**TECHNICAL MANUAL**
**3DXD COMBINER IBOC KIT**
**992 9511 832**

**888-2001-933**


T.M. No. 888-2001-933

## Returns And Exchanges

Damaged or undamaged equipment should not be returned unless written approval and a Return Authorization is received from HARRIS CORPORATION, Broadcast Systems Division. Special shipping instructions and coding will be provided to assure proper handling. Complete details regarding circumstances and reasons for return are to be included in the request for return. Custom equipment or special order equipment, that is not defective, is not returnable. In those instances where return or exchange of equipment is at the request of the customer, or convenience of the customer, a restocking fee will be charged. All returns will be sent freight prepaid and properly insured by the customer. When communicating with HARRIS CORPORATION, Broadcast Systems Division, specify the HARRIS Order Number or Invoice Number.

## Unpacking

Carefully unpack the equipment and preform a visual inspection to determine that no apparent damage was incurred during shipment. Retain the shipping materials until it has been determined that all received equipment is not damaged. Locate and retain all PACKING CHECK LISTs. Use the PACKING CHECK LIST to help locate and identify any components or assemblies which are removed for shipping and must be reinstalled. Also remove any shipping supports, straps, and packing materials prior to initial turn on.

## Technical Assistance

HARRIS Technical and Troubleshooting assistance is available from HARRIS Field Service during normal business hours (8:00 AM - 5:00 PM Central Time). Emergency service is available 24 hours a day. Telephone 217/222-8200 to contact the Field Service Department or address correspondence to Field Service Department, HARRIS CORPORATION, Broadcast Systems Division, P.O. Box 4290, Quincy, Illinois 62305-4290, USA. The HARRIS factory may also be contacted through a FAX facility (217/221-7096).

## Replaceable Parts Service

Replacement parts are available 24 hours a day, seven days a week from the HARRIS Service Parts Department. Telephone 217/222-8200 to contact the service parts department or address correspondence to Service Parts Department, HARRIS CORPORATION, Broadcast Systems Division, P.O. Box 4290, Quincy, Illinois 62305-4290, USA. The HARRIS factory may also be contacted through a FAX facility (217/221-7096) or e-mail at TSUPPORT@HARRIS.COM.

NOTE

The # symbol used in the parts list means used with (e.g. #C001 = used with C001).

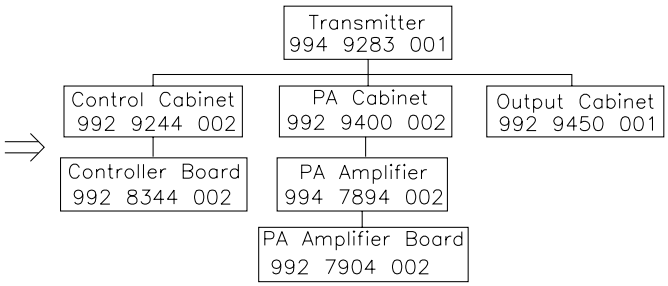
## Guide to Using Harris Parts List Information

The Harris Replaceable Parts List Index portrays a tree structure with the major items being leftmost in the index. The example below shows the Transmitter as the highest item in the tree structure. If you were to look at the bill of materials table for the Transmitter you would find the Control Cabinet, the PA Cabinet, and the Output Cabinet. In the Replaceable Parts List Index the Control Cabinet, PA Cabinet, and Output Cabinet show up one indentation level below the Transmitter and implies that they are used in the Transmitter. The Controller Board is indented one level below the Control Cabinet so it will show up in the bill of material for the Control Cabinet. The tree structure of this same index is shown to the right of the table and shows indentation level versus tree structure level.

Example of Replaceable Parts List Index and equivalent tree structure:

Replaceable Parts List Index

| | | | |
|---|---|---|---|
| Table 7–1. | Transmitter | 994 9283 001 | 7–2 |
| Table 7–2. | Control Cabinet | 992 9244 002 | 7–3 |
| Table 7–3. | Controller Board | 992 8344 002 | 7–6 |
| Table 7–4. | PA Cabinet | 992 9400 002 | 7–7 |
| Table 7–5. | PA Amplifier | 994 7894 002 | 7–9 |
| Table 7–6. | PA Amplifier Board | 992 7904 002 | 7–10 |
| Table 7–7. | Output Cabinet | 992 9450 001 | 7–12 |




The part number of the item is shown to the right of the description as is the page in the manual where the bill for that part number starts.

Inside the actual tables, four main headings are used:

Table #-#. ITEM NAME - HARRIS PART NUMBER - this line gives the information that corresponds to the Replaceable Parts List Index entry;

HARRIS P/N column gives the ten digit Harris part number (usually in ascending order);

DESCRIPTION column gives a 25 character or less description of the part number;

REF. SYMBOLS/EXPLANATIONS column 1) gives the reference designators for the item (i.e., C001, R102, etc.) that corresponds to the number found in the schematics (C001 in a bill of material is equivalent to C1 on the schematic) or 2) gives added information or further explanation (i.e., “Used for 208V operation only,” or “Used for HT 10LS only,” etc.).

Inside the individual tables some standard conventions are used:

A # symbol in front of a component such as #C001 under the REF. SYMBOLS/EXPLANATIONS column means that this item is used on or with C001 and is not the actual part number for C001.

In the ten digit part numbers, if the last three numbers are 000, the item is a part that Harris has purchased and has not manufactured or modified. If the last three numbers are other than 000, the item is either manufactured by Harris or is purchased from a vendor and modified for use in the Harris product.

The first three digits of the ten digit part number tell which family the part number belongs to - for example, all electrolytic (can) capacitors will be in the same family (524 xxxx 000). If an electrolytic (can) capacitor is found to have a 9xx xxxx xxx part number (a number outside of the normal family of numbers), it has probably been modified in some manner at the Harris factory and will therefore show up farther down into the individual parts list (because each table is normally sorted in ascending order). Most Harris made or modified assemblies will have 9xx xxxx xxx numbers associated with them.

The term “SEE HIGHER LEVEL BILL” in the description column implies that the reference designated part number will show up in a bill that is higher in the tree structure. This is often the case for components that may be frequency determinant or voltage determinant and are called out in a higher level bill structure that is more customer dependent than the bill at a lower level.

