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4MX 25, 50 and 100 Series AM Transmitter

HD Operation Application Guide

Enable HD Operation by Installing an ASI 10 HD Signal Generator

597-4050-004, Revision B
5/22/08

**4MX 25, 50 and 100
Series AM Transmitter
HD Operation Application Guide
Enable HD Operation by Installing an ASi 10 HD Signal Generator**

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1. 4MX Transmitter HD Radio™ Operation Setup

1.1. Overview

4MX Series AM Transmitters are fully HD Radio™ compatible with the connection of an external ASi 10 HD Signal Generator. See the ASi 10 Manual for additional information.

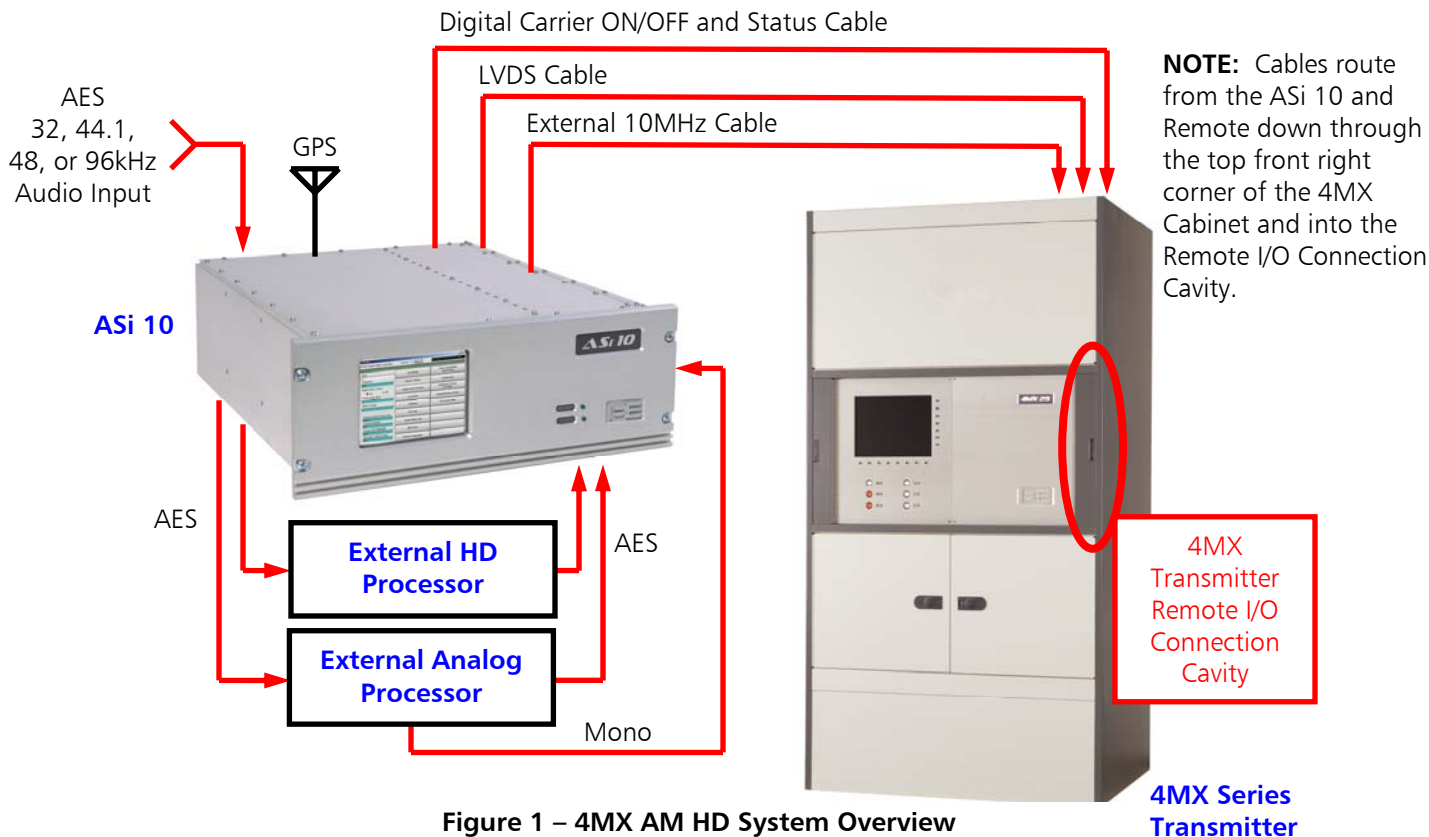


Figure 1 – 4MX AM HD System Overview

1.2. Tools / Items Required for Installation

- ☐ ASi 10 HD Signal Generator (909-6026-MB3)
- ☐ ASi 10 Installation Kit (979-0544)
- ☐ 4MX Installation Kit (977-4051)
- ☐ 19" Wide ancillary equipment rack (not supplied)
- ☐ Tools for installation of Rack Hardware (not supplied)
- ☐ No. 2 Phillips Screwdriver (not supplied)
- ☐ Small Flat Blade Screwdriver (not supplied)
- ☐ External Mouse (not supplied – must be connected to change I.P. Address)
- ☐ External Keyboard (not supplied – must be connected to change I.P. Address)
- ☐ Modulation Monitor (not supplied)
- ☐ Spectrum Analyzer (not supplied)

1.3. Estimated Time for Installation

It will take approximately 1 hour to install and setup the ASi 10 with a 4MX transmitter. Please note that the transmitter will be off of the air during this process.

2. Turn the 4MX AC Breaker to OFF

Turn the **4MX's AC Breaker** (located on the rear of the transmitter) to **OFF** before proceeding with the Installation of the ASi 10.

3. Install the ASi 10 Digital Signal Generator

Install the **ASi 10 Digital Signal Generator** into an ancillary 19" wide (48.3 cm) equipment rack near the transmitter, STL link, and Audio Processing equipment. The **ASi 10** requires 7" (17.78 cm) height of rack space.



Figure 2 – ASi 10 Signal Generator

4. Connect External Mouse and Keyboard

Connect an External Mouse and Keyboard to the appropriate "labeled" jacks (NOT USB ports) of the ASi 10. A mouse and keyboard **MUST** both be connected to change the I.P Address. Please note that the ASi will ONLY recognize the Mouse and Keyboard when the operating system boots up.

5. Turn the ASi ON

Connect the AC Power Cord to the unit and turn the AC Power Switch to ON.



6. Verify / Enter Critical System Settings

6.1. Enter the IP Address and Subnet Mask of the ASi 10

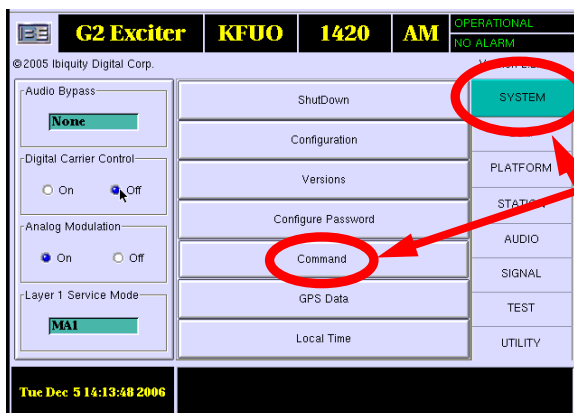


Figure 3 – Command Menu

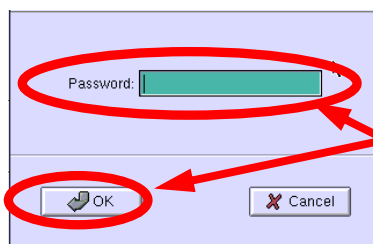


Figure 4 – Password Menu

Uncheck the virtual keyboard box as shown

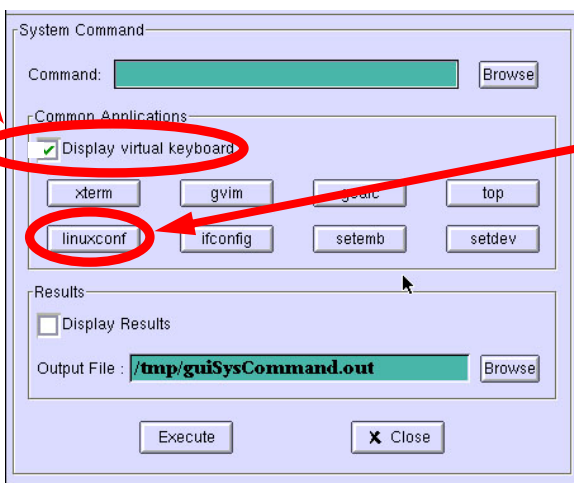


Figure 5 – linuxconf Menu

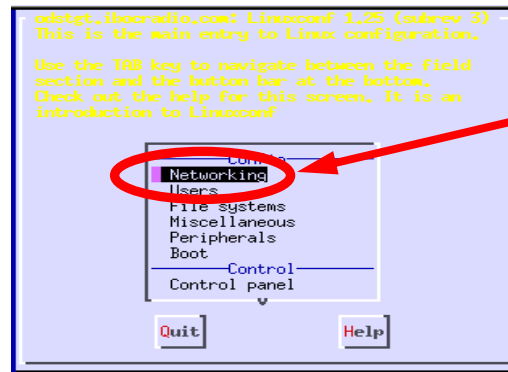


Figure 6 – Networking Menu

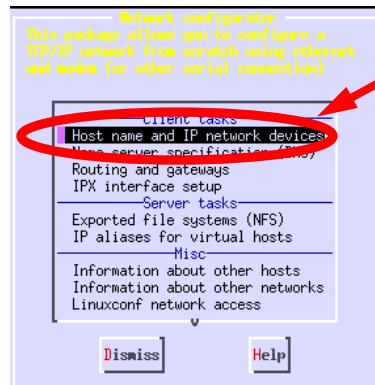


Figure 7 – Host name and IP network devices Menu

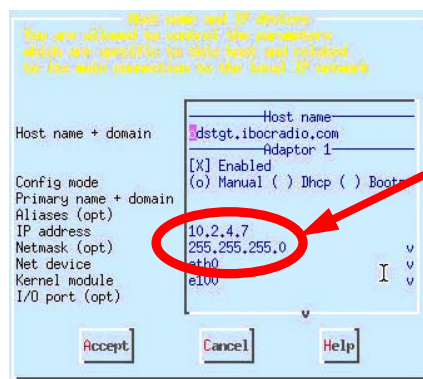
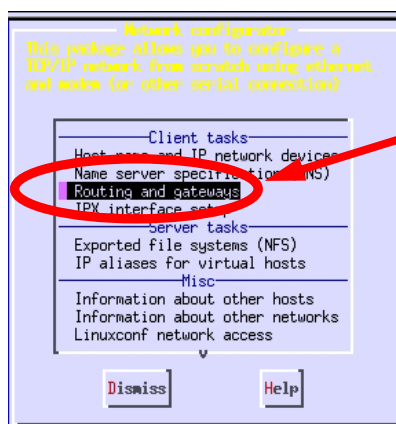


Figure 8 – Networking Sub-Menu



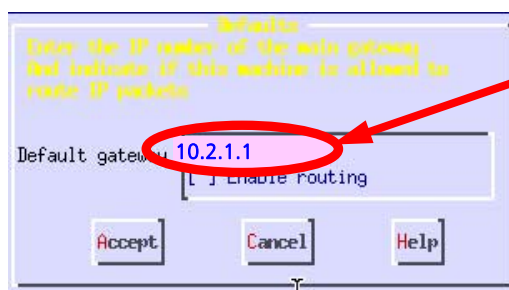
Step 7 – If you are using a Gateway, select **Routing and Gateways** then **<Enter>** on the keyboard

Figure 9 – Client , Server, and Misc Tasks Menu



Step 8 – Select **Defaults** then **<Enter>** on the keyboard

Figure 10 – Client , Server, and Misc Tasks Menu



Step 9 – Enter the Gateway Address for your network (if applicable)

Figure 11 – Gateway Menu

- Step 10** - Press **<TAB>** , type **A** to Accept, then press **<Enter>** on the keyboard.
- Step 11** - Press **<TAB>** , type **D** to Dismiss, then press **<Enter>** on the keyboard.
- Step 12** - Press **<TAB>** , type **Q** to Quit, then press **<Enter>** on the keyboard.
- Step 13** - Press **<TAB>** twice to highlight **Do It**, type **D**, then press **<Enter>** on the keyboard.
- Step 14** - The Command window should now be displayed.

6.2. Verify / Enter the Station Information

Verify that the Station Information was set at the factory.

