional Checks

1. Perform system level Signal to Noise Check. Refer to Service Methods CD; System Level Procedures; Functional Checks; Signal to Noise Check.
2. Perform Section 3-2 Coil Imaging Performance Verification.

2-3 Periodic Quality Assurance Check

On a periodic basis, such as during planned maintenance, perform the quality assurance checks as outlined below to ensure the coils is operating properly.

1. Check external cable for cracks or cuts.
2. Perform Section 3-2 Coil Imaging Performance Verification and record data values in Data Sheet.

SECTION 3 – FUNCTIONAL CHECKS

3-1 Scope

The Functional Checks procedure in this section is intended for use on Signa software releases 9.0 and above.

3-2 Purpose

The procedure described in this section will be used to perform a quality assurance check on the Phased Array Shoulder Coil.

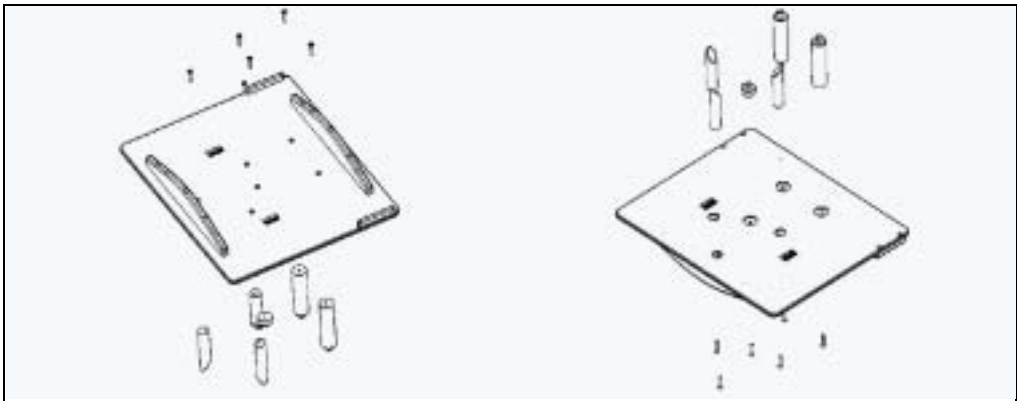
3-3 Overview

This procedure will walk you through collecting images and calculating SNR numbers for those images. This procedure insures the quality of the coil received at the customer site. This procedure gives detailed instructions to perform this test. The coil configuration file must be installed prior to the performance testing of this coil.

3-4 Procedure

3-4-1 Coil and Phantom Setup for the QA Scan

1. Assemble the phantom positioner as shown in *Figure 5*.



Step 1 – Assemble the two tall large diameter posts (with small diameter posts on top) to the phantom positioning plate using the brass screws provided. The two tall large diameter posts will fit into the two large diameter pockets at the head end of the plate.

Step 2 – Assemble the three small diameter posts (with angled top) to the phantom positioning plate using the brass screws provided. These three posts have the mounting holes offset from the center of the rod so they can only be assembled in the three holes in the plate that have the corresponding offset mounting holes.

Step 3 – Assemble the short large diameter post (with small diameter posts on top) to the phantom positioning plate using the brass screws provided. The short large diameter post fits into the remaining pockets in the center of the positioning plate.

Figure 5: Assembling the phantom positioner.

2. Position the phantom positioner onto the table and place the coil and phantom onto the positioner (see *Figure 6*).

Figure 6: Positioning the phantom.

