



Broadcast Electronics Inc.

4100 North 24th Street, Quincy, Illinois 62305 USA • Phone (217) 224-9600 • Fax (217) 224-9607 • www.bdcast.com • bdcast@bdcast.com



4MX Series Transmitters

DSP Exciter Replacement and Calibration Application Guide

597-4050-008, Revision E
1/10/08

4MX Series Transmitters

DSP Exciter Replacement and Calibration Application Guide

©2008 Broadcast Electronics Inc. All rights reserved.

The information in this publication is subject to improvement and change without notice. Although every effort is made to ensure the accuracy of the information in this manual, Broadcast Electronics Inc. accepts no responsibility for any errors or omissions. Broadcast Electronics Inc. reserves the right to modify and improve the design and specifications of the equipment in this manual without notice. Any modifications shall not adversely affect performance of the equipment so modified.

Proprietary Notice

This document contains proprietary data of Broadcast Electronics Inc. No part of this publication may be reproduced, transmitted, transcribed, stored in a retrieval system, translated into any other language in any form or by any means, electronic or mechanical, including photocopying or recording, for any purpose, without the express written permission of Broadcast Electronics Inc.

Trademarks

Broadcast Electronics and the BE logo are registered trademarks of Broadcast Electronics Inc.

All other trademarks are property of their respective owners.

Table of Contents

1	Replacing/Calibrating the 4MX DSP Exciter PCB	1
1.1	Overview	1
1.2	Items/Tools Required.....	1
1.3	ESD Awareness.....	1
2	Replacing the DSP Exciter PCB.....	2
2.1	Ensure that the Transmitter's AC Power Breaker is turned to OFF.....	2
2.2	Remove the Remote I/O Access Panel	3
2.3	Disconnect Cables from the DSP Exciter PCB.....	4
2.4	Remove DSP PCB Mounting Hardware	5
2.5	Loosen DSP Exciter PCB Mounting Bracket Hardware.....	5
2.6	Remove DSP Exciter Mounting Screws.....	6
2.7	Remove Mounting Bracket from DSP Exciter PCB	6
2.8	Install Mounting Bracket on Replacement DSP PCB.....	7
2.9	Install DSP Exciter Mounting Screws.....	7
2.10	Tighten DSP Exciter PCB Mounting Bracket Hardware	8
2.11	Install DSP PCB Mounting Hardware.....	8
2.12	Connect Cables to the DSP Exciter PCB	9
3	4MX Negative Overlap Calibration (SW Ver 45.X.X.X.X or Newer) ...	10
3.1	Background	10
3.2	Connect Scope CH1 to J22 and CH2 to J9	10
3.3	Set Negative Overlap to 29ns.....	11
3.4	Negative Overlap Calibration.....	13
4	4MX Fwd Pwr Calibration (SW Ver 45.X.X.X.X or Newer).....	19
4.1	Ensure the Transmitter's RF Output is Connected to a 50-J0 Ohm Load ..	19
4.2	Connect RF Ammeter to Transmitter's RF Output.....	19
4.3	Transmitter Forward Power Calibration	19
5	Audio Setup and Calibration	28
5.1	Set the Active Audio Input	28
5.2	Assign the Audio Input Type	28
5.3	No Backup Audio.....	28
5.4	AES/EBU Input.....	28
5.5	Set Audio Positive / Negative Indicator Peak Levels.....	29
5.6	Audio Input Connections	30
5.7	Adjust R120 and R133.....	30
5.8	Setup Audio Processor Asymmetry	31
5.9	Setup the Incoming Audio Gain in the 4MX.....	32
5.10	Set the Modulation Level	33



6	Verification	33
7	RF Customer Service Contact Information	34



1 Replacing/Calibrating the 4MX DSP Exciter PCB

1.1 Overview

This document describes the necessary steps to replace and calibrate the DSP Exciter PCB in a 4MX Series Transmitter.

WARNING: This application guide is strictly intended to assist field personnel while replacing a DSP Exciter Board in a 4MX transmitter and it should ONLY be used in conjunction with support from the BE RF Customer Service Organization. Resultant damage to the transmitter or transmitter site may occur if this application guide is not followed correctly. Contact the BE RF Customer Service Organization before beginning this procedure.

1.2 Items/Tools Required

Supplied by Customer:

- ☐ No. 2 Phillips Screwdriver
- ☐ 1/4" Nutdriver
- ☐ 9/16" Open End Wrench
- ☐ RF Ammeter (Delta TCA-40/80-EXR or equivalent)
- ☐ 2 Channel Oscilloscope (Agilent Infinium or equivalent as described in Figures 30 and 32)

Supplied by B.E.

- ☐ 4MX DSP Exciter PCB (P/N 917-0400) (Only if deemed necessary by Customer Service)
- 977-4001 Kit, 4MX Calibration
 - ☐ Cable, RF, BNC to SMA for Connection to Scope (P/N 947-4052, Qty 2)
 - ☐ L1 Adjustment Tool (P/N 930-104)
 - ☐ Potentiometer Adjustment Tool (P/N 930-100A)

1.3 ESD Awareness



During the upgrade process be sure to exercise ESD precautions.

2 Replacing the DSP Exciter PCB

2.1 Ensure that the Transmitter's AC Power Breaker is turned to OFF



Figure 1 – Turn 4MX AC Breaker to OFF

<continue to next page>

2.2 Remove the Remote I/O Access Panel

Step 1 – Using a No. 2 Phillips Screw Driver remove the (2) screws from the right door as shown.



Step 2 – Using a No. 2 Phillips Screw Driver remove the (3) screws from the hinge area as shown



Step 3 – Use the fold-out handle to remove the Remote Control I/O and Audio Input Access Panel



