FM–10T
FM–10TS
10 KILOWATT
FM TRANSMITTERS

November, 1998 IM No. 597–0098–014

IMPORTANT INFORMATION

EQUIPMENT LOST OR DAMAGED IN TRANSIT.

When delivering the equipment to you, the truck driver or carrier's 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 – REPLACEMENT PARTS.

Technical assistance is available from Broadcast Electronics by letter, prepaid telephone, fax, 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 Customer Service Department for a shipping container. Do not the mail equipment. We can assume no liability for inbound damage, and necessary repairs become the obligation of the shipper. Prior arrangement is necessary. Contact the Customer Service 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 by fax at the number shown below.

FACILITY CONTACTS –

Broadcast Electronics, Inc. – Quincy Facility
4100 N. 24th St. P.O. BOX 3606
Quincy, Illinois 62305
Telephone: (217) 224–9600
Fax: (217) 224–9607
E–Mail: General – bdcast@bdcast.com
Web Site: www.bdcast.com

RF PRODUCT TECHNICAL ASSISTANCE – REPAIR – EMERGENCY/WARRANTY REPLACEMENT PARTS –

Telephone: (217) 224–9600
E–Mail: rfservice@bdcast.com
Fax: (217) 224–9607

NON–EMERGENCY REPLACEMENT PARTS –

Fax: (217) 224–9609

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.

WARRANTY ADJUSTMENT.

Broadcast Electronics, Inc. warranty is included in the Terms and Conditions of Sale. In the event of a warranty claim, replacement or repair parts will be supplied F.O.B. factory. At the discretion of Broadcast Electronics, the customer may be required to return the defective part or equipment to Broadcast Electronics, Inc. F.O.B. Quincy, Illinois. Warranty replacements of defective merchandise will be billed to your account. This billing will be cleared by a credit issued upon return of the defective item.

PROPRIETARY NOTICE.

MODIFICATIONS.

Broadcast Electronics, Inc. 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.

WARNING

OPERATING HAZARDS

READ THIS SHEET 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. BERYLLIUM – OXIDE POISONING – Dust or fumes from BeO ceramics used as thermal links with conduction cooled power tubes and power transistors are highly toxic and can cause serious injury or death. Additional information follows.

D. 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.

E. 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 tubes operate at voltages high enough to kill through electrocution. Personnel should always break the primary circuits of the power supply and discharge high voltage capacitors when direct access to the tube is required.

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 leakproof. 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.

DANGER — BERYLLIUM OXIDE CERAMICS (BeO) – AVOID BREATHING DUST OR FUMES

BeO ceramic material is used as a thermal link to carry heat from a tube or transistor to the heat sink. Do not perform any operation on any BeO ceramic which might produce dust or fumes, such as grinding, 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.

HOT SURFACES

The anode portion of power tubes is often air–cooled or conduction–cooled. The air–cooled external surface normally operates at a high temperature (up to 200° to 300°C). Other portions of the tube may also reach high temperatures, especially the cathode insulator and the cathode/heater surfaces. All hot surfaces may remain hot for an extended time after the tube is shut off. To prevent serious burns, take care to prevent and avoid any bodily contact with these surfaces both during and for a reasonable cooling down period after tube operation.

PUBLICATION ADDENDUM
SPECIAL ASSEMBLY REQUIREMENTS
FM-10T/FM-10TS TRANSMITTER

1-1. **INTRODUCTION.**

1-2. Due to special shipping requirements, selected components of the Broadcast Electronics FM-10T/FM-10TS transmitter have been disassembled to prevent damage during shipment. This publication addendum provides information required for the re-assembly of the transmitter IN ADDITION TO the information provided in SECTION II, INSTALLATION. Perform the following assembly instructions before proceeding to the procedures described in this manual.

1-3. **SPECIAL ASSEMBLY.**

1-4. **GENERAL.** Components removed from the transmitter for shipment contain identification tags to permit reinstallation. Items such as interconnecting wires, cables, and miscellaneous small parts are taped or tied in for shipment. Remove all tape, string, and packing material used for shipping purposes as each item is installed.

1-5. Terminal blocks and wires contain identification tags with information regarding reconnection. Mounting hardware will be placed in small bags attached to each removed component or inserted in the component mounting holes.

WARNING ***ENSURE NO PRIMARY POWER IS CONNECTED TO THE TRANSMITTER BEFORE PROCEEDING.***

WARNING

1-6. **FM-10T HIGH VOLTAGE POWER SUPPLY CABINET.** Install components removed from the FM-10T high voltage power supply cabinet by performing the following procedures. Ensure no primary power is connected to the transmitter before attempting any component installation.

1-7. **220V AC Power Supply Operation.** For 220V ac power supply transmitters, refer to Figure 1 and install the components in the power supply cabinet by performing the following procedures.

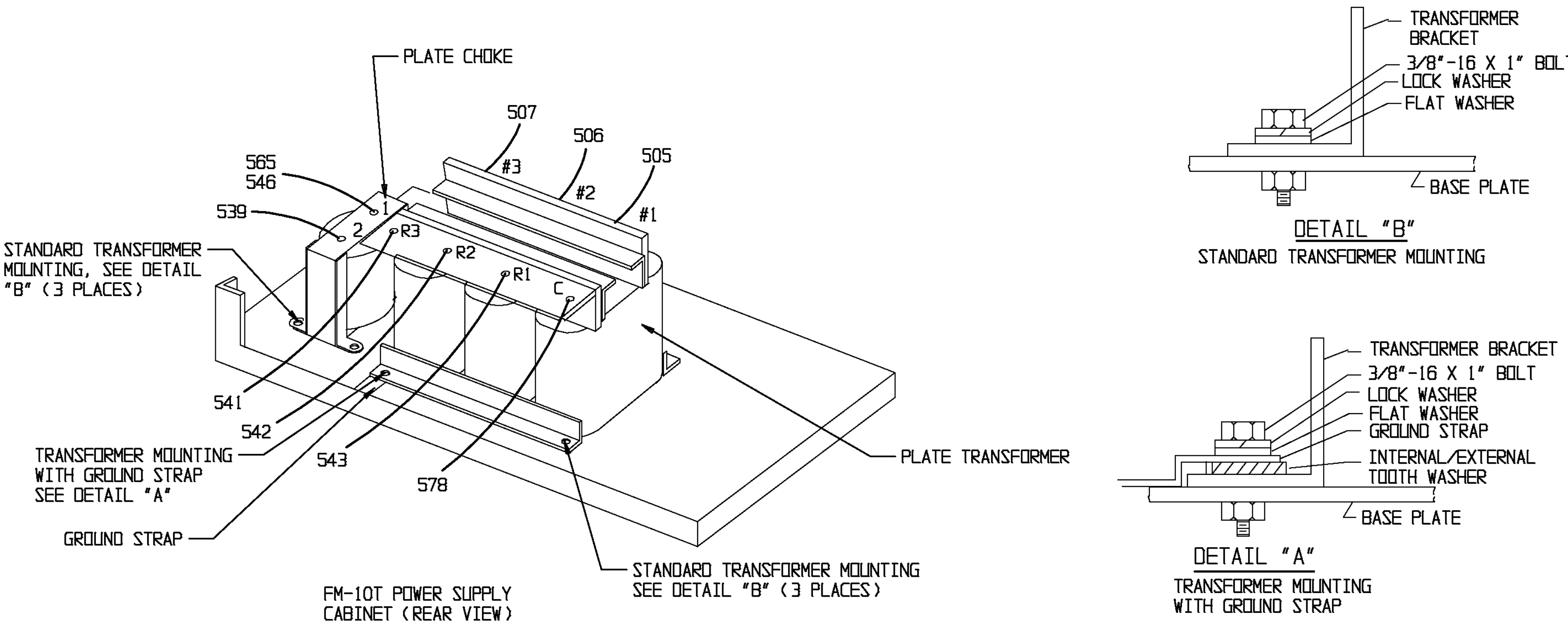
1-8. Install the plate choke as follows:

A. Place the plate choke in the proper position on the power supply cabinet base-plate.

B. Connect wires 540, 546, and 565 to the plate choke as shown.

1-9. Install the plate transformer as follows:

A. Place the plate transformer in the proper position on the power supply cabinet base-plate.



597-0098-411

FIGURE 1. FM-10T POWER SUPPLY BASE-PLATE INSTALLATION, 220V POWER SOURCE

WARNING ***ENSURE THE GROUND STRAP ON THE PLATE TRANSFORMER IS PROPERLY INSTALLED.***

WARNING

B. Mount the plate transformer to the base-plate as shown. Ensure the ground strap is properly installed on the transformer mounting bracket.

C. Connect wires 505 through 507 to the plate transformer primary as shown.

D. Connect wires 541 through 543 to the plate transformer secondary as shown.

1-10. Remove the jumper wires between the terminals on plate supply capacitors C5 and C18.

1-11. **380V AC Power Supply Operation.** For 380V ac power supply transmitters, refer to Figure 2 and install the components in the power supply cabinet by performing the following procedures.

1-12. Install the plate choke as follows:

A. Place the plate choke in the proper position on the power supply cabinet base-plate.

B. Connect wires 540, 546, and 565 to the plate choke as shown.

1-13. Install the plate transformer as follows:

A. Place the plate transformer in the proper position on the power supply cabinet base-plate.

WARNING ***ENSURE THE GROUND STRAP ON THE PLATE TRANSFORMER IS PROPERLY INSTALLED.***

WARNING

B. Mount the plate transformer to the base-plate as shown. Ensure the ground strap is properly installed on the transformer mounting bracket.

C. Connect wires 505, 506, 507, and 580 to the plate transformer primary as shown.

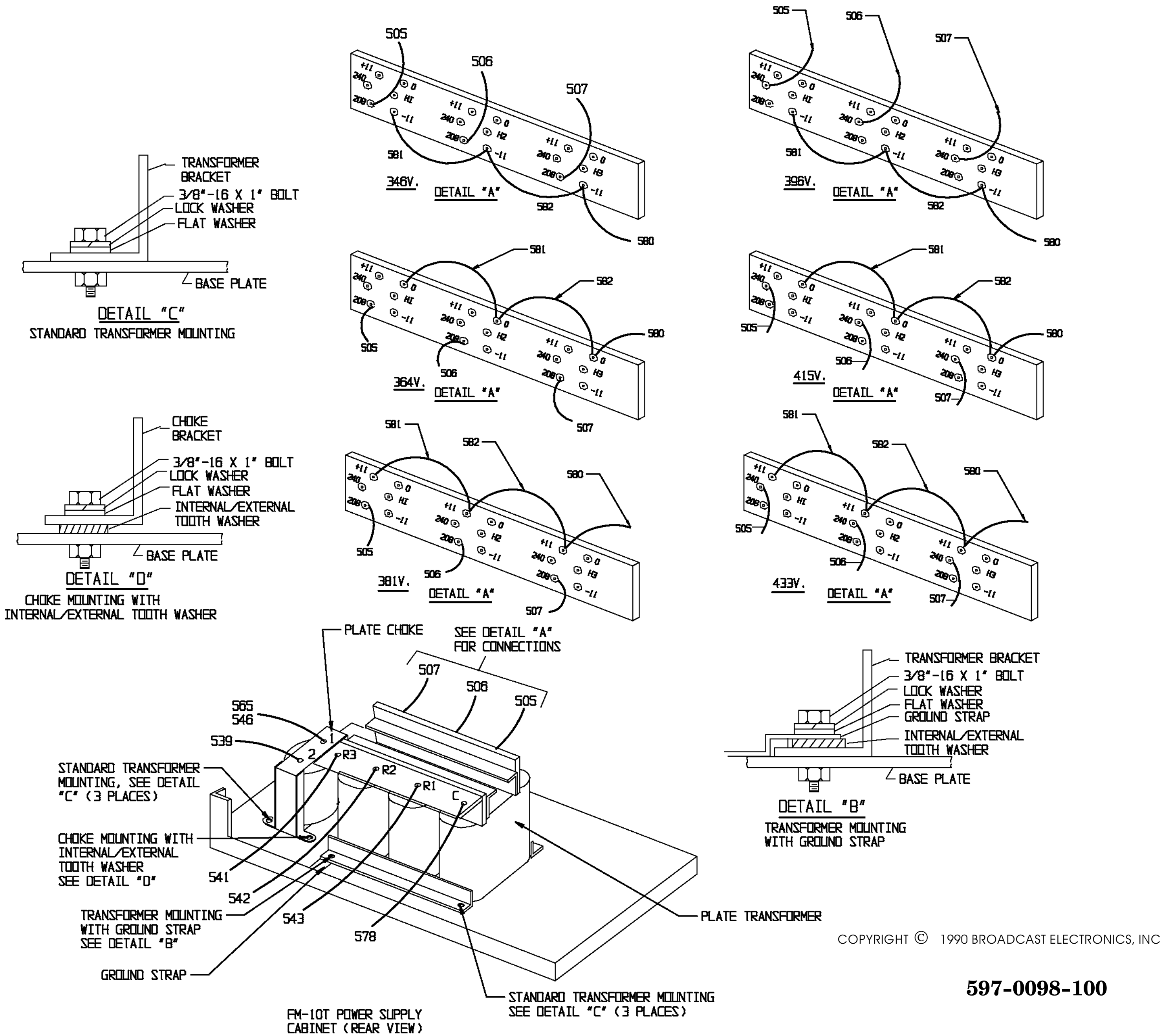
D. Connect wires 541, 542, 543, and 578 to the plate transformer secondary as shown.

1-14. Remove the jumper wires between the terminals on plate supply capacitors C5 and C18.

WARNING ***ENSURE NO PRIMARY POWER IS CONNECTED TO THE TRANSMITTER BEFORE PROCEEDING.***

WARNING

1-15. **FM-10TS HIGH VOLTAGE POWER SUPPLY CABINET.** Install components removed from the FM-10TS high voltage power supply cabinet by performing the following procedures. Ensure no primary power is connected to the transmitter before attempting any component installation.



597-0098-100

FIGURE 2. POWER SUPPLY BASE-PLATE INSTALLATION, 380V POWER SOURCE

1–16. **Plate Supply Chokes.** Refer to Figure 3 and install the plate chokes as follows:

A. Place plate supply chokes L2 and L3 in the proper position on the power supply cabinet base–plate.

B. Connect wires 584, 546, and 565 to L2 as shown.

C. Connect wires 543, 580, 583, and 582 to L3 as shown.

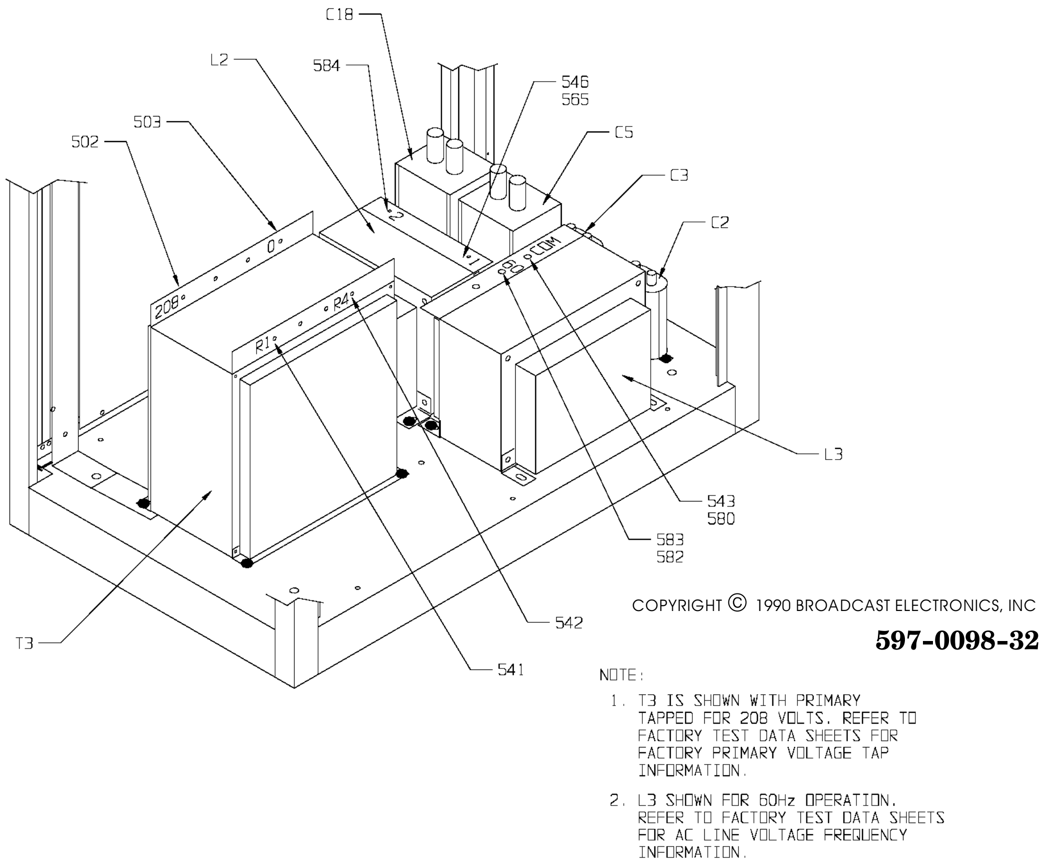


FIGURE 3. FM-10TS POWER SUPPLY BASE-PLATE INSTALLATION

1–17. **Plate Supply Transformer.** Refer to Figure 3 and install the plate transformer as follows:

A. Place the plate transformer in the proper position on the power supply cabinet base–plate.

WARNING ***ENSURE THE GROUND STRAP ON THE PLATE TRANSFORMER IS PROPERLY INSTALLED.***

WARNING

B. Mount the plate transformer to the base–plate as shown. Ensure the ground strap is properly installed on the transformer mounting bracket.

C. Connect wires 502 and 503 to the plate transformer primary as shown.

D. Connect wires 541 and 542 to the plate transformer secondary as shown.

1–18. **Plate Supply Capacitors.** Remove the jumper wires between the terminals on plate supply capacitors C5 and C18.

WARNING ***ENSURE NO PRIMARY POWER IS CONNECTED TO THE TRANSMITTER BEFORE PROCEEDING.***

WARNING

1-19. **PA/DRIVER CABINET.** Install components removed from the PA/driver cabinet by performing the following procedures. Ensure no primary power is connected to the transmitter before attempting any component installation.

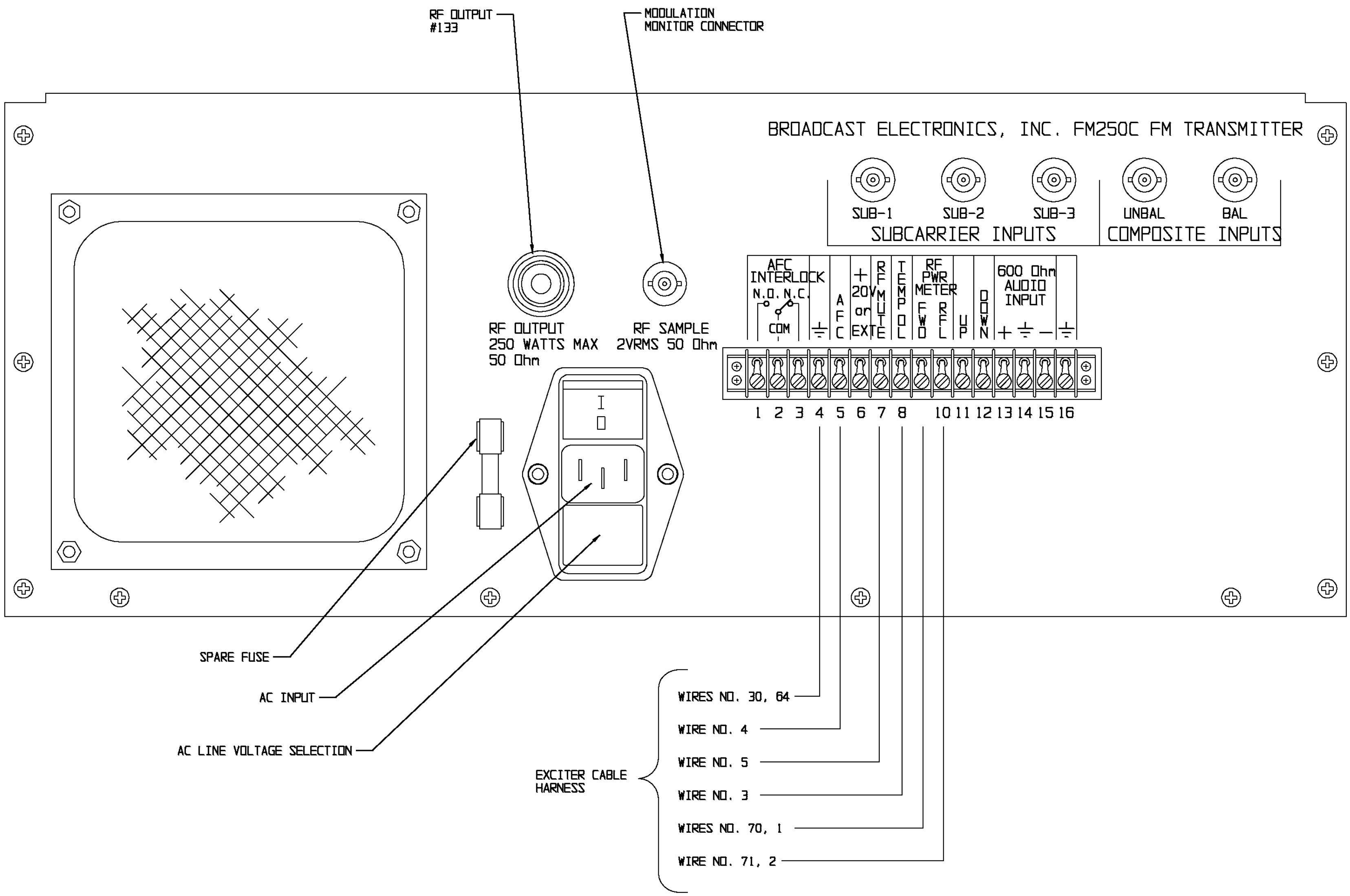
1–20. **FM-250C Exciter.** Remove the exciter from the shipping container.

1–21. If required, refer to the FM–10T/FM–10TS installation diagram in SECTION II, INSTALLATION of the instruction manual for the location of the FM–250C exciter in the PA/driver cabinet. Install the exciter by lifting the unit onto the slide rails.

1–22. Refer to Figure 4 and attach the following cables to the exciter rear–panel receptacles.

WIRE OR CABLE IDENTIFICATION	EXCITER REAR-PANEL RECEPTACLE
133	RF OUTPUT
EXCITER AC INPUT	AC INPUT
EXCITER CABLE HARNESS	TB1

1–23. **Blower Assembly.** Unpack the blower assembly by removing the shipping strap securing the assembly to the cabinet chassis.



597-0098-408

FIGURE 4. FM-250C REAR-PANEL CONNECTIONS

SCOPE OF MANUAL

This manual consists of two sections and provides the following information for the Broadcast Electronics FM–10T/FM–10TS transmitters.

A. PART I – Contains information relative to installation, operation, and maintenance applicable to the overall transmitter.

B. PART II – Contains detailed information for the following transmitter modular units.

TRANSMITTER CONTROLLER

PART I - TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

PART II - TABLE OF CONTENTS

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. Information presented by this section provides a general description of the Broadcast Electronics FM-10T/FM-10TS transmitters and lists equipment specifications.

1-3. RELATED PUBLICATIONS.

1-4. The following list of publications provides data for equipment associated with the FM-10T/FM-10TS transmitters.

PUBLICATION NUMBER	EQUIPMENT
597-1004	FM-250C FM Exciter
597-0008-004	FC-30 SCA Generator
597-9900	LYNX FM Digital Stereo Generator
597-8000	PREDATOR FM Digital Exciter
597-9091	RTDS - Remote Transmitter Diagnostic System

1-5. EQUIPMENT DESCRIPTION.

1-6. The Broadcast Electronics FM-10T and FM-10TS are one-tube 10 kW FM transmitters designed for continuous operation in the 87.5 MHz to 108 MHz FM broadcast band (refer to Figure 1-1). Specific transmitter features include: 1) a folded half-wave cavity PA stage, 2) a microprocessor control system, and 3) a 250 watt solid-state exciter with a digital frequency synthesizer. The RF power amplifier, FM exciter, and control circuitry is housed in a single cabinet. A high voltage power supply is housed in a separate cabinet which may be located remotely from the PA/driver cabinet if desired. The following text provides ordering information for various transmitter configurations, optional equipment, and accessories and recommended spare parts kits.

1-7. TRANSMITTER CONFIGURATIONS.

1-8. The FM-10T/FM-10TS transmitters may be ordered in the following configurations:

MODEL NO.	PART NUMBER	DESCRIPTION
FM-10T	909-1110-205	FM-10T Transmitter complete with FM-250C FM Exciter, 1 5/8 inch low-pass filter, 208/240V ac three-phase 60 Hz operation, high voltage power supply adjacent to PA/driver cabinet.
FM-10T	909-1110-305	FM-10T Transmitter complete with FM-250C FM Exciter, 1 5/8 inch low-pass filter, 208/240V ac three-phase 50 Hz operation, high voltage power supply adjacent to PA/driver cabinet.
FM-10T	909-1110-385	FM-10T Transmitter complete with FM-250C FM Exciter, 1 5/8 inch low-pass filter, 339/437V ac three-phase 50 Hz operation, high voltage power supply adjacent to PA/driver cabinet.
FM-10TS	909-1110-255	FM-10TS Transmitter complete with FM-250C FM Exciter, 1 5/8 inch low-pass filter, 208/240V ac single-phase 60/50 Hz operation, high voltage power supply adjacent to PA/driver cabinet.

597-0098-1

FIGURE 1-1. FM-10T TRANSMITTER

MODEL NO.	PART NUMBER	DESCRIPTION
----	909-0136	Remote Power Supply Cabinet Configuration.
FM-10T	909-1110-306	FM-10T Transmitter complete with FM-250C FM Exciter, 3 1/8 inch low-pass filter, 208/240V ac three-phase 50 Hz operation, high voltage power supply adjacent to PA/driver cabinet.
FM-10T	909-1110-386	FM-10T Transmitter complete with FM-250C FM Exciter, 3 1/8 inch low-pass filter, 339/437V ac three-phase 50 Hz operation, high voltage power supply adjacent to PA/driver cabinet.
FM-10T	909-1110-206	FM-10T Transmitter complete with FM-250C FM Exciter, 3 1/8 inch low-pass filter, 208/240V ac three-phase 60 Hz operation, high voltage power supply adjacent to PA/driver cabinet.

MODEL NO.	PART NUMBER	DESCRIPTION
FM–10TS	909–1110–256	FM–10TS Transmitter complete with FM–250C FM Exciter, 3 1/8 inch low–pass filter, 208/240V ac single–phase 60/50 Hz operation, high voltage power supply adjacent to PA/driver cabinet.

1–9. ACCESSORIES AND SPARE PARTS KITS.

1–10. The following accessory products and spare parts kits are available for use in the FM–10T/FM–10TS transmitters:

PART NUMBER	DESCRIPTION
909–9000	LYNX FM digital stereo generator.
909–0051–204	FC–30 FM SCA generator.
909–8250	PREDATOR 250 Watt FM Digital Exciter And Digital Input.
909–8251	PREDATOR 250 Watt FM Digital Exciter And Analog Input.
909–8252	PREDATOR 250 Watt FM Analog Exciter And Analog Input.
979–0094	Recommended spare parts kit for the FM–10T/ FM–10TS and FM–250C exciter. Includes selected meters, switches, relays etc. Does not include semi–conductors.
979–0095	Recommended spare semiconductor kit for the FM–10T/FM–10TS and FM–250C exciter.
979–0095–005	Recommended spare semiconductor kit for the FM–10T/FM–10TS transmitters only. Does not include exciter spare semiconductors.
979–0094–005	Recommended spare parts kit for the FM–10T/ FM–10TS transmitter only. Includes selected meters, switches, relays, etc. Does not include semiconductors.
979–0133–014	Recommended spare HV rectifier kit for the FM–10T transmitter.
907–0016–054	VMC–16 Voice Remote Control Unit, FM–10T/ FM–10TS.
909–9091	RTDS (Remote Transmitter Diagnostic System) for T–Series transmitters. A Windows 95 software product designed to allow a user to control transmitter operations and diagnose transmitter problems from a remote location. Factory installation.
909–9091–001	RTDS (Remote Transmitter Diagnostic System) for T–Series transmitters. A Windows 95 software product designed to allow a user to control transmitter operations and diagnose transmitter problems from a remote location. Field installation.

1–11. EQUIPMENT SPECIFICATIONS.

1–12. Refer to Table 1–1 for the electrical specifications and Table 1–2 for the physical and environmental specifications of the Broadcast Electronics FM–10T/FM–10TS transmitters.

TABLE 1-1. FM-10T/FM-10TS ELECTRICAL SPECIFICATIONS
(Sheet 1 of 2)

PARAMETER	SPECIFICATION
RF POWER OUTPUT	4.5 kW to 11.0 kW (as specified).
FREQUENCY RANGE	87.5 to 108 MHz (as specified). Exciter programmable in 10 kHz increments.
RF OUTPUT IMPEDANCE	50 Ohms, resistive (others available by special request).
RF OUTPUT CONNECTOR	1 5/8 inch coupling standard. 3 1/8 inch EIA flange optional.
MAXIMUM VSWR	1.8:1 (will operate into a higher VSWR with automatic power reduction).
TUBE COMPLEMENT	4CX7500A
AM SIGNAL-TO-NOISE RATIO:	
Asynchronous	55 dB below an equivalent reference carrier with 100% AM modulation @ 400 Hz, 75 microsecond deemphasis (no FM modulation present).
Synchronous	45 dB below an equivalent 10 kW reference carrier with 100% AM modulation @ 1 kHz, no deemphasis (FM modulation: ±75 kHz @ 1 kHz).
FM SIGNAL-TO-NOISE RATIO:	
Mono/Composite	85 dB below ±75 kHz deviation @ 400 Hz measured in a 20 Hz to 30 kHz bandwidth with 75 microsecond deemphasis.
Stereo	80 dB or better below 100% modulation @ 400 Hz, measured in a 20 Hz to 30 kHz bandwidth with 75 microsecond deemphasis.
DISTORTION	
Mono/Composite	
Harmonic	0.03% or less at 400 Hz.
SMPTE Intermodulation Distortion	0.05% or less, 60 Hz/7 kHz, Ratio: 4:1 Monophonic, 1:1 Composite.
CCIF Intermodulation Distortion	
Mono	0.02% or less, 15 kHz/14 kHz, 1:1 Ratio.
Composite	0.03% or less, 15 kHz/14 kHz, 1:1 Ratio.
Transient Intermodulation Distortion	0.02% or less, sine wave/square wave.

TABLE 1-1. FM-10T/FM-10TS ELECTRICAL SPECIFICATIONS
(Sheet 2 of 2)

PARAMETER	SPECIFICATION
DISTORTION (Con't)	
Stereo	
Harmonic	0.05% or less at 400 Hz.
SMPTE Intermodulation Distortion	0.08% or less, 60 Hz/7 kHz, 4:1 Ratio.
CCIF Intermodulation Distortion	0.05% or less, 15 kHz/14 kHz, 1:1 Ratio.
Transient Intermodulation Distortion	0.05% or less, sine wave/square wave.
STEREO SEPARATION	50 dB or better, 30 Hz to 15 kHz.
DYNAMIC STEREO SEPARATION	40 dB or better, 30 Hz to 15 kHz (normal program content).
LINEAR CROSSTALK (Main to Sub/Sub to Main Due to Phase Matching)	45 dB Minimum below 100% modulation, 30 Hz to 15 kHz.
NON-LINEAR CROSSTALK (Main to Sub/Sub to Main Due to Distortion Products)	70 dB Minimum below 100% modulation.
RF HARMONIC SUPPRESSION	Meets all FCC/DOC requirements and CCIR recommendations.
POWER SUPPLY RECTIFIERS	Silicon.
AC POWER REQUIREMENTS	
FM-10T	196 to 252V ac 50/60 Hz or 341V to 435V ac 50 Hz, three-phase closed-Delta or Wye (as specified).
FM-10TS	196 to 252V ac 50/60 Hz single-phase.
AC POWER CONSUMPTION	
FM-10T	15.8 kW typical at a 10 kW RF power output, 0.94 power factor.
FM-10TS	20.0 kW typical at a 10 kW RF power output, 0.97 power factor.
PA EFFICIENCY	80% typical.
OVERALL EFFICIENCY	
FM-10T	63% typical (AC line input to RF output).
FM-10TS	50% typical (AC line input to RF output).

TABLE 1-2. FM-10T/FM-10TS PHYSICAL AND ENVIRONMENTAL SPECIFICATIONS

PARAMETER	SPECIFICATION
PHYSICAL	
DIMENSIONS:	
PA/Driver Cabinet	Width: 33.7 inches (85.6 cm). Height: 70 inches (177.8 cm). Depth: 37.2 inches (94.49 cm).
High Voltage Power Supply Cabinet	Width: 22.7 inches (57.66 cm). Height: 70 inches (177.8 cm). Depth: 37.2 inches (94.49 cm).
WEIGHT:	
PA/Driver Cabinet	810 pounds (367 kg).
High Voltage Power Supply Cabinet	1000 pounds (453.6 kg).
CUBAGE:	
PA/Driver Cabinet	53 cubic feet (1.5 m^3).
High Voltage Power Supply Cabinet	36 cubic feet (1.01 m^3).
ENVIRONMENTAL	
HEAT DISSIPATION (10 kw OUTPUT)	
FM-10T	5.8 kW (19,795 BTU/H).
FM-10TS	10 kW (34,130 BTU/H).
COOLING AIR REQUIREMENTS	800 cubic feet per minute (22.6 m^3/min).
AMBIENT TEMPERATURE RANGE	+14°F to +122°F (-10°C to +50°C).
MAXIMUM ALTITUDE	
50 Hz Models	0 to 7,500 feet above sea level (0 to 2286 meters).
60 Hz Models	0 to 10,000 feet above sea level (0 to 3048 meters).
MAXIMUM HUMIDITY	95%, non-condensing.

SECTION II
INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains information required for the installation and preliminary checkout of the Broadcast Electronics FM-10T/FM-10TS Transmitters.

2-3. UNPACKING.

2-4. The equipment becomes the property of the customer when the equipment is delivered to the carrier. Carefully unpack the transmitter. 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.

2-5. 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, Inc.

2-6. INSTALLATION REQUIREMENTS.

2-7. ENVIRONMENTAL.

2-8. Table 1-2 provides environmental conditions which must be considered prior to transmitter installation.

2-9. COOLING AIR.

2-10. If outside air is to be used to cool the transmitter, the air inlet duct must be sized to allow adequate air flow. The air must be dry and well filtered. If intake louvers are used, operation of the louvers must be electrically interlocked with the transmitter operation.

2-11. If the heated transmitter air is to be ducted from the room, the duct system must not introduce any back-pressure on the equipment. Proper allowances for air flow will ensure that only a limited amount of heat is dissipated into the equipment interior. The duct system must allow for a minimum air flow of 800 cubic feet of air per minute (22.6 m^3/min).

2-12. As a minimum requirement, any duct work must have a cross-sectional area equal to the exhaust area of the PA/driver cabinet (refer to Figure 2-1). Sharp bends in the duct system will introduce back-pressure and are not permissible. A radius bend must be used if a right angle turn is required. An exhaust fan may be used to overcome duct losses or overcome wind pressures if the duct is vented to the outside.

2-13. PRIMARY POWER.

2-14. **FM-10T.** The FM-10T transmitter is designed for operation from a closed-delta or wye connected three-phase power source. Operation from an unsatisfactory power source will void the warranty on this transmitter as any resultant damage is beyond the control of the manufacturer. Before attempting installation of the transmitter, assure that the proper power source is installed. Acceptable power input configurations are shown in Figure 2-2.

2-15. An open-delta, V to V, T to T, T to L, or Scott connected power source will provide unsatisfactory transmitter performance as transients and unstable power can damage components of the FM-10T and provide degraded transmitter specifications. Any of these systems will develop a considerable imbalance between phases in voltage, phase angle, or both voltage and phase angle. These problems can result in premature failure of power supply and RF circuit components.

2–16. It is important that the local electric utility be consulted to ensure that the correct service is provided before connection of the transmitter to a primary power source. The proper power source can readily be identified by the use of three transformers with one winding each or one transformer with three windings instead of the use of two transformers as required for the unacceptable configurations.

2–17. **FM-10TS.** The FM–10TS transmitter is designed for operation from a 220V ac 60 Hz single phase power source. Consult the local electric utility company to ensure that the correct service is provided before connection of the transmitter to the primary power source.

2–18. INSTALLATION.

2–19. Each transmitter is wired, 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 an understanding of the circuitry, nomenclature, and installation requirements. Installation is accomplished as follows: 1) placement, 2) component installation, 3) remote control connections, 4) wiring, and 5) initial checkout.

2–20. EQUIPMENT PLACEMENT.

WARNING ***ENSURE NO PRIMARY POWER IS CONNECTED TO THE TRANSMITTER BEFORE PROCEEDING.***

WARNING

2–21. The FM–10T/FM–10TS transmitters are designed for two types of installations: 1) adjacent high voltage power supply cabinet installation or 2) remote high voltage power supply cabinet installation. If the cabinets are positioned apart, access holes in the top and bottom of the cabinets allow either overhead or under–floor routing of interconnecting wiring (see Figure 2–1).

2–22. Regardless of the type of installation, the floor must be capable of supporting the total transmitter weight. The floor support should be more than marginal to maintain proper cabinet alignment and reduce vibration.

2–23. After determining the position of the cabinets, place the PA/driver cabinet in the desired location on a smooth and level surface. Remove the four shipping skid bolts (located under the bottom of the skid) and lift the PA/driver cabinet from the skid.

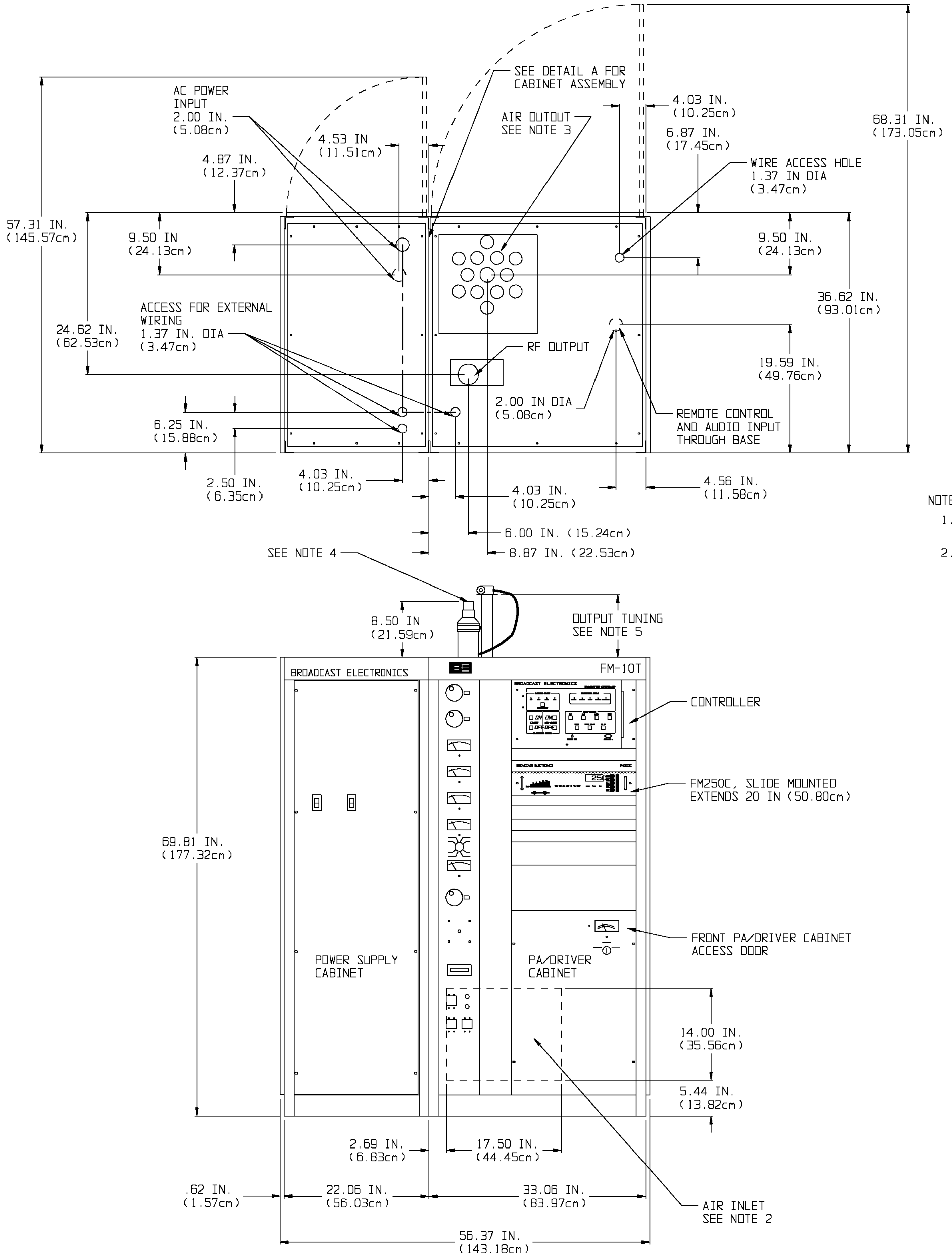
2–24. Place the power supply cabinet in the desired location and remove the shipping skid (remove four bolts located under the bottom of the skid). If the high voltage power supply is positioned adjacent to the PA/driver cabinet, the cabinets must be bolted together through the vertical or horizontal chassis rails. Refer to Figure 2–1 and bolt the cabinets together using four 1/4–20 X 1 inch bolts and lock washers (located in the accessory kit).

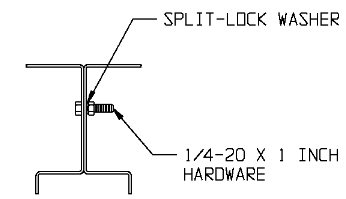
2–25. COMPONENT INSTALLATION.

WARNING ***ENSURE NO PRIMARY POWER IS CONNECTED TO THE TRANSMITTER BEFORE PROCEEDING.***

WARNING

2–26. For ease of component installation and cabinet wiring, the power supply cabinet rear door, the PA/driver cabinet rear door, and the PA/driver cabinet lower front access panel should be removed and remain off until installation is complete. The power supply and PA/driver cabinet doors may be removed by lifting each door off the hinges. To remove the PA/driver cabinet front panel, remove the four hex–head cap mounting screws with the 5/32 inch hex wrench (located in the accessory kit).

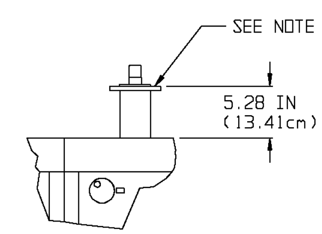




DETAIL A

NOTES:

1. TOP CABINET RAIL SHOWN.
2. BOLT CABINET TOGETHER THOUGH TOP RAIL AND REAR VERTICAL RAIL, 2 PLACES EACH. MATCHING HOLES PROVIDED IN HOLES.



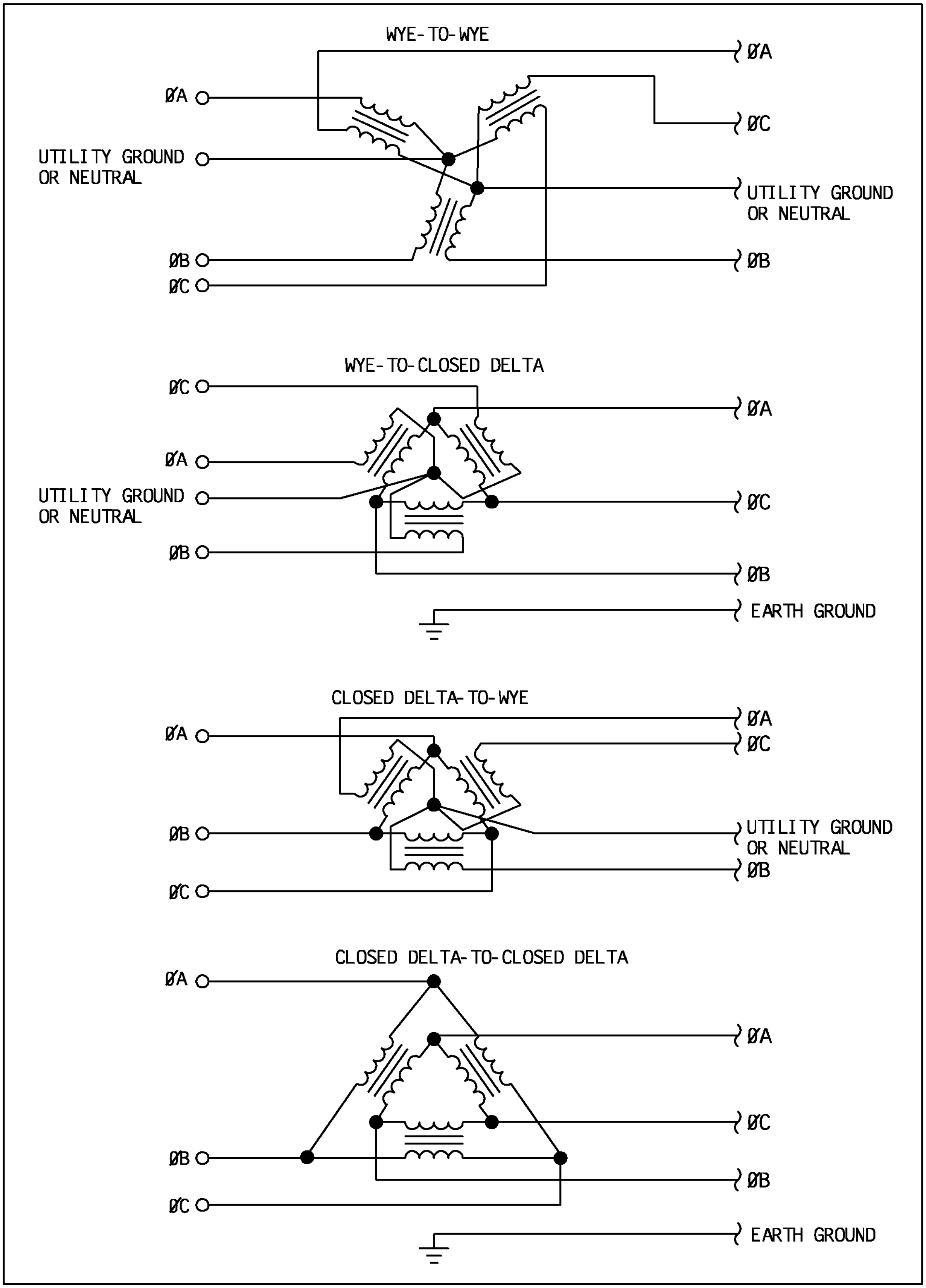
VIEW B

NOTES:

1. POWER SUPPLY CABINET MAY BE LOCATED FROM PA/DRIVER CABINET IF DESIRED. 30 FEET (9.14m) STANDARD.
2. AIR INLET, FILTER REQUIRED (BE P/N 407-0062).
   LOCATION: REAR OF PA/DRIVER CABINET
   DIMENSIONS:
   WIDTH: 17.5 INCHES (44.5cm).
   HEIGHT: 14 INCHES (35.6cm).
3. AIR OUTLET:
   PRIMARY: TOP OF PA/DRIVER CABINET
   SECONDARY: TOP OF POWER SUPPLY CABINET
4. RF OUTPUT CONNECTION: 1.625 INCH EIA 50 OHM COUPLING, 1.625 FEMALE FLANGE,OR 1.625 MALE FLANGE STANDARD. 3.125 INCH EIA 50 OHM MALE FIELD FLANGE OPTIONAL. SEE VIEW "B".
5. TUNING LINE HEIGHT (DETERMINED BY TRANSMITTER FREQUENCY:
   MAXIMUM: 11 INCHES (27.94cm), FREQUENCY: 108 MHz.
   MINIMUM: 1 INCH (2.54cm), FREQUENCY: 87.5 MHz.
6. CUBAGE:
   PA/DRIVER CABINET: 53.0 CUBIC FEET (1.5m^3)
   POWER SUPPLY CABINET: 36.0 CUBIC FEET (1.01m^3)
7. WEIGHT:
   PA/DRIVER CABINET: 810 POUNDS (367kg).
   POWER SUPPLY CABINET: 1000 POUNDS (453.6kg).
8. FLOOR: 180 POUNDS PER SQUARE FOOT (MAX.)
9. COOLING AIR REQUIREMENTS: 800 CUBIC FEET PER MINUTE (22.6m^3 /MIN).
10. AC INPUT:
    FM-10T-196 TO 252VAC 50/60Hz OR 341 TO 435VAC 50Hz, THREE-PHASE CLOSED-DELTA OR WYE, 65 AMPERES MAXIMUM.
    FM-10TS-196 TO 252VAC 50/60Hz SINGLE PHASE, 120 AMPERES MAXIMUM.
11. HEAT DISSIPATION (10kW OUTPUT): FM-10T - 5.8kW (19,795 Btu/H).
    FM-10TS - 10kW (34,130 Btu/H)
12. POWER CONSUMPTION: FM-10T - 15.8 kW FOR A 10 kW RF POWER OUTPUT, 0.94 POWER FACTOR.
    FM-10TS - 20 kW FOR A 10 kW RF POWER OUTPUT, 0.97 POWER FACTOR.
13. PRIMARY AC FUSED SERVICE DISCONNECT
    THREE PHASE
    FUSE SIZE: 100A
    WIRE SIZE: No. 1 COPPER THHN OR EQUIVALENT
    SINGLE PHASE
    FUSE SIZE: 175A
    WIRE SIZE: 3/0 COPPER THHN OR EQUIVALENT
    FUSED DISCONNECT SWITCH RECOMMENDED. REFER TO THE NATIONAL ELECTRIC CODE OR LOCAL CODES FOR PROPER FUSE SIZES.

597-0098-409

FIGURE 2-1. FM-10T/FM-10TS INSTALLATION DIAGRAM



597-0099-11

FIGURE 2-2. ACCEPTABLE AC POWER INPUT CONFIGURATIONS

2–27. Interconnecting wires and cables are tied for shipment. Remove all tape, wire ties, string, and packing material. Cables, connectors, and miscellaneous components to be installed are shipped in separate containers. The following text provides information for the installation of these items. Throughout the installation procedures, ensure the transmitter adjustments are not moved from the factory preset positions.

WARNING ***ENSURE NO PRIMARY POWER IS CONNECTED TO THE TRANSMITTER BEFORE PROCEEDING.***

WARNING

2–28. **HIGH VOLTAGE POWER SUPPLY CABINET.** Unpack components located in the high voltage power supply cabinet as follows.

2–29. Unwrap the grounding stick and place the stick on the interlocked hanger. Ensure the wire tie securing the grounding stick hanger interlock switch is removed.

2–30. Unwrap the cabinet interlock connector. For transmitters with a remote high voltage power supply, unwrap the high voltage power supply interlock extension cable.

2–31. Unwrap the PA/driver cabinet ac power cable harness (cable connected to TB16) which is coiled inside the high voltage cabinet.

2–32. The high voltage power supply is equipped with a half–voltage receptacle. Ensure the half–voltage supply jack is inserted into the 6600 VDC receptacle.

WARNING ***ENSURE NO PRIMARY POWER IS CONNECTED TO THE TRANSMITTER BEFORE PROCEEDING.***

WARNING

2–33. **PA/DRIVER CABINET.** Unpack and check components located in the PA/driver cabinet as follows.

2–34. **FM-250C Exciter.** Remove the slide retainers from the exciter.

2–35. Loosen the exciter front–panel turn–lock fasteners and extend the unit forward.

2–36. Loosen the eight turn–lock fasteners on top of the exciter and remove the top cover.

2–37. Remove any packing material from the inside of the exciter.

2–38. Ensure the **POS-MUTE-NEG** switch on the power supply/control circuit board is operated to POS.

2–39. Ensure the **NORM-EXT** switch is operated to NORM.

2–40. Refer to the final test data sheets shipped with the transmitter and ensure the AFC/PLL assembly SYNTHESIZER FREQUENCY SELECTION switches are correctly positioned.

2–41. Replace the exciter top–panel.

2–42. Secure the eight turn–lock fasteners.

2–43. **Optional Equipment.** If the transmitter is equipped with the optional LYNX stereo generator and the FC–30 SCA generator, refer to the LYNX and FC–30 instruction manuals and perform any unpacking and programming checks described in SECTION II, INSTALLATION.

2–44. **RF Enclosure.** Open the cavity access door.

2–45. Disconnect the plate line B+ banana plug which is located along the left side of the plate–line.

2–46. Unpack the plate–line assembly by removing all tape and shims from the cavity shelf. Raise and rotate the plate–line to lock the plate–line in the up position.

2–47. Carefully remove all packing material from the tube socket.

2–48. Carefully install the PA tube with a steady downward pressure. Do not rotate or rock the tube during installation to prevent damage to the tube socket.

2–49. After the PA tube is fully seated, rotate and slowly lower the plate–line over the PA tube until the plate–line shelf–stops engage the cavity shelf. The plate–line will cover approximately one–half of the tube anode when properly installed.

2–50. Align the plate–line connections and reconnect the B+ banana plug. Ensure all plate–line connections are secure.

2–51. Secure the plate–line to the tube with the strap clamp. The plate–line must not move from the PA tube when upward pressure is applied.

2–52. Close and lock the PA cavity access door.

NOTE ***ENSURE THE TRANSMITTER COARSE TUNING IS ADJUSTED IN THE FOLLOWING STEP.***

NOTE

2–53. Adjust the transmitter coarse tuning as follows:

A. On the top of the transmitter and the cavity, loosen the PA tuning line clamps.

B. Raise the PA tuning line until the factory scribed line is aligned with the top of the cavity clamping flange (refer to Figure 2–3). Ensure the tuning line is perpendicular to the top surface of the cabinet. Secure the tuning line clamps.

C. Ensure the coarse PA INPUT TUNING cyclometer on the rear of the RF enclosure indicates the value listed on the factory final test data sheets and the control is locked.

2–54. Check the following components located on the rear of the RF enclosure.

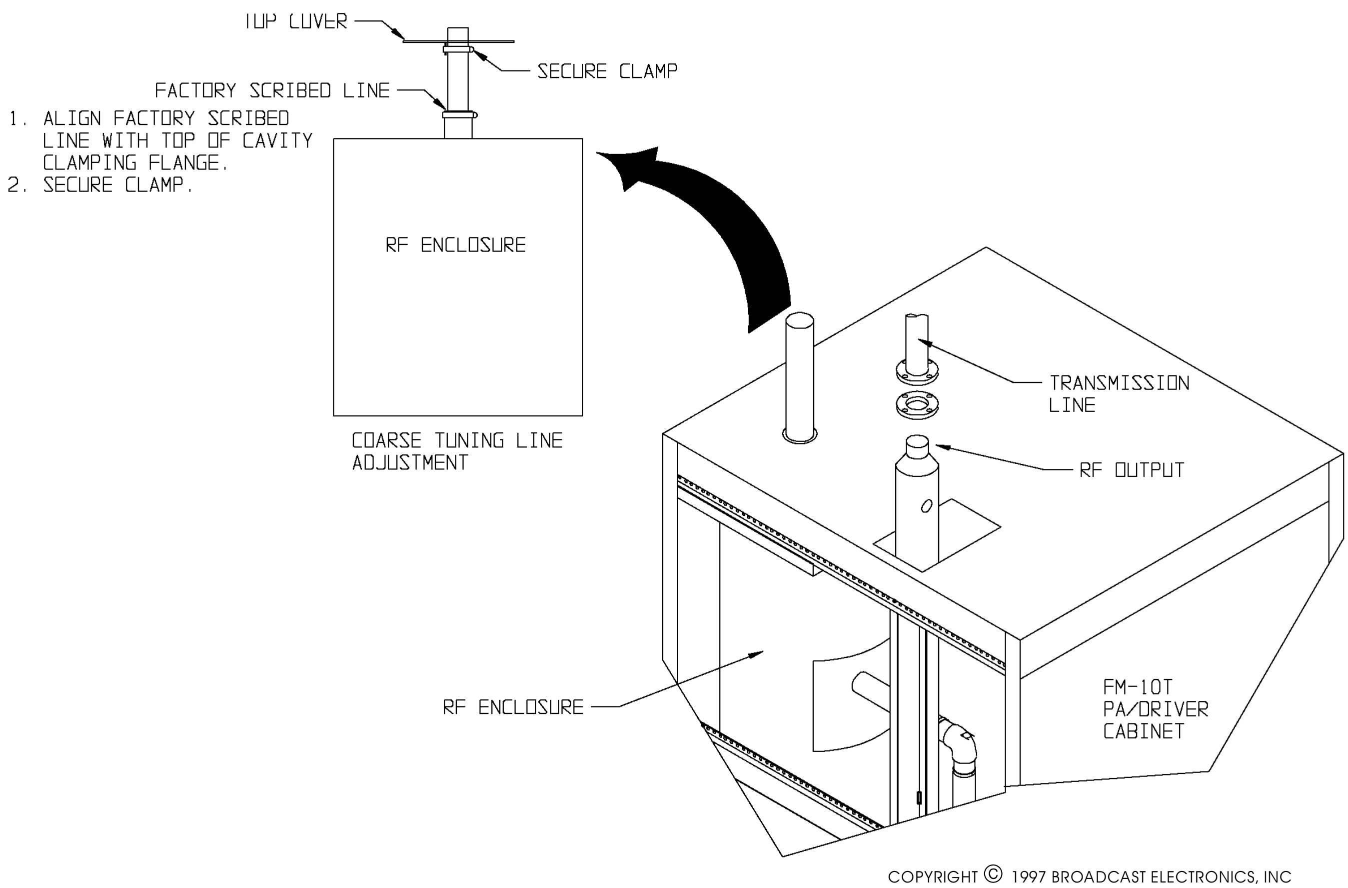
A. Ensure the NEUT cyclometer indicates the value listed on the factory final test data sheets.

B. Ensure the second harmonic suppressor is adjusted to the factory preset scribed line on the adjustment control rod. If adjustment is required, loosen the two lock screws and adjust the suppressor in or out as required. Do not rotate suppressor during adjustment.

2–55. **RF Transmission Line Connection.** Figure 2–3 presents the FM–10T/FM–10TS RF transmission line connections. Refer to Figure 2–3 and perform the transmission line connections as follows:

2–56. Insert the flanged–to–unflanged coupling as shown and secure the coupling with the strap clamp.

2–57. Connect the RF transmission line to the low–pass filter as shown.



597-0098-7

FIGURE 2-3. FM-10T/FM-10TS RF OUTPUT TRANSMISSION LINE CONNECTION

2-58. **Miscellaneous Assemblies.** Unpack the PA/driver cabinet grounding stick and the fail-safe solenoid assembly as follows:

A. Unpack the PA/driver cabinet grounding stick and place the stick on the interlocked hanger. Ensure the ty-wrap securing the grounding stick hanger interlock switch is removed.

B. Remove the cover from the FAIL-SAFE SOLENOID ASSEMBLY and remove the ty-wraps from the solenoid plunger. Replace the assembly cover.

2-59. **REMOTE CONTROL.**

2-60. The FM-10T/FM-10TS transmitters are designed for complete remote control operations (refer to Figure 2-4). The transmitters will interface with almost any remote control unit such as the Broadcast Electronics VMC-16 Voice Remote Control System. The following text presents a description of the FM-10T/FM-10TS remote control functions and indications. The remote control connections are located on the transmitter remote interface panel (refer to Figure 2-4).

TB1 PIN DESCRIPTIONS

1	APC ON COMMAND	* AUTOMATIC POWER CONTROL ON CONTROL POSITIVE CONTROL - MOMENTARY CONTACT TO +5 TO +15VDC REQUIRED TO OPERATE APC ON. NEGATIVE CONTROL - MOMENTARY CONTACT TO GROUND REQUIRED TO OPERATE APC ON.
2	FILAMENT ON COMMAMND	* FILAMENT ON CONTROL POSITIVE CONTROL - MOMENTARY CONTACT TO +5 TO +15VDC REQUIRED TO ENABLE THE FILAMENTS. NEGATIVE CONTROL - MOMENTARY CONTACT TO GROUND REQUIRED TO ENABLE THE FILAMENTS.
3	FILAMENT OFF COMMAND	* FILAMENT OFF CONTROL POSITIVE CONTROL - MOMENTARY CONTACT TO +5 TO +15VDC REQUIRED TO DISABLE THE FILAMENTS. NEGATIVE CONTROL - MOMENTARY CONTACT TO GROUND REQUIRED TO DISABLE THE FILAMENTS.
4	HIGH VOLTAGE ON COMMAND	* HIGH VOLTAGE ON CONTROL POSITIVE CONTROL - MOMENTARY CONTACT TO +5 TO +15VDC REQUIRED TO ENABLE THE HIGH VOLTAGE. NEGATIVE CONTROL - MOMENTARY CONTACT TO GROUND REQUIRED TO ENABLE THE HIGH VOLTAGE.
5	HIGH VOLTAGE OFF COMMAND	* HIGH VOLTAGE OFF CONTROL POSITIVE CONTROL - MOMENTARY CONTACT TO +5 TO +15VDC REQUIRED TO DISABLE THE HIGH VOLTAGE. NEGATIVE CONTROL - MOMENTARY CONTACT TO GROUND REQUIRED TO DISABLE THE HIGH VOLTAGE.
6	RAISE PA PWR COMMAND	* TRANSMITTER RAISE POWER CONTROL POSITIVE CONTROL - MOMENTARY CONTACT TO +5 TO +15VDC REQUIRED TO RAISE TRANSMITTER POWER. NEGATIVE CONTROL - MOMENTARY CONTACT TO GROUND REQUIRED TO RAISE TRANSMITTER POWER.
7	LOWER PA PWR COMMAND	* TRANSMITTER LOWER POWER CONTROL POSITIVE CONTROL - MOMENTARY CONTACT TO +5 TO +15VDC REQUIRED TO LOWER TRANSMITTER POWER. NEGATIVE CONTROL - MOMENTARY CONTACT TO GROUND REQUIRED TO LOWER TRANSMITTER POWER.
8	PRESET PA PWR COMMAND	* PRESET POWER ON CONTROL POSITIVE CONTROL - MOMENTARY CONTACT TO +5 TO +15VDC REQUIRED TO ENABLE PRESET POWER. NEGATIVE CONTROL - MOMENTARY CONTACT TO GROUND REQUIRED TO ENABLE PRESET POWER.
9	OVERLOAD RESET COMMAND	* OVERLOAD RESET CONTROL POSITIVE CONTROL - MOMENTARY CONTACT TO +5 TO +15VDC REQUIRED TO RESET THE OVERLOAD CIRCUIT. NEGATIVE CONTROL - MOMENTARY CONTACT TO GROUND REQUIRED TO RESET THE OVERLOAD CIRCUIT.
10	NO CONNECTION	
11	NO CONNECTION	
12	NO CONNECTION	
13	NO CONNECTION	
14	NO CONNECTION	
15	APC ON STATUS	APC ON INDICATION. LOW (0 VDC) WHEN ACTIVE
16	FILAMENT ON STATUS	FILAMENT ON INDICATION. LOW (0 VDC) WHEN ACTIVE
17	REMOTE DISABLE STATUS	REMOTE DISABLE INDICATION. LOW (0 VDC) WHEN ACTIVE
18	HIGH VOLTAGE ON STATUS	HIGH VOLTAGE ON INDICATION. LOW (0 VDC) WHEN ACTIVE.
19	PLATE OVERLOAD STATUS	PLATE OVERLOAD INDICATION. LOW (0 VDC) WHEN ACTIVE.
20	SCREEN OVERLOAD STATUS	SCREEN OVERLOAD INDICATION. LOW (0 VDC) WHEN ACTIVE.
21	GRID OVERLOAD STATUS	GRID OVERLOAD INDICATION. LOW (0 VDC) WHEN ACTIVE.
22	VSWR OVERLOAD STATUS	VSWR OVERLOAD INDICATION. LOW (0 VDC) WHEN ACTIVE.
23	OVERLOAD STATUS	OVERLOAD CIRCUIT INDICATION. LOW (0 VDC) WHEN ACTIVE.
24	PRESET STATUS	PRESET POWER INDICATION. LOW (0 VDC) WHEN ACTIVE.
25	NO CONNECTION	

 597-0220-418

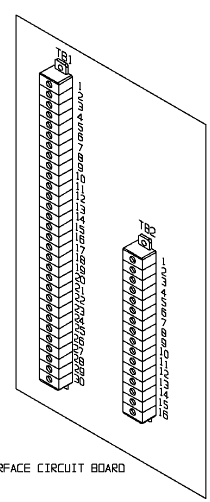
FIGURE 2-4. REMOTE CONTROL INTERFACING (SHEET 1 OF 2)

TB1 PIN DESCRIPTIONS

Pin	Name	Description	Interface
26	FAILSAFE STATUS	FAILSAFE INTERLOCK INDICATION. LOW (0 VDC) WHEN ACTIVE.	0V, +V
27	INTERLOCK STATUS	INTERLOCK INDICATION. LOW (0 VDC) WHEN ACTIVE.	0V, +V
28	BLOWER STATUS	BLOWER ON INDICATION. LOW (0 VDC) WHEN ACTIVE.	0V, +V
29	FILAMENT STATUS	FILAMENT ON INDICATION. LOW (0 VDC) WHEN ACTIVE.	0V, +V
30	HIGH VOLTAGE STATUS	HIGH VOLTAGE ON INDICATION. LOW (0 VDC) WHEN ACTIVE.	0V, +V

TB2 PIN DESCRIPTIONS

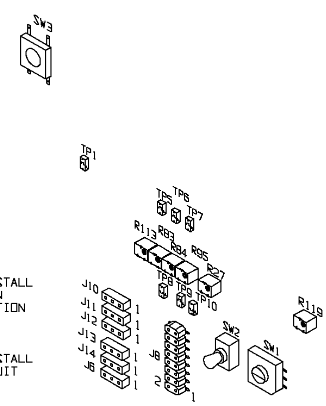
Pin	Name	Description	Interface
1	FWD PWR OUT	** TRANSMITTER FORWARD POWER METER OUTPUT. +2V OR +4 VDC FULL SCALE INDICATION +2V = INSTALL JUMPER P12 IN POSITION 2-3 +4V = INSTALL JUMPER P12 IN POSITION 1-2 LOG OR LINEAR FORMAT. LOG = INSTALL JUMPER IN J8 PINS 15-16. LINEAR = REMOVE JUMPER FROM J8 PINS 15-16. METER GROUND RECOMMENDED.	+2 OR +4 VDC
2	RFL PWR OUT	** TRANSMITTER REFLECTED POWER METER OUTPUT. +2V OR +4 VDC FULL SCALE INDICATION +2V = INSTALL JUMPER P13 IN POSITION 2-3 +4V = INSTALL JUMPER P13 IN POSITION 1-2 LOG OR LINEAR FORMAT. LOG = INSTALL JUMPER IN J8 PINS 15-16. LINEAR = REMOVE JUMPER FROM J8 PINS 15-16. METER GROUND RECOMMENDED.	+2 OR +4 VDC
3	IPA FWD PWR OUT	** IPA FORWARD POWER METER OUTPUT. +2V OR +4 VDC FULL SCALE INDICATION +2V = INSTALL JUMPER P14 IN POSITION 2-3 +4V = INSTALL JUMPER P14 IN POSITION 1-2 LOG OR LINEAR FORMAT. LOG = INSTALL JUMPER IN J8 PINS 15-16. LINEAR = REMOVE JUMPER FROM J8 PINS 15-16. METER GROUND RECOMMENDED.	+2 OR +4 VDC
4	PLATE VOLTAGE OUT	** PLATE VOLTAGE METER OUTPUT. +2V OR +4 VDC FULL SCALE INDICATION +2V = INSTALL JUMPER P10 IN POSITION 2-3 +4V = INSTALL JUMPER P10 IN POSITION 1-2 LOG OR LINEAR FORMAT. LOG = INSTALL JUMPER IN J8 PINS 15-16. LINEAR = REMOVE JUMPER FROM J8 PINS 15-16. METER GROUND RECOMMENDED.	+2 OR +4 VDC
5	PLATE CURRENT OUT	** PLATE CURRENT METER OUTPUT. +2V OR +4 VDC FULL SCALE INDICATION +2V = INSTALL JUMPER P11 IN POSITION 2-3 +4V = INSTALL JUMPER P11 IN POSITION 1-2 LOG OR LINEAR FORMAT. LOG = INSTALL JUMPER IN J8 PINS 15-16. LINEAR = REMOVE JUMPER FROM J8 PINS 15-16. METER GROUND RECOMMENDED.	+2 OR +4 VDC
6	METERING GROUND	METER GROUND FOR METER CONNECTIONS.	METER GROUND
7	METERING GROUND	METER GROUND FOR METER CONNECTIONS.	METER GROUND
8	METERING GROUND	METER GROUND FOR METER CONNECTIONS.	METER GROUND
9	NO CONNECTION		
10	EXT INTERLOCK OUT	CONNECTION FOR AN EXTERNAL INTERLOCK SUCH AS A TEST LOAD OR MOTORIZED COAXIAL SWITCH.	
11	EXT INTERLOCK IN		
12	NO CONNECTION		
13	CHASSIS GROUND	CHASSIS GROUND. CHASSIS GROUND FOR REMOTE CONTROL CONNECTIONS.	CHASSIS GROUND
14	CHASSIS GROUND	CHASSIS GROUND. CHASSIS GROUND FOR REMOTE CONTROL CONNECTIONS.	CHASSIS GROUND
15	RMT PWR +15 VDC	+15 VDC SUPPLY FROM CONTROLLER. PROVIDES A +15 VDC SUPPLY FOR REMOTE SWITCHES AND INDICATORS.	+15 VDC
16	RMT PWR +15 VDC	+15 VDC SUPPLY FROM CONTROLLER. PROVIDES A +15 VDC SUPPLY FOR REMOTE SWITCHES AND INDICATORS.	+15 VDC



REMOTE INTERFACE CIRCUIT BOARD

NOTES: * POSITIVE CONTROL - INSTALL P6 ON CONTROLLER MAIN CIRCUIT BOARD IN POSITION 2-3. FACTORY DEFAULT. SEE DETAIL 'A'.

