Broadcast Electronics
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HD Radio
Pure Digital. Clear Radio.

FXi 60/250 Exciter

VPe Upgrade and Quick Install Guide

597-0542-XM5
Revision C
October 7, 2013

FXi 60/250 Exciter

VPe Upgrade and Quick Install Guide

Broadcast Electronics Product Warranty (Two-Year Limited)

BE hereby warrants all new products manufactured by BE against any defects in material or workmanship at the time of delivery thereof, or that develop under normal use within a period of two (2) years from the date of shipment.

BE reserves the right to repair equipment under warranty with new or refurbished equipment or parts. BE's sole responsibility with respect to any equipment or parts not conforming to this warranty is to replace or repair such equipment upon the return thereof F.O.B. to BE's factory in Quincy, Illinois, U.S.A. In the event of replacement pursuant to the foregoing warranty, only the unexpired portion of the warranty from the time of the original purchase will remain in effect for any such replacement.

This warranty shall exclude the following products, component parts and/or assemblies:

(a) Transmitter power output tubes shall only carry the original manufacturers' or suppliers' standard warranty in effect on their original shipment date.

(b) All computers, computer peripherals, cables, hard disk drives, etc., shall only carry the manufacturers' or suppliers' standard warranty in effect on their original shipment date.

(c) "Components", defined as separate and individual parts (e.g. transistors, integrated circuits, capacitors, resistors, inductors, fans, etc), resold by BE from another manufacturer or supplier, shall only carry a 90 day warranty, effective the date of shipment. Any such 'Components' being returned for warranty claim must be (1) returned in their original packaging and (2) must be in new, unused condition. BE is unable to process or resolve component defects or performance concerns on components that have been soldered, installed, wired or in any way altered from new their new condition.

(d) "Resale Equipment", defined as equipment purchased from another manufacturer or supplier, then resold by BE, shall only carry such manufacturer's or supplier's standard warranty in effect as of the original shipment date. All warranty claims against any and all 'resale equipment' sold by BE must be filed directly with the original equipment manufacturer. BE is unable to process or resolve equipment defects or performance concerns on products or services not manufactured by BE.

This warranty shall not extend to claims resulting from any acts of God, terrorism, war, defects or failures caused by Purchaser or user abuse or misuse, operator error, or unauthorized attempts to repair or alter the equipment in any way.

Under no circumstances shall BE be responsible for indirect, incidental or consequential damages, including, but not limited to transportation costs, non-authorized repair or service costs, downtime costs, costs for substituting equipment or loss of anticipated profits or revenue, incurred by Purchaser, whether based in contract, tort or for negligence or breach of statutory duty or otherwise. The terms of the foregoing warranty shall be null and void if the equipment has been altered or repaired without specific written authorization from BE, or if not installed according to BE's instruction manuals, including, but not limited to, the absence of proper grounding, surge (TVSS) protection on the AC circuit panel or proper lightning protection/grounding on all output circuits, or if equipment is operated under environmental conditions or circumstances other than those specifically described in BE's product literature or instruction manual which accompany the equipment. The warranty shall be voided if the product or subassembly is equipped with a tamper seal and that tamper seal is broken. BE shall not be liable for any expense of any nature whatsoever incurred by the original user without prior written consent of BE. The warranty provided herein shall terminate at the end of the period set forth above. This warranty extends only to the original Purchaser and is not transferable. There are no third party beneficiaries of any of the provisions of

this warranty. If the equipment is described as “used” equipment, it is sold as is and where is and no warranty applies unless authorized in writing.

EXCEPT AS SET FORTH HEREIN, AS TO TITLE AND AS SPECIFICALLY REQUIRED BY LAW, THERE ARE NO OTHER WARRANTIES, OR ANY AFFIRMATIONS OF FACT OR PROMISES BY BE, WITH REFERENCE TO THE EQUIPMENT, OR TO MERCHANTABILITY, FITNESS FOR A PARTICULAR APPLICATION, SIGNAL COVERAGE, INFRINGEMENT, OR OTHERWISE, WHICH EXTEND BEYOND THE DESCRIPTION OF THE EQUIPMENT ON THE FACE HEREOF.

IMPORTANT INFORMATION

EQUIPMENT LOST OR DAMAGED IN TRANSIT

When delivering the equipment to you, the truck driver or carriers' agent will present a receipt for your signature. Do not sign it until you have:

1) Inspected the containers for visible signs of damage and 2) Counted the containers and compared with the amount shown on the shipping papers. If a shortage or evidence of damage is noted, insist that notation to that effect be made on the shipping papers before you sign them.

Further, after receiving the equipment, unpack it and inspect thoroughly for concealed damage. If concealed damage is discovered, immediately notify the carrier, confirming the notification in writing, and secure an inspection report. This item should be unpacked and inspected for damage WITHIN 15 DAYS after receipt. Claims for loss or damage will not be honored without proper notification of inspection by the carrier.

RF PRODUCT TECHNICAL ASSISTANCE, REPAIR SERVICE, PARTS -

Technical assistance is available from Broadcast Electronics by letter, prepaid telephone or E-mail. Equipment requiring repair or overhaul should be sent by common carrier, prepaid, insured, and well protected. If proper shipping materials are not available, contact the RF Technical Services Department for a shipping container. Do not mail the equipment. We can assume no liability for inbound damage, and necessary repairs become the obligation of the shipper. Prior arrangement is necessary. Contact the RF Technical Services Department for a Return Authorization.

Emergency and warranty replacement parts may be ordered from the following address. Be sure to include the equipment model number, serial number, part description, and part number. Non-emergency replacement parts may be ordered directly from the Broadcast Electronics stock room at the number shown below.

RF TECHNICAL SERVICES

Telephone: +1 (217) 224-9617
E-Mail: rfservice@bdcast.com
Fax: +1 (217) 224-6258

FACILITY CONTACTS

Broadcast Electronics, - Quincy Facility
4100 N. 24th St. P.O. BOX 3606
Quincy, Illinois 62305
Telephone: +1 (217) 224-9600
Fax: +1 (217) 224-6258
General E-Mail: bdcast@bdcast.com
Web Site: www.bdcast.com

PARTS

Telephone: +1 (217) 224-9617
E-Mail: parts@bdcast.com

RETURN, REPAIR, AND EXCHANGES

Do not return any merchandise without our written approval and Return Authorization. We will provide special shipping instructions and a code number that will assure proper handling and prompt issuance of credit. Please furnish complete details as to circumstances and reasons when requesting return of merchandise. All returned merchandise must be sent freight prepaid and properly insured by the customer.

MODIFICATIONS

Broadcast Electronics, reserves the right to modify the design and specifications of the equipment in this manual without notice. Any modifications shall not adversely affect performance of the equipment so modified.

SAFETY PRECAUTIONS

PLEASE READ AND OBSERVE ALL SAFETY PRECAUTIONS

ALL PERSONS WHO WORK WITH OR ARE EXPOSED TO POWER TUBES, POWER TRANSISTORS, OR EQUIPMENT WHICH UTILIZES SUCH DEVICES MUST TAKE PRECAUTIONS TO PROTECT THEMSELVES AGAINST POSSIBLE SERIOUS BODILY INJURY. EXERCISE EXTREME CARE AROUND SUCH PRODUCTS. UNINFORMED OR CARELESS OPERATION OF THESE DEVICES CAN RESULT IN POOR PERFORMANCE, DAMAGE TO THE DEVICE OR PROPERTY, SERIOUS BODILY INJURY, AND POSSIBLY DEATH.

DANGEROUS HAZARDS EXIST IN THE OPERATION OF POWER TUBES AND POWER TRANSISTORS

The operation of power tubes and power transistors involves one or more of the following hazards, any one of which, in the absence of safe operating practices and precautions, could result in serious harm to personnel.

A. HIGH VOLTAGE - Normal operating voltages can be deadly. Additional information follows.

B. RF RADIATION - Exposure to RF radiation may cause serious bodily injury possibly resulting in Blindness or death. Cardiac pacemakers may be affected. Additional information follows.

C. HOT SURFACES - Surfaces of air-cooled radiators and other parts of tubes can reach temperatures of several hundred degrees centigrade and cause serious burns if touched. Additional information follows.

D. RF BURNS - Circuit boards with RF power transistors contain high RF potentials. Do not operate an RF power module with the cover removed.

HIGH VOLTAGE

Many power circuits operate at voltages high enough to kill through electrocution. Personnel should always break the primary AC Power when accessing the inside of the transmitter.

RADIO FREQUENCY RADIATION

Exposure of personnel to RF radiation should be minimized, personnel should not be permitted in the vicinity of open energized RF generating circuits, or RF transmission systems (waveguides, cables, connectors, etc.), or energized antennas. It is generally accepted that exposure to "high levels" of radiation can result in severe bodily injury including blindness. Cardiac pacemakers may be affected.

The effect of prolonged exposure to "low level" RF radiation continues to be a subject of investigation and controversy. It is generally agreed that prolonged exposure of personnel to RF radiation should be limited to an absolute minimum. It is also generally agreed that exposure should be reduced in working areas where personnel heat load is above normal. A 10 mW/cm^2 per one tenth hour average level has been adopted by several U.S. Government agencies including the Occupational Safety and Health Administration (OSHA) as the standard protection guide for employee work environments. An even stricter standard is recommended by the American National Standards Institute which recommends a 1.0 mW/cm^2 per one tenth hour average level exposure between 30 Hz and 300 MHz as the standard employee protection guide (ANSI C95.1-1982).

RF energy must be contained properly by shielding and transmission lines. All input and output RF connections, such as cables, flanges and gaskets must be RF leak proof. Never operate a power tube without a properly matched RF energy absorbing load attached. Never look into or expose any part of the body to an antenna or open RF generating tube or circuit or RF transmission system while energized. Monitor the tube and RF system for RF radiation leakage at regular intervals and after servicing.

HOT SURFACES

The power components in the transmitter are cooled by forced-air and natural convection. When handling any components of the transmitter after it has been in operation, caution must always be taken to ensure that the component is cool enough to handle without injury.

Table of Contents

Figures

1 Overview

This document contains the necessary steps required to upgrade an FXi 60 or 250 exciter and recommendations for upgrading the RF transmission system surrounding it with Vector Power Enhancement (VPe). FXi with VPe provides higher IBOC injection levels while still meeting FCC spurious emissions requirements.

Before visiting the transmitter site with the VPe installation kit in hand, some additional preparations and planning must be made. Step 3 Upgrade FXi software requires access to the internet and a method for file transfer to the PC to be used in the FXi software update process. The FXi software update is not included in the installation kit for this device. Local IP network interfacing – also not included in the installation kit for this device – is required for step 8 Connect RF Feedback.

There are slight variations in installation between Exgine and IBOC systems. There are also differences in installation requirements between transmitter models and broadcast system setups. Different installation kits are prepared for different system types. This document details differences based on standard recommended setup configurations, however every transmission system is unique and may present unexpected complications.

Any run-time monitoring or remote Ethernet connectivity to the VPe system is optional. Network cables and hardware depend on the desired networking setup and are relatively common in today's marketplace.

Recommended order for quick installation:

1. Upgrade FXi software
2. Remove FXi from current installation and access the interior
3. Modify hardware and cabling
4. Install VPe
5. Connect VPe cabling
6. Re-install FXi in transmitter
7. Connect RF Feedback
8. Access VPe Web Interface
9. Tune the System for HD Operation
10. Verify system operation

For details in operation, please see the FXi with VPe Operation Manual. For electronic copies of any technical documentation please visit http://www.bdcast.com/information-center/ and follow navigation on the left side of the page – authorized login is required for download of technical documents.

2 Preparing to Install

VPe is packaged with a series of upgrade kits that provide necessary hardware. These kits are tailored to existing Broadcast Electronics HD Transmitter standard installations.

Table 1 – FXi VPe Upgrade Installation Kit Numbers

PART NUM	DESCRIPTION
979-0025-002	FMi 17T, 20T, 25T
979-0073-002	FMi 31, 73
979-0402-002	FMi 106, 201, 301, 402
979-0703-002	FMi 703 Delivered Before April 2010
979-0703-004	FMi 703 Delivered After April 2010
979-1405-002	FMi 1405 Delivered Before April 2010
979-1405-004	FMi 1405 Delivered After April 2010
979-9250-002	FXi 60/250 Standalone Transmitters

2.1 Verify Contents of Shipment

All kits have these common parts.