Figure 2 – Remote Control I/O Access Panel Removal

2.3 Disconnect Cables from the DSP Exciter PCB

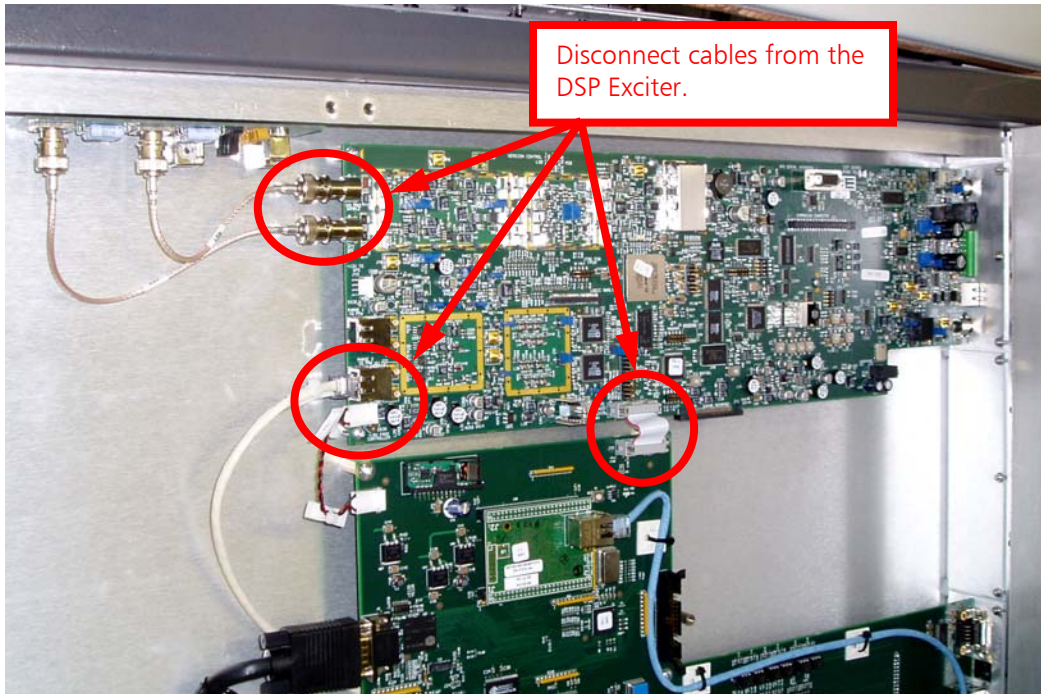


Figure 3 – Disconnect Cables from the DSP Exciter PCB

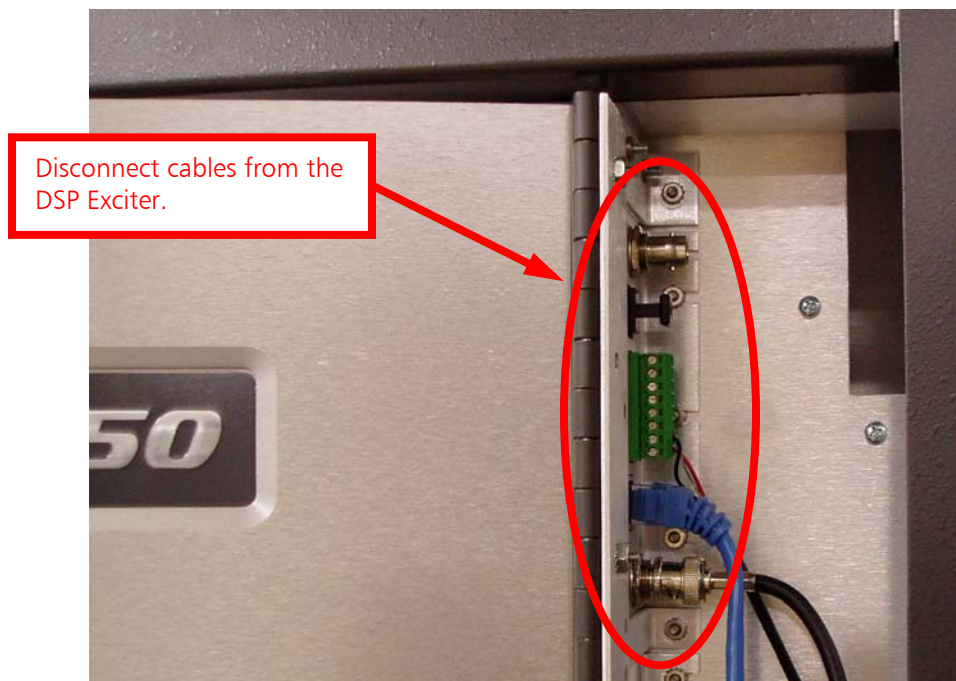


Figure 4 – Disconnect Cables from the DSP Exciter PCB

2.4 Remove DSP PCB Mounting Hardware

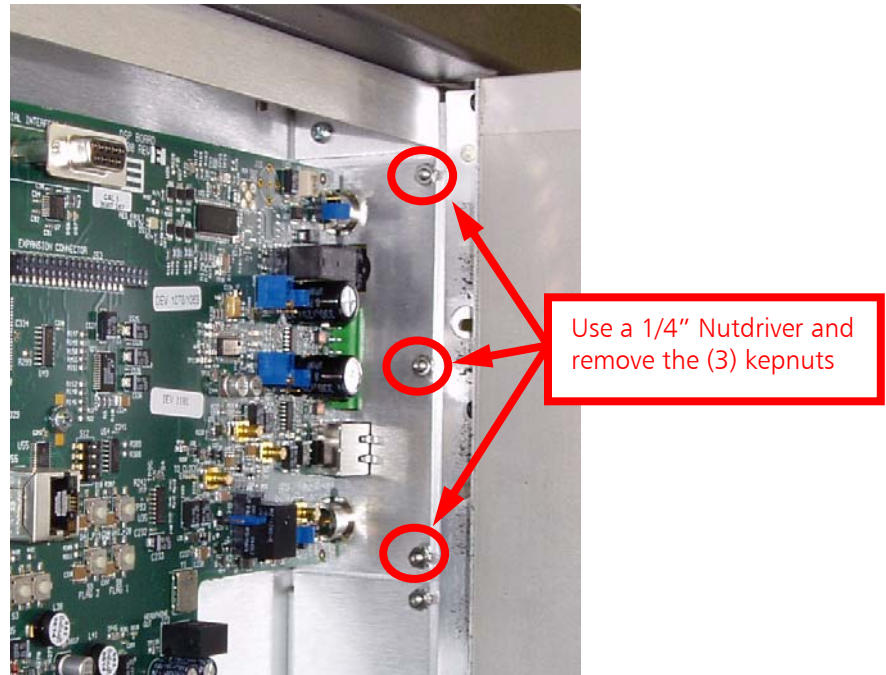


Figure 5 – Hardware Removal

2.5 Loosen DSP Exciter PCB Mounting Bracket Hardware

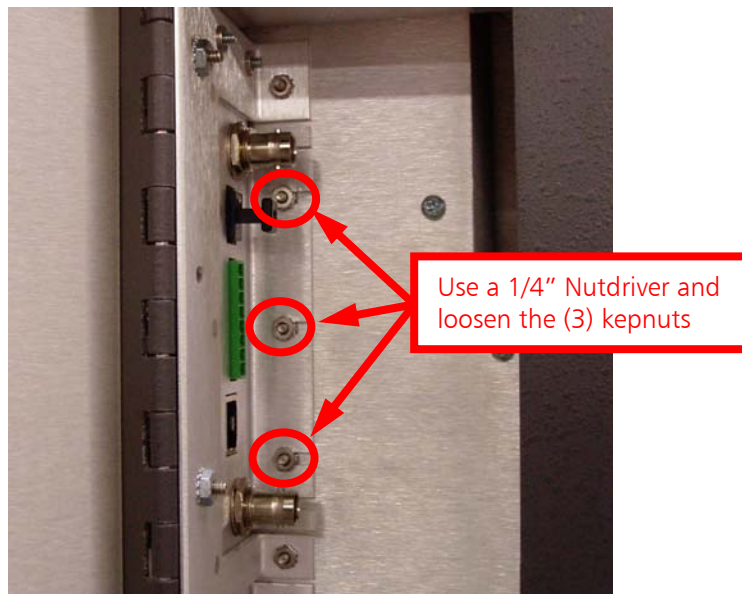


Figure 6 – Loosen DSP Exciter Mounting Bracket Hardware

2.6 Remove DSP Exciter Mounting Screws

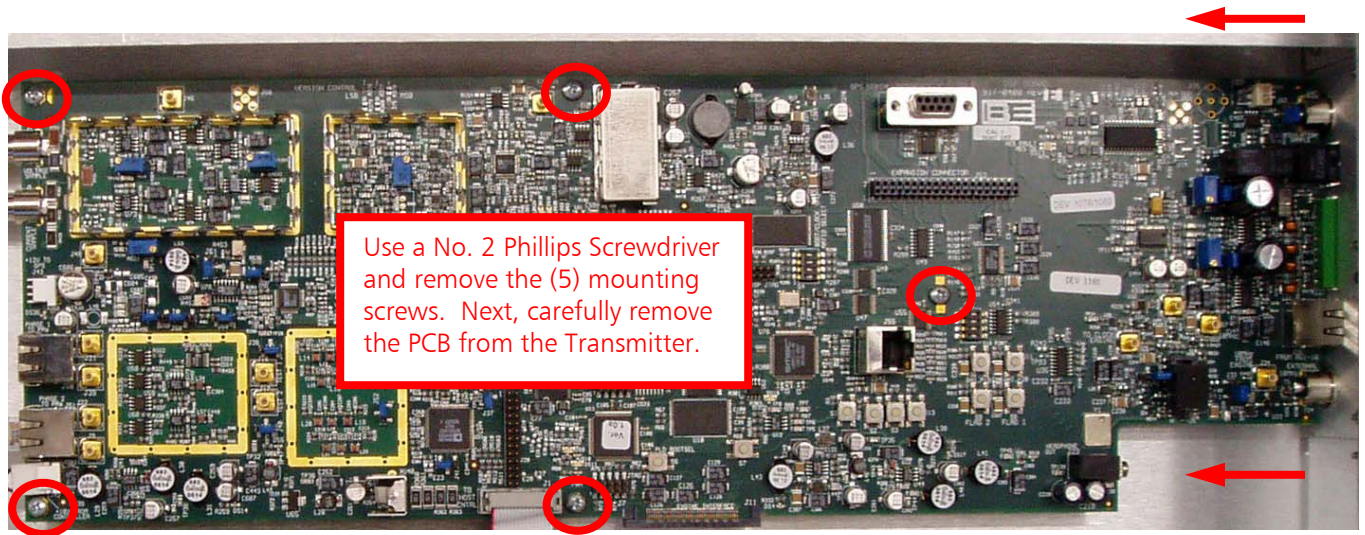


Figure 7 – Mounting Screw Removal

2.7 Remove Mounting Bracket from DSP Exciter PCB

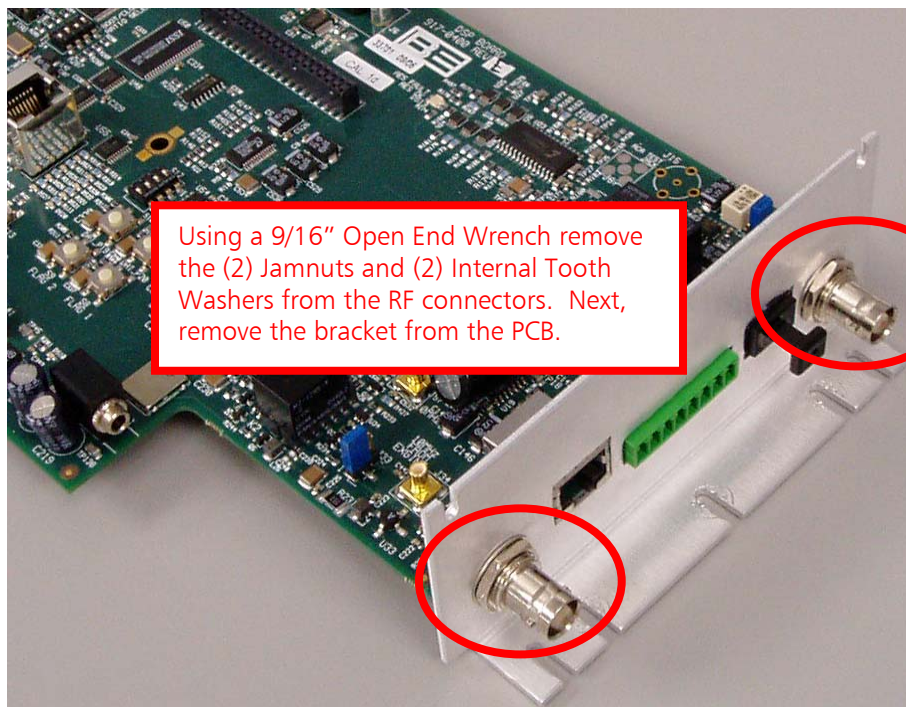


Figure 8 – Mounting Bracket Removal

2.8 Install Mounting Bracket on Replacement DSP PCB

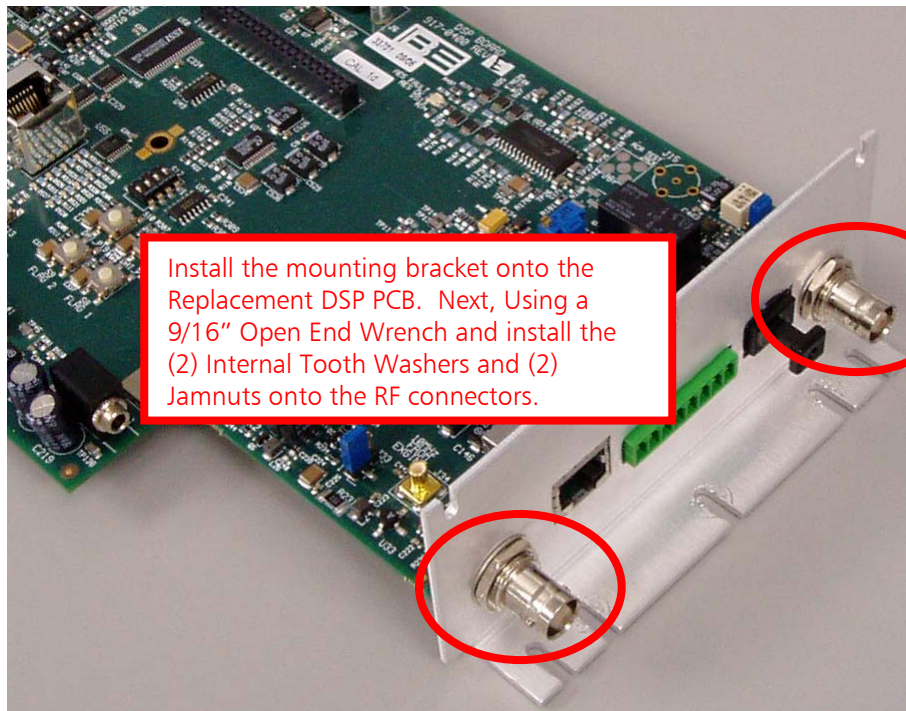


Figure 9 – Mounting Bracket Installation

2.9 Install DSP Exciter Mounting Screws

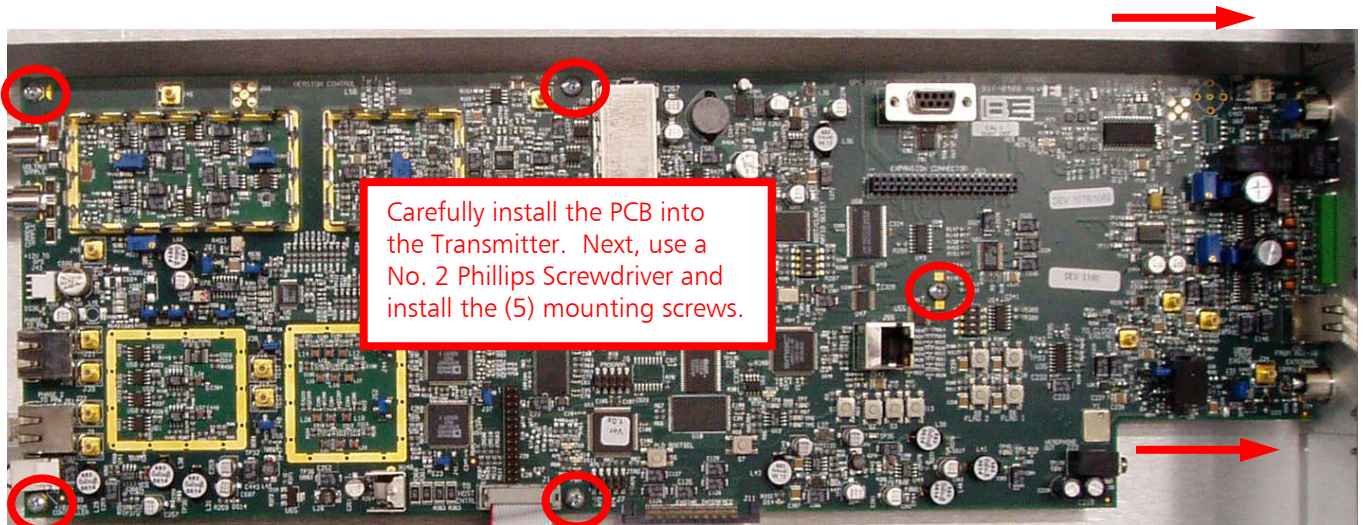


Figure 10 – Mounting Screw Installation

2.10 Tighten DSP Exciter PCB Mounting Bracket Hardware

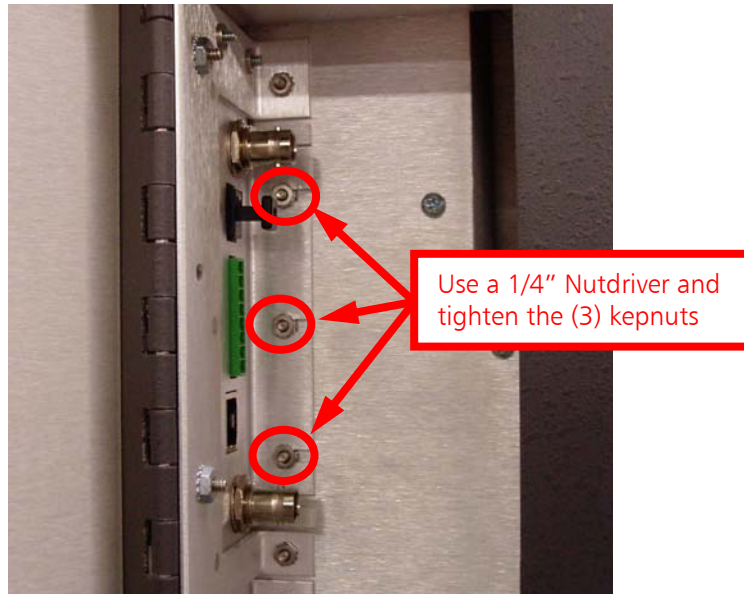


Figure 11 – Tighten DSP Exciter Mounting Bracket Hardware

2.11 Install DSP PCB Mounting Hardware

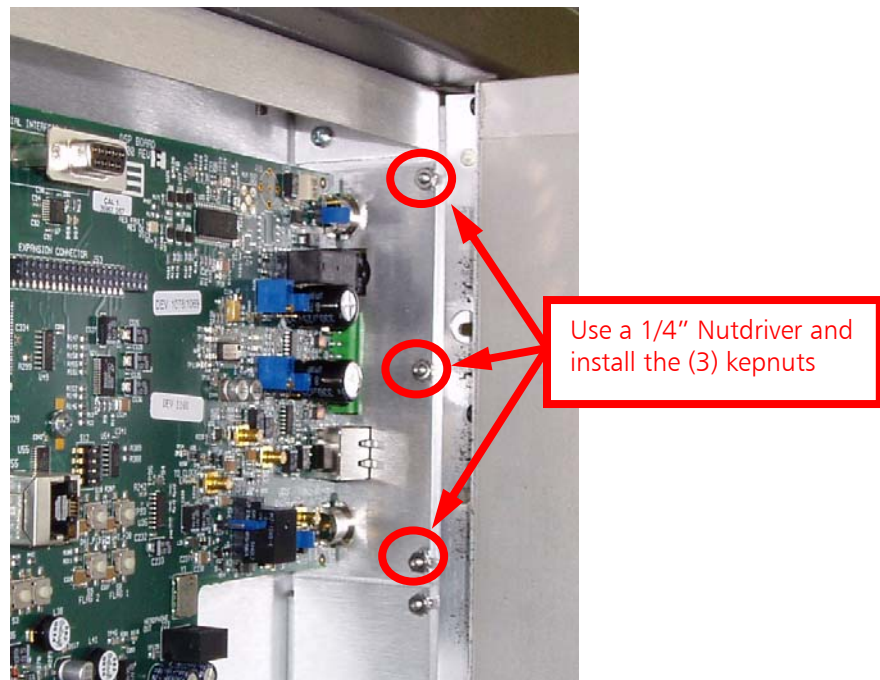