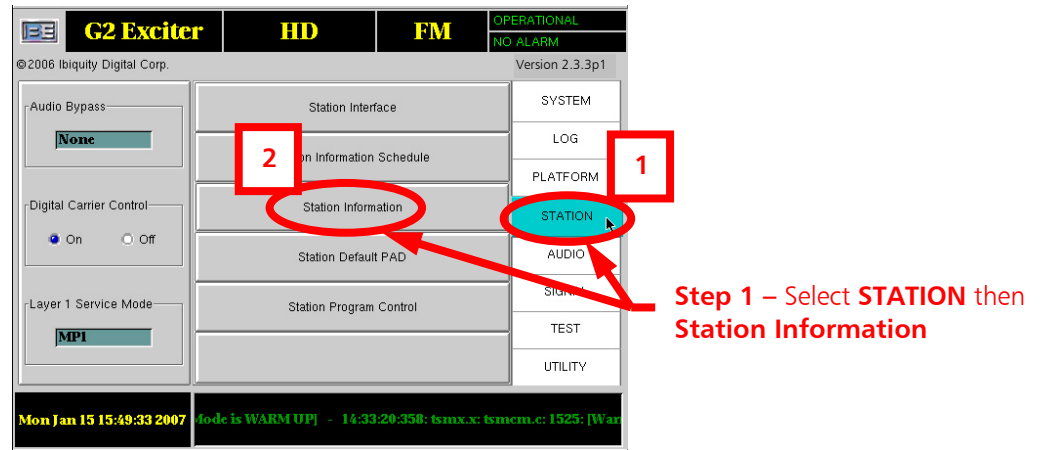


Figure 12 – Station Information

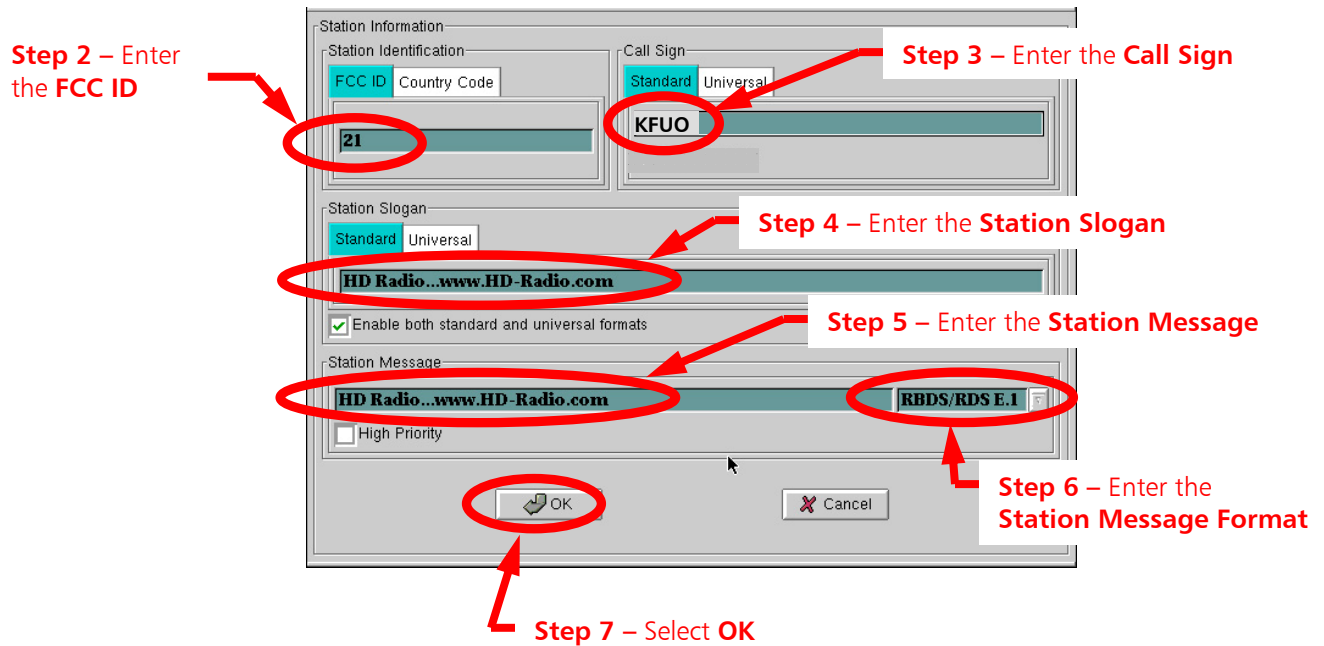


Figure 13 – Station Information Menu

6.3. Verify / Enter I/Q Scale Factor

The I/Q Scale Factor should have been set at the factory but it is good to verify.

Step 1 - When the ASI GUI appears, select **SIGNAL**, then **I/Q Scale Factor**.

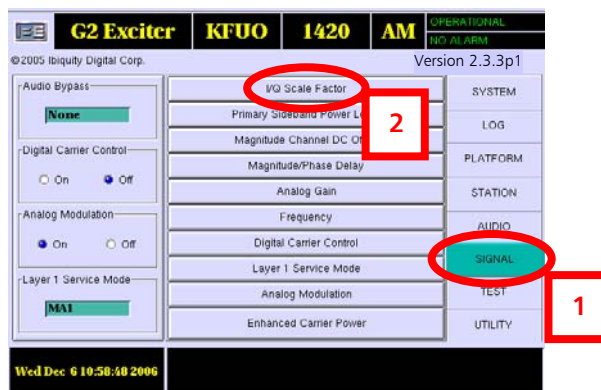


Figure 14 – I/Q Scale Factor

Step 2 – The **I/Q Scale Factor** MUST be set **12000.0**.



Figure 15 – I/Q Scale Factor

6.4. Verify / Enter Sideband Level Settings

The Sideband Level settings should have been set at the factory but it is good to verify.

Step 1 - Select **SIGNAL**, then **Primary Sideband Power Level**.

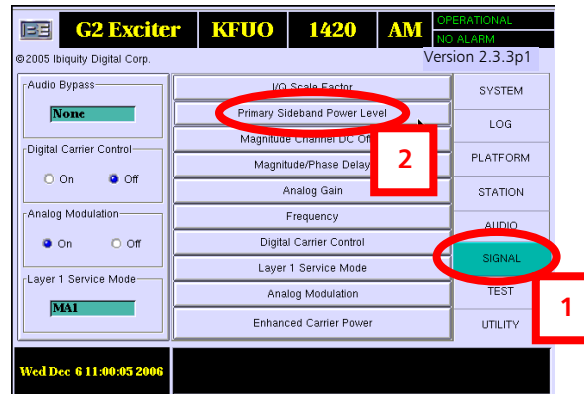


Figure 16 – Primary Sideband Power Level

Step 2 – The default Primary Sideband Power Level settings are as follows.

The default is **0.000 dB** for both **Upper** and **Lower Sideband Scaling**.

The default **Scaling Increment** is **1.000 dB** for both.

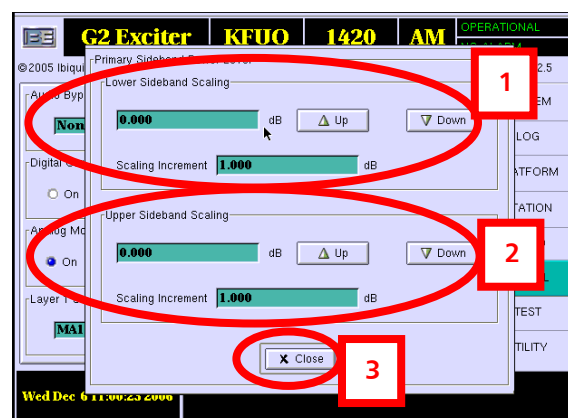


Figure 17 – Primary Sideband Power Level

6.5. Verify / Enter Magnitude DC Offset

The Magnitude DC Offset setting should have been set at the factory but it is good to verify.

Step 1 - Select **SIGNAL**, then **Magnitude Channel DC Offset**.

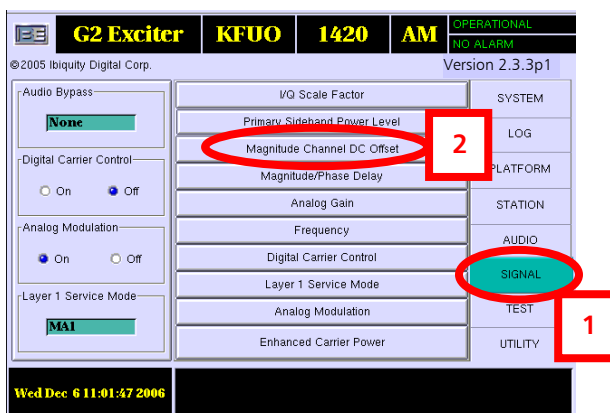


Figure 18 – Magnitude Channel DC Offset

Step 2 – The **Magnitude DC Channel** default is **-1.0000** as shown. If necessary, use the keypad to change, select **Apply**, then **Enter**.

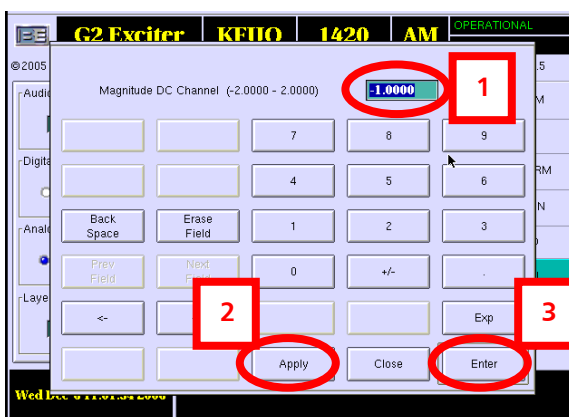


Figure 19 – Magnitude Channel DC Offset

6.6. Verify / Enter Magnitude / Phase Delay

The Magnitude / Phase Delay should have been set at the factory but it is good to verify.

Step 1 - Select SIGNAL, then Magnitude / Phase Delay.

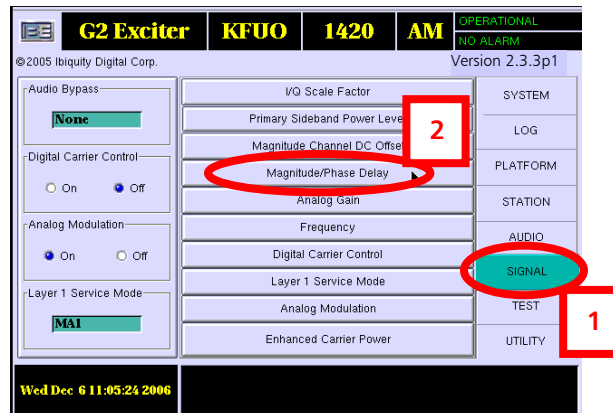


Figure 20 – Magnitude / Phase Delay

Step 2 – The default Magnitude / Phase Delay values for Day and Night are 11156.

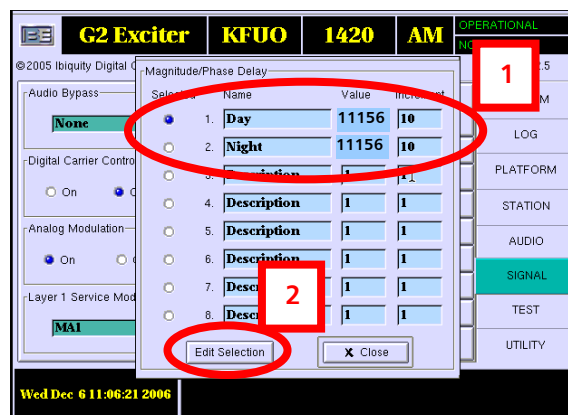


Figure 21 – Magnitude / Phase Delay

6.7. Verify / Enter Analog Gain

The Analog Gain should have been set at the factory to **0.800** but it is good to verify.

Step 1 - Select **SIGNAL**, then **Analog Gain**.

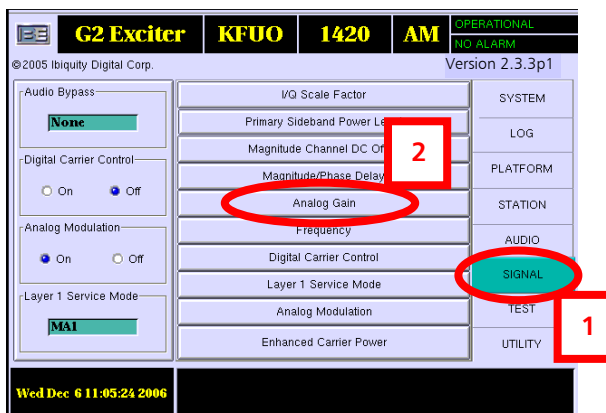


Figure 22 – Analog Gain

Step 2 – The **Analog Gain** should be set to **0.800**.

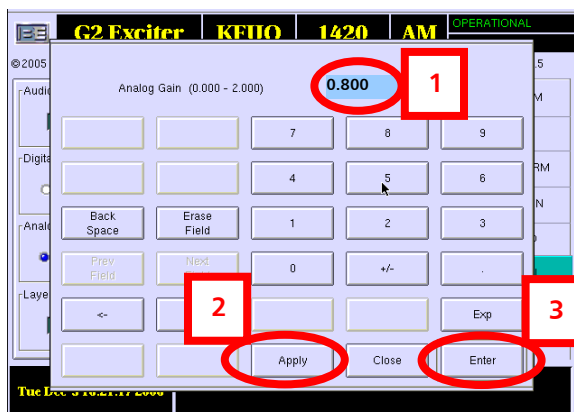


Figure 23 – Analog Gain

6.8. Verify / Enter Frequency

The Frequency should have been set at the factory to match that of the 4MX transmitter but it is good to verify.

Please note that the output frequency of the ASi has no impact on the frequency of the ASi signals to the 4MX or the output frequency of the 4MX. The frequency set here is the reference output of the AM HD signal coming out of the ASi's AM OUT port. This signal can be useful for determining proper operation of the ASi.

Step 1 - Select **SIGNAL**, then **Frequency**.

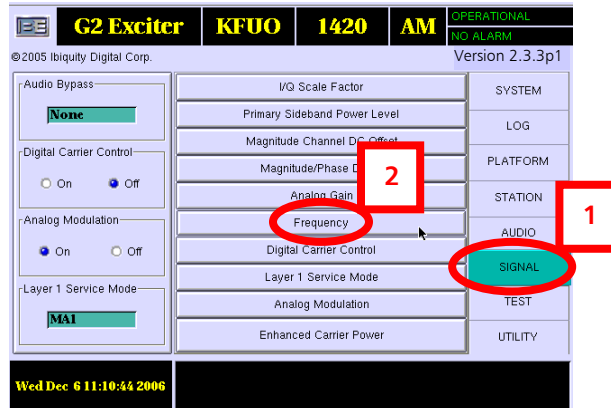


Figure 24 – Frequency

Step 2 – Enter the Frequency matching that of the AM Transmitter exactly.

