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1- DESCRIPTION

Eddy Current Measurement Tool (ECMT) is a One Button Touch service tool to compensate for eddy currents induced by the gradients in the conducting structures near the gradient coil. The tool provides an easy to use Graphical User Interface (GUI) that can be invoked from the Service Desktop Manager. The supporting software for this tool is available with 8.3 or later software.

Note

If a system is calibrated with one version of the Eddy Compensation tool (Guided Grafidy or ECMT), the same tool must be used for updates or start from beginning with different tool. If a different tool is used to compensate eddy currents the result will be bad plots

The use of ECMT requires a new test fixture. The new test fixture includes 6 coils with 6 samples of CuSO₄ and a multiplexer board, which enables the collection of data from all 3 planes without having to reposition any coils. The new fixture is compatible with both 1.0T systems and 1.5T systems.

ECMT will adjust and compensate for Linear Long, Linear Very Long, and B₀ Eddy Currents. Short-term eddy currents are compensated for with default values.

2- TIME, TOOLS, AND PREREQUISITE PROCEDURES REQUIRED

Time

Estimation of time required to perform this procedure is 2 (two) hours.



POISON HAZARD! THE PHANTOM CONTAINS CuSO₄. DO NOT INGEST. DISPOSE OF AS A HAZARDOUS WASTE ACCORDING TO STATE AND FEDERAL REGULATIONS.

Tools

Item	Description	Part Number	Qty.
1.	ECMT Kit	2234621	1
	<i>Kit includes the following:</i>		
	ECMT Fixture	2233016	1
	ECMT Cable (30 ft.) (To System Cabinet)	2219093	1
	ECMT Cables (30 ft.)	2219093-2	3
	Bottle of CuSO ₄	2238315	1
	BNC Bullets	46-282886P1	6
	ECMT Cable with Balun (To QD box)	2219092	1
	Spare Coil (includes sample)	2243352-7	1
2.	Surface Coil Quick Disconnect (QD) Box	46-282468G2 or 46-317222G6	1

THE FOLLOWING PROCEDURES SHOULD BE PERFORMED PRIOR TO ECMT

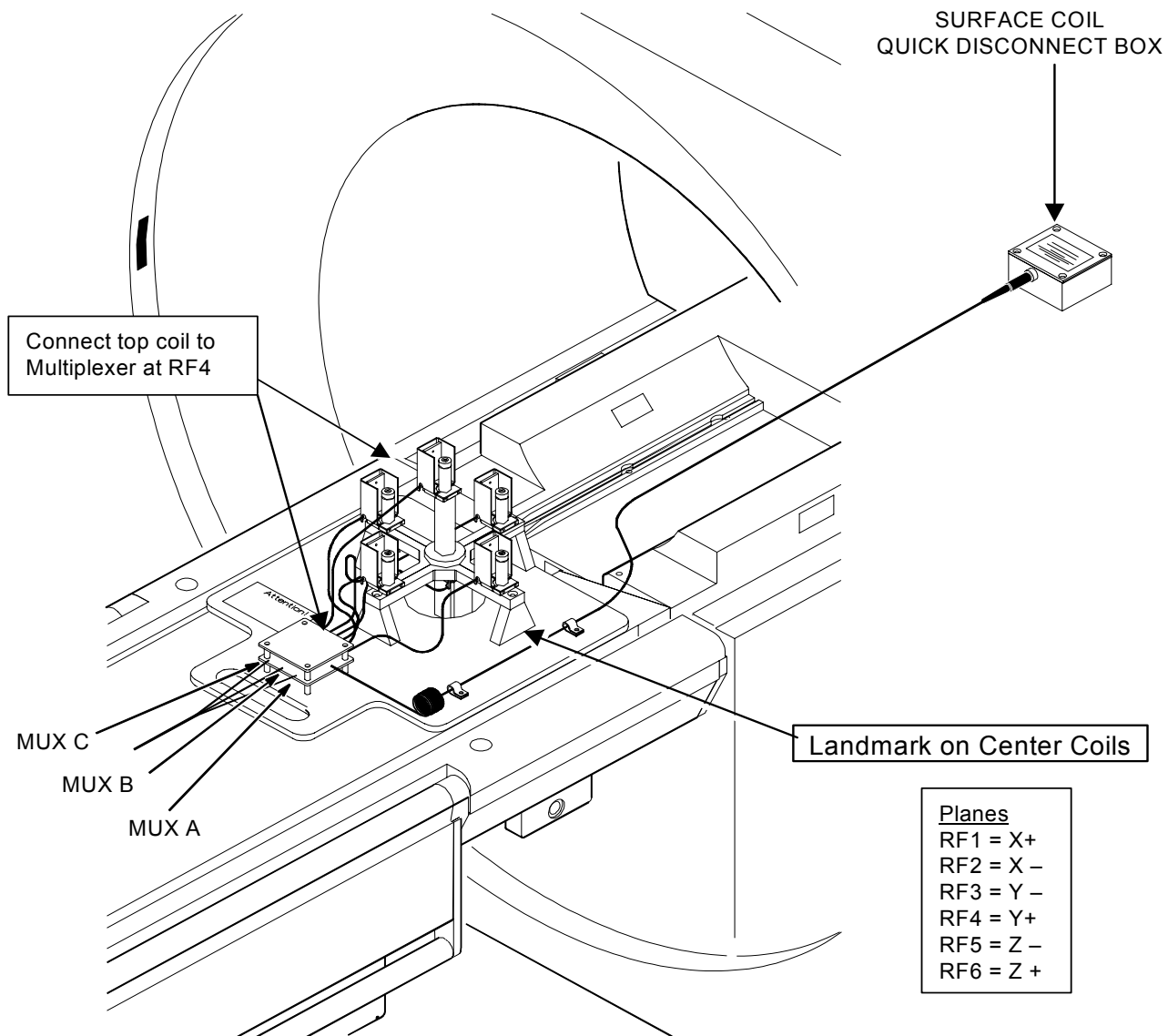
1. GEOMETRY VERIFICATION (at initial install)
2. ELECTRICAL ISOCENTER CALIBRATION (at initial install)
3. AUTO-LCOIL (Diagnostic)
4. DC OFFSET ADJUSTMENT (Diagnostic)

For ***TwinSpeed*** system, ensure that the above procedures have been performed for both gradient modes.

3- PROCEDURE

3-1 Set-up

1. From the Scan Desktop, select [**New Pt**]. Enter *geservice* for the **Patient ID**, and **weight of 111**.
2. Remove the ECMT fixture from the case and install the top coil, which is removed for storage. Be sure to connect the coil to the multiplexer board at RF4.
3. Place the ECMT fixture on the table, as in illustration 3-1.
4. Connect the Surface Coil Quick Disconnect box (site supplied) to the coil, and plug it into the surface coil port on the head carriage.



ECMT FIXTURE
ILLUSTRATION 3-1

3-1 Set-up (continued)

5. Connect one end of a 3 coaxial cable wire harness to the BNC connectors on the ECMT fixture labeled Mux A, Mux B, and Mux C. (See Illustration 3-2)
6. Landmark on the center of the ECMT fixture and Move to Scan. (See Illustration 3-1)

Note

You must select new exam, and landmark prior to the start of ECMT. Failure to do so may result in the SVAT script hanging the computer.

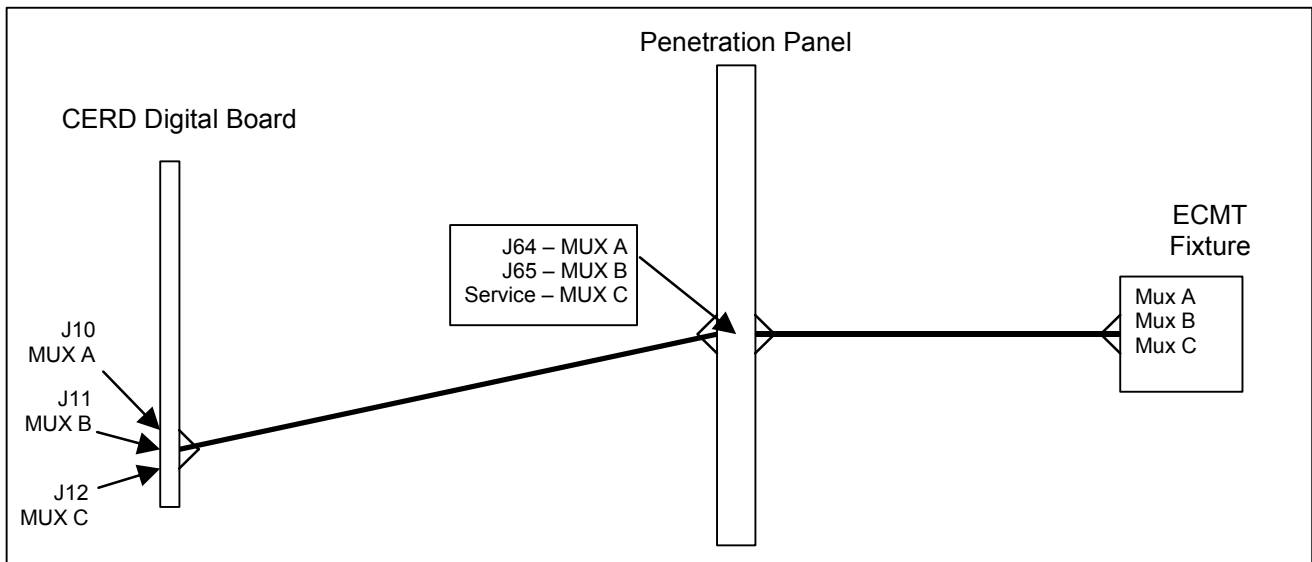
7. Connect the other end of the 3 coaxial cable wire harness to the penetration panel BNC feed-through connectors. (See Illustration 3-2) Use BNC bullets and additional 50 ft. cables as necessary.

Note

The following BNC feed-throughs have been reserved on the penetration panel for the ECMT cables (J64, J65, and Service).



Do not allow the BNC cables to dangle and short the Shield Cooler filters at the Penetration Panel.



ECMT SETUP
ILLUSTRATION 3-2

8. Connect another 3 coaxial cable wire harness on the equipment room side of the penetration panel at the BNC feed-throughs. (i.e., J64, J65, and Service) (See Illustration 3-2)
9. Connect the other end of the 3 coaxial cable wire harness to the CERD Digital board at J10, J11, and J12. (See Illustration 3-2) Use BNC bullets and additional 50 ft. cables as necessary.