	BEI Part #	Quantity	Description
☐	959-0142-100	1	1-20 dB Variable Attenuator Assembly
☐	979-0609	1	Installation Kit – VPE in FXi 60/250 with Exgine or IBOC
☐	339-0101-001	2	10dB 1W 50 Ohm Fixed Attenuator
☐	402-0000	5	Ty-wraps
☐	409-0126	2	Card Guide 4.5”L
☐	420-0817	2	Screwlock set with nuts and washers
☐	423-6002	4	#6 Split Lock Washer
☐	441-6032	4	Standoff 1/4" Hex 6-32 x 2"L
☐	471-4268	1	VPe Mounting Bracket
☐	500-211	4	Screw 4-40 x 3/8” Phillips Pan Head Black Zinc
☐	597-0542-XM5	1	Upgrade Guide – VPE in FXi (this document)
☐	597-0610	1	VPE Operation Manual
☐	809-2190-010	1	VPe Assembly
☐	846-0003	1	3’ CAT5E Lan Cable
☐	919-0610	1	VPe Controller Board
☐	947-0020	1	2.5' BNC CABLE (Discard for Exgine installations)
☐	949-0558	1	Cable 20.0”L, SMA Right Angle, SMB Right Angle
☐	949-0559	2	Cable 12.0”L, SMA Right Angle, SMB Straight
☐	949-0560	1	Red/Black Power Cable 10.0”L
☐	949-0561	1	VPe communication cable
☐	949-0562	1	Cable 12.0”L, SMA Right Angle, SMB Right Angle
☐	959-0600-100	1	Ethernet & I/O assembly for IBOC/Exgine and VPe
☐	979-0542-U41	1	U41 V1.3

FMi 17T, 20T, or 25T

☐ 402-0014	2	HOSE CLAMP
☐ 947-0020	1	2.5' BNC CABLE
☐ 949-0557	1	8' BNC CABLE
☐ 959-0082-055	1	DIRECTIONAL COUPLER, 3 1/8" 55DB

FMi 31, or 73

☐ 420-4013	4	SCREW, STAINLESS STEEL 4-40X1 PAN HEAD
☐ 423-4002	4	WASHERS, STAINLESS STEEL 4 SPLIT LOCK
☐ 463-5206-040	1	DIRECTIONAL COUPLER, 1 5/8" 40DB
☐ 463-5206-200	1	TRANSMISSION LINE, 1 5/8" x 3 1/4" L FOR COUPLER
☐ 949-0404	1	2' N CABLE
☐ 949-0556	2	2.5' BNC CABLE, HEAVY SHIELDING
☐ MY-201-061	2	ADAPTER COUPLING 1 5/8" TO N

FMi 106, 201, 301, or 402

☐ 420-4013	4	SCREW, STAINLESS STEEL 4-40X1 PAN HEAD
☐ 421-6008	2	6-32 KEP NUT
☐ 422-6107	2	SCREW, STAINLESS STEEL 6-32X7/16 PAN HEAD
☐ 423-4002	4	WASHERS, STAINLESS STEEL 4 SPLIT LOCK
☐ 427-0007	1	1 5/8" CONNECTOR WITH HOSE CLAMPS
☐ 463-5206-045	1	DIRECTIONAL COUPLER, 1 5/8" 45DB
☐ 463-5206-200	1	TRANSMISSION LINE, 1 5/8" x 3 1/4" L FOR COUPLER
☐ 471-5717	1	ATTENUATOR MOUNTING PLATE
☐ 947-0020	2	2.5' BNC CABLE

FMi 703

☐ 417-0017	1	BNC BULKHEAD
☐ 421-0102	2	10-32 KEP NUT
☐ 471-5273-100	1	PLATE FOR BULKHEAD
☐ 471-5718	1	ATTENUATOR MOUNTING PLATE
☐ 947-0020	1	2.5' BNC CABLE
☐ 949-0556	1	2.5' BNC CABLE, HEAVY SHIELDING
☐ 949-0563	1	1' BNC CABLE, HEAVY SHIELDING
☐ 959-0082-045	1	DIRECTIONAL COUPLER, 3 1/8" 45DB

Transmitters Delivered Before April 2010 Include

☐ 463-5200-101	1	Output FM10S/FMi703 Outer Conductor

FMi 1405

☐ 417-0017	1	BNC BULKHEAD
☐ 421-0102	2	10-32 KEP NUT
☐ 471-5273-100	1	PLATE FOR BULKHEAD
☐ 471-5718	1	ATTENUATOR MOUNTING PLATE
☐ 947-0020	1	2.5' BNC CABLE
☐ 949-0557	1	8' BNC CABLE, HEAVY SHIELDING
☐ 949-0563	1	1' BNC CABLE, HEAVY SHIELDING

☐ 959-0082-050	1	DIRECTIONAL COUPLER, 3 1/8" 50DB

Transmitters Delivered Before April 2010 Include

☐ 463-5205-101	1	Output FM20S/FMi1405 Outer Conductor

FXi 60/250 Standalone Transmitters

☐ 420-4013	4	SCREW, STAINLESS STEEL 4-40X1 PAN HEAD
☐ 423-4002	4	WASHERS, STAINLESS STEEL 4 SPLIT LOCK
☐ 463-5206-035	1	DIRECTIONAL COUPLER, 3 1/8" 35dB
☐ 463-5206-200	1	TRANSMISSION LINE, 1 5/8" x 3 1/4" L FOR COUPLER
☐ 949-0404	1	2' N CABLE
☐ 949-0556	2	2.5' BNC CABLE, HEAVY SHIELDING
☐ MY-201-061	2	ADAPTER COUPLING 1 5/8" TO N

2.2 Items Sold Separately or Not Supplied

☐ Networking hardware for Ethernet connectivity – crossover Ethernet cable for temporary direct connection, otherwise Ethernet cables and switch.

☐ PC (laptop) with serial port and RS232 communications software, such as Hyper Terminal
Alternatively, a PC with USB ports and a separate USB-Serial adapter device.

☐ 849-9091 Null modem cable supplied with FXi installation kit

2.3 Tools and Materials

☐ Spectrum Analyzer
☐ 3/16" nut driver
☐ 3/8" nut driver (FMi 703 and 1405 installations only)
☐ 1/4" nut driver
☐ 5/16" nut driver or large flat blade screwdriver
☐ 5/16" wrench
☐ Small Phillips screwdriver
☐ Large Phillips screwdriver
☐ Needle Nose Pliers
☐ Side Cutters
☐ Potentiometer turner

IBOC Systems

☐ 9/16" wrench or deep well socket nut driver (BNC depth)
☐ Small Flat Blade Screwdriver

Cable Management

☐ Extra Tie-wraps

2.4 Estimated Time for Installation

Installation and initial setup should take approximately 2 hours. The transmitter system will be off of the air during this entire process.

3 Upgrade FXi software

FXi controller software should be running V2.XX.41 for compatibility with VPe software. Registered user login is required to access the software file and referenced pdf guide.

3.1 Download software from bdcast.com

Navigate to http://bdcast.com/support/rf-technical-services. Refine the results to Product "FXi 60" or "FXi 250" and Information Type "Downloads (Software/Firmware)". Click the FXi 60/250 Exciter Software. On the page that loads, click the "Click to Download" link and save the file to the personal computer with serial com port and HyperTerminal.

3.2 Download and follow the FXi 60/250 Exciter Software Upgrade Guide

Navigate to http://bdcast.com/information-center/application-guides. Again, refine the results by selecting Product "FXi 60" or "FXi 250". In the results that load select "FXi 60/250 Software Upgrade Application Guide". Load the pdf file on the personal computer with serial com port and HyperTerminal or another viewing device that will be accessible during installation. Printing a hard copy is also a viable option.

4 Remove FXi from current installation and access the interior

4.1 Turn transmitter RF off.

4.2 Power down all devices in the transmission system.

4.3 Disconnect power (AC main breaker) to the transmission system.

ENSURE AC MAIN IS DISCONNECTED AND LOCKED OUT BEFORE INTERACTING WITH ANY AC CONNECTIONS

4.4 Disconnect all cabling from the back of the FXi.

It is recommended to take a picture or write notes for the existing cabling configuration.

4.5 Remove the four front panel screws.

Support the weight of the FXi and use a large Phillips screwdriver to remove the front panel rack mount screws.

4.6 Set the FXi on a suitable workbench for installation of VPe hardware.

4.7 Remove FXi cover to access to the interior

Use a Phillips screwdriver to remove top cover screws.

5 Hardware and cabling

5.1 10MHz Cable

Disconnect the 10MHz cable shown in Figure 1 from the IBOC/Exgine card. For IBOC systems, set the cable end aside to be re-connected later. If Exgine is installed, also disconnect the other end and discard the cable.

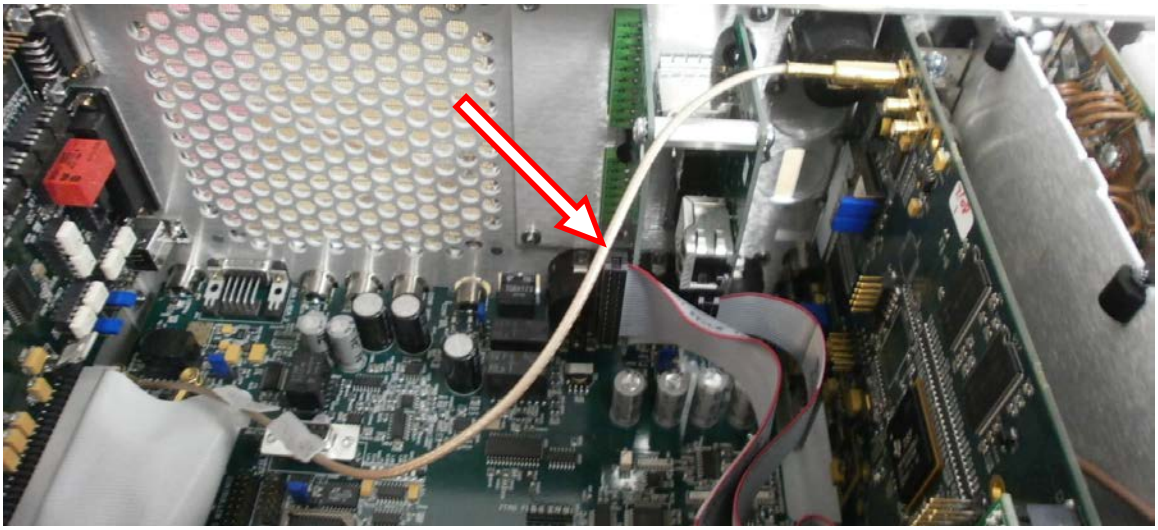

Figure 1 – Internal 10MHz cable

Plug the SMB end of the provided 949-0562 12" SMA-SMB cable into same jack as the old cable, Exgine AUX J31. Set the SMA end safely aside.

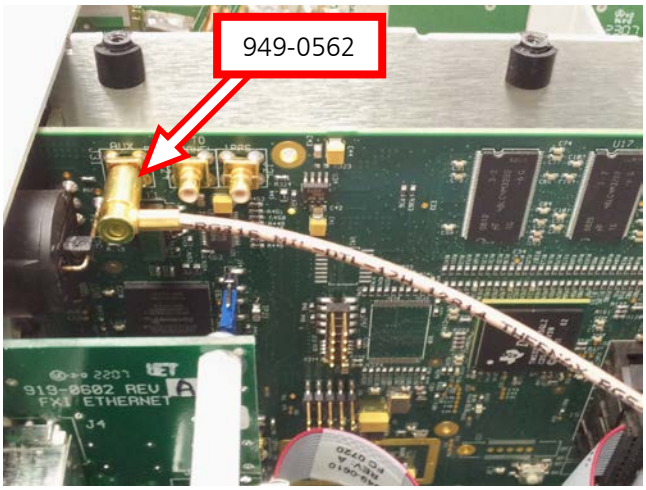

Figure 2 – Exgine AUX J31 and RF Sample Cable Detail

5.2 Temporarily Remove the IBOC Card

Exgine system installations can skip this section. The Exgine card does not need to be removed to access needed internal jacks as required with IBOC cards.

Remove the card mounting screw.

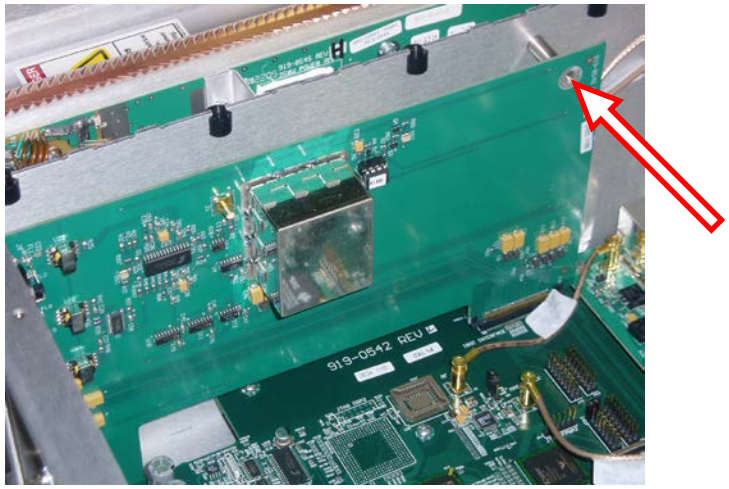

Figure 3 – IBOC Mounting Screw

Use a small Phillips screwdriver to remove the screws from all three of the XLR shells.

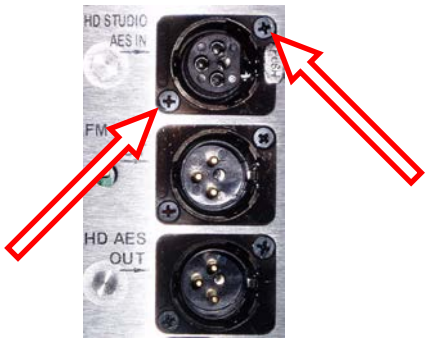

Figure 4 – IBOC XLR Connectors

Using a small flat blade screwdriver, turn the locking screws counter clockwise. Remove the XLR shells.

Figure 5 – XLR Shell Lock

Use a 9/16" wrench to remove the three nuts from the IBOC BNC connectors.

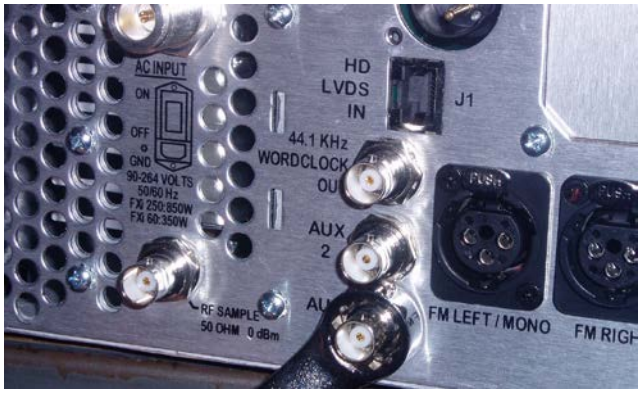

Figure 6 – BNC Nuts

Carefully unseat the IBOC card and set it on the chassis.

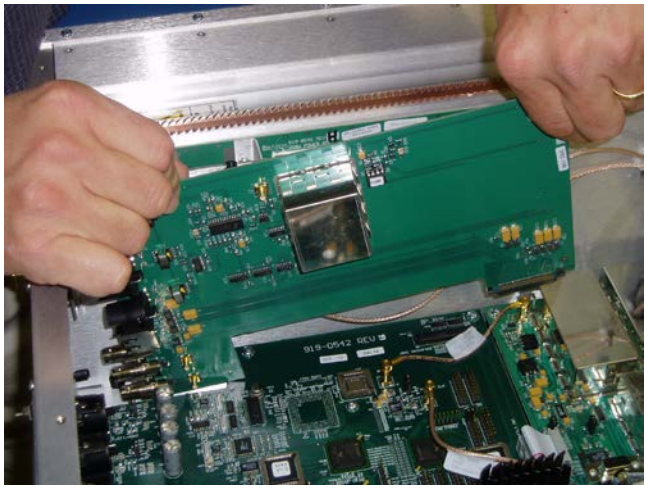

Figure 7 – IBOC Card Removal

Connect the SMA right angle connector of the 20" cable to J3 on the IBOC card.

