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# **FXi 60/250 Exciter**

## **U41 Upgrade Application Guide**

### **Version 2.0 for FMi 703 and FMi 1405**

597-0541-009, Revision G  
10/27/10

## **FXi 60/250 Exciter**

### **U41 Upgrade Application Guide**

### **Version 2.0 for FMi 703 and FMi 1405**

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## 1 Purpose of this Document

This document provides instructions for upgrading U41 on the FXi 60/250 Exciter's motherboard.

## 2 Tools / Items Needed

- ☐ No. 2 Phillips Screw Driver
- ☐ PLCC Extraction Tool
- ☐ U41 Replacement PLCC (supplied by B.E.)
- ☐ PC with Serial Port and Windows HyperTerminal
- ☐ 9 Pin Null Modem Cable
- ☐ Spectrum Analyzer

## 3 ESD Awareness



During the upgrade process be sure to exercise ESD precautions.

## 4 Estimated Time for Upgrade

Providing that you have the tools / items listed above it will take approximately 15 – 30 minutes to upgrade U41.

## 5 Power OFF the FXi 60/250

Turn the power switch on the rear panel of the FXi 60/250 to the OFF position.

## 6 Disconnect and Remove Exciter From Rack

Next, disconnect and remove the FXi 60/250 Exciter from the Transmitter.

## 7 Remove Top Cover

Remove the Top Cover screws from the FXi 60/250 using a No. 2 Phillips Screw Driver.

## 8 Replace U41 on the Motherboard

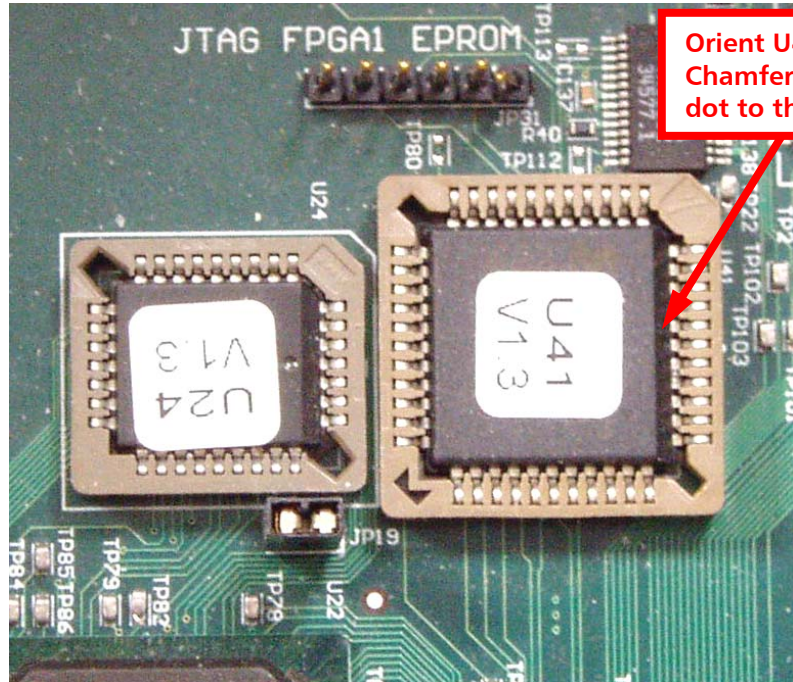
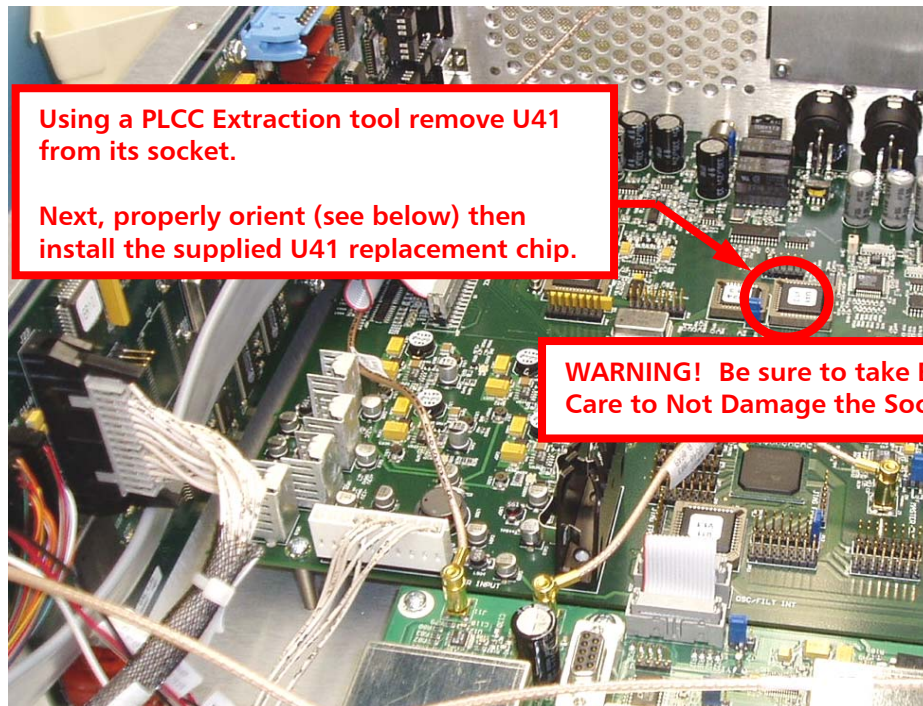


Figure 1 – U41 Orientation and Installation

## 9 Install Top Cover

Re-install the Top Cover and screws on the FXi 60/250 using a No. 2 Phillips Screw Driver.

## 10 Install the FXi 60/250 back into the Tx and Connect Cabling

Install the FXi 60/250 Exciter back into the Transmitter and re-connect all cabling.

## 11 Power ON the FXi 60/250

Power the FXi 60/250 back ON. The transmitter's RF Output must be OFF (muted) at this point.