Figure 12 – Hardware Installation

2.12 Connect Cables to the DSP Exciter PCB

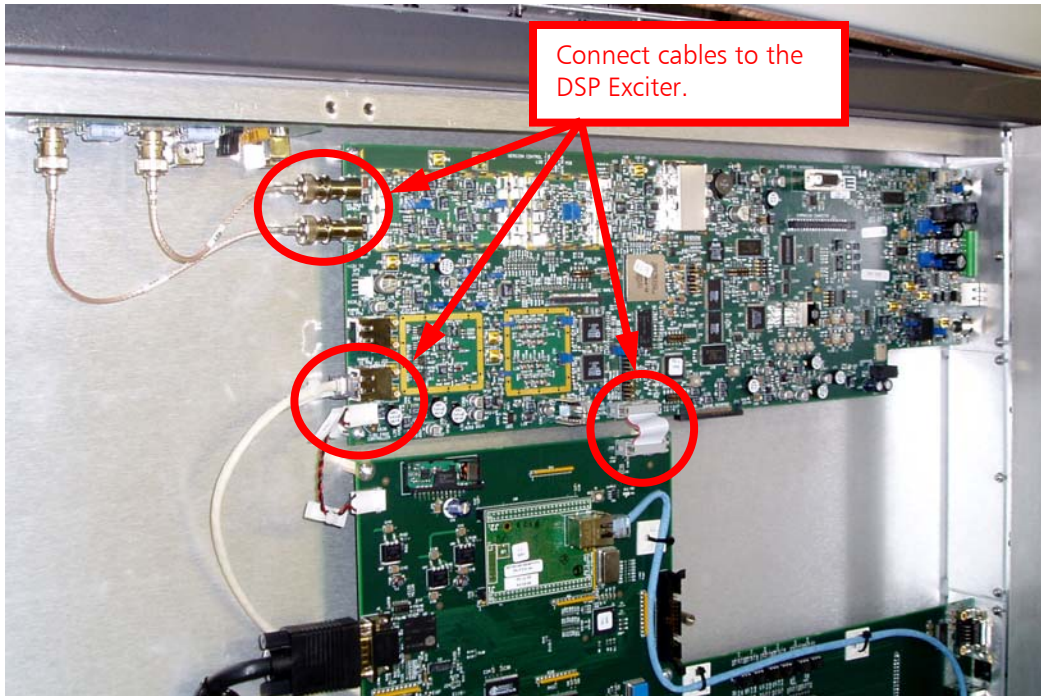


Figure 13 – Connect Cables to the DSP Exciter PCB

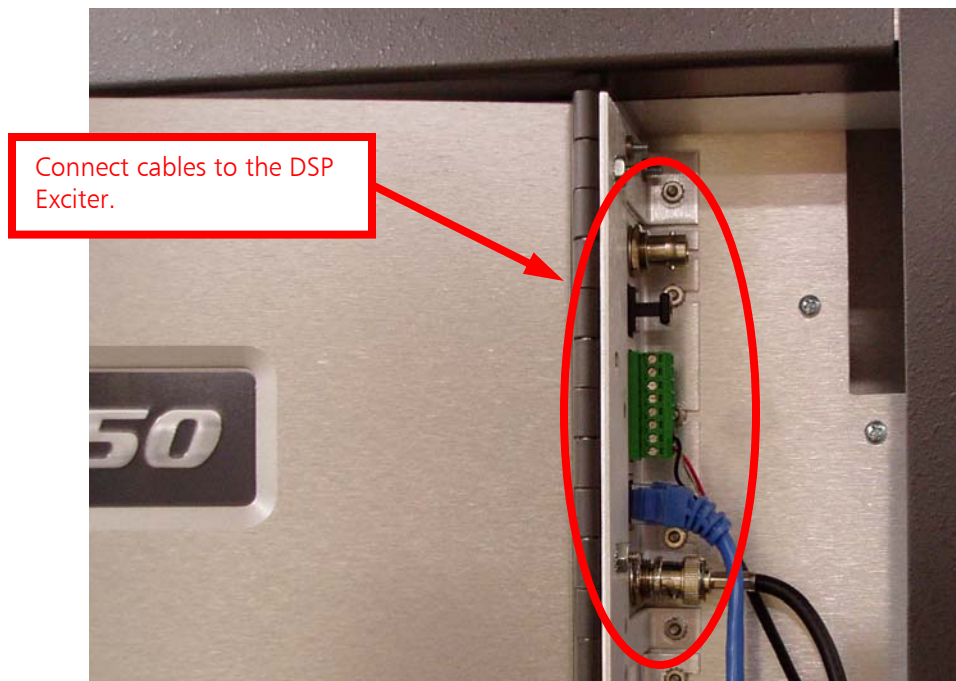


Figure 14 – Connect Cables to the DSP Exciter PCB

3 4MX Negative Overlap Calibration (SW Ver 45.X.X.X.X or Newer)

3.1 Background

A negative overlap adjustment is necessary to optimize the negative peak modulation to approximately -97% in analog mode. Observation has concluded that negative overlap adjustments are necessary over the AM frequency band as well as on a board to board basis.

3.2 Connect Scope CH1 to J22 and CH2 to J9

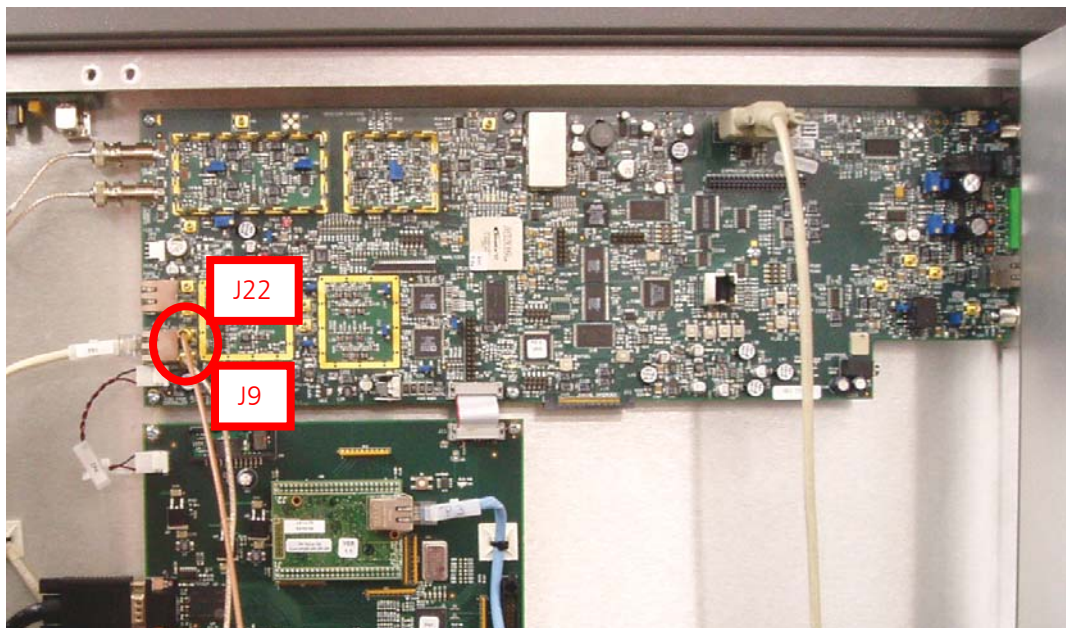


Figure 15 – Connect Scope to DSP PCB J22 and J9

<continue to next page>

3.3 Set Negative Overlap to 30 - 32ns

Step 1 – Put the transmitter into “negative” calibrate mode by pressing (**S1**) on the DSP Exciter until both mode LED’s (**DS1** and **DS29**) are solid.

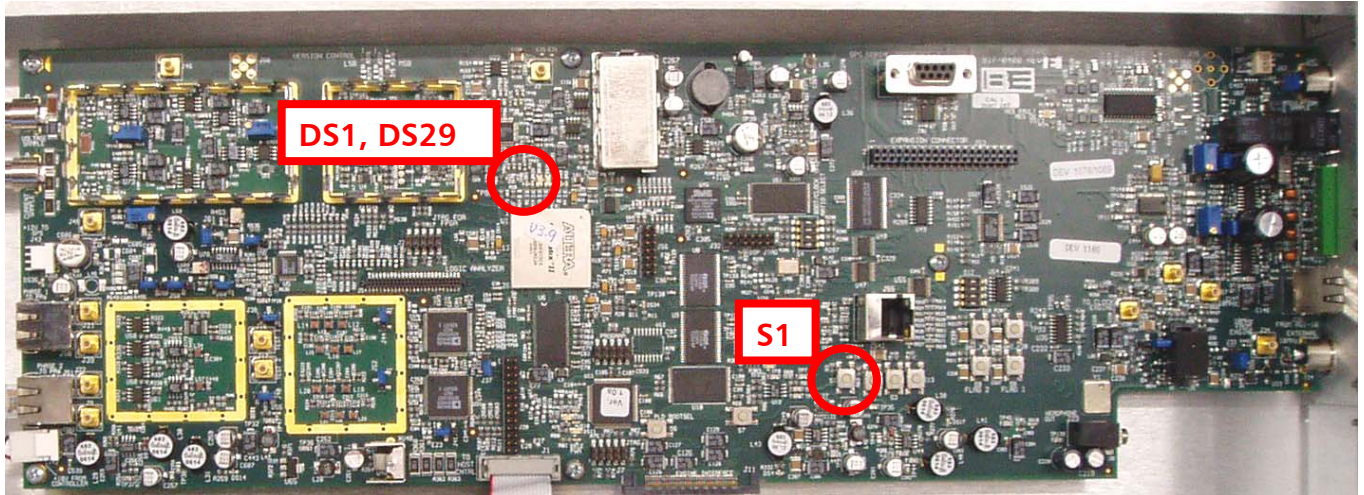


Figure 16 – S1, DS1, and DS29 Locations

Step 2 – Adjust overlap up or down with the right most push button (**S13**). Use the “Invert” button (**S2**) to switch overlap direction. The invert led may be stuck, therefore you may have to hold down the invert push button (**S2**) while adjusting overlap with (**S13**).

