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## **S and FMi Series Transmitter**

### **Smartcore Board Software Upgrade Application Guide**

597-1012-006, Revision J  
11/24/08

## **S and FMi Series Transmitter**

### **Smartcore Board Software Upgrade Application Guide**

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# 1 Prepare to Upgrade Smartcore Board Software

## 1.1 Overview

This document provides the necessary information to successfully upgrade **Smartcore Board Software** in Broadcast Electronics **"S and FMi Series Solid State FM Transmitters."** Contact B.E.'s RF Customer Support and request the Smartcore Board Software Upgrade Kit. Please be sure to indicate the model of your transmitter. The upgrade kit includes a **"Z-World Serial Programming Interface"** device.

After upgrading the FM10S/FMi 703 Transmitter with Smartcore Software v1.0.52 or v2.1.20 for a FM20S/FMi 1405, it is necessary to upgrade U7 and U107 on the Module Control Board(s) to v1.0.9. In addition, if the Transmitter is an FMi 703 or an FMi 1405, U41 on the FXi 60/250 Exciter Motherboard must be upgraded to v2.0.

## 1.2 Tools / Items Needed for Smartcore Software Upgrade

- ☐ PC with CD drive, Serial Port, and Windows HyperTerminal
- ☐ 9 pin Female to Male Null Modem Cable (for Transmitter RTDS port interface)
- ☐ 979-1010-001 Kit, Software Upgrade, FM10S/FMi703 Smartcore Board  
– or –
- ☐ 979-1020-001 Kit, Software Upgrade, FM20S/FMi1405 Smartcore Board
- ☐ Spectrum Analyzer

## 1.3 Tools / Items Needed for Additional Required Upgrades

- ☐ 979-0505 Kit, U7 & U107 (Qty 1 for FM 10S/FMi 703; Qty 2 for FM 20S/FMi 1405)
- ☐ 979-0539-V20 Kit, Software Upgrade, FXi 60/250 U41, v2.0

## 1.4 Upgrading a FM10S Transmitter with Smartcore v1.0.30 (or older)

Please note that if you are upgrading an FM 10S Transmitter from Smartcore Software v1.0.30 or older, additional calibration steps are required (included in this document).

## 1.5 Upgrading a FM20S Transmitter with Smartcore v2.1.9 (or older)

Please note that if you are upgrading an FM 20S Transmitter from Smartcore Software v2.1.9 or older, additional calibration steps are required (included in this document).

## 1.6 Estimated Time for Smartcore Board Software Upgrade

Providing that you have the tools listed above, it will take approximately 30 - 60 minutes to complete the transmitter's Smartcore Board software upgrade.

# 2 Software Upgrade Files

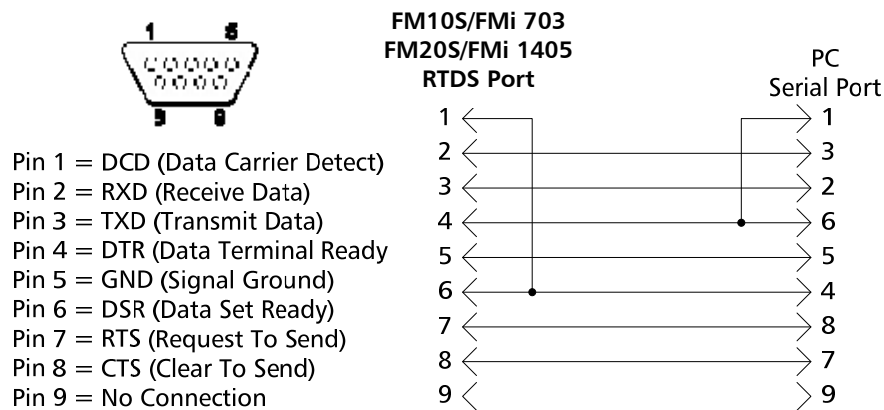
**Step 1** – Create a directory, **C:\Smartcore**, on the hard drive of your PC.



**Step 2** – Copy the upgrade files from the Upgrade CD into **C:\Smartcore**.

**Step 3** – Next, unzip the (2) .zip files into the **C:\Smartcore** directory.

### 3 Null Modem Cable Pinout



**Figure 1 – Null Modem Cable Pinout**

### 4 Recording Transmitter Parameters Prior to Upgrade

Before upgrading the Smartcore Board software, it is recommended that all of the transmitter's present operating parameters be recorded first.

**Step 1** – Ensure that the Transmitter is ON and Operational.

**Step 2** – Connect a Null Modem Serial Cable (not supplied) from the COM port of the PC to the RTDS port on the front of the Transmitter.

**Step 3** – To enable HyperTerminal communication with Transmitters that are running older software, simultaneously depress the **FWD POWER** and **PA CURRENT** buttons on the transmitter's front panel as shown in Figure 2.

This is **ONLY** necessary if the transmitter you are trying to communicate with is an:

**FM10S Transmitter running Smartcore Software v1.0.30 (or older)**

– or an –

**FM20S Transmitter running Smartcore Software v2.1.9 (or older).**



Only Applies to the following:

FM10S Transmitter running Smartcore Software v1.0.30 (or older)  
FM20S Transmitter running Smartcore Software v2.1.9 (or older)

Figure 2 – Enabling HyperTerminal Communication

**Step 4** – Launch Windows HyperTerminal by going to **START -> ALL PROGRAMS -> ACCESSORIES -> COMMUNICATIONS -> HYPERTERMINAL**. Name the connection and then select **OK**.

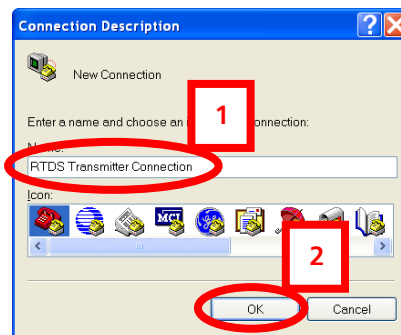
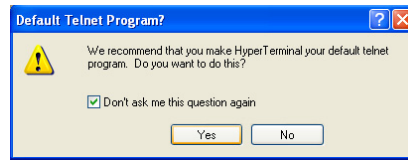


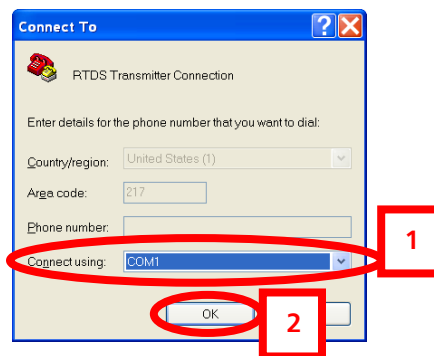
Figure 3 – HyperTerminal Connection Description Menu

**Step 5** – 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.



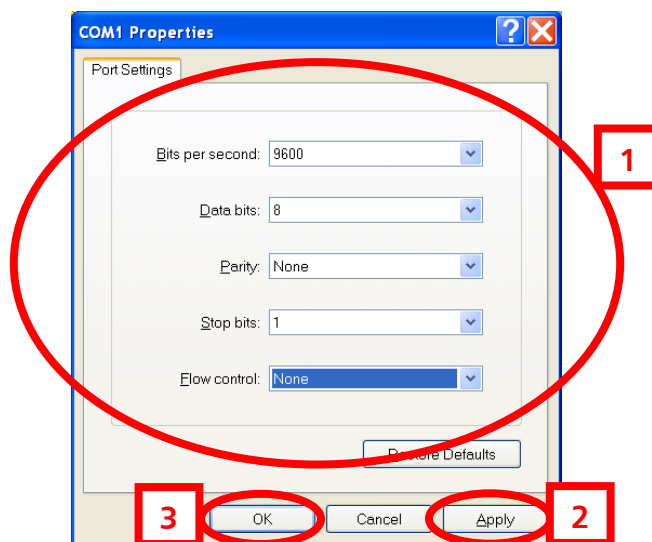
**Figure 4 – Default Telnet Program Menu**

**Step 6** – Select the appropriate connection port (**COM1** is the most common) from the pull down, then select **OK**.



**Figure 5 – HyperTerminal Connect To Menu**

**Step 7** – Configure the **Port Settings** as shown below, select **Apply** then **OK**.



**Figure 6 – Port Settings Menu**

**Step 8** – Next, the HyperTerminal command window should appear. Type <Enter> to display the command prompt. At the prompt, type "A" to display the transmitter's present operating parameters. Record the "**Software Revision Level**" and the transmitter's present "**Operating Parameters**" for reference later.

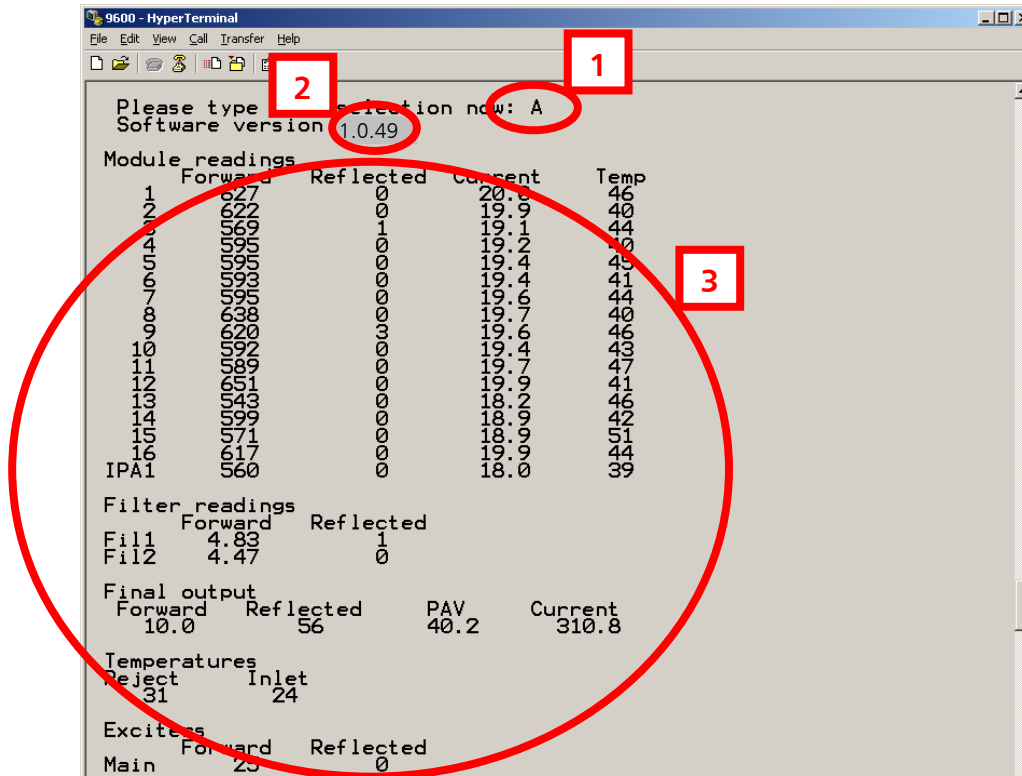


Figure 7 – HyperTerminal Command Window

## 5 Upgrading Smartcore Board Software

**Step 1** – Ensure that AC Power is applied to the Transmitter.

**Step 2** – Ensure that the Transmitter's RF Output is OFF (Muted).

**Step 3** – Open the Transmitter Controller door.

**Step 4** – Connect the "Z-World Programming Device" to the COM port of your PC and then to JTAG connector JP1 on the Smart Core Board as shown below.



