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FM-250C IPA
250 WATT
FM Amplifier
Instruction Manual

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FM-250 IPA. 250 WATT FM Amplifier
Instruction Manual

Broadcast Electronics
Product Warranty (Two-Year Limited)

BE hereby warrants all new products manufactured by BE against any defects in material or workmanship at the time of delivery thereof, or that develop under normal use within a period of two (2) years from the date of shipment.

BE reserves the right to repair equipment under warranty wit h new or refurbished equipment or parts. BE's sole responsibility with respect to any equipment or parts not conforming to this warranty is to replace or repair such equipment upon the return thereof F.O.B. to BE's factory in Quincy, Illinois, U.S.A. In the event of replacement pursuant to the foregoing warranty, only the unexpired portion of the warranty from the time of the original purchase will remain in effect for any such replacement.

This warranty shall exclude the following products, component parts and/or assemblies:

(a) IPA unit power output tubes shall only carry the original manufacturers' or suppliers' standard warranty in effect on their original shipment date.

(b) All computers, computer peripherals, cables, hard disk drives, etc., shall only carry the manufacturers' or suppliers' standard warranty in effect on their original shipment date.

(c) "Components", defined as separate and individual parts (e.g. transistors, integrated circuits, capacitors, resistors, inductors, fans, etc), resold by BE from another manufacturer or supplier, shall only carry a 90 day warranty, effective the date of shipment. Any such 'Components' being returned for warranty claim must be (1) returned in their original packaging and (2) must be in new, unused condition.
BE is unable to process or resolve component defects or performance concerns on components that have been soldered, installed, wired or in any way altered from new their new condition.

(d) "Resale Equipment", defined as equipment purchased from another manufacturer or supplier, then resold by BE, shall only carry such manufacturers' or suppliers' standard warranty in effect as of the original shipment date. All warranty claims against any and all 'resale equipment' sold by BE must be filed directly with the original equipment manufacturer. BE is unable to process or resolve equipment defects or performance concerns on products or services not manufactured by BE.

This warranty shall not extend to claims resulting from any acts of God, terrorism, war, defects or failures caused by Purchaser or user abuse or misuse, operator error, or unauthorized attempts to repair or alter the equipment in any way.

Under no circumstances shall BE be responsible for indirect, incidental or consequential damages, including, but not limited to transportation costs, non-authorized repair or service costs, downtime costs, costs for substituting equipment or loss of anticipated profits or revenue incurred by Purchaser, whether based in contract, tort or for negligence or breach of statutory duty or otherwise.
The terms of the foregoing warranty shall be null and void if the equipment has been altered or repaired without specific written authorization from BE, or if not installed according to BE's instruction manuals including, but not limited to, the absence of proper grounding, surge (TVSS) protection on the AC circuit panel or proper lightning protection/grounding on all output circuits, or if equipment is operated under environmental conditions or circumstances other than those specifically described in BE's product literature or instruction manual which accompany the equipment. **The warranty shall be voided if the product or subassembly is equipped with a tamper seal and that tamper seal is broken.** BE shall not be liable for any expense of any nature whatsoever incurred by the original user without prior written consent of BE.

The warranty provided herein shall terminate at the end of the period set forth above. This warranty extends only to the original Purchaser and is not transferable. There are no third party beneficiaries of any of the provisions of this warranty. If the equipment is described as “used” equipment, it is sold as is and where is and no warranty applies unless authorized in writing.

EXCEPT AS SET FORTH HEREIN, AS TO TITLE AND AS SPECIFICALLY REQUIRED BY LAW, THERE ARE NO OTHER WARRANTIES, OR ANY AFFIRMATIONS OF FACT OR PROMISES BY BE, WITH REFERENCE TO THE EQUIPMENT, OR TO MERCHANTABILITY, FITNESS FOR A PARTICULAR APPLICATION, SIGNAL COVERAGE, INFRINGEMENT, OR OTHERWISE, WHICH EXTEND BEYOND THE DESCRIPTION OF THE EQUIPMENT ON THE FACE HEREOF.

IMPORTANT INFORMATION

EQUIPMENT LOST OR DAMAGED IN TRANSIT -

When delivering the equipment to you, the truck driver or carriers' agent will present a receipt for your signature. Do not sign it until you have:

1) Inspected the containers for visible signs of damage and 2) Counted the containers and compared with the amount shown on the shipping papers. If a shortage or evidence of damage is noted, insist that notation to that effect be made on the shipping papers before you sign them.

Further, after receiving the equipment, unpack it and inspect thoroughly for concealed damage. If concealed damage is discovered, immediately notify the carrier, confirming the notification in writing, and secure an inspection report. This item should be unpacked and inspected for damage WITHIN 15 DAYS after receipt. Claims for loss or damage will not be honored without proper notification of inspection by the carrier.

RF PRODUCT TECHNICAL ASSISTANCE, REPAIR SERVICE, PARTS -

Technical assistance is available from Broadcast Electronics by letter, prepaid telephone or E-mail. Equipment requiring repair or overhaul should be sent by common carrier, prepaid, insured, and well protected. If proper shipping materials are not available, contact the RF Technical Services Department for a shipping container. Do not mail the equipment. We can assume no liability for inbound damage, and necessary repairs become the obligation of the shipper. Prior arrangement is necessary. Contact the RF Technical Services Department for a Return Authorization.

Emergency and warranty replacement parts may be ordered from the following address. Be sure to include the equipment model number, serial number, part description, and part number. Non-emergency replacement parts may be ordered directly from the Broadcast Electronics stock room at the number shown below.

RF TECHNICAL SERVICES -

Telephone: +1 (217) 224-9617
E-Mail: rfservice@bdcast.com
Fax: +1 (217) 224-6258

FACILITY CONTACTS -

Broadcast Electronics, Quincy Facility
4100 N. 24th St. P.O. BOX 3606
Quincy, Illinois 62305
Telephone: +1 (217) 224-9600
Fax: +1 (217) 224-6258
General E-Mail: bdcast@bdcast.com
Web Site: www.bdcast.com

PARTS -

Telephone: +1 (217) 224-9617
E-Mail: parts@bdcast.com

RETURN, REPAIR, AND EXCHANGES -

Do not return any merchandise without our written approval and Return Authorization. We will provide special shipping instructions and a code number that will assure proper handling and prompt issuance of credit. Please furnish complete details as to circumstances and reasons when requesting return of merchandise. All returned merchandise must be sent freight prepaid and properly insured by the customer.

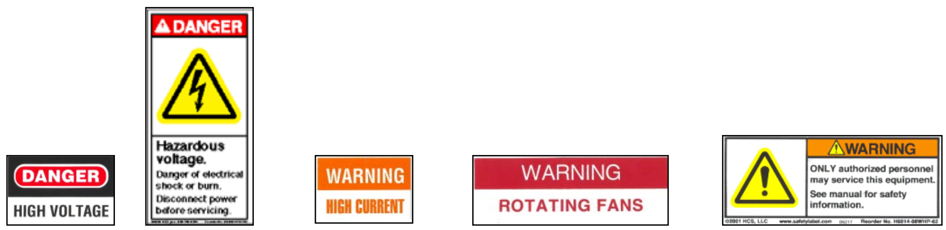
MODIFICATIONS -

Broadcast Electronics, reserves the right to modify the design and specifications of the equipment in this manual without notice. Any modifications shall not adversely affect performance of the equipment so modified.

SAFETY PRECAUTIONS

PLEASE READ AND OBSERVE ALL SAFETY PRECAUTIONS//

ALL PERSONS WHO WORK WITH OR ARE EXPOSED TO POWER TUBES, POWER TRANSISTORS, OR EQUIPMENT WHICH UTILIZES SUCH DEVICES MUST TAKE PRECAUTIONS TO PROTECT THEMSELVES AGAINST POSSIBLE SERIOUS BODILY INJURY. EXERCISE EXTREME CARE AROUND SUCH PRODUCTS. UNINFORMED OR CARELESS OPERATION OF THESE DEVICES CAN RESULT IN POOR PERFORMANCE, DAMAGE TO THE DEVICE OR PROPERTY, SERIOUS BODILY INJURY, AND POSSIBLY DEATH.



DANGEROUS HAZARDS EXIST IN THE OPERATION OF POWER TUBES AND POWER TRANSISTORS -

The operation of power tubes and power transistors involves one or more of the following hazards, any one of which, in the absence of safe operating practices and precautions, could result in serious harm to personnel.

A. **HIGH VOLTAGE** Normal operating voltages can be deadly. Additional information follows.

B. **RF RADIATION** Exposure to RF radiation may cause serious bodily injury possibly resulting in Blindness or death. Cardiac pacemakers may be affected. Additional information follows.

C. **HOT SURFACES** Surfaces of air-cooled radiators and other parts of tubes can reach temperatures of several hundred degrees centigrade and cause serious burns if touched. Additional information follows.

D. **RF BURNS** Circuit boards with RF power transistors contain high RF potentials. Do not operate an RF power module with the cover removed.

HIGH VOLTAGE –

Many power circuits operate at voltages high enough to kill through electrocution. Personnel should always break the primary AC Power when accessing the inside of the IPA unit.

RADIO FREQUENCY RADIATION

Exposure of personnel to RF radiation should be minimized, personnel should not be permitted in the vicinity of open energized RF generating circuits, or RF transmission systems (waveguides, cables, connectors, etc.), or energized antennas. It is generally accepted that exposure to “high levels” of radiation can result in severe bodily injury including blindness. Cardiac pacemakers may be affected.

The effect of prolonged exposure to “low level” RF radiation continues to be a subject of investigation and controversy. It is generally agreed that prolonged exposure of personnel to RF radiation should be limited to an absolute minimum. It is also generally agreed that exposure should be reduced in working areas where personnel heat load is above normal. A 10 mW/cm^2 per one tenth hour average level has been adopted by several U.S. Government agencies including the Occupational Safety and Health Administration (OSHA) as the standard protection guide for employee work environments. An even stricter standard is recommended by the American National Standards Institute which recommends a 1.0 mW/cm^2 per one tenth hour average level exposure between 30 Hz and 300 MHz as the standard employee protection guide (ANSI C95.1-1982).

RF energy must be contained properly by shielding and transmission lines. All input and output RF connections, such as cables, flanges and gaskets must be RF leak proof. Never operate a power tube without a properly matched RF energy absorbing load attached. Never look into or expose any part of the body to an antenna or open RF generating tube or circuit or RF transmission system while energized. Monitor the tube and RF system for RF radiation leakage at regular intervals and after servicing.

HOT SURFACES –

The power components in the IPA unit are cooled by forced-air and natural convection. When handling any components of the IPA unit after it has been in operation, caution must always be taken to ensure that the component is cool enough to handle without injury.

Table of Contents

1 Overview

Information presented by this section provides a general description of the FM-250C IPA unit features and lists equipment specifications.

1.1 RELATED PUBLICATIONS.

The following list of publications provides data for equipment and options associated with the FM-250C IPA unit.

1.2 EQUIPMENT DESCRIPTION.

The FM-250C IPA unit is available in several configurations. Refer to the following list for various IPA unit models.

MODEL	PART NO.	DESCRIPTION
FM-250C IPA	909-0251-603	FM-250C IPA, Solid State, 220V ac 50/60 Hz, 25 to 250 Watt FM IPA unit

1.3 PHYSICAL DESCRIPTION.

The FM-250C chassis is equipped with slide rails to allow easy access to all assemblies when the unit is extended from the rack see Figure 1-1. Removal and installation of assemblies within the IPA unit is facilitated by the semi modular mechanical construction. Each assembly is firmly mounted to the main chassis and electrically connected to the main wiring harness with plugs and jacks. Input and output connections are routed to a rear-panel terminal strip, BNC connectors and type N connectors.

Figure 1-1. FM-250C IPA UNIT

1.4 ELECTRICAL DESCRIPTION.

The Broadcast Electronics FM-250C IPA unit is a solid-state wideband FM IPA unit providing a continuously variable RF output from 25 to 250 watts into a 50 Ohm load at any frequency within the 87.5 to 108 MHz FM broadcast band in 10 kHz increments. A dual primary power transformer and a voltage selector allows operation from a wide range of ac input potentials.

1.4.1 METERING.

IPA unit operating parameters are monitored by a front-panel digital LCD multi-meter and an LED display. Multi-meter functions are identified by LED indicators which illuminate when a function switch is operated. The multi-meter can also be operated as a high-impedance test meter for internal measurements.

1.4.2 STATUS DISPLAYS.

The FM-250C IPA unit is designed with front-panel LEDs to indicate the status of three main IPA unit operating potentials, two preset limits.

1.4.3 CONTROL CIRCUIT.

The control circuitry provides automatic control of RF output to maintain a preset power output. In addition, the control circuitry: 1) eliminates adjustments after the initial setup and 2) protects the RF output circuitry from excessive temperatures, high VSWR conditions, high current, over-voltage conditions, and short circuit conditions.

1.4.4 RF AMPLIFIER.

The RF amplifier is a broadband 25 to 250 watt amplifier covering the entire commercial FM broadcast band. Tuning of the amplifier is not required.

1.5 EQUIPMENT SPECIFICATIONS.

Refer to Table 1-1 for electrical specifications and Table 1-2 for physical and environmental specifications of the FM-250C IPA unit.

Table 1-1. FM-250C IPA unit Specifications

PARAMETER	SPECIFICATIONS
AC INPUT POWER REQUIREMENTS	97 to 133V AC or 194 to 266V AC, 50/60 Hz.
RF OUTPUT IMPEDANCE	50 Ohms.
POWER OUTPUT	25 Watts to 250 Watts, Continuously Variable. Type “N” Female Connector.
R.F. HARMONIC AND SPURIOUS SUPPRESSION (CONDUCTED)	Meets or exceeds all FCC, DOC, and CCIR standards.
FREQUENCY RANGE	87.5 MHz to 108 MHz

Table 1-2. PHYSICAL AND ENVIRONMENTAL SPECIFICATIONS

PARAMETER	SPECIFICATION
PHYSICAL	
WEIGHT:	
UNPACKED	53 Pounds (24.0 kg).
PACKED	59 Pounds (26.8 kg).
DIMENSIONS:	
HEIGHT	7 Inches (17.78 cm).
WIDTH	19.00 Inches (48.3 cm).
DEPTH	19.00 Inches (48.3 cm).
ENVIRONMENTAL	
AMBIENT OPERATING TEMPERATURE	+32°F to +122°F (0°C to +50°C)
HUMIDITY	95% Maximum, Non-Condensing.
ALTITUDE	
50 Hz	0 to 7500 Feet (2286 m) Above Sea Level.
60 Hz	0 to 10,000 Feet (3048 m) Above Sea Level.

2 INSTALLATION

This section contains information required for installation and preliminary checkout of the Broadcast Electronics FM-250C IPA unit.

2.1 UNPACKING.

The equipment becomes the property of the customer when the equipment is delivered to the carrier. Carefully unpack the IPA unit. Perform a visual inspection to determine that no apparent damage has been incurred during shipment. All shipping materials should be retained until it is determined that the unit has not been damaged. Claims for damaged equipment must be promptly filed with the carrier or the carrier may not accept the claim.

The contents of the shipment should be as indicated on the packing list. If the contents are incomplete, or if the unit is damaged electrically or mechanically, notify both the carrier and Broadcast Electronics.

2.2 INSTALLATION.

Each IPA unit is assembled, operated, tested, and inspected at the factory prior to shipment and is ready for installation when received. Prior to installation, this publication should be studied to obtain a thorough understanding of the operation, circuitry, nomenclature, and installation requirements. Installation is accomplished as follows: 1) Preliminary Installation, 2) Wiring, and 3) IPA unit Checkout.

2.2.1 PRELIMINARY INSTALLATION.

ENVIRONMENTAL CONSIDERATIONS. Table 1-2 provides physical and environmental conditions which should be considered prior to FM-250C IPA unit installation.

WARNING ***ENSURE ALL IPA UNIT POWER IS DEENERGIZED BEFORE PROCEEDING.***

WARNING

AC LINE VOLTAGE PROGRAMMING. TheFM-250C IPA unit is programmed for the appropriate line voltage when shipped from the factory. Check the ac line voltage programming as follows:

Place the IPA unit on a work surface.

Remove any packing material from the outside of the IPA unit.

Refer to Figure 2-1 and ensure the ac line voltage selector module is programmed for the ac line voltage to be used (110/120V or 220/240V). The following text presents the ac line voltage programming:

LINE VOLTAGE	VOLTAGE SELECTOR PROGRAMMING
97-133V	100V/120V
194-266V	220V/240V

If an alternate ac line voltage is required, remove the ac line voltage selector module with a small flat lade screwdriver. Re-insert the selector module so that the correct ac line voltage arrow is aligned with the arrow on the receptacle.

Ensure the line fuse and spare fuse are both slow-blow types and rated at 10.0 amperes for the 97 to 133 volt range or 5.0 amperes for the 194 to 266 volt range.

PLACEMENT. The FM-250C IPA unit may be installed in any convenient location in a 19 inch (48.3 cm) rack within reach of signal and power cables. The unit requires a 7 inch (17.78 cm) vertical space in a 19 inch rack. The IPA unit should not be installed directly above or below heat generating equipment, otherwise no special requirements need be observed.

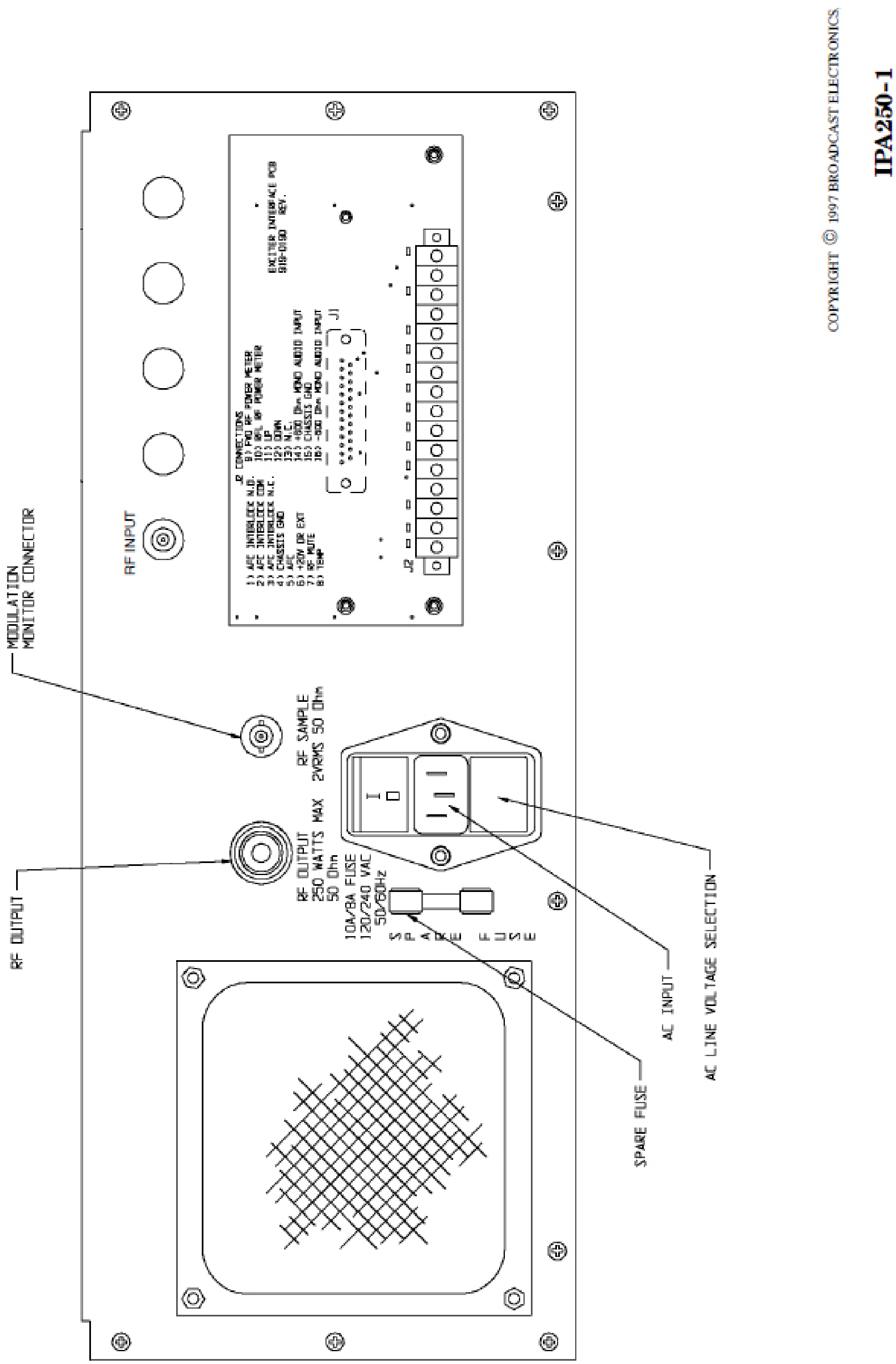


Figure 2-1. FM-250C IPA REAR-PANEL CONNECTIONS

SLIDE-RAIL INSTALLATION AND IPA UNIT MOUNTING. The IPA unit is designed to be mounted in a rack using slide rails. To install the slide rails, proceed as follows:

A. Locate the slide rail mounting brackets and the movable portion of each slide rail in the accessory kit.

B. Refer to Figure 15-1, DRAWINGS and secure the slide rail mounting brackets to the respective side of the rack cabinet with the hardware supplied.

CAUTION ***ENSURE THE SLIDE RAILS ARE PARALLEL TO EACH OTHER AND LEVEL BEFORE DRILLING ANY HOLES TO MOUNT THE REAR OF THE SLIDE RAILS.***

CAUTION

C. Secure the movable portion of the slide rail to the mounting brackets with the hardware supplied.

D. After the slide rails are mounted, lift the IPA unit over the slide stops and onto the rails. Push the IPA unit into the rack.

OPTION PROGRAMMING. The FM-250C IPA unit is equipped with several programmable options. Refer to Figure 2-2 and the following text and program the options as desired.

Pull the IPA unit forward until the slide rail stops are encountered.

Loosen the eight turn-lock fasteners on the top of the IPA unit and remove the top cover.

Remove any packing material from the inside of the IPA unit.

Check the programming of the switches and jumpers on the power control circuit board as follows:

1. Check the programming of NORM-EXT switch S1. Not used.
2. Check the programming of POS-MUTE-NEG switch S2. Not used.
3. Check the programming of rear-panel/DAC power control header J6. Not used.
4. Check the programming of remote reflected power/P.A. temperature header J8. Ensure J8 is programmed: 1) in position 1-2 for reflected power indications to be displayed by the RFL switch on the IPA unit multi-meter or 2) in position 2-3 for P.A. temperature indications to be displayed by the RFL switch on the IPA unit multi-meter (used for diagnostics only). The IPA unit is factory programmed for reflected power indications.
5. Check the programming of operation/test power control header J7. Ensure J7 is programmed: 1) in position 1-2 for normal power control operation or 2) in position 2-3 for test power control operation. The IPA unit is factory programmed for normal power control operation.

WARNING ***ENSURE ALL SYSTEM POWER IS DISCONNECTED BEFORE PROCEEDING.***

WARNING

2.3 WIRING.

RF OUTPUT. The FM-250C IPA unit is equipped with a Type N RF output connector. Refer to Figure 2-1 and connect a coaxial cable (located in the accessory kit) between the RF OUTPUT connector on the IPA unit rear-panel and a 50 Ohm RF load capable of dissipating the output of the IPA unit.

WARNING ***ENSURE THE EXCITER CASE ISCONNECTED TO EARTH GROUND.***

WARNING

GROUND. Ensure a ground wire is connected from TB1-4 on the IPA unit rear-panel terminal board to earth ground. Connect the terminal to earth ground using 18 gauge wire.

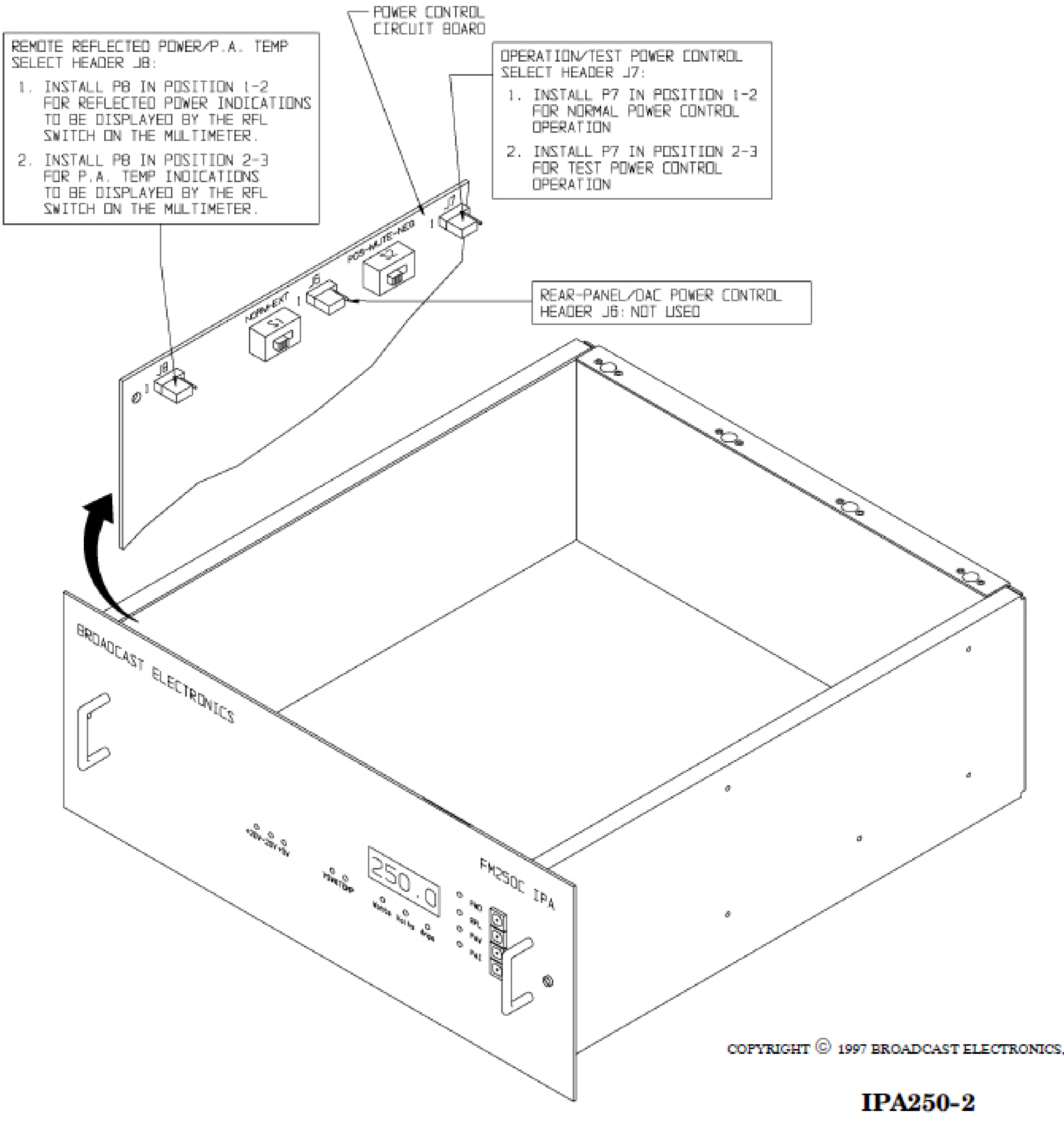


Figure 2-2. FM-250C IPA COMPONENT LOCATION DIAGRAM

RF INPUT CONNECTION. The RF input is located at the RF IN receptacle on the rear-panel. The input requires approximately 6.5 watts of drive for a 250 watt output. Connect the RF input signal to the RF IN receptacle using a coaxial cable.

REMOTE METERING. Temperature, forward power, and reflected power can be monitored from a remote location if desired. If remote metering is desired, refer to the following text.

Over–Temperature Indicator. The over-temperature indicator will output a HIGH (+18V dc) when the RF amplifier heat-sink temperature exceeds 85°C. Connect the wiring to J2-8.

Remote Forward/Reflected Power Metering. The forward power meter indication will provide a 2V dc signal to indicate a 250 watt forward power output. The reflected power meter in-dication will provide a 2V dc signal to indicate a 10 watt reflected power output. Connect the remote metering to J2-9/J2-10.

2.4 IPA UNIT CHECKOUT.

Before proceeding, check the following:

A. Ensure primary power is properly programmed.
B. Ensure the chassis ground connection is secure.
C. Ensure all signal inputs are secure.
D. Ensure the RF output is properly connected.
E. Ensure all external cabling is properly dressed and secured.

2.4.1 PRIMARY AC POWER.

CAUTION ***THE PRIMARY AC POWER USED MUST BE THE SAME AS DISPLAYED ON THE AC LINE VOLTAGE SELECTOR MODULE.***

CAUTION

The IPA unit requires approximately 10.0 amperes for the 97 to 133 volt range or 5 amperes for the 194 to 266 volt range. Connect the IPA unit to an appropriate power source with the power cord provided.

2.4.2 INITIAL OPERATION.

To initially operate the IPA unit, perform the following procedure.

Operate the rear-panel on/off switch to ON. When ac power is applied to the unit, the following events will occur.

A. The fan will begin to operate.

B. The +20V, -20V, and +5V status indicators will illuminate.

C. The multi-meter WATTS and FWD indicators will illuminate.

Depress the multi-meter PAV switch.