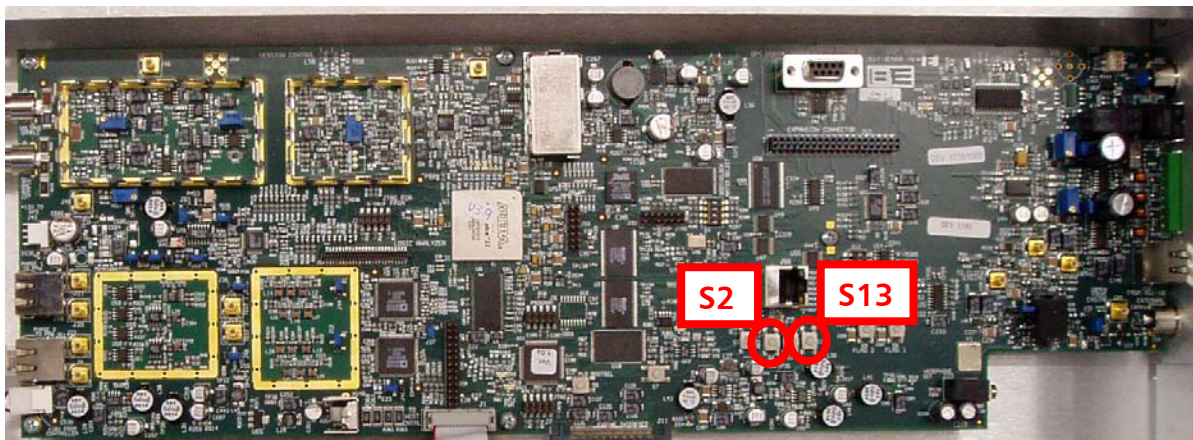
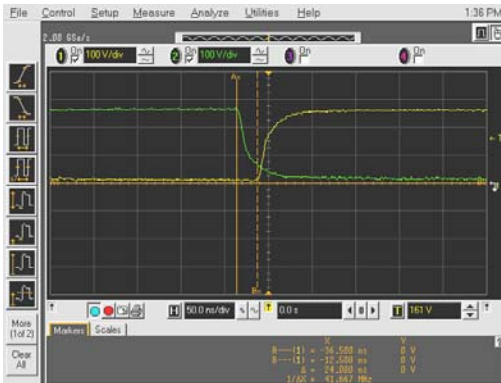


Figure 17 – S2 and S13 Locations

Step 3 – When the overlap is set to **30 - 32ns** on the scope press the “second-from the right” (**S3**) push button on the DSP Exciter to save the calibration. **DS3** will flash rapidly for a few seconds then return to a slower flashing sequence.



Scope Setup:

Input = 50Ω

Vertical = 100V/div

Trigger = Auto, Channel 1, Rising Edge, DC Coupled

Figure 18 – Measure Waveform Time Differential

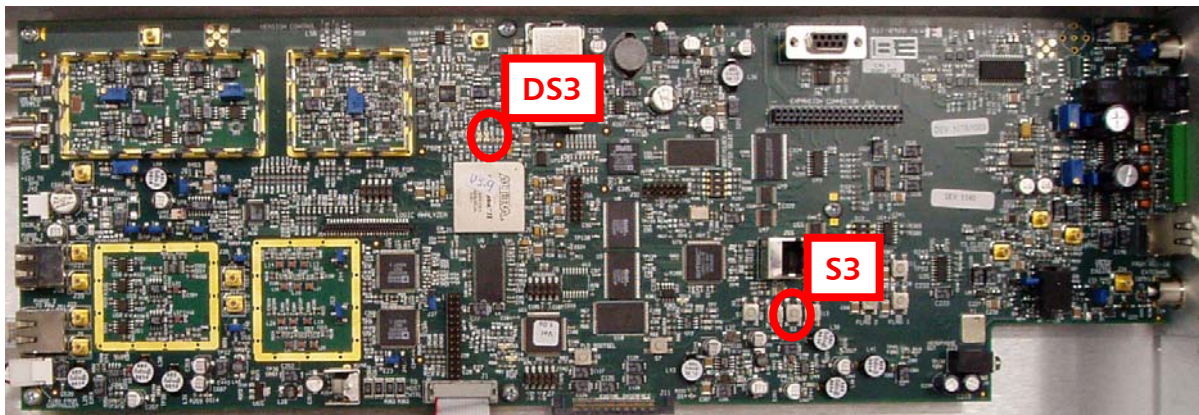


Figure 19 – S3 and DS3 Locations

Step 4 – Cycle AC Power.



Turn the AC Breaker to the **OFF** position then back the **ON** position

Figure 20 – Turn 4MX AC Breaker to OFF then Back to ON

3.4 Negative Overlap Calibration

Step 1 – Ensure that the forward power selected is 50 kW for 4MX50 and 25 kW for 4MX25.

Step 2 – Enter the calibration mode by selecting the factory setup menu screen.

MAIN MENU -> DIAG -> HELP (then press 4 buttons simultaneously as shown).



Figure 21 – Factory Setup Menu Access

Step 3 – The login menu will appear. Press the buttons “469687” and hit **ENTER**.

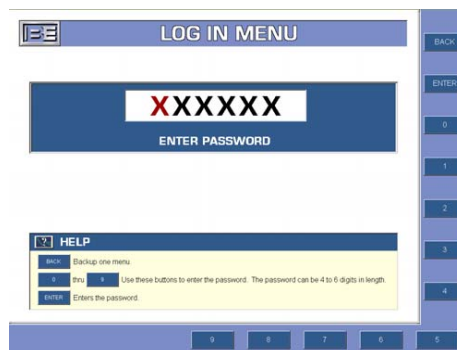


Figure 22 – Login Menu

Step 4 – The Factory Setup Menu will appear. Select “**CALIBRATE EXCITER**”.

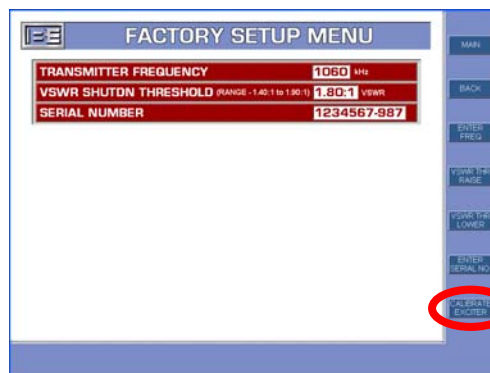


Figure 23 – Factory Setup Menu

Step 5 – The Exciter Calibration Menu will appear. Select **“START CAL”**.

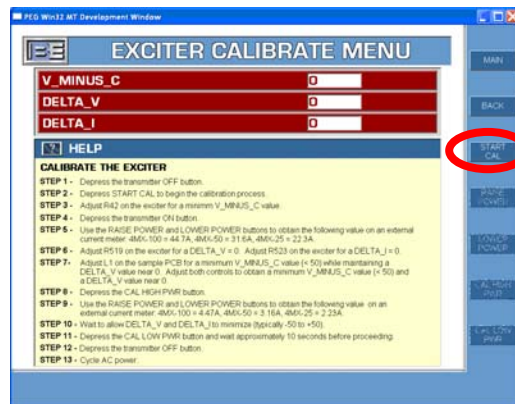


Figure 24 – Exciter Calibration Menu

Step 6 – Turn the Transmitter’s RF Output to ON.



Figure 25 – Turn the Transmitter’s RF Output to ON

Step 7 – Use the “**RAISE POWER**” and “**LOWER POWER**” buttons to achieve the **MINIMUM** RF current on the external RF Ammeter attached to the transmitter’s RF output.

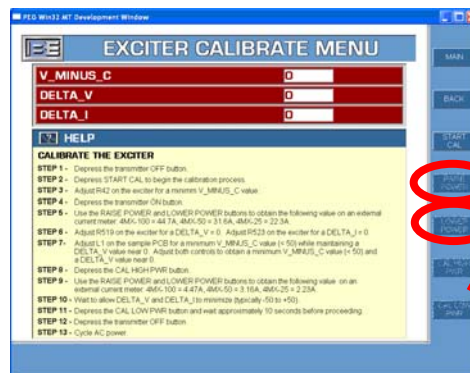
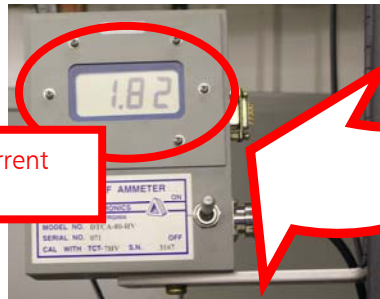


Figure 26 – Exciter Calibrate Menu

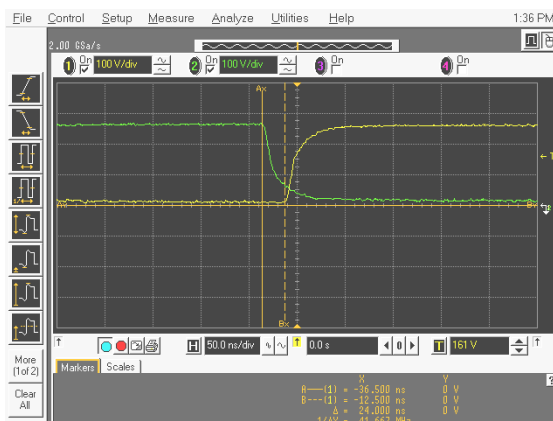


NOTE: You must see a “dip” in the current reading.

Figure 27 – External RF Ammeter attached to Transmitter’s RF Output

NOTE: If you do not have an external RF current meter, set the negative overlap for 25ns. Monitor negative modulation and move this value more negative to achieve 95% – 97% negative modulation peaks.

Step 8 – Once the minimum current has been achieved on the external RF Ammeter, measure and record the time differential from the knee of each waveform as shown.



Scope Setup:

Input = 50Ω
Vertical = 100V/div
Trigger = Auto, Channel 1, Rising Edge, DC Coupled

Figure 28 – Measure Waveform Time Differential

Step 9 – Turn the transmitter's RF Output to OFF.



Figure 29 – Turn the Transmitter's RF Output to OFF

Step 10 – Cycle AC Power to the transmitter.



Turn the AC Breaker to the **OFF** position then back to the **ON** position

Figure 30 – Cycle the Transmitter's AC Power Breaker

Step 11 – Next, put the transmitter into "negative" calibrate mode by pressing (S1) on the DSP Exciter until both mode LED's (DS1 and DS29) are solid.

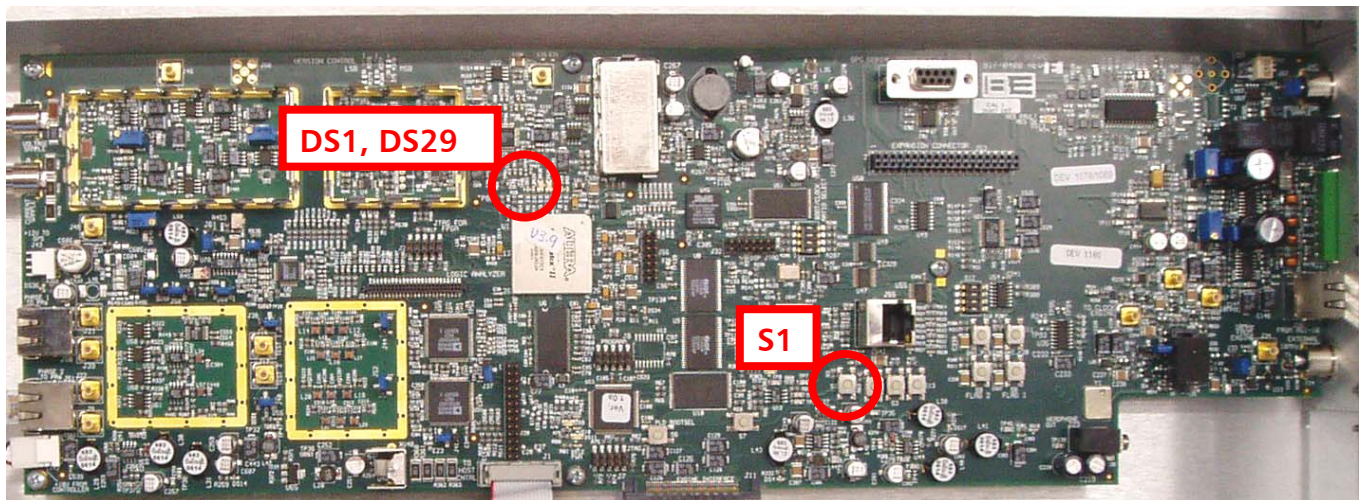


Figure 31 – S1, DS1, and DS29 Locations

Step 12 – Adjust overlap up or down with the right most push button (**S13**). Use the “Invert” button (**S2**) to switch overlap direction. The invert led may be stuck, therefore you may have to hold down the invert push button (**S2**) while adjusting overlap with (**S13**) to the value recorded in **STEP 8**.

