TECHNICAL MANUAL

OPERATION AND MAINTENANCE INSTRUCTIONS WITH ILLUSTRATED PARTS BREAKDOWN (ORGANIZATIONAL/INTERMEDIATE)

RADIO FREQUENCY AMPLIFIER, AM7223/URC, P/N 10086-0000

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SAFETY SUMMARY

The following are general safety precautions that are not related to any specific procedures and therefore do not appear elsewhere in this publication. These are recommended precautions that personnel must understand and apply during many phases of operation and maintenance.

KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must at all times observe all safety regulations. Do not replace components with the power supply turned on. Under certain conditions, dangerous potentials may exist when the power control is in the off position, due to charges retained by capacitors. To avoid casualties, always remove power and discharge circuits to ground before touching any circuit components. Remove watches and rings before performing any maintenance procedures.

DO NOT SERVICE OR ADJUST ALONE

Under no circumstances should any person reach into or enter the enclosure for the purpose of servicing or adjusting the equipment except in the presence of someone who is capable of rendering aid.

RESUSCITATION

Personnel working with or near high voltages should be familiar with modern methods of resuscitation. Cardiopulmonary resuscitation procedures are outlined in T.O. 31-1-141-1, and annual refresher training requirements are outlined in AFOSH STD 127-50.

The following warnings appear in the text in this volume, and are repeated here for emphasis.

WARNING

Dangerous voltages exist in this radio equipment. Before removing any covers, disconnect the primary power.

WARNING

Avoid breathing fumes generated by soldering. Eye protection is required.

WARNING

Improper grounding of the Remote Control Unit can cause dangerous voltage to be present on the equipment chassis in the event of a malfunction.

HANDLING OF ELECTROSTATIC DISCHARGE SENSITIVE DEVICES (ESDS)

Electrostatic Discharge Sensitive Devices (ESDS) must be handled with certain precautions that must be followed to minimize the effect of static build-up. Consult T.O. 00-25-234, DOD Std-1686, and DOD HDBK 263. ESDS Devices are identified in this technical order by the following symbol:

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GLOSSARY

A	Ampere(s)
A/D	Analog-to-Digital (Converter)
AFSK	Audio frequency shift keying; a baseband modulation scheme in which two audio frequencies are used to represent binary coded data; the frequency is shifted to one frequency to represent a 1 (mark) and to the other to represent a 0 (space).
AGC	Automatic gain control
ALE	Address latch enable
AM	Amplitude modulation; a modulation scheme in which the carrier is made to vary in amplitude in accordance with the modulating signal.
AME	Amplitude modulation equivalent
ANTIVOX	Prevents false VOX operation; see VOX
BFO	Beat Frequency Oscillator, used in SSB detection circuits
BIT	Built-in Test
BIU	Bus interface unit
BW	Bandwidth
CPU	Central processing unit
CREV	Converter reverse
CW	Continuous wave; a wave that does not vary in amplitude or frequency and is turned on and off to carry intelligence, e.g., Morse Code
D/A	Digital-to-Analog (Converter)
dB	Decibel(s)
dBm	Decibel(s) relative to one milliwatt
EMI	Electromagnetic interference
EPROM	Erasable programmable read-only memory
EU	Execution unit
HF	High frequency; a radio frequency band extending from about 3 MHz to 30 MHz; in this manual, HF includes 1.6 to 30 MHz.
HV	High voltage
IF	Intermediate frequency
IM	Intermodulation (distortion)
I/O	Input/Output
KREV	Keyer reverse
LCD	Liquid crystal display
LED	Light emitting diode
LPA	Linear power amplifier
LSB	Lower sideband; a modulation scheme in which the intelligence is carried on the first sideband below the carrier frequency; see SSB
MIC	Microphone
mA	Milliampere(s)
mV	Millivolt(s)
NBSV	Narrow band secure voice
PEP	Peak envelope power
PPC	Peak power control
PWB	Printed wiring board
RAM	Random access memory
rms	Root mean square
RTC	Real time clock
RX	Receive

GLOSSARY (Continued)

S TONE	Sidetone
SSB	Single sideband; a modulation scheme in which the intelligence is carried by one of the carrier sidebands, the other sideband and the carrier center frequency being suppressed
TGC	Transmitter gain control
TX	Transmit
uA	Microampere(s)
uP	Microprocessor
USB	Upper sideband; a modulation scheme in which the intelligence is carried on the first sideband above the carrier frequency; see SSB
uV	Microvolt(s)
Vac	Volts, alternating current
VCO	Voltage controlled oscillator
Vdc	Volts, direct current
VOX	Voice operated transmission
VSWR	Voltage standing wave ratio; the ratio of the maximum to the minimum voltage of a standing wave on a radio frequency transmission line
W	Watt(s)

INTRODUCTION

The purpose of this on-equipment level manual is to provide all information necessary for the installation, operation and on-equipment maintenance of Amplifier, Radio Frequency, AM-7223/URC, manufactured by the RF Communications Group of Harris Corporation, Rochester, New York. The manual is divided into eight chapters. The contents of each chapter are briefly described in the following paragraphs.

Chapter 1 provides a general description and a list of capabilities and limitations of the Amplifier, Radio Frequency, AM-7223/URC. A list of companion equipment references are included along with the components that form the AM-7223/URC.

Chapter 2 provides the information necessary for planning and carrying out the installation of the Amplifier, Radio Frequency, AM-7223/URC. A dimensional outline drawing is provided to show dimensions and other information required for proper installation.

Chapter 3 provides instructions for preparing the Amplifier, Radio Frequency, AM-7223/URC for use, including the initial application of power and checkout. Instructions for repacking the equipment for reshipment are also included in Chapter 3.

Chapter 4 provides complete operating instructions for the Amplifier, Radio Frequency, AM-7223/URC in all modes and contains a list of operating controls and indicators.

Chapter 5 provides a complete theory of operation for the Amplifier, Radio Frequency, AM-7223/URC. An overall theory and detailed theory of individual functional circuits are provided.

Chapter 6 describes the on-equipment location maintenance procedures. On-equipment location maintenance is based on the use of built-in test (BIT) features of the equipment to isolate problems to the replaceable subassembly or printed wiring board (PWB) level. Depot maintenance is supplied in a separate publication, T.O. 35C1-2-892-3. The Depot Manual is based on performance testing and trouble analysis of the subassembly or PWB to locate and replace faulty parts at the lowest replaceable unit level (LRU).

Chapter 7 contains the Illustrated Parts Breakdown (IPB) information at the on-equipment level. This includes assemblies and parts that may be replaced at the on-equipment location.

Chapter 8 contains all fold-out (FO) drawings. A cross reference list is provided as well as the individual drawings referenced throughout chapters 1 to 7. The diagrams are numbered FO-1, FO-2, etc. They are printed on sheets with page-size blank aprons to permit viewing the diagram with the rest of the book closed or opened to another page.

APPLICABLE SPECIFICATIONS

The following specifications, standards, and publications were used in the preparation of this manual.

SPECIFICATION	NAME
MIL-M-38798B, para. 3.4	Combined Operation and Maintenance Instructions Manual (Equipment).
MIL-M-38807, Amend. 4	Preparation of Illustrated Parts Breakdown.
MIL-M-38790 and MIL-M-38784A	General Requirements for Preparation of Technical Manuals.

APPLICABLE STANDARDS

STANDARD	NAME
MIL-STD-12	Abbreviations for use on Drawings and in Technical Type Publications.
MIL-STD-15-1A	Graphic Symbols for Electrical Components.
MIL-STD-17-1	Mechanical Symbols.
MIL-STD-806	Graphic Symbols for Logic Diagrams.

APPLICABLE PUBLICATIONS

PUBLICATION	NAME
DOD 5200.20	Distribution Statements on Technical Documents.
USAS Y14.15-1966	Electrical and Electronic Diagrams.
USAS Y32.16-1968	Electrical and Electronic Reference Designations.
T.O. 31-1-141 (Series)	Technical Manual-Basic Electronic Technology and Testing Practices.

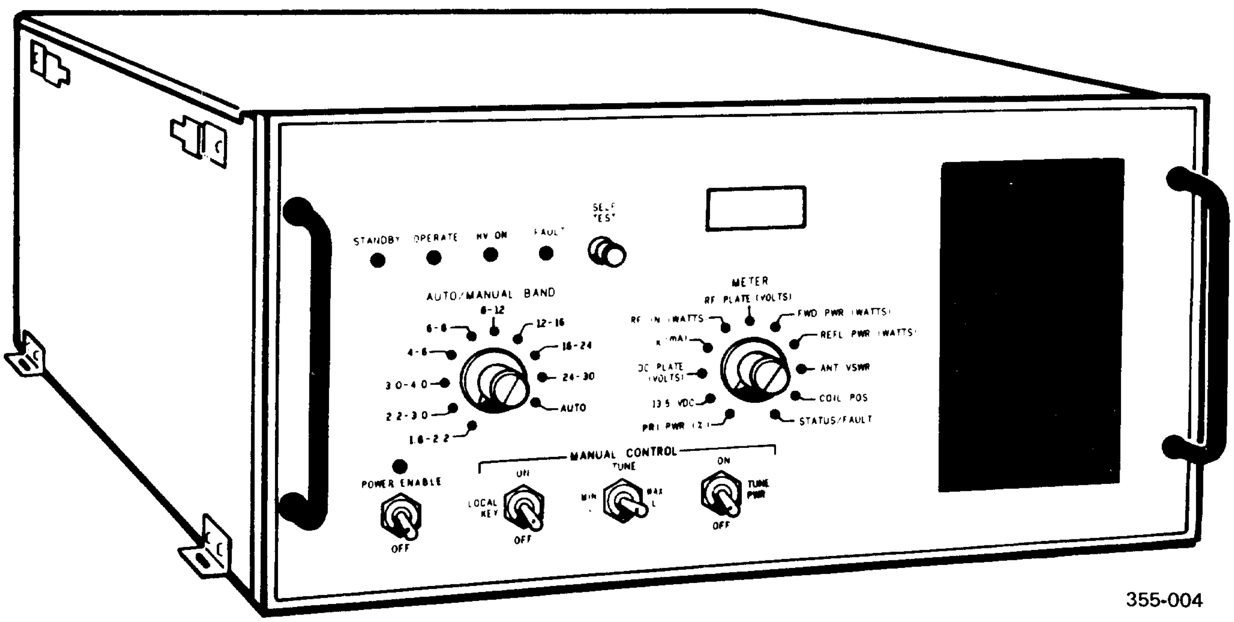

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Figure 1-1. Radio Frequency Amplifier AM-7223/URC

CHAPTER 1

GENERAL INFORMATION

1-1. GENERAL DESCRIPTION AND USE. Radio Frequency Amplifier AM-7223/URC, shown in figure 1-1, and hereafter known as the 500 Watt LPA, is a microprocessor controlled power amplifier that amplifies the selected HF (high frequency) input signal from a 100 Watt Transceiver in the frequency range of 1.6 to 30 MHz. The output level delivered by the 500 Watt LPA is 500 watts PEP (peak envelope power) with multiple tone input signals, or 250 watts average with lock keyed CW or a continuous single tone input signal. The 500 Watt LPA tunes automatically in response to frequency data from the 100 Watt Transceiver and to its own internally generated fine tuning (servo) signals. Automatic tuning is accomplished in 10 seconds or less. The 500 Watt LPA can also be tuned manually, using front panel controls.

a. Applications. The 500 Watt LPA is used in applications where the 100 watt output of the 100 Watt Transceiver is not sufficient to provide for the desired level of communication. Built-in test (BIT) features provide fault indications in response to a test routine initiated either at the 100 Watt Transceiver, in automatic mode, or at the 500 Watt LPA front panel in the manual mode. Fault indications are sent to the 100 Watt Transceiver for display as fault codes that aid in localizing malfunctions to problem areas in the 500 Watt LPA.

b. Power Requirements. The 500 Watt LPA may be operated from either an ac or a dc power source. In an ac powered system, primary input power, 115/208/230 Vac, is applied through the primary power relay and the rear panel circuit breakers to both the high voltage transformer and the low voltage transformer, while A4 provides the +13.5 Vdc necessary to operate all of the other circuits in the 500 Watt LPA. In a dc powered system, +28 Vdc is applied to the DC Inverter Option (PP-8093/URC) to develop a 400 Hz, 160 volt square wave that is applied to High Voltage Transformer T1 to obtain the plate high voltage. Low Voltage Power Supply A4 uses 28 Vdc directly to produce 13.5 Vdc for the tube filaments and for other low voltage requirements of the 500 Watt LPA. A4 also contains a 400 Hz, 115 Vac inverter which is used to power the cooling fan, B1.

c. Reliability. The 500 Watt LPA is designed for continuous operation under severe environmental conditions in either fixed or mobile applications. Automatic sensing circuits protect the LPA from damage due to overdrive, abnormal tuning, or high VSWR, including open or short circuit conditions, high and low line voltages, insufficient air flow, and/or overtemperature.

1-2. EQUIPMENT FUNCTIONAL DESCRIPTION. Figure 1-2 is a simplified functional diagram used to support the following discussion.

a. Signal Paths. Control, tuning, and support logic for the 500 Watt LPA, including 100 Watt Transceiver interface data and parameters from Front Panel Assembly A7, are administered by Microprocessor Control PWB Assembly A6. Frequency information is sent to the LPA from the 100 Watt Transceiver upon initiation of a keyline command after a frequency change greater than 1%. This information is read by the microprocessor, which generates a bandswitch code that is applied through the Servo/Bandswitch Drive PWB Assembly A2A3 to an open-seeking bandswitch wafer. The microprocessor also determines the required direction of rotation of the tuning inductor to reach a pre-tune position and issues a MIN L or MAX L direction command to the coil servo. When both the inductor and the bandswitch have arrived at the pre-tune positions, the microprocessor initiates a fine tune sequence. This sequence is accomplished by calling for tune power from the 100 Watt Transceiver and monitoring the RF plate voltage while adjusting the variable inductor slowly. When fine tuning has been completed, the 500 Watt LPA informs the 100 Watt Transceiver that the PA Operate mode is established.

b. Outputs.

(1) In the Transmit mode, the XCVR RF signal is routed by the T/R relay on the Output Filter PWB Assembly A3 to the Tube Assembly A1 where it is

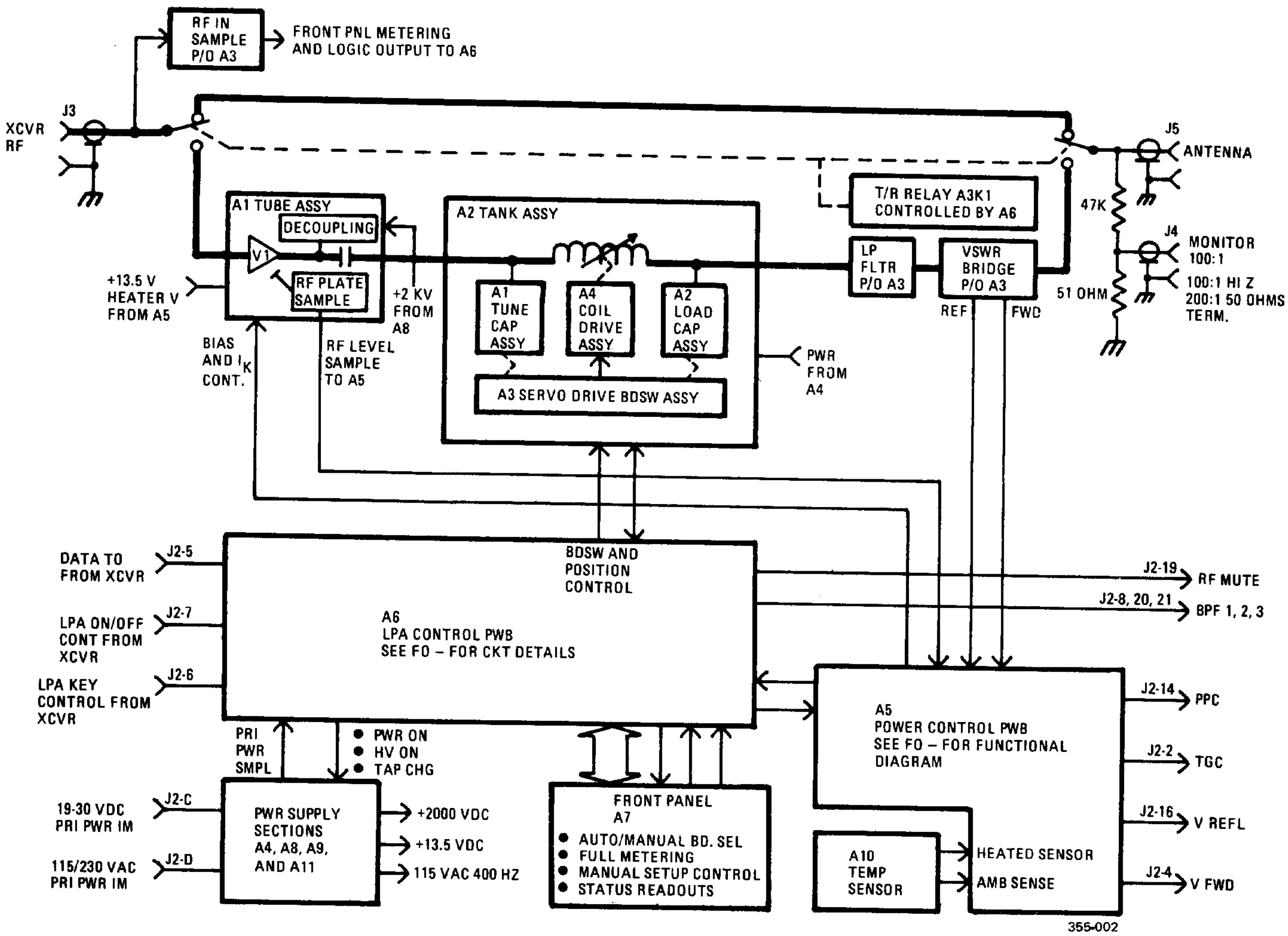


Figure 1-2. Simplified Functional Diagram

amplified. The RF signal then passes through the tuned 500 Watt Tank Assembly A2 to the Low Pass Filter and the VSWR Bridge circuit on the Output Filter Assembly A3. From the VSWR Bridge circuit, the RF signal is applied to the antenna connector J5 on the 500 Watt LPA via the T/R relay.

(2) In the receive mode, the RF signal from the antenna connector J5 is routed to the XCVR RF connector J3 via the T/R relay on the Output Filter Assembly A3.

1-3. MECHANICAL DESIGN. The mechanical construction of the 500 Watt LPA is shown in figure 1-3. The unit consists of one major assembly with twelve subassemblies. The major assembly is the 500 Watt LPA Chassis Assembly, which contains all of the subassemblies. The twelve subassemblies are: Tube Assembly A1, Tank Assembly A2, Output Filter PWB Assembly A3, Low Voltage Power Supply PWB Assembly A4, Power Control PWB Assembly A5, Microprocessor Control PWB Assembly A6, Front Panel Assembly A7, Bleeder/Rectifier PWB Assembly A8, DC Control PWB Assembly A9, Temperature Sensor PWB Assembly A10, LV Filter PWB Assembly A11, and Fan B1. The tunable components of the 500 Watt LPA are located in Tank Assembly A2. The top cover of the Chassis Assembly is removable so that all other assemblies are accessible for removal or maintenance.

1-4. LEADING PARTICULARS. The characteristics of the 500 Watt LPA are summarized in table 1-1. This table includes physical data and operating/storage environment data.

1-5. CAPABILITIES AND LIMITATIONS. The capabilities and limitations of the 500 Watt LPA are described in table 1-2.

1-6. EQUIPMENT AND ACCESSORIES SUPPLIED. Table 1-3 lists the supplied assemblies, components, units, cables, and accessory kits that pertain to the 500 Watt LPA.

1-7. EQUIPMENT REQUIRED BUT NOT SUPPLIED. Table 1-4 lists equipment required, but not supplied, for the installation and operation of the 500 Watt LPA. It is specifically designed to interface with the equipment listed in table 1-4.

1-8. SPECIAL TOOLS AND TEST EQUIPMENT. The servicing and maintenance of the 500 Watt LPA does not require any special tools, test jigs, or fixtures. All on-equipment maintenance uses the BIT feature, and replacement of indicated assemblies is completed with common hand tools, e.g., screwdriver, etc. Refer to the Depot Manual for a list of test equipment used to service this equipment at the Depot level.

1-9. RELATED PUBLICATIONS. Table 1-6 lists the Technical Order publications related to the use of the 500 Watt LPA.

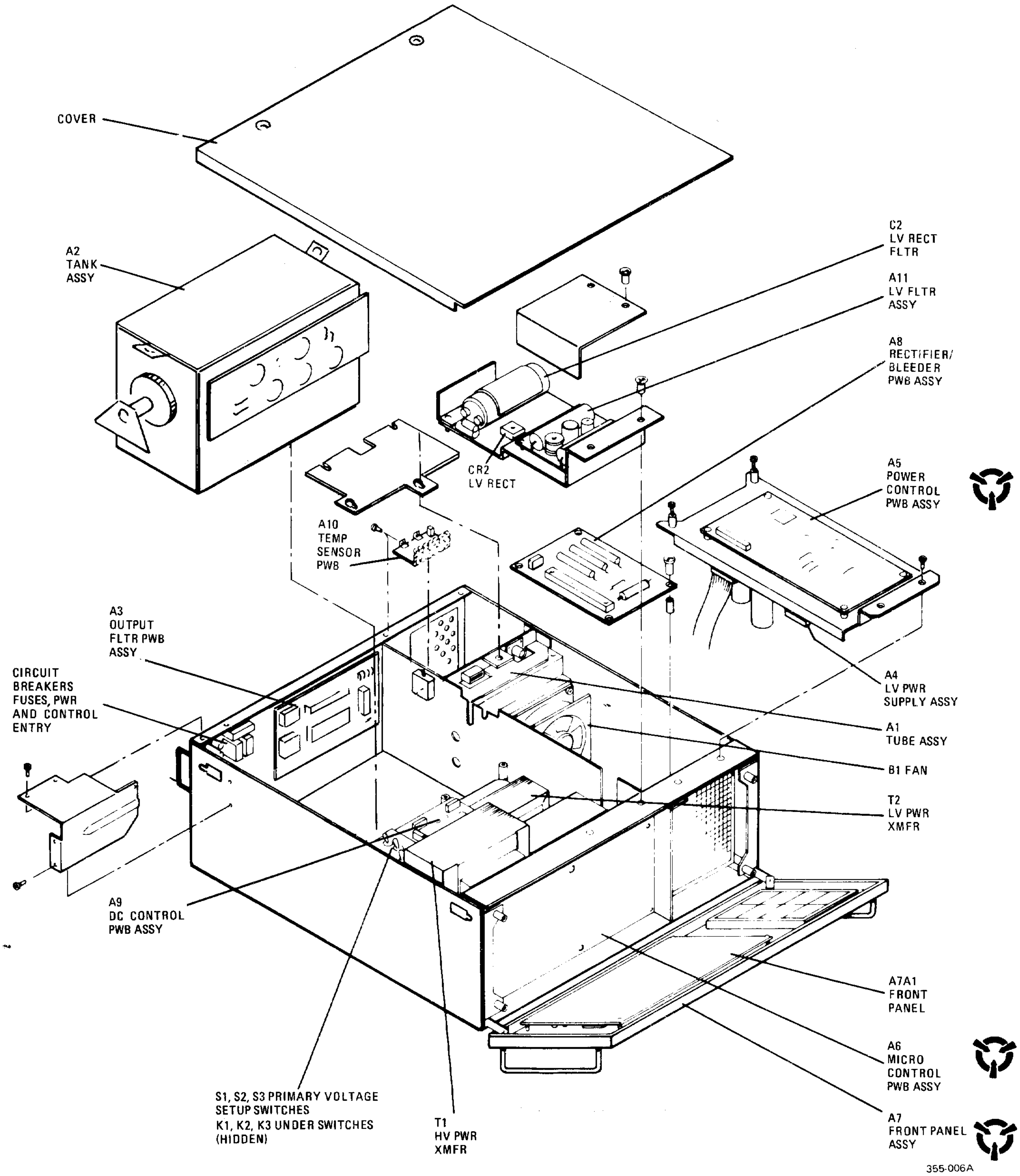


Figure 1-3. Identification of Subassemblies

Table 1-1. Leading Particulars

Item	Characteristic or Value
Dimensions: Height: Width: Depth:	 07.00 inches (17.80 cm) 16.75 inches (42.54 cm) 20.50 inches (52.07 cm)
Weight:	78.00 pounds (29.09 kg) Crated Weight is approx. 95 pounds (35.44 kg)
Mounting:	Desk, rack, or stack
Power Requirements:	Input Power: Ac: 115/208/230 Vac ± 10% at 50 to 400 Hz, single phase, 16/8/8 amps maximum Dc: +28.0 Vdc, 10 amps maximum
Operating Environment:	Temperature: -30 C to +50 C Relative Humidity: 10% to 95% (non-condensing)
Storage Environment:	Temperature: -35 C to +70 C Relative Humidity: 10% to 95% (non-condensing)
Operating Altitude:	10,000 feet above mean-sea-level (MSL)
Transport Altitude:	40,000 feet above MSL
Shock/Vibration:	MIL-STD-810C
Cooling:	Convection and forced air (built-in fan)

Table 1-1. Leading Particulars (Continued)

Item	Characteristic or Value
Cabling Requirements:	Rear Panel Connections J1 - POWER J2 - XCVR CONTROL A3J3 - XCVR RF A3J4 - RF MONITOR A3J5 - ANTENNA
Transportability:	Manual methods apply
Setup Time:	Less than 1 hour

Table 1-2. Capabilities and Limitations

	Description of Characteristic
Use:	Signal amplification from 100 watts to 500 watts between the 100 Watt Transceiver and the 100/500 Watt Antenna Coupler (e.g., Receiver-Transmitter, Radio RT-1446/URC and Antenna Coupler CU-2310/URC).
Frequency Range and Tuning Capability:	1.6 to 30 MHz in AUTO or in nine MANUAL bands: Band 1 - 1.6 to 2.2 MHz Band 2 - 2.2 to 3.0 MHz Band 3 - 3.0 to 4.0 MHz Band 4 - 4.0 to 6.0 MHz Band 5 - 6.0 to 8.0 MHz Band 6 - 8.0 to 12.0 MHz Band 7 - 12.0 to 16.0 MHz Band 8 - 16.0 to 24.0 MHz Band 9 - 24.0 to 30.0 MHz
RF Drive Power Required:	65 watts for full power output

Table 1-2. Capabilities and Limitations (Continued)

	Description of Characteristic
Maximum Rated RF Bypass Power:	100 watts average or 100 watts PEP
Maximum Rated RF Output Power:	500 watts PEP when loaded with two tones driven by the 100 Watt Transceiver. 250 watts continuous average power with a CW input signal or a single-tone input signal.
Tuning Mode:	Automatic with Manual tuning backup. Automatic Tune Time - 10 seconds Maximum
Metering:	Forward power, reflected power, cathode current, DC plate voltage, RF plate voltage, VSWR, RF input power, 13.5 Vdc, and primary power
Channel Change Time:	5 seconds nominal
Nominal Output Impedance:	50 ohms
Working VSWR:	2:1 (self-protecting for any load)
Intermodulation Distortion:	Third order harmonic is more than 33 dB down from the rated PEP output of two equal tones.
Harmonic Output:	More than 40 dB down
Features:	RF Protection Circuits protect the 500 Watt LPA from overdriving or abnormal tuning and from abnormal VSWR, including the condition of a short or open circuit. Automatic receive capability is available in unkeyed state. The LPA can be remotely controlled from the 100 Watt Transceiver. Tests points and metering facilitate operation and maintenance. This unit provides high/low line protection and protection from overtemperature and low air flow conditions.

Table 1-2. Capabilities and Limitations (Continued)

	Description of Characteristic
Primary Power Requirements:	115/208/230 Vac (single phase) - 150 W, standby - 150 W, operate (unkeyed) - 1350 W, operate (keyed, 250 W avg. power out) or +28 Vdc (with use of optional DC inverter) - 150 W, standby - 150 W, operate (unkeyed) - 1350 W, operate (keyed, 250 W avg. power out)
Remote Capability:	100 feet (30.4 M) separation (maximum) between 100 Watt Transceiver and 500 Watt LPA. 250 feet (76.2 M) between 500 Watt LPA and 100/500 Watt Antenna Coupler. 20 feet (6.1 M) separation (maximum) between DC Inverter Option and 500 Watt LPA, depending on size of wire.
Control Lines (J1) :	115 COMMON/230 : 115/230 VAC 115/230 VAC : 115/230 VAC GND : GND +19 TO +30 VDC* : 19-30 VDC GND* : GND 115 VAC* : 115 VAC 115 VAC COMMON* : GND TAP CHANGE* : 13.5 V HV ON* : 13.5 V GND* : GND *Used when the primary power source is the DC Inverter Option.
Control Lines (J2):	PPC - : GND PPC + : 5.6 volts (Threshold) TGC - : GND TGC + : 0 volts to 8 volts V REFLD : 4 volts = 500 W V FWD : 4 volts = 500 W LPA ON/OFF : 13.5 volts = ON RF MUTE : 0 volts = MUTE LPA KEY : 0 volts = KEYED DATA - : GND DATA + : 0 volts to 5 volts LPA ID : GND

Table 1-2. Capabilties and Limitations (Continued)

Description of Characteristic	
Transceiver Interface:	RF coaxial cable and a 19-wire control cable (14 active an 5 spares)
Antenna Coupler Interface:	RF coaxial cable
Tune Power Requirements:	3 watts to 10 watts to carrier

Table 1-3. Equipment and Accessories Supplied

Qty	Item	Use
1	Amplifier, Radio Frequency AM-7223/URC	Amplifies 100 Watt Transceiver output to 250 W AVG/500 W PEP.
1	Technical Manual TO 31R2-2URC-101	Contains installation and maintenance information for the 500 Watt LPA.

Table 1-4. Equipment Required but Not Supplied*

Qty	Item	Use
1	100 Watt Transceiver RT-1446/URC	Companion equipment. Used for reception and transmission of RF signals.
1	Antenna	Required for reception and transmission of radio frequency signals.
1 Drop per screw	Loctite #262 (Red)	For screws fastening handles to front panel.

Table 1-4. Equipment Required by Not Supplied* (Continued)

1 Drop per screw	Loctite #242 (Blue)	For screws fastening handles to rear panel.
1 Drop per screw	Loctite #222 (Violet)	For Fl. Hd. screws fastening L.V. Filter Cover.
As Required	P20-0003-000	For bonding channel gasket to L.V. Filter Cover.
1	Ancillary Kit, 10086-0060. consisting of items listed below.	Provides mounting hardware and interface connectors.
1	Power Cable Assy, 10086-0080	Connects 500 Watt LPA to 115/208/230 Vac Source.
1	Connector/Receptacle. 25 Pin. J22-0001-002	Mates with J2 on back of 500 Watt LPA.
1	Connector, Pins, 25 Pin J22-0001-001	Mates with J8 on back of 100 Watt Transceiver.
2	Hood, D Connector, 25 Pos J55-0015-025	Used with J22-0001-001 and J22-0001-002.
2	Ferrule J55-0015-901	Used with J22-001-001 and J22-0001-002.
4	Post, Stacking 10087-3107	Used on 500 Watt LPA when 100 Watt Transceiver is stacked on top.
4	Feet Z17-0010-001	Used on the bottom of the 500 Watt LPA when in the desk or stacked configuration.

*For test equipment required, see table 6-3.

Table 1-5. Optional Equipment

Qty	Item	Description
1	Remote Control Unit C-11329/URC	Used when it is desired to operate the 100 Watt Transceiver and the 500 Watt LPA from a remote location.
1	100/500 Watt Antenna Coupler, CU2310/URC	Companion equipment; used to match the 100 Watt Transceiver or the 500 Watt LPA to the antenna system.
1	DC Inverter Option, PP-8093/URC	Used when it is desired to operate the 100 Watt Transceiver and the 500 Watt LPA from a 28 Vdc power source.
1	Transit Case, CY-8360/URC which includes the items listed below:	Case used to transport the 500 Watt LPA.
1	Control Cable (6 feet), 10086-0026	For connecting the 500 Watt LPA to the transceiver control jack.
1	RF Cable (6 feet), 10086-0027	For connecting the 500 Watt LPA to the RF IN/OUT jack on the transceiver.

Table 1-6. Related Publications

Title	Publication No.
100/500 Watt Antenna Coupler, CU-2310/URC	
On-Equipment Manual	TO 31R2-2URC-111
Depot Manual	TO 31R2-2URC-113
Work Cards	TO 31R2-2URC-116WC-1
Receiver-Transmitter, Radio, RT-1446/URC	
On-Equipment Manual	TO 31R2-2URC-81
Depot Manual	TO 31R2-2URC-83
Work Cards	TO 31R2-2URC-86WC-1
Amplifier, Radio Frequency, AM-7223/URC	
On-Equipment Manual	TO 31R2-2URC-101
Depot Manual	TO 31R2-2URC-103
Work Cards	TO 31R2-2URC-106WC-1
Power Supply, PP-7913/URC	
On-Equipment Manual	TO 35C1-2-892-1
Depot Manual	TO 35C1-2-892-3
Work Cards	TO 35C1-2-892-6WC-1
Amplifier, Radio Frequency, AM-7224/URC	
On-Equipment Manual	TO 31R2-2URC-121
Depot Manual	TO 31R2-2URC-123
Work Cards	TO 35C1-2-892-6WC-1
Remote Control Unit, C-11329\URC	
On-Equipment Manual	TO 31R2-2URC-91
Depot Manual	TO 31R2-2URC-93
Work Cards	TO 31R2-2URC-96WC-1
1KW Antenna Coupler Group, AN/URA-38A	TO 31R2-2URA-38-1
RF601	TO 31R2-2TSC38-82
DR-525	TO 31S1-4-228-1

CHAPTER 2

INSTALLATION

WARNING

Dangerous voltages exist in this radio equipment.
Before removing any cover, disconnect primary power.

Section I. INSTALLATION LOGISTICS

2-1. EQUIPMENT UNPACKING PROCEDURE. The 500 Watt LPA is packed in a corrugated cardboard box for shipment. A two-piece foam enclosure protects the equipment from rough handling.

a. When the unit is received, carefully inspect the exterior of the box. Look for any damage, signs of rough handling or weather exposure (e.g., water damage) or signs that the box may have been tampered with. If any of these conditions are present, carefully note and report them to the proper authority (refer to T.O. 00-35D-54). An external sticker on the shipping box provides additional instructions concerning inspection of the package.

b. Refer to figure 2-1 for instructions concerning unpacking the box. The box consists of double-walled cardboard with reinforced strapping tape. A sharp knife is required to open the box. Use the knife carefully to avoid injury. Keep the packing box in a secure place for possible future use.

c. After removing the equipment from the box, use the packing list in the ancillary package to verify the presence of each item in the shipment. Any shortages of items should be reported to the proper authority (refer to T.O. 00-35D-54).

d. The boxed equipment weighs a total of approximately 95 pounds. Use normal care to move the boxed equipment into the general location where it is to be installed. Once unpacked, the 500 Watt LPA weighs a total of 78 pounds and may be handled by two individuals.

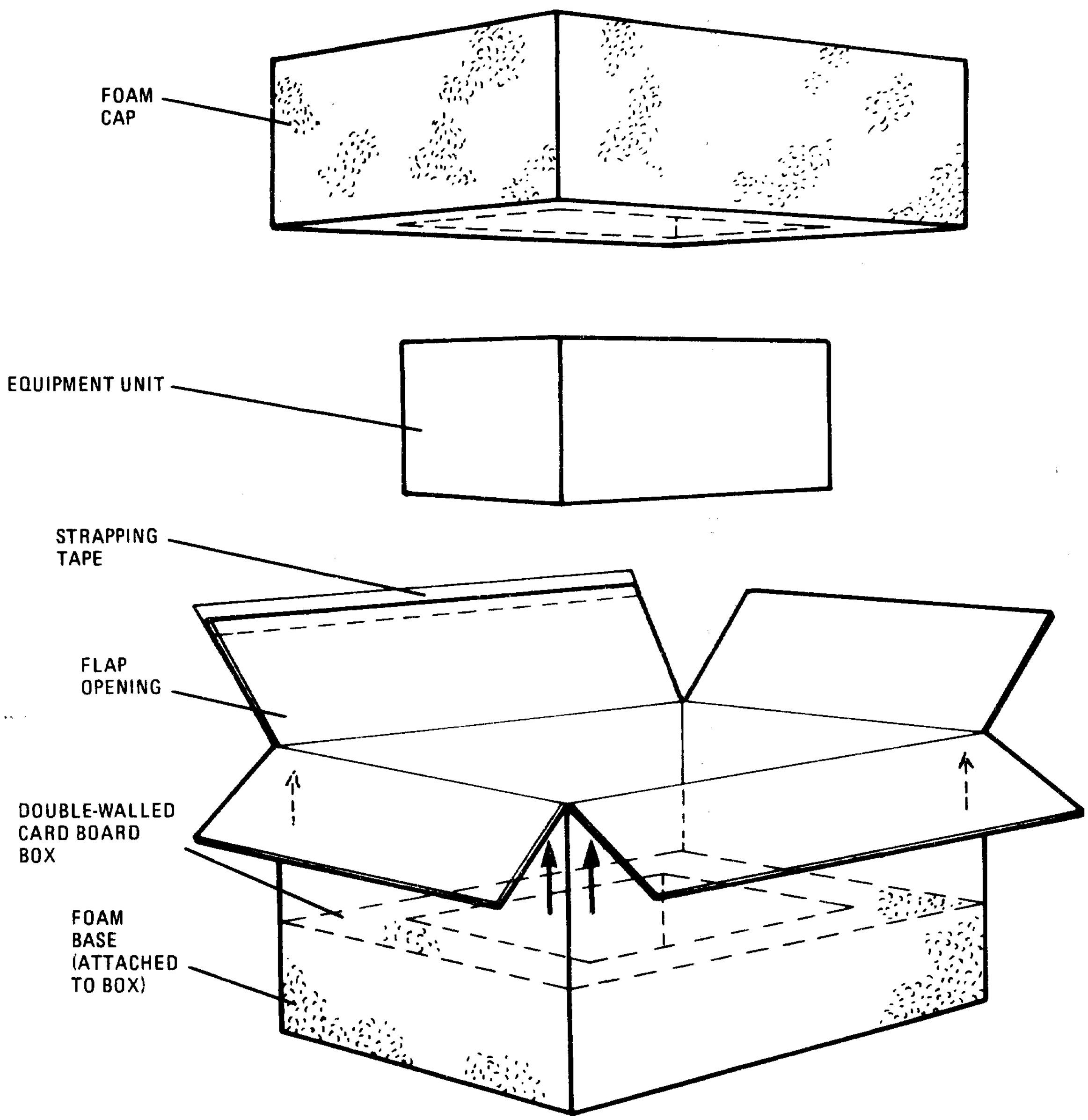
2-2. PREPARATION FOR INSTALLATION. Site selection is the most important consideration in preparing for installation of the equipment. Details for site selection will vary depending on the use of the 500 Watt LPA.

2-3. SITE CONSIDERATION. A number of factors should be considered, from security to operational requirements, and it is the responsibility of the user to determine which has precedence. Each of the following items should be considered in site selection:

a. Power Source. Power requirements identified in table 1-1 should be observed (see chapter 1 of this manual).

b. Loading. Depending on the installation method, be sure the selected space has adequate strength to support the weight of the equipment, which is approximately 80 pounds.

c. Accessibility. Consider the space needed for access to the equipment for servicing, operating, and maintenance.



UNPACKING PROCEDURE

1. PLACE BOX ON FLOOR WITH ARROWS MARKED ON EACH SIDE POINTING UP.
2. CUT TAPE ON TOP OF BOX AND REMOVE FOAM CAP FROM BOX.
3. LIFT EQUIPMENT UNIT OUT OF BOX.
4. SAVE BOX AND FOAM CAP FOR RESHIPMENT.

350-003

Figure 2-1. Unpacking the Equipment

d. Transceiver Interface. Be sure the maximum length of the 500 Watt LPA control cable does not exceed 100 feet, and that the maximum distance between the 500 Watt LPA and the 100/500 Watt Antenna Coupler does not exceed 250 feet.

e. System Ground. Make sure the system is properly grounded for safety (e.g., lightning hazard) (refer to T.O. 31-10-24).

f. Environment. The 500 Watt LPA will operate normally over an ambient temperature range of -30 degrees C to +50 degrees C.

g. Interaction. All control interfaces are RF filtered to minimize interaction with other electronic equipment.

h. Heat Dissipation. Cooling in the 500 Watt LPA is accomplished by convection and forced air (built-in fan). Provide sufficient space for cooling air to enter and exhaust from the unit.

i. Servicing. Allow for space to store any replacement assemblies, servicing tools, and test equipment.

j. Companion Equipment. Since the 500 Watt LPA is to be operated in conjunction with some of the companion equipment identified in table 1-4 (see chapter 1 of this manual), additional considerations may be required as identified in the companion equipment manuals.

k. Mounting. Once the site has been selected, the method of mounting the equipment should be considered. Each mounting method requires a particular type of mounting hardware. The mounting holes at the sides of the equipment can be used for slide mounts, brackets, or stacking posts, depending on the manner of installation. Most installations of the equipment will result in one of the mounting techniques described in the following paragraphs.

l. Installation Configuration. Figure 2-2 shows the basic equipment configuration in the 500 Watt LPA site installation The 500 Watt LPA is connected between the 100 Watt Transceiver and the 100/500 Watt Antenna Coupler in the RF line, while both the 500 Watt LPA and the 100/500 Watt Antenna Coupler have their own control interfaces with the 100 Watt Transceiver. The equipment configuration may be connected to any type antenna, depending upon the particular equipment application.

m. Grounding. Proper grounding of the 500 Watt LPA is recommended to prevent possible serious personnel hazards in the event of an equipment malfunction. Refer to T.O. 31-10-24. A good ground is 10 ohms or less.

WARNING

Improper grounding of the 500 Watt LPA equipment can cause HIGH VOLTAGE dangerous to life to be present on the equipment chassis in the event of a malfunction.

The ground straps should be constructed of wide copper strap or braid, and should be as short as possible. Ground straps should be clamped and bonded to a cold water pipe or other metal conductor that provides a good ground.

n. Typical 500 Watt LPA Installation. Cable type and installation precautions for this type of 500 Watt LPA installation are basically the same as for an installation where an antenna coupler is not used. A typical stack mount 500 Watt LPA installation is shown in figure 2-3.

