SELLMEYER ENGINEERING
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MEMBER AFCCE

HARRIS

DX-50

TEST PROCEDURE

HARRIS Communications

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Harris Radio Field Service

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HARRIS CORP, QUINCY
CONTROLLED
PRODUCTION DOCUMENT
WHEN IN GREEN

1. SCOPE

This production test procedure applies to the HARRIS DX 25/50 Transmitters PN's 994-9168-001 and 994-9150-001

Throughout this procedure you will find test parameters expressed as two values separated by a slash, ex 25,000/50,000. The first value applies to the DX 25 and the second to the DX 50.

Prepared by: _______ **Date:** *21 Sept 1994*

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List Of Figures and Tables

3. REFERENCE INFORMATION

3.1 Publications

Technical Manuals #988-2290-001 (DX50) and #988-2297-001 (DX25U)

3.2 Drawings and Forms

1. Packing Instructions, DX50/DX25U #817-2099-045
2. Frequency determined charts #839-7855-137 (DX50) and #839-7855-138 (DX25U)
3. Final Test Data Sheets (attached)
4. TUNING Chart #839-7855-140
5. OVERALL schematics #839-7855-068 (DX50) and #839-7855-151 (DX25U)

3.3 Specification Summary

3.3.1 Power Output

2500/5000 to 27,500/55,000 watts

3.3.2 RF Output Impedance

50 ohms unbalanced, front panel matching range of 1.2:1 VSWR carrier.

3.3.3 Audio Input

Transformerless, 600 ohms balanced at 0 dBm "10 dB. Also, 150 ohms balanced 50 ohms balanced

3.3.4 Audio Response

"0.5 dB from 20 Hz to 10,000 Hz.

3.3.5 Audio Distortion and Noise

1. Harmonic Distortion: at 95 % modulation 30 to 10,000 Hz 0.9 % or less, 5/10 to 27.5/55 kW
2. Intermodulation Distortion: 60/7000 Hz 4:1 SMPTE standard 1.3 % Max at 95 % modulation and 25/50 KW output 0.8 % Max 1.1
3. Noise: Better than 65 dB below 1 KHz 100 % modulation at 25/50 kW.

3.3.6 Square Wave Response

Overshoot: Less than 0.5 % at 400 Hz, 80 % modulation.

Tilt: Less than 1 % at 40 Hz, 80 % modulation.

3.3.7 Modulation Capability

135 % positive peak program material at 27.5/55 KW.

3.3.8 AM Stereo

IQM better than -36 dB at 95 % 1 KHz modulation of main carrier

3.3.9 Carrier Shift

Less than 1 % at 100 %, 1000 Hz modulation.

3.3.10 Harmonics

Exceeds FCC and CCIR requirements.

3.3.11 Power Requirements

363 to 502 Vac, 3 wire delta, 48 to 63 Hz, 60/120 amperes

plus 240 Vac, 1 phase, 48 to 63 Hz, 12/25 amperes.

4. Resources Required

4.1 General Test Equipment:

The following equipment or their equivalents are required to perform these tests.

1. Audio Generator And Distortion Analyzer (AUD ANAL) Sound Tech, 1710A
2. Audio Generator And Distortion Analyzer (AUD PREC) Audio Prec. SYS-22
3. Oscilloscope (SCOPE), HP 1745A
4. Frequency Counter (CNTR), HP 5254C
5. Modulation Monitor (MOD MON), Harris AM-90
6. AM Stereo Monitor Motorola STM-1
7. Function Generator (FUNC GEN) Wavetek 111

8 Ammeter, Bell CG 1100D

9 Spectrum Analyzer (SA), HP 3585A

10 Digital Multimeter (DMM), Fluke 8012A

11 Vector Impedance Meter (VIM) HP 4193A

12 Power Meter Westinghouse PG-191

13 Vac, 3 phase, 50 ampere variable transformer (VARIAC)

14. RF sampling port, HARRIS special

15 RF load/Power Meter, 160 KW dissipation

4.2 Special Test Equipment:

Remote control fixture, HARRIS #199-0345-001

4.3 Software

Not Applicable.

5. Test Conditions

Unless otherwise specified all tests shall be performed under the following conditions:

5.1 Input Power

440 Vac, 60 Hz, 3 Phase

220 Vac, 60 Hz, 1 Phase

5.2 Ambient Temperature:

Normal factory ambient.

5.3 Ambient Humidity:

Normal factory ambient.

5.4 Ambient Atmospheric Pressure:

Normal factory ambient.

5.5 Warm-up Period:

Unit under test (UUT) must be ON and operating at full carrier power and 95 % modulation for at least 30 minutes just prior to reading and recording data sheet performance parameters.

5.6 Load Impedance

Nominal 50 "2 ohm coaxial load capable of 160 KW dissipation

5.7 Power Output

HIGH	27,500/55,000 watts
MEDIUM	12,500/25000 watts
LOW	2500/5000 watts

Unless customer specifies, then

HIGH	Not to exceed 30,000/60,000 watts
MEDIUM	As specified
LOW	As specified

6. Preliminary Tests

6.1 Visual Inspection

Visually inspect the UUT for workmanship, assembly, and process errors. Any errors found should be recorded, and information shown to the originating manufacturing group or individual. Use of this feed back technique is the most powerful tool we have for quickly uncovering faulty or misadjusted equipment, errors in Test Procedures or OP Sheets, or other process errors that may have drifted out of acceptable quality limits.

Neglect in providing this feedback may cover up flaws in our manufacturing processes that affect a broad spectrum of products before found and corrected, resulting in higher manufacturing costs, poor quality, or both.

#OUR REPUTATION DEPENDS ON QUALITY

6.2 Safety

1. Shorting sticks must measure less than 0.1 ohm to ground. Before turning power on be absolutely sure that all door and panel interlocks are in place and operating correctly.

2. Always turn off line power at the wall box before entering transmitter. When entering, crack the door about 3 inches and count to 5 before fully opening door. This procedure assures complete discharge of the HV filter capacitors.

CAUTION

USE THE SHORTING STICK ON ALL POWER SUPPLIES BEFORE PROCEEDING TO WORK ON THE TRANSMITTER.

7. Test Setup

7.1 Frequency Determined Components

Check all frequency determined (FD) components against drawing # 839-7855-137 for correct type and value. Enter complete information on the FINAL TEST DATA sheets.

7.1.1 Output Network

Install FD parts at 1C1, 1C2, 1C3, 1C4, 1L4, 2C1A, 2C1B, 2C2B, 2C3B, 2C4B & 2C6 as required by the FD chart

7.1.2 Oscillator (A17) (Normal Setup)

1. Install format frequency crystal in the Y1 position
2. Set P1 1 to 2
3. Set P3 1 to 3
4. Set P4 1 to 3
5. Set P5 1 to 2
6. Set P6 1 to 2
7. For frequencies 525 to 1250 KHZ set P2 1 to 3.
8. For frequencies 1251 to 1620 KHZ set P2 1 to 2.
9. Set S1 per the TUNING Chart.
10. At J3 connect the plug so that the locking devices engage.
11. If using an external oscillator Set P3 1 to 2
12. For TTL input: Set P5 1 to 2
13. For 50 ohm input: Set P5 1 to 3

14. With combiner: Set P4 1 to 2

7.1.3 A/D Converter (A34)

7.1.3.1 Board revision -001

1. For 530 to 820 KHZ set P10 1 to 3.
2. For 821 to 1705 KHZ set P10 1 to 4.
3. Set both sides of P11 to OUT.
4. Set S1-2 ON, the other S1 switches OFF.
5. Set S2 1 CLOSED and 2 OPEN for the DX 25/CLOSE both 1 & 2 for the DX 50.
6. R79 was preset at Board Test

7.1.3.2 Board Revision -002

1. For 530 to 820 KHZ set JP10 5 to 6 (sample frequency = carrier frequency)
2. For 821 to 1705 KHZ set JP10 1 to 2 (sample frequency = 1/2 carrier frequency).
3. Set JP11 1 to 3 and 2 to 4
4. Set S1-2 ON, the other S1 switches OFF.
5. Set S2 1 CLOSED and 2 OPEN for the DX 25/CLOSE both 1 & 2 for the DX 50.

7.1.4 Analog Input (A35)

1. Set OFFSET (R84) 6 turns from maximum CW.
2. Set the DITHER LEVEL ADJUST (R43) maximum CCW.
3. Set DISTORTION ADJUST (R52) midrange.
4. Set P1 to NORMAL.

7.1.5 DRIVER SUPPLY REGULATOR (A22)

1. Set LOOP SWITCH (S1) OPEN.
2. Set OPEN LOOP ADJ (R2) maximum CCW.
3. Set CLOSED LOOP ADJ (R12) maximum CCW.

7.1.6 Output Monitor (A27)

1. Install C14, C28, L5, and L7 as required per the FD Chart.
2. Set S1 switches per the TUNING Chart.
3. Set S2 switches per the TUNING Chart.
4. Set S6 switches per the TUNING Chart.
5. Set S7 switches per the TUNING Chart.
6. Set S9 switches per the TUNING Chart.
7. Set P1 1 to 3 and P3 1 to 3.
8. Set P2 per the TUNING chart

7.1.7 Driver Combiner (A14)

Verify that efficiency coils L2 through L16 are tapped per the tuning chart.

Verify that T8 is tapped full winding (1-2) at TB5.

7.1.8 Driver Encoder (A19)

1. Set S1 & S2 OFF. Set J5 1 to 2 (AUTO)
2. Set R17, R19, R49, R50, R51, R60 and R98 to midrange.
3. Install JP1, JP2, and JP3 per the TUNING chart.

7.1.9 DC Regulator (A30)

Set jumper J1 1 to 2 (NORMAL). NOTE: Do not leave low voltage on for an extended period with this jumper in TEST as the DC REGULATOR must have cooling air from operating PA fans. In NORMAL the DC REGULATOR is turned OFF with PA and cooling fans.

1.	MODULATION ENCODERS (A36, A37)	
2.	On DX 50 A36	On DX 50 A37
3.	Set J20 1 to 2	Set J20 1 to 3
4	Set J21 1 to 2	Set J21 1 to 3
5.	Patch P15 to P11	Leave P15 & P11 open
6.	On DX25 A36	

7. Set J20 1 to 2

8. Set J21 1 to 2

9. Patch P15 to P10

7.1.10 Binary Combiner (A1)

1. Set jumpers J30 through J33 to TUNING Chart value.

2. Tap L1-L6/L1-L5 per the TUNING Chart.

3. Verify the following jumpers.

	JP1	JP2	JP3	JP4	JP5	JP6	JP7	JP8
DX-25U	IN	IN	IN	IN	IN	OUT	OUT	IN
DX-50	IN	IN	IN	OUT	OUT	IN	IN	IN

7.1.11 Efficiency Coils

Tap the remaining efficiency coils per TUNING Chart

7.2 Front Panel

1 On the Front Panel set REMOTE CONTROL switch to LOCAL

2 POWER SWITCH to FWD

7.3 Interconnections

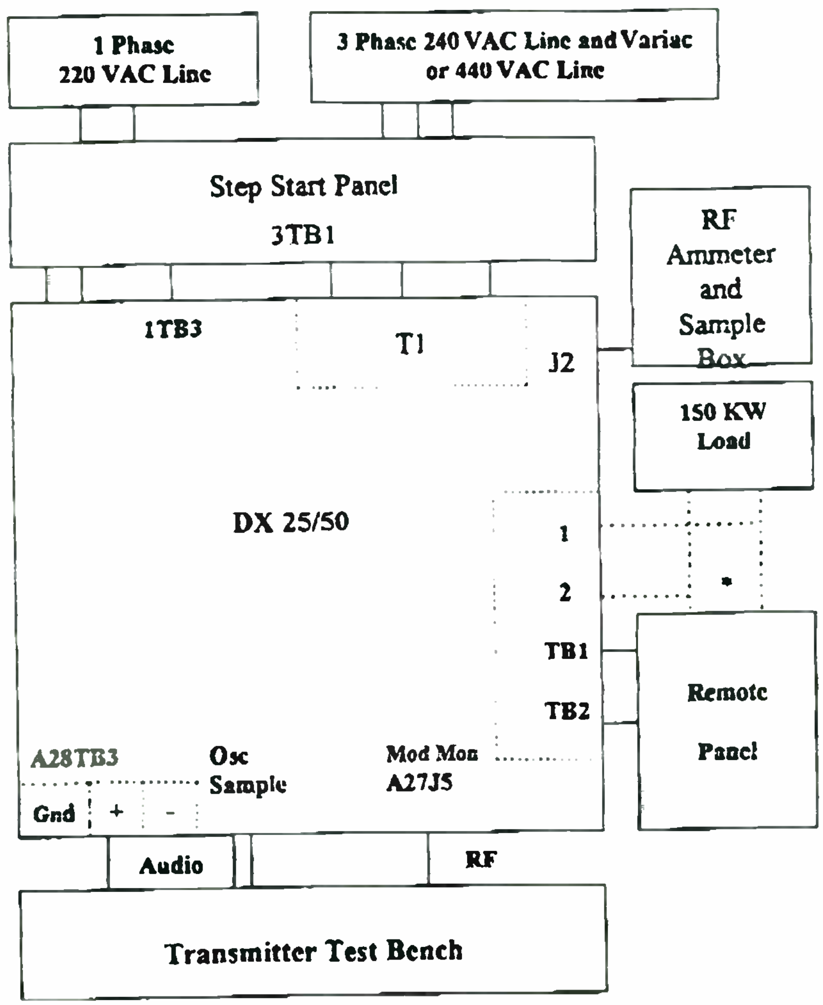
1. Connect test equipment, primary power, step start box, and transmitter as indicated in Figure 1, page 15 and the OVERALL schematic #839-7855-068. Main power must be OFF at the wall box. The 440 Vac wall box should be fused with 150 ampere fuses. For now connect the output of the 220 Vac 3 Phase VARIAC to the front 3 terminals of K2. The leads to T1 connect to the 3 rear terminals of K2. Later the 440 Vac line will be connected into the front three terminals on K2 and the 220 Vac lines removed.

2. Interconnect control lines between the transmitter 1TB3 and step-start box 3TB1 per OVERALL schematic #839-7855-068. Connect 220 Vac input to 3TB1-1 & 2 in the step-start box.

