Document ID: 3184

Q2 LMQXB Cold Mass Module Assembly Traveler

333643 / Rev. D

Job No:	**248**
E + F Project/Task No.:	**300/1.1.1.6.2**
M + S Project/Task No.:	**300/1.1.1.6.2**

Place This Side Down For Scanning!!!

LMQXB08-0

Document ID:

3184

Job No.:

248

Project/Task No.

300/1.1.1.6.2

Series:

LQXB

Serial No:

LMQXB08

Rework ID:

0

Specification No.:

333643

Revision:

D

LMQXB08-0

Fermi National Accelerator Laboratory
Batavia, IL 60510

LARGE HADRON COLLIDER
Q2 - LMQXB
COLD MASS MODULE ASSEMBLY TRAVELER

Reference Drawing(s):
Q2 Cold Mass Welded Assembly (ME-390309)
Q2 Module Assembly (ME-369895)

Project/Task Number:

Released By: *John Szostak* **Magnet/Device Series:** *LQXB*

Date Issued: *9/21/2004 1:44:34 PM* **Scanned Pages:** 119

Prepared by: J. Szostak

Title	Signature	Date
TD / E&F Process Engineering	*Jamie Blowers* Bob Jensen / Designee	*7/14/04*
TD / LHC Production Supervisor	*Jim Rife* Jim Rife / Designee	*7/14/04*
TD / LHC Production Engineer	*Rodger Bossert* Rodger Bossert / Designee	*7/14/04*
TD / LHC Project Engineer Cryostat	*Tom Page* Tom Nicol / Designee	*7/14/04*
TD / LHC Project Physicist	*Mike Lamm* Michael Lamm / Designee	*7/14/04*
TD / LHC Program Manager	*Jim Strait* Jim Kerby / Designee	*7/14/04*

Revision Page (1 of 2)

Revision	Step No.	Revision Description	TRR No.	Date
None	N/A	Initial Release	N/A	10/15/02
A	6.5	Modified Step. Changed MiniLevel Tolerance to +/- 0.05 mm/m per Tom Page.	1513	7/17/03
	6.10	Modified Step. Changed MiniLevel Tolerance to +/- 0.05 mm/m per Tom Page.		
	7.18	Modified Step. Changed to "Cut Q2b Quadrant 4 Lead at end of splice per Drawing (ME-369895)."		
	7.22	Modified Step. Added Picture to show all three Bus Leads. (13kA, 5kA 8kA)		
	7.29.2	Modified Step. Changed End of step to read "...Figure 7.29.2-A below." Corrected Picture to reflect accurate wiring diagram. Per **DR No. HGQ-0374**.		
	7.36	Modified Step. Changed MiniLevel Tolerance to +/- 0.05 mm/m per Tom Page.		
	8.1	Modified Step. Added Voltage Tap Serial Numbers to Tables.		
	11.11	Added Step. "Tack weld the corrector mounting hardware in place as per Q2 Coldmass Welded Assembly (ME-390309)."		
	11.13	Added Step. "Mount and adjust the Shipping restraint screws."		
	13.1	Modified Step. Added Voltage Tap Serial Numbers to Tables.		
	14.1	Modified Step. Added new wire information for installation of Hypertronics per Mike Lamm.		
	14.2	Modified Step. Added new wire information for installation of Hypertronics per Mike Lamm.		
B	6.11	Added Step. "Perform a Stretched Wire Verification Measurement."	1578	1/15/04
	7.1	Removed Step. "Obtain Lead Bus (ME-369825). Inspect Bus for damaged or broken areas. Clean Bus using lint free Heavy Duty Wipers (Fermi stock 1660-0150) and Isopropyl Alcohol (Fermi stock 1920-0300)." Moved to Q2 Insulated Bus Assembly Traveler (333721) per LMQXB04. Step 5.3		
	7.2	Removed Step. "Obtain parts for Bus Assembly (ME-369826) and assemble per Q2 Module Assembly Insulated Bus Assembly (ME-369826)." Moved to Q2 Insulated Bus Assembly Traveler (333721) per LMQXB04. Step 5.4		
	7.3	Removed Step. "Verify Bus Assembly (ME-369826) is assembled correctly per Q2 Module Assembly Insulated Bus Assembly (ME-369826)." Moved to Q2 Insulated Bus Assembly Traveler (333721) per LMQXB04. Step 5.5		
	7.4	Removed Step. "Hipot the 5kA Lead Bus to the 8kA and 13 kA Lead Busses on table before inserting into magnets. Power the 5kA bus to 5000V and ground the 13kA Lead Bus and the 8kA Lead Bus. **(Max. Leakage < 0.5μA).**" Moved to Q2 Bus Assembly Traveler (333721) per LMQXB04. Step 5.6		
	7.5	Removed Step. "Hipot the Corrector Magnet (MD-390312) Busses at 5kV before inserting into magnet in both the parallel and checkerboard configurations as shown below. Corrector Wires not shaded should be at high potential, while those shaded should be connected to each other and grounded. **(Max. Leakage < 0.5μA)**" Moved to Q2 Bus Assembly Traveler (333721) per LMQXB04. Step 5.7		
	7.22	Modified Step. Added a "Floating" Column Header to Table 7.22 and "RTD's and Warm-up Heaters" in that column.		
	7.23	Modified Step. Added Note. "**All wires in this table have been previously soldered to the Magnet except for the Cryogenic (warm-up) Heater Wires.**" Modified Table 7.23. Added CERN Labels per Rodger Bossert. Added Technician Signoff per LQXB04.		

Revision Page (2 of 2)

Revision	Step No.	Revision Description	TRR No.	Date
B (Continued)	7.27	Modified Step. Added "Attach Instrumentation Bus Channel Lock (MB-369937) to Q2b Non Lead End as per Q2 Module Assembly (ME-369895, page 4 of 4)"	1578 (Continued)	1/15/04
	7.30	Modified Step. Changed resistance check of RTD's and Warm-up Heaters per Rodger Bossert. New Step 7.25.		
	7.31	Modified Step. Changed hipot of RTD's and Warm-up Heaters per Rodger Bossert. New Step 7.26.		
	8.0	Modified Step. Changed electrical procedure specifications per Rodger Bossert. Added new tables with CERN Labels and new pictures.		
	11.3	Modified Step. Changed to "Install Spider Assembly (MC-430044) to protect wires." Removed checkboxes and added Responsible Authority signoff.		
	11.8	Removed Step. "Install Spider Assemblies (MC-369885) to protect wires/bus, if necessary."		
	13.0	Modified Step. Changed electrical procedure specifications per Rodger Bossert. Added new tables with CERN Labels and new pictures.		
	15.0	Modified Step. Changed electrical procedure specifications per Rodger Bossert. Added new tables with CERN Labels and new pictures.		
C	1.4	Removed Step. "All personnel performing steps in this traveler must have documented training for this traveler and associated operating procedures."	1602	4/7/04
	7.26	Modified Step. Modified table. Removed row to record Temperature of Building (+/- 5°). Not necessary for hipots.		
	7.30	Added Step. "Ensure that the MCBX Corrector Magnet (MD-390312) is against the Mount Hardware and the bolts are "snug", before leveling and rotating."		
	7.36	Added Step "Attach Voltage Tap Wires to Corrector Magnet (MD-390312) as per Q2 Module Assembly (ME-369895)."		
	10.12	Modified Step. Changed to "Hipot the Beam Tube to coil, heaters and ground. (5kV) (Max. Leakage < 0.5μA)."		
	11.14	Added Step. "Undo Clamps."		
	11.15	Added Step. "Perform a stretched wire measurement of the system to align the Cold Mass within ± .2 mR"		
D	7.23	Modified Step. Changed to "Install Warm-up Heaters (ME-369834) to the Lead Ends and Non-Lead Ends of Q2a and Q2b as per Q2 Module Assembly (ME-369895)." Per LMQXB06.	1636	7/14/04
	7.26	Modified Step. Added "Use Droege Serial No. 910 (FNAL Part No. 51330) or equivalent." Modified Tables.		
	8.1	Modified Step. Added new method of measuring Ls &Q per Rodger Bossert.		
	8.4	Modified Step. Added Responsible Authority signoff per LMQXB06.		
	9.4	Removed Step. Moved to 9.1.		
	9.10	Removed Step. Moved to new 9.6.		
	11.0	Added Note. "Ensure that a protective sleeve is placed inside the bellows between the convolutions and the bracket to prevent damage to the convolutions." per **DR No. HGQ-0423.**		
	11.3	Removed Step. "Install Spider Assembly (MC-430044) to protect wires." Per LMQXB06/Rodger Bossert.		
	11.13	Modified Step. Added "(Weld Specification ES-333781)"		
	11.14	Modified Step. Changed to "Undo the Cold Mass / Cryostat Station Support & Clamping Fixture (ME-369768)."		

Revision Page (3 of 3)

Revision	Step No.	Revision Description	TRR No.	Date
D (Continued)	13.1	Modified Step. Added new method of measuring Ls &Q per Rodger Bossert.	1636 (Continued)	7/14/04
	13.3	Modified Step. Added "Have Crew Chief verify setup and sign below before continuing."		
	13.4	Modified Step. Added Responsible Authority signoff per LMQXB06.		
	14.2	Modified Step. Added Technician Signoff per LMQXB06.		
	15.1	Modified Step. Added new method of measuring Ls &Q per Rodger Bossert.		
	15.3	Modified Step. Modified Table.		

Ensure appropriate memos and specific instructions are placed with the traveler before issuing the sub traveler binder to production.

1.0 General Notes

1.1 All steps that require a sign-off shall include the Technician/Technician(s)s first initial and full last name.

1.2 No erasures or white out will be permitted to any documentation. All incorrectly entered data shall be corrected by placing a single line through the error, initial and date the error before adding the correct data.

1.3 All Discrepancy Reports issued shall be recorded in the left margin next to the applicable step.

1.4 Personnel shall perform all tasks in accordance with current applicable ES&H guidelines and those specified within the step.

1.5 Cover the product/assembly with Green Herculite (Fermi stock 1740-0100) when not being serviced or assembled.

2.0 Parts Kit List

2.1 Attach the completed Parts Kit for this production operation to this traveler. Ensure that the serial number on the Parts Kit matches the serial number of this traveler. Verify that the Parts Kit received is complete.

J. Grootte
Process Engineering/Designee

9/23/04
Date

3.0 Q2 Module Alignment

XXX 3.1 Record the serial number for each Magnetic Component Assembly.

Q2a Serial Number: MQXB 03

Q2b Serial Number: MQXB 13

MCBX Serial Number: HCMCBX-001-SI000019

Responsible Authority/Physicist — Date: 9-25-04

3.2 File the End Plate Welds, and Alignment Welds at the Non-Lead End of Coldmass Q2a to allow Center Body Tube (MC-390112) to fit properly.

Technician(s) — Date: 9/25/04

4.0 Q2a Magnet Placement (Module Assembly Tooling)

4.1 Configure tooling for Q2a/Q2b Cold Mass assembly per (ME-369768).

Technician(s) _____ Date 9/27/04

4.2 Configure tooling for Corrector Mounting per (ME-369780), 13.780 Diameter Corrector Magnet.

Technician(s) _____ Date 9/27/04

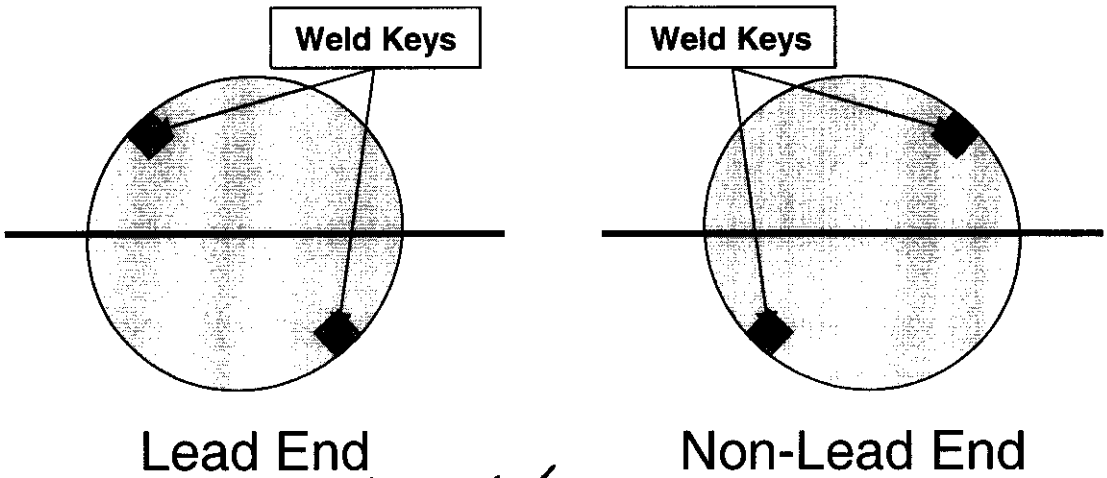
4.3 Configure tooling for End Dome Mounting per (ME-369765, View F-F) (Insert Item 22).

Technician(s) _____ Date 9/27/04

4.4 Move the Q2a Cold Mass to the Cold Mass Module Assembly Tooling, placing it nearest the East End of ICB, with the Lead End of the Magnet facing East as per Q2 Cold Mass Welded Assembly (ME-390309).

Technician(s) _____ Date 9/27/04

4.5 Rotate the Q2a Cold Mass, such that the Weld Keys are approximately at a 45° diagonal.



Technician(s) _____ Date 9/27/04

4.6 Slide the Center Body Tube (MC-390112) over Return End of Q2a Coldmass as per Q2 Cold Mass Welded Assembly (ME-390309).

Technician(s) _____ Date 9/27/04

5.0 Q2b Magnet Placement (Module Assembly Tooling)

5.1 Move the Q2b Cold Mass to the Cold Mass Module Assembly Tooling, placing it nearest the West End of ICB, with the Lead End of the Magnet Facing West as per Q2 Cold Mass Welded Assembly (ME-390309).

Technician(s) _____ Date 9/27/04

5.2 Position the Cold Masses so that the distance from the magnetic center of Q2a Cold Mass to the magnetic center of Q2b Cold Mass as denoted by the markings on the OD of the Cold Mass is 6524mm +/- 2 mm

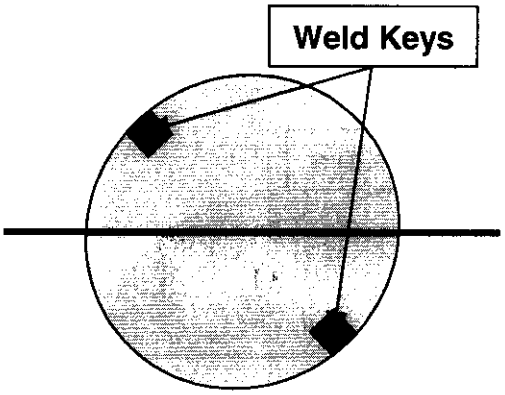
Note(s):

Needs to be the warm magnetic offset 6519.6 mm, plus 3/16" (4.4mm) allowance for weld shrinkage.

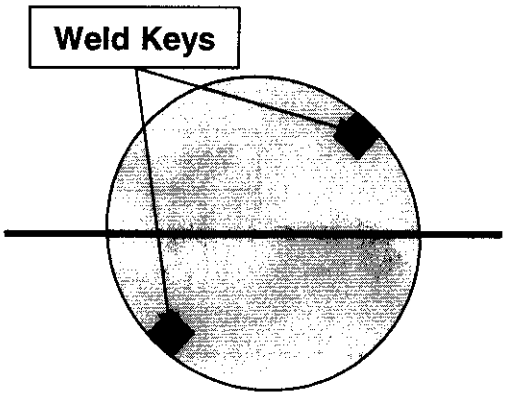
SWG

Technician(s) _____ Date 9/27/04

5.3 Rotate the Q2b Cold Mass such that the Weld Keys are approximately at a 45° diagonal.



Lead End



Non-Lead End

Technician(s) _____ Date 9/27/04

6.0 Q2a / Q2b Module Alignment

Q2a

XXX 6.1 Determine and record the location at which the level gauge should be mounted to the Cold Mass.

Distance from Lead End Plate: Center ~~inches.~~

Responsible Authority/Physicist — Date 9/28/04

6.2 Mount the Twist Measuring Fixture to the Q2a Cold Mass at the assigned position.

Technician(s) — Date 9/28/04

6.3 Mount the Precision V Block to the top of the Twist Measuring Fixture.

Technician(s) — Date 9/28/04

6.4 Place the Mini Level on the top surface of the V Block.

Technician(s) — Date 9/28/04

6.5 Rotate the Q2a Cold Mass until the Mini Level reads Horizontal 0.00 mm/m (+/- 0.05 mm/m).

Note(s):

Mini Level should be "zeroed" at reference stand location before this operation.

Technician(s) — Date 9/28/04

Q2b

XXX 6.6 Determine and record the location at which the level gauge should be mounted to the Q2b Cold Mass.

Distance from Lead End Plate: Center ~~inches.~~

T. Pm — 9/28/04
Responsible Authority/Physicist — Date

6.7 Mount the Twist Measuring Fixture to the Q2b Cold Mass at the assigned position.

Technician(s) — 9/28/04
Date

6.8 Mount the Precision V Block to the top of the Twist Measuring Fixture.

Technician(s) — 9/28/04
Date

6.9 Place the Mini Level on the top surface of the V Block.

Technician(s) — 9/28/04
Date

6.10 Rotate the Q2b Cold Mass until the Mini Level reads Horizontal 0.00mm/m (+/- 0.05 mm/m).

Note(s):

Mini Level should be "zeroed" at reference stand location before this operation.

Technician(s) — 9/28/04
Date

6.11 Perform a Stretched Wire Verification Measurement.

Technician(s) — 9/27/04
Date

7.0 Bus & Instrumentation Connection and Assembly

Note(s):

Figure "7.0-A" shows the configuration of magnet and corrector bus leads in a Q2 Magnet.

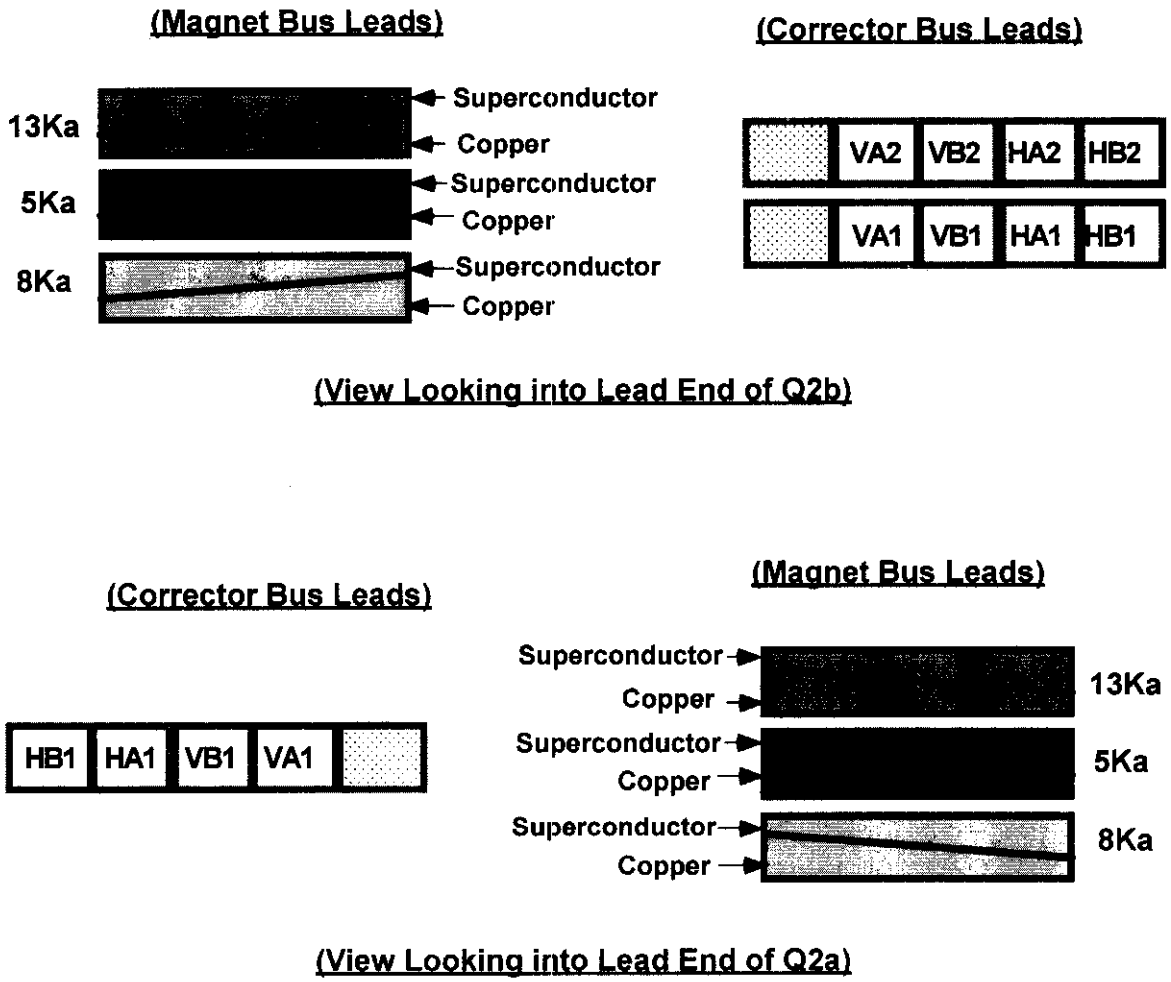


Figure 7.0-A

7.1 Slide Completed Bus Assembly (ME-369826) into Q2 as per Q2 Module Assembly (ME-369895).

Technician(s) _____ Date 9/30/04

7.2 Connect the Bus Housing Lock (MB-369870) to the Bus Assembly (ME-369826) and Q2b Return End Plate as per Q2 Module Assembly (ME-369895).

Technician(s) _____ Date 9/30/04

7.3 Connect the Bus Housing End Support (MB-369892) on the Q2a End per (ME-369895).

Technician(s) _____ Date 9/30/04

7.4 Connect the Bus Housing End Support (MB-369892) on the Q2b End per (ME-369895).

Technician(s) _____ Date 9/30/04

7.5 Set up the Power Leads for splicing. Create a ¾" space behind the Kevlar wrapped Leads to allow for Thermal Contraction differences between the bus and Cold Masses

Technician(s) _____ Date 10/1/04

7.6 Solder 13kA bus to Q2a Quadrant 4 lead as per Q2 Module Assembly (ME-369895) per LHC Cable Splice Joint Procedure (ES-369950).

Technician(s) _____ Date 10/1/04

Note: Cut both Q4 Lead and 13K bus

7.7 Cut Q2a Quadrant 4 Lead at end of splice per Drawing (ME-369895).

Technician(s) _____ Date 10/04/04

7.8 Insulate splice area with ¾ overlap, .001 x 3/8 wide kapton.

Technician(s) _____ Date 10/6/04

7.9 Attach the Q2a Bus Housing Extension (MD-369872) to Q2a Lead as per Q2 Module Assembly (ME-369895).

Technician(s) _____ Date 10/6/04

7.10 Attach the Q2a Bus Housing Extension Base (MC-369873) to Q2a Lead as per Q2 Module Assembly (ME-369895).

Technician(s) _____ Date 10/6/04

7.11 Attach the Q2a Bus Housing Extension Cover (MD-369874) to Q2a Lead as per Q2 Module Assembly (ME-369895).

Technician(s) _____ Date 10/6/04

7.12 Solder 13kA bus to Q2b Quadrant 4 lead as per Q2 Module Assembly (ME-369895) as per LHC Cable Splice Joint Procedure (ES-369950).

Technician(s) _____ Date 9/30/04

7.13 Cut Q2b Quadrant 4 Lead at end of splice per Drawing (ME-369895).

Technician(s) _____ Date 10/4/04

7.14 Insulate splice area with ¾ overlap, .001 x 3/8 wide kapton.

Technician(s) _____ Date 10/6/04

7.15 Attach the Q2b Bus Housing Extension (MD-369867) to Q2b Lead as per Q2 Module Assembly (ME-369895).

Technician(s) _____ Date 10/6/04

7.16 Verify that there is a ¾" clearance between the Bus Housing Extension Cover and the End Plate. If not, modify extension cover to allow clearance.

Crew Chief _____ Date 10/6/04

7.17 Attach the Q2b Bus Housing Extension Cover (MD-369874) to Q2b Lead as per Q2 Module Assembly (ME-369895).

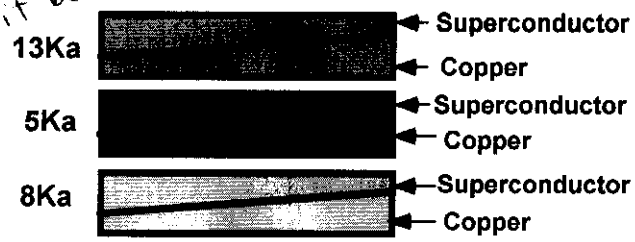
Technician(s) _____ Date 10/6/04

TRR #1734

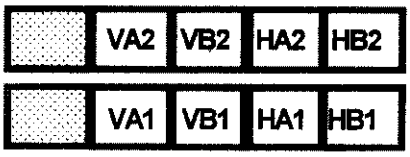
XXX 7.17 Hipot the 5kA Lead Bus to all other components at 5 kV. Ensure that all Magnet components ~~(i.e. both Yokes~~, *all Coils, Strip Heaters and 8kA Bus*) are grounded. **(Max. Leakage < 0.5μA)**

Review this value. Should it be 2.5uA?

(Magnet Bus Leads)



(Corrector Bus Leads)



(View Looking into Q2b)

Power Lead Assembly Hipot	Leakage or Failure Voltage	~~Floating~~	Pass	Fail
5kA to all other components	1137 nA	RTD's and Warm-up Heaters	-	

Technician(s) — Date: 10/7/04

Responsible Authority/Physicist — Date: 10/8/04

TRR# 1734 NOT INSTALLED YET, PLEASE REMOVE

7.18 Prepare Q2a Lead End Instrumentation wire bundle. Wrap the Q2a Lead End instrumentation wires into Bus Cable as per (MB-369897). Wire Labels and descriptions are shown in Table 7.18 and per (MB-369897).

Note(s):

All wires in this table have been previously soldered to the Magnet except for the Cryogenic (warm-up) Heater Wires.

Q2a bundle MB-369897 (From Lead End of Q2a)				
Wire Description	**Fermi Label**	**CERN Label**	**Gauge**	
Q2a Lead Voltage Tap "a", primary	VTa1Q2a	EE1112	26	Twist all three together
Q2a Lead Voltage Tap "b", primary	VTb1Q2a	EE1312	26	
Q2a Center Voltage Tap "c", primary	VTc1Q2a	EE1212	26	
Q2a lead Voltage Tap "a", redundant	VTa2Q2a	EE1122	26	Twist all three together
Q2a Lead Voltage Tap "b", redundant	VTb2Q2a	EE1322	26	
Q2a Center Voltage Tap "c", redundant	VTc2Q2a	EE1222	26	
1/4 coil tap (Q1 inner - Q3 outer)	VTdQ2a	EMPTY	26	
1/4 coil tap (Q2 inner - Q4 outer)	VTeQ2a	EMPTY	26	
Q2A Cryogenic Heater lead end - wire toward cold mass end plate (CERN #1 I+)	W1aQ2A	EH8312+	20	Install and Twist Together
Q2A Cryogenic Heater lead end - wire toward cold mass mag center (CERN #1 I-)	W2aQ2A	EH8312-	20	
Q2a Protection (Strip) Heater, 1-4 & 2-3 circuit (FNAL lead A+) (CERN lead #1+)	H1aQ2a	YT1112+	20	Twist together
Q2a Protection (Strip) Heater, 1-4 & 2-3 circuit (FNAL lead A-) (CERN lead #1-)	H2aQ2a	YT1112-	20	
Q2a Protection (Strip) Heater, 1-2 & 3-4 circuit (FNAL lead B+) (CERN lead #2+)	H1bQ2a	YT1122+	20	Twist together
Q2a Protection (Strip) Heater, 1-2 & 3-4 circuit (FNAL lead B-) (CERN lead #2-)	H2bQ2a	YT1122-	20	

Table 7.18

Technician(s) _____ Date 10/7/04

7.19 Pull wire bundle from Q2a through entire Q2 Assembly and mark the Q2b Lead End Plate position on bundle. **(See Note below)** Leave sufficient slack in cable to allow for differential thermal contraction.

Note(s):

When Bus Assembly (ME-369896) is inserted into the Q2 in step 7.27, the mark from step 7.24 should be located 1 inch from the Q2b end of the aluminum channel.

Technician(s) _____ Date 10/8/04

XXX 7.20 Verify that there is sufficient slack in cable to allow for differential thermal contraction.

Responsible Authority/Physicist _____ Date 10/8/04

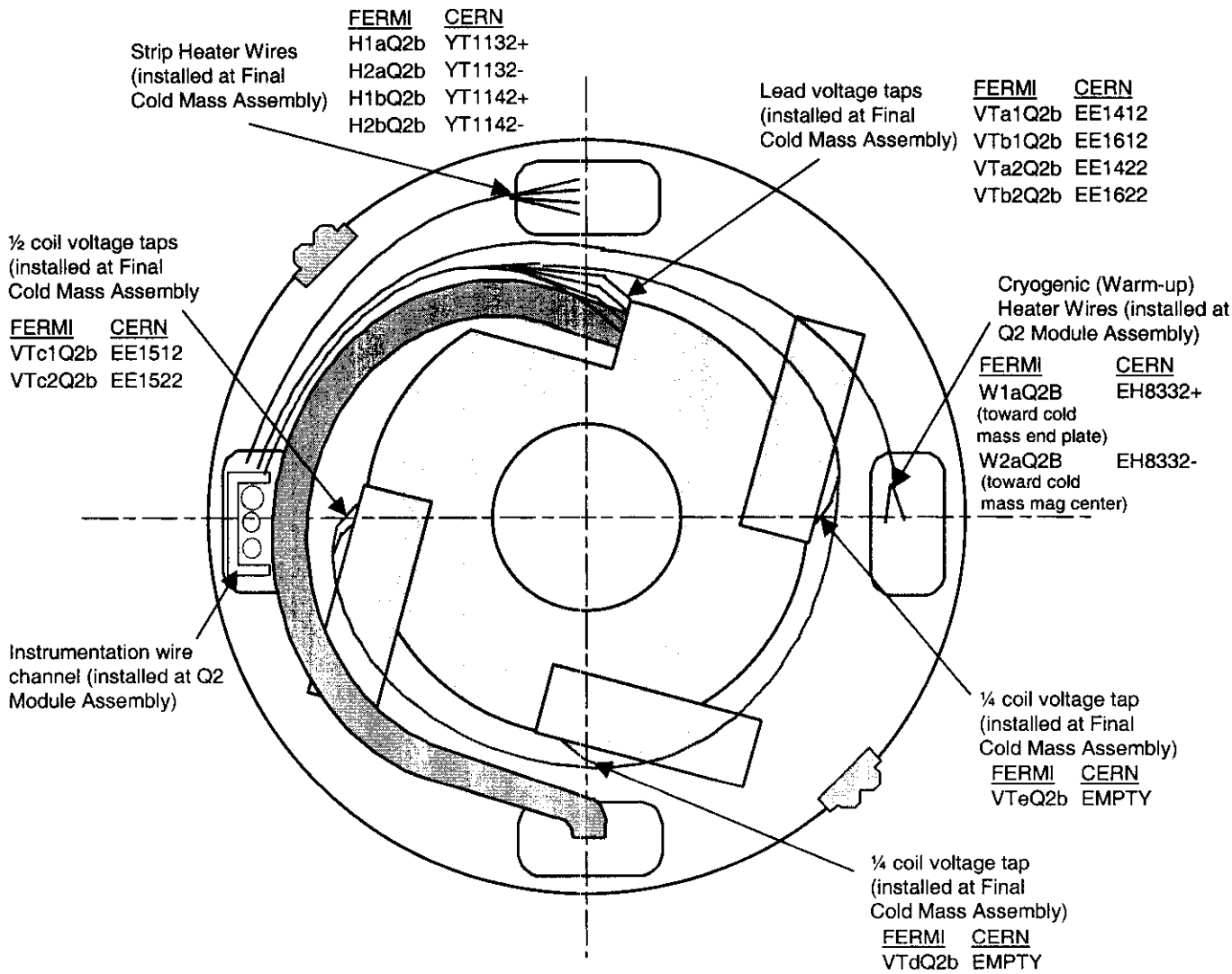
7.21 Remove Q2a bundle from Q2 Assembly.

Technician(s) _____ Date 10/8/04

7.22 Slide Instrumentation Bus Assembly (ME-369896) into the proper Q2 Port as per Q2 Module Assembly (ME-369895). As instrumentation Bus Assembly is being inserted, feed Bus Cable (MA-369897) from Lead End of Q2a (4 strip heater wires, 8 voltage tap wires and 2 warm-up heater wires) into bus channel, wrapping entire channel intermittently with glass tape and Kevlar string as shown in drawing (ME-369896). Attach Instrumentation Bus Channel Lock (MB-369937) to Q2b Non Lead End as per Q2 Module Assembly (ME-369895, page 4 of 4).

