TECHNICAL MANUAL

SX-1 AM TRANSMITTER

MAINTENANCE MANUAL

994 8581 001

994 8581 003

HARRIS

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MANUAL REVISION HISTORY
SX-1 AM TRANSMITTER MAINTENANCE MANUAL
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024	09/16/83	27667A	Replaced the following pages: Title Page, 2-2, 7-2, 7-6, 7-20, 7-21, 7-86, 7-87 & 7-88, 7-89/7-90, 8-1 & 8-2, 8-15/8-16, 8-75/8-76 Added Manual Revision History Page
022	09-29-83	27736	Replaced the following pages: Title Page, Manual Revision History Page, 7-15 & 7-16 and 7-65 & 7-66
025	09-30-83	27740	Replaced the following pages: Title Page, Manual Revision History Page, 7-3, 7-9, 7-10, and 7-31
023	10-04-83	27737	Replaced the following pages: Title Page, Manual Revision History Page, 7-60, 8-33/8-34
020	10-07-83	27731	Replaced the following pages: Title Page, Manual Revision History Page 7-7, 7-8, 7-9, 7-10, 7-15, 7-16, 7-17, 7-18, 7-28, 7-34, 7-35, 7-36
021	10-13-83	27738	Replaced the following pages: Title Page, Manual Revision History Page 8-7/8-8
026	10-31-83	27770	Replaced the following pages: Title Page, Manual Revision History Page iv thru xvi 2-6, 2-7 & 2-8 All of Sections IV, V, and VII Added the following: 3-3/3-4
027	11-14-83	27779	Replaced the following pages: Title Page, Manual Revision History Page 7-30, 7-33, 7-34
029	11-22-83	27833	Replaced the following pages: Title Page, Manual Revision History Page xv/xvi, 7-1, 7-2, 7-5, 7-24, 7-25, 7-29, 7-34, 7-54, 7-55, 7-56, 7-57, 8-2, 8-45/8-46
028	12-01-83	27800	Replaced the following pages: Title Page, Manual Revision History Page xv/xvi, 8-2 Added the following pages: 8-77/8-78, 8-79/8-80, 8-81/8-82, 8-83/8-84

WARNING

THE CURRENTS AND VOLTAGES IN THIS EQUIPMENT ARE DANGEROUS. PERSONNEL MUST AT ALL TIMES OBSERVE SAFETY 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 references:

- 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.

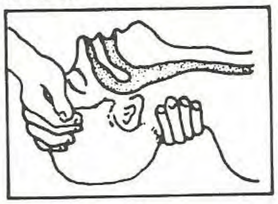
Treatment of Electrical Shock

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

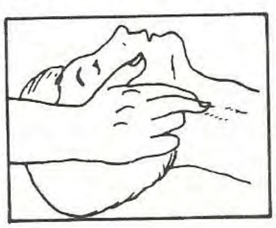
IF NOT BREATHING,
BEGIN ARTIFICIAL
BREATHING

TILT HEAD
PINCH NOSTRILS
MAKE AIRTIGHT SEAL

4 QUICK FULL BREATHS

REMEMBER MOUTH TO MOUTH RESUSCITATION
MUST BE COMMENCED AS SOON AS POSSIBLE

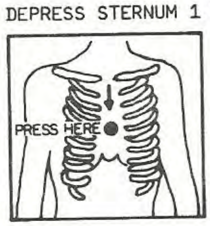
CHECK CAROTID PULSE



IF PULSE ABSENT,
BEGIN ARTIFICIAL
CIRCULATION

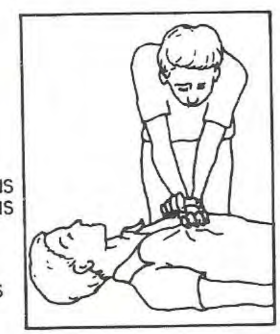
(C) CIRCULATION

DEPRESS STERNUM 1 1/2" TO 2"



APPROX. 80 SEC. { ONE RESCUER
15 COMPRESSIONS
2 QUICK BREATHS

APPROX. 60 SEC. { 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
      (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 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)

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APPENDIX B. TEST EQUIPMENT

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LIST OF ILLUSTRATIONS

SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION

1-2. SCOPE AND PURPOSE

1-3. This technical manual contains information necessary to install and maintain the SX-1 AM TRANSMITTER. The various sections of this technical manual provide the following types of information.

a. SECTION I, GENERAL INFORMATION, provides introduction to technical manual contents.

b. SECTION II, OPERATION, provides identification and functions of boards and other internally mounted controls and indicators as well as a list of typical readings for the SX-1 AM TRANSMITTER.

c. SECTION III, EMERGENCY OPERATING PROCEDURES, provides emergency modes of operation.

d. SECTION IV, MAINTENANCE, provides preventive and corrective maintenance as well as alignment procedures.

e. SECTION V, TROUBLESHOOTING, provides a listing of the protection devices in the transmitter as well as low power and high power troubleshooting procedures.

f. SECTION VI, PRINCIPLES OF OPERATION, provides detailed theory of operation of the various sections of the transmitter.

g. SECTION VII, PARTS LIST, provides parts list for the transmitter.

h. SECTION VIII, DIAGRAMS, provides diagrams to aid in the maintenance of the transmitter.

i. APPENDIX A, INSTALLATION, provides detailed installation procedures and initial turn on instructions.

j. APPENDIX B, TEST EQUIPMENT, provides a list of the test equipment provided and recommended to perform maintenance on the transmitter.

WARNING: Disconnect primary power prior to servicing.

SECTION II

OPERATION

2-1. INTRODUCTION

2-2. Refer to the Operator's Manual supplied with transmitter for information on front panel controls and indicators, along with information necessary to setup and operate the transmitter on a daily basis. Information on controls and indicators on a board by board basis will be supplied in this section.

WARNING

IF ANY OF THE FUSES IN THE SX-1 TRANSMITTER REQUIRE REPLACING, ENSURE THAT ONLY AN EXACT REPLACEMENT FUSE IS USED. A DIFFERENT MANUFACTURER'S FUSE OF THE SAME SIZE AND/OR RATING DOES NOT FULFILL THE REQUIREMENT FOR EXACT REPLACEMENT.

2-3. The following is a list of figures and/or tables supplied in this section of the technical manual.

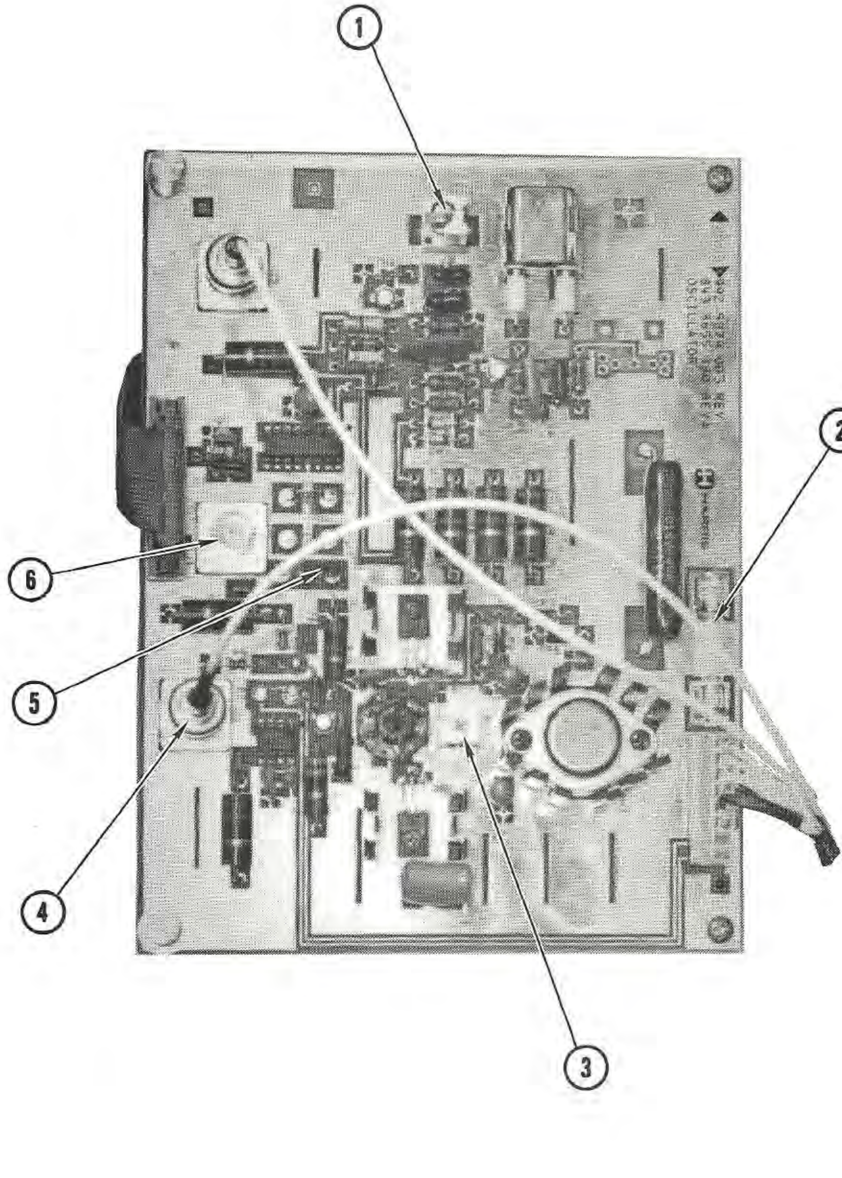

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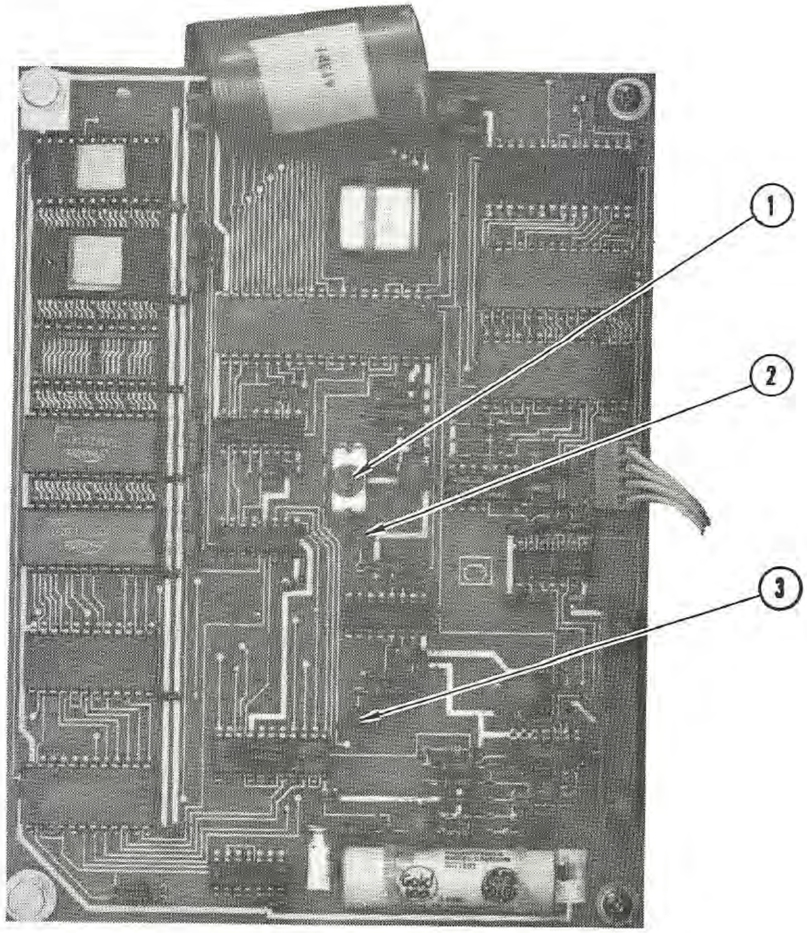
Figure 2-1. Oscillator Board A16, Controls and Indicators

WARNING: Disconnect primary power prior to servicing.

Table 2-1. Oscillator Board A16, Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	Frequency Adjustment A16C1	Adjusts the carrier frequency approximately $\pm$20 Hz.
2	+30V FUSE A16F1	Protects +30 volt supply from faults within the oscillator.
3	Output Level Adjustment A16R27	Adjusts the oscillator output drive level.
4	Frequency Monitor A16J4	Output for optional Frequency Monitor/ Counter (e.g. HARRIS AF-80 or equivalent).
5	Frequency Source Selector, A16P5	Used to select onboard crystal oscillator as frequency source (jumper 1-3) or external source (jumper 1-2).
6	External Drive A16J1	Input for external frequency source (e.g. AM Stereo Exciter, Combiner Common Drive). Nominal input level 5 volts p-p.

WARNING: Disconnect primary power prior to servicing.



2126-2

Figure 2-2. System Controller Board A13, Controls and Indicators

Table 2-2. System Controller Board A13, Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	Reset Control, A13S1	Depressing S1 causes Controller to perform power fail restart. This pushbutton should be depressed if RED LED comes on.
2	Controller Status Indicator, GO, A13DS1	Glows GREEN to indicate Controller functioning normally.
3	Controller Status Indicator, NO GO A13DS2	Glows RED to indicate Controller malfunction.

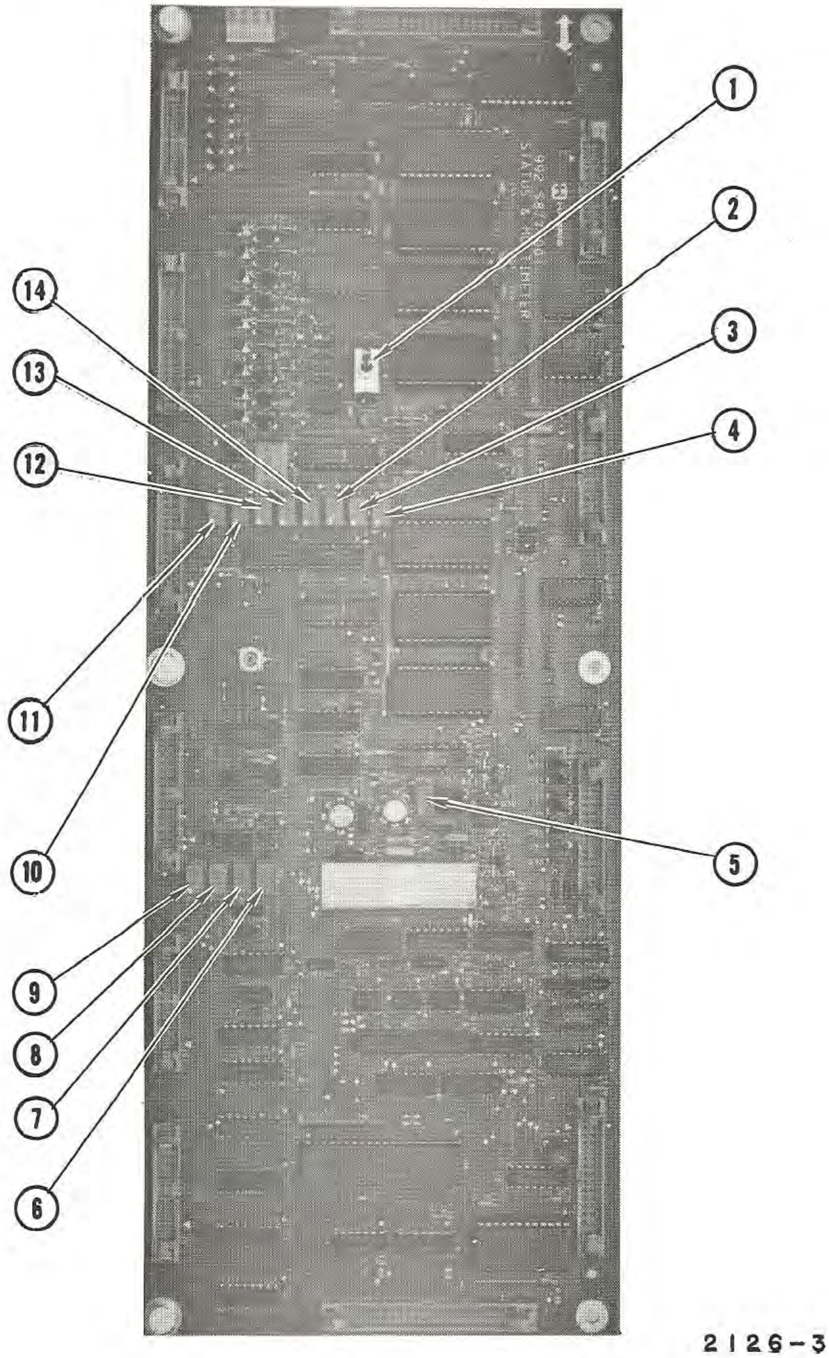


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Figure 2-3. Status and Multimeter Board A12, Controls and Indicators

WARNING: Disconnect primary power prior to servicing.

Table 2-3. Status and Multimeter Board A12, Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	Local Switch Control	When S1 is in the UP position, the remote control inputs are disabled. When S1 is in the DOWN position, the remote control inputs are enabled.
2	RF Drive Level Overload Adjustment R56	Adjusting R56 clockwise decreases sensitivity of RF Drive Level Overload. Adjusting R56 counterclockwise increases sensitivity of RF Drive Level Overload.
3	Final Power Amplifier Peak Current Overload Adjustment R57	Adjusting R57 clockwise decreases sensitivity of Final Power Amplifier Peak Current Overload. Adjusting R57 counterclockwise increases sensitivity of Final Power Amplifier Peak Current Overload.
4	RF Drive Level Minimum Amplitude Overload Adjustment R58	Adjusting R58 clockwise increases sensitivity of RF Drive Level Minimum Amplitude Overload. Adjusting R58 counterclockwise decreases sensitivity of RF Drive Level Minimum Amplitude Overload. NOTE The high voltage will not come on if RF Drive level is not within preset limits - both maximum and minimum.
5	A/D Converter Calibrate Adjustment R59	Adjusting R59 clockwise will decrease the reading seen on #/* 52 display on the Digital Display. R59 should be adjusted for 10.00 on #/* 52 display.
6	Forward Power Calibration Potentiometer R62	Calibrates forward power on power meter.
7	Reflected Power Calibration Potentiometer R61	Calibrates reflected power on power meter.

WARNING: Disconnect primary power prior to servicing.

Table 2-3. Status and Multimeter Board A12, Controls and Indicators (Continued)

REF.	CONTROL/INDICATOR	FUNCTION
8	PA Current Calibration Potentiometer R60	Calibrates PA CURRENT meter.
9	PA Voltage Calibration Potentiometer R63	Calibrates PA VOLTAGE meter.
10	Adjustment R52	No function at this time. Spare.
11	Antenna VSWR Adjustment R51	Adjusting R51 clockwise decreases sensitivity of VSWR Overload. Adjusting R51 counterclockwise increases sensitivity of VSWR Overload.
12	PA Module VSWR Overload Adjustment R53	Adjusting R53 clockwise decreases sensitivity of PA Module Overload. Adjusting R53 counterclockwise increases sensitivity of PA Module Overload.
13	Supply Current Overload Adjustment R54	Adjusting R54 clockwise decreases sensitivity of 260 VDC Power Supply Current Overload. Adjusting R54 counterclockwise increases sensitivity of 260 VDC Power Supply Current Overload.
14	Supply Voltage Overload Adjustment R55	Adjusting R55 clockwise decreases sensitivity of 260 VDC Power Supply Voltage Overload. Adjusting R55 counterclockwise increases sensitivity of 260 VDC Power Supply Voltage Overload.

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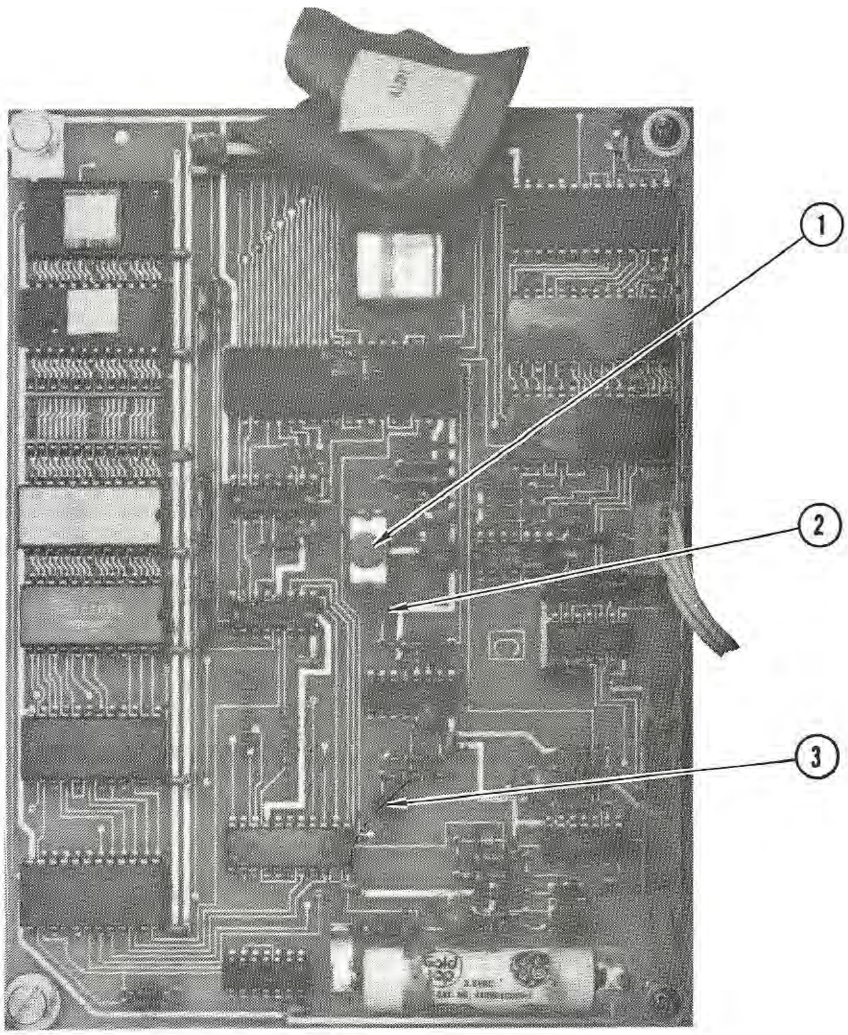

Figure 2-4. System Controller Board A14, Controls and Indicators

WARNING: Disconnect primary power prior to servicing.

Table 2-4. System Controller Board A14, Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	Reset Control, A14S1	Depressing S1 causes Controller to perform power fail restart. This pushbutton should be pushed if RED LED comes on.
2	Controller Status Indicator, GO, A14DS1	Glows GREEN to indicate Controller functioning normally.
3	Controller Status Indicator, NO GO A14DS2	Glows RED to indicate Controller malfunction.

WARNING: Disconnect primary power prior to servicing.

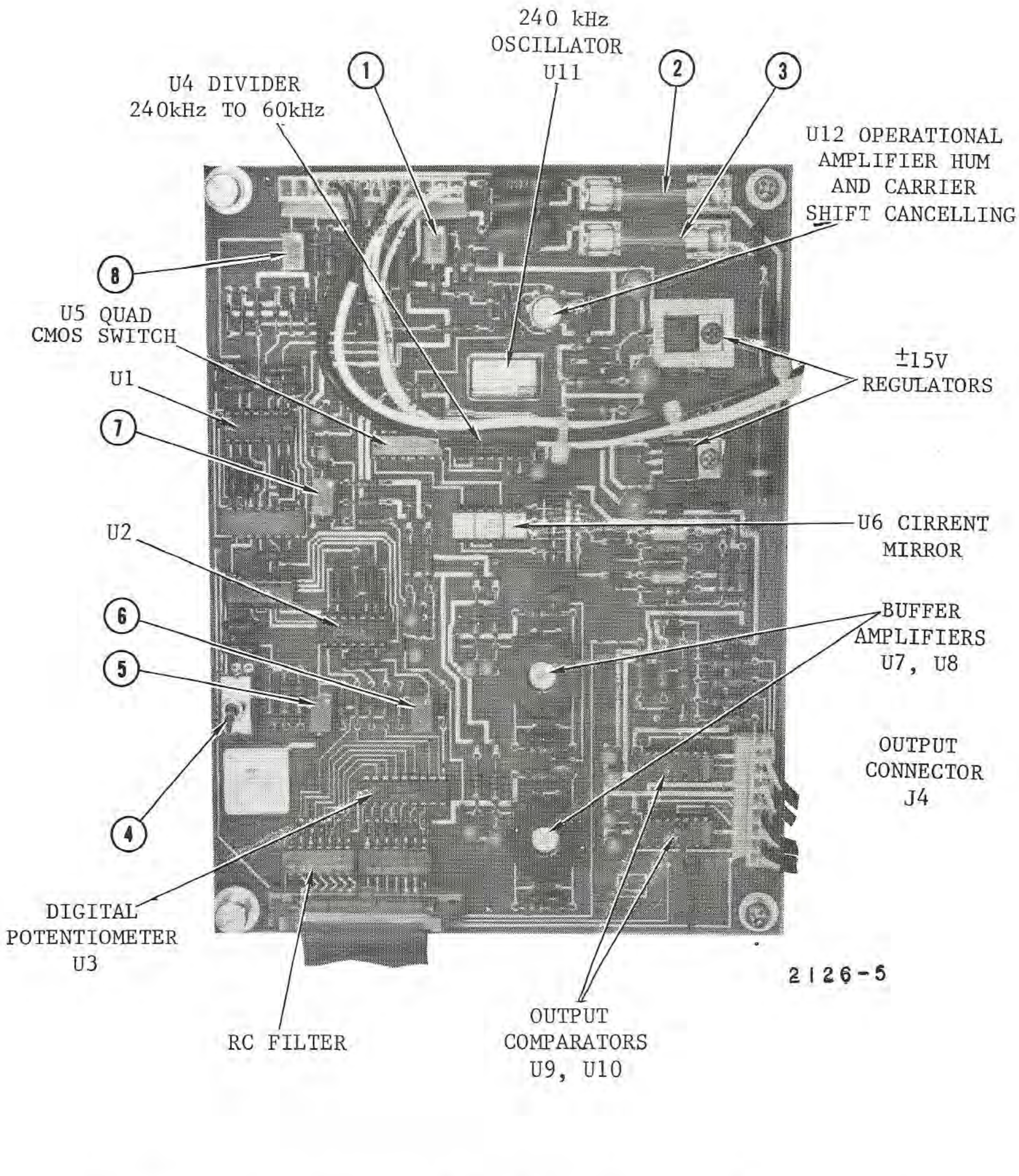

Figure 2-5. PDM Generator Board A15, Controls and Indicators

WARNING: Disconnect primary power prior to servicing.

Table 2-5. PDM Generator Board A15, Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	Hum Null Adjustment A15R30	Adjusts Power Supply hum. Adjust for best signal to noise ratio when running Proof of Performance.
2	+30V Fuse, A15F1	.5 Amp fuse (3AG) used to protect +30 volt supply from over current condition.
3	-30V Fuse, A15F2	.5 Amp fuse (3AG) used to protect -30 volt supply from over current condition.
4	Flat/Bessel Select Control, A15S1	Selects type of frequency response transmitter will have. Best loudness will be obtained in BESSEL position, while flatter frequency response will be obtained in FLAT position.
5	Maximum Output Power Adjustment, A15R28	With multimeter position 44 reading .999, adjust for maximum desired output power from transmitter.
6	Zero Output Power Adjustment, A15R98	With multimeter position 44 reading .000, adjust R98 for zero output power from transmitter.
7	180 Degree Phase Balance Adjustment A15R14	Adjusts two phases of the Polyphase System to balance the phase voltages at each of the RF Amplifiers. Adjust R14 for closest match of voltages on multimeter positions 06, 07, 08, and 09.
8	Audio Input Level Adjustment, A15R21	Adjusts audio input level from -10 to +10 dBm.

WARNING: Disconnect primary power prior to servicing.

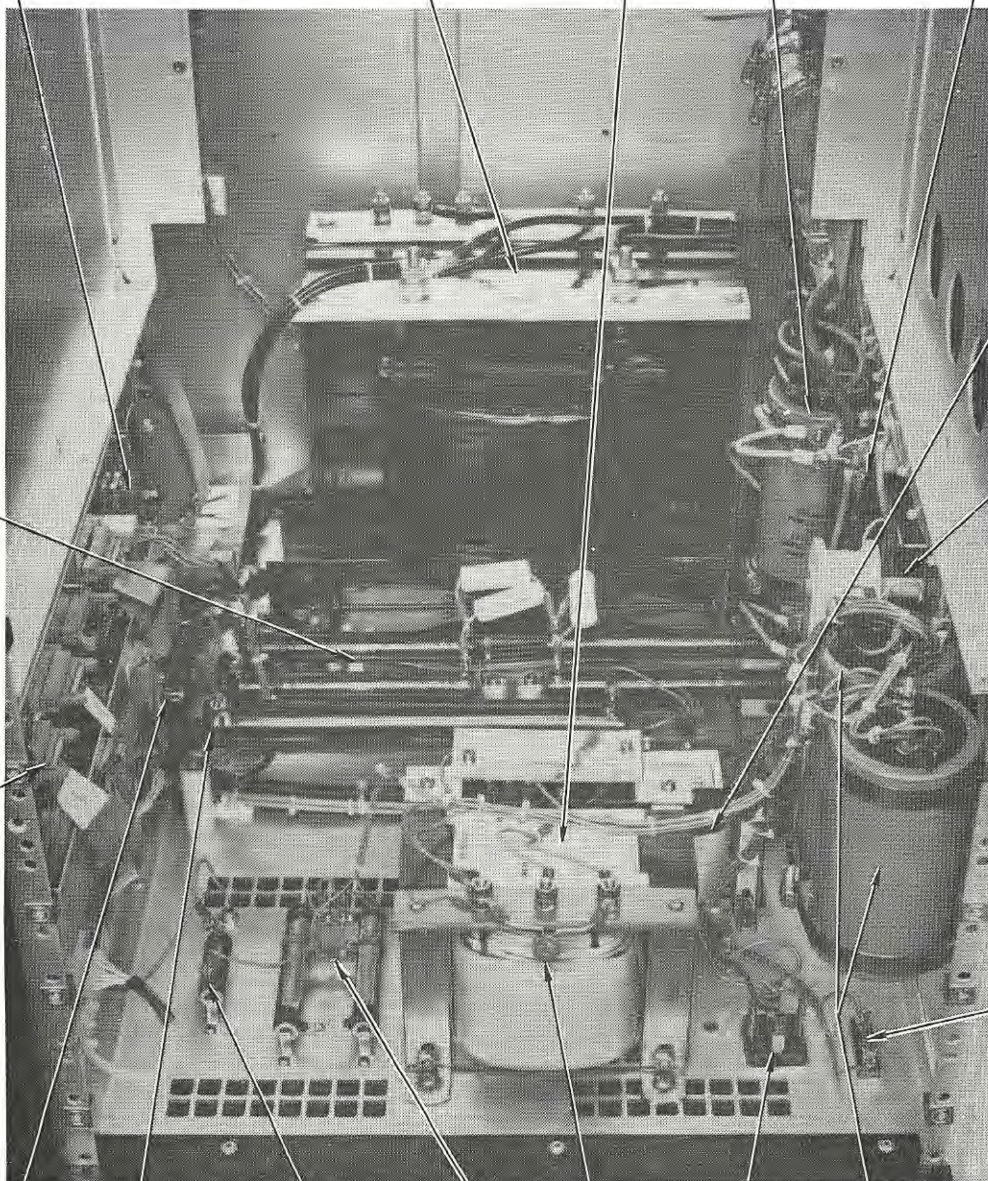

Figure 2-6. Base of SX-1, Controls and Indicators

Table 2-6. Base of SX-1, Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1.	Power Transformer A19T1	Main Power Supply transformer for 260 volt dc supply.
2	30V Power Transformer A20T1	Secondary Power Supply transformer for +30VDC, -30VDC, and 24 VAC.
3	Interlock Fuse A20F1	2 Amp fuse (Slo-Blo) used to protect external interlock circuits from accidental grounding. If fuse is blown transmitter will not return to air.
4	IPA Supply Adjustment A20R3 and A20R4	Adjusts the supply voltage for the IPA. FACTORY PRESET - DO NOT ADJUST.

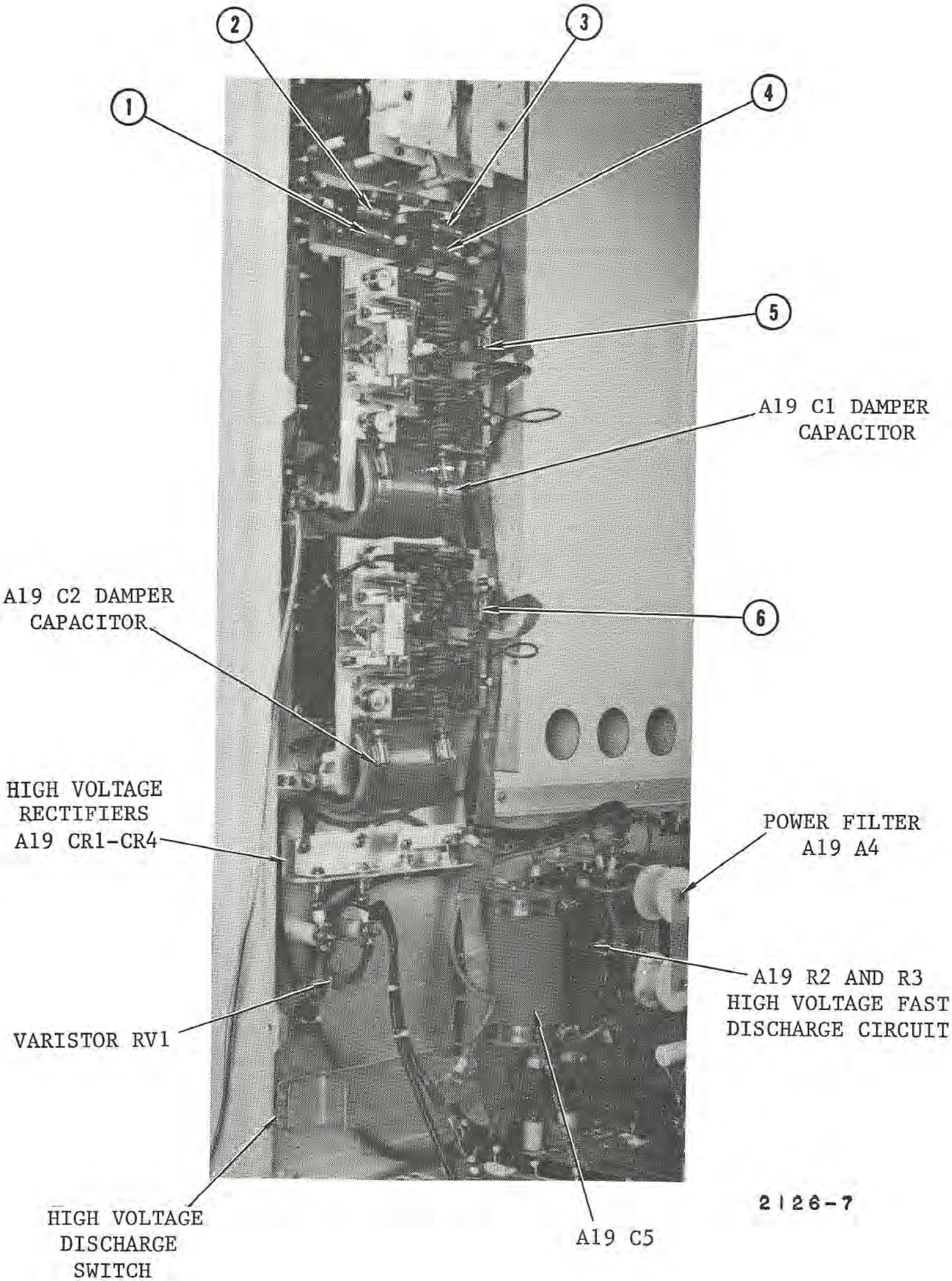

Figure 2-7. PDM Amplifier Boards A6 and A7, Controls and Indicators

Table 2-7. PDM Amplifier Boards A6 and A7, Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	PDM Amplifier Fuse A10F1-A	Protects the PDM Amplifier from over current surges.
2	PDM Amplifier Fuse A10F1-B	Protects the PDM Amplifier from over current surges.
3	PDM Amplifier Fuse A10F2-A	Protects the PDM Amplifier from over current surges.
4	PDM Amplifier Fuse A10F2-B	Protects the PDM Amplifier from over current surges.
5	A6F1	Protects +30 volt supply from over current surges on PDM Amp Board A6.
6	A7F1	Protects +30 volt supply from over current surges on PDM Amp Board A7.

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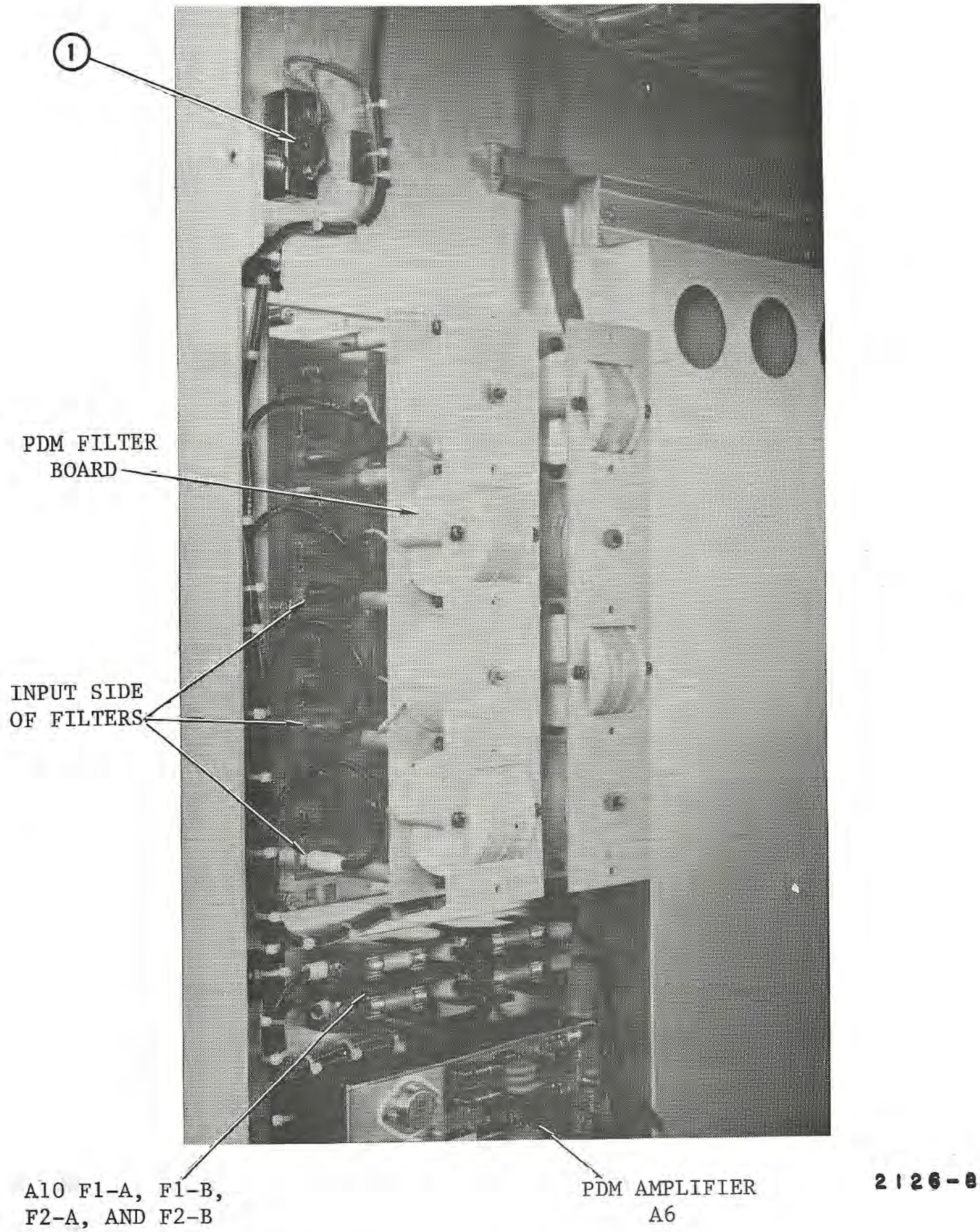

Figure 2-8. PDM Filter Board A10, Controls and Indicators

WARNING: Disconnect primary power prior to servicing.

Table 2-8. PDM Filter Board A10, Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	Interlock Switch A19S3	Rear Door control interlock. When A19S3 is disengaged, ground is removed from return leads of main contactors; thus preventing unwanted energizing of 260 volt power supply.

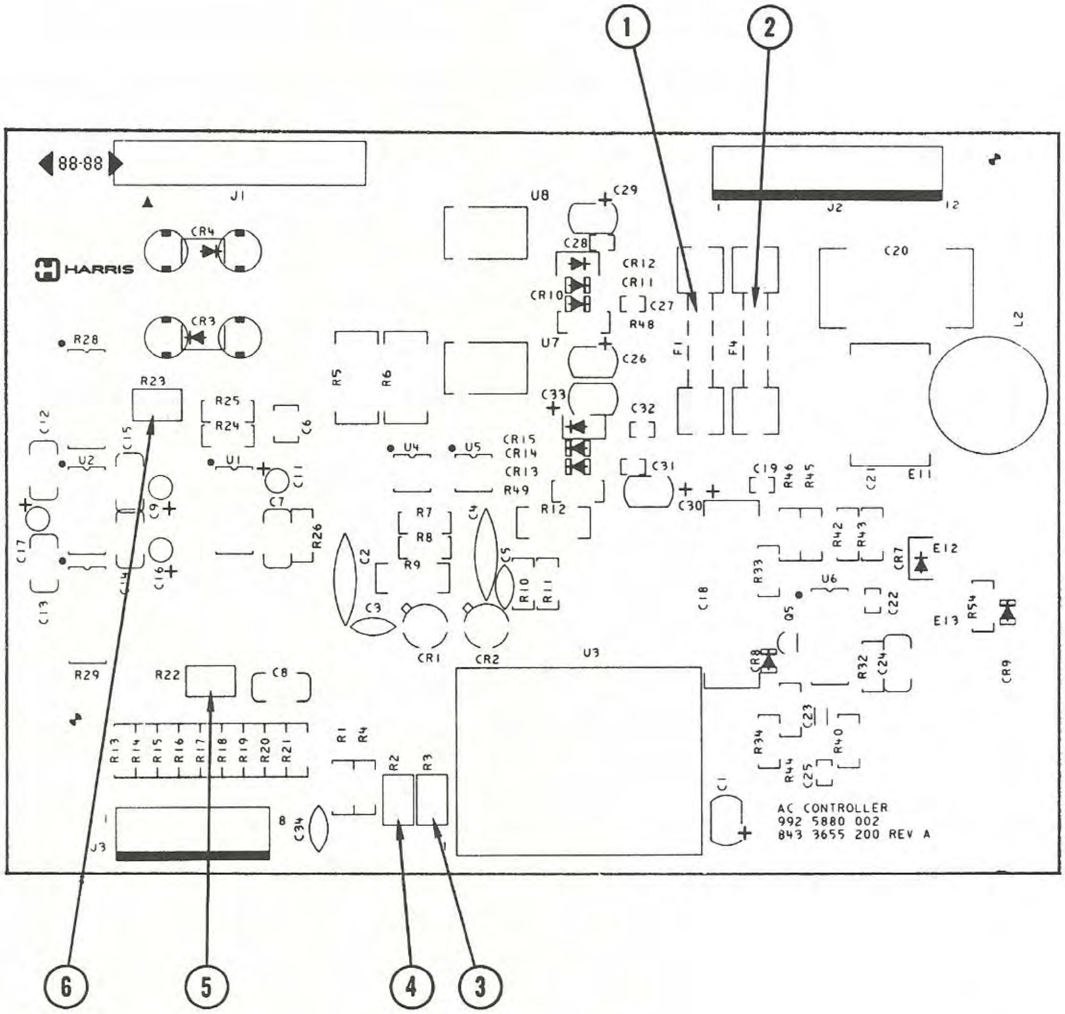

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Figure 2-9. AC Controller Board A25, Controls and Indicators

Table 2-9. AC Controller Board A25, Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	24 VAC Fuse A25F1	2 Amp (Slo-Blo) fuse used to protect the Solid State relays from supply over current conditions.
2	+30V Fuse, A25F4	3 Amp (Fast) fuse used to protect the +5 volt power supply from accidental over current conditions.
3	PA Current Zero Adjustment A25R3	Used to adjust electrical zero of PA Current meter.
4	PA Current Calibration Adjustment A25R2	Used to adjust the calibration of the PA Current digital reading position 05.
5	PA Volt Zero Adjustment, A25R22	Used to adjust the electrical zero of PA voltmeter.
6	Supply Current Calibration Adjustment, A25R23	Used to adjust the calibration of 260 volt power supply current on multimeter position 02.

WARNING: Disconnect primary power prior to servicing.

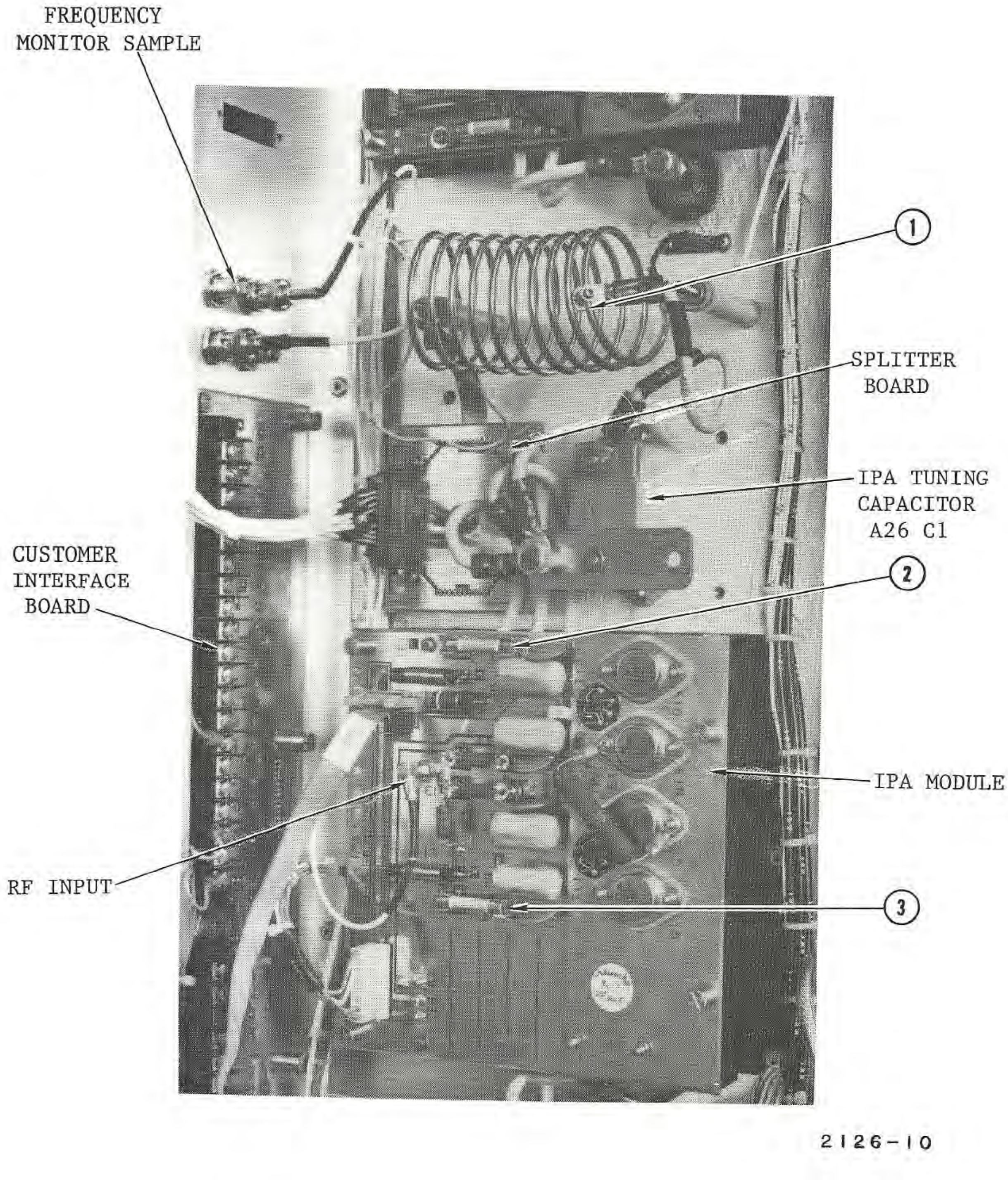

Figure 2-10. IPA Board A5 and IPA Power Splitter Board A26A1, Controls and Indicators

Table 2-10. IPA Board A5 and IPA Power Splitter Board A26A1, Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	IPA Tuning A26L1	Used to adjust match between IPA and input of PA Module.
2	+30V Fuse, A5F12	Protects +30V supply from over current conditions on the IPA.
3	+30V Fuse, A5F11	Protects +30V supply from over current conditions on the IPA.

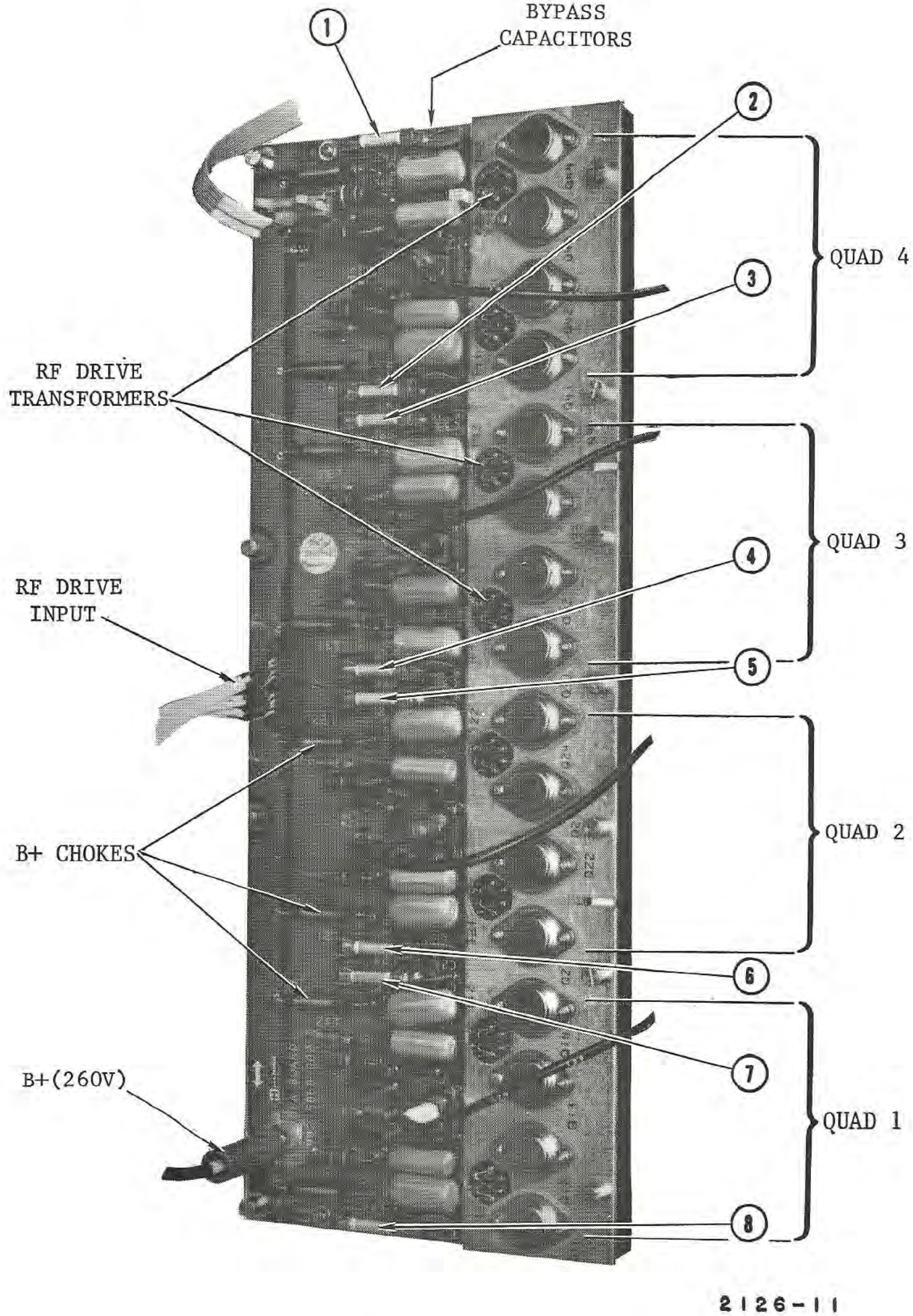

Figure 2-11. PA Board A1, Controls and Indicators

Table 2-11. PA Board A1, Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1 thru 8	PA Current Limiting Fuses	These fuses protect other circuitry in the transmitter should a PA module fail. As a result of the fusing scheme used in the transmitter, sections of a power amplifier may fail and still allow the remaining sections of the power amplifier to operate properly.

WARNING

THESE FUSES ARE SPECIAL RECTIFIER TYPE FUSES ESPECIALLY DESIGNED TO PROTECT RECTIFIERS AND TRANSISTORS. USE OF REGULAR GLASS FUSES DEFEATS THE PROTECTION AND CAN RESULT IN DESTRUCTION OF THE GLASS CASE - POSSIBLY RESULTING IN PERSONNEL INJURY FROM FLYING GLASS OR FROM GLASS PARTICLES THROWN INTO THE TRANSMITTER INTERIOR.

CAUTION

THE RECTIFIER TYPE FUSE IS FASTER ACTING THAN THE REGULAR FAST ACTING FUSES AND SO IS USED TO PREVENT CASCADING FAILURES. A PA FAILURE MAY OCCUR WITHOUT UNDUE STRESS ON THE MODULATOR. USE OF THE GLASS TYPE FUSES DEFEATS THIS PROTECTION AND WILL VOID THE WARRANTY.

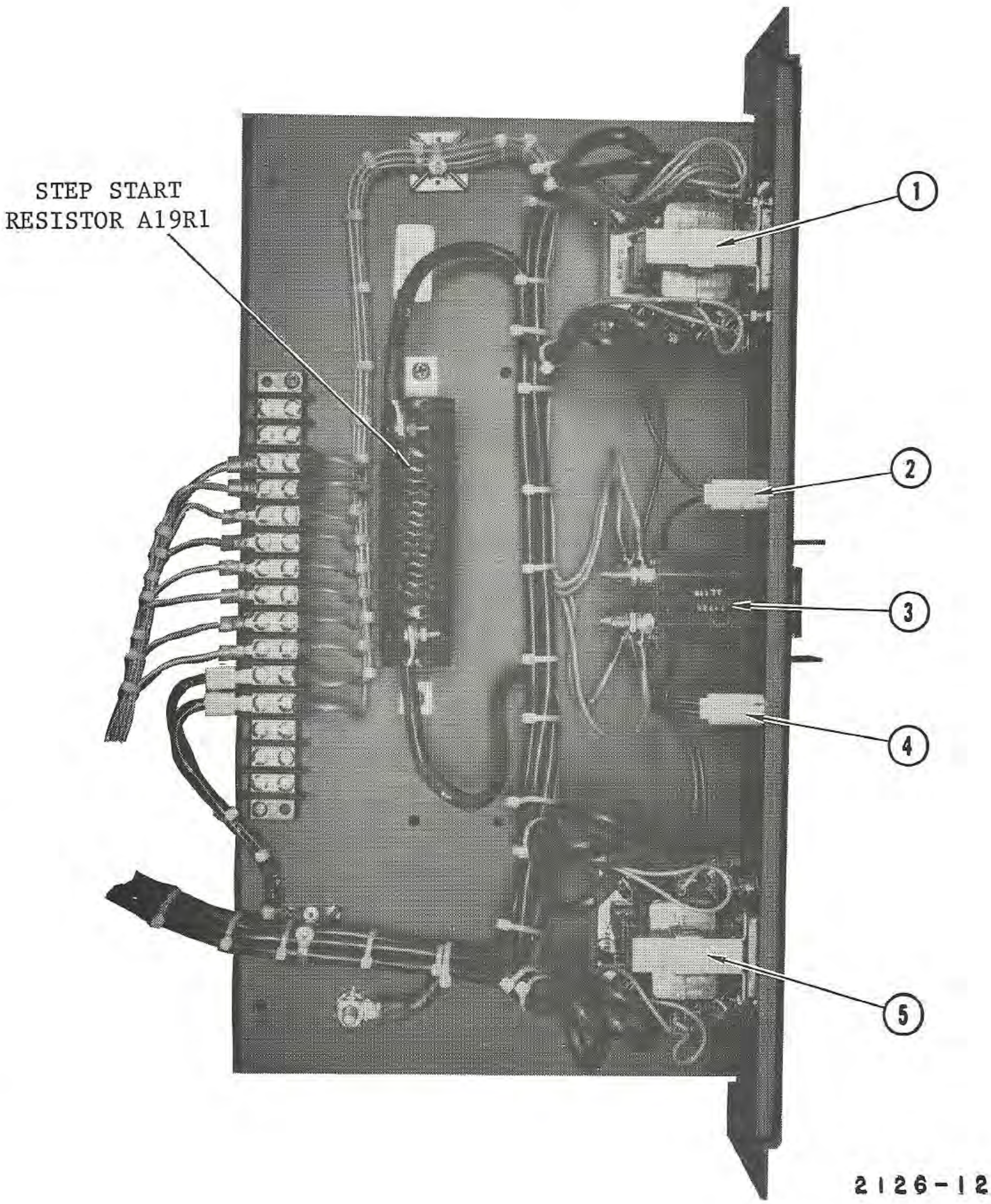

Figure 2-12. AC Power Panel, Controls and Indicators
Top View With Power Panel Removed From Transmitter

Table 2-12. AC Power Panel, Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	Relay K2	Relay K2 is used to apply ac to the high voltage transformer through a current limiting resistor during step start sequence.
2	Lamp DS1	DS1 will illuminate when power is applied to the low voltage circuitry.
3	Circuit Breaker, CB1	10 Amp circuit breaker to protect the low voltage power supply from an over current condition.
4	Lamp DS2	DS2 will illuminate when power is applied from the Main Disconnect Switch (i.e. cabinet is receiving ac power).
5	Relay K1	Relay K1 is used to apply ac mains directly to the high voltage transformer.

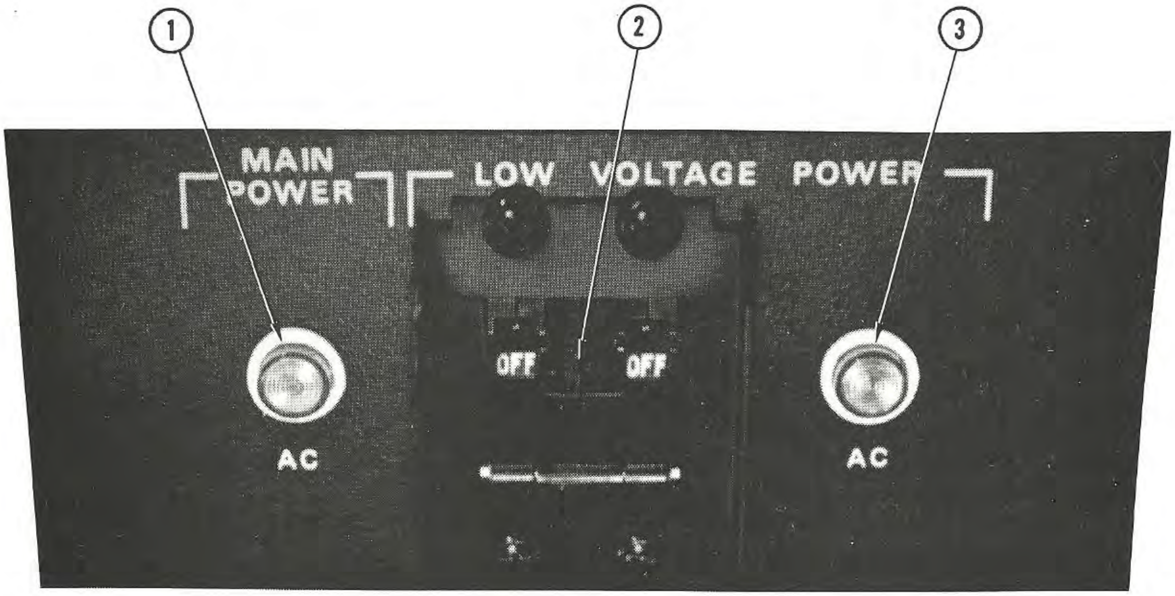

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Figure 2-13. AC Power Panel, Controls and Indicators
Front View

Table 2-13. AC Power Panel, Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	POWER AC, indicator	When illuminated, indicates main ac power is applied to transmitter.
	LOW VOLTAGE POWER	
2	Circuit Breaker	When set to ON position, applies ac power to low voltage transmitter power supplies. Provides low voltage power lines with over current protection.
3	AC, indicator	When illuminated, indicates ac power supplied to low voltage circuits in transmitter.

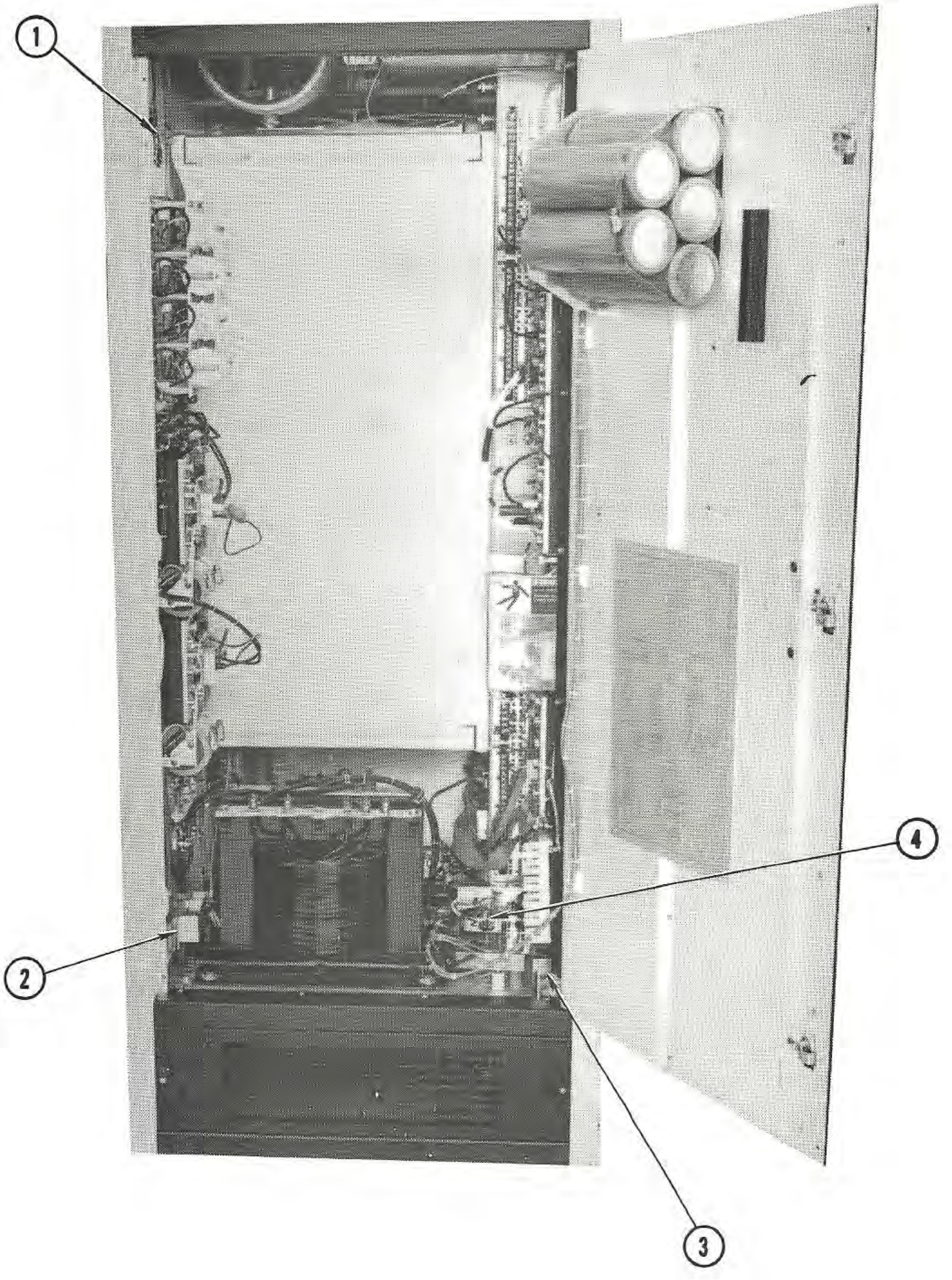


Figure 2-14. Rear View of Transmitter Showing Interlock Switches

WARNING: Disconnect primary power prior to servicing.

Table 2-14. Rear View of Transmitter Showing Interlock Switches

REF.	CONTROL/INDICATOR	FUNCTION
1	Door Interlock Switch A19S3	When rear door is opened, this switch will interrupt the control voltage to the primary contactors, allowing them to deenergize.
2	Door Safety Switch A19S6	When rear door is partially opened, this switch will discharge the energy storage capacitors through large resistors for current limiting.
3	Door Safety Switch A19S1	When rear door is fully opened, this switch will short the power supply directly to ground.
4	+260V Fuse, A19F2	Protects 260 V supply from faults on the PA module.

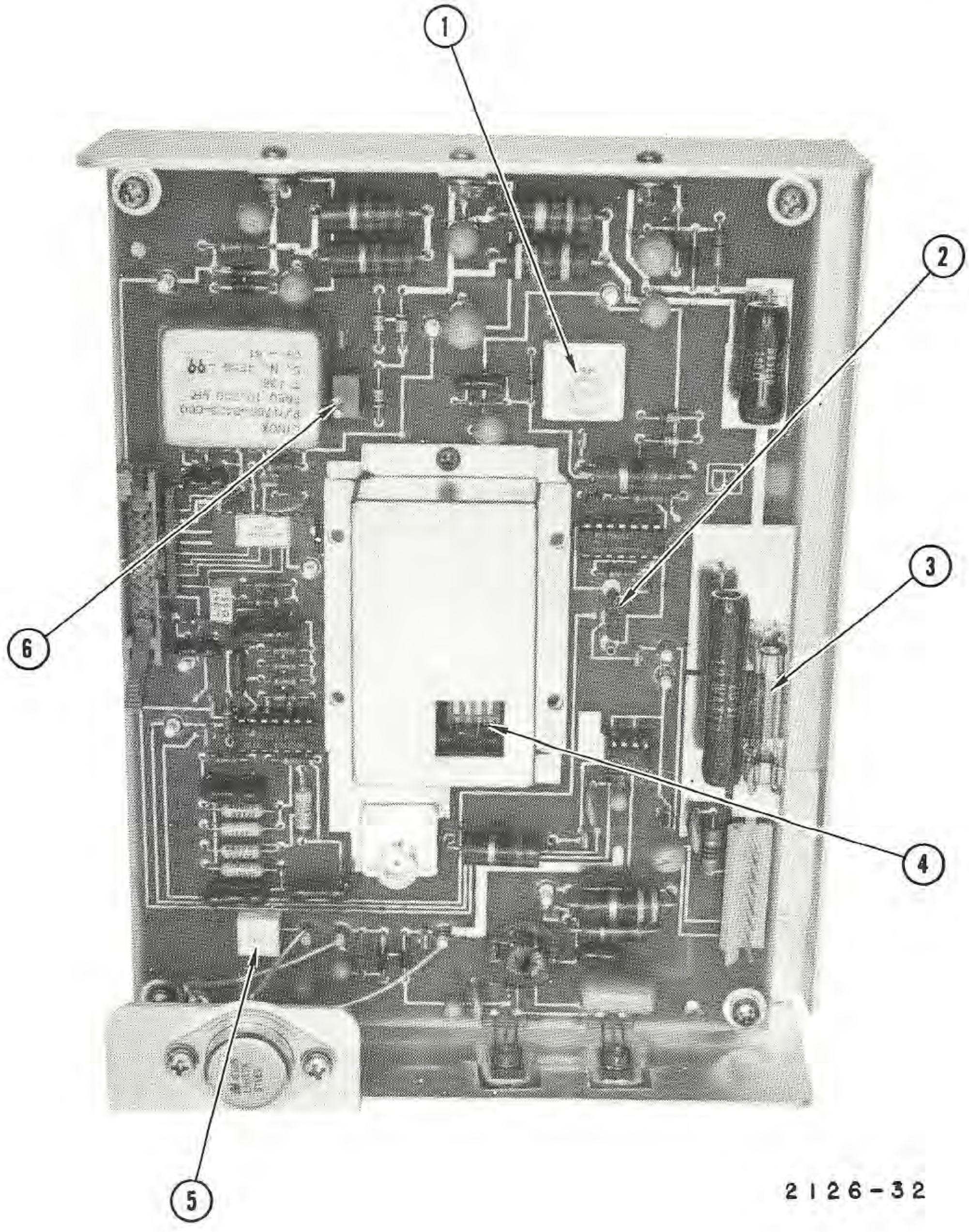


Figure 2-15. Optional Frequency Synthesizer, Controls and Indicators

WARNING: Disconnect primary power prior to servicing.

Table 2-15. Optional Frequency Synthesizer, Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	External Frequency Source Jack J1	An external frequency source can drive the oscillator by injecting approximately a 10 volt peak-to-peak signal into J1. P2 must be connected between 1 and 2.
2	RF Source Selector P2	To select the RF source from the Frequency Synthesizer connect P2 between 1 and 3. To select the RF source from the external input J1 connect P2 between 1 and 2.
3	Fuse, F1	This fuse protects the 30 volt wiring for the entire board (2A fuse).
4	Frequency Band Selection Switches Dip Package S1	To select which choke is used in the VCO circuit close the following switch (only one): 525-800 kHz S3 801-1175 kHz S2 1176-1605 kHz S1
5	Output Level Adjustment R41	This potentiometer adjusts the DC voltage supplied to the output transistors. Turning the potentiometer clockwise will increase the output level.
6	Frequency Reference Adjustment R14	Adjust this potentiometer to obtain exactly 10.00 MHz out of the TCXO at turret E16.
7	Frequency Sample Jack J4	A 15 volt peak-to-peak square wave with a 50 ohm source is available at J4 for frequency calibration.

Table 2-16. Typical Readings

Panel Meters

	1100 W Carrier	MED PWR 100% Mod	LO PWR 100% Mod
PA Volts	99	67	48
PA Amps	12	8.4	6
RF Power (watts)	1100	540	270
Reflected (watts)	0	0	0

Internal Status Readouts

Code	Parameter	Reading @ 1100 Watts Carrier
01	PS Volts	249
02	PS Current	5.9
03	Fwd. Power	120
04	Refl. Power	0
05	PA Current	12.0
06-09	Phase Voltage	105
10	IPA Drive Level	100
11	PA (A1) Temp	52
15	IPA (A5) Temp	32
16	PDM (A6) Temp	37
17	PDM (A7) Temp	37
20	Phase Det.	0.14
21	PA (A1) Fuses	119
25	IPA (A5) Fuses	119
26	PDM (A6) Output	15
27	PDM (A7) Output	15
41	Low Pwr Set	.448 @ 250 Watts
42	Med Pwr Set	.639 @ 500 Watts
43	High Pwr Set	.938 @ 1100 Watts
44	Current Pwr	.938
50	+5 Volts	5.25
51	+15 Volts	15.44
52	Ref. Volts	10.00
88	Lamp Test	8.8.8.8.8.

SECTION III

EMERGENCY OPERATING PROCEDURES

3-1. INTRODUCTION

3-2. This section of the technical manual contains information on emergency operating procedures on the SX-1 AM TRANSMITTER.

3-3. EMERGENCY OPERATING PROCEDURES FOR SX TRANSMITTERS

3-4. The SX-1 transmitter is equipped with several safety devices both for the protection of operating personnel and the reliability of the transmitter itself. In most cases the transmitter is capable of determining if continued operation is acceptable following a failure and will continue to remain on the air in all but the most severe cases. This section will discuss some of the do's and don'ts of operation that should be followed should any of the safety/protection devices or circuits be activated.

3-5. VSWR PROTECTION

3-6. The VSWR protection built into the SX-1 transmitter is both for the protection of the high power circuitry and the protection of external equipment which might be installed between the transmitter and the antenna system. In general the VSWR overloads and limits set in the transmitter's control circuitry should not be bypassed or limits increased past the recommended levels set at the factory. UNDER NO CIRCUMSTANCES SHOULD THE POWER OF THE TRANSMITTER BE INCREASED WITH THE USE OF THE LOADING OR TUNING CONTROLS. The directional coupler within the transmitter will detect this effort to change the load impedance and will cause the transmitter to remove itself from the air. If a change in antenna impedance causes the reflected power to increase a thorough investigation should be made of all equipment connected between the transmitter and the antenna. If there are shorted/-open capacitors or inductors in the antenna matching equipment the transmitter will most likely detect this as a high VSWR condition and shut down. This feature is as much for the protection of the external equipment as it is for the protection of the transmitter and should not be defeated. At all times the TUNING and LOADING controls should be adjusted so as to minimize reflected power as indicated on the transmitter when operated into a properly tuned antenna.

3-7. POWER AMPLIFIER FAILURE

3-8. When a failure of the main Power Amplifier has occurred the transmitter will show a reduction in output power and a similar decrease in the PA CURRENT and in most cases will not show a change in PA VOLTAGE. The output power of the transmitter should not be increased by adjustment of the TUNING or LOADING controls under this condition. It is permissible to allow the transmitter to continue operating at this reduced power until maintenance personnel are available to correct the malfunction. The transmitter control circuits will continue to monitor the operation of the failed module and

WARNING: Disconnect primary power prior to servicing.

there should be no ill effects on transmitter operation other than reduced power output. If abnormal operation such as audible distortion in the demodulated audio is noted, the transmitter should be scheduled for maintenance as soon as possible.

3-9. PDM AMPLIFIER MODULE FAILURE

3-10. When a failure of a PDM amplifier module occurs there are fuses in series with each amplifier section to remove that section from operation. This will result in a reduction in output power much like a Power Amplifier failure. The same comments apply here as for a Power Amplifier failure. In certain rare instances when a PDM Amplifier fails there will be an increase in the carrier power. This condition is most apparent when the transmitter is being operated at reduced power or the incorrect fuses have been installed in the PDM circuitry. In these cases it may be impossible to lower the output power to an acceptable level with the LOWER pushbutton on the front of the transmitter. If this condition occurs the transmitter should be removed from service and maintenance personnel alerted to the problem as quickly as possible.

3-11. POWER SUPPLY FAILURE

3-12. If the main power supply should fail, corrective action will have to be performed in most cases before operation can be restored. However certain components can fail and with proper precautions the transmitter can be safely operated. One of these items is the step start resistor(s). Should a step start resistor fail in the open mode the inrush current into the transmitter will increase dramatically. This can cause premature tripping of circuit breakers in the primary service to the transmitter but will not damage the transmitter itself.

3-13. If a rectifier should fail the transmitter can not be operated by simply removing the failed diode. This can cause failure of the remaining diodes in the power supply and will increase the power supply ripple causing a severe degradation in the signal to noise ratio of the transmitter. Another problem with this procedure will be increased heating and possible damage of the power transformer due to high peak currents. This mode of operation is not recommended and is discouraged by the manufacturer.

3-14. CRYSTAL FAILURE

3-15. If a crystal should fail the transmitter will lose its ability to maintain the proper frequency control as required by the FCC and in most cases the oscillator will shut down causing a fault in drive level to be detected by the control circuits. An acceptable frequency reference can be a stable rf signal generator. The SX-1 transmitter is equipped with an external input on the oscillator board for use by stereo exciters and external frequency sources. This is a 50 ohm input and requires 5 volts peak to peak for correct operation. If a signal generator is used to set the carrier frequency care must be taken to insure proper frequency of operation as required by the FCC.

3-16. SYSTEM CONTROLLER BOARD FAILURE

3-17. If one of the two System Controller boards fails, the transmitter may or may not display any symptoms. If the transmitter starts to show control or Digital Display problems, which may include changing power for no reason, flashing of status lights, or garbage on the Digital Display. At this point open the pullout drawer and look to see if both System Controller boards have their green LED's illuminated.

3-18. If one of the two System Controllers has a red LED illuminated, depress that board's blue reset pushbutton. If that board's green LED does not illuminate, then assume that this board has failed.

3-19. Remove all power from the transmitter and disconnect the long blue ribbon connector from the failed board.

3-20. Reapply power and the transmitter should return to normal operation on the single System Controller board.

3-21. Have the defective board replaced or repaired as soon as possible. It is possible for a System Controller board to be defective yet have a green LED on. In this instance operate the transmitter with only one System Controller board at a time. Using this method it may be possible to determine which board is causing the problem. Again the transmitter will operate normally with only one good System Controller board connected.

WARNING: Disconnect primary power prior to servicing.

SECTION IV

MAINTENANCE

4-1. INTRODUCTION

4-2. This section provides preventive maintenance information and corrective maintenance procedures. The information contained in this section is to provide guidance for establishing a comprehensive maintenance program to promote operational readiness and eliminate downtime. Particular emphasis is placed on preventive maintenance and record-keeping functions.

4-3. STATION RECORDS

4-4. The importance of keeping station performance records cannot be overemphasized. Separate logbooks should be maintained by operation and maintenance activities. These records can provide data for predicting potential problem areas and analyzing equipment malfunctions.

4-5. MAINTENANCE LOGBOOK

4-6. The maintenance logbook should contain a complete description of all maintenance activities required to keep the equipment in operational status. A listing of maintenance information to be recorded and analyzed to provide a data base for a failure reporting system is as follows:

DISCREPANCY	Describe the nature of the malfunction including all observable symptoms and performance characteristics.
CORRECTIVE ACTION	Describe the repair procedure used to correct the malfunction.
DEFECTIVE PART(S)	List all parts and components replaced or repaired and include the following details: a. TIME IN USE b. PART NUMBER c. SCHEMATIC NUMBER d. ASSEMBLY NUMBER e. REFERENCE DESIGNATOR
SYSTEM ELAPSED TIME	Total time on equipment
NAME OF REPAIRMAN	Person who actually made the repair
STATION ENGINEER	Indicates Chief Engineer noted and approved the repair of the equipment

4-7. PREVENTIVE MAINTENANCE

4-8. Preventive maintenance is a systematic series of operations performed periodically on equipment. Because these procedures cannot be applied indiscriminately, specific instructions are necessary. Preventive maintenance consists of six operations: inspecting, feeling, tightening, cleaning, adjusting, and painting.

a. INSPECT. Inspection is the most important preventive maintenance operation because it determines the necessity for the others. Become thoroughly acquainted with normal operating conditions in order to recognize and identify abnormal conditions readily. Inspect for the following:

   1. Overheating, which is indicated by discoloration, bulging of parts, and peculiar odors.

   2. Oxidation.

   3. Dirt, corrosion, rust, mildew, and fungus growth.

b. FEEL. Use this operation to check parts for overheating. By this means the lack of proper ventilation or the existence of some defect can be detected and corrected before serious trouble occurs. Become familiar with operating temperatures in order to recognize deviations from the normal range.

c. TIGHTEN. Tighten loose screws, bolts, and nuts. Do not tighten indiscriminately as fittings that are tightened beyond the pressure for which they are designed may be damaged or broken.

d. CLEAN. Clean parts only when inspection shows that cleaning is required and only use approved cleaning solvent.

e. ADJUST. Make adjustments only when inspection shows that they are necessary to maintain normal operation.

f. PAINT. Paint surfaces with the original type of paint (using prime coat if necessary) whenever inspection shows rust, or worn or broken paint film.

4-9. MAINTENANCE OF COMPONENTS

4-10. The following paragraphs provide information necessary for the maintenance of components.

4-11. TRANSISTORS. Preventive maintenance of transistors is accomplished by performing the following steps:

a. Inspect the transistors and surrounding area for dirt as accumulations of dirt or dust could form leakage paths.

b. Use compressed dry air to remove dust from the area.

c. Examine all transistors for loose connections or corrosion. Tighten the transistor mounting hardware to no more than 5 inch-pounds. Overtightening the transistor hardware will cause the silicon insulators to curl up on the ends and possibly short through. When replacing a MOSFET transistor, be sure to alternate frequently between the mounting posts to tighten the hardware down evenly. This will minimize the possibility of shorting through an insulator. Torque specification for transistor mounting hardware is 5 inch-pounds.

CAUTION

IF THE TRANSISTORS IN THE IPA REQUIRE CHANGING, ENSURE THAT ALL OF THE TRANSISTORS ARE OF THE SAME TYPE NUMBER AND ARE FROM THE SAME MANUFACTURER.

4-12. INTEGRATED CIRCUITS. Preventive maintenance of integrated circuits is accomplished by performing the following steps:

CAUTION

USE CARE TO AVOID THE BUILDUP OF STATIC ELECTRICITY WHEN WORKING AROUND INTEGRATED CIRCUITS.

a. Inspect the integrated circuits and surrounding area for dirt as accumulations of dirt or dust could form leakage paths.

b. Use compressed dry air to remove dust from the area.

4-13. CAPACITORS. Preventive maintenance of capacitors is accomplished by performing the following steps:

a. Examine all capacitor terminals for loose connections or corrosion.

b. Ensure that component mountings are tight. (Do not overtighten capacitor mounting straps as excessive pressure could cause internal shorting of the capacitors.

c. Examine the body of each capacitor for swelling, discoloration, or other evidence of breakdown.

d. Use standard practices to repair poor solder connections with a low-wattage soldering iron.

e. Clean cases and bodies of all capacitors.

f. Inspect the bleeder resistors when inspecting the electrolytic capacitors.

4-14. FIXED RESISTORS. Preventive maintenance of fixed resistors is accomplished by performing the following steps:

a. When inspecting a chassis, printed-circuit board, or discrete component assembly, examine resistors for dirt or signs of overheating. Discolored, cracked, or chipped components indicate a possible overload.

b. When replacing a resistor, ensure that the replacement value corresponds to the component designated by the schematic diagram and parts list.

c. Clean dirty resistors with a small brush.

4-15. VARIABLE RESISTORS. Preventive maintenance of variable resistors is accomplished by performing the following steps:

a. Inspect the variable resistors and tighten all loose mountings, connections, and control knob setscrews (do not disturb knob alignment). Sliding taps on adjustable resistors such as A20R3 should be snug, but not excessively tight. Overtightening can damage the resistor.

b. If necessary, clean component with a dry brush or a lint-free cloth.

c. When dirt is difficult to remove, clean component with a lint-free cloth moistened with an approved cleaning solvent.

4-16. FUSES. Preventive maintenance is accomplished by performing the following steps:

a. When a fuse blows, determine the cause before installing a replacement.

CAUTION

IF ANY OF THE FUSES IN THE SX-1 TRANSMITTER REQUIRE REPLACING, ENSURE THAT ONLY AN EXACT REPLACEMENT FUSE IS USED. A DIFFERENT MANUFACTURER'S FUSE OF THE SAME SIZE AND/OR RATING DOES NOT FULFILL THE REQUIREMENT FOR EXACT REPLACEMENT.

b. Inspect fuse caps and mounts for charring and corrosion.

c. Examine clips for dirt, and, if necessary, clean with a small brush.

d. If necessary, tighten fuse clips and connections to the clips. The tension of the fuse clips may be increased by pressing the clip sides closer together.