Connect the SMA right angle connector of the 12" SMA right angle to SMB right angle cable to J2 on the IBOC card.

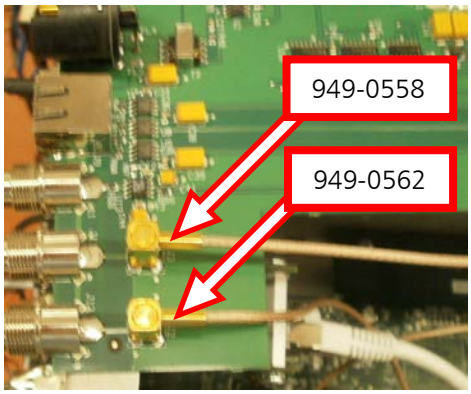

Figure 8 – IBOC Auxiliary Connections

Securely reseat the IBOC card and re-attach all of the connections:

1. Mounting screw.
2. 10MHz cable to J1.
3. XLR shell locks, XLR case screws, and BNC nuts with locking washers.

5.3 Remove screws and RF cable

Use a Phillips screwdriver to remove the four screws as shown in Figure 9. Set the screws aside – they are used in step 5.5 below. Also remove the SMB cable connecting DSP board RF output to clock/filter board RF Input.

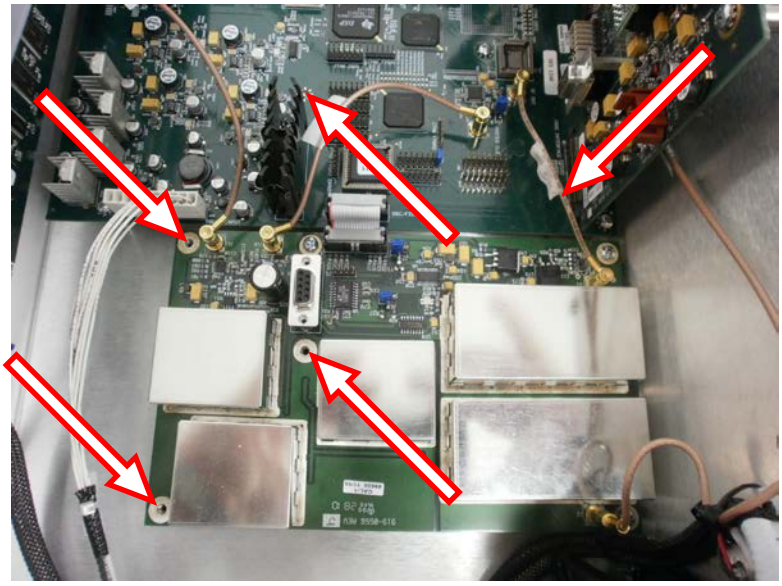

Figure 9 – Remove Screws and Cable

5.4 Insert stand-offs

Use the four provided split-lock washers with stand-offs. Screw the stand-offs with washers in the now-available screw holes. Snug the stand-offs with a 1/4" nut driver, do not over tighten.

Figure 10 – Inserted Stand-offs

5.5 Replace U41 Chip

Remove and discard the existing U41 chip, Figure 11 left, on the controller board by using a small flat screwdriver to pry the corner as shown in the right picture of Figure 11.

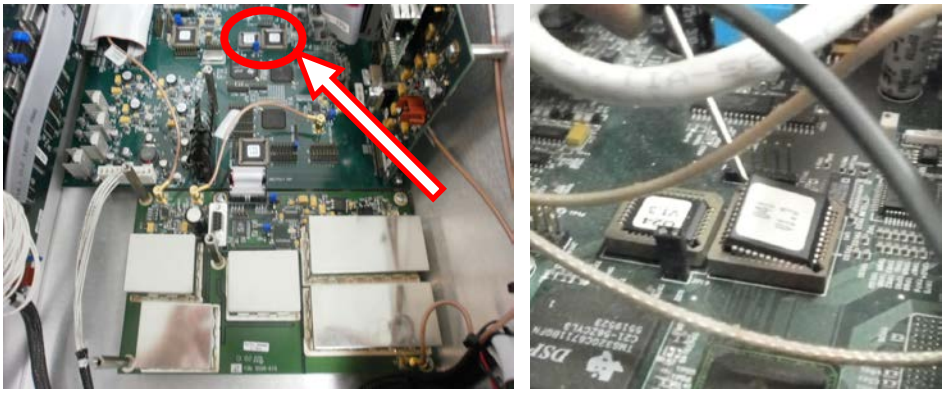

Figure 11 – U41 Chip

Ensure that the small corner notch, shown in Figure 12, lines up with the small notch in the chip mount, highlighted in Figure 13. Line up the pins and firmly seat the chip in the mount.

Note that the label is not necessarily oriented as shown in Figure 12 to the right.

Figure 12 - U41 V1.3

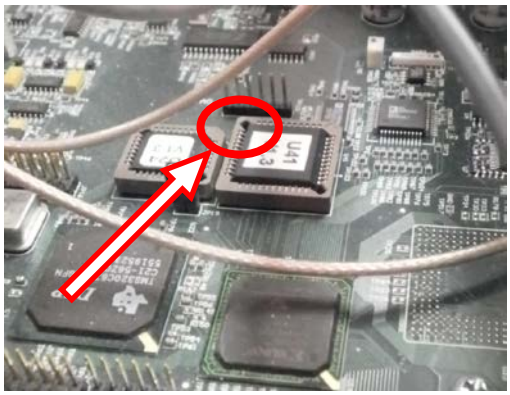

Figure 13 – Installed U41

5.6 Attach mounting plate

Use four screws removed in step 5.1 to secure the mounting plate to the new stand-offs. Note the direction of the mounting plate in Figure 14.

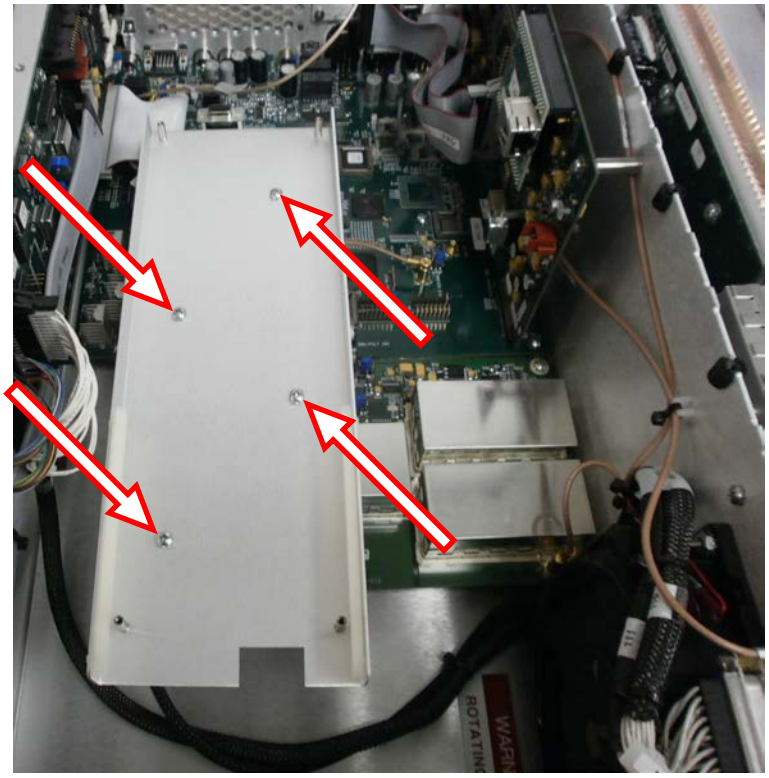

Figure 14 – Mounting plate

5.7 Attach card guides

Snap the provided plastic card guides into place on the inside edge of the mounting bracket as shown in the figure to the right.

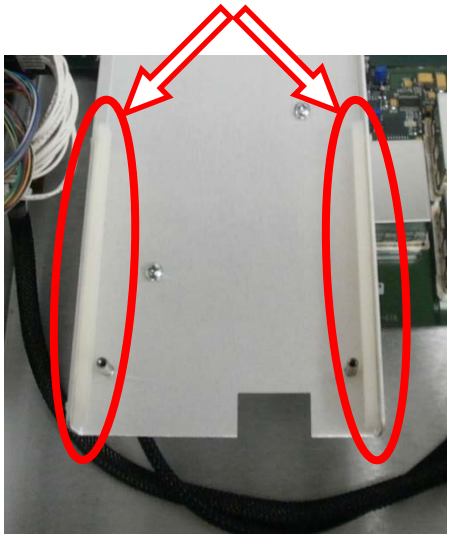

Figure 15 – Card Guides

5.8 Install VPe 10MHz cable – Exgine Installations

IBOC systems cannot be chained in the same manner and require two external 10MHz inputs. Do the step below for Exgine installations only.

Feed the SMB side of the provided 20" SMA right angle to SMB right angle cable under the ribbon cable and into the SMB jack labeled J510 "10MHz TO IBOC CARD".

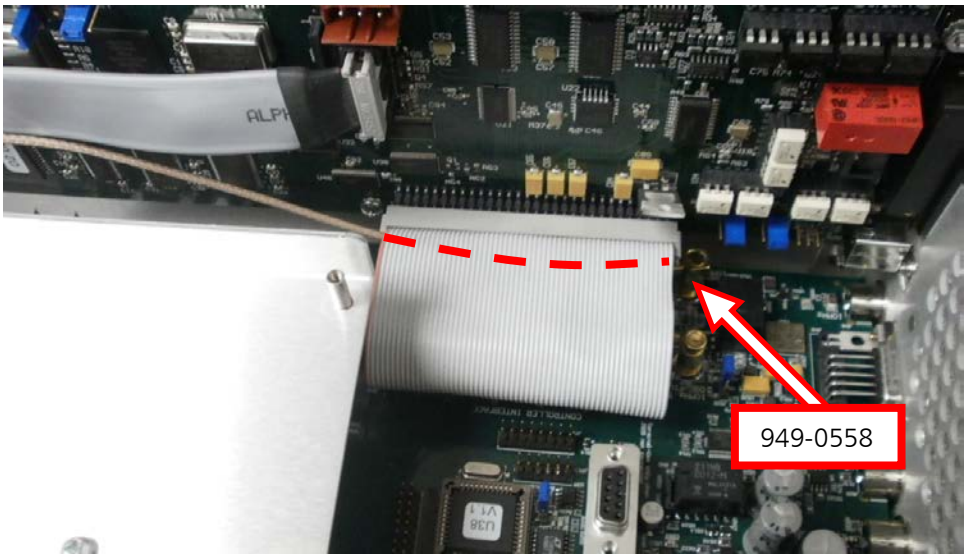

Figure 16 – VPe 10MHz Cable Exgine System

5.9 Install RF cables

Connect the two 949-0559 12" SMB straight to SMA right angle cables by plugging the straight SMB ends into J2 RF OUT on the DSP board and J1 SAMPLE on the clock/filter board as shown in Figure 17.

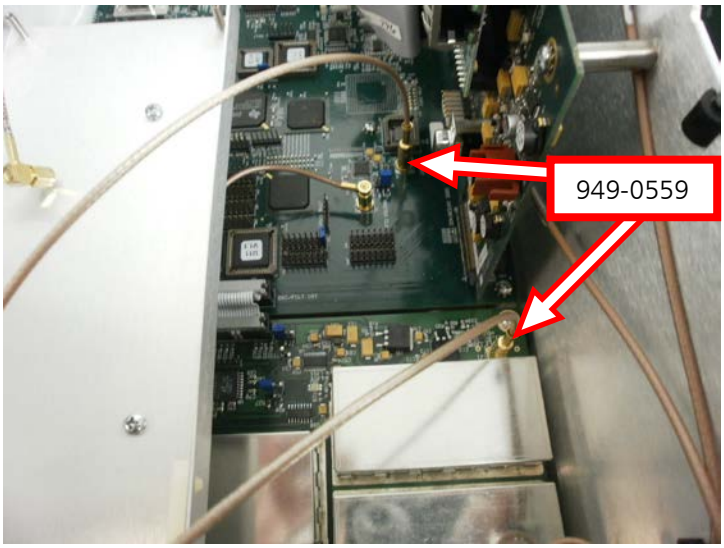

Figure 17 – RF Cables

6 Install VPe

6.1 Insert VPe Assembly

Refer to Figure 18:

1. Angle the board assembly and insert the board into the card guides. Lower the assembly until it is horizontal.

2. Slide the assembly into place, lining up the screw holes with the mounting plate's stand-offs.

3. Secure the board assembly with two of the provided black screws using a small phillips screwdriver.

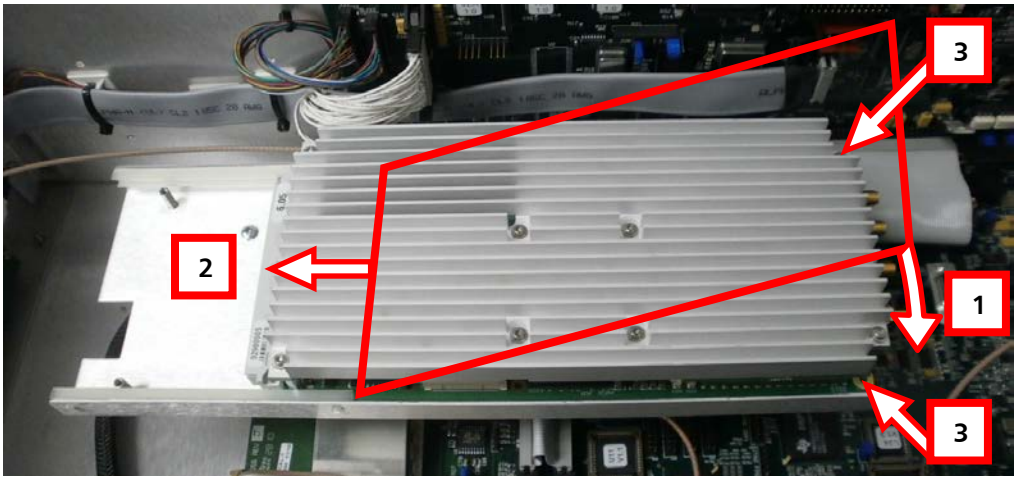

Figure 18 – VPe Assembly Mounting

6.2 Insert VPe Controller board

Follow a similar process with the VPe Controller board. Refer to Figure 19.

