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## 1 - OVERVIEW

This procedure explains various methods for troubleshooting problems with the Multi-Channel Select/Head Switch (MSHS). A flowchart is provided that the reader is to follow during the course of troubleshooting an MSHS problem. This flowchart will, at certain points, refer the reader back to various sections in this document. The reader will perform the instructions in the sections and then, when finished, will return to the back to complete the flowchart at the point where the diversion originally occurred.

Before beginning the troubleshooting process, it may be helpful for the reader to understand the theory of operation of the MSHS. This information can be found in the document entitled, “**0.7T THEORY FOR MULTICOIL SELECT/HEAD SWITCH (MSHS)**” (PT1THC2.DOC) located on the Service CDROM.

### 1-1 Required Tools

TABLE 1-1  
EQUIPMENT REQUIRED

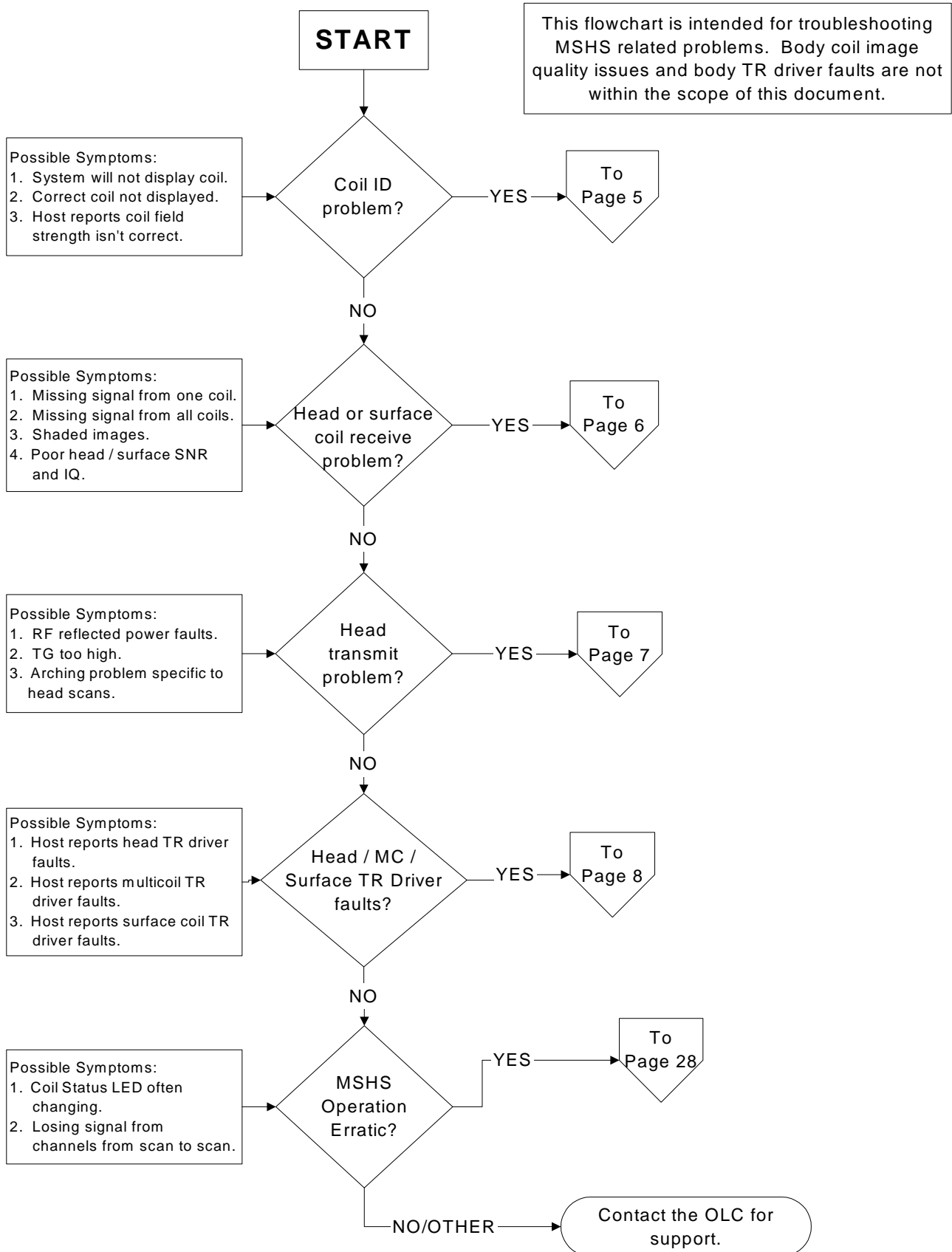
| Item | Description   | Part Number    |
|------|---|----------------|
| 1.   | RS-232 9-pin to 25-pin sub – D Serial Cable (NOT null-modem) (See <b>Note</b> below) [needed for loopback tests only]             | Obtain locally |
| 2.   | 25-pin sub-D female-female gender changer adapter [needed for loopback tests only]  | Obtain locally |
| 3.   | 9-pin sub-D female connector (ideally using crimp-on leads) [needed for loopback tests only]                                      | Obtain locally |
| 4.   | Two 1 inch long pieces of insulated 24 gauge (size not critical) wire to be used <b>ONLY</b> if performing the TCU Loopback Test. | Obtain locally |
| 5.   | 100 MHz Oscilloscope  | 46-183029P61   |
| 6.   | Digital Multimeter (DMM)  | 46-194427P49   |

#### Note

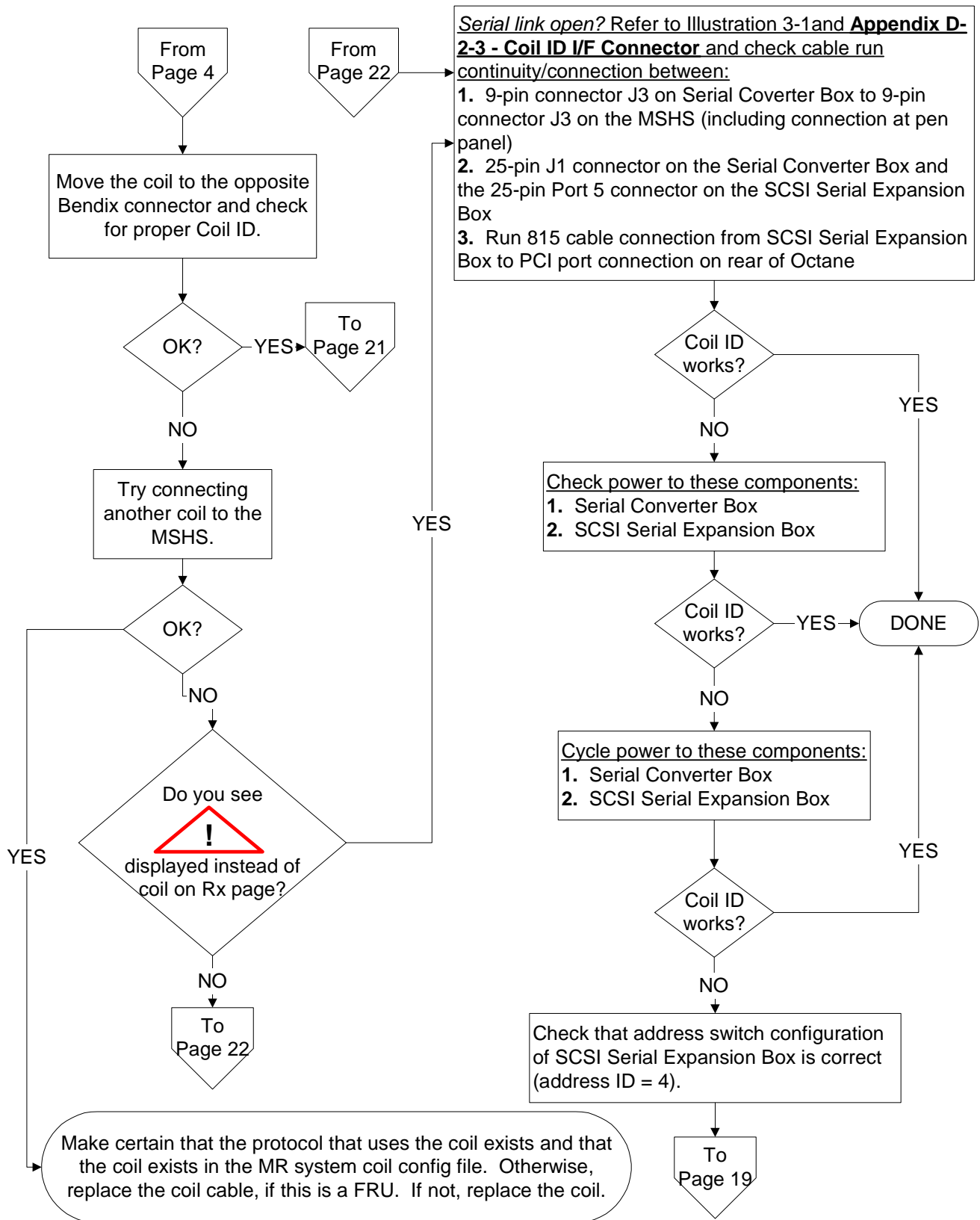
The serial cable that was delivered in the top of the GRFD cabinet for the SSM is a null-modem cable and cannot be used in this application without a null-modem adapter.

## 2 - MSHS TROUBLESHOOTING FLOWCHARTS

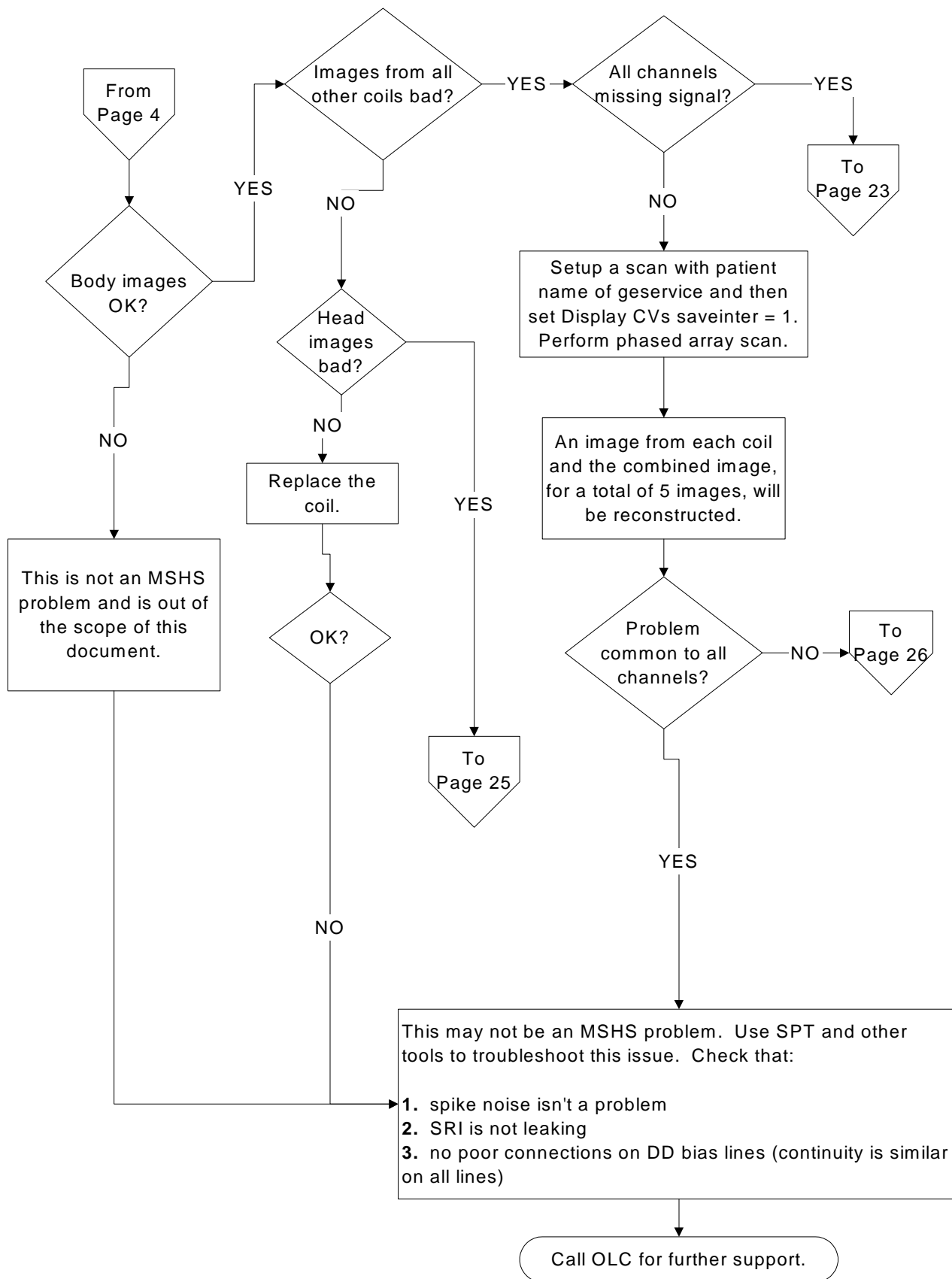
### 2-1 Main Body



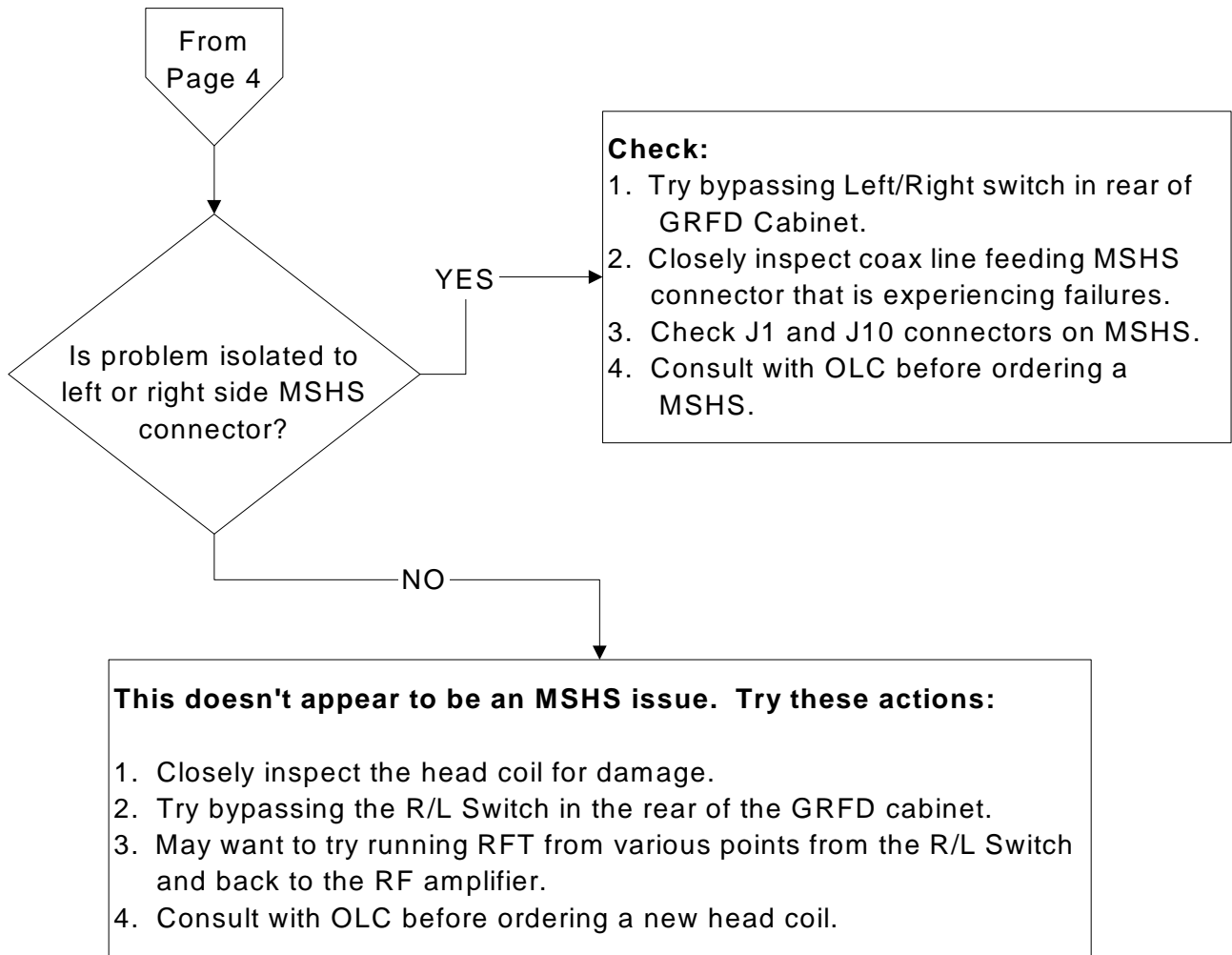
2-2 Coil ID Troubleshooting (Section 1 of 7)



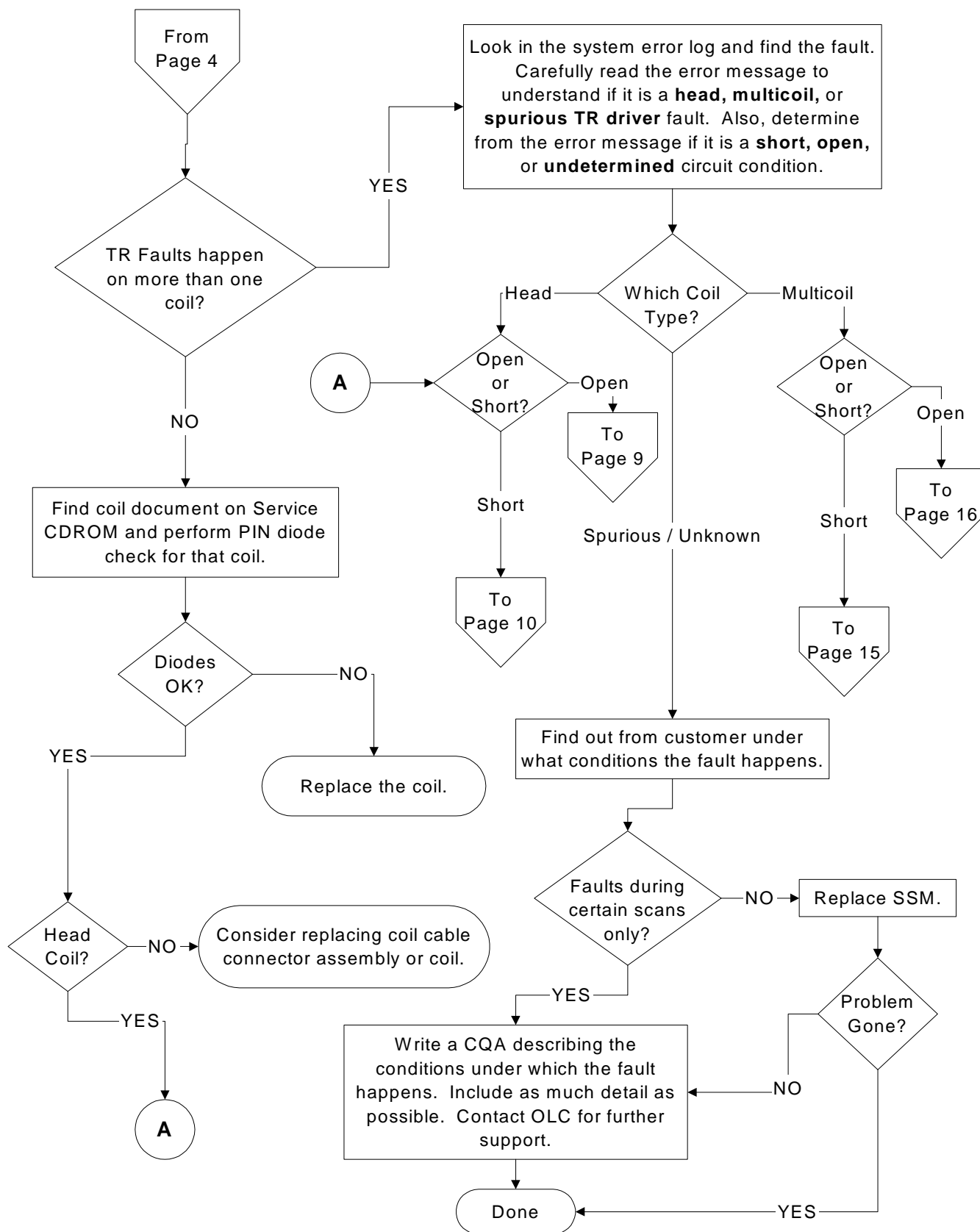
### 2-3 Head or Surface Coil Receive Troubleshooting (Section 1 of 6)



