

**DRM UPGRADE KIT**

**INSTALLATION**

**PROCEDURES**

**FOR**

**TYPE 418F**

**100 kW, HF,**

**BROADCAST TRANSMITTER**

COPYRIGHTED © 2009 BY  
CONTINENTAL ELECTRONICS  
4212 S. BUCKNER BLVD.  
DALLAS, TEXAS 75227  
[www.contelec.com](http://www.contelec.com)

(214) 381-7161

FAX: (214) 381-4949

---

**ISSUED - 27 FEBRUARY 2009**

## WARNING

**HIGH VOLTAGES ARE EXPOSED WHEN CABINET DOORS OR ACCESS PANELS ARE OPENED. WHEN WORKING INSIDE THE EQUIPMENT, BE SURE THAT ALL CIRCUIT BREAKERS ARE OFF AND THAT PRIMARY POWER IS DISABLED AT THE WALL DISCONNECT OR CIRCUIT BREAKER UNLESS OTHERWISE DIRECTED. ALWAYS SHORT ALL HIGH VOLTAGE TERMINALS TO GROUND WITH THE GROUNDING STICK PROVIDED. FAILURE TO COMPLY MAY RESULT IN DEATH ON CONTRACT.**

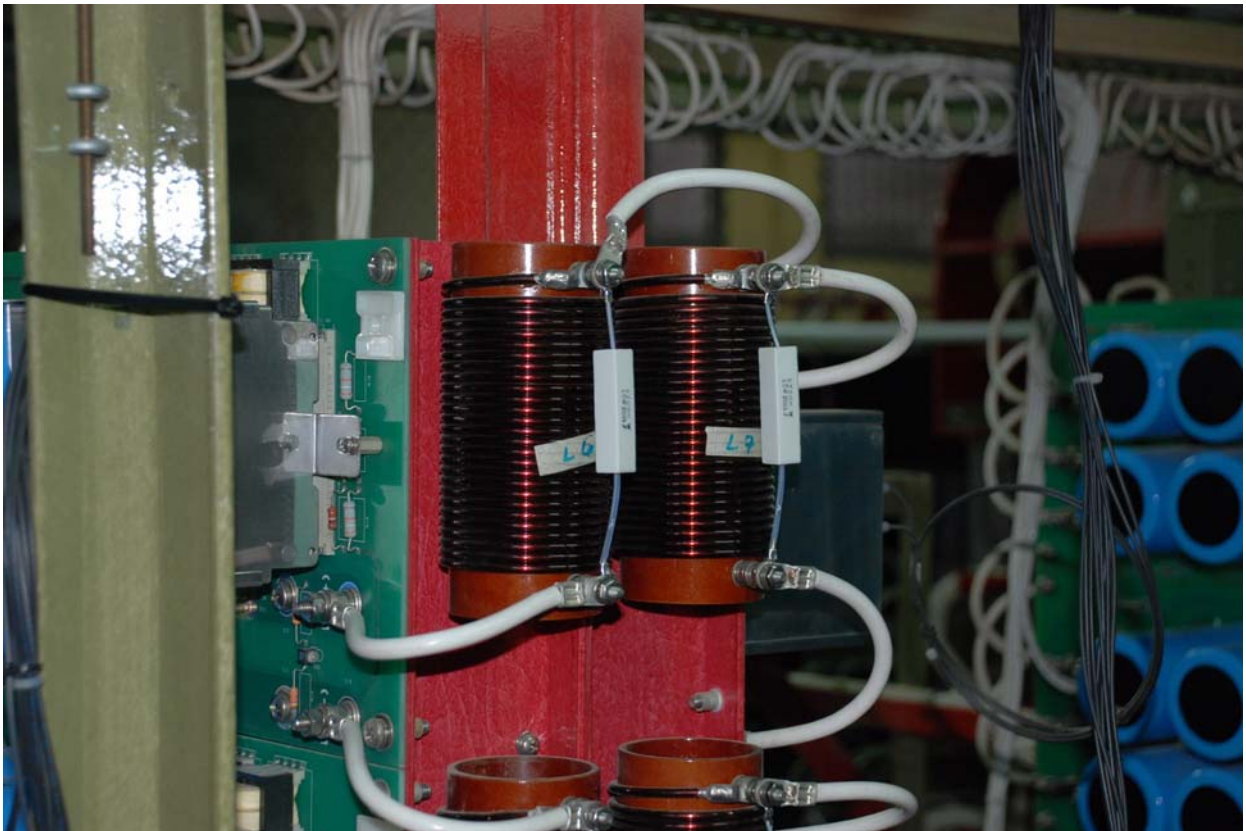
Prior to making any changes to or within the transmitter and/or modulator assemblies, make absolutely sure that all voltage sources have been removed, safety ground switches are closed and utilize a ground stick on the circuit you are working on. Voltage sources include not only 480VAC, but also the 120VAC Control Power.