3. Landmark the coil at the crosshair.
4. At the magnet, press "**Alignment Light**" to turn on the light. Move the cradle to align the coil to the alignment lights. Press "**Landmark**" to landmark the alignment.
5. Move the coil to scan position by clicking on the "Move to Scan" button.
6. From the **Scan Desktop**, start new scan by selecting [**New Pt**]; set **Patient ID** to "*geservice*" and Patient Weight to "*111*" pounds. Click [**Patient Position**] to open protocols window.
7. Set the protocols using Table 3-4-1 Coronal Signal Protocol.
8. Select [**Save Series**] then [**Prepare to Scan**].
9. Prior to the scan, open the [**Display CVs**] menu under [**Research Operations**].
10. Set the "**saveinter**" CV to 1, saving the intermediate images. This is required to ensure all channels are operating well.
11. Select [**Auto Prescan**] then [**Scan**].
12. After the scan is complete, select [**Scan**] to run the series again.
13. Bring the table all the way out and remove the shoulder coil from the phantom positioner. Press the "Move to Scan" button to move the phantom back to isocenter.
14. Select the sequence that was just run on the shoulder coil, right click on the sequence and select [**Copy Series**]. Right click again and select [**Paste Series**].
15. Select [**View Edit**] and change the coil to Body Coil.
16. Select [**Save Series**] then [**Prepare to Scan**].
17. Select [**Auto Prescan**], after the prescan is complete, select [**Scan**].
18. After the scan is complete, select [**Scan**] to run the series again.
19. End the exam when the scan is complete. This will ensure that all CVs return to their default values.

CORONAL SIGNAL PROTOCOL – TABLE 3-4-1

Patient/Exam Information	
Patient ID	geservice
Patient Name	shoulder pa
Patient Weight	111 lbs. (50 kg)
Patient Position	
Patient Position	Supine
Patient Entry	Head First
Coil	US Shoulder Coil / Body Coil
Series Description	cor sig
Imaging Parameters	
Plane	Coronal
Mode	2D
Pulse Seq	FSE-XL
Imaging Options	none
PSD Name	*leave blank*
Protocol	*leave blank*
Scan Timing	
# of Echoes	1
TE	17
TR	500
Echo Train Length/Flip Angle	4
Bandwidth	15.63
Additional Parameters	
no entries required in this area	
Acquisition Timing	
Freq	256
Phase	256
NEX	1
Phase FOV	1
Preq DIR	S/I
Auto Center Freq	Peak
Autoshim	Off
Phase Correct	On
Contrast	Off
# of Reps B4 Pause	0
Scanning Range	
FOV	20
Slice Thickness	5
Spacing	1.5

	A/P	L/R Center	S/I Center
Start	**A10**	**0**	**I31**
End	**A10**		
# Slices	**1**	Table Delta	**0.0**

3-4-2 SNR Measurement

1. Subtract image four from image eight in series one, by selecting the image browser then clicking on the "add/sub" button on the right side.
2. Select the exam, series and image eight to be the minuend. Select the "-" minus sign in the MODE section of the window.
3. Select the exam, series and image four to be the subtrahend. Click on the equal sign in the MODE section. This will subtract image four from image eight. This image will be put into its own series, usually 100. Select the noise image in the same series as the rest of the images for display.
4. Measure with a circle, an area of 18000mm^2 plus or minus 100mm^2 on this noise image. This circle should be placed inside the phantom ball image (see *Figure 7*).

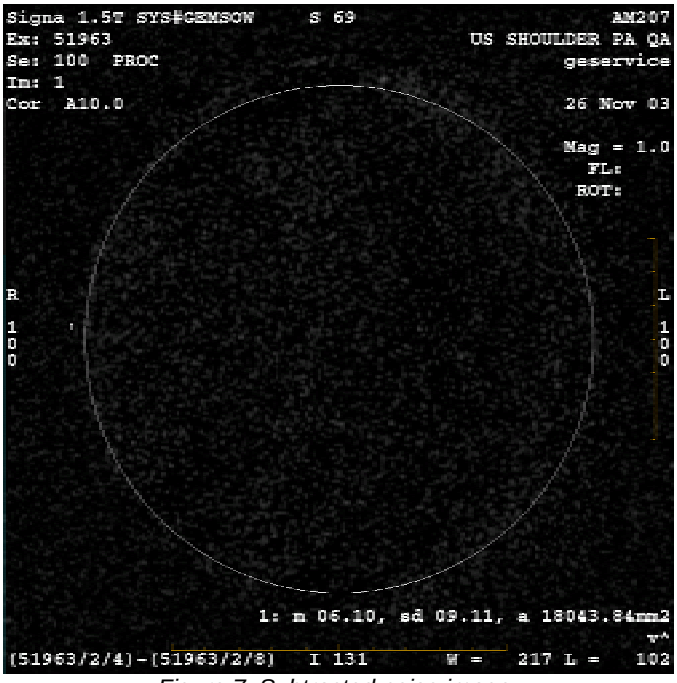


Figure 7: Subtracted noise image.

