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FM T Series Transmitter Field Upgrade Application Guide

Upgrade Your Existing FM Only Tube Transmitter for FM + HD Operation

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FM T Series Transmitter

Field Upgrade Application Guide

Upgrade Your Existing FM Only Tube Transmitter for FM + HD Operation

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1 “FM-T” to “FMi T” Field Conversion Overview

1.1 Purpose of this Document

The purpose of this document is to describe the necessary steps for the “field conversion” of a B.E. “**FM-T Series FM ONLY**” Tube Transmitter to a “**FMi T Series FM + HD**” Tube Transmitter.

It is important to note that the **FMi 17T** is derived from the FM-25T, the **FMi 21T** from the FM-30T, and the **FMi 25T** from the FM-35T. The FMi T Series and FM-T Series Transmitters are physically identical except for components and technology discussed in this document.

- FM-25T -----> **FMi 17T**
- FM-30T -----> **FMi 21T**
- FM-35T -----> **FMi 25T**

1.2 Additional Documentation to Review

In addition to this document and B.E Manual 597-0096-014, the following B.E. documents should also be reviewed. These documents are included in the shipment from B.E. and may also be found at www.bdcast.com under “support”.

- FXi 60/250 Exciter Manual, 597-0541
- FXi 60/250 Exciter w/Exgine and XPi 10 Exporter Quick Install Guide, 597-0542-XM3
- FSi 10 HD Signal Generator, 597-0542-002
- Tube Tx Blower Motor Inverter Installation Application Guide, 597-2022
- White Paper - Measuring the HD Radio Spectrum of an FM Transmitter

1.3 Items / Tools Required for Field Conversion

Items:

- 979-1117, FMi 17T / 21T Field Upgrade Kit
- or -
- 979-1125, FMi 21T Field Upgrade Kit
- FSi 10 HD Signal Generator
- or -
- XPi 10 Exporter
- FXi Exciter (re-work existing or new – See Section 1.4)
- 979-2022-003, Kit, Inverter, FMi 21T/25T, 60 Hz, 3 Phase

Tools:

- No. 1 Phillips Screwdriver
- No. 2 Phillips Screwdriver
- Small Jeweler’s Flat Blade Screwdriver
- Large Flat Blade Screwdriver
- 5/16” Nut Driver or Wrench
- 7/16” Nut Driver or Wrench
- 9/16” Nut Driver or Wrench
- 1/2” Nut Driver or Wrench
- PLCC Extraction Tool



Tools (continued):

- Personal Computer with Windows Hyperterminal Communication Program
- Null Modem Cable
- Network Analyzer
- 700°F Soldering Iron
- SN 63PB37 Solder or Equivalent
- General Soldering Tools

1.4 IMPORTANT! Upgrading "FM ONLY" FXi 60 Exciters

An FXi 60 Exciter is required for HD Operation of the Tube Transmitter.

Existing **FXi 60 Exciters** require the upgrade of the **Controller Board (919-0541-001)**, the addition of **Attenuators (339-0061 or 339-0025) & (959-6002)**, and the upgrade of **U41** on the DSP Motherboard.

The **FXi 60 Exciter** will also require the addition of the **IBOC Card (if using in conjunction with an FSi 10)** or an **Exgine Card (if using in conjunction with an XPi 10)**.

IMPORTANT NOTE: If the existing FXi's rear panel does NOT have the large cutout with cover plate as noted below, the FXi will require additional upgrades that must be performed at the factory. If this is the case, contact RF Customer Service for a Return Authorization and request that the FXi be upgraded for use with an HD TUBE Transmitter. You will also need to specify if your HD System will be using an FSi 10 or an XPi 10.

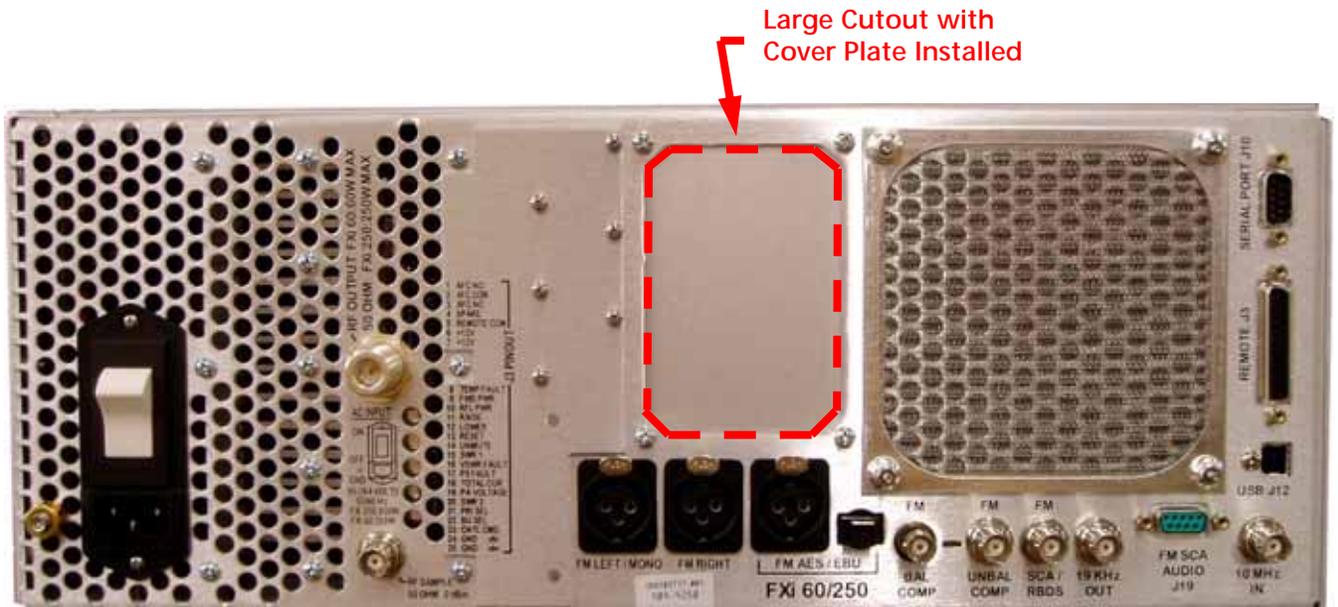


Figure 1 – FXi 60/250 FM ONLY Exciter (No IBOC or Exgine Card Installed)



1.5 RF Customer Service Contact Information

RF Customer Service -

Telephone: (217) 224-9617

E-Mail: rfservice@bdcast.com

Fax: (217) 224-9607

1.6 Estimated Completion Time

Customers should plan for the transmitter to be off of the air for 6 - 8 hours during the upgrade process.

1.7 ESD Awareness



During the conversion / upgrade process be sure to exercise ESD precautions as the upgrade kit contains ESD sensitive components.

1.8 Transmitter Overview

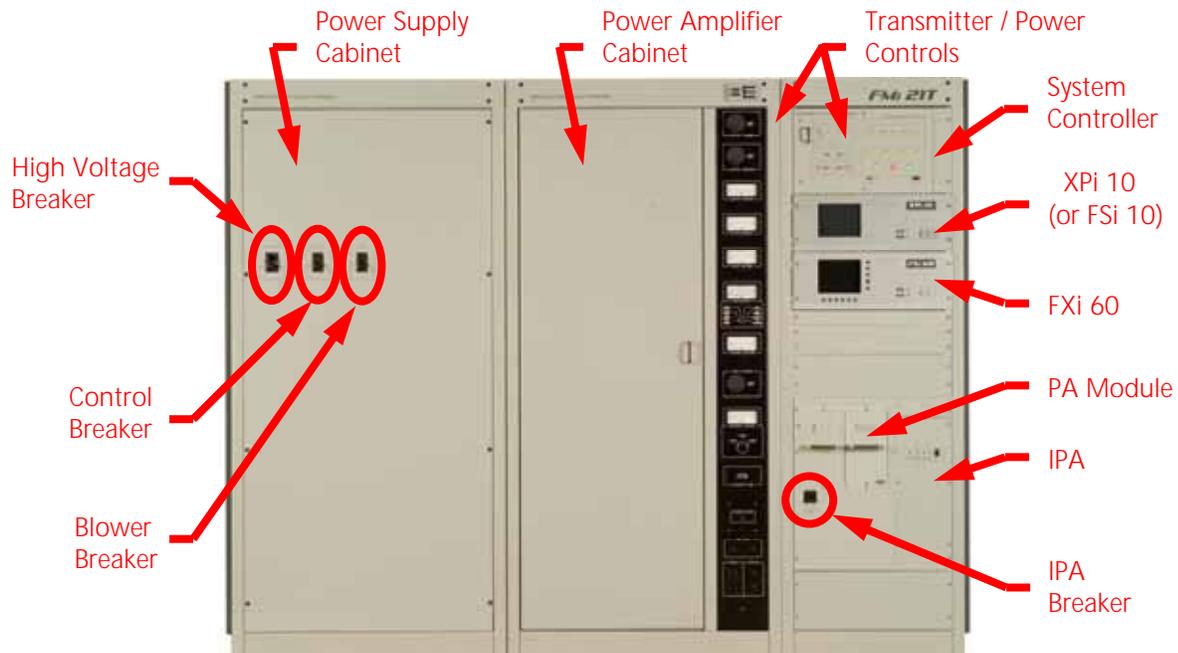


Figure 2 – FMi T Series Transmitter

2 “FM-T” to “FMi T” Field Conversion

2.1 Turn the Transmitter OFF (from the Transmitter’s Front Panel)

Depress **BOTH** the **Filament** and **High Voltage OFF** buttons on the front panel of the transmitter. The blowers will run until the tube has been cooled. Once the blowers stop, proceed with turning the Primary AC Breaker at the Service Entrance to OFF.

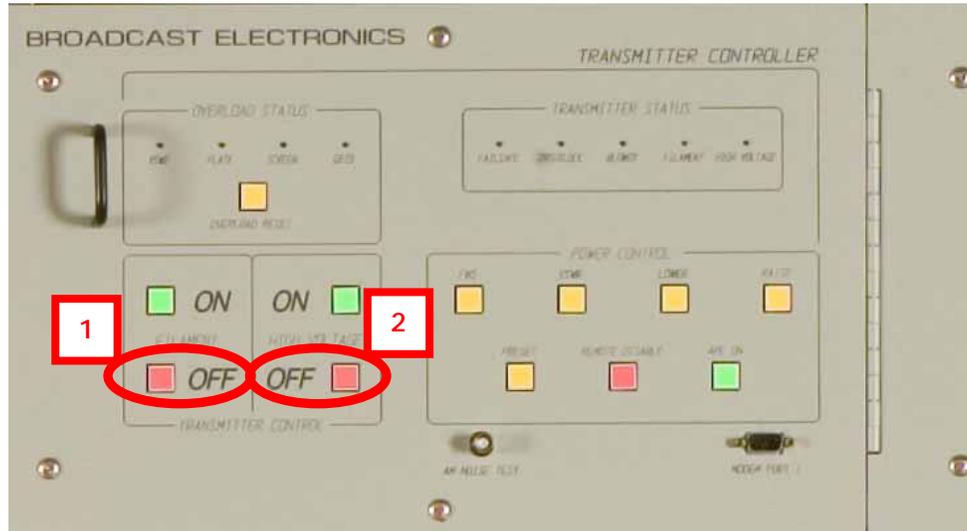


Figure 3 – Transmitter Controller

2.2 Turn the Service Entrance Primary AC Power Breaker to OFF

Before starting the upgrade / conversion of the transmitter, ensure that the Primary AC Power Breaker at the Service Entrance has been turned to OFF!

Ensure that AC Power has been disconnected from the transmitter and is locked out before proceeding!

2.3 Install LC Filters on the Filament Lines In the Grid Compartment

2.3.1 Remove Grid Compartment Cover

Using a No. 2 Phillips Screwdriver, remove the Qty (10) Phillips Screws and Qty (10) Lock Washers securing the grid compartment cover panel.

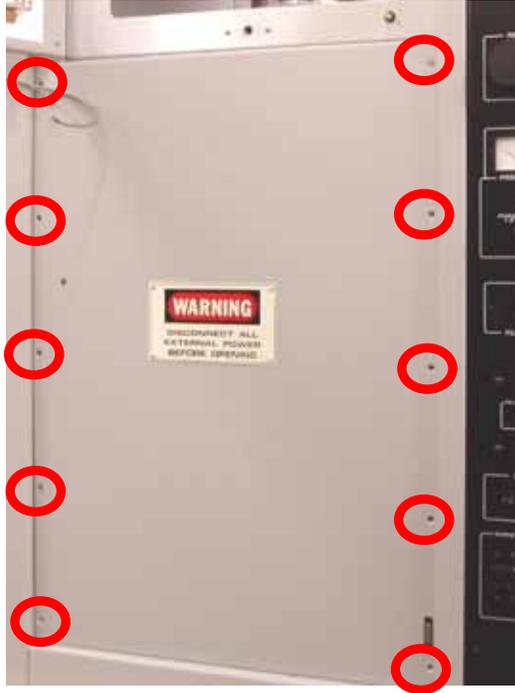


Figure 4 – Grid Compartment Cover Panel

2.3.2 Remove Grid Compartment Access Panel

Using a No. 2 Phillips Screwdriver, remove the Qty (16) Phillips Screws and Qty (16) Lock Washers securing the grid compartment access panel.

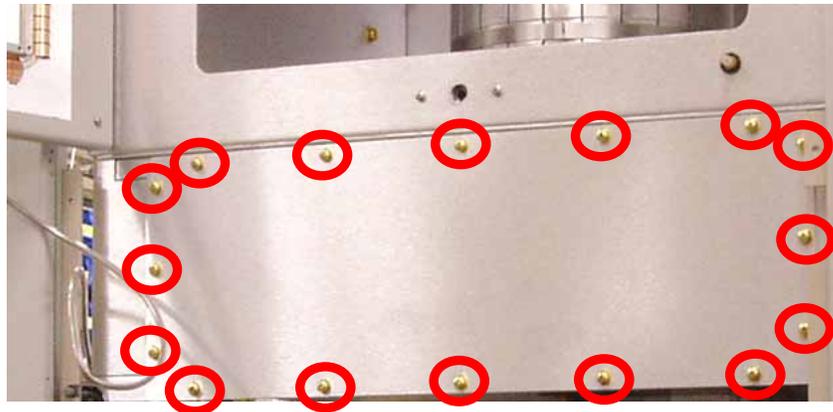


Figure 5 – Grid Compartment Access Panel

2.3.3 Install LC Filter 959-6000, Qty (1)

Install LC Filter 959-6000, Qty (1) as shown below.

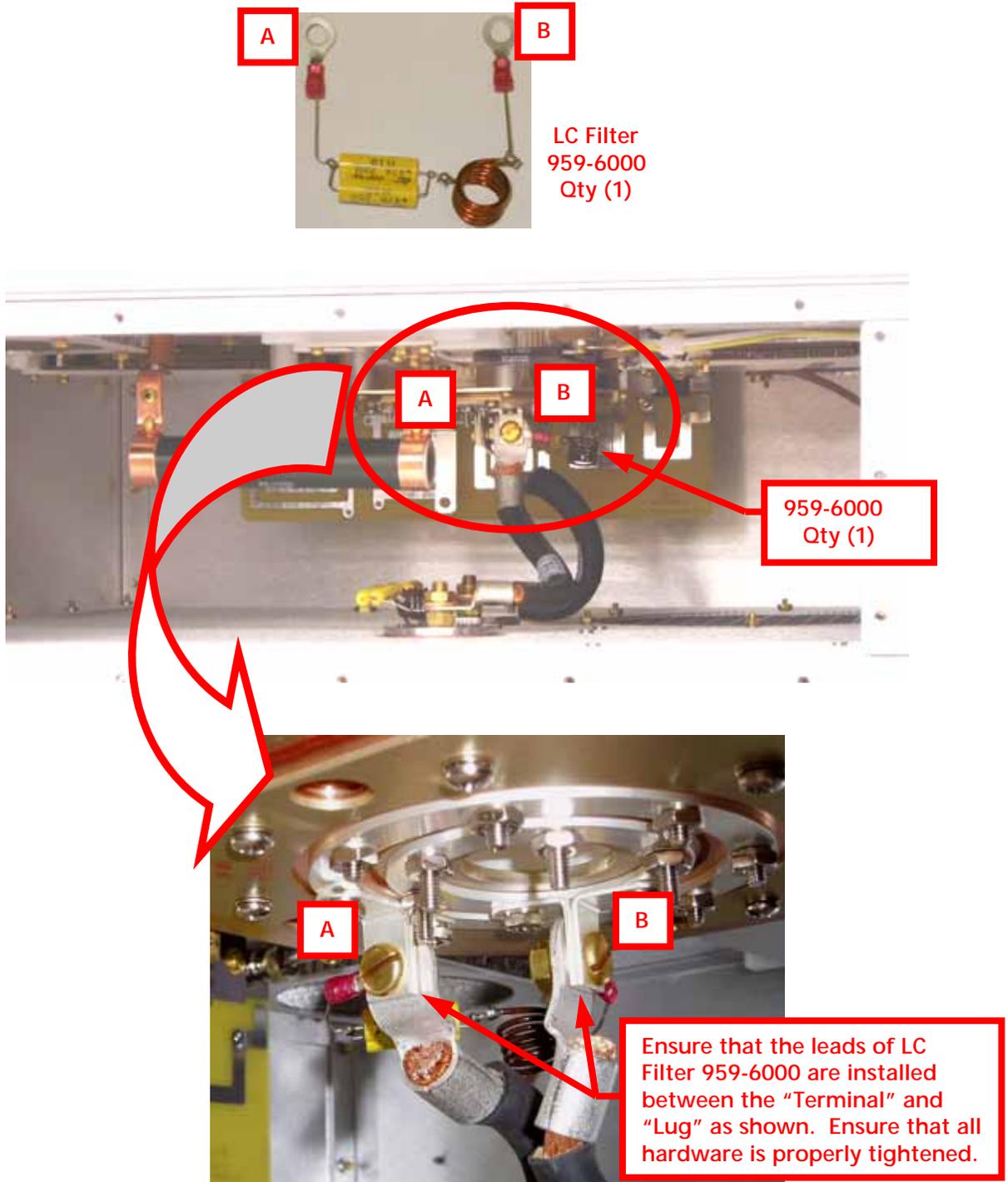


Figure 6 – LC Filter 959-6000 Installation

2.3.4 Install LC Filter 959-6001, Qty (2)

Install LC Filter 959-6001, Qty (2), as shown below.