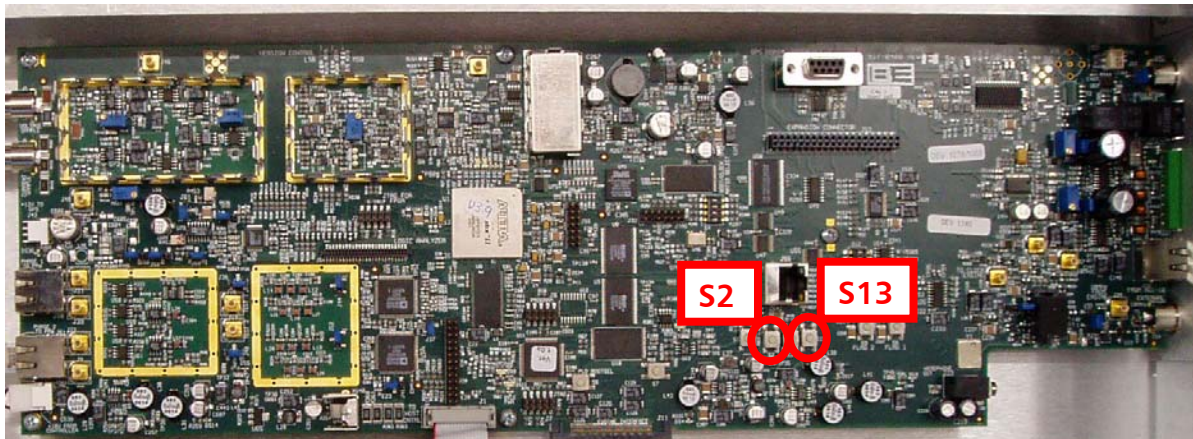


Figure 32 – S2 and S13 Locations

Step 13 – When the overlap is set to the desired level on the scope press the “second-from the right” (**S3**) push button on the DSP Exciter to save the calibration. DS3 will flash rapidly for a few seconds then return to a slower flashing sequence.

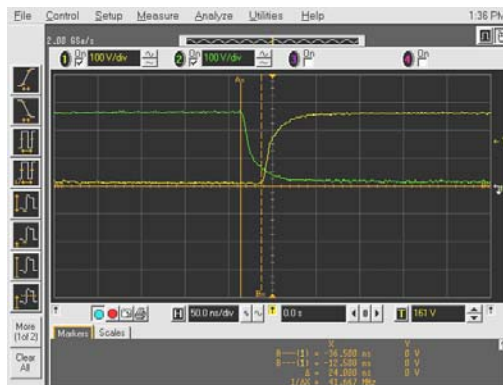


Figure 33 – Measure Waveform Time Differential

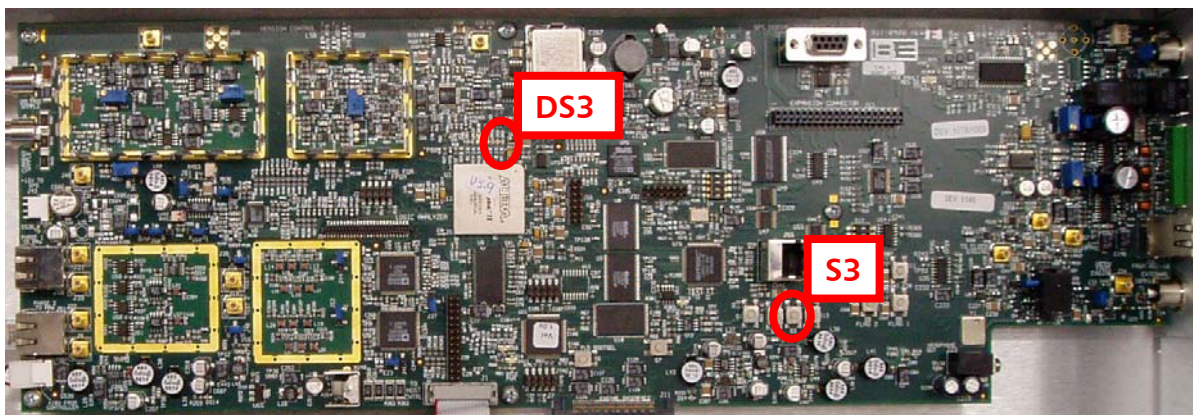


Figure 34 – S3 and DS3 Locations

Step 14 – Cycle AC Power to the transmitter.



Figure 35 – Cycle the Transmitter's AC Power Breaker

Step 15 – Verify on the scope that the overlap is set correctly.

4 4MX Fwd Pwr Calibration (SW Ver 45.X.X.X.X or Newer)

4.1 Ensure the Transmitter's RF Output is Connected to a 50-J0 Ohm Load

Ensure the Transmitter's RF Output is connected to a 50-J0 Ohm Load capable of handling 50kW un-modulated power (for a 4MX 50) or 25kW un-modulated power (for a 4MX 25).

NOTE: If the transmitter is connected to a load that is not 50-J0 Ohms, the system will be improperly calibrated!

4.2 Connect RF Ammeter to Transmitter's RF Output



Figure 36 – RF Ammeter Connection

4.3 Transmitter Forward Power Calibration

Step 1 – Ensure that the forward power selected is 50 kW for 4MX50 and 25 kW for 4MX25.

Step 2 – Turn the Transmitter's RF output to OFF.

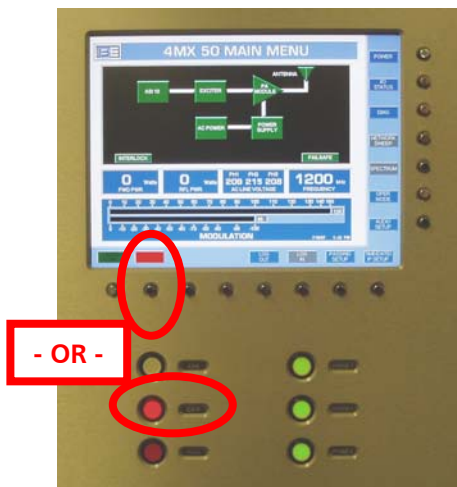


Figure 37 – Turn the Transmitter's RF Output to OFF

Step 3 – Enter the calibration mode by selecting the factory setup menu screen.

MAIN MENU -> DIAG -> HELP (then press 4 buttons simultaneously as shown).



Figure 38 – Factory Setup Menu Access

Step 4 – The login menu will appear. Press the buttons “469687” and hit **ENTER**.

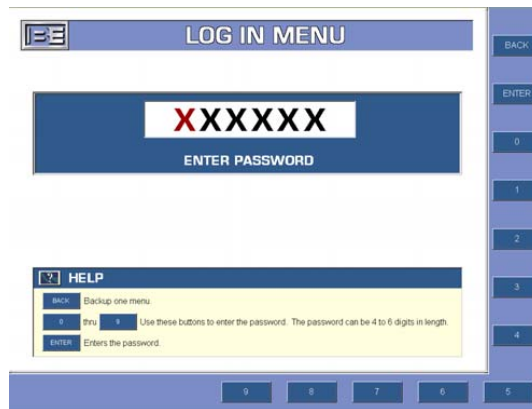


Figure 39 – Login Menu

Step 5 – The Factory Setup Menu will appear. Verify that the Frequency is correct and the VSWR Shutdown Threshold has been set to 1.80:1 or higher then select “**CALIBRATE EXCITER**”.

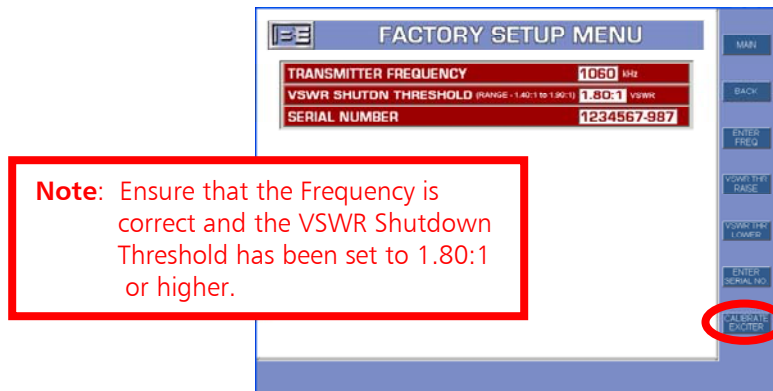


Figure 40 – Factory Setup Menu

Step 6 – The Exciter Calibration Menu will appear. Select **“START CAL”**.

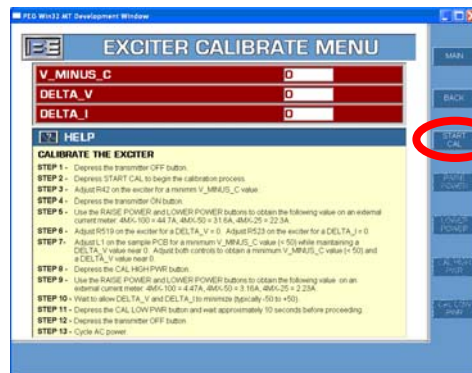


Figure 41 – Exciter Calibration Menu

Step 7 – Adjust **R42** on the DSP Exciter for a minimum **V_MINUS_C** value (<50, typically 30).

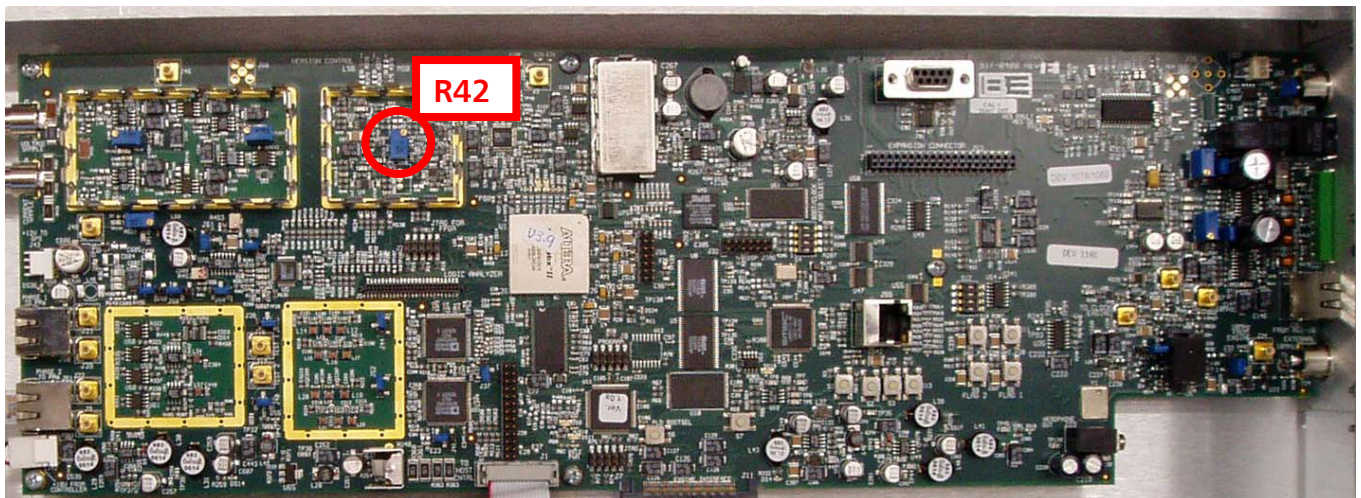


Figure 42 – R42 Location

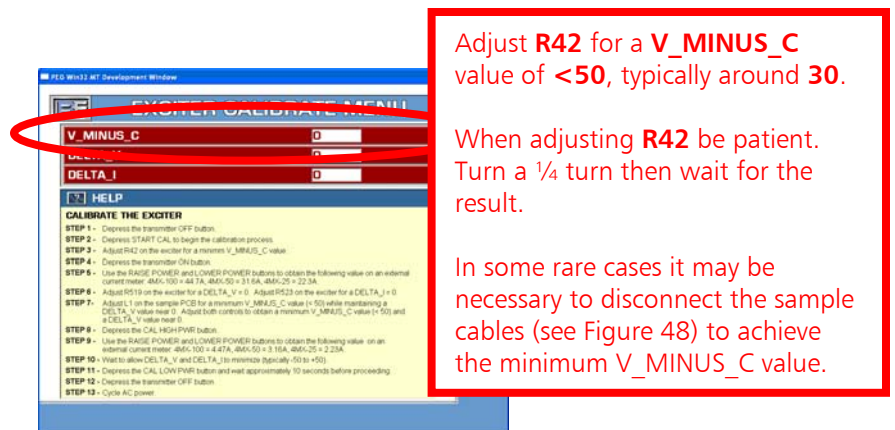


Figure 43 – Exciter Calibrate Menu

Step 8 – Turn the Transmitter's RF output to ON.