If necessary, use the keypad to change the frequency, select **Apply**, then **Enter**.



Figure 25 – Frequency

Step 3 – A message will now appear stating “The system will now restart tuned to XXX kHz, Continue Yes or No?”

Verify that the frequency matches that of the transmitter, then select **Yes**.



6.9. Verify / Enter Enhanced Carrier Power

Enhanced Carrier Power should have been set at the factory but it is good to verify.

Step 1 - Select **SIGNAL**, then **Enhanced Carrier Power**.

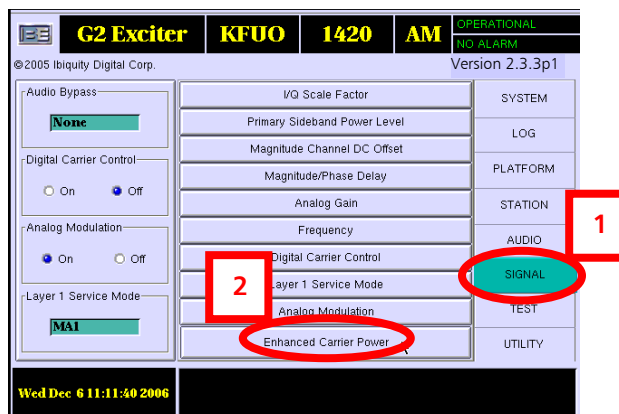


Figure 26 – Enhanced Carrier Power

Step 2 – The default is **Normal**.

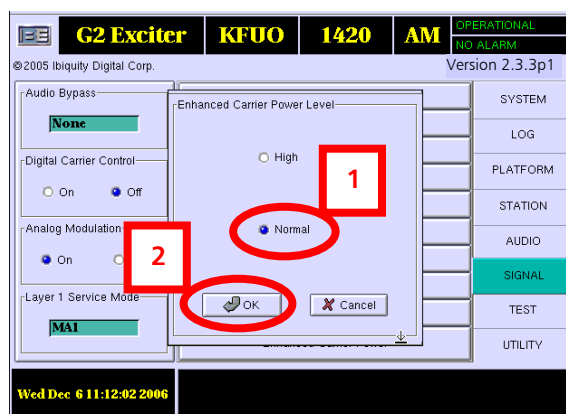


Figure 27 – Enhanced Carrier Power Level

6.10. Verify / Enter Analog Audio Bandwidth

Analog Audio Bandwidth should have been set at the factory but it is good to verify.

Step 1 - Select **AUDIO, then **Analog Audio Bandwidth**.**

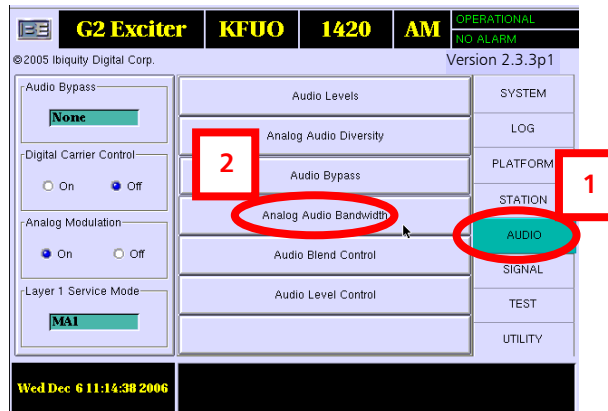


Figure 28 – Analog Audio Bandwidth

Step 2 – The default is 5 kHz Internal.

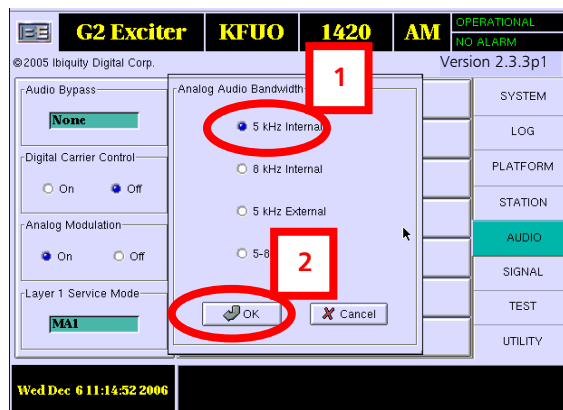


Figure 29 – Analog Audio Bandwidth

6.11. Verify / Enter Audio Level Control

Audio Level Control should have been set at the factory but it is good to verify.

Step 1 - Select AUDIO, then Audio Level Control.

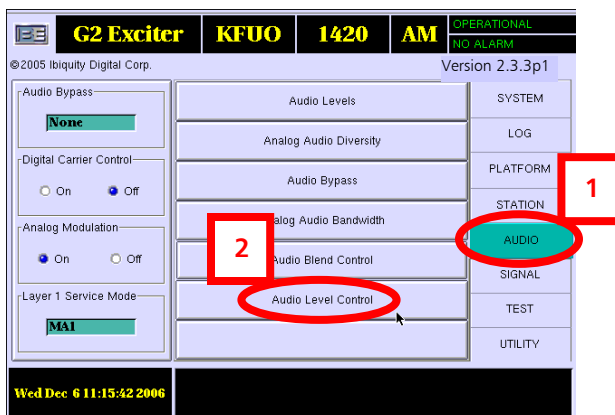


Figure 30 – Audio Level Control

Step 2 – The default is 0.



Figure 31 – Audio Level Control

6.12. Set Watchdog to Enabled

The Watchdog should have been set to Enable at the factory but it is good to verify.

Step 1 - Select **STATION**, then **Station Interface**.

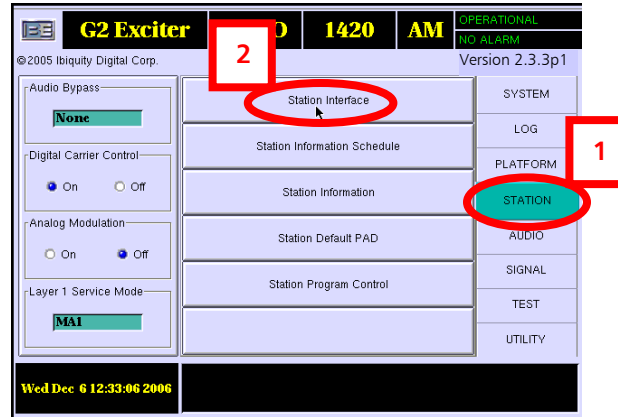


Figure 32 – Station Interface

Step 2 – Ensure that **Watchdog Enable** is selected. When Watchdog is Enabled, the Watchdog timer on the Station Interface Card (SIC) will be enabled. When it is enabled, the SIC will monitor the motherboard. If there is no activity for 1 second the host processor is assumed to be locked up. The Audio Bypass relays will be set to Bypass, the system operational relay will be opened, and the exciter will be re-booted. Enabling the Watchdog circuit may prevent a “DEAD AIR” situation if the motherboard or host processor locks up on the ASI.

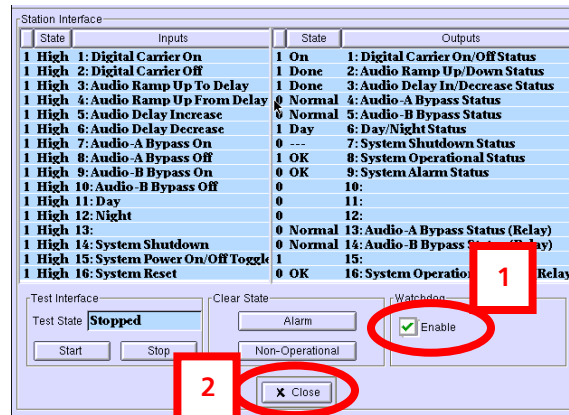


Figure 33 – Station Interface

6.13. Sync Local Time to GPS

Step 1 – On the Main GUI Menu select the **Date / Time** window.

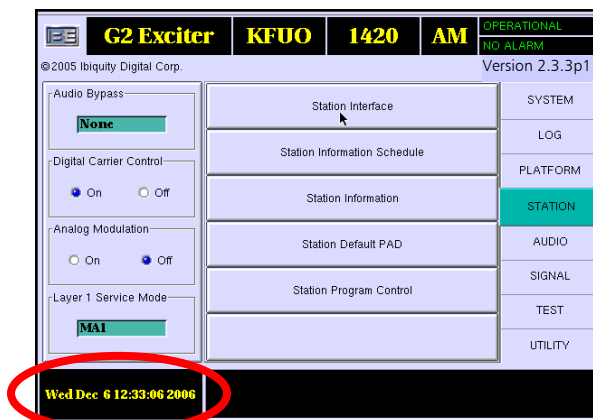


Figure 34 – Date / Time

Step 2 – Select the **Sync Local Time to GPS** check box, then select **OK**.
Next, when the "It is recommended that system be restarted to expedite GPS time synchronization" menu appears, select **OK**.

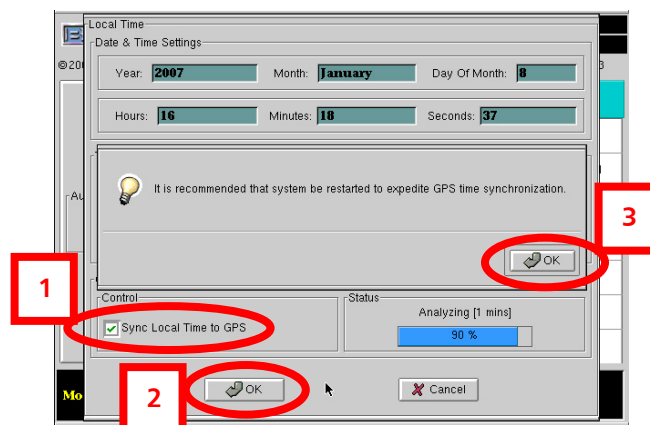


Figure 35 – Sync Local Time to GPS

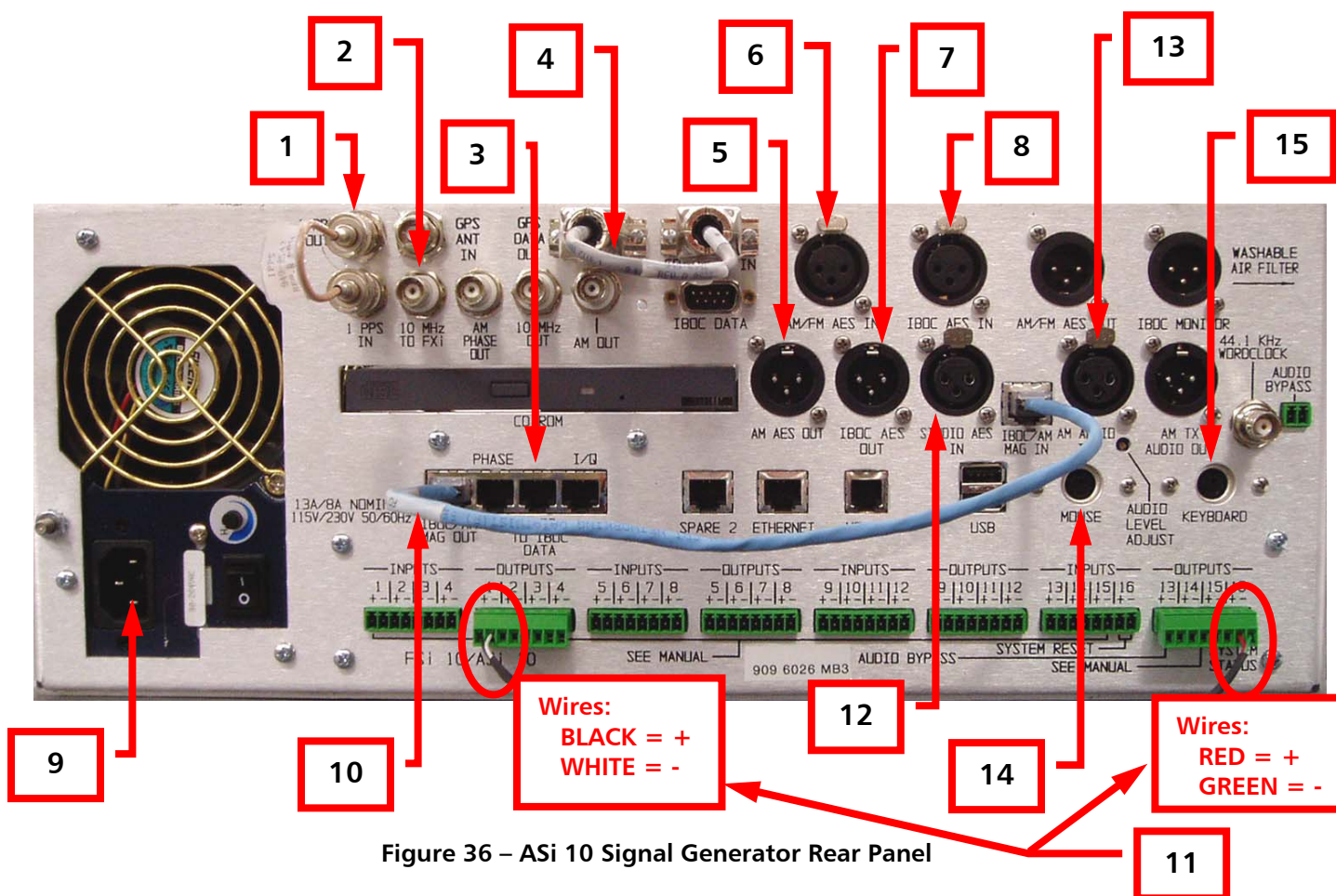
7. System Cabling

The **ASi 10 Installation Kit (979-0544)** comes with XLR connectors and 50 feet of AES/EBU cable to allow for custom fitting of Audio cables. 10 feet of mono analog cable (Belden 8451) is also supplied in the ASi 10 Installation Kit and should be used for the ASi (AM AUDIO IN) to the Analog Processor (ANALOG OUTPUT) connection.