NEGATIVE CONTROL - INSTALL P6 ON CONTROLLER CIRCUIT BOARD IN POSITION 1-2. SEE DETAIL 'A'.



**
DETAIL 'A'
CONTROLLER MAIN CIRCUIT BOARD

597-0220-418A

FIGURE 2-4. REMOTE CONTROL INTERFACING (SHEET 2 OF 2)

2–61. The transmitter controller allows the selection of positive or negative control logic. Positive/negative control is determined by header J6 on the controller main circuit board assembly. Positive control requires the use of a momentary contact to a +5 volt to +15 volt dc signal to activate the function. Negative control requires the use of a momentary contact to ground to activate the function. The transmitter controller is factory programmed for positive remote control operations.

2–62. The remote meter outputs can be configured for: 1) +2/+4 volt dc full–scale indications and 2) a log or linear format. +2/+4 volt dc full–scale programming is determined by headers J10 through J12 on the controller main circuit board. The log/linear control is determined by header J8 pins 15–16 on the controller main circuit board. Refer to Figure 2–4 and the following text to connect remote control equipment to the transmitter.

2–63. **Remote APC On Control.** The APC (automatic–power–control) on function is located at TB1–1. The function can be activated using positive or negative control. Positive control requires the use of a momentary contact to a +5 volt to +15 volt dc signal to enable APC operation. Negative control requires the use of a momentary contact to ground to enable APC operation.

2–64. **Remote Filament On Control.** The filament on function is located at TB1–2. The function can be activated using positive or negative control. Positive control requires the use of a momentary contact to a +5 volt to +15 volt dc signal to enable the filaments. Negative control requires the use of a momentary contact to ground to enable the filaments.

2–65. **Remote Filament Off Control.** The filament off function is located at TB1–3. The function: 1) provides one–button–off control by disabling the high voltage and the filaments and 2) can be activated using positive or negative control. Positive control requires the use of a momentary contact to a +5 volt to +15 volt dc signal to disable the: 1) filaments and 2) high voltage if not previously disabled. Negative control requires the use of a momentary contact to ground to disable the: 1) filaments and 2) high voltage if not previously disabled.

2–66. **Remote High Voltage On Control.** The high voltage on function is located at TB1–4. The function: 1) provides one–button–on control by enabling the high voltage and the filaments and 2) can be activated using positive or negative control. Positive control requires the use of a momentary contact to a +5 volt to +15 volt dc signal to enable the: 1) high voltage and 2) filaments if not previously enabled. Negative control requires the use of a momentary contact to ground to enable the: 1) high voltage and 2) filaments if not previously enabled.

2–67. **Remote High Voltage Off Control.** The high voltage off function is located at TB1–5. The function can be activated using positive or negative control. Positive control requires the use of a momentary contact to a +5 volt to +15 volt dc signal to disable the high voltage. Negative control requires the use of a momentary contact to ground to disable the high voltage.

2–68. **Remote PA Power Level Raise Control.** The transmitter PA power level raise control is located at TB1–6. The function can be activated using positive or negative control. Positive control requires the use of a momentary contact to a +5 volt to +15 volt dc signal to raise the transmitter power level. Negative control requires the use of a momentary contact to ground to raise the transmitter power level.

2–69. **Remote Power Level Lower Control.** The transmitter PA power level lower control is located at TB1–7. The function can be activated using positive or negative control. Positive control requires the use of a momentary contact to a +5 volt to +15 volt dc signal to lower the transmitter power level. Negative control requires the use of a momentary contact to ground to lower the transmitter power level.

2–70. **Remote Preset Power On Control.** The preset power on function is located at TB1–8. The function can be activated using positive or negative control. Positive control requires the use of a momentary contact to a +5 volt to +15 volt dc signal to enable preset power operation. Negative control requires the use of a momentary contact to ground to enable preset power operation.

2–71. **Remote Overload Reset Control.** The overload reset control is designed to reset the transmitter overload circuitry. The reset control is located at TB1–9. The function can be activated using positive or negative control. Positive control requires the use of a momentary contact to a +5 volt to +15 volt dc signal to reset the transmitter overload circuitry. Negative control requires the use of a momentary contact to ground to reset the transmitter overload circuitry.

2–72. **No Connection.** No connection at the following locations:

1) TB1–10 through TB1–14.

2) TB1–25.

3) TB2–9.

4) TB2–12.

2–73. **APC On Indicator.** The APC on indicator provides a signal to indicate when APC operation is enabled. The APC on indicator is located at TB1–15. The indicator will go LOW (0 volts dc) to indicate when APC operation is enabled.

2–74. **Filament On Indicator.** The filament on indicator provides a signal to indicate when the filaments are enabled. The filament on indicator is located at TB1–16. The indicator will go LOW (0 volts dc) to indicate when the filaments are enabled.

2–75. **Remote Disable Indicator.** The remote disable indicator provides a signal to indicate when the remote control inputs are disabled. The remote disable indicator is located at TB1–17. The indicator will go LOW (0 volts dc) to indicate when the remote control inputs are disabled.

2–76. **Remote High Voltage On Indicator.** The remote high voltage on indicator provides a signal to indicate when the high voltage is enabled. The remote high voltage on indicator is located at TB1–18. The indicator will go LOW (0 volts dc) to indicate when the high voltage is enabled.

2–77. **Remote Plate Overload Indicator.** The remote plate overload indicator provides a signal to indicate when a plate overload has occurred. The remote plate overload indicator is located at TB1–19. The indicator will go LOW (0 volts dc) to indicate when a plate overload has occurred.

2–78. **Remote Screen Overload Indicator.** The remote screen overload indicator provides a signal to indicate when a screen overload has occurred. The remote screen overload indicator is located at TB1–20. The indicator will go LOW (0 volts dc) to indicate when a screen overload has occurred.

2–79. **Remote Grid Overload Indicator.** The remote grid overload indicator provides a signal to indicate when a grid overload has occurred. The remote grid overload indicator is located at TB1–21. The indicator will go LOW (0 volts dc) to indicate when a grid overload has occurred.

2–80. **Remote VSWR Overload Indicator.** The remote VSWR overload indicator provides a signal to indicate when a VSWR overload has occurred. The remote VSWR overload indicator is located at TB1–22. The indicator will go LOW (0 volts dc) to indicate when a VSWR overload has occurred.

2–81. **Remote Overload Indicator.** The remote overload indicator provides a signal to indicate when a plate, screen, grid, or VSWR overload has occurred. The remote overload indicator is located at TB1–23. The indicator will go LOW (0 volts dc) to indicate when an overload has occurred.

2–82. **Remote Preset Power Indicator.** The preset power indicator provides a signal to indicate when preset power operation is enabled. The preset power indicator is located at TB1–24. The indicator will go LOW (0 volts dc) to indicate when preset power operation is enabled.

2–83. **Remote Failsafe Indicator.** The failsafe indicator provides a signal to indicate when the failsafe interlock is closed. The failsafe indicator is located at TB1–26. The indicator will go LOW (0 volts dc) to indicate when the failsafe interlock is closed.

2–84. **Remote Interlock Indicator.** The interlock indicator provides a signal to indicate when the internal interlocks are closed. The interlock indicator is located at TB1–27. The indicator will go LOW (0 volts dc) to indicate when the internal interlocks are closed.

2–85. **Remote Blower Indicator.** The blower indicator provides a signal to indicate when the transmitter blower is operational. The blower indicator is located at TB1–28. The indicator will go LOW (0 volts dc) to indicate when the blower is operational.

2–86. **Remote Filament Indicator.** The filament indicator provides a signal to indicate when the filament contactor is energized. The filament indicator is located at TB1–29. The indicator will go LOW (0 volts dc) to indicate when the filament contactor is energized.

2–87. **Remote High Voltage Indicator.** The high voltage indicator provides a signal to indicate when the high voltage contactor is energized. The high voltage indicator is located at TB1–30. The indicator will go LOW (0 volts dc) to indicate when the high voltage contactor is energized.

2–88. **Remote Forward Power Meter Indications.** Remote forward power meter indications are located at TB2–1. The forward power meter output can be configured for a +2 or +4 volt dc full–scale meter indication. The forward power full–scale indication is 11,000 watts. In addition, the forward power sample can be provided in a log or linear format. The transmitter is shipped with the sample programmed for a linear format. The meter ground is recommended for remote metering connections (TB2–6 through TB2–8).

2–89. **Remote Reflected Power Meter Indications.** Remote reflected power meter indications are located at TB2–2. The reflected power meter output can be configured for a +2 or +4 volt dc full–scale meter indication. The reflected power full–scale indication is 3100 watts. In addition, the reflected power sample can be provided in a log or linear format. The transmitter is shipped with the sample programmed for a linear format. The meter ground is recommended for remote metering connections (TB2–6 through TB2–8).

2–90. **Remote Plate Voltage Meter Indications.** Remote plate voltage meter indications are located at TB2–4. The plate voltage meter output can be configured for a +2 or +4 volt dc full–scale meter indication. The plate voltage full–scale indication is 10,000 volts. In addition, the plate voltage sample can be provided in a log or linear format. The transmitter is shipped with the sample programmed for a linear format. The meter ground is recommended for remote metering connections (TB2–6 through TB2–8).

2–91. **Remote Plate Current Meter Indications.** Remote plate current meter indications are located at TB2–5. The plate current meter output can be configured for a +2 or +4 volt dc full–scale meter indication. The plate current full–scale indication is 3.5 amps. In addition, the plate current sample can be provided in a log or linear format. The transmitter is shipped with the sample programmed for a linear format. The meter ground is recommended for remote metering connections (TB2–6 through TB2–8).

2–92. **Remote IPA Forward Power Meter Indications.** Not Used in the FM–10T/FM–10TS.

2–93. **Chassis Ground.** Chassis ground is designed to be used for remote control connections. Chassis ground is located at TB2–13 and TB2–14.

2–94. **+15V DC Supply.** A +15 volt dc supply is provided for the remote control switches and indicators. The +15 volt dc supply is located at TB2–15 and TB2–16.

2–95. **WIRING.**

WARNING *ENSURE NO PRIMARY POWER IS CONNECTED TO THE TRANSMITTER BEFORE PROCEEDING.*

WARNING

2–96. **TRANSFORMER TAPS.** Ensure the transmitter is wired for the input voltage and line frequency to be used. The screen transformer, the plate transformer, the bias transformer, and the filament voltage regulator must be checked and changed if required (see Figure 2–5).

WARNING *ENSURE NO PRIMARY POWER IS CONNECTED TO THE TRANSMITTER BEFORE PROCEEDING.*

WARNING

2–97. **INPUT VOLTAGE CHECK.** Check the FM exciter, the optional stereo generator, and the optional SCA generator ac input voltages as follows:

A. The primary ac line voltage with which the transmitter will be used (208V or 230/240V) must be visible on the ac line voltage selector circuit board located adjacent to the ac input connector on each unit.

B. If an ac line voltage selector must be changed, remove the ac line voltage selector circuit board with a small pair of needle–nose pliers. Reinsert the circuit board so that the correct ac line voltage is visible when the circuit board is reinserted into the receptacle.

WARNING *ENSURE NO PRIMARY POWER IS CONNECTED TO THE TRANSMITTER BEFORE PROCEEDING.*

WARNING

2–98. **CABINET INTERCONNECTIONS.** Refer to the following cabinet interconnection procedures for the type of transmitter installation used.

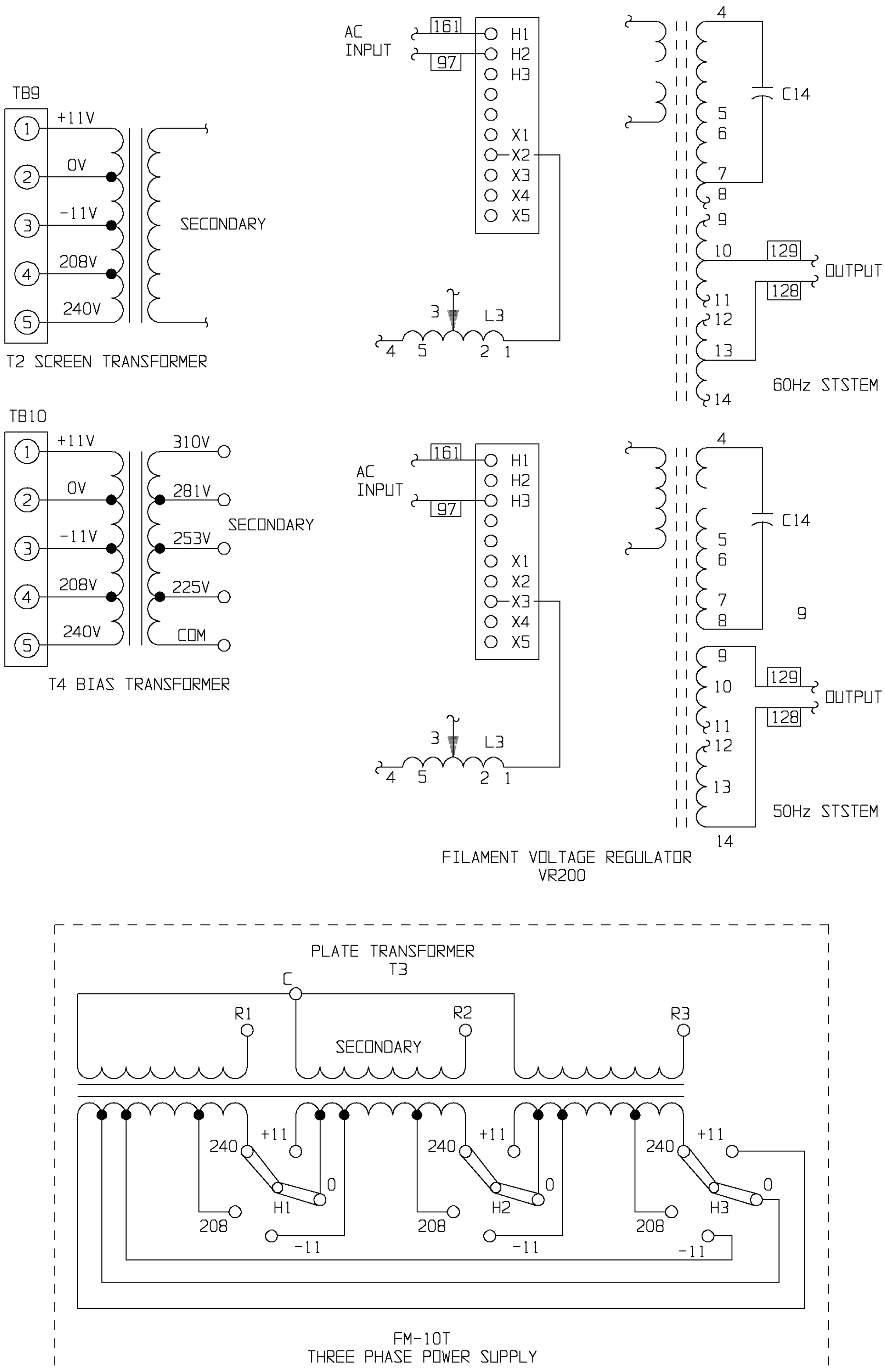
2–99. **Cabinet Interconnections For Adjacent Power Supply Cabinet Installation.** For an adjacent power supply cabinet installation, refer to Figure 2–6 and perform the following cabinet interconnections:

CAUTION *TO PREVENT DAMAGE TO THE WIRING HARNESS ASSEMBLY, ROUTE WIRES 631-640 TO TB15 IN A MANNER TO ENSURE THE WIRES DO NOT TOUCH THE BLOWER ASSEMBLY.*

CAUTION

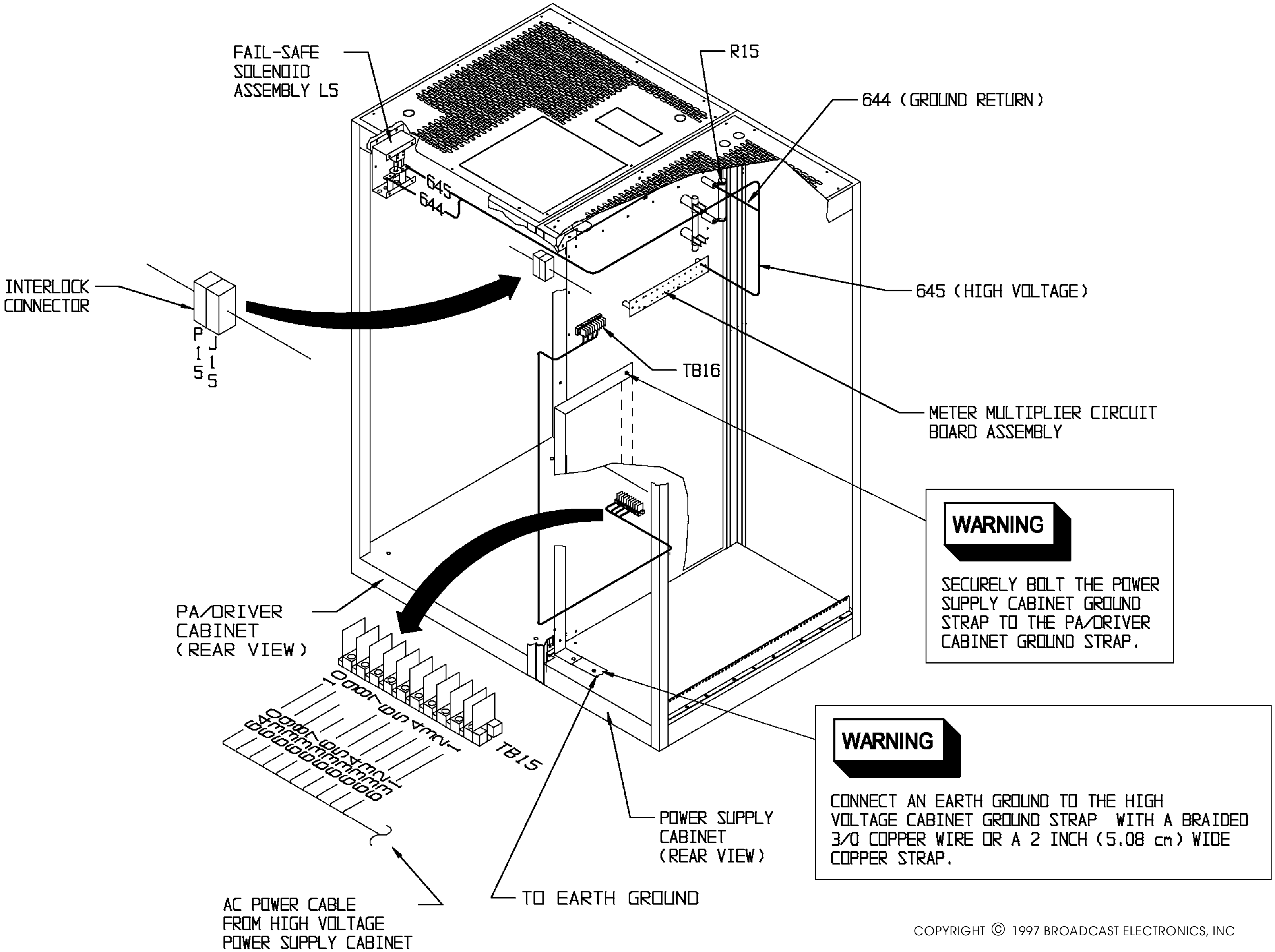
A. Connect wires 631 through 640 to TB15 in the PA/driver cabinet. Route wires 631 through 640 in a manner to ensure the wires do not touch the blower assembly.

B. Attach interlock connector P15 to J15.



597-0098-9

FIGURE 2-5. TRANSFORMER TAPS



597-0098-11

FIGURE 2-6. CABINET INTERCONNECTIONS, ADJACENT POWER SUPPLY CABINET INSTALLATIONS

CAUTION ***TO PREVENT SEVERE DAMAGE TO THE HIGH VOLTAGE POWER SUPPLY, ENSURE WIRES 644 AND 645 ARE PROPERLY INSTALLED IN THE TRANSMITTER.***

CAUTION

C. Connect high voltage wire 645 to the meter multiplier circuit board assembly in the power supply cabinet as shown.

D. Connect ground return wire 644 to the top terminal of resistor R15 as shown.

WARNING ***ENSURE ALL CABINET GROUND CONNECTIONS ARE PERFORMED IN THE FOLLOWING STEP.***

WARNING

E. Attach the ground connections in the cabinets as follows:

1. Connect the appropriate size braided copper wire or 2 inch wide (5.08 cm) copper strap from earth ground to the power supply cabinet ground strap as shown.
2. Bolt the power supply cabinet ground strap to the PA/driver cabinet ground strap as shown.

2–100. **Cabinet Interconnections For Remote Power Supply Cabinet Installation.** For a remote power supply cabinet installation, refer to Figure 2–7 and perform the following cabinet interconnections:

WARNING ***ROUTE CABINET INTERCONNECTING HIGH VOLTAGE AND AC POWER CABLES IN 1 INCH (2.54 cm) METALLIC CONDUIT TO PREVENT EXPOSURE TO HAZARDOUS VOLTAGES.***

WARNING

A. For overhead wiring installations, use the PA cabinet and power supply cabinet overhead wiring access holes and route the high voltage and ac power cables from the power supply cabinet to the PA/driver cabinet through 1 inch (2.54 cm) metallic conduit. For under–floor installations, route the ac cables using the PA/driver cabinet and power supply cabinet under–floor access holes. Route all dc control cables in access holes separate from the ac and high voltage cables.

WARNING ***CONNECT THE CONDUIT TO THE GROUND STRAP IN EACH CABINET.***

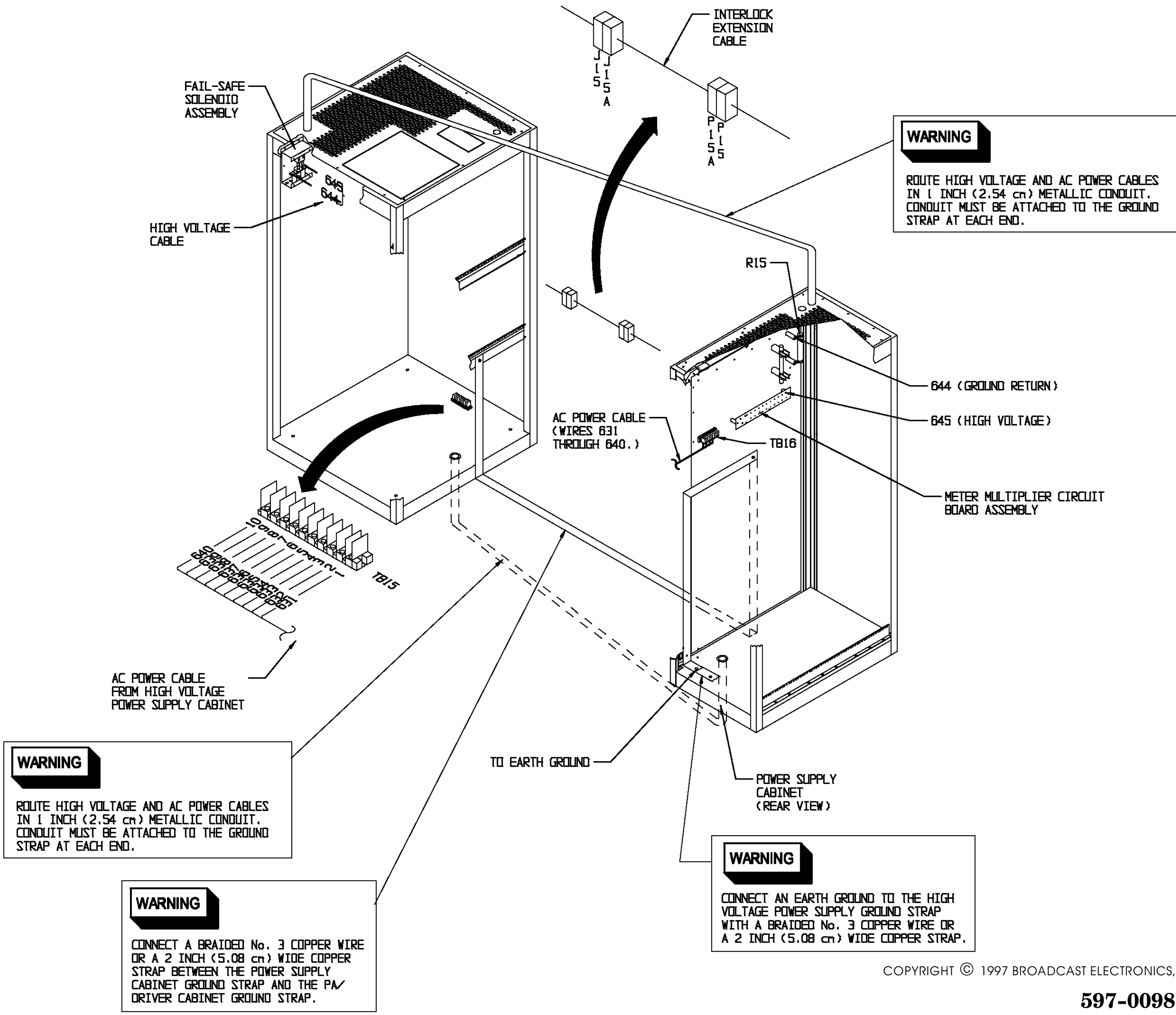
WARNING

B. For overhead wiring installations, connect the conduit to the ground strap in each cabinet.

CAUTION ***TO PREVENT DAMAGE TO THE WIRING ASSEMBLY, ROUTE WIRES 631-640 TO TB15 IN A MANNER TO ENSURE THE WIRES DO NOT TOUCH THE BLOWER ASSEMBLY.***

CAUTION

C. Connect ac power wires 631 through 640 to TB15 in the PA/driver cabinet. Route wires 631 through 640 in a manner to ensure the wires do not touch the blower assembly.



597-0098-12

FIGURE 2-7. CABINET INTERCONNECTIONS, REMOTE POWER SUPPLY CABINET INSTALLATIONS

D. Connect the interlock extension cable between J15 and P15.

CAUTION
CAUTION

TO PREVENT SEVERE DAMAGE TO THE HIGH VOLTAGE POWER SUPPLY, ENSURE WIRES 644 AND 645 ARE PROPERLY INSTALLED IN THE TRANSMITTER.

E. Connect high voltage wire 645 to the meter multiplier circuit board assembly in the power supply cabinet as shown.

F. Connect ground return wire 644 to the top terminal of resistor R15 as shown.

WARNING
WARNING

ENSURE ALL CABINET GROUND CONNECTIONS ARE PERFORMED IN THE FOLLOWING STEP.

G. Attach the ground connections in the cabinets as follows:

1. Connect the appropriate size braided copper wire or 2 inch wide (5.08 cm) copper strap from earth ground to the power supply cabinet ground strap as shown.
2. Connect the appropriate size braided copper wire or 2 inch wide (5.08 cm) copper strap from the power supply cabinet ground strap to the PA/driver cabinet ground strap as shown.

WARNING
WARNING

ENSURE PRIMARY POWER IS DISCONNECTED BEFORE PROCEEDING.

CAUTION
CAUTION

THE AC DISTRIBUTION PANEL PROVIDES A 220V AC OPERATING SUPPLY FOR OPTIONAL EQUIPMENT. ENSURE ALL 220V AC AND 110V AC EQUIPMENT IS PROPERLY CONNECTED TO THE PANEL.

2–101. **OPTIONAL EQUIPMENT WIRING.** An ac distribution panel is provided in the PA/driver cabinet for the application of ac power to the PA/driver cabinet modular components. Mount and wire any optional equipment not provided with the transmitter to the distribution panel (refer to Figure 2–8). The ac distribution panel provides a 220V ac operating supply for the optional equipment. Ensure all 220V ac and 110V ac equipment is properly connected to the panel.

2–102. **SIGNAL INPUTS.** Refer to the applicable technical manual for the exciter, stereo generator, and SCA generator and wire the inputs and control connections to each unit.

2–103. **FAILSAFE INTERLOCK.** The FM–10T/FM–10TS transmitters are equipped with a failsafe interlock circuit such as for a test load or remote control failsafe connection. The failsafe interlock circuit is independent of the transmitter safety interlock circuit and will disable only the high voltage plate supply when opened. The interlock is located at TB2–10 and TB2–11 on the transmitter remote interface panel. Refer to Figure 2–4 and connect the interlock wiring to TB2–10 and TB2–11 as shown. If unused, ensure the factory installed jumper is connected between the terminals.

2–104. **TRANSMITTER MONITORING - MODEM CONNECTIONS.** The FM–10T/FM–10TS transmitters are equipped with: 1) a built–in front–panel modem port and 2) a built–in rear–panel modem port. The modem ports allow modems to be connected to the transmitter for local and remote monitoring of transmitter parameters using a future local/remote diagnostic system.

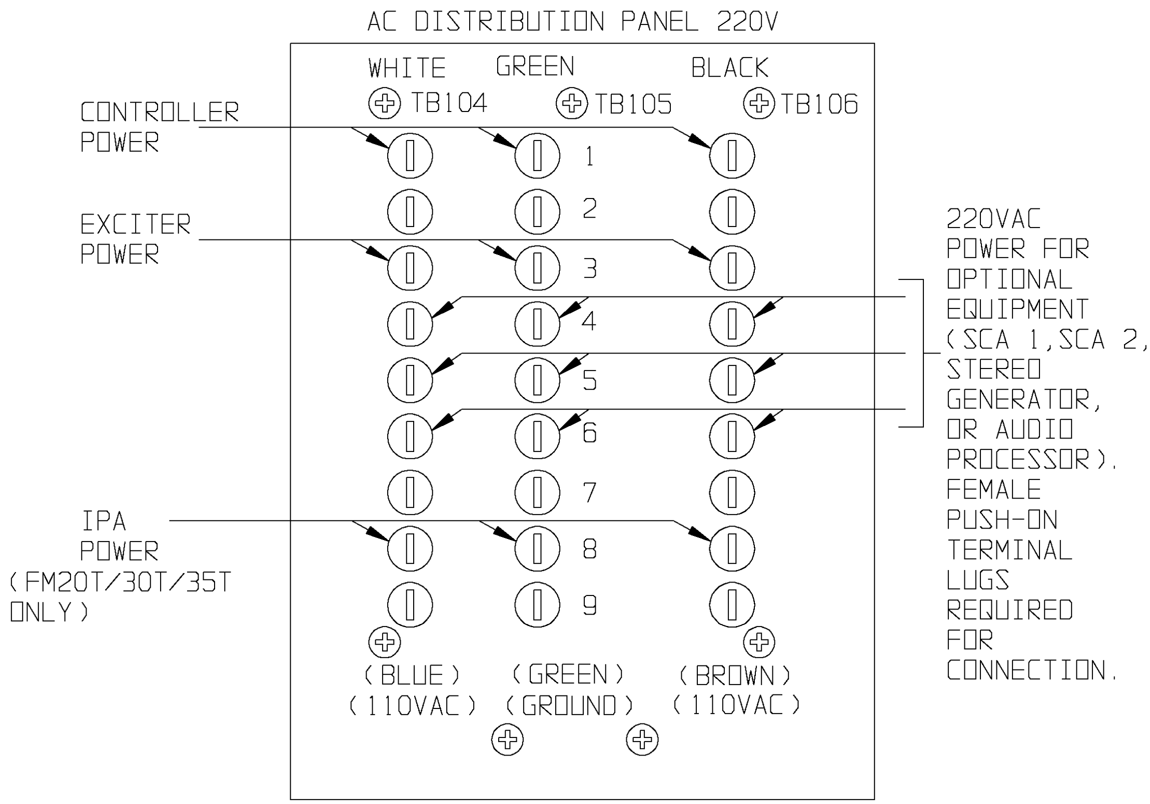


FIGURE 2-8. OPTIONAL EQUIPMENT WIRING **597-0220-403**

2-105. **TRANSMITTER MONITORING - PRINTER CONNECTIONS.** The FM-10T/FM-10TS transmitters are equipped with a built-in printer port. The printer port allows transmitter parameters to be printed using a local printer and a future local/remote diagnostic system.

2-106. **AC POWER CONNECTIONS.** The following text presents the ac power connections for the FM-10T and FM-10TS transmitters. Refer to the following information and connect the FM-10T/FM-10TS transmitters to the appropriate power supply.

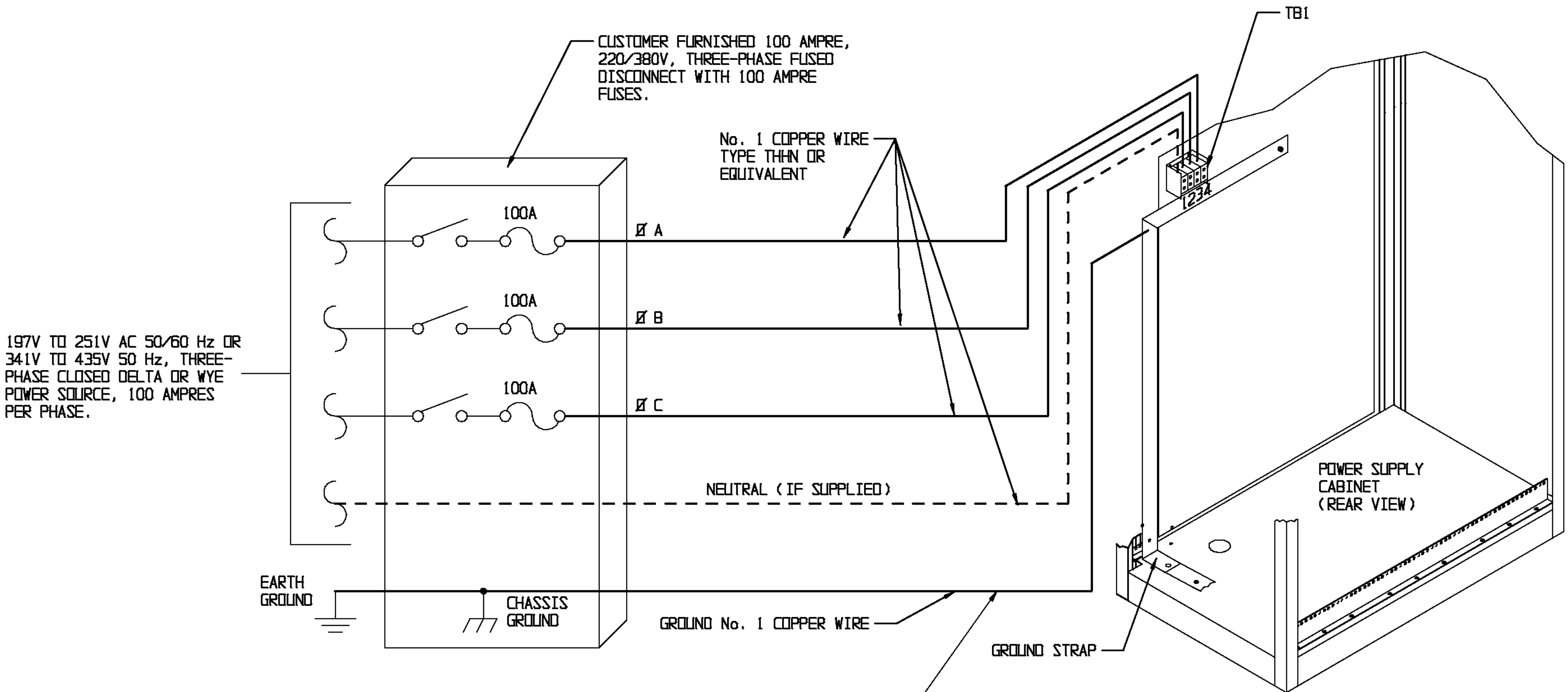
WARNING ***ENSURE PRIMARY POWER IS DISCONNECTED BEFORE PROCEEDING.***

WARNING

WARNING ***ENSURE AN EARTH GROUND CONDUCTOR IS SECURELY CONNECTED TO THE POWER SUPPLY CABINET GROUND TERMINAL.***

WARNING

2-107. **FM-10T.** A three-phase power source of 196 to 252V ac, 50/60 Hz or 341 to 435V ac, 50 Hz at 100 Amperes per phase is required for transmitter operation. Ensure the power source is supplied from an acceptable ac transformer configuration (refer to PRIMARY POWER). For operating safety, the power source must be routed to the transmitter through a fused power disconnect (see Figure 2-9).



WARNING

IF THE POWER CABINET IS LOCATED REMOTELY FROM THE PA/DRIVER CABINET, ENSURE A No. 1 COPPER WIRE OR A 2 INCH (5.08cm) WIDE COPPER STRAP IS CONNECTED FROM THE POWER SUPPLY CABINET GROUND STRAP TO THE PA/DRIVER CABINET GROUND STRAP.

WARNING

ENSURE AN EARTH GROUND IS CONNECTED TO THE POWER SUPPLY CABINET GROUND STRAP WITH BRAIDED No. 1 COPPER WIRE OR A 2 INCH (5.08cm) WIDE COPPER STRAP.

597-0098-14

FIGURE 2-9. FM-10T PRIMARY AC WIRING

2–108. Refer to Figure 2–9 and connect the 100 Ampere three–phase service to ac input terminal strip TB1 in the high voltage power supply cabinet through a fused service disconnect. Ensure a utility company ground conductor is securely connected to the power supply cabinet ground lug. For a three–phase WYE service, ensure the neutral wire is connected to ac input terminal TB1–1.

WARNING ***ENSURE PRIMARY POWER IS DISCONNECTED BEFORE PROCEEDING.***
WARNING

WARNING ***ENSURE AN EARTH GROUND CONDUCTOR IS SECURELY CONNECTED TO THE POWER SUPPLY CABINET GROUND TERMINAL.***
WARNING

2–109. **FM-10TS.** A single–phase power source of 196 to 252V ac, 50/60 Hz at 175 Amperes is required for transmitter operation. For operating safety, the power source must be routed to the transmitter through a fused power disconnect (see Figure 2–10).

2–110. Refer to Figure 2–10 and connect the 175 Ampere single–phase service to ac input terminal strip TB301 in the power supply cabinet through a fused service disconnect. Ensure a utility company ground conductor is securely connected to the power supply cabinet ground lug.

2–111. **INITIAL CHECKOUT.**

WARNING ***ENSURE PRIMARY POWER IS DISCONNECTED BEFORE PROCEEDING.***
WARNING

2–112. Replace all panels and doors etc. on the transmitter.

2–113. Ensure the transmitter is completely installed by checking the following items:

A. Ensure primary power is correctly wired.

B. Ensure all ground connections are secure.

C. Ensure the cabinet ground straps are properly connected to earth ground.

D. Ensure all RF connections are secure.

E. Ensure the station monitor is properly connected to the transmission line RF sample port.

F. Ensure all connections at terminal boards are secure.

G. Rotate the blower and fans by hand to ensure no obstructions are present.

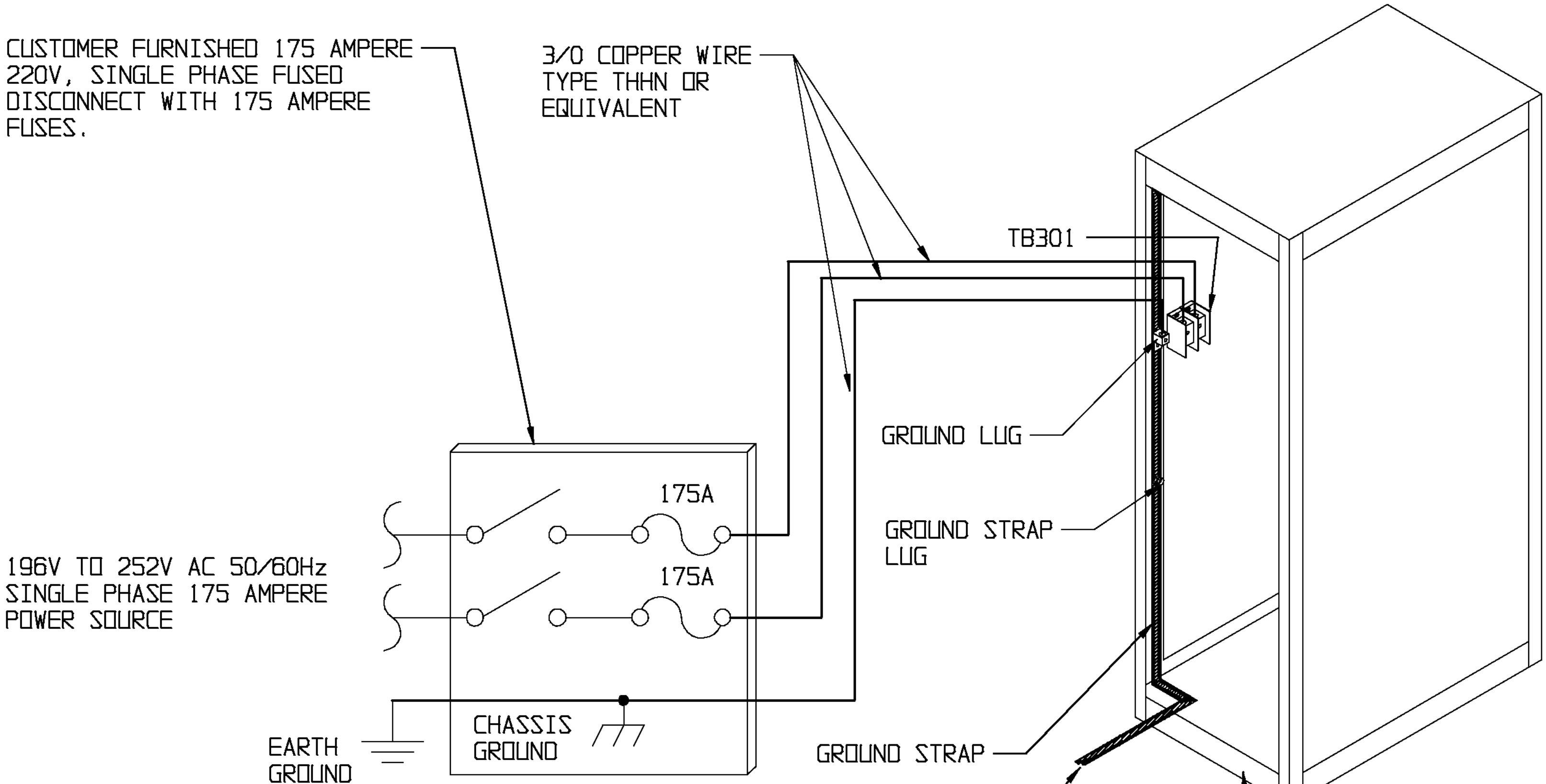
H. Using an insulator, check relay operation manually to be certain all have free movement.

I. Remove any extra hardware and wire lying within the cabinets.

J. Ensure all guards at terminal strips, circuit breakers etc. are secure.

K. Using a miniature flat–blade screwdriver, mechanically zero all meters.

L. Ensure the transmitter shorting sticks are on the hangers and close all doors.



WARNING

IF THE POWER SUPPLY CABINET IS LOCATED REMOTELY FROM THE PA/DRIVER CABINET, ENSURE A 3/0 COPPER WIRE OR A 2 INCH (5.08 cm) WIDE COPPER STRAP IS CONNECTED FROM THE POWER SUPPLY CABINET GROUND STRAP TO THE PA/DRIVER GROUND STRAP.

WARNING

ENSURE AN EARTH GROUND IS CONNECTED TO THE POWER SUPPLY CABINET GROUND STRAP WITH BRAIDED 3/0 COPPER WIRE OR 2 INCH (5.05 cm) WIDE COPPER STRAP

597-0098-413

FIGURE 2-10. FM-10TS PRIMARY AC WIRING

2–114. Operate all six front–panel circuit breakers to OFF and ensure all transmitter controls are preset to the positions indicated on the final test data sheets.

2–115. Ensure an RF load is connected to the transmitter.

2–116. Adjust the transmitter **FILAMENT VOLTAGE** control fully counterclockwise (minimum).

2–117. Extend the exciter forward to expose the **RF OUTPUT ADJ.** control access hole in top–panel. Adjust the control fully counterclockwise (minimum).

2–118. The following procedure will refer to the factory final test data sheets supplied with the transmitter. Some differences in the actual operation may be noted due to differences in primary power or antenna systems.

2–119. **CONTROLLER AND INTERLOCK CHECKOUT.** Check the controller and the transmitter interlock circuit by performing the following procedures.

2–120. **Controller Checkout.** Close the wall–mounted fused disconnect.

2–121. Operate the **CONTROL** and **BLOWER** circuit breakers to ON. The **HIGH VOLTAGE, SCREEN,** and **FILAMENT** circuit breakers must remain OFF.

2–122. Ensure the **FILAMENT ON** and **HIGH VOLTAGE ON** switch/indicators are extinguished.

2–123. Open the controller cabinet door and check the following items on the main circuit board.

A. Ensure the **–15** indicator is illuminated.

B. Ensure the **+15** indicator is illuminated.

C. Ensure the **+5** indicator is illuminated.

2–124. **Interlock Checkout.** Complete the following procedure step by step and note the controller **INTERLOCK STATUS** indicator. If problems occur, deenergize all primary power and troubleshoot the series interlock circuit with an Ohmmeter.

2–125. Ensure the **CONTROL** and **BLOWER** circuit breakers are operated to ON and the **HIGH VOLTAGE, SCREEN,** and **FILAMENT** circuit breakers are operated to OFF.

WARNING ***DEENERGIZE PRIMARY POWER BEFORE PROCEEDING.***
WARNING

2–126. Operate the **CONTROL** circuit breaker to OFF.

2–127. Remove the PA/driver cabinet lower front access panel.

WARNING ***DO NOT TOUCH ANYTHING WITHIN THE TRANSMITTER WITH POWER ENERGIZED.***
WARNING

2–128. Operate the **CONTROL** circuit breaker to ON. The controller **TRANSMITTER STATUS INTERLOCK** indicator will be extinguished.

WARNING ***DEENERGIZE PRIMARY POWER BEFORE PROCEEDING.***
WARNING

2–129. Operate the **CONTROL** circuit breaker to OFF.

2–130. Replace the PA/driver cabinet lower front access panel.

2–131. Operate the **CONTROL** circuit breaker to ON. The controller **INTERLOCK STATUS** indicator will illuminate.

2–132. Open the PA/driver cabinet rear door. The controller **TRANSMITTER STATUS INTERLOCK** indicator will extinguish.

2–133. Close the PA/driver cabinet rear door. The controller **TRANSMITTER STATUS INTERLOCK** indicator will illuminate.

2–134. Open the PA/driver cabinet rear door and perform the following:

WARNING ***WARNING*** ***PERFORM THE FOLLOWING PROCEDURES AS INDICATED. DO NOT TOUCH ANYTHING WITHIN THE TRANSMITTER WITH POWER ENERGIZED.***

A. Depress the PA/driver cabinet rear door interlock switch and raise the cabinet grounding stick from the hanger. The controller **TRANSMITTER STATUS INTERLOCK** indicator will extinguish.

B. Replace the grounding stick. The controller **TRANSMITTER STATUS INTERLOCK** indicator will illuminate.

C. While depressing the PA/driver cabinet rear door interlock switch, open the PA cavity access door. The controller **TRANSMITTER STATUS INTERLOCK** indicator will extinguish.

D. Close the PA cavity access door. The controller **TRANSMITTER STATUS INTERLOCK** indicator will illuminate.

E. Close the PA/driver cabinet rear door.

2–135. Open the power supply cabinet rear door. The controller **TRANSMITTER STATUS INTERLOCK** indicator will extinguish.

2–136. Close the power supply cabinet rear door. The controller **TRANSMITTER STATUS INTERLOCK** indicator will illuminate.

2–137. Open the power supply cabinet rear door and perform the following:

WARNING ***WARNING*** ***PERFORM THE FOLLOWING PROCEDURES AS INDICATED. DO NOT TOUCH ANYTHING WITHIN THE TRANSMITTER WITH POWER ENERGIZED.***

A. Depress the power supply cabinet rear door interlock switch and raise the cabinet grounding stick from the hanger. The controller **TRANSMITTER STATUS INTERLOCK** indicator will extinguish.

B. Replace the grounding stick. The controller **TRANSMITTER STATUS INTERLOCK** indicator will illuminate.

C. Close the power supply cabinet rear door.

2–138. If equipment is connected to the failsafe interlock circuit, check the operation as follows:

A. Open the failsafe interlock. The controller **TRANSMITTER STATUS FAILSAFE** indicator will extinguish.

B. Close the failsafe interlock. The **TRANSMITTER STATUS FAILSAFE** indicator will illuminate.

2–139. **BLOWER CHECKOUT.** Check blower operation by performing the following procedure.

2–140. Ensure the **CONTROL** and **BLOWER** circuit breakers are operated to ON. The **HIGH VOLTAGE, SCREEN** and **FILAMENT** circuit breakers must remain OFF.

2–141. Depress the **FILAMENT ON** switch/indicator to illuminate the switch/indicator. The **FILAMENT ON** switch/indicator, **TRANSMITTER STATUS BLOWER ,** and the **TRANSMITTER STATUS FILAMENT** indicators will illuminate and the blower will begin operation.

2–142. Ensure the blower, **TRANSMITTER STATUS BLOWER** indicator, and the **TRANSMITTER STATUS FILAMENT** indicator are operating properly. At high altitudes, the **TRANSMITTER STATUS BLOWER** indicator may not illuminate. If this occurs, contact the Broadcast Electronics Customer Service Department.

2–143. **EXCITER CHECKOUT.** Check exciter operation by performing the following procedure.

2–144. Ensure the **CONTROL** and **BLOWER** circuit breakers are operated to ON. The **HIGH VOLTAGE, SCREEN** and **FILAMENT** circuit breakers must remain OFF.

2–145. Depress the **HIGH VOLTAGE ON** switch/indicator to illuminate the switch/indicator.

2–146. Apply audio to the exciter. The presence of audio programming will be noted on the exciter digital **MODULATION** meter. The +20V, –20V, +5V, and **LOCK** status indicators will illuminate.

2–147. Depress the exciter multimeter **AFC** switch.

A. The multimeter will indicate a potential within the range of +2.0 volts to +9.0 volts, dependent upon carrier frequency. Refer to the final test data sheets for the correct voltage indication.

2–148. Depress the exciter multimeter **PAV** switch.

A. The multimeter will indicate a potential within a range of +0.0 volts to 0.5 volts (assuming the exciter is configured for a minimum RF power output).

2–149. Depress the exciter multimeter **PAI** switch.

A. The multimeter will indicate approximately 0.0 amperes (assuming the exciter is configured for a minimum RF power output).

2–150. Depress the **FILAMENT OFF** switch.

2–151. Remove the audio from the exciter.

2–152. **PRELIMINARY OPERATION AND TUNING.** Operate and tune the transmitter by performing the following procedure.

2–153. Ensure the **CONTROL** and **BLOWER** circuit breakers are operated to ON. The **HIGH VOLTAGE, SCREEN** and **FILAMENT** circuit breakers must remain OFF.

2–154. Ensure the controller **TRANSMITTER STATUS INTERLOCK** and indicator is illuminated. If the indicator is extinguished, open the wall–mounted fused disconnect and check the following:

A. All panels are installed.

B. All shorting sticks are on the hangers.

C. All doors are closed.

2–155. If equipment is connected to the failsafe interlock, ensure the controller **TRANSMITTER STATUS FAILSAFE** indicator is illuminated. If the indicator is extinguished, open an appropriate power source disconnect if required and check the interlock switch.

2–156. Ensure the **FILAMENT ON** and **HIGH VOLTAGE ON** switch/indicators are extinguished.

2–157. Ensure the exciter **RF OUTPUT POWER ADJ** control is fully counterclockwise (minimum).

2–158. Depress the controller **APC ON** switch/indicator to extinguish the switch/indicator.

2–159. Depress the controller **REMOTE DISABLE** switch/indicator to illuminate the switch/indicator.

2–160. Depress the controller **FWD** switch/indicator to illuminate the switch/indicator.

CAUTION
CAUTION

ENSURE AN RF LOAD IS CONNECTED TO THE TRANSMITTER AND THE FILAMENT VOLTAGE CONTROL IS ADJUSTED TO APPROXIMATELY MID-RANGE.

2–161. Operate the **FILAMENT** circuit breaker to ON.

2–162. Depress the **FILAMENT ON** switch/indicator. Both the **FILAMENT ON** switch/indicator and the **FILAMENT TRANSMITTER STATUS** indicator will illuminate and the blower will begin operation.

2–163. Adjust the **FILAMENT ADJUST** control to obtain a **FILAMENT VOLTAGE** meter indication of 7.0 volts.

2–164. Operate the **MULTIMETER** switch to **GRID VOLTAGE** and note the presence of PA stage grid bias without drive.

2–165. Operate the **SCREEN** and **HIGH VOLTAGE** circuit breakers to ON.

2–166. Depress the **HIGH VOLTAGE ON** switch/indicator. Both the **HIGH VOLTAGE ON** switch/indicator and the **HIGH VOLTAGE TRANSMITTER STATUS** indicator will illuminate.

2–167. Note the presence of plate voltage on the **PLATE VOLTAGE** meter.

2–168. If equipment is connected to the external interlock, open the external interlock. The **FAILSAFE TRANSMITTER STATUS** and **HIGH VOLTAGE** indicators will extinguish and the PA plate voltage will be removed.

2–169. Close the external interlock. PA plate voltage will be restored, the transmitter will resume operation, and the **FAILSAFE TRANSMITTER STATUS** and **HIGH VOLTAGE** indicators will illuminate.

2–170. Adjust the exciter **RF POWER OUTPUT ADJ** control to obtain approximately five Watts from the exciter.

2–171. Depress the exciter multimeter **PAV** switch.

The multimeter will indicate a potential within the range of +0.0 volts to +0.5 volts (assuming an RF output power of less than 1 Watt).

2–172. Depress the exciter multimeter **PAI** switch.

The multimeter will indicate approximately 0.0 amperes (assuming RF output power of less than 1 Watt).

2–173. Depress the exciter multimeter **FWD** switch.

2–174. Operate the **MULTIMETER** switch to **RFL POWER** and adjust the **INPUT TUNING** control to obtain a minimum reflected power indication on the **MULTIMETER**.

CAUTION

CAUTION

CHECK THE TRANSMITTER OUTPUT POWER INDICATION TO ENSURE TRANSMITTER OUTPUT POWER IS PRESENT.

2–175. Note the presence of output power on the **OUTPUT POWER** meter. If no output power is indicated, perform the following:

1. Ensure the PA coarse tuning line is properly adjusted.
2. Adjust the **OUTPUT TUNING** control for a maximum indication on the **OUTPUT POWER** meter.

2–176. Adjust the exciter output to approximately 90 Watts.

2–177. If the FM–250C VSWR indicator illuminates during the remainder of the initial checkout procedure, this indicates that the input circuit load is incorrect. To correct the situation, readjust the **INPUT TUNING** control for a minimum reflected power indication on the FM–250C.

2–178. Adjust the **OUTPUT TUNING** and **OUTPUT LOADING** controls for a maximum **OUTPUT POWER** meter indication.

2–179. Depress the controller **RAISE** switch/indicator for approximately three seconds.

2–180. Depress the controller **APC ON** switch/indicator to illuminate the switch/indicator. The **LOWER** switch/indicator will illuminate until the APC feature returns the screen variable auto–transformer to minimum.

2–181. Depress the **APC ON** switch/indicator. The switch/indicator will extinguish.

2–182. Depress the **RAISE** switch/indicator. Continue to depress the switch/indicator until the **OUTPUT POWER** meter indicates 25% power.

2–183. Adjust the **OUTPUT TUNING** and **OUTPUT LOADING** controls for a maximum **OUTPUT POWER** meter indication.

2–184. Operate the **MULTIMETER** switch to **EXCITER RFL POWER** and adjust the **INPUT TUNING** control to obtain a minimum reflected power indication on the **MULTIMETER**.

2–185. Depress the **RAISE** switch/indicator. Continue to depress the switch/indicator until a 50% indication is obtained on the **OUTPUT POWER** meter.

2–186. Depress the **VSWR** switch/indicator to illuminate the switch/indicator.

2–187. The **OUTPUT POWER** meter must indicate a VSWR of less than 1.8:1. An excessive VSWR indicates improper load connections.

2–188. Depress the **FWD** switch/indicator to illuminate the switch/indicator.

2–189. Adjust the **OUTPUT TUNING** and **OUTPUT LOADING** controls for a maximum indication on the **OUTPUT POWER** meter concurrent with a minimum indication on the **PLATE CURRENT** meter.

2–190. Adjust the exciter **RF POWER OUTPUT ADJ** control to obtain the value stated on the factory test data sheets.

2–191. Operate the **MULTIMETER** switch to **EXCITER RFL POWER** and adjust the **INPUT TUNING** control to obtain a minimum reflected power indication on the **MULTIMETER**.

2–192. Depress the **RAISE** switch/indicator. Continue to depress the switch/indicator until a 100% power indication is noted on the **OUTPUT POWER** meter. If a plate or screen current overload occurs, it may be necessary to adjust the **OUTPUT LOADING** for better efficiency before increasing power to 100%.

2–193. Operate the **MULTIMETER** switch to **EXCITER RFL POWER** and adjust the **INPUT TUNING** control for a minimum reflected power indication on the **MULTIMETER**.

2–194. Adjust the **OUTPUT LOADING** and **OUTPUT TUNING** controls to obtain the values stated on the factory test data sheets.

2–195. Check the **FILAMENT VOLTAGE** meter and adjust the **FILAMENT ADJUST** control as required. The meter must indicate 7.0 volts.

CAUTION ***DO NOT EXCESSIVELY UNLOAD THE PA CIRCUIT IN THE FOLLOWING STEP.***

CAUTION

2–196. Adjust the PA stage for the most efficient operation by adjusting the **OUTPUT TUNING** and **OUTPUT LOADING** controls for a maximum indication on the **OUTPUT POWER** meter concurrent with a minimum indication on the **PLATE CURRENT** meter.

2–197. Operate the **MULTIMETER** switch to **EXCITER RFL POWER** and adjust the **INPUT TUNING** control for a minimum reflected power indication.

2–198. Depress the **RAISE** or **LOWER** switch/indicators as required to obtain a 100% **OUTPUT POWER** meter indication.

2–199. Compare the meter indications to those provided on the final test data sheets. All meter indications should be approximately the same as those stated on the final test data sheets.

2–200. Depress the **APC ON** switch/indicator. The switch/indicator will illuminate and the transmitter will maintain a constant 100% rated RF output.

2–201. To adjust the transmitter to maintain a level other than 100%, the **APC ON** switch/indicator must be illuminated. Depress either the **RAISE** or the **LOWER** switch/indicator as desired until the desired percentage of transmitter power output is indicated by the **OUTPUT POWER** meter. The automatic power control feature will require some time to track the reference to the new set point. The automatic power control feature will then maintain this new established RF output level.

2–202. If remote operation is desired, the **REMOTE DISABLE** switch/indicator must be extinguished. TB1–17 on the remote interface circuit board provides a status signal which can be connected to a light or alarm to remind the engineer of the status of the remote disable switch. This feature will hopefully prevent inadvertent remote lockout if the engineer should leave the transmitter site and forget to enable remote operation.

SECTION III
OPERATION

3-1. INTRODUCTION.

3-2. This section identifies all controls and indicators associated with the FM-10T/FM-10TS transmitters and provides standard operating procedures.

3-3. CONTROLS AND INDICATORS.

3-4. Refer to Figures 3-1 and 3-2 for the location of all controls and indicators associated with normal operation of the FM-10T/FM-10TS transmitters. The function of each control or indicator is described in Tables 3-1 and 3-2.

3-5. OPERATION.

NOTE *NOTE* ***THE FOLLOWING PROCEDURE IS PRESENTED UNDER THE ASSUMPTION THAT THE TRANSMITTER IS COMPLETELY INSTALLED AND IS FREE OF ANY DISCREPANCIES.***

3-6. TURN ON.

3-7. Operate all circuit breakers to ON.

3-8. Depress the **REMOTE DISABLE** switch/indicator to illuminate the switch/indicator.

3-9. Depress the **FILAMENT ON** switch/indicator, then depress the **HIGH VOLTAGE ON** switch/indicator. Each switch/indicator will illuminate as it is depressed.

3-10. If all interlocks are closed, the transmitter will be operational after a short delay to allow PA tube filament warm-up.

3-11. Check and log all meter indications and the status of the various indicators to assure proper equipment operation. A sample log sheet is provided in Table 3-3.

3-12. Depress the **FWD** switch/indicator to illuminate the switch/indicator and check the forward power output.