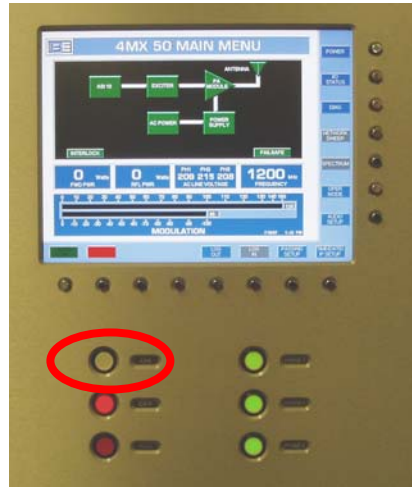


Figure 44 – Turn the Transmitter's RF Output to ON

Step 9 – Use the **RAISE POWER** and **LOWER POWER** buttons to obtain the following value on an external RF current meter: 4MX100 = 44.7A, 4MX50 = 31.6A, 4MX25 = 22.3A

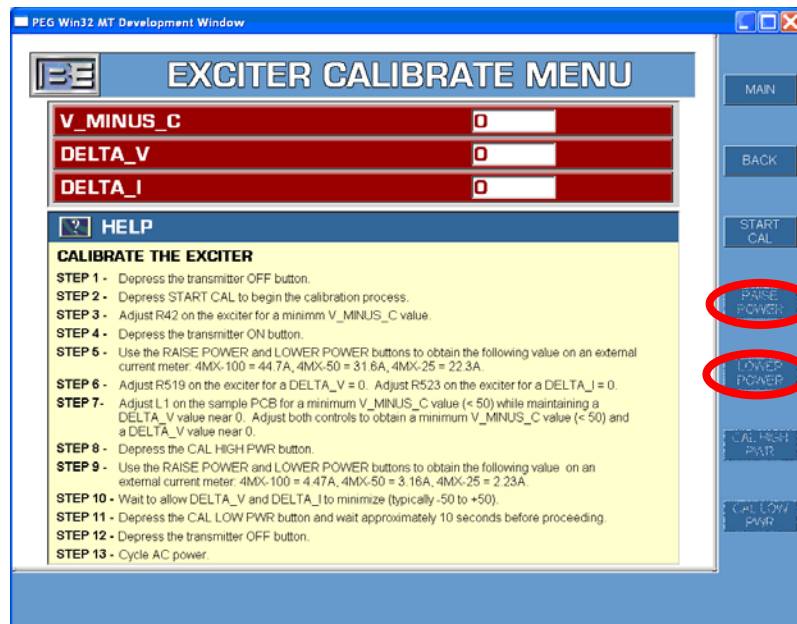


Figure 45 – Exciter Calibrate Menu

Step 10 – On the DSP Exciter adjust **R519** for a **DELTA_V=0** (+/- 5 typical) and **R523** for a **DELTA_I=0** (+/- 5 typical).

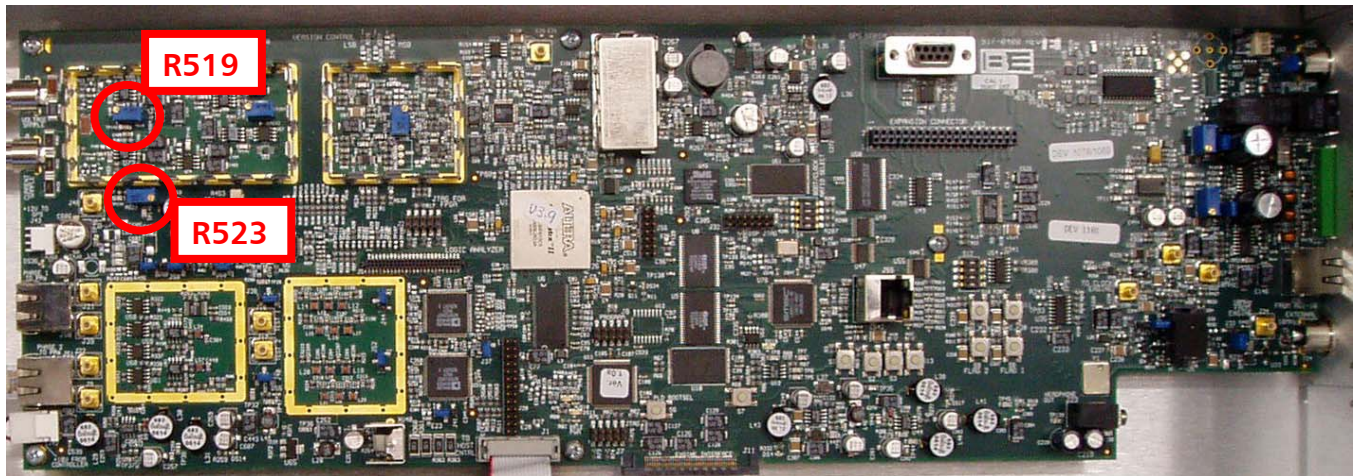


Figure 46 – R519 and R523 Locations

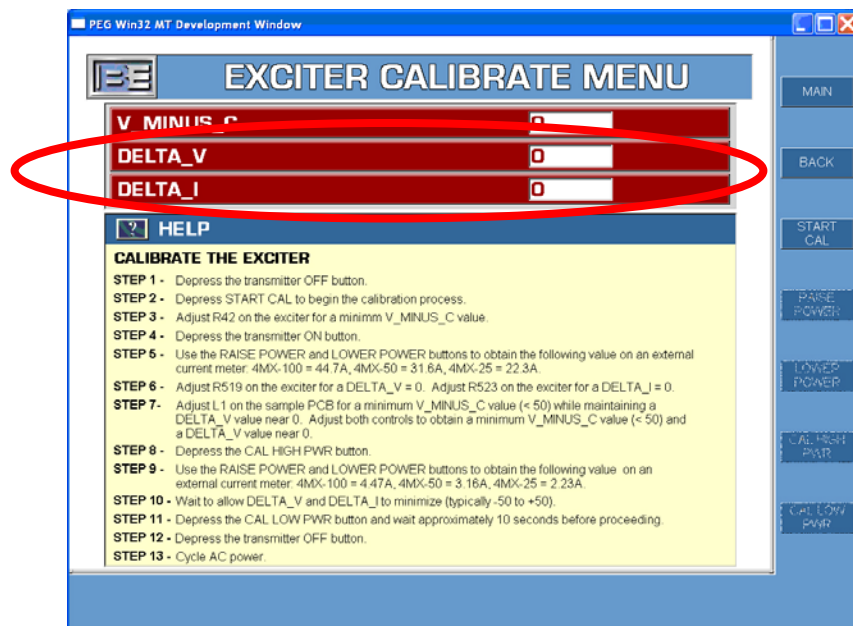


Figure 47 – Exciter Calibrate Menu

<continue to next page>

Step 11 – Adjust **L1** on the **Sample PCB** and **R519, R523** on the **DSP Exciter** (if necessary) to obtain a minimum **V_MINUS_C** value **<50** (+/- 10), and **DELTA_V, DELTA_I** values near **0** (+/- 5 typical). Adjust **R42** ONLY if necessary.

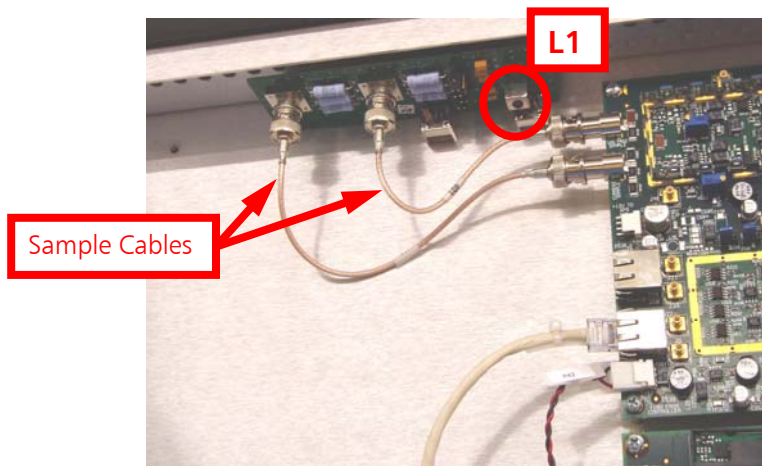


Figure 48 – L1 Location

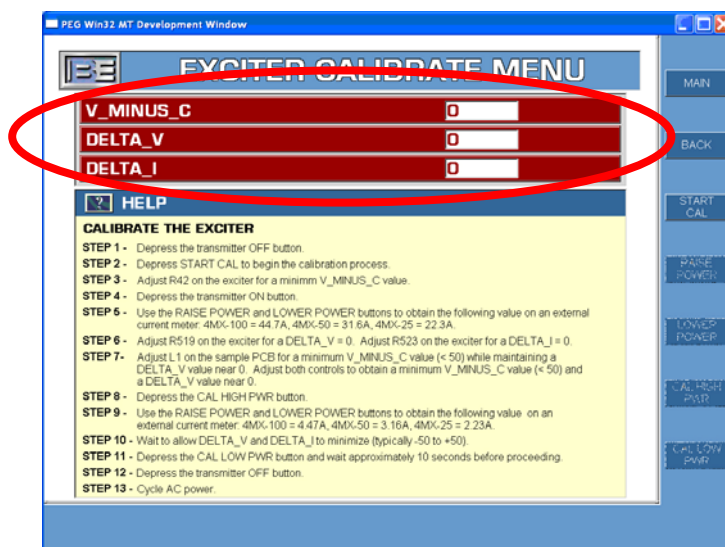


Figure 49 – Exciter Calibrate Menu

<continue to next page>

Step 12 – Depress the **CAL HIGH PWR** button.

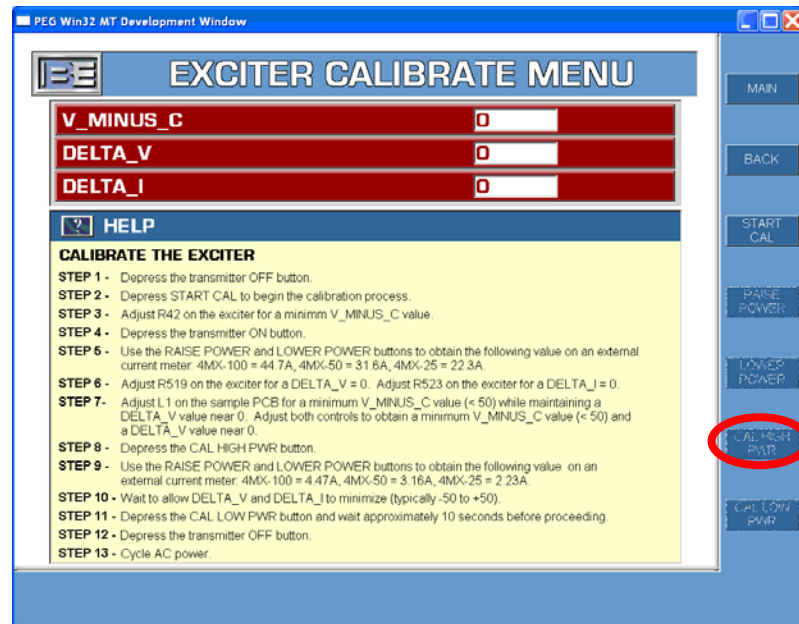


Figure 50 – Exciter Calibrate Menu

Step 13 – Use the **RAISE POWER** and **LOWER POWER** buttons to obtain the following value on an external current meter: 4MX100 = 4.47A, 4MX50 = 3.16A, 4MX25 = 2.23A

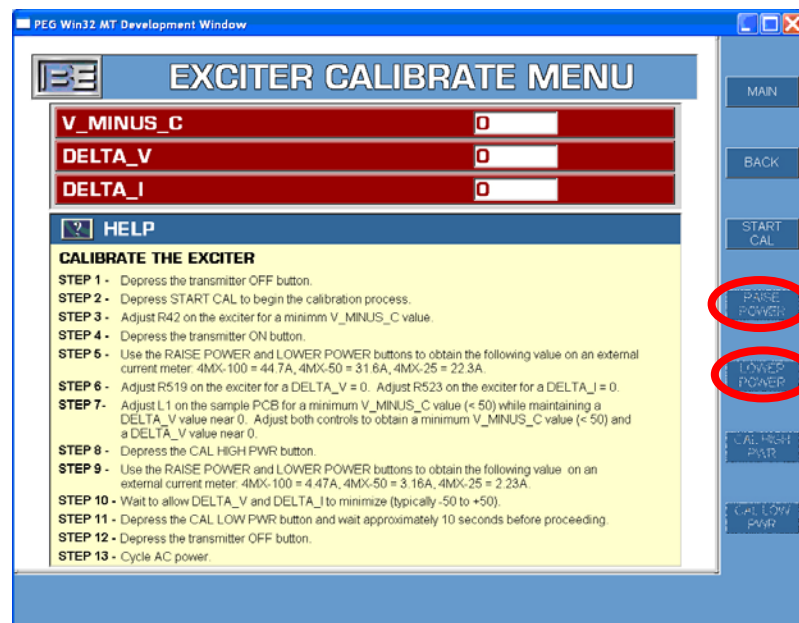


Figure 51 – Exciter Calibrate Menu

Step 14 – Wait to allow **DELTA_V** and **DELTA_I** to stabilize (typically -15 to +15).