HARRIS Broadcast Systems Division
P.O. Box 4290, QUINCY, IL 62305

# PARTS ORDER FORM

HARRIS PHONE: 217-222-8200
HARRIS FAX: 217-221-7096

BILLING INFORMATION

CUSTOMER NAME: _____

ADDRESS: _____

_____

_____

_____

TELEPHONE NUMBER: _____

FAX NUMBER: _____

PREFERRED PAYMENT METHOD: _____

SHIPPING INFORMATION

SHIP TO: _____
(if different from billing information)

ADDRESS: _____

_____

_____

_____

TELEPHONE NUMBER: _____

FAX NUMBER: _____

SHIPPING METHOD PREFERRED: _____

FREQUENCY (If required): _____

EQUIPMENT NAME: _____

EQUIPMENT PART NUMBER: _____

EQUIPMENT SERIAL NUMBER: _____

## GUIDE FOR ORDERING PARTS

Please use the following parts order form, filling is as much information as possible. The complete informaiton will allow double checking the part number for correctness or locating a substitude if the part is not available.
The equipment name, part number, and serial number will be found on the metal ID plate on the back of the unit. The serial number MUST be included for any parts ordered under warranty.
Describe the part using the description in the parts list if possible. Include the schematic information, schematic number, or number of next higher assembly. The next higher assembly is usually a 992-xxxx-00x type.

| ITEM # | QTY ORD | HARRIS PART NUMBER | DESCRIPTION OF PART (PART'S NAME, DESCRIPTION, SPECIFICATION FROM PARTS LIST IF AVAILABLE) | SCHEMATIC REFERENCE REFERENCE NAME (e.g. C001, R100, etc) | ITEM USED ON (NEXT HIGHER ASSEMBLY IF KNOWN) (e.g. C001 used on 992 8025 001, SCHEMATIC 839 8099 991) | COMMENTS |
|---|---|---|---|---|---|---|
| | | | | | | |
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## WARNING

**THE CURRENTS AND VOLTAGES IN THIS EQUIPMENT ARE DANGEROUS. PERSONNEL MUST AT ALL TIMES OBSERVE SAFETY WARNINGS, INSTRUCTIONS AND REGULATIONS.**

This manual is intended as a general guide for trained and qualified personnel who are aware of the dangers inherent in handling potentially hazardous electrical/electronic circuits. It is not intended to contain a complete statement of all safety precautions which should be observed by personnel in using this or other electronic equipment.

The installation, operation, maintenance and service of this equipment involves risks both to personnel and equipment, and must be performed only by qualified personnel exercising due care. HARRIS CORPORATION shall not be responsible for injury or damage resulting from improper procedures or from the use of improperly trained or inexperienced personnel performing such tasks.

During installation and operation of this equipment, local building codes and fire protection standards must be observed. The following National Fire Protection Association (NFPA) standards are recommended as reference:

- Automatic Fire Detectors, No. 72E
- Installation, Maintenance, and Use of Portable Fire Extinguishers, No. 10
- Halogenated Fire Extinguishing Agent Systems, No. 12A

## WARNING

**ALWAYS DISCONNECT POWER BEFORE OPENING COVERS, DOORS, ENCLOSURES, GATES, PANELS OR SHIELDS. ALWAYS USE GROUNDING STICKS AND SHORT OUT HIGH VOLTAGE POINTS BEFORE SERVICING. NEVER MAKE INTERNAL ADJUSTMENTS, PERFORM MAINTENANCE OR SERVICE WHEN ALONE OR WHEN FATIGUED.**

Do not remove, short-circuit or tamper with interlock switches on access covers, doors, enclosures, gates, panels or shields. Keep away from live circuits, know your equipment and don’t take chances.

## WARNING

**IN CASE OF EMERGENCY ENSURE THAT POWER HAS BEEN DISCONNECTED.**

## WARNING

**IF OIL FILLED OR ELECTROLYTIC CAPACITORS ARE UTILIZED IN YOUR EQUIPMENT, AND IF A LEAK OR BULGE IS APPARENT ON THE CAPACITOR CASE WHEN THE UNIT IS OPENED FOR SERVICE OR MAINTENANCE, ALLOW THE UNIT TO COOL DOWN BEFORE ATTEMPTING TO REMOVE THE DEFECTIVE CAPACITOR. DO NOT ATTEMPT TO SERVICE A DEFECTIVE CAPACITOR WHILE IT IS HOT DUE TO THE POSSIBILITY OF A CASE RUPTURE AND SUBSEQUENT INJURY.**

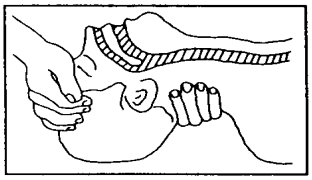
## TREATMENT OF ELECTRICAL SHOCK

1. IF VICTIM IS NOT RESPONSIVE FOLLOW THE A-B-CS OF BASIC LIFE SUPPORT.

PLACE VICTIM FLAT ON HIS BACK ON A HARD SURFACE

### (A) AIRWAY

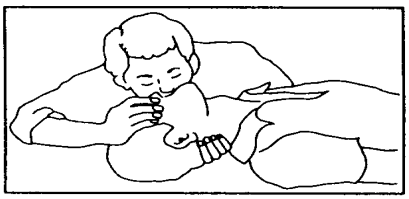
IF UNCONSCIOUS,
OPEN AIRWAY



LIFT UP NECK
PUSH FOREHEAD BACK
CLEAR OUT MOUTH IF NECESSARY
OBSERVE FOR BREATHING

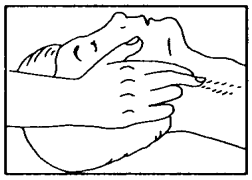
### (B) BREATHING

IF NOT BREATHING,
BEGIN ARTIFICIAL BREATHING



TILT HEAD
PINCH NOSTRILS
MAKE AIRTIGHT SEAL
4 QUICK FULL BREATHS
REMEMBER MOUTH TO MOUTH
RESUSCITATION MUST BE
COMMENCED AS SOON AS POSSIBLE

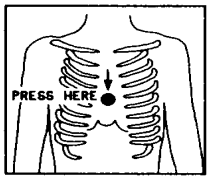
CHECK
CAROTID PULSE



IF PULSE ABSENT,
BEGIN ARTIFICIAL
CIRCULATION

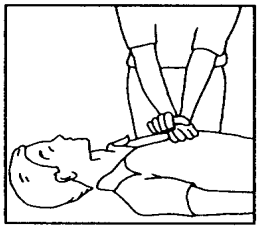
### (C) CIRCULATION

DEPRESS STERNUM 1 1/2 TO 2 INCHES




APPROX. RATE OF COMPRESSIONS --80 PER MINUTE
- ONE RESCUER
- 15 COMPRESSIONS
- 2 QUICK BREATHS

APPROX. RATE OF COMPRESSIONS --60 PER MINUTE
- TWO RESCUERS
- 5 COMPRESSIONS
- 1 BREATH



NOTE: DO NOT INTERRUPT RHYTHM OF COMPRESSIONS
WHEN SECOND PERSON IS GIVING BREATH

CALL FOR MEDICAL ASSISTANCE AS SOON AS POSSIBLE.

2. IF VICTIM IS RESPONSIVE.

A. KEEP THEM WARM
B. KEEP THEM AS QUIET AS POSSIBLE
C. LOOSEN THEIR CLOTHING
D. A RECLINING POSITION IS RECOMMENDED

## FIRST-AID

Personnel engaged in the installation, operation, maintenance or servicing of this equipment are urged to become familiar with first-aid theory and practices. The following information is not intended to be complete first-aid procedures, it is a brief and is only to be used as a reference. It is the duty of all personnel using the equipment to be prepared to give adequate Emergency First Aid and thereby prevent avoidable loss of life.