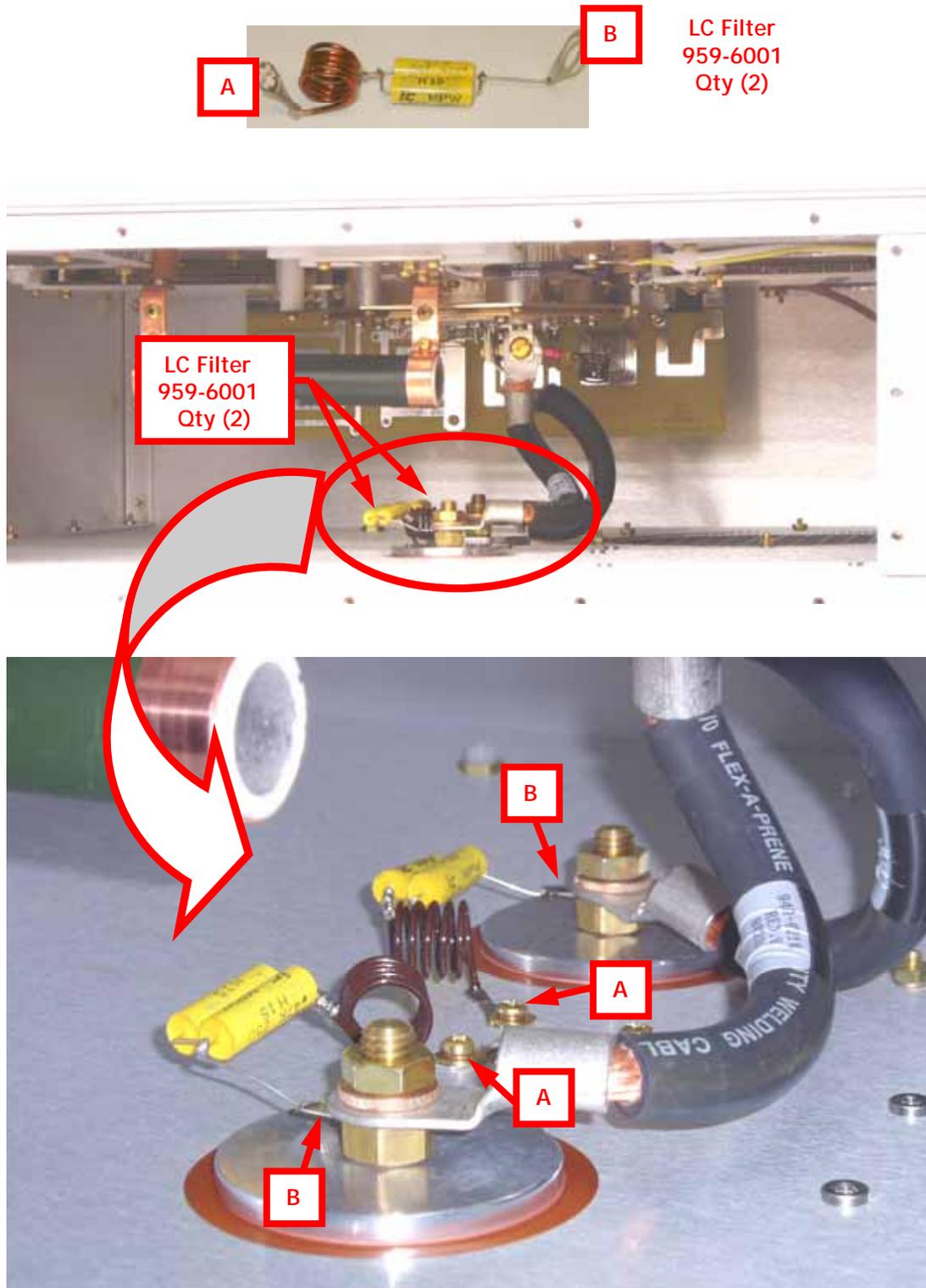


Figure 7 – LC Filter 959-6001 Qty (2) Installation

2.3.5 Install Grid Compartment Access Panel

Using a No. 2 Phillips Screwdriver, install the Qty (16) Phillips Screws and Qty (16) Lock Washers that secure the grid compartment access panel.

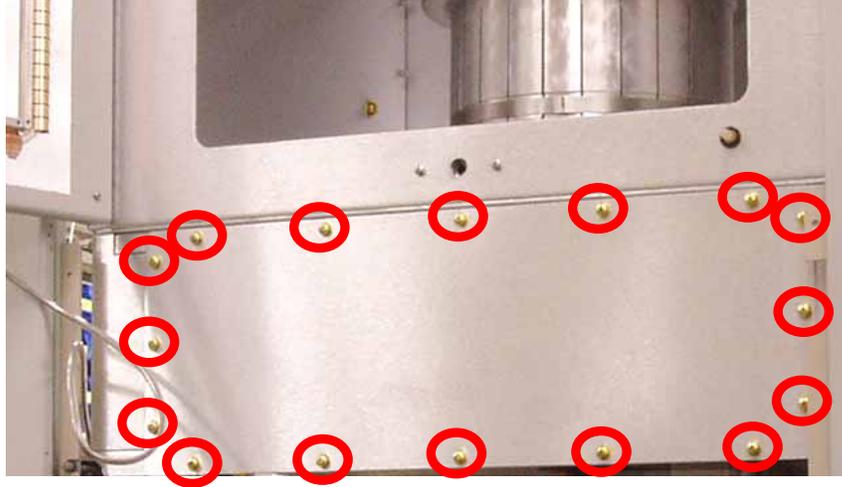


Figure 8 – Grid Compartment Access Panel

2.3.6 Install Grid Compartment Cover

Using a No. 2 Phillips Screwdriver, install the Qty (10) Phillips Screws and Qty (10) Lock Washers that secure the grid compartment cover panel.



Figure 9 – Grid Compartment Cover Panel

2.4 IPA Modifications

2.4.1 IPA Control Board (919-0434-001) Modifications

Step 1 – Using a No. 2 Phillips Screwdriver remove the Qty (6) screws securing the IPA Cover Plate.

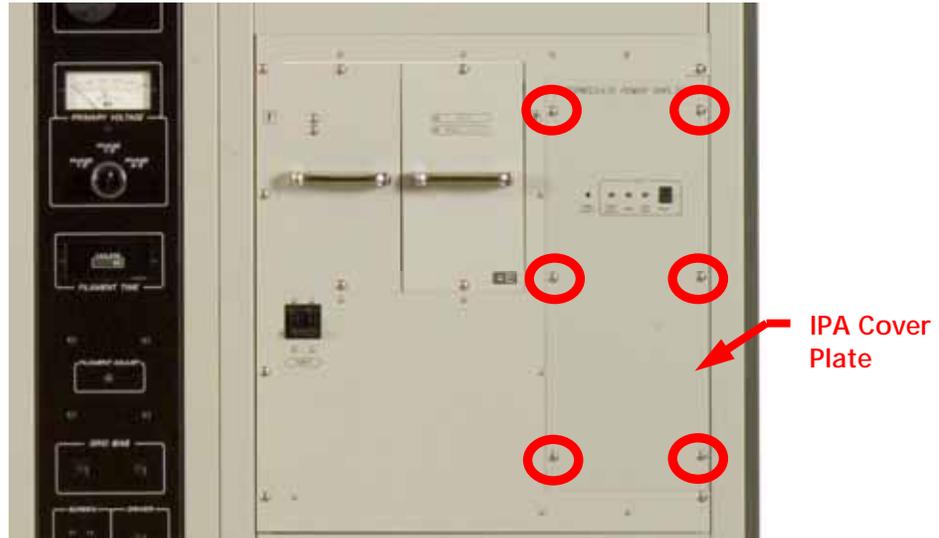


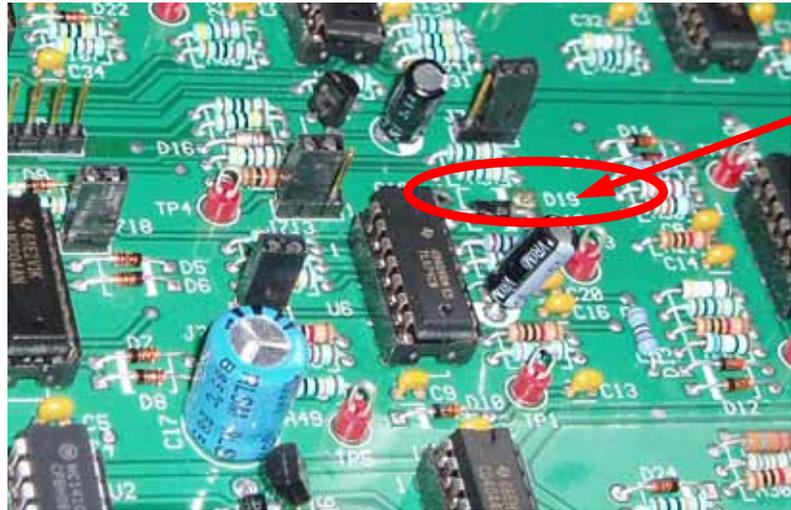
Figure 10 – IPA Cover Plate Removal

Step 2 – Disconnect cabling and remove the IPA Control Board (919-0434-001).



Figure 11 – IPA Control Board (919-0434-001) Removal

Step 3 – Locate and remove D19.



Locate and Remove D19 (already removed in this photo)

Figure 12 – IPA Control Board (919-0434-001) D19 Removal

Step 4 – Relocate P713 to Pins 2 & 3.

Relocate P713 from Pins 1 & 2 to Pins 2 & 3 of J713 as shown.

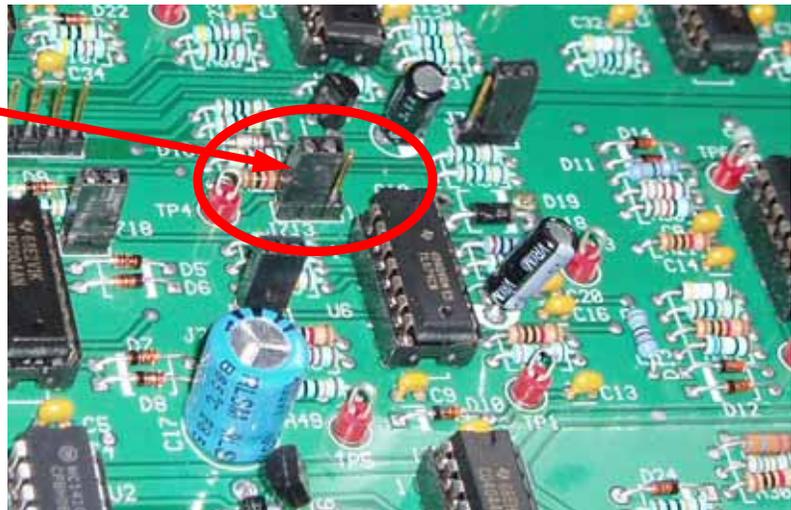


Figure 13 – IPA Control Board (919-0434-001) P713 Relocation

Step 5 – Re-install the IPA Control Board (919-0434-001).

Step 6 – Reconnect cabling.

2.4.2 IPA Status Indicator Board (919-0434-002) Modifications

Step 1 – Disconnect IPA Status Indicator Board (919-0434-002).

Step 2 – Using a 5/16" Nut Driver remove Qty (3) 6-32 Kepnuts that secure the IPA Status Indicator Board (919-0434-002) to the transmitter.

IPA Status
Indicator Board
(919-0434-002)



Figure 14 – IPA Control Board (919-0434-001) P713

Step 3 – Remove R204 and replace with the 4.75K Ohm, 1/4W, 1%, Metal Resistor (103-4741) provided in the upgrade kit.



Figure 15 – IPA Status Indicator Board (919-0434-002) R204 Replacement

Step 4 – Reinstall the IPA Status Indicator Board (919-0434-002) and connect cabling.

Step 5 – Install Cover Plate.

2.5 Replace the PA Module

2.5.1 New PA Module's Front Panel

Included in the Upgrade Kit is a **Tan Colored PA Module Front Panel (471-0979)** and a **Black Handle (486-2285)**.

Note: It is not really necessary to change the front panel and handle, they are included in the kit for customers who want to maintain the original color scheme of the transmitter.

Step 1 – Remove the Grey Front Panel and Silver Handle from the new PA Module.

Step 2 – Install the Tan Colored Front Panel and Black Handle.

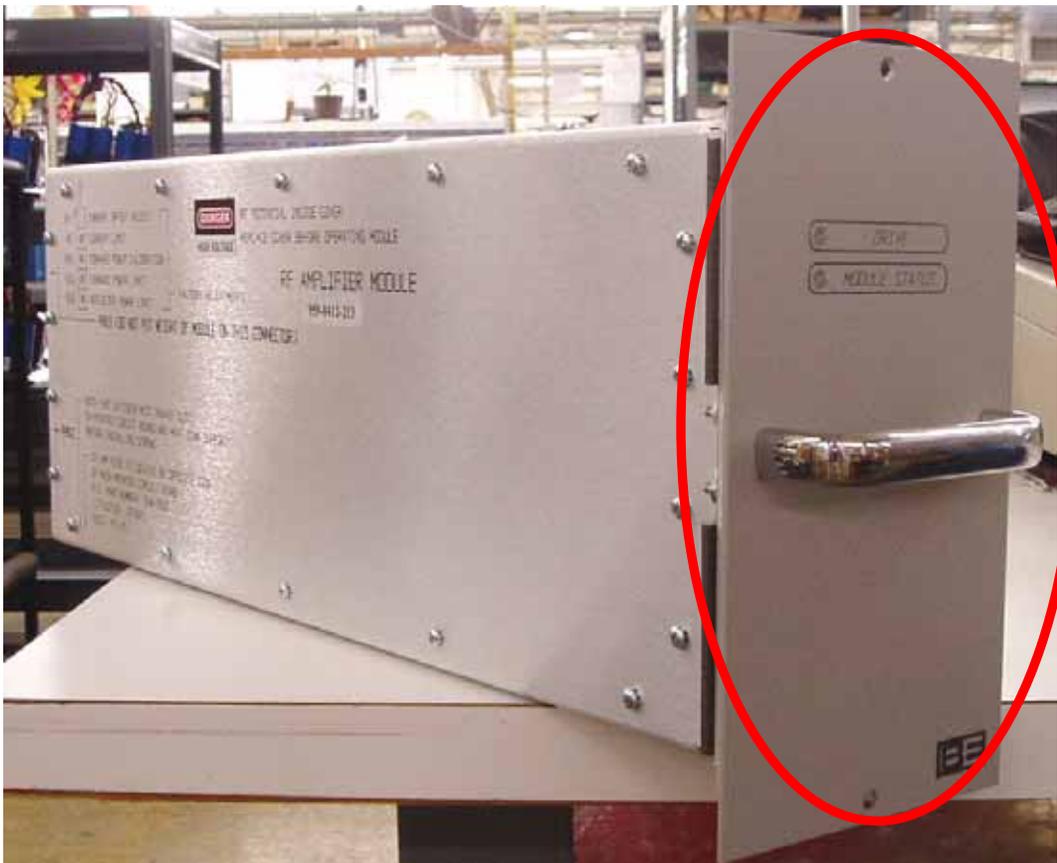


Figure 16 – PA Module Front Panel Replacement

2.5.2 Replace the PA Module in the Transmitter

Step 1 – Using a No. 2 Phillips Screwdriver remove the Qty (2) Phillips Screws securing the PA Module.



Figure 17 – PA Module (959-0412-213) Installation

Step 2 – Remove the existing PA Module and install the new one.

Step 3 – Re-install hardware.

2.6 Remove Existing Exciter

Disconnect and remove the existing Exciter from the Transmitter. If the Exciter is an FXi 60 it will need to be reworked before reinstalling it back into the transmitter. If the Exciter is something other than an FXi 60, it will need to be replaced. An FXi 60 Exciter is required for HD Operation of the Tube Transmitter.

2.7 IMPORTANT! Upgrading "FM ONLY" FXi 60 Exciters

Existing **FXi 60 Exciters** require the upgrade of the **Controller Board (919-0541-001)**, the addition of **Attenuators (339-0061 or 339-0025) & (959-6002)**, and the upgrade of **U41** on the DSP Motherboard.

The **FXi 60 Exciter** will also require the addition of the **IBOC Card (if using in conjunction with an FSi 10)** or an **Exgine Card (if using in conjunction with an XPi 10)**.

IMPORTANT NOTE: If the existing FXi's rear panel does NOT have the large cutout with cover plate as noted below, the FXi will require additional upgrades that must be performed at the factory. If this is the case, contact RF Customer Service for a Return Authorization and request that the FXi be upgraded for use with an HD TUBE Transmitter. You will also need to specify if your HD System will be using an FSi 10 or an XPi 10.