7.4 RF Load

Connect the RF LOAD and the water FLOW SWITCH interlock to TB1-1 and 2. Switch should be closed with proper water flow.

Figure 1 Test Connections



* Dotted line indicate alternate interlock connections when REMOTE panel is used.

7.5 Setup

1. Remove A24F1 through F10 & A25F1 through F9 from the fuse boards as well as 25 amp fuses F20 & F21. A24 is the bottom fuse board. A25 the top.

2. Remove 3 amp fuses A16F1 & F2 and 2 amp fuse A16F3 from the Buffer Amplifier.

3. Verify that T1 & T2 are tapped to your test station line voltages.

4. Carefully adjust and tighten the SPARK GAP (E101) to 0.090/0.125 inches.

5. Switch LOW VOLTAGE power OFF at CB1 OR CB2.

6. Set R1 PREDRIVER VOLTAGE ADJ full CCW (maximum resistance).

7. Set R2 BUFFER VOLTAGE ADJ full CCW (maximum resistance).

8. Alignment and Test

8.1 Output Network

Use the VIM tuned to format frequency. Isolate and set the following components to the values indicated:

DX25	DX 50
2C2 to 13/-89 ohms	17/-89 ohms
2C4 to 75/-89 ohms	63/-89 ohms
Tap 2L3 to A*/+88 ohms	A/+88 ohms

– 3rd Harmonic

Connect 2C3 in parallel with the series combination of 2L3 and 2C5 when used and tune to resonance at 3 times format frequency with 2C3A as evidenced by a high impedance reading at 0 reactance on the VIM. Short the unused turns of 2L3 except in the 820 to 970 KHZ frequency range where there should be only 2 or 3 unused turns.

With the output network fully connected and into a 50 ohm RF load set its input impedance to 4.5/0/8/0 at 2C6 with 2C6 disconnected from the PA combiner pipe or at 2L1 if 2C6 is not used in your FD configuration. Use the front panel TUNING and LOADING controls to set this impedance.

– 8Ω ±j0

* Where A = 100,000/ (1.257 × F_o) + 42. When C5 is NOT used A = 41.

Example at 1000KHZ. A = 100,000/(1.257× 1000) + 42 = 79.5 + 42 = 121.5

NOTE. Set the VIM to one-half format frequency.

1. Calculate the value to tap 1L4 to as follows,

2. 1L4(ohms) = 1000/(3.14 X Fo X C4) Fo in KHZ, C4 in Mfd

3. Example for Fo = 1000 KHZ, C4 = 0.04 Mfd

4. 1L4(ohms) = 1000/(3.14 X 1000 X 0.04) = 7.96 ohms
   1000/(3.14 x 1200 x .04 = 6.63Ω

5. The 1L4, 1C4 combination should then resonate at Fo/2.

8.1.1 Frequency Response

1. Slip a large torroid with at least 18 turns of wire over the 2C6/2L1 input conductor then connect the conductor to ground through a 12-18" test lead. Drive the torroid with the SA tracking generator. Connect transmitter output to the SA 50 ohm input, or, if the transmitter is already connected to a 50 ohm load connect a X10 SCOPE probe to 2J2 and use the SA 1 meg input. Check that all output network components are in place, that all connections are tight, and that there are no other connections to the network.

2. Network response must be down 4.5±0.5 dB at 75 KHZ from carrier.

8.2 Low Voltage

8.2.1 Short Checks

Check with an Ohmmeter for Power Supply shorts to ground. NOTE- Capacitors may require charging time before the indicated readings. Use the Ohmmeter polarity that gives the highest readings, but also verify that all filter capacitors are properly polarized. All readings on Simpson 260 RX100 scale.

PLUG	BOARD
A30J1&J5	DC Regulator
A38J4	Controller
A34J1	A/D Converter
A35J5	Analog Input
A27J6	Output Monitor
A17J1	Oscillator
A28J3	External Interface
A22J2&J3	Driver Supply Regulator
A39J3	Driver Encoder

>>> CAUTION <<<

THIS IS THE FIRST APPLICATION OF POWER TO THIS TRANSMITTER - BE PREPARED TO TURN POWER OFF AT THE FIRST SIGN OF TROUBLE. ALSO, AFTER THIS POINT, TO INSURE YOUR OWN SAFETY YOU MUST OPEN CABINET DOORS SLOWLY AND USE SHORTING STICKS PROVIDED TO SHORT ALL SUPPLIES BEFORE WORKING ON THE TRANSMITTER.

1. On the Meter Panel set the MULTIMETER switch to +22 VDC. Connect an external Meter to the +30 Vdc supply at the SPARE fuse behind the center PA cabinet FRONT door.

2. Turn ON LOW VOLTAGE wall box. **Do not turn on the 440 Vac wall box at this time.**

3. Turn ON LOW VOLTAGE breaker CB1 then turn ON CB2. VERIFY immediately that the external meter indicates 30-35 Vdc. If not, then TURN ALL POWER OFF and troubleshoot.

4. Referring to the following table verify that proper voltages appear on the proper pins of each of the power plugs disconnected above.

Jack-Pin	Voltage	Jack-Pin	Voltage
Controller		**A/D Converter**	
A38J4-1	+22	A34J1-1	+22
A38J4-2	Gnd	A34J1-2	Gnd(B)
A38J4-3	---	A34J1-3	---
A38J4-4	-22	A34J1-4	-22
A38J4-5	---	A34J1-5	Shld(Gnd)
A38J4-6	+8	A34J1-6	+8
A38J4-7	Gnd	A34J1-7	Gnd(A)
A38J4-8	-8		
A38J4-9	Shld(Gnd)		
Analog Input		**Output Monitor**	
A35J5-1	+22	A27J6-1	---
A35J5-2	Gnd	A27J6-2	-8
A35J5-3	---	A27J6-3	---
A35J5-4	-22	A27J6-4	---
A35J5-5	Shld(Gnd)	A27J6-5	---
		A27J6-6	---
Oscillator		A27J6-7	+8
A17J1-1	+22	A27J6-8	Gnd
A17J1-2	Gnd	A27J6-9	Shld(Gnd)
A17J1-3	---	A27J6-10	---
A17J1-4	-22		
A17J1-5	Shld(Gnd)	**Driver Supply Regulator**	
		A22J2-1	+22
External Interface		A22J2-2	Gnd

Jack-Pin	Voltage	Jack-Pin	Voltage
A28J3-1	+22	A22J2-3	---
A28J3-2	Gnd	A22J2-4	+230(if on)
A28J3-3	---	A22J2-5	---
A28J3-4	-22	A22J2-6	+115(if on)
A28J3-5	---	A22J2-7	+115(if on)
A28J3-6	+8	A22J2-8	+115(if on)
A28J3-7	Gnd	A22J2-9	---
A28J3-8	-8	A22J2-10	Gnd
A28J3-9	Shld(Gnd)		

Driver Encoder

A39J3-1	+22
A39J3-2	+8
A39J3-3	---
A39J3-4	-8
A39J3-5	Shld(Gnd)

Once proper voltages are verified turn OFF the LOW VOLTAGE switch and reconnect all power plugs.

8.2.3 Normal Indications

1. Turn ON the LOW VOLTAGE power switch.
2. Shortly after power up the BANDPASS FILTER VSWR and ANTENNA VSWR lamps should light RED then back to GREEN indicating normal operation of the VSWR logic circuits.
3. Now press MANUAL TEST. This VSWR lamp cycle should repeat. After power has been ON a few seconds all front panel (FP) lamps should be lit GREEN.

4 Verify that "22 VDC and "8 VDC readings are normal on the MULTIMETER.

5 Make sure all 3 phase power is disconnected then press LOW. The following sequence of events should occur:

a) Contactor K1 should energize and dropout

b) Front panel UNDERDRIVE LED should light YELLOW for about 0.3 seconds.

c) After about a 1 second wait K1 should again energize and dropout.

d) BUFFER & UNDERDRIVE LED's should light RED.

e) Nothing further should occur until the operator takes action.

8.2.4 Presets

8.2.4.1 Overloads

Verify or set the following overload (OL) points by connecting the DMM as indicated and adjusting the indicated control on the LED board to set the threshold.

Overload	DMM to:	Control	Threshold
Antenna VSWR	A27TP4	A27R24	2.00 VDC
Filter VSWR	A27TP3	A27R23	0.8/1.0 VDC*
Overdrive	TP5	A32R41	Maximum CCW
Underdrive	TP8	A32R67	Maximum CW
Peak Current	TP7	A32R68	11.5 VDC
Average Current	TP6	A32R42	4.0 VDC

* Note this is a fixed setting and will not be changed later.

8.2.4.2 Driver Encoder(A19)

Make the following presets on the DRIVER ENCODER board.

Preset	DNN to:	Control	Set Level
Driver OFF	TP1	R17	5.00 Vdc
Driver ON	TP2	R19	3.20 Vdc
CALIBRATE	TP3	R49	2.73 Vdc
AMB 1	TP4	R50	2.50 Vdc
AMB 2	TP5	R51	2.50 Vdc
TEMP LOWER	TP6	R60	7.00 Vdc

8.3 RF Circuits

8.3.1 Oscillator (A17)

1. Connect CNTR to A17J5 (FREQUENCY MONITOR SAMPLE). Turn LOW VOLTAGE ON. Adjust trimmer A17C1 to set Y1 frequency to exact format frequency. If a second crystal is installed in Y2 then set P6 1-3 and P1 1-3 and adjust A17C3 to set Y2 frequency.

2. Set frequency close now and exact later after a minimum 30 minute warm-up time has elapsed. A second warm-up period is required before adjusting A17C3 to set Y2 to exact format frequency.

8.3.2 Buffer Amp (A16)

NOTE: RF MODULE switching waveforms are easily monitored at the TP1 and TP2 test points at the front of each RF MODULE. SCOPE ground may be connected to the board ground plane. RF MODULE drive waveforms are monitored at the ungrounded ends of CR3 and 4. CR3 and TP1 are on side A.

1. Verify that DRIVER COMBINER (A14) motherboard jumper and efficiency coils are set per paragraph 6.1.7. Verify that C3A, B, & C and L5 are per the FD chart.

2. Install 3 amp fuses A16F1 & F2 & 2 amp fuse A16F3 on the BUFFER board.

3. Disable the RF UNDERDRIVE fault by jumping A32CR8 cathode to GND on the LED board.

Connect the SCOPE to the ungrounded end of PREDRIVER CR3 or 4 (Predriver B drive signal). Press A32S1 (OSC TEST) on the LED board. Signal should be a distorted square

wave at carrier frequency about 17 Vp-p in amplitude. Set this signal to 17 Vp-p with R2 BUFFER VOLTAGE ADJ. At some frequencies it may not be possible to get 17 Vp-p. If so leave R2 set for maximum drive

8.3.3 HV Supply Startup

1. Turn power OFF at the wall box.

2. Reinstall fuses F21 & A24F10 on the FUSE board/3. A24F1 through F9 and

3. A25F1 through F10 must still be removed. A24 is the lower fuse board.

4. Check that all drive cables are in place.

5. Install all panels and close all doors. Turn power ON at the wall box.

NOTE.

Figure 3 Drive(17 Vp-p)

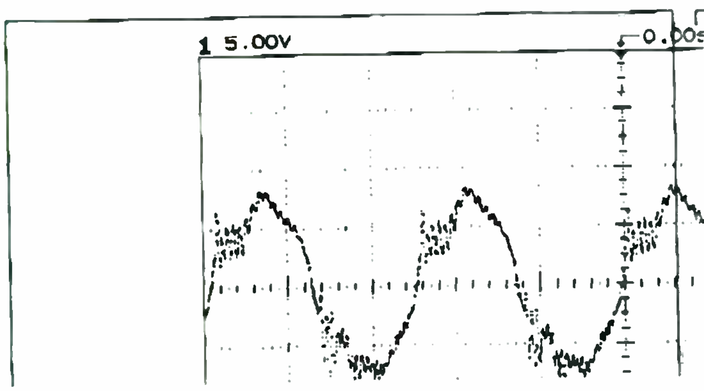
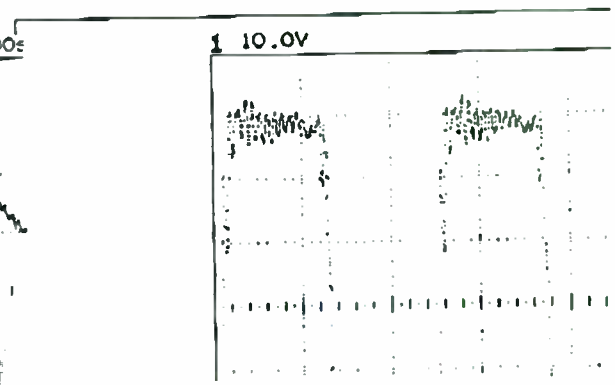


Figure 2 Drain Switching (60 Vp-p)



BE ALERT AS THIS IS FIRST APPLICATION OF HIGH VOLTAGE ! ! !

6 Be sure the 220 volt VARIAC is set CCW to zero output then activate HV by pressing LOW. Listen for the click......click, click of the STEP START sequence. If all appears normal slowly increase the VARIAC output while monitoring AC line current with a clamp-on AC ammeter and PA SUPPLY VOLTAGE with the front panel MULTIMETER. As the VARIAC output is increased PA SUPPLY VOLTAGE should come up to over 100 volts, AC line current should remain under 5 amperes. PREDRIVER +VDC should read near 30 Vdc on the RF MULTIMETER (A23)

8.3.4 Predriver

1 Connect the SCOPE to the ungrounded end of D1CR3 or 4 (D1 drive signal)

2. Set SCOPE to display 30 Vp-p. See.

3. Adjust L1 PREDRIVER TUNING looking for peak RF DRIVE level on the SCOPE (driver gate). This should somewhat coincide with peak RF MULTIMETER PREDRIVER IDC of less than 2 amperes.

4. Leave L1 set to the slightly inductive side for cooler operation. Check all driver amps D1-D14 for drive. Drive level will only be 8 to 12 Vp-p at this time.