**IMPORTANT!!** Ensure that the ribbon cable connector is oriented and installed exactly as shown!

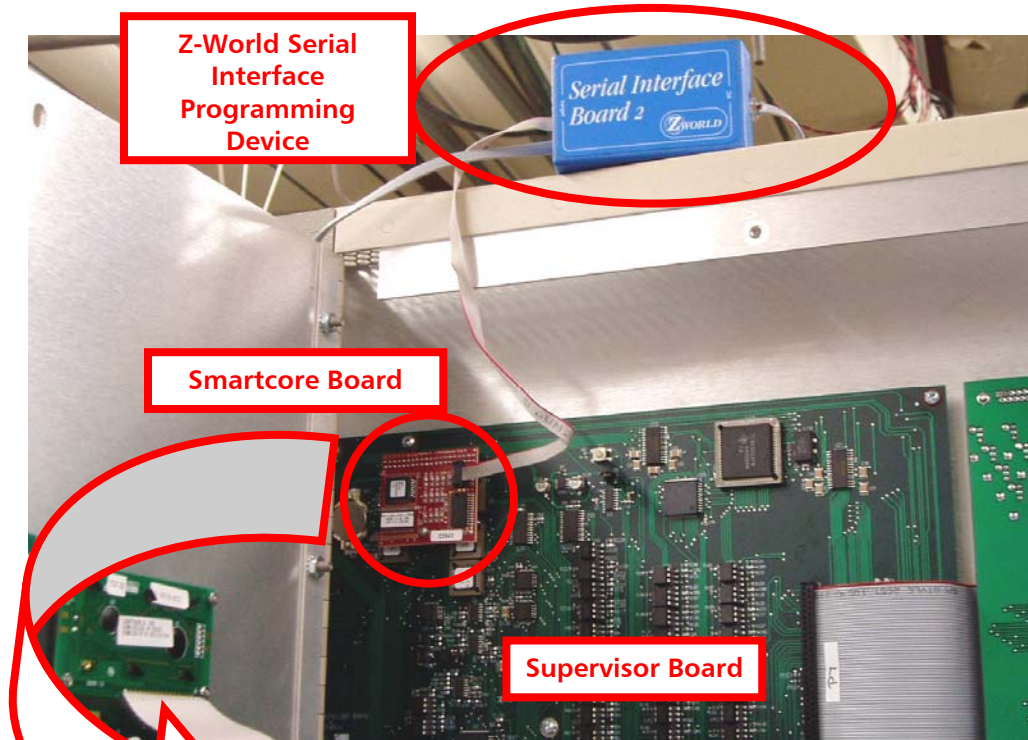


Figure 8 – Smart Core Board

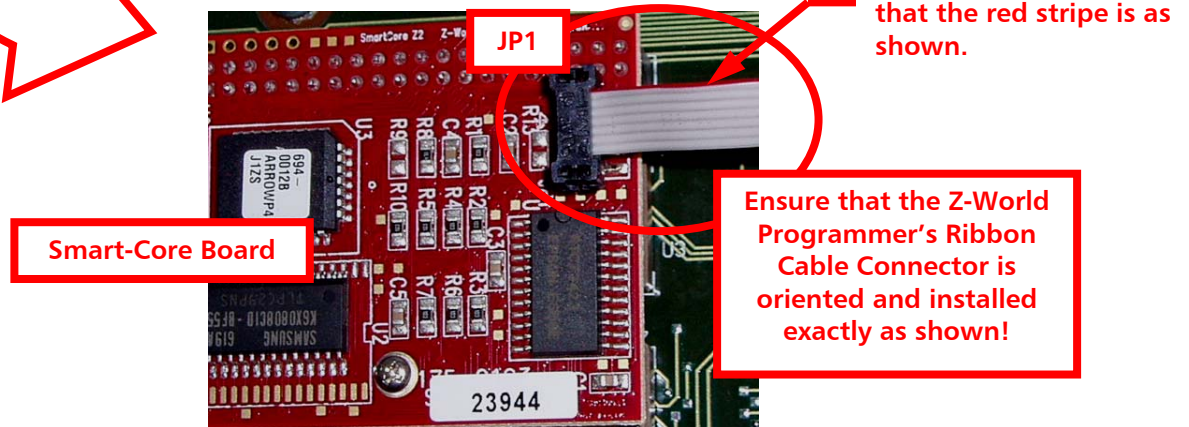


Figure 9 – Z-World Programming Connector Orientation

**Step 5** – Depress **Reset Switch S1** on the Supervisor board.

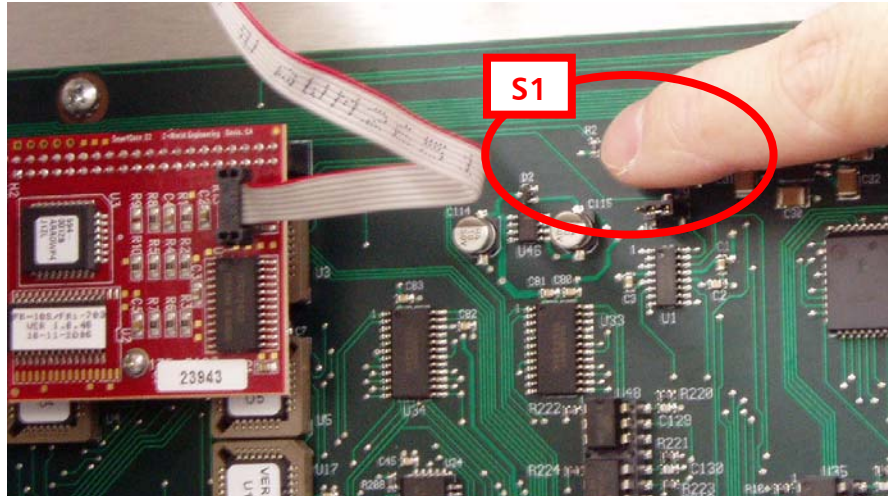


Figure 10 – Reset Switch S1

**Step 6** – Next, launch the “**prgloadr**” Programming Application by double clicking on the file.

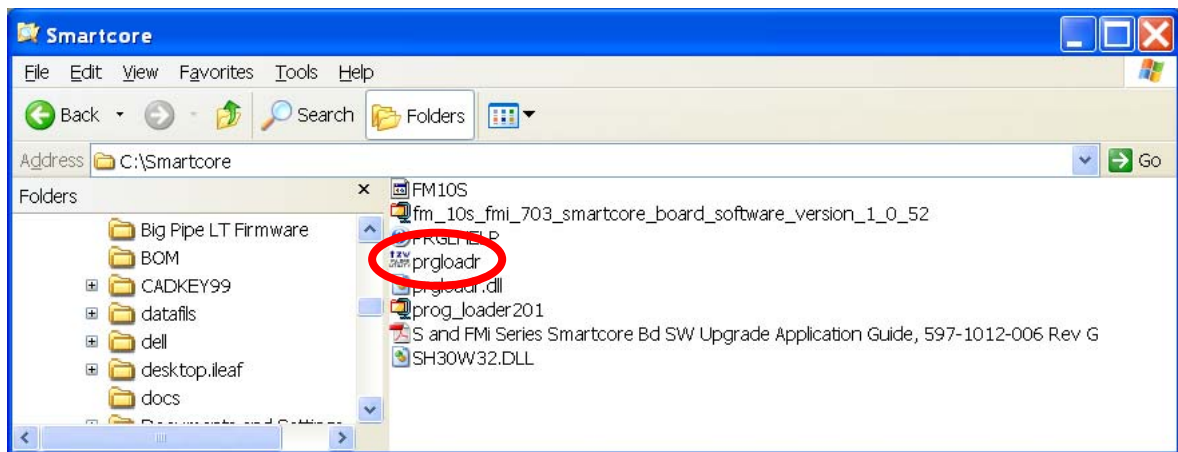


Figure 11 – Launch the “prgloadr” Application

**Step 7** – Upon launching the “**prgloadr**” Application, the resetting target screen will appear.

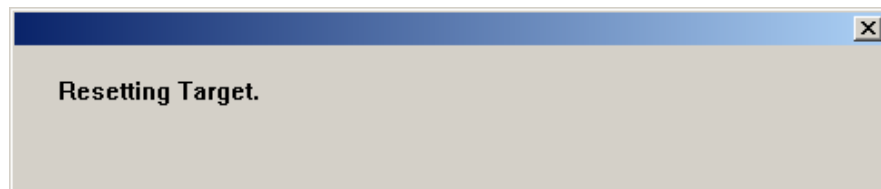
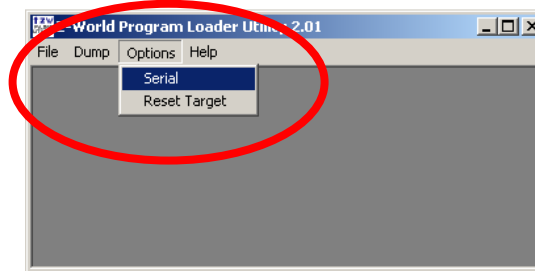


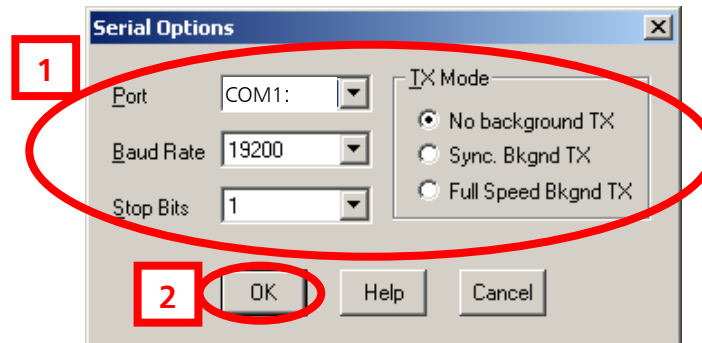
Figure 12 – Resetting Target

**Step 8** – Select the **Options**, then **Serial** to configure the communication protocol.



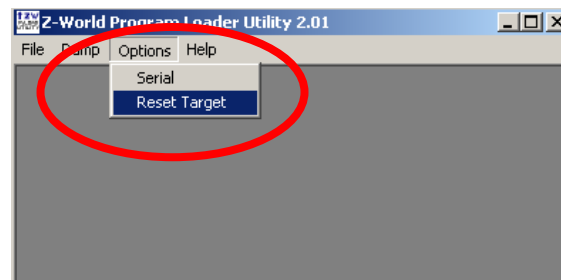
**Figure 13 – Options Menu**

**Step 9** – Set the **COM Port** (COM1 most common), **Baud Rate** to **19200**, and **Stop Bits** to **1**, ensure that **No background TX** is selected as shown, then select **OK**.