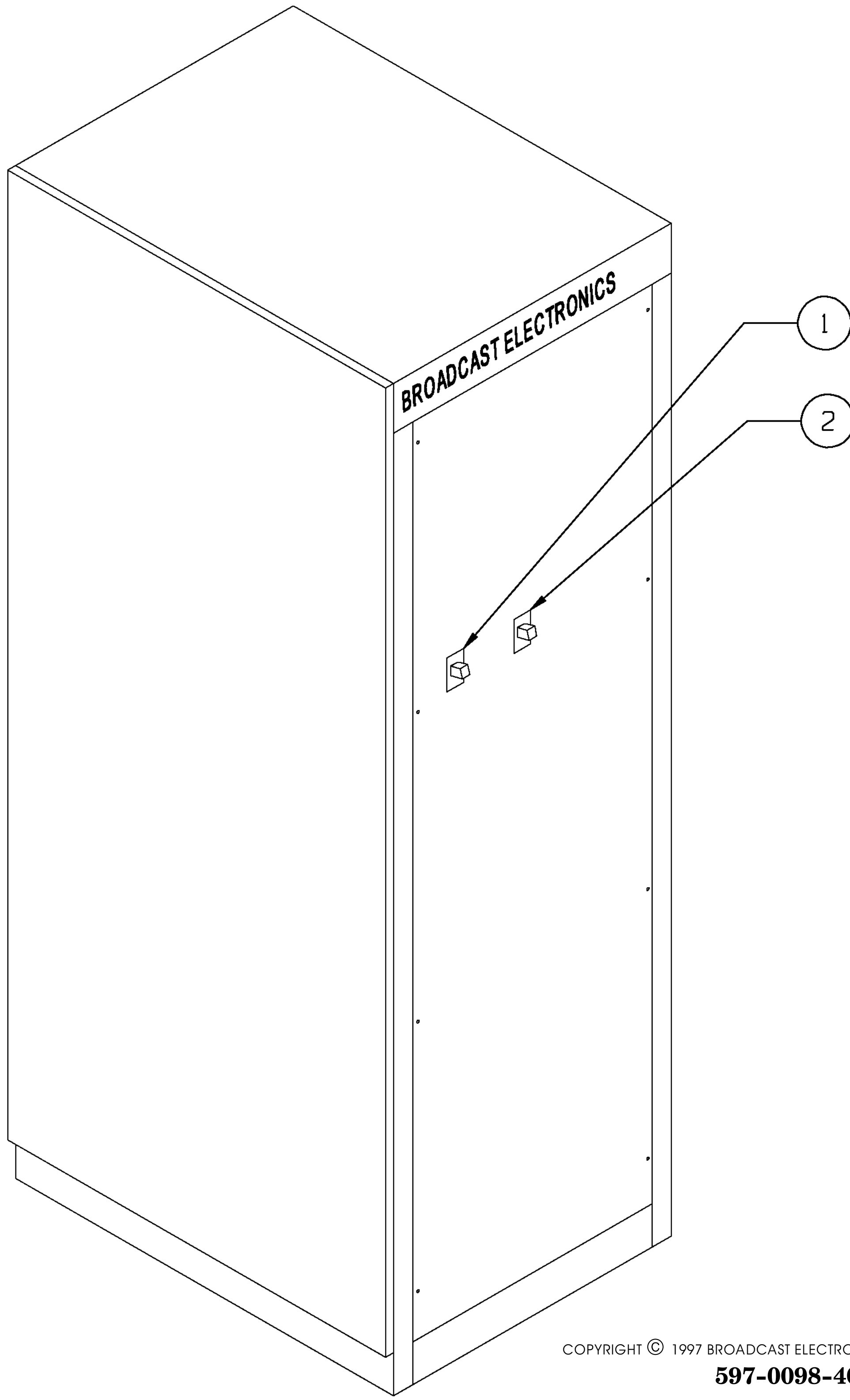
NOTE *NOTE* ***THE VSWR METER IS MOST ACCURATE WHEN THE TRANSMITTER IS OPERATED AT 100% (NORMAL TPO) POWER. TRANSMITTER OPERATION AT A REDUCED POWER LEVEL WILL RESULT IN REDUCED VSWR METER ACCURACY.***

3-13. Depress the **VSWR** switch/indicator to illuminate the switch/indicator and check the VSWR.

3-14. Select the type of RF output power control:

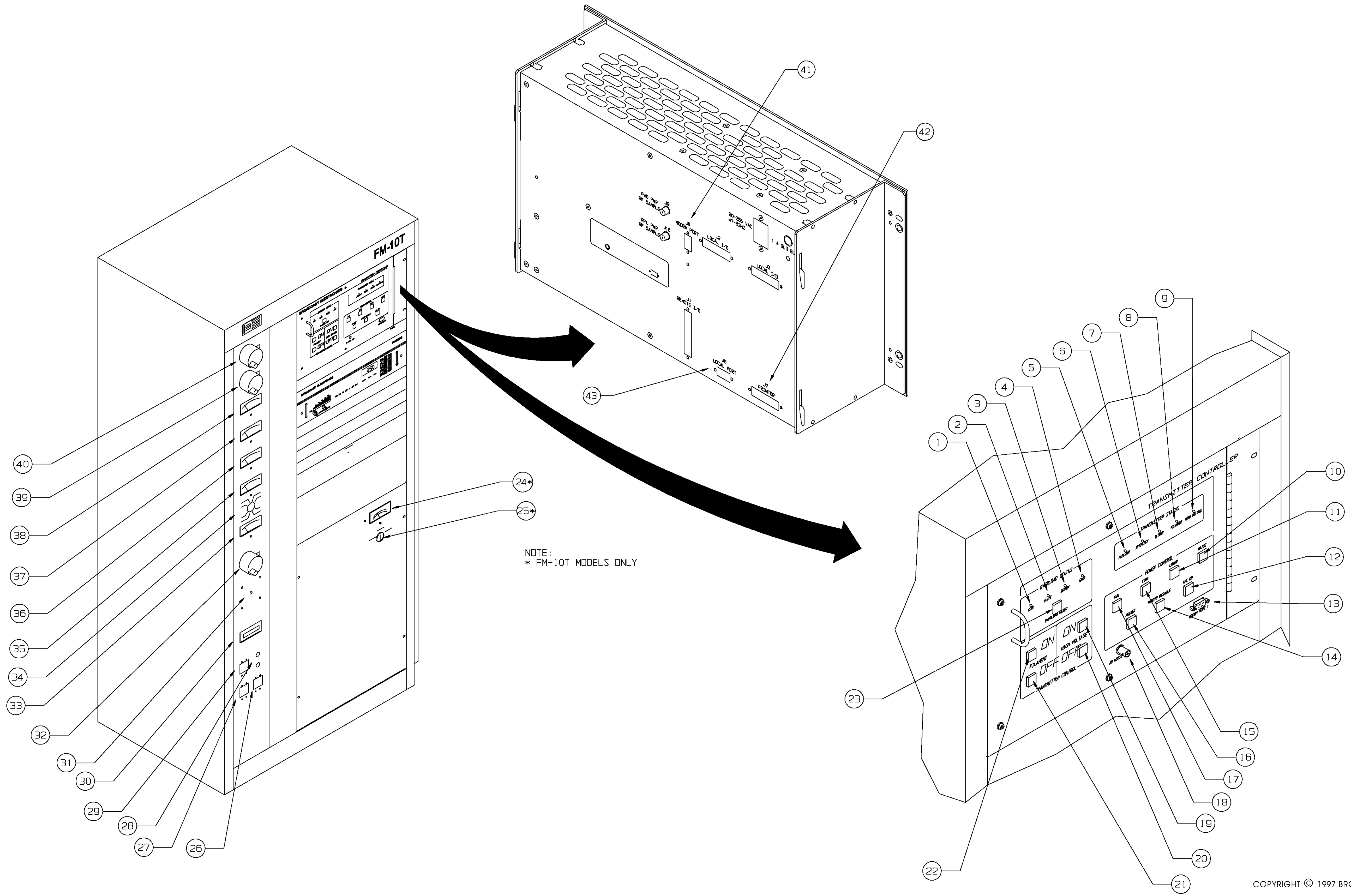
A. If manual power control is desired, proceed as follows:

1. Depress the **APC ON** switch/indicator to extinguish the switch/indicator.



597-0098-400

FIGURE 3-1. FM-10T/FM-10TS POWER SUPPLY CABINET CONTROLS AND INDICATORS



597-0098-401

FIGURE 3-2. FM-10T/FM-10TS PA/DRIVER CABINET CONTROLS AND INDICATORS

2. Depress the **RAISE** or **LOWER** switch/indicator to raise or lower the transmitter RF output power as indicated by the **OUTPUT POWER** meter.

B. If automatic power control is desired, depress the **APC ON** switch/indicator to illuminate the switch/indicator. To adjust the level at which the automatic power control circuitry will maintain, proceed as follows:

1. Depress the **APC ON** switch/indicator to illuminate the switch/indicator.

2. Depress the **RAISE** or **LOWER** switch/indicator as required to establish a new RF power output level as indicated by the **OUTPUT POWER** meter.

3-15. If remote operation is desired, depress the **REMOTE DISABLE** switch/indicator to extinguish the switch/indicator. This will enable both local and remote operation.

3-16. **TURN OFF.**

3-17. Depress the **FILAMENT OFF** switch/indicator. After a period of blower operation to allow the PA tube to cool, the equipment will deenergize.

3-18. **OPERATING THE TRANSMITTER FOR MAXIMUM TUBE LIFE.**

3-19. The FM-10T/FM-10TS transmitters are equipped with an Eimac 4CX7500A tetrode. Maximum tube life is obtained by the implementation of a tube management program. A tube management program consists of operating and monitoring the transmitter to maintain an optimum tube filament voltage. This optimum voltage prevents premature de-carbonization of the tube filament and will result in maximum tube life. To maximize transmitter tube life, implement the procedures and operations presented in the following tube management program.

TUBE MANAGEMENT PROGRAM

1) Refer to APPENDIX A and perform the procedures presented in the Eimac publication titled "Extending Transmitter Tube Life - Eimac Application Bulletin No. 18. - March 1990".

2) Refer to APPENDIX A and the information presented in "Eimac Technical Data Sheet - 4CX7500A Tetrodes".

3) The procedures presented in any "Eimac Product Bulletins" shipped with the tube.

TABLE 3-1. FM-10T/FM-10TS POWER SUPPLY CABINET CONTROLS AND INDICATORS

INDEX NO.	NOMENCLATURE	FUNCTION
1	**HIGH VOLTAGE** Circuit Breaker	Provides overload protection and primary power control of the PA high voltage plate supply.
2	**CONTROL** Circuit Breaker	Provides overload protection and primary power control of all transmitter power supplies except for the PA plate and PA screen supplies.

TABLE 3-2. FM-10T/FM-10TS PA/DRIVER CABINET CONTROLS AND INDICATORS (Sheet 1 of 4)

INDEX NO.	NOMENCLATURE	FUNCTION
1	**VSWR OVERLOAD** Indicator	Indicates a PA stage VSWR overload has occurred when illuminated.
2	**PLATE OVERLOAD** Indicator	Indicates a PA plate circuit overload has occurred when illuminated.
3	**SCREEN OVERLOAD** Indicator	Indicates a PA screen circuit overload has occurred when illuminated.
4	**GRID OVERLOAD** Indicator	Indicates a PA grid power supply overload has occurred when illuminated.
5	**FAILSAFE STATUS** Indicator	Indicates the external interlock is closed when illuminated.
6	**INTERLOCK STATUS** Indicator	Indicates all transmitter internal interlocks are closed when illuminated.
7	**BLOWER STATUS** Indicator	Indicates proper operation of the blower when illuminated.
8	**FILAMENT STATUS** Indicator	Indicates primary ac power is applied to the PA filament regulator when illuminated.
9	**HIGH VOLTAGE STATUS** Indicator	Indicates the plate power supply is operational when illuminated.
10	**POWER CONTROL RAISE** Switch/Indicator	SWITCH: In the automatic mode, moves the APC reference upward when depressed. In the manual mode, operates the screen control motor in a direction which will raise transmitter RF output power when depressed. INDICATOR: Illuminates to indicate the screen control motor is operating in a direction which will raise the transmitter RF power output.
11	**POWER CONTROL LOWER** Switch/Indicator	SWITCH: In the automatic mode, moves the APC reference downward when depressed. In the manual mode, operates the screen control motor in a direction which will reduce transmitter RF output power when depressed. INDICATOR: Illuminates to indicate the screen control motor is operating in a direction which will lower the transmitter RF power output.

TABLE 3-2. FM-10T/FM-10TS PA/DRIVER CABINET CONTROLS AND INDICATORS (Sheet 2 of 4)

INDEX NO.	NOMENCLATURE	FUNCTION
12	**POWER CONTROL APC ON** Switch/Indicator	SWITCH: Selects APC control operation of the transmitter. INDICATOR: Indicates the transmitter is under APC control when illuminated.
13	**MODEM PORT 1**	A modem port used with a future transmitter monitoring and diagnostic option.
14	**POWER CONTROL REMOTE DISABLE** Switch/Indicator	SWITCH: Inhibits or enables transmitter remote operation. INDICATOR: Indicates remote operation is inhibited when illuminated.
15	**POWER CONTROL VSWR** Switch/Indicator	SWITCH: Configures the **OUTPUT POWER** meter to display VSWR. INDICATOR: Illuminates to indicate the **OUTPUT POWER** meter is configured to display VSWR.
16	**POWER CONTROL PRESET** Switch/Indicator	SWITCH: Selects transmitter operation at a preset RF power output level. INDICATOR: Indicates transmitter operation at a preset RF power level (such as half power) when illuminated.
17	**POWER CONTROL FWD** Switch/Indicator	SWITCH: Configures the **OUTPUT POWER** meter to display forward power. INDICATOR: Illuminates to indicate the **OUTPUT POWER** meter is configured to display forward power.
18	**AM NOISE TEST** Receptacle	Test receptacle for AM noise measurements.
19	**HIGH VOLTAGE ON** Switch/Indicator	SWITCH: Energizes the step/start contactors when depressed to activate the plate and screen power supplies and enables the exciter. INDICATOR: Indicates a high voltage-on command has been received by the transmitter controller.
20	**HIGH VOLTAGE OFF** Switch/Indicator	SWITCH: Deenergizes the plate and screen power supplies and mutes RF drive when depressed. INDICATOR: Indicates a high voltage-off command has been received by the transmitter controller.

TABLE 3-2. FM-10T/FM-10TS PA/DRIVER CABINET CONTROLS AND INDICATORS (Sheet 3 of 4)

INDEX NO.	NOMENCLATURE	FUNCTION
21	**FILAMENT OFF** Switch/Indicator	SWITCH: Deenergizes all transmitter RF circuit power. The blower and flushing fans will operate for approximately thirty–five seconds after the **FILAMENT OFF** switch has been depressed. INDICATOR: Indicates a filament–off command has been received by the transmitter controller.
22	**FILAMENT ON** Switch/Indicator	SWITCH: 1) Energizes the control contactor when depressed to apply voltage to the exciter, filament, and grid circuitry. 2) Energizes the blower and flushing fans. INDICATOR: Indicates a filament–on command has been received by the transmitter controller.
23	**OVERLOAD RESET** Switch/Indicator	SWITCH: Clears the overload circuit memory when depressed. INDICATOR: Indicates an overload condition exists when illuminated.
24	**PRIMARY VOLTAGE** Meter	On FM–10T models only, displays PHASE 1–2, PHASE 2–3, or PHASE 3–1 primary ac input voltage potentials as selected by the **PRIMARY VOLTAGE** switch.
25	**PRIMARY VOLTAGE** Switch	On FM–10T models only, selects PHASE 1–2, PHASE 2–3, and PHASE 3–1 primary ac input voltage parameters to be displayed on the **PRIMARY VOLTAGE** meter.
26	**BLOWER** Circuit Breaker	Provides overload protection and primary power control for the blower, flushing fan, and the transmitter controller.
27	**FILAMENT** Circuit Breaker	Provides overload protection and primary power control for the PA tube filament supply, the control grid bias supply, and the hum null circuitry.
28	**DRIVER** Circuit Breakers	Provides overload protection and primary power control for the FM exciter.
29	**SCREEN** Circuit Breaker	Provides overload protection and primary power control for the PA screen grid power supply.
30	**FILAMENT TIME** Meter	Indicates hours of filament circuit operation.
31	**FILAMENT ADJUST** Control	Adjusts the PA tube filament voltage.

TABLE 3-2. FM-10T/FM-10TS PA/DRIVER CABINET CONTROLS AND INDICATORS (Sheet 4 of 4)

INDEX NO.	NOMENCLATURE	FUNCTION
32	**INPUT TUNING** Control and Cyclometer	Tunes the PA stage input circuit to resonance.
33	**FILAMENT VOLTAGE** Meter	Indicates the PA tube filament voltage.
34	**MULTIMETER** Switch	Selects **PA GRID CURRENT, GRID VOLTAGE, SCREEN VOLTAGE, SCREEN CURRENT, EXC FWD POWER,** or **EXC RFL POWER** parameters to be displayed on the **MULTIMETER**.
35	**MULTIMETER**	Displays **PA GRID CURRENT, GRID VOLTAGE, SCREEN VOLTAGE, SCREEN CURRENT, EXC FWD POWER,** or **EXC RFL POWER** as selected by the **MULTIMETER** switch.
36	**PLATE VOLTAGE** Meter	Displays the PA stage plate potential.
37	**PLATE CURRENT** Meter	Displays the PA stage plate current.
38	**OUTPUT POWER** Meter	Displays transmitter percentage of RF output power or output VSWR as selected by the **POWER CONTROL FWD** and **VSWR** switch/indicators.
39	**OUTPUT LOADING** Control and Cyclometer	Adjusts the PA stage output loading.
40	**OUTPUT TUNING** Control and Cyclometer	Tunes the PA stage output circuit to resonance.
41	**MODEM PORT 2**	A modem port used with a future transmitter monitoring and diagnostic option.
42	**PRINTER PORT**	A printer port used with a future transmitter monitoring and diagnostic option.
43	**LOCAL PORT**	A communication port used with a future dual/main/alternate transmitter control system.

TABLE 3-3. INDICATOR CHECKLIST

INDICATOR	STATUS		
FAILSAFE STATUS	ON	OFF	
INTERLOCK STATUS	ON	OFF	
BLOWER STATUS	ON	OFF	
FILAMENT STATUS	ON	OFF	
HIGH VOLTAGE STATUS	ON	OFF	
VSWR OVERLOAD	ON	OFF	NOTE
PLATE OVERLOAD	ON	OFF	OPERATIONAL STATUS SHOWN BY SHADED INDICATOR
SCREEN OVERLOAD	ON	OFF	
GRID OVERLOAD	ON	OFF	
OVERLOAD RESET SWITCH/INDICATOR	ON	OFF	
FILAMENT ON SWITCH/INDICATOR	ON	OFF	
HIGH VOLTAGE ON SWITCH/INDICATOR	ON	OFF	
REMOTE DISABLE SWITCH/INDICATOR	ON	OR OFF	
PRESET SWITCH/INDICATOR	ON	OFF	
APC ON SWITCH/INDICTOR	ON	OFF	
LOWER SWITCH/INDICATOR	ON	OFF	
RAISE SWITCH/INDICATOR	ON	OFF	

METER	INDICATION	
	POWER	VSWR
OUTPUT POWER	%	:1
PLATE CURRENT	A	
PLATE VOLTAGE	kV	
MULTIMETER		
SCREEN VOLTAGE	V	
SCREEN CURRENT	mA	
GRID VOLTAGE	V	
GRID CURRENT	mA	
EXCITER FWD POWER	W	
EXCITER REFLECTED POWER	W	
FILAMENT VOLTAGE	V	
FILAMENT TIME	HOURS	

597-0098-412

SECTION IV
THEORY OF OPERATION

4-1. INTRODUCTION.

4-2. This section presents the theory of operation for the Broadcast Electronics FM-10T/FM-10TS transmitters.

4-3. The FM-10T/FM-10TS transmitters are divided into functional blocks which are discussed by the following text. The functional blocks consist of the FM exciter, the power amplifier, the transmitter controller, metering circuitry, and the associated power supply circuitry. The power supply and RF circuitry are discussed in further detail at the end of this section. The transmitter controller is described in detail by the CONTROLLER section of this manual. Refer to Figure 4-1 and the overall schematic diagram in SECTION VII as required for the following explanation.

4-4. ELECTRICAL DESCRIPTION.

4-5. FM EXCITER.

4-6. The Broadcast Electronics FM-250C is a totally solid-state wideband FM exciter providing a continuously variable RF output from 25 to 250 watts. The FM-250C operates into a 50 Ohm load at any frequency within the 87.5 to 108 MHz FM broadcast band. The exciter may be programmed to any frequency within the FM band in 10 kHz increments. The FM-250C is mounted on slides to allow easy access to the internal semi-modular exciter circuitry.

4-7. The FM-250C will accept multiple wideband composite inputs from a stereo generator or SCA generator as well as a 600 Ohm balanced audio input. Refer to publication 597-1004 for a detailed explanation of the FM-250C exciter features.

4-8. POWER AMPLIFIER.

4-9. The FM-10T/FM-10TS operates from a single 4CX7500A tetrode to provide 10 kW of RF power on a single frequency within the FM broadcast band of 87.5 MHz to 108 MHz. The power amplifier operates in a high-gain, grid-driven class C configuration. A patented input circuit matches the 50 Ohm output of the exciter to the higher grid input impedance. Use of a large coaxial cavity results in high PA efficiency for comparatively low power consumption. Removal of the PA tube is simple and quick due to the cavity design. A blower cooling system forces air through the tube socket, anode fins, and out through the main transmission line chimney. A differential air pressure sensor monitors the effectiveness of the cooling system and removes power to the tube if air flow is interrupted.

4-10. **POWER AMPLIFIER CAVITY.** The PA stage employs a patented folded half-wave coaxial cavity constructed with aluminum and copper tubing. The cavity design eliminates the high voltage blocking capacitors and high current sliding contacts of conventional cavities through a unique output tuning and coupling technique. A grounded concentric copper center conductor tunes the cavity by varying the length inserted into the open end of a transmission line inner conductor. The main inner conductor is insulated from ground and carries the full anode dc potential. DC power is fed at the RF voltage null point, approximately one-quarter wave from the tube anode for effective RF decoupling. An untuned loop is used to couple the RF energy into the transmission line.

4-11. **OUTPUT COUPLING.** Energy is coupled into the transmission line by an adjustable untuned loop which functions in the electromagnetic field within the cavity. One end of the output loop is connected to ground, while the other connects to the center conductor of the output transmission line through flexible straps.

4–12. **OUTPUT TUNING.** Output tuning is accomplished by adjusting a threaded rod which mechanically expands or contracts a beryllium copper bellows on the end of the grounded center conductor inserted into the main conductor line. Coarse frequency adjustment is accomplished by pre–setting the length of the center conductor into the cavity.

4–13. **NEUTRALIZATION.** Neutralization is accomplished in the transmitter by an adjustable distributed inductance which develops a counteractive voltage swing between the screen and ground. This cancels out the voltage fed through the internal capacitances of the tube and the stray capacitances of the tube socket. This form of self–neutralization results in very stable operation and requires no adjustment when the power tube is replaced.

4–14. **SECOND HARMONIC SUPPRESSOR.** A patented second harmonic suppressor is incorporated into the PA cavity design. This consists of a capacitive disc and a series inductance to ground coupled to the main line at the fundamental frequency RF voltage null point. Here, the second harmonic exhibits a high voltage and the suppressor presents a low impedance to ground which reduces the amplitude of the second harmonic. This unique method of harmonic suppression has minimal effect on the fundamental frequency and does not add losses to the PA cavity at the fundamental frequency.

4–15. **OUTPUT CIRCUIT.** A low–pass filter is provided with the transmitter to attenuate all residual second and higher order harmonics. This filter functions over the entire FM broadcast band. Two RF directional couplers are mounted after the filter in the output transmission line connection. The couplers provide filtered forward and reflected power RF samples to the automatic power control unit. A third coupler provides a forward power sample for external test equipment.

4–16. **TRANSMITTER CONTROLLER.**

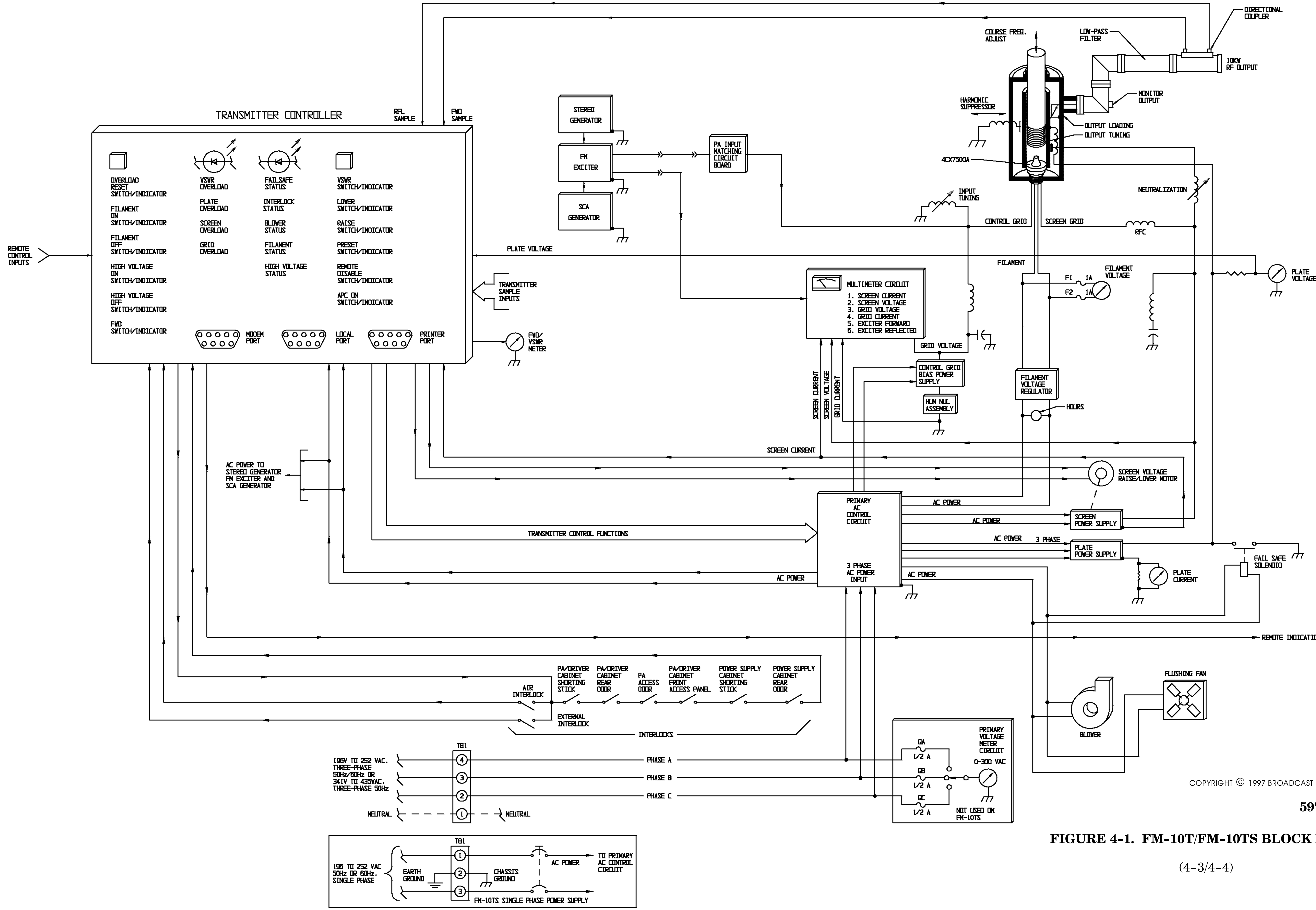
4–17. Transmitter control operations and parameter monitoring are performed by a built–in microprocessor based controller. The controller incorporates extensive use of RFI filtering, optical isolation, and state–of–the–art microprocessor technology to assure maximum reliability.

4–18. The controller is designed with 12 switch/indicators, 9 status indicators, 3 modem ports, and a printer port. Adjustable timers are provided to determine filament warm–up time, blower run–down time, overload–recycle time, and warm–up defeat time. In addition, the controller is equipped with adjustable plate, screen, grid, and VSWR overload limits. The timers and the overload limits are adjusted by controls on the main circuit board. The range of all controls is limited, however so that the safe operating limits of the transmitter cannot be exceeded by incorrect adjustment.

4–19. All transmitter control and monitoring operations are directed by a state–of–the–art Z–SOFT microcontroller. The microcontroller is housed on a single plug–in daughter circuit board. The circuit board plugs directly into a header on the controller main circuit board.

4–20. The controller operates from a modular switching power supply assembly. Three LEDs on the main circuit board monitor the status of the +5V, +15V, and –15V power supplies. A Lithum battery backup system has been incorporated into the circuit design. The battery is designed to maintain the controller memory during power failures and has a useful life of approximately 2 years.

4–21. The transmitter controller performs several operations. The following text presents a description of the major controller functions.



597-0098-402

FIGURE 4-1. FM-10T/FM-10TS BLOCK DIAGRAM

4–22. **AUTOMATIC RF OUTPUT LEVEL CONTROL.** The controller is designed to provide manual and automatic RF output power level controller. When the unit is configured for automatic power control (APC) operation, the controller monitors screen current, PA forward power, PA reflected power, and the exciter forward power and automatically adjusts the PA screen voltage via a dc servo motor–driven variable autotransformer to maintain a constant transmitter RF output. If excessive PA reflected power, excessive screen current, or low exciter power is measured, the "raise power" command will be inhibited to prevent an overload from occurring. Manual screen control is assumed by switching the APC feature to off. In the manual mode the raise and lower switches directly control the dc servo motor to vary the screen voltage supply. In the APC mode, the switches control a reference voltage stored in the microprocessor memory. This memory is maintained by the battery backup system so that the transmitter can automatically return to the desired power level whenever power is applied.

4–23. The dc servo motor control circuit uses a full–on/full–off scheme to drive the dc servo motor. This feature, combined with a deadband, eliminates hunting in this servo loop. The front panel **RAISE** and **LOWER** switches illuminate when the motor is driven by manual or automatic operation.

4–24. **VSWR FOLDBACK PROTECTION.** When the unit is in the APC mode, PA forward power is automatically reduced if output reflected power becomes excessive enough to overload the transmitter. As the condition which caused the high VSWR returns to normal, RF power will be proportionately raised until full power is again restored.

4–25. **SOFT START.** The controller monitors PA plate voltage and reduces the screen voltage to zero upon its absence. When the plate supply is energized, as during initial turn on, the controller will gradually increase the screen voltage until the stored power setting is achieved. This prevents inadvertent VSWR overloads at turn on, such as during icing of an antenna.

4–26. **MOMENTARY POWER INTERRUPTION.** In the event of a momentary power interruption, proper transmitter operation will resume immediately after power returns. If an extended power failure occurs, information maintained by the battery back–up system will enable the controller to initiate a start cycle to automatically return the transmitter to operation without assistance. If the transmitter internal interlock string opens during a power failure, the automatic restart feature will be defeated and the transmitter will enter the off condition when power is re–applied.

4–27. **OVERLOADS.** If an overload occurs, the transmitter will deenergize, allow the overload to clear, then automatically return to operation. If four overloads occur within 60 seconds, the transmitter will deenergize. The overload must be manually cleared and the transmitter **HIGH VOLTAGE ON** switch/indicator depressed before operation will resume. Single overloads of greater than 220 milliseconds duration will immediately deenergize the high voltage and filament supplies.

4–28. **INDICATORS.** Four LEDs are provided on the front panel as overload status indicators. The first overload that occurs will be latched into the controller and will illuminate the appropriate red VSWR, PLATE, SCREEN, or GRID LED and the yellow overload reset switch/indicator. All further overloads are monitored by the controller but will not be displayed by the LEDs.

4–29. Five STATUS indicators illuminate to indicate an operational condition as follows: 1) the **FAILSAFE** LED indicates the external interlock is closed, 2) the **INTERLOCK** LED indicates that the internal interlock loop is closed, 3) the **BLOWER** LED indicates that the air pressure is correct for the PA stage to operate, 4) the **FILAMENT** LED indicates primary ac power is applied to the filament transformer, and 5) the **HIGH VOLTAGE** LED indicates primary ac power is applied to the high voltage plate supply.

4-30. **METERING.**

4-31. Seven front panel meters are provided to indicate transmitter operating parameters. Output power and output VSWR indications are presented on a precision output power meter. Plate voltage and plate current information are displayed on separate meters for optimum convenience.

4-32. Additional transmitter metering features include a six function multimeter. The multimeter selects and displays information on vital transmitter operating parameters such as: 1) screen current, 2) screen voltage, 3) grid current, 4) grid voltage, 5) exciter forward power, and 6) exciter reflected power. An iron-vane voltmeter is used to measure filament voltage. A **FILAMENT TIME** meter is provided to indicate hours of filament circuit operation. Primary ac voltage monitoring is provided by a primary ac voltmeter. The meter selects and displays the voltage between all three phases of the ac input. All meter currents are measured on the ground side of each supply to prevent high voltages across the meters.

4-33. **EXCITER METERING.** The exciter operating parameters are displayed by two additional meters and several status indicators. For detailed information on exciter metering, refer to FM-250C exciter manual 597-1004.

4-34. **POWER SUPPLIES.**

4-35. A three-phase ac input of 196 to 252 volts or 341 to 435 volts is required to operate the transmitter internal power supplies. The plate power supply requires a three-phase ac input with the remainder of the power supplies requiring conventional 220V single-phase circuits obtained from two phases of the three-phase input. Power to the plate supply is applied in two steps to reduce the in-rush current at power-on to limit stress and extend component life in the plate supply.

4-36. The control grid bias and screen power supplies consist of conventional full-wave rectification circuits with input filter sections. A hum-null circuit consisting of a transformer and potentiometer assembly injects a small 60 Hz ac voltage in series with the ground return of the grid bias supply to cancel residual ripple from the tetrode amplifier.

4-37. The plate supply is a three-phase primary, six-phase secondary supply. The primary circuit is connected in a closed delta arrangement and the secondary is connected in a wye configuration. Advantages of this type of supply is good regulation and low percentage of ripple output which requires little filtering.

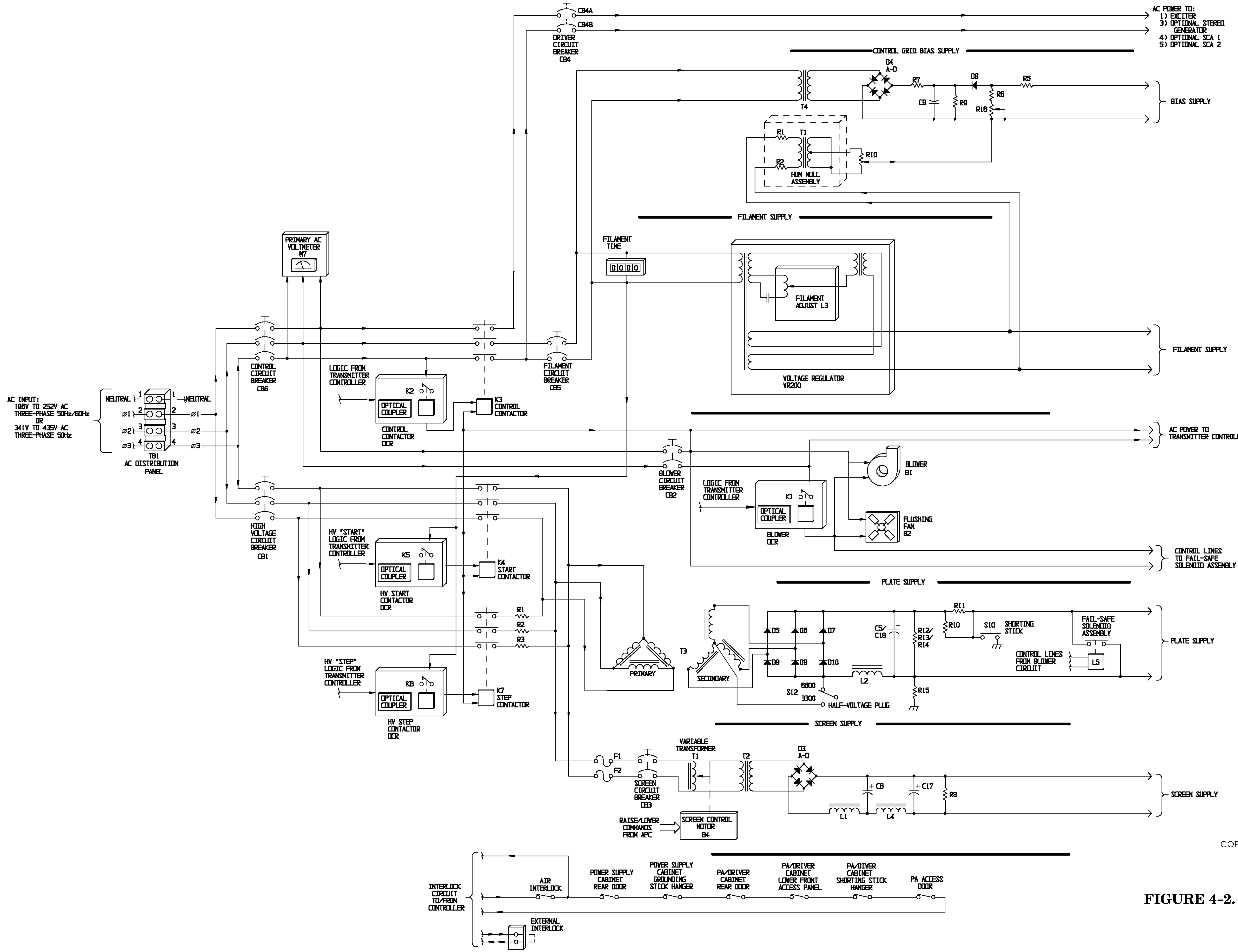
4-38. The filament supply consists of a variable transformer assembly which is used to adjust a high-current low-voltage regulator assembly. The regulator assembly is designed to regulate a wide range of ac input potentials into a stable 240 ±1% volt output.

4-39. Each modular component of the transmitter is equipped with a self-contained ac power supply. In addition, a battery back-up supply in the transmitter controller maintains operational information during power outages.

4-40. DETAILED DESCRIPTION.

4-41. **POWER SUPPLIES.**

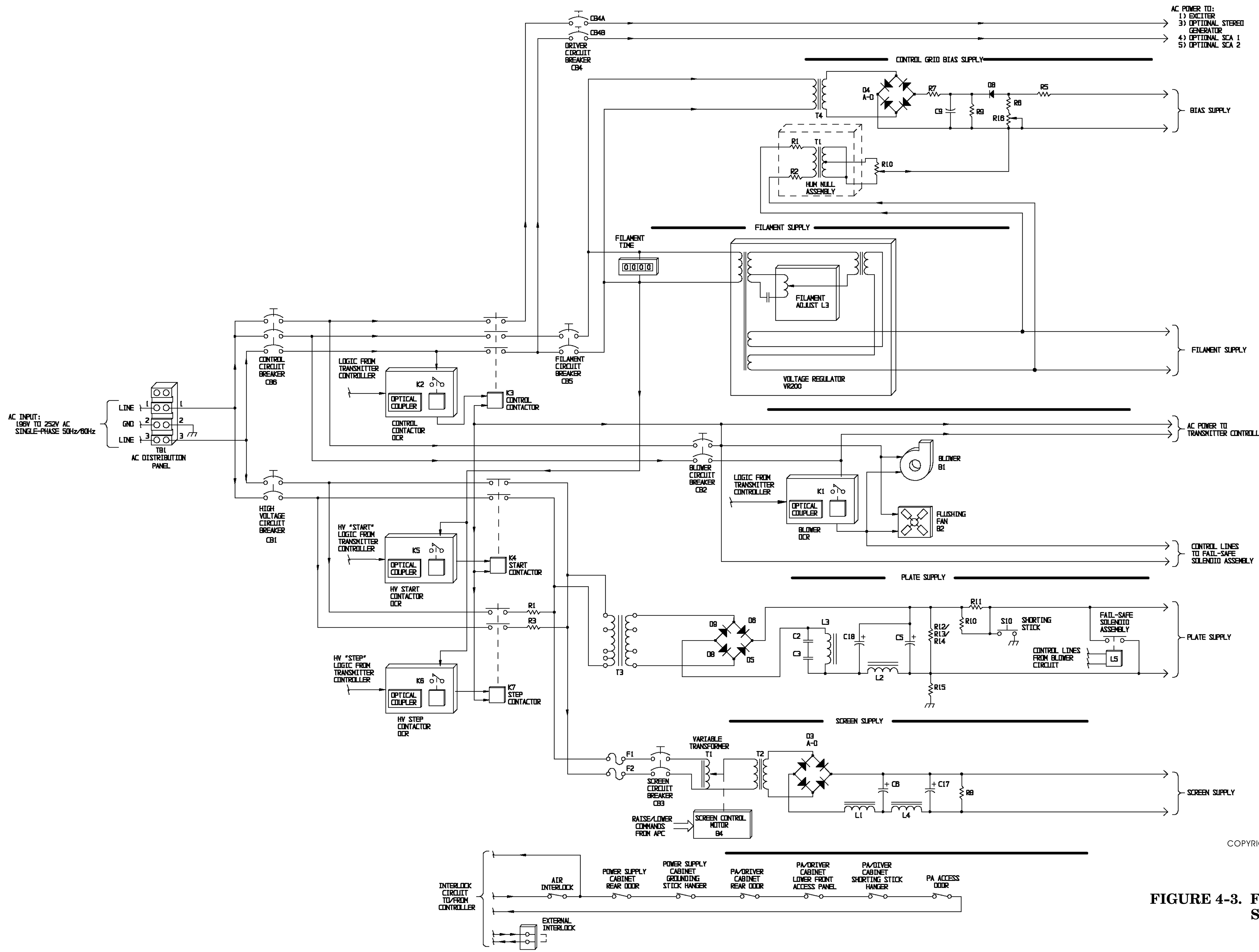
4-42. The FM-10T requires a three-phase power source of 196V to 252V ac 50/60 Hz or 341V to 435V ac 50 Hz at 65 amperes per phase (refer to Figure 4-2). The FM-10TS requires a single-phase power source of 196V to 252V ac 50/60 Hz at 175 Amperes (refer to Figure 4-3). The following list presents approximate operating voltage and currents of the transmitter for the rated RF power output.



597-0098-403

FIGURE 4-2. FM-10T POWER SUPPLY SIMPLIFIED SCHEMATIC

(4-7/4-8)



597-0098-404

FIGURE 4-3. FM-10TS POWER SUPPLY SIMPLIFIED SCHEMATIC
(4-9/4-10)

PARAMETER	APPROXIMATE VALUES
A. PA PLATE	+6600V at 2.0 Amperes
B. PA SCREEN GRID	+800V at 0.070 Amperes
C. PA CONTROL GRID	–300V at 0.040 Amperes
D. PA FILAMENT	7V ac at 110 Amperes
E. HUM NULL	7V ac at 0.15 Amperes

4–43. SEQUENCE OF OPERATION.

4–44. When the transmitter fused disconnect is closed, ac power is distributed to the **CONTROL** (CB6) and **HIGH VOLTAGE** (CB1) circuit breakers. Closing the circuit breakers routes ac power to the following circuitry:

CIRCUIT BREAKER	CIRCUITRY
HIGH VOLTAGE	Power amplifier plate and screen supplies.
CONTROL	Transmitter blower circuit and an ac control circuit (filament supply, control grid bias supply, exciter, and optional stereo and SCA generators).

4–45. AC power is routed to the controller when **BLOWER** circuit breaker CB2 is closed. A start sequence is initiated when the **FILAMENT ON** switch/indicator is depressed. The controller will enable blower optically–coupled–relay K1. K1 will apply single–phase power to blower B1, flushing fan B2, and fail–safe solenoid assembly L5. After the blower begins operation, the air switch interlock will close. With the air interlock and all transmitter internal interlocks closed, the controller will enable control contactor optically–coupled–relay K2. K2 will energize control contactor K3 which applies ac power to the filament supply, hum null assembly, control grid bias supply, and to a driver ac control circuit. With the **DRIVER** circuit breakers closed, power is applied to the exciter and the optional SCA and stereo generators.

4–46. Assuming the **HIGH VOLTAGE ON** switch/indicator has been depressed, and the PA filament heating delay of at least ten seconds has expired, the controller will enable step/start contactor optically–coupled–relays K5 and K6. K6 will energize step contactor K7 which limits plate supply current in–rush through: 1) resistors R1, R2, and R3 in FM–10T models and 2) resistors R1 and R3 in FM–10TS models. K5 will energize start contactor K4 to apply full input potential to the plate and screen power supplies.

4–47. If during a start sequence an internal interlock opens, the entire start sequence will be cancelled and must be re–initiated manually. If an internal interlock opens during operation, the entire power supply section will deenergize. If the interlock is promptly closed, the blower and flushing fans will resume operation to cool the PA tube. To continue transmitter operation, a new manually initiated start sequence is required. Whenever power is removed from the blower and flushing fans, the fail–safe solenoid assembly will short the plate supply to ground.

4–48. If the **HIGH VOLTAGE OFF** switch/indicator is depressed, the plate and screen power supplies will deenergize. If the **FILAMENT OFF** switch/indicator is depressed, all remaining power supplies will deenergize. The blower and flushing fan will continue operation for 30 seconds or more to cool the PA tube, then deenergize.

4–49. FM-10T PA PLATE POWER SUPPLY.

4–50. Three–phase ac power for the PA plate supply is applied to transformer T3. T3 is a three–phase primary, six phase secondary transformer. The primary winding is connected in a closed delta arrangement and protected by circuit breaker CB1. The secondary winding is connected in a wye configuration. Component stress at power on is eliminated by a step/start circuit which limits supply in–rush current.

4–51. Full–wave rectification is accomplished through high–voltage precision diodes D5 through D10. Filtering for the supply is accomplished by a one–section choke–input filter (L2). The choke is inserted in the negative leg of the supply to eliminate the dc potential between the choke and ground. Shunt capacitors C5 and C18 bypass residual ac ripple at frequencies above 360 Hz to ground. Bleeder resistors R12, R13, and R14 increase regulation and in conjunction with the fail–safe solenoid assembly, enhance safety. A series resistance in the anode dc feedline limits peak energy in the event of arc–overs in the power amplifier stage. A one–half voltage supply tap is provided for transmitter troubleshooting.

4–52. Component stress at power–on is eliminated by a step/start circuit which limits plate supply in–rush current. The step/start circuit is interlocked through contacts of the filament circuit breaker and the control contactor to assure that the filament circuit is energized before a high–voltage–on sequence can be initiated. A high–voltage–on sequence begins when the controller energizes step contactor K7 via K6. After 100 milliseconds, the controller will energize start contactor K4 via K5. Next, the step contactor will deenergize after it has been energized for 160 milliseconds. In this manner, the current limiting resistors will only be subject to heating during a 100 millisecond interval between the step and start contactor closures.

4–53. **FM-10TS PA PLATE POWER SUPPLY.**

4–54. Single–phase ac power for the PA plate supply is applied to transformer T3. T3 is a single phase transformer with multiple primary and secondary taps. Transformer T3 is protected from over current conditions by circuit breaker CB1. Component stress at power on is eliminated by a step/start circuit which limits supply in–rush current.

4–55. Full–wave rectification is accomplished through high–voltage precision diodes D5, D6, D8, and D9. Filtering for the supply is accomplished by an LC filter consisting of: 1) capacitors C2 and C3 and 2) inductors L2 and L3. The chokes are inserted in the negative leg of the supply to eliminate the dc potential between the choke and ground. Shunt capacitors C5 and C18 bypass residual ac ripple at frequencies above 360 Hz to ground. Bleeder resistors R12, R13, and R14 increase regulation and in conjunction with the fail–safe solenoid assembly, enhance safety. A series resistance in the anode dc feedline limits peak energy in the event of arc–overs in the power amplifier stage.

4–56. Component stress at power–on is eliminated by a step/start circuit which limits plate supply in–rush current. The step/start circuit is interlocked through contacts of the filament circuit breaker and the control contactor to assure that the filament circuit is energized before a high–voltage–on sequence can be initiated. A high–voltage–on sequence begins when the controller energizes step contactor K7 via K6. After 100 milliseconds, the controller will energize start contactor K4 via K5. Next, the step contactor will deenergize after it has been energized for 160 milliseconds. In this manner, the current limiting resistors will only be subject to heating during a 100 millisecond interval between the step and start contactor closures.

4–57. **PA SCREEN POWER SUPPLY.** The screen power supply is a full–wave bridge–rectified supply with a two–stage L–section filter. Overload protection for the circuit is provided by circuit breaker CB3. The primary of screen transformer T2 is connected to variable autotransformer T1 which is used to adjust the screen supply output. A dc motor connected to the variable autotransformer allows both manual and automatic control of the screen voltage. Capacitors C6 and C17 provide additional power supply filtering. Bleeder resistor R8 improves regulation and enhances safety.

4–58. **PA CONTROL GRID BIAS POWER SUPPLY.** The control grid bias supply is a full–wave bridge–rectified supply with a single C–section filter. Overload protection for the supply is provided by circuit breaker CB5. Resistors R7 and R9 operate to determine the cut–off point of the supply. Diode D8 isolates the tube grid from the bias supply to improve immunity to AM noise. Bleeder resistor R6 improves regulation and enhances safety. Resistor R16 is provided to limit the current in–rush.

4–59. **Hum Null Supply.** The ground path of the grid bias supply is routed through a hum–null circuit which introduces a small 60 Hz ac component into the supply to cancel hum in the PA tube from the filament supply. The amplitude of the 60 Hz signal is adjusted by potentiometer R10. The hum null voltage is out–of–phase with the 60 Hz ripple component of the filament supply.

4–60. **PA FILAMENT SUPPLY.** The PA filament supply is a low–voltage high current ac supply. Overload protection for the circuit is provided by circuit breaker CB5. Filament voltage regulator VR200 provides a stable ac input voltage environment. Variable inductor L3 provides accurate filament voltage adjustment. A **FILAMENT TIME** meter indicates hours of filament circuit operation.

4–61. **RF CIRCUITRY.**

4–62. **FM EXCITER.** The modulated FM signal for RF circuit operation is generated by the FM–250C FM exciter (see Figure 4–4). Approximately 200 watts of drive is required to operate the PA circuitry. Refer to publication 597–1004 for a complete description of the FM exciter.

4–63. **POWER AMPLIFIER.** The PA stage contains a single 4CX7500A tetrode operated as a Class C amplifier in a folded half–wave cavity to output 10 kW of RF power. The amplifier operates in a grid driven configuration and exhibits high efficiency and ease of maintenance. The following text describes the operation of components and circuits within the PA stage.

4–64. **PA Input Circuit.** The grid impedance–matching circuit used in the transmitter consists of a combination of series inductor and shunt capacitor elements, implemented on a printed circuit board. The inductors and capacitors are etched into the copper–clad laminate. Multiple LC sections match the 50 Ohm source impedance to the higher input impedance of the PA tube.

4–65. This input matching design provides wide bandwidth and improves reliability, stability, and maintainability of the transmitter. A single tuning/loading control in the input circuit is provided to adjust and match the 50 Ohm driver impedance to the higher input impedance of the grid over the 88 to 108 MHz FM broadcast band.

4–66. The grid circuit is adjusted for proper operation with two paralleled slider inductors which connect to ground. The controls employ sliding shorts to tune the grid capacitance to resonance. One inductor is mechanically connected to the front panel input tuning control while the other inductor is connected to a counter in the rear of the RF enclosure. Fine tuning is accomplished by adjusting either one of the inductors (normally the front panel control). A resistive loading component is included in the circuit to broaden the overall response.

4–67. The screen ring is connected through four fixed inductors (L7, L8, L10, and L11) to four copper–clad Kapton bypass capacitors (C7, C8, C16, and C17) to ground. The bypass capacitors short any ac components to ground and aid in neutralization. Neutralization is accomplished by adjusting the length of an internal inductor (L15) which is connected to a capacitive plate (C18) at the tube anode. This neutralization circuit introduces an out–of–phase current component causing a voltage swing across the screen to ground which cancels internal ac feed–thru components. Two spark–gaps are provided to safely conduct energy if the tube should arc internally.

4–68. **Power Amplifier Cavity.** The PA cavity used in the transmitter employs a folded half–wave coaxial resonator constructed with aluminum and copper tubing (see Figure 4–5). The design eliminates the high voltage blocking capacitors and high current shorting contacts of conventional cavities. A grounded concentric center conductor tunes the cavity with a variable re–entrant length inserted into the end of a transmission line inner conductor. The main inner conductor is insulated from ground and carries the full anode dc potential. DC power is fed at the RF voltage null point, approximately one–quarter wave from the anode for effective RF decoupling. An untuned loop operating in the electro–magnetic field is used to couple the RF energy into the transmission line. Rather than attenuating second harmonic after the signal has been generated and amplified, the circuitry within the cavity essentially eliminates formation of the second harmonic component.

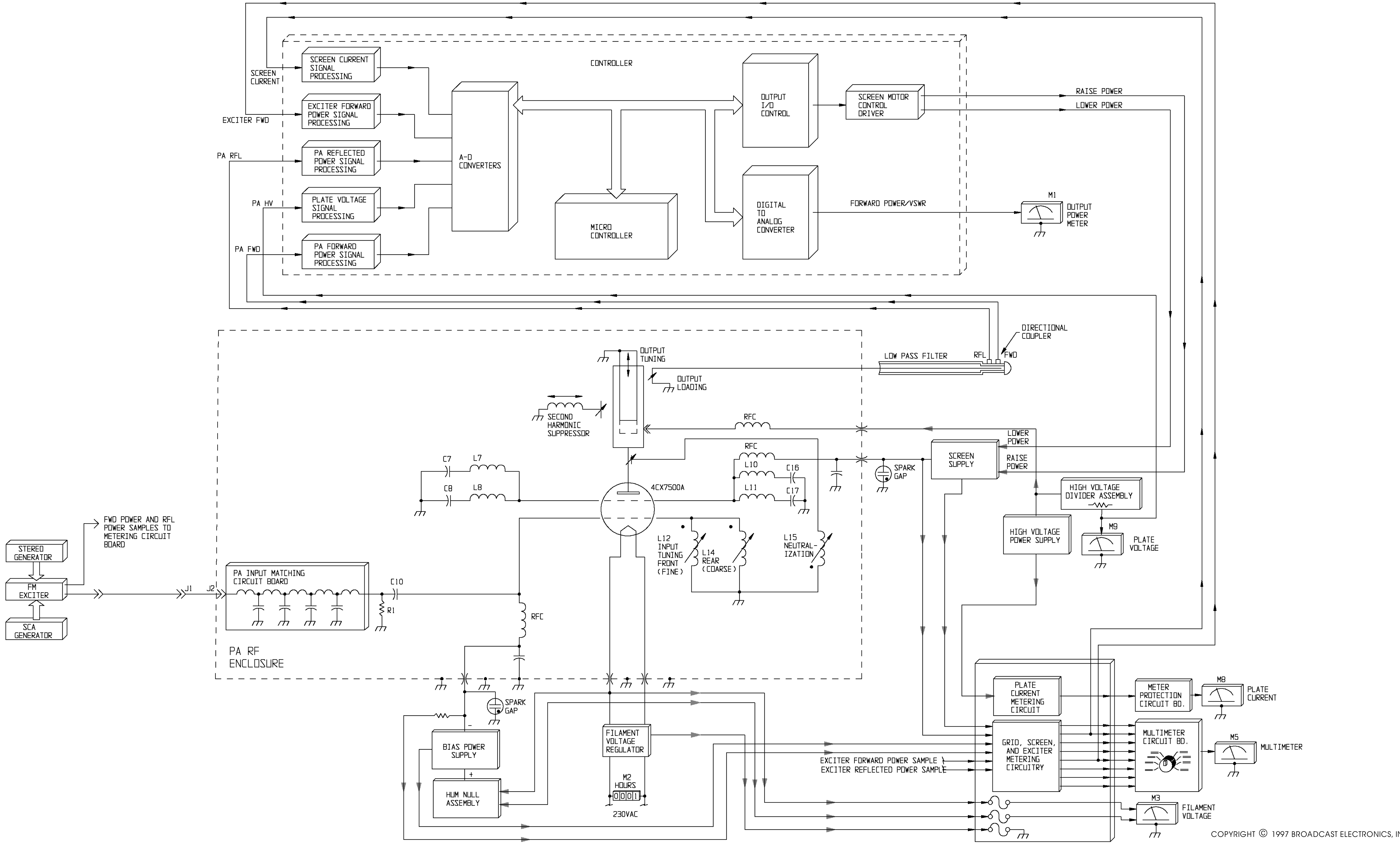
4–69. Plate tuning is accomplished by an adjustable bellows on the center portion of the plate line which is maintained at chassis ground potential. The PA plate potential is applied to the main conductor (the fixed portion of the plate line) at the fundamental frequency RF voltage null point. Second harmonic suppression is accomplished by a series LC circuit consisting of L6 and C9 which is inserted at the peak voltage point to essentially eliminate the second harmonic component.

4–70. **PA Output Circuit.** Output coupling is accomplished with an untuned loop intercepting the magnetic field concentration at the voltage null point of the main line. The PA loading control varies the angular position of the plane of the loop with respect to the plate line, changing the amount of magnetic field which it intercepts. Multiple phosphor bronze leaves connect one side of the output loop to ground and the other side to the center conductor of the output transmission line. This allows for mechanical movement of the loop by the PA loading control without utilizing any sliding contacts. The grounded loop improves immunity to lightning and static buildup on the antenna connection.

4–71. A pair of directional couplers located in the output transmission line provide RF output voltages proportional to the PA forward and reflected power. The RF output voltages provide power and VSWR samples for the output power meter and the transmitter controller. An additional port in the transmission line provides a point to connect a station modulation monitor.

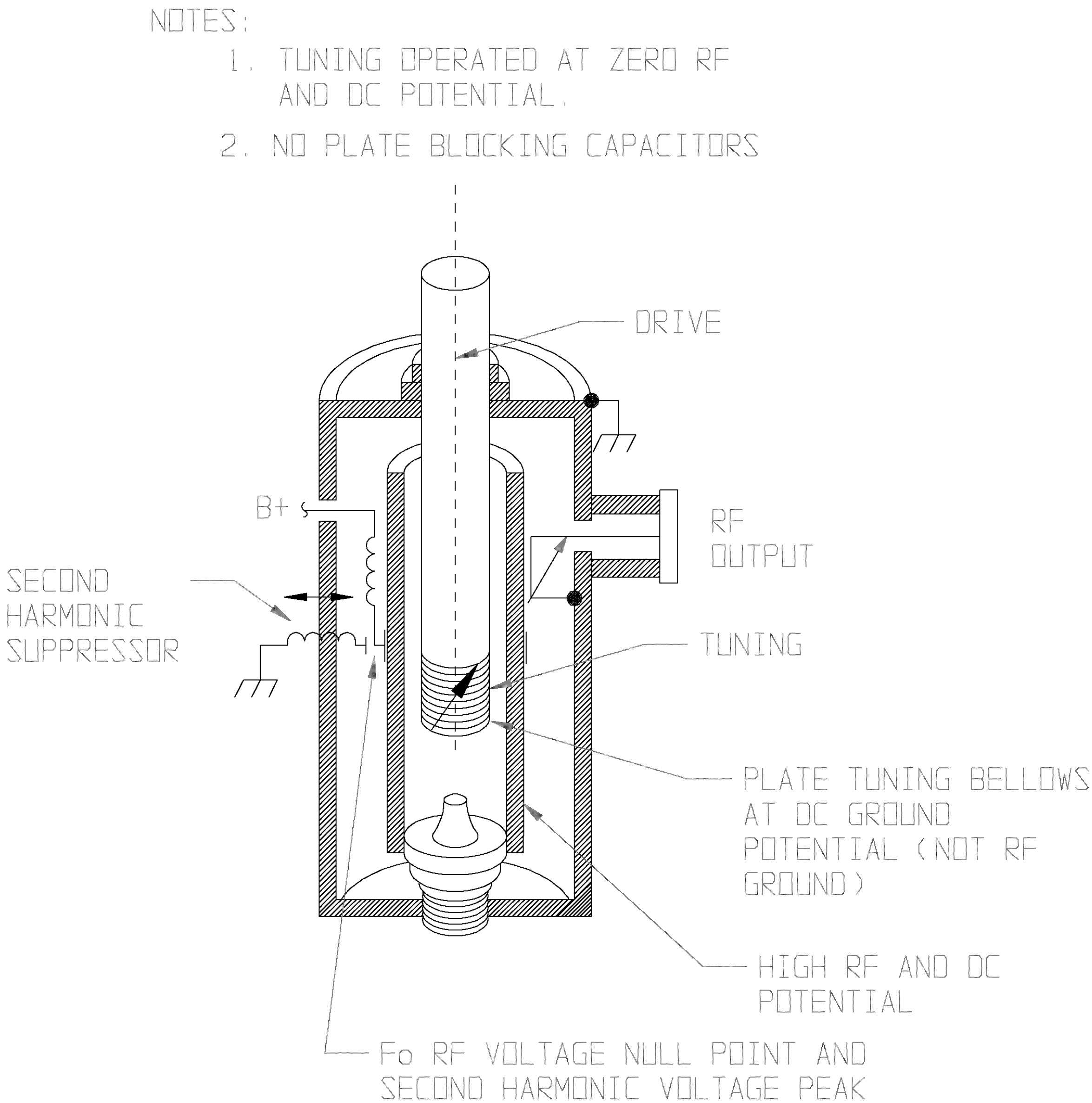
4–72. **PA METERING.** Seven meters are used to indicate transmitter operating parameters. The plate current, multimeter, and the filament voltage meters measure samples from a PA metering circuit board which is mounted on the side of the RF enclosure. Additional samples from this circuit board are routed to the controller. The PA metering circuit board also contains fuses which protect the filament meter wiring. Plate voltage metering is obtained from a high voltage meter multiplier circuit board. Power output metering is derived from circuitry within the controller. A filament time meter indicates total elapsed time of filament circuit operation. The filament voltage meter is an iron–vane type and accurately measures the filament voltage at the cavity feed–thru terminals. Monitoring of ac input potentials is provided by a primary ac voltage meter.

4–73. **AUTOMATIC POWER CONTROL.** The transmitter controller monitors a number of transmitter parameters to function as part of a closed loop which maintains a constant RF output level from the transmitter (see Figure 4–4).



597-0098-405

FIGURE 4-4. RF CIRCUIT SIMPLIFIED SCHEMATIC



597-0098-406

FIGURE 4-5. PA CAVITY

4-74. PA forward and reflected power samples from the transmitter low-pass filter are applied to individual rectifier/amplifier circuits in the controller. The outputs from the rectifier/amplifier circuits are routed to analog-to-digital (A-to-D) circuitry. The A-to-D circuitry converts the signals to a digital format and routes the signals to the microprocessor. The microprocessor uses the signals: 1) to output forward power and VSWR samples to the output power meter, 2) to output forward and reflected power samples to the remote meter terminals, and 3) for automatic RF output power control operations. The controller monitors several parameters such as the forward and reflected power, screen current, and exciter forward power to determine if power control and correction is required. When automatic power control is enabled and power correction is required, the controller will use the adjustable screen supply autotransformer to obtain the desired power level.

4–75. When APC operation is enabled and as RF output power varies, the controller will act to maintain the established RF output level. If inadequate exciter drive exists for normal operation, PA reflected power increases, or if screen current is high, any power increase will be inhibited. If the PA reflected power increases to a point which may damage the RF circuitry of the transmitter, the controller will reduce the RF output to a safe level and the transmitter will continue to operate. Full power will be automatically re–established when the VSWR condition is corrected.

4–76. As an additional function, the controller will reduce the PA screen potential to minimum whenever the plate voltage is off. Whenever the plate voltage is energized, the controller will gradually increase the PA screen voltage until the rated transmitter RF output is established unless limited by low exciter drive, a high VSWR condition, or high screen current.

SECTION V
MAINTENANCE

5-1. INTRODUCTION.

5-2. This section provides general maintenance information, electrical adjustment procedures, and troubleshooting information for the Broadcast Electronics FM-10T/FM-10TS transmitters.

5-3. SAFETY CONSIDERATIONS.

WARNING
WARNING

NEVER OPEN THE EQUIPMENT UNLESS ALL TRANSMITTER PRIMARY POWER IS DISCONNECTED. USE THE GROUNDING STICK PROVIDED TO ENSURE ALL COMPONENTS AND ALL SURROUNDING COMPONENTS ARE DISCHARGED BEFORE ATTEMPTING MAINTENANCE ON ANY AREA WITHIN THE TRANSMITTER.

5-4. The transmitter contains high voltages and currents which, if regarded carelessly, could be fatal. The transmitter has many built-in safety features, however good judgment, care, and common sense are the best accident preventives. The maintenance information contained in this section should be performed only by trained and experienced maintenance personnel.

5-5. It is extremely dangerous to attempt to make measurements or replace components with power energized, therefore such actions must not be performed. The design of the equipment provides safety features such that when a door is opened or an access panel is removed, interlock switches will deenergize all dc power supplies and release the fail-safe discharge solenoid across the plate supply. Do not bypass the interlock switches as a maintenance short-cut.

5-6. The PA cavity access door actuates an interlock switch if the door is opened during transmitter operation. All dc supplies will be deenergized and the plate supply will be shorted to ground.

5-7. Two grounding sticks are provided as a safety feature. Each grounding stick consists of a metal hook with an insulated handle. The metal end is connected to chassis ground. Use the grounding stick to touch every part in the area or circuit on which maintenance is to be performed before attempting maintenance.

5-8. Each grounding stick rests on a hook switch. When the grounding stick is removed, the associated hook switch will open the transmitter safety interlock string and deenergize all transmitter dc potentials until the grounding stick is replaced.

5-9. FIRST LEVEL MAINTENANCE.

WARNING ***NEVER OPEN THE EQUIPMENT UNLESS ALL TRANSMITTER PRIMARY POWER IS DISCONNECTED.***

WARNING

5-10. First level maintenance consists of procedures applied to the equipment to prevent future failures. The procedures are performed on a regular basis and the results recorded in a maintenance log. Preventive maintenance of the transmitter consists of good housekeeping, lubrication, and checking performance levels using the meters and various indicators built into the equipment.

5-11. MISCELLANEOUS.

WARNING ***NEVER OPEN THE EQUIPMENT UNLESS ALL TRANSMITTER PRIMARY POWER IS DISCONNECTED. USE THE GROUNDING STICK PROVIDED TO ENSURE ALL COMPONENTS AND ALL SURROUNDING COMPONENTS ARE DISCHARGED BEFORE ATTEMPTING MAINTENANCE ON ANY AREA WITHIN THE TRANSMITTER.***

WARNING

5-12. On a regular basis, clean the equipment of accumulated dust. Check for overheated components, tighten loose hardware, and lubricate mechanical surfaces as required. A lubricant such as "Lubriplate" should be applied sparingly to the tuning drives, cables, the PA tuning line right angle gear mechanism, and the cyclometer drives behind the front panel. The PA output loading screw drive should be opened (four screws) and lubricated every 36 months, or more often if resistance is noted.

5-13. CONTROLLER BATTERY.

5-14. The transmitter controller is equipped with a Lithium battery. The battery has a useful life of approximately two years. After approximately two years of service, replace the controller battery using BEI part number 350-2032.

5-15. AIR FILTER.

5-16. Air filter replacement is accomplished from outside the transmitter without interrupting equipment operation. The filter should be checked once each week with replacement done on an as-required basis. A dirty filter could result in dust accumulation leaking into the cabinet from seams, door jambs, etc. Never reverse a dirty filter. Always replace the filter.