A. The multi-meter VOLTS and PAV indicators will illuminate.

B. The multi-meter will indicate a potential within the range of 0 volts to +0.5 volts (assuming an RF output power of less than 1 Watt).

Depress the multi-meter PAI switch.

A. The multi-meter AMPS and PAI indicators will illuminate.

B. The multi-meter will indicate approximately 0 amperes (assuming an RF output power of less than 1 Watt).

Depress the multi-meter FWD switch.

A. Extend the IPA unit forward on the slide rails to expose the R.F. POWER OUTPUT ADJ. control access hole in the left side of the top cover.

B. Using an insulated adjustment tool, adjust the IPA unit output power to the desired level.

WARNING

DISCONNECT IPA UNIT PRIMARY POWER BEFORE PROCEEDING.

WARNING

Disconnect ac primary power from the IPA unit.

Disconnect the RF load and connect the IPA unit output to the antenna or PA input.

3 OPERATION

This section identifies all controls and indicators associated with the FM-250C IPA unit and provides standard operating procedures.

3.1 CONTROLS AND INDICATORS.

Refer to Figure 3-1 for the location of all controls and indicators associated with normal operation of the FM-250C IPA unit. The function of each control or indicator is described in Table 3-1.

3.2 OPERATION.

NOTE THE FOLLOWING PROCEDURE ASSUMES THAT THE IPA UNIT IS COMPLETELY INSTALLED AND IS FREE OF ANY DISCREPANCIES. NOTE

3.2.1 TURN ON.

Operate the rear-panel as power switch to ON. The following events will occur:

A. The flushing fan will operate.

B. The +20V, -20V, and +5V operating voltage status indicators will immediately illuminate.

C. The multi-meter will be operated to the forward power function and indicate a previously adjusted RF output level.

Operate the multi-meter forward switch to illuminate the FWD indicator and record the multi-meter output power indication.

Operate the multi-meter reflected switch to illuminate the RFL indicator and record the multi-meter reflected power indication.

The forward and reflected power indications may be converted to a VSWR ratio using Table 3-2. To use the table, divide the multi-meter reflected power indication by the multi-meter forward power indication. Locate the quotient in the POWER RATIO column. The VSWR is listed across from the POWER RATIO entry.

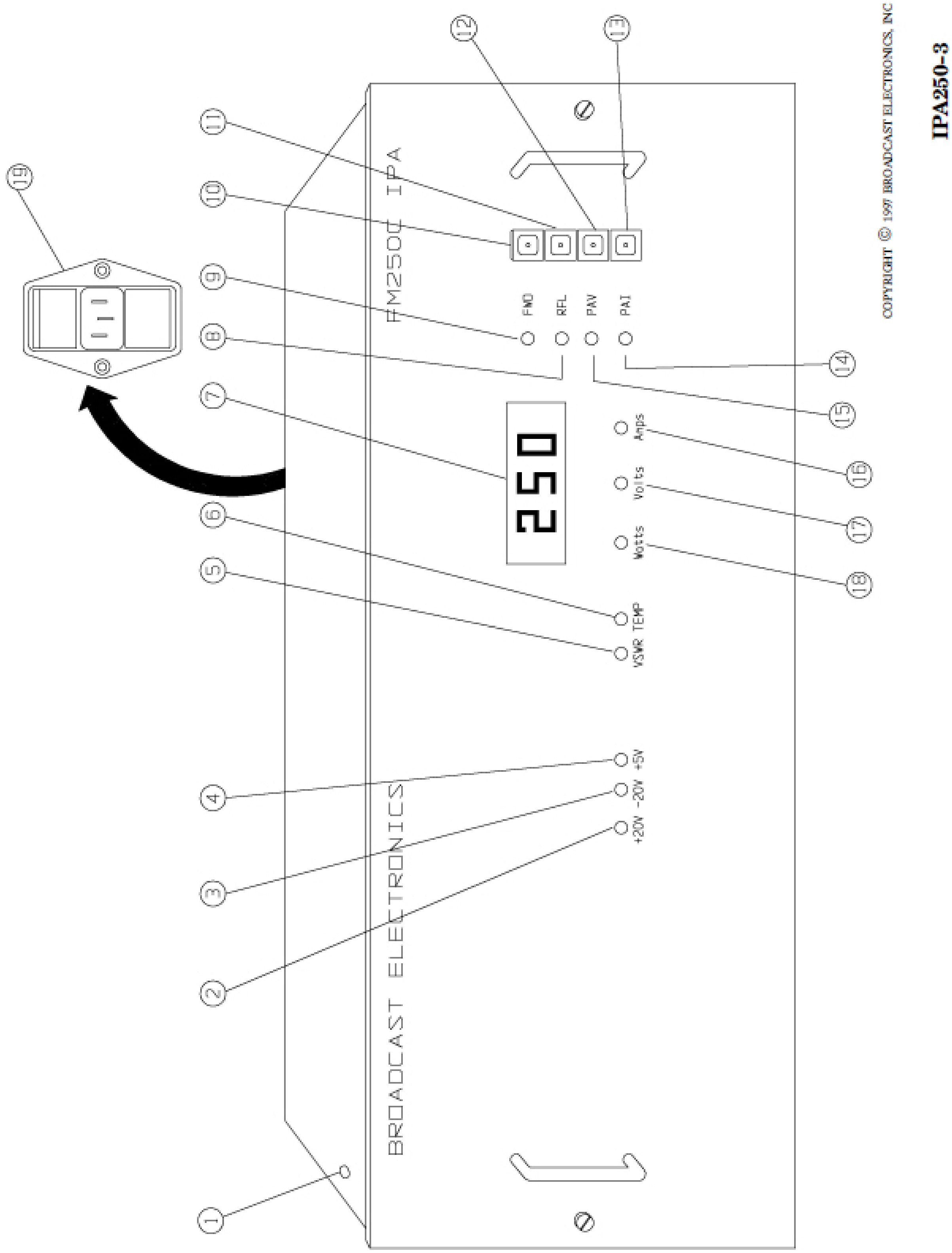


Figure 3-1. FM-250C IPA UNIT CONTROLS AND INDICATORS

Table 3-1. FM-250C/E CONTROL AND INDICATORS

ITEM NO.	NOMENCLATURE	FUNCTION
1	RF Power Output Level Control	Adjusts IPA unit RF output level. CW adjustment increases output level.
2	+20V Status Indicator	Illuminates to indicate the presence of the +20 volt operating potential.
3	-20V Status Indicator	Illuminates to indicate the presence of the -20 volt operating potential.
4	+5V Status Indicator	Illuminates to indicate the presence of the +5 volt operating potential.
5	VSWR Status Indicator	Illuminates to indicate reflected power exceeds 10 watts.
6	TEMP Status Indicator	Illuminates to indicate the RF amplifier heat-sink temperature exceeds a preset limit.
7	Multi-meter LCD Display	Indicates units of voltage, power, or current as selected by the multi-meter switches.
8	RFL Multi-meter Indicator	Illuminates to indicate the reflected power multi-meter function is selected.
9	FWD Multi-meter Indicator	Illuminates to indicate the forward power multi-meter function is selected.
10	FWD Multi-meter Switch	Selects the forward power multi-meter function when depressed.
11	RFL Multi-meter Switch	Selects the reflected power multi-meter function when depressed.
12	PAV Multi-meter Switch	Selects the PA voltage multi-meter function when depressed.
13	PAI Multi-meter Switch	Selects the PA current multi-meter function when depressed.
14	PAI Multi-meter Indicator	Illuminates to indicate the PA current multi-meter function is selected.
15	PAV Multi-meter Indicator	Illuminates to indicate the PA voltage multi-meter function is selected.
16	Amps Multi-meter Unit Indicator	Illuminates when the multi-meter indicates units of current.
17	Volts Multi-meter Unit Indicator	Illuminates when the multi-meter indicates units of voltage.
18	Watts Multi-meter Unit Indicator	Illuminates when the multi-meter indicates units of power.

19	AC Power ON/OFF Switch	Provides primary AC power control for the IPA unit.

Table 3-2. POWER/VSWR CONVERSION

Reflected Power in Watts = POWER RATIO Forward Power in Watts	VSWR
0.000	1.0:1
0.002	1.1:1
0.008	1.2:1
0.017	1.3:1
0.028	1.4:1
0.040	1.5:1
0.053	1.6:1
0.074	1.75:1
0.111	2.0:1
0.183	2.5:1
0.250	3.0:1
0.360	4.0:1

4 THEORY OF OPERATION

This section presents overall theory of operation for the FM-250C IPA unit.

For the purpose of explaining the FM-250C IPA unit circuitry, the IPA unit is divided into functional subassemblies. A detailed description of each subassembly is presented in Part II of this manual. A block diagram of the FM-250C IPA unit is presented in Figure 4-1.

4.1 FUNCTIONAL DESCRIPTION.

4.1.1 POWER SUPPLY CIRCUIT.

Primary ac power is applied to the IPA unit through a combination voltage selector, line filter, fuse holder, and on/off switch module. This device provides: 1) on/off control of the primary ac power, 2) overload protection for the entire IPA unit, 3) allows selection of a wide range of ac input potentials, and 4) RFI filtering. Power from the selector/filter/switch module is applied to a power transformer.

All dc potentials for IPA unit operation are generated by a power supply circuit board. The circuit board is equipped with two switching power supply circuits. One circuit provides the RF amplifier circuitry on the RF amplifier assembly with a variable 0 to +48V main PAV supply. The supply contains overvoltage, over-current, under-voltage, short-circuit, and over-temperature protection circuitry.

The second switching power supply circuit provides potentials of ±20 volts, ±15 volts, and +5 volts. The regulated supplies are full wave rectified, filtered, and electronically regulated to assure stable equipment operation. They are protected from overvoltage, over-current, reverse voltage, and short-circuit conditions and distributed throughout the IPA unit to various subassemblies. Front-panel LEDs provide status indication of the +20 volt, -20 volt, and +5 volt operating potentials.

4.1.2 POWER CONTROL CIRCUIT.

The circuitry on the power control circuit board regulates the operation of the RF amplifier within preset limits dependent upon several parameters such as forward RF power output, reflected power, RF amplifier heat sink temperature, dc current, and dc supply voltage. The circuit board contains forward/reflected power amplifiers, over temperature circuitry, over current circuitry, and VSWR circuitry.

The control circuit monitors temperature, PA current, and VSWR conditions. The forward/ reflected power amplifiers provide the control circuitry with forward and reflected power samples. The over temperature circuitry monitors the total RF amplifier assembly heat sink temperature. The PA current circuit monitors the PA current for over current conditions. The VSWR circuit monitors the RF output for VSWR conditions. If a temperature, over current, or VSWR condition exceeds the reference, the circuit will automatically reduce the power output. This will maintain safe operation of the RF output transistor under the worst case conditions. If excessive VSWR exists, a front-panel VSWR indicator will illuminate. If an over-temperature condition exists, a front-panel TEMP indicator will illuminate.

4.1.3 METERING CIRCUIT.

Metering of important IPA unit operating parameters is provided by a digital multi-meter. Four steady-state parameters are selected by front-panel switches and displayed on a liquid crystal display (LCD). Additional circuitry on the metering circuit board converts the multi-meter into a high-impedance test instrument for internal voltage measurements.

4.1.4 RF AMPLIFIER ASSEMBLY.

The RF amplifier transistor is mounted on a large heat sink positioned in the direct air flow from a cooling fan. Heat sink temperature is monitored by the control circuitry. If an over-temperature condition exists, the control circuit will automatically reduce RF power to maintain safe operation of the RF devices.

The broadband characteristic of the amplifier eliminates the necessity for adjustments at any frequency within the FM band, and enhances amplifier stability under varying load conditions.

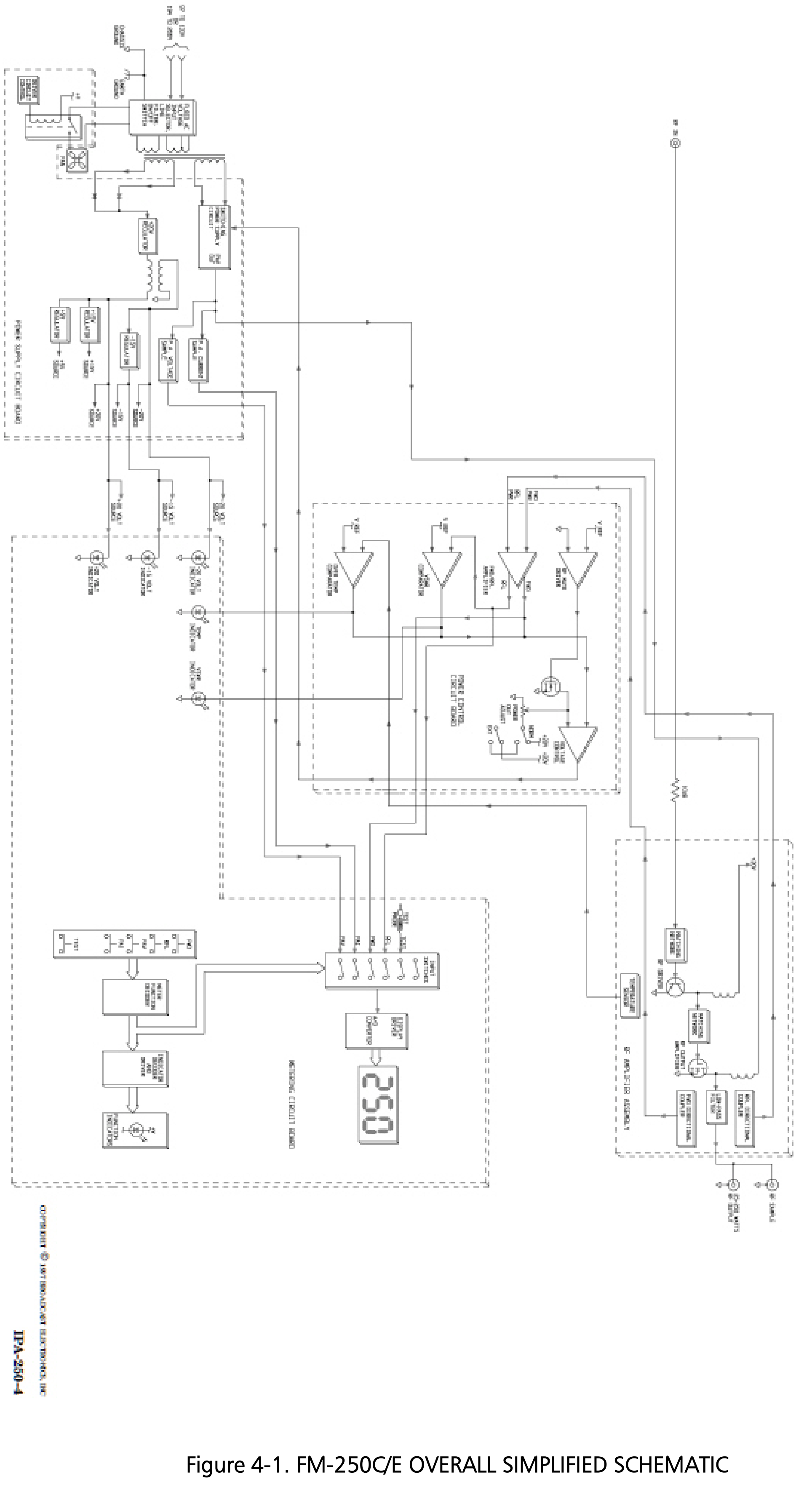


Figure 4-1. FM-250C/E OVERALL SIMPLIFIED SCHEMATIC

5 MAINTENANCE

This section provides general maintenance information, electrical adjustment procedures, and troubleshooting information for the FM-250C IPA unit.

5.1 SAFETY CONSIDERATIONS.

WARNING THE IPA UNIT CONTAINS GUARDS FOR HAZARDOUS VOLTAGES PRESENT AT THE AC LINE SELECTOR AND HIGH CURRENTS PRESENT AT THE
WARNING POWER TRANSISTORS MOUNTED ON THE RF AMPLIFIER HEAT SINK ASSEMBLY. NEVER
WARNING OPERATE THE IPA UNIT WITHOUT THE GUARDS.

WARNING

WARNING USE THE INSULATED TUNING TOOL PROVIDED FOR ANY ADJSUTMENTS AND DO NOT TOUCH ANY
WARNING COMPONENT WITHIN THE IPA UNIT WHEN POWER IS ENERGIZED.

Low voltages are used throughout the IPA unit circuitry; however, maintenance with power energized is always considered hazardous and caution should be observed. It is possible to receive minor RF burns from the high impedance points of the RF power amplifier with the IPA unit top-panel removed.

WARNING ***ENSURE ALL PRIMARY POWER IS DISCONNECTED FROM THE EXCITER BEFORE ATTEMPTING EQUIPMENT***
WARNING ***MAINTENANCE***

5.2 FIRST LEVEL MAINTENANCE.

First level maintenance consists of precautionary procedures applied to equipment to pre vent future failures. These procedures are performed on a regular basis and the results recorded in a performance log.

Periodically, the IPA unit chassis and fan filter should be cleaned of accumulated dust using a brush and vacuum cleaner. Check for overheated components, tighten loose hardware, and lubricate mechanical surfaces (such as the slide rails) as required. Check performance levels by utilizing the multi-meter functions and status indicators provided.

5.3 SECOND LEVEL MAINTENANCE.

Second level maintenance consists of procedures required to restore the FM-250C/E to operation after a fault has occurred.

The maintenance philosophy of the FM-250C IPA unit consists of problem isolation to a specific assembly. Refer to the applicable section of this manual for detail troubleshooting information to isolate a problem to specific components. If desired, the entire assembly may be returned to Broadcast Electronics for repair or replacement.

5.3.1 ADJUSTMENTS.

Adjustment procedures for all controls on all circuit boards are provided by each applicable section of this manual.

5.4 TROUBLESHOOTING.

Most troubleshooting consists of visual checks. The various IPA unit indicators (meters, LED's, and fuses) should be observed to isolate the malfunction to a specific area as listed below. Typical meter indications are presented in Table 5-1 and IPA unit power demand requirements are listed in Table 5-2.

A. Power Supply Circuit
B. Metering Circuit
C. RF Amplifier
D. Control Circuit

Table 5-1. TYPICAL METER INDICATIONS

MULTIMETER SWITCH POSITION		MULTIMETER INDICATION		
TEST				
	+20 V	+19 to +21 V DC		
	- 20 V	- 19 to -21 V DC		
	+5 V	+4.8 to +5.2 V DC		
PAV	RF POWER	**87.5 MHz**	**98.1 MHz**	**107.9 MHz**
	62 Watts	22.8 + V DC	19.6 + V DC	19.6 + V DC
	125 Watts	32.8 + V DC	28.8 + V DC	29.0 + V DC
	187 Watts	39.9 + V DC	35.2 + V DC	35.9 + V DC
	250 Watts	46.1 + V DC	40.9 + V DC	41.3 + V DC
PAI	RF POWER	**87.5 MHz**	**98.1 MHz**	**107.9 MHz**
	62 Watts	3.3 Ampere	4.5 Ampere	4.8 Ampere
	125 Watts	4.7 Ampere	5.7 Ampere	5.9 Ampere
	187 Watts	6.0 Ampere	6.6 Ampere	6.8 Ampere
	250 Watts	7.4 Ampere	7.5 Ampere	7.5 Ampere
FWD		25 to 250 Watts		
RFL		Less than 6 Watts		

Table 5-2. AC POWER REQUIREMENTS

RF POWER OUTPUT MIDBAND 98.1 MHz	AC INPUT	POWER REQUIREMENTS
250 W	230 V AC	2.9 Ampere
187 W	230 V AC	2.3 Ampere
125 W	230 V AC	1.8 Ampere
62 W	230 V AC	1.2 Ampere
250 W	121.4 V AC	4.5 Ampere
187 W	121.4 V AC	3.75 Ampere
125 W	121.4 V AC	2.97 Ampere
62 W	121.4 V AC	2.1 Ampere

DC VOLTMETER. The FM-250C/E is equipped with a high impedance voltmeter which can be employed to measure internal dc potentials. To convert the front-panel multi-meter to a dc test instrument, refer to Figure 5-1 and the following procedure.

Procedure. To convert the multi-meter to a test instrument, proceed as follows:

A. Slide the IPA unit forward and remove the top-cover.

WARNING DO NOT TOUCH ANY FEED THROUGH CAPACITORS OR COMPONENTS ON THE RF AMPLIFIER MODULE WITH POWER APPLIED.

WARNING

B. Operate the test switch/indicator on the metering circuit board assembly to illuminate the switch/indicator. All multi-meter function indicators will extinguish and the LCD display will indicate zero volts.

C. The test probe is mounted directly behind the metering circuit board inside the chassis. The test probe measures D.C. voltage.

D. To restore normal operation of the meter, depress any front-panel multi-meter function switch. Replace the top-cover.

Once the trouble is isolated, refer to the applicable section discussing the theory of operation and troubleshooting procedures for the respective assembly to assist in problem resolution. All internal components may be accessed by removing the top cover (refer to Figure 5-1).

5.5 IPA UNIT PREPARATION FOR SHIPMENT

If the IPA unit is removed from service to be shipped to another location, ensure the following steps are accomplished prior to shipping:

A. Ensure the top-cover is secured to the IPA unit.

B. Pack the IPA unit in a carton, allowing 2 inches (5.08 cm) minimum of packing material all around the IPA unit.

C. Provide adequate insurance coverage.

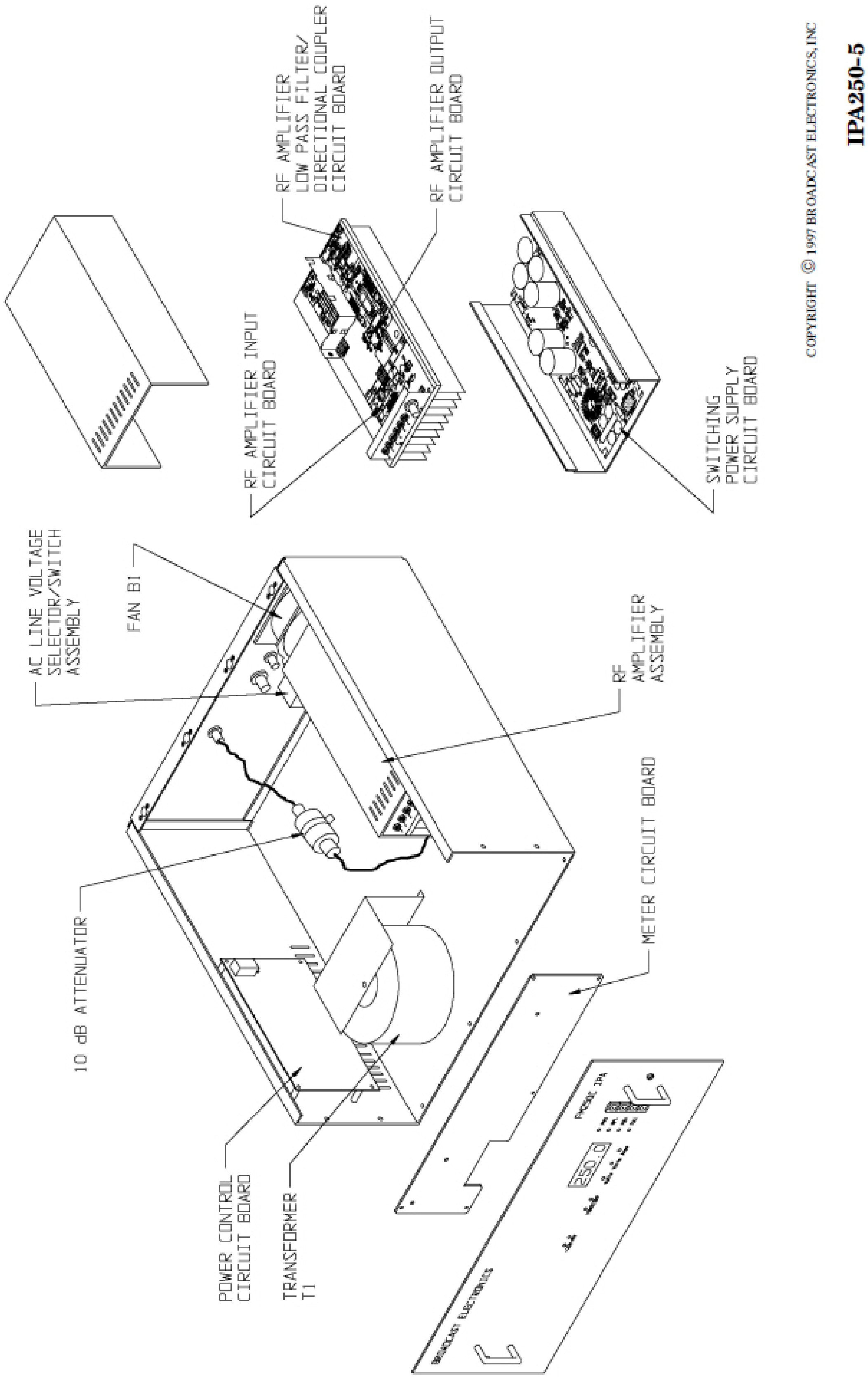


Figure 5-1. FM-250C IPA UNIT COMPONENT LOCATOR

WARNING BERYLLIUM OXIDE CERAMICS (BeO) – AVOID BREATHING DUST OR FUMES.

WARNING

WARNING PORTIONS OF THE WHITE CASE MATERIAL OF THE FM-250C IPA UNIT RF AMPLIFIER TRANSISTORS ARE MADE OF BeO CERAMIC MATERIAL. DO NOT PERFORM ANY OPERATION ON

WARNING ANY BeO CERAMIC WHICH MIGHT PRODUCE DUST OR FUMES, SUCH AS GRINGING, GRIT BLASTING, OR ACID CLEANING. BERYLLIUM OXIDE DUST OR FUMES ARE HIGHLY TOXIC AND BREATHING THEM CAN RESULT IN SERIOUS PERSONAL INJURY OR DEATH. BeO CERAMICS MUST BE DISPOSED OF ONLY IN A MANNER PRESCRIBED BY THE DEVICE MANUFACTURER. USE CARE IN REPLACING TRANSISTORS OF THIS TYPE.

COMPONENT REPLACEMENT. The circuit boards used in the FM-250C IPA unit are double-sided boards with plated-through holes. Because of the plated-through holes, solder fills the holes by capillary action. These conditions require that defective components be removed carefully to avoid damage to the board.

On all circuit boards, the adhesion between the copper trace and the circuit board fails at almost the same temperature as solder melts. A circuit board trace can be destroyed by excessive heat or lateral movement during soldering. Use of a small iron with steady pressure is required for circuit board repairs.

To remove a soldered component from a circuit board, cut the leads from the body of the defective component while the device is still soldered to the board. Grip each component lead with long nose pliers. Touch the soldering iron to the lead at the solder connection on the circuit side of the board. When the solder begins to melt, push the lead through the back side of the board and cut off the clinched end of the lead. Each lead may now be heated independently and pulled out of each hole. The holes may be cleared of solder by carefully re-heating with a low wattage iron and removing the residual solder with a soldering vacuum tool.

Install the new component and apply solder from the circuit side of the board. If no damage has been incurred to the plated-through holes, soldering of the component side will not be required.

WARNING MOST SOLVENTS WHICH WILL REMOVE ROSIN FLUX ARE VOLATILE AND TOXIC BY THEIR NATURE AND SHOULD BE USED ONLY IN SMALL AMOUNTS IN A

WARNING WELL VENTILATED AREA, AWAY FROM FLAME, INLCUDING CIGARETTES AND SOLDER IRONS.

WARNING

OBSERVE THE MANUFACTURER'S CAUTIONARY INSTRUCTIONS.

WARNING

After soldering, remove residual flux with a suitable solvent. Rubbing alcohol is highly diluted and is not effective.

The board should be checked to ensure the flux has been removed. Rosin flux is not normally corrosive; however, the flux will absorb enough moisture in time to become conductive and cause problems.

INTEGRATED CIRCUITS. Special care should be exercised with integrated circuits. Each integrated circuit must be installed by matching the integrated circuit notch with the notch on the socket. Do not attempt to remove an integrated circuit from a socket with your fingers. Use an integrated circuit puller to lightly pry the component from the socket.

6 POWER CONTROL CIRCUIT

This section provides general information and specifications relative to the operation of the power control circuit board.

6.1 DESCRIPTION.

The circuitry on the power control circuit board regulates the operation of the RF amplifier within preset limits depending on the forward power output, PA current, reflected power, VSWR, and RF amplifier assembly temperature. The circuit board is designed with forward and reflected power amplifier circuits, an over temperature protection circuit, an over current protection circuit, and a VSWR protection circuit.

6.2 THEORY OF OPERATION

This section presents the theory of operation for the FM-250C IPA power control circuit board. A simplified schematic diagram of the power control circuit board is presented in Figure 6-1.

6.2.1 FUNCTIONAL DESCRIPTION.

FORWARD/REFLECTED POWER AMPLIFIER CIRCUITS. The forward/reflected amplifier circuits provide forward and reflected power voltage samples to the power control circuit and the metering circuit board. The forward power amplifier circuit consists of amplifier U1A, forward power calibration control R4, the forward power squaring circuit, and amplifier U2B. The reflected power amplifier circuit consists of amplifier U1B, reflected power calibration control R25, the reflected power squaring circuit, and amplifier U2D.