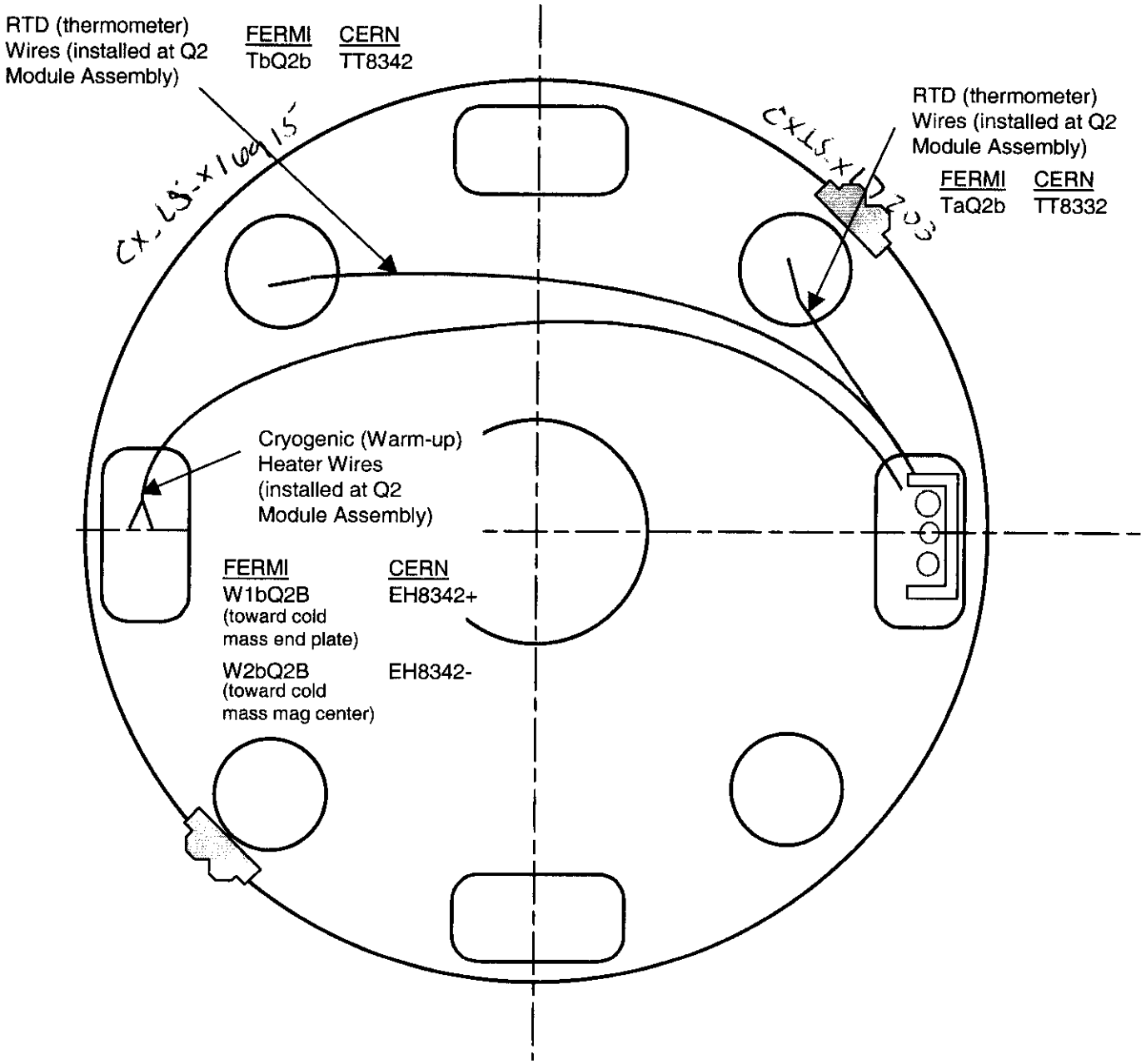
Refer to Figures 7.22-A, 7.22-B, 7.22-C, 7.22-D and Drawing (ME-369895) to see the positions at which all wires are attached to the End Plates.

Technician(s) _____ Date 10/8/04



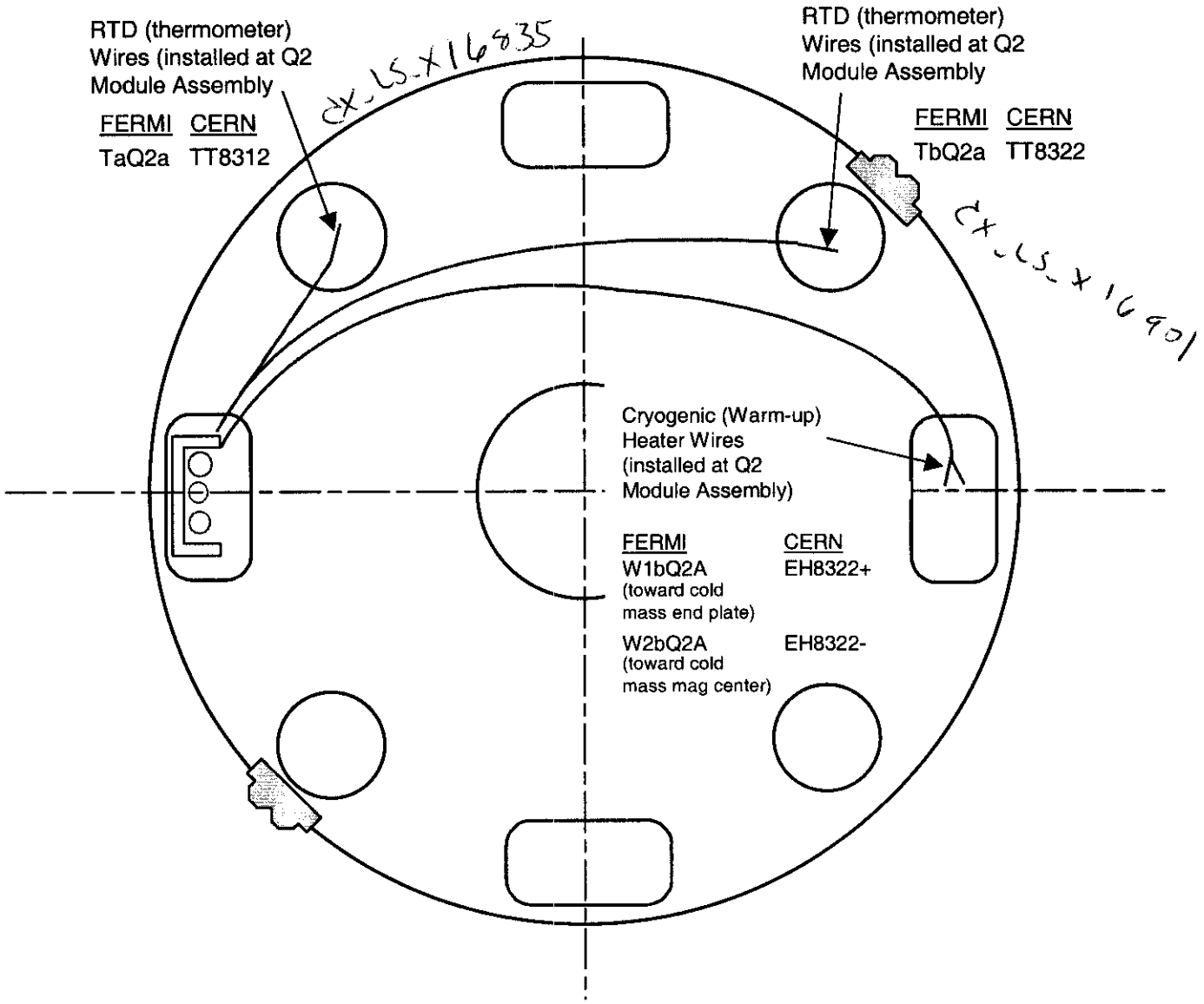
Looking at Lead End of Q2b

Figure 7.22-A



Looking at Non-lead End of Q2b

Figure 7.22-B



Looking at Non-lead End of Q2a

Figure 7.22-C

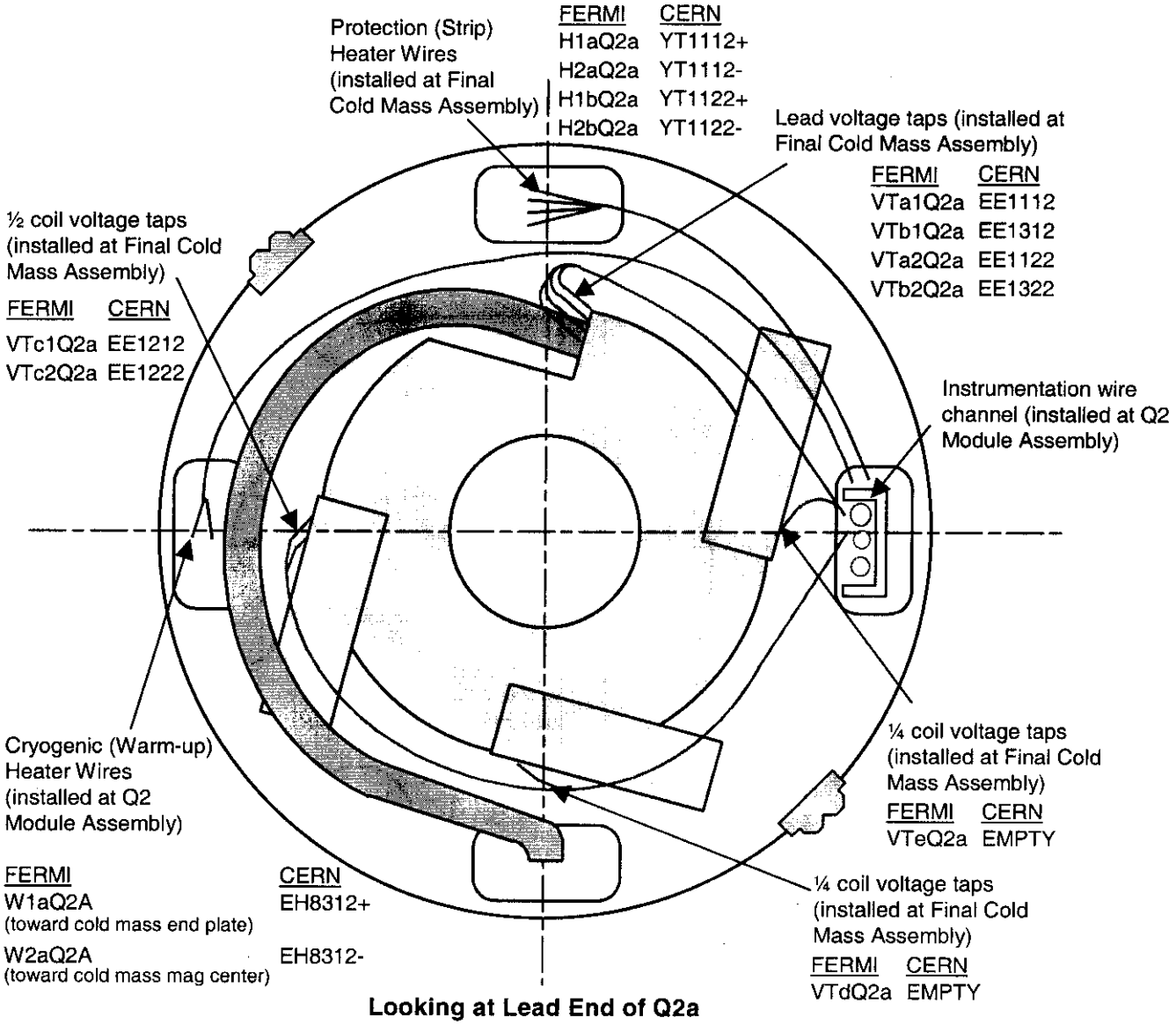

Protection (Strip) Heater Wires (installed at Final Cold Mass Assembly)
FERMI CERN
H1aQ2a YT1112+
H2aQ2a YT1112-
H1bQ2a YT1122+
H2bQ2a YT1122-
Lead voltage taps (installed at Final Cold Mass Assembly)
FERMI CERN
VTa1Q2a EE1112
VTb1Q2a EE1312
VTa2Q2a EE1122
VTb2Q2a EE1322
½ coil voltage taps (installed at Final Cold Mass Assembly)
FERMI CERN
VTc1Q2a EE1212
VTc2Q2a EE1222
Instrumentation wire channel (installed at Q2 Module Assembly)
Cryogenic (Warm-up) Heater Wires (installed at Q2 Module Assembly)
¼ coil voltage taps (installed at Final Cold Mass Assembly)
FERMI CERN
VTeQ2a EMPTY
FERMI CERN
W1aQ2A EH8312+
(toward cold mass end plate)
W2aQ2A EH8312-
(toward cold mass mag center)
¼ coil voltage taps (installed at Final Cold Mass Assembly)
FERMI CERN
VTdQ2a EMPTY
Looking at Lead End of Q2a

Figure 7.22-D

7.23 Install Warm-up Heaters (ME-369834) to the Lead Ends and Non-Lead Ends of Q2a and Q2b as per Q2 Module Assembly (ME-369895).

7.23.1 Install Warm-up Heaters (MA-369834) onto the Warm-up Heater Base Plate (MA-369829).

7.23.2 Solder wires (MA-369833) to the Warm-up Heaters as per (ME-369895).

7.23.3 Install Warm-up Heater Base Plates (MA-369829) by bolting into holes in End Plate. (Check each box as Heater is installed.)

Warm-up Heater #1 ☑

Warm-up Heater #2 ☑

Warm-up Heater #3 ☑

Warm-up Heater #4 ☑

Technician(s) _____ Date 10/10/04

7.24 Install RTD's as per Q2 Module Assembly (ME-369895). Record Serial Numbers of each RTD in the table below. Attach Data Sheet for each RTD to traveler.

7.24.1 Attach RTD's (MA-369835) (Qty. 2) to each Return End Plate as per Q2 Module Assembly (ME-369895).

7.24.2 Solder wires (MA-369836) to RTD's as per Q2 Module Assembly (ME-369895). Individual RTD wiring is shown in Figure 7.24.2-A below.

TOP VIEW

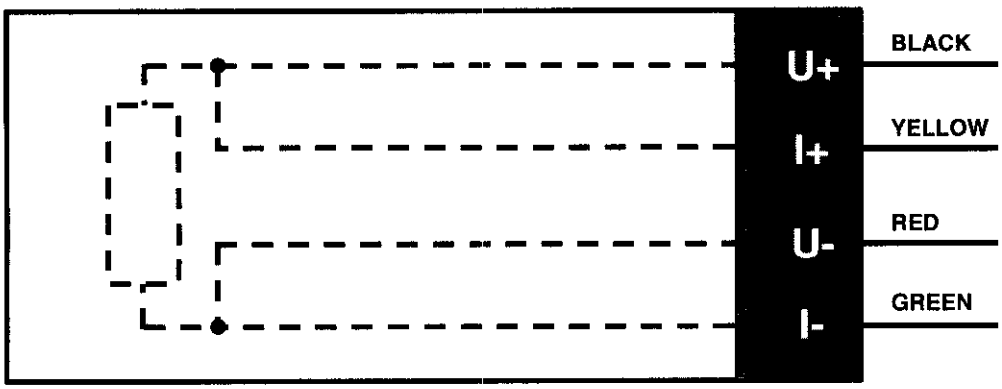


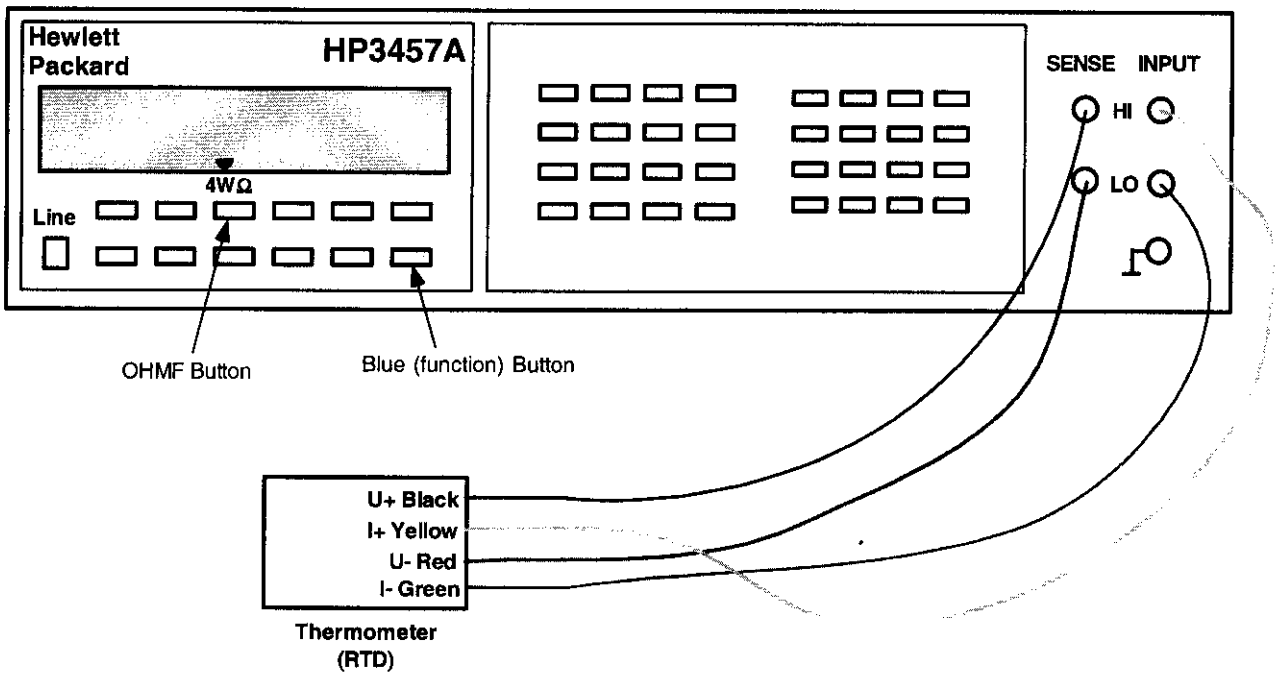
Figure 7.24.2-A

Technician(s) _____ Date 10/10/04

7.25 Measure Resistance of all RTD's and Cryogenic (warm-up) Heaters. Record the Data below.

To measure the resistance of a Thermometer (RTD):

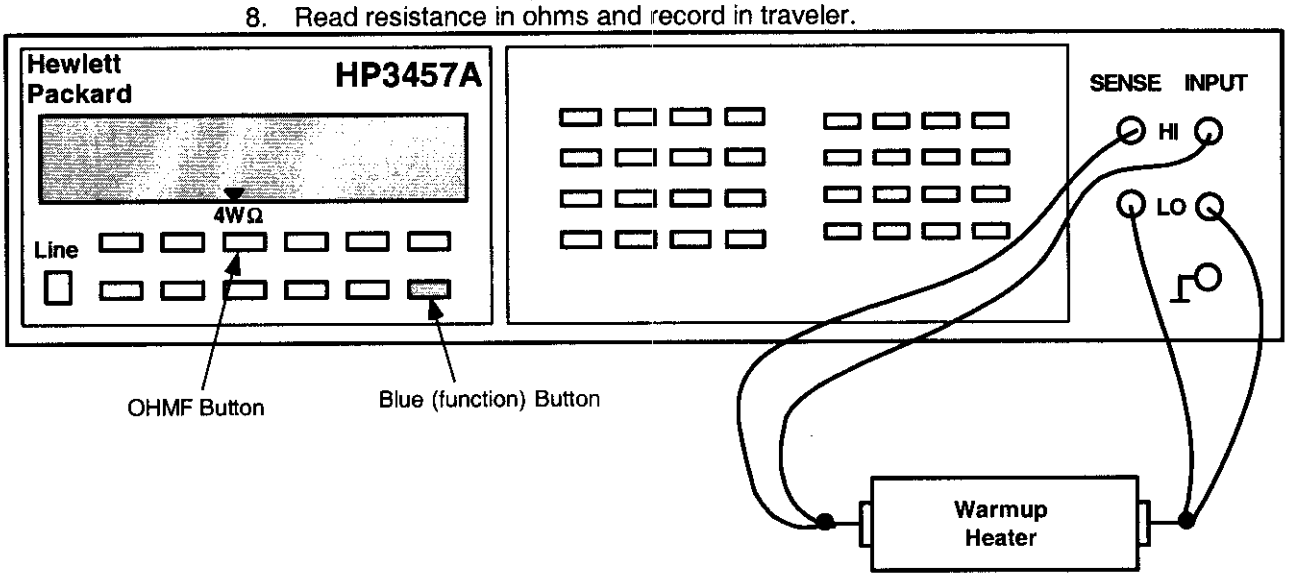
1. Use Hewlett Packard HP3457A digital multimeter.
2. Record temperature of building within +/- 5 degrees.
3. Press line button to turn line on.
4. Connect wires as shown in Figure below.
   U+ (Black) to Sense HI
   I+ (Yellow) to Input HI
   U- (Red) to Sense LO
   I- (Green) to Input LO
5. Push blue button (function key) once.
6. Push OHMF button.
7. Verify arrow in readout is above the 4WΩ (meaning a 4 wire resistance measurement).
8. Read resistance in ohms and record in traveler.



RTD's					
Temperature of Building (+/- 5°): 73°					
Serial No.	Location	Fermi	CERN	Measured Ω	Mfr. Ω (Expedition)
CX-LS-X16835	Q2a Inst. Bus Side	TaQ2a	TT8312	66.725	64.91
CX-LS-X16901	Q2a Non-Bus Side	TbQ2a	TT8322	67.632	65.70
CX-LS-X17203	Q2b Inst. Bus Side	TaQ2b	TT8332	65.777	63.915
CX-LS-X16915	Q2b Non-Bus Side	TbQ2b	TT8342	68.238	66.313

To measure the resistance of a Cryogenic (warm-up) Heater

1. Use Hewlett Packard HP3457A digital multimeter.
2. Record temperature of building within +/- 5 degrees.
3. Press line button to turn line on.
4. Connect wires as shown in Figure below.
5. Push blue button (function key) once.
6. Push OHMF button.
7. Verify arrow in readout is above the 4WΩ (meaning a 4 wire resistance measurement).
   Note: Although this is technically a 4 wire measurement, it is effectively a 2 wire measurement, since there are only 2 wires connected to each heater.
8. Read resistance in ohms and record in traveler.



Cryogenic (warm-up) Heaters			
Temperature of Building (+/- 5°): 73°			
Location	Fermi	CERN	Measured Ω
Q2a Lead End	W1aQ2A	EH8312+	16.807
	W2aQ2A	EH8312-	
Q2a Non-Lead End	W1bQ2A	EH8322+	16.519
	W2bQ2A	EH8322-	
Q2b Lead End	W1aQ2B	EH8332+	16.225
	W2aQ2B	EH8332-	
Q2b Non-Lead End	W1bQ2B	EH8342+	16.487
	W2bQ2B	EH8342-	

Technician(s)

10/10/04
Date

7.26 Hipot Cryogenic (warm-up) Heaters (300 V) to ground. (Max Leakage < 0.1 μA) Use Droege Serial No. 910 (FNAL Part No. 51330) or equivalent.

STOP

Have Crew Chief verify setup and sign below before continuing.

Crew Chief _____ Date 10-11-04

Cryogenic (warm-up) Heaters			
Temperature of Building (+/- 5°): 73°			
Location	**Fermi**	**CERN**	**Max. Leakage < 0.1 μA**
Q2a Lead End	**W1aQ2A**	**EH8312+**	> 1 μA
	W2aQ2A	**EH8312-**	
Q2a Non-Lead End	**W1bQ2A**	**EH8322+**	> 1 μA
	W2bQ2A	**EH8322-**	
Q2b Lead End	**W1aQ2B**	**EH8332+**	> 1 μA
	W2aQ2B	**EH8332-**	
Q2b Non-Lead End	**W1bQ2B**	**EH8342+**	> 1 μA
	W2bQ2B	**EH8342-**	

Hipot RTD's (100 V) to ground. (Max Leakage < 0.1 μA) Use Droege Serial No. 910 (FNAL Part No. 51330) or equivalent.

STOP

Have Crew Chief verify setup and sign below before continuing.

Crew Chief _____ Date 10-11-04

RTD's				
Serial No.	**Location**	**Fermi**	**CERN**	**Max. Leakage < 0.1 μA**
CX-LS-X 16835	**Q2a Inst. Bus Side**	**TaQ2a**	**TT8312**	> .1 μA
CX-LS-X 16901	**Q2a Non-Bus Side**	**TbQ2a**	**TT8322**	> .1 μA
CX-LS-X 17203	**Q2b Inst. Bus Side**	**TaQ2b**	**TT8332**	> .1 μA
CX-LS-X 16915	**Q2b Non-Bus Side**	**TbQ2b**	**TT8342**	> .1 μA

Technician(s) _____ Date 10/10/04

old magnet mounts already on magnet being reused

7.27 Install the mounts for the MCBX Corrector Magnet (MD-390312) on the Return End of Q2a as per Q2 Cold Mass Welded Assembly (ME-390309).

N/A

Technician(s) Date

7.28 Place the MCBX Corrector Magnet (MD-390312) in the Corrector Magnet Mounting Tooling, between Q2a and Q2b. The Flange end of the MCBX should face the Return End Plate of Q2a.

Technician(s) 10/13/04 Date

7.29 Attach the MCBX Corrector Magnet Alignment Tooling (ME-390390) to the MCBX Corrector Magnet (MD-390312). Align the Scribe Lines on the Corrector Magnet (MD-390312) with those on the tooling.

Technician(s) 10/13/04 Date

? 7.30 Ensure that the MCBX Corrector Magnet (MD-390312) is against the Mount Hardware and the bolts are "snug", before leveling and rotating.

Crew Chief 10-13-04 Date

7.31 Mount the Mini Level to the top of the MCBX Corrector Magnet Alignment Tooling.

Note(s):

Mini Level should be "zeroed" at reference stand location before this operation.

Technician(s) 10/13/04 Date

7.32 Rotate the MCBX Corrector Magnet (MD-390312) such that the Mini Level is Horizontal 0.00 mm/m (+/- 0.05 mm/m).

Technician(s) 10/13/04 Date

7.33 Move the MCBX Corrector Magnet (MD-390312) up against the Mounting Hardware to the Q2a Magnet, and bolt the MCBX Corrector Magnet (MD-390312) to the Q2a Cold Mass as per Q2 Cold Mass Welded Assembly (ME-390309). Shim and torque, as needed, while monitoring levels.

Technician(s) _____ Date 10/13/04

XXX 7.34 Verify Alignment of MCBX Corrector Magnet (MD-390312) as per Q2 Cold Mass Welded Assembly (ME-390309).

Responsible Authority/Physicist _____ Date 10/18/04

7.35 Connect the MCBX Corrector Magnet (MD-390312) Bus wires from Bus Assembly (ME-369826) to the MCBX Corrector Magnet (MD-390312) as per Q2 Module Assembly (ME-369895).

Technician(s) _____ Date 10/15/04

7.36 Attach Voltage Tap Wires to Corrector Magnet (MD-390312) as per Q2 Module Assembly (ME-369895).

Technician(s) _____ Date 10/16/04

Same thing

7.37 Wrap the Correction Coil Mounting Blocks (MC-390203) (Qty. 4) with 3 mil Kapton as per Q2 Module Assembly (ME-369895).

Technician(s) _____ Date 10/16/04

TRR# 1734 (combined steps)

7.38 Solder MCBX Corrector Magnet Voltage Tap Wires (MA-369832) as per Q2 Module Assembly (ME-369895).

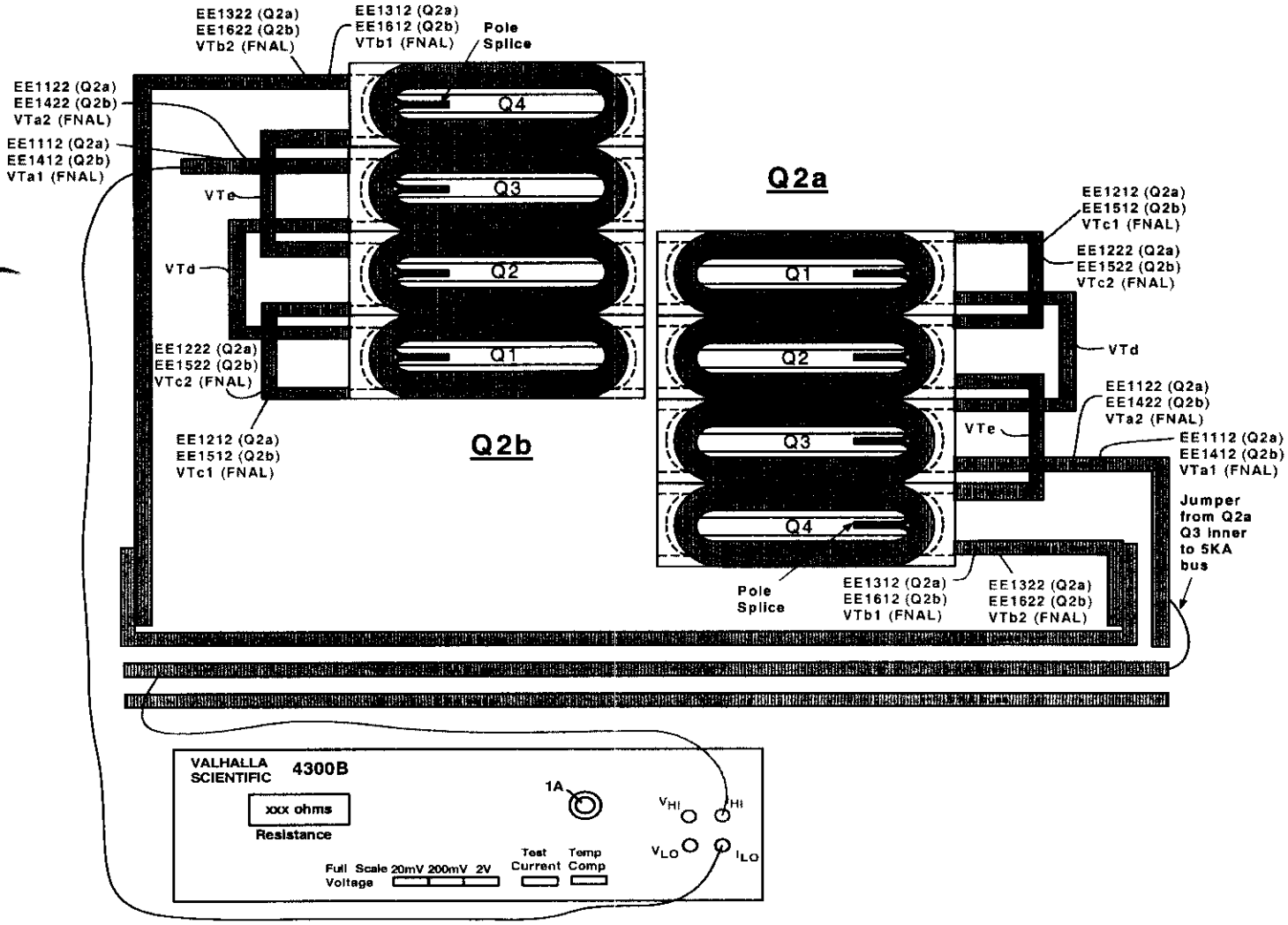
Technician(s) _____ Date _____

8.0 Electrical Inspection

8.1 Perform an electrical inspection on each of the Individual Quadrants and the Cold Masses. Refer to the Valhalla and Leader Free Standing Coil Measurement Procedure (ES-292306).

To measure the resistance of a bussed Q2:

1. Use Valhalla Scientific 4300B digital micro-ohmmeter.
2. Set Test Current to 1 amp.
3. Set Scale to 2V full scale.
4. Turn temperature compensation on.
5. Turn test current off.
6. Put jumper between Q2a Q3 inner power lead and 5 KA bus as shown in figure.
7. Connect I_{HI} to the 5KA bus (Q2a Q3 inner power lead) as shown in figure.
8. Connect I_{LO} to the Q2b Q3 inner power lead as shown in figure.
9. Turn test current on.
10. Connect V_{HI} and V_{LO} to voltage taps as shown below.
11. Read resistance and record in traveler.



(Q2a) Resistance				Nominal ~ 560 to 585 mΩ
Voltage Tap Serial Numbers				Quadrant Total Resistance
Connect	Fermi	CERN	Quadrant	
V_{HI}	VTdQ2a	EMPTY	Quadrant 1	572.3 mΩ
V_{LO}	VTc1Q2a	EE1212		
V_{HI}	VTc1Q2a	EE1212	Quadrant 2	572.5 mΩ
V_{LO}	VTeQ2a	EMPTY		
V_{HI}	VTa1Q2a	EE1112	Quadrant 3	572.8 mΩ
V_{LO}	VTdQ2a	EMPTY		
V_{HI}	VTeQ2a	EMPTY	Quadrant 4	572.8 mΩ
V_{LO}	VTb1Q2a	EE1312		

V_{HI}	VTa1Q2a	EE1112	Total Cold Mass	Nominal ~ 2.305 Ω
V_{LO}	VTb1Q2a	EE1312		2.291 Ω

Technician(s) _____ Date 10/16/04

Check resistance of Redundant Voltage Taps.