Sections 7.1, 7.2, and 7.3 discuss the necessary cable connections between the **ASi 10, 4MX Transmitter**, and **Audio Processing** equipment.

Refer to the **4MX / ASi System Connection Diagram 597-4050-004** located in the back of this document for typical 4MX / ASi system cabling.

7.1. ASi 10 Rear Panel Connections



1. **1 PPS OUT to 1 PPS IN** – Connect **Jumper Cable (949-0543)** supplied with the ASi 10 Installation Kit.
2. **10 MHz** – Connect the **10' Long BNC to BNC Cable**, supplied in the ASi Installation Kit, from the **10 MHz Port** on the **ASi 10** to the **External 10 MHz Input** of the **4MX Series Transmitter** (see Section 7.3 for transmitter connection).
3. **LVDS TO IBOC DATA** – Connect the **Shielded Ethernet Cable (846-0010)**, supplied in the 4MX Installation Kit, to the **LVDS TO IBOC DATA** port on the **ASi 10** and then to the **LVDS Input** of the **4MX Transmitter** (see Section 7.3 for transmitter connection).
4. **GPS DATA OUT to GPS DATA IN** – Connect **Jumper Cable (949-0542)** supplied with the **ASi 10**, from the **GPS DATA OUT** port to the **GPS DATA IN** port on the **ASi 10**.
5. **AM AES OUT** – Connect an AES Audio Cable from the **AM AES OUT** port of the **ASi 10** and then to the **AM AES IN** port on the **External Analog Audio Processor**. XLR Connectors and AES Cable are provided in the **ASi 10 Installation Kit** (see Section 12 for cable construction).
6. **AM/FM AES IN** – Connect an AES Audio Cable from the **AM AES IN** port of the **ASi 10** and then to the **AM AES OUT** port on the **External Analog Audio Processor**. XLR Connectors and AES Cable are provided in the **ASi 10 Installation Kit** (see Section 12 for cable construction).



7. **IBOC AES OUT** – Connect an AES Audio Cable from the **IBOC AES OUT** port of the **ASi 10** and then to the **IBOC AES IN** port on the **External HD Audio Processor**. XLR Connectors and AES Cable are provided in the **ASi 10 Installation Kit** (see Section 12 for cable construction).
8. **IBOC AES IN** – Connect an AES Audio Cable from the **IBOC AES IN** port of the **ASi 10** and then to the **IBOC AES OUT** port on the **HD Audio Processor**. XLR Connectors and AES Cable are provided in the **ASi 10 Installation Kit** (see Section 12 for cable construction).
9. **AC POWER** – Connect **Line cord (682-0001 or 682-0003)** supplied in the **ASi 10 Installation Kit**.
10. **IBOC/AM MAG OUT to IBOC/AM MAG IN** – Connect **Jumper Cable (949-0547)** supplied with the **ASi 10**, from the **IBOC/AM OUT** port to the **IBOC/AM MAG IN** port on the **ASi 10**.
11. **DIGITAL CARRIER ON/OFF & STATUS OUTPUT** – Connect the **Digital Carrier ON/OFF & Status Output Cable (947-5002)** to **Outputs 1 (Blk/White wires)** and **Output 16 (Red/GRN wires)** as shown in Figure 36 (see Section 7.3 for transmitter connections).
12. **STUDIO AES IN** – Connect the **AES Audio Source** (32, 44.1, 48, or 96 kHz) to the **STUDIO AES IN** port on the **ASi 10**. XLR Connectors and AES Cable are provided
13. **AM AUDIO IN** – Connect a **Mono Analog Audio Cable** to here and to the **Analog Output** of the **Analog Audio Processor**. Mono analog cable, Belden 8451, and XLR connectors are supplied in the ASi installation kit (see Section 12 for cable construction).
14. **Mouse** – An external Mouse **MUST** be connected to the labeled jack (not USB ports) of the ASi 10 when upgrading software or changing the I.P. Address.
15. **Keyboard** – An external Keyboard **MUST** be connected to the labeled jack (not USB ports) of the ASi 10 when upgrading software or changing the I.P. Address.

7.2. Audio Processing Equipment

Refer to the Operation Manual of the Audio Processing equipment for setup information.

7.3. ASi 10 to 4MX Transmitter Connections

Refer to the **4MX / ASi System Connection Diagram 597-4050-004** located in the back of this document for typical 4MX / ASi system cabling.

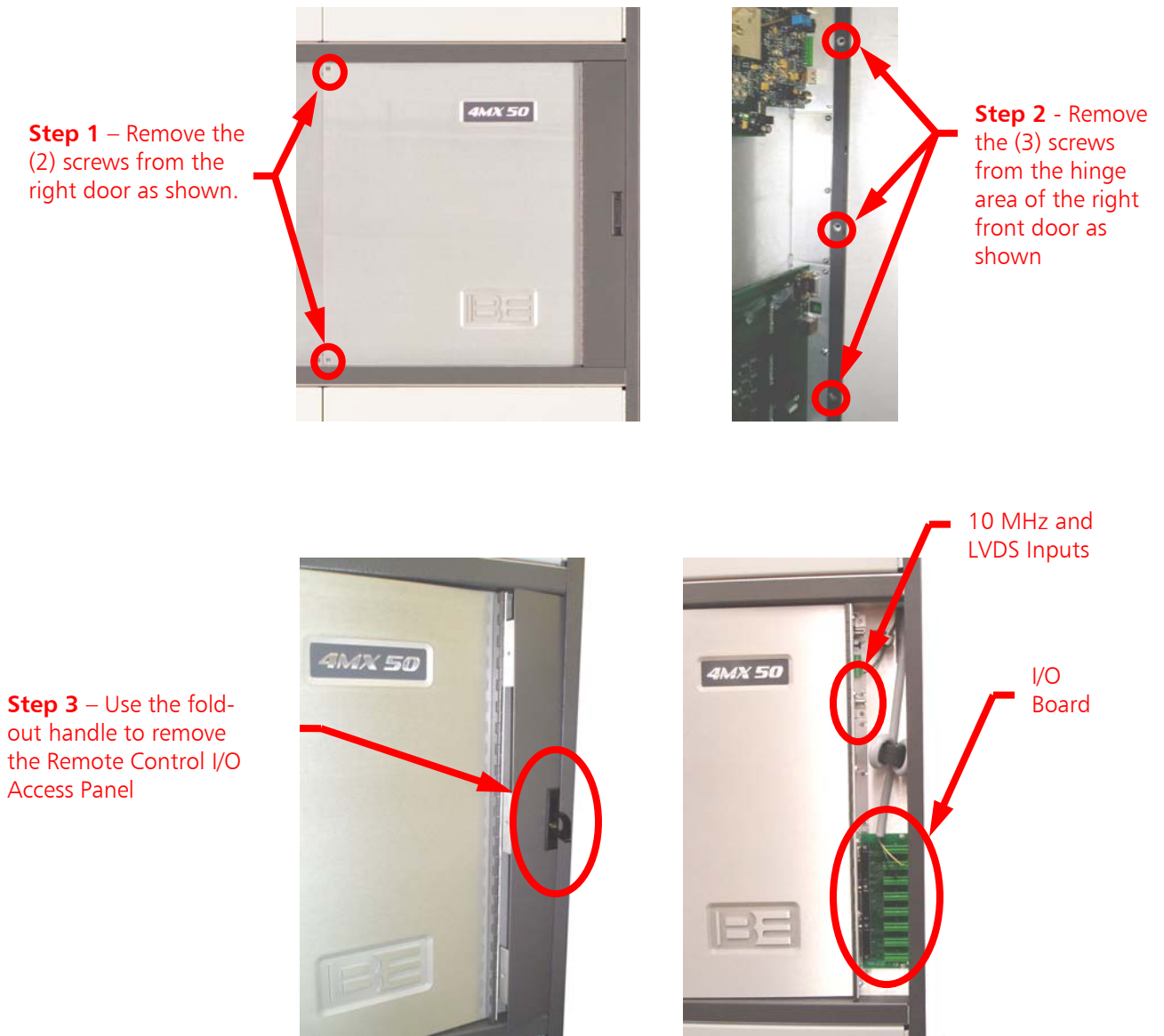


Figure 37 – Removal of the Remote Control I/O Access Panel

NOTE: ALL CONNECTIONS TO / FROM THE 4MX (AUDIO INPUTS, MODULATION SAMPLE, ASI-10 INPUT, EXTERNAL 10MHz, AND ALL CONNECTIONS TO THE REMOTE I/O BOARD) MUST BE ROUTED THROUGH FERRITE RINGS (375-0007, SUPPLIED IN THE 4MX 25/50 INSTALLATION KIT) AND WRAPPED 6 TURNS. IF THE FERRITE RINGS ARE NOT INSTALLED, DAMAGE TO THE TRANSMITTER MAY RESULT!

FAILURE TO PROPERLY INSTALL THE FERRITE RINGS WILL VOID THE WARRANTY OF THE TRANSMITTER!!!

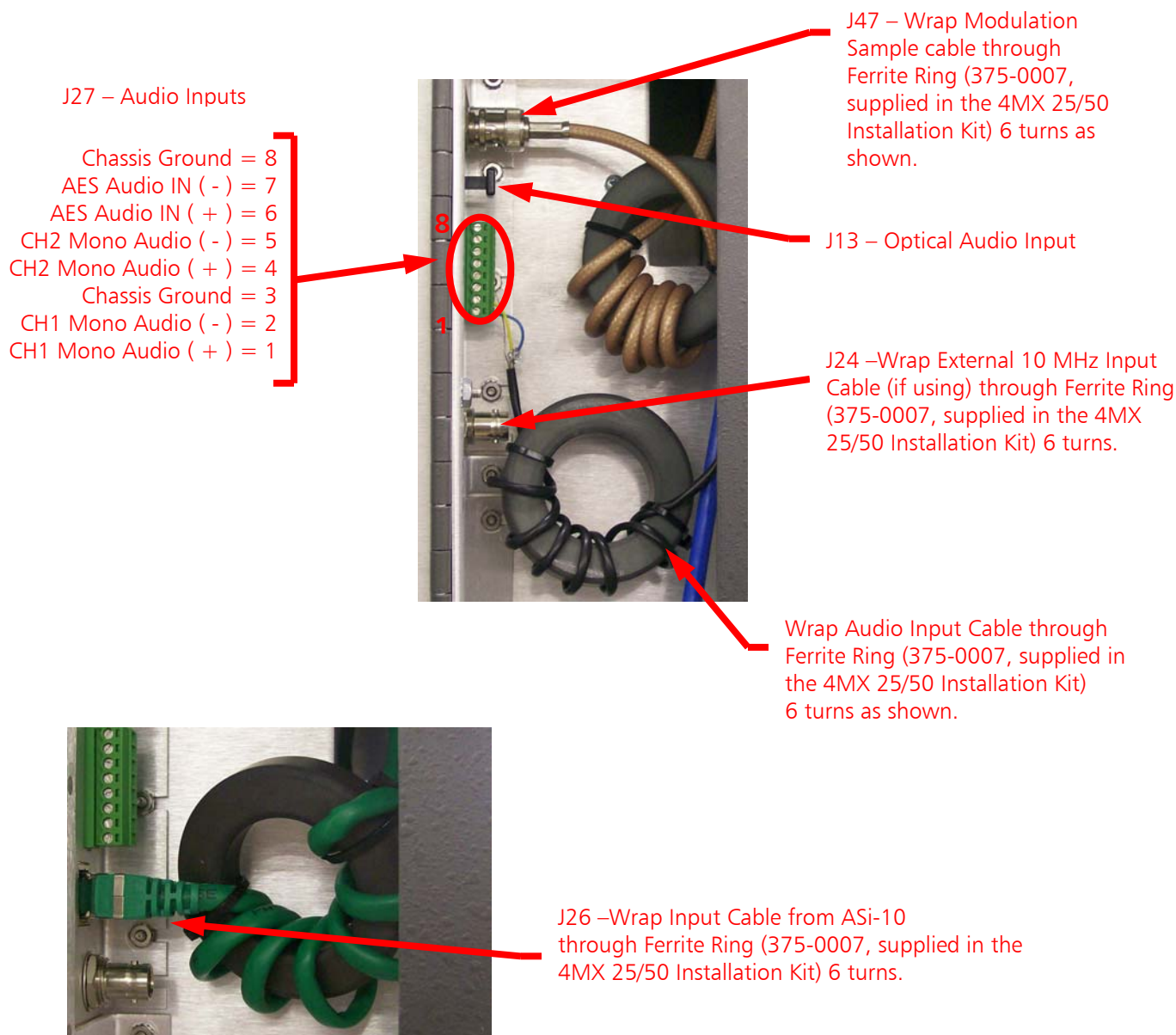


Figure 38 – Ferrite Ring Installation Examples

Step 4 – Route the **BNC Coax Cable** (10' long, included in the ASi Installation Kit – identified in Section 7.1 as Item 2) for the **External 10 MHz** down through the top of the transmitter cabinet into the Remote I/O Connection Cavity and connect to the **External 10 MHz Input** as shown below in **Figure 39**.

Ensure that Ferrite Ring (375-0007) has been installed as illustrated in Figure 38.