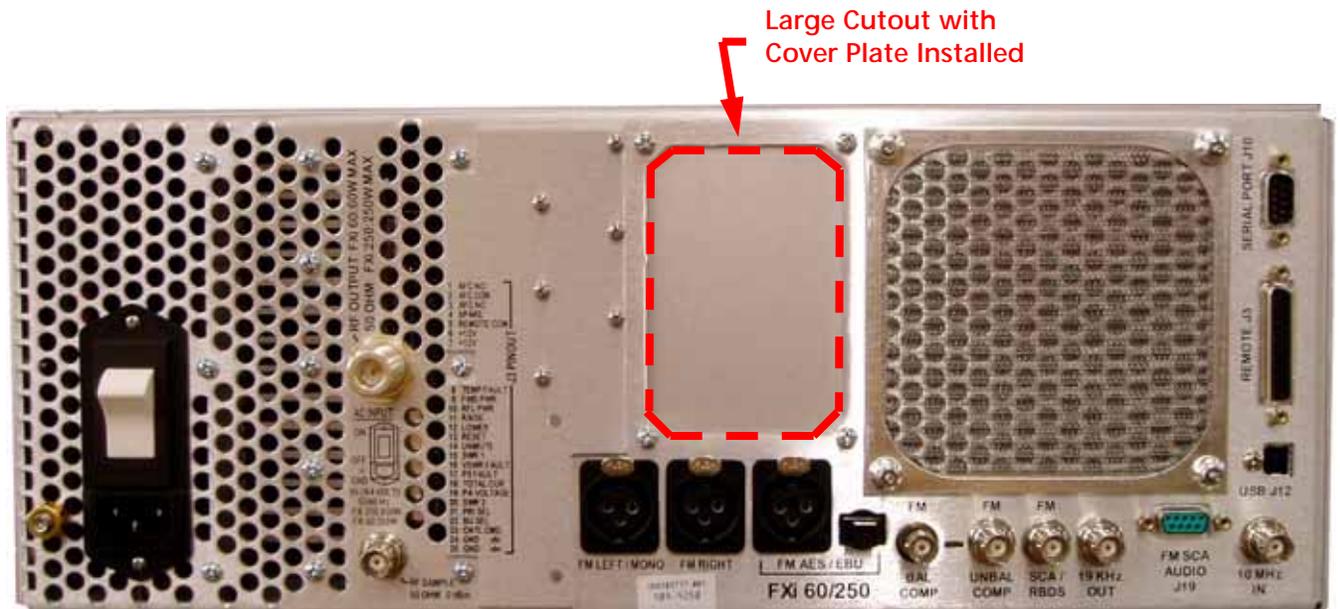


Figure 18 – FXi 60/250 FM ONLY Exciter (No IBOC or Exgine Card Installed)

2.8 Upgrading an Existing FXi 60 Exciter

2.8.1 Remove Existing Attenuator RF Cables

Step 1 – Using a No. 2 Phillips Screwdriver, remove the Exciter's cover

Step 2 – Locate, disconnect and remove the cables shown below.