Treatment of Electrical Burns

1. Extensive burned and broken skin
   a. Cover area with clean sheet or cloth. (Cleanest available cloth article.)
   b. Do not break blisters, remove tissue, remove adhered particles of clothing, or apply any salve or ointment.
   c. Treat victim for shock as required.
   d. Arrange transportation to a hospital as quickly as possible.
   e. If arms or legs are affected keep them elevated.

**NOTE**

If medical help will not be available within an hour and the victim is conscious and not vomiting, give him a weak solution of salt and soda: 1 level teaspoonful of salt and 1/2 level teaspoonful of baking soda to each quart of water (neither hot or cold). Allow victim to sip slowly about 4 ounces (a half of glass) over a period of 15 minutes. Discontinue fluid if vomiting occurs. (Do not give alcohol.)

2. Less severe burns - (1st & 2nd degree)
   a. Apply cool (not ice cold) compresses using the cleanest available cloth article.
   b. Do not break blisters, remove tissue, remove adhered particles of clothing, or apply salve or ointment.
   c. Apply clean dry dressing if necessary.
   d. Treat victim for shock as required.
   e. Arrange transportation to a hospital as quickly as possible.
   f. If arms or legs are affected keep them elevated.

REFERENCE:

ILLINOIS HEART ASSOCIATION

AMERICAN RED CROSS STANDARD FIRST AID AND PERSONAL SAFETY MANUAL (SECOND EDITION)

# Table of Contents

## 1.1 Pre-Installation Checklist for AM HD Radio

There are several considerations that must be made prior to installation of an AM IBOC system. This section covers some of these items.

### 1.1.1 STL.

The STL output must be in AES format in order to interface with ePAL and the Dexstar exciter. If the STL is presently analog, as a minimum, an A/D converter (Lucent 9624 or equivalent) will be required in the package. If audio interconnect cabling is customer supplied, it must meet specifications for low capacitance 110-ohm AES cable. Belden 1800A (Harris Part Number 253-0132-000) is recommended.

### 1.1.2 Audio Processing

Existing legacy AM audio processors without AES inputs AND outputs at 44.1 kHz cannot continue to be used, even on the analog audio chain. Qualifying products for the analog chain include Optimod 9200-UD (with the AES option), and the Omnia 4.5am. Qualifying products for the DAB chain include the Optimod 6200, and the Omnia 6DAB.

### 1.1.3 Rack Space

At least 13 RU (22.75") of additional rack space will be required:
ePAL (2RU)
Dexstar (4RU)
UPS (1 RU)
DAB Audio Processor (2RU)
Future (IBOC) Modulation Monitor (4RU-estimated)
Rack must have rear rails in order to facilitate mounting the Dexstar, and should be 27" to 30" in depth. The Harris rack is 30" deep.

### 1.1.4 Antenna

Impedance sweeps of the antenna system, at the transmitter output connector from 20 kHz below carrier to +20 kHz above carrier at 5 kHz intervals, should be available for evaluation by the station's consultant or Harris Corporation prior to installation.

### 1.1.5 Test Equipment.

For customers who choose self-installation, a spectrum analyzer (Agilent E4411B or equivalent) will be required. The analyzer must be capable of 300 Hz resolution bandwidth, and have a dynamic range of 90 dB. A 60 MHz or higher resolution oscilloscope will also be required to observe the modulated carrier.

### 1.1.6 Monitoring

Wide-band AM modulation monitors cannot accurately display analog modulation with digital carriers on. A modulation monitor with optional 5 and 8 kHz lowpass filters is recommended. The Belar AMMA-2 fulfills this requirement. Modulation monitors to demodulate or measure the digital signal should be available by Spring, 2005.

## 1.2 3DXD COMBINER IBOC INSTALLATION PROCEDURE

### **1.2.1** Equipment needed

Transmitter and Exciter under test
iBiquity Reference Receiver, Ward Beck Audio Bit Buddy ABB-1, stereo headphones or Kenwood KDC-X579 and KTC-HR100 or equivalent receiver, audio amplifier and speakers
DAB *and* AM Digital Audio Processor, ex. Orban 6200 and 9200
CD player with AES output or AES source
60 MHz Oscilloscope and 10X probe or BNC TEE connector and cable
E4402, E4411B, Agilent Spectrum Analyzer or equivalent
Frequency Counter
Optional: AM Mod Monitor with built in 5KHz filter
Optional: ePAL (component of Harris IBOC HDR audio rack)

The ePAL contains a rate converter, distribution amp, and analog switch. Main functions of the ePAL are AES audio rate conversion with multiple outputs, external sync to the 44.1 kbps clock from the Dexstar exciter, and a switch for audio bypassing.

### **1.2.2 Interconnection**

See Figure 1 for basic interconnects. For specifics on interconnection with an optional Harris HDR audio rack, consult the AM IBOC EQUIPMENT RACK Drawing Package, HPN 917-2332-782. The wiring diagram for the AM DAB Exciter Rack is drawing 843-5523-908.
Refer to 839-8220-401