5. Record the standard deviation (sd) value in Table 3-4-2 for the three ROI's.
6. Open the Browser and select image four from the coronal signal scan.
7. Click on the "Grid" button to display the grid on image four.
8. Center the grid on signal image four, then draw three separate circles along the grid (see *Figure 8*).

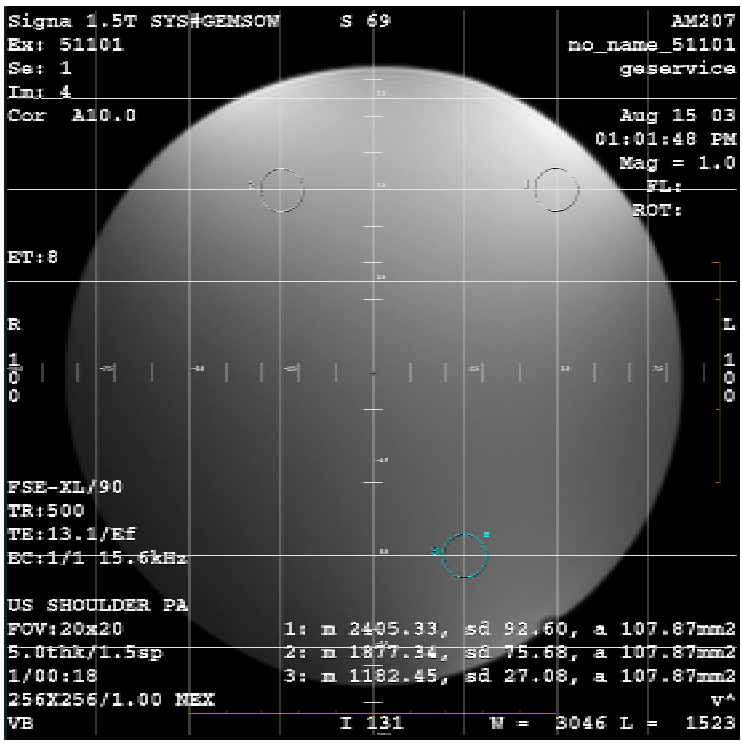


Figure 8: Signal phantom image.

9. Record the mean (m) signals in Table 3-4-2 for the three ROI's then calculate the SNR.
10. To complete the Body Coil SNR measurement, use the procedure as described above by subtracting image one from image two to create the noise scan. Measure with a circle an area of 18000mm^2 plus or minus 100mm^2 on this noise image. This circle should be placed inside the phantom ball image.
11. Record the standard deviation (sd) value in Table 3-4-2 for the three ROI's.
12. Open the Browser and select image one from the coronal signal scan body coil series.
13. Follow the same steps in the procedure above and record the mean (m) signals in Table 3-4-2 for the three ROI's then calculate the SNR.

SNR CALCULATIONS – TABLE 3-4-2

Shoulder Coil Sample	**Mean 1**	**Mean 2**	**Mean 3**
Noise from first image	2405.33	1877.34	1182.45
Mean Signal from the circles	9.11	9.11	9.11
SNR = Mean Signal / Noise	264.03	206.07	129.79
Body Coil Sample	**Mean 1**	**Mean 2**	**Mean 3**
Noise from first image	950.43	993.31	989.19
Mean Signal from the circles	44.62	44.62	44.62
SNR = Mean Signal / Noise	21.30	22.26	22.17
BODY COIL SNR	**Mean 1**	**Mean 2**	**Mean 3**
Noise from first image			
Mean Signal from the circles			
SNR = Mean Signal / Noise			
Tolerance for these measurements			
SHOULDER COIL SNR	**Mean 1**	**Mean 2**	**Mean 3**
Noise from first image			
Mean Signal from the circles			
SNR = Mean Signal / Noise			
Tolerance for these measurements			

This is not a Shoulder Coil specification. The coil must be compared against the body coil performance.