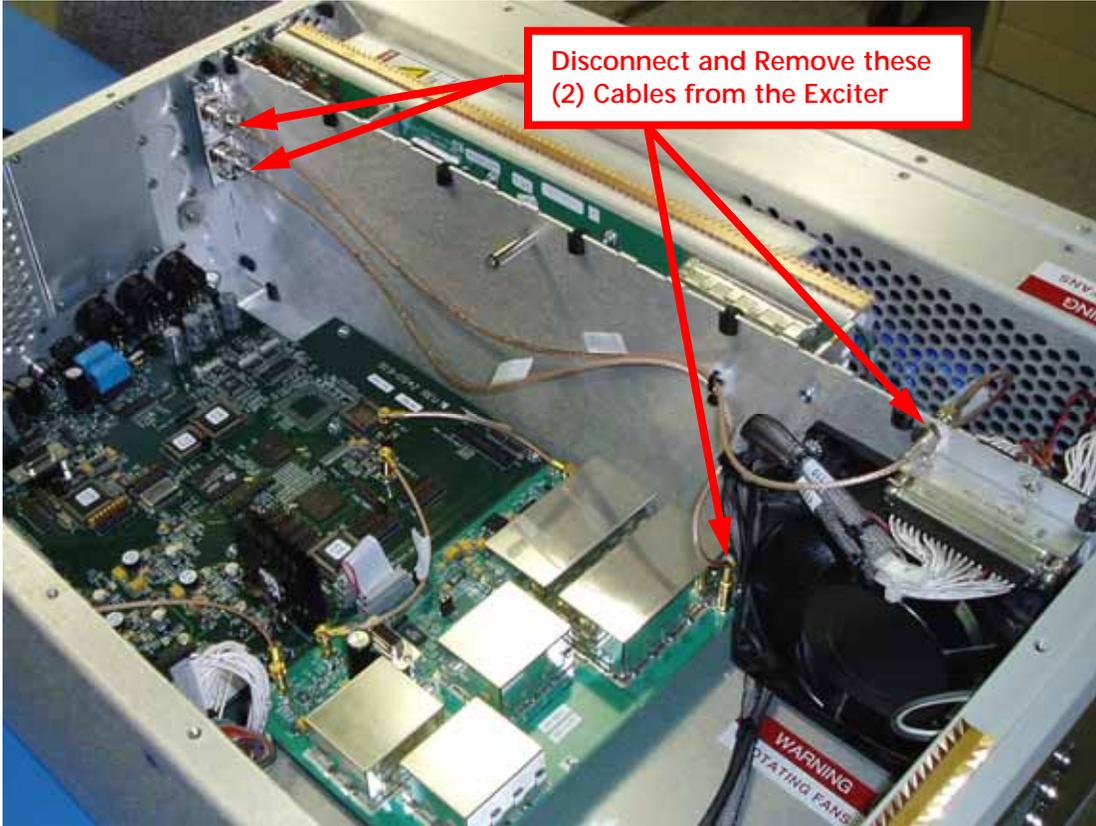


Figure 19 – Existing Attenuator Cable Removal

2.8.2 Install Fixed Attenuator (339-0061)



Figure 20 – Fixed Attenuator Installation

2.8.3 Install W59, W65, and W66

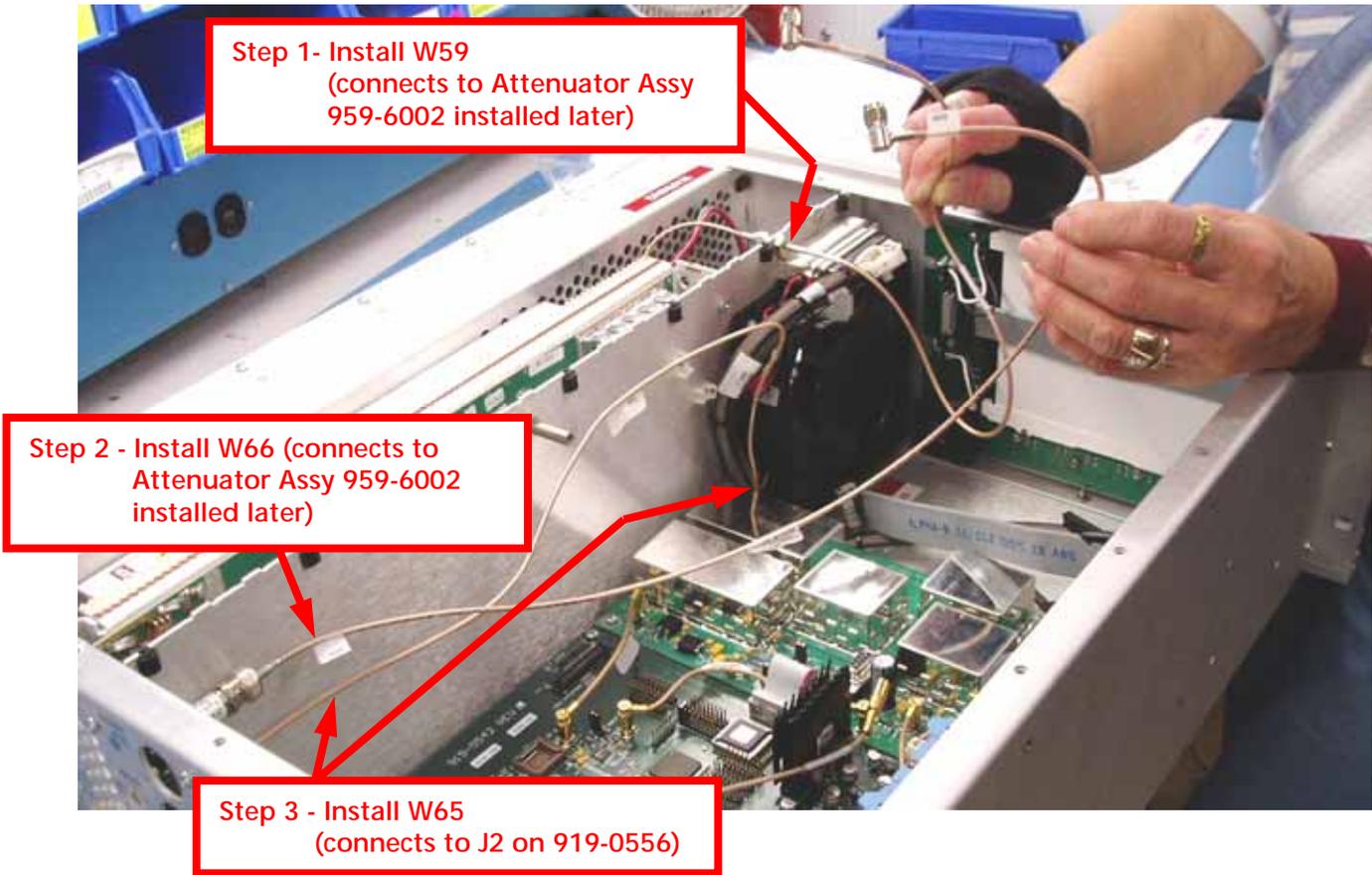


Figure 21 – Attenuator Cable Installation

2.8.4 Upgrading the FXi's Controller Board to (919-0541-001)

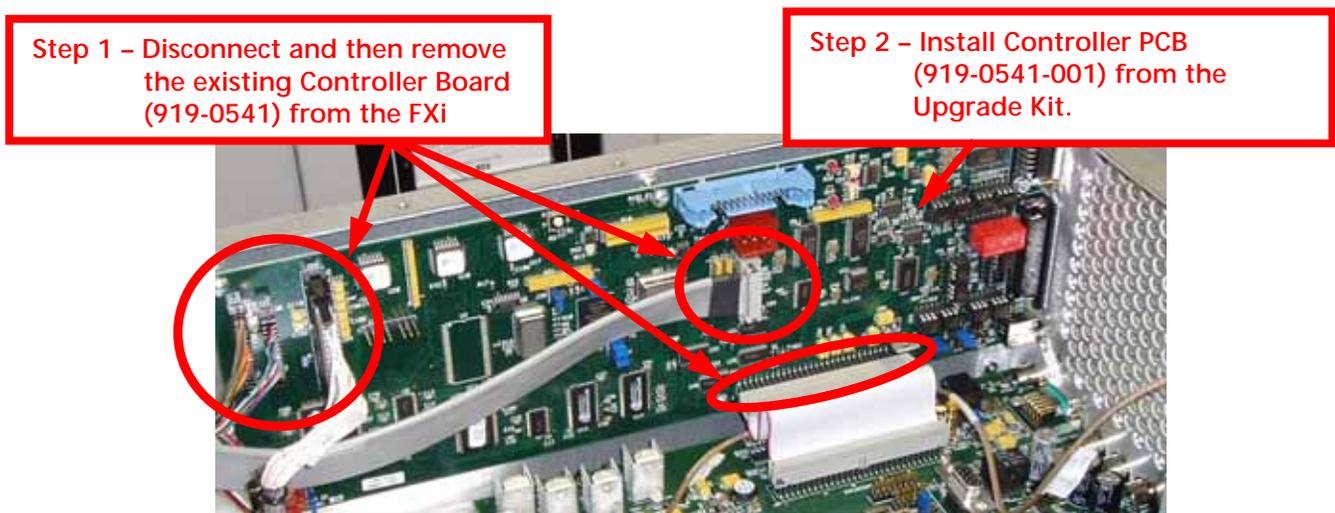


Figure 22 – FXi Controller Board Replacement



2.8.5 Installing the Attenuator Assembly (959-6002)

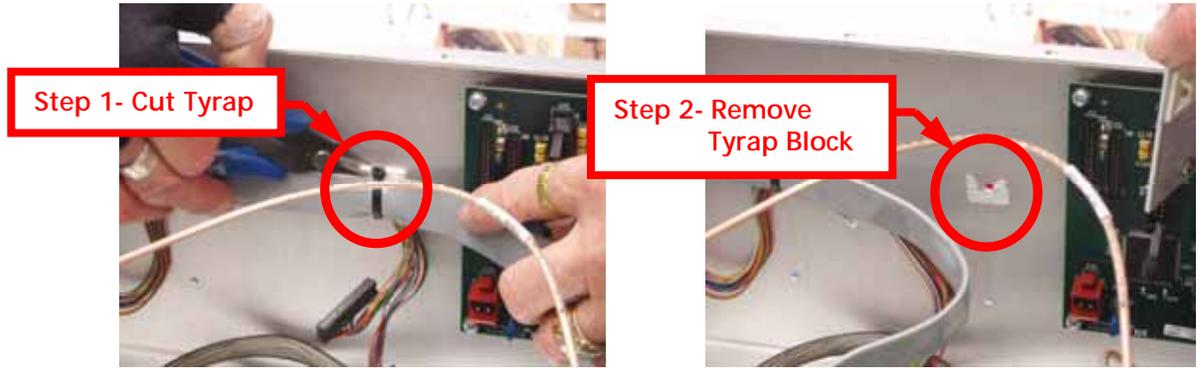


Figure 23 – Tyrap / Block Removal

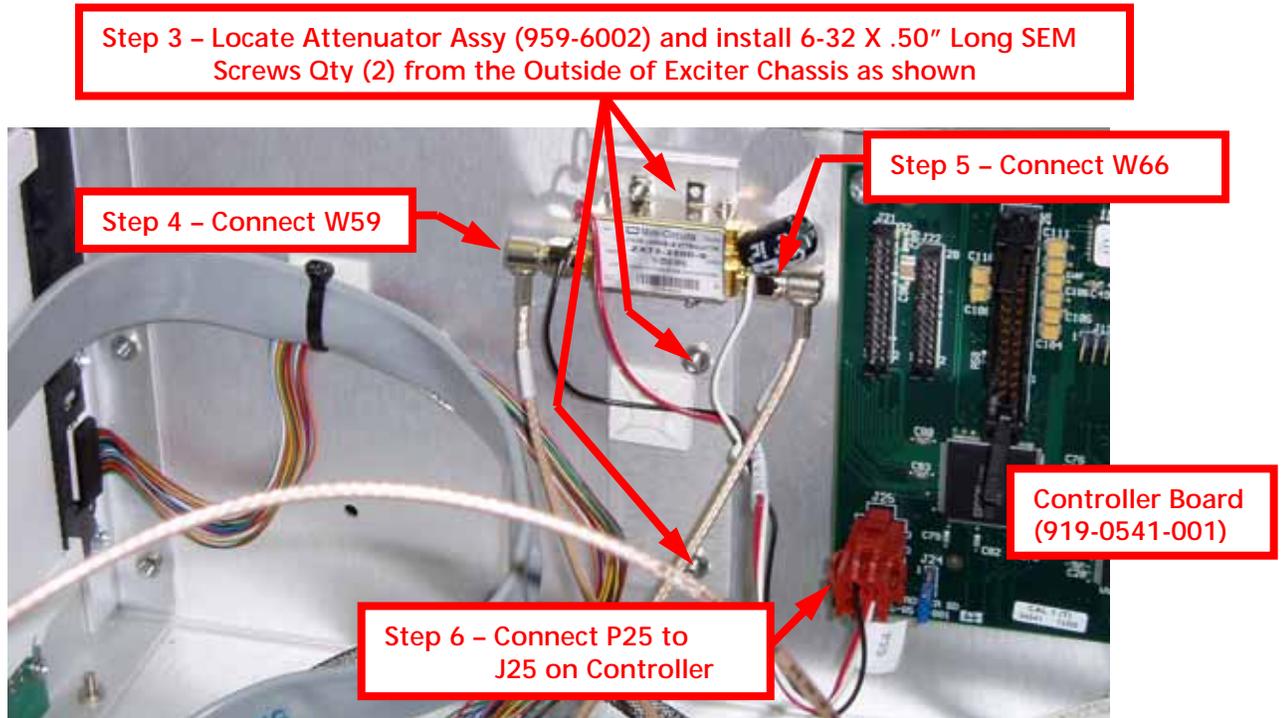


Figure 24 – Attenuator Installation

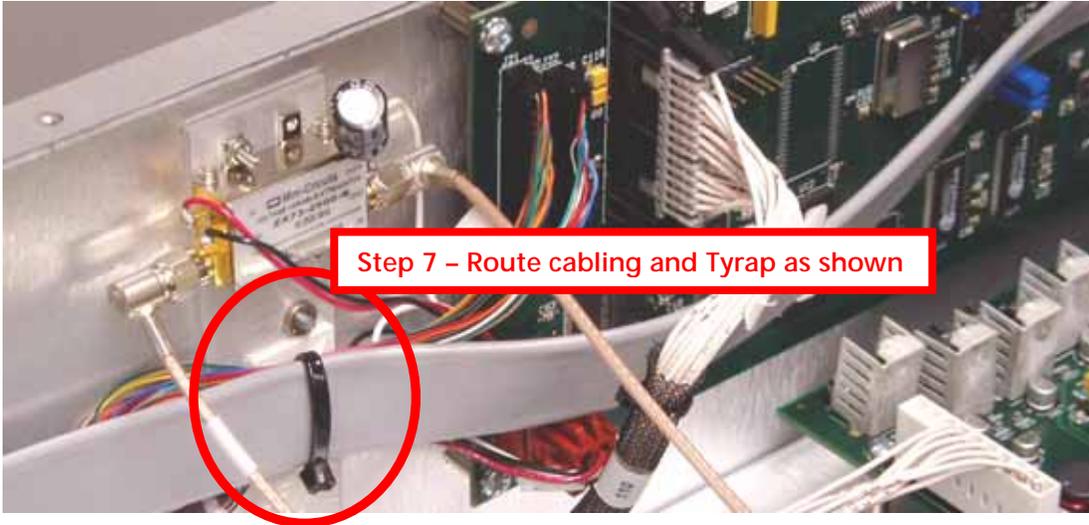


Figure 25 - Route Cables and Tyrap

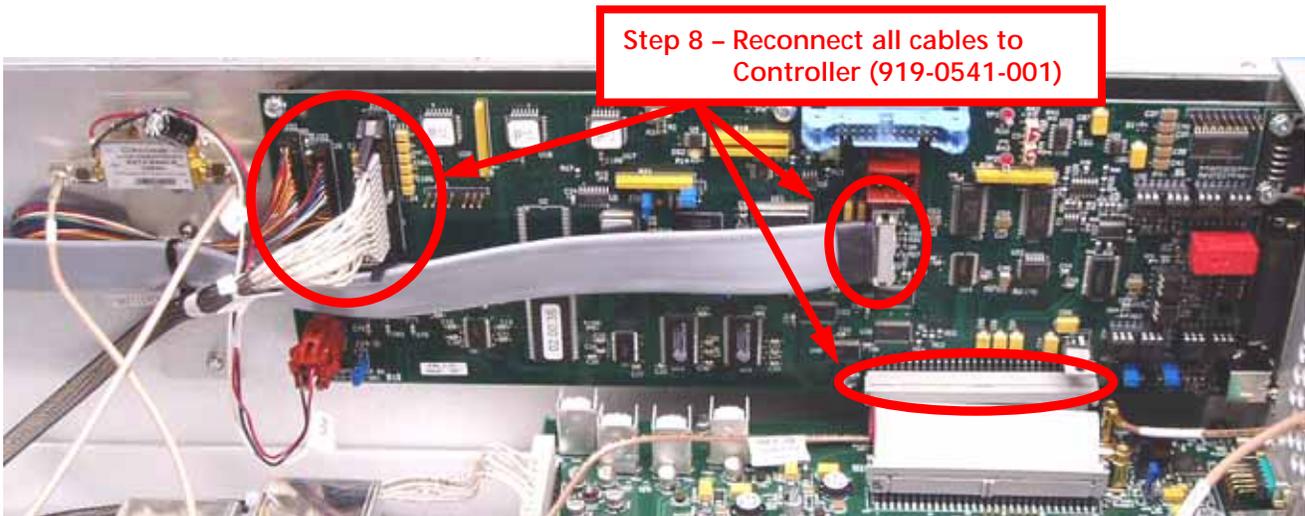


Figure 26 - Route Cables and Tyrap

2.8.6 Ensure Controller Board P24 Jumper is on Pins 2 and 3

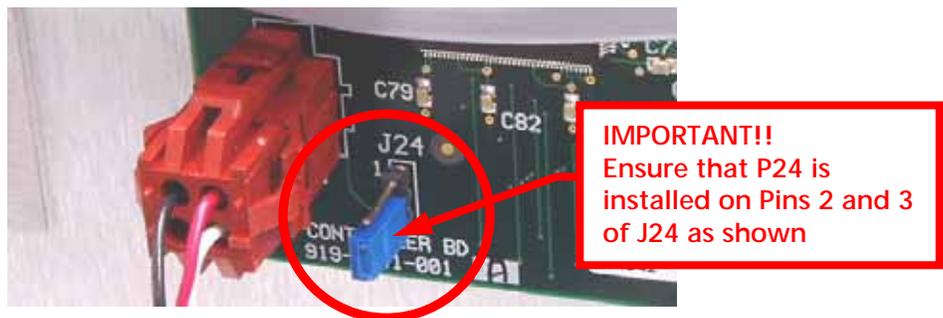


Figure 27 - Controller Board P24 Jumper Setting

2.8.7 Replace U41 on the Motherboard



Figure 28 – U41 Installation

2.8.8 Installing the IBOC Card (if using in the FXi conjunction with an FSi)

If you are planning to use the FXi Exciter in conjunction with an FSi 10, you must install the **IBOC Card (919-0546)** into the FXi 60. The IBOC Card and other needed components for its installation are included in the **FSi 10 Installation Kit (979-0543)**.

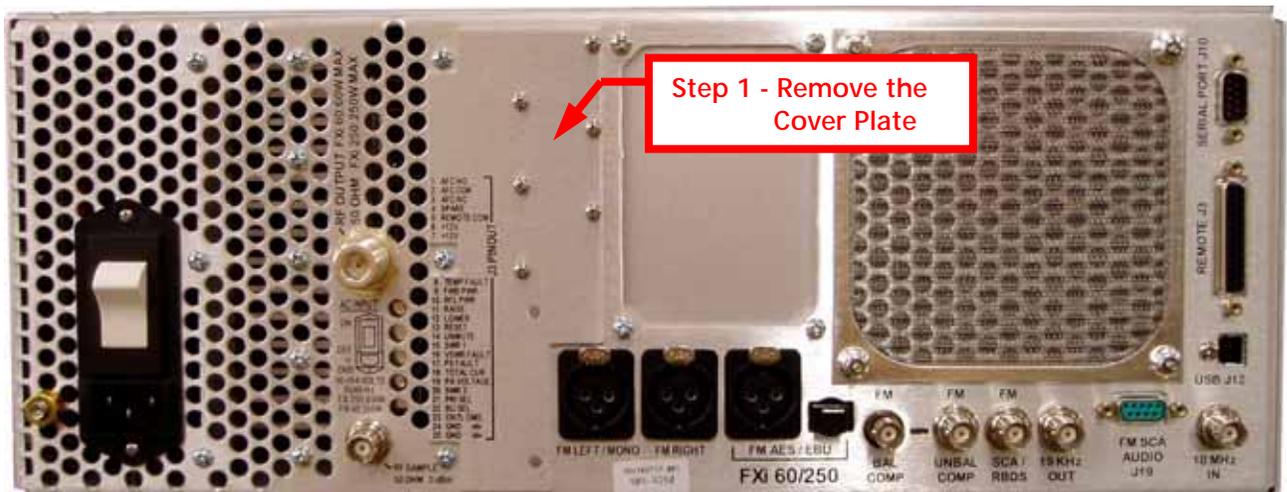


Figure 29 – FXi 60/250 FM ONLY Exciter (Rear View)



Figure 30 - IBOC Card Installation

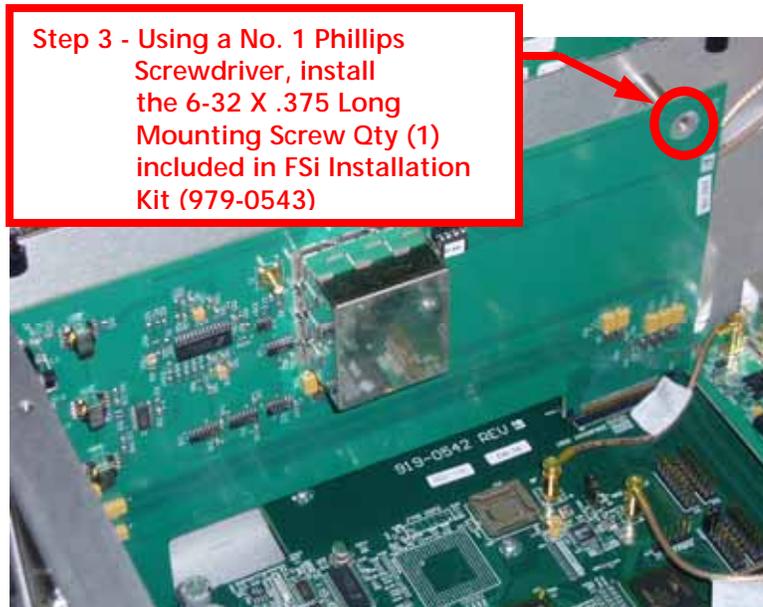


Figure 31 - IBOC Card Mounting Hardware

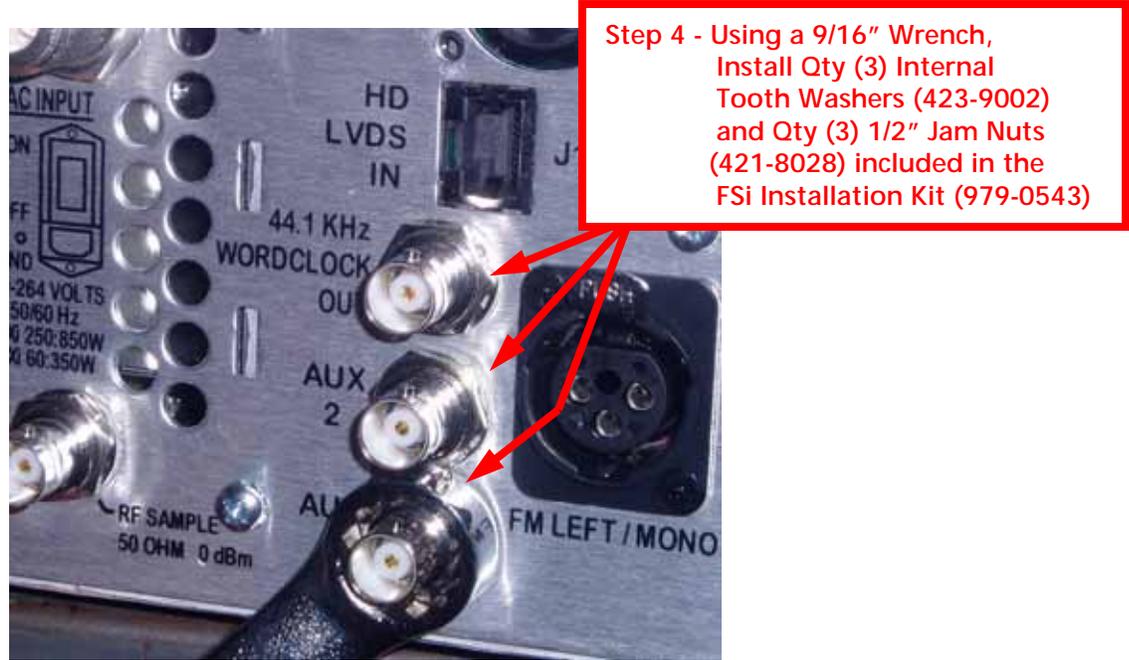


Figure 32 – IBOC Card BNC Mounting Hardware

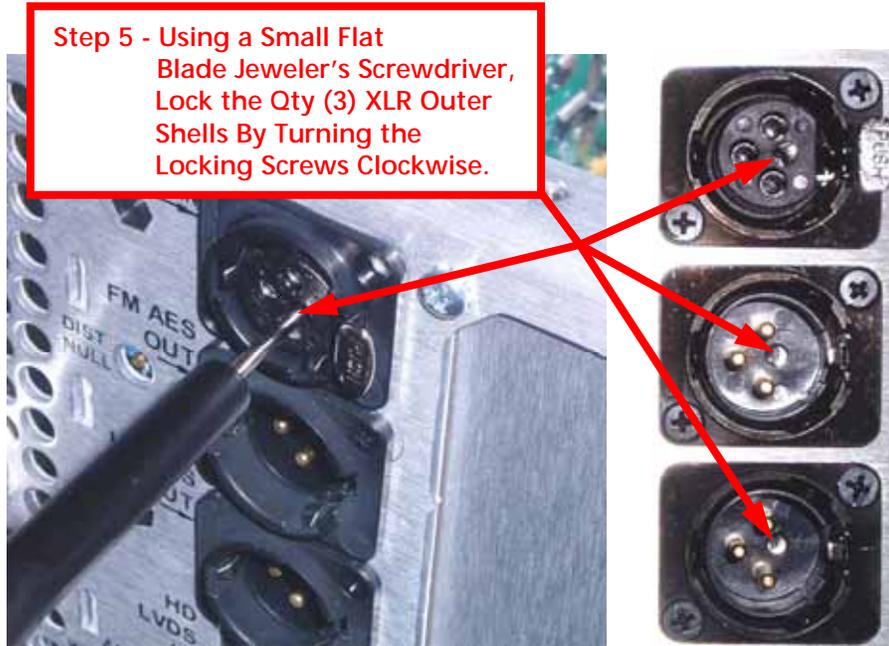


Figure 33 – Install XLR Connector Outer Shells

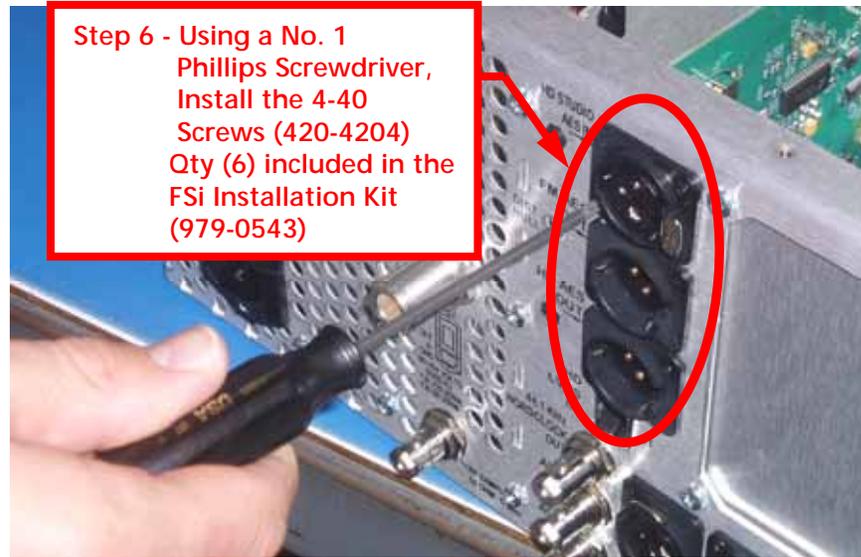


Figure 34 – IBOC Card XLR Mounting Hardware

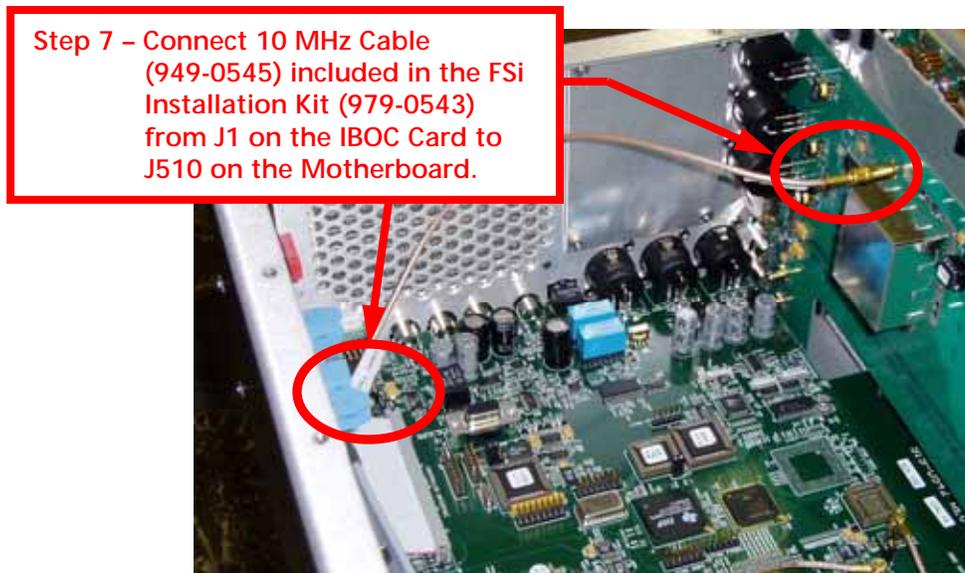


Figure 35 – 10 MHz Cable Installation

2.8.9 Installing the Exgine Card (if using the FXi in conjunction with an XPi)

For Exgine Card Installation into the FXi, locate **FXi Exciter Exgine Upgrade Kit (909-0600)**. This kit was shipped with the XPi 10 Exporter. Reference document **597-0545** included in the Exgine Upgrade Kit.