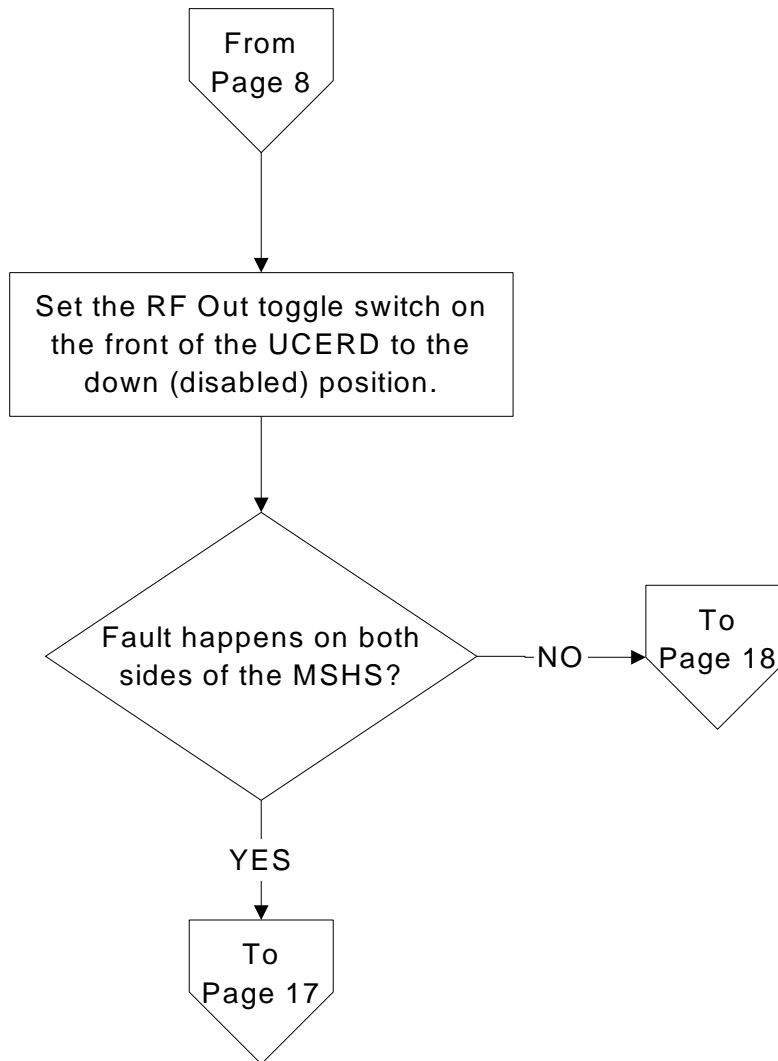
### 2-4 Head Transmit Troubleshooting



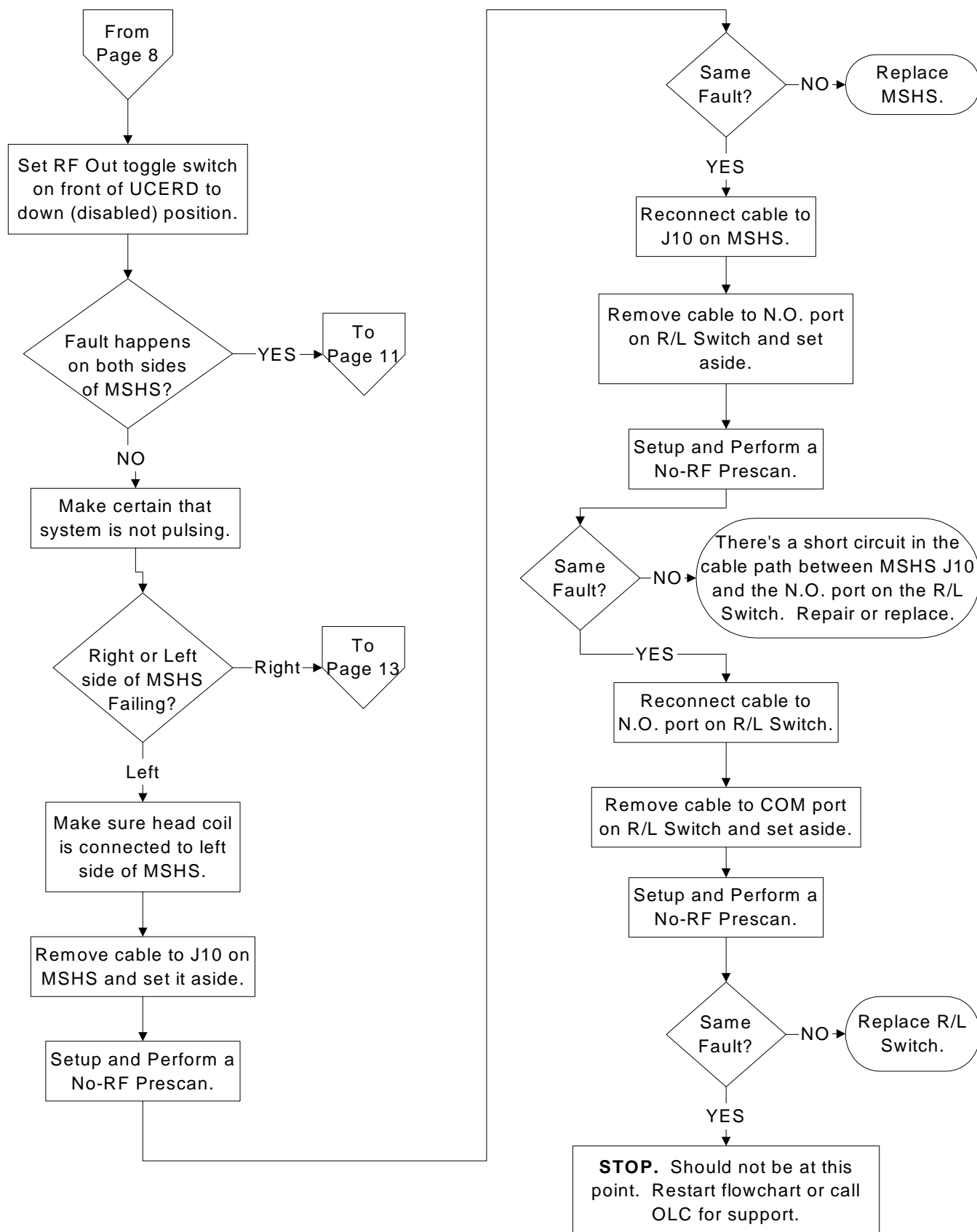
2-5 Head / MC / Surface TR Driver Troubleshooting (Section 1 of 11)



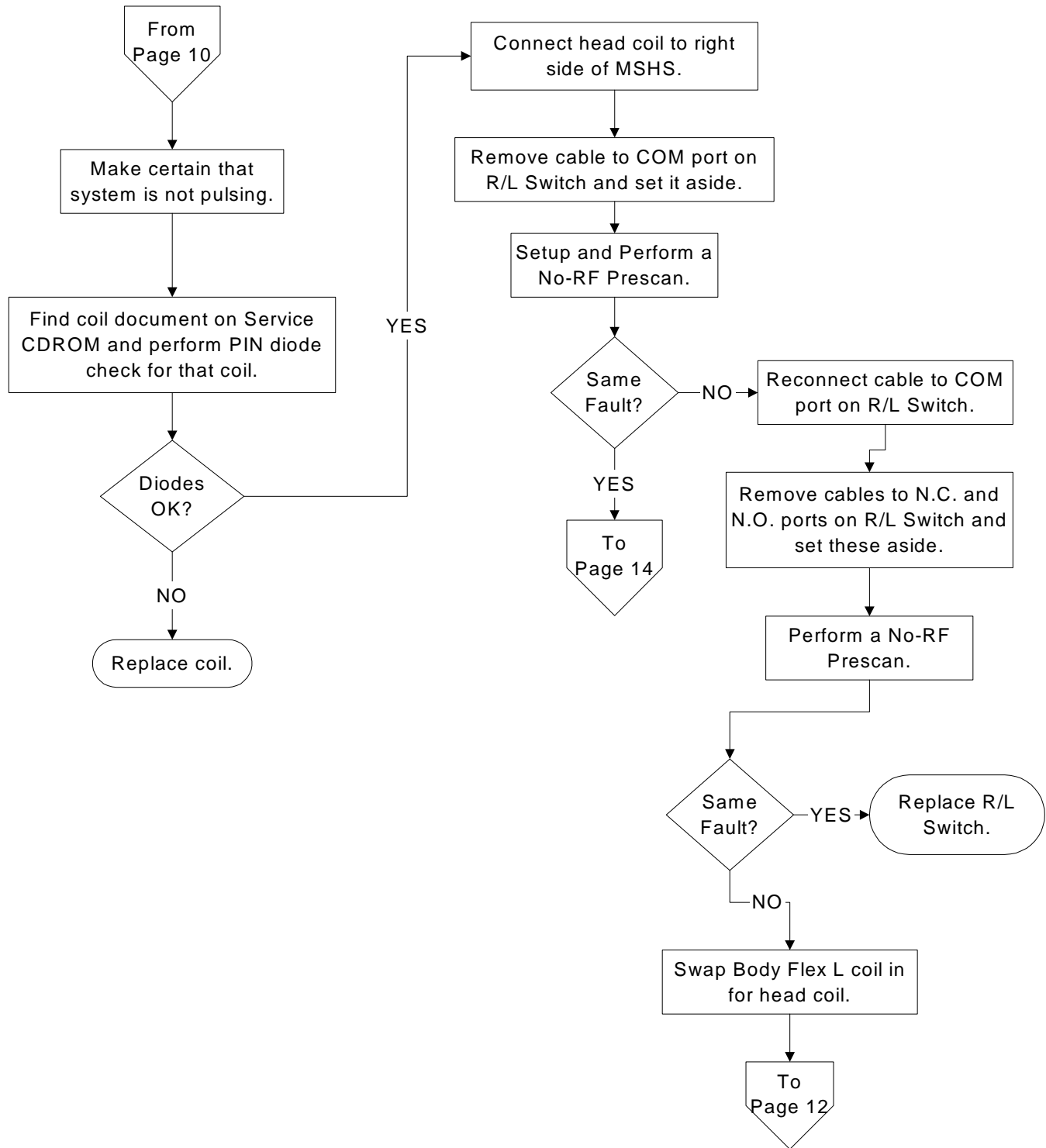
### 2-6 Head / MC / Surface TR Driver Troubleshooting (Section 2 of 11)



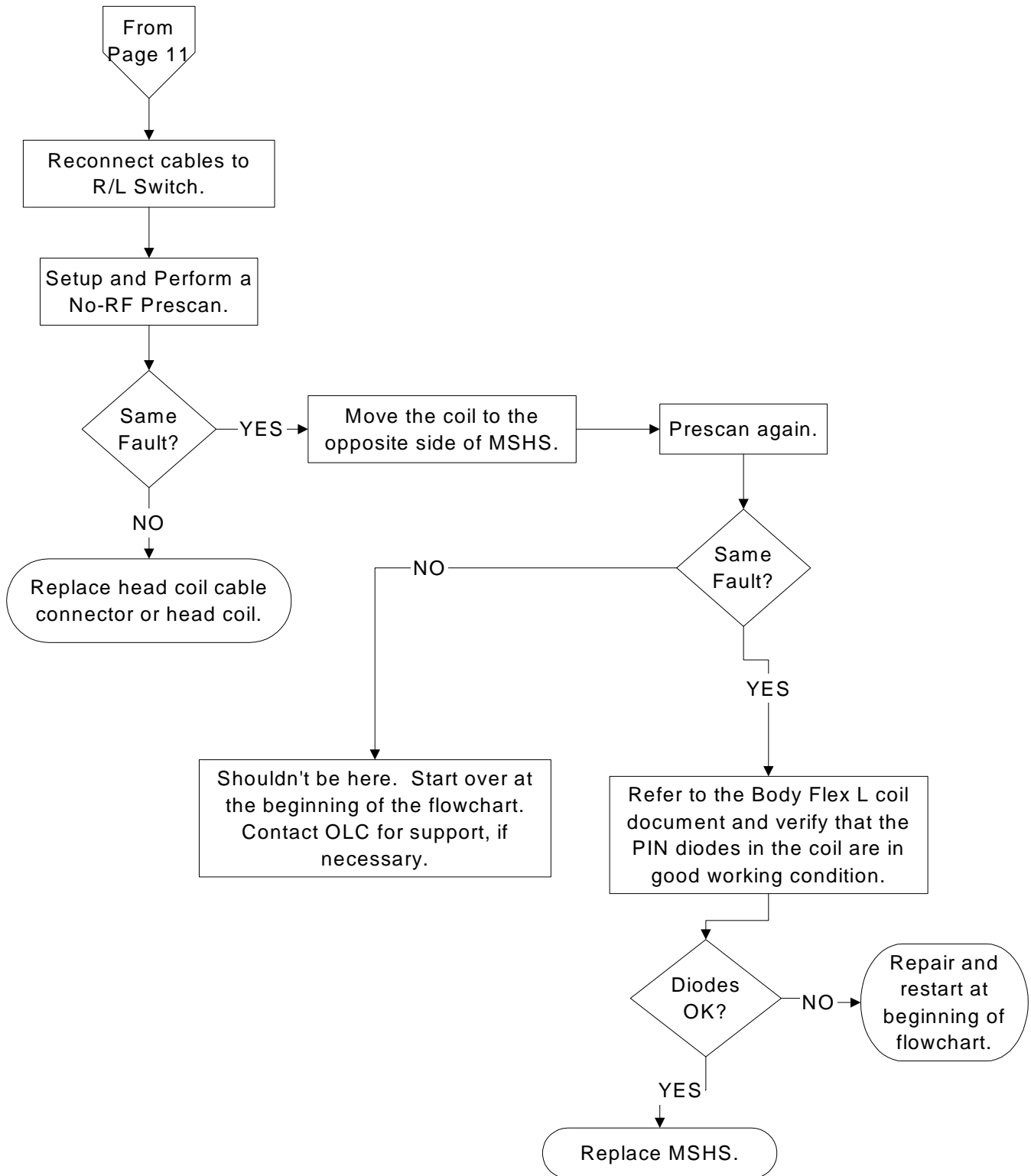
2-7 Head / MC / Surface TR Driver Troubleshooting (Section 3 of 11)



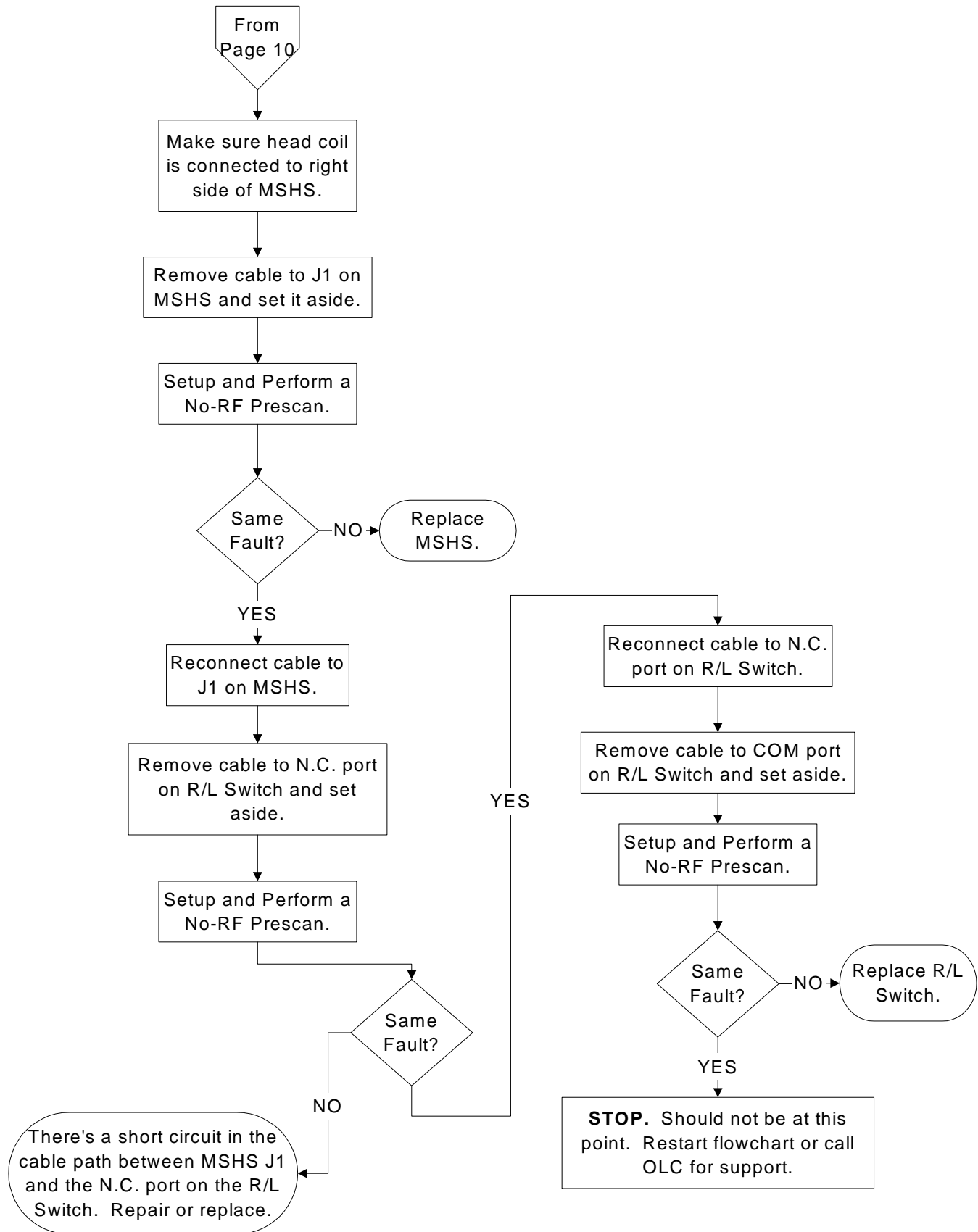
### 2-8 Head / MC / Surface TR Driver Troubleshooting (Section 4 of 11)



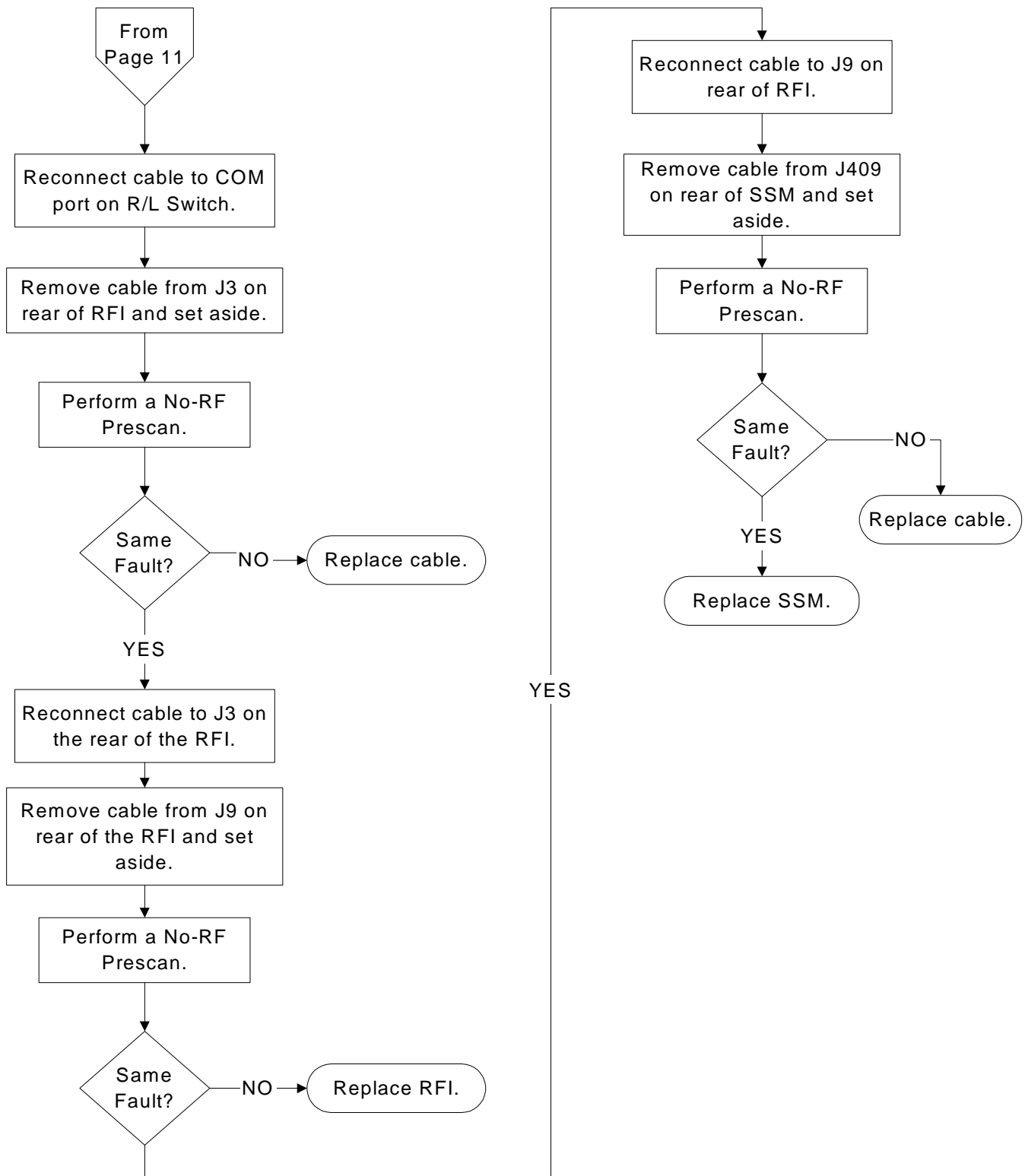
### 2-9 Head / MC / Surface TR Driver Troubleshooting (Section 5 of 11)