Forward Amplifier. A dc output from the forward power directional coupler is applied to the non-inverting input of U1A. U1A is configured as an amplifier with the gain determined by forward power calibrate control R4. The output of U1A is routed to: 1) power level control header J7 and 2) forward power square circuit calibration control R7. Header J7 programs the power control circuit for normal or test operation. P7 is provided only to allow a test reference to be routed to the power control circuit during troubleshooting/test conditions. The squaring circuit consists of forward power square circuit calibration control R7 and integrated circuits U2A and U3. U2A and U3 convert the voltage sample to a power sample. The current output of the squaring circuit is routed to voltage converter amplifier U2B. U2B provides a forward power voltage sample to the metering circuit board and the remote forward power indication terminal on the IPA unit rear panel.

Reflected Amplifier. A dc output from the reflected power directional coupler is applied to the non-inverting input of U1B. U1B is configured as an amplifier with the gain determined by reflected power calibrate control R25. The output of U1B is routed to: 1) VSWR comparator U5A and 2) reflected power square circuit calibration control R28. The squaring circuit consists of reflected power square circuit calibration control R28 and integrated circuits U2C and U4. U2C and U4 convert the voltage sample to a power sample. The current output of the squaring circuit is routed to voltage converter amplifier U2D. U2D provides a reflected power voltage sample to the P.A. temp/reflected power select header J8 and the remote reflected power indication terminal on the IPA unit rear panel. Header J8 allows the selection of a reflected power or P.A. temperature signal to be routed to the metering circuit board. The jumper is programmed to select the temperature sample only during temperature troubleshooting operations.

6.2.2 P.A. TEMPERATURE CIRCUIT.

The P.A. temperature circuit provides automatic RF power reduction if the RF amplifier assembly temperature exceeds a preset level. This circuit consists of temperature sensor U2 on the RF amplifier circuit board, RF amplifier temperature amplifier U1C, over-temperature comparator U5B, and temperature LED comparator U6B.

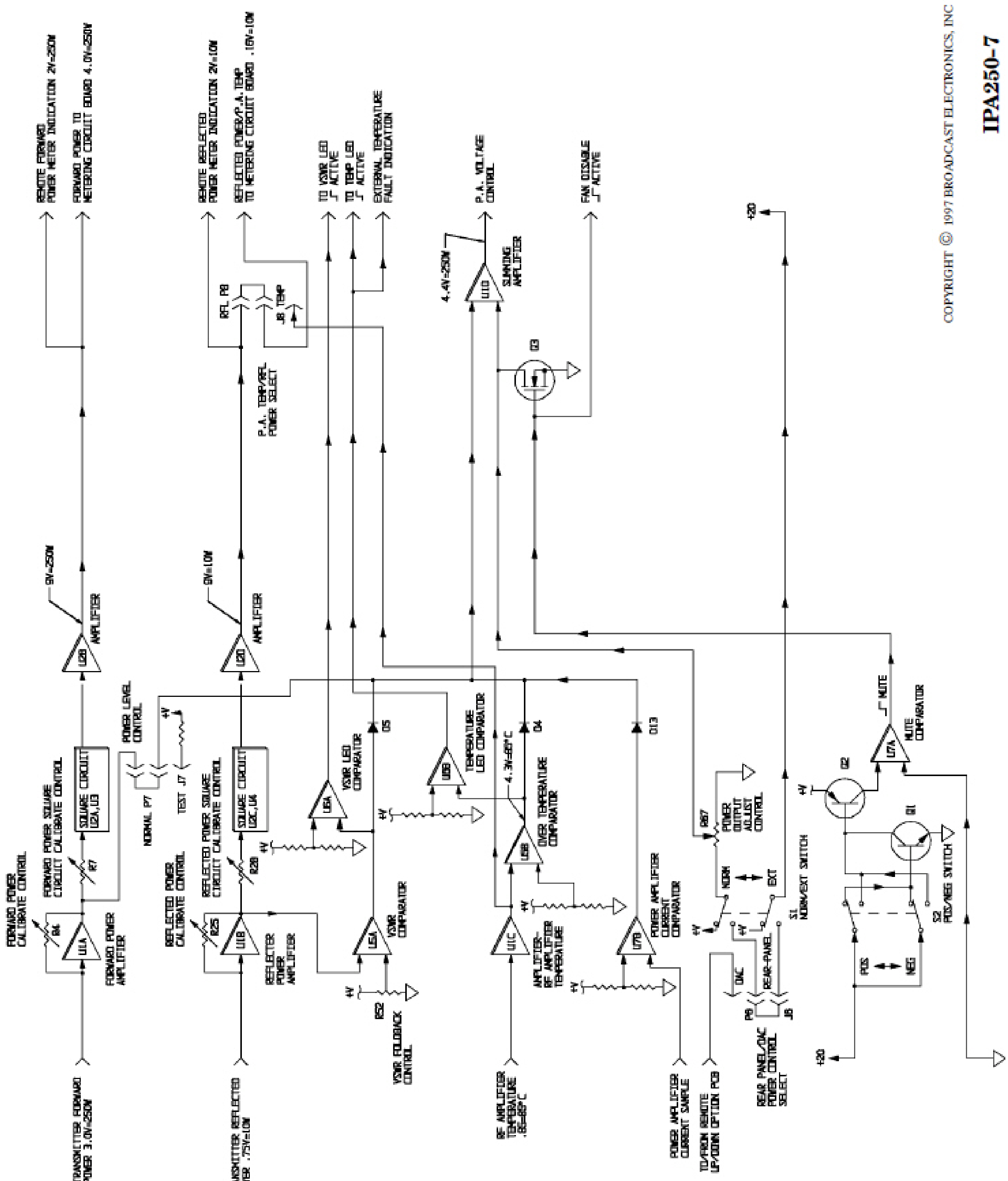


Figure 6-1. CONTROL CIRCUITRY SIMPLIFIED SCHEMATIC

The output of temperature sensor U2 on the RF amplifier circuit board is applied to non-inverting amplifier U1C. The output of U1C is applied to: 1) over temperature comparator U5B and 2) P.A. temperature/reflected power select header J8. As the RF amplifier temperature increases, the output level of temperature sensor U2 will increase. If this potential exceeds a threshold level established by a reference, U5B will route a dc voltage to the power control circuit and to temperature LED comparator U6B. Header J8 allows the selection of the P.A. temperature for troubleshooting operations.

The power control circuit will respond by creating a fold-back condition to reduce the PA control voltage. If the voltage from U5B exceeds the reference voltage at U6B, the output of U6B will go HIGH. The HIGH is routed to: 1) the metering circuit board to illuminate the TEMP LED and 2) the remote external PA temperature fault indicator.

6.2.3 P.A. CURRENT CIRCUIT.

The P.A. current is monitored for over current conditions by a comparator circuit. A current sample from the power amplifier assembly is applied to P.A. current comparator U7B. If the sample exceeds the reference, U7B will output a dc voltage to the power control circuit. The power control circuit will create a fold-back condition to reduce the PA control voltage.

6.2.4 VSWR CIRCUIT.

The IPA unit VSWR is monitored by a comparator circuit. A reflected power sample from U1B is applied to VSWR comparator U5A. If the sample exceeds the reference, U5A will output a dc voltage to the power control circuit. The power control circuit will create a fold-back condition and reduce the PA control voltage.

The output of U5A is also routed to VSWR LED comparator U6A. If the voltage from U5A exceeds the reference voltage at U6A, the output of U6A will go HIGH. The HIGH is routed to the metering circuit board to illuminate the VSWR LED.

6.2.5 POWER CONTROL CIRCUIT.

The power control circuit provides manual and automatic IPA unit power control operation. Manual power control is when the FM-250C IPA output power is controlled manually using the internal power adjust control, the optional up/ down power control panel, or an external voltage source. Automatic power control is when the FM-250C IPA output power is controlled automatically by the power control circuit. The power control circuit will automatically maintain a constant output power in response to changing load conditions. The power control circuit also responds to high VSWR, PA over-current and over temperature conditions in both the automatic and manual modes by initiating a fold-back operation. The fold-back operation reduces the IPA unit output power to protect the IPA unit circuitry during the high VSWR, PA over current, and PA over temperature conditions.

Manual Power Control Operation. Automatic/manual power control operation is established by normal/test jumper J7. When J7 is in the test position, the FM-250C IPA output power will not automatically adjust to changing load conditions. The output power must be increased/decreased manually using the power output adjust control R67.

Automatic Power Control Operation. Automatic/manual power control operation is established by normal/test jumper J7. When J7 is in the normal position, the power control circuit will automatically maintain a constant output power during changing load conditions by routing a forward power control sample to the protection circuit. The forward power sample allows the power control circuit to automatically maintain a constant RF output power.

Protection Circuitry. The protection circuitry consists of VSWR comparator U5A, PA over temperature comparator U5B, PA over current comparator U7B, and summing amplifier U1D. When a high VSWR, over temperature, or over current condition occurs, a voltage is applied to the inverting input of summing amplifier U1D. U1D will create a fold-back condition. The fold-back condition will reduce the PA control voltage and result in the reduction of the IPA unit output power. As the condition which caused the fold-back clears, U1D will respond by increasing the PA control voltage to return the IPA unit output power to normal.

6.3 MAINTENANCE

This section provides maintenance information, electrical adjustment procedures and troubleshooting information for the power control circuit board.

6.3.1 FORWARD POWER CIRCUIT CALIBRATION.

Potentiometer R4 calibrates the forward power detection circuit. Potentiometer R7 calibrates the forward power square circuit. Perform the following procedure calibrate the forward power detection and forward power square circuits.

Required Equipment. The following tools and equipment are required for the forward power calibration.

A. Insulated adjustment tool, shipped with the IPA unit (P/N 407-0083).

B. Non-inductive 250 watt 50 Ohm test load.

C. Coaxial Accessory Cable.

D. Calibrated 50 Ohm inline wattmeter.

E. Digital multi-meter, Fluke 75 or equivalent.

Procedure. To adjust forward power calibrate control R4 and forward power square circuit calibration control R7, proceed as follows:

A. The IPA unit MULTI-METER must be calibrated prior to adjusting the forward power calibration controls. Refer to MULTI-METER DISPLAY CALIBRATION in the METERING CIRCUIT section of this manual and perform the procedure to calibrate the display.

B. Apply primary power and record the front-panel FWD meter indication.

WARNING

DISCONNECT IPA UNIT PRIMARY POWER BEFORE PROCEEDING.

WARNING

C. Disconnect the IPA unit primary power.

D. Connect a 250 watt 50 Ohm test load and in-line wattmeter to the rear-panel RF OUTPUT receptacle. Refer to Figure 6-4. Configure the wattmeter for forward power operations.

E. Refer to Figure 6-3 and place jumper P7 in position 2-3.

F. Connect the digital multi-meter between TP1 and ground.

G. Apply primary power and operate the IPA unit.

WARNING

DONOT TOUCH ANY COMPONENT WITHIN THE IPA UNIT WITH POWER APPLIED.

WARNING

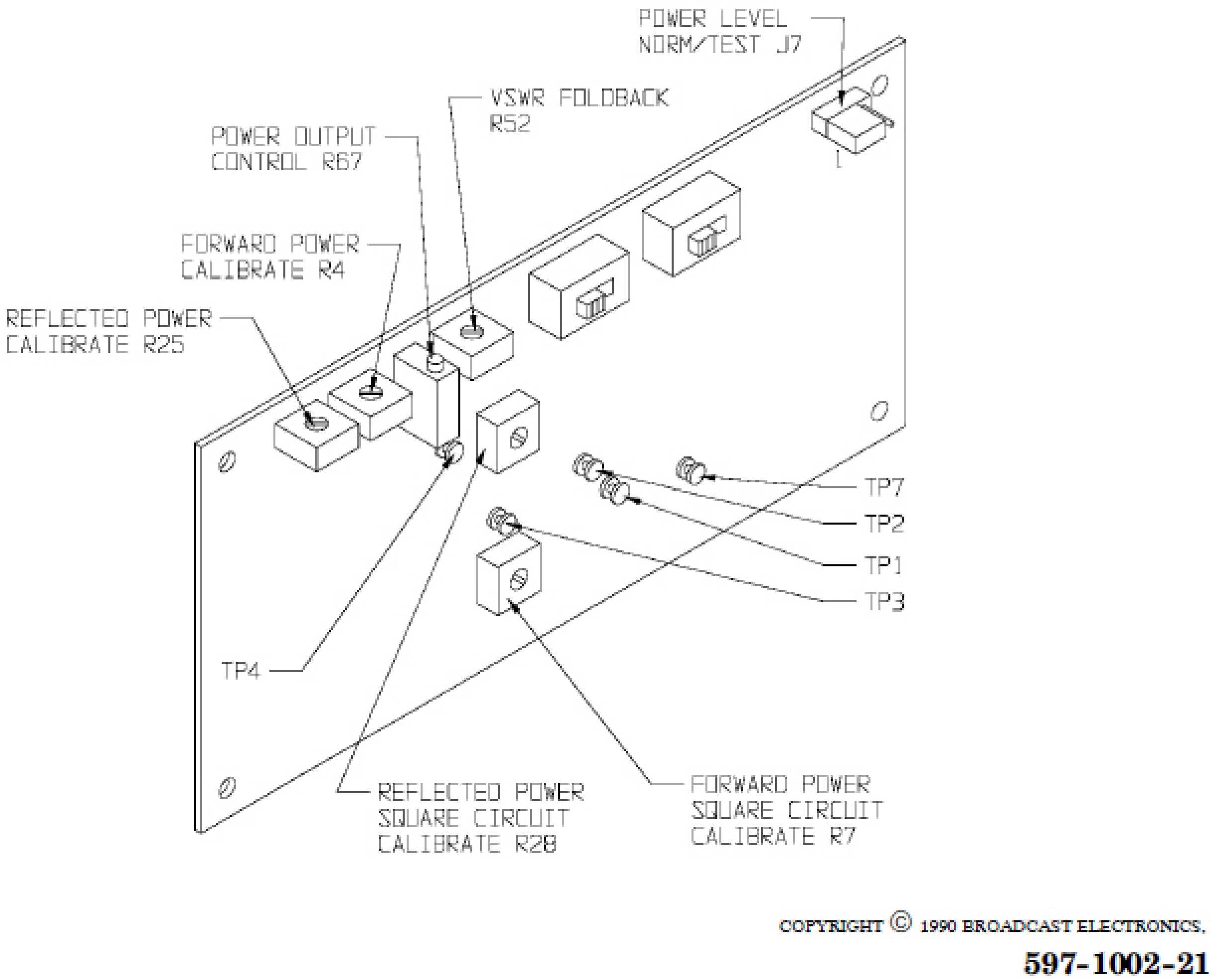


Figure 6-2. POWER CONTROL CIRCUIT BOARD CONTROLS

WARNING

DO NOT TOUCH ANY COMPONENT WITHIN THE IPA UNIT WITH POWER APPLIED.

WARNING

H. Refer to Figure 6-3 and adjust power output control R67 for a 250 watt output power indication on the external meter.

I. Refer to Figure 6-3 and adjust forward power calibrate control R4 for 3.000V at TP1.

J. Connect the digital multi-meter between TP3 and ground.

K. Check for a 9.00 volt dc multi-meter indication. If the multi-meter does not indicate 9.00 volts, refer to Figure 6-3 and adjust forward power square circuit calibrate control R7 for a 9.00 volt dc indication on the multi-meter.

L. Check for a 250 watt indication on the IPA unit multi-meter. If the IPA unit multi-meter does not indicate 250 watts, refer to Figure 6-3 and adjust forward power calibrate control R4 for a 250 watt indication on the IPA unit multi-meter.

M. Disconnect the IPA unit primary power.

N. Refer to Figure 6-3 and place jumper P7 in position 1-2.

O. Apply primary power and operate the IPA unit.

P. Refer to Figure 6-3 and adjust power output control R67 for the forward power value recorded at the beginning of the procedure.

WARNING

DISCONNECT IPA UNIT PRIMARY POWER BEFORE PROCEEDING.

WARNING

Q. Disconnect the IPA unit primary power.

R. Remove the test equipment and replace the IPA unit top-panel.

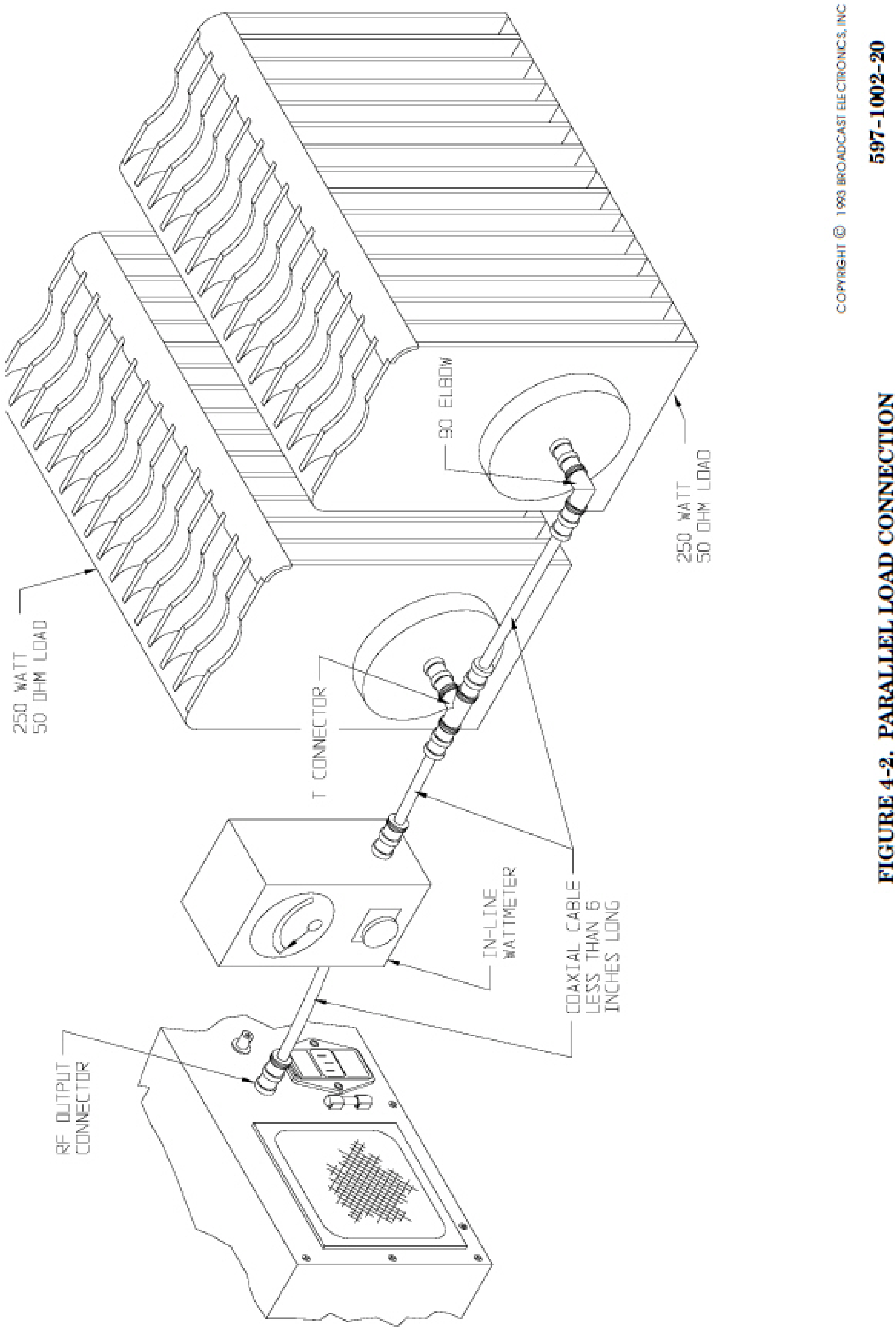


Figure 6-3. PARALLEL LOAD CONNECTION

WARNING

DONOT TOUCH ANY COMPONENT WITHIN THE IPA UNIT WITH POWER APPLIED.

WARNING

6.3.2 REFLECTED POWER CIRCUIT AND VSWR FOLDBACK CALIBRATION.

Potentiometer R25 calibrates the reflected power detection circuit. Potentiometer R28 calibrates the reflected power square circuit. Potentiometer R52 determines the level for VSWR fold-back operation. Perform the following procedure to calibrate the reflected power detection circuit, reflected power square circuit, and the VSWR fold-back level.

Required Equipment. The following tools and equipment are required for the reflected power and VSWR fold-back calibrations.

A. Insulated adjustment tool, shipped with the IPA unit (P/N 407-0083).

B. Two Non-inductive 250 watt 50 Ohm test loads.

C. Coaxial Accessory Cable.

D. Coaxial Test Cables.

E. Type N Tee.

F. Calibrated 50 Ohm inline wattmeter.

G. Digital multi-meter, Fluke 75 or equivalent.

Procedure. To adjust reflected power calibrate control R25, reflected power square circuit calibration control R28, and VSWR fold-back control R52, proceed as follows:

A. The IPA unit MULTI-METER must be calibrated prior to adjusting the reflected power circuit and the VSWR fold-back calibration controls. Refer to MULTI-METER DISPLAY CALIBRATION in the METERING CIRCUIT section of this manual and perform the procedure to calibrate the display.

B. Apply primary power and record the front-panel FWD meter indication.

WARNING

DISCONNECT IPA UNIT PRIMARY POWER BEFORE PROCEEDING.

WARNING

C. Disconnect the IPA unit primary power.

D. Refer to Figure 6-4 and connect: 1) two 250 watt 50 Ohm test loads in parallel and 2) the inline wattmeter to the RF OUTPUT receptacle as shown. Configure the wattmeter for reflected power measurements.

E. Refer to Figure 6-3 and operate power output control R67 fully counterclockwise.

F. Connect the digital multi-meter between TP2 and ground.

G. Apply primary power and operate the IPA unit.

WARNING

DONOT TOUCH ANY COMPONENT WITHIN THE IPA UNIT WITH POWER APPLIED.

WARNING

H. Refer to Figure 6-3 and adjust power output control R67 for a 10 watt reflected power indication on the external meter.

I. Refer to Figure 6-3 and adjust reflected power calibrate control R25 for a 3.000V at TP2.

J. Connect the digital multi-meter between TP4 and ground.

K. Check for a 9.00 volt dc multi-meter indication. If the multi-meter does not indicate 9.00 volts, refer to Figure 6-3 and adjust reflected power square circuit calibrate control R28 for a 9.00 volt dc indication on the multi-meter.

L. If required, readjust reflected power calibrate control R25 for a 10 watt indication on the IPA unit multi-meter.

M. Connect the digital multi-meter between TP7 and ground.

N. Refer to Figure 6-3 and adjust VSWR fold-back calibrate control R52 for a 4.3 volt indication on the multi-meter. The IPA unit front-panel VSWR indicator will illuminate. If the VSWR indicator does not illuminate, readjust VSWR fold-back calibrate control R52 slightly until the VSWR indicator just illuminates.

O. Refer to Figure 6-3 and operate power output control R67 fully counterclockwise.

WARNING

DISCONNECT IPA UNIT PRIMARY POWER BEFORE PROCEEDING.

WARNING

P. Disconnect the IPA unit primary power.

Q. Disconnect all test equipment.

R. Connect a single 50 Ohm 250 watt load and inline wattmeter to the IPA unit RF OUTPUT receptacle as shown. Configure the wattmeter for forward power measurements.

S. Depress the front-panel FWD meter function switch.

T. Apply power and operate the IPA unit.

U. Refer to Figure 6-3 and adjust power output control R67 for the forward power value record at the beginning of the procedure.

WARNING

DISCONNECT IPA UNIT PRIMARY POWER BEFORE PROCEEDING.

WARNING

V. Disconnect the IPA unit primary power.

W. Remove the test equipment and replace the IPA unit top-panel.

6.4 TROUBLESHOOTING THE POWER CONTROL BOARD CIRCUITRY.

The troubleshooting philosophy for the power supply/control circuit board consists of isolating a problem to a specific circuit. The problem may be further isolated by referencing the following information and Table 6-1 which presents troubleshooting information.

Table 6-1. POWER CONTROL CIRCUIT BOARD TROUBLEHSOOTING

SYMPTOM	CIRCUITRY TO CHECK
NO P.A. CONTROL VOLTAGE	1. Check for a 4.4 DC voltage at TP8. 2. If the voltage at TP8 is present, check R64. 3. If the voltage at TP8 is not present, check for approximately 4.4 volts DC at U1 pin 12. 4. If the voltage at U1 pin 12 is present, check for approximately 4.4 volts DC at U1 pin 13. 5. If the voltage at U1 pin 13 is present, defective U1D. 6. If the voltage at U1 pin 12 is not present, check for a +20.0 DC voltage at U7 pin 1. 7. If the voltage at U7 pin 1 is present: 1) remove the external mute signal, 2) check U7, Q2, or Q3. 8. If the voltage at U7 pin 1 is not present, check Q3 and R67.
NO FORWARD POWER METER INDICATION	1. Check for approximately 3.0 volts DC at TP1. 2. If the voltage at TP1 is present, check U2A, U2B, and U3. 3. If the voltage at TP1 is not present, check U1A.
NO REFLECTED POWER METER INDICATION	1. Check for approximately 3.0 volts DC at TP2. 2. If the voltage at TP2 is present, check U2C, U2D, and U4. 3. If the voltage at TP2 is not present, check U1B.
NO VSWR FOLDBACK OPERATION	1. Check U5A.
NO P.A. CURRENT FOLDBACK OPERATION	1. Check U7B.
NO OVER TEMPERATURE FOLDBACK OPERATION	1. Check U1C and U5B.

WARNING

DISCONNECT PRIMARY POWER FROM THE IPA UNIT BEFORE REMOVING ANY COMPONENTS.

WARNING

CAUTION

CAUTION

INADVERTENT CONTACT BETWEEN ADJACENT COMPONENTS AND CIRCUIT TRACES MAY DAMAGE THE POWER SUPPLY/CONTROL BOARD.

After the problem is isolated and power is totally de-energized, refer to the schematic diagrams and the theory of operation to facilitate in problem resolution. The defective circuitry may be repaired locally or the circuit board may be returned to Broadcast Electronics for repair or replacement.

6.5 REMOVAL AND INSTALLATION

This section provides removal and installation procedures for the power control circuit board.

6.5.1 REMOVAL PROCEEDURE

REQUIRED EQUIPMENT. A number 2 Phillips screwdriver with a 4 inch (10.16 cm) shaft is required to remove the power supply/control circuit board from the IPA unit chassis.

PROCEDURE. To remove the power supply/control circuit board, proceed as follows:

WARNING

DISCONNECT PRIMARY POWER TO THE IPA REMOVING ANY UNIT BEFORE PROCEEDING.

WARNING

A. Disconnect the primary power to the IPA unit.
B. Remove the IPA unit top-cover.
C. Disconnect P12, P21, P13 and P10 from the circuit board.
D. Disconnect P5 if the optional remote power control option is installed in the unit.
E. Remove the mounting screw securing the circuit board to the chassis.
F. With slight pressure, pull the circuit board from the mounting stud at each corner.

6.5.2 INSTALLATION PROCEDURE.

To install the power supply/control circuit board after repairs have been completed, proceed as follows:

WARNING

DISCONNECT PRIMARY POWER TO THE IPA REMOVING ANY UNIT BEFORE PROCEEDING.

WARNING

A. Disconnect the primary power to the IPA unit.
B. Follow the REMOVAL PROCEDURE in reverse order.

7 IPA UNIT METERING CIRCUIT BOARD

This section provides general information and specifications relative to operation of the IPA unit metering circuit board.

7.1 DESCRIPTION.

The metering circuit board is equipped with LED status indicators for the +5 volt, +20 volt, -20 volt, and TEMP operating parameters. The metering circuit board also includes a multi-meter circuit with an LCD display for measuring four steady-state operating parameters. In addition, the multi-meter can be converted into a high-impedance dc voltmeter for troubleshooting purposes.

7.2 INTERNAL VOLTMETER CHARACTERISTICS.

The internal voltmeter input impedance is 1.5 Meg Ohms. The meter is capable of measuring dc potentials from 0 to ±45 volts.

7.3 THEORY OF OPERATION

This section presents the theory of operation for the metering circuit board.

7.3.1 FUNCTIONAL DESCRIPTION.

The metering circuit board contains four circuits. A simplified schematic diagram of the metering circuit board is presented in Figure 7-1. Refer to Figure 7-1 as required for a description of the following circuits.

A. Status Indicator Circuits

B. Multi-meter Circuit

C. Voltage Regulator Circuits

7.3.2 STATUS INDICATOR CIRCUITS.

The metering circuit board contains five LEDs to provide IPA unit status indications. DS2 through DS4 will illuminate to indicate the presence of +20V, -20V, and +5V primary operating potentials. DS7 and DS8 will illuminate to indicate excessive VSWR and excessive RF amplifier temperature.

7.3.3 MULTI-METER CIRCUIT.

The multi-meter circuit and LCD display provides a visual indication of five IPA unit steady state operating parameters. Meter function switches S1 through S6 are routed directly to the input of meter function encoder U9. When a function switch is depressed, a momentary HIGH is input to U9.

U9 will generate a three digit BCD code to the input of meter function latch U10 and a HIGH to one shot U8A. U8A outputs a momentary LOW to the clock input of U10 which latches the information and routes the BCD code to the input of meter function/input switch decoder U11.

U11 will decode the information and output logic HIGHs to operate the appropriate input switch(es) for the selected meter function. These HIGHs are also routed to indicator de coder/driver U12 and the decimal point locator logic. U12 outputs a LOW to illuminate a function indicator and appropriate unit of measure indicator (Watts, Amps, or Volts).