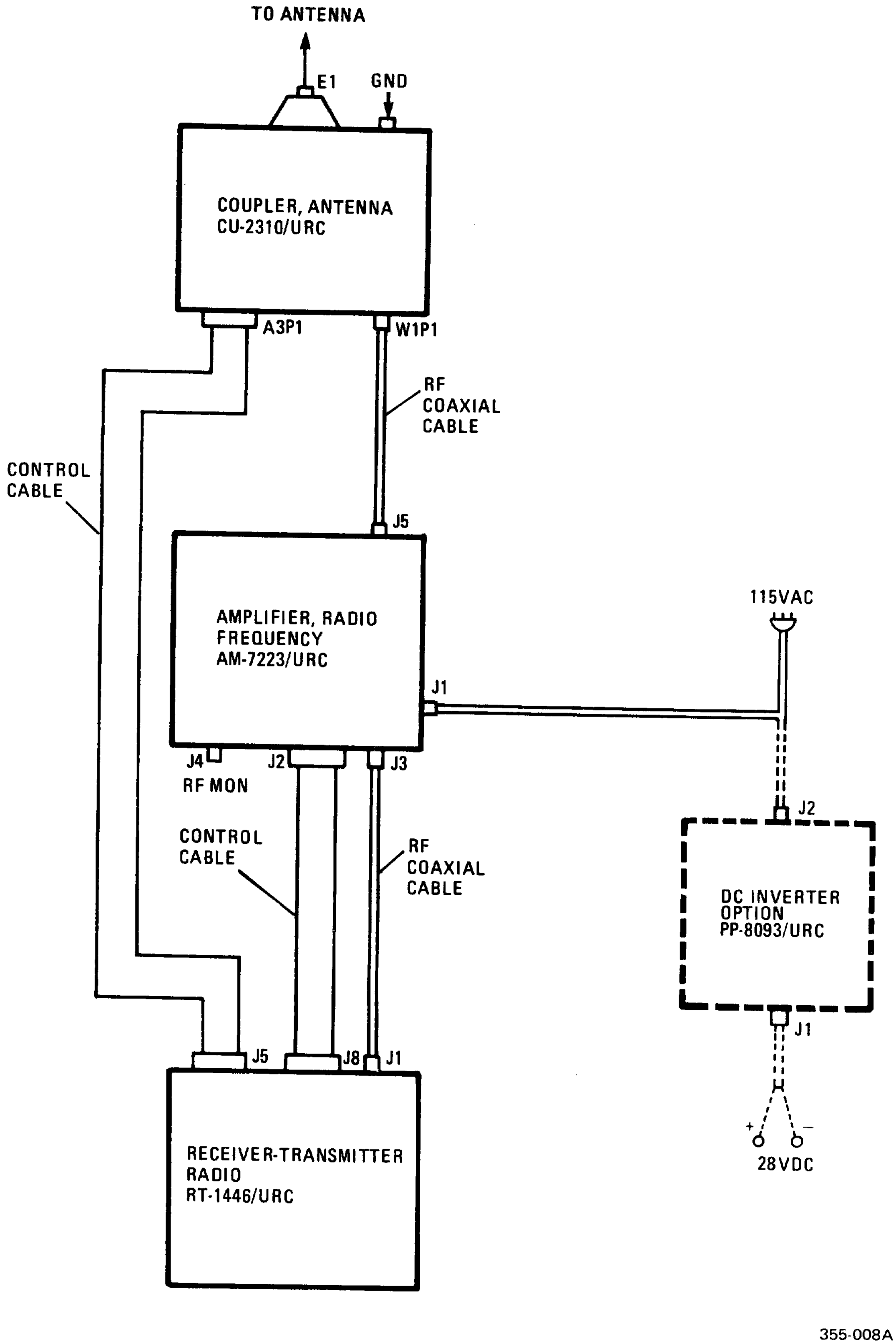


Figure 2-2. Basic Equipment Configuration

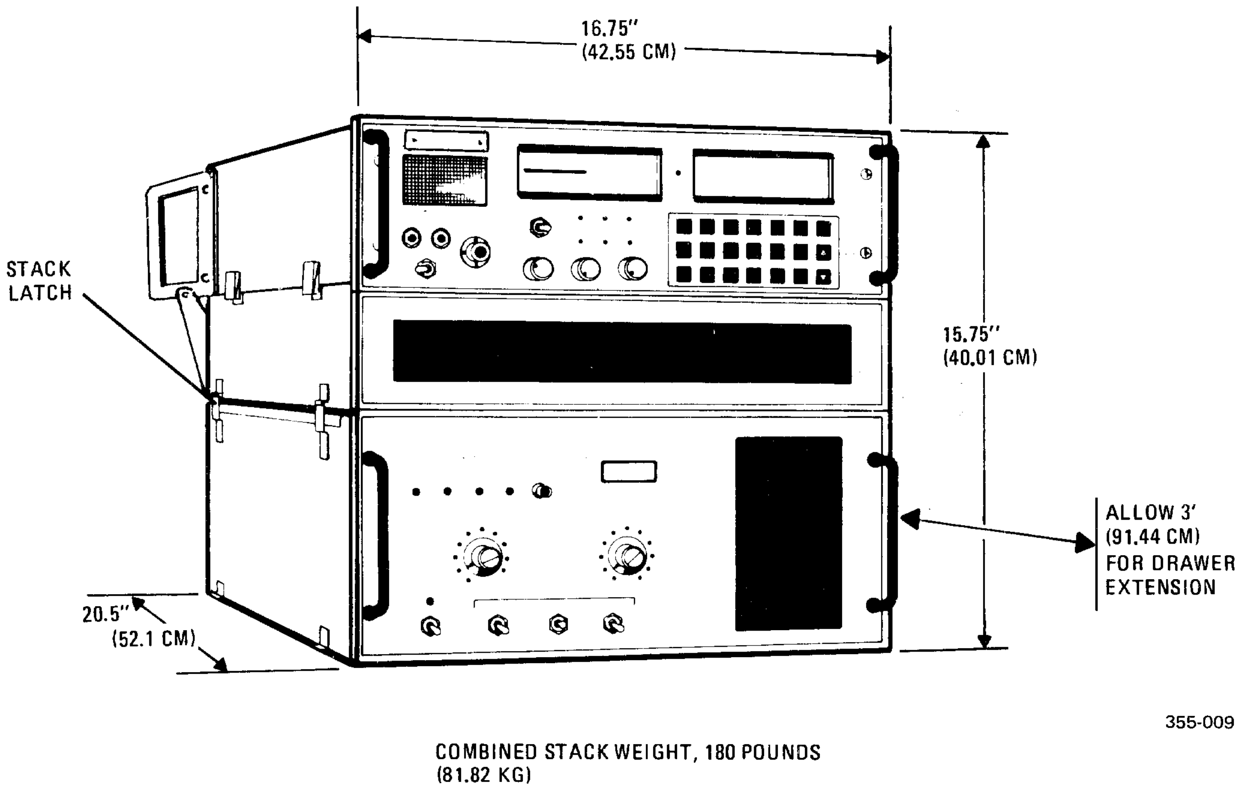


Figure 2-3. Typical Stack-Mount Installation

Section II. INSTALLATION PROCEDURE

2-4. INSTALLING THE EQUIPMENT. After unpacking the equipment and selecting the site, install the 500 Watt LPA as described in the following paragraphs.

a. Time Requirements. Installation should not take more than one hour regardless of the equipment configuration, not including the time necessary to install an antenna or any companion equipment, or to fabricate cables.

b. Tool Requirements. Installation is accomplished with common hand tools; e.g., socket wrenches, screwdrivers, pliers, etc.

c. Personnel Requirements. Equipment positioning requires two individuals to lift and place the unit in position. Once the equipment is positioned and secured, one person can complete the installation in approximately 30 minutes.

2-5. 500 WATT LPA STACK MOUNTING INSTRUCTIONS

a. Refer to table 1-1 for the 500 Watt LPA dimensions. Figure 2-4 illustrates these dimensions. Make sure that the mounting surface allows adequate room for ventilation intakes and outlets, and has proper clearance for cable interconnection.

b. Install the stack mounting post, using the hardware provided in the ancillary kit and the screw holes provided in the chassis of the 500 Watt LPA.

c. Install the bumper feet to the bottom of the 500 Watt LPA chassis.

d. Secure the 500 Watt LPA to the mounting surface, using appropriate hardware.

2-6. 500 WATT LPA RACK MOUNTING INSTRUCTIONS

a. Refer to table 1-1 for the 500 Watt LPA dimensions. Make sure that the mounting surface allows adequate room for ventilation intakes and outlets, and has proper clearance for cable interconnection.

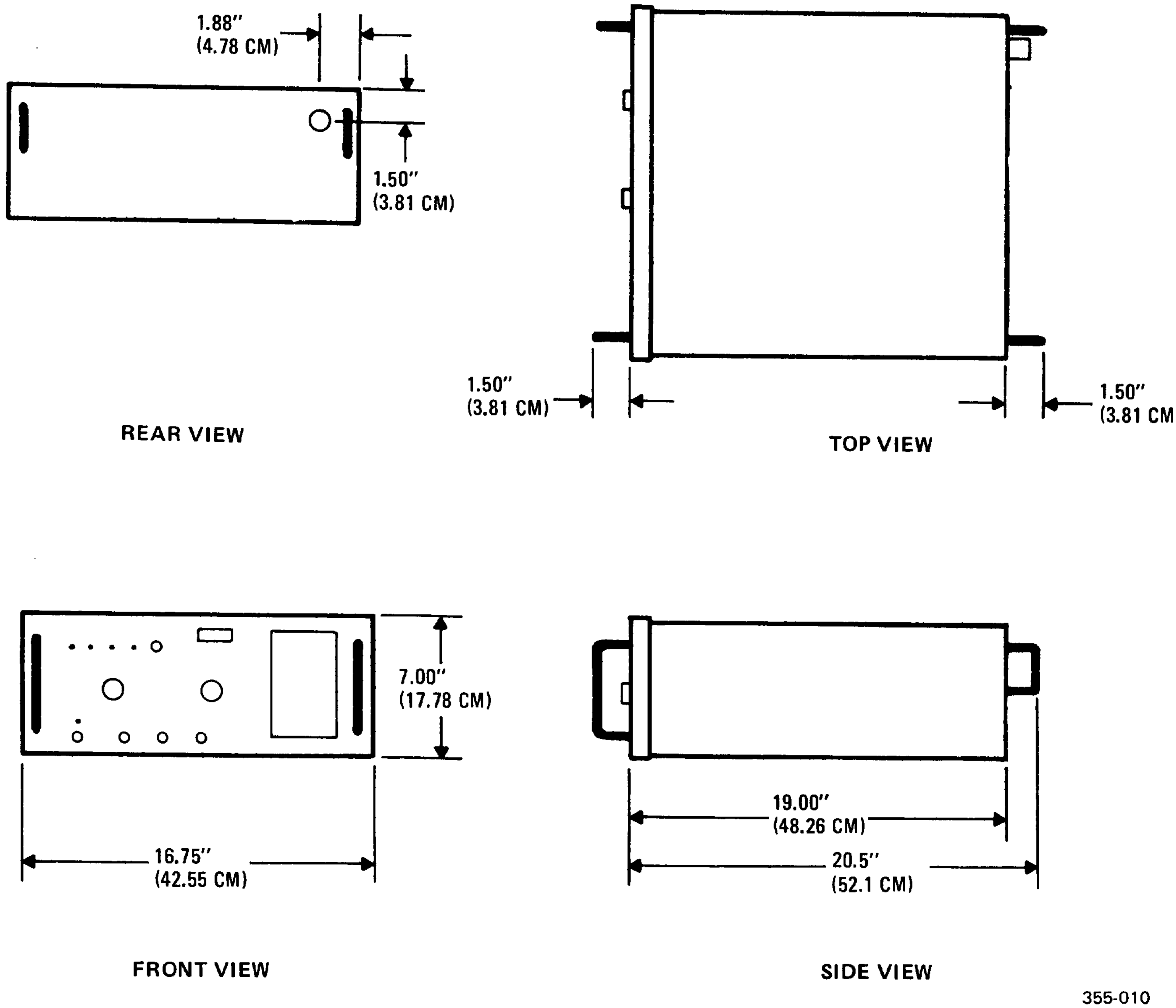


Figure 2-4. Dimensions

b. Install slide mounting brackets and slides, using the appropriate hardware.

c. Carefully lift the LPA and insert the slides in the mounting rack slide brackets. Ensure that equipment is properly seated.

2-7. CABLING CONNECTIONS. After the equipment has been positioned and secured, fabricate and connect the 500 Watt LPA cables as described in the following paragraphs. Be sure that the 500 Watt LPA is configured for the intended voltage and that the POWER ON/OFF switch is in the OFF position before connecting the equipment to any power source.

a. Interconnection and Interface. The user is responsible for fabrication of cables. Refer to figure 2-2 for the identification of cables required between the different 500 Watt LPA connectors. Figure 2-5 shows the locations of the rear panel connectors, and table 2-1 contains interconnection information.

b. Cable Fabrication. The fabrication of the control cable is shown in figure 2-6 (sheets 1 and 2), and the fabrication of all RF coaxial cables is shown in figure 2-7.

Table 2-1. Interconnection Cabling Information

J1 Power (AC) (LPA end) Mating connector: MS3106A28-20S Cable type: 14-gauge conductors minimum		
J1-P Ground J1-J 115/208/230 Vac J1-A 115/208/230 Vac Common	IF 208 V INSTEAD OF 230 V ONLY HIGH VOLTAGE IS INCREASED	
J1 Power (DC) (LPA end) See DC Inverter Option, PP-8093/URC		
J2 Control (LPA end) Mating connector: J22-0001-002 (female)		J8 Control (Transceiver end) Mating connector: J22-0001-001 (male)
J2-1	PPC Ground	J8-1
J2-2	TGC +	J8-2
J2-3	Ground (VF, VR)	J8-3
J2-4	Vfwd	J8-4
J2-5	DATA +	J8-5
J2-6	LPA Key *	J8-6

* Indicates that the signal is active low. On schematic diagrams, active low signals have a bar over the top.

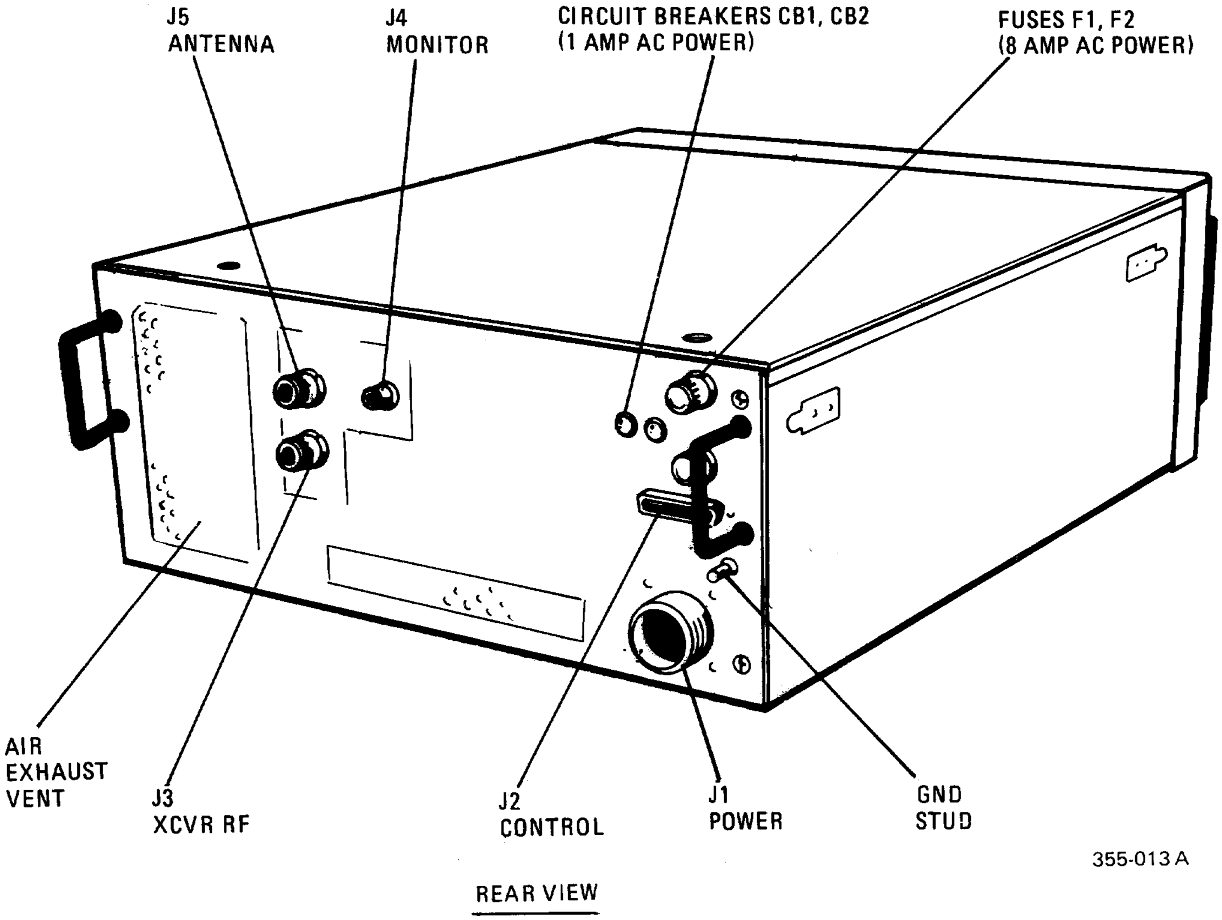


Figure 2-5. Rear Panel Connector Locations

Table 2-1. Interconnection Cabling Information (continued)

J2-7	LPA On/Off *	J8-7
J2-8	Spare	J8-8
J2-9	Ground	J8-9
J2-10	Not Used	J8-10
J2-11	Not Used	J8-11
J2-12	Not Used	J8-12
J2-13	Not Used	J8-13
J2-14	PPC	J8-14
J2-15	TGC -	J8-15
J2-16	VREFL	J8-16
J2-17	LPA ID *	J8-17
J2-18	DATA -	J8-18
J2-19	RF Mute *	J8-19
J2-20	Spare	J8-20
J2-21	Spare	J8-21
J2-22	Ground	J8-22
J2-23	Not Used	J8-23
J2-24	Not Used	J8-24
J2-25	Not Used	J8-25
J3 XCVR RF (LPA end) Mating connector: M39012/01-0005 (coaxial) Cable type: RG-8/U or RG-213 (coaxial)		J1 XCVR RF (Transceiver end) Mating connector: M39012/01-0005 (coaxial) Cable type: RG-8/U or RG-213 (coax)
J4 RF Monitor (LPA end) Mating connector: KC-59-89 (coaxial) Cable type: RG-188 (coaxial)		
J5 Antenna (LPA end) Mating connector: M39012/01-0005 (coaxial) Cable type: RG-8/U or RG-213 (coaxial)		W1P1 Antenna (Coupler end) Mating connector: M39012/01-0005 (coaxial) Cable type: RG-8/U or RG-213 (coax)

* Indicates that the signal is active low. On schematic diagrams, active low signals have a bar over the top.

2-8. CHECKING THE INSTALLATION. After the 500 Watt LPA has been installed and interconnection cables are connected, verify that each item in the list below has been completed before applying power. Power application and initial equipment testing are discussed in chapter 3 of this manual.

a. All connectors are attached and tight.

b. Ground wires are connected between the 500 Watt LPA and a known good ground. Examples of good grounds are a cold water pipe, a long copper stake driven into solid earth, or a system ground bus at an existing site.

c. Hardware for the equipment is properly tightened, and the equipment cannot be tipped or moved.

d. Provisions are adequate for heat dissipation.

e. Refer to chapter 3 for the proper power application procedures.

2-9. PRIMARY VOLTAGE SWITCH SETTINGS. After unpacking the equipment, the desired primary voltage switch settings should be made before connecting the equipment to any power source. Refer to figure 2-9. Under the top cover of the 500 Watt LPA is the A9 Assembly which contains jumper JMP1 and three toggle switches: S1, S2, and S3. These controls are used to set the primary voltages for the 500 Watt LPA. Figure 2-9 illustrates all the primary voltage switch settings possible: Detail A shows the 115 Vac and the dc setting, detail B shows the 208 Vac setting, and detail C shows the 230 Vac setting. To obtain the desired voltage setting, perform the following procedure.

WARNING

Voltages dangerous to life exist in this radio equipment. 115/208/230 Vac is present in the 500 Watt LPA chassis. Make sure that all circuit points which may be touched during this procedure are at ground potential.

a. Verify that the 500 Watt LPA is not connected to any power source, and set the POWER ENABLE switch on the front panel of the 500 Watt LPA to OFF.

b. Remove the cover which fits over the top of the 500 Watt LPA.

c. Refer to figure 2-9 and select from details A, B, and C, which switch setting to use.

d. To set the primary voltage switches to the 115 Vac/dc position for operation in either 115 Vac or in dc, perform the following procedure.

(1) If the metal voltage selection bar is not in the position shown in detail A, obtain a no. 1 Phillips screwdriver. Remove the two Phillips screws that fasten the metal voltage selection bar to the chassis of the 500 Watt LPA.

(2) Remove the voltage selection bar.

(3) Set switches S1, S2, and S3 to the 115 Vac/dc setting shown in detail A.

(4) Move JMP1 to the proper jumper receptacle position shown in figure 2-9. Note that JMP1 is placed on one jumper receptacle for operation with the DC Inverter Option and on another jumper receptacle for ac operation.

(5) Place the metal bar on the two upper receptacles for the Phillips screws so that the voltage selection bar indicates the 115 Vac/dc markings as shown in detail A.

(6) Replace and firmly tighten the two Phillips screws.

(7) Refer to chapter 3 for the proper power application procedures.

e. To set the primary voltage switches to the 208 Vac position, perform the following procedure.

(1) If the metal voltage selection bar is not in the position shown in detail B, obtain a no. 1 Phillips screwdriver and remove the two Phillips screws that fasten the metal voltage selection bar to the chassis.

(2) Remove the voltage selection bar.

(3) Set switches S1, S2, and S3 to the 208 Vac setting shown in detail B.

(4) Ensure that JMP1 is on the ac jumper receptacle as shown in figure 2-9.

(5) Verify that the voltage selection bar indicates the 208 Vac markings, and place the metal bar on the two lower screw positions as shown in detail B.

Modify primary voltage from 230 to 208 VAC

see operation manual pages 37 & 38

Measurements with power supply 222 VAC 50 Hz
at F1FRVs shack in january 2013

Switches in position 230 VAC

Primary power 96%
13.5 VDC 13.5
DC plate Volts 1825
Ik mA 56

Switches in position 208 VAC

Primary power 96%
13.5 VDC 13.5
DC plate Volts 2060
Ik mA 63

THIS IS AN INTERESTING WAY TO IMPROVE AMP PERFORMANCES
Thats all Fox !!!!!!

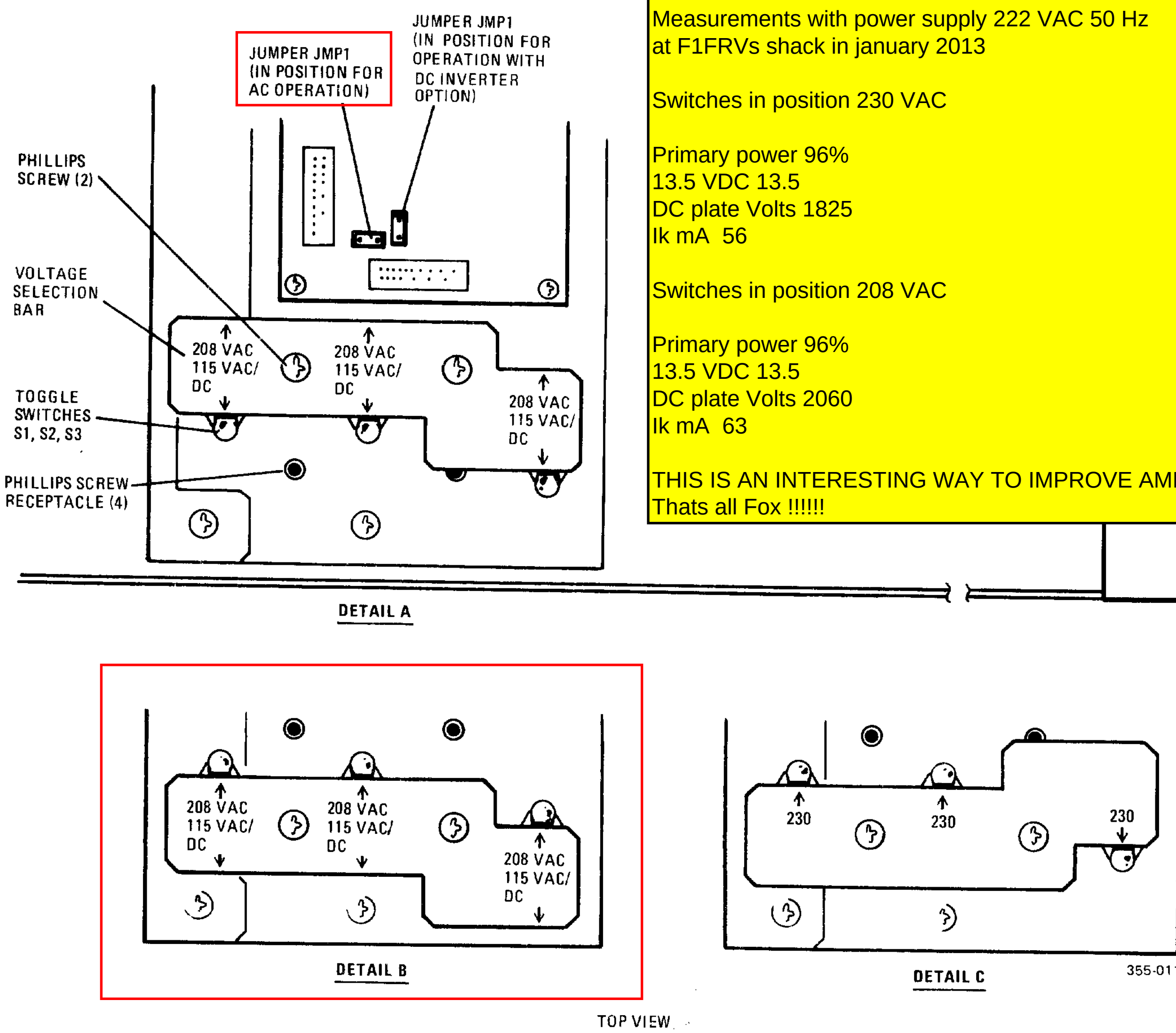


Figure 2-9. Primay Power Voltage Switch Settings

(6) Replace and firmly tighten the two Phillips screws.

(7) Refer to chapter 3 for the proper power application procedures.

f. To set the primary voltage switches to the 230 Vac position, perform the following procedure.

(1) If the metal voltage selection bar is not in the position shown in detail C, obtain a no. 1 Phillips screwdriver and remove the two Phillips screws that fasten the metal voltage selection bar to the chassis.

(2) Remove the voltage selection bar.

(3) Set switches S1, S2, and S3 to the 230 Vac setting shown in detail C.

(4) Ensure that JMP1 is on the ac jumper receptacle as shown in figure 2-9.

(5) Verify that the voltage selection bar indicates the 230 Vac markings, and place the metal bar on the two lower screw positions as shown in detail C.

(6) Replace and firmly tighten the two Phillips screws.

(7) Refer to chapter 3 for the proper power application procedures.

CHAPTER 3

PREPARATION FOR USE AND RESHIPMENT

Section I. PREPARATION FOR USE

3-1. INITIAL CONTROL SETTINGS. This section details the initial control settings prior to the application of power to the 500 Watt LPA. These control settings are listed in table 3-1. Note that all controls, except the power circuit breakers, are on the front panel of the 500 Watt LPA; companion equipment controls will not be discussed. It is assumed that the 500 Watt LPA is installed and correctly connected to a compatible, fully operational 100 Watt Transceiver as described in chapter 2 of this manual. If in doubt about the installation of the 500 Watt LPA, verify the information in chapter 2 before proceeding.

3-2. INITIAL POWER APPLICATION. This portion of the manual provides a step-by-step sequence for the initial application of power to the 500 Watt LPA. Upon completion of the listed steps, the operator will have confirmed that the 500 Watt LPA is ready for the checkout test procedure that is found in paragraph 3-4.

3-3. STEP-BY-STEP SEQUENCE FOR INITIAL POWER APPLICATION.

Table 3-1. Initial Control Settings

Control	Initial Setting
1. CB1 (POWER) (REAR PNL)	Select ON position.
2. CB2 (POWER) (REAR PNL)	Select ON position.
3. POWER ON/OFF	Select OFF position.
4. LOCAL KEY ON/OFF	Select OFF position.
5. TUNE MIN L/MAX L	Spring loaded to center postion (Neutral).
6. TUNE PWR ON/OFF	Select TUNE PWR OFF position.
7. AUTO/MANUAL BAND	Select AUTO position.
8. METER	Select STATUS/FAULT position.

a. With the Transceiver ON/OFF switch in the ON position and the radio frequency amplifier power enable switch in the OFF position, complete any power application checks for the associated 100 Watt Transceiver as indicated in Receiver-Transmitter, Radio RT-1446/URC, TO 31R2-2URC-81, chapter 3.

b. Verify that the power source (ac or dc, depending upon system configuration) for the 500 Watt LPA matches the input power requirements described in table 1-1, and paragraph 2-9.

c. Set POWER ENABLE/OFF switch to the ENABLE position; then turn on 500 Watt LPA from the associated 100 Watt Transceiver front panel by pressing the [2ND][AMP PWR] keyboard controls. If the 500 Watt LPA has never been turned on or if the power has been off for more than 10 seconds, there will be a three minute warmup period upon power application before the 500 Watt LPA can go to the OPERATE mode. When the power is applied, the STANDBY indicator should come on and flash during the 3-minute equipment warmup. At the end of warmup, the STANDBY indicator should show a steady indication.

3-4. STEP-BY-STEP SEQUENCE FOR MANUAL BUILT-IN TEST PROCEDURE.

NOTE

Ensure antenna coupler is tuned prior to each manual operation.

a. Set the AUTO/MANUAL BAND switch to the band corresponding to the frequency selected on the associated 100 Watt Transceiver (bands begin at 0000 and end at 9999; for example, 2.1999 would fall in the 1.6 to 2.2 band, but 2.2000 would fall in the 2.2 to 3.0 band). After one second the bandswitch should drive to the switch position selected.

b Rotate the METER switch on the LPA front panel to the STATUS/FAULT position.

c. Press the SELF TEST button on the LPA front panel.

d. Check that all LPA front panel LEDs come on and that all LCD segments on the meter display are on. NOTE: if the test is initiated while the LPA is in warmup (STANDBY LED was flashing before the SELF TEST button was pushed), only fault codes 2-01 through 2-08 can be displayed. This is because the full routine cannot be run until the LPA is warmed up (refer to the automatic diagnostic BIT test description in the Appendix at the end of Chapter 6).

(1) A "PASS" message on the METER display indicates that the BIT (Built-In-Test) has been passed.

(2) A fault code (0001 through 0022) on the METER display indicates that a part of the test has failed. All further testing is stopped. Refer to table 6-2 (in Chapter 6) for an explanation of the fault codes.

(3) After the test cycle is complete, moving the METER switch out of the STATUS/FAULT position removes the LPA from the test mode. The fault code may be cleared by commanding the LPA to OPERATE from the 100 Watt Transceiver (if the LPA is placed in AUTO) or by moving the METER selector switch to the STATUS/FAULT position and then out again.

(4) If all indications are normal, proceed to the next paragraph.

3-5. STEP-BY-STEP SEQUENCE FOR AUTOMATIC BUILT-IN TEST PROCEDURE.

a. Set the AUTO/MANUAL BAND switch on the LPA to AUTO.

b. Command the 500 Watt LPA to perform the SELF TEST from the 100 Watt Transceiver front panel by pressing the following keyboard controls in sequence: [2ND][STB/OPR] [2ND][TX KEY] [2ND] [TEST] [2ND][TX KEY].

c. Check that all LPA front panel LEDs come on and that all LCD segments on the meter display are on.

(1) A "PASSEd" message on the 100 Watt Transceiver's display indicates that the BIT (Built-In-Test) has been passed.

(2) A fault code (2-01 through 2-22) on the 100 Watt Transceiver's display indicates that a part of the LPA test has failed. (The fault code will also appear on the LPA's LCD display if the METER selector switch is move to the STATUS/FAULT position.) All further testing is stopped. Refer to table 6-2 (in Chapter 6) for an explanation of the fault codes.

(3) The fault code may be cleared by commanding the LPA to OPERATE from the 100 Watt Transceiver or by moving the LPA's METER selector switch out of the STATUS/FAULT position.

(4) If all indications are normal, proceed to the next paragraph.

3-6. INITIAL CHECKOUT. In the initial checkout the 500 Watt LPA is checked for readiness through the use of the front panel controls and indicators. The checkout procedure should be conducted immediately after performing the initial power application. This sequence does not cover each feature of the 500 Watt LPA, only those necessary to prove normal performance. Refer to chapter 4, Operation, for complete operation information. Features related to the use of companion equipment are not discussed. This sequence assumes the initial power application procedure has been performed.

3-7. STEP-BY-STEP SEQUENCE FOR MANUAL TUNING PROCEDURE.

a. Set the associated 100 Watt Transceiver to the desired frequency.

b. At the 500 Watt LPA, select the band corresponding to the selected transceiver frequency using the AUTO/MANUAL BAND switch.

c. Set the METER selector switch to the COIL POS position.

d. Using the spring-loaded TUNE control, pre-position the coil to the value indicated on the Manual Tune Chart, Figure 3-1, for the frequency selected on the 100 Watt Transceiver. Move the TUNE control toward MIN L or MAX L until the the number on the LCD display matches the number on the chart.

e. Set the METER switch to either the FWD PWR (WATTS) or the RF PLATE (VOLTS) position.

f. When the bandswitch is finished tuning the bandswitch wafer, set the MANUAL TUNE PWR switch to the ON position. When this is done, a TUNE POWER REQUEST message is sent to the XCVR and the 500 Watt LPA is keyed. If a fault is detected while this switch is active, the 500 Watt LPA will drop back to STANDBY and the MANUAL TUNE PWR switch must be turned OFF before the fault can be cleared.

g. Observing the METER display, use the TUNE switch to tune the servo coil to the maximum rf output (watts) or rf plate volts by switching to MIN L or MAX L.

h. Turn OFF the MANUAL TUNE PWR switch.

NOTE

Turning off the TUNE PWR switch notifies the 100 Watt Transceiver that the LPA is tuned, whether it actually is or not. Therefore, before you turn this switch off, make sure that you have correctly tuned the LPA. Otherwise, there is the possibility of a severe mismatch between the LPA and the antenna system, resulting in a high VSWR and low forward power.

i. Set the MANUAL LOCAL KEY switch to the ON position. The 500 Watt LPA should go to the OPERATE condition and the OPERATE indicator should come on steady.

3-8. STEP-BY-STEP SEQUENCE FOR AUTOMATIC TUNING PROCEDURE.

a. Set the LOCAL KEY switch to OFF, and set the AUTO/MANUAL BAND select switch to the AUTO position. This deactivates all of the manual tune switches. On the 100 Watt Transceiver front panel, press the [2ND][STBY/OPR] keypad pushbuttons to place the 500 Watt LPA in the operate mode.

b. Select a different frequency band at the companion 100 Watt Transceiver, and key the 100 Watt Transceiver. The 500 Watt LPA should tune to the new frequency in 10 seconds or less. If not, a fault code is displayed.

c. This completes the initial checkout procedure. If any problems were encountered during this procedure, refer to chapter 6, Maintenance.

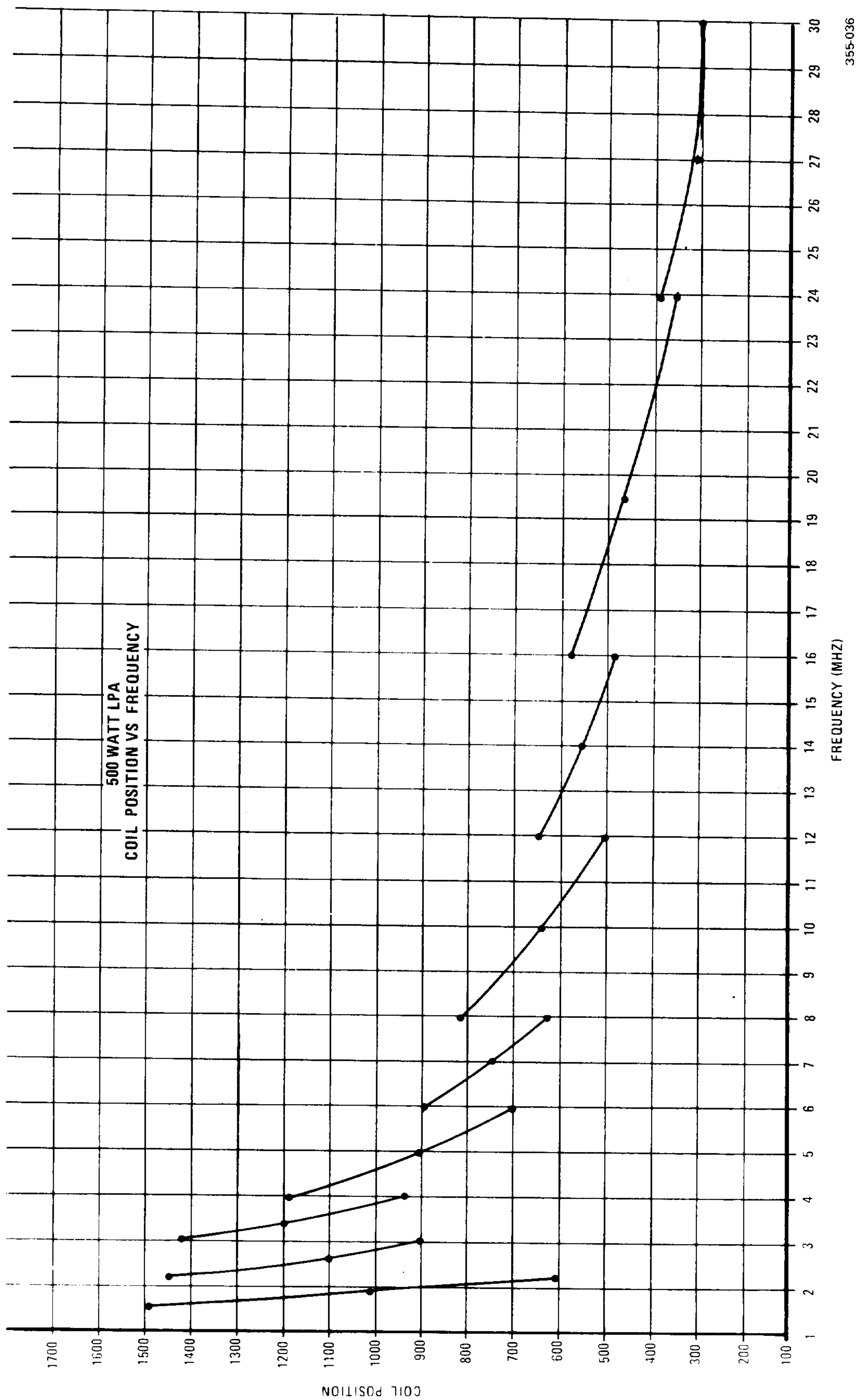


Figure 3-1. Manual Tune Chart

Section II. PREPARATION FOR RESHIPMENT

3-9. PREPARATION FOR RESHIPMENT. This portion of the manual contains step-by-step procedures for disassembly and repacking the 500 Watt LPA for reshipment.

3-10. STEP-BY-STEP DISASSEMBLY PROCEDURE.

a. Ensure that all power sources associated with the 500 Watt LPA and any interfacing companion equipment are shut down.

b. Disconnect all interface cables, power cables, and grounding straps connected to the 500 Watt LPA.

c. Replace plastic dust caps on all LPA connectors.

d. Carefully remove the 500 Watt LPA from the stack mounted or rack mounted system configuration.

e. Unbolt mounting brackets or slide brackets and slides, whichever the case may be, and pack them for shipment.

3-11. STEP-BY-STEP PACKING AND CRATING PROCEDURE.

a. Refer to figure 2-1. Repackage the interface cables, the power cable, and the mounting hardware associated with the 500 Watt LPA in the original or an equivalent container.

b. Place the 500 Watt LPA into the original or an equivalent container.

c. Close and bind the container, using reinforced tape for reshipment.

CHAPTER 4

OPERATION

Section I. CONTROLS AND INDICATORS

4-1. CONTROL AND INDICATOR DESCRIPTIONS. All 500 Watt Linear Power Amplifier (500W LPA) controls and indicators are explained in table 4-1 and shown in figure 4-1.

4-2. FRONT PANEL CONTROLS. The three main functions associated with the 500W LPA controls and indicators are AUTOmatic tuning, MANUAL tuning, and status reporting. Most of the 500W LPA control functions are selected via two rotary switches. Toggle switches control the primary power application and MANUAL tuning mode.

4-3. OPERATING INSTRUCTIONS. For specific information regarding the operating instructions of the 500W LPA, see section II of this chapter.

Table 4-1. 500W LPA, Operating Controls and Indicators

Controls or Indicators	Function
STANDBY (Indicator)	Indicates when the LPA is in STANDBY or WARMUP mode. Flashes for 3 minutes after power application (WARMUP mode) and is on steady during STANDBY mode.
OPERATE (Indicator)	Indicates when the LPA is in OPERATE mode. Light goes out if there is a fault and the LPA returns to STANDBY mode.
HV ON (Indicator)	Indicates when the high voltage (i.e.,more than 100 volts) is applied to the power amplifier tube.
FAULT (Indicator)	Indicates when a FAULT exists in the LPA. Remains lit until the fault is cleared.
SELF TEST (Push button switch)	Used to activate the BIT self test routine.
METER (LCD Indicator)	Four digit LCD (Liquid Crystal Display) that diplays the selected METER function; e.g., % of PRI PWR, 13.5 VDC, DC PLATE (VOLTS), I_K (mA), RF IN (WATTS), RF PLATE (VOLTS), FWD PWR (WATTS), REFL PWR (WATTS), ANT VSWR, COIL POS, or STATUS/FAULT.

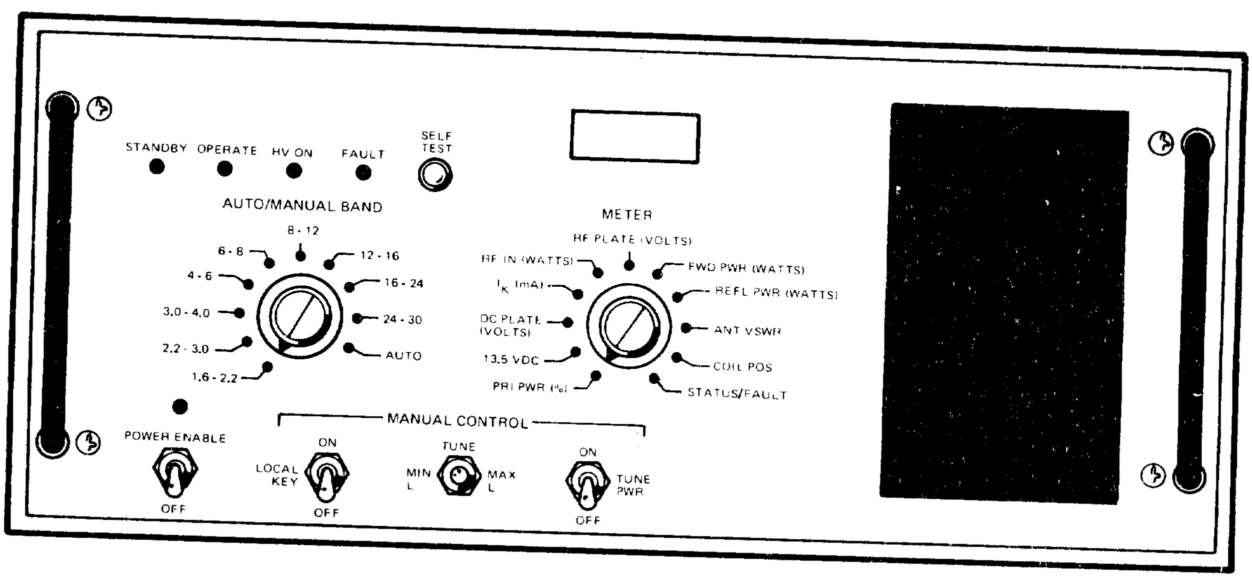


Figure 4-1. Operating Controls and Indicators

Table 4-1. 500W LPA, Operating Controls and Indicators (Continued)

Controls or Indicators	Function
AUTO/MANUAL BAND (Control wafer switch)	Selects auto or manual operation in the chosen band. In Auto mode, tuning is initiated by a Tune command from the 100 Watt transceiver and is controlled by the microprocessor. In Auto mode, the MANUAL TUNE, MANUAL TUNE POWER, and MANUAL LOCAL KEY controls are inactive. When not in Auto mode, the switch controls the position of the band wafer. The 500W LPA has nine bands.
METER (Control Wafer switch)	Selects the input to the METER display (e.g., PRI PWR (%), 13.5 VDC, DC PLATE (VOLTS), I_K (MA), RF IN (WATTS), RF PLATE (VOLTS), FWD PWR (WATTS), REFL PWR (WATTS), ANT VSWR, COIL POS, or STATUS/FAULT).
POWER ENABLE (Control Toggle Switch)	Controls the primary power input.
MANUAL CONTROL-LOCAL KEY (Control Toggle Switch)	Active only in Manual mode. When in the ON position, sends a Local Key message to transceiver and keys the 500W LPA.
MANUAL CONTROL-TUNE (Control Spring Loaded-Center Toggle Switch)	Active only in Manual mode. Used to control the position of the tune variable coil.
MANUAL CONTROL-TUNE PWR ON/OFF (Control Toggle Switch)	Active only in Manual mode. Used to request or inhibit tuning power from 100 Watt Transceiver.