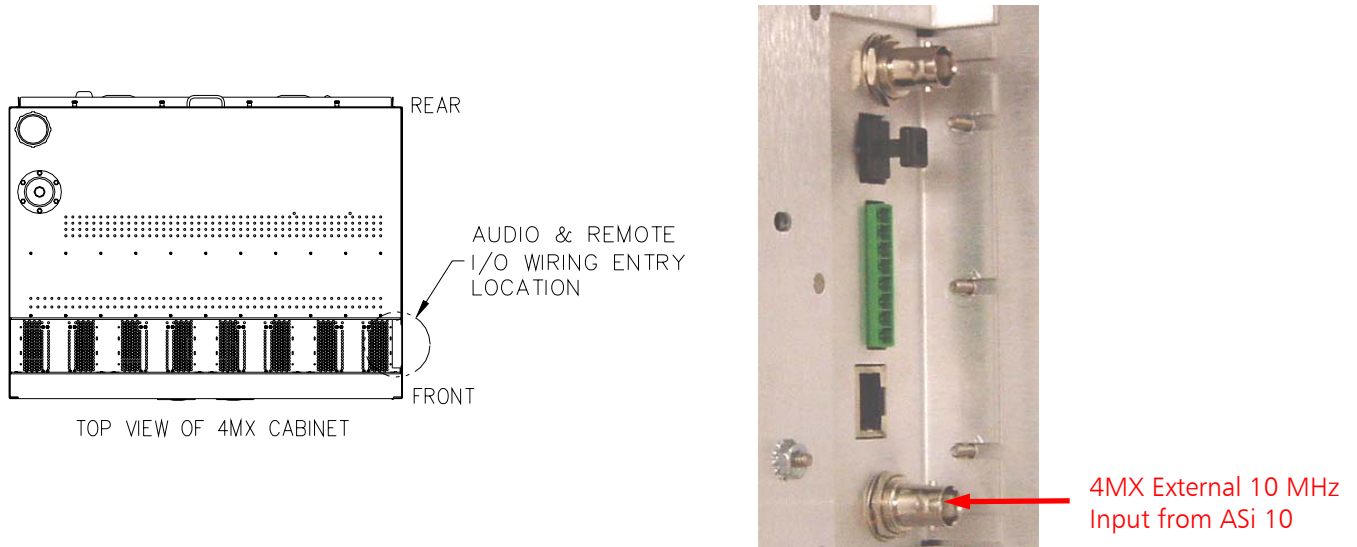


Figure 39 – ASi 10 to 4MX 25/50 Connection

Step 5 – Route the **Shielded Ethernet LVDS Cable** (846-0010, identified in Section 7.1 as Item 3) down through the top of the 4MX Cabinet to the Remote I/O Connection Cavity of the Transmitter. Next, connect the cable to the **LVDS Input** of the 4MX as shown in **Figure 40** below.

Ensure that Ferrite Ring (375-0007) has been installed as illustrated in Figure 38.

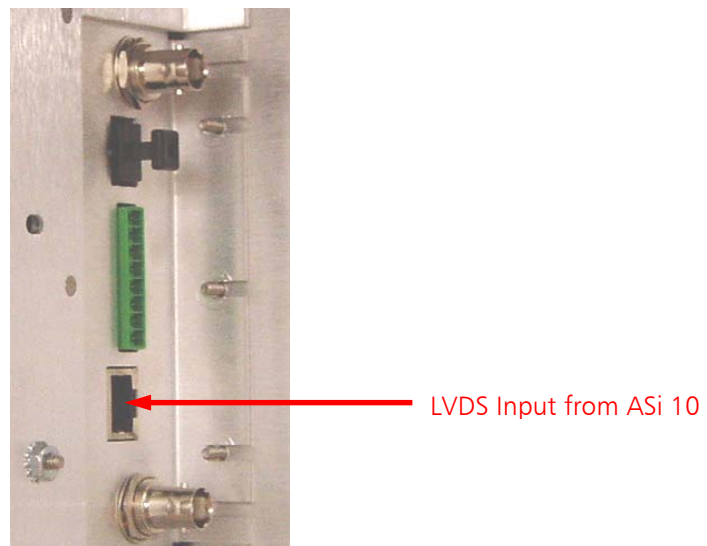


Figure 40 – ASi 10 to 4MX 25/50 Connection

Step 6 – Connect the **Digital Carrier ON/OFF and Status Output Cable** (947-5002 identified in Section 7.1 as Item 11) to the ASI 10 and route down through the top right front corner of the 4MX Cabinet to the Remote I/O Connection Cavity of the Transmitter. Route and connect the Cable to the 4MX as shown in **Figure 41** below.

Ensure that Ferrite Ring (375-0007) has been installed as illustrated in Figure 38.

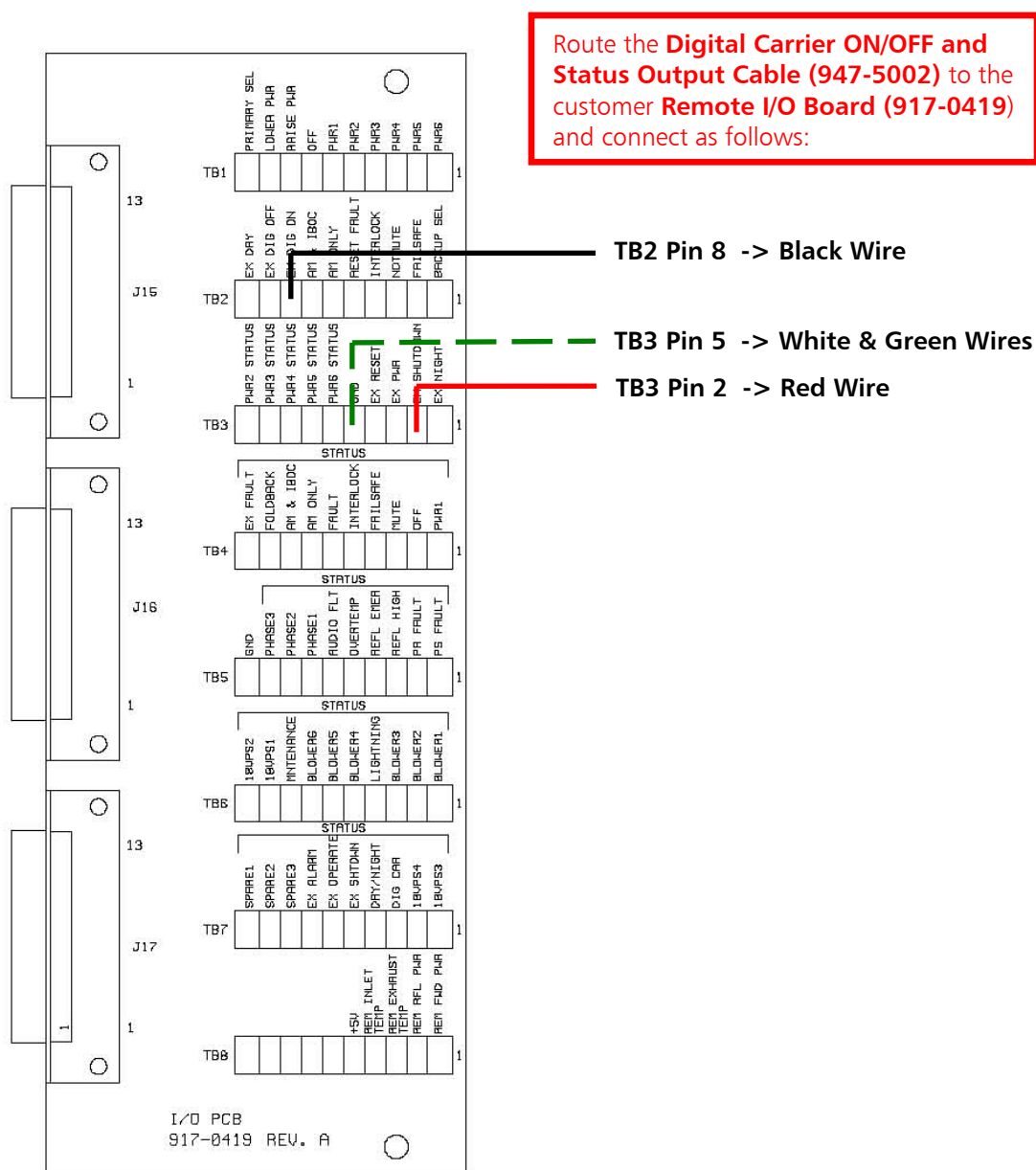


Figure 41 – Digital Carrier ON/OFF and Status Output Cable (947-5002) Connections

Step 7 – Install the Remote I/O Access Panel on the 4MX Transmitter.

Step 7a – Install the Remote I/O Access Panel as shown



Step 7b – Use a No. 2 Phillips Screwdriver and install the (3) screws in the Hinge area of the Right Front Door

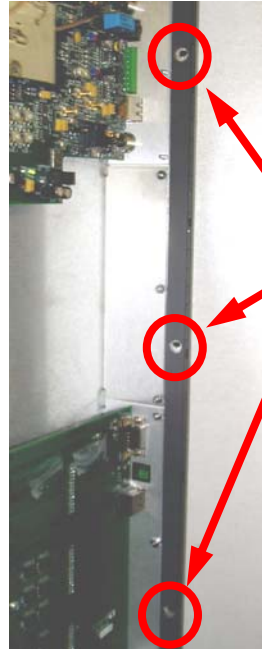


Figure 42 – Removal of the Remote Control I/O Access Panel

8. Coarse Tuning for HD Operation with a Tone

8.1. Ensure that the ASi 10 is ON and Operational

Ensure that the ASi 10 is powered ON and is operational. The ASi MUST be ON and putting out an LVDS signal before applying AC Power to the transmitter.

8.2. Turn the 4MX Transmitter's AC Breaker to ON

Next, turn the **AC Power Breaker** on the rear of the **4MX** to **ON**.

8.3. Ensure that the 4MX Transmitter's RF OUTPUT is OFF

Ensure that the transmitter's **RF Output** is **OFF** at this point.

8.4. Put the Transmitter into HD Operating Mode

Step 1 – Select OPER MODE.

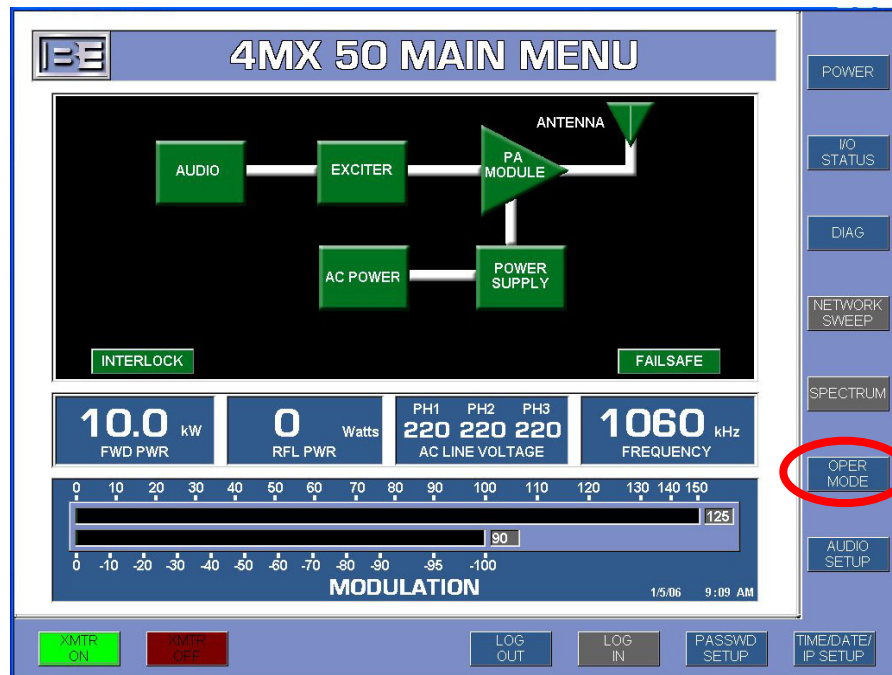


Figure 43 – Operate Mode

Step 2 – Select HD AM MODE.

OPERATING MODE MENU

REMOTE CONTROL (ENABLE OR DISABLE) **ENABLE**

HD

OPER MODE - SELECTED **ANALOG AM** **STATUS** **ANALOG AM**

DIG CARRIER STATUS **ON** **ANTENNA STATUS** **DAY**

ASI STATUS (OPERATIONAL OR NON OPERATIONAL) **NON OPERATIONAL**

ANTENNA - DAY **MAG** **0** **MAG/PHASE DELAY** **0**

ANTENNA - NIGHT **MAG** **0** **MAG/PHASE DELAY** **0**

? HELP

BACK Backup one menu. **REMOTE ENABLE** **REMOTE DISABLE** Use these buttons to enable or disable transmitter remote control operation.

ANALOG AM MODE **HD AM MODE** Use the ANALOG AM button to select analog AM transmitter operation (no HD operation with audio from 4MX exciter). Use the HD AM button to select HD AM operation (AM and HD carriers with audio from ASI).

MAG/PH DL RAISE **MAG/PH DL LOWER** Magnitude and Phase Delay buttons. Use these buttons to adjust the magnitude and phase signal time relationship. Positive numbers indicate the magnitude signal is being delayed. Negative numbers indicate the phase signal is being delayed.

MAG RAISE **MAG LOWER** Use these buttons to adjust the amplitude of the magnitude signal.