## 12 Set the Max Scale Factor

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

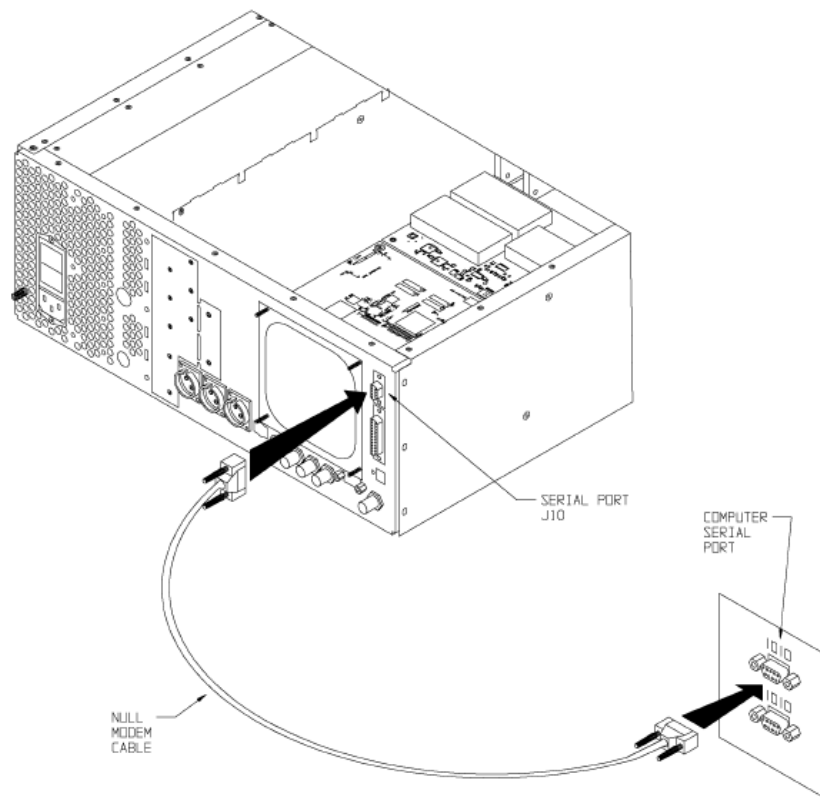
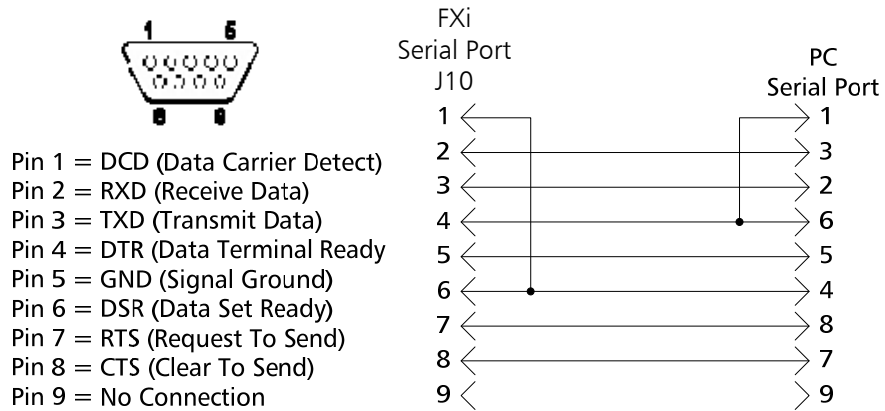
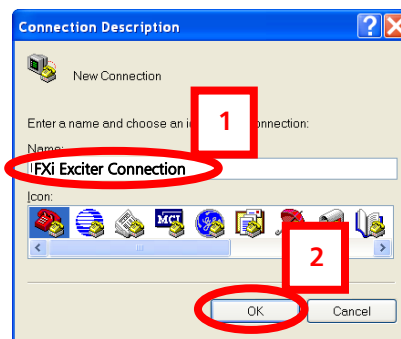


Figure 2 – PC to FXi Serial Port Null Modem Cable Connection



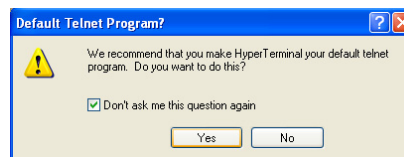
**Figure 3 – Serial Cable / Null Modem Adapter Pinout**

**Step 2** – Launch Windows HyperTerminal by going to **START -> ALL PROGRAMS -> ACCESSORIES -> COMMUNICATIONS -> HYPERTERMINAL**. Name the connection and then select **OK**.



**Figure 4 – HyperTerminal Connection Description Menu**

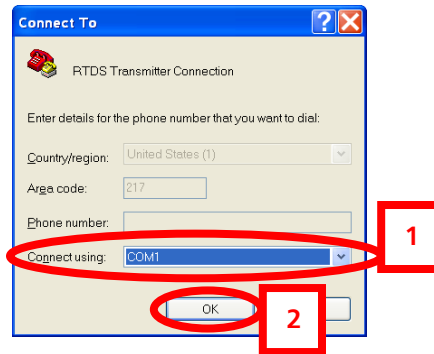
**Step 3** – The default telnet question box may appear. Select **Yes** if you want HyperTerminal to be your default telnet program. Select **No** if you do not want it to be.



**Figure 5 – Default Telnet Program Menu**

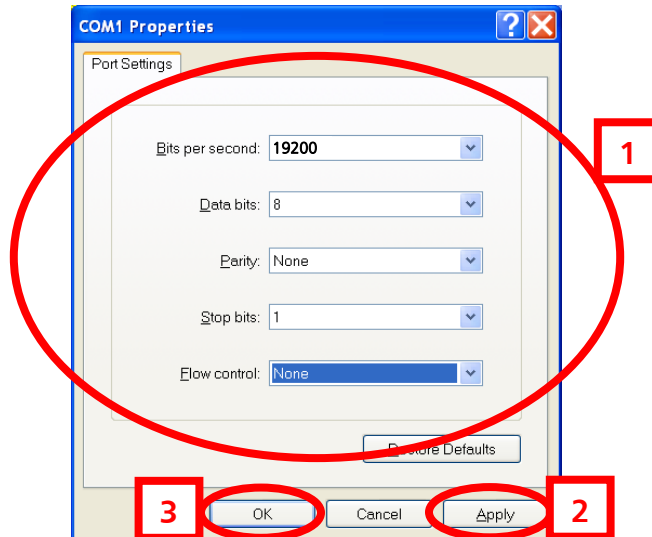


**Step 4** – Select the appropriate connection port (**COM1** is the most common) from the pull down, then select **OK**.