1. Angle the board assembly and insert the board into the card guides. Lower the assembly until it is horizontal.

2. Slide the assembly into place. Ensure that the connectors between boards are firmly mated.

3. Secure the board assembly with the remaining two provided black screws using a small phillips screwdriver.

Figure 19 – Power I/O Board Assembly Mounting

7 Connect VPe Cabling

7.1 Connect VPe 10MHz

Connect the loose end of the 949-0558 20" SMA cable (connected to the DSP board in Exgine systems or the IBOC card in IBOC systems) to the 10MHz Input on the VPe controller board, refer to Figure 20.

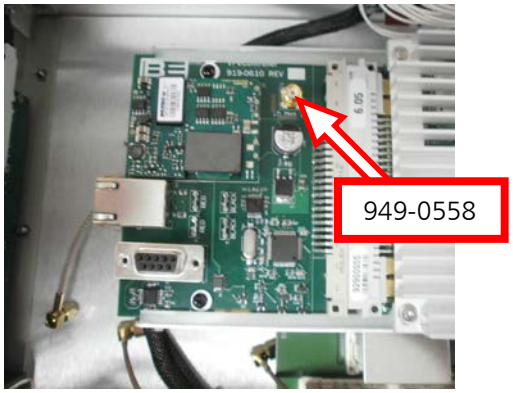

Figure 20 – VPe 10MHz

7.2 Route and Connect Power

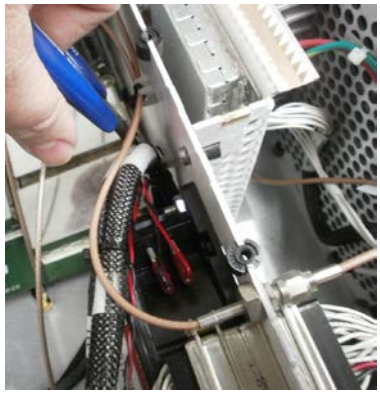

Figure 21 - Existing Cable Harness

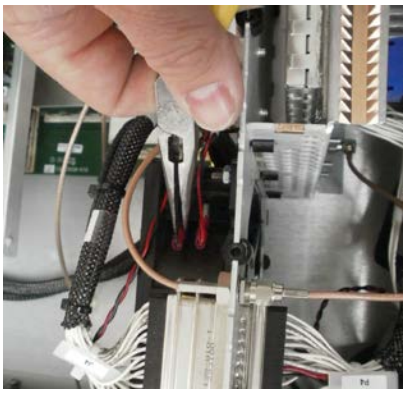

Figure 22 - Fan Power

Use side cutters to cut the tie-wrap securing the fan power cables as shown in Figure 21.

Use needle nose pliers to unplug power from the fan assembly as shown in Figure 22.

Refer to Figure 23 and follow the silk screen on the board for correct wire colors.

Utilizing the provided red/black power cable, plug one set of ends into the fan power connections. Plug the other ends to the VPe controller board. Note that crossing the streams may result in backwards fan operation.

DO NOT CROSS-CONNECT POWER CABLING

Connect the existing power cable to the VPe controller board.

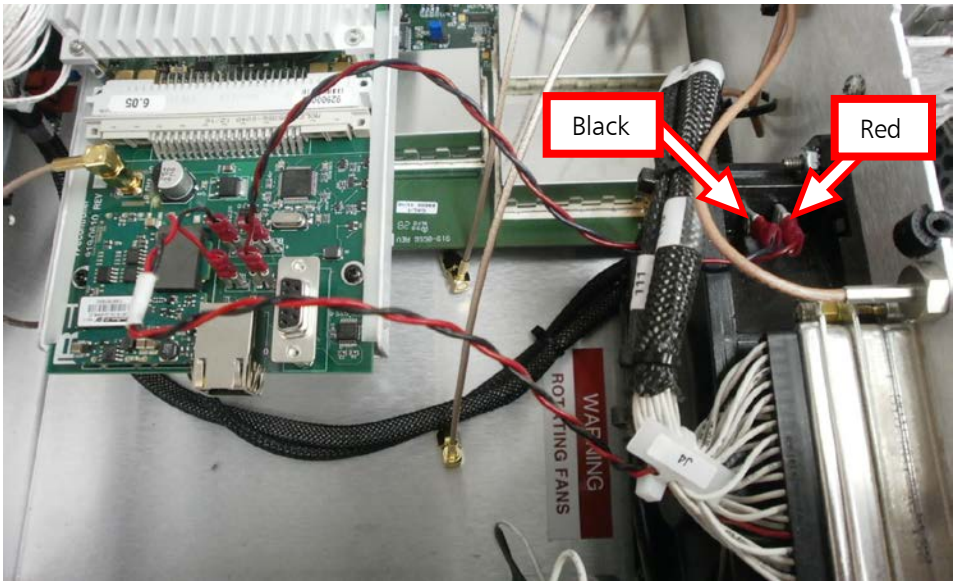

Figure 23 – Power Connections

Ty-wrap the power cables as shown in Figure 24. Cables near the fan cannot be left hanging. They may interfere with fan operation or become damaged by the fan.

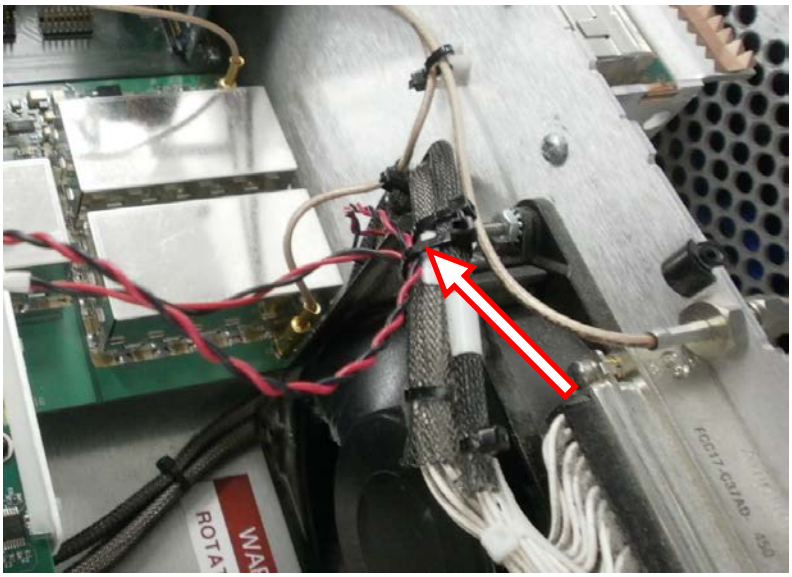

Figure 24 – Wrapped Power Cables

7.3 Install Ethernet & I/O Assembly

Refer to Figure 25. Unplug the internal Ethernet & I/O cables (left picture) and remove the four external screws (right picture) from the existing IBOC cover plate or Exgine Ethernet and I/O Assembly. Remove and discard this plate/assembly.

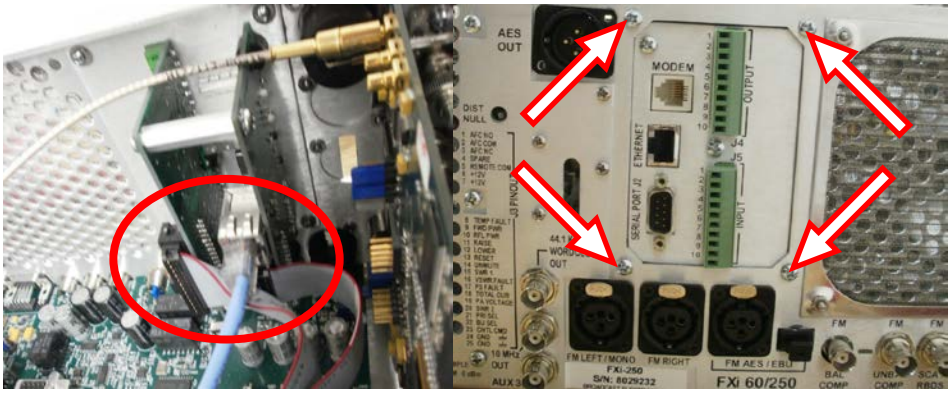

Figure 25 – Ethernet & I/O

Insert the provided Ethernet & I/O board and connect the external assembly screws. If installing in an Exgine system, reconnect all of the internal Exgine cabling as well.

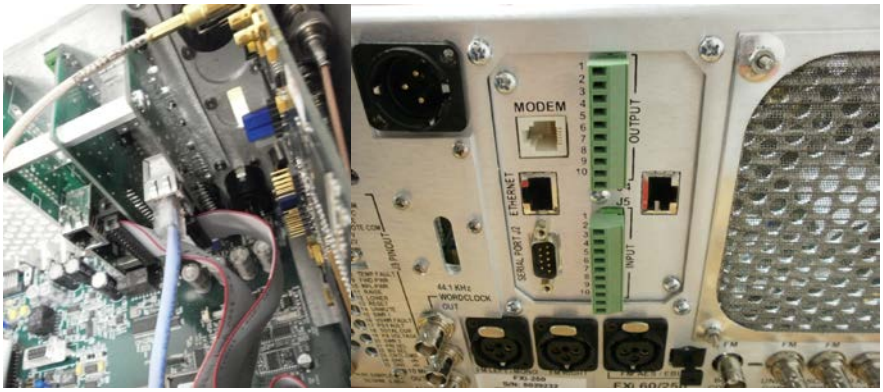

Figure 26 – VPe and Exgine Ethernet & I/O

Figure 27 – IBOC System with VPe and Exgine Ethernet & I/O

Plug the provided Cat5E cable into the new internal RJ45 jack. Plug the other cable into the RJ45 jack on the VPe controller board.

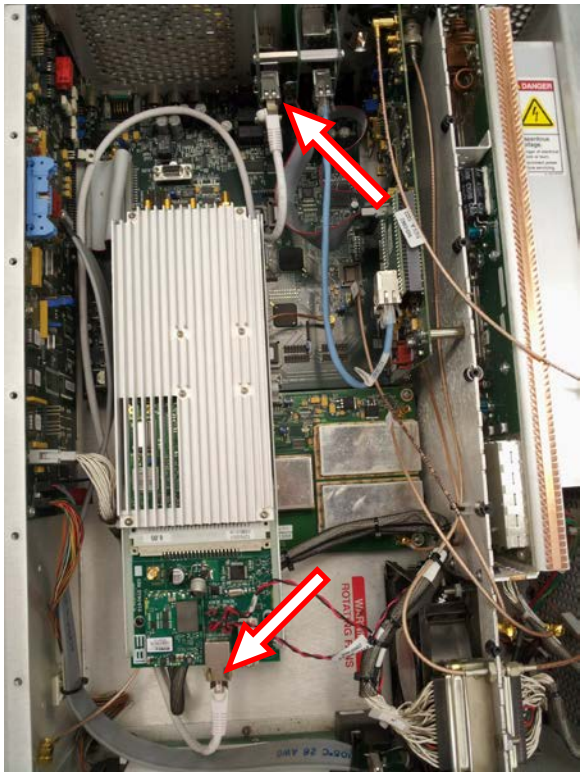

Figure 28 – VPe Internal Ethernet Cable

7.4 Connect RF Cables to VPe

Connect the provided attenuators to the VPe jacks as shown. Also connect the loose end of 949-0562 IBOC J3 cable, Exgine J31 cable

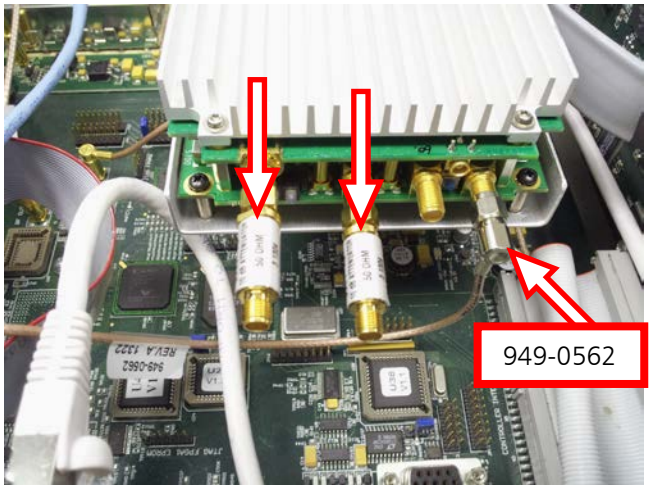

Figure 29 – Attenuators and Sample Input

Connect the VPe RF Output attenuator to the clock/filter board input cable as shown.

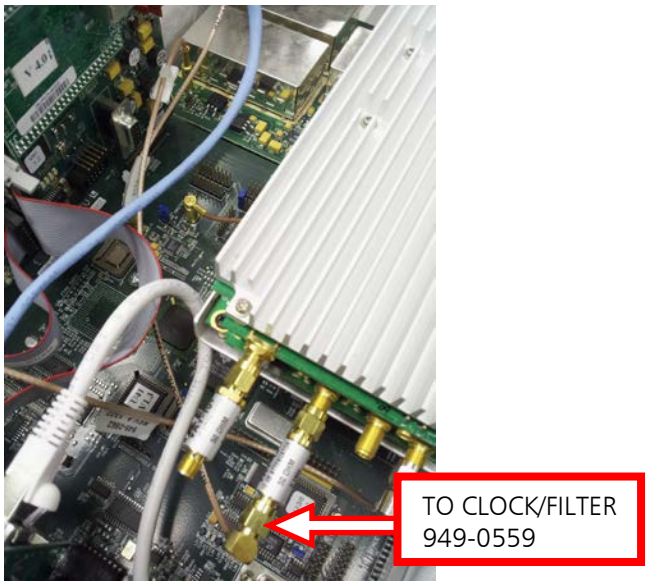

Figure 30 – VPe RF Output

Connect the VPE RF Input attenuator to the DSP board output cable as shown.