5-17. The transmitter uses one disposable type air filter 1 inch X 16 inches X 20 inches (2.54 cm X 40.64 cm X 50.8 cm). Additional filters may be ordered for replacement (P/N 407-0062) or purchased locally. Always install the filter with the airflow arrow pointing towards the blower. The exciter is also equipped with an air filter. Refer to the exciter manual for additional information.

5–18. **BLOWER MAINTENANCE.**

WARNING *NEVER OPEN THE EQUIPMENT UNLESS ALL TRANSMITTER PRIMARY POWER IS DISCONNECTED. USE THE GROUNDING STICK PROVIDED TO ENSURE ALL COMPONENTS AND ALL SURROUNDING COMPONENTS ARE DISCHARGED BEFORE ATTEMPTING MAINTENANCE ON ANY AREA WITHIN THE TRANSMITTER.*

WARNING

5–19. Inspect the blower and the flushing fan for dust accumulation and periodically clean the blower and fan using a brush and vacuum cleaner. The blower and fan motors are cooled by air passing around each motor. If the ambient air temperature is too high or if the air flow is restricted, the lubricant will gradually vaporize from the motor bearings and bearing failure will occur. If dirty air passes over the motors, accumulated dust will impair motor cooling unless the accumulation is wiped from and blown out of the motor.

5–20. The blower and fan impeller blades should be inspected and cleaned periodically. If the transmitter is operated in a very dusty environment, dust will build up on the concave side of the blower and fan impellers. If this happens, air flow will be reduced and unbalance will result with a possibility of damage to the blower or fans.

5–21. The blower motor and the flushing fan are equipped with sealed element–type bearings which do not permit lubrication. Therefore, no regular motor lubrication maintenance is required. However, check the blower and flushing fan mounting hardware at regular intervals to ensure proper operation.

5–22. SECOND LEVEL MAINTENANCE.

WARNING *NEVER OPEN THE EQUIPMENT UNLESS ALL TRANSMITTER PRIMARY POWER IS DISCONNECTED.*

WARNING

5–23. Second level maintenance consists of procedures required to restore the transmitter to operation after a fault has occurred. The maintenance philosophy of the transmitter consists of problem isolation to a specific area. Subsequent troubleshooting provided by each applicable assembly of this manual will assist isolation to a specific assembly or component. If desired, a defective assembly may be returned to the factory for repair or exchange.

5–24. **GENERAL.**

5–25. **PA STAGE.** Power amplifier tube life is a result of several circuit parameters. Usually, the first indication of the decline of a tube is a slight reduction in power output. This can normally be corrected by a small increase in filament voltage. It may be wise to order a new tube at this time. Further reductions in power output can be compensated in the same manner only a limited number of times. An Eimac application paper titled “Extending Transmitter Tube Life” is provided in APPENDIX A of this manual. Excess control grid or screen grid dissipation will shorten the life of a tube. Also, excess plate dissipation always indicates trouble. Typical PA efficiency is plotted in Figure 5–1 and should be referenced to estimate PA efficiency for a particular power level.

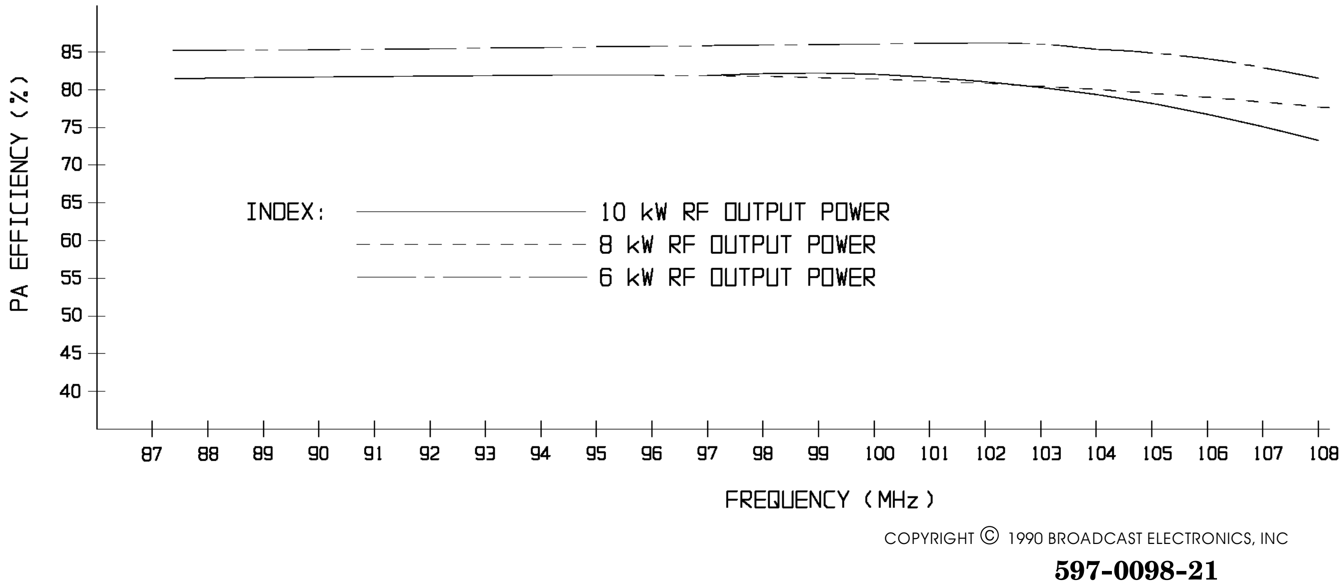


FIGURE 5-1. FM-10T/FM-10TS TYPICAL PA EFFICIENCY

5-26. **PA Tube Warranty.** The transmitter PA tube is covered by warranty from the Varian/Eimac Company, the tube manufacturer, not Broadcast Electronics, Inc. However, a tube purchased from Broadcast Electronics which is defective must be returned to Broadcast Electronics with a customer–completed warranty claim service report. A warranty claim service report form is shipped with each tube obtained from Broadcast Electronics, Inc. Following this procedure, Broadcast Electronics will expedite immediate shipment of a new tube. Contact the Broadcast Electronics, Inc. Customer Service Department for additional details as required. It is recommended that the warranty report be completed as soon as the new tube is placed in operation while the nominal voltages are known.

5-27. **ADJUSTMENTS.**

WARNING
WARNING

NEVER OPEN THE EQUIPMENT UNLESS ALL TRANSMITTER PRIMARY POWER IS DISCONNECTED. USE THE GROUNDING STICK PROVIDED TO ENSURE ALL COMPONENTS AND ALL SURROUNDING COMPONENTS ARE DISCHARGED BEFORE ATTEMPTING MAINTENANCE ON ANY AREA WITHIN THE TRANSMITTER.

5-28. Adjustment procedures for controls associated with the transmitter controller are presented in the CONTROLLER section of this manual. Adjustment procedures for the power supply and PA controls are presented as follows:

A. AM Noise Adjustment.

B. Control Grid Bias Level Adjustment.

C. Plate Current Meter Calibration.

D. Second Harmonic Suppressor Adjustment.

E. Neutralization.

5-29. **AM NOISE.** The transmitter is equipped with an **AM NOISE** test receptacle. The test receptacle is located on the transmitter controller and provides a calibrated AM waveform sample for direct measurement of synchronous and asynchronous AM noise parameters. Refer to the following text for procedures to minimize AM noise parameters in the transmitter.

5-30. **Synchronous AM Noise.** Synchronous AM noise is incidental amplitude modulation of the carrier by the presence of FM modulation. The synchronous AM noise level is related to: 1) the transmitter overall bandwidth and 2) transmitter tuning. An application paper titled "TECHNIQUES FOR MEASURING SYNCHRONOUS AM NOISE IN FM TRANSMITTERS" is available from Broadcast Electronics, Inc. The paper presents detailed information on AM noise measurements and procedures for tuning the transmitter to minimize the synchronous AM noise level. If adjustment of the transmitter is desired, perform the procedures in the application paper and tune the transmitter for a minimum synchronous AM noise level.

5-31. **Asynchronous AM Noise.** Asynchronous AM noise is residual amplitude modulation of the transmitter output due primarily to power supply ripple. The transmitter hum null circuit injects a small 60 Hz voltage into the bias power supply to cancel ac components in the supply and reduce asynchronous AM noise. Adjustment of the circuit will not normally be required in the field. However, if it is certain that hum null circuit adjustment is required, proceed as follows.

5-32. **Required Equipment.** The following equipment is required to adjust the hum null circuit.

A. Distortion analyzer (Tektronics Model AA501 or equivalent).

B. One locally fabricated test cable consisting of the following:

  A. 10 feet (3.05 m) of Belden RG58A/U coaxial cable (BE P/N 622-0050).

  B. Two BNC connectors (Pomona UG68/U-BE P/N 417-0205).

WARNING
WARNING

NEVER OPEN THE EQUIPMENT UNLESS ALL TRANSMITTER PRIMARY POWER IS DISCONNECTED. USE THE GROUNDING STICK PROVIDED TO ENSURE ALL COMPONENTS AND ALL SURROUNDING COMPONENTS ARE DISCHARGED BEFORE ATTEMPTING MAINTENANCE ON ANY AREA WITHIN THE TRANSMITTER.

5-33. **Procedure.** To adjust the hum null circuit, proceed as follows:

5-34. Refer to Figure 5-2 and connect the distortion analyzer to the controller **AM NOISE** test receptacle using the coaxial test cable (Item B). Configure the distortion analyzer for dBm level indications.

5-35. Operate the transmitter at a normal output power level.

5-36. Refer to Figure 5-2 and adjust hum null control R10 for a minimum asynchronous AM noise indication on the distortion analyzer.

5-37. Disconnect and remove all test equipment.

5-38. **CONTROL GRID BIAS LEVEL ADJUSTMENT.** A control in the grid bias circuit allows adjustment of the grid bias voltage. Adjustment of the control will not normally be required in the field. If it is certain that grid bias adjustment is required, contact the Broadcast Electronics Customer Service Department for a recommended test procedure and a list of required equipment.

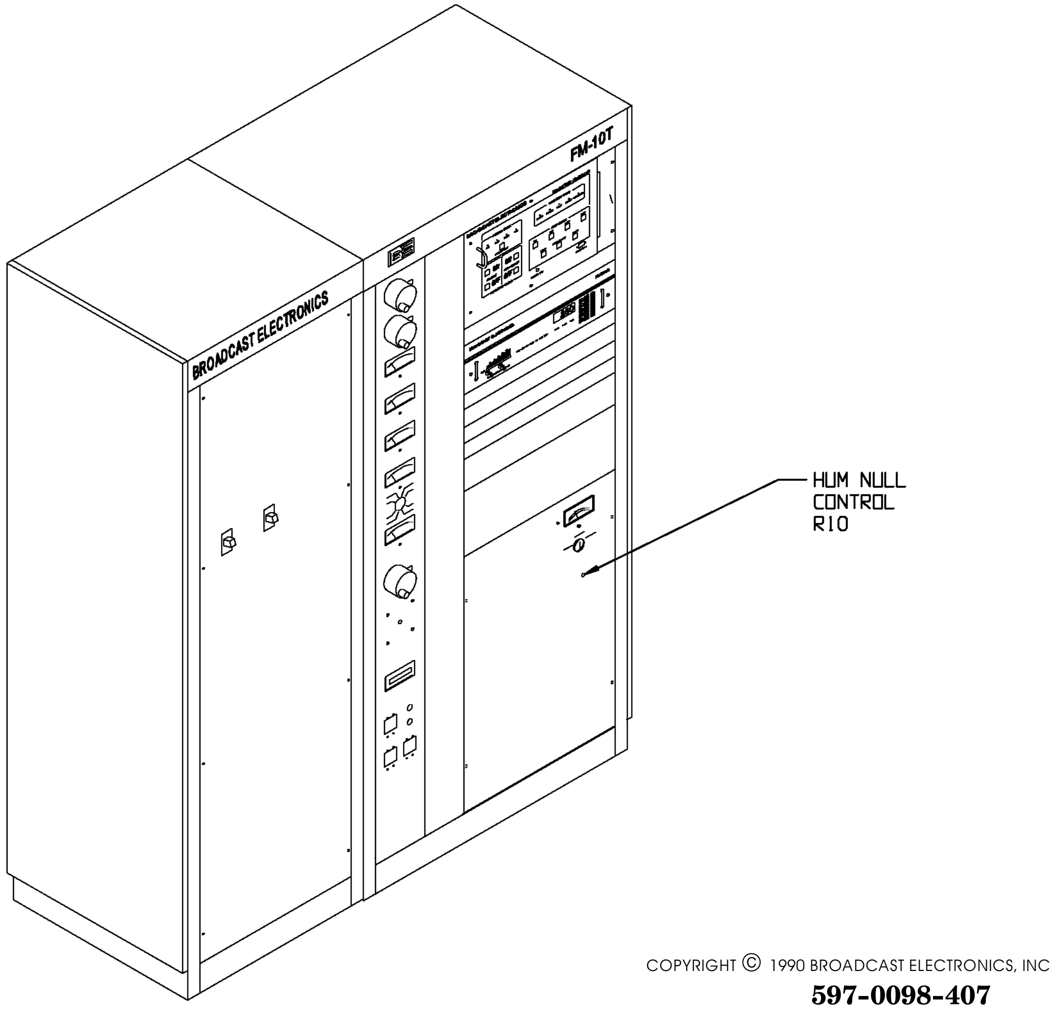


FIGURE 5-2. HUM NULL CONTROL LOCATION

5-39. **PLATE CURRENT METER CALIBRATION.** The plate current meter assembly is equipped with a calibration control. Due to the special equipment required to adjust the calibration control, the control is not considered field adjustable. If it is certain that adjustment of the plate current meter calibration control is required, contact the Broadcast Electronics Customer Service Department for maintenance information on the plate current meter assembly.

5-40. **SECOND HARMONIC SUPPRESSOR.** Adjustment of the second harmonic suppressor in the field will not normally be required, even if the PA tube is replaced. Adjustment should be attempted only when absolutely necessary. Misadjustment of the suppressor could result in sporadic operation, possibly damaging the PA tube, the cavity, or the low-pass filter. It is suggested the customer contact the Broadcast Electronics Customer Service Department before attempting this adjustment. If it is certain that adjustment of the second harmonic suppressor is required, proceed as follows.

5-41. **Required Equipment.** The following equipment is required to adjust the transmitter second harmonic suppressor.

A. 1/16 inch (1.6 mm) hex wrench.

B. Tektronix Model 492 Spectrum Analyzer or equivalent capable of displaying frequencies at twice the transmitter frequency of operation.

C. 50 Ohm 10 dB resistive attenuator pad, BNC jack to BNC plug (Texscan FP-50).

D. A test cable for the spectrum analyzer consisting of the following:

1. 10 feet (3.05 m) of Belden RG58A/U coaxial cable (BE P/N 622-0050).

2. Two BNC plugs (Pomona UG88/U--BE P/N 417-0205).

E. Six inch scale.

WARNING *NEVER OPEN THE EQUIPMENT UNLESS ALL TRANSMITTER PRIMARY POWER IS DISCONNECTED. USE THE GROUNDING STICK PROVIDED TO ENSURE ALL COMPONENTS AND ALL SURROUNDING COMPONENTS ARE DISCHARGED BEFORE ATTEMPTING ANY MAINTENANCE.*

WARNING

5-42. **Procedure.** To adjust the second harmonic suppressor, proceed as follows:

WARNING *DISCONNECT ALL TRANSMITTER PRIMARY POWER-BEFORE PROCEEDING.*

WARNING

5-43. Deenergize all primary power to the transmitter.

5-44. Open the PA/driver cabinet rear door.

5-45. Connect one end of the spectrum analyzer cable (Item D) to the RF sample port on the transmission line elbow.

5-46. Connect the attenuator pad (Item C) in series with the spectrum analyzer cable and attach the attenuator pad to the spectrum analyzer input.

5-47. Close the PA/driver cabinet rear door.

5-48. Energize the transmitter primary ac input.

5-49. Operate the transmitter at the normal power output and ensure all PA stage tuning and loading controls are correctly adjusted.

5-50. Record the level of the second harmonic displayed on the spectrum analyzer ______________.

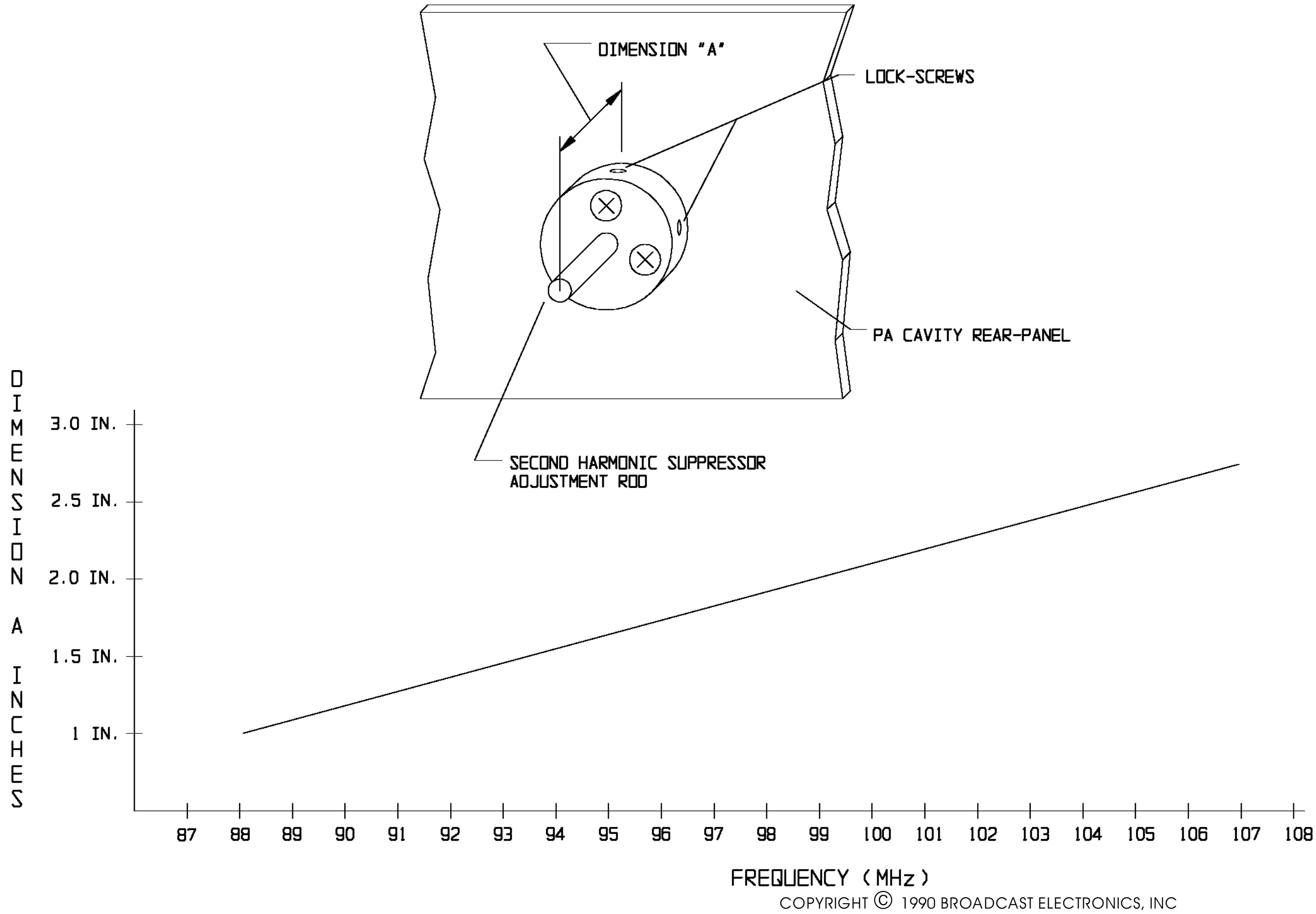
WARNING *DISCONNECT ALL TRANSMITTER PRIMARY POWER-BEFORE PROCEEDING.*

WARNING

5-51. Disconnect all transmitter primary power.

5-52. Open the PA/driver cabinet rear door.

5-53. Loosen the two hex-head lock-screws securing the second harmonic suppressor adjustment rod very slightly--just enough to allow in and out adjustment (see Figure 5-3).



597-0098-23

FIGURE 5-3. SECOND HARMONIC SUPPRESSOR ADJUSTMENT

CAUTION ***THE SECOND HARMONIC SUPPRESSOR IS ADJUSTED BY SLIDING THE ADJUSTMENT ROD IN OR OUT. DO NOT ROTATE THE ROD.***

CAUTION

NOTE ***THE ORIGINAL HARMONIC SUPPRESSOR ADJUSTMENT DIMENSION IS RECORDED ON THE FACTORY FINAL TEST DATA SHEETS IF THE DIMENSION MUST BE REFERENCED.***

NOTE

5–54. Move the second harmonic suppressor adjustment rod slightly (approximately 1/16 inch). Record the amount moved and the direction (in or out) ______________. Slightly tighten the two screws to secure the rod in place.

5–55. Close the PA/driver cabinet rear door.

5–56. Operate the transmitter at the normal power output and check for a minimum second harmonic indication displayed on the spectrum analyzer.

5–57. Repeat paragraphs 5–52 through 5–57, moving the second harmonic suppressor adjustment rod slightly in or out as required to minimize the second harmonic indication.

WARNING **_DISCONNECT ALL TRANSMITTER PRIMARY POWER-BEFORE PROCEEDING._**

WARNING

5-58. After the correct placement of the second harmonic suppressor is determined, disconnect all transmitter primary power.

5-59. Open the PA/driver cabinet rear door.

5-60. Secure the two hex-head lock-screws on the second harmonic suppressor bushing (see Figure 5-3).

5-61. Disconnect the spectrum analyzer cable from the transmission line.

5-62. Close the PA/driver cabinet rear door. Refer to Figure 5-3 and record the new harmonic suppressor dimension _______________.

5-63. **NEUTRALIZATION.** PA neutralization in the field will not normally be required, even if the PA tube is replaced. If it is certain that adjustment of the neutralization circuitry is required, proceed as follows.

CAUTION **_INCORRECT NEUTRALIZATION CAN RESULT IN INSTABILITY WHICH COULD DAMAGE THE PA TUBE, CAVITY, OR LOW-PASS FILTER. CONSULT THE FACTORY BEFORE ATTEMPTING PA NEUTRALIZATION._**

CAUTION

5-64. **Required Equipment.** The following equipment is required to complete PA neutralization.

- A. Spectrum analyzer (Tektronix Model 492 or equivalent).
- B. 25 Watt, 50 Ohm RF attenuator/termination with -20 dB sample output, type N receptacles (Bird Model 8340-030 or equivalent).
- C. Two locally fabricated cables, each consisting of the following:
  1. 36 inches (91.44 cm) of Belden RG 58A/U coaxial cable (BE P/N 622-0050).
  2. Two BNC plugs (Pomona UG88/U--BE P/N 417-0205).
- D. Three adapters, BNC receptacle to type N plug (Pomona UG201A/U--BE P/N 417-3288).
- E. No. 2 Phillips screwdriver, 4-inch (10.2 cm) blade.
- F. Flat-tip screwdriver, 4-inch (10.2 cm) blade and 1/4 inch (0.64 cm) tip.
- G. Exciter line cord (P/O exciter accessory pack--BE P/N 682-0001).
- H. Electrical extension cord, 3-wire, 12 feet (3.7 m) long.
- I. One BNC receptacle to type N plug (Pomona UG201A/U - BE P/N 417-3288).

5-65. **Procedure.** To adjust PA neutralization, proceed as follows:

5-66. Operate the transmitter at the normal power output and ensure all PA stage tuning and loading controls are correctly adjusted.

5-67. Secure the **INPUT TUNING, OUTPUT LOADING,** and **OUTPUT TUNING** control knobs in position with tape. The controls must not be moved until the entire procedure has been completed.

WARNING ***DISCONNECT ALL TRANSMITTER PRIMARY POWER-BEFORE PROCEEDING.***

WARNING

5-68. Deenergize all primary power to the transmitter.

5-69. Open the PA/driver cabinet rear door.

5-70. Disconnect the coaxial cable from the exciter RF OUTPUT connector.

5-71. Disconnect the cable from the **PA RF INPUT** receptacle.

5-72. Connect one cable between the PA RF INPUT (J1) connector and the RF termination -20 dB output.

5-73. Connect a BNC-to-type N adapter on the RF attenuator/termination input connector.

5-74. Connect one cable between the exciter RF OUTPUT connector and the input to the RF termination.

5-75. Disconnect wire No. 5 from TB1-7 on the rear of the exciter and connect a temporary wire jumper from TB1-6 to TB1-7. Flag the temporary jumper with a piece of tape marked "TEMPORARY".

5-76. Disconnect the exciter line cord and remove the fuse from the AC LINE VOLTAGE SELECTOR on the rear panel. Cover the line cord plug with a piece of tape marked "240 VOLTS".

5-77. Remove the exciter AC LINE VOLTAGE SELECTOR circuit board with a small pair of needle-nose pliers and record the circuit board voltage indication ______________ . Reinsert the circuit board so that "115/120V" is visible when the circuit board is inserted into the receptacle.

5-78. Replace the exciter fuse with a slow-blow type rated at 10 Amperes.

5-79. Connect the exciter accessory line cord to the extension cord. Route the extension cord out through the top or bottom of the cabinet to a 110 to 120 volt ac source.

5-80. Connect the accessory exciter line cord to the exciter.

WARNING ***PRIMARY TRANSMITTER POWER MUST REMAIN OFF THROUGHOUT THE FOLLOWING PROCEDURE.***

WARNING

5-81. Assure that the exciter is operating independently of the transmitter.

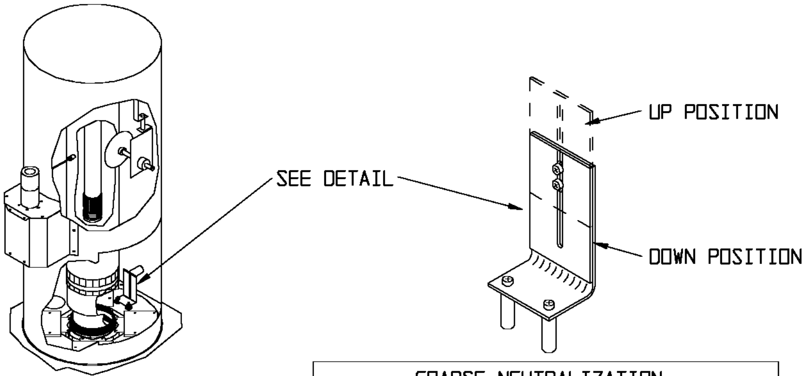
5-82. Connect the spectrum analyzer to the RF sample port in the transmitter output transmission line. Adjust the analyzer to obtain a reference level display and position the analyzer so that it may be viewed from the rear of the transmitter.

5-83. Refer to Figure 5-4 and check the NEUT cyclometer indication. Correct neutralization will be found near the original factory set position.

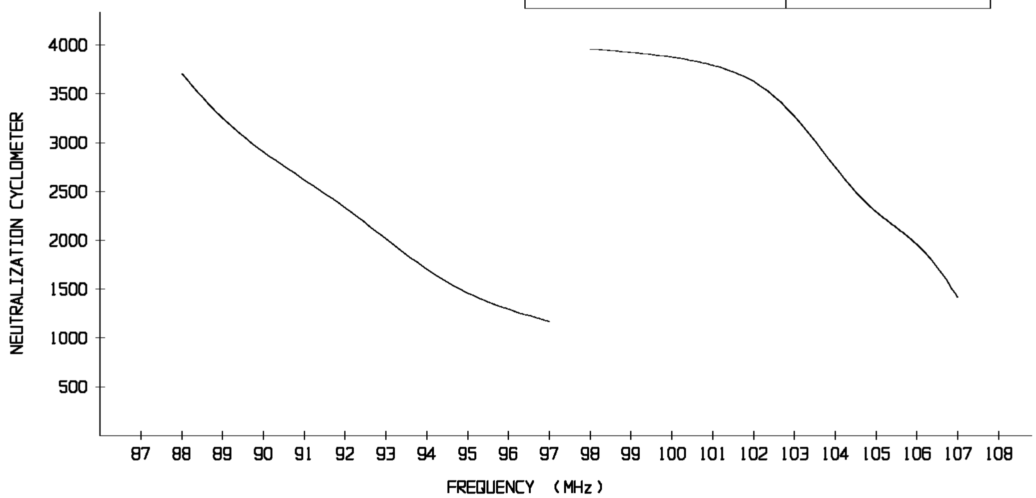
5-84. Adjust PA neutralization by adjusting the NEUT cyclometer for a minimum indication on the spectrum analyzer.

5-85. Record the new NEUT cyclometer indication ______________.

5-86. Disconnect the spectrum analyzer from the transmission line RF sample output.



COARSE NEUTRALIZATION	
FREQUENCY	PLATE POSITION
88 MHz TO 98 MHz	UP
98.1 MHz TO 108 MHz	DOWN



597-0098-24

FIGURE 5-4. PA NEUTRALIZATION

CAUTION ***DO NOT CONNECT THE EXCITER TO THE LINE CORD WIRED INTO THE TRANSMITTER IN THE FOLLOWING STEP.***

CAUTION

WARNING ***DISCONNECT ALL EXCITER PRIMARY POWER BEFORE PROCEEDING.***

WARNING

5-87. Remove the electrical extension cord and exciter line cord. Do not connect the exciter to the line cord wired into the transmitter at this time.

5-88. Remove the fuse from the exciter rear panel AC LINE VOLTAGE SELECTOR.

5-89. Remove the AC LINE VOLTAGE SELECTOR circuit board with a small pair of needle-nose pliers. Reinsert the circuit board so that the voltage recorded in the preceding text is visible when the circuit board is inserted into the receptacle.

5-90. Replace the fuse with a slow-blow type rated at 5 Amperes.

5-91. Remove the tape from the exciter line cord and connect the plug to the exciter.

5-92. Remove the temporary wire jumper from TB1 on the exciter rear panel and reconnect wire No. 5 to TB1-7.

5-93. Remove the cabling and test load connected between the exciter RF OUTPUT connector and the PA RF INPUT connector. Remove the adapter from the PA RF INPUT connector.

5-94. Reconnect the exciter to the PA input.

5-95. **TRANSMITTER POWER LEVEL CHANGE.**

WARNING *WARNING* ***NEVER OPEN THE EQUIPMENT UNLESS ALL TRANSMITTER PRIMARY POWER IS DISCONNECTED. USE THE GROUNDING STICK PROVIDED TO ENSURE ALL COMPONENTS AND ALL SURROUNDING COMPONENTS ARE DISCHARGED BEFORE ATTEMPTING MAINTENANCE ON ANY AREA WITHIN THE TRANSMITTER.***

5-96. Each transmitter is programmed, operated, and tested at a specific power level at the factory prior to shipment. If at a future date the transmitter is to be operated at a power level other than the original factory programmed level, the following transmitter parameters must be checked and adjusted if required to assure proper transmitter operation. If problems occur during initial operation, contact the Broadcast Electronics Customer Service Department for additional service procedures.

A. Refer to SECTION III, OPERATION and reset the APC operating reference.

B. Energize the transmitter primary ac power and operate the transmitter. Adjust the input tuning control for a minimum exciter reflected power indication on the multimeter (for high reflected power conditions, use the multimeter grid current function and maximum grid current information for indications of correct tuning operations).

C. Refer to CONTROLLER SECTION II, MAINTENANCE and perform the FORWARD POWER CALIBRATION and REFLECTED POWER CALIBRATION adjustment procedures.

5-97. **TRANSMITTER FREQUENCY CHANGE PROCEDURE.**

CAUTION *CAUTION* ***CONSULT THE FACTORY BEFORE ATTEMPTING TO CHANGE THE TRANSMITTER OPERATING FREQUENCY.***

5-98. **GENERAL.** The following text presents an overall procedure to change the transmitter operating frequency. The procedure specifies operational adjustment procedures located throughout this publication and FM-250C Exciter publication 597-1004. To change the transmitter operating frequency, proceed as follows.

5-99. **Procedure.** To change the transmitter operating frequency, proceed as follows:

WARNING

WARNING

NEVER OPEN THE EQUIPMENT UNLESS ALL TRANSMITTER PRIMARY POWER IS DISCONNECTED. USE THE GROUNDING STICK PROVIDED TO ENSURE ALL COMPONENTS AND ALL SURROUNDING COMPONENTS ARE DISCHARGED BEFORE ATTEMPTING MAINTENANCE ON ANY AREA WITHIN THE TRANSMITTER.

WARNING

WARNING

DISCONNECT ALL TRANSMITTER PRIMARY POWER-BEFORE PROCEEDING.

5–100. Disconnect all transmitter primary power. The primary ac power must remain OFF unless specified by an adjustment procedure.

5–101. Refer to Figure 5–5A and adjust the transmitter coarse output tuning by raising or lowering the PA tuning line on top of the PA cavity. Refer to Figure 5–5B and coarse adjust the transmitter input tuning cyclometers.

5–102. Refer to Figure 5–3 and coarse adjust the transmitter second harmonic suppressor. The suppressor is adjusted by loosening the two hex–head lock screws and moving the adjustment rod in or out as required. Do not rotate the rod during adjustment.

5–103. Refer to Figure 5–4 and coarse adjust the transmitter neutralization cyclometer and the neutralization plate in the PA cavity.

5–104. Refer to FM–250C publication 597–1004, PART II SECTION 4, AFC/PLL ASSEMBLY and perform the FREQUENCY SELECTION procedure. Operate and test the exciter independently from the transmitter.

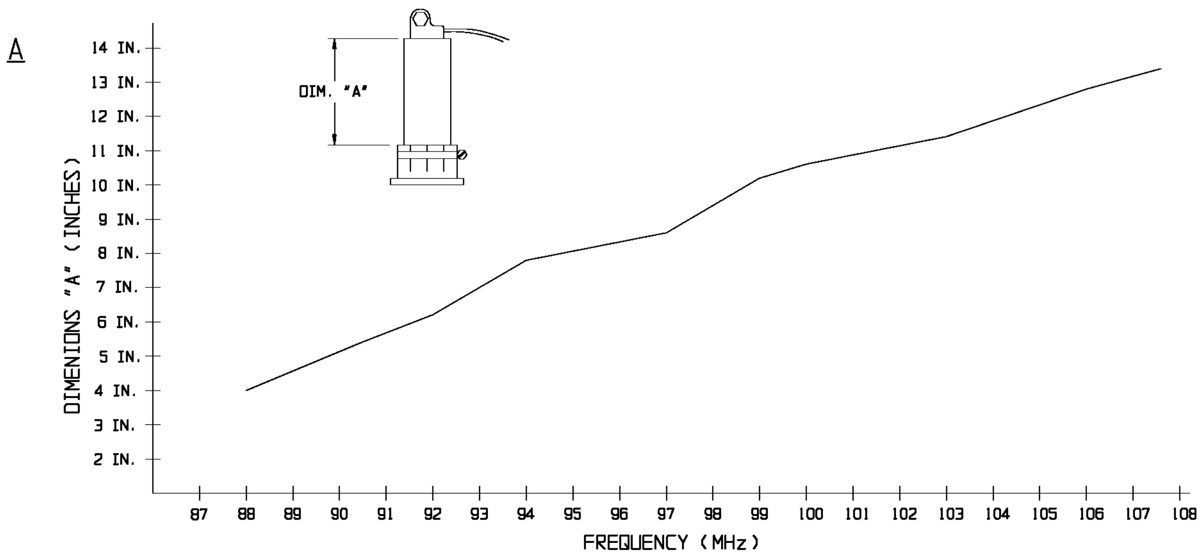
5–105. Refer to SECTION II, INSTALLATION and perform the PRELIMINARY OPERATION AND TUNING procedure to obtain a 10% power indication from the transmitter. Use a spectrum analyzer to monitor spurious activity during tuning. Also, use an in–line wattmeter connected to the transmitter output transmission line for all power output indications.

5–106. Refer to the adjustment procedures in the preceding text and perform the NEUTRALIZATION procedure.

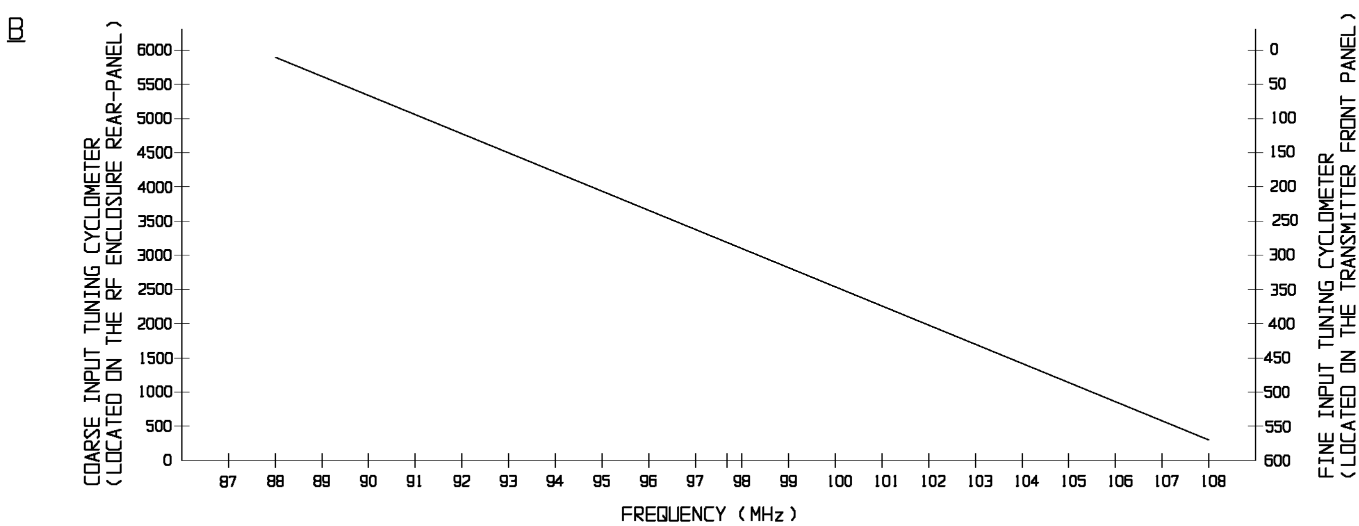
5–107. Refer to SECTION II, INSTALLATION and complete the PRELIMINARY OPERATION AND TUNING procedure to obtain a 100% power indication from the transmitter.

5–108. Refer to the adjustment procedures in the preceding text and perform the SECOND HARMONIC SUPPRESSOR adjustment procedure.

5–109. Refer to CONTROLLER SECTION II, MAINTENANCE and perform the FORWARD POWER CALIBRATION and REFLECTED POWER CALIBRATION adjustment procedures.



COARSE OUTPUT TUNING



COARSE INPUT TUNING

597-0098-25

FIGURE 5-5. COARSE TUNING ADJUSTMENTS

5–110. **TROUBLESHOOTING.**

WARNING *NEVER OPEN THE EQUIPMENT UNLESS ALL TRANSMITTER PRIMARY POWER IS DISCONNECTED. USE THE GROUNDING STICK PROVIDED TO ENSURE ALL COMPONENTS AND ALL SURROUNDING COMPONENTS ARE DISCHARGED BEFORE ATTEMPTING MAINTENANCE ON ANY AREA WITHIN THE TRANSMITTER.*

WARNING

5–111. Most troubleshooting consists of visual checks. Due to the dangerous voltages and currents in the equipment, it is considered extremely hazardous to work with power energized. Therefore, the various transmitter indicators (meters, LEDs, fuses, and circuit breakers) should be used to isolate the malfunction to one of the specific areas listed below. Typical meter indications are presented in Table 5–1 and typical transmitter primary power demand requirements are listed in Table 5–2 and 5–3.

TRANSMITTER TROUBLESHOOTING AREAS

A. Power Supplies
B. Exciter
C. Power Amplifier
D. Transmitter Controller
E. Transmitter Load

CAUTION *MANY COMPONENTS IN THE TRANSMITTER ARE MOUNTED TO HEATSINKS UTILIZING A FILM OF HEATSINK COMPOUND FOR THERMAL CONDUCTION.*

CAUTION

CAUTION *IF ANY SUCH COMPONENT IS REPLACED, ENSURE A THIN FILM OF A ZINC-BASED HEATSINK COMPOUND IS USED (BE P/N 700-0028) TO ASSURE GOOD HEAT DISSIPATION.*

CAUTION

5–112. Once trouble is isolated, refer to the applicable section of this manual which presents the theory of operation and troubleshooting information for the respective assembly to assist in problem resolution. Figures 5–6 through 5–11 provide illustrations to assist in component location.

TABLE 5-1. FM-10T/FM-10TS TYPICAL METER INDICATIONS, 10kW POWER OUTPUT (Sheet 1 of 2)

METER	INDICATION
OUTPUT POWER:	
FORWARD	100%
VSWR	1.2:1
PLATE CURRENT	2.0 A
PLATE VOLTAGE	6600 V
SCREEN VOLTAGE	800 V

TABLE 5-1. FM-10T/FM-10TS TYPICAL METER INDICATIONS, 10 kW POWER OUTPUT (Sheet 2 of 2)

METER	INDICATION
SCREEN CURRENT	70 mA
GRID VOLTAGE	–300 V
GRID CURRENT	45 mA
FILAMENT VOLTAGE	7.0 V
EXCITER FORWARD POWER	200 W

TABLE 5-2. FM-10T TYPICAL POWER DEMAND, 10 kW POWER OUTPUT

AC LINE FREQUENCY	AC LINE VOLTAGE	AC LINE CURRENT
60 Hz	210 V	50 A PER PHASE
50 Hz	220 V	50 A PER PHASE
50 Hz	380 V	28 A PER PHASE

TABLE 5-3. FM-10TS TYPICAL POWER DEMAND, 10 kW POWER OUTPUT

AC LINE FREQUENCY	AC LINE VOLTAGE	AC LINE CURRENT
60 Hz	215 V	120 A

5-113. **COMPONENT REPLACEMENT ON CIRCUIT BOARDS.** All the FM-10T/FM-10TS transmitter circuit boards are double-sided boards with plated through-holes with the exception of the transmitter controller main and front panel circuit boards. Due to the double-sided design, the components on the circuit boards can be replaced without damage if standard soldering techniques are used. The FM-10T/FM-10TS transmitter controller main and front-panel circuit boards are constructed using surface mount technology. Therefore, components on the controller main circuit and front-panel circuit boards can not be replaced without destruction of the circuit board traces.

5-114. On all double-sided circuit boards with 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. The adhesive securing the copper track to the boards melts at almost the same temperature as solder. A circuit board track 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.

5-115. To remove a component from a double-sided circuit board, cut the leads from the body of the defective component while the device is still soldered to the board.

5-116. Grip each component lead, one at a time, with long nose pliers. Turn the board over and touch the soldering iron to the lead at the solder connection. When the solder begins to melt, push the lead through the back side of the board and cut off the bent outer 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.

5-117. Install the new component and apply solder from the bottom side of the board. If no damage has been done to the plated through-holes, soldering of the top side is not required.

WARNING

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 WELL VENTILATED AREA, AWAY FROM FLAME, INCLUDING CIGARETTES AND A HOT SOLDERING IRON.

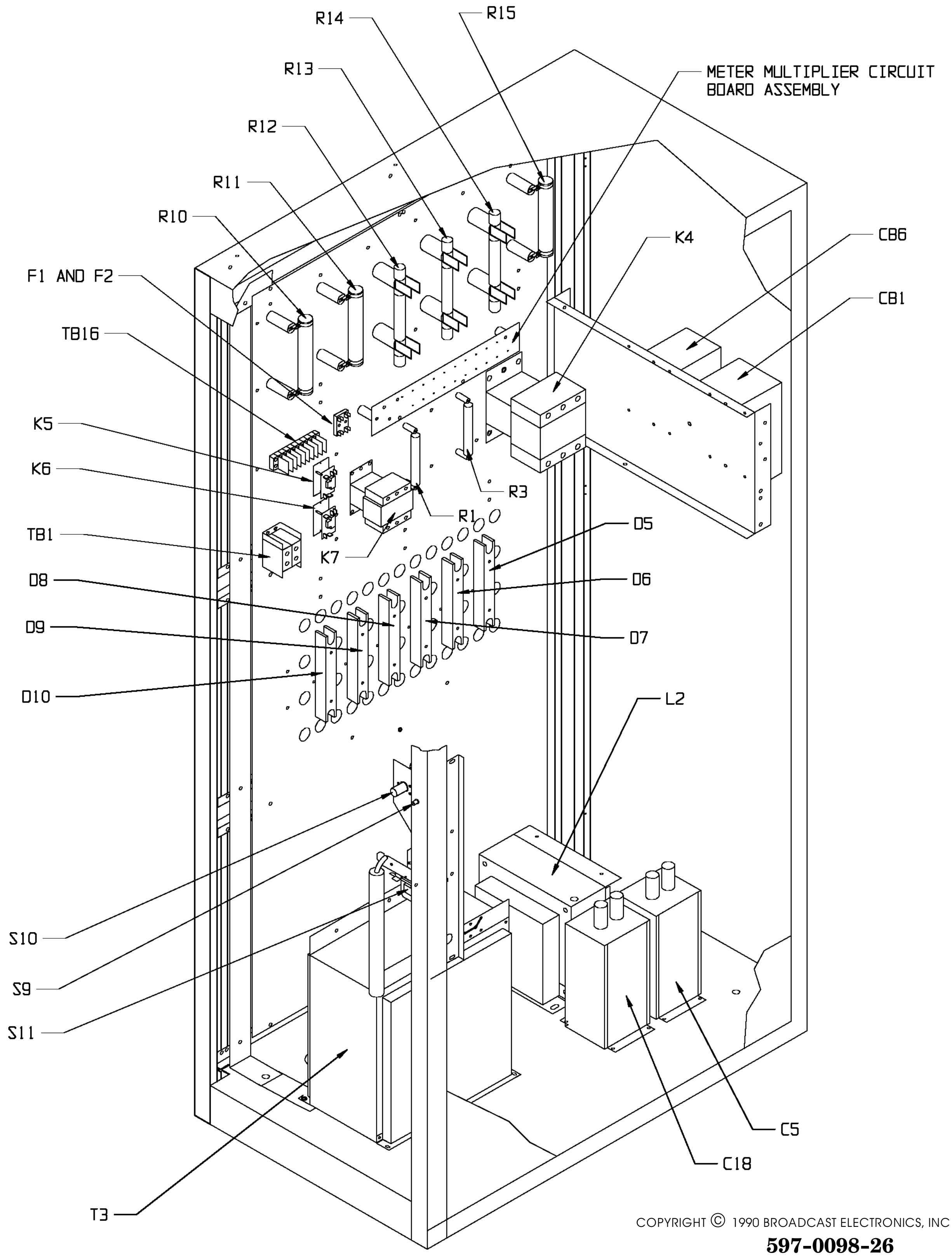
WARNING

WARNING

OBSERVE THE MANUFACTURER'S CAUTIONARY INSTRUCTIONS.

5-118. After soldering, remove flux with a cotton swab moistened with a suitable solvent. Rubbing alcohol is highly diluted and is not effective. Solvents are available in electronic supply houses which are useful.

5-119. The board should be checked to ensure the flux has been removed and not just smeared about. Rosin flux is not normally corrosive, but rosin will absorb enough moisture in time to become conductive and cause problems.



597-0098-26

FIGURE 5-6. FM-10T POWER SUPPLY CABINET COMPONENT LOCATOR

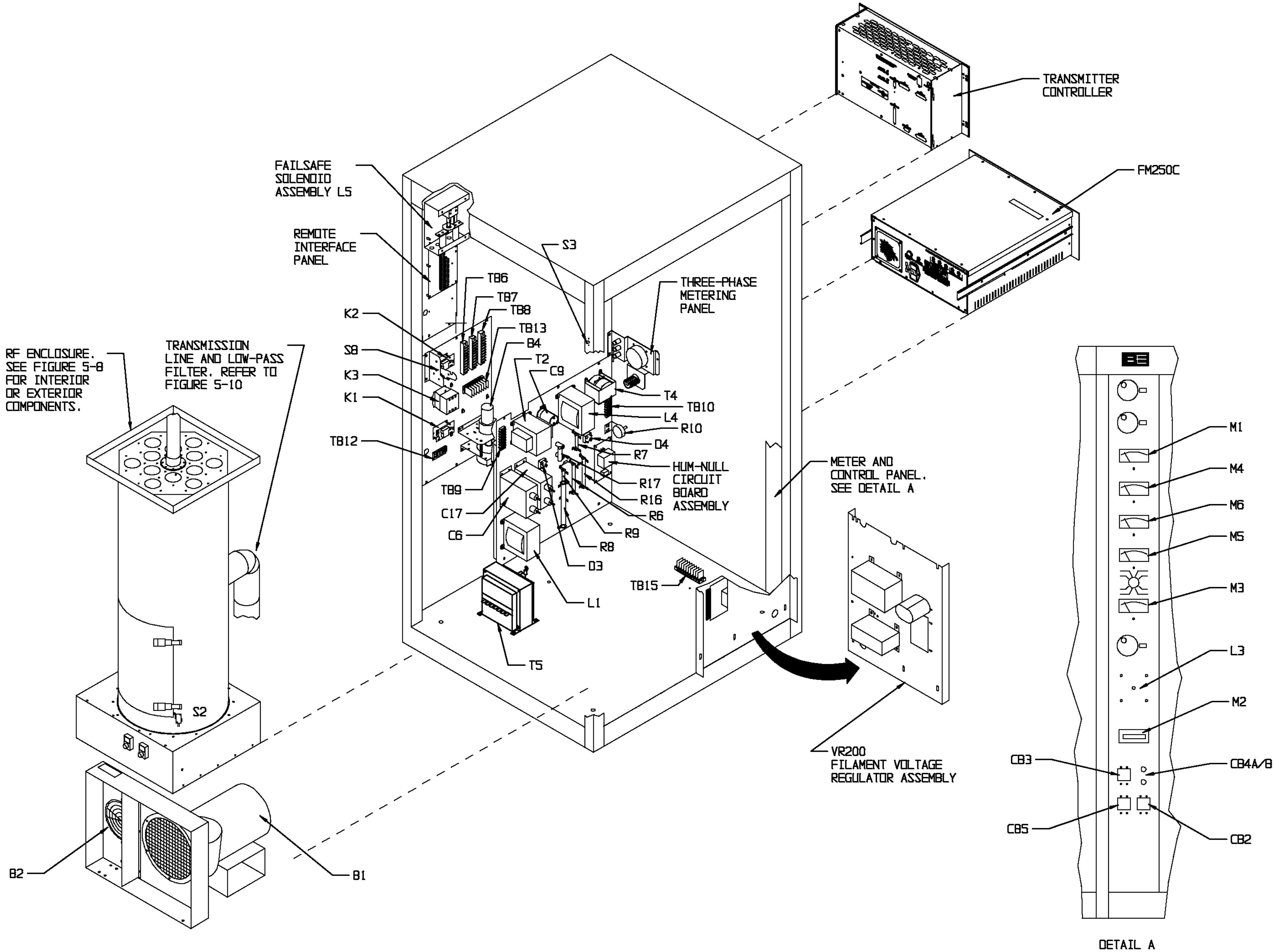
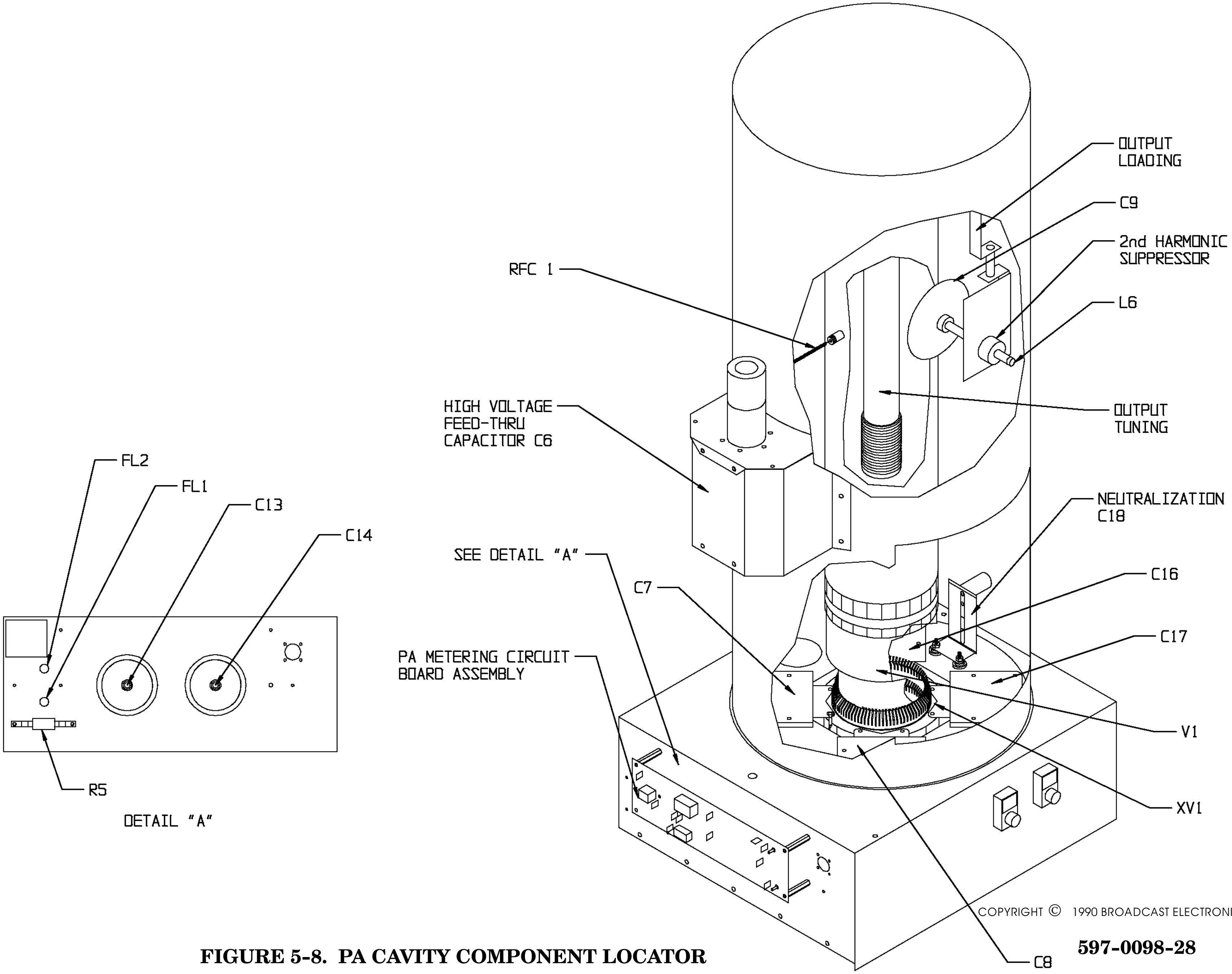


FIGURE 5-7. FM-10T/FM-10TS PA/DRIVER CABINET COMPONENT LOCATOR

597-0098-410

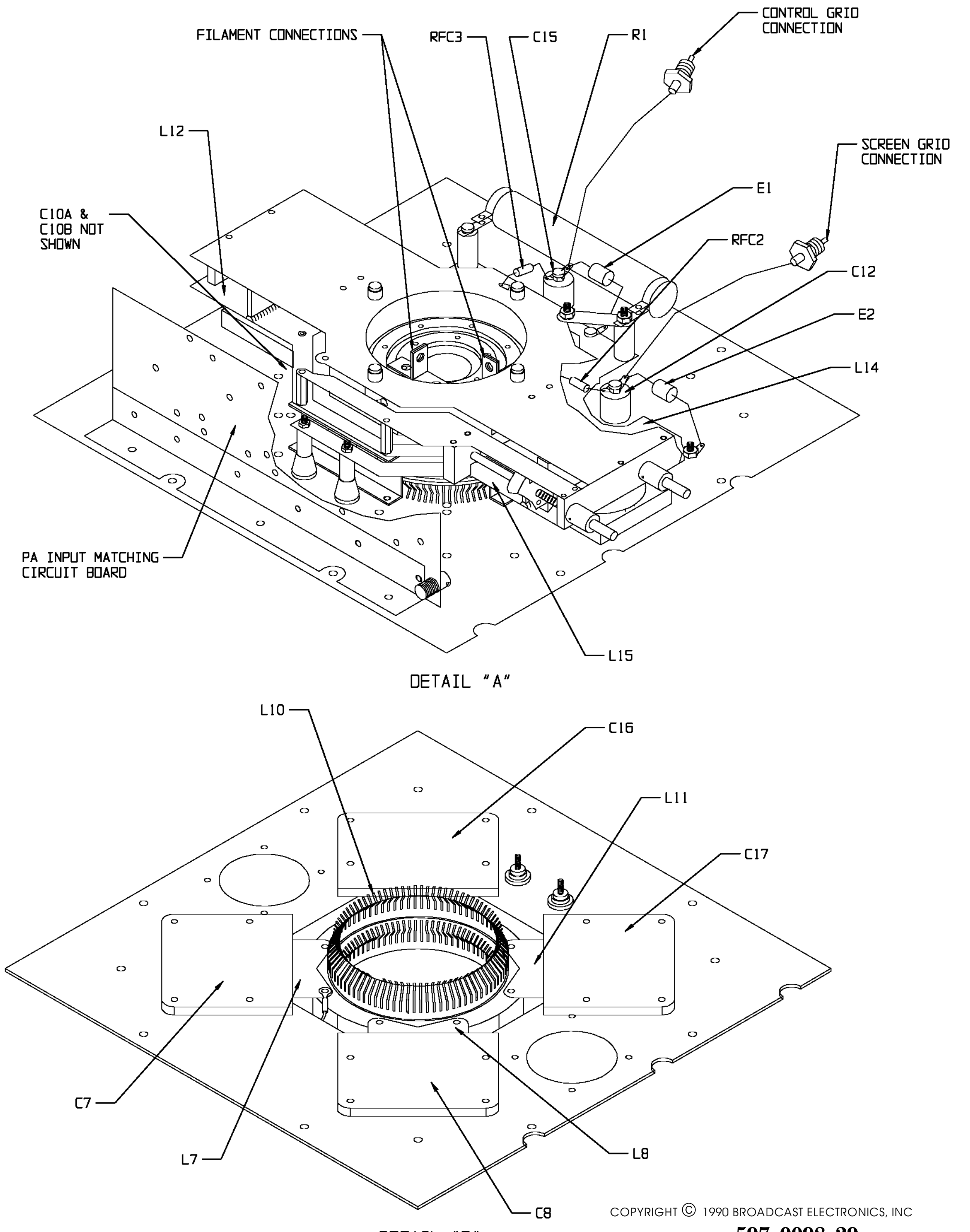
WARNING: DISCONNECT POWER PRIOR TO SERVICING

BROADCAST ELECTRONICS INC



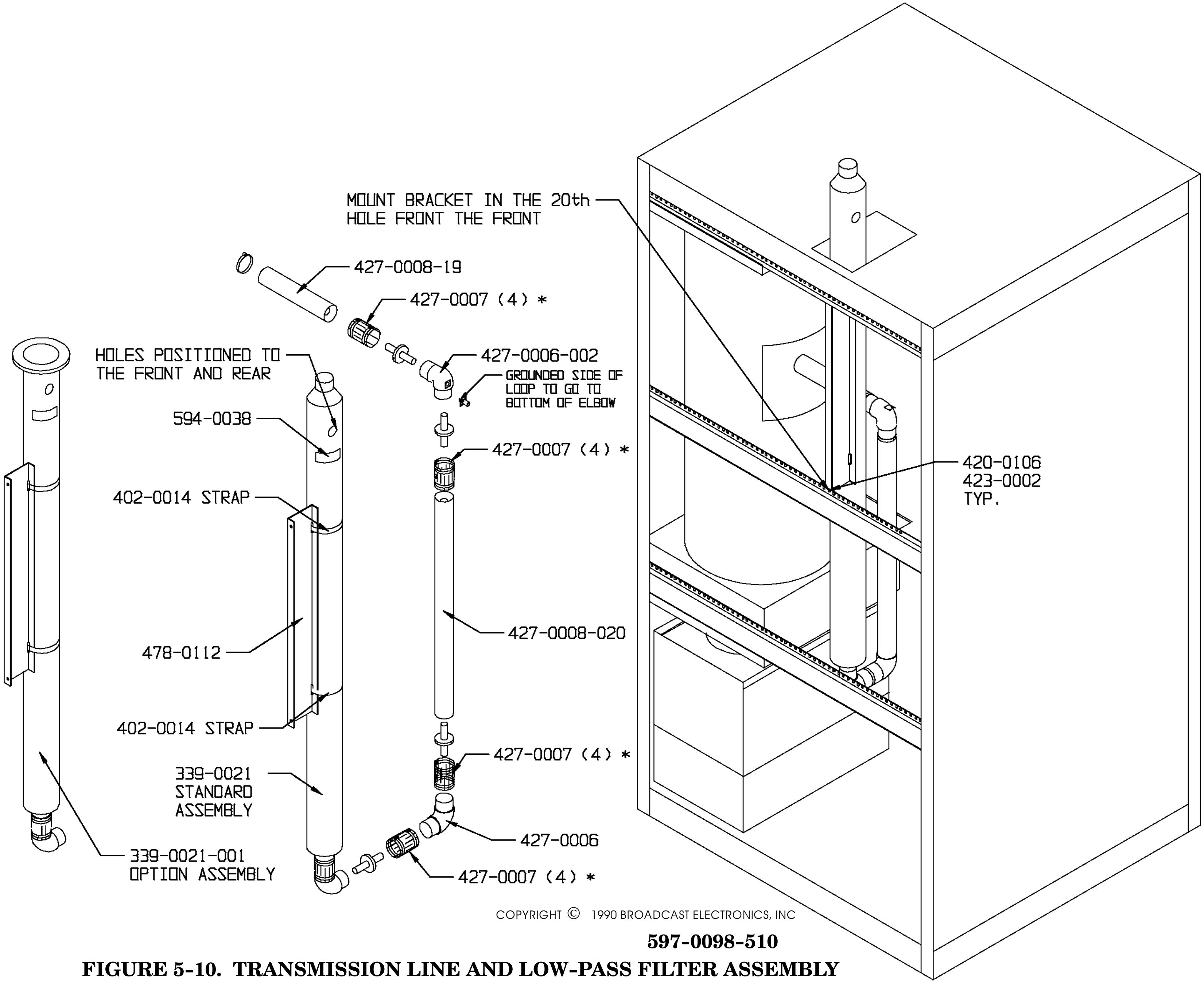
597-0098-28

FIGURE 5-8. PA CAVITY COMPONENT LOCATOR



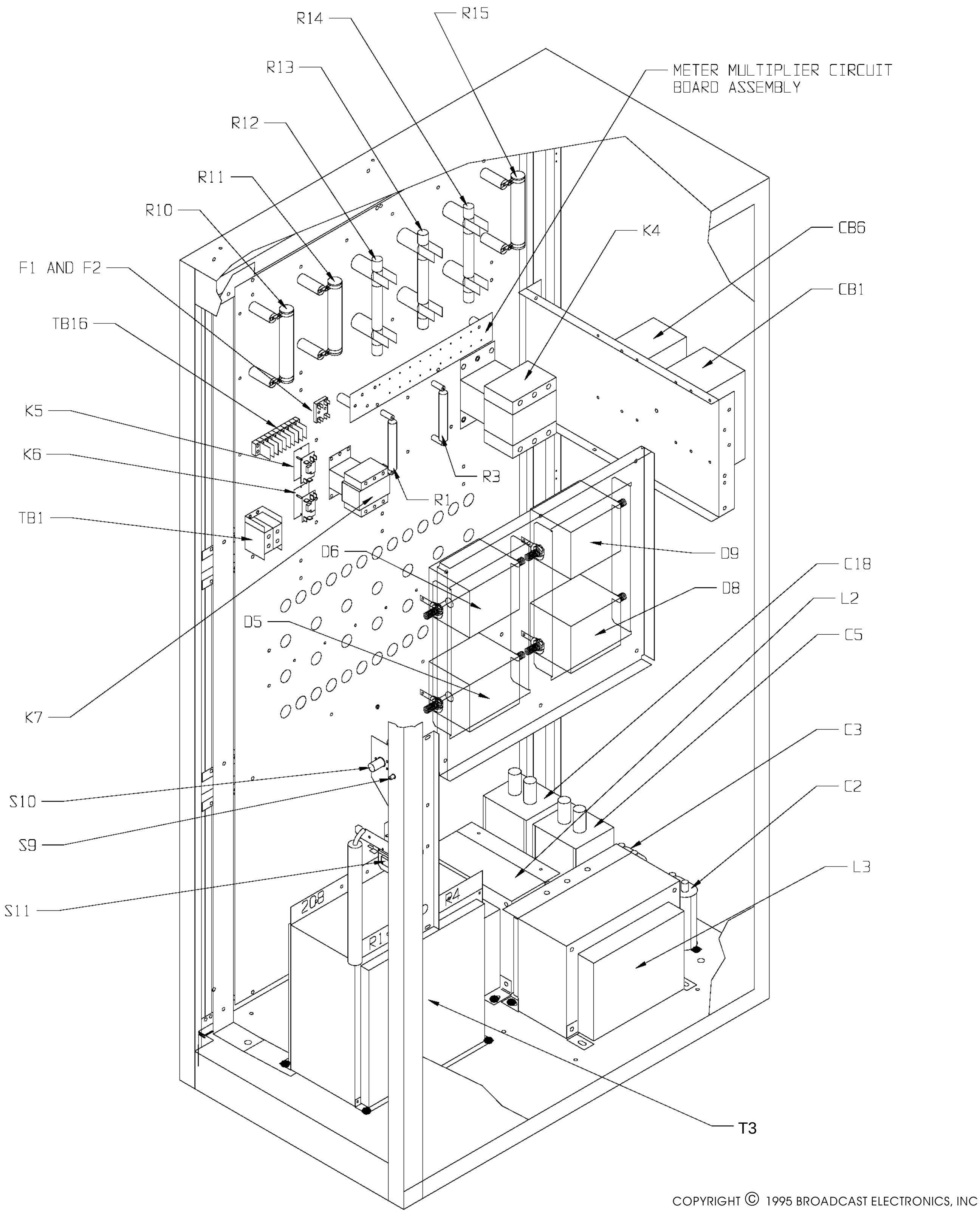
597-0098-29

FIGURE 5-9. PA INPUT CIRCUIT COMPONENT LOCATOR



597-0098-510

FIGURE 5-10. TRANSMISSION LINE AND LOW-PASS FILTER ASSEMBLY



597-0098-31

FIGURE 5-11. FM-1OTS POWER SUPPLY CABINET COMPONENT LOCATOR

SECTION VI
PARTS LISTS

6-1. INTRODUCTION.