Section II. OPERATING INSTRUCTIONS

4-4. INTRODUCTION. Operating instructions are only those for the 500W LPA. Refer to the technical manuals for any companion equipment such as the 100W Transceiver.

4-5. OPERATING SEQUENCES. A summary of the paragraphs containing the operating instructions is provided for reference.

4-6. POWER-UP

4-7. WARMUP

4-8. BASIC FUNCTION OPERATION

a. AUTO/MANUAL BAND Selection

b. MANUAL TUNE PWR Switch

c. MANUAL LOCAL KEY Switch

d. MANUAL TUNE Switch

e. SELF TEST Switch

f. METER Selection Switch

4-9. TRANSCEIVER CONTROLLED OPERATIONS

4-10. MICROPROCESSOR CONTROLLED OPERATIONS

a. Meter Display Update

b Fault Check

c. Built-In-Test (BIT)

4-6. POWER-UP. The circuit breakers on the rear panel, and the POWER ENABLE/OFF switch on the front panel must be in the POWER ENABLE position for the 500 Watt LPA to operate. Power is then turned on and off from the front panel of the 100 Watt Transceiver.

4-7. WARMUP. When the 500 Watt LPA is turned on for the first time or after power has been off for more than 10 seconds, there must be a three-minute warmup period before the 500 Watt LPA can go to the STANDBY mode. During this time the MANUAL controls, TUNE PWR, and LOCAL KEY are disabled. The STANDBY LED indicator flashes during the warmup period. After three minutes the STANDBY LED indicator stops flashing and stays lighted. If the BIT (Built-In-Test) is initiated during the warmup period, some but not all functions are tested.

4-8. BASIC FUNCTION OPERATION. The functions selected from the 500 Watt LPA front panel include: Auto/Manual Band selection, Manual Tune Power, Manual Local Keying, Manual Tuning, Self Test, and Meter Functions.

a. <u>AUTO/MANUAL BAND Selection.</u>

(1) This front panel, ten-position, AUTO/manual rotary switch selects between the automatic mode operation and the manual mode operation in the chosen frequency band. In AUTO mode, tuning is automatic and is controlled completely by signals from the associated 100 Watt Transceiver. In this mode, the Manual Tune, Manual Tune Power, Manual Local Key, and Self Test controls are disabled.

(2) When AUTO/MANUAL BAND switch is not in the AUTO position, the 500 Watt LPA is in MANUAL mode and the switch selects the current operating frequency band. The 500 Watt LPA has nine operating frequency bands. Selecting a new switch position causes the internal band switch wafer to be turned to its corresponding position. Before the wafer can turn, the microprocessor will wait until the operator leaves the band switch in one position for more than one second. Then the Microprocessor sends an RF Mute signal to the associated 100 Watt Transceiver, and unkeys the 500 Watt LPA. The microprocessor will not turn the bandswitch wafer while there is RF power at the XCVR RF input of the 500 Watt LPA. When the 500 Watt LPA is unkeyed, the microprocessor will switch the bandswitch. The Manual Tune, Manual Tune Power, Manual Local Key, and Self Test controls are disabled while the wafer is turning.

b. <u>MANUAL TUNE PWR Switch</u>. When manual band is selected and the MANUAL TUNE PWR switch is moved to the ON position, a Tune Power Request message is sent to the associated 100 Watt Transceiver and the 500 Watt LPA is keyed. When the MANUAL TUNE PWR switch is activated, any previous fault indications are cleared. If a fault is detected while this switch is active, the 500 Watt LPA will drop back to STANDBY and the MANUAL TUNE

PWR switch must be turned off before the fault can be cleared. Activation of the tune mode causes the 100 Watt Transceiver to transmit a CW carrier emission. This level is then controlled by the 500 Watt LPA to that which causes about 225 milliamperes of cathode current.

c. MANUAL LOCAL KEY Switch. When the MANUAL LOCAL KEY switch is move to the ON position, the 500 Watt LPA is placed in OPERATE and is keyed. The MANUAL LOCAL KEY is active only in the MANUAL mode. When the MANUAL LOCAL KEY switch is activated, any previous fault indications are cleared. If a fault is detected while this switch is active, the 500 Watt LPA will drop back to STANDBY and the MANUAL LOCAL KEY switch must be turned off before the fault can be cleared. The manual LOCAL KEY switch will key only the 500 Watt LPA; the 100 Watt Transceiver must be keyed independently.

d. MANUAL TUNE Switch. The MANUAL TUNE switch allows the operator to fine tune the 500 Watt LPA by controlling the position of the tune variable coil. Moving the switch to the left or to the right causes the coil to be moved toward MIN L or to MAX L by a discrete step. Holding the switch either to the left or to the right causes the coil to continue being moved by these steps, and causes the step size to be increased. The MANUAL TUNE switch is active only in the MANUAL mode.

e. SELF TEST Button. With the AUTO/MANUAL BAND switch in any position except AUTO (the band selected should contain the frequency displayed on the 100 Watt Transceiver's front panel) and with the METER switch in the STATUS/FAULT position, pushing the SELF TEST pushbutton initiates the BIT (Built- In-Test) procedure. The BIT procedure tests all functional modules and displays failures on the meter display when the STATUS/FAULT position of the METER switch is selected. At the start of the test, all front panel LCD segments and LED indicators are lighted. They remain lighted until the test is completed

NOTE

If the test is initiated while the LPA is in warmup (STANDBY LED was flashing before the SELF TEST button was pushed), only fault codes 2-01 through 2-08 can be displayed. This is because the full routine cannot be run until the LPA is warmed up (refer to the automatic diagnostic BIT test description in the Appendix at the end of Chapter 6).

(1) A "PASS" message on the METER display indicates that the BIT (Built-In-Test) has been passed.

(2) A fault code (0001 through 0022) on the METER display indicates that a part of the test has failed. All further testing is stopped. Refer to Table 6-2 (in Chapter 6) for an explanation of the fault codes.

(3) Moving the METER switch out of the STATUS/FAULT position removes the LPA from the test mode. The fault code may be cleared by commanding the LPA to OPERATE from the 100 Watt Transceiver (if the LPA is placed in AUTO) or by moving the METER selector switch to the STATUS/FAULT position and then out again.

f. METER Select Switch. The METER select switch controls the inputs to the METER LCD display. The eleven possible functions that can be displayed are shown in table 6-1 in Chapter 6. Table 6-1 describes each function, indicates the range of measurement of each function, and indicates what the normal operating ranges are.

4-9. TRANSCEIVER CONTROLLED OPERATIONS. Automatic tuning of the 500 Watt LPA is controlled completely by the companion 100 Watt Transceiver when the AUTO/MANUAL BAND select switch is in the AUTO position.

4-10. MICROPROCESSOR CONTROLLED OPERATIONS.

a. Meter Display Update.

(1) Periodically the microprocessor reads the appropriate inputs and calculates a new value for the METER LCD display. The Meter Display routine is inactive during the BIT routine. The analog inputs are read every 100 milliseconds and an average or peak value is displayed every second for the functions indicated in table 4-2.

Table 4-2. Meter Display Reading

Meter Function	Type of Reading
PRI PWR (%)	Average
13.5 VDC	Average
DC PLATE (VOLTS)	Average
I_K	Average
RF IN (WATTS)	Peak
RF PLATE (VOLTS)	Peak
FWD PWR (WATTS)	Peak
REFL PWR (WATTS)	Peak
ANT VSWR	Peak

(2) If COIL POS is selected, the coil position is displayed. Range is 100 to 1770.

(3) If the STATUS/FAULT position is selected and the FAULT LED is lit, a fault code is displayed. When the METER select switch is moved out of the STATUS/FAULT position, the fault code is cleared and the FAULT LED is turned off.

b. Fault Check. The 500 Watt LPA performs periodic status checks on itself whenever it is energized. These checks are performed automatically and require no interaction or commands from the operator. These checks include the following and result in the indications or actions listed:

NOTE

When the FAULT light comes on, the appropriate fault code will be displayed on the meter if the selector switch is moved to the STATUS/FAULT position. When the meter selector switch is moved out of the STATUS/FAULT position, the fault code will be cleared and the FAULT light will be turned off. The fault can also be cleared by commanding the 500 Watt LPA back to OPERATE from the 100 Watt Transceiver's front panel or from the 500 Watt LPA's front panel (if in manual); but if the fault condition continues to exist, the FAULT light will come on again.

CHECK	RESULT
LPA temperature, I_K(cathode current)	If out of range for more than 2 seconds, the FAULT light comes on and the LPA goes into STANDBY (STANDBY light comes on)
Primary power, 13.5 V power supply, DC plate voltage, Forward power output, Reflected power output	If out of range for more than 3 seconds, the FAULT light comes on and the LPA goes into STANDBY (STANDBY light comes on)
The 500 Watt LPA also performs operational status checks on itself. During tuning, keying, and STANDBY/OPERATE status changes, it checks for expected reactions from the band switch,tuning coil, key relay, RF input sensor, forward and reflected power sensors, and the sensors for cathode current, DC plate voltage, and RF plate voltage. It also checks the serial control data link between the 100 Watt Transceiver and the 500 Watt LPA.	If a fault is detected, the FAULT light comes on and the LPA goes into STANDBY.(STANDBY light comes on)

c. Built-In-Test (BIT). The BIT software for the 500 Watt LPA tests all of its functions for the purpose of detecting hardware faults. For instructions on how to initiate the BIT test, see paragraphs 3-4 and 3-5; for a complete description of the events that occur during the BIT test, see the Appendix at the end of Chapter 6.

CHAPTER 5

THEORY OF OPERATION

Section I. GENERAL INFORMATION

5-1 INTRODUCTION. The 500 Watt LPA is a microprocessor based amplifier designed for automatic operation with other HF transmitting and receiving system elements. In addition to the many automatic operating features, the amplifier also includes fault detection and isolation features and manual operating options as required to satisfy sophisticated user requirements.

a. Tuning. Tuning is either completely automatic, in response to serial data inputs from a compatible 100 Watt Transceiver; or manual, using the few simple front panel setup controls. Tuning times are minimal, limited only by the travel times for the servo-controlled tuning elements. These circuits work with the microprocessor control system to minimize travel and response times.

b. Metering and Protection Circuits. Metering and protection circuits provide the operator and technician with visual feedback for all vital performance indicators. Similar inputs to the microprocessor continuously work to protect the unit and to provide optimum performance.

5-2. FUNCTIONAL ASSEMBLIES. Figure 5-1 is a simplified functional diagram of the 500 Watt LPA that shows all input and output functions, and includes all major component assemblies in a functionally related format. Each subassembly is functionally interrelated. The microprocessor controls these functions to automate and optimize performance for a wide range of conditions. It is important that the technician understand these interrelationships so that the equipment can be most effectively used and maintained. The twelve major subassemblies can be divided into four major subgroups as follows:

- The RF signal processing subgroup, consisting of A1, A2, and A3.
- The power control subgroup, consisting of A3, A5, and A10.
- The microprocessor control system, which includes the front panel, and consists of assemblies A6 and A7.
- The power supply subgroup, consisting of A4, A8, A9, and A11.

a. RF Signal Processing Subgroup.

(1) Refer to figure 5-1. RF drive from the 100 Watt Transceiver enters the 500 Watt LPA at J3 on the rear panel and is routed by T/R relay A3K1 to the A1 tube assembly in the transmit mode. In the receive mode, A3K1 is deenergized and the J5 ANTENNA input is connected directly to J3 for receiver operation. T/R switching is controlled by the A6 PWB in response to an LPA Key Control input from either the 100 Watt Transceiver or the LPA front panel. The 100 Watt Transceiver RF input level is sampled and detected on the A3 assembly to develop metering and logic control signals.

(2) All amplification is accomplished by a single power triode operating in a grounded grid configuration. RF drive from the 100 Watt Transceiver is applied to the cathode circuit. Both cathode bias and cathode current for the power triode are controlled by the A5 Power Control PWB in response to both keyline and tune control signals. An RF plate voltage sample is sensed at the A1 Tube Assembly for use by the A6 Micro Control PWB Assembly for tuning and by the A5 Power Control PWB Assembly for protection against high plate voltage swings. Because of the power triode configuration, only one B+ voltage is required. The 2000 Vdc for this purpose is supplied by the Power Supply Group. The output of the A1 Tube Assembly goes directly to the A2 Tank Assembly.

(3) The plate impedance of the power triode of the A1 Tube assembly is transformed to the output antenna impedance, nominally 50 ohms, by the A2 Tank Assembly. The Tank Assembly contains four component subassemblies as shown in figure 5-1. All

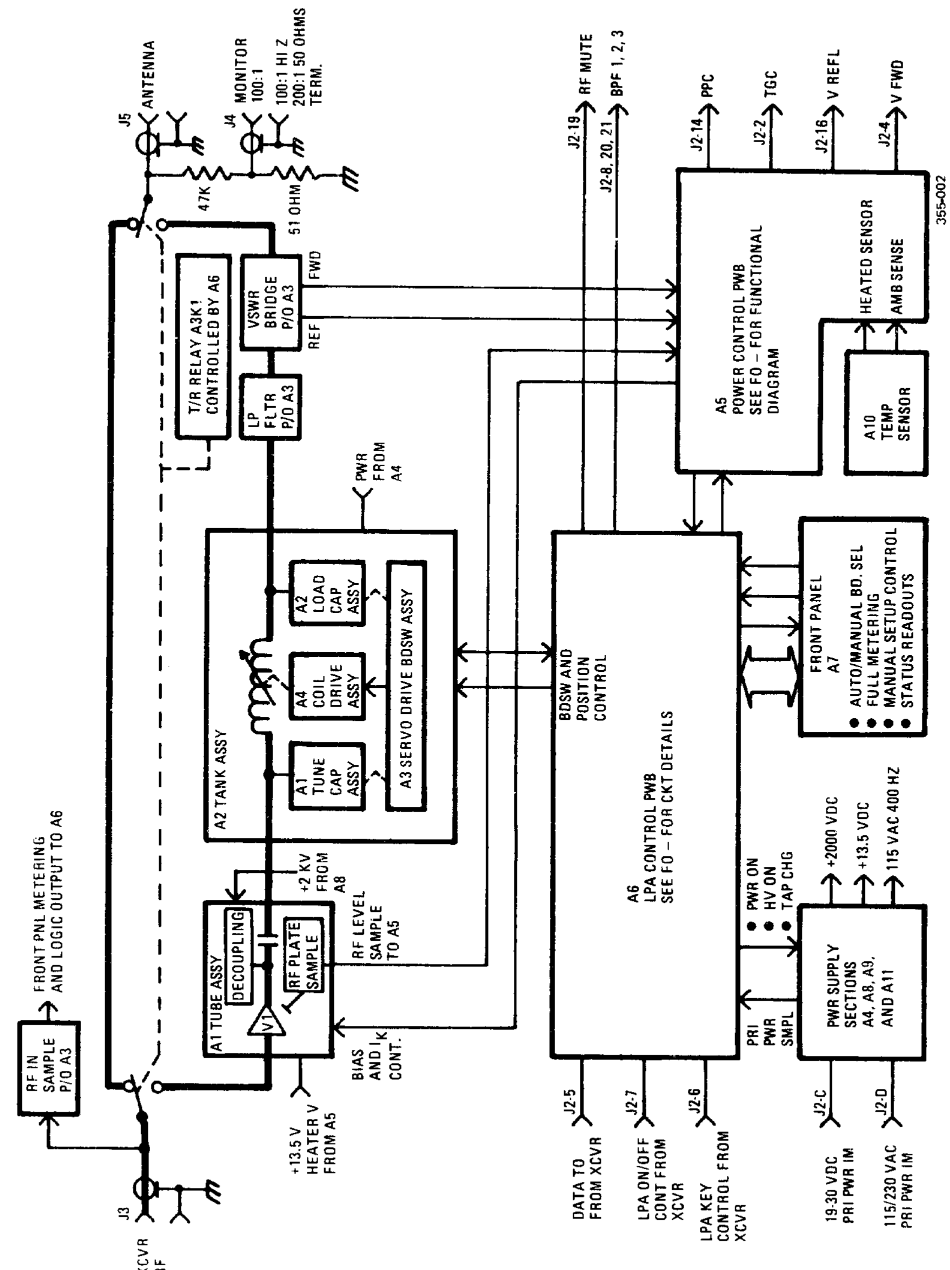


Figure 5-1. Functional Block Diagram

functions are controlled by the A6 Micro Control PWB assembly in response to inputs from either the A1 Tube Assembly and the 100 Watt Transceiver or the front panel. Subassemblies A2A1 and A2A2 make lumped capacitance changes through a bandswitch controlled by an open-seeking wafer, motor B2, and subassembly A2A3. Fine tuning is accomplished by variable inductor A2L1 driven by subassemblies A2A3 and A2A4.

(4) Low pass filtering of the tuned A2 Tank Assembly output is accomplished at A3 to attenuate undesired output components. This filter sharply attenutates all output frequency components above 30 MHz. The VSWR Bridge, also part of the A3 Assembly, provides very precise analog outputs that are directly proportional to the forward and reflected power components on the output transmission line. These outputs are used for metering, power control (TGC and PPC), and in a number of software related control functions at A6. A separate 50 ohm RF monitor output is provided at J4. This provides a divided down sample of the RF output voltage usable with common test equipment.

b. Power Control Subgroup. The power control subgroup consists of the Power Control PWB Assembly, the Temperature Sensor PWB Assembly and the Output Filter PWB Assembly. The Power Control Assembly uses the signals from the Output Filter PWB Assembly to generate a TGC control signal that is representative of the envelope of the RF output signal. The TGC control signal is routed to the 100 Watt Transceiver for control of the system RF output level. The transceiver compares the TGC signal to an internal IF sample and adjusts its drive to maintain these two samples at equal amplitudes. Thus, if the IF sample is low, the power output of the 500W LPA will be correspondignly low. The advantage of this type of control is that the system gain does not vary unnecessarily. As an example, should the operator stop talking, the system gain control loop does not increase in an attempt to artificially maintain a given output. Instead, the comparator type of TGC control system used maintains the same peak-to-valley ratio in the 500W LPA output as in the 100 Watt Transceiver IF. The TGC signal in the 500W LPA is modified by the reflected power sample from the Output Filter PWB Assembly and by the ambient temperature sample from the Temperature Sensor PWB Assembly as well as from other samples on the Power Control PWB Assembly; i.e., cathode current sample and RF plate to DC plate comparison sample, in order to maintain the 500W LPA within its safe operating parameters.

c. Microprocessor Control. The microprocessor control system consists of the A6 Micro Control PWB Assembly and the A7 Front Panel Assembly. The Micro Control PWB Assembly has a 64K memory and operates at a clock rate of approximately 5 MHz. It controls the automatic tuning and operating sequences for the 500W LPA. The Front Panel Assembly provides monitoring, metering, and manual controls as described in chapter 4.

d. Power Supply Subgroup. The 500 Watt LPA can be operated on 208 Vac, 115/230 Vac, or 19 Vdc to 30 Vdc. Once set up for the appropriate input line voltage, all power supply functions are controlled automatically, including low line/high line tap selections (switching is inhibited during keydown). Four separate assemblies make up the power supply: LV Power Supply A4, HV Rectifier/Bleeder Assembly A8, LV Filter PWB A11; and DC Control PWB A9.

Section II. 500 WATT LPA CIRCUIT THEORY

5-3. DETAILED DISCUSSIONS. The detailed discussions for each subassembly contain simplified functional diagrams, as appropriate. Refer also to the related schematic and to the Interconnection Diagram in chapter 8, Foldout Drawings, for circuit detail.

5-4. TUBE ASSEMBLY A1.

a. Cathode Circuits.

(1) Refer to figure 5-2. The power triode, V1, is connected in a cathode driven, grounded grid configuration. In this configuration, the tube is biased off with a positive voltage with respect to the grid, which is at ground potential. This voltage, approximately 20 volts, guarantees that the tube does not conduct when the transmitter is unkeyed. When the LPA is keyed, the tube is biased on, at approximately 5 volts, for class AB operation. Rf drive from the transceiver is applied to the cathode of the tube, causing the bias voltage to vary about the DC bias point. This variation causes the tube to conduct more when the bias voltage decreases and conduct less as the voltage increases. The RF voltage swing at the plate of the tube varies in phase with the voltage variation at the cathode, causing amplification of the RF drive present at the cathode of the tube.

2) With the transmitter keyed, the 100 Watt Transceiver output is connected through the T/R relay on the Output Filter PWB Assy to the RF input, J2, of the Tube PWB Assy. Resistors R1, R2, R3, and R4 form an input pad that attenuates the RF input signal by approximately 3 dB and presents a constant 50 ohm impedance to the output of the transceiver. C1 and C2 are DC blocking capacitors that prevent the cathode bias voltage from being fed back to the transceiver's output. C3 and L2 are a high frequency L-C matching network. The cathode bias voltage from the Power Control PWB Assy enters the Tube PWB Assy through connector J1-1/2 and is RF filtered by C4, C5, and L1. If the normal cathode bias circuit should fail open, resistor R5 at the cathode of V1 would develop a cutoff bias for V1. For a complete discussion of the bias circuit, see paragraph 5-8, f, for the Power Control PWB Assy. The cathode of the amplifier tube, V1, is indirectly heated by an isolated filament whose power, 13.5 Vdc, enters through connector J1-7/8 and is RF filtered by Z1, a ferrite bead, and C6.

b. Plate circuits. The DC plate voltage enters the Tube PWB Assy through a high voltage connector, P1, and is filtered by plate chokes L3 and L4 and bypass capacitors C9, C10, C11. The RF output of tube, V1, passes through the parasitic suppressor A1R1/A1L1 and through output coupling/DC blocking capacitors A1C1/A1C2 to the output connector A1J3.

c. RF Plate Sample Circuit.

(1) The RF plate sample circuit provides an output that is proportional to the RF voltage present at the plate of the tube. This output is used by the Micro Control PWB Assy for tuning of the Tank Assy and is compared with a DC plate voltage sample as part of the power control and protection circuitry on the Power Control PWB Assy. AUTO

(2) The RF plate sample circuit is made up of a capacitor divider, a peak detector, and a resistor divider. The top capacitor of the capacitor divider is formed by the anode of the tube and a copper plane on the printed wire board (PWB). The bottom capacitor is C7. Diode CR1, inductor L5, and capacitor C8 form the peak detector. Resistors R6 and R7 divide the output of the peak detector to a level that is usable by the Micro Control PWB Assy. One volt of output at J1-4 represents 660 volts of peak RF voltage swing at the plate of the tube. VR1 prevents the output at J1-4 from going above a level that is usable by the Micro Control PWB Assy.

5-5. TANK ASSEMBLY A2

a. RF Circuits. The Tank Assembly uses a Pi network to transform the output impedance, nominally 50 ohms, to a higher impedance at the plate of the amplifier tube, nominally 1600 ohms. The Pi network is composed of bandswitched tune capacitors (Tune Cap PWB Assy A1), variable inductor L1, fixed inductor L2, bandswitch S1, and bandswitched load capacitors (Load Cap PWB Assy A2). Both the Tune Cap PWB Assy and the Load Cap PWB Assy are made up of groups of fixed capacitors that are added together by a three pole bandswitch. As an example, the tune capacitors for band 1 are capacitors A1C1, A1C2, A1C3, A1C4, A1C5, and A1C6, while the tune capacitors for band 2 are A1C3, A1C4, A1C5, A1C6, and A1C7. Likewise, the Load Cap PWB Assy follows in a similar manner. Fixed inductor, L2, is used in band 1 only and is shorted out

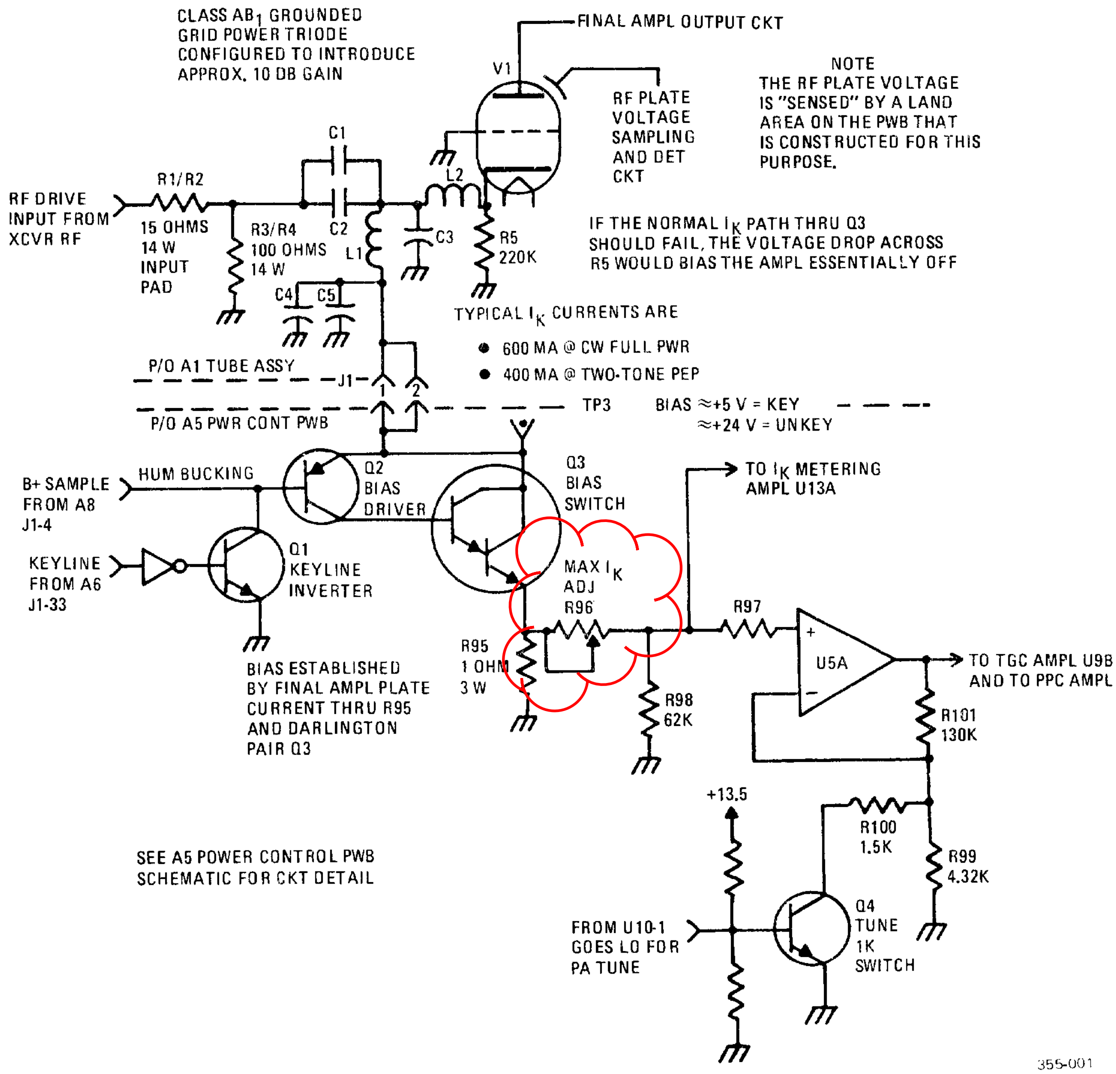


Figure 5-2. Bias and I_K Limit Control

by switch S1 in bands 2 through 9. The bandswitches A1S1, S1, and A2S1 are ganged together and driven ty a common motor whose control is from the Servo/Bandswitch Drive PWB Assy and open seeking switch wafer S2. The variable coil L1 is the only tuning element in the Tank Assy and its control is through the Coil Drive Assy and the Servo/Bandswitch Drive PWB Assy.

b. Bandswitch Drive Circuit. The Servo/Bandswitch Drive PWB Assy A2A3 is the control interface for all units that make up the Tank Assembly A2. All control is from the Micro Control PWB Assy A6. Bandswitch control from A6 is a BCD code which is converted to a decimal code by BCD-to-decimal decoder U1. The output of U1 presents a high, 5 volts, on one of the ten output lines indicating the band that is selected. The ten outputs are connected to the bandswitch decoding wafer, S2, through steering diodes CR5 through CR14 and RF filters R43 through R46 and C16 through C25. The decoding wafer is open seeking; that is, when a new band is selected, the output of the decoder U1 for that band goes high. That output is connected through its steering diode and rf filter to switch S2, through S2 and its common, S2-C, back to the Servo/Bandswitch Drive PWB Assy. The high from S2-C turns on bandswitch drivers A3Q10 and A3Q11, energizing the bandswitch motor B1 through connector A3J3-1/2 and A3J3-3/4. The bandswitch motor runs until the decoding wafer's common opens at the band selected, removing the high from the bandswitch drive transistors and the drive to the motor. Although the circuit contains outputs for ten bands, only nine are used in the 500 watt LPA. Resistors A3R21 and A3R22 divide the output motor voltage, 13.5 volts, down to 5 volts for a signal to the Micro Control PWB Assy to indicate that power is being supplied to the bandswitch motor. The Micro Control PWB Assy then generates an RF Mute signal to remove RF drive from the 100 Watt Transceiver to prevent hot switching of the bandswitches. RF MUTE

c. Coil Drive Control Circuits.

(1) All in-band tuning is accomplished by the Coil Drive Assy A4 and Servo/Bandswitch Drive PWB Assy 3.

(2) The Coil Drive Assy, A4, contains the coil drive motor, A4B1, and a limit switch A4S1, which indicates when the variable coil is at either minimum or maximum inductance. Also, the A4 assembly has a shaft encoder, G1, that rotates turn for turn with the variable inductor. The outputs of the encoder, TWA and TWB, are pulses that are representative of the degree of rotation of the variable inductor. The two signals are shifted in phase such that the direction of rotation can be determined by sampling and comparing the two outputs.

(3) The Servo/Bandswitch Drive PWB Assy, A3, contains the coil drive circuit. Since the circuit for driving the variable inductor toward minimum inductance is identical to that which drives the inductor toward maximum inductance, only one of the circuits will be discussed.

(4) Control for driving the inductor toward minimum inductance enters the A3 assembly through J1-15. MIN L DRIVE, a low level signal, biases transistor Q4 on, which in turn biases both Q5 and Q6 on. With Q5 on, 13.5 volts is present at connector J2-5/6; and with Q6 on, ground is present at connector J2-7/8. This places 13.5 volts across the motor such that it rotates the inductor toward minimum inductance. The MIN L DRIVE signal also biases Q7 on through resistor R13, which places 13.5 volts at the base of Q1. This inhibits Q1 from turning on, preventing the MAX L drive circuit from being active.

(5) When no drive signal (either MIN L DRIVE or MAX L DRIVE) from the Micro Control PWB Assembly is present at the A3 Assembly, the coil drive motor A4B1 is dynamically braked. Q9 is biased on through resistor R15. This biases both Q3 and Q6 on, which in turn places a ground at both J2-5/6 and J2-7/8 and across the motor. When either the MIN L DRIVE or MAX L DRIVE signal is present, Q9 is biased off through either CR2 or CR1, respectively, biasing both Q3 and Q6 off.

(6) Limit switch information, either MIN L STOP or MAX L STOP, enters the A3 Assembly at J2-16 and J2-14. These signals are a high level, 13.5 volts. When the MIN L Stop is active, indicating that the variable inductor is at minimum inductance, transistor Q4 is biased off through CR16, thus inhibiting the MIN L drive circuit and shutting off the drive to the motor. Also, Q14 is biased on, applying a ground to J1-5 which indicates to the Micro Control PWB Assembly that the inductor is at minimum inductance. The Micro Control Assembly then removes the MIN L DRIVE signal.

(7) The 5 volt regulator circuit supplies 5 volts for the encoder A4G1 and the BCD-to-decimal decoder A3U1. This circuit is made up of pass

transistor Q12, zener diode VR1, and bias resistor R24. Resistor R23 drops part of the voltage, reducing the power dissipation in Q12. Capacitors C13 and C14 filter the output.

5-6. OUTPUT FILTER ASSEMBLY A3. The 500 Watt Output Filter Assembly includes the RF Input Sampling Circuit, the T/R Relay, the Low Pass Filter, and the VSWR Bridge. The RF input sampling circuit provides dc output representative of the peak rf input voltage to an analog-to-digital converter on Microprocessor PWB A6. A3C18 and A3C19 form a capacitive voltage divider to pick off the desired sampling level; A3CR5, A3C20, A3R12, and A3R13 detect and filter the sample. The T/R Relay operates when a control ground is supplied via an output latch on Microprocessor PWB A6 in response to key control from the 100 Watt Transceiver or manual control - via the microprocessor - from the front panel. The Low Pass Filter (inductors L1, L2, and L3 and capacitors C1 - C10) has a pass frequency up to 30 MHz, and attenuates sharply above this frequency.

a. VSWR Bridge. The VSWR Bridge is designed to provide analog outputs for both the forward and reflected power output components. T1 and T2 and R1 and R2 provide for a voltage proportional to current on the 50 ohm line, while C11 and C12/C13 provide a voltage divider on the 50 ohm line. These voltages are then summed and rectified, with CR2 detecting the forward power sample, and CR1 detecting the reflected power sample. R4 is used to adjust the exact symmetry of these circuits. The adjustment can be made by terminating the output in a purely resistive 50 ohm load (dummy load) and by adjusting R4 for minimum reflected power (a null). The reflected sample output level is fixed (nominally 7 volts for 500 watts reflected), but the forward component is adjustable (R7) and is set up so that at 500 watt forward power, the output at J6-6/8 (TP1 on the A5 Power Control PWB) is exactly 7 Vdc. The forward and reflected power analog outputs are supplied to Power Control PWB A5.

b. RF Monitor. An RF monitor output is also picked off at the A3 Assembly and made available at J4 on the rear panel. R10 and R11 comprise a resistive voltage divider.

5-7. LV POWER SUPPLY PWB ASSEMBLY A4. Input to the LV Power Supply assembly passes through the LV filter assembly as shown on figure 5-3. The schematic for the LV Power Supply Assembly is located in the Depot Manual. FO-2 is a simplified diagram of the A4 Assembly. This diagram includes a functional diagram of the pulse width modulating regulator U1. The LV Power Supply Assembly uses a series pass switching regulator to supply a regulated 13.5 Vdc output voltage. The Assembly accepts input voltages from 17 to 33 volts, above and below which the modulator is shut down and inhibits operation of the regulator. The regulator circuit contains a current limit circuit that will reduce the output voltage from the nominal 13.5 volts if the current draw is above ten amps. In the basic operation, the input voltage is passed to the output filter as a train of pulses at a fixed rate. The duty cycle of the pulses is variable and is determined by the amount of error in the output voltage. Since the output filter network has a choke input, a flyback diode allows the current through the choke to continue during the off-time of the pass transistor. The pulses are integrated to yield a voltage at the output of the filter. This output is compared to a stable reference in the regulator. The result of the comparison determines the duty cycle of the pulses and thus the output voltage. The assembly also contains a fan inverter circuit that converts the 13.5 volt dc output of the switcher to 115 volts ac at 400 Hz.

a. Pulse Width Modulator U1. Pulse width modulator U1 contains all control circuitry of the A4 regulated power supply. The 16-pin dual-in-line package contains the voltage reference, error amplifier, oscillator, pulse width modulator, pulse steering flip-flop, dual alternating output switches, and current limiting and shutdown circuitry. The following discussion describes elements within the regulator chip.

(1) The oscillator in U1 uses an external resistor (R25 and pin 6) to establish a constant charging current into an external capacitor (C12 at pin 7). This provides a linear ramp voltage on the capacitor which is used as a reference for the comparator. The discharge time of C12 determines the pulse width of the oscillator output pulse. This pulse is used as a blanking pulse to both outputs. Since the two switcher outputs are connected in parallel, the frequency of the oscillator is the frequency of the output.

(2) Within U1, there is a complete linear regulator designed to provide a constant 5 volt output with input voltage variations of 8 volts to 40 volts. It is internally compensated and short-circuit protected, and is used both to generate a reference voltage and

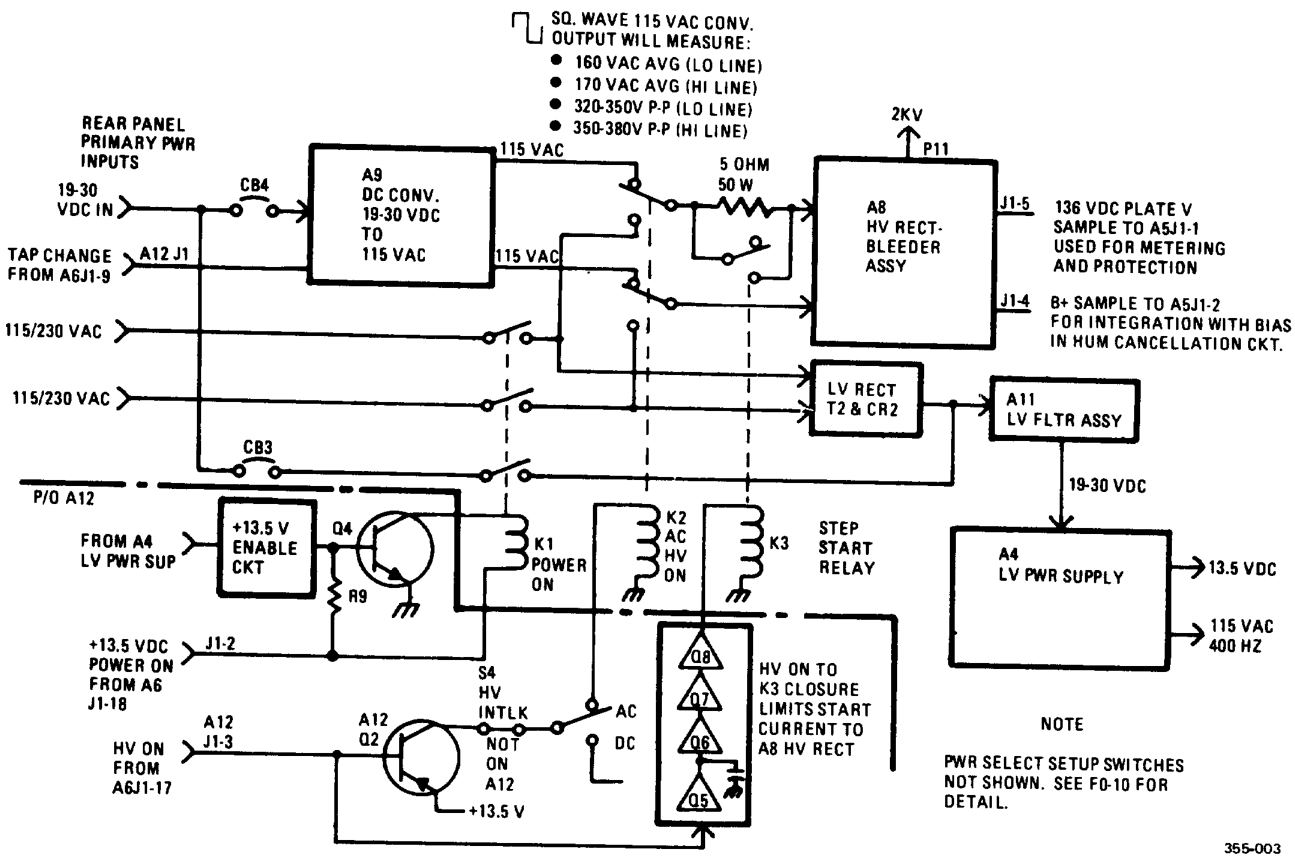


Figure 5-3. Power Supply Simplified Diagram

as the regulated source for all the internal timing and controlling circuitry.

(3) The error amplifier circuit is a simple differential input, transconductance amplifier. The gain of this amplifier is nominally 10,000 but is reduced by a feedback network or by shunting the output to ground. Phase response of the amplifier is compensated by an external RC (C5, C6 and R16) combination at pin 9. Since the error amplifier is powered by the internal 5-volt reference voltage, the acceptable common-mode input voltage range is restricted to 1.8 to 3.4 volts. This means the reference must be divided down to be compatible with the amplfier input.

(4) The +13.5 Vdc output of the LV Power Supply Assembly is fed back to pin U1-1 through a voltage-divider network, resistors R22, R23, and R24. Output Voltage Adjust Potentiometer R23 can be used to adjust this output voltage. The divided-down feedback voltage at U1-1 is compared to a reference voltage (2.5 volts) at pin U1-2 (+IN). The error voltage that results from this comparison is used to control the pulse width at the output of U1. The output pulse at the junction of U1-11 and U1-14 narrows to prevent the output voltage from increasing and widens to prevent the output voltage from decreasing. The signal has a maximum duty cycle of 80% set by the external circuit of Q5, R13, R14, R15 and steering diode CR10. The output pulses are integrated to determine the dc component in the output filter (made up of T5, L1, C22, and C23).

(5) Since the error amplifier is a transconductance design, the output impedance is very high (approximately 5 megohms) and can source or sink only 200 microamperes. Internal shutdown and current limit circuits are connected at pin 9, but any other circuit which can sink 200 microamperes can pull this point to ground, thereby shutting off both outputs. A "soft start" circuit is used to hold pin 9 to ground (and shut off both outputs) when power is first applied. As the soft start capacitor (C2) charges, the output pulse slowly increases from zero until the feedback loop takes control.

(6) The current limiting circuit (shown in the simplified block diagram as an operational amplifier) is a single transistor amplifier. It is frequency compensated. A second transistor provides termperature compensation and a reduction of input threshold to 200 millivolts. When this threshold is exceeded, the amplifying transistor turns on and linearly decreases the output pulse width by pulling the output of the error amplifier toward ground.

(7) The 19 to 30 Vdc input to LV Power Supply Assembly A4 is routed through transistor Q6 to pins U1-12 (CA) and U1-13 (CB) of the pulse-width modulating regulator. The voltage at these pins is routed by two internal transistors (when enabled) to output pins U1-11 (EA) and U1-14 (EB). The Pulse Width Modulation (PWM) duty cycle varies with line voltage and varies slightly with load. These variations in turn vary the on-time of the pass transistors to give the exact pulse-width needed to produce the desired output voltage. The output is then filtered to give a regulated voltage with extremely small ripple content and good regulation.

b. <u>Voltage Limiter.</u> The voltage limiter circuit limits the voltage to the pulse width modulator to 27 volts. Resistors R21 and R12 and zener diode VR2 maintain the base voltage of pass transistor Q6 at or below 27.7 volts, thus maintaining the emitter of Q6 at or below 27 volts. Capacitors C7 and C8 provide filtering of the supply voltage to the modulator U1.

c. <u>Undervoltage Protection and Soft Start.</u> When the input voltage at J3-4/5/6 is less than 17, the under voltage transistor Q1 is turned off, the shut-down transistor Q2 is turned on, and the soft start transistor Q4 is turned on, holding capacitor C2 at ground and pin 9 of the modulator at ground through diode CR3. Pin 9 of the modulator controls the duty cycle with 0 volts being 0% and 3.2 volts being 100%. As the input voltage rises above 17 volts, zener diode VR1 conducts, biasing on Q1 which in turn biases off Q2. Soft start transistor Q4 is turned off, allowing capacitor C2 to charge through R2. As C2 charges, it allows the modulator's duty cycle to increase to its maximum value.

d. <u>Overvoltage Protection.</u> When the voltage at the input connector J3-4/5/6 exceeds 35 volts, the overvoltage protection transistor Q3 is biased on. This in turn biases the shut down transistor Q2 on, which applies a positive voltage to the shut down pin of the modulator, which inhibits the output of the modulator. Q2 also biases soft start transistor Q4 on, which discharges C2 and holds pin 9 of the modulator at ground.

e. <u>Predriver, Driver and Pass Transistors.</u> The outputs of the modulator U1-11/14 bias on the predriver transistor Q7 when their output goes high. Q7 biases on driver transistor Q9 which turns on pass transistor Q8. The base drive for Q8 is supplied from current transformer T1 that has a turns ratio of 1:13. The primary of the transformer samples the collector current of the pass transistor and provides a base current inversely proportional to the turns ratio. Thus, the base current equals one thirteenth of the collector current.

f. Current Sense Circuit. The current sense circuit contains two current transformers, one that samples the output current of the pass transistor and one that samples the current in the flyback diode CR8. The two secondaries are diode added by CR6 and CR7 producing a current feedback signal that is inputted to the pulse width modulator via the filter network consisting of capacitors C13 and C14 and resistors R31, R32, R34, and R46. The filter network provides phase compensation to achieve the proper loop response at current sense input pin U1-4.

g. Output Filter. The output filter contains transformer T5 whose primary stores energy during the on time of the pass transistor and releases it during the off time. The secondary of T5 adds additional base drive to the pass transistor through CR11, C9, and R26. Capacitors C22 and C23 and inductor L1 complete the filter network.

h. 115 Vac Fan Inverter Circuit.