Q2a Redundant Voltage Taps			
Connect	Fermi	CERN	Resistance
V_{HI}	VTa2Q2a	EE1122	1.146 Ω
V_{LO}	VTc2Q2a	EE1222	
V_{HI}	VTc2Q2a	EE1222	1.146 Ω
V_{LO}	VTb2Q2a	EE1322	

Technician(s) _____ Date 10/16/04

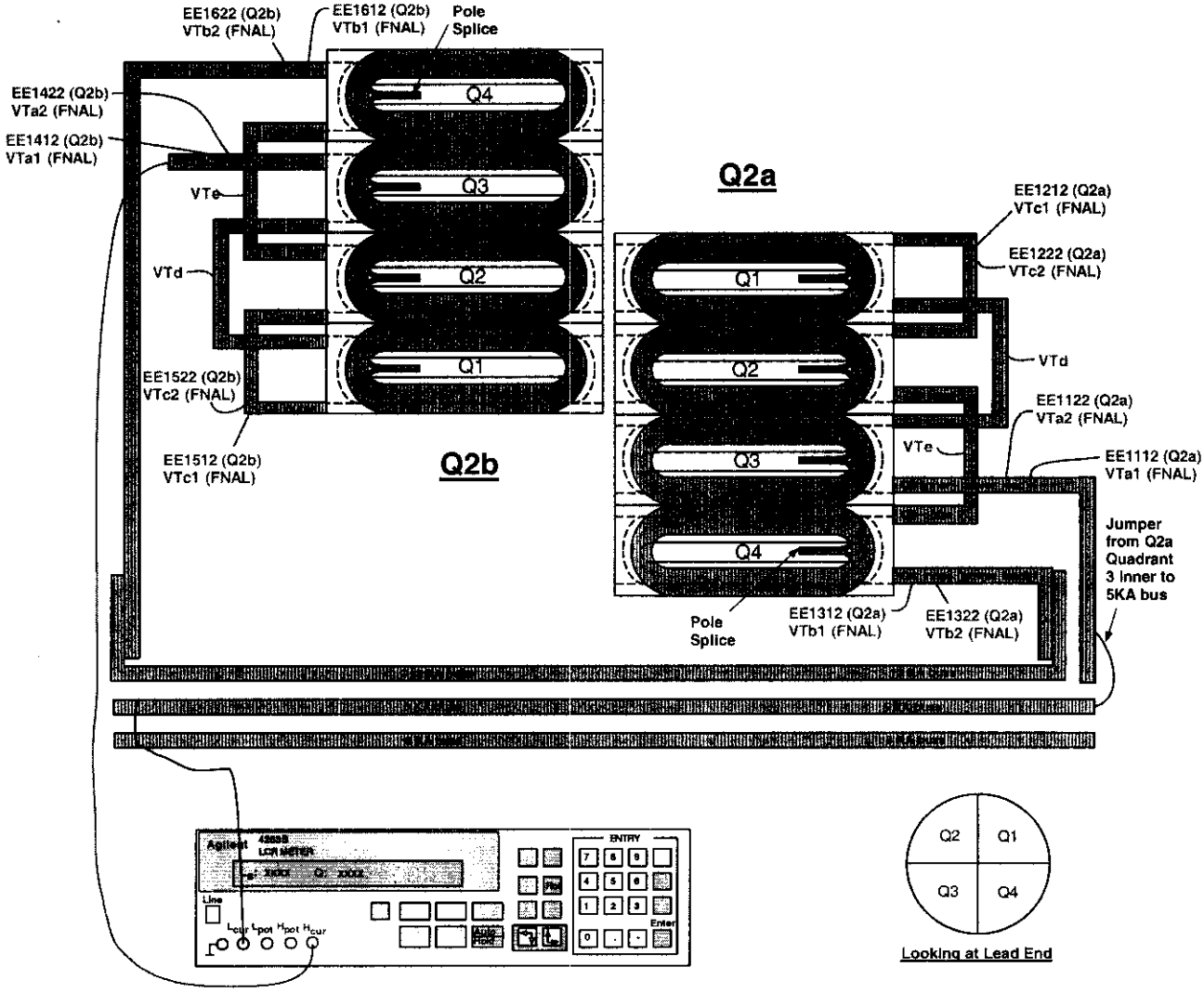
To measure Ls and Q of a Bussed Q2a:

1. Use Agilent 4263B LCR Meter.
2. Turn power on by pushing Line button. Wait 30 seconds until display screen is lit.
3. Recall program #1. To do this, push recall (Rcl), then push #1, then push Enter.
4. Push Auto/Hold button to release hold.
5. Verify that the frequency displayed in the upper right corner of the display screen is 1000 Hz and the level recorded in the lower right corner of the display screen is 1V or 1000 mV.
6. Connect jumper between Q2a/Quadrant 3 inner power lead and 5KA bus as shown in figure.
7. Connect H_{cur} to Q2b/Quadrant 3 inner power lead as shown in figure.
8. Connect L_{cur} to 5KA bus as shown in figure.
9. Connect H_{pot} and L_{pot} buttons to voltage taps as shown below.

To measure Q2a:

- To measure Q1, connect H_{pot} to VTc1 (EE1212 for Q2a), and L_{pot} to VTd.
- To measure Q2, connect H_{pot} to VTe and L_{pot} to VTc1 (EE1212 for Q2a).
- To measure Q3, connect H_{pot} to VTd and L_{pot} to VTa1 (EE1112 for Q2a).
- To measure Q4, connect H_{pot} to VTb1 (EE1312 for Q2a), and L_{pot} to VTe.
- To measure total, connect H_{pot} to VTb1 (EE1312 for Q2a), and L_{pot} to VTa1 (EE1112 for Q2a).

10. Read Ls and Q from display and record in traveler.



(Q2a) Inductance				Nominal ~ 2.880 to 2.935 mH
Voltage Tap Serial Numbers				Quadrant Total Inductance
Connect	Fermi	CERN	Quadrant	
L_{POT}	VTdQ2a	EMPTY	Quadrant 1	3.3596 mH
H_{POT}	VTc1Q2a	EE1212		
L_{POT}	VTc1Q2a	EE1212	Quadrant 2	3.3563 mH
H_{POT}	VTeQ2a	EMPTY		
L_{POT}	VTdQ2a	EMPTY	Quadrant 3	3.3352 mH
H_{POT}	VTa1Q2a	EE1112		
L_{POT}	VTeQ2a	EMPTY	Quadrant 4	3.3101 mH
H_{POT}	VTb1Q2a	EE1312		

L_{POT}	VTa1Q2a	EE1112	Total Cold Mass	Nominal ~ 13.3376 mH
H_{POT}	VTb1Q2a	EE1312		13.357 mH

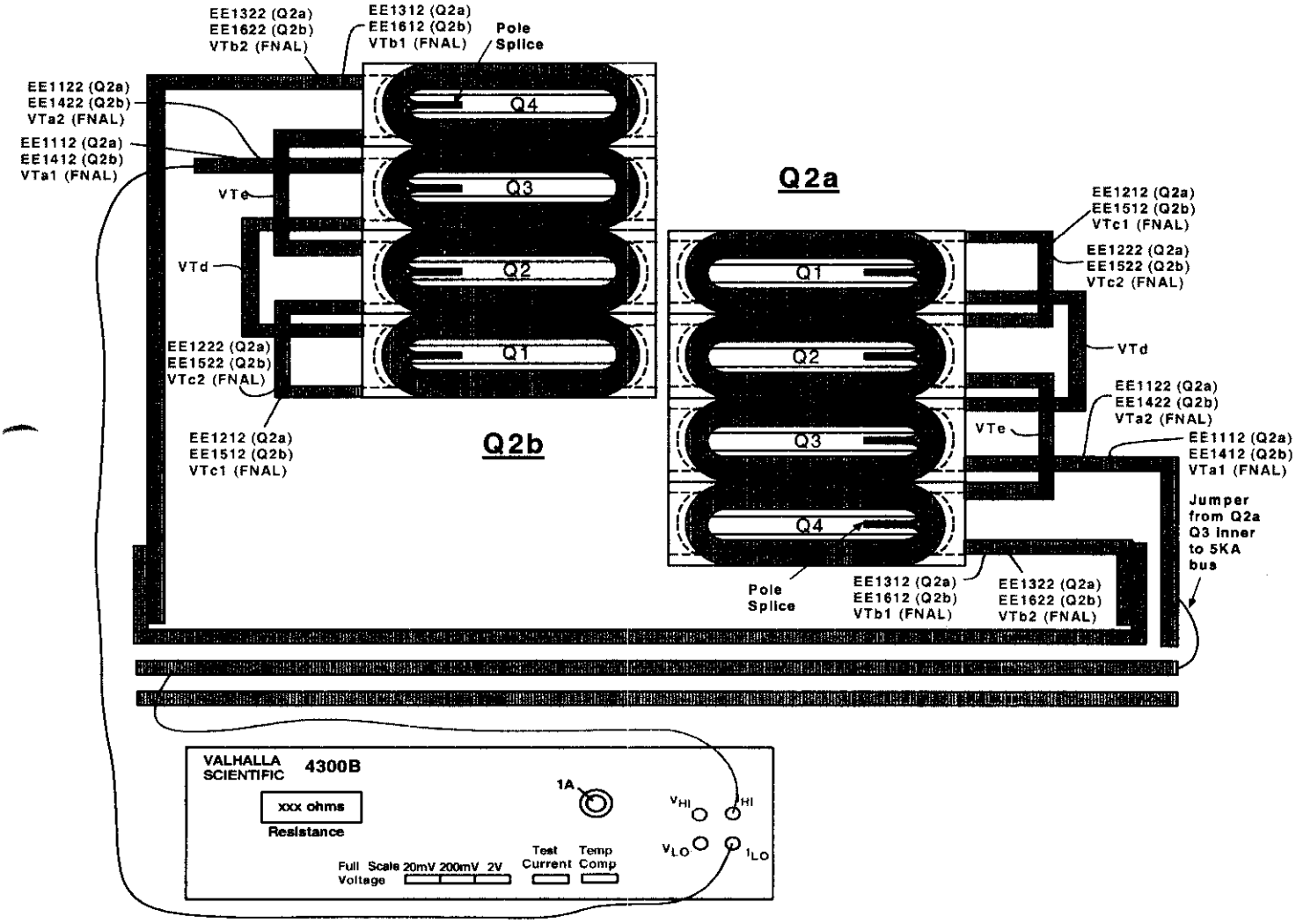
(Q2a) Q-Factor				Nominal ~ 4.5 to 5.2
Voltage Tap Serial Numbers				Quadrant Total Q
Connect	Fermi	CERN	Quadrant	
L_{POT}	VTdQ2a	EMPTY	Quadrant 1	5.3
H_{POT}	VTc1Q2a	EE1212		
L_{POT}	VTc1Q2a	EE1212	Quadrant 2	5.2
H_{POT}	VTeQ2a	EMPTY		
L_{POT}	VTa1Q2a	EE1112	Quadrant 3	5.1
H_{POT}	VTdQ2a	EMPTY		
L_{POT}	VTeQ2a	EMPTY	Quadrant 4	
H_{POT}	VTb1Q2a	EE1312		5.3

L_{POT}	VTa1Q2a	EE1112	Total Cold Mass	Nominal ~ 5.036
H_{POT}	VTb1Q2a	EE1312		5.2

Technician(s) _____ Date 10/16/04

To measure the resistance of a bussed Q2:

1. Use Valhalla Scientific 4300B digital micro-ohmmeter.
2. Set Test Current to 1 amp.
3. Set Scale to 2V full scale.
4. Turn temperature compensation on.
5. Turn test current off.
6. Put jumper between Q2a Q3 inner power lead and 5 KA bus as shown in figure.
7. Connect I_{HI} to the 5KA bus (Q2a Q3 inner power lead) as shown in figure.
8. Connect I_{LO} to the Q2b Q3 inner power lead as shown in figure.
9. Turn test current on.
10. Connect V_{HI} and V_{LO} to voltage taps as shown below.
11. Read resistance and record in traveler.



(Q2b) Resistance				Nominal ~ 560 to 585 mΩ
Voltage Tap Serial Numbers				Quadrant Total Resistance
Connect	Fermi	CERN	Quadrant	
V_{HI}	VTc1Q2b	EE1512	Quadrant 1	573.1 mΩ
V_{LO}	VTdQ2b	EMPTY		
V_{HI}	VTeQ2b	EMPTY	Quadrant 2	572.1 mΩ
V_{LO}	VTc1Q2b	EE1512		
V_{HI}	VTdQ2b	EMPTY	Quadrant 3	572.5 mΩ
V_{LO}	VTa1Q2b	EE1412		
V_{HI}	VTb1Q2b	EE1612	Quadrant 4	572.6 mΩ
V_{LO}	VTeQ2b	EMPTY		

V_{HI}	VTb1Q2b	EE1612	Total Cold Mass	Nominal ~ 2.305 Ω
V_{LO}	VTa1Q2b	EE1412		2.291 Ω

Technician(s) _____ Date 10/16/04

Check the resistance of the Redundant Voltage Taps.

Q2b Redundant Voltage Taps			
Connect	Fermi	CERN	Resistance
V_{HI}	VTc2Q2b	EE1522	1.146 Ω
V_{LO}	VTa2Q2b	EE1422	
V_{HI}	VTb2Q2b	EE1622	1.145 Ω
V_{LO}	VTc2Q2b	EE1522	

Technician(s) _____ Date 10/16/04

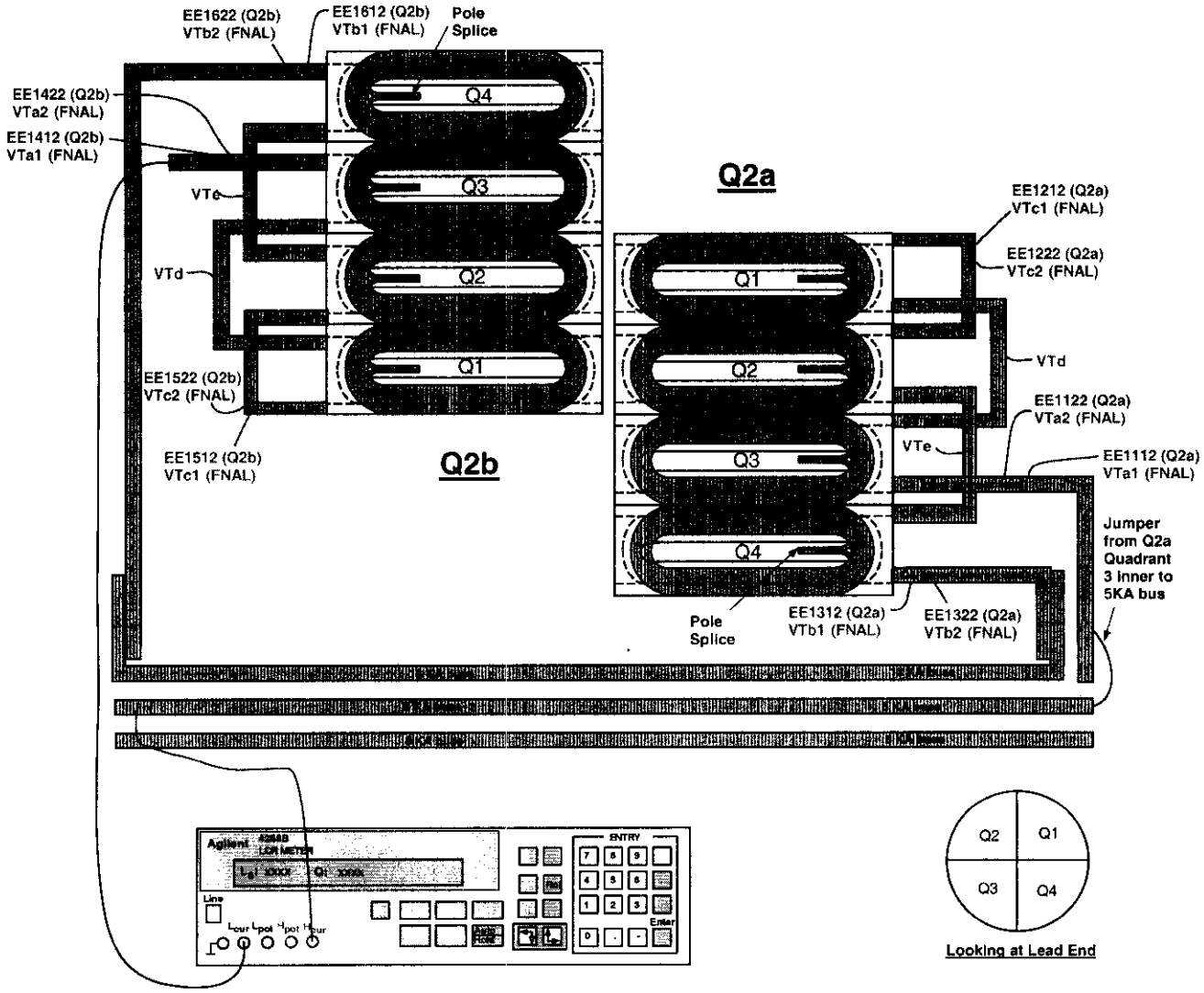
To measure Ls and Q of a Bussed Q2b:

1. Use Agilent 4263B LCR Meter.
2. Turn power on by pushing line button. Wait 30 seconds until display screen is lit.
3. Recall program #1. To do this, push recall (Rcl), then push #1, then push Enter.
4. Push Auto/Hold button to release hold.
5. Verify that the frequency displayed in the upper right corner of the display screen is 1000 Hz and the level recorded in the lower right corner of the display screen is 1V or 1000 mV.
6. Connect jumper between Q2a/Quadrant 3 inner power lead and 5KA bus as shown in figure.
7. Connect H_{cur} to 5KA bus as shown in figure.
8. Connect L_{cur} to Q2b/Quadrant 3 inner power lead as shown in figure.
9. Connect H_{pot} and L_{pot} buttons to voltage taps as shown below.

To measure Q2b:

- To measure Q1, connect H_{pot} to VTc1 (EE1512 for Q2b), and L_{pot} to VTd.
- To measure Q2, connect H_{pot} to VTe and L_{pot} to VTc1 (EE1512 for Q2b).
- To measure Q3, connect H_{pot} to VTd and L_{pot} to VTa1 (EE1412 for Q2b).
- To measure Q4, connect H_{pot} to VTb1 (EE1612 for Q2b) and L_{pot} to VTe.
- To measure total, connect H_{pot} to VTb1 (EE1612 for Q2b) and L_{pot} to VTa1 (EE1412 for Q2b).

10. Read Ls and Q from display and record in traveler.



(Q2b) Inductance				Nominal ~ 2.880 to 2.935 mH
Voltage Tap Serial Numbers				Quadrant Total Inductance
Connect	Fermi	CERN	Quadrant	
H_{POT}	VTc1Q2b	EE1512	Quadrant 1	3.3643 mH
L_{POT}	VTdQ2b	EMPTY		
H_{POT}	VTeQ2b	EMPTY	Quadrant 2	3.3645 mH
L_{POT}	VTc1Q2b	EE1512		
H_{POT}	VTdQ2b	EMPTY	Quadrant 3	3.3640 mH
L_{POT}	VTa1Q2b	EE1412		
H_{POT}	VTb1Q2b	EE1612	Quadrant 4	3.3327 mH
L_{POT}	VTeQ2b	EMPTY		

H_{POT}	VTb1Q2b	EE1612	Total Cold Mass	Nominal ~ 13.3376 mH
L_{POT}	VTa1Q2b	EE1412		13.424 mH

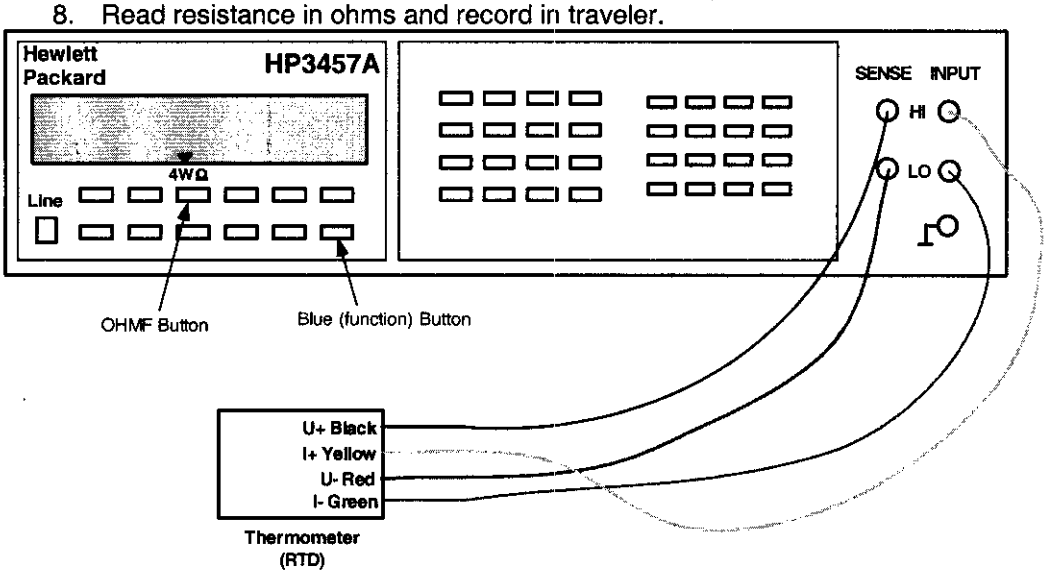
(Q2b) Q-Factor				Nominal ~ 4.5 to 5.2
Voltage Tap Serial Numbers				Quadrant Total Q
Connect	Fermi	CERN	Quadrant	
H_{POT}	VTc1Q2b	EE1512	Quadrant 1	5.1
L_{POT}	VTdQ2b	EMPTY		
H_{POT}	VTeQ2b	EMPTY	Quadrant 2	5.2
L_{POT}	VTc1Q2b	EE1512		
H_{POT}	VTdQ2b	EMPTY	Quadrant 3	5.1
L_{POT}	VTa1Q2b	EE1412		
H_{POT}	VTb1Q2b	EE1612	Quadrant 4	5.2
L_{POT}	VTeQ2b	EMPTY		

H_{POT}	VTb1Q2b	EE1612	Total Cold Mass	Nominal ~ 5.036
L_{POT}	VTa1Q2b	EE1412		5.2

Technician(s) _____ Date 10/16/01

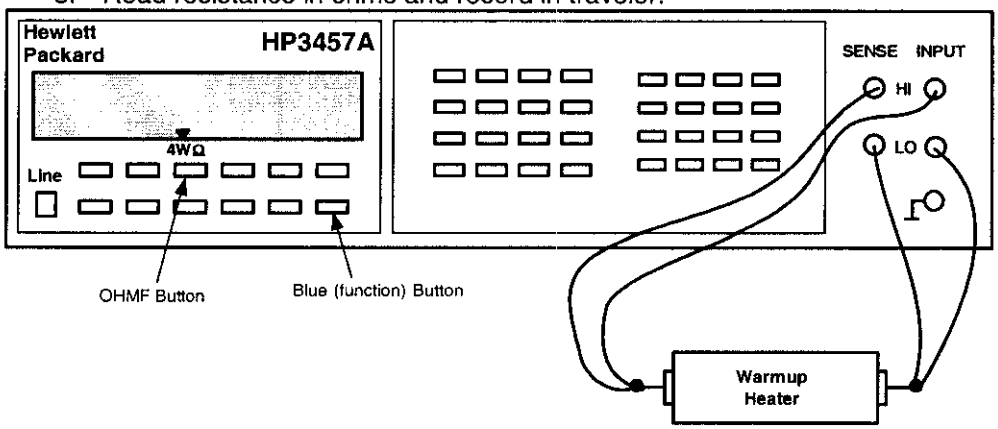
To measure the resistance of a Thermometer (RTD):

1. Use Hewlett Packard HP3457A digital multimeter.
2. Record temperature of building within +/- 5 degrees.
3. Press line button to turn line on.
4. Connect wires as shown in Figure below.
   U+ (Black) to Sense HI
   I+ (Yellow) to Input HI
   U- (Red) to Sense LO
   I- (Green) to Input LO
5. Push blue button (function key) once.
6. Push OHMF button.
7. Verify arrow in readout is above the 4WΩ (meaning a 4 wire resistance measurement).
8. Read resistance in ohms and record in traveler.



To measure the resistance of a Cryogenic (Warm-up) Heater

1. Use Hewlett Packard HP3457A digital multimeter.
2. Record temperature of building within +/- 5 degrees.
3. Press line button to turn line on.
4. Connect wires as shown in Figure below.
5. Push blue button (function key) once.
6. Push OHMF button.
7. Verify arrow in readout is above the 4WΩ (meaning a 4 wire resistance measurement).
   Note: Although this is technically a 4 wire measurement, it is effectively a 2 wire measurement, since there are only 2 wires connected to each heater.
8. Read resistance in ohms and record in traveler.



Q2a - RTD's and Cryogenic (warm-up) Heaters			
Temperature of Building (+/- 5°): 73°			
Component	**Fermi**	**CERN**	**Resistance**
Q2a RTD, primary	TaQ2a	TT8312	66.602 Ω
Q2a RTD, redundant	TbQ2a	TT8322	67.454 Ω
Q2A Cryogenic (warm-up) Heater (LE) - wire toward cold mass end plate (CERN #1 I+)	W1aQ2A	EH8312+	16.826 Ω
Q2A Cryogenic (warm-up) Heater (LE) - wire toward cold mass mag center (CERN #1 I-)	W2aQ2A	EH8312-	
Q2A Cryogenic (warm-up) Heater (Non-LE) - wire toward cold mass end plate (CERN #2 I+)	W1bQ2A	EH8322+	16.524 Ω
Q2A Cryogenic (warm-up) Heater (Non-LE) - wire toward cold mass mag center (CERN #2 I-)	W2bQ2A	EH8322-	

Technician(s) _____ Date 10/16/04

Q2b - RTD's and Cryogenic (warm-up) Heaters			
Temperature of Building (+/- 5°): 73°			
Component	**Fermi**	**CERN**	**Resistance**
Q2b RTD, primary	TaQ2b	TT8332	~~67.456~~ 65.656 Ω
Q2b RTD, redundant	TbQ2b	TT8342	68.106 Ω
Q2B Cryogenic (warm-up) Heater (LE) - wire toward cold mass end plate (CERN #1 I+)	W1aQ2B	EH8332+	16.228 Ω
Q2B Cryogenic (warm-up) Heater (LE) - wire toward cold mass mag center (CERN #1 I-)	W2aQ2B	EH8332-	
Q2B Cryogenic (warm-up) Heater (Non-LE) - wire toward cold mass end plate (CERN #2 I+)	W1bQ2B	EH8342+	16.490 Ω
Q2B Cryogenic (warm-up) Heater (Non-LE) - wire toward cold mass mag center (CERN #2 I-)	W2bQ2B	EH8342-	

Technician(s) _____ Date 10/16/04

Using the Hewlett Packard HP3457A digital multimeter, measure the Strip Heater Resistance for Q2a and Q2b.

Q2a Strip Heater Resistance				
Fermi	CERN	Description	Limit	Resistance
H1aQ2a	YT1112+	Circuit A	18.20 to 21 Ω	19.989 Ω
H2aQ2a	YT1112-			
H1bQ2a	YT1122+	Circuit B	18.20 to 21 Ω	20.028 Ω
H2bQ2a	YT1122-			

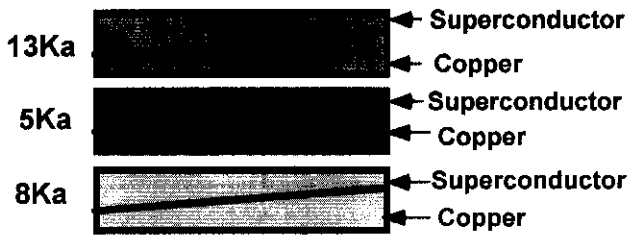
Technician(s) _____ Date 10/18/04

Q2b Strip Heater Resistance				
Fermi	CERN	Description	Limit	Resistance
H1aQ2b	YT1132+	Circuit A	18.20 to 21 Ω	18.132 Ω
H2aQ2b	YT1132-			
H1bQ2b	YT1142+	Circuit B	18.20 to 21 Ω	18.148 Ω
H2bQ2b	YT1142-			

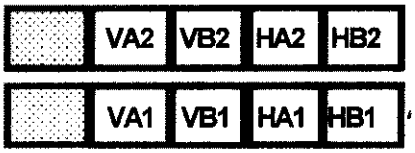
Technician(s) _____ Date 10/18/04

8.2 Using the HP3457A, connect power thru the connector Power Leads (HA2 and HB2 to measure Q2-H2 or VA2 and VB2 to measure Q2-V2). Connect the Sense Leads as shown in table below and record resistance.

(Magnet Bus Leads)



(Corrector Bus Leads)



(View Looking into Q2b)

MCBX Corrector Coil Taps			
Component	**FermiLab Label**	**CERN Label**	**Resistance**
Q2-H2	**VTH2**	**EE8122**	8.43 Ω
	HA2	**N/A**	
Q2-V2	**VTV2**	**EE8112**	8.34 Ω
	VA2	**N/A**	

Technician(s) _____ Date 10/18/04

These measurements are incorrect → see page P84

8.4 Check Q1 Instrumentation Bus Wires for Continuity.

Module	Pin	Fermi	CERN	KEK	Description	Done
M2	1	VTa1Q1	EE1111	a1	Q1 Lead Voltage Tap "a", primary	✓
M2	2	VTa2Q1	EE1121	a2	Q1 Lead Voltage Tap "a", redundant	✓
M2	3	VTc1Q1	EE1211	c1	Q1 Center Voltage Tap "c", primary	✓
M2	4	VTc2Q1	EE1221	c2	Q1 Center Voltage Tap "c", redundant	✓
M2	5	VTb1Q1	EE1311	b1	Q1 Lead Voltage Tap "b", primary	✓
M3	5	VTb2Q1	EE1321	b2	Q1 Lead Voltage Tap "b", redundant	✓
M5	1	VTH1	EE8121		Corrector voltage tap Q1-H1 (skew dipole) (on MCBX, MCBXH, A+ lead)	✓
M5	2	VTV1	EE8111		Corrector voltage tap Q1-V1 (normal dipole) (on MCBX, MCBXV A+ lead)	✓
M7	1	W1aQ1	EH8311+		Q1 Cryogenic Heater lead end - wire at top (CERN #1 I+)	✓
M7	2	W2aQ1	EH8311-		Q1 Cryogenic Heater lead end - wire at bottom (CERN #1 I-)	✓
M7	3	W1bQ1	EH8321+		Q1 Cryogenic Heater non-lead end - wire at top (CERN #2 I+)	✓
M7	4	W2bQ1	EH8321-		Q1 Cryogenic Heater non-lead end - wire at bottom (CERN #2 I-)	✓
M9	1	H1aQ1	YT1111+	HA1	Q1 Protection (Strip) Heater, ("a" circuit) (CERN lead #1+)	✓
M9	3	H2aQ1	YT1111-	HA2	Q1Protection (Strip) Heater, ("a" circuit) (CERN lead #1-)	✓
M9	5	H1bQ1	YT1121+	HB1	Q1 Protection (Strip) Heater, ("b" circuit) (CERN lead #2+)	✓
M10	4	H2bQ1	YT1121-	HB2	Q1 Protection (Strip) Heater, ("b" circuit) (CERN lead #2-)	✓
M12	1	TaQ1_I+	TT8311 I+		Q1 RTD, primary Wire color: Yellow	✓
M12	2	TaQ1_I-	TT8311 I-		Q1 RTD, primary Wire color: Green	✓
M12	3	TaQ1_V+	TT8311 U+		Q1 RTD, primary Wire color: Black	✓
M12	4	TaQ1_V-	TT8311 U-		Q1 RTD, primary Wire color: Red	✓
M12	5	TbQ1_I+	TT8321 I+		Q1 RTD, primary Wire color: Yellow	✓
M12	6	TbQ1_I-	TT8321 I-		Q1 RTD, primary Wire color: Green	✓
M12	11	TbQ1_V+	TT8321 U+		Q1 RTD, primary Wire color: Black	✓
M12	10	TbQ1_V-	TT8321 U-		Q1 RTD, primary Wire color: Red	✓

Technician(s) — Date: 12/18/04

Range on mine — Responsible Authority/Physicist — Date: 12/14/04

9.0 Dome Setup

9.1 Attach IP End Dome (MD-390197) (Q2a) to the End Dome Positioning Fixture (MD-369776). Feed the Electrical wires/Bus through the proper ports as the Dome is brought into position against the End Plate. Ensure that no damage to wires has occurred during insertion.

Technician(s) _____ Date 10/18/04

9.2 Align IP End Dome (MD-390197) as shown in Q2 Cold Mass Welded Assembly (ME-390309).

Technician(s) _____ Date 10/18/04

9.3 Level the IP End Dome (MD-390197) using the Ball Socket (MD-369777) and the Mini Level.

Technician(s) _____ Date 10/18/04

9.4 Mark the IP End Dome (MD-390197) and the End Plate with a Horizontal Witness Line. This Step will be used in Step 11.0 to reposition the Domes prior to Welding.

Technician(s) _____ Date 10/18/04

9.5 Remove the IP End Dome (MD-390197) from the Tooling.

Technician(s) _____ Date 10/18/04

9.6 Attach Non-IP End Dome (MD-390253) (Q2b) to the End Dome Positioning Fixture (MD-369776). Feed the Electrical wires/bus through the proper ports as the Non-IP End Dome (MD-390253) is brought into position against the End Plate.

Technician(s) _____ Date 10/18/04

9.7 Align Non-IP End Dome (MD-390253) as shown in Q2 Cold Mass Welded Assembly (ME-390309).

Technician(s) _____ Date 10/18/04

9.8 Level the Non-IP End Dome (MD-390253) using the Ball Socket (MD-369777) and the Mini Level.

Technician(s) _____ Date 10/18/04

9.9 Mark the Non-IP End Dome (MD-390253) and the End Plate with a Horizontal Witness Line. This Step will be used in Step 11.0 to reposition the Domes prior to Welding.