**Figure 6 – HyperTerminal Connect To Menu**

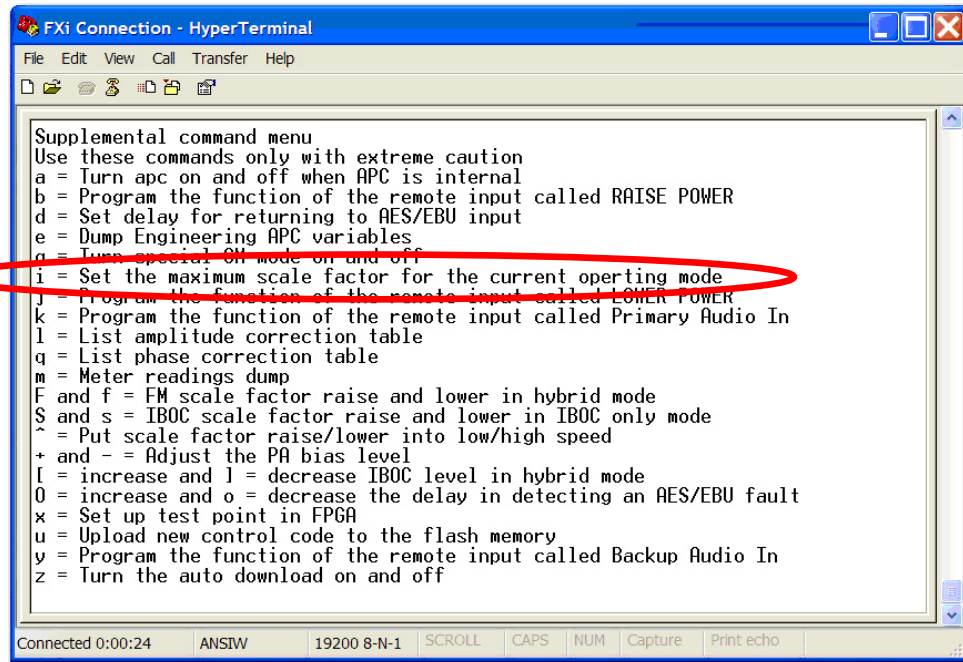
**Step 5** – Configure the **Port Settings** as shown below, select **Apply** then **OK**.



**Figure 7 – Port Settings Menu**

**Step 6** – After selecting **OK** the HyperTerminal communication window will appear as shown on the following page.

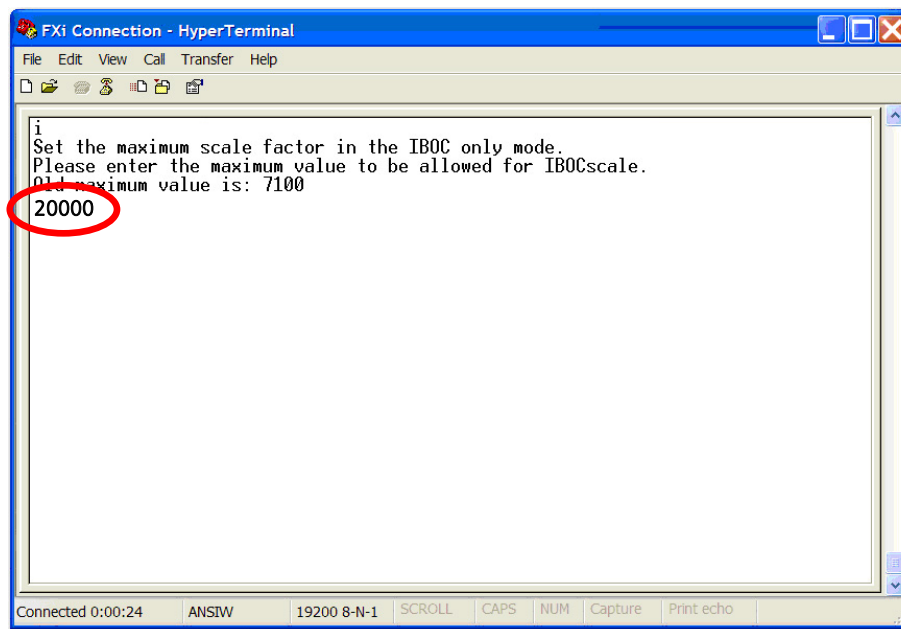
**Step 7** – Type “?” and the **Supplemental Command Menu** will then appear.



**Figure 8 – HyperTerminal Supplemental Command Menu**

**Step 8** – Press “i” (lower case) on the keyboard of the PC to change the scale factor of the “current” IBOC Operating Mode (IBOC Only or FM + IBOC).