(1) The fan inverter circuit contains both a driver transformer, T3, which sets the frequency of oscillation and an output transformer, T4, which sets the output voltage. The 13.5 volt output of the regulator circuit is applied to the center tap of the output transformer and to the center tap of the driver transformer through a bias network, C16, CR9, R39, R40 and R41, which supplies the return path for the drive transistors, Q10 and Q11. Resistor R44 provides an offset voltage across T3 such that transistor Q11 is biased on more than Q10 when power is first applied. This starts the inverter oscillating.

(2) As Q11 conducts, a voltage is induced in winding T4-5/6 with a polarity that makes terminal 5 more positive than terminal 6. Then, by transformer action, terminal 1 is more positive than terminal 2. A voltage is also induced in the driver transformer T3 primary that makes terminal T3-5 more positive than T3-1. By transformer action, secondary winding terminal T3-10 is more positive than terminal T3-8, causing Q11 to be more strongly forward biased. This action continues until Q11 is driven into saturation. When this occurs, the primary voltage can no longer increase and a condition of quasi-stable equilibrium is maintained. With a constant voltage across the windings, both the current and the magnetic flux increase until the core reaches saturation. At this time, the exciting current required by the transformer exceeds that which can be supplied by Q11, causing Q11 to turn off. As the flux in the transformer collapses, the polarity in the transformer is opposite to that originally induced. Therefore, Q10 is biased on and is driven to saturation in a like manner. The flux will then again collapse, turning off Q10 and turning on Q11, thus completing the cycle. R-C networks R42/C17 and R43/C18 provide snubbing action to protect the transistors from any spikes that might be generated.

(3) The AC voltage induced in the primary of T4 is coupled by transformer action to the secondary and to the output pins of J2. Capacitor C19 provides a phase shift for the fan.

5-8. POWER CONTROL PWB ASSEMBLY A5. The Power Control PWB assembly performs the following functions: meter processing, TGC and PPC generation, cathode biasing, and temperature sensor processing. Figure FO-2 is a simplified diagram of the Power Control PWB Assembly. The Power Control PWB Assembly schematic is located in the Depot Manual.

a. Meter Processing Circuits.

(1) The forward and reflected power samples from the Output Filter PWB Assembly A3 are directed to the Power Control PWB Assembly for processing for both metering information for the LPA front panel and for power control processing for generation of the TGC and PPC control signals.

(2) The forward power sample enters the Power Control PWB Assembly at J2-8. Resistor network R5 and R9 sets the appropriate bias level for the forward power sample from the Output filter. Operational amplifier U1A has a gain of one and acts as a buffer to prohibit any interaction between the VSWR bridge on the Output Filter Assembly and the processing of the signal on the Power Control PWB Assembly. Diode CR1, resistors R15, and capacitor C5 peak detect for forward power sample, while divider network R17 and R19 sets the full power voltage to 4 volts at the input to FWD METERING AMP U2A. Amplifier U2A also has a gain of one and supplies the forward metering sample to the Micro

Control PWB Assembly through J1-9 and to the 100 Watt Transceiver through J1-17. Zener diode VR4 inhibits the output from going above 5.1 volts.

(3) The reflected power sample enters the Power Contorl PWB Assembly at J2-7. Resistor network R6 and R27 sets the appropriate bias level for the reflected power sample from the Output Filter. Operational amplifier U1B has a gain of three and acts as a buffer to prohibit any interaction between the VSWR bridge on the Output Filter Assembly and the processing of the signal on the Power Control PWB Assembly. Diode CR2, resistor R16, and capacitor C6 peak detect the reflected power sample, while divider network R18 and R20 sets the full power reflected voltage to 4 volts at the input to REFLD METERING AMP U2B. Amplifier U2B has a gain of one and supplies the reflected metering sample to the Micro Control PWB Assembly through J1-6 and to the 100 Watt Transceiver through J1-18. Zener diode VR5 inhibits the output from going above 5.1 volts.

b. TGC Circuits AGC VERS LE TX

(1) The TGC signal is generated from a combination of the forward power and reflected power samples. FWD/REFLD AMP U3A uses the higher of the two signals to generate the TGC signal. The reflected power sample becomes equal to the forward power sample when the output VSWR is 2:1. At VSWR's above 2:1, the reflected power sample will be the dominant sample and thus control the level of the TGC voltage. The gain of U3A is adjustable from 1 to 1.25 and is set to amplify the input voltage to 8 volts as well as compensate for any variation of the IF sample in the 100 Watt Transceiver. The output of U3B is fed to the CONTROL LOOP VARIABLE GAIN AMP consisting of U9A and U8.

(2) Unijunction transistor U8 acts as a voltage variable resistor which modifies the gain of amplifier U9A. As the voltage at U8-3 goes negative, the gain of U9A is increased, causing the envelope of the forward and or reflected power sample to increase. This increase is detected by the 100 Watt Transceiver's TGC circuits as an RF power output signal increase, causing the RF power drive level to be reduced. There are four inputs that can cause a gain change, if any of their thresholds are exceeded. The four inputs are the CW/FSK power threshold, the I_K cathode sample, the over-temperature threshold, and the RF/DC plate sample.

(3) The TGC output of amplifier U9A is connected through solid state switch U10 to output amplfier TGC AMP U9B. Switch U10 controls which signal is used as the TGC signal to the Transceiver. When the LPA is the tune mode, switch U10 is open, causing the power control of the LPA to be generated by the cathode current sample; and when in the ready mode, U10 is closed enabling the control through the above path. LED DS1 indicates that there is TGC voltage being sent to the 100 Watt Transceiver, and diode CR26 prevents the TGC signal from going negative.

c. CW/FSK Power Control. The Forward/reflected power envelope is sampled through diode CR5 from the output of the FWD/REFLD AMP in the TGC control circuit by an averaging network consisting of diode CR6, capacitor C10, and resistors R32 and R33. Resistor R34 provides an adjustment of the output of this network to the input of the CW/FSK AVG PWR AMP, U4A, which has a gain of two. The output of U4A is diode ORed with the cathode sample, the ambient temperature sample, and the RF/DC plate sample to the GAIN CONTROL THRESHOLD AMP U4B. When any of these samples exceeds the threshold of 5 volts set by resistor divider R42 and R43, the output of U4B goes positive. The output of U4B is inverted by GAIN CONTROL POLARITY INVERTER U7A and fed to the controlling input of the unijuction transistor U8, thus increasing the gain of the CONTROL LOOP GAIN AMP U9A and thereby causing the output power of the LPA to be decreased.

d. PPC Control Circuit. The PPC control circuit samples the outputs from the RF/DC plate comparator, the cathode current amplifier, and the FWD/REFLD AMP U3A. The cathode current sample and the forward/reflected power sample are divided by resistor network R107 and R108 and diode ORed to the output of the RF/DC plate comparator and inputted to the PPC UNIT GAIN AMP U5B. Amplifier U5B has unity gain and acts as a buffer amplifier to supply a PPC voltage to the 100 Watt Transceiver where it is thresholded at 5 volts. When the output of the PPC amplifier exceeds this level, the transciever's PPC circuits cause the transceiver's RF output to drop to minimum output, thus causing an immediate power cutback out of the LPA. This circuit is used only as protection in the event that the TGC does not or cannot react to an overload to prevent damage to the LPA. The output of the PPC amplifier is also fed to the PPC INDICATOR THRESHOLD AMP U13B. When the PPC output voltage exceeds 5 volts, as set

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by resistor divider R116 and R117, the output of U13B goes high, lighting LED DS2 and indicating that the control loop is under PPC control.

e. RF/DC Plate Voltage Comparator.

(1) The peak RF voltage swing at the plate of the amplifier tube A1V1 is compared to the DC plate voltage. If the RF voltage swing approaches the maximum available swing, as set by the DC plate voltage, a voltage is generated by the RF/DC COMPARATOR and fed to both the TGC circuit and the PPC circuit for power cutback. This prevents the RF plate voltage swing from equalling the DC plate voltage and thus will prevent excessive grid current from being drawn by the amplifier tube.

(2) The RF plate sample enters the Power Control PWB Assembly on connector J1-36 and is fed to the Micro Control PWB Assembly through J1-10 for monitoring and display. Likewise, the DC plate sample enters the Power Control PWB Assembly through J1-1 and is fed to the Micro Control PWB Assembly through J1-8. Zener diode VR7 and resistor network R83, R84, and R85 set both the threshold level and the gain of the RF/DC COMPARATOR U3B. When the threshold is exceeded (this varies directly with the DC plate voltage), the output of U3B goes high and is fed to both the TGC through diode CR29 and the PPC circuit through CR18. The rate at which the RF plate voltage approaches the DC plate voltage will determine whether the TGC loop or the PPC loop will control the output power.

f. Cathode Current and Bias Circuits.

(1) The Power Control PWB Assembly contains both the cathode bias circuit and the cathode current control and metering circuits.

(2) The cathode bias is set by the B+ sample voltage, resistors R93 and R94, and transistors Q1, Q2, and Q3. When Q1 is biased off, the amplififer tube is biased off at approximately 20 volts. This voltage is set by a resistor divider network on the Bleeder/Resistor PWB Assembly A8, resistors R93 and R94, and transistors Q2 and Q3. An active low KEYLINE signal present at J1-3 is inverted by KEYLINE SCHMITT TRIGGER U11A to a high, which biases on Q1 and shorts out R94, lowering the voltage at the base of Q2 to about 5 volts, thus biasing on Q2, Q3, and A1V1. The B+ sample also contains an AC component that is representative of the AC ripple on the DC plate supply. This affects the bias point in such a way that the AC hum component on the RF output signal is cancelled or reduced.

(3) Resistor R95 in the emitter lead of Q3 measures the cathode current. The resultant voltage is divided by resistors R96 and R98 and amplified by amplifier U5A. Resistor R96 is used to adjust the maximum plate current allowable before TGC/PPC cutback will take place. The gain of U5A is changed from approximately 31 during normal operation to approximately 120 during a tune cycle by the TUNE I_K SWITCH being biased on the resistor R106 when CONTROL LOGIC SWITCH U10 is open.

(4) The LPA tunes on constant cathode current, and this is controlled by the output of U5A being fed to the input of the TGC AMP U9B through resistor R62 and diode CR16. During the TUNE mode, switch U10 is open, removing the forward/reflected power signal from the input to the TGC AMP and releasing the ground from diode CR15, allowing CR16 to conduct. During normal operation, switch U10 is closed, connecting the forward/reflected signal to the TGC AMP and grounding CR15, which reverse biases CR16 and biases off TUNE I_K SWITCH Q4 through CR14.

(5) The output of the cathode current amplifier is connected to the GAIN CONTROL THRESHOLD AMP U4B through diode CR10, resistor divider R47 and R48, and diode CR8. If the output of the amplifier exceeds 7.4 volts, then the threshold of the GAIN CONTROL THRESHOLD AMP causes the gain of the TGC loop to increase, thus reducing the RF power output. In addition, the output of the I_K amplifier U5A is connected to the PPC AMP U5B through CR19 to generate a PPC signal if the cathode current should exceed approximately 800 milliamperes.

g. Control Logic Switch. Control Logic Switch U10, in addition to switching the TGC input from the forward/reflected sample in normal to the cathode current sample in tune, also removes the internal power control potentiometer from the circuit in tune mode and antenna tune mode. Antenna tune mode is not used in the 500 Watt LPA but is in the 1000 Watt LPA. Also U10 switches the coupler tune power potentiometer into the TGC circuit when the antenna tune mode is selected (an active low signal). Both the POWER CONTROL potentiometer and the COUPLER TUNE PWR potentiometer feed voltages to the input of the TGC GAIN CONTROL POLARITY INVERTER, which increase/decrease the gain of the TGC loop, thereby reducing/increasing the RF output power of the LPA.

CUT EITHER R102 ON A6 BOARD, OR R122 ON A5 BOARD TO VALIDATE THE POWER CONTROL POTENTIOMETER, AND SWR PROTECTION CIRCUIT.

h. Temperature Sensor Circuits.

(1) The Power Control PWB Assembly contains the processing circuits for the Temperature Sensor PWB Assembly outputs. There are two outputs for the Temperature Sensor, an output that is proportional to the ambient temperature and one that is proportional to the air flow past the sensor assembly.

(2) The ambient sensor input at J2-3 is directed to two comparators, one for air flow and one for overtemperature. The output of the sensor is 10 milivolts per degree Kelvin, which correlates to 2.73 volts for 0 degrees Centigrade. The OVER TEMP THRESHOLD AMP U6B compares the output of the ambient sensor to a threshold voltage equating to 150 degrees C, above which its output goes positive. The output of the amplifier is directed to the variable gain stage of the TGC loop through diode CR11, resistors R49 and R47, and diode CR8, thus causing cutback of the output power when this threshold is exceeded. If the ambient temperature is not reduced through power cutback but increases, this increased level is detected by FAULT INVERTER U11E. The output of the inverter goes low, indicating a XMTR FAULT and causing the LPA to go into standby. Feedback resistor, R152 sets up a hysteresis loop in the OVER TEMP THRESHOLD AMP so that once cutback has occurred, the temperature must decrease beyond a certain point before the LPA can be brought back to full output power.

(3) The ambient sensor output is also compared to the heated sensor input by AIR FLOW COMPARATOR U6A. When the heated sensor is between 15 and 21 degrees above the ambient sensor, the output of the AIR FLOW COMPARATOR goes positive such that the AIR FLOW FAULT THRESHOLD AMP U7B is enabled. The positive output of a U7B goes positive, lighting LED DS4, LO AIR, and causing the output of FAULT INVERTER U11E to go low, indicating a XMTR FAULT.

i. -8 Volt Regulator. The -8 volt regulator consists of an oscillator, an amplifier, a rectifier, and a filter. SCHMITT TRIGGER OSC U11C, resistor R129, and capacitor C51 form an oscillator whose frequency is approximately 12 KHz. POWER AMP U12 amplifies the output of U11C to 13.5 volts. Capacitor C54 couples the output of U12 to rectifiers CR24 and CR25 and filter C55. The output voltage is approximately -8 volts.

5-9. MICRO CONTROL PWB ASSEMBLY A6.

The Micro Control PWB Assembly controls all functions within the LPA except for Power Enable, which is a hardwired signal from the 100 Watt Transceiver used to turn on the LPA, and TGC/PPC control signals that are hardwired and under control of the Power Control PWB Assembly. Refer to the Micro Control PWB schematic for the following discussion. This schematic is found in the Depot Manual.

a. Transceiver Data Link. Data between the 100 Watt Transceiver and the LPA is serialized and transmitted via a two wire link. Opto isolator U4 isolates the link from the receive data input of the microprocessor U1. The TXD output of microprocessor U1 is normally high when in the receive mode. This output biases transistor Q2 on through hex buffer U10-4/5, which enables the opto isolator's input for reception of data from the 100 Watt Transceiver. The receive data from U4-1 is inverted by NAND gate U3-5/6/4 and inputted to the RXD input of the microprocessor. The transmit data is from the TXD output of the microprocessor and is transmitted to the 100 Watt Transceiver via hex buffer U10-4/5, transistor Q2, and opto isolator U4.

b. Clock circuits.

(1) The clock control signals for the Micro Control PWB Assembly are generated by the Clock Oscillator circuit. This circuit consists of crystal oscillator Y1, capacitors C38 and C39, resistors R1 and R2, and hex inverters U8-1/2, U8-3/4,.and U8-5/6. The output frequency of this circuit is 4.9152 MHz. This signal is connected to both the XTAL 1 input of the microprocessor U1 and a dual 4-bit counter, U31, from which all other clock frequencies are derived.

(2) Three outputs of counter U31 are used. The 614.4 KHz clock is used for the clock for the analog to digital converter U6. The 307.2 KHz clock output is inputted to counter U32 where it is further divided down to a 150 Hz clock. This is connected to the second 4-bit counter of U31 where it is divided down to produce a 9.373 Hz clock. This clock is inverted by hex inverter U17-1/2 and ANDed with the power on reset circuit of resistor R20 and capacitor C13 by NAND gate U3-1/2/3. The output of U3 is connected to the Reset of microprocessor U1. This both holds the microprocessor reset until the power supply stabilizes during power on and resets the micro if U31 is not reset within the clock frequency

(approximately every .1 seconds) by the P3.4 output of U1 going low.

(3) Counter U32, in addition to the 150 Hz clock, has three other clock outputs: a 153.6 KHz clock, a 300 Hz clock, and a 75 Hz clock. The first two are used by the microprocessor U1, while the 75 Hz clock is used by the Front Panel PWB Assembly as the clock for the data display by the LCD.

c. Interrupts. The microprocessor has two interrupts: one is the 300 Hz clock, and the other is generated from the inputs of the Tank Assembly coil drive encoder, TWA and TWB. The TWA signal is shaped by schmitt trigger inverter U17-9/8 and fed to an edge detector circuit, capacitors C36 and C37, resistors R5-8 and R5-10, and hex inverter U17-5/6. This circuit detects both a positive going and a negative going pulse. Likewise, the TWB signal is shaped by U17-11/10 and fed to an edge detector circuit, capacitors C24 and C29, resistors R5-6 and R5-7, and hex inverter U17-3/4. These four outputs, TWA positive going, TWA negative going, TWB positive going, and TWB negative going, are ORed and inverted by NOR gate U26. The output of U26 is fed to the second interrupt of microprocessor U1. When any motion of the coil drive assembly is detected, the microprocessor is interrupted and records the motion of the variable inductor, thus keeping track of its position.

d. Input Latch. The input latch U28 converts eight parallel inputs to a BITE word that is read into the microprocessor as required. Five of these inputs are from the Tank Assembly; BD SW ON indicates bandswitch motion, TWA and TWB indicate direction and rotation of the variable inductor, and MIN L LIMIT and MAX L LIMIT indicate when the variable inductor is at either end stop. The EXT INTLK input is not used. The XMTR FAULT is from the Power Control PWB Assembly and indicates a temperature fault. LPA KEY is a hardwired signal from the 100 Watt Transceiver; and, when low, activates the keylines in the LPA. The microprocessor polls the input latch as required by software by enabling the output enable input (OE) of U28.

e. Analog to Digital Converter. A/D Converter U6 converts any one of the eight inputs to a digital BITE that is representative of the analog signal. All inputs are based on a 5 volt maximum value, while the output is an 8 BIT word. Microprocessor U1 selects which input is to be converted through address inputs A0, A1, A2, and address enable input ALE of U6. The START input of U6 starts the conversion process, while the OE input enables the output lines so that the microprocessor can read the BITE word.

f. Microprocessor circuits.

(1) The microprocessor U1 is an 8 bit control oriented CPU. It contains a 128 byte read/write data memory, a full duplex UART, two 16 bit timer/counters, a programmable I/O, a 64K-byte bus expansion control, and oscillator and clock circuits. It can address up to 64K bytes of external program memory and/or 64 bytes of external data.

(2) The external program memory is contained in EPROM U2, while the data is both held in the on-chip memory as well as in the external RAM U29.

(3) Input/output ports P0.0 through P0.7 serve as both address data outputs as well as data inputs. I/O ports P2.0 through P2.7 serve only as output address ports. Latch U12 latches the output address data, while the I/O ports are accepting data. Address decoder U27 decodes the address and the read and write commands for control of the external RAM U29, the INPUT LATCH U28, the A/D converter U6, and the OUTPUT LATCH U13. Parallel to serial converter U15 converts up to eight parallel inputs to a serial eight bit word. The 1000 Watt LPA identification bit (KW ID) is the only input to U15.

(4) I/O ports P1.0 through P1.7 are used for control and data to/from the Front Panel Assembly. Data is sent to and received from the Front Panel Assembly in serial form through the serial data line. Serial Clk is the clock signal for clocking in/out the data to/from shift registers on the Front Panel Assembly. LCD OUT ENABLE enables the LCD display, while F.P. IN ENABLE enables the front panel switch data to be sent to the microprocessor. F.P. OUT ENABLE enables the front panel LEDs.

g. Output Latches. Serial data from the microprocessor is clocked into 2 serial to parallel output latches U19 and U25 for control of the LPA. Output drivers U20 and U30 are open collector darlington transistor arrays that act as buffers between the output device and the serial to parallel latches. One output RF MUTE is sent to the 100 Watt Transceiver as a hardwired input for shutting off the RF drive from the transceiver during certain LPA operations. WHEN BANDSWITCH IS MOVING

OUTPUT LATCH U13 is a parallel in parallel out latch for latching parallel data from the microprocessor to the output. These outputs are also buffered by an open collector darlington transistor array and serve as control for the Tank Assembly.

There are a number of hardwired jumpers on the Micro Control PWB Assembly that program the method of control of the keylines. Both the T/R kEYLINE and the KEYLINE are programmed to be under microprocessor U1 control from the inputs from either the 100 Watt Transceiver in AUTO mode or the front panel in MANUAL mode.

5-10. FRONT PANEL ASSEMBLY A7. The Front Panel Assembly contains both display and manual controls for operation of the LPA. Display is from both a group of LEDs and from an LCD whose input is controlled by a rotary switch. There are four toggle switches, one pushbutton switch, and two rotary switches.

a. LED Display.

(1) Information for four of the five LEDs is sent to the Front Panel Assembly via the serial data line from the Micro Control PWB Assembly. The serial data is clocked into the serial to parallel converter U26 by the F.P. OUT EN signal from the Micro Control PWB Assembly. The data is converted to parallel data by U26, and the parallel outputs of U26 drive their respective LED transistor dirver and LED.

(2) The fifth LED, POWER ENABLE, is controlled by the 5 volts supply from the Micro Control PWB Assembly to indicate that power is present in the LPA.

b. LCD Display. The LCD display DS1 is a 4 digit, 8 segment display that is driven by LCD driver U28. The information for display is serially clocked into the driver chip U28 by the LCD CLK line and the LCD OUT EN line from the Micro Control PWB Assembly.

c. Manual Control Switches. Manual control switches, TUNE PWR, LOCAL KEY, and TUNE, as well as SELF TEST pushbutton switch, are inputted to parallel in-serial out chip U20. When the microprocessor activates the FP IN EN line along with the SERIAL CK, the data from the switches is sent to the microprocessor on the Micro Control PWB Assembly.

d. Rotary Switches. Data from the two rotary switches, METER and AUTO MANUAL BAND, is inputted to parallel in-serial out chips U17, U18, and U19. These converters are controlled via the FP IN EN and SERIAL CK lines from the Micro Control PWB Assembly. It should be noted that the serial data from all front panel switches, with the exception of the POWER ENABLE switch, are linked together through parallel to serial converters U17, U18, U19, and U20.

5-11. BLEEDER/RECTIFIER PWB ASSEMBLY A8. Refer to the 500 Watt Power Supply Schematic for the following discussion. This schematic is found in the Depot Manual. The Bleeder/Rectifier PWB Assembly contains the high voltage rectifier CR1 and the high voltage bleeder resistors R1, R2, R3, and R4. The DC plate sample that is fed to the Power Control PWB Assembly for comparison to the RF plate sample is generated from resistor divider R5 and R6 on this assembly. Zener diode VR1 prevents the sample from exceeding 5.1 volts, and capacitor C1 provides bypassing. R-C network R7 and C2 provide the B+ sample that is used by the Power Control PWB Assembly for both setting the bias levels and for the AC hum feedback for cancellation on the RF output signal.

5-12. DC CONTROL PWB ASSEMBLY A9. Refer to the 500 Watt Power Supply Schematic for the following discussion. This schematic is found in the Depot Manual. The DC Control PWB Assembly contains an overvoltage shutdown circuit, a tap change relay driver circuit, a step start relay driver circuit, and a high voltage relay driver circuit (figure 5-4).

a. Overvoltage Circuits. The overvoltage circuit samples the 13.5 volts from the LV Power Supply PWB Assembly. If the voltage exceeds 16 volts, zener diode VR1 conducts and fires the SCR OVERVOLTAGE LATCH Q3. Q3 in turn biases off transistor Q4, which removes the ground from the PWR ON relay R1 in the LPA chassis, thus dropping out the power on relay and removing primary power from the LPA. Since the power enabling the power on relay comes from the 100 Watt Transceiver, the LPA must be turned off at the transceiver by pressing [2nd][AMP PWR] on the transceiver's front panel keyboard. This will remove the 13.5 volts from the transceiver to the LPA and allow the SCR OVERVOLTAGE LATCH to reset. LPA ON/OFF

b. Tap Change Circuit. A low level at the TAP CHANGE input J1-1 will enable the TAP CHANGE RELAY DRIVER and put 13.5 volts at J3-8 and at the

TAP SELECT	AVG READING METER, I.E. SIMPSON	RMS READING METER ≈90% OF SQ WAVE	P-P READING DEVICE, I.E. OSCILLOSCOPE
@ LO LINE	≈160 VAC	≈144 VAC	320 - 350
@ HI LINE	≈170 VAC	≈153 VAC	350 - 380

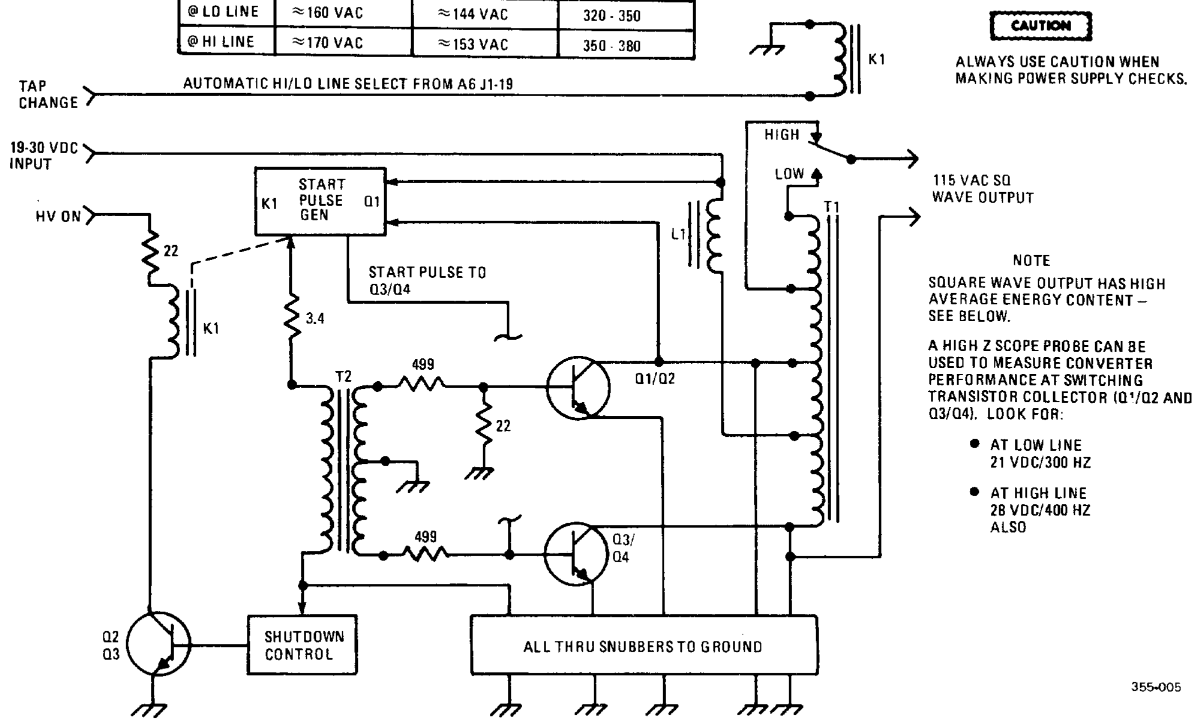


Figure 5-4. A9 Dc Converter Assembly Simplified Diagram

POWER connector of the LPA (J1-L). This output is used only when the optional DC inverter is used to supply the primary power to the LPA. It is activated when the primary power sample indicates that the primary power, in this case 28 Vdc, is more than 20% low. This signal changes taps in the optional inverter so that the primary voltage supplied to the LPA is increased to normal.

c. High Voltage On Circuit. When a low level HV ON signal is present at J1-3, HIGH VOLTAGE RELAY DRIVER transistor Q2 is biased on to provide 13.5 volts to the AC HV ON relay K2 in the LPA chassis. This applies the AC voltage to the primary of the high voltage transformer T1 through step start resistor R1.

d. Step Start Circuit. At the same time Q2 is biased on, transistor Q5 is biased on. Capacitor C3 is charged through the emitter/collector junction of Q5 and resistor R14. When the voltage on C3 reaches .7 volts above the emitter voltage of transistor Q6, which is set by divider R16 and R17, Q6 turns on. Q6 biases on darlington configuration transistors Q7 and Q8, applying 13.5 volts to the step start relay K3 in the chassis of the LPA. K3 shorts out step start resistor R1 and allows the full primary voltage to be applied to the high voltage transformer.

e. Primary Power Sample. Resistors R5 and R6 sample and divide the unregulated low voltage DC supply for use by the Micro Control PWB Assembly as the primary power sample.

5-13. TEMPERATURE SENSOR PWB ASSEMBLY A10. Refer to the Power Control PWB Assembly schematic for the following discussion. This schematic is found in the Depot Manual. The Temperature Sensor PWB Assembly contains two temperature sensitive integrated circuits, U1 and U2. The output of the ICs varies directly with their temperature. For every degree Kelvin, the output raises 10 millivolts, such that at a room ambient of 20 degrees centigrade, the output would be 2.93 volts. Both outputs are fed to the Power Control PWB Assembly for processing.

a. Heated Sensor Circuit. The HEATED SENSOR U1 is preheated by resistor R1 to raise its temperature above the ambient temperature. If there is sufficient air flow past this sensor, it will be held at a lower temperature than if there was no air flow but still at a higher temperature than the ambient. This temperature is typically 7 degrees. Thus, the output of U1 will be representative of the air flowing past the sensor assembly.

b. Ambient Sensor Circuit. AMBIENT SENSOR U2 measures the ambient temperature. It also contains an adjustment R2 to calibrate it with U1 the heated sensor. Resistor R3 acts to equate the thermal mass of U1 to that of U2.

5-14. LV FILTER ASSEMBLY A11. Refer to the 500 Watt Power Supply schematic for the following discussion. This schematic is found in the Depot Manual. The LV Filter PWB Assembly contains a double Pi filter composed of capacitors C1, C2, C3, indicator L1, capacitor C4, inductor L2, and capacitor C5. This filter is used to remove any unwanted spurious signals for the LV Voltage Power Supply PWB Assembly.

CHAPTER 6

MAINTENANCE

WARNING

Voltages dangerous to life exist in this radio equipment. Before removing the top cover, disconnect the primary power and wait 30 seconds. This allows time for all voltages to bleed off.

Section I. INTRODUCTION

6-1. CHAPTER ORGANIZATION. This chapter is divided into five sections. Section I tells how the chapter is organized, describes the on-equipment maintenance philosophy, and introduces you to the concept of BIT (Built-In Test). Section II is a detailed presentation of how to use BIT to trouble-shoot and repair the 500 Watt Linear Power Amplifier (hereafter referred to as the LPA). Section III consists of removal and replacement procedures for the faulty modules identified by BIT. Section IV is dedicated to Periodic Maintenance Procedures. Section V contains alignment procedures for the replaceable modules.

6-2. ON-EQUIPMENT MAINTENANCE PHILOSOPHY. The 500 Watt LPA is designed so that you can make most repairs without removing the equipment from its location. The procedures in this chapter should enable you to identify and correct most equipment malfunctions within 15 minutes.

NOTE

Field and Organizational Maintenance of the modules and Circuit Card Assemblies is limited only to the removal, replacement, and alignments given in chapter 6.

Tool List

Screwdrivers:

- 3/16-inch flat blade (4 inches long)
- No. 1 Phillips
- No. 2 Phillips
- Phillips, right-angle, ratchet (optional)

Wrenches:

- 6-inch adjustable
- 0.050-inch Allen

Nut Drivers: 3/16, 9/16, 1/4, 5/16 (optional)

Needle Nose Pliers (optional)

Alignment Tool Kit

6-3. BIT (BUILT-IN TEST). The key to servicing the 500 Watt LPA is a feature called BIT. BIT, which is an acronym for Built-In Test, consists of several systems, some manual and some automatic. These systems are the front panel controls and displays (including a multi-function meter), periodic automatic status checking, a manual diagnostic routine, and two different automatic diagnostic routines (an overall system test initiated from the 100 Watt Transceiver and an LPA self-test initiated from the 500 Watt LPA). When used in conjunction with this manual, these systems allow rapid and accurate fault diagnosis.

Section II. PERFORMANCE TESTING AND TROUBLE ANALYSIS USING BIT

6-4. FRONT PANEL CONTROLS AND DISPLAYS. The front panel controls and displays are utilized to control and monitor equipment operation during fault diagnosis. The displays provide an indication of equipment status, and a built-in meter allows digital monitoring of the parameters listed in Table 6-1. See Chapter 4 in this manual for a detailed discussion of all the controls and indicators.

6-5. PERIODIC AUTOMATIC STATUS CHECKING. The equipment performs periodic status checks on itself whenever it is energized. These checks are performed automatically and require no interaction or commands from the operator. These checks include the following and result in the indications or actions listed:

6-6. MANUAL DIAGNOSTIC BIT ROUTINE. A manual diagnostic BIT routine is included in this section to assist in fault diagnosis. Figure 6-1, which is a flowchart of the major steps in this routine, provides a sequence of observations which can be used to supplement the automatic BIT routines described in the following paragraph. In addition to Figure 6-1, which is the main flowchart, there are four supplementary flowcharts. Two of these (Flowcharts A and B) are referenced from Figure 6-1. The other two (Flowcharts C and D) are used for troubleshooting high and low output power conditions, respectively. For convenience, all flowcharts (Figures 6-1 through 6-16) are located at the end of this section.

Check	Result
LPA temperature, 1_K (cathode current)	If out of range for more than 2 seconds, the FAULT light comes on and the LPA goes into STANDBY (STANDBY light comes on)
Primary power, 13.5 V power supply, DC plate voltage, Forward power output, Reflected power output	If out of range for more than 3 seconds, the FAULT light comes on and the LPA goes into STANDBY (STANDBY light comes on)
The 500 Watt LPA also performs operational status checks on itself. During tuning, keying, and STANDBY/OPERATE status changes, it checks for expected reactions from the band switch, tuning coil, key relay, RF input sensor, forward and reflected power sensors, and the sensors for cathode current, DC plate voltage, and RF plate voltage. It also checks the serial control data link between the 100 Watt Transceiver and the 500 Watt LPA.	If a fault is detected, the FAULT light comes on and the LPA goes into STANDBY (STANDBY light comes on)

NOTE

When the FAULT light comes on, the appropriate fault code will be displayed on the meter if the selector switch is moved to the STATUS/FAULT position. When the meter selector switch is moved out of the STATUS/FAULT position, the fault code will be cleared and the FAULT light will be turned off. The fault can also be cleared by commanding the 500 Watt LPA back to OPERATE from the 100 Watt Transceiver's front panel or from the 500 Watt LPA's front panel (if in manual); but if the fault condition continues to exist, the FAULT light will come on again.

6-7. AUTOMATIC DIAGNOSTIC BIT ROUTINES. The automatic diagnostic BIT routines available for troubleshooting the 500 Watt LPA are of two kinds. The first is an overall system test, which checks not only the LPA, but also the 100 Watt Transceiver, the Remote Control Unit, and the 100/500 Watt Antenna Coupler. You initiate this routine from the transceiver front panel by pressing 2ND, TX KEY; 2ND, TEST; and 2ND, TX KEY. The second automatic BIT routine is a self-test for the 500 Watt LPA only, which you initiate from the LPA (refer to the detailed procedure for running the LPA self-test in paragraph 6-8, d). In the first routine, fault codes are displayed on the transceiver's display (and also on the LPA's front panel meter when the selector switch is in the STATUS/FAULT position); in the second routine, fault codes are displayed on the LPA's front-panel meter (the meter selector switch must be in the STATUS/FAULT position). Upon detection of a fault, the test process stops and the corresponding fault code is displayed. The Appendix at the end of this chapter lists the events that occur during the LPA self-test (this same sequence of events occurs during the LPA portion of the overall system test, with minor variations). Successful completion of these routines assures you that the LPA is operationally ready for use. Running the automatic diagnostic BIT routines for performance testing and verification is therefore another major use of the BIT feature.

6-8. TROUBLESHOOTING WITH BIT. The first stage in the troubleshooting process is becoming aware that a fault condition exists. This usually happens as the result of an observation (for example, you notice that a FAULT light is on) or as the result of a deterioration in the equipment's peformance (for example, the person you're communicating with informs you that your signal is very weak). You can also use the front panel meter on the LPA to see whether its key operating parameters are within the normal range (see Table 6-1). In any case, it's always a good idea to make a note whenever you notice anything unusual. This will come in handy if you have to do any troubleshooting. The nature of the fault determines whether you should use the manual diagnostic BIT routine or one of the automatic diagnostic BIT routines.

a. Using the FAULT lights. Whenever a FAULT light comes on during normal operation of the equipment, the first thing you should do is press 2ND, TEST on the transceiver front panel. This causes a fault code to be displayed. You can then look up the fault code in Table 6-2, which tells you what to do to identify and correct the problem.

b. Using the Manual Diagnostic BIT Flowchart. The manual diagnostic BIT flowchart, Figure 6-1, should be used whenever you observe an obvious problem while operating the 500 Watt LPA, but none of the FAULT lights comes on. It suggests preliminary observations and actions that you should perform before you initiate one of the automatic diagnostic BIT routines. Sometimes, when there is a problem with the display or when the microprocessor is inoperative, you cannot use the automatic diagnostic BIT routines at all. In these cases, you must rely entirely on the manual diagnostic BIT flowchart.

c. Using the Automatic Diagnostic BIT Routines. When you initiate one of the automatic diagnostic BIT routines, you must use Table 6-2 to interpret the results. This table lists in numerical order all the possible fault codes for the 500 Watt LPA (codes 2-01 through 2-22). Fault codes for the 100 Watt Transceiver (codes 1A1A1-0 through 1A1A19-2), 100/500 Watt Antenna Coupler (codes 3-01 and 3-02), and Remote Control Unit (code 4-01) are listed in Chapter 6 of the technical manuals for those components. Note that in some cases the fault code itself is sufficient to identify the faulty module. In other cases, you will be required to so some additional checking to isolate the problem (this is the reason why flowcharts are used for many of the fault codes). Table 6-2 and the flowcharts tell you what to do to fix the problem, which in most cases consists of simply replacing a module. Instructions for removing and replacing the modules can be found in Section III of this chapter, "Removal/Replacement Procedures."

d. Running the LPA Self-Test. Use the following procedure to run the LPA self-test:

(1) Rotate the AUTO/MANUAL BAND switch on the LPA front panel to the band that contains the frequency displayed on the transceiver (bands begin at 0000 and end at 9999; for example, 2.1999 would fall in the 1.6 to 2.2 band, but 2.2000 would fall in the 2.2 to 3.0 band).

(2) Rotate the METER switch on the LPA front panel to the STATUS/FAULT position.

(3) Press the SELF TEST button on the LPA front panel.

NOTE

The automatic BIT routine transmits full power into the antenna system at the selected frequency. The consequences of this transmission should be considered before exercising BIT into an antenna. An alternative is to replace the antenna with a dummy load.

Another important consideration when using the automatic BIT routine is that this routine tests the LPA only at the frequency currently selected by the 100 Watt Transceiver.

(4) Check that all LPA front panel LEDs come on and that all LCD segments on the meter display are on. NOTE: If the test is initiated while the LPA is in warmup (STANDBY LED was flashing before the SELF TEST button was pushed), only fault codes 2-01 through 2-08 can be displayed. This is because the full routine cannot be run until the LPA is warmed up (refer to the automatic diagnostic BIT test description in the Appendix at the end of this chapter).

Table 6-1. Meter Functions and Normal Operating Ranges

Position	Function	Range/Units	Normal (STBY/ WARM-UP)	Normal (OPERATE, KEYED IN CW)
PRI PWR (%)	Displays the average primary power input as a percentage of the nominal value	0% to 166%	90 to 110	90 to 110
13.5 VDC	Displays the average output of the low voltage power supply	0 to +22 Vdc	11 to 16	11 to 16
DC PLATE (VOLTS)	Displays the average plate voltage of the power amplifier tube	0 to +3300 Vdc	0	1600 to 2300*
I_K	Displays the average cathode (plate) current of the power amplifier tube	0 to 2000 mA	0	350 to 500*
RF IN (WATTS)	Displays the peak RF input power from the 100 Watt Transceiver	0 to 250 W	0 to 100**	10 to 40*
RF PLATE (VOLTS)	Displays the peak RF voltage at the plate of the power amplifier tube (with respect to the average DC voltage)	0 to 3300 Vdc	0	800 to 1200 *
FWD PWR (WATTS)	Displays the peak forward power at the RF output	0 to 750 W	0	200 to 300
REFL PWR (WATTS)	Displays the peak reflected power at the RF output	0 to 750 W	0	0 to 25 depending on load *

Table 6-1. Meter Functions and Normal Operating Ranges (Continued)

Position	Function	Range/Units	Normal (STBY/ WARMUP)	Normal (OPERATE, KEYED IN CW)
ANT VSWR	Displays the peak ratio of the mismatch between the 1 KW LPA and its load, be it antenna, antenna coupler, or dummy load	1:1 to 999:1	0	1:1 to 2:1*
COIL POS	Displays the servo coil position	100 to 1770	Refer to the Tune Chart, Figure 3-1	
STATUS/ FAULT	Displays a fault code. If the FAULT light is lit and the meter is switched to the STATUS/FAULT position, a fault code will be displayed. When the selector switch is moved out of the STATUS-/FAULTposition, the fault code will be cleared and the FAULT light will be turned off.	Fault codes		

*With a power output of 250 Watts, as indicated on the FWD PWR meter.
**With the transceiver keyed; otherwise, the reading will be 0 W.

Table 6-2. Fault Code Chart

NOTES

This table lists only the fault codes for the LPA (codes 2-01 through 2-22). For an explanation of the fault codes for the 100 Watt Transceiver (codes 1A1A1- 0 through 1A1A19-2), the 100/500 Watt Antenna Coupler (codes 3-01 and 3-02), and the Remote Control Unit (code 4-01), refer to Chapter 6 of the technical manuals for those equipments.

Fault codes for the LPA are listed as they appear on the 100 Watt Transceiver's display. On the LPA's display, "2-" appears as "00". For example, code 2-09 on the transceiver's display would appear as "0009" on the LPA's display.

Code	Explanation	Procedure
2-01	MICRO-CONTROL FAULT.	Replace Micro Control PWB Assembly.
2-02	Not used.	
2-03	PRIMARY POWER FAULT.	Refer to flowchart 2-03.
2-04	13.5 V SUPPLY FAULT.	Refer to flowchart 2-04.
2-05	TRANSMITTER FAULT.	Refer to flowchart 2-05.
2-06	BAND SWITCH DRIVE FAULT.	Replace Tank Assembly. If problem persists, replace Micro Control PWB Assembly.
2-07	SERVO COIL DRIVE FAULT.	Replace Tank Assembly. If problem persists, replace Micro Control PWB Assembly.
2-08	HIGH VOLTAGE ON IN STANDBY.	Refer to flowchart 2-08. ← NORMAL IF MANUALTUNE SWITCH IS "ON"
2-09	HIGH VOLTAGE FAULT IN OPERATE.	Refer to flowchart 2-09.
2-10	PLATE CURRENT ON W/BIAS OFF.	Refer to flowchart 2-10.
2-11	PLATE CURRENT FAULT W/BIAS ON.	Refer to flowchart 2-11.