3-2 Start-up

1. From the Service Desktop, select **[Cal/Checks]**, highlight **ECMT (Eddy Current Measurement Tool)** and select **[Start]**. The ECMT Window will appear as shown in Illustration 3-5.
For *TwinSpeed*, the **GradMode** Popup menu appears first. Highlight **Whole** and click on **OK**. Current GradMode is shown in top right corner of the ECMT Window.

Note

Different terms are used for the two ECMT modes depending upon which software version is used. In version 8.3, the two ECMT modes are called “Operator Mode” and “Expert Mode”. In versions 8.4, ASP2 and CNV3, the two modes are called “Manual Mode” and “Automated Mode”. However,

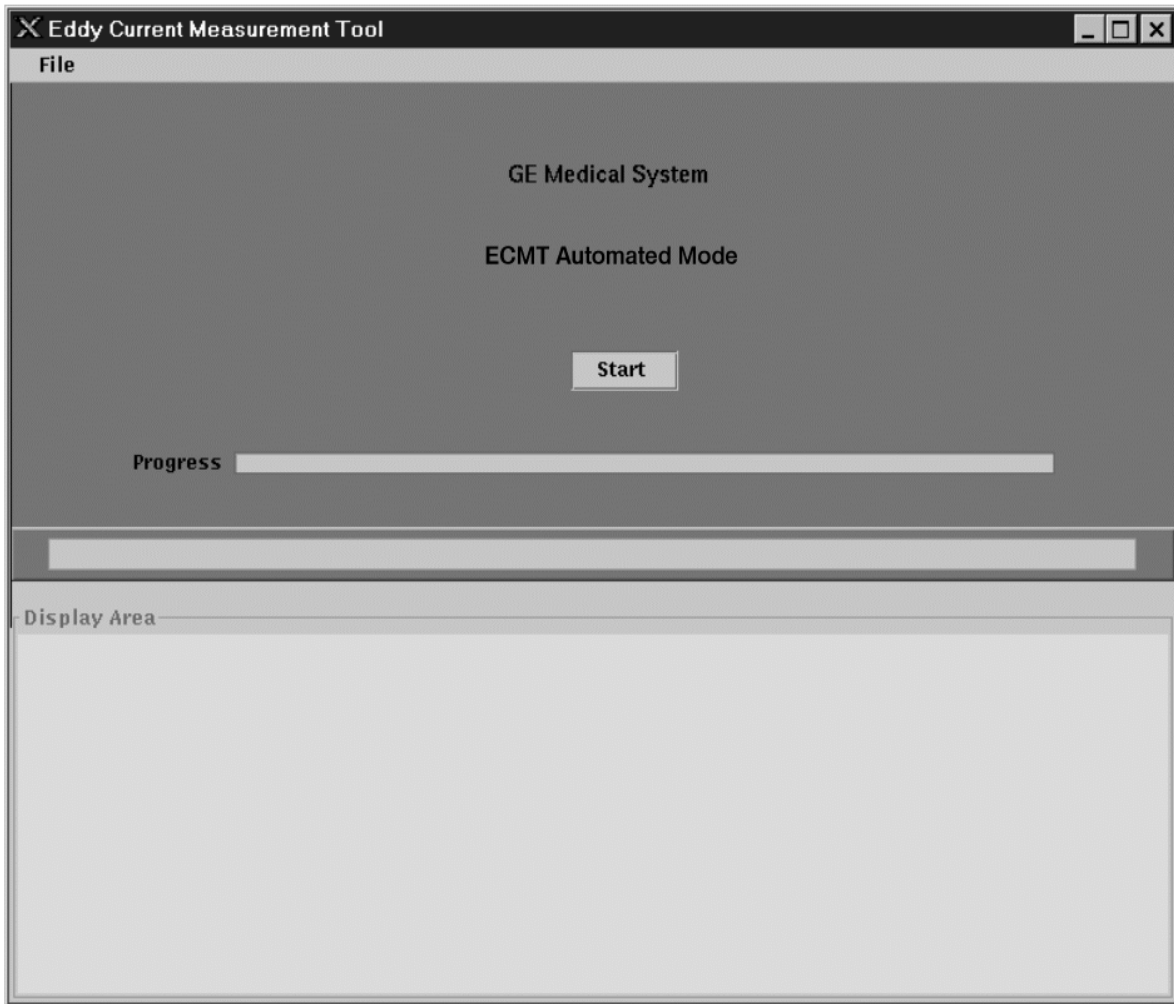
- **Operator Mode** operates the same way as **Automated Mode**.
- **Manual Mode** operates the same way as **Expert Mode**.

2. Select **[Start]** from the Eddy Current Measurement tool window, and an Operator Mode Window will appear. See Illustration 3-6.
3. From the **[File]** drop down menu, select **[Automated Mode]** (select **[Operator Mode]** for software version 8.3), **[Start]**.
4. Use the default selections for axis, and initialize the current grafidy calibration files. Select **[Continue]** to proceed.
5. The SVAT script will begin, and the protocol will be downloaded, prescanned, and scanned. Be patient, the prescan takes approximately 3 minutes to complete. If the scan does not start, check the Signa message log for errors.

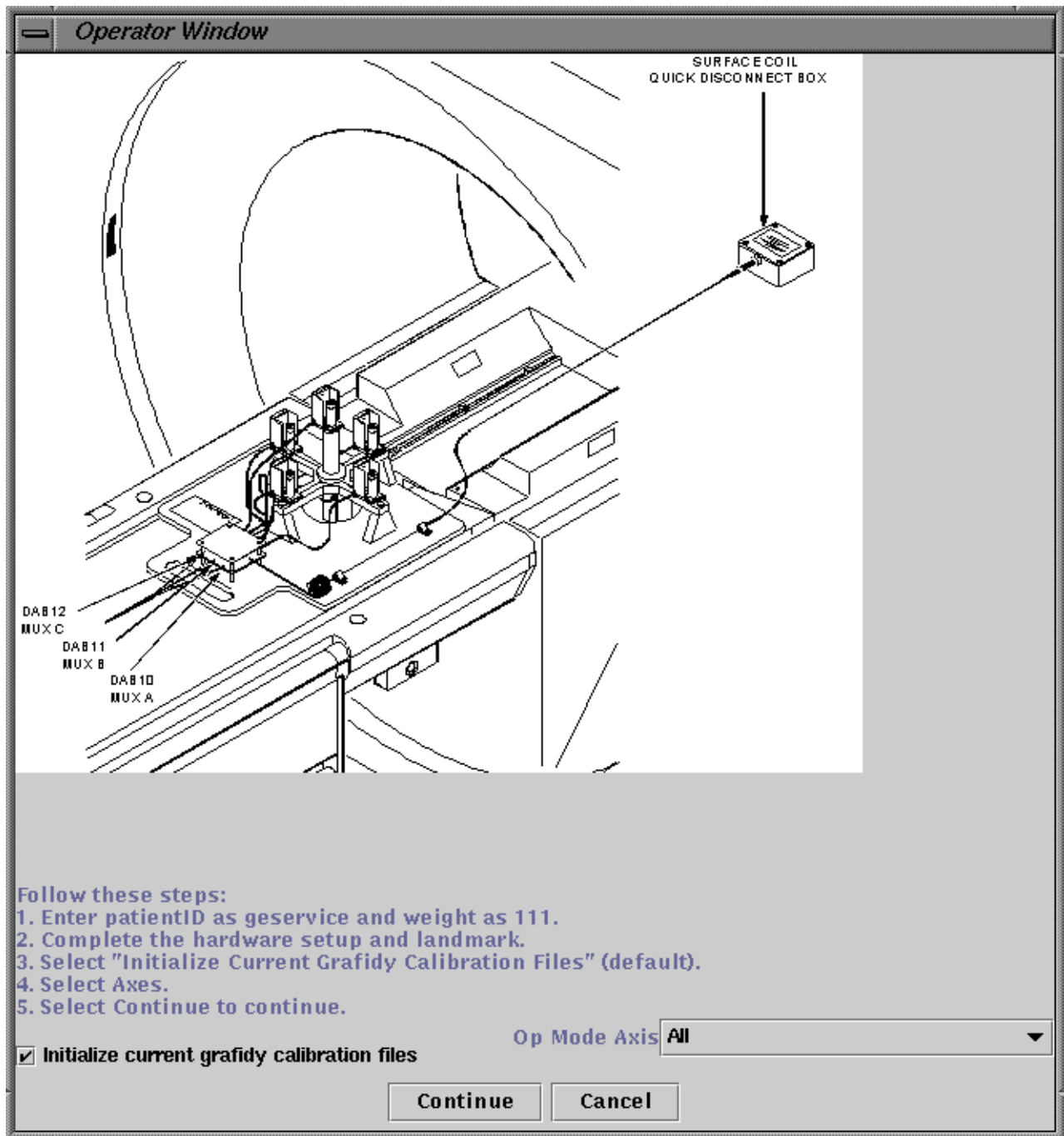
Note

Samples need to be refilled periodically. See Appendix A.

6. Once the scan has started, it will take approximately 1½ hours to calibrate the system. Multiple iterations will run automatically until all parameters pass, or until the maximum number of iterations is reached.
7. When the calibration is completed, there will be a status message; “ECMT calibration is completed”. See Illustration 3-7.



EDDY CURRENT MEASUREMENT TOOL GUI (EXAMPLE)
ILLUSTRATION 3-5



AUTOMATED (OPERATOR) MODE GUI
ILLUSTRATION 3-6

3-3 Aborting ECMT

1. If **[Abort]** is selected, a confirmation window appears. The following message appears after selecting **[Abort]**:

- | |
|---|
| <ol style="list-style-type: none">1. Press Stop Scan Button on Keyboard.2. Press OK button below on this dialog box. |
|---|

2. Follow the on-screen directions to terminate ECMT properly. If the scanner is not operating correctly after aborting ECMT, reboot the system.

Note

If the ECMT SVAT script is not terminated properly, the scanner will not operate normally.

3-4 ECMT Results

1. The results of the ECMT procedure can be viewed on the bottom of the screen in the display area. See Illustration 3-7.