6-2. This section provides descriptions and part numbers of electrical components, assemblies, and selected mechanical parts required for maintenance of the Broadcast Electronics FM-10T/FM-10TS FM Transmitter. Each table entry in this section is indexed by reference designators appearing on the applicable schematic diagram. Parts for the transmitter controller are listed in the CONTROLLER section of this manual.

TABLE 6-1. REPLACEABLE PARTS LISTS
(Sheet 1 of 2)

TABLE	DESCRIPTION	PART NO.	PAGE
6-2	FM-10T TRANSMITTER	909-1110-205/ /-305 /-385	6-3
6-3	FM-10T TRANSMITTER	909-1110-206 /-306 /-386	6-3
6-4	FM-10TS TRANSMITTER	909-1110-255	6-3
6-5	FM-10TS TRANSMITTER	909-1110-256	6-4
6-6	FM-10T POWER SUPPLY CABINET ASSEMBLY	959-0277-100	6-4
6-7	FM-10T CONTACTOR PANEL ASSEMBLY	959-0277-002	6-4
6-8	FM-10TS POWER SUPPLY CABINET ASSEMBLY	959-0303-100	6-5
6-9	FM-10TS CONTACTOR PANEL ASSEMBLY	959-0303-002	6-5
6-10	METER MULTIPLIER ASSEMBLY	919-0079	6-6
6-11	OPTICALLY-COUPLED-RELAY (OCR) ASSEMBLY	919-0096	6-6
6-12	POWER SUPPLY CABLE HARNESS ASSEMBLY	949-0129/-001	6-7
6-13	GROUND STICK HANGER ASSEMBLY	955-0038	6-7
6-14	FM-10T POWER AMPLIFIER/DRIVER CABINET ASSEMBLIES	959-0275-100 -0276-100 -0309-100	6-7
6-15	FM-10TS POWER AMPLIFIER/DRIVER CABINET ASSEMBLY	959-0304-100	6-8
6-16	3-PHASE AC VOLTMETER ASSEMBLY	959-0271-010	6-8
6-17	SHIELD CELL/TUNING LINE ASSEMBLY	959-0272-101	6-9
6-18	ASSEMBLY, EXHAUST AIR TEMPERATURE SENSOR	919-0082	6-9
6-19	SCREEN AND BIAS PANEL ASSEMBLY	959-0275-001	6-9
6-20	POWERSTAT PANEL ASSEMBLY	959-0275-102	6-10
6-21	POWERSTAT ASSEMBLY	959-0121-100	6-10
6-22	METER PANEL ASSEMBLY	959-0275-105 959-0310-100	6-10
6-23	FAN AND BLOWER ASSEMBLY	959-0275-006	6-11
6-24	FM-10T BASIC POWER AMPLIFIER/DRIVER CABINET ASSEMBLY	959-0275-007	6-11

TABLE 6-1. REPLACEABLE PARTS LISTS
(Sheet 2 of 2)

TABLE	DESCRIPTION	PART NO.	PAGE
6-25	PLATE CURRENT METER ASSEMBLY	959-0291	6-11
6-26	METER PROTECTION CIRCUIT BOARD ASSEMBLY	919-0109-002	6-11
6-27	CABLE ASSEMBLY, POWER AMPLIFIER/DRIVER CABINET	949-0166-100	6-12
6-28	HUM NULL CIRCUIT BOARD ASSEMBLY	919-0112	6-12
6-29	MULTIMETER CIRCUIT BOARD ASSEMBLY	919-0049-001	6-12
6-30	RF ENCLOSURE ASSEMBLY	959-0287	6-12
6-31	CHIMNEY ASSEMBLY	959-0287-001	6-13
6-32	TRANSMISSION LINE ASSEMBLY	959-0287-002	6-13
6-33	TUBE SOCKET AND INPUT TUNING ASSEMBLY	959-0231	6-13
6-34	POWER AMPLIFIER INPUT MATCHING CIRCUIT BOARD ASSEMBLY	919-0064-001	6-14
6-35	PA METERING CIRCUIT BOARD ASSEMBLY	919-0048-007	6-14
6-36	REMOTE INTERFACE PANEL ASSEMBLY	959-0117-100	6-15
6-37	FAIL-SAFE SOLENOID ASSEMBLY	959-0083	6-15
6-38	REMOTE POWER SUPPLY INTERCONNECTING CABLE ASSEMBLY	949-0130	6-16
6-39	OUTPUT DIRECTIONAL COUPLER ASSEMBLY	959-0082-045	6-16
6-40	ACCESSORY PARTS KIT	969-0014	6-16
6-41	REMOTE INTERFACE CIRCUIT BOARD ASSEMBLY	919-0439	6-16

TABLE 6-2. FM-10T TRANSMITTER - 909-1110-205/-305/-385

REF. DES.	DESCRIPTION	PART NO.	QTY.
V1	PA Tube, Eimac, 4CX7500A	240-0001	1
----	Accessory Parts Kit	969-0014	1
----	Power Supply Cabinet Assembly	959-0277-100	1
----	Cable Assembly, Power Supply Adjacent Interconnect Jumpers	949-0131	1
----	Output Directional Coupler Assembly	959-0082-045	2
	FOR 60 Hz TRANSMITTER MODELS 909-1110-205		
----	Power Amplifier/Driver Cabinet Assembly	959-0275-100	1
	FOR 339V TO 437V 50 Hz TRANSMITTER MODELS 909-1110-385		
----	Power Amplifier/Driver Cabinet Assembly	959-0276-100	1
	FOR 196V TO 252V 50 Hz TRANSMITTER MODELS 909-1110-305		
----	Power Amplifier/Driver Cabinet Assembly	959-0309-100	1

TABLE 6-3. FM-10T TRANSMITTER - 909-1110-206/-306/-386

REF. DES.	DESCRIPTION	PART NO.	QTY.
V1	PA Tube, Eimac, 4CX7500A	240-0001	1
----	Accessory Parts Kit	969-0014	1
----	Power Supply Cabinet Assembly	959-0277-100	1
----	Cable Assembly, Power Supply Adjacent Interconnect Jumpers	949-0131	1
----	Output Directional Coupler Assembly	959-0082-045	2
	DELETE PARTS		
----	Harmonic Low-Pass Filter, 15 kW, 88 to 108 MHz, 3 1/8 Inch	339-0021	1
----	Adapter, 1 5/8 inch EIA Flanged to Unflanged	427-0010	1
	ADD PARTS		
----	Harmonic Low-Pass Filter, 15 kW, 88 to 108 MHz, 3 1/8 Inch	339-0021-001	1
----	Flange, 3 1/8 inch EIA	427-0001	1
	FOR 60 Hz TRANSMITTER MODELS 909-1110-206		
----	Power Amplifier/Driver Cabinet Assembly	959-0275-100	1
	FOR 339V TO 437V 50 Hz TRANSMITTER MODELS 909-1110-386		
----	Power Amplifier/Driver Cabinet Assembly	959-0276-100	1
	FOR 196V TO 252V 50 Hz TRANSMITTER MODELS 909-1110-306		
----	Power Amplifier/Driver Cabinet Assembly	959-0309-100	1

TABLE 6-4. FM-10TS TRANSMITTER - 909-1110-255
(Sheet 1 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
V1	PA Tube, Eimac, 4CX7500A	240-0001	1
----	Accessory Parts Kit	969-0014	1

TABLE 6-4. FM-10TS TRANSMITTER - 909-1110-255
(Sheet 2 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Cable Assembly, Power Supply Adjacent Interconnect Jumpers	949-0131	1
----	Assembly, FM-10TS Power Supply Cabinet	959-0303-100	1
----	Output Directional Coupler Assembly	959-0082-045	2
----	Assembly, FM-10TS Power Amplifier/Driver Cabinet	959-0304-100	1

TABLE 6-5. FM-10TS TRANSMITTER - 909-1110-256

REF. DES.	DESCRIPTION	PART NO.	QTY.
V1	PA Tube, Eimac, 4CX7500A	240-0001	1
----	Accessory Parts Kit	969-0014	1
----	Cable Assembly, Power Supply Adjacent Interconnect Jumpers	949-0131	1
----	Assembly, FM-10TS Power Supply Cabinet	959-0303-100	1
----	Output Directional Coupler Assembly	959-0082-045	2
----	Assembly, FM-10TS Power Amplifier/Driver Cabinet	959-0304-100	1
	DELETE PARTS		
----	Harmonic Low-Pass Filter, 15 kW, 88 to 108 MHz, 3 1/8 Inch	339-0021	1
----	Adapter, 1 5/8 inch EIA Flanged to Unflanged	427-0010	1
	ADD PARTS		
----	Harmonic Low-Pass Filter, 15 kW, 88 to 108 MHz, 3 1/8 Inch	339-0021-001	1
----	Flange, 3 1/8 inch EIA	427-0001	1

TABLE 6-6. FM-10T POWER SUPPLY CABINET ASSEMBLY - 959-0277-100

REF. DES.	DESCRIPTION	PART NO.	QTY.
C5, C18	Capacitor, Electrolytic, 4 uF, 8 kV	047-0004	2
CB1	Circuit Breaker, 3-Pole, 480V ac, 70 Amperes (**HIGH VOLTAGE** Circuit Breaker)	341-0042	1
CB6	Circuit Breaker, 3-Pole, 480V ac, 20 Amperes (**CONTROL** Circuit Breaker)	341-0044	1
L2	Choke, 2.2 uH +20% ±5%, 25 Ohms DC Resistance Maximum	360-4184	1
T3	Transformer, (Plate Supply) Primary: Three-Phase, 208/240V ±11V ac, 50/60 Hz, Delta Configuration Secondary: Three-Phase, 4662V @ 2.32 Amperes, Wye Configuration	370-4183	1
----	Interlock Switch, Micro, Door, SPDT, 0.5A @125V dc	346-3302	1
----	Ground Stick Hanger Assembly	955-0038	1
----	Ground Stick Assembly	959-0145	1
----	Ground Switch Assembly	955-0030-001	1
----	Contactor Panel, FM-10T	959-0277-002	1

TABLE 6-7. FM-10T CONTACTOR PANEL ASSEMBLY - 959-0277-002
(Sheet 1 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
D5 THRU D10	Power Rectifier, PIV: 18 kV V_F = 21.0V dc @ 1.85 Amperes MAX	230-0009	6

TABLE 6-7. FM-10T CONTACTOR PANEL ASSEMBLY - 959-0277-002
(Sheet 2 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
F1, F2	Fuse, 20 Amperes, 250V, Slow-Blow	334-0020	2
K4	Contactor (Start Contactor) Coil: 220V ac 50/60 Hz Contacts: 3-Pole, 75 Amperes, 600V	341-0043	1
K5,K6	Assembly, Optically-Coupled-Relay (OCR) (Step Driver, Start Driver)	919-0096	2
K7	Contactor (Step Contactor) Coil: 110V to 230V ac 50/60 Hz Contacts: 3-Pole, 40 Amperes, 600V	341-0053	1
R1 THRU R3	Resistor, 2 Ohm ±5%, 50W, W/W	132-1004	3
R12 THRU R14	Resistor, 100 k Ohm ±5%, 175W	132-1064	3
R10, R11, R15	Resistor, 22 Ohm ±20%, 150W	139-0220	3
TB1	Terminal Strip, 4-Terminal (AC Input)	412-0040	1
TB16	Barrier Strip, Single-Section, 600V	412-0725	10
XF1/XF2	Holder, Fuse, 2-Pole	415-0003	1
----	Barrier Strip, End Cap (for TB16)	412-0730	1
----	Jack, Banana, 1 kV, Capacitance: 7.0 pF (Half-Voltage Tap)	417-0109	2
----	Meter Multiplier Assembly	919-0079	1
----	Power Supply Cabinet Cable Harness Assembly	949-0129	1

TABLE 6-8. FM-10TS POWER SUPPLY CABINET ASSEMBLY - 959-0303-100

REF. DES.	DESCRIPTION	PART NO.	QTY.
C2, C3	Capacitor, Polypropylene Film, 0.97 uF ±5%, 2500 V RMS @ 120 Hz Non-Polarized	047-0006	2
C5, C18	Capacitor, Electrolytic, 4 uF, 8 kV	047-0004	2
CB1	Circuit Breaker, 3-Pole, 600V ac, 150 Amperes (**HIGH VOLTAGE** Circuit Breaker)	341-0051	1
CB6	Circuit Breaker, 3-Pole, 480V ac, 20 Amperes (**CONTROL** Circuit Breaker)	341-0044	1
D5, D6, D8, D9	High Voltage Rectifier Assembly, 28 kV PRV @ 8 Amperes	230-0004	4
L2	Choke, 2.2 uH +20% ±5%, 25 Ohms DC Resistance Maximum	360-4184	1
L3	Choke, P18523, Tuned 5.06/3.5HY	361-0005	1
T3	Transformer, (Plate Supply) Primary: Single-Phase, 208/240V ±11V ac, 50/60 Hz Secondary: Single-Phase, Taps For: 6300V/5670V/5100V	370-0051	1
----	Ground Stick Hanger Assembly	955-0038	1
----	Interlock Switch, Micro, Door, SPDT, 0.5A @125V dc	346-3302	1
----	Ground Stick Assembly	959-0145	1
----	Ground Switch Assembly	955-0030-001	1
----	Contactor Panel, FM-10TS	959-0303-002	1

TABLE 6-9. FM-10TS CONTACTOR PANEL ASSEMBLY - 959-0303-002
(Sheet 1 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
F1, F2	Fuse, 20 Amperes, 250V, Slow-Blow	334-0020	2

TABLE 6-9. FM-10TS CONTACTOR PANEL ASSEMBLY - 959-0303-002 (Sheet 2 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
K4	Contactor (Start Contactor) Coil: 120/208-240 V ac 60 Hz 120/190-220V ac 50 Hz Contacts: 3-Pole, 120 Amperes, 550V	341-0054	1
K5,K6	Assembly, Optically-Coupled-Relay (OCR) (Step Driver, Start Driver)	919-0096	2
K7	Contactor (Step Contactor) Coil: 110V to 230V ac 50/60 Hz Contacts: 3-Pole, 40 Amperes, 600V	341-0053	1
R1 THRU R3	Resistor, 2 Ohm ±5%, 50W, W/W	132-1004	2
R12 THRU R14	Resistor, 100 k Ohm ±5%, 175W	132-1064	3
R10, R11, R15	Resistor, 22 Ohm ±20%, 150W	139-0220	3
TB16	Barrier Strip, Single-Section, 600V	412-0725	10
XF1/XF2	Holder, Fuse, 2-Pole	415-0003	1
----	Barrier Strip, End Cap (for TB16)	412-0730	1
----	Jack, Banana, 1 kV, Capacitance: 7.0 pF (Half-Voltage Tap)	417-0109	2
----	Meter Multiplier Circuit Board Assembly	919-0079	1
----	Power Supply Cabinet Cable Harness Assembly	949-0129-001	1
----	Cable Assembly, Power Supply Adjacent Interconnect Jumpers	949-0131	1

TABLE 6-10. METER MULTIPLIER ASSEMBLY - 919-0079

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1	Capacitor, Mica, 390 pF ±5%, 100V	042-3922	1
D1	Diode, Zener, 1N4739A, 9.1V ±5%, 1W	200-0009	1
R1 THRU R10	Resistor, 1 Meg Ohm ±1%, 2W	140-0003	10
R11	Resistor, 4.99 k Ohm ±1%, 1/4W	100-5041	1
----	Blank Circuit Board	519-0079	1

TABLE 6-11. OPTICALLY-COUPLED-RELAY (OCR) ASSEMBLY - 919-0096 (Sheet 1 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1	Capacitor, Ceramic Disc, 0.001 uF, 1 kV	002-1034	1
C2	Capacitor, Electrolytic, 47 uF, 35V	020-4773	1
C3	Capacitor, Ceramic Disc, 0.03 uF, 300V	000-1051	1
C4	Capacitor, Ceramic Disc, 0.001 uF, 1 kV	002-1034	1
D1	Diode, 1N4005, Silicon, 600V @ 1 Ampere	203-4005	1
D2	Diode, Zener, 1N5359, 24V, 5W	200-5359	1
D4	Diode, 1N4005, Silicon, 600V @ 1 Ampere	203-4005	1
D5	Bridge Rectifier, MDA970A3, 4 Amps, 50-200V	239-0003	1
E1 THRU E5	Terminal, Male, 0.25 Tab	410-0025	5
F1, F2	Fuse, PCB Mount, 250V, 3 Amperes	330-0055	2
K1	Relay, Coil: 24V dc, 30A, 660 Ohms ±10% dc Resistance Contacts: SPST, 0.5 to 15A @ 12 to 240V dc	270-0054	1
MOV1	Metal Oxide Varistor, V272A60, 27V AC RMS, 120 Joules	140-0023	1
R1	Resistor, 2 k Ohm ±3%, 10W	130-2032	1

TABLE 6-11. OPTICALLY-COUPLED-RELAY (OCR) ASSEMBLY - 919-0096 (Sheet 2 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
R2	Resistor, 560 Ohm ±5%, 1/2W	110-5633	1
R3	Resistor, 820 Ohm ±5%, 1/2W	110-8233	1
R4	Resistor, 51.1 Ohm ±1%, 1/4W	103-5112	1
R5	Resistor, 2 k Ohm ±3%, 10W	130-2032	1
U1	Integrated Circuit, 4N33, Optical Isolator, Infared LED-Photo NPN Darlington Transistor Coupled Pair, 1500V Isolation	229-0033	1
XU1	Socket, 6-Pin DIP	417-0600	1
----	Blank Circuit Board	519-0096	1

TABLE 6-12. POWER SUPPLY CABLE HARNESS ASSEMBLY - 949-0129/-001

REF. DES.	DESCRIPTION	PART NO.	QTY.
P15	Connector, D-Type, 9-Pin	417-0900	1
----	Pins, Connector	417-0142	9
----	Plug, Banana, 25 Amperes AC	418-0039	1

TABLE 6-13. GROUND STICK HANGER ASSEMBLY - 955-0038

REF. DES.	DESCRIPTION	PART NO.	QTY.
S302	Microswitch, SPDT, 0.5A @ 125V dc	346-6100	1

TABLE 6-14. FM-10T POWER AMPLIFIER/DRIVER CABINET ASSEMBLIES - 959-0275-100/959-0276-100/959-0309-100 (Sheet 1 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
B1	Blower, 500 ft/min at 4.2 inches H_2O Motor: Single-Phase 220V ac 50/60 Hz, 3450 RPM @ 60 Hz, 2 hp	380-0010	1
S1, S3	Interlock Switch, SPDT, 0.5A @ 125V dc (PA Cabinet Lower Front Access Panel and Rear Door Interlocks)	346-3302	2
S6	Switch, Pressure, 120-480V ac 60 Hz, 15 Amperes (Air Pressure Switch)	340-0011	1
VR200	Transformer/Regulator Filament, Z3516	370-0053	1
TB15	Barrier Strip, Single-Section, 600V (10 For TB15,)	412-0725	10
----	Ground Stick Assembly	959-0145	1
----	Ground Stick Hanger Assembly	955-0038	1
----	Cable Assembly, Power Amplifier/Driver Cabinet	949-0166-100	1
----	Remote Interface Panel Assembly	959-0117-100	1
----	Assembly, Transmitter Controller	959-0430	1
----	Assembly, 3-Phase Voltmeter	959-0271-010	1
----	Assembly, Shield Cell/Tuning Line	959-0272-101	1
----	FM-250C Exciter, 220V ac 50/60 Hz Operation	909-0251-304	1
----	Turnlock Fastener, 1/4 Turn		
	Stud	424-0008	2
	Retainer	424-0006	2
----	PA Metering Circuit Board Assembly	919-0048-007	1

TABLE 6-14. FM-10T POWER AMPLIFIER/DRIVER CABINET ASSEMBLIES - 959-0275-100/959-0276-100/959-0309-100 (Sheet 2 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Tube Socket and Input Tuning Assembly	959-0231	1
----	Assembly, Meter Panel	959-0275-105	1
----	Assembly, Fan and Blower	959-0275-006	1
----	Assembly, RF Enclosure	959-0287	1
----	Assembly, Transmission Line	959-0287-002	1
----	Assembly, Powerstat Panel	959-0275-102	1
	FOR 959-0276-100 ASSEMBLY		
	DELETE PARTS		
----	Assembly, 3-Phase Voltmeter	959-0271-010	1
----	Assembly, Meter Panel	959-0275-105	1
	ADD PARTS		
----	Assembly, 3-Phase 380V ac Voltmeter	959-0271-011	1
----	Assembly, Meter Panel	959-0310-100	1
	FOR 959-0309-100 ASSEMBLY		
	DELETE PARTS		
----	Assembly, Meter Panel	959-0275-105	1
	ADD PARTS		
----	Assembly, Meter Panel	959-0310-100	1

TABLE 6-15. FM-10TS POWER AMPLIFIER/DRIVER CABINET ASSEMBLY - 959-0304-100

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Assembly, FM-10T Power Amplifier/Driver Cabinet	959-0275-100	1
	DELETE PARTS		
----	Assembly, Three-Phase AC Voltage Meter	959-0271-010	1

TABLE 6-16. 3-PHASE AC VOLTMETER ASSEMBLY - 959-0271-010

REF. DES.	DESCRIPTION	PART NO.	QTY.
F1 THRU F3	Fuse, AGC, 1/2 Ampere	330-0050	3
	FOR MODELS 909-1110-205 ONLY		
M7	Meter, 3.5 Inch (8.89 cm), Iron Vane Type, 0-300V ac Range, 60 k Ohm Resistance (PRIMARY VOLTAGE)	310-0032	1
	FOR MODELS 909-1110-305/-385 ONLY		
M7	Meter, 3.5 Inch (8.89 cm), Iron Vane Type, 0-500V ac Range, 150 k Ohm Resistance (PRIMARY VOLTAGE)	310-0060	1
S10 THRU S12	Assembly, Meter Select Switch		
	Switch: KS46B, Square D	341-0021	1
	Contactor: KA-1, Square D	341-0020	1
	Cam Assembly: Type F, Square D	341-0019	1
XF1 THRU XF3	Fuseholder, Panel Mount	415-2012	3

TABLE 6-17. SHIELD CELL/TUNING LINE ASSEMBLY - 959-0272-101

REF. DES.	DESCRIPTION	PART NO.	QTY.
L10	Assembly, Bellows, Output Tuning Line	463-0043	1
----	Output Tuning Line, 23.62 inches (60 cm) X 1 5/8 inch OD	463-0042	1
----	Exhaust Air Circuit Board	919-0082	1

TABLE 6-18. ASSEMBLY, EXHAUST AIR TEMPERATURE SENSOR - 919-0082

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1,C2	Capacitor, Mica, 390 pF ±5%, 100V	042-3922	2
C3,C4	Capacitor, Ceramic, 0.001 uF ±10%, 1 kV	002-1034	2
J1	Socket, 4-Pin	418-0255	1
R1	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R2	Resistor, 2.2 k Ohm ±5%, 1/4W	100-2243	1
U1	Integrated Circuit, LM35DZ, Celsius Temperature Sensor, TO-92 Case	220-0035	1
----	Blank Circuit Board	519-0082	1

TABLE 6-19. SCREEN AND BIAS PANEL ASSEMBLY - 959-0275-001

REF. DES.	DESCRIPTION	PART NO.	QTY.
C6	Capacitor, Mylar, 10 uF, 2 kV	047-0002	2
C9	Capacitor, Electrolytic, 80 uF, 450V	028-8076	1
D3, D4	Bridge Rectifier, H440, Peak Reverse Voltage: 4 kV DC Forward Current: 750 mA Forward Voltage @ 150 mA dc: 6V	239-0440	2
D8	Diode, MR506, 600V, 3 Amperes	203-0506	1
R6	Resistor, Adjustable, 2.5 k Ohm ±5%, 50W, W/W	130-2553	1
R7	Resistor, 2 k Ohm ±5%, 25W, W/W	132-0207	1
R8	Resistor, 10 k Ohm ±5%, 100W, W/W	132-1053	1
R9	Resistor, 7.5 k Ohm ±5%, 50W, W/W	132-7543	1
R10	Potentiometer, 50 Ohm ±10%, 25W, W/W	195-0149-001	1
R16	Resistor, Adjustable, 5 k Ohm ±5%, 50W, W/W	180-0578	1
R17	Resistor, 50 Ohm, 25W, W/W	130-5023	1
T2	Transformer (Screen Supply) Primary: 208/240V ±11V ac 50/60 Hz, Single-Phase Secondary: 1110V @ 0.15A Continuous, 15 Ohm dc Resistance	370-0009	1
T4	Transformer, (Bias Supply) Primary: 208/240V ±11V ac 50/60 Hz, Single-Phase Secondary: 1: 225V @ 0.2A Continuous 2: 253V @ 0.2A Continuous 3: 281V @ 0.2A Continuous 4: 310V @ 0.2A Continuous 1500 Volt Insulation, 70 Ohm dc Resistance	370-0006	1
TB9	Barrier Strip, 6 Terminal	412-0008	1
TB10	Barrier Strip, 5 Terminal	412-0005-1	1
----	Choke, 10 Henrys, 0.4A, 2500 Volt Insulation, 92 Ohm dc Resistance	377-0002	1
----	Hum Null Circuit Board Assembly	919-0112	1

TABLE 6-20. POWERSTAT PANEL ASSEMBLY - 959-0275-102

REF. DES.	DESCRIPTION	PART NO.	QTY.
K1	Assembly, Optically-Coupled-Relay (Blower Driver)	919-0096	1
K2	Assembly, Optically-Coupled-Relay (Control Contactor Driver)	919-0096	1
K3	Contactor (Control Contactor), Coil: 208 to 240V, 60 Hz or 208 to 220V, 50 Hz Contacts: 3 Sets SPST, 25A, 600V	341-0033	1
TB6 THRU TB8	Barrier Strip, 9 Terminal	412-0090	3
TB12	Barrier Strip, 4 Terminal	412-0011	2
TB13	Barrier Strip, Single-Section, 600V	412-0725	7
----	Screen Powerstat Assembly	959-0121-100	1

TABLE 6-21. POWERSTAT ASSEMBLY - 959-0121-100

REF. DES.	DESCRIPTION	PART NO.	QTY.
B4	Motor, Gearhead, 12V dc @ 235 mA, 9.1 r/min, Torque: 240 oz/in.	381-0001	1
D1, D2	Diode, 1N4005, Silicon, 600V @ 1 Ampere	203-4005	2
S4, S5	Microswitch, SPDT, 125V @ 4 Ampere (Limit Switches)	346-6100-1	2
T1	Autotransformer, Variable Input: 240V 50/60 Hz, Output: 0-240V @ 0.7A	374-0003	1
TB5	Barrier Strip, 4 Terminal	412-0011	1

TABLE 6-22. METER PANEL ASSEMBLY - 959-0275-105/959-0310-100 (Sheet 1 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1	Capacitor, Ceramic Disc, 0.001 uF, 1 kV	002-1034	1
C10 THRU C12	Capacitor, Ceramic Disc, 0.001 uF, 1 kV	002-1034	3
CB2	Circuit Breaker, 2-Pole, 240V, 30 Amperes (**BLOWER** Circuit Breaker)	341-0047	1
CB3	Circuit Breaker, 2-Pole, 250V, 2 Amperes (**SCREEN** Circuit Breaker)	341-0009	1
CB4A/B	Circuit Breaker, 2-Pole, 250V, 7 Amperes, Push On (**DRIVER** Circuit Breaker)	341-0060	2
CB5	Circuit Breaker, 2-Pole, 250V, 15 Amperes (FILAMENT)	341-0032	1
L3	Transformer, Variable, Superior Electric Type 21, 120V ac 50/60 Hz Input, 0-120V ac @ 5A Output	370-1790-001	1
M1	Meter, 3.5 inch (8.89 cm), Taut Band Type, FS = 200 uA dc ±2%, 230 Ohm Movement (OUTPUT POWER Meter)	310-0058	1
	FOR ASSEMBLY 959-0275-105		
M2	Meter, 0 - 99, 999.9 Hour, Non-Resettable, 230 Volt, 3.5 inch (8.89 cm) (FILAMENT TIME Meter)	310-0000-002	1
	FOR ASSEMBLY 959-0310-100		
M2	Meter, 0 - 99, 999.9 Hour, Non-Resettable, 230 Volt, 3.5 inch (8.89 cm) (FILAMENT TIME Meter)	310-0000-003	1
M3	Meter, 3.5 inch (8.89 cm), Iron Vane Type, 0-10V AC ±3% Movement (FILAMENT VOLTAGE Meter)	310-0024	1

TABLE 6-22. METER PANEL ASSEMBLY - 959-0275-105/959-0310-100 (Sheet 2 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
M4	Meter Assembly (PLATE CURRENT)	959-0291	1
M5	Multimeter, 3.5 inch (8.89 cm), Taut Band Type, FS = 1 mA dc ±2%, 35 Ohm Resistance (MULTIMETER)	310-0057	1
M6	Meter, 3.5 inch (8.89 cm), Taut Band Type, FS = 1 mA dc ±1%, 35 Ohm Resistance (PLATE VOLTAGE Meter)	310-0051	1
----	Multimeter Circuit Board Assembly	919-0049-001	1

TABLE 6-23. FAN AND BLOWER ASSEMBLY - 959-0275-006

REF. DES.	DESCRIPTION	PART NO.	QTY.
B2	Fan, 6-Inch (15.24 cm), 250 ft^3/min, 220V ac, 50/60 Hz, 40 Watt	380-7650	1
J2	Housing, Connector, 4-Pin	418-0233	1
----	Pins, Connector (for J2)	417-0036	2

TABLE 6-24. FM-10T BASIC POWER AMPLIFIER/DRIVER CABINET ASSEMBLY - 959-0275-007

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Screen and Bias Panel Assembly	959-0275-001	1

TABLE 6-25. PLATE CURRENT METER ASSEMBLY - 959-0291

REF. DES.	DESCRIPTION	PART NO.	QTY.
M4	Meter, 3.5 inch (8.89 cm), Taut Band Type, FS = 1 mA ±2%, 0 - 3 A Range, 35 Ohm Resistance (PLATE CURRENT)	310-0054	1
----	Meter Protection Circuit Board Assembly	919-0109-002	1

TABLE 6-26. METER PROTECTION CIRCUIT BOARD ASSEMBLY - 919-0109-002

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1, C2	Capacitor, Ceramic, 0.001 uF, 1 kV	002-1034	2
D1	Diode, Zener, 1N4728, 3.3V ±5%, 1W	201-4728	1
E1, E2	Terminal, Male Disconnect	410-0025	2
R1	Resistor, 680 Ohm ±5%, 1W	120-6833	1
R2	Resistor, 182 Ohm ±1%, 1/4W	103-1823	1
R3	Potentiometer, 200 Ohm ±10%, 1/2W	177-2034	1
----	Blank Meter Protection Circuit Board	519-0109	1

TABLE 6-27. CABLE ASSEMBLY, POWER AMPLIFIER/DRIVER CABINET - 949-0166-100

REF. DES.	DESCRIPTION	PART NO.	QTY.
J1	Connector, Housing, 6-Pin (PA Metering Circuit Board)	418-0670	1
J15	Connector, D-Type, 9-Pin	417-0901	1
P1, P1	Connector, Ribbon Cable, 10-Pin (PA Metering Circuit Board)	417-1003	2
P1, P2	Connector, Housing, 4-Pin	418-0240	2
P2	Connector, Housing, 15-Pin (PA Metering Circuit Board)	417-2379	1
----	Connector, Housing, Male, 25-Pin	417-0251	2
----	Connector, Plug, BNC APC: P9, P10 Directional Coupler: RFL, FWD Exciter: RF OUTPUT IPA: RF INPUT	417-0094	4
----	Connector, Jack, Type-N (IPA: P13, RF Enclosure: P1)	418-0031	2
----	Connector, Plug, Type-N (RF Enclosure, PA Input)	417-0076	1
----	Connector, Plug, BNC (RF Enclosure, PA Input)	417-0095	1
----	Connector, 37-Pin Male, IDC Dsub	417-2819	1
----	Receptacle, Pins	417-0036	1
----	Socket, Pins (For J15)	417-0143	8
----	Pins, Connector (For 4-Pin, 6-Pin, and 12-Pin Connectors)	417-0053	18
----	Pins, Connector (For 25-Pin Connectors 417-0251)	417-0142	30

TABLE 6-28. HUM NULL CIRCUIT BOARD ASSEMBLY - 919-0112

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1	Capacitor, Electrolytic, 470 uF, 50V	024-4783	1
R1, R2	Resistor, 22 Ohm ±5%, 2W	130-2223	2
T1	Transformer, Circuit Board Mount Primary: 7.5V ac at 0.248 Amperes Secondary: 6.2V ac at 0.3 Amperes with Center Tap	371-0010	1
TB1	Barrier Strip, 4 Terminal	411-0815	1
----	Blank, Hum Null Circuit Board	519-0112	1

TABLE 6-29. MULTIMETER CIRCUIT BOARD ASSEMBLY - 919-0049-001

REF. DES.	DESCRIPTION	PART NO.	QTY.
J1	Connector, Ribbon Cable, 10-Pin, PCB Mount	418-1003	1
S1	Switch, Rotary, Panel Mount, 6 Position, Contacts: single pole, 28V dc @ 0.5A	340-0119	1
----	Terminal, Male Disconnect	410-0025	2
----	Blank Multimeter Circuit Board Assembly	519-0049-001	1

TABLE 6-30. RF ENCLOSURE ASSEMBLY - 959-0287
(Sheet 1 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
C9	Capacitor, Plate, Second Harmonic Suppressor	474-0187	1
C13, C14	Capacitor, 700 pF, 1.5 kV, Filament Feedthru:		
	Kapton Dielectric	519-0039	4
	Teflon Spacer	441-0054	2
J3	Jack, Binding Post/Banana, 01-1050-1-02	417-0074	1

TABLE 6-30. RF ENCLOSURE ASSEMBLY - 959-0287
(Sheet 2 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
L6	Inductor, Second Harmonic Suppressor	463-0047	1
P3	Plug, Banana, Uninsulated	418-0007	1
R5	Resistor, 250 Ohm, 25W, W/W	130-2503	1
RFC1	Inductor, RF Choke (Plate Circuit Connection)	360-0074	1
S2	Microswitch, SPDT, Roller Activated	346-3300	1
----	Fingerstock, PA Cavity Access	469-0368	12
----	Connector Assembly, Transmission Line, Modified	427-0009-1	1
----	High Voltage Feed-Thru Capacitor Assembly	955-0049-002	1
----	Final Unit Cable Assembly	949-0162	1
----	Assembly, RF Enclosure Chimney	959-0287-001	1

TABLE 6-31. CHIMNEY ASSEMBLY - 959-0287-001

REF. DES.	DESCRIPTION	PART NO.	QTY.
J3	Jack, Binding Post/Banana, 01-1050-1-02	417-0074	1
L9	Chimney, PA	459-0132	1

TABLE 6-32. TRANSMISSION LINE ASSEMBLY - 959-0287-002

REF. DES.	DESCRIPTION	PART NO.	QTY.
J2	Connector, BNC, Modified	417-0203-2	1
----	Harmonic Low-Pass Filter, 15 kW, 88 to 108 MHz, 1 5/8 Inch	339-0021	1
----	Transmission Line Elbow, Modified With Sampling Port	427-0006-002	1
----	Elbow, 1 5/8 Inch Copper, 90 Degrees, Equal Legs	427-0006	1
----	Coupling, Unflanged, 1 5/8	427-0007	5
----	Transmission Line, Outer, 8.125 Inches Inner, 7.250 Inches	427-0008-19	1
----	Transmission Line, Outer, 22.095 Inches Inner, 21.22 Inches	427-0008-020	1

TABLE 6-33. TUBE SOCKET AND INPUT TUNING ASSEMBLY - 959-0231
(Sheet 1 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
C7, C8	Capacitor, Kapton, 1000 pF, 2 kV (Screen Bypass)	519-0095	2
C10	Capacitor, Kapton, 2000 pF, 1.5 kV (Grid Blocking)	519-0038	1
C12, C15	Capacitor, Ceramic, 500 pF ±20%, 5 kV	008-5024	2
C16, C17	Capacitor, Kapton, 1000 pF, 2 kV, (Screen Bypass)	519-0095	2
E1	Spark Gap, 1000V dc ±20% Breakdown, 5000A Discharge Maximum	140-0015	1
E2	Spark Gap, 2500V dc ±20% Breakdown, 2500A Discharge Maximum	140-0016	1
FL1, FL2	Feedthru - Grid and Screen, 1200 pF, 2500V, 25A Maximum	339-0012	2
L7, L7A, L8, L8A, L10, L10A, L11, L11A	Inductor, Plates, Neutralization	474-0288	4

TABLE 6-33. TUBE SOCKET AND INPUT TUNING ASSEMBLY - 959-0231
(Sheet 2 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
L12, L14	Grid Tuning Assembly:		
	Top Plate	474-0289	1
	Bottom Plate	474-0290	1
	Shorting Bar	459-0131	1
R1	Resistor, 750 Ohm, 50W, Non-Inductive	139-7532	1
RFC2, RFC3	Choke, 80 to 200 MHz, 1100 mA Maximum	360-0144	2
XV1	Socket, Eimac, SK-350	417-0350	1
----	Power Amplifier Input Matching Circuit Board Assembly	919-0064-001	1

TABLE 6-34. POWER AMPLIFIER INPUT MATCHING CIRCUIT BOARD ASSEMBLY - 919-0064-001

REF. DES.	DESCRIPTION	PART NO.	QTY.
E1 thru E8	Terminal Turret, Two Shoulder	413-0025	8
J2	Receptacle, BNC	417-0014	1
----	Blank, PA Input Matching Circuit Board	519-0064	1
----	Blank, Matching Capacitor Circuit Board	519-0064-001	1

TABLE 6-35. PA METERING CIRCUIT BOARD ASSEMBLY - 919-0048-007
(Sheet 1 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1 THRU C3	Capacitor, Mica, 390 pF ±5%, 100V	042-3922	3
C4, C5	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	2
C6, C7	Capacitor, Mica, 390 pF ±5%, 100V	042-3922	2
C8, C9	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	2
C10	Capacitor, Mica, 390 pF ±5%, 100V	042-3922	1
C11, C12, C13	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	3
C14	Capacitor, Mica, 390 pF ±5%, 100V	042-3922	1
C15, C16	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	2
C17	Capacitor, Mica, 390 pF ±5%, 100V	042-3922	1
C18	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	1
C19	Capacitor, Mica, 390 pF ±5%, 100V	042-3922	1
C20	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	1
C21	Capacitor, Electrolytic, 470 uF, 50V	024-4783	1
D1 THRU D7	Diode, Zener, 1N4739A, 9.1V ±10%, 1W	200-0009	7
E1 thru E10	Terminal, Male Disconnect	410-0025	10
E11, E12	Terminal Turret, Two Shoulder	413-1597	2
E13	Terminal, Male Disconnect	410-0025	1
F1, F2	Fuse, AGC, 1 Ampere, Fast Blow	330-0100	2
F3	Fuseable Link, 28 AWG	630-2806	.208
J1	Connector, 10-Pin	418-1003	1
J2	Connector, 15-Pin	417-0169	1
J3	Connector, 6-Pin	417-0677	1
L1	RF Choke, 2.2 uH ±10%, 0.4 Ohms DC Resistance, 550 mA Maximum	360-2200	1
R1	Resistor, 100 Ohm ±5%, 1/2W	110-1033	1
R2	Resistor, 1 Ohm ±1%, 5W, W/W	132-1111	1

TABLE 6-35. PA METERING CIRCUIT BOARD ASSEMBLY - 919-0048-007
(Sheet 2 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
R3	Resistor, 0.5 Ohm ±1%, 5W, W/W	130-5001	1
R4, R5	Resistor, 0.5 Meg Ohm ±1%, 2W	140-0005	2
R6	Resistor, 4.99 k Ohm ±1%, 1/4W	100-5041	1
R7	Resistor, 5.11 k Ohm ±1%, 1/4W	103-5141	1
R8	Resistor, 4.99 k Ohm ±1%, 1/4W	100-5041	1
R9	Resistor, 0.5 Meg Ohm ±1%, 2W	140-0005	1
R10	Resistor, 5.62 k Ohm ±1%, 1/4W	103-5624	1
R11	Resistor, 49.9 k Ohm ±1%, 1/4W	103-4951	1
R12	Resistor, 26.7 k Ohm ±1%, 1/4W	103-2675	1
R13	Resistor, 49.9 k Ohm ±1%, 1/4W	103-4951	1
R14	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	1
R15	Resistor, 100 Ohm ±5%, 1/2W	110-1033	1
R16	Resistor, 22 Ohm ±1%, 3W	130-2221	1
R18	Resistor, 1 k Ohm ±1%, 1/4W	100-1041	1
R19	Resistor, 48.7 k Ohm ±1%, 1/4W	103-4875	1
R20	Resistor, 24.3 k Ohm ±1%, 1/4W	103-2435	1
R21	Resistor, 49.9 k Ohm ±1%, 1/4W	103-4951	1
R22	Resistor, 5.49 k Ohm ±1%, 1/4W	103-5494	1
R23	Resistor, 1 k Ohm ±1%, 1/4W	100-1041	1
R24	Resistor, 10 Ohm ±1%, 1W	120-1021	1
R26	Resistor, 1 k Ohm ±1%, 1/4W	100-1041	1
R27	Resistor, 24.3 k Ohm ±1%, 1/4W	103-2435	1
R28	Resistor, 16.2 k Ohm ±1%, 1/4W	103-1625	1
R29	Resistor, 49.9 k Ohm ±1%, 1/4W	103-4951	1
R30	Resistor, 4.99 k Ohm ±1%, 1/4W	100-5041	1
R31	Resistor, 2.43 k Ohm ±1%, 1/4W	103-2434	1
R37	Resistor, 100 k Ohm ±5%, 1/4W	103-1062	1
R39	Resistor 2.94 k Ohm ±1%, 1/4W	103-2941	1
R41	Resistor, 1 k Ohm ±1%, 1/4W	100-1041	1
TP1	Terminal Turret, Two Shoulder	413-1597	1
U1, U2	Integrated Circuit, LM358N, Dual Operational Amplifier, 8-Pin DIP	221-0358	2
XF1, XF2	Fuse Clip	415-2068	4
XU1, XU2	Socket, 8-Pin DIP	417-0804	2
----	Blank, PA Metering Circuit Board	519-0048-002	1

TABLE 6-36. REMOTE INTERFACE PANEL ASSEMBLY - 959-0117-100

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Fail-Safe Solenoid Assembly	959-0083	1
----	Remote Interface Circuit Board Assembly	919-0439	1

TABLE 6-37. FAIL-SAFE SOLENOID ASSEMBLY - 959-0083

REF. DES.	DESCRIPTION	PART NO.	QTY.
L5	Solenoid, 230V ac 50/60 Hz, DC Resistance: 360 Ohm ±10%	281-0004	1
TB11	Barrier Strip, 2-Terminal	412-0002	1
----	Barrier Strip, Insulated, 2-Terminal	407-0122	1

TABLE 6-38. REMOTE POWER SUPPLY INTERCONNECTING CABLE ASSEMBLY - 949-0130

REF. DES.	DESCRIPTION	PART NO.	QTY.
P15	Plug, 9-Pin	417-0900	1
J15	Receptacle, Housing, 9-Pin	417-0901	1
----	Pins, Connector (For P15)	417-0142	9
----	Pins, Receptacle (For J15)	417-0143	9

TABLE 6-39. OUTPUT DIRECTIONAL COUPLER ASSEMBLY - 959-0082-045

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Receptacle, BNC	417-0016	1
----	Resistor, 120 Ohm ±5%, 2W	120-1233	1
----	Choke, 1.5 uH ±10%, 580 mA	360-0032	1

TABLE 6-40. ACCESSORY PARTS KIT - 969-0014

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Binder and Manuals, FM-10T/FX-50	959-0232-014	1
----	Hex Key, 5/32 inch	710-0219	1
----	Adapter, 1 5/8 inch EIA Flanged to Unflanged	427-0010	1
----	Cell, Battery, 3V, 190 mAh	350-2032	1

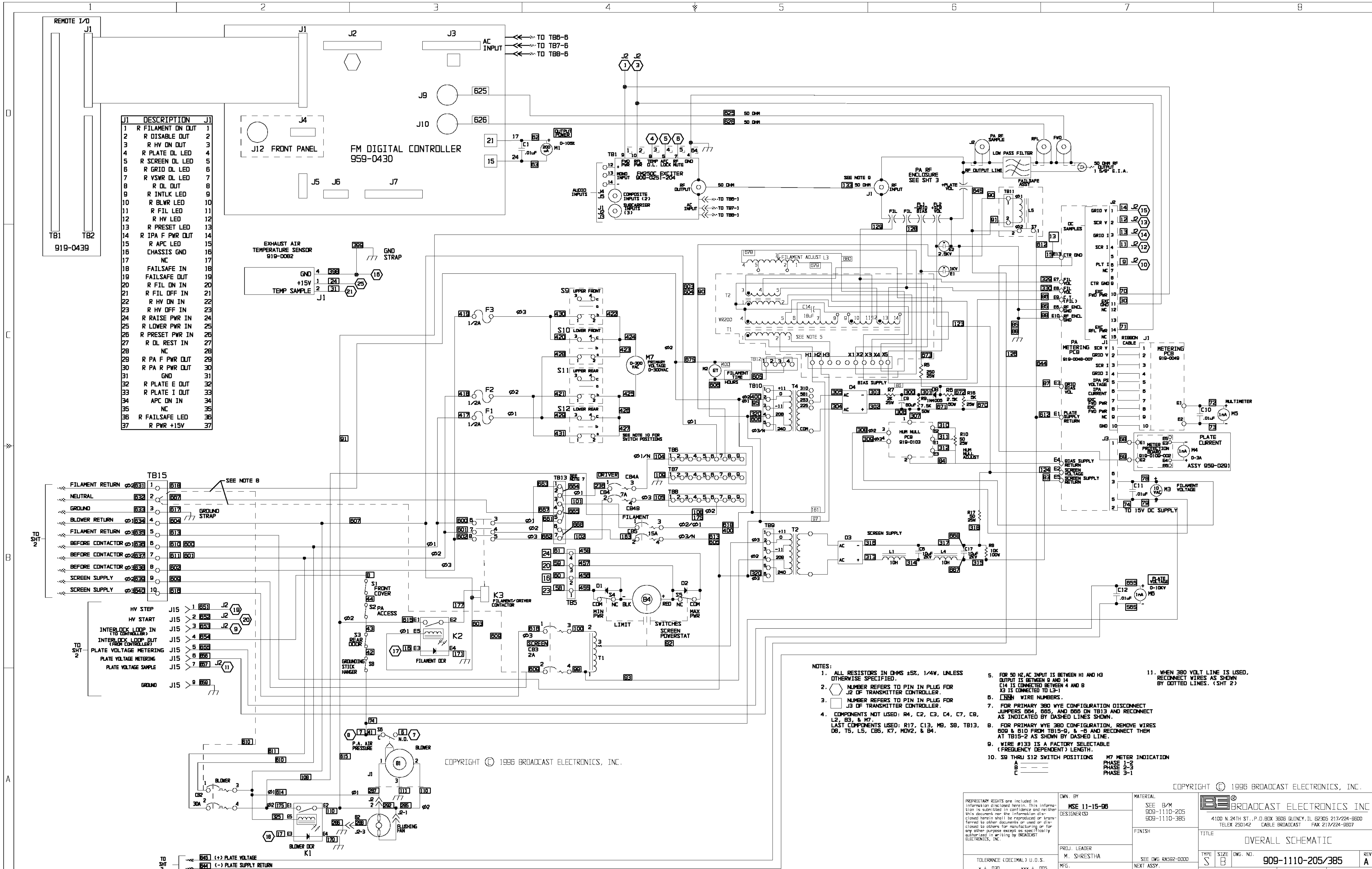
TABLE 6-41. REMOTE INTERFACE CIRCUIT BOARD ASSEMBLY - 919-0439

REF. DES.	DESCRIPTION	PART NO.	QTY.
J1	Connector, 40-Pin RibbonCable	417-0173	1
TB1	Barrier Strip, 30-Position	412-3000	1
TB2	Barrier Strip, 16-Position	412-1600	1
----	Blank Remote Interface Circuit Board	519-0439	1

SECTION VII
DRAWINGS

7-1. INTRODUCTION.

7-2. This section provides schematic diagrams and assembly diagrams as indexed below for the FM-10T/FM-10TS transmitter.



J1	DESCRIPTION	J1
1	R FILAMENT ON OUT	1
2	R DISABLE OUT	2
3	R HV ON OUT	3
4	R PLATE OL LED	4
5	R SCREEN OL LED	5
6	R GRID OL LED	6
7	R VSWR OL LED	7
8	R OL OUT	8
9	R INTLK LED	9
10	R BLWR LED	10
11	R FIL LED	11
12	R HV LED	12
13	R PRESET LED	13
14	R IPA F PWR OUT	14
15	R APC LED	15
16	CHASSIS GND	16
17	NC	17
18	FAILSAFE IN	18
19	FAILSAFE OUT	19
20	R FIL ON IN	20
21	R FIL OFF IN	21
22	R HV ON IN	22
23	R HV OFF IN	23
24	R RAISE PWR IN	24
25	R LOWER PWR IN	25
26	R PRESET PWR IN	26
27	R OL REST IN	27
28	NC	28
29	R PA F PWR OUT	29
30	R PA R PWR OUT	30
31	GND	31
32	R PLATE E OUT	32
33	R PLATE I OUT	33
34	APC ON IN	34
35	NC	35
36	R FAILSAFE LED	36
37	R PWR +15V	37

NOTES:

1. ALL RESISTORS IN OHMS ±5%, 1/4W, UNLESS OTHERWISE SPECIFIED.
2. NUMBER REFERS TO PIN IN PLUG FOR J2 OF TRANSMITTER CONTROLLER.
3. NUMBER REFERS TO PIN IN PLUG FOR J3 OF TRANSMITTER CONTROLLER.
4. COMPONENTS NOT USED: R4, C2, C3, C4, C7, C8, L2, B3, & M7.
   LAST COMPONENTS USED: R17, C13, M9, S8, TB13, D8, T5, L5, CB5, K7, MOV2, & B4.
5. FOR 50 HZ,AC INPUT IS BETWEEN H1 AND H3
   OUTPUT IS BETWEEN 9 AND 14
   C14 IS CONNECTED BETWEEN 4 AND 8
   X3 IS CONNECTED TO L3-1
6. NNN WIRE NUMBERS.
7. FOR PRIMARY 380 WYE CONFIGURATION DISCONNECT JUMPERS 664, 665, AND 666 ON TB13 AND RECONNECT AS INDICATED BY DASHED LINES SHOWN.
8. FOR PRIMARY WYE 380 CONFIGURATION, REMOVE WIRES 609 & 610 FROM TB15-9, & -8 AND RECONNECT THEM AT TB15-2 AS SHOWN BY DASHED LINE.
9. WIRE #133 IS A FACTORY SELECTABLE (FREQUENCY DEPENDENT) LENGTH.
10. S9 THRU S12 SWITCH POSITIONS — M7 METER INDICATION
    A — PHASE 1-2
    B — PHASE 2-3
    C — PHASE 3-1
11. WHEN 380 VOLT LINE IS USED, RECONNECT WIRES AS SHOWN BY DOTTED LINES. (SHT 2)

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

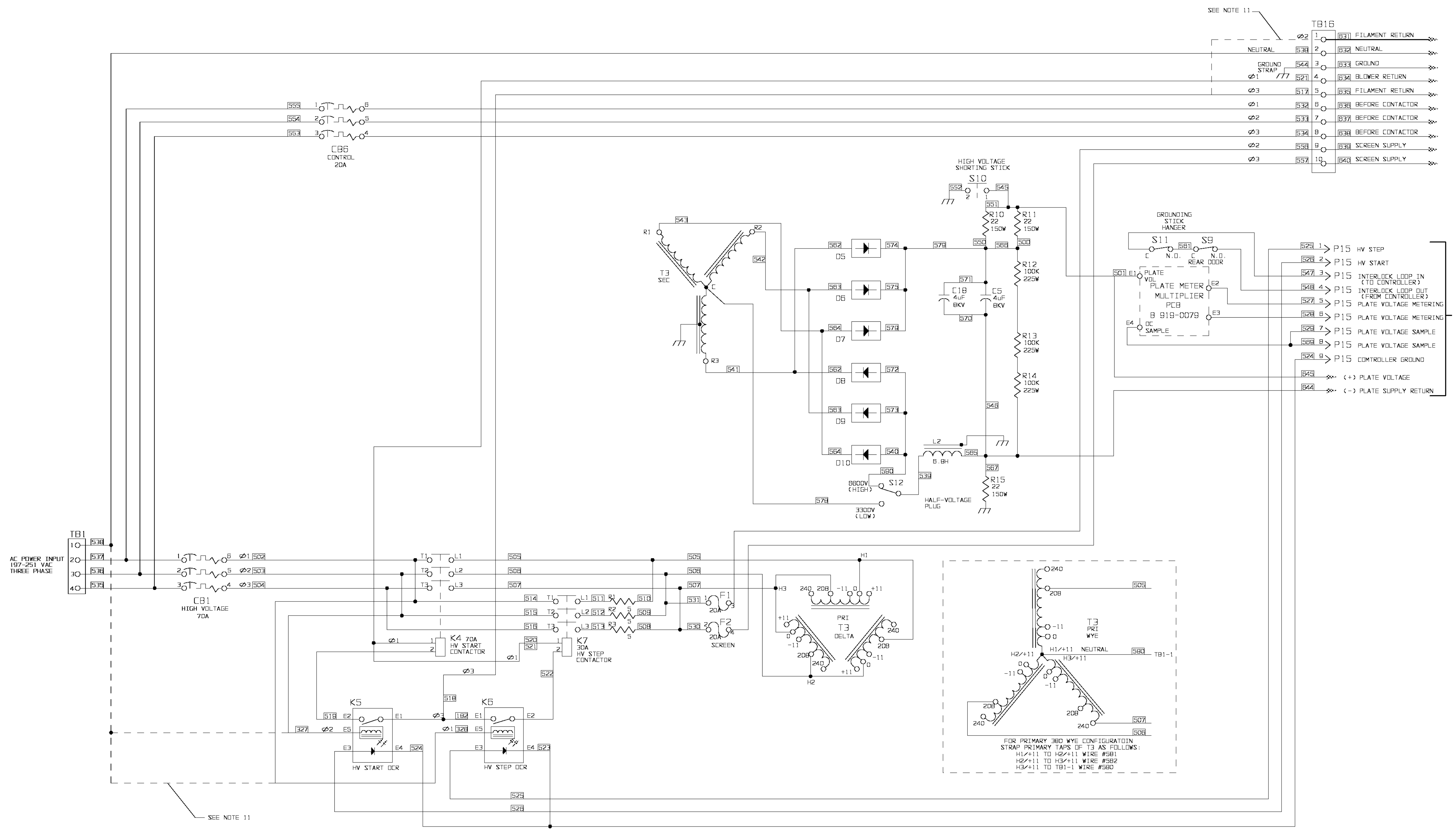
DWN. BY: MSE 11-15-96
DESIGNER(S):
PROJ. LEADER: M. SHRESTHA
MFG.:
MATERIAL: SEE B/M 909-1110-205 909-1110-385
FINISH: SEE DWG RA592-0000
NEXT ASSY.:

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: OVERALL SCHEMATIC

TYPE	SIZE	DWG. NO.	REV
S	B	909-1110-205/385	A

MODEL: FM-10T — SCALE: NONE — SHEET 1 OF 3



COPYRIGHT © 1996 BROADCAST ELECTRONICS, INC.

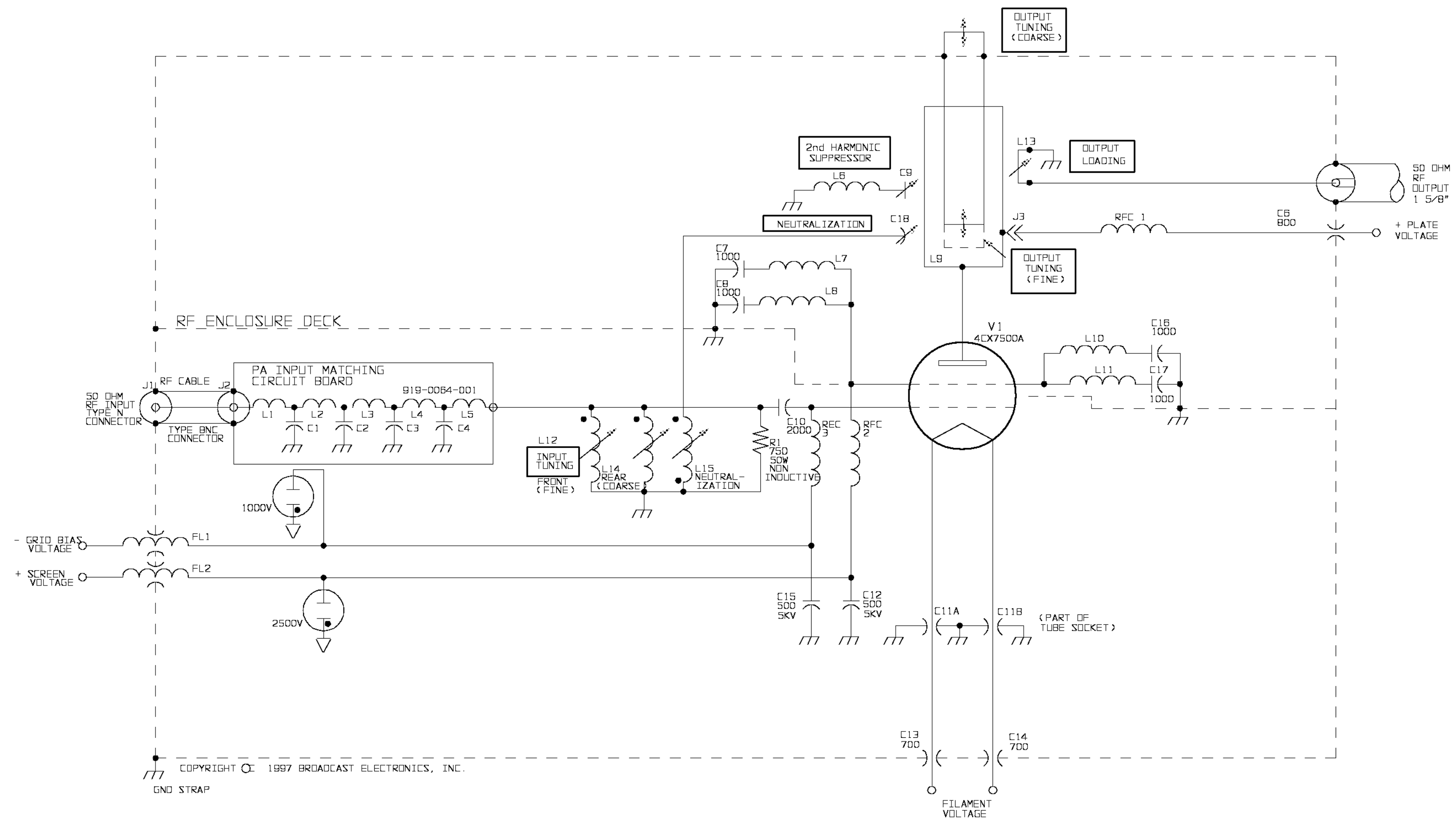
DWN. BY	MSE 11-15-96
DESIGNER(S)	
PROJ. LEADER	M. SHRESTHA
MFG.	
TOLERANCE (DECIMAL) U.O.S.	.x ± .030 .xx ± .015 .xxx ± .005 ANGLES ± 1°
MATERIAL	SEE B/M 909-1110-205 909-1110-385
FINISH	SEE DWG RA592-0000
NEXT ASSY.	

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: OVERALL SCHEMATIC

TYPE	SIZE	DWG. NO.	REV
S	B	909-1110-205/909-1110-385	A

MODEL FM-10T | SCALE NONE | SHEET 2 OF 3



NOTES:

1. ALL CAPACITORS IN pF; ALL RESISTORS IN OHMS, UNLESS OTHERWISE SPECIFIED
2. COPPER-CLAD FILM CAPACITORS: C6-C8, C10, C11, C13, C14, C16 & C17
3. C11 IS PART OF TUBE SOCKET.
4. COMPONENTS LAST USED: C18, E2, FL2, J3, L15, R1, RFC3 & V1

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

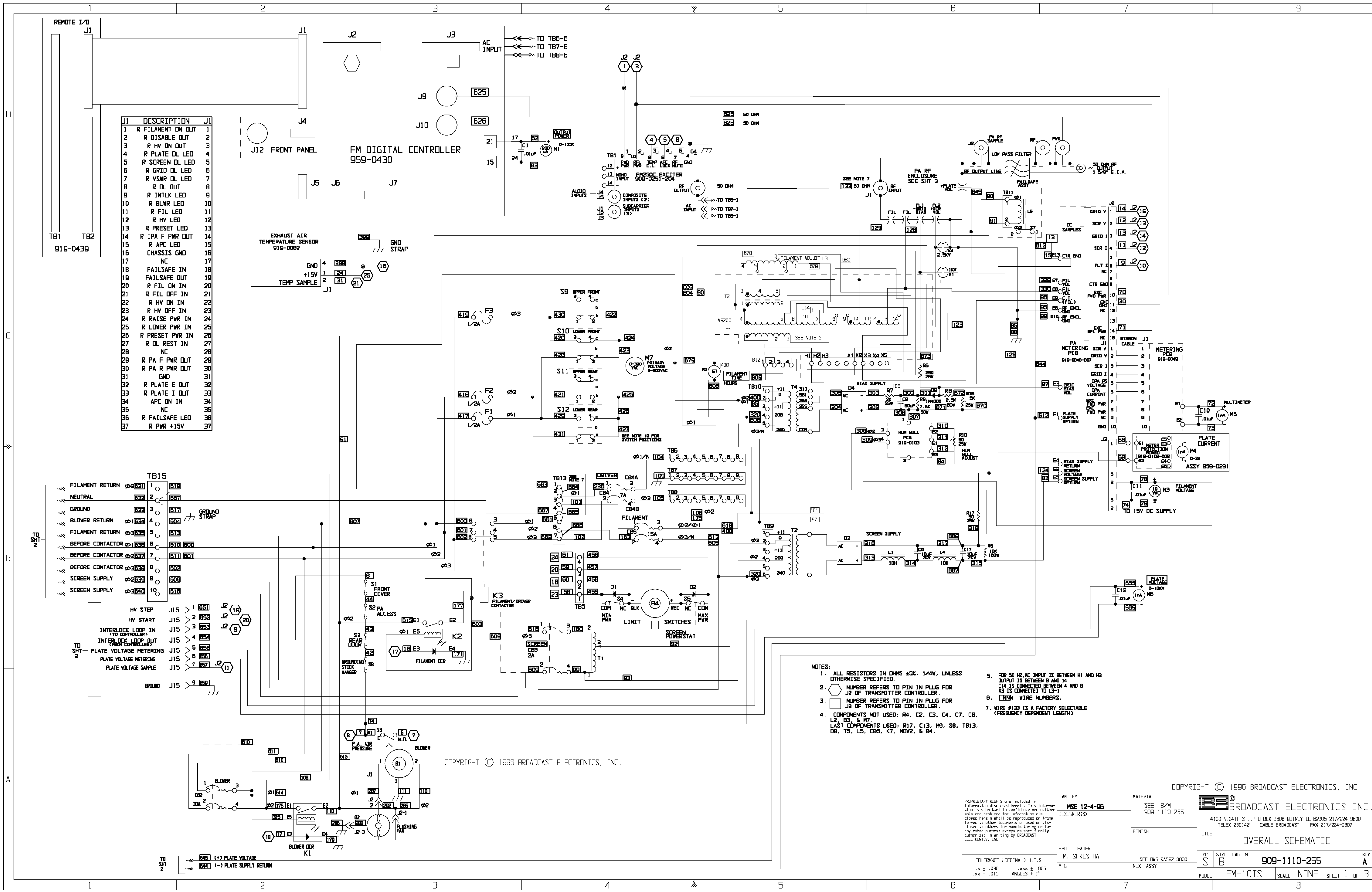
DWN. BY	MSE 11-15-96
DESIGNER(S)	
PROJ. LEADER	M. SHRESTHA
MFG.	
MATERIAL	SEE B/M 909-1110-205 909-1110-385
FINISH	SEE DWG RA592-0000
NEXT ASSY.	