5. Press OFF. NOTE operation of the HV crowbar circuit by observing that the PA SUPPLY reading falls very rapidly

8.3.5 Full High Voltage

1. Turn OFF the 220 Vac wall box. Remove the 220 volt VARIAC from K2 and connect 440 Vac from the 440 volt wall box. Do not disconnect the 220 volt single phase wall power.

2. Remove the BUFFER to allow high voltage testing without the possibility of excess driver currents.

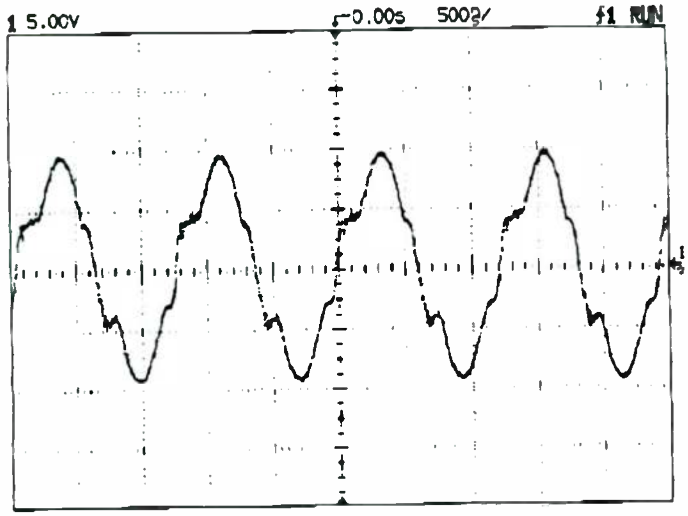
3. Turn ON the 220 Vac single phase wall box AND the 440 Vac box

4. Press LOW then quickly press OFF. Note that PA SUPPLY voltage moves upscale then falls off. Also verify that BLOWER MOTORS are all blowing from the output compartment into the PA compartment. If not, turn OFF the 440 wall box and interchange any two of the 3 phase input leads. If the 4 blowers are not all turning the same direction, blower wiring must be corrected.

5. If everything is normal, re-install the BUFFER then press LOW and allow full high voltage to come up

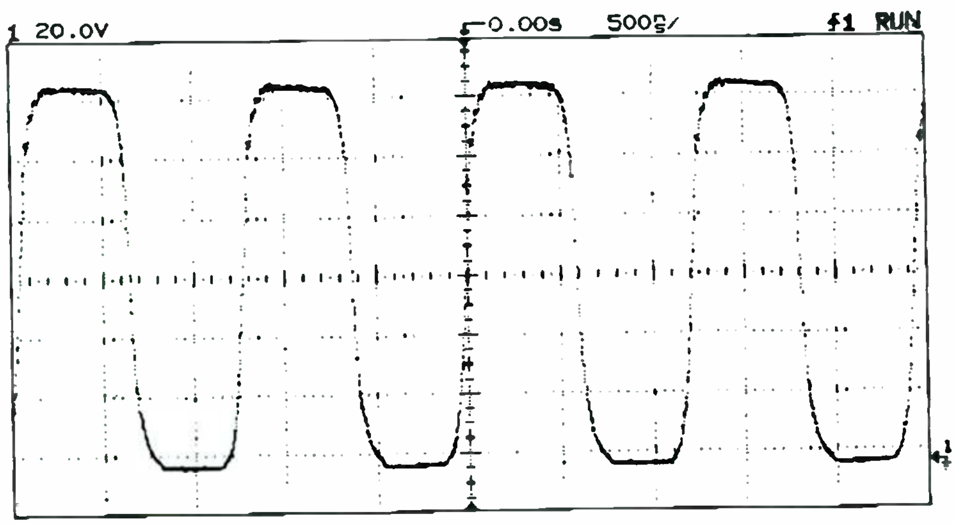
6. Adjust R1 PREDRIVER VOLTAGE ADJ and T8 taps at TB-5 to set drive level at 21 Vp-p. Recheck PREDRIVER TUNING. This circuit is quite broad and should not require further adjustments except as may be required to optimize IQM (see para. Neutralizition (IQM Adjustment) (A40), paragraph number 8.4.15, page 47). Check both drive input and output switching waveforms. See Figure 2. Drain Switching (60 Vp-p), page 15, for proper switching waveforms

Check for consistent drive level (within ±1 Vp-p) at all Driver gates D1 through D14CR3 & 4. NOTE: There will be some level difference depending on whether a particular module is ON or OFF.



Drive (17 Vp-p)

Figure 4 Predriver Wavefroms



8.3.6 Driver Regulator (A22)

NOTE

Normally the DRIVER SUPPLY REGULATOR board is pretested and you may skip this paragraph.

1. Remove the BUFFER board and press LOW to turn on HV.
2. Verify DRIVER +VDC reading near 120 Vdc then switch the RF MULTIMETER to read DRIVER A voltage. Switch A22S1 on the DRIVER SUPPLY REGULATOR to OPEN
3. Adjust A22R2 CCW until the DRIVER A voltage is near zero then CW while observing that the voltage increases to about 110 Vdc. Now switch to DRIVER B and turn R2 CCW for a near zero reading then CW while observing that the DRIVER B reading will also increase to about 110 Vdc.
4. Section B should turn on when section A reaches about 115 Vdc. Assure that this transition occurs smoothly. If not check the board.
5. Turn R2 to set DRIVER A voltage to about 50 Vdc
6. Switch S1 to CLOSED. DRIVER A and DRIVER B should both read 115 Vdc.
7. This is normal with no drive. The loop is turning both sections on full in an effort to raise drive. If both A and B do not read near 115 Vdc check the board
8. Set R12 full CCW. Press OFF. Switch S1 to OPEN.
9. Re-install the BUFFER board.

8.3.6.1 Driver & Conversion Pulse (D1 through D14 & A34)

1. There are basically three ways to vary driver output level as seen at the PA modules. The goal is to obtain proper driver output (22-24 Vp-p of drive at the PA's) with the proper combination of these three methods
2. The three methods are.
   a) DRIVER REGULATOR Adjustment.
   b) Number of DRIVER MODULES ON.
   c) STEP TRANSFORMER T10 tapping on the DRIVER COMBINER
3. The optimum combination is to have all DRIVER MODULES active (D1-D5 and D9-D14), and the DRIVER REGULATOR operating with DRIVER SECT 8A voltage

between 40 and 90 Vdc. It is preferred to have as many drivers ON as possible in order to have the lowest possible source impedance and to optimize load sharing.

4. Therefore the STEP TRANSFORMER T10 must be set properly to help achieve this optimum NOTE that the AUTO and SPARE driver switches should be OFF until after Driver tune. The SPARE driver should be OFF in most all cases.

5. All driver modules D1-D5 and D9-D14 should be active and the configuration of T10 set to achieve the desired drive level. T10 can be set to 3 different configurations (STEP DOWN, STEP UP, and OUT OF CIRCUIT) T10 will typically make a 20% change in driver output level. It will have an effect on driver tuning. The length of the DRIVER STRAP (1L5) will then need to be adjusted. This strap should be adjusted in 1-2" increments in order to see its effects and obtain driver resonance. To repeat, the goal is to have all DRIVER MODULES active and a DRIVER SECT 8A voltage between 40 and 90 Vdc It is preferred to have T10 set for step down or out of circuit if proper drive level can be obtained. Step-up tends to produce poorer driver efficiency.

6 The three different configurations of T10 are illustrated in Figure 5 through Figure 7on page 30. NOTE also that C3A, C3B, and C3C, are FD parts in the driver tuning circuit. Try different values if required to achieve resonance, or if optimum IMD and/or IQM cannot be achieved later. DO NOT use a DRIVER STRAP length less than 5". Decrease C3 values if necessary to maintain this minimum length.

7. Connect the SCOPE to monitor DRIVER switching at the D1TP1 test point. Press LOW to activate HV.

8. Adjust 1L5 to inductive side of resonance (longer strap) as indicated by good DRIVER switching waveforms and proper DRIVER IDC of 12/22 amperes maximum See Figure 8 for driver waveforms.

9. Check PA drive level to PA MODULE RF1. NOTE that PA drive and driver current should both peak at resonance. This is quite broad when using the DRIVER TUNE control. The best indication of resonance is a dip in DRIVER A volts with S1 CLOSED (closed loop operation).

10. Proper drive levels can only be observed with PA MODULE "ON". So long as fuses A24F1 through F9 and A25F1 through F9 are removed, all PA's can be turned ON at once by removing the TEST JUMPER from the ANALOG INPUT board and adjusting MAX POWER ADJ A35R27 to set the voltage at A35TP3 to -0.75 Vdc. Press RAISE to turn all Modules ON. The "ON" condition can be verified by observing that the GREEN LED is lit on the PA MODULE of interest. The PA TURN OFF switch (A38S5) on the CONTROLLER board must be in its ON position to turn any PA MODULES on.

Steve 7852

11. Driver tuning is typically quite broad and DRIVER STRAP 1L5 may be adjusted a few inches either side of resonance without changing drive level Adjust the tuning on the

inductive side (longer strap) for most efficient driver operation. Keep in mind that driver tuning can effect IQM and may be varied if better IQM is required (see para. 7.4.13)

Figure 5 T10 Step Down (Lower Drive Output)

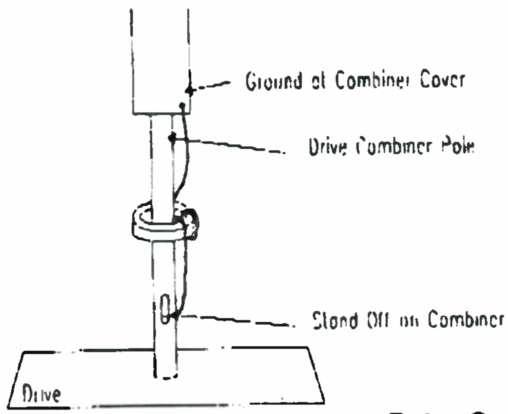


Figure 6 T10 Step Up Higher Drive Output

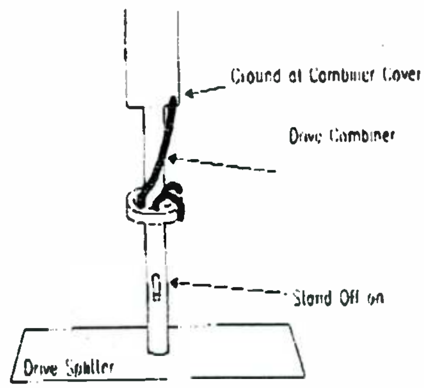
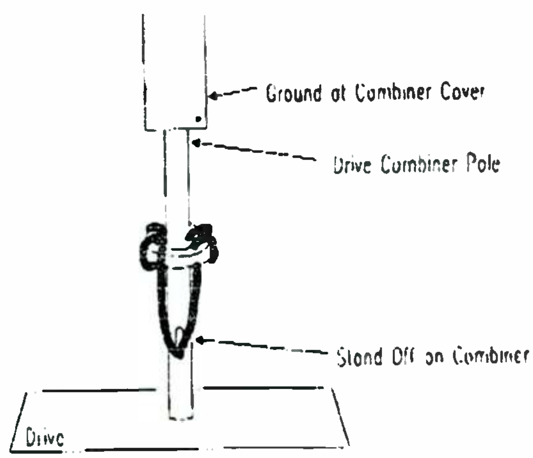


Figure 7 T10 Out of Circuit



8.3.6.2 For A/D Converter -001

Check conversion pulse width at A/D CONVERTER A34TP2 and adjust with A34R79 to set a 300 ns pulse width. NOTE: In the frequency range of 700 to 820 KHZ and also 1400 to 1705 KHZ this pulse should be set to 200 ns width.

FOR A/D CONVERTER -002

1. Set the pulse width at A34TP3 to 40 ns with control A34R78. This pulse width is NOT frequency dependent.

2. Switch the DRIVER SUPPLY REGULATOR A22S1 to OPEN and verify that drive level can be adjusted with A22R2 on the board. Verify a drive level of 20 Vp-p MAXIMUM with A22R2 full CCW. Turn A22R2 CW. DRIVER A voltage should move from near zero to 115 Vdc, then DRIVER B voltage should move up from zero volts. Driver tuning may change slightly when DRIVER A voltage is turned on and may therefore need readjusted with driver A on.

3. Set A22R2 for 23 Vp-p drive with a DRIVER A voltage of 40 to 80 Vdc.

4. Check for a drive level of 23"2 Vp-p at each side of all PA amplifiers before proceeding. If drive is not right check DRIVE SPLITTER and drive cables as well as motherboards and PA amplifiers for faults.

5. Press OFF. Remove the CR8-GND jumper from the LED board (A32). Press LOW

6. Reduce drive level to 18 Vp-p. NOTE: It may be necessary to remove fuses from one or more DRIVER PA MODULES to lower the drive this far. Set UNDERDRIVE THRESHOLD A32R67 (CCW is lower fault level) on the LED board for underdrive fault. Increase drive level to 26 Vp-p. If necessary switch in the spare driver module with A19S1. Set OVERDRIVE THRESHOLD A32R41 (CW is more sensitive) for overdrive fault.

7. Reset drive level to 23 Vp-p. Switch A22S1 to CLOSED. Set A22R12 to give 23 Vp-p of drive.

8. Verify proper drive level and phasing to A and B sides of each PA module (22 to 24 Vp-p and "5 degrees).

REMEMBER:

PA amplifiers must be ON to measure drive phase and amplitude. Normally with all PA fuses out all modules can be turned ON by removing A35J1, or power can be raised to maximum with RAISE control, and MAX PWR ADJ A35R27 on the ANALOG INPUT board can be set to maximum power. This will turn on all steps.

8.3.7 RF Amplifiers (RF33-RF96)/(RF1 - RF128)

1. Turn all power OFF. If necessary return A35J1 to NORMAL.

2. Verify fuses A24F1 through F9 and A25F1 through F9 are still removed.

3. Verify RF OUTPUT is properly terminated and WATER INTERLOCK is properly connected (6.2).

4. Verify output network is tuned (6.4).

5. Verify no audio input to transmitter.

6. Monitor A35TP7 with a DC meter (level is about 3 Vdc).

NOTE.

Pressing and holding A38S4 while pressing RAISE or LOWER will speed up power changing operations.