FWD/RFL METER OPERATION. When the forward or reflected power meter function is selected, input switches U6A and U3A or U3B will operate and route a sample voltage to the input of amplifier U4A. The linear output of U4A is routed through input switch U6A to A/D converter/display driver U7. U7 converts the analog voltage to digital information by activating the appropriate display segment control lines to DS12. LCD meter display DS12 will indicate a value as numerical characters.

A/D converter/display driver U7 also routes information to a decimal point locator logic circuit consisting of U13B, U13C, and U13D. With information from U11 and U7, this circuit will position the decimal point within the displayed value.

Test point TP2 is employed to determine the condition of the LCD display. When +5 volts is applied to TP2, U7 will activate all segment control lines which illuminates all DS12 display segments.

Meter calibration control R56 is provided to adjust the multi-meter for an accurate indication in the test meter mode of operation.

PAV AND PAI METER OPERATION. When the PA voltage function is selected, input switch U6B will operate and route a sample voltage to the input of A/D converter/display driver U7. When the PA current function is selected, a voltage sample from the power sup-ply circuit board is applied to the A/D converter/display driver U7 through input switch U6C. U7 converts the analog voltage to digital information by activating the appropriate display segment control lines to DS12. LCD meter display DS12 will indicate a value as numerical characters.

TEST METER OPERATION. When the test meter function is selected, input switch U3C will operate and route test probe potentials to the input of U7 through buffer U4B.

METER FUNCTION PRESET CIRCUIT. A meter function preset circuit consisting of resistor R61, capacitor C32, transistor switch Q4, and one shot U8B automatically selects the forward power meter function when IPA unit primary power is applied. Q4 will output a LOW to U8B as C32 charges through R61. U8B outputs a momentary HIGH to forward power meter function switch S1 and the input of meter function encoder U9.

7.3.4 VOLTAGE REGULATOR CIRCUITS.

The metering circuit board contains four voltage regulator circuits which convert the FM-250C/E primary operating voltages to potentials required for circuit board operation. All regulators are equipped with overload protection, thermal overload protection, and current limiting circuits.

Voltage regulator circuit U15 converts a -20 volt potential into a -15 volt source. This -15 volts is also applied to the input of regulator circuit U16 which provides a -5 volt potential. Voltage regulator circuit U14 converts a +20 volt potential into a +15 volt source. Voltage regulator U17 converts the +15V regulated supply to +7.5 volts. The +7.5 volt supply is used as a reference for the LCD meter display and the LED bar graph display.

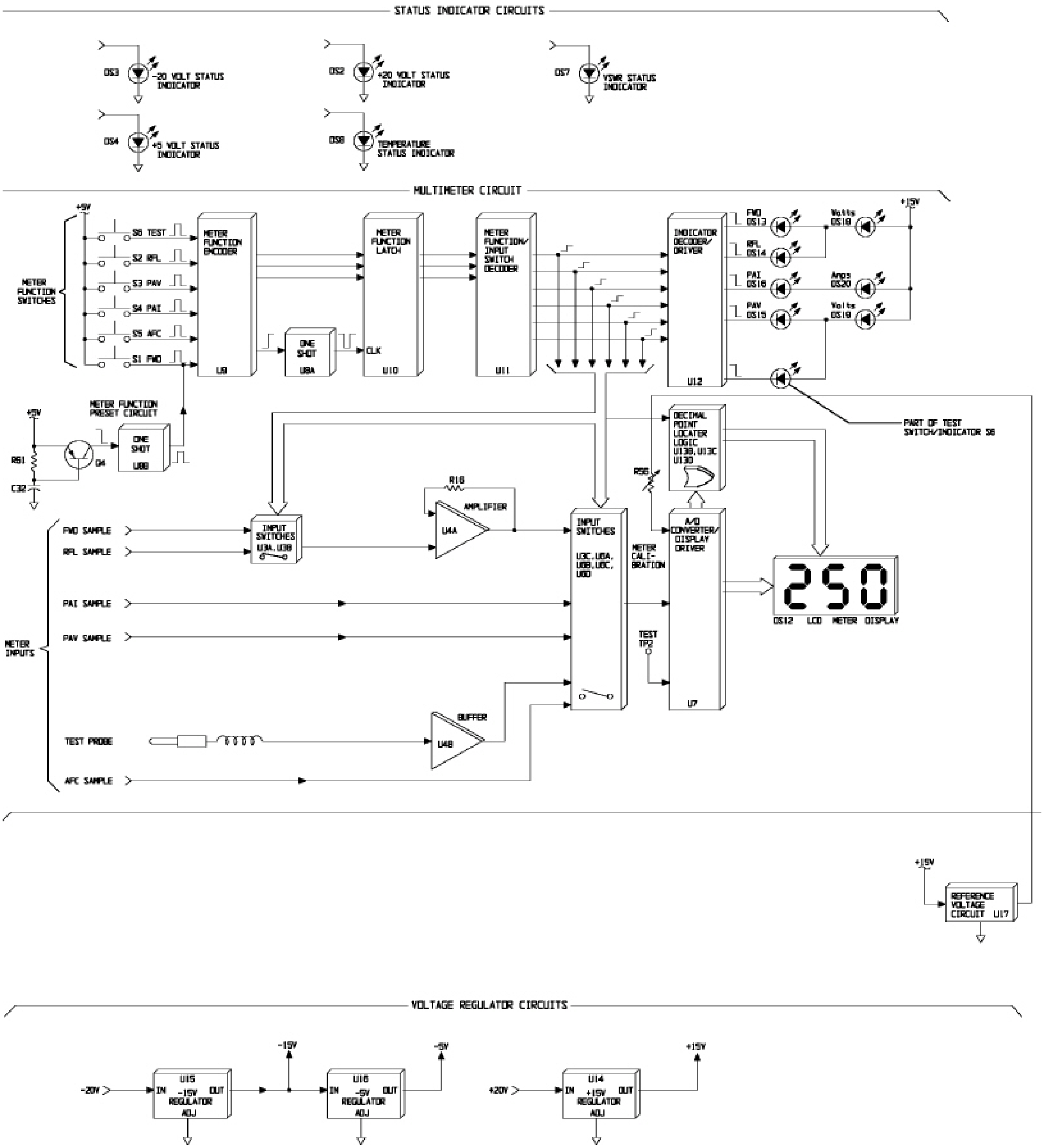


Figure 7-1. METERING BOARD SIMPLIFIED SCHEMATIC

7.4 MAINTENANCE

This section provides maintenance information, electrical adjustment procedures and troubleshooting information for the metering circuit board assembly.

7.4.1 ELECTRICAL ADJUSTMENTS.

REQUIRED EQUIPMENT. The following tools and equipment are required for electrical adjustment procedures.

A. Insulated adjustment tool, shipped with the IPA unit (P/N 407-0083).

B. Digital voltmeter, Fluke 75 or equivalent.

C. Low distortion audio generator.

D. Calibrated oscilloscope.

METER CALIBRATE CONTROL (R56). Potentiometer R56 on the metering circuit board adjusts the multi-meter circuitry for an accurate indication. To adjust R56, refer to Figure 7-2 as required and proceed as follows.

Procedure. To adjust meter calibration control R56, proceed as follows:

WARNING

DISCONNECT IPA UNIT PRIMARY POWER BEFORE PROCEEDING.

WARNING

A. Disconnect the IPA unit primary power.

B. Remove the top-cover.

C. Connect an external 2.0 volt dc source and a multi-meter to test point TP7.

D. Apply IPA unit primary power and operate the test switch/indicator on the metering circuit board to illuminate the switch/indicator.

WARNING

DO NOT TOUCH ANY COMPONENT WITHIN THE IPA UNIT WITH POWER APPLIED.

WARNING

E. With an insulated adjustment tool, adjust R56 until the front-panel LCD display indicates 1000.

WARNING

DISCONNECT THE PRIMARY POWER TO THE IPA UNIT BEFORE PROCEEDING.

WARNING

F. Disconnect the power to the IPA unit, remove the test equipment, replace the test probe in the clip provided, and replace the top-cover.

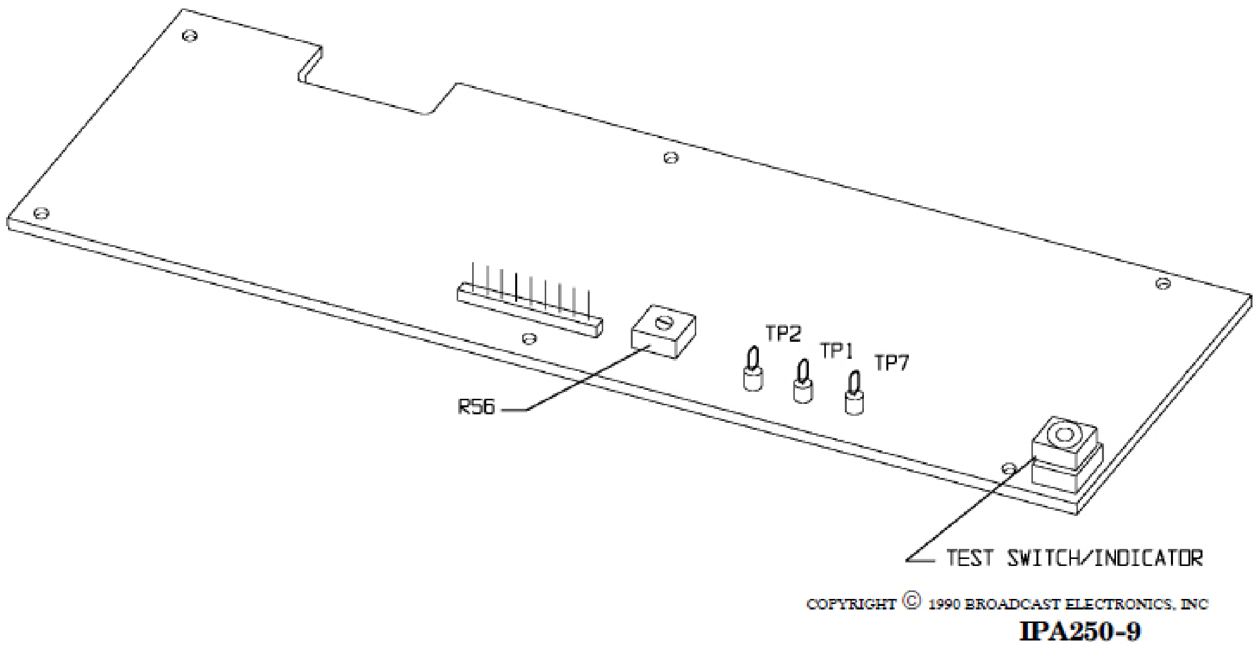


Figure 7-2. METERING CIRCUIT BOARD CONTROLS AND TEST POINTS

7.4.2 TROUBLESHOOTING.

The troubleshooting philosophy for the metering circuit board consists of isolating a problem to a specific circuit. The problem may be further isolated by referencing the following information and Table 7-1 which presents troubleshooting information for the metering circuit board.

WARNING

DISCONNECT THE POWER FROM THE IPA UNIT BEFORE REMOVING OR REPLACING ANY COMPONENTS.

WARNING

CAUTION

INADVERTENT CONTACT BETWEEN ADJACENT COMPONENTS AND CIRCUIT TRACES MAY DAMAGE THE POWER SUPPLY/CONTROL BOARD.

CAUTION

After the problem is isolated and power is totally de-energized, refer to the schematic diagrams and the theory of operation to facilitate in problem resolution. The defective circuitry may be repaired locally or the circuit board may be returned to Broadcast Electronics for repair or replacement.

Table 7-1. METERING CIRCUIT BOARD TROUBLESHOOTING

SYMPTOM	DEFECT/REMEDY
NO MULTIMETER FUNCTION SWITCH OPERATION	1. Check integrated circuit U8A. 2. Check integrated circuit U9. 3. Check integrated circuit U10. 4. Check integrated circuit U11.
NO PAV MULTIMETER FUNCTION	1. Check PAV switch S3. 2. Check input switch U6B.
NO FWD POWER FUNCTION SELECTED WHEN PRIMARY POWER IS APPLIED	1. Check integrated circuit U8B. 2. Check transistor Q4 and associated components.
NO MULTIMETER FUNCTION AND UNIT MEASURE INDICATORS	1. Check integrated circuit U12.
NO FWD POWER METER INDICATION	1. Check input switch U3A.
NO FWD AND RFL POWER METER INDICATION	1. Check input switch U6A. 2. Check integrated circuit U4A and associated components.
NO LCD DISPLAY	1. Check integrated circuit U7. 2. Check display DS12.

7.5 REMOVAL AND INSTALLATION

This section provides removal and installation procedures for the metering circuit board assembly.

7.5.1 REMOVAL PROCEDURE.

REQUIRED EQUIPMENT. The following equipment is required to remove the metering circuit board assembly.

A. Flat tip screwdriver, 4 inch (10.16 cm) shaft with 1/4 inch tip.

B. Number 2 Phillips screwdriver, 4 inch (10.16 cm) shaft.

C. Number 1 Phillips screwdriver, 4 inch (10.16 cm) shaft.

PROCEDURE. The removal of the metering circuit board assembly requires the IPA unit be placed on a suitable work surface. To remove the metering circuit board assembly, refer to Figure 7-3 and proceed as follows:

WARNING

DISCONNECT IPA UNIT PRIMARY POWER BEFORE PROCEEDING.

WARNING

A. Disconnect the primary power from the IPA unit.

B. Remove the IPA unit top-cover and disconnect P14 from the metering circuit board.

C. Remove the two front-panel mounting screws on each side of the chassis.

D. Remove the four front-panel mounting screws on the underside of the chassis and lower the front-panel.

E. Remove the five screws securing the shield to the circuit board assembly.

F. Remove the five stand-offs and one screw securing the circuit board assembly to the front-panel.

G. Lift the circuit board assembly from the front-panel by applying light pressure on the multi-meter function switches.

7.5.2 INSTALLATION PROCEDURE.

To install the metering circuit board assembly after repairs have been completed, proceed as follows:

WARNING

DISCONNECT IPA UNIT PRIMARY POWER BEFORE PROCEEDING.

WARNING

A. Disconnect the primary power from the IPA unit.

B. Follow the REMOVAL PROCEDURE in reverse order.

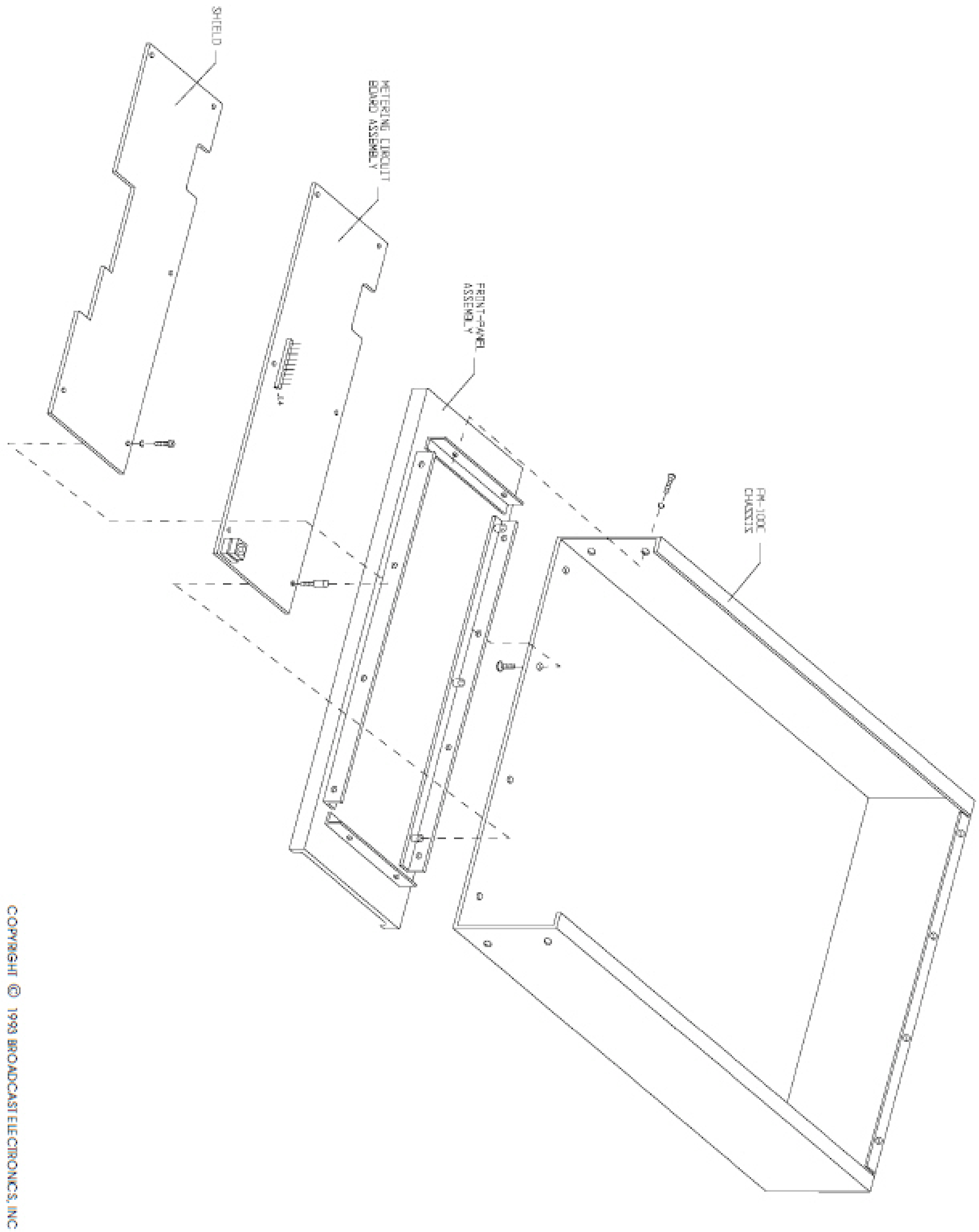


Figure 7-3. METERING CIRCUIT REMOVAL AND INSTALLATION DIAGRAM

8 RF Amplifier

This section provides general information and specifications relative to the operation of the RF amplifier assembly.

8.1 DESCRIPTION.

The RF amplifier assembly is equipped with three stages of amplification to increase the low level RF input signal to an adjustable level of 25 to 250 watts. Directional coupler sensing lines on the circuit board provide both forward and reflected power outputs for monitoring and control of amplifier operation. DC power for the RF amplifier assembly and the +20 volt regulator is provided by a modular switching power supply assembly.

DC power for all the IPA unit assemblies is provided by a switching power supply cir-cuit board. The circuit board provides the: 1) a variable dc PA voltage, 2) ±20 volts dc, 3) ±15 volts dc, and 4) +5 volts dc. The RF amplifier assembly PA voltage provides a variable dc supply to control the RF output power. The ±20, ±15, and +5 volt supplies are routed throughout the IPA unit assemblies.

8.2 ELECTRICAL SPECIFICATIONS.

Refer to Table 8-1for electrical specifications of the RF amplifier assembly.

Table 8-1. RF Amplifier Electrical Specifications

PARAMETER	SPECIFICATIONS
SIGNAL LEVELS:	
RF AMPLIFIER	
INPUT	6.5 Watts at 50 Ohms.
OUTPUT	25 to 250 Watts RF at 50 Ohms (adjustable).
DIRECTIONAL COUPLER OUTPUT	
FORWARD	3V DC = 250 Watts.
REFLECTED	0.75V DC = 10 Watts.

8.3 THEORY OF OPERATION

This section presents the theory of operation for the IPA unit RF amplifier assembly.

8.3.1 RF AMPLIFIER ASSEMBLY DESCRIPTION.

The RF amplifier assembly consists of: 1) an RF amplifier input circuit board, 2) an RF amplifier output circuit board, and 3) a low-pass filter/directional coupler board. All wiring to and from the assembly is routed through plugs and jacks for ease of maintenance. A fan is installed on the IPA unit rear-panel to maintain proper operating temperature.

The RF amplifier assembly is equipped with a two-stage FM broadband amplifier with a maximum output power of 250 watts. Output levels from 25 to 250 watts are achieved by adjusting the power transistor supply voltage. Due to the broadband characteristics, tuning of the amplifier is not required.

In addition, the RF amplifier assembly contains forward and reflected power directional couplers and an input mute circuit. The directional coupler outputs and operating potentials are routed from the circuit board through the chassis with feed-through capacitors to prevent RF interference.

A simplified schematic diagram of the RF amplifier circuit board is presented in Figure 8-1. Refer to Figure 8-1 as required for a description of the following circuit boards:

A. RF amplifier input circuit board.

B. RF amplifier output circuit board.

C. Low-pass filter/directional coupler circuit board.

8.3.2 RF AMPLIFIER INPUT CIRCUIT BOARD.

The RF amplifier input circuit board consists of a driver amplifier, and associated components. An impedance matching network is designed to provide maximum broadband frequency stabilization.

DRIVER AMPLIFIER. The driver amplifier consists of transistor Q1, an impedance matching network, resistor R8, and inductor L3. This stage provides approximately 8 watts of output power to the following stage. L3 provides a dc return path for Q1. R8 en-sures stable amplifier operation. Capacitors C43/C18 and micro strip inductor SL3 match the output impedance of Q1 to the input impedance of the next amplifier stage.

Driver amplifier Q1 operates from a dc potential of +20 volts. Inductors L4 and L5, and capacitors C15, C16, and C17 provide power supply isolation. Potentiometer R11 establishes the bias for the power transistor on the RF amplifier output circuit board.

8.3.3 RF AMPLIFIER OUTPUT CIRCUIT BOARD.

The RF amplifier output circuit board consists of balun W2, power transistor Q4, step-up transformer T1, an impedance matching circuit, a low-pass filter, and a directional coupler circuit. Balun W2 is designed to convert the unbalanced output of transistor Q1 on the RF amplifier input circuit board to a balanced signal to drive power transistor Q4. The output of W2 is applied through termination and stabilization components R17 through R20 and RF coupling capacitors C20 through C23 to power transistor Q4.

Power transistor Q4 is the primary amplifier device. The device is designed to output 250 watts of RF power. Q4 operates from an adjustable dc potential of 0 to +48 volts. The adjustable potential is preset by circuitry on the power supply/control circuit board and is automatically maintained by feedback from the forward power directional coupler. Induc-tors L6 and capacitor C30 provide power supply isolation.

The output of Q4 is applied to push-pull step-up transformer T1. Transformer T1: 1) pro-vides dc blocking, 2) converts the balanced output of Q4 to an unbalanced signal, and 3) provides a 50 Ohm output. The 50 Ohm output is routed to a low-pass filter and a directional coupler circuit on the low-pass filter/directional coupler circuit board.

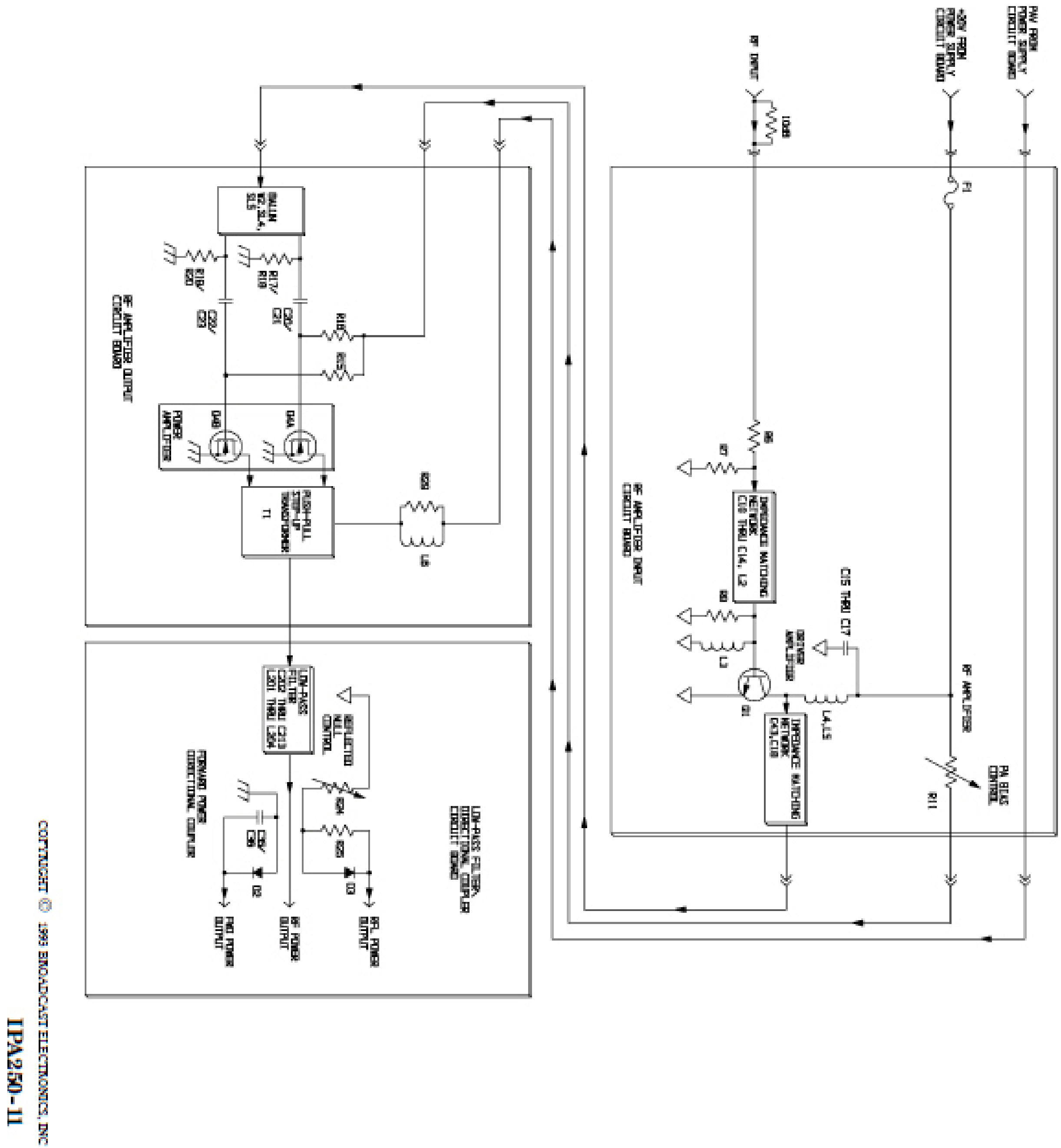


Figure 8-1. RF AMPLIFIER SIMPLIFIED SCHEMATIC

8.3.4 LOWPASS FILTER/DIRECTIONAL COUPLER CIRCUIT BOARD.

LOWPASS FILTER CIRCUIT. The RF amplifier output signal harmonic and spur frequencies are reduced to FCC, DOC, and CCIR levels by a low-pass filter. The filter is a third order low-pass circuit consisting of inductors L201 through L204 and capacitors C202 through C213. The output of the circuit is routed through the directional coupler circuit to the RF output connector.

8.3.5 DIRECTIONAL COUPLER CIRCUITS.

The directional couplers provide two dc signals obtained by rectifying a sample of the RF output signal. Due to the polarity of the samples, one signal will represent the forward output signal and the other will represent the reflected.

FORWARD DIRECTIONAL COUPLER. The forward voltage sample is obtained from a micro-strip inductor on the circuit board near the output line. This signal is rectified and filtered by diode D202 and capacitors C218 and C220.

REFLECTED DIRECTIONAL COUPLER. The reflected voltage sample is obtained from a micro-strip inductor on the circuit board near the output line. This signal is rectified and filtered by diode D203 and capacitors C219 and C221. The directivity of the circuit is adjusted by null control R208.

RF SAMPLE CIRCUIT. A sample of the RF output signal is routed to filter capacitors C222 and C223. The capacitors provide a sample of the RF output signal for application to the RF SAMPLE receptacle.

8.4 POWER SUPPLY CIRCUIT BOARD DESCRIPTION.

A simplified schematic diagram of the Power Supply circuit board is presented in Figure 8-2. Refer to Figure 8-2 as required for a description of the Power Supply Circuit Board.

The RF amplifier assembly is equipped with a switching power supply circuit board. The circuit board provides all the dc voltage potentials for the IPA unit. A power amplifier voltage switching supply circuit provides a variable dc voltage for the power amplifier circuit. A second switching power supply circuit provides ±20 volt, ±15 volt, and +5 volt supplies for the IPA unit circuitry. The following text presents a description of the power supply circuit board circuitry.

8.4.1 POWER AMPLIFIER VOLTAGE SWITCHING SUPPLY CIRCUIT.

SOFTSTART AND RECTIFIER CIRCUIT. An ac voltage potential from secondary winding A of primary power transformer T1 is applied to optical coupler U11 and SCRs D24 and D25. Optical coupler U11 functions as an ac line voltage zero crossing detector. Each time the ac line phase approaches zero degrees, U11 will output a HIGH to bias transistor Q8 on. With Q8 on, transistor Q9 will route a LOW to operational amplifier U9A.

U9A, resistor R52, and capacitor C38 are configured to generate a modified triangle wave-form. The triangle waveform is applied to rectifier driver transistors Q10 and Q11. The triangle waveform and transistors Q10/Q11 are used to provide soft-start operation of SCR rectifiers D24 and D25. The soft-start operation eliminates the component stress by limiting the inrush current.