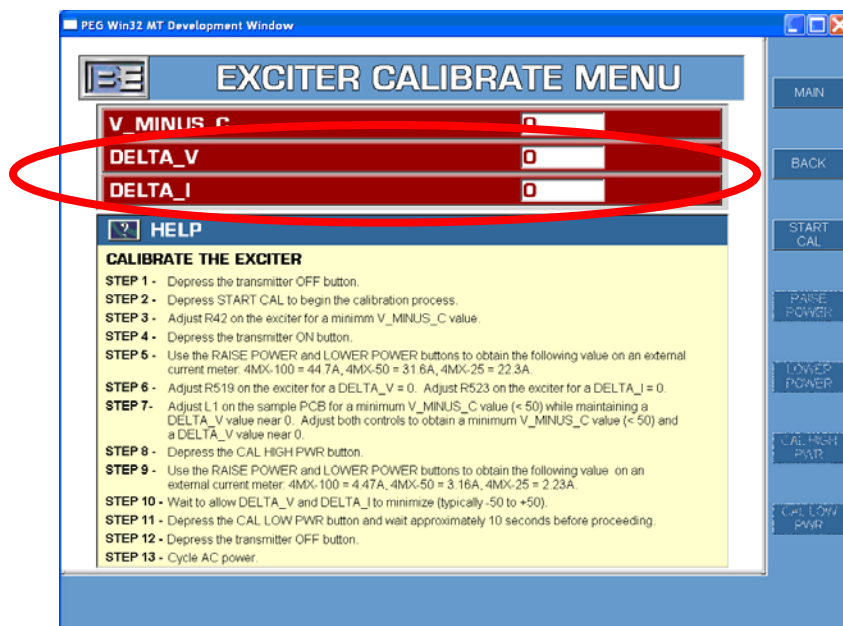


Figure 52 – Exciter Calibrate Menu

Step 15 – Depress the **CAL LOW PWR** button and wait approximately **10** seconds before proceeding.

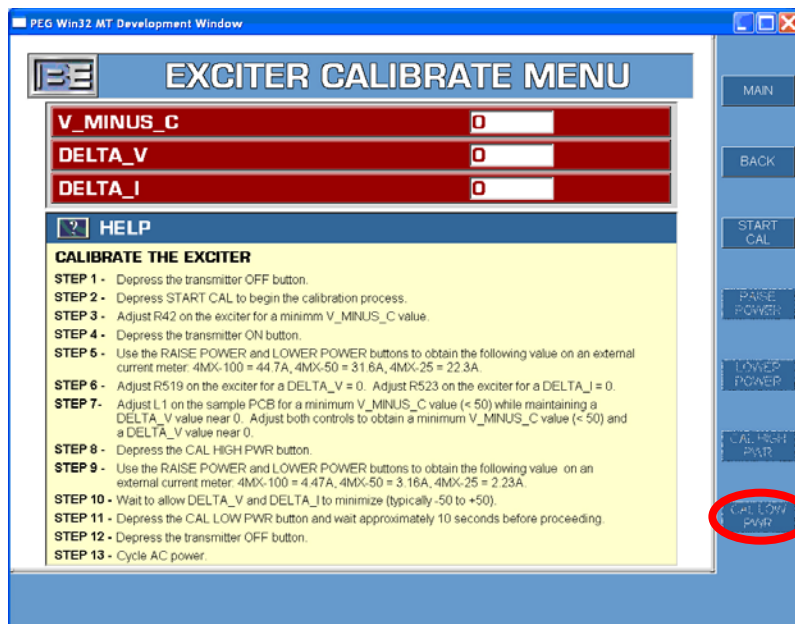


Figure 53 – Exciter Calibrate Menu

Step 16 – Depress the transmitter's RF Output OFF button.



Figure 54 – Turn the Transmitter's RF Output to OFF

Step 17 – Cycle AC power.



Turn the AC Breaker to the **OFF** position then back to the **ON** position

Figure 55 – Cycle the Transmitter's AC Power Breaker

Step 18 – Verify on the scope that the overlap is set correctly.

5 Audio Setup and Calibration

From the Main GUI Menu, select **AUDIO SETUP**.

Please note that if you are planning to run in HD mode (with an ASi) and are using Analog 1 and/or Analog 2 for back up, you must go through the Audio Setup procedure for each of the Analog Audio sources. If there is an ASi-10 HD failure, the 4MX will automatically switch to the primary audio input.

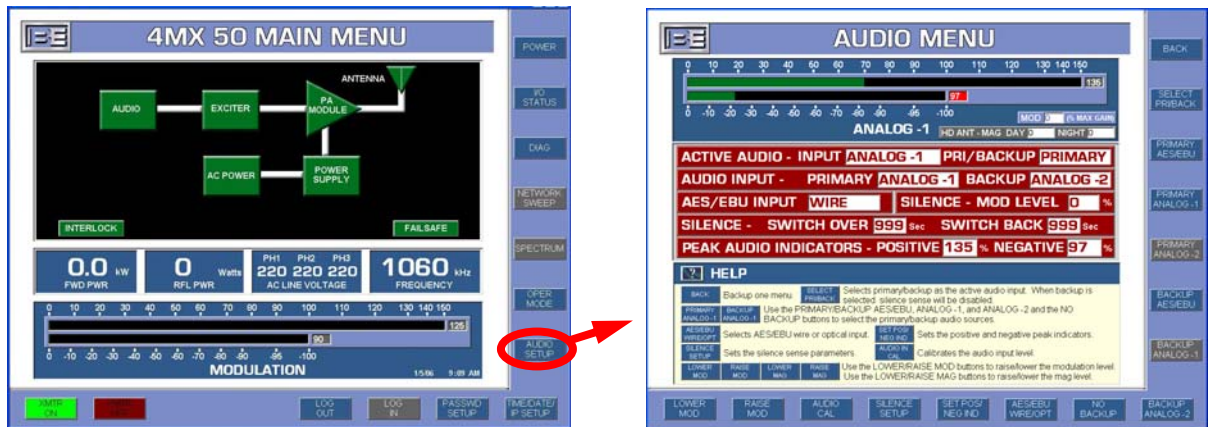


Figure 56 – Audio Setup Menu

5.1 Set the Active Audio Input

The 4MX 25/50 audio input type can be set for either a **PRIMARY** or a **BACKUP** audio input source. This selection may be made on the right side of the Audio Menu by depressing either the **SELECT PRIMARY** or **SELECT BACKUP** buttons. The factory default for the Active Audio is **PRIMARY**.

5.2 Assign the Audio Input Type

Next, you must assign the Audio Input signal type. If you chose **PRIMARY** in step 2.12.8.1, then you must select either **PRIMARY ANALOG-1**, **PRIMARY ANALOG-2**, or **PRIMARY AES/EBU**. If you chose **BACKUP**, then you must select either **BACKUP ANALOG-1**, **BACKUP ANALOG-2**, or **BACKUP AES/EBU**. If an input is selected as Primary it is not available as a choice for secondary input and vice versa.

5.3 No Backup Audio

If no Backup Audio source is being used, select **NO BACKUP**.

5.4 AES/EBU Input

If an AES/EBU input is being used, you must select either **AES/EBU OPTICAL** or **AES/EBU WIRE**.



5.5 Set Audio Positive / Negative Indicator Peak Levels

To set the positive and negative audio indicator peak levels, select **SET POS/NEG IND** from the Audio Menu and the Set Peak Indicator Menu will appear.

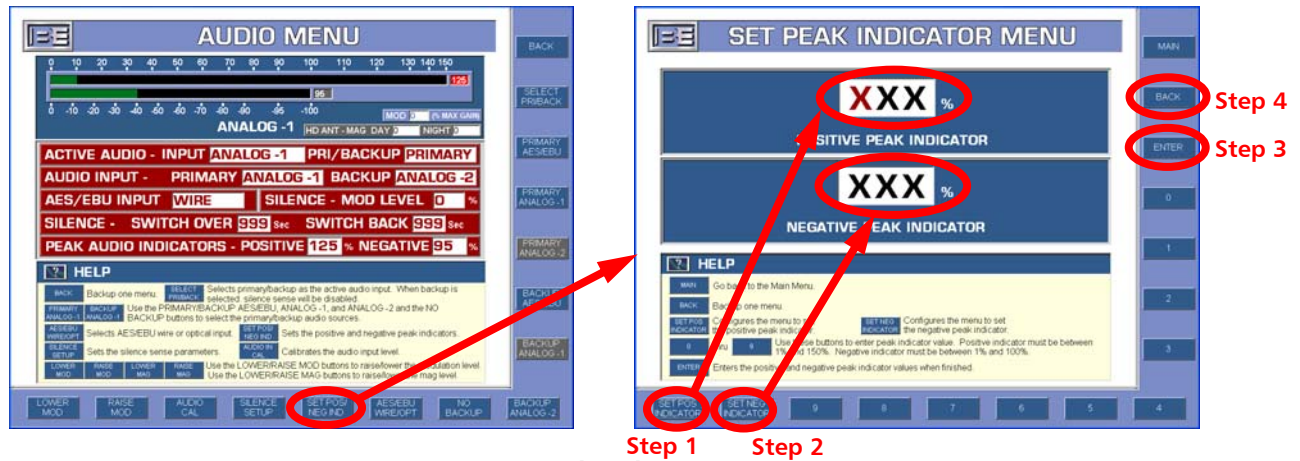


Figure 57 – Set Peak Indicator Menu

Step 1 - Select the **SET POS INDICATOR** button and then enter **125%** (typical value) for an initial starting point. The range for this setting is **1 – 150%**.

Step 2 - Select the **SET NEG INDICATOR** button and then enter **97%** (typical value) for an initial starting point. The range for this setting is **1 – 100%**.

Step 3 - Select the **ENTER** button.

Step 4 - Select **BACK** to return to the Audio Menu.

5.6 Audio Input Connections

Before connecting the Audio source to the 4MX 25/50, make sure of the following.

- ☐ Ensure that the Audio Source is turned OFF.
- ☐ Ensure that the 4MX 25/50's RF Output Power is now OFF.

Proceed with connecting the Audio source to the 4MX 25/50. The Audio Inputs enter the 4MX 25/50 through the top of the cabinet in the same location as the remote control connections. The Audio Inputs then route down through the cabinet to the Audio Input terminal block. **CH1 is the default Audio Input factory setting.**

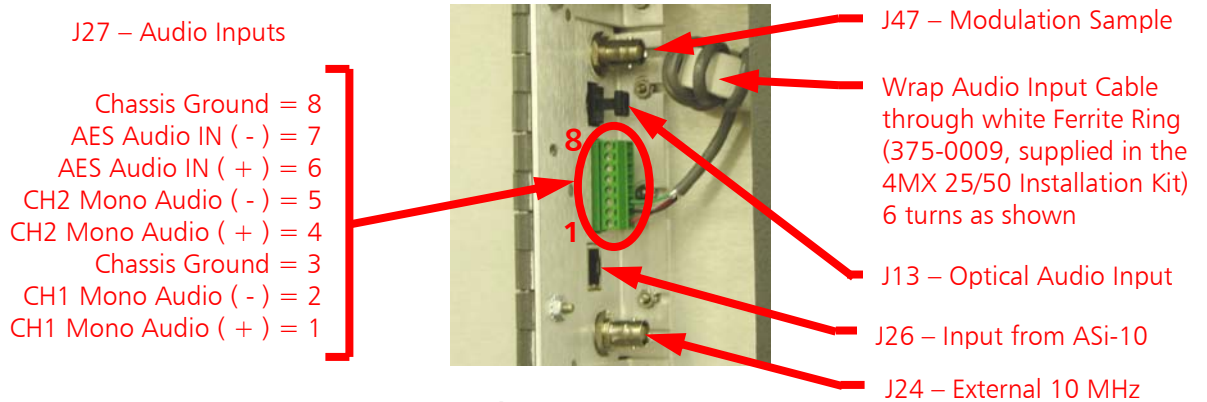


Figure 58 – Audio Input Connections

5.7 Adjust R120 and R133

On the 4MX Exciter Board, remove P63 from Pins 2 and 3 of J63. Measure the resistance from J63 Pin 3 to R130 Pin 2, if not 1K then adjust potentiometer R133 until a resistance reading of 1K is achieved. Place P63 back onto Pins 2 and 3 of J63.