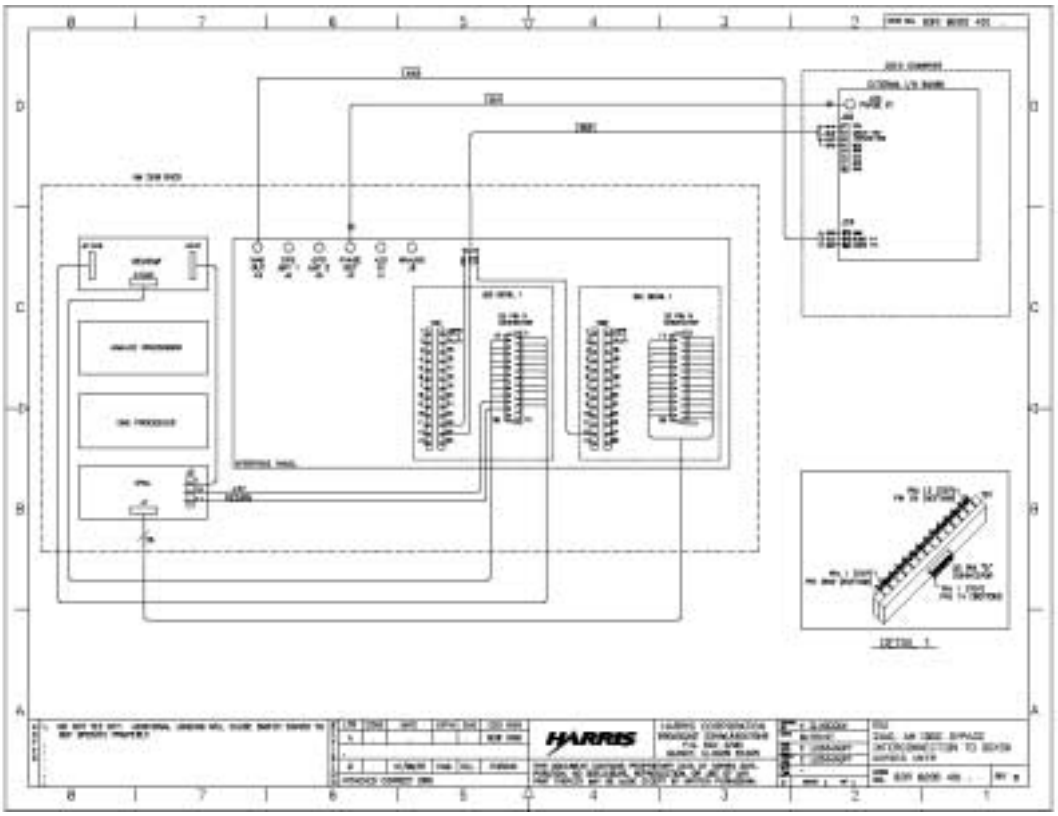


***Figure 1 Combiner/IBOC Interconnect***

If you did not purchase the optional Harris HDR audio rack and require further support material contact Harris Radio Field Service at +217 222 8200 or e-mail to tsupport@harris.com.

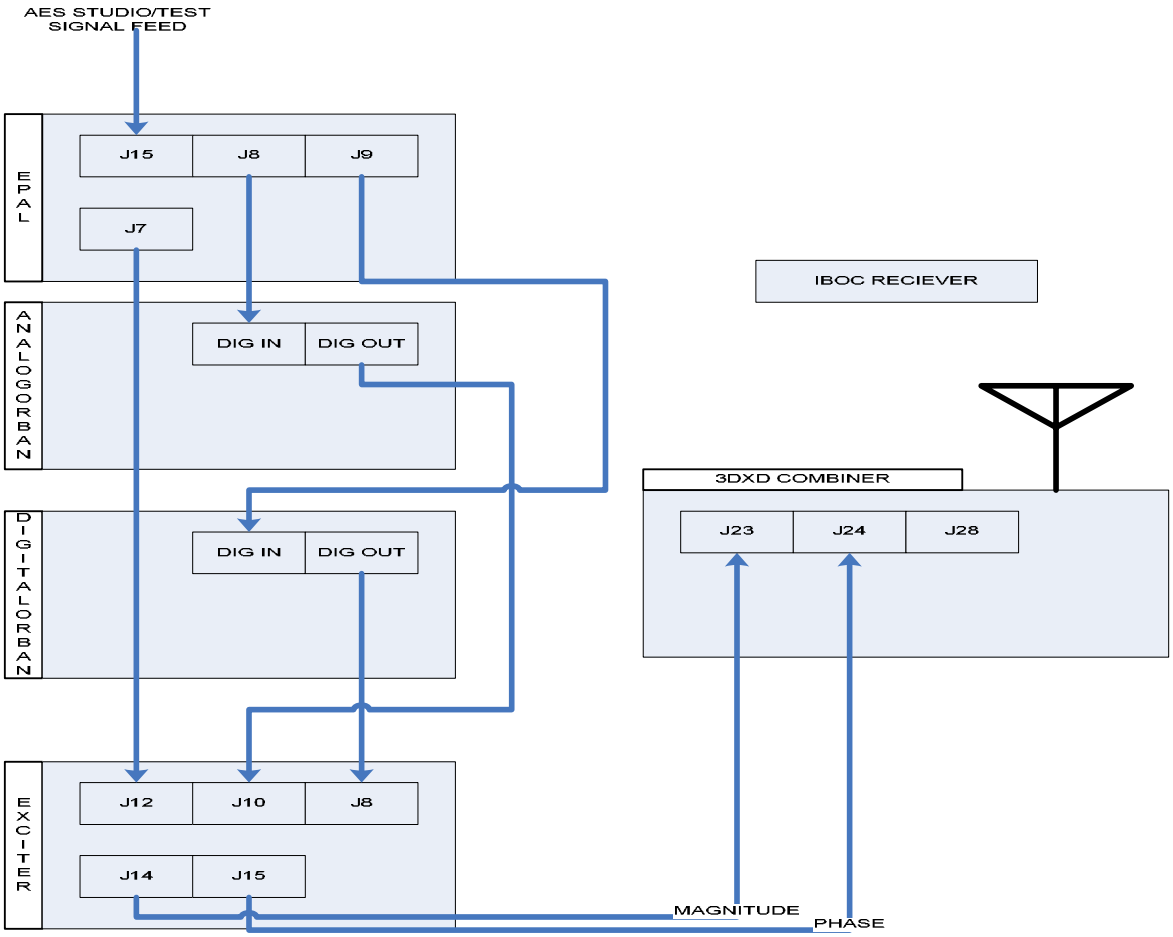



***Figure 2 IBOC BLOCK DIAGRAM***

### 1.2.3 Epal setup

**Note:** Interconnection of Wire 302 between the 3DXD Combiner and IBOC Rack will allow the 3DX to control the Bypass/Operate mode in the ePAL, when the ePAL is in Manual mode. While in the Manual mode, the ePAL indicator for Manual Mode flashes red, this is normal.

For review,
Operate is when RF and audio are routed from the Dexstar exciter.
Bypass is when analog audio from the processor and RF from the internal exciter are selected.

Automatic Mode places the Dexstar in charge of switching the audio and RF between Operate and Bypass.

Manual mode enables the front panel or rear panel remote i/o of the ePAL to switch between Operate and Bypass.

In the event the exciter should experience a non-recoverable fault, it may not have the ability to switch to bypass. To avoid an off-air condition, it may be considered better to have the transmitter, remote control or front panel of the ePAL control Operate/Bypass in the Manual mode, rather than the exciter in Automatic.

### 1.2.4 Exciter Setup

#### 1.2.4.1 Ensuring Dexstar is in AM mode

View the upper right hand corner of GUI.

#### 1.2.4.2 Set operating frequency

On System screen, touch the password entry box enter password “1234”, then touch “enter” box will show “valid until <time>”.

Go to the “System Setup” screen, then “Station Setup” screen. Touch “Carrier Frequency” window and enter desired frequency. System will direct you to restart the exciter for the new frequency setting to take effect; do so if the carrier frequency is not correct. The Switch Board will require realignment if the frequency was not correct.

Check the carrier frequency at the AM Phase Out, A11J5, with the frequency counter.

Use the oscilloscope to measure and set the AM Phase output level for 5.0 vpp while operating into a 50 ohm load, as stated above in section 1.2.3.4. See Figure 2 for reference.