3-4-3 Performance Compared to Body Coil

The test that will be used to verify performance when compared to the Body Coil will be SNR and measured with a 15cm head phantom. SNR will be measured using the protocol described in Section 3-4-1.

3-5 Decision Criteria

The SNR of the Phased Array Shoulder Coil will be at least four times greater than the Body Coil using the same phantom, phantom holder and scan parameters.

3-6 External Cable Check

PIN Diode Check from the Connector:

Step 1 – Select the Diode Test function on the multi-meter.

Step 2 – Using *Figure 9* and Expected Readings – Table 3-3 below for the correct pin locations, connect the negative multi-meter lead to the connector pin on Row A and connect the positive multi-meter lead to the connector pin on Row B.

Step 3 – The reading on the digital multi-meter should be 0.5 ± 0.1 volts. If the reading is below 0.2 volts, either the output cable is shorted or one of the pin diodes on the feed board and the PIN diode board is defective. If the reading is above 1.0 volts, either the output cable or the DC wires are open.

EXPECTED READINGS – TABLE 3-6

Coil Element Number	Positive Lead Connection	Negative Lead Connection	Voltage Reading
Saddle 2	11B	11A	0.5 ± 0.1
Loop	9B	9A	0.5 ± 0.1
Saddle 1	7B	7A	0.5 ± 0.1
Saddle 2	11A	11A	Open
Loop	9A	9A	Open
Saddle 1	7A	7A	Open

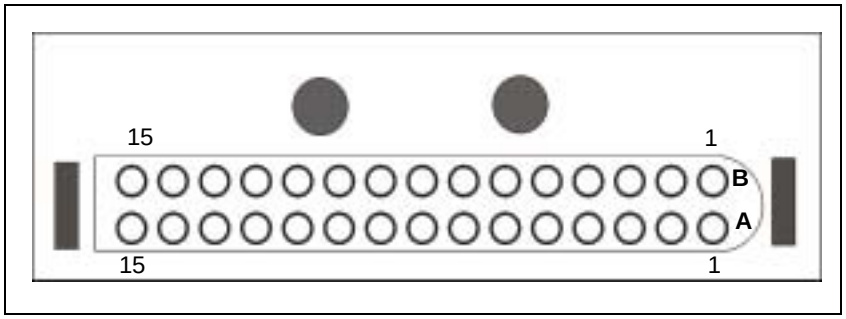


Figure 9: 30-pin Bendix connector.

3-7 PIN Diodes Check

Same as External Cable Check.

3-8 Mechanical Hardware Check

None.

3-9 Troubleshooting Tips

Symptom #1: The system reports a coil fault during prescan.

Probable Cause	Suggested Actions	Resolution
The coil connector has become disconnected from the system interface.	Check to make sure the coil connector is fully engaged.	Engage connector and try the scan again.
One or more PIN diodes have failed.	From inside the coil, check the PIN diodes using a DVM. Use diode mode for forward-bias measurements and resistance mode for reverse-bias measurements. Note that there should be no reverse-bias leakage. Bad PIN diodes are usually shorted or exhibit reverse-bias leakage current.	Replace the coil.
There is a DC short or open somewhere within the DC path inside the coil.	Check the coil and associated DC paths with a DVM, in both diode check and resistance modes.	If a short or open is observed, then replace the coil.
The output cable has a short or an open.	Disconnect the cable at the coil and check each coaxial line with a DVM (resistance). Try moving and twisting the cable as you watch the meter to find any intermittent connections. Inspect the center pins of the SMB and Bendix connections for wear and proper engagement into the mating connection.	Replace the coil.
There is a problem with the DC bias from the system interface.	Check to ensure the correct DC bias is being provided to the coil during transmit and receive per GEMS System Service Manual. Try a similar 2-channel coil to see if the same problem occurs	Correct MRI system problem.