Technician(s) _____ Date 10/18/04

9.10 Remove the Non-IP End Dome (MD-390253) from the Tooling.

Technician(s) _____ Date 10/18/04

10.0 Beam Tube Insertion

10.1 Inspect the Beam Tube (MD-369802) for damage. Clean Beam Tube using lint free Heavy Duty Wipers (Fermi stock 1660-0150) and Isopropyl Alcohol (Fermi stock 1920-0300) as per Insulated Beam Tube Assembly for Q2a/Q2b (MD-369802).

Technician(s) _____ Date 10/20/04

XXX 10.2 Verify Alignment of Q2a, Q2b and Corrector Magnet (MD-390312) as per Q2 Cold Mass Welded Assembly (ME-390309).

Responsible Authority/Physicist _____ Date 10/20/04

DR# HGQ-0499

10.3 Using Insertion Tooling, insert the Beam Tube (MD-369802) into the Magnet Assembly as per Beam Tube Insertion Tooling (MD-369789).

Technician(s) _____ Date 10-20-04

10.4 Center the Beam Tube (MD-369802) between the Cold Masses by leaving equal amounts of insulated Beam Tube protruding from the End Plates. Measure from the face of the End Plate to the End of the Kapton Wrap on the Beam Tube.

Technician(s) _____ Date 10/20/04

10.5 Measure the Beam Tube length and record this measurement below.

10.5.1 Beam Tube Length: 14288

10.5.2 Subtract 12,610 mm (± 2mm) from the Beam Tube Length, and record here: 1678

10.5.3 Divide the Number recorded in step 10.5.2 by 2 and record here: 839

The measurement recorded in step 10.5.3 is the amount to be cut off from each end.

Technician(s) _____ Date 10/20/04

10.6 Measure from one end of the Beam Tube and place a mark at the distance from step 10.5.3.

Technician(s) _____ Date 10/20/04

10.7 Verify the placement of the Mark, measured in Step 10.6 is correct.

Crew Chief _____ Date 10/20/04

10.8 Using the Wachs Cutter, cut the Beam Tube at the Mark from Step 10.6.

Technician(s) _____ Date 10/20/04

10.9 Measure from one end of the Beam Tube and place a mark at the distance from step 10.5.3.

Technician(s) _____ Date 10/20/04

10.10 Verify the placement of the Mark, measured in Step 10.9 is correct. Measuring from the End Plate, this mark should be equal to the 'End Plate to Beam Tube' distance at the other end.

Crew Chief _____ Date 10-21-04

10.11 Using the Wachs Cutter, cut the Beam Tube at the Mark from Step 10.9.

Technician(s) _____ Date 10/21/04

XXX 10.12 Hipot the Beam Tube to coil, heaters and ground. (5kV) (Max. Leakage < 0.5μA).

STOP

Have Crew Chief verify setup and sign below before continuing.

Crew Chief _____ Date 10/20/04

Hipot	Leakage or Failure Voltage	Pass	Fail
Beam Tube to coil, heaters and ground	.052	✓	

Technician(s) _____ Date 10-20-04

Responsible Authority/Physicist _____ Date 10/20/04

11.0 Dome Installation

STOP

Ensure that a protective sleeve is placed inside the bellows between the convolutions and the bracket to prevent damage to the convolutions.

11.1 Reposition the IP End Dome as shown in Q2 Cold Mass Welded Assembly (ME-390309) using the Horizontal Witness Line from step 9.5.

Technician(s) _____ Date 10/21/04

11.2 Feed the Electrical wires/Bus through the proper ports as the IP End Dome (MD-390197) is brought into position against the End Plate.

Technician(s) _____ Date 10/21/04

11.3 Tack weld the IP End Dome in place at approximately 6-8 places around the Dome per (ME-390309).

Weldor(s) _____ Date 10/21/04

11.4 Weld the IP End Dome, skip weld around to minimize distortion per (ME-390309).

Weldor(s) _____ Date 10/23/04

11.5 Reposition the Non-IP End Dome as shown in Q2 Cold Mass Welded Assembly (ME-390309) using the Horizontal Witness Line from step 9.11.

Technician(s) _____ Date 10/21/04

11.6 Feed the Electrical wires/Bus through the proper ports as the Non-IP End Dome is brought into position against the End Plate.

Technician(s) _____ Date 10/21/04

11.7 Tack weld the Non-IP End Dome in place at approximately 6-8 places around the Dome as per (ME-390309).

Weldor(s) _____ Date 10/21/04

11.8 Weld the Non-IP End Dome, skip weld around to minimize distortion as per (ME-390309).

Weldor(s) _____ Date 10/21/04

11.9 Tack weld the corrector mounting hardware in place as per Q2 Coldmass welded assembly (ME-390309).

Weldor(s) _____ Date 10/21/04

11.10 If needed, perform a stretched wire measurement of the system, noting the relative position and roll of the three magnetic elements to each other.

Performed Stretch Wire Measurement?

Yes ☐ No ☒ (No Signature necessary, if 'No' box is checked)

Technician(s) Date

11.11 Mount and adjust the Shipping restraint screws.

Note(s):
Weld to corrector if necessary.

Technician(s) 10-22-04
Date

11.13 Weld the Center Body Tube (MC-390112) as per Q2 Cold Mass Welded Assembly (ME-390309). (Weld Specification ES-333781)

Weldor(s) 10/23/04
Date

11.14 Undo the Cold Mass / Cryostat Station Support & Clamping Fixture (ME-369768).

Technician(s) 10/25/04
Date

XXX 11.15 Perform a stretched wire measurement of the system to align the Cold Mass within ± .2 mR.

F. Dinasco →

Responsible Authority/Physicist 10/27/04
Date

12.0 Cold Bore

12.1 Flare both ends of the Beam Tube using Flaring Tool (MC-390416) per Q2 Cold Mass Welded Assembly (MB-390309).

Technician(s) _____ Date 10/28/04

12.2 Position Cold Bore Flange (MC-390300) over the Beam Tube and onto IP End Dome (Q2a) per Q2 Cold Mass Welded Assembly (MB-390309).

Technician(s) _____ Date 10/28/04

12.3 Weld the Beam Tube to the Flange at IP End as per Q2 Cold Mass Welded Assembly (ME-390309).

Weldor(s) _____ Date 10/28/04

12.4 Add Spacer between Beam Tube Flange and End Dome, if necessary.

Spacer Added? Yes ☒ No ☐

Technician(s) _____ Date 10-28-04

12.5 Position the Cold Bore Flange (MC-390300) over the Beam Tube and onto the Non-IP End Dome (Q2b) per Q2 Cold Mass Welded Assembly (MB-390309).

Technician(s) _____ Date 10-28-04

12.6 Weld Beam Tube to Flange at NON-IP End as per Q2 Cold Mass Welded Assembly (ME-390309).

Weldor(s) _____ Date 10/28/04

12.7 Align Beam Tube and the Flange at IP End per Q2 Cold Mass Welded Assembly (MB-390309).

Technician(s) _____ Date 11-1-04

12.8 Weld the Flange to the IP End Dome as per Q2 Cold Mass Welded Assembly (ME-390309).

Bob W.

Weldor(s) _____ Date 11/1/04

STRETCHED WIRE NEEDED HERE

12.9 Align Beam Tube and Flange at NON-IP End per Q2 Cold Mass Welded Assembly (MB-390309).

Technician(s) _____ Date 11-1-04

12.10 Weld the Flange to the Non-IP End Dome as per Q2 Cold Mass Welded Assembly (ME-390309).

TRR# 1734 Bob W.

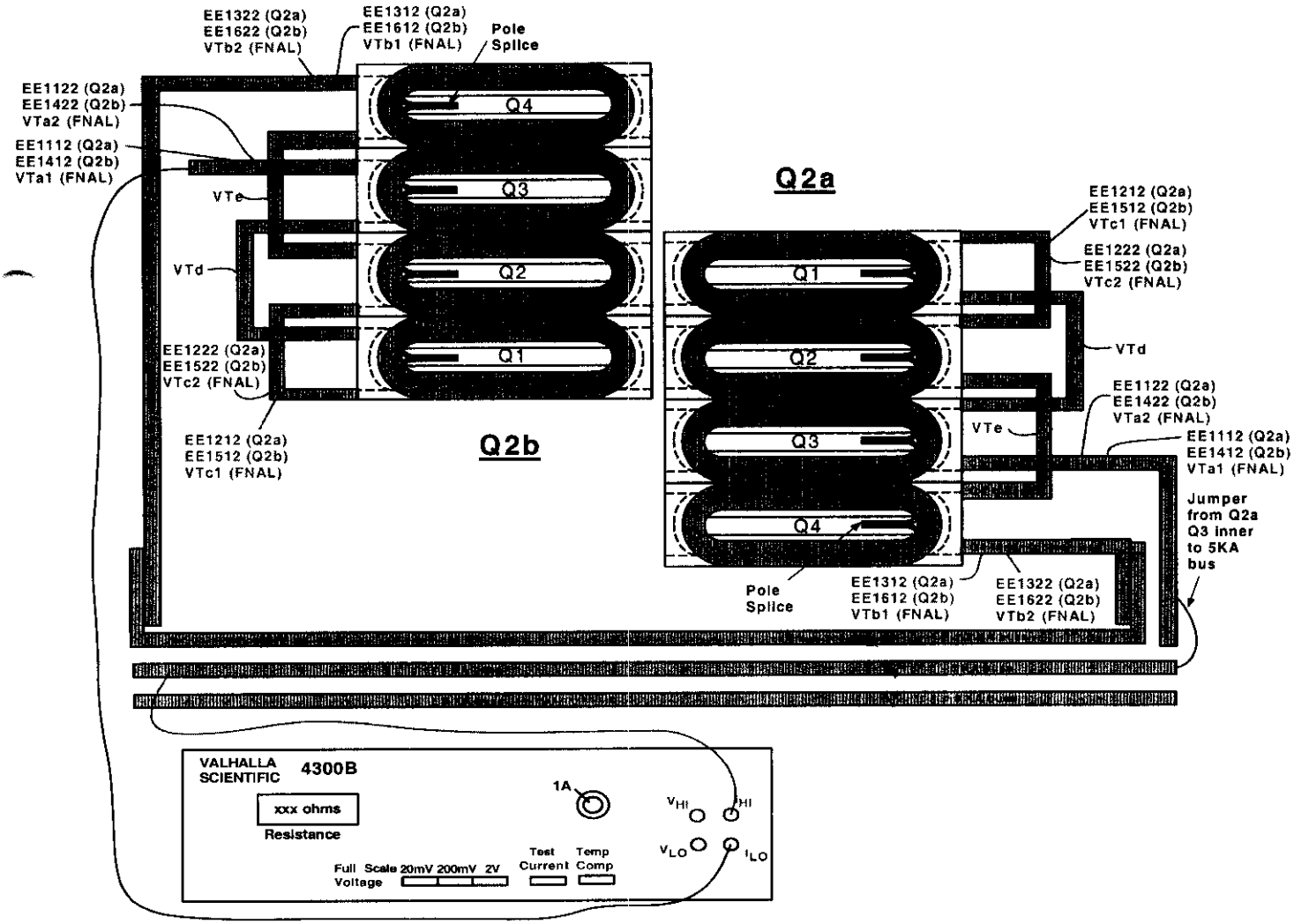
Weldor(s) _____ Date 11/1/04

13.0 Electrical Inspection

13.1 Perform an electrical inspection on each of the Individual Quadrants and the Cold Masses. Refer to the Valhalla and Leader Free Standing Coil Measurement Procedure (ES-292306).

To measure the resistance of a bussed Q2:

1. Use Valhalla Scientific 4300B digital micro-ohmmeter.
2. Set Test Current to 1 amp.
3. Set Scale to 2V full scale.
4. Turn temperature compensation on.
5. Turn test current off.
6. Put jumper between Q2a Q3 inner power lead and 5 KA bus as shown in figure.
7. Connect I_{HI} to the 5KA bus (Q2a Q3 inner power lead) as shown in figure.
8. Connect I_{LO} to the Q2b Q3 inner power lead as shown in figure.
9. Turn test current on.
10. Connect V_{HI} and V_{LO} to voltage taps as shown below.
11. Read resistance and record in traveler.



(Q2a) Resistance				Nominal ~ 560 to 585 mΩ
Voltage Tap Serial Numbers				Quadrant Total Resistance
Connect	Fermi	CERN	Quadrant	
V_{HI}	VTdQ2a	EMPTY	Quadrant 1	.5720 mΩ
V_{LO}	VTc1Q2a	EE1212		
V_{HI}	VTc1Q2a	EE1212	Quadrant 2	.5721 mΩ
V_{LO}	VTeQ2a	EMPTY		
V_{HI}	VTa1Q2a	EE1112	Quadrant 3	.5719 mΩ
V_{LO}	VTdQ2a	EMPTY		
V_{HI}	VTeQ2a	EMPTY	Quadrant 4	.5722 mΩ
V_{LO}	VTb1Q2a	EE1312		

V_{HI}	VTa1Q2a	EE1112	Total Cold Mass	Nominal ~ 2.305 Ω
V_{LO}	VTb1Q2a	EE1312		2.298 Ω

Technician(s) 11-2-04 Date

Check resistance of Redundant Voltage Taps.

Q2a Redundant Voltage Taps			
Connect	Fermi	CERN	Resistance
V_{HI}	VTa2Q2a	EE1122	1.146 Ω
V_{LO}	VTc2Q2a	EE1222	
V_{HI}	VTc2Q2a	EE1222	1.145 Ω
V_{LO}	VTb2Q2a	EE1322	

Technician(s) 11-2-04 Date

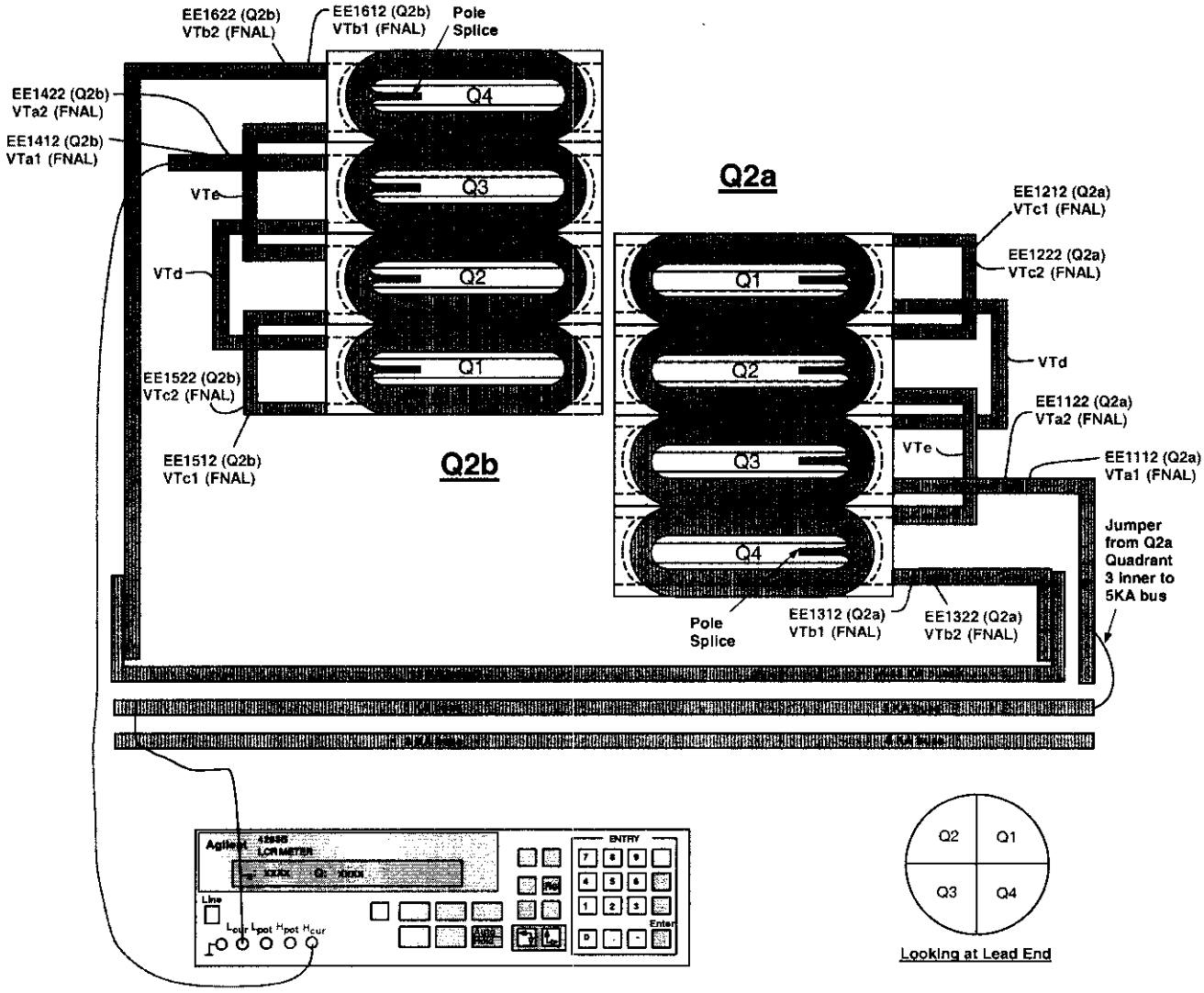
To measure Ls and Q of a Bussed Q2a:

1. Use Agilent 4263B LCR Meter.
2. Turn power on by pushing Line button. Wait 30 seconds until display screen is lit.
3. Recall program #1. To do this, push recall (Rcl), then push the #1, then push Enter.
4. Push Auto/Hold button to release hold.
5. Verify that the frequency displayed in the upper right corner of the display screen is 1000 Hz and the level recorded in the lower right corner of the display screen is 1V or 1000 mV.
6. Connect jumper between Q2a/Quadrant 3 inner power lead and 5KA bus as shown in figure.
7. Connect H_{cur} to Q2b/Quadrant 3 inner power lead as shown in figure.
8. Connect L_{cur} to 5KA bus as shown in figure.
9. Connect H_{pot} and L_{pot} buttons to voltage taps as shown below.

To measure Q2a:

- To measure Q1, connect H_{pot} to VTc1 (EE1212 for Q2a), and L_{pot} to VTd.
- To measure Q2, connect H_{pot} to VTe, and L_{pot} to VTc1 (EE1212 for Q2a).
- To measure Q3, connect H_{pot} to VTd and L_{pot} to VTa1 (EE1112 for Q2a).
- To measure Q4, connect H_{pot} to VTb1 (EE1312 for Q2a), and L_{pot} to VTe.
- To measure total, connect H_{pot} to VTb1 (EE1312 for Q2a), and L_{pot} to VTa1 (EE1112 for Q2a).

10. Read Ls and Q from display and record in traveler.



(Q2a) Inductance				Nominal ~ 2.880 to 2.935 mH
Voltage Tap Serial Numbers				Quadrant Total Inductance
Connect	Fermi	CERN	Quadrant	
L_{POT}	VTdQ2a	EMPTY	Quadrant 1	3.359 mH
H_{POT}	VTc1Q2a	EE1212		
L_{POT}	VTc1Q2a	EE1212	Quadrant 2	3.269 mH
H_{POT}	VTeQ2a	EMPTY		
L_{POT}	VTdQ2a	EMPTY	Quadrant 3	3.336 mH
H_{POT}	VTa1Q2a	EE1112		
L_{POT}	VTeQ2a	EMPTY	Quadrant 4	3.31 mH
H_{POT}	VTb1Q2a	EE1312		

L_{POT}	VTa1Q2a	EE1112	Total Cold Mass	Nominal ~ 13.3376 mH
H_{POT}	VTb1Q2a	EE1312		13.401 mH

(Q2a) Q-Factor				Nominal ~ 4.5 to 5.2
Voltage Tap Serial Numbers				Quadrant Total Q
Connect	Fermi	CERN	Quadrant	
L_{POT}	VTdQ2a	EMPTY	Quadrant 1	5.2
H_{POT}	VTc1Q2a	EE1212		
L_{POT}	VTc1Q2a	EE1212	Quadrant 2	5.2
H_{POT}	VTeQ2a	EMPTY		
L_{POT}	VTa1Q2a	EE1112	Quadrant 3	5.1
H_{POT}	VTdQ2a	EMPTY		
L_{POT}	VTeQ2a	EMPTY	Quadrant 4	5.2
H_{POT}	VTb1Q2a	EE1312		

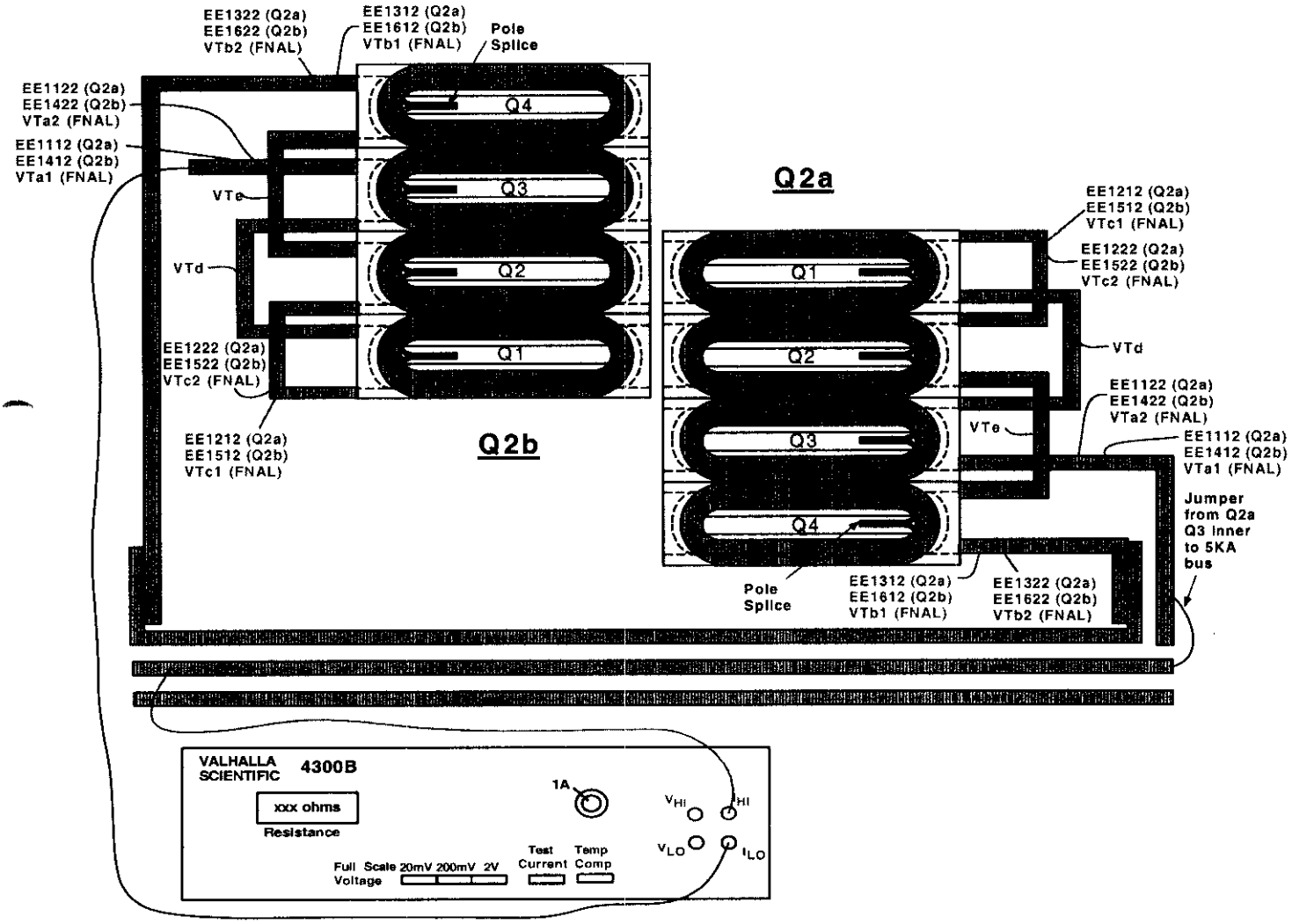
L_{POT}	VTa1Q2a	EE1112	Total Cold Mass	Nominal ~ 5.036
H_{POT}	VTb1Q2a	EE1312		5.2

Technician(s)

11-2-04
Date

To measure the resistance of a bussed Q2:

1. Use Valhalla Scientific 4300B digital micro-ohmmeter.
2. Set Test Current to 1 amp.
3. Set Scale to 2V full scale.
4. Turn temperature compensation on.
5. Turn test current off.
6. Put jumper between Q2a Q3 inner power lead and 5 KA bus as shown in figure.
7. Connect I_{HI} to the 5KA bus (Q2a Q3 inner power lead) as shown in figure.
8. Connect I_{LO} to the Q2b Q3 inner power lead as shown in figure.
9. Turn test current on.
10. Connect V_{HI} and V_{LO} to voltage taps as shown below.
11. Read resistance and record in traveler.



(Q2b) Resistance				Nominal ~ 560 to 585 mΩ
Voltage Tap Serial Numbers				Quadrant Total Resistance
Connect	Fermi	CERN	Quadrant	
V_{HI}	VTc1Q2b	EE1512	Quadrant 1	.5732 mΩ
V_{LO}	VTdQ2b	EMPTY		
V_{HI}	VTeQ2b	EMPTY	Quadrant 2	.5722 mΩ
V_{LO}	VTc1Q2b	EE1512		
V_{HI}	VTdQ2b	EMPTY	Quadrant 3	.5722 mΩ
V_{LO}	VTa1Q2b	EE1412		
V_{HI}	VTb1Q2b	EE1612	Quadrant 4	.5728 mΩ
V_{LO}	VTeQ2b	EMPTY		

V_{HI}	VTb1Q2b	EE1612	Total Cold Mass	Nominal ~ 2.305 Ω
V_{LO}	VTa1Q2b	EE1412		2.298 Ω

Technician(s) 11-2-04 Date

Check the resistance of the Redundant Voltage Taps.

Q2b Redundant Voltage Taps			
Connect	Fermi	CERN	Resistance
V_{HI}	VTc2Q2b	EE1522	1.147 Ω
V_{LO}	VTa2Q2b	EE1422	
V_{HI}	VTb2Q2b	EE1622	1.145 Ω
V_{LO}	VTc2Q2b	EE1522	

Technician(s) 11-2-04 Date

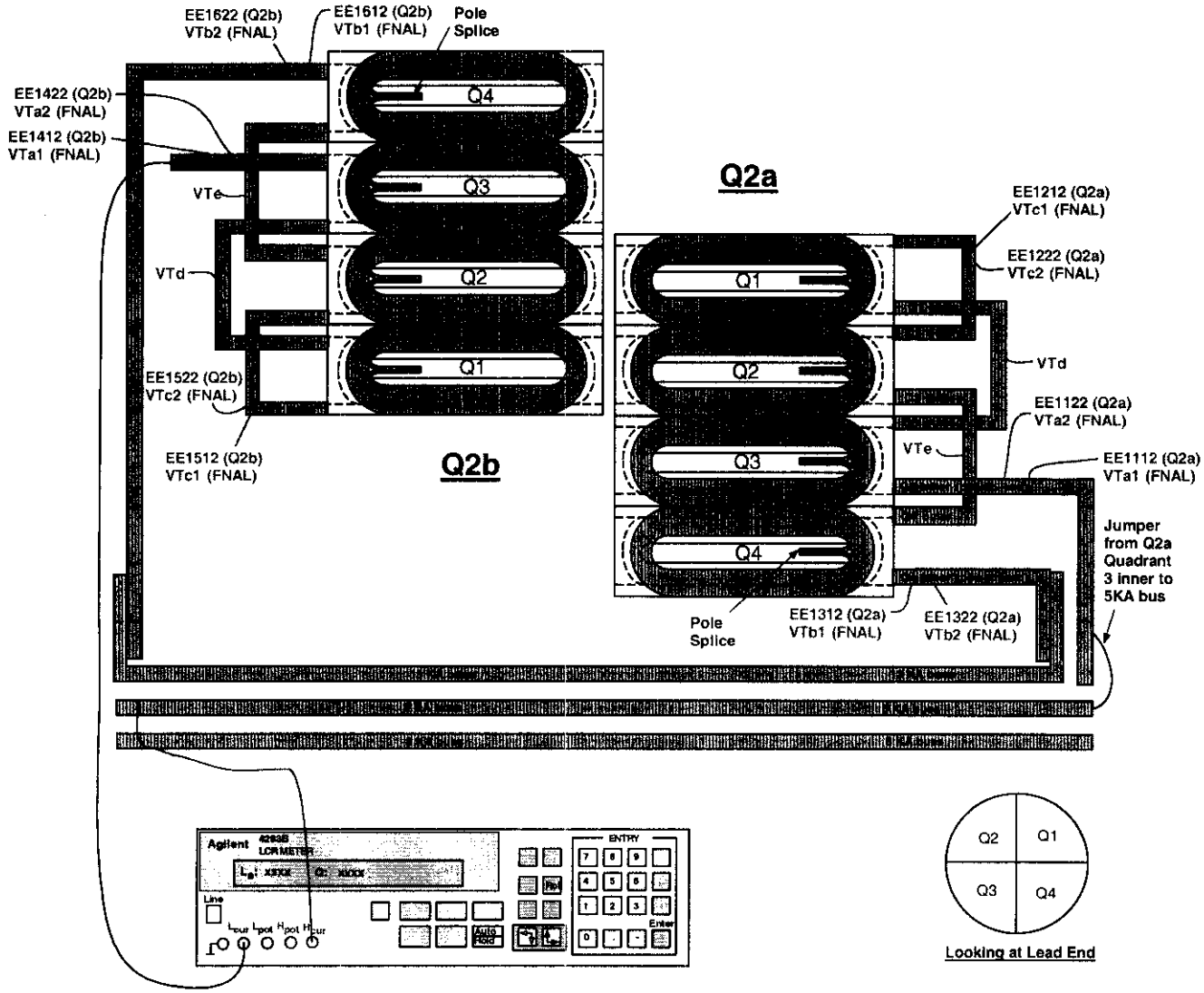
To measure Ls and Q of a Bussed Q2b:

1. Use Agilent 4263B LCR Meter.
2. Turn power on by pushing line button. Wait 30 seconds until display screen is lit.
3. Recall program #1. To do this, push recall (Rcl), then push #1, then push Enter.
4. Push Auto/Hold button to release hold.
5. Verify that the frequency displayed in the upper right corner of the display screen is 1000 Hz and the level recorded in the lower right corner of the display screen is 1V or 1000 mV.
6. Connect jumper between Q2a/Quadrant 3 inner power lead and 5KA bus as shown in figure.
7. Connect H_{cur} to 5KA bus as shown in figure.
8. Connect L_{cur} to Q2b/Quadrant 3 inner power lead as shown in figure.
9. Connect H_{pot} and L_{pot} buttons to voltage taps as shown below.

To measure Q2b:

- To measure Q1, connect H_{pot} to VTc1 (EE1512 for Q2b), and L_{pot} to VTd.
- To measure Q2, connect H_{pot} to VTe and L_{pot} to VTc1 (EE1512 for Q2b).
- To measure Q3, connect H_{pot} to VTd and L_{pot} to VTa1 (EE1412 for Q2b).
- To measure Q4, connect H_{pot} to VTb1 (EE1612 for Q2b) and L_{pot} to VTe.
- To measure total, connect H_{pot} to VTb1 (EE1612 for Q2b) and L_{pot} to VTa1 (EE1412 for Q2b).