**Figure 14 – Serial Options**

**Step 10** – Next, select **Options** then **Reset Target**.



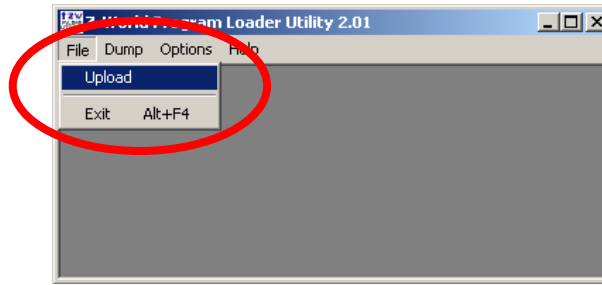
**Figure 15 – Reset Target**

**Step 11** – The **Resetting Target** screen will now appear.



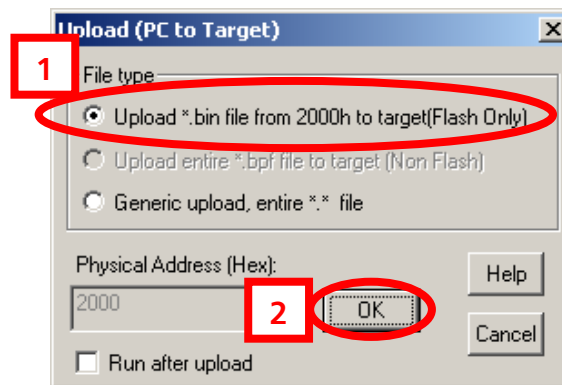
**Figure 16 – Resetting Target**

**Step 12** – Next, select **File** then **Upload**.



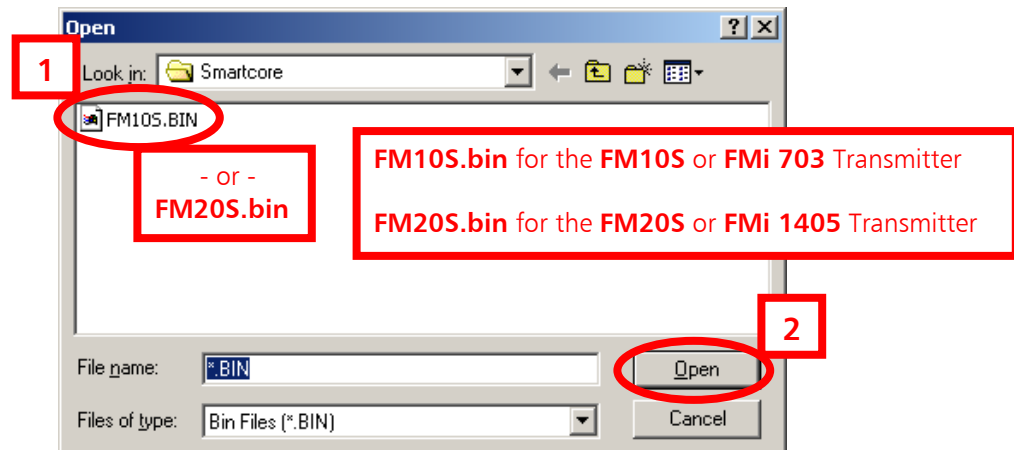
**Figure 17 – File Upload**

**Step 13** – Select the File type as shown.



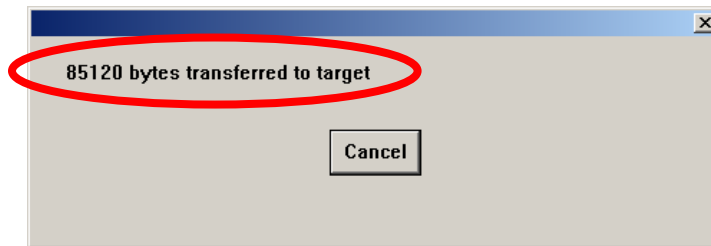
**Figure 18 – File Type to Upload**

**Step 14** – Navigate to the **C:\Smartcore** directory, select the **.BIN** file, then select **Open**.



**Figure 19 – Selecting the .BIN File for Upload**

**Step 15** – The following screen will appear indicating that the software load is in process. The bytes transferred to target number should increase steadily until complete.

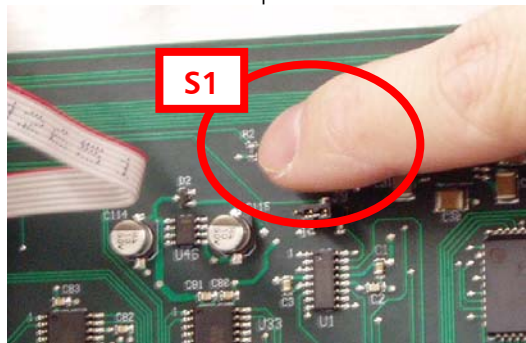


**Figure 20 – Bytes Transferred to Target Screen**

**Step 16** – Close the "Z-World Program Loader Utility 2.01" Programming Application on the PC.

**Step 17** – Disconnect the Z-World Programming Device from the JTAG connector on the Smartcore Board.

**Step 18** – Depress **Reset Switch S1** on the Supervisor board.



**Figure 21 – Reset Switch S1**

## 6 Upgrade U7 & U107 to v1.09

You **MUST** upgrade U7 and U107 on the Module Control Boards to v1.0.9 using Upgrade Kit 979-0505 (Qty 1 for FM 10S/FMi 703; Qty 2 for FM 20S/FMi 1405). Included in the Kits are detailed instructions (597-1012-007) for the upgrade.

### Note

If you upgraded from one of the following, proceed directly to **Section 10**.

**FM10S Transmitter running Smartcore Software v1.0.30 (or older)**

– or an –

**FM20S Transmitter running Smartcore Software v2.1.9 (or older).**

If you upgraded from a newer version than listed above, proceed to **Section 7** and **DO NOT** perform any of the steps in **Section 10**.

## 7 Upgrade U41 on the Exciter's Motherboard to v2.0

**Note:** Upgrading U41 is **ONLY** necessary if using the FXi Exciter with an **FMi 703** or **FMi 1405** Transmitter. If this is the case, you **MUST** upgrade U41.

Upgrade U41 on the Exciter's Motherboard to v2.0 using Upgrade Kit 979-0539-V20. Included in the Kit are detailed instructions (597-0541-009) for the upgrade.

## 8 Setup & Verify Transmitter Parameters After Upgrade

After upgrading the Smartcore Board software, verify that all of the transmitter's operating parameters are similar to as they were prior to the upgrade.

**Step 1** – Ensure that the Transmitter's RF Output is OFF (muted).

**Step 2** – Connect a Null Modem Serial Cable (not supplied) from the COM port of the PC to the RTDS port on the front of the Transmitter.

**Step 3** – Next, launch Windows HyperTerminal by going to **START -> ALL PROGRAMS -> ACCESSORIES -> COMMUNICATIONS -> HYPERTERMINAL**

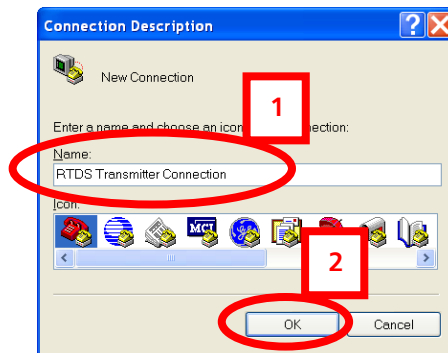
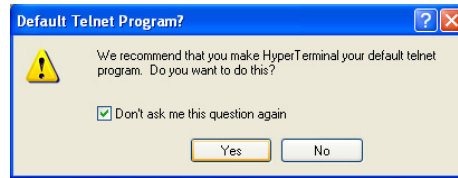


Figure 22 – HyperTerminal Connection Description Menu

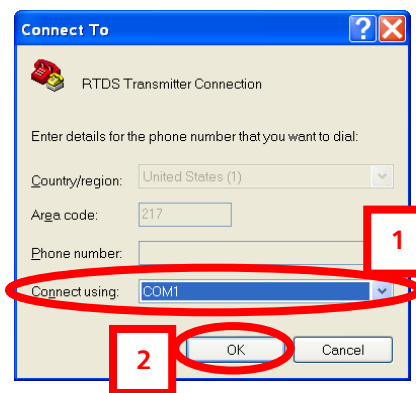


**Step 4** – The default telnet question box may appear. Select **Yes** if you want HyperTerminal to be your default telnet program. Select **No** if you do not want it to be.



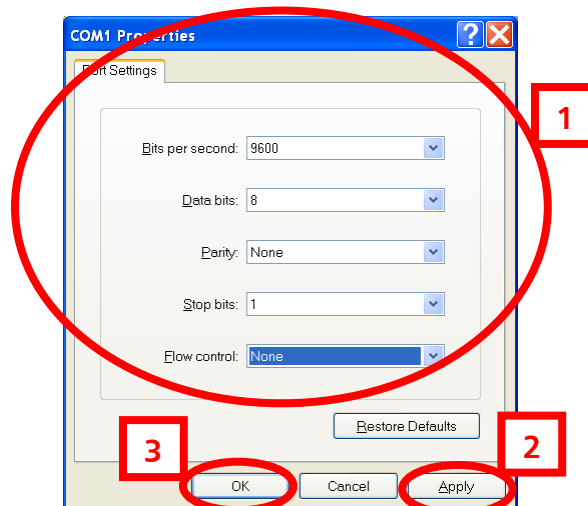
**Figure 23 – Default Telnet Program Menu**

**Step 5** – Select the appropriate connection port (**COM1** is the most common) from the pull down, then select **OK**.



**Figure 24 – HyperTerminal Connect To Menu**

**Step 6** – Configure the **Port Settings** as shown below, select **Apply** then **OK**.

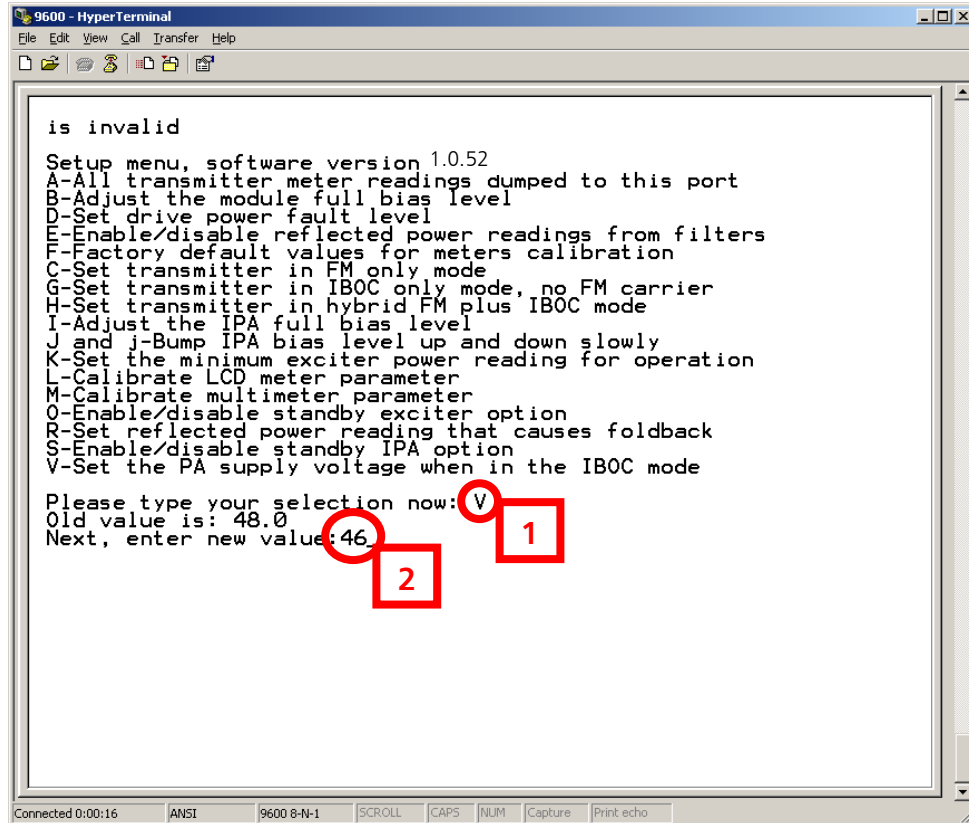


**Figure 25 – Port Settings Menu**



**Step 7** – This step is **ONLY** necessary for an **FMi 703** or a **FMi 1405** Transmitter.

It is necessary to change the PA supply voltage (PAV) from 48V to 46V (ensure that U41 has been upgraded on the Exciter's Motherboard to v2.0 first). This decrease in PAV will also improve the reliability of the PA Modules. Once the HyperTerminal window appears, hit the **<Enter>** key. When the command prompt appears, type **"V"**, then type **"46"** and press **<Enter>**.