4-17. SWITCHES. Preventive maintenance of switches is accomplished by performing the following steps:

a. Inspect switch for defective mechanical action or looseness of mounting and connections.

b. Examine cases for chips or cracks. Do not disassemble switches.

c. Inspect accessible contact switches for dirt, corrosion, or looseness of mountings or connections.

d. Check contacts for pitting, corrosion, or wear.

e. Operate the switches to determine if they move freely and are positive in action.

f. Tighten all loose connections and mountings.

g. Be sure to include an inspection of the power supply discharge switches located at the bottom of the door opening.

4-18. INDICATORS AND INDICATOR SWITCHES. Preventive maintenance of indicator lamps and indicator switches is accomplished by performing the following steps:

a. To remove an indicator bulb (OFF/FAULT, LOW, MED, HIGH, RAISE or LOWER) pull straight out on the indicator button. The indicator lamp may then be removed from the lens (indicator button). When re-inserting the lens, depressing the switch is unavoidable. Therefore, care must be taken to avoid disrupting normal operation.

b. To replace one of the front panel switches requires removal of the Switch board behind the meter panel.

4-19. TOROIDS. Inspect the drive transformer assemblies periodically for any signs of stress. These would be T11 and T12 on the IPA and T11, T12, T21, T22, T31, T32, T41, and T42 on the Power Amplifier board A1. In particular, check the zener diodes on these transformer assemblies for signs of over dissipation. When overdissipated, these zeners will lose their normal glossy finish. If any of these zeners are found in this condition, it would be wise to check the rf drive system.

4-20. The toroids on the backside of the IPA and PA should be inspected when the modules are removed for replacing transistors. A crack or break in any core may cause damage to the transistors of the same quad. The best way of inspecting the toroidal cores is by rotating the core. This will allow a complete visual inspection.

4-21. PRINTED-CIRCUIT BOARDS. Preventive maintenance of printed-circuit boards is accomplished by performing the following steps:

a. Inspect the printed-circuit boards for cracks or breaks.

b. Inspect the wiring for open circuits or raised foil.

c. Check components for breakage or discoloration due to overheating.

d. Clean off dust and dirt with a clean, dry lint-free cloth.

e. Use standard practices to repair poor solder connections with a 40 watt soldering iron.

CAUTION

ENSURE THAT THERMAL COMPOUND IS APPLIED TO CONNECTING PLATES OF PA, IPA, AND PDM AMPLIFIER BOARDS BEFORE THEY ARE INSTALLED ON HEAT SINKS AND THAT HARDWARE SECURING BOARD TO HEAT SINK IS PROPERLY TORQUED TO 5-INCH POUNDS. THIS IS ALSO THE TORQUE REQUIRED FOR THE TRANSISTOR MOUNTING SCREWS. ALSO INSURE NO BURRS OR DIRT PARTICLES ARE ON THE MATING SURFACES.

4-22. AIR SYSTEM.

a. The air filter should be cleaned routinely. The intervals between cleaning will depend on the environment.

b. Replace filter if worn out.

WARNING: Disconnect primary power prior to servicing.

4-23. USING THE KEYPAD AND DISPLAY UNIT

4-24. BASIC CONTROL AND STATUS

4-25. There are several features designed into the SX transmitter for diagnostic purposes. In this section we will explore these features and get familiar with the operation of the Keypad in enough detail to assist with diagnosing almost any board or module failure.

NOTE

> Remember it will be better if personnel actually use the Keypad during this learning process.

4-26. STATUS/FAULT DISPLAY. When the transmitter's low voltage is first powered up both the # and * display should read 00. This is the fault/-status display and should indicate 0 if the transmitter is ready to turn on. If the display does not read 0 refer to Table 4-1 for an explanation of the display and what particular fault(s) or alarm(s) may exist inside the transmitter and possible causes for these. The only faults which can be reasonably expected to exist when the transmitter has just been powered up are the drive level overloads. The power supply voltage, supply current, PA current, and VSWR conditions should only occur if the transmitter is turned on because these signals only exist during actual transmitter air operation. If one of these overloads are found to exist when the transmitter is powered up try to first clear these faults. The key number to clear faults is 99. By depressing *99 or #99 the System Controller will clear all fault conditions and then reexamine the fault detectors for faults which may still exist. When *99 is depressed, for example, the upper display will go blank when the * is depressed and then when depressing each 9 the number will be echoed in the upper display area. When the digit 9 has been depressed two times the display will change back to 00 and the next line on the display will indicate any faults which still exist. If faults other than RF DRIVE LEVEL are still indicated, refer to Section VI for theory on the Status and Multimeter board as an aid to troubleshooting the Status and Multimeter board. If the drive level faults are still indicated begin trouble shooting the RF drive system.

4-27. SUPPLY VOLTAGE. Positions 0 through 10 will be the most frequently used on the transmitter since these positions are concerned with the actual operation of the main power supplies and output modules. Position 01 measures the DC voltage on the main high voltage power supply when the transmitter is on the air. The Factory Final Test Data Sheets should be consulted to determine what supply voltage the transmitter had when it was tested at the factory. Bring the transmitter on the air by depressing one of the three power buttons and enter the following sequence on the Keypad to observe the main power supply voltage '*01'. The voltage displayed on the * display should be within ±10% of the voltage recorded on the Factory Final Test Data Sheet. If this is not the case then the main power transformer is probably tapped incorrectly for line voltage or a component has failed in the power supply (.e.g. open rectifier or failed contactor). Refer to the

Table 4-1. SX MULTIMETER CODE DESCRIPTIONS

CODE #	DESCRIPTION	FORMAT
	BASIC CONTROL & STATUS	
00	STATUS/FAULT DISPLAY	999
01	POWER SUPPLY VOLTAGE	999
02	POWER SUPPLY CURRENT	99.9
03	FORWARD POWER [UNCAL.]	999
04	REFLECTED POWER [UNCAL.]	999
05	POWER AMPLIFIER CURRENT	99.9
06	PHASE 2 PA VOLTS	999
07	PHASE 1 PA VOLTS	999
08	PHASE 4 PA VOLTS	999
09	PHASE 3 PA VOLTS	999
10	IPA DRIVE LEVEL	999
	TEMPERATURE READINGS	
11	A1 TEMP	999
12	A2 TEMP	999
13	A3 TEMP	999
14	A4 TEMP	999
15	IPA TEMP	999
16	PHASE 2 TEMP	999
17	PHASE 1 TEMP	999
18	PHASE 4 TEMP	999
19	PHASE 3 TEMP	999
20	PHASE ANGLE DETECTOR OUTPUT	9.99
	FAULT/STATUS PER MODULE	
21	A1 FUSE FINDER	999
22	A2 FUSE FINDER	999
23	A3 FUSE FINDER	999
24	A4 FUSE FINDER	999
25	IPA FUSE FINDER	999
26	A6 Q19 & Q20	999
27	A7 Q19 & Q20	999
28	A8 Q19 & Q20	999
29	A9 Q19 & Q20	999
36	A6 Q39 & Q40	999
37	A7 Q39 & Q40	999
38	A8 Q39 & Q40	999
39	A9 Q39 & Q40	999
	USER PROGRAMMING	
40	IDLE POWER LEVEL	.999
41	LOW POWER LEVEL	.999
42	MEDIUM POWER LEVEL	.999
43	HIGH POWER LEVEL	.999
44	PRESENT POWER LEVEL	.999
45	FREQUENCY SYNTHESIZER FREQUENCY & LOCK IND	9999.F or .0
46	TOTAL NUMBER OF FAULTS	999

CODE #	DESCRIPTION	FORMAT
	INTERNAL REFERENCES	
50	+5 VOLT POWER SUPPLY	9.99
51	+15 VOLT POWER SUPPLY	99.99
52	+10.0000 VOLT REFERENCE	99.99
71	STORED PWR SUPPLY VOLTAGE	999
72	STORED PWR SUPPLY CURRENT	99.9
73	STORED FORWARD POWER	999
74	STORED REFLECTED POWER	999
75	STORED PA CURRENT	99.9
76	STORED PHASE 2 VOLTS	999
77	STORED PHASE 1 VOLTS	999
78	STORED PHASE 3 VOLTS	999
79	STORED PHASE 4 VOLTS	999
80	STORED IPA DRIVE LEVEL	999
81	STORED PHASE ANGLE DETECTOR VOLTAGE	9.99
	TEST ROUTINES	
88	LAMP TEST	.8.8.8.8.8.
	COMMANDS	
95	FREQUENCY SYNTHESIZER FREQUENCY PROGRAMMING	95XXXX
99	CLEAR FAULT STATUS MEM	

WARNING: Disconnect primary power prior to servicing.

installation instructions for directions on how to set the taps on the main and low voltage power transformers.

4-28. POWER SUPPLY CURRENT. Key in the following sequence '#02'. This will cause the # display to indicate what current is being drawn by the main power supply. This reading should be approximately equal to the current indicated by the following equation: I = POWER OUT / (MAIN DC VOLTAGE X 0.80). The actual reading at the factory is recorded on the Factory Test Data Sheet at rated power output.

4-29. FORWARD/REFLECTED POWER. Key in the following sequence '*03#04'. This will display the relative signals out of the Directional Coupler. This can be used to compute the VSWR seen by the power amplifier modules using the following table by calculating the ratio of reflected to forward volts. To do this simply divide the number on position 04 by the number on position 03 with the transmitter unmodulated. Then refer to the table below for VSWR.

RATIO	VSWR
0.00	1:1
0.01	1.02:1
0.025	1.05:1
0.05	1.11:1
0.075	1.16:1
0.10	1.22:1
0.15	1.35:1
0.20	1.50:1

4-30. The tuning procedure of the SX transmitter calls for minimizing the VSWR of the PA and from this table it can be seen that making the reading on position 04 zero will make the VSWR seen by the PA equal to 1:1 or a perfect match. In practice it may be impossible to hold the VSWR at 1:1 but this chart shows the purpose of the positions 03 and 04 and the interaction of the LOADING and TUNING controls in minimizing VSWR at the PA. The VSWR overloads are adjusted to trip at or below 1.5:1 VSWR at full output power. However since only the reflected voltage is capable of causing an overload the transmitter will tolerate a higher VSWR at reduced power output. If the transmitter is observed to trip off do to high VSWR the output power should be reduced manually and the VSWR at the PA module(s) checked using positions 03 and 04 and the above chart. The TUNING and LOADING controls can be adjusted to correct for minor changes in antenna impedance; however a significant change in the VSWR could indicate a problem with the antenna, or the matching equipment, or even a problem with the output network of the transmitter itself.

4-31. PA CURRENT. Position 05 is the PA current meter position and should read closely to the analog meter on the front of the transmitter. This position is for reference only and the actual current as displayed on the PA CURRENT meter on the transmitter should be used for the station log and for calculating power using the indirect method.

4-32. PA VOLTAGE. Positions 06, 07, 08, 09 are the phase voltages of each of the PDM phases within the transmitter. These positions should all read approximately the same voltage within ±5%. A gross imbalance in these readings would indicate a PA or PDM amplifier failure and a minor imbalance would indicate that the PDM Generator may need adjustment. To be sure of which refer to positions 20 through 39 to determine if one of the power amplifiers has failed. If not, then suspect the PDM Generator and refer to the trouble shooting guide for this board.

4-33. IPA DRIVE LEVEL. Display position 10 by depressing * or # followed by 10. The * or # display will then indicate the relative amount of drive to the final power amplifier. This is a unitless number which means that the number displayed on position 10 is used for reference only.

NOTE

The reading obtained on position 10 is different when the transmitter is on the air as opposed to being off the air. The readings on position 10 should be recorded at each power setting and also when the transmitter is off the air at the time the transmitter is installed so that these readings may be referenced in the future for diagnostic purposes.

4-34. If the number displayed on position 10 is significantly different (i.e. more than 15-20%) from that noted when the transmitter was originally installed the IPA module or Oscillator may be faulty. If position 10 indicates a reading which is nearly zero the IPA module is producing no power and the fuses should be checked for failure. The following paragraphs will discuss how to check a fuse on the IPA and PA modules.

4-35. FUSE FINDER. The blown fuse detectors are operated by current flowing through a resistor and LED circuit instead of flowing through the fuse which is blown. This allows the LED, contained within an optoisolator, to operate a transistor whose output is fed into the Status and Multimeter board where the System Controller can measure the voltage out of the optoisolator and display this as a relative reading on the digital display. The blown fuse detector for the IPA is position 25. By pressing * or # 25 the System Controller will be instructed to display the reading out of the optoisolator. This reading is normally that which is indicated on the Factory Final Test Data Sheets and is typically between 110 and 120. If a reading is observed which is significantly less that the number on the final test data sheet, one or both of the fuses on the IPA is probably blown or missing. In certain cases it is possible for a transistor on the IPA to fail without a fuse opening up due to the current limiting resistor in series with the IPA on the SX-1. A simple ohmmeter test with the power removed from the cabinet can lead to the fuse that has blown. If the fuse is replaced and it blows again then there is probably a faulty transistor in the circuit with the blown fuse and the IPA module should be replaced. The following modules have blown fuse detectors installed:

POSITION	21	A1-----POWER AMPLIFIER	(SX-1, SX-2.5, SX-5)
POSITION	22	A2-----POWER AMPLIFIER	(SX-5)
POSITION	23	A3-----POWER AMPLIFIER	(SX-5)
POSITION	24	A4-----POWER AMPLIFIER	(SX-2.5, SX-5)
POSITION	25	A5-----IPA MODULE	(SX-1, SX-2.5, SX-5)

NOTE

The fuse finders only operate when the module is powered up and the detector will not indicate a blown fuse if the module is powered off.

4-36. There is also a fuse detector on the PA module. The status of this fuse detector can be displayed by displaying position 21 (A1) on the display. The procedure is the same as for the IPA module and if a drop in the reading from the final test data reading is observed then a fuse has opened up on the module indicated. If repeated attempts at replacing the faulty fuse(s) are required then the module should be removed and serviced or replaced at the earliest convenience of maintenance personnel.

4-37. TEMPERATURE READINGS. Along with the blown fuse detectors on each RF module there are also temperature sensors on all power modules. The temperature of each of these sensors can be read in degrees Centigrade on the digital display. An example would be *15 will select the sensor attached to the IPA module and display the temperature of the IPA in degrees Centigrade. This feature can be used to determine if a module has malfunctioned by noting the temperature of each module when the transmitter is operating properly and then watching for significant increases in a particular module. The following modules have temperature sensors installed:

POSITION	11	A1-----POWER AMPLIFIER	(SX-1, SX-2.5, SX-5)
POSITION	12	A2-----POWER AMPLIFIER	(SX-5)
POSITION	13	A3-----POWER AMPLIFIER	(SX-5)
POSITION	14	A4-----POWER AMPLIFIER	(SX-2.5, SX-5)
POSITION	15	A5-----IPA MODULE	(SX-1, SX-2.5, SX-5)
POSITION	16	A6-----PDM AMPLIFIER	(SX-1, SX-2.5, SX-5)
POSITION	17	A7-----PDM AMPLIFIER	(SX-1, SX-2.5, SX-5)
POSITION	18	A8-----PDM AMPLIFIER	(SX-5)
POSITION	19	A9-----PDM AMPLIFIER	(SX-5)

4-38. If a request is made to display the temperature of a module which does not exist in the transmitter the display will show EEEEEE to indicate an error in entry of the position number

4-39. PDM AMP TRANSISTORS. There are also sensors contained on the PDM amplifier modules to detect if a transistor has failed. These sensors consist of a detector which measures the average voltage on the output transistors. The number displayed is relative to the power setting (pulse width). It will decrease as power is turned up. Consult the factory test data sheets for typical readings. If a transistor fails it will in most cases fail in the shorted drain to source mode. When this occurs the sensor will indicate nearly 0 volts when the transmitter is in operation. In this condition PA AMPS and possibly PA VOLTS will read substantially higher than normal. The following positions are available for use to detect failed MOSFETS on the PDM amplifier modules:

POSITION	26	A6-----PDM AMPLIFIER (SX-1, SX-2.5, SX-5)
POSITION	27	A7-----PDM AMPLIFIER (SX-1, SX-2.5, SX-5)
POSITION	28	A8-----PDM AMPLIFIER (SX-5)
POSITION	29	A9-----PDM AMPLIFIER (SX-5)
POSITION	36	A6-----PDM AMPLIFIER (SX-1, SX-2.5, SX-5)
POSITION	37	A7-----PDM AMPLIFIER (SX-1, SX-2.5, SX-5)
POSITION	38	A8-----PDM AMPLIFIER (SX-5)
POSITION	39	A9-----PDM AMPLIFIER (SX-5)

4-40. PHASE ANGLE DETECTOR. Position 20 will indicate the Phase Angle Detector voltage. This voltage is a reference only and should be at a null when the transmitter is properly tuned. As always, refer to the Factory Test Data to find the minimum number obtained at the factory.

4-41. POWER LEVEL SETTINGS. The following discussion will cover the display positions which indicate the relative power settings of the transmitter. The transmitter is equipped to handle virtually any power level that is within the FCC type accepted power range at the touch of a pushbutton. The power levels for LOW, MEDIUM, and HIGH are adjustable independently and the audio input level tracks the power output level within $\pm$ 2% from 10% to 100% of full power so no adjustment of the audio processing gear need be made when changing power levels. This feature should simplify procedures at stations where more than one power level is required through the broadcast day.

4-42. By using the positions 40 through 44 the operator can be assured that each power setting is correct for the particular power output desired.

4-43. Position 41 will indicate the relative power setting for LOW power.

4-44. Position 42 will indicate the relative power setting for MEDIUM power.

4-45. Position 43 will indicate the relative power setting for HIGH power.

4-46. The relative power settings are used to set the carrier level pulse width of the POLYPHASE PULSE DURATION MODULATOR. These settings may range from .000 to .999. Remember that these are relative settings of PDM amplifier pulse width and not output power (e.g. .800 may represent 1000 watts and .500 may represent 500 watts). These settings are changed by depressing either the RAISE (increase setting) or LOWER (decrease setting) pushbutton on the upper right front panel. The actual power setting limits are controlled by R28 on the PDM Generator board.

4-47. The System Controller will adjust the setting on which the transmitter is currently operating (e.g. if the transmitter is on MEDIUM power then position 42 will be affected). It is important to note that there is no built in limitation which forces MEDIUM power to be less than HIGH power.

4-48. Position 40 is used for the 'HV OFF' setting. In other words when the transmitter is off the air depressing RAISE or LOWER will affect position 40. This setting determines the rate at which the high voltage supply is discharged by the power amplifiers. A desirable setting is .300 to .400. The pulse width setting will move to that set by position 40 whenever the transmitter is off the air except in the case of a potentially damaging fault condition in which case the pulse width setting will always be .000 regardless of the indications of positions 40-43.

4-49. Position 44 is used to indicate the relative power setting that is actually being used by the System Controller. Normally this will be the same as position 40 when the transmitter is off the air except as mentioned above with regard to a fault condition. Another feature of the power control section of the transmitter is that when the transmitter is brought on the air by depressing LOW, MEDIUM, or HIGH pushbuttons the power is ramped up from zero to the setting programmed earlier or at the factory. This action can be observed with the following sequence '*43#44'. This will show the high power setting on the upper display and the present power setting on the lower display.

4-50. Now depress the HIGH pushbutton to bring the transmitter on the air at full power. While the transmitter is coming on the air observe that the lower display changed to .000 and then quickly increased to be equal to the upper display. The raise pushbutton also was illuminated during this time to indicate that the power was being raised. Depress the MEDIUM pushbutton and observe the change in position 44. Depressing '*42' should show that position 44 and 42 are now the same. If position 42 is less than position 43 it should also have been observed that the LOWER pushbutton was illuminated briefly while the change in power was being made.

4-51. During the broadcast day if changes in power line voltage cause the power to drift the power can be changed by depressing RAISE or LOWER and this new level will be recorded by the System Controller automatically for use the next time the transmitter is operated at this power level. This feature is useful during a power failure because the transmitter will automatically return to the air after a power failure at the same level that existed before the AC failed. This feature is made possible by using a special rechargeable maintenance free battery on the System Controller to retain certain information about the operation of the transmitter. In the unlikely event that the battery should fail the System Controller will reset all power settings to .000 and remain off the air until the operator depresses one of the three power buttons. Failure of the battery in no way prevents the operator from turning on the transmitter however the RAISE button will have to be depressed and held until the correct power output is reached.

4-52. INTERNAL REFERENCES. There are 4 positions which are concerned with the operation of the status and metering circuitry itself. These positions are as follows:

POSITION	50	5 volt power supply output voltage
POSITION	51	15 volt power supply output voltage
POSITION	52	10.00 volt reference for A/D converter (multimeter)
POSITION	88	LAMP TEST

NOTE

When a reading observed on the display is questionable the 10.00 volt reference should be checked to see if the automatic calibration system is operating normally.

4-53. Position 52 should read 10.00 volts and small corrections can be made by adjustment of R59 on the Status and Multimeter board. If position 52 can not be made to read 10.00 volts through adjustment of R59 then the A/D converter-automatic calibration system has failed and the Status and Multimeter board should be repaired or replaced. If the 5 volt power supply reads less that 4.75 volts or more than 5.50 volts then the 5 volt power supply has failed somehow and the AC Controller board should be repaired or replaced. The +15 volt power supply is also contained on the AC Controller board and if the +15 drops below 13.5 volts or increases to more that 17.0 volts the AC Controller should be repaired or replaced.

4-54. TESTING THE DISPLAY SEGMENTS. Position 88 is used to test the LED display for burned out segments. Depressing '#88*88' will cause the display to light up all segments so a check can be made for display failure. If any segment does not light up then that LED digit should be replaced.

4-55. <u>CORRECTIVE MAINTENANCE AND ADJUSTMENT PROCEDURES</u>

4-56. REPLACING BOARDS AND REPLACING BOARD COMPONENTS

4-57. The following boards may be replaced or have components replaced without the need for adjustments or measurements:

System Controller boards A13 and A14

PDM Pull UP boards

PDM Filter board

Switch board A17

Customer Interface boards A22 and A23

Keyboard/Display board A12A1

IPA Power Splitter board

IPA and PA Toroid boards

PDM Power Filter board

4-58. The boards which follow have no adjustments, but can be partially checked prior to turning on the high voltage.

4-59. IPA MODULE

4-60. The IPA module can be checked with an oscilloscope by touching the scope probe tip to A5 Q12 or Q13 while only the low voltage is on. Expect an rf square wave at the operating frequency with an amplitude equal to the IPA supply voltage. If square waves are not found at Q12 and Q13 refer to the troubleshooting section.

4-61. When replacing the IPA module, be sure an even coating of thermal compound is applied to the mating heat sink surfaces. Be certain to tighten down the captive fasteners which mount the IPA module to the heat sink.

4-62. PA MODULE

4-63. Refer to the procedure for checking RF DRIVE AMPLITUDE, RF DRIVE PHASING, and LOW VOLTAGE TESTING. It is usually advisable to check the RF drive amplitude on the module before turning on the high voltage. It is <u>not</u> usually necessary to readjust the IPA tuning.

4-64. When replacing the PA module, be sure an even coating of thermal compound is applied to the mating heat sink surfaces. Be certain to tighten down the captive fasteners which mount the PA module to the heat sink. Be sure the RF drive cable J2 is fully locked into position.

4-65. PDM AMPLIFIERS

4-66. Check jumper plug P4 next to the Molex connector J2 to ensure it is in the correct position for transmitter (SX-1, SX-2.5, SX-5).

4-67. With only the low voltage on and a * or #44 reading in the 300-400 range, check the PDM drive to the output transistors of the PDM Amplifiers. Connect an oscilloscope across R21, R22, R41 and R42 on the PDM Amplifiers. A 15 volts peak-to-peak 60 kHz pulse should be found at all eight resistors. The resistors listed are 1000 ohms, 2 watts each. The ground side is away from the output transistors.

4-68. The PDM Amplifiers may be further checked using the procedure for LOW VOLTAGE TESTING.

4-69. When replacing the PDM Amplifier module, be sure an even coating of thermal compound is applied to the mating heat sink surfaces. Be certain to tighten down the captive fasteners which mount the PDM Amplifier module to the heat sink. Be especially sure to tighten the captive fastener which attaches the PDM Pull Up board to the large capacitor.

WARNING: Disconnect primary power prior to servicing.

4-70. The following boards require adjustment:

4-71. RFI BOARD A24

4-72. The only adjustments on the RFI board pertain to the modulation monitor level. If the transmitter is located at a remote site where the modulation sample is not used, disregard these adjustments.

4-73. Refer to the paragraph entitled ADJUSTING THE MODULATION MONITOR SAMPLE OUTPUT for proper procedure to adjust the modulation monitor sample output.

4-74. RF OSCILLATOR A16

4-75. A16C1 trims the carrier frequency at least ±20 Hz. This should only be adjusted according to a frequency monitoring instrument or service.

4-76. A16R27 should be adjusted while observing the IPA square waves on an oscilloscope. Connect an oscilloscope to A5Q12 and turn only the low voltage on. Adjust A16R27 for good, stable class D operation of the IPA. Too little drive to the IPA may result in poor class D operation or IPA oscillations. Too much rf drive will cause considerable IPA ringing and a slight loss in IPA efficiency. Excessive output from the Oscillator board will result in overworking of the A16 output stage.

CAUTION

DO NOT ADJUST A16R27 WITH THE HIGH VOLTAGE ON. THIS MAY ENDANGER THE PA IF THE IPA OSCILLATES DURING THE ADJUSTMENT PROCEDURE.

4-77. PDM GENERATOR A15

4-78. If the PDM Generator is being replaced with a new one, very little adjustment should be necessary. If the PDM Generator is being repaired, it may be wise to perform the following alignment procedure.

4-79. Check the 06-09 readings on the digital display after bringing the transmitter power output up. These readings should agree within 2-3 volts. If there is some imbalance in these readings, refer to the paragraph entitled ALIGNING THE PDM GENERATOR. A severe imbalance may be a fault elsewhere in the modulator system.

4-80. Turn the transmitter on at HIGH power. Raise the * or #44 reading to approximately 970, but do not allow the power output to exceed the rated power of transmitter. The output power should be low as a result of the adjustment to R28 in the preceeding step.

WARNING: Disconnect primary power prior to servicing.

4-81. DIRECTIONAL COUPLER A18

4-82. Refer to the procedure described in paragraph entitled ADJUSTMENT OF DIRECTIONAL COUPLER. Readjustment should not be necessary when only replacing a diode.

4-83. PHASE ANGLE DETECTOR A27A1

4-84. Refer to procedure given in paragraph entitled ADJUSTMENT OF PHASE ANGLE DETECTOR. No adjustment should be required when replacing a diode.

4-85. AC CONTROLLER BOARD A25

4-86. When installing a new AC Controller board or one which has just been repaired, there are a few checks that can be made upon application of low voltage.

4-87. CHECK THE 5 VOLT SUPPLY. Disconnect P14 from the Status and Multimeter board A12. This is the cable that supplies 5 volts to A12. Disconnecting P14 will take the load off of the 5 volt supply.

4-88. Connect a dc voltmeter between P14-3 (wire #63) and ground.

CAUTION

IN THE FOLLOWING STEPS ONLY MOMENTARILY SET THE LOW VOLTAGE CIRCUIT BREAKER TO ON TO MINIMIZE THE POSSIBILITY OF DAMAGING THE +5 VOLT FILTER COMPONENTS ON THE AC CONTROLLER BOARD. NEVER LEAVE THE LOW VOLTAGE CIRCUIT BREAKER ON FOR MORE THAN 5-10 SECONDS IF A PROBLEM EXISTS IN THE +5 VOLT POWER SUPPLY. IF ANY ODOR IS OBSERVED OR IF ANY OF THE FILTER CAPACITORS ON THE AC CONTROLLER BOARD APPEAR TO BE DAMAGED, DO NOT APPLY LOW VOLTAGE TO THE TRANSMITTER UNTIL THE CAUSE OF THE DAMAGE HAS BEEN DETERMINED AND THE DAMAGED FILTER CAPACITORS HAVE BEEN REPLACED.

4-89. Momentarily set the LOW VOLTAGE circuit breaker to ON. Normally, the voltage at P14-3 would be about 6 volts. If it is not, refer to the paragraph entitled TROUBLESHOOTING A 5 VOLT SUPPLY FAILURE.

4-90. Plug A12P14 back in when it is determined the 5 volt supply is running properly.

4-91. The digital display should then light up.

4-92. CHECK PLUS AND MINUS 15 VOLTS. +15 volts should be found at the cathode of CR12 on the AC Controller board. -15 volts should be found at the anode of CR15. If troubleshooting is necessary, refer to the AC Controller board schematic and check ±30 volts going to the board.

4-93. All new boards are tested and calibrated in a transmitter before they are shipped. PA VOLTS, PA AMPS, and supply current metering will be nearly calibrated. Being that these metering circuits consist of elements which are wired into the transmitter cabinet, exact calibration can only be obtained by including these elements in the calibration. This is accomplished by following the meter calibration procedures beginning with the paragraph entitled METER CALIBRATION PROCEDURE.

4-94. In general, readjustment should be made whenever a component which may affect meter calibration is replaced.

4-95. STATUS AND MULTIMETER BOARD A12

4-96. Replacement of the Status and Multimeter board may be accomplished faster and smoother if the calibration and overload potentiometers are preset using a volt/ohmmeter.

4-97. A digital multimeter rather than an analog meter is best suited to this task since the final objective is to make little or no adjustment at all when the high voltage is on.

4-98. If the transmitter is operational, set it to its normal power and record the front panel PA VOLTS, PA CURRENT, FORWARD POWER, and #44 position on the keypad.

4-99. Turn transmitter off.

4-100. With only the transmitter low voltage circuit breaker on, measure and record the voltages on the following IC pins. Use of an IC pin extender makes the measurements much easier. The two IC's are located under the row of eight blue calibration potentiometers on the board.

CAUTION

BE CAREFUL IN MEASURING VOLTAGES BECAUSE DAMAGE CAN OCCUR TO IC'S ON THE BOARD IF IC PINS ARE SHORTED TOGETHER.

4-101. Measure and record the following points to ground:

OVERLOAD	ADJUSTMENT	IC	PIN	VOLTAGE MEASURED
Overvoltage	R55	U44	7	________
PA Current	R57	U44	5	________
Underdrive	R58	U44	10	________
Overdrive	R56	U44	9	________
Power Supply Current	R54	U45	11	________
Phase Angle VSWR	R53	U45	5	________
Directional Coupler Reflected Power	R51	U45	6	________

WARNING

SHUT OFF ALL AC POWER BEFORE PROCEEDING WITH THE FOLLOWING STEPS.

4-102. Shut off all ac power and remove all plugs from the Status and Multimeter board. If desired, totally remove the board from the transmitter and set it on a piece of cardboard on a table for making the following measurements.

4-103. Use the ohmmeter to measure the resistance between the following connector pin numbers. These will determine the meter calibration potentiometer settings of the new board. Read the resistance as critically as possible.

4-104. All of the ribbon connectors have odd numbered pins on one side and even numbered pins on the other side. Look at one of the ribbon cables. There should be an arrow in one corner on the outside. The arrow denotes pin 1. The next pins would be 3, 5, 7, etc. down the length of this side of the connector. On the other side the pin opposite pin 1 would be pin 2. Pins 4, 6, 8, etc. will then be down this side of the connector.

METER AFFECTED	ADJUSTMENT	MEASUREMENT BETWEEN	RESISTANCE
PA CURRENT	R60	J4-4 and J9-8	________
REFLECTED POWER	R61	J4-8 and J11-17	________
FORWARD POWER	R62	J4-14 and J11-15	________
PA VOLTAGE	R63	J4-2 and J9-14	________

4-105. Make the same resistance measurements on the new Status and Multimeter board, but adjust the meter calibration potentiometers (R60-R63) to the same values as recorded previously.

4-106. Install the new Status and Multimeter board and fasten all connectors in place.

4-107. Turn on the low voltage and check to make sure the digital display is illuminated and is displaying 0's in the Key * and Key # positions. The fault light may be illuminated at this time and there may be a fault number showing. This is normal at this time. Otherwise there will be 0's in the display. Also check to see that the green LED's are illuminated on both System Controller boards.

4-108. Depress #52 on the digital display. This should read 10.00 ±.01V. If it is off, set it to 10.00 with R59 on the Status and Multimeter board.

4-109. Depress #50 and #51. Number 50 should read approximately 5V and #51 should read approximately 15V.

4-110. Using the table where overload voltages were recorded, set the overload potentiometers to the same voltages as recorded in that table. This will ensure the overloads are set to the same threshold as on the old board.

4-111. Once this is completed, bring the transmitter power up to the normal power level. Display #44 and use the RAISE-LOWER pushbuttons to make the displayed number the same as recorded previously. Let the transmitter stabilize for approximately five minutes. The PA VOLTS, PA CURRENT, and FORWARD POWER should be equal to the readings first recorded.

4-112. If the meter readings appear questionable, follow the meter calibration procedures in the paragraph entitled METER CALIBRATION PROCEDURE. This may be necessary, especially if an analog meter is used to preset the calibration potentiometers.

NOTE

Be sure to place the REMOTE-LOCAL switch to the proper position for normal transmitter operation.

4-113. SETTING UP THE OPTIONAL FREQUENCY SYNTHESIZER

4-114. The Frequency Synthesizer in the SX-1 transmitter is capable of operating over the entire AM broadcast band (525 kHz to 1605 kHz). This frequency source is programmable from the Keypad on the pull-out drawer. To set the frequency first select the proper band for operation and then follow the instructions for programming the frequency of operation.

4-115. SETTING THE BAND SWITCHES. Located within the VCO (copper box) on the Frequency Synthesizer board is a four pole dual in-line switch S1. S1 must be set to the correct band for the frequency of operation. There are three bands as follows:

525 kHz to 800 kHz	S1 and S2 open	S3 closed
801 kHz to 1175 kHz	S1 and S3 open	S2 closed
1176 kHz to 1605 kHz	S2 and S3 open	S1 closed

NOTE

S1 can be reached with a small adjustment tool through the rectangular hole in the copper cover over the VCO on the Frequency Synthesizer board.

4-116. PROGRAMMING THE FREQUENCY SYNTHESIZER. The frequency is programmed using the special key code 95 followed by the frequency in kilohertz. For example:

To obtain a frequency of 1000 kHz key in *951000

The display will echo all the digits depressed on the upper display and upon entering the last digit the Frequency Synthesizer will be programmed for operation at 1000 kHz and the digits that were entered in the display will be blanked. If an error is detected while entering the frequency simply repeat the procedure. To exit the frequency entry mode simply enter any other key code (i.e. *45).

NOTE

4 digits are required to set the frequency; e.g. 610 kHz is entered as *950610.

4-117. To check the frequency that is programmed into the Frequency Synthesizer use the key code 45 to view the frequency and the status of the Frequency Synthesizer lock detect signal. For example:

Key in the following - #45

The display will show the frequency followed by a decimal point and the status of the lock detect signal. If the Frequency Synthesizer is locked on frequency, the display will show the frequency followed by .0 and if unlocked the display will show the frequency attempted followed by .F. During some conditions of unlocked operation the status signal will temporarily go in and out of lock causing the display to rapidly change from .0 to .F until a locked condition is established.

NOTE

> The SX-1 uses frequency determinant components in the IPA, PA's, Output Network and Modulation Monitor Sample. These components may need to be changed if the frequency of the transmitter is changed.

4-118. ALIGNING THE PDM GENERATOR

4-119. Turn the transmitter on at LOW power. Lower the * or #44 reading to 000 using the LOWER pushbutton.

4-120. Verify the existence of triangle waves at U9-9 and U10-9 on the PDM Generator. The triangle waves should look very linear, as those shown in the photos at the end of Section V.

4-121. Use a digital voltmeter to verify that there is less than 10 mVdc at U9-9 and U10-9.

4-122. Connect an oscilloscope to the side of R46 nearest the edge of the printed circuit board. Set the oscilloscope to measure 15 volts p-p of 60 kHz pulses.

4-123. Adjust R98 in a clockwise direction until pulses appear. Rotate R98 counterclockwise until the pulses just disappear.

4-124. Depress the RAISE pushbutton until a very narrow pulse appears. A very narrow pulse will not reach 15 volts p-p.

4-125. Move the oscilloscope probe to the side of R45 nearest the printed circuit board edge. Adjust R14 until a very narrow pulse, as in the preceeding step, is observed (should be of the same amplitude).

4-126. Rotate R28 several turns counterclockwise.

4-127. Turn the transmitter on at HIGH power. Raise or lower the * or #44 reading to approximately 970, but do not allow the power output to exceed 1100 watts The output power should be low as a result of the adjustment to R28 in the preceeding step.

4-128. Adjust R28 on the PDM Generator to produce 1100 watts or to the highest normal power the transmitter will operate at, whichever is lower. For example if 1000 watts is the transmitter normal high power level, set R28 for 1000 watts.

4-129. Check the * or #06-09 readings on the digital display. These should agree with each other and with the PA voltmeter within 2 or 3 volts. If not, make a slight readjustment of R14.

4-130. Switch to LOW power and depress the RAISE pushbutton until the desired low power setting is reached.

4-131. R21 should be set for the desired audio input sensitivity between -10 dBm and +10 dBm.

4-132. R30 should be adjusted to minimize 120 Hz noise. R30 should always affect noise when adjusted to extremes.

4-133. Turn the transmitter off and set (with the LOWER pushbutton) the * or #44 reading to 300-400. This determines the rate at which the PA discharges the HV following an OFF command.

4-134. ADJUSTMENT OF DIRECTIONAL COUPLER

4-135. The following procedure can be used to adjust the Directional Coupler board for proper operation.

NOTE

This procedure assumes that the remainder of the Output Network within the transmitter is properly adjusted and only the Directional Coupler needs adjustment. If other portions of the Output Network need adjustment see the section on Output Network adjustment first before beginning with this procedure.

a. Ensure that the transmitter is connected to a 50 ohm dummy load.

WARNING

ENSURE ALL POWER IS REMOVED FROM TRANSMITTER AND THAT GROUNDING STICK HAS BEEN USED TO DISCHARGE ANY RESIDUAL POTENTIAL WHERE POWER HAS BEEN APPLIED BEFORE PERFORMING THE FOLLOWING STEPS.

b. Disconnect the strap from the post at the rear of the Directional Coupler which connects the Directional Coupler to L2.

c. Connect a Vector Impedance Meter or other Impedance Bridge to the post at the rear of the Directional Coupler using the roof top of the transmitter for ground.

d. Adjust the front panel LOADING and TUNING controls for an impedance reading of 50+j0 on the impedance bridge.

e. Reconnect the strap removed in step b.

f. Adjust R51 on the Status and Multimeter board (A12) clockwise at least 12 turns to desensitize the VSWR overload. The VSWR sensing circuit registers a '32' on the digital display when triggered.

g. Bring the transmitter on the air at 50% of rated power.

h. Observe the forward and reflected indications on the front panel meter. If there is significant reflected power adjust C9 on the Directional Coupler to minimize the reflected power. C9 can be accessed through a hole in the roof of the transmitter on the right side near the rear of the cabinet. C9 is the adjustable capacitor closest to the front of the transmitter.

i. Increase power of transmitter to full power as indicated by the station monitoring equipment. (Typically a calibrated RF ammeter connected in series with the 50 ohm dummy load or a calorimetric dummy load.)

j. Adjust C9 to minimize reflected power as in step h. above.

k. Turn transmitter off and wait for power to decrease to zero.

CAUTION

ATTEMPTING STEP 1. WITH THE TRANSMITTER ON MAY RESULT IN DAMAGE TO THE DIRECTIONAL COUPLER BECAUSE AN ARC MAY DEVELOP WHEN THE PLUGS ARE REMOVED.

l. Note which way plugs P2 and P3 are installed in the Directional Coupler. These plugs can be reached through a hole in the top of the cabinet on the right side near the rear. Notice that the plugs are connected side by side in two sockets. Remove both plugs and insert them at 90 degree angles to the positions that they were in.

m. Bring transmitter on the air at full power and adjust R61 on the Status and Multimeter board so that the reflected position indicates the correct power output for the transmitter.

n. Switch to forward power and observe the indication. If it is not zero, adjust C2 on the Directional Coupler to minimize forward power. C2 can be accessed through the roof of the transmitter on the right side near the rear of the cabinet. C2 is the adjustable capacitor closest to the rear of the cabinet. Recheck reflected power calibration and adjust if necessary using R61 on Status and Multimeter board.

o. Switch to LOW power and set output power at 90 watts.

NOTE

The power output of the transmitter will be indicated on the reflected position at this time.

p. Adjust R51 on Status and Multimeter board counterclockwise until the VSWR protection takes effect. PA VOLTS, PA AMPS, and POWER output will be fluttering at some amount below the normal set power level. A '32' will be registered in the FAULT/STATUS display position 00. The OFF/FAULT lamp should be illuminated.

q. Turn transmitter off and wait for power to decrease to zero. This will take longer that normal due to the effects of the VSWR protection and is normal.

CAUTION

ATTEMPTING STEP r. WITH THE TRANSMITTER ON MAY RESULT IN DAMAGE TO THE DIRECTIONAL COUPLER BECAUSE AN ARC MAY DEVELOP WHEN THE PLUGS ARE REMOVED.

r. Reconnect the plugs on the Directional Coupler the way they were before step l.

s. Turn the transmitter back on at full power.

t. Adjust R62 on the Status and Multimeter board until the forward power meter indicates the power measured in step i.

u. Transmitter is now ready for operation.

4-136. ADJUSTMENT OF PHASE ANGLE DETECTOR

4-137. This procedure can be used to adjust the Phase Angle Detector board.

NOTE

This procedure assumes that the remainder of the Output Network within the transmitter is properly adjusted and only the Phase Angle Detector needs adjustment. If other portions of the Output Network need adjustment, see the section on Output Network adjustment first before beginning with this procedure. Also, if the transmitter has just gone through a frequency change in the field, insure that the proper frequency determined components have been installed.

WARNING

ENSURE ALL POWER IS REMOVED FROM TRANSMITTER AND THAT GROUNDING STICK HAS BEEN USED TO DISCHARGE ANY RESIDUAL POTENTIAL WHERE POWER HAS BEEN APPLIED BEFORE PERFORMING THE FOLLOWING STEPS.

a. With the TRANSMITTER POWERED OFF disconnect J1 and J2 from the Phase Angle Detector noting which cable connects to which BNC connector.

b. Connect an RF signal generator tuned to the carrier frequency of the transmitter and adjusted for a level between 1 and 10 volts RMS to J2 and connect an RF voltmeter to J1.

c. Adjust C2 (middle capacitor) until the voltage measured on J1 is a minimum. At this point there is no further adjustment of C2 required.

d. Reconnect J1 and J2 to the same BNC connectors as in step a. and close the door of the transmitter.

e. Bring the main power up on the transmitter and increase output to full power. If the Phase Angle Detector overload is recycling (displayed as '64' on FAULT/STATUS position 00) decrease power until it stops.

f. Key in the following sequence on the Keypad on the front of the pull-out drawer '*20' and note the reading (.01 typical).

g. Refer the reading in step f. to that which is recorded on the Factory Test Data Sheets. If the reading is higher, C1 and C3 need to be adjusted until the reading is nulled. C1 and C3 can only be adjusted with the rear door open, therefore the TRANSMITTER MUST BE TURNED OFF BEFORE ADJUSTING C1 OR C3 and then turned back on after closing the rear door.

WARNING

ENSURE ALL POWER IS REMOVED FROM TRANSMITTER AND THAT GROUNDING STICK HAS BEEN USED TO DISCHARGE ANY RESIDUAL POTENTIAL WHERE POWER HAS BEEN APPLIED BEFORE PERFORMING THE FOLLOWING STEPS.

h. Since both C1 and C3 affect the reading on position 20, they must both be adjusted for best null; however, there is minimum interaction between the two controls so one may be adjusted first and then the other.

i. Once the reading on position 20 is nulled and is equal to or close to the Factory Test Data Sheet reading, the adjustment is complete.

4-138. OUTPUT NETWORK COLD TUNING

4-139. The Output Network should require retuning only if a component is replaced. If this occurs ensure that the following caution note is followed.

CAUTION

THE RESONANT FREQUENCY OF L2-C2 MUST BE MEASURED ONLY WHEN THE REAR DOOR IS CLOSED. A FREQUENCY SHIFT OF APPROXIMATELY 4 KHZ WILL BE NOTED WHEN THE DOOR IS OPEN.

WARNING

ENSURE ALL VOLTAGE HAS BEEN REMOVED FROM TRANSMITTER AND GROUNDING STICK IS USED TO GROUND ALL POINTS WHERE AC OR RF POWER HAS BEEN APPLIED BEFORE PROCEEDING WITH THE FOLLOWING PROCEDURE.

4-140. The following paragraphs describe a cold tuning procedure for the Output Network. All voltage must be removed from the transmitter in order to cold tune the Output Network. Tuning the Output Network should not be attempted in the presence of an rf field on or near the frequency of the transmitter. For example, the procedure for set up cannot be used while a standby transmitter is on. The presence of an rf field on the same or adjacent frequency will make achieving the proper adjustment very difficult.

4-141. THIRD HARMONIC TRAP L7-C4. Disconnect from the loading coil (A21L5) the strap which goes to A21L7, the third harmonic coil. This will separate the third harmonic trap circuit from the rest of the Output Network.

4-142. Adjust L7 for resonance (minimum impedance) at the third harmonic of the carrier frequency. This may be accomplished with an rf bridge, vector impedance meter, or any suitable impedance measuring device connected between L7 and ground near A21C4.

4-143. Resonance may also be determined with a variable RF generator when used with an oscilloscope and a resistor. Put a 10k ohm resistor in series with the RF signal going to the trap circuit. Connect the oscilloscope with a low capacity probe to the trap coil. Resonance occurs at the frequency where the amplitude on the oscilloscope is minimum.

4-144. BANDPASS FILTER L2-C2. Disconnect the strap which connects to the input side (towards rear of transmitter) of the Directional Coupler.

4-145. Disconnect the strap which connects to the feedthrough bolt on the enclosure containing A21L1 and A21C1.

4-146. Connect an RF bridge, vector impedance meter, or any suitable impedance measuring device between the strap which was disconnected from the Directional Coupler and ground.

4-147. L2-C2 is set for resonance (maximum impedance) at the carrier frequency. Adjust L2 by rotating the entire coil. It will be necessary to loosen mounting hardware in order to accomplish this.

CAUTION

THE RESONANT FREQUENCY OF L2-C2 MUST BE MEASURED ONLY WHEN THE REAR DOOR IS CLOSED. A FREQUENCY SHIFT OF APPROXIMATELY 4 KHZ WILL BE NOTED WHEN THE DOOR IS OPEN.

4-148. Due to the close proximity of the back door, it is necessary to have the back door closed for reading the exact resonance of L2-C2. L2-C2 should be set to resonance no more than 2 kHz from carrier frequency.

4-149. At resonance the impedance of L2-C2 is 2500 ohms or more.

4-150. TEE NETWORK - LOAD AND TUNE. Connect L2-C2 to the input of the Directional Coupler. The strap to the feedthrough bolt on the L1-C1 enclosure should still be disconnected.

WARNING: Disconnect primary power prior to servicing.

4-151. Connect the RF bridge to the output end of the Directional Coupler (towards front of transmitter).

4-152. Adjust TUNING and LOADING for 50 ohms j0 at this point.

NOTE

Refer to factory test data sheet for data on impedance of L2 and L1.

4-153. L2 SLIDING TAP. The tap on L2 is set for the correct loading of the PA module. The impedance that the PA module operates into is a complex impedance, with the resistive part being approximately 7 ohms.

4-154. Sliding the tap towards the ground end of L2 will result in heavier loading of the PA.

4-155. L1 TAP. L1 sets the reactive component that the PA modules should operate into. The PA normally sees a reactance of 1 to 5 ohms depending on frequency and performance related conditions.

4-156. METER CALIBRATION PROCEDURE

4-157. MECHANICAL ZEROING. Check the mechanical zeroing of the front panel meters by unplugging J4 from the Status and Multimeter board and examining each meter. Access to the mechanical zero adjustments may be gained by removing the dress panel. Be sure to plug J4 back in after checking the mechanical zero of the meters.

4-158. FORWARD/REFLECTED POWER. Calibration of the power output meter is covered in paragraph on ADJUSTMENT OF DIRECTIONAL COUPLER.

4-159. PA VOLTS. Turn the transmitter on at low power and lower the power setting (* or # 44) to 000. Turn transmitter off and then back on again at low power.

4-160. The front panel PA VOLTS reading should read exactly zero.

WARNING

IF ACCESS TO THE AC CONTROLLER IS REQUIRED, REMOVE ALL POWER FROM THE TRANSMITTER BEFORE ATTEMPTING ACCESS.

4-161. If the PA VOLTS does not read exactly zero, R22 on the AC Controller board will have to be adjusted. Due to the location of the AC Controller board, all power will have to be removed from transmitter before making the adjustment. Adjusting R22 clockwise moves the meter pointer up scale and counterclockwise moves the meter pointer downscale. Adjust R22 slightly and recheck the electrical zero with the high voltage on and a 000 power setting.

4-162. After correct electrical zeroing of the PA VOLTS meter is achieved, shut the transmitter off.

4-163. In the following procedure a DC Voltmeter is used to measure the differential between the PDM Filter outputs (PA low side) and the B+ (PA high side). Place the DC Voltmeter outside of the cabinet, positioned where it can be read accurately.

WARNING

ENSURE ALL POWER IS REMOVED FROM THE TRANSMITTER BEFORE ATTEMPTING TO ROUTE THE LEADS IN THE FOLLOWING STEPS.

4-164. Route the voltmeter leads inside to the connections described in the following paragraphs.

4-165. The voltmeter leads may be routed through one of the bottom side access holes and up through the Remote Wiring grommet or from the front of the transmitter by sliding the drawer out and routing the wiring through the holes located in the upper right hand side of the drawer enclosure which allow access into the main enclosure.

4-166. The voltmeter leads may have to be extended in order to reach the appropriate connections.

4-167. Connect the positive lead of an accurate DC Voltmeter to the B+ (260V) connection on the PA Module A1 (the large red plug J3).

4-168. Connect the negative lead of the voltmeter to the PDM Filter board output E42.

4-169. Close the rear door and return power to transmitter. Bring transmitter on at LOW, MEDIUM or HIGH power level.

4-170. Adjust R63 on the Status and Multimeter board to make the PA VOLT meter agree with the DC Voltmeter reading.

WARNING

ENSURE ALL POWER IS REMOVED FROM THE TRANSMITTER BEFORE ATTEMPTING TO REMOVE THE LEADS IN THE FOLLOWING STEPS.

4-171. Remove all power from transmitter and remove voltmeter leads from cabinet.

4-172. PA AMPS. Switch the transmitter on at low power and lower the power setting (* or #44) to 000.

4-173. The PA AMPS meter should read exactly zero.

4-174. IF PA AMPS meter does not read exactly zero, it will be necessary to adjust R3 on the AC Controller board A25.

WARNING

IF ACCESS TO THE AC CONTROLLER IS REQUIRED, REMOVE ALL POWER FROM THE TRANSMITTER BEFORE ATTEMPTING ACCESS.

4-175. If the PA AMPS does not read exactly zero, R3 on the AC Controller board will have to be adjusted. Due to the limited access of the AC Controller board, all power will have to be removed from transmitter before making the adjustment. Adjust R3 slightly and recheck the electrical zero with the high voltage on and a 000 power setting. If a substantial change in the PA current meter reading is obtained when the transmitter high voltage is applied, it may indicate a problem on the AC Controller or in the wiring near the PA current shunt (A19R5).

4-176. After correct electrical zeroing of the PA AMPS meter is achieved, turn the transmitter off and open the back door.

WARNING

ENSURE ALL POWER IS REMOVED FROM THE TRANSMITTER BEFORE ATTEMPTING TO ROUTE THE LEADS IN THE FOLLOWING STEPS.

4-177. Locate a DC Ammeter where it can be seen from front of transmitter and route its leads through one of the bottom side access holes and up through the Remote Wiring grommet.

4-178. The positive lead of the ammeter should connect to the PA shunt. Be sure the external DC Ammeter and its connections are positioned so they will not short to ground. Also be sure the wiring to the external DC Ammeter is capable of 12 amps and has at least a 300 volt insulation rating.

4-179. If a Clamp On Ammeter is used, insure that it is not RFI sensitive. Also note that the heat from the PA Current Shunt could damage the insulation.

4-180. Turn transmitter on at HIGH power and increase power until full power has been reached as determined by the power meter or the antenna current meter. Note readings on external Ammeter.

4-181. Enter * or #05 on the digital display. The reading on the digital display should agree with the reading on the external DC Ammeter.

WARNING

IF ACCESS TO THE AC CONTROLLER IS REQUIRED IN THE FOLLOWING STEPS, REMOVE ALL POWER FROM THE TRANSMITTER BEFORE ATTEMPTING ACCESS.

4-182. If the digital reading does not agree with the reading on the external DC Ammeter, it will be necessary to adjust R2 on the AC Controller board A25. Due to the limited access of the AC Controller board, all power will have to be removed from transmitter before making the adjustment. Adjust R2 slightly and then recheck the calibration.

4-183. Repeat until R2 is properly adjusted to agree with the external DC Ammeter reading.

4-184. Once the digital reading agrees with the external DC Ammeter, R60 on the Status and Multimeter board A12 should be adjusted to make the front panel PA AMPS meter read correctly.

WARNING

ENSURE ALL POWER IS REMOVED FROM THE TRANSMITTER BEFORE ATTEMPTING TO REMOVE THE LEADS IN THE FOLLOWING STEPS.

4-185. Remove all power from transmitter and remove external DC Ammeter's leads from cabinet.

4-186. POWER SUPPLY CURRENT CALIBRATION. Function 02 on the digital display reads power supply current. Calibration of this reading is made on A25 the AC Controller board.

WARNING

ENSURE ALL POWER IS REMOVED FROM THE TRANSMITTER BEFORE ATTEMPTING TO ROUTE THE LEADS IN THE FOLLOWING STEPS.

4-187. Locate a DC Ammeter where it can be seen from the front of the transmitter and route its leads through one of the bottom side access holes and up through the Remote Wiring grommet.

4-188. Route the wiring for the DC Ammeter through this opening and connect it in series with the supply current shunt resistor A19R4. This is located to the front of the high voltage rectifiers. Connect the positive side of the DC Ammeter to the shunt (leave the white wire in place on the shunt). The negative side of the meter should connect to the black welding cable removed from the shunt.

4-189. Turn the transmitter on at HIGH POWER.

4-190. The digital reading on function 02 should agree with the DC Ammeter.

WARNING

IF ACCESS TO THE AC CONTROLLER IS REQUIRED IN THE FOLLOWING STEPS, REMOVE ALL POWER FROM THE TRANSMITTER BEFORE ATTEMPTING ACCESS.

4-191. If the digital reading does not agree with the reading on the external DC Ammeter, it will be necessary to adjust R23 on the AC Controller board A25. Due to the limited access of the AC Controller board, all power will have to be removed from the transmitter before making the adjustment. Adjust R23 slightly and then recheck the calibration.

4-192. Repeat until R23 is properly adjusted to agree with the external DC Ammeter reading.

WARNING

ENSURE ALL POWER IS REMOVED FROM THE TRANSMITTER BEFORE ATTEMPTING TO REMOVE THE LEADS IN THE FOLLOWING STEP.

4-193. Remove all power from the transmitter and remove external DC Ammeter's leads from cabinet. Be sure to reconnect the black welding cable to the shunt.

4-194. OVERLOAD ADJUSTMENT PROCEDURES

4-195. All overload threshold adjustments are made on A12, the Status and Multimeter board.

4-196. R55 OVERVOLTAGE (STATUS INDICATION "1")

4-197. Check the supply voltage on the digital display (* or #01). Compare this reading to the figure on the factory test data sheet. If the present reading differs significantly from the test data value, an appropriate adjustment will have to be made in the transformer tapping.

WARNING

ENSURE ALL AC POWER IS REMOVED FROM TRANSMITTER AND THAT GROUNDING STICK IS USED TO REMOVE ANY RESIDUAL VOLTAGE THAT MAY BE PRESENT BEFORE MAKING ANY ATTEMPT AT CHANGING ANY TRANSFORMER TAPS.

4-198. After an acceptable supply voltage has been observed, reduce the power output to zero by switching to low power and depressing the LOWER pushbutton. This will allow the supply voltage to increase due to the absence of a load on the supply.

4-199. Rotate R55 counterclockwise until the transmitter trips off and displays the fault condition. Rotate R55 one and one-half turns clockwise from this point.

4-200. R54 POWER SUPPLY CURRENT (STATUS INDICATION "16") AND R57 PA CURRENT (STATUS INDICATION "2")

NOTE

R54 and R57 overload adjustments need to be set so that R57 (PA CURRENT) trips slightly before R54 (POWER SUPPLY CURRENT). This is accomplished by setting both overloads under the same conditions but backing the R54 overload off by 1/3 of a turn.

4-201. Check the present PA CURRENT reading (* or #05) against the value on the factory test data sheet for the same operating conditions. If the present reading is significantly higher, it will be necessary to investigate the cause before proceeding with the following R57 adjustment.

4-202. Locate R57 on the Status and Multimeter board and turn clockwise approximately three turns.

4-203. Check the present power supply current reading (* or #02) against the value on the factory test data sheet for the same operating conditions. If the present reading is significantly different, it will be necessary to investigate the cause before proceeding with the R54 adjustment procedure.

4-204. With the transmitter operating at 110% power output (1100 watts for SX-1, 2750 watts for SX-2.5, and 5500 watts for SX-5), modulate with 20 Hz to 100%. Increase the audio level 0.5dB (6%). Adjust R54 counterclockwise until the transmitter faults. Adjust R54 1/3 of a turn clockwise from this trip point. FAULT light should now be illuminated but transmitter should be producing full power.

4-205. Adjust R57 counterclockwise until the transmitter faults. Leave R57 at this setting. Transmitter FAULT light should remain illuminated but transmitter should be cycling on and off.

4-206. Decrease audio level 0.5dB (6%) and verify that transmitter is producing full power.

4-207. R58 UNDERDRIVE (STATUS INDICATION "4")

4-208. Before adjusting the underdrive threshold, verify the rf drive on the PA module to be within normal limits. Refer to the IPA tuning procedure for specific information on checking the drive level.

4-209. Modulate the transmitter to 100% with 400 Hz at 110% power output (1100 watts for SX-1, 2750 watts for SX-2.5, and 5500 watts for SX-5). Adjust R58 clockwise until the transmitter trips off and displays the fault. Rotate R58 one and one-half turns counterclockwise from the trip point.

4-210. R56 OVERDRIVE (STATUS INDICATION "8")

4-211. Before adjusting the overdrive threshold, verify the rf drive on the PA module to be within normal limits. Refer to the IPA tuning procedure for specific information on checking the drive level.

4-212. Modulate the transmitter to 100% with 400 Hz at 110% power output (1100 watts for SX-1, 2750 watts for SX-2.5, and 5500 watts for SX-5). Adjust R56 counterclockwise until the transmitter trips off and displays the fault. Rotate R56 one and one-half turns clockwise from the trip point.

4-213. R51 VSWR - REFLECTED POWER (STATUS INDICATION "32")

WARNING

ENSURE THAT THE POWER OUTPUT IS ALL THE WAY DOWN BEFORE CHANGING THE POSITION OF P2 AND P3 IN THE FOLLOWING STEP. IF P2 OR P3 ARE REMOVED WHILE THERE IS STILL POWER OUTPUT, ARCING MAY DEVELOP AT P2 AND P3.

4-214. Set the power output to 90 watts for SX-1, 200 watts for SX-2.5, or 400 watts for the SX-5 using the LOW power position and the LOWER push-button. Shut the transmitter off and allow time for the power output to reach zero. Remove and rotate 90 degrees plugs P2 and P3 on the Directional Coupler. These are accessed through a hole in the top of the cabinet, towards the right rear (as viewed from front of transmitter). A set of needlenose pliers will be needed.

4-215. Turn the transmitter back on at the power level set in the previous paragraph. Forward power will now read zero and reflected power will be the same as set in the previous paragraph. Adjust R51 counterclockwise to the point where the sensing circuit operates. Adjust R51 one third of a turn clockwise from the point where the sensing circuit operated.

WARNING

ENSURE THAT THE POWER OUTPUT IS ALL THE WAY DOWN BEFORE CHANGING THE POSITION OF P2 AND P3 IN THE FOLLOWING STEP. IF P2 OR P3 ARE REMOVED WHILE THERE IS STILL POWER OUTPUT, ARCING MAY DEVELOP AT P2 AND P3.

4-216. Shut the transmitter off and wait for the power output to reach zero. This will take longer than normal due to the low power setting and the action of the VSWR protection circuit. Put P2 and P3 back in their original positions on the Directional Coupler.

4-217. R53 VSWR - PHASE ANGLE DETECTOR (STATUS INDICATION "64")

WARNING

DO NOT MODULATE THE TRANSMITTER WHEN PERFORMING THE FOLLOWING PROCEDURE.

4-218. Clear the # display with a #99 entry on the Keypad.

4-219. While on HIGH power, rotate the PA TUNING control to the left while watching *20 on the Digital Display. When *20 reaches 3.30, the VSWR protection should operate and a "64" should be displayed on the # display.

4-220. If a "64" is not displayed on the # display, rotate R53 counterclockwise until it does appear.

4-221. If a "64" is displayed before *20 reaches 3.30, rotate R53 clockwise until the *20 reading can be raised to 3.30. Clear the overload display with a #99 entry on the Keypad and then rotate R53 counterclockwise until the "64" reading is displayed on the # display.

4-222. Rotate TUNING control to the right to minimize the *20 reading.

4-223. TUNING PROCEDURE

4-224. IPA TUNING PROCEDURE

WARNING

ENSURE THE HIGH VOLTAGE AND LOW VOLTAGE ARE TURNED OFF BEFORE PROCEEDING WITH THE FOLLOWING STEPS.

4-225. With the high voltage and the low voltage off, connect an oscilloscope across R13 on the PA module A1. If R13 is not used, place the probe on the appropriate standoff. The ground lead of the oscilloscope should connect to the side of R13 away from the copper heatsink.

4-226. Set the low voltage circuit breaker to ON. There should be approximately 25-30 volts p-p of rf drive present. This checks the rf drive to Q11 and Q12. Now proceed to check the rest of the drive levels on both modules. All levels should be relatively equal; within the 25-30 volt p-p range.

4-227. The IPA tuning coil (A26L1) is normally set at or very near the peak of rf drive voltage. The best IPA tuning occurs at the peak of rf drive or slightly on the capacitive side.

WARNING

BEFORE MAKING ANY CHANGE IN THE TAP SETTING ON THE IPA COIL, REMOVE THE LOW VOLTAGE BY SETTING THE LOW VOLTAGE CIRCUIT BREAKER TO OFF. THE IPA PRODUCES ENOUGH POWER TO CAUSE AN RF BURN.

4-228. Before making any change in the tap setting, shut off the low voltage. THE IPA PRODUCES ENOUGH POWER TO CAUSE AN RF BURN.

WARNING

REMOVE ALL POWER FROM TRANSMITTER BEFORE MAKING ANY ADJUSTMENTS TO A20R3 OR A20R4.

4-229. If the rf drive exceeds 32 volts p-p, the tap on A20R3 and A20R4 should be adjusted to a higher resistance.

4-230. Proper IPA tuning may be found by making small incremental adjustments to the tap on the IPA tuning coil and then observing the results on the oscilloscope.

NOTE

Changing the PA module (A1) should not require the retuning of A26L1.

4-231. It is desired that the Oscillator board drive the IPA sufficiently to produce stable, yet efficient class D operation. Under-driving the IPA will yield poor stability. Over-driving the IPA will cause a decrease in IPA efficiency and overworking of the Oscillator output transistors.

4-232. Move the scope connections to the IPA, A5. Place the probe on either of the transistors to the inside, Q12 or Q13. A 30 to 60 volt p-p rf square wave with ringing should be present on both Q12 and Q13.

4-233. Adjust R27 on A16, the RF Oscillator and observe the IPA waveform on the oscilloscope. As the drive to the IPA is decreased, ringing will decrease. Eventually, the IPA transistors will stop operating in class D (switching) mode and will possibly oscillate.

4-234. Adjust A16R27 so that the IPA is operating in stable class D fashion, but do not adjust R27 so far that considerable ringing is produced on the IPA waveform.

4-235. TUNING AND LOADING CONTROLS

4-236. The TUNING and LOADING controls should initially be adjusted to minimize reflected power. This may seem a bit unconventional, but is due to the location of the Directional Coupler within the Output Network.

4-237. During the initial tune-up, the null in reflected power should be found to be well within the range of the TUNING and LOADING controls. If these controls require considerable adjustment, the antenna is probably not properly tuned. The impedance at the transmitter output terminal should be measured and adjusted if necessary.

4-238. More exact adjustment of the TUNING and LOADING controls may be obtained by using position 20 on the Digital Display. Minimize the number on position 20 by alternate adjustment of the PA TUNE and LOAD controls. The minimum position 20 number should coincide with minimum reflected power.

4-239. Slight adjustment of the PA TUNING control may be made to improve intermodulation distortion (IMD) by a few tenths of a percent. This may result in some reflected power being indicated. Reducing IMD with the TUNING control sacrifices PA efficiency to some degree, so it is wise to monitor the PA efficiency while making this adjustment. PA TUNING should not be moved more than one-half turn to reduce IMD.

4-240. ADJUSTING THE MODULATION MONITOR SAMPLE OUTPUT

4-241. The modulation monitor sample circuit consists of a capacitive divider with the adjustable portion of the circuit located on the RFI board A24. A BNC connector is provided on the RFI board for connecting to a modulation monitor.

4-242. The level out of the BNC connector is primarily dependent on the fixed capacitors that are installed in the RFI board next to the trimmer capacitors. These capacitors are normally factory selected for customer operating power levels but the switches associated with the capacitors allow customer selection of which capacitors will be in circuit. The trimmer capacitors (C40 thru C43) allow fine adjustment of the modulation monitor sample level for each of the customer power levels.

4-243. C40, the bottom trimmer affects the sample level at all three power levels.

4-244. C41 is exclusively for low power (located just to right of C40).

4-245. C42 is exclusively for medium power (located just to right of C41).

4-246. C43 is exclusively for high power (located just to right of C42).

WARNING

ENSURE ALL POWER IS REMOVED FROM TRANSMITTER PRIOR TO MAKING ANY OF THE ADJUSTMENTS IN THE FOLLOWING STEPS AND GROUND ALL CONNECTIONS WHERE POWER HAS BEEN APPLIED.

4-247. Due to the proximity of the trimmer capacitors to high voltage, it is advised that these adjustments be made through a succession of trial and error settings, with changes in settings made with all voltage removed from transmitter.

4-248. Tightening the trimmer capacitors will reduce the monitor level. Loosening will increase the monitor level. Adding capacitors in positions parallel to the trimmer capacitors will reduce the monitor level. Taking these capacitors out will increase the monitor level. Adding or subtracting amounts of fixed capacitance should only be done if the trimmer capacitors will not adjust to the proper level.

4-249. SX-1 TOP REMOVAL PROCEDURE

WARNING

ENSURE ALL POWER IS REMOVED AND NETWORK COMPONENTS ARE SHORTED WITH SHORTING STICK BEFORE PERFORMING THE FOLLOWING PROCEDURE.

4-250. Make sure all power is turned off and network components are shorted with shorting stick.

4-251. Remove eight screws holding perforated bottom shield on L1 cover and remove shield. Refer to figure 4-1.

4-252. Mark position of clip on L1 and then remove and fold strap back into C1 compartment.

4-253. Mark position of clip on L7 and then remove clip and fold back near L5.

4-254. Remove 10-32 Phillips head screw from C3 connector strap that goes to L4.

4-255. Remove BNC coax connector on J2 (cable A27A1P2).

4-256. Remove the two 6-32 screws holding Directional Coupler shield to side panel bracket (near left side of L2 looking in from back of cabinet) - see figure 4-2.

4-257. Remove two 6-32 screws that hold the Directional Coupler shield to cabinet top. (Screws are located on top of cabinet.) See figure 4-3.

4-258. Remove the Directional Coupler shield from cabinet by taking it forward and down past the end of L2.

4-259. Disconnect the BNC coax connector from Directional Coupler PC board jack J1 located above and to the left of L2.

4-260. Disconnect the blue ribbon plug from jack on Directional Coupler PC board unit located above and to the left of L2.

4-261. Remove the 1/4-20 nut and lock washer from L1 support bolt on top of cabinet.

4-262. Remove all of the 8-32 screws around the perimeter of top access panel. See figure 4-3.

4-263. From the rear of transmitter, grasp both handles on top access panel and lift straight up until L2 clears transmitter top. Then remove complete assembly toward rear of cabinet and down to desired work area.

4-264. Reinstall the SX-1 top by reversing the above procedure.

CAUTION

TO PROTECT DIRECTIONAL COUPLER ASSEMBLY WHEN REINSTALLING SX-1 TOP, KEEP RIGHT HAND SIDE OF TOP ASSEMBLY (AS VIEWED FROM REAR) AGAINST CABINET SIDE WHEN LOWERING TOP ASSEMBLY INTO CABINET.

4-265. TECHNICAL ASSISTANCE

4-266. HARRIS Technical and Troubleshooting assistance is available from HARRIS Field Service during normal business hours (8:00 a.m - 5:00 p.m. Central Standard 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 Group, P.O. Box 4290, Quincy, Illinois 62305-4290, USA. The HARRIS factory may also be contacted through a TWX facility (910-246-3312) or a TELEX service (40-4347).

WARNING: Disconnect primary power prior to servicing.

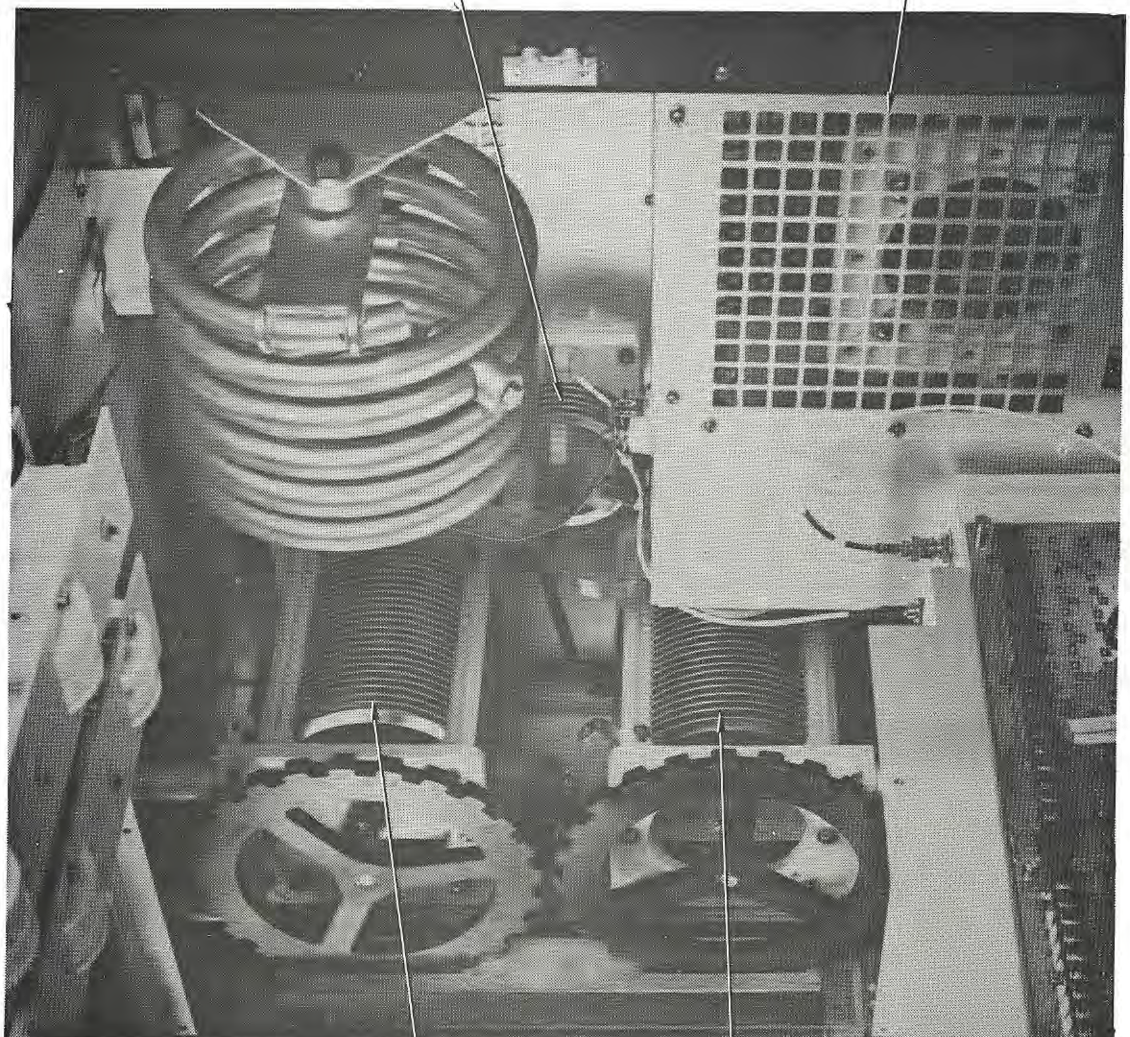
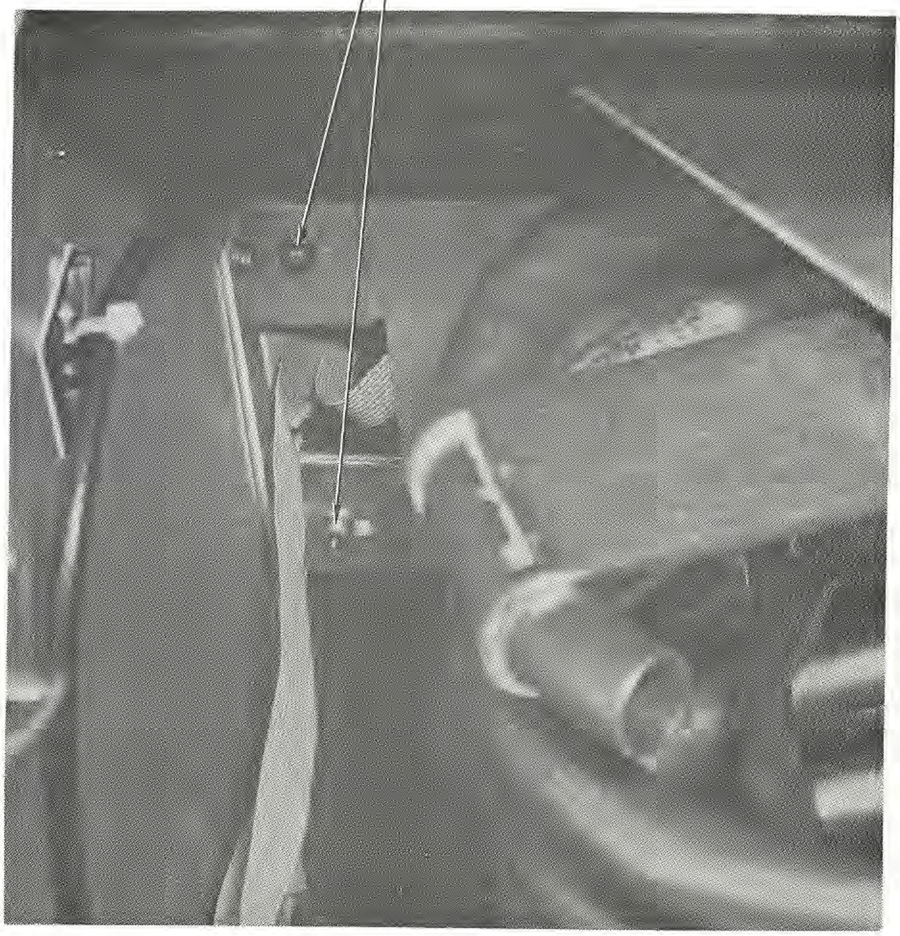


Figure 4-1. View Showing L1 Cover

WARNING: Disconnect primary power prior to servicing.

TWO DIRECTIONAL COUPLER COVER SCREWS THAT ARE TO BE REMOVED. DO NOT REMOVE SCREWS THAT ATTACH TO SIDE WALL.



2126-14

Figure 4-2. Directional Coupler Cover Screws

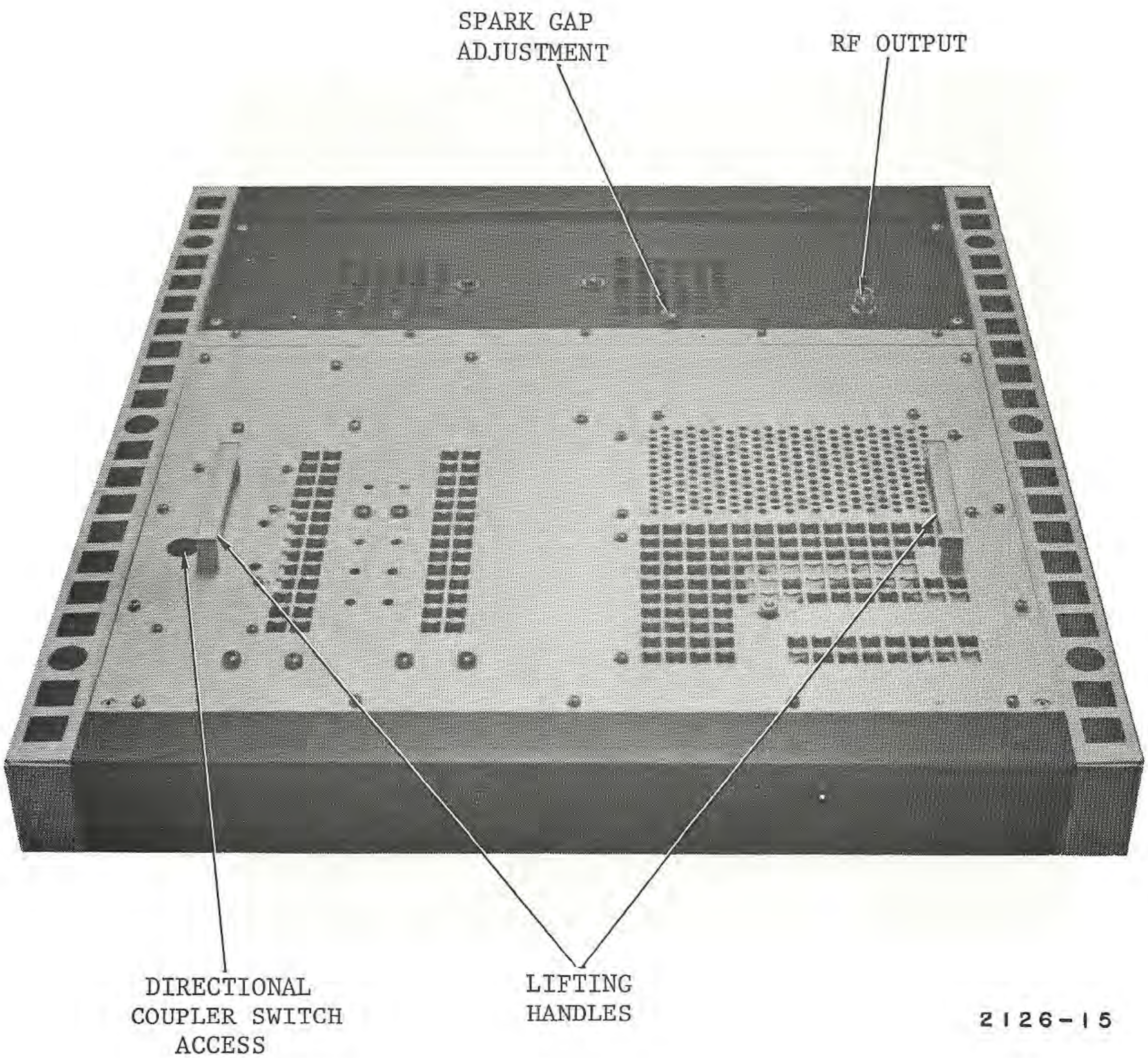


Figure 4-3. Top of SX-1

WARNING: Disconnect primary power prior to servicing.

SECTION V

TROUBLESHOOTING

5-1. INTRODUCTION

5-2. This section of the technical manual will contain troubleshooting procedures for the SX-1 AM TRANSMITTER.

Table 5-1. Troubleshooting The SX-1 AM TRANSMITTER

WARNING: Disconnect primary power prior to servicing.

Table 5-1. Troubleshooting The SX-1 AM TRANSMITTER (Continued) Page

WARNING: Disconnect primary power prior to servicing.

Table 5-1. Troubleshooting The SX-1 AM TRANSMITTER (Continued) Page

WARNING: Disconnect primary power prior to servicing.

5-3. INITIAL TROUBLESHOOTING

5-4. The following paragraphs are a guide to the most basic problems and will hopefully guide the technician to more extensive levels of troubleshooting as it becomes necessary.

5-5. SYMPTOM: TRANSMITTER WILL NOT TURN ON - NO CONTROL BUTTONS ARE ILLUMINATED

5-6. POSSIBLE CAUSES.

5-7. Loss of AC Power. Look at the amber indicators down by the Low Voltage circuit breaker at the bottom of the cabinet. If the circuit breaker is up and both indicators are illuminated, the AC power is probably alright.

5-8. Loss Of 5 Volt Power Supply. Look at the digital display. If it is illuminated, the 5 volt supply is working. If not, refer to the paragraphs on troubleshooting a 5 volt supply failure.

5-9. Loss Of Plus Or Minus 15 Volts. Use a voltmeter to check the voltage at P13 which is connected to A12, the Status and Multimeter board. Pins 1 and 4 should have +15 volts. Pins 2 and 3 should have -15 volts. The regulators providing these voltages are on the AC Controller board. Refer to the schematic of the AC Controller board if troubleshooting is necessary.

5-10. System Controller Locked Out. Inspect both System Controller boards in the pull out drawer. Check to see if the green or red LED's are illuminated. Red signifies a System Controller is locked out. Attempt to reset them by depressing the RESET switch in the middle of each board.

5-11. Loose Ribbon Connectors. Make sure all ribbon connectors are fully seated and locked in place on all boards in the pull out drawer. Do this for the RFI board (A24) as well.

5-12. Single System Controller Malfunction. Unplug P1 only from either System Controller board. Check to see if the transmitter will turn on. If it will not, try operating the other System Controller board by plugging the first one back in and unplugging P1 from the other one.

NOTE

Do not remove any plugs while the power is on.

5-13. SYMPTOM: TRANSMITTER WILL NOT TURN ON - FAULT LAMP ILLUMINATED

5-14. POSSIBLE CAUSES.

5-15. Fault Status. Check fault status on the digital display by entering * or #00. Try to clear the fault status by entering * or #99. A fault code will be displayed which may be found under Possible Causes for Overloads.

5-16. SYMPTOM: LOW, MED, OR HIGH PUSHBUTTON INDICATORS ILLUMINATE, BUT CONTACTORS DO NOT ENERGIZE. NO FAULT LAMP ILLUMINATED OR STATUS INDICATED.

5-17. POSSIBLE CAUSES.

5-18. Open Door. Make sure the door is closed and latched. Make sure the door closure actually closes the interlock switch. A "click" should be audible as the door is pushed shut.

WARNING

BEFORE PERFORMING THE FOLLOWING STEP, DISCONNECT ALL POWER FROM THE TRANSMITTER AND USE GROUNDING STICK TO DISCHARGE ALL POINTS BEFORE TOUCHING THEM.