Figure 31 – VPe RF Input

Use the 5/16" wrench to snug all connectors. Do not over tighten.

7.5 Insert Screwlocks and Connect Communications

Gather the screwlocks and splitlock washers from the screwlock kits. Note that the four flat washers and two nuts in each kit can be discarded in this installation.

Insert the splitlock washers on the screwlocks on DB9 headers on the VPe controller board and the FXi DSP board. Use 3/16" nut driver to insert the screwlocks as shown in Figure 32.

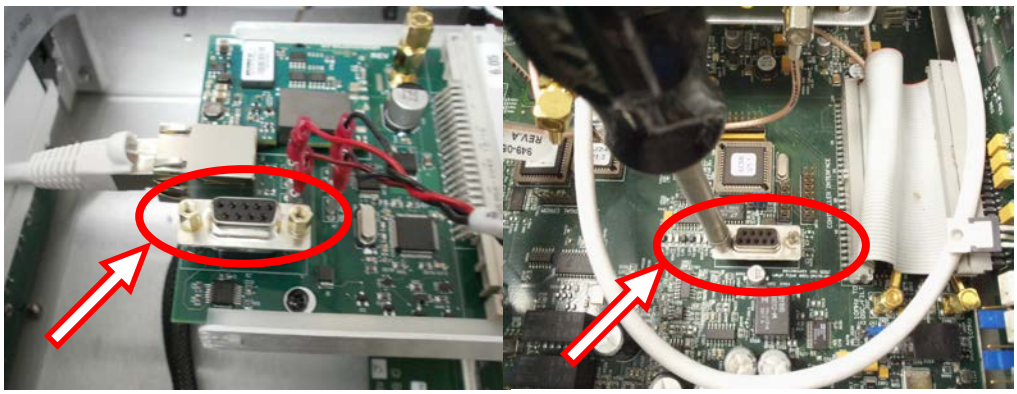

Figure 32 - Screwlocks

Connect the provided communications cable to both of these D-Subminiature connectors. Use a small flathead screwdriver to tighten the jackscrews.

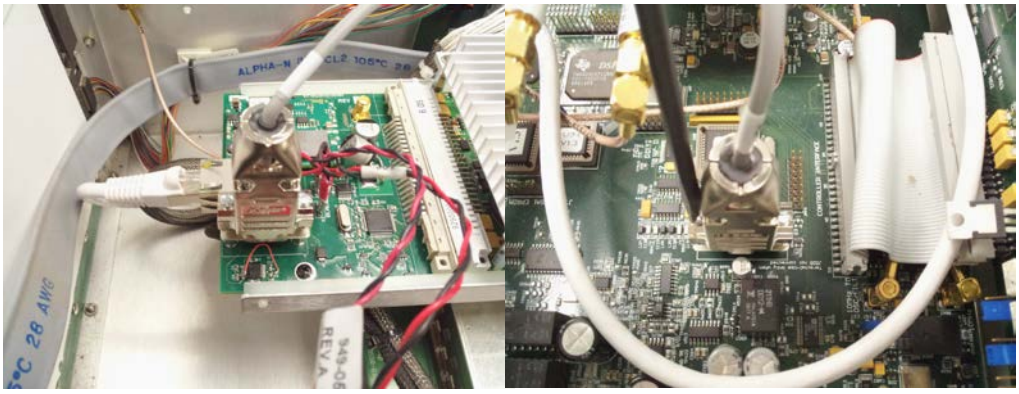

Figure 33 - Communications Cable

7.6 Reset Null Pot

Use the potentiometer turner to turn the Null Pot fully clockwise (at most 25 turns). Refer to Figure 34.

Figure 34 – Distortion Null Pot

7.7 Re-install the FXi Exciter in the Transmitter

Remember to reconnect everything that was disconnected in section 4.

1. FXi top cover.
2. Front panel rack screws.
3. AC power cord.
4. RF output cable.
5. LVDS IN for IBOC or Ethernet for Exgine.
6. Audio program service cabling.
7. Remote interfacing connectors.

8 Connect RF Feedback and 10MHz Clocking

VPe requires a sample of the RF signal output by the transmitter. This signal is compared to the linear output of the FXi exciter to determine appropriate pre-distortion control.

Kits are designed around standard BE transmitter setup configurations. Every FM transmission system is unique and can present unexpected installation challenges.

8.1 In-line RF feedback coupler

FMi 703, 1405, 17T, 20T, and 25T systems all come with couplers assembled. For installations in these systems, skip to the appropriate subsection for installation of the coupler in transmission line.

All other standard BE transmitters utilize 1 5/8" transmission line. Kits for these transmitters contain parts for the RF sample coupler, and some assembly is required.

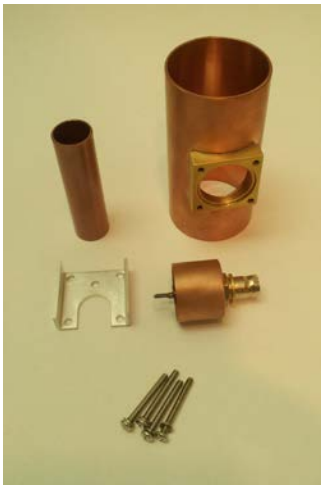

Figure 35 – RF Sample Coupler Parts

1. Start assembly of the coupler by placing the BNC RF coupler on the transmission line.

Figure 36 – RF Sample Coupler Assembly Step 1

2. Place the bracket strap on top of RF coupler.

Figure 37 – RF Sample Coupler Assembly Step 2

3. Insert split lock washers into the provided screws, and insert the screws to secure the bracket to the transmission line. Tighten with a Phillips screwdriver.

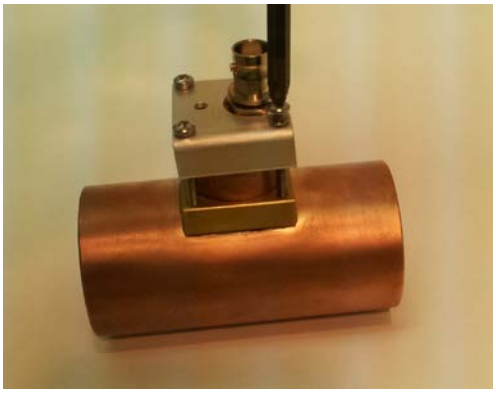

Figure 38 – RF Sample Coupler Assembly Step 3

FXi standalone, FMi 31, and FMi 73 all utilize N-type connector outputs. The kits for these include two 1 5/8" to N-type connectors. Other systems can ignore these steps.

1. Insert the inner conductor into the plug of one of the adapters.

Figure 39 – 1 5/8" to N Adapter Inner Conductor

2. Slide the adapter onto the 1 5/8" line. Connect the other Adapter to the other end of the transmission line. Secure hose clamps with 5/16" nut driver (or flat blade screwdriver).

Figure 40 – 1 5/8" to N Adapters Final

8.1.1 FXi Standalone, FMi 31, and 73

To install the assembly in the transmission system, swap the N connector on the RF output of the transmitter to the output of the coupler assembly. This is a directional coupler, so ensure that the BNC jack on the coupler is towards the transmitter side of the transmission cabling. Refer to Figure 41.

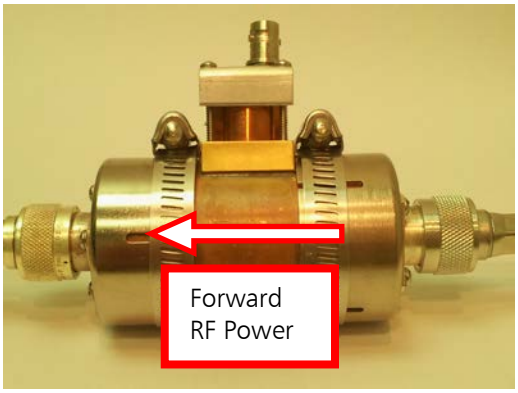

Figure 41 – N Type Transmission

Connect the provided N-type cable between the transmitter RF output and the input of the coupler assembly. Secure to the mounting rack with provided ty-raps.

8.1.2 FMi 106, 201, 301, 402

Standard installations of these transmitters utilize 1 5/8" transmission line, shown in Figure 42. The kits include [1] RF sample directional coupler assembly, [2] straight coupler, and hose clamps for the two new joints.

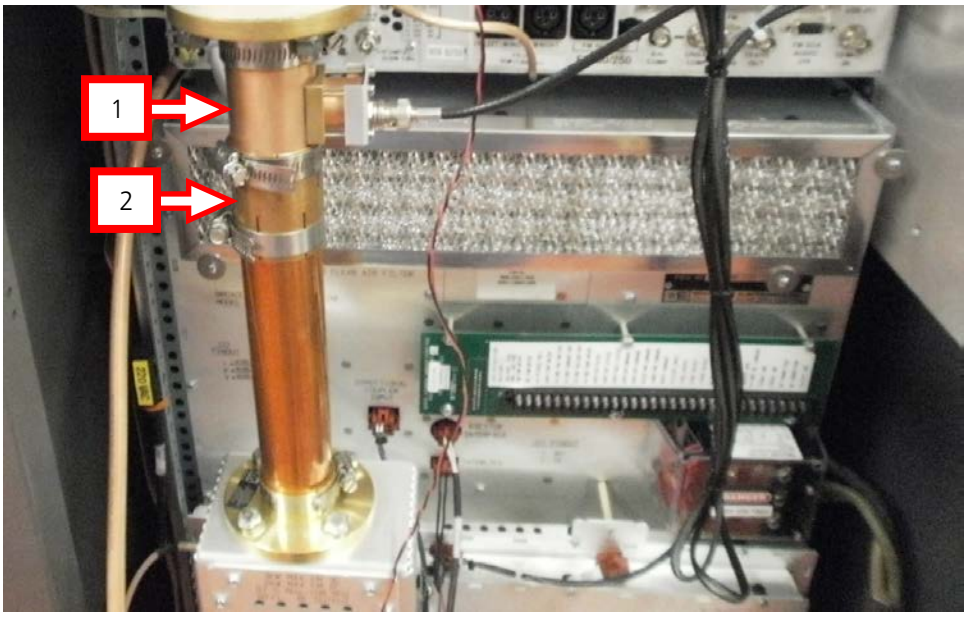

Figure 42 – Typical 1 5/8" RF Coupler Installation

This is a directional coupler, so ensure that the BNC jack on the coupler is towards the transmitter side of the transmission line. Refer to Figure 43.

Figure 43 – 1 5/8" RF Coupler Detail

8.1.3 FMi 703 and 1405

Transmitters shipped after April 2010 have a required hole cut out of the final transmission line inside the cabinet. Check the transmission line for a cover plate secured by hose clamps.

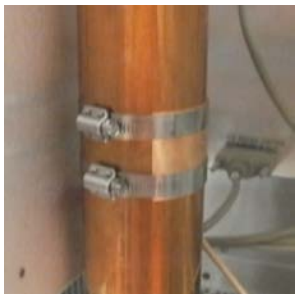

Figure 44 – Existing Covered Coupler Hole

If the hole and cover plate are present, simply loosen the hose clamps with a 5/16" nut driver (or flat blade screwdriver), remove the plate, and skip to insertion of the coupler.

Note that the 703 cabinet is typically pictured. The 1405 system follows a similar installation pattern, but has a shorter output transmission line in the auxiliary cabinet.

For systems delivered before April 2010 with transmission line that does not have the required hole:

1. Start the transmission line replacement process by disconnecting the flange on top of the transmitter cabinet. Use a 9/16" wrench to hold the bolt and another 9/16" wrench to unscrew the nut. Once all bolts are removed, set the transmission line and flange to the side.

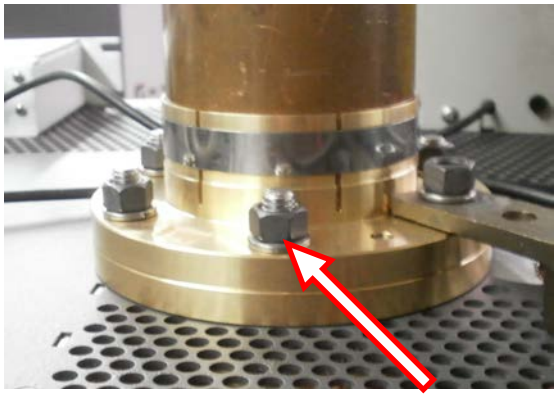

Figure 45 – External Flange

2. Loosen the hose clamps on the top and bottom of the internal transmission line section, and slide the flange end out of the top of the transmitter.

Figure 46 – Top Flange

3. Disconnect all BNC cables from the transmission line (note where they are plugged in as they will be reconnected later). Lift the inner and out conductor of the line section so that both clear the bottom flange. Angle the line out and slide it down to remove it from the cabinet.
4. Add the two provided hose clamps in the middle for attaching the new coupler. Loosen one set of hose clamps at a time and transfer existing couplers to the new transmission line.
5. Reverse the process used to remove the transmission line. Use the existing inner conductor.
   5.1. Angle both the inner and outer conductors in and insert the top.
   5.2. Swing the bottom in so the line is vertical, and insert both conductors into the bottom flange. Tighten the bottom hose clamp.
   5.3. Reconnect all BNC cabling
   5.4. Insert the top flange and tighten the hose clamp.
   5.5. Reconnect the external flange using the nuts, bolts, and lock washers.

Insert the coupler assembly and secure it with hose clamps.

Figure 47 – 3 1/8" Coupler Installed

Begin changing out the cabinet divider panel by cutting the ty-wrap and removing the eight screws with a Phillips screwdriver. Note that the cable tie mount is attached via one of these panel screws.

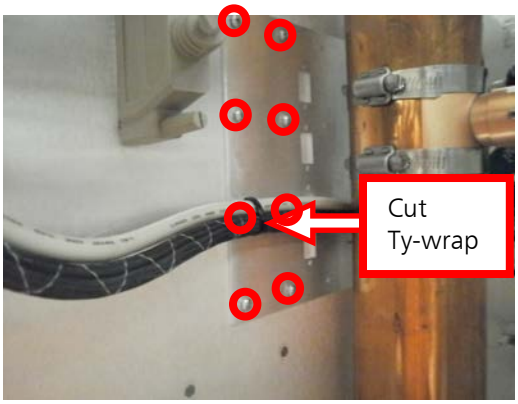

Figure 48 – Remove Existing Panel

Assemble BNC panel.