BACK **REMOTE ENABLE** **REMOTE DISABLE** **ANALOG AM MODE** **HD AM MODE** **MAG/PH DL RAISE** **MAG/PH DL LOWER** **MAG LOWER** **MAG RAISE**

Figure 44 – Select HD AM MODE

OPERATING MODE MENU

REMOTE CONTROL (ENABLE OR DISABLE) **ENABLE**

HD

OPER MODE - SELECTED **HD AM** **STATUS** **HD AM**

DIG CARRIER STATUS **ON** **ANTENNA STATUS** **DAY**

ASI STATUS (OPERATIONAL OR NON OPERATIONAL) **OPERATIONAL**

ANTENNA - DAY **MAG** **29000** **MAG/PHASE DELAY** **-1**

ANTENNA - NIGHT **MAG** **0** **MAG/PHASE DELAY** **0**

? HELP

BACK Backup one menu. **REMOTE ENABLE** **REMOTE DISABLE** Use these buttons to enable or disable transmitter remote control operation.

ANALOG AM MODE **HD AM MODE** Use the ANALOG AM button to select analog AM transmitter operation (no HD operation with audio from 4MX exciter). Use the HD AM button to select HD AM operation (AM and HD carriers with audio from ASI).

MAG/PH DL RAISE **MAG/PH DL LOWER** Magnitude and Phase Delay buttons. Use these buttons to adjust the magnitude and phase signal time relationship. Positive numbers indicate the magnitude signal is being delayed. Negative numbers indicate the phase signal is being delayed.

MAG RAISE **MAG LOWER** Use these buttons to adjust the amplitude of the magnitude signal.

BACK **REMOTE ENABLE** **REMOTE DISABLE** **ANALOG AM MODE** **HD AM MODE** **MAG/PH DL RAISE** **MAG/PH DL LOWER** **MAG LOWER** **MAG RAISE**

Figure 45 – HD AM MODE



8.5. Turn AES Audio Source to OFF

Turn the AES Audio Source to the ASI to OFF.

8.6. Set Digital Carrier Control to OFF, Analog Modulation to ON

On the ASI main GUI, set **Digital Carrier Control** to **OFF** and **Analog Modulation** to **ON**.

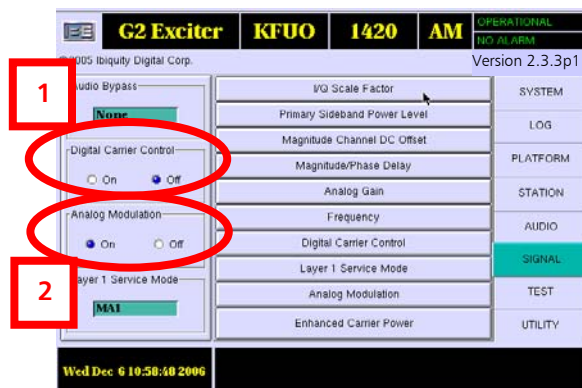


Figure 46 – Digital Carrier Control OFF, Analog Modulation ON

8.7. Disconnect “AM/FM AES IN”

On the rear panel of the ASI, disconnect the AES Audio cable (previously connected to Audio Processing Equipment) from the **AM/FM AES IN** port.



Figure 47 – Disconnect AM/FM AES IN

8.8. Install “AM/FM AES IN” to “IBOC MONITOR” Jumper on ASI

On the rear of the ASI, install an AES Audio Cable jumper from the **AM/FM AES IN** to the **IBOC MONITOR** (use cable disconnected in Section 8.7).



Figure 48 – Install “AM/FM AES IN” to “IBOC MONITOR” Jumper

8.9. Setup the ASi for Tone

On the Main Menu of the ASi, go to **Audio** -> **Analog Audio Diversity**. Next, select **Tone Monitor**. The ASi will generate a tone on the IBOC MONITOR port.

Step 1 – Select **AUDIO** then **Analog Audio Diversity**.

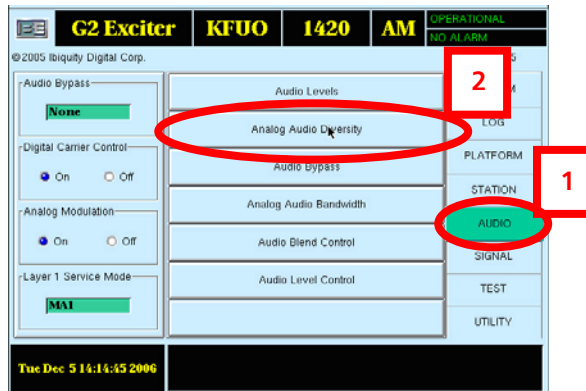


Figure 49 – Analog Audio Diversity

Step 2 – Select **Tone Monitor**, then **Close**.

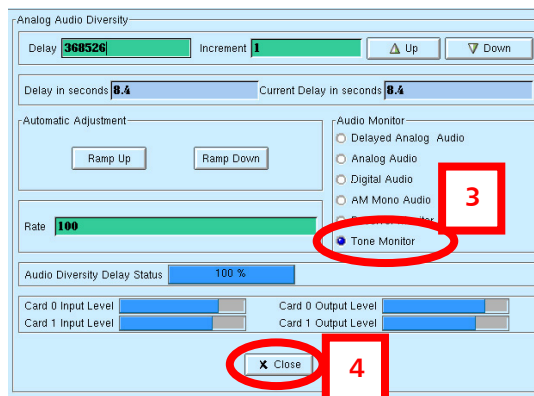


Figure 50 – Select Tone Monitor

8.10. Turn the Transmitter's RF Output Power to ON

Turn the Transmitter's RF Output Power ON (select a lower preset power level at this point).

8.11. Connect Modulation Monitor to the Transmitter

Connect a Modulation Monitor to the sample port of the transmitter.



8.12. Raise / Lower Magnitude for 80% Modulation

Adjust the Magnitude by using **MAG RAISE** and **MAG LOWER** buttons until **80% Modulation** is achieved on the **Modulation Monitor**. Please note that this setting will likely be in the range of 28,000 – 31,000.

Default Magnitude = 29000

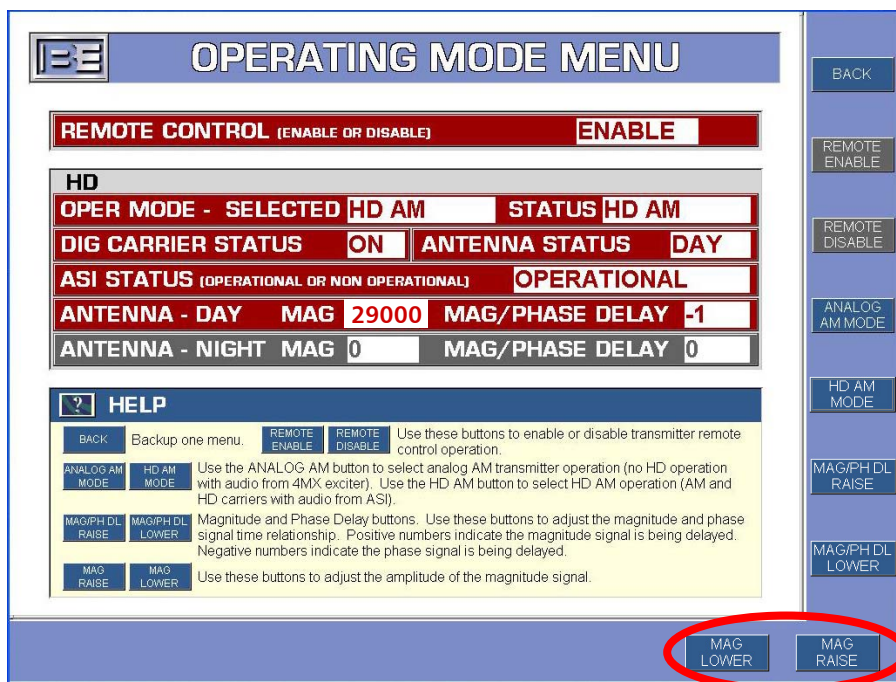


Figure 51 – Raise / Lower Magnitude

8.13. Turn the Tone Monitor OFF

If you wish to have a different signal type other than "Tone" output on the IBOC MONITOR port, select it from the list then select Close. In this example we will change to Digital Audio.

Step 1 – Select **AUDIO** then **Analog Audio Diversity**.

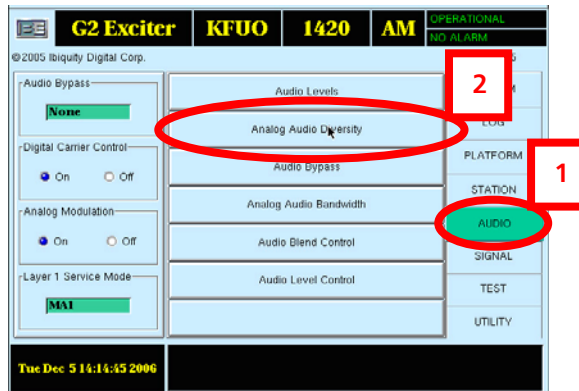


Figure 52 – Analog Audio Diversity

Step 2 – Select **Digital Audio**, then **Close**.

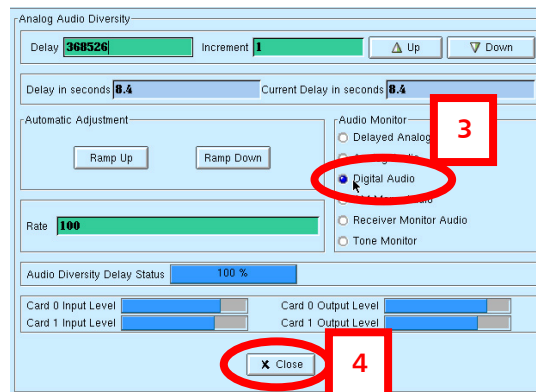


Figure 53 – Select Tone Monitor

8.14. Disconnect "AM/FM AES IN" to "IBOC MONITOR" Jumper

Next, on the rear of the ASi, disconnect the AES Audio Cable jumper from the **AM/FM AES IN** to the **IBOC MONITOR** installed in Section 8.8.

8.15. Re-connect "AM/FM AES IN" to the Analog Processor

Re-connect the **AM/FM AES IN** to the AES output of the Analog Processor disconnected in Section 8.7.



8.16. Turn AES Audio Source to ON

Turn the AES Audio Source to the ASi to ON.

8.17. Set Digital Carrier Control ON, Analog Modulation OFF

Next, on the ASi turn **Digital Carrier Control** to **ON**, and **Analog Modulation** to **OFF**.

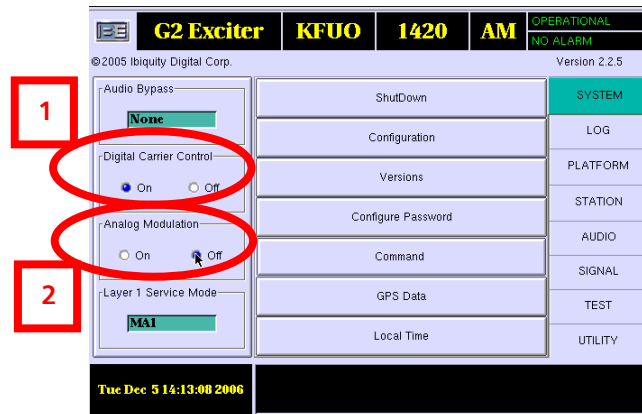


Figure 54 – Digital Carrier Control ON / Analog Modulation OFF

9. Checking the AM IBOC Spectrum

9.1. AM Spectral Measurements

The following identifies how to measure an AM TX for operation in HD.

9.2. AM Spectral Emissions Limits

The following table is the emissions mask for AM HD performance as specified by iBiquity. This is the emissions limits when the analog bandwidth is 5kHz.

Note that all measurements are made in a 300Hz bandwidth and relative to an unmodulated carrier.

AM HD FCC Spectral Mask	
offset from carrier frequency	level relative to unmodulated carrier (dB/300Hz)
5 to 10kHz	-34.3 dB
10 to 15kHz	-26.8dB
15 to 15.2 kHz	-28 dB
15.2 to15.8 kHz	$[-39 - (\text{Freq offset in kHz} - 15.2) * 43.3]$ dB
15.8-25 kHz	-65 dB
25-30.5 kHz	$[-65 - (\text{Freq offset in kHz} - 25) * 1.273]$ dB
30.5-75 kHz	$[-72 - (\text{Freq offset in kHz} - 30.5) * 0.292]$ dB
>75 kHz	-80dB

Figure 55 - AM HD Spectral Mask Limits

In addition, there are two notes on the iBiquity specification in regard to discrete spurious such as in a PWM TX.

They are:

- 1) No more than two discrete components within 75 kHz of the carrier frequency shall exceed the spectral emission limits by more than 10dB.
- 2) No more than four discrete components removed from the carrier frequency by more than 75 kHz shall exceed the spectral emission limits by more than 5dB.



Figure 56 below shows the AM spectral emissions limits mask for HD in red. The limit shown in red is the implementation of the table in **Figure 55** above. The emissions limits shown in blue in **Figure 56** below are the AM emissions limits as set by the FCC and are currently documented in the FCC rules for standard AM operation without HD.

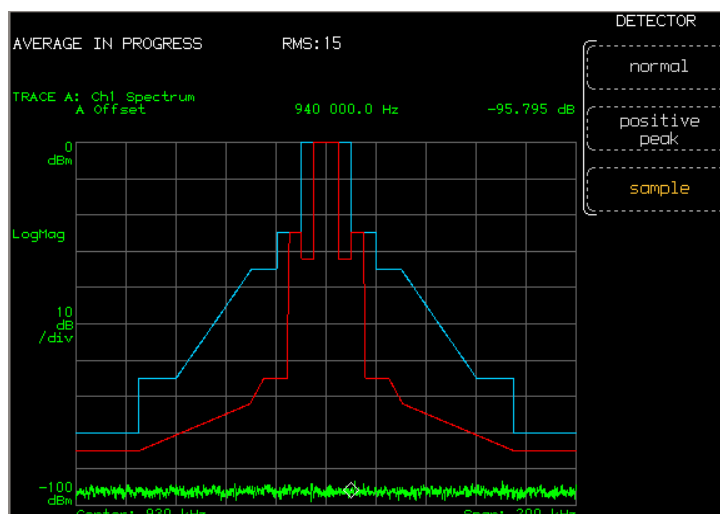


Figure 56 - Emissions Limits in Graphical Form

9.3. Setting up the Spectrum Analyzer

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.