When an item number is referenced in these procedures, please refer to parts list, PL203353-1, and the Packing List for component identification.

### **1. MODULATOR.**

#### **1.1 Install Inter-Switch Swamping Resistors.**

Install a single 20-ohm resistor with crimp terminal (Items 12 (2 ea) and 13) across each of the inter-switch inductors as seen in Figure 1. It is best to use an open-ended wrench and nut driver while performing this task. Use the open-ended wrench to ensure that the hardware stack does not twist while the top nut is loosened or tightened. In addition, be careful not to apply any twist to the Modulator Power Switch hardware stacks.



**Figure 1. Swamping Resistors.**

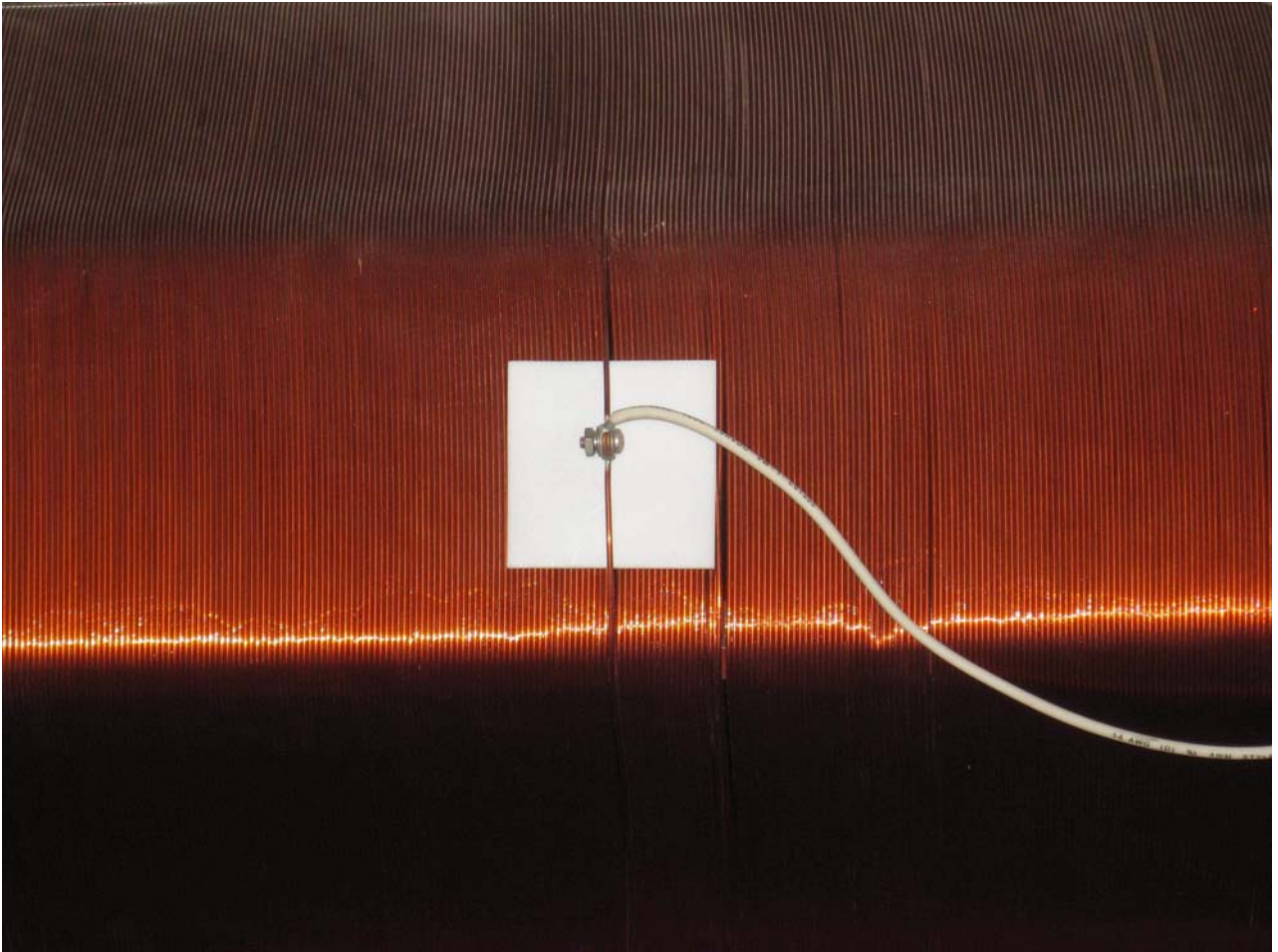
## 1.2 Inductor Taps.