5-19. Failsafe Interlock Open. A closure should be provided between A23TB1-14 and -18 for normal operation. If a remote control system or other equipment is connected to these terminals, check for the closure at the interlock terminals. Turn the low voltage OFF and ground the terminals with a grounding stick before using an ohmmeter to check for closure.

5-20. Fuse Open. Check F1 on A25, the AC Controller board. Also check A20F1 located next to A20T1, the low voltage transformer.

5-21. AC Voltages On A25. Connect an AC voltmeter to F1 on the AC Controller board. 24 VAC should be present if the low voltage is on, A20F1 is good, and a closure is provided between A23TB1-14 and -18.

5-22. If any of the ON pushbuttons (LOW, MEDIUM, or HIGH) are depressed, 24 VAC should appear momentarily at J2-6 on A25. It will not be necessary to close the door for this test.

5-23. Open Contactor Coil. If the voltage appears at J2-6 in the preceeding step, then it is possible that the coil of K2 is open. Shut the low voltage off and ohmmeter check from J2-6 to ground. The circuit under test will be the coil of K2, the door interlock, and the associated wiring.

5-24. SYMPTOM: TRANSMITTER FAULT LIGHT ILLUMINATED. RAISE LIGHT ILLUMINATED. ALL THREE PANEL METERS INDICATE UP SCALE APPROXIMATELY 1/8 AND ARE OSCILLATING. POSITION 00 ON KEYPAD SHOWS 32, 64, or 96.

5-25. This indicates that an extreme VSWR overload is occurring and that the transmitter is continuously recycling to protect itself.

5-26. POSSIBLE CAUSES.

5-27. Transmitter Grossly Mistuned Or Antenna Problem. Operate transmitter into known good load.

5-28. <u>RF Contactor Or Transmission Line Connector Failure</u>. Give physical inspection.

5-29. <u>Acorn Arc Gap Above Loading Control</u>. Check for arcing or insufficient spacing.

5-30. <u>Output Tuning Or Loading Control Defective</u>. Check for smooth operation and obvious arcing.

5-31. <u>Burnt Or Loose Connections In Output Network</u>. Give good physical inspection.

5-32. <u>Phase Angle Detector Cable Bad Or Disconnected</u>. Repair or reconnect.

5-33. <u>Glass Arc Gap On Directional Coupler Board</u>. Remove and see if VSWR diminishes.

5-34. SYMPTOM: TRANSMITTER MAY OR MAY NOT BE ABLE TO BE TURNED ON. THE DIGITAL DISPLAY MAY BE GARBLED. THE TRANSMITTER MAY WANT TO PERFORM AN "ON" FUNCTION BY ITSELF

5-35. One or both of the System Controllers are not feeding the proper data to the Status and Multimeter board.

5-36. POSSIBLE CAUSES.

5-37. <u>Power Supply Voltages On Status And Multimeter Board</u>. Check power supply voltages on Status and Multimeter board and System Controller boards. Check for +5V on J14 Molex pin 3. Check for +15V on J13 Molex pins 1 and 4. Check for -15V on J13 Molex pins 2 and 3.

5-38. <u>Ribbon Cable Connections</u>. Ensure that all ribbon cable connectors are locked into their proper socket and are tight. Check the connectors on the Status and Multimeter, System Controllers, and RFI boards.

5-39. <u>System Controller Board</u>. Turn off transmitter low voltage and disconnect the large ribbon connector from one of the System Controller boards. Turn low voltage on and check operation. If ok replace or troubleshoot System Controller board. If problem persists, reconnect the first System Controller and disconnect the other one to see if it is the problem.

5-40. <u>Status And Multimeter Board</u>. If the System Controllers are not suspect, the Status and Multimeter board may be. Replacement or troubleshooting is required.

5-41. SYMPTOM: TRANSMITTER OPERATES NORMALLY BUT ALL DIGITAL DISPLAY VOLTAGES READ INCORRECTLY

5-42. Depress #52 on Keyboard. This should read +10.00. If off by more than 0.02V and if it cannot be adjusted by R59 on Status and Multimeter board, then the analog to digital converter is at fault.

5-43. POSSIBLE CAUSES.

5-44. U40, The Analog To Digital Converter Is Bad. Check for +12V on pin 40, +5V on pin 39, and -5V on pin 9. Depress *52 and #52 on Keyboard. If all parameters above are okay, U40 is suspect.

5-45. U38, 10V Reference. Pin 3 of U40 should be 10.00 VDC. If not, replace U38.

5-46. Q31, Q30, U40's Voltage Regulators. If the +12 or -5 voltage supplies to U40 are not correct, these regulators may be bad.

5-47. U57 Analog Buffer. Depress *52 and #52 on Keypad. Measure the voltage on U57 pin 3 and U57 pin 2 - both should be +10V. If not 10V suspect U57.

5-48. SYMPTOM: TRANSMITTER SHUTS OFF IMMEDIATELY AFTER TURN ON, CONTACTORS CLICK OR CHATTER OR DROP OUT INTERMITTENTLY

5-49. POSSIBLE CAUSES.

5-50. Fault Status. Check fault status on the digital display by entering * or #00. Attempt to clear the fault status by entering * or #99. A fault code will be displayed which may be found under Possible Causes for Overloads.

5-51. If no fault status is indicated, check for intermittent interlock wire or switch.

5-52. Possible dirty contacts on K1 and/or K2 which supply control signals to the System Controller.

5-53. Open step-start resistor.

5-54. SYMPTOM: TRANSMITTER STAYS ON (CONTACTORS ENERGIZED), BUT NO POWER OUTPUT AND HIGH VOLTAGE SUPPLY MAY OR MAY NOT BE ON

5-55. Enter * or #01 on the digital display. This should normally be 240-260 volts with the transmitter in any of the ON modes. If the supply voltage is zero, there is possibly an open in the HV circuitry, blown B+ fuses, or no AC voltage is being supplied to TB1-1 and -2. If the transmitter was installed with separate primary power circuits, check the one which provides power for the high voltage supply. If a lack of supply voltage is not the problem, refer to the paragraphs under Troubleshooting the PDM Generator, beginning with NO PULSES AT J4, causing zero power output from the transmitter.

WARNING: Disconnect primary power prior to servicing.

5-56. SYMPTOM: REMOTE CONTROL FUNCTIONS DO NOT WORK

5-57. POSSIBLE CAUSES.

5-58. REMOTE/LOCAL Switch. Check to see that the REMOTE/LOCAL switch on the Status and Multimeter board is in the REMOTE position.

5-59. Remote Control Improperly Wired. Review the installation instructions in Appendix A.

5-60. Remote Control Unit Not Functioning. Check the remote unit to see that it is providing closures to the transmitter. Otherwise, use a clip lead to momentarily provide the contact closures at the remote control unit to see which equipment is at fault.

5-61. Loss Of +10 Volts. Check at A23TB1-20 for 10 VDC when the low voltage is ON. If it is not present, A20CR2 and/or A20R5 may be at fault.

5-62. Ribbon Connectors Loose. Ensure that the ribbon connectors on the Customer Interface boards are fully seated. Also do the same on the Status and Multimeter board.

5-63. Optical Isolator Failure. Failures in this area would probably inhibit only those inputs with defective optical isolators. Ohmmeter test the input side of A12U2, U3, and U4 at the Customer Interface board. They should test as diodes. Otherwise measure across each optical isolator input on A12 to see if a voltage is being applied as the remote control circuits are activated.

5-64. TROUBLESHOOTING A 5 VOLT SUPPLY FAILURE

5-65. Loss of the 5 volt supply will result in the transmitter appearing almost as though the ac power has been disconnected. The digital display will be dark and the transmitter cannot be turned on. The neon indicators beside the low voltage circuit breaker should still be illuminated, showing that ac is still being applied to the transmitter.

5-66. Set the LOW VOLTAGE circuit breaker to OFF and open the back door.

5-67. Check F4 on the AC Controller board A25. A blown fuse could be an indication of a failure in the 5 volt supply, but not necessarily. Replace F4 if blown.

5-68. Disconnect P14 from the Status and Multimeter board A12. This is the cable that supplies 5 volts to A12. Disconnecting P14 will take the load off of the 5 volt supply.

5-69. Connect a dc voltmeter to between P14-3 (wire #63) and ground.

CAUTION

IN THE FOLLOWING STEPS ONLY MOMENTARILY SET THE LOW VOLTAGE CIRCUIT BREAKER TO ON TO MINIMIZE THE POSSIBILITY OF DAMAGING THE +5 VOLT FILTER COMPONENTS ON THE AC CONTROLLER BOARD. NEVER LEAVE THE LOW VOLTAGE CIRCUIT BREAKER ON FOR MORE THAN 5-10 SECONDS IF A SYMPTOM EXISTS IN THE +5 VOLT POWER SUPPLY. IF ANY ODOR IS OBSERVED OR IF ANY OF THE FILTER CAPACITORS ON THE AC CONTROLLER BOARD APPEAR TO BE DAMAGED, DO NOT APPLY LOW VOLTAGE TO THE TRANSMITTER UNTIL THE CAUSE OF THE DAMAGE HAS BEEN DETERMINED AND THE DAMAGED FILTER CAPACITORS HAVE BEEN REPLACED.

5-70. Momentarily set the LOW VOLTAGE circuit breaker to ON. Normally the voltage at P14-3 would be about 6 volts, but in this case may be 30 volts.

5-71. If the voltage at P14-3 is normal (6 volts), there is probably no fault with the 5 volt supply. The fault is more likely with the 5 volt components on the Status and Multimeter board or one of the System Controller boards. Plug P14 back in and see if the digital display stays illuminated.

5-72. If the voltage at P14-3 is about 30 volts, Q1 on the AC Controller board A25 is probably shorted. With Q1 shorted, the output of U6-12 should be high (+30 volts), indicating an effort to shut Q1 off.

5-73. Q1 is an IRF9130, a p channel MOSFET. The procedure for ohmmeter testing MOSFETS may be used, except reverse all polarities for this type of transistor.

5-74. If U6-12 is low, the fault is probably in U6.

5-75. After replacing the suspected component, verify that the voltage at P14-3 is normal (6 volts) before connecting P14 to J14 on the Status and Multimeter board.

5-76. POSSIBLE CAUSES FOR OVERLOADS

5-77. FAULT STATUS INDICATION "1", POWER SUPPLY VOLTAGE

5-78. SUPPLY VOLTAGE TOO HIGH. Check * or #01 on the digital display. Compare this reading with the value recorded on the factory test data.

WARNING

ENSURE ALL AC VOLTAGE HAS BEEN REMOVED FROM THE TRANSMITTER AND THAT THE GROUNDING STICK IS USED TO REMOVE ANY RESIDUAL VOLTAGE THAT MAY BE PRESENT BEFORE THE TAPS ON THE HIGH VOLTAGE TRANSFORMER ARE CHANGED.

5-79. If the present 01 reading is significantly higher, remove all ac voltage being supplied to transmitter and retap the high voltage power supply transformer to the next higher primary number. For example, if the transformer is presently tapped to 240/0, change the tapping to 240/+11 to reduce the supply voltage.

5-80. If the transmitter has been operating with the proper supply voltage for some time, and only recently increased, check to see if the power line voltage has increased.

5-81. OVERLOADS WITHOUT THE HIGH VOLTAGE ON. Check the 01 reading on the digital display. It should be zero. If this function shows a voltage (possibly higher than a normal operating parameter), suspect U1 on A25, the AC Controller board.

5-82. If 01 shows a zero indication, it is likely there is a fault on the Status and Multimeter board A12. The fault may be with U44 or U46 on A12.

5-83. FAULT STATUS "2", PA CURRENT OVERLOAD

5-84. RANDOM TRIPS WITH AUDIO. PA current overloads may be caused by overmodulation or subaudible signals. Check your modulation level. It may be wise to check the calibration of the modulation monitor if it has not been calibrated recently. It is possible the monitor is reading low and in fact the transmitter is being overmodulated.

5-85. If the modulation level is proper, then there may be subaudible signals getting to the transmitter. The SX series of transmitters and some modern day audio equipment can pass subaudible signals. Take note of when the overloads occur. It may be possible to relate the overloads to a particular source. Turn-table rumble, especially START-UP RUMBLE, can be of such level to cause PA current overloads. The solution may be to perform service on the source of the subaudible signals or install a filter in the program line. Some audio processors have switchable low frequency cut-off filters. These will filter out the subaudible signals without degrading the ON AIR sound of the transmitter.

5-86. PA CURRENT OVERLOADS AT TURN ON. If a PA current overload occurs everytime an attempt is made to turn the transmitter on, there is most likely a problem in the modulator system. If PA AMPS and POWER OUTPUT meters deflect upwards at each turn on, it is evident there is current actually flowing in the PA. Investigate the possible modulator problem. Refer to paragraph on shorts in the modulator system for more information.

5-87. PA CURRENT OVERLOADS, CONTINUOUS CYCLING. This most likely indicates a PDM Generator problem. Refer to section on troubleshooting the PDM Generator - outputs at J4 always high.

5-88. PA CURRENT OVERLOADS WITHOUT THE HIGH VOLTAGE ON. This is indicative of a problem in the overload circuitry since PA current cannot actually exist with the high voltage off. Check to see if the PA AMPS meter is reading upscale. If it is, check or replace U3 on A25, the AC Controller board. If the PA AMPS meter is reading zero, there is likely a defective IC on the Status and Multimeter board.

5-89. FAULT STATUS INDICATION "4", UNDERDRIVE

5-90. Refer to the section on troubleshooting the rf drive system. Low drive could be caused by mistuning of the IPA, abnormally low IPA supply voltage, or certain failed components in the IPA section.

5-91. If the rf drive system is normal, there may be a faulty component on the Status and Multimeter board A12. Follow the overload adjustment procedure to check the sensitivity of the overload. If the rf drive level is normal but the overload condition will not clear check or replace A12 U44 or U46. Refer to the troubleshooting section on the Status and Multimeter board.

5-92. FAULT STATUS INDICATION "8", OVERDRIVE

5-93. Overdrive may be caused by excessive IPA supply voltage. On the SX-1 and SX-2.5, check the voltages at the fuses on the PDM Generator board A15. There should be +30 volts ± 2 volts at F1 and -30 volts ± 2 volts at F2. Check the rf drive voltage on the PA as directed in the section on troubleshooting the rf drive system. If the rf drive voltage is found to be within limits (23-32 volts) there is not an overdrive condition. If the rf drive is found to be above 32 volts, refer to the procedure for IPA tuning. On the SX-5, check the voltage on the IPA and refer to the Factory Test Data Sheets.

5-94. If there is an overdrive fault indicated, but no actual overdrive condition exists, check the sensitivity of the overdrive threshold using the procedure for overload adjustment. If the fault will not clear, refer to the section on troubleshooting A12 the Status and Multimeter board. A12 U44 or U46 may be at fault.

5-95. FAULT STATUS INDICATION "16", POWER SUPPLY CURRENT OVERLOAD

5-96. RANDOM TRIPS WITH AUDIO. Refer to paragraph entitled RANDOM TRIPS WITH AUDIO under the heading FAULT STATUS "2", PA CURRENT OVERLOADS. All of the information presented there is applicable to this overload also.

5-97. SHORTED DAMPER DIODE. A shorted damper diode will cause high amounts of supply current to be drawn when the PDM Amplifiers are conducting. With a zero pulse width setting (* or #44 reading of 000) a shorted damper diode will have no effect and the high voltage will stay on. Check to see if the heavy supply current is drawn with a 000 pulse width setting. A 000 pulse width setting may be obtained by opening an interlock (back door), selecting a power level, and then depressing the LOWER pushbutton until 000 is displayed on the digital readout on the * or #44 function.

WARNING

ENSURE ALL AC VOLTAGE HAS BEEN REMOVED FROM THE TRANSMITTER AND THAT THE GROUNDING STICK IS USED TO REMOVE ANY RESIDUAL VOLTAGE THAT MAY BE PRESENT BEFORE THE FOLLOWING STEPS ARE PERFORMED.

CAUTION

NEVER OPERATE THE TRANSMITTER WITHOUT THE DAMPER CIRCUIT COMPLETE. THE VOLTAGES IN THE PDM CIRCUITRY WILL RISE TO A DESTRUCTIVE LEVEL WITHOUT THE COMPLETE DAMPER CIRCUITRY.

5-98. If supply current soars as the pulse width is brought up, check the damper diodes, A6 and A7 CR1. This may be done with an ohmmeter. The damper diode (CR1) is located between the pairs of MOSFETs on the PDM Amplifiers. The cathode is the case. The anodes connect to the cases of each MOSFET. The damper diodes may be checked without removing them from the modules. To completely isolate the cathode side of the damper diodes, the PDM PULL-UP boards should be removed. Never attempt to operate the transmitter with a PDM PULL-UP board removed. Operating without the damper circuit complete, the voltages in the PDM circuitry will rise to a destructive level.

5-99. MECHANICAL FAILURE OF SAFETY SHORTING SWITCHES ON DOORS.

5-100. SHORTED B+ FILTER CAPACITOR (MAY ONLY SHORT OUT WHEN HV IS APPLIED).

5-101. MODULATOR EFFICIENCY. A decrease in modulator efficiency could cause supply current overloads. Compare the factory test data values for supply voltage (* or #01) and supply current (* or #02) versus the existing values for these parameters. If the existing supply volts multiplied by the supply amps product is higher than the product of these figures on the factory test data for the same rf power output, the modulator efficiency is indicated to be lower. This means there is either a modulator efficiency problem or a metering problem; either of which could cause supply current overloads.

5-102. Checking out the metering involves putting a dc ammeter in series with the power supply shunt. Refer to the section on meter calibration.

5-103. Check temperature readings of A6 and A7, the PDM Amplifiers on the digital display (* or #16 and 17). Higher than normal readings could indicate poor modulator efficiency but these readings are also dependent upon conditions affecting heat transfer.

5-104. Modulator efficiency is dependent on the rise and fall times of the PDM drive pulse. Connect an oscilloscope across the gate resistors R21, R22, R41, and R42 on A6 and A7. A rise time of 45 nsec and a fall time of 66 nsec is typical.

5-105. FAULT STATUS INDICATION "32", VSWR (DIRECTIONAL COUPLER REFLECTED SAMPLE)

5-106. TRIPS OCCUR WITH HIGH LEVELS OF MODULATION AND HIGH POWER. If this problem is encountered in the first hours of operation, there may be a set-up problem. Refer to the initial turn on procedure and maintenance section where PA tuning and PA loading are described.

5-107. Check the reflected power reading on the front panel. This reading should be zero. An increase in the reflected power would indicate that the load impedance has changed from the initial tune up or that the transmitter tuning or loading has changed (either through front panel adjustment or by a failure on an Output Network component.)

5-108. If a dummy load is available, try operating the transmitter into it. If there is no reflected power problem when operating into the dummy load, there is probably a problem in the antenna system.

5-109. If the reflected power problem still exists when operating into the dummy load, there may be a faulty capacitor or connection in the transmitter's Output Network.

5-110. If there is no reflected power indicated, yet VSWR overloads occur on peaks of modulation, check the glass spark gap on the Directional Coupler. A18 E1 may be firing at a lower than normal voltage. E1 may be removed to determine if this is the problem.

WARNING

ENSURE ALL AC VOLTAGE HAS BEEN REMOVED FROM THE TRANSMITTER AND THAT THE GROUNDING STICK IS USED TO REMOVE ANY RESIDUAL VOLTAGE THAT MAY BE PRESENT BEFORE E1 IS REMOVED.

5-111. CONTINUOUS CYCLING. Continuous VSWR cycling when the transmitter is tuned on indicates a severe change in the impedance the PA is operating into. The transmitter will probably stay on at a reduced power, but the reflected power may be as much as the forward power, depending upon the extent of the problem.

5-112. Connect the transmitter into a dummy load if one is available to determine if the fault is with the antenna system or the transmitter. If the antenna system is a directional array, the VSWR problem may be found to be peculiar to one pattern only.

5-113. A faulty capacitor or broken connection in the Output Network may be the cause if the transmitter also does not operate properly into a dummy load. A thorough inspection of the Output Network may reveal the problem.

WARNING

REMOVE ALL AC POWER AND DISCHARGE ALL POINTS WHERE RESIDUAL MAY REMAIN BEFORE PREFORMING AN INSPECTION OF THE OUTPUT NETWORK.

5-114. FAULT STATUS INDICATION "64", VSWR (PHASE ANGLE DETECTOR OUTPUT)

5-115. All of the same causes for "32" overloads apply to "64" overloads. The basic difference is that the circuitry sensing the "64" overload is faster than the "32" overload circuitry.

5-116. CONTINUOUS CYCLING, NO POWER OUT. If the transmitter continuously cycles and displays a "64" and not a "32" depress the LOWER pushbutton until the transmitter stays on. Check the FORWARD/REFLECTED POWER meter readings. If both read zero, it is evident there is no rf power reaching the Directional Coupler location in the Output Network.

WARNING

REMOVE ALL AC POWER AND DISCHARGE ALL POINTS WHERE RESIDUAL MAY REMAIN BEFORE PREFORMING AN INSPECTION OF THE OUTPUT NETWORK.

5-117. Inspect the PA secondary wiring connections, C1, L2, and C2 in the Output Network along with the rf connections to the Directional Coupler.

5-118. FAULT STATUS INDICATION "96", VSWR (BOTH VSWR SENSORS)

5-119. A "96" is an indication that both VSWR sensing circuits detected a VSWR condition ("32" + "64" = "96"). This does not mean that the VSWR condition was particularly unusual, since both sensing circuits are of similar sensitivity. A "96" overload may be diagnosed in the same manner as a "32".

5-120. HANDLING MOSFETS

5-121. Due to the fragile nature of the gate of a MOSFET, special care in their handling is required. The gate junction may be destroyed by static electricity if the static electricity is allowed to discharge through the MOSFET. For example, walking across a carpet to pick up a MOSFET that is not protected by antistatic packaging could result in the destruction of the MOSFET. A static charge could build up on a person as they walk across the carpet. This static charge will eventually have to be discharged. Discharging to the MOSFET could damage the MOSFET.

NOTE

MOSFET transistors which are in circuit are immune to this damage.

5-122. The MOSFET transistors are shipped in antistatic packaging. The transistors should remain in this packaging until they are to be used or tested.

5-123. TESTING MOSFETS

5-124. The MOSFETs used in the SX transmitters may be checked with an ohmmeter. However there is a requirement which restricts the use of some ohmmeters. If the battery voltage is too low (under 3V) or too high (over 20V) the ohmmeter cannot be used. A battery voltage less than 3V will not give an operational check of the transistor and a battery voltage greater than 20V may result in damage to the transistor under test. A Simpson 260, which uses a 9V battery on the Rx10k scale works quite well.

5-125. The following test applies to all MOSFETs used in the transmitter, but is not necessarily applicable to MOSFETs used in other equipment.

WARNING: Disconnect primary power prior to servicing.

5-126. This test will show how a MOSFET can be switched "on" and "off" by charging and discharging the gate of the MOSFET.

5-127. Refer to figure 5-1 for the following test. Connect the positive lead of the ohmmeter to the case (drain) of the transistor. Momentarily connect the negative lead to the gate and then connect it to the source. The ohmmeter should read at least 2 megaohms. Remove the positive lead from the case and momentarily touch it to the gate. Reconnect the positive lead to the case. The ohmmeter should read very near zero ohms.

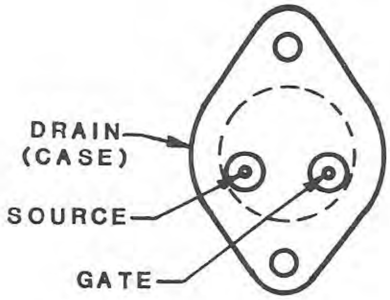


Figure 5-1. Outline of MOSFET

5-128. IN-CIRCUIT OHMMETERING THE PDM AMP (A6 AND A7) MOSFETS

WARNING

REMOVE ALL PRIMARY POWER AND DISCHARGE ALL HIGH VOLTAGE COMPONENTS WITH GROUNDING STICK BEFORE PERFORMING THE FOLLOWING PROCEDURE.

5-129. Remove all primary power and discharge all high voltage components with grounding stick.

5-130. Using an ohmmeter on the Rx1 scale, check fuses A10F1A, A10F1B, A10F2A, and A10F2B. These are located on the left wall of the transmitter as viewed from the rear (along with the PDM Amplifiers and PDM Filter).

5-131. Measure across R21, R22, R41, and R42 using an ohmmeter. Each should read 1000 ohms. If the ohmmeter shows a short, the transistor connected with that resistor has failed. This is only a check of the MOSFET gate circuit to see if it is shorted, but it is usually the only test needed to identify defective transistors.

5-132. If the ohmmeter checks across R21, R22, R41 and R42 appear normal, but a PDM Amplifier is strongly suspected of having a shorted transistor, ohmmeter check the drain circuit.

5-133. Remove P5 and P6 from both A6 and A7. Also remove the PDM pull-up boards from A6 and A7. Check the resistance from J5 and J6 of each board to ground. All should measure at least 300k ohms. A low reading indicates that a transistor is bad. Note that two transistors are connected together at the drain and source. It will be necessary to remove one from the circuit to determine if one or both are bad.

5-134. If it is necessary to replace one of the power MOSFETs (Q19, Q20, Q39, or Q40) refer to the paragraphs on HANDLING MOSFETS and TESTING MOSFETS before beginning.

5-135. IN-CIRCUIT OHMMETERING THE PA (A1 AND A4) TRANSISTORS

WARNING

REMOVE ALL PRIMARY POWER AND DISCHARGE ALL HIGH VOLTAGE COMPONENTS WITH GROUNDING STICK BEFORE PERFORMING THE FOLLOWING PROCEDURE.

5-136. RF Drive MUST BE turned off for this test.

5-137. Using an ohmmeter on the Rx1 scale, check the fuses on the PA module. Remove ALL EIGHT fuses and discard any open ones. A blown fuse usually indicates one or two transistors have failed.

5-138. The PA module can be removed from the transmitter for troubleshooting, but disconnecting the large red banana plug from J3 will allow troubleshooting the PA module in place.

5-139. Use an ohmmeter on the Rx10k scale to troubleshoot the transistors.

NOTE

Which lead is the positive lead of the ohmmeter must be known in order to perform the following troubleshooting procedure.

5-140. Notice the pattern of mounting hardware on the PA transistors. Half of the transistors are fastened down with two hex nuts. The case of these transistors connect to the B+ line via the rf chokes and the fuses. The other transistors are fastened down with one hex nut and one brass phillips head screw.

5-141. Connect the positive lead of the ohmmeter to the case of a transistor across from a fuse (transistors labeled with an A in figure 5-2). The negative lead should be connected to the nearest transistor across from a banana jack (transistors labeled with a B in figure 5-2). For a good transistor, the ohmmeter will read greater than 300k. A shorted one will read as such on the ohmmeter. The transistor which has been tested is the one being touched with the positive ohmmeter lead.

5-142. Connect the positive ohmmeter lead to the case of a transistor labeled with an B in figure 5-2. Connect the negative lead to the small banana jack located near that transistor (banana jacks are labeled with an C in figure 5-2). The ohmmeter will read near 700k ohms for a good transistor. A shorted or leaky transistor will read substantially lower. As before, the transistor being tested is the one being touched with the positive ohmmeter lead.

5-143. It is advisable to check all sixteen transistors by the above procedure rather than test only those associated with blown fuses. Once familiar with the procedure, it will only take a short period of time to check all sixteen transistors. By checking all transistors a comparison can also be taken between pairs of transistors for future reference.

5-144. Before installing any replacements, refer to the paragraphs on HANDLING MOSFETS and TESTING MOSFETS.

5-145. OHMMETER TESTING THE IPA

WARNING

ENSURE ALL AC POWER HAS BEEN REMOVED FROM TRANSMITTER AND GROUNDING STICK IS USED TO REMOVE ANY RESIDUAL VOLTAGES THAT MAY BE PRESENT PRIOR TO BEGINNING THE FOLLOWING PROCEDURE.

5-146. Turn off ac power to the transmitter.

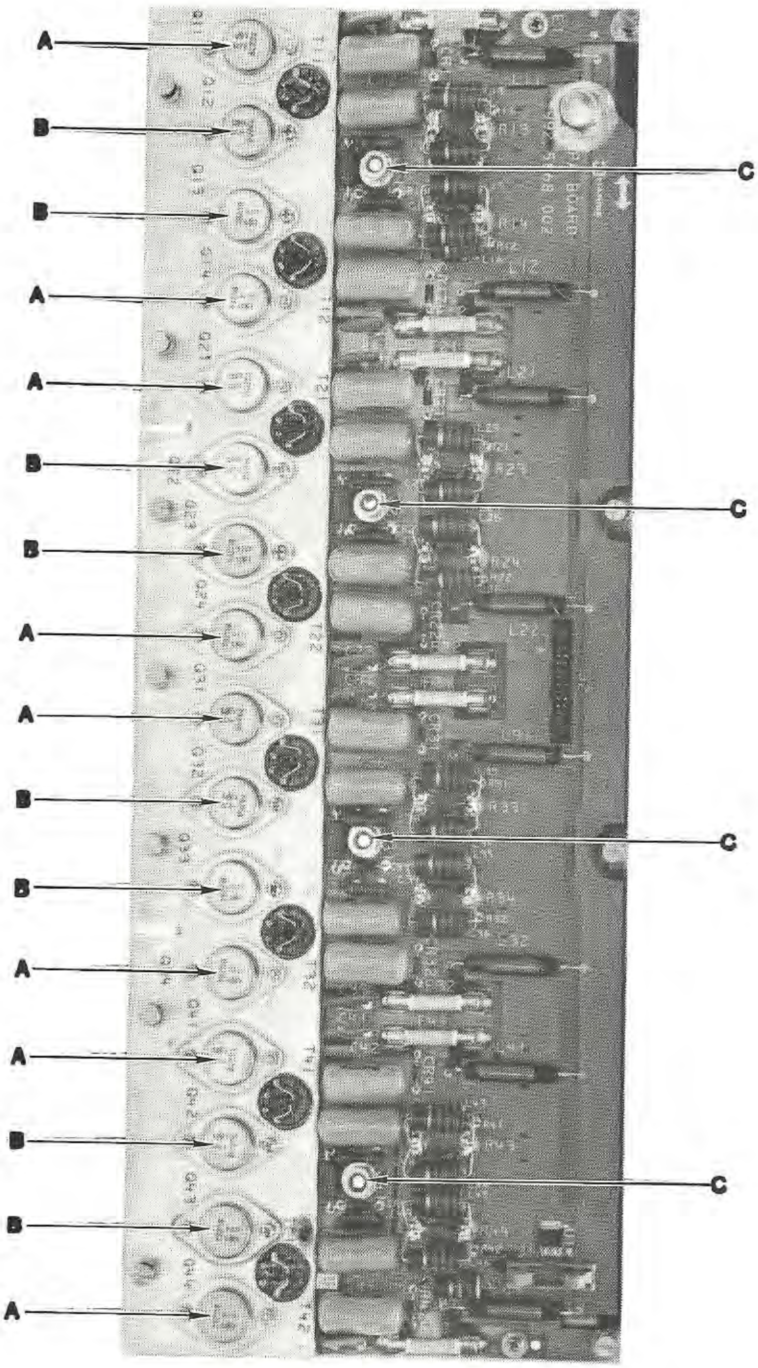
5-147. Remove P3, the Molex connector, from A5, the IPA board.

5-148. Check and remove both fuses. Discard if open.

5-149. Disconnect one end of the large resistor bridging Q12 and Q13. Put the screw back.

5-150. Connect an ohmmeter positive lead to the case of Q11. Touch the negative lead to the case of Q12. The ohmmeter should read greater than 500k. This is a test of Q11.

5-151. Connect the positive ohmmeter lead to the case of Q12. Put the negative lead on E5. The ohmmeter should read greater than 500k. This is a test of Q12.



2126-39

Figure 5-2. PA Transistor Identification

WARNING: Disconnect primary power prior to servicing.

5-152. Refer to paragraphs on HANDLING MOSFETS and TESTING MOSFETS before replacing any transistors.

NOTE

> Reconnect the large resistor previously disconnected when finished with ohmmeter testing.

5-153. Connect an ohmmeter positive lead to the case of Q14. Touch the negative lead to the case of Q13. The ohmmeter should read greater than 500k. This is a test of Q14.

5-154. Connect the positive ohmmeter lead to the case of Q13. Put the negative lead on E5. The ohmmeter should read greater than 500k. This is a test of Q13.

5-155. Refer to paragraphs on HANDLING MOSFETS and TESTING MOSFETS before replacing any transistors.

NOTE

> Reconnect the large resistor previously disconnected when finished with ohmmeter testing.

5-156. TROUBLESHOOTING THE RF OSCILLATOR

5-157. SYMPTOM: NO OUTPUT.

5-158. Open Fuse/Loss of +30V. Check the dc voltage on each side of F1. 30 volts should be present anytime ac power is supplied to the transmitter and the low voltage circuit breaker is set to ON.

5-159. Q1,Q2,CR1. Using an oscilloscope, check the signals at Q1 and Q2 per the schematic. Frequency of the signals at Q1 and Q2 should be 2 or 4 times the carrier frequency, depending on the jumper wire arrangement at E3-E6. CR1 sets the supply voltage for Q1 and Q2 to 15 volts.

5-160. U1,CR4. The output of U1 at E6 should be a 4-5 volt peak to peak square wave at the carrier frequency. In the SX-2.5 and SX-5 which include an rf drive muting circuit, the voltage at U1-2 is used to gate U1 on and off. During a normal on condition, U1-2 should be high (+5 volts). CR4 sets the supply voltage for U1 to be 5.1 volts.

5-161. U2. U2 should provide a voltage level shift from 5 volts peak-to-peak at pin 2 to 15 volts peak-to-peak at pin 7. Both signals should be square waves.

5-162. U3. U3 determines the dc level supplied to Q3 and Q4 as a means of controlling the rf output level of the Oscillator board. Check the voltage at the collector of Q3 (10-25 volts). U3 may be open if no voltage is supplied to Q3.

5-163. TROUBLESHOOTING THE FREQUENCY SYNTHESIZER

5-164. SYMPTOM: NO OUTPUT AT J2 PIN 6.

a. Open Fuse/Loss of +30V. Check the dc voltage on each side of F1. Plus 30 volts should be present anytime ac power is supplied to the transmitter and the low voltage circuit breaker is set to on.

b. Loss of +15V, -15V, +9V, +5V. Check the dc voltage at E10 for +15V, E15 for -15V, E11 for +9V, and E12 for +5V. These voltages should be present whenever +30V is present. If -15V is missing, check the cable routing back from pins 3 and 4 on J2. If one or more of the remaining voltages are missing, the corresponding regulator may be malfunctioning.

c. E1, E2. Unless the transmitter is part of a combined transmission system, there should be a jumper wire between E1 and E2.

d. P1. Unless the transmitter is being supplied with an external RF drive signal, P1 must be connected as follows: the center conductor (1) should be jumpered to the conductor closest to U5 (3).

e. Loss Of Reference. With an oscilloscope and/or frequency counter verify that the waveform at E16 is a 9 volt peak-to-peak, 10.000 MHz, approximate square wave. If this signal is off frequency, it can be adjusted by potentiometer R14.

f. U9. U9 determines the dc level supplied to Q8 and Q9 as a means of controlling the RF output level of the Synthesizer board. Check the dc voltage at the collector of Q8 or E4 (10-25 volts). U9 may be open if no voltage is supplied to Q8.

g. U5. U5 should divide its input waveform frequency by 10. In order for this to occur, pins 1 and 13 should be in the logic 1 state (greater than 2 volts but less than 5.25 volts). If pin 13 is not in the logic 1 state, the RF KILL line (J3-3) could be shorted to ground.

h. Q6. Using an oscilloscope, check the signal at the collector of Q6. It should be an approximate sine wave at a frequency of 10 times the desired carrier. If there is no signal at the collector of Q6, this indicates that U4 (VCO) is not functioning properly. (In order to take this measurement, the VCO protective cover will have to be removed.)

5-165. SYMPTOM: IMPROPER OUTPUT FREQUENCY/LOSS OF LOCK.

a. Improper Reference. With an oscilloscope and/or frequency counter check to see if the waveform at E16 is a 9V peak-to-peak, 10.000 MHz, approximate square wave. If this signal is off frequency, it can be adjusted by potentiometer R14.

b. Improper Band Setting. Check to see if S1 (the four section DIP switch which is viewable through the hole in the VCO cover) is in the proper setting for the desired carrier frequency:

ONLY S1-3 closed for frequency range of 525-800 KHz

ONLY S1-2 closed for frequency range of 801-1175 KHz

ONLY S1-1 closed for frequency range of 1176-1605 KHz

c. U2. U2 contains the programmable reference and loop frequency dividers plus a digital phase detector. The output of the phase detector is on pin 12. When the PLL is locked, the waveform at pin 12 will be a very low duty cycle pulse train at a 10 KHz repetition rate. When the PLL is not locked, the waveform at pin 12 will be a positive or negative pulse-width-modulated signal at a 10 KHz rate. Using an oscilloscope, verify that this pulse-width-modulated signal is present on pin 12 of U2 when the frequency produced at E1 is not the desired carrier frequency. If this waveform is not at a 10 KHz rate and the reference signal at E16 is at 10.000 MHz it is highly likely that U2 is not being properly programmed. This could be due to a intermittent connection between J3 and U2 or a faulty synthesizer chip (U2).

d. U3. The output of the phase detector (U2 pin 12) is fed into the loop filter which is made up of operational amplifier U3 and assorted resistors and capacitors. The first section of U3 is used only as a buffer for the components which determine the dynamics of the loop (R18, R19, and C22). Section one's output (U3 pin 1) should be fairly similar to that of U2 pin 12. The remaining three sections of U3 remove the 10 KHz ac component from the output of the phase detector. With the loop out of lock, the voltage at U3 pin 14 will be either +9 volts or 0 volts depending on the state of the VCO. If these conditions are present, the loop filter is probably operating properly.

e. Open Loop. Using an oscilloscope, check to see if the VCO signal (collector of Q6) is reaching U2 pin 3. If the PLL is open the synthesizer will not lock to the desired carrier frequency.

5-166. TROUBLESHOOTING THE RF DRIVE SYSTEM

5-167. SYMPTOM: UNDERDRIVE OVERLOAD WILL NOT ALLOW TRANSMITTER TO COME ON. An underdrive overload is registered as a '4' in the overload status system. It is an indication of low/no rf drive to the PA.

5-168. Blown IPA Fuse. Enter * or #25 on the keypad. Observe the display for an abnormally low reading. A low reading would indicate a blown fuse on the IPA. A normal reading is not necessarily proof that the IPA is okay.

5-169. Check PA Drive. With the low voltage circuitry on, connect an oscilloscope across the series combination of R11 and L13 on the PA module, A1. The oscilloscope ground lead should connect to L13, on the end furthest away from the heat sink. The oscilloscope probe should connect to the end of R11 nearest the heat sink. A normal reading would be 23 to 32 volts peak to peak. Move the oscilloscope connections to R12 and L16. There are eight such RL combinations on the PA. All should have the same peak to peak voltage. If rf drive is okay, there is a control circuit problem on the Status and Multimeter board. Refer to the theory section for the Status and Multimeter board.

5-170. In the SX-1, SX-2.5 and the SX-5, low drive may appear as a series of short bursts of RF at 100 mS intervals. Use a low sweep speed on the oscilloscope to observe this. This bursting is normal (i.e. the Oscillator is being told to perform a drive kill because of a fault being detected). The drive kill is added protection during a VSWR trip or other overload. Because all the overloads are tied into the PDM/RF drive kill command, the drive level sensing is disabled for the duration of the kill signal. This prevents the underdrive fault from being indicated during a non-RF drive problem. If however the RF drive is low, it will be detected immediately once the RF sensing is enabled. The result will be a signal that resembles something fed through a tone burst generator.

5-171. If the RF drive is in a bursting mode, it will appear that way all the way back to the divider output of the Oscillator board. It would be possible to adjust A12R58 (the underdrive fault) to get the RF drive to stay on. This means should only be used to ease the troubleshooting of low drive with only the low voltage on. Do not turn the high voltage on if the RF drive is low.

5-172. Check IPA Square Waves. If the rf drive is low or non existent, move the oscilloscope to the IPA (A5). Connect the ground lead to E7 or to the heat sink. Touch the probe to the case of Q12 and Q13. A 30 to 60 volt peak to peak square wave at the carrier frequency should be on both Q12 and Q13. On the SX-5, the waveform will be 50 to 120 volts peak to peak.

5-173. Tuning Circuit Open. If both Q12 and Q13 have the square waves, but no rf drive is on the PA, start looking for bad connections in the IPA to PA drive circuitry. Inspect the drive coaxes for proper seating in the PA board and Splitter board. Check the coil and capacitor connections. Also check connections to the Toroid board on the back of the IPA.

WARNING: Disconnect primary power prior to servicing.

5-174. IPA Output Tuning. If the PA drive is low, but the Q12 and Q13 square waves are okay, the IPA tuning is suspect. Check or replace the series tuning capacitor(s) A16C1. Refer to the procedure for IPA tuning. On the SX-5, this voltage will be higher, refer to the Factory Test Data Sheets and compare.

5-175. IPA Half Failure. If only one square wave appears okay at Q12 or Q13, then there is one or more failed transistors on the IPA. Remove the IPA and refer paragraph on OHMMETER TESTING THE IPA.

5-176. Check IPA Drive And Supply Voltage. If there are no square waves at Q12 or Q13, check for drive to the IPA. Also check for -30 Vdc at E6 and 10-30 Vdc at L11 or L12. Connect the oscilloscope probe to R2 on the IPA. There should be 12 to 25 volts peak to peak of rf drive to the IPA. On the SX-5, this voltage will be higher, refer to the Factory Test Data Sheets and compare.

5-177. Check Oscillator/Frequency Synthesizer Output. If the IPA is receiving no drive, check the Oscillator board A16 or optional Frequency Synthesizer board A16. If the Oscillator board is used, connect the oscilloscope to either side of C10. There should be a 10 to 25 volts peak to peak square wave present. If the Oscillator or Frequency Synthesizer board has no output, refer to the appropriate troubleshooting section.

5-178. Oscillator/Frequency Synthesizer To IPA Drive Coax Open. If the Oscillator output seems okay, check for broken connections from the Oscillator board A16 to the IPA A5. J2-6 should measure 2 ohms to ground with a dc ohmmeter.

5-179. TROUBLESHOOTING A PA VOLTS/PA AMPS RATIO CHANGE

5-180. POSSIBLE CAUSES

5-181. IMPEDANCE CHANGE. The PA volts to PA amps ratio is sensitive to the impedance seen by the PA module. If the impedance seen by the PA module changes, whether from an antenna impedance shift or from adjusting the front panel TUNING and LOADING controls, the PA VOLTS/PA AMPS ratio will be affected. Small changes will only cause a ratio change. Large changes will cause VSWR overloads. Check reflected power and the phase angle detector output on the digital display (functions 04 and 20 respectively). Function 4 should be near zero. Function 20 should be less than 1.00 on an SX-1. On a SX-2.5 or SX-5 *20 should be near zero. VSWR trips begin around 100 watts reflected power on the SX-1, 250 watts on the SX-2.5 and 500 watts on the SX-5.

5-182. PA FAILURE. A PA failure will result in a decrease in PA amps. PA volts will usually increase slightly. Check function 21 and 24 on the digital display. A low reading indicates a blown fuse on the PA module. The amount that a function reading drops depends on the power setting and the extent of the PA failure. A normal reading will be about 119. One open PA fuse should cause this reading to drop to below 100 (if the power setting is for full power operation).

5-183. Refer to section on IN-CIRCUIT OHMMETERING THE PA MODULE.

5-184. MODULATOR FAILURE - OPEN OR SHORT.

5-185. An open condition in the modulator section will cause a large drop in power output and PA AMPS. PA VOLTS may go to zero or show little change at all. Check functions 06 thru 09 on the digital display. One of these will read near zero if there is an open condition in the modulator section. See paragraph entitled MODULATOR FAILURE - OPEN.

5-186. A short to ground on a PDM phase will result in a dramatic increase in PA AMPS. There is also a one in four chance the PA VOLTS metering will pin. This is because the front panel meter connects to only one of the phases. A PA current overload may also be caused by this condition. Check functions 06 thru 09 on the digital display. These show the PA voltages of the four PDM phases. Normally these voltages will equal each other within 2 to 3 volts. In this case, one phase will read the full supply voltage (approximately 260 volts).

5-187. Modulator Failure - Short.

5-188. Isolating the failure can be attempted first with an ohmmeter.

a. OHMMETER TESTING.

WARNING

REMOVE ALL POWER AND GROUND ALL POINTS WHERE POWER HAS BEEN APPLIED WITH GROUNDING STICK BEFORE PERFORMING THE FOLLOWING STEPS.

Ensure all power is removed from transmitter and that all points where power has been applied are grounded before proceeding. Temporarily block open the door shorting switches located at the bottom of the back door opening. There is one switch at the hinge and one at the latch side. Use cardboard or other similar material.

WARNING

DO NOT DEFEAT OR BYPASS THE DOOR INTERLOCK SWITCHES.

Connect the ohmmeter negative lead to cabinet ground. Touch the positive lead to the output MOSFETs of the PDM Amplifiers A6 and A7 using the Rx1 scale on the ohmmeter. Initially, there will be capacitor action on the ohmmeter. The reading will start near zero and then rise toward infinity. This is the initial charging of the HV filter capacitors by the ohmmeter.

A shorted PDM phase will read near zero ohms. If none of the PDM phases are found to be shorted to ground skip to paragraph <u>HOT CHECKS</u>.

1. <u>Shorted PDM Amp</u>. If a shorted PDM phase is found, remove the banana plug from that PDM Amplifier to determine if the PDM Amplifier itself is at fault. If a PDM Amplifier output is shorted, refer to paragraph on IN-CIRCUIT OHMMETERING OF THE PDM AMP MOSFETS for further verification.

2. <u>PA Module Fault</u>. If the PDM Amplifier is okay, but the banana plug removed from the PDM Amplifier shows a short to ground, pull the small banana plugs from the PA module A1. If the short goes away, the PA is at fault. Check at each small banana jack of the PA for a short to ground. A short there would be caused by a shorted diode (CR13, CR23, CR33, or CR43) or a shorted capacitor in the same circuit.

3. <u>Shorted PDM Filter</u>. If the banana plug wire removed from the PDM Amplifier still shows a short to ground even with the PA banana plugs removed, there is a short on the PDM Filter. Trace the wire showing the short into the PDM FIlter board. There could be a shorted capacitor or shorted clamping diode in that section of the PDM Filter board.

b. <u>HOT CHECKS</u>. Remove the insulating material from both door switches. Leave the back door open and turn the transmitter on at low power (contactors will not energize due to the open door interlock).

Monitor * or #44 on the digital display and depress the LOWER pushbutton until the display reads 000. Depress the OFF push-button.

Close the back door and depress LOW power pushbutton. Contactors should energize and normally there would be no PA volts, PA amps, or power output. However, in this case there will be several amps of PA current, PA volts may be pinned, and there will be some power output. Depress OFF pushbutton.

1. <u>PDM Generator Fault.</u> Pull P4 from J4 on A15 the PDM Generator. Turn the transmitter back on. If the indications are normal as described in the previous step, there is a problem with the PDM Generator. Refer to section on PDM Generator troubleshooting.

2. PA Module Fault. Open the back door and remove the banana plugs from J11, J21, J31, and J41 on the PA module A1. Position the banana plugs so that they will not make contact with anything when the door is closed. Keep in mind what position the back door capacitors will be when the door is closed. Close the back door and turn the transmitter on LOW power. If there are still PA amps and power output, there is a short to ground occurring at one of banana jacks J11, J21, J31 ,or J41 on PA module A1.

WARNING

ENSURE ALL POWER HAS BEEN REMOVED FROM TRANSMITTER AND THAT GROUNDING STICK IS USED TO GROUND ALL POINTS WHERE POWER HAS BEEN APPLIED BEFORE PERFORMING THE FOLLOWING STEP.

To find out which banana jack is shorted, remove/install fuses on the PA module to isolate which PA Quad draws current when the HV is applied.

CAUTION

ANYTIME THAT THE HIGH VOLTAGE HAS BEEN APPLIED AND NO PA CURRENT HAS BEEN DRAWN, THE HIGH VOLTAGE SUPPLY WILL NOT BE ROUTINELY DISCHARGED. ALL HIGH VOLTAGE CAPACITORS HAVE BLEEDER RESISTORS ON THEM, WHICH WILL REQUIRE SEVERAL MINUTES TO FULLY DISCHARGE THE SUPPLY. OPENING THE BACK DOOR WILL CAUSE A VERY RAPID DISCHARGING OF THE SUPPLY. DUE TO THE AMOUNT OF DISCHARGE CURRENT, IT IS BEST TO ALLOW THE HIGH VOLTAGE SUPPLY TO BLEED OFF FOR A COUPLE OF MINUTES BEFORE OPENING THE BACK DOOR. THIS WILL DECREASE THE CHANCE OF DAMAGING THE DOOR SWITCHES AND/OR ELECTROLYTIC CAPACITORS. SUPPLY VOLTAGE CAN BE MONITORED BY DEPRESSING * OR # 01.

3. PDM Filter Fault. If the PA current did not flow when the banana plugs were removed from the PA, it means a short to ground exists somewhere in the modulator section. Put the banana plugs back into position on the PA. Remove the banana plugs from J5 and J6 on both PDM Amplifiers A6 and A7. This will test the PDM Filter when the high voltage is turned on.

Close the back door and depress the LOW power pushbutton. If there are several amps of PA current, one of the PDM Filter sections has a short to ground. Determine which one by removing/installing the banana plugs on the PA to find out which one carries the PA current when the high voltage is turned on.

WARNING

ENSURE ALL POWER IS REMOVED FROM TRANSMITTER AND GROUNDING STICK IS USED TO DISCHARGE ALL POINTS WHERE POWER HAS BEEN APPLIED BEFORE THE FOLLOWING STEP IS PERFORMED.

Trace that banana plug back to the appropriate filter section with an ohmmeter. A short to ground on the PDM Filter may be caused by a capacitor. A defect of this type cannot necessarily be found with an ohmmeter since the capacitor may break down as voltage is applied. It may be necessary to remove these capacitors from the circuit in order to determine if they contribute to the fault condition.

A shorted clamping diode will cause the 2 ohm resistor near it to heat up when voltage is applied.

4. PDM Amplifier Fault. If the PA current only flows when the PDM Amplifier banana plugs are in place, one of the PDM Amplifiers is at fault. Determine which one of the PDM Amplifiers is at fault with a process of removing/installing banana plugs on the PDM Amplifiers A6 and A7, then turning the high voltage back on.

WARNING

ENSURE ALL POWER IS REMOVED FROM TRANSMITTER AND GROUNDING STICK IS USED TO DISCHARGE ALL POINTS WHERE POWER HAS BEEN APPLIED BEFORE THE FOLLOWING STEP IS PERFORMED.

After determining which half of which PDM Amplifier is at fault, check the PDM Amplifier MOSFETs again with an ohmmeter. Be sure all voltages are off, including the low voltage supply.

If the MOSFETs are okay, there must be a problem in the circuitry which drives the MOSFET gate. Turn the low voltage on and check across the gate resistors (R21 and R22 or R41 and R42 depending upon the half of the module in question). P4 will have to be removed from J4 on A15, the PDM Generator. The voltage across these resistors should be zero, but a faulty drive circuit will produce up to 15 volts. If the voltage across both resistors in that half of the module have several volts across them, the input amplifier U11 or U31 is suspect. If only one of the two gate resistors has voltage on it, the NPN transistor in the drive circuit is probably shorted.

5-189. Modulator Failure - Open.

WARNING

TURN THE TRANSMITTER OFF AND DISCONNECT ALL PRIMARY POWER BEFORE PROCEEDING WITH THE FOLLOWING STEPS. GROUND ALL POINTS WITH GROUNDING STICK BEFORE TOUCHING.

a. OPEN FUSE. Turn the transmitter OFF and disconnect all primary power. Ground out all points with grounding stick before touching. Using an ohmmeter on the Rx1 scale, check A10F1A, F1B, F2A, and F2B. These fuses are located on the left side of the transmitter along with the PDM Amplifiers and PDM Filter board as viewed from the rear of the transmitter. These fuses are mounted in fuse blocks, not to be confused with the fuses on the PDM Amplifier boards A6 and A7.

   If a fuse is blown, it would be wise to make ohmmeter checks of the PDM Amplifiers to determine if there is a short circuit present.

b. CHECKING GATE DRIVE. Apply low voltage only to the transmitter. Make sure the transmitter is off by depressing the OFF pushbutton. Check *44 on the digital display. If necessary, depress RAISE or LOWER pushbutton to put the *44 reading in the 300-400 range.

   Use an oscilloscope to check the PDM drive signals across R21, R22, R41, and R42 on the PDM Amplifiers A6 and A7. There should be a 15 volt peak-to-peak 60 kHz pulse at each of the eight locations.

   If the gate drive is missing on any of the eight resistors listed, it will be necessary to trace the signal backwards through the amplifier to find where it has been lost. The PDM pulses should not change visibly as they are traced from the PDM Generator to the gates of the PDM Amplifier transistors.

c. OPEN MOSFETS. If the gate drive signal exists at all eight PDM MOSFETS, then it is indicated that at least two of them are open. An open pair of PDM Amplifier transistors will render one PDM phase unable to conduct current. In order to check the transistors for this, they must be removed from the circuit. See paragraph entitled HANDLING AND TESTING MOSFETS.

d. BAD CONNECTION. If the fuses, gate drive, and transistors are all okay, there is probably a loose connection from the PDM Amplifiers to the PA. With all power disconnected from the transmitter, make an ohmmeter check from the PDM Amplifier transistor cases to the PA banana jacks J11, J21, J31, and J41. This ohmmeter check will include the fuseblock fuses, the PDM filter coils, as well as all connections up to the PA. Since there are four PDM phases, there will be four ohmmeter check required.

5-190. PROBING THE INSIDE OF THE TRANSMITTER

5-191. It is possible to safely observe oscilloscope waveforms of the PA and modulator sections with the high voltage on. This can be done by making use of a BNC bulkhead connector at the back of the pull out drawer enclosure.

5-192. With the primary power turned off, open the back door and locate J6. This is the upper left BNC connector in the group of four located directly above A23, the bottom Customer Interface board. This connector is usually used for the frequency sample.

5-193. Connect the BNC connector end of an oscilloscope probe to J6. The probe tip and ground lead should be placed at the desired test location.

5-194. Pull out the drawer and disconnect the white cable from J6. In its place, connect a length of coax (3 to 4 feet) to be connected to the oscilloscope.

5-195. The above procedure implements a feed-through oscilloscope probe which may be used to safely observe any waveform in the transmitter.

NOTE

The capacitance of the coax used will reduce the frequency response of the oscilloscope measurement. This is particularly true if a X10 probe is used inside the transmitter. For this reason use a reasonably short coax and consider its effects when observing the waveforms.

WARNING: Disconnect primary power prior to servicing.

5-196. LOW VOLTAGE TESTING

5-197. Most SX transmitter failures can be pinpointed without actually applying high voltage by using a combination of ohmmeter tests and normal low voltage tests. However, there may be times when it becomes desirable to safely test the PA and modulator under more complete operation. This can be done without the high voltage on by substituting +30 volts for the 260 volt supply. In this condition, supply voltage (*01) will be 30 volts. All other readings except supply current (*02) will be functional. Except for the readings that are derived from the normal low voltage circuitry, all readings will be considerably lower than usual. This can be especially useful in looking for a short in the PDM system since the transmitter may be ran without fear that any components are being overstressed. All transistors may be checked for switching operation while running on +30 volts.

5-198. PROCEDURE.

WARNING

BEFORE PERFORMING THE FOLLOWING PROCEDURE, DISCONNECT ALL POWER FROM THE TRANSMITTER AND USE GROUNDING STICK TO DISCHARGE ALL POINTS BEFORE TOUCHING THEM.

a. Disconnect all primary power from the transmitter.

b. For an extra margin of safety, disconnect and insulate the primary leads from the high voltage transformer.

c. Connect a heavy gauge (#14 or larger) clip lead from the positive (+) side of A20C1 (76,000 uF @ 40V) to the positive (+) side of A19C5 (3300 uF @ 350V).

CAUTION

ENSURE THE BACK DOOR IS CLOSED BEFORE REAPPLYING LOW VOLTAGE TO THE TRANSMITTER OR DAMAGE TO THE LOW VOLTAGE POWER SUPPLY WILL RESULT.

d. Keep in mind that the safety switches which close as a door opens are still in circuit. Both doors will need to be closed <u>before</u> the low voltage is energized. Failure to do so will damage the low voltage power supply since a short is applied to the high voltage circuitry with a door open.

CAUTION

DO NOT PERFORM THE FOLLOWING TEST FOR MORE THAN 5 MINUTES AT A TIME AND ALLOW A MINIMUM OF 5 MINUTES BEFORE REAPPLYING POWER IF THE TEST NEEDS TO BE RERUN.

e. With both doors closed, set the Low Voltage circuit breaker to the ON position. PA VOLTS, PA AMPS, and POWER output will now deflect upscale slightly.

f. The RAISE/LOWER pushbuttons should be capable of adjusting PA voltage from 0 to about 15 volts.

g. As described before, readings may be taken from the digital display to aid in diagnosing the condition of the transmitter.

WARNING

BEFORE PERFORMING THE FOLLOWING STEP, DISCONNECT ALL POWER FROM THE TRANSMITTER AND USE GROUNDING STICK TO DISCHARGE ALL POINTS BEFORE TOUCHING THEM.

h. When the low voltage testing is complete, be sure to turn the primary power OFF, remove the clip lead, and reconnect the high voltage transformer primary wires.

5-199. RF DRIVE PHASING MEASUREMENT

5-200. The RF drive phasing measurement may be useful in locating some problems which may be obscure to other means of troubleshooting. Repeated failures of a particular PA transistor set might be caused by a large drive phasing imbalance. Drive phase imbalance could also reduce PA efficiency.

5-201. Measurements of the rf drive are made with the transmitter in the OFF mode, but the low voltage supply should be energized. This is the usual condition when the transmitter is ready to be turned on.

5-202. For the following procedure, an oscilloscope which can be externally triggered will be required. This will allow examination of the phase relationship between drive signals on the PA.

5-203. Connect an oscilloscope across R13 on the PA module, with the probe tip on the end of R13 closest to the transistors. Depending of the frequency of the transmitter, R13 may or may not be installed. However, the mounting posts for R13 are always accessible.

5-204. The voltage across R13 should be 23-32 volts peak-to-peak.

5-205. Adjust the horizontal vernier of the oscilloscope so that one full rf cycle occupies a certain number of divisions on the oscilloscope. For example: 9 divisions. Each division is then 40 degrees (there are 360 degrees in one cycle).

5-206. Use the external trigger input of the oscilloscope and connect it to J4 or R25 on the RF Oscillator.

5-207. Adjust the oscilloscope triggering, then verify its operation by disconnecting the external trigger input. The oscilloscope should lose sync as this is done.

5-208. Increase the vertical sensitivity of the oscilloscope by a step or two. This will cause the trace to go off scale.

5-209. Disconnect the vertical input, then adjust vertical positioning so that the oscilloscope trace is exactly in the middle of the screen.

5-210. Reconnect the vertical input.

5-211. Increase the sweep speed of the oscilloscope. If the oscilloscope has a X10 multiplier, use it to make the oscilloscope show 4 degrees per division horizontally (40 degrees divided by 10). Otherwise increase the sweep speed as possible to increase the resolution of the oscilloscope to a value comparable to the 4 degree per division set up.

5-212. Adjust the horizontal position of the oscilloscope to place the zero crossing of the rf drive signal in the center of the oscilloscope. The oscilloscope has now been set up to measure degrees of phase shift relative to the drive signal across the R13 position.

5-213. Move the oscilloscope probe to R14, the next rf drive test point.

5-214. If the oscilloscope trace passes exactly through the center of the screen, the phase of the drive across R14 is the same (0 degrees) as across R13. If the zero crossing on the oscilloscope occurs somewhere other than the center of the screen, then that drive signal differs from the R13 reference by an amount which can be measured according to the calibration setup.

5-215. Check the phase of the drive signals across R23, R24, R33, R34, R43, and R44.

5-216. Total variation in drive phasing should be no more than ± 5 degrees.

5-217. Possible causes for rf drive phase imbalance are:

a. FAILED PA TRANSISTORS. A simple ohmmeter check of the transistors will nearly always identify defective ones. Failed transistors should also present problems which are more easily identified than drive phase error, such as reduced power output, PA volts/amps ratio change, blown fuse, low rf drive voltage, etc.

b. FREQUENCY DETERMINED COMPONENT WRONG. Check to see that the PA input tuning components such as L14, C10, R11, L13, and R13 are properly soldered and are in good physical condition. If any of these components have recently been installed, recheck their values. To determine if the fault is with the PA module or the drive cable, make an impedance measurement of each drive input.

c. BAD RF DRIVE CABLE. The rf drive cable consists of eight individual coaxes. If the shield of one coax is open, the drive will be different for one set of transistors. Remove the rf drive cable from the splitter board. An ohmmeter check between all shields on the splitter end of the cable should show zero ohms if the other end is still plugged into the PA. Be sure to flex the cable some to check for intermittent connections.

d. BAD RF DRIVE TRANSFORMER. If possible, make comparisons between the impedance at each PA input (L14, L15, L24, L25, L34, L35, L44, and L45). An input which measures an unusual voltage or phase will show up as an unusual impedance.

A comparison of input impedances can also be made while shorting the primary of each of the drive transformers (T11, T12, T21, T22, T31, T32, T41, and T42). If the impedances are now all the same, it is fairly safe to assume that the input tuning components are alright and the fault lies with the drive transformer.

5-218. TROUBLESHOOTING AM NOISE

5-219. When troubleshooting a noise problem, it is important to know the level and frequency of the noise. Knowing the frequency of the noise, it is possible to isolate the source. The frequency of the noise may be determined by connecting an oscilloscope to the output of most distortion analyzers. The oscilloscope display will be the total noise. Measure the period of the noise with the highest amplitude to determine the dominant noise component.

5-220. An alternate method of determining the noise frequency is by tuning a distortion analyzer to it. A fully automatic distortion analyzer cannot be used in this way. While measuring the noise, switch the analyzer to the THD mode. Then tune the frequency of the analyzer for a dip in the meter reading on the analyzer. Depending on the number of significant noise frequencies affecting the total noise figure, there may be more than one dip in the analyzer reading. Frequency of the noise may be read from the analyzer frequency settings. An audio spectrum analyzer may also be used for determining both noise frequency and amplitude.

5-221. A listening test could be misleading since the dominant noise component may actuality be above or below the range of the receiver or human hearing. Following are some hints on solving various noise problems. These are categorized according to frequency.

a. 50/60 HZ. This is a power line frequency and is not usually a significant noise component in the SX transmitter, due to the design of the power supplies. If investigating a 50/60 Hz noise problem, first examine the audio input wiring and make a measurement with the audio cable going directly from the audio generator to the transmitter input terminals. This will eliminate any effects of the patch panel wiring or noise from other audio equipment in the system. Audio lines are normally balanced. That is, the audio line current does not flow in ground. Grounding of either side of the audio connectors can sometimes result in noise. If it is determined that the 50/60 Hz noise is actually generated in the transmitter, a bad rectifier is suspected. The dominant noise frequency of a single phase full wave rectified power supply is normally twice the power line frequency.

WARNING

ENSURE ALL VOLTAGE HAS BEEN REMOVED AND THE SHORTING STICK HAS BEEN USED TO REMOVE ANY RESIDUAL VOLTAGES BEFORE MEASURING THE RESISTANCE OF ANY RECTIFIERS.

Using an ohmmeter to check each of the four rectifier diodes in the HV supply (A19CR1, A19CR2, A19CR3, and A19CR4). Also check the block type rectifier bridge (A20CR1) in the ±30 volt supply. An open rectifier would also result in a decrease in supply voltage. Also use an oscilloscope to look for any evidence of 50/60 Hz noise in the power supplies. ±30 volts and a high voltage supply sample appear on the PDM Generator, A15. ±30 volts is at the fuses of the PDM Generator and the high voltage supply sample is at J1-7.

b. 100/120HZ. This is the principle noise frequency of all the low level supplies. In the SX-1 and the SX-2.5, it is also the main noise component of the High Voltage Supply. In the SX-5, which uses a 3-phase HV supply, the principle noise component is 300/360Hz. An adjustment for power supply noise cancellation is on A15, the PDM Generator. The adjustment is R30 and normally is capable of adjusting the noise from 50 dB below 100% modulation to greater than 60 dB. The only noise affected by this adjustment is power supply related since this cancellation circuit only concerns noise from the high voltage power supply. While adjusting R30, watch for an effect on the noise level. High noise of this frequency that cannot be minimized by adjustment may indicate an open capacitor or open connection in the high voltage supply.

If 100/120Hz noise is generated in the SX-5, an imbalance is indicated in the 3-phase power supply. Check the balance of the 3-phase AC primary power. It may also be necessary to check the high voltage rectifiers and interconnecting wires for loose or open connections.

If A15R30 does not affect the noise level, it will be necessary to troubleshoot the noise cancellation circuit on the PDM Generator.

c. 60 KHZ. This can only show up in a wideband audio noise measurement or as a spurious emission 60 kHz above or below the transmitter operating frequency. This could be caused by an imbalance in the operation of the Polyphase system. Check */#06, 07, 08, and 09. These should agree within 2-3 volts. If there are substantial differences in these readings, it will be necessary to troubleshoot the PDM Generator (A15) or the PDM Amplifiers (A6, A7) for pulse width imbalance. A failure of a PDM Amplifier will also cause a drastic change in power output.

d. RFI NOISE ON AUDIO. Check the audio wiring to the transmitter for proper grounding of the shield at the Customer Interface board A22. Also make sure that neither audio conductor is grounded. Grounding of either side of an audio line takes away common mode rejection, which is essential in preventing this type of noise.

The SX transmitter is designed with extensive RFI filtering on the audio input circuitry and furthermore has a solid state instrumentation input circuit with high common mode rejection.

5-222. TROUBLESHOOTING THE PDM GENERATOR

5-223. SYMPTOM: HUM NULL CONTROL R30 HAS NO EFFECT ON THE NOISE LEVEL.

5-224. The HUM NULL adjustment affects only power supply noise on the carrier. It cannot be expected to reduce noise unrelated to the noise in the transmitter's high voltage supply. The HUM NULL control should always be capable of increasing the noise, unless another noise source is present at an overwhelming level. The typical range of noise adjustment accomplished by the HUM NULL control, assuming all other noise components are insignificant, is from 50 to greater than 60 db below 100 percent modulation.

5-225. No DC Sample. Check the dc voltage at J1-7 or L3 on the PDM Generator while the high voltage is on. There should be approximately 9 volts dc present. If the 9 volts dc is not present shut the transmitter off and troubleshoot the resistor divider A19R14 and R15 at the PA metering shunt on the floor of the transmitter. Also ohmmeter check the wiring from the divider to the PDM Generator.

5-226. U12 Defective. If the 9 volts dc is present at J1-7, check the voltage at U12-3. This should be around 1.3 volts dc depending on the exact voltage at J1-7 and resistor tolerances. U12 is wired as a voltage follower, so the voltage at U12-6 should be the same.

5-227. R30 Defective. If the dc voltage out of U12-6 is normal and R30 has no effect on the noise level, the problem is most likely R30 itself.

5-228. SYMPTOM: NO PULSES AT J4, CAUSING ZERO POWER OUTPUT FROM THE TRANSMITTER.

a. POWER SETTING. Check the */#44 reading on the digital display. Power settings above 000 should produce pulses out of the PDM Generator. Inability to achieve a normal */#44 reading would indicate trouble with the control circuitry on the Status and Multimeter or System Controller board.

b. LOSS OF PLUS AND MINUS 15 VOLTS. Check for the presence of +15 volts at the cathode of CR16 and -15 volts at the anode of CR19 on the PDM Generator. These supply voltages should be present anytime the low voltage (±30) is on.

c. PDM KILL. Check the voltage at the collector of Q4 on the PDM Generator. It should be about 15 volts. If it is near zero volts, check for +5 volts at J3-2. This is accessible on R100, located near Q3 and Q4. The voltage at J3-2 is 5 volts for normal operation and near zero during a PDM KILL. Q3 and/or Q4 may be at fault if 5 volts is present at J3-2, but no +15 volts is present at the collector of Q4. A continuous PDM KILL signal (J3-2 low) would be the fault of control circuitry on the Status and Multimeter board.

d. DC/AUDIO FAILURE. Measure the voltage at U2-14. Normally this will be 2 volts or less depending on the power setting. The voltage at U1-14 will be the same, except of opposite polarity. As these voltages go toward zero, PDM pulse width and power output normally increase. Abnormalities in this area could be caused by U2 or U3. Check the voltage at U2-8. Typically it will be about 3 volts. If U2-8 is not normal, U2 would be the most likely cause.

e. LOSS OF TRIANGLE WAVES. Using an oscilloscope, check at U9-9 and U10-9 for a 3.5-4.0 volts peak to peak 60 kHz triangle wave. If the triangle wave is not there, check at U7-3 and U8-3. If the triangle wave exists at U7-3 and U8-3 but is not at U9-9 and U10-9, U7 and U8 are suspect. These are buffer amplifiers which have unity voltage gain, so the input and output signals should look the same. U7 and U8 are independent of each other. No dc voltage greater than 50 mV should appear at the outputs (pin 6) of U7 or U8.

If the triangle waves are not getting to buffer amplifiers U7 and U8, use the oscilloscope to check the output of the 240 kHz oscillator at U11-8. This should be a 240 kHz square wave about 12-15 volts peak to peak. If no such signal is present, U11 or U4 are possible at fault. If U11 is working properly, use the oscilloscope to check the outputs of U4 at pins 2 and 12. 60 kHz square waves (12-15 volts peak to peak) should be at pins 2 and 12.

With U4 operating normally, U5 may be checked by using the oscilloscope to check its outputs. Pins 9 and 16 should give a waveform which is low (near zero volts) for half of the 60 kHz cycle and then ramps up linearly. The amplitude of the ramp from start to finish is 3.5-4.0 volts.

The cathode of CR10 and CR8 should give a triangle wave superimposed on a dc level. The circuitry consisting of U5, U6, Q1, and Q2 makes up the square wave to triangle wave converters. A review of the theory of operation may be helpful in the troubleshooting process. The two square wave to triangle wave converters operate independently of each other; thus it is possible to use comparison measurements if one is working. Replacing components in the triangle wave converters may be the fastest way of locating the problem.

5-229. SYMPTOM: IMBALANCE IN OUTPUT PULSE WIDTHS. (Causes PDM Phase Voltage Imbalance.)

a. AUDIO IMBALANCE. An imbalance in the two phases of the DC/AUDIO circuitry is characterized by an imbalance in the duty cycle between the two outputs of both threshold comparators U9 and U10. Each dual comparator is driven by one triangle wave and both phases of audio. Any duty cycle imbalance between the two outputs of either U9 or U10 is most likely caused by an imbalance of the DC/AUDIO circuitry.

Measure the voltage at U2-14 and U1-14. These should be 2 volts or less, equal, and opposite in polarity. U2-14 will normally be positive and U1-14 will be negative. The exact voltage at U1-14 is adjustable by R14 (balance), but major dissimilarities in the voltage at U1-14 and U2-14 are probably caused by a failure of U1.

b. TRIANGLE WAVE IMBALANCE. An imbalance in the triangle waves driving the output comparators will result in the outputs of U9 differing from those of U10. If the DC/AUDIO balance is correct, both outputs of U9 will be the same, but will differ in pulse width from the outputs of U10.

Using an oscilloscope, check the triangle waves at U9-9 and U10-9. The signals at U9-9 and U10-9 should be exactly the same. Each should be a 3.5-4.0 volt peak to peak 60 kHz

WARNING: Disconnect primary power prior to servicing.

triangle wave. Check these same inputs points for dc using a digital voltmeter. Ideally, there will be zero volts. However, there can be as much as 50 mV of dc at these locations. DC voltages higher than this indicate a bad buffer amplifier (U7 or U8) or leaky coupling capacitor (C40 or C58).

Differences in peak to peak amplitude may be caused by the square wave to triangle wave conversion circuitry. The best method of locating the defective component is by tracing the signal backwards to the 60 kHz dividers, while comparing the two identical circuit paths. Refer to the PDM Generator schematic and the paragraph on LOSS OF TRIANGLE WAVES for more information.

5-230. SYMPTOM: OUTPUT(S) AT J4 ALWAYS IN A HIGH STATE, CAUSING ONE OR MORE PDM AMPLIFIERS TO CONDUCT FULL TIME. This problem may be found without turning on the high voltage. Lower the pulse width setting down to 000 on the digital display (* or #44) by depressing the LOWER pushbutton. Identify which output(s) of the PDM generator are at fault by connecting a voltmeter or oscilloscope to R45, R46, R62, and R63. The faulty output(s) will be as much as 15 volts positive. The normal voltage with a 000 pulse width setting is 0.1 to 0.3 Vdc.

a. <u>ONLY ONE OUTPUT HIGH</u>. This is probably a fault of U9 or U10, depending on the output line in question. The outputs of U9 and U10 are open collectors. If the connection from one of these outputs to the pull-up resistor (R45, R46, R62, or R63) is open, the corresponding output terminal of the PDM Generator board will be continuously high. Check the voltage directly at the appropriate pin on U9 or U10 to determine that the connections are good.

b. <u>TWO OUTPUTS ARE HIGH</u>. If the signals at J4-3 and J4-8 of the PDM Generator are both high, U1 most likely has failed. Check the voltage at U1-14. Normally it is -2 volts or less, but in this case it might be +2 volts or greater. A gross misadjustment of R14 could cause this condition.

c. <u>ALL FOUR OUTPUTS ARE HIGH</u>. This could be caused by U2 or U3. Check the voltage at U2-14. Normally it is +2 volts or less, but in this case may be -2 volts or further negative.

5-231. <u>TROUBLESHOOTING HIGH TEMPERATURE READINGS</u>

5-232. HIGH AMBIENT

5-233. If the transmitter operates in an environment which fluctuates in temperature, the temperature of the transmitter components can be expected to fluctuate also. Consider the ambient when checking the module temperature readouts. High ambient should result in a uniform increase in all module temperatures. Factory test data is taken in a 22 to 25 degree Centigrade ambient.

5-234. AIR OBSTRUCTION

5-235. Both the air intake and exhaust openings must be free of any obstructions. On the SX-2.5 and SX-5 forced air is used the filters should be kept clean. On the SX-1 no filter should be used on the air intake because of the convection cooling system. Be sure there is nothing to obstruct the air exhaust, such as books, panels, etc.

a. SX-1 - Convection cooling - NO AIR FILTER IS USED

b. SX-2.5 - ONE BLOWER IS USED. FILTER USED.

c. SX-5 - TWO BLOWERS USED, but the blowers have separate intakes located in the bottom rear of transmitter. A filter is used for PDM AMP wall and cabinet flushing. The blower dedicated to the PA SIDE USES UNFILTERED AIR.

5-236. MODULE HEAT SINKING

5-237. Each module has a heat sink which is a permanent attachment of the module. It is important that this heat sink has good thermal contact with the aluminum heat sink which is fastened to the transmitter cabinet. This would include an even coating of thermal compound applied to mating portions of the heat sinks as well as making sure all heat sink fasteners are properly secured. A bent or warped heat sink will also cause poor heat sinking. Examine the mating surfaces to be certain there are no metal burrs or debris.

5-238. PA TEMPERATURE IS HIGH

5-239. Refer to the preceeding paragraphs which apply to all modules before attempting to find a specific problem with the operation of the PA module.

5-240. Having already checked out the other causes for high temperature, it is now evident that the PA is dissipating more power that it was intended to. The following paragraphs will describe causes for excess dissipation.

5-241. OUTPUT POWER TOO HIGH. Check the present transmitter readings against the factory test data values and and ratings of the transmitter. If the power calculated from antenna base or common point current is lower than the transmitter output meter, there may be some error in the calculated power. Checking this will involve a measurement of the impedance at the RF ammeter and a calibration check of the RF ammeter.

5-242. PA TUNING. Among the parameters affected by PA tuning is PA efficiency. Compare the present PA readings against the factory test data sheets for the same power output to determine if the efficiency is lower than normal. Refer to the section on PA tuning for details on PA tuning.

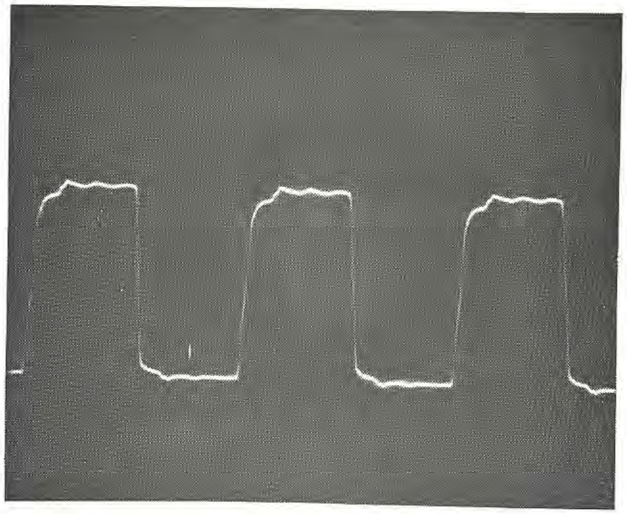
5-243. ABNORMAL RF DRIVE LEVEL. Refer to paragraph on troubleshooting the RF Drive System for information on measuring the RF drive level on the PA module. Excessive drive can reduce PA efficiency by a few percentage points. Abnormally low drive could result in reduced PA efficiency and perhaps unstable operation of the PA.

5-244. If the drive level is not within the 23-32 volts peak-to-peak range, adjustment of the IPA will have to be made. Refer to the IPA tuning procedure.

5-245. If the drive level is very much out of the proper range, the UNDERDRIVE and OVERDRIVE overloads should be checked. These overloads should prevent energizing of the high voltage supply if the drive level is wrong.

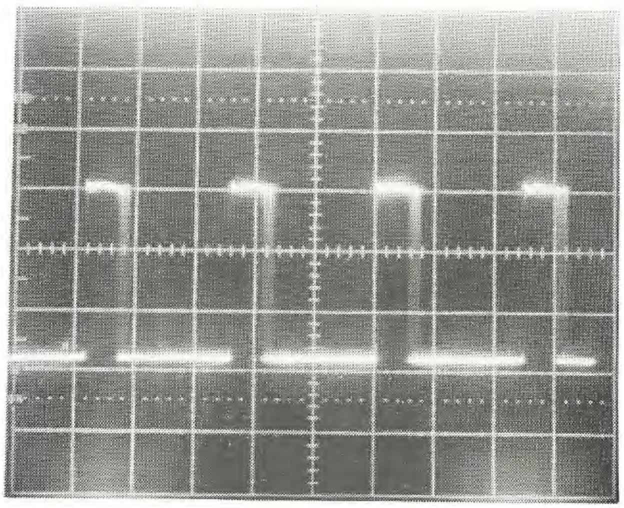
5-246. RF DRIVE PHASE BALANCE. Refer to the procedure for checking RF drive phasing. Differences in RF drive phasing will cause pairs of PA transistors to switch at different times. Depending upon the amount of phase imbalance, this could result in decreased PA efficiency.

WARNING: Disconnect primary power prior to servicing.



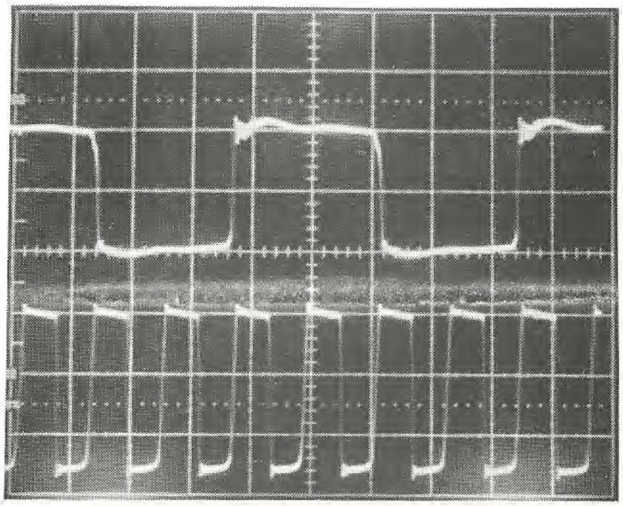
2126-24

Figure 5-3. J4 on A16 Oscillator - 15 volts p-p



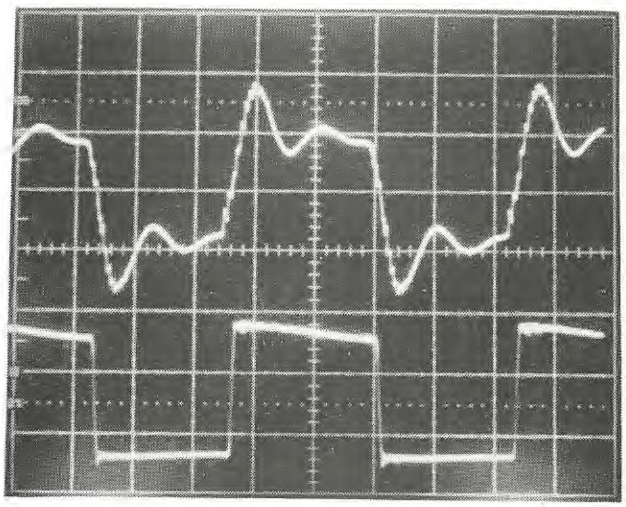
2126-25

Figure 5-4. Q1 Collector on A25 AC Controller
30 volts p-p, 50 usec per division



2126-26

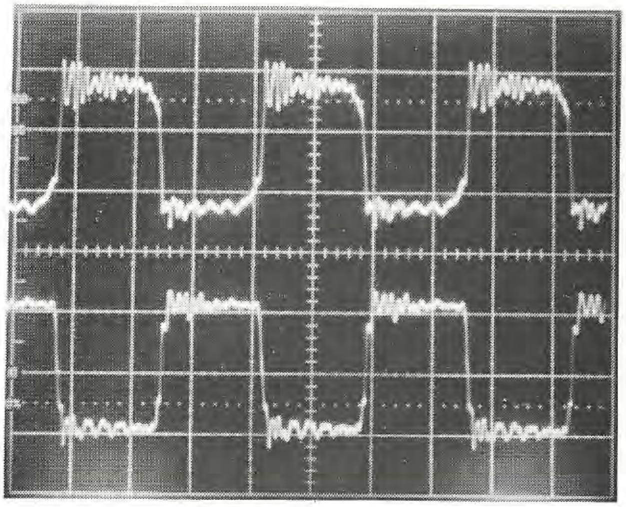
Figure 5-5. Upper Trace - A16 Oscillator Board Output at C10
10-25 volts p-p
Lower Trace - Q2 Collector, A16 Oscillator Board Before Divide By 4



2126-27

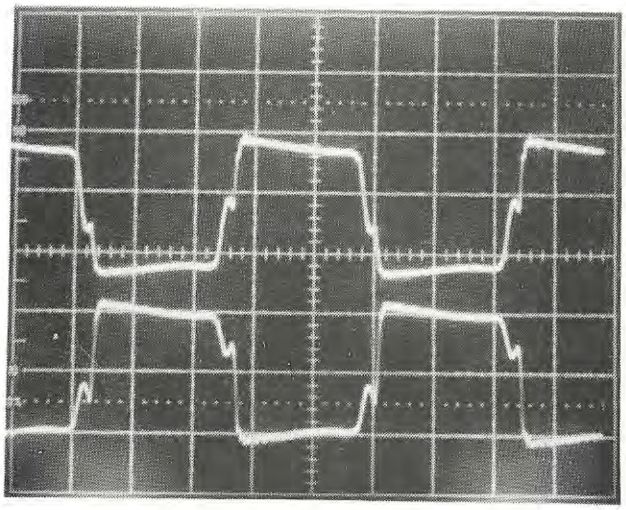
Figure 5-6. Upper Trace - IPA Input, 10 volts per division
Lower Trace - IPA Transistor Output, 20 volts per division

WARNING: Disconnect primary power prior to servicing.