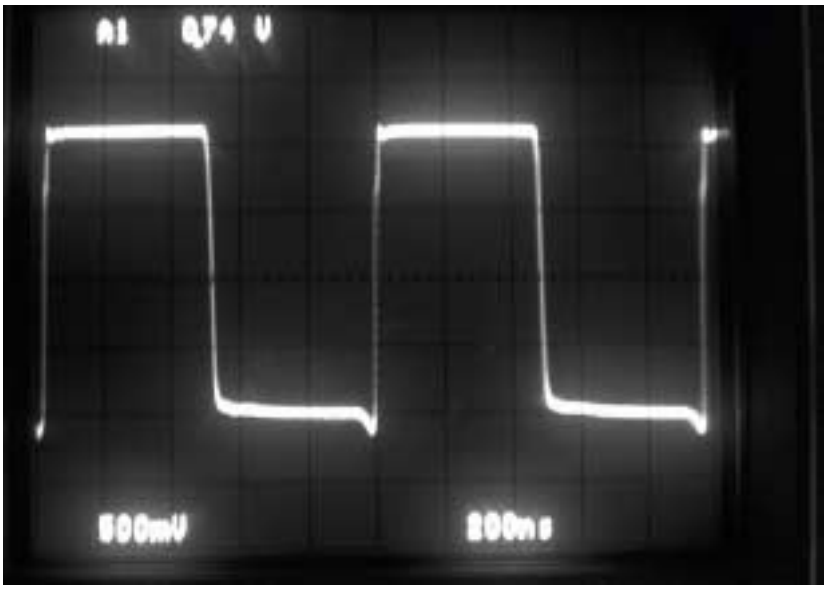



***Figure 3 AM Phase Output***

1.2.4.3 Exciter Presets

Navigate throughout the GUI and set the following.

I/Q scale factor = 12000
DC Offset = -1
Analog gain = 1.25
Enhanced Carrier power = Normal
Analog Modulation = ON
Analog Audio BW =
Digital Carriers = OFF
Magnitude/ Phase Delay = 12000
Magnitude/ Phase Delay Step Size = 50
SB level = 0,0

### 1.2.5 AES Analog Processor,

Orban 9200 settings, for example.

Select appropriate preset, for example MUSIC MEDIUM or JAZZ
BW = 50 to 5KHz
Dig out = -3dbfs **(WARNING: SEE NOTE BELOW)**
Pos Peak = 141% (final setting for +125% analog modulation)
Final clip 1.5
Select sinewave test mode at 100%.

**IMPORTANT NOTE: Check the analog audio AES Audio Input Source level.** The AES audio source supplied to the Dexstar AES AUDIO INPUT A13J10 must be limited to –3DBFS.

Set the audio processor digital output to no greater than –3dBfs output. This will still allow for a maximum setting of +141% positive peaks on an Orban.

Since IBOC uses phase modulation of the RF carrier, over 100% modulation on negative peaks can cause a 180 degrees phase shift of the carrier, or phase reversal. It is possible to overdrive the DEXSTAR resulting in erroneous drive signals and unnecessary phase reversals. This could lead to symptoms ranging from unwanted spectrum splatter to possible transmitter stress and or failure. Monitor the IF/AM OUT J2 (BNC) port on the exciter with an oscilloscope and verify no negative modulation peaks exceed greater than 98% negative.

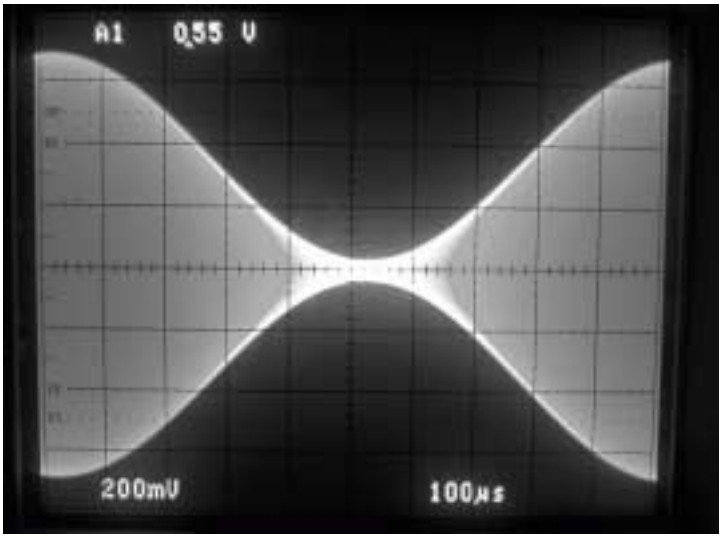



***Figure 4 Dexstar AM/IF port, 98% 1KHz modulation***

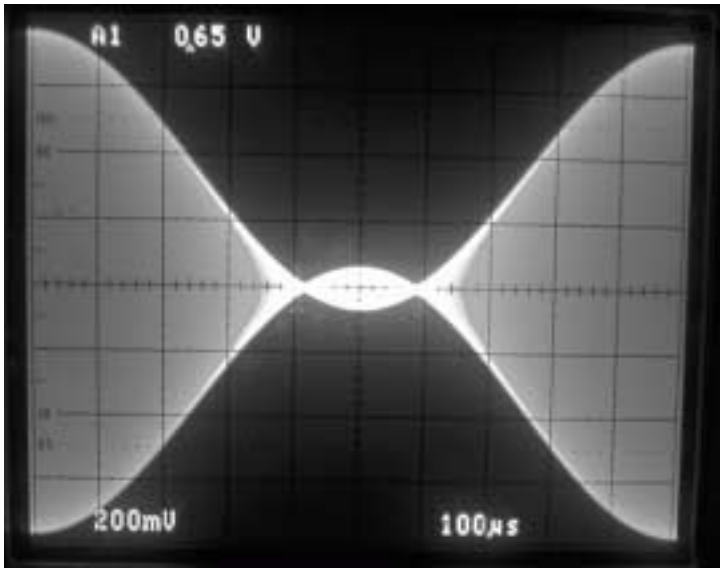



***Figure 5 Dexstar IF/AM Port Overdriven Example***

### 1.2.6 Combiner RF Switch Board Setup

The procedure for adjustment of the RF Switch Board in the Combiner A2A3 is as follows:
1. Connect an oscilloscope to monitor the digital phase output of the Dexstar while it is loaded into 50 ohms. This can be accomplished by terminating it directly into a 50 ohm input of an oscilloscope or by terminating into a 50 ohm rf termination load and tee off with an oscilloscope set to 1Meg ohm input. Adjust the RF phase output of the Dexstar for 5 volts peak to peak..
2. Monitor the digital phase (RF drive) input from the Dexstar at TP38 on the RF Switch Board A2A3 with an oscilloscope and Set dip switches S5 and adjust C109 for a peak sine wave. This will need to be re-adjusted if carrier frequency is changed in the Dexstar.