**Figure 26 – HyperTerminal (set PAV to 46 volts)**

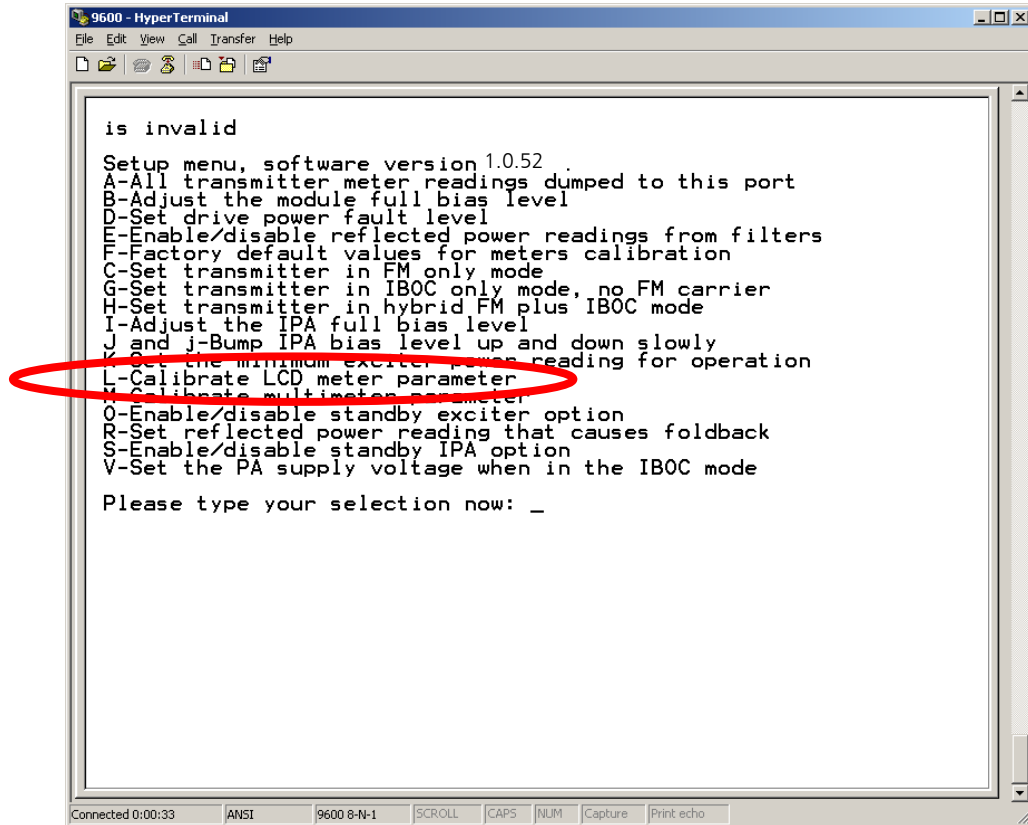
**Step 8** – Turn the Transmitter's RF Output to ON. The new FMi 703 and FMi 1405 transmitter code implements a soft start feature and upon turn on, fault reset, or module fault. This soft start gets the transmitter up to approximately 35% power instantaneously, then the power will ramp to approximately 75% power within 5 seconds, then the power will ramp slowly to full rated power. This last ramp can be from 45-60 seconds. This soft start prevents any overdrive conditions from occurring and thus protecting the PA modules.



**Figure 27 – Turn Transmitter's RF Output ON**



**Step 9** – The new transmitter code allows the LCD meter to be calibrated in any of the three operating modes. So, if you are in HD only mode and need to re-calibrate the meter you simply type "L" at the command prompt in HyperTerminal then enter the value taken from the external power meter. You can also do this in FM+HD mode or FM Only mode, however the cal factors for FM Only and FM+HD are the same so if you re-cal the LCD in FM+HD it affects the FM Only LCD as the values have proven to be the same.



**Figure 28 – Calibrate LCB Panel Meter**

**Note:** If calibrating in an HD mode of operation, a “true average” external power meter must be used.

**Step 10** – Next, the HyperTerminal command window should appear. At the prompt, type “A” to display the transmitter’s present operating parameters. Verify that the “**Software Revision Level**” has incremented and the transmitter’s present “**Operating Parameters**” are similar to what was recorded prior to the upgrade.

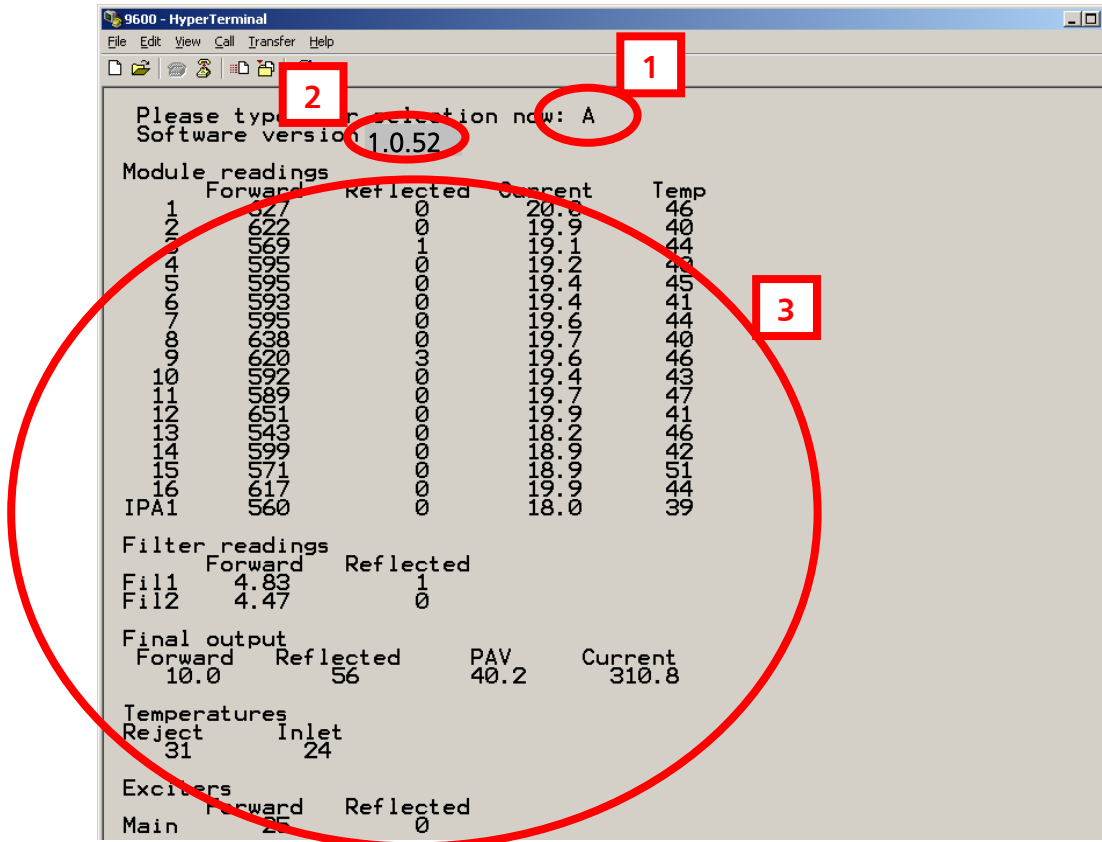


Figure 29 – HyperTerminal Command Window

**Step 11** – If operating in an HD mode, it is **MANDATORY** that an HD spectral measurement be performed! If operating in an HD mode proceed to **Section 9**.

## 9 FM HD Spectral Measurements

This section describes the technique for accurately tuning and measuring the FM HD Radio™ Spectrum of an FMi 703 or FMi 1405 Transmitter.

### 9.1 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 30 - FM HD Radio™ Spectral Emissions Limits Mask in Tabular Form

Figure 31 shows the FM spectral emissions limits mask for HD. The limits shown are the implementation of the table in Figure 30 above.

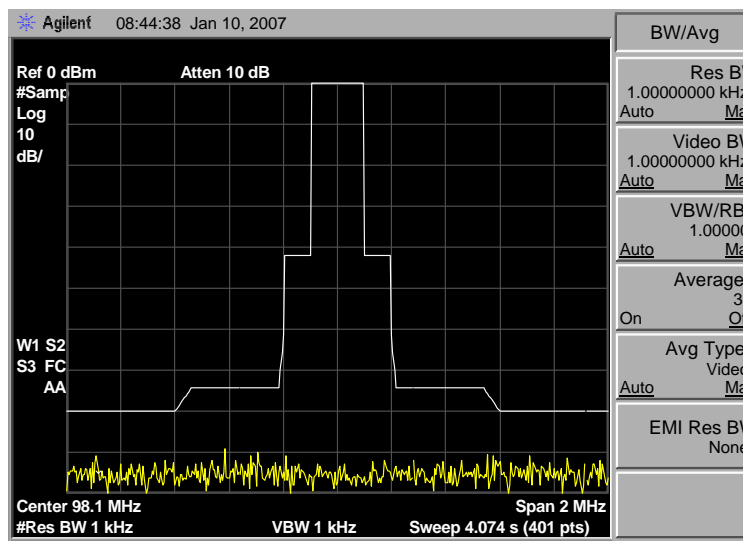


Figure 31 - FM HD Radio™ Spectral Emissions Limits Mask in Graphical Form

## 9.2 Setting up the Spectrum Analyzer

### 9.2.1 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 9.2.2.

### 9.2.2 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 32. 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.