When power is required from the circuit, the Q10/Q11 will output pulses to slowly bias SCRs D24/D25 on. D24/D25 will output a dc potential to the negative leg of a filter circuit consisting of capacitors C33 through C36 to generate a filtered +52 volt supply. The supply is applied to the switching power supply circuit.

SWITCHING POWER SUPPLY CIRCUIT. The switching power supply circuit is controlled by the PA voltage control signal from the power control circuit board. The 0V to 5V PA voltage control signal is applied to integrated circuit U13A. U13A is configured as an in-verting amplifier. When the PA control voltage is 0V, U13A will output 5 volts to the voltage control port of switching power supply controller U6. When the PA control voltage is +5V, U13A will output 2.5 volts to U6. The maximum power control voltage is established by maximum output voltage adjust potentiometer R84. U6 is designed to output a variable pulse-width signal in response to the PA voltage control signal. When the PA voltage con-trol signal increases, the duty cycle of the pulse will increase. When the PA voltage control signal decreases, the duty cycle of the pulse will decrease. The outputs of U6 are summed and applied to high-side switching power supply driver U7. U7 will output a variable pulse width signal to switching transistor Q7.

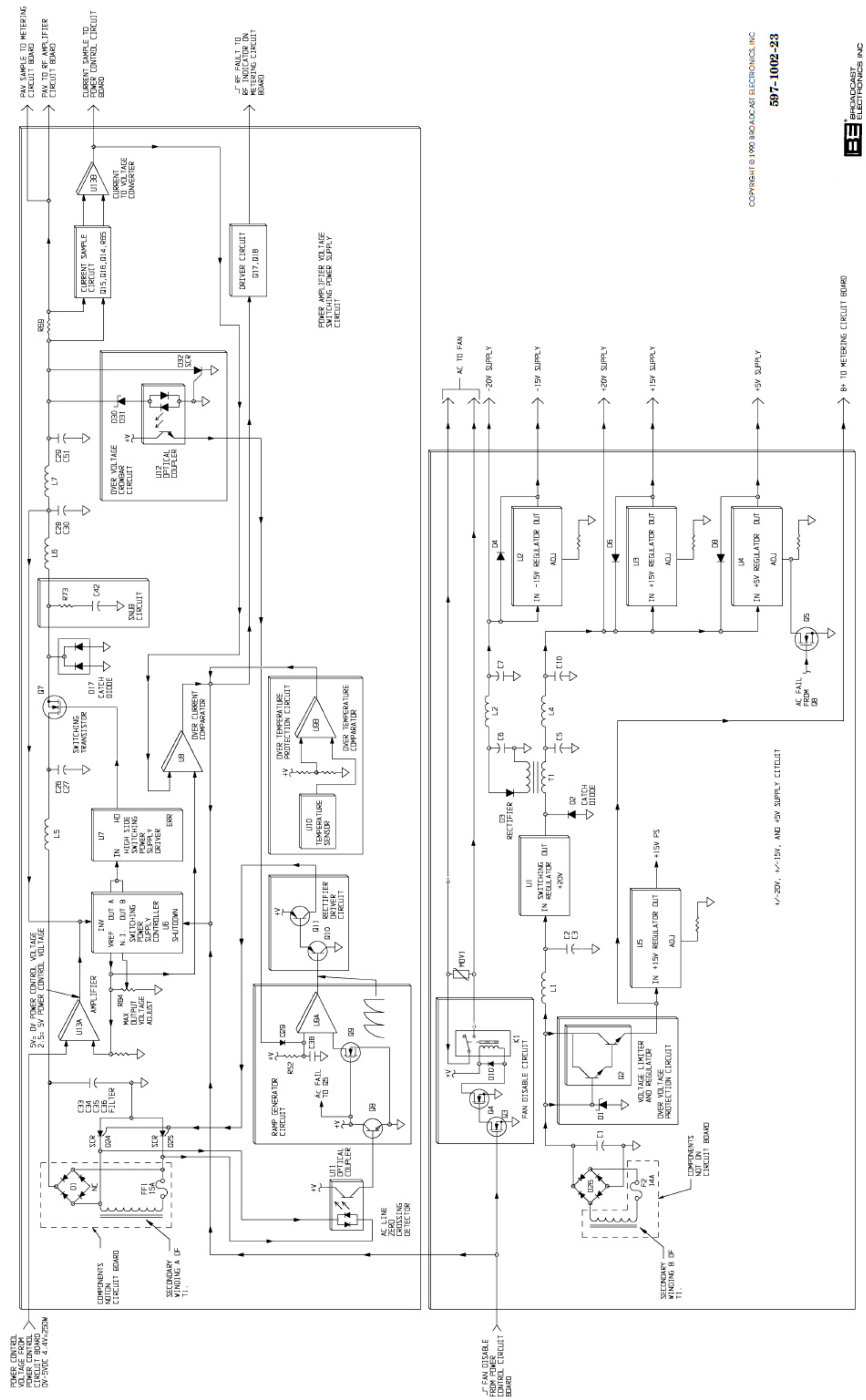


Figure 8-2. POWER SUPPLY CIRCUIT BOARD SIMPLIFIED SCHEMATIC

Q7 responds to the control signal by turning on/off at a 100 kHz rate. This on/off action operates together with inductor L5 and catch diode D17 to regulate the dc supply from the filter circuit. The output Q7, L5, and D17 creates a variable regulated dc voltage. Q7 is protected from switching transients by a snub circuit. The snub circuit consists of resistor R73 and capacitor C42.

The output from Q7, L5, and D17 is applied to a two section LC low-pass filter. The first section consists of inductor L6 and capacitors C28 and C50. The second section consists of inductor L7 and capacitors C29 and C51. The filter is designed to remove ripple in the dc supply voltage. The output from the filter is routed to the RF amplifier transistors on the RF amplifier circuit board and an over voltage crowbar circuit.

OVER CURRENT PROTECTION CIRCUIT. An error voltage generated by a current sense pin from high-side switching power supply driver U7 is applied to over current comparator U8. U8 compares the error sample to a sample from the PA voltage control signal. If the error voltage increases above the PA voltage control sample, U8A will output a HIGH. The HIGH is applied to the shutdown pin of U6 to momentarily terminate circuit operation and to illuminate the RF indicator on the metering circuit board assembly. The momentary termination is designed to allow the fault condition to be re-moved and restart circuit operation by initiating a soft-start cycle.

OVER VOLTAGE CROWBAR CIRCUIT. A dc voltage sample from the switching power supply circuit is applied to zener diodes D30 and D31. If the dc voltage exceeds approxi-mately 52 volts, zener diodes D30 and D31 will conduct. With D30/D31 conducting, optical coupler U12 will be enabled. When U12 is enabled: 1) SCR D32 will be enabled to clamp the output to 0 volts and 2) a HIGH is applied to U9A and to U6 to terminate power supply circuit operation. The crowbar circuit is reset by removing ac power from the unit for a minimum of 1 second. In addition to the over voltage protection, the switching power sup-ply circuit is inherently protected from under voltage conditions by U6 and U7.

CURRENT SAMPLE CIRCUIT. The power amplifier voltage current is sampled by a circuit consisting of transistors Q14 through Q16 and resistors R65 and R69. The sample is routed to current-to-voltage converter U13A. The output of U13A is routed for application to the power control circuit board.

OVER TEMPERATURE PROTECTION CIRCUIT. The module air temperature is monitored by temperature sensor U10. U10 is designed to output a specific dc voltage for each degree of temperature. The voltage is applied to over temperature comparator U9B. When the voltage from U10 is above the reference voltage, U9B will output a HIGH. The HIGH is applied to the shutdown pin of U6 to terminate power supply circuit operation.

8.4.2 ±20V, ±15V, AND +5V POWER SUPPLY CIRCUIT.

+20V, +15V, AND +5V CIRCUIT. An ac voltage potential from secondary winding B of primary power transformer T1 is applied to bridge rectifier D26. The rectified dc output from D26 is applied to filter capacitor C1. The filtered dc voltage from C1 is applied to switching regulator U1. U1 operates in association with inductor L1 and catch diode D2 to provide a regulated +20 volt dc supply for application to a winding of transformer T1. The winding of T1, inductor L4, and capacitors C5/C10 function as a two section LC low-pass filter. The filter is designed to remove the ripple from the dc voltage. The output from the filter provides the +20 volt supply for all circuitry in the IPA unit. U1 also protects the circuit from under voltage conditions.

The +20 volt supply is also applied to +15 volt regulator U3 and +5 volt regulator U4. U3 and U4 are three terminal positive adjustable regulators containing internal thermal over-load and short-circuit current limiting features. Further protection for U3 is provided by diode D6. D6 protects U3 from a reverse polarity potential applied to the output. Further protection for U4 is provided by diode D8. D8 protects U4 from a reverse polarity potential applied to the output. Transistor Q5 is provided to immediately short the +5 volt supply to ground when an ac power failure occurs.

-20V AND -15V CIRCUIT. A second winding of T1 is used to generate the -20 volt and -15 volt supplies. A negative potential from T1 is rectified by diode D3 and applied to a low-pass LC filter consisting of capacitors C6/C7 and inductor L2. The filter is used to remove ripple in the dc voltage. The output from the filter provides the 20 volt supply for all the circuitry in the IPA unit.

The -20 volt supply is also applied to -15 volt regulator U2. U2 is a three terminal negative adjustable regulator containing internal thermal overload and short-circuit current limiting features. Further protection for U2 is provided by diode D4. D4 protects U2 from a reverse polarity potential applied to the output.

UNREGULATED B+ AND +15VPS CIRCUIT. The unregulated B+ and +15VPS circuit consists of zener diode D1, transistor Q2, and regulator U5. The circuit provides a limited and unregulated +27 volt supply for the metering circuit board and creates a +15VPS supply for application to the power supply circuit board. Over voltage protection is provided by zener diode D1. If the dc voltage exceeds approximately 27 volts, zener diode D1 will conduct. When D1 is enabled, the dc voltage from D26 will be clamped to approximately 27 volts.

Transistor Q2 functions as a voltage limiter. Q2 provides approximately 27 volts to: 1) the PA metering circuitry on the metering circuit board and 2) +15 volt regulator U5. U5 is a three terminal positive adjustable regulator containing internal thermal overload and short-circuit current limiting features. The +15 volt output from U5 is routed to the circuitry on the power supply circuit board. Q2 is protected from over current conditions by transistor Q1 and R15.

8.4.3 FAN DISABLE CIRCUIT.

The fan disable circuit consists of transistors Q3/Q4 and relay K1. When the IPA unit fan is to be disabled, a HIGH fan disable signal from the power control circuit board is applied to transistor Q3 and to the shutdown pin of switching power supply controller U6. The HIGH will bias Q3 on. With Q3 on, transistor Q4 will be biased on to enable relay K1 and disable the IPA unit fan. The HIGH will also disable U6 to terminate operation of the PA voltage circuit.

8.5 MAINTENANCE

This section provides maintenance information, electrical adjustment procedures, and troubleshooting information for the RF amplifier assembly.

8.5.1 ELECTRICAL ADJUSTMENTS.

Although the following controls are not located on the RF amplifier assembly, the controls effect the operation of the RF amplifier. The adjustment procedure for each control is presented in the power control circuit board section of this manual.

A. VSWR Foldback Calibration Control (R52).
B. Forward Power Calibration Control (R4).
C. Reflected Power Calibration Control (R25).

REQUIRED EQUIPMENT. The following tools and equipment are required for electrical adjustment procedures.

A. Insulated adjustment tool, shipped with the IPA unit (P/N 407-0038).
B. Non-inductive, 250 watt, 50 Ohm test load.
C. Coaxial accessory cable.

8.5.2 RFL NULL (R208).

The RFL NULL control on the RF amplifier output circuit board adjusts the directivity of the reflected power directional coupler. Potentiometer R208 is adjusted as follows.

Procedure. To adjust reflected power null control R208, proceed as follows:

WARNING

DISCONNECT THE PRIMARY POWER
TO THE IPA UNIT BEFORE PROCEEDING.

WARNING

A. Disconnect the IPA unit primary power.

B. Remove the IPA unit top-cover and the access hole plug at the top and rear of the RF amplifier assembly (refer to Figure 8-3).

C. Connect a 250 watt non-inductive test load to the IPA unit rear-panel RF OUTPUT receptacle.

D. Apply primary power and operate the IPA unit for 250 watts as indicated on the front panel meter.

E. Depress the front-panel RFL meter function switch.

WARNING MAINTENANCE WITH POWER APPLIED IS ALWAYS CONSIDERED HAZARDOUS AND THEREFORE CUATION SHOULD BE OBSERVED. DO NOT TOUCH ANY COMPONENTS WITHIN THE IPA UNIT WHEN POWER IS APPLIED.

WARNING

WARNING

USE AN INSULATED TOOL FOR ADJUSTMENT.

WARNING

F. Refer to Figure 8-3 and adjust R208 for minimum reflected power as indicated on the front-panel meter.

WARNING

DISCONNECT THE PRIMARY POWER TO THE IPA UNIT B E F O R E PROCEEDING.

WARNING

G. Disconnect the IPA unit primary power.

H. Remove all test equipment and replace the access hole plug and IPA unit top-cover.

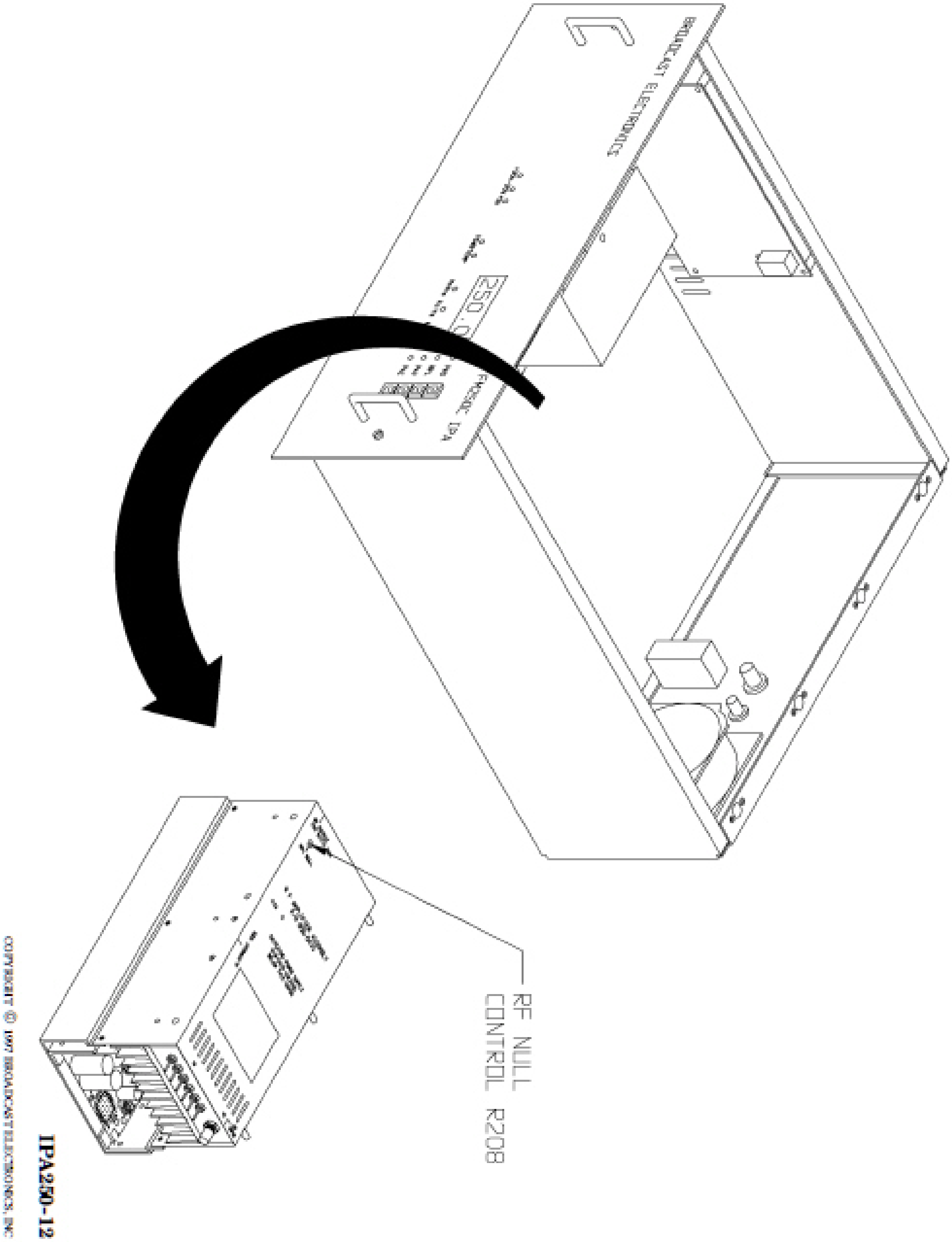


Figure 8-3. RF AMPLIFIER CIRCUIT BOARD CONTROLS.

8.5.3 PA BIAS (R11).

PA BIAS control R11 on the RF amplifier input circuit board adjusts the amplifier bias current. PA bias adjustment is required only when RF amplifier transistor Q1 is replaced. Due to the specialized equipment required to adjust the control, PA bias is not considered field adjustable. Therefore, if an RF amplifier device fails, contact the Broadcast Electronics Technical Services department for information on a power amplifier module exchange program.

8.5.4 POWER SUPPLY CIRCUIT BOARD ELECTRICAL ADJUSTMENTS.

The power supply circuit board is equipped with maximum output voltage adjust control R84. Due to the critical nature of the control, the control is not considered field adjustable. If the control is to be adjusted, contact the Broadcast Electronics Technical Services Department.

8.6 TROUBLESHOOTING.

WARNING HIGH RF VOLTAGE IS PRESENT IN THE RF AMPLIFIER MODULE WITH THE COVER REMOVED. NEVER TROUBLESHOOT THE RF AMPLIFIER MODULE WITH POWER ENERGIZED AND THE COVER REMOVED.

WARNING

POWER AMPLIFIER MODULE TROUBLESHOOTING/REPAIR. An RF amplifier assembly problem may be isolated by referencing Figure 8-4 which presents troubleshooting information for the RF amplifier assembly. If the problem is isolated to the power amplifier module, the module requires specialized equipment for troubleshooting and repair operations. Therefore, most power amplifier module troubleshooting and repair cannot be performed in the field. If the power amplifier module is determined to be defective, the module may be exchanged (refer to Power Amplifier Module Exchange program in the following text).

Power Amplifier Module Exchange Program. If the FM-250C IPA power amplifier module is determined to be defective, Broadcast Electronics has established a power amplifier module exchange program. The program allows the customer to: 1) exchange a defective module for a reconditioned FM-250C IPA power amplifier module or 2) obtain an FM-250C IPA power amplifier module on loan during the repair of the defective module. Terms of the program are available from the Broadcast Electronics Technical Services Department.

WARNING THE POWER SUPPLYCIRCUIT BOARD CONTAINS HAZARDOUS VOLTAGES WITH THE RF AMPLIFIER REMOVED. DO NOT TYROUBLESHOOT THE POWER SUPPLY CIRCUIT BOARD WITH THE RF AMPLIFIER REMOVED.

WARNING

POWER SUPPLY CIRCUIT BOARD TROUBLESHOOTING/REPAIR. Do to the hazardous voltages present on the power supply circuit board with the RF amplifier assembly removed, all power supply circuit board troubleshooting must be performed using a digital voltmeter and resistance checks. Table 8-2 presents troubleshooting information for the power supply circuit board. Refer to Table 8-2 as required for troubleshooting information.

WARNING

DISCONNECT THE PRIMARY POWER TO THE IPA UNIT B E F O R E PROCEEDING.

WARNING

CAUTION

INADVERTENT CONTACT BETWEEN ADJACENT COMPONENTS AND CIRCUIT TRACES MAY DAMAGE THE RF AMPLIFIER ASSEMBLY.

CAUTION

After the problem is isolated and power is totally de-energized, refer to the schematic diagrams and the theory of operation to facilitate in problem resolution. The defective circuitry may be repaired locally or the circuit board may be returned to Broadcast Electronics for repair or replacement.

Table 8-2. POWER SUPPLY CIRCUIT BOARD TROUBLESHOOTING

SYMPTOM	CIRCUITRY TO CHECK
NO P.A. VOLTAGE	1. Check the crowbar circuit. Reset the crowbar circuit by: 1) operating the rear-panel ON/OFF switch to OFF for approximately 1 second and 2) then operate the unit to ON. 2. Check the power supply circuit for thermal, over-current, or crowbar shutdown. For thermal shutdown, check the fan and allow the circuit board to cool. For over-current shutdown, check for short circuit or low AC line-voltage conditions, For crowbar shutdown, operate the unit to OFF for approximately 1 second and then operate the unit to ON. 3. Operate a digital multi-meter to diode check and place the leads on the source and drain of Q7. a. If Q7 is shorted, replace Q7. b. If Q7 is not shorted, replace U6 and U7 c. If no P.A. voltage is present, contact the Broadcast Electronics Customer Service Department.
NO +20V, +15V, AND +5V SUPPLY	1. Check U1, D2, C5, C10, T1, and L4.
NO +15V SUPPLY	1. Check U3.
NO +5V SUPPLY	1. Check U4.
NO -20V AND -15V SUPPLY	1. Check T1, C6, C7, and L2.
NO -15V SUPPLY	1. Check U2.
NO UNDER VOLTAGE SHUTDOWN	1. Check D11, D12, Q5, and Q6.

NO OVER VOLTAGE SHUTDOWN	1. Check D30, D31, D32, and U12.
NO OVER CURRENT SHUTDOWN	1. Check U8.

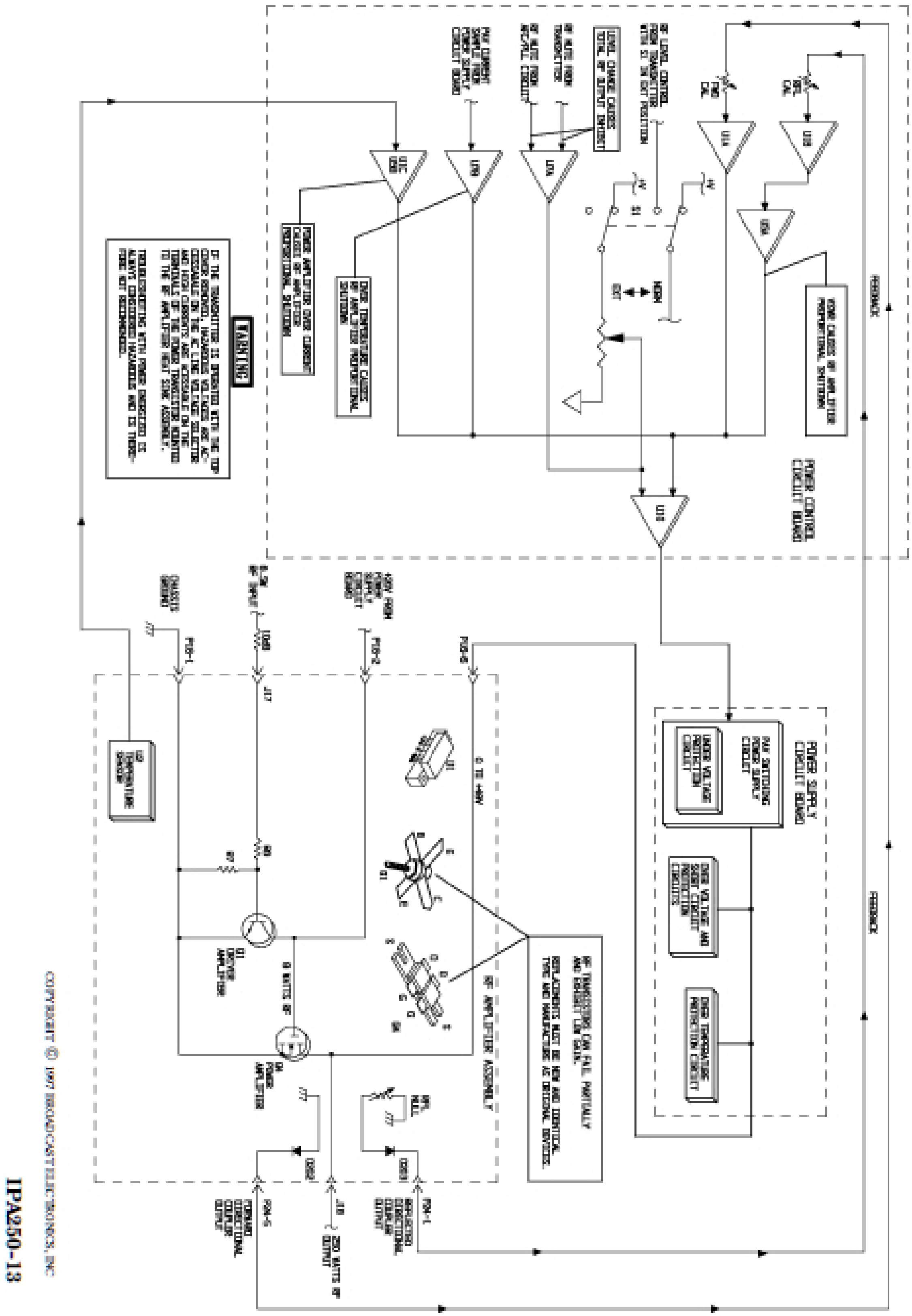


Figure 8-4. RF AMPLIFIER TROUBLESHOOTING INFORMATION.

8.7 RF AMPLIFIER REMOVAL AND INSTALLATION

This section provides removal and installation procedures for the RF amplifier assembly.

8.7.1 REMOVAL PROCEDURE.

REQUIRED EQUIPMENT. A number 2 Phillips screwdriver with a 4 inch (10.16 cm) shaft is required to remove the RF amplifier assembly from the IPA unit chassis.

RF AMPLIFIER REMOVAL PROCEDURE. The removal of the RF amplifier assembly requires the IPA unit be placed on a suitable work surface. To remove the RF amplifier assembly, proceed as follows:

WARNING

DISCONNECT IPA UNIT PRIMARY POWER BEFORE PROCEEDING.

WARNING

1. To remove the RF amplifier assembly from the chassis, proceed as follows:
   - A. Disconnect the primary power from the IPA unit.
   - B. Remove the IPA unit top-cover and disconnect J15 from P15 on the RF amplifier assembly power/control cable.
   - C. Remove the 6 screws from the side of the chassis which secure the RF amplifier assembly to the unit.
   - D. Disconnect BNC connector P17 from J17 on the front of the RF amplifier assembly.
   - E. Disconnect Type N connector J19 from the RF OUT receptacle on the rear-panel.
   - F. Disconnect BNC connector J3 from the RF SAMPLE receptacle on the rear-panel.
   - G. Disconnect 12Pin connector P11 from J11 on the power supply circuit board.
   - H. Remove the RF amplifier assembly from the chassis.
2. To remove the RF amplifier module, proceed as follows:
   - A. Disconnect 20 Pin connector P20 from J20 on the power supply circuit board.
   - B. Remove the 6 RF amplifier module mounting screws and lift the RF amplifier module from the assembly.
3. To remove the power supply circuit board, proceed as follows:
   - A. Remove the 7 power supply circuit board mounting screws.
   - B. Slide the power supply circuit board from the assembly.

8.7.2 RF AMPLIFIER INSTALLATION PROCEDURE.

To install the RF amplifier assembly after repairs have been completed, proceed as follows:

WARNING

DISCONNECT IPA UNIT PRIMARY POWER BEFORE PROCEEDING.

WARNING

A. Disconnect the primary power from the IPA unit.

B. Follow the REMOVAL PROCEDURE in reverse order.

8.8 POWER SUPPLY REMOVAL PROCEDURE.

8.8.1 REMOVAL PROCEDURE.

The power supply is located in the RF amplifier assembly. To remove the RF amplifier and the power supply, refer to Figure 8-5 and proceed as follows:

Remove the RF amplifier assembly as follows:

WARNING

DISCONNECT IPA UNIT PRIMARY POWER BEFORE PROCEEDING.

WARNING

A. Disconnect the primary power from the IPA unit.

B. Refer to the preceding text and perform the RF AMPLIFIER REMOVAL PROCEDURE to remove the RF amplifier assembly from the IPA unit chassis.

Remove the power supply as follows:

A. Remove the three screws which secure the power supply to the RF amplifier assembly. Discard the three mounting screws.

B. Remove the power supply circuit board from the heat sink assembly.

POWER SUPPLY INSTALLATION PROCEDURE - NEW REPLACEMENT ASSEMBLY

To install the power supply circuit board after repairs have been completed, proceed as follows:

WARNING

DISCONNECT IPA UNIT PRIMARY POWER BEFORE PROCEEDING.