### 1.2.7 AM Magnitude setup

Monitor the transmitter output sample and exciter IF/AM output on a dual channel scope. Modulate the Dexstar exciter with 1 khz tone at -3 dBFS from the audio processor. The level should be set for 95% as measured at the IF/AM port.
Set the AM Magnitude potentiometer at rear of Dexstar, so the transmitter's depth of modulation matches that of what's observed on the IF/AM port. (95%) (Leave the transmitter's audio gain setting at +10 dBm, to keep normal AM mono operation.)
**Note:** This depth of modulation matching step must be performed before the digital carriers levels are adjusted, since the AM magnitude potentiometer affects the digital carrier level.
**Note:** If adjustment of the AM Magnitude potentiometer at the rear of the Dexstar fails to match the modulation level of the transmitter and IF/AM port, or if the adjustment is near or at maximum, an adjustment of the DUC board in the exciter is required. Gain access to the exciter by extending it on the slide-rails. Remove the top of the exciter. Locate R199 on the DUC board, see Figure 8. This adjustment is typically set at or very near maximum output, or fully CCW, to achieve an output of +14dBm. Modulation should then be reduced with the rear panel potentiometer to allow headroom for final touch-up later. Again, the final setting of the rear panel control should not be fully CW, as this may result in not being able to reduce the "spectral regrowth" covered later in this chapter.

***Figure 6 Dexstar DUC Board AM Magnitude Output adjust R199 location***

If the password has timed out, on the System screen, touch the password entry box enter password “1234”, then touch “enter” box will show “valid until <time>”.
On the Dexstar front panel GUI display, select System Setup. Select Digital Carrier ON.

**Note:** Add 20 dB of attenuation at the input of the spectrum analyzer. Also, reduce the modulation monitor sample by adjusting the appropriate monitor level adjustment potentiometer. The absolute level of the analog carrier should not exceed 0 dBm on the spectrum analyzer display to avoid overloading or damaging the front end of the analyzer.

Connect the spectrum analyzer to the modulation monitor port.

Set the spectrum analyzer as follows:
Center Frequency: set to carrier frequency
Resolution Bandwidth: 300 Hz
Span: 100 KHz
Amplitude: set un-modulated analog carrier to top graticule
Detector: Sample, (Peak = OFF)
Video BW: OFF or highest setting
Averaging: ON, set to average 10 sweeps during tuning, 100 sweeps for final measure
Sweep: 500 milliseconds or auto
Sample points: 400 to tune, maximum number of points for final measure

On the spectrum analyzer, check the primary carrier levels referenced to the analog carrier. If necessary, set the SB level controls so the primary carrier levels are –28.7db down. Refer to Figure 8.

**Note:** Spectrum Analyzer resolution bandwidth must be set to 300Hz and span set to 100khz for proper reference level. The peak detector function must be OFF!

1.2.7.1 Analog Gain setup.

Turn transmitter off, monitor "IF AM Out" at rear of exciter.

Apply –3DBFS 1 KHz tone from the audio processor and set Analog Gain, on AM System Setup page, to achieve negative 98% modulation. See Figure 6. The initial set-up value is 1.25 and the maximum is 1.35. Exceeding 1.35 will shut the RF carrier off out of the exciter to avoid over modulation and phase reversals.

**Note:** Figure 7 is an example of an overdriven exciter and results in phase reversals of the drive signal (AM Phase out). **This is to be avoided.** (Ibiquity directs us to set this for 100% negative modulation at this point. A modulation depth of 98% allows some headroom to help avoid overdriving the exciter. It is at this juncture we depend on the negative limiting capability of the audio processor to avoid exceeding (or approaching) pinch off and thus overdriving the exciter.)

Turn digital carriers OFF. Turn transmitter (TX) on. Check modulation level of TX, it should also be 98%. When done, turn digital carriers back on.

**Note:** The depth of modulation matching setup was done in the previous step, step 1.2.6.1, and should not have been disturbed by the exciter's analog level re-adjustment.

1.2.7.2 Magnitude/ Phase Delay Optimization

Monitor the "spectral regrowth" area on the spectrum analyzer. This is the segment of the spectrum about double the frequency of the digital carriers, located 20 to 30Khz above and below the analog carrier. See Fig.2.
On AM System Setup page, adjust Magnitude/Phase Delay up/down arrows until spectral regrowth is minimized.

**Note**: The Delay is preset at 13455, and the step size 50. Typically, the final setting of the delay will be around 12,400. If necessary, reduce the step size to 10 or further to ensure the delay setting is optimized.

Make slight adjustment to the AM Magnitude adjustment on the rear of the Dexstar to insure the regrowth is minimized.

Record spectrum occupied bandwidth. It should resemble the waveform in Figure 9.

Compare the spectrum with the AM Hybrid Emissions Limits in Figure 10. The waveform should not exceed the mask at any point. This is shown in Enhanced carrier mode.