1. Press HIGH Press LOWER and hold until the DC level reaches zero volts.

2. Press MEDIUM Press LOWER and hold until the DC level reaches zero volts.

3. Press LOW. Press LOWER and hold until the DC level reaches zero volts.

4. Set the ANALOG INPUT voltage at A35TP3 to -0 75 volts with A35R27. This sets maximum cw output power to about 25/50 KW

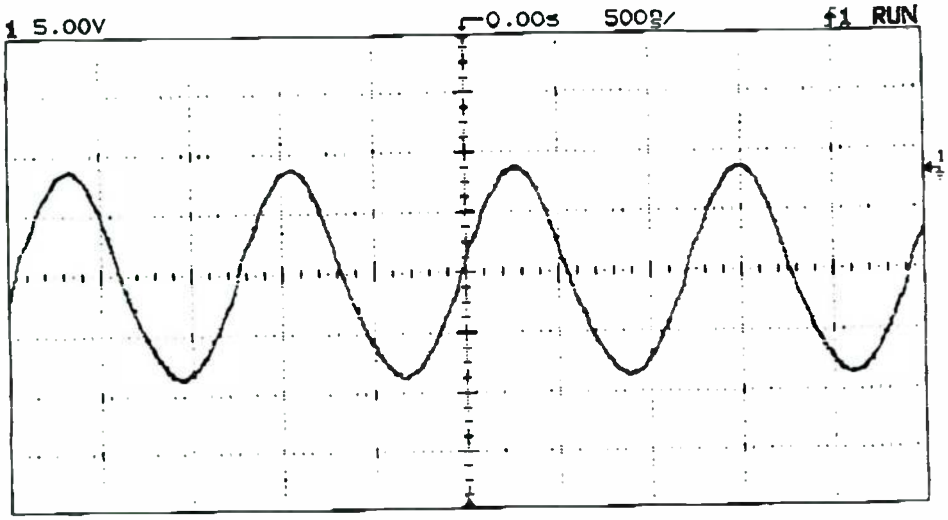
5. Do a rough B- Preset by setting B- LEVEL REG A and B- LEVEL REG B controls for 2.2 Vdc as read on the DC REGULATOR DMM when set to AMTRB- and BMTRB-.

6. FOR DX50-

   a) If removed reinstall fuses F20 & F21 then reinstall fuses A25F1, F3, F5 F7 & F10 as well as A24F9 & F10

7. FOR DX25U-

Figure 8 Drive (20 Vp-p)



If removed reinstall fuses F20 & F21 then reinstall fuses A24F2 F4 F6 F8 F9 & F10

8 Press LOW Verify with SCOPE at the MOD ENCODER Flex-Patch that all binary and big steps are near zero volts. Press RAISE. SUPPLY CURRENT METER should move upscale. Release RAISE when current reads about 10/20 amperes. The KILOWATTS meter should move upscale too.

NOTE:

You may also need to roughly null A27C4 with POWER in REFLECTED position to prevent early VSWR trips, as well as ANTENNA and FILTER controls on the OUTPUT MONITOR. See paragraphs 7.4 4 and 7.4.5 for further details.

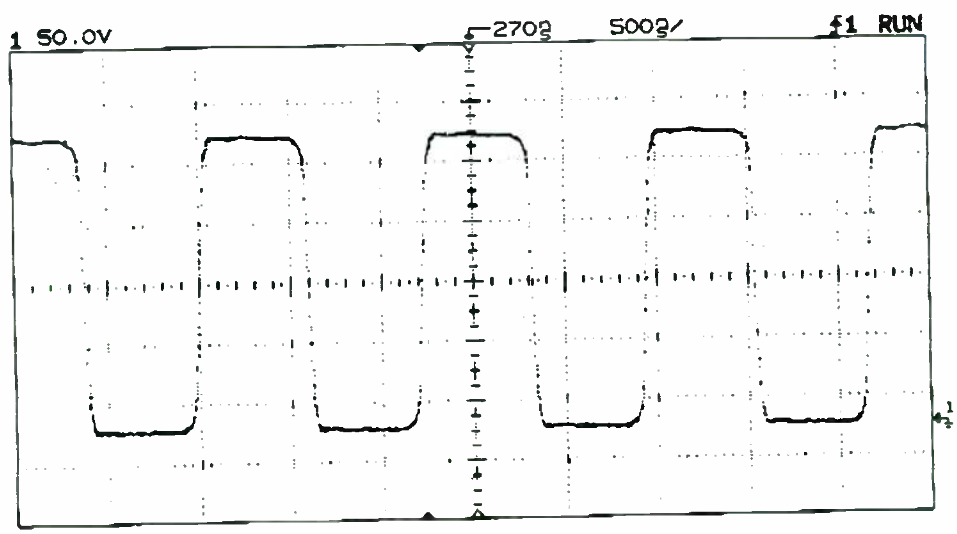
1 Look at PA switching waveforms for steps 1-5 (RF1. 2. 3, 4, and 5) with the SCOPE

a) Figure 8 and Figure 9 show typical PA waveforms. Try the following tuning sequence;

b) First rough tune TUNING control for peak POWER.

2. As you tune slightly off the power peak in one direction note that PA CURRENT will fall more rapidly than RF POWER (increasing efficiency). Leave transmitter tuned on the

Figure 9 Drain Switching (225 Vp-p)



inductive side. (CCW is inductive)

3. If operation looks normal, turn the transmitter OFF. Install all the remaining A25 and A24 fuses. Turn the transmitter back ON. Slowly increase power by pressing RAISE. Stop at 20-25/40-50 amperes PA CURRENT.

4. Determine RF POWER and roughly calibrate the RF POWER meter to that power with A31R1 on the SWITCHBOARD METER PANEL. NOTE that A31S8 must be in the FWD position and that A27P1 and P2 (Output Monitor) must both jumper 1-2 for proper calibration setup.

5. To afford maximum transmitter protection at this point verify that VSWR protection is set (see paragraph 7.4.6), also do a rough OSCILLATOR SYNC adjustment (paragraph 7.4.8).

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NOTE:

All PA efficiency measurements must be performed with ALL binaries OFF. Binary current is not metered through the front panel shunt, and therefore too high a PA efficiency reading will result if one or more of the binaries are ON

8.3.8 Full CW Power

1. Press LOWER to ramp output power down to zero

NOTE:

Any power level (LOW, MEDIUM, or HIGH) may be ramped to zero without RF power by first setting the RF TURN OFF switch (A38S5) to turn PA's OFF, then pressing power level, then LOWER.

1. Press RAISE and slowly raise power to 2500/5000 watts. Check PA switching waveforms through step 5 verifying that these steps are turned ON. Modulate to 100 percent with a 100 Hz triangle wave while carefully watching for problems. Roughly set A/D Phasing at step 5 as follows;

   a) Modulate the transmitter at 10 KHz 95%. Monitor THD.

   b) Set the A34S1 switches on the A/D Converter board to minimize THD. If absolutely necessary the phasing of wire #92 may be reversed at the splitter board. Do this only if ABSOLUTELY NECESSARY.

2. Roughly adjust B- per paragraph 7.4.11. 2500/5000 watts will require about 8/16 big steps ON. Set jumper A30J1 1-2 (NORMAL)

3. Press MEDIUM then RAISE to slowly raise power to 12,500/25,000 watts. Modulate to 100 percent with the 100 Hz triangle. NOTE: 12,500/25,000 watts CW should occur with about 16/33 big steps ON.

Press HIGH then RAISE to slowly raise power to 25,000/50,000 watts. Again modulate to 100 percent with the 100 Hz triangle wave. Turn modulation OFF and verify good PA drain waveforms. Verify # of steps ON, POWER, and PA current as follows:

DX25U			DX50		
POWER	PA AMPS	STEPS ON*	POWER	PA AMPS	STEPS ON
KW			10KW		
KW			25KW		
KW			50KW		

8.3.9 Loading Control Adjustment (For TPO's of 27.5/55 KW and below)

1. Operate the transmitter at 27.5/55 KW. Measure positive peak capability. If greater than 125%, adjust the LOADING CONTROL to lower power by 10%. Use the RAISE control to raise power back to 27.5/55 KW. Measure positive peak capability again and continue to reduce loading and raising power until 125% positive peaks are just achieved at 27.5/55 KW. If positive peaks are under requirement then adjust loading for more power and use LOWER to compensate until positive peak capability is correct.

8.3.10 Loading Control Adjustment (For TPO's above 27.5/55 KW)

1. Use the procedure outlined above except use assigned TPO to set the 125% capability

8.3.11 Tuning Adjustment

1. The transmitter may be tuned OFF power peak for optimum performance but not more than 5% (1.25/2.5 KW power reduction)

2. For purposes of ensuring that the C1 voltage ratings are not exceeded, make sure that the PA Tuning counter setting is NO HIGHER than the value listed in the following table. This assumes that the C1 values are as listed in the Frequency Determined component chart.

3. L1 should be tapped as needed to establish C1 tuning within this limit

* If you are new, please contact an experienced technician, Test Engineering, or Development for instruction on counting the PA Amps that are turned on, and any other instruction that might be required.

Frequency	DX-25U PA Tuning	DX-50 PA Tuning
525-530	No Constraints	No Constraints
531-590	No Constraints	No Constraints
591-650	No Constraints	29
651-750	No Constraints	47
751-819	35	33
820-970	No Constraints	14
971-1080	27	45
1081-1220	46	18
1221-1400	23	55
1401-1499	33	17
1500-1620	37	22

1 Check for PA amplifier heating as follows:

Run the transmitter for 5 minutes or more at 25/50 KW 100 % modulation while looking for any warm spots in the exhaust air stream.

2. Press OFF.

Quickly feel the cases of all exposed MOSFETS starting at step 1. The MOSFETS do cool quickly so you may need to check one quarter of the amplifiers then repeat steps 1, 2, and 3 for the remaining MOSFETS

3. A warmer than normal MOSFET is an indication of a problem. Check both drive and drain phasing to locate the problem.

4. Also check OUTPUT NETWORK components for unusual heating at this point.

5. Carefully set A/D Phasing at step 40/80 as follows;

NOTE: Step 40 is silk-screened #72 for the DX25U, 80 is 80 for the DX50

Modulate the transmitter at 10 KHz 95%. Monitor THD

6. Set the A34S1 switches on the A/D Converter board to minimize THD. If absolutely necessary the phasing of wire #92 may be reversed at the splitter board. Do this only if ABSOLUTELY NECESSARY.

7. Check that the carrier waveform at U12-5 is the 4-6 Vp-p range. It must not fall below 4 Vp-p with modulation.

8. If you should have a problem with PA FAILURES then use the A/D phasing procedure outlined in APPENDIX para. 3.0.

8.4 Final Adjustments and Calibration

8.4.1 Binary Alignment (A18)

8.4.1.1 Binary Phasing

1. Because the 6/5 binary steps (1/2, 1/4, 1/8, 1/16, 1/32 and 1/16) work at different voltage levels and with different turns ratios into the main combiner, phasing of their outputs (drain waveform) will vary from the big steps, but may be corrected by adjusting the active turns used on the EFFICIENCY COILS (A1L1-L5) of each binary as follows;

   NOTE:

   A/D Phasing (APPENDIX para. 3) must be completed before Binary Alignment. Step 40 is silk-screened #72 for the DX25U, 80 is 80 for the DX50

2. Set up the SCOPE per APPENDIX para. 1 except set channel gain to look at 230 Vp-p drain waveforms.

3. Press MEDIUM. Operate the transmitter at about half power but set exact power to turn all binary steps ON by watching PA CURRENT. As power is raised this current will tend to take small downward jumps each time all binaries are turned OFF and a big step ON. Set the power to just before the current jumps down. At this point almost all binaries will be ON. Check big steps 1 through 4 and set up the SCOPE for zero reference on the A side average of these four steps.

4. Record the drain phasing of each binary. NOTE that some of the binaries operate on lower power and you may need to change SCOPE gain especially on the 1/16th and smaller steps. These steps should be within "10 degrees if the binary efficiency coils were set to the TUNING CHART values. When checking phasing reference side A then measure binary sides A as there can be nearly a 2 degree difference between sides A and B.

5. Turn power OFF. Reduce the active turns of each binary efficiency coil about one turn for each two degrees of lagging phase shift or increase one active turn for each degree of

leading phase shift. DO NOT REDUCE EFFICIENCY COIL TURNS TO LESS THAN 1/2 OF THE GIVEN FD VALUE.

6 Recheck phasing. Repeat the above as required to set 1/2 through 1/8th steps within "1 degree of the step 1 through 4 reference and the 1/16th and smaller steps to within -5 to -10 degrees. Try to keep a consistent error (all lagging or all leading).

7. It is also advisable to check that drain phasing of steps 1-10 are within "2 degrees and to try to get drain phasing of steps 1-4 to within "1 degree by swapping PA MODULES with higher steps. This will help smooth modulation glitches near the -100 percent points

8. Modulate the transmitter at 2.5/5 KW and check each binary to make sure that it is not self commutating due to too little inductance of its EFFICIENCY coil, if so tap in more L and accept the phase error which will result.

NOTE:

Misadjusted B- is the major contributor to self commutation, see Para. 7.4 11.

9. Also check some OFF big steps at 25/50 KW power level as these too can self commutate from too few EFFICIENCY coil turns. If a problem is found then retap efficiency coils to their next higher step.

8.4.1.2 Binary Taps

1. When a big step turns on all binary steps turn off and transmitter output power should be exactly 1/32nd of a big step larger. The purpose of setting binary taps is to ensure that each binary puts its allotted power into the output combiner. Their total will then add to 31/32nd of a big step.

NOTE:

Binary alignment affects AM S/N. Improper alignment will cause higher noise since the smaller binary steps are the only steps active during noise measurement. These steps are attempting to correct for power supply ripple. Also as binary alignment improves the amount of S/N change with POWER RAISE and LOWER will also improve.

2. Modulate the transmitter with a 100 Hz triangle wave and operate at 10 percent modulation and about 2500/5000 watts of output power. Set power and modulation to just turn on big step 9/16 at positive peaks and to just turn off big step 8/15 at negative peaks. Expand the SCOPE trace to observe any discontinuities (glitches) in the modulation process. You may need to sync the SCOPE with the FUNC GEN sync output and to put the 1/4th or 1/2 step switching waveform (from the MOD ENCODER) on trace B to help spot exact switching points and which steps may be out of line

3. Adjust binary combiner taps J30 through J33 on the BINARY COMBINER motherboard to provide smooth modulation transitions. NOTE that there are taps for the 1/2 through 1/16 steps only, and that you have a choice of -5, 0, and +5 percent.