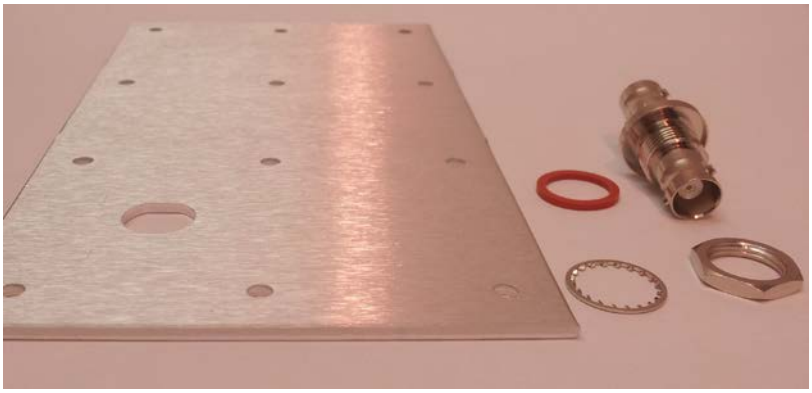

Figure 49 – Panel Parts

1. Insert the gasket in the grove as shown.

Figure 50 - Bulkhead BNC with Gasket Installed

2. Insert the BNC bulkhead connector by lining up the notch in the connector's threads with the D in the hole.

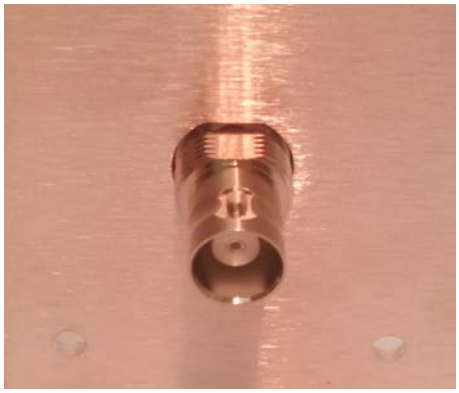

Figure 51 – Bulkhead BNC in Panel D Hole

3. Insert the locking washer and nut. Tighten the nut with a 5/8" wrench.

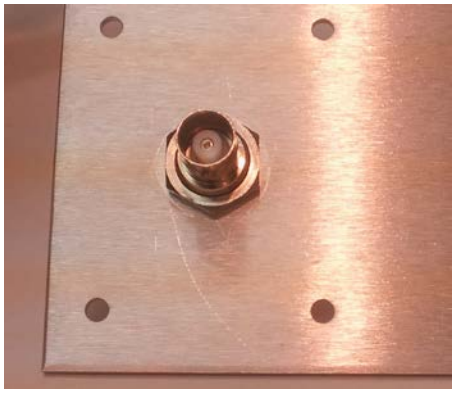

Figure 52 – Bulkhead BNC

Insert the panel and attach it using the eight screws (including the cable mount) that were removed from the old panel. Ty-wrap the cables back to the cable mount.

Figure 53 – Installed Panel

For FMi 703 installations simply connect the 2.5' heavily shielded BNC cable between the bulkhead connection and the newly installed RF sample coupler.

FMi 1405 installations require feeding the 8′ heavily shielded BNC cable between the cabinets through the hole shown in Figure 54. Connect one end to the bulkhead BNC newly installed in the panel, and connect the other end to the newly installed RF sample coupler on the output transmission line.

Figure 54 – FMi 1405 Cabinet

8.1.4 FMi 17T, 20T, and 25T

More recent T-series transmitters should be similarly equipped with a coupler hole and cover plate. If the updated coupler is not attached to the low pass filter output as shown, please contact RF Technical Services. Contact information is found on page iii.

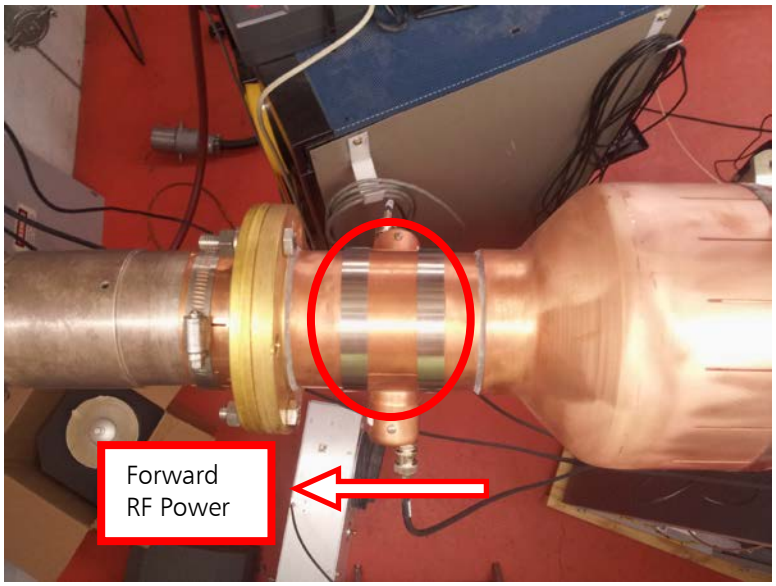

Figure 55 – T Series Coupler Location

To install the coupler assembly loosen the hose clamps – be careful with the existing couplers that are also held by these hose clamps – and remove the cover plate.

Insert the coupler with the BNC jack oriented closest to the low pass filter, as is the case with the existing forward power coupler, and secure all three couplers with the hose clamps. Connect the provided 8′ heavily shielded BNC cable to the coupler and feed it through the top of the transmitter cabinet for connection to the attenuator (detailed in next sections).

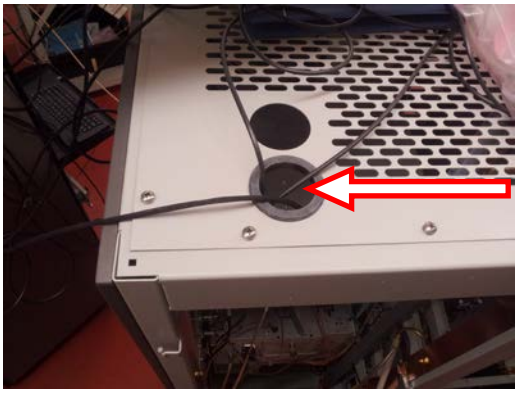

Figure 56 – T Series Feedback Cabling

8.2 Feedback Variable Attenuator

FMi 301, 402, 703 and 1405 transmitter installations require mounting brackets for their cabinets. All other standard transmitter configurations are designed to mount on EIA racks. FMi 106 and 201 installations scrap the kit's bracket, two screws, and two nuts.

8.2.1 FMi 301 and 402

Locate two holes in the side of the unit behind the exciter mounting rails. Feed the provided screws in the holes through the side, and secure the bracket with the provided Kep nuts as shown.

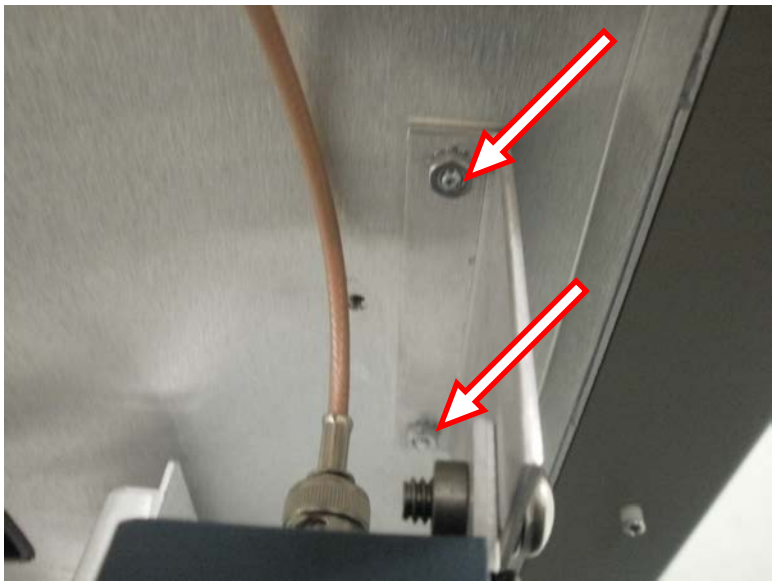

Figure 57 – FMi 301 and 402 Attenuator Mounting Bracket

Using one of the 2.5' BNC cables provided, connect the RF sample coupler to the variable attenuator assembly. For simplicity, connect that BNC cable to the attenuator BNC jack on the side with mounting screw holes. Using a large Phillips screwdriver, provided rack mounting screws, and split lock washers, mount the variable attenuator assembly to the bracket.

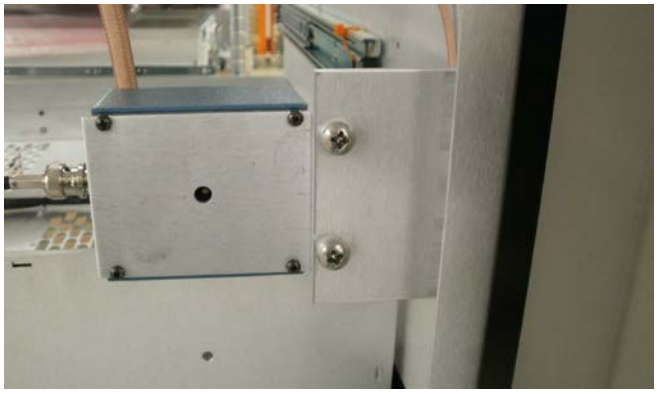

Figure 58 - FMi 301 and 402 Attenuator Mounted

Connect the other provided 2.5' BNC cable to the remaining BNC jack.

8.2.2 FMi 703 and 1405 Attenuator Mounting

Use the provided Phillips head screws to secure the attenuator box to the mounting bracket as shown. Also connect the 2.5' BNC cable while the jack is easily accessible.

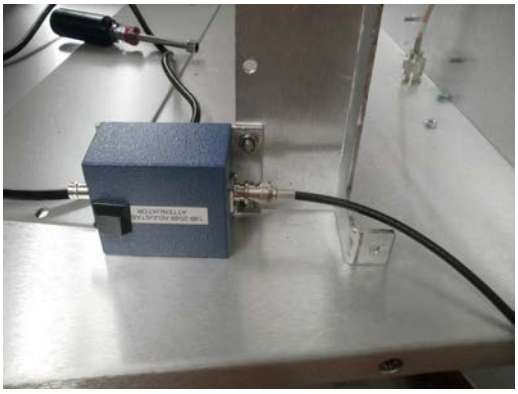

Figure 59 – FMi 703 and 1405 Attenuator Mount

Attach the mounting bracket to the cabinet using two Kep nuts and a 3/8" nut driver as shown.

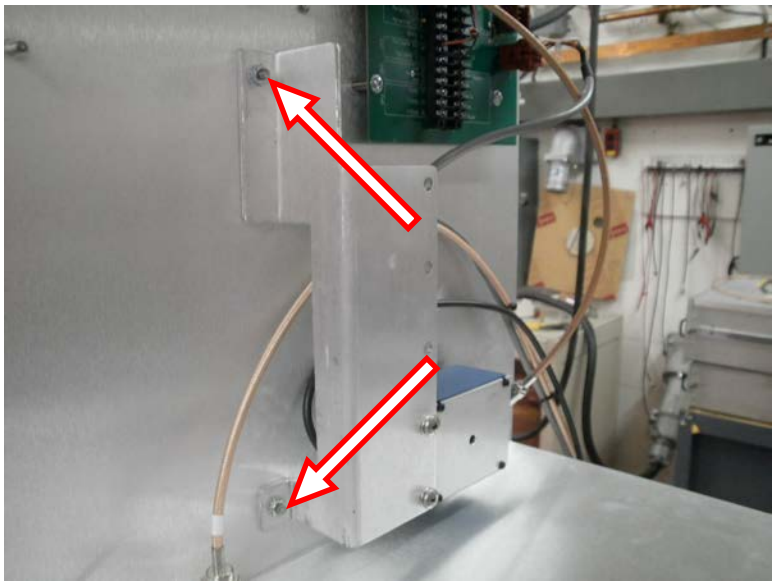

Figure 60 – FMi 703 and 1405 Mounted Attenuator Bracket

Attach the 1′ heavily shielded BNC cable between the newly installed BNC bulkhead connector and the attenuator input.

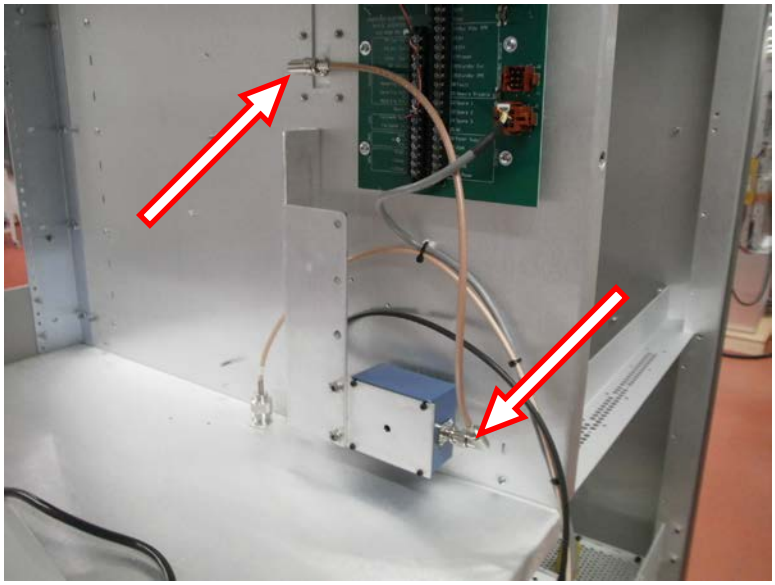

Figure 61 – FMi 703 and 1405 Attenuator Input

See the end of section 8.2 for the final FXi connection.

8.2.3 Other Transmitter Attenuator Mounting

Using one of the 2.5' BNC cables provided, connect the RF sample coupler to the variable attenuator assembly. For simplicity, connect to the BNC on the side with mounts as shown in Figure 62.