2.9 Install Screw Locks on Attenuation Control Board (919-0299)

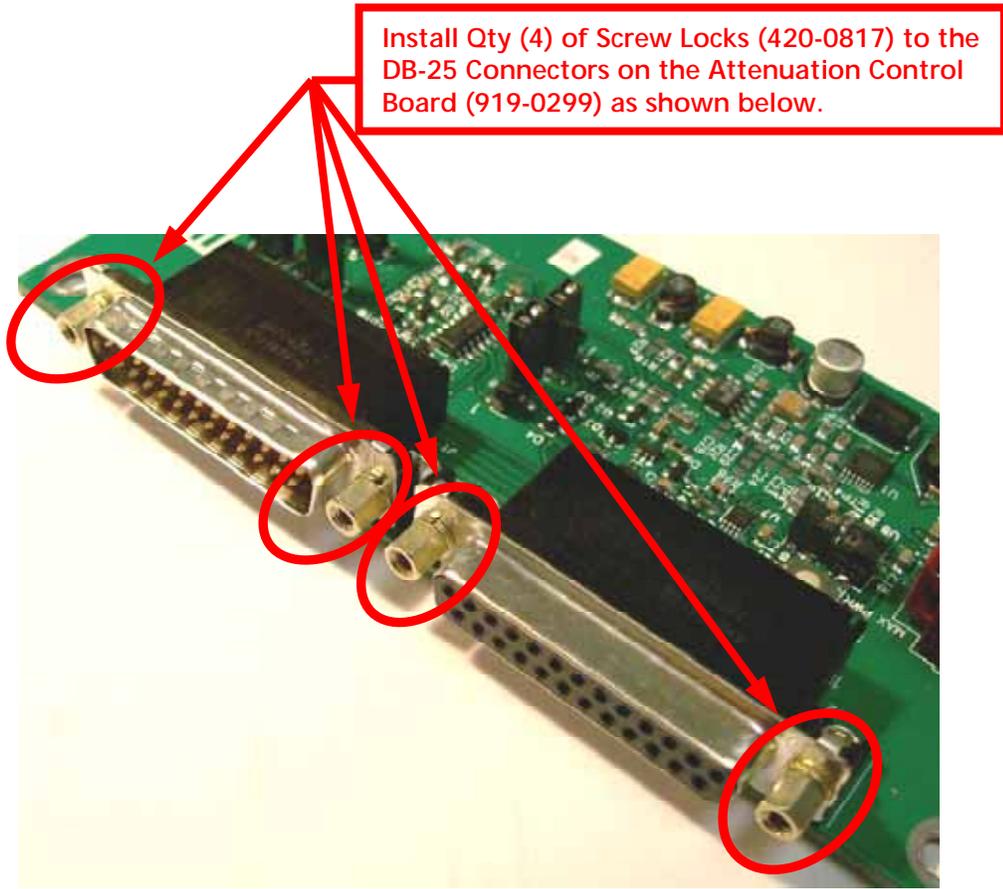


Figure 36 – Screw Lock Installation

2.10 J7, J8, J9 & J10 Initial Settings on Attenuation Control Board

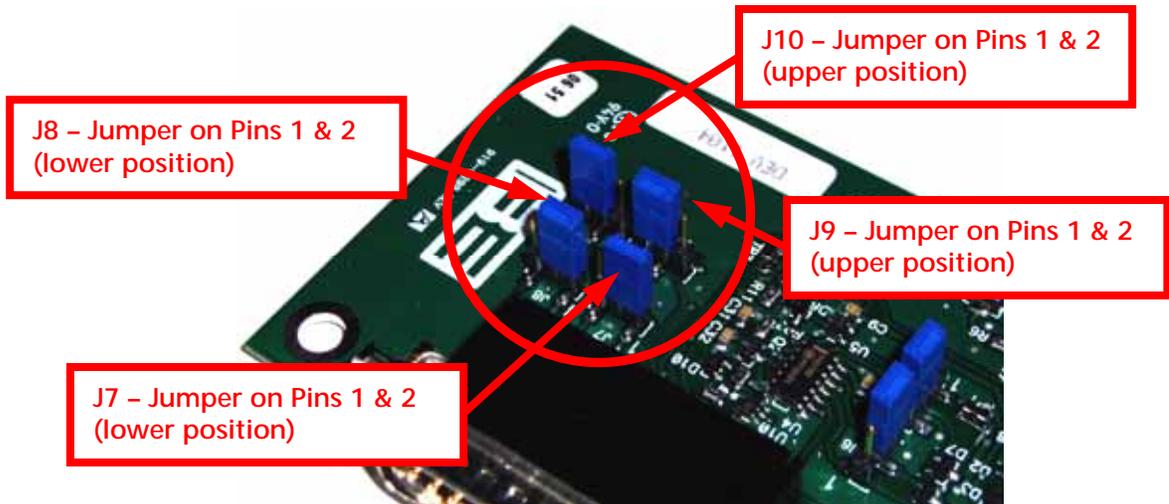


Figure 37 – J7, J8, J9, and J10 Jumper Settings

2.11 Install Attenuation Control Board (919-0299)



Mount the Attenuation Control PCB (919-0299) to the cabinet rail as shown using Qty (2) Standoffs (441-0101), Qty (4) #10 Split Locks (423-0002), and Qty (4) #10 Phillips Screws X .375 Long (420-0106).



Attenuation Control Board (919-0299)

Figure 38 – Attenuation Control Board (919-0299) Installation

2.12 Modify Existing Exciter System Cabling

The existing Exciter System Cable must be modified to facilitate communication between the new **Exciter** and the **Attenuation Control Board (919-0299)**.

Step 1 – Locate the “**Add-On**” Cable shown below in the Installation Kit



Figure 39 – “Add-On” Cable

Step 2 – Next, locate the 25 pin connector that was connected to J3 on the Exciter in the Controller Cabinet.



Figure 40 – Locate Exciter J3 Cable

Step 3 – Solder **Wire #1** of the “Add-On” cable into **Pin 6** of the connector.

Step 4 – Solder **Wire #3** of the “Add-On” cable into **Pin 23** of the connector.

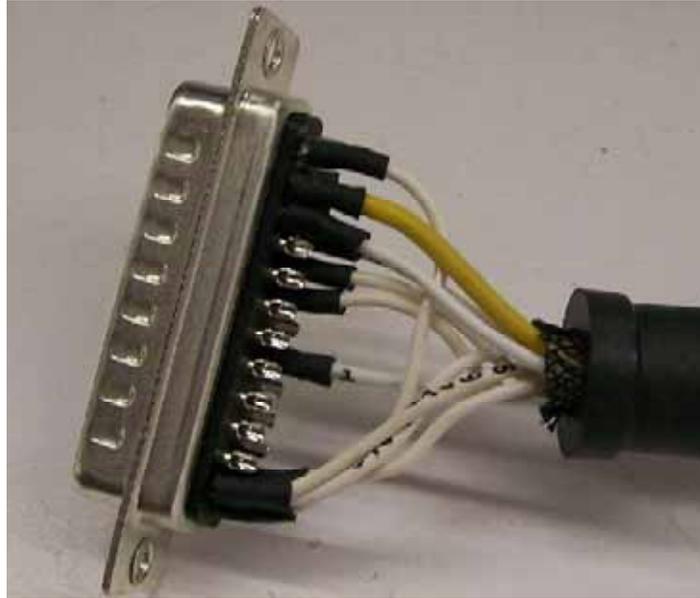
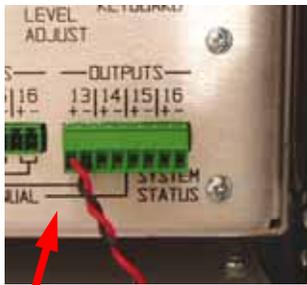


Figure 41 – Exciter J3 Cable Connector

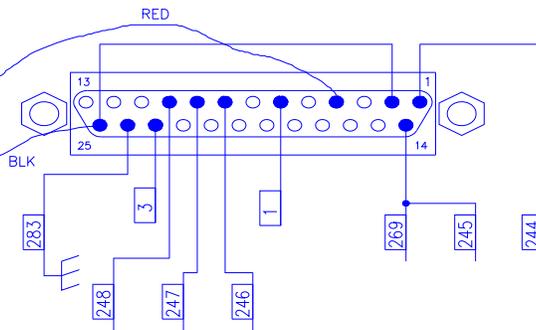


418-1550-008 PART OF WIRE HARNESS 949-0549

FXi EXCITER P3 WIRING.
SOLDER THE WIRES INTO THE 25 pin 'D' CONNECTOR FROM ACCESSORY KIT 979-0540. WIRES ARE FROM HARNESS 949-0142-300 AND 949-0549.

- PIN-WIRE
- 1 - #244
 - 2 - jumper
 - 4 - RED (949-0549)
 - 6 - #1
 - 8 - #246
 - 9 - #247
 - 10 - #248
 - 14 - #245 & #269
 - 23 - #3
 - 24 - #283
 - 25 - jumper, BLK (949-0549)
- JUMPER 22 GA. WIRE

FXi WIRING



This Cable and Connector ONLY necessary if using an FSi 10. Cable and Connector IS NOT needed if using an XPi 10. Connect to the FSi 10 as shown.

Figure 42 – Exciter J3 Cable Connector



Step 5 – Route the “Add-On” Cable along the existing cable and tyrap as shown.

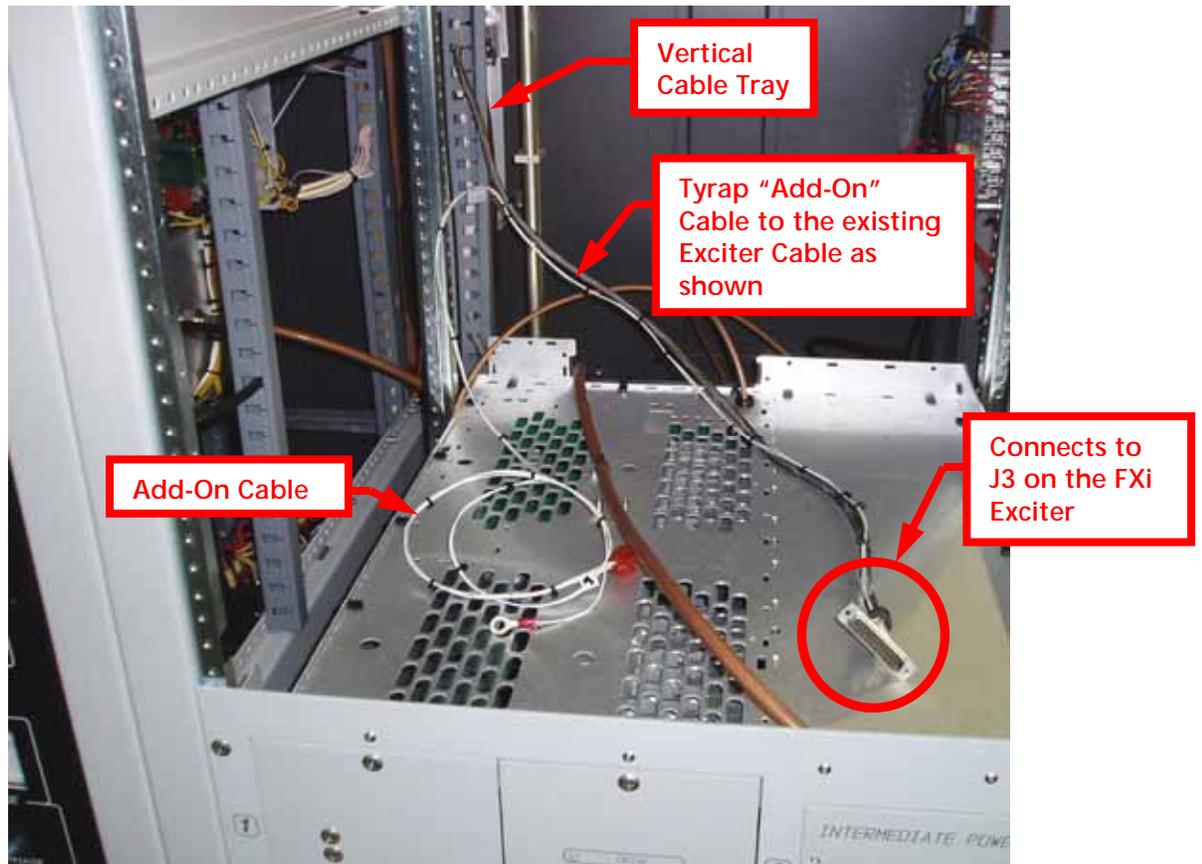


Figure 43 – Front View of Control Cabinet (Exciter Removed)

Step 6 – Open the Vertical Cable Tray and route the “Add-On” cable to the top as shown.

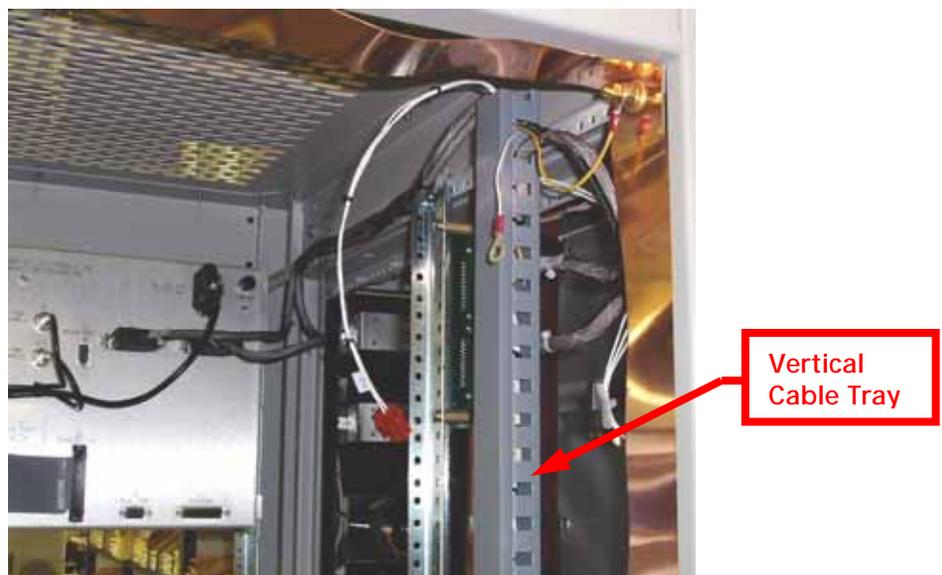


Figure 44 – Rear View of Controller Cabinet

Step 7 – Connect the **Ground Lug** of the “Add-On” Cable to the **Ground Strap Stud** as shown.

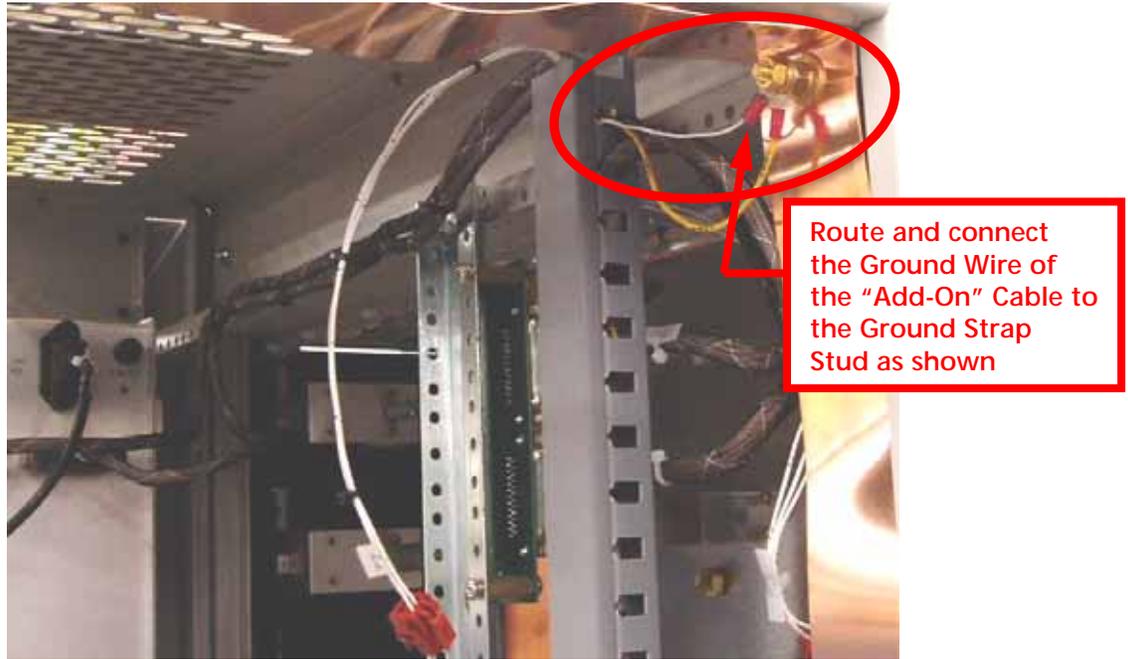


Figure 45 – Rear View of Controller Cabinet

Step 8 – Connect **P3** of the “Add-On” Cable to the **Attenuation Control Board (919-0299)** as shown.