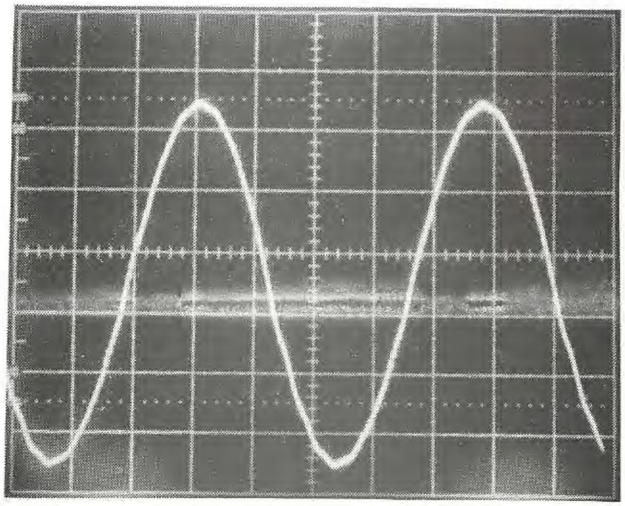
2126-28

Figure 5-7. PA Transistor Outputs from One Quad
1450 kHz, No Modulation



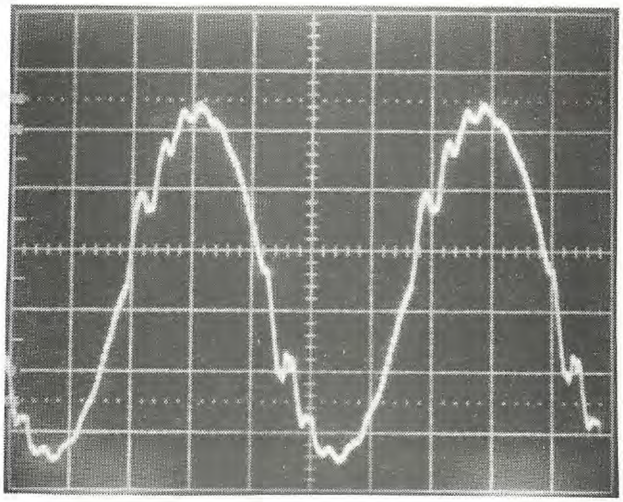
2126-29

Figure 5-8. PA Transistor Outputs from One Quad
550 kHz, No Modulation



2126-30

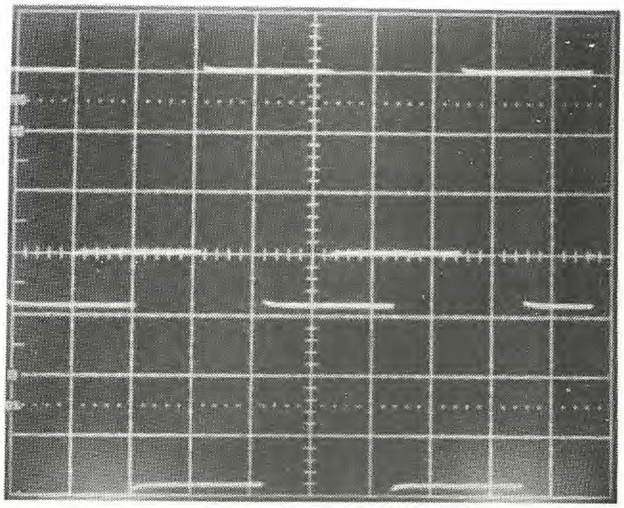
Figure 5-9. PA RF Drive Waveform, PA OFF, 30 volts p-p



2126-31

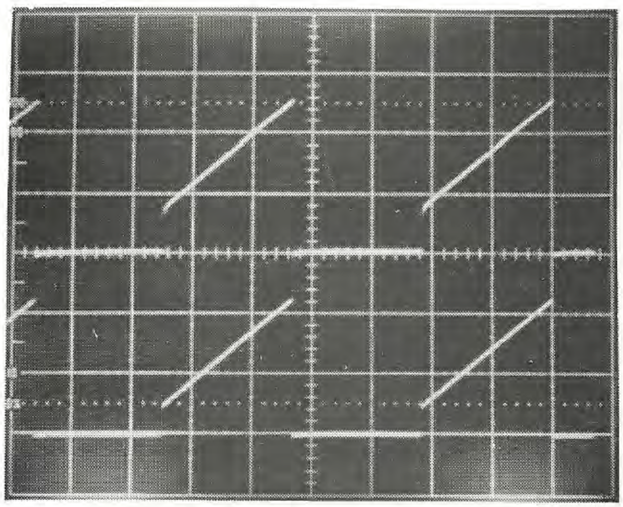
Figure 5-10. PA RF Drive, PA ON at 1kW, 30 volts p-p

WARNING: Disconnect primary power prior to servicing.



2126-32

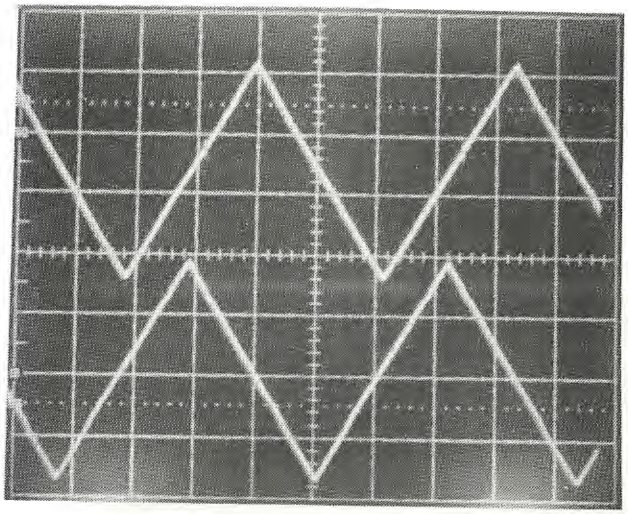
Figure 5-11. 60 kHz Square Waves at A15 PDM Generator U5-11 and U5-14, 15 volts p-p



2126-33

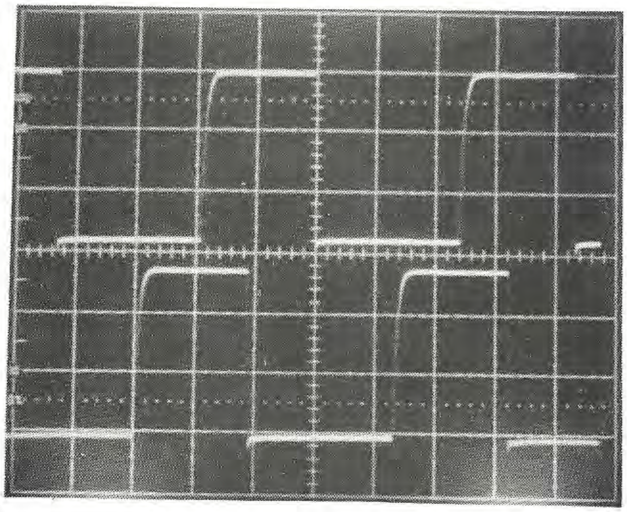
Figure 5-12. Upper Trace - U5-9 on A15 PDM Generator
Lower Trace Q2 Collector on A15,
Waveform is dc offset above ground by 2 to 4 volts
(2 volts per division on both traces)

WARNING: Disconnect primary power prior to servicing.



2126-34

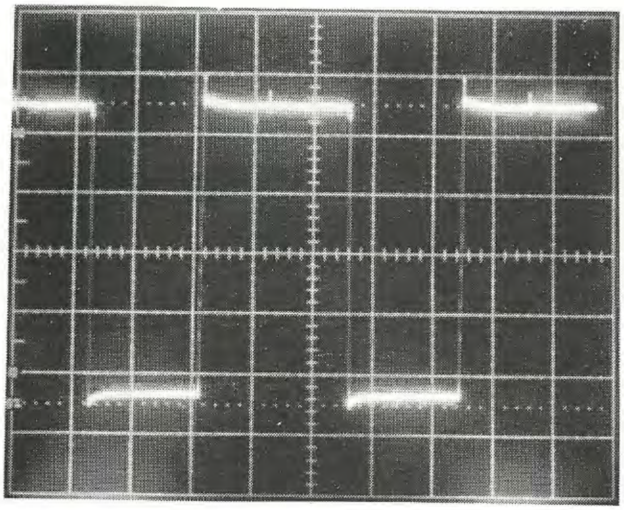
Figure 5-13. Upper Trace - U7-6 (R42), 3.5 volts p-p
Lower Trace - U8-6 (R59) U8 leads by 90 degrees



2126-35

Figure 5-14. Upper Trace - U10-12 (R62), 15 volts p-p
Lower Trace - U9-7 (R46) U9 leads by 90 degrees

WARNING: Disconnect primary power prior to servicing.



2126-36

Figure 5-15. PDM Amp A6, A7 Outputs, 250 volts p-p
J5, J6 (Cases of MOSFETs)

Table 5-2. Listing of Protection Devices in SX-1

CAUTION

IF ANY OF THE FUSES IN THE SX-1 TRANSMITTER REQUIRE REPLACING, ENSURE THAT ONLY AN EXACT REPLACEMENT FUSE IS USED. A DIFFERENT MANUFACTURER'S FUSE OF THE SAME SIZE AND/OR RATING DOES NOT FULFILL THE REQUIREMENT FOR EXACT REPLACEMENT.

REF. DES.	LOCATION	SHOWN IN FIGURE	FUNCTION
A16F1	Oscillator Board	2-1	Protects +30 volt supply from faults within the oscillator.
A15F1	PDM Generator Board	2-5	Used to protect +30 volt supply from over current condition.
A15F2	PDM Generator Board	2-5	Used to protect -30 volt supply from over current condition.
A20F1	Base of SX-1	2-6	Interlock fuse used to protect external interlock circuits from accidental grounding.
A6F1	PDM Amp A6	2-7	Protects +30 volt supply from over current surges on PDM Amp A6.
A7F1	PDM Amp A7	2-7	Protects +30 volt supply from over current surges on PDM Amp A6.
A10F1-A	PDM Amplifier	2-7	Protects the PDM Amplifier from over current surges.
A10F1-B	PDM Amplifier	2-7	Protects the PDM Amplifier from over current surges.
A10F2-A	PDM Amplifier	2-7	Protects the PDM Amplifier from over current surges.
A10F2-B	PDM Amplifier	2-7	Protects the PDM Amplifier from over current surges.
A25F1	AC Controller Board	2-9	Protects the solid state relays from supply over current conditions.
A25F4	AC Controller Board	2-9	Used to protect the +5 volt power supply from accidental over current conditions.
A19F2	Base of SX-1	2-9	Protects 260 volt supply from faults on the PA module.
A5F12	IPA Board	2-10	Protects +30 volt supply from IPA faults.
A5F11	IPA Board	2-10	Protects +30 volt supply from IPA faults.

Table 5-2. Listing of Protection Devices in SX-1 (Continued)

CAUTION

IF ANY OF THE FUSES IN THE SX-1 TRANSMITTER REQUIRE REPLACING, ENSURE THAT ONLY AN EXACT REPLACEMENT FUSE IS USED. A DIFFERENT MANUFACTURER'S FUSE OF THE SAME SIZE AND/OR RATING DOES NOT FULFILL THE REQUIREMENT FOR EXACT REPLACEMENT.

REF. DES.	LOCATION	SHOWN IN FIGURE	FUNCTION
A1F11	PA Module	2-11	Protects other circuitry in transmitter from over current condition in PA Module.
A1F12	PA Module	2-11	Protects other circuitry in transmitter from over current condition in PA Module.
A1F21	PA Module	2-11	Protects other circuitry in transmitter from over current condition in PA Module.
A1F22	PA Module	2-11	Protects other circuitry in transmitter from over current condition in PA Module.
A1F31	PA Module	2-11	Protects other circuitry in transmitter from over current condition in PA Module.
A1F32	PA Module	2-11	Protects other circuitry in transmitter from over current condition in PA Module.
A1F41	PA Module	2-11	Protects other circuitry in transmitter from over current condition in PA Module.
A1F42	PA Module	2-11	Protects other circuitry in transmitter from over current condition in PA Module.
A20CB1	AC Power Panel	2-12	Protects the low voltage power supply from an over current condition.
A16F1	Frequency Synthesizer	2-15	Protects +30 volt supply from faults within the oscillator.

Table 5-3. FUSES, SX-1 XMTR

CAUTION

IF ANY OF THE FUSES IN THE SX-1 TRANSMITTER REQUIRE REPLACING, ENSURE THAT ONLY AN EXACT REPLACEMENT FUSE IS USED. A DIFFERENT MANUFACTURER'S FUSE OF THE SAME SIZE AND/OR RATING DOES NOT FULFILL THE REQUIREMENT FOR EXACT REPLACEMENT.

REF DESIGNATOR	HARRIS PART NO.	DESCRIPTION	SHOWN IN FIGURE
A1F11,A1F12 A1F21,A1F22 A1F31,A1F32 A1F41,A1F42	398 0403 000	FUSE, RECTIFIER 3A 250V CERAMIC 1/4 X 1-1/4 LITTELFUSE 322003	2-11
A10F1A,A10F1B A10F2A,A10F2B	398 0410 000	FUSE, FAST 10A 500VDC MAX 13/32 X 1-1/2, HIGH FAULT CURRENT CAPACITY, 600VAC RMS MAX, 200K AMPS (AC) INTERRUPTING RATING, BUSSMANN KLM10	2-7
A15F1, A15F2	398 0015 000	FUSE FAST .5A 250V CARTRIDGE .25 IN DIA X 1.25 IN LG AGC BUSSMANN OLD 3AG 312.500 LITTELFUSE	2-5
A16F1 (OSCILLATOR)	398 0017 000	FUSE 3AG FAST 1A 250 CARTRIDGE .25 IN DIA X 1.25 IN LG AGC BUSSMANN 312001 LITTELFUSE	2-1
A16F1 (FREQ SYN)	398 0019 000	FUSE 3AG FAST 2A 250 CARTRIDGE .25 IN. DIA X 1.25 IN. LG AGC BUSSMANN 312002 LITTELFUSE	2-15
A19F2	398 0413 000	FUSE, SEMICONDUCTOR 25A 9/16 X 2, 400VDC MAX, 700VAC (RMS) MAX, 235K AMPS (AC) INTERRUPTING CAPACITY, 1200V MAX ARC INTERNATIONAL RECTIFIER SF70P25	2-9
A19F1A,A19F1B	398 0221 000	FUSE 30A 250V 2 ELEMENT CART .562 DIA X 2 LG BUSSMANN FRN-R-30	in external fuse box
A20F1	398 0081 000	FUSE SLOW 2A 125V/250V CARTRIDGE .25 IN DIA X 1.25 IN LG MDL BUSSMANN 313002 LITTELFUSE	2-6

WARNING: Disconnect primary power prior to servicing.

Table 5-3. FUSES, SX-1 XMTR (Continued)

CAUTION

IF ANY OF THE FUSES IN THE SX-1 TRANSMITTER REQUIRE REPLACING, ENSURE THAT ONLY AN EXACT REPLACEMENT FUSE IS USED. A DIFFERENT MANUFACTURER'S FUSE OF THE SAME SIZE AND/OR RATING DOES NOT FULFILL THE REQUIREMENT FOR EXACT REPLACEMENT.

REF DESIGNATOR	HARRIS PART NO.	DESCRIPTION	SHOWN IN FIGURE
A25F1	398 0081 000	FUSE SLOW 2A 125V/250V CARTRIDGE .25 IN DIA X 1.25 IN LG MDL BUSSMANN 313002 LITTELFUSE	2-9
A25F4	398 0019 000	FUSE 3AG FAST 2A 250 CARTRIDGE .25 IN. DIA X 1.25 IN. LG AGC BUSSMANN 312002 LITTELFUSE	2-9
A5F11,A5F12	398 0403 000	FUSE, RECTIFIER 3A 250V CERAMIC 1/4 X 1-1/4 LITTELFUSE 322003	2-10
A6F1,A7F1	398 0019 000	FUSE 3AG FAST 2A 250 CARTRIDGE .25 IN. DIA X 1.25 IN. LG AGC BUSSMANN 312002 LITTELFUSE	2-7

SECTION VI

PRINCIPLES OF OPERATION

6-1. INTRODUCTION

6-2. This section of the maintenance manual will present the principles of operation for the individual sections of the SX-1 AM TRANSMITTER. Included will be information on AC Power Flow, RF Power Flow, System Controller Logic, and principles of operation of the individual boards and networks used in the SX-1 AM TRANSMITTER.

6-3. PERSONNEL PROTECTION

6-4. Extensive interlocking and safety switches have been provided on these transmitters because of the low impedance high current capabilities of these power supplies. The access doors to these transmitters are provided with three safety switches. The first safety switch is operated by a small pin protruding through a hole and, upon opening the door, interrupts the control voltage to the primary contactors allowing them to deenergize. Upon opening the door further, a large switch with heavy silver contacts is provided to discharge the energy storage capacitors through large resistors for current limiting. Upon opening the door further a switch operated also by the door shorts the power supply to the cabinet eliminating any possible voltage remaining on the filter capacitors.

WARNING

THE NORMAL PROCEDURE IN TRANSMITTER TURN OFF SHOULD BE FOLLOWED IN DEENERGIZING THIS TRANSMITTER. TURN OFF THE HIGH VOLTAGE BY DEPRESSING THE OFF BUTTON. LOW VOLTAGE MAY THEN BE REMOVED BY SETTING THE LOW VOLTAGE CIRCUIT BREAKER TO OFF. IF YOU MUST ENTER THE TRANSMITTER, ALLOW THE POWER SUPPLY TO DISCHARGE AS INDICATED BY THE FRONT PANEL METERS. DISCONNECT ALL PRIMARY POWER SERVICE. OPEN THE DOOR SLOWLY TO ALLOW THE INITIAL RESISTOR DISCHARGE MECHANISM TO FUNCTION. UPON OPENING THE DOOR FURTHER THE POWER SUPPLY WILL BE SHORTED TO GROUND AND MADE SAFE. A GROUNDING STICK IS PROVIDED IN THE TRANSMITTER AND SHOULD BE USED TO ASSURE THAT <u>ALL HIGH VOLTAGE</u> HAS BEEN REMOVED UNDER FAULT CONDITIONS. BE CAREFUL NOT TO GROUND ANY CONNECTIONS WHICH ARE STILL ENERGIZED. THIS WOULD INCLUDE ALL LOW VOLTAGE CIRCUITS IF THE LOW VOLTAGE CIRCUIT BREAKER HAS NOT BEEN SET TO OFF POSITION.

6-5. If the above warning is not heeded, substantial damage may be done to circuit card foil, grounding devices, and the capacitors themselves. Always allow the voltage to be discharged prior to opening the door. If immediate access is an absolute necessity it is recommended that the high voltage be turned off, the door be opened approximately 2 inches and be allowed to remain in this position for 2 seconds before opening further. The main high voltage filter capacitor bank is mounted on the door with resistors directly across the terminals of each capacitor to provide slow discharge of a capacitor in case the circuit board foil should open under fault conditions. In addition to this capacitor bank there is capacitance at the rectifier terminals themselves to provide transient protection in case of over voltage. Additional filter capacitance is connected directly to each PDM amplifier to remove high frequency transients from the high voltage bus directly at the source of the high frequency energy.

6-6. PRINCIPLES OF OPERATION

6-7. AC POWER FLOW

6-8. Single phase ac power for the high voltage circuits enters the transmitter at TB1 terminals 1 and 2. It is then fed in parallel to A19K1 and A19K2. Step start action is obtained by first energizing relay A19K2. This action supplies the single phase ac through resistor A19R1 to transformer A19T1. When relay A19K1 is energized, it shorts out resistor A19R1 and supplies full ac power to transformer A19T1. Approximately 100 milliseconds later A19K2 de-energizes.

6-9. Single phase ac power for the low voltage circuits enters the transmitter at TB1 terminals 5 and 6. It is then fed to circuit breaker A10CB1. When A10CB1 is set to ON, the load side of A10CB1 supplies ac power to A20T1 which in turn supplies voltage to the low voltage power supplies.

6-10. RF POWER FLOW

6-11. The transmitter's carrier frequency originates from the Oscillator (A16) or the optional Frequency Synthesizer (A16). The output signal drives the Intermediate Power Amplifier (IPA, A5) with 1 to 2 watts of carrier power. The output squarewave of the oscillator board is adjustable from 5-25V p-p typically.

6-12. The IPA amplifies the carrier signal to the 50-200 watt level and provides the Power Amplifier module (A1) with its rf drive. The output of the IPA goes through the IPA Toroid board (A5A1) and then through a series tuned LC filter. This filter is tuned to series resonance and attenuates the harmonics of the IPA drive signal so that a sinusoidal waveform of the carrier frequency appears at the input of the PA module. The IPA filter is connected to the IPA Power Splitter board (A26A1) which distributes the rf drive through a separate ribbon coax cable to the PA module.

6-13. The rf is then amplified and modulated on the PA module. The PA Toroid board (A1A1) combines the rf power from the individual amplifiers on the PA module and connects to the Output Network (A21).

WARNING: Disconnect primary power prior to servicing.

6-14. The Output Network is a Butterworth bandpass filter which passes the carrier frequency but attenuates all harmonics. It consists of a series resonant LC section (L1-C1) and a parallel resonant tank circuit (L2-C2). The Directional Coupler (A18) connects to the top of this tank circuit (a 50 ohm point in the Output Network). The Directional Coupler is used for measuring forward and reflected power and provides a modulation sample. The Directional Coupler then connects to the last TEE section consisting of C3-L4-C4-L7-L5. This section matches the antenna impedance (within a VSWR of 1.5:1 at carrier) to 50 ohms at the Directional Coupler. The shunt section, C4-L7, is a third harmonic trap. The last coil, L6, is a drain choke and offers a high impedance to the rf but shorts any static charges to ground.

6-15. AC CONTROLLER

6-16. The AC Controller provides three functions for the transmitter. The first of these functions is the regulation of three voltages for use by the control circuitry on the Status and Multimeter board. Another purpose is the monitoring of certain parameters in the high voltage power supply and the third function is the control of ac power to the high voltage power supply. There are three regulators on the AC Controller. A ±15 volt regulator and a regulator for the microprocessor power supply at approximately +5 volts.

6-17. The first of these regulators U8 performs the function of regulating +30 to plus +15 volts for use by the control and metering circuitry. +30 is applied at J2-10; approximately 7 volts is dropped across CR3. Approximately 23 volts is then applied to the input of U8 and 15 volts regulated is provided at the output. Diodes CR10, CR11 and CR12 comprise a transient protection circuitry and reverse polarity protection for U8. CR12 limits any transients that might appear on the output of U8 to +17 volts thus protecting all of the low level circuitry connected to the +15 volt bus. CR11 provides short circuit protection on the input of U8 and CR10 provides the polarity reversal protection for U8. C26 and C27 are bypasses to prevent U8 from oscillating and C28 and C29 are used to improve the transient load capabilities of U8.

6-18. The - 15 volt regulator works in the exactly the same manner as the +15 volt regulator except the voltages are negative. -30 is applied from J1-2, and -4; 7 volts is dropped across CR4 and approximately -23 volts is applied to the input of U7. -15 volts regulated is provided at the output of U7 and is passed on to J1-26 where it goes on to more control circuitry. -15 volts is also used on the AC Controller along with plus 15 for the operation of U1, U2 and U3.

6-19. The 5V supply consists of a pulse generator and a pass transistor. U6 generates pulses whose duty cycle is dependent on the output voltage of the pass transistor. That is, pass transistor Q1 is only switched on long enough to maintain the 5-6 volt output. Plus 30 volts is applied to J2-10 and current flows through F4 and through R50, R51, R52 and R53. R50 through R53 comprise a .25 ohm metering shunt resistor so that the current into the emitter of Q1 may be monitored by the regulator fold back circuit.

U6 contains the actual regulation circuitry. The output voltage at J2-11 is divided by R45 and R46 and applied to pin 1 of U6. Also coming out of pin 16 of U6 is a +5 reference voltage. This is divided into half by R42 and R43 and applied to pin 2. The voltage across pin 2 and pin 1 is compared and if the voltage on pin 1 is found to be less than the voltage on pin 2, the duty cycle applied to the base of Q1 will be increased until the voltage of pin 1 of U6 equals the voltage on pin 2. Therefore the voltage on pin 1 of U6 will always equal that at pin 2 and will be about 2-1/2 volts. R44 and C23 set the running frequency to be about 8kHz. R40 and C25 comprise a transient network which limits the speed of the regulator in adjusting to load or line variations.

6-20. The current limit adjust potentiometer R47 adjusts the voltage applied at pin 5 of U6. A voltage applied at pin 4 derived from the voltage across R50 through R53 is amplified by transistors Q2, Q3, Q4, Q5 and Q6 and is applied to pin 4 and the two are compared. If the voltage of pin 4 is found to be more than .2 volts greater than the voltage at pin 5, U6 will stop putting out pulses thereby effectively shut down the 5 volt power supply until the current goes below the threshold voltage. In this case U6 will begin to operate again. Supply to J2-11 is approximately 5-1/2 volts at about 2-1/2 to 3 amps for the microprocessor power supply. L2 and C20 and C21 comprise an L-C network which filters the chopping frequency out leaving only dc for use by the microprocessor.

6-21. The voltage applied at J3-6 is a negative sample which is proportional to the current in the high voltage power supply. This signal is applied to R24. R24 and R23 combine with U1 to form an inverting amplifier which turns the negative sample into a positive signal and R23 determines the gain of this signal. This provides a positive buffered sample of supply current and is passed on from J1-11 to the metering circuitry on the Status and Multimeter board.

6-22. J3-5 contains a supply voltage sample. This signal is buffered by U1 and the amplitude of the signal is controlled by R22. R22 functions as a PA VOLTS electrical zero control. The output of U1-8 is used for metering on the Status and Multimeter board. It is also used to compare against the modulator output voltages to derive the four power amplifier voltages used in the SX-1.

6-23. Through the polyphase PDM process, four equal PA voltages are developed. A sample of each of the four phases is applied at J3 on the AC Control board to be compared differentially with the power supply voltage sample. This provides metering capability of the individual phases as well as the front panel PA VOLTS metering. The first phase is applied to J3-4, this voltage is dropped across R19 and R20 and applied to the minus input of U2. Applied to the plus input of U2 is the actual dc power supply voltage sample. These two signals are subtracted (the power supply minus the phase voltages) and a power amplifier voltage is derived at the output of U2. This signal is used in two places. It is used on J1-13 to perform metering function on the front panel of the SX-1. J1-3 is sent to the metering circuit on the Status and Multimeter board for digital readout. The phase 2, 3, and 4 voltages on J3-3, J3-2 and J3-1 all operate in exactly the same manner as the phase 1 signal; thereby producing four ground reference samples which are proportional to the voltage across each of the power amplifier quads in the transmitter.

6-24. U3 provides the PA AMPS metering signal by amplifying the voltage drop across the shunt which is in series with the PA B+ line. The output of U3 is pin 10 and is a ground referenced voltage proportional to the current in the main power amplifier. This signal is provided at J1 pin 19 where it is used for the Status and Multimeter board digital readout and also used for the power amplifier current meter on the front of the SX transmitter. R2 is a gain adjustment. R3 adjusts the electrical zero for the PA AMPS meter.

6-25. The control functions provided by the AC Controller are comprised of U4 and U5 in conjunction with CR1 and CR2. U4 and U5 are optically coupled triac drivers which are used to start CR1 and CR2. CR1 and CR2 are connected in series with the main contactors K1 and K2. When a voltage of about plus 5 volts is applied to J1-17, U4 commences to conduct between pins 6 and 4. At this point CR1 will begin to conduct ac current from J2-4 to J2-8. Connected to J2-8 is K1 and the coil voltage will become about 23 volts and the coil will energize provided the external interlock is closed. The same function happens when the +5 is applied to J1-15; U5 conducts thus thereby turning on CR2 and K2 will be energized.

6-26. The FAILSAFE interlock and the door interlock switches are in series with the main contactor coils. If any interlock is broken the main contactors will drop out thereby removing high voltage power from the transmitter. The transmitter will not come on if the door interlocks are broken or if the FAILSAFE interlock is broken. <u>No visible indication is provided to display an open interlock.</u>

6-27. SWITCH BOARD

6-28. All six of the front panel pushbuttons (LOW, MEDIUM, HIGH, OFF, RAISE, and LOWER) are soldered to the Switch Board. The switches are all connected with one side common to +15 volts. The other side of each switch goes to the Status and Multimeter board to drive an optical isolator input. When any of the pushbuttons is depressed, appropriate action is taken by the microprocessor via the optical isolators. As this occurs, the microprocessor illuminates a lamp which is built into the pushbuttons. This serves as a form of feedback to let the operator know that the control function is taking place. An exception to this is the OFF/FAULT lamp which illuminates only under fault conditions.

6-29. The RAISE and LOWER pushbuttons perform their function even in the OFF mode. In other words, the OFF mode also has a PDM pulse width setting determined by the RAISE and LOWER pushbuttons. This setting determines how rapidly the PA will discharge the high voltage supply when the transmitter is turned off.

6-30. SYSTEM CONTROLLER BOARD

6-31. The System Controller board is so named because all of the logic functions contained within the control circuits are on this board. The System Controller board is comprised of a microprocessor U1 which is an Intel 8085. It is operated with a crystal Y1 whose frequency is a 4.992 MHz. This is divided by 2 in U1 and is provided at pin 37 of U1. Switch S1 in conjunction with C22, R21 and CR1 form the reset circuitry to reset the microprocessor back to instruction location 0000. On depressing S1, U1 will perform the functions that it would normally perform on a power up, that is to say the depression of S1 and its release signals U1 that power has failed and has been restored. Therefore if there is a power fail sequence that the transmitter had set when S1 is pressed, the transmitter will execute a normal power fail restore sequence. If the transmitter is on, the relays will drop out, the main contactors will then go through step start sequence and the transmitter will ramp back to the power it was at previously. U4, U5, U7 and U8 comprise the memory chips used by the 8085 microprocessor. U4 and U5 and U6 are ROM sockets, that is that read only memory is stored in these three sockets and RAM memory is stored in U7 and U8. U4, U5 and U6 contains proprietary information which was designed and written at HARRIS CORPORATION and is copyrighted. U7 and U8 contain 2k by 8 RAM chips commonly known as 2016's.

NOTE

Some transmitters do not have U6 installed.

6-32. U2 forms the interrupt control structure for the 8085. Interrupts are applied at the inputs of U2 which are pins 22, 23, 24 and 25 and then U2 signals U1 through the interrupt line (INT) that one of the lines is requesting an interrupt. U1 responds and the interrupt is serviced. IC's which can generate interrupts include U16 and U17. U16 forms the RS232C UART and is used to transmit serial information to a CRT or to some other serial device connected to the SX transmitter. U17 forms another UART which is connected to the other microprocessor or System Controller board in the SX transmitter.

6-33. There are two System Controller boards in the SX transmitter and they are exactly alike in every way and they communicate with one another through U17. U12 in conjunction with the circuitry of U13 and Q1 form a memory circuit which maintains power after a power failure. The battery B1 maintains about 3.6 volts during a power failure thereby retaining all of the information contained within U12. Data is retained 6-9 months by U12 during power loss. Contained within U12 is the information about the current status of the transmitter and the current power level assigned to LOW, MEDIUM and HIGH. Therefore after a power failure it is not necessary to reprogram any of the power level information as it is retained by U12. U9 is a 3 function device; it has 3 built in dividers used to provide programmable rates to U16 and U17. U9 receives its instructions from the microprocessor U1 and sets up divide ratios which are variable depending on the clock rate that the microprocessor desires for U16 and U17. It also divides the clock frequency of the microprocessor down to approximately 1 kHz, thereby providing 1 kHz interrupt signal which goes to pin 21 of U2. This 1 kHz interrupt signal is used by the microprocessor for timing functions.

6-34. U14 is a timer which is used by the System Controller board to ensure that U1 is currently executing instructions and running properly. If for any reason U1, the 8085, should not respond to interrupts or some other malfunction U14 will time out thereby turning off DS1 the green LED and turning on DS2 the red LED. When this happens, the U14 will apply a signal to the trap input of U1 pin 6; when this happens, U1 will try to execute a halt instruction and stop allowing the other System Controller board in the transmitter to take over and completely operate the transmitter. The only indication will be the fact that the red light has illuminated on the System Controller board. One may attempt to restart the microprocessor board by depressing S1. If this does not work, the board has probably malfunctioned and should be returned to HARRIS for repair. There are no adjustments on the System Controller board and there are no parts that can be readily serviced by the user.

6-35. STATUS AND MULTIMETER

6-36. PURPOSE. The Status and Multimeter board is used in the SX Transmitters to provide circuitry for the monitoring and displaying of important information about other modules within the transmitter. This includes information about each of the power amplifiers within the transmitter and the main power supply along with information about the status and control system itself. The Status and Multimeter board also provides signals for operating the main power supply and the power output of the transmitter. The signals required for the operation of a Frequency Synthesizer are also provided on transmitters with this option.

6-37. OVERVIEW. The control and monitoring functions are logically contained within the specially programmed read only memories (ROMS) on the System Controller board and the circuitry on the Status and Multimeter board simply responds to the instructions given by either of the System Controllers. These instructions are constantly being transmitted through the main interface connectors on the Status and Multimeter board J7 and J12 with the results being sent back to the System Controller through the same connector. In other words the System Controller communicates with the Status and Multimeter board through a bi-directional bus. The power for the System Controller is also provided through this same connector thus a System Controller may be removed from operation by simply unplugging the ribbon cable leading to it.

6-38. DESCRIPTION OF THE BUS. The Status and Multimeter board communicates to the System Controller through a bi-directional bus. This bus consists of a single set of 8 data lines (DB0 - DB7) with 6 control lines (ALE, WR, RD, READY, A, and B) to provide timing information. These data and control lines are duplicated for both System Controllers.

6-39. The control lines are used to inform the Status and Multimeter board as to what type of information is being requested or transmitted by the System Controller. Also the Status and Multimeter board must know where the information is going or from where it is to come. This requires a new type of information known as addressing.

6-40. The System Controller always provides the address for any bus transaction. This information is provided on the 8 data lines and the A or B lines. Since the 8 data lines are used to also transmit the information itself the Status and Multimeter board must store the address in temporary memory to free the data lines for transmission of information. This is accomplished by the ALE lines and the two 8212 latches (U19 and U24). When a new address is being provided by a System Controller the ALE line from that controller will be pulsed high (1) then low (0) and the address latch must then store the information contained on the 8 data lines. U19 provides the address latch for the address from J12 and U24 latches the address from J7. The outputs from these latches form the internal address buses on the Status and Multimeter board. There are two internal buses with separate address and data lines to simplify the internal circuitry. The first of these buses is called the A bus and the second is the B bus. The address lines for the A bus are labeled ABA0 through ABA7 and the address lines for the B bus are labeled ABB0 through ABB7. The data lines are labeled DBA0 through DBA7 and DBB0 through DBB7 respectively.

6-41. BUS ARBITRATION LOGIC. The two control lines labeled A and B are used to indicate which of the two buses on the Status and Multimeter board the System Controller wishes to communicate with. The A and B lines are active low which is to say that they are low when they are true. This is true of all the control lines except READY. Signals which are active low are marked with a line above the signal designator on the schematic. If the System Controller #1 (connected through J12) has requested the A bus then the connections from U19 to the internal bus are correct and no switching is required. However if System Controller #1 requests the B bus then the address from the A bus must be transferred to the B bus through the address bus transfer switch made up of U20 and U21. The address and data switches are activated by the output from U9 pin 6 going to the high state. The reverse of the above is true if System Controller #2 requests the A bus. This could cause problems since both System Controllers are operating independently and some means must be provided to prevent both System Controllers from accessing the same internal bus at the same time. The bus arbitration logic (U12 and U15) is used to determine if there is the possibility of this happening and then to determine which of the two System Controllers made the first request. This prevents the second controller from gaining access until the first has finished the current transaction. If the bus arbitration logic detects a problem the offending System Controller will be asked to wait until the first controller completes the current transaction. This is done by activating the wait state generation circuitry through U14 (inverter) and U10, U11, and U13 (open collector gates).

Example: The B1 input (J12 pin 1) is low indicating that System Controller #1 is requesting the B bus. U15 pin 12 would be high indicating a B bus transaction is in progress. Then the B2 (J7 pin 1) input becomes low indicating that System Controller #2 is requesting the same B bus. At this point U12 pin 11 would be high and U12 pin 12 would be low thus U12 pin 13 would be low. Also U14 pin 6 will be low. When this occurs both inputs on U13 pins 1 and 2 will be low causing the output pin 3 to go low. This signal is inverted by U41 pin 2 having two effects. U12 pin 3 will be high preventing any write request from System Controller #2 and causing U41 pin 4 to go low removing the ready indication from System Controller #2 thus putting it into a wait state. When System Controller #1 has finished B1 will go high again and the preceeding discussion will reverse and after a short time delay (caused by R50 and C12) the ready signal to System Controller #2 will be restored to the high state allowing it to continue with its bus request.

6-42. This same basic sequence is repeated for all conditions except System Controller #1 requesting the A bus and System Controller #2 requesting the B bus which can occur at the same time with no interference. U9 pins 4 and 5 are used to determine if a bus transfer is needed and if so activates the bus transfer switches. When the bus transfer switches are activated the output of the address latch is disabled and the processor isolator for the System Controller which is waiting is activated preventing any unwanted coupling of signals from System Controller #1 to System Controller E2.

6-43. READ WRITE SELECTION. U16, U17 and U18 are used to gate the RD and WR signals from each System Controller to the proper RDA, RDB or WRA, WRB lines depending on the A1, B1, A2, B2 control lines. The RD and WR signals are used by the System Controller to indicate to the Status and Multimeter board whether a read or write request is being made. If the RD line is low this indicates that a read operation is being made. If the WR line is low this indicates that a write operation is being requested.

6-44. 'A' BUS DEVICES. There are several devices connected to each of the two internal buses on the Status and Multimeter board. Here we will describe the operation of the devices connected to the A bus.

6-45. Synthesizer Control Latch U54. This is an 8212 data latch with its outputs connected to 8 open collector transistors through 3.3k base resistors. When CS0 is low the data on DBA0 through DBA7 is latched into U54 and transmitted to the outputs of U54. The outputs of U54 are inverted by Q13 through Q20 and then through J1 are connected to the input of the Frequency Synthesizer. Through this control latch the System Controller can set the frequency of the Frequency Synthesizer in increments of 1kHz.

6-46. Status Input Latch U42. U42, an 8282 8 bit latch, is activated by U9 pin 11 going low. This will cause U42 to place the information on its inputs to be placed onto DBA0 through DBA7 where it can be read by either System Controller.

WARNING: Disconnect primary power prior to servicing.

6-47. U42 pin 1 contains the position of S1. If S1 is open (REMOTE mode) then U42 pin 1 will be high else if S1 is closed (LOCAL mode) U42 pin 1 will be low.

6-48. U42 pin 2 contains the status of the internal reset circuitry on the Status and Multimeter board. During power up the internal devices on the Status and Multimeter board are reset by R10 and C2 through U39 pin 9. This signal will slowly increase in amplitude until the threshold of U39 is reached. When this occurs U39 pin 8 will go low and U39 pin 10 will go high removing the reset condition from the data latches on the Status and Multimeter board. The System Controller monitors U42 pin 2 during power up sequencing so that no information is written to the Status and Multimeter board until the reset time has expired.

6-49. U42 pin 3 contains the state of the external PDM KILL signal from the Customer Interface board. When the PDM KILL signal is activated through the opto-isolator U4 pins 1 and 2, the output of the opto-isolator pin 15 will go low. Thus when the input to U42 pin 3 is low the System Controller will remove all PDM signals to the PDM amplifiers causing a shutdown of all rf output from the transmitter.

6-50. U42 pin 4 contains the state of the EXTERNAL HIGH POWER INTERLOCK. This signal is used to prevent the unwanted accessing of high power during nighttime operation or at other times when operation at high power may damage components in the low power phasing networks of stations with low power directional arrays. By activating the high power interlock on the Customer Interface board U4 pin 10 will be low. When the System Controller detects a low condition on the input of U42 pin 4, depressing the HI POWER button on the front panel will have no effect.

6-51. U42 pin 5 contains the state of the contactor K2. When K2 is closed a circuit is completed between J9 pin 6 and +15. Through the action of zener diode CR10, 4.7 volts will be applied to U42 pin 5 (which will be interpreted as a high) signaling the System Controller that the contactor K2 has closed.

6-52. U42 pin 6 contains the state of the contactor K1. When K1 is closed a circuit is completed between J9 pin 4 and +15. Through the action of zener diode CR11 4.7 volts will be applied to U42 pin 6 (which will be interpreted as a high) signaling the System Controller that the contactor K1 has closed.

6-53. U42 pin 7 contains the state of the High Voltage Power Supply. When the High Voltage Power Supply has risen to a certain threshold U43 pin 1 will go low indicating to the System Controller that the High Voltage Power Supply does not have a short circuit and is capable of providing voltage to the main power amplifiers.

6-54. U42 pin 8 contains the state of the lock detector on the optional Frequency Synthesizer. When the Frequency Synthesizer is in lock (indicating that it is on the correct frequency) J1 pin 1 will be above 7.5 volts and this will cause the output of U43 pin 7 to go low indicating to the System Controller that the Frequency Synthesizer is ready for on-air operation.

6-55. Overload Input Latch U46. U46 is an 8282 8 bit latch which is activated by U9 pin 3 going low causing U46 to place the information contained on its inputs on DBA0 through DBA7. The information contained in U46 is read by the System Controller every millisecond. This requires that an overload condition on the input of U46 must exist at least for 1 millisecond to be recognized. This is because the System Controller only sees the contents of U46 at the instant U9 pin 3 goes low. If an overload condition exists for less than one millisecond between the times that the System Controller reads the overload latch then the overload will not be recognized. This is not usually a problem except when setting the overload thresholds. This should be done by using the logic probe supplied with the transmitter to indicate the output of the overload comparators rather than waiting for the transmitter to overload normally.

6-56. U46 pin 1 contains the state of the voltage on the main power supply. If the voltage on the main power supply exceeds the level preset by R55 then U44 pin 1 will go low indicating to the System Controller that the power supply voltage is excessive and requires some action. Adjusting R55 clockwise will increase the preset threshold.

6-57. U46 pin 2 contains the state of the current in the main power amplifier. If the current to the main power amplifier is greater than the threshold set by R57 then the output of U44 pin 2 will go low causing the System Controller to remove the PDM drive signals to the PDM amplifiers causing a shutdown of rf output from the transmitter. If this action removes the overload the transmitter will recycle back on the air again.

6-58. U46 pin 3 contains the state of the drive level detector U44 pin 13. If the drive level goes below the threshold set by R58 then the output of U44 pin 13 will go low causing the System Controller to remove the PDM drive and to shut down the rf output of the transmitter. If this condition persists for more than 10 milliseconds the System Controller will remove the main power to the transmitter. The System Controller will not allow the transmitter to be turned on if U46 pin 3 is low indicating insufficient drive for safe operation.

6-59. U46 pin 4 works exactly as U46 pin 3 except it contains the state of the overdrive detector U44 pin 14. If the drive is above the level set by R56 the same action will be initiated by the System Controller as for an underdrive condition.

6-60. U46 pin 5 contains the state of the main power supply overload detector U45 pin 13. If the main power supply current becomes greater than the level set by R54 then U45 pin 13 will become low and the System Controller will interpret this on the next reading of U46. The action will typically be to remove the PDM drive from the transmitter thus taking it off the air and then reapplying PDM drive after the overcurrent condition has disappeared. If for some reason (supply shorted) the overcurrent condition should persist the System Controller will open the contactors to the main power supply and the transmitter will remain off the air.

6-61. U46 pin 6 contains the state of U45 pin 14. At this time there is no function assigned to U46 pin 6.

6-62. U46 pin 7 contains the state of the phase angle detector overload comparator U45 pin 2. The Phase Angle Detector supplies a voltage to the input of U45 pin 4 which is compared against the level set by R53. When the signal from the Phase Angle Detector crosses the threshold set by R53, U45 pin 2 becomes low causing a one-shot to fire (U7). U7 pin 5 will go high causing an interrupt to each System Controller. This signal also causes U15 pin 8 to become low thus clearing U53, U47 and U48. This will cause the outputs of these latches to become low thus removing all PDM drive from the transmitter's PDM amplifiers. This action also causes the indicator lights on the transmitter to extinguish briefly; however, they will be restored by the System Controller as soon as it has acknowledged the interrupt from U7 pin 5.

6-63. U46 pin 8 contains the state of the VSWR overload comparator U45 pin 1. When the reflected power exceeds the level set by R51 on the input of the comparator, U45 pin 1 will become high. This signal is sent to each System Controller via J7 pin 19 or J12 pin 19. The action of the System Controller will be to remove PDM drive from the transmitter and then as soon as possible restore the PDM drive and continue with the transmitter on the air. This action is necessary in the event of a failure of some component in the transmission system causing the transmitter to be subjected to a high continuous VSWR.

6-64. PDM Power Latch U47. U47 is an 8212 data latch which contains the least significant 8 bits of data that is transmitted to the PDM generator after being translated to CMOS logic levels by U50 and U51. These 8 bits along with 4 bits from U48 make up the 3 BCD digits of data required by the PDM generator to adjust the output power of the transmitter. When U47 pin 1 goes low, U47 latches the data contained on DBA0 through DBA7 and transmits that data to its outputs.

6-65. PDM And Status Latch U48. U48 is an 8212 data latch which is activated by pin 1 going low causing U48 to latch the data on DBA0 through DBA7 and transmit that data to its outputs. The lower 4 bits make up the remainder of the 12 bits needed by the PDM generator for power control. The upper 4 bits are used to cause the illumination of 4 of the front panel lights.

6-66. U48 pin 15 is used to illuminate the OFF/FAULT light on the front panel by turning on Q1. This also causes DS1 to illuminate and activates the fault status indication on the Customer Interface panel.

6-67. U48 pin 17 turns on Q2 causing DS2 and the LOW light on the front panel to illuminate and activates the low status indication on the Customer Interface panel.

6-68. U48 pin 19 turns on Q3 and illuminates DS3 and the MEDIUM light on the front panel and activates the med status indication on the Customer Interface panel.

6-69. U48 pin 21 turns on Q4 and illuminates DS4 and the HIGH light on the front panel and activates the high status indication on the Customer Interface panel.

6-70. Analog And Relay Control Latch U49. U49 is an 8212 data latch which is activated by pin 1 going low causing it to latch DBA0 through DBA7 onto its outputs.

6-71. U49 pins 2, 13 and 14 are brought low during power up to clear any unknown information contained in the latch.

6-72. U49 pins 4 and 6 are used as two of the bits for the automatic analog scaler system. These two bits are first translated to CMOS logic levels by U33 and then go on to U35 which is the actual scaler.

6-73. U49 pin 8 is used to activate the analog-digital (A/D) converter U40. This pin is brought high then low again by the System Controller to start the A/D converter on the next conversion cycle.

6-74. U49 pin 10 is brought to the high state to turn off Q32 and thus turns on Q33 which is connected to the main power supply contactor drivers on the AC Controller board. This action will cause K2 in the main power supply to be turned on.

6-75. U49 pin 15 is brought to the high state to turn off Q34 and thus turns on Q35 which is connected to the main power supply contactor drivers on the AC Controller board. This action will cause K1 in the main power supply to be turned on.

6-76. U49 pin 17 is brought to the high state to turn on Q36 and thus cause U39 pin 8 to go high which causes a reset of all the devices on the Status and Multimeter board. This normally occurs only on power up.

6-77. U49 pin 19 is brought to the high state to turn on Q37 and thus turns on K1 on the RFI board. K1 is used to switch the level of the rf sample to the station modulation monitor so that the monitor may have a constant level at each power setting of the transmitter.

6-78. U49 pin 21 is brought to the high state to turn on Q38 and thus turns on K2 on the RFI board. K2 is used to switch the level of the rf sample to the station modulation monitor so that the monitor may have a constant level at each power setting of the transmitter.

6-79. Status LEDs Latch U53. U53 is an 8212 data latch which is activated by pin 1 going low causing U53 to latch the data on the DBA0 through DBA7 and to transmit that information to its outputs.

6-80. U53 pin 4 turns on Q5 causing DS5 and the LOWER light on the front panel to illuminate and activates the lower status indication on the Customer Interface panel.

6-81. U53 pin 6 turns on Q6 causing DS6 and the RAISE light on the front panel to illuminate and activates the raise status indication on the Customer Interface panel.

6-82. U53 pins 8, 10, 15, 17 and 19 are unused at this time.

6-83. When U53 pin 21 is high it enables the PDM Generator to output pulses to the PDM amplifiers and also enables the Oscillator or Frequency Synthesizer to output power to the IPA. When this signal is low no PDM pulses are available and no output from the Oscillator or Frequency Synthesizer will be present.

6-84. A-Bus Address Decoder U52. U23, a 74LS138, is used to decode the address supplied on ABA2 through ABA4 and uses WRA as an enable. When WRA is low the address on ABA2 through ABA4 is used to select one of the seven outputs CS0 through CS6 which will go low and cause its latch to save the information on DBA0 through DBA7.

6-85. MUX And Scaler Data Latches U29 AND U30. U29 and U30 are 8212 data latches which are used to set the automatic scaler system scale factor and to determine which analog channel will be monitored.

6-86. The lower 6 bits of U29 are used to set the analog multiplexer channel to the desired analog input. These 6 bits are translated from TTL to CMOS logic levels by U31 and are then sent on to the analog multiplexers U25, U26, U27, U28, and U34.

6-87. The upper 2 bits of U29 along with U30 and two bits from U49 are used to set the analog scale factor in U35 after being translated from TTL to CMOS logic levels by U32 and U33.

6-88. Analog Multiplexer System. When U29 selects one of the decimal channel numbers that signal is routed through the multiplexer to the analog buffer U57 pin 3. This is a voltage follower and the output on pin 1 is applied through the calibration potentiometer R59 to the analog scaler U35 which will scale the input signal by a value supplied by U32 and U33. This value is stored in the read only memory of the System Controller and is different for each channel selected. The current output of the scaler U35 is converted into a voltage by the scaler amplifier U37 and this voltage is applied to the input of the analog to digital converter U40. U40 is also supplied with a highly accurate and stable reference voltage by U38. This signal can be selected by the multiplexer and allows for correct adjustment of R59 to compensate for any non-linearities in the scaler U35.

6-89. 'B' BUS DEVICES.

6-90. Analog-Digital Converter U40. U36 reads the address from ABB2 through ABB4 and selects which of the three bytes of information the A/D converter is to supply to DBB0 through DBB7. These three bytes of information are as follows:

> When the B bus address is hexidecimal 14 and U9 pin 8 is high (RDB is active) U36 pin 10 goes low and its inverted by U39 pin 2 so that a high signal is applied to U40 pin 37. When this occurs U40 will place on DBB5 through DBB7 the internal status of the A/D converter.
>
> When the B bus address is hexidecimal 18 U36 pin 9 will be low and U40 pin 19 will be high instructing U40 to place the least significant 8 bits of the current conversion on DBB0 through DBB7.
>
> When the B bus address is hexidecimal 1C then U36 pin 7 will be low and U40 pin 18 will be high instructing U40 to place the upper 5 bits of the current conversion on DBB0 through DBB4.

6-91. In this way the System Controller can read the 13 bit digital word which corresponds to the analog voltage on the input of the selected multiplexer. The digital word is converted to decimal and can be displayed on the digital display on the front of the pull-out drawer.

6-92. Table 6-1 is a list of the analog signals into the multiplexer and their associated pin numbers into the multiplexer chips.

6-93. Keyboard And Display Controller U6. U6 is a special programmable keyboard and display controller called an 8279. This device has the ability to detect switch closures which are connected to its input and also to display up to 16 digits of information on an appropriate display device. The controller requires a clock to use as timing for all of its functions so U39 is used to form an oscillator by connecting R40 from U39 pin 12 to 13 and C16 from pin 13 to ground. This provides a frequency of about 500 kHz at the clock input pin 3 of U6. U6 is selected by the System Controller for reading or writing on the B bus using RDB, WRB, ABB0 and the output of the decoder U36 pin 11 which corresponds to hexidecimal addresses 10 and 11. At power up U6 is reset by the rest line on pin 9 which is derived from U39 pn 8. Using the clock U6 sends out column addresses on pins 32 through 35 to activate a certain column of switches. As each column is activated U6 reads which switches are closed by means of the row lines pins 39, 1, 2, 5, 6, and 7. If U6 detects a low level on a row line it will register that a switch is closed in the column that is currently indicated by the column address on the row that indicated a low level. In this way each switch can be detected uniquely for open or closed status.

6-94. U5 is used an an address decoder and its outputs are used to strobe each group of opto-isolator transistors (U1, U2, U3, and U4). If current is flowing in the internal LED of the opto-isolator the output transistor will be turned on and will look like a closed switch to U6 and will be recognized as on.

Table 6-1. Analog Signals and Multiplexer Pins

DECIMAL CHANNEL #	SIGNAL NAME	INPUT CHIP	PIN #
00	A7 Q19/20	U26	13
01	A9 Q39/40	U26	1
02	A7 TEMP.	U26	15
03	A9 TEMP.	U26	2
04	A7 Q39/40	U26	14
05	A6 Q19/20	U26	5
06	A4 TEMP.	U26	12
07	A8 Q19/20	U26	4
08	+5 VOLT SUPPLY	U34	1
16	P.A. CURRENT	U28	13
17	A8 TEMP.	U28	1
18	PHASE 2 VOLTS	U28	15
19	PHASE 1 VOLTS	U28	2
20	PHASE 3 VOLTS	U28	14
21	MAIN SUPPLY CURRENT	U28	5
22	MAIN SUPPLY VOLTAGE	U28	12
23	PHASE 4 VOLTS	U28	4
24	+10,00 VOLT REFERENCE	U34	2
32	A6 TEMPERATURE	U27	13
33	A2 FUSE FINDER	U27	1
34	A8 Q39/40	U27	15
35	A2 TEMPERATURE	U27	2
36	A6 Q39/40	U27	14
37	A4 FUSE FINDER	U27	5
38	A1 TEMPERATURE	U27	12
39	A1 FUSE FINDER	U27	4
40	+15 VOLT SUPPLY	U34	5
48	A5 TEMPERATURE	U25	13
49	IPA DRIVE LEVEL	U25	1
50	REFLECTED POWER	U25	15
51	FORWARD POWER	U25	2
52	A5 FUSE FINDER	U25	14
53	A9 Q19/20	U25	5
54	A3 TEMPERATURE	U25	12
55	A3 FUSE FINDER	U25	4
56	PHASE ANGLE DETECTOR	U34	4

6-95. The column scan lines and row return lines are also connected to the keyboard and display board in the same fashion to allow recognition of keys depressed on the keypad. U55 is a dual flip-flop connected as a divide by 4 which strobes U5 on and off which means that on every other scan the opto-isolators will not be strobed. If an opto-isolator is being activated continuously the action of U55 and U5 will cause it to appear to the keyboard controller to only be activated on every other scan. This causes the controller to believe that the opto-isolator is being turned on and off about once very 40 milliseconds. This is important because the keyboard controller will only recognize when a switch is closed and does not give an indication when it is released so that functions which require continuous closure such as the raise function appear to the System Controller to be just several rapid closures of the raise switch. The data from the display buffer contained within U6 and written there by the System Controller is transmitted to the display board through J8 after being buffered by U8. One half of U7 is used as a pulse delay one-shot to delay the strobe signal from U6 pin 23 to the strobe input of the keyboard and display board J8 pin 2. This one-shot is used to enable each of the digits to be latched in the TIL-308 display chips on the digital display.

6-96. Analog Outputs. There are two analog buffers to provide isolation between the remote control interface and the power meters on the transmitter. U56 is connected as two voltage followers and buffers the forward and reflected power indications to the customer interface panel. J3-1 contains the forward sample. J3-3 contains the reflected power sample. J3-5 contains the PA voltage sample which is isolated by R13. J3-7 contains the PA current sample which is isolated by R14.

6-97. PDM GENERATOR

6-98. The general purpose of the PDM Generator board is to set up the carrier power levels for the transmitter and to convert the incoming audio to a PDM signal to modulate the transmitter.

6-99. The audio input circuitry starting at pins J1-4 and J1-6 is a balanced input terminated in 600 ohms. The rest of the RFI circuitry for the audio input resides on the customer interface board. Diodes CR1, CR2, CR3 and CR4 act as clamps to prevent the audio signals from going more than ±15 volts. Operational amps whose outputs are U1-7, U1-1 and U1-8 consist of a solid state transformer which converts the incoming balanced audio to a single ended signal at pin U1-8. R21 adjusts the audio input gain continuously from -10 dBm to +10 dBm. From there the audio may pass through a Bessel low pass filter through op amps U2-7 and U2-1. Switch 1 determines whether the Bessel filter is in the audio circuitry path or not. This Bessel filter is optional and rolls off the high frequency audio to prevent excessive overshoot of the PDM filter during squarewave modulation. This filter is programmable in that resistor network R18 can be chosen by the customer to give the desired audio frequency response and overshoot characteristics.

6-100. Past S1, op amp U2-14 acts as a summing amplifier and adds the dc through R28 and the audio through R32 into the digital pot U3. R28 acts as a maximum power adjustment to limit the output pulse width of the PDM generator. R28 is also a fine adjustment for modulation tracking to keep the modulation constant at all power levels. U3 is a digital potentiometer which is controlled by the Status and Multimeter board. It attenuates the dc and audio coming from U2-14 and controls the pulse width of the PDM output. The signals coming in on J3 are binary coded decimal and step the attenuation of U3 in vary fine increments. The resistors and capacitors on the input status lines coming in on J3 act as RFI filters. The digital potentiometer output goes through one more op amp, U2 pin 13. This op amp again sums the audio and dc and sends the signal to the output comparators of the PDM generator. R98 is adjusted to give 0 pulse width when all the status lines on J3 are low; to give no transmitter output power. Diode CR5 protects U3-1 from going more than .7 volts negative in case the -15 volt supply comes up before the +15 volt supply when the low voltage is turned on. The output of U2 pin 1 is also sent to another op amp U1-13 This op amp inverts the audio coming from U2-14 and also is used to balance the two audio lines to make sure their dc and audio components are equal. This is done by pot R14. Through this adjustment the output pulse widths coming out of the PDM generator should be exactly the same.

6-101. The triangle circuitry of the PDM generator begins with U11, a 240 kHz oscillator whose output is a 15 volt peak-to-peak square wave. This signal is sent to divider U4. U4 divides the 240 kHz by 4 and sends two 60 kHz square waves whose phase relationship is 90 degrees apart. These two square waves control the analog switches U5. Transistors Q1 and Q2 and their associated circuitry consists of a current source which supplies the transistors in U6 with a constant current to charge up capacitors C37 and C38. When the switches in U5 are closed, the current flowing through the transistors in U6 flow through the switches in U5 to ground; thereby linearly discharging the capacitors C37 and C38. When the switches in U5 are open, the current flowing through U6 flows into the capacitors C37 and C38; thereby charging up these capacitors in a linear fashion. The voltage developed across these capacitors are the 60 kHz PDM ramps or triangle waves. These two triangle waves are now 90 degrees apart and are about 4 volts peak-to-peak. These triangle waves are now sent to the output comparators U9 and U10 which, along with the audio signals will develop the PDM signals. These signals fed to the output comparators U9 and U10 are injected into the comparators such that the output signals are each 90^{o} apart, thus giving the four polyphase PDM signals. The 4 PDM signals leave the PDM Generator board on J4-1, -3, -6 & -8 and are sent to the PDM Amplifiers. The outputs of comparators U9 and U10 are open collector outputs. Their supply is derived from the collector of Q4. Q3 and Q4 are part of a PDM kill circuit which is used to turn the transmitter off under various overload conditions. This signal is sent from the Status and Multimeter board. Under normal operating conditions the PDM KILL signal on J3-2 will be approximately +5 volts and transistor Q4 will supply approximately 15 volts dc to the 750 ohm resistors for the output of the comparators. The output PDM signals will therefore be approximately 15 volts peak-to-peak. When a PDM KILL is sent from the Status and Multimeter board, J3-2 will be approximately 0 volts and Q4 will turn off; thus turning the output comparators off.

6-102. There is a hum null adjustment on the PDM generator which cancels the power supply hum from the high voltage power supply. This signal comes in on J1-7; L3 and C87 consists of a RFI filter for this sample. Potentiometer R30 is the hum null adjustment. This adjustment is made to minimize the power supply noise; thereby giving the best signal to noise ratio for the transmitter output. Resistor R97 is a carrier shift resistor. This resistor along with resistors A19R15 and A19R14, where J3 pin 2 is connected, compensate for power supply sag and maintain the carrier output power level by injecting a small dc component into the audio circuitry of op amp U2 pin 9.

6-103. The +15 volt power supply starts with an RFI filter, L1 and C85. This filter rejects any rf energy that would be coupled into the 30 volt bus coming in on J1 pin 12. Diode CR14 prevents the input of voltage regulator U13 from going negative. CR16 on the output of U13 acts as a transient suppressor and prevents the output of the voltage regulator from going above approximately 15 volts. Diode CR15 protects U13 if there should be a short on the input. This same discussion applies to the negative 15 volt supply except all the voltage polarities are now reversed.

6-104. PDM AMPLIFIER

6-105. The general purpose of the PDM amplifier is to amplify the incoming PDM signals from the PDM generator and to pass this amplified signal through the PDM filter to modulate the power amplifiers. The incoming signal from the PDM generator is of the level 0 to 15 volts peak-to-peak. This signal comes in on J2-3 and J2-1. Plug P4 is positioned one and two. This allows two phases of the PDM signal to drive two separate pairs of PDM amplifier transistors. The PDM input signal passes through isolation resistors R11 and R31 and into current amplifiers U11 and U31. These IC's act as voltage followers and pass the PDM signal to the class B drivers (transistors Q13, Q14, Q15, Q16, Q35, Q36 and Q33 and Q34). Only the first leg of the PDM amplifier drive circuitry will be discussed; the other three legs have exactly the same operation.

6-106. The push-pull driver transistors Q13 and Q14 are voltage followers. The outputs from U11-3 and -5 are identical. Therefore when the voltage is high, coming out of U11, Q13 will be on; when the signal coming out of U11 is low, Q14 will be on. Resistors R17 and R18 and capacitor C13 in the collector circuit of Q13 lower the 30 volt supply to approximately 15 volts; otherwise the level of the signal would be too great for the gate of Q19. C13 also provides stored energy when Q13 turns on to charge up the gate of Q19. Capacitor C14 in the base of transistor Q14 quickly discharges the base of Q14 when turning it off. CR14 clamps the gate voltage of transistor Q19 to approximately 15 volts and acts as a transient suppressor to absorb any voltage transients on the gate of transistor Q19. Diodes CR12 and CR13 have two purposes. Their first purpose is to provide two diode drops for any offset voltages from transistor Q14 and U11 when the PDM signal is low. The voltage at the emitter of Q14, when the PDM signal is low, is approximately 1 volt; therefore at the gate of Q19 the voltage will be approximately 0 and thereby decrease the chances for leakage currents into the gate of Q19 or accidental turn on. Their other purpose is to stand off the high voltage on the gate of Q19 if transistor Q19 should fail drain to gate. Capacitors C17, C18 and C19 also have two purposes. The first is to pass the 60 kHz signal to turn off Q19; the second is again to prevent the chances of failing driver circuitry beyond CR14 if Q19 should fail, drain to gate. These capacitors then will charge up to the high voltage power supply and CR14 will clamp the voltage on the other side of the capacitors to approximately 15 volts. R21 acts as a pull down and load resistor to help prevent any accidental turn on of Q19.

6-107. Transistors Q19 and Q20 are effectively in parallel and will share the current from the PDM filter. When the incoming PDM signal is high, Q19 and Q20 will be on and will short the PDM filter to ground. When the incoming PDM signal is low, transistors Q19 and Q20 will be off and the PDM filter will be unterminated and its voltage will rise to the power supply voltage. C23 and R23 form a snubber circuit. This circuit reduces the high voltage overshoot transient when Q19 turns off. R25, R26, CR19, R27 and C25 form a PDM status indicator for the Controller and the front display panel. This detector will supply a dc voltage to the Controller if the transistor Q19 is switching satisfactorily. If Q19 is shorted, there will be 0 voltage sent to the Controller through this circuit on J1 pin 7. The PDM filter makes connection to the PDM amplifiers at jacks J5 and J6. Damper diode CR1 prevents the voltage at the end of the PDM filter from rising above the high voltage power supply when the PDM amplifier transistors turn off. The damper diodes make connection to the power supply through the PDM pull up board. TC1 monitors the temperature of the PDM amplifier heatsink and sends a dc voltage to the Status and Multimeter board for monitoring information.

6-108. PDM PULL-UP BOARD

6-109. The general purpose of the PDM pull-up board is to bypass the damper diode and to aid in maintaining constant rise time of the PDM waveform to improve the modulation linearity. Point E2 is connected to the high voltage power supply. It is also bypassed with a large electrolytic capacitor. C1 also provides additional rf bypassing for the damper diode on the PDM amplifier. The PDM pull-up signal comes in on J1 from a current source which is formed by A19L1, a two henry choke and A19R20, a 500 ohm resistor. This choke and resistor are connected in series to the high voltage power supply and make up a current source for choke L1 and L2 on the PDM Pull-Up board. The energy from A19L1 and A19R20 is transferred to chokes L1 and L2. These chokes inject current into the PDM amplifier transistors and help to charge up any transistor and stray capacitance in the circuit when the transistor is turning off. This current is necessary because during negative peaks of modulation the current in the PDM filter is very low. When the PDM signal has low duty cycle, in other words when the transistors in the PDM amplifier are on more than off, the current injected into the PDM amplifier transistors from L1 and L2 will have low peak content. However, when the PDM signal has high duty cycle, in another words when the PDM amplifier transistor are off more than on, the peak current injected into the transistors from L1 and L2 will be high since the time that this current can flow is very short. Therefore, this circuit is self tracking; in other words, the peak current injected into the transistors increases as the PDM signal goes toward pinching off the carrier; thereby quickly charging up the stray capacitances in the PDM amplifier transistors.

6-110. PDM FILTER

6-111. The general purpose of the PDM filter is to filter the 60 kHz switching waveform coming from the PDM amplifiers and pass the audio and dc components to modulate the PA module(s). The PDM filter consists of 4 identical low pass filters, each filter has two L-C sections. The second capacitor does not exist on the PDM filter but is located on the PA module where the PDM signal is injected into the power amplifier. In the case of the SX-1 each separate filter is of a different PDM phase. Coupling capacitors C13, C23, C33 and C43 couple the PDM filters together to cancel the 60 kHz component, but yet remain a high impedance to the audio component. The clamping diodes on the inputs and outputs of the filter help to prevent the input and output voltages from going below ground. The resistors in series with the diodes help to limit the current in these diodes if this condition should exist. Resistors R13, R23, R33 and R43 are sampling resistors that are used for metering the PA voltage at each of the four filter outputs. This information is sent to the Status and Multimeter board via the AC Controller. The outputs of the PDM filters are tied directly to the power amplifier modulation input jacks. In addition to this connection there are four resistors and three capacitors connected to the output of the PDM filter which act as a high frequency audio equalization circuit. This circuit helps to balance the PDM phases at high frequency modulation.

6-112. OSCILLATOR A16

6-113. The oscillator is the standard frequency determining source. The crystal oscillator stage is a voltage stabilized Pierce circuit operating at 2 or 4 times the carrier frequency. The crystal operates in its parallel resonant mode and meets FCC requirements.

6-114. For carrier frequencies of 1250 kHz and below, the crystal operates at 4 times the carrier frequency, and for carrier frequencies above 1250 kHz the crystal operates at 2 times the carrier frequency.

6-115. Buffer/squaring amplifier Q2 is lightly coupled to the oscillator and provides a 5 volt square wave to the programmable divider U1. This divider will divide the crystal frequency by 2 or 4 to obtain the carrier frequency. The divider drives a level shifter U2 which produces a 15 volt square wave. This stage drives the class D output transistor pair Q3 and Q4 which produce about 2 watts of rf drive to the IPA. The output drive level is adjusted by varying the dc voltage applied to the collector of transistor Q3. This dc voltage is obtained from regulator U3 and is determined by resistor R27. Increasing R27 produces more rf output.

6-116. OPTIONAL FREQUENCY SYNTHESIZER (A16)

6-117. The Frequency Synthesizer is capable of deriving rf carriers from 525 to 1605 kHz in 1 kHz steps from one stable 10.0 MHz source.

6-118. The Frequency Synthesizer uses a phase locked loop (PLL) principle to derive the output rf carrier from the 10.0 MHz reference frequency. The loop consists of synthesizer chip (U2), loop filter (U3), and VCO (U4). The Frequency Synthesizer is programmed by the Status and Multimeter board (A12) thru the data lines entering on J3. This data programs the reference frequency dividers and the channel frequency dividers in the PLL feedback loop. Chip U2 contains the reference dividers, the channel dividers, and the phase detector.

6-119. The reference frequency of 10.0 MHz is derived by the TCXO, U10. Potentiometer R14 is adjusted to obtain exactly 10.0 MHz out of U2 pin 16 on turret E16. Transistor Q5 acts as a buffer and level shifts the 15 volt signal from the TCXO to the 9 volt signal level acceptable by U2. The 10 MHz signal is divided down to 10 kHz by the reference dividers internal to U2 and connected to one input of the phase comparator. The output of the channel dividers is connected to the other input of the phase comparator internal to U2. The phase comparator error signal (U2 pin 12) is fed into the loop filter, U3.

6-120. The loop filter has two purposes: 1) to determine the lock time, overshoot, gain, and phase response of the PLL, and 2) to filter the 10 kHz noise generated by the phase comparator. The first section comprising R18, R19, and C22 forms a low pass filter and determines the dynamic characteristics of the PLL. The first operational amplifier in U3 acts as a buffer-voltage follower. The second stage of U3 forms another low pass filter. The third and fourth stages of U3 form a low pass notch filter with a notch placed at 10.0 kHz. This filter prevents the 10 kHz noise from getting into the VCO circuit. When the loop is locked, the output of the loop filter will be a dc voltage. When the filter is unlocked, the output of the loop filter will be an ac voltage which will attempt to drive the loop into lock via the error signal from the phase comparator.

6-121. The voltage out of the loop filter reverse biases varactor CR7, which varies its capacitance. CR7, C19, and one of the chokes L5, L6, or L7 form a parallel resonant tank circuit for the VCO, U4. (See table on Frequency Synthesizer schematic in Section VIII for switch positions.) Choke L4 prevents any rf from getting back into the loop filter. Capacitors C32 and C33 are bypasses for internal bias points. Components C34, C35 and L3 form a decoupling network for the +5 volt power input. The VCO output, U4 pin 3, runs at 10 times the rf carrier and is amplified by transistor stage Q6 up to approximately 8 volts peak-to-peak. It is then fed back into the channel dividers in U2 pin 3 to close the PLL.

6-122. The output of Q6 is also fed outside the PLL to transistor stage Q7. This stage level shifts the 8 volt p-p signal to 0-5 volts TTL level for U5. Capacitor C39 helps Q7 to turn off and diode CR8 prevents the base of Q7 from going negative. U5 divides the incoming signal by 10 to derive the carrier frequency.

6-123. The divider drives a level shifter U6 which produces a 15 volt square wave. This stage drives the class D output transistor pair Q8 and Q9 which produce about 2 watts of rf drive to the IPA. The output drive level is adjusted by varying the dc voltage applied to the collector of transistor Q8. This dc voltage is obtained from regulator U9 and is determined by potentiometer R41. Increasing R41 resistance produces more rf output.

6-124. The lock detect signal at U2 pin 13 if filtered and sent to the Status and Multimeter board for status information. A high level indicates the loop is locked and a pulsing signal indicates the loop is unlocked. The RF KILL line coming in on J3 pin 3, when low, clears counter U5 and turns off the output of the Frequency Synthesizer board.

6-125. The dc voltages used on the Frequency Synthesizer board are -15 volts, +5 volts, +9 volts, +15 volts, and +30 volts. The -15 volts is derived off of this board and enters on J2 pin 3. Components L1 and C1 decouple this line. The +30 volts supply feeds the +15 volt, +9 volt, and +5 volt regulator circuits. On the +15 volt power supply, U7, C11 and C10 act as filter capacitors for the input and output respectively.

6-126. Resistor R40 prevents the regulator from latching up during momentary power failures. CR11 and CR13 protect the regulator if there is a short to ground on the input or output respectively. The above discussion also applies to the +5 volt dc power supply, U8.

6-127. The +9 volt dc power supply is derived from a transistor-zener diode regulator, Q2. R4 provides base current for Q2 and reverse biases zener diodes CR2 and CR3. Capacitor C6 provides output filtering. Diode CR1 protects U2 if an overvoltage condition occurs or if Q2 fails.

6-128. IPA BOARD

6-129. The IPA Board consists of a class D bridge amplifier using high power MOSFET transistors. This board uses ±30 volts dc from the low voltage power supply. The IPA is driven from the oscillator or synthesizer through jack J2. The carrier signal is applied to transformer T11 and T12. Chokes L1 and L2 help to parallel resonate the input of this transformer assembly for carrier frequencies greater than 800 kHz; for frequencies less than 800 kHz these chokes should be removed. Capacitors C11, C12, C13, C14, C16, C17, C18 and C19 rf bypass the ±30 volt supply.

6-130. Transistors Q11, Q12, Q13 and Q14 are driven hard into class D operation. Transistors Q11 and Q13 are driven 180 degrees out of phase with respect to Q12 and Q14. During the positive half of the rf cycle Q11 and Q13 are simultaneously on; then during the negative half of the rf cycle Q12 and Q14 are on. This produces a carrier squarewave waveform of twice the supply voltage across terminals E11 and E12. These terminals then connect to the IPA toroid board.

WARNING: Disconnect primary power prior to servicing.

6-131. Blown fuses are detected via diode CR11 or CR12. Temperature sensor TC1 monitors the heatsink temperature of this board. This information is sent back to the controller for status information.

6-132. IPA TOROID BOARD

6-133. The IPA Toroid Board transforms the signal from the IPA board to the PA transistors. This board makes connection to the IPA at terminals E11 and E12. It consists of a transformer with one primary winding and three secondary windings in parallel. One end of the secondary winding is connected to cabinet ground, the other end makes connection to the IPA series tuned filter. The transformer's turns ratio performs an impedance transformation from the PA transistors to the IPA transistors. The turns ratio on this transform varies with carrier frequency.

6-134. PA BOARD

6-135. The PA Board consists of four bridge class D amplifiers with four power MOSFETs to a bridge. The high side of the PA is connected to the high voltage power supply (270 volts) through jack J3. The low side of the PA is connected to the Modulator through jacks J11, J12, J13, and J14. The rf drive enters the board through jack J2.

6-136. The following discusses the first quad-bridge on the PA board and applies to the other three bridges. The series chokes (not used at all frequencies) L14 and L15 help to isolate failed transistors from the rest of the circuit so that the rf drive will not sag. Resistors R11 and R13 help swamp the input drive circuit. The parallel chokes L13 and L16 parallel resonate the rf drive input for carrier frequencies of 1100 kHz and above. For carrier frequencies below 1100 kHz, these chokes should removed. (The self inductance of the transformers T11 and T12 parallel resonate the input circuit for these carrier frequencies.) RF chokes L11 and L12 allow only dc currents to flow in fuses F11 and F12.

6-137. Transistors Q11 and Q13 are driven 180 degrees out of phase with respect to transistors Q12 and Q14 via transformers T11 and T12. During one half of the rf cycle Q11 and Q13 are driven into saturation while Q12 and Q14 are cutoff. During the other half of the rf cycle Q12 and Q14 are driven into saturation while Q11 and Q13 are in cutoff. This produces a squarewave voltage waveform of twice the bridge voltage [jack J3 (270 volts) minus jack J11 (modulator volts)] across the output transformer on the PA Toroid Board.

6-138. Capacitors C11, C12, C13, and C14 rf bypass the 270 volt supply on transistors Q11 and Q14. Capacitors C16, C17, C18, and C19 rf bypass the modulator input and also are the last shunt capacitors in the PDM filter. Diode CR13 prevents the modulator voltage from going below ground.

6-139. Blown fuses are detected via diodes CR11 and CR12. The PA module's heatsink temperature is monitored with TC1. This information is sent to the Controller for status information.

6-140. PA TOROID

6-141. The PA Toroid board combines the rf power produced by the bridge amplifiers on the PA board. It makes connection to the PA board at terminals E11 and E12 (bridge amplifier 1). Each transformer transforms the signal from the bridge amplifier to the output network. T11, T21, T31, and T41 consist of a toroidal transformer with one primary winding and two parallel secondary windings. The secondary windings of transformers T11, T21, T31, and T41 are in series such that the rf voltage across all of the transformers is summed. The rf current in each toroid's secondary winding is equal.

6-142. One end of the secondary windings is connected to cabinet ground and the other end of the secondary windings is connected to the output network. Thus, the power from each bridge amplifier is summed such that at the end of the power combiner string the transmitter's output power is achieved.

6-143. Capacitors C11, C21, C31, and C41 are dc blocks. Resistors R11, R1B, R12, R1C, etc. provide a test signal of the bridge amplifier output at jack J1.

6-144. OUTPUT NETWORK

6-145. The function of the output network is to accomplish the following:

a. Harmonic Filtering. The network reduces all harmonics to at least 80 dB below the desired carrier when operated into a broadband resistive load. (Note: the FCC requires 80 dB for 5 kW, 77 dB for 2.5 kW, and 73 dB for 1 kW.)

b. Impedance Matching. The network provides an impedance transformation from the nominal 50 ohm output connection to the PA Toroid board. The real part of the impedance presented to the PA Toroid board is approximately 28 ohms (for 5 kW, 14 ohms for 2.5 kW and 7 ohms for 1 kW). The imaginary part is such that the reactance of the PA toroids and the inter connections is cancelled to give zero reactance to the output transistors at the carrier frequency.

c. Tuning and Loading. The network provides a means to accommodate antenna loads at the carrier frequency of up to approximately a VSWR of 1.5 relative to the nominal 50 ohm load. Since in the general case a load has errors in both the resistive and reactive parts, two controls are required. The TUNING and LOADING controls are largely independent with a minimum of interaction.

d. Minimum deterioration of antenna bandwidth. The network has a maximally flat amplitude Butterworth bandpass response. This insures minimum deterioration of the bandwidth of the antenna load.

e. Minimum distortion of AM Stereo. The Butterworth bandpass response has the required amplitude flatness and phase linearity to cause minimum distortion to AM Stereo sidebands.

f. Network efficiency. The network has approximately 5 percent dissipative losses.

g. Adjacent channel rejection. The bandpass characteristic of the network provides rejection to other signals picked up by the antenna system and delivered toward the transmitter. This reduces the generation of any possible intermodulation products and restricts the amount of lightning energy returned to the output transistors.

6-146. THEORY OF DESIGN. The output network is derived from a three pole Butterworth bandpass filter followed by a 45 degree TEE network. The Butterworth bandpass portion is designed using standard techniques for an unterminated input. The basic form is shown in figure 6-1. The impedance level of the 2nd and 3rd sections is 50 ohms nominally. The 1st section operates at the impedance level of the load presented to the PA Toroid board. Norton's transformations are used to accomplish the impedance change while maintaining the flat Butterworth characteristic. The transformation is implemented by a change to the inductor of the 1st section and by tapping down on the inductor of the 2nd section. At the carrier frequency, the 1st and 3rd sections are series resonant and the 2nd section is parallel resonant.

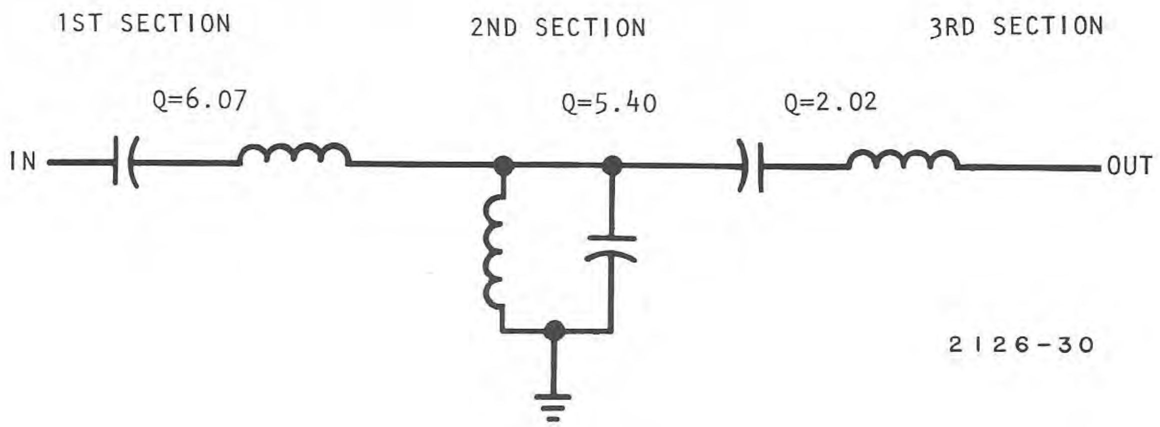
6-147. The TEE network follows the standard design of a 45 degree network with a unity impedance transformation. The basic form is shown in figure 6-2.

6-148. The 45 degree phase shift provides minimum interaction between the TUNING and LOADING controls. The output series arm can be adjusted to compensate for minor changes in the real part of the antenna load. The input series arm can be adjusted to compensate for a minor reactive antenna load. A 50 ohm non-reactive load is presented to the Butterworth filter. The bandwidth of the TEE network is so broad that it does not significantly affect the maximally flat bandpass characteristic of the Butterworth filter. The low pass configuration does however add to the harmonic rejection.

6-149. The shunt arm was designed to form a 3rd harmonic trap. The design criterion is such that at the carrier frequency the capacitive reactance is the same as required for the TEE network plus is series resonant at the 3rd harmonic.