- 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 AM 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). Adjust the external variable attenuator until the un-modulated AM carrier is at the 0dBm reference line.

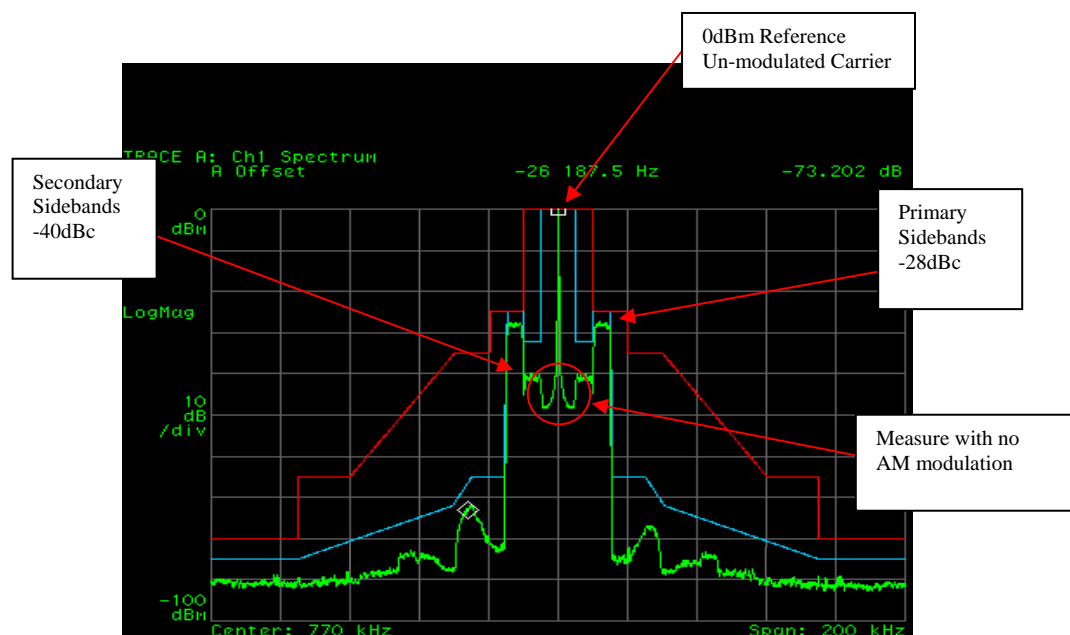


Figure 57 - 0dBm reference (Aligned AM IBOC Transmitter)

Resolution Bandwidth, Span, Detector, and Averaging:

When measuring an AM HD spectrum the spectrum analyzer must have the **Resolution Bandwidth** (RBW) set to **300Hz**. The **Span** setting of **200 kHz** is not required but is a good setting to view performance. The **Detector** should be set to **Sample** and **Averaging** should be set to **30**.

An un-modulated AM transmitter spectrum that is properly aligned magnitude and phase should appear as shown in Figure above. It is critical that this measurement is made with no AM modulation. In addition the primary sidebands should be ~28dB down from the un-modulated carrier and the secondary sidebands should be ~40dB down from the un-modulated carrier in a good system.

All measurement **MUST** be made into a known good 50 ohm load prior to putting TX into an antenna system. This ensures that the TX is known to be operating properly aside from the antenna system.



NOTE: When the TX is operated into an antenna system the magnitude and phase may have to be re-adjusted for best spectral performance.

Figure 58 below shows an AM transmitter with the phase and magnitude misaligned. As you can see the inter-modulation products fall outside the emissions mask and this system should be adjusted for proper operation.

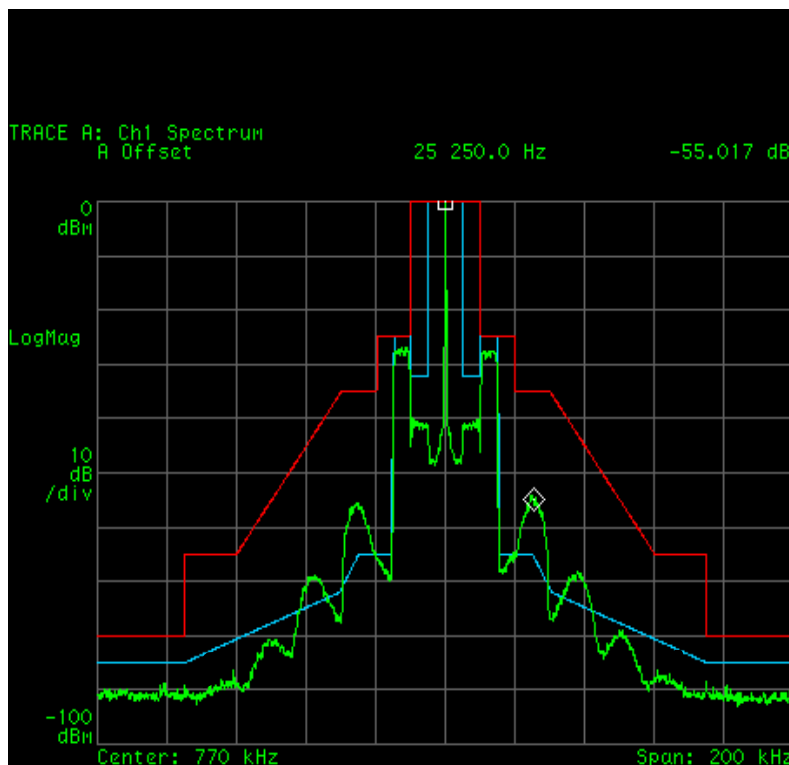


Figure 58 - Misaligned AM Transmitter

10. Fine Tuning for HD Operation

10.1. Adjust Magnitude and Phase in the 4MX

While monitoring the Spectrum adjust the **MAG RAISE**, **MAG LOWER**, **MAG/PH DL RAISE**, and **MAG/PH DL LOWER** values in the 4MX until the transmitter's spectrum meets the mask and looks similar to the spectrum in **Figure 57**.

Step 1 – Adjust the **Magnitude** for best spectrum by using **MAG RAISE** and **MAG LOWER** buttons. Please note that this setting will likely be in the range of 28,000 to 31,000.

Default Magnitude = 29000

Step 2 – Adjust the **Phase Delay** for best spectrum by using **MAG/PH DL RAISE** and **MAG/PH DL LOWER** buttons. If this adjustment is required only adjust in increments of 1 and view the results on the spectrum. Please note that most systems will require very small adjustments, if any, from the default value. This value will likely be in the range of -3 to +3.

Default Phase Delay = -1

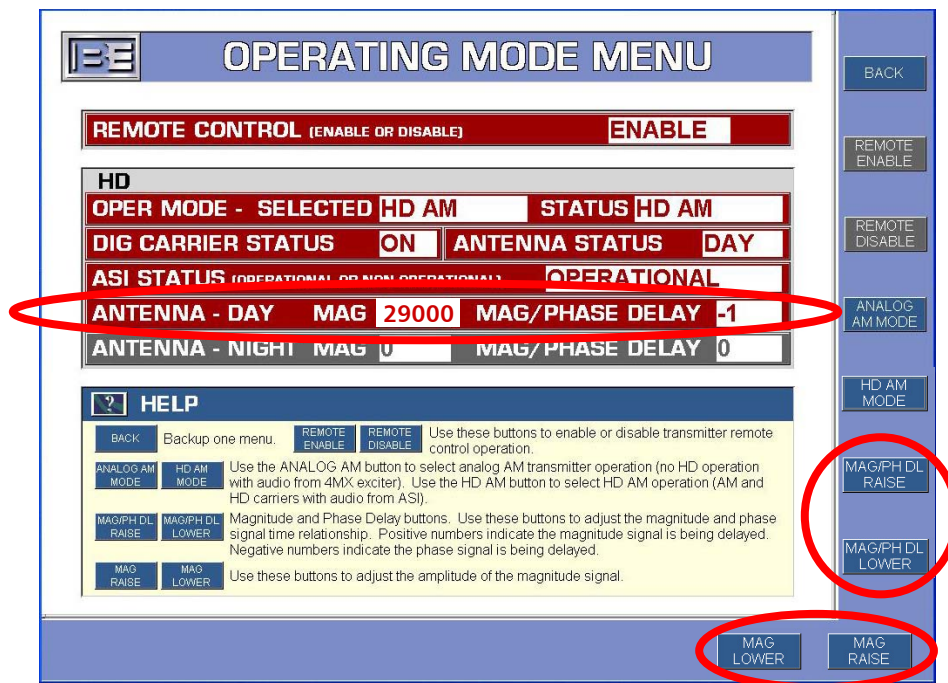


Figure 59 – Magnitude / Phase Adjustments

10.2. Turn Digital Carriers ON, Analog Modulation ON

Next, on the ASi turn **Digital Carrier Control** to **ON**, and **Analog Modulation** to **ON**. The transmitter's spectrum should be properly aligned and look similar to the spectrum in **Figure 57**.

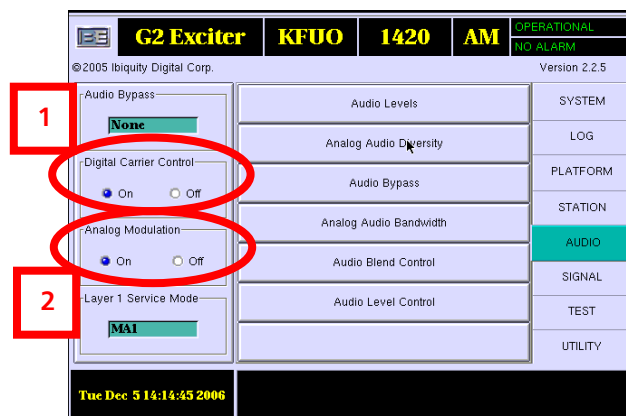


Figure 60 – Digital Carrier Control ON / Analog Modulation ON

10.3. Adjust the Analog Gain in the ASi

Adjust the Analog Gain in the ASi to achieve **125 to 150% Peak Positive** modulation by changing the Analog Gain value as shown below.

Step 1 - Select **SIGNAL**, then **Analog Gain**.

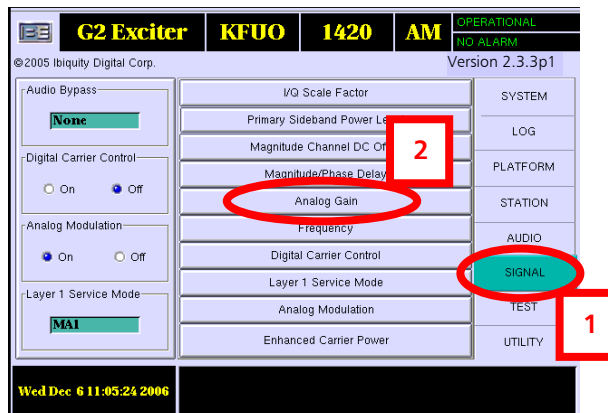


Figure 61 – Analog Gain

Step 2 – The **Analog Gain** should be adjusted in the range of **1.250** to **1.500** to achieve **125 to 150% Peak Positive** modulation.

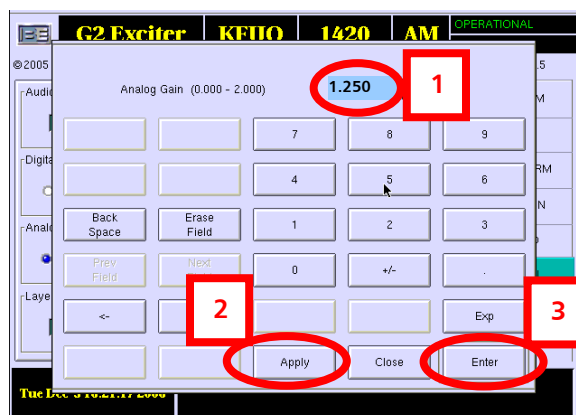


Figure 62 – Analog Gain

Step 3 – Ensure that the transmitter's spectrum is properly aligned and looks similar to **Figure 57**.

11. Audio Level Control

After the HD system is completely installed, it may be necessary to adjust the Audio Level Control in the ASI 10 to ensure that the Analog and HD signal levels are approximately the same. This is important so when a receiver goes from the Analog signal to the HD signal (or vice versa) the volume level to the listeners is the same.

Step 1 - On a HD Receiver tune to the broadcast signal of the transmitter. The HD receiver first will go to the analog signal and then to the HD signal. Listen for this change and adjust the Audio Level control until the volume level is approximately the same for both signals.

Step 2 - Select **AUDIO**, then **Audio Level Control**.

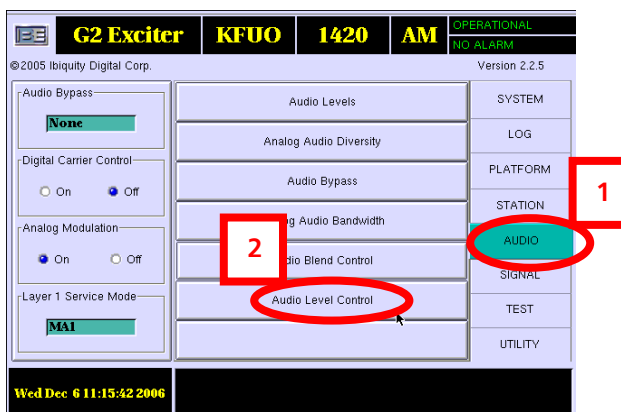


Figure 63 – Audio Level Control

Step 3 - The default is **0**. The range for this setting is (-8 to +7dB).