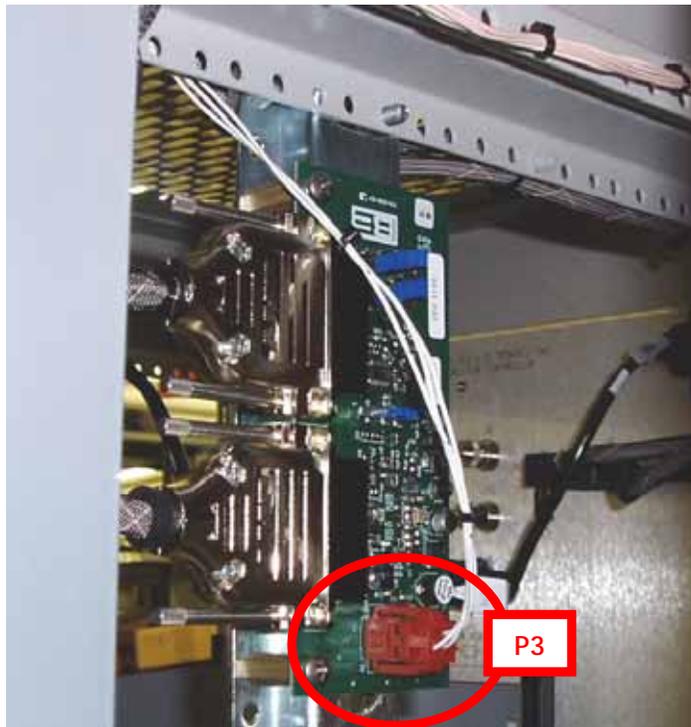


Figure 46 – Attenuation Control Board (919-0299)

2.13 Unplug and Replace J101 and P201 Connector Shells

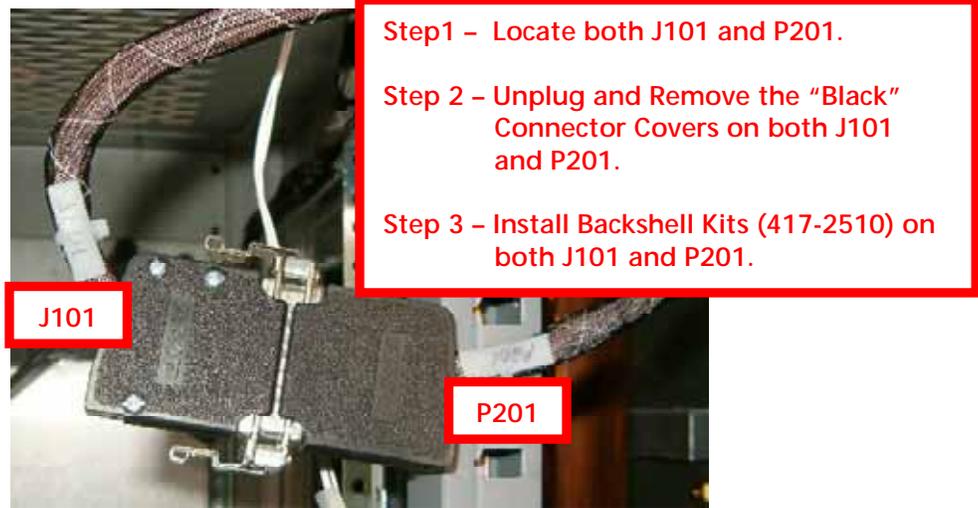


Figure 47 – J101 / P201

2.14 Plug J101 and P201 into the Attenuation Control Board

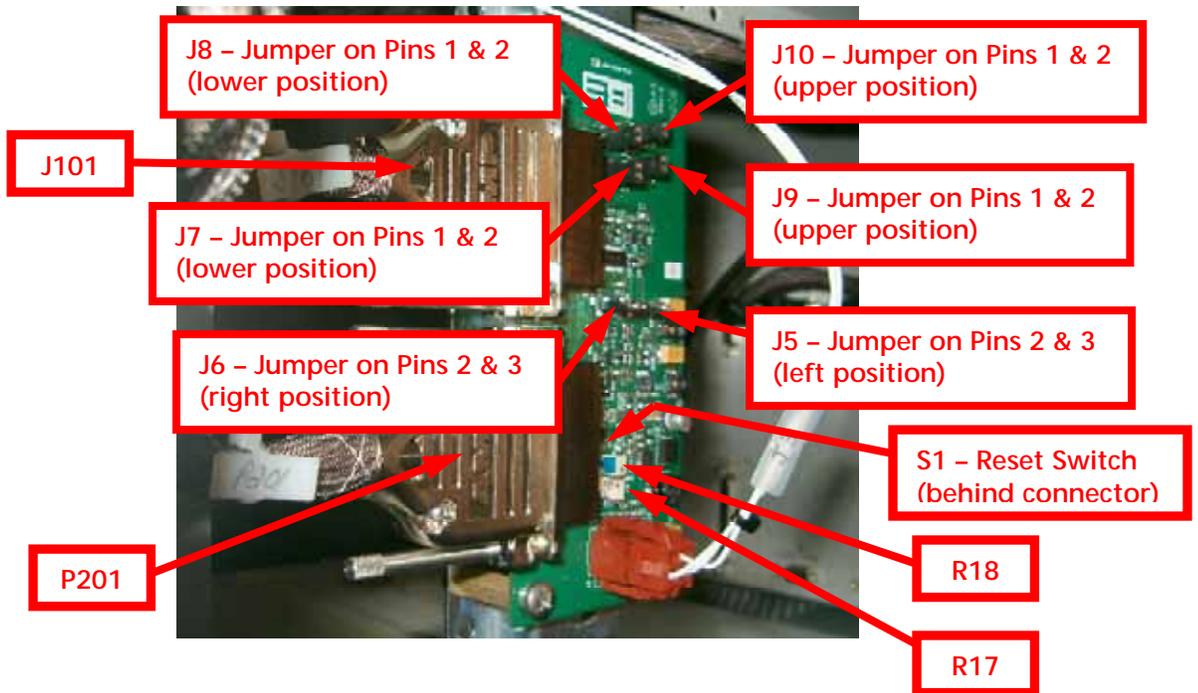


Figure 48 – J101 / P201 Connection to Attenuation Control Board

2.15 Install FXi 60 Exciter into Transmitter

Install the FXi 60 Exciter into the Transmitter as shown below using supplied rack hardware. Please Note that the FXi 60 must be mounted below of the XPi 10 (or FSi 10) for mechanical reasons. Supplied cable lengths were based upon this mounting configuration.

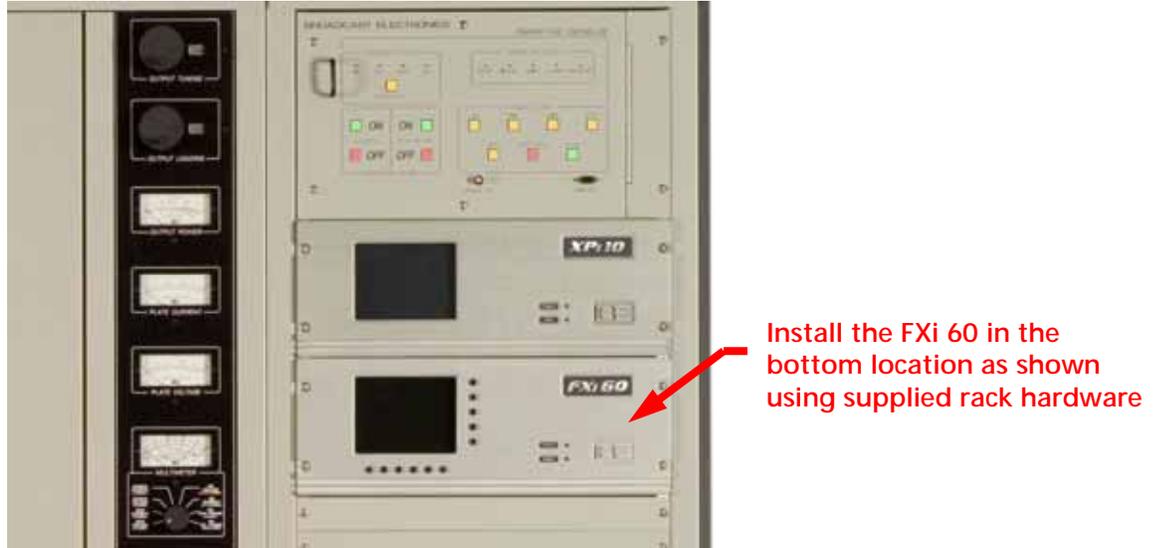


Figure 49 – FXi 60 Installation

2.16 Install XPi 10 (or FSi 10) into Transmitter

Install the XPi 10 (or FSi 10) into the Transmitter as shown below using supplied rack hardware. Please Note that the XPi 10 (or FSi 10) must be mounted on top of the FXi 60 Exciter for mechanical reasons. Supplied cable lengths were based upon this mounting configuration. If desired, the XPi 10 may be installed at the Studio Site.

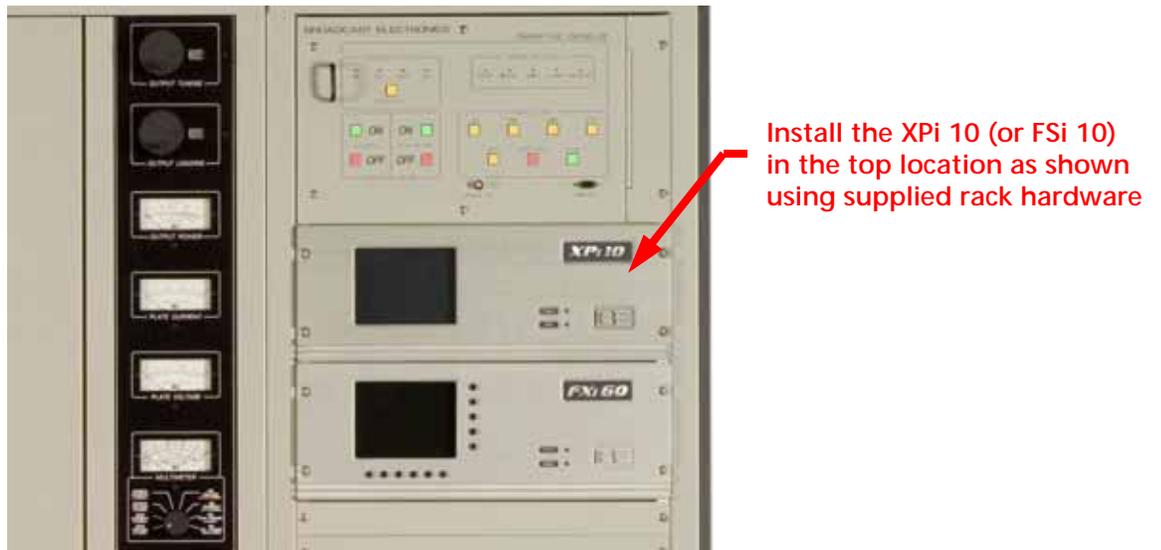


Figure 50 – XPi 10 (or FSi 10) Installation

2.17 FXi 60, XPi 10 (or FSi 10) AC Power Connections

2.17.1 FXi 60 AC Power Connection

Connect the wires of the AC Power cord of the FXi Exciter into the AC Distribution Block as shown below. The AC Distribution block is located along the back rail of the Controller Cabinet.

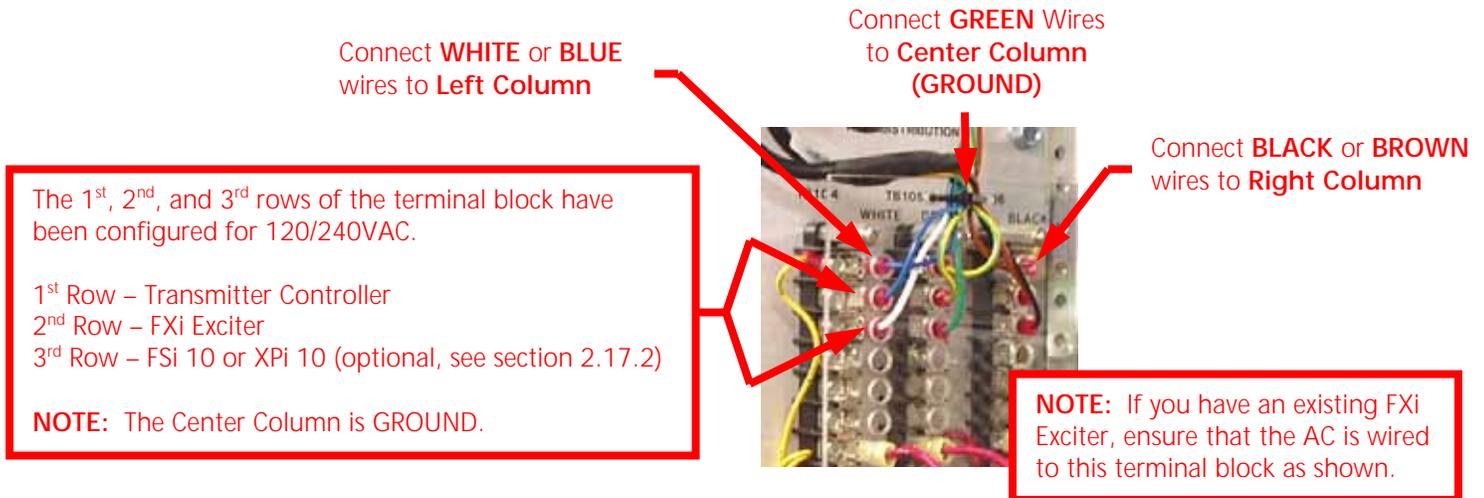


Figure 51 – AC Distribution Block Connections

2.17.2 XPi 10 (or FSi 10) AC Power Connection

Due to the boot-up time of the XPi 10 (or FSi 10), it is recommended that the XPi 10 (or FSi 10), be powered from a separate 120V AC Power source other than the terminal block in the back of the transmitter control cabinet.

2.18 FXi 60, FSi 10, XPi 10 Interconnect Cabling

2.18.1 FXi 60 and FSi 10 Interconnect Cabling

If the transmitter is configured with the FXi 60 Exciter and the FSi 10 HD Signal Generator, refer to the **FSi 10 HD Signal Generator Manual, 597-0542-002 (Page 69)**, for installation, cabling, and setup instructions.

Please note that the FXi Exciter and the FSi 10 MUST be installed at the Transmitter Site.

2.18.2 FXi 60 (w/Engine) and XPi 10 Interconnect Cabling

If the transmitter is configured with the FXi (w/Engine) and the XPi 10 Exporter, refer to **FXi 60/250 Exciter (w/Engine) and XPi 10 Exporter Quick Installation Guide, 597-0542-XM3**, for installation, cabling, and setup instructions. Please note that the FXi Exciter MUST be installed at the transmitter site. The XPi 10 Exporter may be installed at EITHER the Studio or Transmitter Site. See the HD System Configuration Drawings included in the Quick Installation Guide.

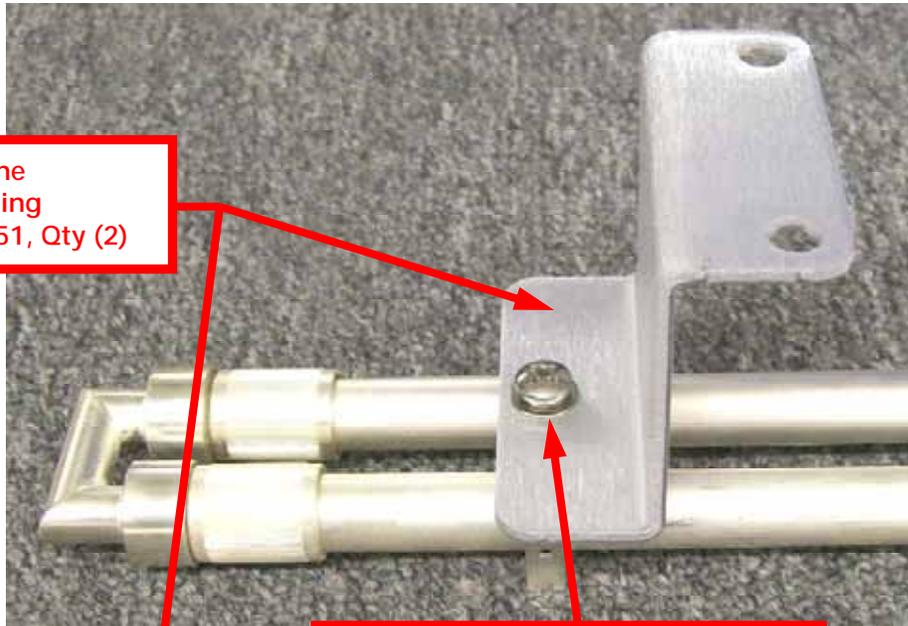
2.19 FXi 60 and FSi 10 AES Bypass Configuration

Refer to the **FSi 10 HD Signal Generator Manual, 597-0542-002 (Page 69)**, for installation, cabling, and setup instructions regarding the use of a Broadcast Tools DMSIII Audio Switcher with the FXi Exciter and the FSi 10 HD Signal Generator.