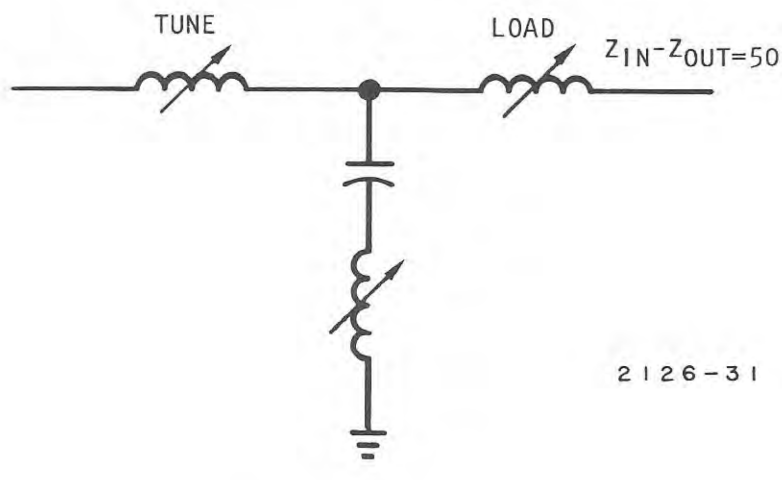
6-150. Since the output of the bandpass filter and the input of the TEE network both consist of a series inductor, a single component is used in the transmitter. Since the TEE network presents 50 ohms to the filter and since the 3rd section is series resonant a 50 ohm non-reactive load is presented to the 2nd section. This provides an ideal location for the directional coupler. Under ideal conditions, the directional coupler should indicate no reverse power to confirm no VSWR at the junction of the 2nd and 3rd filter sections. Note that the Directional Coupler does not indicate the small VSWR or reverse power that may exist in some installations at the transmitter output terminal. Best engineering practice is to adjust the antenna system for 50 ohms non-reactive (VSWR = 1.0) at the transmitter output terminal. The TEE network can however accommodate, with only minor performance deterioration, VSWR's up to about 1.5 of any phase.

6-151. Part of the capacitance and part of the inductance of the 1st section exist on the PA Toroid board. Capacitor C1 in the output network is selected to give a net capacitive reactance determined by the desired Q of the first section. Since there is distributed inductance in the PA Toroid board, the inductor of the first section of the filter is adjusted to zero reactance to the PA transistors. This technique accommodates the reactances on the PA Toroid board, gives a non-reactive load to the transistors for maximum efficiency, and maintains proper Q of the 1st section of the filter for correct Butterworth bandpass characteristics.



2126-30

Figure 6-1. Output Network



2126-31

Figure 6-2. TEE Network

6-152. The capacitors for the output network are specified in less than 5% increments in reactance (10% for TEE network) for the AM broadcast band. With the specified capacitors and proper alignment, the network will accomplish all of the required functions.

6-153. DIRECTIONAL COUPLER

6-154. The general purpose of the Directional Coupler is to monitor the forward and reflected power out of the transmitter and to send this information to the Status and Multimeter board for the front panel power meter. It also provides the modulation sample. This directional coupler was designed to be in a 50 ohm system so that the directional coupler will only know and work properly when the Output Network is tuned such that the top of the tank circuit out to C2 is in a 50 ohm resistive system. Transformer T1 provides a rf current sample for the coupler. This current is injected in the resistors R3, R4, R5, R9, R6, R7, R8 and R10 and a voltage is developed across them for this current sample. Capacitors C1 and C10 along with their capacitor dividers provide the voltage sample for the coupler. The directional coupler is nulled when the voltage from the capacitive divider and the current from the transformer is identical (such that no current will flow in the detector diodes, C1 or CR2). In the forward leg, the voltage and current will be out of phase such that maximum signal will be on the output of the detector CR1. On the reflected leg, the current sample and voltage sample will be exactly in phase such that no current will flow in CR2 and thereby no signal will be developed at the output of this detector. The L-C filter on the output of the detector acts as an audio low-pass filter and filters any rf energy off of the detector output. Resistors R1 and R2 are terminating resistors and along with resistors on the RFI board and the Status and Multimeter board provide a pad for this dc voltage which is being used to drive the output power meter. Capacitor C11 is the modulation sample capacitor; this voltage is sent to the RFI board where it is terminated in some additional capacitors. Spark gap E1 provides some lightning protection in the case that the antenna or transmitter would be hit by a lightning strike. Plugs P2 and P3 are used to change the phase of the transformer current sample so that each leg of the directional coupler can be nulled independently.

6-155. VSWR BOARD (OR PHASE ANGLE DETECTOR BOARD)

6-156. The purpose of the Phase Angle Detector board is to detect any changes that occur in the load presented to the PA Module and to trip the transmitter off if the VSWR exceeds a certain level.

6-157. A current sample is injected into J1 from a current transformer placed around the ground post of the PA Combiner secondary winding. A voltage sample at J2 is formed by C3-C4 and an external capacitor located after C1 in the Output Network. The signals at J1 and J2 are matched exactly in amplitude by adjusting C3, and in phase by adjusting C1. Transformer T1 is tuned to parallel resonance at the carrier frequency by L2, C2 and C6 to provide harmonic rejection of the signals at J1 and J2.

6-158. When the transmitter is tuned properly into the desired load impedance, the signals on both sides of T1 will be exactly the same; therefore no signal is sent to the output, J3. Under a VSWR condition, a voltage is developed across T1 and is rectified by diodes CR1 and CR2. This signal charges up capacitor C5 through R4 very quickly. R5 provides a very slow discharge path for C5 so that the signal is present long enough for the detection circuit on the Status and Multimeter Board to recognize it. Diode CR3 prevents this signal from going negative or more that 10V positive.

6-159. HIGH VOLTAGE POWER SUPPLY

6-160. INTRODUCTION. The SX series transmitters contains power supplies with very low impedance and high current capabilities with large amounts of stored energy.

WARNING

DUE TO THE LARGE CURRENT CAPABILITIES OF THESE POWER SUPPLIES UNDER SHORT CIRCUIT CONDITIONS EXTREME CAUTION SHOULD EXHIBITED WHEN TROUBLESHOOTING AND WORKING AROUND THIS TRANSMITTER. ALWAYS DISCONNECT POWER BEFORE OPENING COVER, DOORS, ENCLOSURES, PANELS OR SHIELDS. ALWAYS USE GROUNDING STICKS AND SHORT OUT HIGH VOLTAGE POINTS BEFORE SERVICING. ENSURE DUST, DIRT AND CHIPS ARE REMOVED FROM CABINET BEFORE POWER SUPPLY OPERATION IS STARTED. NEVER MAKE INTERNAL ADJUSTMENTS, PERFORM MAINTENANCE, OR SERVICE WHEN ALONE OR WHEN TIRED.

6-161. The purpose of the High Voltage Power Supply in this transmitter line is to supply the primary high power voltage for operation of the power amplifier and modulator circuitry.

6-162. The main high voltage transformer is installed in the bottom of the cabinet with the associated rectifiers on the wall directly beside the transformer. Double interlock switches are located on each door opening. The step/start sequence is controlled by the microprocessor controller located in the pullout drawer.

6-163. DESCRIPTION. The SX-1 transmitter has single-phase full-wave rectifier power supplies.

6-164. The single phase power supply was selected for convenience of hookup and the ability of small amounts of power being drawn from a single phase power line without excessive current drain. The disadvantage of a single phase power supply of this type is the power factor associated with this type of a rectifier. When being used on a large capacitor, input filter causes large pulses of current flow in the primary line which causes low power factor as a result. This power factor being harmonically related rather than waveform phase shift is not correctable with external means. Because of the small power drain this is not considered to be a disadvantage for this type of power equipment. The negative side of all the power supply is returned to cabinet ground through a shunt resistor which is used to measure power supply current. The positive voltage is supplied to the PA amplifier chassis. There are no taps on the secondary of the power transformer for voltage adjustment. There are taps on the primary of all the transformer to allow line voltage adjustment from 197 volts to 251 volts with 11 volt steps.

6-165. During the turn on sequence a resistor is connected in series with the primary of each transformer to limit the capacitor charging current to a safe value for 500 milliseconds. The time duration of this step/start sequence is controlled by the microprocessor and upon the completion of the initial step/start sequence the run contactor energizes and allows full voltage to be applied to the primary of the transformer. After an additional 100 milliseconds, the step/start contactor deenergizes removing the resistor from the circuit.

6-166. Extensive interlocking and safety switches have been provided on these transmitters because of the low impedance high current capabilities of these power supplies. The access doors to these transmitters are provided with three safety switches. The first safety switch is operated by a small pin protruding through a hole and, upon opening the door, interrupts the control voltage to the primary contactors allowing them to deenergize. Upon opening the door further, a large switch with heavy silver contacts is provided to discharge the energy storage capacitors through large resistors for current limiting. Upon opening the door further, a switch operated also by the door shorts the power supply to the cabinet eliminating any possible voltage remaining on the filter capacitors.

WARNING

THE NORMAL PROCEDURE IN TRANSMITTER TURN OFF SHOULD BE FOLLOWED IN DEENERGIZING THIS TRANSMITTER. TURN OFF THE HIGH VOLTAGE BY DEPRESSING THE OFF BUTTON. IF YOU MUST ENTER THE TRANSMITTER, ALLOW THE POWER SUPPLY TO DISCHARGE AS INDICATED BY THE FRONT PANEL METERS. OPEN THE DOOR SLOWLY TO ALLOW THE INITIAL RESISTOR DISCHARGE MECHANISM TO FUNCTION. UPON OPENING THE DOOR FURTHER THE POWER SUPPLY WILL BE SHORTED TO GROUND AND MADE SAFE. A GROUNDING STICK IS PROVIDED IN THE TRANSMITTER TO ASSURE THAT ALL VOLTAGE HAS BEEN REMOVED UNDER FAULT CONDITIONS.

6-167. If the above warning is not heeded substantial damage may be done to circuit card foil, grounding switches, and the capacitors themselves. Always allow the voltage to be discharged prior to opening the door. If immediate access is an absolute necessity, it is recommended that the high voltage be turned off, the door be opened approximately 2 inches and be allowed to remain in this position for 2 seconds before being opened further. The main high voltage filter capacitor bank is mounted on the door with resistors directly across the terminals of each capacitor to provide slow discharge of a capacitor in case the circuit board foil should open under fault conditions. In addition to this capacitor bank there is capacitance at the rectifier terminals themselves to provide transient protection in case of over voltage. Additional filter capacitance is connected directly to each PDM amplifier to remove high frequency transients from the high voltage bus directly at the source of the high frequency energy.

6-168. Additional transient protection is provided by an MOV (Metal Oxide Varistor) located directly across the secondary terminals on each transformer. The purpose of this device is to clamp the secondary voltage at some voltage in excess of normal operating voltage in case of a high voltage transient coming in the ac line power.

6-169. It is recommended that spare MOV's of the appropriate size be carried as spare parts for each transmitter. If severe transient conditions exist on the power line and the MOV fails frequently other transient suppression means should be provided to eliminate this problem. As discussed previously the shunt in the return of the power supply to ground (negative leg) provides a current sample to the microprocessor controller for display on the front panel when appropriate keypad numbers are input to the controller. In addition a sample of the power supply voltage is connected through the controller to the PDM amplifier for regulation of the transmitter output power as a function of DC power supply voltage.

6-170. The operation is as follows: if the power supply voltage changes because of an ac power input variation the voltage sample feedback to the PDM generator will cause the power output of the transmitter to change back to the value set by the controller in initial operation.

6-171. LOW VOLTAGE POWER SUPPLY

6-172. INTRODUCTION. The purpose of the low voltage power supply is to provide a ±30 volt system for supplying power to all control and driver functions in the transmitter. The 30 volts is not regulated, however, individual boards that require regulation will do onboard regulation for 15 and 5 volt applications.

6-173. DESCRIPTION. The ±30 volt power supply is driven with a power transformer with 208/240 taps plus taps for ±11 volt variations to compensate for customer line variations. The secondary of the transformer is center tapped with an MOV (Metal Oxide Varistor) across the secondary terminals for transient protection the same as on the high voltage power supplies. The center tap of the transformer is grounded and full wave rectifier diodes rectify each half of the secondary voltage to produce +30 volts at 11 amps maximum and -30 volts at 11 amps maximum. The filter capacitor for each half consists of one 76,000 microfarad capacitor rated at 40 volts. There is a 500 ohm bleeder resistor across each capacitor.

6-174. The low voltage power supply is not step/started and is on whenever ac power is applied to the transmitter and the circuit breaker in the base of the cabinet is on the pilot light on the front panel in the base of the cabinet will be illuminated when the low voltage power supply is on.

6-175. Since this a low voltage power supply, there are no interlocks on the doors controlling this power supply. All printed circuit boards in the pull out drawer are powered from this supply and therefore will be serviceable with the high voltage turned off and only the low voltage power supply in operation. The oscillator card will be supplying rf to the IPA under these conditions. The ±30 volt supply will also be powering the IPA which will be driving input rf to the power amplifier module boards under these conditions. There will be voltage on the IPA matching LC network between the IPA and common point pc board. Voltages within this circuit can exceed 70 volts and therefore are protected with a high voltage shield that must remain in place during operation of this equipment.

SECTION VII

PARTS LIST

7-1. INTRODUCTION

7-2. This section of the technical manual contains a list of the replaceable parts for the SX-1 AM TRANSMITTER. Table 7-1 gives an index to the replaceable parts section.

7-3. REPLACEABLE PARTS SERVICE

7-4. 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 Transmission Division, P.O. Box 4290, Quincy, Illinois 62305-4290, USA. The HARRIS factory may also be contacted through a TWX facility (910-246-3312) or a TELEX service (40-4347).

Table 7-1. REPLACEABLE PARTS LIST INDEX

WARNING: Disconnect primary power prior to servicing.

Table 7-2. SX-1 1KW SSAM XMTR - 994 8581 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
A01L14, A01L15 A01L24, A01L25 A01L34, A01L35 A01L44, A01L45 FREQ DETERMINED	494-0378-000	CHOKE, RF 0.33 UH	0	EA
A01L14, A01L15 A01L24, A01L25 A01L34, A01L35 A01L44, A01L45 FREQ DETERMINED	494-0381-000	CHOKE, RF 0.56 UH	0	EA
A01L14, A01L15 A01L24, A01L25 A01L34, A01L35 A01L44, A01L45 FREQ DETERMINED	494-0384-000	CHOKE, RF 1.00 UH	0	EA
A01L14, A01L15 A01L24, A01L25 A01L34, A01L35 A01L44, A01L45 FREQ DETERMINED	494-0386-000	CHOKE, RF 1.50 UH	0	EA
A01L14, A01L15 A01L24, A01L25 A01L34, A01L35 A01L44, A01L45 FREQ DETERMINED	494-0388-000	CHOKE RF 2.20 UH	0	EA
A01L14, A01L15 A01L24, A01L25 A01L34, A01L35 A01L44, A01L45 FREQ DETERMINED	494-0390-000	CHOKE RF 3.30 UH	0	EA
A27A1L1, A27A1L2 FREQ DETERMINED	494-0399-000	CHOKE RF 12.0UH	0	EA
A27A1L1, A27A1L2 FREQ DETERMINED	494-0401-000	CHOKE RF 18.0UH	0	EA
A27A1C4, A27A1C6 FREQ DETERMINED	500-0755-000	CAP, MICA 270PF 500V 5%	0	EA
A27A1C6, FREQ DET	500-0761-000	CAP, MICA 150PF 500V 5%	0	EA
A27A1C4 A27A1C6 FREQ DETERMINED	500-0835-000	CAP, MICA 470PF 500V 5%	0	EA
A27A1C6, FREQ DET	500-0838-000	CAP, MICA 560PF 300V 5%	0	EA
A27A1C6, FREQ DET	500-0840-000	CAP, MICA 680PF 300V 5%	0	EA
A27A1C4, A27A1C6 FREQ DETERMINED	500-0841-000	CAP, MICA 750PF 300V 5%	0	EA
A27A1C6, FREQ DET	500-0842-000	CAP, MICA 820PF 300V 5%	0	EA
A27A1C6, FREQ DET	500-0844-000	CAP, MICA 1000PF 100V 5%	0	EA

WARNING: Disconnect primary power prior to servicing.

Table 7-2. SX-1 1KW SSAM XMTR - 994 8581 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
A01C10, A01C15 A01C20, A01C25 A01C30, A01C35 A01C40, A01C45 FREQ DETERMINED	500-0883-000	CAP 4700PF 500V 5%	0	EA
A26C1, FREQ DET	504-0048-000	CAP .02UF 2KV 5%	0	EA
A26C1, FREQ DET	504-0197-000	CAP .03 UF 1500V 5%	0	EA
A21C2, FREQ DET	504-0243-000	CAP.0047 UF 6KV	0	EA
A21C2, FREQ DET	504-0244-000	CAP. MICA 5100PF 4KV	0	EA
A21C2, FREQ DET	504-0270-000	CAP 7500PF 4KV 5%	0	EA
A21C2, FREQ DET	504-0372-000	CAP 5600PF 4KV	0	EA
A21C2, FREQ DET	504-0396-000	CAP 6200PF 4KV 5%	0	EA
A21C2, FREQ DET	504-0430-000	CAP 8200PF 4KV 5%	0	EA
A21C2, FREQ DET	504-0431-000	CAP 9100PF 4KV 5%	0	EA
A21C2, FREQ DET	504-0432-000	CAP 11,000PF 4KV 5%	0	EA
A21C2, FREQ DET	504-0442-000	CAP 13,000PF 3KV 5%	0	EA
A21C2, FREQ DET	504-0443-000	CAP 18,000PF 2KV 5%	0	EA
A21C2, FREQ DET	504-0444-000	CAP 12,000PF 3KV 5%	0	EA
A21C2, FREQ DET	504-0445-000	CAP 16,000PF 3KV 5%	0	EA
A18C11, FREQ DET	504-0451-000	CAP 500PF 3KV TYPE 271	0	EA
A18C11, FREQ DET	504-0452-000	CAP 680PF 3KV TYPE 271	0	EA
A21C3, FREQ DET	516-0743-000	CAP 25PF 15KVDC 5%	0	EA
A21C3, FREQ DET	516-0744-000	CAP 50PF 15KVDC 5%	0	EA
A21C1, A21C3 A21C4, FREQ DET	516-0745-000	CAP 100PF 15KVDC 5%	0	EA
A21C3, FREQ DET	516-0746-000	CAP 150PF 10KVDC 5%	0	EA
A21C1, A21C3 A21C4, FREQ DET	516-0747-000	CAP 200PF 7.5 KVDC 5%	0	EA
A21C1, A21C3 A21C4, FREQ DET	516-0748-000	CAP 400PF 4KVC 5%	0	EA
A01R13, A01R13A A01R13B, A01R14 A01R14A, A01R14B A01R23, A01R23A A01R23B, A01R24 A01R24A, A01R24B A01R33, A01R33A A01R33B, A01R34 A01R34A, A01R34B A01R43, A01R43A A01R43B, A01R44 A01R44A, A01R44B	540-0589-000	RES 120.0 OHM 2W 5%	0	EA
ACCESSORY OPTION	700-0850-000	DIGITAL LOGIC PROBE #MLB1	0	EA
	990-1012-001	REC S/C AND FUSE KIT	0	EA
A1	992-5868-002	SX-1 PA BOARD	0	EA
A1A1	992-5868-003	PA TOROID BD	0	EA
A5	992-5870-002	IPA BOARD	0	EA

WARNING: Disconnect primary power prior to servicing.

Table 7-2. SX-1 1KW SSAM XMTR - 994 8581 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
A5A1, FREQ DET	992-5870-004	IPA TOROID BOARD 12:2	0	EA
A5A1, FREQ DET	992-5870-005	IPA TOROID BOARD, 12 TO 3	0	EA
A05A01, FREQ DET	992-5870-007	IPA TOROID BOARD, 16 TO 2	0	EA
A5A1, FREQ DET	992-5870-008	IPA TOROID BOARD 14 TO 3	0	EA
A016 OPTION	992-5879-003	OSCILLATOR BD	0	EA
	992-5881-001	SX-1 PARTS,FORMAT/FREQ	1	EA
A27A01	992-5882-001	PHASE ANGLE DETECTOR	1	EA
A016 OPTION	992-5885-002	FREQUENCY SYN BOARD	0	EA
	992-6197-001	SX-1 HORIZONTAL PKG CHK L	0	EA
	992-6197-002	SX-1 VERTICAL PKG CHK LIS	0	EA
OSCILLATOR OPTION	992-6260-007	SX44 SOFTWARE PKG	0	EA
FREQ SYN OPTION	992-6260-008	SX44S SOFTWARE PKG	0	EA
A16Y1 OSCILLATOR OPTION	992-6414-001	CRYSTAL SELECTION LIST	0	EA
	994-8581-002	SX-1 BASIC 1KW AM XMTR	0	EA
	817-0914-051	SX-1 FREQ DET CHART	0	EA
ACCCESSORY OPTION	992-6057-001	SPARE FUSES, SX-1 XMTR	0	EA

WARNING: Disconnect primary power prior to servicing.

Table 7-3. SPARE FUSES, SX-1 XMTR - 992 6057 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
A1F11,A1F12	398 0403 000	FUSE RECTIFIER 3A 250V		
A1F21,A1F22				
A1F31,A1F32				
A1F41,A1F42			8.0	
A10F01A,A10F01B	398 0410 000	FUSE FAST 10A 500VDC MAX		
A10F02A,A10F02B			4.0	
A15F001,A15F002	398 0015 000	FUSE FAST CART .500A 250V	2.0	
A16F1	398 0017 000	FUSE FAST CART 1A 250V	1.0	
A16F001	398 0019 000	FUSE FAST CART 2A 250V	1.0	
A19F2	398 0413 000	FUSE, SEMICONDUCTOR 25A	1.0	
A19F1A,A19F1B	398 0221 000	FUSE DUAL CART 30A 250V	2.0	
A25F1	398 0081 000	FUSE SLO CART 2A 125/250V	1.0	
A25F004	398 0019 000	FUSE FAST CART 2A 250V	1.0	
A5F11,A5F12	398 0403 000	FUSE RECTIFIER 3A 250V	2.0	
A6F001,A7F001	398 0019 000	FUSE FAST CART 2A 250V	2.0	
OSCIL	398 0017 000	FUSE FAST CART 1A 250V	1.0	

WARNING: Disconnect primary power prior to servicing.

Table 7-4. SX-1 PA BOARD - 992 5868 002

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
CR11,CR12	384 0020 000	RECTIFIER IN4005	2.0	
CR013	384 0751 000	DIODE UES1306	1.0	
CR21,CR22	384 0020 000	RECTIFIER IN4005	2.0	
CR023	384 0751 000	DIODE UES1306	1.0	
CR31,CR32	384 0020 000	RECTIFIER IN4005	2.0	
CR033	384 0751 000	DIODE UES1306	1.0	
CR41,CR42	384 0020 000	RECTIFIER IN4005	2.0	
CR043	384 0751 000	DIODE UES1306	1.0	
C001	506 0246 000	CAP .47UF 63V 5%	1.0	
C010	000 0000 003	FREQUENCY DETERMINED PART	1.0	
C11	516 0081 000	CAP, DISC .01UF 1KV 20%	1.0	
C12	508 0538 000	CAP .15 UF 400WVDC 5%	1.0	
C13	516 0081 000	CAP, DISC .01UF 1KV 20%	1.0	
C14	508 0538 000	CAP .15 UF 400WVDC 5%	1.0	
C015	000 0000 003	FREQUENCY DETERMINED PART	1.0	
C16,C17	508 0537 000	CAP .047 UF 600WVDC 5%	2.0	
C18,C19	500 0881 000	CAP 3000 PF 500V 5%	2.0	
C020	000 0000 003	FREQUENCY DETERMINED PART	1.0	
C21	516 0081 000	CAP, DISC .01UF 1KV 20%	1.0	
C22	508 0538 000	CAP .15 UF 400WVDC 5%	1.0	
C23	516 0081 000	CAP, DISC .01UF 1KV 20%	1.0	
C24	508 0538 000	CAP .15 UF 400WVDC 5%	1.0	
C025	000 0000 003	FREQUENCY DETERMINED PART	1.0	
C26,C27	508 0537 000	CAP .047 UF 600WVDC 5%	2.0	
C28,C29	500 0881 000	CAP 3000 PF 500V 5%	2.0	
C030	000 0000 003	FREQUENCY DETERMINED PART	1.0	
C31	516 0081 000	CAP, DISC .01UF 1KV 20%	1.0	
C32	508 0538 000	CAP .15 UF 400WVDC 5%	1.0	
C33	516 0081 000	CAP, DISC .01UF 1KV 20%	1.0	
C34	508 0538 000	CAP .15 UF 400WVDC 5%	1.0	
C035	000 0000 003	FREQUENCY DETERMINED PART	1.0	
C36,C37	508 0537 000	CAP .047 UF 600WVDC 5%	2.0	
C38,C39	500 0881 000	CAP 3000 PF 500V 5%	2.0	
C040	000 0000 003	FREQUENCY DETERMINED PART	1.0	
C41	516 0081 000	CAP, DISC .01UF 1KV 20%	1.0	
C42	508 0538 000	CAP .15 UF 400WVDC 5%	1.0	
C43	516 0081 000	CAP, DISC .01UF 1KV 20%	1.0	
C44	508 0538 000	CAP .15 UF 400WVDC 5%	1.0	
C045	000 0000 003	FREQUENCY DETERMINED PART	1.0	
C46,C47	508 0537 000	CAP .047 UF 600WVDC 5%	2.0	
C48,C49	500 0881 000	CAP 3000 PF 500V 5%	2.0	
F11,F12,F21,F22 F31,F32,F41,F42	398 0403 000	FUSE RECTIFIER 3A 250V	8.0	
J1	610 0830 000	HEADER, 10 PIN PC RIBBON	1.0	
J002	610 0873 000	HEADER KIT, 20 PIN EJECT	1.0	
J3	612 0401 000	JACK, BANANA	1.0	
J11,J21,J31,J41	612 0301 000	JACK BANANA BRASS	4.0	
L11,L12	494 0395 000	CHOKE, 40UH 2 AMP	2.0	

WARNING: Disconnect primary power prior to servicing.

Table 7-4. SX-1 PA BOARD - 992 5868 002 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
L013	494 0398 000	CHOKE RF 10.0UH	1.0	
L014,L015	000 0000 003	FREQUENCY DETERMINED PART	2.0	
L016	494 0398 000	CHOKE RF 10.0UH	1.0	
L21,L22	494 0395 000	CHOKE, 40UH 2 AMP	2.0	
L023	494 0398 000	CHOKE RF 10.0UH	1.0	
L024,L025	000 0000 003	FREQUENCY DETERMINED PART	2.0	
L026	494 0398 000	CHOKE RF 10.0UH	1.0	
L31,L32	494 0395 000	CHOKE, 40UH 2 AMP	2.0	
L033	494 0398 000	CHOKE RF 10.0UH	1.0	
L034,L035	000 0000 003	FREQUENCY DETERMINED PART	2.0	
L036	494 0398 000	CHOKE RF 10.0UH	1.0	
L41,L42	494 0395 000	CHOKE, 40UH 2 AMP	2.0	
L043	494 0398 000	CHOKE RF 10.0UH	1.0	
L044,L045	000 0000 003	FREQUENCY DETERMINED PART	2.0	
L046	494 0398 000	CHOKE RF 10.0UH	1.0	
Q011,Q012,Q013 Q014,Q021,Q022 Q023,Q024,Q031 Q032,Q033,Q034 Q041,Q042,Q043 Q044	380 0649 000	TRANSISTOR IRF350	16.0	
R1	540 0651 000	RES 47.0K OHM 2W 5%	1.0	
R011,R012	546 0295 000	RES 50 OHM 3.25W 5%	2.0	
R013,R013A R013B,R014 R014A,R014B	000 0000 003	FREQUENCY DETERMINED PART	6.0	
R15	546 0293 000	RES 2 OHM 2.5W 5%	1.0	
R021,R022	546 0295 000	RES 50 OHM 3.25W 5%	2.0	
R023,R023A R023B,R024 R024A,R024B	000 0000 003	FREQUENCY DETERMINED PART	6.0	
R25	546 0293 000	RES 2 OHM 2.5W 5%	1.0	
R031,R032	546 0295 000	RES 50 OHM 3.25W 5%	2.0	
R033,R033A R033B,R034 R034A,R034B	000 0000 003	FREQUENCY DETERMINED PART	6.0	
R35	546 0293 000	RES 2 OHM 2.5W 5%	1.0	
R041,R042	546 0295 000	RES 50 OHM 3.25W 5%	2.0	
R043,R043A R043B,R044 R044A,R044B	000 0000 003	FREQUENCY DETERMINED PART	6.0	
R45	546 0293 000	RES 2 OHM 2.5W 5%	1.0	
TC1	382 0707 000	IC LM335AZ	1.0	
T11,T12,T21,T22 T31,T32,T41,T42	939 5695 053	TRANSFORMER, TOROID	8.0	
U1	382 0355 000	IC 4N25	1.0	

WARNING: Disconnect primary power prior to servicing.

Table 7-4. SX-1 PA BOARD - 992 5868 002 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
XF11A,XF11B XF12A,XF12B XF21A,XF21B XF22A,XF22B XF31A,XF31B XF32A,XF32B XF41A,XF41B XF42A,XF42B	402 0129 000	CLIP FUSE	16.0	
	358 2738 000	STDOFF 4-40 M/M X .5 LG	8	
	410 0384 000	INSULATOR, #4 SCREW	32.0	
	410 0385 000	INSULATOR, TO-3 SILICON	16.0	
	612 1127 000	JACK, CONNECTOR,THRU HOLE	32	
#J3	817 0914 015	SPACER	1.0	
#J11,#J21,#J31 #J41	817 0914 021	SPACER	4.0	
	843 3655 199	INSULATOR, PA	1	

WARNING: Disconnect primary power prior to servicing.

Table 7-5. TRANSFORMER, TOROID - 939 5695 053

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
CR1,CR2	386 0412 000	ZENER UDZ718 18V	2.0	

WARNING: Disconnect primary power prior to servicing.

Table 7-6. IPA BOARD - 992 5870 002

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
CR11,CR12	384 0020 000	RECTIFIER IN4005	2.0	
C001	506 0246 000	CAP .47UF 63V 5%	1.0	
C11	516 0081 000	CAP, DISC .01UF 1KV 20%	1.0	
C12	508 0538 000	CAP .15 UF 400WVDC 5%	1.0	
C13	516 0081 000	CAP, DISC .01UF 1KV 20%	1.0	
C14,C16,C17	508 0538 000	CAP .15 UF 400WVDC 5%	3.0	
C18,C19	516 0081 000	CAP, DISC .01UF 1KV 20%	2.0	
F11,F12	398 0403 000	FUSE RECTIFIER 3A 250V	2.0	
JUMPER	000 0000 003	FREQUENCY DETERMINED PART	1.0	
J1	610 0830 000	HEADER, 10 PIN PC RIBBON	1.0	
J2	620 0515 000	RECP 50-051-0000	1.0	
J3	610 0831 000	CONN 8 PIN PC MT	1.0	
L11,L12	494 0395 000	CHOKE, 40UH 2 AMP	2.0	
Q011,Q012,Q013	380 0652 000	TRANSISTOR IRF130		
Q014			4.0	
R1	540 0634 000	RES 9.1K OHM 2W 5%	1.0	
R002	546 0295 000	RES 50 OHM 3.25W 5%	1.0	
R011	546 0300 000	RES, POWER 510 OHM 13W 5%	1.0	
R13,R14	546 0293 000	RES 2 OHM 2.5W 5%	2.0	
TC1	382 0707 000	IC LM335AZ	1.0	
T11,T12	939 5695 053	TRANSFORMER, TOROID	2.0	
U1	382 0355 000	IC 4N25	1.0	
XF11A,XF11B	402 0129 000	CLIP FUSE		
XF12A,XF12B			4.0	
#R11	354 0338 000	LUG 4 RING RED	2	
#Q11,#Q12,#Q13	410 0385 000	INSULATOR, TO-3 SILICON		
#Q14			4.0	

WARNING: Disconnect primary power prior to servicing.

Table 7-7. TRANSFORMER, TOROID - 939 5695 053

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
CR1,CR2	386 0412 000	ZENER UDZ718 18V	2.0	

Table 7-8. OSCILLATOR BD - 992 5879 003

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
CR001	386 0082 000	ZENER 1N4744A 15V	1.0	
CR002,CR003	384 0205 000	DIODE SILICON 1N914	2.0	
CR004	386 0135 000	ZENER 1N4733A 5.1V	1.0	
CR005	386 0300 000	ZENER 1N4730A 3.9V	1.0	
CR006,CR007	384 0357 000	RECTIFIER 1N4004		
CR008			3.0	
CR009	386 0300 000	ZENER 1N4730A 3.9V	1.0	
C001	520 0439 000	CAP, AIR VAR 2.4-24.5PF	1.0	
C002	500 0803 000	CAP MICA 5UUF 500V	1.0	
C003	500 0837 000	CAP, MICA 510PF 500V 5%	1.0	
C004	516 0387 000	CAP .47 UF 10V	1.0	
C005	500 0761 000	CAP, MICA 150PF 500V 5%	1.0	
C006	516 0080 000	CAP DISC .01UF 600V	1.0	
C007	526 0309 000	CAP, 22UF 35V 20%	1.0	
C008	516 0453 000	CAP .1UF 100V 20%	1.0	
C009	526 0342 000	CAP 2.7UF 35V 10%	1.0	
C010	508 0378 000	CAP .22 UF 100V 10%	1.0	
C011	516 0375 000	CAP .01UF 50V	1.0	
C012	526 0342 000	CAP 2.7UF 35V 10%	1.0	
C013	500 0843 000	CAP, MICA 910PF 100V 5%	1.0	
C014	516 0453 000	CAP .1UF 100V 20%	1.0	
C015	516 0375 000	CAP .01UF 50V	1.0	
C016	516 0453 000	CAP .1UF 100V 20%	1.0	
C017,C018	526 0318 000	CAP 10UF 35V 20%	2.0	
C019,C020	516 0453 000	CAP .1UF 100V 20%	2.0	
C021	500 0818 000	CAP MICA 50UUF 500V	1.0	
F001	398 0017 000	FUSE FAST CART 1A 250V	1.0	
J001	620 1677 000	RECEPTACLE PANEL BNC	1.0	
J002	610 0831 000	CONN 8 PIN PC MT	1.0	
J003	610 0827 000	HEADER, 20 PIN PC RIBBON	1.0	
J004,J005	620 1677 000	RECEPTACLE PANEL BNC	2.0	
L001	494 0196 000	CHOKE RF 100UH	1.0	
P005	610 0679 000	PLUG, SHORTING	1.0	
Q001,Q002	380 0083 000	TRANSISTOR 2N2369	2.0	
Q003,Q004	380 0586 000	TRANSISTOR MJE200	2.0	
Q005	380 0125 000	TRANSISTOR 2N4401	1.0	
Q006	380 0327 000	TRANSISTOR 2N2222A	1.0	
R001	540 1185 000	RES 39.0K OHM 1/2W 5%	1.0	
R002	540 1113 000	RES 18.0K OHM 1/2W 5%	1.0	
R003	540 1224 000	RES 39.0 OHM 1/2W 5%	1.0	
R004	540 1188 000	RES 270.0 OHM 1/2W 5%	1.0	
R005	540 1116 000	RES 1.0K OHM 1/2W 5%	1.0	
R006	540 1114 000	RES 4.7K OHM 1/2W 5%	1.0	
R007	540 0595 000	RES 220.0 OHM 2W 5%	1.0	
R008	540 0611 000	RES 1.0K OHM 2W 5%	1.0	
R009	540 0595 000	RES 220.0 OHM 2W 5%	1.0	
R010	540 1178 000	RES 750.0 OHM 1/2W 5%	1.0	
R011	540 1114 000	RES 4.7K OHM 1/2W 5%	1.0	

Table 7-8. OSCILLATOR BD - 992 5879 003 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
R012	542 0056 000	RES 20 OHM 10W	1.0	
R013	540 0580 000	RES 51.0 OHM 2W 5%	1.0	
R014	540 0308 000	RES 100.0 OHM 1W 5%	1.0	
R015	540 0613 000	RES 1.2K OHM 2W 5%	1.0	
R016	540 0936 000	RES 10.0K OHM 1/4W 5%	1.0	
R017	540 1116 000	RES 1.0K OHM 1/2W 5%	1.0	
R023	540 0611 000	RES 1.0K OHM 2W 5%	1.0	
R024	540 0296 000	RES 33.0 OHM 1W 5%	1.0	
R025	540 0580 000	RES 51.0 OHM 2W 5%	1.0	
R026	540 1188 000	RES 270.0 OHM 1/2W 5%	1.0	
R027	550 0623 000	POT, 5K OHM .5W 10%	1.0	
T001	939 5695 117	XFMR, OSCILLATOR TOROID	1.0	
U001	382 0074 000	IC 7476	1.0	
U002	382 0726 000	IC DS0026J-8/MMH0026CP1	1.0	
U003	382 0475 000	IC 317	1.0	
XF1A,XF1B	402 0129 000	CLIP FUSE	2.0	
XY001	404 0267 000	SOCKET CRYSTAL	1.0	
#U003	335 0254 000	WASHER, TEFLON #4	2	
#Q003,#Q004	404 0513 000	HEAT SINK PA1-1CB	2	
#U003	404 0727 000	HEAT SINK, TO-3	1	
#U003	410 0232 000	INSULATOR, MICA	1	
#Q003,#Q004	410 0344 000	INSULATOR, KAPTON	2	
#L002	414 0087 000	BEAD. FERRITE SHIELD	1	

WARNING: Disconnect primary power prior to servicing.

Table 7-9. FREQUENCY SYN BOARD - 992 5885 002

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
CR001,CR002	386 0123 000	ZENER 1N4732A 4.7V	2.0	
CR003	386 0135 000	ZENER 1N4733A 5.1V	1.0	
CR004,CR005	386 0300 000	ZENER 1N4730A 3.9V	2.0	
CR007	528 0032 000	DIODE, VARACTOR 40-460PF	1.0	
CR008	384 0205 000	DIODE SILICON 1N914	1.0	
CR009,CR010	384 0597 000	RECT 1N4002		
CR011,CR012				
CR013,CR014			6.0	
C001	516 0375 000	CAP .01UF 50V	1.0	
C002	526 0238 000	CAP 33UF 35V 20%	1.0	
C004,C005	526 0342 000	CAP 2.7UF 35V 10%	2.0	
C006	526 0238 000	CAP 33UF 35V 20%	1.0	
C007	500 0818 000	CAP MICA 50UUF 500V	1.0	
C008,C009	526 0049 000	CAP 6.8UF 35V 20%	2.0	
C010	526 0238 000	CAP 33UF 35V 20%	1.0	
C011,C012	526 0351 000	CAP 6.8UF 50V 20%	2.0	
C013	500 0818 000	CAP MICA 50UUF 500V	1.0	
C014	526 0351 000	CAP 6.8UF 50V 20%	1.0	
C017	526 0097 000	CAP 47 UF 35V 20%	1.0	
C018	516 0453 000	CAP .1UF 100V 20%	1.0	
C019	500 0804 000	CAP, MICA 10PF 500V 5%	1.0	
C020,C021	516 0453 000	CAP .1UF 100V 20%	2.0	
C022	506 0246 000	CAP .47UF 63V 5%	1.0	
C023,C024	516 0453 000	CAP .1UF 100V 20%	2.0	
C025	500 0899 000	CAP 4300PF 500V 5%	1.0	
C026	500 0754 000	CAP, MICA 220PF 500V 5%	1.0	
C027	500 0887 000	CAP 2200PF 500V 5%	1.0	
C028,C029	500 0902 000	CAP 3300PF 500V 5%	2.0	
C030	500 0787 000	CAP 200PF 500V 5%	1.0	
C031	516 0067 000	CAP DISC .003UF 1KV 20%	1.0	
C032,C033,C034	516 0453 000	CAP .1UF 100V 20%	3.0	
C035	526 0049 000	CAP 6.8UF 35V 20%	1.0	
C036	516 0375 000	CAP .01UF 50V	1.0	
C037	500 0992 000	CAP 5600PF 300V 5%	1.0	
C038	516 0375 000	CAP .01UF 50V	1.0	
C039	500 0818 000	CAP MICA 50UUF 500V	1.0	
C040,C041	516 0453 000	CAP .1UF 100V 20%	2.0	
C042,C043	516 0375 000	CAP .01UF 50V	2.0	
C044	508 0378 000	CAP .22 UF 100V 10%	1.0	
C045	500 0843 000	CAP, MICA 910PF 100V 5%	1.0	
C046,C047,C048	516 0453 000	CAP .1UF 100V 20%	3.0	
C049	500 0759 000	CAP, MICA 100PF 500V 5%	1.0	
C050	516 0453 000	CAP .1UF 100V 20%	1.0	
F001	398 0019 000	FUSE FAST CART 2A 250V	1.0	
J001	620 1677 000	RECEPTACLE PANEL BNC	1.0	
J002	610 0831 000	CONN 8 PIN PC MT	1.0	
J003	610 0827 000	HEADER, 20 PIN PC RIBBON	1.0	
J004,J005	620 1677 000	RECEPTACLE PANEL BNC	2.0	

WARNING: Disconnect primary power prior to servicing.

Table 7-9. FREQUENCY SYN BOARD - 992 5885 002 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
L001,L003,L004	494 0196 000	CHOKE RF 100UH	3.0	
L005	494 0387 000	CHOKE, RF 1.80 UF	1.0	
L006	494 0388 000	CHOKE RF 2.20 UH	1.0	
L007	494 0391 000	CHOKE RF 3.90 UH	1.0	
P006	610 0679 000	PLUG, SHORTING	1.0	
Q001	380 0125 000	TRANSISTOR 2N4401	1.0	
Q002	380 0320 000	TRANSISTOR TIP29	1.0	
Q005,Q006,Q007	380 0189 000	TRANSISTOR 2N3904	3.0	
Q008,Q009	380 0586 000	TRANSISTOR MJE200	2.0	
Q010	380 0327 000	TRANSISTOR 2N2222A	1.0	
R001	540 0936 000	RES 10.0K OHM 1/4W 5%	1.0	
R002	540 0613 000	RES 1.2K OHM 2W 5%	1.0	
R003	540 0590 000	RES 130.0 OHM 2W 5%	1.0	
R004	540 0607 000	RES 680.0 OHM 2W 5%	1.0	
R014	550 0958 000	POT 10K OHM 1/2 W 10%	1.0	
R015	540 0936 000	RES 10.0K OHM 1/4W 5%	1.0	
R016	540 0905 000	RES 510.0 OHM 1/4W 5%	1.0	
R018	540 0913 000	RES 1.1K OHM 1/4W 5%	1.0	
R019	540 0911 000	RES 910.0 OHM 1/4W 5%	1.0	
R020	540 0940 000	RES 15.0K OHM 1/4W 5%	1.0	
R021,R022	540 0948 000	RES 33.0K OHM 1/4W 5%	2.0	
R023,R024	540 0951 000	RES 43.0K OHM 1/4W 5%	2.0	
R025	540 0947 000	RES 30.0K OHM 1/4W 5%	1.0	
R026	540 0952 000	RES 47.0K OHM 1/4W 5%	1.0	
R028	548 1401 000	RES 12.1K OHM 1/4W 1%	1.0	
R029	548 0366 000	RES 22.1K OHM 1/4W 1%	1.0	
R030	548 1401 000	RES 12.1K OHM 1/4W 1%	1.0	
R031	548 1403 000	RES 2490 OHM 1/4W 1%	1.0	
R032	548 1548 000	RES 37.4K OHM 1/4W 1%	1.0	
R033	540 0929 000	RES 5.1K OHM 1/4W 5%	1.0	
R034	540 1119 000	RES 1.8K OHM 1/2W 5%	1.0	
R035	540 1118 000	RES 220.0 OHM 1/2W 5%	1.0	
R036	540 1204 000	RES 91.0 OHM 1/2W 5%	1.0	
R037	540 1151 000	RES 10.0 OHM 1/2W 5%	1.0	
R038	540 0943 000	RES 20.0K OHM 1/4W 5%	1.0	
R039	540 1117 000	RES 150.0 OHM 1/2W 5%	1.0	
R040	540 1116 000	RES 1.0K OHM 1/2W 5%	1.0	
R041	550 0623 000	POT, 5K OHM .5W 10%	1.0	
R042	540 0580 000	RES 51.0 OHM 2W 5%	1.0	
R043	540 0898 000	RES 270.0 OHM 1/4W 5%	1.0	
R045	540 1386 000	RES NETWORK 10K OHM 2%	1.0	
R046	540 0591 000	RES 150.0 OHM 2W 5%	1.0	
R047	540 1116 000	RES 1.0K OHM 1/2W 5%	1.0	
R048	540 0580 000	RES 51.0 OHM 2W 5%	1.0	
R049	542 0056 000	RES 20 OHM 10W	1.0	
R050	542 0017 000	RES 150 OHM 5W	1.0	
R051	540 0591 000	RES 150.0 OHM 2W 5%	1.0	
R052	540 1116 000	RES 1.0K OHM 1/2W 5%	1.0	
R053	540 0575 000	RES 33.0 OHM 2W 5%	1.0	

WARNING: Disconnect primary power prior to servicing.

Table 7-9. FREQUENCY SYN BOARD - 992 5885 002 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
R054	540 0308 000	RES 100.0 OHM 1W 5%	1.0	
R055	540 0936 000	RES 10.0K OHM 1/4W 5%	1.0	
R056	540 0939 000	RES 13.0K OHM 1/4W 5%	1.0	
R057	540 0864 000	RES 10.0 OHM 1/4W 5%	1.0	
S001	604 0852 000	SWITCH, ROCKER DIP 4-SPST	1.0	
T001	939 5695 117	XFMR, OSCILLATOR TOROID	1.0	
U002	382 0725 000	IC MC145145P	1.0	
U003	382 0552 000	IC TL074CN3	1.0	
U004	382 0724 000	IC 1648	1.0	
U005	382 0667 000	IC 74S196	1.0	
U006	382 0726 000	IC DS0026J-8/MMH0026CP1	1.0	
U007	382 0359 000	IC 7815	1.0	
U008	382 0184 000	IC 340T-5/7805 +5V REG	1.0	
U009	382 0475 000	IC 317	1.0	
U010	700 0423 000	OSC, CRYSTAL 10MHZ	1.0	
XF01A,XF01B	402 0129 000	CLIP FUSE	2.0	
XU002	404 0507 000	SOCKET, IC 18 PIN	1.0	
XU003,XU004	404 0674 000	SOCKET, IC 14 CONT		
XU005			3.0	
XU006	404 0673 000	SOCKET, IC 8 CONT	1.0	
XU009	404 0661 000	SOCKET, TRANSISTOR	1.0	
#U009	410 0385 000	INSULATOR, TO-3 SILICON	1	
#Q002,#Q008	410 0344 000	INSULATOR, KAPTON		
#Q009,#U007				
#U008			5	
#Q002,#U007	335 0262 000	DF137A INSULATING WASHER		
#U008			3	

WARNING: Disconnect primary power prior to servicing.

Table 7-10. IPA TOROID BOARD, 16 TO 2 - 992 5870 007

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
C11	508 0538 000	CAP .15 UF 400WVDC 5%	1.0	
R011,R012	540 0089 000	RES 47.0K OHM 1/2W 5%	2.0	

WARNING: Disconnect primary power prior to servicing.

Table 7-11. PA TOROID BD - 992 5868 003

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
C11,C21,C31,C41	508 0538 000	CAP .15 UF 400WVDC 5%	4.0	
J1	404 0675 000	SOCKET, IC 16 CONT	1.0	
R1	540 1386 000	RES NETWORK 10K OHM 2%	1.0	
R11,R12,R21,R22 R31,R32,R41,R42	540 0116 000	RES 620.0K OHM 1/2W 5%	8.0	
#T11,#T21,#T31 #T41	255 0018 000	WIRE, 10AWG 15KV STRD SPC	13.0	FT
#T11,#T21,#T31 #T41	414 0243 000	TOROID, FERRITE	4.0	
	843 3655 025	PC BD, TOROID	1.0	
#T11,#T21,#T31 #T41	917 0914 010	STAPLE	64.0	

WARNING: Disconnect primary power prior to servicing.

Table 7-12. CRYSTAL SELECTION LIST - 992 6414 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
540	444 2177 000	XTAL NE6A 2160KHZ	1.0	
550	444 2178 000	XTAL NE6A 2200KHZ	1.0	
560	444 2179 000	XTAL NE6A 2240KHZ	1.0	
570	444 2180 000	XTAL NE6A 2280 KHZ	1.0	
580	444 2181 000	XTAL NE6A 2320KHZ	1.0	
590	444 2182 000	XTAL NE6A 2360KHZ	1.0	
600	444 2183 000	XTAL NE6A 2400 KHZ	1.0	
610	444 2184 000	XTAL NE6A 2440KHZ	1.0	
620	444 2185 000	XTAL NE6A 2480KHZ	1.0	
630	444 2186 000	XTAL NE6A 2520KHZ	1.0	
640	444 2187 000	XTAL NE6A 2560KHZ	1.0	
650	444 2188 000	XTAL NE6A 2600KHZ	1.0	
660	444 2189 000	XTAL NE6A 2640KHZ	1.0	
670	444 2190 000	XTAL NE6A 2680 KHZ	1.0	
680	444 2191 000	XTAL NE6A 2720KHZ	1.0	
690	444 2192 000	XTAL NE6A 2760KHZ	1.0	
700	444 2193 000	XTAL NE6A 2800KHZ	1.0	
710	444 2194 000	XTAL NE6A 2840KHZ	1.0	
720	444 2195 000	XTAL NE6A 2880KHZ	1.0	
730	444 2196 000	XTAL NE6A 2920KHZ	1.0	
740	444 2197 000	XTAL NE6A 2960KHZ	1.0	
750	444 2198 000	XTAL NE6A 3000KHZ	1.0	
760	444 2199 000	XTAL NE6A 3040KHZ	1.0	
770	444 2200 000	XTAL NE6A 3080KHZ	1.0	
780	444 2201 000	XTAL NE6A 3120KHZ	1.0	
790	444 2202 000	XTAL NE6A 3160KHZ	1.0	
800	444 2203 000	XTAL NE6A 3200KHZ	1.0	
810	444 2204 000	XTAL NE6A 3240KHZ	1.0	
820	444 2205 000	XTAL NE6A 3280KHZ	1.0	
830	444 2206 000	XTAL NE6A 3320KHZ	1.0	
840	444 2207 000	XTAL NE6A 3360KHZ	1.0	
850	444 2208 000	XTAL NE6A 3400KHZ	1.0	
860	444 2209 000	XTAL NE6A 3440KHZ	1.0	
870	444 2210 000	XTAL NE6A 3480KHZ	1.0	
880	444 2211 000	XTAL NE6A 3520KHZ	1.0	
890	444 2212 000	XTAL NE6A 3560KHZ	1.0	
900	444 2213 000	XTAL NE6A 3600KHZ	1.0	
910	444 2214 000	XTAL NE6A 3640KHZ	1.0	
920	444 2215 000	XTAL NE6A 3680KHZ	1.0	
930	444 2216 000	XTAL NE6A 3720KHZ	1.0	
940	444 2217 000	XTAL NE6A 3760KHZ	1.0	
950	444 2218 000	XTAL NE6A 3800KHZ	1.0	
960	444 2219 000	XTAL NE6A 3840KHZ	1.0	
970	444 2220 000	XTAL NE6A 3880KHZ	1.0	
980	444 2221 000	XTAL NE6A 3920KHZ	1.0	
990	444 2222 000	XTAL NE6A 3960KHZ	1.0	
1000	444 2223 000	XTAL NE6A 4000KHZ	1.0	
1010	444 2224 000	XTAL NE6A 4040KHZ	1.0	

WARNING: Disconnect primary power prior to servicing.

Table 7-12. CRYSTAL SELECTION LIST - 992 6414 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
1020	444 2225 000	XTAL NE6A 4080KHZ	1.0	
1030	444 2226 000	XTAL NE6A 4120KHZ	1.0	
1040	444 2227 000	XTAL NE6A 4160KHZ	1.0	
1050	444 2228 000	XTAL NE6A 4200KHZ	1.0	
1060	444 2229 000	XTAL NE6A 4240KHZ	1.0	
1070	444 2230 000	XTAL NE6A 4280KHZ	1.0	
1080	444 2231 000	XTAL NE6A 4320KHZ	1.0	
1090	444 2232 000	XTAL NE6A 4360KHZ	1.0	
1100	444 2233 000	XTAL NE6A 4400KHZ	1.0	
1110	444 2234 000	XTAL NE6A 4440KHZ	1.0	
1120	444 2235 000	XTAL NE6A 4480KHZ	1.0	
1130	444 2236 000	XTAL NE6A 4520KHZ	1.0	
1140	444 2237 000	XTAL NE6A 4560KHZ	1.0	
1150	444 2238 000	XTAL NE6A 4600KHZ	1.0	
1160	444 2239 000	XTAL NE6A 4640KHZ	1.0	
1170	444 2240 000	XTAL NE6A 4680KHZ	1.0	
1180	444 2241 000	XTAL NE6A 4720KHZ	1.0	
1190	444 2242 000	XTAL NE6A 4760KHZ	1.0	
1200	444 2243 000	XTAL NE6A 4800KHZ	1.0	
1210	444 2244 000	XTAL NE6A 4840KHZ	1.0	
1220	444 2245 000	XTAL NE6A 4880KHZ	1.0	
1230	444 2246 000	XTAL NE6A 4920KHZ	1.0	
1240	444 2247 000	XTAL NE6A 4960KHZ	1.0	
1250	444 2248 000	XTAL NE6A 5000KHZ	1.0	
1270	444 2249 000	XTAL NE6A 2540KHZ	1.0	
1290	444 2250 000	XTAL NE6A 2580KHZ	1.0	
1310	444 2251 000	XTAL NE6A 2620KHZ	1.0	
1330	444 2252 000	XTAL NE6A 2660KHZ	1.0	
1350	444 2253 000	XTAL NE6A 2700KHZ	1.0	
1370	444 2254 000	XTAL NE6A 2740KHZ	1.0	
1390	444 2255 000	XTAL NE6A 2780KHZ	1.0	
1410	444 2256 000	XTAL NE6A 2820KHZ	1.0	
1430	444 2257 000	XTAL NE6A 2860KHZ	1.0	
1450	444 2258 000	XTAL NE6A 2900KHZ	1.0	
1470	444 2259 000	XTAL NE6A 2940KHZ	1.0	
1490	444 2260 000	XTAL NE6A 2980KHZ	1.0	
1510	444 2261 000	XTAL NE6A 3020KHZ	1.0	
1530	444 2262 000	XTAL NE6A 3060KHZ	1.0	
1550	444 2263 000	XTAL NE6A 3100KHZ	1.0	
1570	444 2264 000	XTAL NE6A 3140KHZ	1.0	
1590	444 2265 000	XTAL NE6A 3180KHZ	1.0	
1260	444 2654 000	XTAL NE6A 2520KHZ	1.0	
1280	444 2655 000	XTAL NEGA 2560KHZ	1.0	
1300	444 2656 000	XTAL NE6A 2600KHZ	1.0	
1320	444 2657 000	XTAL NE6A 2640KHZ	1.0	
1340	444 2658 000	XTAL NE6A 2680KHZ	1.0	
1360	444 2659 000	XTAL NE6A 2720KHZ	1.0	
1380	444 2660 000	XTAL NE6A 2760KHZ	1.0	
1400	444 2661 000	XTAL NE6A 2800KHZ	1.0	

WARNING: Disconnect primary power prior to servicing.

Table 7-12. CRYSTAL SELECTION LIST - 992 6414 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
1420	444 2662 000	XTAL NE6A 2840KHZ	1.0	
1440	444 2663 000	XTAL NE6A 2880KHZ	1.0	
1460	444 2664 000	XTAL NE6A 2920KHZ	1.0	
1480	444 2665 000	XTAL NE6A 2960KHZ	1.0	
1500	444 2666 000	XTAL NE6A 3000KHZ	1.0	
1520	444 2667 000	XTAL NE6A 3040KHZ	1.0	
1540	444 2668 000	XTAL NE6A 3080KHZ	1.0	
1560	444 2669 000	XTAL NE6A 3120KHZ	1.0	
1580	444 2670 000	XTAL NE6A 3160KHZ	1.0	
1600	444 2671 000	XTAL NE6A 3200KHZ	1.0	
	816 3493 001	CRYSTAL DET. CHART	0	

WARNING: Disconnect primary power prior to servicing.

Table 7-13. PHASE ANGLE DETECTOR - 992 5882 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
CR001,CR002	384 0205 000	DIODE SILICON 1N914	2.0	
CR003	386 0085 000	ZENER 1N4740A 10V	1.0	
C001,C002,C003	500 0854 000	CAP 210-1000PF	3.0	
C004	000 0000 003	FREQUENCY DETERMINED PART	1.0	
C5	506 0234 000	CAP .0022UF 63V 5%	1.0	
C006	000 0000 003	FREQUENCY DETERMINED PART	1.0	
J001,J002	620 2023 000	RECEPTACLE, BNC VERT PCB	2.0	
J003	620 0515 000	RECP 50-051-0000	1.0	
L001,L002	000 0000 003	FREQUENCY DETERMINED PART	2.0	
R001,R002	540 0577 000	RES 39.0 OHM 2W 5%	2.0	
R004	540 1215 000	RES 20.0 OHM 1/2W 5%	1.0	
R005	540 0977 000	RES 510.0K OHM 1/4W 5%	1.0	
T001	917 0914 179	TRANSFORMER, PHASE ANGLE	1.0	

Table 7-14. SX44 SOFTWARE PKG - 992 6260 007

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
A13U4,A13U5	382 0575 000	IC 2716		
A13U6			3.0	
A13U7,A13U8	382 0700 000	IC 2016/2128	2.0	
A14U4,A14U5	382 0575 000	IC 2716		
A14U6			3.0	
A14U7,A14U8	382 0700 000	IC 2016/2128	2.0	

Table 7-15. SX44S SOFTWARE PKG - 992 6260 008

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
A13U4,A13U5	382 0575 000	IC 2716		
A13U6			3.0	
A13U7,A13U8	382 0700 000	IC 2016/2128	2.0	
A14U4,A14U5	382 0575 000	IC 2716	2.0	
A14U6				
A14U7,A14U8	382 0700 000	IC 2016/2128	2.0	

Table 7-16. REC S/C ANDFUSE KIT - 990 1012 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
	380 0125 000	TRANSISTOR 2N4401	.0	
	380 0126 000	TRANSISTOR 2N4403	.0	
	380 0189 000	TRANSISTOR 2N3904	.0	
	380 0190 000	TRANSISTOR 2N3906	.0	
	380 0528 000	TRANSISTOR TIP125	.0	
	380 0586 000	TRANSISTOR MJE200	.0	
	380 0587 000	TRANSISTOR MJE210	0	
	382 0072 000	IC 7403	.0	
	382 0074 000	IC 7476	.0	
	382 0172 000	IC LH0002CH-A+	0	
	382 0237 000	IC 3045	.0	
	382 0357 000	IC CA3100T	.0	
	382 0359 000	IC 7815	.0	
	382 0360 000	IC 7915	.0	
	382 0415 000	IC 324	.0	
	382 0419 000	IC 74C14	.0	
	382 0460 000	IC 308A	.0	
	382 0475 000	IC 317	.0	
	382 0552 000	IC TL074CN3	0	
	382 0565 000	IC 74LS138 TTL DECOD	.0	
	382 0569 000	IC 8212	.0	
	382 0588 000	IC 4013	.0	
	382 0617 000	IC LM319	.0	
	382 0726 000	IC DS0026J-8/MMH0026CP1	.0	
	384 0020 000	RECTIFIER IN4005	.0	
	384 0612 000	DIODE 1N3070	0	
	384 0351 000	RECTIFIER, 2N5756	.0	
	384 0431 000	RECT. 1N4001	.0	
	384 0702 000	RECT 100PIV 27A MDA-990-2	.0	
	384 0704 000	TRIAC DRIVER MOC3020	.0	
	384 0705 000	RECT 80A 1000V PIV	.0	
	384 0708 000	RECT 30A 400V	.0	
	386 0135 000	ZENER 1N4733A 5.1V	.0	
	398 0015 000	FUSE FAST CART .500A 250V	.0	
	398 0403 000	FUSE RECTIFIER 3A 250V	.0	
	398 0411 000	FUSE FAST 15A 500VDC MAX	0	
	398 0413 000	FUSE, SEMICONDUCTOR 25A	0	
	380 0649 000	TRANSISTOR IRF350	0	
	380 0652 000	TRANSISTOR IRF130	0	
	410 0385 000	INSULATOR, TO-3 SILICON	0	

WARNING: Disconnect primary power prior to servicing.

Table 7-17. SX-1 PARTS,FORMAT/FREQ - 992 5881 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
A19F1A,A19F1B	398 0221 000	FUSE DUAL CART 30A 250V	2.0	
A19S5	604 0958 000	SAFETY SWITCH, 250V, 30A	1.0	
#A1A1,#A5A1	300 1485 000	SCREW 4-40 X 5/16	14	
	300 1573 000	SCREW 10-32 X 1/4	72	
#A21C2,#A21C2A	300 1629 000	SCREW 1/4-28 X 5/16		
#A21C2B,#A21C2C			4	
	646 1294 000	NAMEPLATE, XMTR EQUIPMENT	1	
#A21C1,#A21C4	813 5002 052	STANDOFF, 10-32 X 1-1/2	12	
#A21C1	813 5021 039	STANDOFF, 10-32 X 1/8	6	
#A21C3,#A21C3A	813 5606 003	STUD BRS 10-32 X 1/2		
#A21C3B,#A21C3C			4	
#A21C1,#A21C4	813 5606 007	STUD BRS 10-32 X 3/4	12	
#A21C1	813 5606 011	STUD, BRS 10-32 X 1	6	
	817 0914 116	STRAP A26C1 TO A26C1A	1	
	817 0914 143	STRAP, A33 TO A21L2	1	
	817 0914 145	STRAP, A21C1 TO E33	1	
	817 0914 147	STRAP, A21C4 TO L7	1	
#A21C1	817 0914 195	STANDOFF, INSULATED	6	
	829 8305 429	PLATE, A21C3 CONN.	2	
	829 8305 434	STRAP, A21C1 TO A21L1	1	
	829 8305 435	STRAP, A21C3 JUMPER	1	
#A21C1,#A21C4	829 8305 489	STRAP, INTERCONNECT	10	
#A21C1,#A21C4	829 8305 491	STRAP, JUMPER	3	
#A21C1,#A21C4	829 8305 492	STRAP, INTERCONNECT	4	
	829 8305 621	STRAP, A18 TO E22	1	
#A21C1,#A21C4	839 5695 149	PLATE, CAP MTG	3	
#A1	839 5695 251	INSULATOR, PA MODULE	1	
	917 0914 155	STRAP, A26C1 TO A26C1A	1	
	929 8305 481	COAX CABLE, PA/PWR SPLIT	1	
	929 8305 497	PLATE, A21C3 MTG	1	
	939 5695 145	SHIELD, L1	1	
	939 5695 147	SHIELD, A21L1 FRONT	1	
#A26L1	939 5695 221	SHIELD, COIL SAFETY	1	
	988 2125 001	DOC PKG- SX XMTR OPER MAN	1	
	988 2126 001	DOC PKG - SX-1 AM XMTR	1	
	988 2188 001	DOC PKG- SX VENDOR INFO	1	
#A21L1	994 7784 003	COIL CLIP 1/2 RIBBON	1	
#A21C3	410 0017 000	INS ROUND NS5W 0310	3	
#A21C3	813 5606 010	STUD BRS 10-32 x 7/8	3	
	817 0914 142	STRAP A18 TO A21C3	1	

WARNING: Disconnect primary power prior to servicing.

Table 7-18. COAX CABLE,PA/PWR SPLIT - 929 8305 481

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
	612 1069 000	HOUSING, 20 POS RECEPT	2	
	618 0213 000	COAX CABLE RG188A/U	20	FT
	354 0710 000	CONTACT, 22/26 RECEPTACLE	32	
	296 0261 000	TUBG SHRINKABLE .125	.9	FT
	252 0375 000	WIRE 24 AWG STRD BLK	1.4	FT
	296 0264 000	TUBING SHRINKABLE .5	.3	FT
	829 8305 481	COAX CABLE ASSY, PA/PWR	0	

WARNING: Disconnect primary power prior to servicing.

Table 7-19. SX-1 BASIC 1KW AM XMTR - 994 8581 002

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
A01,A05	000 0000 002	APPEARS ON HIGHER LEVEL	2.0	
A6,A7	992 5872 001	PDM AMP BOARD	2.0	
A01A01	000 0000 002	APPEARS ON HIGHER LEVEL	1.0	
A10	000 0000 004	SUB ASSY, P/O THIS BILL	1.0	
A12	992 5877 003	STATUS/MULTIMETER BD	1.0	
A13,A14	992 5876 001	SYSTEM CONTROLLER BOARD	2.0	
A15	992 5878 002	PDM GEN BOARD	1.0	
A16	000 0000 002	APPEARS ON HIGHER LEVEL	1.0	
A17	992 5883 001	SWITCH BOARD	1.0	
A18	992 5884 002	1KW DIRECTIONAL COUPLER	1.0	
A19,A20,A21	000 0000 004	SUB ASSY, P/O THIS BILL	3.0	
A22,A23	992 5890 001	CUSTOMER INT. BOARD	2.0	
A024	992 5886 003	RFI BOARD	1.0	
A26,A27	000 0000 004	SUB ASSY, P/O THIS BILL	2.0	
A10A1	992 5873 001	1 KW PDM FILTER BD	1.0	
A10C01,A10C02	508 0539 000	CAP 2 UF 400VDC 10%		
A10C03			3.0	
A10F1A,A10F1B	398 0410 000	FUSE FAST 10A 500VDC MAX		
A10F2A,A10F2B			4.0	
A10R01,A10R02	546 0171 000	RES 100 OHMS 100W		
A10R03,A10R04			4.0	
A10XF1,A10XF2	402 0177 000	FUSE BLOCK, 2 POLE	2.0	
A12A1	992 5875 001	KEYBOARD/DISPLAY BD	1.0	
A17DS1,A17DS2	396 0183 000	LAMP 14V .08A #382		
A17DS3,A17DS4				
A17DS5,A17DS6			6.0	
A18E1	560 0044 000	SPARK GAP 1500V	1.0	
A19A1	992 5887 001	H. V. FILTER BD	1.0	
A19A4	992 5871 001	PDM PWR FILTER BD	1.0	
A19CR1,A19CR2	384 0705 000	RECT 80A 1000V PIV		
A19CR3,A19CR4			4.0	
A19C1,A19C2	524 0178 000	CAP 860 UF 450V	2.0	
A19C03	500 0781 000	CAP 2200 PF 500V 1%	1.0	
A19C5	524 0344 000	CAP 3300 UF 350 WVDC	1.0	
A19DS1	406 0358 000	PILOT LIGHT AMBER	1.0	
A19F1	000 0000 002	APPEARS ON HIGHER LEVEL	1.0	
A19F2	398 0413 000	FUSE, SEMICONDUCTOR 25A	1.0	
A19K1,A19K2	570 0253 000	CONTACTOR 3 POLE 40A	2.0	
A19L1	476 0272 000	REACTOR 814 3018 001	1.0	
A19RV1	560 0049 000	VARISTOR V275LA15A	1.0	
A19R1	542 1010 000	RES 5.5 OHM 155W	1.0	
A19R2,A19R3	542 1586 000	RES 2 OHM 180W 10%	2.0	
A19R04	917 0914 207	RES, METERING SHUNT	1.0	
A19R05	917 0914 059	RESISTOR, METERING SHUNT	1.0	
A19R6,A19R7	540 0652 000	RES 51.0K OHM 2W 5%		
A19R8			3.0	
A19R11,A19R12	542 0103 000	RES 20000 OHM 10W		
A19R13			3.0	

WARNING: Disconnect primary power prior to servicing.

Table 7-19. SX-1 BASIC 1KW AM XMTR - 994 8581 002 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
A19R14	548 0678 000	RES 4750 OHM 1/4W 1%	1.0	
A19R15	548 2052 000	RES 130K OHM 2W 1%	1.0	
A19R20	542 0358 000	RES 500 OHM 200W	1.0	
A19S3	604 0061 000	SW MICRO BZ2RQ1A2	1.0	
A19S05	000 0000 002	APPEARS ON HIGHER LEVEL	1.0	
A19T1	472 1315 000	XMFR, POWER	1.0	
A19XF2	402 0179 000	FUSE BLOCK 1 POLE	1.0	
A20CB1	606 0159 000	CIRCUIT BREAKER 10A	1.0	
A20CR1	384 0702 000	RECT 100PIV 27A MDA-990-2	1.0	
A20CR2	386 0015 000	ZENER 1N2974B 10V	1.0	
A20C1,A20C2	524 0342 000	CAP 76,000UF 40WVDC	2.0	
A20DS1	406 0358 000	PILOT LIGHT AMBER	1.0	
A20F01	398 0081 000	FUSE SLO CART 2A 125/250V	1.0	
A20RV1	560 0054 000	VARISTOR 95ACRMS 20J	1.0	
A20R01,A20R02	540 0618 000	RES 2.0K OHM 2W 5%	2.0	
A20R3,A20R4	552 0085 000	RES ADJ 50 OHM 50W	2.0	
A20R5	542 0170 000	RESISTOR 50 OHM 25W	1.0	
A20T1	472 1269 000	XFMR, RECTIFIER	1.0	
A20XF01	402 0024 000	FUSE HOLDER	1.0	
A21C1,A21C2	000 0000 003	FREQUENCY DETERMINED PART		
A21C3,A21C4			4.0	
A21L1	943 4025 001	COIL, FXD 17FC1644	1.0	
A21L02	000 0000 002	APPEARS ON HIGHER LEVEL	1.0	
A21L2	943 3655 091	COIL ASSY	1.0	
A21L3	839 5695 115	COIL, TAPPING	1.0	
A21L4,A21L5	943 3777 001	COIL, VAR. 44VC2345	2.0	
A21L6	494 0070 000	CHOKE R.F. 2 MHY	1.0	
A21L7	929 8305 421	COIL, ASSY, 6 TURNS	1.0	
A26A1	992 5889 001	IPA PWR SPLITTER BD	1.0	
A26C1	000 0000 003	FREQUENCY DETERMINED PART	1.0	
A26L1	929 8305 437	COIL, IPA FILTER	1.0	
A27A1	000 0000 002	APPEARS ON HIGHER LEVEL	1.0	
A27C1	516 0200 000	CAP, HV 25PF 7500V 10%	1.0	
A27T1	917 0914 221	XFMR, PHASE ANGLE 28T	1.0	
A5A1	000 0000 003	FREQUENCY DETERMINED PART	1.0	
A6A1,A7A1	992 5872 003	PDM PULL-UP BOARD	2.0	
CR1,CR2,CR3,CR4	384 0431 000	RECT. 1N4001		
CR5,CR6			6.0	
C1,C2,C3	516 0081 000	CAP, DISC .01UF 1KV 20%	3.0	
J001	917 0914 167	RECEPTACLE, OUTPUT TYPE N	1.0	
J2,J3,J4,J5,J6	620 0455 000	ADPT BNC UG492A/U		
J7,J8,J9			8.0	
M001	632 1055 000	METER 0-150VDC SCL	1.0	
M2	632 1015 000	METER 0-20A SCL	1.0	
M3	632 1019 000	METER 0-1500W SCL	1.0	
S1	917 0914 003	SWITCH, MODIF.	1.0	
TB1	614 0681 000	TERM BOARD BTH6	1.0	
TB2	614 0059 000	TERM BOARD 15 TERM	1.0	
TS001	614 0165 000	TERM STRIP 9 STEEL B	1.0	

WARNING: Disconnect primary power prior to servicing.

Table 7-19. SX-1 BASIC 1KW AM XMTR - 994 8581 002 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
	302 0602 000	SCREW 6-32 X 1/2	4.0	
	302 0618 000	SCREW 6-32 X 1/4	4.0	
#A17S1,#A17S2 #A17S3,#A17S4 #A17S5,#A17S6	304 0148 000	NUT 1/2-32 BRASS	6	
	324 0239 000	PUSHNUT FASTENER	4.0	
#A19CR1,#A19CR2 #A19CR3,#A19CR4	335 0227 000	WASHER, INSULATING	8.0	
#A19CR1,#A19CR2 #A19CR3,#A19CR4	335 0252 000	WASHER, TEFLON	4.0	
	350 0046 000	RIVET POP .156X.254	3.0	
	350 0048 000	RIVET POP .093X.337	4.0	
	356 0208 000	CLAMP, FLAT CABLE	15.0	
	356 0214 000	CLAMP, FLAT CABLE 1 IN.	3.0	
#A19R20	358 0004 000	BRACKET RESISTOR MTG	2	
	358 0239 000	PL BUTTON 1.00 HOLE	2.0	
	358 0582 000	BOLT, CRG 1/4 X 1-1/2 LG	4	
	358 2418 000	SLIDE, DRAWER 8.75 LG PR	1.0	
	358 2426 000	PLUG, WHITE 2" HOLE	4.0	
#A21L4,#A21L5	358 2470 000	WHEEL	2.0	
#A19S1,#A19S1A #A19S6,#A19S6A #E40	358 2511 000	STANDOFF, 10-32 X 3/4	5.0	
#A19C1,#A19C2	358 2555 000	BUSHING, FLANGED .375 ID	2.0	
	358 2588 000	FLAT CABLE MOUNT	5	
	358 2589 000	FLAT CABLE MOUNT	5	
	358 2739 000	PLASTIC CAP 5/8-24	1	
#1N2974B	386 0015 000	ZENER 1N2974B 10V	1	
#A17S5,#A17S6	406 0417 000	LENS, WHITE 3/4 SQ	2.0	
#A26L1,#A26L1A	410 0013 000	INS ROUND NS5W 0216	2.0	
#PS	410 0014 000	INS ROUND NS5W 0220	2	
	424 0410 000	GROMMET 1.38 MTG DIA	2.0	
#TOP	448 0338 000	HANDLE #505	2	
	448 0740 000	LATCH, LIFT/TURN FLUSH	4.0	
#A17S1	598 0169 000	SWITCH CAP, PB, RED	1.0	
#A17S2,#A17S3 #A17S4	598 0170 000	SWITCH CAP, PB, GR	3.0	
#E23,#E24	614 0401 000	TERMINAL INSULATED	2	
#A20T1	646 0973 000	LABEL 230V	1.0	
	646 0994 000	HOLDER NAMEPLATE	1.0	
	646 1031 000	NAMEPLATE, HARRIS	1.0	
	646 1305 000	INSERT SX-1	1.0	
#S1	650 0117 000	KNOB ROUND WHITE DOT	1.0	
#A12A1,#A12A1A #A12A1B	813 4999 025	STANDOFF 6-32 X 7/16	3.0	
#A26A1,#A26A1A #A26A1B,#A26A1C	813 4999 028	SPACER	4.0	
#E22	813 5001 068	STANDOFF 10-32 X 1	1	
#A15	813 5018 007	STDOFF 6-32 X 1/2 3/8 HEX	4	

Table 7-19. SX-1 BASIC 1KW AM XMTR - 994 8581 002 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
#A19S1,#A19S1A #A19S6,#A19S6A	813 5021 039	STANDOFF, 10-32 X 1/8	4.0	
#A21L1	813 5089 031	SPACER, 3/8 LG	1.0	
#A25,#A25A #A25B,#A25C #A26A,#A26A1A #A26A1B,#A26A1C	813 5604 007	STUD BRS 6-32 X 3/4	8	
#A19K1	813 5605 009	STUD BRS 8-32 X 7/8	4	
#A26L1,#A26L1A	813 5605 019	STUD BRS 8-32 X 1-1/2	2	
#E30,#E31	813 5606 015	STUD BRS 10-32 X 1-1/4	2	
#E34,#E35	813 5606 021	STUD 10-32 X 1-3/4	2	
	814 7797 001	ROD, GND HOOK	1.0	
	814 9584 001	SPACER	4.0	
	814 9585 001	HANDLE	2.0	
#A21L4,#A21L4A	817 0914 026	SPACER	2.0	
#A21L5,#A21L5A	817 0914 027	SPACER	2.0	
#A21L4,#A21L5	817 0914 028	SPACER	2.0	
	817 0914 079	RUNNING LIST, SX-1	1.0	
#E30,#E31	817 0914 097	STRAP, RECTIFIERS	2.0	
	817 0914 114	STRAP, A21L5 TO A21L7	1.0	
	817 0914 115	STRAP, A26L1 TO A26A1	1.0	
	817 0914 139	STRAP, A21L4 TO A21C3	1	
	817 0914 159	PLUNGER, SWITCH	1.0	
	817 0914 171	CONTACT, CAB GRD	2	
	817 0914 189	STRAP, A21C3 TO L4	1	
#A21C2	817 0914 191	STANDOFF, INSULATED	2	
	817 0914 193	STRAP, A21C2	1	
	817 0914 227	STRAP, A21L4 INTERCONNECT	1	
	817 0914 238	STRIP, PROTECTION	1	
	829 8305 001	LABEL, SX-1 COMPONENT	1.0	
	829 8305 029	COVER, BOTTOM	1.0	
	829 8305 063	STRAP, SHIPPING	2.0	
	829 8305 071	WINDOW, NUMERIC DISPLAY	1.0	
#A19A1	829 8305 131	ANGLE, HV FILTER	1.0	
	829 8305 141	STRAP, A21C3 TO A21L4	2.0	
	829 8305 146	ANGLE, DIODE	1.0	
	829 8305 155	STRAP, GND	1.0	
	829 8305 213	SUPPORT, RIBBON CABLE	1.0	
	829 8305 374	DAM, AIR	1.0	
	829 8305 375	DAM, AIR	1.0	
	829 8305 377	DAM, AIR	2.0	
	829 8305 378	DAM, AIR	1.0	
	829 8305 379	DAM, AIR	1.0	
	829 8305 381	LOCATION DWG, AIR DAM	1.0	
	829 8305 383	LOCATION DWG, AIR DAM	1.0	
#A19C1,#A19C2	829 8305 411	ANGLE, GND	2.0	
	829 8305 441	STRAP, A21L5 TO J1	1.0	
	829 8305 443	TUBE, A21L1 TO E20	1.0	
#A20CB1	829 8305 455	GUARD, CIR BKR	1.0	

WARNING: Disconnect primary power prior to servicing.

Table 7-19. SX-1 BASIC 1KW AM XMTR - 994 8581 002 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
#GND	829 8305 459	ROD, GND	1.0	
	829 8305 469	PALLET, SHIPPING	1	
	829 8305 477	BRACKET, CAB GRD	1	
	829 8305 479	CLIP, GRD ROD MTG	1	
	829 8305 485	SHIELD, PWR SUPPLY	1	
#A18	829 8305 501	BRKT, SHIELD	1	
#A21L2	829 8305 503	SUPPORT, END	1	
#A19R20	829 8305 557	SHIELD, HEAT	1	
	829 8305 597	SHIM, DWR SLIDE	1	
	829 8305 598	TUBE, A21L5 TO A21L4	1	
#A19CR1	829 8305 647	BRACKET H.V. RECT	1	
#A19CR1	829 8305 648	PLATE H.V. RECT	1	
#A20T1	839 0206 029	COVER, TERM. BD.	1.0	
	839 4782 007	PANEL, BLANK 7 RU	4.0	
	839 5695 011	BEZEL, METER PNL	1.0	
	839 5695 027	HINGE	1.0	
	839 5695 087	PANEL, DRESS SCREEN	1.0	
	839 5695 097	PANEL, HV COVER	1.0	
	839 5695 247	WIRING DIAG-SX1 PWR SUP	0	
	839 5695 309	TUBE, A21L5 INTERCONNECT	1	
	839 5695 329	WIRING DIAGRAM	0	
	843 3655 015	SIDE, RIGHT/LEFT	2.0	
	843 3655 029	CHASSIS, DWR	1.0	
	843 3655 141	TOP, CABINET CENTER	1	
	852 8846 060	RIBBON CABLE LAYOUT	0	
	917 0914 073	COVER, RACK ENCL.	1.0	
#A20C1,#A20C2	929 8305 089	CLAMP ADJ	2.0	
#A19A1	929 8305 090	CLAMP ADJ	1.0	
	929 8305 139	STOP, SLIDING DWR	1.0	
#A19S6	929 8305 180	BRACKET, SHORTING SW.	1.0	
#A19S1	929 8305 181	BRACKET, SHORTING	1.0	
	929 8305 241	CABLE #4, POWER SUPPLY	1.0	
	929 8305 247	CABLE #1 SX-1 MAIN	1.0	
#A19C1,#A19C1A #A19C2,#A19C2A #A19C3,#A19C3A	929 8305 301	CLAMP, MODIFICATION	6.0	
#A19C1,#A19C2	929 8305 413	BRACKET, CAP	2.0	
	929 8305 423	CABLE #6, CONTROL DRAWER	1.0	
	929 8305 425	CABLE #3, HV FILTER	1.0	
	929 8305 431	CABLE #5, JUMPERS	1.0	
#A19S6	929 8305 450	PLATE, SHORTING	1.0	
#A19S1	929 8305 451	PLATE, SHORTING SW.	1.0	
#A18	929 8305 499	SHIELD, DIR COUPLER	1	
	929 8305 515	BOTTOM, A19C1 ENCLOSURE	1	
	939 5695 023	PANEL, DWR FRONT	1.0	
	939 5695 049	PANEL, VAR. COIL ADJ	1.0	
	939 5695 075	DOOR, REAR	1.0	
	939 5695 111	TOP, RACK ENCLOSURE	1.0	

Table 7-19. SX-1 BASIC 1KW AM XMTR - 994 8581 002 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
	939 5695 112	BOTTOM, RACK ENCLOSURE	1.0	
#A6,#A7	939 5695 141	HEATSINK, 1KW PDM AMP	2.0	
	939 5695 159	CABLE, A15P3/A12P2	1.0	
	939 5695 166	CABLE, A13P1/A12P12	1.0	
	939 5695 167	CABLE, A12P1/A16P3	1.0	
	939 5695 168	CABLE, A12P7/A14P1	1.0	
	939 5695 169	CABLE, A12A1P1/A12P8	1.0	
	939 5695 171	CABLE, A12P5/A22P2	1.0	
	939 5695 173	CABLE, A12P3/A22P1	1.0	
	939 5695 174	CABLE, A12P10/A24P10	1.0	
	939 5695 175	CABLE, A12P9/A24P9	1.0	
	939 5695 176	CABLE, A12P6/A23P2	1.0	
	939 5695 177	CABLE, A12P4/A24P8	1.0	
	939 5695 178	CABLE, A12P11, A24P11	1.0	
	939 5695 179	CABLE, A5P1/A18P1/A24P2	1.0	
	939 5695 180	CABLE, A24P1/A17P1	1.0	
	939 5695 181	CABLE, A6P1/A7P1/A24P5	1.0	
	939 5695 182	CABLE, A24P7/A25P1	1.0	
	939 5695 183	CABLE, A1P1/A24P3	1.0	
	943 3655 049	BASE	1.0	
	943 3655 053	SIDE, RACK ENCL	2.0	
#A1	943 3655 069	HEATSINK, PA	1.0	
#A5	943 3655 071	HEATSINK, IPA MOD.	1.0	
	943 3655 083	DIVIDER, DRWR	1.0	
	943 3655 093	CHASSIS, HV CONTACTOR	1.0	
	943 3655 143	TOP, CABINET REAR	1	
	952 8846 002	BOTTOM, CABINET	1	
	952 8846 045	TOP, CABINET FRONT	1	
	952 8846 049	SHIELD, INNER LEFT	1	
	952 8846 051	SHIELD, INNER RIGHT	1	
	992 5880 002	AC CONTROLLER BOARD	1	
#A21L7	994 7784 002	COIL CLIP 3/8 RIBBON	1.0	
	999 2048 001	WIRE TUBING LIST	1.0	
	999 2179 001	HARDWARE LIST	1	
#A21L2	300 2795 000	SCREW 1/2 - 13 X 1	1	
#A21L3	300 2883 000	SCREW 3/8-16 X 1-1/2	1	
#A21L3	304 0011 000	NUT HEX 3/8-16 BRASS	1	
#A21L3	308 0011 000	.375 FLAT WASHER BRS	2	
#A21L3	312 0053 000	.375 SPLT WASHER BRZ	2	
#A21L2	312 0055 000	.5 SPLIT WASHER BRZ	1	
#E33	335 0080 000	WASHER NYLON .5 HOLE	2	
	304 0166 000	NUT, SQ 1/4-20	2	
#A21L7	929 8305 649	BAR, COIL MTG	1	
	086 0001 002	SEALANT	0	

WARNING: Disconnect primary power prior to servicing.