4. Dither may be set at this time to help smooth the ramp (see para. 7.4.12). This may help see the effects of any binary misalignment. If the binaries seem to line up but do not quite match a big step then fixed resistor A34R70 on the A/D CONVERTER may be changed to vary big step amplitude at the time of turn on. Lowering R70 increases big step amplitude.

8.4.2 Power and Modulation Sets (A34 and A35)

8.4.2.1 Power Set

1. Press HIGH then RAISE. Release RAISE at 30,000/60,000 watts output or when power will go no higher. If you reach 30,000/60,000 watts then adjust MAX PWR ADJ A35R27 on the ANALOG INPUT board to set power DOWN to 25,000/50,000 watts. Press RAISE. Repeat this cycle until power will not raise.

2. Adjust R27 to set power to 30,000/60,000 watts. Press LOWER to set power to 25,000/50,000 watts.

8.4.2.2 Modulation Set

1. Connect the AUD ANAL to the AUDIO INPUT on the EXTERNAL INTERFACE board. Set the AUD ANAL to a very low 1000 Hz output.

2. Press LOW. Slowly increase the AUD ANAL output while observing transmitter r-f output on the SCOPE. Look for a normal AM modulation waveform. Slowly increase AUD ANAL output to produce 100 percent modulation.

3. Adjust R15 for 100 percent modulation with +10 dBm audio input.

8.4.2.3 Modulation Tracking

8.4.2.3.1 A/D Converter -001

1. Modulation tracking is controlled with OFFSET A34R75 control on the A/D CONVERTER board. Remove modulation and ramp transmitter power down to zero. Monitor bits 11 and 12 on the MOD ENCODER and set R75 so that bits 11and/or 12 switch with circuit noise but not bits 10 and down. Note that bits 11 and 12 can be turned off with a negative offset and avoid that condition. Turning R75 CW will turn on more bits. If R75 is turned too far CW the transmitter will produce power even if ramped full down.

2. Check modulation tracking at 90 percent modulation to be within [illegible] dB at LOW, MEDIUM, and HIGH power. Adjusting R75 will normally have more effect on low power modulation than on high.

8.4.2.3.2 A/D Converter -002

1. Use A34R7 instead of R75, however, you will note only a very small response.

8.4.3 Modulation Monitor Level Sets(A27)

Connect a 50 ohm BNC cable to A27J5 (OUTPUT MONITOR). Cable length should not exceed 20 feet. Connect the other cable end to a high impedance (1 megohm or greater) SCOPE capable of accurately displaying a 30 Vp-p signal at carrier frequency.

8.4.3.1 LOW Power Set

Operate the transmitter at LOW Power. Note voltage level on the SCOPE. Turn transmitter OFF and adjust L107 as required to set SCOPE reading to 28.3 Vp-p. Repeat as required to set the 28.3 Vp-p level.

8.4.3.2 MEDIUM Power Set

After setting low power, go to MEDIUM Power. Adjust MED PWR MON ADJ A27R31 for a 28.3 Vp-p reading on the SCOPE.

8.4.3.3 HIGH Power Set

After setting low and medium powers, go to HIGH Power. Adjust HIGH PWR MON ADJ A27R33 for 28.3 Vp-p on the SCOPE.

8.4.4 Antenna Detector Null (A27)

1. Set forward power to 25/50 KW.

2. On the OUTPUT MONITOR (A27) connect a SCOPE probe to TP5 Depress S5 and set S8 to CAL, then adjust C29 for a minimum signal at TP5 It may be necessary to add additional C with S9-3 at low band or additional L with S9-4 at high band. This sets transformer primary to resonance. DO NOT change.

3. Return S8 to NORMAL. Connect the second SCOPE probe to TP5 and make sure that both scope traces are in phase and of equal amplitude. If not get a better SCOPE or match the probes as the SCOPE MUST NOT introduce phase error at this point.

4. Connect one of the probes to TP6. Set L12 to the center of its range then set S6 switches to move the two SCOPE traces approximately in phase.

5. Adjust C15 to set the two traces to the same amplitude then adjust L12 to bring them in phase.

6. Continue adjusting L12 for phase and C15 for amplitude until the signals at TP6 and TP5 have the same amplitude and are in phase.

7. To double check this adjustment switch the Panel MULTIMETER to DET NULL (ANT) and verify that the meter is nulled. Also check TP9 with the SCOPE for a null (near zero) level.

8.4.5 Filter Detector Null (A27)

1. Set forward power to 25/50 KW. On the OUTPUT MONITOR (A27) connect a SCOPE probe to TP10. Depress S5 and set S8 to CAL, then adjust C21 for a minimum signal at TP10. Additional C and L may be added at band ends with S1-3 or S1-4. This sets transformer primary to resonance. DO NOT change.

2. Return S8 to NORMAL. Connect the second SCOPE probe to TP10 and make sure that both scope traces are in phase. If not get a better SCOPE as the SCOPE MUST NOT introduce phase error at this point.

3. Connect one of the probes to TP1. Set S7 switches to move the two SCOPE B traces approximately in phase. Switch in L5, L6, L7, L8, and/or C39 or C47

4. Adjust C16 to set the two traces to the same amplitude then adjust L5-L8 to bring B them in phase. If needed S2 may be used to switch additional capacity in parallel with C16

5. Continue adjusting L5-L8 for phase and C16 for amplitude until the signals at TP1 and TP10 have the same amplitude and are in phase.

6. To double check this adjustment switch the Panel MULTIMETER to DET NULL (FILTER) and verify that the meter is nulled. Also check at TP8 with the SCOPE for a null (near zero) level.

7. VSWR THRESHOLD SETTINGS

8. Verify that ANTENNA and FILTER samples are nulled at full power per the previous paragraphs.

9. Reverse the ANTENNA CURRENT sample T1 at the OUTPUT SAMPLE BOARD (A26).

10. Operate the transmitter at 1.5/3.0 KW output power. Note that the ANTENNA front panel null meter now reads upscale.

11. On the OUTPUT MONITOR board verify that BPF THRESH A27R23 is set to 0.8/1 Vdc as read at A27TP3.

12. On the OUTPUT MONITOR board adjust the ANT THRESH A27R24 for an ANTENNA VSWR trip

13. Reverse the operations in paragraphs 7.4.6.2 & 7.4.6.3 to return antenna and filter samples to normal.

14. DIRECTIONAL COUPLER BALANCE and CALIBRATION (A27)

NOTE

Before making these adjustments the OUTPUT NETWORK must have been tuned per paragraph 7.1 and the transmitter must be connected to a suitable 50 ohm load per paragraph 6.5. Verify that A27P1 and A27P3 are both jumped 1-3 per para. 6.1.6

8.4.6 Reflected Balance

Set the POWER METER to FORWARD. Press HIGH. Set power to 25/50 KW. Switch POWER METER to REFLECTED. Adjust A27C40 on the OUTPUT MONITOR for a null reading on the REFLECTED POWER METER. If required at low band C30 may be connected with P2.

8.4.7 Forward Balance

1. Turn the transmitter OFF.

2. Change Jumper P1 to 1-2 and P3 to 1-2. This reverses the functions of the Forward and Reflected couplers.

3. Set the POWER METER to FORWARD. Press HIGH. The Power Meter reading should be very low

4. Adjust A27C6 on the OUTPUT MONITOR board for a null reading on the FORWARD POWER METER

8.4.8 Reflected Calibration

1. Set POWER METER to REFLECTED. Set power output to 25/50 Kilowatts as determined calorimetrically. Calibrate REFLECTED to 25/50 Kilowatts with A31R2 on the SWITCHBOARD/METER board.

2. Turn the transmitter OFF.

3. Return P1 to 1-3 and P3 to 1-3 as originally set.

8.4.9 Forward Calibration

Press HIGH. Set POWER METER to FORWARD. Calibrate FORWARD to 25/50 Kilowatts with A31R1 as set in the previous paragraph.

8.4.10 Oscillator Sync Adjustment (A17)

NOTE:

SET PREDRIVER TUNING BEFORE SETTING OSCILLATOR SYNC ADJUSTMENT. PREDRIVER TUNING MUST THEN BE LOCKED AS RETUNING THE DRIVER CIRCUITS WILL CHANGE OSCILLATOR SYNC. (OSCILLATOR SYNC IS AN IMPORTANT PART OF PA PROTECTION UNDER ADVERSE CONDITIONS).

1. Operate the transmitter at 25/50 KW cw. Using a SCOPE that will introduce no phase error (see 7.4.4.2) connect one channel to Oscillator A17TP4 and the second channel to TP5. Using S1 for coarse phase settings and L4 for fine tuning set the two traces in phase. If required a course (180 degrees) phase adjustment may be made by reversing leads to the pickup transformer (T6) located in the output compartment.

2. The duty cycle of the output sample may differ from the oscillator sample so use the phasing control to align the leading edges of the waveform. Use as little C as possible because more will tend to lower the sample input and you may not get enough sample output at lower power. Verify a pulse at TP4 at reduced (2500/5000 watts) power. If necessary move the pickup transformer (T6) nearer to the output line.

8.4.11 Power Supply Protection (A32)

1. Set R86 to fully Clockwise then Counter Clockwise 4 turns.

2. Turn the High Voltage off.

3. Disconnect 2 fuses.

4. Turn the transmitter on at 50 KW carrier

5. Ensure that the timer trips OFF within 1.5 minutes. Make necessary adjustments to R86 to affect this.

6. Reconnect when finished.

8.4.11.1 Current Protection (A32)

1. Turn PEAK CURRENT OVERLOAD A32R68 and AVERAGE CURRENT THRESHOLD A32R42 both full CCW. Set the transmitter for 25/50 KW output or specified TPO if higher.

2. Modulate at 100% with a 20 Hz sine wave. Increase the audio input B level 1.4 dB. Adjust the PEAK CURRENT THRESHOLD A32R68 CW for an OVERCURRENT trip.

3. Modulate with 20 Hz at 100%. Increase modulation audio 0.5 dB. Adjust the AVERAGE CURRENT THRESHOLD A32R42 until the OVERCURRENT LED just lights AMBER.

8.4.11.2 Average Current Overload Test

NOTE: When checking +10 dB overdrive the DC REGULATOR (A30) NORMAL/TEST jumper must be set to NORMAL. The LCD Multimeter must be out of circuit (switch marker either straight UP or straight DOWN). Modulate the transmitter with 400 Hz sinewave. Verify it will continue to operate with at least 10 dB over 100% audio overdrive. The transmitter should trip OFF with between 10 and 15 dB of overdrive. Transmitter supply current should not exceed 250/500 amperes during any of these conditions.

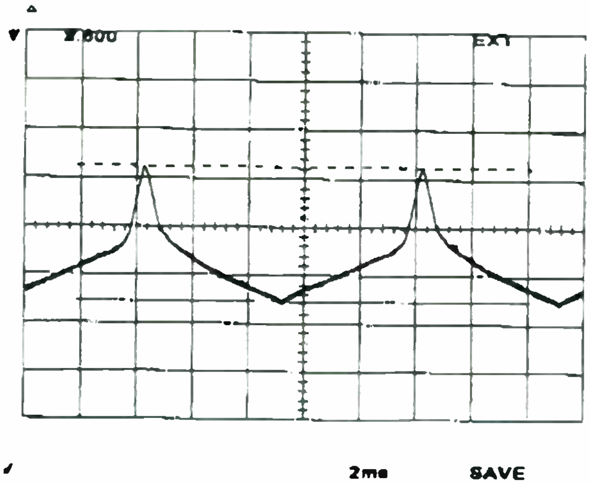
8.4.11.3 Program Modulation Check

Modulate the transmitter with high density program modulation. Increase the modulation level until transmitter current is averaging 200/400 amperes and the OVER CURRENT LED is AMBER at least 75% of the time. The transmitter should NOT trip OFF under these conditions. If OVER CURRENT overloads do occur, the PEAK CURRENT OVERLOAD A32R68 may be backed off 1-2 turns but the voltage at A32TP7 must NOT exceed 11.5 Vdc.

8.4.12 Adjustment (A30 and A35)

1. The B- signal is required to provide smooth switching transitions, especially between binary and big steps.
2. With the transmitter OFF connect and setup test equipment as follows;
3. Connect the SCOPE to monitor A30TP6 and/or A30TP30 on the DC Regulator.
4. Set SCOPE sweep to monitor modulation frequencies.
5. Set the FUNC GEN for a 100 Hz triangle wave and connect to transmitter modulation input.

Figure 10 B- Waveform



8.4.13 Presets

1 Preset OFFSET A35R84 control for 2.72 Vdc at the R84 wiper (Right end of R83)

2. At 2.5/5 KW CW power and no modulation preset the DC level on the SCOPE (A30TP6 and A30TP30 (DX 50 only) to -3.71 Vdc with MOD B- ADJ A30R93 and A30R51 (DX 50 only).

NOTE:

As evident from above there are 2 B- controls and test points on the DX 50. During the following make sure to keep the 2 B- levels within about 0.2 volts of each other.

3. Go to 2.5/5 KW power at 100 percent, 100Hz triangle modulation. Adjust A35R84 OFFSET control until the top of the SCOPE waveform starts to flatten then back off slightly. NOTE that the top of the waveform corresponds to -peak modulation.

4. Reduce modulation to about 5%, this allows glitches to be more easily seen. A30R93 B and A30R51 (DX 50 only) (MOD B- ADJ) will shift the DC value of the waveform, that is, move it up and down on the SCOPE. This can be used to reduce the glitches on the demodulated audio waveform. Positive going glitches indicate a too negative B- is applied to the PA amplifiers at that portion of the waveform. Negative going glitches indicate B- is too positive at that point. The positive peak of audio normally requires the most negative B- while the negative peaks require the least negative B-.

5. The MOD B- level typically is set for -2 to -2.5 V on its positive peak (which is a negative modulation peak). Look at the demodulated audio and adjust A30R51 and A30R93 (DX 50 only) (MOD B- ADJ) to reduce any glitches on the waveform as much as possible.