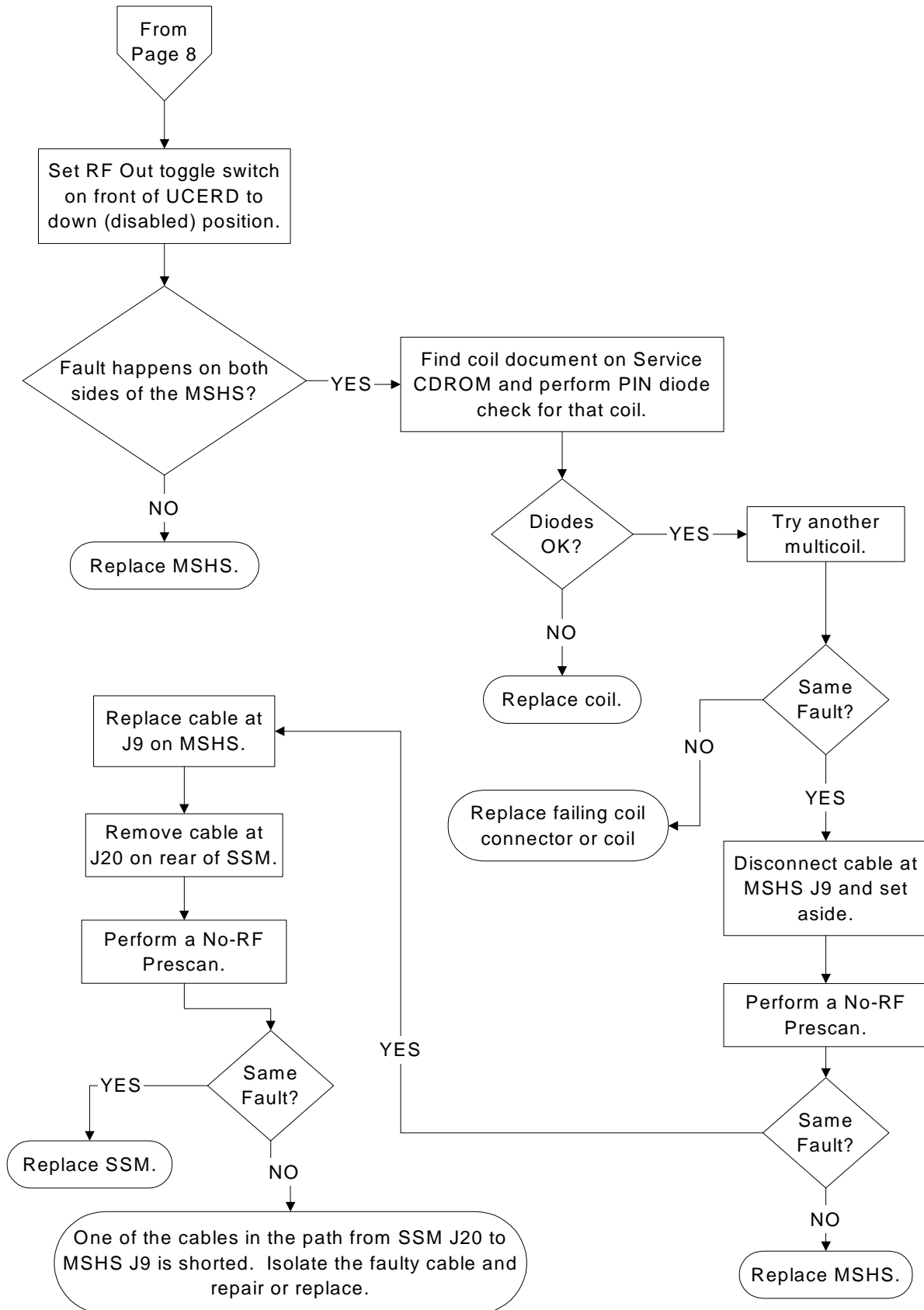
### 2-10 Head / MC / Surface TR Driver Troubleshooting (Section 6 of 11)



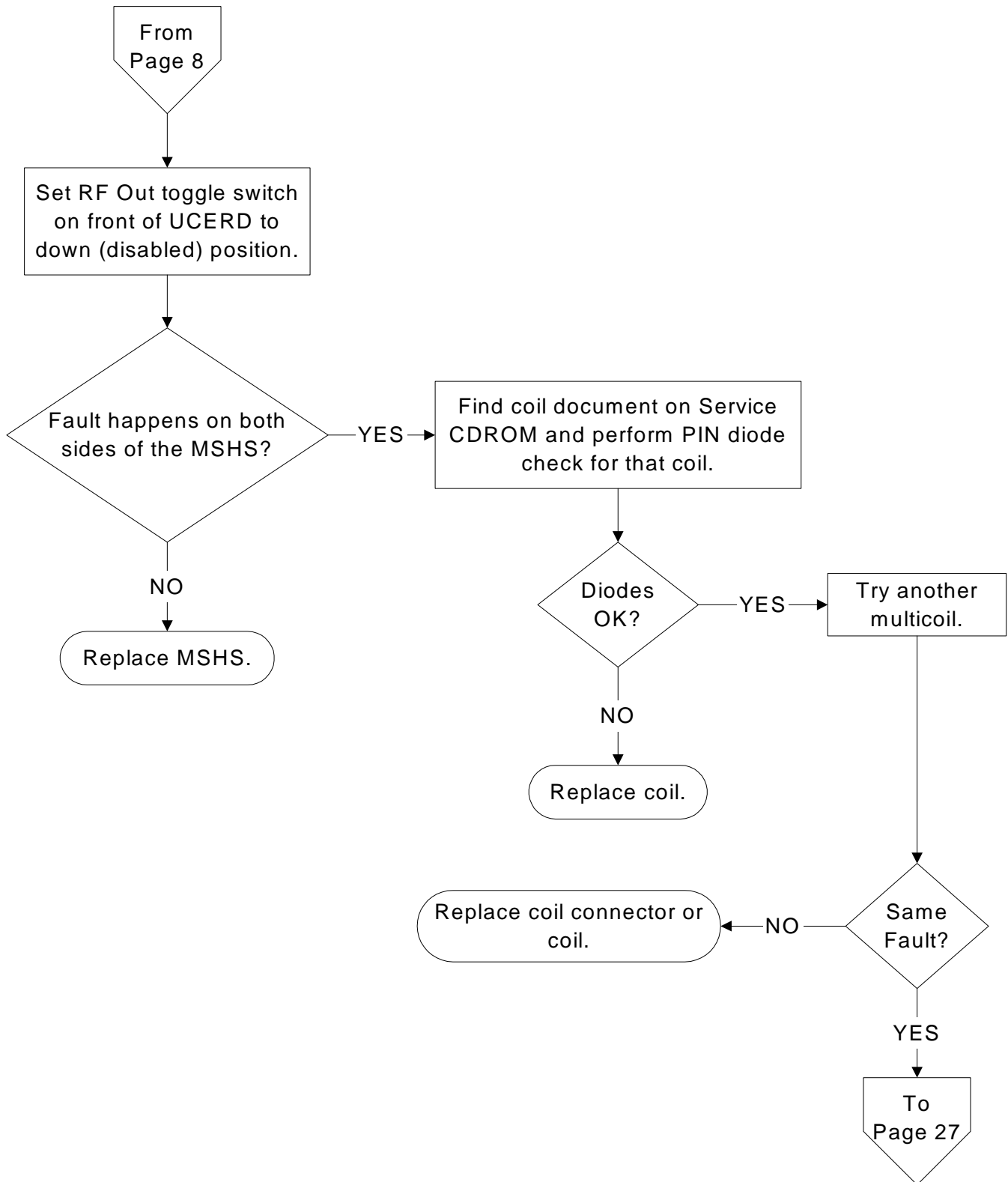
### 2-11 Head / MC / Surface TR Driver Troubleshooting (Section 7 of 11)



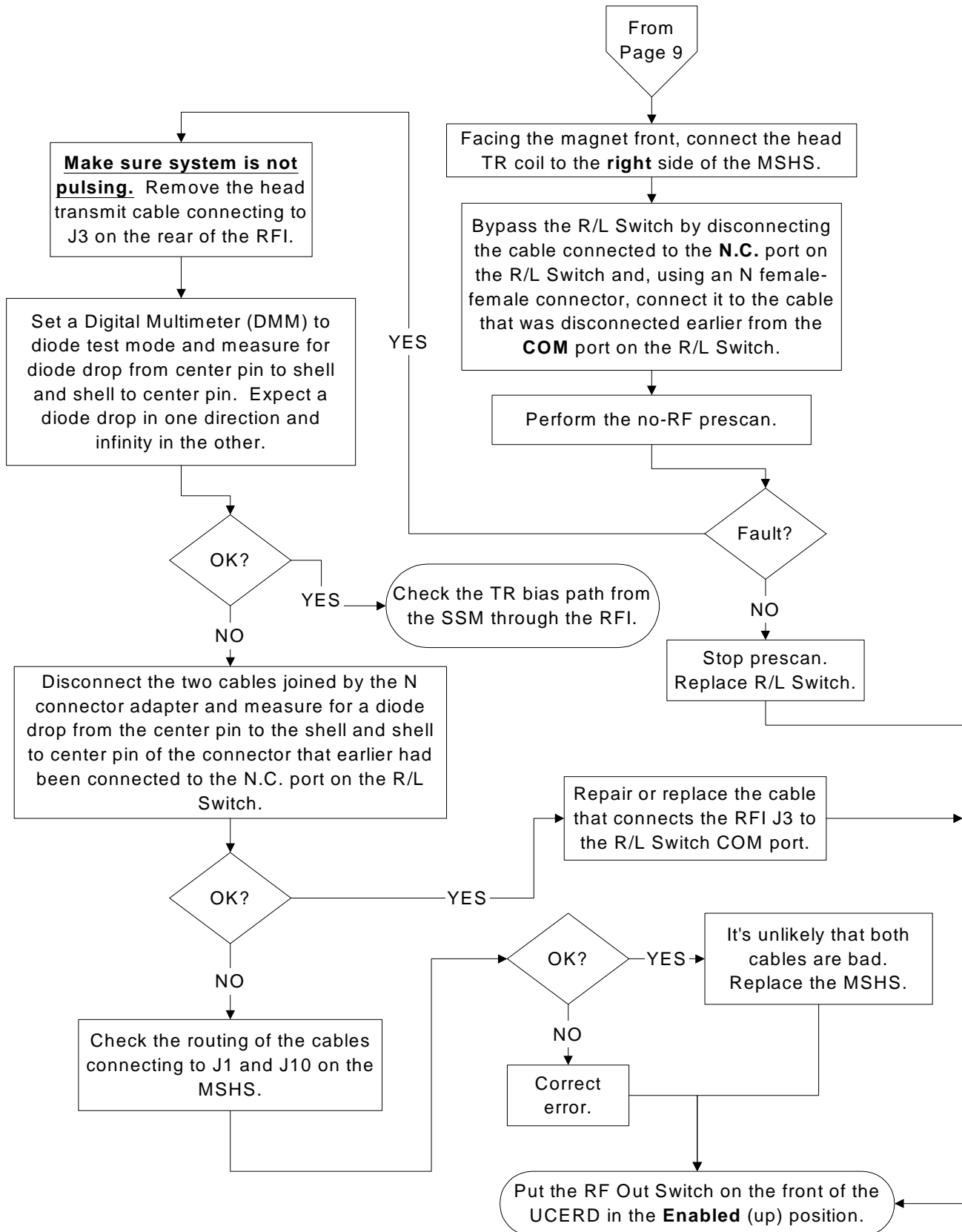
### 2-12 Head / MC / Surface TR Driver Troubleshooting (Section 8 of 11)



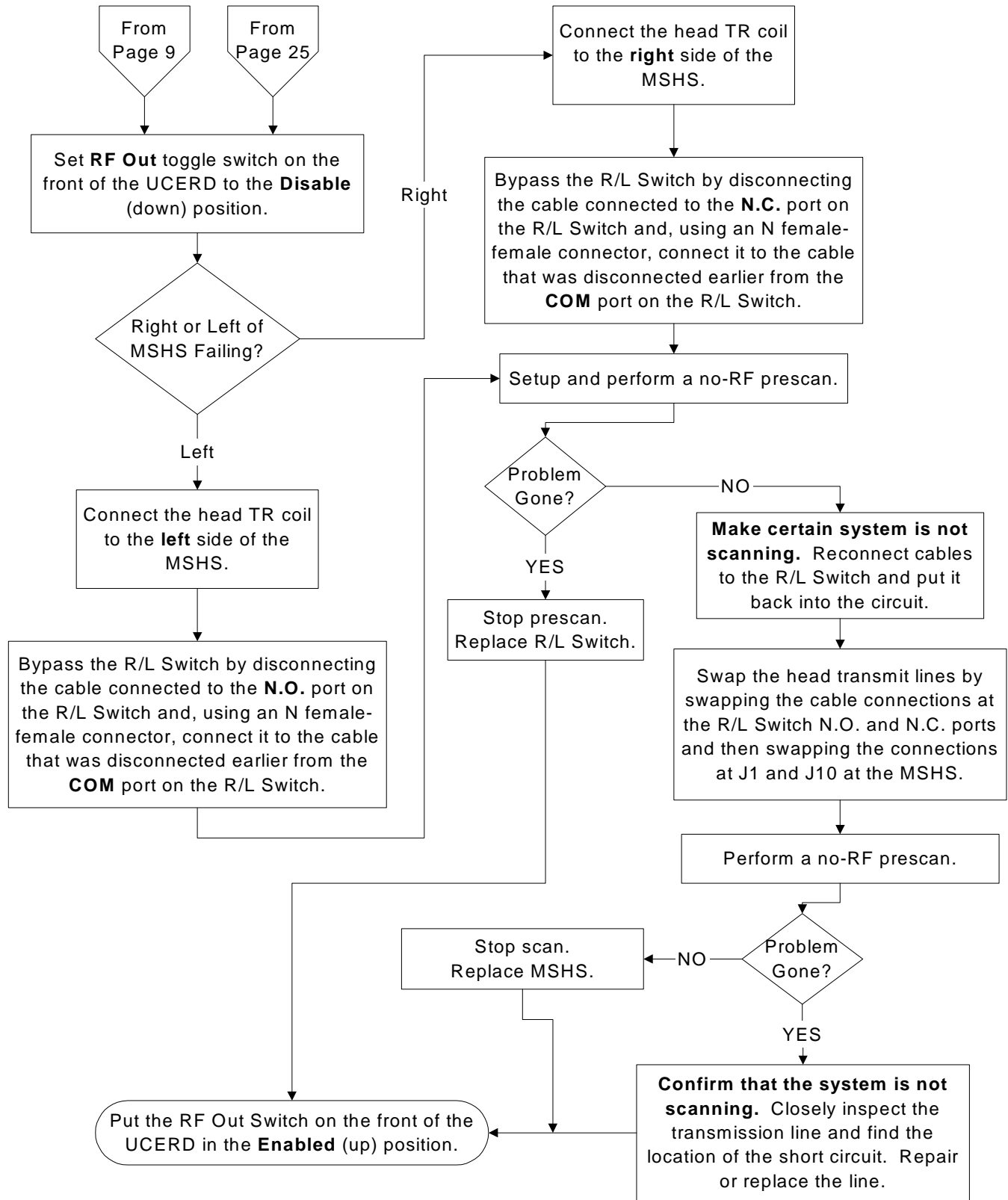
### 2-13 Head / MC / Surface TR Driver Troubleshooting (Section 9 of 11)



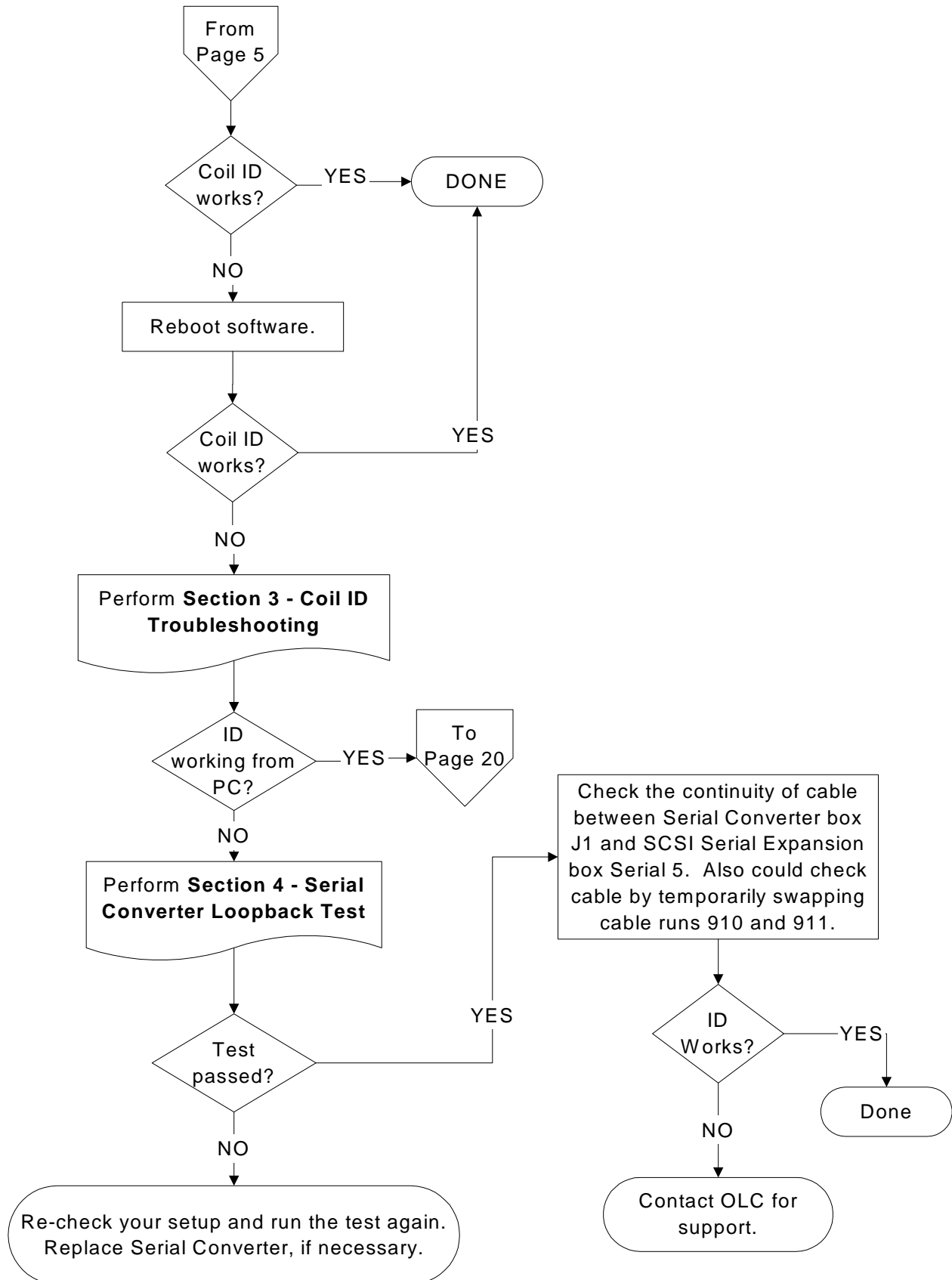
2-14 Head / MC / Surface TR Driver Troubleshooting (Section 10 of 11)



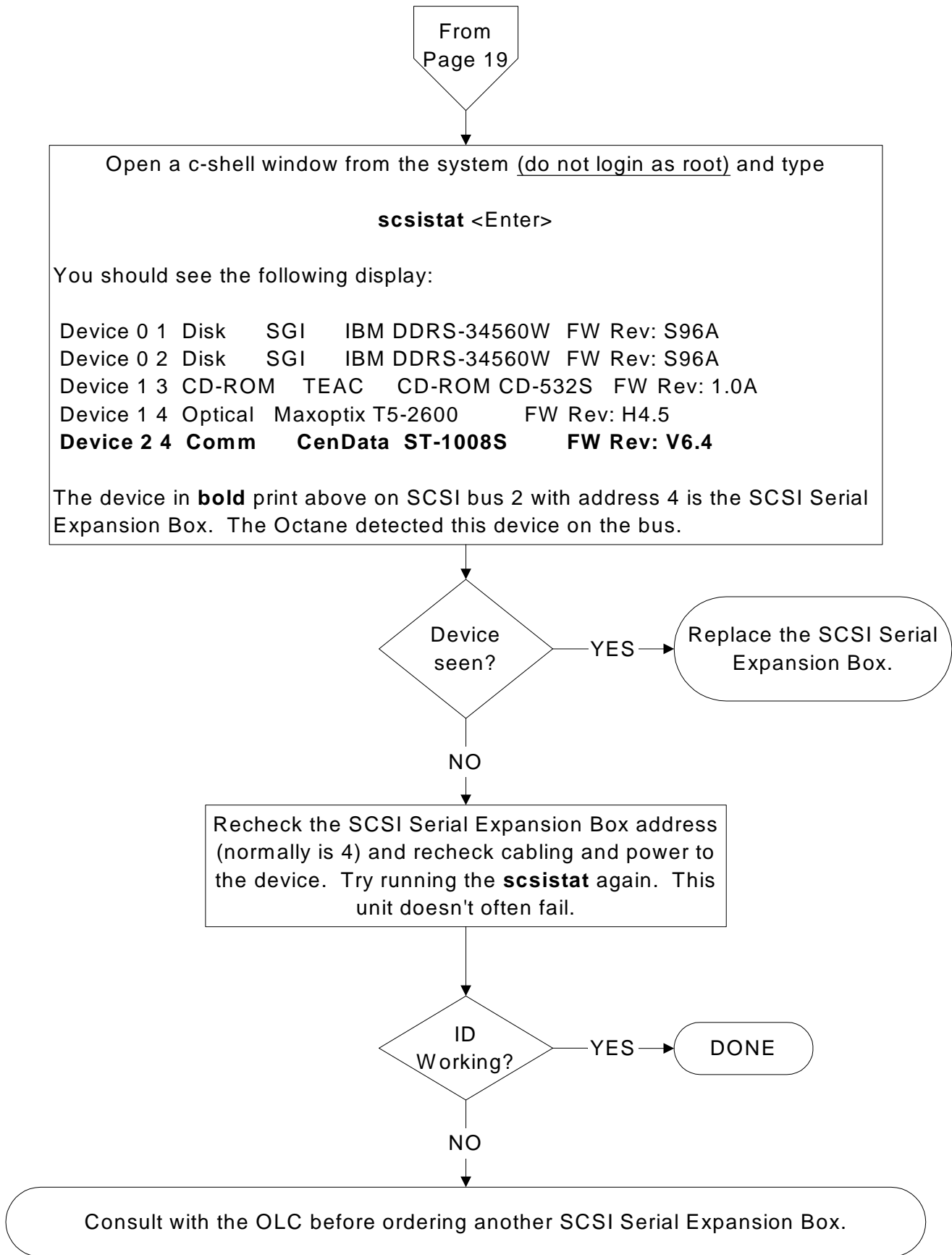
### 2-15 Head or Surface Coil Receive Troubleshooting (Section 2 of 6)