2.20 Install Line Stretcher Mounting Brackets and Coaxial Adapters



Step 1- Install Line Stretcher Mounting Brackets 471-5451, Qty (2)



420-0108 , #10-32 Screw, Qty (2)
423-0002, #10 Split Lock, Qty (2)
423-0001, #10 Flat Washer, Qty (2)



Step2 - Install N-Adapter 550-134, Qty (2)

Step 3 - Install N-Plug to BNC Jack Adapter 417-3288, Qty (2)

Figure 52 – Line Stretcher Mounting Bracket and Adapter Installation



2.21 Install Line Stretcher (427-0064)

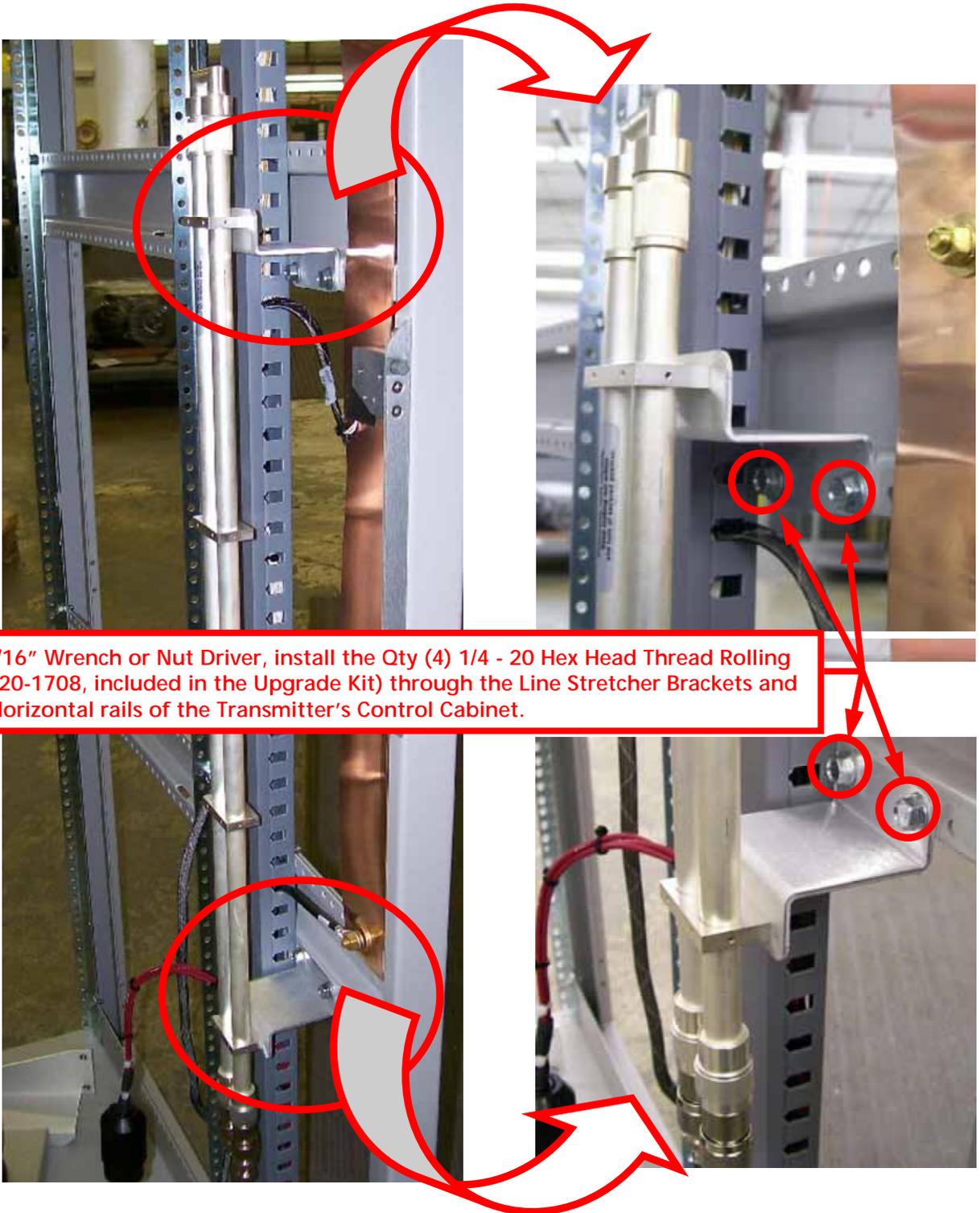


Figure 53 – Line Stretcher Cabinet Mounting

2.22 Line Stretcher (427-0064) Connections

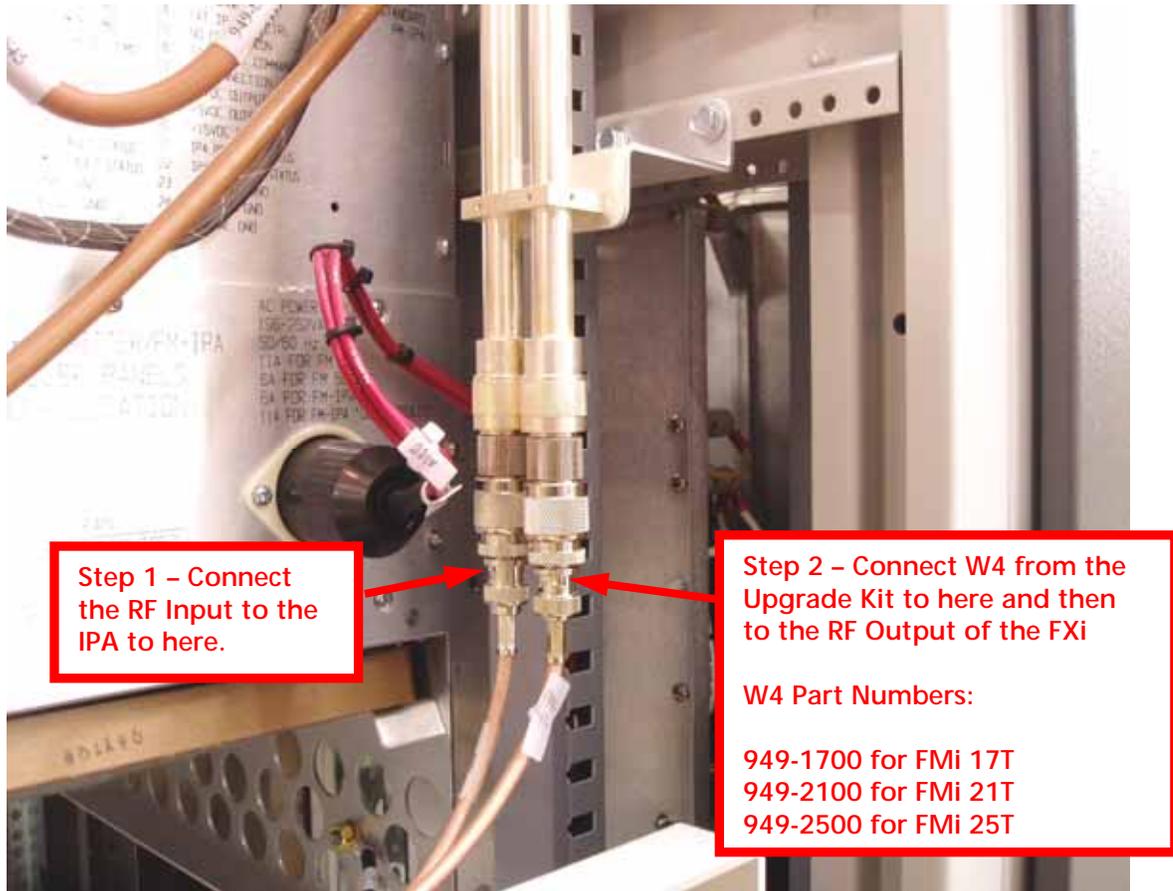


Figure 54 – Line Stretcher Connections

2.23 Line Stretcher Initial Setting

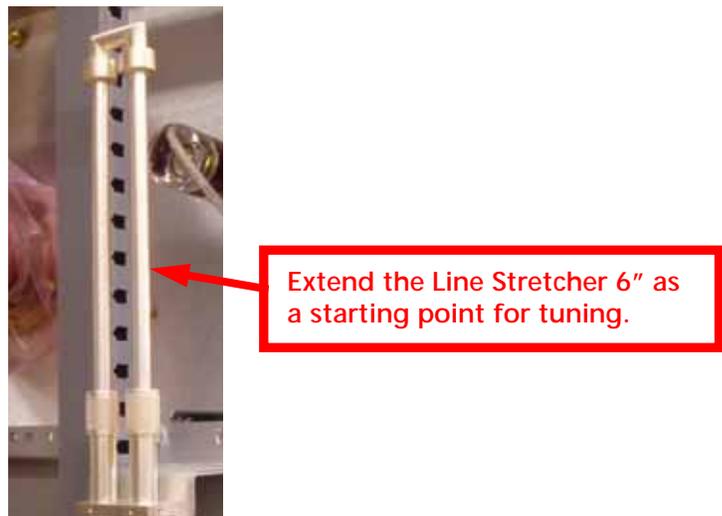


Figure 55 – Line Stretcher Initial Setting

2.24 Install New Tube

Included in the Upgrade Kit is a new Tube. Replace the existing Tube with the new Tube from the kit.

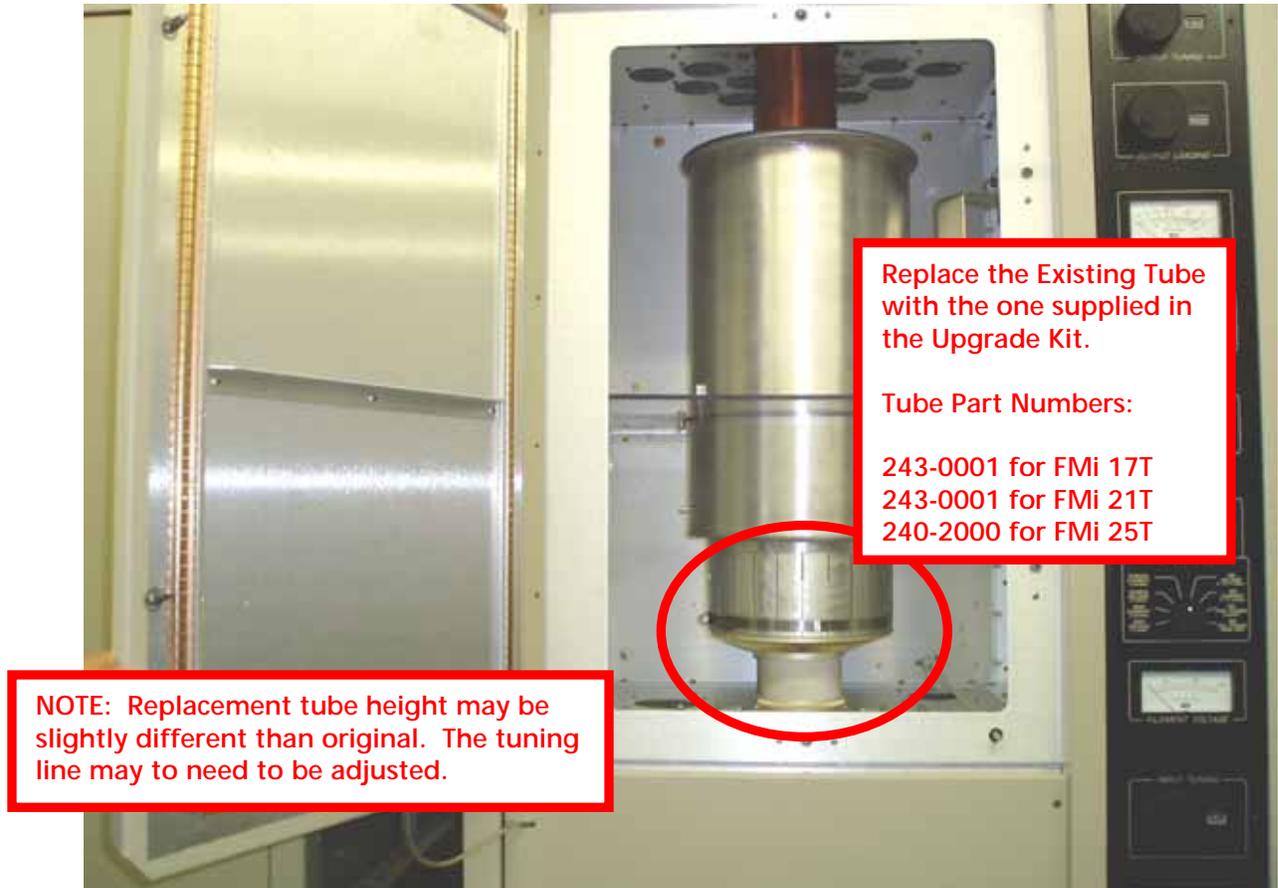


Figure 56 – Tube Replacement

2.25 Install AC Blower Motor Frequency Inverter

An AC Frequency Inverter (B.E. Part Number 341-2022) should be installed to increase blower motor speed in FM-30T, FM-35T, FMI 21T, and FM25T Tube Transmitters for improved cooling.

Included in the Field Upgrade Kit is an AC Frequency Inverter Kit (B.E. Part Number 979-2022-003). The Inverter Kit contains the necessary components and instructions for the installation of the inverter.

3 FXi Exciter Setup

3.1 Configure the Exciter Transmitter Type

Prior to operating the transmitter, ensure that the **Transmitter Type** has been set to **STAND-ALONE** in the FXi.

Step 1 – From the **Main Menu** select **PA/POWER**.

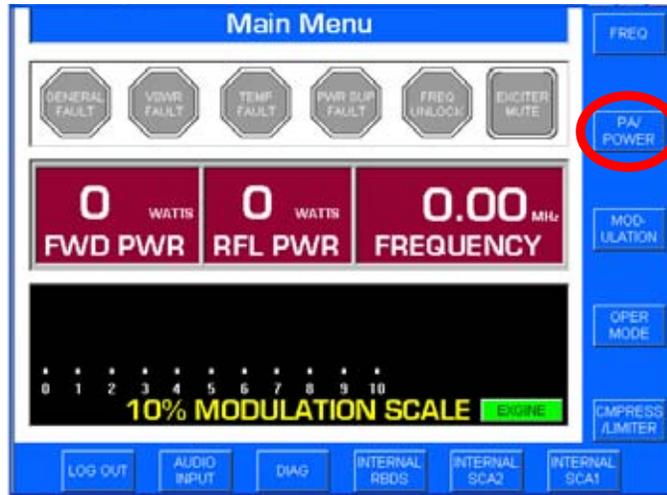


Figure 57 – FXi Main Menu

Step 2 – Next, select **STANDALONE**.

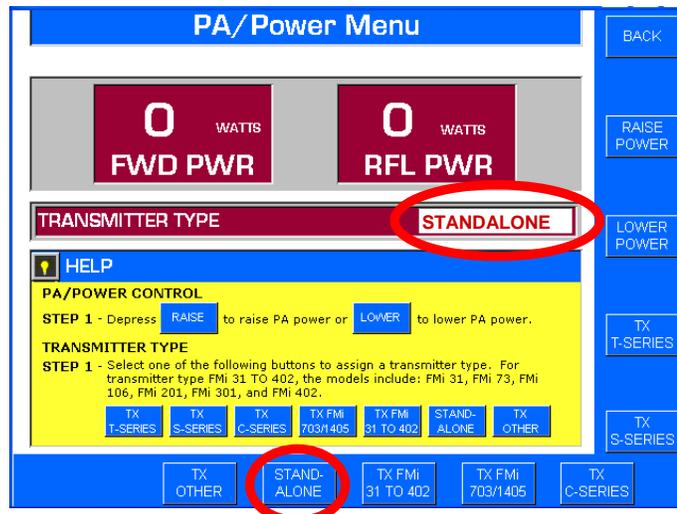


Figure 58 – FXi PA/Power Menu



3.2 FXi Exciter IBOC Scale Factor and Operating Mode

Step 1 – Next, go to the FXi Exciter GUI Main Menu and select **OPER MODE**.

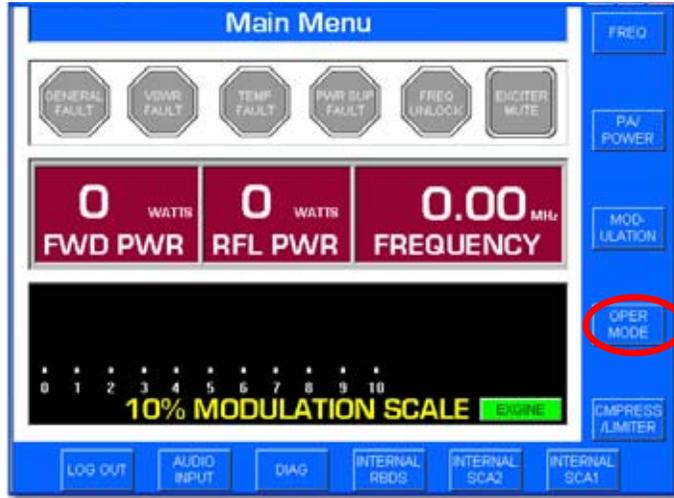


Figure 59 – FXi Main Menu

Step 2 – Select **IBOC MENU**.

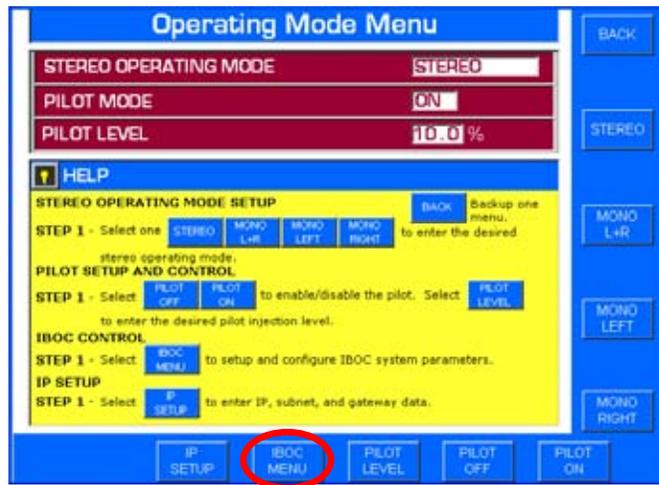
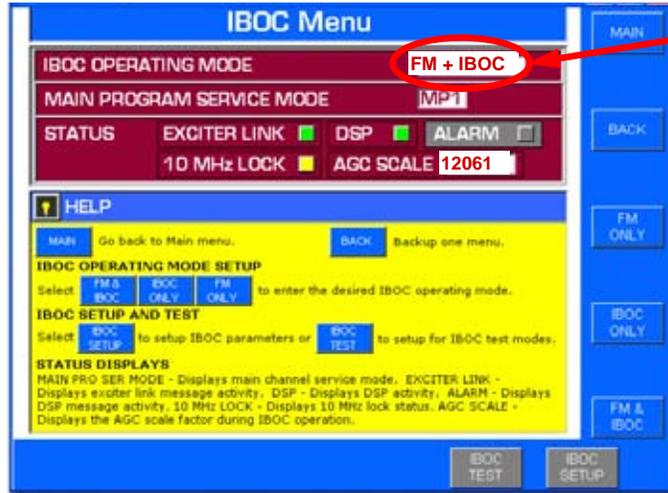


Figure 60 – Operating Mode Menu



Step 3 – Ensure that the IBOC OPERATING MODE is set to FM + IBOC (Hybrid).