Referring to assembly drawing 179476-1 (100kW Modulator), locate lowpass filter inductor L1.

1. While standing between modulator assemblies A1 and A2, look towards L1 as seen in Figure 2.
2. Starting from the left side of L1, count to turn 154. Mark this turn with indelible ink and confirm that this is the 154<sup>th</sup> turn from the left side of L1.
3. Using a flat blade screwdriver, carefully push inward three turns on either side of the marked 154<sup>th</sup> turn.
4. Using slip-joint pliers, carefully pull the 154<sup>th</sup> turn outward. It is best to alternate between steps 3 and 4 a few times, until the 154<sup>th</sup> turn is far enough separated from the adjacent turns to allow removal of the enamel insulation and to slip Item 26 (Strap, Copper) around the wire.
5. Using coarse sand paper and eventually bear cloth, remove the enamel insulation from the entire diameter of the wire for a distance twice the width of the copper strap.
6. Place the copper strap around the wire with the connection point towards you. It is recommended that you place the hardware stack-up (Items 23, 24, 25, and 27) on the copper strap prior to soldering.
7. Using a soldering iron of sufficient wattage, solder the copper strap to the 154<sup>th</sup> turn of inductor L1.
8. Place Item 31 (Insulator, Mounting Plate) under the tapped turn as seen in Figure 3.
9. Connect W10 from the tap on turn 154 to the right side connection of L1 as seen in Figure 2.