Table 6-2. Fault Code Chart (Continued)

Code	Explanation	Procedure
2-12	RF MUTE NOT WORKING.	Check interconnecting cable between transceiver and LPA. Replace if necessary. If problem persists, replace Micro Control PWB Assembly. If problem still persists, replace LPA/Coupler Interface PWB Assembly in 100 Watt Transceiver (see transceiver technical manual).
2-13	NO RF INPUT W/TUNE POWER.	Refer to flowchart 2-13. (Code 2-20 is displayed during auto tune.)
2-14	PLATE CURRENT FAULT WHEN KEYED	Refer to flowchart 2-14.
2-15	NO TUNE PEAK W/RF INPUT POWER.	Refer to flowchart 2-15.
2-16	FORWARD POWER FAULT.	Refer to flowchart 2-16.
2-17	VSWR/REFLECTED POWER FAULT.	Check coax connections to Output Filter (Meter indicates VSWR >2.25:1.) PWB Assembly. If problem persists, check output coax cable to antenna system. If problem still persists, check antenna system. If problem still persists, replace Output Filter PWB Assembly.
2-18	POWER GAIN FAULT.	Replace Tube Assembly. If problem persists, replace Tank Assembly. If problem still persists, replace Output Filter PWB Assembly.
2-19	Not used.	
2-20	This is not an automatic BIT fault code. This code should appear only during normal operation and only if the LPA fails to tune correctly.	Initiate the LPA self-test (see paragraph 6-8, d), and use this table to diagnose the problem.
2-21	LPA-TRANSCEIVER LINK FAULT.	Check interconnecting control cable between transceiver and LPA. Replace if necessary. If problem persists, replace LPA/Coupler Interface PWB Assembly in transceiver (refer to transceiver technical manual). If problem still persists, replace Micro Control PWB Assembly.

Table 6-2. Fault Code Chart (Continued)

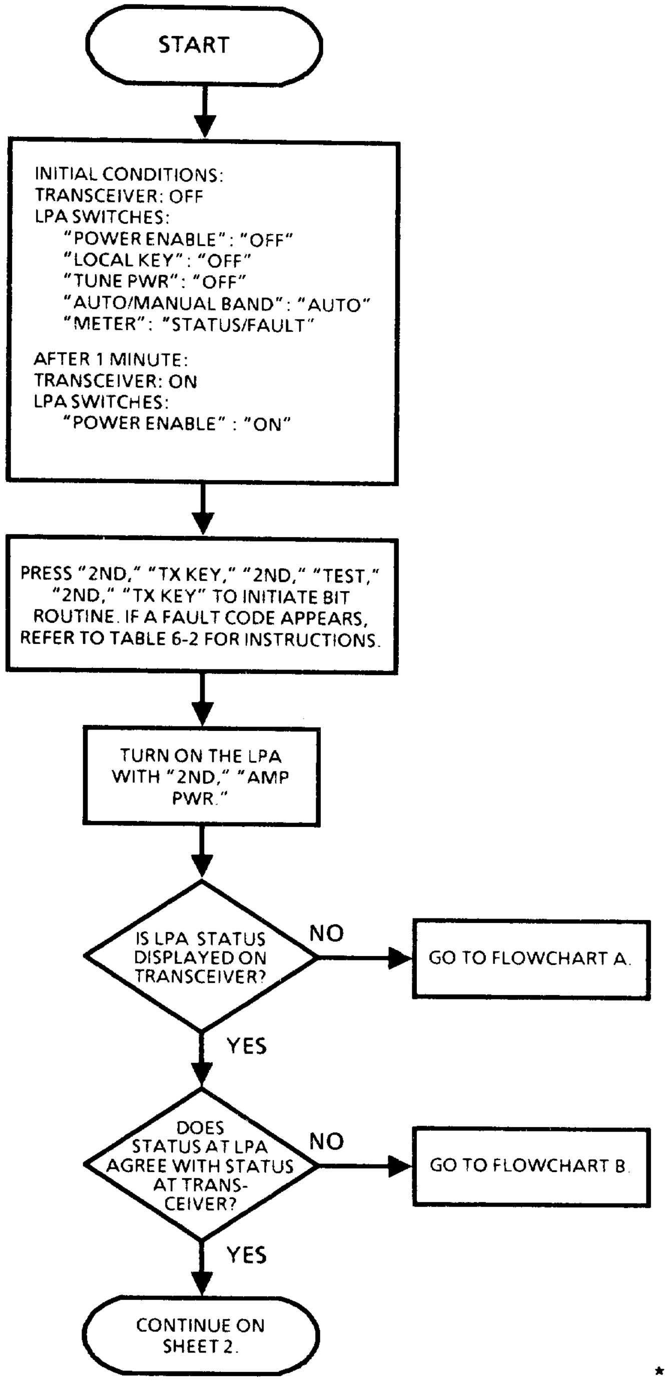
Code	Explanation	Procedure
2-22	This is not an automatic BIT fault code. This code should appear only during normal operation. The meter indicates cathode current (I_K), but no FWD PWR.	Initiate the automatic diagnostic BIT routine (either from the transceiver or from the LPA--see par. 6-7 and 6-8, d), and use this table to diagnose the problem.

MANUAL DIAGNOSTIC BIT ROUTINE FAULT ISOLATION CHART

MORE FAULT ISOLATION CODES IN SERVICE MANUAL PAGES 22 TO 42

NOTE
REFER TO TABLE OF CONTENTS FOR REPLACEMENT PROCEDURE PARAGRAPH REFERENCES

NOTE:
IF A FAULT LIGHT COMES ON AT ANY TIME DURING THIS PROCEDURE, STOP AND PRESS "2ND," "TEST" TO DISPLAY THE FAULT CODE. THEN REFER TO TABLE 6-2 FOR INSTRUCTIONS.



*355-017-1

Figure 6-1. Manual Diagnostic BIT Routine, Fault Isolation Chart (Sheet 1 of 3)

MANUAL DIAGNOSTIC BIT ROUTINE FAULT ISOLATION CHART (Cont.)

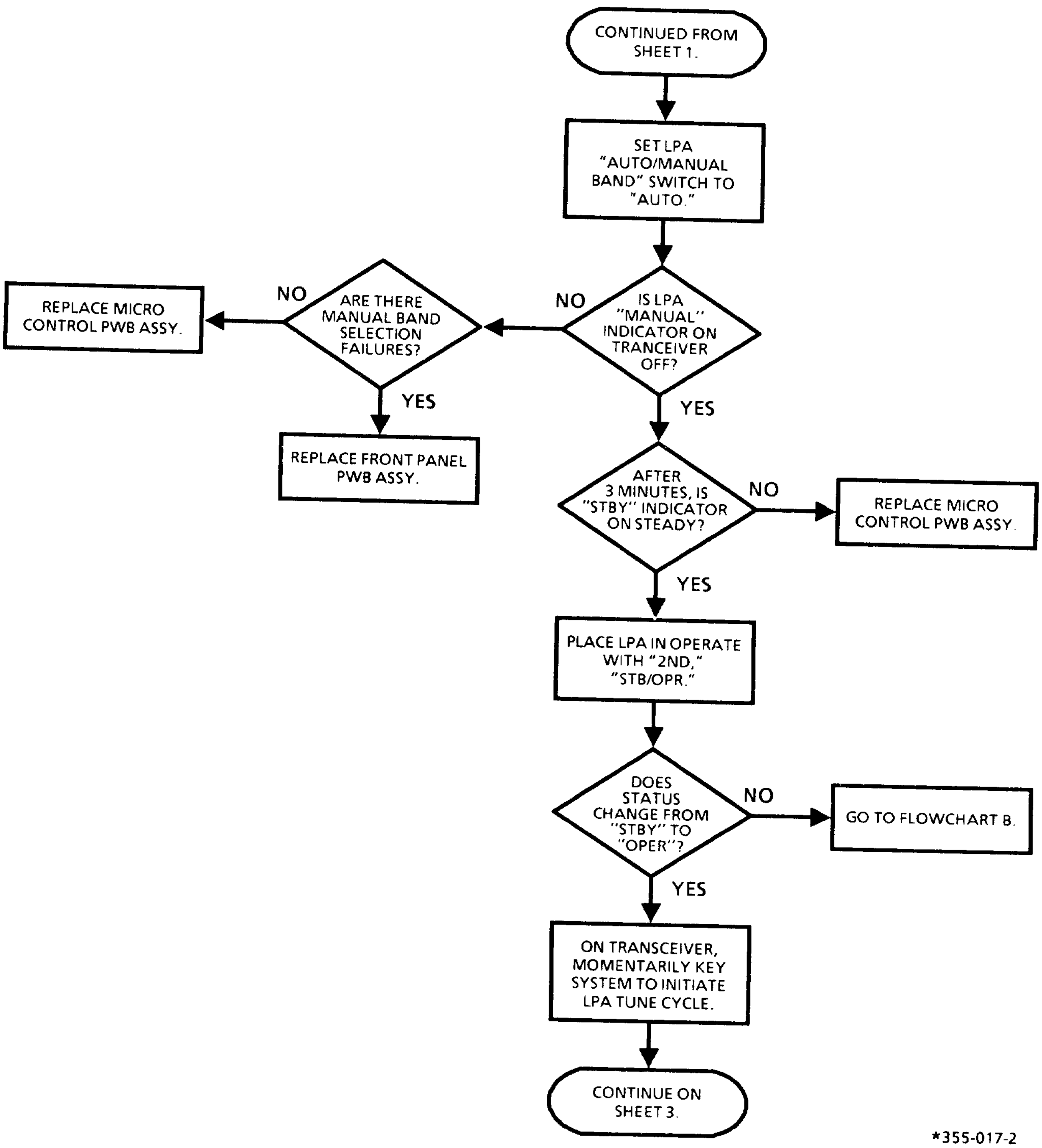


Figure 6-1. Manual Diagnostic BIT Routine, Fault Isolation Chart (Sheet 2 of 3)

MANUAL DIAGNOSTIC BIT ROUTINE FAULT ISOLATION CHART (Cont.)

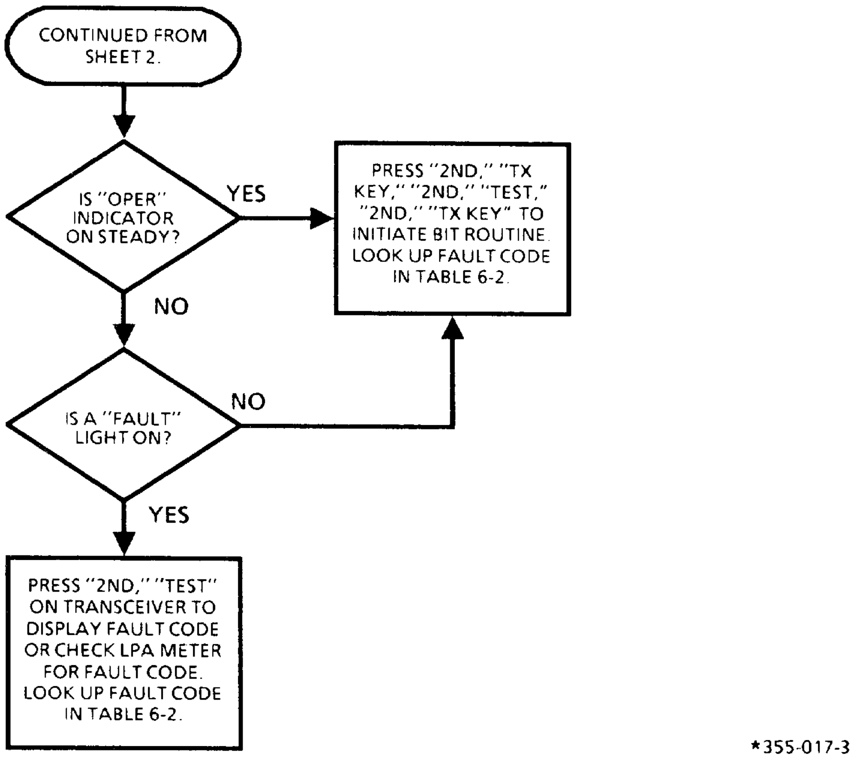


Figure 6-1. Manual Diagnostic BIT Routine, Fault Isolation Chart (Sheet 3 of 3)

FAULT ISOLATION CHART A

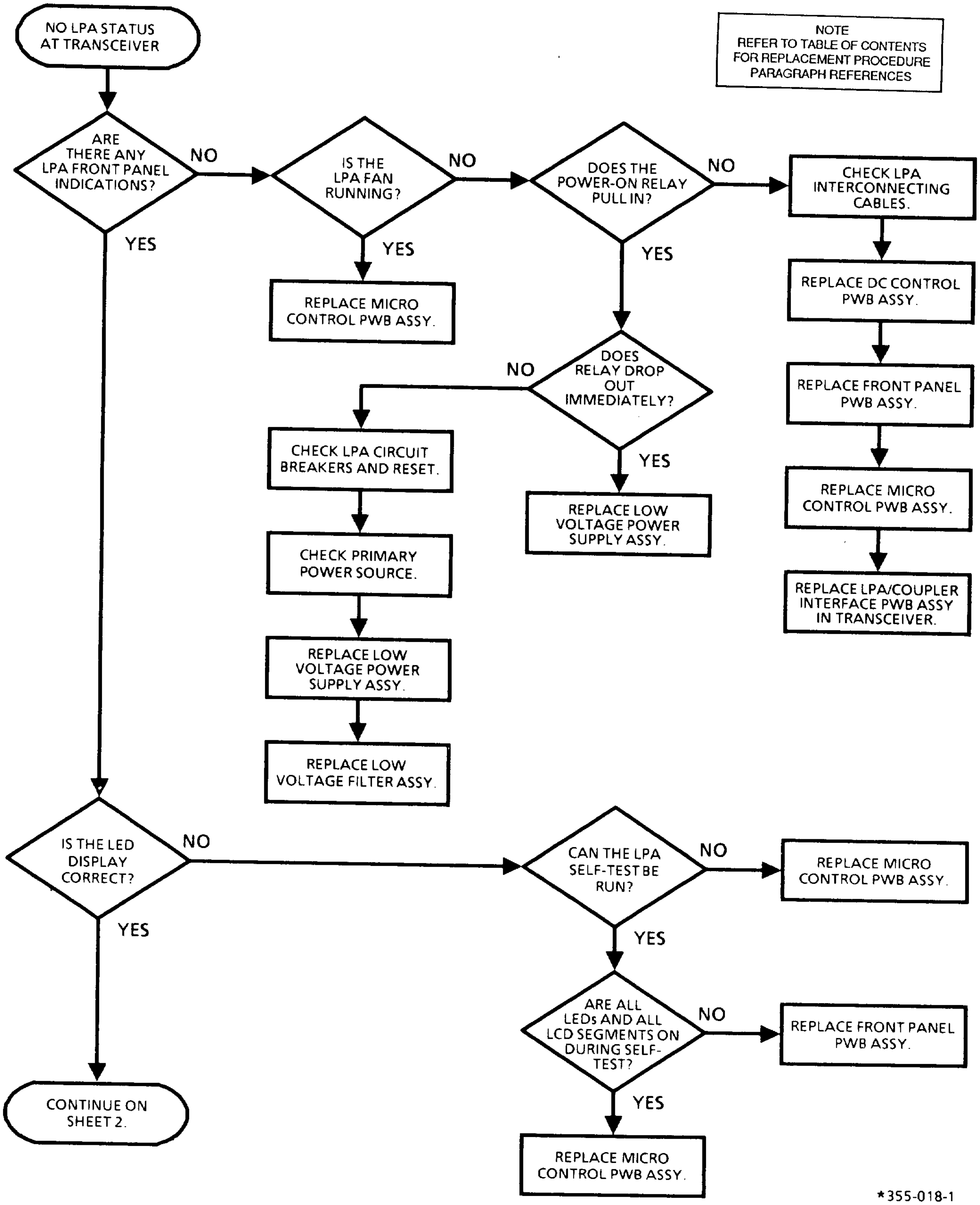


Figure 6-2. Fault Isolation Chart A (Sheet 1 of 2)

FAULT ISOLATION CHART A (Cont.)

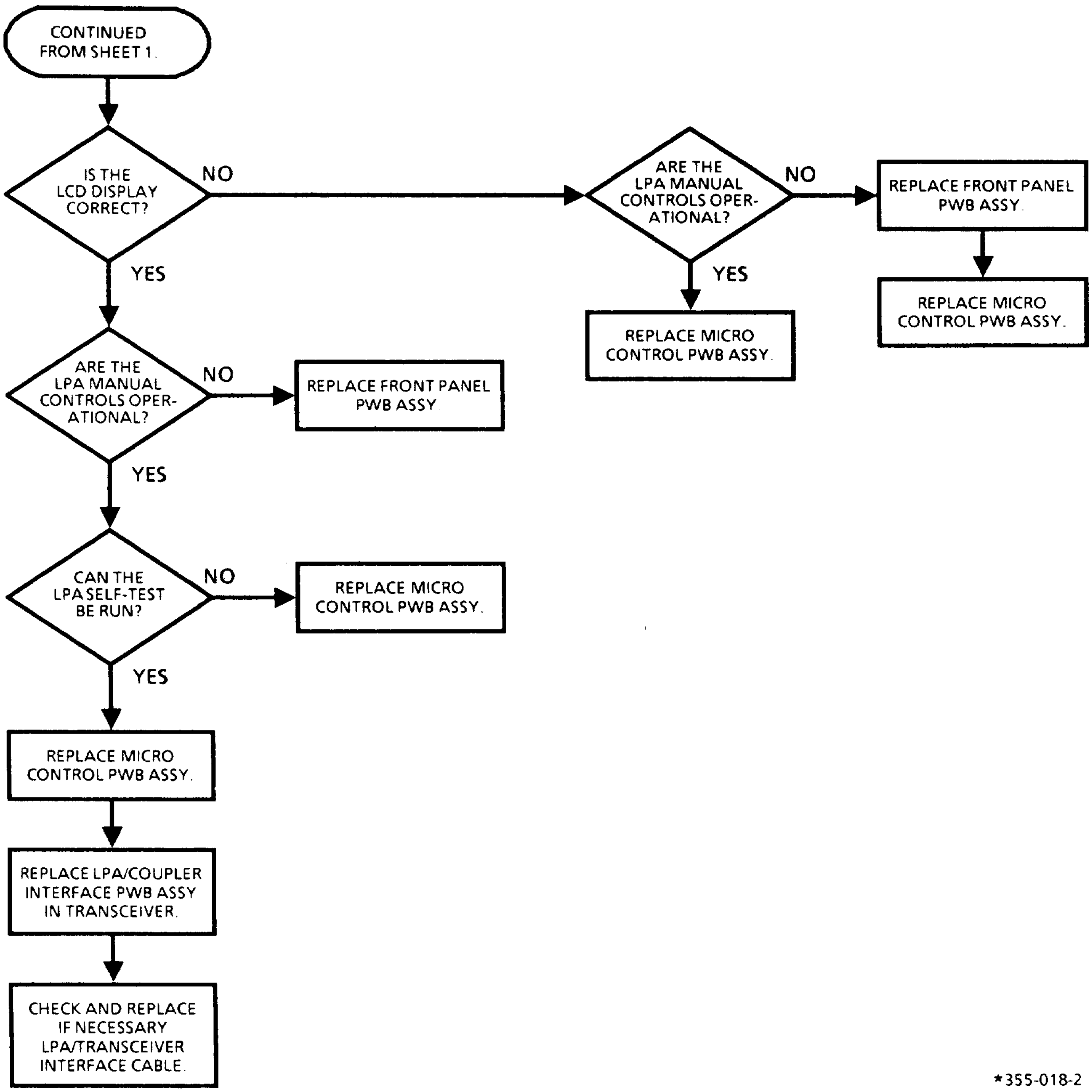


Figure 6-2. Fault Isolation Chart A (Sheet 2 of 2)

FAULT ISOLATION CHART B

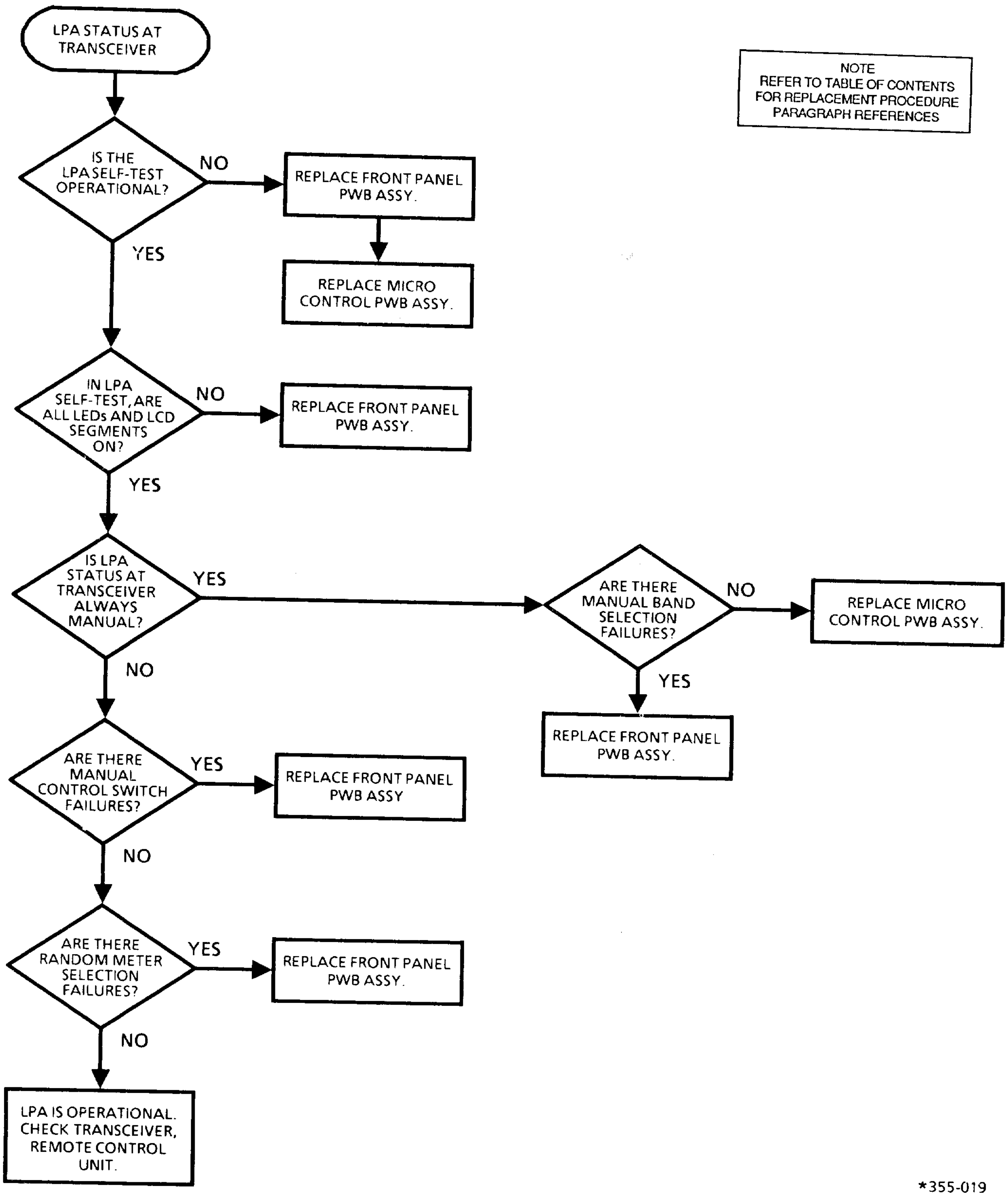


Figure 6-3. Fault Isolation Chart B

FAULT ISOLATION CHART C

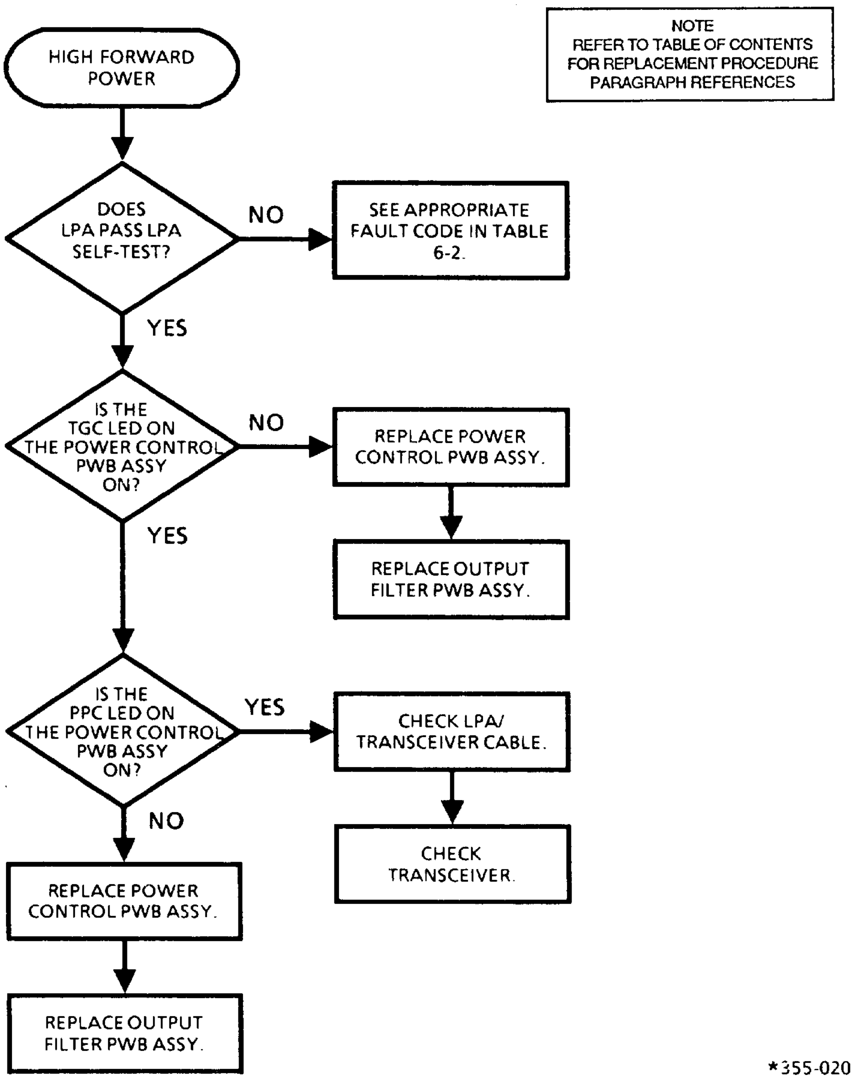


Figure 6-4. Fault Isolation Chart C

FAULT ISOLATION CHART D

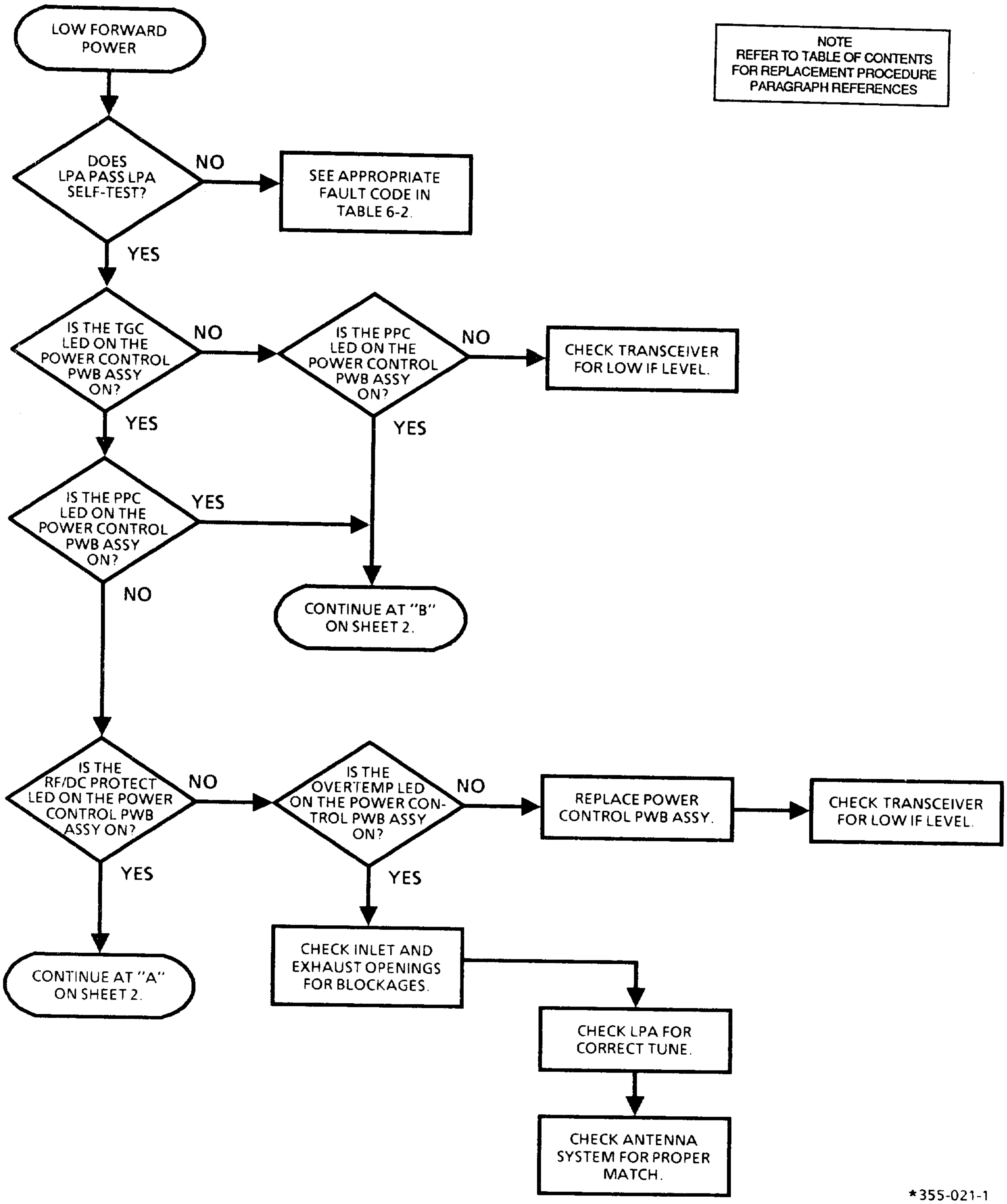


Figure 6-5. Fault Isolation Chart D (Sheet 1 of 2)

FAULT ISOLATION CHART D (Cont.)

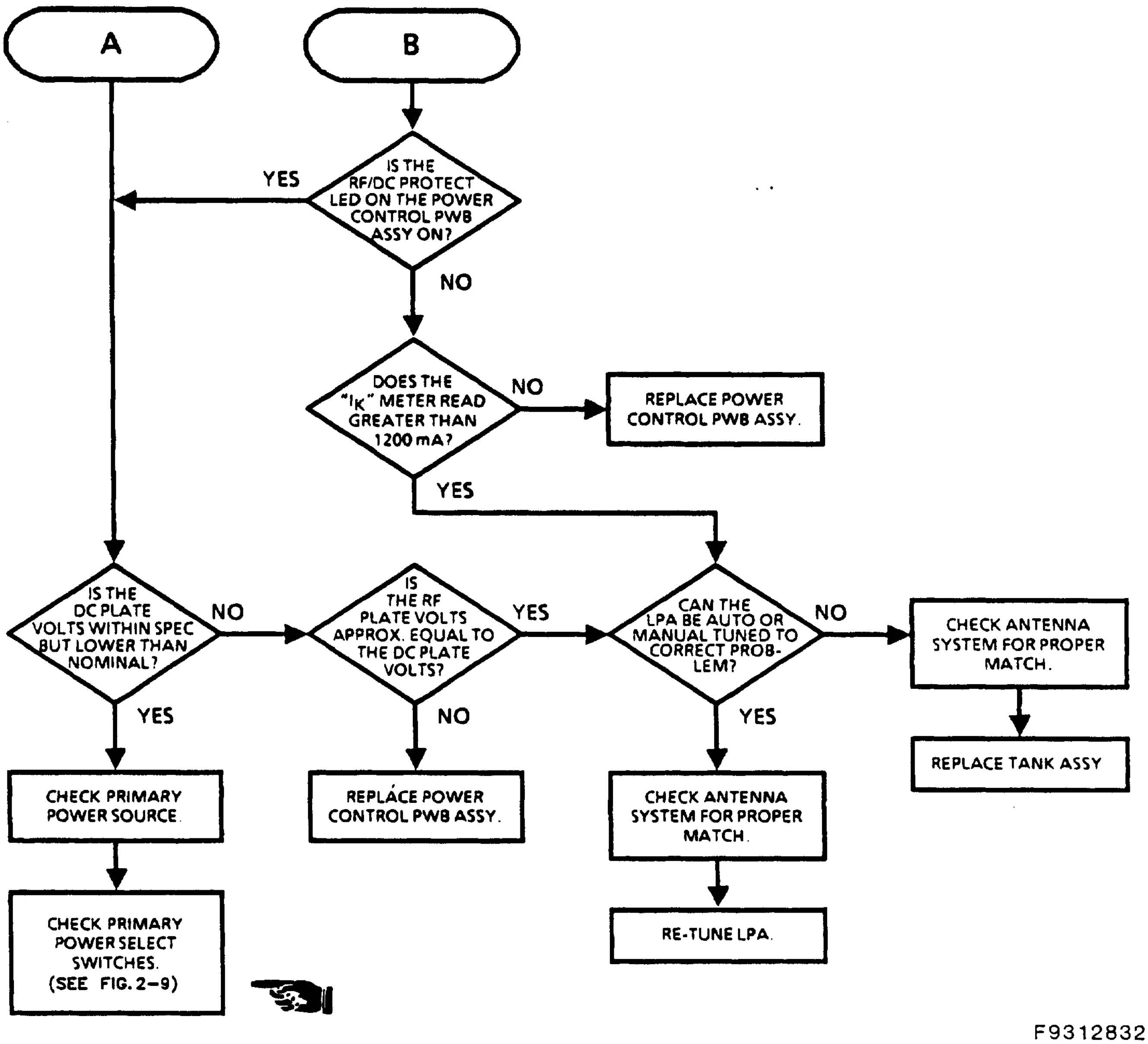


Figure 6-5. Fault Isolation Chart D (Sheet 2 of 2)

FAULT ISOLATION CHART 2-03

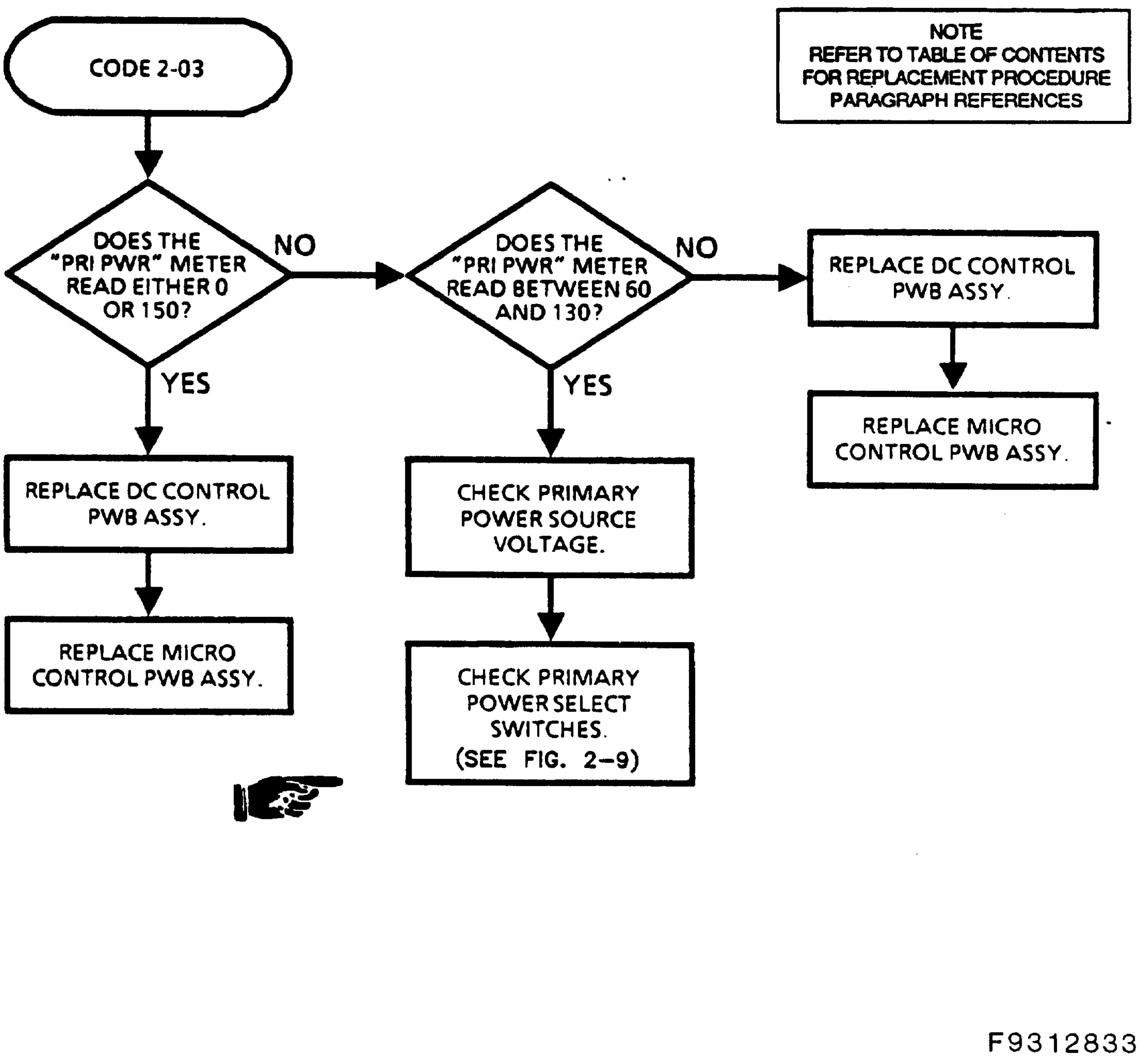


Figure 6-6. Fault Isolation Chart for Fault Code 2-03

FAULT ISOLATION CHART 2-04

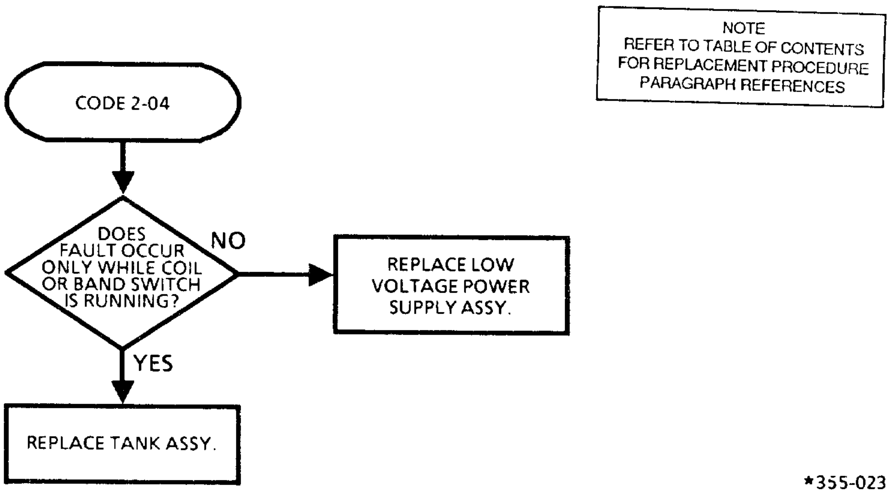


Figure 6-7. Fault Isolation Chart for Fault Code 2-04

FAULT ISOLATION CHART 2-05

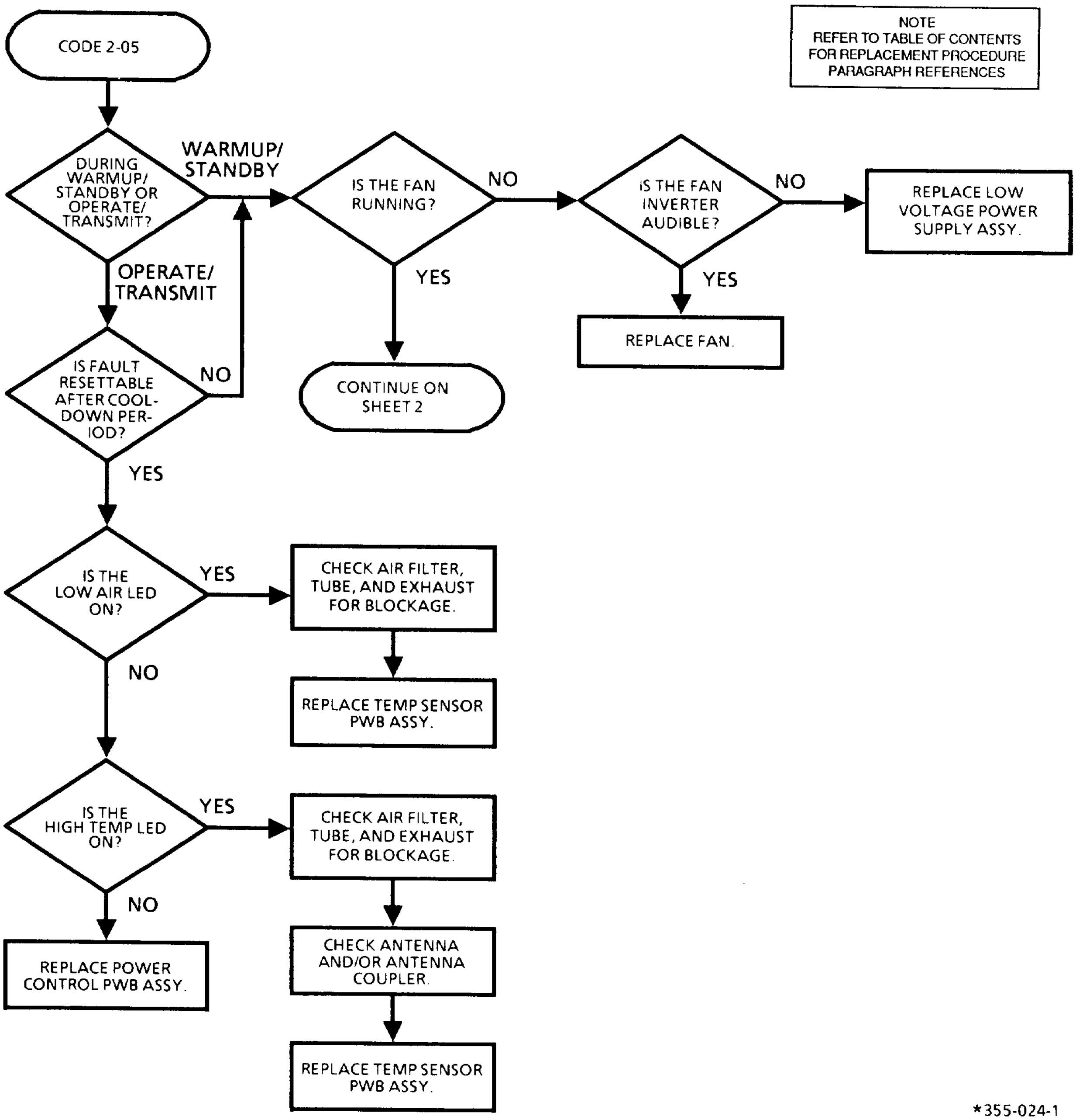


Figure 6-8. Fault Isolation Chart for Fault Code 2-05 (Sheet 1 of 2)

FAULT ISOLATION CHART 2-05 (Cont.)