WARNING

A. Disconnect the primary power to the IPA unit.

B. Follow the REMOVAL PROCEDURE in reverse order.

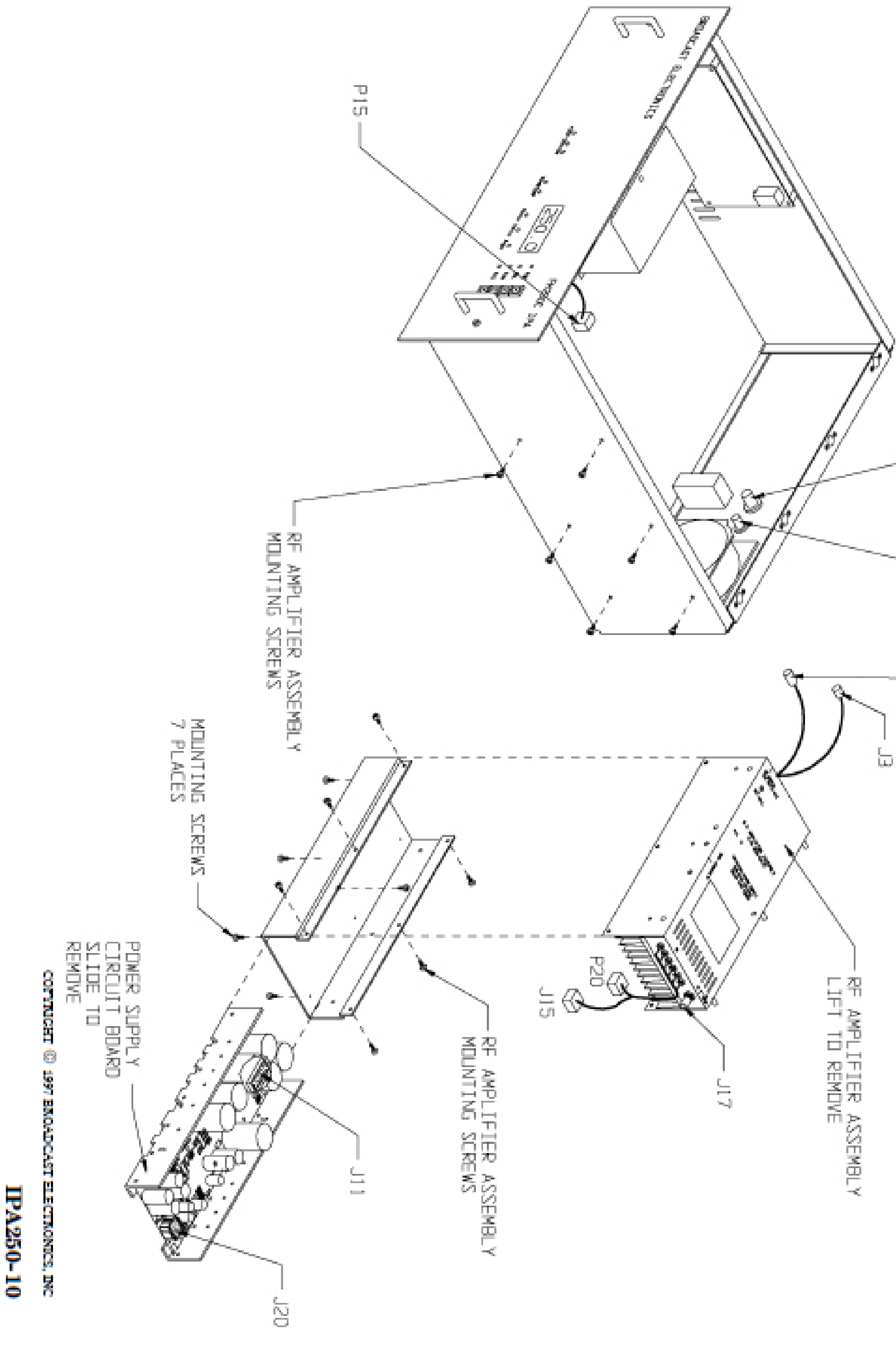


Figure 8-5. RF AMPLIFIER ASSEMBLY/POWER SUPPLY CIRCUIT BOARD REMOVAL.

9 BE Part Numbers

This section provides parts lists for the FM-250C IPA unit. The parts lists provide descriptions and part numbers of electrical components, assemblies, and selected mechanical parts required for maintenance. Each parts list entry in this section is indexed by reference designators appearing on the applicable schematic diagrams.

This bill of material uses an indented structure to show relationships of parts into sub assemblies. Example; all BOM LEVEL 2 parts are contained in the BOM LEVEL 1 part immediately above it.

9.1 FM-250C, Solid State IPA

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
0	909-0251-604	FM SOLID STATE 250 WATT IPA		
..1	140-0036	VARISTOR,V275LA20A	2	
..1	330-0401	FUSE,MDA 4A 250V CER SLO-BLO	1	
..1	330-1000	FUSE,MDA 10A 250V SLO-BLO	2	
..1	330-1500-001	FUSE, 15A, 250V, CERAMIC, SLO-BLOW	1	
..1	339-0027	JFW 10DB 20 WATT ATTENUATOR	1	
..1	370-0250	XMFR,POWER,FM-250C XMTR	1	
..1	380-4600	FAN,4 1/2	1	
..1	380-5502	FILTER,FAN	1	
..1	380-6307	FINGER GUARD,FAN,4.125 CENTERS	1	
..1	400-2170	GROMMET,FOR 3/8	1	
..1	402-0000	TY-RAP	7	
..1	402-0008	MTG DEVICE,FOR #6SCR,TIE CBL	1	
..1	402-0051	TY-RAP, W/FLAG	1	
..1	410-0050	LUG,TERM,10-12GA,FEMSPADE	2	
..1	410-0051	LUG,TERM,14-16GA,FEMSPADE	3	
..1	415-1010	FUSE CLIP,LITTLEFUSE,101002	2	
..1	415-1011	FUSE CLIP,LITTLEFUSE,105002	1	
..1	415-2012	FUSEHOLDER,PANEL MOUNT, 10A	1	
..1	415-2012-020	FUSEHOLDER,PANEL MOUNT, 20A	1	
..1	417-0017	RECP,BNC,BULKHEAD,UG-492A/U	2	

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
..1	417-0095	CONN,BNC RG/U142 31-326 AMPH	2	
..1	417-0226	JACK,N FOR RG58U AMPH (NLU-)	1	
..1	417-0372	CONTACT,CONN,FC112N2	4	
..1	417-0420	CONN, FEM, 4 POSITION, POWER-LOK, WIRE	1	
..1	417-0432	CONTACT, FEMALE, POWER-LOK, 20-24 AWG	4	
..1	417-6500	MODULE,IEC 5 FUNCTION	1	
..1	418-0031	PLUG,N FOR RG-58/142B/U	1	
..1	418-0035	ADPTR,JACK-JACK 82-66 AMPHENOL	1	
..1	420-1145	SCREW,1/4-20X4.5,PPHS SST	1	
..1	420-4105	SCREW,4-40X.312,S.S. PH	2	
..1	420-4110	SCREW,4-40X.625,S.S. PH	8	
..1	420-4406	SCREW,4-40X.375,S.S. PH UC	2	
..1	420-6105	SCREW,6-32X.312,S.S. PH	7	
..1	420-6106	SCREW,6-32X.375,S.S. PH	23	
..1	420-6108	SCREW,6-32X.500,S.S. PH	3	
..1	420-8006	SCREW,8-32X.375,S.S. PH FLH UC	4	
..1	420-8107	SCREW,8-32X.437,S.S. PHH	8	
..1	420-8124	SCREW,8-32X1.000,S.S. PHH	1	
..1	421-1001	1/4-20 S.S. HEX NUT	3	
..1	421-1105	RIV,BLD 3/32OD X .187 GRIP,CSK	16	
..1	421-1113	RIV,CLOSED-END .125 X .316L	1	
..1	421-4008	4-40 KEP NUT	12	
..1	421-6001	6-32 S.S. HEX THIN NUT	2	
..1	421-6008	6-32 KEP NUT	11	
..1	422-6106	SCREW,SEMS 6-32 X 3/8 PAN PH. ST."	12	
..1	422-6107	SCREW,SEMS 6-32 X 7/16 PAN PH.ST."	1	
..1	423-1001	1/4 FLAT .500 X .255 X .050	3	

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
..1	423-1002	1/4 LOCK SPLIT	3	
..1	423-1026	WASH,FENDER,1/4ID,1 1/4OD	1	
..1	423-3004	5/16 LOCK INT TOOTH THIN	2	
..1	423-6002	#6 LOCK SPLIT	24	
..1	423-6011	#6 FLAT .310 X .160 X .030	1	
..1	423-8002	#8 LOCK SPLIT	9	
..1	441-0131	STOFF,ALUM 1/4HEX 5/16M/FEM632	6	
..1	441-0152	STOFF,#6-32,MALE/FEM 1/4	2	
..1	441-8217	STOFF,ALUM 1/4HEX X 5/8 6-32	5	
..1	450-1700	PLUG,HOLE,1/2 NYL BLACK 2643	4	
..1	465-0090-101	ANGLE,UPPER FRT PNL,CE EXCITER	1	
..1	465-0091-100	ANGLE,LOWER FRT PNL,FX50	1	
..1	466-0093	ANGLE,FRONT PANEL MOUNT,FX50	2	
..1	467-0178	BOOT,INSULATING FOR 360-6504	1	
..1	469-0365	FINGER STOCK,1S197520A	32	
..1	469-0365-1	STRIP,RFI SHIELD	2	
....2	469-0365	FINGER STOCK,1S197520A	2.75	
..1	469-0366-1	STRIP,RFI SHIELD 1.25	4	
....2	469-0366	FINGER STOCK (NOTE!!!!!)	1.25	
..1	469-0366-2	STRIP,RFI SHIELD 4.25	6	
....2	469-0366	FINGER STOCK (NOTE!!!!!)	4.25	
..1	471-0584-100	COVER,TOP,FM250C/E	1	
..1	471-0795	SHIELD,FRONT PANEL PCB,FX-50	1	
....2	471-0795-009	SHLD,FRT PNL PCB,FX-50,UNSCRND	1	
..1	471-0954-600	PANEL,STATUS,FM-250C IPA	1	
..1	471-2500-601	PANEL, REAR, 250W IPA, NEW VERSION	1	
....2	471-2500-009	PANEL,REAR,(UNSCREENED)FM-250C	1	
..1	471-2501-100	CHASSIS,FM-250C/E	1	

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
..1	471-2509	SHIELD,TOROID,FM-250C	1	
..1	471-2510	SHIELD,PWR CONNECTOR,FM-250C	1	
..1	471-5289-003	BRACKET,FUSE HOLDER,FM250,SCREENED T	1	
....2	471-5289	BRACKET,FUSE HOLDER,FX50,FM100,FM250,UNSCREENED	1	
..1	486-0004	HANDLE 1 3/4	2	
..1	486-0014	FERRULE,BLK,FOR .25 DIA HANDLE	4	
..1	488-0010	LATCH,LO-PROFILE 27-10-501-50	2	
..1	594-0250	LABEL,CAUTION,TOP COVER,FM EXC	1	
..1	597-1004-001	INSTRUCTION MANUAL, FM 250C FM IPA	1	
..1	601-1802	WIRE,AWG18,19/30 RED (*NOTE)	0.25	
..1	601-2209	WIRE,AWG22,7/30 WHT	0.5	
..1	611-2500	TUB,HT SHK,1/4	0.5	
..1	621-0001	CBL,COAX TEFLON RG 142B/U BELD	2.5	
..1	690-1200	TUB,BLK,PVC 105C,1/2	0.25	
..1	919-0108-600	METERING, FM-250 IPA	1	
....2	003-1054	CAP,CER,MNLY,.1uF,50V,20%	26	C15, C17, C18, C19, C24, C27, C28, C30, C31, C34, C35, C36, C37, C38, C39, C40, C41, C42, C43, C44, C45, C50, C52, C54, C56, C57
....2	023-1076	CAP,LYTIC,10uF,50V,STDUP	5	C32, C33, C51, C53, C55
....2	023-1084	CAP,LYTIC,100MFD,35V,STDUP,RAD	4	C46, C47, C48, C49
....2	030-3353	CAP,POLY FILM,.033UF,200V,10%	1	C29
....2	040-5013	CAP,MICA,50PF,500V,5%	1	C26
....2	042-3922	CAP,MICA,390PF,100V,5%	4	C7, C16, C23, C25
....2	100-1013	RES,1 OHM,1/4W,5%	2	R113, R114
....2	100-1041	RES,1K OHM,1/4W,1%	4	R16, R44, R47, R51

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
....2	100-1051	RES,10K OHM,1/4W,1%	9	R8, R52, R60, R66, R67, R68, R69, R70, R71
....2	100-1111	RES,118 OHM,1/4W,1%	1	R110
....2	100-1231	RES,121 OHM,1/4W,1%	4	R78, R80, R82, R88
....2	100-1551	RES,15K OHM,1/4W,1%	1	R57
....2	100-3161	RES,316K OHM,1/4W,1%	1	R10
....2	100-3373	RES,3.3MEG OHM,1/4W,5%	1	R59
....2	100-3951	RES,39.2K OHM,1/4W,1%	1	R48
....2	100-6031	RES,604 OHM,1/4W,1%	1	R89
....2	103-1007	RES,1 MEG OHM,1/4W,1%,METAL	2	R9, R54
....2	103-1024	RES,1.02K OHM,1/4W,1%,METAL	2	R46, R49
....2	103-1062	RES,100K OHM,1/4W,1%,METAL	4	R5, R53, R64, R65
....2	103-1105	RES,11K OHM,1/4W,1%,METAL	2	R7, R50
....2	103-1331	RES,1.33K OHM,1/4W,1%,METAL	2	R79, R81
....2	103-1826	RES,182K OHM,1/4W,1%,METAL	1	R58
....2	103-2003	RES,200 OHM,1/4W,1%,METAL	2	R75, R76
....2	103-2495	RES,24.9K OHM,1/4W,1%,METAL	1	R45
....2	103-2673	RES,267 OHM,1/4W,1%,METAL	1	R63
....2	103-3631	RES,365 OHM,1/4W,1%,METAL	1	R83
....2	103-4755	RES,47.5K OHM,1/4W,1%,METAL	2	R61, R62
....2	103-4951	RES,49.9K OHM,1/4W,1%,METAL	1	R55
....2	103-5112	RES,51.1 OHM,1/4W,1%,METAL	1	R77
....2	103-6193	RES,619 OHM,1/4W,1%,METAL	3	R72, R73, R74
....2	103-6343	RES,634 OHM,1/4W,1%,METAL	1	R1
....2	103-6984	RES,6.98K OHM,1/4W,1%,METAL	1	R43
....2	103-7503	RES,750 OHM,1/4W,1%,METAL	1	R3
....2	177-1054	RES,TRMR,10K,VERT ADJ	1	R56
....2	200-4742	DIODE,ZENER,1N4742A	2	D18, D19

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
....2	203-4005	DIODE,1N4005	2	D20, D21
....2	203-4148	DIODE,1N4148	6	D8, D9, D15, D16, D27, D26
....2	210-3906	2N3906 PNP 40V 2A .35W 250MHZ	1	Q4
....2	220-0317	VR,LM317LZ TO92	1	U17
....2	220-7136	A/D,3-1/2 DIGIT LCD,ICL7136CPL	1	U7
....2	221-4227	AMP,DUAL OP	1	U4
....2	225-0004	IC,CD4066BE	2	U3, U6
....2	226-2004	MC1416,ULN2004 7-DRLNGTNS DP16	1	U12
....2	227-0317	VR,LM317T,LM317KC	1	U14
....2	227-0337	VOLTAGE REGULATOR,3 TERM, NEG	2	U15, U16
....2	228-4028	IC,MC14028B	1	U11
....2	228-4071	IC,MC14070 QUAD EXCLUSIVE OR	1	U13
....2	228-4076	IC,MC14076 QUAD REGISTER	1	U10
....2	228-4532	IC,MC14532B 8-BIT PRIOR ENCOD	1	U9
....2	228-4538	IC,MC14538B NATL SEMICONDUCTOR	1	U8
....2	320-0016	LED,GRN PANEL INDICATOR	6	DS2, DS3, DS4, DS18, DS19, DS20
....2	320-0017	LED,RED MV57173 I OR H	6	DS7, DS8, DS13, DS14, DS15, DS16
....2	320-0021	DISP,LCD,4-DIGIT,0.7	1	DS12
....2	340-0107	KEYSWITCH,SI20601H1 SECME (NOTE)	5	S1, S2, S3, S4, S6
....2	402-0000	TY-RAP	1	
....2	413-0106	TERM,TEST POINT,OVAL,RED	7	E1, TP1, TP2, TP6, TP7, TP3, TP4
....2	417-0172	SKT, 20 PIN SINGLE ROW,SAMTEC	2	
....2	417-0200	CONN,HEADER 20 PIN	1	J14
....2	417-0804	SOCKET,8-PIN DIP,BURNDY	1	XU4
....2	417-1404	SOCKET,14-PIN DIP	3	XU3, XU6, XU13

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
....2	417-1604	SKT,16-PIN,DIP	5	XU8, XU9, XU10, XU11, XU12
....2	417-4005	SOCKET,40-PIN,DIP,HIGH RELIABILITY	1	XU7
....2	420-6104	SCREW,6-32X.250,S.S. PH	3	
....2	423-6002	#6 LOCK SPLIT	3	
....2	426-6000	PEM NUT,#6-32 KFS2-632	3	
....2	449-0006	TEST CLIP,COILED	1	
....2	519-0108-250	PCB,BLANK,METERING (scan)	1	
..1	919-0190	ASSY,PCB,FM EXITER INTERFACE	1	
....2	103-5141	RES,5.11K OHM,1/4W,1%,METAL	1	R1
....2	340-0004	SW,JUMPER PROGRAMMABLE	1	P3
....2	412-1600	BARR STP,16 POS,BEAU	1	J2
....2	417-0003	CONN,HEADER 3 PIN	1	J3
....2	417-2503	RCPT,25 PIN D, MALE	1	J1
....2	519-0190	PCB,MACH,FM EXCITER INTERFACE	1	
..1	919-0429	ASSY,PCB, SWITCHING P.S. FM-250C	1	
....2	002-2013	CAP,CER,DISC,20PF,1KV,10%	4	C16, C41, C46, C56,
....2	003-1054	CAP,CER,MNLY,.1uF,50V,20%	15	C4, C20, C24, C25, C30, C31, C32, C39, C40, C43, C44, C45, C54, C55, C60,
....2	003-4712	CAP,CER,47PF,50V,5%	1	C63
....2	003-4733	CAP,MONO CER,.047uF,50V,5%	1	C53,
....2	003-4743	CAP,CER MNLY,.47uF,50V,10%	2	C61, C62
....2	020-1026	CAP,LYTIC,1000UF,35,RADIAL	4	C5, C6, C7, C10,
....2	020-2273	CAP,LYTIC,22UF,35V,RADIAL	1	C21,
....2	020-4785	CAP,LYTIC,470UF,100V,20%,STDUP	6	C2, C3, C28, C29, C50, C51,
....2	020-4795	CAP,LYTIC,4700UF,100V,20%,SNAP MT	7	C1, C26, C27, C33, C34, C35, C36,

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
....2	023-1076	CAP,LYTIC,10uF,50V,STDUP	12	C8, C9, C11, C12, C13, C14, C15, C17, C18, C22, C38, C58,
....2	024-1064	CAP,LYTIC,1UF,50V,RAD	1	C49,
....2	030-1043	CAP,CER MOLDED,.01uF,200V,RAD	2	C37, C52,
....2	040-1522	CAP,MICA,150PF,500V,RAD	1	C57
....2	040-2223	CAP,MICA,220PF,500V,RAD	1	C23
....2	041-1031	CAP,MICA,1000PF,100V,1%	5	C19, C42, C47, C48, C59,
....2	100-1051	RES,10K OHM,1/4W,1%	9	R2, R12, R13, R38, R42, R54, R85, R17, R63
....2	100-1231	RES,121 OHM,1/4W,1%	8	R6, R8, R10, R21, R29, R75, R77, R78,
....2	100-1841	RES,1.82K OHM,1/4W,1%	1	R32,
....2	100-2713	RES,2.7 OHM,1/4W,5%	2	R14, R15
....2	100-3051	RES,30.1K OHM,1/4W,1%	2	R50, R98
....2	100-3373	RES,3.3MEG OHM,1/4W,5%	3	R47, R74, R76,
....2	103-1007	RES,1 MEG OHM,1/4W,1%,METAL	4	R43, R51, R24, R56
....2	103-1056	RES,105K OHM,1/4W,1%,METAL	1	R90,
....2	103-1062	RES,100K OHM,1/4W,1%,METAL	2	R89, R94
....2	103-1215	RES,12.1K OHM,1/4W,1%,METAL	1	R28,
....2	103-1331	RES,1.33K OHM,1/4W,1%,METAL	6	R7, R9, R22, R57, R80, R82,
....2	103-1376	RES,137K OHM,1/4W,1%,M	1	R100
....2	103-1404	RES,1.40K OHM,1/4W,1%,METAL	2	R71, R72,
....2	103-1693	RES,169 OHM,1/4W,1%,METAL	1	R92,
....2	103-2054	RES,2.05K OHM,1/4W,1%,METAL	1	R91,
....2	103-2211	RES,22.1K OHM,1/4W,1%,METAL	2	R4, R64,
....2	103-2212	RES,22.1 OHM,1/4W,1%,METAL	2	R33, R93
....2	103-2494	RES,2.49K OHM,1/4W,1%,METAL	6	R36, R39, R44, R45, R46, R27

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
....2	103-2495	RES,24.9K OHM,1/4W,1%,METAL	1	R68,
....2	103-2744	RES,2.74K OHM,1/4W,1%,METAL	2	R3, R5,
....2	103-3014	RES,3.01K OHM,1/4W,1%,METAL	10	R20, R25, R19, R37, R48, R53, R67, R81, R41, R99
....2	103-3631	RES,365 OHM,1/4W,1%,METAL	1	R11
....2	103-3922	RES,39.2 OHM,1/4W,1%,METAL	2	R34, R96
....2	103-4741	RES,4.75K OHM,1/4W,1%,METAL	2	R1, R30,
....2	103-4951	RES,49.9K OHM,1/4W,1%,METAL	3	R49, R52, R40,
....2	103-4996	RES,499K OHM,1/4W,1%,METAL	2	R66, R16,
....2	103-5112	RES,51.1 OHM,1/4W,1%,METAL	1	R31
....2	103-5141	RES,5.11K OHM,1/4W,1%,METAL	1	R18
....2	103-5764	RES,5.76K OHM,1/4W,1%,METAL	3	R86, R87, R88,
....2	103-5765	RES,57.6K OHM,1/4W,1%,METAL	1	R23,
....2	103-6813	RES,681 OHM,1/4W,1%,METAL	2	R83, R97
....2	110-2223	RES,22 OHM,1/2W,5%	1	R55,
....2	130-1033-300	RES,100 OHM,3W,1%	1	R79
....2	130-1053	RES,10K OHM,2W,5%	1	R95
....2	130-1843	RES,1.8K OHM,2W,5%	4	R59, R60, R61, R62,
....2	130-2223	RES,22 OHM,2W,5%	1	R73,
....2	132-0114	RES,1.5 OHM,10W,5%,WW	1	R26,
....2	139-0007	RES,.005 OHM,5W,3%,WW	3	R35, R58, R69,
....2	140-0006	VARISTOR,V130LA10A,GE	1	MOV1,
....2	177-2035	RES,TRMR,200 OHM,25T TOP ADJ	1	R65,
....2	177-2045	RES,TRMR,2K,10T,TOP ADJ 3299W	1	R84
....2	200-0015	DIODE,ZENER,15V,1W,1N4744A	1	D34
....2	200-0024	DIODE,ZENER,24V,1W,5%,1N4749A	1	D30,
....2	200-0027	DIODE,ZENER,1N4750A,27V	1	D31,
....2	200-1620	DIODE,FAST RECOVERY,16JPF20	1	D17,

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
....2	200-4751	DIODE,ZENER,IN4751A 30V 1W	1	D1,
....2	203-4005	DIODE,1N4005	5	D4, D6, D8, D22, D23,
....2	203-4148	DIODE,1N4148	16	D5, D7, D9, D10, D11, D14, D15, D16, D18, D19, D20, D21, D27, D28, D29, D33
....2	210-0120	TSTR,TIP120 NPN SILICON PWR	1	Q2,
....2	210-0250	TSTR,IRFP250,MOSFET	1	Q7,
....2	210-0511	TSTR,IRF511,POWER MOSFET	1	Q13,
....2	210-6520	TSTR,PNP,300V TO-92,.5A	3	Q10, Q11, Q12,
....2	210-7000	TSTR,2N7000,MOSFET	7	Q3, Q4, Q9, Q5, Q6, Q17, Q18
....2	211-0006	MPS-A06 NPN 80V .5A .3W 100MHZ	4	Q1, Q8, Q15, Q16,
....2	219-0031	TSTR,TIP31A	1	Q19
....2	220-0035	IC,LM35DZ CELSIUS TEMP SENSOR	1	U10,
....2	220-0311	IC,LT311 LINEAR	1	U8,
....2	220-3799	IC,MPQ3799,TRANS ARRAY,PNP	1	Q14,
....2	221-0072	AMP,OP,BIFET TLO72CP	1	U13,
....2	221-0393	IC,LM393N,VOLT COMPARATOR	1	U9,
....2	226-0500	RES NET,5K 16-PIN DIP 1%	1	R70,
....2	227-0317	VR,LM317T,LM317KC	3	U3, U4, U5,
....2	227-0337	VOLTAGE REGULATOR,3 TERM, NEG	1	U2,
....2	227-1074	IC,DC-DC CONVERTER,5A,60V,TO-220	1	U1,
....2	227-2125	IC,IR2125 HIGH SIDE DRVR, 500V	1	U7,
....2	228-3525	IC,SG3525AN,PWM CONTROL	1	U6,
....2	229-0111	IC,AC INPUT OPTO-ISOLATOR	2	U11, U12,
....2	229-0336	IC,VOLT REF DIODE LM336Z-2.5	1	D35
....2	230-0015	RECT,SILC,MR2406	2	D12, D13
....2	230-0020	RECT,ULTRAFAST,MUR820 8A 200V TO220	2	D2, D3,

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
....2	237-6508	SCR,2N6508	3	D24, D25, D32,
....2	239-0003	BRDG RECT,6PH20 EDI	1	D26,
....2	270-0065	REL,SPDT,12VDC,DIP	1	K1,
....2	360-2201	COIL,(L6),SWITCHING PWR SUPPLY (SBCM)	1	L6
......3	360-7157	TOROID,IRON PWDR,T157-52	1	
......3	555-2201	LABOR ONLT, 360-2201	1	
......3	640-1400	WIRE,14GA,MAGNET	0.174	
....2	360-2202	COIL,(L5),SWITCHING PWR SUPPLY (SBCM)	2	L5, L7,
......3	360-7068	TOROID,IRON PWDR,T68-52D	1	
......3	555-2202	LABOR ONLY 360-2202	1	
......3	640-1400	WIRE,14GA,MAGNET	0.014	
....2	364-0001	CHOKE,WBC2.5/A-3B1	3	L1, L2, L4,
....2	370-4701	XMFR,TOROID,(T1),SW PWR SUPPLY (SBCM)	1	T1
......3	360-7068	TOROID,IRON PWDR,T68-52D	1	
......3	555-4701	LABOR ONLY 370-4701	1	
......3	640-2200-1	WIRE,AWG 22,MAGNET,GRN	0.009	
......3	640-2200-2	WIRE,AWG 22,MAGNET,RED	0.009	
....2	402-0001	TY-RAP,T+B TY24M,1-1/4 DIA	2	
....2	407-0132	WASH,SHOULDER #4 .215 OD POLY	10	
....2	409-0247	INSULATOR,TO-218/247,ADHESIVE BACK	2	
....2	413-0025	TERM,TURRET,2 SHLDR,.360,GOLD FLASH	2	XR69
....2	413-0106	TERM,TEST POINT,OVAL,RED	6	TP1, TP2, TP3, TP4, TP5, TP6
....2	417-0230	CONN,20-PIN,MR SERIES,PCB,AMP	1	J20,
....2	417-0370	CONN,MALE,PCB MT,PLB127690 (NOTE)	1	J11,
....2	417-0600	SKT,IC 6 PIN	2	XU11, XU12,
....2	417-0804	SOCKET,8-PIN DIP,BURNDY	3	XU7, XU8, XU9,
....2	417-1604	SKT,16-PIN,DIP	1	XU6,

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
....2	420-4107	SCREW,4-40X.437,S.S. PH	10	
....2	420-4108	SCREW,4-40X.500,S.S. PH	2	
....2	420-6106	SCREW,6-32X.375,S.S. PH	3	
....2	420-6108	SCREW,6-32X.500,S.S. PH	7	
....2	420-6110	SCREW,6-32X.625,S.S. PH	1	
....2	421-4001	4-40 S.S. HEX NUT	12	
....2	421-6001	6-32 S.S. HEX THIN NUT	1	
....2	421-6008	6-32 KEP NUT	3	
....2	421-6908	SHEET EDGE CONNECTOR 6-32	6	
....2	423-4001	#4 FLAT SS .250 X .125 X .018	10	
....2	423-4002	#4 LOCK S.S. SPLIT	12	
....2	423-6002	#6 LOCK SPLIT	11	
....2	423-6011	#6 FLAT .310 X .160 X .030	2	
....2	441-0009	SPR,PHENOLIC 1/4RND X 1/2 #6	14	
....2	455-0071	HEATSINK,CLIP-ON,PCB MT,TO-220	3	XD32, XU2, XU3,
....2	471-2507	HEATSINK,PCB,SWITCHING POWER SUPPLY	1	
....2	471-2514	HEATSINK,LT,SWITCHING PWR SPLY	1	
....2	471-2515	BRKT,HEATSINK SUPT,SW PWR SPLY	1	
....2	519-0429	PCB,MACH,SWITCHING P.S. FM-25(scan)	1	
....2	700-0063	RTV,SEALANT 738 3 OZ DOW	0.001	
....2	DB68027	Sil Pad TO220 .75x.5" ADHSV Berquist 3223-07AC-58"	10	
..1	919-0430-600	ASSY,PCB FM250 IPA POWER CONTROL	1	
....2	003-1054	CAP,CER,MNLY,.1uF,50V,20%	19	C1, C2, C4, C5, C6, C7, C9, C10, C11, C12, C14, C15, C16, C19, C23, C27, C29, C30, C31
....2	003-4743	CAP,CER MNLY,.47uF,50V,10%	1	C33