### 2-16 Coil ID Troubleshooting (Section 2 of 7)




### 2-17 Coil ID Troubleshooting (Section 3 of 7)



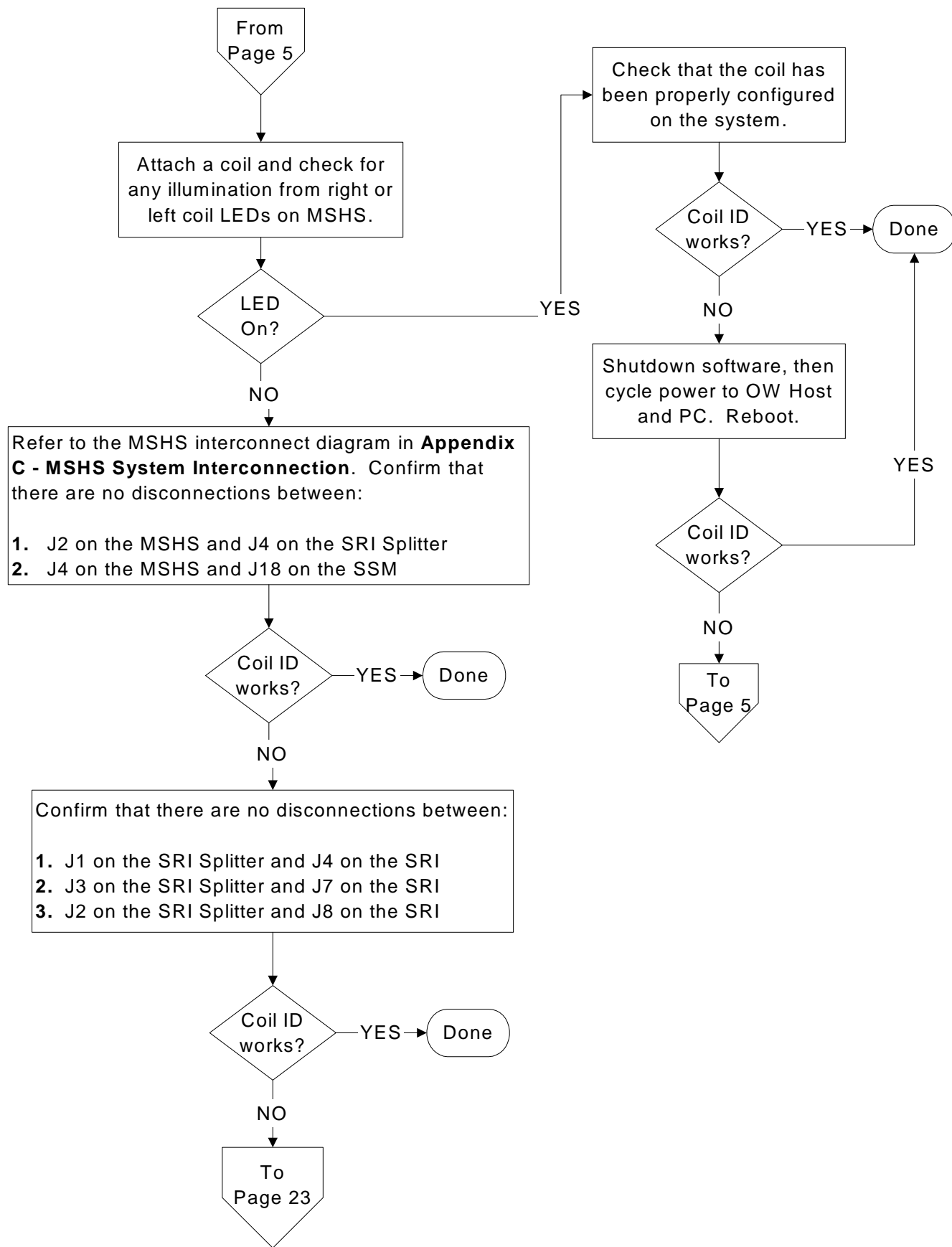
## 2-18 Coil ID Troubleshooting (Section 4 of 7)

From  
Page 5

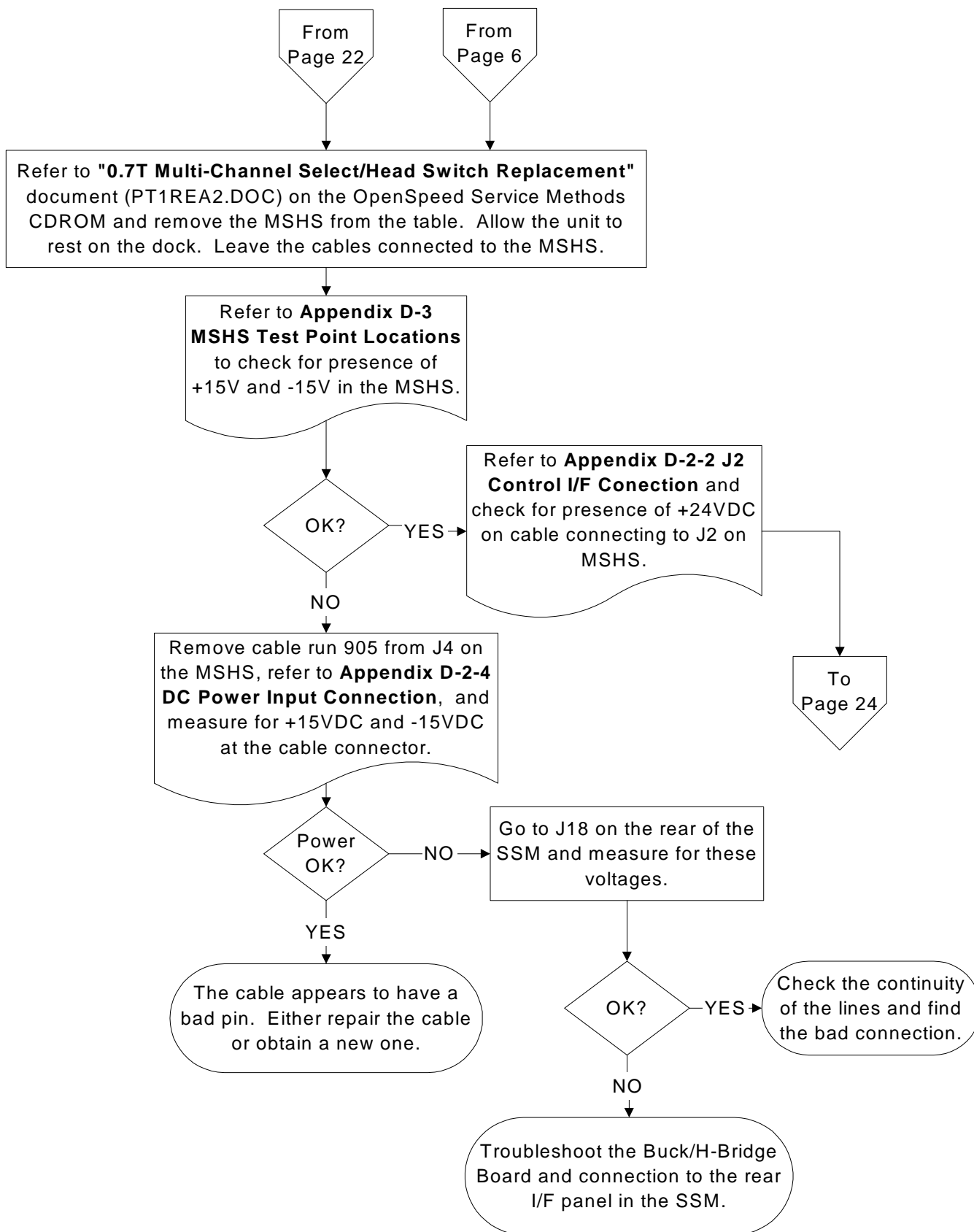


Check the MSHS connector on the side that wasn't recognizing the coil for damaged pins. Also inspect the coil connector. If the faulty connection is on the MSHS and it cannot be repaired then the MSHS will need to be replaced.

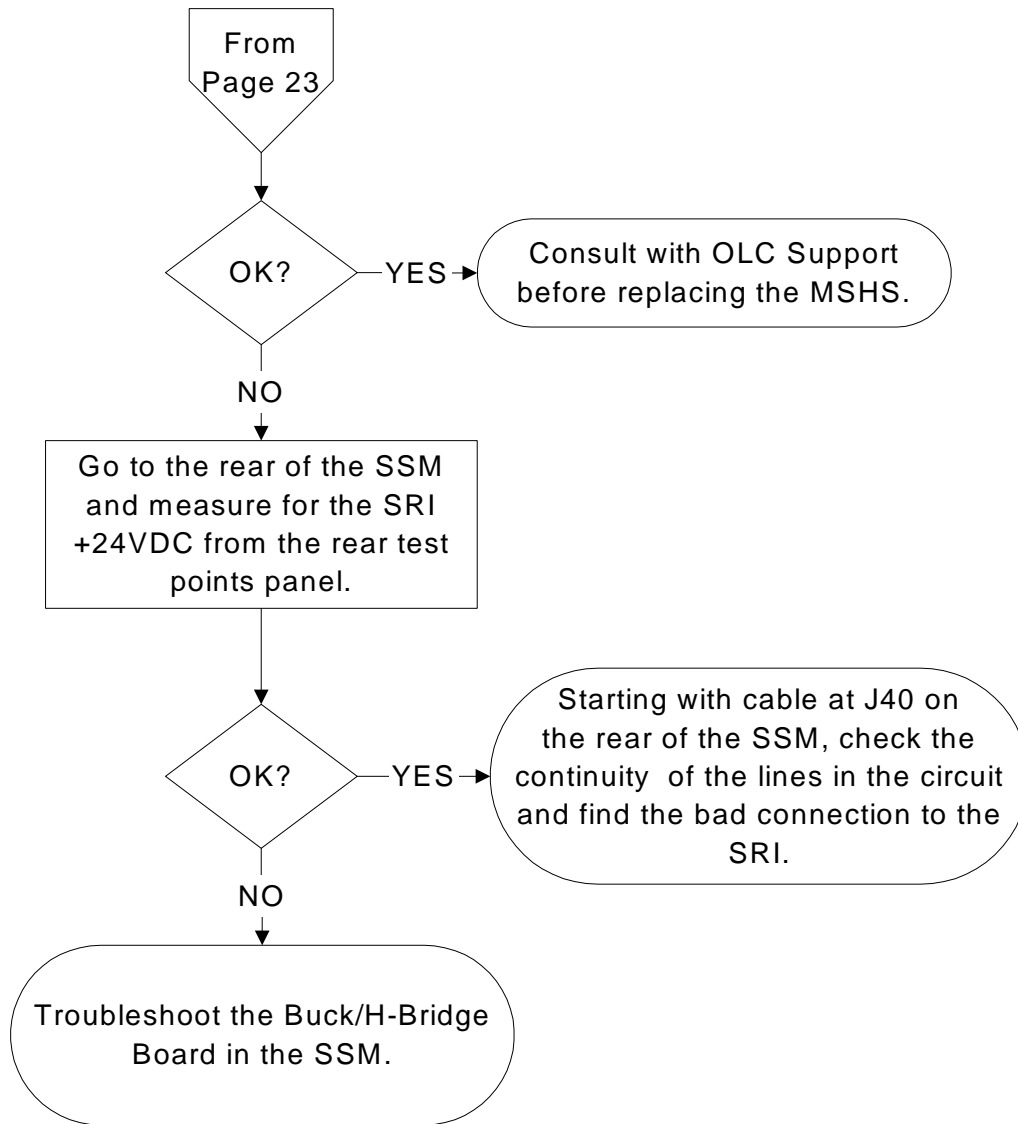
2-19 Coil ID Troubleshooting (Section 5 of 7)



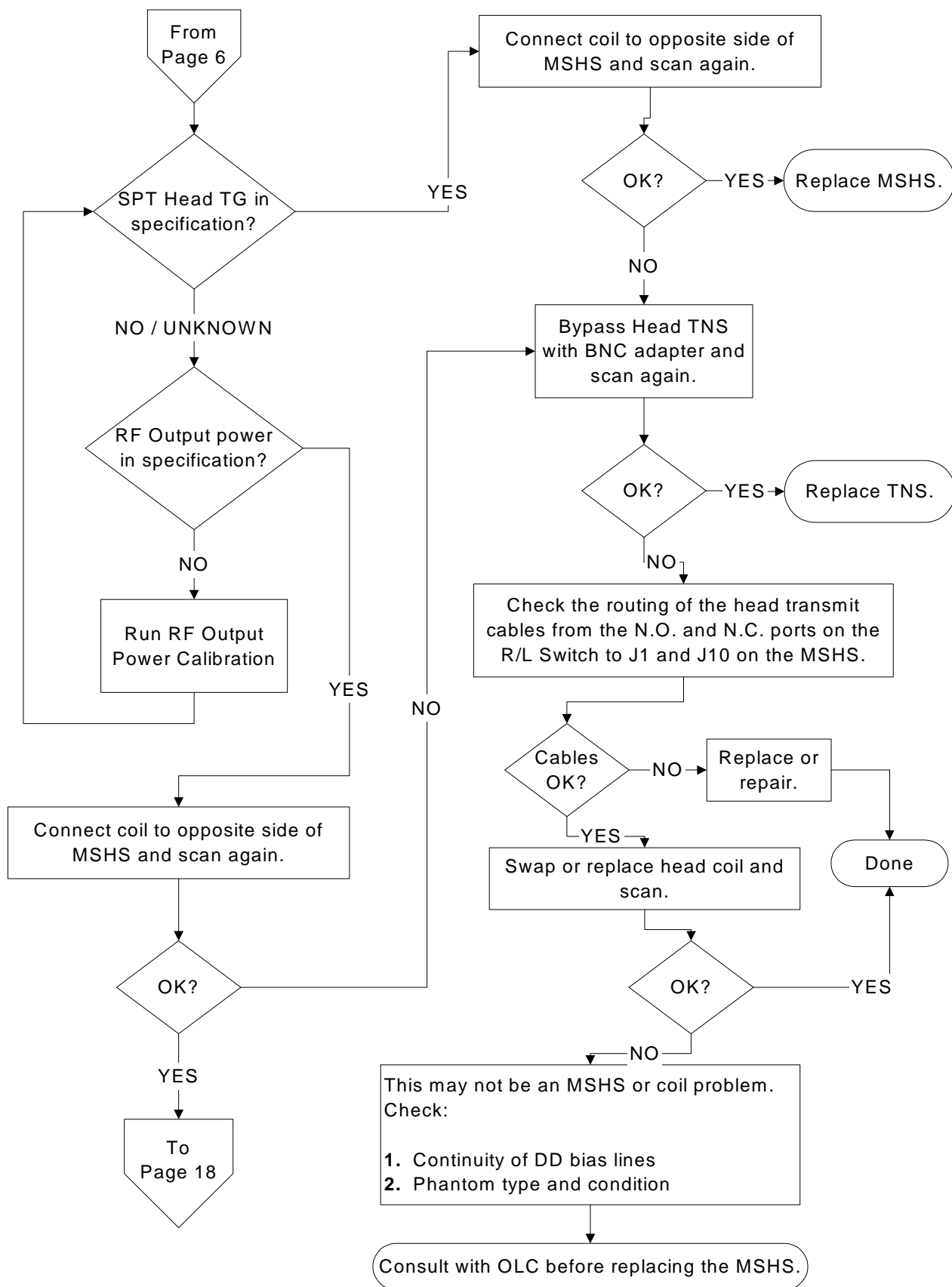
### 2-20 Coil ID (Section 6 of 7) or Head / Surface Coil Rcvr Trbleshooting (Section 3 of 6)



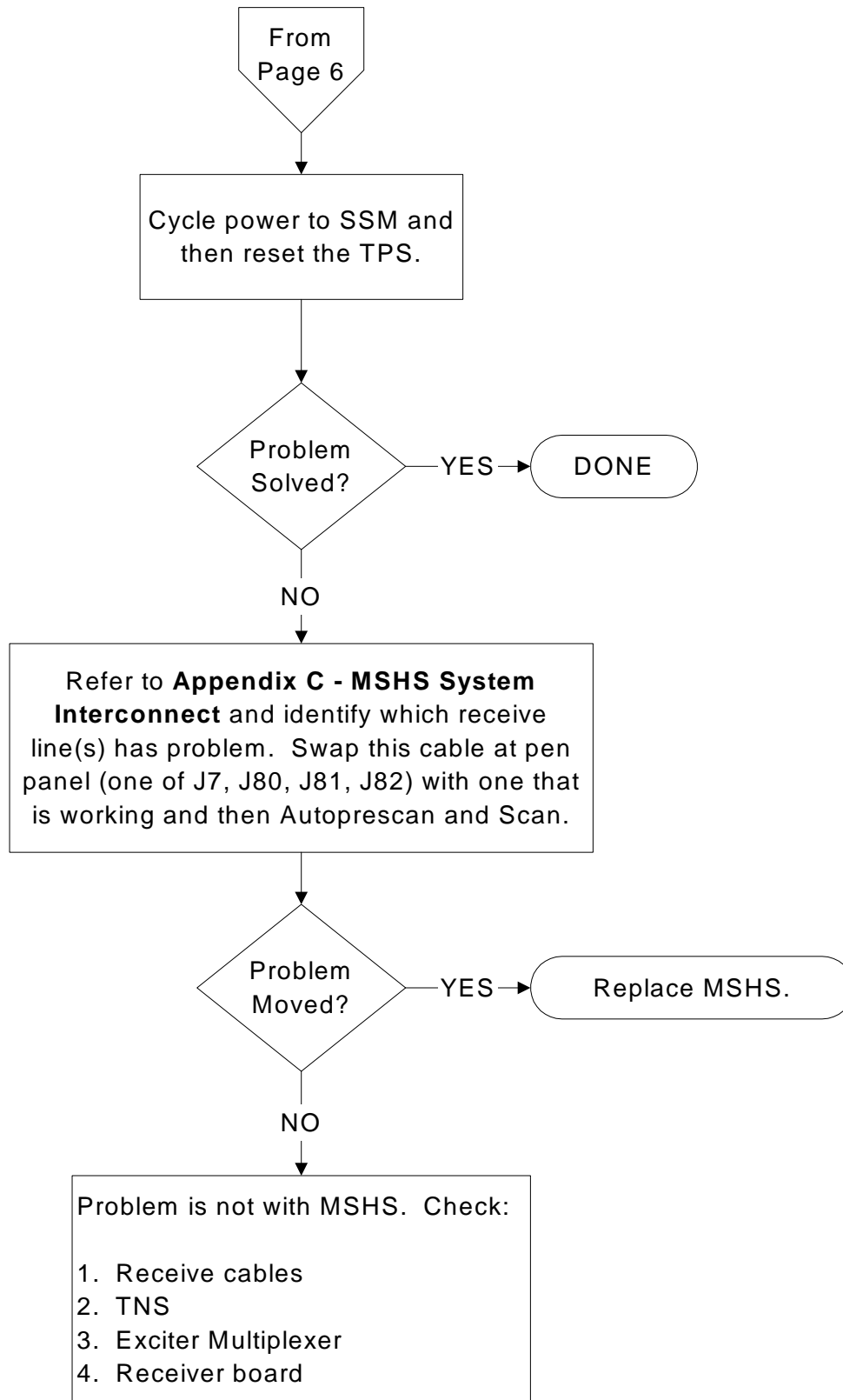
2-21 Coil ID (Section 7 of 7) or Head / Surface Coil Rcve Trbleshooting (Section 4 of 6)