10. Read Ls and Q from display and record in traveler.



(Q2b) Inductance				Nominal ~ 2.880 to 2.935 mH
Voltage Tap Serial Numbers				Quadrant Total Inductance
Connect	Fermi	CERN	Quadrant	
H_{POT}	VTc1Q2b	EE1512	Quadrant 1	3.321 mH
L_{POT}	VTdQ2b	EMPTY		
H_{POT}	VTeQ2b	EMPTY	Quadrant 2	3.351 mH
L_{POT}	VTc1Q2b	EE1512		
H_{POT}	VTdQ2b	EMPTY	Quadrant 3	3.346 mH
L_{POT}	VTa1Q2b	EE1412		
H_{POT}	VTb1Q2b	EE1612	Quadrant 4	3.344 mH
L_{POT}	VTeQ2b	EMPTY		

H_{POT}	VTb1Q2b	EE1612	Total Cold Mass	Nominal ~ 13.3376 mH
L_{POT}	VTa1Q2b	EE1412		13.411 mH

(Q2b) Q-Factor				Nominal ~ 4.5 to 5.2
Voltage Tap Serial Numbers				Quadrant Total Q
Connect	Fermi	CERN	Quadrant	
H_{POT}	VTc1Q2b	EE1512	Quadrant 1	5.1
L_{POT}	VTdQ2b	EMPTY		
H_{POT}	VTeQ2b	EMPTY	Quadrant 2	5.2
L_{POT}	VTc1Q2b	EE1512		
H_{POT}	VTdQ2b	EMPTY	Quadrant 3	5.2
L_{POT}	VTa1Q2b	EE1412		
H_{POT}	VTb1Q2b	EE1612	Quadrant 4	5.1
L_{POT}	VTeQ2b	EMPTY		

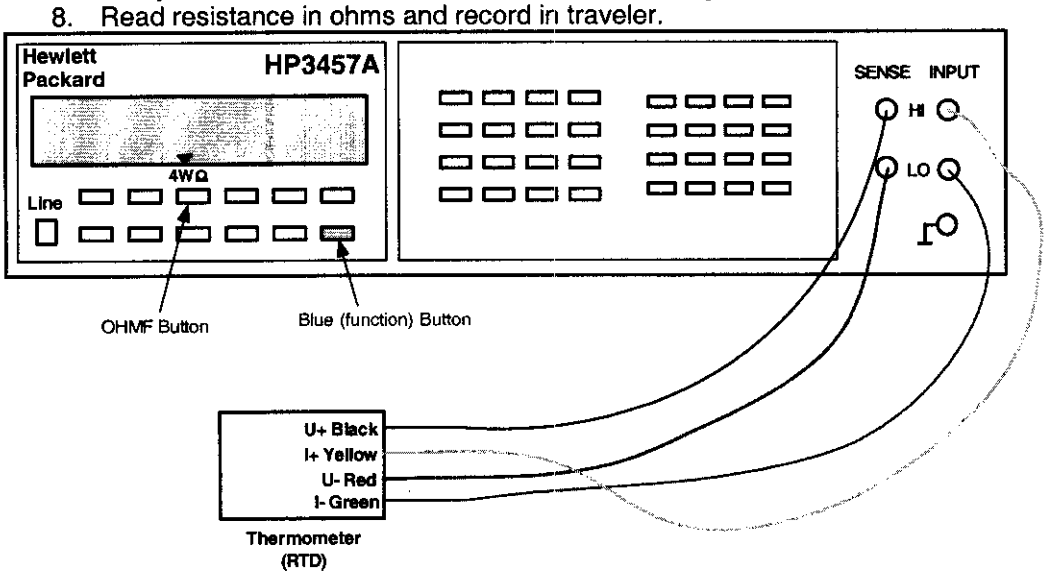
H_{POT}	VTb1Q2b	EE1612	Total Cold Mass	Nominal ~ 5.036
L_{POT}	VTa1Q2b	EE1412		5.2

Technician(s)

11-2-04
Date

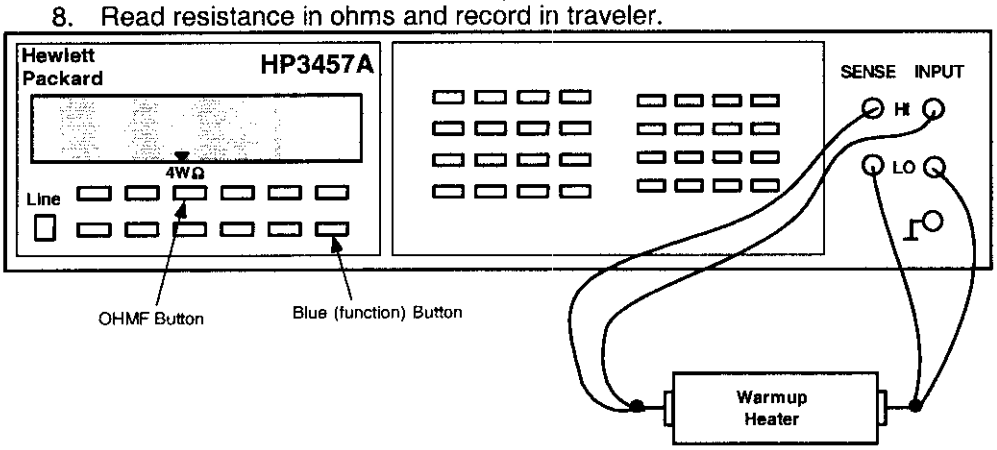
To measure the resistance of a Thermometer (RTD):

1. Use Hewlett Packard HP3457A digital multimeter.
2. Record temperature of building within +/- 5 degrees.
3. Press line button to turn line on.
4. Connect wires as shown in Figure below.
   U+ (Black) to Sense HI
   I+ (Yellow) to Input HI
   U- (Red) to Sense LO
   I- (Green) to Input LO
5. Push blue button (function key) once.
6. Push OHMF button.
7. Verify arrow in readout is above the 4W□ (meaning a 4 wire resistance measurement).
8. Read resistance in ohms and record in traveler.



To measure the resistance of a Cryogenic (Warm-up) Heater

1. Use Hewlett Packard HP3457A digital multimeter.
2. Record temperature of building within +/- 5 degrees.
3. Press line button to turn line on.
4. Connect wires as shown in Figure below.
5. Push blue button (function key) once.
6. Push OHMF button.
7. Verify arrow in readout is above the 4W□ (meaning a 4 wire resistance measurement).
   Note: Although this is technically a 4 wire measurement, it is effectively a 2 wire measurement, since there are only 2 wires connected to each heater.
8. Read resistance in ohms and record in traveler.



Q2a - RTD's and Cryogenic (warm-up) Heaters			
Temperature of Building (+/- 5°): 70°			
Component	**Fermi**	**CERN**	**Resistance**
Q2a RTD, primary	TaQ2a	TT8312	66.710 Ω
Q2a RTD, redundant	TbQ2a	TT8322	67.491 Ω
Q2A Cryogenic (warm-up) Heater (LE) - wire toward cold mass end plate (CERN #1 I+)	W1aQ2A	EH8312+	16.826 Ω
Q2A Cryogenic (warm-up) Heater (LE) - wire toward cold mass mag center (CERN #1 I-)	W2aQ2A	EH8312-	
Q2A Cryogenic (warm-up) Heater (Non-LE) - wire toward cold mass end plate (CERN #2 I+)	W1bQ2A	EH8322+	16.888 Ω
Q2A Cryogenic (warm-up) Heater (Non-LE) - wire toward cold mass mag center (CERN #2 I-)	W2bQ2A	EH8322-	

Technician(s) 11-2-04 Date

Q2b - RTD's and Cryogenic (warm-up) Heaters			
Temperature of Building (+/- 5°): 70°			
Component	**Fermi**	**CERN**	**Resistance**
Q2b RTD, primary	TaQ2b	TT8332	65.111 Ω
Q2b RTD, redundant	TbQ2b	TT8342	68.101 Ω
Q2B Cryogenic (warm-up) Heater (LE) - wire toward cold mass end plate (CERN #1 I+)	W1aQ2B	EH8332+	16.301 Ω
Q2B Cryogenic (warm-up) Heater (LE) - wire toward cold mass mag center (CERN #1 I-)	W2aQ2B	EH8332-	
Q2B Cryogenic (warm-up) Heater (Non-LE) - wire toward cold mass end plate (CERN #2 I+)	W1bQ2B	EH8342+	16.491 Ω
Q2B Cryogenic (warm-up) Heater (Non-LE) - wire toward cold mass mag center (CERN #2 I-)	W2bQ2B	EH8342-	

Technician(s) 11-2-04 Date

Using the Hewlett Packard HP3457A digital multimeter, measure the Strip Heater Resistance for Q2a and Q2b.

Q2a Strip Heater Resistance				
Fermi	CERN	Description	Limit	Resistance
H1aQ2a	YT1112+	Circuit A	18.20 to 21 Ω	18.881 Ω
H2aQ2a	YT1112-			
H1bQ2a	YT1122+	Circuit B	18.20 to 21 Ω	18.791 Ω
H2bQ2a	YT1122-			

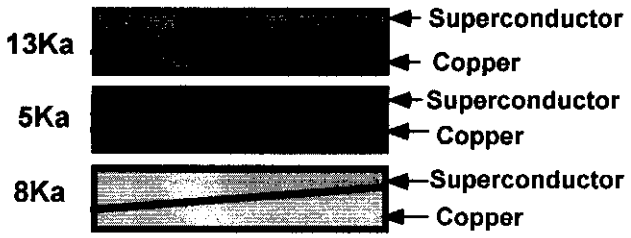
Technician(s) _____ Date 11-2-04

Q2b Strip Heater Resistance				
Fermi	CERN	Description	Limit	Resistance
H1aQ2b	YT1132+	Circuit A	18.20 to 21 Ω	17.886 Ω
H2aQ2b	YT1132-			
H1bQ2b	YT1142+	Circuit B	18.20 to 21 Ω	17.86 Ω
H2bQ2b	YT1142-			

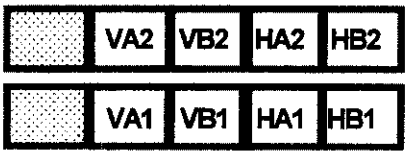
Technician(s) _____ Date 11-2-04

13.2 Using the HP3457A, connect power thru the corrector Power Leads (HA2 and HB2 to measure Q2-H2 or VA2 and VB2 to measure Q2-V2). Connect the Sense Leads as shown in table below and record resistance.

(Magnet Bus Leads)



(Corrector Bus Leads)



(View Looking into Q2b)

MCBX Corrector Coil Taps			
Component	**FermiLab Label**	**CERN Label**	**Resistance**
Q2-H2	VTH2	EE8122	~~27.4~~ Ω
	HA2	HA2 ~~N/A~~	
Q2-V2	VTV2	EE8112	16.9 Ω
	VA2	VA2 ~~N/A~~	

MJL

Technician(s)

11-2-04
Date

CHANGE THIS STEP TO ROGER BOSSERT

TRR#1659

See Roger about changing this chart. Need to add measurements from tap to each lead, and across leads. Also need "nominal" box.
RB 11-5-04

XXX 13.3 Hipot according to table below. Hipot to 5kV. Maximum leakage is 3μA.

STOP

Have Crew Chief verify setup and sign below before continuing.

Crew Chief _____ Date 11/2/04

Hipot Heaters to Coil and Ground.

High Potential	Grounded	Floating	Leakage
All Strip Heaters	Coils, Yoke, Q1 Instrumentation Bus, Lead and Corrector Coil Busses, RTD's and Warm-up Heaters	Nothing	.401 μA

Hipot according to table below. Hipot to 5kV. Maximum leakage is 3μA.

STOP

Have Crew Chief verify setup and sign below before continuing.

Crew Chief _____ Date 11/2/04

Hipot Coil to Heaters and Ground.

High Potential	Grounded	Floating	Leakage
All Coils	Strip Heaters, Yoke, Q1 Instrumentation Bus, 8kA and 5kA Lead Busses and Corrector Coil Busses, RTD's and Warm-up Heaters	Nothing	.063 μA

Technician(s) _____ Date 11-2-04

Responsible Authority/Physicist _____ Date 11-2-04

Move to AT Tab 13.2

13.4 Check Q1 Instrumentation Bus Wires for Continuity.

Module	Pin	Fermi	CERN	KEK	Description	Done
M2	1	VTa1Q1	EE1111	a1	Q1 Lead Voltage Tap "a", primary	✓
M2	2	VTa2Q1	EE1121	a2	Q1 Lead Voltage Tap "a", redundant	✓
M2	3	VTc1Q1	EE1211	c1	Q1 Center Voltage Tap "c", primary	✓
M2	4	VTc2Q1	EE1221	c2	Q1 Center Voltage Tap "c", redundant	✓
M2	5	VTb1Q1	EE1311	b1	Q1 Lead Voltage Tap "b", primary	✓
M3	5	VTb2Q1	EE1321	b2	Q1 Lead Voltage Tap "b", redundant	✓
M5	1	VTH1	EE8121		Corrector voltage tap Q1-H1 (skew dipole) (on MCBX, MCBXH, A+ lead)	✓
M5	2	VTV1	EE8111		Corrector voltage tap Q1-V1 (normal dipole) (on MCBX, MCBXV A+ lead)	✓
M7	1	W1aQ1	EH8311+		Q1 Cryogenic Heater lead end - wire at top (CERN #1 I+)	✓
M7	2	W2aQ1	EH8311-		Q1 Cryogenic Heater lead end - wire at bottom (CERN #1 I-)	✓
M7	3	W1bQ1	EH8321+		Q1 Cryogenic Heater non-lead end - wire at top (CERN #2 I+)	✓
M7	4	W2bQ1	EH8321-		Q1 Cryogenic Heater non-lead end - wire at bottom (CERN #2 I-)	✓
M9	1	H1aQ1	YT1111+	HA1	Q1 Protection (Strip) Heater, ("a" circuit) (CERN lead #1+)	✓
M9	3	H2aQ1	YT1111-	HA2	Q1Protection (Strip) Heater, ("a" circuit) (CERN lead #1-)	✓
M9	5	H1bQ1	YT1121+	HB1	Q1 Protection (Strip) Heater, ("b" circuit) (CERN lead #2+)	✓
M10	4	H2bQ1	YT1121-	HB2	Q1 Protection (Strip) Heater, ("b" circuit) (CERN lead #2-)	✓
M12	1	TaQ1_I+	TT8311 I+		Q1 RTD, primary Wire color: Yellow	✓
M12	2	TaQ1_I-	TT8311 I-		Q1 RTD, primary Wire color: Green	
M12	3	TaQ1_V+	TT8311 U+		Q1 RTD, primary Wire color: Black	✓
M12	4	TaQ1_V-	TT8311 U-		Q1 RTD, primary Wire color: Red	✓
M12	5	TbQ1_I+	TT8321 I+		Q1 RTD, primary Wire color: Yellow	✓
M12	6	TbQ1_I-	TT8321 I-		Q1 RTD, primary Wire color: Green	✓
M12	11	TbQ1_V+	TT8321 U+		Q1 RTD, primary Wire color: Black	✓
M12	10	TbQ1_V-	TT8321 U-		Q1 RTD, primary Wire color: Red	✓

SPARE

Technician(s) — Date: 11-2-04

Responsible Authority/Physicist — Date: 11-2-04

14.0 Installation of Hypertronics

14.1 Install Hypertronics Connectors at **Q2a** end as per Q2 Cold Mass Welded Assembly (ME-390309) and Hypertronics Connector Assembly Q2 Magnet Return End (MB-418133). Pin Numbers for connectors are shown in Table 14.1 below.

Table 14.1

Q2 connector (ip, or Q2a end) for Q1-Q2 connection. Completed on 11-20-03.					
Module	**Pin**	**Fermilab Label**	**CERN Label**	**KEK Label**	**Description**
M1	1				Blank Module
M1	2				
M1	3				
M1	4				
M1	5				
M2	1	VTa1Q1	EE1111	a1	Q1 Lead Voltage Tap "a", primary
M2	2	VTa2Q1	EE1121	a2	Q1 Lead Voltage Tap "a",redundant
M2	3	VTc1Q1	EE1211	c1	Q1 Center Voltage Tap "c", primary
M2	4	VTc2Q1	EE1221	c2	Q1 Center Voltage Tap "c", redundant
M2	5	VTb1Q1	EE1311	b1	Q1 Lead Voltage Tap "b", primary
M3	1	Empty	Empty		No Connection
M3	2	Empty	Empty		No Connection
M3	3	Empty	Empty		No Connection
M3	4	Empty	Empty		No Connection
M3	5	VTb2Q1	EE1321	b2	Q1 Lead Voltage Tap "b",redundant
M4	1				Blank Module
M4	2				
M4	3				
M4	4				
M4	5				
M5	1	VTH1	EE8121		Corrector voltage tap Q1-H1 (skew dipole) (on MCBX, MCBXH, A+ lead)
M5	2	VTV1	EE8111		Corrector voltage tap Q1-V1 (normal dipole) (on MCBX, MCBXV A+ lead)
M5	3	Empty	Empty		No Connection
M5	4	Empty	Empty		No Connection
M5	5	Empty	Empty		No Connection

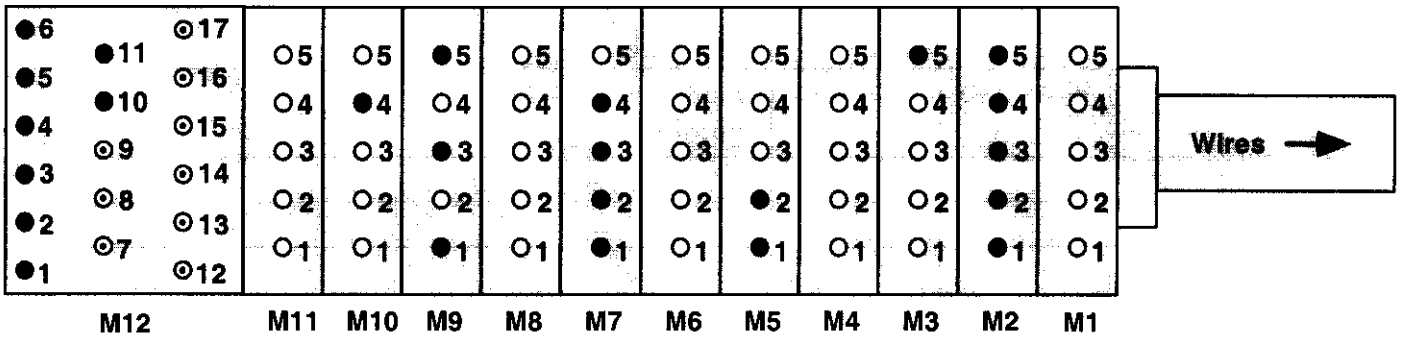
Table 14.1

Module	Pin	Fermilab Label	CERN Label	KEK Label	Description
M6	1				Blank Module
M6	2				
M6	3				
M6	4				
M6	5				
M7	1	W1aQ1	EH8311+		Q1 Cryogenic Heater lead end - wire at top (CERN #1 I+)
M7	2	W2aQ1	EH8311-		Q1 Cryogenic Heater lead end - wire at bottom (CERN #1 I-)
M7	3	W1bQ1	EH8321+		Q1 Cryogenic Heater non-lead end - wire at top (CERN #2 I+)
M7	4	W2bQ1	EH8321-		Q1 Cryogenic Heater non-lead end - wire at bottom (CERN #2 I-)
M7	5	Empty	Empty		No connection
M8	1				Blank Module
M8	2				
M8	3				
M8	4				
M8	5				
M9	1	H1aQ1	YT1111+	HA1	Q1 Protection (Strip) Heater, ("a" circuit) (CERN lead #1+)
M9	2	Empty	Empty		No connection
M9	3	H2aQ1	YT1111-	HA2	Q1Protection (Strip) Heater, ("a" circuit) (CERN lead #1-)
M9	4	Empty	Empty		No connection
M9	5	H1bQ1	YT1121+	HB1	Q1 Protection (Strip) Heater, ("b" circuit) (CERN lead #2+)
M10	1	Empty	Empty		No Connection
M10	2	Empty	Empty		No Connection
M10	3	Empty	Empty		No Connection
M10	4	H2bQ1	YT1121-	HB2	Q1 Protection (Strip) Heater, ("b" circuit) (CERN lead #2-)
M10	5	Empty	Empty		No Connection

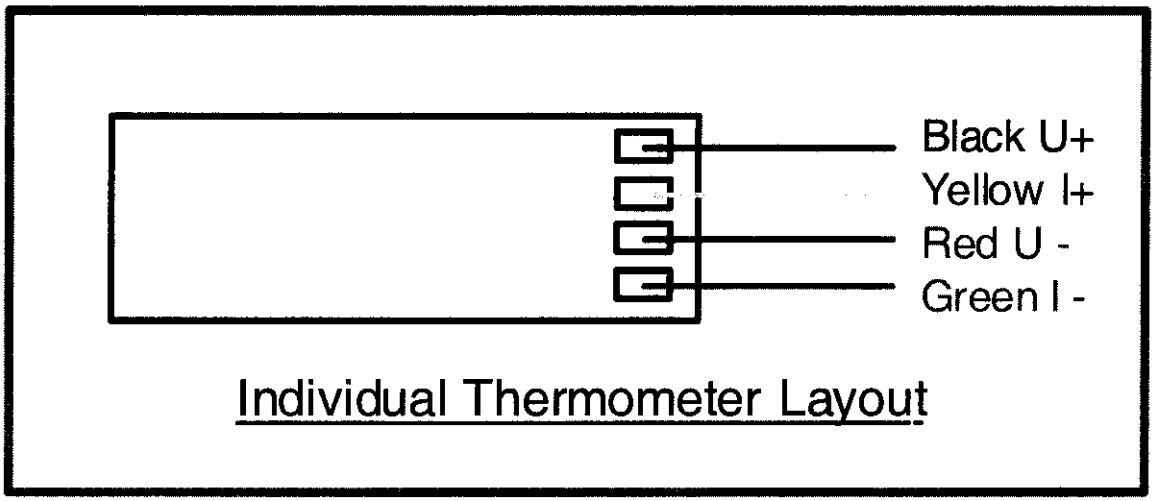
Table 14.1

Module	Pin	Fermilab Label	CERN Label	KEK Label	Description
M11	1				Blank Module
M11	2				
M11	3				
M11	4				
M11	5				
Note: Pin numbers of Module M12 are not listed in numerical order					
M12	1	TaQ1_I+	TT8311 I+		Q1 RTD, primary Wire color: Yellow
M12	2	TaQ1_I-	TT8311 I-		Q1 RTD, primary Wire color: Green
M12	3	TaQ1_V+	TT8311 U+		Q1 RTD, primary Wire color: Black
M12	4	TaQ1_V-	TT8311 U-		Q1 RTD, primary Wire color: Red
M12	5	TbQ1_I+	TT8321 I+		Q1 RTD, redundant: Wire color: Yellow
M12	6	TbQ1_I-	TT8321 I-		Q1 RTD, redundant: Wire color: Green
M12	11	TbQ1_V+	TT8321 U+		Q1 RTD, redundant: Wire color: Black
M12	10	TbQ1_V-	TT8321 U-		Q1 RTD, redundant: Wire color: Red
M12	9	Empty	Empty		No connection
M12	8	Empty	Empty		No connection
M12	7	Empty	Empty		No connection
M12	12	Empty	Empty		No connection
M12	13	Empty	Empty		No connection
M12	14	Empty	Empty		No connection
M12	15	Empty	Empty		No connection
M12	16	Empty	Empty		No connection
M12	17	Empty	Empty		No connection

Hypertronics Connector Pin Locations for Q2 (ip, or Q2a end)
VIEW: Female (receptacle) solder cup side



● Hole filled in grey: Wire soldered to pin.
⊙ Hole with dot in center: Pin exists but no wire soldered to it.
O Hole filled in white: No pin. Hole is drilled out.



Technician(s) _____ Date 11/5/04

14.2 Install Hypertronics Connectors at **Q2b** end as per Q2 Cold Mass Welded Assembly (ME-390309) and Hypertronics Connector Assembly (MB-418083).
Pin Numbers for connectors are shown in Table 14.2 below.

Table 14.2

Q2 connector (non-ip, or Q2b end) for Q2-Q3 connection Completed on 11-20-03					
Module	**Pin**	**Fermilab Label**	**CERN Label**	**KEK Label**	**Description**
M1	1				Blank Module
M1	2				
M1	3				
M1	4				
M1	5				
M2	1	VTa1Q1	EE1111	a1	Q1 Lead Voltage Tap "a" , primary
M2	2	VTa2Q1	EE1121	a2	Q1 Lead Voltage Tap "a", redundant
M2	3	VTc1Q1	EE1211	c1	Q1 Center Voltage Tap "c", primary
M2	4	VTc2Q1	EE1221	c2	Q1 Center Voltage Tap "c", redundant
M2	5	VTb1Q1	EE1311	b1	Q1 Lead Voltage Tap "b", primary
M3	1	VTc1Q2a	EE1212		Q2a Center Voltage Tap "c", primary
M3	2	VTdQ2a	Empty		Q2a Quarter Coil Voltage Tap "d" (Q1inner-Q3 outer interface)
M3	3	VTa2Q2a	EE1122		Q2a lead Voltage Tap "a", redundant
M3	4	VTa1Q2a	EE1112		Q2a Lead Voltage Tap "a", primary
M3	5	VTb2Q1	EE1321	b2	Q1 Lead Voltage Tap "b", redundant
M4	1	VTc2Q2a	EE1222		Q2a Center Voltage Tap "c", redundant
M4	2	VTeQ2a	Empty		Q2a Quarter Voltage Tap "e", (Q2 inner -Q4 outer interface)
M4	3	VTb1Q2a	EE1312		Q2a Lead Voltage Tap "b", primary
M4	4	VTb2Q2a	EE1322		Q2a Lead Voltage Tap "b", redundant
M4	5	VTb1Q2b	EE1612		Q2b lead Voltage Tap "b", primary
M5	1	VTdQ2b	Empty		Q2b Quarter Coil Voltage Tap "d" (Q1inner-Q3 outer interface)
M5	2	VTc2Q2b	EE1522		Q2b Center Voltage Tap "c", redundant
M5	3	VTc1Q2b	EE1512		Q2b Center Voltage Tap "c", primary
M5	4	VTeQ2b	Empty		Q2b Quarter Voltage Tap "e", (Q2 inner -Q4 outer interface)
M5	5	VTb2Q2b	EE1622		Q2b Lead Voltage Tap "b" redundant

Table 14.2

Module	Pin	Fermilab Label	CERN Label	KEK Label	Description
M6	1	VTa1Q2b	EE1412		Q2b Lead Voltage Tap "a", primary
M6	2	VTa2Q2b	EE1422		Q2b Lead Voltage Tap "a", redundant
M6	3	Empty	Empty		No connection
M6	4	Empty	Empty		No connection
M6	5	Empty	Empty		No connection
M7	1				Blank Module
M7	2				
M7	3				
M7	4				
M7	5				
M8	1	VTH1	EE8121		Corrector voltage tap Q1-H1 (skew dipole) (on MCBX, MCBXH, A+ lead)
M8	2	VTV1	EE8111		Corrector voltage tap Q1-V1 (normal dipole) (on MCBX, MCBXV A+ lead)
M8	3	VTH2	EE8122		Corrector voltage tap Q2-H2 (skew dipole) (on MCBX, MCBXH, A+ lead)
M8	4	VTV2	EE8112		Corrector voltage tap Q2-V2 (normal dipole) (on MCBX, MCBXV, A+ lead)
M8	5	Empty	Empty		No connection
M9	1				Blank Module
M9	2				
M9	3				
M9	4				
M9	5				
M10	1	W1aQ1	EH8311+		Q1 Cryogenic Heater lead end - wire at top (CERN #1 I+)
M10	2	W2aQ1	EH8311-		Q1 Cryogenic Heater lead end - wire at bottom (CERN #1 I-)
M10	3	W1bQ1	EH8321+		Q1 Cryogenic Heater non-lead end - wire at top (CERN #2 I+)
M10	4	W2bQ1	EH8321-		Q1 Cryogenic Heater non-lead end - wire at bottom (CERN #2 I-)
M10	5	Empty	Empty		No connection

Table 14.2

Module	Pin	Fermilab Label	CERN Label	KEK Label	Description
M11	1	W1aQ2A	EH8312+		Q2A Cryogenic Heater lead end - wire toward cold mass end plate (CERN #1 I+)
M11	2	W2aQ2A	EH8312-		Q2A Cryogenic Heater lead end - wire toward cold mass mag center (CERN #1 I-)
M11	3	W1bQ2A	EH8322+		Q2A Cryogenic Heater non-lead end- wire toward cold mass end plate (CERN #2 I+)
M11	4	W2bQ2A	EH8322-		Q2A Cryogenic Heater non-lead end- wire toward cold mass mag center (CERN #2 I-)
M11	5	Empty	Empty		No connection
M12	1	W1aQ2B	EH8332+		Q2B Cryogenic Heater lead end - wire toward cold mass end plate (CERN #1 I+)
M12	2	W2aQ2B	EH8332-		Q2B Cryogenic Heater lead end - wire toward cold mass mag center (CERN #1 I-)
M12	3	W1bQ2B	EH8342+		Q2B Cryogenic Heater non-lead end- wire toward cold mass end plate (CERN #2 I+)
M12	4	W2bQ2B	EH8342-		Q2B Cryogenic Heater non-lead end- wire toward cold mass mag center (CERN #2 I-)
M12	5	Empty	Empty		No connection
M13	1				Blank Module
M13	2				
M13	3				
M13	4				
M13	5				
M14	1	H1aQ1	YT1111+	HA1	Q1 Protection (Strip) Heater, ("a" circuit) (CERN lead #1+)
M14	2	Empty	Empty		No connection
M14	3	H2aQ1	YT1111-	HA2	Q1Protection (Strip) Heater, ("a" circuit) (CERN lead #1-)
M14	4	Empty	Empty		No connection
M14	5	H1bQ1	YT1121+	HB1	Q1 Protection (Strip) Heater, ("b" circuit) (CERN lead #2+)

Table 14.2

Module	Pin	Fermilab Label	CERN Label	KEK Label	Description
M15	1	Empty	Empty		No connection
M15	2	H1aQ2a	YT1112+		Q2a Protection (Strip) Heater, 1-4 & 2-3 circuit (FNAL lead A+) (CERN lead #1+)
M15	3	Empty	Empty		No connection
M15	4	H2bQ1	YT1121-	HB2	Q1 Protection (Strip) Heater, ("b" circuit) (CERN lead #2-)
M15	5	Empty	Empty		No connection
M16	1	H2aQ2a	YT1112-		Q2a Protection (Strip) Heater, 1-4 & 2-3 circuit (FNAL lead A-) (CERN lead #1-)
M16	2	Empty	Empty		No connection
M16	3	H1bQ2a	YT1122+		Q2a Protection (Strip) Heater, 1-2 & 3-4 circuit (FNAL lead B+) (CERN lead#2+)
M16	4	Empty	Empty		No connection
M16	5	H2bQ2a	YT1122-		Q2a Protection (Strip) Heater, 1-2 & 3-4 circuit (FNAL lead B-) (CERN lead #2-)
M17	1	Empty	Empty		No connection
M17	2	H2aQ2b	YT1132-		Q2b Protection (Strip) Heater, 1-4 & 2-3 circuit (FNAL lead A-) (CERN lead #1-)
M17	3	Empty	Empty		No connection
M17	4	H1aQ2b	YT1132+		Q2b Protection (Strip) Heater, 1-4 & 2-3 circuit (FNAL lead A+) (CERN lead #1+)
M17	5	Empty	Empty		No connection
M18	1	H1bQ2b	YT1142+		Q2b Protection (Strip) Heater, 1-2 & 3-4 circuit (FNAL lead B+) (CERN lead#2+)
M18	2	Empty	Empty		No connection
M18	3	H2bQ2b	YT1142-		Q2b Protection (Strip) Heater, 1-2 & 3-4 circuit (FNAL lead B-) (CERN lead #2-)
M18	4	Empty	Empty		No connection
M18	5	Empty	Empty		No connection

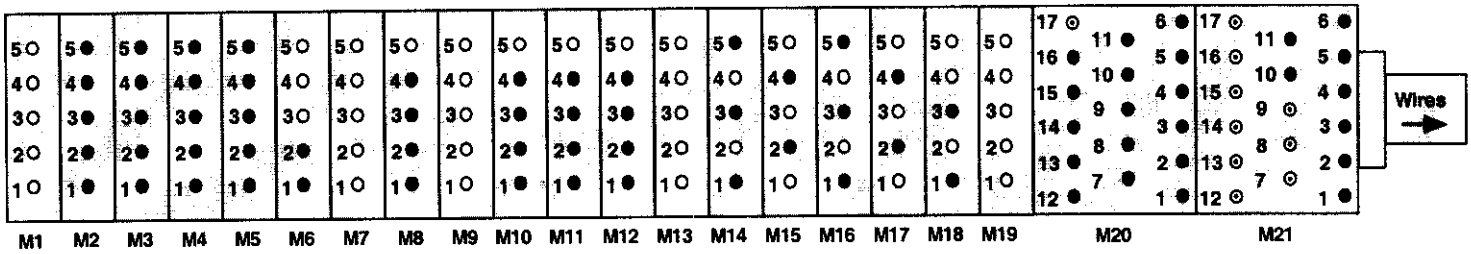
Table 14.2

Module	Pin	Fermilab Label	CERN Label	KEK Label	Description
M19	1				Blank Module
M19	2				
M19	3				
M19	4				
M19	5				
Note: Pin numbers of Module M20 are not listed in numerical order					
M20	1	TaQ1_I+	TT8311 I+		Q1 RTD, primary Wire color: Yellow
M20	2	TaQ1_I-	TT8311 I-		Q1 RTD, primary Wire color: Green
M20	3	TaQ1_V+	TT8311 U+		Q1 RTD, primary Wire color: Black
M20	4	TaQ1_V-	TT8311 U-		Q1 RTD, primary Wire color: Red
M20	5	TbQ1_I+	TT8321 I+		Q1 RTD, redundant: Wire color: Yellow
M20	6	TbQ1_I-	TT8321 I-		Q1 RTD, redundant: Wire color: Green
M20	11	TbQ1_V+	TT8321 U+		Q1 RTD, redundant: Wire color: Black
M20	10	TbQ1_V-	TT8321 U-		Q1 RTD, redundant: Wire color: Red
M20	9	TaQ2a_I+	TT8312 I+		Q2a RTD, primary Wire color: Yellow
M20	8	TaQ2a_I-	TT8312 I-		Q2a RTD, primary Wire color: Green
M20	7	TaQ2a_V+	TT8312 U+		Q2a RTD, primary Wire color: Black
M20	12	TaQ2a_V-	TT8312 U-		Q2a RTD, primary Wire color: Red
M20	13	TbQ2a_I+	TT8322 I+		Q2a RTD, redundant: Wire color: Yellow
M20	14	TbQ2a_I-	TT8322 I-		Q2a RTD, redundant: Wire color: Green
M20	15	TbQ2a_V+	TT8322 U+		Q2a RTD, redundant: Wire color: Black
M20	16	TbQ2a_V-	TT8322 U-		Q2a RTD, redundant: Wire color: Red
M20	17	Empty	Empty		No connection

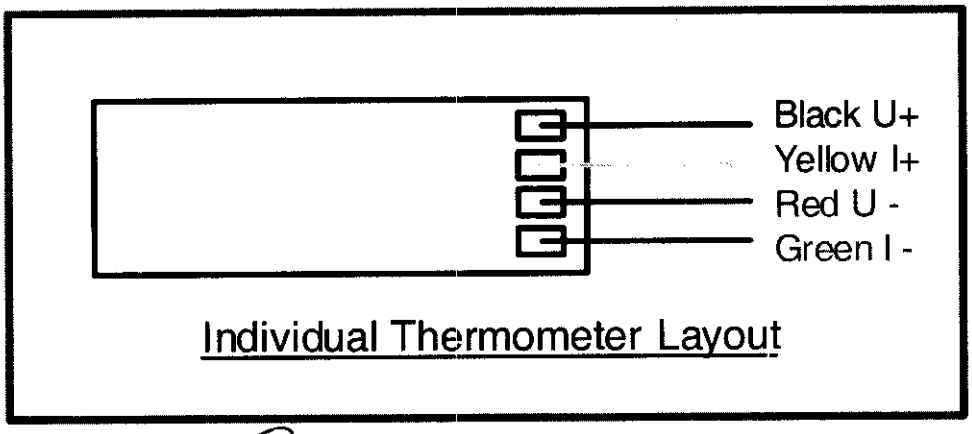
Table 14.2

Note: Pin numbers of Module M21 are not listed in numerical order					
Module	**Pin**	**Fermilab Label**	**CERN Label**	**KEK Label**	**Description**
M21	1	TaQ2b_I+	TT8332 I+		Q2b RTD, primary Wire color: Yellow
M21	2	TaQ2b_I-	TT8332 I-		Q2b RTD, primary Wire color: Green
M21	3	TaQ2b_V+	TT8332 U+		Q2b RTD, primary Wire color: Black
M21	4	TaQ2b_V-	TT8332 U-		Q2b RTD, primary Wire color: Red
M21	5	TbQ2b_I+	TT8342 I+		Q2b RTD, redundant: Wire color: Yellow
M21	6	TbQ2b_I-	TT8342 I-		Q2b RTD, redundant: Wire color: Green
M21	11	TbQ2b_V+	TT8342 U+		Q2b RTD, redundant: Wire color: Black
M21	10	TbQ2b_V-	TT8342 U-		Q2b RTD, redundant: Wire color: Red
M21	9	Empty	Empty		No connection
M21	8	Empty	Empty		No connection
M21	7	Empty	Empty		No connection
M21	12	Empty	Empty		No connection
M21	13	Empty	Empty		No connection
M21	14	Empty	Empty		No connection
M21	15	Empty	Empty		No connection
M21	16	Empty	Empty		No connection
M21	17	Empty	Empty		No connection

Hypertronics Connector pin locations for Q2 (non-ip, or Q2b end)
VIEW: Male (pin) solder cup side



- ● **Hole filled in grey: Wire soldered to pin.**
- ⊙ **Hole with dot in center: Pin exists but no wire soldered to it.**
- ○ **Hole filled in white: No pin. Hole is drilled out.**



Technician(s) _____ Date 11/5/04

XXX 14.3 Check installation of Hypertronics. Ensure Hypertronics were installed as per Q2 Cold Mass Welded Assembly (ME-390309), Hypertronics Connector Assembly Q2 Magnet Return End (MB-418133) and Hypertronics Connector Assembly (MB-418083).