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
....2	023-1084	CAP,LYTIC,100MFD,35V,STDUP,RAD	5	C22, C24, C25, C26, C28
....2	024-1064	CAP,LYTIC,1UF,50V,RAD	2	C17, C21
....2	031-1043	CAP,MYLAR FILM,.01UF,100V,RAD	2	C18, C20
....2	042-3322	CAP,MICA,330PF,500V,5%	2	C3, C8
....2	100-1013	RES,1 OHM,1/4W,5%	1	R95
....2	100-1024	RES,10 OHM,1/4W,5%,CARBON COMP	2	R64, R69
....2	100-1031	RES,100 OHM,1/4W,1%,METAL	1	R3
....2	100-1041	RES,1K OHM,1/4W,1%	12	R5, R21, R26, R38, R45, R55, R81, R82
....2	100-1051	RES,10K OHM,1/4W,1%	6	R41, R51, R60, R75, R76, R84
....2	100-1841	RES,1.82K OHM,1/4W,1%	1	R40
....2	100-2041	RES,2K OHM,1/4W,1%	4	R13, R19, R30, R36
....2	103-1007	RES,1 MEG OHM,1/4W,1%,METAL	4	R17, R34, R77, R83
....2	103-1062	RES,100K OHM,1/4W,1%,METAL	10	R44, R46, R54, R56, R63, R65, R66, R79, R87, R88
....2	103-1105	RES,11K OHM,1/4W,1%,METAL	2	R58, R61
....2	103-1244	RES,1.24K OHM,1/4W,1%,METAL	1	R20
....2	103-1261	RES,121K OHM,1/4W,1%,METAL	1	R70
....2	103-1551	RES,15.4K OHM,1/4W,1%,METAL	1	R2
....2	103-1561	RES,150K OHM,1/4W,1%,METAL	2	R14, R31
....2	103-2054	RES,2.05K OHM,1/4W,1%,METAL	1	R23
....2	103-2241	RES,2.21K OHM,1/4W,1%,METAL	1	R80
....2	103-2495	RES,24.9K OHM,1/4W,1%,METAL	3	R15, R32, R50
....2	103-3014	RES,3.01K OHM,1/4W,1%,METAL	4	R6, R27, R39, R89
....2	103-3325	RES,33.2K OHM,1/4W,1%,METAL	1	R78
....2	103-3405	RES,34K OHM,1/4W,1%,METAL	1	R49
....2	103-4024	RES,4.02K OHM,1/4W,1%,METAL	2	R62, R68

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
....2	103-4224	RES,4.22K OHM,1/4W,1%,METAL	1	R86
....2	103-4441	RES,4.42K OHM,1/4W,1%,METAL	3	R59, R92, R93
....2	103-4755	RES,47.5K OHM,1/4W,1%,METAL	4	R71, R72, R73, R74
....2	103-4874	RES,4.87K OHM,1/4W,1%,METAL	1	R43
....2	103-4951	RES,49.9K OHM,1/4W,1%,METAL	1	R85
....2	103-4996	RES,499K OHM,1/4W,1%,METAL	2	R1, R22
....2	103-5495	RES,54.9K OHM,1/4W,1%,METAL	1	R37
....2	103-6814	RES,6.81K OHM,1/4W,1%,METAL	1	R24
....2	103-6984	RES,6.98K OHM,1/4W,1%,METAL	2	R18, R35
....2	103-7505	RES,75K OHM,1/4W,1%,METAL	1	R53
....2	103-7541	RES,7.50K OHM,1/4W,1%,METAL	1	R94
....2	103-8663	RES,866 OHM,1/4W,1%,METAL	1	R42
....2	103-9315	RES,93.1K OHM,1/4W,1%,METAL	2	R8, R29
....2	110-1043	RES,1K OHM,1/2W,5%	3	R47, R48, R57
....2	177-1054	RES,TRMR,10K,VERT ADJ	2	R7, R28
....2	178-1054	RES,TRMR,10K,HORZ ADJ	2	R4, R25
....2	178-2044	RES,TRMR,2K,HORZ ADJ	1	R52
....2	178-5046	RES,TRMR,5K,1/2W,MT	1	R67
....2	200-0015	DIODE,ZENER,15V,1W,1N4744A	1	D9
....2	200-4733	DIODE,ZENER,1N4733A, 5%	2	D7, D12
....2	203-4005	DIODE,1N4005	2	D6, D11
....2	203-4148	DIODE,1N4148	7	D1, D2, D4, D5, D8, D10, D13
....2	210-3906	2N3906 PNP 40V 2A .35W 250MHZ	1	Q2
....2	210-7000	TSTR,2N7000,MOSFET	1	Q3
....2	211-3904	TSTR,2N3904	1	Q1
....2	220-3183	IC,CA3183 5 TRANS ARRAY NPN	2	U3, U4
....2	221-0074	AMP,OP,BIFET TLO74CW	2	U1, U2

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
....2	221-0358	AMP,DUAL OP,LM358	3	U5, U6, U7
....2	227-7905-A	IC,VR,MC79L05,-5V,T0-92 CASE	1	U9
....2	229-0336	IC,VOLT REF DIODE LM336Z-2.5	1	D3
....2	340-0004	SW,JUMPER PROGRAMMABLE	7	P6, P7, P8
....2	345-0863	SW,SLD,DPDT,SWCFT C56206L2	2	S1, S2
....2	413-0106	TERM,TEST POINT,OVAL,RED	15	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15
....2	417-0003	CONN,HEADER 3 PIN	7	J6, J7, J8
....2	417-0169	CONN 15 PIN 640503-1 AMP	2	J12, J13
....2	417-0200	CONN,HEADER 20 PIN	0.3	J5
....2	417-0804	SOCKET,8-PIN DIP,BURNDY	3	XU5, XU6, XU7
....2	417-1276	CONN,PCB,12 PIN	1	J10
....2	417-1404	SOCKET,14-PIN DIP	2	XU1, XU2
....2	417-1604	SKT,16-PIN,DIP	2	XU3, XU4
....2	418-0900	CONN,9 PIN 640501-5 AMP	1	J21
....2	519-0430	PCB,MACH,POWER CONTROL BD,FM-(scan)	1	
....2	601-2209	WIRE,AWG22,7/30 WHT	0.5	
..1	919-0445-600	RFI FILTER, 250W IPA, NEW VERSION	1	
....2	003-1054	CAP,CER,MNLY,.1uF,50V,20%	8	C304, C305, C306, C307, C308, C309, C310, C311
....2	100-1041	RES,1K OHM,1/4W,1%	3	R302, R306, R307,
....2	100-1051	RES,10K OHM,1/4W,1%	1	R303,
....2	103-5112	RES,51.1 OHM,1/4W,1%,METAL	2	R310, R311
....2	103-8254	RES,8.25K OHM,1/4W,1%,METAL	2	R304, R305,
....2	130-2423	RES,240 OHM,2W,5%	1	R301
....2	201-0027	ZENER VOLTAGE SUPPRESSOR,+/-27V	4	D302, D303, D304, D305

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
....2	201-0040	ZENER VOLTAGE SUPPRESSOR,+/-18V	4	D306, D307, D308, D309
....2	340-0004	SW,JUMPER PROGRAMMABLE	2	P308, P309
....2	411-0001	FILTER,EMI 10,000PF 3PIN	8	FL304, FL305, FL306, FL307, FL308, FL309, FL310, FL311
....2	417-0003	CONN,HEADER 3 PIN	2	J308, J309
....2	417-0200	CONN,HEADER 20 PIN	1	J307,
....2	417-1276	CONN,PCB,12 PIN	1	J306
....2	417-2502-FER	RCPT,25 PIN D,FEMALE,FERITE FILTER	1	J1
....2	426-6000	PEM NUT,#6-32 KFS2-632	10	
....2	519-0445-001	PCB,MACH,RFI FILTER	1	
......3	519-0445	PCB,MACH,RFI FILTER BREAKAWAY	0.5	
..1	949-0413-002	WIRE HARNESS,FM250 (SBCM)	1	
....2	402-0000	TY-RAP	40	
....2	402-0051	TY-RAP, W/FLAG	12	
....2	410-0015	LUG,TERM #8 RING CRIMP 12-10	1	
....2	410-1552	LUG,TERM #8 RING CRIMP 16-22	1	
....2	410-1553	LUG,TERM #10 RING CRIMP 16-22	1	
....2	417-0036	PIN CONN,AMP,350967-1	18	
....2	417-0053	SKT,CONN 641294-1 AMP	41	
....2	417-0059	CONN,9 PIN 1-640521-0 AMP	1	P21,
....2	417-0122	HSNG,20 POS MOD IV 3-87499-7	2	
....2	417-0123	HSNG,16 POS MOD IV 2-87499-9	1	
....2	417-0148	HSNG,10 POS MOD 1V 1-87499-7	1	
....2	417-0175	CONN, HOUSING, 20 PIN	1	
....2	417-0224	KEYING PLUG MOD IV 87077 AMP	2	
....2	417-0371	CONN,FEM,PLB12F0000,POSITRONIC	1	
....2	417-0372	CONTACT,CONN,FC112N2	3	

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
....2	417-0381	CONTACT,CONN,MC112N 7690	4	
....2	417-0421	CONN, MALE, 4 POSITION, POWER-LOK, WIRE	1	
....2	417-2379	CONN,155OC HOUSING,AMP,MR	2	P13, P12,
....2	417-8500	PLUG AND CORD ET,AM500 FAN	1	
....2	417-8766	CONTACT,CRIMP,MOD-IV 87809-1	52	
....2	418-0034	PLUG,BNC DUAL CRIMP 1-227079-6	2	
....2	418-1271	CONN,HOUSING,12PIN	2	P306, P10,
....2	601-1202	WIRE,AWG12 19/25 RED	1	
....2	601-1604	WIRE,AWG16, 19/29 YEL	2.2	
....2	601-1604-006	WIRE,AWG 16,STRANDED,LIGHT BLUE	0.3	
....2	601-1800	WIRE,AWG18 19/30 BLK	17	
....2	601-1800-006	WIRE,AWG 18,STRANDED,LIGHT BLUE	1.5	
....2	601-1800-054	WIRE,AWG 18,STRANDED,GREEN/YELLOW	3	
....2	601-2209	WIRE,AWG22,7/30 WHT	79.5	
....2	611-1875	TUB,HT SHK,3/16	1.6	
....2	621-1359	CBL,COAX,RG316/U,50 OHM	6	
....2	622-8451	WIRE,BELD 8451,SHIELD,1PR	10.5	
..1	959-0415-600	ASSY,RF AMP,FM-250 IPA	1	
....2	008-1033	CAP,FEEDTHRU,1000PF,20%,500V	5	
....2	009-1513	CAP,CER CHIP,15PF,500V,5%	1	C44
....2	009-4723	CAP,CER CHIP,470PF,200V,5%	4	
....2	130-3333	RES,330 OHM,2W,5%	1	
....2	210-0151	TSTR,RF PWR MOSFET,MRF-151G	1	
....2	213-6198	TSTR,RF PWR,2N6198	1	
....2	360-0003	FERRITE BEAD,.291 DIA	17	
....2	370-0052	XFMR,RF AMP OUTPUT,FM-3C	1	
....2	370-0721	INPUT TRANSFORMER	1	

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
....2	400-0207	STRIP,QUIET SHIELD,.250x.375""	0.22	
....2	402-0000	TY-RAP	1	
....2	402-0008	MTG DEVICE,FOR #6SCR,TIE CBL	1	
....2	402-0835	CLAMP,CBL,3/8	1	
....2	407-0119	MOUNT,PUSH,CBL TIE PM-1	1	
....2	407-0186	TOOL,ADJ 8 T000/5 SPECTROL	1	
....2	415-1010	FUSE CLIP,LITTLEFUSE,101002	2	
....2	417-0017	RECP,BNC,BULKHEAD,UG-492A/U	1	
....2	417-0133-001	WIRE STUFFER CAP,#230707-1,AMP	1	
....2	420-0305	SCREW,4-40X.375,BR PH SC	2	
....2	420-0504	SCREW,6-32X.375,BR PH SC	6	
....2	420-0509	SCREW,10-32X.500,BR SL PAN HD	1	
....2	420-4105	SCREW,4-40X.312,S.S. PH	2	
....2	420-6105	SCREW,6-32X.312,S.S. PH	2	
....2	420-6106	SCREW,6-32X.375,S.S. PH	23	
....2	420-6108	SCREW,6-32X.500,S.S. PH	4	
....2	420-6131	SCREW,6-32X.875,BR PH SC	2	
....2	420-6604	SCREW,6-32X.250,S.S. PH FH UC	2	
....2	420-8109	SCREW,8-32X.250,BR PH	4	
....2	421-0801	#10-32 BR HEX NUT	1	
....2	421-6908	SHEET EDGE CONNECTOR 6-32	7	
....2	421-8002	8-32 HEX NUT, BRASS	1	
....2	423-0005	#10 LOCK SPLIT (BRONZE)	1	
....2	423-1012	#4 LOCK INT TOOTH (BRONZE)	2	
....2	423-6002	#6 LOCK SPLIT	29	
....2	423-6004	#6 LOCK SPLIT (BRONZE)	8	
....2	423-6011	#6 FLAT .310 X .160 X .030	8	
....2	423-8005	#8 LOCK SPLIT	4	

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
....2	450-0651	PLUG,HOLE,5/16	2	
....2	455-0049-003	HEATSINK,RF AMP,FM250C	1	
......3	455-0049-001	HEATSINK,RF AMP,FX50	1	
......3	555-0049-003	COST,LABOR 455-0049-003	1	
....2	471-2504	COVER,RF AMP, FM-250C	1	
......3	471-2504-009	COVER,RF AMP (UNSCREENED) FM-250C	1	
....2	471-2505	PLATE, BACK, RF AMP, FM-250C	1	
....2	471-2506	SHIELD,LOW PASS FILTER, FM-250C	1	
....2	471-2511	SHIELD,LOW PASS FILTER,RF AMP	1	
....2	471-2513	STRIP,CLIP-ON,RF AMP	1	
....2	474-0301	PLATE,FRT,RF AMP PCB COVER	1	
....2	594-0500	LABEL,DANGER	1	
....2	919-0410-600	ASSY,PCB,RF INPUT,FM-250 IPA	1	
......3	003-1523	CAP,MONO CER,.0015uF,100V,5%	2	C44, C45
......3	024-2274	CAP,LYTIC,22UF,100V,STDUP	2	C16, C42
......3	038-4753	CAP,PYST,.47UF,100V	1	C17
......3	040-5612	CAP,MICA,56PF,350V,10%	1	C43
......3	040-6813	CAP,MICA,68PF,500V,5%	1	C9
......3	042-2000	CAP,MICA,200PF,350V,10%	2	C10, C11
......3	042-3922	CAP,MICA,390PF,100V,5%	6	C5, C6, C7, C8, C15, C24
......3	046-0003	CAP,MICA,RF,80PF,350V,10%	2	C13, C14
......3	046-0005	CAP,MICA,150PF,350V,10%	1	C12
......3	046-0022	CAP,MICA,RF,22PF	1	C18
......3	100-1051	RES,10K OHM,1/4W,1%	2	R4, R2
......3	100-1231	RES,121 OHM,1/4W,1%	1	R27
......3	100-2041	RES,2K OHM,1/4W,1%	2	R5, R12
......3	103-1021	RES,10 OHM,1/4W,1%,METAL	2	R28, R14

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	103-2212	RES,22.1 OHM,1/4W,1%,METAL	1	R8
......3	103-2495	RES,24.9K OHM,1/4W,1%,METAL	1	R10
......3	103-4755	RES,47.5K OHM,1/4W,1%,METAL	1	R3
......3	103-5112	RES,51.1 OHM,1/4W,1%,METAL	1	R7
......3	110-3623	RES,36 OHM,1/2W,5%	1	R6
......3	130-2223	RES,22 OHM,2W,5%	1	R9
......3	177-1055	RES,TRMR,10K,10 TURN TOP ADJ	1	R11
......3	211-3904	TSTR,2N3904	1	Q2
......3	218-0032	TSTR,TIP32A,2N6125	1	Q3
......3	330-0200	FUSE,3AG,2 AMP	1	F1
......3	364-0002	CHOKE,VK200-20/4B FERROXCUBE	2	L1, L4
......3	364-0010	CHOKE,MOLDED RF 10UHY 10%	1	L3
......3	364-0051	COIL,MOLDED .051UH	1	L2
......3	410-0025	TERM,MALE DISCONNECT PC .25TAB	1	E101
......3	415-2068	CLIP,FUSE,15AMP,LITTLEFUSE,102071	2	
......3	417-0677	CONN,PCB MT,6PIN MALE	1	J16
......3	519-0426	PCB,MACH,RF AMP INPUT, FM-100C	1	
......3	640-1800	WIRE AWG 18 EN MAGNET	0.031	L5
....2	919-0427	ASSY,PCB,RF AMP OUTPUT BD,FM-250C	1	
......3	009-1032	CAP,CER CHIP,1000PF,100V,5%	3	C19, C20, C21,
......3	009-1033	CAP,CER CHIP,1000PF,500V,5%	1	C38,
......3	046-1030	CAP,METAL FEED,1000PF,350V,10%	1	C31
......3	101-2243	RES,CHIP,2.2K OHM,1/4W,5%	3	R15, R16, R17,
......3	111-2223	RES,CHIP,22 OHM,1W,5%	4	R18, R19, R20, R21,
......3	130-1023	RES,10 OHM,2W,5%	1	R29,
......3	220-0035	IC,LM35DZ CELSIUS TEMP SENSOR	1	U2,
......3	360-0146	CHOKE,RF AMP DECOUPLING,FM-1C	1	L6
........4	640-1400	WIRE,14GA,MAGNET	0.04	

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	410-0025	TERM,MALE DISCONNECT PC .25TAB	1	E102,
......3	417-0133	TERM,BARREL .125 552699-4 AMP	1	E103,
......3	519-0427	PCB,MACH,RF AMP OUTPUT BD,FM-250C	1	
......3	600-0008	FLEXSTRIP, 7 COND 1	1	P24,
....2	919-0428	ASSY,PCB,LPF/COUPLER BD,FM-250C	1	
......3	003-3312	CAP,CER,33PF,100V,5%	2	C220, C221,
......3	009-1013-001	CAP,CER CHIP,10pF,500V,2%	3	C201, C212, C213,
......3	009-1032	CAP,CER CHIP,1000PF,100V,5%	5	C215, C216, C217, C218, C219,
......3	009-1503	CAP,CER CHIP,1.5pF,500V,+1-.250pF	2	C222, C214,
......3	009-1513-001	CAP,CER CHIP,15pF,500V,2%	4	C204, C205, C209, C208,
......3	009-5613	CAP,CER CHIP,56PF,500V,5%	1	C223,
......3	009-8003-001	CAP,CER CHIP,8.2pF,500V,3%	4	C203, C206, C202, C207,
......3	096-0010	CAP,TRMR,CER,2-8PF,350V,LUG MNT,NPO	1	C211,
......3	100-1051	RES,10K OHM,1/4W,1%	4	R204, R205, R209, R203,
......3	100-1231	RES,121 OHM,1/4W,1%	1	R210,
......3	103-1561	RES,150K OHM,1/4W,1%,METAL	1	R207,
......3	103-4996	RES,499K OHM,1/4W,1%,METAL	1	R201,
......3	103-5141	RES,5.11K OHM,1/4W,1%,METAL	1	R202,
......3	103-6040	RES,60.4 OHM,1/4W,1%,METAL	1	R206,
......3	177-1035	RES,TRMR,100 0HM,25T TOP 3299W	1	R208,
......3	201-2800	DIODE,HOT CARRIER	3	D201, D202, D203,
......3	360-0145	COIL,L1,FM-1C LPF (SBCM)	1	L204,
........4	640-1200	WIRE,12GA,MAGNET	0.035	
......3	360-0147	COIL,3.5 TURNS,LPF,FM100C (SBCM)	1	L203,
........4	601-0111	12 AWGBUSS .080 FLOOR STOCK FT	0.45	
......3	360-0148	COIL,4.5 TURNS,LPF,FM100C (SBCM)	2	L202, L201,

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
........4	601-0111	12 AWGBUSS .080 FLOOR STOCK FT	0.51	
......3	400-1259	GROMMET,3/8 OD X 5/32 ID #1259	1	
......3	402-0000	TY-RAP	2	
......3	519-0428	PCB,MACH,LPF/COUPLER BD,FM-250C	1	
......3	600-0008	FLEXSTRIP, 7 COND 1	1	J201,
......3	949-0415	WIRE HARNESS LPF FM-250C (SBCM)	1	
........4	402-0051	TY-RAP, W/FLAG	2	
........4	417-8029	CONN,JACK,BULKHEAD,SMA,HEX CRIMP	1	
........4	417-8031	CONN,PLUG,STRAIGHT,SMA,HEX CRIMP	1	
........4	418-0031	PLUG,N FOR RG-58/142B/U	1	
........4	418-0034	PLUG,BNC DUAL CRIMP 1-227079-6	1	
........4	611-1250	TUB,HT SHK,1/8	1.75	
........4	621-0001	CBL,COAX TEFLON RG 142B/U BELD	1	
........4	621-1359	CBL,COAX,RG316/U,50 OHM	1	
....2	949-0414	WIRE HARNESS,RF AMP, FM-250C (SBCM)	1	
......3	402-0000	TY-RAP	12	
......3	402-0051	TY-RAP, W/FLAG	3	
......3	410-0051	LUG,TERM,14-16GA,FEMSPADE	2	
......3	410-0060	LUG,TERM,#10 RING CRIMP 10-12G	1	
......3	410-1553	LUG,TERM #10 RING CRIMP 16-22	1	
......3	417-0053	SKT,CONN 641294-1 AMP	46	
......3	417-0176	CONN,20 PIN FEM,AMP 1-350245-9	2	P15, P20,
......3	418-0026	PLUG,KEYING 350591-1 AMP	1	
......3	418-0034	PLUG,BNC DUAL CRIMP 1-227079-6	1	W1
......3	418-0670	HOUSING,CONN,6PIN FEM	1	P16
......3	601-1604	WIRE,AWG16, 19/29 YEL	0.75	
......3	601-1800	WIRE,AWG18 19/30 BLK	17	
......3	601-2209	WIRE,AWG22,7/30 WHT	12	

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	621-1359	CBL,COAX,RG316/U,50 OHM	0.65	
..1	969-0007-100	KIT, HARDWARE RACK FM-100C/250C	1	
....2	402-0001	TY-RAP,T+B TY24M,1-1/4 DIA	4	
....2	420-0108	SCREW,10-32X.500,S.S. PHH	4	
....2	420-0508	SCREW,10-32X.500,S.S. FLH	8	
....2	420-8110	SCREW,8-32X.625,S.S. PHH	4	
....2	421-0102	10-32 KEP NUT	8	
....2	423-0001	WASHER,FLAT,#10 SST,.438 X .203 X .065	8	
....2	459-0138	RETAINER,SLIDE BRKT	2	
....2	469-0415	SLIDE, EXCITER CHASSIS	1	
....2	470-0238	BRKT,MTG,APC+IPA,FM1.5A	4	
....2	701-0005	ANTISTATIC ZIPLOC BAG 4X6 4MIL	1	

10 RF Technical Services Contact Information

RF Technical Services -

Telephone: **(217) 224-9617**
E-Mail: **rfservice@bdcast.com**
Fax: **(217) 224-6528**
web: **www.bdcast.com**

11 Drawings

The following pages present the FM-250C IPA unit drawings.

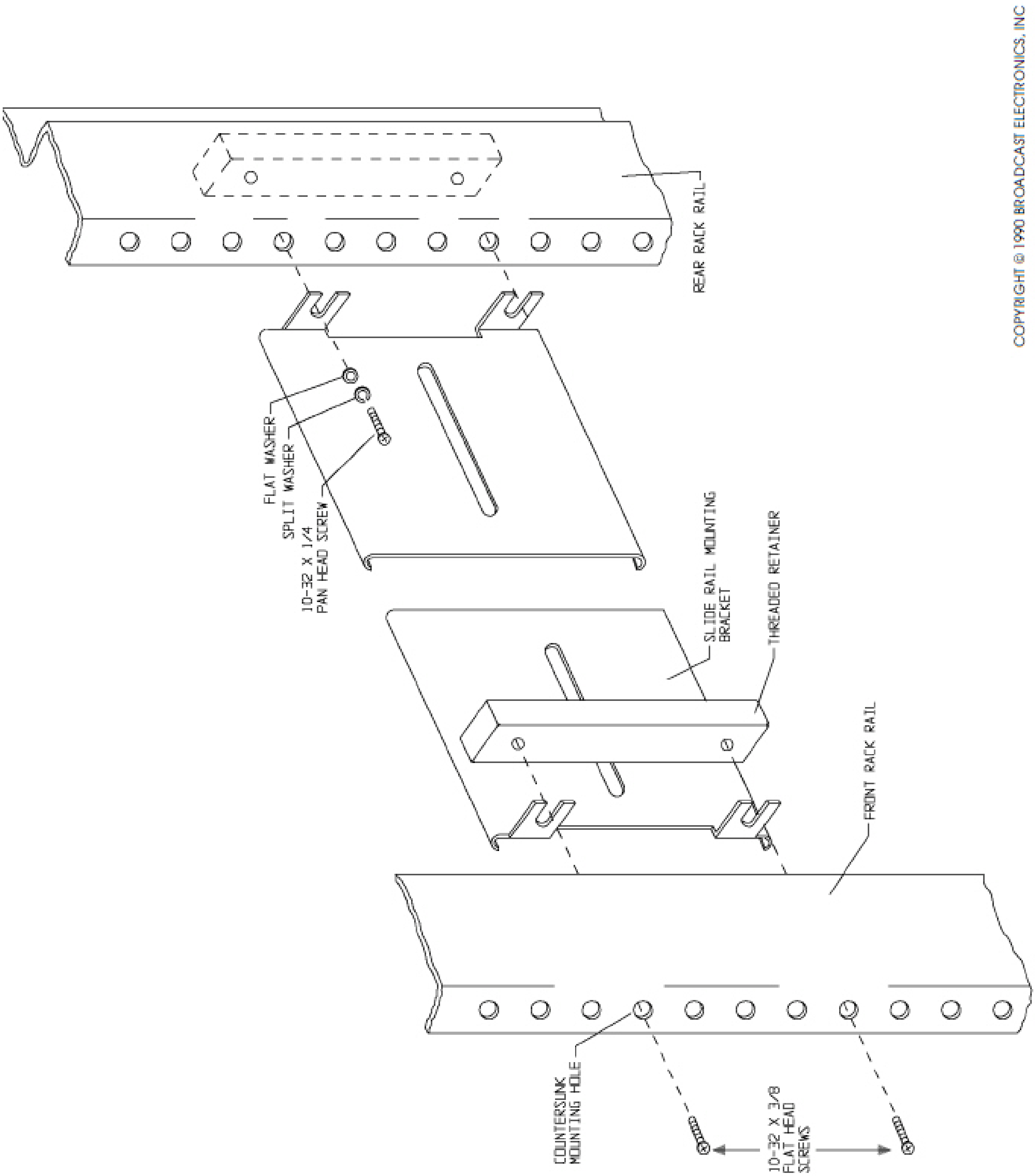
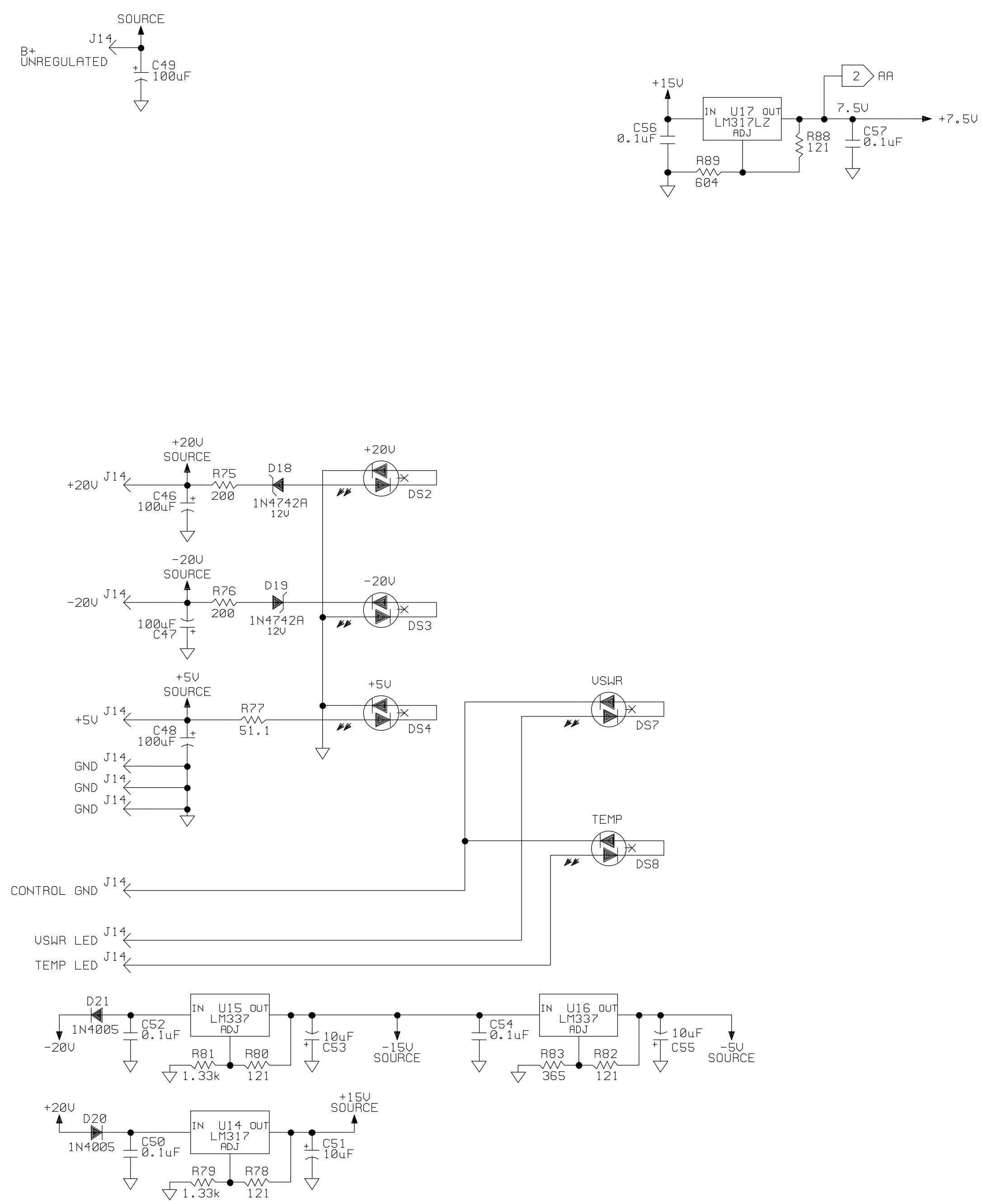


Figure 11-1. IPA UNIT FRONT RAIL MOUNTING APPLICATIONS

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN



NOTES:

1. ALL RESISTORS IN OHMS, 1/4W, 1%, UNLESS OTHERWISE SPECIFIED.

TOLERANCE (DECIMAL) U.O.S.
.x ± .030 .xxx ± .005
.xx ± .015 ANGLES ± 1°

DWN. BY

DESIGNER(S)

PROJ. LEADER

MFG.