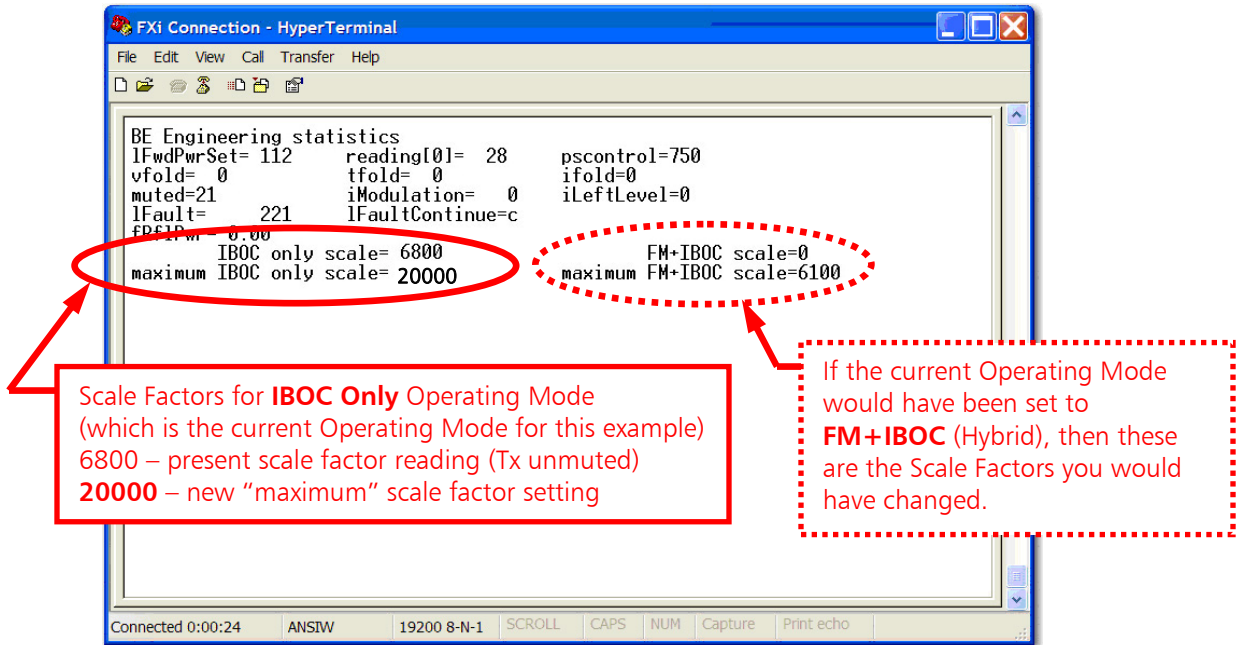
**Step 9** – After pressing “i”, the following command prompt will appear. Enter the AGC Scale setting of **20000** and press **Enter**.



**Figure 9 – “i” Command to Change Maximum Scale Factory**

**Step 10** – To verify that the scale factor was changed, press “e” (lower case) on the keyboard.

Please note that the new U41 correction runs at a higher scale factor for improved spectral performance. The operating scale factor in HD only mode is typically around 14500 and the operating scale factor for HD+FM mode is typically around 10500. When installing the new U41 you must make sure that the maximum IBOC scale factor in the exciter has been raised to 20,000 to allow for the higher operating numbers. With the new soft start feature, you do not need to make the maximum IBOC scale factor close to the operating number, it can be several thousand higher to account for temperature variations, etc.



**Figure 10 – “e” Command to Review Engineering Statistics**

## 13 Smartcore Board Software Continuation

If performing this firmware upgrade in conjunction with upgrading the Smartcore Board Software to v1.0.50 or newer for the FM 10S / FMi 703 or v2.1.20 or newer for the FM 20S / FMi 1405, return to the Smartcore Board Software Upgrade Application guide (part number 597-1012-006).

## 14 FM HD Spectral Measurements

If operating in an HD mode, it is **MANDATORY** that an HD spectral measurement be performed! This section describes the technique for accurately tuning and measuring the FM HD Radio™ Spectrum of an FMi 703 or FMi 1405 Transmitter.

## 14.1 FM Spectral Emissions Limits Mask

The following table is the emissions mask for FM HD Radio™ performance as specified by iBiquity. Note that all measurements are made in a 1 kHz bandwidth and relative to an un-modulated carrier.

FM HD FCC Spectral Mask	
Frequency, F, Offset Relative to Carrier	Level, dB / kHz
100 - 200 kHz offset	- 40 dB
200 - 250 kHz offset	[ - 61.4 dB – (frequency in kHz – 200 kHz) X 0.260]
250 - 540 kHz offset	- 74.4 dB
540 - 600 kHz offset	[ - 74.4 dB – (frequency in kHz – 540 kHz) X 0.093]
> 600 kHz offset	- 80 dB

Figure 11 - FM HD Radio™ Spectral Emissions Limits Mask in Tabular Form

Figure 12 shows the FM spectral emissions limits mask for HD. The limits shown are the implementation of the table in Figure 11 above.

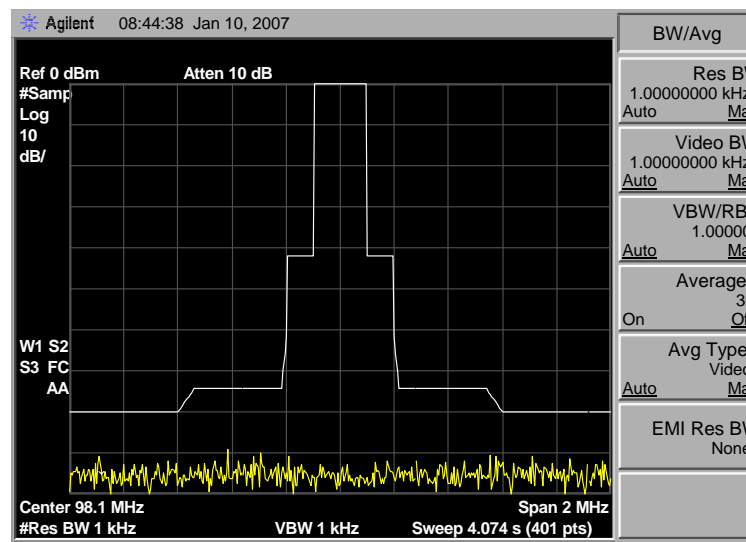


Figure 12 - FM HD Radio™ Spectral Emissions Limits Mask in Graphical Form



## 14.2 Setting up the Spectrum Analyzer

### 14.2.1 Reference

Setting the reference for the measurement is critical to taking accurate data and the following steps should be taken. When setting this reference point the analyzer detector MUST be set to peak, Averaging Off, and no modulation present on the FM carrier.

- 1) The reference level on the spectrum analyzer should be set at 0dBm. That is the top line on the spectrum is 0dBm. All measurements should be referenced to this point.
- 2) Apply an un-modulated FM signal to the spectrum analyzer input (external variable and/or fixed attenuation should be in line with the front to avoid overdriving or damage to the spectrum analyzer). Adjust the external variable attenuator until the un-modulated FM carrier is at the 0dBm reference line.
- 3) If measuring an HD Only signal that does not have a reference carrier, the detector should be set to sample, 1 kHz RBW and the top of the HD carrier should be -42dB down. See Section 14.2.2.