NOTE that there will be some glitches at the negative modulation peaks that you will not usually be able to totally remove without causing additional glitches on the positive portions of the modulation. Compromise.

6. Increase power to 25/50 KW and make sure that the peak negative B- does not exceed -6 V. CLIP control A30R39 can be readjusted for a more typical -5 volt peak.

8.4.14 Dither Sets (A35)

Set Transmitter for about 500/1000 watts output. Modulate 95 percent with a 100 Hz triangle.

8.4.14.1 Frequency Set

Connect SCOPE channel A to TP10, channel B to TP11. Sync SCOPE on A. Set DITHER FREQUENCY ADJUST A35R41 for a nominal 72 KHz (13.9 us period) waveform on SCOPE A. Make sure that the A and B waveforms are in sync. Center R41 between points where the waveforms lose sync. NOTE that the exact frequency depends on carrier frequency but select a sync point near 72 KHz. Do not set dither frequency above 75 KHz due to FCC limits.

8.4.14.2 Level Set

Expand the demodulated output up on the SCOPE until you can see individual modulation "steps". Turn the DITHER LEVEL ADJUST A35R43 control CW to the point where you can no longer distinguish individual steps on the SCOPE. This will normally occur with the control set about midrange. Do not use dither to totally remove small bumps or notches as an increase in dither also increases the 70 KHz spectrum components. Dither may also be set for minimum AM noise.

8.4.15 Neutralizition (IQM Adjustment) (A40)

1. The neutralizing circuit is normally connected out of circuit, but may be installed to obtain optimum IQM. Connecting this circuit properly will allow IQM to be optimum near the IMD optimum when adjusting PA TUNING. Set PA TUNING for optimum IMD and measure IQM. Turn the transmitter OFF. Connect wire #132 to TB5. Typically the NEUTRALIZATION circuit is connected across only 1 or 2 turns of the predriver transformer T8. Connect one lead of wire #132 to the same terminal as wire #73. The other lead should connect to a terminal on either side in order to connect across one turn of T8. The phase of wire #132 will be changed if IQM becomes worse.

2. Turn the transmitter ON and readjust PA TUNING for best IMD. If IQM is worse, reverse the leads of wire #132 and try again. NOTE that with the neutralizing circuit connected, PREDRIVER TUNING will have an effect on IQM and should be adjusted while watching IQM. It must not be adjusted more than 0.5 ampere off of the peak Predriver current.

NO

PP - 48/49

Table 1 Remote Functions

OSC	Remove jumper A17P2. Push A32S1 on back of LED board
BUFF	Pull BUFFER board out, Push A32S1 on back of LED board
PDRV	Push A32S1 on back of LED board
B SPARE	Spray A19U16 with freezemist
A RF AMP	Remove a fuse from an RF amplifier, Turn transmitter ON
CBAR	-----
MON +5	Pull 0.5 amp fuse A27F1
MON -5	Pull 0.5 amp fuse A27F2
LDVSW	Push A27S4 on OUTPUT MONITOR
NTVSW	Push A27S3 on OUTPUT MONITOR
AIN +15	Pull 0.5 amp fuse A35F2
AIN -15	Pull 0.5 amp fuse A35F3
A/D +15	Pull 1 amp fuse A34F1
A/D -15	Pull 0.5 amp fuse A34F3
A/D +5	Pull 2 amp fuse A34F2
CONERR	With transmitter running remove A34P10
A REG B+	Move P-1 on DC REGULATOR to TEST, Pull 7 amp fuses A30F2&3
REG B-	Move P-1 on DC REGULATOR to TEST, Pull 5 amp fuses A30F5&6
A CABINL	Move P1 on DC REGULATOR TO TEST, Pull a PA module
EXTINL	Remove jumper on the REMOTE fixture
DORINL	Open module door
B SUPPV	Short A32U1 pin 2 to GND momentarily
B SUPPI	Overmodulate the transmitter
A UDRV	Read Vdc at A32TP8-Turn R67 CCW to trip-Reset TP8 reading

A ODRV	Read Vdc at A32TP5-Turn R41 CW to trip-Reset TP5 reading
AIROVR	Block airflow to the AIR SWITCH/spray A19U16 with freezemist
A HIVOLT	SUPP Set power to 27,500/50,000 and modulate 110% with 55 Hz
LOCAL	Switch to LOCAL on the FRONT PANEL
REMOTE	Switch to REMOTE on the FRONT PANEL
B SLFTST	Press MANUAL TEST on the FRONT PANEL/and on REMOTE

8.4.21 Harmonics, Spurious & Occupied Bandwidth

1. Using the 3585A SA check spurious and harmonic levels from Fo/2 to 10Fc. Note all down from Fo less than 85 dB with correction. All harmonics and spurious must be down at least 80 dB. NOTE: The Fc/2 level can be nulled with the 1L4 tap and the 1.5 & 3Fc levels may be nulled with the 2L3 tap and 2C3 adjustment.

2. Along with checking the harmonic spectrum for FCC compliance, the occupied bandwidth of the transmitter must be checked. Operate the transmitter at rated power and 85%, 7.5 KHZ modulation. On the Spectrum Analyzer, verify that all components greater than 75 KHZ away from carrier are down 80 dB or more. Use spans of 200 KHZ, 400 KHZ, and 1 MHz. Also look

3. B for components at "1/2 Fc for frequencies above 820 KHZ.

4. If numerous components are above spec, check for a bad RF amplifier, improper binary phasing, binary alignment, A/D phasing, Modulated B-, or output network tuning.

8.4.22 A Airflow Interlock Verification/Adjustment

This paragraph (7.4.19A) applies to the original air flow sensor used in the DX 25U/50 (Warren/G-V SAF 1025025). See paragraph 7.4.19B for the newer improved air flow sensor adjustment.

CURRENT REVISION DATE: 10/14/97 8:39 AM

NOTE:

FOR ALL ADJUSTMENTS AND VERIFICATIONS BE SURE AIR SENSOR(S) HAVE BEEN ALLOWED AT LEAST ONE (1) MINUTE TO STABILIZE. FANS ARE EASILY SHUT OFF BY REMOVING 2 OF THE 3 FUSES MOUNTED NEAR EACH FAN.

9. Transmitter Operating At 60 Hz Line

9.1 VERIFICATION

1. Operate the transmitter for a minimum of 15 minutes at full power with 100% 1 KHz modulation.
2. Verify that the AIRFLOW SENSOR will shut down the transmitter with the middle 2 fans disabled, ALL DOORS CLOSED, and NO air filter blockage.
3. With 3 fans running, observe that the transmitter will remain ON with ALL DOORS OPEN.
4. If the air interlock fails any of the above tests, the AIRFLOW SENSOR located on the DRIVER ENCODER board may need to be set per the following adjustment procedure.

9.2 ADJUSTMENT

1. Operate the transmitter for a minimum of 15 minutes at full power with 100% 1 KHz modulation.
2. Disable the middle 2 fans, block 2 air filters and OPEN THE DRIVER DOOR ONLY. Lift tab on sensor to gain access to the adjustment control and NOTE that a CCW turn reduces the amount of airflow needed to keep the transmitter ON while CW increases needed airflow. Also NOTE that 1/16 of a turn typically makes the difference between proper and improper operation.
3. Adjust the sensor so that the transmitter just trips OFF. Now operate the transmitter with 3 fans running. Verify that it will stay ON with ALL DOORS OPEN. If not, readjust the sensor until the above conditions can be met. Repeat the above verification procedure.

10. Transmitter Operating At 50 Hz Line

10.1 Verification

1. Operate the transmitter for a minimum of 15 minutes at full power with 100% 1 KHz modulation.
2. Verify that the AIRFLOW SENSOR will shut down the transmitter with the middle 2 fans disabled, DRIVER DOOR OPEN, and NO air filter blockage.

3. With 3 fans running, observe that the transmitter will remain ON with ALL DOORS OPEN.

4. If the air interlock fails any of the above tests, the AIRFLOW SENSOR located on the DRIVER ENCODER board may need to be set per the following adjustment procedure.

10.2 Adjustment

1. Operate the transmitter for a minimum of 15 minutes at full power with 100% 1 KHz modulation.

2. Disable the middle 2 fans, block 2 air filters and OPEN THE FRONT DRIVER DOOR ONLY. Lift tab on sensor to gain access to the adjustment control and NOTE that a CCW turn reduces the amount of airflow needed to keep the transmitter ON while CW increases needed airflow. Also NOTE that 1/16 of a turn typically makes the difference between proper and improper operation.

3. Adjust the sensor so that the transmitter just trips OFF. Now operate the transmitter with 3 fans running. Verify that it will stay ON with ALL DOORS OPEN. If not, readjust the sensor until the above conditions can be met. Repeat the above verification procedure.

11. 50 Hz Setup With Transmitter Operating At 60 Hz Line

11.1 VERIFICATION

1. Operate the transmitter for a minimum of 15 minutes at full power with 100% 1 KHz modulation.

2. Verify that the AIRFLOW SENSOR will shut down the transmitter with the middle 2 fans disabled, ALL DOORS OPEN, and NO air filter blockage.

3. With 3 fans running, observe that the transmitter will remain ON with THE LEFT AND CENTER DOORS OPEN.

4. If the air interlock fails any of the above tests, the AIRFLOW SENSOR located on the DRIVER ENCODER board may need to be set per the following adjustment procedure.

11.2 ADJUSTMENT

1. Operate the transmitter for a minimum of 15 minutes at full power with 100% 1 KHz modulation.

2. Disable the middle 2 fans, and OPEN ALL DOORS. Lift tab on sensor to gain access to the adjustment control and NOTE that a CCW turn reduces the amount of airflow needed to keep the transmitter ON while CW increases needed airflow. Also NOTE that 1/16 of a turn typically makes the difference between proper and improper operation.

3. Adjust the sensor so that the transmitter just trips OFF. Now operate the transmitter with 3 fans running. Verify that it will stay ON with THE LEFT AND CENTER DOORS OPEN. If not, readjust the sensor until the above conditions can be met. Repeat the above verification procedure.

12. Airflow Interlock Verification/Adjustment

This paragraph (7.4.19B) applies to the newer improved air flow sensor adjustment. See paragraph 7.4.19A for the original air flow sensor used in the DX 25U/50 (Warren/G-V SAF 1025025).

NOTE:

FOR ALL ADJUSTMENTS AND VERIFICATIONS BE SURE AIR SENSOR(S) HAVE BEEN ALLOWED AT LEAST ONE (1) MINUTE TO STABILIZE. FANS ARE EASILY SHUT OFF BY REMOVING 2 OF THE 3 FUSES MOUNTED NEAR EACH FAN.

12.1 Transmitter Operating At 60 Hz Line

12.1.1 VERIFICATION

1. Operate the transmitter for a minimum of 15 minutes at full power with 100% 1 KHz modulation.

2. Verify that the AIRFLOW SENSOR will shut down the transmitter with the middle 2 fans disabled, ALL DOORS CLOSED, and NO air filter blockage.

3. With 3 fans running, observe that the transmitter will remain ON with ALL DOORS CLOSED. The AIR INTERLOCK LED on the front panel should be lit AMBER.

4. If the air interlock fails any of the above tests, the AIRFLOW SENSOR located on the DRIVER ENCODER board may need to be set per the following adjustment procedure.

12.1.2 Adjustment

1. Operate the transmitter for a minimum of 15 minutes at full power with 100% 1 KHz modulation. All fans running.

2. With the DRIVER DOOR OPEN, adjust the AIR FLOW CAL R98 for a 2.25 Vdc reading at the AIR TP11. Close the driver door and verify that this reading increases to 2.5 Vdc "0.05 Vdc.

3. Operate the transmitter with 3 fans running and ALL DOORS CLOSED. Verify that the AIR INTERLOCK LED on the front panel lights AMBER after approximately 3 minutes of operation. The AIR TP11 voltage should now be between 2.8 and 3.1 Vdc.

4. Operate the transmitter with 2 fans out and ALL DOORS CLOSED. Verify that it shuts down within 5 minutes of turn on.

12.2 Transmitter Operating At 50 Hz Line

12.2.1 VERIFICATION

1. Operate the transmitter for a minimum of 15 minutes at 27.5/55 KW with 100% 1 KHz modulation.

2. Verify that the AIRFLOW SENSOR will shut down the transmitter with the middle 2 fans disabled, ALL DOORS CLOSED, and NO air filter blockage.

3. With 3 fans running, observe that the transmitter will remain ON with ALL DOORS CLOSED. The AIR INTERLOCK LED on the front panel should be lit AMBER.

4. If the air interlock fails any of the above tests, the AIRFLOW SENSOR located on the DRIVER ENCODER board may need to be set per the following adjustment procedure.

12.2.2 Adjustment

1. Operate the transmitter for a minimum of 15 minutes at full power with 100% 1 KHz modulation. All fans running.

2. With the DRIVER DOOR OPEN, adjust the AIR FLOW CAL R98 for a 2.25 Vdc reading at the AIR TP11. Close the driver door and verify that this reading increases to 2.5 Vdc "0.05 Vdc.

3 Operate the transmitter with 3 fans running and ALL DOORS CLOSED. Verify that the AIR INTERLOCK LED on the front panel lights AMBER after approximately 1 minute of operation. The AIR TP11 voltage should now be between 2.8 and 3.1 Vdc.

4. Operate the transmitter with 2 fans out and the DRIVER DOOR OPEN. Verify that it shuts down within 5 minutes of turn on.

12.3 50 Hz Setup With Transmitter Operating At 60 Hz Line

12.3.1 VERIFICATION

1. Operate the transmitter for a minimum of 15 minutes at full power with 100% 1 KHz modulation.

2. Verify that the AIRFLOW SENSOR will shut down the transmitter with the middle 2 fans disabled, DRIVER DOOR OPEN and NO air filter blockage.

3. With 3 fans running, observe that the transmitter will remain ON with LEFT AND CENTER DOORS OPEN. The AIR INTERLOCK LED on the front panel should be lit AMBER.

4. If the air interlock fails any of the above tests, the AIRFLOW SENSOR located on the DRIVER ENCODER board may need to be set per the following adjustment procedure.