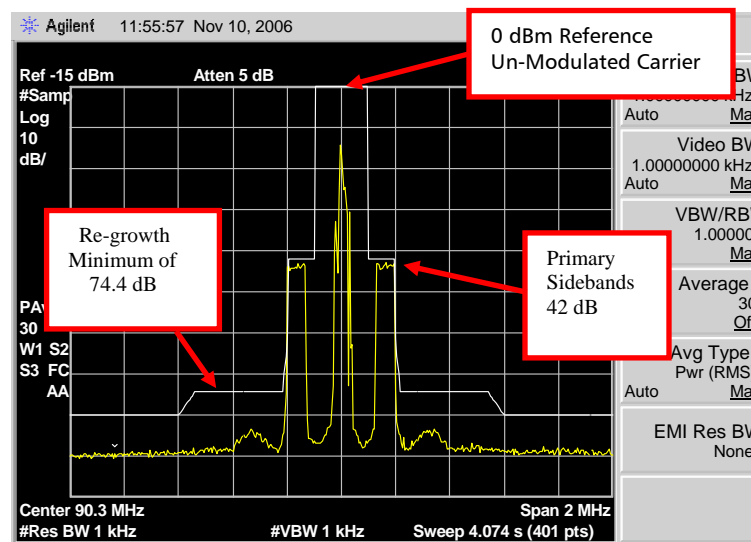


Figure 32 – Properly Aligned FM HD Radio™ Spectrum

### 9.3 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

### 9.4 Set the PA Bias Level

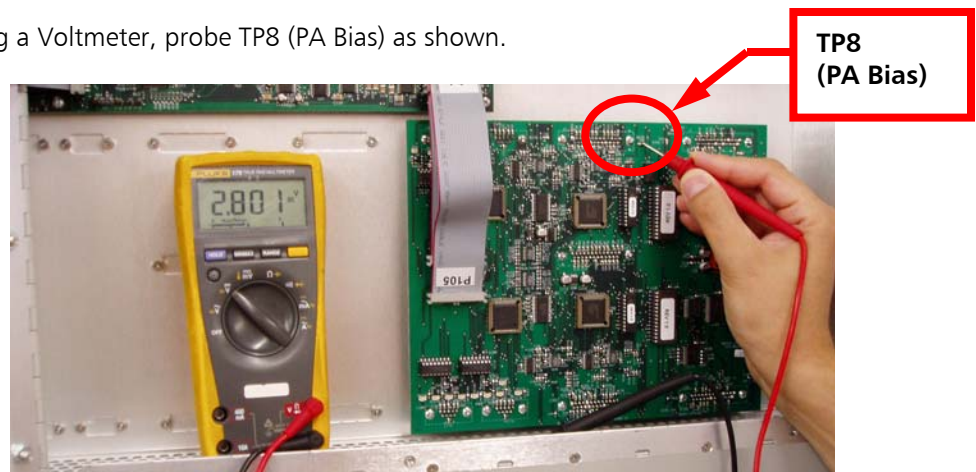
**Step 1** – Establish HyperTerminal communication with the Transmitter using a Null Modem Cable @ 9600, N, 8, 1 and connect to the d-sub connector on the front of the transmitter.

**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.



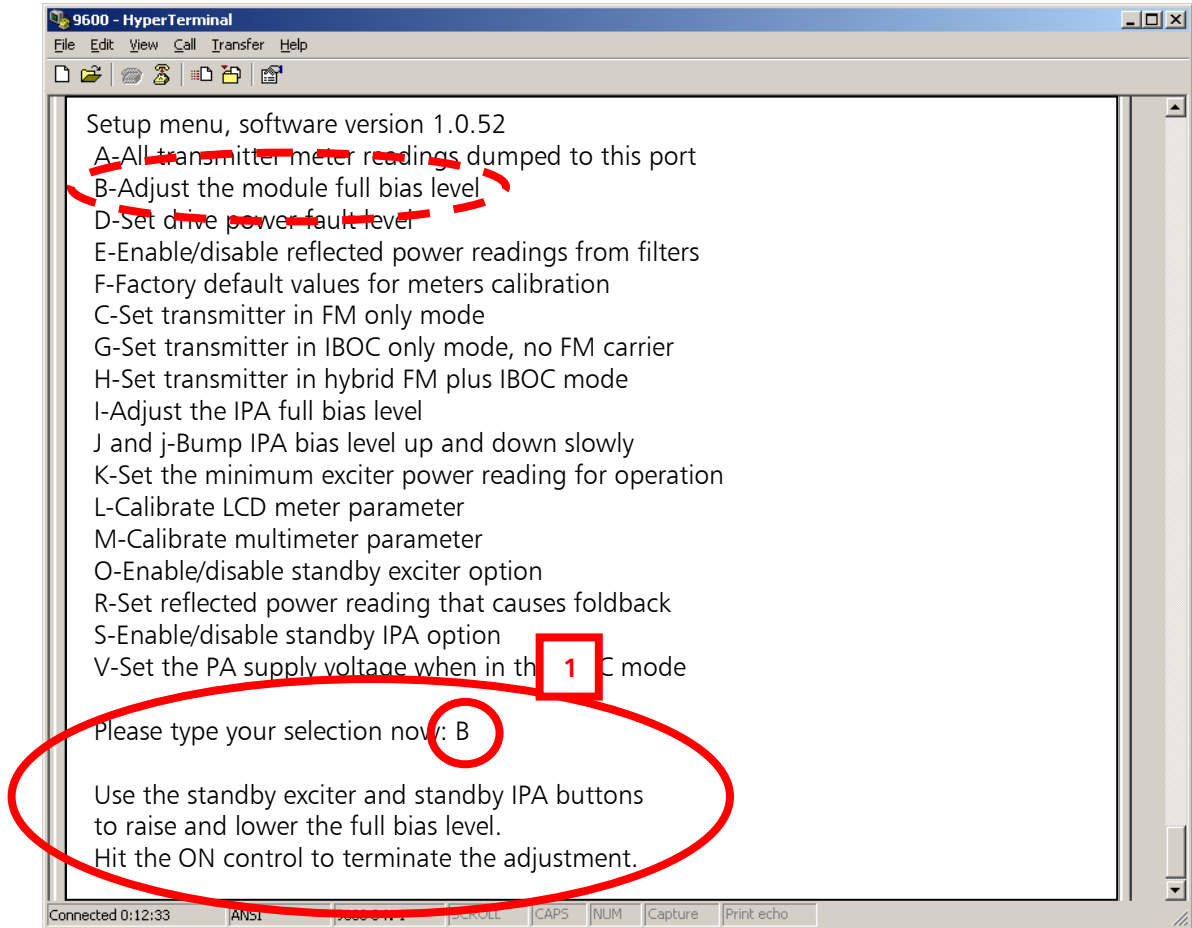
**Figure 33 – TP8 (PA Bias Voltage)**

< proceed to the next page >

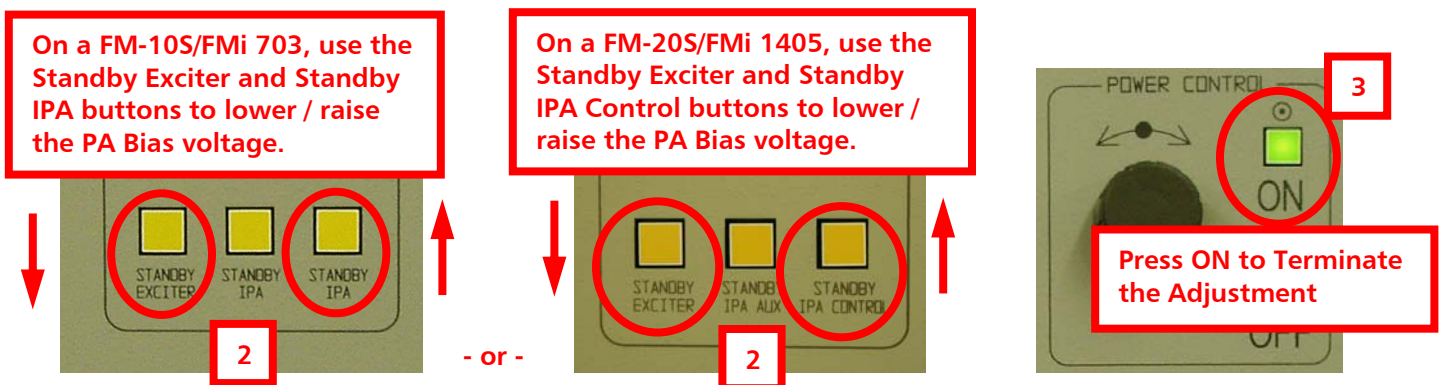
**Step 6** – See Figures 34 and 35 below. Press “B” on the keyboard and follow the on screen instructions for raising / lowering the PA Bias Voltage. The PA Bias Voltage should be adjusted to the approximate values using the Standby Exciter button to lower the value and Standby IPA to raise the value. 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)



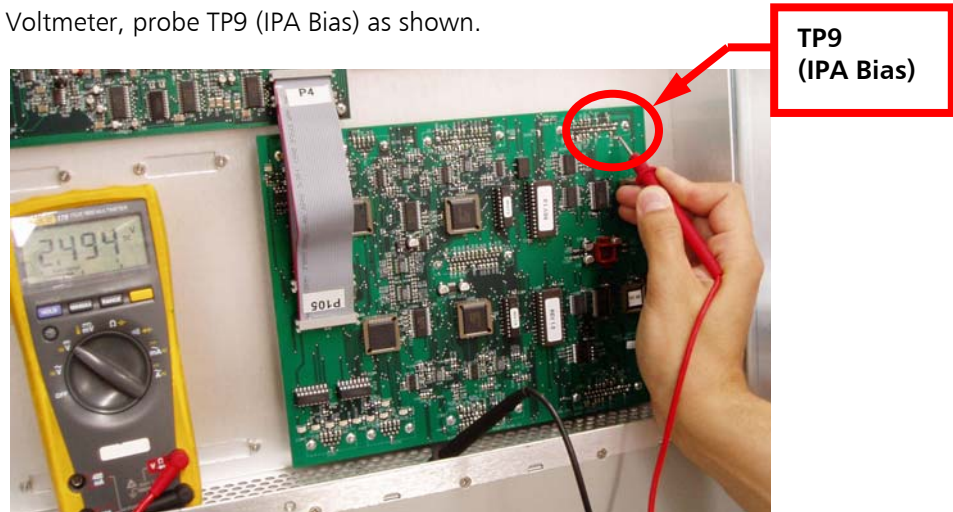
**Figure 34 – PA Bias Voltage Adjustment**