### 14.2.2 Resolution Bandwidth, Span, Detector, and Averaging

When measuring an FM HD spectrum the spectrum analyzer must have the Resolution Bandwidth (RBW) set to 1 kHz and Video Bandwidth (VBW) set to 1 kHz. The Span setting of 2 MHz is not required but is a good setting to view performance. The Detector should be set to Sample and Averaging over a minimum time span of 30 seconds and minimum of 100 sweeps.

When measuring the HD signal the FM carrier should have normal program modulation applied. The Modulated FM Transmitter Spectrum that is properly aligned should appear as shown in Figure 13. The modulated FM carrier will vary depending on program content. The primary sidebands should be ~42dB down from the un-modulated carrier and the secondary sidebands (re-growth) should be a minimum of ~74.4 dB down from the un-modulated carrier. In a good system the re-growth will be  $\leq 80$  dB down as shown below.

All measurements MUST be made into a known good 50 ohm load prior to putting Transmitter into antenna.

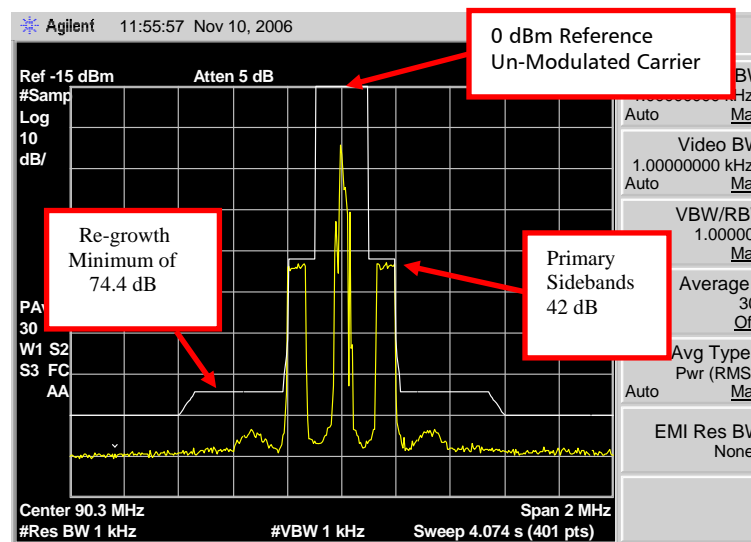


Figure 13 – Properly Aligned FM HD Radio™ Spectrum

### 14.3 FMi 703 and FMi 1405 Spectral Adjustments

NOTE: This procedure is not necessary for FM ONLY Transmitters!

There are (3) points of adjustment when tuning an FMi 703 or FMi 1405 Transmitter for best spectrum. Please NOTE that all three of these adjustments interact with each other. If one is adjusted then the others will be affected too. It will be necessary to go back and forth between the three until the best spectrum is achieved.

In the Transmitter:

- 1) PA Bias Level
- 2) IPA Bias Level

In the Exciter:

- 3) Distortion Null

#### 14.4 Set the PA Bias Level

**Step 1** – Establish HyperTerminal communication with the Transmitter using a Null Modem Cable @ 9600, N, 8, 1 and connect to the d-sub connector on the front of the transmitter.

**Step 2** – Verify communication by pressing <enter> on the keyboard. Text should appear in the HyperTerminal window.

**Step 3** – Ensure that BOTH the Transmitter and Exciter are in the desired mode of operation (IBOC ONLY or FM+IBOC).

**Step 4** – Ensure that the Transmitter's RF Output ON.

**Step 5** – Using a Voltmeter, probe TP8 (PA Bias) as shown.



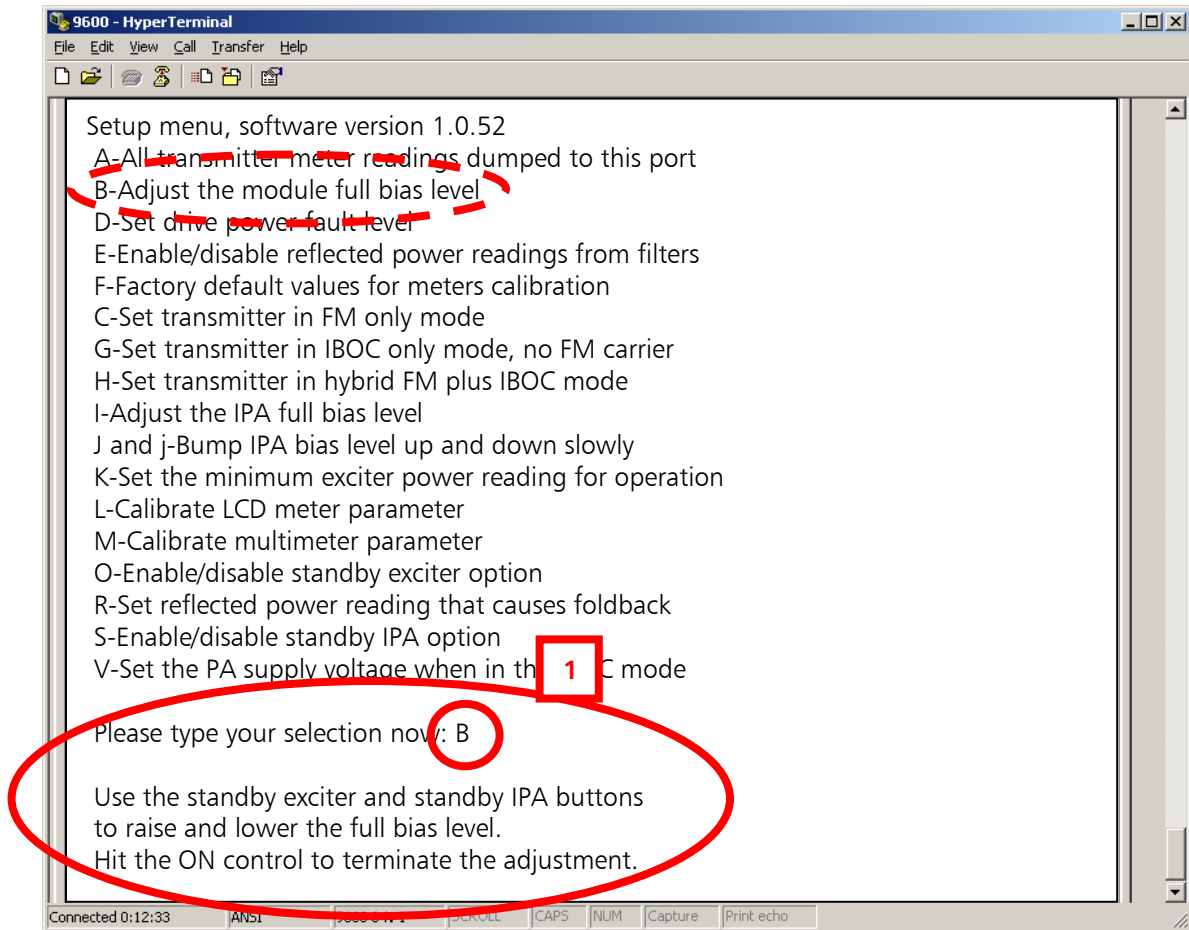
Figure 14 – TP8 (PA Bias Voltage)