Symptom #2: The coil does not pass SNR tests or exhibits poor image quality on patient scans.

Probable Cause	Suggested Actions	Resolution
One or more of the coil channels has a high noise level.	Look at the uncombined images to determine which channel has the problem. Compare the noise standard deviation measurements between channels and system performance logs; they should be approximately the same.	Replace the coil.
One or more of the coil channels has low signal.	Look at the uncombined images to determine which channel has the problem. Compare signal mean measurements between channels and system performance logs.	Replace the coil.
There is a problem with the DC bias from the system interface.	Check to ensure the correct DC bias is being provided to the coils during transmit and receive per GEMS System Service Manual.	Correct MRI system DC bias problem.

Coil Element Information

Element Name	Not Used	Not Used	Not Used	Saddle 2	Loop	Saddle 1	Not Used	Not Used	Not Used
Channel Number	1	2	3	4	5	6	7	8	N/A
Selected Channel	no	no	no	yes	yes	yes	no	no	N/A
Mc Bias Driver #	1	1	2	2	3	3	4	4	N/A
Active Bias Driver	no	no	no	yes	yes	yes	no	no	N/A

SECTION 4 – MAINTENANCE

4-1 Coil Care

WARNING!

Detach the coil connector from the scanner before attempting to clean the coil. Do not touch the connectors with bare fingers. Never press a sharp object against the surface of the connector. Do not reattach the connector after cleaning the coil until the coil has dried completely. Electric shock may result if the coil is attached to the system during cleaning or when it is wet.

CAUTION

Do not spray or pour cleaning solution directly on the coil. Do not submerge the coil in the solution. The coil contains sensitive electronic components that could be damaged by the solution. The coil cannot be sterilized and should be cleaned only according to the procedure outlined in this section.

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

4-2 Special Care Requirements

Prior to returning a coil for service, use a ten percent bleach solution (as described above) to eliminate risk of exposure to potentially infectious materials.

SECTION 5 – REPLACEMENT

Simple removals that are clearly obvious are not described here.

Unless otherwise noted, the steps for re-assembly are the reverse order of the steps described for disassembly.

5-1 External Cable Replacement

Step 1 – Remove the coil covers by taking out the screws located in the covers (six on right side, three on left).

Step 2 – Remove the two screws that hold the cable clamp in position (cable is captured beneath).

Step 3 – Remove the three SMB connectors located on the tuning boards (TP1, TP2, TP3).

Step 4 – Remove the cable assembly from the coil.

Step 5 – To install the new cable assembly, start by capturing the cable beneath the cable clamp and install the two screws removed in Step 2.

Step 6 – Connect the SMB connectors to the correct PCB (Black RF-TP1, Silver RF-TP2, Brown RF-TP3).

Step 7 – Install the covers and replace the screws removed in Step 1. Make sure to capture the strain relief inside of the covers.

Step 8 – On the bad cable assembly remove the four screws that hold the interface housing together.

Step 9 – Transfer the interface housing to the new cable assembly already installed onto the coil. Replace the four screws removed in Step 8.