Next, remove P64 from Pins 2 and 3 of J64. Measure the resistance from J64 Pin 3 to R123 Pin 2, if not 1K then adjust potentiometer R120 until a resistance reading of 1K is achieved. Place P64 back onto Pins 2 and 3 of J64.

These pots should not need to be adjusted after ensuring they are set to 1K. This requires using an external processor's audio level adjustments to provide the correct audio level into the 4MX and using the audio gain adjustments found in Section 5.9.

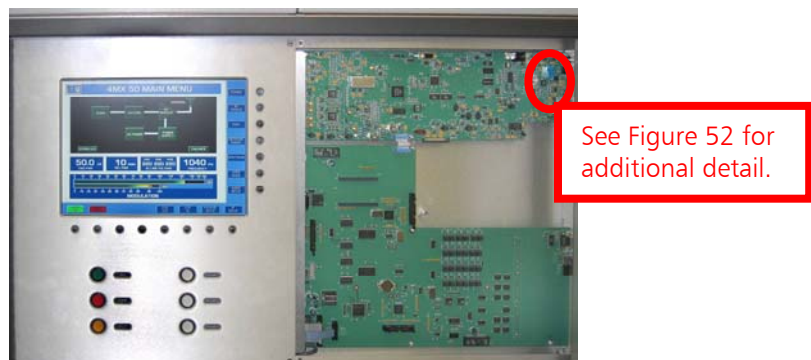


Figure 59 – Audio Calibration

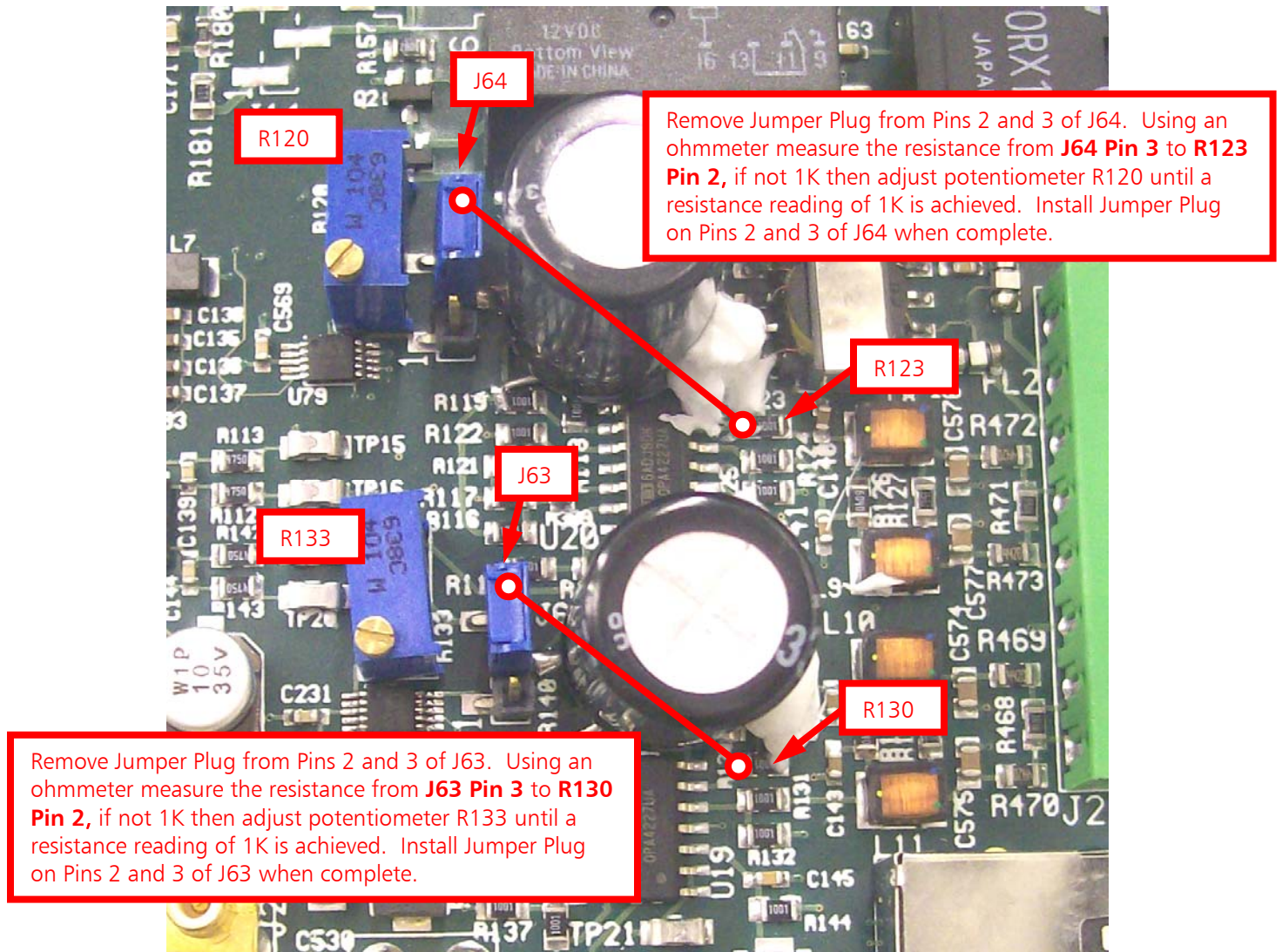


Figure 60 – Audio Calibration Detail

5.8 Setup Audio Processor Asymmetry

Find a song with content as high as you would ever expect to operate the system at and adjust the Audio Processor's asymmetry for that song. You should see the asymmetry on the main screen meter or on the audio menu meter.

5.9 Setup the Incoming Audio Gain in the 4MX

Step 1 – From the 4MX's MAIN Gui menu, select **AUDIO SETUP** then **AUDIO CAL.**

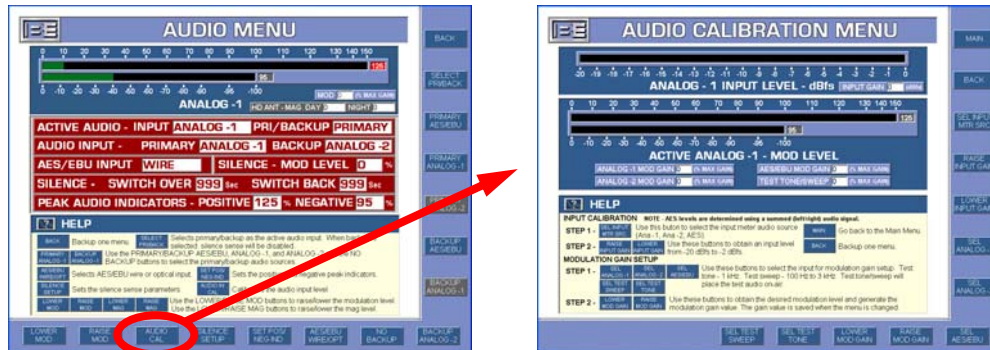


Figure 61 – Audio Calibration Menu

Step 2 – Next, use the **SEL INPUT MTR SRC** button to toggle to the audio source that you are setting up.

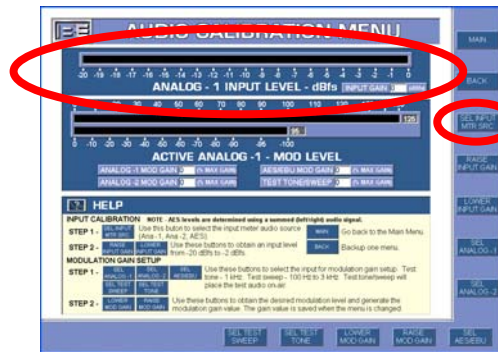


Figure 62 – Audio Calibration Menu

Step 3 – Set the output of the Audio Processor to -5dBfs. Use the **RAISE INPUT GAIN** and **LOWER INPUT GAIN** buttons in the Audio Calibration Menu to set the audio input gain in the 4MX to 0.

If the audio processor cannot output enough level then adjust the input gain in the Audio Calibration Menu of the 4MX to provide enough gain so that the input level will increase to -5dBfs on the meter.

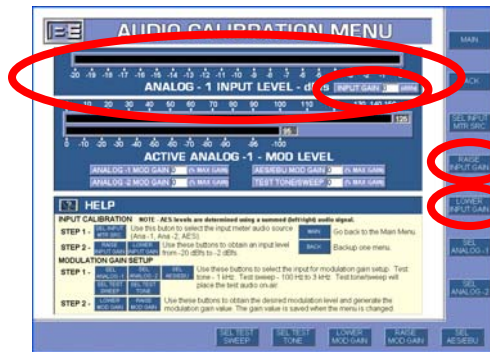


Figure 63 – Audio Calibration Menu

Step 4 – Repeat Steps 1 thru 3 for backup audio sources.

5.10 Set the Modulation Level

Step 1 – From the 4MX's MAIN Gui menu, select **AUDIO SETUP** then **AUDIO CAL.**

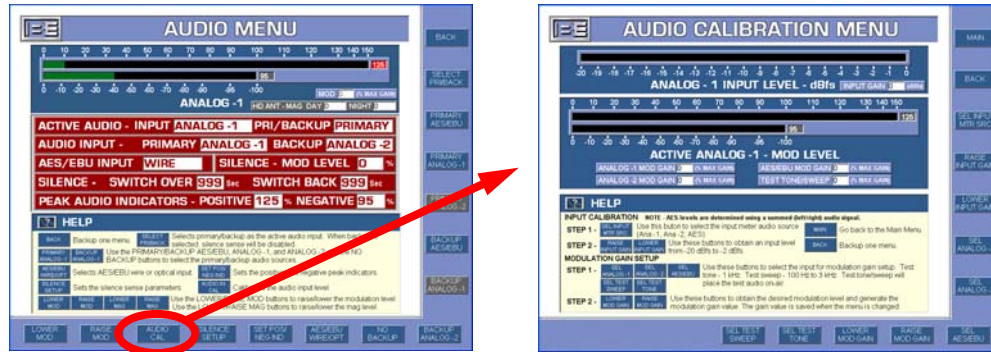


Figure 64 – Audio Calibration Menu

Step 2 – Turn the Transmitter's RF Output to ON. The Transmitter's RF Output must be ON to set the modulation gain.

Step 3 – Next, use the **LOWER MOD GAIN** and **RAISE MOD GAIN** buttons to set the Modulation Level for the active audio. Use the **SEL ANALOG-1**, **SEL ANALOG-2**, and **SEL AES/EBU** buttons to change the active audio.

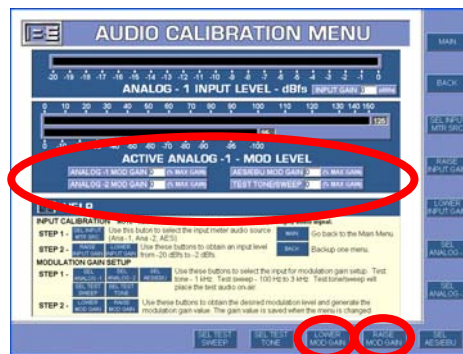


Figure 65 – Audio Calibration Menu

6 Verification

With analog audio applied, turn the transmitter's RF Output to ON and verify -97% peaks are observed. Repeat procedure if necessary.

7 RF Customer Service Contact Information

RF Customer Service -

Telephone: (217) 224-9617

E-Mail: rfservice@bdcast.com

Fax: (217) 224-6258