< proceed to the next page >

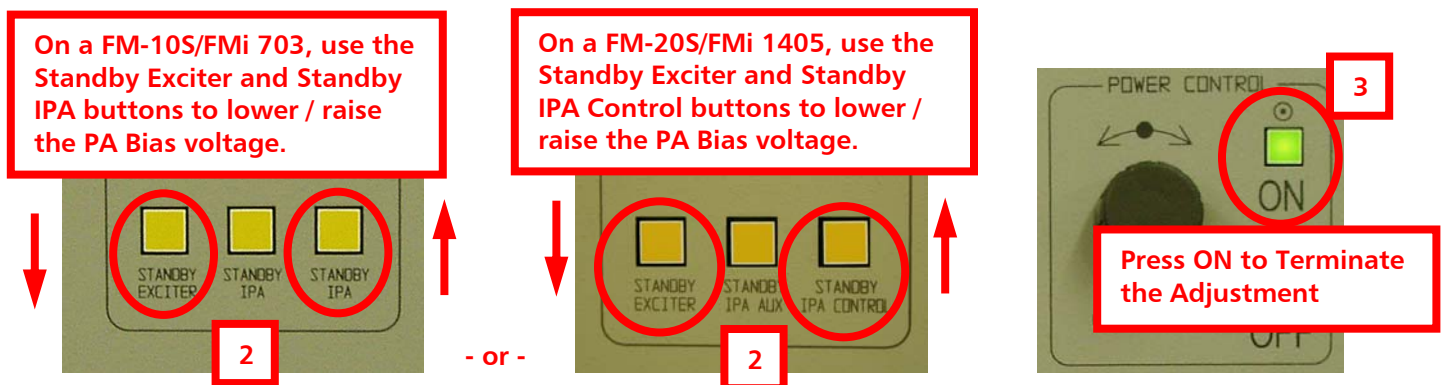
**Step 6** – See Figures 15 and 16 below. Press “B” on the keyboard and follow the on screen instructions for raising / lowering the PA Bias Voltage. The PA Bias Voltage should be adjusted to the approximate values using the Standby Exciter button to lower the value and Standby IPA to raise the value. When the desired value is reached press the ON button.

IBOC Only = approximate average 2.71V (min. 2.65 and max. 2.80)

FM + IBOC = approximate average 2.69V (min. 2.67 and max. 2.73)



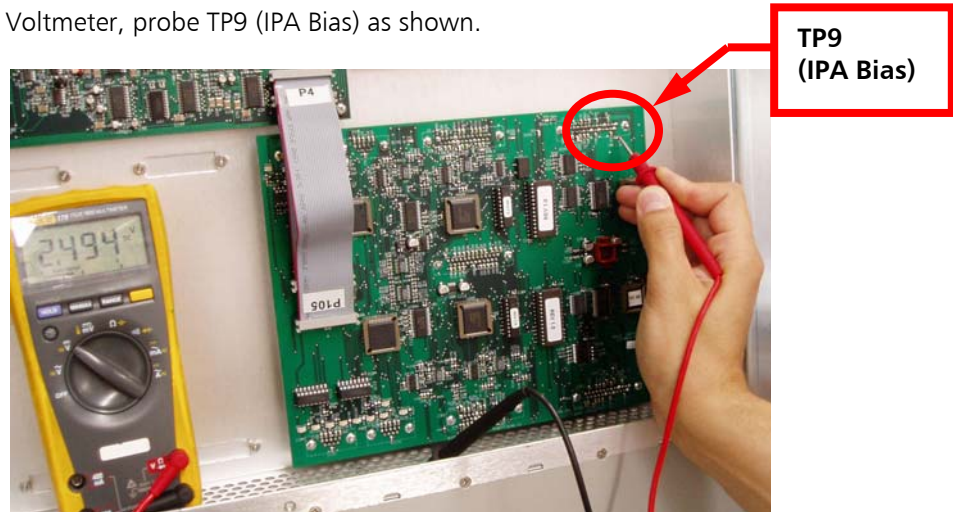
**Figure 15 – PA Bias Voltage Adjustment**