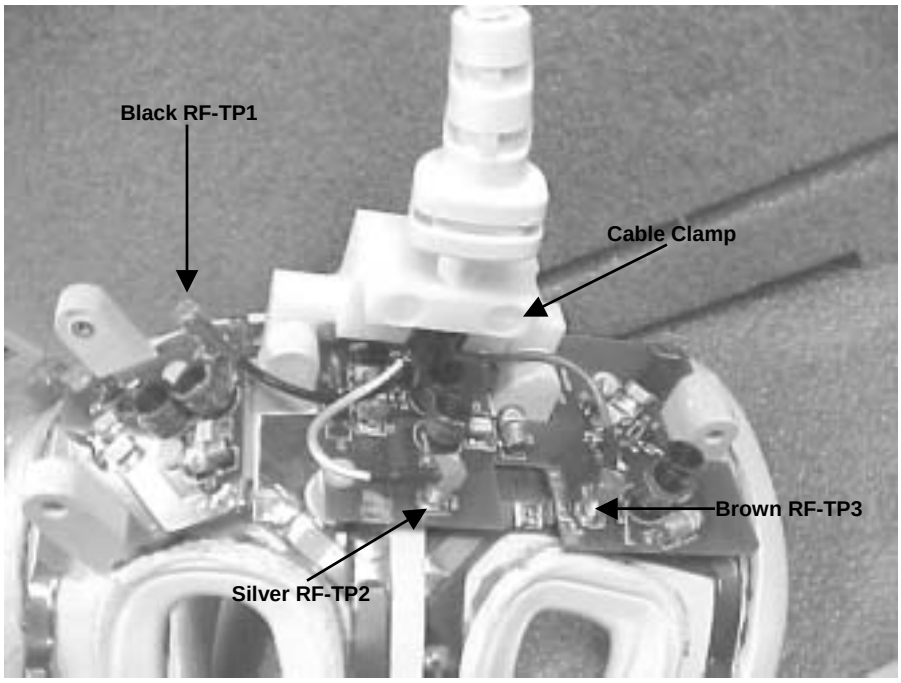


Figure 10: Cable assembly.

SECTION 6 – RENEWAL PARTS

6-1 Field Replaceable Units

FIELD REPLACEABLE UNITS – TABLE 6-1

Part Name	GE Part #
Coil	2375136-2
Cable Assembly	2375136-8
Phantom Positioner	2375136-3

6-2 Other Replaceable Accessories

OTHER REPLACEABLE ACCESSORIES LIST – TABLE 6-2

Part Name	GE Part #
Patient Comfort Pad	2375136-5
Positioning Straps (Set of 2)	2375136-4