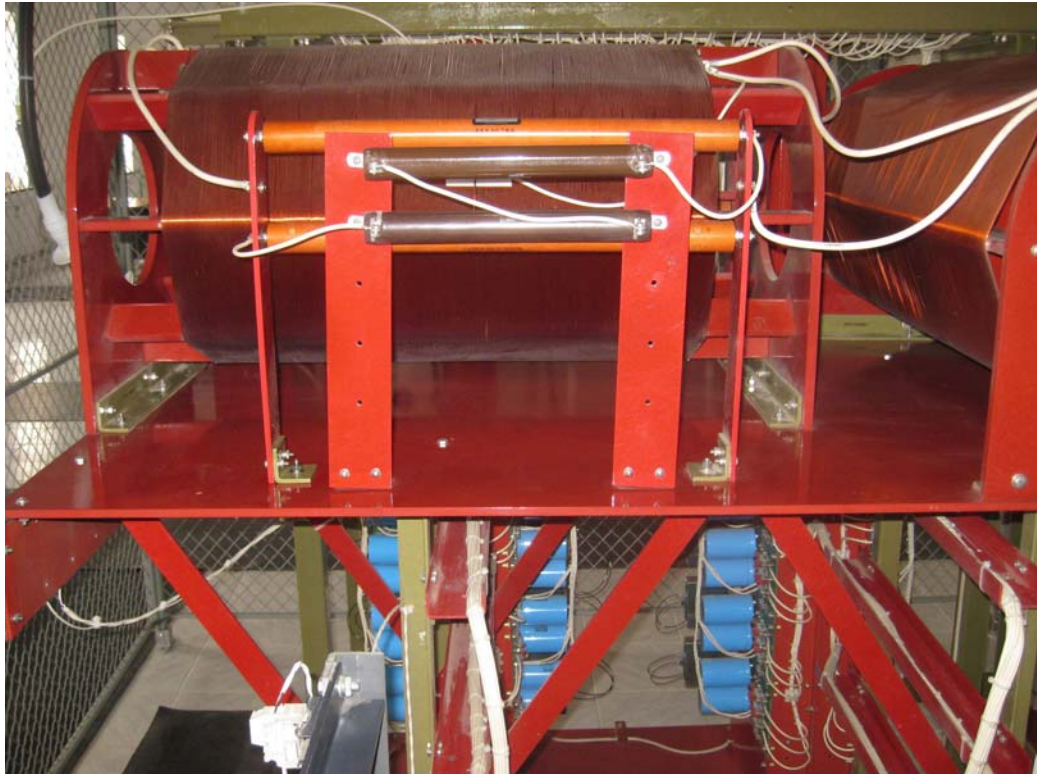
**Figure 2. Inductor L1.**



**Figure 3. Mounting Plate Insulator.**

Referring to assembly drawing 179476-1 (Modulator 100kW), locate lowpass filter inductor L2.

1. While standing between the lowpass filter assembly and A2T1, look towards L2 as seen in Figure 4.
2. Start counting from the left side of L2 and count to turn 170. Mark this turn by indelible ink and confirm that this is the 170<sup>th</sup> turn from the left side of L2.
3. Using a flat blade screwdriver, carefully push inward three turns on either side of the marked 170<sup>th</sup> turn.
4. Using slip-joint pliers, carefully pull the 170<sup>th</sup> turn outward. It is best to alternate between steps 3 and 4 a few times, until the 170<sup>th</sup> turn is far enough separated from the adjacent turns to allow removal of the enamel insulation and to slip Item 26 (Strap, Copper) around the wire.
5. Using coarse sand paper and eventually bear cloth remove the enamel insulation from the entire diameter of the wire for a distance twice the width of the copper strap.
6. Place the copper strap around the wire with the connection point towards you. It is recommended that you place hardware stack-up (Items 23, 24, 25, and 27) on the copper strap prior to soldering.
7. Using a soldering iron of sufficient wattage, solder the copper strap to the 170<sup>th</sup> turn of inductor L2.
8. Place Item 31 (Insulator, Mounting Plate) under the tapped turn as seen in Figure 3.
9. Connect W11 from the tap on turn 170 to the right side connection of L2 as seen in Figure 5.