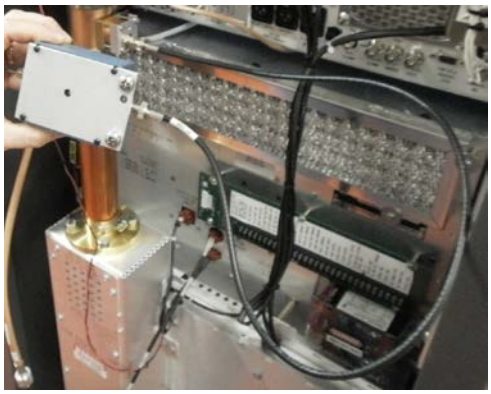

Figure 62 – Feedback Variable Attenuator

Using a large Phillips screwdriver, provided rack mounting screws, and split lock washers, mount the variable attenuator assembly in the rack as shown in Figure 63. Be sure to select a rack location where the hole in the cover is accessible by a potentiometer turner. Note that this device occupies two rack units.

Connect the other provided 2.5' BNC cable to the remaining BNC jack.

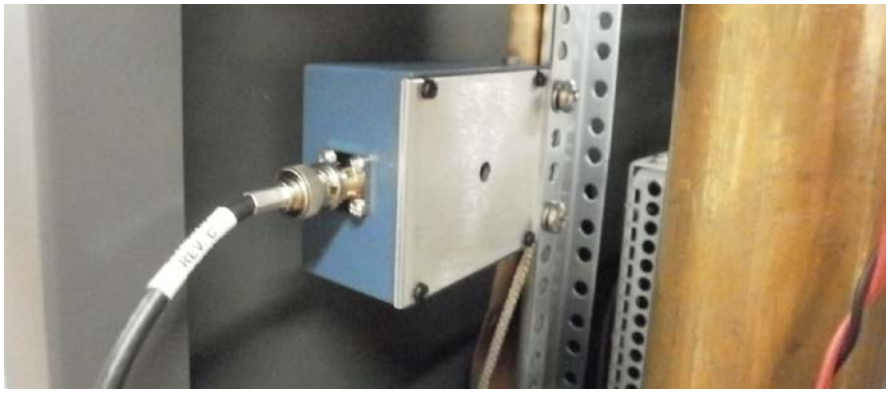

Figure 63 - Feedback Variable Attenuator Rack Mounting

For all installations, connect the other end of the 2.5' BNC cable to AUX 3 on the FXi as shown in Figure 64.

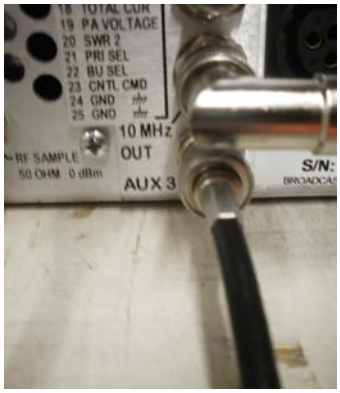

Figure 64 - Feedback Input

8.3 AUX 2 VPe 10MHz Input for IBOC Systems

Connect the supplied 2.5' BNC cable to AUX 2 on the IBOC card. Connect the other end of this cable to 10MHz OUT on the FSi.

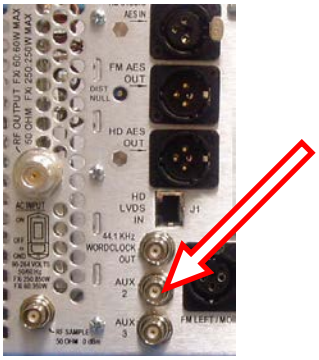

Figure 65 – AUX 2 10MHz Input

For nonstandard installations, the same 10MHz that is plugged into the FXi 10MHz in should be used for this input (as with the FSi). A BNC tee or other setup may be put together for this purpose.

9 VPe Web Interface

At this stage in the process, AC should be applied to the transmission system. Ensure that the transmitter has RF turned off.

The VPe system comes standard with a built in web server. This must be accessed during setup to verify feedback levels into the VPe board.

9.1 Connect PC to the VPe Ethernet Port

Physically connect to the VPe Ethernet jack with a network cable. For direct connection use a Cat5 or higher crossover cable. If a network is already set up, simply connect through a switch.

Figure 66 – VPe Ethernet Jack

The default IP configuration for VPe is 192.168.168.168 with a subnet mask 255.255.0.0. If this is not the case, the VPe unit can be reset to factory defaults by pressing the small blue button on the board between SMA connectors, see Figure 67.

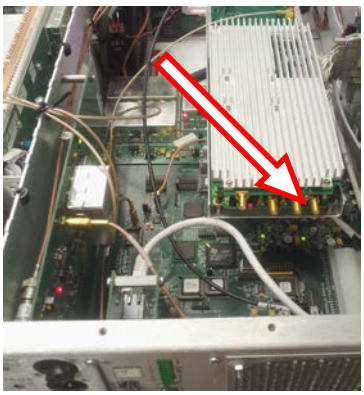

Figure 67 – VPe Factory Defaults Reset Button

Communication between the PC and VPe will only occur if they are on the same sub-network. To accomplish this on Windows XP, double click on the Local Area Connection system tray icon in the right corner of the task bar. This brings up the dialog box in Figure 68.

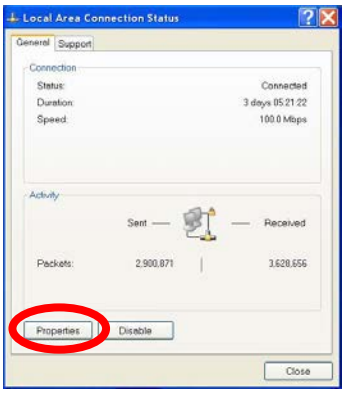

Figure 68 – Windows XP Local Area Connection Status Dialog Box

Click Properties to bring up the Local Area Connection Properties dialog box.

Refer to Figure 69. Scroll to the bottom of the list [1] to find Internet Protocol (TCP/IP). Once TCP/IP is selected [2], click properties [3].

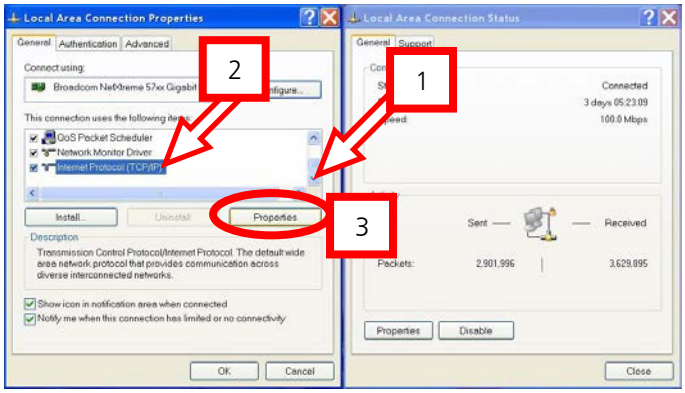

Figure 69 – Local Area Connection Properties Dialog Box

Click the button to select Use the following IP address. Enter 192.168.1.1 in the IP address and 255.255.0.0 in the Subnet mask. Click ok on this dialog. Click ok on the Local Area Connection Properties dialog. Click close in the Local Area Connection Status dialog for the settings to take effect.

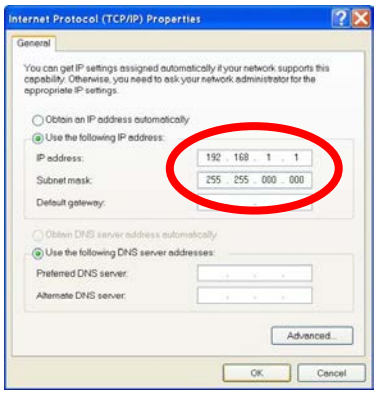

Figure 70 – Internet Protocol (TCP/IP) Properties Dialog Box

Simply load a web browser and enter 192.168.168.168 in the address bar. If the network is set up properly in hardware and on the PC, a password prompt dialog box should pop up. Enter "admin" in the user name field and leave the password field blank. Click OK.

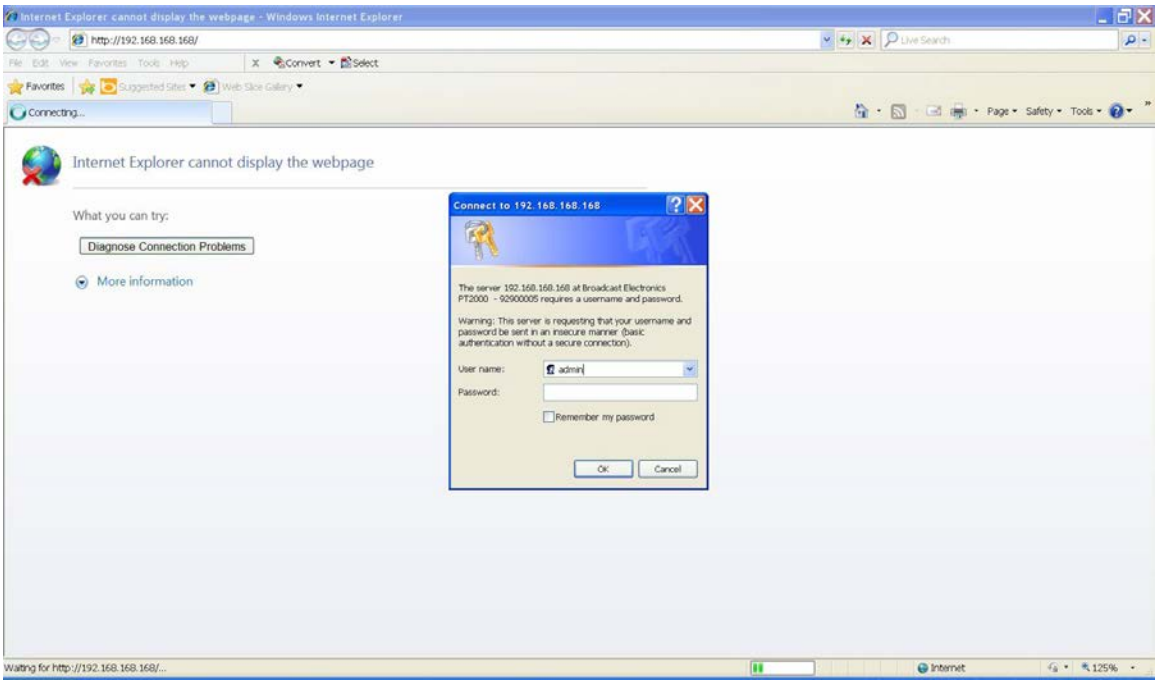

Figure 71 – Login Dialog

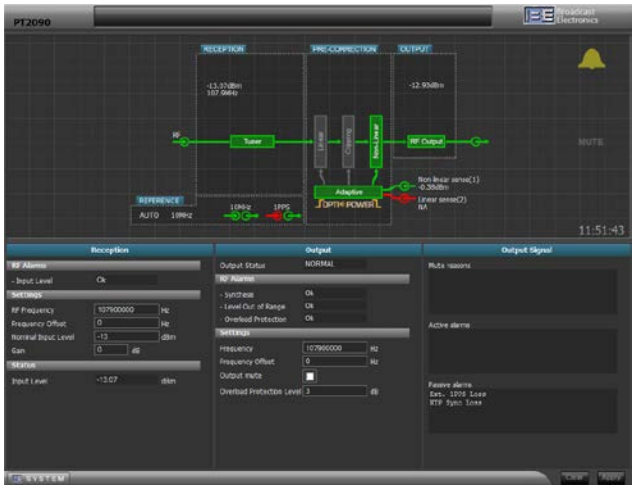

Figure 72 - VPe Web Interface

9.2 Set up IP Network Configuration

Having the VPe on an IP network is entirely optional. If there is no network to connect through, this section can be skipped.

Network settings are changed through the web interface, so changes might not be reversible. If the device gets into an unknown configuration, simply reset factory defaults in hardware as described in section 9.1.

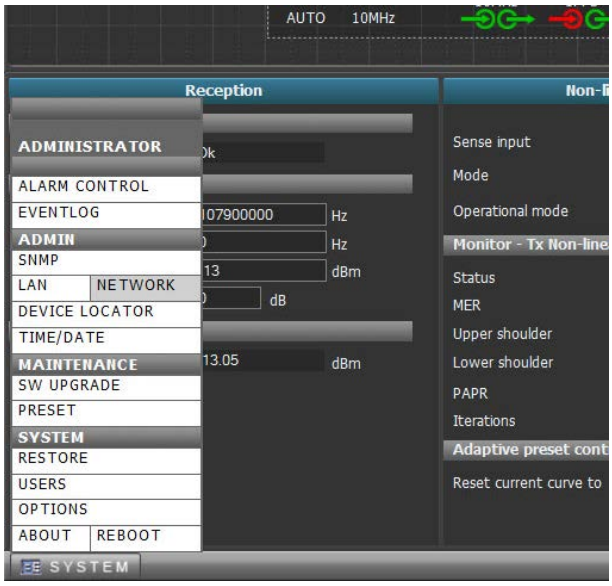

Figure 73 – Web Navigation to Network Configuration

To set the network configuration click SYSTEM in the lower left corner – scroll down if necessary. Select NETWORK from the popup menu, edit the text boxes with your network information, and click Apply when finished updating (this should not cause a loss of connection to the VPe web service). Repeat a similar process by selecting LAN in the popup menu and update the IP configuration(s) for VPe. Upon clicking apply the IP address and subnet will immediately change and the web page will time out.

Once the VPe IP and subnet mask are changed and updated, repeat the process in section 9.1 to set the PC back to the network where the VPe web service now resides. If the VPe networks settings change was not successful, the device should be reset to factory defaults by pressing the small blue button on the board between SMA connectors, see Figure 67.

Consult your local IT expert for assistance with network setup.