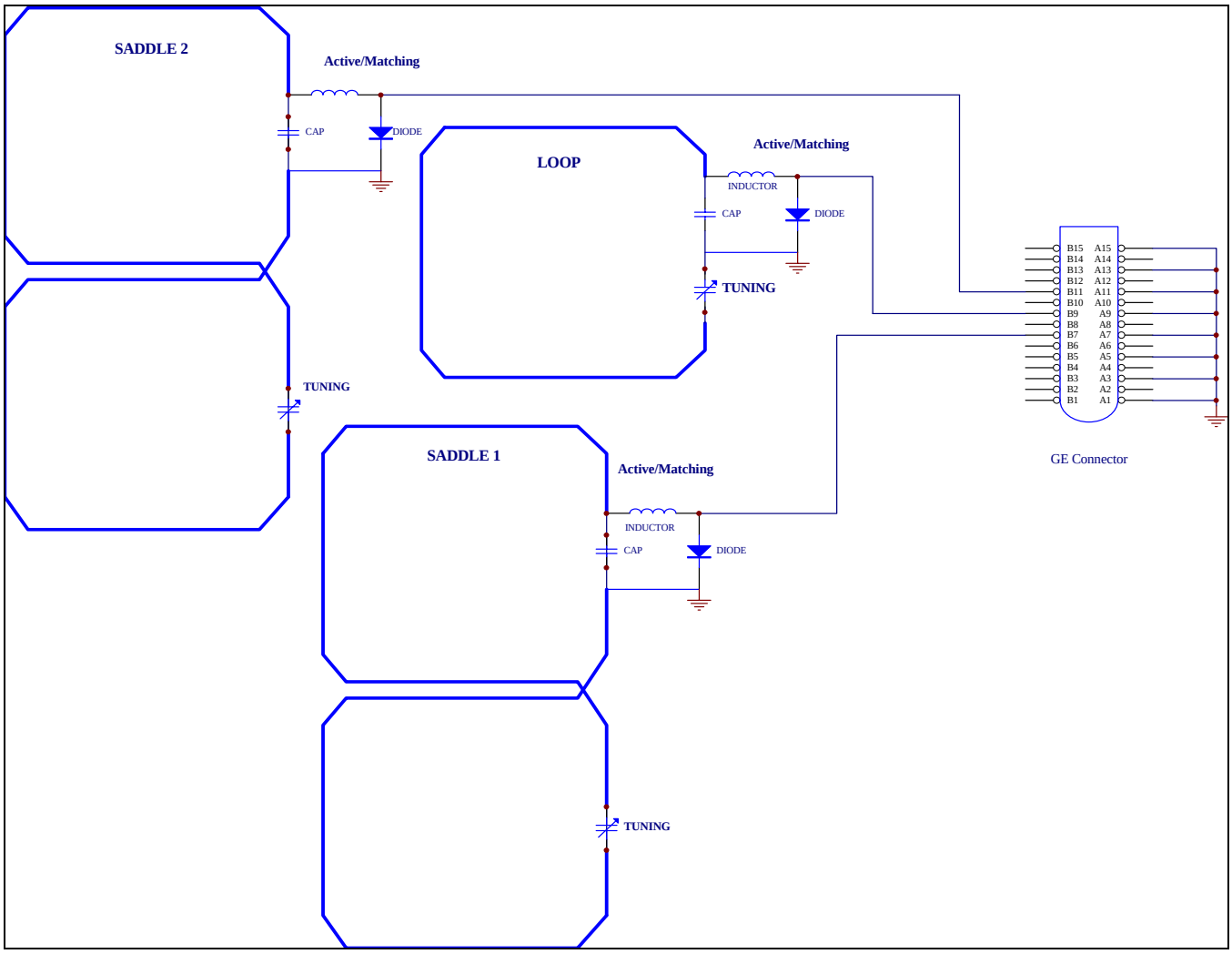
SECTION 7 – APPENDIX

7-1 Coil Configuration for Signa (These parameters are correct for release 9.1, some parameters may not be present in earlier releases.

Parameter	Modes
Coil Name	USAI PA Shoulder
Coil Type	3
Extremity Coil	no
Cable Loss	1.05
Coil Loss	1.72
Recon Scale Factor	1
Linear vrs Quadrature	1
Multiple Receiver Coil?	yes
Number of Receivers	4
Starting Receiver ID	0
Ending Receiver ID	3
Multi-Coil Port Enable	6
Multi-Coil Port Error Enable	6
Additional Transmit Attenuation	0
Number of Fast Receivers	0
Starting Fast Receiver ID	4
Ending Fast Receiver ID	4
Start TA Value	90
End RG Value	12
Multi-Coil Recon Enable	4
Phased Array T/R Coil for Autoshim	-1
Head Default Frequency Direction	0
Axial Plane SCIC value	1.5 0.2 0.2 7.0 32 0.3 1.05
Sagittal Plane SCIC value	1.5 0.2 0.2 7.0 32 0.3 1.05
Coronal Plane SCIC value	1.5 0.2 0.2 7.0 32 0.3 1.05
Mulitcoil Separation Direction	0
Multicoil Switch Select	0

The configuration file for the EXCITE and EXCITE II is included in the software shipped with the coil. To install, add the coil to the site coil list.

7-2 Schematic



REVISION HISTORY

Rev	Date	Author	Primary Reason for Change
A	04/03	Teresa DeMarco	First Issue
2	01/04	Teresa DeMarco	Revised Section 3 and General Modifications
3	07/04	J. Michael Watral	Revised Table 3-4-1(changed the slice thickness to 5mm), Table 3-6 (corrected the pin names), and Table 7-1(corrected the Port Enable and Error Enable values).
4	11/04	T. Reisker	Update coil configuration table values for release 9.x