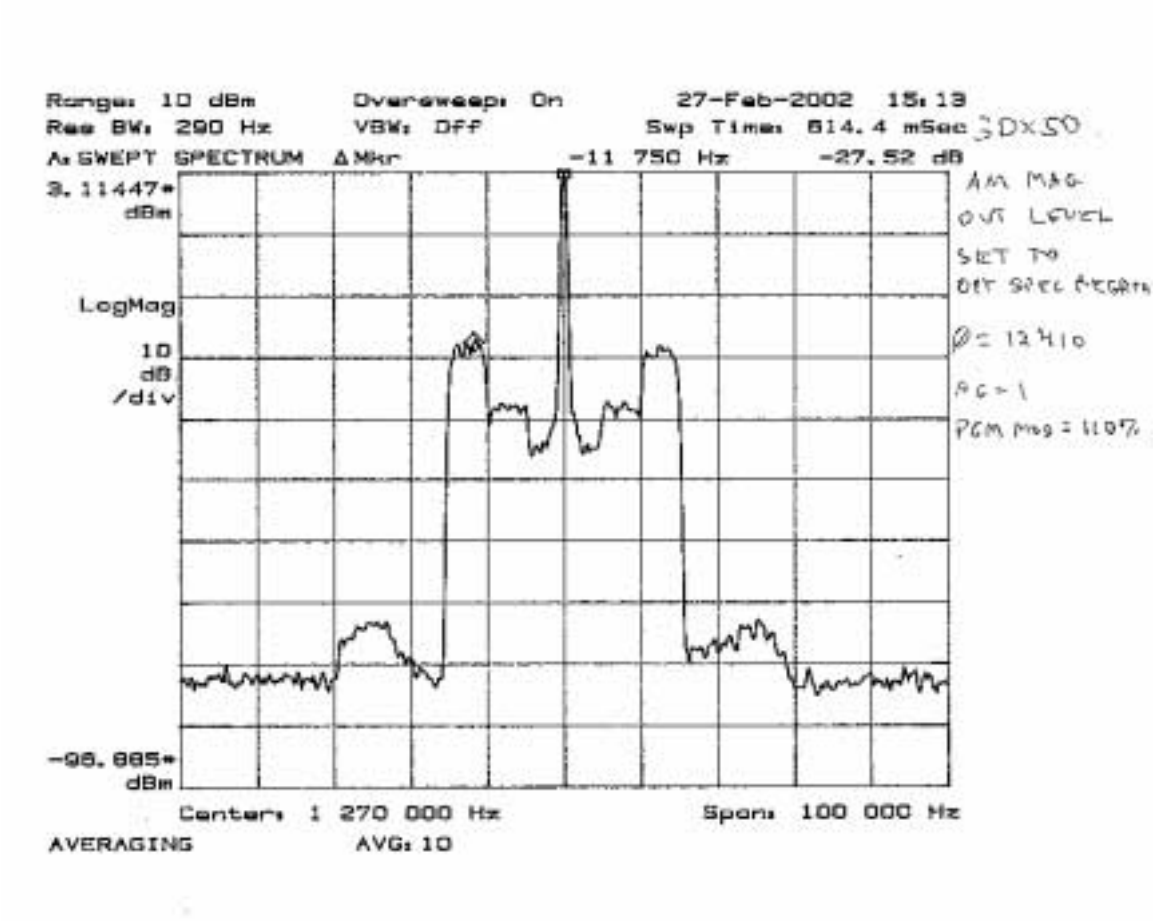



***Figure 7 100KHz Spectrum, Magnitude level + phase optimized***

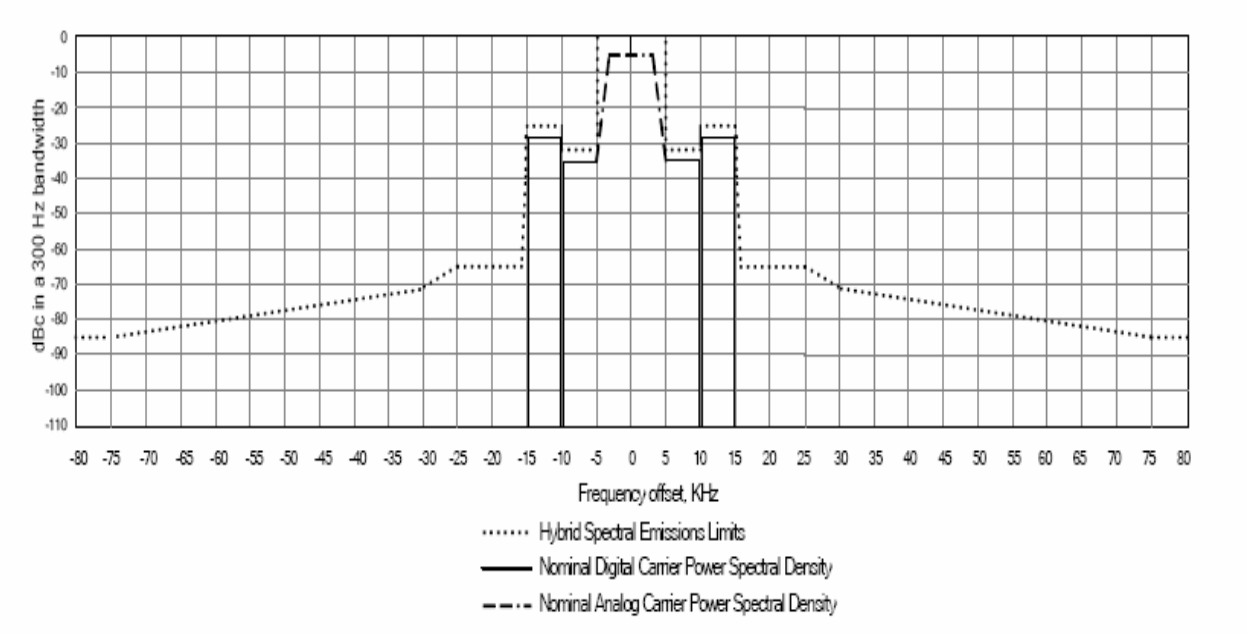



***Figure 8***

***Table 1*** *AM Hybrid Spectral Emissions Limits*

| Frequency Offset Relative to Carrier | Level Relative to Unmodulated Carrier (dBc per 300 Hz) |
|---|---|
| 15 to 15.2 kHz offset | -28 |
| 15.2 to 15.8 kHz offset | -39 – (\|frequency offset in kHz\| - 15.2) · 43.3 |
| 15.8 to 25 kHz offset | -65 |
| 25 kHz to 30.5 kHz offset | -65 – (\|frequency offset in kHz\| - 25) · 1.273 |
| 30.5 kHz to 75 kHz offset | -72 – (\|frequency offset in kHz\| - 30.5) · 0.292 |
| > 75 kHz offset | -85 |

### **1.2.8** System Verification

#### 1.2.8.1 Audio Proof

Test and record the results of Analog performance. Note tests to be conducted with and without IBOC carriers on. Use response and distortion tests comparable to the standard factory test sweep found in the transmitter factory test data.

**Note:** With the digital carriers on a 5khz filter is required on the detected audio sample, or use the new Belar mod monitor with the built in DAB filter.

Test the DAB Digital broadcast service.

At this time, this is a subjective evaluation of the broadcast signal due to limitations of the IBOC receiver. Use a Bit Buddy connected to an iBiquity Reference receiver AES digital output. Select the split mode of operation to monitor analog audio in one channel and digital in the other. Set the diversity delay on the Dexstar so that both audio sources are coincident.

Alternatively, you may use a commercially available receiver in the broadcasters mode. Consult the receiver manufacturer's instruction manual for details.

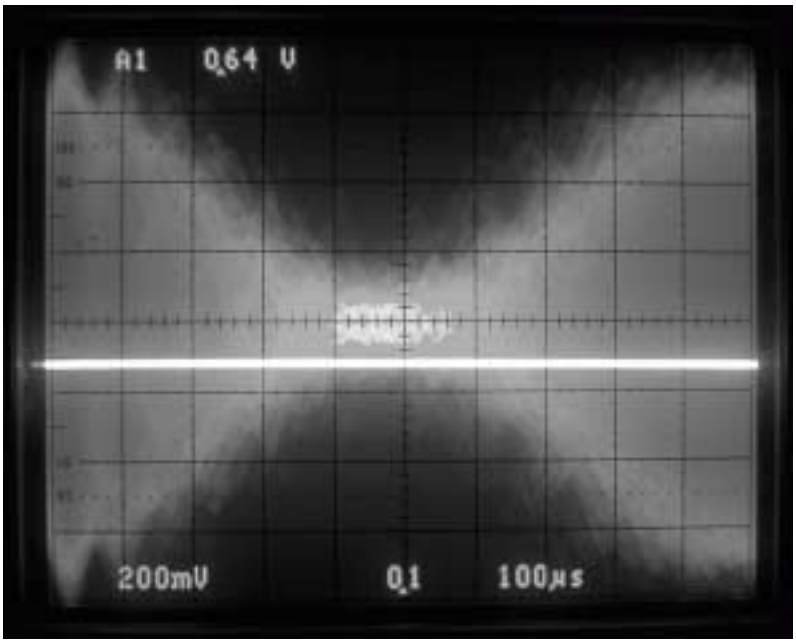



***Figure 9 98% 1 KHZ sine modulation with digital carriers on***

### 1.2.9 Troubleshooting.

If the spectral regrowth cannot be minimized, the likely cause may be a missing RF or magnitude component. Figure 12 depicts the output spectrum when the magnitude (audio only) connection is correct, but the transmitter was still operating on the internal exciter. Notice the absence of digital carriers around the analog channel.