Table 7-19. SX-1 BASIC 1KW AM XMTR - 994 8581 002 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
#A10R01	358 0003 000	BRACKET RESISTOR MTG		
#A10R01A				
#A10R02				
#A10R02A				
#A10R03				
#A10R03A				
#A10R04				
#A10R04A				
#A19R04				
#A19R04A				
#A19R05				
#A19R05A			12	
	358 1974 000	SPEED NUT 10-32	44	
#A12,#A12A	358 2401 000	STANDOFF, HINGED 1/4 OD		
#A12B,#A13				
#A13A,#A14				
#A14A,#A16				
#A16A			9	
#E33	410 0152 000	INS, BUSHING NS5W-4103	1	
#E33	410 0156 000	INS, BUSHING NS5W-4203	1	
	424 0502 000	BUMPER 5/8 DIA X 1/4 THK	2	
#A21L01	813 5004 087	STANDOFF, 1/4-20 X 1	3	
#E20	813 5019 047	SPACER 3/4 LG.	1	
#E14,#E15,#E21	813 5019 051	STANDOFF 10-32 X 1-1/2	3	
#E13,#E34,#E35	813 5606 019	STUD BRS 10-32 X 1-1/2		
#E39			4	
#E33	813 5606 024	STUD BRS 10-32 X 2-1/4	1	
#A21L01	813 5608 007	STUD BRS 1/4-20 X 3/4	6	
#A21L2	817 0914 153	CLAMP, COIL TAPPING	1	
#A21L3	817 0914 183	PLATE, TAPPING	1	
#A19S1	829 8305 179	BRACKET, SHORTING SW.	1	
	943 3655 131	SHIELD, A21C1 ENCL	1	
	302 0589 000	SCREW 10-32 X 5/8	36	
#A19C1,#A19C2	358 2554 000	STANDOFF 10-32 X 3/4	2	
#A10R01	410 0016 000	INS ROUND NS5W 0308		
#A10R01A				
#A10R02				
#A10R02A				
#A10R03				
#A10R03A				
#A10R04				
#A10R04A				
#A19S01				
#A19S01A				
#A19S06				
#A19S06A,#E20				
#E30,#E31,#E34				
#E35,#E39			18	

Table 7-19. SX-1 BASIC 1KW AM XMTR - 994 8581 002 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
#A12,#A12A	813 5018 011	STDOFF 3/8 HEX 6-32 X 1		
#A12B,#A13				
#A13A,#A14				
#A14A,#A16				
#A16A,#A18				
#A18A,#A18B				
#A18C,#A25				
#A25A,#A25B				
#A25C			17	
#A26L01	813 5605 007	STUD BRS 8-32 X 3/4		
#A26L01A			2	
#A20C1,#A20C1A	813 5606 011	STUD, BRS 10-32 X 1		
#A20C2,#A20C2A				
#E10,#E20,#E29			7	
#A10R1,#A10R1A	813 5606 007	STUD BRS 10-32 X 3/4		
#A10R2,#A10R2A				
#A10R3,#A10R3A				
#A10R4,#A10R4A				
#A19S1,#A19S1A				
#A19S6,#A19S6A				
#A39,#E14,#E15				
#E20			16	

WARNING: Disconnect primary power prior to servicing.

Table 7-20. PDM AMP BOARD - 992 5872 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
CR1	384 0708 000	RECT 30A 400V	1.0	
CR11	384 0205 000	DIODE SILICON 1N914	1.0	
CR12,CR13	384 0020 000	RECTIFIER IN4005	2.0	
CR14	384 0720 000	DIODE, 15V ICTE-15	1.0	
CR15	384 0205 000	DIODE SILICON 1N914	1.0	
CR16,CR17	384 0020 000	RECTIFIER IN4005	2.0	
CR18	384 0720 000	DIODE, 15V ICTE-15	1.0	
CR19,CR31	384 0205 000	DIODE SILICON 1N914	2.0	
CR32,CR33	384 0020 000	RECTIFIER IN4005	2.0	
CR34	384 0720 000	DIODE, 15V ICTE-15	1.0	
CR35	384 0205 000	DIODE SILICON 1N914	1.0	
CR36,CR37	384 0020 000	RECTIFIER IN4005	2.0	
CR38	384 0720 000	DIODE, 15V ICTE-15	1.0	
CR39	384 0205 000	DIODE SILICON 1N914	1.0	
C1	526 0351 000	CAP 6.8UF 50V 20%	1.0	
C002	506 0246 000	CAP .47UF 63V 5%	1.0	
C11	516 0453 000	CAP .1UF 100V 20%	1.0	
C13	526 0351 000	CAP 6.8UF 50V 20%	1.0	
C14	516 0375 000	CAP .01UF 50V	1.0	
C15	526 0351 000	CAP 6.8UF 50V 20%	1.0	
C16	516 0375 000	CAP .01UF 50V	1.0	
C17,C18,C19,C20	516 0419 000	CAP .05 UF 500V		
C21,C22			6.0	
C23,C24	500 0837 000	CAP, MICA 510PF 500V 5%	2.0	
C25,C31	516 0453 000	CAP .1UF 100V 20%	2.0	
C33	526 0351 000	CAP 6.8UF 50V 20%	1.0	
C34	516 0375 000	CAP .01UF 50V	1.0	
C35	526 0351 000	CAP 6.8UF 50V 20%	1.0	
C36	516 0375 000	CAP .01UF 50V	1.0	
C37,C38,C39,C40	516 0419 000	CAP .05 UF 500V		
C41,C42			6.0	
C43,C44	500 0837 000	CAP, MICA 510PF 500V 5%	2.0	
C45	516 0453 000	CAP .1UF 100V 20%	1.0	
F1	398 0019 000	FUSE FAST CART 2A 250V	1.0	
J1	610 0830 000	HEADER, 10 PIN PC RIBBON	1.0	
J2	610 0840 000	CONN., 4 PIN PC MTG	1.0	
J5,J6	612 0301 000	JACK BANANA BRASS	2.0	
L1	494 0395 000	CHOKE, 40UH 2 AMP	1.0	
P4	610 0679 000	PLUG, SHORTING	1.0	
Q13	380 0125 000	TRANSISTOR 2N4401	1.0	
Q14	380 0587 000	TRANSISTOR MJE210	1.0	
Q15	380 0125 000	TRANSISTOR 2N4401	1.0	
Q16	380 0587 000	TRANSISTOR MJE210	1.0	
Q019,Q020	380 0649 000	TRANSISTOR IRF350	2.0	
Q33	380 0125 000	TRANSISTOR 2N4401	1.0	
Q34	380 0587 000	TRANSISTOR MJE210	1.0	
Q35	380 0125 000	TRANSISTOR 2N4401	1.0	
Q36	380 0587 000	TRANSISTOR MJE210	1.0	

WARNING: Disconnect primary power prior to servicing.

Table 7-20. PDM AMP BOARD - 992 5872 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
Q039,Q040	380 0649 000	TRANSISTOR IRF350	2.0	
R11	540 1102 000	RES 100.0 OHM 1/2W 5%	1.0	
R12	540 1147 000	RES 27.0K OHM 1/2W 5%	1.0	
R13	540 1164 000	RES 390.0 OHM 1/2W 5%	1.0	
R14	540 1117 000	RES 150.0 OHM 1/2W 5%	1.0	
R15	540 1164 000	RES 390.0 OHM 1/2W 5%	1.0	
R16	540 1117 000	RES 150.0 OHM 1/2W 5%	1.0	
R17,R18,R19,R20	546 0294 000	RES 150 OHM 2.5W 5%	4.0	
R21,R22	540 0611 000	RES 1.0K OHM 2W 5%	2.0	
R23,R24	540 0570 000	RES 20.0 OHM 2W 5%	2.0	
R25	540 1198 000	RES 470.0K OHM 1/2W 5%	1.0	
R26,R27	540 1111 000	RES 10.0K OHM 1/2W 5%	2.0	
R31	540 1102 000	RES 100.0 OHM 1/2W 5%	1.0	
R32	540 1147 000	RES 27.0K OHM 1/2W 5%	1.0	
R33	540 1164 000	RES 390.0 OHM 1/2W 5%	1.0	
R34	540 1117 000	RES 150.0 OHM 1/2W 5%	1.0	
R35	540 1164 000	RES 390.0 OHM 1/2W 5%	1.0	
R36	540 1117 000	RES 150.0 OHM 1/2W 5%	1.0	
R37,R38,R39,R40	546 0294 000	RES 150 OHM 2.5W 5%	4.0	
R41,R42	540 0611 000	RES 1.0K OHM 2W 5%	2.0	
R43,R44	540 0570 000	RES 20.0 OHM 2W 5%	2.0	
R45	540 1198 000	RES 470.0K OHM 1/2W 5%	1.0	
R46,R47	540 1111 000	RES 10.0K OHM 1/2W 5%	2.0	
TC1	382 0707 000	IC LM335AZ	1.0	
U11,U31	382 0172 000	IC LH0002CH-A+	2.0	
XF1A,XF1B	402 0129 000	CLIP FUSE	2.0	
#U11,#U31	404 0250 000	HEAT SINK, FOR TO-5 CASE	4.0	
#CR1,#Q19,#Q20 #Q39,#Q40	410 0383 000	INSULATOR TO-3 MICA	10.0	
#E13	813 5018 027	STANDOFF, HEX	2.0	
#CR1,#Q20,#Q39	813 5016 042	STANDOFF, 9/16 LG	6	

WARNING: Disconnect primary power prior to servicing.

Table 7-21. PC BD ASSY,PDM AMP - 943 3655 039

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
J4A,J4B,J4C	612 0904 000	JACK, PC MT	3.0	

Table 7-22. STATUS/MULTIMETER BD - 992 5877 003

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
CR001,CR002	386 0137 000	ZENER 1N4746A 18V		
CR003,CR004				
CR005,CR006				
CR007,CR008				
CR009			9.0	
CR010,CR011	386 0123 000	ZENER 1N4732A 4.7V	2.0	
CR012	384 0719 000	DIODE, 5V ICTE-5	1.0	
CR013	386 0135 000	ZENER 1N4733A 5.1V	1.0	
CR014	384 0205 000	DIODE SILICON 1N914	1.0	
CR015	386 0083 000	ZENER 1N4742A 12V	1.0	
CR016	384 0205 000	DIODE SILICON 1N914	1.0	
CR017,CR018	384 0321 000	DIODE 5082-2800/1N5711	2.0	
C001	500 0843 000	CAP, MICA 910PF 100V 5%	1.0	
C002	516 0453 000	CAP .1UF 100V 20%	1.0	
C003	500 0812 000	CAP, MICA 30PF 500V 5%	1.0	
C004	506 0237 000	CAP .0068UF 63V 5%	1.0	
C005	516 0453 000	CAP .1UF 100V 20%	1.0	
C006	500 0759 000	CAP, MICA 100PF 500V 5%	1.0	
C007	516 0453 000	CAP .1UF 100V 20%	1.0	
C008	526 0318 000	CAP 10UF 35V 20%	1.0	
C009	526 0342 000	CAP 2.7UF 35V 10%	1.0	
C010	516 0453 000	CAP .1UF 100V 20%	1.0	
C011	526 0047 000	CAP 220UF 10V 20%	1.0	
C012	500 0759 000	CAP, MICA 100PF 500V 5%	1.0	
C013	516 0453 000	CAP .1UF 100V 20%	1.0	
C014	500 0759 000	CAP, MICA 100PF 500V 5%	1.0	
C015	506 0246 000	CAP .47UF 63V 5%	1.0	
C016	500 0819 000	CAP, MICA 51PF 500V 5%	1.0	
C017	500 0831 000	CAP MICA 250UUF 500V	1.0	
C021,C022,C023	516 0453 000	CAP .1UF 100V 20%		
C024,C025,C026				
C027,C028,C029				
C030,C031,C032				
C033,C050,C051				
C052,C053,C054				
C055,C056,C057				
C058,C059,C060				
C061,C062,C063				
C064,C065,C066				
C067,C068,C069				
C070,C071,C072				
C073,C074,C075				
C076,C077,C078				
C079,C080			44.0	
C090	526 0097 000	CAP 47 UF 35V 20%	1.0	

WARNING: Disconnect primary power prior to servicing.

Table 7-22. STATUS/MULTIMETER BD - 992 5877 003 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
DS001,DS002	384 0601 000	LED, RED		
DS003,DS004				
DS005,DS006				
DS007,DS008				
DS009			9.0	
J001	610 0827 000	HEADER, 20 PIN PC RIBBON	1.0	
J002,J003,J004	610 0828 000	HEADER, 26 PIN PC RIBBON	3.0	
J005,J006	610 0827 000	HEADER, 20 PIN PC RIBBON	2.0	
J007	610 0854 000	HEADER, 40 PIN PC RIBBON	1.0	
J008,J009	610 0828 000	HEADER, 26 PIN PC RIBBON	2.0	
J010,J011	610 0827 000	HEADER, 20 PIN PC RIBBON	2.0	
J012	610 0854 000	HEADER, 40 PIN PC RIBBON	1.0	
J013,J014	610 0840 000	CONN., 4 PIN PC MTG	2.0	
J015	620 0515 000	RECP 50-051-0000	1.0	
Q001,Q002,Q003	380 0125 000	TRANSISTOR 2N4401		
Q004,Q005,Q006				
Q007,Q008,Q009				
Q013,Q014,Q015				
Q016,Q017,Q018				
Q019,Q020			17.0	
Q030	380 0126 000	TRANSISTOR 2N4403	1.0	
Q031	380 0125 000	TRANSISTOR 2N4401	1.0	
Q032	380 0126 000	TRANSISTOR 2N4403	1.0	
Q033	380 0125 000	TRANSISTOR 2N4401	1.0	
Q034	380 0126 000	TRANSISTOR 2N4403	1.0	
Q035	380 0125 000	TRANSISTOR 2N4401	1.0	
Q036,Q037,Q038	380 0189 000	TRANSISTOR 2N3904	3.0	
R001	540 0912 000	RES 1.0K OHM 1/4W 5%	1.0	
R002	540 0968 000	RES 220.0K OHM 1/4W 5%	1.0	
R004	540 0912 000	RES 1.0K OHM 1/4W 5%	1.0	
R006,R007	548 1361 000	RES 10K OHM 1/4W 1%	2.0	
R008	540 0993 000	RES 2.4M OHM 1/4W 5%	1.0	
R009	540 0912 000	RES 1.0K OHM 1/4W 5%	1.0	
R010	540 1116 000	RES 1.0K OHM 1/2W 5%	1.0	
R011	548 1361 000	RES 10K OHM 1/4W 1%	1.0	
R012	548 0394 000	RES 5110 OHM 1/4W 1%	1.0	
R013,R014	540 0916 000	RES 1.5K OHM 1/4W 5%	2.0	
R015,R016	540 0936 000	RES 10.0K OHM 1/4W 5%	2.0	
R017,R018,R019	540 0912 000	RES 1.0K OHM 1/4W 5%	3.0	
R020	540 0918 000	RES 1.8K OHM 1/4W 5%	1.0	
R021	540 0889 000	RES 110.0 OHM 1/4W 5%	1.0	
R022,R023	540 0929 000	RES 5.1K OHM 1/4W 5%	2.0	
R024,R025,R026	540 0920 000	RES 2.2K OHM 1/4W 5%	3.0	
R027,R028	540 0929 000	RES 5.1K OHM 1/4W 5%	2.0	
R029,R030	540 0936 000	RES 10.0K OHM 1/4W 5%	2.0	
R031,R032	540 1359 000	RES NETWORK 3300 OHM	2.0	
R034	540 1376 000	RES NETWORK 1000 OHM 2%	1.0	
R035,R036	540 1386 000	RES NETWORK 10K OHM 2%	2.0	
R037	540 1376 000	RES NETWORK 1000 OHM 2%	1.0	

WARNING: Disconnect primary power prior to servicing.

Table 7-22. STATUS/MULTIMETER BD - 992 5877 003 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
R038	540 1386 000	RES NETWORK 10K OHM 2%	1.0	
R039	540 1392 000	RES NETWORK 4700 OHM 2%	1.0	
R040	540 0936 000	RES 10.0K OHM 1/4W 5%	1.0	
R041,R042	540 0909 000	RES 750.0 OHM 1/4W 5%	2.0	
R043	540 0924 000	RES 3.3K OHM 1/4W 5%	1.0	
R044	540 0951 000	RES 43.0K OHM 1/4W 5%	1.0	
R046	540 0977 000	RES 510.0K OHM 1/4W 5%	1.0	
R047	540 0929 000	RES 5.1K OHM 1/4W 5%	1.0	
R048,R049	540 0888 000	RES 100.0 OHM 1/4W 5%	2.0	
R050	540 0929 000	RES 5.1K OHM 1/4W 5%	1.0	
R051,R052,R053	550 0958 000	POT 10K OHM 1/2 W 10%		
R054,R055,R056				
R057,R058			8.0	
R059	550 0956 000	POT 2000 OHM 1/2W 10%	1.0	
R060	550 0959 000	POT 20K OHM 1/2 W 10%	1.0	
R061,R062	550 0962 000	POT 200K OHM 1/2W 10%	2.0	
R063	550 0959 000	POT 20K OHM 1/2 W 10%	1.0	
R064	540 1386 000	RES NETWORK 10K OHM 2%	1.0	
S001	604 0904 000	SWITCH, SPDT TOGGLE	1.0	
U001,U002,U003	382 0510 000	IC OPTO ISOL		
U004			4.0	
U005	382 0565 000	IC 74LS138 TTL DECOD	1.0	
U006	382 0579 000	IC 8279	1.0	
U007	382 0581 000	IC 74LS123	1.0	
U008	382 0669 000	IC 74LS367N	1.0	
U009	382 0556 000	IC 74LS00N	1.0	
U010,U011	382 0125 000	IC SN75453BP	2.0	
U012	382 0557 000	IC 74LS02	1.0	
U013	382 0125 000	IC SN75453BP	1.0	
U014	382 0558 000	IC 74LS04N, TTL INV	1.0	
U015	382 0560 000	IC 74LS27	1.0	
U016,U017	382 0580 000	IC 74LS32	2.0	
U018	382 0309 000	IC SN74LS08N-PEP-3	1.0	
U019	382 0569 000	IC 8212	1.0	
U020,U021,U022	382 0523 000	IC MC14066BCPDS		
U023			4.0	
U024	382 0569 000	IC 8212	1.0	
U025,U026,U027	382 0463 000	IC 4051/14051		
U028			4.0	
U029,U030	382 0569 000	IC 8212	2.0	
U031,U032,U033	382 0721 000	IC MC14504BCP	3.0	
U034	382 0463 000	IC 4051/14051	1.0	
U035	382 0718 000	IC AD7525KN	1.0	
U036	382 0565 000	IC 74LS138 TTL DECOD	1.0	
U037	382 0460 000	IC 308A	1.0	
U038	382 0685 000	IC AD584JH	1.0	
U039	382 0419 000	IC 74C14	1.0	
U040	382 0517 000	IC 7550/97550	1.0	
U041	382 0622 000	IC 74LS14N	1.0	

WARNING: Disconnect primary power prior to servicing.

Table 7-22. STATUS/MULTIMETER BD - 992 5877 003 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
U042	382 0670 000	IC P8282	1.0	
U043	382 0522 000	IC LM393N/CA3290E	1.0	
U044,U045	382 0648 000	IC LM339A	2.0	
U046	382 0670 000	IC P8282	1.0	
U047,U048,U049	382 0569 000	IC 8212	3.0	
U050,U051	382 0721 000	IC MC14504BCP	2.0	
U052	382 0565 000	IC 74LS138 TTL DECOD	1.0	
U053,U054	382 0569 000	IC 8212	2.0	
U055	382 0363 000	IC 74S74	1.0	
U056,U057	382 0428 000	IC LM358	2.0	
U058,U059,U060 U061	382 0523 000	IC MC14066BCPDS	4.0	
XU019,XU024 XU029,XU030 XU047,XU048 XU049,XU053 XU054	404 0682 000	SOCKET, IC 24 CONT.	9.0	

WARNING: Disconnect primary power prior to servicing.

Table 7-23. SYSTEM CONTROLLER BOARD - 992 5876 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
B1	660 0036 000	BATTERY, NI CD, 3.6V NOM	1.0	
CR1	384 0205 000	DIODE SILICON 1N914	1.0	
CR2	384 0719 000	DIODE, 5V ICTE-5	1.0	
CR3	386 0093 000	ZENER 1N4728 3.3V	1.0	
CR4	384 0321 000	DIODE 5082-2800/1N5711	1.0	
CR5,CR6,CR7,CR8	384 0205 000	DIODE SILICON 1N914	4.0	
CR9,CR10	384 0431 000	RECT. 1N4001	2.0	
C1,C2,C3,C4,C5 C6,C7,C8,C9,C10 C11,C12,C13,C14 C15,C16,C17,C18 C19,C20	516 0453 000	CAP .1UF 100V 20%	20.0	
C21	526 0106 000	CAP 27UF 35V 10%	1.0	
C22	526 0350 000	CAP 3.9 UF 35V 10%	1.0	
C23	526 0309 000	CAP, 22UF 35V 20%	1.0	
C24	526 0047 000	CAP 220UF 10V 20%	1.0	
C25	526 0311 000	CAP 2.2UF 35V 10%	1.0	
C26,C27,C28	500 0761 000	CAP, MICA 150PF 500V 5%	3.0	
DS1	384 0610 000	LED, GREEN	1.0	
DS2	384 0611 000	LED, RED	1.0	
J1	610 0854 000	HEADER, 40 PIN PC RIBBON	1.0	
J2	610 0828 000	HEADER, 26 PIN PC RIBBON	1.0	
J3	610 0840 000	CONN., 4 PIN PC MTG	1.0	
J4,J5,J6	610 0787 000	HEADER, STRAIGHT 6 POS	3.0	
P4A,P4B,P5A,P5B P6A,P6B	612 0954 000	JUMPER, MINI, FEMALE	6.0	
Q1,Q2	380 0126 000	TRANSISTOR 2N4403	2.0	
R1	540 0946 000	RES 27.0K OHM 1/4W 5%	1.0	
R2,R3,R4	540 0912 000	RES 1.0K OHM 1/4W 5%	3.0	
R5	540 1134 000	RES 33.0 OHM 1/2W 5%	1.0	
R6	540 1161 000	RES 27.0 OHM 1/2W 5%	1.0	
R7	540 0912 000	RES 1.0K OHM 1/4W 5%	1.0	
R8	540 0923 000	RES 3.0K OHM 1/4W 5%	1.0	
R9	540 0960 000	RES 100.0K OHM 1/4W 5%	1.0	
R10	540 1102 000	RES 100.0 OHM 1/2W 5%	1.0	
R11	540 0905 000	RES 510.0 OHM 1/4W 5%	1.0	
R12	540 0960 000	RES 100.0K OHM 1/4W 5%	1.0	
R13	540 1015 000	RES 20.0M OHM 1/4W 5%	1.0	
R14	540 0912 000	RES 1.0K OHM 1/4W 5%	1.0	
R15,R16	540 1188 000	RES 270.0 OHM 1/2W 5%	2.0	
R17	540 0931 000	RES 6.2K OHM 1/4W 5%	1.0	
R18	540 0912 000	RES 1.0K OHM 1/4W 5%	1.0	
S1	604 0905 000	SWITCH, PUSHBUTTON, MOM	1.0	
U1	382 0573 000	IC 8085A	1.0	
U2	382 0572 000	IC P8259A-8	1.0	
U3	382 0569 000	IC 8212	1.0	
U004,U005,U006 U007,U008	000 0000 002	APPEARS ON HIGHER LEVEL	5.0	

Table 7-23. SYSTEM CONTROLLER BOARD - 992 5876 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
U9	382 0571 000	IC 8253	1.0	
U10,U11	382 0565 000	IC 74LS138 TTL DECOD	2.0	
U12	382 0712 000	IC 5101	1.0	
U13	382 0626 000	IC 4093B/14093B	1.0	
U14	382 0581 000	IC 74LS123	1.0	
U15	382 0561 000	IC 74LS74	1.0	
U16,U17	382 0640 000	IC 8251	2.0	
U18	382 0292 000	IC 75189/1489	1.0	
U19	382 0291 000	IC 75188/1488	1.0	
XU4,XU5,XU6,XU7	404 0682 000	SOCKET, IC 24 CONT.		
XU8			5.0	
Y1	444 2694 000	CRYSTAL 4.992MHZ	1.0	

Table 7-24. PDM GEN BOARD - 992 5878 002

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
CR001,CR002	384 0205 000	DIODE SILICON 1N914		
CR003,CR004			4.0	
CR005	384 0321 000	DIODE 5082-2800/1N5711	1.0	
CR007,CR008	384 0205 000	DIODE SILICON 1N914		
CR009,CR010				
CR011,CR012			6.0	
CR014,CR015	384 0431 000	RECT. 1N4001	2.0	
CR016	384 0720 000	DIODE, 15V ICTE-15	1.0	
CR017,CR018	384 0431 000	RECT. 1N4001	2.0	
CR019	384 0720 000	DIODE, 15V ICTE-15	1.0	
C005	500 0759 000	CAP, MICA 100PF 500V 5%	1.0	
C006	500 0787 000	CAP 200PF 500V 5%	1.0	
C007,C008	516 0453 000	CAP .1UF 100V 20%	2.0	
C009	526 0049 000	CAP 6.8UF 35V 20%	1.0	
C010	500 0759 000	CAP, MICA 100PF 500V 5%	1.0	
C011,C012	516 0453 000	CAP .1UF 100V 20%	2.0	
C013	500 0759 000	CAP, MICA 100PF 500V 5%	1.0	
C014	500 0787 000	CAP 200PF 500V 5%	1.0	
C015	500 0759 000	CAP, MICA 100PF 500V 5%	1.0	
C016	500 0787 000	CAP 200PF 500V 5%	1.0	
C017	526 0049 000	CAP 6.8UF 35V 20%	1.0	
C018,C019	516 0453 000	CAP .1UF 100V 20%	2.0	
C020	500 0787 000	CAP 200PF 500V 5%	1.0	
C021	500 0838 000	CAP, MICA 560PF 300V 5%	1.0	
C022	500 0827 000	CAP, MICA 130PF 500V 5%	1.0	
C023,C024	516 0453 000	CAP .1UF 100V 20%	2.0	
C025	526 0049 000	CAP 6.8UF 35V 20%	1.0	
C026	500 0832 000	CAP, MICA 360PF 500V 5%	1.0	
C027	526 0049 000	CAP 6.8UF 35V 20%	1.0	
C028,C029	516 0453 000	CAP .1UF 100V 20%	2.0	
C030	500 0819 000	CAP, MICA 51PF 500V 5%	1.0	
C031,C033	516 0453 000	CAP .1UF 100V 20%	2.0	
C034	500 0759 000	CAP, MICA 100PF 500V 5%	1.0	
C035	526 0342 000	CAP 2.7UF 35V 10%	1.0	
C036	516 0453 000	CAP .1UF 100V 20%	1.0	
C037,C038	506 0227 000	CAP .015UF 50V 1%	2.0	
C039	500 0810 000	CAP MICA 24UUF 500V	1.0	
C040	516 0511 000	CAP 0.47UF 100V 20%	1.0	
C041	516 0453 000	CAP .1UF 100V 20%	1.0	
C042	526 0342 000	CAP 2.7UF 35V 10%	1.0	
C043	516 0453 000	CAP .1UF 100V 20%	1.0	
C044	500 0836 000	CAP MICA 500 PF 500V	1.0	
C045	526 0342 000	CAP 2.7UF 35V 10%	1.0	
C046,C047,C048	516 0453 000	CAP .1UF 100V 20%	3.0	
C049,C050	526 0342 000	CAP 2.7UF 35V 10%	2.0	
C051	516 0453 000	CAP .1UF 100V 20%	1.0	
C052	526 0342 000	CAP 2.7UF 35V 10%	1.0	
C053	516 0453 000	CAP .1UF 100V 20%	1.0	

Table 7-24. PDM GEN BOARD - 992 5878 002 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
C055	500 0784 000	CAP 300PF 500V 5%	1.0	
C056,C057	516 0453 000	CAP .1UF 100V 20%	2.0	
C058	516 0511 000	CAP 0.47UF 100V 20%	1.0	
C059	500 0810 000	CAP MICA 24UUF 500V	1.0	
C060	516 0453 000	CAP .1UF 100V 20%	1.0	
C061	526 0342 000	CAP 2.7UF 35V 10%	1.0	
C062	516 0453 000	CAP .1UF 100V 20%	1.0	
C063	500 0836 000	CAP MICA 500 PF 500V	1.0	
C064	526 0342 000	CAP 2.7UF 35V 10%	1.0	
C065,C066,C067	516 0453 000	CAP .1UF 100V 20%	3.0	
C068,C069	526 0342 000	CAP 2.7UF 35V 10%	2.0	
C070	516 0453 000	CAP .1UF 100V 20%	1.0	
C072	500 0759 000	CAP, MICA 100PF 500V 5%	1.0	
C073	500 0844 000	CAP, MICA 1000PF 100V 5%	1.0	
C074	526 0097 000	CAP 47 UF 35V 20%	1.0	
C075	526 0238 000	CAP 33UF 35V 20%	1.0	
C076	526 0097 000	CAP 47 UF 35V 20%	1.0	
C077	526 0238 000	CAP 33UF 35V 20%	1.0	
C078,C079,C080	516 0511 000	CAP 0.47UF 100V 20%		
C081			4.0	
C082,C083	500 0787 000	CAP 200PF 500V 5%	2.0	
C084	500 0812 000	CAP, MICA 30PF 500V 5%	1.0	
C085,C086,C087	516 0419 000	CAP .05 UF 500V	3.0	
C088	516 0511 000	CAP 0.47UF 100V 20%	1.0	
C089,C090,C091	516 0453 000	CAP .1UF 100V 20%		
C092,C093,C094				
C095,C096,C097				
C098,C099,C100				
C101			13.0	
F001,F002	398 0015 000	FUSE FAST CART .500A 250V	2.0	
J001	610 0832 000	CONN 12 PIN PC MT	1.0	
J002	620 1677 000	RECEPTACLE PANEL BNC	1.0	
J003	610 0828 000	HEADER, 26 PIN PC RIBBON	1.0	
J004	610 0831 000	CONN 8 PIN PC MT	1.0	
L001,L002	494 0445 000	CHOKE, HIGH CURRENT 470UH	2.0	
L003	494 0419 000	CHOKE RF 1000.0UH	1.0	
Q001,Q002	380 0126 000	TRANSISTOR 2N4403	2.0	
Q003	380 0125 000	TRANSISTOR 2N4401	1.0	
Q004	380 0126 000	TRANSISTOR 2N4403	1.0	
R006	540 1181 000	RES 680.0 OHM 1/2W 5%	1.0	
R007,R008	540 1111 000	RES 10.0K OHM 1/2W 5%	2.0	
R009,R010	540 0984 000	RES 1.0M OHM 1/4W 5%	2.0	
R011	540 1102 000	RES 100.0 OHM 1/2W 5%	1.0	
R012	540 0929 000	RES 5.1K OHM 1/4W 5%	1.0	
R013	540 0936 000	RES 10.0K OHM 1/4W 5%	1.0	
R014	550 0961 000	POT 50K OHM 1/2W 10%	1.0	
R015	540 0936 000	RES 10.0K OHM 1/4W 5%	1.0	
R016	540 1102 000	RES 100.0 OHM 1/2W 5%	1.0	
R017	540 1356 000	RES NETWORK 10K OHM 2%	1.0	

WARNING: Disconnect primary power prior to servicing.

Table 7-24. PDM GEN BOARD - 992 5878 002 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
R018	540 1403 000	RES NETWORK 22K OHM 2%	1.0	
R019	540 1102 000	RES 100.0 OHM 1/2W 5%	1.0	
R020	540 0935 000	RES 9.1K OHM 1/4W 5%	1.0	
R021	550 0949 000	POT 100K OHM 1/2W 10%	1.0	
R022	540 0936 000	RES 10.0K OHM 1/4W 5%	1.0	
R023	540 1102 000	RES 100.0 OHM 1/2W 5%	1.0	
R025	540 0943 000	RES 20.0K OHM 1/4W 5%	1.0	
R027	540 0912 000	RES 1.0K OHM 1/4W 5%	1.0	
R028	550 0984 000	POT 500K OHM 1/2W 10%	1.0	
R029	540 0912 000	RES 1.0K OHM 1/4W 5%	1.0	
R030	550 0962 000	POT 200K OHM 1/2W 10%	1.0	
R031,R032,R033	540 1111 000	RES 10.0K OHM 1/2W 5%	3.0	
R034	540 1131 000	RES 30.0K OHM 1/2W 5%	1.0	
R035	540 1107 000	RES 20.0K OHM 1/2W 5%	1.0	
R036	540 0912 000	RES 1.0K OHM 1/4W 5%	1.0	
R041,R042	540 1159 000	RES 100.0K OHM 1/2W 5%	2.0	
R043,R044	540 1151 000	RES 10.0 OHM 1/2W 5%	2.0	
R045,R046	540 1178 000	RES 750.0 OHM 1/2W 5%	2.0	
R049,R050	540 0935 000	RES 9.1K OHM 1/4W 5%	2.0	
R052	548 0318 000	RES 1000 OHM 1/4W 1%	1.0	
R053	540 1159 000	RES 100.0K OHM 1/2W 5%	1.0	
R055	548 0318 000	RES 1000 OHM 1/4W 1%	1.0	
R056,R058,R059	540 1159 000	RES 100.0K OHM 1/2W 5%	3.0	
R060,R061	540 1151 000	RES 10.0 OHM 1/2W 5%	2.0	
R062,R063	540 1178 000	RES 750.0 OHM 1/2W 5%	2.0	
R066,R067	540 0580 000	RES 51.0 OHM 2W 5%	2.0	
R094,R095	540 1342 000	RES NETWORK 10K OHM	2.0	
R096	540 0942 000	RES 18.0K OHM 1/4W 5%	1.0	
R097	540 0953 000	RES 51.0K OHM 1/4W 5%	1.0	
R098	550 0962 000	POT 200K OHM 1/2W 10%	1.0	
R099	540 0914 000	RES 1.2K OHM 1/4W 5%	1.0	
R100	540 1114 000	RES 4.7K OHM 1/2W 5%	1.0	
R101	540 1116 000	RES 1.0K OHM 1/2W 5%	1.0	
R102	540 1112 000	RES 510.0 OHM 1/2W 5%	1.0	
S001	604 0904 000	SWITCH, SPDT TOGGLE	1.0	
U001,U002	382 0552 000	IC TL074CN3	2.0	
U003	382 0718 000	IC AD7525KN	1.0	
U004	382 0588 000	IC 4013	1.0	
U005	382 0664 000	IC SD5000N	1.0	
U006	382 0237 000	IC 3045	1.0	
U007,U008	382 0357 000	IC CA3100T	2.0	
U009,U010	382 0617 000	IC LM319	2.0	
U011	700 0868 000	CRYSTAL OSC, 240KHZ CMOS	1.0	
U012	382 0460 000	IC 308A	1.0	
U013	382 0359 000	IC 7815	1.0	
U014	382 0360 000	IC 7915	1.0	
XR018,XU001 XU002,XU006 XU009,XU010	404 0674 000	SOCKET, IC 14 CONT	6.0	

Table 7-24. PDM GEN BOARD - 992 5878 002 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
	402 0129 000	CLIP FUSE	4	
#U007,#U008	404 0250 000	HEAT SINK, FOR TO-5 CASE	2	
#U013,#U014	404 0513 000	HEAT SINK PA1-1CB	2	
#U014	410 0335 000	INSULATOR, SCREW	1	
#U014	410 0344 000	INSULATOR, KAPTON	1	

WARNING: Disconnect primary power prior to servicing.

Table 7-25. SWITCH BOARD - 992 5883 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
J1	610 0825 000	HEADER, 20 PIN PC RIBBON	1.0	
S1,S2,S3,S4,S5	598 0394 000	SWITCH BASE SPST-NO		
S6			6.0	

WARNING: Disconnect primary power prior to servicing.

Table 7-26. DIR. COUPLER BOARD - 992 5884 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
CR001,CR002	384 0612 000	DIODE 1N3070	2.0	
C001	516 0413 000	CAP 10 PF 7.5KV 10%	1.0	
C2	500 0771 000	CAP TRIMMER 50-380PF	1.0	
C003,C004	500 0761 000	CAP, MICA 150PF 500V 5%	2.0	
C005,C006	500 0787 000	CAP 200PF 500V 5%	2.0	
C007,C008	500 0761 000	CAP, MICA 150PF 500V 5%	2.0	
C9	500 0771 000	CAP TRIMMER 50-380PF	1.0	
C010	516 0413 000	CAP 10 PF 7.5KV 10%	1.0	
C011	000 0000 003	FREQUENCY DETERMINED PART	1.0	
C012,C013	500 0903 000	CAP 2700PF 500V 5%	2.0	
E1	000 0000 002	APPEARS ON HIGHER LEVEL	1.0	
J1	610 0830 000	HEADER, 10 PIN PC RIBBON	1.0	
J4	620 1677 000	RECEPTACLE PANEL BNC	1.0	
L001,L002	494 0198 000	CHOKE RF 10MH	2.0	
P2,P3	610 0679 000	PLUG, SHORTING	2.0	
R001,R002	540 1183 000	RES 5.6K OHM 1/2W 5%	2.0	
R003	540 0589 000	RES 120.0 OHM 2W 5%	1.0	
R004	540 0588 000	RES 110.0 OHM 2W 5%	1.0	
R005,R006	540 0586 000	RES 91.0 OHM 2W 5%	2.0	
R007	540 0588 000	RES 110.0 OHM 2W 5%	1.0	
R008	540 0589 000	RES 120.0 OHM 2W 5%	1.0	
R009,R010	540 0590 000	RES 130.0 OHM 2W 5%	2.0	
T1	929 8305 081	XFMR, OUTPUT TOROID	1.0	

WARNING: Disconnect primary power prior to servicing.

Table 7-27. CUSTOMER INT. BOARD - 992 5890 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
C101F,C102F	508 0404 000	CAP .15UF 100V 10%	2.0	
C103F	500 0878 000	CAP 1500 PF 500V 5%	1.0	
C11A	516 0453 000	CAP .1UF 100V 20%	1.0	
C11F	508 0404 000	CAP .15UF 100V 10%	1.0	
C11K	516 0074 000	CAP, DISC .005UF 1KV 20%	1.0	
C111F,C112F	508 0404 000	CAP .15UF 100V 10%	2.0	
C113F	500 0878 000	CAP 1500 PF 500V 5%	1.0	
C12A	516 0453 000	CAP .1UF 100V 20%	1.0	
C12F	508 0404 000	CAP .15UF 100V 10%	1.0	
C12K	516 0074 000	CAP, DISC .005UF 1KV 20%	1.0	
C121F,C122F	508 0404 000	CAP .15UF 100V 10%	2.0	
C123F,C13F	500 0878 000	CAP 1500 PF 500V 5%	2.0	
C13K	516 0074 000	CAP, DISC .005UF 1KV 20%	1.0	
C131F,C132F	508 0404 000	CAP .15UF 100V 10%	2.0	
C133F	500 0878 000	CAP 1500 PF 500V 5%	1.0	
C14K	516 0074 000	CAP, DISC .005UF 1KV 20%	1.0	
C21A	516 0453 000	CAP .1UF 100V 20%	1.0	
C21F	508 0404 000	CAP .15UF 100V 10%	1.0	
C22A	516 0453 000	CAP .1UF 100V 20%	1.0	
C22F	508 0404 000	CAP .15UF 100V 10%	1.0	
C23F	500 0878 000	CAP 1500 PF 500V 5%	1.0	
C31A	516 0453 000	CAP .1UF 100V 20%	1.0	
C31F	508 0404 000	CAP .15UF 100V 10%	1.0	
C32A	516 0453 000	CAP .1UF 100V 20%	1.0	
C32F	508 0404 000	CAP .15UF 100V 10%	1.0	
C33F	500 0878 000	CAP 1500 PF 500V 5%	1.0	
C41A	516 0453 000	CAP .1UF 100V 20%	1.0	
C41F	508 0404 000	CAP .15UF 100V 10%	1.0	
C42A	516 0453 000	CAP .1UF 100V 20%	1.0	
C42F	508 0404 000	CAP .15UF 100V 10%	1.0	
C43F	500 0878 000	CAP 1500 PF 500V 5%	1.0	
C51A	516 0453 000	CAP .1UF 100V 20%	1.0	
C51F	508 0404 000	CAP .15UF 100V 10%	1.0	
C52A	516 0453 000	CAP .1UF 100V 20%	1.0	
C52F	508 0404 000	CAP .15UF 100V 10%	1.0	
C53F	500 0878 000	CAP 1500 PF 500V 5%	1.0	
C61F,C62F	508 0404 000	CAP .15UF 100V 10%	2.0	
C63F	500 0878 000	CAP 1500 PF 500V 5%	1.0	
C71F,C72F	508 0404 000	CAP .15UF 100V 10%	2.0	
C73F	500 0878 000	CAP 1500 PF 500V 5%	1.0	
C81F,C82F	508 0404 000	CAP .15UF 100V 10%	2.0	
C83F	500 0878 000	CAP 1500 PF 500V 5%	1.0	
C91F,C92F	508 0404 000	CAP .15UF 100V 10%	2.0	
C93F	500 0878 000	CAP 1500 PF 500V 5%	1.0	
J1	610 0828 000	HEADER, 26 PIN PC RIBBON	1.0	
J2	610 0827 000	HEADER, 20 PIN PC RIBBON	1.0	
J3	610 0840 000	CONN., 4 PIN PC MTG	1.0	
L101F	494 0438 000	CHOKE, R.F. MOLDED 33 UHY	1.0	

WARNING: Disconnect primary power prior to servicing.

Table 7-27. CUSTOMER INT. BOARD - 992 5890 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
L102F	494 0218 000	CHOKE WIDE BAND	1.0	
L11F	494 0438 000	CHOKE, R.F. MOLDED 33 UHY	1.0	
L11K	494 0419 000	CHOKE RF 1000.0UH	1.0	
L111F	494 0438 000	CHOKE, R.F. MOLDED 33 UHY	1.0	
L112F,L12F	494 0218 000	CHOKE WIDE BAND	2.0	
L12K	494 0419 000	CHOKE RF 1000.0UH	1.0	
L121F	494 0438 000	CHOKE, R.F. MOLDED 33 UHY	1.0	
L122F	494 0218 000	CHOKE WIDE BAND	1.0	
L131F	494 0438 000	CHOKE, R.F. MOLDED 33 UHY	1.0	
L132F	494 0218 000	CHOKE WIDE BAND	1.0	
L21F	494 0438 000	CHOKE, R.F. MOLDED 33 UHY	1.0	
L22F	494 0218 000	CHOKE WIDE BAND	1.0	
L31F	494 0438 000	CHOKE, R.F. MOLDED 33 UHY	1.0	
L32F	494 0218 000	CHOKE WIDE BAND	1.0	
L41F	494 0438 000	CHOKE, R.F. MOLDED 33 UHY	1.0	
L42F	494 0218 000	CHOKE WIDE BAND	1.0	
L51F	494 0438 000	CHOKE, R.F. MOLDED 33 UHY	1.0	
L52F	494 0218 000	CHOKE WIDE BAND	1.0	
L61F	494 0438 000	CHOKE, R.F. MOLDED 33 UHY	1.0	
L62F	494 0218 000	CHOKE WIDE BAND	1.0	
L71F	494 0438 000	CHOKE, R.F. MOLDED 33 UHY	1.0	
L72F	494 0218 000	CHOKE WIDE BAND	1.0	
L81F	494 0438 000	CHOKE, R.F. MOLDED 33 UHY	1.0	
L82F	494 0218 000	CHOKE WIDE BAND	1.0	
L91F	494 0438 000	CHOKE, R.F. MOLDED 33 UHY	1.0	
L92F	494 0218 000	CHOKE WIDE BAND	1.0	
R11A	540 1204 000	RES 91.0 OHM 1/2W 5%	1.0	
R11K	540 1103 000	RES 110.0 OHM 1/2W 5%	1.0	
R12A	540 1204 000	RES 91.0 OHM 1/2W 5%	1.0	
R12K	540 1103 000	RES 110.0 OHM 1/2W 5%	1.0	
R13A	540 1204 000	RES 91.0 OHM 1/2W 5%	1.0	
R13K	540 1103 000	RES 110.0 OHM 1/2W 5%	1.0	
R14A	540 1204 000	RES 91.0 OHM 1/2W 5%	1.0	
R14K	540 1103 000	RES 110.0 OHM 1/2W 5%	1.0	
R15K	540 1181 000	RES 680.0 OHM 1/2W 5%	1.0	
R21A,R22A,R23A R24A,R31A,R32A R33A,R34A,R41A R42A,R43A,R44A R51A,R52A,R53A R54A	540 1204 000	RES 91.0 OHM 1/2W 5%	16.0	
TB1,TB2	614 0731 000	TERM BOARD, PC MT 20 TERM	2.0	

WARNING: Disconnect primary power prior to servicing.

Table 7-28. RFI BOARD - 992 5886 003

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
CR011E	384 0205 000	DIODE SILICON 1N914	1.0	
CR022,CR023	384 0431 000	RECT. 1N4001	2.0	
C011B	516 0453 000	CAP .1UF 100V 20%	1.0	
C011C	526 0342 000	CAP 2.7UF 35V 10%	1.0	
C011D	516 0081 000	CAP, DISC .01UF 1KV 20%	1.0	
C011E	506 0246 000	CAP .47UF 63V 5%	1.0	
C011F	508 0404 000	CAP .15UF 100V 10%	1.0	
C011H,C011J	508 0416 000	CAP .068 UF 50V 5%	2.0	
C011M	506 0246 000	CAP .47UF 63V 5%	1.0	
C012F	508 0404 000	CAP .15UF 100V 10%	1.0	
C012H,C012J	516 0453 000	CAP .1UF 100V 20%	2.0	
C013F,C013H	500 0878 000	CAP 1500 PF 500V 5%	2.0	
C021B	516 0453 000	CAP .1UF 100V 20%	1.0	
C021C	526 0342 000	CAP 2.7UF 35V 10%	1.0	
C021D	516 0081 000	CAP, DISC .01UF 1KV 20%	1.0	
C021F	508 0404 000	CAP .15UF 100V 10%	1.0	
C021H	508 0378 000	CAP .22 UF 100V 10%	1.0	
C021J	508 0416 000	CAP .068 UF 50V 5%	1.0	
C022F	508 0404 000	CAP .15UF 100V 10%	1.0	
C022H,C022J	516 0453 000	CAP .1UF 100V 20%	2.0	
C023F,C023H	500 0878 000	CAP 1500 PF 500V 5%	2.0	
C031B	516 0453 000	CAP .1UF 100V 20%	1.0	
C031C	526 0342 000	CAP 2.7UF 35V 10%	1.0	
C031D	516 0081 000	CAP, DISC .01UF 1KV 20%	1.0	
C031H	506 0246 000	CAP .47UF 63V 5%	1.0	
C031J	508 0416 000	CAP .068 UF 50V 5%	1.0	
C032H,C032J	516 0453 000	CAP .1UF 100V 20%	2.0	
C033H	508 0378 000	CAP .22 UF 100V 10%	1.0	
C033J	522 0391 000	CAP 1000UF 16V	1.0	
C040,C041	500 0854 000	CAP 210-1000PF	2.0	
C041B	516 0453 000	CAP .1UF 100V 20%	1.0	
C041C	526 0342 000	CAP 2.7UF 35V 10%	1.0	
C041D	516 0081 000	CAP, DISC .01UF 1KV 20%	1.0	
C042,C043	500 0854 000	CAP 210-1000PF	2.0	
C044	500 0844 000	CAP, MICA 1000PF 100V 5%	1.0	
C045	500 0845 000	CAP, MICA 2000PF 500V 5%	1.0	
C046	500 0888 000	CAP 3900PF 500V 5%	1.0	
C047	500 1187 000	CAP 8200PF 100V 5%	1.0	
C048	500 0844 000	CAP, MICA 1000PF 100V 5%	1.0	
C049	500 0845 000	CAP, MICA 2000PF 500V 5%	1.0	
C050	500 0888 000	CAP 3900PF 500V 5%	1.0	
C051	500 1187 000	CAP 8200PF 100V 5%	1.0	
C051B	516 0453 000	CAP .1UF 100V 20%	1.0	
C051C	526 0342 000	CAP 2.7UF 35V 10%	1.0	
C051D	516 0081 000	CAP, DISC .01UF 1KV 20%	1.0	
C052	500 0844 000	CAP, MICA 1000PF 100V 5%	1.0	
C053	500 0845 000	CAP, MICA 2000PF 500V 5%	1.0	
C054	500 0888 000	CAP 3900PF 500V 5%	1.0	

WARNING: Disconnect primary power prior to servicing.

Table 7-28. RFI BOARD - 992 5886 003 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
C055	500 1187 000	CAP 8200PF 100V 5%	1.0	
C061B	516 0453 000	CAP .1UF 100V 20%	1.0	
C061C	526 0342 000	CAP 2.7UF 35V 10%	1.0	
C061D	516 0081 000	CAP, DISC .01UF 1KV 20%	1.0	
C071B	516 0453 000	CAP .1UF 100V 20%	1.0	
C071D	516 0081 000	CAP, DISC .01UF 1KV 20%	1.0	
C081B	516 0453 000	CAP .1UF 100V 20%	1.0	
C081D	516 0081 000	CAP, DISC .01UF 1KV 20%	1.0	
C091B	516 0453 000	CAP .1UF 100V 20%	1.0	
C091D	516 0081 000	CAP, DISC .01UF 1KV 20%	1.0	
C101B,C111B	516 0453 000	CAP .1UF 100V 20%	2.0	
C111D	516 0081 000	CAP, DISC .01UF 1KV 20%	1.0	
C121B	516 0453 000	CAP .1UF 100V 20%	1.0	
C121D	516 0081 000	CAP, DISC .01UF 1KV 20%	1.0	
C131B	516 0453 000	CAP .1UF 100V 20%	1.0	
C131D	516 0081 000	CAP, DISC .01UF 1KV 20%	1.0	
C141B	516 0453 000	CAP .1UF 100V 20%	1.0	
C141D	516 0081 000	CAP, DISC .01UF 1KV 20%	1.0	
C151B	516 0453 000	CAP .1UF 100V 20%	1.0	
C151D	516 0081 000	CAP, DISC .01UF 1KV 20%	1.0	
C161B,C171B C181B,C191B C201B,C211B C221B,C231B C241B,C251B C261B,C271B C281B,C291B	516 0453 000	CAP .1UF 100V 20%	14.0	
J001,J002,J003 J004,J005,J006	610 0827 000	HEADER, 20 PIN PC RIBBON	6.0	
J007,J008,J009	610 0828 000	HEADER, 26 PIN PC RIBBON	3.0	
J010,J011	610 0827 000	HEADER, 20 PIN PC RIBBON	2.0	
J012,J013,J014	610 0831 000	CONN 8 PIN PC MT	3.0	
J015,J016	620 1677 000	RECEPTACLE, PC MT, BNC	2.0	
K001,K002	578 0021 000	RELAY DPDT	2.0	
L011F	494 0438 000	CHOKE, R.F. MOLDED 33 UHY	1.0	
L011H	494 0189 000	CHOKE RF 82 UH	1.0	
L011J	494 0441 000	CHOKE, RF PWR 82UH 4.8A	1.0	
L012F	494 0218 000	CHOKE WIDE BAND	1.0	
L012H	494 0405 000	CHOKE RF 56.0UH	1.0	
L012J	494 0440 000	CHOKE, RF PWR 56UH 5.5A	1.0	
L013H	494 0218 000	CHOKE WIDE BAND	1.0	
L021F	494 0438 000	CHOKE, R.F. MOLDED 33 UHY	1.0	
L021H	494 0384 000	CHOKE, RF 1.00 UH	1.0	
L021J	494 0441 000	CHOKE, RF PWR 82UH 4.8A	1.0	
L022F	494 0218 000	CHOKE WIDE BAND	1.0	
L022H	494 0384 000	CHOKE, RF 1.00 UH	1.0	
L022J	494 0440 000	CHOKE, RF PWR 56UH 5.5A	1.0	
L023H	494 0218 000	CHOKE WIDE BAND	1.0	
L031H	494 0189 000	CHOKE RF 82 UH	1.0	

Table 7-28. RFI BOARD - 992 5886 003 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
L031J	494 0441 000	CHOKE, RF PWR 82UH 4.8A	1.0	
L032H	494 0405 000	CHOKE RF 56.0UH	1.0	
L032J	494 0440 000	CHOKE, RF PWR 56UH 5.5A	1.0	
L033H	494 0218 000	CHOKE WIDE BAND	1.0	
R001,R002,R003	540 1390 000	RES NETWORK 6800 OHM	3.0	
R004	546 0295 000	RES 50 OHM 3.25W 5%	1.0	
R011B	540 1112 000	RES 510.0 OHM 1/2W 5%	1.0	
R011C	540 0844 000	RES 6.2 OHM 1/2W 5%	1.0	
R011D	540 1112 000	RES 510.0 OHM 1/2W 5%	1.0	
R011E	540 1202 000	RES 51.0K OHM 1/2W 5%	1.0	
R011M	540 1111 000	RES 10.0K OHM 1/2W 5%	1.0	
R012B	540 1112 000	RES 510.0 OHM 1/2W 5%	1.0	
R012C	540 0844 000	RES 6.2 OHM 1/2W 5%	1.0	
R012D	540 1112 000	RES 510.0 OHM 1/2W 5%	1.0	
R012E	540 1159 000	RES 100.0K OHM 1/2W 5%	1.0	
R012M	540 1112 000	RES 510.0 OHM 1/2W 5%	1.0	
R013E	546 0295 000	RES 50 OHM 3.25W 5%	1.0	
R021B	540 1112 000	RES 510.0 OHM 1/2W 5%	1.0	
R021C	540 0844 000	RES 6.2 OHM 1/2W 5%	1.0	
R021D,R022B	540 1112 000	RES 510.0 OHM 1/2W 5%	2.0	
R022C	540 0844 000	RES 6.2 OHM 1/2W 5%	1.0	
R022D,R031B	540 1112 000	RES 510.0 OHM 1/2W 5%	2.0	
R031C	540 0844 000	RES 6.2 OHM 1/2W 5%	1.0	
R031D,R032B	540 1112 000	RES 510.0 OHM 1/2W 5%	2.0	
R032C	540 0844 000	RES 6.2 OHM 1/2W 5%	1.0	
R032D,R041B	540 1112 000	RES 510.0 OHM 1/2W 5%	2.0	
R041C	540 0844 000	RES 6.2 OHM 1/2W 5%	1.0	
R041D,R042B	540 1112 000	RES 510.0 OHM 1/2W 5%	2.0	
R042C	540 0844 000	RES 6.2 OHM 1/2W 5%	1.0	
R042D,R051B	540 1112 000	RES 510.0 OHM 1/2W 5%	2.0	
R051C	540 0844 000	RES 6.2 OHM 1/2W 5%	1.0	
R051D,R052B	540 1112 000	RES 510.0 OHM 1/2W 5%	2.0	
R052C	540 0844 000	RES 6.2 OHM 1/2W 5%	1.0	
R052D,R061B	540 1112 000	RES 510.0 OHM 1/2W 5%	2.0	
R061C	540 0844 000	RES 6.2 OHM 1/2W 5%	1.0	
R061D,R062B	540 1112 000	RES 510.0 OHM 1/2W 5%	2.0	
R062C	540 0844 000	RES 6.2 OHM 1/2W 5%	1.0	
R062D,R071B R071D,R072B R072D,R081B R081D,R082B R082D,R091B R091D,R092B R092D,R101B R102B,R111B	540 1112 000	RES 510.0 OHM 1/2W 5%	16.0	
R111D	540 1151 000	RES 10.0 OHM 1/2W 5%	1.0	
R112B	540 1112 000	RES 510.0 OHM 1/2W 5%	1.0	
R112D	540 1151 000	RES 10.0 OHM 1/2W 5%	1.0	

WARNING: Disconnect primary power prior to servicing.

Table 7-28. RFI BOARD - 992 5886 003 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
R121B,R121D	540 1112 000	RES 510.0 OHM 1/2W 5%		
R122B,R122D				
R131B,R131D				
R132B,R132D				
R141B,R141D				
R142B,R142D				
R151B,R151D				
R152B,R152D				
R161B,R162B				
R171B,R172B				
R181B,R182B				
R191B,R192B				
R201B,R202B				
R211B,R212B				
R221B,R222B				
R231B,R232B				
R241B,R242B				
R251B,R252B				
R261B,R262B			38.0	
R271B,R272B	540 1151 000	RES 10.0 OHM 1/2W 5%	2.0	
R281B,R282B	540 1112 000	RES 510.0 OHM 1/2W 5%		
R291B,R292B			4.0	
S001,S002,S003	604 0885 000	SWITCH, MINI DIP ROCKER	3.0	
#L011J,#L012J	357 0056 000	NUT, HEX 4-40 NYLON WHITE		
#L021J,#L022J				
#L031J,#L032J			6	
#L011J,#L012J	357 0077 000	SCREW, NYLON 4-40 X 1"		
#L021J,#L022J				
#L031J,#L032J			6	
	448 0734 000	CAPTIVE PNL FASTENER 6-32	6	
	839 5695 340	SCHEM, RFI BOARD	0	
	843 3655 202	PC BD, RFI	1	

WARNING: Disconnect primary power prior to servicing.

Table 7-29. 1 KW PDM FILTER BD - 992 5873 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
C11,C12	508 0538 000	CAP .15 UF 400WVDC 5%	2.0	
C13	508 0539 000	CAP 2 UF 400VDC 10%	1.0	
C21,C22	508 0538 000	CAP .15 UF 400WVDC 5%	2.0	
C23	508 0539 000	CAP 2 UF 400VDC 10%	1.0	
C31,C32	508 0538 000	CAP .15 UF 400WVDC 5%	2.0	
C33	508 0539 000	CAP 2 UF 400VDC 10%	1.0	
C41,C42	508 0538 000	CAP .15 UF 400WVDC 5%	2.0	
C43	508 0539 000	CAP 2 UF 400VDC 10%	1.0	
J11,J21,J31,J41	612 0301 000	JACK BANANA BRASS	4.0	
L11	929 8305 086	COIL ASSY (37TURNS)	1.0	
L12	929 8305 085	COIL ASSY, 36 TURN	1.0	
L21	929 8305 086	COIL ASSY (37TURNS)	1.0	
L22	929 8305 085	COIL ASSY, 36 TURN	1.0	
L31	929 8305 086	COIL ASSY (37TURNS)	1.0	
L32	929 8305 085	COIL ASSY, 36 TURN	1.0	
L41	929 8305 086	COIL ASSY (37TURNS)	1.0	
L42	929 8305 085	COIL ASSY, 36 TURN	1.0	
R13,R23,R33,R43	548 0825 000	RES 150K OHM 1/4W 1%	4.0	

WARNING: Disconnect primary power prior to servicing.

Table 7-30. KEYBOARD/DISPLAY BD - 992 5875 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
C1,C2	516 0453 000	CAP .1UF 100V 20%	2.0	
C3,C4,C5,C6	526 0342 000	CAP 2.7UF 35V 10%	4.0	
DS1,DS2,DS3,DS4 DS5,DS6,DS7,DS8 DS9,DS10,DS11 DS12,DS13,DS14 DS15,DS16	382 0380 000	IC TIL-308/745-0008/1706R	16.0	
J1	610 0826 000	HEADER, 26 PIN PC RIBBON	1.0	
R1,R2,R3	540 0912 000	RES 1.0K OHM 1/4W 5%	3.0	
S1	604 0948 000	KEYBOARD 12 POS X-Y	1.0	
U1	382 0094 000	IC 7445	1.0	
U2	382 0563 000	IC 74LS154	1.0	
XDS1,XDS2,XDS3 XDS4,XDS5,XDS6 XDS7,XDS8,XDS9 XDS10,XDS11 XDS12,XDS13 XDS14,XDS15 XDS16	404 0675 000	SOCKET, IC 16 CONT	16.0	
	610 0837 000	JUMPER, FLEX 7-C 2" LG	1.0	

WARNING: Disconnect primary power prior to servicing.

Table 7-31. H. V. FILTER BD - 992 5887 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
C1,C2,C3,C4,C5	524 0341 000	CAP 5100 UF 350WVDC	5.0	
R1,R2,R3,R4,R5	542 0103 000	RES 20000 OHM 10W	5.0	
A19A1F1,A19A1F2 A19A1F3,A19A1F4 A19A1F5,A19A2F1 A19A2F2,A19A2F3 A19A2F4,A19A2F5	398 0433 000	FUSE 1 TIME 6A 250V	10.0	
#C1,#C1A,#C2 #C2A,#C3,#C3A #C4,#C4A,#C5 #C5A	300 1575 000	SCREW 10-32 X 3/8	10.0	
	308 0007 000	10 FLAT WASHER BRASS	10.0	
#C1,#C1A,#C2 #C2A,#C3,#C3A #C4,#C4A,#C5 #C5A	354 0386 000	TERM, LOCKING #10 RING	10.0	

Table 7-32. IPA PWR SPLITTER BD - 992 5889 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
J001,J002	610 0873 000	HEADER KIT, 20 PIN EJECT	2.0	

WARNING: Disconnect primary power prior to servicing.

Table 7-33. PDM PULL-UPBOARD - 992 5872 003

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
CR001,CR002	384 0686 000	DIODE, DSR3400X, 400V PIV	2.0	
CR003,CR004	384 0751 000	DIODE UES1306	2.0	
C001	508 0539 000	CAP 2 UF 400VDC 10%	1.0	
C002	516 0081 000	CAP, DISC .01UF 1KV 20%	1.0	
J001	612 0301 000	JACK BANANA BRASS	1.0	
L001,L002	494 0395 000	CHOKE, 40UH 2 AMP	2.0	
#J001	817 0914 021	SPACER	2	

Table 7-34. CABLE #4, POWER SUPPLY - 929 8305 241

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
	829 8305 241	CABLE #4 ASSY.	0	
	852 8846 041	CABLE LAYOUT	1.0	
	252 0004 000	WIRE STRD 18AWG RED	18.0	FT
	252 0006 000	WIRE STRD 14AWG BLU	9.0	FT
	252 0007 000	WIRE STRD 12AWG BLK	7.2	FT
	252 0210 000	WIRE 8 AWG STRD BLK	30.0	FT
	354 0001 000	TERM LUG RED RING 6	16.0	
	354 0008 000	TERM LUG BLUE RING 6	4.0	
	354 0023 000	TERM LUG YEL RING 6	2.0	
	354 0703 000	TERM, PRESSURE #8 RING	14	
	354 0289 000	LUG .25 RING D71	3.0	
	354 0324 000	LUG 10 RING	2.0	
	354 0010 000	LUG BLUE RING 10	4.0	
	296 0263 000	TUBG SHRINKABLE .375	1.6	FT
	354 0260 000	LUG 6 RING SOLDERLES	2.0	
	817 0914 079	RUNNING LIST, SX-1	1.0	
	354 0311 000	LUG 10 RING	1	

WARNING: Disconnect primary power prior to servicing.

Table 7-35. CABLE #1 SX-1 MAIN - 929 8305 247

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
A01P11	610 0290 000	PLUG, NYLON BANANA WHITE	1.0	
A01P31	610 0292 000	PLUG, NYLON BANANA BLACK	1.0	
A1P3	610 0838 000	PLUG, GIANT BANANA, RED	1.0	
A1P21	610 0291 000	PLUG, NYLON BANANA RED	1.0	
A1P41	610 0298 000	PLUG, NYLON BANANA GREEN	1.0	
A10P11	610 0290 000	PLUG, NYLON BANANA WHITE	1.0	
A10P21	610 0291 000	PLUG, NYLON BANANA RED	1.0	
A10P31	610 0292 000	PLUG, NYLON BANANA BLACK	1.0	
A10P41	610 0298 000	PLUG, NYLON BANANA GREEN	1.0	
A18P4	620 0502 000	PLUG BNC UG-88/U	1.0	
A24P12,A24P14	612 0526 000	RECEPTACLE 8 CKT	2.0	
A24P15	620 0502 000	PLUG BNC UG-88/U	1.0	
A25P2	612 0816 000	CONN 12 CKT	1.0	
A25P3	612 0526 000	RECEPTACLE 8 CKT	1.0	
A5P2	620 0566 000	PLUG, RT ANGLE UG1466/U	1.0	
A5P3	612 0526 000	RECEPTACLE 8 CKT	1.0	
A6P2,A7P2	612 0949 000	HOUSING, CONN 4 PIN	2.0	
A7P5	610 0295 000	PLUG, NYLON BANANA ORANGE	1.0	
A7P6	610 0296 000	PLUG, NYLON BANANA YELLOW	1.0	
P007B,P008B	620 1913 000	PLUG, STRAIGHT BNC CRIMP	2.0	
P2B,P3B,P4B,P5B	620 1914 000	PLUG, STRAIGHT BNC CRIMP	4.0	
A06A1P01	610 0290 000	PLUG, NYLON BANANA WHITE	1.0	
A07A1P01	610 0292 000	PLUG, NYLON BANANA BLACK	1.0	
	252 0003 000	WIRE STRD 20AWG WHT	113.4	FT
	252 0004 000	WIRE STRD 18AWG RED	94.2	FT
	252 0006 000	WIRE STRD 14AWG BLU	45.4	FT
	252 0007 000	WIRE STRD 12AWG BLK	57.4	FT
	252 0008 000	WIRE STRD 10AWG GRY	9.3	FT
	253 0021 000	WIRE 18 STD 1-C SHLD	2.4	FT
	255 0018 000	WIRE, 10AWG 15KV STRD SPC	3.7	FT
	253 0031 000	WIRE 20AWG 2C STRD	2	FT
	296 0253 000	TUBG, SHRINKABLE 3/16	1.6	FT
	296 0260 000	TUBG SHRINKABLE .093	.1	FT
	296 0261 000	TUBG SHRINKABLE .125	.4	FT
	296 0262 000	TUBG SHRINKABLE .25	1.2	FT
	296 0263 000	TUBG SHRINKABLE .375	.3	FT
	354 0001 000	TERM LUG RED RING 6	19	
	354 0002 000	TERM LUG RED RING 8	1	
	354 0003 000	TERM LUG RED RING 10	10	
	354 0004 000	LUG RED RING .25	1.0	
	354 0008 000	TERM LUG BLUE RING 6	4.0	
	354 0010 000	LUG BLUE RING 10	9	
	354 0011 000	LUG BLUE RING .25	3.0	
	354 0323 000	LUG 8 RING SOLDERLES	8	
	354 0134 000	CONNECTOR GND SHEATH	2	
	354 0137 000	CONNECTOR GND SHEATH	2	
	354 0324 000	LUG 10 RING	10	
	354 0338 000	LUG 4 RING RED	6.0	

WARNING: Disconnect primary power prior to servicing.

Table 7-35. CABLE #1 SX-1 MAIN - 929 8305 247 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
	354 0586 000	TERM, SNAP-ON	4.0	
	354 0689 000	TERM, 18-24 AWG CRIMP	36	
	618 0051 000	COAX CABLE RG58C U	9.5	FT
	618 0081 000	COAX CABLE RG187A/U	30.6	FT
	618 0213 000	COAX CABLE RG188A/U	5.2	FT
	817 0914 079	RUNNING LIST, SX-1	1.0	
	852 8846 039	CABLE LAYOUT	1.0	
	829 8305 247	CABLE #1 ASSY, SX-1 MAIN	0	
	354 0615 000	TERM. FOR 22-26 AWG CRIMP	4	
	354 0023 000	TERM LUG YEL RING 6	6	
	354 0311 000	LUG 10 RING	1	

WARNING: Disconnect primary power prior to servicing.

Table 7-36. CABLE #6, CONTROL DRAWER - 929 8305 423

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
A12P13,A12P14	612 0949 000	HOUSING, CONN 4 PIN	2.0	
A12P15	620 0566 000	PLUG, RT ANGLE UG1466/U	1.0	
A13P3,A14P3	612 0949 000	HOUSING, CONN 4 PIN	2.0	
A15P1	612 0816 000	CONN 12 CKT	1.0	
A15P4,A16P2	612 0526 000	RECEPTACLE 8 CKT	2.0	
A22P3	612 0949 000	HOUSING, CONN 4 PIN	1.0	
A24P13	612 0526 000	RECEPTACLE 8 CKT	1.0	
P16P4,P2A,P3A	620 1914 000	PLUG, STRAIGHT BNC CRIMP		
P4A,P5A,P6A			6.0	
P7A,P8A	620 1913 000	PLUG, STRAIGHT BNC CRIMP	2.0	
A27A1P3	620 0566 000	PLUG, RT ANGLE UG1466/U	1.0	
	252 0003 000	WIRE STRD 20AWG WHT	71.5	FT
	618 0213 000	COAX CABLE RG188A/U	15.8	FT
	354 0689 000	TERM, 18-24 AWG CRIMP	39	
	296 0265 000	TUBG SHRINKABLE 1/16	.5	FT
	296 0253 000	TUBG, SHRINKABLE 3/16	1.9	FT
	618 0081 000	COAX CABLE RG187A/U	29.7	FT
	253 0059 000	CABLE, AUD 2C 22AWG	6.4	FT
	296 0262 000	TUBG SHRINKABLE .25	.5	FT
	296 0263 000	TUBG SHRINKABLE .375	.2	FT
	852 8846 037	CABLE LAYOUT	1.0	
	829 8305 423	CABLE #6 ASSY, CNTR DVR	0	
	354 0615 000	TERM. FOR 22-26 AWG CRIMP	6	

WARNING: Disconnect primary power prior to servicing.

Table 7-37. CABLE #3, HV FILTER - 929 8305 425

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
	829 8305 425	CABLE #3 HV FILTER	0	
	252 0008 000	WIRE STRD 10AWG GRY	17.5	FT
	354 0023 000	TERM LUG YEL RING 6	2.0	
	839 5695 215	CABLE #3 LAYOUT	1.0	
	354 0324 000	LUG 10 RING	3.0	
	354 0323 000	LUG 8 RING SOLDERLES	1.0	
	817 0914 079	RUNNING LIST, SX-1	1.0	

WARNING: Disconnect primary power prior to servicing.

Table 7-38. CABLE #5, JUMPERS - 929 8305 431

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
A6P5	610 0295 000	PLUG, NYLON BANANA ORANGE	1.0	
A6P6	610 0296 000	PLUG, NYLON BANANA YELLOW	1.0	
A27A1P1,A27A1P2	620 1913 000	PLUG, STRAIGHT BNC CRIMP	2.0	
	829 8305 431	CABLE ASSY.	0	
	252 0374 000	CABLE, WELDING 6AWG 600V	9.7	FT
	252 0210 000	WIRE 8 AWG STRD BLK	3.2	FT
	252 0008 000	WIRE STRD 10AWG GRY	4.1	FT
	252 0007 000	WIRE STRD 12AWG BLK	1.6	FT
	354 0324 000	LUG 10 RING	14.0	
	354 0287 000	LUG 10 RING D36	7	
	354 0292 000	LUG 10 RING	4	
	255 0018 000	WIRE, 10AWG 15KV STRD SPC	1.2	FT
	354 0600 000	LUG 3/8 RING	2.0	
	296 0263 000	TUBG SHRINKABLE .375	1.2	FT
	354 0289 000	LUG .25 RING D71	3	
	354 0311 000	LUG 10 RING	4.0	
	254 0017 000	WIRE ROPE 10AWG	6.2	FT
	296 0019 000	PLASTIC TUBE 4 AWG CLEAR	5.4	FT
	354 0703 000	TERM, PRESSURE #8 RING	6	
	252 0003 000	WIRE STRD 20AWG WHT	2.5	FT
	252 0004 000	WIRE STRD 18AWG RED	2	FT
	354 0001 000	TERM LUG RED RING 6	8	
	354 0003 000	TERM LUG RED RING 10	5	
	296 0253 000	TUBG, SHRINKABLE 3/16	.5	FT
	252 0006 000	WIRE STRD 14AWG BLU	3	FT
	354 0010 000	LUG BLUE RING 10	2	
	354 0009 000	TERM LUG BLUE RING 8	1	
	354 0002 000	TERM LUG RED RING 8	1	
	618 0213 000	COAX CABLE RG188A/U	6.5	FT
	296 0264 000	TUBING SHRINKABLE .5	.2	FT

WARNING: Disconnect primary power prior to servicing.

Table 7-39. AC CONTROLLER BOARD - 992 5880 002

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
CR001,CR002	384 0351 000	RECTIFIER, 2N5756	2.0	
CR003,CR004	384 0719 000	DIODE, 5V ICTE-5	2.0	
CR007	384 0726 000	RECT 1N5822	1.0	
CR008	386 0083 000	ZENER 1N4742A 12V	1.0	
CR009	386 0085 000	ZENER 1N4740A 10V	1.0	
CR010,CR011	384 0431 000	RECT. 1N4001	2.0	
CR012	384 0720 000	DIODE, 15V ICTE-15	1.0	
CR013,CR014	384 0431 000	RECT. 1N4001	2.0	
CR015	384 0720 000	DIODE, 15V ICTE-15	1.0	
C001	526 0309 000	CAP, 22UF 35V 20%	1.0	
C002	516 0419 000	CAP .05 UF 500V	1.0	
C003	516 0375 000	CAP .01UF 50V	1.0	
C004	516 0419 000	CAP .05 UF 500V	1.0	
C005	516 0375 000	CAP .01UF 50V	1.0	
C006	506 0246 000	CAP .47UF 63V 5%	1.0	
C007	500 0759 000	CAP, MICA 100PF 500V 5%	1.0	
C008	500 0831 000	CAP MICA 250UUF 500V	1.0	
C009,C011	526 0108 000	CAP 4.7UF 35V 20%	2.0	
C012,C013,C014	500 0787 000	CAP 200PF 500V 5%		
C015			4.0	
C016,C017	526 0108 000	CAP 4.7UF 35V 20%	2.0	
C018	522 0299 000	CAP 250 UF 50V	1.0	
C019	516 0453 000	CAP .1UF 100V 20%	1.0	
C020	522 0523 000	CAP 470UF 16V	1.0	
C021	508 0540 000	CAP 2UF 100VDC	1.0	
C022	516 0453 000	CAP .1UF 100V 20%	1.0	
C023	506 0239 000	CAP .022UF 63V 5%	1.0	
C024	500 0844 000	CAP, MICA 1000PF 100V 5%	1.0	
C025	516 0453 000	CAP .1UF 100V 20%	1.0	
C026	526 0351 000	CAP 6.8UF 50V 20%	1.0	
C027,C028	516 0453 000	CAP .1UF 100V 20%	2.0	
C029	526 0318 000	CAP 10UF 35V 20%	1.0	
C030	526 0351 000	CAP 6.8UF 50V 20%	1.0	
C031,C032	516 0453 000	CAP .1UF 100V 20%	2.0	
C033	526 0318 000	CAP 10UF 35V 20%	1.0	
C034	516 0435 000	CAP .05UF 100V 20%	1.0	
F001	398 0081 000	FUSE SLO CART 2A 125/250V	1.0	
F004	398 0402 000	FUSE RECTIFIER 2A 250V	1.0	
J001	610 0828 000	HEADER, 26 PIN PC RIBBON	1.0	
J002	610 0832 000	CONN 12 PIN PC MT	1.0	
J003	610 0831 000	CONN 8 PIN PC MT	1.0	
L002	492 0711 000	FILTER COIL 560UH 4.0A	1.0	
Q001	380 0656 000	TRANSISTOR IRF9130	1.0	
Q005	380 0189 000	TRANSISTOR 2N3904	1.0	
R001	540 1102 000	RES 100.0 OHM 1/2W 5%	1.0	
R002	550 0947 000	POT 1K OHM 1/2W 10%	1.0	
R003	550 0959 000	POT 20K OHM 1/2 W 10%	1.0	
R004	540 1102 000	RES 100.0 OHM 1/2W 5%	1.0	

Table 7-39. AC CONTROLLER BOARD - 992 5880 002 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
R005,R006	540 0584 000	RES 75.0 OHM 2W 5%	2.0	
R007,R008	540 1190 000	RES 240.0 OHM 1/2W 5%	2.0	
R009	540 0298 000	RES 39.0 OHM 1W 5%	1.0	
R010,R011	540 1190 000	RES 240.0 OHM 1/2W 5%	2.0	
R012	540 0298 000	RES 39.0 OHM 1W 5%	1.0	
R013	548 0932 000	RES 100K OHM 1/4W 1%	1.0	
R014	548 1361 000	RES 10K OHM 1/4W 1%	1.0	
R015	548 0932 000	RES 100K OHM 1/4W 1%	1.0	
R016	548 1361 000	RES 10K OHM 1/4W 1%	1.0	
R017	548 0932 000	RES 100K OHM 1/4W 1%	1.0	
R018	548 1361 000	RES 10K OHM 1/4W 1%	1.0	
R019	548 0932 000	RES 100K OHM 1/4W 1%	1.0	
R020	548 1361 000	RES 10K OHM 1/4W 1%	1.0	
R021	540 1235 000	RES 120.0K OHM 1/2W 5%	1.0	
R022	550 0959 000	POT 20K OHM 1/2 W 10%	1.0	
R023	550 0962 000	POT 200K OHM 1/2W 10%	1.0	
R024	540 1111 000	RES 10.0K OHM 1/2W 5%	1.0	
R025,R026	540 1189 000	RES 9.1K OHM 1/2W 5%	2.0	
R028,R029	540 1356 000	RES NETWORK 10K OHM 2%	2.0	
R032	540 1201 000	RES 910.0 OHM 1/2W 5%	1.0	
R033	540 1111 000	RES 10.0K OHM 1/2W 5%	1.0	
R034	540 1116 000	RES 1.0K OHM 1/2W 5%	1.0	
R040	540 1111 000	RES 10.0K OHM 1/2W 5%	1.0	
R042,R043	548 0394 000	RES 5110 OHM 1/4W 1%	2.0	
R044	540 1145 000	RES 6.8K OHM 1/2W 5%	1.0	
R045	548 0313 000	RES 4990 OHM 1/4W 1%	1.0	
R046	548 1394 000	RES 3.92K OHM 1/4W	1.0	
R048,R049	540 1105 000	RES 5.1K OHM 1/2W 5%	2.0	
R050	256 0005 000	WIRE, CUPRON 24 AWG	1.0	FT
R054	540 1201 000	RES 910.0 OHM 1/2W 5%	1.0	
U001,U002	382 0719 000	IC LM324AN	2.0	
U003	382 0716 000	IC 289J	1.0	
U004,U005	384 0704 000	TRIAC DRIVER MOC3020	2.0	
U006	382 0722 000	IC 3524	1.0	
U007	382 0360 000	IC 7915	1.0	
U008	382 0359 000	IC 7815	1.0	
XF001A,XF001B	402 0129 000	CLIP FUSE		
XF004A,XF004B			4.0	
XQ001	404 0661 000	SOCKET, TRANSISTOR	1.0	
#U007,#U008	404 0513 000	HEAT SINK PA1-1CB	2	
#Q001	410 0385 000	INSULATOR, TO-3 SILICON	1	
#Q001	829 8305 633	HEATSINK, AC CONT	1	
#U007	410 0335 000	INSULATOR, SCREW	1	
#U007	410 0381 000	INSULATOR .562 X .812	1	

WARNING: Disconnect primary power prior to servicing.

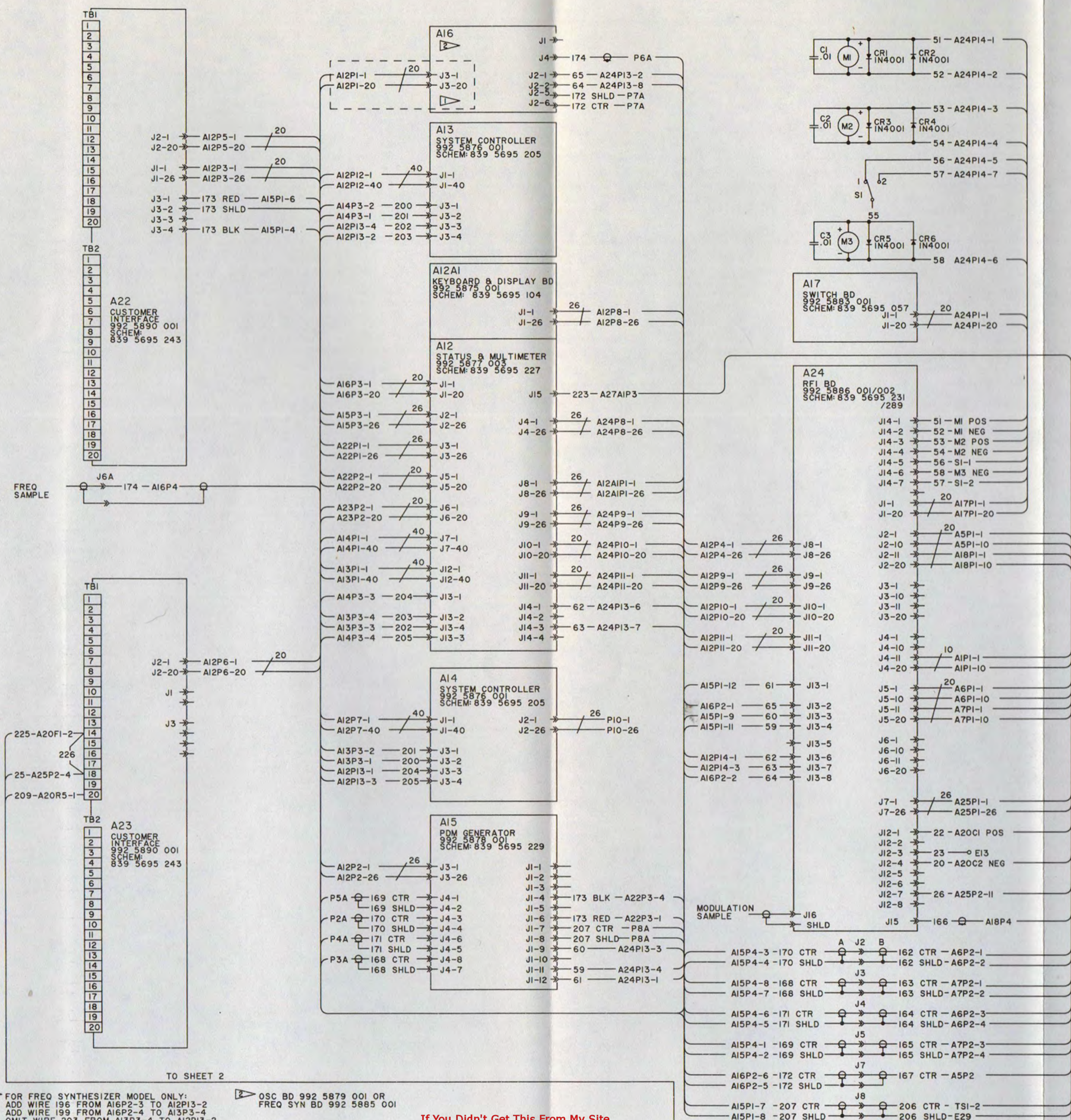
SECTION VIII

MAINTENANCE AIDS

8-1. INTRODUCTION

8-2. This section of the technical manual contains diagrams to aid in the maintenance of the SX-1 AM TRANSMITTER.