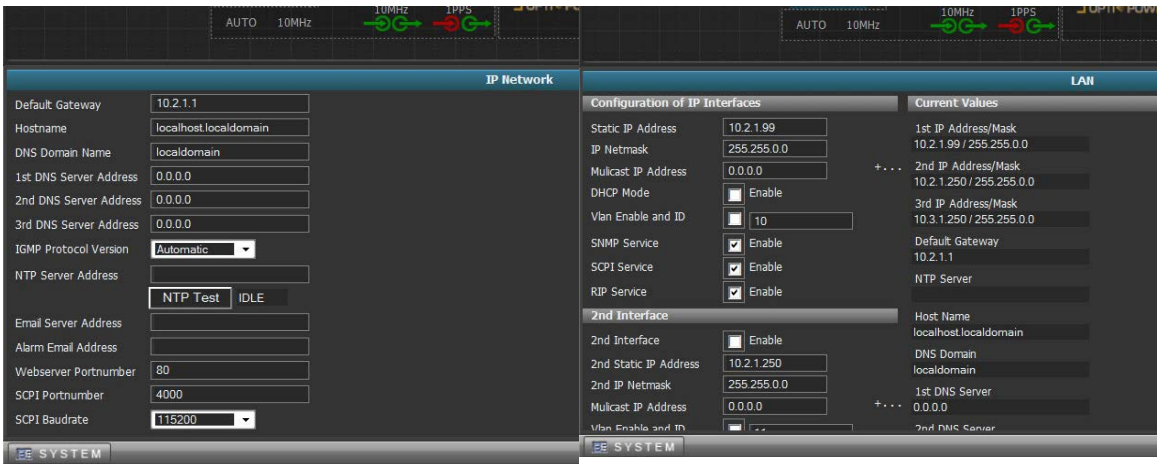

Figure 74 – IP Network and LAN Pages

9.3 Set Time

Follow a similar process to select TIME/DATE. Enter the date and time in the Set date and time text fields, select the appropriate time zone in the Timezone dropdown, and click Apply to update the date and time.

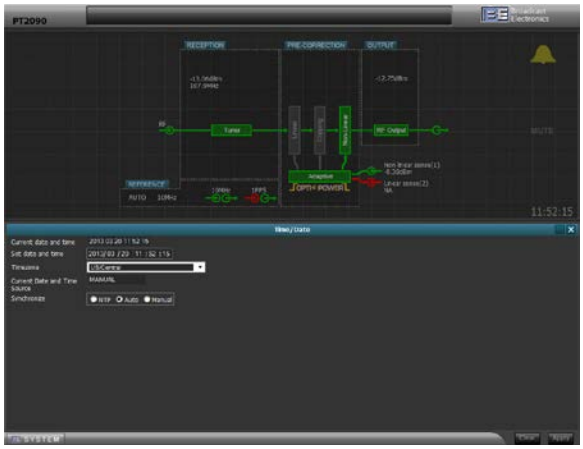

Figure 75 – Time/Date Page

9.4 Prepare the Interface

Display and writing of control parameters within VPe can be accomplished by dragging and dropping the appropriate graphic into one of the three interface columns as shown in Figure 76. The most useful and highly recommended blocks for HD implementations are shown in this figure.

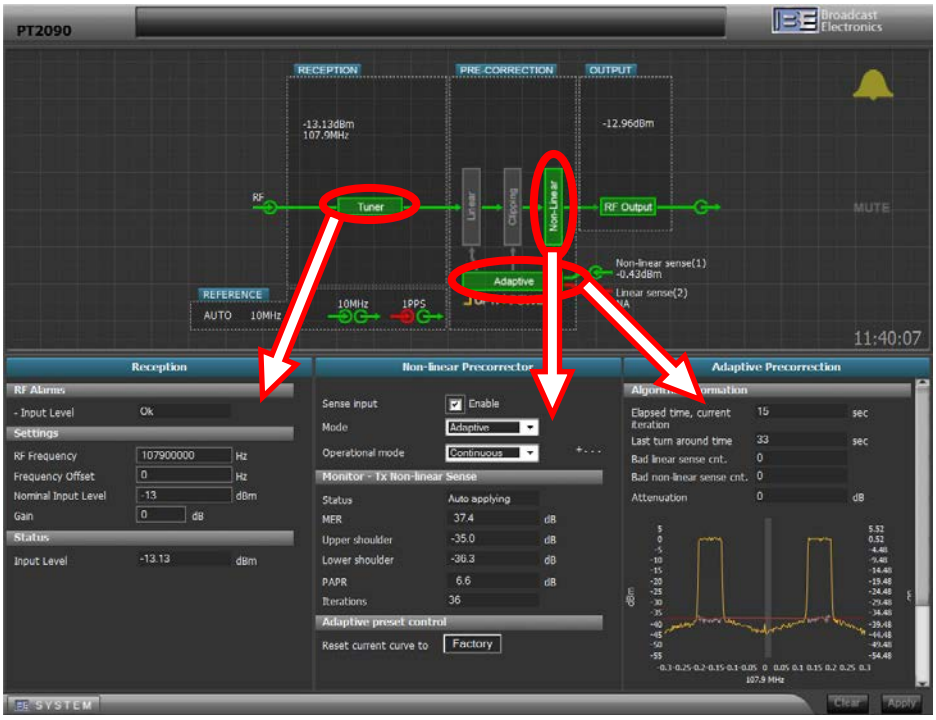

Figure 76 – Main Interface Configuration

10 Tune the System for HD Operation

Frequency must be initially synchronized between the FXi and VPe. To do this simply change the frequency in the FXi interface (and then change it back to the original). Verify the RF Frequency setting in the Reception column of the Web Interface.

VPe should come with adaptive pre-distortion uninitialized. To ensure that the system adapts as quickly as possible from the most ideal conditions, click "Factory" at the bottom of the Non-linear Precorrector column in the VPe web page. Note that this particular reset should be done whenever there are changes to the transmitter's power amplification or a shift from FM+HD to HD only.

It is also recommended to verify that the transmitter type selection remains correct. On the FXi main interface screen navigate to PA/POWER. Check that the transmitter type is correct for your transmitter.

It is highly recommended that the transmitter be run into a dummy load for standard setup procedures detailed in this section. VPe – and any adaptive pre-correction system – takes some time to adapt the wave form output by a transmitter.

10.1 AGC scale factor

On the FXi interface navigate from the main screen to OPER MODE and then to IBOC MENU. Verify that the intended IBOC mode is selected – either IBOC only or FM & IBOC.

Connect to the communications port by following the steps detailed in the FXi 60/250 Exciter Software Upgrade Guide, see section 3.2. Enter "?" to see the list of commands.

Enter "i" to load the prompt for changing maximum scale factor for the current mode. At this prompt type "25000" and press enter. The display should look like Figure 77.

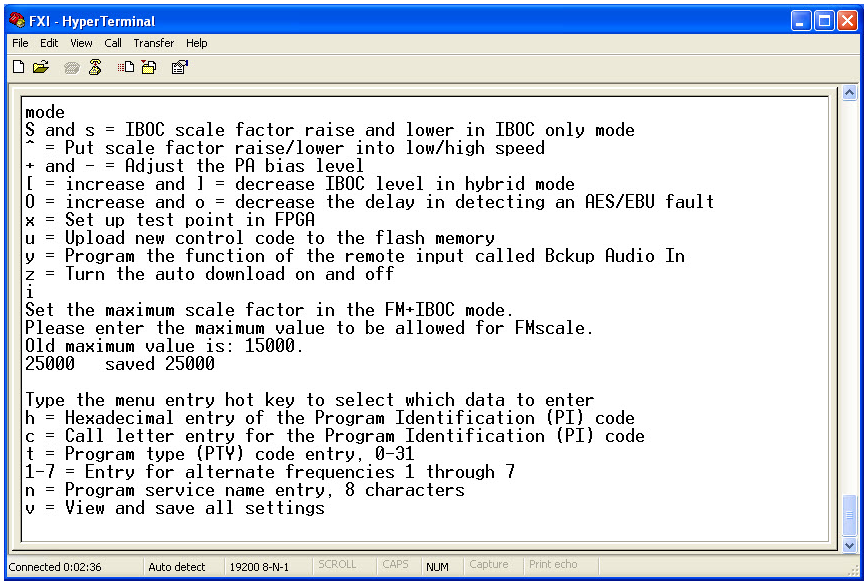

Figure 77 – Maximum AGC Scale Factor Change

Turn transmitter RF on. In the FXi IBOC MENU watch the AGC SCALE display until it hits 25000 indicating the maximum FXi DSP output level has been reached. Using the pot turner, slowly turn the DIST NULL potentiometer, which can be seen in Figure 34, counter clockwise. If this process is done too fast power can suddenly spike and cause damage to power amplifiers. Do this until the transmitter settles into full output power.

Once full total output power is achieved, tune the potentiometer until the AGC SCALE is between 19000 and 22000. Verify on the VPe web page that the "reception" input display is within 5 dB of -13 dBm for hybrid modes and -17 dBm for HD only modes.

10.2 Feedback attenuator

The transmitter should now be running at full output power. Use the potentiometer turner on the variable attenuator shown in Figure 63 and observe the non-linear feedback sense highlighted in Figure 78. Adjust until the level is approximately 0 dBm +/- 1 dB.

Figure 78 – Feedback Level

10.3 Side Band Levels and Total Power Output

With the transmitter running at full output power, set the spectrum analyzer reference level. Set the spectrum to 2 MHz span 1 kHz RBW, and 3 or more sample averaging to observe side band levels.

If not already connected to the communications port, follow the steps detailed in the FXi 60/250 Exciter Software Upgrade Guide, see section 3.2 Enter "?" to see the list of commands.

While adjusting, the terminal will print out an arbitrary "Offset" parameter. Take note of the original offset (increase then decrease) as a means to restore the system to the original state. This is not, however, the dB value representing the actual sideband level. A Spectrum analyzer must be used to verify levels correctly.

Refer to Figure 79. Once communication has been established, simply press "[" or "]" keys to increase and decrease relative sideband levels respectively. After each change measure relative levels on the spectrum analyzer until the desired side band level is achieved. Allow time for the transmitter power control to settle and the spectrum analyzer to update measurements between adjustments.

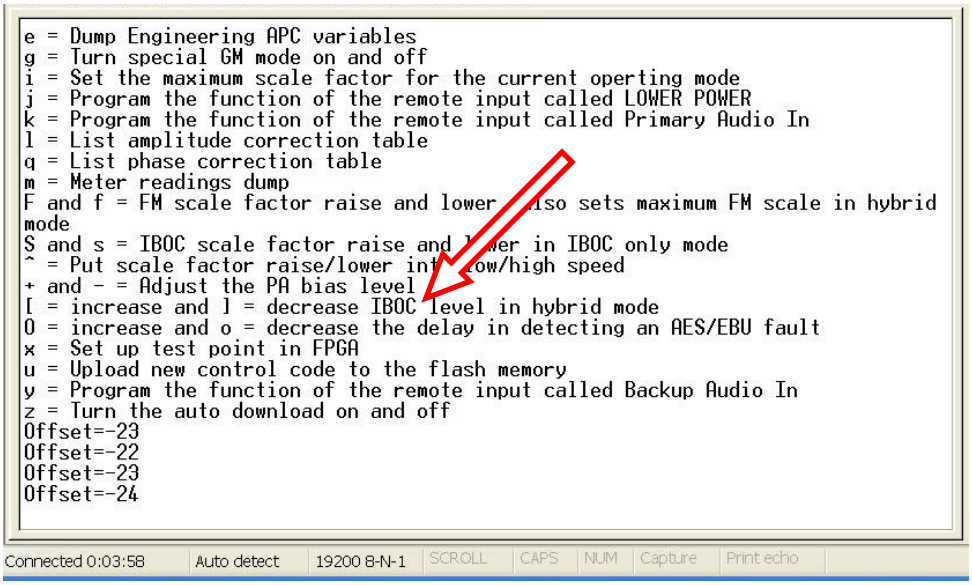

Figure 79 – Side Band Level Adjustment

11 Verify HD System Operation

Use the spectrum analyzer to observe the RF signal. For testing, the spectrum should be set to 2 MHz span 1 kHz RBW, and 3 or more sample averaging. Replace all modulation from the FM signal – this includes stereo pilot and any subcarriers – with a 1kHz monophonic tone at the full +- 75 kHz deviation. This is typically a worst case tone for hybrid intermods, and verification under these condtions should guarantee safe operation with normal analog FM program services.

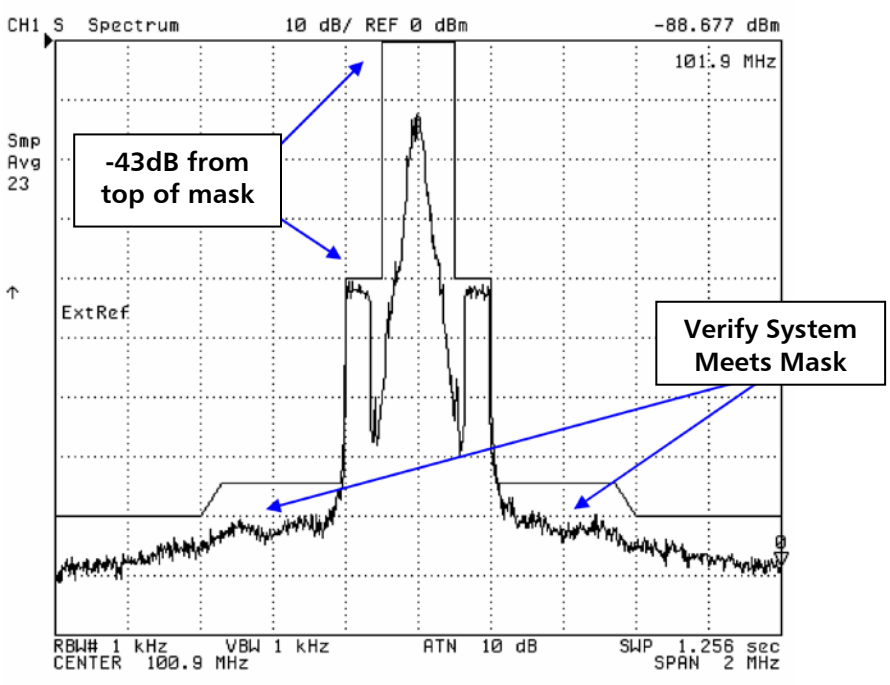

Figure 80 - Hybrid FM-HD -20 dB with Mask