12.3.2 Adjustment

1. Operate the transmitter for a minimum of 15 minutes at full power with 100% 1 KHz modulation.

2. Block 1/2 of the air input to the transmitter. With the DRIVER DOOR OPEN, adjust the AIR FLOW CAL R98 for a 2.25 Vdc reading at the AIR TP. Close the driver door and verify that this reading increases to 2.5 Vdc "0.05 Vdc.

3. Operate the transmitter with 3 fans running and the LEFT AND CENTER DOORS OPEN. Verify that the AIR INTERLOCK LED on the front panel lights AMBER after approximately 1 minute of operation. The AIR TP voltage should now be between 2.8 and 3.1 Vdc.

4. Operate the transmitter with 2 fans out and the DRIVER DOOR OPEN. Verify that it shuts down within 5 minutes of turn on.

13. Final Data and Wrap up

13.1 Continuous Run

Operate the transmitter continuously for a minimum 12 hour period at 27.5/55 KW with a minimum of 100% pink noise or program peak modulation. At completion of the run check for blown RF Modules and any unusual heating of output network components. Any problems requiring repair will require the continuous run to be repeated.

13.2 Data

Complete the computerized data sheets by running Audio Precision S1.EXE with FORMAT50.PRO and supporting programs. When testing is complete, Initial or use your stamp to mark the Inspection Label in the "TEST" box.

13.3 Output Network

1. Use a permanent marker to mark the location of each movable tap on 2L1 and 2L3. Take photographs as required of the OUTPUT NETWORK to enable the customer to reassemble the network following tear down and shipping.

2. Verify that the tuning constraints listed in para. 7.3.9 have not been exceeded.

13.4 Control Seals

Seal the following controls,

A19R17	RESET
A19R19	DRIVER
A19R49	CAL
A19R50	AMB1
A19R51	AMB2
A19R60	TEMP LWR
A27C3	FORWARD BAL
A27C4	REFLECTED BAL
A27C27	FILTER PHASE DET
A27R23	FILTER VSWR TRIP ADJUST
A27C13	ANTENNA PHASE DET
A27R24	ANTENNA VSWR TRIP ADJUST
A30R51	MOD B- ADJ
A30R93	MOD B- ADJ (DX 50 only)
A31R1	FWD
A31R2	REFLD
A32R86	POWER SUPPLY PROTECTION SENSITIVITY
A32R41	OVERDRIVE THRESHOLD
A32R67	UNDERDRIVE THRESHOLD
A32R68	PEAK CURRENT THRESHOLD
A32R42	AVERAGE CURRENT THRESHOLD
A34R75	OFFSET
A34R79	CONVERSION START PULSE

A35R27 MAX PWR ADJ

A35R41 DITHER FREQUENCY ADJUST

A35R43 DITHER LEVEL ADJUST

A35R52 DISTORTION ADJUST

A35R84 OFFSET

A35R85 GAIN

13.5 Product Disposition

1. For all product that pass test place a test stamp or sign the stamp and or any other action that indicates this product has been tested and found to be in conformance to all Harris Quality Standards.

2. Product that does not pass test shall be corrected and uncorrected product shall be dispositioned by the lead engineer, contact Rufus Warren at extension 7448.

14. DX 25/50 Format Procedure

14.1 RF Drive Phasing

14.1.1 Setup

1. RF drive is measured with all RF MODULES off, that is power output set to zero.

   NOTE

   RF MODULE switching waveforms are easily monitored at TP1 & TP2 at the front of each RF MODULE. SCOPE ground may be connected to the board ground plane. RF MODULE drive is monitored at the ungrounded ends of CR3 and 4. TP1 and CR3 are on side A.

2. Connect the SCOPE to monitor the drive A of the first convenient module. Use AC coupled input as there is a DC component on the drive.

3. Level should be 23 Vp-p, if not it may be set with A22R12 (Driver Supply Regulator). Refer to format test procedure para. 6.7.4 for additional information if drive cannot be set.

4. Adjust the horizontal vernier of the SCOPE so that one full RF cycle (360 degrees) occupies 9 divisions on the screen. Each division then equals (360/9) or 40 degrees.

5. Connect SCOPE external trigger to A17J5 on the Oscillator.

6 Adjust SCOPE triggering, then verify external triggering by disconnecting the external trigger input. The SCOPE should lose sync

7. Increase vertical sensitivity by a step or 2, Causing the trace to expand off screen.

8. Disconnect the vertical input, then adjust vertical positioning so that the SCOPE trace is exactly in the center of the screen. Reconnect the vertical input.

9. Increase the sweep speed of the SCOPE. If the SCOPE has a X10 multiplier, use it to make the SCOPE display 4 degrees (40/10) per division horizontally. Otherwise increase the sweep speed as possible to increase the resolution of the screen to a value comparable to the 4 degree per division setup

10 Adjust the horizontal position of the SCOPE to place the zero crossing of the drive signal in the center of the screen. The SCOPE is now setup to measure degrees of phase shift relative to the drive you presently have connected.

11. Move the scope probe to side B of the PA MODULE.

12. If the SCOPE trace passes exactly through the center of the screen the phase shift of that drive is 0 degrees. If the zero crossing occurs somewhere other than center screen then the phase shift can be read from the screen. Scale is 4 degrees per division if you were able to follow the setup as given in paragraphs A1.4 through A1.10.

13. Check the phase shift of sides A and B for each PA MODULE (A44-91). Total variation (biggest positive plus the biggest negative reading) must not exceed 10 degrees.

14. Check the following if phasing is not within the above limits.

14.1.2 Failed PA Transistors

A simple ohmmeter check of each transistor will nearly always identify defective ones. Failed transistors will normally present problems more easily identified than phase error, such as reduced power output, PA volts/ampere ratio change, blown fuse, distortion, LOW drive level, etc.

14.1.3 Bad RF Drive Cable

The drive cable consists of 8 individual coaxes. If the shield of one coax is open, drive will be different for one PA MODULE. Remove and check the cable. Be sure to flex it looking for any intermittent conditions.

14.1.4 Bad RF Drive Transformer

If possible, make comparisons between the impedance of different PA MODULE input circuits. An input which measures an unusual voltage or phase will measure an unusual input impedance.

14.2 Square Wave Overshoot

NOTE:

Generator impedance is critical to proper operation of the input Bessel filter. Be sure to use the proper input plug on the ANALOG INPUT board (A35J1, 2, OR 3) to match your square wave generator output impedance. This will be J3 for the specified Wavetek generator which has an output impedance of 50 ohms or less.

1. Adjust SCOPE for 4 divisions of RF carrier (25 percent per division).
2. Set the MOD MON for -81 percent modulation on the peak flasher.

   NOTE:

   This assumes that you will have approximately 1 percent overshoot so that the flat part of the square wave is 80 percent.

3. Apply a 400 Hz squarewave and increase until the peak flasher lights.
4. Increase SCOPE gain by 2 (12.5 percent per division or 2.5 percent per small division).
5. Read positive overshoot on the SCOPE and record.

14.3 A/D Phasing

1. This procedure sets the A/D conversion timing to force step changes at carrier wave zero crossing to minimize switching transients and PA transistor stress.
2. With power OFF connect the following, see Figure 16 A/D Phasing Connections, page 70.
3. Insert a PA MODULE modified to monitor transistor at the specified step location. (Normally step 9/15 at 2.5/5 KW and step 40/80 at 25/50 KW.)
4. Connect the A side current monitor terminal to SCOPE channel A. NOTE that the A side of a PA MODULE is always the inner side of the module.
5. Connect the B side current monitor terminal to SCOPE channel B.
6. Connect A17J5 FREQUENCY MONITOR SAMPLE to the FUNC GEN sync input.
7. Set FUNC GEN to 1/100th of the carrier frequency and for a squarewave output.
8. Set FUNC GEN output to minimum. Connect to the transmitter modulation input.
9. Connect a FUNC GEN pulse or squarewave output to SCOPE external sync. Set SCOPE sweep to observe about 2 cycles of the modulation waveform.

10 Press LOW (2.5/5 KW). Increase modulation level and note the change in the current waveform as the PA MODULE turns ON and OFF. A small change in power level may help stabilize the waveform.

11. Set the delayed sweep window to the first turn ON point on the main sweep then expand the delayed sweep to observe individual RF cycles.

12. Set the A34S1 switches on the A/D Converter board so that there are no apparent switching transients on one trace and a minimum transient on the other. Also verify that the "A" side of the amplifier turns on before the "B" side. Different combinations of A to D phasing and Mod B- will have an effect on which side turns on first. For most combinations of switch settings A should switch before B. Also verify that the modulated B- is between -4 and -5 Vdc at 25/50 KW. At the low end of the band "B" may want to switch before "A" more predominately.

13. Press HIGH (25/50 KW) and repeat the previous process at step 40/80. Try to keep the step 40/80 transient less than the peak switching currents.

14. At 2.5/5 KW the transient level may exceed peak switching currents as the lower power peak currents are lower.

15. Check that the carrier waveform at U12-5 is in the 4-6 Vp-p range. It must not fall below the 4 Vp-p level with modulation. If it does you may need to reduce the output feedback level by moving the proper pickup coil in the output cavity further away from the output line. This range is necessary for effective dynamic control of A/D phasing.

Following are examples of switching waveforms shown in Figure 11 through Figure 15. These are voltage waveforms of the drive and drain signals locaed on the Pas. They are included to verify the A/D phasing setup of Paragraph 14.3, page 60.