Technician(s) _____ Date 11/05/04

Responsible Authority/Physicist _____ Date 11/5/04

DR HUQ 0503

Replace as Below

TRR# 1659 XXI Inspect connector for ensuring free of flux + kapton install properly

Responsible

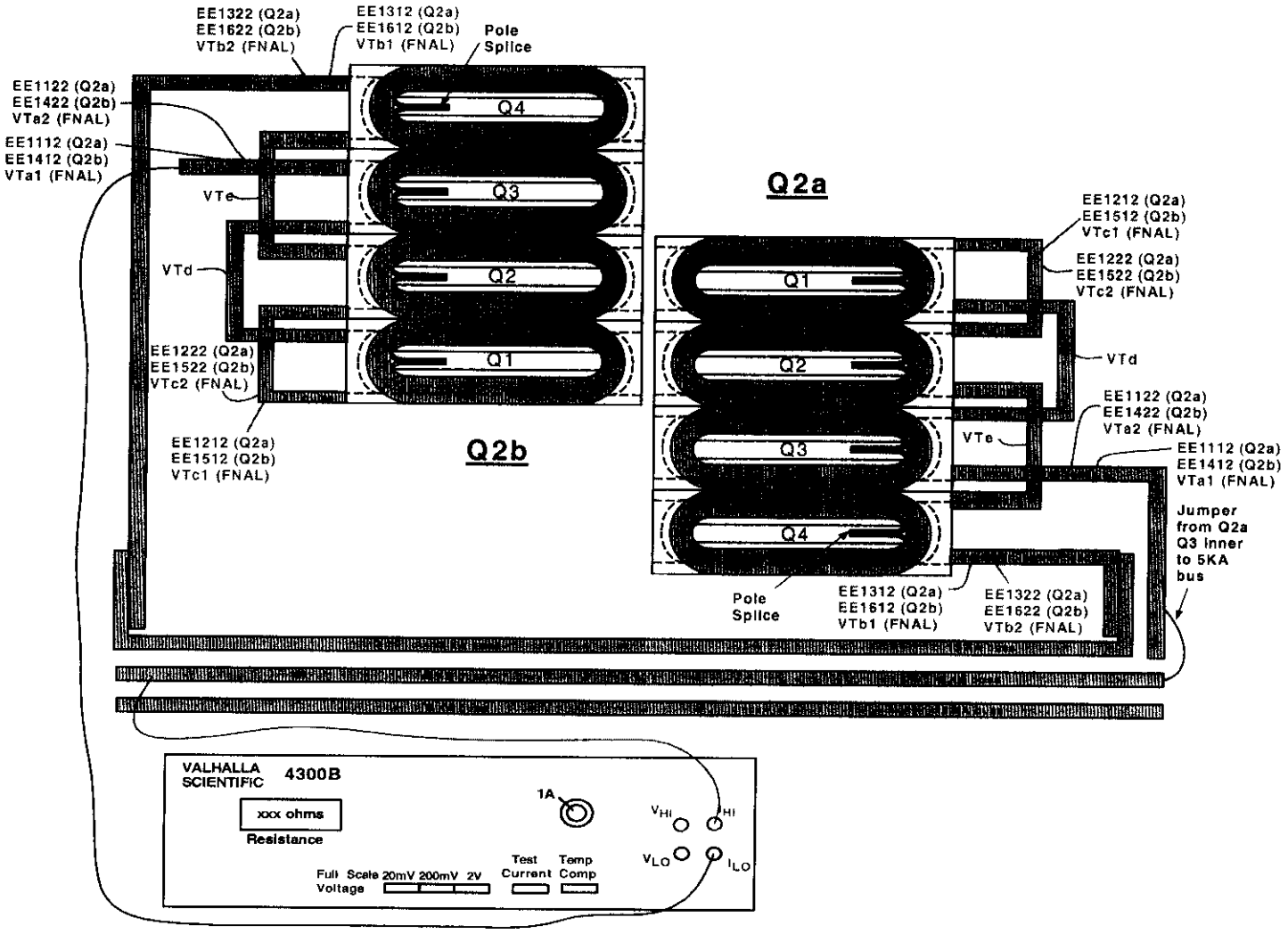
XX AFTER responsible

15.0 Final Electrical Inspection

15.1 Perform an electrical inspection on each of the Individual Quadrants and the Cold Masses. Refer to the Valhalla and Leader Free Standing Coil Measurement Procedure (ES-292306).

To measure the resistance of a bussed Q2:

1. Use Valhalla Scientific 4300B digital micro-ohmmeter.
2. Set Test Current to 1 amp.
3. Set Scale to 2V full scale.
4. Turn temperature compensation on.
5. Turn test current off.
6. Put jumper between Q2a Q3 inner power lead and 5 KA bus as shown in figure.
7. Connect I_{HI} to the 5KA bus (Q2a Q3 inner power lead) as shown in figure.
8. Connect I_{LO} to the Q2b Q3 inner power lead as shown in figure.
9. Turn test current on.
10. Connect V_{HI} and V_{LO} to voltage taps as shown below.
11. Read resistance and record in traveler.



(Q2a) Resistance				Nominal ~ 560 to 585 mΩ
Voltage Tap Serial Numbers				Quadrant Total Resistance
Connect	Fermi	CERN	Quadrant	
V_{HI}	VTdQ2a	EMPTY	Quadrant 1	570.5 mΩ
V_{LO}	VTc1Q2a	EE1212		
V_{HI}	VTc1Q2a	EE1212	Quadrant 2	570.7 mΩ
V_{LO}	VTeQ2a	EMPTY		
V_{HI}	VTa1Q2a	EE1112	Quadrant 3	571.0 mΩ
V_{LO}	VTdQ2a	EMPTY		
V_{HI}	VTeQ2a	EMPTY	Quadrant 4	571.1 mΩ
V_{LO}	VTb1Q2a	EE1312		

V_{HI}	VTa1Q2a	EE1112	Total Cold Mass	Nominal ~ 2.305 Ω
V_{LO}	VTb1Q2a	EE1312		2.285 Ω

A Gould
Technician(s)

11/06/04
Date

Check resistance of Redundant Voltage Taps.

Q2a Redundant Voltage Taps			
Connect	Fermi	CERN	Resistance
V_{HI}	VTa2Q2a	EE1122	1143.7 mΩ
V_{LO}	VTc2Q2a	EE1222	
V_{HI}	VTc2Q2a	EE1222	1142.0 mΩ
V_{LO}	VTb2Q2a	EE1322	

A Gould
Technician(s)

11/06/04
Date

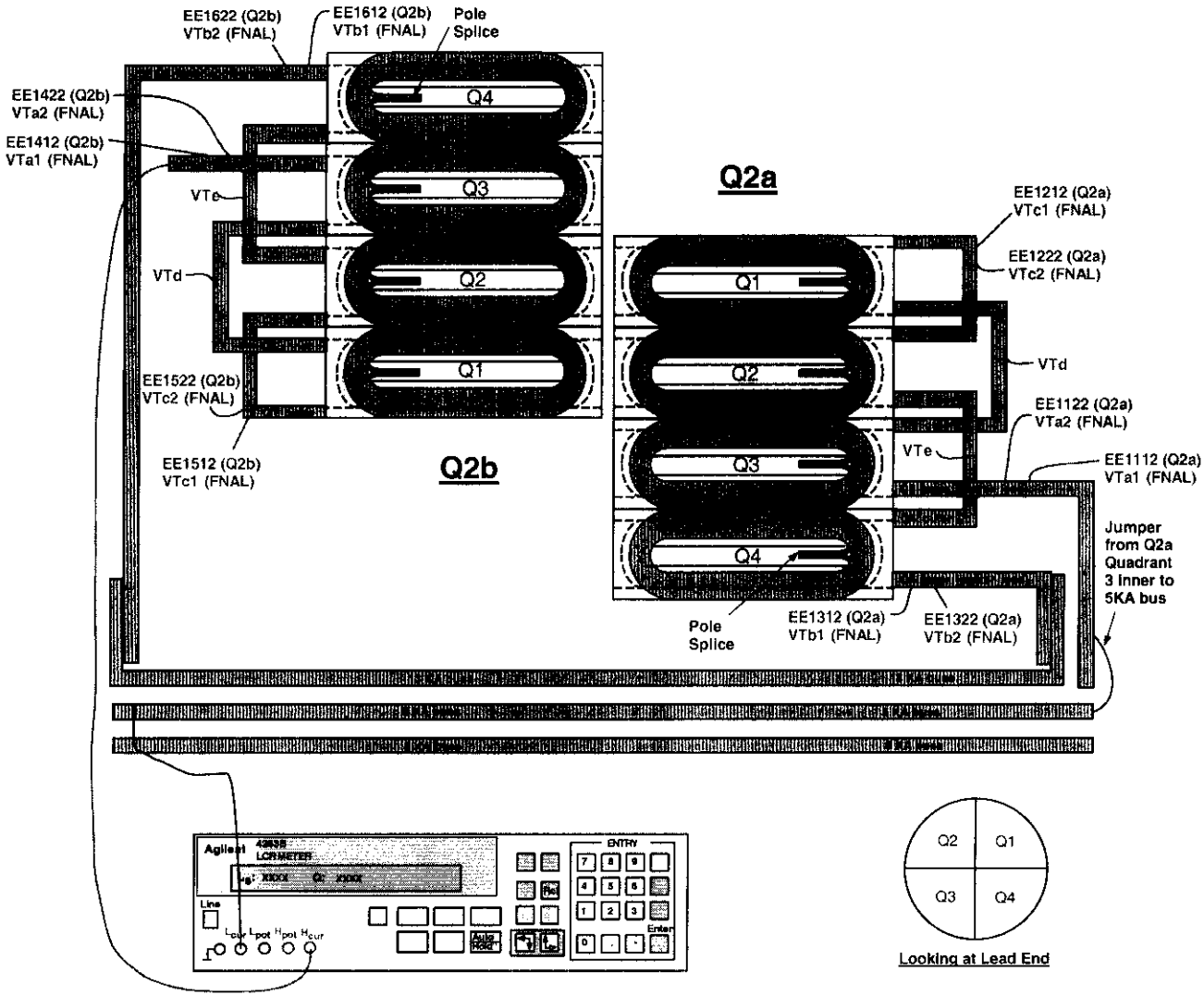
To measure Ls and Q of a Bussed Q2a:

1. Use Agilent 4263B LCR Meter.
2. Turn power on by pushing Line button. Wait 30 seconds until display screen is lit.
3. Recall program #1. To do this, push recall (Rcl), then push the #1, then push Enter.
4. Push Auto/Hold button to release hold.
5. Verify that the frequency displayed in the upper right corner of the display screen is 1000 Hz and the level recorded in the lower right corner of the display screen is 1V or 1000 mV.
6. Connect jumper between Q2a/Quadrant 3 inner power lead and 5KA bus as shown in figure.
7. Connect H_{cur} to Q2b/Quadrant 3 inner power lead as shown in figure.
8. Connect L_{cur} to 5KA bus as shown in figure.
9. Connect H_{pot} and L_{pot} buttons to voltage taps as shown below.

To measure Q2a:

- To measure Q1, connect H_{pot} to VTc1 (EE1212 for Q2a), and L_{pot} to VTd.
- To measure Q2, connect H_{pot} to VTe, and L_{pot} to VTc1 (EE1212 for Q2a).
- To measure Q3, connect H_{pot} to VTd and L_{pot} to VTa1 (EE1112 for Q2a).
- To measure Q4, connect H_{pot} to VTb1 (EE1312 for Q2a), and L_{pot} to VTe.
- To measure total, connect H_{pot} to VTb1 (EE1312 for Q2a), and L_{pot} to VTa1 (EE1112 for Q2a).

10. Read Ls and Q from display and record in traveler.



(Q2a) Inductance				Nominal ~ 2.880 to 2.935 mH
Voltage Tap Serial Numbers				Quadrant Total Inductance
Connect	Fermi	CERN	Quadrant	
L_{POT}	VTdQ2a	EMPTY	Quadrant 1	3.3508 mH
H_{POT}	VTc1Q2a	EE1212		
L_{POT}	VTc1Q2a	EE1212	Quadrant 2	3.3422 mH
H_{POT}	VTeQ2a	EMPTY		
L_{POT}	VTdQ2a	EMPTY	Quadrant 3	3.3104 mH
H_{POT}	VTa1Q2a	EE1112		
L_{POT}	VTeQ2a	EMPTY	Quadrant 4	3.3060 mH
H_{POT}	VTb1Q2a	EE1312		

L_{POT}	VTa1Q2a	EE1112	Total Cold Mass	Nominal ~ 13.3376 mH
H_{POT}	VTb1Q2a	EE1312		13.306 mH

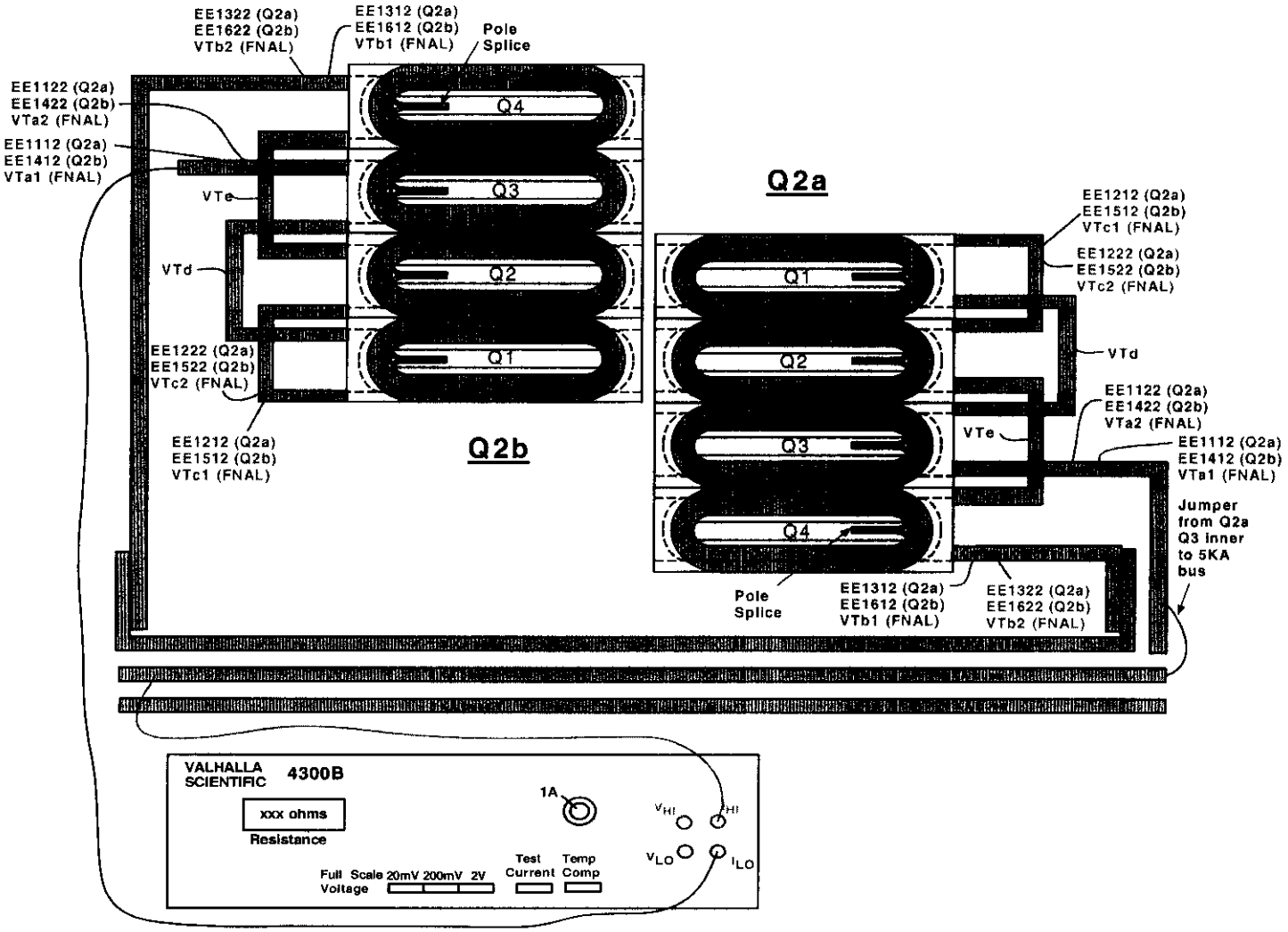
(Q2a) Q-Factor				Nominal ~ 4.5 to 5.2
Voltage Tap Serial Numbers				Quadrant Total Q
Connect	Fermi	CERN	Quadrant	
L_{POT}	VTdQ2a	EMPTY	Quadrant 1	4.2
H_{POT}	VTc1Q2a	EE1212		
L_{POT}	VTc1Q2a	EE1212	Quadrant 2	4.2
H_{POT}	VTeQ2a	EMPTY		
L_{POT}	VTa1Q2a	EE1112	Quadrant 3	4.0
H_{POT}	VTdQ2a	EMPTY		
L_{POT}	VTeQ2a	EMPTY	Quadrant 4	4.3
H_{POT}	VTb1Q2a	EE1312		

L_{POT}	VTa1Q2a	EE1112	Total Cold Mass	Nominal ~ 5.036
H_{POT}	VTb1Q2a	EE1312		4.2

Technician(s) _____ Date 11/6/04

To measure the resistance of a bussed Q2:

1. Use Valhalla Scientific 4300B digital micro-ohmmeter.
2. Set Test Current to 1 amp.
3. Set Scale to 2V full scale.
4. Turn temperature compensation on.
5. Turn test current off.
6. Put jumper between Q2a Q3 inner power lead and 5 KA bus as shown in figure.
7. Connect I_{HI} to the 5KA bus (Q2a Q3 inner power lead) as shown in figure.
8. Connect I_{LO} to the Q2b Q3 inner power lead as shown in figure.
9. Turn test current on.
10. Connect V_{HI} and V_{LO} to voltage taps as shown below.
11. Read resistance and record in traveler.



(Q2b) Resistance				Nominal ~ 560 to 585 mΩ
Voltage Tap Serial Numbers				Quadrant Total Resistance
Connect	Fermi	CERN	Quadrant	
V_{HI}	VTc1Q2b	EE1512	Quadrant 1	571.5 mΩ
V_{LO}	VTdQ2b	EMPTY		
V_{HI}	VTeQ2b	EMPTY	Quadrant 2	570.5 mΩ
V_{LO}	VTc1Q2b	EE1512		
V_{HI}	VTdQ2b	EMPTY	Quadrant 3	571.2 mΩ
V_{LO}	VTa1Q2b	EE1412		
V_{HI}	VTb1Q2b	EE1612	Quadrant 4	571.1 mΩ
V_{LO}	VTeQ2b	EMPTY		

V_{HI}	VTb1Q2b	EE1612	Total Cold Mass	Nominal ~ 2.305 Ω
V_{LO}	VTa1Q2b	EE1412		2.285 Ω

Technician(s) _____ Date 11/6/04

Check the resistance of the Redundant Voltage Taps.

Q2b Redundant Voltage Taps			
Connect	Fermi	CERN	Resistance
V_{HI}	VTc2Q2b	EE1522	1142.5 mΩ
V_{LO}	VTa2Q2b	EE1422	
V_{HI}	VTb2Q2b	EE1622	1141.5 mΩ
V_{LO}	VTc2Q2b	EE1522	

Technician(s) _____ Date 11/6/04

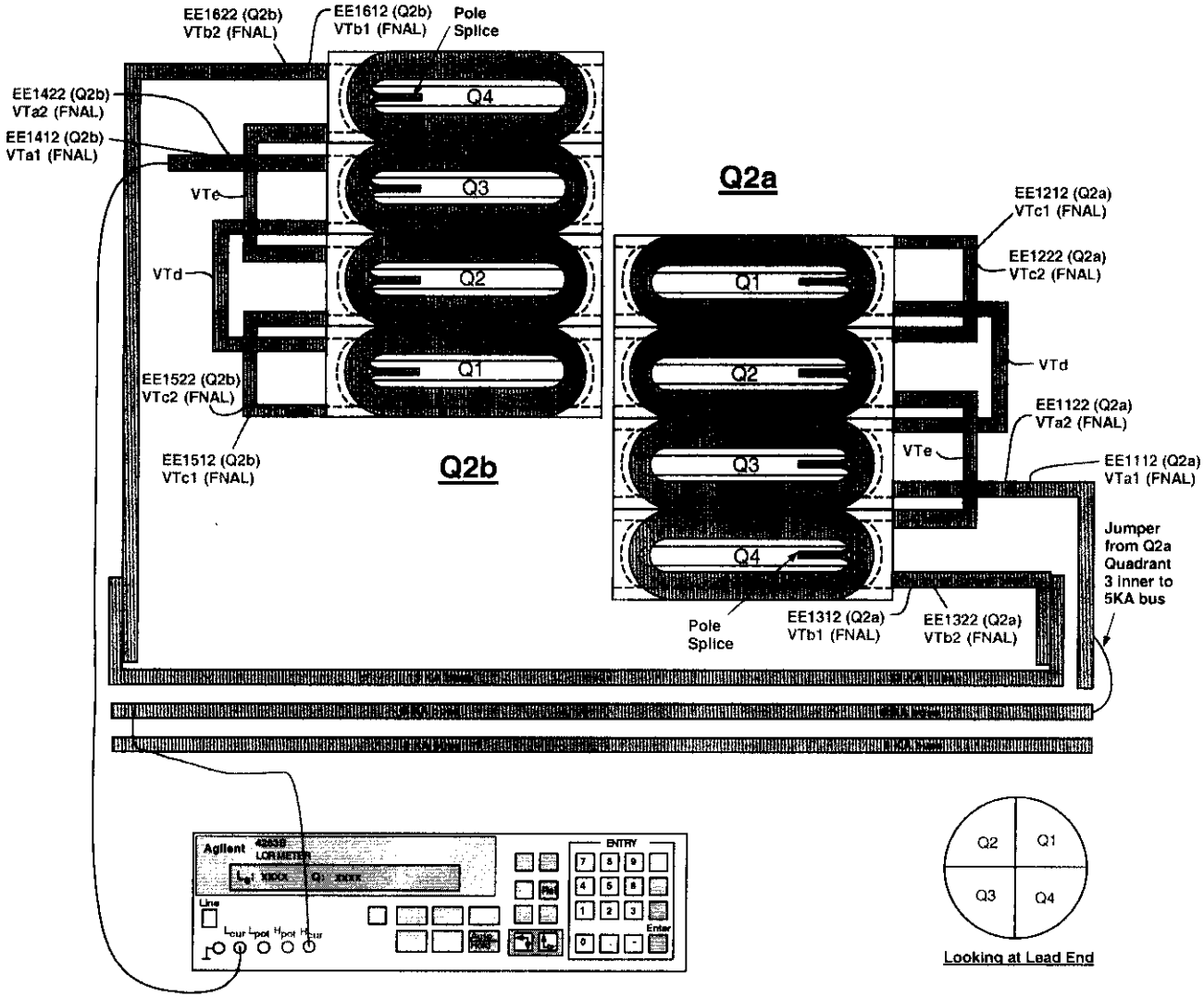
To measure Ls and Q of a Bussed Q2b:

1. Use Agilent 4263B LCR Meter.
2. Turn power on by pushing line button. Wait 30 seconds until display screen is lit.
3. Recall program #1. To do this, push recall (Rcl), then push #1, then push Enter.
4. Push Auto/Hold button to release hold.
5. Verify that the frequency displayed in the upper right corner of the display screen is 1000 Hz and the level recorded in the lower right corner of the display screen is 1V or 1000 mV.
6. Connect jumper between Q2a/Quadrant 3 inner power lead and 5KA bus as shown in figure.
7. Connect H_{cur} to 5KA bus as shown in figure.
8. Connect L_{cur} to Q2b/Quadrant 3 inner power lead as shown in figure.
9. Connect H_{pot} and L_{pot} buttons to voltage taps as shown below.

To measure Q2b:

- To measure Q1, connect H_{pot} to VTc1 (EE1512 for Q2b), and L_{pot} to VTd.
- To measure Q2, connect H_{pot} to VTe and L_{pot} to VTc1 (EE1512 for Q2b).
- To measure Q3, connect H_{pot} to VTd and L_{pot} to VTa1 (EE1412 for Q2b).
- To measure Q4, connect H_{pot} to VTb1 (EE1612 for Q2b) and L_{pot} to VTe.
- To measure total, connect H_{pot} to VTb1 (EE1612 for Q2b) and L_{pot} to VTa1 (EE1412 for Q2b).

10. Read Ls and Q from display and record in traveler.



(Q2b) Inductance				Nominal ~ 2.880 to 2.935 mH
Voltage Tap Serial Numbers				Quadrant Total Inductance
Connect	Fermi	CERN	Quadrant	
H_{POT}	VTc1Q2b	EE1512	Quadrant 1	3.3460 mH
L_{POT}	VTdQ2b	EMPTY		
H_{POT}	VTeQ2b	EMPTY	Quadrant 2	3.3440 mH
L_{POT}	VTc1Q2b	EE1512		
H_{POT}	VTdQ2b	EMPTY	Quadrant 3	3.3404 mH
L_{POT}	VTa1Q2b	EE1412		
H_{POT}	VTb1Q2b	EE1612	Quadrant 4	3.3209 mH
L_{POT}	VTeQ2b	EMPTY		

H_{POT}	VTb1Q2b	EE1612	Total Cold Mass	Nominal ~ 13.3376 mH
L_{POT}	VTa1Q2b	EE1412		13.347 mH

(Q2b) Q-Factor				Nominal ~ 4.5 to 5.2
Voltage Tap Serial Numbers				Quadrant Total Q
Connect	Fermi	CERN	Quadrant	
H_{POT}	VTc1Q2b	EE1512	Quadrant 1	4.1
L_{POT}	VTdQ2b	EMPTY		
H_{POT}	VTeQ2b	EMPTY	Quadrant 2	4.1
L_{POT}	VTc1Q2b	EE1512		
H_{POT}	VTdQ2b	EMPTY	Quadrant 3	4.0
L_{POT}	VTa1Q2b	EE1412		
H_{POT}	VTb1Q2b	EE1612	Quadrant 4	4.2
L_{POT}	VTeQ2b	EMPTY		

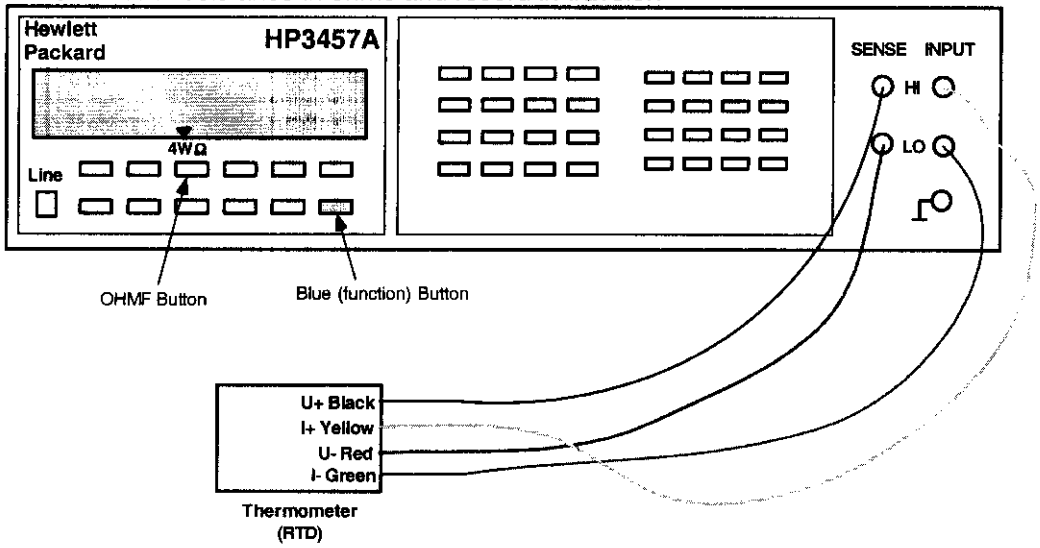
H_{POT}	VTb1Q2b	EE1612	Total Cold Mass	Nominal ~ 5.036
L_{POT}	VTa1Q2b	EE1412		4.1

Technician(s)

Date 11/06/04

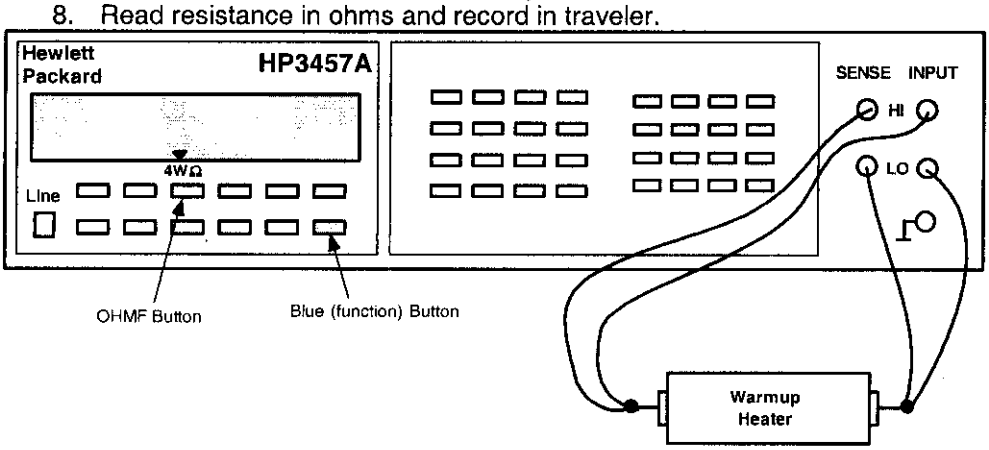
To measure the resistance of a Thermometer (RTD):

1. Use Hewlett Packard HP3457A digital multimeter.
2. Record temperature of building within +/- 5 degrees.
3. Press line button to turn line on.
4. Connect wires as shown in Figure below.
   U+ (Black) to Sense HI
   I+ (Yellow) to Input HI
   U- (Red) to Sense LO
   I- (Green) to Input LO
5. Push blue button (function key) once.
6. Push OHMF button.
7. Verify arrow in readout is above the 4WΩ (meaning a 4 wire resistance measurement).
8. Read resistance in ohms and record in traveler.