The IBOC Operating Mode **MUST** be set to FM + IBOC (Hybrid)

Figure 61 – IBOC Menu

3.3 Verify FXi Exciter's Operating Frequency

Prior to operating the FMi T Series transmitter, ensure that the FXi's Frequency is set to the correct Frequency.

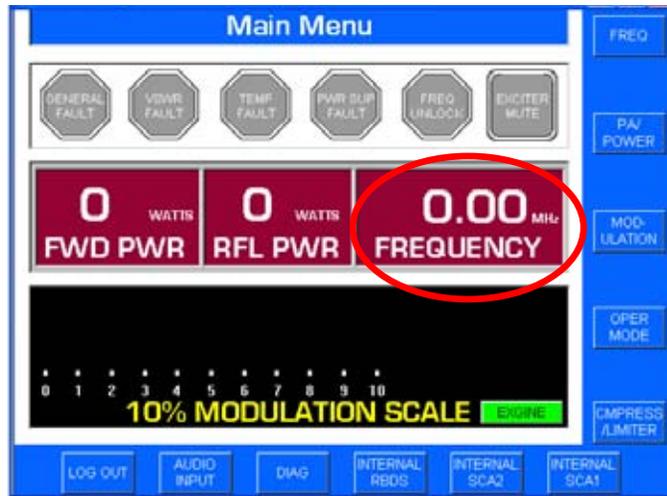


Figure 62 – FXi Main Menu

3.4 Distortion Null Potentiometer

Turn **DIST NULL** pot on back of Exciter 20 turns CCW (max signal).

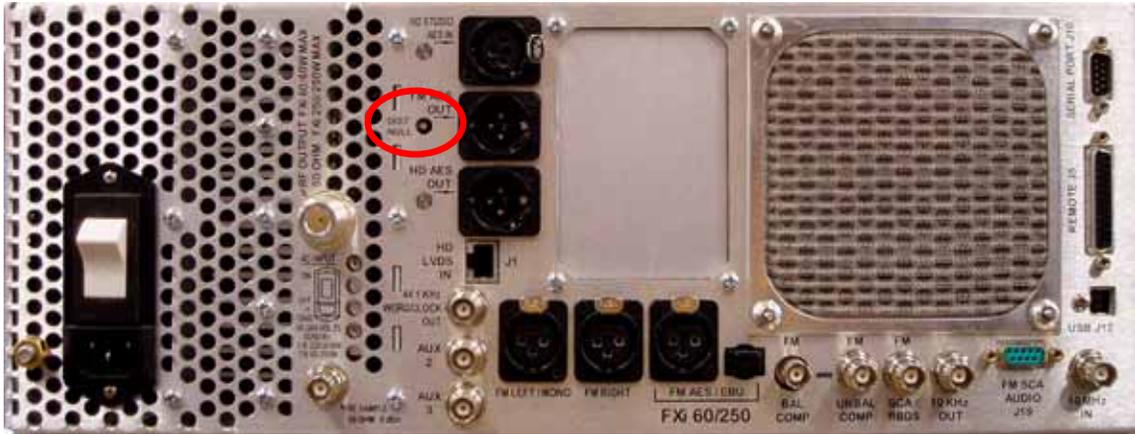


Figure 63 – FXi Distortion Null Potentiometer

3.5 Establish Communication with the Exciter using Hyperterminal

Step 1 – Connect a null modem cable from a PC to the Exciter’s Serial Port J10.

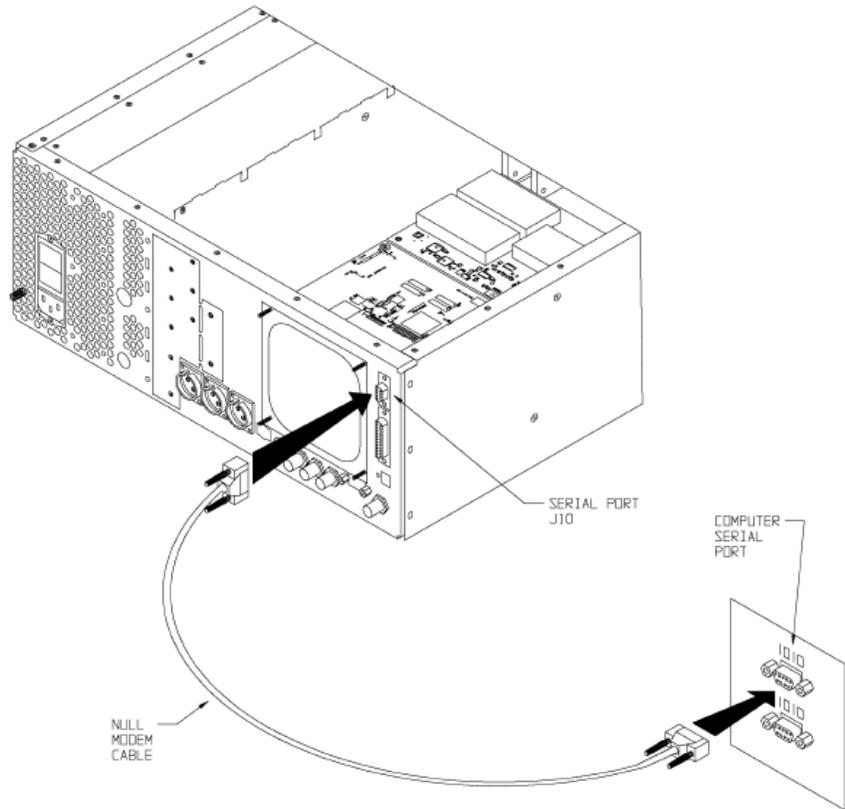


Figure 64 – PC to FXi Serial Port Null Modem Cable Connection



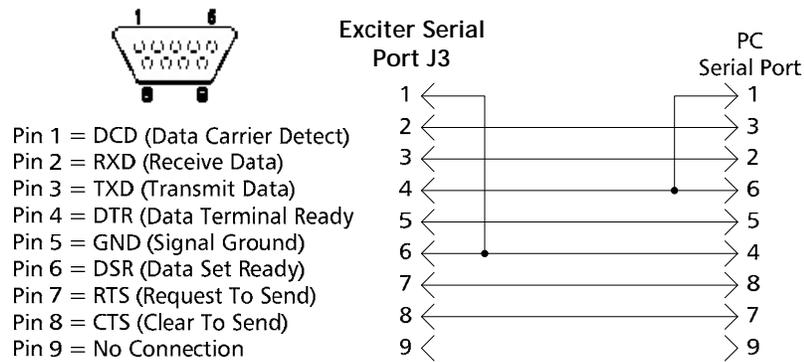


Figure 65 – Serial Cable / Null Modem Adapter Pinout

- Step 2** – From the Desktop go to: **START-> ALL PROGRAMS-> ACCESSORIES-> COMMUNICATION-> HYPERTERMINAL** and click the mouse.
- Step 3** – The HyperTerminal dialog box should now be displayed. In the **CONNECTION DESCRIPTION** box, enter the name of the shortcut that you want to be created such as *FXi Connection*.
- Step 4** – Select and click **OK**.
- Step 5** – The **CONNECT TO** dialog box will now appear. In the **CONNECT USING** dialog box, ensure that the correct COM Port is selected (typically **COM 1** is used) and then click **OK**.
- Step 6** – The **COM1 PROPERTIES** dialog box will appear. Move the cursor to the **BITS PER SECOND** dialog box and select **19200**.
- Step 7** – Move the cursor to the **DATA BITS** dialog box and select **8**.
- Step 8** – Move the cursor to the **PARITY** dialog box and select **NONE**.
- Step 9** – Move the cursor to the **STOP BITS** dialog box and select **1**.
- Step 10** – Move the cursor to the **FLOW CONTROL** dialog box and select **NONE**.
- Step 11** – Select **OK** and the HyperTerminal communication window will appear.
- Step 12** – Type “?” and the **Supplemental Command Menu** will then appear..

```

FXI Connection - HyperTerminal
File Edit View Call Transfer Help
Supplemental command menu
Use these commands only with extreme caution
a = Turn apc on and off when APC is internal
b = Program the function of the remote input called RAISE POWER
d = Set delay for returning to AES/EBU input
e = Dump Engineering APC variables
g = Turn special GM mode on and off
i = Set the maximum scale factor for the current operating mode
j = Program the function of the remote input called LOWER POWER
k = Program the function of the remote input called Primary Audio In
l = List amplitude correction table
q = List phase correction table
m = Meter readings dump
F and f = FM scale factor raise and lower in hybrid mode
S and s = IBOC scale factor raise and lower in IBOC only mode
^ = Put scale factor raise/lower into low/high speed
- and - = Adjust the PA bias level
I = increase and l = decrease IBOC level in hybrid mode
0 = increase and o = decrease the delay in detecting an AES/EBU fault
x = Set up test point in FPGA
u = Upload new control code to the flash memory
y = Program the function of the remote input called Backup Audio In
z = Turn the auto download on and off

Connected 0:00:24 ANSIW 19200 8-N-1 SCROLL CAPS NUM Capture Print echo

```

Figure 66 – HyperTerminal Supplemental Command Menu

3.6 Set FXi Exciter APC to OFF using Hyperterminal

Using Hyperterminal, ensure that APC is set to OFF by typing “a” (lowercase). Please note that the Exciter APC should NEVER be on.

3.7 Set FXi Scale Factor using Hyperterminal

Using Hyperterminal, type “f” (lowercase) repeatedly or hold the key down to lower the scale factor for Hybrid Mode to the minimum value.

4 System Setup and Tuning

4.1 Initial Power Up

Step 1 - Verify that a power control board is present, that it has been tested and that the following connections have been made:

Function	Exciter J3 Pin	Power Control Board J3 Pin
+12VDC	6 or 7	1
GND	24, 25 or tx GND strap	2
Control Voltage	23	3

Step 2 - Turn R17 and R18 on Power Control Board (919-0299) CCW 20 turns.

Step 3 - Turn POWER ADJUST on IPA Front Panel fully CCW (min IPA voltage).

Step 4 - Ensure that Screen Voltage Powerstat is in "zero" position.

Step 5 - Verify FM + IBOC Scale Factor is set to minimum value.

Step 6 - Turn on transmitter breakers and filament button only (no high voltage).

Step 7 - Turn off transmitter APC.

Step 8 - Press LOWER button for 15 seconds or more. Exciter internal attenuator is now set for min. signal.

Step 9 - Without turning off exciter power move J7, J8, J9 & J10 on the Power Control Board to position 2-3. RAISE and LOWER are now controlling screen voltage. Attenuator will remain unchanged.

Step 10 - Press high voltage ON button.

NOTE: AT ALL TIMES watch for high plate current or any other anomalies. Shut off immediately if plate current jumps to a high value unexpectedly.

Step 11 - Select "IPA Voltage" on the selectable panel meter. Verify that IPA voltage is low (<25V).

Step 12 - Turn POWER ADJUST on IPA front panel CW until IPA voltage reads 48V.

Step 13 - Select "Screen Voltage" on the selectable panel meter.

Step 14 - Press RAISE until screen voltage reaches 550V. RF output power should be low or zero. Initial screen voltage is now set.

Step 15 - Turn off high voltage and filament

Step 16 - Move J7, J8, J9 & J10 on power control board to pos. 1-2

Step 17 - Press filament and high voltage ON.

Step 18 - Using hyperterminal increase FM + IBOC scale factor to 11000 while monitoring plate current.



Step 19 - Press RAISE until output power = approx. 30% of TPO. Plate current and RF power should start to rise after a 3-5 seconds.

Step 20 - Adjust Output Tuning and Output loading for max power. Adjust Input Tuning control for minimum reflected power.

Step 21 - Raise power to approx. 60% of TPO. Adjust output tuning/loading and input tuning as before.

Step 22 - Raise power to 100% of TPO. Adjust output tuning/loading and input tuning as before.

Note: Transmitter power control will be very touchy (coarse resolution) until power control board is fully set up. Transmitter APC will not be stable at this point. Using the loading control adjust the transmitter's plate efficiency from maximum to approx. 68% as a starting point for IBOC tuning. This should be done by adjusting the loading control and then compensating with the RAISE button to keep output power near the TPO as the efficiency is lowered. Note that when increasing the loading, the numbers on the cyclometer are lowered. The plate current for a given output power, plate voltage and efficiency is:

$$I_{plate} = 100 * P_{out} / (\text{Plate Efficiency} * V_{plate})$$

4.2 Power Control Board Setup

Note: For best results this should be done when tube operating temperature has stabilized.

Step 1 - Press plate and filament OFF buttons

Step 2 - Verify transmitter and exciter APC are both OFF.

Step 3 - Verify FM+IBOC scale factor is at optimum level if known, otherwise 11000.

Step 4 - Turn DIST NULL pot on exciter back panel CW 20 turns (max attenuation).

Step 5 - Press RAISE for 30 seconds or more. Internal attenuator is now at max signal

Step 6 - Press plate and filament ON buttons. High voltage should come up with no RF.

Step 7 - Adjust DIST NULL pot CCW until output power = 1.30 *TPO.

Step 8 - Press plate and filament OFF buttons

Step 9 - Press LOWER for >30 seconds

Step 10 - Press plate and filament ON buttons. RF output power should be near zero.

Step 11 - Turn R18 CW until output power = TPO*0.7.

Step 12 - Press S1 on power control board.

Step 13 - Turn on transmitter APC. Adjust APC set point to TPO

Step 14 - Turn off APC. Press LOWER button until minimum power is reached.



Step 15 - Turn on APC. Verify that transmitter returns smoothly to APC set point under APC control.

Step 16 - Verify that transmitter can produce $1.25 * TPO$ by pressing RAISE button. Return transmitter power to TPO. Transmitter is now ready for IBOC spectrum tuning.



5.1 Tuning for IBOC Spectrum

Exciter Configuration for IBOC tuning is as follows:

100% Modulation = 75kHz
 Preemphasis = NO
 Primary Audio Input = AES/EBU
 Compressor Mode = OFF

The transmitter should be modulated with the same content and audio processing that will be used on the air.

If available, connect a Spectrum Analyzer to the port located on the RF Output transmission line elbow located between the Transmitter and the Low Pass filter. With the Transmitter running at TPO, look at the Spectrum and compare to the plot provided in the factory test data. On the Spectrum Analyzer, set the Resolution Bandwidth to 1kHz, Detector to Sample, Span to 2MHz, and Average to 100.

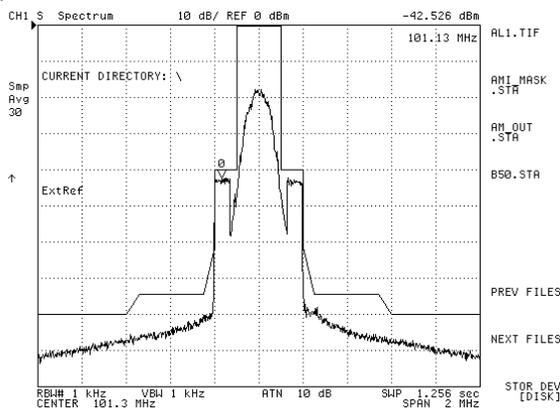


Figure 65 – Typical FMi T Series Transmitter Spectral Plot

This completes the initial system checkout for the FMi T Series Transmitter.

5.2 Tuning Guidelines

The following general guidelines apply to tuning the FMiT transmitters:

- Output tuning is adjusted for maximum power
- Output loading is used to adjust efficiency. Usually efficiency must be sacrificed to obtain a better output spectrum.
- Input match is adjusted for minimum reflected power. This can be slightly mistuned to improve symmetry in the output spectrum.
- The FM+IBOC scale factor is adjusted for the best possible spectrum.
- The line stretcher on the exciter output can be adjusted and affects output power and symmetry of the spectrum. Cable segments may need to be added.
- It is usually necessary to place cable segments with adapters on the IPA output to optimize the

phase between the tube and IPA.

- Screen voltage can be adjusted by manually turning the screen variac. A setting of 500V to 600V is typical. Adjustments in screen voltage, in addition to changing power, will affect the symmetry of the output spectrum. Lower screen voltages give slightly higher efficiency.
- IPA supply voltage is adjustable using the IPA POWER adjustment on the IPA front panel. Typically this is set from 42V to 48V.

Once the best possible spectrum is achieved it is then possible to optimize efficiency by:

- Re-tapping the plate transformer for minimum plate voltage while preserving an acceptable spectrum.
- Further small adjustments in loading, tuning and FM+IBOC scale factor.
- Any multiple segment exciter output cable is replaced with a single cable of the same length.

At the end of all tuning is desirable for dissipated power in the tube to be within the following limits:

FMI25T: $P_{diss} < 12,300W$

FMI21T: $P_{diss} < 10,400W$

FMI17T: $P_{diss} < 8,400 W$

Where $P_{diss} = [100 / \text{Plate Efficiency}] - 1] * P_{out}$

6 RF Technical Services Contact Information

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