Figure 11 An Example of a Trace that is *NOT Acceptable*

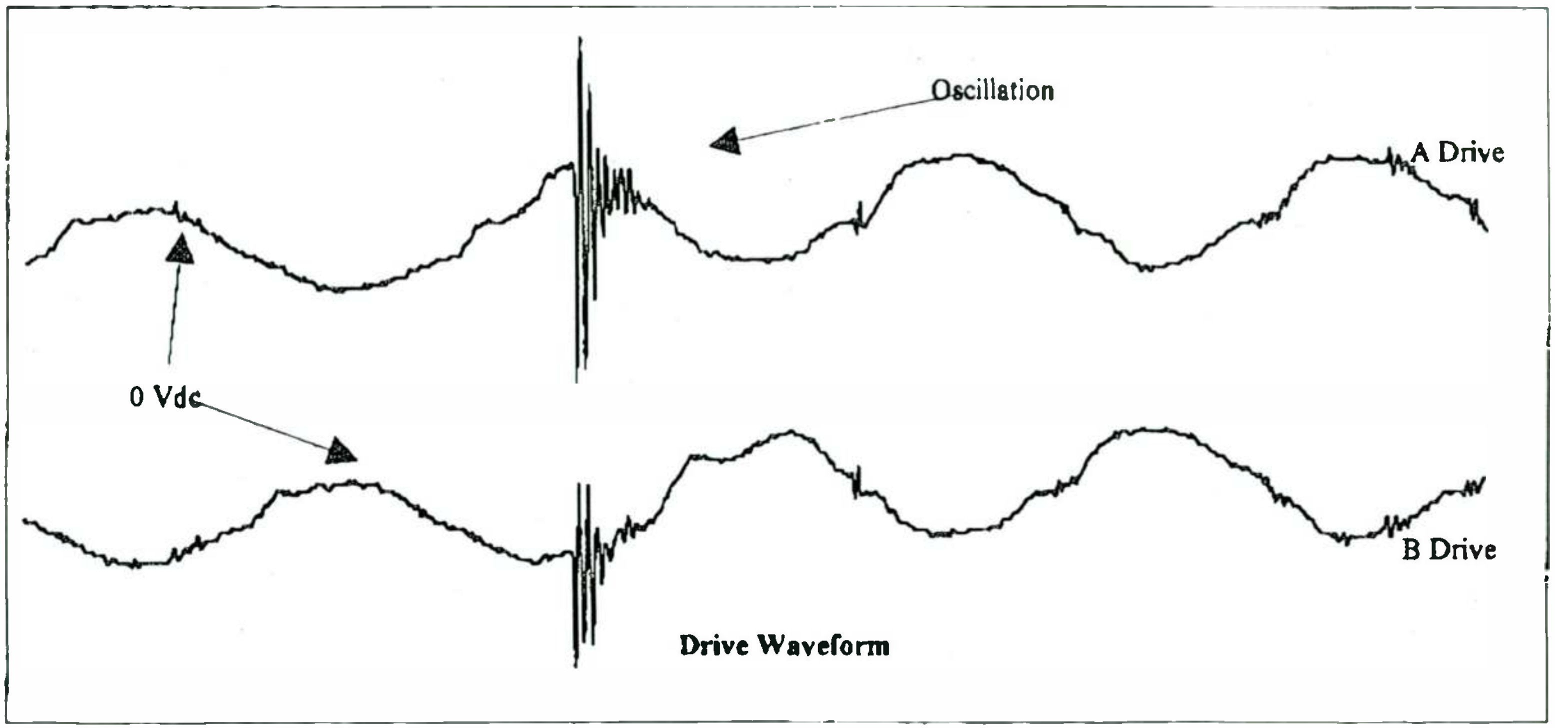


Figure 12 Example of *Good Waveform*

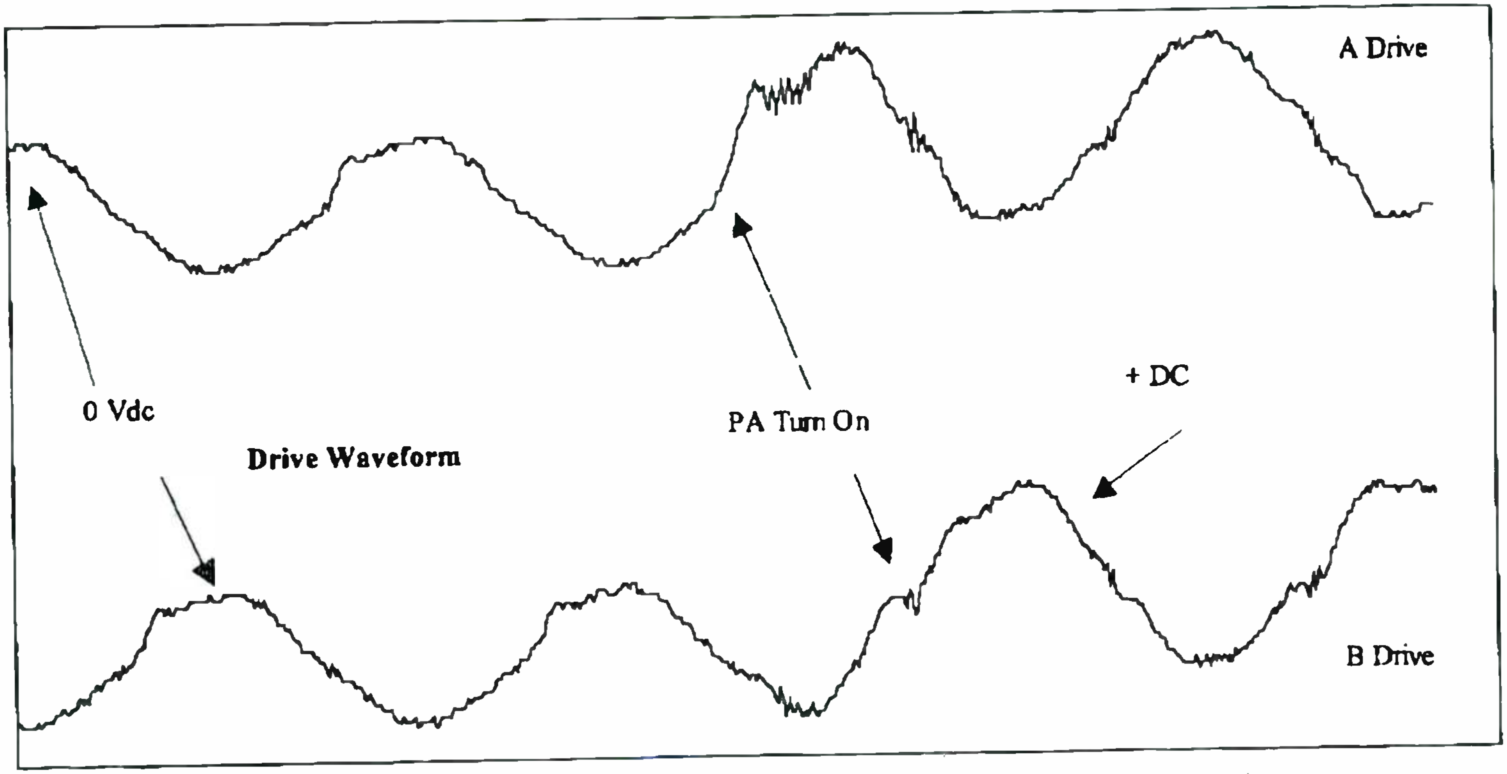


Figure 13 Example of *Good A/D Phasing*

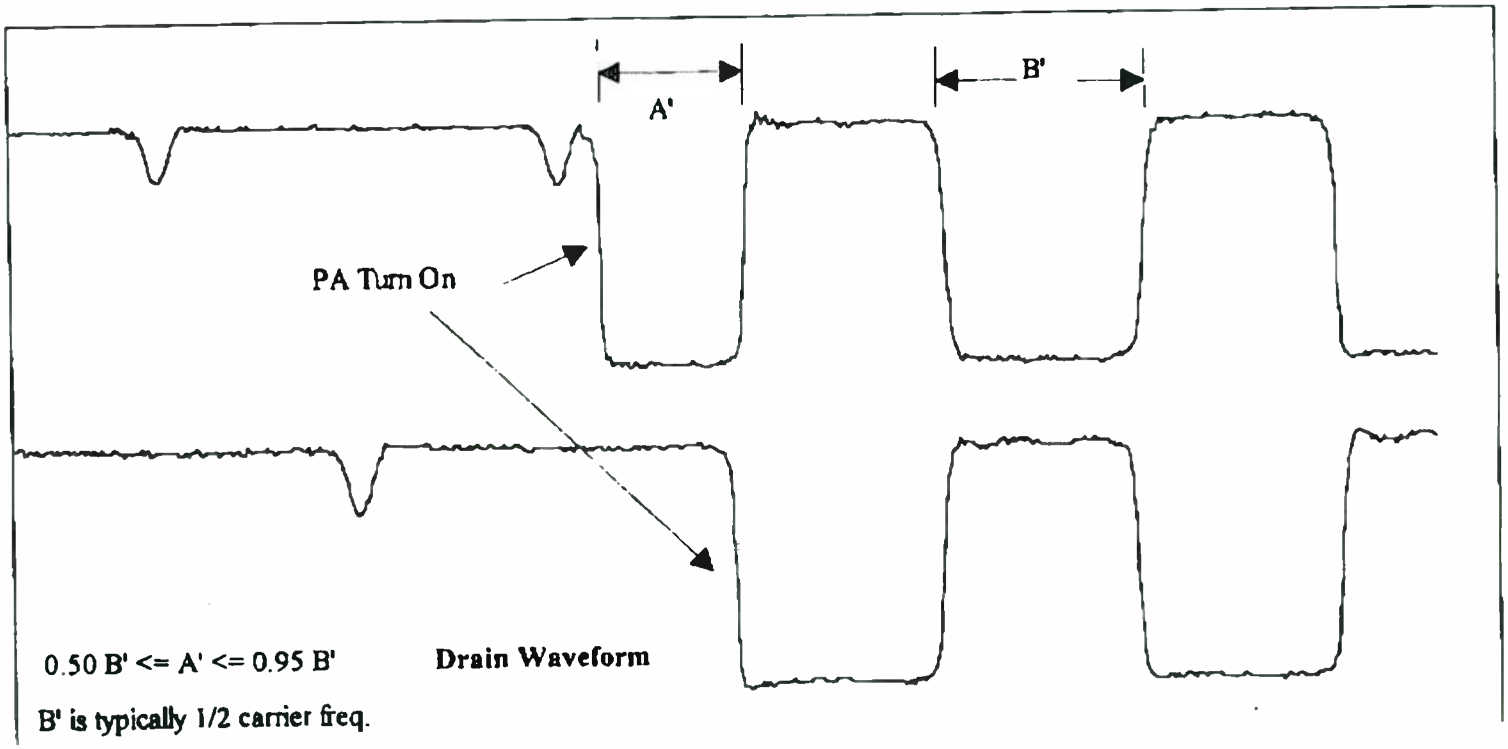


Figure 14 Example *Not Acceptable*

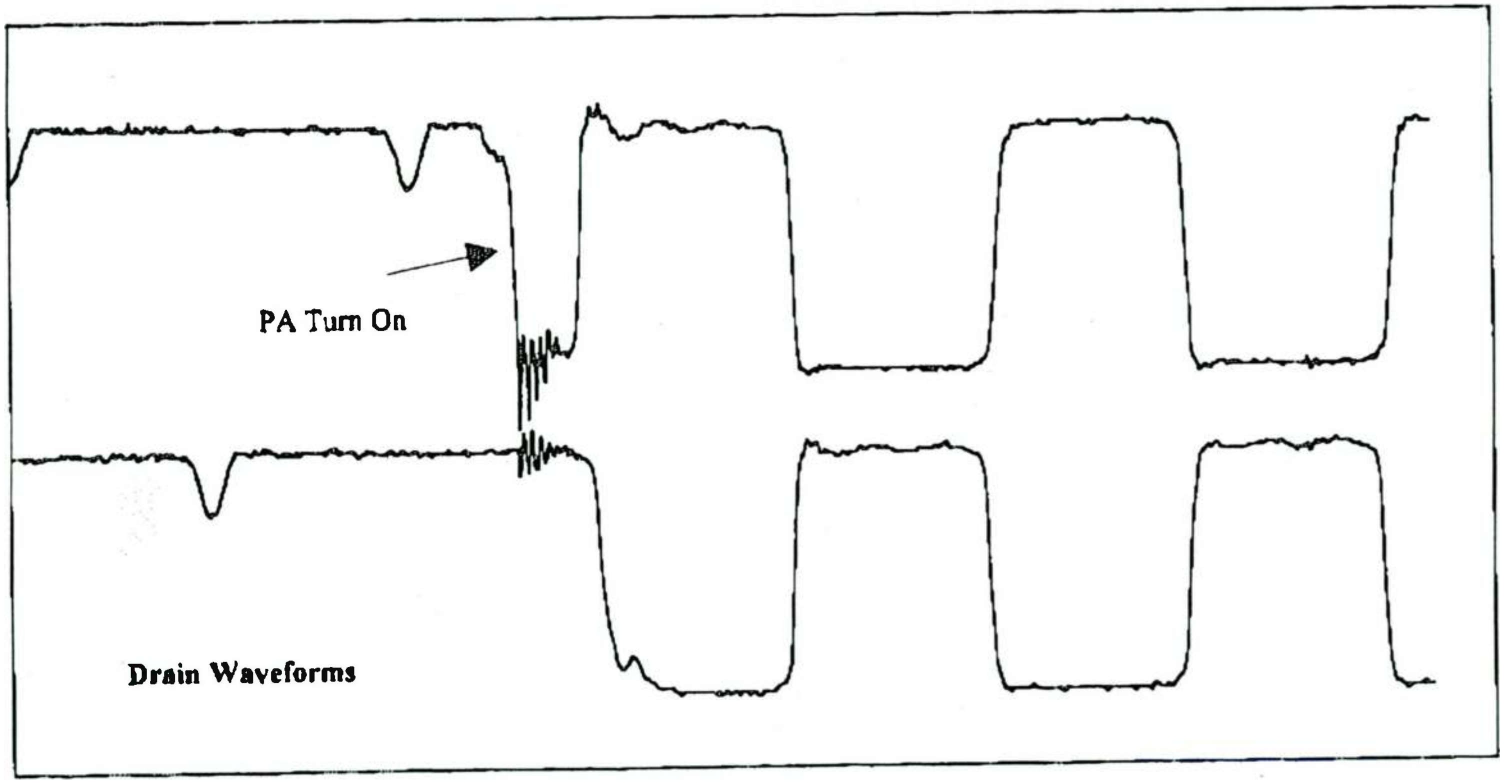
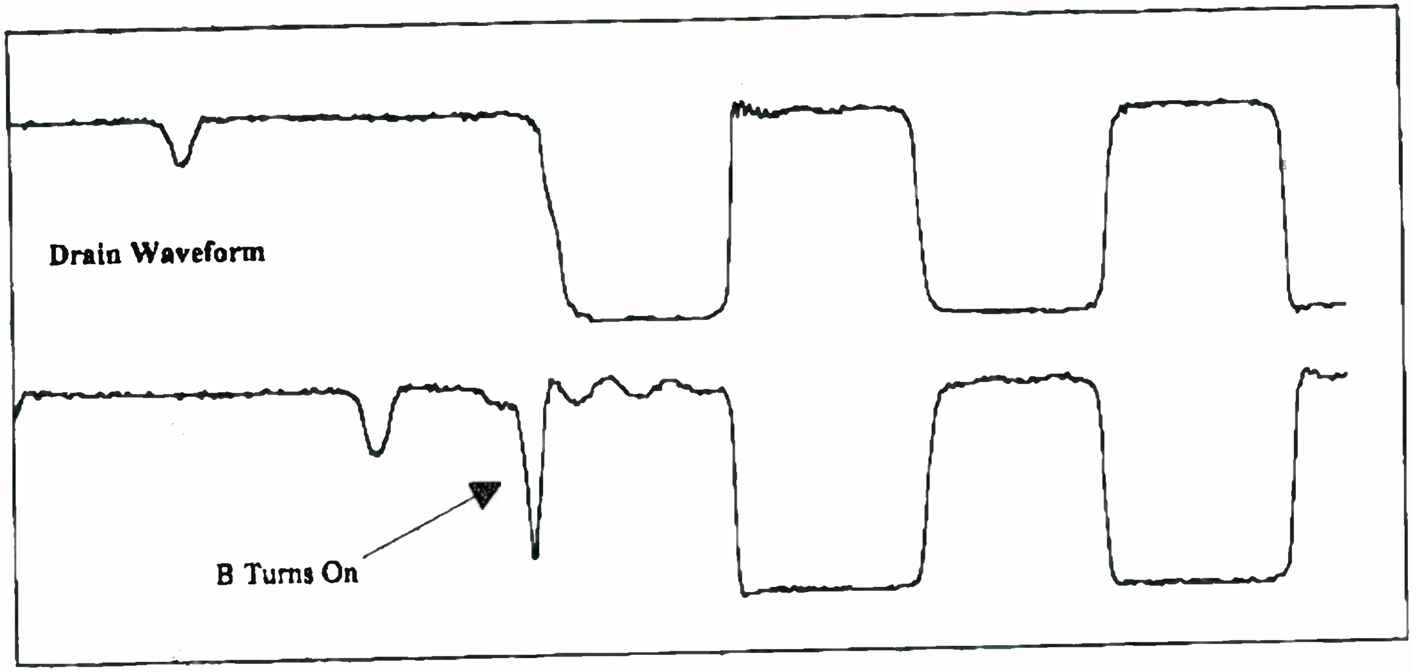


Figure 15 An Example *Not Acceptable*



The high frequency oscillation, Figure 11, may possibly damage the MOSFETs and the ferrite beads used to suppress the oscillations; also, note the large voltage swing associated with the oscillation, this is indicative of excessive switching currents.

Note, Figure 12, that "A" drive turns on before "B" drive. The PA module turned on at the point where the drive rises above zero (0) volts DC. Ideally, this should occur near the crossover of the positive and negative swings of the carrier frequency.

In Figure 13 is a good example of A/D phasing. "A" turns on before "B", there are no oscillations and the first turn on pulse of "A" is greater than 50% of "B" but less than 95% of the normal width of "B" The first turn on cycle of the "A" wave should be 50 to 95% of the normal width of "A". This will guarantee the A/D phasing is not timed too close together. Too close will cause problems with the switching and may damage circuits.

An example of A/D phasing where "A" has a first pulse too narrow and too far from the drive crossover is shown in Figure 14. This case will cause a severe oscillation that may be detrimental to the PA modules. An example showing B turning on before A, Figure 15, this also may be detrimental to the PA modules.

While checking A/D phasing, check numerous combinations of phasing and record what combinations are safe and which ones to avoid. Later you may optimize the transmitter's performance at high frequencies by selecting one of the safer phase adjustments. Again, avoid using any untried or known bad phase adjustments while modulating the transmitter. Checking A/D phasing requires observing the drive waveforms as well as the drain waveforms.

Figure 16 A/D Phasing Connections