**Figure 35 – PA Bias Voltage Adjustment**

## 9.5 Set the IPA Bias Level

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



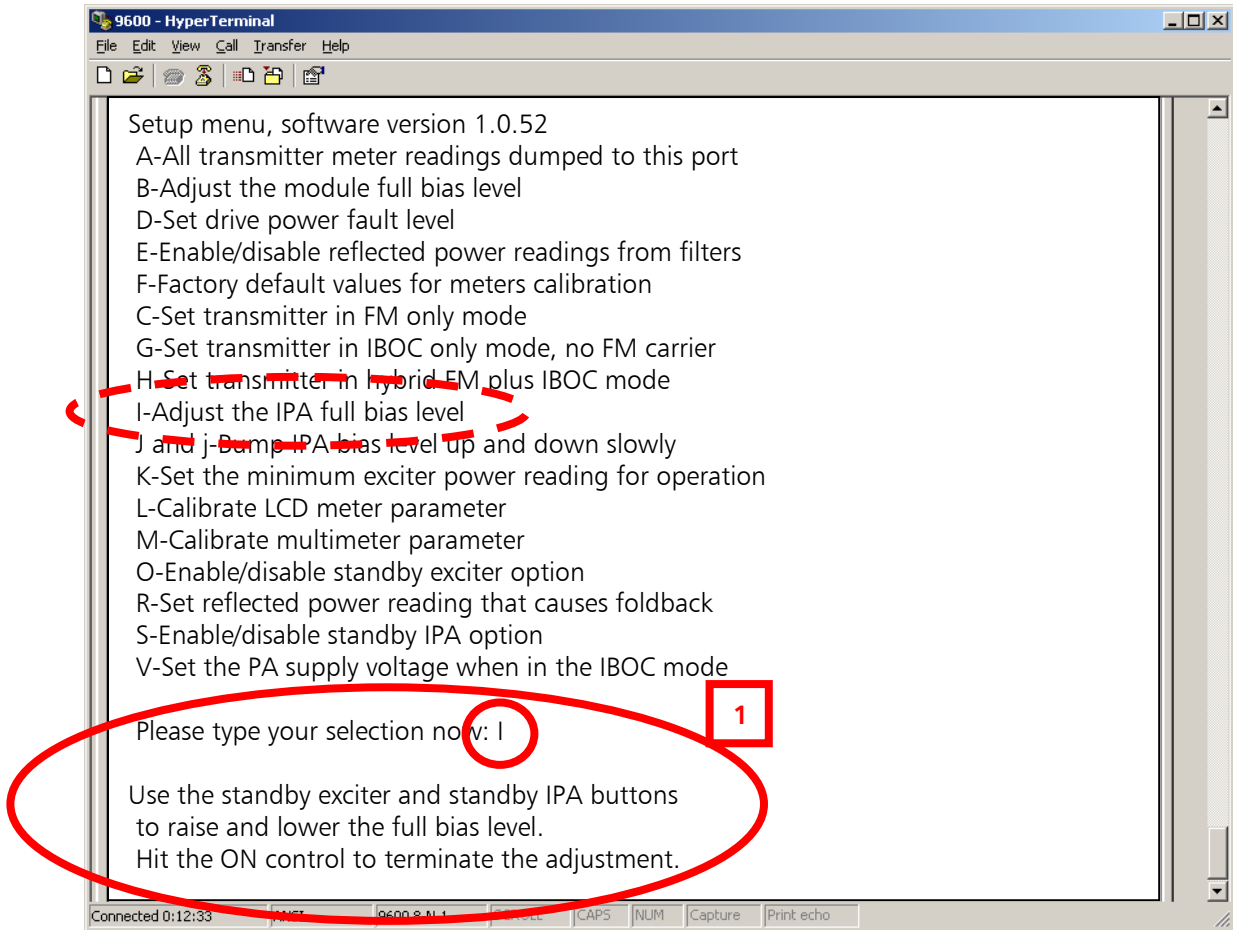
**Figure 36 – TP9 (IPA Bias Voltage)**

< proceed to the next page >

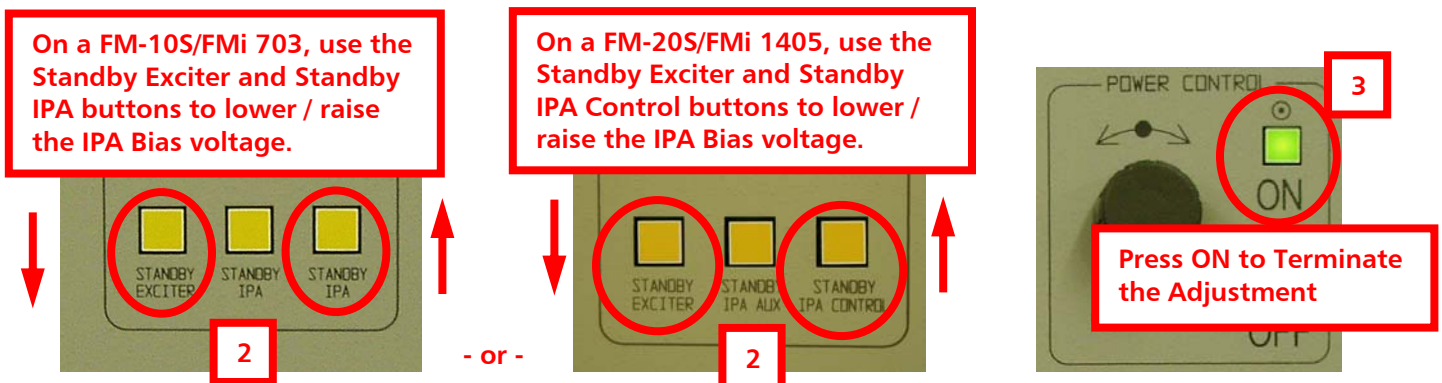
**Step 2** – See Figures 37 & 38 below. Press “I” and follow the on screen instructions for raising / lowering the IPA Bias Voltage. The IPA Bias Voltage should be adjusted to the approximate values using the Standby Exciter button to lower the value and Standby IPA to raise the value. When the desired 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 37 – IPA Bias Voltage**



**Figure 38 – IPA Bias Voltage Adjustment**



## 9.6 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 40 below).

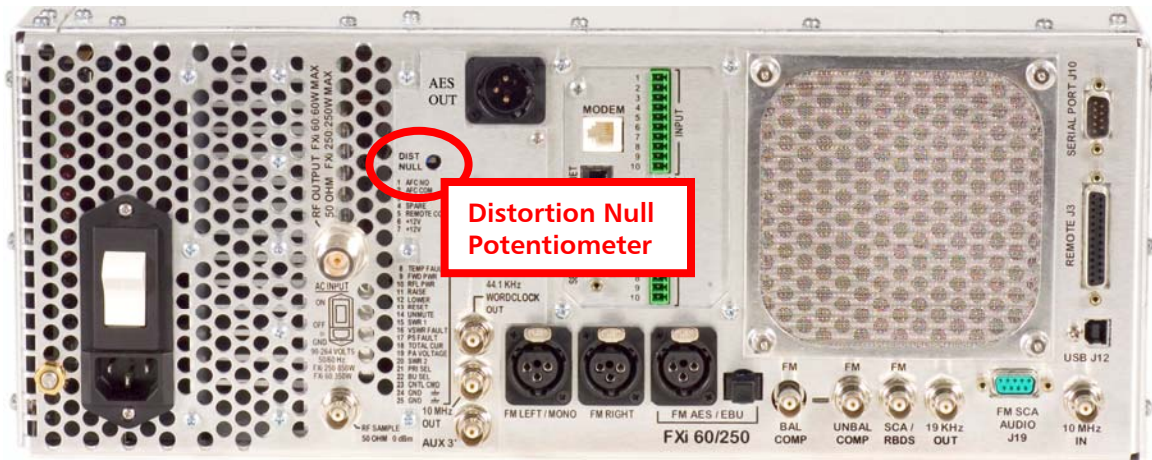


Figure 39 – Distortion Null Adjustment

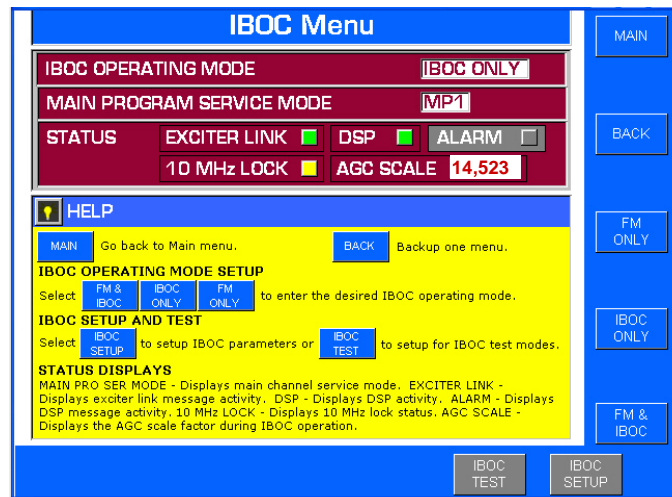


Figure 40 – AGC Scale Factor

## 9.7 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.

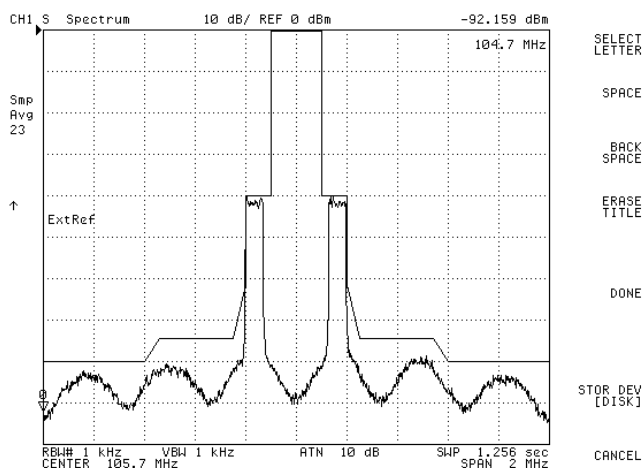


Figure 41 – Typical Properly Aligned HD Only Spectrum

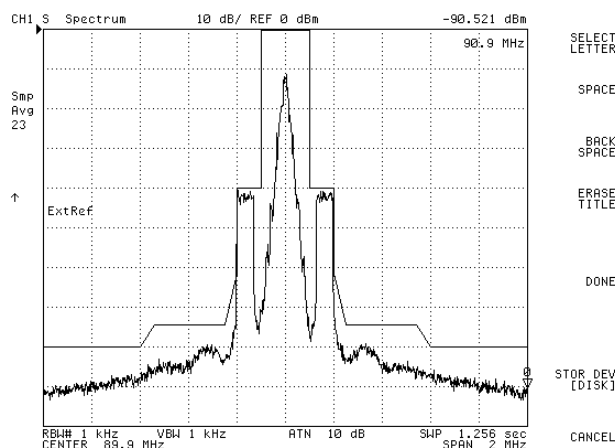


Figure 42 – Typical Properly Aligned FM+HD (Hybrid) Spectrum

## 10 Transmitter Front Panel Multimeter Calibration

**NOTE:** This section discusses the necessary steps to calibrate the transmitter's front panel multimeter Exciter Frequency, Exciter FWD PWR, and Transmitter's FWD Power after upgrading software. This procedure is **ONLY** necessary if the transmitter you have upgraded was either of the following:

**FM10S Transmitter running Smartcore Software v1.0.30 (or older)**

– or an –

**FM20S Transmitter running Smartcore Software v2.1.9 (or older)**

**Step 1** – Ensure that an **External Watt Meter** is connected to the Transmitter's RF Output.

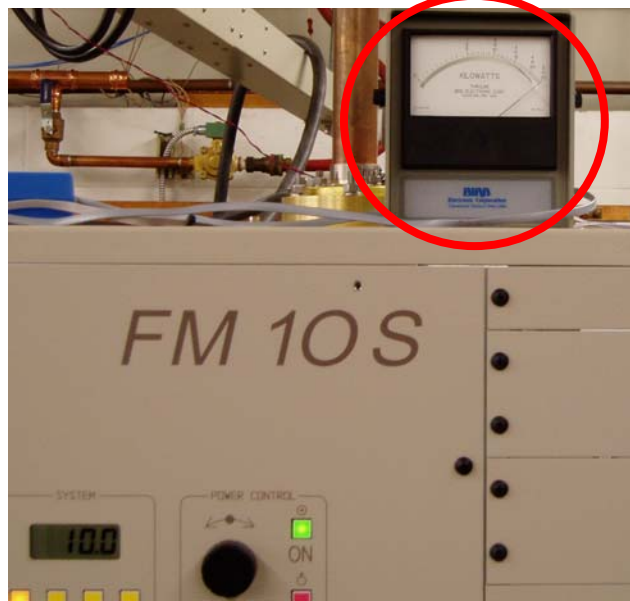
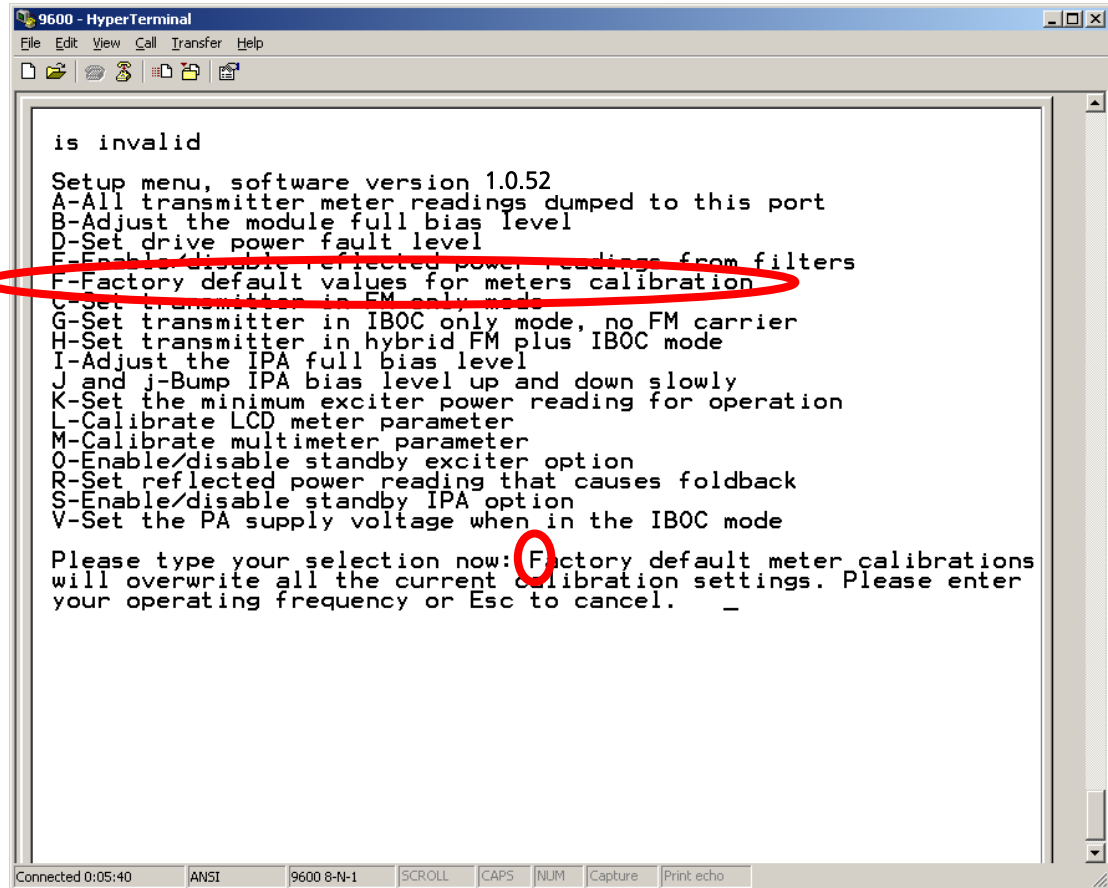


Figure 43 – External Watt Meter

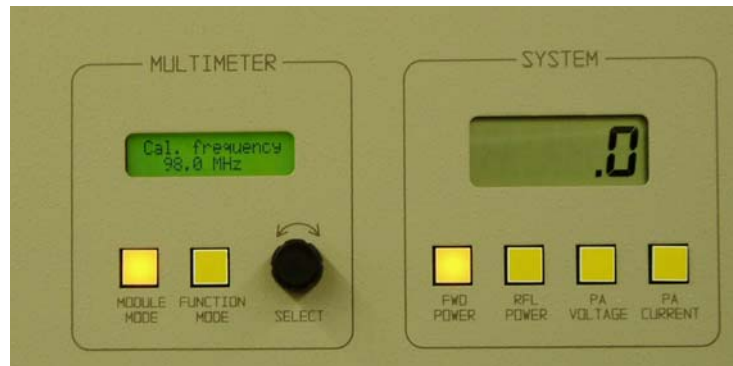
**Step 2** – Establish communication with the transmitter using HyperTerminal.

**Step 3** – At the HyperTerminal command prompt, type “F”.



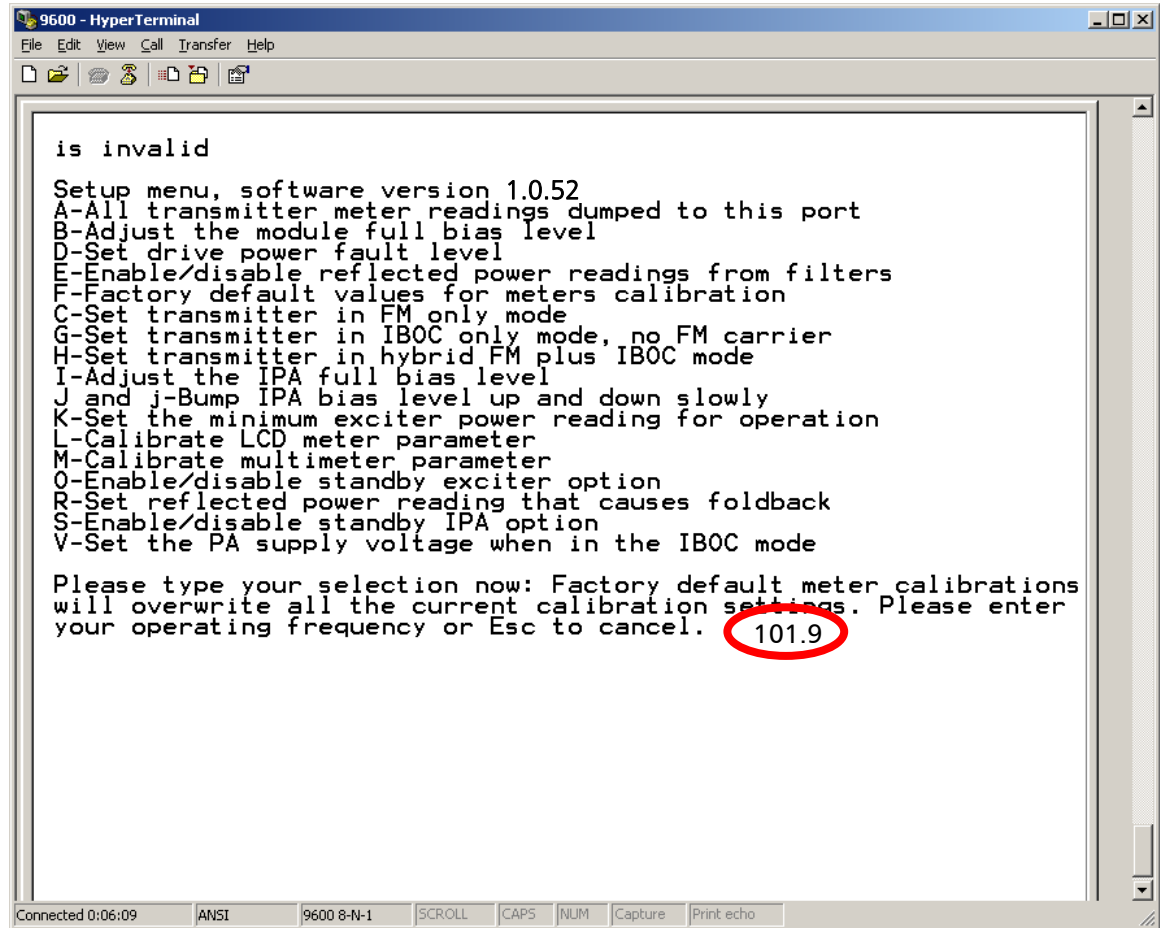
**Figure 44 – Transmitter Meter Calibration**

**Step 4** – Turn the **SELECT** knob until the **Cal. frequency** is displayed on the transmitter’s multimeter. Please note that the default **Cal. frequency** is **98.0 MHz**.



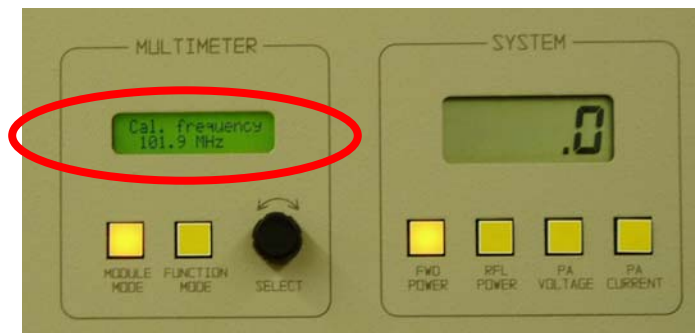
**Figure 45 – Transmitter Meter Calibration**

**Step 5** – Next, type the Transmitter’s Frequency then hit <Enter>. The **Cal. frequency** must be the exact same as that of the exciter.



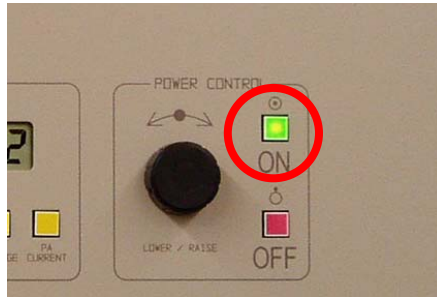
**Figure 46 – Transmitter Frequency Calibration**

**Step 6** – The **Cal. frequency** should now display the value entered in **Step 5**.



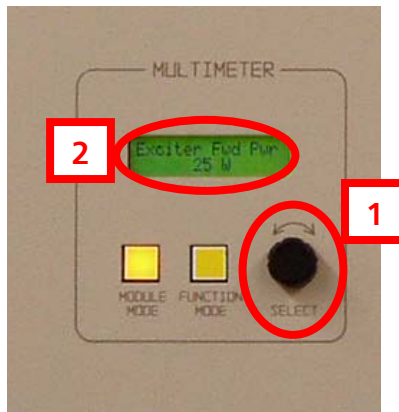
**Figure 47 – Transmitter Meter Calibration**

**Step 7** – Next, press the **ON** button to turn the transmitter's **RF Output** to **ON** (un-mute).



**Figure 48 – Turn Transmitter's RF Output ON**

**Step 8** – Using the Multimeter selector knob, go to **Exciter Fwd Pwr**.



**Figure 49 – Multimeter Exciter Fwd Pwr**

**Step 9** – To calibrate the transmitter's **Exciter Fwd Pwr** meter, type "**M**", then type either **25** (for a **FM10S**) or **50** (for a **FM20S**) and press **<Enter>**. This value is the Exciter's Output Power Level. Ensure that the Exciter is set at the proper level for your specific transmitter!