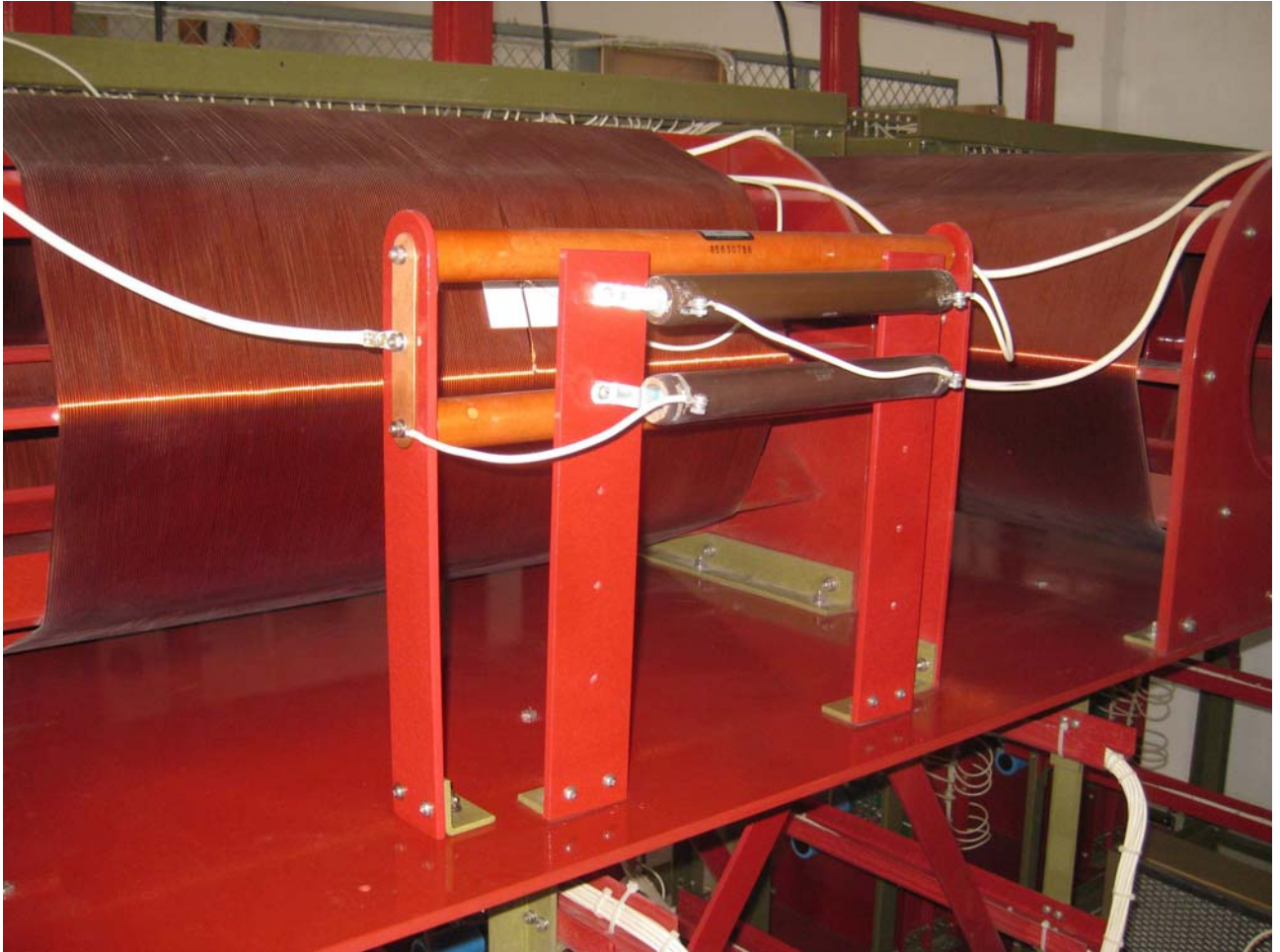
**Figure 4. Inductor L2.**



**Figure 5. Inductor L2 - Right Side Connection.**

### 1.3 Notch Filter Swamping Resistors.

1. Pre-assemble resistor supports using Items 20, 21, 22, 23, 24 and 25 for the resistor brackets and Items 15, 16, 17, 18 and 19 for the mounting brackets.
2. Drill holes into the lowpass filter support plate to mount the resistor supports in front of capacitor C5 as seen in Figure 6.
3. Insert damping resistors Item 14 and tighten the hardware.
4. Install cables W7, W8 and W9 according to Wire List WL199666-1 as seen in Figures 6 and 7.



**Figure 6. Cable Installation - Left Side.**



**Figure 7. Cable Installation - Right Side.**

#### **1.4 Change Filter Capacitor Values.**

1. Remove capacitor C5 (300pF @ 75kV), which is in parallel with L2.
2. Install a shorting wire across the terminals of the 300pF capacitor for storage.
3. Install 2ea of Item 33 (100pF @ 75kV) in the place of C5.
4. Remove capacitor C1 (7000pF @ 75kV), which is connected to the node between L1 and L2.
5. Install a shorting wire across the terminals of the 7000pF capacitor for storage.
6. Install 2ea of Item 32 (1000pF @ 75kV) in the place of C1.

#### **2. MODULATOR CONTROLLER.**

##### **2.1 Input-Output CCA.**

1. Carefully remove the Input-Output CCA (9A11) and place it on top of Modulator Controller Assembly Unit 9, on a static protective pad or bag with the component side down.
2. Using a small soldering iron and solder wick, remove R1, R2, R3, C1, C3, C4, C6, L1 and L2.
3. Leave R1 not used. Replace both R2 and R3 with a 33.2 ohm, 1/2W resistor, CEC P/N 724-5053-070.
4. Replace C1, C3, C4 and C6 with Item 10, a 180pF, 500WVDC capacitor.
5. Replace both L1 and L2 with Item 9, a 4700μH coil.
6. Connect the DRM exciter envelope output to terminal board TB1-1 and TB1-2.