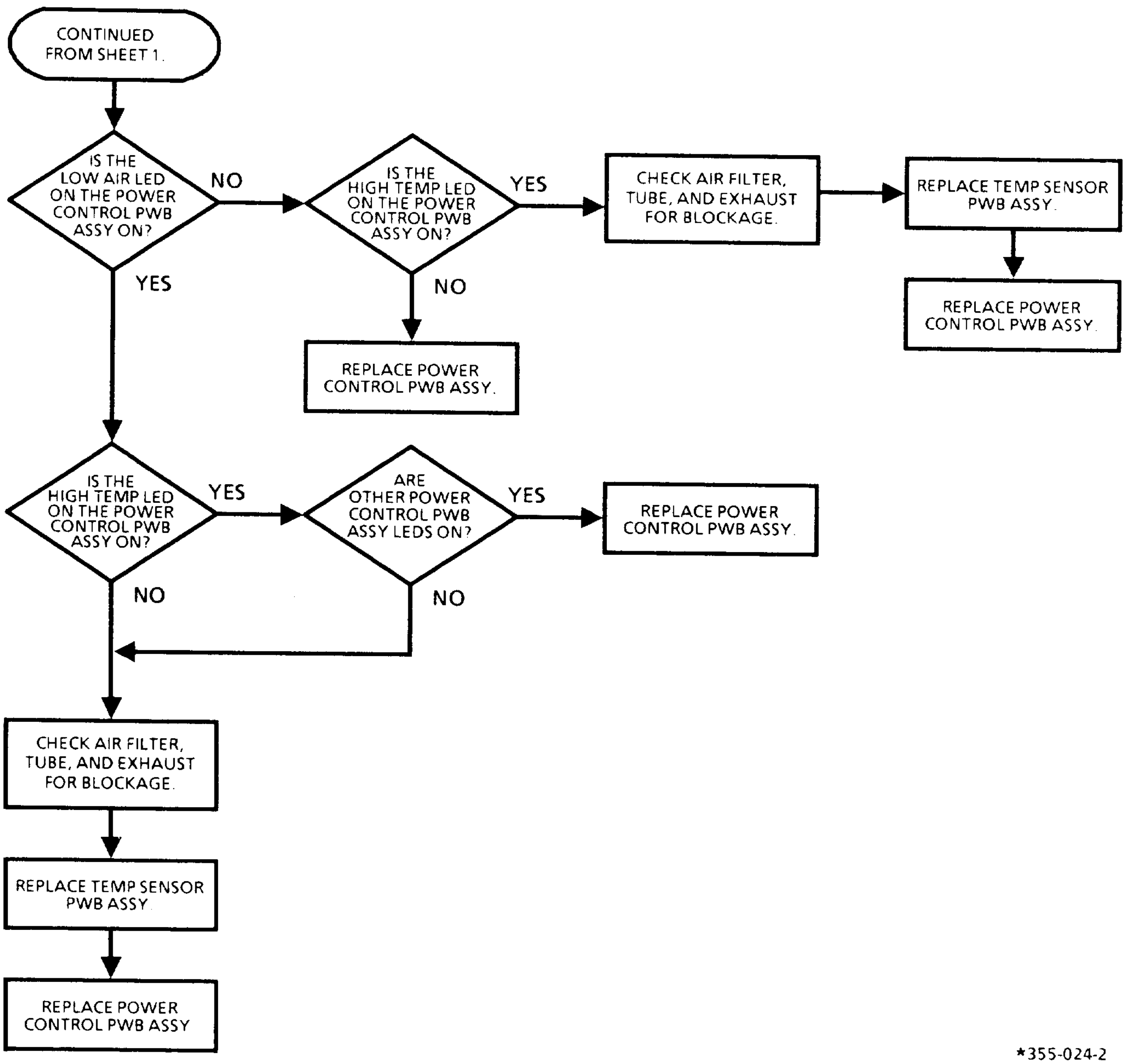


Figure 6-8. Fault Isolation Chart for Fault Code 2-05 (Sheet 2 of 2)

FAULT ISOLATION CHART 2-08

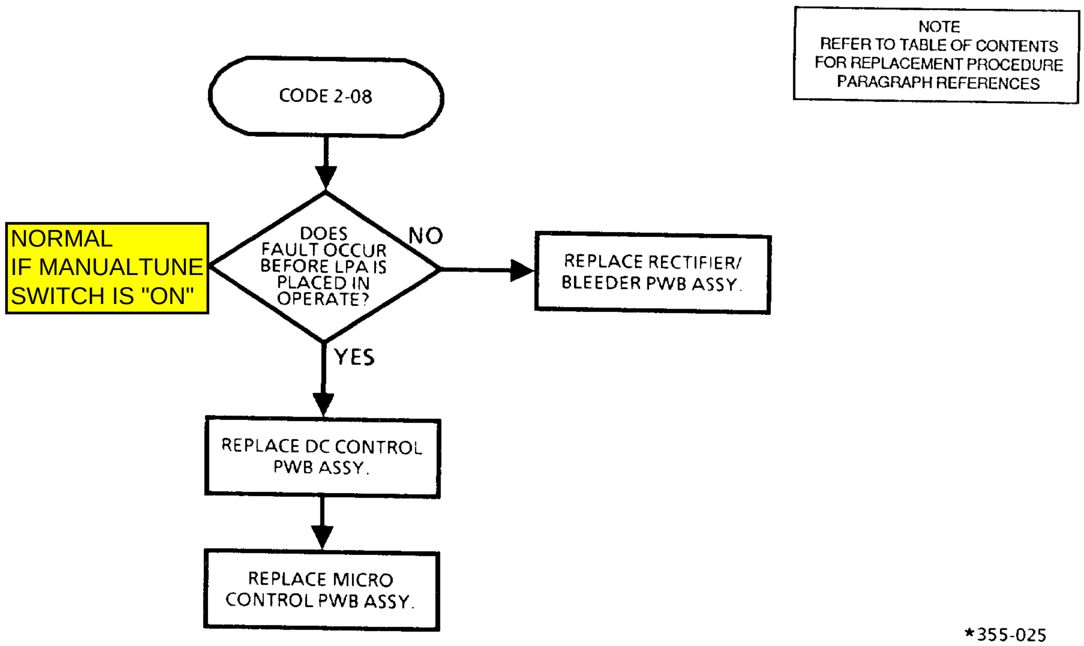


Figure 6-9. Fault Isolation Chart for Fault Code 2-08

FAULT ISOLATION CHART 2–09

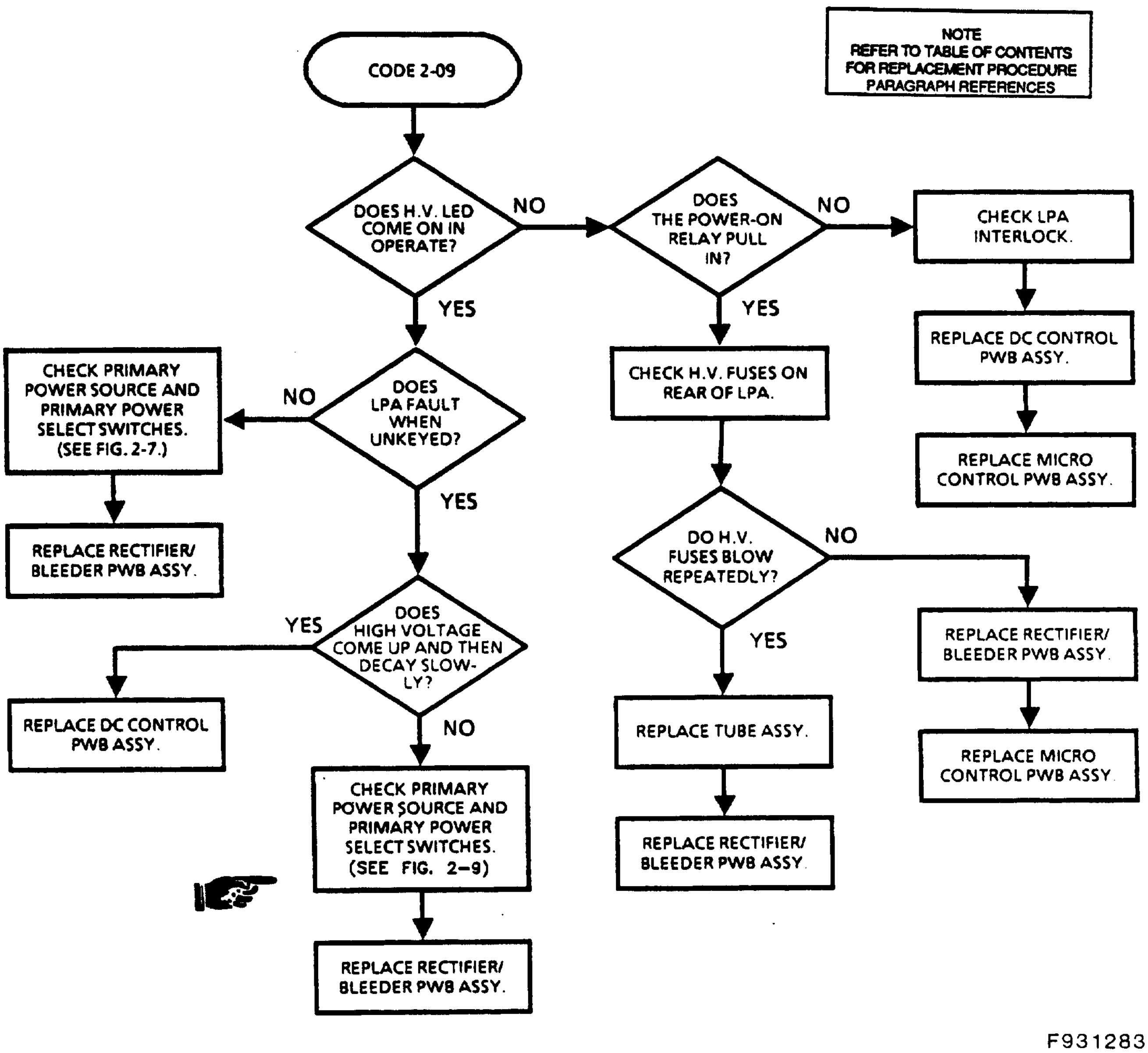


Figure 6-10. Fault Isolation Chart for Fault Code 2-09

FAULT ISOLATION CHART 2-10

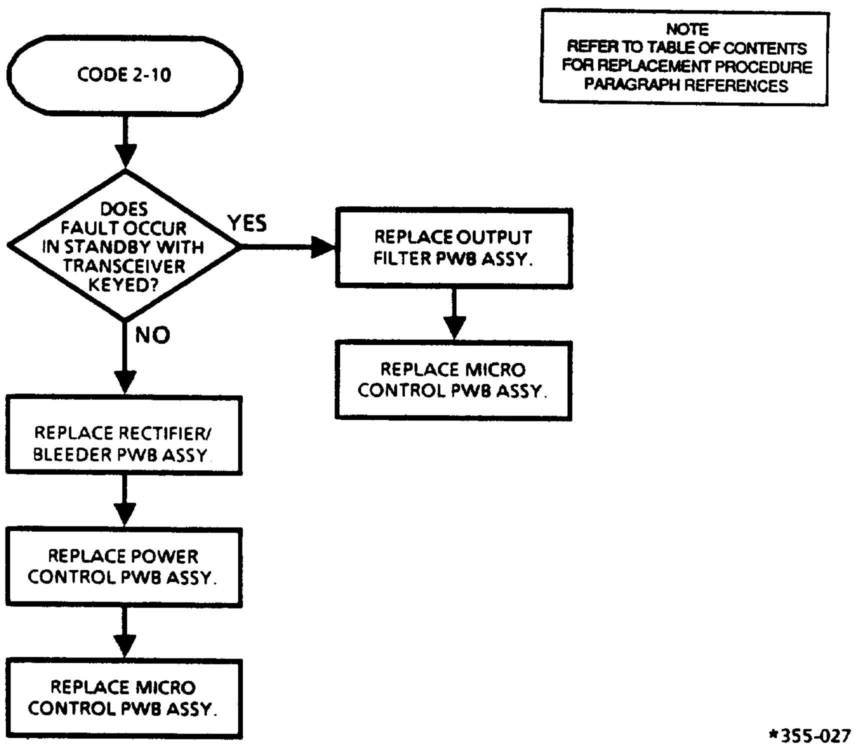


Figure 6-11. Fault Isolation Chart for Fault Code 2-10

SEE ALSO SERVICE MANUAL PAGE 23

FAULT ISOLATION CHART 2-11

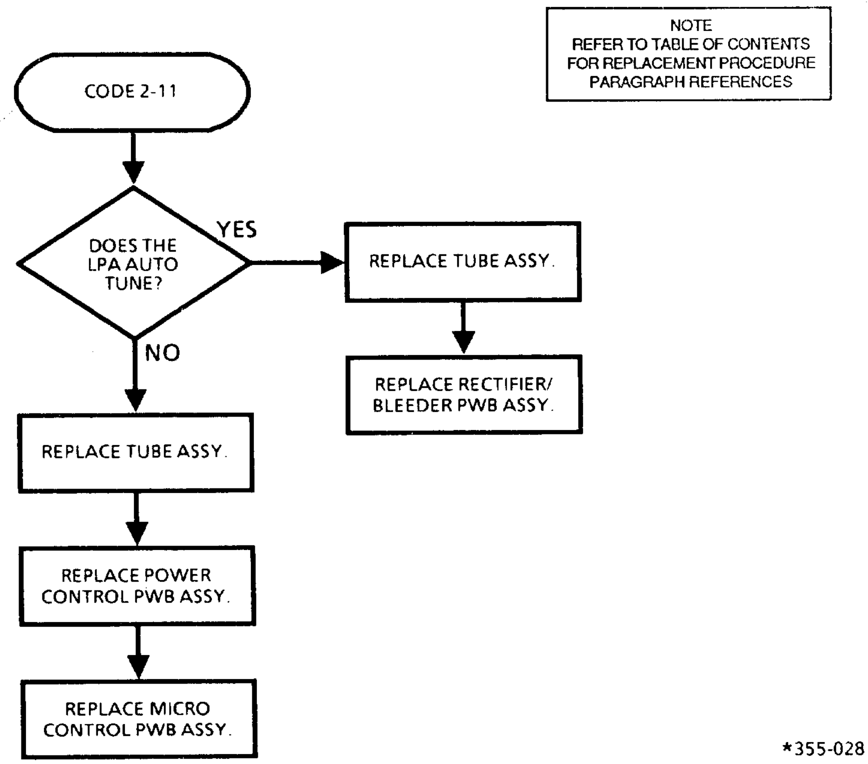
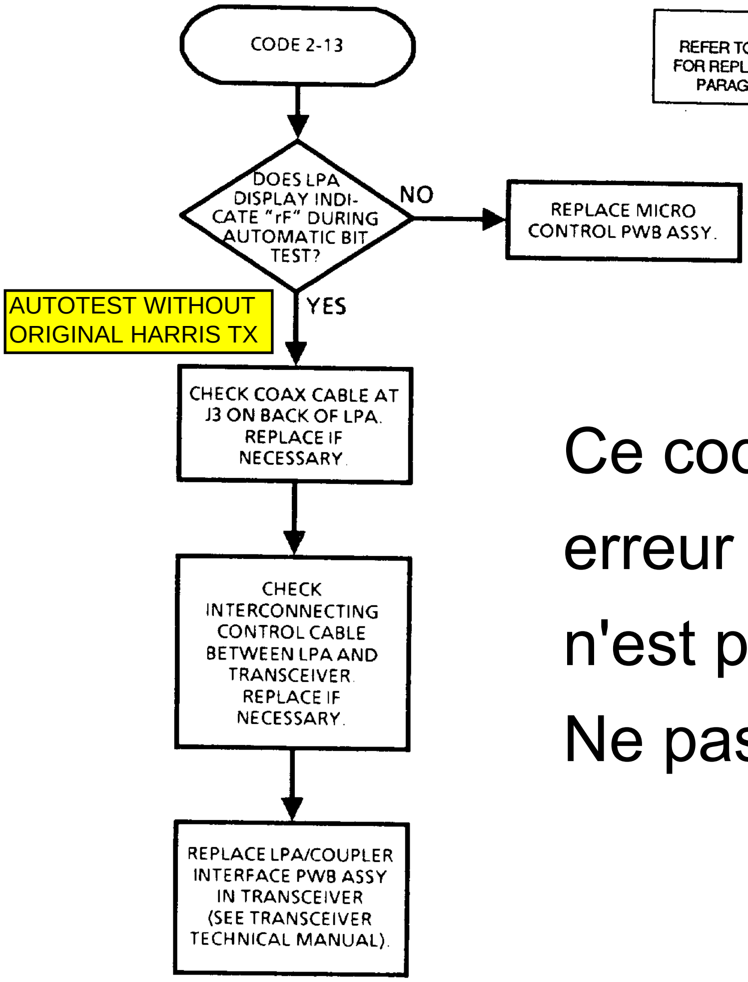


Figure 6-12. Fault Isolation Chart for Fault Code 2-11

FOR CODE 2-12 SEE SERVICE MANUAL PAGE 33

FAULT ISOLATION CHART 2-13

NOTE
REFER TO TABLE OF CONTENTS FOR REPLACEMENT PROCEDURE PARAGRAPH REFERENCES



Ce code n'est pas une erreur si le TX Harris n'est pas utilisé !!!!
Ne pas en tenir compte

*355-029

Figure 6-13. Fault Isolation Chart for Fault Code 2-13

FAULT ISOLATION CHART 2-14

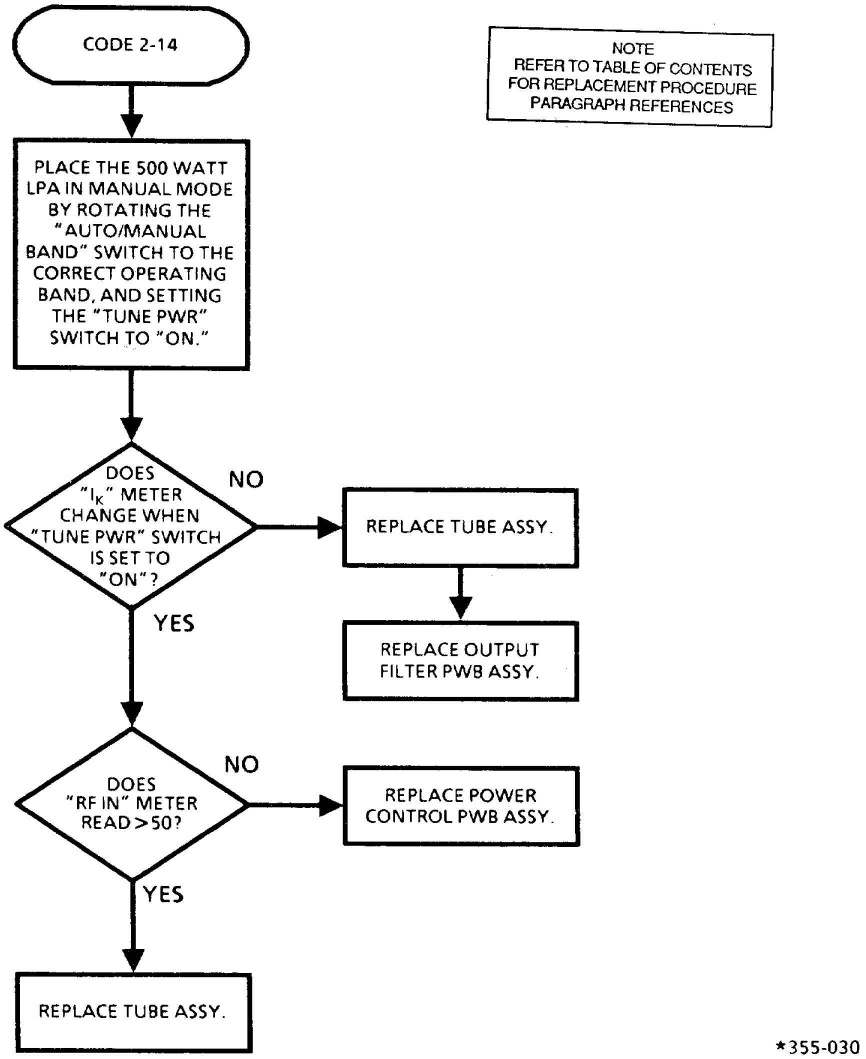


Figure 6-14. Fault Isolation Chart for Fault Code 2-14

FAULT ISOLATION CHART 2-15

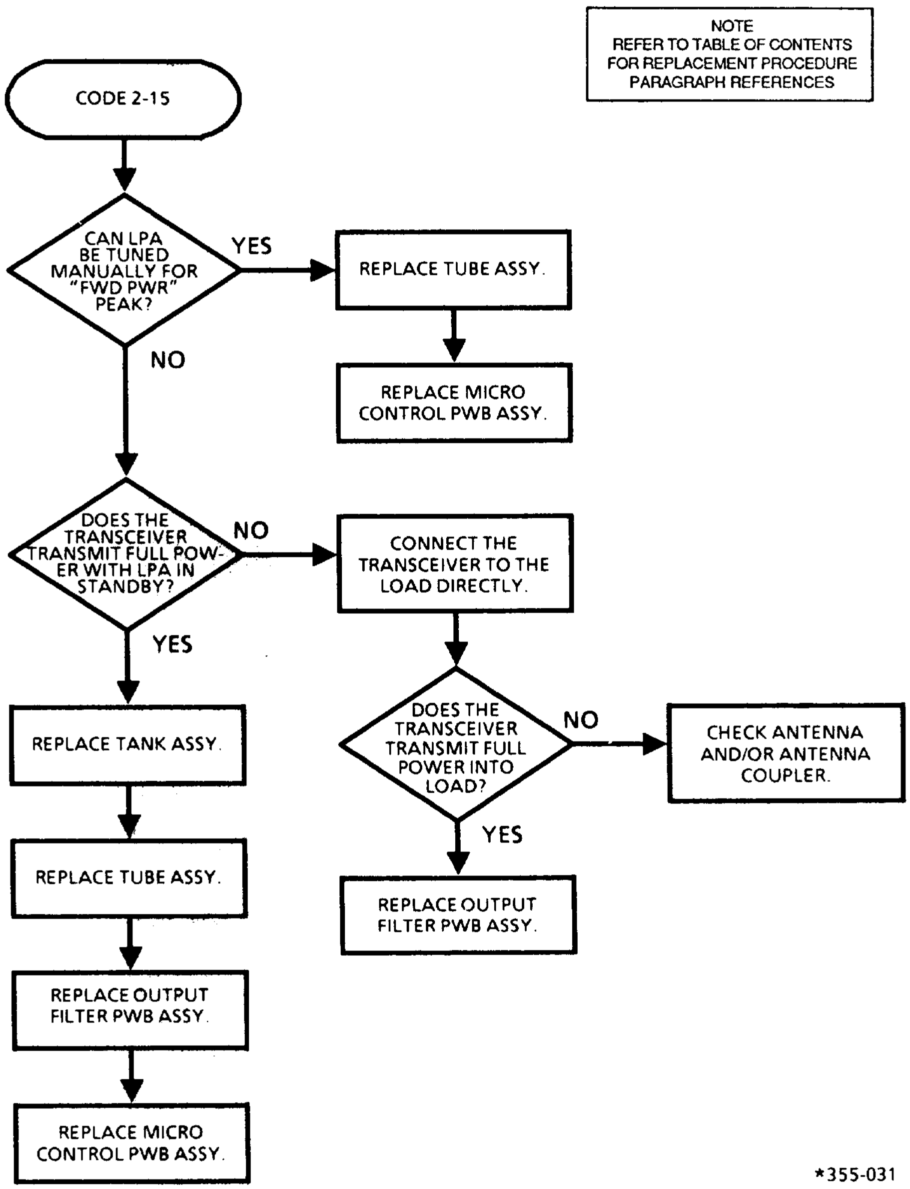


Figure 6-15. Fault Isolation Chart for Fault Code 2-15

FAULT ISOLATION CHART 2-16

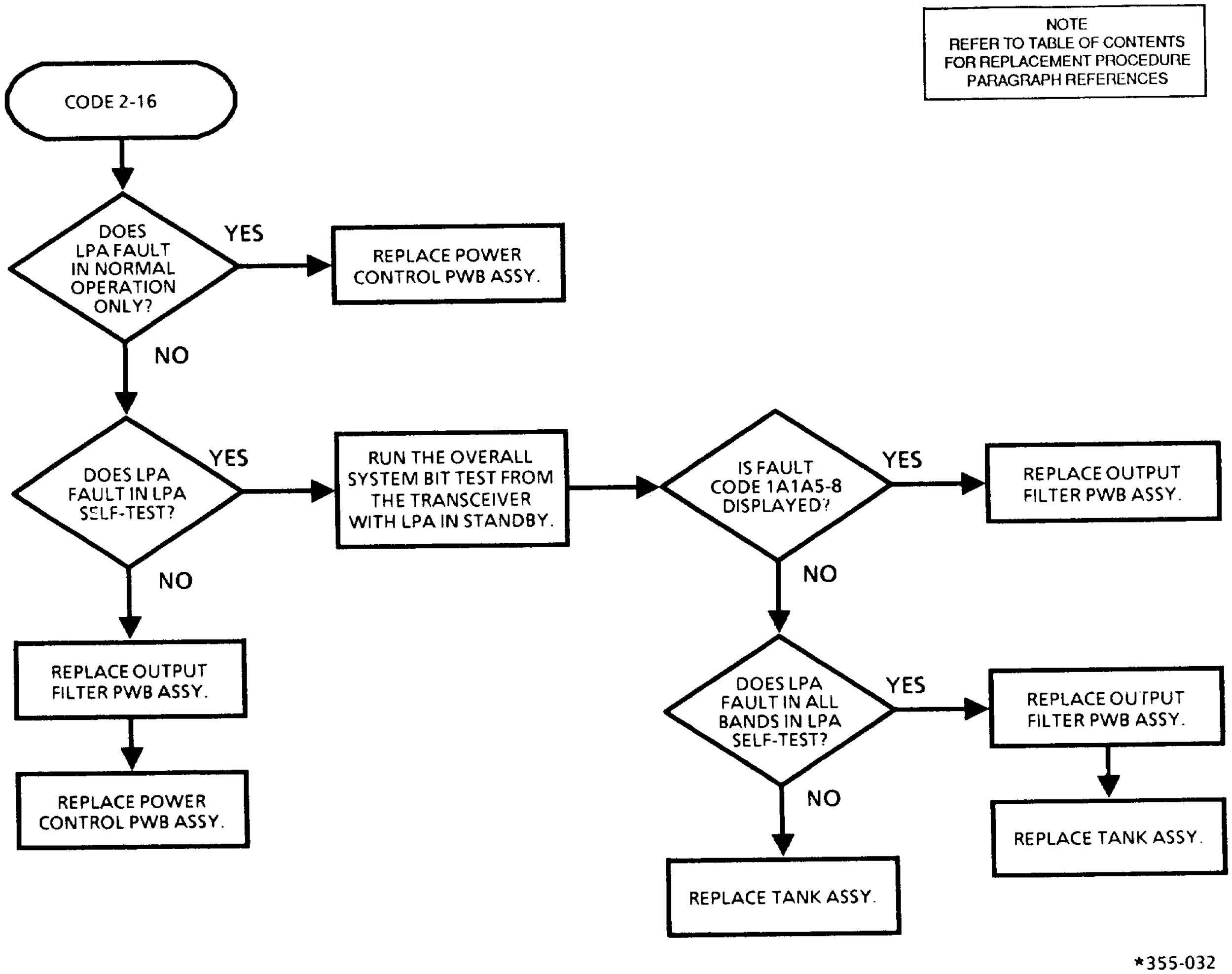


Figure 6-16. Fault Isolation Chart for Fault Code 2-16

Section III. REMOVAL/REPLACEMENT PROCEDURES

WARNING

Voltages dangerous to life exist in this radio equipment. Before removing the top cover, disconnect the primary power and wait 30 seconds. This allows time for all voltages to bleed off.

CAUTION

Use care when disconnecting ribbon cables, coax cables, etc.

NOTE

Refer to drawing FO-4 while doing the following procedures. This drawing has an apron which allows you to look at it while reading the procedures. The numbers in parentheses in the procedural steps correspond to the numbered items on the drawing. For example, A35 refers to item 35 on view A.

6-9. TUBE ASSEMBLY.

a. Removal.

(1) Disconnect the input power from the 500 Watt Linear Power Amplifier.

(2) Loosen the two 1/4-turn fasteners (B6), and remove the top cover (B7).

(3) Loosen four Phillips screws holding the "HIGH VOLTAGE" cover over the Tube Assembly (B18).

(4) While holding down the Tank Assembly's lifting handle, slide the cover toward the front and remove it.

(5) Disconnect the coax cable from the Tube Assembly coax connector (B14).

(6) Disconnect the ribbon cable from the Tube Assembly ribbon cable connector (B19).

WARNING

As an added safety precaution, short the anode (plate) of tube to ground with a grounding rod before performing the next step. See Figure 6-17.

(7) Unplug the gray high-voltage wire from the small circuit board on the tube.

(8) Slide the Tube Assembly up and out of the chassis.

b. Replacement.

NOTE

When installing the "HIGH VOLTAGE" cover, make sure that it presses down the interlock switch (B32). Otherwise, the high voltage will not be present when the 500 Watt Linear Power Amplifier is placed in OPERATE (fault code 2-09 will be generated).

Reverse the order of the above steps.

6-10. TANK ASSEMBLY.

a. Removal.

(1) Disconnect the input power from the 500 Watt Linear Power Amplifier.

(2) Loosen the two 1/4-turn fasteners (B6), and remove the top cover (B7).

(3) Loosen the four Phillips screws holding the "HIGH VOLTAGE" cover over the Tube Assembly (B18).

(4) Slide the cover toward the front and remove it.

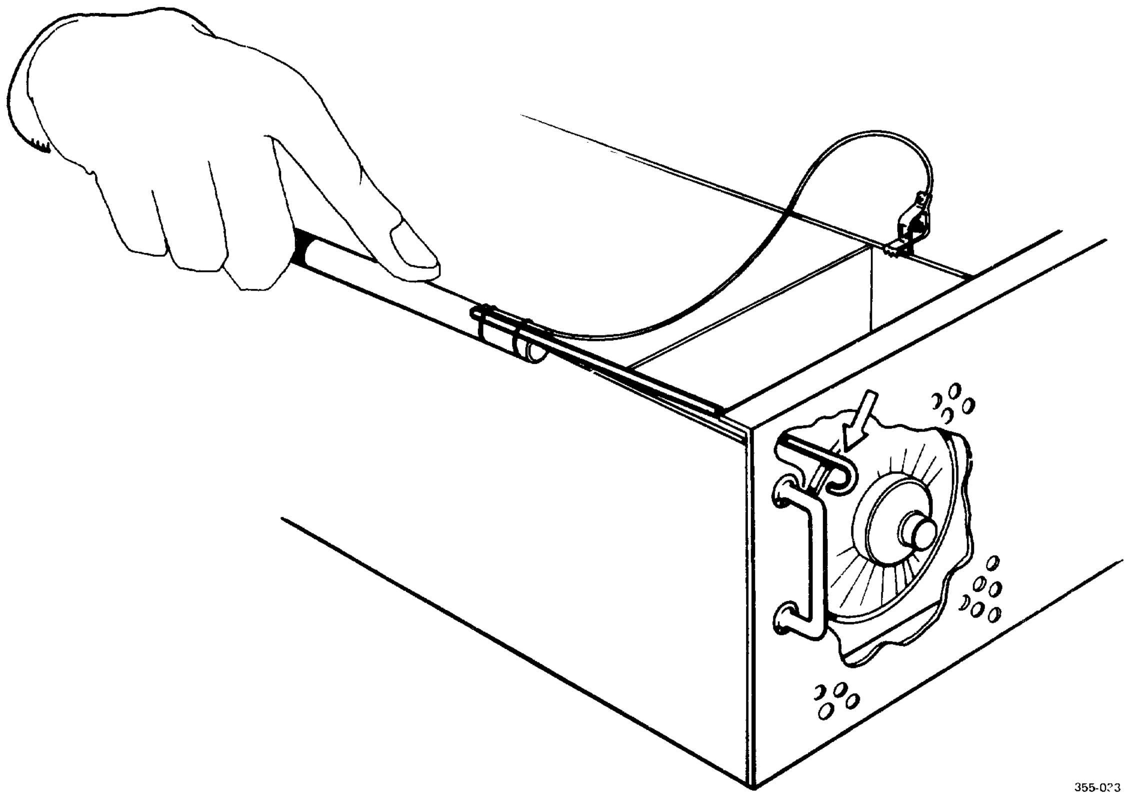


Figure 6-17. Grounding the Tube Anode

WARNING

As an added safety precaution, short the anode (plate) of the tube to ground with a grounding rod before performing the next step. See Figure 6-17.

(5) Unplug the gray high-voltage wire from the small circuit board on the tube.

(6) Disconnect the coax cable (coming out of the bottom of the Tank Assembly) at J1 on the Output Filter PWB Assembly (B31).

(7) Using the two white plastic "handles" (B26), carefully lift the Tank Assembly (B27) off its four mounting pins, and disconnect the ribbon cable from the bottom of the circuit board.

(8) Remove the Tank Assembly.

b. Replacement.

NOTE

When installing the "HIGH VOLTAGE" cover, make sure that it presses down the interlock switch (B32). Otherwise, the high voltage will not be present when the 500 Watt Linear Power Amplifier is placed in OPERATE (fault code 2-09 will be generated).

Reverse the order of the above steps.

6-11. OUTPUT FILTER PWB ASSEMBLY.

a. Removal.

(1) Disconnect the input power from the 500 Watt Linear Power Amplifier.

(2) Loosen the two 1/4-turn fasteners (B6), and remove the top cover (B7).

NOTE

Make a note of the positions of the coax cables before disconnecting them.

(3) Disconnect the three cables at the top of the Output Filter Board (B31).

(4) Loosen the two slotted, spring-loaded captive screws (B29) at the top of the mounting bracket holding the Output Filter PWB Assembly to the rear panel.

(5) Remove the Output Filter PWB Assembly and the mounting bracket.

(6) Remove the eight Phillips screws and lock washers holding the Output Filter PWB Assembly to the mounting bracket.

(7) Remove the Output Filter PWB Assembly from the mounting bracket.

b. Replacement.

Reverse the order of the above steps.

6-12. LOW VOLTAGE POWER SUPPLY ASSEMBLY.

a. Removal.

(1) Disconnect the input power from the 50(Watt Linear Power Amplifier.

(2) Loosen the two 1/4-turn fasteners (B6), and remove the top cover (B7).

(3) Loosen the two slotted, spring-loaded captive screws (B10) at the rear of the mounting bracket (B11) for the Power Control PWB Assembly (B8) and the Low Voltage Power Supply Assembly (B12).

(4) Remove the two Phillips screws (B13) at the front of the mounting bracket.

(5) Disconnect the coax cable and the ribbon cable from their connectors (B14, B19) on the Tube Assembly.

(6) Lift the mounting bracket away from the chassis.

(7) Disconnect the three cables from the Low Voltage Power Supply Assembly.

(8) Loosen the five captive Phillips screws holding the Low Voltage Power Supply Assembly to the mounting bracket.

(9) Remove the Low Voltage Power Supply Assembly from the mounting bracket.

b. Replacement.

Reverse the order of the above steps.

6-13. POWER CONTROL PWB ASSEMBLY.

a. Removal.

(1) Disconnect the input power from the 500 Watt Linear Power amplifier.

(2) Loosen the two 1/4-turn fasteners (B6), and remove the top cover (B7).

(3) Disconnect the two cables from the Power Control PWB Assembly (B8).

(4) Loosen the five captive Phillips screws (B9) holding the Power Control PWB Assembly.

(5) Remove the Power Control PWB Assembly.

b. Replacement.

Reverse the order of the above steps.

6-14. MICRO CONTROL PWB ASSEMBLY.

a. Removal.

(1) Disconnect the input power from the 500 Watt Linear Power Amplifier.

(2) Loosen the four captive Phillips screws (A35) on the front panel (A1).

(3) Pull the front panel straight out and swing it down into its horizontal position.

(4) Disconnect the ribbon cable from the Front Panel PWB Assembly (B3).

(5) Loosen the six captive Phillips screws (B4) holding the Micro Control PWB Assembly (B5) to the chassis.

(6) Move the Micro Control PWB Assembly to the right, lean it forward, and then disconnect the ribbon cable from the back.

(7) Remove the Micro Control PWB Assembly.

b. Replacement.

Reverse the order of the above steps.

6-15. FRONT PANEL PWB ASSEMBLY.

a. Removal

(1) Disconnect the input power from the 500 Watt Linear Power Amplifier.

(2) On the front panel (A1), remove the retaining nuts, washers, and lock washers from the four toggle switches and from the SELF TEST pushbutton switch.

(3) Remove the knobs from the AUTO/MANUAL BAND and METER rotary switches. Each knob is secured by two setscrews. Remove the nuts and lock washers from the switches.

(4) Loosen the four captive Phillips screws (A35) on the front panel.

(5) Pull the front panel straight out and swing it down into its horizontal position.

(6) Remove the two Phillips screws (B2) and the lock washers holding the Front Panel PWB Assembly (B3).

(7) Disconnect the ribbon cable from the Front Panel PWB Assembly.

(8) Remove the Front Panel PWB Assembly.

b. Replacement.

Reverse the order of the above steps.

6-16. RECTIFIER/BLEEDER PWB ASSEMBLY.

a. Removal.

(1) Disconnect the input power from the 500 Watt Linear Power Amplifier.

(2) Loosen the two 1/4-turn fasteners (B6), and remove the top cover (B7).

(3) Loosen the two slotted, spring-loaded captive screws (B10) at the rear of the mounting bracket (B11) for the Power Control PWB Assembly (B8) and the Low Voltage Power Supply Assembly (B12).

(4) Remove the two Phillips screws (B13) at the front of the mounting bracket.

(5) Disconnect the coax cable and the ribbon cable from their connectors (B14, B19) on the Tube Assembly.

(6) Lift the mounting bracket away form the chassis and rest it on the Low Voltage Filter Assembly (B15).

(7) Disconnect the cables at J1 and J2 on the Rectifier/ Bleeder PWB Assembly (B16).

(8) Disconnect the two red wries (with the spade-lug terminals) from the High Voltage Rectifier on the Rectifier/ Bleeder PWB Assembly.

WARNING

As an added safety precaution, short the anode (plate) of the tube to ground with a grounding rod before performing the next step. See Figure 6-17.

(9) Remove the mounting nut, and disconnect the white wire (with the ring terminal) from the ceramic insulator post on the High Voltage Capacitor.

(10) Remove the mounting nut, and disconnect the black ground wire from the chassis.

(11) Loosen the four captive Phillips screws (B17), and remove the Rectifier/Bleeder PWB Assembly.

b. Replacement.

Reverse the order of the above steps.

6-17. DC CONTROL PWB ASSEMBLY.

a. Removal.

(1) Disconnect the input power from the 500 Watt Linear Power Amplifier.

(2) Loosen the two 1/4-turn fasteners (B6), and remove the top cover (B7).

(3) Disconnect the three cables from the DC Control PWB Assembly (B28).

(4) Loosen the four captive Phillips screws holding the DC Control PWB Assembly.

(5) Remove the DC Control PWB Assembly.

b. Replacement.

Reverse the order of the above steps.

6-18. TEMP SENSOR PWB.

a. Removal.

(1) Disconnect the input power from the 500 Watt Linear Power Amplifier.

(2) Loosen the two 1/4-turn fasteners (B6), and remove the top cover (B7).

(3) Loosen the four Phillips screws holding the "HIGH VOLTAGE" cover over the Tube Assembly (B18).

(4) Slide the cover toward the front and remove it.

(5) Reach down and disconnect the cable from the Temp Sensor PWB (B21).

(6) Remove the two Phillips screws (B22) holding the Temp Sensor PWB to the rear grille (B23).

(7) Lift out the Temp Sensor PWB.

b. Replacement.

NOTE

When installing the "HIGH VOLTAGE" cover, make sure that is presses down the interlock switch (B32). Otherwise, the high voltage will not be present when the 500 Watt Linear Power Amplifier is placed in OPERATE (fault code 2-09 will be generated).

Reverse the order of the above steps.

6-19. LOW VOLTAGE FILTER ASSEMBLY.

a. Removal.

(1) Disconnect the input power from the 500 Watt Linear Power Amplifier.

(2) Loosen the two 1/4-turn fasteners (B6), and remove the top cover (B7).

(3) Remove the three Phillips screws (B24) holding the cover (B25) for the Low Voltage Filter Assembly (B15).

(4) Remove the cover for the Low Voltage Filter Assembly.

(5) Disconnect the two spade-lug terminals from the Low Voltage Filter Assembly.

(6) Loosen the two slotted, spring-loaded captive screws (B10) at the rear of the mounting bracket (B11) for the Power Control PWB Assembly (B8) and the Low Voltage Power Supply Assembly (B12).

(7) Remove the two Phillips screws (B13) at the front of the mounting bracket.

(8) Disconnect the coax cable and the ribbon cable from their connectors (B14, B19) on the Tube Assembly.

(9) Lift the mounting bracket (B11) away from the chassis and disconnect the Low Voltage Filter Assembly cable at J3 on the Low Voltage Power Supply Assembly (B12).

(10) Loosen the four captive Phillips screws holding the Low Voltage Filter Assembly.

(11) Remove the Low Voltage Filter Assembly.

b. Replacement.

Reverse the order of the above steps.

6-20. FAN.

a. Removal.

(1) Remove the Tube Assembly. Follow the procedure in paragraph 6-14.

(2) Loosen the two slotted, spring-loaded captive screws (B10) at the rear of the mounting bracket (B11) for the Power Control PWB Assembly (B8) and the Low Voltage Power Supply Assembly (B12).

(3) Remove the two Phillips screws (B13) at the front of the mounting bracket.

(4) Lift the mounting bracket away from the chassis and rest it on the Output Filter PWB Assembly (B15).

(5) Using a short-handled Phillips screwdriver or an offset Phillips screwdriver, remove the four mounting screws for the Fan (B20).

(6) Disconnect the Fan cable from the Low Voltage Power Supply Assembly (B12).

(7) Remove the Fan.

b. Replacement.

Reverse the order of the above steps.

6-21. AIR FILTER.

a. Removal.

Remove the air filter by grasping it between your fingers and pulling it out.

b. Replacement.

Push the filter back in along the edges of the front panel (A1) cutout.

c. Cleaning.

Wash the filter (A36) in a solution of mild soap and water, dry, and replace.

6-22. PERIODIC MAINTENANCE ACTIONS. The 500 Watt Linear Amplifier requires only a limited amount of periodic maintenance. The following actions are recommended at the intervals listed. During any of the specific procedures listed, take note of any unusual equipment conditions which may indicate degrading or degraded performance, and make necessary corrections.

a. Front Panel Meter Readings. Every 56 days of equipment operation, check and observe all front panel meter readings. Observe they are within normal limits and no degradation of parameters is noted.

b. Clean Air Filter. Clean the equipment air filter every 56 days of 24-hour continuous equipment operation, or sooner if filter is noticeably soiled. Use soap and water; dry thoroughly before replacing.

c. Lubricate Tank Assembly. Every 168 days of equipment operation, or 500 tune cycles, whichever comes first, the Tank Assembly A1A2 tune coil should be lubricated. See Paragraph 6-10 for tank assembly removal. Do the following:

(1) Remove tuning coil from tank assembly by performing following steps.

(a) Manually position the Tank Assembly coil to its rear end stop (electrical)

(b) Place Tank Assembly on bench so that the flex cable and plastic tabs are facing up and Motor unit is facing away. Back of tuning coil itself will be facing you.

NOTE

Make note of the position of the ring terminals before disconnecting them.

(c) Remove the two nuts, and disconnect the two ring terminals at the rear of the coil. Watch for brass bushing on upper terminal as it easily falls out.

(d) Remove the four Phillips screws from the white plastic handles on the top of the Tank Assy. Note the dress and position of the flexible cable, and be careful not to damage it.

(e) Turn over Tank Assy so that it is resting on the flex cable, again be careful not to damage the flex cable.

(f) Remove the tuning coil assembly and its coupling half by carefully pulling and sliding the tuning coil assy to the left so that the tuning coil can clear the RF toroidial coil.

(2) Clean the coil turns, coils shafts and the electrical contacts on the coil shafts with isopropyl alcohol.