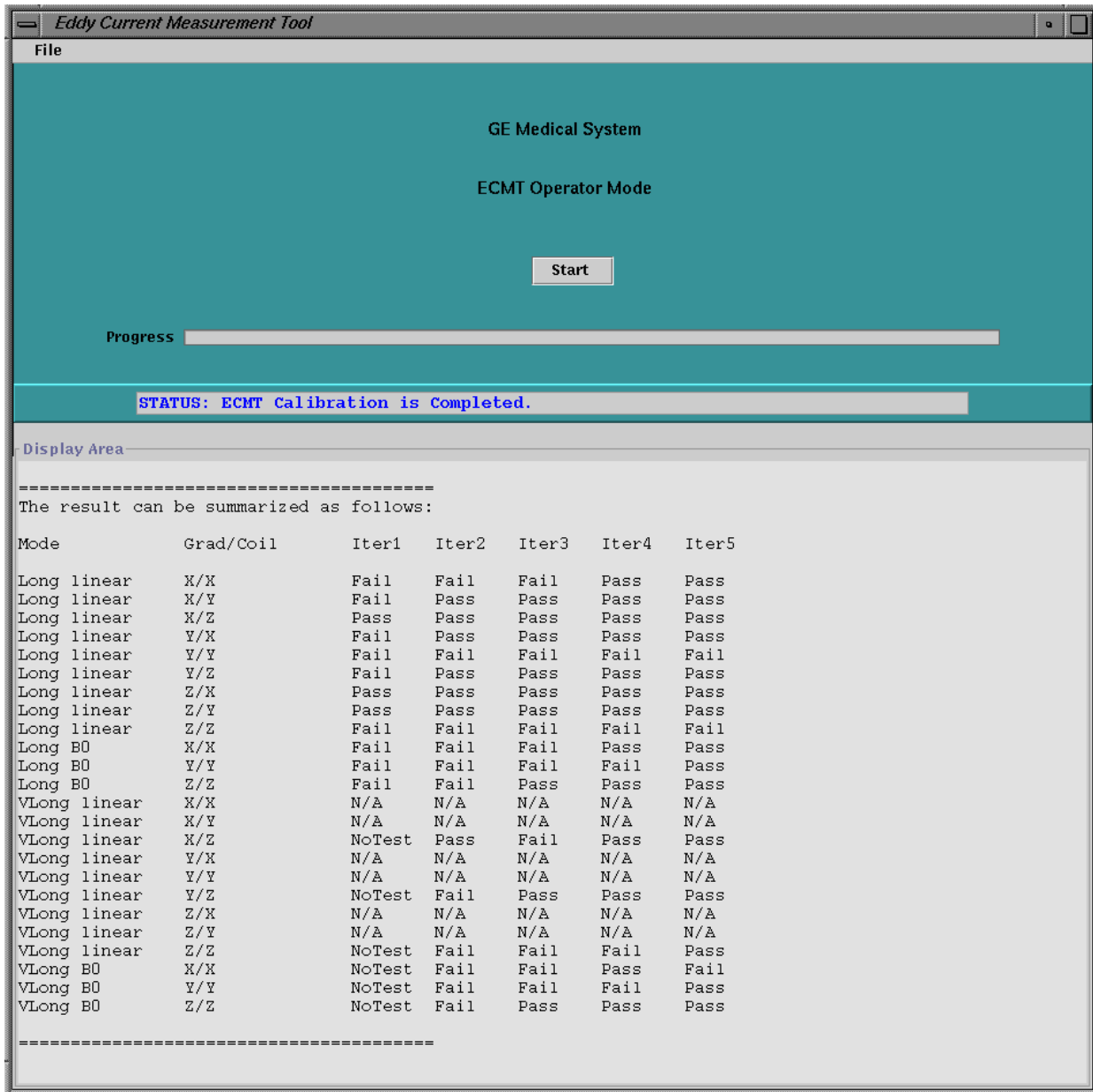
Note

You can expand the size of the display window by placing the mouse on one of the corners and dragging the corner away from the window.

2. If any of the Axis fails, you can either select **[Start]** again in the operator mode, and uncheck the box for **Initialize current grafidy calibration files**, or go into the Expert (Manual) Mode to only calibrate individual axis. See Section 4 for Expert (Manual) Mode.

3-5 Exiting ECMT

1. To exit ECMT, select **File, Quit**, then **OK** from the GUI. (Allow for few seconds for software to exit.)



ECMT RESULTS [EXAMPLE]
ILLUSTRATION 3-7

2. After completing ECMT, run the DC Offset diagnostic one more time.

3-6 Repeating ECMT for GradMode = "ZOOM" (TwinSpeed system only)

Repeat ECMT procedure again from 3-2 to 3-5 by re-running for GradMode = "ZOOM".

4- EXPERT (MANUAL) MODE

4-1 Starting Expert Mode

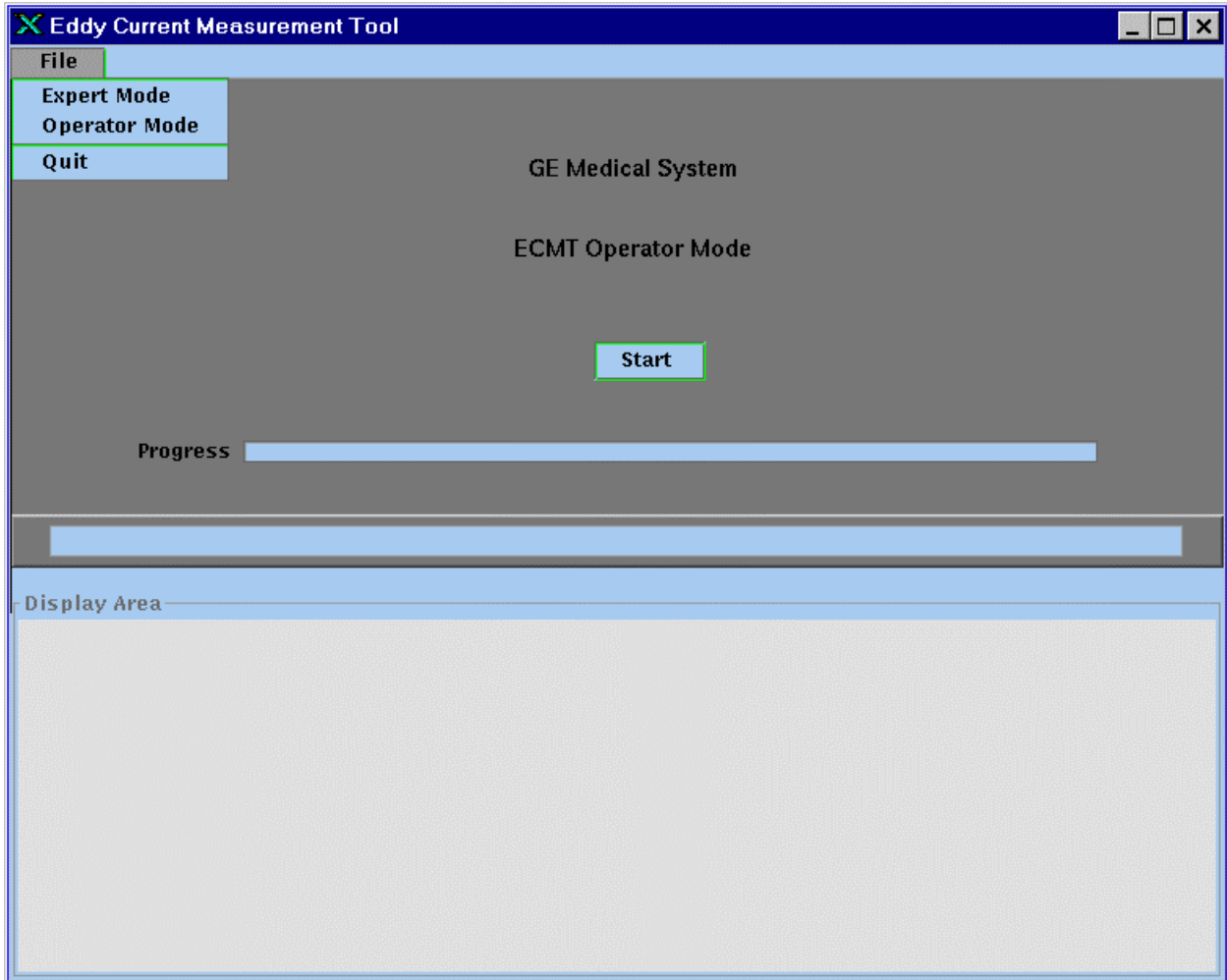
1. From the Operator Mode window of ECMT, select **[File]**, **[Expert Mode]** (select **[Manual Mode]** for software version 8.3). See Illustration 4-1.

(For **TwinSpeed** the current GradMode is also displayed in top right corner. In the event that a different GradMode is to be used, refer to section 3-5 to exit ECMT. This should be followed by section 3-2 to re-enter ECMT and select the GradMode.)

Note

Different terms are used for the two ECMT modes depending upon which software version is used. In version 8.3, the two ECMT modes are called “Operator Mode” and “Expert Mode”. In versions 8.4, ASP2 and CNV3, the two modes are called “Manual Mode” and “Automated Mode”. However,