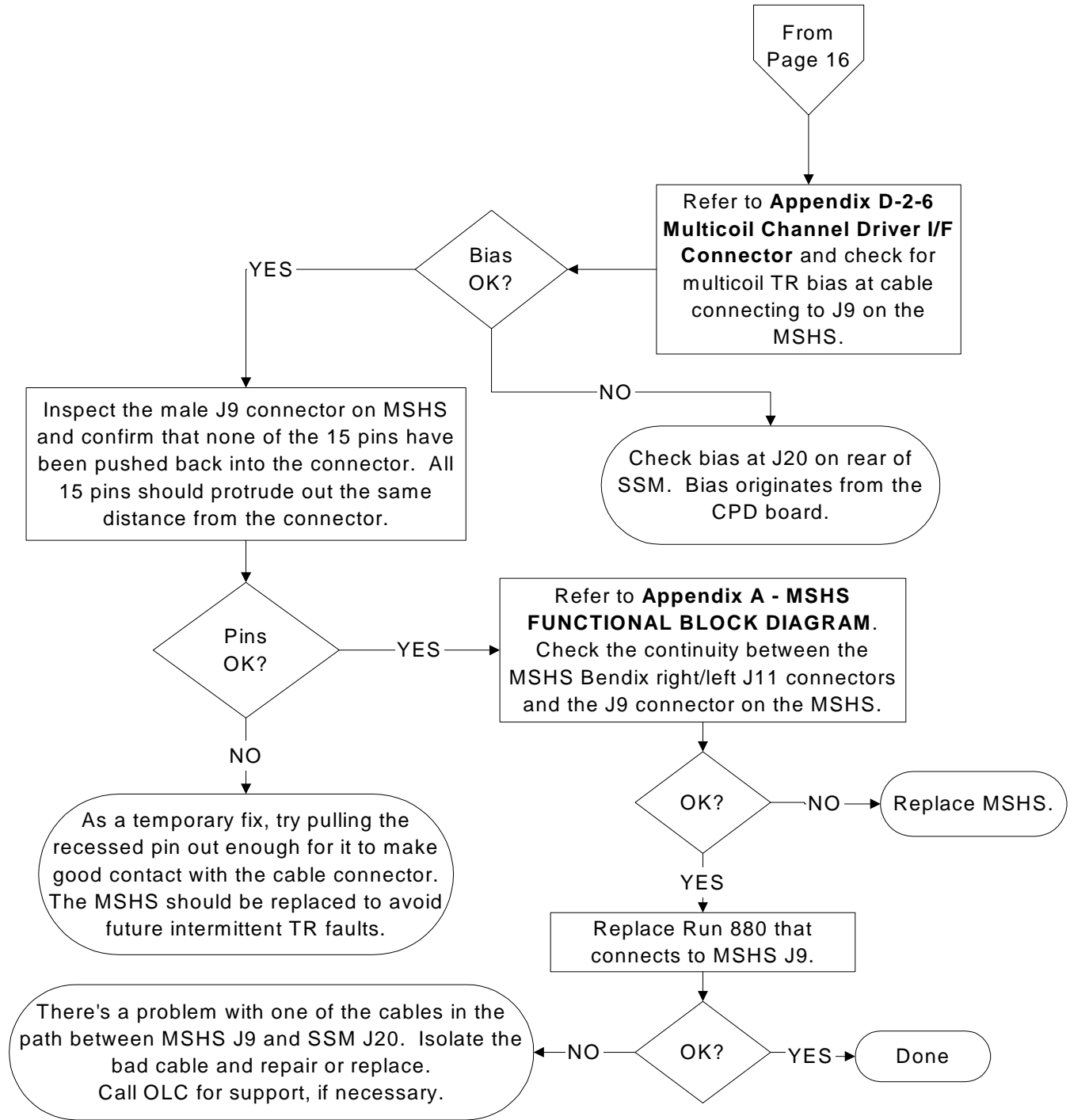
2-22 Head or Surface Coil Receive Troubleshooting (Section 5 of 6)



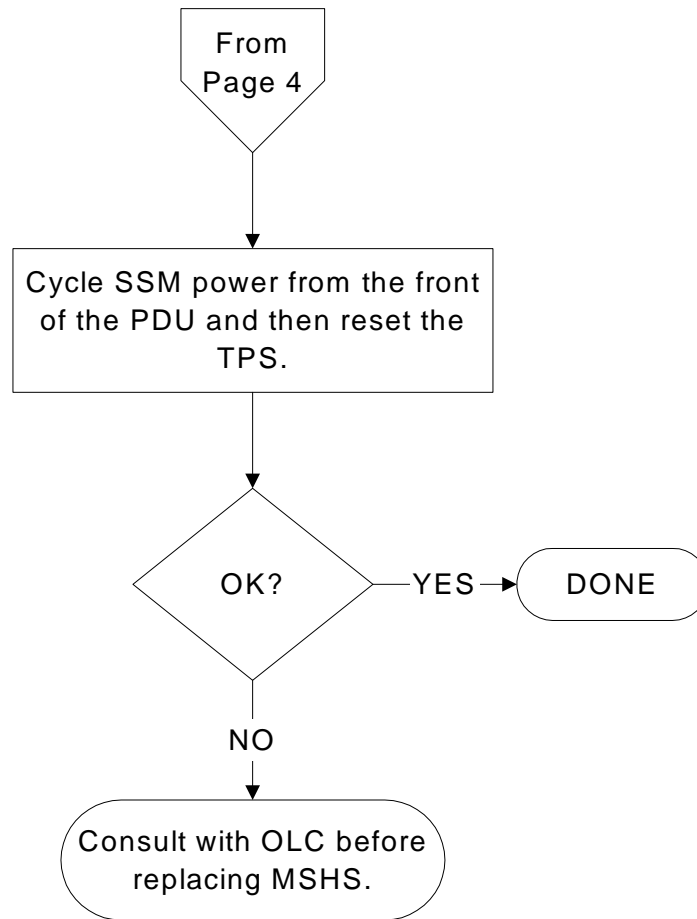
### 2-23 Head or Surface Coil Receive Troubleshooting (Section 6 of 6)



### 2-24 Head / MC / Surface TR Driver Troubleshooting (Section 11 of 11)

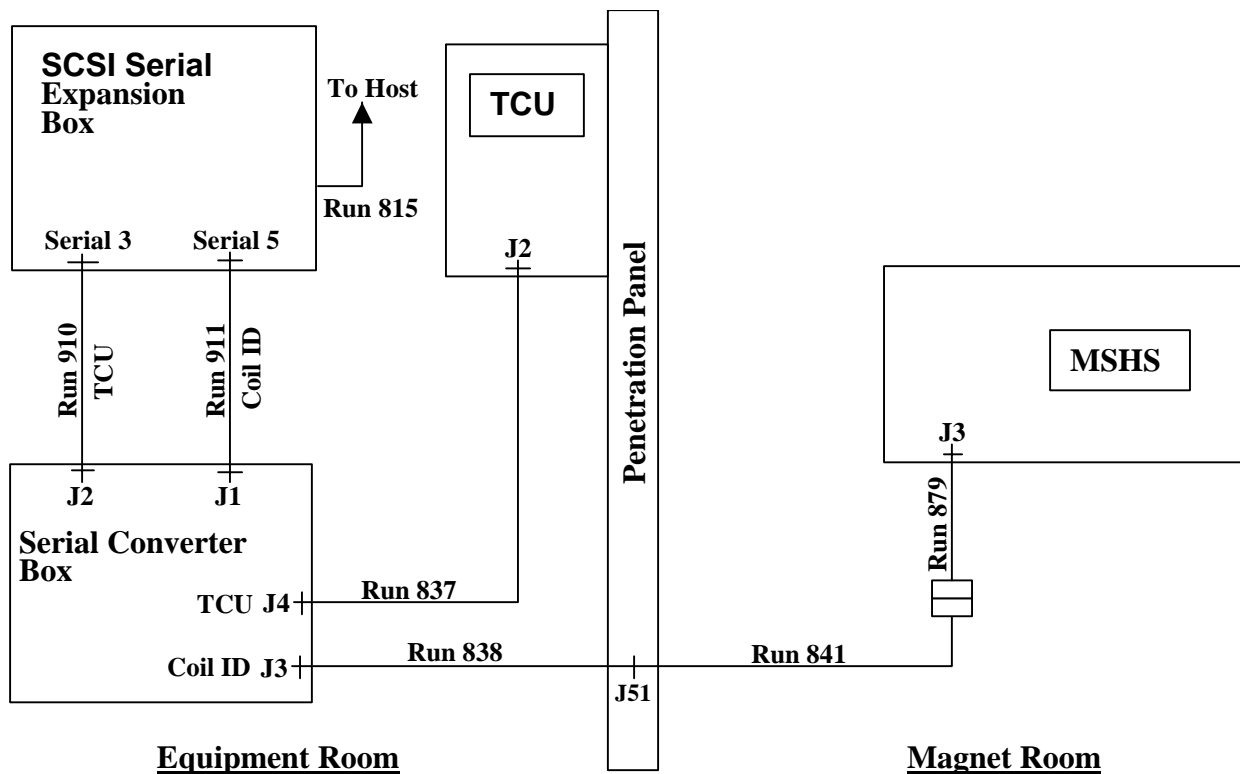


### 2-25 MSHS Operation Erratic



### 3 - COIL ID TROUBLESHOOTING

Embedded in the male Bendix connector of each MR coil is an identity chip. The MSHS should be able to identify all coils connected to it by reading the information on this chip. The system reads this information from an RS-422 data connection at J3 on the MSHS. See Illustration 3-1 below for a diagram of the coil ID and TCU serial communication path. Two methods are available to the FE for manually checking the functionality of the coil ID circuit. The first method simply involves opening a c-shell window and executing the **coiltest** script. This script is documented in **Section 3-1 Checking Coil ID With The “coiltest” Script**. This script provides a simple and quick way to check the basic functionality of coils connected to either side of the MSHS. The second method allows the FE, using special software and the service laptop, to bypass the SCSI Serial Expansion Box and check the coil ID circuit independent of the host computer. This process is described in **Section 3-2 Checking Coil ID With The PC Laptop**. This is helpful for troubleshooting loss of communication to the MSHS and intermittent coil ID problems.



COIL ID AND TCU SERIAL COMMUNICATION PATH  
ILLUSTRATION 3-1

### 3-1 Checking Coil ID With The “coiltest” Script

The coiltest script is provided with the system software and checks for coils connected to either the left or right side MSHS Bendix connectors. If a coil is connected to a connector then the script will query the coil and display three pieces of data specific to that coil; the coil Mag Str (Magnet Strength), unique Coil Code (this is listed twice), and the Coil Field Strength (in Gauss). If a coil is not connected to a MSHS Bendix connector then the four parameter fields listed for that connector will not contain any data.

1. On the Service Desktop select the **C Shell..** icon.
2. Position the mouse cursor inside the c shell window and type **coiltest** at the prompt and then select <Enter>.
3. A result similar to that shown in Illustration 3-2 will be displayed. Note that the result in Illustration 3-2 shows that the head coil is connected to the right side of the MSHS.

```
{sdc@b9b}[1] coiltest
COIL ID TEST TOOL
Querying left side connector...
Mag Str :
Coil Code:
Coil Field Strength: 0
Coil Code:
Querying right side connector...
Mag Str : 0.7T
Coil Code: MRIDHEADPA
Coil Field Strength: 7000
Coil Code: MRIDHEADPA
END OF COIL ID TEST
```

**OUTPUT FROM COILTEST SCRIPT**  
ILLUSTRATION 3-2

### 3-2 Checking Coil ID With The PC Laptop

#### 3-2-1 Required Tools

TABLE 3-1  
EQUIPMENT REQUIRED

| Item | Description   | Part Number    |
|------|---|----------------|
| 1.   | RS-232 9-pin to 25-pin Serial Cable (NOT null-modem)<br>(See <b>Note</b> below) | Obtain locally |
| 2.   | 25-pin female-female gender changer adapter                                     | Obtain locally |

#### Note

The serial cable that was delivered in the top of the GRFD cabinet for the SSM is a null-modem cable and cannot be used in this application without a null-modem adapter.

#### 3-2-2 Hardware Setup

1. Connect the HeadPA coil (or connect any other surface coil) to either side of the MSHS.
2. Locate the SCSI Serial Expansion Box (OW1 A16) attached to the rear of the operator table and remove the run 911 cable from the connector labeled Serial Port 5. See Illustration 3-3.

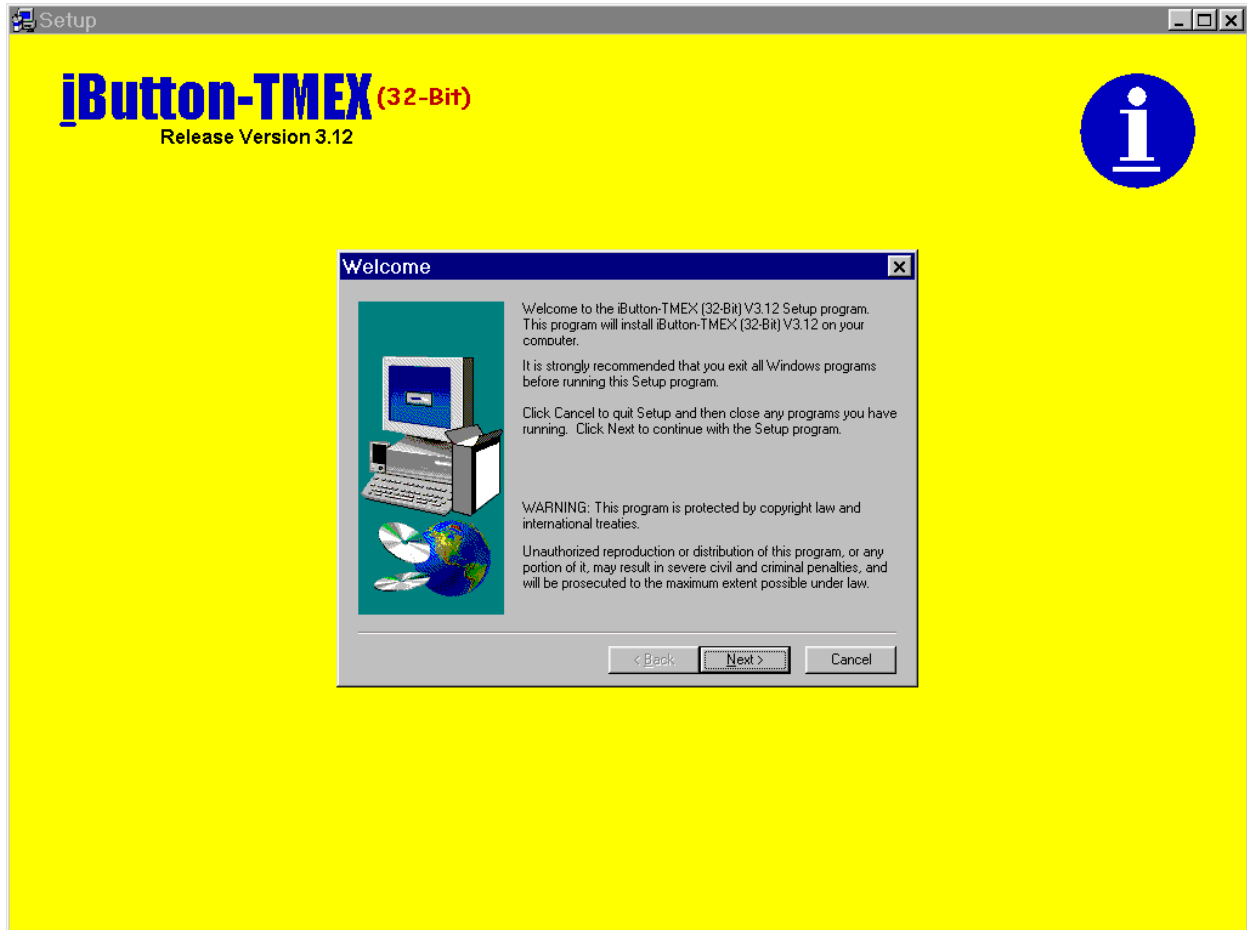


SCSI SERIAL EXPANSION BOX  
ILLUSTRATION 3-3

3. Attach the 25-pin female-female gender changer adapter to the 25-pin connector on the serial cable and then connect this assembly to the run 911 cable that was previously removed from Serial Port 5 on the SCSI Serial Expansion Box.
4. Connect the 9-pin end of the serial cable to the 9-pin serial connector on the rear of the field laptop.

### 3-2-3 Software Installation and Operation

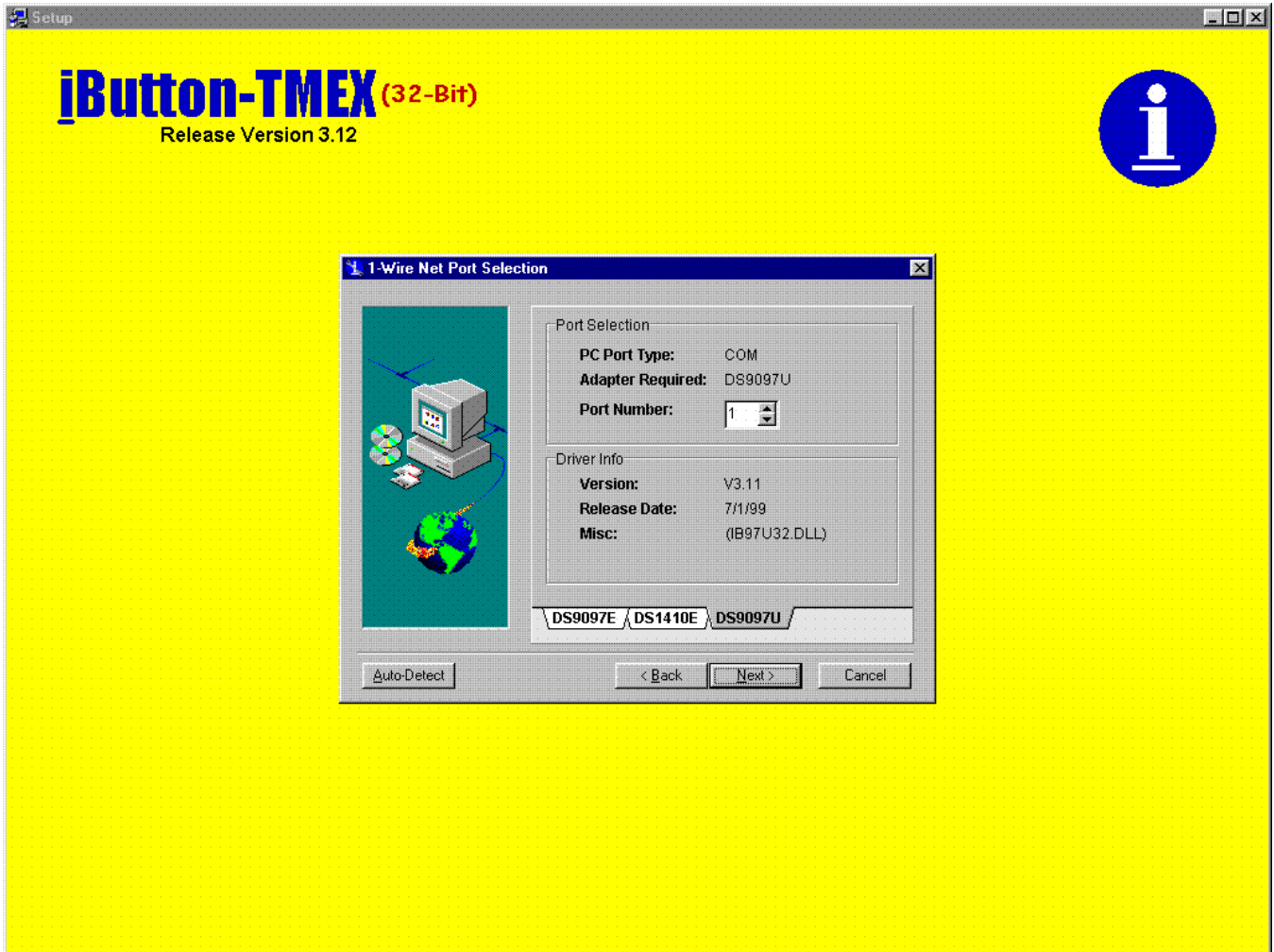
1. Verify the laptop is booted and disable any software, such as communication programs or PDA hotlink utilities, that will prevent other programs from using the laptop serial port.
2. Install the TMEX software on the laptop.
  - a. Load the Service Methods CDROM (part # 2250758) into the drive.
  - b. Select **Start** and then **Run**.
  - c. In the box type **e:\tmex\tm312\_32.exe**. This will load the program from the CDROM.
  - d. Follow the directions and load the software. See Illustration 3-4.



**TMEX SOFTWARE LOAD SCREEN**  
ILLUSTRATION 3-4

### 3-2-3 Software Installation and Operation (Continued)

- e. After many questions the software will prompt you to select the correct interface for the 1-wire network. See Illustration 3-5.