## 2.2 Motherboard.

1. Remove all cards that are in the back of the Unit 9 Modulator Controller Assembly (A10, A11, A12, A13 and A15) and place them on static protective mats or bags.
2. Using Item 11 (28AWG, Green, Kynar, Insulated Wire), install the following six jumpers on Backplane 9A14

J1-C5 to J3-A9	J3-A10 to J3-C10
J3-A9 to J3-C9	J11-C2 to J13-A2
J1-C7 to J3-A10	J13-A2 to J13-C2

3. Return the cards to their respective slots in the back of the Modulator Controller Assembly.

## 2.3 DRM Envelope Input CCA.

Remove the blank panel from the 9A2 slot and insert Item 6 (CCA, DRM Envelope Input, 201877-1).

## 2.4 Audio Path CCA.

Remove the existing Audio Path CCA (175813) and insert Item 5 (CCA, Audio Path, 201853-1).

## 2.5 PA Screen Supply Assembly.

Assemble frame using assembly drawing 201868 and parts list PL201868-2. Remove the following components from the 418F transmitter Utility Cabinet, Unit 2, and install them on the 201869 frame using assembly drawing 201868.

2A1	179899 Modulator Power Switch
2A2	179899 Modulator Power Switch
2-#174	201870 Screen Metering Assembly
2C1	951-5026-010 Capacitor, 1 $\mu$ F, 3kV
2C2, 2C3 and 2C4	933-5034-030 Capacitor, 2 $\mu$ F, 580VAC
2L1	668-6069-010 Reactor, 10H
2L2 and 2L3	175303 Series Inductor
2L4	187604 Inductor Screen Assembly
2T1	662-6207-010 Step-Up Power Transformer

Wire Screen Assembly per wirelist WL201868-1 and Schematic 201875 using the provided wiring harness.



### 3. INITIAL ALIGNMENT.

#### 3.1 Audio Path CCA.

Prior to application of high voltage, align the Audio Path CCA according to the Audio Path Alignment Procedure below.

##### 3.1.1 Audio Path Alignment.

The following is the alignment procedure for the Audio Path CCA, A4, located in the modulator controller assembly. Reference Schematic Diagram 201854. This procedure assumes the operator has a working knowledge with the circuits associated with this card. The alignment procedure consists of a low level alignment with zero RF output power and a high level alignment with 100% RF output power.

**3.1.1.1 Preliminary Alignment.** Prior to applying power to the circuit card, turn potentiometers R4, R1, R53, and R87 fully counterclockwise. Using an extender card, install the Audio Path CCA into the card cage slot for the A4 card. Apply power to the modulator controller but **DO NOT TURN ON HIGH VOLTAGE** at this time. Ensure Tune Power is not enabled as audio is muted in Tune Power.