MATERIAL

FINISH

SEE DWG RA592-0000

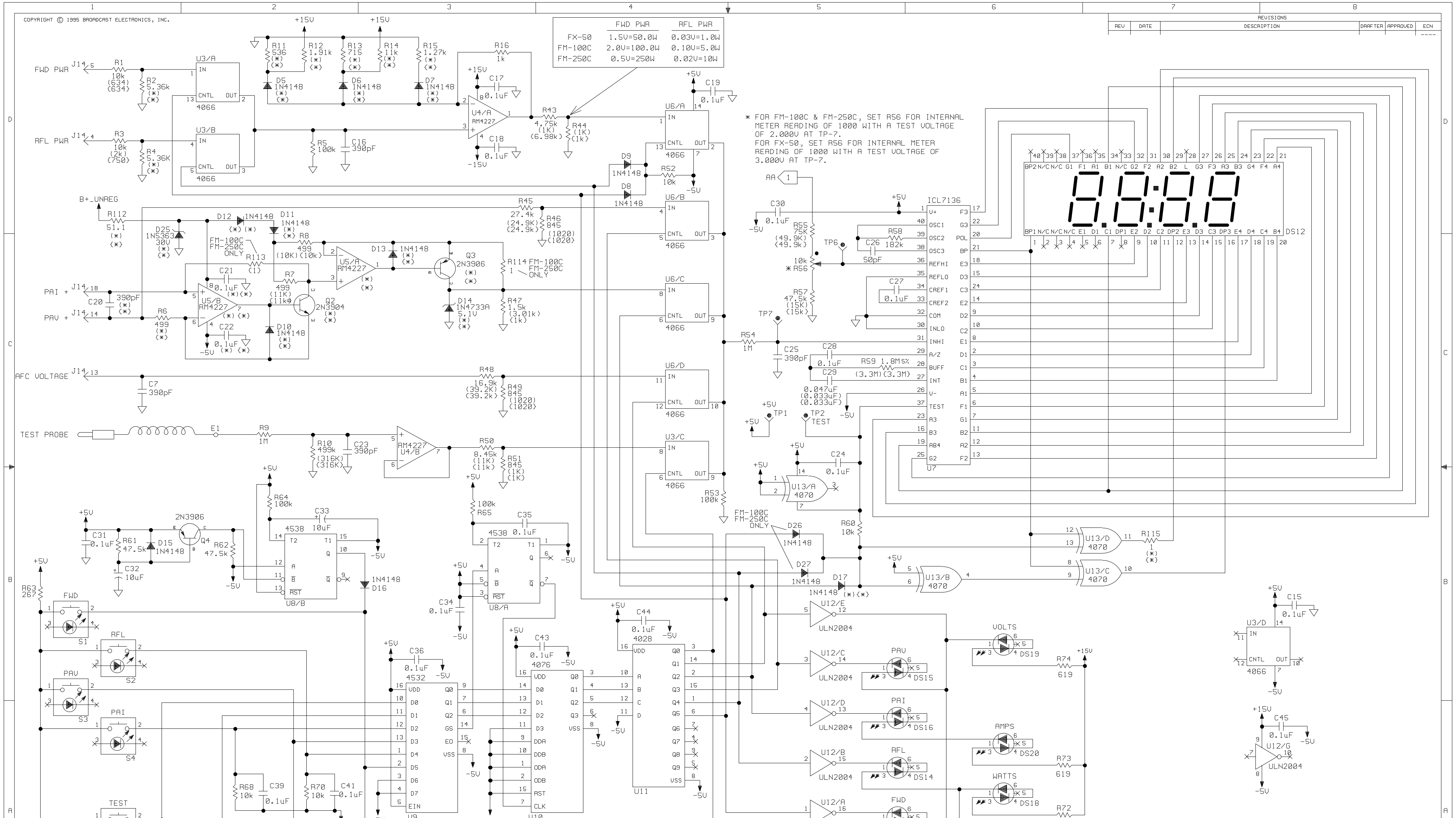
NEXT ASSY.

BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305 217/224-9600
TELEX 250142 CABLE BROADCAST FAX 217/224-9607

TITLE SCHEMATIC METERING PCB

TYPE	SIZE	DWG. NO.	REV
S	B	919-0108-600	

MODEL	SCALE	SHEET
IPA250W	NONE	1 OF 2



	FWD PWR	RFL PWR
FX-50	1.5V=50.0W	0.03V=1.0W
FM-100C	2.0V=100.0W	0.10V=5.0W
FM-250C	0.5V=250W	0.02V=10W

TOLERANCE (DECIMAL) U.O.S.
.x ± .030 .xxx ± .005
.xx ± .015 ANGLES ± 1°

DWN. BY
DESIGNER(S)
PROJ. LEADER
MFG.
MATERIAL
FINISH
SEE DWG RA592-0000
NEXT ASSY.

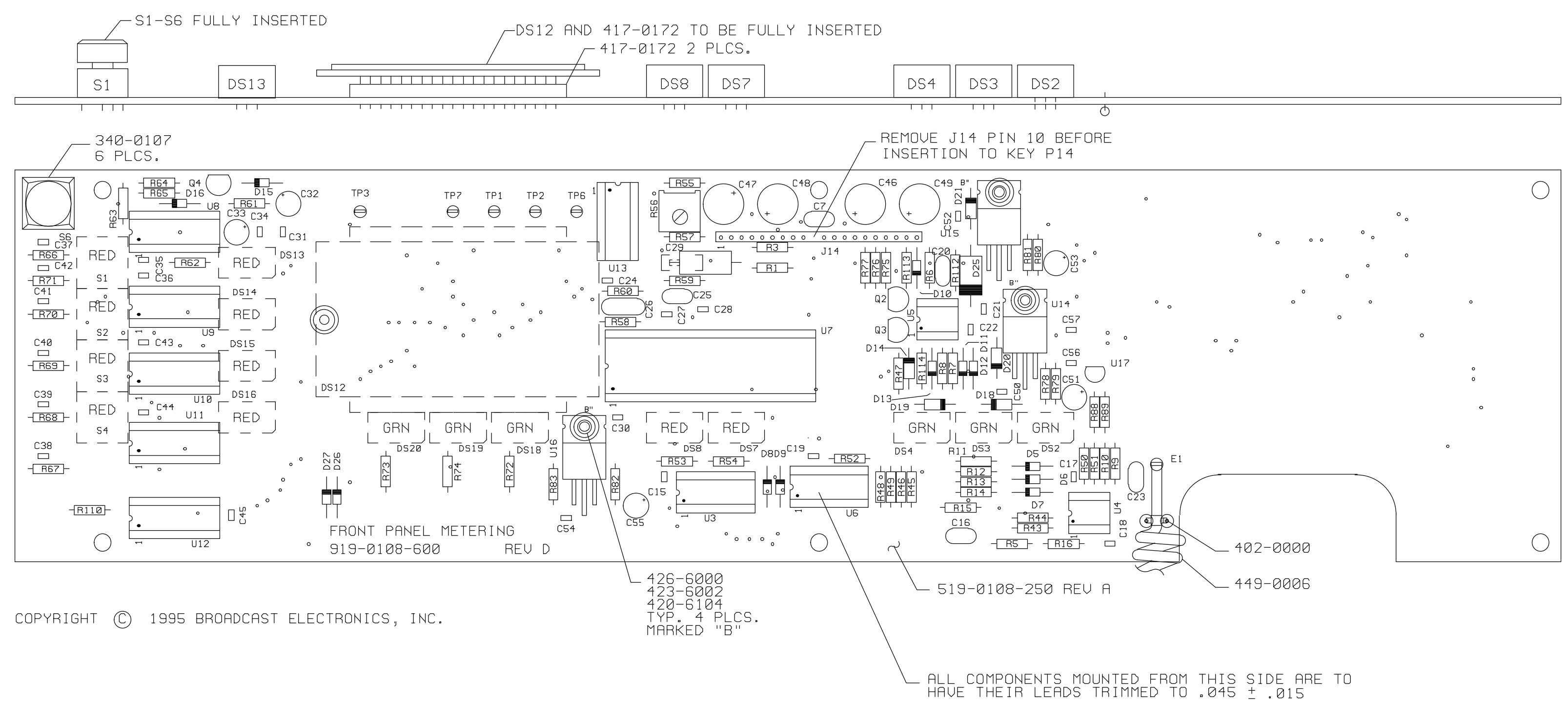
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305 217/224-9600
TELEX 250142 CABLE BROADCAST FAX 217/224-9607

TITLE SCHEMATIC METERING PCB

TYPE	SIZE	DWG. NO.	REV
S	B	919-0108-600	

MODEL IPA250W SCALE NONE SHEET 2 OF 2

REVISIONS					
REV	DATE	DESCRIPTION	DFTSMN	ENGR	ECN
D	1-5-01	DELETED R2,R4,R115,D17,DS17 & S5	KT		----



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TOLERANCE (DECIMAL) U.O.S.
.X ± .030 .XXX ± .005
.XX ± .015 ANGLES ± 1°

DWN. BY
CHKD
ME
PROJ. ENGR.
MFG.

MATERIAL
FINISH
~~SEE DWG AA592-0000~~
NEXT ASSY.

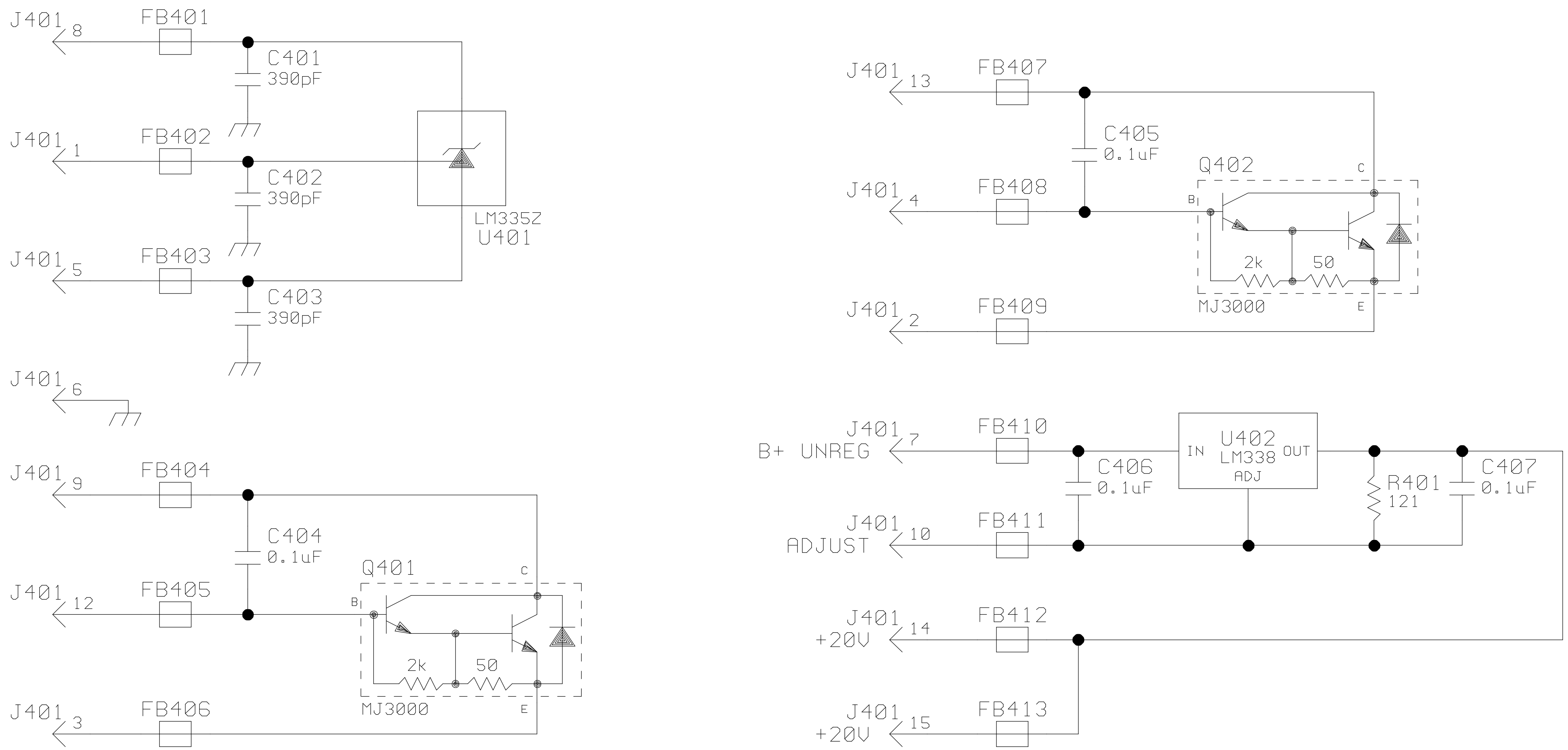
BE ® BROADCAST ELECTRONICS INC.
4100 N.24TH ST. P.O.BOX 3606 QUINCY,IL. 62305 PH. 217/224-9600
TELEX 250142 CABLE BROADCAST FAX 217/224-9607

TITLE
PCB ASSEMBLY
FRONT PANEL METERING BD

TYPE	SIZE	DWG No.	REV
A	C	919-0108-600	D

MODEL IPA250W SCALE 1=1 SHEET 1 OF 1

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
A	3-29-93	PROTOTYPE RELEASE.	JLF		----
-	8-2-93	MODEL BUILD RELEASE.	JLF	CLL	----
-	10-8-93	ENGINEERING RELEASE.	JLF		----



NOTES:

1. ALL REFERENCE DESIGNATORS START AT 401.
1. ALL RESISTORS IN OHMS; 1/4W, 1% UNLESS OTHERWISE SPECIFIED.
2. LAST COMPONENT USED: C407, FB413, J401, Q402, R401, U402
3. COMPONENTS NOT USED:
4. SEE ASSEMBLY: AC919-0410-004

TOLERANCE (DECIMAL) U.O.S.
.x ± .030 .xxx ± .005
.xx ± .015 ANGLES ± 1°

DWN. BY JLF 3-29-93

DESIGNER(S) CLL 8/4/93

PROJ. LEADER

MFG.

MATERIAL

FINISH

SEE DWG AA592-0000

NEXT ASSY.

BE® BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305 217/224-9600
TELEX 250142 CABLE BROADCAST FAX 217/224-9607

TITLE SCHEMATIC RF AMP REGULATOR PCB

TYPE	SIZE	DWG. NO.	REV
S	B	919-0410-004	A

MODEL FM-100C | SCALE NONE | SHEET 1 OF 1

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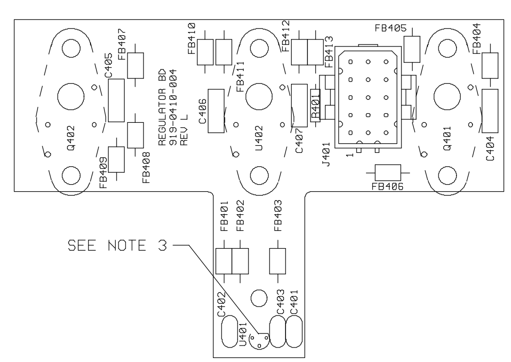
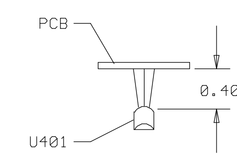
REVISIONS						
REV	DATE	SUFFIX/REV	DESCRIPTION	DRAFTER	APPROVED	ECN
C	8-2-93	-	MODEL BUILD RELEASE.	JLF	CLL	----
D	10-5-93	-001 -003	INCREASED PAD CLEARANCES TO GND PLANE ON -001 & -003 BDS. C312-313 WERE 040-1022. ADD DETAIL "B".	JLF	CLL	9085
-	10-8-93	-	ENGINEERING RELEASE.	JLF	CLL	----
E	10-13-94	- -003	SEPARATED -001 BD FRM BRKWY. SEE AB919-0410-001. RENAMED TB301 TO TB1.	JLF	BG	9295 9309
F	6-2-95	-003 -004 -005	UPDATED SILKSCREEN ARTWORK.	JLF	CLL	9444
G	11-13-95	-003	ADDED NOTE AS TO LENGTH OF WIRE FOR J301-J305	MERK		9573
H	11-27-96	-003 -004	ADDED NOTE 5, 1.0 IN WAS .75	MSE	DL	9636
J	1-6-96	-003	ADDED R310, R311, J308, J309	MSE	DL	9703
K	5-7-97	-005	519-0410-005J WAS 519-0410-005G	MSE	DL	9801
L	6-21-01	ALL	OBSOLETED -004 & -005, SEPERARTED 517-0036 & 0410-004	KT		10459

NOTES:

1. COMPONENTS SHOWN WITH DASHED LINES TO BE INSTALLED ON OPPOSITE SIDE.
2. TAPE TO BE PLACED OVER MOUNTING HOLES OF Q401-402 & U401-402 BEFORE SOLDER REFLOW.
3. U401 TO BE MOUNTED ON OPPOSITE SIDE AND SPACED OFF FROM PCB SURFACE AS SHOWN IN DETAIL "A".





DETAIL "A"

PROPRIETARY RIGHTS are included in information disclosed herein. This information is submitted in confidence and neither this document nor the information disclosed herein shall be reproduced or transferred to other documents or used or disclosed to others for manufacturing or for any other purpose except as specifically authorized in writing by BROADCAST ELECTRONICS, INC.	DWN. BY JLF 7/13/93 DESIGNER(S) JRC 8/4/93, CLL 8/4/93 PROJ. LEADER	MATERIAL SEE BOM 919-0410-004 FINISH ~~SEE DWG RA592-0000~~	BROADCAST ELECTRONICS INC. 4100 N.24TH ST. P.O.BOX 3606 QUINCY,IL. 62305 PH. 217/224-9600 TELEX 250142 CABLE BROADCAST FAX 217/224-9607 TITLE PCB ASSEMBLY RFI FILTER/REGULATOR
TOLERANCE (DECIMAL) U.O.S. .X ± .030 .XXX ± .005 .XX ± .015 ANGLES + 1°	MFG.	NEXT ASSY. -	TYPE A, SIZE C, DWG No. 919-0410-004, REV L MODEL FM-100C, SCALE 1:1, SHEET 1 OF 1

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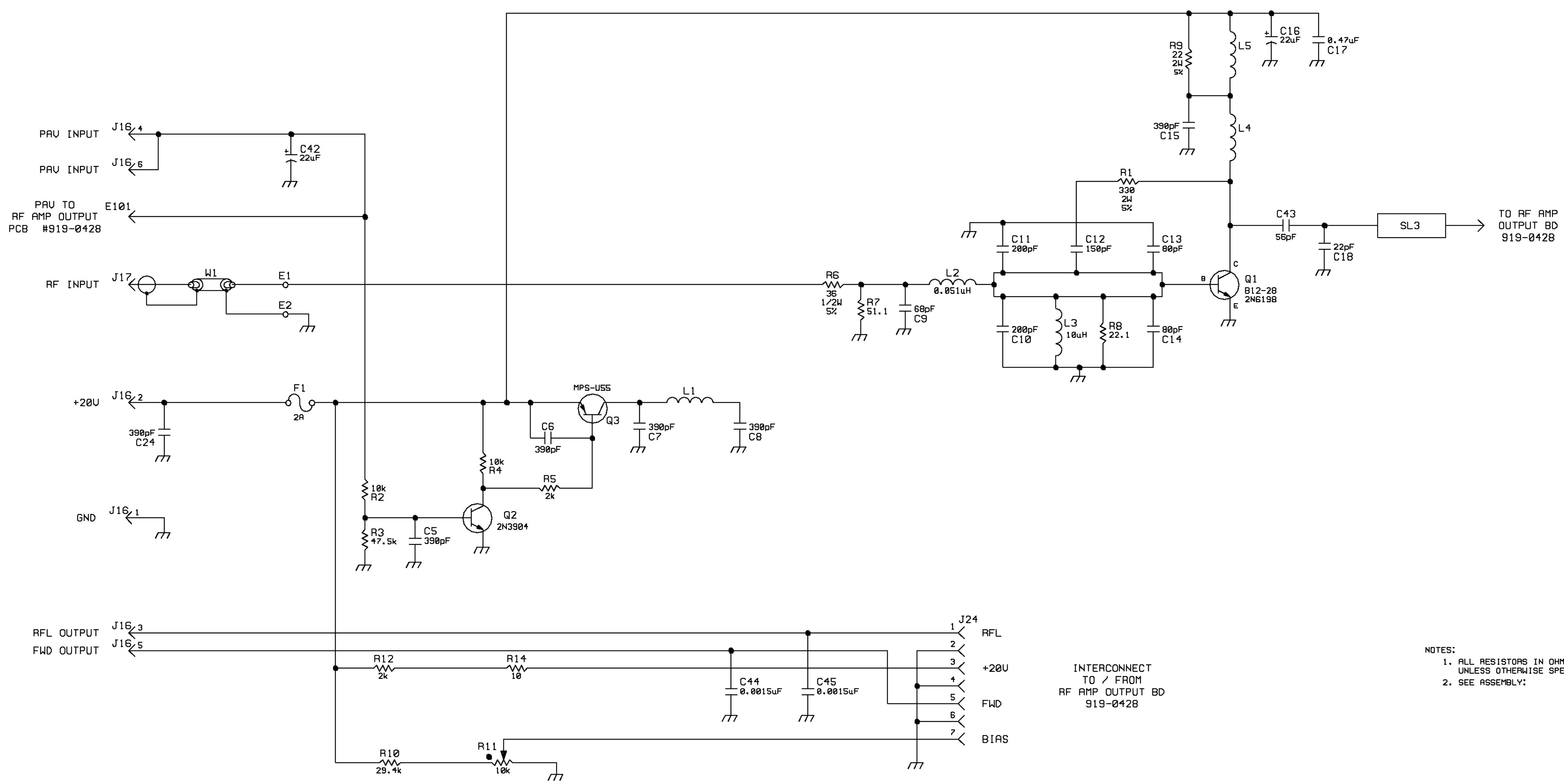
REVISIONS

REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN



NOTES:
1. ALL RESISTORS IN OHMS, 1/4W, 1%, UNLESS OTHERWISE SPECIFIED.
2. SEE ASSEMBLY:

TOLERANCE (DECIMAL) U.O.S.
.x ± .030 .xxx ± .005
.xx ± .015 ANGLES ± 1°

DWN. BY

DESIGNER(S)

PROJ. LEADER

MFG.

MATERIAL

FINISH

SEE DWG A8592-0000

NEXT ASSY.

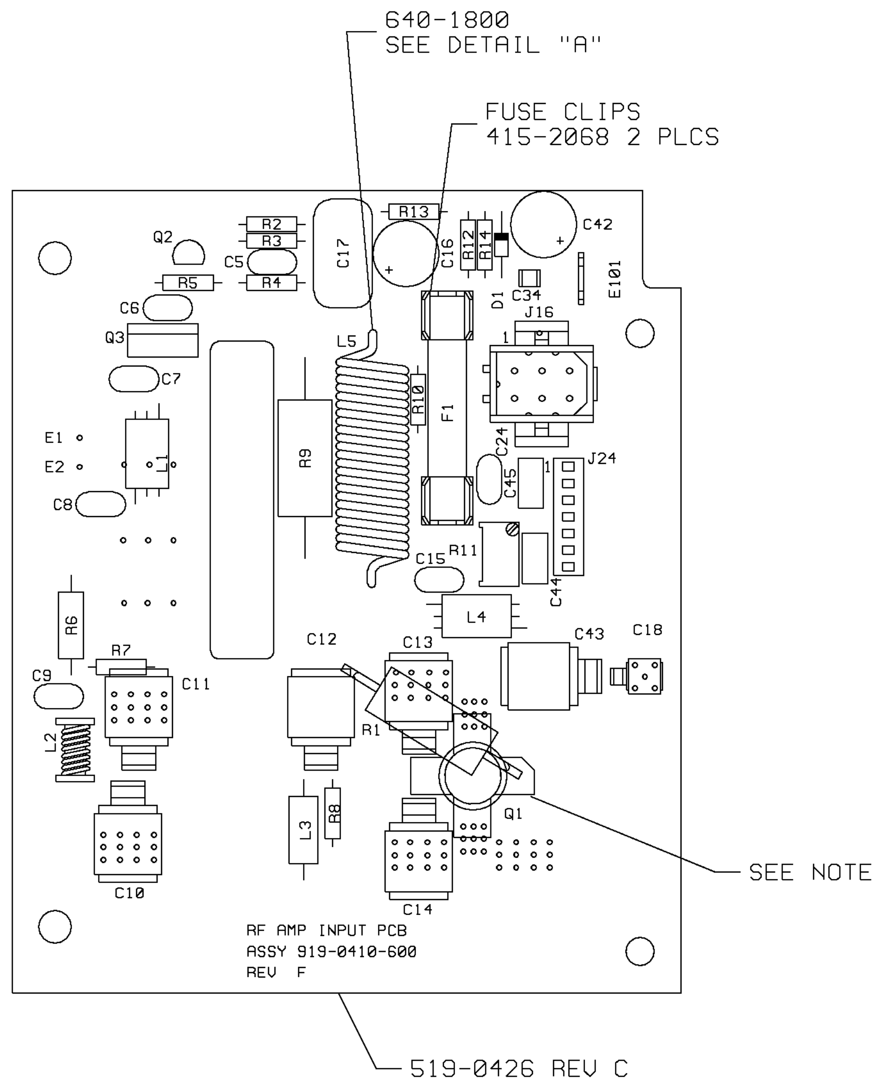
BE® BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305 217/224-9600
TELEX 250142 CABLE BROADCAST FAX 217/224-9607

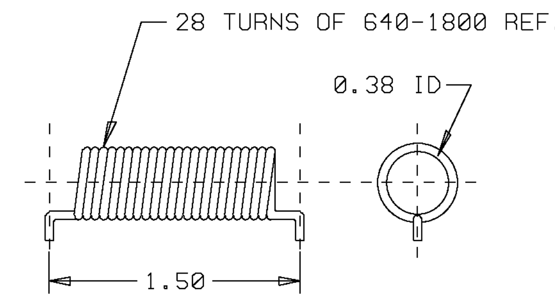
TITLE SCHEMATIC RF AMP INPUT PCB

TYPE	SIZE	DWG. NO.	REV
S	D	919-0410-600	A

MODEL IPA250W SCALE NONE SHEET 1 OF 1

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN





DETAIL "A"

SCALE = 1:1

NOTES:

1. COMPONENTS Q1 & R1 ARE INSTALLED DURING RF AMP FINAL ASSEMBLY, AND ARE SHOWN HERE FOR REFERENCE ONLY.

TOLERANCE (DECIMAL) U.O.S.
.X ± .030 .XXX ± .005
.XX ± .015 ANGLES + 1°

DWN. BY

DESIGNER(S)

PROJ. LEADER

MFG.

MATERIAL

FINISH

NEXT ASSY.

BROADCAST ELECTRONICS INC.
4100 N. 24TH ST. P.O.BOX 3606 QUINCY,IL. 62305
217/224-9600 FAX 217/224-9607

TITLE PCB ASSEMBLY
RF AMP INPUT BD

TYPE	SIZE	DWG No.	REV
A	B	919-0410-600	

MODEL IPA250W | SCALE 1:1 | SHEET 1 OF 1