**Note:** If a Standby Exciter Kit is installed, repeat Steps 8 – 9 while the Standby Exciter is online.

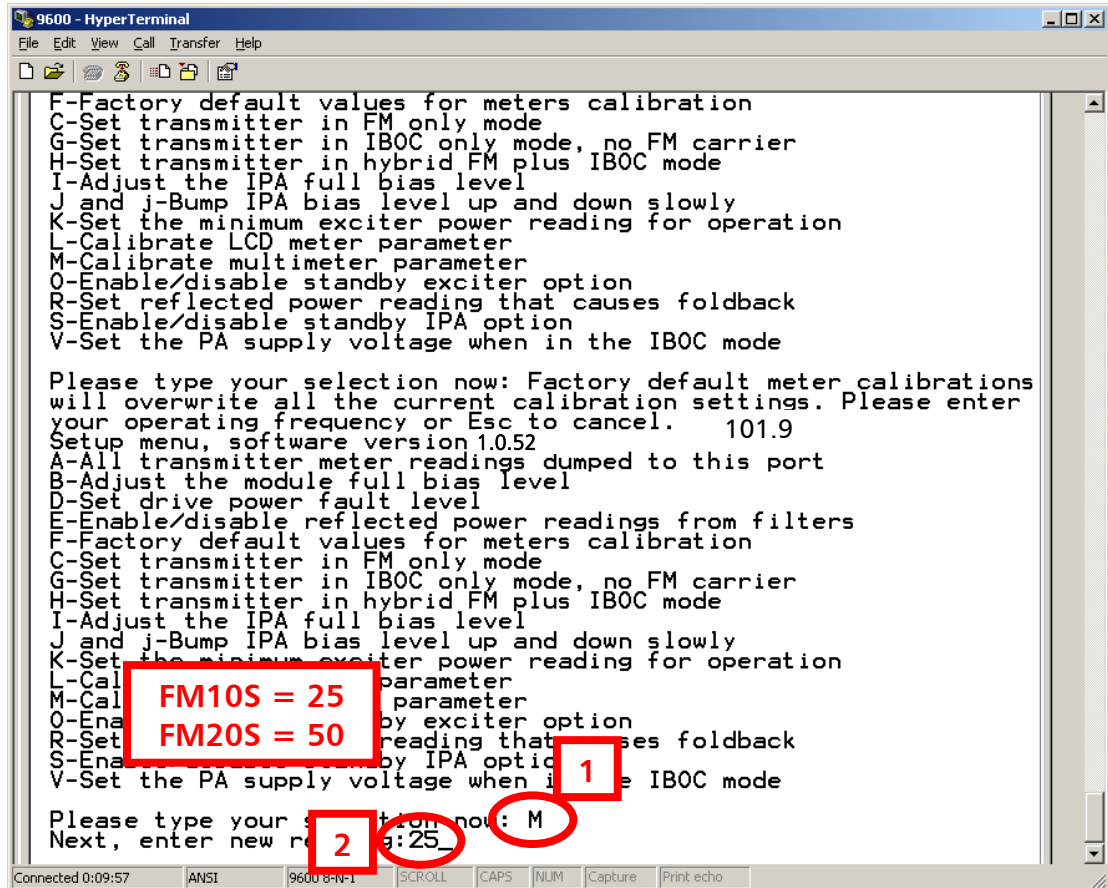


Figure 50 – Transmitter Meter Calibration

**Step 10** – Using the **Power Control Knob**, raise the transmitter's **RF Output Power** until TPO has been achieved on the **External Watt Meter**.

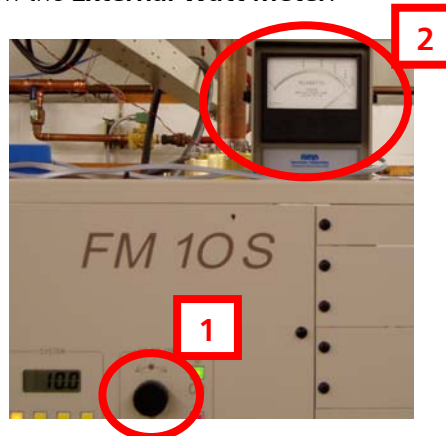


Figure 51 – Transmitter Fwd Pwr Calibration



**Step 11** – Next, type “L” and then enter the TPO level (in kW) from the External Watt Meter (10 for this example), then type <Enter>.

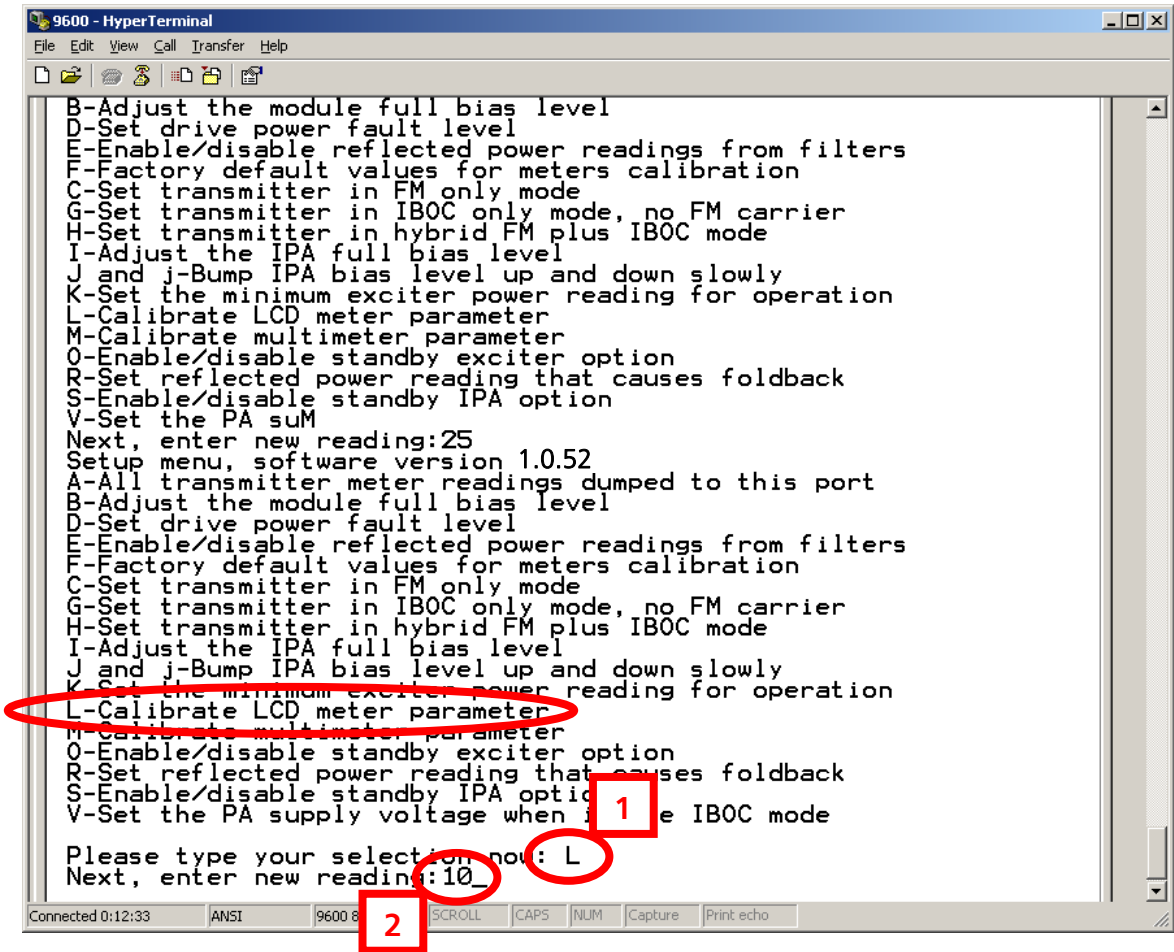


Figure 52 – Transmitter Fwd Pwr Meter Calibration

**Step 12** – The transmitter’s **Fwd Pwr Meter** should now read the value entered in **Step 10**.

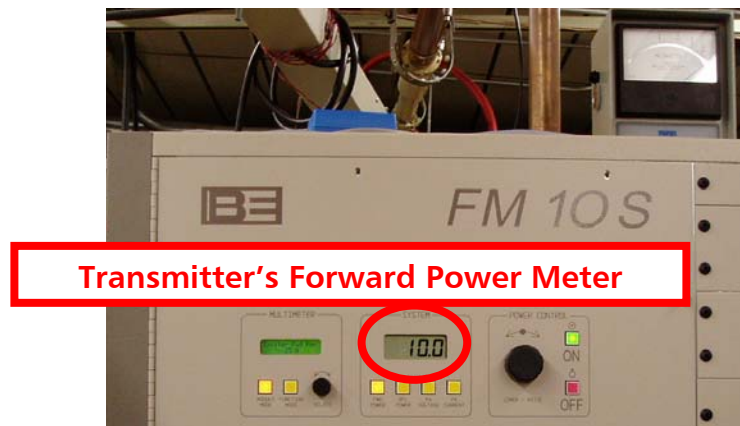


Figure 53 – Transmitter Fwd Pwr Meter Calibration





**Step 13** – Type “A” to display the transmitter’s present operating parameters. Verify that the “Software Revision Level” has incremented and the transmitter’s present “Operating Parameters” are similar to what was recorded prior to the upgrade (see **Section 4** for additional information).

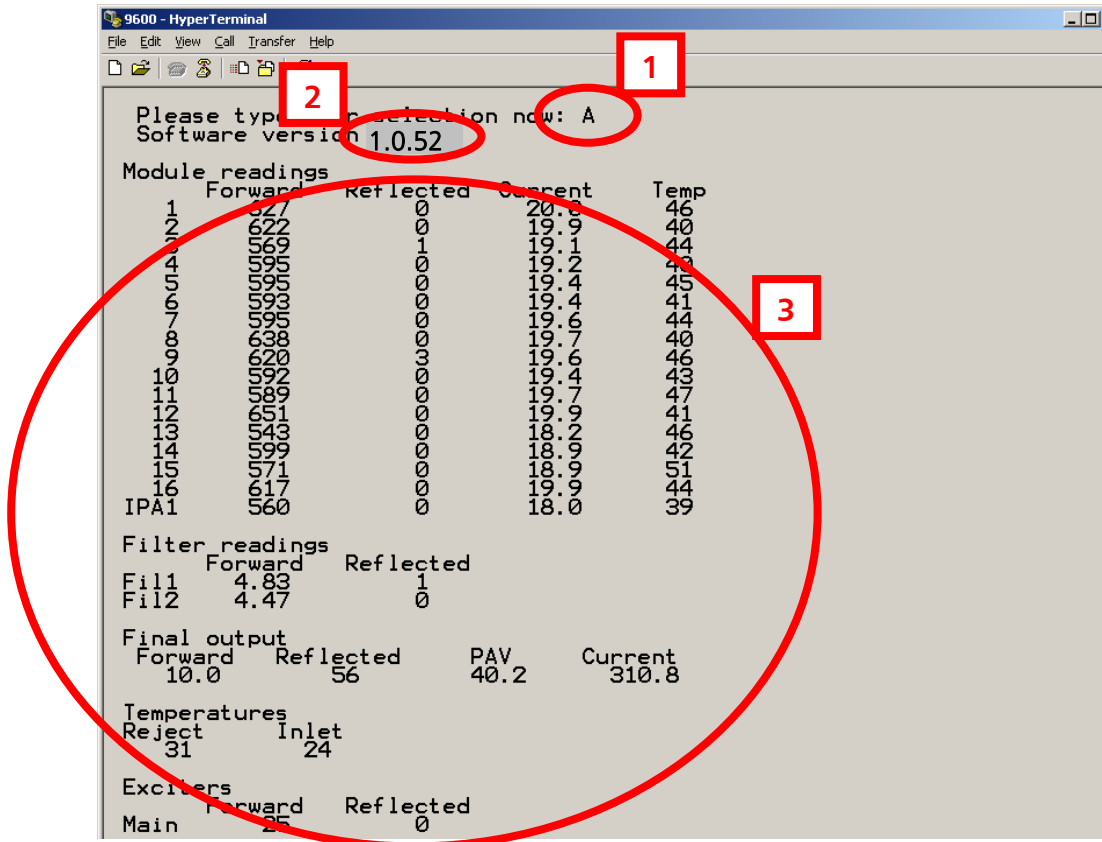


Figure 54 – HyperTerminal Command Window

## 11 RF Technical Services Contact Information

RF Technical Services -

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