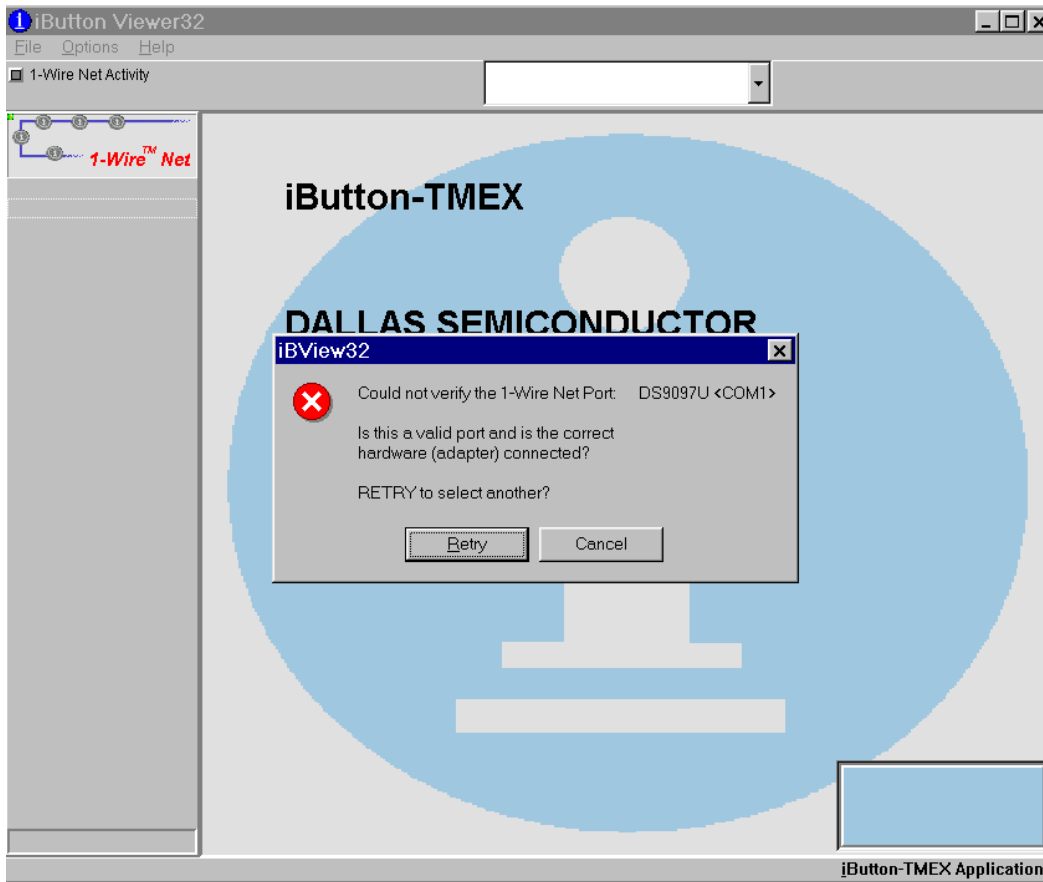


**PORT SELECTION SCREEN**  
ILLUSTRATION 3-5

- f. Select **DS9097U** as shown in Illustration 3-5 and then select **Next**.

### 3-2-3 Software Installation and Operation (Continued)

g. If an error message like the one shown in Illustration 3-6 is displayed:

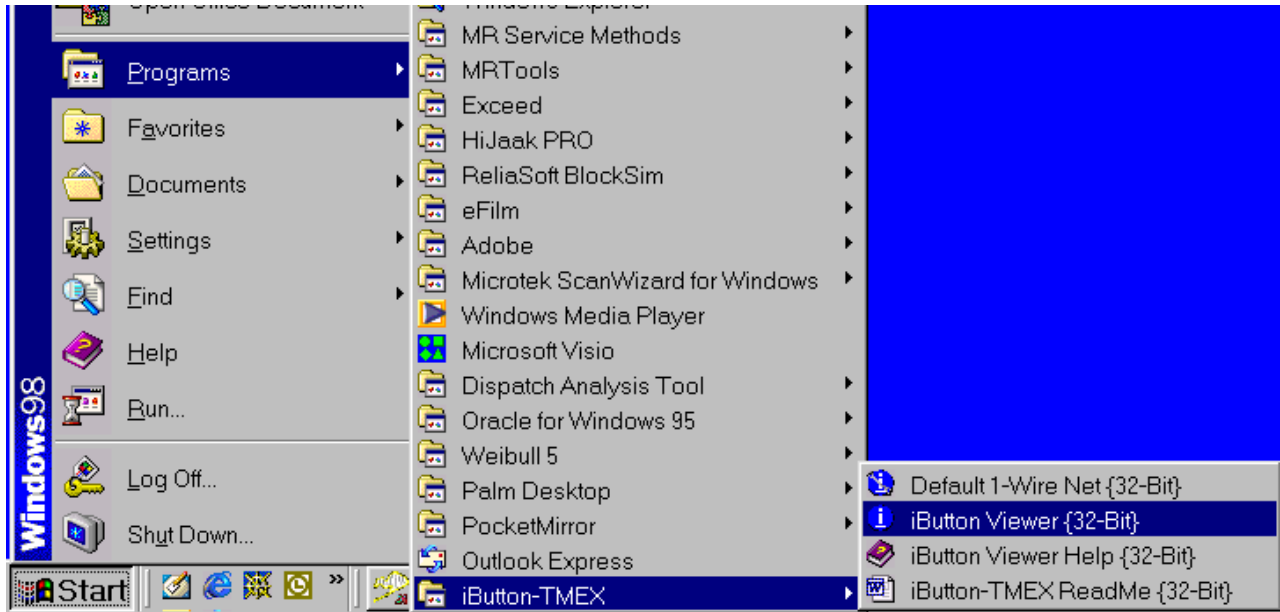


**TMEX PORT ERROR EXAMPLE SEEN DURING LOAD**  
ILLUSTRATION 3-6

- i. Check again and close any software utilities that have control of the serial port.
  - ii. If the MSHS is not communicating then it would be normal for this error to be displayed. Click **Cancel** to accept COM1 as the default and finish the load.
- h. Allow the program to reboot the computer. After the reboot, again disable any programs, such as communication programs or PDA hotlink utilities, that might not relinquish use of the serial port.

### 3-2-3 Software Installation and Operation (Continued)

3. Select **Start, Programs, iButton-TMEX, iButton Viewer {32 Bit}**. See Illustration 3-7.

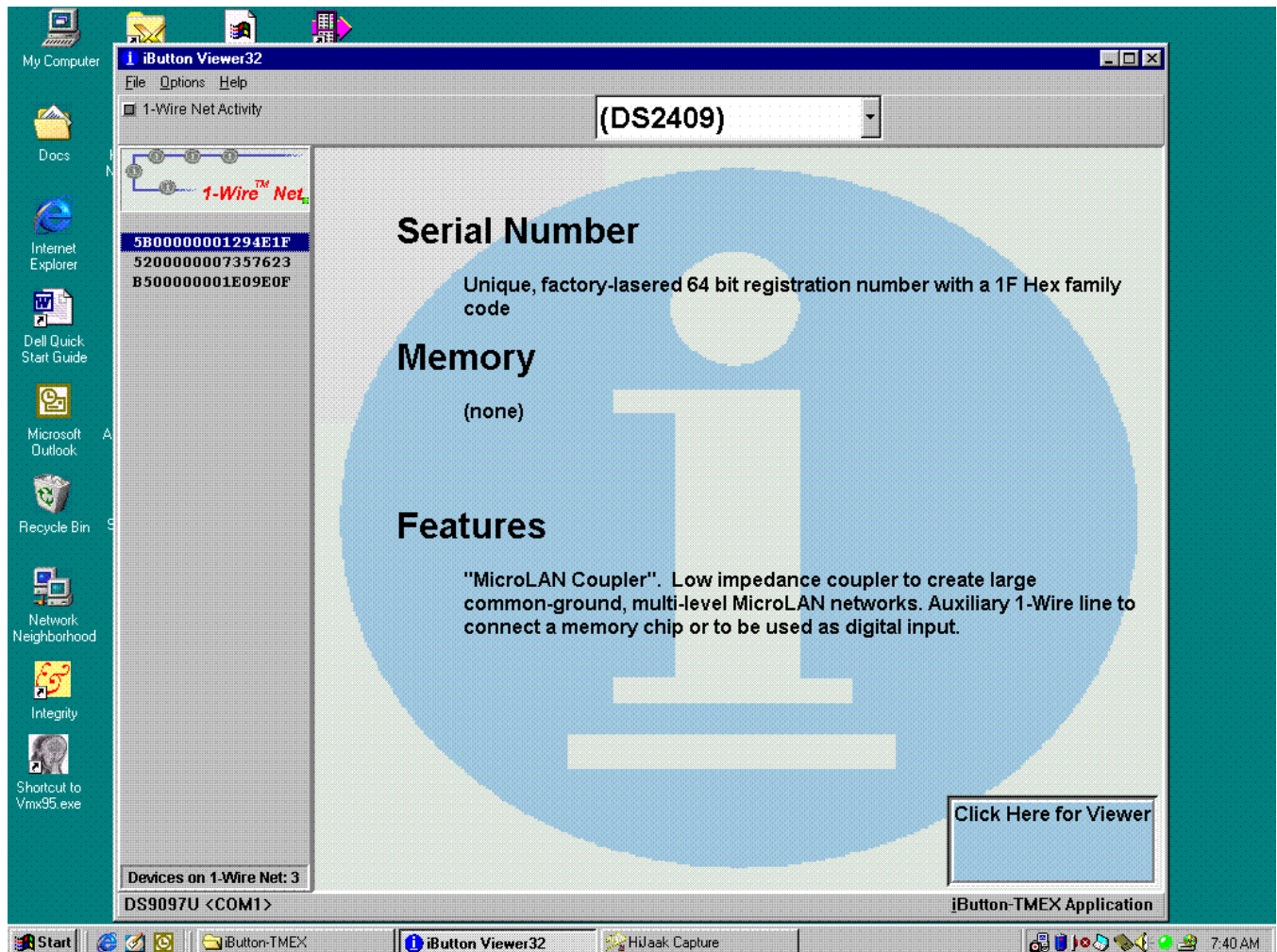


**TMEX SOFTWARE STARTUP**  
ILLUSTRATION 3-7

4. If the MSHS is not communicating then a screen like the one seen previously in Illustration 3-6 will be seen.

### 3-2-3 Software Installation and Operation (Continued)

5. If the MSHS is communicating and a surface coil is connected to the MSHS, then a screen like that shown in Illustration 3-8 will be seen.
  - a. Note the 3 lines of 16 character (64 bit) hexadecimal code seen in the upper left portion of the window. The top line of characters (highlighted) shows that the ID chip inside the MSHS is communicating. The other two lines underneath show that a surface coil is connected and the ID chips are being read from the MSHS.
  - b. If a coil is not connected to the MSHS or if the MSHS cannot read the ID chip in the coil Bendix connector, then only the top line of 16 characters would be seen.

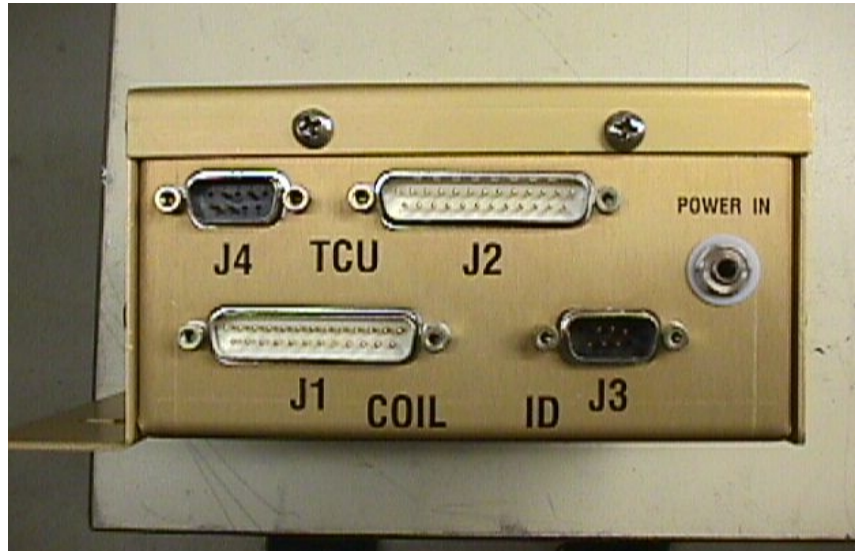


**IBUTTON ACTIVITY SCREEN SHOWING MSHS ID AND COIL ID**  
ILLUSTRATION 3-8

6. Remove the 25-pin gender changer/serial cable assembly from the run 911 connector and re-attach the run 911 cable to Serial Port 5 on the SCSI Serial Expansion Box.

### 3-2-3 Software Installation and Operation (Continued)

7. Locate the Serial Converter Box (OW A17) mounted on the rear of the operator table and remove the run 911 cable from the 25-pin J1 connector. See Illustration 3-9.



**SERIAL CONVERTER BOX**  
ILLUSTRATION 3-9

- a. Connect the 25-pin gender changer/serial cable assembly to the J1 connector on the Serial Converter Box.
- b. Check that the MSHS and any connected coils are communicating by repeating in actions described in step 5.
- c. If no communication to the MSHS is seen then exit the TMEX program by selecting File, then Exit and restart as in step 3.
- d. If communication is now possible after the restart then check cable run 911 for damage.
- e. If error messages are still seen after restarting the program then there may be a problem with the laptop configuration, serial port, cable, or there is not a problem with any of these items but, instead, the MSHS is not communicating.
  - i. Check that the laptop serial port is enabled in BIOS.
  - ii. Confirm that the laptop serial port pins are not damaged
  - iii. Inspect the serial cable for damage and open connections.
  - iv. Confirm that that there is no software running in the background on the PC that has control of the serial port.
  - v. Try using another PC laptop.

### 3-2-3 Software Installation and Operation (Continued)

- vi. If certain that the laptop hardware, software, and cables are in good working order then proceed directly to **Section 3-3 Restoration**.

### 3-3 Restoration

1. Remove the gender changer/serial cable assembly from the laptop and cable run 911 or the Serial Converter Box.
2. Reconnect cable run 911 to the SCSI Serial Expansion Box Serial Port 5 and, if necessary, to the Serial Converter Box connector J1.
3. Exit the TMEX program running on the PC by selecting **File** in the upper left corner of the window and then **Exit**.
4. Return to the Troubleshooting Flowchart.

## 4 - SERIAL CONVERTER LOOPBACK TESTS

The Serial Converter converts the RS-232 signals from the SCSI Serial Expansion Box to RS-422 for use by the Multicoil Select/Head Switch (MSHS) and to RS-485 for use by the Temperature Control Unit (TCU). Conversion is accomplished by two identical modules within the Serial Converter Box that are configured, via DIP switches, so that each can provide the proper RS-422 or RS-485 output signals. The J4 (TCU) and J3 (COIL ID) ports are, however, wired differently and are not interchangeable. This section describes a standalone process utilizing the field laptop, Windows 95/98 HyperTerminal software, and locally obtained hardware for checking the functionality of both sections of the Serial Converter.

### 4-1 Required Tools

TABLE 4-1  
 EQUIPMENT REQUIRED

| Item | Description   | Part Number    |
|------|---|----------------|
| 1.   | RS-232 9-pin to 25-pin sub – D Serial Cable (NOT null-modem) (See <b>Note</b> below)  | Obtain locally |
| 2.   | 25-pin sub-D female-female gender changer adapter   | Obtain locally |
| 3.   | 9-pin sub-D female connector (ideally using crimp-on leads)   | Obtain locally |
| 4.   | Two 1 inch long pieces of insulated 24 gauge (size not critical) wire to be used <b>ONLY</b> if performing the TCU Loopback Test. | Obtain locally |

**Note**

The serial cable that was delivered in the top of the GRFD cabinet for the SSM is a null-modem cable and cannot be used in this application without a null-modem adapter.

### 4-2 Coil ID Loopback Test – External

#### 4-2-1 Hardware Configuration for Coil ID Loopback Test

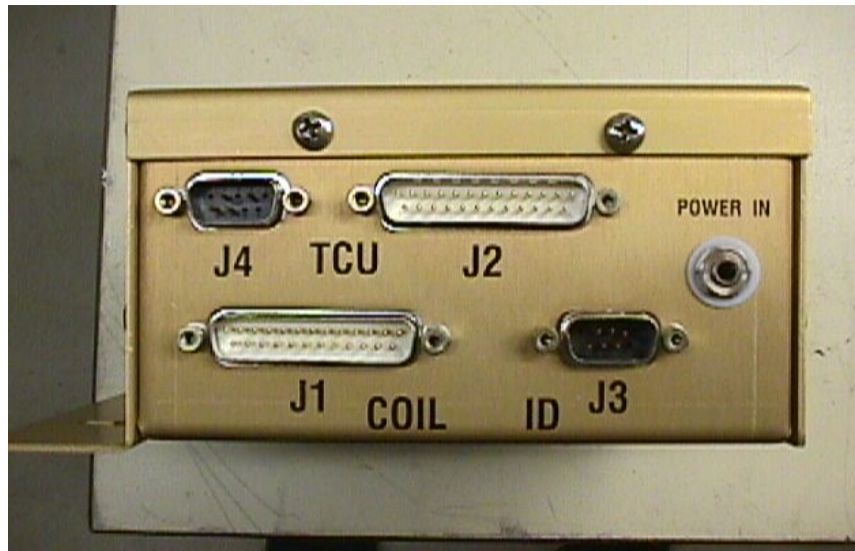
1. Wire the locally obtained 9-pin sub-D female connector as shown in Table 4-2. The pin numbers should be printed near each pin on the connector.

TABLE 4-2  
 WIRING CHART

|                      |
|----------------------|
| <b>Connect Pins:</b> |
| 2 and 8              |
| 3 and 7              |

#### 4-2-1 Hardware Configuration for Coil ID Loopback Test (Continued)

2. Remove the 25-pin, sub-D connector of cable run 911 from J1 on the Serial Converter Box. See Illustration 4-1.



SERIAL CONVERTER BOX  
ILLUSTRATION 4-1

3. Remove the 9-pin, sub-D connector of cable run 838 from J3 on the Serial Converter Box.
4. Connect the 9-pin sub-D female connector wired in step 1 to J3 on the Serial Converter Box.
5. Connect the 25-pin sub-D female-female gender changer adapter to the 25-pin sub-D serial cable connector.
6. Connect the 25-pin sub-D gender changer/serial cable assembly to J1 on the Serial Converter Box.
7. Connect the 9-pin sub-D serial cable connector to the serial port on the rear of the field laptop.

#### 4-2-2 Software Configuration

1. Confirm that the laptop is booted and operational.
2. At the laptop, position the mouse into the lower left corner of the screen and click **Start**, then **Run**.
3. Type **hypertrm** in the entry box and then click **[OK]**.
4. **IF** the system reports that HyperTerminal is **not** found then it must be installed.
  - a. Select **Start**, then **Settings**, then **Control Panel**, then **Add/Remove Programs**.

### 4-2-2 Software Configuration (Continued)

- b. At the top of the *Add/Remove Programs Properties* window select **Windows Setup**.
  - c. Scroll down the menu from the left scroll bar and select **Communications**.
  - d. Scroll down the menu from the left scroll bar and click on the check mark box to the left of **HyperTerminal**. A check mark will appear in the left box when it has been selected. Click on **[OK]**.
  - e. At the *Add/Remove Programs Properties* window select **[OK]**. The system will indicate that it is attempting to load this program.
  - f. Windows 95 users will, at this point, be asked to reboot. Select **[Yes]**. After the reboot repeat the process starting at step 9.
  - g. Windows 98 users will notice that the installation ends but will not see any special prompt.
- 5. In the *Connection Description* window enter **Term** as the *Name*.
  - 6. Select the GE logo as the icon and then click **[OK]**.
  - 7. In the *Connect To* window, left mouse click on the down-arrow mark in the *Connect using* box. Select **Direct to Com1** and then click **[OK]**.
  - 8. Refer to Table 4-3 and configure the *COM1 Properties* windows as shown.

TABLE 4-3  
**COMMUNICATIONS SETTINGS**

|                 |          |
|-----------------|----------|
| Bits per second | 9600     |
| Data Bits       | 8        |
| Stop Bits       | 1        |
| Parity          | none     |
| Flow Control    | Xon/Xoff |

**Note**

The communication settings for this test are not critical.

- 9. Select and click on **[OK]** when done.
- 10. Select File from the top of the window and then click on Save. This saves this configuration for future use as an entry labeled **Term.ht**.

**Note**

This configuration can be used again in the future by clicking on **Term.ht** from the *HyperTerminal* window.

### 4-2-3 Loopback Test

Type any combination of characters on the keyboard. These should be echoed on the screen. Typed characters that echo on the screen indicate that the section of the Serial Converter that services the MSHS is working properly.

Check the loopback connector wiring, serial cable connection, laptop serial port configuration, and Serial Converter power supply if echoed characters are not seen. The DIP switch settings of each internal converter can also be checked. See **Section 5 – Serial Converter Configuration** for information needed to check the configuration or to reconfigure (swap) converters.

### 4-2-4 Restoration

1. Select "File" and "Exit" from the upper left menu bar to quit the Hyperterminal program.
2. Remove the gender changer/serial cable assembly from J1 on the Serial Converter Box and from the serial port on the rear of the laptop.
3. Reconnect cable run 911 to connector J1 on the Serial Converter Box.
4. Remove the 9-pin sub-D female connector from J3 on the Serial Converter Box.
5. Reconnect cable run 838 to connector J3 on the Serial Converter Box.
6. Return to the Troubleshooting Flowchart.

### 4-3 TCU Loopback Test – Internal

The TCU port uses an RS-485 2-wire, one-way communication link that cannot be tested in the same way as was the COIL ID port. TCU port testing must be done from inside the Serial Converter Box.