**Figure 16 – PA Bias Voltage Adjustment**

## 14.5 Set the IPA Bias Level

**Step 1** – Using a Voltmeter, probe TP9 (IPA Bias) as shown.



**Figure 17 – TP9 (IPA Bias Voltage)**

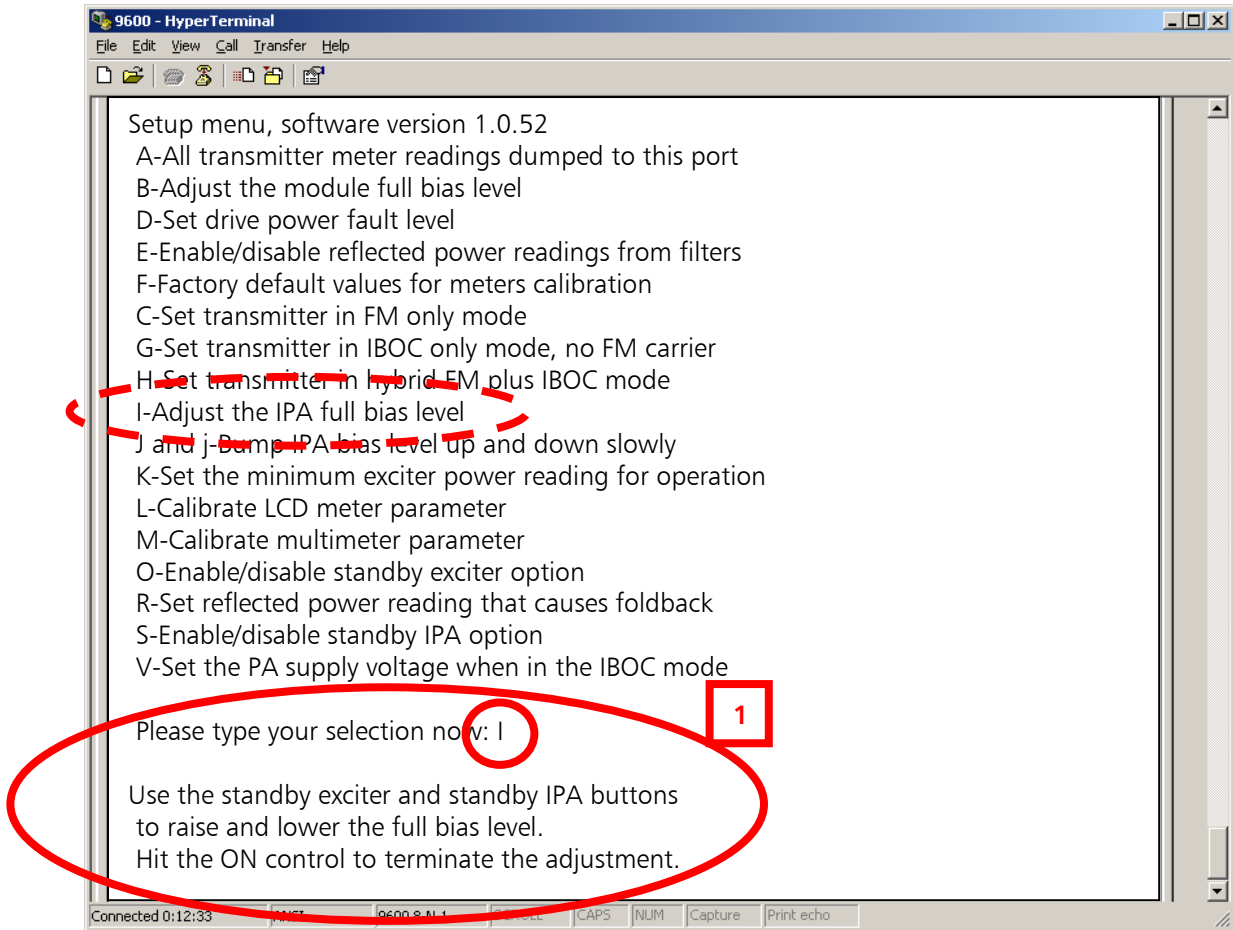
< proceed to the next page >



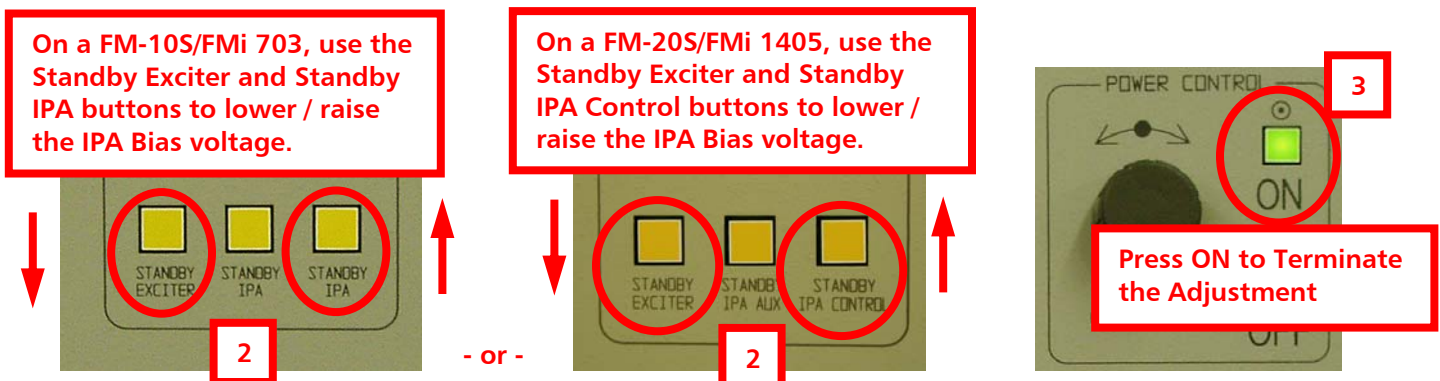
**Step 2** – See Figures 18 & 19 below. Press “I” and follow the on screen instructions for raising / lowering the IPA Bias Voltage. The IPA Bias Voltage should be adjusted to the approximate values using the Standby Exciter button to lower the value and Standby IPA to raise the value. When the desired value is reached press the ON button.

IBOC Only = approximate average 2.60 (min. 2.47 and max. 2.79)

FM + IBOC = approximate average 2.59 (min. 2.33 and max. 2.91)



**Figure 18 – IPA Bias Voltage**



**Figure 19 – IPA Bias Voltage Adjustment**

## 14.6 Distortion Null Adjustment

Adjust the distortion Null Potentiometer on the rear of the Exciter until the AGC Scale is set to approximately 14,500 for HD Only (or 10,500 for FM + HD). This can be monitored on the Front Panel GUI of the FXi under the Operating Mode -> IBOC Menu (see Figure 21 below).