(3) Apply a light coating of Dow Corning DC 44 (FSCM 71984) silicone lubricant to the coil turns using a soft, lint-free cloth. The lubricant should be invisible to the naked eye but sufficient to make the turns feel slippery.

(4) Apply a heavier, slightly visible coating to each of the electrical contact shafts and to the spring contact shafts. Some lubricant buildup, after running the coil is acceptable.

(5) Apply one drop of Anderol 401D

(FCSM 99559) instrument oil (or equivalent Silicone oil) to each of the oilite bushings in th ecoil and plates. It is not necessary to apply lubricant to the nylon gears.

(6) Alignment and reassembly of tune coil into Tank Assy.

(a) With the Tune Tank Assy in the same position as in step (1)(e) turn the tune coil counter clockwise as seen from driven end until pulley hits on mechanical end stop. Then turn tune coil clockwise until driven end coupling half lines up with drive pins in Tune Tank Assy; not more than 1/2 to 3/4 turn from mechnical end stop on ensuring the mechanical switch on the gear end of the tank assy is engaged and the switch is depressed away from the Tank Drive Motor.

(b) Install tune coil into Tank Assy by reversing steps from paragraph 1.

d. Dust Accumulation. Check the tube fins on the Tube Assembly, A1A1, and Rectifier Bleeder Assembly, A1A8, for dust accumulation every 56 days. Remove any excessive accumulation as required.

Section V. ALIGNMENT PROCEDURES

6-23. INTRODUCTION. This section contains instructions for checking and adjusting the replaceable subassemblies in the 500 Watt LPA. This section also contains circuit board layouts to help you identify the components that can be adjusted. To do the procedures described in this section, you need the test equipment listed in table 6-3 or equivalent equipment.

NOTE

Ensure that the primary power meter % reading is in accordance with table 6-1 throughout performance of alignment procedures.

6-24. ALIGNMENT PROCEDURES.

NOTE

Refer to figure 1-3 for identification of subassemblies.

a. Tube Assy., A1

No adjustments.

b. Tank Assy., A2

No adjustments.

c. Output Filter PWB Assy., A3

CAUTION

High voltage present on this assembly.

(1) R4, Null Adjustment

Table 6-3. Test Equipment*

Generic Name	Military Designation	Manufacturer, Model No.	Federal Stock No.	Required Range
Electronic Voltmeter w/ AC Probe & T-connector		Hewlett Packard, Model 410C Model 11036A Model 11042A		10 to 244 V rms; 1.6 to 30 MHz (peak reading)
Digital Multimeter		Fluke, Model 8012A		200 mV to 250 Vac; 200 mV to 40 Vdc; 0 to 20 megohms
Dummy Load		Bird, Model 8833		500 W (pk), 250 W (avg), 50 ohms
100 Watt Transceiver	RT-1446/URC	RF Communications Model RF-350	5820-01-162-3406	

* NOTE: Equivalent items authorized

NOTE

This adjustment assumes the following initial conditions:

- The LPA has been turned off for at least 10 seconds.
- The LPA's AUTO/MANUAL BAND Switch is in the AUTO position.

(a) Connect the 500 Watt LPA Antenna connector J5 to a dummy load.

(b) Remove the top cover from the LPA.

(c) Connect a digital multimeter between test point TP2 and ground on the Power Control PWB Assy (see figure 6-18).

(d) Turn the LPA on and set the operating frequency at the transceiver to 16.0000 MHz in CW mode. After the LPA has warmed up (is in STANDBY), place the LPA in OPERATE and tune the system.

(e) Key the system and adjust R4 (on the Output Filter PWB Assy -- see figure 6-19) for a null (may go into negative region) on the multimeter.

(2) R7, Forward Power Sample

NOTE

This adjustment assumes the following initial conditions:

- The LPA has been turned off for at least 10 seconds.
- The LPA's AUTO/MANUAL BAND Switch is in the AUTO position.

(a) Using a Model 11042A T-connector, connect an HP-410C Voltmeter (or equivalent) between the LPA's RF output connector J5 and the dummy load.

(b) Remove the top cover from the LPA.

(c) Connect a digital multimeter between test point TP1 and ground on the Power Control PWB Assy (see figure 6-18). Rotate R34 on the Power Control PWB Assy fully counterclockwise.

(d) Turn the LPA on and set the operating frequency at the transceiver to 16.0000 MHz in CW mode. After the LPA has warmed up (is in STANDBY), place the LPA in OPERATE and tune the system.

(e) Key the system and observe the output voltage on the HP-410C and the forward power sample voltage on the digital multimeter. The HP-410C should read 158 Vac and the multimeter should read 7.00 Vdc. USE A WATTMETER TO READ 500 W OUTPUT INSTEAD 158 V ON HP-410

(f) If both read higher or both read lower than the above voltages, adjust the Loop Gain Potentiometer R29 on the Power Control PWB Assy so that the HP-410C reads 158 Vac. Observe the voltage on the multimeter.

(g) If the multimeter reads 7.00 ±0.05 Vdc, no adjustment of R7 is required.

(h) If the reading is less than 6.95 Vdc, adjust R29 on the Power Control PWB Assy for a reading of slightly less than 150 Vac on the HP-410C. Continue this procedure until the multimeter voltage is 7.00 ±0.05 Vdc when the HP-410C voltage is 158 ±2 Vac.

(i) If the reading is more than 7.05 Vdc, adjust R7 for a reading of slightly less than 6.95 Vdc on the multimeter. Readjust R29 on the Power Control PWB Assy for 158 Vac on the HP-410C. Continue this procedure until the multimeter voltage is 7.00 ±0.05 Vdc when the HP-410C voltage is 158 ±2 Vac.

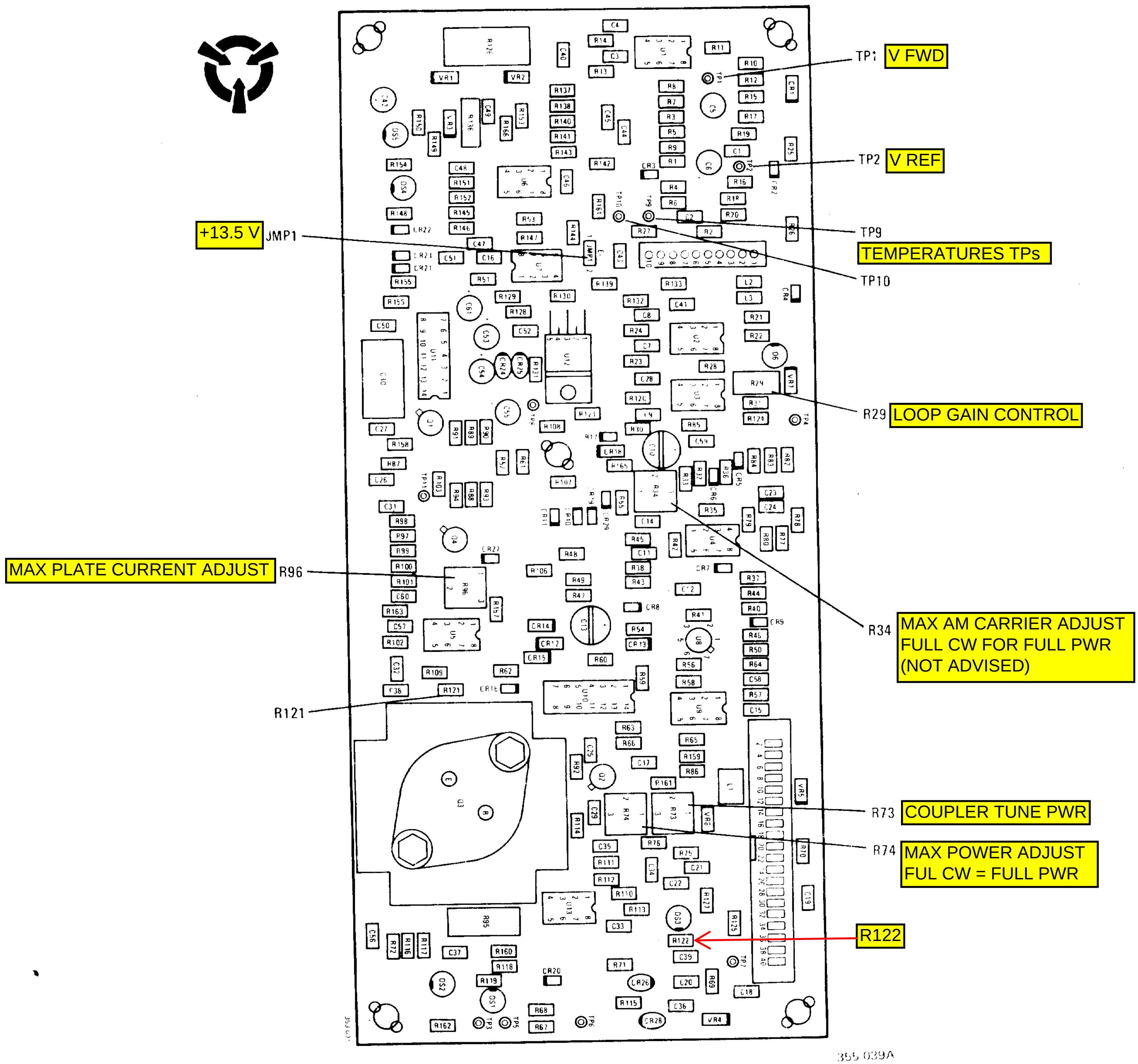


Figure 6-18. Power Control PWB Assy.

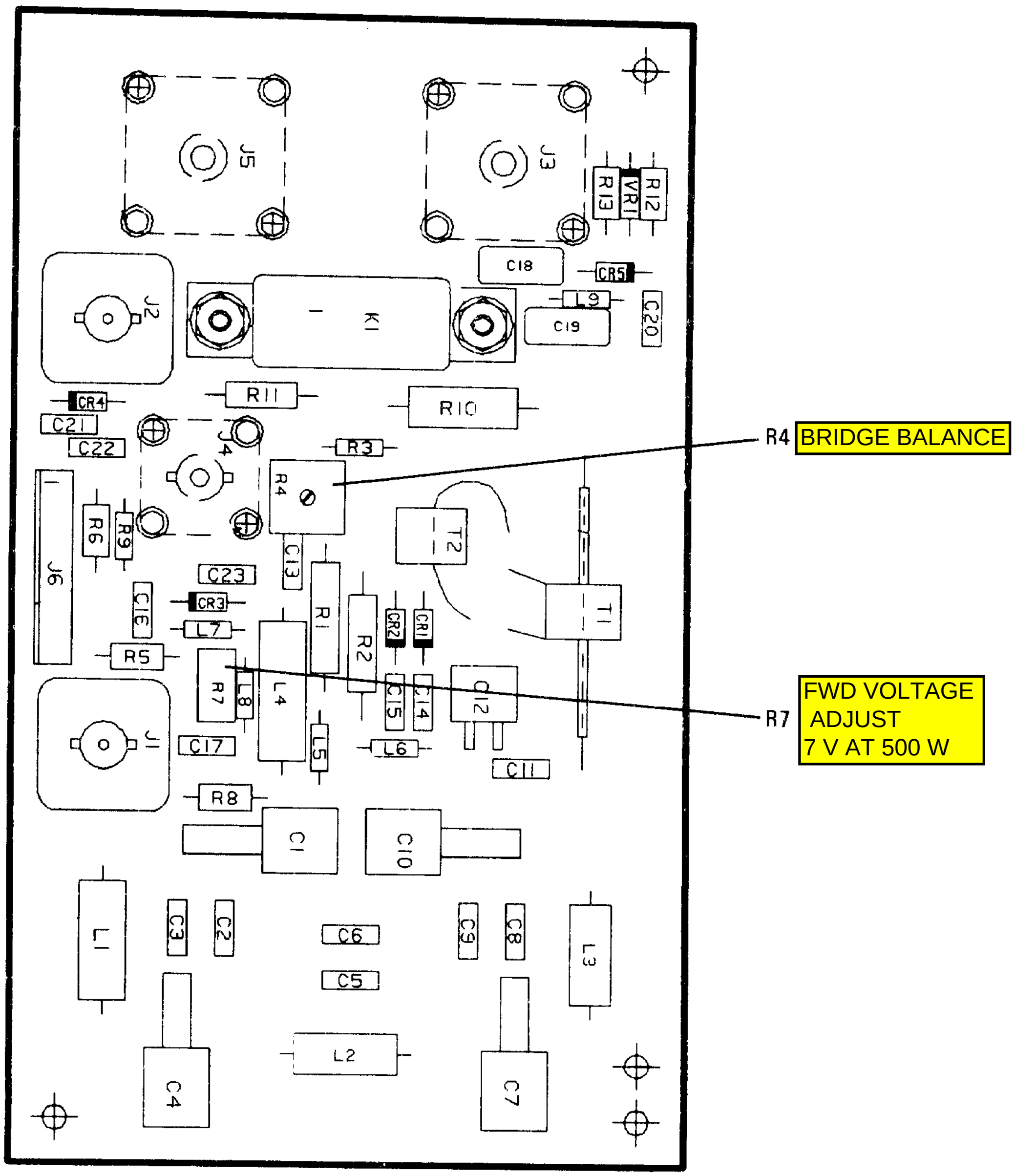


Figure 6-19. Output Filter PWB Assy.

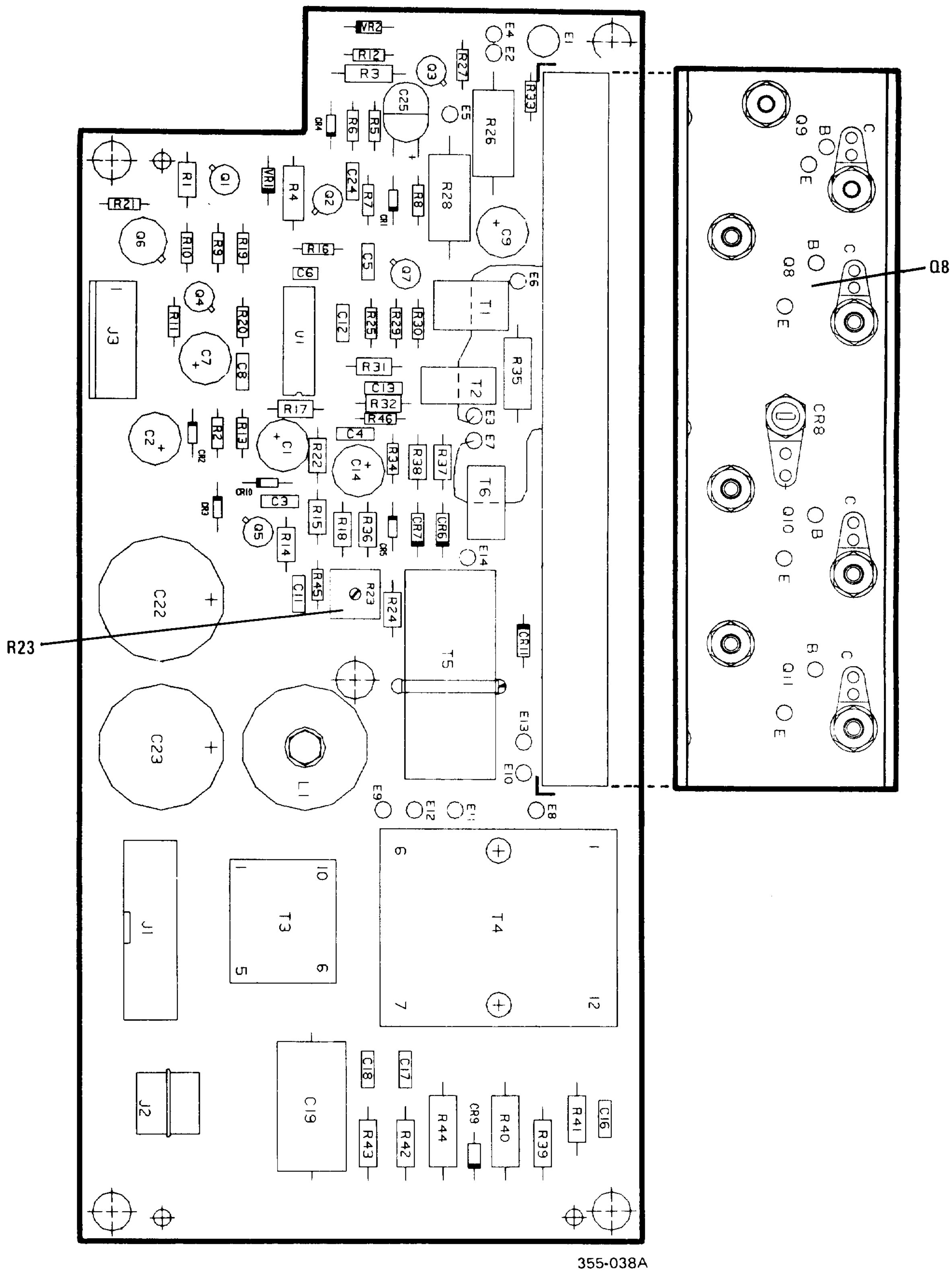


Figure 6-20. Low Voltage Power Supply PWB Assy.

(j) Readjust R34 on the Power Control PWB Assy so that the HP-410C reads 112 ±2 Vac when the system is keyed in CW mode.

d. Low Voltage Power Supply PWB Assy A4

WARNING

Set amplifier in stanby mode before R23, Voltage Adjustment, to avoid high voltage risk.

(1) R23, +13.5 Vdc Voltage Adjustment

NOTE

No adjustment required if front panel reads +13.5 Vdc.

(a) Connect Digital Voltmeter to the collector of Q8 (see figure 6-20).

(b) Adjust R23 for +13.5 Vdc ±0.05 Vdc while PA is in standby mode.

e. Power Control PWB Assy. A5

(1) R29, Loop Gain Control

NOTE

This adjustment assumes the following initial conditions:

- The LPA has been turned off for at least 10 seconds.
- The LPA's AUTO/MANUAL BAND Switch is in the AUTO position.
- R4 and R7 on the Output Filter PWB Assy are correctly adjusted.

(a) Using a Model 11042A T-connector, connect an HP-410C Voltmeter (or equivalent) between the LPA's RF output connector J5 and the dummy load.

(b) Adjust power Control Potentiometer R74 on the Power Control PWB Assy (see figure 6-18) fully clockwise, and adjust R34 fully counterclockwise.

(c) Turn the LPA on and set the operating frequency at the transceiver to 16.0000 MHz in CW mode. After the LPA has warmed up (is in STANDBY), place the LPA in OPERATE and tune the system.

(d) Key the system and adjust the Loop Gain Control R29 for a reading of 158 to 160 Vac on the HP-410C.

(2) R34, CW/FSK Power Adjustment

(a) Using a Model 11042-A T-connector, connect an HP-410C Voltmeter (or equivalent) between the LPA's RF output connector J5 and the dummy load.

(b) Turn the LPA on and set the operating frequency at the transceiver to 16.0000 MHz in CW mode. After the LPA has warmed up (is in STANDBY), place the LPA in OPERATE and tune the system.

(c) Key the system and adjust R34 (see figure 6-18) for a reading of 112 ±2 Vac on the HP-410C.

(3) R73, Coupler Tune Power Adjustment .

NOTE

This adjustment assumes the following initial conditions.

- The LPA has been truned off for at least 10 seconds.
- The LPA's AUTO/MANUAL BAND Switch is in the AUTO position.
- R4 and R7 on the Output Filter PWB Assy are correctly adjusted.

(a) Connect the LPA's RF output connector J5 to a dummy load.

(b) Turn the LPA on and set the operating frequency at the transceiver to 16.0000 MHz in CW mode. After the LPA has Warmed up (is in STANDBY), place the LPA in OPERATE and tune the system.

(c) Connect a ground to the J1-5 side of R121 on the Power Control PWB Assy (see figure 6-18). This will place the Power Control PWB Assy into the coupler tune mode.

(d) Set the LPA meter select switch to the FWD PWR (WATTS) position and key the system. Adjust R73 on the Power Control PWB Assy for 200 watts on the front panel meter.

(e) Unkey the system and remove the ground from R121.

(4) R74, Power Control Adjustment

This potentiometer is normally set fully clockwise. If reduced output power is required in all modes, then this is accomplished by adjusting R74 counterclockwise until the desired output power is attained.

(5) R96, Max Plate Current Adjustment

NOTE

This adjustment assumes the following initial conditions:

- The LPA has been turned off for at least 10 seconds.
- The LPA's AUTO/MANUAL BAND Switch is in the AUTO position.
- R4 and R7 on the Output Filter PWB Assy are correctly adjusted.

(a) Connect the LPA's RF output connector J5 to a dummy load.

(b) Turn the LPA on and set the operating frequency at the transceiver to 16.0000 MHz in CW mode. After the LPA has warmed up (is in STANDBY), set the LPA's AUTO/MANUAL BAND Switch to the 16-24 position.

(c) Set the TUNE PWR Switch to the ON position, and set the METER Switch to the I_K (mA) position.

(d) Adjust R96 on the Power Control PWB Assy for 225 ±8 on the front panel meter.

f. Micro Control PWB Assy, A6

No adjustments.

g. Front Panel PWB Assy, A7

No adjustments.

h. Rectifier/Bleeder PWB Assy, A8

No adjustments.

i. DC Control PWB Assy, A9

No adjustments.

j. Temp Sensor PWB Assy, A10

NOTE

This adjustment can be performed on a "cold" LPA (one that has been turned off for at least 15 minutes) or a "hot" LPA (one that has been turned on for more than 10 seconds). If you remove the JMP1 jumper (on the Power Control PWB Assy) from a cold LPA, you can begin the adjustment procedure immediately (as soon as you turn the LPA on). However, if you remove the jumper from an LPA that has been on for more than 10 seconds, then you must allow 15 minutes for the temperature sensors to stabilize at ambient before doing the adjustment.

(1) Remove JMP1 on the Power Control PWB Assembly (see figure 6-18).

NOTE

With Jumper 1 removed, equipment will show a fault (JMP-1 PN is 65474-001).

(2) With the LPA in warmup (for a cold LPA) or standby (for a hot LPA), connect a digital multimeter between test points TP9 and TP10 on the Power Control PWB Assy.

(3) If the voltage is 0 ±2 mVdc, no adjustment is necessary. If not, adjust R2 (R2 is accessible through the rear grille of the LPA-- see figures 1-3 and 6-21) until the voltage is within the limits.

(4) Re-install JMP1 on the Power Control PWB Assy.

k. Low Voltage Filter Assy, A11

No adjustments.

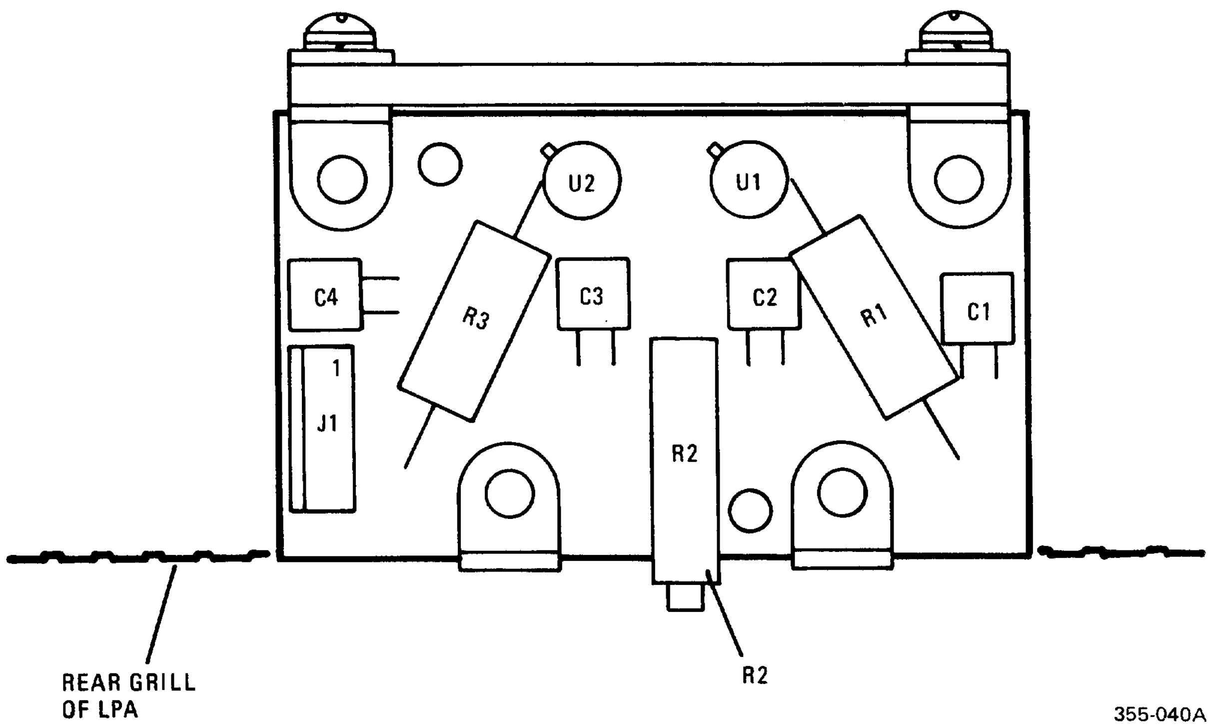


Figure 6-21. Temp Sensor PWB Assy.

APPENDIX

CHECKS PERFORMED DURING THE AUTOMATIC BIT ROUTINE FOR THE 500 WATT LPA

NOTE

If BIT is initiated during WARMUP, only the tests up to and including the Band Switch/Servo Coil Test are performed.

1. Front Panel Test. At the start of the test, the front panel is disabled and remains so for the remainder of the test. Also at the start of the test, all front panel LCD segments and LED indicators are turned on. They stay on for the remainder of the test with the exception of the condition when tune power is requested from the 100 Watt Transceiver (see "Keying Test").

2. Micro Control Test. The microprocessor is checked. If its operation is determined to be incorrect, FAULT 2-01 is declared.

3. Primary Power Test. The primary power level is sampled. If it is not between 80 and 120% of the nominal value, FAULT 2-03 is declared.

4. Low Voltage Supply Test. The 13.5 V supply is sampled. If it is not between 10 and 16 Vdc, FAULT 2-04 is declared.

5. Transmitter Fault Test. If the XMTR-FAULT signal line (temperature sensor) is active, FAULT 2-05 is declared.

6. Band Switch/Servo Coil Test. For this test, a band other than the current operating band is selected for the band switch. Once this position is reached, the switch returns to the current operating band position. If the switch does not turn, or if it takes over 10 seconds to reach the selected band, FAULT 2-06 is declared. The coil is moved to MIN L and then to MAX L, and the coil position counter is checked at both limits. If the coil does not move, or if the position counter is inaccurate, FAULT 2-07 is declared. If the 500 Watt LPA is in WARMUP, no further testing is done.

7. High Voltage Test. With the 500 Watt LPA in STANDBY, FAULT 2-08 is declared if the DC plate voltage is greater than 100 volts. The 500 Watt LPA is put into OPERATE. If the DC plate voltage is not between 1200 and 3000 volts, FAULT 2-09 is declared. If the plate current is greater than 5 mA, FAULT 2-10 is declared.

8. Bias Test. The power amplifier bias is turned on (the LPA is keyed without RF drive). If the plate current is not between 20 and 150 mA, FAULT 2-11 is declared.

9. Keying Test. An RF MUTE message is sent to the 100 Watt Transceiver. If the RF input signal level is not below 6 watts in 200 milliseconds, FAULT 2-12 is declared. If the RF input falls below 6 watts, the T/R relay is keyed and the RF MUTE signal is removed. Tune Power Request (TPR) and Transmit Gain Control Tune Power Request (TGC TPR) messages are sent to the 100 Watt Transceiver. The message "rF" is sent to the METER LCD display to let the operator know that RF input power is required to complete the test. This message remains until the RF input signal level is greater than 5 watts. If the RF input signal is not greater than 5 watts in 20 seconds, FAULT 2-13 is declared. If the RF input signal level is sufficient, the power amplifier plate current is checked. If the power amplifier plate current is not between 160 mA and 280 mA, FAULT 2-14 is declared. The DC plate voltage is checked again at this point; and if it is not within the previously specified limits for the OPERATE mode (1200 to 3000 Vdc), FAULT 2-09 is declared.

10. Tuning Test. A TGC Lock command is sent to the 100 Watt Transceiver. Using the auto-tuning software, the coil is moved toward MIN L while searching for a tune peak. If no tune peak is found, FAULT 2-15 is declared. When the tune peak is found, forward power is checked. If the forward power is not between 30 watts and 90 watts, FAULT 2-16

is declared. If the forward power is normal, the VSWR is checked. If the VSWR is not less than 2.25:1, FAULT 2-17 is declared. If the VSWR is normal, the ratio of forward power to RF input power is checked. This ratio must be between 5 and 60. If not, FAULT 2-18 is declared. Tune Power Request Off, TGC Tune Power Request Off, and TGC Lock Off commands are sent to the 100 Watt Transceiver when this part of the test is completed.

11. Transceiver Serial Link Test. As in normal operation, certain failures in the serial link to the transceiver during the BIT test cause FAULT 2-21 to be declared.

12. Test Completion.

(a) The BIT tests described in the above paragraphs are continued until a fault is encountered. When a fault is flagged, all further testing is aborted.

(1) If the BIT test was initiated from the 100 Watt Transceiver, the fault code is displayed on the transceiver LCD display. The fault code will also appear on the LPA's LCD display if the METER selector switch is placed in the STATUS/FAULT position. The fault code may be cleared by commanding the LPA to OPERATE from the 100 Watt Transceiver or by moving the METER selector switch out of the STATUS/FAULT position.

(2) If the BIT test was initiated from the LPA, the fault code is displayed on the LPA's front panel meter. The fault code will also appear on the transceiver's LCD display if "2ND," "TEST" is pressed. To remove the LPA from the test mode, the METER selector switch must be moved cut of the STATUS/FAULT position. The fault code may be cleared by commanding the LPA to OPERATE from the 100 Watt Transceiver (if the LPA is placed back in AUTO) or by moving the METER selector switch to the STATUS/FAULT position and then out again.

(b) If no fault is encountered during any of the tests, the following occurs:

(1) If the BIT test was initiated from the 100 Watt Transceiver, the message "PASSEd" is displayed on the transceiver front panel for 5 seconds; and the LPA front panel returns immediately to its normal operating mode.

(2) If the BIT test was initiated from the LPA, the message "PASS" is displayed on the meter. The message will remain there as long as the METER selector switch is in the STATUS/FAULT position. When the selector switch is moved out of the STATUS/FAULT position, the message disappears and the LPA front panel returns to its normal operating mode.

CHAPTER 7

ILLUSTRATED PARTS BREAKDOWN

Section 1. INTRODUCTION

7-1. PURPOSE. This chapter lists, illustrates, and describes the assemblies and detail parts for the 500 Watt LPA. Its purpose is for the identification, requisitioning, and issuance of parts at the organizational (on-equipment) level.

7-2. SCOPE. Only parts that are coded as replaceable at the organizational level are listed in this chapter. These include the major assemblies and a few detail parts. Mounting hardware is listed only if it is used to attach a replaceable assembly or detail part and only if it is not held captive to the assembly or part. In general, the assemblies and parts installed at the time the 500 Watt LPA was manufactured are listed and identified in this chapter. When an assembly or part (including vendor items), which is different from the original, was installed during the manufacture of later items, series, or blocks, all assemblies and parts are listed (and "Usable-On" coded). However, when the original assembly or part does not have continued application (no spares of the original were procured or such spares are no longer authorized for replacement), only the preferred assembly or part is listed. Also, when an assembly or part was installed during modification, and the original does not have continued application, only the preferred item is listed. Interchangeable and substitute assemblies and parts, subsequently authorized by the Government, are not listed in this chapter; such items are identified by information available through the Interchangeable and Substitute (I & S) Data Systems. Refer to T.O. 00-25-184. When a standard size part can be replaced with an oversize or undersize part, the latter parts, showing sizes, are also listed. Repair Parts Kits and Quick Change Units are listed when they are available for replacement.

7-3. CHAPTER ORGANIZATION. This chapter is divided into two sections. Section I, INTRODUCTION, explains the purpose, scope, and organization of the chapter. Section II, MAINTENANCE PARTS LIST, consists of illustrations, in which the assemblies and detail parts of the 500 Watt LPA are identified by numbers (called index numbers), followed by a list which contains parts numbers, descriptions, and other relevant data for the items identified on the illustrations.

7-4. SOURCE, MAINTENANCE, AND RECOVERABILITY (SMR) CODES. This chapter contains Air Force Peculiar In-Being Source and Repair Codes only. Definitions of these SMR codes, as well as detailed coding criteria and transposition matrices for each coding method may be obtained from T.O. 00-25-195. Refer to page 7-3.

7-5. FEDERAL SUPPLY CODES FOR MANUFACTURERS (FSCM). The codes used in this chapter are as follows. The first list is in numerical order by FSCM; the second is in alphabetical order by manufacturer name.

Note: Field and organizational maintenance of the modules and circuit card assemblies is limited only to the removals, replacements, and alignments given in chapter 6.

JOINT MILITARY SERVICES UNIFORM SMR CODING MATRIX T.O. 00-25-195

SOURCE

1st Position		2nd Position	
P	Procurable	A	Stocked
		B	Insurance
		C	Deteriorative
		E	Support Equipment, Stocked
		F	Support Equipment, Nonstocked
		G	Sustained Life Support
K	Component of a Repair Kit	F	Intermediate Kit
		D	Depot Kit
		B	In Both Kits
M	Manufacture	O	Organization
		F	Intermediate
		D	Depot
A	Assemble	O	Organization
		F	Intermediate
		D	Depot
X	Nonprocured	A	Requisition NHA
		B	Reclamation from IM
		C	Mfg Drawings

MAINTENANCE — USE

3rd Position	
O	Remove/ Replace at Organizational Level
F	Remove/ Replace at Intermediate Level
D	Remove/Replace at Depot Level

MAINTENANCE — REPAIR

4th Position	
Z	No Repair
B	No Repair Recondition
O	Repair at Organizational
F	Repair at Intermediate
D	Limited Repair at O or F Level Overhaul at Depot
L	Repair at Depot

RECOVERABILITY

5th Position	
Z	Nonreparable Condemn at 3rd Position Level
O	Reparable Condemn at Organizational
F	Reparable Condemn at Intermediate
D	Reparable Condemn at Depot
A	Special Handling

ERRC CODE

6th Position	
N	Nonrecoverable XB3 Condemn at Any Level
P	Recoverable XF3 Condemn at Field
C	Recoverable XD1 (SCARS) Condemn at Depot
T	Recoverable XD2 Condemn at Depot
S	Nonexpendable Support Equipment, Depot ND2
U	Nonexpendable Support Equipment, Organizational and Intermediate NF2

Section II. MAINTENANCE PARTS LIST

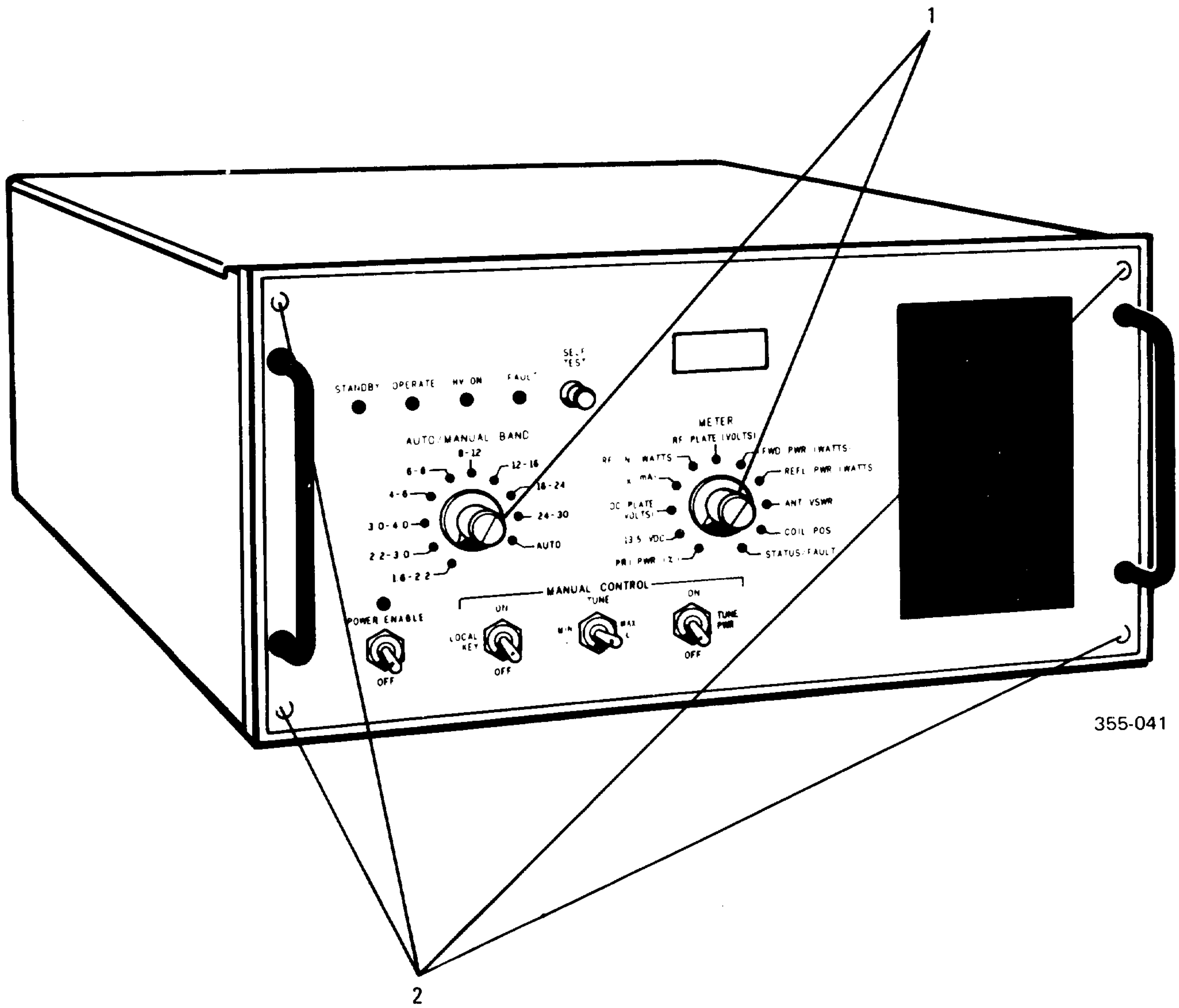


Figure 7-1. 500 Watt LPA, AM-7223/URC, Front View

ILLUSTRATED PARTS BREAKDOWN

Fig & Index No.	Part No.	FSCM	Description 1 2 3 4 5 6 7	Units Per Assy	Usable on Code	SMR Code
7-1-1	MS91528-1F1B	96906	KNOB	2		PAOZZ
	AN565DC4L4	88044	. SCREW, SET (AP)	4		PAOZZ
2	10086-2015	14304	SCREW, MACHINE	4		XB
	10086-2016	14304	WASHER, FLAT	4		XB
	H17-1001-005	14304	RETAINER	4		XB

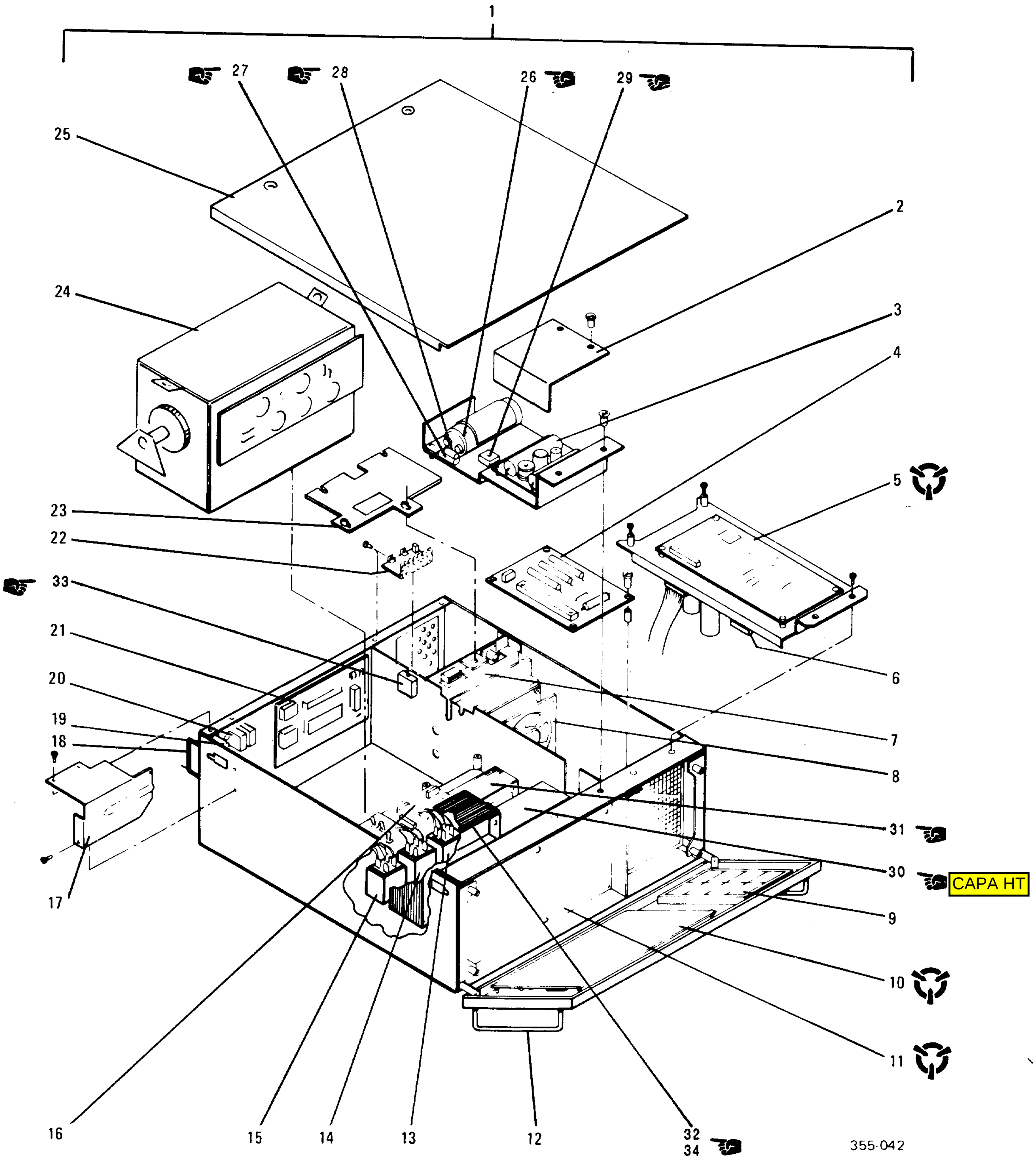


Figure 7-2. 500 Watt LPA, AM-7223/URC, Exploded View

FIGURE & INDEX NUMBER	PART NUMBER	FSCM	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE	SMR CODE
7-	10086-0000	14304	AMPLIFIER, RF*			PEODD
-1	10086-3100	14304	. AMPLIFIER, RF	1		XA
-2	10086-1131	14304	. . COVER, L.V. FILTER**	1		XB
	MS21266-1N	96906	. . CHANNEL, NONMETALLIC**	1 1/2 in		PAOZZ
	MS24693-C24	96906	. . SCREW, MACHINE (AP)**	2		PAOZZ
	MS51957-27	96906	. . SCREW, MACHINE (AP)	1		PAOZZ
	MS35338-136	96906	. . WASHER, LOCK	5		PAOZZ
-3	10086-1130	14304	. . L.V. FILTER PWB ASSY, A11	1		PAOLD
-4	10086-1150	14304	. . RECT/BEEDER PWB ASSY, A8	1		PAOLD
-5	10086-7100	14304	. . POWER CONTROL PWB ASSY, A5	1		PAODD
-6	10086-1500	14304	. . L.V. POWER SUPPLY PWB ASSY, A4	1		PAODD
-7	10086-3200	14304	. . TUBE PWB ASSY, A1	1		PAODD
	3CX800A7		. . . TUBE, ELECTRON	1		PAOZZ
-8	10086-1400	14304	. . FAN ASSY	1		PAOZZ
	MS51957-30	96906	. . SCREW, MACHINE (AP)	4		PAOZZ
	MS15795-805	96906	. . WASHER, FLAT (AP)	4		PAOZZ
	MS35338-136	96906	. . WASHER, LOCK (AP)	Ref.		PAOZZ
-9	10086-2010	14304	. . FILTER, AIR	1		PAOZZ
-10	10086-2100	14304	. . FRONT PANEL PWB ASSY, A7A1	1		PAODD
-11	10086-9200	14304	. . MICRO CONTROL PWB ASSY, A6	1		PAOLD
-12	A1013-29	06540	. . HANDLE	2		XB
	16022A2	06540	. . BUSHING	4		XB
	MS24693-C272	96906	. . SCREW, MACHINE	8		PAOZZ
-13	389CX-84	94696	. . RELAY	1		PAOZZ
	H-6768	14304	. . NUT, KEPS (AP)	3		PAOZZ
	MS15795-806	96906	. . WASHER, FLAT (AP)	3		PAOZZ
-14	389CX-87	94696	. . RELAY	1		PAOZZ
	H-6768	14304	. . NUT, KEPS (AP)	Ref.		PAOZZ
	MS15795-806	96906	. . WASHER, FLAT (AP)	Ref.		PAOZZ
-15	389CX-86	94696	. . RELAY	1		PAOZZ
	H-6768	14304	. . NUT, KEPS (AP)	Ref.		PAOZZ
	MS15795-806	96906	. . WASHER, FLAT (AP)	Ref.		PAOZZ
-16	10086-1170	14304	. . DC CONTROL PWB ASSY, A9	1		PAOLD
-17	10086-3191	14304	. . COVER, CIRCUIT BREAKER	1		XB
	MS24693-C26	96906	. . SCREW MACHINE (AP)	3		PAOZZ
	MP-0745	14304	. . LABEL, H.V	2		MDO
-18	10340-A-1032-2	06540	. . HANDLE	2		XB
	MS24693-C272	96906	. . SCREW, MACHINE (AP)	Ref.		PAOZZ
-19	F03B250V1/8AS	81349	. . FUSE	2		PAOZZ
-20	W58XB1A6A-2	89265	. . CIRCUIT BREAKER	2		PAOZZ
-21	10086-4500	14304	. . OUTPUT FILTER PWB ASSY, A3	1		PAODD
	MS51957-14	96906	. . SCREW, MACHINE (AP)	8		PAOZZ
	MS35338-135	96906	. . WASHER, LOCK (AP)	6		PAOZZ
-22	10086-7200	14304	. . THERMAL SENSOR PWB ASSY, A10	1		PAODD
	MS51957-14	96906	. . SCREW, MACHINE (AP)	Ref.		PAOZZ
	MS15795-804	96906	. . WASHER, FLAT (AP)	2		PAOZZ
	MS35338-135	96906	. . WASHER, LOCK (AP)	2		PAOZZ
-23	10086-3108	14304	. . COVER, R.F. SHIELD	1		XB
	MS51957-29	96906	. . SCREW, MACHINE	2		PAOZZ
	MS35333-71	96906	. . WASHER, LOCK	2		PAOZZ
	MP-0745	14304	. . LABEL, H.V	Ref.		MDO
-24	10086-3700	14304	. . TANK ASSY, A2	1		PAOLD
-25	10086-3105	14304	. . COVER	1		XB
	F4-35-SS	32039	. . STUD	2		XB
	SR4	72794	. . RETAINER	2		PAOZZ

*Installation requires Ancillary Kit 10086-0060 (See Figure 7-3).