#### 4-3-1 Hardware Configuration for TCU Loopback Test

1. Verify that all the cables connected to the Serial Converter Box are correctly labeled.
2. Remove all the cables, including the power cable, from the Serial Converter Box.
3. Remove the Serial Converter Box from its mounting bracket under the operator table and relocate it temporarily to a static-safe work area in close proximity to a wall outlet and the field laptop.
4. Remove all the screws from the Serial Converter Box and lift off and carefully set aside the screws and top cover.
5. Connect the 25-pin sub-D female-female gender changer adapter to the 25-pin sub-D serial cable connector.
6. Connect the 25-pin sub-D gender changer/serial cable assembly to J2 on the Serial Converter Box.
7. Connect the 9-pin sub-D serial cable connector to the serial port on the rear of the field laptop.
8. While observing good ESD prevention practices (ie. working on grounded static mat, wearing anti-static strap) loosen the setscrews on the terminal strip at the rear of the TCU converter and remove the small, 22 gauge colored wires connected to T+ and T- from the terminal strip. Do not remove the black wires connected to G on the terminal strip.
9. Route the two locally obtained 1 inch long test wires to the connectors on the terminal strip as shown in Table 4-4.

TABLE 4-4  
TCU LOOPBACK TEST WIRING

|                 |
|-----------------|
| <b>Connect:</b> |
| T+ and R+       |
| T- and R-       |

### 4-3-1 Hardware Configuration for TCU Loopback Test (Continued)

10. Configure that DIP switches on the rear of the TCU converter according to Table 4-5 (This configuration should match that of the COIL ID converter).

TABLE 4-5  
TCU LOOPBACK TEST SWITCH CONFIGURATION

| Switch | Position  |
|--------|-----------|
| 1      | Down/Open |
| 2      | Down/Open |
| 3      | Down/Open |
| 4      | Down/Open |
| 5      | Up/Closed |

**Note**

Down/Open position is the switch angled in the direction of the rear of the converter. Most of the DIP switch packages are also marked "OPEN" to make this position clear.

11. Plug the AC power transformer into a 120VAC power source and then plug the adapter cable into the "POWER IN" plug on the Serial Converter Box.

### 4-3-2 Software Configuration

1. Confirm that the laptop is booted and operational.
2. At the laptop, position the mouse into the lower left corner of the screen and click **Start**, then **Run**.
3. Type **hypertrm** in the entry box and then click **[OK]**.
4. **IF** the system reports that HyperTerminal is **not** found then it must be installed.
  - a. Select **Start**, then **Settings**, then **Control Panel**, then **Add/Remove Programs**.
  - b. At the top of the *Add/Remove Programs Properties* window select **Windows Setup**.
  - c. Scroll down the menu from the left scroll bar and select **Communications**.
  - d. Scroll down the menu from the left scroll bar and click on the check mark box to the left of **HyperTerminal**. A check mark will appear in the left box when it has been selected. Click on **[OK]**.

### 4-3-2 Software Configuration (Continued)

- e. At the *Add/Remove Programs Properties* window select **[OK]**. The system will indicate that it is attempting to load this program.
  - f. Windows 95 users will, at this point, be asked to reboot. Select **[Yes]**. After the reboot repeat the process starting at step 9.
  - g. Windows 98 users will notice that the installation ends but will not see any special prompt.
5. In the *Connection Description* window enter **Term** as the *Name*.
  6. Select the GE logo as the icon and then click **[OK]**.
  7. In the *Connect To* window, left mouse click on the down-arrow mark in the *Connect using* box. Select **Direct to Com1** and then click **[OK]**.
  8. Refer to Table 4-3 and configure the *COM1 Properties* windows as shown.

TABLE 4-6  
**COMMUNICATIONS SETTINGS**

|                 |          |
|-----------------|----------|
| Bits per second | 9600     |
| Data Bits       | 8        |
| Stop Bits       | 1        |
| Parity          | none     |
| Flow Control    | Xon/Xoff |

**Note**

The communication settings for this test are not critical.

9. Select and click on **[OK]** when done.
10. Select File from the top of the window and then click on Save. This saves this configuration for future use as an entry labeled **Term.ht**.

**Note**

This configuration can be used again in the future by clicking on **Term.ht** from the *HyperTerminal* window

### 4-3-3 Loopback Test

Type any combination of characters on the keyboard. These should be echoed on the screen. Typed characters that echo on the screen indicate that the section of the Serial Converter that services the TCU is working properly.

**4-3-3 Loopback Test (Continued)**

Check the loopback connector wiring, serial cable connection, laptop serial port configuration, and Serial Converter power supply if echoed characters are not seen. The DIP switch settings of each internal converter can also be checked. See **Section 5 – Serial Converter Configuration** for information needed to check the configuration or to reconfigure (swap) converters.

**4-3-4 Restoration**

1. Select "File" and "Exit" from the upper left menu bar to quit the Hyperterminal program.
2. Disconnect the wall transformer from the 120VAC power source and remove the power plug from the "POWER IN" connector on the Serial Converter Box.
3. Remove the gender changer/serial cable assembly from J2 on the Serial Converter Box and from the serial port on the rear of the laptop.
4. Remove the test wires from the TCU converter (top unit) terminal strip.
5. Refer to Table 4-7 and replace the wires removed earlier from the TCU converter terminal strip.

TABLE 4-7  
**TCU CONVERTER WIRING RECONNECT**

| Wire Color (may change) | Terminal Strip Connection | Corresponding J4 pin |
|-------------------------|---------------------------|----------------------|
| Purple                  | T +                       | 7                    |
| Green                   | T -                       | 2                    |
| Black                   | G                         | 4                    |
| Black                   | G                         | 6                    |

6. Refer to Table 4-8 and reconfigure the DIP switch settings on the rear of the TCU converter.

TABLE 4-8  
**TCU CONVERTER DEFAULT SWITCH CONFIGURATION**

| Switch | Position  |
|--------|-----------|
| 1      | Up/Closed |
| 2      | Down/Open |
| 3      | Up/Closed |
| 4      | Up/Closed |
| 5      | Down/Open |

#### 4-3-4 Restoration (Continued)

##### Note

Down/Open position is the switch angled in the direction of the rear of the converter. Most of the DIP switch packages are also marked "OPEN" to make this position clear.

7. Verify that all the wiring has been routed to the proper terminal strip locations, the DIP switch settings are correct, and that the plug-in power connectors to each converter are fully seated.
8. Replace the cover and screws on the Serial Converter Box.
9. Secure the Serial Converter Box back into position under the operator table.
10. Reconnect cable run 911 to connector J1 on the Serial Converter Box.
11. Reconnect cable run 910 to connector J2 on the Serial Converter Box.
12. Reconnect cable run 837 to connector J4 on the Serial Converter Box.
13. Reconnect cable run 838 to connector J3 on the Serial Converter Box.
14. Reconnect the wall transformer to the proper 120VAC power source and then connect the power cable connector into the "POWER IN" port on the Serial Converter Box.
15. Return, if necessary, to the Troubleshooting Flowchart.

## 5 – SERIAL CONVERTER CONFIGURATION

This section provides the default configuration information for each of the serial converters. Note that this information would allow one to swap converters. That is, if the COIL ID serial converter failed, then the TCU converter could be configured to operate, temporarily, as a COIL ID converter. The converse situation is also possible.

### 5-1 DIP Switch Settings

1. See Table 5-1 for the default DIP switch configuration for the internal COIL ID (J1) serial converter.

TABLE 5-1  
DEFAULT DIP SWITCH CONFIGURATION FOR COIL ID SERIAL CONVERTER

| Switch | Position  |
|--------|-----------|
| 1      | Down/Open |
| 2      | Down/Open |
| 3      | Down/Open |
| 4      | Down/Open |
| 5      | Up/Closed |

2. See Table 5-2 for the default DIP switch configuration for the internal TCU (J2) serial converter.

TABLE 5-2  
DEFAULT DIP SWITCH CONFIGURATION FOR TCU SERIAL CONVERTER

| Switch | Position  |
|--------|-----------|
| 1      | Up/Closed |
| 2      | Down/Open |
| 3      | Up/Closed |
| 4      | Up/Closed |
| 5      | Down/Open |

### 5-2 Default Serial Converter Wiring Configurations

1. See Table 5-3 for the default wiring configuration for the internal COIL ID (J1) serial converter.

TABLE 5-3  
COIL ID CONVERTER WIRING RECONNECT

| Wire Color (may change) | Terminal Strip Connection | Corresponding J3 pin |
|-------------------------|---------------------------|----------------------|
| Yellow                  | T +                       | 3                    |
| Brown                   | T -                       | 8                    |
| Purple                  | R +                       | 7                    |
| Green                   | R -                       | 2                    |
| Black                   | G                         | 4                    |
| Black                   | G                         | 6                    |

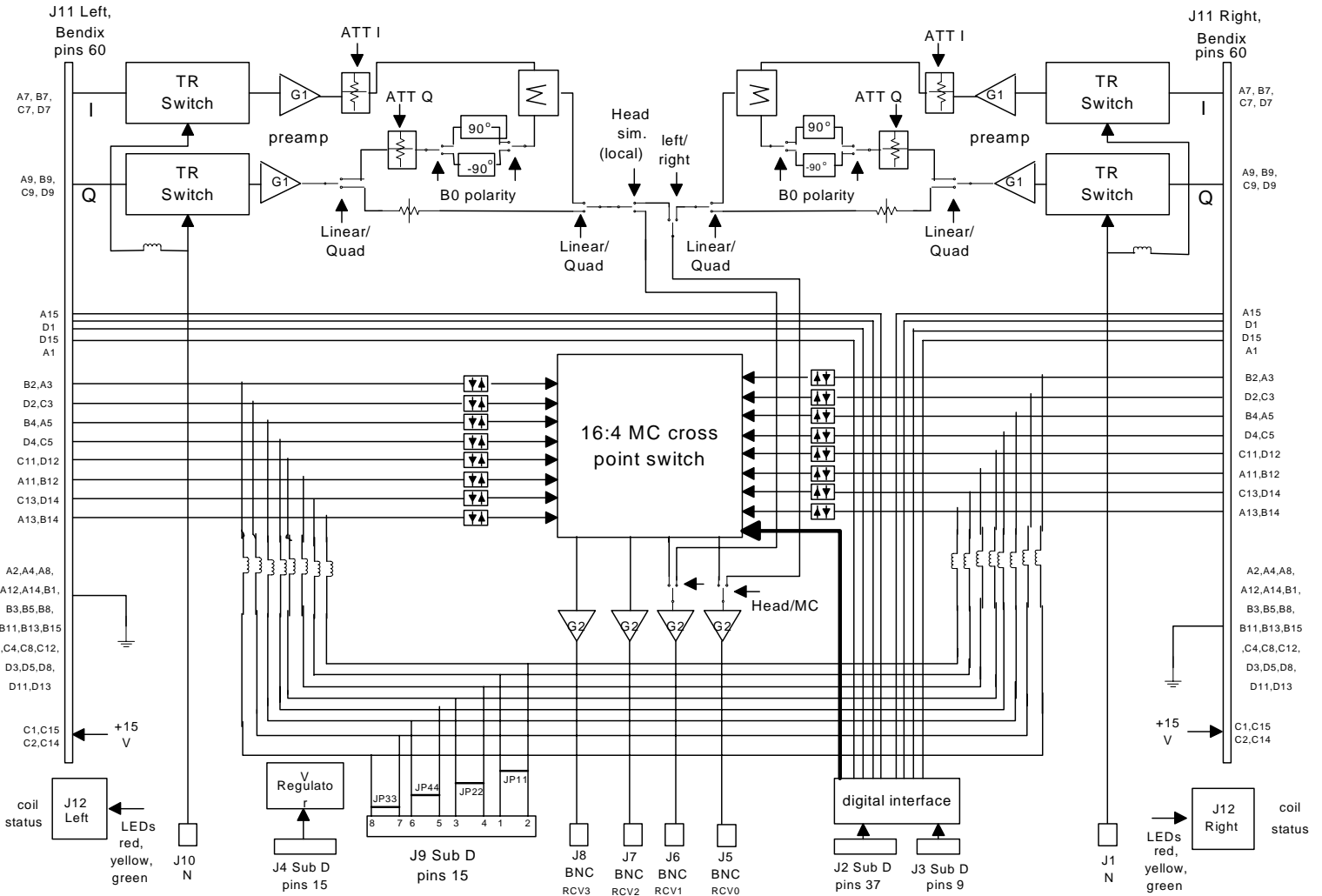
2. See Table 5-4 for the default wiring configuration for the internal TCU (J2) serial converter.

TABLE 5-4  
TCU CONVERTER WIRING RECONNECT

| Wire Color (may change) | Terminal Strip Connection | Corresponding J4 pin |
|-------------------------|---------------------------|----------------------|
| Purple                  | T +                       | 7                    |
| Green                   | T -                       | 2                    |
| Black                   | G                         | 4                    |
| Black                   | G                         | 6                    |

### APPENDIX A – MSHS FUNCTIONAL BLOCK DIAGRAM

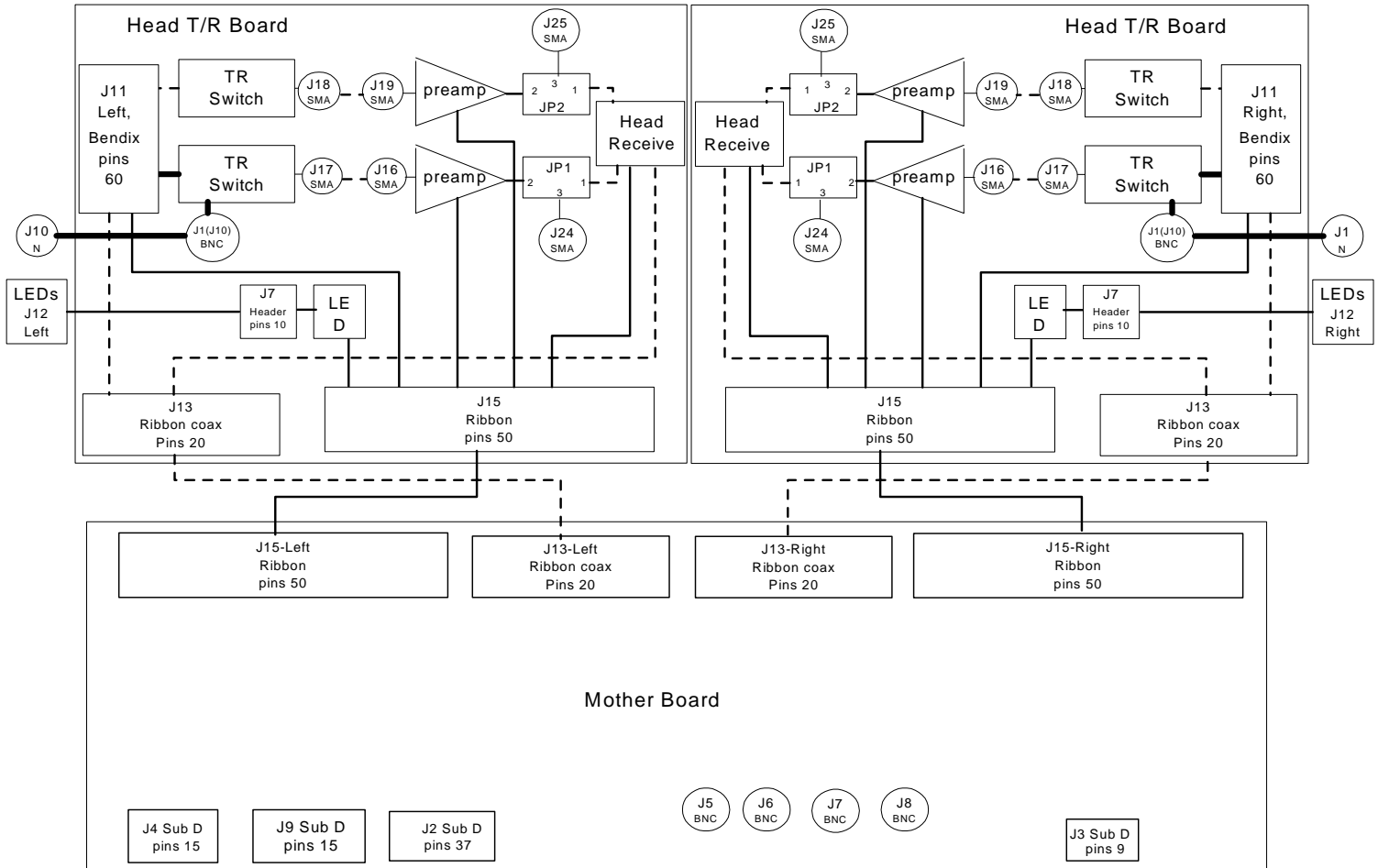
The MSHS Functional Block Diagram provides a high-level view of the operation of the MSHS. Some of the connector pin numbers are listed on the diagram. See **0.7T THEORY FOR MULTICOIL SELECT/HEAD SWITCH (MSHS)** document (PT1THC2.DOC) for more information concerning connectors, pins, and signals. This information can also be found in **APPENDIX D – MSHS CONNECTORS** of this document.



**MSHS FUNCTIONAL BLOCK DIAGRAM**  
ILLUSTRATION A-1

**APPENDIX B – MSHS CONNECTION DIAGRAM**

The MSHS Connection Diagram shows the 3 individual boards in the MSHS, the interconnections between the sections on the boards, the interconnections between the boards, and the signal flow between the sections on the boards and the boards.



**Key:** Bias and Control ———  
 Transmit Signal ———  
 Receive Signal - - - - -

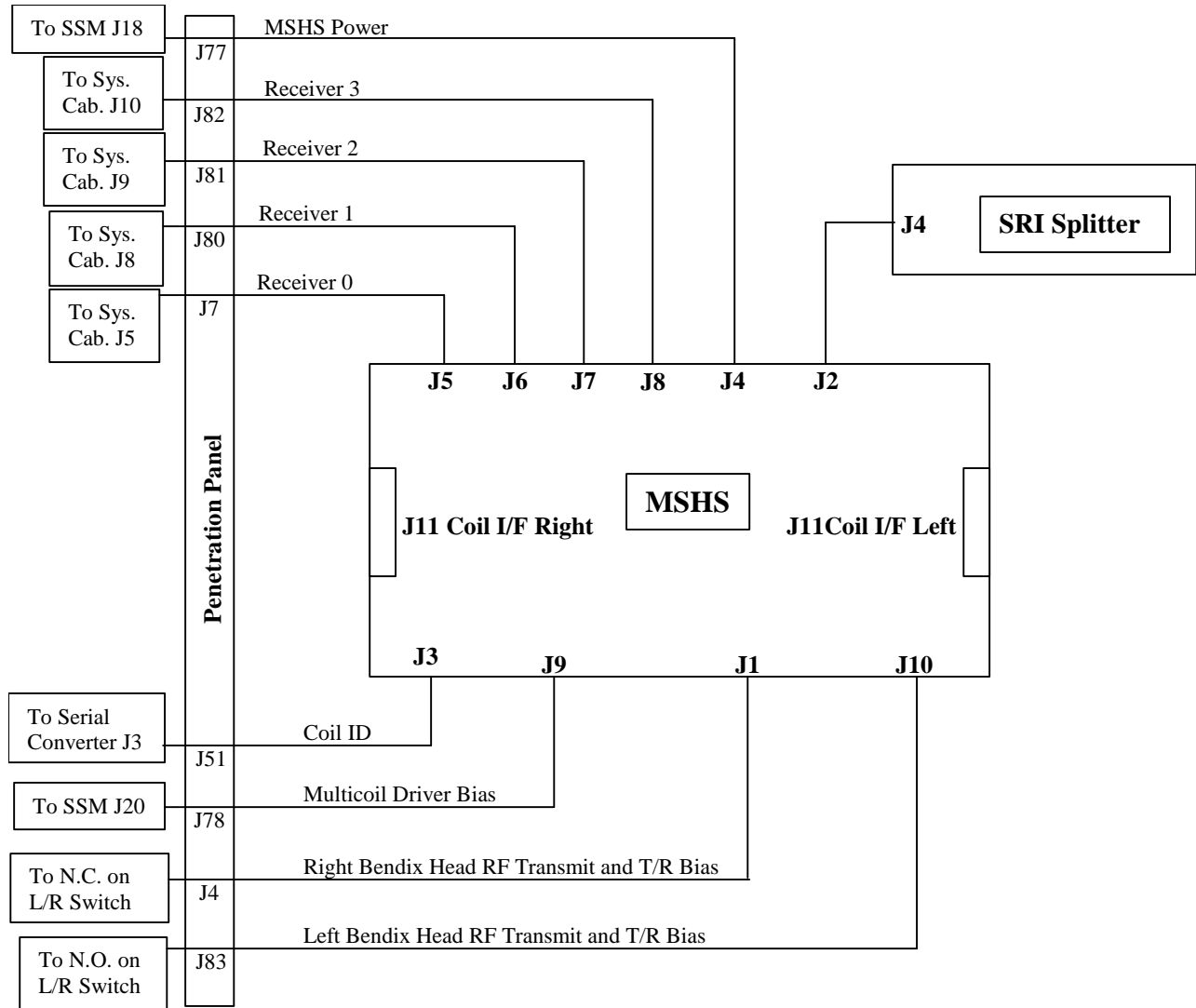
**MSHS CONNECTION DIAGRAM**  
 ILLUSTRATION B-1

**Note**

The MSHS is a FRU and none of the internal boards or cables that comprise the MSHS are currently FRUs. If the MSHS fails, then the whole unit must be replaced.

**APPENDIX C – MSHS SYSTEM INTERCONNECT**

Illustration 3-3 below shows the cable interconnections between the MSHS and the rest of the system.