WARNING: **Disconnect primary power prior to servicing.**



FOR FREQ SYNTHESIZER MODEL ONLY:
ADD WIRE 196 FROM A16P2-3 TO A12P13-2
ADD WIRE 199 FROM A16P2-4 TO A13P3-4
OMIT WIRE 203 FROM A13P3-4 TO A12P13-2

OSC BD 992 5879 001 OR
FREQ SYN BD 992 5885 001

FIGURE 8-1. WIRING DIAGRAM SX-1
(SHEET 1 OF 2)
839 5695 329

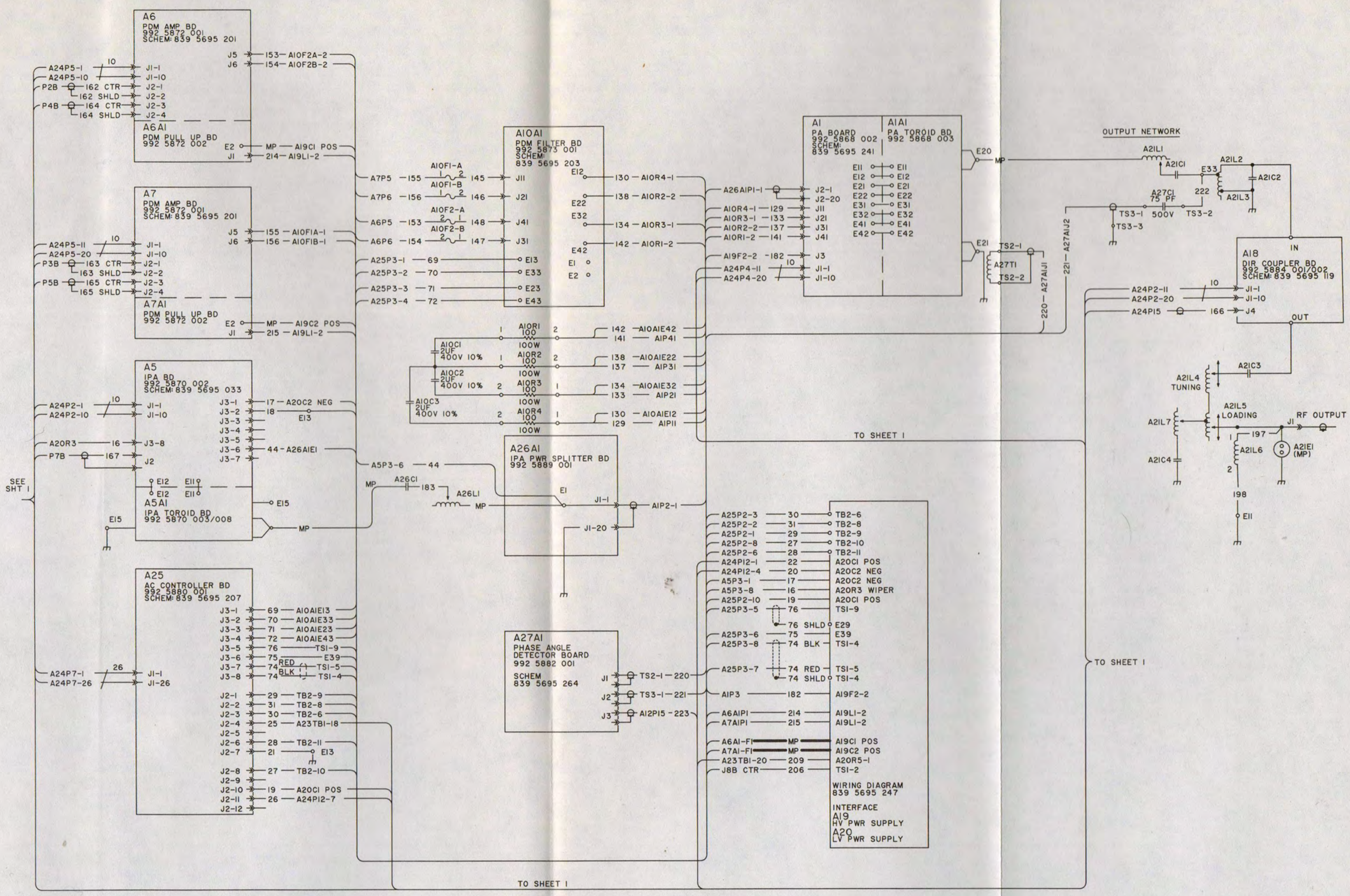


FIGURE 8-1. WIRING DIAGRAM SX-1
(SHEET 2 OF 2)
839 5695 329

G

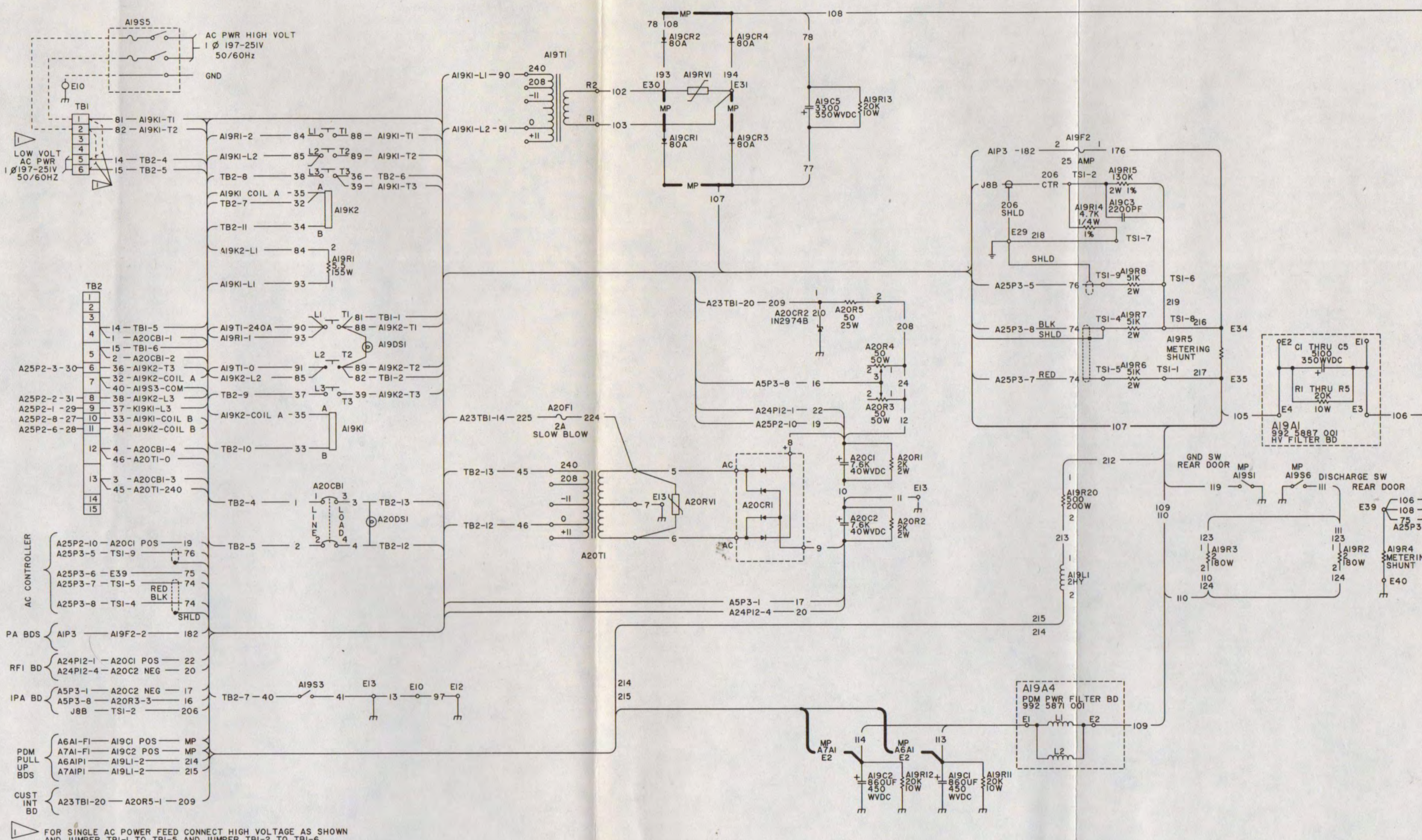
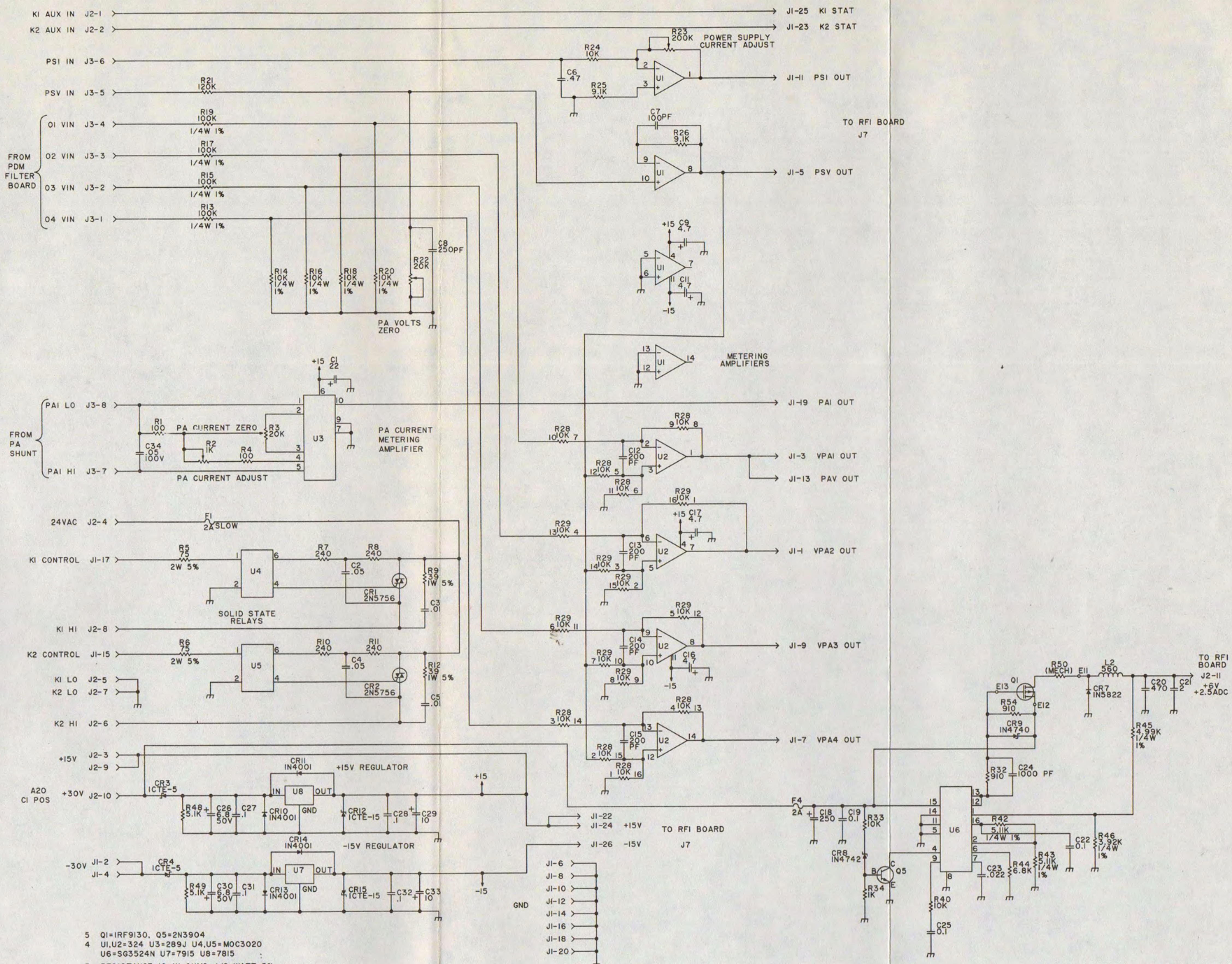


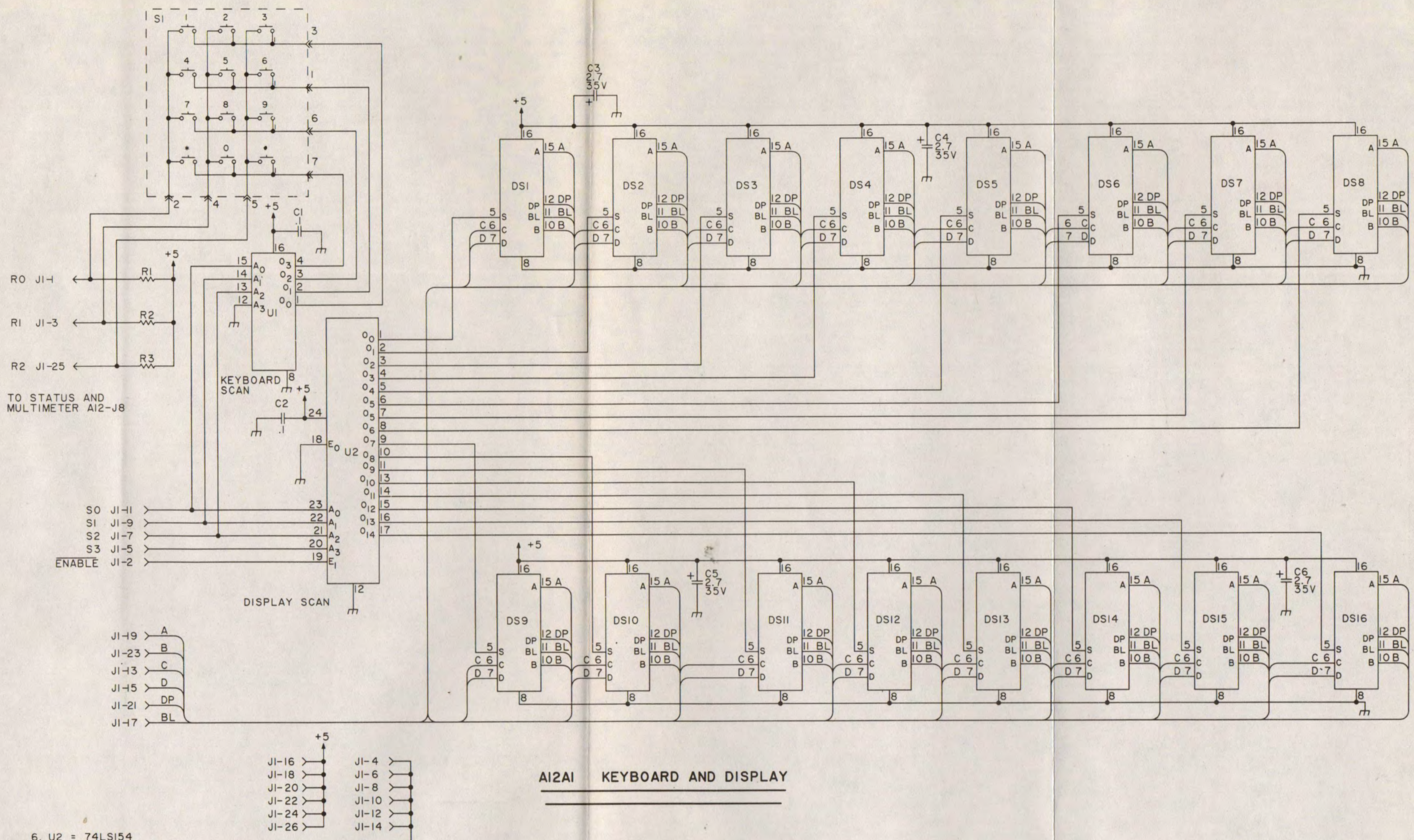
FIGURE 8-2. WIRING DIAGRAM
POWER SUPPLY SX-1
839 5695 247



5 Q1=IRF9130, Q5=2N3904
4 U1,U2=324 U3=289J U4,U5=MOC3020
U6=SG3524N U7=7915 U8=7815
3 RESISTANCE IS IN OHMS, 1/2 WATT 5% UNLESS OTHERWISE NOTED
2 INDUCTANCE IS IN UH
1 CAPACITANCE IS IN UF, UNLESS OTHERWISE NOTED

6. REMOVE ALL POWER BEFORE DISCONNECTING J1 OR J2.

FIGURE 8-3. SCHEMATIC
AC CONTROLLER
839 5695 327



6. U2 = 74LS154
5. U1 = MC7445P
4. DS1 THRU DS16 = TIL-308
3. RESISTORS ARE 1K 1 4 WATT 5%
2. CAPACITANCE IS IN UF
1. RESISTANCE IS IN OHMS
UNLESS OTHERWISE NOTED:

FIGURE 8-4. SCHEMATIC
KEYBOARD/DISPLAY
839 5695 104

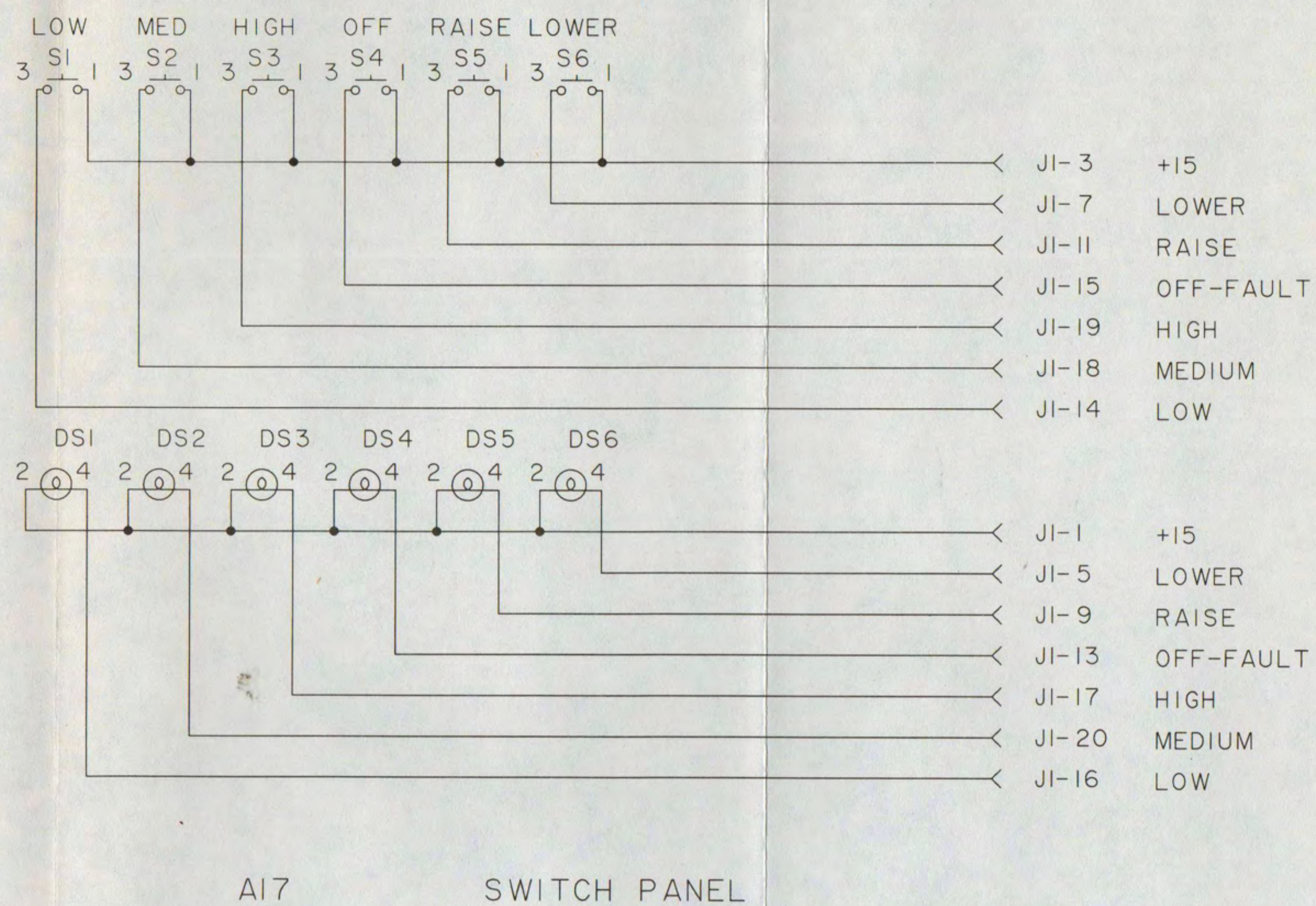
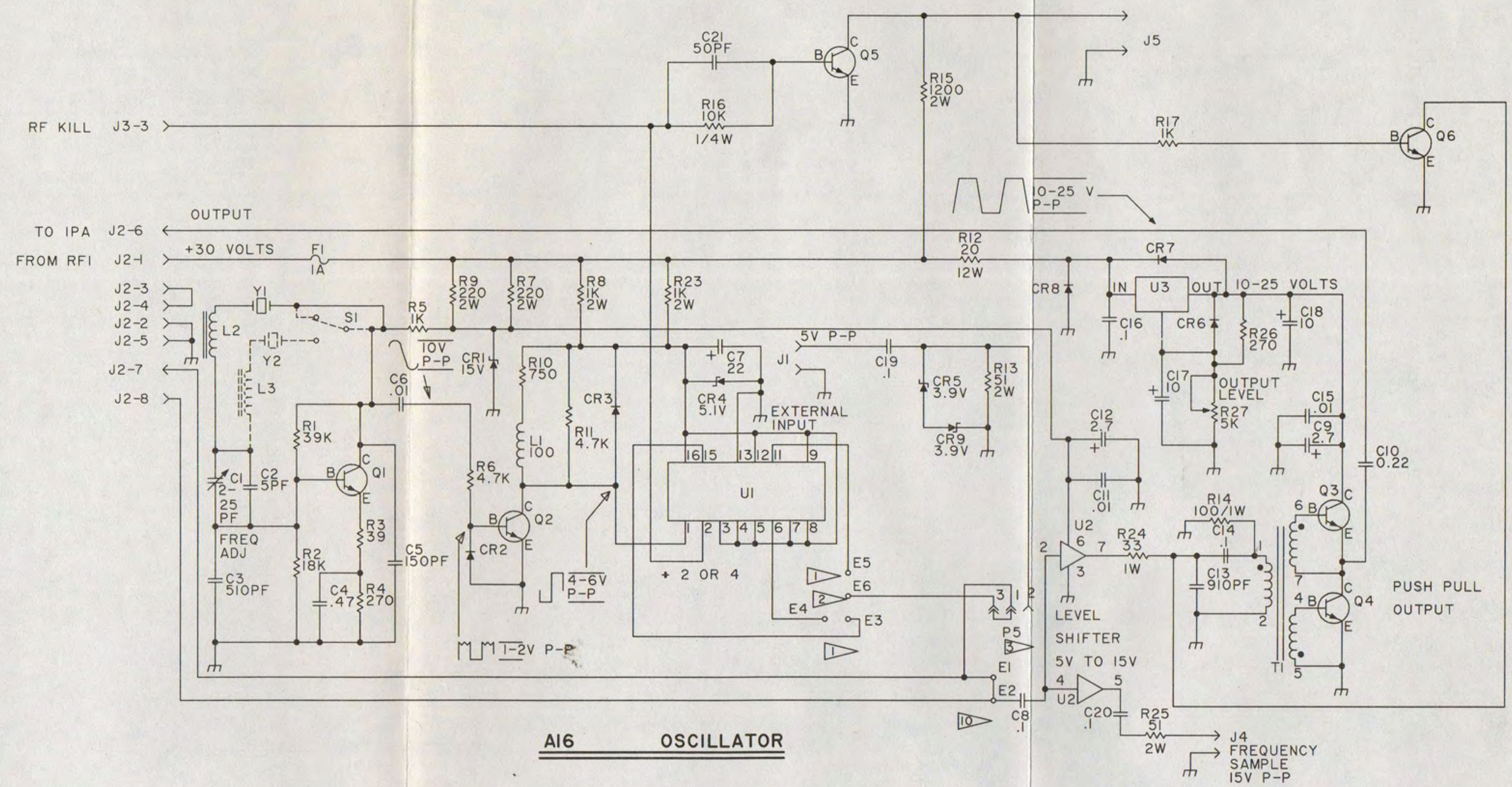


FIGURE 8-5. SCHEMATIC
SWITCH BOARD
839 5695 057



6. INDUCTANCE IS IN UH
5. CAPACITANCE IS IN UF
4. RESISTANCE IS IN OHMS, 1/2 WATT,5%

3 JUMPER 1 TO 3 FOR INTERNAL USE: 1 TO 2 FOR EXTERNAL USE

2 JUMPER E3 TO E6 DIVIDE BY 2

1 JUMPERS E3 & E4, E5 & E6 DIVIDE BY 4

UNLESS OTHERWISE NOTED:

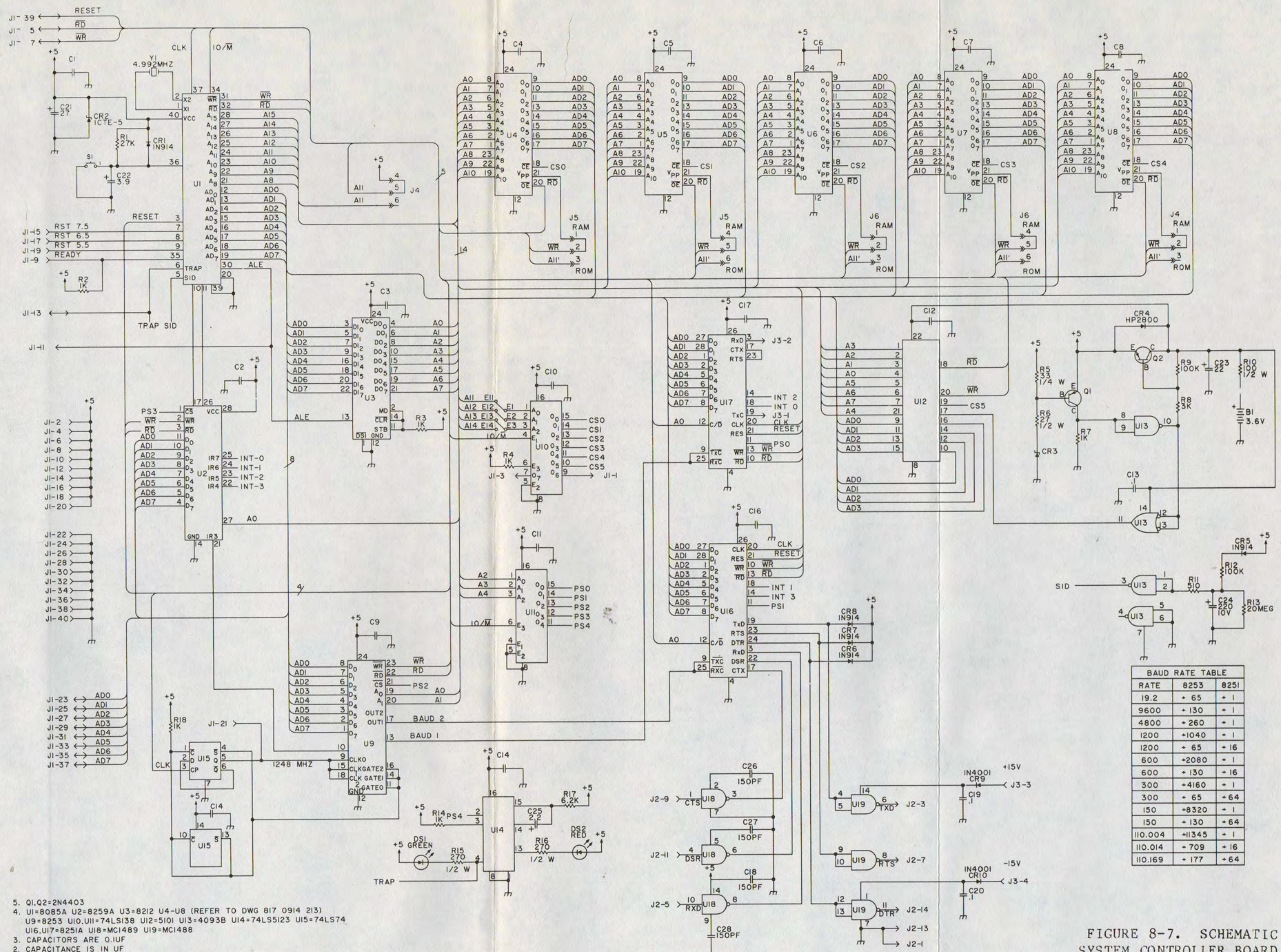
10 JUMPER E1 TO E2

9. Q1,Q2 = 2N2369 Q3,Q4 = MJE200
 Q5 = 2N4401 Q6 = 2N2222A

8. CR1 = 1N4744A CR2,CR3 = 1N914 CR4 = 1N4733A
 CR5,CR9 = 1N4730A CR6,CR7,CR8 = 1N4004

7. U1 = SN7476N U2 = DS0026J-8
 U3 = LM317K

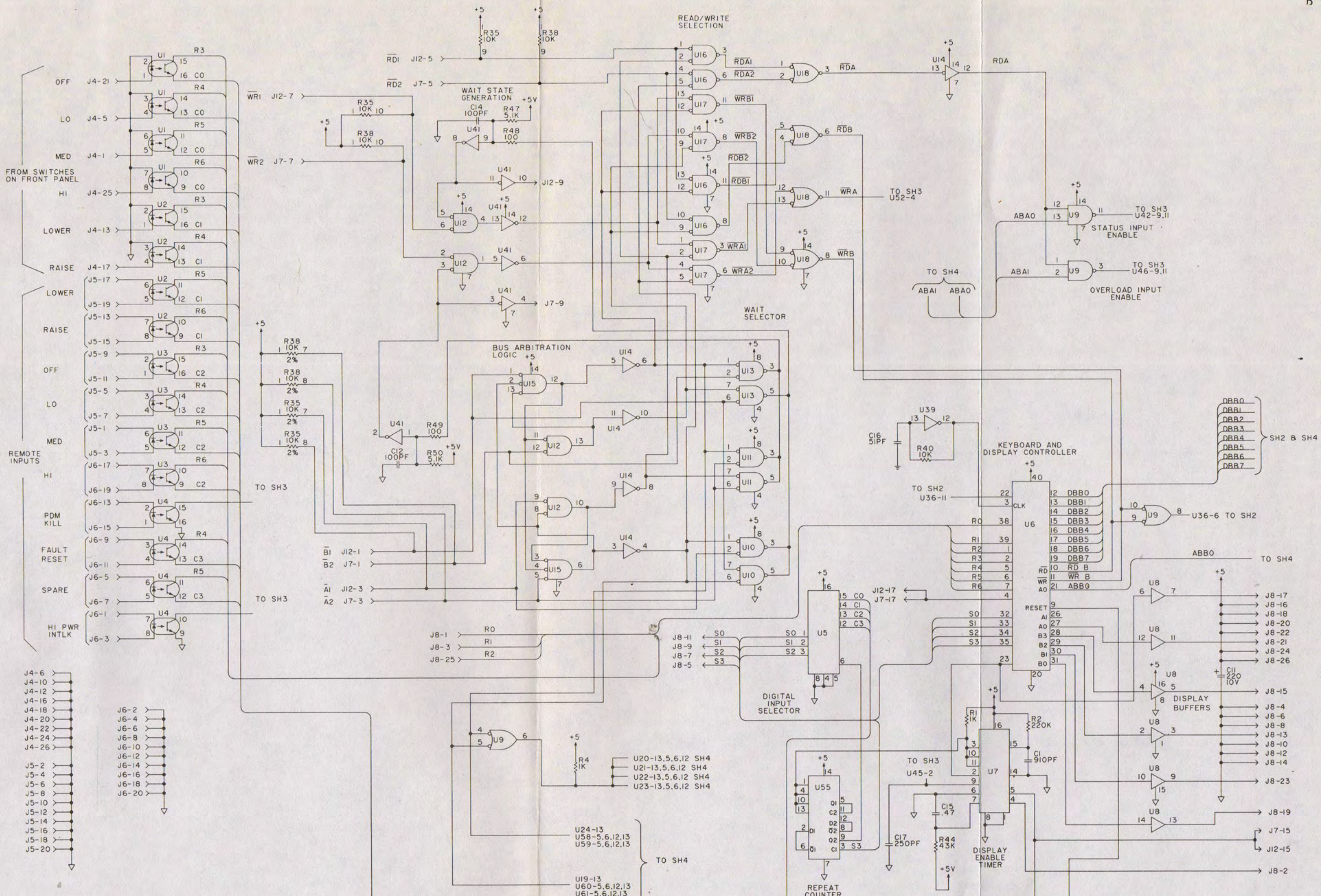
FIGURE 8-6. SCHEMATIC
OSCILLATOR BOARD
839 5695 330



BAUD RATE TABLE		
RATE	8253	8251
19.2	÷ 65	÷ 1
9600	÷ 130	÷ 1
4800	÷ 260	÷ 1
1200	÷1040	÷ 1
1200	÷ 65	÷ 16
600	÷2080	÷ 1
600	÷ 130	÷ 16
300	÷4160	÷ 1
300	÷ 65	÷64
150	÷8320	÷ 1
150	÷ 130	÷64
110.004	÷11345	÷ 1
110.014	÷ 709	÷ 16
110.169	÷ 177	÷64

5. Q1,Q2=2N4403
4. U1=8085A U2=8259A U3=8212 U4-U8 (REFER TO DWG 817 0914 213)
   U9=8253 U10,U11=74LS138 U12=5101 U13=4093B U14=74LS5123 U15=74LS74
   U16,U17=8251A U18=MC1489 U19=MC1488
3. CAPACITORS ARE 0.1UF
2. CAPACITANCE IS IN UF
1. ALL RESISTORS ARE IN OHMS.1 4 WATT,5%
   UNLESS OTHERWISE NOTED

FIGURE 8-7. SCHEMATIC
SYSTEM CONTROLLER BOARD
839 5695 205

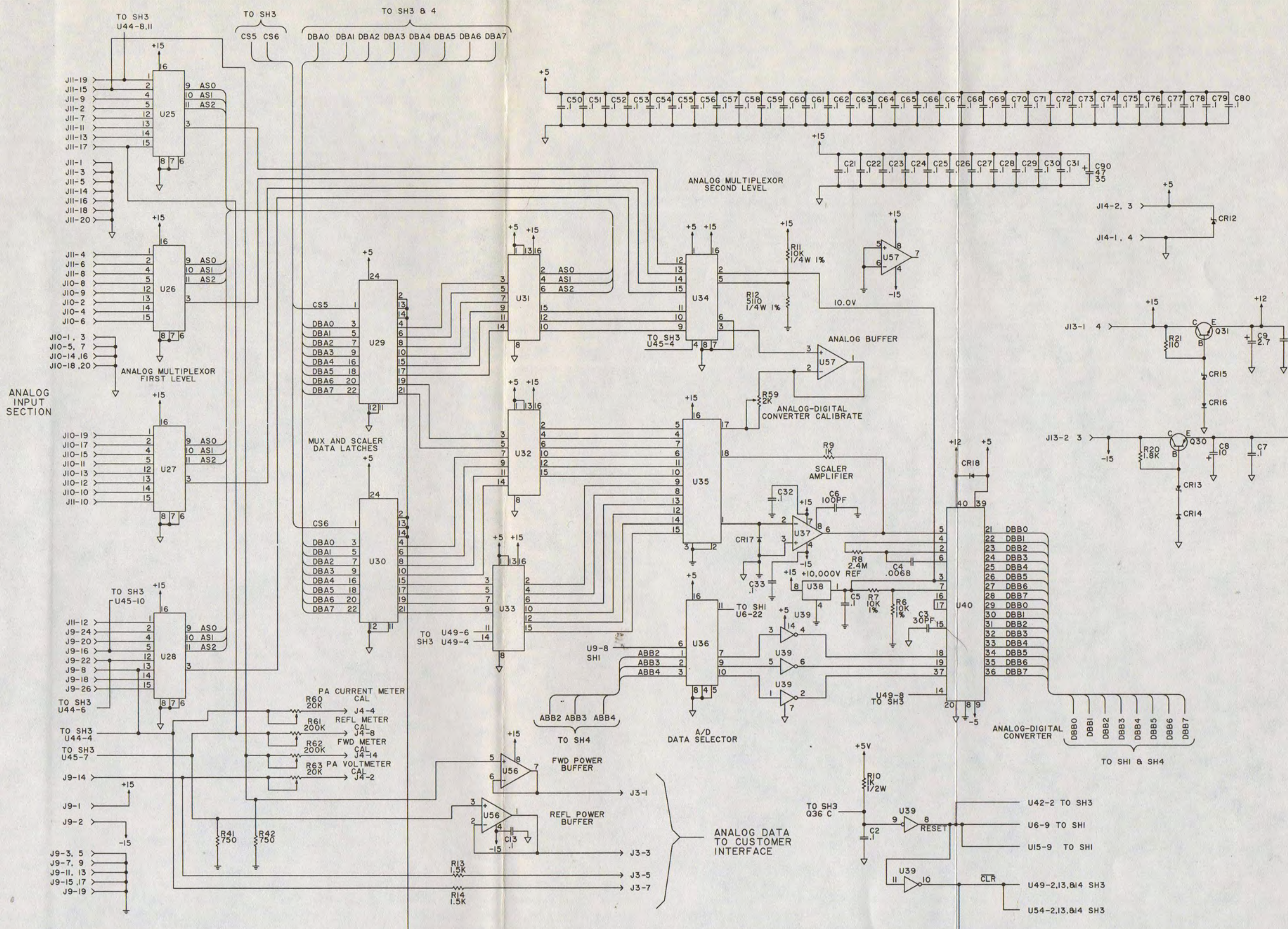


3. U1-U4 = ILQ-74 U5 = 74LS138
U6 = 8279 U7 = 74LS123 U8 = 74LS367N
U9 = 74LS00 U10,U11,U13 = 75453
U12 = 74LS02
U14 = 74LS04N U15 = 74LS27
U16,U17 = 74LS32 U18 = 74LS08
U39 = 74C14 U41 = 74LS14
U55 = 74LS74

2. RESISTORS ARE IN OHMS, 1/4W, 5%
1. CAPACITANCE IN UF
UNLESS OTHERWISE NOTED:

FIGURE 8-8. SCHEMATIC
STATUS/MULTIMETER
(SHEET 1 OF 4)
839 5695 299

B



1. U25-U28,U34 = CD4051BE U29,U30 = 8212
U31-U33 = MC14504BCP U35 = AD7525 U36 = 74LS138
U37 = LM308AH U38 = AD584JH U39 = 74C14
U40 = AD7550BD U56,U57 = LM358

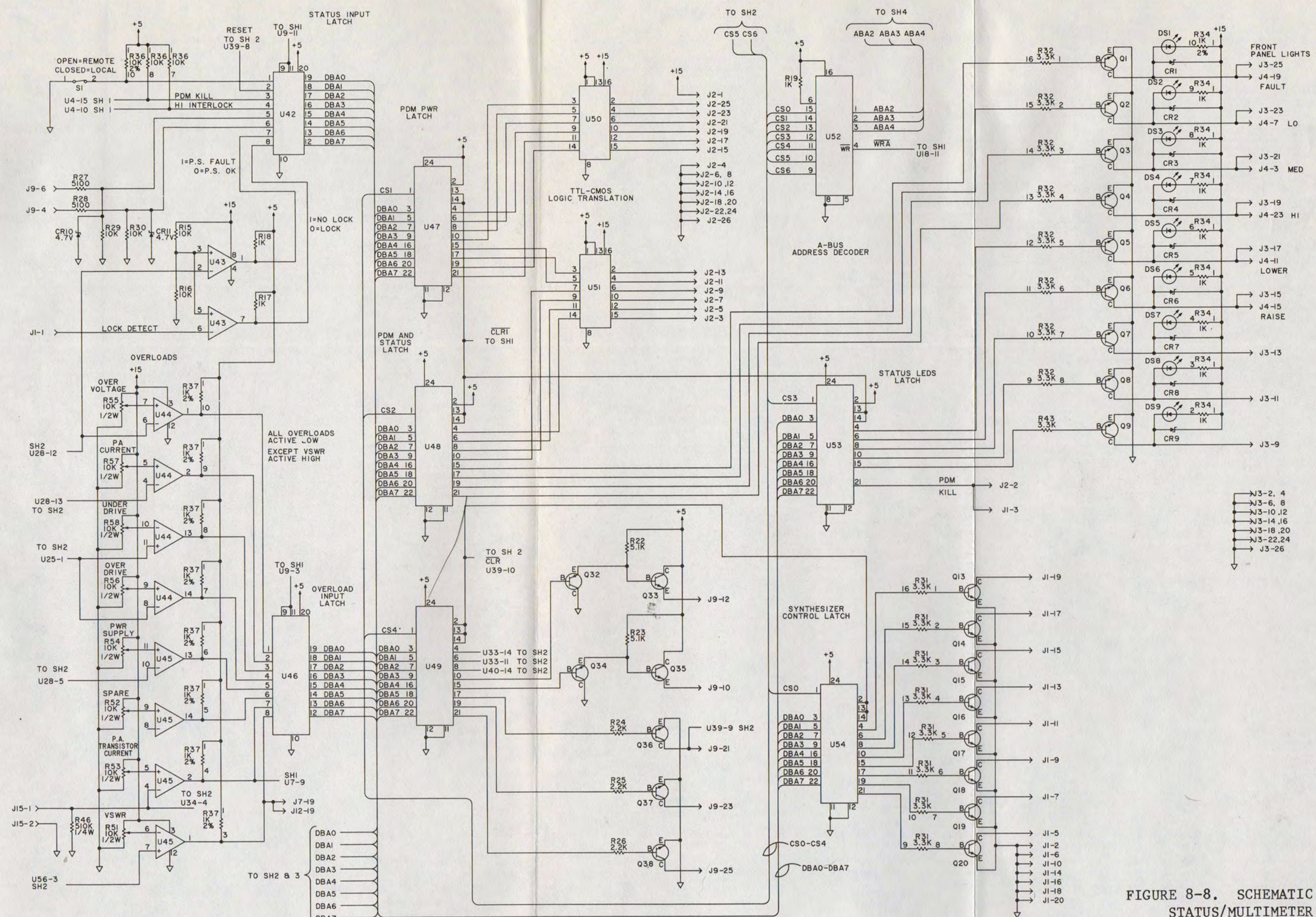
CR12 = ICTE-5
CR13 = IN4733A CR14,CR16 = IN914
CR15 = IN4742
CR17,CR18=HP2800

Q30 = 2N4403 Q31 = 2N4401

STATUS AND MULTIMETER

A12

FIGURE 8-8. SCHEMATIC
STATUS/MULTIMETER
(SHEET 2 OF 4)
839 5695 299



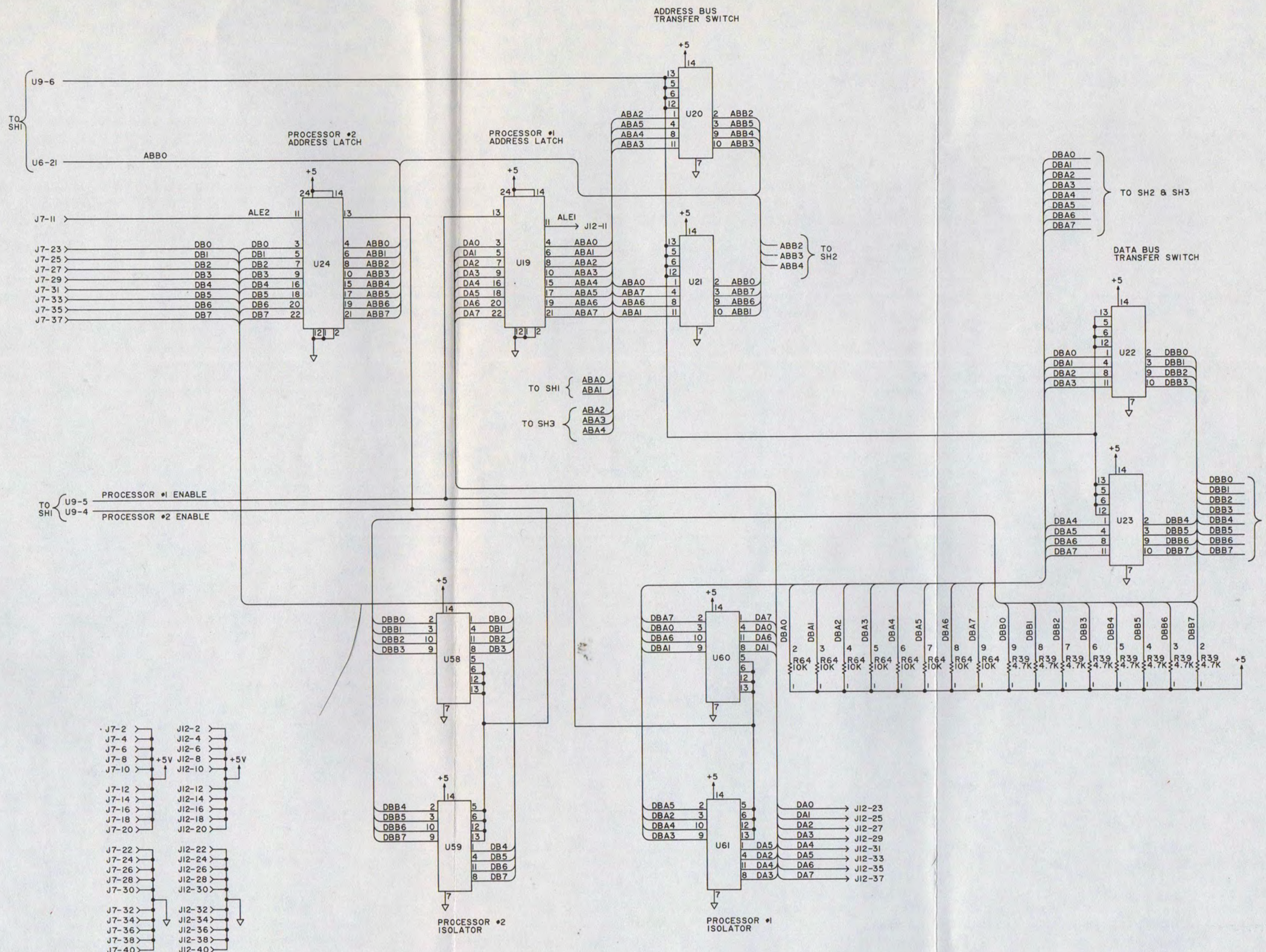
1. U42,U46 = 8282 U43 = LM393N U44,U45 = LM339AN
U47,U48,U49,U53,U54 = 8212 U50,U51 = MC14504BCP
U52 = 74LS138
CR1-CR9 = M IN4746A CR10,CR11 = IN4732
Q1-Q9,Q13-Q20,Q33,Q35 = 2N4401
Q32,Q34 = 2N4403 Q36,Q37,Q38 = 2N3904

STATUS AND MULTIMETER

A12

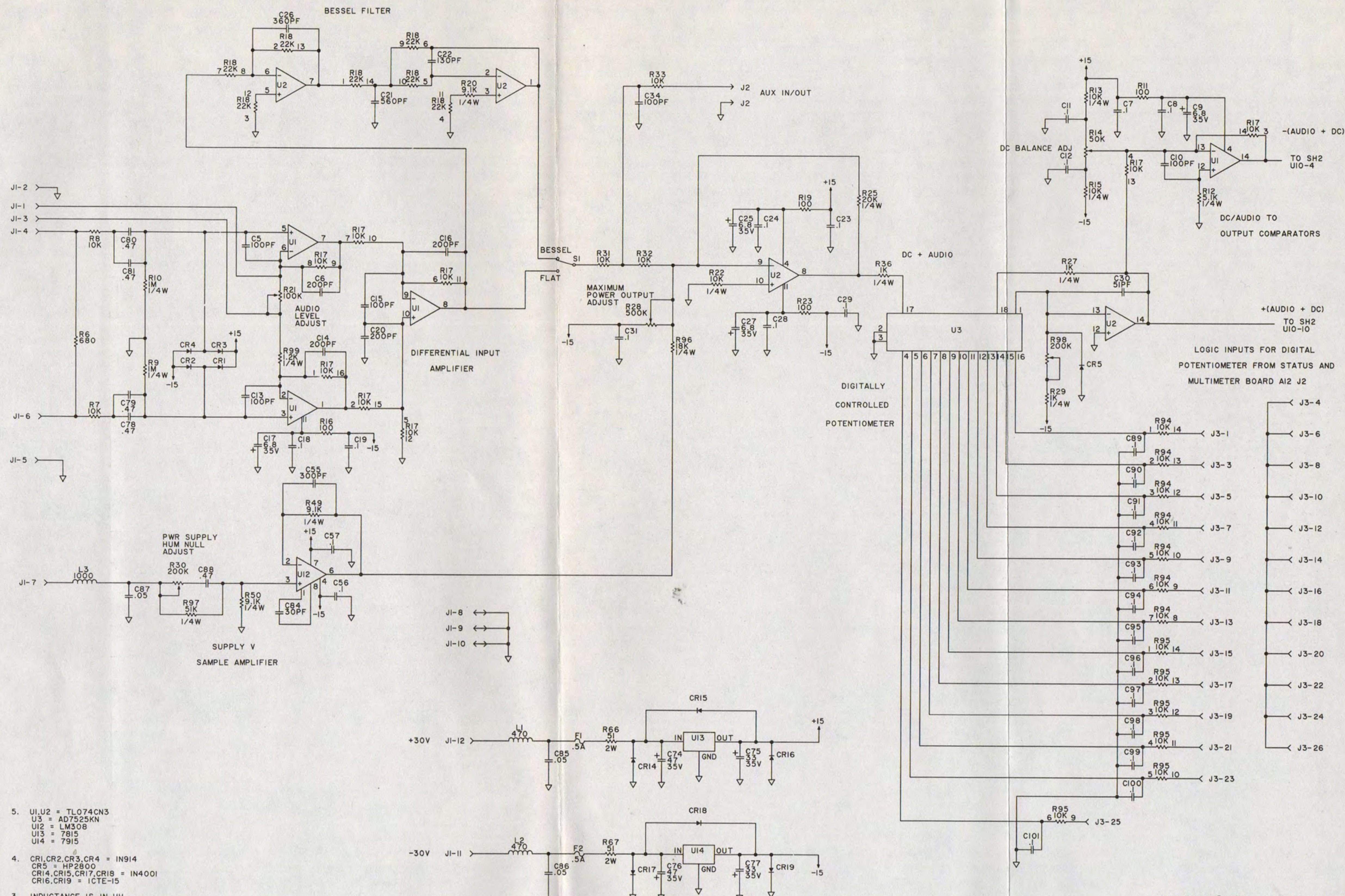
FIGURE 8-8. SCHEMATIC
STATUS/MULTIMETER
(SHEET 3 OF 4)
839 5695 299

A



1. U19,U24 = 8212
U20-U23 = MC14066
U58-U61 = MC14066

FIGURE 8-8. SCHEMATIC
STATUS/MULTIMETER
(SHEET 4 OF 4)
839 5695 299



5. U1,U2 = TL074CN3
U3 = AD7525KN
U12 = LM308
U13 = 7815
U14 = 7915

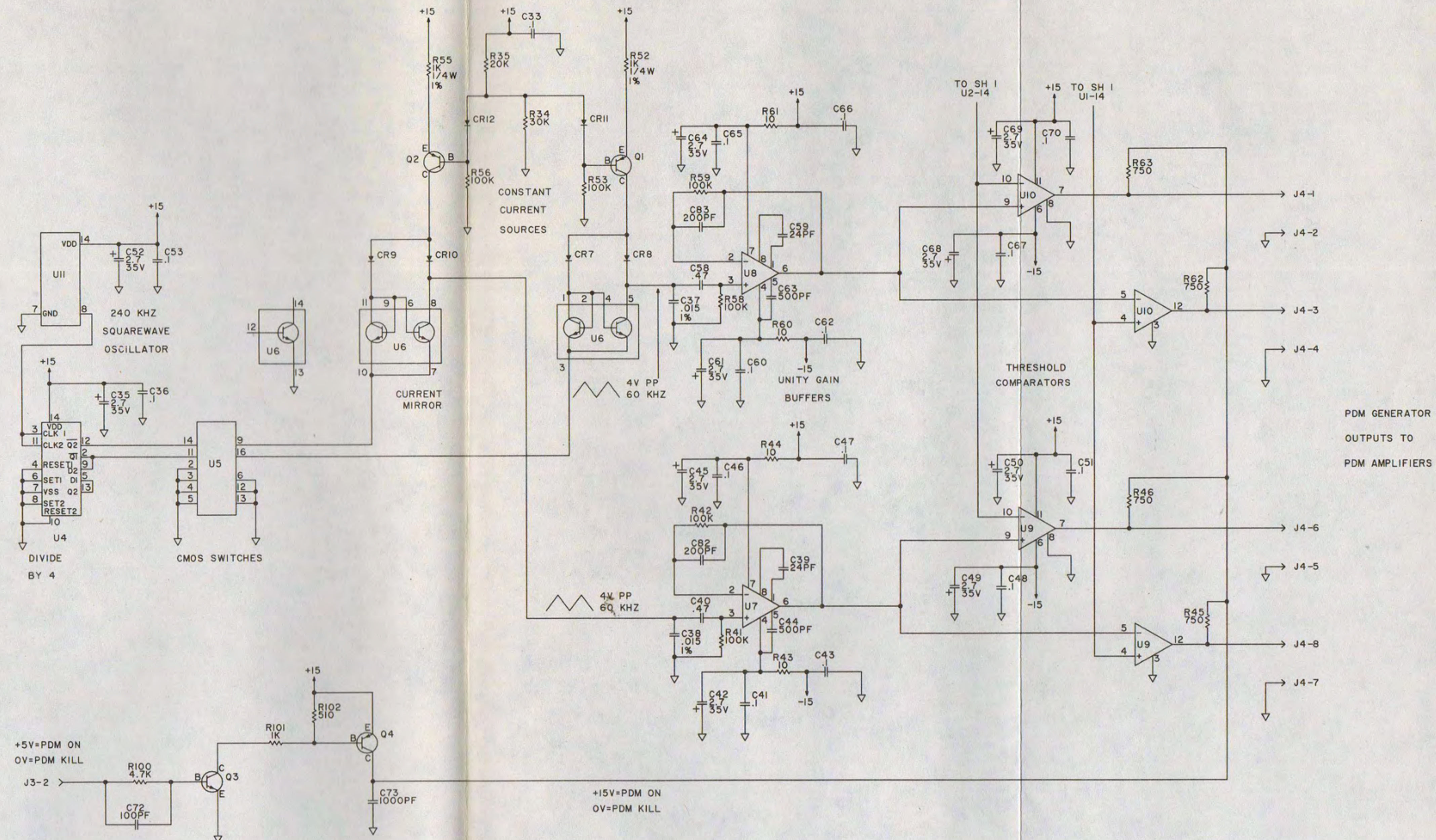
4. CR1,CR2,CR3,CR4 = IN914
CR5 = HP2800
CR14,CR15,CR17,CR18 = IN4001
CR16,CR19 = ICTE-15

3. INDUCTANCE IS IN UH

2. CAPACITANCE IS IN UF

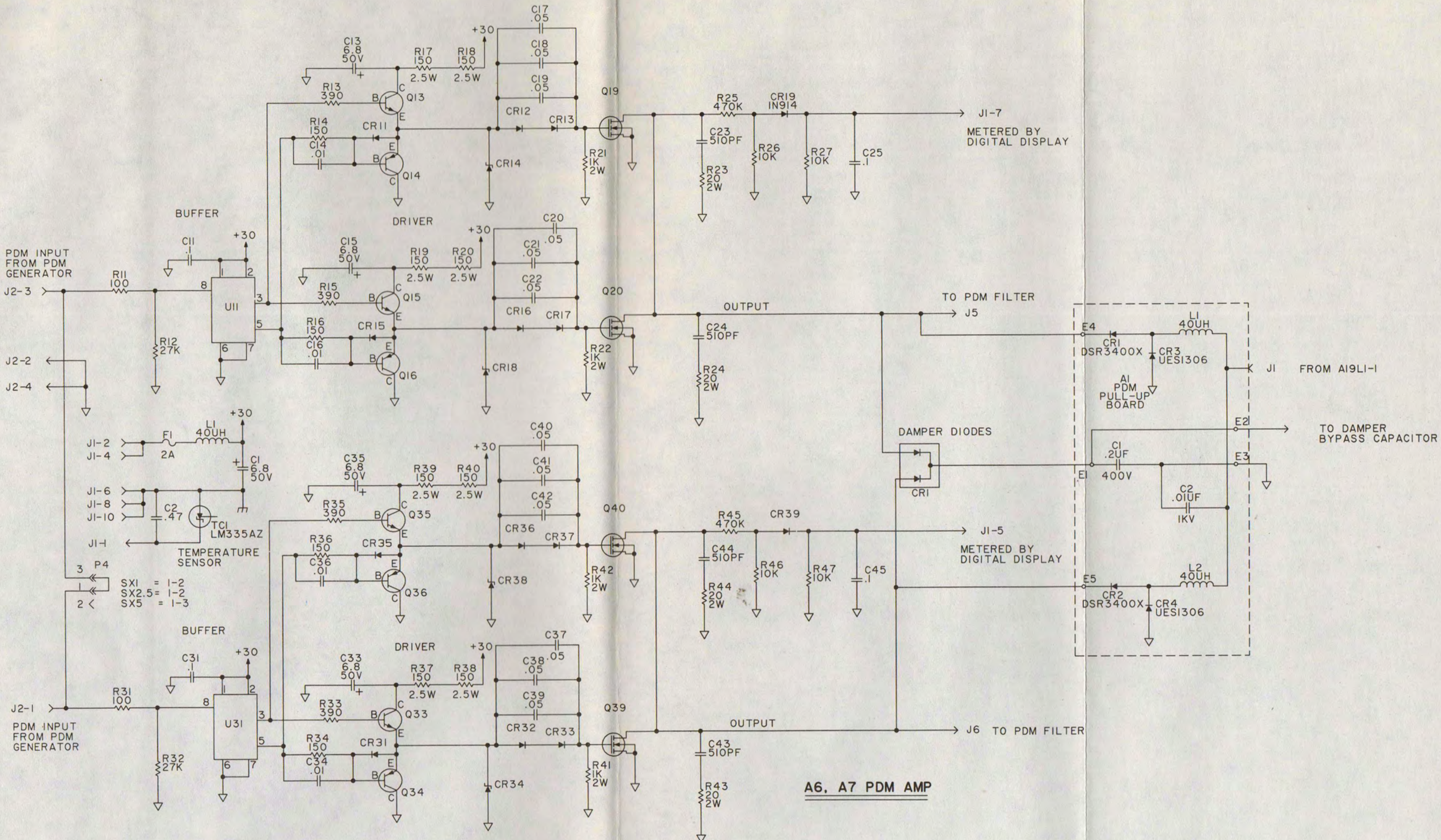
1. RESISTORS ARE IN OHMS, 1/2W, 5%
UNLESS OTHERWISE NOTED:

FIGURE 8-9. SCHEMATIC
PDM GENERATOR BOARD
(SHEET 1 OF 2)
839 5695 313



3. U4 = 4013
   U5 = SD5000N
   U6 = 3045
   U7,U8 = CA3100T
   U9,U10 = LM319
   U11 = 240 KHZ CRYSTAL OSCILLATOR
2. Q1,Q2,Q4 = 2N4403
   Q3 = 2N4401
1. CR7,CR8,CR9,CR10,CR11,CR12 = IN914

FIGURE 8-9. SCHEMATIC
PDM GENERATOR BOARD
(SHEET 2 OF 2)
839 5695 313



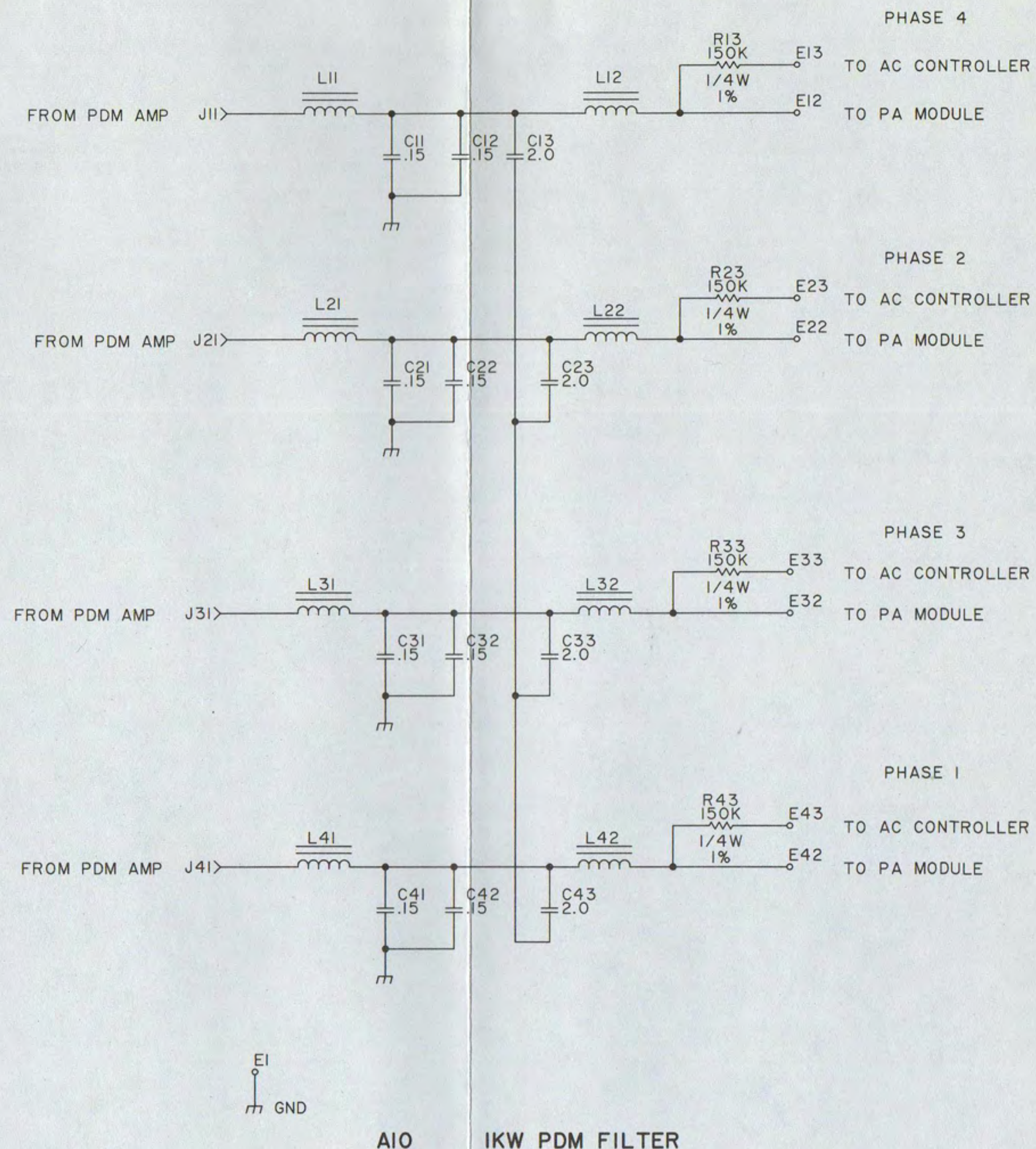
3. CAPACITANCE IS IN UF
2. RESISTORS ARE 1/2WATT 5%
1. RESISTANCE IS IN OHMS
UNLESS OTHERWISE NOTED:

6. CR1 = UES2606 CR11 CR15 CR19 CR31 CR35 CR39 = IN914
CR12 CR13 CR16 CR17 CR32 CR33 CR36 CR37 = IN4005
CR14 CR18 CR34 CR38 = ICTE-15

5. Q13 Q15 Q33 Q35 = 2N4401: Q14 Q16 Q34 Q36 = MJE-210
Q19 Q20 Q39 Q40 = IRF-350

4. U11 U31 = LH0002CH

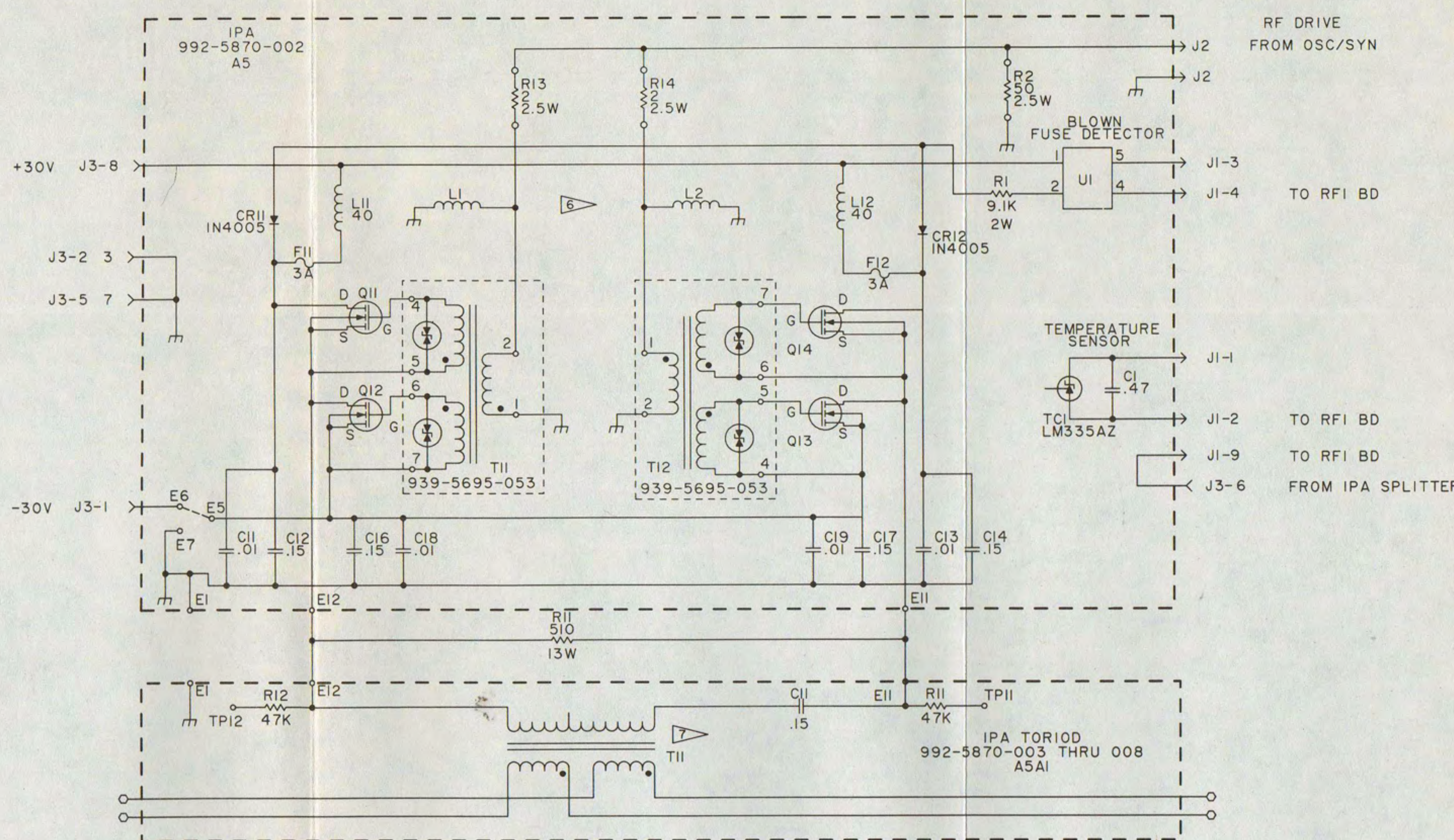
FIGURE 8-10. SCHEMATIC
PDM AMPLIFIER
839 5605 317



1. CAPACITANCE IS IN UF

UNLESS OTHERWISE NOTED:

FIGURE 8-11. SCHEMATIC
1KW PDM FILTER
839 5695 203

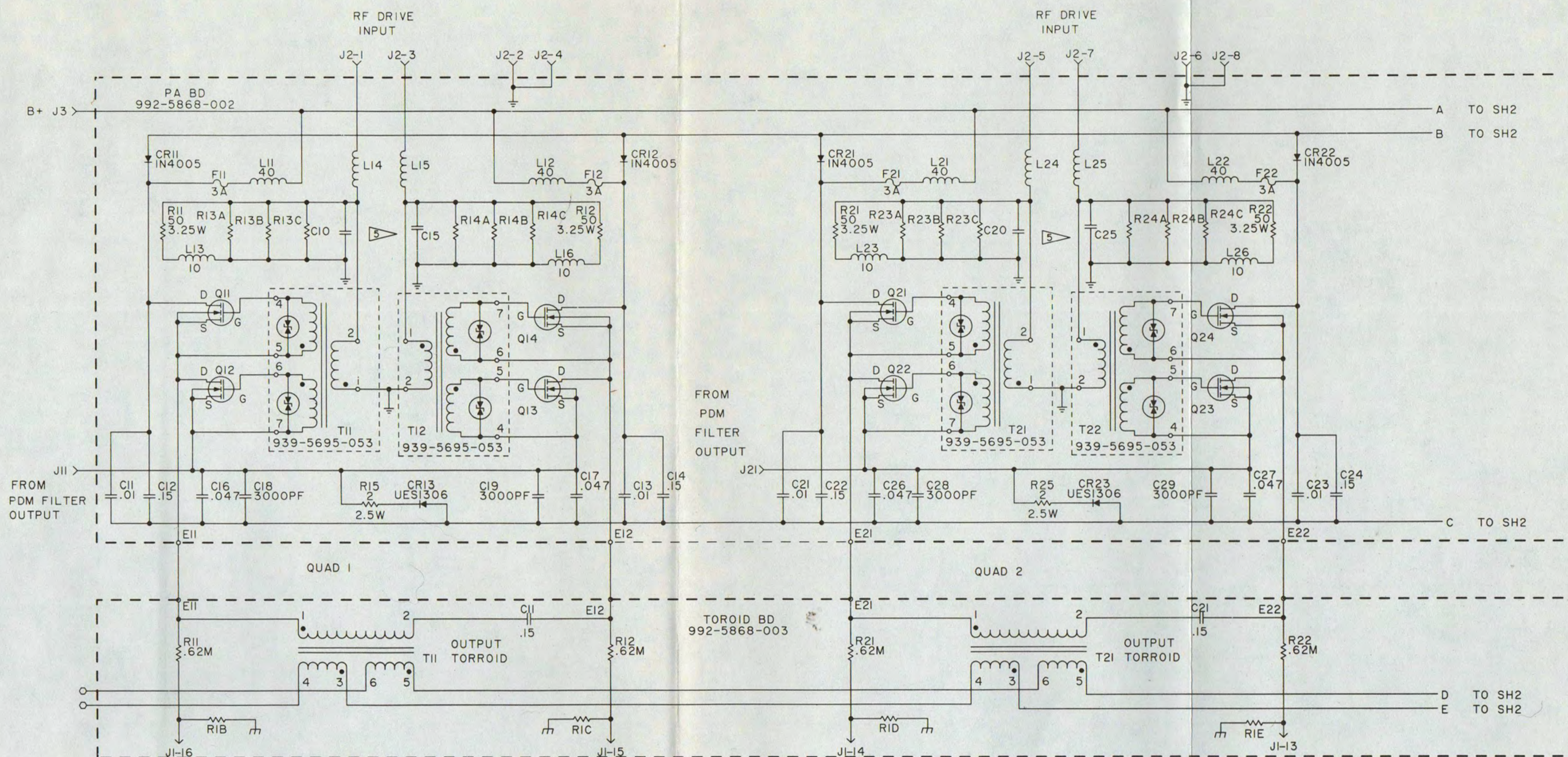


5 Q11,Q12,Q13,Q14 = TRF 130
4 U1 = 4N25
3 INDUCTANCE IN UH
2 CAPACITANCE IN UF
1 RESISTANCE IN OHMS, 1/2 WATT, 5% UNLESS OTHERWISE NOTED:

7 NUMBER IF WIRES AND TURNS ARE FREQUENCY DETERMINED

6 FREQUENCY DETERMINED: L1, L2

FIGURE 8-12. SCHEMATIC
IPA BOARD
839 5695 033

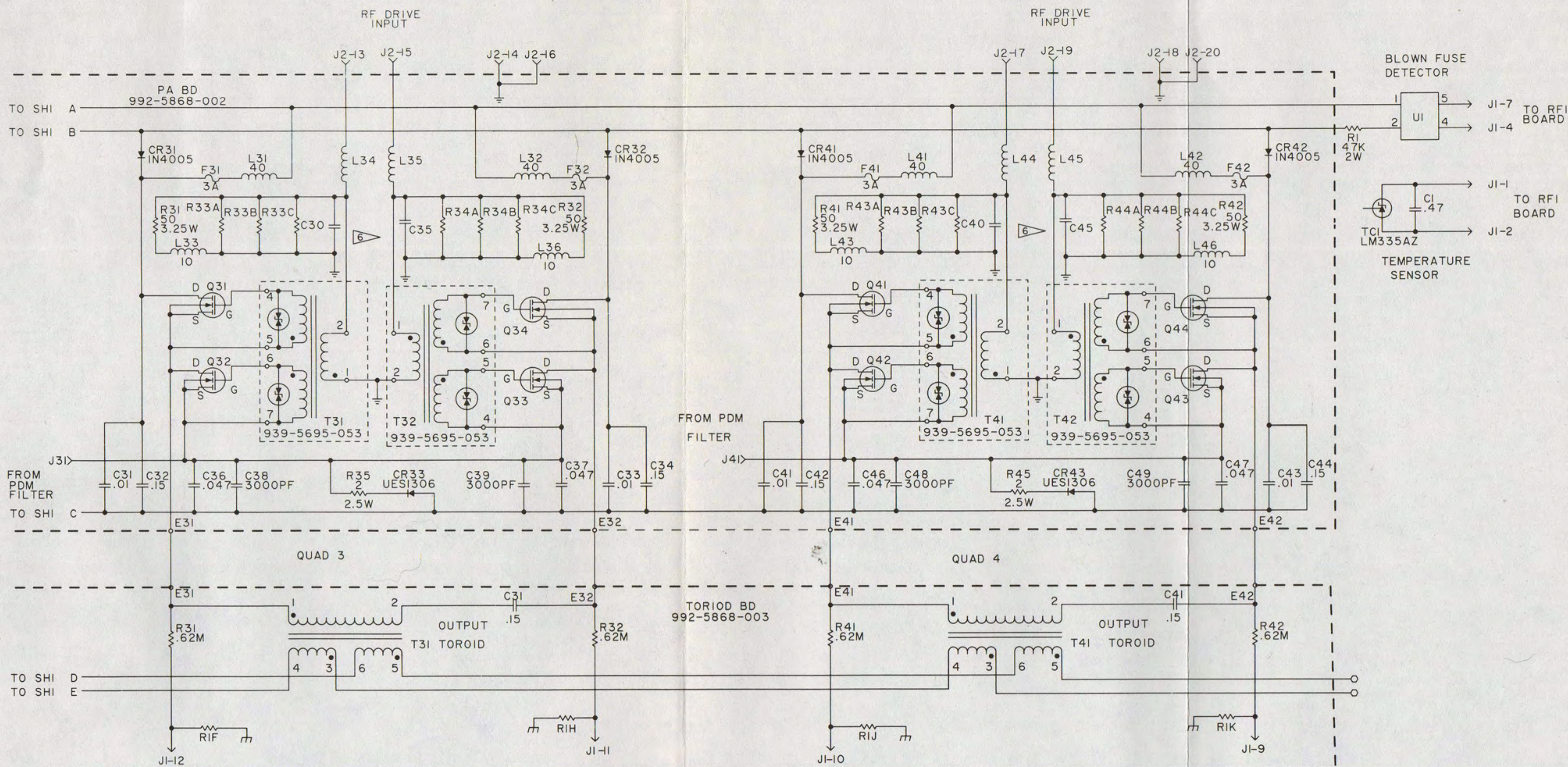


7 J1-TEST FOR FACTORY USE

5 FREQUENCY DETERMINED: R13,R14,R23,R24 - 120 /2W
L14,L15,L24,L25 - .33 UH
C10,C15,C20,C25 - 4700 PF

4 Q11,Q12,Q13,Q14
Q21,Q22,Q23,Q24 = IRF-350
3 INDUCTANCE IN UH
2 CAPACITANCE IN UF
1 RESISTANCE IN OHMS, 1/2 WATT, 5%
UNLESS OTHERWISE NOTED:

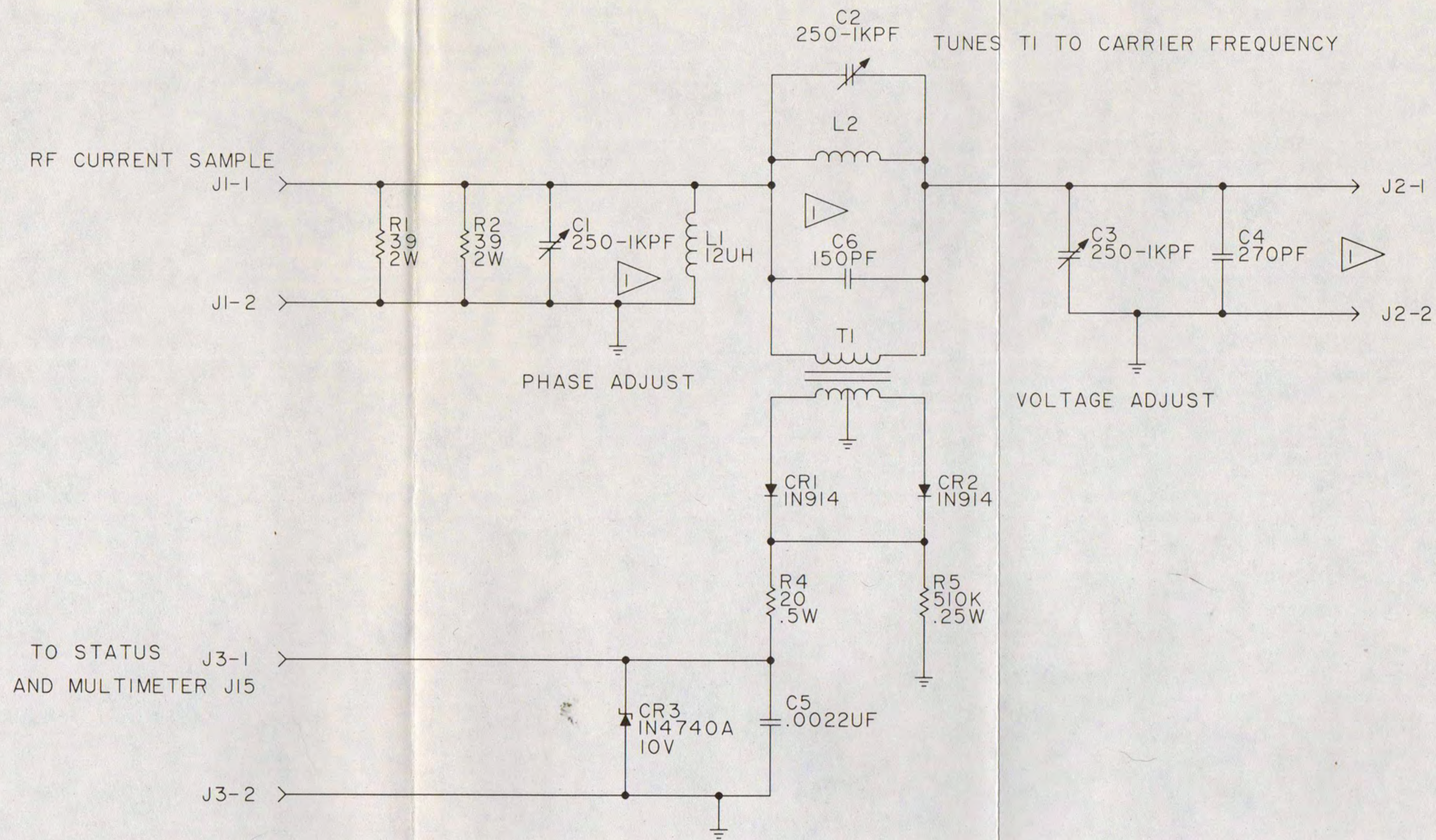
FIGURE 8-13. SCHEMATIC
PA MODULE
(SHEET 1 OF 2)
839 5695 241



5 Q31,Q32,Q33,Q34
Q41,Q42,Q43,Q44 = IRF-350
4 U1 = 4N25
3 INDUCTANCE IN UH
2 CAPACITANCE IN UF
1 RESISTANCE IN OHMS, 1/2 WATT, 5% UNLESS OTHERWISE NOTED:

6 FREQUENCY DETERMINED: R33,R34,R43,R44 - 120 /2W
L34,L35,L44,L45 - .33 UH
C30,C35,C40,C45 - 4700 PF

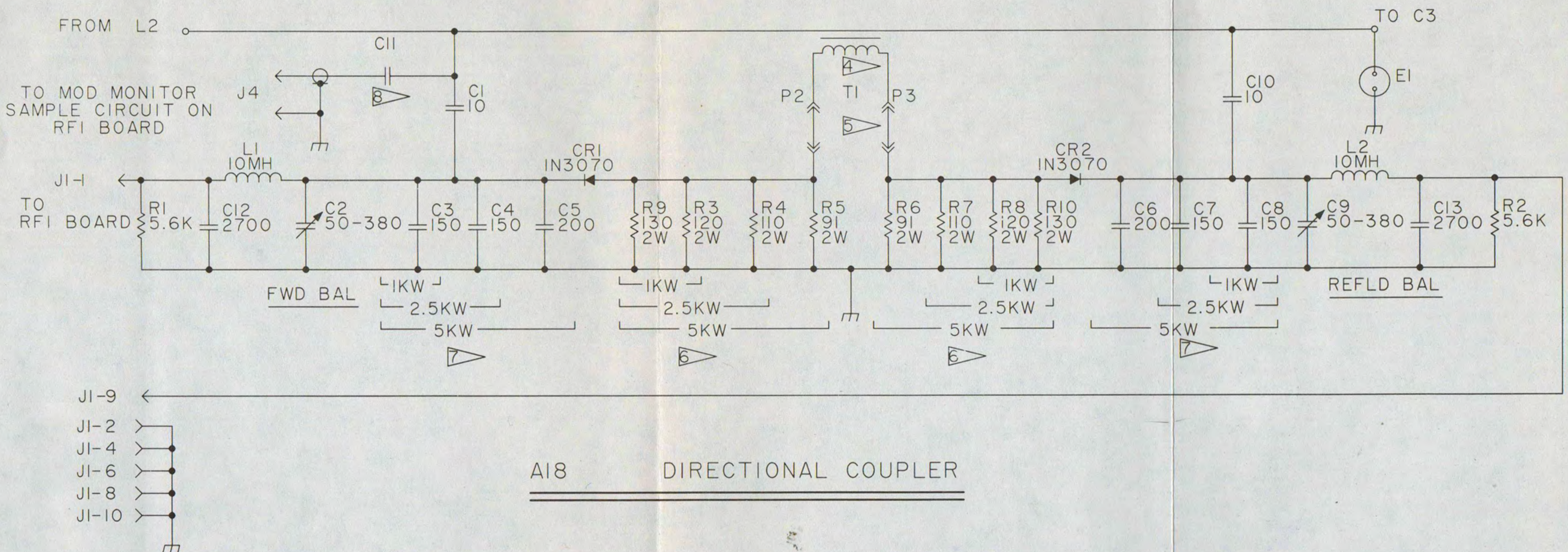
FIGURE 8-13. SCHEMATIC PA MODULE
(SHEET 2 OF 2)
839 5695 241



2. DO NOT REMOVE J1 WHILE TRANSMITTER IS OPERATING

(1) L1, L2, C4, & C6 ARE FREQUENCY DETERMINED

FIGURE 8-14. SCHEMATIC
PHASE ANGLE DETECTOR BOARD
839 5695 264

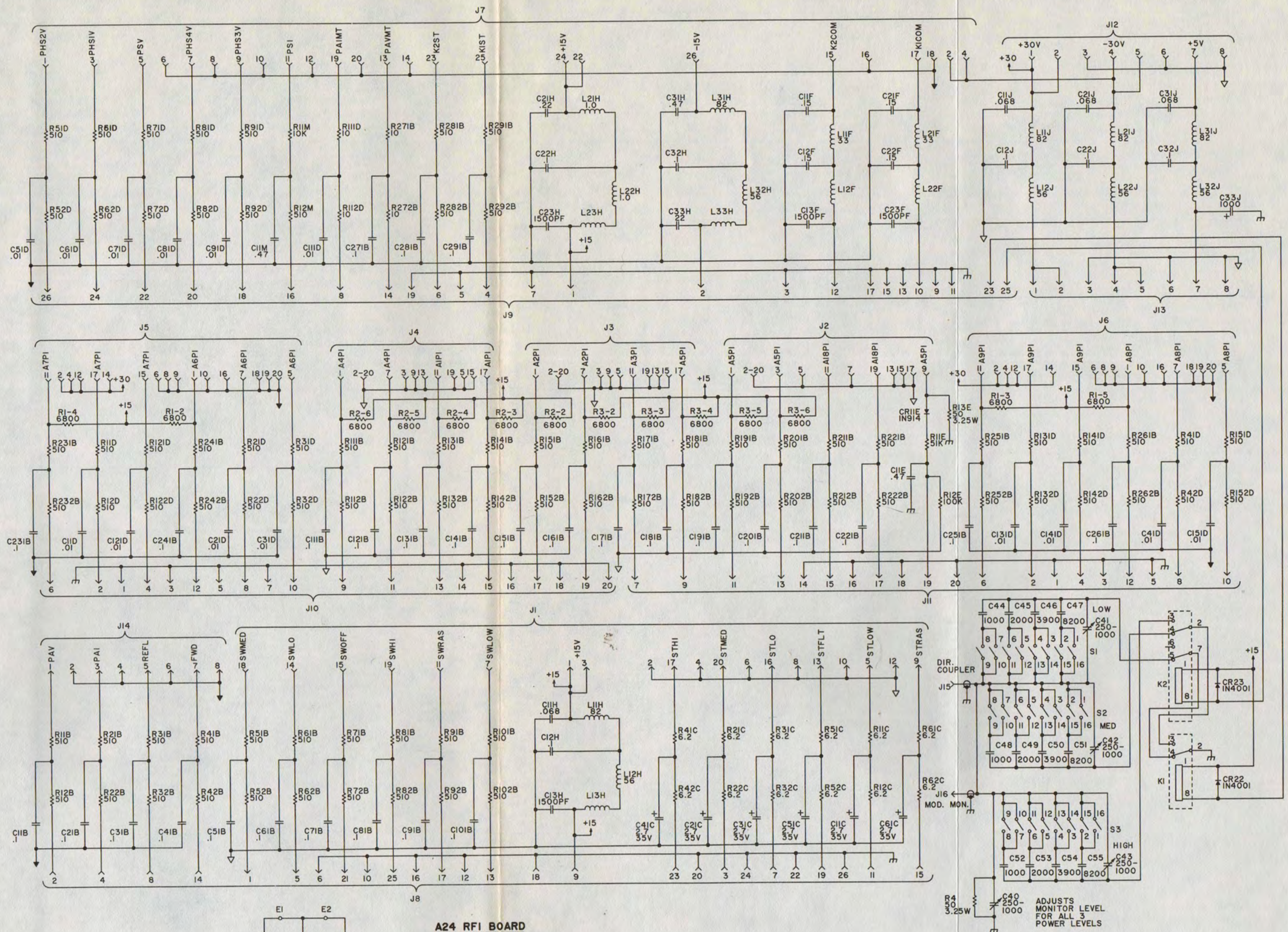


A18 DIRECTIONAL COUPLER

8. C11 FREQUENCY DETERMINED
7. CLIP OUT C4,C5,C6,C7 FOR 1KW: C5,C6 FOR 2.5KW
6. CLIP OUT R4,R5,R6,R7 FOR 1KW: R5,R6 FOR 2.5KW
5. FOR TEST: TO CALIBRATE IN FWD/REFLD MODE -- DO NOT REMOVE-- -- WHILE TRANSMITTER IS OPPERATING --
4. TRANSFORMER: TOROID INDIANA GENERAL CF-123, Q1 MATERIAL, 40 TURNS #20 WIRE
3. CAPACITANCE IS IN PF
2. RESISTORS ARE 1/2WATT 5%
1. RESISTANCE IS IN OHMS

UNLESS OTHERWISE NOTED

FIGURE 8-15. SCHEMATIC
DIRECTIONAL COUPLER BOARD
839 5695 119



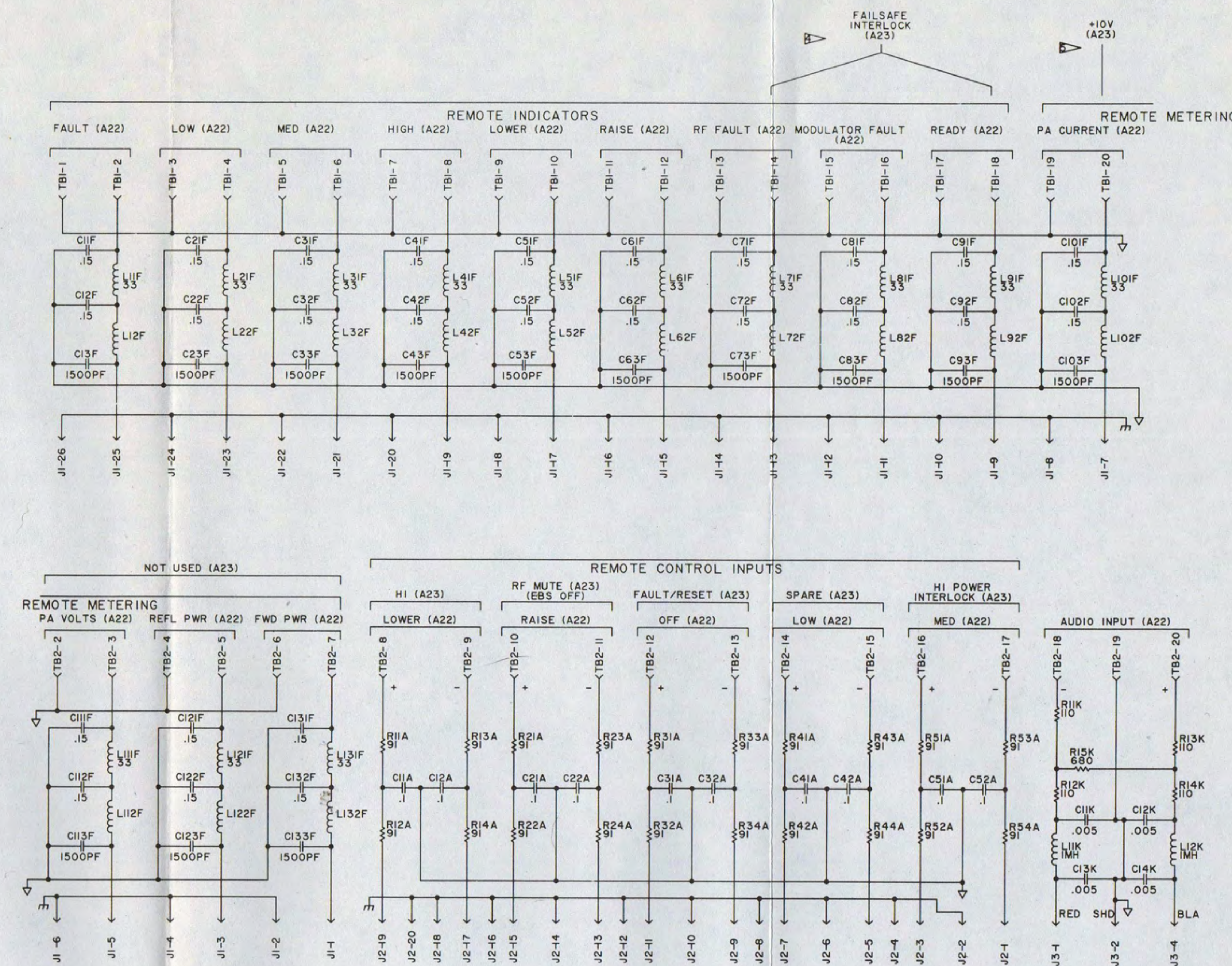
3. INDUCTANCE IS IN UH
2. RESISTORS ARE IN OHMS, 1/4 WATT, 5%
1. CAPACITANCE IS IN UF
UNLESS OTHERWISE NOTED:

FIGURE 8-16. SCHEMATIC
RFI BOARD
839 5695 340

B

3. INDUCTANCE IS IN UH
2. RESISTORS ARE IN OHMS, 1/4 WATT, 5%
1. CAPACITANCE IS IN UF
UNLESS OTHERWISE NOTED:

FIGURE 8-17. SCHEMATIC
RFI BOARD
(P/N 992 5886 002)
839 5695 289



CUSTOMER INTERFACE A22,A23

IOV SUPPLY FOR REMOTE CONTROL INPUTS/OUTPUTS

PROVIDE A NORMALLY CLOSED CIRCUIT CAPABLE OF 1 AMP AT 125 VAC BETWEEN A23TB1-14 AND A23TB1-18.