To measure the resistance of a Cryogenic (Warm-up) Heater

1. Use Hewlett Packard HP3457A digital multimeter.
2. Record temperature of building within +/- 5 degrees.
3. Press line button to turn line on.
4. Connect wires as shown in Figure below.
5. Push blue button (function key) once.
6. Push OHMF button.
7. Verify arrow in readout is above the 4WΩ (meaning a 4 wire resistance measurement).
   Note: Although this is technically a 4 wire measurement, it is effectively a 2 wire measurement, since there are only 2 wires connected to each heater.
8. Read resistance in ohms and record in traveler.



Q2a - RTD's and Cryogenic (warm-up) Heaters			
Temperature of Building (+/- 5°): 70°			
Component	**Fermi**	**CERN**	**Resistance**
Q2a RTD, primary	TaQ2a	TT8312	66.763 Ω
Q2a RTD, redundant	TbQ2a	TT8322	67.670 Ω
Q2A Cryogenic (warm-up) Heater (LE) - wire toward cold mass end plate (CERN #1 I+)	W1aQ2A	EH8312+	18.0827 Ω
Q2A Cryogenic (warm-up) Heater (LE) - wire toward cold mass mag center (CERN #1 I-)	W2aQ2A	EH8312-	
Q2A Cryogenic (warm-up) Heater (Non-LE) - wire toward cold mass end plate (CERN #2 I+)	W1bQ2A	EH8322+	17.8002 Ω
Q2A Cryogenic (warm-up) Heater (Non-LE) - wire toward cold mass mag center (CERN #2 I-)	W2bQ2A	EH8322-	

Technician(s) _____ Date 11/6/04

Q2b - RTD's and Cryogenic (warm-up) Heaters			
Temperature of Building (+/- 5°): 70°			
Component	**Fermi**	**CERN**	**Resistance**
Q2b RTD, primary	TaQ2b	TT8332	65.808 Ω
Q2b RTD, redundant	TbQ2b	TT8342	68.328 Ω
Q2B Cryogenic (warm-up) Heater (LE) - wire toward cold mass end plate (CERN #1 I+)	W1aQ2B	EH8332+	17.3862
Q2B Cryogenic (warm-up) Heater (LE) - wire toward cold mass mag center (CERN #1 I-)	W2aQ2B	EH8332-	~~17.3856~~ 5N6 Ω
Q2B Cryogenic (warm-up) Heater (Non-LE) - wire toward cold mass end plate (CERN #2 I+)	W1bQ2B	EH8342+	17.7681
Q2B Cryogenic (warm-up) Heater (Non-LE) - wire toward cold mass mag center (CERN #2 I-)	W2bQ2B	EH8342-	Ω

Technician(s) _____ Date 11/6/04

Using the Hewlett Packard HP3457A digital multimeter, measure the Strip Heater Resistance for Q2a and Q2b.

Q2a Strip Heater Resistance				
Fermi	CERN	Description	Limit	Resistance
H1aQ2a	YT1112+	Circuit A	18.20 to 21 Ω	20.1991 Ω
H2aQ2a	YT1112-			
H1bQ2a	YT1122+	Circuit B	18.20 to 21 Ω	20.2414 Ω
H2bQ2a	YT1122-			

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11/6/04
Date

Q2b Strip Heater Resistance				
Fermi	CERN	Description	Limit	Resistance
H1aQ2b	YT1132+	Circuit A	18.20 to 21 Ω	18.258 Ω
H2aQ2b	YT1132-			
H1bQ2b	YT1142+	Circuit B	18.20 to 21 Ω	18.288 Ω
H2bQ2b	YT1142-			

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Technician(s)

11/6/04
Date

Power VA2 + VB2

VA2	FE 8112	16.8191
FE 8112	VB2	.0602
VA2	VB2	16.8752

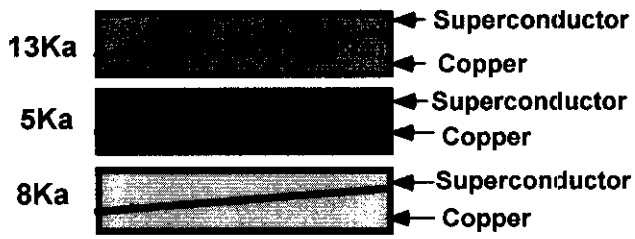
Power HA2 + HB2

HA2	8122	.0382
8122	HB2	21.6205
HA2	HB2	21.6310

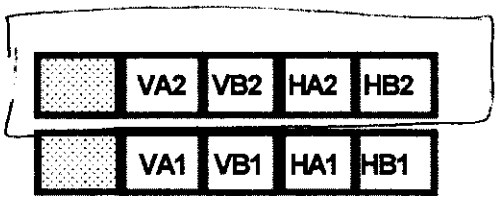
S. Gauld
11/6/04
AS per
Rodger Bossert

15.2 Using the HP3457A, connect power thru the connector Power Leads (HA2 and HB2 to measure Q2-H2 or VA2 and VB2 to measure Q2-V2). Connect the Sense Leads as shown in table below and record resistance.

(Magnet Bus Leads)



(Corrector Bus Leads)



(View Looking into Q2b)

SEE PAGE BEFORE SNG 11/6/04

TRR# 1659

MCBX Corrector Coil Taps			
Component	**FermiLab Label**	**CERN Label**	**Resistance**
Q2-H2	**VTH2**	**EE8122**	N/A Ω
	HA2	**N/A**	
Q2-V2	**VTV2**	**EE8112**	N/A Ω
	VA2	**N/A**	

Technician(s) _____ Date 11/06/04

XXX 15.3 Ground as indicated according to table below. Hipot Hypertronics to 5kV. Maximum leakage is 3μA. Refer to hipot procedure TD-03-014. (Next page) 11-8-04

Hipot Heaters to Coil and Ground.

2)

High Potential	Grounded	Floating	Leakage
All Strip Heaters	Coils, Yoke, Q1 Instrumentation Bus, 8kA and 5kA Lead Busses and Corrector Coil Busses, RTD's and Warm-up Heaters	Nothing	1.329 μA

Hipot Coil to Heaters and Ground.

1)

High Potential	Grounded	Floating	Leakage
All Coils	Strip Heaters, Yoke, Q1 Instrumentation Bus, 8kA and 5kA Lead Busses and Corrector Coil Busses, RTD's and Warm-up Heaters	Nothing	1.71 μA

Technician(s) _____ Date 11/8/04 11-9-04

"extra" Hipot

Responsible Authority/Physicist _____ Date 11/11/04

1) Hipot to 3 KA & floating leakage ≈ 0.7 μA

2) Hipot to 3 KA floating to leakage ≈ 0.7 μA – jumped from .5 – 2 μA on 3058

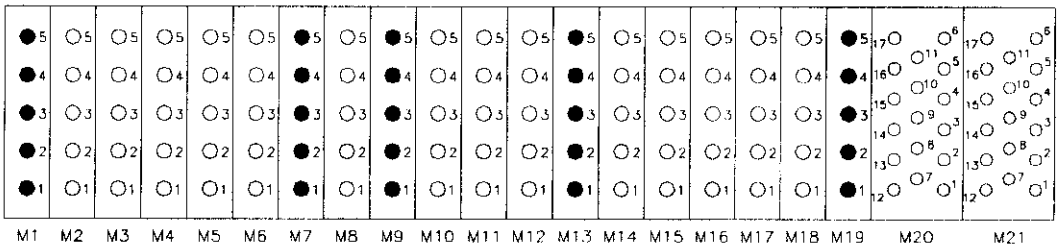
→ Hipot higher than ~~[illegible]~~ normal, but within limits.

Notes:

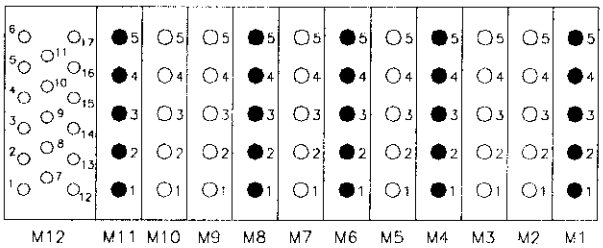
LHC PRODUCTION MAGNETS
HIPOT TEST PROCEDURE WITH HYPERTRONICS CONNECTORS INSTALLED
Technical Division Note #TD-03-014

Prepared by: Ruben Carcagno
Approved by: Mike Lamm
Date: 12/19/2002
Reviewed and approved by Rodger Bossert : 1/30/04

Q2–Q3 Connector
VIEW: Male (Pin) Solder Cup Side



Q2–Q1 Connector
VIEW: Female (Receptacle) Solder Cup Side



1. Connect the Hipot test fixture to the Q2-Q3 connector and to the Q2-Q1 connector. This fixture has all pins in a group connected together. Groups are separated by blank modules.
2. Make sure the connectors are completely isolated from ground. It is best to have the connectors attached to the magnet in their final position using the isolated bracket provided for this purpose. If this is not possible, make sure that connector rails are not touching ground.
3. Make sure the magnet bus is isolated from ground. Use Kapton to wrap any exposed bus ends.
4. Short all corrector bus together. Wrap with Kapton.
5. Connect together two 5kA and 8kA Bus leads. Connect to ground. Wrap together in Kapton.
6. **COIL HIPOT**: From the solder cup side of the Hipot test fixtures, connect all groups together except the group corresponding to coil voltage taps (group M2 to M6 in the Q2-Q3 connector and group M2 to M3 in Q2-Q1 connector). Connect the groups that are connected together to ground, and connect the coil voltage taps group in the Q2-Q3 connector to High Voltage. Ramp to 5,000 Volts and record results.
7. **STRIP HEATERS HIPOT**: From the solder cup side of the Hipot test fixtures, connect all groups together except the group corresponding to strip heaters (group M14 to M18 in Q2-Q3 connector and group M9 to M10 in Q2-Q1 connector). Connect the groups that are connected together to ground, and connect the Strip Heater group in the Q2-Q3 connector to High Voltage. Ramp to 5,000Volts and record results.

15.4 Check Q1 Instrumentation Bus Wires for Continuity.

Module	Pin	Fermi	CERN	KEK	Description	Done
M2	1	VTa1Q1	EE1111	a1	Q1 Lead Voltage Tap "a", primary	✓
M2	2	VTa2Q1	EE1121	a2	Q1 Lead Voltage Tap "a", redundant	✓
M2	3	VTc1Q1	EE1211	c1	Q1 Center Voltage Tap "c", primary	✓
M2	4	VTc2Q1	EE1221	c2	Q1 Center Voltage Tap "c", redundant	✓
M2	5	VTb1Q1	EE1311	b1	Q1 Lead Voltage Tap "b", primary	✓
M3	5	VTb2Q1	EE1321	b2	Q1 Lead Voltage Tap "b", redundant	✓
M5	1	VTH1	EE8121		Corrector voltage tap Q1-H1 (skew dipole) (on MCBX, MCBXH, A+ lead)	✓
M5	2	VTV1	EE8111		Corrector voltage tap Q1-V1 (normal dipole) (on MCBX, MCBXV A+ lead)	✓
M7	1	W1aQ1	EH8311+		Q1 Cryogenic Heater lead end - wire at top (CERN #1 I+)	✓
M7	2	W2aQ1	EH8311-		Q1 Cryogenic Heater lead end - wire at bottom (CERN #1 I-)	✓
M7	3	W1bQ1	EH8321+		Q1 Cryogenic Heater non-lead end - wire at top (CERN #2 I+)	✓
M7	4	W2bQ1	EH8321-		Q1 Cryogenic Heater non-lead end - wire at bottom (CERN #2 I-)	✓
M9	1	H1aQ1	YT1111+	HA1	Q1 Protection (Strip) Heater, ("a" circuit) (CERN lead #1+)	✓
M9	3	H2aQ1	YT1111-	HA2	Q1Protection (Strip) Heater, ("a" circuit) (CERN lead #1-)	✓
M9	5	H1bQ1	YT1121+	HB1	Q1 Protection (Strip) Heater, ("b" circuit) (CERN lead #2+)	✓
M10	4	H2bQ1	YT1121-	HB2	Q1 Protection (Strip) Heater, ("b" circuit) (CERN lead #2-)	✓
M12	1	TaQ1_I+	TT8311 I+		Q1 RTD, primary Wire color: Yellow	✓
M12	2	TaQ1_I-	TT8311 I-		Q1 RTD, primary Wire color: Green	✓
M12	3	TaQ1_V+	TT8311 U+		Q1 RTD, primary Wire color: Black	✓
M12	4	TaQ1_V-	TT8311 U-		Q1 RTD, primary Wire color: Red	✓
M12	5	TbQ1_I+	TT8321 I+		Q1 RTD, primary Wire color: Yellow	✓
M12	6	TbQ1_I-	TT8321 I-		Q1 RTD, primary Wire color: Green	✓
M12	11	TbQ1_V+	TT8321 U+		Q1 RTD, primary Wire color: Black	✓
M12	10	TbQ1_V-	TT8321 U-		Q1 RTD, primary Wire color: Red	✓

TRR#1659
Check installation of hyp. + verify all resistances acceptable

Technician(s) — Date 11/06/04

Responsible Authority/Physicist — Date 11/06/04

16.0 Production Complete

XXX 16.1 Process Engineering verify that the LHC Cold Mass Module Assembly Traveler (5520-TR-333643) is accurate and complete. This shall include a review of all steps to ensure that all operations have been completed and signed off. Ensure that all Discrepancy Reports, Nonconformance Reports, Repair/Rework Forms, Deviation Index and dispositions have been reviewed by the Responsible Authority for conformance before being approved.

Comments:

_____
_____
_____
_____
_____
_____
_____

Process Engineering/Designee

MAY 1 2 2005
Date

TD - Engineering Fabr ation Component Kit List

ORIGINA

Process Engineering

Component Serial No. LMQXB08

Kit submitted by: JOHN SZOSTAK Ext. 2003

Fermi ID No. 02943C

Date submitted: 9-Sep-04

Need date: 15-Sep-04

Deliver to: ICB

Use with Traveler No. 333643

Job No. 248

M&S task number: 300 1.1.1.3.4

Drawing Title: Q2 COLD MASS WELDED ASSEMBLY

Drawing No. ME-390309 Rev. B

Drawing Title: Q2 LE HYPERTRONICS CONNECTOR ASSEMBLY

Drawing No. MB-418083 Rev. B

Drawing Title: *Q2 INSTRUMENTATION WIRE FEED THRU ASSEMBLY*

Drawing No. *ME-369896* *Rev. B*

Drawing Title: *Q2 NON-LE HYPERTRONICS CONNECTOR ASSEMBLY*

Drawing No. *MB-418133* *Rev.*

Material Control

Parts available

Verified by: Marsha Schmidt MS

Fermi ID No. 04223N

Date submitted to stockroom: 9/14/2005

Parts issued

Issued by: Marsha Schmidt

Fermi ID No. 04223N

Date issued: 9/16/04

Parts received by E&F: [illegible]

Fermi ID No. 4845

Date received by E&F: 9/22/04

	Description	Dwg Size	Number	Rev	Unit	Quantity Required	Location	Quantity Issued	E&F Verified	Routing Form Number	Spares Number / Comment
1	INSULATING VARNISH & ADHESIVE	MA	369417	-	-	A / R					
2	Q2 MQXB PRODUCTION COLDMASS	ME	369655	C	-	ICB HAS					
3	INSULATED BEAM TUBE	MD	369802	-	-	ICB HAS					
4	Q2 MODULE ASSEMBLY/INSULATED BUS ASSEMBLY	ME	369826	C	-	ICB HAS					
5	WARM UP HEATER BASE PLATE	MB	369829	A	EA	4	IB4 Bin	4	✓	79120	36 pcs.
6	WARM UP HEATER	MA	369834	A	EA	4	IB4 Bin	4	✓	79919	27 pcs.
7	RTD TEMPERATURE SENSOR	MA	369835	A	EA	4	R2,S2,L5	4	✓	79920	35 pcs.

ORIGINAL

TD - Engineering Fabr tion Component Kit List

ORIGINAL

	Description	Dwg Size	Number	Rev	Unit	Quantity Required	Location	Quantity Issued	E&F Verified	Routing Form Number	Spares Number / Comment
8	BUS HOUSING EXTENSION	MD	369867	-	EA	1	IB4 Bin	1	✓	78975	2 pcs.
9	Q2 BUS HOUSING LOCK	MB	369870	B	EA	1	IB4 Bin	1	✓	79684	2 pcs.
10	Q2A BUS HOUSING EXTENSION	MD	369872	B	EA	1	R1,S3,L2	1	✓	79597	1 pc
11	Q2A BUS HOUSING EXTENSION BASE	MC	369873	A	EA	1	R1,S1,L3	1	✓	78993	2 pcs.
12	Q2 BUS HOUSING EXTENSION COVER	MB	369874	A	EA	2	R2,S2,L4	2	✓	79598	4 pcs.
13	BUS HOUSING END SUPPORT	MC	369892	A	EA	2	R1,S1,L3	2	✓	79579	4 pcs.
14	RTD MOUNTING BLOCK	MA	369893	B	EA	4	IB4 Bin	4	✓	80543	34 pcs.
15	Q2 LOCK-INSTRUMENTATION BUS CHANNNEL	MB	369937	-	EA	1	IB4 Bin	1	✓	78587	2 pcs.
16	SHCS 4-40 x 1/4" S.S.	MA	369938	-	EA	8	IB4 Bin	8	✓	79032	120 pcs.
17	LEAD SPLICE CABLE CLAMP ASSEMBLY	MB	369981	-	EA	2	IB4 Bin	2	✓	79609	4 pcs.
18	Q2 TRANSITION AREA SLEEVE	MC	390112	B	EA	1	P/N	1	✓	78283	3 pcs.
19	IP END DOME WELDMENT	MD	390197	B	EA	1	P/N	1	✓	78072	2 pcs.
20	MCBX CORRECTOR MOUNTING SPACER	MC	390203	-	EA	4	IB4 Bin	4	✓	77194	8 pcs.
21	MCBX CORRECTOR MTG. FLAT WASHER	MB	390228	-	EA	4	IB4 Bin	4	✓	80991	41 pcs.
22	TRANSPORTATION RESTRAINT ADJUSTING SCREW	MB	390230	A	EA	4	IB4 Bin	4	✓	76664	8 pcs.
23	1/2 - 20 x 3.5" SILVER PLATED SCREW	MA	390248	-	EA	4	IB4 Bin	4	✓	74623	22 pcs.
24	NON IP END DOME WELDMENT	MD	390253	A	EA	1	P/N	1	✓	78338	2 pcs.
25	MCBX TRANSPORTATION RESTRAINT NUT	MC	390294	-	EA	4	IB4 Bin	4	✓	76666	56 pcs.

ORIGINAL

TD - Engineering Fabr tion Component Kit List

	Description	Dwg Size	Number	Rev	Unit	Quantity Required	Location	Quantity Issued	E&F Verified	Routing Form Number	Spares Number / Comment
26	BEAM TUBE FLANGE	MC	390300	B	EA	2	R10,1,2	2	✓	77028	38 pcs.
27	MCBX CORRECTION COIL ASSEMBLY	MD	390312	-	-	ICB HAS			OK		
28	CORRECTOR SHIM, 0.002"	MA	390482	-	EA	4	R2,S2,L4	4	✓	79123	101 pcs.
29	CORRECTOR SHIM, 0.005"	MA	390483	-	EA	4	R2,S2,L4	4	✓	79124	108 pcs.
30	CORRECTOR SHIM, 0.010"	MA	390484	-	EA	4	R2,S2,L4	4	✓	79125	91 pcs.
31	CORRECTOR SHIM, 0.015"	MA	390485	-	EA	4	R2,S2,L4	4	✓	79126	79 pcs.
32	MCBX CORRECTOR MAGNET FACE PLATE	MD	390671	A	EA	1	R1,2,4	1	✓	80652	2 pcs.
33	SHCS #10-24 UNC x 1.00 LG STN STL	MA	393011	-	EA	4	IB4 Bin	4	✓	81108	85 pcs.
34	1/4 - 28 x 1" HEX SHCS, S.S.	MA	393029	-	EA	16	IB4 Bin	16	✓	77851	88 pcs.
35	#10 - 32 x 0.188" CUP POINT SET SCREW, S.S.	MA	393030	-	EA	8	IB4 Bin	8	✓	77839	10 pcs. *
36	SHCS 1/4-20 x 1.25"	MA	393178	-	EA	8	IB4 Bin	8	✓	79632	60 pcs.
37	SHCS 1/4-20 x 1/2" S.S.	MA	393179	-	EA	14	IB4 Bin	14	✓	79629	111 pcs.
38	SHCS M4 x 10mm SS	MA	393180	-	EA	8	IB4 Bin	8	✓	79631	931 pcs.
39	PLAIN FLAT WASHER M4#6	MA	393181	-	EA	8	IB4 Bin	8	✓	81226	248 pcs.
40	SHCS 1/4-20 UNC x 1.00 LG STN STL	MA	393199	-	EA	4	IB4 Bin	4	✓	81109	88 pcs.
41	SHCS #6-32 UNC x .625 LG STN STL	MA	393264	-	EA	10	IB4 Bin	10	✓	81106	68 pcs.
42	6-32 x .875" LG STN STL	MA	393265	-	EA	4	IB4 Bin	4	✓	80968	191 pcs.
43	SHCS #6-32 UNC x 1.25 LG STN STL	MA	393266	-	EA	4	IB4 Bin	4	✓	81107	86 pcs.

TD - Engineering Fabr tion Component Kit List

ORIGINAL

	Description	Dwg Size	Number	Rev	Unit	Quantity Required	Location	Quantity Issued	E&F Verified	Routing Form Number	Spares Number / Comment
44	Q2A LEAD SPLICE END TRIANGLE	MB	430013	-	EA	1	R1,1,2	1	✓	80287	2 pcs.
HYPERTRONICS CONNECTOR ASSEMBLY (LEAD END)		MB	418083	B	EA	(1)					Place part #'s 46 -54 in one bag and label as MB-418083
45	CONNECTOR COVER & ACCESS COVER (23 UNITS)	MC	418067-A	A1	EA	1	R1,1,2	1	✓	N/A	4 pcs.
46	GROMMET	MA	418113	*	EA	1	IB4 Bin	1	✓	N/A	24 pcs.
47	CLAMPING BAR	MA	418112	*	EA	1	IB4 Bin	1	✓	79990	25 pcs.
48	TIE-DOWN LINK	MA	418109	A	EA	4	R1,1,2	4	✓	79854	73 pcs.
49	SUPPORT ARM WELDMENT (23-UNIT)	MC	418080-A	B	PAIR	1	IB4 Bin	1	✓	80118	5 pcs.
50	SCREW - #6-32 x 3/8 LG.	MA	418116	*	EA	4	R1,1,2	4	✓	79892	96 pcs.
51	SCREW - #4-40 x 1/2 LG.	MA	418117	*	EA	4	R1,1,2	4	✓	79891	148 pcs.
52	THREADED STUD ASSEMBLY	MA	418114	B	EA	4	IB4 Bin	4	✓	81553	111 pcs.
53	23 UNIT MALE (PIN) RACK (Q2 - Q3 CONNECTOR)	MA	418107	A	EA	1	R1,S1,L2	1	✓	N/A	3 pcs.
54	ANTI-ARC KAPTON	MA	418143	*	EA	17	R1,1,2	17	✓	N/A	1358 pcs.
Q2 INSTRUMENTATION WIRE FEED THRU ASSEMBLY		*ME*	*369896*	*B*	*EA*	*(1)*					
55	*Q2 WIRE FEED-THRU CHANNEL*	*MC*	*369899*	-	*EA*	*1*	X P/N	1	✓	78969	2 pcs.
56	*PRODUCTION AID KEVLAR STRING*	*MA*	*369912*	-		*A / R*					
57	*Q2 MODULE ASSY INSTR. CHANNEL COVER STRIP*	*MB*	*369941*	-	*EA*	*11*	R1,S2,L3	11	✓	78798	73 pcs.
HYPERTRONICS CONNECTOR ASSEMBLY (NON-LEAD END)		*MB*	*418133*	-	*EA*	*(1)*					Place part #'s 58 -63 in one bag and label as MB-418133
58	*CONNECTOR COVER & ACCESS COVER (13 UNITS)*	*MC*	*418067-A*	*A*	*PAIR*	*1*	R1,1,2	1	✓	N/A	4 pcs.

TD - Engineering Fabr tion Component Kit List

ORIGINAL

	Description	Dwg Size	Number	Rev	Unit	Quantity Required	Location	Quantity Issued	E&F Verified	Routing Form Number	Spares Number / Comment
59	*GROMMET*	*MA*	*418113*	-	*EA*	*1*	IB4 Bin	1	✓	N/A	24 pcs.
60	*CLAMPING BAR*	*MA*	*418112*	-	*EA*	*1*	IB4 Bin	1	✓	79990	25 pcs.
61	*SCREW - #6-32 x 3/8 LG.*	*MA*	*418116*	-	*EA*	*4*	R1,1,2	4	✓	79892	96 pcs.
62	*THREADED STUD ASSEMBLY*	*MC*	*418114*	-	*EA*	*4*	IB4 Bin	4	✓	81553	111 pcs.
63	*13 UNIT FEMALE (PIN) RACK*	*MA*	*418108*	A	*EA*	*1*	R1,S1,L2	1	✓	N/A	3 pcs.

Traveler Title:	Specification No:	Revision:	DR No:
Q2 LMQXB Cold Mass Module Assembly Traveler	5520-TR-333643	D	HGQ-0503

Step No:	Drawing No:	Routing Form No:	Serial No:	Rework ID:
14.3	ME-369895		LMQXB08	0

Discrepancy Description:

Upon checking the hypertronics connector, it was realized that tap EE8112 was soldered onto the B side of the corrector as opposed to the A side.

Originator: Damon Bice

Date: 11/5/2004

Cause of Nonconformance:

Technician error.

Responsible Authority: Rodger Bossert

Date: 12/27/2004

Disposition:

Continue with assembly. Access to this tap in no longer possible. Make note in acceptance table when magnet is shipped that this tap (EE8112) is on the B lead.

Responsible Authority: Rodger Bossert

Date: 12/27/2004

Corrective Action to Prevent Recurrence:

Inform technician of error. Follow traveler more closely in future. No Traveler Change.

Responsible Authority: Rodger Bossert

Date: 12/27/2004

Corrective Action/Disposition Verified By: John Szostak

Date: 1/19/2005

Will Configuration be affected?: ☐ YES ☑ NO

Identified problem area:

☐ Material ☐ Manpower ☑ Method ☐ Machine ☐ Measurement

Reviewed By: Bob Jensen

Date: 1/20/2005

Traveler Title:	Specification No:	Revision:	DR No:
Q2 LMQXB Cold Mass Module Assembly Traveler	5520-TR-333643	D	HGQ-0499

Step No:	Drawing No:	Routing Form No:	Serial No:	Rework ID:
10.3	369895		LMQXB08	0

Discrepancy Description:

While pushing the beam tube into the cold masses from the Q2A end, the beam tube got stuck and was pulled back out. The insulation on the beam tube was damaged about 38-39 mm long. It seemed to stick on the non lead end of the Q2B cold mass.

Originator: Steve Gould

Date: 10/20/2004

Cause of Nonconformance:

Insulation was torn on insertion into the Q2A/Q2B assembly.

Responsible Authority: Thomas Page

Date: 10/21/2004

Disposition:

Remove the torn insulation. Insert the beam tube from the Q2B end. Continue with the assembly.

Responsible Authority: Thomas Page

Date: 10/21/2004

Corrective Action to Prevent Recurrence:

None at this time. No Traveler Change.

Responsible Authority: Thomas Page

Date: 10/21/2004

Corrective Action/Disposition Verified By: John Szostak

Date: 12/6/2004

Will Configuration be affected?: ☐ YES ☑ NO

Identified problem area:

☐ Material ☐ Manpower ☑ Method ☐ Machine ☐ Measurement

Reviewed By: Bob Jensen

Date: 12/6/2004

Revision Request Control Number: 1659

Specification Number: 5520 - TR - 333643 Current Revision: D

Traveler or Document Title Q2 LMQXB Cold Mass Module Assembly Traveler

Step #/Description of Revision:

5.2 Modified Step. Changed + / - 2 mm to +4 / -0 per LMQXB07.
7.17 Modified Step. Added "Have Crew Chief verify setup and sign below before continuing." per Jim Rife.
8.0 Modified Electrical Inspection per Rodger Bossert.
8.2 Modified Step. Added Picture of Corrector Bus Leads. Modified Table.
10.3 Added Step. "Prepare the Beam Tube insertion area with .003" Kapton Tape."
13.0 Modified Electrical Inspection per Rodger Bossert.
13.2 Modified Step. Added Picture of Corrector Bus Leads. Modified Table.
15.0 Modified Electrical Inspection per Rodger Bossert.
15.2 Modified Step. Added Picture of Corrector Bus Leads. Modified Table.

John Szostak	Jim Rife	8/3/2004
Originator	Responsible Authority	Date
Revision Incorporated into the Traveler:	John Szostak	12/15/2004
	Revision Incorporated By	Date
Process Engineering Final Review:	Bob Jensen	12/15/2004
	Process Engineering/Designee	Date

Instructions for the completion of the Revision Request Form

Note(s):

Multiple steps may be effected by one Revision Request Form but only one specific Traveler or Document may be effected by each Revision Request Form.

If completing this form by hand, a Revision Request Control Number must be obtained before processing.

If completing this form entirely by electronic means, the printed copy to be filed in the Process Engineering Office is to be initialed by the individual incorporating the Revision Request and the individual who reviewed the Traveler or Document.

Originator Instructions:

1) Specification Number: - Enter the Specification Number of the Traveler or Document to be revised. (Document title is inserted automatically from the spec. #)

2) Current Revision: - Enter the Revision of the Traveler or Document to be revised.

3) Step# / Description of the Revision: - Enter a description of the revision to be made and the step# it applies to, if applicable. If needed to describe the revision attach a copy of the page(s). If the revision is coming from a related document such as a Discrepancy Report or an Engineering Order attach a copy of that document to the Revision Request Form.

4) Originator: - Originator is the person generating the form. (Select Name from List)

5) Responsible Authority: - Responsible Authority is person responsible for the process in question. (Select Name from List)

Process Engineering Office Instructions:

1) Revision Incorporated into the Traveler: - Signature of the individual who incorporated the revision.

2) Process Engineering Final Review: - Review the Traveler or Document revised, sign and date the form. The original completed Revision Request Form will be retained by the Process Engineering Office in the Revision Request Binder.

Revision Request Control Number: 1734

Specification Number: 5520 - TR - 333643 Current Revision: E

Traveler or Document Title Q2 LMQXB Cold Mass Module Assembly Traveler

Step #/Description of Revision:

7.18 Modified Step. Changed Max. Leakage from < 0.5μA to < 3μA per LMQXB08. Changed Table. Removed "RTD's and Warm-up Heaters" from Floating column.
7.37 Removed Step. "Attach Voltage Tap Wires to Corrector Magnet (MD-390312) as per Q2 Module Assembly (ME-369895)."
7.37 Added Step. "Solder MCBX Corrector Magnet Voltage Tap Wires (MA-369832) to Corrector Magnet (MD-390312) as per Q2 Module Assembly (ME-369895)."
7.39 Removed Step. "Solder MCBX Corrector Magnet Voltage Tap Wires (MA-369832) as per Q2 Module Assembly (ME-369895)."
12.9 Added Step. "Perform a Stretched Wire Verification Measurement." Per LMQXB08.

John Szostak	Jim Rife	5/9/2005
Originator	Responsible Authority	Date

Revision Incorporated into the Traveler:

Revision Incorporated By	Date

Process Engineering Final Review:

Process Engineering/Designee	Date

Instructions for the completion of the Revision Request Form

Note(s):

Multiple steps may be effected by one Revision Request Form but only one specific Traveler or Document may be effected by each Revision Request Form.

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Originator Instructions:

1) Specification Number: - Enter the Specification Number of the Traveler or Document to be revised. (Document title is inserted automatically from the spec. #)

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Process Engineering Office Instructions:

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CERN
CH-1211 Geneva 23
Switzerland

the **Large Hadron Collider** project

AT MEL Document No.
LHC-MCBX-FR-0001 rev. **1.0**

EDMS Document No.