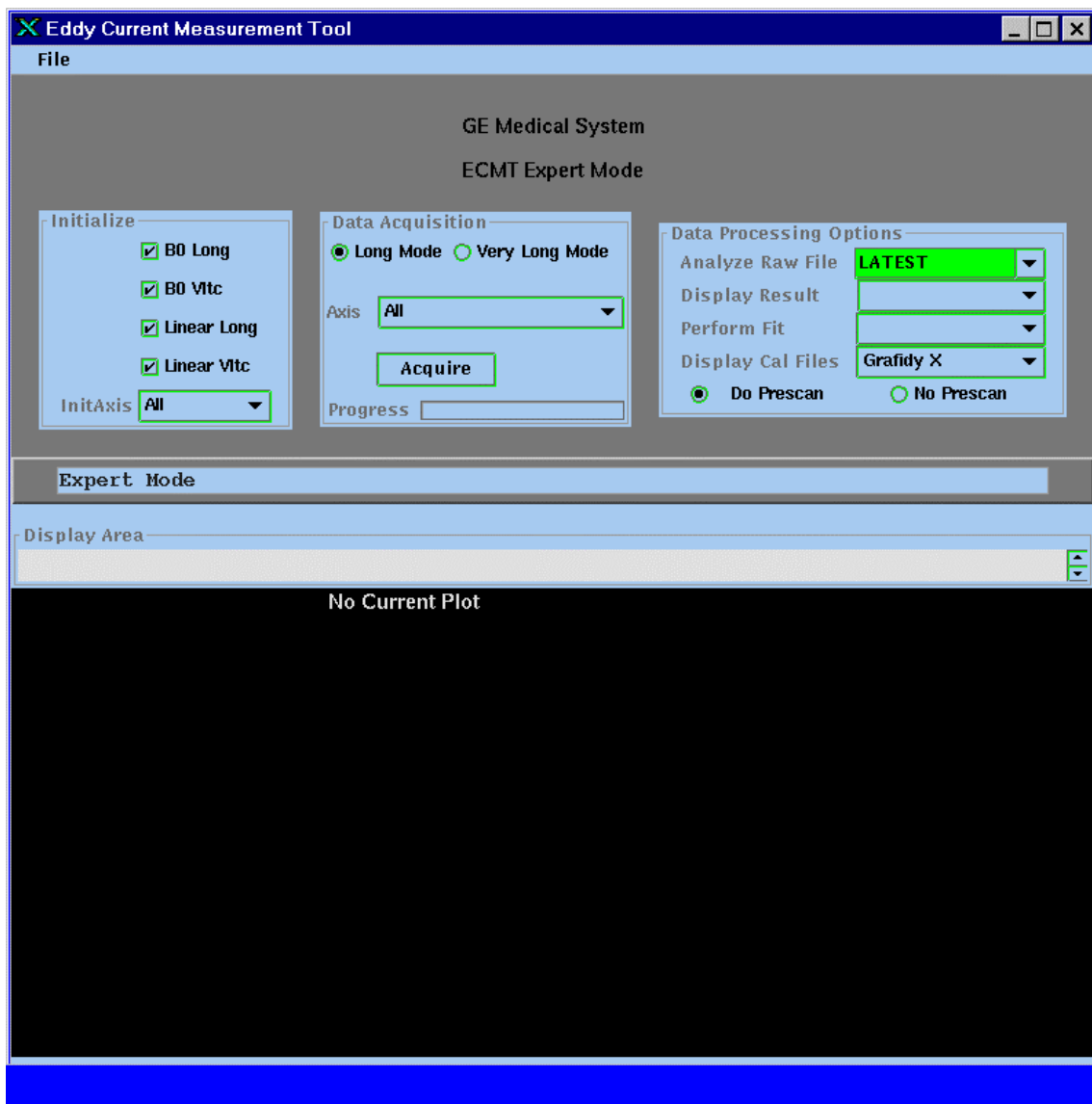
- **Operator Mode** operates the same way as **Automated Mode**.
- **Manual Mode** operates the same way as **Expert Mode**.



ENTERING EXPERT (MANUAL) MODE
ILLUSTRATION 4-1

4-2 Expert (Manual) Mode Options

1. Expert (Manual) Mode allows the user to initialize calibration files, process raw data, and acquire raw data for individual axis. See Illustration 4-2.
 - Initialize - If the Initialize box is checked, the current grafidy cal files will be initialized with zeros when the **[Acquire]** button is selected.
 - Data Acquisition - The user can select between Long and Very Long Mode as well as the individual axis to calibrate. The scan starts when the **[Acquire]** button is selected.
 - Data Processing - The user can analyze raw data files and perform fits for the collected data.



EXPERT (MANUAL) MODE OPTIONS (EXAMPLE)
ILLUSTRATION 4-2

4-3 ECMT Files

The following files pertain to and are used by ECMT.

/usr/g/bin

ecmt1 - psd file

ecmt1.psd.o - psd file

ecmt_time.txt - Resource file for psd. Contains timing for RF pulses.

ecmt_time_vltc.txt - Resource file for psd. Contains vltc timing for RF pulses.

ecmt_coil.rf - Resource file for psd. Provides coil pattern instructions.

ecmt_coil_vltc.rf - Resource file for psd. Provides vltc coil patterns.

ecmt_graf.rf - Resource file for psd. Contains Nex, number of coils, resolution and bandwidth.

ecmt_graf_vltc.rf - Resource file for psd. Contains Nex, number of coils, resolution and bandwidth for vltc.

/usr/g/bin/tools

runecmt - ecmt startup file

ecmt.log - results file with specifications (contains data for each axis).

ecmt_spec - spec file, and also the last line contains the fit iteration limit.

Ecmt.jar - Java based GUI. Invokes SVAT scripts.

ecmt_init_sys_params - reads the system and grafidy config files, creates *ecmt.sys*.

ecmt_update_fit - writes *grafidy*.cal* files, which updates *ecccoeff.dat* and *gram_tune.dat*.

ecmtAPS1 - Autoprescan SVAT script.

ecmt_process_raw - processes raw data files in sdf format. Creates pdf files.

ecmt_zero_fit_params - initializes the *grafidy*.cal* files and updates *ecccoeff.dat* and *gram_tune.dat* files.

ecmtDL - download SVAT script.

ecmt_read_raw_hdr

endscan - SVAT script to end exam

ecmtSCAN - SVAT script to perform scan

ecmt_setup.gif - hardware setup picture.

Prescribe - SVAT script to setup protocol.

ecmt_eval_processed - computes maximum deviations between the compensated gradient waveform and the ideal waveform at various times.

ecmt_sort_raw - reformats and analyzes raw data gathered from an ECMT scan. Creates sdf files for *ecmt_process_raw*.

ecmt_fit_processed - calculates the compensation needed to restore correct gradient shape. Updates the *ecmt.results* file.

swing.jar - system java class library file

/usr/g/caldir

(Note: For **TwinSpeed** all the files below are linked to either .WHOLE or .ZOOM)

- grafidyx.cal - x-axis calibration file. Used to create ecccoeff.dat and gram_tune.dat.
- grafidyy.cal - y-axis calibration file. Used to create ecccoeff.dat and gram_tune.dat.
- grafidyz.cal - z-axis calibration file. Used to create ecccoeff.dat and gram_tune.dat.
- ecccoeff.dat - contains B₀ correction data. Coefficient file for the WARP.
- gram_tune.dat - contains linear long and very long correction data. Not used on SR20.
- short_tc.sgd.ssn - contains short time constant correction for SGD.
- short_tc.120.ssn - contains short time constant correction for SR120 (EchoSpeed).
- short_tc.77.ssn - contains short time constant correction for SR77 (HiSpeed).
- short_tc.default - contains short time constant correction for SGD.

Table 4-1 shows the detailed breakdown of the grafidy.cal files.

TABLE 4-1
EDDY CURRENT CALIBRATION FILE STRUCTURE
(grafidyx.cal, grafidyy.cal and grafidyz.cal)

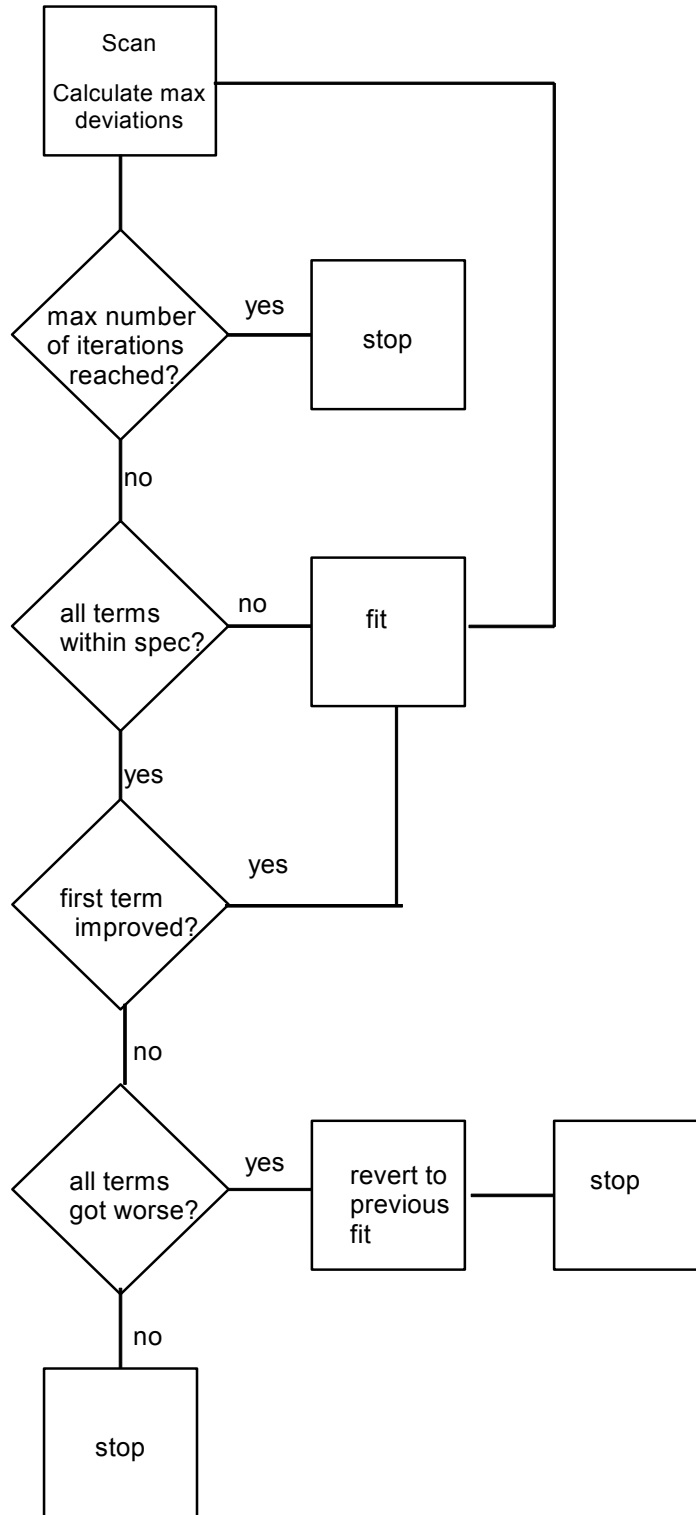
<i>taus</i>	<i>alphas</i>		<i>grafidyx.ca</i>	<i>grafidyy.c</i>	<i>grafidyz.c</i>
0.00000 0	0.0000 00	B0 Longtime Constants	X	Y	Z
0.000000	0.0000 00		X	Y	Z
0.00000 0	0.0000 00		X	Y	Z
0.00000 0	0.0000 00		X	Y	Z
0.00000 0	0.0000 00	On Axis Linear and Crossterm Long Time Constants (4 time constants per term)	x - x	Y - X	Z - X
0.00000 0	0.0000 00		X - X	Y - X	Z - X
0.00000 0	0.0000 00		X - X	Y - X	Z - X
0.00000 0	0.0000 00		X - X	Y - X	Z - X
0.00000 0	0.0000 00		X - Y	Y - Y	Z - Y
0.00000 0	0.0000 00		X - Y	Y - Y	Z - Y
0.00000 0	0.0000 00		X - Y	Y - Y	Z - Y
0.00000 0	0.0000 00		X - Y	Y - Y	Z - Y
0.00000 0	0.0000 00		X - Z	Y - Z	z - z

0.00000 0	0.0000 00	On Axis Short Time Constants (4 time constants)	X - Z	Y - Z	Z - Z
0.00000 0	0.0000 00		X - Z	Y - Z	Z - Z
0.00000 0	0.0000 00		X - Z	Y - Z	Z - Z
0.00000 0	0.0000 00		X	Y	Z
0.00000 0	0.0000 00	Very Long Time Constants (2 time constants per term)	X	Y	Z
0.00000 0	0.0000 00		X	Y	Z
0.00000 0	0.0000 00		X	Y	Z
0.00000 0	0.0000 00		X	Y	Z
0.00000 0	0.0000 00		x - x	Y - X	Z - X
0.00000 0	0.0000 00	Very Long B0 Time Constants	X - X	Y - X	Z - X
0.00000 0	0.0000 00		X - Y	Y - Y	Z - Y
0.00000 0	0.0000 00		X - Y	Y - Y	Z - Y
0.00000 0	0.0000 00		X - Z	Y - Z	z - z
0.00000 0	0.0000 00		X - Z	Y - Z	Z - Z
0.00000 0	0.0000 00		X	Y	Z
0.00000 0	0.0000 00		X	Y	Z

5- ECMT LOGIC

5-1 ECMT Process Flow

(For *TwinSpeed* system, the following process is applicable to each GradMode separately.)