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

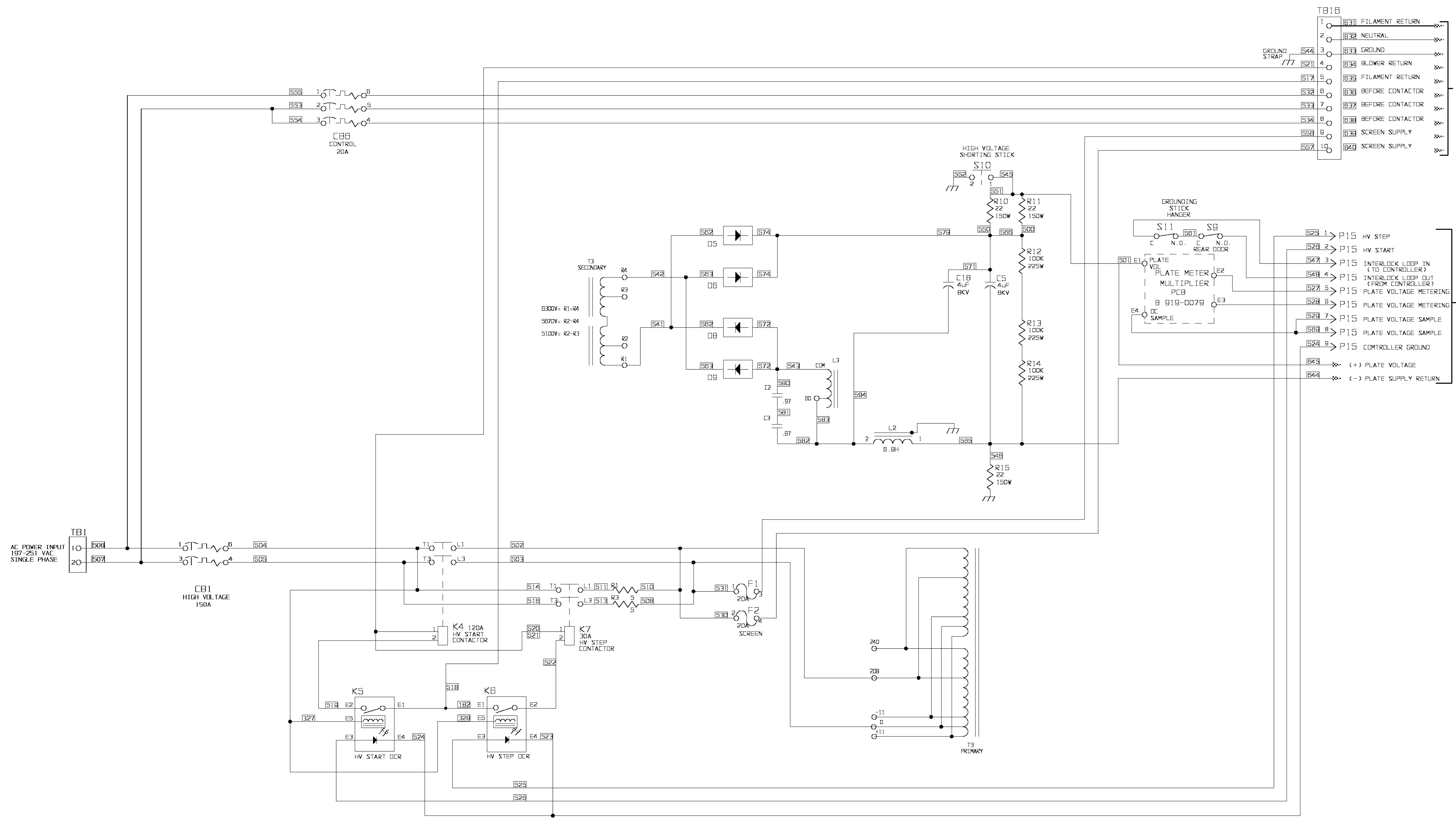
TITLE: OVERALL SCHEMATIC

TYPE	SIZE	DWG. NO.	REV
S	B	909-1110-205/909-1110-385	A

MODEL FM-10T SCALE NONE SHEET 3 OF 3



REMOTE I/O
TB1 TB2
919-0439
FM DIGITAL CONTROLLER
959-0430
J12 FRONT PANEL
AC INPUT
TO TB6-6
TO TB7-6
TO TB8-6
EXHAUST AIR TEMPERATURE SENSOR 919-0082
GND
+15V
TEMP SAMPLE
GND STRAP
J1 DESCRIPTION J1
1 R FILAMENT ON OUT 1
2 R DISABLE OUT 2
3 R HV ON OUT 3
4 R PLATE OL LED 4
5 R SCREEN OL LED 5
6 R GRID OL LED 6
7 R VSWR OL LED 7
8 R OL OUT 8
9 R INTLK LED 9
10 R BLWR LED 10
11 R FIL LED 11
12 R HV LED 12
13 R PRESET LED 13
14 R IPA F PWR OUT 14
15 R APC LED 15
16 CHASSIS GND 16
17 NC 17
18 FAILSAFE IN 18
19 FAILSAFE OUT 19
20 R FIL ON IN 20
21 R FIL OFF IN 21
22 R HV ON IN 22
23 R HV OFF IN 23
24 R RAISE PWR IN 24
25 R LOWER PWR IN 25
26 R PRESET PWR IN 26
27 R OL REST IN 27
28 NC 28
29 R PA F PWR OUT 29
30 R PA R PWR OUT 30
31 GND 31
32 R PLATE E OUT 32
33 R PLATE I OUT 33
34 APC ON IN 34
35 NC 35
36 R FAILSAFE LED 36
37 R PWR +15V 37
FM250C EXCITER 909-0251-204
COMPOSITE INPUTS (2)
SUBCARRIER INPUTS (3)
AUDIO INPUTS
RF OUTPUT
50 OHM
PA RF ENCLOSURE SEE SHT 3
LOW PASS FILTER
FAILSAFE ASSY
50 OHM RF OUTPUT 1 5/8" E.I.A.
FILAMENT ADJUST L3
SEE NOTE 5
SEE NOTE 7
BIAS SUPPLY
SCREEN SUPPLY
HUM NULL PCB 919-0103
PA METERING PCB 919-0048-007
METERING PCB 919-0049
METER PROTECTION BOARD
PLATE CURRENT ASSY 959-0291
MULTIMETER
FILAMENT VOLTAGE
PLATE VOLTAGE
TO 15V DC SUPPLY
PRIMARY VOLTAGE 0-300VAC
SEE NOTE 10 FOR SWITCH POSITIONS
UPPER FRONT
LOWER FRONT
UPPER REAR
LOWER REAR
TB15
FILAMENT RETURN
NEUTRAL
GROUND
BLOWER RETURN
FILAMENT RETURN
BEFORE CONTACTOR
BEFORE CONTACTOR
BEFORE CONTACTOR
SCREEN SUPPLY
SCREEN SUPPLY
TO SHT 2
GROUND STRAP
HV STEP
HV START
INTERLOCK LOOP IN (TO CONTROLLER)
INTERLOCK LOOP OUT (FROM CONTROLLER)
PLATE VOLTAGE METERING
PLATE VOLTAGE METERING
PLATE VOLTAGE SAMPLE
GROUND
S1 FRONT COVER
S2 PA ACCESS
S3 REAR DOOR
GROUNDING STICK HANGER
K3 FILAMENT/DRIVER CONTACTOR
K2
FILAMENT OCR
DRIVER
FILAMENT
SCREEN
MIN PWR
LIMIT
SWITCHES
MAX PWR
SCREEN POWERSTAT
P.A. AIR PRESSURE
BLOWER
BLOWER OCR
K1
FLUSHING FAN
(+) PLATE VOLTAGE
(-) PLATE SUPPLY RETURN
COPYRIGHT © 1996 BROADCAST ELECTRONICS, INC.
NOTES:
1. ALL RESISTORS IN OHMS ±5%, 1/4W, UNLESS OTHERWISE SPECIFIED.
2. NUMBER REFERS TO PIN IN PLUG FOR J2 OF TRANSMITTER CONTROLLER.
3. NUMBER REFERS TO PIN IN PLUG FOR J3 OF TRANSMITTER CONTROLLER.
4. COMPONENTS NOT USED: R4, C2, C3, C4, C7, C8, L2, B3, & M7.
LAST COMPONENTS USED: R17, C13, M9, S8, TB13, D8, T5, L5, CB5, K7, MOV2, & B4.
5. FOR 50 HZ,AC INPUT IS BETWEEN H1 AND H3
OUTPUT IS BETWEEN 9 AND 14
C14 IS CONNECTED BETWEEN 4 AND 8
X3 IS CONNECTED TO L3-1
6. NNN WIRE NUMBERS.
7. WIRE #133 IS A FACTORY SELECTABLE (FREQUENCY DEPENDENT LENGTH)
COPYRIGHT © 1996 BROADCAST ELECTRONICS, INC.
DWN. BY MSE 12-4-96
DESIGNER(S)
PROJ. LEADER M. SHRESTHA
MFG.
TOLERANCE (DECIMAL) U.O.S.
MATERIAL SEE B/M 909-1110-255
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 OVERALL SCHEMATIC
TYPE S SIZE B DWG. NO. 909-1110-255 REV A
MODEL FM-10TS SCALE NONE SHEET 1 OF 3



COPYRIGHT © 1996 BROADCAST ELECTRONICS, INC.

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

DWN. BY MSE 12-4-96
DESIGNER(S)
PROJ. LEADER
MFG.

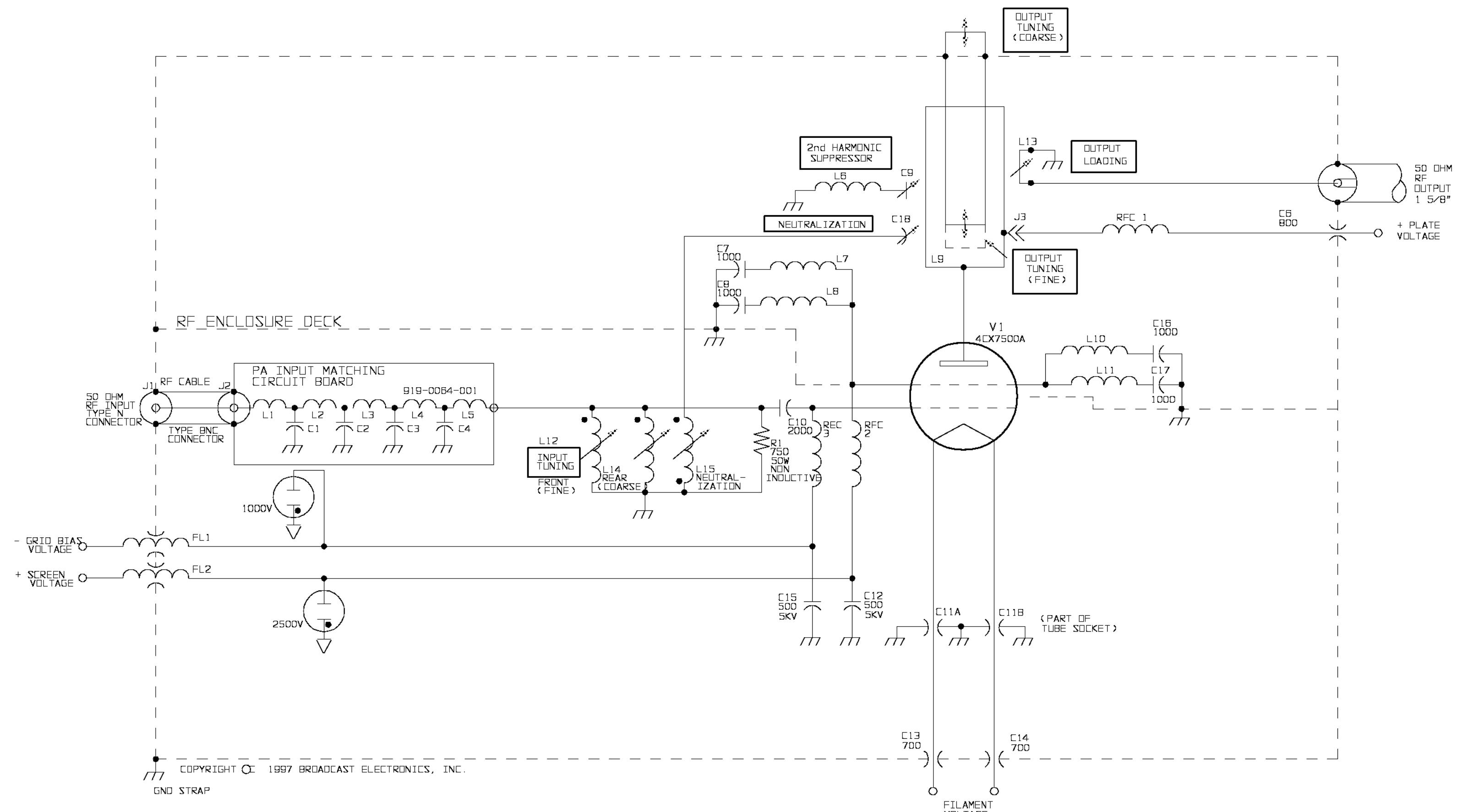
MATERIAL SEE B/M 909-1110-255
FINISH SEE DWG RA592-0000
NEXT ASSY.

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 OVERALL SCHEMATIC

TYPE	SIZE	DWG. NO.	REV
S	B	909-1110-255	A

MODEL FM-10BS SCALE NONE SHEET 2 OF 3



NOTES:

1. ALL CAPACITORS IN pF; ALL RESISTORS IN OHMS, UNLESS OTHERWISE SPECIFIED
2. COPPER-CLAD FILM CAPACITORS: C6-C8, C10, C11, C13, C14, C16 & C17
3. C11 IS PART OF TUBE SOCKET.
4. COMPONENTS LAST USED: C18, E2, FL2, J3, L15, R1, RFC3 & V1

COPYRIGHT © 1996 BROADCAST ELECTRONICS, INC.

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

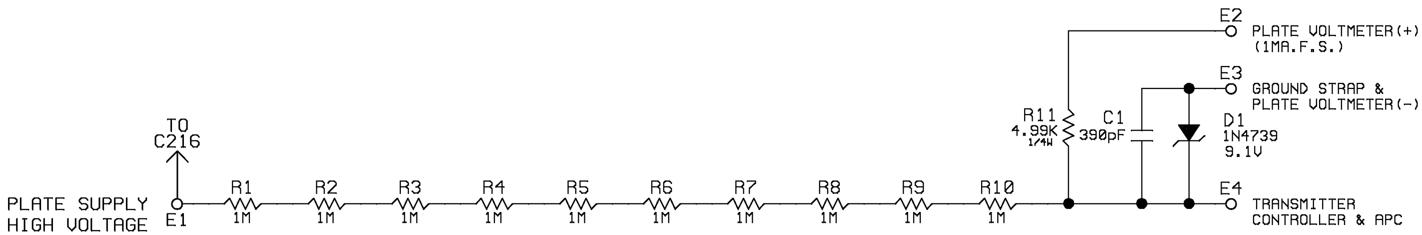
DWN. BY	MSE 12-4-96
DESIGNER(S)	
PROJ. LEADER	
MFG.	
MATERIAL	SEE B/M 909-1110-255
FINISH	SEE DWG RA592-0000
NEXT ASSY.	

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 OVERALL SCHEMATIC

TYPE	SIZE	DWG. NO.	REV
S	B	909-1110-255	A

MODEL FM-10BS SCALE NONE SHEET 3 OF 3



NOTES:

1. ALL RESISTORS IN OHMS; 2W, 1%, UNLESS OTHERWISE SPECIFIED.
2. LAST COMPONENT USED: C1, D1, E4, R11
3. SEE PCB ASSEMBLY AB919-0079

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

DWN. BY: KT 6-16-97

DESIGNER(S):

PROJ. LEADER: W.L.HARNESS

MFG.:

MATERIAL: SEE BOM 919-0079

FINISH:

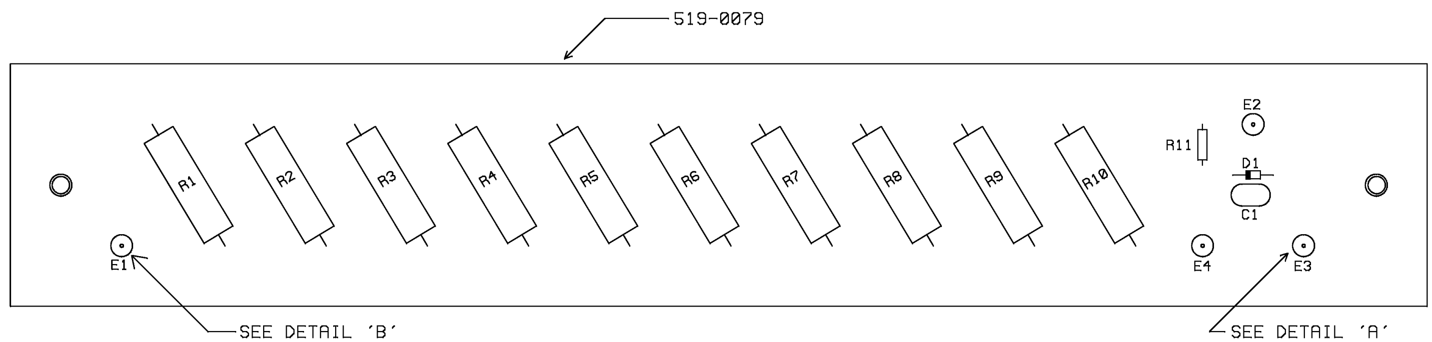
NEXT ASSY.:

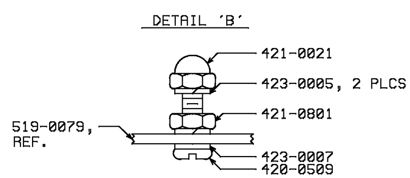
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305
217/224-9600 FAX 217/224-9607

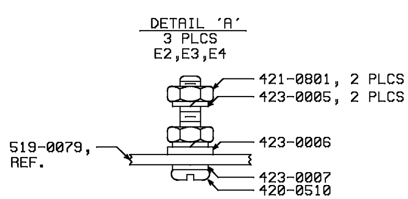
TITLE: PCB SCHEMATIC METER MULTIPLIER

TYPE	SIZE	DWG. NO.	REV
S	B	919-0079	B

MODEL XMTRS | SCALE NONE | SHEET 1 OF 1







NOTES:
1. LAST COMPONENTS USED: C1, D1, E4, R11.
2. SEE PCB SCHEMATIC: SB919-0079

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

DWN. BY: KT 6-17-97
DESIGNER(S):
PROJ. LEADER: W.L.HARNESS
MFG.:

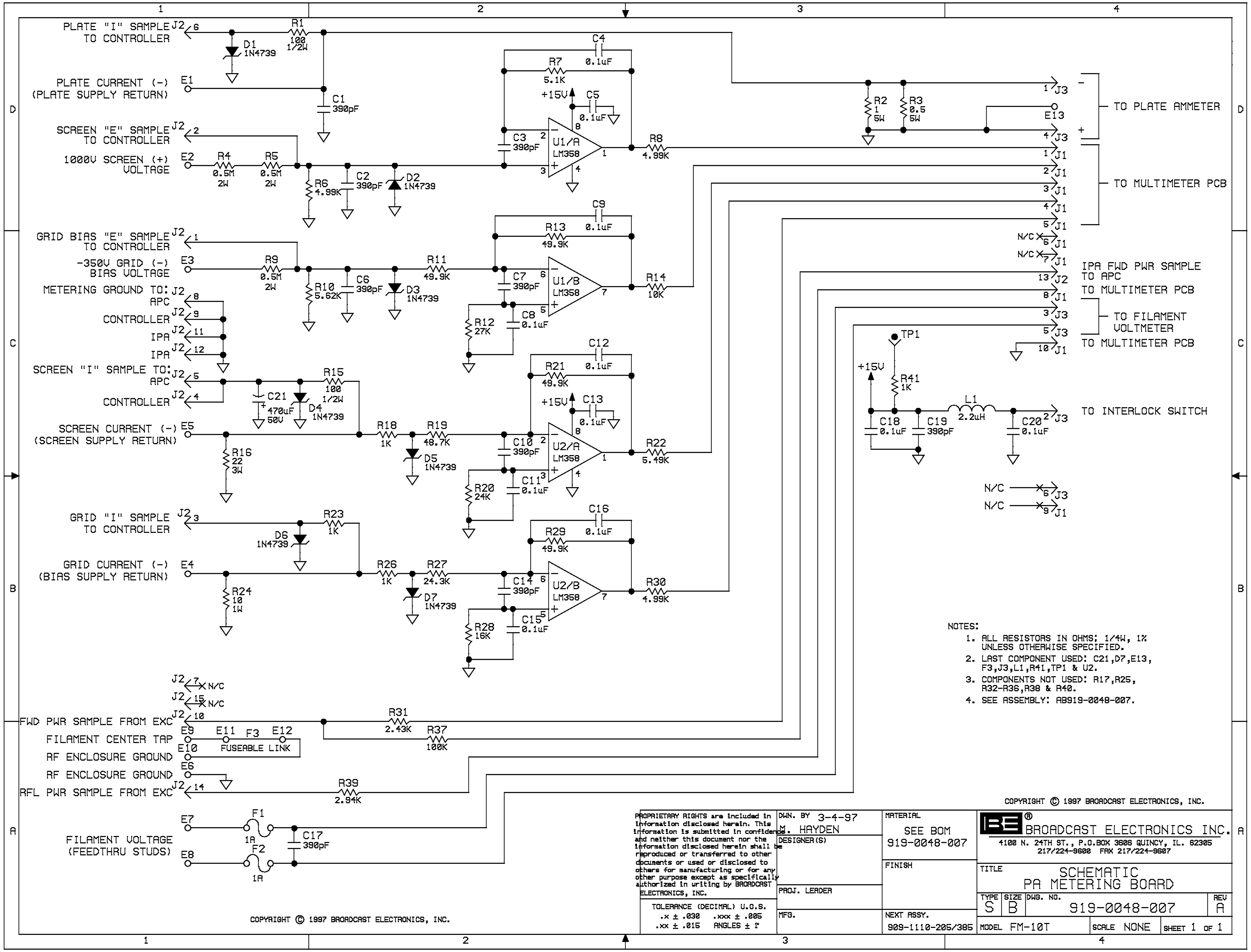
MATERIAL: SEE B/M NO. 919-0079
FINISH:
NEXT ASSY.:

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

TITLE: PCB ASSEMBLY-METER PROTECTION BD.

TYPE	SIZE	DWG No.	REV
A	B	919-0079	C

MODEL: XMTRS | SCALE: 1/1 | SHEET 1 OF 1



NOTES:
1. ALL RESISTORS IN OHMS; 1/4W, 1% UNLESS OTHERWISE SPECIFIED.
2. LAST COMPONENT USED: C21,D7,E13, F3,J3,L1,R41,TP1 & U2.
3. COMPONENTS NOT USED: R17,R25, R32-R36,R38 & R40.
4. SEE ASSEMBLY: A919-0048-007.

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

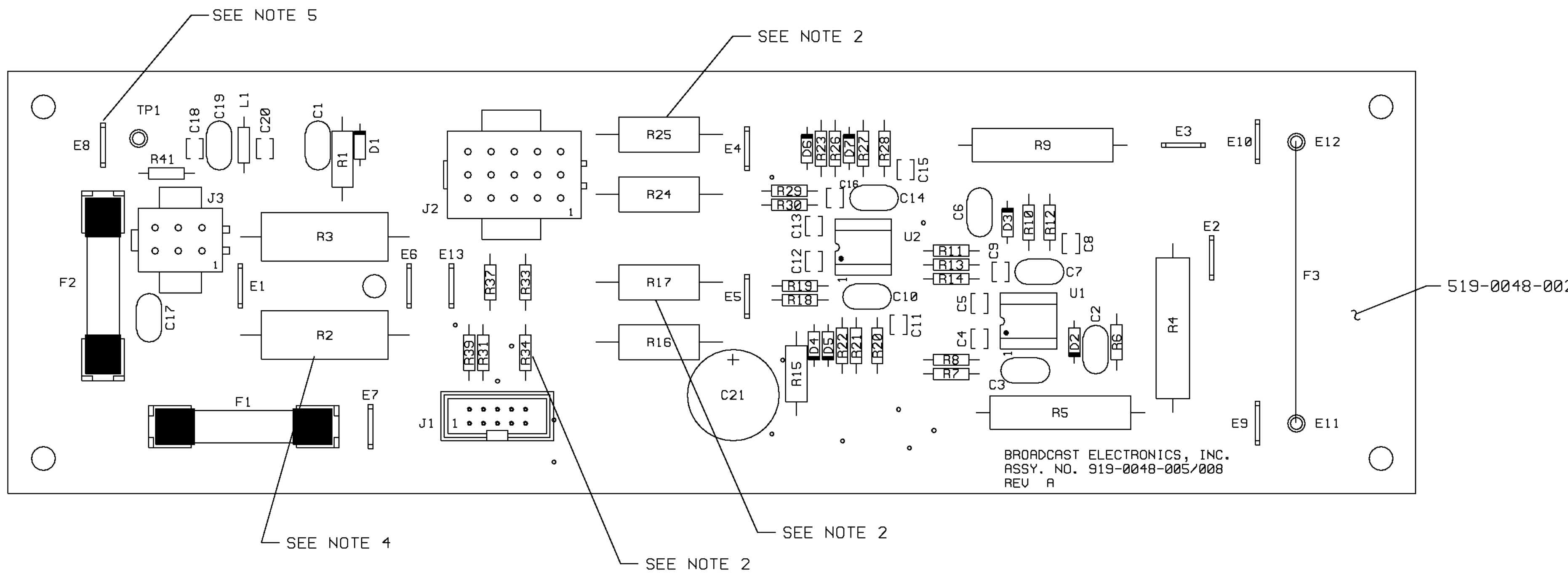
DWN. BY	3-4-97 M. HAYDEN
DESIGNER(S)	
PROJ. LEADER	
MFG.	
MATERIAL	SEE BOM 919-0048-007
FINISH	
NEXT ASSY.	909-1110-205/305

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

TITLE: SCHEMATIC PA METERING BOARD

TYPE	SIZE	DWG. NO.	REV
S	B	919-0048-007	A

MODEL FM-10T SCALE NONE SHEET 1 OF 1



NOTES:

1. LAST COMPONENT USED: C21,D7,E13,F3,J3,L1,R41,TP1 & U2.
2. R17,R25,R32-R36,R38 & R40 NOT USED ON FM-5T & FM-10T.
   R31,R32,R35,R36,R38 & R40 NOT USED ON FM-20T,FM-30T & FM-35T.
3. SEE B/M AND SCHEMATIC SB919-0048-005 FOR FM-30T & FM-35T
   SEE B/M AND SCHEMATIC SB919-0048-006 FOR FM-20T
   SEE B/M AND SCHEMATIC SB919-0048-007 FOR FM-10T
   SEE B/M AND SCHEMATIC SB919-0048-008 FOR FM-5T
4. R2,R3 BODY SIZE IS LARGER THAN SHOWN ON
   MODELS: FM-30T & FM-35T.
5. E1-E13 (410-0025) MUST BE STRAIGHT UP ON BOARD.

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

DWN. BY	2-6-97 M. HAYDEN
DESIGNER(S)	
PROJ. LEADER	
MFG.	
MATERIAL	SEE BOM 919-0048-005 919-0048-006 919-0048-007 919-0048-008
FINISH	
NEXT ASSY.	

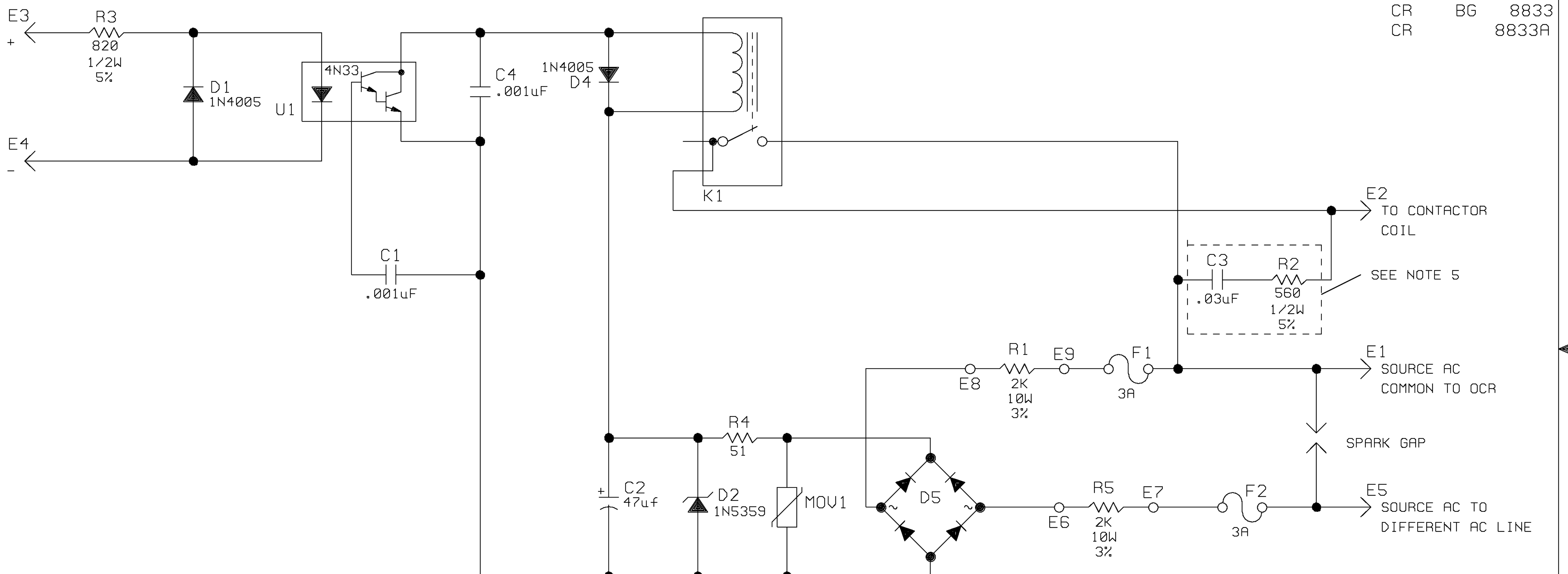
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST. P.O.BOX 3606 QUINCY,IL. 62305
217/224-9600 FAX 217/224-9607

TITLE: PCB ASSEMBLY PA METERING BOARD

TYPE	SIZE	DWG No.	REV
A	B	919-0048-005/006/007/008	A

MODEL FM-5T/10T/20T FM-30T/35T | SCALE 1/1 | SHEET 1 OF 1

JAH	TJL	7419
CR	BG	8833
CR		8833A



NOTES:

1. ALL RESISTORS IN OHMS; 1/4W, 1% UNLESS OTHERWISE SPECIFIED.
2. LAST COMPONENT USED:R5,F2,MOV1,C4, D4,U1,K1,E9
3. COMPONENTS NOT USED:D3
4. SEE ASSEMBLY:AB 919-0096
5. THESE COMPONENTS NOT USED ON 919-0096-001 C3,R2

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

DWN. BY JAH 11-26-91
CHKD BG 11-92
ME
PROJ. ENGR. BG 11-92
MFG.

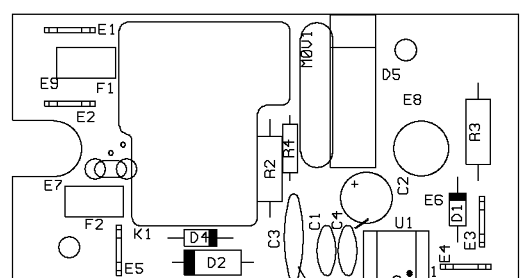
MATERIAL SEE B/M 919-0096 919-0096-001
FINISH SEE DWG RA592-0000
NEXT ASSY.

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 OPTICALLY COUPLED RELAY

TYPE	SIZE	DWG. NO.	REV
S	B	919-0096,-001	J

MODEL FM XMTR'S | SCALE NONE | SHEET 1 OF



REMOVE R2 AND C3 FROM 919-0096
TO MAKE 919-0096-001

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

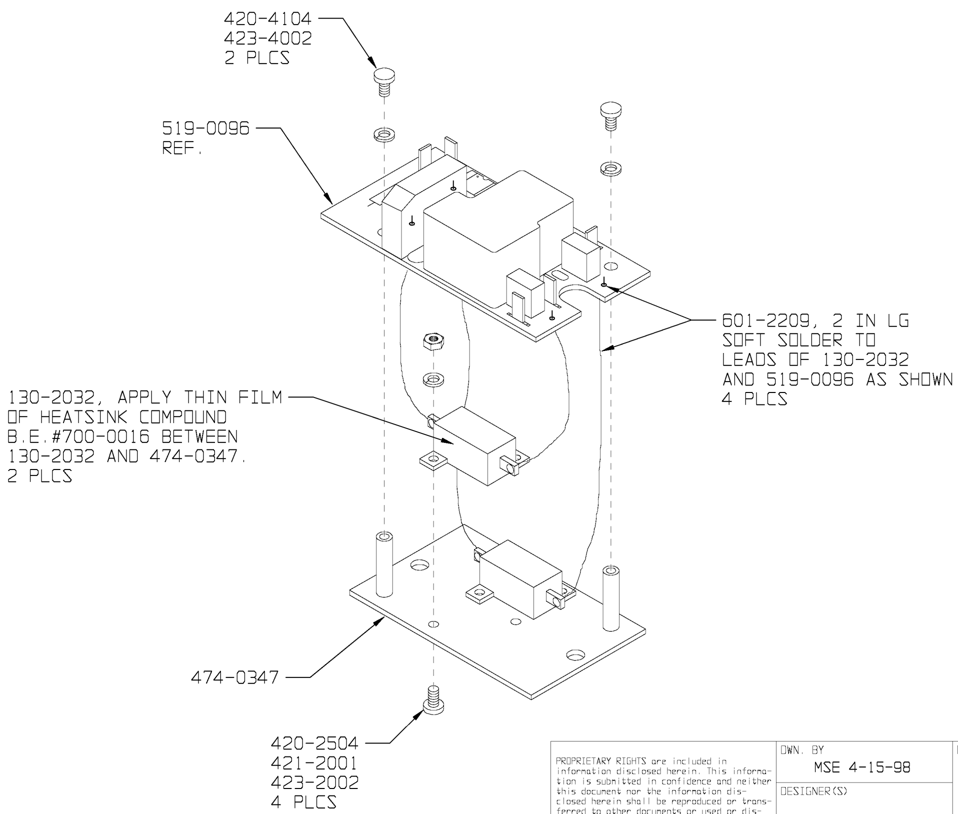
DWN. BY	JAH 12-13-91
DESIGNER(S)	
PROJ. LEADER	J.TUCKER 7-14-86
MFG.	J.STEINKAMP 7-14-86
MATERIAL	SEE B/M 919-0096 919-0096-001
FINISH	~~SEE DWG AA592-0000~~
NEXT ASSY.	

®
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
OPTICALLY COUPLED RELAY BD.

TYPE	SIZE	DWG No.	REV
A	B	919-0096, 919-0096-001	N

MODEL TRANSMITTERS | SCALE 1=1 | SHEET 1 OF 2



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

DWN. BY: MSE 4-15-98
DESIGNER(S):
PROJ. LEADER:
MFG.:

MATERIAL: SEE BOM 919-0096, -001
FINISH:
SEE DWG RA592-0000
NEXT ASSY.:

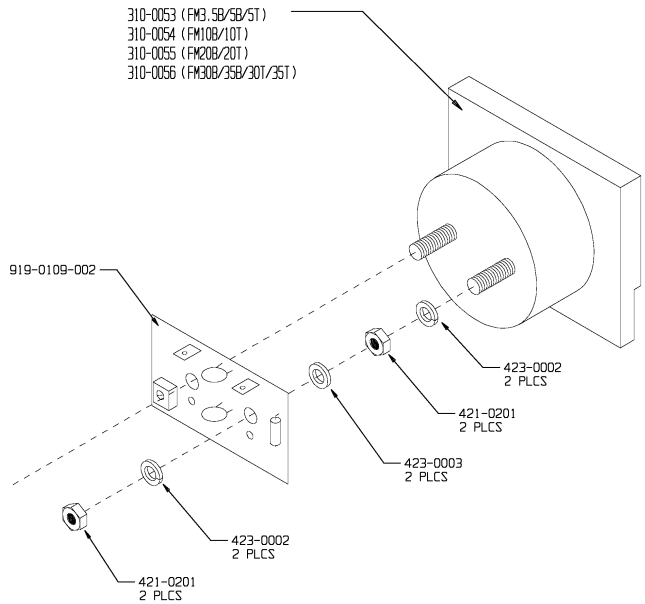
BE® BROADCAST ELECTRONICS INC.
4100 N.24TH ST.,P.O.BOX 3606 QUINCY,IL 62305 217/224-9600
TELEX 250142 CABLE BROADCAST FAX 217/224-9607

TITLE: ASSY, PCB OPTICALLY COUPLED RELAY (OCR)

TYPE: A | SIZE: B | DWG. NO.: 919-0096, -001 | REV: N

MODEL: XMTRS | SCALE: 1/1 | SHEET 2 OF 2

COPYRIGHT © 1998 BROADCAST ELECTRONICS, INC.



ASSY. NO.	CALIBRATION VOLTAGE	XMTR MODEL
959-0300	1.00 VDC	FM3.5B/5B/5BS/5T
959-0291	0.985 VDC	FM10B/10T
959-0292	0.99 VDC	FM20B/20T
959-0293	1.01 VDC	FM30B/35B/30T/35T

NOTES:

1) ASSEMBLED UNIT TO BE GIVEN TO INCOMING INSPECTION FOR SET-UP AND CALIBRATION AND DELIVERY TO STOCK.

2) INCOMING- SET CALIBRATOR AS PER TABLE 50 OHM DIVIDER OFF - ADJUST POTENTIOMETER FOR FULL SCALE READING ON METER, SEAL POTENTIOMETER WITH ANTI-TAMPER LACQUER (B.E. 700-0130)

3) PCB 919-0109-002 USED IN FM3.5B,5B,5T FM10B,10T,20B,20T,30B,30T,35B,35T.

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

DWN. BY: KT 6-10-97
DESIGNER(S):
PROJ. LEADER: MUKUNDA B. SHRESTHA
MFG.: JAS 6-2-88

MATERIAL: SEE B/M
FINISH:
SEE DWG RA592-0000
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

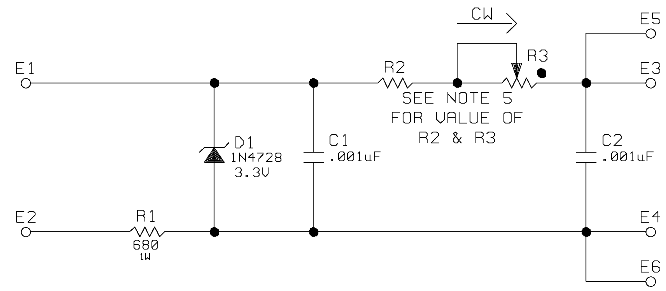
TITLE: ASSY, PLATE METER

TYPE: A | SIZE: B | DWG. NO. 959-0291(FM10B),959-0292(FM20B) 959-0293(FM30/35B) 959-0300(FM3.5B,5B,5BS) | REV: C

MODEL: FM3.5B,5B,5T,5BS,5TBS,10B,10T 20B,20T,30B,30T,35B,35T | SCALE: NTS | SHEET 1 OF 1

NOTES:

1. ALL RESISTORS IN OHMS; 1/4W, 5%, UNLESS OTHERWISE SPECIFIED.
2. LAST COMPONENT USED: C2, D1, E6, R3
3. SEE PCB ASSEMBLY AB919-0109, 919-0109-001, 919-0109-002.
4. 919-0109 USED IN FM-35A, FM-30A, FM-20A.
   919-0109-001 USED IN FM-10A.
   919-0109-002 USED IN FM-3.5B, FM-5B, FM-5BS, FM-10B, FM-20B, FM-30B, FM-35B.
5. R2: 103-2493 USED IN 919-0109.
   100-4713 USED IN 919-0109-001.
   103-1823 USED IN 919-0109-002.
   R3: 177-1034 USED IN 919-0109, 919-0109-001.
   177-2034 USED IN 919-0109-002.



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

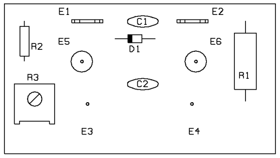
DWN. BY	KT 6-10-97
DESIGNER(S)	
PROJ. LEADER	M. SHRESTHA 6-13-88
MFG.	
MATERIAL	SEE BOM 919-0109
FINISH	
NEXT ASSY.	

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

TITLE: PCB SCHEMATIC
METER PROTECTION BD

TYPE	SIZE	DWG. NO.	REV
S	B	919-0109/-001/-002	E

MODEL SEE NOTE 4 | SCALE NONE | SHEET 1 OF 1



NOTES:
1. LAST COMPONENTS USED: C2, D1, E6, R3.
2. SEE PCB SCHEMATIC: SB919-0109, 919-0109-001, 919-0109-002.

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

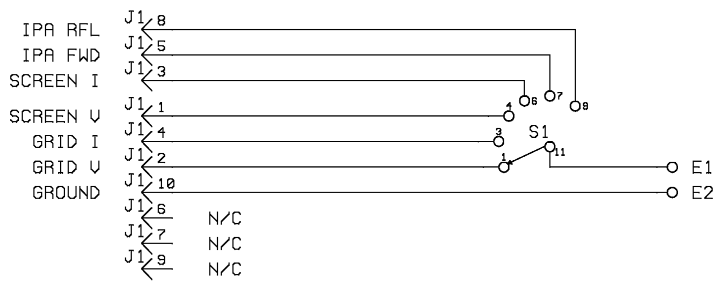
DWN. BY: KT 6-11-97
DESIGNER(S):
PROJ. LEADER: 6-13-88 M.SHRESTHA
MFG.:
MATERIAL: SEE B/M NO. 919-0109
FINISH:
NEXT ASSY.:

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

TITLE: PCB ASSEMBLY- METER PROTECTION BD.

TYPE	SIZE	DWG No.	REV
A	B	919-0109/-001/-002	E

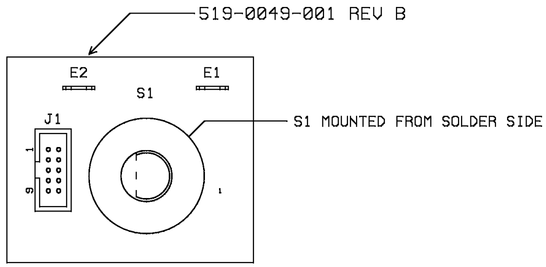
MODEL: SEE SB919-0109 | SCALE 1/1 | SHEET 1 OF 1



NOTES:
1. LAST COMPONENT USED: E2, J1, S1
2. SEE PCB ASSEMBLY AB919-0049-001

TOLERANCE (DECIMAL) U.O.S.	.x ± .030 .xxx ± .005 / .xx ± .015 ANGLES ± 1°
DWN. BY	KT 6-20-97
DESIGNER(S)	
PROJ. LEADER	4-10-89 M.SHRESTHA
MFG.	4-10-89 P.R.BROSE
MATERIAL	SEE BOM 919-0049-001
FINISH	
NEXT ASSY.	AB919-0049-001
TITLE	PCB SCHEMATIC MULTIMETER BOARD
TYPE	S
SIZE	B
DWG. NO.	919-0049-001
REV	B
MODEL	FM-3.5B, FM-5B FM-10B
SCALE	NONE
SHEET	1 OF 1

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



NOTES:
1. LAST COMPONENTS USED: E2, J1, S1.
2. SEE PCB SCHEMATIC: SB919-0049-001.

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

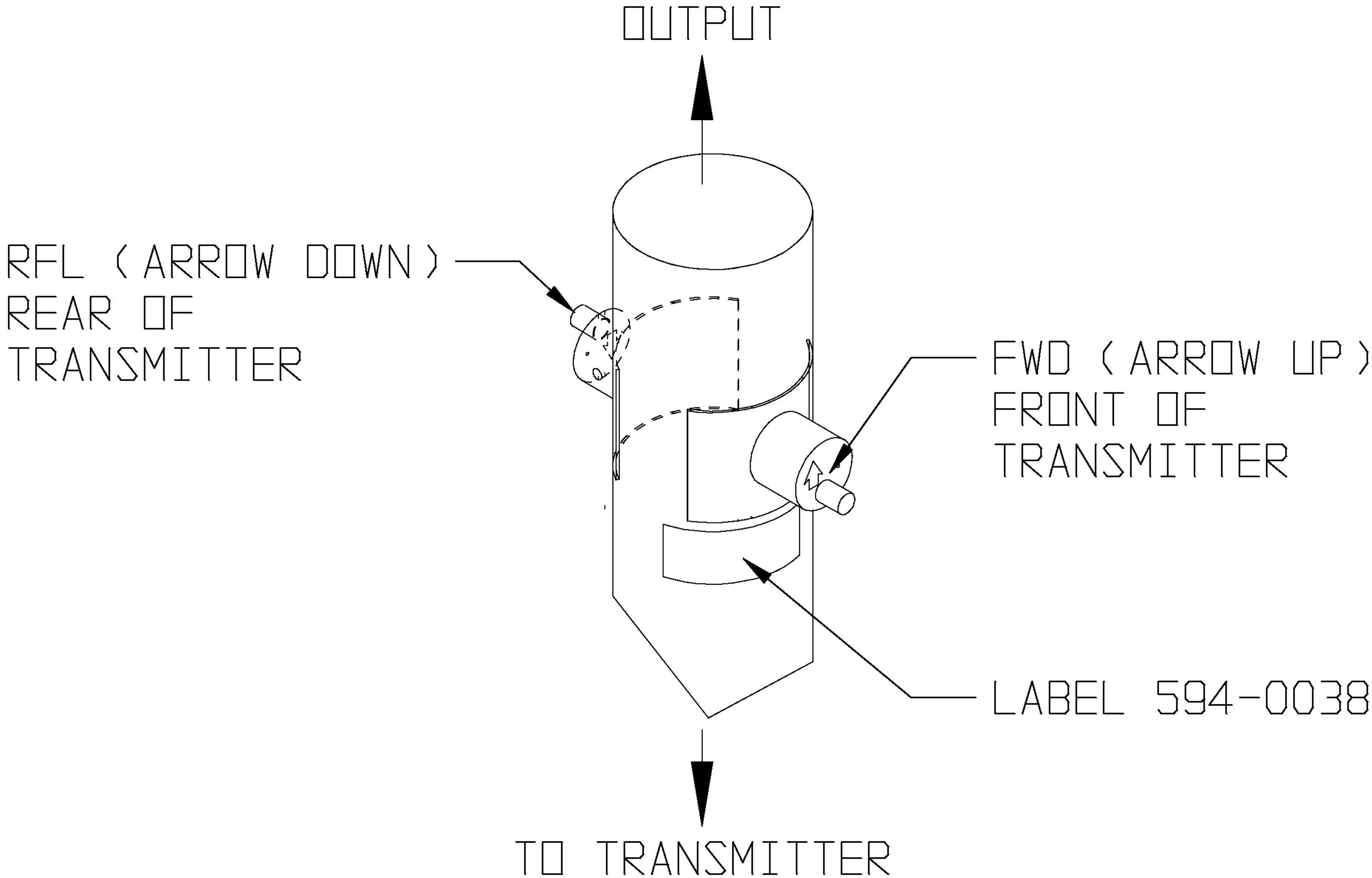
DWN. BY	KT 6-20-97
DESIGNER(S)	J.STEINKAMP 4-10-89
PROJ. LEADER	M.SHRESTHA 4-10-89
MFG.	P.R.BROSE 4-8-89
MATERIAL	SEE B/M NO. 919-0049-001
FINISH	
NEXT ASSY.	

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

TITLE
PCB ASSEMBLY-
MULTIMETER BOARD

TYPE	SIZE	DWG No.	REV
A	B	919-0049-001	B

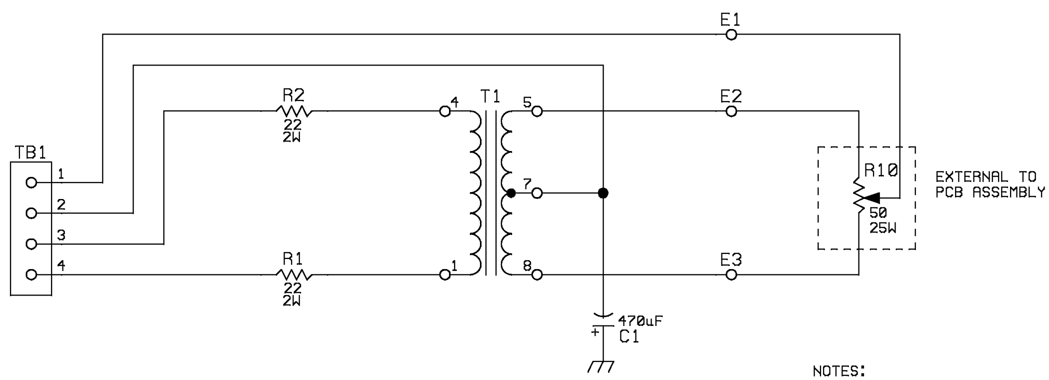
MODEL FM-3.5B, FM-5B FM-10B | SCALE 1/1 | SHEET 1 OF 1



597-0032-506A

FIGURE 7-14. ASSEMBLY DIAGRAM, DIRECTIONAL COUPLER

REVISIONS					
REV	DATE	DESCRIPTION	DFTSMN	ENGR	ECN



NOTES:

1. RESISTORS ARE IN OHMS;1/4, 5%
   UNLESS OTHERWISE SPECIFIED.
2. LAST COMPONENT USED:T1,TB1,E3,C1,& R2.
3. COMPONENTS NOT USED:
4. SEE PCB ASSEMBLY: AB 919-0112

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

DWN. BY JAH 8-17-89
CHKD
ME
PROJ. ENGR.
MFG.

MATERIAL SEE B/M 919-0112
FINISH SEE DWG AA592-0000
NEXT ASSY.

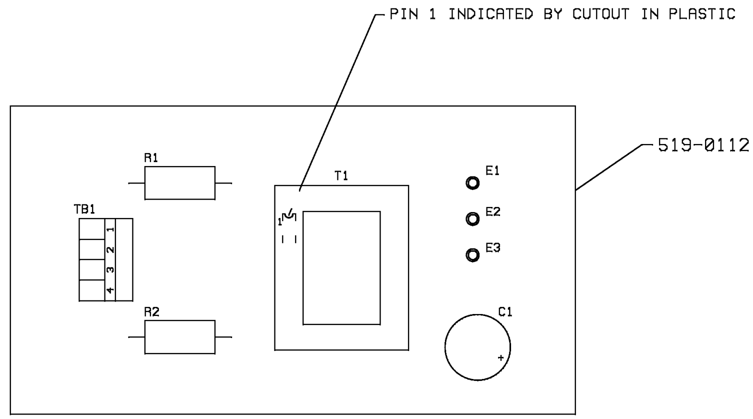
BROADCAST ELECTRONICS INC.®
4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305 217/224-9600
TELEX 250142 CABLE BROADCAST FAX 217/224-9607

TITLE HUM NULL BD

TYPE	SIZE	DWG. NO.	REV
S	B	919-0112	A

MODEL XMTR'S | SCALE NONE | SHEET 1 OF 1

REVISIONS					
REV	DATE	DESCRIPTION	DFTSMN	ENGR	ECN



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

DWN. BY JAH 10-24-89
CHKD
ME
PROJ. ENGR.
MFG.

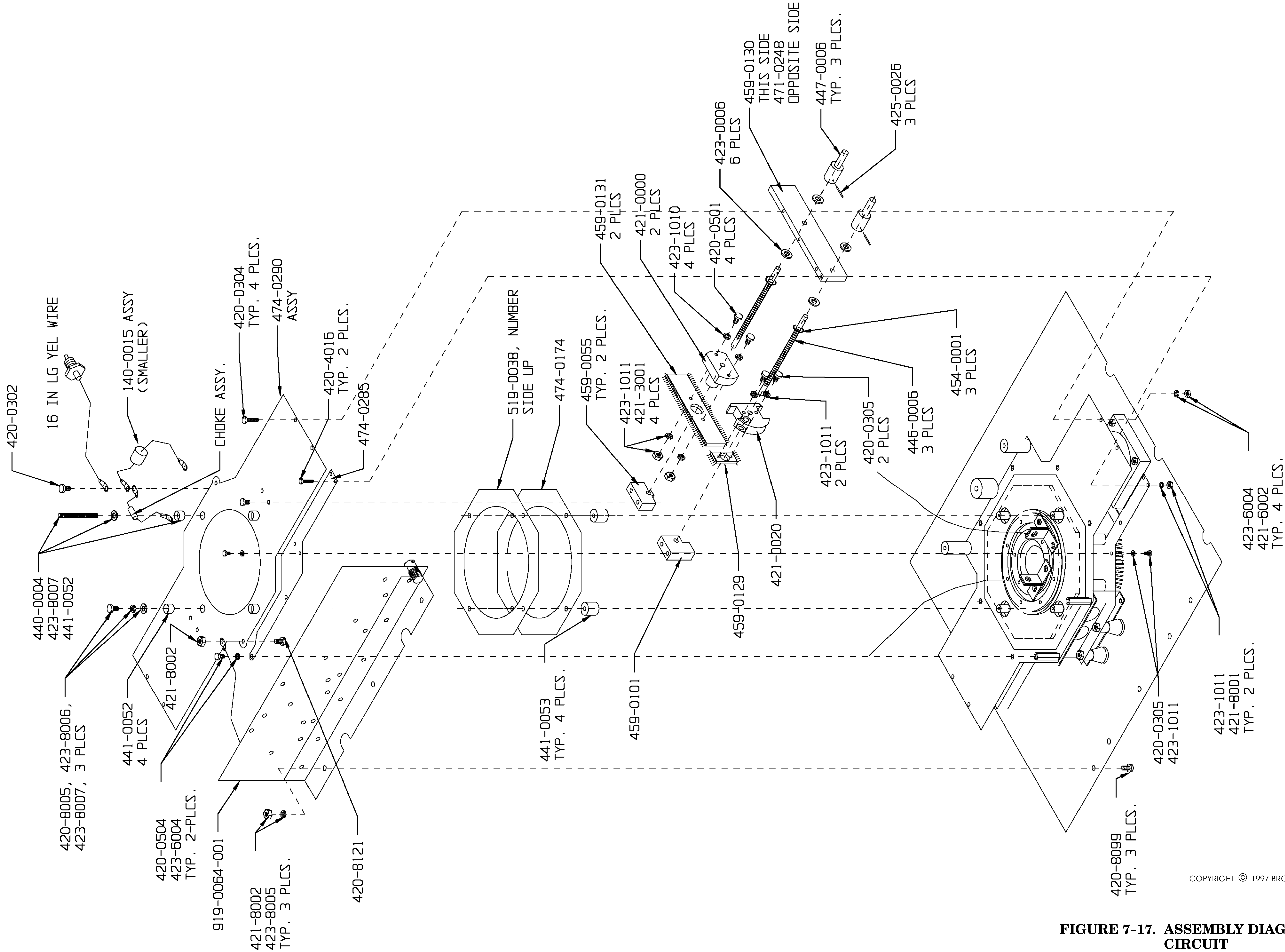
MATERIAL SEE B/M 919-0112
FINISH
SEE DWG AA592-0000
NEXT ASSY.

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
HUM NULL

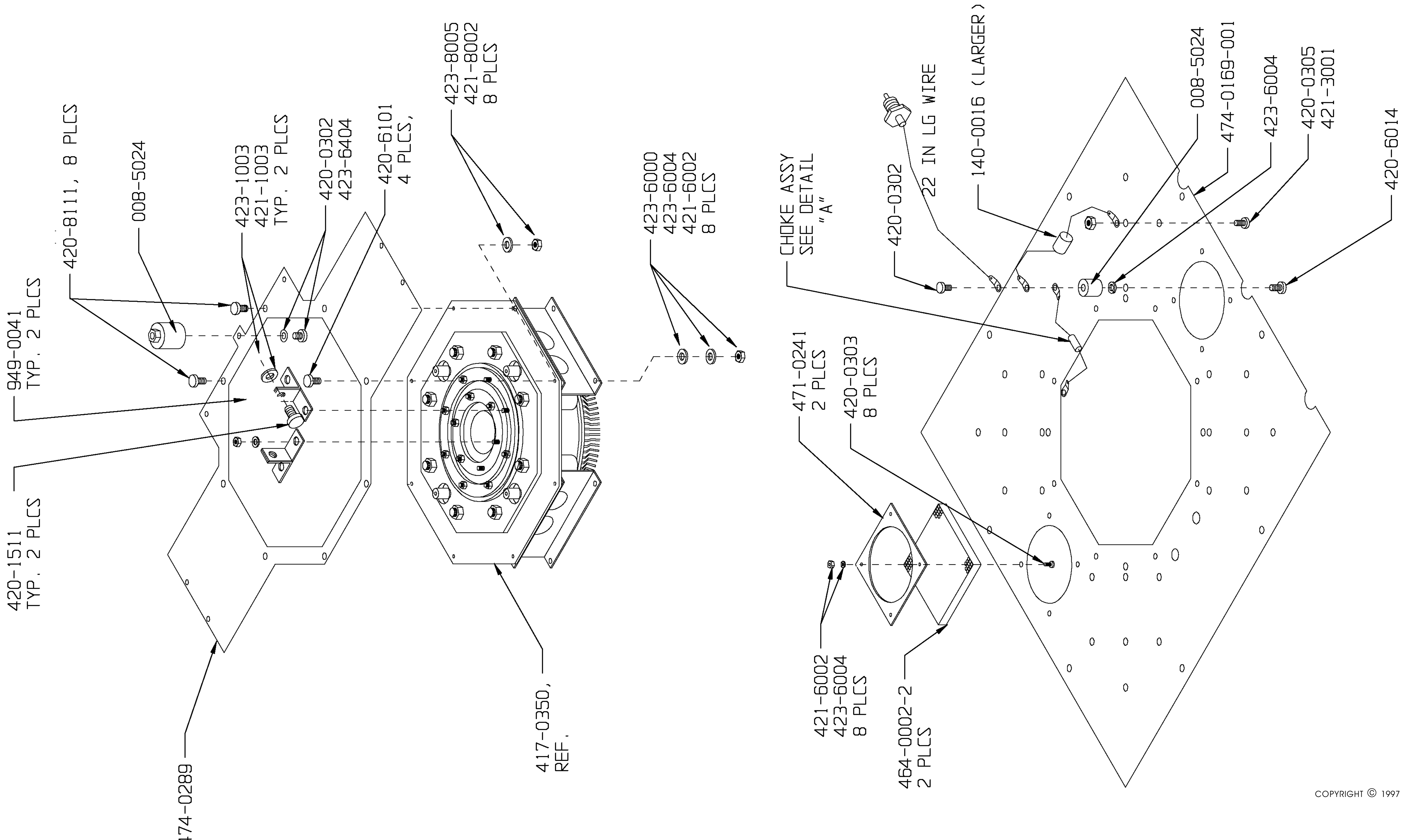
TYPE	SIZE	DWG.No.	REV
A	B	919-0112	A

MODEL XMTR'S SCALE 1/1 SHEET 1 OF 1



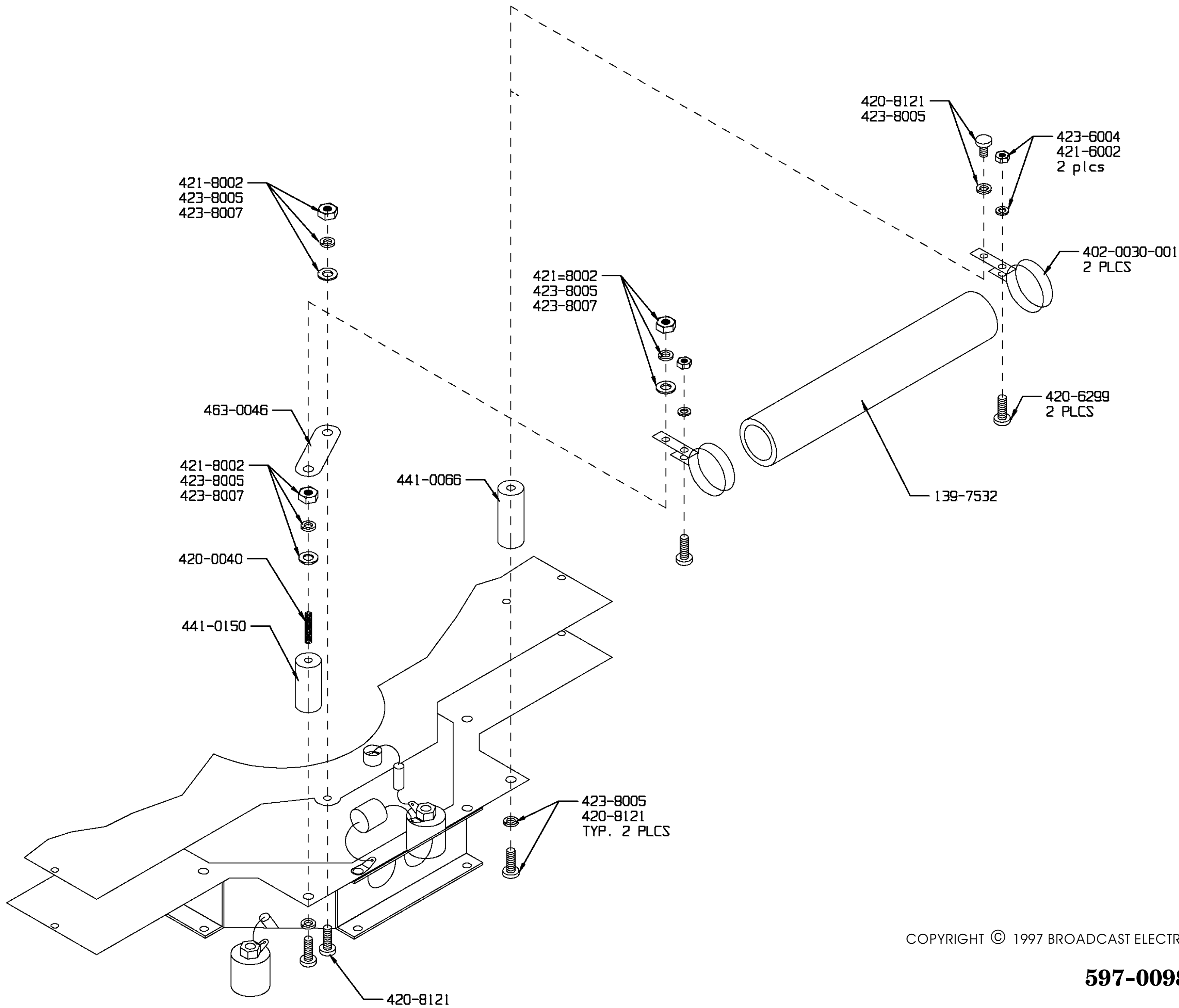
597-0098-100A

FIGURE 7-17. ASSEMBLY DIAGRAM, PA INPUT CIRCUIT (Sheet 1 of 4)



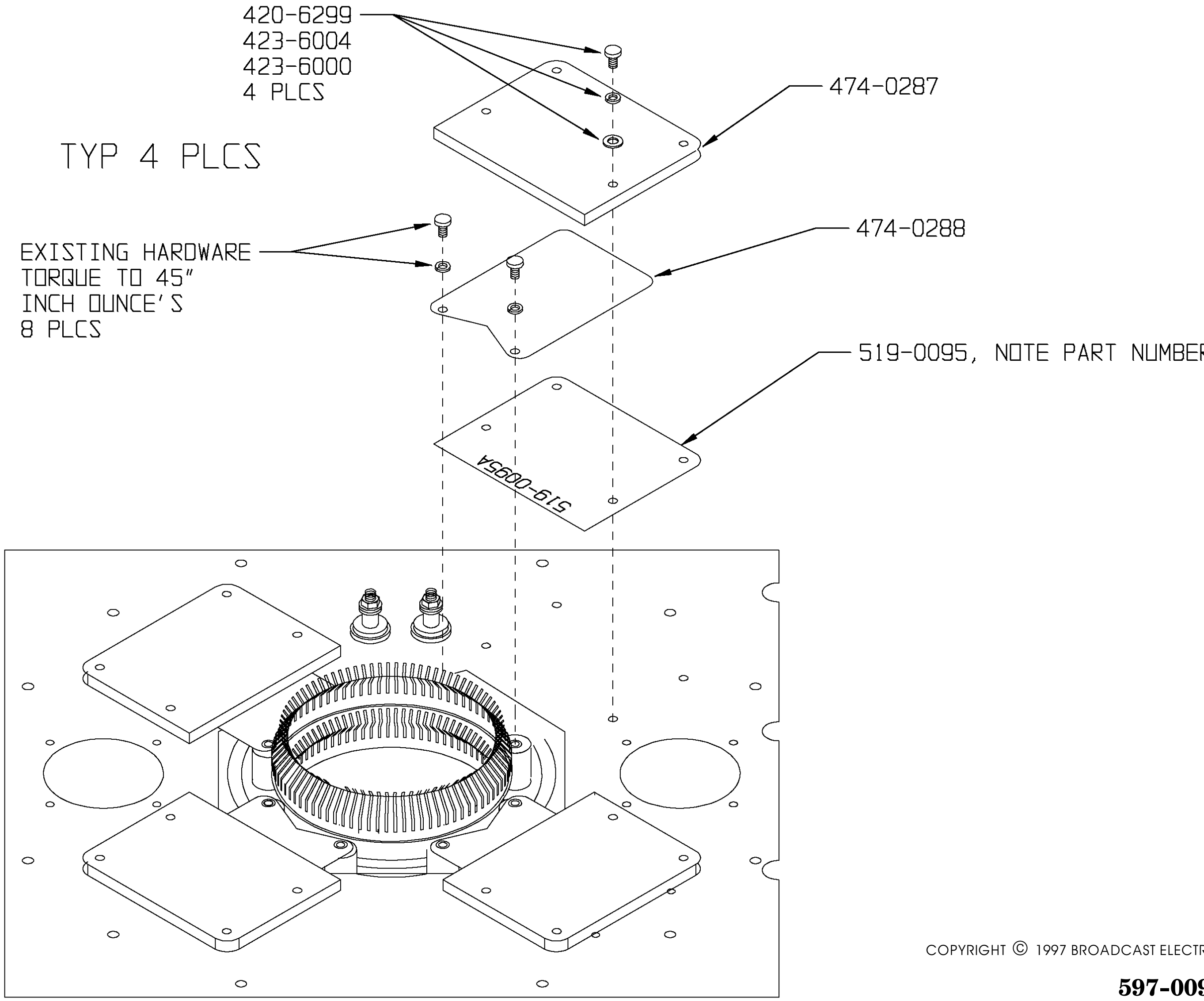
597-0098-100B

FIGURE 7-17. ASSEMBLY DIAGRAM, PA INPUT CIRCUIT (Sheet 2 of 4)