Certificate of Conformity

Part name:	MCBX Inner Triplet Dipole Corrector		
LHC Identification No.:	HCMCBX_001-SI000019	Serial No.:	HCMCBX_001-SI000019
Shipped To:	CERN	***Shipment No:***	***19***
		Shipment	***06/01/04***
Manufacturer:	SIGMAPHI	Contract No.:	F375/LHC/LHC
Related tech. Specification:	LHC-MCBX-CI-0001 and addenda		
Related drawings:	LHCMCBX_0012 (1525-CN-1001)		
Responsible person at CERN:	Mikko Karppinen	***Tel.***	+41 22 767 4305
		E-mail.	Mikko.Karppinen@cern.ch
Responsible person at SIGMAPHI:	Damien Neuvéglise	***Tel.***	+33 2 97 01 08 80
		E-mail.	dneuveglise@sigmaphi.fr
SIGMAPHI certifies that the delivered material conforms to the technical specification mentioned above:			
Date: 06/01/04	***Name: D.Neuvéglise***		***Signature: D.Neuvéglise***

Acceptance test results

		MCBXV (Inner)	***MCBXH (Outer)***	***Remarks:***
RT dc resistance (Ω):	***SIGMAPHI:***	***17.8***	***21.7***	
	CERN:	***17,38***	***21,34***	
	CMA[1]:	17.44	21.59	
Inductance @1 kHz/100 Hz (mH)	***SIGMAPHI:***	***66.39 / 113.30***	***68.15 / 161.35***	
	CERN	***63.10 / 84.39***	***58.24 / 97.49***	
	CMA:	63.2 / 84.49	58.3 / 97.69	
R.T. leakage current to ground @ 1.5 kV (μA):	***SIGMAPHI:***	***0.01875***	***0.075***	
	CERN:	***0.004***	***0.008***	
	CMA:			

	Cold Mass Assembler
Visual inspection	
Name / Signature	
Date	

Accepted: ☒

Rejected: ☐

[1] Cold Mass Assembler

Comments (SigmaPhi):	***Rajout d'un clinquant de 0.05mm entre les tôles et l'outershell***

Comments (CERN):	***The magnetic axis of this assembly has not been measured at warm.***
	The scribe line is made relative to the dowel pin holes on the connection plate.
	During the combined powering field was rotated 0-360 deg at 90 % nominal current @ 1.9 K.
	MCBXV(inner)and MCBXV (outer) reached 685 A and 692 A respectively during the individual powering

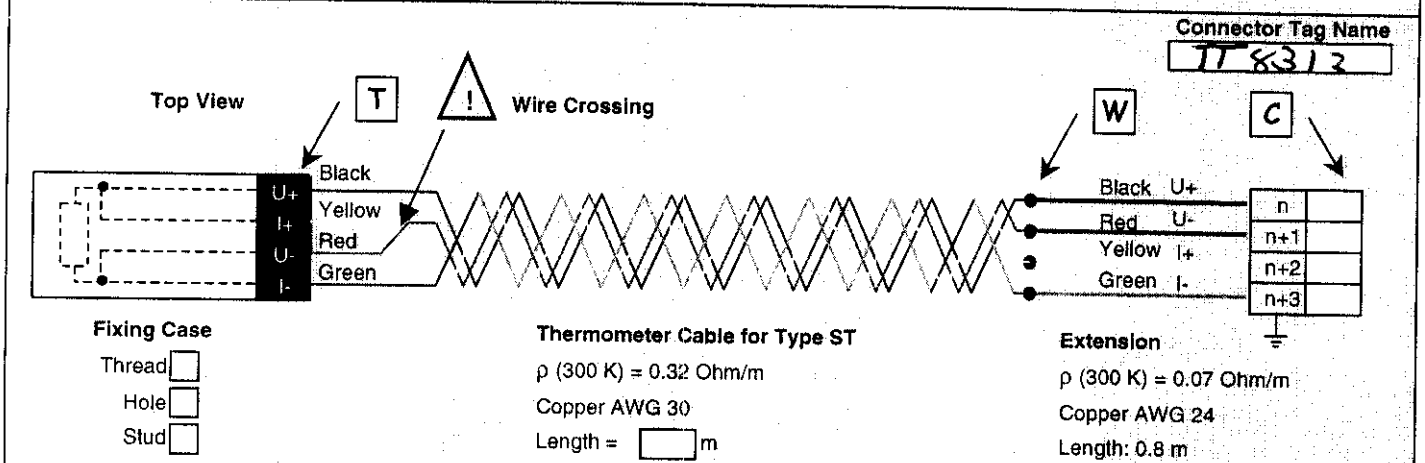
Comments (CMA):	

Cryogenic Thermometer Traveller

DESCRIPTION

Part description:	Cryogenic thermometer	**Top Assembly Identification:**	LMQXB08
Part Identification:	HCQITESCXT-CR012710	**Manufactured By:**	Fermilab
Serial Number:	CX_LS_X16835		

CABLING



CHECKS

Intervention	Date/ DD-MMM-YYYY	Check Point	R(U+,U-,I+,I-) [Ohm] 4W	R(U-,I-) [Ohm] 2W	R(U+,I+) [Ohm] 2W	R(U+,GND) [Ohm] 2W	Temperature [K]	Firm/Laboratory	Checked by
Calibration	*21-Jan-2002*	T	*66.3*	*n.a*	*n.a*	*OVL*	*Ambient*	*IPN*	*Joly*
Expedition	*12-Mar-2003*	T	*64.910*	*0.1*	*0.1*	*OVL*	*293*	*CERN*	*Grivat*
Reception	10/10/04	T W C	66.725				73 °F	Fermi	Evans
		T W C							
		T W C							
		T W C							
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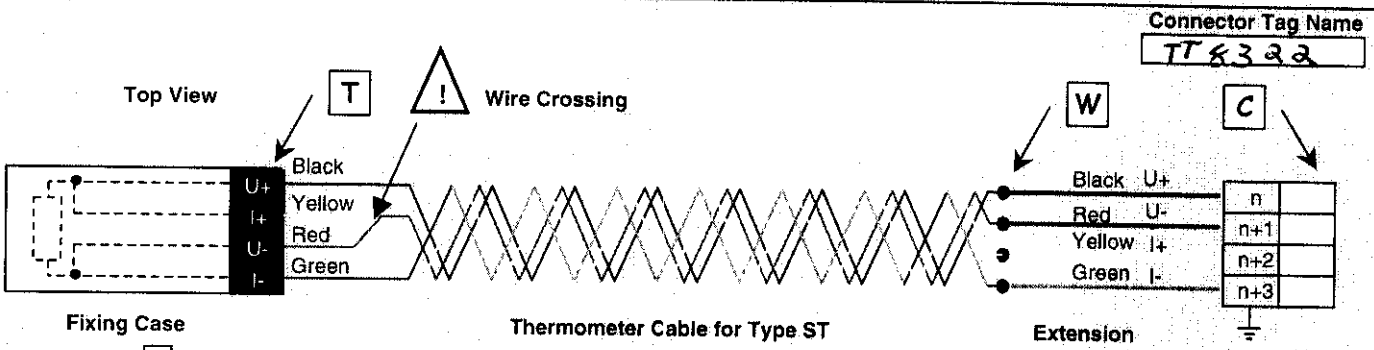
Cryogenic Thermometer Traveller

DESCRIPTION

Part description:	Cryogenic thermometer	**Top Assembly Identification:**	LMQXB08
Part Identification:	HCQITESCXT-CR012870	**Manufactured By:**	Fermilab
Serial Number:	CX_LS_X16901		

CABLING



Fixing Case

Thread ☐
Hole ☐
Stud ☐

Thermometer Cable for Type ST

ρ (300 K) = 0.32 Ohm/m
Copper AWG 30
Length = ☐ m

Extension

ρ (300 K) = 0.07 Ohm/m
Copper AWG 24
Length: 0.8 m

CHECKS

Intervention	Date/ DD-MMM-YYYY	Check Point	R(U+,U-,I+,I-) [Ohm] 4W	R(U-,I-) [Ohm] 2W	R(U+,I+) [Ohm] 2W	R(U+,GND) [Ohm] 2W	Temperature [K]	Firm/Laboratory	Checked by
Calibration	*04-Feb-2002*	T	*67.4*	*n.a*	*n.a*	*OVL*	*Ambient*	*IPN*	*Joly*
Expedition	*12-Mar-2003*	T	*65.700*	*0.1*	*0.1*	*OVL*	*293*	*CERN*	*Grivat*
Reception	15/10/04	T W C	67.632				73°F	Fermi	Evans
		T W C							
		T W C							
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		T W C							

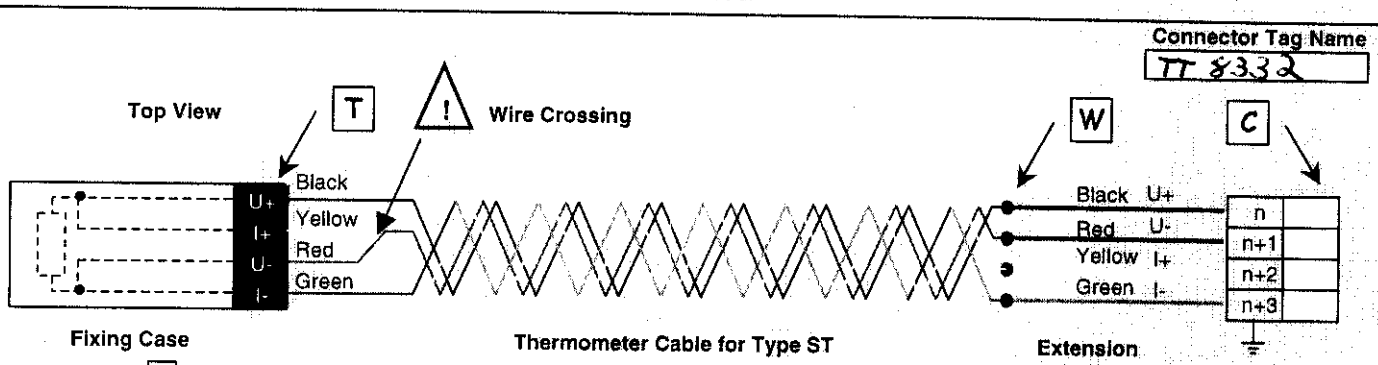
In Case of problem, do not hesitate to contact Responsible person at CERN. Tel:+41 22 767 4266

Cryogenic Thermometer Traveller

DESCRIPTION

Part description:	Cryogenic thermometer	**Top Assembly Identification:**	LMQXB08
Part Identification:	HCQITESCXT-CR013370	**Manufactured By:**	Fermilab
Serial Number:	CX_LS_X17203		

CABLING



Fixing Case

Thread ☐
Hole ☐
Stud ☐

Thermometer Cable for Type ST

ρ (300 K) = 0.32 Ohm/m
Copper AWG 30
Length = ☐ m

Extension

ρ (300 K) = 0.07 Ohm/m
Copper AWG 24
Length: 0.8 m

CHECKS

intervention	Date/ DD-MMM-YYYY	Check Point	R(U+,U-,I+,I-) [Ohm] 4W	R(U-,I-) [Ohm] 2W	R(U+,I+) [Ohm] 2W	R(U+,GND) [Ohm] 2W	Temperature [K]	Firm/Laboratory	Checked by
Calibration	04-Feb-2002	T	65.38	n.a	n.a	OVL	Ambient	IPN	Joly
Expedition	12-Mar-2003	T	63.915	0.1	0.1	OVL	293	CERN	Grivat
Reception	10/10/04	T W C	65.777				73°K	Fermi	Evans
		T W C							
		T W C							
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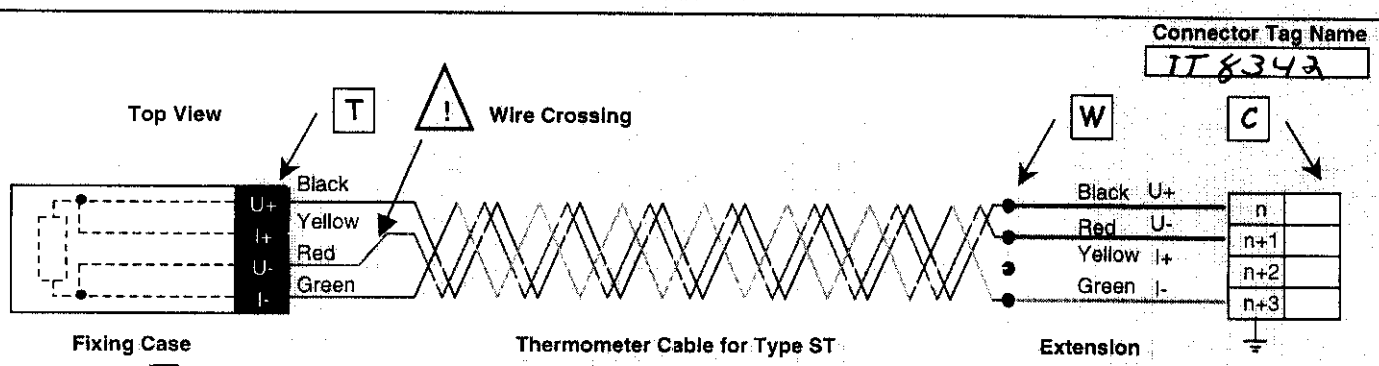
Cryogenic Thermometer Traveller

DESCRIPTION

Part description:	Cryogenic thermometer	**Top Assembly Identification:**	LMQXB08
Part Identification:	HCQITESCXT-CR012920		
Serial Number:	CX_LS_X16915	**Manufactured By:**	Fermilab

CABLING



Fixing Case

Thread ☐
Hole ☐
Stud ☐

Thermometer Cable for Type ST

ρ (300 K) = 0.32 Ohm/m
Copper AWG 30
Length = ☐ m

Extension

ρ (300 K) = 0.07 Ohm/m
Copper AWG 24
Length: 0.8 m

CHECKS

Intervention	Date/ DD-MMM-YYYY	Check Point	R(U+,U-,I+,I-) [Ohm] 4W	R(U-,I-) [Ohm] 2W	R(U+,I+) [Ohm] 2W	R(U+,GND) [Ohm] 2W	Temperature [K]	Firm/Laboratory	Checked by
Calibration	*04-Feb-2002*	T	*67.59*	*n.a*	*n.a*	*OVL*	*Ambient*	*IPN*	*Joly*
Expedition	*12-Mar-2003*	T	*66.313*	*0.1*	*0.1*	*OVL*	*293*	*CERN*	*Grivat*
Reception	10/10/04	T W C	68.236				73°F	Ferm.	Evans
		T W C							
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FORM #1 FIXED VOLTAGE TAPS _1A_FORM

Test of Q2A&B FVTs
Clamp BUS #1 & BUS #2 together on return end
Apply 1 A current between BUS #1 & BUS #3
Connect Current Source: BUS #1 to Positive and BUS #3 to Negative
Use a 3457 or equilvent DVM and record measurement to 4 decimal places
Use 2 wires Voltage Measurements Technique:
1. Connect DVM LO wire to BUS#3 (or Negative output of Power source)
2. HI wire of DVM will move through breakout box to measure V
DO NOT USE DC CURRENT LARGER THAN 2A.
DO NOT RUN DC CURRENT THROUGH MAGNET LONGER THAN 30MIN.

BUS #1
BUS #2
BUS #3
BUS #4

POWER BUS LOCATION

HYPERTRONICS CONNECTOR		FNAL Labels	Description	Break Box Labels	Expected Voltage, V	Measured, V	
Module	Pin						
M3	4	VTa1Q2a	Q2a Lead Voltage Tap "a", primary	EE1112	0.0100	.010794 V	
M3	3	VTa2Q2a	Q2a lead Voltage Tap "a", redundant	EE1122	0.0100	.010795 V	
M4	3	VTb1Q2a	Q2a Lead Voltage Tap "b", primary	EE1312	2.2000	2.38493 V	NOTE: THIS VALUE SHOULD BE BETWEEN 5 AND 15 MV HIGHER THAN EE1612
M4	4	VTb2Q2a	Q2a Lead Voltage Tap "b", redundant	EE1322	2.2000	2.38494 V	
M3	1	VTc1Q2a	Q2a Center Voltage Tap "c", primary	EE1212	1.2000	1.20014 V	
M4	1	VTc2Q2a	Q2a Center Voltage Tap "c", redundant	EE1222	1.2000	1.20014 V	
M3	2	VTdQ2a	Q2a Quarter Coil Voltage Tap "d" (1-3 interface)	VTdQ2a	0.6000	0.6046 V	
M4	2	VTeQ2a	Q2a Quarter Voltage Tap "e", (2-4 interface)	VTeQ2a	1.7000	1.7913 V	
M6	1	VTa1Q2b	Q2b Lead Voltage Tap "a", primary	EE1412	4.6000	4.7789 V	
M6	2	VTa2Q2b	Q2b Lead Voltage Tap "a", redundant	EE1422	4.6000	4.7790 V	
M4	5	VTb1Q2b	Q2b lead Voltage Tap "b", primary	EE1612	2.3000	2.39847 V	NOTE: THIS VALUE SHOULD BE BETWEEN 10 AND 100 MV HIGHER THAN EE16
M5	5	VTb2Q2b	Q2b Lead Voltage Tap "b" redundant	EE1622	2.3000	2.39847 V	
M5	3	VTc1Q2b	Q2b Center Voltage Tap "c", primary	EE1512	3.5000	3.5884V	
M5	2	VTc2Q2b	Q2b Center Voltage Tap "c", redundant	EE1522	3.5000	3.5884 V	
M5	1	VTdQ2b	Q2b Quarter Coil Voltage Tap "d" (1-3 interface)	VTdQ2b	4.0000	4.1783 V	
M5	4	VTeQ2b	Q2b Quarter Voltage Tap "e", (2-4 interface)	VTeQ2b	2.8000	2.9896 V	

LMQX808
1/7

Form #2 CRYO HEATER CHECK_OUT

MEASURE RESISTANCE ACROSS EACH HEATER USING HANDHELD METER
MEASURE RESISTANCE FROM HEATER TO GND USING HANDHELD METER

Module	Pin		Expected Resistance, OHM	Measured Resistance, OHM	FNAL Label	Description
M11	1	EH8312+	17	18.37	W1aQ2A	Q2A Cryogenic Heater lead end - wire toward cold mass end plate (CERN #1 I+)
M11	2	EH8312-			W2aQ2A	Q2A Cryogenic Heater lead end - wire toward cold mass mag center (CERN #1 I-)
M11	3	EH8322+	17	18.09	W1bQ2A	Q2A Cryogenic Heater non-lead end wire toward cold mass end plate (CERN #2 I+)
M11	4	EH8322-			W2bQ2A	Q2A Cryogenic Heater non-lead end wire toward cold mass mag center (CERN #2 I-)
M12	1	EH8332+	17	17.69	W1aQ2B	Q2B Cryogenic Heater lead end - wire toward cold mass end plate (CERN #1 I+)
M12	2	EH8332-			W2aQ2B	Q2B Cryogenic Heater lead end - wire toward cold mass mag center (CERN #1 I-)
M12	3	EH8342+	17	18.09	W1bQ2B	Q2B Cryogenic Heater non-lead end wire toward cold mass end plate (CERN #2 I+)
M12	4	EH8342-			W2bQ2B	Q2B Cryogenic Heater non-lead end wire toward cold mass mag center (CERN #2 I-)

M11	1	EH8312+	more than 20MOHM	INF	W1aQ2A	Q2A Cryogenic Heater lead end - wire toward cold mass end plate (CERN #1 I+)
		GND				
M11	3	EH8322+	more than 20MOHM	INF	W1bQ2A	Q2A Cryogenic Heater non-lead end wire toward cold mass end plate (CERN #2 I+)
		GND				
M12	1	EH8332+	more than 20MOHM	INF	W1aQ2B	Q2B Cryogenic Heater lead end - wire toward cold mass end plate (CERN #1 I+)
		GND				
M12	3	EH8342+	more than 20MOHM	INF	W1bQ2B	Q2B Cryogenic Heater non-lead end wire toward cold mass end plate (CERN #2 I+)
		GND				

LMQXB08
3/7

Form #3 PROTECTION STRIP HEATERS

MEASURE RESISTANCE ACROSS EACH HEATER USING HANDHELD METER
MEASURE RESISTANCE FROM HEATER TO GND USING HANDHELD METER
MEASURE RESISTANCE FROM HEATER TO COIL USING HANDHELD METER

Module	Pin	Breakout BOX Labels	Expected Resistance, OHM	Measured Resistance OHM	FNAL Label	Description
M15	2	YT1112+	20	20.48	H1aQ2a	Q2a Protection (Strip) Heater, 1-4 & 2-3 circuit (FNAL lead A+) (CERN lead #1+)
M16	1	YT1112-			H2aQ2a	Q2a Protection (Strip) Heater, 1-4 & 2-3 circuit (FNAL lead A-) (CERN lead #1-)
M16	3	YT1122+	20	20.52	H1bQ2a	Q2a Protection (Strip) Heater, 1-2 & 3-4 circuit (FNAL lead B+) (CERN lead#2+)
M16	5	YT1122-			H2bQ2a	Q2a Protection (Strip) Heater, 1-2 & 3-4 circuit (FNAL lead B-) (CERN lead #2-)
M17	2	YT1132-	20	18.54	H2aQ2b	Q2b Protection (Strip) Heater, 1-4 & 2-3 circuit (FNAL lead A-) (CERN lead #1-)
M17	4	YT1132+			H1aQ2b	Q2b Protection (Strip) Heater, 1-4 & 2-3 circuit (FNAL lead A+) (CERN lead #1+)
M18	1	YT1142+	20	18.56	H1bQ2b	Q2b Protection (Strip) Heater, 1-2 & 3-4 circuit (FNAL lead B+) (CERN lead#2+)
M18	3	YT1142-			H2bQ2b	Q2b Protection (Strip) Heater, 1-2 & 3-4 circuit (FNAL lead B-) (CERN lead #2-)
M15	2	YT1112+	more than 20MOHM	INF	H1aQ2a	Q2a Protection (Strip) Heater, 1-4 & 2-3 circuit (FNAL lead A+) (CERN lead #1+)
		GND				
M16	3	YT1122+	more than 20MOHM	INF	H1bQ2a	Q2a Protection (Strip) Heater, 1-2 & 3-4 circuit (FNAL lead B+) (CERN lead#2+)
		GND				
M17	2	YT1132-	more than 20MOHM	INF	H2aQ2b	Q2b Protection (Strip) Heater, 1-4 & 2-3 circuit (FNAL lead A-) (CERN lead #1-)
		GND				
M18	1	YT1142+	more than 20MOHM	INF	H1bQ2b	Q2b Protection (Strip) Heater, 1-2 & 3-4 circuit (FNAL lead B+) (CERN lead#2+)
		GND				
M15	2	YT1112+	more than 20MOHM	INF	H1aQ2a	Q2a Protection (Strip) Heater, 1-4 & 2-3 circuit (FNAL lead A+) (CERN lead #1+)
		COIL				
M16	3	YT1122+	more than 20MOHM	INF	H1bQ2a	Q2a Protection (Strip) Heater, 1-2 & 3-4 circuit (FNAL lead B+) (CERN lead#2+)
		COIL				
M17	2	YT1132-	more than 20MOHM	INF	H2aQ2b	Q2b Protection (Strip) Heater, 1-4 & 2-3 circuit (FNAL lead A-) (CERN lead #1-)
		COIL				
M18	1	YT1142+	more than 20MOHM	INF	H1bQ2b	Q2b Protection (Strip) Heater, 1-2 & 3-4 circuit (FNAL lead B+) (CERN lead#2+)
		COIL				

LMQXBØ8
4/7

Form#4 RTDs Measurements

MEASURE RESISTANCE ACROSS EACH RTD USING A FOUR WIRE METER
MEASURE RESISTANCE FROM RTD TO GROUND USING HANDHELD METER
MEASURE RESISTANCE FROM RTD TO THE COIL USING HANDHELD METER

Module	Pin	Breakout BOX Labels	Expected Resistance , OHM	Measured Resistance OHM	FNAL Label	Description
M20	9	TT8312 I+	57	66.73	TaQ2a_I+	Q2a RTD, primary Wire color: Yellow
M20	8	TT8312 I-			TaQ2a_I-	Q2a RTD, primary Wire color: Green
M20	7	TT8312 U+			TaQ2a_V+	Q2a RTD, primary Wire color: Black
M20	12	TT8312 U-			TaQ2a_V-	Q2a RTD, primary Wire color: Red
M20	13	TT8322 I+	57	67.64	TbQ2a_I+	Q2a RTD, redundant: Wire color: Yellow
M20	14	TT8322 I-			TbQ2a_I-	Q2a RTD, redundant: Wire color: Green
M20	15	TT8322 U+			TbQ2a_V+	Q2a RTD, redundant: Wire color: Black
M20	16	TT8322 U-			TbQ2a_V-	Q2a RTD, redundant: Wire color: Red
M21	1	TT8332 I+	57	65.79	TaQ2b_I+	Q2b RTD, primary Wire color: Yellow
M21	2	TT8332 I-			TaQ2b_I-	Q2b RTD, primary Wire color: Green
M21	3	TT8332 U+			TaQ2b_V+	Q2b RTD, primary Wire color: Black
M21	4	TT8332 U-			TaQ2b_V-	Q2b RTD, primary Wire color: Red
M21	5	TT8342 I+	57	68.31	TbQ2b_I+	Q2b RTD, redundant: Wire color: Yellow
M21	6	TT8342 I-			TbQ2b_I-	Q2b RTD, redundant: Wire color: Green
M21	11	TT8342 U+			TbQ2b_V+	Q2b RTD, redundant: Wire color: Black
M21	10	TT8342 U-			TbQ2b_V-	Q2b RTD, redundant: Wire color: Red
M20	9	TT8312 I+	more than 20MOHM	INF	TaQ2a_I+	Q2a RTD, primary Wire color: Yellow
		GND				
M20	13	TT8322 I+	more than 20MOHM	INF	TbQ2a_I+	Q2a RTD, redundant: Wire color: Yellow
		GND				
M21	1	TT8332 I+	more than 20MOHM	INF	TaQ2b_I+	Q2b RTD, primary Wire color: Yellow
		GND				
M21	5	TT8342 I+	more than 20MOHM	INF	TbQ2b_I+	Q2b RTD, redundant: Wire color: Yellow
		GND				
M20	9	TT8312 I+	more than 20MOHM	INF	TaQ2a_I+	Q2a RTD, primary Wire color: Yellow
		COIL				
M20	13	TT8322 I+	more than 20MOHM	INF	TbQ2a_I+	Q2a RTD, redundant: Wire color: Yellow
		COIL				
M21	1	TT8332 I+	more than 20MOHM	INF	TaQ2b_I+	Q2b RTD, primary Wire color: Yellow
		COIL				
M21	5	TT8342 I+	more than 20MOHM	INF	TbQ2b_I+	Q2b RTD, redundant: Wire color: Yellow
		COIL				

LMQXB08
5/7

BUS	NA	3	4	1	2
	XXX	V2A	V2B	H2A	H2B
	XXX	V1A	V1B	H1A	H1B
	POSITION OF CCOIL BUS				

Form#5 Correction COILs

MEASURE RESISTANCE ACROSS BOTH CCOIL BUSES
MEASURE RESISTANCE FROM CCOIL TO GROUND
MEASURE RESISTANCE BETWEEN BOTH TAPS
MEASURE RESISTANCE FROM EACH TAP TO CCOIL BUS
MEASURE CONTINUITY OF Q1 CCOIL BUS
MEASURE FOR SHORT BETWEEN Q1 CCOIL BUS AND GRD

Horizontal Corrector Coil resistance				Expected	Measured		
H2-A	CCOIL BUS #1			22.5 OHMS	22.18		
H2-B	CCOIL BUS #2						
Vertical Corrector Coil resistance							
V2-A	CCOIL BUS #3			19 OHMS	17.42		
V2-B	CCOIL BUS #4						
H2-A	CCOIL BUS #1			more than 20MOHM	INF		
	GND						
V2-A	CCOIL BUS #3			more than 20MOHM	INF		
	GND						
M8	3	EE8122		more than 20MOHM	INF	VTH2	Corrector voltage tap Q2-H2 (skew dipole) (on MCBX, MCBXH, A+ lead)
M8	4	EE8112				VTV2	Corrector voltage tap Q2-V2 (normal dipole) (on MCBX, MCBXV, A+ lead)
M8	3	EE8122		less than 5 OHMS	1.92	VTH2	Corrector voltage tap Q2-H2 (skew dipole) (on MCBX, MCBXH, A+ lead)
		Ccoil Bus#1					
M8	4	EE8112		less than 5 OHMS	18.69	VTV2	Corrector voltage tap Q2-V2 (normal dipole) (on MCBX, MCBXV, A+ lead)
		Ccoil Bus#3					NOTE : tap is misplaced
M8	3	EE8122		more than 14 OHMS	23.43	VTH2	Corrector voltage tap Q2-H2 (skew dipole) (on MCBX, MCBXH, A+ lead)
		Ccoil Bus#2					
M8	4	EE8112		more than 14 OHMS	1.86	VTV2	Corrector voltage tap Q2-V2 (normal dipole) (on MCBX, MCBXV, A+ lead)
		Ccoil Bus#4					NOTE : tap is misplaced

CHECK CONTINUITY OF Q1 CCOIL BUS

FEED END	RETURN END	EXPECTED	MEASURED
V1-A	V1-A	LESS THAN 4 OHMS	3.85
V1-B	V1-B	LESS THAN 4 OHMS	3.89
H1-A	H1-A	LESS THAN 4 OHMS	3.9
H1-B	H1-B	LESS THAN 4 OHMS	3.84

CHECK FOR SHORT BETWEEN CCOIL BUS & GND — more than 20m ohms — INF

LMQXB08 6/7

Form#6 Feed through Test

MEASURE RESISTANCE BETWEEN ALL 24-Q1 FEED THROUGH SIGNALS

	EXPECTED RESISTANCE	
EE1111	< 1 OHM	OK
EE1121	< 1 OHM	OK
EE1211	< 1 OHM	OK
EE1221	< 1 OHM	OK
EE1311	< 1 OHM	OK
EE1321	< 1 OHM	OK
EE8121	< 1 OHM	OK
EE8111	< 1 OHM	OK
EH8311+	< 1 OHM	OK
EH8311-	< 1 OHM	OK
EH8321+	< 1 OHM	OK
EH8321-	< 1 OHM	OK
YT1111+	< 1 OHM	OK
YT1111-	< 1 OHM	OK
YT1121+	< 1 OHM	OK
YT1121-	< 1 OHM	OK
TT8311I+	< 1 OHM	OK
TT8311I-	< 1 OHM	OK
TT8311U+	< 1 OHM	OK
TT8311U-	< 1 OHM	OK
TT8321I+	< 1 OHM	OK
TT8321I-	< 1 OHM	OK
TT8321U+	< 1 OHM	OK
TT8321U-	< 1 OHM	OK

7/7
LMQX808

(Q2a) Resistance				Nominal ~ 560 to 585 mΩ
Voltage Tap Serial Numbers				Quadrant Total Resistance
Connect	Fermi	CERN	Quadrant	
V_{HI}	VTdQ2a	EMPTY	Quadrant 1	581.1 mΩ
V_{LO}	VTc1Q2a	EE1212		
V_{HI}	VTc1Q2a	EE1212	Quadrant 2	581.1 mΩ
V_{LO}	VTeQ2a	EMPTY		
V_{HI}	VTa1Q2a	EE1112	Quadrant 3	581.3 mΩ
V_{LO}	VTdQ2a	EMPTY		
V_{HI}	VTeQ2a	EMPTY	Quadrant 4	581.2 mΩ
V_{LO}	VTb1Q2a	EE1312		

V_{HI}	VTa1Q2a	EE1112	Total Cold Mass	Nominal ~ 2.305 Ω
V_{LO}	VTb1Q2a	EE1312		2.327 Ω

Technician(s) _____ Date _____

Check resistance of Redundant Voltage Taps.

Q2a Redundant Voltage Taps			
Connect	Fermi	CERN	Resistance
V_{HI}	VTa2Q2a	EE1122	1161.8 Ω
V_{LO}	VTc2Q2a	EE1222	
V_{HI}	VTc2Q2a	EE1222	1162.0 Ω
V_{LO}	VTb2Q2a	EE1322	

Technician(s) _____ Date 9/27/04

(Q2a) Inductance				Nominal ~ 2.880 to 2.935 mH
Voltage Tap Serial Numbers				Quadrant Total Inductance
Connect	Fermi	CERN	Quadrant	
L_{POT}	VTdQ2a	EMPTY	Quadrant 1	3.3324 mH
H_{POT}	VTc1Q2a	EE1212		
L_{POT}	VTc1Q2a	EE1212	Quadrant 2	3.3305 mH
H_{POT}	VTeQ2a	EMPTY		
L_{POT}	VTdQ2a	EMPTY	Quadrant 3	3.3131 mH
H_{POT}	VTa1Q2a	EE1112		
L_{POT}	VTeQ2a	EMPTY	Quadrant 4	3.2887 mH
H_{POT}	VTb1Q2a	EE1312		

L_{POT}	VTa1Q2a	EE1112	Total Cold Mass	Nominal ~ 13.3376 mH
H_{POT}	VTb1Q2a	EE1312		13.251 mH

(Q2a) Q-Factor				Nominal ~ 4.5 to 5.2
Voltage Tap Serial Numbers				Quadrant Total Q
Connect	Fermi	CERN	Quadrant	
L_{POT}	VTdQ2a	EMPTY	Quadrant 1	5.1
H_{POT}	VTc1Q2a	EE1212		
L_{POT}	VTc1Q2a	EE1212	Quadrant 2	5.1
H_{POT}	VTeQ2a	EMPTY		
L_{POT}	VTa1Q2a	EE1112	Quadrant 3	5.1
H_{POT}	VTdQ2a	EMPTY		
L_{POT}	VTeQ2a	EMPTY	Quadrant 4	5.2
H_{POT}	VTb1Q2a	EE1312		

L_{POT}	VTa1Q2a	EE1112	Total Cold Mass	Nominal ~ 5.036
H_{POT}	VTb1Q2a	EE1312		5.1

Technician(s)

9/27/04
Date

Using the Hewlett Packard HP3457A digital multimeter, measure the Strip Heater Resistance for Q2a and Q2b.

Q2a Strip Heater Resistance				
Fermi	CERN	Description	Limit	Resistance
H1aQ2a	YT1112+	Circuit A	18.20 to 21 Ω	20.039 Ω
H2aQ2a	YT1112-			
H1bQ2a	YT1122+	Circuit B	18.20 to 21 Ω	20.088 Ω
H2bQ2a	YT1122-			

Technician(s) 9-27-04 Date

Q2b Strip Heater Resistance				
Fermi	CERN	Description	Limit	Resistance
H1aQ2b	YT1132+	Circuit A	18.20 to 21 Ω	Ω
H2aQ2b	YT1132-			
H1bQ2b	YT1142+	Circuit B	18.20 to 21 Ω	Ω
H2bQ2b	YT1142-			

Technician(s) Date