ECMT PROCESS FLOW
ILLUSTRATION 5-1

5-2 ECMT Fit/Rejection Criteria

Long Linear (on axis and crossterms)

1. If the performance data is in spec for all three time periods, then
 - a. If the third time period max deviation is less than or equal to 0.01, then stop.
 - b. If the third time period max deviation delta (between current and previous fit) is less than or equal to 0.005, then stop.
 - c. Else, continue to fit.
2. If any one of the max deviation values diverge out of spec (all were in spec in the previous iteration), then revert to the previous fit parameters and stop.
3. Else, continue to fit.

Long B_0 (on axis only)

1. If it is the first iteration, do not fit.
2. If the performance data are in spec for all three time periods, then
 - a. If the third time period max deviation is less than or equal to 0.05, then stop.
 - b. If the third time period max deviation delta (between the current and previous iteration is less than or equal to 0.01, then stop.
 - c. Else, continue to fit.
3. If any one of the max deviation values diverge out of spec (all were in spec in the previous iteration), then revert to the previous fit parameters.
4. Else, continue to fit.

Very Long Linear(X/Z, Y/Z, Z/Z)

1. If the max deviation value (one time period only) is in spec, then stop.
2. If the max deviation value is diverging (current is worse than previous), revert to the previous fit parameters and stop.
3. Else, continue to fit.

Very Long B_0 (on axis only)

1. If the max deviation value (one time period only) is in spec, then
 - a. If the max deviation is less than or equal to 0.05, then stop.
 - b. If the max deviation delta (between current and previous iteration) is less than or equal to 0.01, then stop.
 - c. Else, continue to fit.
2. If the max deviation is worse than previous iteration, then revert to the previous fit parameters.
3. Else, continue to fit.

6- SAVING/RESTORING GRAFIDY FILES

This section details how to back up the `ecccoeff.dat`, and the `gram_tune.dat` files before a pass of Grafidy is performed. This is useful if you are in troubleshooting mode, and want to restore the system to its original calibration.

The `ecccoeff.dat` file is also used to store the B_0 (zeroeth order) coefficients for systems **with** a GRAM and works in conjunction with the `gram_tune.dat` file. The `gram_tune.dat` file is downloaded at the beginning of a scan, when Grafidy is run, or when Gradient Diagnostics are run except for SR20 systems, which do not use `gram_tune.dat`. This file contains the eddy current (first order) coefficients for systems **with** a GRAM.

It is possible to back up grafidy files in either of two ways: from the Install GUI, or from a C-shell on the Service desktop. The Install GUI will also backup all of the `grafidy.cal` files which are the files used to create `ecccoeff.dat` and `gram_tune.dat`.

6-1 Backing Up Grafidy Files From the Install GUI:

1. Click on **[Install]** and enter password **operator**.
2. Place MOD in the appropriate drive.
3. Select Save/Restore tab.
4. Click on **[Save Info]**.

6-2 Restoring Grafidy Files From the Install GUI:

1. Click on **[Install]** and enter password **operator**.
2. Place MOD in the appropriate drive.
3. Select Save/Restore tab.
4. Click on **[Restore Info]**, and answer the appropriate questions.

6-3 Backing Up Grafidy Files From a C-Shell on the Service Desktop:

1. At the prompt, type: `cd /usr/g/caldir <Enter>`
- 2a. For single gradient systems, type: `cp ecccoeff.dat ecccoeff.bak <Enter>`
- 2b. For *TwinSpeed* system, type: `cp ecccoeff.dat.WHOLE ecccoeff.bak.WHOLE <Enter>`
`cp ecccoeff.dat.ZOOM ecccoeff.bak.ZOOM <Enter>`
- 3a. For single gradient systems, type: `cp gram_tune.dat gram_tune.bak <Enter>`

(Not needed on SR20 systems)

3b. For **TwinSpeed** system, type:

cp gram_tune.dat.WHOLE gram_tune.bak.WHOLE <Enter>

cp gram_tune.dat.ZOOM gram_tune.bak.ZOOM <Enter>

(Not needed on SR20 systems)

Note You may want to also backup the grafidyx.cal, grafidyy.cal, and the grafidyz.cal, as these files are used to create ecccoeff.dat and gram_tune.dat.

6-4 Restoring Grafidy Files From a C-Shell on The Service Desktop

1. Ensure that you are in the */usr/g/caldir* directory.

2a. For single gradient systems, type: **cp ecccoeff.bak ecccoeff.dat <Enter>**

2b. For **TwinSpeed** system, type: **cp ecccoeff.bak.WHOLE ecccoeff.dat.WHOLE <Enter>**

cp ecccoeff.bak.ZOOM ecccoeff.dat.ZOOM <Enter>

3a. For single gradient systems, type: **cp gram_tune.bak gram_tune.dat <Enter>**

(Not needed on SR20 systems)

3b. For **TwinSpeed** system, type:

cp gram_tune.bak.WHOLE gram_tune.dat.WHOLE <Enter>

cp gram_tune.bak.ZOOM gram_tune.dat.ZOOM <Enter>

(Not needed on SR20 systems)

7 - TROUBLESHOOTING

7-1 Prescan Failures

The first step in troubleshooting ECMT prescan failures is to check the SIGNA message log for errors. The prescan failure in the log should give a descriptive message as to why it failed, and which axis it had trouble with. All of the following can cause prescan errors:

1. Low signal failures. Modify CV prescan_coil using values 0-5.

Table 7-1
PRE_SCANCOIL AXIS & VALUES

Axis	Value
X+	0
X-	1
Y+	2

Y-	3
Z+	4
Z-	5

2. Bad landmark. See illustration 3-1 for proper landmark.
3. Cables hooked up incorrectly. Re-check cable connections.

Table 7-2
CABLE CONNECTIONS

Cables	
ECMT	CERD
Mux A	J10
Mux B	J11
Mux C	J12

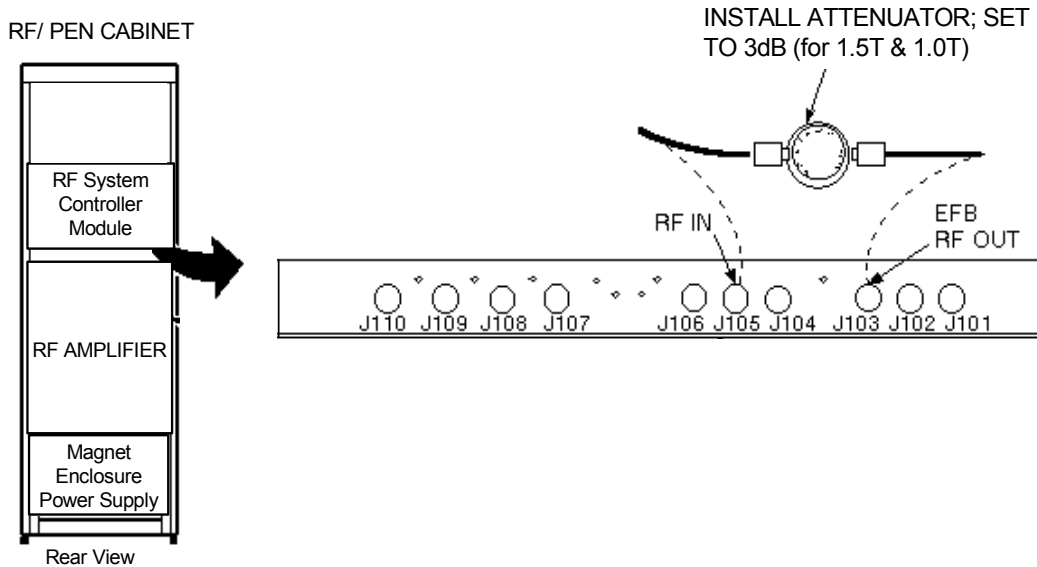
4. DC offset on gradient. Perform the DC Offset adjustment.
5. Auto-Lcoil not completed. Complete Auto-Lcoil prior to ECMT.
6. Electrical ISO-CENTER calibration not completed. Complete Electrical ISO-CENTER calibration before ECMT.
7. Empty sample cylinders. Refill sample vials with CuSO₄ before running ECMT. See Appendix A.
8. Top coil not installed, or not hooked up to RF4 on Multiplexer.
9. RF disabled on Exciter. (CERD)
10. Loose Quick disconnect Box.
11. SVAT script problem. Log into TPS and observe SVAT script run to see where the failure is occurring.
12. Geometry Verification not completed. Complete Geometry Verification prior to ECMT.
13. Receiving "85" faults, systems with RF/PEN and RF/PEN II cabinets may need to bypass Envelope Feedback.

For the RF/PEN Cabinet, disconnect the BNC from RF OUT (J103) and disconnect the BNC from RF IN (J105). Add a rotary attenuator (set to 3 dB) in-line between the two disconnected BNC cables, as shown in Illustration 7-1.