**See Table 1-4 for channel adhesive and Loctite for screws.

ILLUSTRATED PARTS BREAKDOWN

Fig & Index No.	Part No.	FSCM	Description 1 2 3 4 5 6 7	Units Per Assy	Usable on Code	SMR Code
7-2-						
26	3120EE183U050APA1	19701	. . CAP, FXD, ELC TLT	1		PAOZZ
27	CTM105VAJ	81349	. . CAP, FXD, MYLAR	1		PAOZZ
28	RC42G102JS	81349	. . RESISTOR, FXD	1		PAOZZ
29	VL148	27777	. . SEMICOND, DIO	1		PAOZZ
30	LK30-106Y	99120	. . CAP, FXD, PAPER	1		PAOZZ
31	10086-1110	14304	. . TRANSFORMER	1		PAOZZ
32	RL6015-100-120-240-PT	75263	. . THERMISTOR	1		PAOZZ
33	MS16106-4	96906	. . SWITCH	1		PAOZZ
34	10086-1112	14304	. . TRANSFORMER	1		PAOZZ

*Includes Ancillary Kit 10086-0060 (See Figure 7-3).
**See Table 1-4 for channel adhesive and Loctite for screws.

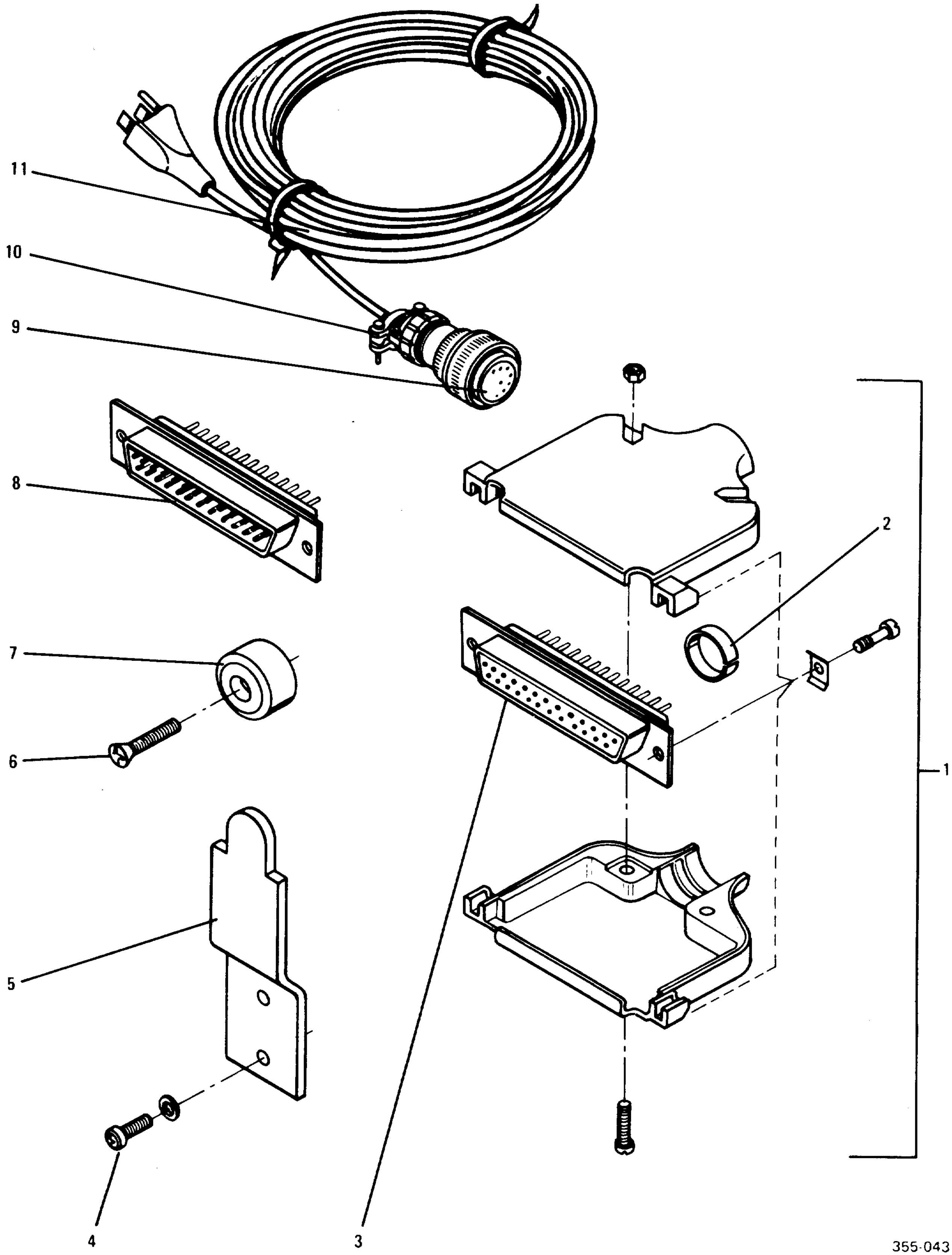


Figure 7-3. Installation Kit for 500 Watt LPA

PART NUMBER	FIGURE AND INDEX NUMBER	QTY PER END ITEM
A1013-29	7-2-12	2
AN565DC4L4	7-1-1	4
CTM105VAJ	7-2-27	1
DB-25P	7-3-8	1
F4-35-SS	7-2-25	2
F03A250V8AS	7-2-19	2
H17-1001-005	7-1-2	4
H-6768	7-2-13	3
	7-2-14	Ref
	7-2-15	Ref
LK30-106Y	7-2-30	1
MP-0745	7-2-17	2
	7-2-23	Ref
MS15795-804	7-2-22	Ref
MS15795-805	7-2-8	4
MS15795-806	7-2-13	3
	7-2-14	Ref
	7-2-15	Ref
MS16106-4	7-2-33	1
MS21266-1N	7-2-2	1
MS24417-1	7-2-10	4
MS24693-C272	7-2-18	Ref
MS24693-C24	7-2-2	2
MS24693-C26	7-2-17	3
MS24693-C272	7-2-12	8
MS3057-16A	7-3-10	1
MS3106A28-20S	7-3-9	1
MS35333-71	7-2-23	2
MS35338-135	7-2-21	8
	7-2-22	
MS35338-136	7-2-2	13
	7-2-8	
	7-3-4	
MS51957-14	7-2-21	8
	7-2-22	Ref
MS51957-27	7-2-2	1
MS51957-28	7-3-4	8
MS51957-29	7-2-23	2
MS51957-30	7-2-8	4
MS51959-29	7-3-6	4
MS91528-1F1B	7-1-1	2
RL6015-100-120-240-PT	7-2-32	1

PART NUMBER	FIGURE AND INDEX NUMBER	QTY PER END ITEM
VL148	7-2-29	1
W58XB1A6A-2	7-2-20	2
RC42G102JS	7-2-28	1
SR4	7-2-25	2
10086-0000	7-2	1
10086-0060	7-3	1
10086-0080	7-3-11	1
10086-1110	7-2-31	1
10086-1112	7-2-34	1
10086-1130	7-2-3	1
10086-1131	7-2-2	1
10086-1150	7-2-4	1
10086-1170	7-2-16	1
10086-1400	7-2-8	1
10086-1500	7-2-6	1
10086-2010	7-2-9	1
10086-2015	7-1-2	4
10086-2016	7-1-2	4
10086-2100	7-2-10	1
10086-3100	7-2-1	1
10086-3105	7-2-25	1
10086-3108	7-2-23	1
10086-3191	7-2-17	1
10086-3200	7-2-7	1
10086-3700	7-2-24	1
10086-4500	7-2-21	1
10086-7100	7-2-5	1
10086-7200	7-2-22	1
10086-9200	7-2-11	1
10087-3107	7-3-5	4
101-BB-1029	7-3-7	4
10340-A-1032-2	7-2-18	2
105559862	7-2-10	1
16022A2	7-2-12	4
17-80250-16	7-3-3	1
3120EE183U050APA1	7-2-26	1
389CX-84	7-2-13	1
389CX-86	7-2-15	1
389CX-87	7-2-14	1
3CX800A7	7-2-7	1
745473-2	7-3-1	2
745508-8	7-3-2	2

ILLUSTRATED PARTS BREAKDOWN

Fig & Index No.	Part No.	FSCM	Description 1 2 3 4 5 6 7	Units Per Assy	Usable on Code	SMR Code
7-3-	10086-0060	14304	INSTALLATION KIT	1		XB
1	745473-2	00779	. COVER, CONN	2		PAOZZ
2	745508-8	00779	. SHIELD CONNECTOR	2		PAOZZ
3	17-80250-16	74868	. CONNECTOR, RCPT, ELEC	1		PAOZZ
4	MS51957-28	96906	. SCREW, MACHINE	8		PAOZZ
	MS35338-136	96906	. WASHER, LOCK	8		PAOZZ
5	10087-3107	14304	. POST, STACKING	4		XB
6	MS51959-29	96906	. SCREW, MACHINE	4		PAOZZ
7	101-BB-1029	11897	. BUMPER, RUBBER	4		XB
8	DB-25P	02660	. CONNECTOR, RCPT, ELEC	1		XB
9	MS3106A28-20S	96906	. CONNECTOR, PLUG, ELEC.	1		XB
10	MS3057-16A	96906	. RETAINER	1		XB
11	10086-0080	14304	. CABLE ASSY, RF*	1		XB

* Includes items 9 and 10.

REFERENCE DESIGNATOR INDEX

Reference Designator	Figure and Index No.	Part Number
A1	7-2-7	10086-3200
A1V1	7-2-7	3CX800A7
A2	7-2-24	10086-3700
A3	7-2-21	10086-4500
A4	7-2-6	10086-1500
A5	7-2-5	10086-7100
A6	7-2-11	10086-9200
A7	7-2-10	10086-2100
A8	7-2-4	10086-1150
A9	7-2-16	10086-1170
A10	7-2-22	10086-7200
A11	7-2-3	10086-1130
B1	7-2-8	10086-1400
CB1, CB2	7-7-20	W58XB1A6A-1
F1, F2	7-2-19	FO3A250V8AS
K1	7-2-13	389CX-84
K2	7-2-14	389CX-87
K3	7-2-15	389CX-86

CHAPTER 8

FOLDOUT DRAWINGS

LIST OF 500 WATT LPA FOLDOUT DRAWINGS

GPO 687-000/41795

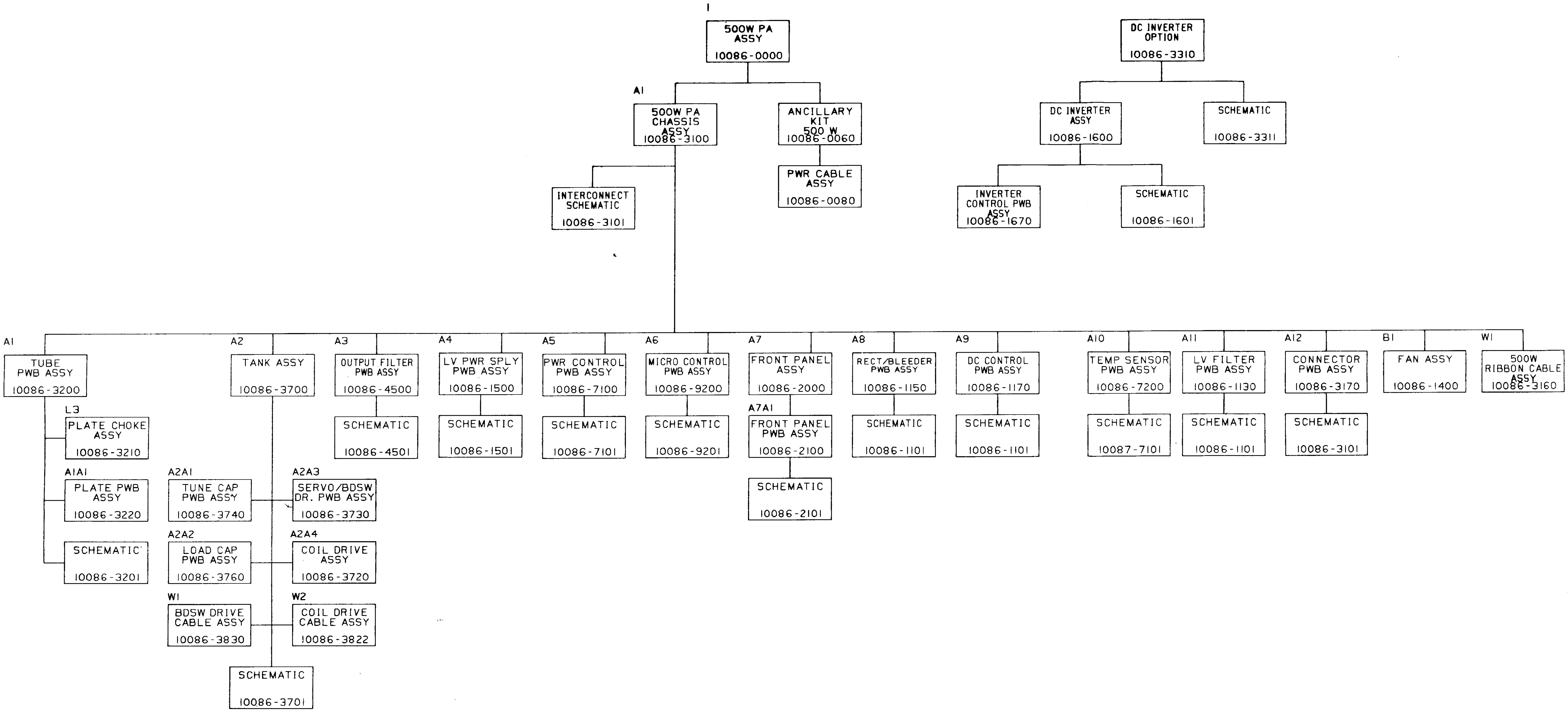
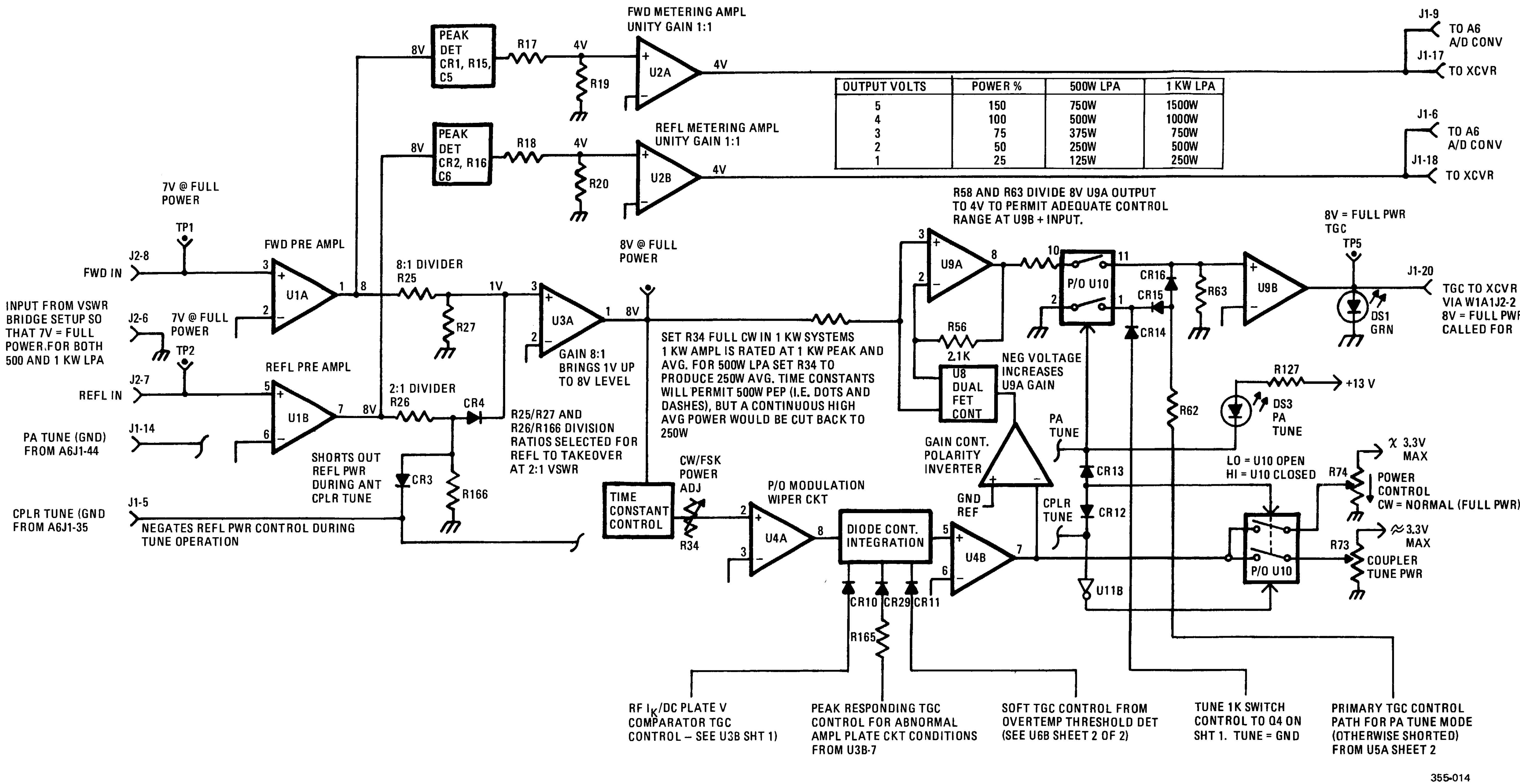


Figure FO-1. Family Tree 500 Watt LPA.



OUTPUT VOLTS	POWER %	500W LPA	1 KW LPA
5	150	750W	1500W
4	100	500W	1000W
3	75	375W	750W
2	50	250W	500W
1	25	125W	250W

Figure FO-2. Power Control PWB Simplified (Sheet 1 of 2).

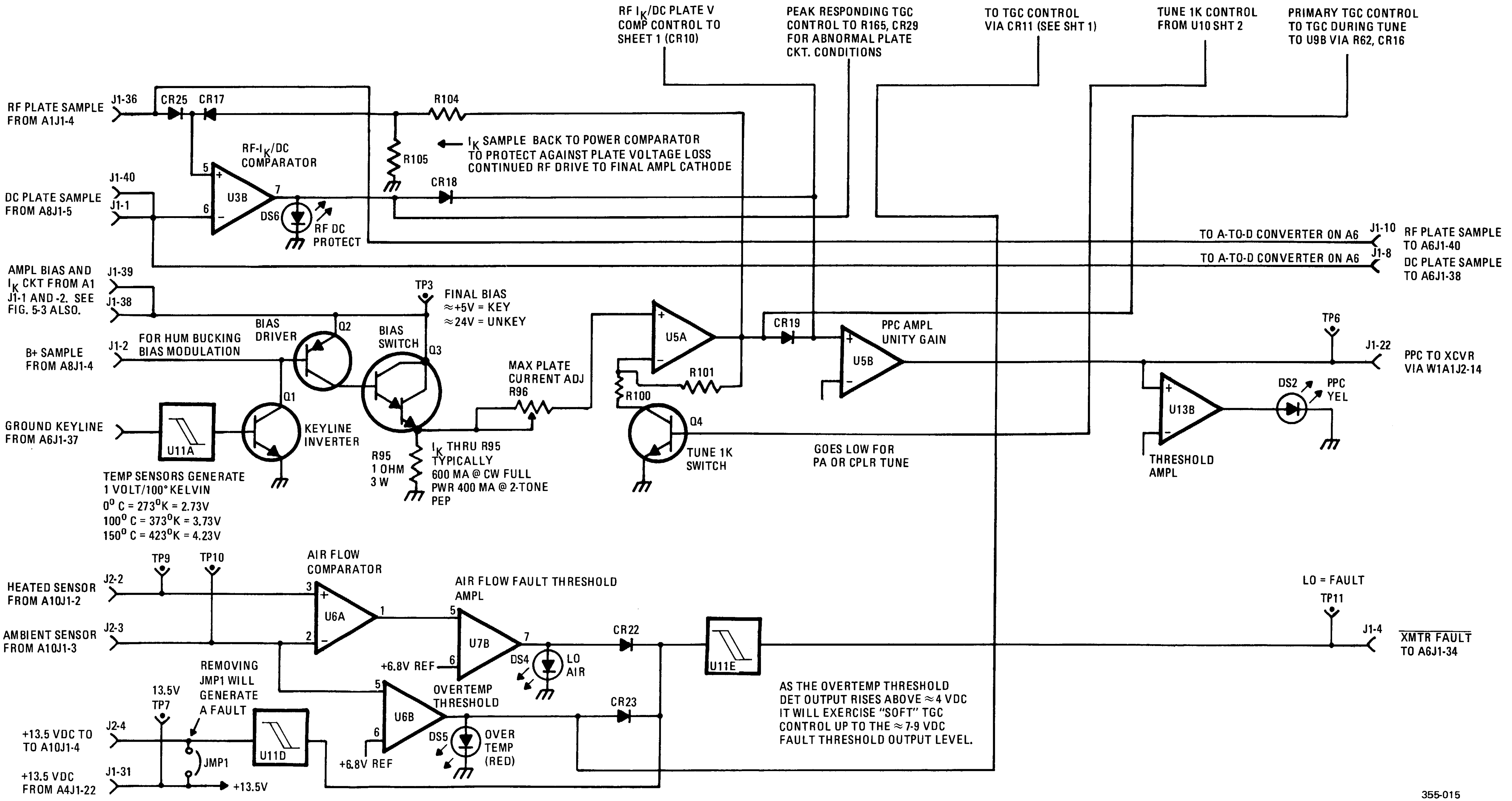


Figure FO-2. Power Control PWB Simplified (Sheet 2 of 2).

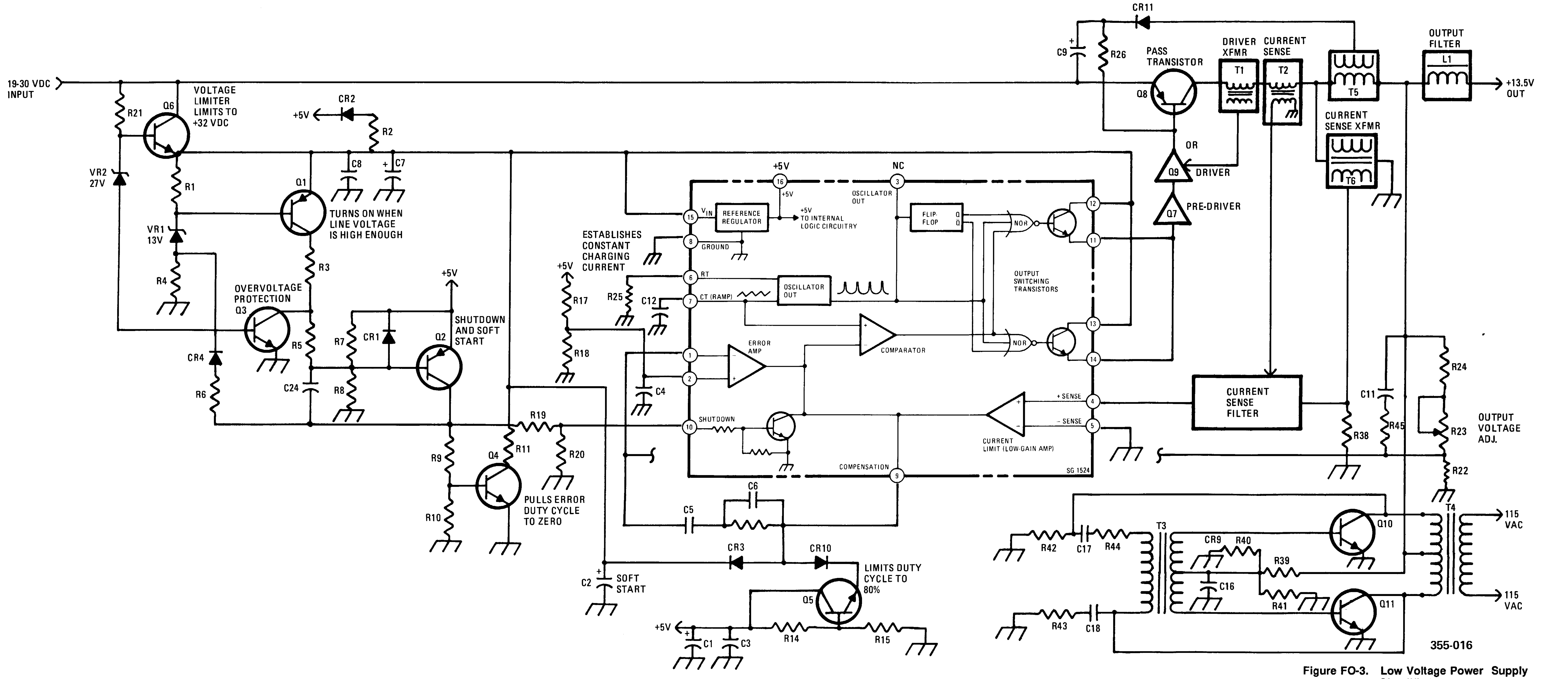
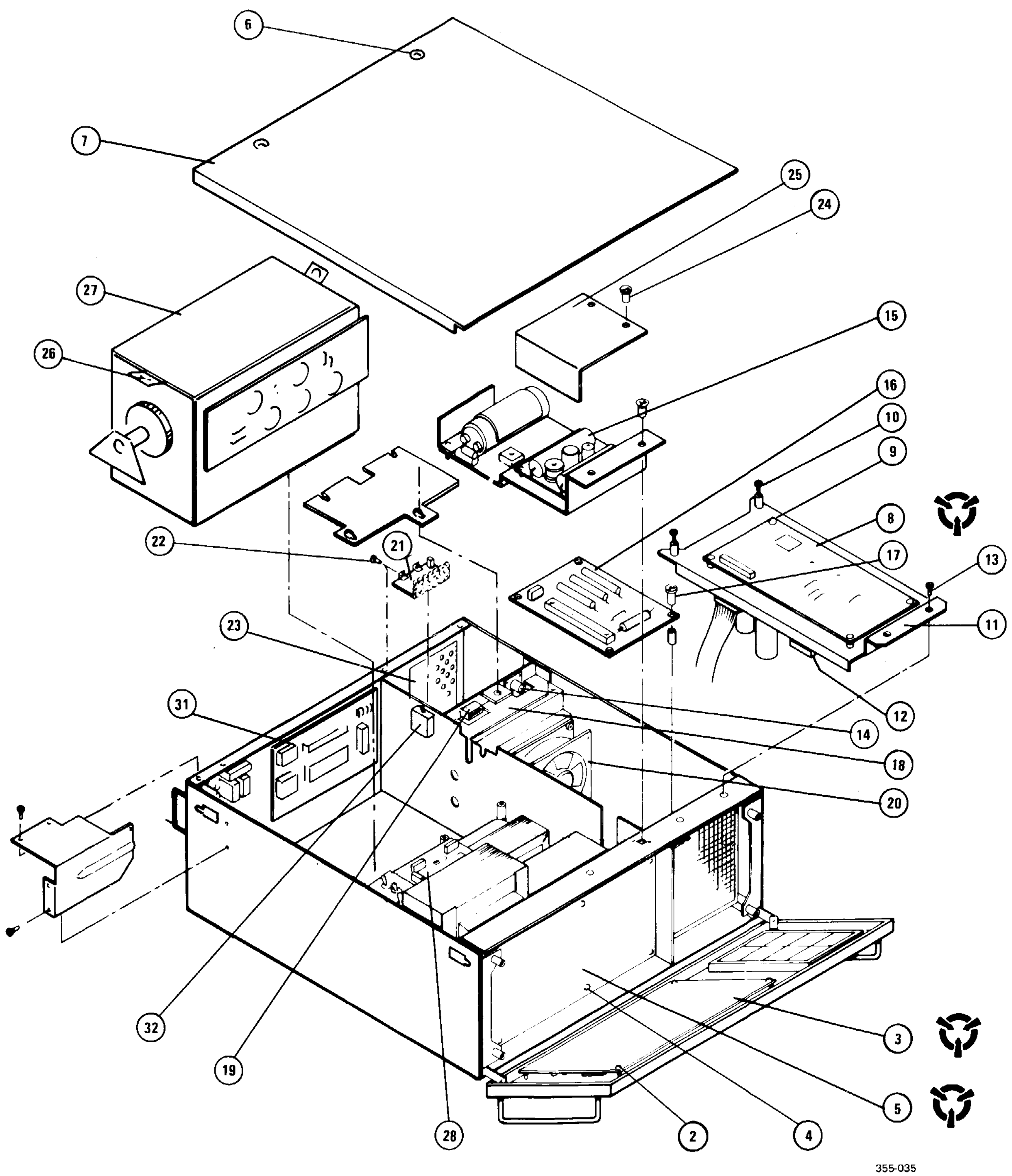


Figure FO-3. Low Voltage Power Supply Simplified

B



A

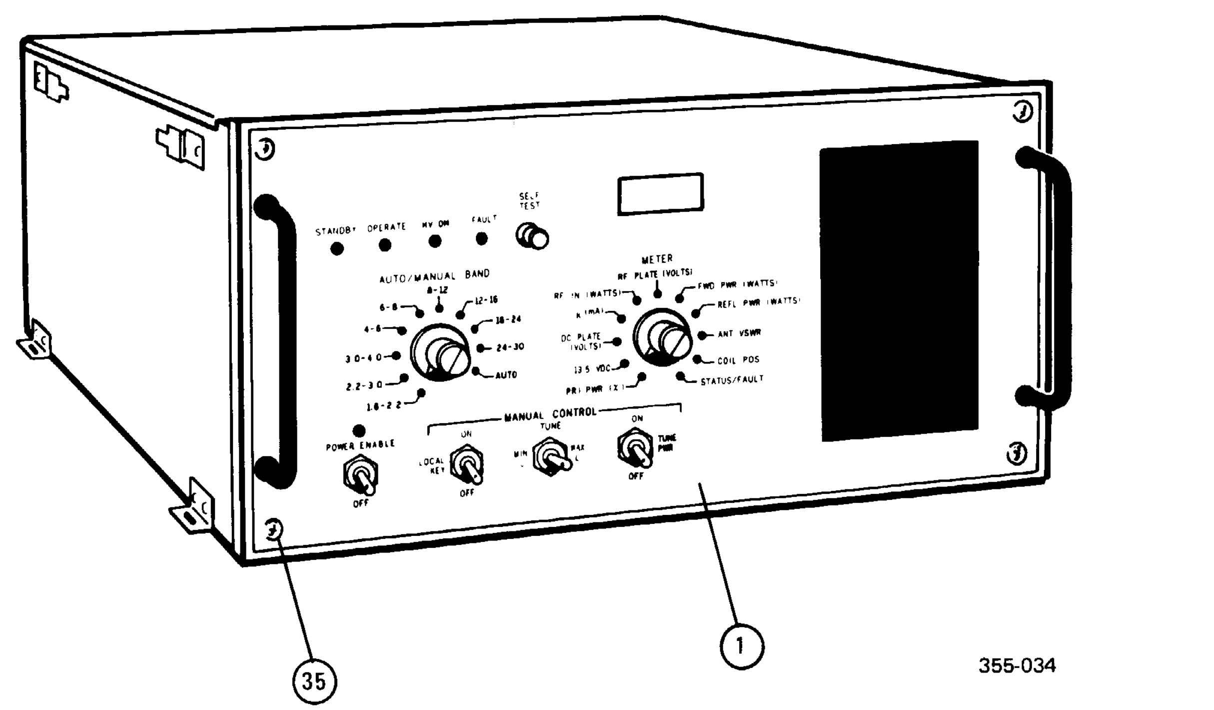


Figure FO-4. Component Location Diagram

NOTE: UNLESS OTHERWISE SPECIFIED:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN FOR DETAIL PARTS. PREFIX THESE WITH UNIT NO. AND/OR ASSEMBLY DESIGNATIONS SHOWN ON DRAWING TO OBTAIN COMPLETE DESIGNATIONS.
2. ALL RESISTOR VALUES ARE IN OHMS, 1/4W, ±5%.
3. ALL CAPACITOR VALUES ARE IN MICROFARADS (UF).
4. ALL INDUCTANCE VALUES ARE IN MILLIHENRIES (MH).
5. VENDOR PART NO. CALLOUTS ARE FOR REFERENCE ONLY. COMPONENTS ARE SUPPLIED PER PART NO. IN PARTS LIST.
6. DC RESISTANCES OF INDUCTIVE ELEMENTS (CHOKES, COILS, MOTOR WINDINGS, ETC.) ARE LESS THAN 1 OHM.
7. PANEL DECALS ARE INDICATED BY BOLD TYPE IN A BOLD BOX, E.G., **ON/OFF**
8. ALL RELAYS ARE SHOWN IN THE DE-ENERGIZED STATE.

HIGHEST REFERENCE DESIGNATION				
REFERENCE DESIGNATIONS NOT USED				

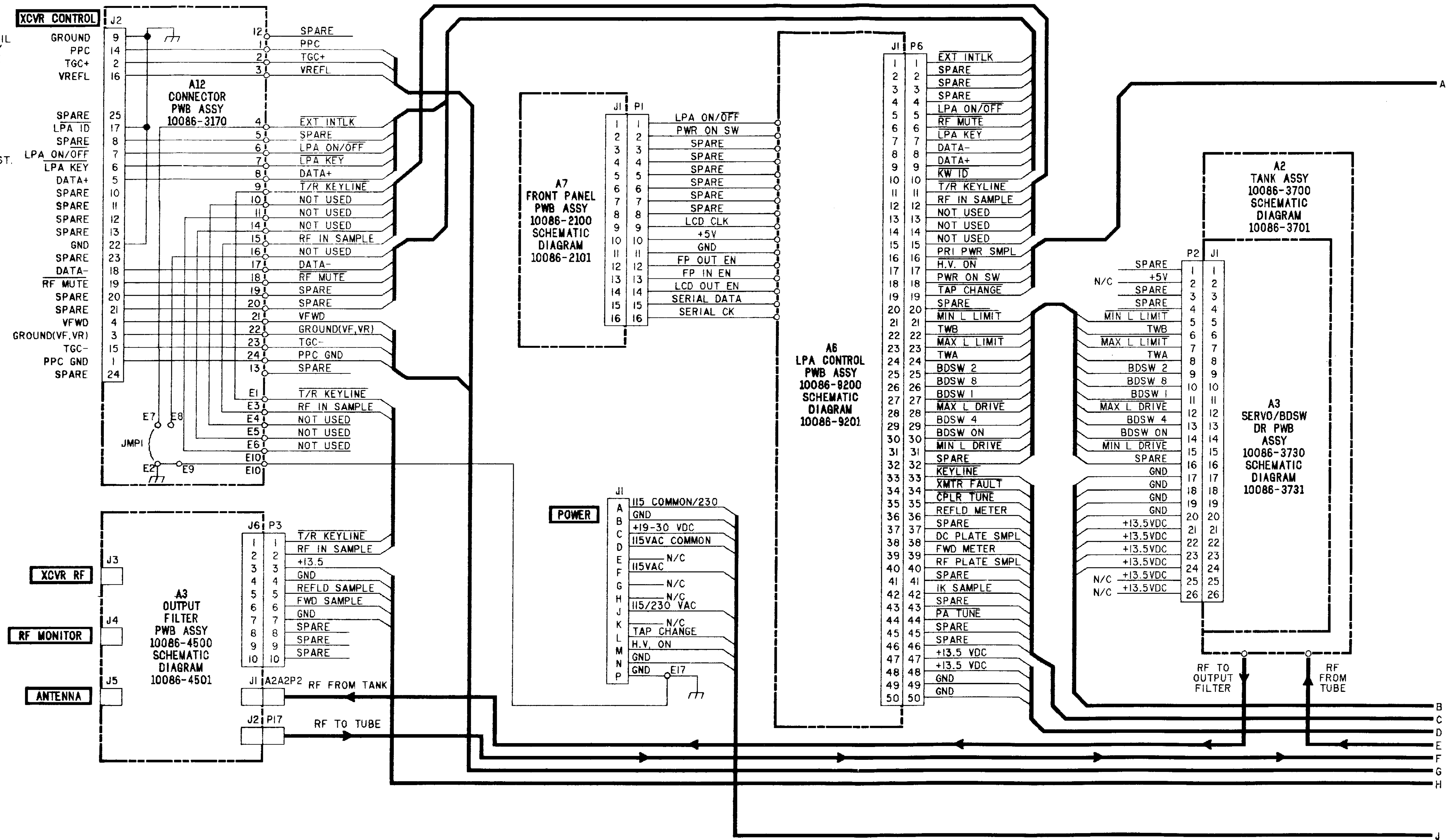


Figure FO-5. Interconnection Diagram (Sheet 1 of 2).

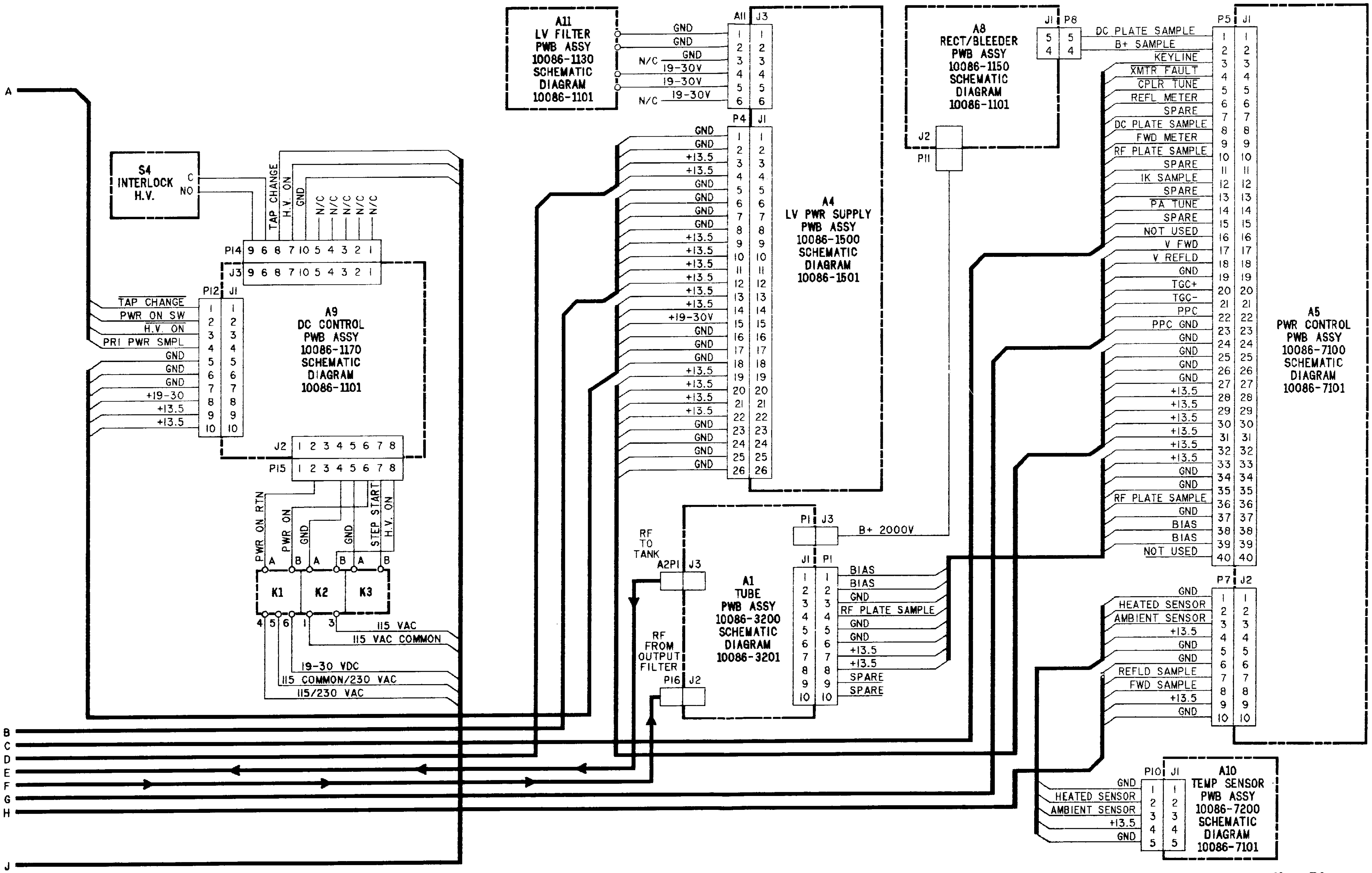


Figure FO-5. Interconnection Diagram (Sheet 2 of 2).