**3.1.1.2 Low Level Alignment.** Perform the following steps to achieve a low level alignment:

1. Begin by adjusting the triangle wave frequency and the square wave frequency on the clock modification card. This is accomplished by measuring the triangle wave frequency at U4A-12 and adjusting R19 until the frequency is approximately 140 kHz. Verify that the square wave frequency at U23A-4 is between 3 and 3.15 MHz.
2. Alignment of the gain adjustment of the audio path's input stage. Measure the signal at U3-1 with an oscilloscope. This signal should be approximately 5.1 volts with no audio present and CCM set to 0 dB attenuation.
3. The operator should apply a 1 kHz tone to the transmitter audio input. The level of this tone should be set to a value where the user expects to achieve 100% modulation.
4. Turn the clipper switch (S2) to the OFF position. Jumper J1 and potentiometer R106 are used to adjust the gain of the input stage. Jumper J1 is used for course adjustments and R106 is used for fine adjustments. When setting J1, jumper R82 to ground if more gain is desired, or jumper R85 to ground if less gain is desired.
5. Adjust R106 until the negative peak of the signal at U3-1 reaches zero volts. After the gain adjustment is completed, continue viewing the signal at U3-1 and turn the clipper switch on.
6. Align the positive and negative peak clipper by adjusting R5 and R6, respectively. After completing this adjustment, turn the clipper switch off.
7. Align the multiplier chips U15 and U7. Device U15 is involved with the signal that drives the transmitter's screen power supplies. The offset of its output is set by R109. Because the negative peak of the triangle wave output (U22-1) is offset by 5 volts, the signal at U15-8 should also be offset by 5 volts. Adjust R109 until the signal at U37-3 is approximately 5 volts.
8. Device U7 is involved with the signal that drives the modulator's power supply. The offset of its output is set by R1. Adjust R1 until the signal at U18-6 is approximately 300 millivolts. Potentiometer R53 is also involved with U7 but should not be adjusted at this time.
9. Finally, adjust the triangle wave's amplitude at U18-6. Adjust R87 until a triangle appears and has a peak-to-peak amplitude of approximately 200 millivolts.

This completes the low level alignment of the Audio Path CCA. At this time, press the power lower button on the transmitter's front panel and confirm that the power control signal at P1-C29 is 0 volts in the following power states: High Power, Low Power, and Tune Power (if applicable).

**3.1.1.3 High Level Alignment.** Perform the following steps to achieve a high level alignment of the Audio Path CCA.

1. Apply a low level 1 kHz tone (approximately 20 dB below 100%) to the transmitter's audio input and turn on the transmitter's high voltage.

**NOTE**

**Both the plate and screen voltage meters should be near 0 volts.**

2. Press power raise button until the plate voltage is approximately 5 kilovolts. Adjust R4 until the screen voltage meter reads 250 volts.

**NOTE**

**The transmitter should be properly tuned.**

3. With the transmitter properly tuned, raise the plate voltage until it reaches its typical full power operating voltage.
4. Adjust R4 until the screen voltage reaches its typical full power operating voltage. At this point, the transmitter's output power should at 100% rated power.

**NOTE**

**The next stage of the high level alignment involves minimizing total harmonic distortion (THD).**

5. Calibrate the THD measuring equipment to be used. Turn R87 fully counterclockwise. Slowly turn R87 clockwise until the first dip in THD is observed. After this is completed, check THD at several modulation depths and audio frequencies. In some cases, the operator may notice a THD problem at high audio frequencies. This may be improved by adjusting R53. The adjustment of R53 injects a second harmonic distortion into the transmitter which is opposite in phase to the second harmonic distortion inherent to some class C amplifiers.

**CAUTION**

**THE OPERATOR SHOULD TAKE GREAT CARE WHEN ADJUSTING R53.  
FAILURE TO COMPLY MAY RESULT IN DAMAGE TO THE TRANSMITTER.**

6. The transmitter's output power should be slightly lowered when adjusting R53 because this potentiometer directly affects the transmitter's plate voltage. Also, over-adjusting R53 can cause THD problems at low audio frequencies and increased positive carrier shift. Therefore, the adjustment of R53 should be a compromise of the following parameters: high audio frequency THD, low audio frequency THD, and positive carrier shift.
7. After minimizing THD, lower the transmitter's output power to approximately 95% rated power and apply a 1 kHz tone at a modulation depth of 100%.
8. R1 effects the modulation capability of the transmitter but also effects plate voltage, so great care should be taken when making this adjustment. On an oscilloscope, observe the negative trough in the envelope of the transmitter's output. Slowly turn R1 clockwise until an increased clipping is noticed in this trough. Now, slowly turn R1 counterclockwise until this clipping is minimized.
9. Remove the audio tone and lower the power to minimum plate voltage. Proper tracking of the screen voltage and the plate voltage is obtained by adjusting R109. Adjust R109 until minimum screen voltage and minimum plate voltage occur simultaneously. This completes the alignment of the audio path circuit card.

**3.2 DRM Envelope Input.**

With the DRM Envelope Input on an extender, adjust R2 fully clockwise. While observing TP1, adjust the output amplitude of the DRM Envelope Source until 8 volts peak is observed.