For the RF/PEN II Cabinet, disconnect the BNC from RF OUT (J103) and disconnect the BNC from RF IN (J3). Add a rotary attenuator (set to 3 dB) in-line between the two disconnected BNC cables, as shown in Illustration 7-2.

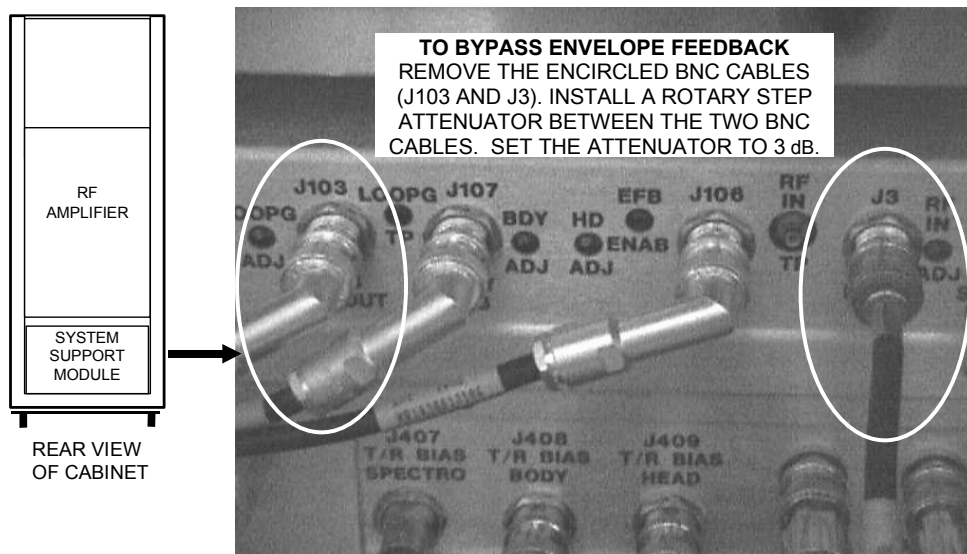
For the RF/PDU Cabinet, disconnect the BNC from J3, which comes from the Systems Cabinet (located on a panel on the back of the RF/PDU Cabinet). Add a rotary attenuator (set to 3dB) in-line between the panel and the BNC cable.

For the SRF Cabinet, disconnect the BNC from J1, which comes from the Systems Cabinet (located on a panel on the back of the SRF Cabinet). Add a rotary attenuator (set to 3dB) in-line between the panel and the BNC cable. See Illustration 7-3.

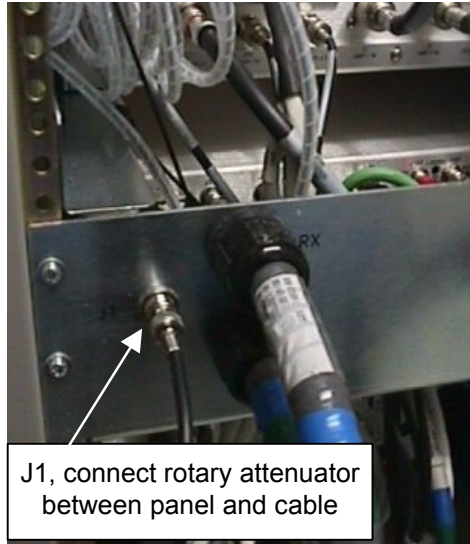


L4700A

RF/PEN SYSTEM CONTROL MODULE WITH EFB BYPASSED
 ILLUSTRATION 7-1



RF PEN II SYSTEM SUPPORT MODULE WITH EFB BYPASSED
 ILLUSTRATION 7-2



REAR OF SRF CABINET, ATTENUATOR CONNECTION
ILLUSTRATION 7-3

7-2 Cannot Meet Specifications

If the cables are hooked up incorrectly, ECMT will not converge. Recheck the cable connections at the Digital board, Pen Wall, and ECMT fixture.

Some magnet types have trouble meeting the X and Y axis B_0 specification. These magnet types include Oxford, S-V, Cx, and LCC. Refer to Service Note 61001 for more information.

The file `/usr/g/service/cclass/ecmt/ecmt_spec` can be edited to change the number of iterations ECMT will do when trying to fit data. The last line of the file can be increased to allow ECMT to do more iterations. The default value is 4.

Contact the OLC for additional information about not meeting specifications.

APPENDIX A – CLEANING & REFILLING CuSO_4 SOLUTION

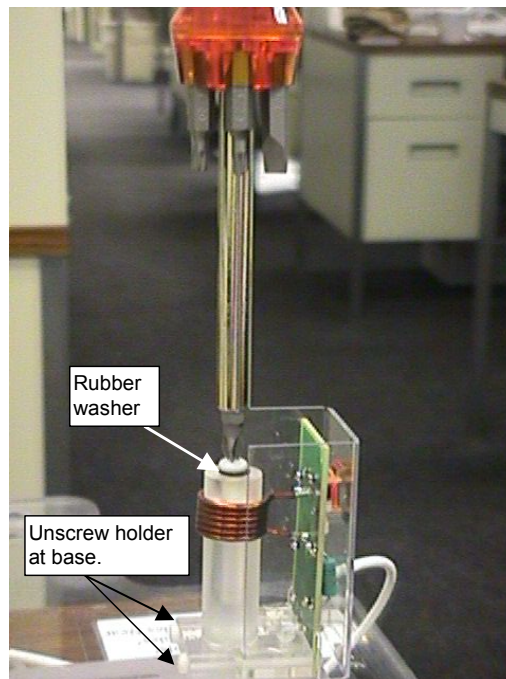
Due to evaporation and leakage, crust and/or residue of CuSO_4 builds up in the sample vial that holds the solution. The sample vial must be cleaned before refills to ensure the correct concentration of CuSO_4 solution is in the vial.

Required Tools & Materials

- Syringe (obtain locally)
- Bottle of CuSO_4 (located in ECMT Kit, GE P/N 2238315)
- Standard Screwdriver (flat-head)
- Water

Procedure

1. Remove the ECMT fixture from the magnet room. Place on a clean work surface.
2. Remove the sample holder from the ECMT fixture by unscrewing at the base of the sample holder.
3. Use a flat-head screwdriver to remove the screw that seals the CuSO_4 solution in the sample vial that is surrounded by the coil. See Illustration A-1. Or see Illustration A-2 for new sample vial. For the newer sample vial use a crescent wrench to remove the screw that seals the CuSO_4 solution.



ECMT FIXTURE SAMPLE HOLDER
ILLUSTRATION A-1



ECMT SAMPLE HOLDER WITH NEW SCREW
ILLUSTRATION A-2

4. Remove the rubber washer on the vial.
5. Empty vial.
6. Hold vial upside down and flush the vial with water using the syringe.
7. Use syringe to force any remaining water out by pumping air into vial.
8. Fill the syringe with CuSO_4 and fill the cylinder. Be sure to leave enough room to put the screw back in.
9. Replace the rubber washer removed in step 4.
10. Replace the phillips head screw removed in step 3 or hex head screw.
11. Replace the sample holder on the ECMT fixture.

APPENDIX B - ECMT DATA SHEET

ECMT DATA SHEET (B0, Long, Very Long)				
Grad/Coil	Mode	Time Interval (M Sec)	Spec	Max. Deviation
X / X	Linear Long	1.0 - 10.0 (ms)	< 0.090	
X / X	Linear Long	10.0 - 100.0 (ms)	< 0.030	
X / X	Linear Long	100.0 - 2000.0 (ms)	< 0.018	
X / X	Long B ₀	1.0 - 10.0 (ms)	< 0.10	
X / X	Long B ₀	10.0 - 100.0 (ms)	< 0.10	
X / X	Long B ₀	100.0 - 2000.0 (ms)	< 0.10	
X / Y	Linear Long	1.0 - 10.0 (ms)	< 0.090	
X / Y	Linear Long	10.0 - 100.0 (ms)	< 0.030	
X / Y	Linear Long	100.0 - 2000.0 (ms)	< 0.018	
X / Z	Linear Long	1.0 - 10.0 (ms)	< 0.090	
X / Z	Linear Long	10.0 - 100.0 (ms)	< 0.030	
X / Z	Linear Long	100.0 - 2000.0 (ms)	< 0.018	
Y / X	Linear Long	1.0 - 10.0 (ms)	< 0.090	
Y / X	Linear Long	10.0 - 100.0 (ms)	< 0.030	
Y / X	Linear Long	100.0 - 2000.0 (ms)	< 0.018	
Y / Y	Linear Long	1.0 - 10.0 (ms)	< 0.090	
Y / Y	Linear Long	10.0 - 100.0 (ms)	< 0.030	
Y / Y	Linear Long	100.0 - 2000.0 (ms)	< 0.018	
Y / Y	Long B ₀	1.0 - 10.0 (ms)	< 0.10	
Y / Y	Long B ₀	10.0 - 100.0 (ms)	< 0.10	
Y / Y	Long B ₀	100.0 - 2000.0 (ms)	< 0.10	
Y / Z	Linear Long	1.0 - 10.0 (ms)	< 0.090	
Y / Z	Linear Long	10.0 - 100.0 (ms)	< 0.030	
Y / Z	Linear Long	100.0 - 2000.0 (ms)	< 0.018	
Z / X	Linear Long	1.0 - 10.0 (ms)	< 0.090	
Z / X	Linear Long	10.0 - 100.0 (ms)	< 0.030	
Z / X	Linear Long	100.0 - 2000.0 (ms)	< 0.018	
Z / Y	Linear Long	1.0 - 10.0 (ms)	< 0.090	
Z / Y	Linear Long	10.0 - 100.0 (ms)	< 0.030	
Z / Y	Linear Long	100.0 - 2000.0 (ms)	< 0.018	
Z / Z	Linear Long	1.0 - 10.0 (ms)	< 0.090	
Z / Z	Linear Long	10.0 - 100.0 (ms)	< 0.030	
Z / Z	Linear Long	100.0 - 2000.0 (ms)	< 0.018	
Z / Z	Long B ₀	1.0 - 10.0 (ms)	< 0.10	
Z / Z	Long B ₀	10.0 - 100.0 (ms)	< 0.10	
Z / Z	Long B ₀	100.0 - 2000.0 (ms)	< 0.10	
X / X	Very Long Linear	2.0 - 100.0 (ms)	N/A	
X / X	Very Long B ₀	2.0 - 100.0 (ms)	< 0.100	
X / Y	Very Long Linear	2.0 - 100.0 (ms)	N/A	
X / Z	Very Long Linear	2.0 - 100.0 (ms)	< 0.018	
Y / X	Very Long Linear	2.0 - 100.0 (ms)	N/A	
Y / Y	Very Long Linear	2.0 - 100.0 (ms)	N/A	
Y / Y	Very Long B ₀	2.0 - 100.0 (ms)	< 0.100	
Y / Z	Very Long Linear	2.0 - 100.0 (ms)	< 0.018	
Z / X	Very Long Linear	2.0 - 100.0 (ms)	N/A	
Z / Y	Very Long Linear	2.0 - 100.0 (ms)	N/A	
Z / Z	Very Long Linear	2.0 - 100.0 (ms)	< 0.018	
Z / Z	Very Long B ₀	2.0 - 100.0 (ms)	< 0.100	