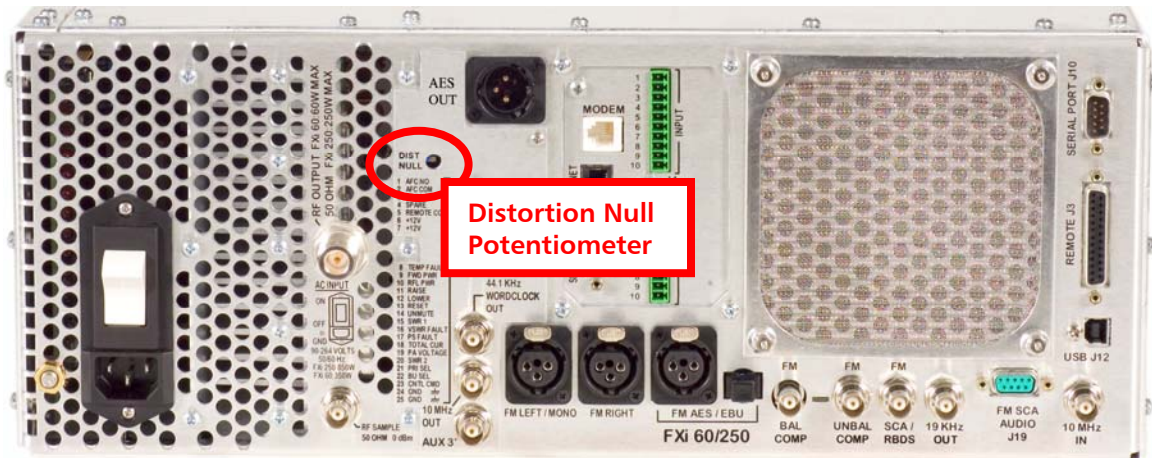


Figure 20 – Distortion Null Adjustment

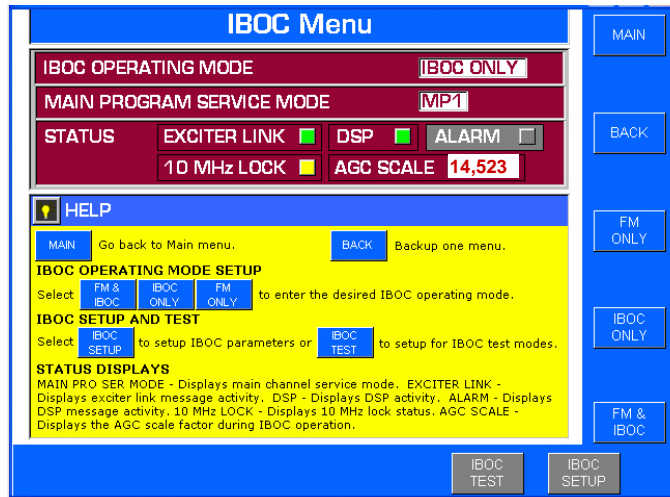


Figure 21 – AGC Scale Factor

## 14.7 Review and Adjust for Best Spectrum

While monitoring the spectrum on the Spectrum Analyzer adjust the Distortion Null above and below the nominal value to obtain optimum performance. Normally, you should only have to adjust this  $\pm 2000$ . IPA Bias may also need to be adjusted again for best results. Go back and forth between the Distortion Null and IPA Bias adjustments until best performance is met.

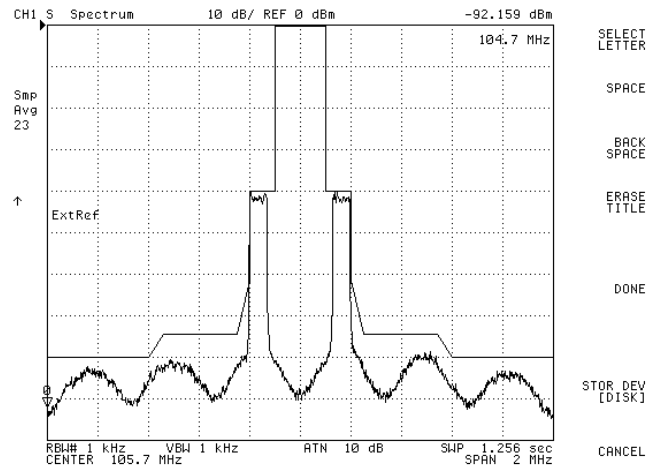


Figure 22 – Typical Properly Aligned HD Only Spectrum

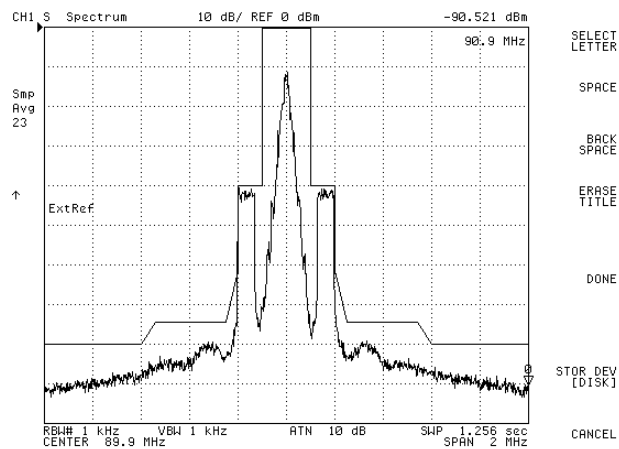


Figure 23 – Typical Properly Aligned FM+HD (Hybrid) Spectrum

## 15 Related Documents

Other Application Guides that are closely related to this guide that may prove beneficial:

- FXi 60/250 Maximum Scale Factor Application Guide; 597-0541-004
- FMi 31/73/106/201/301/402 HD Spectrum Application Guide; 597-5001-002
- FMi 703/1405 HD Spectrum Tuning Application Guide; 597-1012-009
- FXi Exciter HD Injection Level Adjustment; 597-0541-010

## 16 RF Technical Services Contact Information

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