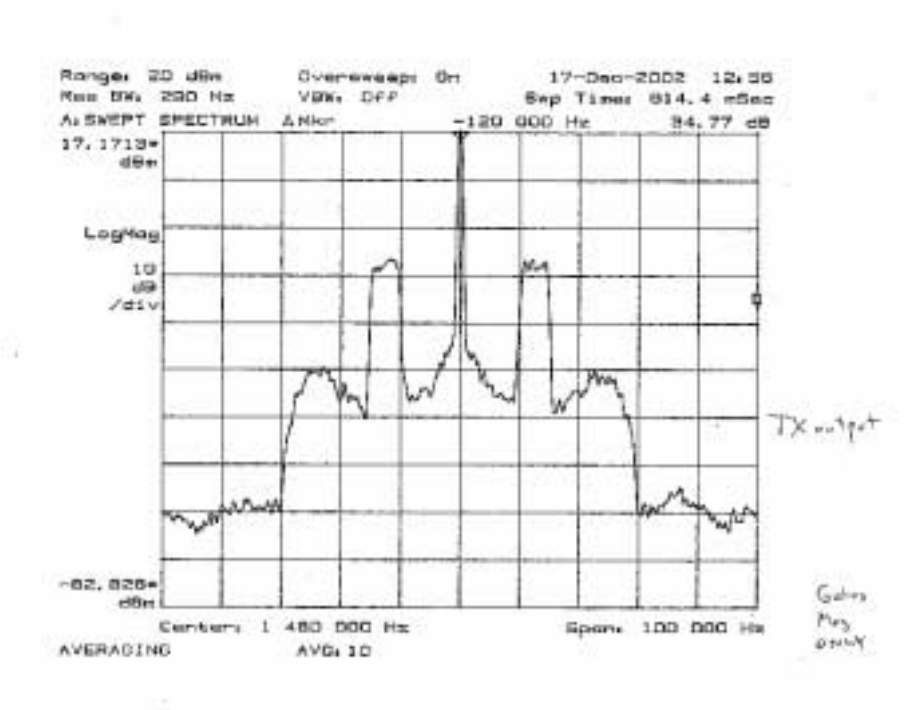



***Figure 10 100KHz Spectrum, IBOC Magnitude component only***

Figure 9 depicts a transmitter operating with RF only from the Dexstar exciter or if the polarity of the Magnitude signal were reversed. An easy way to determine if the polarity is correct is to monitor the IF output port on the exciter and modulation monitor output of the transmitter with an oscilloscope. A sinusoidal waveform, as found in Figure 6, should be in phase. A 180 degree phase reversal would indicate reversed audio polarity, in which case correction of spectral re-growth would not be obtained.

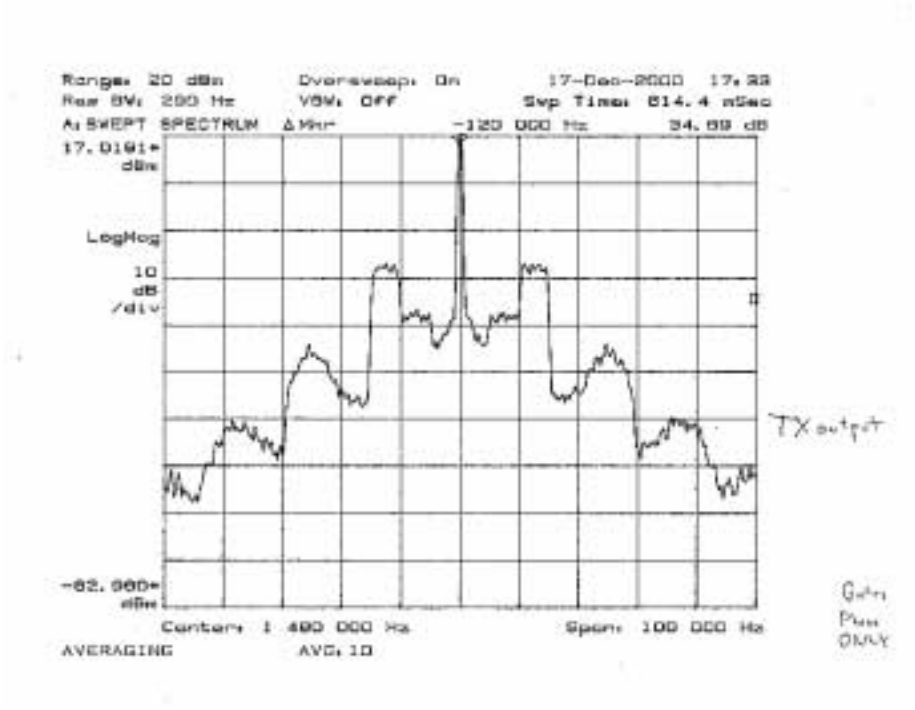



***Figure 11 100KHz Spectrum, IBOC Phase component only or audio polarity reversed***

## Table 1-1. * KIT, 3DXD COMBINER IBOC - 992 9511 832 ((?))

| *Harris PN* | *Description* | *QTY UM* | *Reference Designators* |
|---|---|---|---|
| 358 3452 000 | LEVER, | 1 EA | |
| 917 2332 587 | CABLES, 50FT 3DX50/ AM IBOC INTERFACE | 1 EA | |
| 988 2001 933 | DP, 3DXD COMBINER IBOC KIT | 1 EA | |

## Table 1-2. CABLES, 50FT 3DX50/ AM IBOC INTERFACE - 917 2332 587 (K)

| *Harris PN* | *Description* | *QTY UM* | *Reference Designators* |
|---|---|---|---|
| 253 0059 000 | CABLE, 2C 22AWG AUDIO | 50 | |
| 253 0081 000 | WIRE, 3C 22AWG STRD | 50 | |
| 296 0253 000 | TUBING, SHRINK 3/16 WHITE | 0.50 | |
| 296 0263 000 | TUBING, SHRINK 3/8 WHITE | 0.5 | |
| 354 0005 000 | TERM LUG RED SPADE 6 | 3 | |
| 612 1458 000 | FEMALE CONNECTOR RT ANGLE | 1 | |
| 612 2108 000 | PLUG, XLR TYPE, 3C FEMALE | 1 | |
| 618 0511 000 | COAX CABLE RG-223/U | 50 | |
| 620 0818 000 | PLUG, STRAIGHT BNC | 2 | |
| 817 2332 587 | CADS, 50FT 3DX50/ AM IBOC INTERFACE | 0 | |

## Table 1-3. DP, 3DXD COMBINER IBOC KIT - 988 2001 933 ()

| *Harris PN* | *Description* | *QTY UM* | *Reference Designators* |
|---|---|---|---|
| 839 8220 402 | DIAG, INTERCONNECT IBOC TO 3DX | 0 DWG | |
| 843 5400 861 | SCH, 3DX50 AM DAB EXTERNAL SWITCH | 0 DWG | |
| 888 2001 874 | TM, 3DX IBOC KIT | 0 EA | |