For *TwinSpeed*, use the table below when GradMode = “Whole”

ECMT DATA SHEET (B0, Long, Very Long)				
Grad/Coil	Mode	Time Interval (M Sec)	Spec	Max. Deviation
X / X	Linear Long	1.0 - 10.0 (ms)	< 0.090	
X / X	Linear Long	10.0 - 100.0 (ms)	< 0.030	
X / X	Linear Long	100.0 - 2000.0 (ms)	< 0.018	
X / X	Long B ₀	1.0 - 10.0 (ms)	< 0.10	
X / X	Long B ₀	10.0 - 100.0 (ms)	< 0.10	
X / X	Long B ₀	100.0 - 2000.0 (ms)	< 0.10	
X / Y	Linear Long	1.0 - 10.0 (ms)	< 0.090	
X / Y	Linear Long	10.0 - 100.0 (ms)	< 0.030	
X / Y	Linear Long	100.0 - 2000.0 (ms)	< 0.018	
X / Z	Linear Long	1.0 - 10.0 (ms)	< 0.090	
X / Z	Linear Long	10.0 - 100.0 (ms)	< 0.030	
X / Z	Linear Long	100.0 - 2000.0 (ms)	< 0.018	
Y / X	Linear Long	1.0 - 10.0 (ms)	< 0.090	
Y / X	Linear Long	10.0 - 100.0 (ms)	< 0.030	
Y / X	Linear Long	100.0 - 2000.0 (ms)	< 0.018	
Y / Y	Linear Long	1.0 - 10.0 (ms)	< 0.090	
Y / Y	Linear Long	10.0 - 100.0 (ms)	< 0.030	
Y / Y	Linear Long	100.0 - 2000.0 (ms)	< 0.018	
Y / Y	Long B ₀	1.0 - 10.0 (ms)	< 0.10	
Y / Y	Long B ₀	10.0 - 100.0 (ms)	< 0.10	
Y / Y	Long B ₀	100.0 - 2000.0 (ms)	< 0.10	
Y / Z	Linear Long	1.0 - 10.0 (ms)	< 0.090	
Y / Z	Linear Long	10.0 - 100.0 (ms)	< 0.030	
Y / Z	Linear Long	100.0 - 2000.0 (ms)	< 0.018	
Z / X	Linear Long	1.0 - 10.0 (ms)	< 0.090	
Z / X	Linear Long	10.0 - 100.0 (ms)	< 0.030	
Z / X	Linear Long	100.0 - 2000.0 (ms)	< 0.018	
Z / Y	Linear Long	1.0 - 10.0 (ms)	< 0.090	
Z / Y	Linear Long	10.0 - 100.0 (ms)	< 0.030	
Z / Y	Linear Long	100.0 - 2000.0 (ms)	< 0.018	
Z / Z	Linear Long	1.0 - 10.0 (ms)	< 0.090	
Z / Z	Linear Long	10.0 - 100.0 (ms)	< 0.030	
Z / Z	Linear Long	100.0 - 2000.0 (ms)	< 0.018	
Z / Z	Long B ₀	1.0 - 10.0 (ms)	< 0.10	
Z / Z	Long B ₀	10.0 - 100.0 (ms)	< 0.10	
Z / Z	Long B ₀	100.0 - 2000.0 (ms)	< 0.10	
X / X	Very Long Linear	2.0 - 100.0 (ms)	N/A	
X / X	Very Long B ₀	2.0 - 100.0 (ms)	< 0.100	
X / Y	Very Long Linear	2.0 - 100.0 (ms)	N/A	
X / Z	Very Long Linear	2.0 - 100.0 (ms)	< 0.018	
Y / X	Very Long Linear	2.0 - 100.0 (ms)	N/A	
Y / Y	Very Long Linear	2.0 - 100.0 (ms)	N/A	
Y / Y	Very Long B ₀	2.0 - 100.0 (ms)	< 0.100	
Y / Z	Very Long Linear	2.0 - 100.0 (ms)	< 0.018	
Z / X	Very Long Linear	2.0 - 100.0 (ms)	N/A	
Z / Y	Very Long Linear	2.0 - 100.0 (ms)	N/A	
Z / Z	Very Long Linear	2.0 - 100.0 (ms)	< 0.018	
Z / Z	Very Long B ₀	2.0 - 100.0 (ms)	< 0.100	

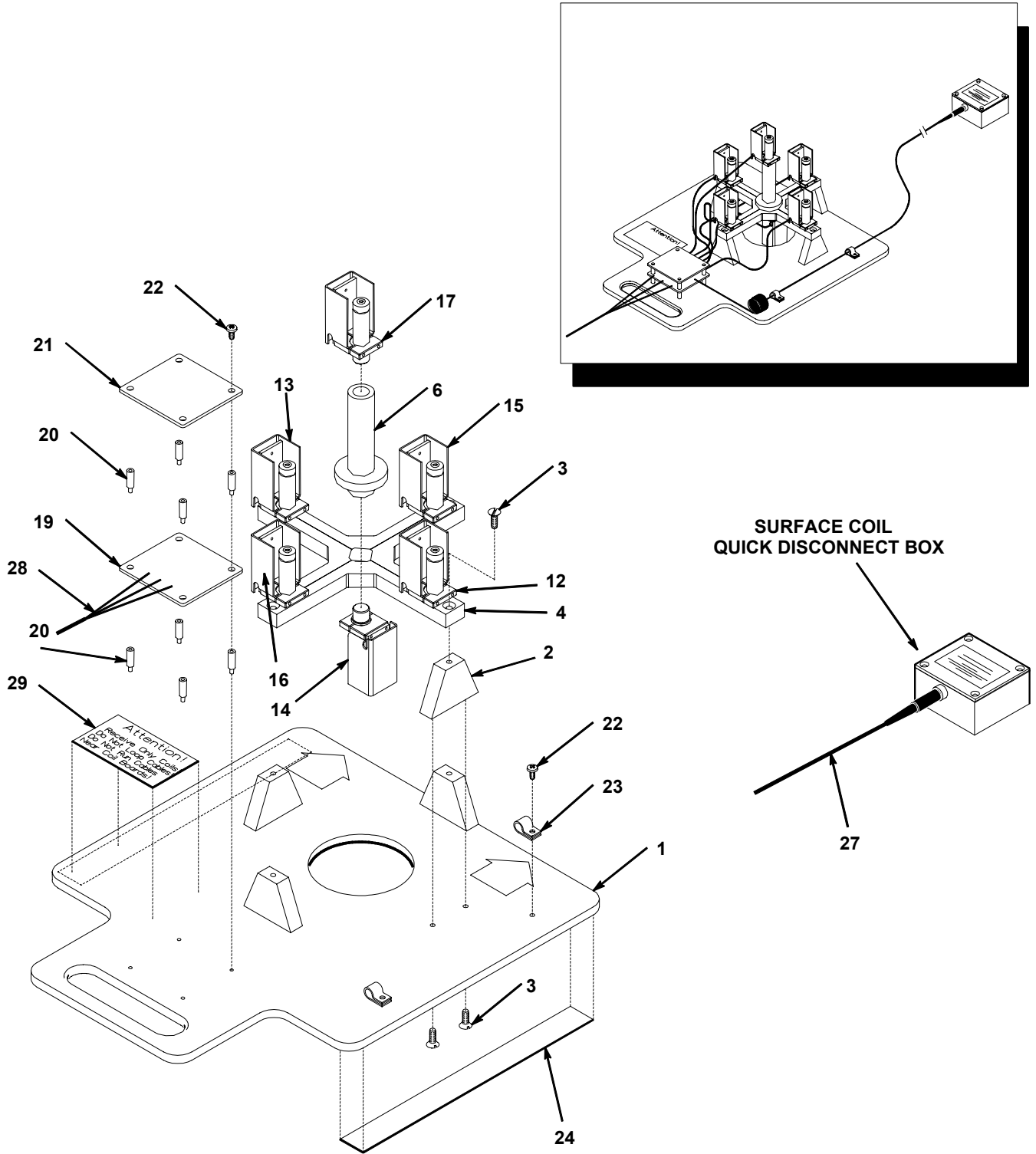
For *TwinSpeed*, use the table below when GradMode = “Zoom”