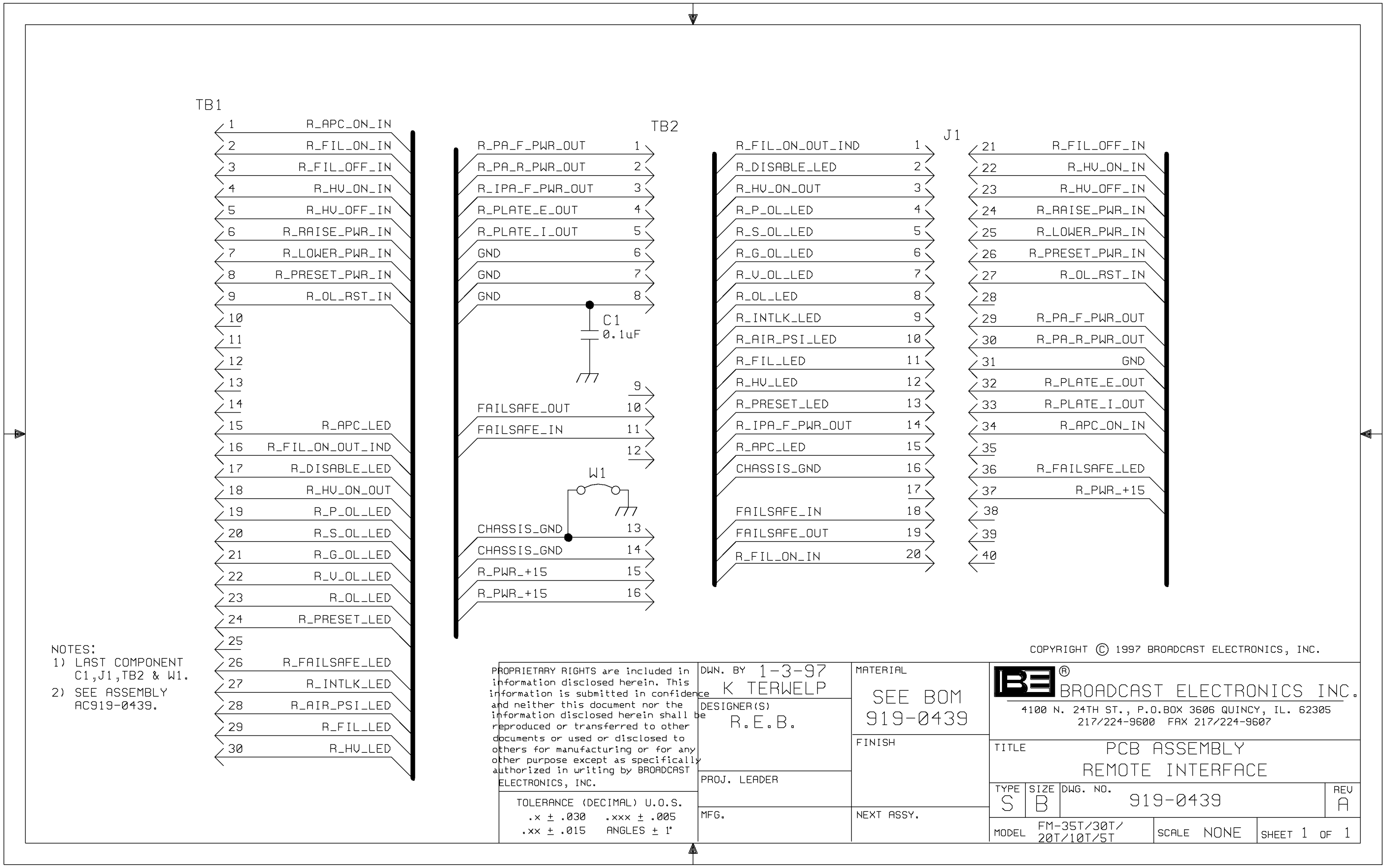
597-0098-100C

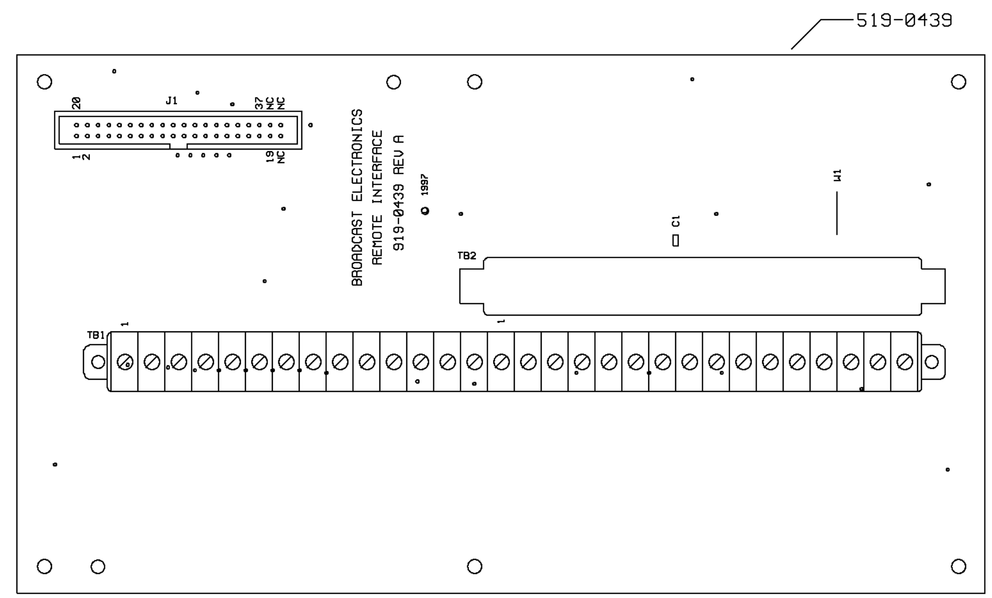
FIGURE 7-17. ASSEMBLY DIAGRAM, PA INPUT CIRCUIT
(Sheet 3 of 4)



597-0098-100D

FIGURE 7-17. ASSEMBLY DIAGRAM, PA INPUT CIRCUIT
(Sheet 4 of 4)


TB1
1 R_APC_ON_IN
2 R_FIL_ON_IN
3 R_FIL_OFF_IN
4 R_HV_ON_IN
5 R_HV_OFF_IN
6 R_RAISE_PWR_IN
7 R_LOWER_PWR_IN
8 R_PRESET_PWR_IN
9 R_OL_RST_IN
10
11
12
13
14
15 R_APC_LED
16 R_FIL_ON_OUT_IND
17 R_DISABLE_LED
18 R_HV_ON_OUT
19 R_P_OL_LED
20 R_S_OL_LED
21 R_G_OL_LED
22 R_V_OL_LED
23 R_OL_LED
24 R_PRESET_LED
25
26 R_FAILSAFE_LED
27 R_INTLK_LED
28 R_AIR_PSI_LED
29 R_FIL_LED
30 R_HV_LED
TB2
R_PA_F_PWR_OUT 1
R_PA_R_PWR_OUT 2
R_IPA_F_PWR_OUT 3
R_PLATE_E_OUT 4
R_PLATE_I_OUT 5
GND 6
GND 7
GND 8
C1
0.1uF
9
FAILSAFE_OUT 10
FAILSAFE_IN 11
12
W1
CHASSIS_GND 13
CHASSIS_GND 14
R_PWR_+15 15
R_PWR_+15 16
J1
R_FIL_ON_OUT_IND 1
R_DISABLE_LED 2
R_HV_ON_OUT 3
R_P_OL_LED 4
R_S_OL_LED 5
R_G_OL_LED 6
R_V_OL_LED 7
R_OL_LED 8
R_INTLK_LED 9
R_AIR_PSI_LED 10
R_FIL_LED 11
R_HV_LED 12
R_PRESET_LED 13
R_IPA_F_PWR_OUT 14
R_APC_LED 15
CHASSIS_GND 16
17
FAILSAFE_IN 18
FAILSAFE_OUT 19
R_FIL_ON_IN 20
21 R_FIL_OFF_IN
22 R_HV_ON_IN
23 R_HV_OFF_IN
24 R_RAISE_PWR_IN
25 R_LOWER_PWR_IN
26 R_PRESET_PWR_IN
27 R_OL_RST_IN
28
29 R_PA_F_PWR_OUT
30 R_PA_R_PWR_OUT
31 GND
32 R_PLATE_E_OUT
33 R_PLATE_I_OUT
34 R_APC_ON_IN
35
36 R_FAILSAFE_LED
37 R_PWR_+15
38
39
40
NOTES:
1) LAST COMPONENT C1,J1,TB2 & W1.
2) SEE ASSEMBLY AC919-0439.
COPYRIGHT © 1997 BROADCAST ELECTRONICS, INC.
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.
TOLERANCE (DECIMAL) U.O.S.
.x ± .030 .xxx ± .005
.xx ± .015 ANGLES ± 1°
DWN. BY 1-3-97
K TERWELP
DESIGNER(S)
R.E.B.
PROJ. LEADER
MFG.
MATERIAL
SEE BOM
919-0439
FINISH
NEXT ASSY.
BE®
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305
217/224-9600 FAX 217/224-9607
TITLE
PCB ASSEMBLY
REMOTE INTERFACE
TYPE S
SIZE B
DWG. NO. 919-0439
REV A
MODEL FM-35T/30T/20T/10T/5T
SCALE NONE
SHEET 1 OF 1



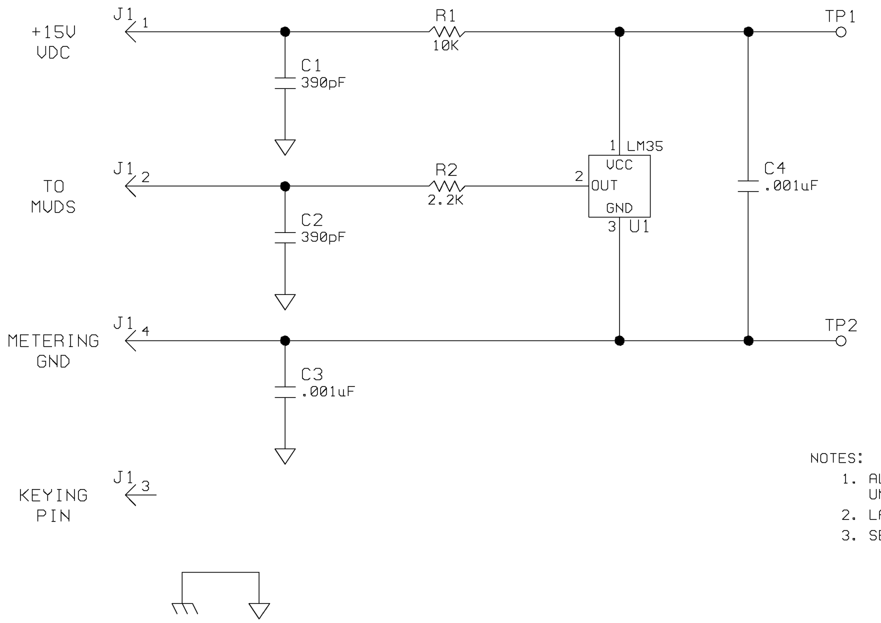
NOTES:
1) LAST COMPONENTS USED:
C1,J1,TB2 & W1.
2) SEE SCHEMATIC SB919-0439.
3) W1 IS NOT STUFFED DURING ASSEMBLY.,

TOLERANCE (DECIMAL) U.O.S.	.X ± .030 .XXX ± .005 .XX ± .015 ANGLES ± 1°
DWN. BY	1-29-97 K. TERWELP
DESIGNER(S)	R.E.B.
PROJ. LEADER	
MFG.	
MATERIAL	SEE BOM 919-0439
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 REMOTE INTERFACE
TYPE	A
SIZE	C
DWG No.	919-0439
REV	A
MODEL	FM-35T/30T/20T/10T/5T
SCALE	1/1
SHEET	1 OF 1

COPYRIGHT © 1997 BROADCAST ELECTRONICS, INC.



NOTES:
1. ALL RESISTORS IN OHMS; 1/4W, 5%, UNLESS OTHERWISE SPECIFIED.
2. LAST COMPONENT USED: C4, J1, R2, TP2, U1
3. SEE PCB ASSEMBLY AB919-0082

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

DWN. BY KT 7-1-97
DESIGNER(S)
PROJ. LEADER JML 5-22-84
MFG.

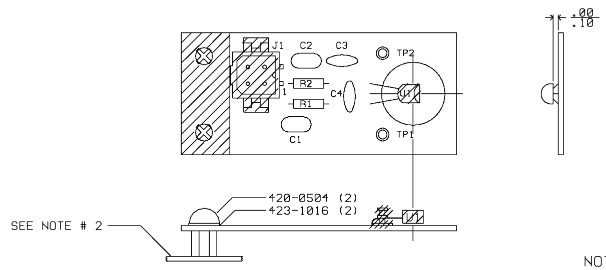
MATERIAL SEE BOM 919-0082
FINISH
NEXT ASSY.

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

TITLE SCHEMATIC, EXHAUST AIR TEMPERATURE SENSOR, PCB

TYPE	SIZE	DWG. NO.	REV
S	B	919-0082	B

MODEL FM3.5A/5A MUDS OPTION | SCALE NONE | SHEET 1 OF 1



NOTES:

1. U1 CENTERED IN .625 HOLE.
2. BOARD SHOWN MOUNTED TO 959-0048 SHIELD CELL ASM.
3. SEE PCB SCHEMATIC: SB919-0082.
4. COVER WITH URETHANE CONFORMAL COATING (700-0126) AFTER COMPONENTS ARE SOLDERED. SEE COATING INSTRUCTIONS.
5. LAST COMPONENTS USED: C4, J1, R2, TP2, U1.

COATING INSTRUCTIONS:

1) MASK BODY OF DEVICE U1 COMPLETLY, MASK TURRETS TP1 & TP2, INSERT 418-0240 DUMMY PLUG IN J1, AND MASK BOTH SIDES OF PCB AT MOUNTING HOLE END AS SHADED.
2) APPLY ONE COAT OF 700-0126, SPRAY ON BOTH SIDES, PER VENDOR INSTRUCTIONS, THEN REMOVE MASKING.
3) ALLOW 15 MINS. DRYING TIME.

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

DWN. BY KT 7-1-97
DESIGNER(S)
PROJ. LEADER JML 5-31-84
MFG.

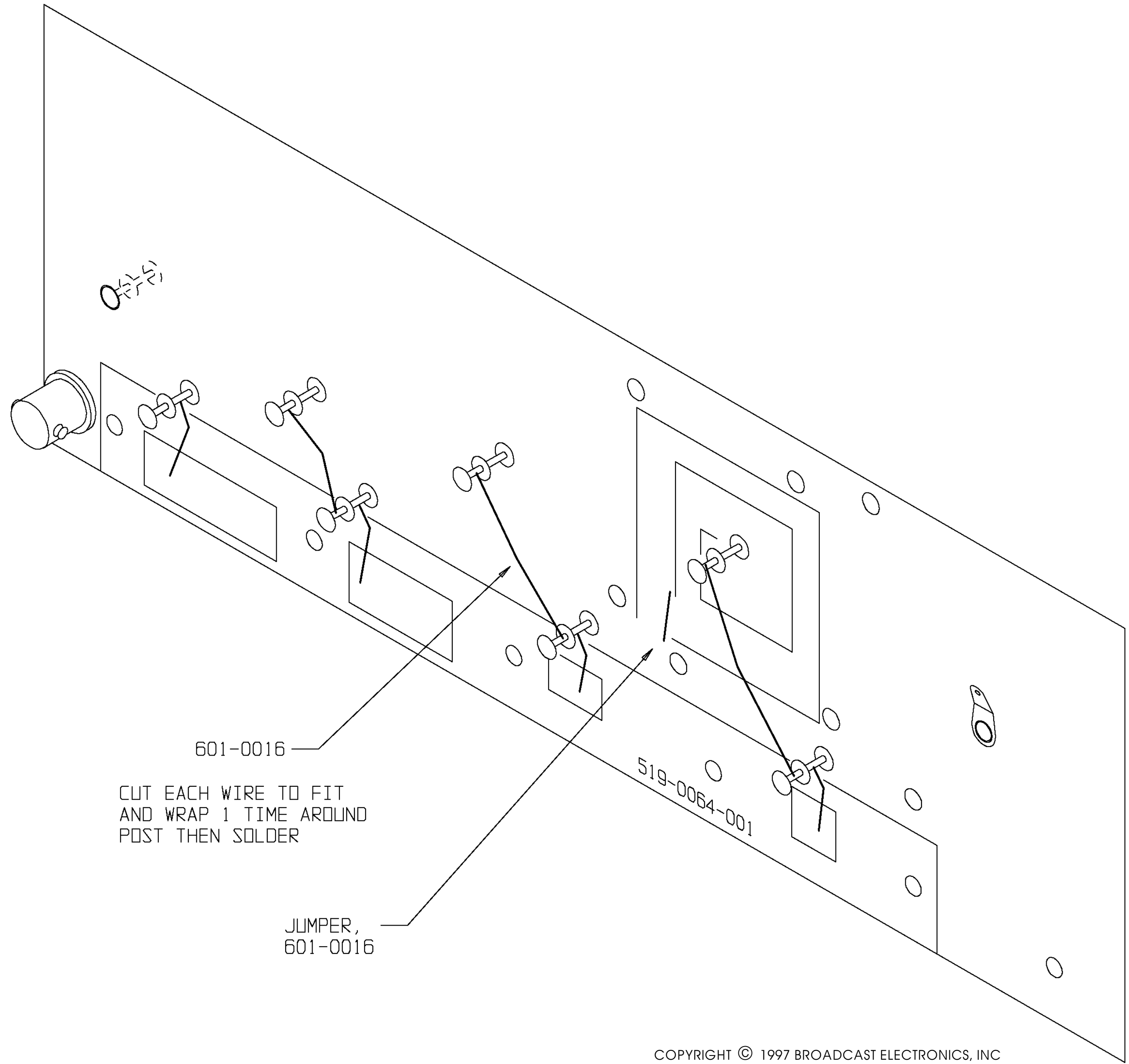
MATERIAL SEE B/M NO. 919-0082
FINISH
NEXT ASSY.

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

TITLE ASM., PCB EXHAUST AIR TEMPERATURE SENSOR

TYPE	SIZE	DWG No.	REV
A	B	919-0082	C

MODEL FM-3.5A/5A MVDS OPTION | SCALE 1/1 | SHEET 1 OF 1



597-0098-414

FIGURE 7-22. ASSEMBLY DIAGRAM, PA MATCHING CIRCUIT BOARD

APPENDIX A
MANUFACTURERS DATA

A-1. INTRODUCTION.

A-2. This appendix provides technical data associated with the operation and maintenance of the FM-10T/FM-10TS transmitters. The information contained in this appendix is presented in the following order.

A. Service Bulletin, Furnas Contactor, Size 75 Amp.

B. Service Bulletin, Furnas Contactor, Size 25 Amp.

C. Service Bulletin, Furnas Contactor, Size 40 Amp.

D. Operating Instructions and Parts List, Cincinnati Fan Company, LM-6C Volume Blower.

E. Technical Data Sheet, Eimac, 4CX7500A Tetrode.

F. Application Paper, Eimac, Extending Transmitter Tube Life.

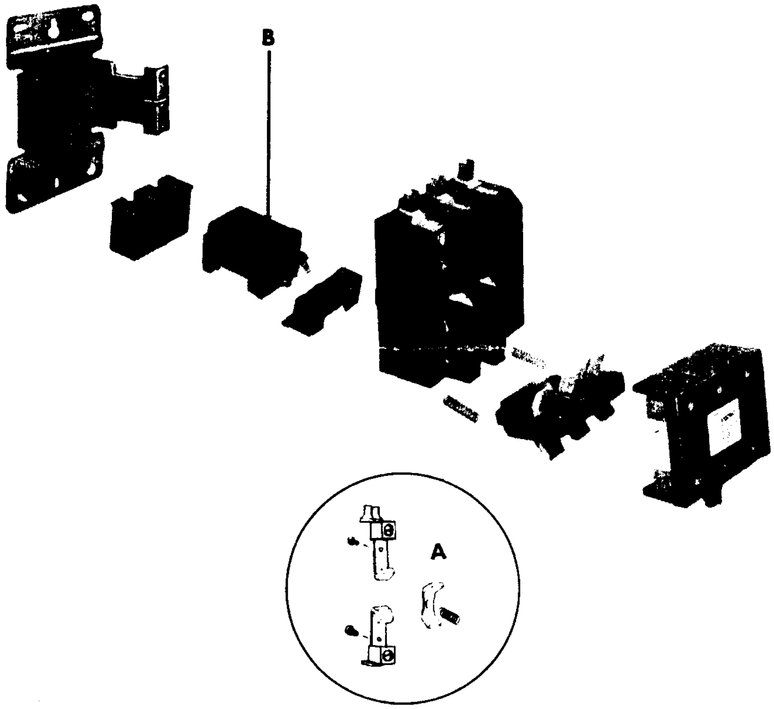
G. Schematic Diagram, Power Supply, Computer Products, NFN40-7610.

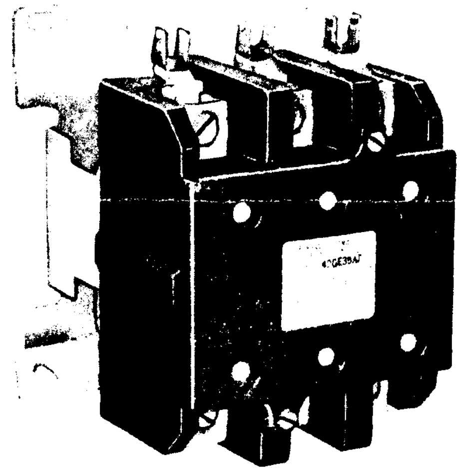
CLASS 42

REPLACEMENT PARTS

MAGNETIC CONTACTORS

File No.	42-GFE
Cat. No. or Class Series	42FE & 42GE
Size	75-90 AMPERE
Date	JUNE, 1974





ITEM	PART NAME		PART NUMBER	
			75 AMP.	90 AMP.
A	Contacts & Spring, One complete pole		75FE42	75GE42
B	Coil, *60 Hertz	24 Volts	75D54772J	75D54772J
		120 Volts	75D54772F	75D54772F
		240 Volts	75D54772G	75D54772G
		480 Volts	75D54772H	75D54772H
	*Other voltages and frequencies available on request			

NOTE: When ordering replacement parts, give catalog number of control and part name and number.

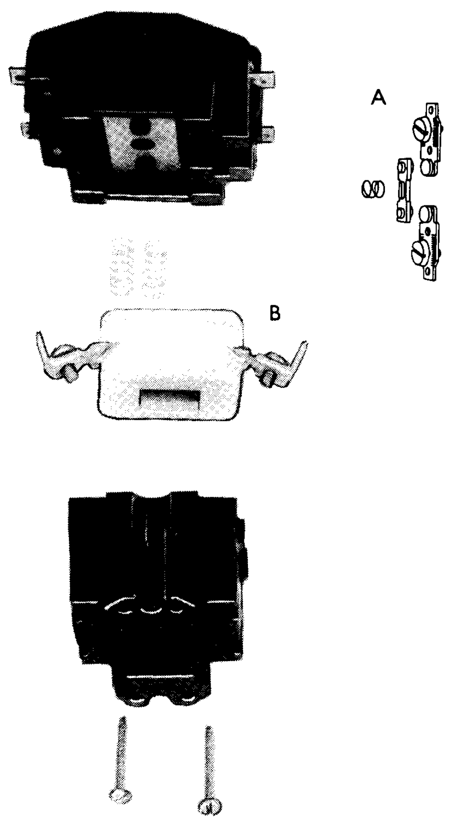
FURNAS ELECTRIC COMPANY ▪ BATAVIA, ILLINOIS

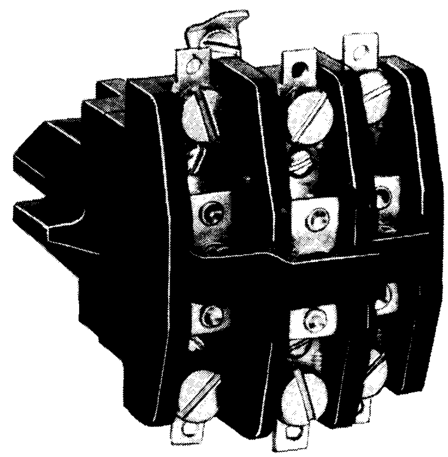
FURNAS

REPLACEMENT PARTS

MAGNETIC CONTACTORS

File No.	41-GNB
Cat. No. or Class Series	41NB
Size	25 Amp
Date	APRIL, 1982





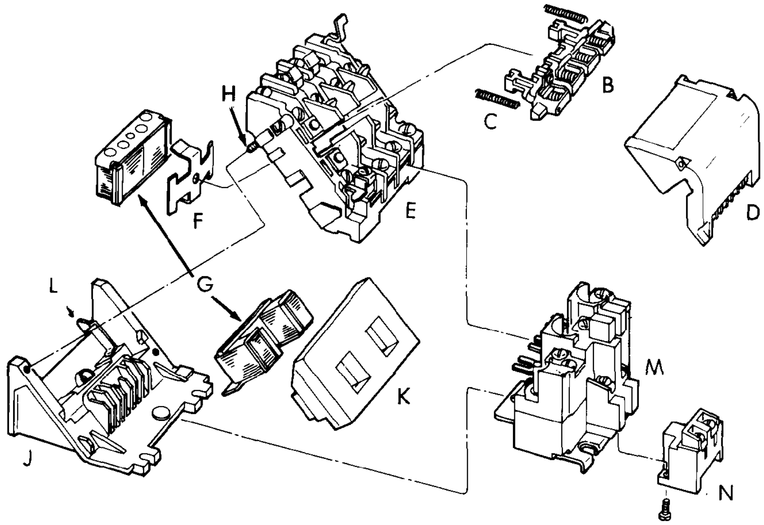
Item	Part Name		Part No.
A	Contacts & Spring, One complete pole		75NB41
B	Coil 60 Hz.	24 Volts	75D54760J
		120 Volts	75D54760F
		208-240 Volts	75D54760G
		440-480 Volts	75D54760H
		575-600 Volts	75D54760E

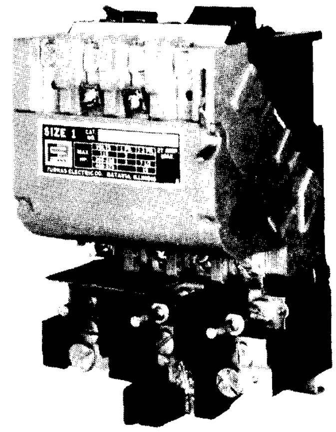
NOTE: When ordering replacement parts, give catalog number of control and part name and number.

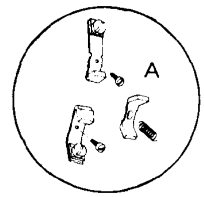
June, 1983
Supersedes Issue of
October, 1982

Starter & Contactors
00, 0, 1, 1P, & 1¾

Class 14 & 40
14BF, 14CF, 14DF, 14EF,
40BF, 40CF, 40DF, 40EF







Item	Part Name		Part Number			
			Size 00	Size 0	Size 1	Size 1P & 1¾
A	Contacts & Spring, One Pole	Power Pole	75BF14	75CF14	75DF14	75EF14
		Interlock Pole	75AF14	75AF14	75AF14	75AF14
B	Cross Arm (less contacts)		D28478001	D28478001	D28478001	D28478001
C	Cross Arm Springs		D24826001	D24826001	D24826001	D24826001
D	Contact Board Cover		D73062001	D73062001	D73062001	D73062001
E	Contact Board (less contacts)		D73116022	D73116022	D73116022	D73116022
F	Armature Spring Clip		D24817001	D24817001	D24817001	D24817001
G	Magnet and Armature		D25551001	D25551001	D255551001	D25551001
H	Contact Board Screw		D24827001	D24827001	D24827001	D24827001
J	Base		D74400001	D74400001	D74400001	D74400001
K	Coil					
	60 Hz 110-120/220-240v	50 Hz 110/190-220v	75D73070A	75D73070A	75D73070A	75D73070A
	220-240/440-480v	190-220/380-440v	75D73070C	75D73070C	75D73070C	75D73070C
	550-600v	550v	75D73070E	75D73070E	75D73070E	75D73070E
L	Coil Spring Clip		D24815001	D24815001	D24815001	D24815001
M	Overload Relays – Melting Alloy (std.)	1 Pole	48DC11AA2	48DC11AA2	48DC11AA2	48EC11AA2
		3 Pole	48DC31AA2	48DC31AA2	48DC31AA2	48EC31AA2
	Overload Relays – Bimetal	1 Pole	48DC17AA2	48DC17AA2	48DC17AA2	48EC17AA2
		3 Pole	48DC37AA2	48DC37AA2	48DC37AA2	48EC37AA2
	Overload Relays – Amb. Comp. Bimetal	1 Pole	48DC18AA2	48DC18AA2	48DC18AA2	48EC18AA2
		3 Pole	48DC38AA2	48DC38AA2	48DC38AA2	48EC38AA2
N	Melting Alloy Overload Kit NO Contacts		48ACNO	48ACNO	48ACNO	48ACNO
P	Auxiliary Interlock Pole NC		49D54682NC	49D54682NC	49D54682NC	49D54682NC

NOTE: When ordering replacement parts, give catalog number of control and part name and number.

Furnas Electric Company 1000 McKee Street, Batavia, Illinois 60510

OPERATING & MAINTENANCE INSTRUCTIONS AND PARTS LIST

for
"PB" & "SPB" Pressure Blowers
"LM" Volume Blowers

CONTENTS

⚠ DANGER

ALL FANS AND BLOWERS SHOWN HAVE ROTATING PARTS AND PINCH POINTS. SEVERE PERSONAL INJURY CAN RESULT IF OPERATED WITHOUT GUARDS. STAY AWAY FROM ROTATING EQUIPMENT UNLESS IT IS DISCONNECTED FROM ITS POWER SOURCE AND ALL ROTATING PARTS HAVE STOPPED MOVING.

READ ALL OPERATING INSTRUCTIONS CONTAINED HEREIN BEFORE INSTALLING EQUIPMENT.

⚠ DANGER

NO GUARANTEE OF ANY LEVEL OF SPARK RESISTANCE IS IMPLIED BY SPARK RESISTANT CONSTRUCTION. IT HAS BEEN DEMONSTRATED THAT ALUMINUM IMPELLERS RUBBING ON RUSTY STEEL MAY CAUSE HIGH INTENSITY SPARKS. AIR STREAM MATERIAL AND DEBRIS OR OTHER SYSTEM FACTORS MAY ALSO CAUSE SPARKS.

cincinnati fan and ventilator company, inc.

CATALOG # PMA-289
SUPERSEDES: PMA-177

I GENERAL SAFETY NOTES

1. Rotating parts including shaft and V-belt drives must be properly guarded to prevent personal injury.

2. Electrical wiring must be accomplished by a qualified electrician in accordance with all applicable codes.

3. Care should be taken:
   - Not to run fan above its safe speed (See Performance Tables in Sales Catalog or call CFV sales office).
   - Not to operate in excessive temperatures (See Limitations in Sales Catalog or call CFV sales office).
   - Not to operate in dangerous environments.
   - Read all instructions carefully.

II RECEIVING

Receiving Inspection

When unit is received, inspect immediately for damaged or missing parts. Even though all units are carefully inspected and prepared for shipment at the factory, rough handling enroute may cause concealed damage or cause nuts, set screws, bolts or locking collars to work loose. Be certain all fasteners are tightened securely. Rotate wheel by hand to verify that it rotates freely and that there are no obstructions.

If concealed damage is found, call the freight carrier and ask for their Inspection Department. Fill out a concealed damage inspection report.

III GENERAL INSTALLATION INSTRUCTIONS

Foundations

Fan foundation must be flat, level and rigid. Where foundation is not completely flat, shims must be placed under fan support at each anchor bolt as required. Bolting fan to an uneven foundation distorts alignment and causes vibration.

Structural steel foundations should be heavily cross-braced for load support.

OPERATION

Before Connecting Power

1. Inspect all fasteners and retighten if necessary:
   a. Foundation bolts.
   b. Set screws in fan and wheel and V-belt drive (See Table #1 & #2).
   c. Housing, bearing and motor mounting.

2. Access Doors should be tight and sealed.

3. Bearings should be checked for alignment and lubrication (See Bearing Maintenance).

4. Turn rotating assembly by hand to insure that it does not strike housing. If the wheel strikes the housing, the wheel may have moved on the shaft or the bearings may have shifted in transit. Correction must be made prior to start up.

5. Check motor to insure proper speed and electrical characteristics.

6. Check V-belt drive for alignment and correct belt tension.

7. After wiring, energize motor for 1 second to check for proper rotation.

Table #1

TORQUE VALUES FOR TAPERED BUSHINGS		
	MINIMUM RECOMMENDED TORQUE (INCH-LBS)	
Bushing Size	Steel Parts	Alum. Parts
H	95	60
P	192	80
Q	350	155
R	350	155

Table #2

SET SCREW TORQUE VALUES			
SET SCREW SIZE		MINIMUM REQUIRED TORQUE (INCH-LBS)	
Diameter & No. of Threads/Inch	Hex Size Across Flats (Allen Wrench)	Steel Set Screw Into Steel Threads	Steel Set Screw Into Alum. Threads or Stainless Steel Set Into Stainless Steel Threads
1/4-20	1/8"	65	65
5/16-18	5/32"	165	100
3/8-16	3/16"	228	155
7/16-14	7/32"	348	230
1/2-13	1/4"	504	330
5/8-11	5/16"	1104	700

NOTE: If wheel set screws are loosened and/or wheel is removed from shaft, set screws must be replaced. Set screws cannot be used more than once. Use knurled, cup point set screws with a locking patch.

IV GENERAL MAINTENANCE

CAUTION

Before any maintenance or service is performed, assure that unit is disconnected from power source to prevent accidental starting.

The key to good fan maintenance is a regular and systematic inspection of all fan parts. Severity of the application should determine frequency of inspection. The components requiring service are generally the moving parts which include bearings, fan propeller, belts, sheaves and motor.

Cast Aluminum & Metal Parts

Cast aluminum and steel parts usually do not require maintenance during the life of the unit except painted metal surfaces that may require periodic repainting. In a severe, dirty operation, the wheel should be cleaned with a wire brush to prevent an accumulation of foreign matter that could result in fan unbalance. After cleaning wheel, inspect for possible cracks or excessive wear, which can cause unbalance. DO NOT operate a wheel that is cracked, chipped, has broken blades or excessive wear. NOTE: If wheel set screws are loosened and/or wheel is removed from shaft, set screws <u>must</u> be replaced. Set screws cannot be used more than once. Belts on V-belt drive units require periodic inspection and replacement when worn. For multiple belt drives, belts should be replaced with matched sets.

Motor Maintenance

1. Disconnect power to motor.

2. Removing dust and dirt: Blow out open type motor windings with low pressure air to remove dust or dirt. Air pressure above 50 P.S.I. should not be used as high pressure may damage insulation and blow dirt under loosened tape. Dust accumulation can cause excessive insulation temperatures.

3. Lubrication: Consult the motor manufacturer for recommendations.

4. Motors must be stored under cover in a clean, dry, vibration-free location. Remove sufficient packaging material to allow circulation of air around motor. Maintain the temperature of the windings a few degrees above that of the surrounding air to protect against condensation. This may be accomplished by using space heaters, if supplied, or by any other safe, reliable method of heating. Measure and record monthly the ambient air temperature and winding temperature.

To prevent rusting of bearing parts, the rotor must be rotated at regular intervals (30 days) to assure these parts are will covered with oil or grease.

V V-BELT DRIVES

Care should be taken not to over tighten V-belt drive. Excessive belt tension overloads fan and motor bearings. It is much less expensive to replace belts worn from slippage than to replace bearings damaged from excessive loading.

Fans shipped completely assembled have had V-belt drive aligned at the factory. Alignment should be rechecked before operation as a precaution due to handling during shipment.

1. Be sure sheaves are locked in position.

2. Key should be seated firmly in keyway.

3. Place straight edge or taut cord across faces of driving and driven sheaves to check alignment. The motor and fan shafts must be parallel with V-belts and at right angles to the shafts.

4. Start the fan. Check for proper rotation. Run fan at full speed. A slight bow should appear on slack side of belt. Disconnect power and adjust belt tension by adjusting motor on its sliding base. All belts must have some slack on one side.

A WORD OF CAUTION ABOUT MOTORS

Using your hand to test the running temperature of a motor can be a very painful experience:

Normal body temperature	98.6° F
Threshold of pain caused by heat	120.0° F
Average temperature of hot tap water	140.0° F
Average temperature of hot coffee	180.0° F
Normal operating temperature of a fully loaded electric motor, open type, 70° F ambient temperature	174.0° F

You cannot wash your hands in 140° F water!

You cannot stir a fresh cup of coffee with your finger!

You cannot place your hand on a motor that is operating properly without burning your hand!

5. If belts squeal at start up, they may be too loose.

6. When belts have had time to seat in the sheave grooves, then readjust belt tension.

V-belt drive assembly can be mounted as follows:

1. Clean motor and fan shafts. Be sure they are free from corrosive material. Clean bore of sheaves and coat with heavy oil for ease of shaft entry. Remove oil, grease, rust or burrs from sheaves.

2. Place fan sheave on fan shaft and motor sheave on its shaft. **Do not pound sheaves on** as this may damage bearings. Tighten sheaves in place per Table # 1.

3. Move motor on slide base so belts can be placed in grooves of both sheaves without forcing. Do not roll belts or use a tool to force belts over the grooves.

4. Align fan and motor shafts so they are parallel. The belts should be at right angles to the shafts. A straight edge or taut cord placed across the face of the sheaves will aid in alignment.

5. Tighten belts by adjusting motor base. Correct tension gives the best drive efficiency. Excessive tension causes undue bearing pressure.

6. Start the fan and run it at full speed. Adjust belt tension until only a slight bow appears on the slack side of the belts. If slippage occurs, a squeal will be heard at start-up. Eliminate this squeal by **disconnecting power** and tightening up the belts.

7. Give belts a few days running time to become seated in sheave grooves, then readjust belt tension.

If the shafts become scratched or marked, carefully remove sharp edges and high spots such as burrs with fine emery cloth or honing stone. Avoid getting emery dust in the bearings.

Do not apply any belt dressing unless it is recommended by the drive manufacturer. V-belts are designed for frictional contact between the grooves and sides of the belts. Dressing will reduce this friction.

Belt tension on an adjustable pitch drive is obtained by moving the motor, not by changing the pitch diameter of the adjustable sheave.

VI FAN BEARING MAINTENANCE

Sealed Bearings

Sealed for life bearings are pre-lubricated with the correct amount of manufacturer-approved ball bearing grease, and are designed for application where relubrication is not required.

Arrangement #2 units feature two single-row deep groove bearings in a cast iron bearing bracket. Dirt and grease guard seals are an integral part of the assembly. For high temperature applications the bearings are pre-lubricated with a high temperature grease.

Relubricatable Bearings

Relubricatable Type Bearings must be relubricated periodically to assure long life. The length of interval between greasing is dependent on the running speed and ambient conditions. The following table covers most situations and can be used as a guide.

Generally Recommended
Relubrication Frequency in MONTHS

Operating Speed (RPM)	Bore in Inches			
	1/2 to 1	1-1/8 to 1-1/2	1-5/8 to 1-15/16	2 to 2-1/2
To 500	6	6	6	6
501-1000	6	6	6	5
1001-1500	6	5	5	4
1501-2000	5	5	4	3
2001-2500	5	5	3	2
2501-3000	5	4	2	2
3001-3500	4	3	2	1
3501-4000	3	3	1	–
4001-4500	2	2	1	–
4501-5000	2	1	–	–

For normal operating conditions the grease should be lithium base and conform to the NLGI grade #2 or #3 consistency and be free of any chemical impurities such as free acid or free alkali, dust, rust, metal particles or abrasives.

If bearings are in a hostile environment such as temperatures above 120° F, high moisture areas or contaminated areas, more frequent lubrication is required. Consult bearing manufacturer for recommendations.

For best results, bearings should be relubricated while in operation. **NOTE**: Due caution for personal safety must be observed when servicing rotating equipment. The grease should be pumped in slowly until a slight bead forms around the seals. This bead, in addition to acting as an indicator of adequate relubrication, provides additional protection against the entry of foreign matter.

By the time the slight-grease bead is formed, it will be noted that the temperature rise is in the neighborhood of 30° F. If necessary to relubricate while the bearing is idle, contact bearing manufacturer for the maximum grease capacity for the various sizes of bearings.

VII WARRANTY

Cincinnati Fan & Ventilator Company warrants products of its own manufacture against defects of material and workmanship under normal use and service for a period of eighteen (18) months from date of shipment or twelve (12) months from date of installation, whichever occurs first. This warranty does not cover ordinary wear and tear, abuse, misuse, overloading, negligence, alteration or systems and/or materials not of Seller's manufacture. Expenses incurred by Buyer(s) in repairing or replacing any defective product will not be allowed except where authorized in writing and signed by an officer of the Seller.

The obligation of Seller under this warranty shall be limited to repairing or replacing F.O.B. Seller's plant, or allowing credit at Seller's option. This warranty is expressly in lieu of all other warranties expressed or implied including the warranties of merchantability and fitness for use and of all other obligations and liabilities of the Seller. The Buyer acknowledges that no other representations were made to him or relied upon him with respect to the quality or function of the products herein sold.

On equipment furnished by the Seller, but manufactured by others, such as motors, Seller extends the same warranty as Seller receives from the manufacturer thereof. Repairs for motors should be obtained from nearest authorized motor service station for the make of motor furnished. All motors used are products of well-known manufacturers with nationwide service facilities. Check the yellow pages of your telephone directory for the location of the nearest service shop.

Cincinnati Fan & Ventilator Company assumes no responsibility for material returned to our plant without our prior written permission.

VIII ORDERING REPLACEMENT PARTS

Replacement or spare parts may be ordered through your local Cincinnati Fan representative. (Refer to drawings that begin on Page 6.) The following information should accompany parts orders:

1. Motor horsepower, frame size, motor speed, voltage, phase, cycle and enclosure. Motor manufacturer's model number from motor nameplate.
2. Fan Speed (if V-belt driven).
3. Fan arrangement number.
4. Fan serial AND model numbers from the FAN nameplate and a complete description of the part.

An adequate stock of repair parts is maintained where possible. If your fan is vital to production or to plant operation, it may be advisable to have all spare parts on hand to minimize the possibility of downtime.

IX FAN TROUBLE SHOOTING

In the event that trouble is experienced in the field, the following are the most common fan difficulties. These points should be checked in order to prevent needless delay and expense.

1. CAPACITY OR PRESSURE BELOW RATING

a. Incorrect direction of wheel rotation.
b. Speed too slow.
c. Dampers or variable inlet vanes not properly adjusted.
d. Poor fan inlet or outlet conditions (elbows, restrictions).
e. Air leaks in system.
f. Damaged wheel.
g. Total resistance of system higher than anticipated.
h. Wheel mounted backwards on shaft.
i. Fan not properly selected for a high temperature and/or high altitude application.

2. VIBRATION AND NOISE

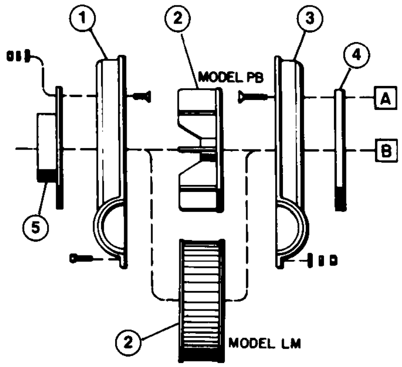
a. Misalignment of bearings, coupling, wheel or V-belt drive.
b. Unstable foundation.
c. Foreign material in fan causing unbalance.
d. Worn bearings.
e. Damaged wheel or motor.
f. Broken or loose bolts and set screws.
g. Bent shaft.
h. Worn coupling.
i. Fan wheel or drive unbalanced.
j. 120 cycle magnetic hum due to electrical input. Check for high or unbalanced voltage.
k. Fan delivering more than rated capacity.
l. Loose dampers.
m. Speed too high or fan rotating in wrong direction.
n. Vibration transmitted to fan from some other source.

3. OVERHEATED BEARINGS

a. Check bearing lubrication.
b. Poor alignment.
c. Damaged wheel or drive.
d. Bent shaft.
e. Abnormal end thrust.
f. Dirt in bearings.
g. Excessive belt tension.

4. OVERLOAD ON MOTOR

a. Speed too high.
b. Blower over capacity due to existing system resistance being lower than original rating.
c. Specific gravity or density of gas above design value.
d. Packing too tight or defective (on fans with stuffing box).
e. Wrong direction of wheel rotation.
f. Shaft bent.
g. Poor alignment.
h. Wheel wedging or binding on inlet bell.
i. Bearings improperly lubricated.
j. Motor improperly wired.
k. Defective motor. Motor must be tested by motor manufacturer's authorized repair shop.



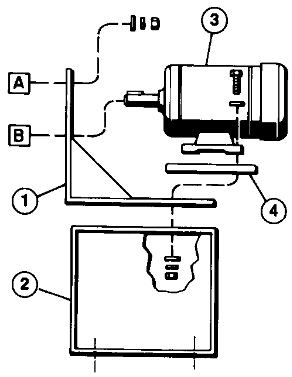
HOUSING WHEEL COMPONENTS

All arrangements

* 1. Housing, inlet side.
* 2. Wheel (PB or LM type).
* 3. Housing, drive side.
  4. Drive side plate (if required).
  5. Inlet side plate (if required).

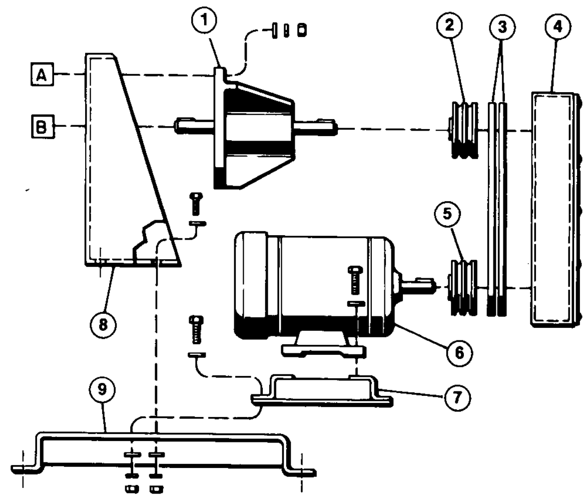
* NOTE: Rotation determined by viewing blower from drive side, **not** looking into inlet.

BASE ARRANGEMENT COMPONENTS



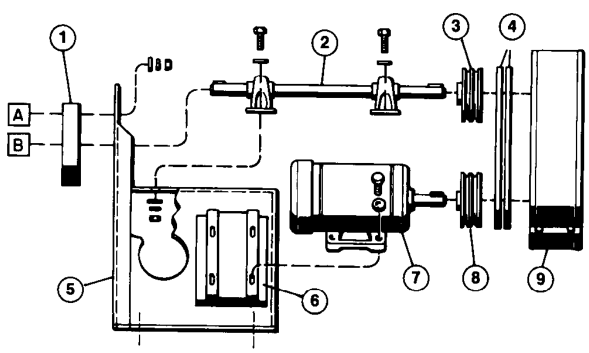
Arrangement 4

1. Angle bracket (if required).
2. Bottom base.
3. Motor.
4. Riser pad (if required).



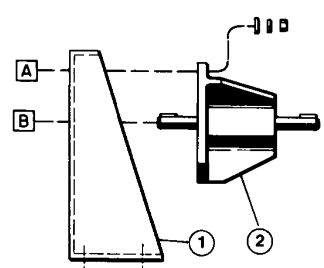
Arrangement 9-2

1. Shaft/bearing assembly.
2. Fan sheave
3. Belt(s).
4. Belt guard.
5. Motor sheave.
6. Motor.
7. Motor slide base.
8. Upright base.
9. Sub base.



Arrangement 9-1

1. Spacer ring.
2. Shaft/bearing assembly.
3. Fan sheave.
4. Belt(s).
5. Bearing base.
6. Motor slide base.
7. Motor.
8. Motor sheave.
9. Belt guard.



Arrangement 2

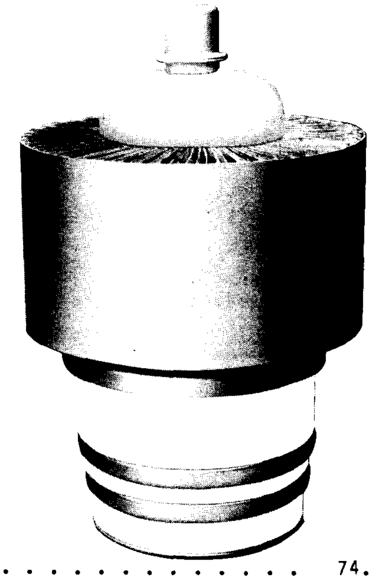
1. Upright base.
2. Shaft/bearing assembly.

TECHNICAL DATA

4CX7500A
VHF
RADIAL BEAM
POWER TETRODE

The EIMAC 4CX7500A is a compact ceramic/metal radial beam power tetrode intended for use in VHF power amplifier applications. It features a type of internal mechanical structure which results in high rf operating efficiency. Low rf losses in this structure permit operation at full ratings to 220 MHz. A dense mesh filament is used which contributes to the high performance capability.

The 4CX7500A has a gain of over 20 dB in FM broadcast service, and is also recommended for rf linear power amplifier service and for VHF-TV linear amplifier service. The anode is rated for 7500 watts of dissipation with forced-air cooling.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten Mesh		
Voltage	7.0 ± 0.35	V
Current, at 7.0 volts	110	A
Amplification Factor, average		
Grid to Screen	4.5	
Direct Interelectrode Capacitances (cathode grounded)[2]		
Cin	145	pF
Cout	20	pF
Cgp	0.5	pF
Direct Interelectrode Capacitances (grids grounded)[2]		
Cin	74.1	pF
Cout	20.6	pF
Cpk	0.065	pF
Maximum Frequency for Full Ratings (CW)	220	MHz

1. Characteristics and operating values are based on performance tests. These figures may change without notice as the result of additional data or product refinement. Varian EIMAC should be consulted before using this information for final equipment design.
2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions:	
Length	8.72 In; 21.5 cm
Diameter	5.66 In; 14.4 cm
Net Weight (approximate)	7.7 Lbs; 3.5 kg
Operating Position	Axis Vertical, Base Up or Down
Cooling	Forced Air
Maximum Operating Temperature, Ceramic/Metal Seals & Anode Core	250°C
Base	Special, Coaxial
Recommended Air-System Socket	HF: EIMAC SK-340
	VHF: EIMAC SK-350
Available Screen Grid Bypass Capacitor Kit for SK-350 or SK-360 (8000 pF @ 5000 DCWV)	EIMAC-SK-355
Recommended Air-System Chimney (for SK-350 or SK-360)	EIMAC SK-346
Recommended EIMAC Cavity Assembly for FM Broadcast Service	CV-2228
Available Anode Connector Clip	EIMAC ACC-3

RADIO FREQUENCY POWER AMPLIFIER
Class C Telegraphy or FM
(Key-down Conditions)

ABSOLUTE MAXIMUM CONDITIONS

DC PLATE VOLTAGE	7500	VOLTS
DC SCREEN VOLTAGE	1500	VOLTS
DC GRID VOLTAGE	-500	VOLTS
DC PLATE CURRENT	3.0	AMPERES
PLATE DISSIPATION	7500	WATTS
SCREEN DISSIPATION	165	WATTS
GRID DISSIPATION	50	WATTS

TYPICAL OPERATION
(Measured data in EIMAC CV2228 FM cavity at 100.5 MHz)

Plate Voltage	6.5	6.5	6.5	kVdc
Screen Voltage	635	750	750	Vdc
Grid Voltage	-460	-275	-400	Vdc
Plate Current	2.1	2.2	2.4	Adc
Screen Current	195	128	140	mAdc
Grid Current	185	90	95	mAdc
Driving Power	247	100	130	W
Efficiency	79.3	77.6	77.0	%
Useful Output Power	10.8	11.1	12.1	kW
Power Gain	16	20	19.7	dB

394625(Effective April 1985)
VA4807

Printed in U.S.A.

Varian EIMAC / 301 Industrial Way / San Carlos, CA / 94070

RADIO FREQUENCY LINEAR AMPLIFIER
Class AB1

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE . . .	7500	VOLTS
DC SCREEN VOLTAGE . .	1500	VOLTS
DC GRID VOLTAGE . . .	-500	VOLTS
DC PLATE CURRENT . . .	3.0	AMPERES
PLATE DISSIPATION . .	7500	WATTS
SCREEN DISSIPATION . .	165	WATTS
GRID DISSIPATION . . .	50	WATTS

Typical Operation, Peak Envelope or Modulation Crest Conditions (frequencies below 30 MHz)

Plate Voltage	7500	Vdc
Zero Signal Plate Current	750	mAdc
Max.Signal Plate Current	2.2	Adc
Screen Voltage	1250	Vdc
Screen Current *	95	mAdc
Grid Bias Voltage **	-190	Vdc
Grid Current *	0	mAdc
Useful Power Out # ##	10	kW
Driving Power *	0	W
Intermodulation Distortion Products §		
3rd Order Products	-32	dB
5th Order Products	-44	dB

* Approximate Value
** Adjust to specified zero-signal plate current
\# PEP output or rf power at crest of modulation envelope
§ Referenced against one tone of a two equal-tone signal
Delivered to the load

TYPICAL OPERATION values are obtained by measurement or by calculation from published characteristic curves. To obtain the specified plate current at the specified bias, screen, and plate voltages, adjustment of the rf grid voltage is assumed. If this procedure is followed, there will be little variation in ouput power when the tube is replaced, even though there may be some variation in grid and screen currents. The grid and screen currents which occur when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no performance degradation providing the circuit maintains the correct voltage in the presence of the current variations.

APPLICATION

MECHANICAL

MOUNTING - The 4CX7500A must be mounted with its axis vertical, base up or down at the convenience of the equipment designer, and should be protected from shock and vibration which could damage the internal structure of the tube.

AIR-SYSTEM SOCKET & CHIMNEY - The EIMAC sockets type SK-340 and SK-350 are designed especially for the concentric base terminals of the 4CX7500A. The SK-340 is intended for use at HF, while the SK-350 is recommended for VHF applications. The SK-346 chimney is intended for use with the either. Use of the recommended air flow rates through either socket will provide effective forced-air cooling of the tube. Air forced into the bottom of the socket passes over the tube terminals and through the chimney and into the anode cooling fins.

COOLING - Forced-air cooling is required in all applications. The blower selected in a given application must be capable of supplying the desired air flow at a back pressure sufficient for the tube, plus any drop caused by ducts and filters. Air flow must be applied before or simultaneously with the application of power, including the filament, and may be removed simultaneously with filament voltage.
Minimum air flow requirements for a maximum anode temperature of 225°C for various altitudes and dissipation levels are listed. The pressure drop values shown are approximate and are for the SK-340/tube/SK-346 combination. If an SK-350 is used air passages in addition to those in the socket may be required for low pressure drop.

Inlet Air Temperature = 25°C

	Plate Diss. Watts	Flow Rate CFM	Press. Drop In.Water
Sea Level	5000	192	1.0
	7500	414	4.3
5000 Feet	5000	232	1.2
	7500	501	5.1
10,000 Feet	5000	281	1.4
	7500	607	6.1

Inlet Air Temperature = 35°C

	Plate Diss. Watts	Flow Rate CFM	Press. Drop In.Water
Sea Level	5000	220	1.25
	7500	476	5.42
5000 Feet	5000	268	1.5
	7500	576	6.5

10,000 Feet	Plate Diss. Watts	Flow Rate CFM	Press. Drop In.Water
	5000	324	1.75
	7500	698	7.75

Inlet Air Temperature = 50°C

Sea Level	Plate Diss. Watts	Flow Rate CFM	Press. Drop In.Water
	5000	280	1.8
	7500	592	7.9

5000 Feet	Plate Diss. Watts	Flow Rate CFM	Press. Drop In.Water
	5000	332	2.1
	7500	717	9.4

10,000 Feet	Plate Diss. Watts	Flow Rate CFM	Press. Drop In.Water
	5000	402	2.5
	7500	868	11.3

With operation at plate dissipation below 5.0 kW and lower air flow inherent with that operation, special attention is required for cooling the center of the stem (base), by means of special directors or some other provision. Temperature measurements in this area should be made, as well as the anode seal areas, during development of the equipment. Temperature-sensitive paints are available for this purpose, and Application Bulletin #20 titled TEMPERATURE MEASUREMENTS WITH EIMAC POWER TUBES is available from EIMAC on request.
An air interlock system should be incorporated in the design to automatically remove all voltages from the tube in case of even a partial failure of the tube cooling air.
It is considered good engineering practice to supply more than the minimum required cooling air, to allow for variables such as dirty air filters, rf seal heating, and dirty anode cooling fins if the tube has been in service for some time.

ELECTRICAL

ABSOLUTE MAXIMUM RATINGS - Values shown for each type of service are based on the "absolute system" and are not to be exceeded under any service conditions. These ratings are limiting values outside which the serviceability of the tube may be impaired. In order not to exceed absolute ratings the equipment designer has the responsibility of determining an average design value for each rating below the absolute value of that rating by a safety factor so that the absolute values will never be exceeded under any usual conditions of supply-voltage variation, load variation, or manufacturing variation in the equipment itself. <u>It does not necessarily follow that combinations of absolute maximum ratings can be attained simultaneously</u>.

FILAMENT OPERATION - At rated (nominal) filament voltage the peak emission capability of the tube is many times that needed for communication service. A reduction in filament voltage will lower the filament temperature, which will substantially increase life expectancy. The correct value of filament voltage should be determined for the particular application. It is recommended the tube be operated at full nominal voltage for an initial stabilization period of 100 to 200 hours before any action is taken to operate at reduced voltage. The voltage should gradually be reduced until there is a slight degradation in performance (such as power output or distortion). The filament voltage should then be increased a few tenths of a volt above the value where performance degradation was noted. The operating point should be rechecked after 24 hours. Filament voltage should be closely regulated when voltage is to be reduced in this manner, to avoid any adverse influence by normal line voltage variations. Filament voltage should be measured at the tube base or socket, using an accurate rms-responding meter. Periodically the procedure outlined above for reduction of voltage should be repeated, with voltage reset as required, to assure best life.

GRID OPERATION - The maximum control grid dissipation is 50 watts, determined approximately by the product of the dc grid current and the peak positive grid voltage.

SCREEN OPERATION - The maximum screen grid dissipation is 165 watts. With no ac applied to the screen grid, dissipation is simply the product of dc screen voltage and the dc screen current. With screen modulation, dissipation is dependent on rms screen voltage and rms screen current. Plate voltage, plate loading, or bias voltage must never be removed while filament and screen voltages are present, since screen dissipation ratings will be exceeded. A protective spark-gap device should be connected between the screen grid and the cathode to guard against excessive voltage.

SCREEN CURRENT - The screen current may reverse under certain conditions and produce negative indications on the screen current meter. This is a normal characteristic of most tetrodes. The screen power supply should be designed with this characteristic in mind, so that the correct operating voltage will be maintained on the screen under all conditions. A current path from the screen to cathode must be provided by a bleeder resistor or a shunt regulator connected between screen and cathode and arranged to pass approximately 10% of the average screen current per connected tube. A series regulated power supply can be used only when an adequate bleeder resistor is provided.

FAULT PROTECTION - In addition to the normal plate over-current interlock, screen current interlock, and air-flow interlock, the tube must be protected from internal damage caused by an internal plate arc which may occur at high plate voltage. A protective resistance should always be connected in series with each tube anode, to absorb power supply stored energy if an internal arc should occur. EIMAC's Application Bulletin #17 titled FAULT PROTECTION contains considerable detail, and is available on request.

HIGH VOLTAGE - Normal operating voltages used with this tube are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage capacitors whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

RADIO-FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 300 MHz most of the energy will pass completely through the human body with little attenuation or heating affect. Public health agencies are concerned with the hazard even at these frequencies. OSHA (Occupational Safety and Health Administration) recommends that prolonged exposure to rf radiation should be limited to 10 milliwatts per square centimeter.

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time. The capacitance values shown here are taken in accordance with Standard RS-191. The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal appliction. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

SPECIAL APPLICATIONS - When it is desired to operate this tube under conditions widely different from those listed here, write to Varian EIMAC; Attn: Product Manager; 301 Industrial Way; San Carlos, CA 94070 U.S.A.

OPERATING HAZARDS

PROPER USE AND SAFE OPERATING PRACTICES WITH RESPECT TO POWER TUBES ARE THE RESPONSIBILITY OF EQUIPMENT MANUFACTURERS AND USERS OF SUCH TUBES. ALL PERSONS WHO WORK WITH OR ARE EXPOSED TO POWER TUBES OR EQUIPMENT WHICH UTILIZES SUCH TUBES MUST TAKE PRECAUTIONS TO PROTECT THEMSELVES AGAINST POSSIBLE SERIOUS BODILY INJURY. DO NOT BE CARELESS AROUND SUCH PRODUCTS.

The operation of this tube may involve the following hazards, any one of which, in the absence of safe operating practices and precautions, could result in serious harm to personnel:

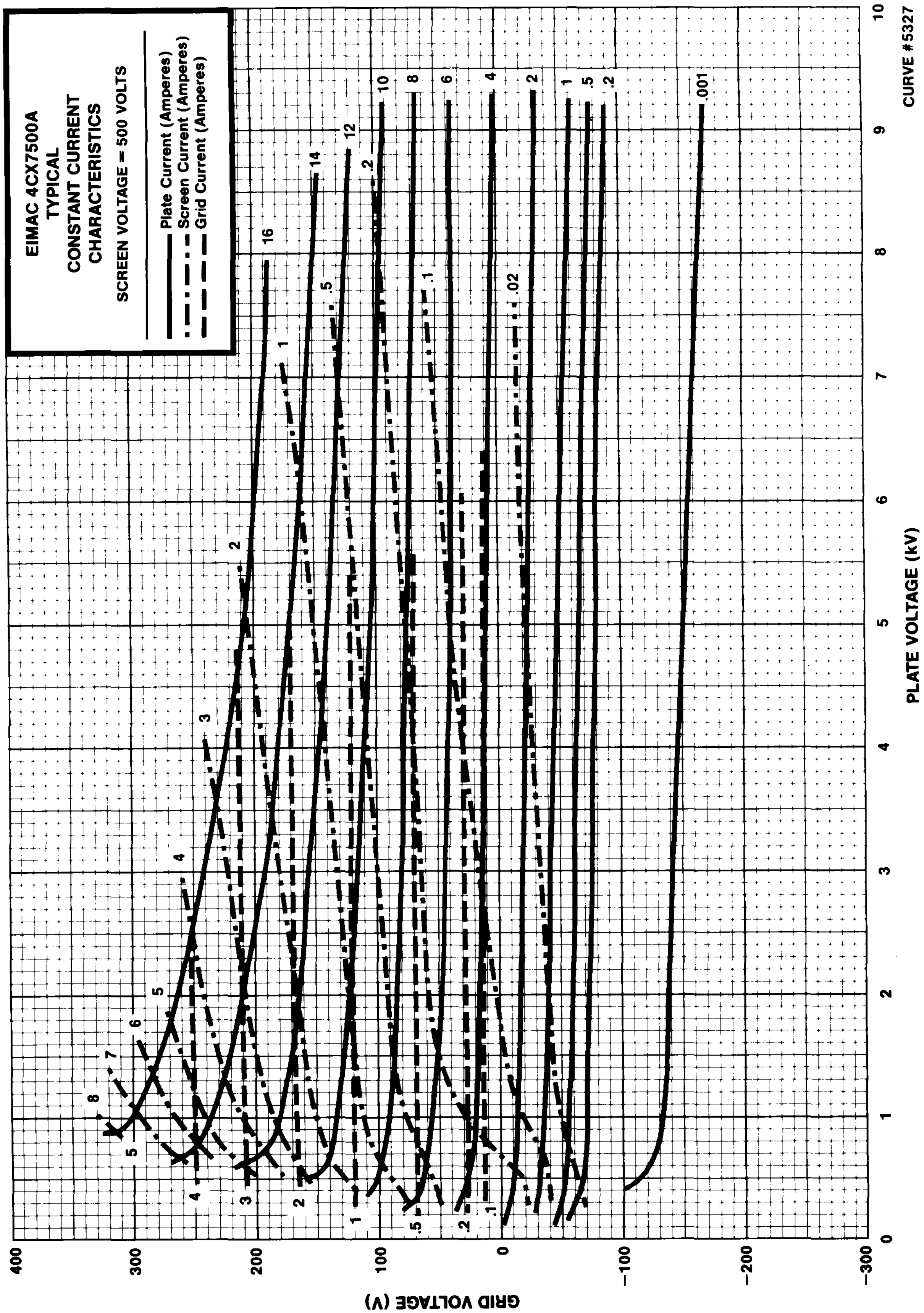
a. HIGH VOLTAGE - Normal operating voltages can be deadly. Remember that HIGH VOLTAGE CAN KILL.