3 INDUCTANCE IS IN UH
2 RESISTORS ARE IN OHMS, 1/2 WATT, 5 %
1 CAPACITANCE IS IN UF
UNLESS OTHERWISE NOTED

FIGURE 8-18. SCHEMATIC
CUSTOMER INTERFACE BOARD
839 5695 243

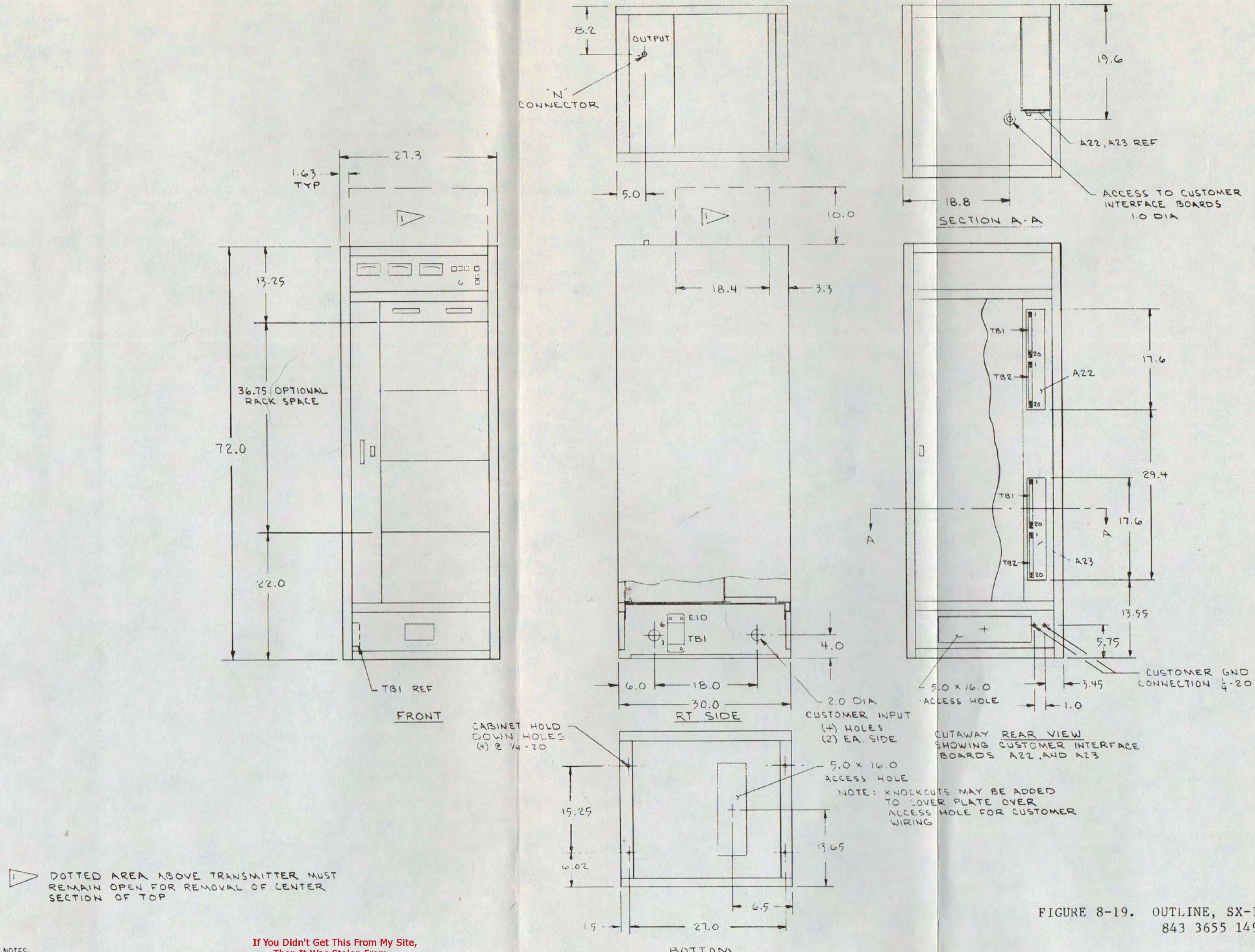


FIGURE 8-19. OUTLINE, SX-1
843 3655 149

CABLE 1, MAIN

CABLE #3, H.V. FILTER

CABLE #4, PWR SUPPLY

CABLE #5, JUMPER

CABLE #6, CONTROL DRAWER

POINT TO POINT COMPONENTS

SYM	FROM	TO
C1	M1(+)	M1(-)
C2	M2(+)	M2(-)
C3	M3(+)	M3(-)
CR1 & 2	M1(+)	M1(-)
CR3 & 4	M2(+)	M2(-)
CR5 & 6	M3(+)	M3(-)
A19C3	TS1-2	TS1-6
A19R6	TS1-1	TS1-5
A19R7	TS1-4	TS1-8
A19R8	TS1-9	TS1-6
A19R11	A19C1(+)	A19C1(-)
A19R12	A19C3(+)	A19C3(-)
A19R13	A19C5(+)	A19C5(-)
A19R14	TS1-2	TS1-7
A19R15	TS1-2	TS1-6
A19RV1	E30	E31
A20R1	A20C1(+)	A20C1(-)
A20R2	A20C2(+)	A20C2(-)
A20RV1	A20T1(SEC)	A20T1(SEC)

1

NOTES:

FIGURE 8-20. SX-1 RUNNING SHEETS
EXPLANATION SHEET
(SHEET 1 OF 10)
817 0914 079

DATE 1-5-82	RUNNING SHEET 817 0914 079		CABLE NO.	REV L M		L

WIRE NO.	FROM		WIRE SIZE AND TYPE	CABLE #	TO	
	EQUIPMENT	TERMINAL			EQUIPMENT	TERMINAL
1	TB2	4	#14 AWG STRD. C-14	4	A20CB1	1-LINE
2	TB2	5	#14 AWG STRD. C-14	4	A20CB1	2-LINE
3	A20CB1	3-LOAD	#14 AWG STRD. C-14	4	TB2	13
4	A20CB1	4-LOAD	#14 AWG STRD. C-14	4	TB2	12
5	A20T1	SECONDARY TAP	#14 AWG STRD. C-14	1	A20CR1	AC
6	A20T1	SECONDARY TAP	#14 AWG STRD. C-14	1	A20CR1	AC
7	A20T1	SECONDARY CTR TAP	#14 AWG STRD. C-14	1	E13	GRD
8	A20CR1	+	#14 AUG STRD. C-14	1	A20C1	+
9	A20CR1	–	#14 AWG STRD. C-14	1	A20C2	–
10	A20C1	–	#14 AWG STRD. C-14	1	A20C2	+
11	A20C2	+	#14 AWG STRD. C-14	1	E13	GRD
12	A20R3	1	#18 AWG STRD. C-18	1	A20C1	+
13	E10		#10 AWG STRD. D-10	1	E13	GRD
14	TB2	4	#12 AWG STRD. D-12	4	TB1	5
15	TB2	5	#12 AWG STRD. D-12	4	TB1	6
16	A20R3	WIPER	#18 AWG STRD. C-18	1	A5P3	8
17	A20C2	–	#18 AWG STRD. C-18	1	A5P3	1
18	E13		#18 AWG STRD. C-18	1	A5P3	2
19	A20C1	+	#18 AWG STRD. C-18	1	A25P2	10
20	A20C2	–	#18 AWG STRD. C-18	1	A24P12	4
21	E13		#18 AWG STRD. C-18	1	A25P2	7
22	A20C1	+	#18 AWG STRD. C-18	1	A24P12	1
23	E13		#18 AWG STRD. C-18	1	A24P12	3
24	A20R3	1	#18 AWG STRD. C-18	5	A20R4	1
25	A25P2	4	#18 AWG STRD. C-18	1	A23TB1	18
26	A24P12	7	#18 AWG STRD. C-18	1	A25P2	11
27	TB2	10	#18 AWG STRD. C-18	1	A25P2	8
28	TB2	11	#18 AWG STRD. C-18	1	A25P2	6

FIGURE 8-20. SX-1 RUNNING SHEETS
(SHEET 2 OF 10)
817 0914 079

WARNING: Disconnect primary power prior to servicing.

DATE 1-5-82	RUNNING SHEET ~~871~~ 817 0914 079	CABLE NO.	REV ~~L~~ M

L

WIRE NO.	FROM		WIRE SIZE AND TYPE	CABLE #	TO	
	EQUIPMENT	TERMINAL			EQUIPMENT	TERMINAL
29	TB2	9	#18 AWG STRD. C-18	1	A25P2	1
30	TB2	6	#18 AWG STRD. C-18	1	A25P2	3
31	TB2	8	#18 AWG STRD. C-18	1	A25P2	2
32	TB2	7	#18 AWG STRD. C-18	4	A19K2	COIL A
33	TB2	10	#18 AWG STRD. C-18	4	A19K1	COIL B
34	TB2	11	#18 AWG STRD. C-18	4	A19K2	COIL B
35	A19K1	COIL A	#18 AWG STRD. C-18	4	A19K2	COIL A
36	TB2	6	#18 AWG STRD. C-18	4	A19K2	T3
37	TB2	9	#18 AWG STRD. C-18	4	A19K1	L3
38	TB2	8	#18 AWG STRD. C-18	4	A19K2	L3
39	A19K1	T3	#18 AWG STRD. C-18	4	A19K2	T3
40	TB2	7	#18 AWG STRD. C-18	1	A19S3	COM
41	A19S3	N.O.	#18 AWG STRD. C-18	1	E13	GRD
42						
43						
44	A26A1	E1	#20 AWG STRD. C-20	1	A5P3	6
45	A20T1	240	#14 AWG STRD. C-14	1	TB2	13
46	A20T1	0	#14 AWG STRD. C-14	1	TB2	12
47						
48						
49						
50						
51	A24P14	1	#20 AWG STRD. C-20	1	M1	+
52	A24P14	2	#20 AWG STRD. C-20	1	M1	-
53	A24P14	3	#20 AWG STRD. C-20	1	M2	+
54	A24P14	4	#20 AWG STRD. C-20	1	M2	-
55	S1	COM	#20 AWG STRD. C-20	1	M3	+
56	S1	1	#20 AWG STRD. C-20	1	A24P14	5

FIGURE 8-20. SX-1 RUNNING SHEETS
(SHEET 3 OF 10)
817 0914 079

WARNING: Disconnect primary power prior to servicing.

DATE 1-5-82	RUNNING SHEET 817 0914 079		CABLE NO.		REV L M	L
WIRE NO.	FROM		WIRE SIZE AND TYPE	CABLE #	TO	
	EQUIPMENT	TERMINAL			EQUIPMENT	TERMINAL
57	S1	2	#20 AWG STRD. C-20	1	A24P14	7
58	A24P14	6	#20 AWG STRD. C-20	1	M3	-
59	A24P13	4	#20 AWG STRD. C-20	6	A15P1	11
60	A24P13	3	#20 AWG STRD. C-20	6	A15P1	9
61	A24P13	1	#20 AWG STRD. C-20	6	A15P1	12
62	A24P13	6	#20 AWG STRD. C-20	6	A12P14	1
63	A24P13	7	#20 AWG STRD. C-20	6	A12P14	3
64	A24P13	8	#20 AWG STRD. C-20	6	A16P2	2
65	A24P13	2	#20 AWG STRD. C-20	6	A16P2	1
66						
67						
68						
69	A25P3	1	#20 AWG STRD. C-20	1	A10A1E13	
70	A25P3	2	#20 AWG STRD. C-20	1	A10A1E33	
71	A25P3	3	#20 AWG STRD. C-20	1	A10A1E23	
72	A25P3	4	#20 AWG STRD. C-20	1	A10A1E43	
73						
74 RED	TS1	5	#20 AWG STRD. 2-C SHLD	1	A25P3	7
74 BLK	TS1	4		1	A25P3	8
74 SHLD	TS1	4				
75	E39		#20 AWG STRD. C-20	1	A25P3	6
76	TS1	9	#18 SING COND. SHLD	1	A25P3	5
76 SHLD	E29					
77	A19CR3,1	CATHODE	#10 AWG STRD. D-10	5	A19C5	+
78	A19CR4,2	ANODE	#10 AWG STRD. D-10	5	A19C5	-
79						
80						
81	TB1	1	#8 AWG STRD. D-8	4	A19K1	T1

FIGURE 8-20. SX-1 RUNNING SHEETS
(SHEET 4 OF 10)
817 0914 079

WARNING: Disconnect primary power prior to servicing.

DATE 1-5-82	RUNNING SHEET 817 0914 079			CABLE NO.	REV ~~L~~ M	L
WIRE NO.	FROM		WIRE SIZE AND TYPE	CABLE #	TO	
	EQUIPMENT	TERMINAL			EQUIPMENT	TERMINAL
82	TB1	2	#8 AWG STRD. D-8	4	A19K1	T2
83						
84	A19K2	L1	#8 AWG STRD. D-8	4	A19R1	2
85	A19K2	L2	#8 AWG STRD. D-8	4	A19K1	L2
86						
87						
88	A19K2	T1	#8 AWG STRD. D-8	4	A19K1	T1
89	A19K2	T2	#8 AWG STRD. D-8	4	A19K1	T2
90	A19K1	L1	#8 AWG STRD. D-8	4	A19T1	240
91	A19K1	L2	#8 AWG STRD. D-8	4	A19T1	0
92						
93	A19R1	1	#8 AWG STRD. D-8	4	A19K1	L1
94						
95						
96						
97	E10		#10 AWG STRD. D-8	4	E12 GRD	
98						
99						
100						
101						
102	A19T1	R2 SECONDARY	#8 AWG STRD. D-8	5	E30	
103	A19T1	R1 SECONDARY	#8 AWG STRD. D-8	5	E31	
104						
105	E35		#10 AWG STRD. D-10	3	A19A1	E4
106	E39		#10 AWG STRD. D-10	3	A19A1	E3
107	A19CR1,3	CATH	#6 AWG STRD. D-6	5	E35	
108	A19CR4,2	ANODE	#6 AWG STRD. D-6	5	E39	
109	E35		#6 AWG STRD. D-6	5	A19A4	E2

FIGURE 8-20. SX-1 RUNNING SHEETS
(SHEET 5 OF 10)
817 0914 079

DATE 1-5-82	RUNNING SHEET 817 0914 079			CABLE NO.	REV L M		L

WIRE NO.	FROM		WIRE SIZE AND TYPE	CABLE #	TO	
	EQUIPMENT	TERMINAL			EQUIPMENT	TERMINAL
110	E35		#10 AWG STRD. D-10	3	A19R3	2
111	A19R2	1	#10 AWG STRD. D-10	5	A19S6	N.O.
112						
113	A19A4	E1	#10 AWG STRD. D-10	1	A19C1	+
114	A19A4	E1	#10 AWG STRD. D-10	1	A19C2	+
115						
116						
117						
118						
119	A19S1	N.O.	#10 AWG STRD. D-10	5	E35	
120						
121						
122						
123	A19R2	1	#10 AWG STRD. D-10	5	A19R3	1
124	A19R2	2	#10 AWG STRD. D-10	5	A19R3	2
125						
126						
127						
128						
129	A10R4	1	#12 AWG STRD. C-12	1	A1P11	
130	A10A1E12		#12 AWG STRD. D-12	1	A10R4	1
131						
132						
133	A10R3	1	#12 AWG STRD. D-12	1	A1P21	
134	A10A1E32		#12 AWG STRD. D-12	1	A10R3	1
135						
136						
137	A10R2	2	#12 AWG STRD. D-12	1	A1P31	

FIGURE 8-20. SX-1 RUNNING SHEETS
(SHEET 6 OF 10)
817 0914 079

DATE 1-5-82	RUNNING SHEET 817 0914 079			CABLE NO.	REV L M		L

WIRE NO.	FROM		WIRE SIZE AND TYPE	CABLE #	TO	
	EQUIPMENT	TERMINAL			EQUIPMENT	TERMINAL
138	A10A1E22		#12 AWG STRD. D-12	1	A10R2	2
139						
140						
141	A10R1	2	#12 AWG STRD. D-12	1	A1P41	
142	A10A1E42		#12 AWG STRD. D-12	1	A10R1	2
143						
144						
145	A10A1P11		#12 AWG STRD. D-12	1	A10F1A	2
146	A10A1P21		#12 AWG STRD. D-12	1	A10F1B	2
147	A10A1P31		#12 AWG STRD. D-12	1	A10F2B	1
148	A10A1P41		#12 AWG STRD. D-12	1	A10F2A	1
149						
150						
151						
152						
153	A10F2A	2	#12 AWG STRD. D-12	5	A6P5	
154	A10F2B	2	#12 AWG STRD. D-12	5	A6P6	
155	A10F1A	1	#12 AWG STRD. D-12	1	A7P5	
156	A10F1B	1	#12 AWG STRD. D-12	1	A7P6	
157						
158						
159						
160						
161						
162	P2B	CTR	RG187	1	A6P2	1
SHLD	P2B	SHLD		1	A6P2	2
163	P3B	CTR	RG187	1	A7P2	1
SHLD	P3B	SHLD		1	A7P2	2

FIGURE 8-20. SX-1 RUNNING SHEETS
(SHEET 7 OF 10)
817 0914 079

WARNING: Disconnect primary power prior to servicing.

DATE 1-5-82	RUNNING SHEET 817 0914 079			CABLE NO.	REV L M			L

WIRE NO.	FROM		WIRE SIZE AND TYPE	CABLE #	TO	
	EQUIPMENT	TERMINAL			EQUIPMENT	TERMINAL
164	P4B	CTR	RG187	1	A6P2	3
SHLD	P4B	SHLD		1	A6P2	4
165	P5B	CTR	RG187	1	A7P2	3
SHLD	P5B	SHLD		1	A7P2	4
166	A24P15	CTR	RG58	1	A18P4	CTR
SHLD	A24P15	SHLD		1	A18P4	SHLD
167	P7B	CTR	RG188	1	A5P2	CTR
SHLD	P7B	SHLD		1	A5P2	SHLD
168	J3A	CTR	RG187	6	A15P4	8
SHLD	J3A	SHLD		6	A15P4	7
169	P5A	CTR	RG187	6	A15P4	1
SHLD	P5A	SHLD		6	A15P4	2
170	P2A	CTR	RG187	6	A15P4	3
SHLD	P2A	SHLD		6	A15P4	4
171	P4A	CTR	RG187	6	A15P4	6
SHLD	P4A	SHLD		6	A15P4	5
172	P7A	CTR	RG188	6	A16P2	6
SHLD	P7A	SHLD		6	A16P2	5
173 RED	A22P3	1	BELDON 2 COND AUDIO	6	A15P1	6
173 SHLD	A22P3	2		6		
173 BLK	A22P3	4		6	A15P1	4
174	P6A	CTR	RG187	6	A16P4	CTR
SHLD	P6A	SHLD		6	A16P4	SHLD
175						
176	E34		#10 15KV SILVER PLATE	5	A19F2	1
177						
178						
179						

FIGURE 8-20. SX-1 RUNNING SHEETS
(SHEET 8 OF 10)
817 0914 079

WARNING: Disconnect primary power prior to servicing.

DATE 1-5-82	RUNNING SHEET 817 0914 079		CABLE NO.		REV M M	M

WIRE NO.	FROM		WIRE SIZE AND TYPE	CABLE #	TO	
	EQUIPMENT	TERMINAL			EQUIPMENT	TERMINAL
180						
181						
182	A19F2	2	#10 15KV SILVER PLATE	1	A1P3	
183	A26L1	CENTER TAP	#10 15KV SILVER PLATE	5	A26C1	
184						
185						
186						
187						
188						
189						
190						
191						
192						
193	E30		#8 STRD. D-8	5	A19CR2	CATHODE
194	E31		#8 STRD. D-8	5	A19CR4	CATHODE
195						
196	A16P2	3	#20 AWG STRD. C-20	6	A12P13	2
197	J1		#20 AWG STRD C-20	5	A21L6	1
198	E11 GRD		#20 AWG STRD C-20	5	A21L6	2
199	A16P2	4	#20 AWG STRD C-20	6	A13P3	4
200	A13P3	1	#20 AWG STRD. C-20	6	A14P3	2
201	A13P3	2	#20 AWG STRD. C-20	6	A14P3	1
202	A13P3	3	#20 AWG STRD. C-20	6	A12P13	4
204	A14P3	3	#20 AWG STRD. C-20	6	A12P13	1
205	A14P3	4	#20 AWG STRD. C-20	6	A12P13	3
206 CTR	TS1	2	RG188	1	P8B	CENTER
206 SHLD	E29 GRD			1	P8B	SHLD

FIGURE 8-20. SX-1 RUNNING SHEETS
(SHEET 9 OF 10)
817 0914 079

WARNING: Disconnect primary power prior to servicing.

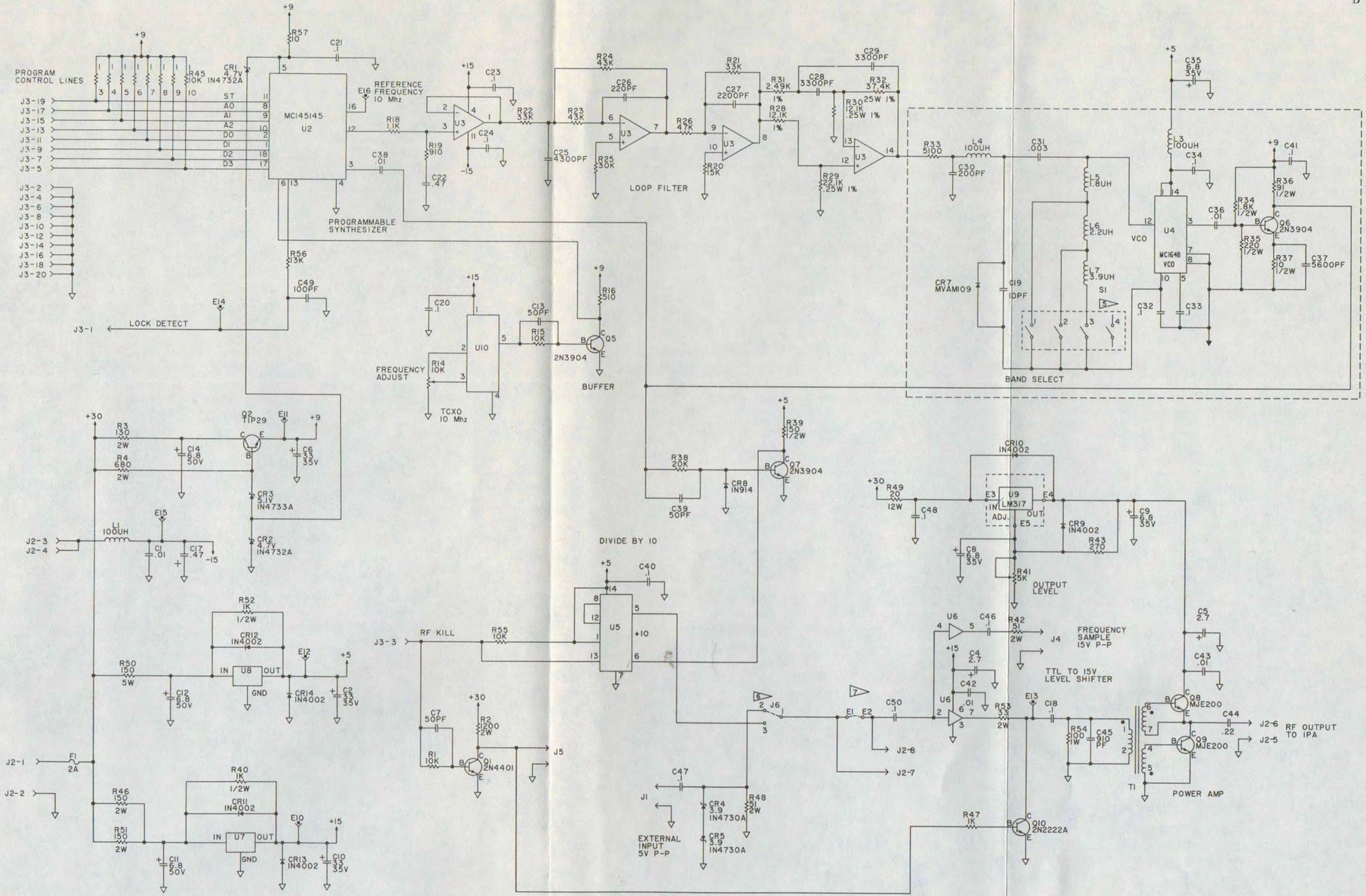
DATE 1-5-82	RUNNING SHEET 817 0914 079			CABLE NO.	REV M M	
WIRE NO.	FROM		WIRE SIZE AND TYPE	CABLE #	TO	
	EQUIPMENT	TERMINAL			EQUIPMENT	TERMINAL
207	P8A	CENTER	RG188	6	A15P1	7-CTR
SHLD	P8A	SHLD		6	A15P1	8-SHLD
208	A20R4	1	#18 AWG STRD C-18	5	A20R5	2
209	A20R5	1	#18 AWG STRD C-18	1	A23TB1	20
210	A20R5	1	#18 AWG STRD C-18	5	A20CR2	CATHODE
211						
212	E35		#14 AWG STRD. C-14	5	A19R20	1
213	A19L1	1	#14 AWG STRD. C-14	5	A19R20	2
214	A19L1	2	#14 AWG STRD. C-14	1	A6A1P1	
215	A19L1	2	#14 AWG STRD. C-14	1	A7A1P1	
216	E34		#20 AWG STRD. C-20	5	TS1	8
217	E35		#20 AWG STRD. C-20	5	TS1	1
218	E29	GRD	#20 AWG STRD. C-20	5	TS1	7
219	TS1	8	#22 BUS BAR	5	TS1	6
220 CTR	E23		RG188	5	A27A1P1	CTR
220 SHLD	E24	2	SHLD	5	A27A1P1	SHLD
221 CTR	A27C1		RG188	5	A27A1P2	CTR
221 SHLD			SHLD	5	A27A1P2	SHLD
223 CTR	A12P15	CTR	RG188	6	A27A1P3	CTR
223 SHLD	A12P15	SHLD	SHLD	6	A27A1P3	SHLD
224	A20F1	1	#18 AWG STRD. C-18	1	A20T1	SECONDARY TAP
225	A20F1	2	#18 AWG STRD C-18	1	A23TB1	14
226	A23TB1	14	#18 AWG STRD C-18	5	A23TB1	18

M

FIGURE 8-20. SX-1 RUNNING SHEETS
(SHEET 10 OF 10)
817 0914 079

WARNING: Disconnect primary power prior to servicing.

B



7 JUMPER E1 TO E2 (FOR COMBINER USE REMOVE JUMPER)

6 FOR EXTERNAL INPUT JUMPER J6-1 TO J6-2
FOR NORMAL OPERATION JUMPER J6-1 TO J6-3

5 S1-3 ONLY CLOSED - 525-800 Khz
S1-2 ONLY CLOSED - 801-1175 Khz
S1-1 ONLY CLOSED - 1176-1605 Khz

4. U2=MC145145, U3=TL074CN3, U4=MC1648, U5=74S196, U6=DS0026J-8
U7=7815, U8=7805, U9=LM317K, U10=10Mhz TCXO
3. RESISTORS ARE 1/4 WATT 5%
2. CAPACITANCE IS IN UF
1. RESISTANCE IS IN OHMS
UNLESS OTHERWISE NOTED:

FIGURE 8-21. OPTIONAL FREQUENCY SYNTHESIZER
839 5695 312

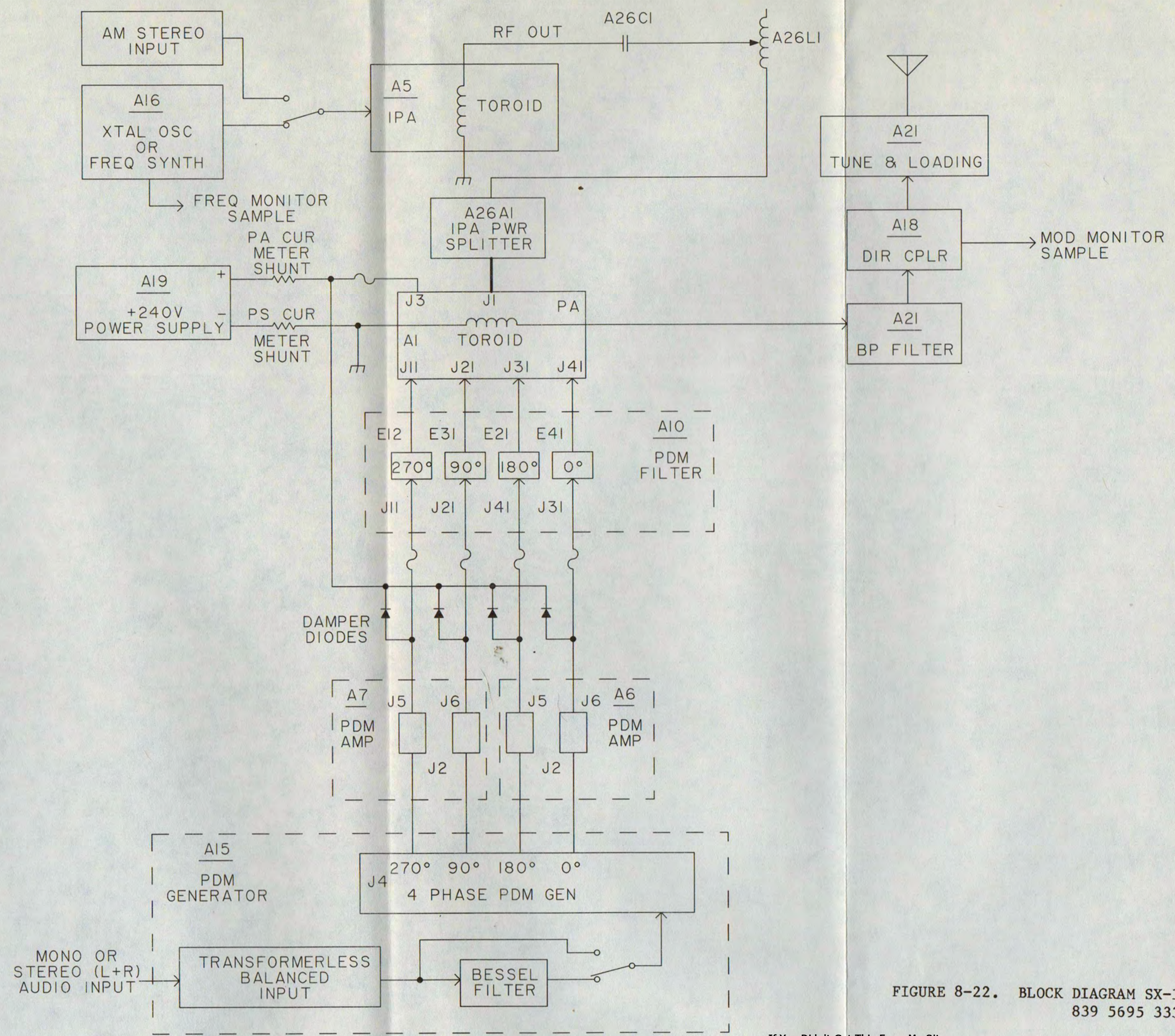
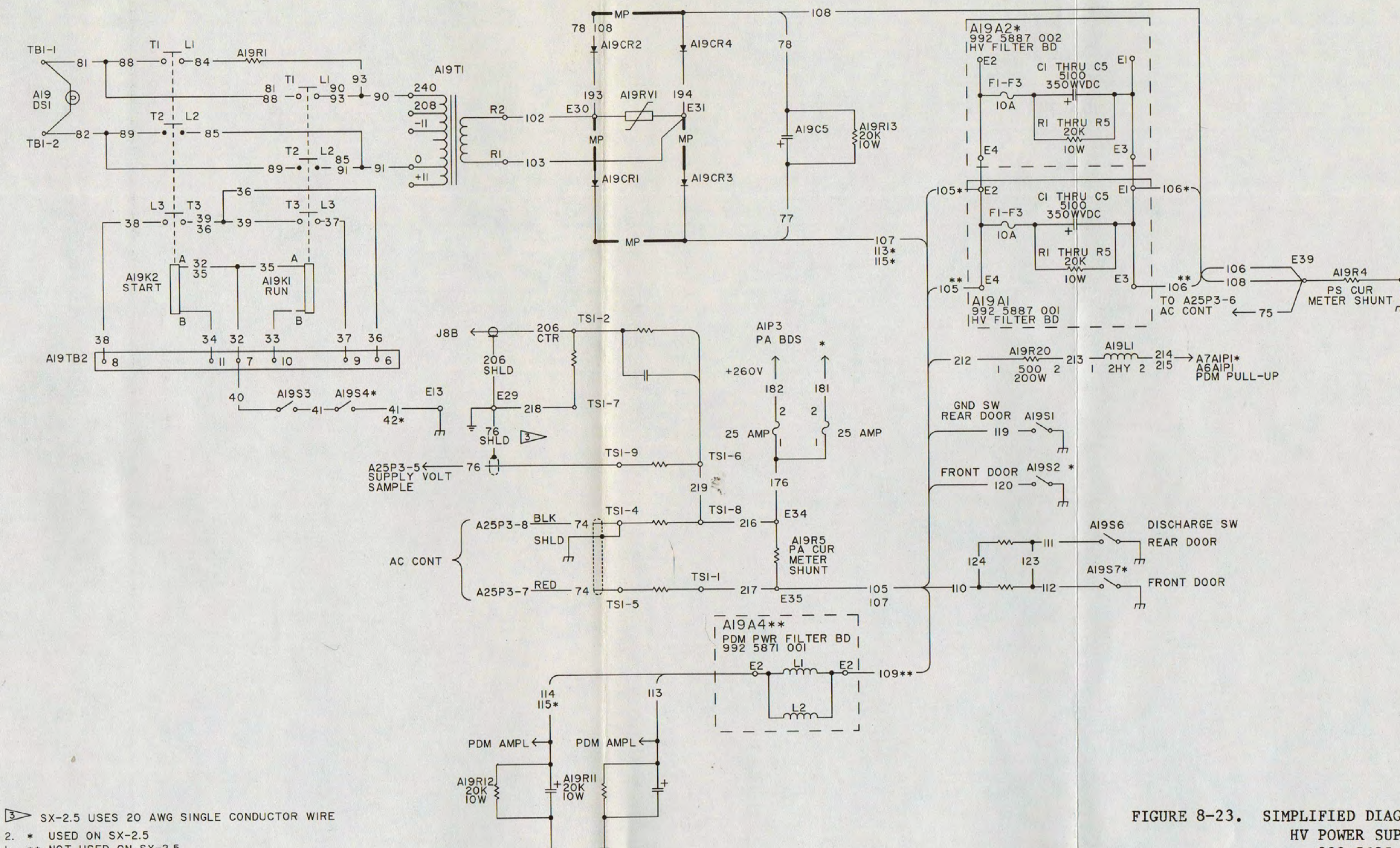


FIGURE 8-22. BLOCK DIAGRAM SX-1
839 5695 333

888-2126-028
8-77/8-78

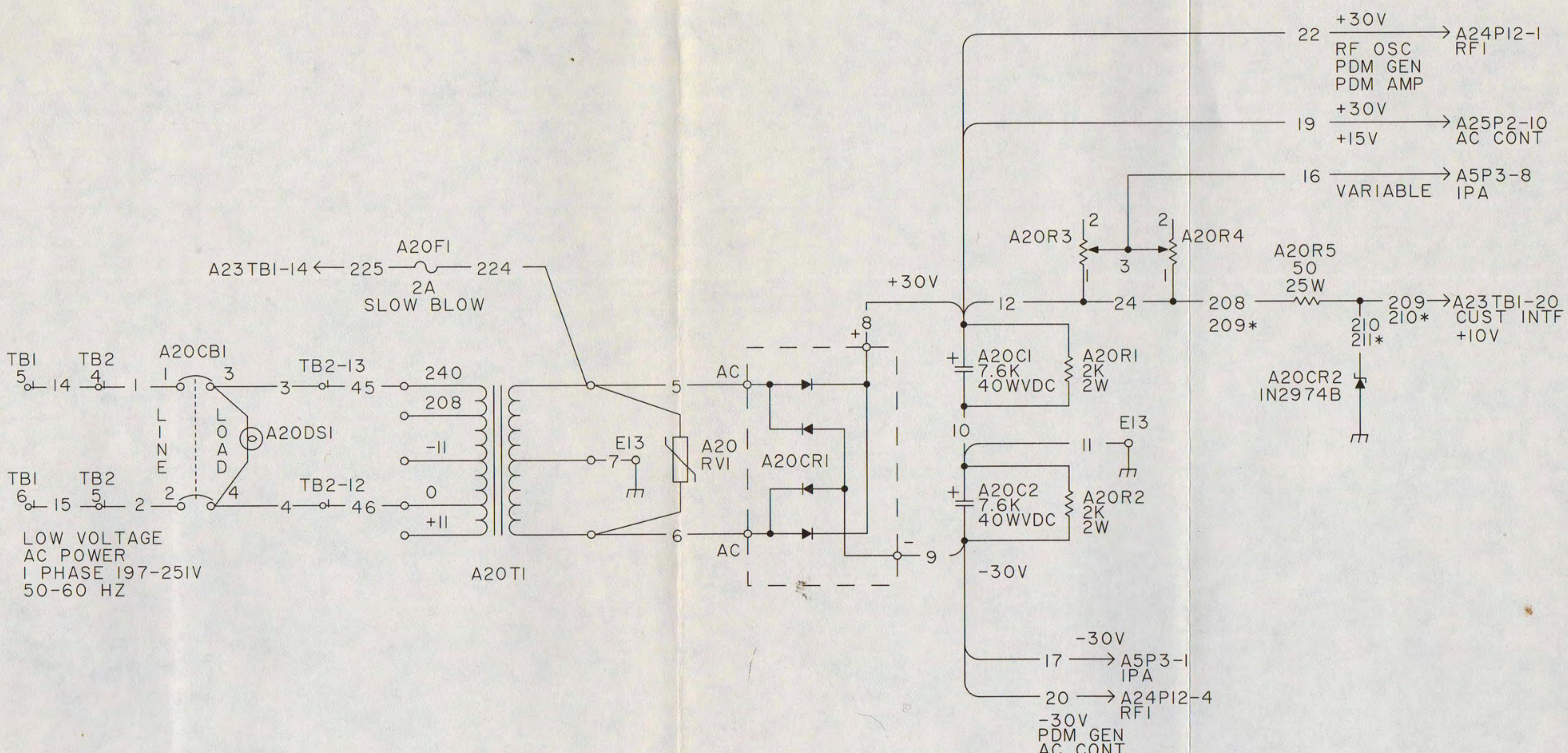


3 SX-2.5 USES 20 AWG SINGLE CONDUCTOR WIRE

2. * USED ON SX-2.5

1. ** NOT USED ON SX-2.5

FIGURE 8-23. SIMPLIFIED DIAGRAM
HV POWER SUPPLY
839 5695 336



1. * DENOTED WIRES USED ON SX-2.5

FIGURE 8-24. SIMPLIFIED DIAGRAM
LV POWER SUPPLY
839 5695 337

888-2126-028
8-81/8-82

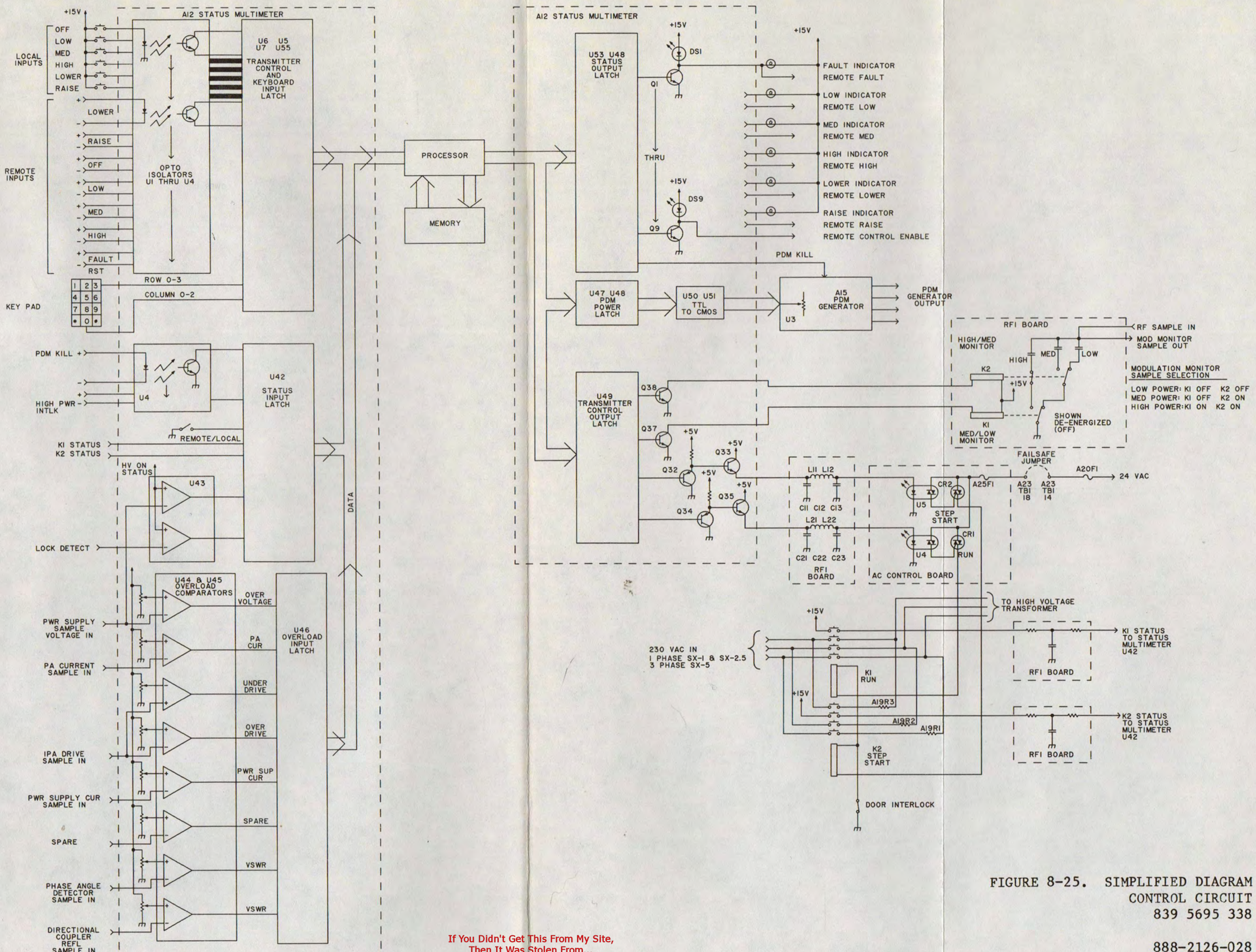


FIGURE 8-25. SIMPLIFIED DIAGRAM
CONTROL CIRCUIT
839 5695 338

888-2126-028
8-83/8-84

APPENDIX A

INSTALLATION

A-1. INTRODUCTION

A-2. This section of the technical manual provides detailed installation procedures and initial turn on instructions for the SX-1 AM TRANSMITTER.

A-3. Under normal conditions, the SX Series of Transmitters are shipped with the HV transformer packed separately with the remainder of the transmitter ready for installation. However, if adverse shipping conditions are anticipated, certain components may be removed for transport in which case these components will be properly identified with appropriate instructions for reinstalling the components and making wiring connections.

A-4. UNPACKING

A-5. Carefully unpack the transmitter and perform a visual inspection to determine that no apparent damage was incurred during shipment. Retain the shipping materials until it has been determined that the unit is not damaged. The contents of the shipment should be as indicated on the Packing Check List which accompanies each shipment. If the contents are incomplete or if the unit is damaged electrically or mechanically, notify the carrier and HARRIS CORPORATION.

A-6. RETURNS AND EXCHANGES

A-7. Damaged or undamaged equipment should not be returned unless written approval and a Return Authorization is received from HARRIS CORPORATION, Broadcast Group. 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 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 Group, specify the Factory Order Number or Invoice Number.

A-8. GENERAL INSTALLATION INFORMATION

A-9. The following installation instructions are of a general nature only but should be read before any actual installation effort is started.

A-10. The SX Series of Transmitters have been designed for rapid and diverse installation. In addition to the 25.7 inch width by 30 inch depth of the equipment, a minimum of 24 inches should be allowed for maintenance access from both the front and rear of the cabinet. Signal and power wires can be connected through several different entries or any desired combination thereof. There are 2 inch diameter round holes at the front and rear of each side panel; there is a 5 inch by 12 inch opening (with cover plate) in the base of the equipment; there are 1 inch round holes in the rear top of each side bustle; all of these entries provide a means to enter the equipment with wires that are then routed into the base of the equipment.

A-11. A fused disconnect box is provided with each transmitter with the proper sized fuses for the maximum transmitter output power. Input power wires should run from this box exclusively to the terminal board installed in the base of the transmitter. Access to this terminal board is gained by removing the cover plate over the face of the contactor chassis. The screws holding the chassis are removed and the chassis must be removed. To totally remove the chassis, slide it forward until it catches and then lift the back of the chassis approximately 1 inch. At this point it's best to lay on the floor to reach inside to the terminal board located on the left side wall.

A-12. The power input terminal board has the interconnect option of powering the total transmitter from one set of input wires or hooking only the transmitter high voltage supply to the wall box and powering the low voltage from a secondary station power system (this is the recommended method). When this alternate connection is used, the wall box switch will control only the modulator/power amplifier high voltage. All other circuits will continue to operate for easier and safer troubleshooting. There is no power output when the high voltage is off and access is available to most parts of the transmitter.

A-13. The normal air flow through the transmitter is taken in through the back of the unit (at the bottom of the cabinet). No filter should be installed here unless forced air is going to be provided as part of the installation. A filter will obstruct the normal convection air flow and allow the transmitter to overheat. Maximum temperature at the base of the transmitter should not be more than 50 degrees C. The air moves from the base of the cabinet into the side panels and into the main enclosure. Air passes over the heat sink fins in the side panels and exits through the holes in the top of the cabinet. This provides efficient chimney action cooling of all the Power Amplifier and Modulator transistors. The air that enters the main enclosure passes directly over the components dissipating heat and exhausts through the output coils and out the top of the transmitter. The circuit cards and their heat sinks have been designed to provide a chimney action to the maximum extent practical.

A-14. The transmitter has been designed with two optional means of air intake. First, all units have a 5 inch by 12 inch access plate in the bottom of the unit. As with the rear air intake, no filtering should be used unless forced air is provided in the installation. Filtering will obstruct the normal convection air flow and allow the transmitter to overheat. If the base opening is used, the removed cover plate will install directly over the normal rear air intake.

A-15. The SX-1 has a natural convection cooling system which depends upon internal dissipation, the ambient temperature, and the absorption characteristics of the room in which it is installed. If remote forced air is installed to supply the unit, the alternate supply system should be designed

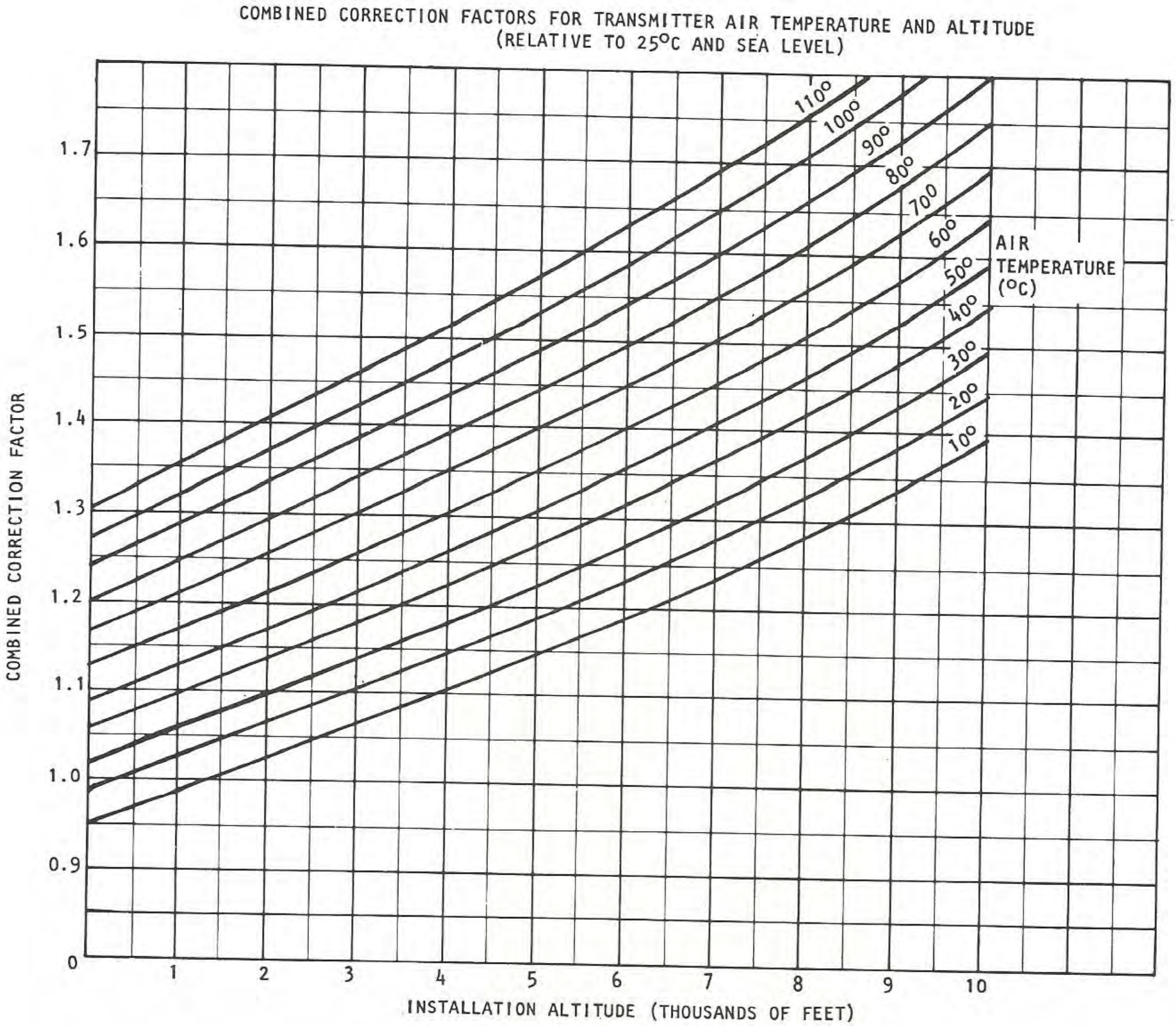


Figure A-1. Correction Factors

To calculate actual reading using the correction factor curve:

SP_{s1} / Correction Factor = SP expected

Where: SP_{s1} = Static Pressure at Sea Level

SP = Corrected Static Pressure

Example: Installation Altitude - - - - - - - - - - -10,000 feet
Inlet Air to Transmitter - - - - - - - - - 50 degrees C
PA Side Bessel Just Below Heat Sinks @ Sea Level - 0.15 inches H_2O

Correction Factor = 1.58 (Refer to Correction Factor Chart)
0.15 / 1.58 = 0.0949 inches H_2O Expected on Site

WARNING: Disconnect primary power prior to servicing.

for 150 SCFM with an air system static pressure reading of 0.15 inches of H_2O at standard conditions (sea level, 20 degrees C ambient) in the PA side bessel just below the heat sinks. This provides 90 SCFM through the PA heat sinks. Refer to Figure A-1 for correction factors to be used in determining proper air flow.

A-17. SETUP PROCEDURES

A-18. GENERAL REQUIREMENTS

A-19. Prior to delivery, pertinent requirements related to the installation and operation of the equipment will have been considered and provided for. The design considerations should encompass physical dimensions of the equipment, access for maintenance, relationship to other equipment, allowance for routing and distribution of input and output lines, adequate lighting, power access, ducting for cooling, if required, and protective grounding.

A-20. The key to a rapid and successful setup is careful planning prior to delivery of the system. HARRIS offers, as an option, engineering services to review and comment on proposed installations. In addition HARRIS offers, as an option, design, fabrication, and installation services to any required level for total integration of the system into a facility.

A-21. Several specific items should be planned for prior to delivery of the system. These items are:

a. Installation of ac power, up to the wall mounted Fused Disconnect Box to be supplied with the transmitter, and, if desired, installation of ac power up to and including the separate Low Voltage AC Power Fused Disconnect Box (not supplied).

b. Installation of utility outlets for test equipment with 8 to 10 feet from the front and rear of the planned equipment location. Outlet boxes may also be installed on the top of transmitter cabinet.

c. Installation of ground strap runs to the required locations and provision to ensure that the straps are electrically bonded to station ground.

d. Installation of any planned air ducts and cable troughs.

e. Purging of the supply air duct system, if used, to assure cleanliness of cooling air.

f. Installation of rf load, if desired, and testing to assure that water/air flow is adequate.

g. Installation of the major portion of the external air exhaust system, if used.

NOTE

If an exhaust bonnet is to be installed above transmitter, allow for access to remove the top of the transmitter for maintenance purposes.

h. Assurance that all required hand tools and special installation tools are available.

A-22. In summary, it is recommended that all interfaces be installed up to the "last piece" between the facility and the transmitter. These last interface runs should be cut to size or customized after the transmitter is set into its final position.

Table A-1. Special Installation Tools and Equipment

Lifting Equipment (Fork Lift, etc)	400 lbs (181 kg) capacity
Hand Tools	For opening wooden crates
Shims (2" by 2")	Aluminum, assorted thicknesses
Hand Operated Hole Punch	For adding 0.25" hardware holes to 0.020" thick copper ground strap at transmitter ground connection.
Ring Lug Crimping Tool	For crimping lugs.
BNC Tooling	Crimp or solder

Table A-2. Equipment Supplied With Transmitter and Listed on Packing Check List Supplied with Transmitter

Spare Fuses	992 6057 001	1
Digital Logic Probe	700 0850 000	1
Safety Switch, 250V, 30A, A19S05	604 0958 000	1
Transformer, Rectifier, A20T01	472 1269 000	1
Transformer, Power, A19T01	472 1315 000	1
Fuse, 30A, 250V, A19F01A, A19F01B	398 0221 000	2

A-23. EQUIPMENT PLACEMENT

A-24. The transmitter should be located to permit adequate maintenance access and sufficient ventilation. Primary ac power cables can enter the transmitter at a variety of locations and the specific location of entry will need to be determined on site. The grounding strap between the transmitter and the station earth ground must be properly connected before ac power wiring is attached to transmitter.

A-25. PRE-INSTALLATION INSPECTION

A-26. INSPECTION

A-27. Install transformer A19T1 and any other pieces of equipment packed separately for shipment. Refer to labels attached to pieces removed for installation locations. Prior to performing the mechanical installation of the SX-1 transmitter the following should be inspected:

a. Check the following connections to ensure that they are tight:
   - High Voltage transformer (A19T1)
   - Low Voltage transformer (A20T1)
   - Rectifier Diodes (A19CR1-CR4)
   - All Filter Capacitors (A19C5, A19C1, A19C2 and back door capacitors)
   - Output Network clips, insulators, and hardware
   - PA Secondary (white HV wire behind PA board A1)
   - All heatsinks and PC board captive fasteners (blade screw-driver slots)
   - IPA input drive coax (white teflon jacket with gold connector on A5)
   - Status/Multimeter Coax (white teflon jacket with a gold connector) inside pull out drawer
   - Phase Angle Detector Coaxes (accessible in the pull out drawer enclosure)
   - PDM Amplifier banana plugs on A6 and A7
   - PDM Filter plugs on A10
   - PDM Filter output hardware (A10)
   - PDM pull-up board hardware, mounted on A6 and A7

b. Check for debris or loose hardware, especially on rectifiers.

c. Check that all ribbon cables are properly locked into their respective printed circuit board connectors.

A-28. MECHANICAL INSTALLATION

A-29. EQUIPMENT POSITIONING

A-30. Following removal of the shipping crate, move the cabinet on its skid as near as possible to its permanent position. If shipping bolts have been used, they will be located at each corner of the skid. Remove the bolts from the underside of the skid.

NOTE

Positioning of the cabinet is to be performed by experienced personnel to prevent damage to the equipment or injury to personnel.

A-31. With a suitable lifting device, raise one end of the transmitter cabinet sufficiently to permit the placing of three lengths of circular bar stock under the cabinet. In this manner the cabinet can be efficiently and carefully rolled off the skid.

A-32. GROUND STRAP INSTALLATION

A-33. Bolt and solder a 2-inch wide copper grounding strap between the grounding connection, located at the bottom right rear of the transmitter under the dust filter cover, and station earth ground.

A-34. ELECTRICAL INSTALLATION

A-35. POWER REQUIREMENTS. The SX-1 is designed to operate from a standard 208/240 Vac, single-phase, 50 to 60 Hz source. Thirty ampere service is required. Wire the primary of A19T1 and A20T1 to the 240, +11 taps. The final taping of A19T1 and A20T1 will be based on results obtained during the initial turn on procedure.

A-36. ELECTRICAL INSTALLATION PROCEDURE

WARNING

ENSURE THAT ALL AC POWER IS OFF PRIOR TO STARTING THE FOLLOWING INSTALLATION PROCEDURE.

A-37. Refer to drawing 839 5695 247 (Wiring Diagram Power Supply SX-1) and connect high voltage ac input power from Fused Disconnect Box A19S5 (supplied with transmitter) to transmitter cabinet terminal board TB1 terminals 1 and 2 (use #6 AWG for runs of 25 feet or less).

NOTE

Terminal board TB1 is accessed by removing the four screws which hold the circuit breaker panel to the front of the transmitter and then sliding the circuit breaker panel forward. Terminal board TB1 is located on the left wall as viewed from the opening presented when the circuit breaker panel is pulled forward. Terminals are numbered from top to bottom.

A-38. If the High Voltage AC Power lines are to be used for the Low Voltage AC Power source also, connect jumpers (supplied by HARRIS) from terminal board TB1-1 to TB1-5 and from TB1-2 to TB1-6 per drawing 839 5695 247, Wiring Diagram Power Supply SX-1).

A-39. If a separate Fused Disconnect Box (not supplied) is to be used to supply the Low Voltage AC Power, connect the output of this second box to transmitter terminal board TB1-5 and TB1-6 using #12 AWG wire and ensure that there are no jumpers installed between TB1-1 and TB1-5 and TB1-2 and TB1-6. This Fused Disconnect Box should be equipped with 15 amp fuses.

A-40. CUSTOMER INTERFACE CONNECTIONS

A-41. Customer interfacing to the transmitter is accomplished by connecting the appropriate connectors from the Customer Interface Boards A22 and A23 per information provided in table A-3.

A-42. AUDIO INPUT INSTALLATION PROCEDURE

A-43. Connect the center conductors of the audio input cable (twisted, shielded pair) to Customer Interface Board A22 terminals 18 and 20 of terminal board TB2. Connect the shield to terminal 19 of terminal board TB2.

A-44. OUTPUT COAX CABLE INSTALLATION

A-45. Connect the output coax cable from the antenna to the RF OUTPUT jack J3 located on top of the transmitter cabinet.

Table A-3. Customer Interface Connection Points

LOCATION AND CONNECTION	FUNCTION	COMMENTS
REMOTE OUTPUTS		
A23TB1-20	+10 volts	Voltage supplied for customer usage in remote switching and indicating applications that follow.
A22TB1-1,A22TB1-3 A22TB1-3,A22TB1-5 A22TB1-7,A22TB1-9 A22TB1-11,A22TB1-13 A22TB1-15,A22TB1-17	Grounds (For reference only)	
A22TB1-2	Remote FAULT indication	Station needs to provide an indicator from this terminal to +10 volts
A22TB1-4	Remote LOW power indication	Same as FAULT
A22TB1-6	Remote MED power indication	Same as FAULT
A22TB1-8	Remote HIGH power indication	Same as FAULT
A22TB1-10	Remote LOWER power indication	Same as FAULT
A22TB1-12	Remote RAISE power indication	Same as FAULT
A22TB1-14	Remote RF FAULT indication	Same as FAULT
A22TB1-16	Remote MODULATOR FAULT indication	Same as FAULT
A22TB1-18	Remote READY indication	Same as FAULT
A22TB1-19	Ground for remote PA CURRENT metering	

Table A-3. Customer Interface Connection Points (Continued)

LOCATION AND CONNECTION	FUNCTION	COMMENTS
<u>REMOTE OUTPUTS</u>		
A22TB1-20	Remote PA CURRENT metering	
A22TB2-2	Ground for remote PA VOLTS metering	
A22TB2-3	Remote PA VOLTS metering	
A22TB2-4	Ground for remote REFL PWR metering	
A22TB2-5	Remote REFLected PoWeR metering	
A22TB2-6	Ground for remote FWD PWR metering	
A22TB2-7	Remote ForWarD PoWeR metering	

NOTE

Remote inputs are optically isloated and require a voltage to be applied to the terminal pairs listed. A +10 volt terminal is provided at A23TB1-20. Typically, one side of the input terminals will be bussed together. For example, tying the even terminals numbers together to +10 volts then requires the remote control unit to only momentarily switch the odd numbered terminals to ground.

LOCATION AND CONNECTION	FUNCTION	COMMENTS
<u>REMOTE CUSTOMER INPUTS</u>		
A22TB2-8,A22TB2-9 + -	Remote LOWER power control	
A23TB2-8,A23TB2-9 + -	Remote HI power control	

WARNING: Disconnect primary power prior to servicing.

Table A-3. Customer Interface Connection Points (Continued)

LOCATION AND CONNECTION	FUNCTION	COMMENTS
<u>REMOTE CUSTOMER INPUTS</u> (Continued)		
A22TB2-10 (+), A22TB2-11 (-)	Remote RAISE power control	
A22TB2-12 (+), A22TB2-13 (-)	Remote OFF control	
A23TB2-12 (+), A23TB2-13 (-)	Remote FAULT/RESET control	
A22TB2-14 (+), A22TB2-15 (-)	Remote LOW power control	
A23TB2-14, A23TB2-15	Spare	
A22TB2-16 (+), A22TB2-17 (-)	Remote MED power control	
A23TB2-10 (+), A23TB2-11 (-)	Remote EBS/PHASOR OFF (PDM KILL) control	
A23TB2-16 (+), A23TB2-17 (-)	Remote HIGH POWER INTERLOCK control	
A23TB1-14, A23TB1-18	FAILSAFE INTERLOCK Terminals	

NOTE

Contactor coil current passes through the Failsafe Interlock terminals. A constant closure is needed. Opening of the contacts results in de-energizing the HV contactor. Contacts and wiring connected to these terminals should be rated at 125 VAC @ 1 amp.

LOCATION AND CONNECTION	FUNCTION	COMMENTS
A24J16 (on RFI Board)	MODULATION MONITOR Sample	10 V RF (RMS) at 50 ohms (Adjustable - see Section IV)
<u>INPUTS</u>		
A22TB2-18	Audio Input	
A22TB2-19	Ground for Audio Input	
A22TB2-20	Audio Input	

WARNING: Disconnect primary power prior to servicing.

A-47. PRE-TURN ON ELECTRICAL CHECKS

A-48. Connect + lead of VOM to B+ lead on PA Module and - lead to cabinet ground. This should measure zero ohms. Open door shorting switches by hand, VOM should deflect toward infinite resistance.

A-49. With leads still connected from previous step, manually simulate the door closing by opening the latch side door switch and the hinge side door switch. Releasing the latch side door switch should give a reading of approximately 2 ohms. Releasing the hinge side door switch should give a reading of zero ohms.

A-50. With VOM measure all transistor cases to heatsink. Make sure resistance measurements read open with VOM on Rx1 scale (ensure door shorting switches are open).

A-51. Check High Voltage Power Supply rectifiers with VOM.

A-52. Check all fuses on Rx1 scale with VOM.

A-53. Check for mechanical zero of front panel meters.

A-54. INITIAL TURN ON PROCEDURES

A-55. Before initial turn on, ensure that the following items are checked:

a. Ground strap is properly connected between transmitter and station earth ground.

b. Check for debris/hardware in base of transmitter and in AC Panel.

c. AC input wiring is properly connected.

d. Transmitter output is properly terminated into a suitable load capable of handling rated output power (antenna or dummy load).

e. Audio input is properly connected.

f. Monitoring equipment is properly connected.

   Modulation Monitor connects to connector J16 on RFI board. Frequency Monitor connects to J6A on bulkhead connector on back of drawer enclosure.

g. Controls and Indicators section of Operators Technical Manual has been reviewed and is understood.

h. The REMOTE/LOCAL switch S1 on the Status and Multimeter board A12 should be in the local mode. If no remote control wiring is connected at this time, it will not matter which position the REMOTE/LOCAL switch is in.

A-56. INITIAL TURN ON

WARNING

THE NORMAL PROCEDURE IN TRANSMITTER TURN OFF SHOULD BE FOLLOWED IN DEENERGIZING THIS TRANSMITTER. TURN OFF THE HIGH VOLTAGE BY DEPRESSING THE OFF BUTTON. LOW VOLTAGE MAY THEN BE REMOVED BY SETTING THE LOW VOLTAGE CIRCUIT BREAKER TO OFF. IF YOU MUST ENTER THE TRANSMITTER, ALLOW THE POWER SUPPLY TO DISCHARGE AS INDICATED BY THE FRONT PANEL METERS. DISCONNECT ALL PRIMARY POWER SERVICE. OPEN THE DOOR SLOWLY TO ALLOW THE INITIAL RESISTOR DISCHARGE MECHANISM TO FUNCTION. UPON OPENING THE DOOR FURTHER THE POWER SUPPLY WILL BE SHORTED TO GROUND AND MADE SAFE. A GROUNDING STICK IS PROVIDED IN THE TRANSMITTER AND SHOULD BE USED TO ASSURE THAT ALL HIGH VOLTAGE HAS BEEN REMOVED UNDER FAULT CONDITIONS. BE CAREFUL NOT TO GROUND ANY CONNECTIONS WHICH ARE STILL ENERGIZED. THIS WOULD INCLUDE ALL LOW VOLTAGE CIRCUITS IF THE LOW VOLTAGE CIRCUIT BREAKER HAS NOT BEEN SET TO OFF POSITION.

CAUTION

IF ANY ABNORMALITIES ARE ENCOUNTERED IN THE FOLLOWING STEPS, STOP THE PROCEDURE, REMOVE ALL POWER, AND PROCEED TO TROUBLESHOOTING SECTION OF SX-1 MAINTENANCE TECHNICAL MANUAL.

A-57. Open rear door.

A-58. Apply ac power through the High Voltage Disconnect Box A19S5 and the optional Low Voltage Disconnect Box if used.

A-59. Set the LOW VOLTAGE circuit breaker A20CB1 to ON position.

A-60. Verify keypad display is illuminated.

A-61. Verify green LED A13/A14 DS1 on System Controller is illuminated. (If two System Controllers are installed check that indicators are illuminated on both boards.)

WARNING

ENSURE ALL VOLTAGE IS REMOVED FROM TRANSMITTER AND ALL POINTS WHERE VOLTAGE HAS BEEN APPLIED ARE GROUNDED BEFORE CHANGING ANY TAPS IN THE FOLLOWING STEP.

A-62. Use a suitable voltmeter to measure the ±30 volt supply. A convenient point for checking these voltages is on the PDM Generator, A15) at the fuses. Measure each voltage with respect to ground. If the voltages are under 28 Vdc, disconnect ac power and retap A20T1 to the next lower primary voltage (taps 240, 0). It is desired that the low voltage supply be between 28 and 32 Vdc both plus and minus. Use a procedure of removing ac power, grounding transformer taps, moving the primary wiring to the next lower increment, then measuring ±30 volt supplies, to achieve the desired supply voltages.

A-63. Verify that when the three power on pushbuttons (LOW, MEDIUM, HIGH) are depressed they illuminate. AC contactors should not be heard energizing at this time.

A-64. Verify that depressing the OFF pushbutton clears all power on pushbuttons. The OFF pushbutton itself will only be illuminated during a fault condition.

A-65. Depress *44 on Keypad to monitor PDM power setting.

A-66. Depress the LOW, MEDIUM, and HIGH pushbuttons independently and lower the PDM power setting using the LOWER pushbutton until reaching .000 on the *44 display.

A-67. Depress the OFF pushbutton. Depress the RAISE or LOWER pushbuttons until an approximate .300 setting is obtained on the *44 display.

A-68. Make sure OFF pushbutton has been depressed.

A-69. Close the rear door. Ensure that all doors and panels are closed. Ensure that all external interlock devices are in place.

A-70. Depress the LOW power pushbutton. The contactors should close and apply main AC voltage to the high voltage supply. During the step start sequence there three contactor "clicks". This is because the first contactor drops out when the second contactor pulls in.

WARNING

IF CONTACTORS DO NOT CLOSE IN THE PRECEEDING STEP, REMOVE ALL POWER FROM TRANSMITTER AND ENSURE FAILSAFE INTERLOCK CONTACTS A23TB1-14 AND A23TB1-18 ARE JUMPERED OR EXTERNAL FAILSAFE HIGH VOLTAGE INTERLOCK CIRCUIT IS PROPERLY CONNECTED. REFER TO TABLE A-3 FOR REQUIREMENTS IN CONNECTING THE EXTERNAL FAILSAFE HIGH VOLTAGE INTERLOCK CIRCUITRY.

A-71. Enter *01 on Keypad. This monitors the power supply voltage. It should be in the range of 200 to 260. This is a fairly broad range due to range of expected ac power line voltages. What is important is that the high voltage supply is actually on.

A-72. Verify that the FAULT indicator is extinguished.

A-73. Depress the RAISE pushbutton and observe the PAV, PAI, and PWR meters.

A-74. Raise the power until the *44 power setting is the same as the low power setting (41) stated on the factory Final Test Data Sheets.

A-75. Switch the power meter to read REFLD power and verify that the reflected power is near zero.

A-76. If the power meter reflected reading is not zero, then adjust the TUNING and LOADING controls to minimize the reflected power. Only very small changes to the TUNING (L4) and LOADING (L5) controls should be necessary.

NOTE

The procedure for tune up may seem a bit unconventional, but it is also uncomplicated. This is due to the special placement of the Directional Coupler in the output network. The procedure of minimizing reflected power assures the PA to be operating into the same carrier impedance as it was during factory testing. While tuning the transmitter into the antenna, proper tuning should be found to be well within the range of the TUNING and LOADING controls. If it appears to require substantial re-adjustment, it is advisable to have the antenna impedance (at the transmitter output terminal) measured and adjusted if necessary. There is only one proper setting for the TUNING and LOADING controls (minimum reflected power). Adjustments in power level should only be made with the RAISE or LOWER pushbuttons.

A-77. The LOADING (L5) control should affect primarily only the real part of the load on the transistors. This determines the ratio of the PA voltage to the PA current.

A-78. The TUNING (L4) control should affect primarily only the reactive part of the load on the transistors. This determines the efficiency of the PA. Maximum efficiency should occur when the transistor voltage and current are in phase.

A-79. It is intended that the maintenance personnel adjust the TUNING and LOADING controls for minimum reflected power on the directional coupler. If testing indicates that proper transmitter operation occurs with significant reflected power, the output network itself may need to be readjusted. This procedure requires special equipment and should not be attempted by station maintenance personnel.

A-80. Depress the HIGH power pushbutton.

A-81. Depress the RAISE pushbutton and watch the PAV, PAI, and PWR meters.

A-82. Raise the power until the *44 power setting is the same as the HIGH power setting stated on the factory Final Test Data Sheets.

A-83. Switch the power meter to read reflected power and verify that the reflected power is near zero.

WARNING: Disconnect primary power prior to servicing.

A-84. Adjust the TUNING and LOADING controls to minimize the reflected power if necessary.

WARNING

ENSURE ALL VOLTAGE IS REMOVED FROM TRANSMITTER AND ALL POINTS WHERE VOLTAGE HAS BEEN APPLIED ARE GROUNDED BEFORE CHANGING ANY TAPS IN THE FOLLOWING STEP.

A-85. Enter *01 on the Keypad/Display to display the high voltage supply voltage. Depending on the exact line voltage, the voltage displayed on the digital readout may be very near or below the figure recorded on the Factory Test Data Sheets. Refer to the Factory Test Data Sheets for this figure. If the *01 reading is significantly below the factory test data figure, shut the transmitter down, disconnect ac power, ground all points where power has been applied, and retap the primary accordingly. It is advisable to make small changes in the primary tapping to arrive at a voltage close to the factory test conditions.

A-86. Adjustments in power output level should be made with the RAISE and LOWER pushbuttons after the correct high voltage supply voltage is obtained. Compare all readings with the factory test data. Report any major discrepancies to the HARRIS Service Department.

A-87. Switching the REMOTE/LOCAL switch S1 on the Status and Multimeter board A12 to the REMOTE position will enable the remote control circuits.

A-88. This concludes the initial turn on procedure. The transmitter is ready for modulation.

A-89. TECHNICAL ASSISTANCE

A-90. HARRIS Technical and Troubleshooting assistance is available from HARRIS Field Service during normal business hours (8:00 a.m - 5:00 p.m. Central Standard 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 Group, P.O. Box 4290, Quincy, Illinois 62305-4290, USA. The HARRIS factory may also be contacted through a TWX facility (910-246-3312) or a TELEX service (40-4347).

APPENDIX B

TEST EQUIPMENT

B-1. INTRODUCTION

B-2. This appendix contains a list of the test equipment provided and/or recommended to perform general maintenance and troubleshooting on the SX-1 AM TRANSMITTER.

An oscilloscope with 15 MHz or higher bandwidth

A VOM with an ohmmeter battery voltage between 3 and 18 V

A low distortion sinewave audio generator

A noise/distortion meter

Digital Logic Probe

WARNING: Disconnect primary power prior to servicing.