If the HD signal level is lower than the Analog, increase this value select **Apply**, then **Enter**.

If the HD signal level is higher than the Analog, decrease this value select **Apply**, then **Enter**.

Make small adjustments in either direction and listen to the affect on the HD receiver.



Figure 64 – Audio Level Control

Step 4 – Repeat process until the HD and Analog signal levels are the same.

12. Audio Cable Construction

Since the required length of the Audio Cables is site dependent, XLR Connectors and AES Audio Cable are included in the ASi 10 Cable Kit for custom length construction.

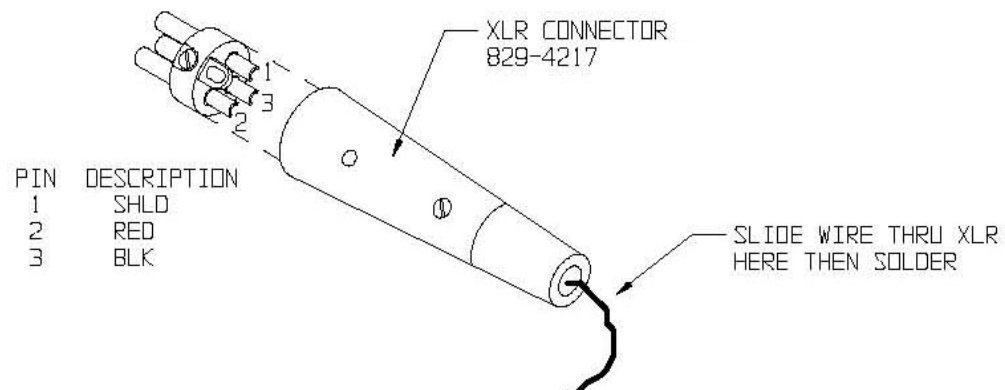


Figure 65 – Male XLR Connector Pinout

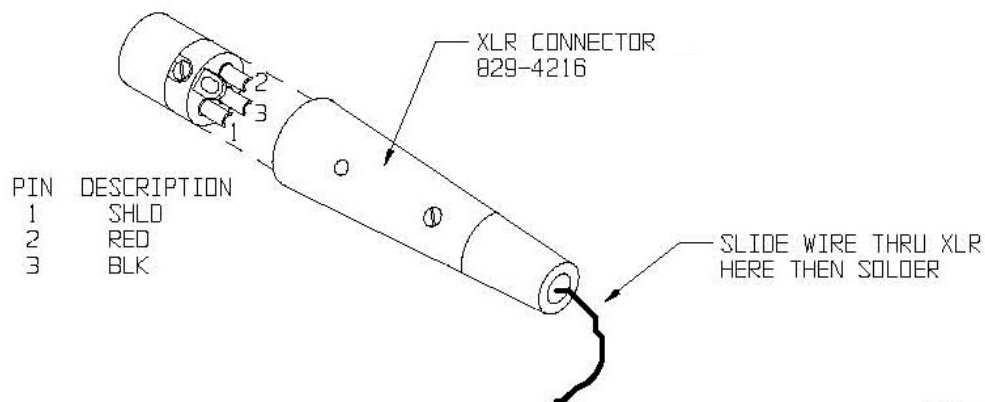


Figure 66 – Female XLR Connector Pinout

13. RF Technical Services Contact Information

RF Technical Services -

Telephone: (217) 224-9617

E-Mail: rfservice@bdcast.com

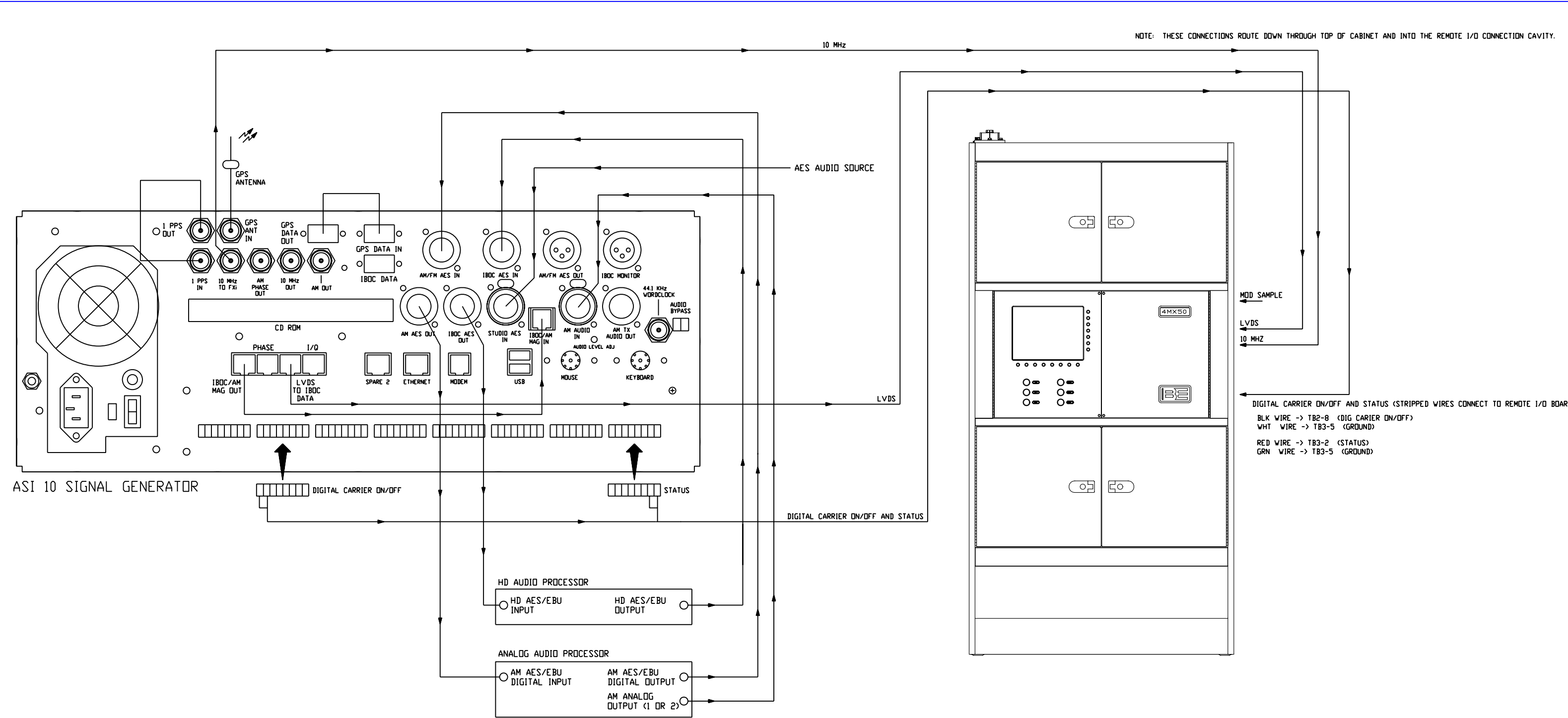
Fax: (217) 224-6258

14. Schematics

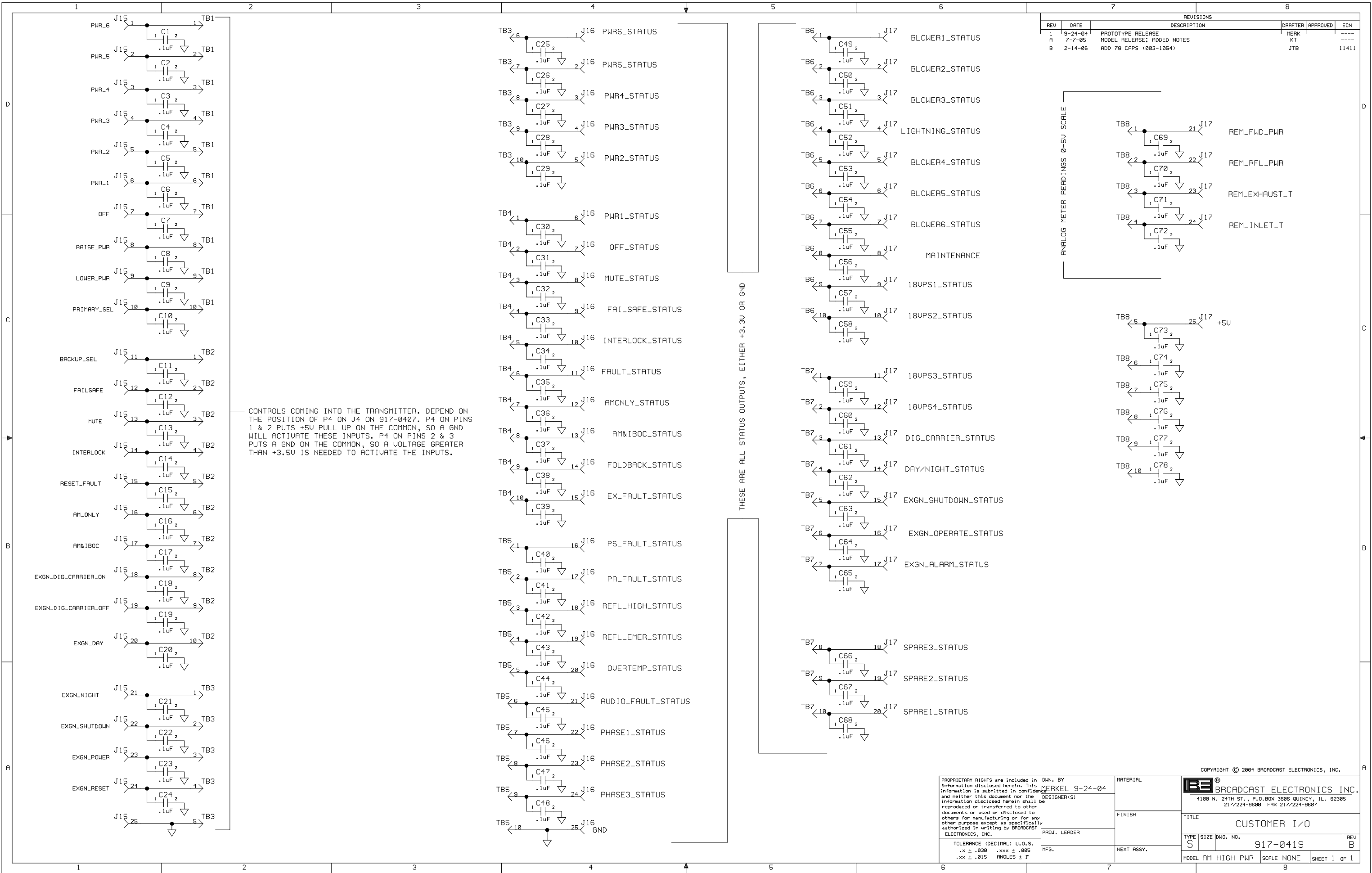
14.1. 4MX Series AM HD Interconnect (597-4050-004)

14.2. 4MX Customer I/O Board (917-0419)





"4MX SERIES TRANSMITTER"
TYPICAL AM HD SYSTEM INTERCONNECT DRAWING
597-4050-004 REV A



D

C

B

A

D

C

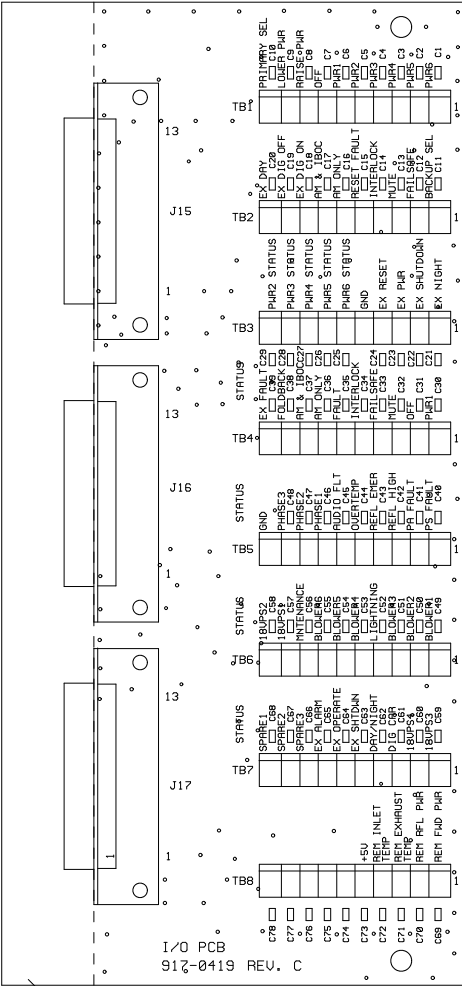
B


A

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	9-24-04	PROTOTYPE RELEASE	MERK	JL	----
2	12-13-04	MOVED CONNECTOR FLANGES FLUXH TO EDGE	KT	JL	----
A	7-7-05	ADDED TEXT; MODEL RELEASE	KT	JL	----
B	1-14-06	ADD NOTE (PTB1-PTB8)	JTB		11367
C	2-14-06	ADD 78 CAPS (003-1054)	JTB		11411

NOTES:

1. INTSALL PTB1-PTB8 (418-1550-010) ONTO TB1-TB8.



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	DESIGNER(S)				
	PROJ. LEADER	FINISH	TITLE ASSEMBLY DRAWING - I/O PCB		
	MFG.				
	TOLERANCE (DECIMAL) U.O.S. .X ± .030 .XXX ± .005 .XX ± .015 ANGLES + 1°		NEXT ASSY.	TYPE A	SIZE C
MODEL AM HIGH PWR				SCALE 1/1	SHEET 1 OF 1