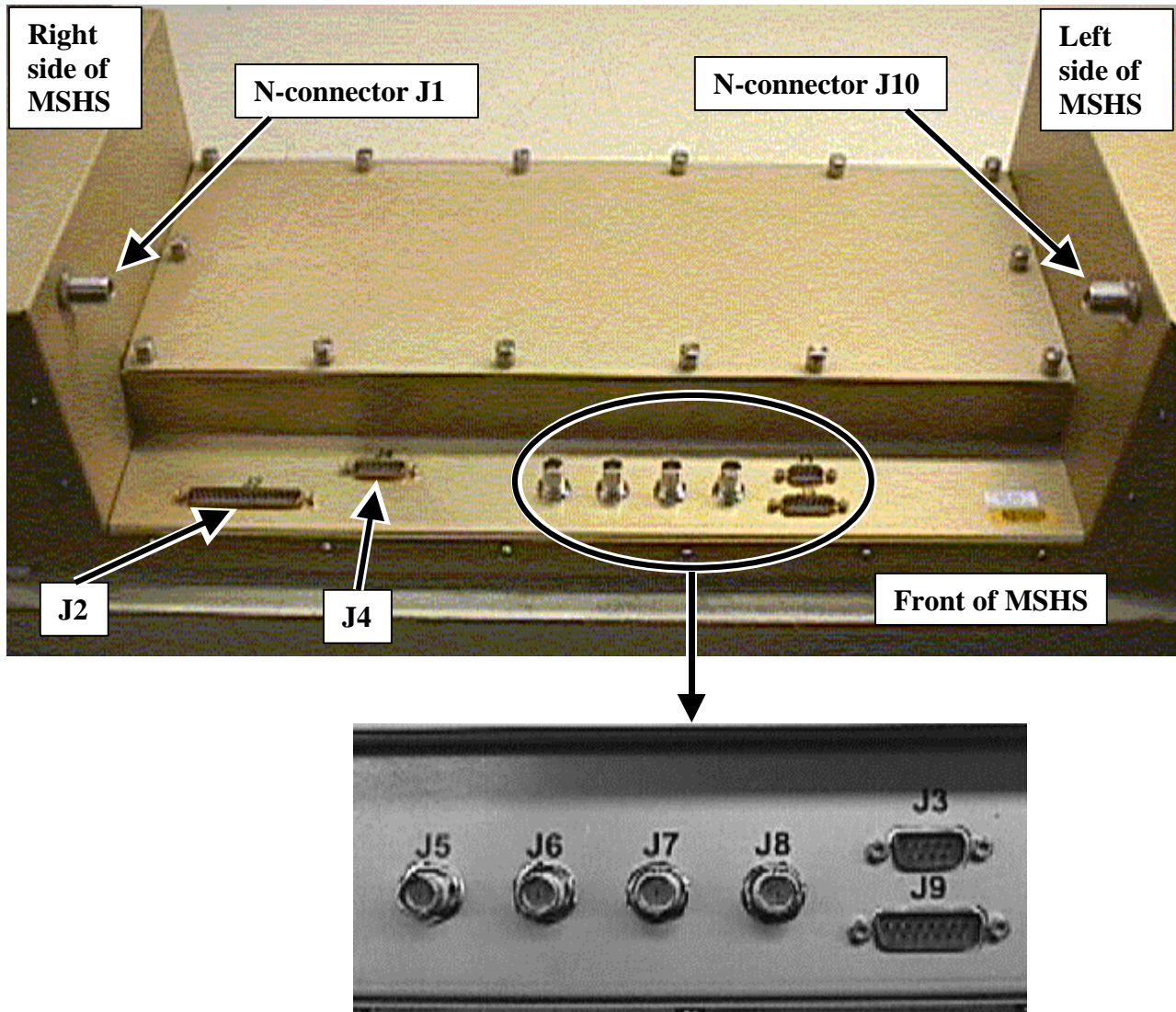
**MSHS SYSTEM INTERCONNECT DIAGRAM**  
 ILLUSTRATION C-1

## APPENDIX D – MSHS CONNECTORS

**Section D-1 MSHS Connector Locations** provides illustrations showing the locations of the MSHS connectors. **Section D-2 MSHS Connector Pins and Signals** identifies the pins on each connector as well as the signals on the individual pins.

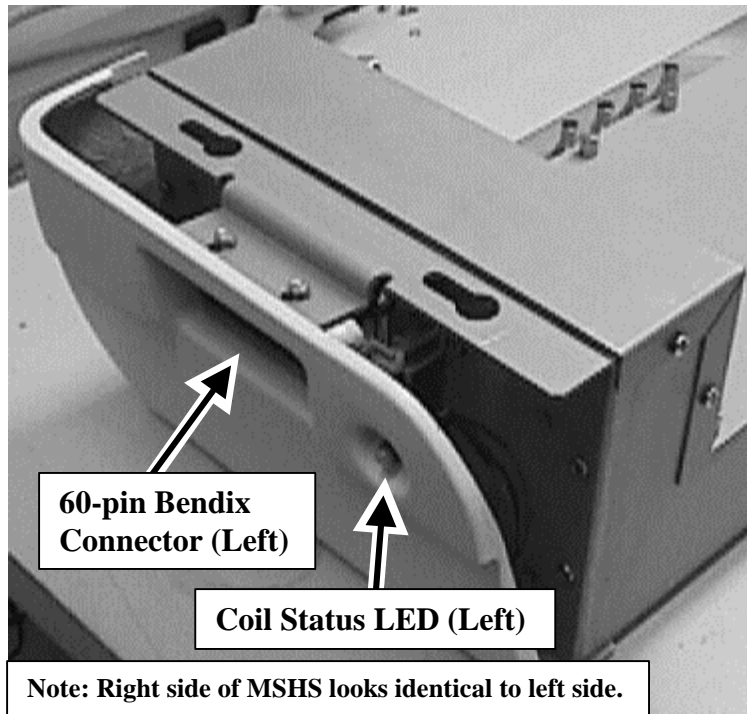
### D-1 MSHS Connector Locations

Illustration D-1 shows the external MSHS connectors that aren't easily seen when the MSHS is mounted into the table. Illustration D-2 shows the 60-pin Bendix coil connector and Coil Status LED on the left side of the MSHS.



**MSHS CONNECTORS**  
ILLUSTRATION D-1

### D-1 MSHS Connector Locations (Continued)



**MSHS LEFT BENDIX CONNECTOR AND LED LOCATION**  
ILLUSTRATION D-2

### D-2 MSHS Connector Pins and Signals

There are 2 N-connectors, 4 sub-D connectors, 2 Bendix coil connectors, and 4 BNC connectors for a total of 12 external cable connectors on the MSHS. This section lists each connector, the pins in the connector, and identifies the signals on each pin.

#### D-2-1 J1 and J10 Head Transmit Interface Connections

J1 and J10 are female, N-type RF coax connectors for head RF power and TR bias (for the head T/R board).

| Connector | Signal Name    | I/O | Description                                   |
|-----------|----------------|-----|---|
| J1        | Right Transmit | I   | Right side transmit power and TR bias signals |
| J10       | Left Transmit  | I   | Left side transmit power and TR bias signals  |

**D-2-2 J2 Control I/F Connection**

J2 is a male, 37-pin, sub-D connector. These control signals come from the SRI. The receive signal attenuation bits, 24 volts, Coil Status LED control, Cross Point Switch selection control, head quad/linear control, head/multicoil receive selection, head/multicoil right or left selection, head transmit right or left selection, B0 polarity (normal/reversed) selection, and left and right coil present signals are carried through this connector.

| J2- | Signal Name        | I/O | Description of Signal   |
|-----|--------------------|-----|---|
| 1   | Att.I bit0         | I   | Attenuator I control bit                                      |
| 2   | Att.I bit1         | I   | Attenuator I control bit.                                     |
| 3   | Att.I bit2         | I   | Attenuator I control bit.                                     |
| 4   | Att.I bit3         | I   | Attenuator I control bit.                                     |
| 5   | Att.I bit4         | I   | Attenuator I control bit.                                     |
| 6   | Spare_no_SRI0      | I   | Spare   |
| 7   | Att.Q bit0         | I   | Attenuator Q control bit.                                     |
| 8   | Att.Q bit1         | I   | Attenuator Q control bit                                      |
| 9   | Att.Q bit2         | I   | Attenuator Q control bit.                                     |
| 10  | Att.Q bit3         | I   | Attenuator Q control bit.                                     |
| 11  | Att.Q bit4         | I   | Attenuator Q control bit.                                     |
| 12  | +24V               | I   | +24 V Supply  |
| 13  | +24V               | I   | +24 V Supply  |
| 14  | +24V               | I   | +24 V Supply  |
| 15  | +24V               | I   | +24 V Supply  |
| 16  | LED#1              | I   | Red   |
| 17  | LED#2              | I   | Yellow  |
| 18  | LED#3              | I   | Green   |
| 19  | Spare_no_SRI1      | I   | Spare   |
| 20  | MC CTL BIT0        | I   | Multi-coil control bit  |
| 21  | MC CTL BIT1        | I   | Multi-coil control bit  |
| 22  | MC CTL BIT2        | I   | Multi-coil control bit  |
| 23  | MC CTL BIT3        | I   | Multi-coil control bit  |
| 24  | MC CTL BIT4        | I   | Multi-coil control bit  |
| 25  | MC CTL BIT5        | I   | Multi-coil control bit  |
| 26  | MC CTL BIT6        | I   | Multi-coil control bit  |
| 27  | MC CTL BIT7        | I   | Multi-coil control bit  |
| 28  | Spare_no_SRI2      | I   | Spare   |
| 29  | Head linear/Quad   | I   | Head linear/quad receive select (high = linear, low = quad)   |
| 30  | Head/MC rec sel    | I   | Head/Multi-channel receive select (high = head, low = MC)     |
| 31  | Head&MC L/R sel    | I   | Head& MC Left/Right receive select (high = left, low = right) |
| 32  | Spare              |     | Spare 0   |
| 33  | Head L_R_TX        | I   | Head TX left/right (high = left, low = right)                 |
| 34  | B0_polarity        |     | Polarization for head Quad receive (high = +90°, low = -90°)  |
| 35  | Spare              |     | Spare 1   |
| 36  | Left coil present  |     | Left coil present (low = coil present)                        |
| 37  | Right coil present |     | Right coil present (low = coil present)                       |

**D-2-3 Coil ID I/F Connector**

J3 is a male, 9-pin, sub-D connector for the Host/Coil ID Interface

| J3- | Signal Name | Description   |
|-----|-------------|---|
| 1   | Not used    |   |
| 2   | RxD-L       | Data from Coil ID to Host – Low side ( differential data )  |
| 3   | TxD-H       | Data from Host to Coil ID – High side ( differential data ) |
| 4   | Gnd         |   |
| 5   | Not used    |   |
| 6   | Gnd         |   |
| 7   | RxD-H       | Data from Coil ID to Host – High side ( differential data ) |
| 8   | TxD-L       | Data from Host to Coil ID – Low side ( differential data )  |

**D-2-4 MSHS DC Power Input Connector**

J4 is a 15-pin, sub-D connector supplying power to the MSHS.

| J4-         | Signal Name | Description  |
|-------------|-------------|--|
| 10,11,13,14 | Ground      | DC Power Return pins                               |
| 8           | -15VDC      | -15V supply ±5% @ 0.5A max. (50mV RMS max. ripple) |
| 1, 3, 6     | +15VDC      | +15V supply ±5% @ 1.0A max. (50mV RMS max. ripple) |

**D-2-5 Receiver Interface BNC Connectors**

J5, J6, J7 and J8 are BNC RF coax connectors

| Connector | Signal Name | I/O | Description       |
|-----------|-------------|-----|-------------------|
| J5        | AUX1        | O   | RF receive signal |
| J6        | AUX2        | O   | RF receive signal |
| J7        | AUX3        | O   | RF receive signal |
| J8        | AUX4        | O   | RF receive signal |

**D-2-6 Multicoil Channel Driver I/F Connector**

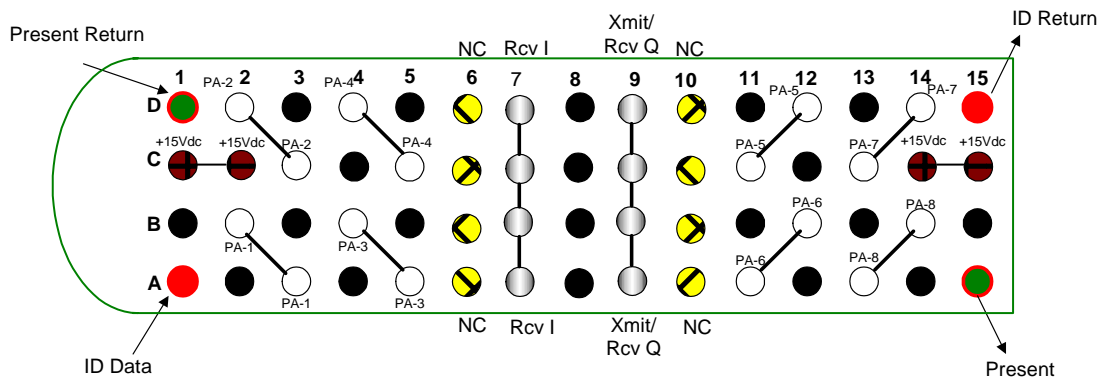
J9 is a male, 15-pin, Sub-D connector. Since the SSM only provides 4 multicoil drivers but the MSHS is capable of biasing up to 8 coils, the even numbered multicoil driver bias lines are jumpered to the odd numbered lines inside the MSHS. This provides multicoil driver bias to the other 4 coils. The USSSM (Universal System Support Subsystem Module), which is a product in development, is equipped with 8 multicoil drivers. The jumpers will be removed when the USSSM replaces the SSM. See the description comments in the table below.

| J9-      | Signal Name | Port Biased | Description   |
|----------|-------------|-------------|---|
| 1        | MCD7        | PA7         | Multi-coil Bias; (+/- 5V)                                     |
| 2        | MCD8        | PA8         | Multi-coil Bias; connected to MCD7 (SSM only) or ± 5V (USSSM) |
| 3        | MCD5        | PA5         | Multi-coil Bias; (+/- 5V)                                     |
| 4        | MCD6        | PA6         | Multi-coil Bias; connected to MCD5 (SSM only) or ± 5V (USSSM) |
| 5        | MCD4        | PA4         | Multi-coil Bias; connected to MCD3 (SSM only) or ± 5V (USSSM) |
| 6        | MCD3        | PA3         | Multi-coil Bias; (+/- 5V)                                     |
| 7        | MCD2        | PA2         | Multi-coil Bias; connected to MCD1 (SSM only) or ± 5V (USSSM) |
| 8        | MCD1        | PA1         | Multi-coil Bias; (+/- 5V)                                     |
| 10 to 14 | Ground      | NA          | Analog ground   |
| 15       | Unused      | NA          | Open, unused  |

**D-2-7 60-pin Bendix Coil I/F Connectors (one on each side of the MSHS)**

J11 is a female, 60-pin, Bendix connector on both the left and right sides of the MSHS for interfacing the head coil and all surface coils. See Illustration D-3 below showing the locations of all 60 pins.

| J11-  | Signal Name  | I/O | Description                |
|---|--------------|-----|----------------------------|
| A1  | Coil ID      | I   | Coil ID Signal             |
| A3, B2  | PA1          | I/O | Multi- coil 1 signal       |
| A5, B4  | PA3          | I/O | Multi- coil 3 signal       |
| A7, B7,C7, D7   | Head Coil I  | I/O | Head coil I channel signal |
| A9, B9,C9, D9   | Head Coil Q  | I/O | Head coil Q channel signal |
| A11, B12  | PA6          | I/O | Multi- coil 6 signal       |
| A13, B14  | PA8          | I/O | Multi- coil 8 signal       |
| A15   | Coil Present | I   | Coil Present Signal        |
| C1, C2, C14, C15  | +15 VDC      | O   | +15 V Supply               |
| C3, D2  | PA2          | I/O | Multi- coil 2 signal       |
| C5, D4  | PA4          | I/O | Multi- coil 4 signal       |
| C11, D12  | PA5          | I/O | Multi- coil 5 signal       |
| C13, D14  | PA7          | I/O | Multi- coil 7 signal       |
| D1  | Present RTN  | O   | Coil Present Return Signal |
| D15   | Coil ID RTN  | O   | Coil ID Return Signal      |
| A6,A10, B6, B10, C6, C10, D6 D10  | NC           |     | Not connected              |
| A2,A4, A8, A12,A14, B1, B3, B5, B8, B11, B13,B15,C4, C8, C12, D3, D5, D8, D11 D13 | Ground       |     | Ground                     |



Xmit/Rcv Q- transmit for and receive in Q-channel  
 Rcv I - receive for I(in-phase)  
 PA- phased Array (1 to 8)  
 NC- No Connection  
 +15 Vdc - preamp power supply voltages  
 ● Gnd

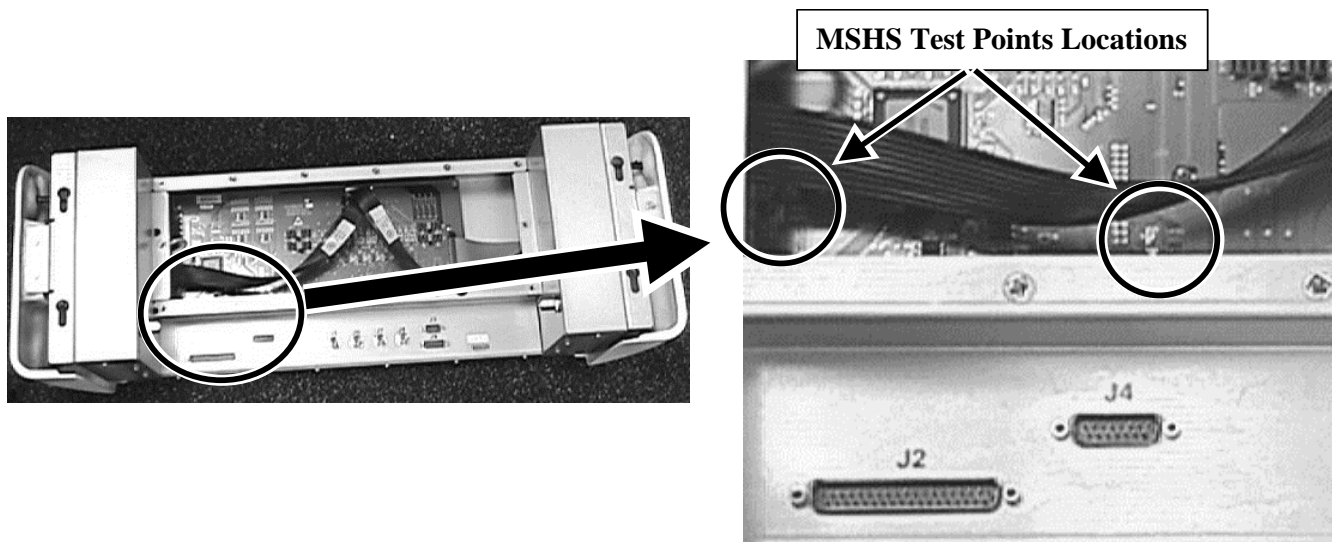
**60-PIN BENDIX CONNECTOR (ONE ON EACH SIDE OF MSHS)**  
ILLUSTRATION D-3

**D-3 MSHS Test Point Locations**

Test points are located inside the MSHS for checking and measuring the +15VDC and -15VDC supply voltages provided by the SSM. The +15VDC is regulated down to +5VDC, referred to as VCC, inside the MSHS. The -15VDC is regulated down to -5VDC, referred to as VEE, inside the MSHS. See Table D-1 for a listing of voltages and corresponding test points. See Illustration D-4 for the location of the test points.

TABLE D-1  
**VOLTAGES AND CORRESPONDING TEST POINTS**

| <u>Voltage</u> | <u>Test Point Label</u> | <u>Comments</u>          |
|----------------|-------------------------|--------------------------|
| +15VDC         | +15VDC                  | From SSM J18.            |
| -15VDC         | -15VDC                  | From SSM J18.            |
| +5VDC          | TP31 or TP36            | VCC in MSHS; from +15VDC |
| -5VDC          | TP32 or TP37            | VEE in MSHS; from -15VDC |



**TOP VIEW OF MSHS WITH COVER REMOVED SHOWING LOCATION OF TEST POINTS ON MH MOTHERBOARD**  
 ILLUSTRATION D-4

## REVISION HISTORY

| REV | DATE             | AUTHOR     | PRIMARY REASONS FOR CHANGE  |
|-----|------------------|------------|---|
| A   | October 19, 2000 | Don Thome  | Preliminary version.  |
| 1   | March 13, 2001   | Don Thome  | Added flowchart comments to replace coil cable on page 4. Made minor corrections. |
| 2   | April 18, 2001   | Don Thome' | Added MSHS diagrams, re-wrote flowchart. Made small corrections.                  |
| 3   | August 24, 2001  | Don Thome' | Added instructions for using coiltest.  |
| 4   | Sept. 20, 2001   | Don Thome' | Added information for using TMEX software.  |
| 5   | Oct. 11, 2001    | Don Thome' | Modified Tables 4-2 and 4-4 to make them easier to understand.                    |
| 6   | Dec. 5, 2001     | Don Thome' | Added information to flowchart at bottom of page 5.                               |