ECMT DATA SHEET (B0, Long, Very Long)				
Grad/Coil	Mode	Time Interval (M Sec)	Spec	Max. Deviation
X / X	Linear Long	1.0 - 10.0 (ms)	< 0.090	
X / X	Linear Long	10.0 - 100.0 (ms)	< 0.030	
X / X	Linear Long	100.0 - 2000.0 (ms)	< 0.018	
X / X	Long B ₀	1.0 - 10.0 (ms)	< 0.10	
X / X	Long B ₀	10.0 - 100.0 (ms)	< 0.10	
X / X	Long B ₀	100.0 - 2000.0 (ms)	< 0.10	
X / Y	Linear Long	1.0 - 10.0 (ms)	< 0.090	
X / Y	Linear Long	10.0 - 100.0 (ms)	< 0.030	
X / Y	Linear Long	100.0 - 2000.0 (ms)	< 0.018	
X / Z	Linear Long	1.0 - 10.0 (ms)	< 0.090	
X / Z	Linear Long	10.0 - 100.0 (ms)	< 0.030	
X / Z	Linear Long	100.0 - 2000.0 (ms)	< 0.018	
Y / X	Linear Long	1.0 - 10.0 (ms)	< 0.090	
Y / X	Linear Long	10.0 - 100.0 (ms)	< 0.030	
Y / X	Linear Long	100.0 - 2000.0 (ms)	< 0.018	
Y / Y	Linear Long	1.0 - 10.0 (ms)	< 0.090	
Y / Y	Linear Long	10.0 - 100.0 (ms)	< 0.030	
Y / Y	Linear Long	100.0 - 2000.0 (ms)	< 0.018	
Y / Y	Long B ₀	1.0 - 10.0 (ms)	< 0.10	
Y / Y	Long B ₀	10.0 - 100.0 (ms)	< 0.10	
Y / Y	Long B ₀	100.0 - 2000.0 (ms)	< 0.10	
Y / Z	Linear Long	1.0 - 10.0 (ms)	< 0.090	
Y / Z	Linear Long	10.0 - 100.0 (ms)	< 0.030	
Y / Z	Linear Long	100.0 - 2000.0 (ms)	< 0.018	
Z / X	Linear Long	1.0 - 10.0 (ms)	< 0.090	
Z / X	Linear Long	10.0 - 100.0 (ms)	< 0.030	
Z / X	Linear Long	100.0 - 2000.0 (ms)	< 0.018	
Z / Y	Linear Long	1.0 - 10.0 (ms)	< 0.090	
Z / Y	Linear Long	10.0 - 100.0 (ms)	< 0.030	
Z / Y	Linear Long	100.0 - 2000.0 (ms)	< 0.018	
Z / Z	Linear Long	1.0 - 10.0 (ms)	< 0.090	
Z / Z	Linear Long	10.0 - 100.0 (ms)	< 0.030	
Z / Z	Linear Long	100.0 - 2000.0 (ms)	< 0.018	
Z / Z	Long B ₀	1.0 - 10.0 (ms)	< 0.10	
Z / Z	Long B ₀	10.0 - 100.0 (ms)	< 0.10	
Z / Z	Long B ₀	100.0 - 2000.0 (ms)	< 0.10	
X / X	Very Long Linear	2.0 - 100.0 (ms)	N/A	
X / X	Very Long B ₀	2.0 - 100.0 (ms)	< 0.100	
X / Y	Very Long Linear	2.0 - 100.0 (ms)	N/A	
X / Z	Very Long Linear	2.0 - 100.0 (ms)	< 0.018	
Y / X	Very Long Linear	2.0 - 100.0 (ms)	N/A	
Y / Y	Very Long Linear	2.0 - 100.0 (ms)	N/A	
Y / Y	Very Long B ₀	2.0 - 100.0 (ms)	< 0.100	
Y / Z	Very Long Linear	2.0 - 100.0 (ms)	< 0.018	
Z / X	Very Long Linear	2.0 - 100.0 (ms)	N/A	
Z / Y	Very Long Linear	2.0 - 100.0 (ms)	N/A	
Z / Z	Very Long Linear	2.0 - 100.0 (ms)	< 0.018	
Z / Z	Very Long B ₀	2.0 - 100.0 (ms)	< 0.100	

Note

Data can be obtained by examining: /usr/g/bin/tools/ecmt.log

APPENDIX C - RENEWAL PARTS



CALIBRATION FIXTURE			2233016	FRU N	
Item	Part Number	FRU	Name	Quantity	Description (Remarks)
1	2233008	N	PLATFORM	1	CLEAR POLYCARBONATE PLATFORM
2	2233009	N	BLOCK	4	CROSS SUPPORT
3	2137220-2	2	M6 NYLON SCR	12	M6 X 10 FLAT HEAD SLOTTED NYLON
4	2233010	N	CROSS	1	CROSS
6	2233011	1	ADAPTER	1	CENTER ADAPTER
12	2243352	N	SAMPLE VIAL	1	ECMT FIXTURE SAMPLE HOLDERS
13	2243352-2	N	SAMPLE VIAL	1	ECMT FIXTURE SAMPLE HOLDERS
14	2243352-3	N	SAMPLE VIAL	1	ECMT FIXTURE SAMPLE HOLDERS
15	2243352-4	N	SAMPLE VIAL	1	ECMT FIXTURE SAMPLE HOLDERS
16	2243352-5	N	SAMPLE VIAL	1	ECMT FIXTURE SAMPLE HOLDERS
17	2243352-6	N	SAMPLE VIAL	1	ECMT FIXTURE SAMPLE HOLDERS
19	2222706	1	CIRCUIT BOARD	1	ECMT MULTIPLEXER BOARD
20	2237786	N	STANDOFF HEX	8	5/8 MALE/FEM NYLON 8-32 THD 1/4 HEX
21	2233015	N	COVER	1	COVER
22	46-208922P10	N	SCREW	6	SCREW
23	46-208713P5	2	CLAMP OR CLIP	2	CLAMP OR CLIP
24	46-170124P1	2	TAPE	AR	DOUBLE COAT FOAM TAPE, .031TK
26*	2219092	2	CABLE	1	COAX CABLE
27	2219093	2	CABLE	1	CABLE
28	2219093-2	2	CABLE	1	CABLE
29	2238723	N	LABEL	1	ATTENTION! RECEIVE ONLY COILS...
30*	46-282886P1	2	BNC FEMALE/FEMALE	6	BNC FEMALE//FEMALE COAXIAL ADAPTER

*Not shown

Additional FRUs

The new vial (2352798) is a FRU 1. This part is listed under 2234622 BOM. The instructions for replacing the vial are located in Appendix D.

The Cuso₄ solution (2238315) is now a FRU 1. This part is listed under the 2234621BOM.

APPENDIX D – REPLACING A SAMPLE VIAL

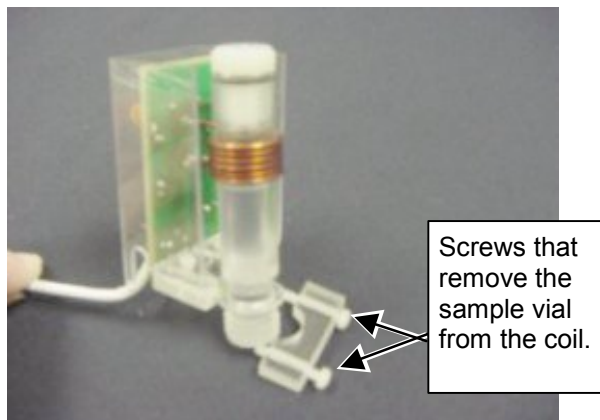
A new design of the sample vial that is more robust to the various climates that are encountered during shipping and storage has been developed.

Required Tools & Materials

- Sample Vial (GE Part Number 2352798)
- Small Flat Head (standard) screwdriver

Procedure

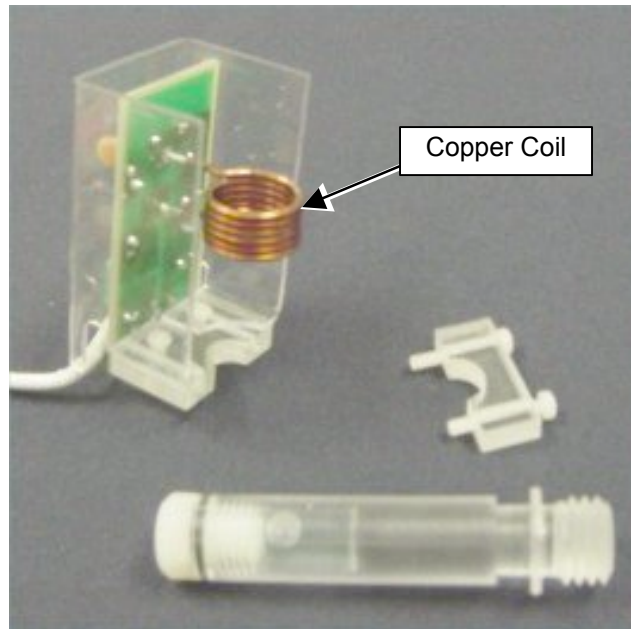
1. Remove the ECMT fixture from the magnet room. Place on a clean work surface.
2. Remove the sample holder from the ECMT fixture by unscrewing at the base of the sample holder.
4. Remove the two (2) screws holding the sample vial to the coil. See Illustration D-1.



SCREW LOCATION TO REMOVE SAMPLE VIAL FROM COIL
ILLUSTRATION D-1

APPENDIX D – REPLACING A SAMPLE VIAL (continued)

4. Once screws are removed, slide the sample vial out from the copper coil. See Illustration D-2.



SAMPLE VIAL REMOVED FROM COIL
ILLUSTRATION D-2

5. Place the replacement sample vial by sliding through the copper coil.
6. Replace the plastic piece that holds the sample vial in the coil and secure by tightening the two (2) screws shown in Illustration D-1.

REVISION HISTORY

REV	DATE	AUTHOR	PRIMARY REASONS FOR CHANGE
A	April 14, 1999	R. Kaufman	Preliminary release.
B	Dec. 23, 1999	R. Kaufman	Completed Appendix A and Appendix C
0	March 3, 2000	K. Keshena	Initial Release
1	Sept. 19, 2000	K. Keshena	Made the following corrections: Page 2, Updated Software Version. Page 3, Corrected order of procedures to be performed. Page 5, Corrected wording of step 7. Page 9, Section 3-5 added step 2. Page 12, ecmt.log, added statement notifying axis info. Page 16, added additional steps to run software. Page 17, added cable info and updated steps 8 & 12. Page 18, moved stp 13 above Illustration. Page 20, step 8, changed solution to subscript. Page 21, added note directing user to data for data sheet.
2	January 22, 2001	K. Keshena	Section 3-2 was changed to reflect additional step of selecting Automated Mode and correcting time to perform. Section 3-5, added statement allowing for a software to exit. Section 4-2, removed statement about viewing plots. Section 7-1 added information for the SRF and RF/PDU cabinets' cable connection for rotary attenuator. Appendix A, tools required was changed due to design changes calling for a flat-head screwdriver.
3	March 15, 2001	M. Jones	Added MUX A, B, C callouts to Illus. 3-2; added info on iterations to Sec 3-2 step 6; changed "defaults" to "faults" Sec 7-1 item 13; moved callouts for items 2, 4, & 12 in Appendix C illustration and made minor corrections to associated list of materials. Changed "interval(s)" to term(s)" in Ill. 5-1 Changed all "CUSO ₄ " to "CuSO ₄ ". Added references to new mode designations (for v. 8.4 on): Operator Mode = Automated Mode; Expert Mode = Manual Mode.
4	July 16, 2001	A. Nevelsky	Updated for TwinSpeed scanner for 9.0 release. J. Wolak corrected ecmt file directories in Sec. 4-3.
5	Jan. 31, 2002	K. Keshena	Corrected the location of ecmt.log file on the system in Appendix B.
6	Oct. 10, 2002	K. Keshena	Added the new sample vial screw head Illustration to Appendix A, updated Appendix C with the new FRUs for the ECMT kit and added Appendix D – Replacing the Sample Vial.