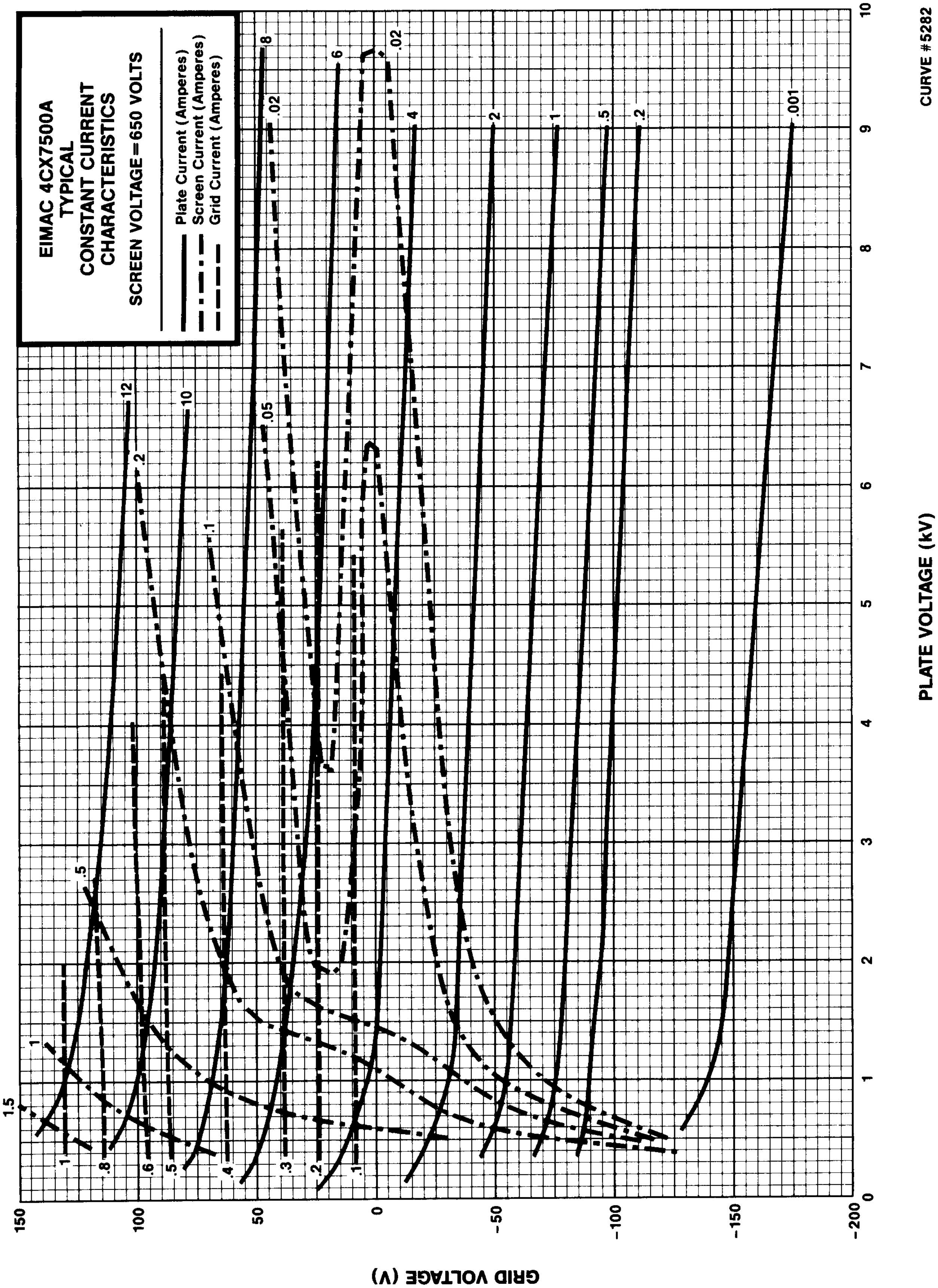
b. LOW-VOLTAGE HIGH-CURRENT CIRCUITS - personal jewelry, such as rings, should not be worn when working with filament contacts or connectors as a short circuit can produce very high current and melting, resulting in severe burns.

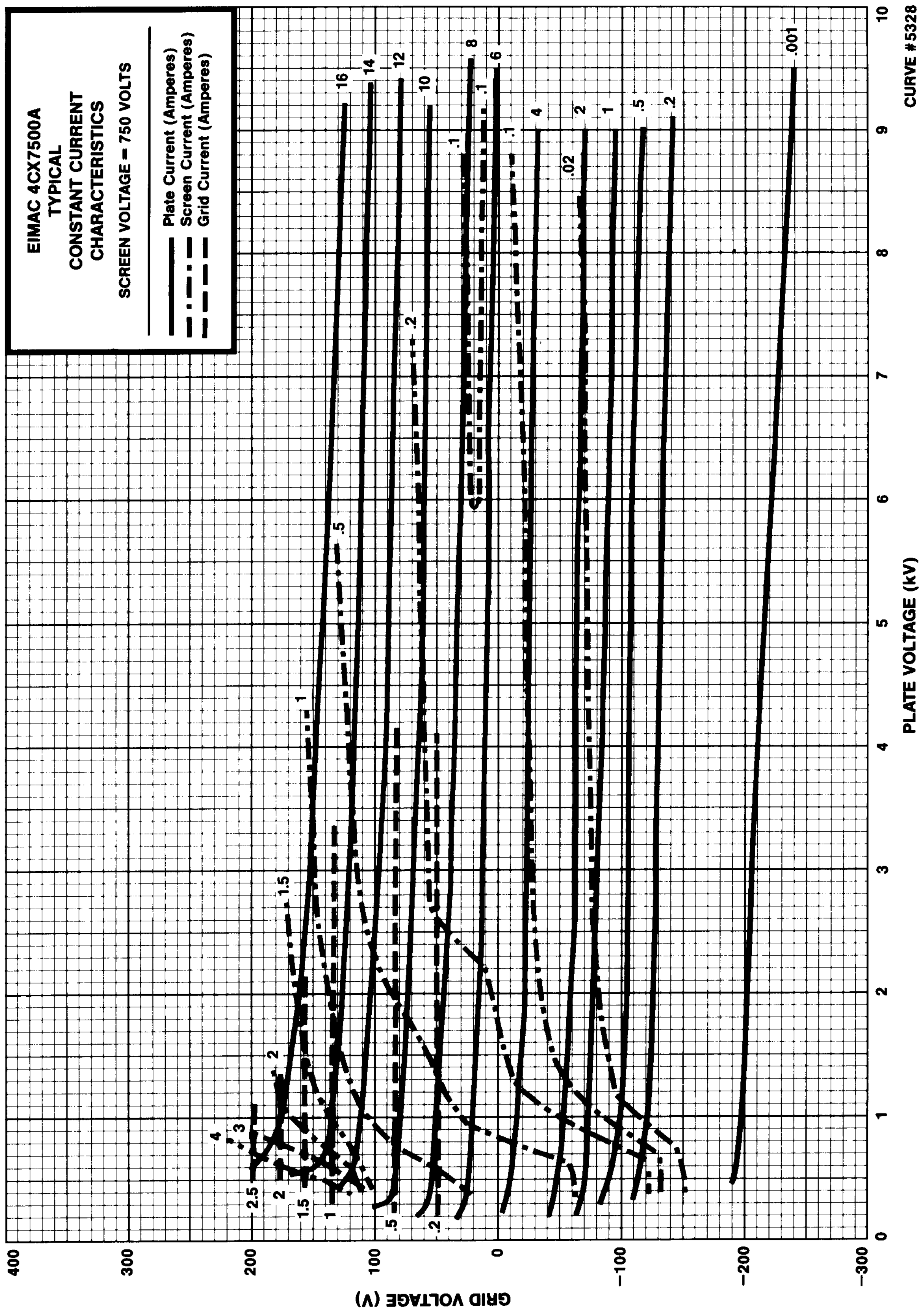
c. RF RADIATION - Exposure to strong rf fields should be avoided, even at relatively low frequencies. The dangers of rf radiation are more severe at UHF and microwave frequencies and can cause serious bodily and eye injuries. CARDIAC PACEMAKERS MAY BE EFFECTED.

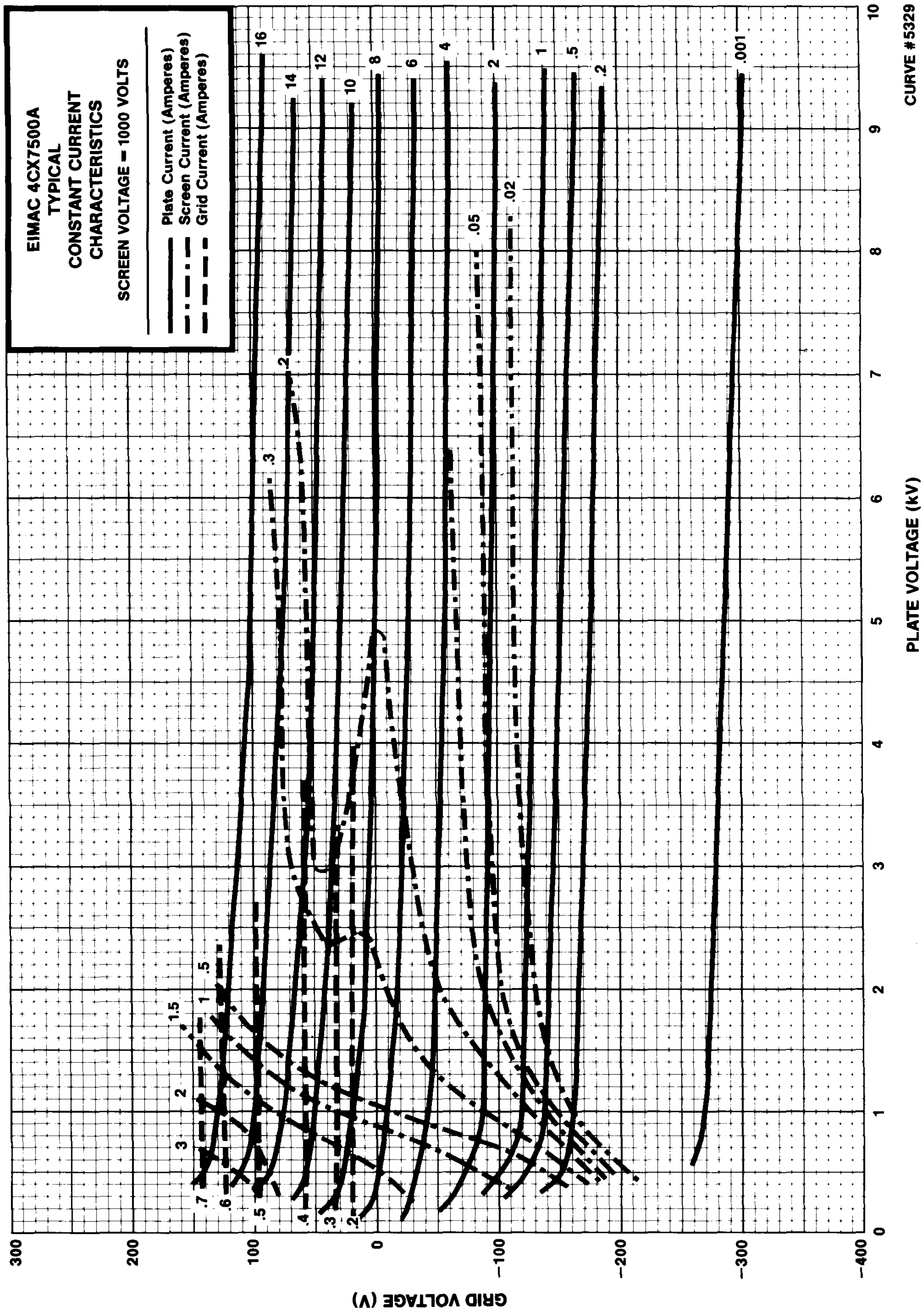
d. HOT SURFACES - Surfaces of tubes can reach temperatures of several hundred °C and cause serious burns if touched for several minutes after all power is removed.

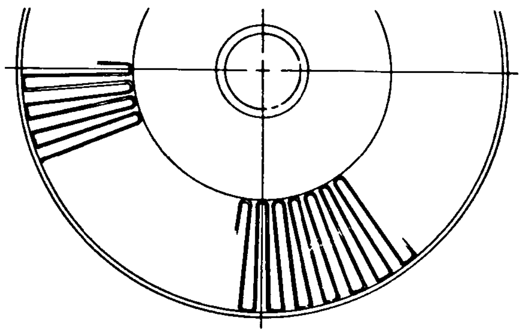
Please review the detailed operating hazards sheet enclosed with each tube, or request a copy from: Varian EIMAC, Power Grid Application Engineering, 301 Industrial Way, San Carlos CA 94070.


EIMAC 4CX7500A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 500 VOLTS
Plate Current (Amperes)
Screen Current (Amperes)
Grid Current (Amperes)
PLATE VOLTAGE (kV)
GRID VOLTAGE (V)
CURVE #5327


EIMAC 4CX7500A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE=650 VOLTS
Plate Current (Amperes)
Screen Current (Amperes)
Grid Current (Amperes)
PLATE VOLTAGE (kV)
GRID VOLTAGE (V)
CURVE #5282


EIMAC 4CX7500A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 750 VOLTS
Plate Current (Amperes)
Screen Current (Amperes)
Grid Current (Amperes)
PLATE VOLTAGE (kV)
GRID VOLTAGE (V)
CURVE #5328

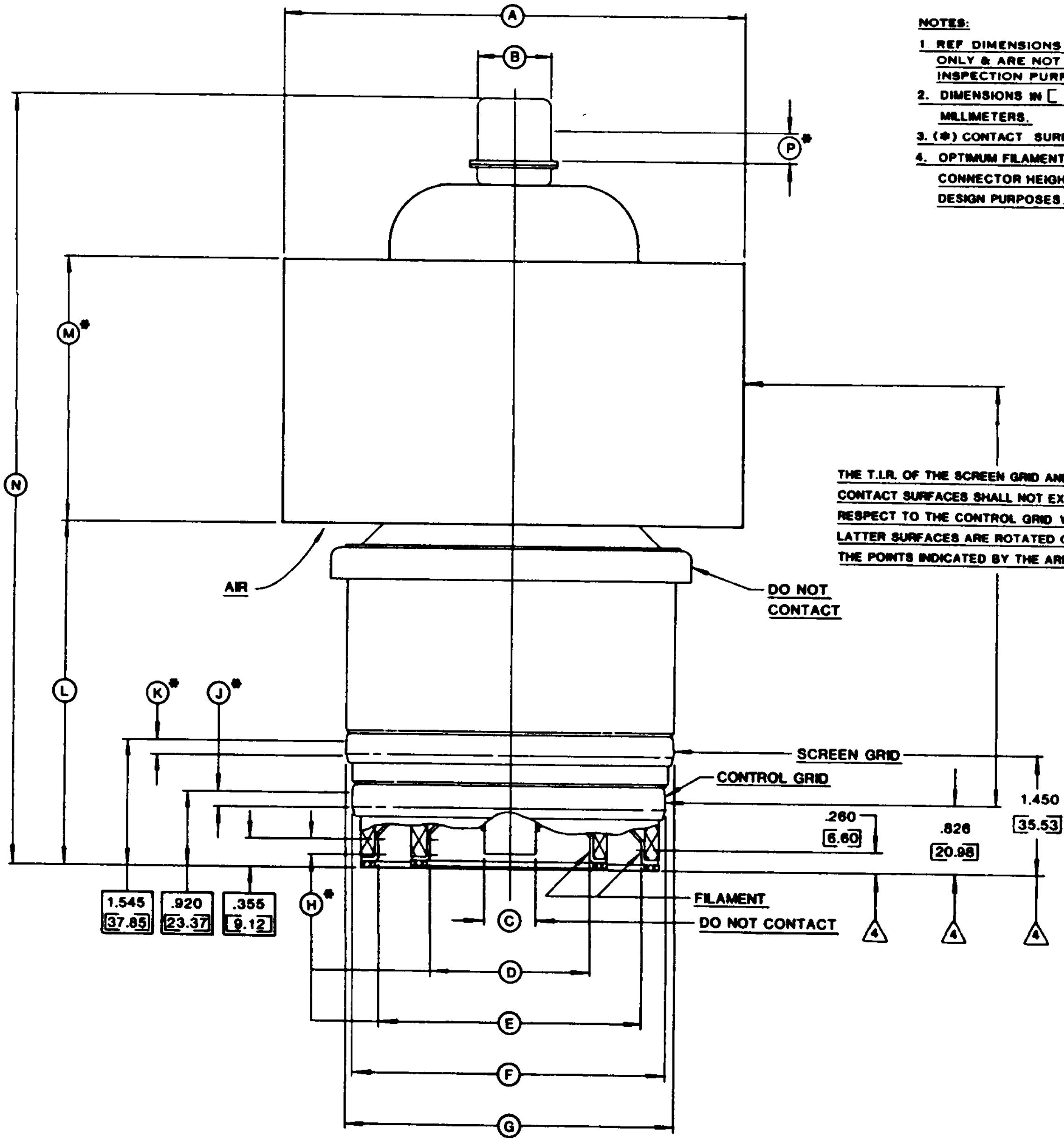

EIMAC 4CX7500A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1000 VOLTS
Plate Current (Amperes)
Screen Current (Amperes)
Grid Current (Amperes)
PLATE VOLTAGE (kV)
GRID VOLTAGE (V)
CURVE #5329



DIMENSIONAL DATA						
	INCHES			MILLIMETERS		
DIM	MIN	MAX	REF.	MIN.	MAX	REF
A	5.539	5.663		140.69	143.84	
B	.855	.895		21.72	22.73	
C	.600	.760		15.24	19.30	
D	1.896	1.936		48.16	49.17	
E	3.133	3.173		79.58	80.59	
F	3.792	3.832		96.32	97.32	
G	3.980	4.020		101.09	102.11	
H	.188			4.78		
J	.188			4.78		
K	.188			4.78		
L	3.863	4.210		97.43	106.93	
M	2.812	3.187		71.42	80.95	
N	8.469	8.718		215.11	246.86	
P	.375			9.53		
R						
S						
T						
U						
V						
W						
Y						

NOTES:

1. REF DIMENSIONS ARE FOR INFO ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. DIMENSIONS IN [ ] ARE MILLIMETERS.
3. (*) CONTACT SURFACE.
4. OPTIMUM FILAMENT & GRID CONNECTOR HEIGHTS FOR SOCKET DESIGN PURPOSES.



THE T.I.R. OF THE SCREEN GRID AND FILAMENT CONTACT SURFACES SHALL NOT EXCEED .040 WITH RESPECT TO THE CONTROL GRID WHEN THE LATTER SURFACES ARE ROTATED ON ROLLERS AT THE POINTS INDICATED BY THE ARROWS

EXTENDING TRANSMITTER TUBE LIFE

EIMAC APPLICATION BULLETIN NO. 18

A carefully followed program of filament voltage management can substantially increase the life expectancy of transmitter power grid tubes. With today's rising operating costs, such a program makes good financial sense.

IN RECENT YEARS station managers have seen a substantial increase in replacement costs for power grid tubes. The blame can be placed on higher manufacturing costs due to inflation, volatile precious metal prices, and an uncertain supply of some exotic metals. The current outlook for the future holds little promise for a reversal in this trend toward higher prices.

One way to offset higher operating costs is to prolong tube life. For years station engineers have used various tricks to get longer operating life, with greater and lesser degrees of success. Success can be maximized, however, by understanding the various

varian® eimac

301 Industrial Way
San Carlos, CA 94070

1678 So.Pioneer Rd.
Salt Lake City, UT 84104

EIMAC Application Bulletin AB-18
Revised March, 1990

factors that affect tube life and implementing a program of filament voltage management.

A number of factors can aid maximum tube life in your transmitter. For example, are the maximum ratings given on the tube manufacturer's data sheet being exceeded? Data sheets are available upon request from most companies. Most tube manufacturers have an application engineering department to assist in evaluating tube performance for a given application. Make use of these services!

Headroom

Is the final power tube of the transmitter capable of delivering power in excess of the desired operating level? Or is the demand for performance so great that minimum output power levels can only be met at rated nominal filament voltage?

Figure 1 can be used as a basic guide to determine if a given transmitter and tube combination has a good probability of giving extended life service. Extended life service is defined as useful operating life beyond that normally achieved by operating at rated nominal filament voltage. The amperes/watt ratio is obtained by dividing average plate current by the product of filament voltage and filament current. If the amperes/watt ratio falls in the "good" to "excellent" range, excess emission is sufficient to permit filament voltage derating. At a lower filament voltage, the filament temperature is lowered, thus extending life. A typical FM transmitter on the market today may have an amperes/watt filament ratio of 0.002 to 0.003. This equipment would be considered an excellent choice to achieve extended tube life. On the other hand, if the amperes/watt ratio falls in the "poor" range, it is unlikely that filament derating is possible due to limited emission. Note that this guideline should be used for thoriated tungsten emitters only, and does not apply to oxide cathode-type tubes.

Instrumentation

Are all tube elements metered in the transmitter? Elements should be metered for both voltage and current, and meters should be redlined to define operation within safe limits. More modern transmitters may incorporate a microprocessor-controlled circuit to monitor all pertinent parameters.

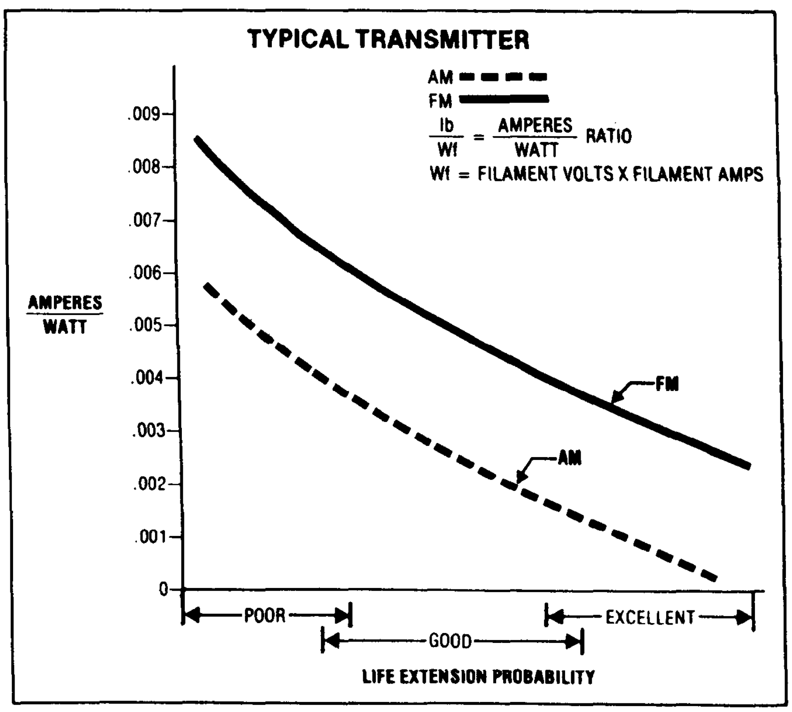
In addition, the following controls are necessary if an effective filament voltage management program is to be undertaken: power output metering for an FM transmitter or a distortion level meter for AM equipment; *accurate* filament voltage metering (an iron-vane instrument is preferred over the more common average responding RMS calibrated type; the filament voltage measurement must be made at the tube socket terminals); filament voltage control, capable of being adjusted to 0.1 V secondary voltage change; and a filament current meter—desirable but optional.

A means must be provided to hold filament voltage constant. If the filament voltage is permitted to vary in accordance with primary line voltage fluctuation, the effect on tube life can be devastating. An acceptable solution is the use of a ferroresonant transformer or line regulator. This accessory is offered by some transmitter manufacturers as an option and should be seriously considered if a tube life extension program is planned.

Transmitter housekeeping

Once the transmitter has been place in operation, tube life is in the hands of the chief engineer. The first action to prolong tube life falls into the category of routine maintenance. Most transmitter manufac-

Fig. 1. Probability of extended life service can be determined from this graph. Divide the average p.a. plate current in amperes by the product of filament voltage and current. The resulting amperes/watt ratio (Y-axis) is projected horizontally to the appropriate curve. The vertical projection to the X-axis indicate the life extension probability.



Extending Transmitter Tube Life

Figure 2

Figure 3

Figure 4

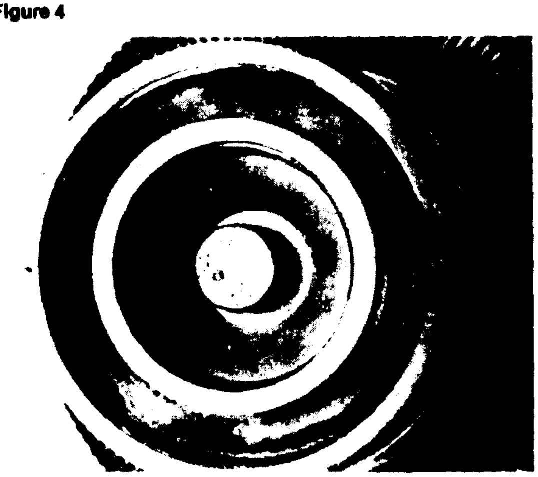


Figure 5

turers have a routine maintenance schedule established in the equipment manual. This procedure must be followed carefully if operating costs are to be held to a minimum. During routine maintenance it is very important to look for tube and socket discoloration, either of which can indicate overheating.

Look for discoloration around the top of the cooler near the anode core and at the bottom of the tube stem where the filament contacts are made. Review Figures 2 and 3 for examples of a tube operating with inadequate cooling. It is possible for discoloration to appear in the areas mentioned if the transmitter has to operate in a dirty environment. If this is the case, the tube should be removed and cleaned with a mild detergent. After cleaning, the tube should be rinsed thoroughly to remove any detergent residue and blown dry with compressed air. If the discoloration remains, this is an indication that the tube has operated at too high a temperature. Check inlet and outlet air ducting and filters for possible air restriction. It may also be necessary to verify that the air blower is large enough to do the job in the present environment and that it is operating at rated capacity.

With the tube removed, the socket should be blown or wiped clean and carefully inspected. Any discoloration in the socket finger stock caused by overheating could contribute to early tube failure. A finger stock that loses its temper through prolonged operation at high temperature will no longer make contact to the tube elements (Figure 4). A well-maintained socket will score the tube contacts when the tube is inserted. If all fingers are not making contact, more currect flows through fewer contacting fingers, causing additional overheating and possible burnout (Figure 5).

Filament voltage management

The useful operating life of a thoriated tungsten emitter can vary widely with filament voltage. Figure 6 describes the relative life expectancy with various filament voltage levels. Obviously, a well-managed filament voltage program will result in longer life expectancy. Improper management, on the other hand, can be very costly.

For a better understanding of this sensitive aging mechanism, the filament itself must be understood. Most filaments in high-power, gridded tubes are a mixture of tungsten and thoria with a chemical com-

***Fig. 2.** Improper cooling means short tube life (left). Discoloration of metal around inner filament stem and anode fins indicates poor cooling or improper operation of tube. Properly cooled and operated tube (right) shows no discoloration after many hours of use. In both cases, good socketing is indicated by scoring on circular connector rings.*

***Fig. 3.** Dirty and discolored cooler of amplifier tube at left indicates combination of discoloration due to heating and lack of cleaning. Tube has operated too hot and dust has collected in anode louvres.*

***Fig. 4.** Minute scoring in base contact rings indicates that socket finger stock has made good, low-resistance contact to tube elements. Well-maintained socket will score the tube contacts when tube is inserted. If all fingers do not make contact, more current will flow through fewer contact fingers, causing additional overheating and burning, as shown in Fig. 5.*

***Fig. 5.** High resistance socket contacts has caused severe burning of contact area in the base. Overheated base caused early demise of tube.*

position of W + ThO_2. A filament made of this wire is not a suitable electron emitter for extended life applications until it is processed. Once the filament is formed into the desired shape and mounted, it is heated to approximately 2100°C in the presence of a hydrocarbon. The resulting thermochemical reaction forms di-tungsten carbide on the filament's surface. Life is proportional to the degree of carburization. If the filament is overcarburized, however, it will be brittle and easily broken during handling and transporting. Therefore, only approximately 25% of the cross-sectional area of the wire is converted to di-tungsten carbide. Di-tungsten carbide has a higher resistance than tungsten; thus, the reaction can be carefully monitored by observing the reduction in filament current as the carburizing process proceeds.

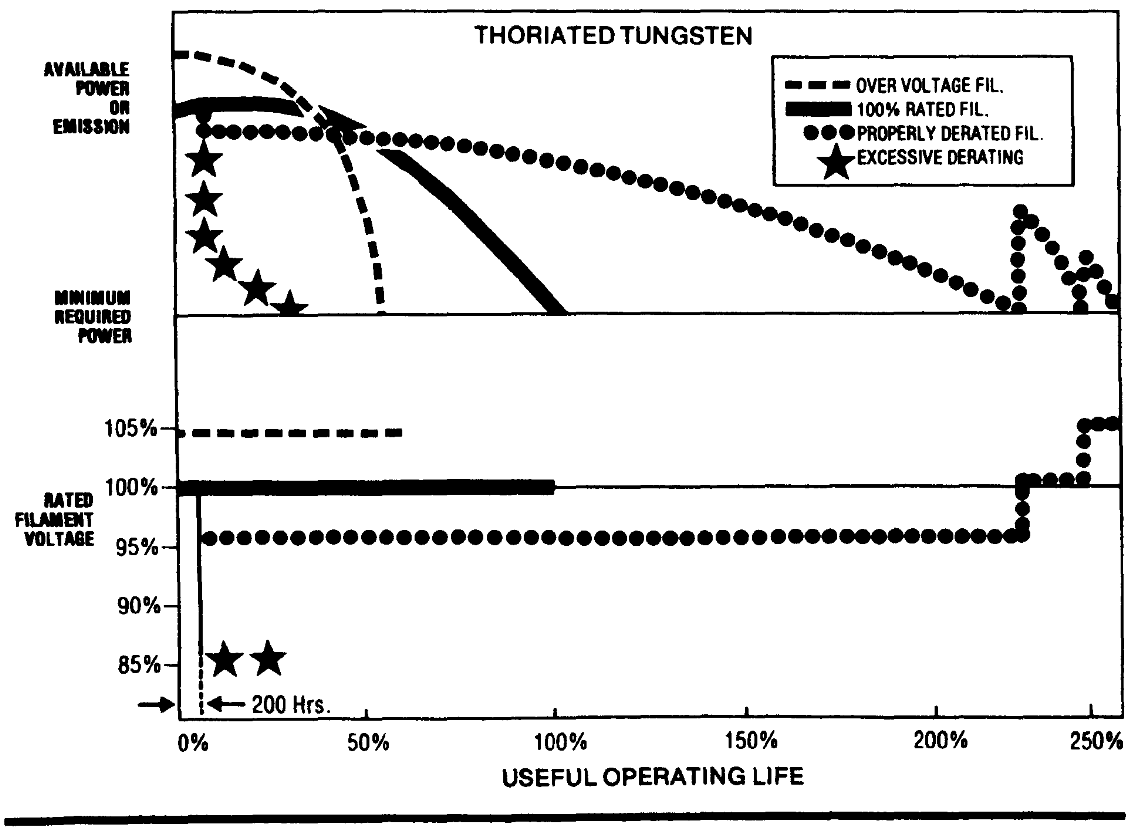
As the tube is used the filament slowly decarburizes. At some point in life, all of the di-tungsten carbide layer is depleted and the reduction of thoria to free thorium stops. The filament is now decarburized and is no longer an effective electron emitter.

The key to extending the life of a thoriated tungsten filament emitter is to control operating temperature. Emitter temperature is a function of the total RMS power applied to the filament. Thus, filament voltage control is temperature control. Temperature varies directly with voltage. As the emitter temperature rises the de-carburizing process is accelerated and tube life shortened. Figure 6 shows that useful tube life can vary significantly with only a 5% change in filament voltage.

FILAMENT VOLTAGE MANAGEMENT (Figure 6)

Filament voltage management allows extended tube life when accompanied by a continuing housekeeping program. When filament voltage is too high (dashes), power tube looses emission rapidly and normal operating life is not achieved. When filament is operated at rated voltage (black curve) normal tube life is achieved in a majority of cases. With a filament voltage management program (bullets), extended tube life may be achieved. When the minimum required output power level is finally reached (right-hand portion of curve), the filament voltage may be raised to rated value, or above, to achieve additional useful operating life. If filament is run "cool" (stars), extremely short life will result. Note that filament voltage management program does not take effect until about 200 hours of operating time have passed.

If voltage management program is not undertaken, tube should be run at rated filament voltage.



Extending Transmitter Tube Life

Of great importance to long tube life is the temperature of the elements and the ceramic-to-metal seals. Element temperature can be held within proper limits by observing the maximum dissipation ratings listed in the data sheet. Seal temperature should be limited to 200°C at the lower anode seal under worst-case conditions. As element temperature rises beyond 200°C, the release of contaminants locked in the materials used in tube manufacturing increases rapidly. These contaminants cause a rapid depletion of the di-tungsten carbide layer of the filament.

When a new power tube is installed in a transmitter, it must be operated at rated nominal filament voltage for the first 200 hours. This procedure is very important for two reasons. First, operation at normal temperature allows the getter to be more effective during the early period of tube life when contaminants are more prevalent. This break-in period conditions the tube for operation at lower filament voltage to obtain longer filament life. Secondly, during the first 200 hours of operation filament emission increases. It is necessary for the life extension program to start at the peak emission point.

A chart recorder or other device should be used to monitor variations in primary line voltage for several days of transmitter operation. The history of line voltage variations during on-air time must be reviewed prior to derating filament voltage. Plan to establish the derated voltage during the time period of historically low line voltage, as this is the worst-case condition. If line variation is greater that ± 3%, filament voltage must be regulated.

Record output power (FM) or distortion level (AM) with the tube operating at rated nominal filament voltage. Next, reduce filament voltage in increments of 0.1 V and record power or distortion levels at each increment. Allow one minute between each increment for the filament emission to stabilize.

When a noticeable change occurs in output power or the distortion level changes, the derating procedure must stop. Obviously, operation at this point is unwise since there is no margin for a drop in line voltage. It is safer to raise the voltage 0.2 V above the critical voltage at which changes are observed to occur. Finally, recheck power output or distortion to see if they are acceptable at the chosen filament voltage level. Recheck again after 24 hours to determine if emission is stable and that the desired performance is maintained. If performance is not repeatable, the derating procedure must be repeated.

Continuing the program

The filament voltage should be held at the properly derated level as long as minimum power or maximum distortion requirements are met. Filament voltage can be raised to reestablish minimum requirements as necessary. This procedure will yield results similar to those shown in the illustration, to achieve as much as 10% to 15% additional life extension. When it becomes necessary to increase filament voltage, it is a good time to order a new tube. Filament voltage can be increased as long as the increase results in maintaining minimum level requirements.

When an increase fails to result in meeting a level requirement, filament emission must be considered inadequate and the tube should be replaced. Don't discard it or sell it for scrap! Put it on the shelf and save it. It will serve as a good emergency spare and may come in very handy some day. Also, in AM transmitters, a low-emission RF amplifier tube can be shifted to modulator use where the peak filament emission requirement is not as severe.

Start planning for longer tube life now! Review the following steps you can take:

- Investigate the manufacturer's ratings on the power tubes in your present equipment, or the transmitter you plan to buy.
- Check that your transmitter has sufficient headroom. Is there a margin of safety in tube operation?
- Look for important instrumentation in the next transmitter you buy. Are all tube elements monitored for voltage and current in the transmitter?
- Whether your transmitter is new or old, start a filament life extension program.

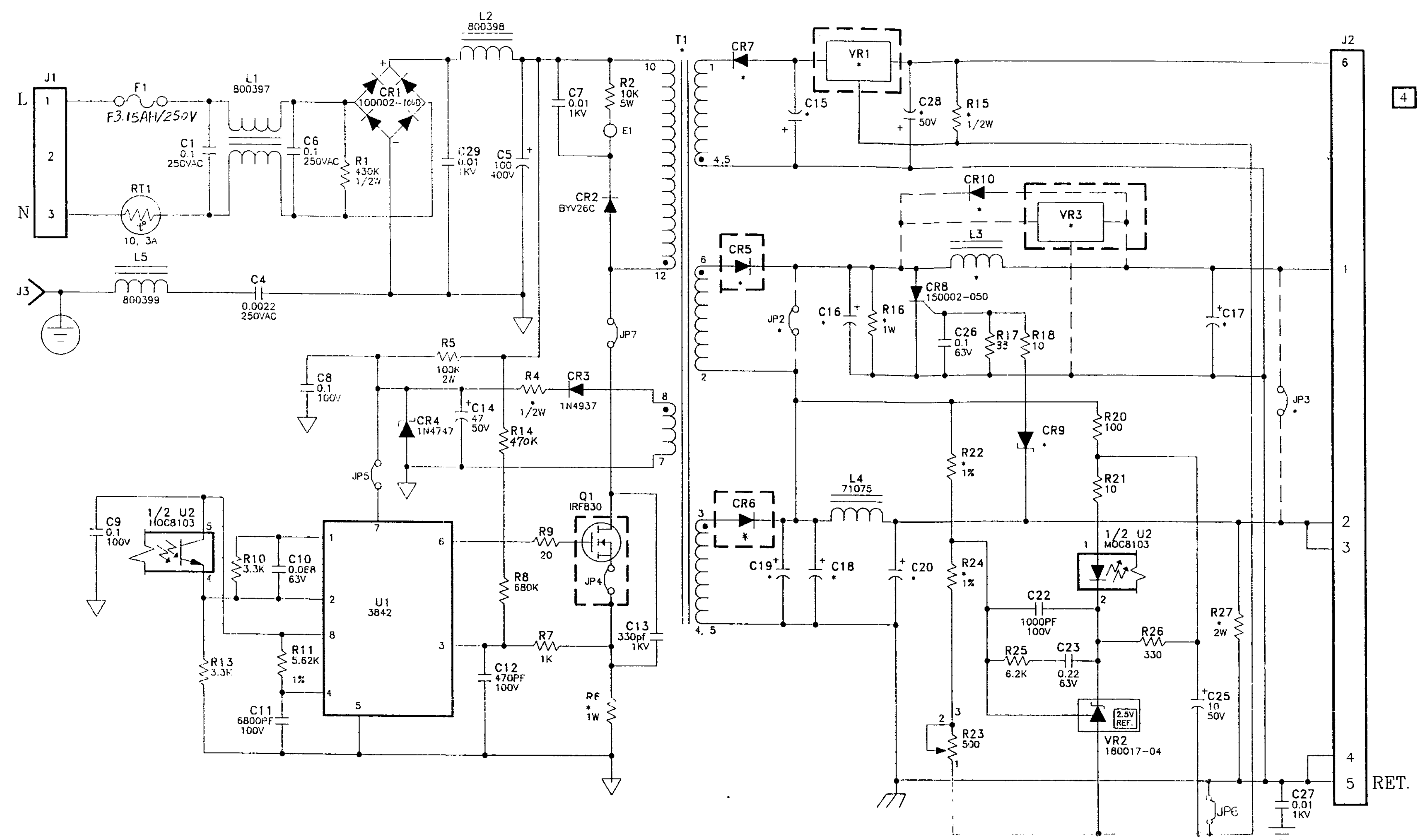
Remember that each time you replace a power tube, the recommended derating procedure must be rerun. Voltage levels required with one tube do not apply to a replacement tube.

When purchasing a tube, insist on a new tube that carries the full, original manufacturer's warranty. Only tubes manufactured by the company of origin have to perform to published data. This is the important reason that transmitter manufacturers buy new, warranted tubes from the original manufacturer.

Thanks to William Barkley, William Orr, William Sain, and Bob Tornoe, all of Varian EIMAC, for their help and suggestions in preparing this paper.

Bibliography

1. Ayer, R.B., "Use of Thoriated-Tungsten Filaments in High Power Transmitting Tubes," *Proceedings of the I.R.E.*, page 591, May, 1952.
2. Kohl, Walter H., *Materials and Techniques for Electron Tubes*, Reinhold Publishing Corp., N.Y., 1960.
3. Horsting, C.W., "Carbide Structures in Carburized Thoriated-Tungsten Filaments," *Journal of Applied Physics*, Volume 18, Jan., 1947.
4. Langmuir, I., "The Electron Emission from Thoriated Tungsten Filaments," *Physical Review*, 1923, Page 357.
5. Walker, H.S., "High Power Transmitting Valves With Thoriated Filaments for Use in Broadcasting," The Institution of Electrical Engineers, Paper No. 3200E, March, 1960.



NOT A CONTROLLED ISSUE
WILL NOT BE KEPT UP TO DATE

MAY 16 1997

720184-008 NFN40-7628	100UF 50V	10UF	100UF [illegible]	10uF,50V	1800uf, 10V	100020-400 3A,400V	100020-400 3A,400V	100049-045 16A,45V	IN4733A	IN4007	N/A	N/A	N/A	24	0.24	680	220	47	2.15K, 1%	1.82K, 1%	800396	16001[illegible] NVR - 2V	160017 PVR +12V
720184-007 NFN40-7624	N/A	N/A	N/A	N/A	330uf, 35V	N/A	N/A	BYW29-200	IN4750A	N/A	JUMPER	JUMPER	N/A	15	0.30	JUMPER	N/A	620	35.7K, 1%	3.92K, 1%	800395	N/A	N/A
720184-006 NFN40-7615	N/A	N/A	N/A	N/A	330uf, 35V	N/A	N/A	BYW29-200	IN4746A	N/A	JUMPER	JUMPER	N/A	15	0.30	JUMPER	N/A	220	17.8K, 1%	3.24K, 1%	800394	N/A	N/A
720184-005 NFN40-7612	N/A	N/A	N/A	N/A	330uf, 35V	N/A	N/A	BYW29-200	IN4743A	N/A	JUMPER	JUMPER	N/A	15	0.27	JUMPER	N/A	180	15.8K, 1%	3.92K, 1%	800393	N/A	N/A
720184-004 NFN40-7610	330UF 35V	47UF	680UF 35V	680uf, 35V	1800uf, 10V	100020-400 3A,400V	BYW29-200	100049-045 16A,45V	IN4733A	N/A	N/A	N/A	H1565	24	0.30	680	470	47	2.15K, 1%	1.82K, 1%	800392	160035 NVR -15V	N/A
720184-003 NFN40-7607	330UF 35V	47UF	680UF 35V	680uf, 35V	1800uf, 10V	100020-400 3A,400V	BYW29-200	100049-045 16A,45V	IN4733A	N/A	N/A	N/A	H1565	24	0.27	100	220	47	2.15K, 1%	1.82K, 1%	800391	160034 NVR -5V	N/A
720184-002 NFN40-7605	N/A	N/A	100UF 50V	N/A	2200uF, 16V	N/A	100020-400 3A,400V	100049-045 16A,45V	IN4733A	N/A	470 1W	JUMPER	N/A	20	0.27	JUMPER	750	47	2.15K, 1%	1.82K, 1%	800390	N/A	N/A
720184-001/ 700181-252 NFN40-7608/B	330UF 35V	47UF	680UF 35V	680uf, 35V	1800uf, 10V	100020-400 3A,400V	BYW29-200	100049-045 16A,45V	IN4733A	N/A	N/A	N/A	H1565	24	0.30	680	220	47	2.15K, 1%	1.82K, 1%	800389	160010 NVR - 2V	N/A
PART NO. MODEL NO.	C15	C28	C16	C17	C18,C19,C20	CR7	CR5	CR6	CR9	CR10	JP2	JP3	L3	R4	R6	R15	R16	R27	R22	R24	T1	VR1	VR3

COMPONENTS VALUE TABLE

	F1
	RT1
JP1,(2,3 OPTION)	JP7
RT1 (OPTION)	RT1
	J3
	T1
	U2
	Q1
	L4
VR3 (OPTION)	VR3
CR10 (OPTION)	CR10
C2,3,21,24	C29
R3,R12,R19	R27
NOT USED	LAST USED

ENVIRONMENTAL TESTS COMPLETE
DATE ________ BY ________

J2 OUTPUT TABLE

PIN No.	720184-001 NFN40-7608	720184-002 NFN40-7605	720184-003 NFN40-7607	720184-004 NFN40-7610	720184-005 NFN40-7612	720184-006 NFN40-7615	720184-007 NFN40-7624	720184-008 NFN40-7628
1	+12V	+5V	+12V	+15V	+12V	+15V	+24V	+12V
2,3	+5V		+5V	+5V				+5V
4,5	RET	RET	RET	RET	RET	RET	RET	RET
6	-12V		-5V	-15V				-12V

[4.] SEE J2 OUTPUT CHART.
3. * SEE COMPONENTS VALUES TABLE.
2. ALL CAPACITANCE VALUES ARE IN MICROFARADS, VOLTAGES ARE IN D.C..
1. ALL RESISTANCE VALUES ARE IN OHMS, 1/4W, 5%.

NOTES: UNLESS OTHERWISE SPECIFIED.

720184-008	NFN40-7628
720184-007	NFN40-7624
720184-006	NFN40-7615
720184-005	NFN40-7612
720184-004	NFN40-7610
720184-003	NFN40-7607
720184-002	NFN40-7605
720184-001	NFN40-7608
USED ON	MODEL NO.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:
.X=± .XX=± .XXX=± ANGLE=±

DO NOT SCALE DRAWING

APPROVALS DATE
DRAWN J.MICHALSKI 6-28-91
CHECKED
ENG.
ENG. MGR.
MFG. ENG.
Q.A. ENG.
RELEASED

COMPUTER PRODUCTS
POWER CONVERSION AMERICA

SCHEMATIC
POWER SUPPLY
NFN40-76XX

SIZE D DRAWING NO. 730184-001 THRU -008 REV. P
SCALE NONE SHEET 1 OF 1

COMPUTER PRODUCTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

SECTION I
TRANSMITTER CONTROLLER THEORY OF OPERATION

1-1. INTRODUCTION.

1-2. The following text provides theory of operation with supporting diagrams for the FM-10T/FM-10TS transmitter controller.

1-3. GENERAL DESCRIPTION.

1-4. All transmitter control and monitoring functions are performed by a microprocessor based controller (refer to Figure 1-1). The controller is designed to monitor the status of several transmitter parameters and perform control actions when required. The controller will interface with almost any remote control device such as the Broadcast Electronics VMC-16 remote control system.

1-5. The controller is equipped with 12 switch/indicators, 4 overload indicators, and 5 status indicators. Controller processing power is provided by a Z-Soft microcontroller. The microcontroller is housed on a small plug-in circuit board. The microcontroller circuit board is designed to plug directly into a header on the controller main circuit board.

1-6. The controller circuitry includes a front-panel modem port, one rear-panel modem port, one rear-panel local port, and a printer port. The modem ports and the printer port are designed to be used with a future remote monitoring and diagnostic system. The rear-panel local port is for interfacing to a future dual/main/alternate transmitter control system.

1-7. A Lithium battery back-up system is included in the controller design. The battery back-up system will maintain the controller memory and other parameters during a power failure. This system allows the transmitter to return to operation after the power failure in the exact same operating conditions.

1-8. A modular switching power supply provides operating potentials for the controller circuitry. Power supply status indications are provided by +15V, -15V, and +5 V indicators.

1-9. FUNCTIONAL DESCRIPTION.

1-10. The following text presents a description of the major functions performed by the transmitter controller. The text describes controller operations during major transmitter functions such as turn-on and automatic power control.

1-11. TRANSMITTER TURN-ON.

1-12. Commands such as filament on and high voltage on are initiated by the front-panel **FILAMENT ON** and **HIGH VOLTAGE ON** switch/indicators. A one-button-start may be selected by depressing only the **HIGH VOLTAGE ON** switch/indicator. As each switch is depressed, the associated switch/indicator will illuminate to indicate that the selected command has been received and stored.

1-13. Assuming the **FILAMENT ON** and/or **HIGH VOLTAGE ON** switch/indicators have been depressed and all internal interlocks are closed, the blower will start. The internal interlock closed condition is identified by the illumination of the front-panel **INTERLOCK** indicator.

1–14. When the air pressure switch closes: 1) the **BLOWER** indicator will illuminate, 2) the filament warm–up timer will start, 3) filament voltage will be applied to the PA tube, and 4) the **FILAMENT** indicator will illuminate. A high–voltage on signal will be output to the high voltage step–start circuitry and the mute command will be removed from the FM exciter: 1) after the filament warm–up delay expires, 2) no overloads exist, 3) all internal interlocks remain closed, 4) the failsafe interlock is closed, 5) the air switch remains closed, and 6) the exciter AFC signal lock status is obtained. The failsafe interlock closed condition is identified by the illumination of the front–panel **FAILSAFE** indicator. The **HIGH VOLTAGE** indicator will illuminate to indicate that a high voltage on command has been output from the controller.

1–15. The high voltage on signal is applied to the step driver. The driver will energize the plate supply step relay to apply primary voltage to the plate supply transformer through three limiting resistors. After a 100 millisecond delay, the controller will enable the start driver. The start driver will energize the start contactor and apply the full primary potential to the plate supply transformer. The step circuit will deenergize after being energized for 160 milliseconds. In this manner, the plate supply inrush is limited and the current limiting resistors are subject to heating only during a 100 millisecond interval before start contactor closure. For added reliability, the limiting resistors are disconnected after 160 milliseconds.

1–16. Simultaneous with generation of the high voltage on start signal, the exciter will be enabled and the **HIGH VOLTAGE** status indicator will illuminate to indicate that the plate supply control signal has been output. The high voltage supply is prevented from step–starting under full load in this manner.

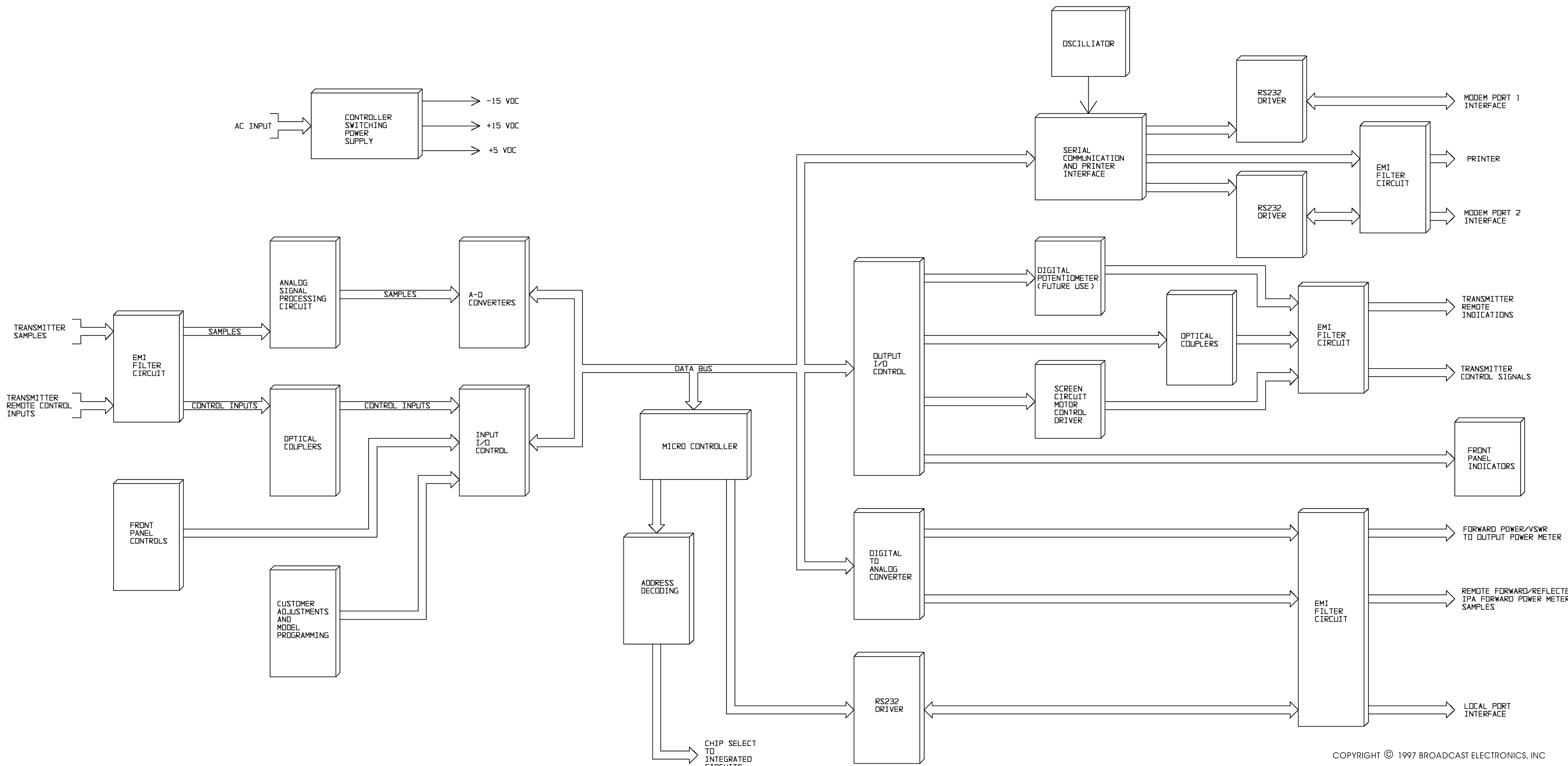
1–17. TRANSMITTER TURN-OFF.

1–18. When the **HIGH VOLTAGE OFF** switch/indicator is depressed, the controller will: 1) deenergize the high voltage supply, 2) extinguish the **HIGH VOLTAGE ON** switch/indicator, and 3) extinguish the **HIGH VOLTAGE STATUS** indicator. A one–button–stop feature is provided when the **FILAMENT OFF** switch/indicator is depressed. When the switch/indicator is depressed, the controller will perform the following operations:

1. Mutes the exciter.
2. De–energize the high voltage supply.
3. De–energize the filament supply.
4. Extinguish the **FILAMENT ON** switch/indicator and the **FILAMENT STATUS** indicator.
5. Initiate a filament cool–down interval.
6. When the filament cool–down timer delay expires, the blower will de–energize and the **BLOWER STATUS** indicator will extinguish.

1–19. REMOTE CONTROL OPERATION.

1–20. Transmitter remote control operation is enabled whenever the **REMOTE DISABLE** switch/indicator is extinguished. Local control of the transmitter is enabled at all times. Remote control inputs are routed: 1) through the controller EMI I/O filter circuit board, 2) through optical isolators, and 3) connected in parallel with the local inputs. The remote control inputs can be enabled by a HIGH or a ground with proper circuit board programming of header J6 on the main circuit board. Remote metering and status outputs are active at all times.



597-0220-423

FIGURE 1-1. TRANSMITTER CONTROLLER BLOCK DIAGRAM

1-21. **INTERLOCKS.**

1-22. The internal interlock circuitry consists of a series string of normally closed switches mounted in areas which contain electrical or mechanical hazards. Each switch is mechanically activated by a door or panel to deenergize the entire transmitter when opened. If an internal interlock opens, the transmitter will deenergize immediately. The transmitter must be manually restored to operation after the open interlock is closed. The controller front-panel **INTERLOCK** indicator will extinguish to indicate an open interlock. If the opened internal interlock is closed before the filament cool-down timer interval expires, the blower will re-energize for the remaining duration of the cool-down cycle and then de-energize. If the air pressure interlock opens, the power supplies will de-energize immediately. When the interlock closes, the transmitter will return to operation automatically.

1-23. The failsafe interlock circuitry consists of an external switch such as from a test load or remote control failsafe circuit connected to the failsafe interlock terminals on the remote interface circuit board. If the failsafe interlock is opened, only the high voltage plate supply will be deenergized. The controller **FAILSAFE** and **HIGH VOLTAGE** indicators will extinguish to indicate an open interlock. When the failsafe interlock is closed, the transmitter will return to operation automatically.

1-24. **OVERLOAD OPERATION.**

1-25. Plate current, screen current, control grid bias supply current, and PA reflected power are monitored for overload conditions. If an overload occurs, the overload initiate an overload control sequence.

1-26. Any overload will illuminate the **OVERLOAD** indicator and initiate two timed intervals. A timer and counter monitors the number of times an overload occurs during a 60 second interval. A second overload recycle timer delays restoration of the transmitter to operation to allow the condition that prompted the overload to dissipate.

1-27. When the timed interval delaying restoration of the transmitter to operation has expired, the transmitter will recycle back into operation. If no further overloads occur during the 60 second interval following the first overload, the 60 second timer will clear the overload counter. If four overload recycles occur during the 60 second counter/timer interval, the transmitter will deenergize and must be manually reset. This can be done by depressing the **OVERLOAD** switch/indicator, the **FILAMENT ON** switch/indicator, and the **HIGH VOLTAGE ON** switch/indicator. The overload can also be cleared by remote control if remote control is enabled.

1-28. If an overload persists in duration for longer than 0.22 seconds, the controller will consider the overload a short circuit and immediately deenergize the transmitter. The transmitter must then be manually restored to operation after the fault is repaired.

1-29. The overload reset sequence is initiated when the **OVERLOAD RESET** switch/indicator is depressed. When the switch/indicator is depressed, the following actions will occur.

1. The **OVERLOAD RESET** switch/indicator and the overload diagnostic indicator (**PLATE, SCREEN, GRID,** or **VSWR**) indicator will extinguish.
2. The overload timer/counter will be reset.
3. The overload recycle timer will be reset.

1-30. **EMI I/O CIRCUIT BOARD.**

1-31. All controller inputs and outputs are routed through connectors J1, J2, and J3 mounted to the EMI I/O circuit board. The circuitry consists of PI-section low-pass LC filters effective to 108 MHz and connected in series with each input and output to prevent RF leakage into the controller. Each input/output also contains a transzorb. The transzorb limits the input/output signal to ±15 volts.

1–32. **AC POWER FAILURE.**

1–33. The controller is equipped with a battery back–up system. When ac power is lost, the following actions will occur:

1. The filament restart delay timer is set as soon as ac power is lost. If ac power is removed long enough for the filament restart delay timer interval to expire, the filament timer will reset. When power returns, a new filament heating delay will be initiated before the plate supply is energized. If the ac power outage is momentary and the timer does not expire, high voltage will energize immediately upon restoration of ac power.

2. The overload feature will be inhibited.

3. The battery back–up system will maintain the controller memory. This system allows the transmitter to return to operation after the power failure in the exact same operating conditions.

1–34. **POWER CONTROL OPERATION.**

1–35. The controller is designed with two power control modes: 1) manual and 2) automatic. Manual/automatic power control operation is controlled by the **APC ON** switch/indicator. The controller is configured for manual power control when the **APC ON** switch/indicator is extinguished. The controller is configured for automatic power control when the **APC ON** switch/indicator is illuminated.

1–36. The controller manipulates the RF output power using the screen supply. The primary of the screen power transformer is controlled by variable autotransformer which is driven by dc servo motor B4. The controller manipulates the RF output power by routing raise/lower commands B4. A raise command rotates the motor in a manner which increases the screen voltage. As a result of the increase in screen voltage, the RF output power will increase. A lower command rotates the motor in a manner which decreases the screen voltage. Limit switches on the motor prevent possible damage to the autotransformer by disconnecting the drive signal at the end of travel for each direction.

1–37. **MANUAL POWER CONTROL OPERATION.**

1–38. Manual operation refers to operation of the transmitter with the APC feature off. In this mode, RF power output is not automatically controlled, but responds only to manual raise and lower commands. In the manual mode, the **RAISE** and **LOWER** switch/indicators directly control the dc servo motor which varies the screen voltage supply.

1–39. **AUTOMATIC POWER CONTROL (APC) OPERATION.**

1–40. When the controller is in the automatic mode, the **RAISE** and **LOWER** switch/indicators control a power control reference point. When the **RAISE** switch/indicator is depressed, the power control reference point is raised and the transmitter output power level will increase. When the **LOWER** switch/indicator is depressed, the power control reference point is lowered and the transmitter output power level will decrease.

1–41. The transmitter output power level will respond to the changes in the power control reference point. The controller manipulates the RF output power using the screen supply dc servo motor. Once the desired output level is established using the RAISE/LOWER switch/indicators, the controller will automatically maintain the established RF output power level.

1–42. The controller is equipped with circuitry which rectifies and calibrates the PA directional coupler forward and reflected power signals. These signals serve as control inputs. In addition to the forward and reflected power signals, PA screen current, and IPA forward power allow automatic control of the PA screen voltage using a dc servo motor. If excessive PA reflected power, excessive screen current, or low IPA power is measured, the "raise power" function will be inhibited to prevent an overload condition. The absence of plate voltage will inhibit the raise function and signal the controller to adjust the screen voltage to minimum. Excessive transmitter RF output or a high PA reflection will first inhibit the raise function. If the condition exceeds the limits, the circuit will initiate a sequence which lowers power proportionately in response to the condition.

1–43. **VSWR FOLDBACK.**

1–44. In the automatic power control mode, PA power will be automatically reduced if PA reflected power becomes excessive enough to overload the transmitter. As the condition which caused the high VSWR returns to normal, RF power will be proportionally raised until full output is restored. A similar circuit for PA forward power will reduce power if the output is excessive.

1–45. A dead–band window is used to prevent the controller from hunting. If reflected power is below the lower limit of the dead–band, the controller will perform no correction. If reflected power increases beyond the lower limit, the raise feature will be inhibited to prevent the forward power control function from raising power to avoid a transmitter overload. If the PA reflected power continues to rise and is within the dead–band, no lowering of power will occur. If the upper limit of the dead–band is reached, a lower command will be applied.

1–46. **SOFT START.**

1–47. Soft start operation is when APC is enabled, the controller monitors the plate voltage and reduces the screen voltage to zero upon the absence of plate voltage. When the plate supply is energized such as during power–on, the controller will perform the following:

1. Gradually increase the screen voltage until the APC power level reference is achieved unless limited by low IPA drive, excessive screen current, or a high VSWR condition. This prevents inadvertent cycling of the VSWR overload at turn–on if the load is not optimal such as during an ice storm.

2. When the plate voltage sample decreases below the fixed level, the following events will occur:

   A. The raise function will be inhibited.

   B. The controller will output a lower command to: 1) lower the screen voltage and 2) stop lowering the screen voltage at a minimum level. Once the minimum level is achieved, the lower command will remain.

   C. When the HIGH VOLTAGE ON switch/indicator is depressed, the plate voltage sample from the plate meter multiplier circuit board will rise above the fixed reference. The raise inhibit will be removed along with the power lower signal and the APC mode will be allowed to re–establish the transmitter RF power.

1-48. **OUTPUT POWER CONTROL.**

1-49. The controller uses a dead-band to determine how the PA forward power control circuit will react when PA forward power increases or decreases beyond the established level. When power is within the dead-band, the controller will take no control action. If the PA forward power decreases by 2% or more from 100%, the controller will start corrective action by applying the raise power command. If PA forward power then increases by 2% or more from 100%, the raise function is to be inhibited. This is the upper edge of the deadband. If PA power should continue to increase to a point which is 2% above the desired power level reference, the controller will lower the power. As the PA power is lowered to the normal level, the controller will remove the power lower command. The power will remain at this point within the power level reference point deadband. If the power should drop below the lower limit, the unit will again apply the raise command. The circuit will now function normally to control power and maintain operation within the deadband.

NOTE ***PRESET POWER IS ONLY USED FOR EMERGENCY OPERATION AT LESS THAN LICENSED POWER OPERATION.***

NOTE

1-50. **PRESET POWER.**

1-51. Preset power is normally used to automatically switch the transmitter to a predetermined power output level such as half-power for periods of auxiliary generator operation. The following events are to occur during preset power operation.

1. The APC functions as before, only the preset power reference is used to determine the APC power level reference. The transmitter power output will now be determined by the preset power level reference.

2. If ac power is momentarily removed from the controller, the preset power command will be automatically maintained.

3. When the APC ON and PRESET switch/indicators are illuminated, any adjustment of the RAISE and LOWER switch/indicators will adjust the preset power level reference.

1-52. **CONTROLLER POWER SUPPLY MODULE.**

1-53. The transmitter controller is equipped with a modular switching power supply assembly. The assembly is not manufactured by Broadcast Electronics. Therefore, no theory of operation can be provided.

SECTION II
TRANSMITTER CONTROLLER MAINTENANCE

2-1. INTRODUCTION.

2-2. This section provides maintenance information for the FM-10T/FM-10TS transmitter controller.

2-3. SAFETY CONSIDERATIONS.

2-4. The FM-10T/FM-10TS transmitters contain high voltages and currents which, if regarded carelessly, could be fatal. The transmitter has many built-in safety features, however; good judgment, care, and common sense are the best accident preventives. The maintenance information contained in this section should be performed only by trained and experienced maintenance personnel.

2-5. MAINTENANCE.

WARNING ***NEVER OPEN THE EQUIPMENT UNLESS ALL TRANSMITTER PRIMARY POWER IS DISCONNECTED.***

WARNING

2-6. The maintenance philosophy consists of preventative maintenance such as cleaning applied to the equipment of forestall future failures and second level maintenance consisting of procedures required to restore the equipment to operation after a fault. The following text presents the controller adjustments.

2-7. MAIN CIRCUIT BOARD CONTROL ADJUSTMENTS.

2-8. **OVERLOAD CONTROLS.** The following text presents the overload adjustment procedures. If more than one control is adjusted, adjust the controls as follows: 1) VSWR, 2) PLATE, 3) SCREEN, and 4) GRID.

2-9. **VSWR OVERLOAD THRESHOLD ADJUST.** To adjust the VSWR overload threshold, proceed as follows.

2-10. **Required Equipment.** The following equipment is required to adjust the VSWR overload threshold.

A. 7 dB attenuator, BNC connections.

B. 5/16 inch nut-driver.

CAUTION ***THE OVERLOAD THRESHOLD LEVEL ADJUSTMENTS DETERMINE WHEN THE TRANSMITTER INITIATES ACTION. IF A CONTROL IS INCORRECTLY ADJUSTED THE CONTROLLER MAY NOT SENSE THE FAULT AND DAMAGE TO THE TRANSMITTER MAY RESULT.***

CAUTION

2-11. **Procedure.** To adjust the control, proceed as follows.

2-12. Check and adjust reflected power meter calibration control R84 before proceeding (refer to REFLECTED POWER CALIBRATION in the following text).

2–13. Apply power to the transmitter.

2–14. Refer to Figure 2–1 and select VSWR OVERLOAD as follows:

1. Operate customer adjustment function switch SW1 to position 6.
2. Depress and hold customer adjustment up/down switch S2 in the up position to raise the threshold.

2–15. Disconnect cable 626 from the reflected power directional coupler (↓ port) on the transmitter low–pass filter.

2–16. Using the nut–driver, loosen the clamps securing the reflected power directional coupler to to the low–pass filter.

2–17. Rotate the reflected power directional coupler 180 degrees so the arrow on the coupler is up (↑). Secure the clamps.

2–18. Connect the 7 dB attenuator to the reflected power directional coupler and connect cable 626 to the attenuator.

2–19. Apply power and operate the transmitter at the normal RF power output as indicated by the front panel **OUTPUT POWER** meter.

2–20. Depress the **VSWR** switch/indicator to illuminate the switch/indicator.

2–21. Refer to Figure 2–1 and use up/down switch S2 to lower the VSWR overload threshold until the **VSWR OVERLOAD** indicator and the **OVERLOAD RESET** switch/indicator illuminate and the transmitter cycles off.

2–22. Depress the **HIGH VOLTAGE OFF** switch then depress the **LOWER** switch/indicator for approximately 4 seconds to lower the transmitter power.

2–23. Depress the **OVERLOAD RESET** and the **HIGH VOLTAGE ON** switch/indicators.

2–24. Depress the **RAISE** switch/indicator to raise power. The transmitter will cycle off at a VSWR indication of 2.8 : 1. If not, repeat the adjustment.

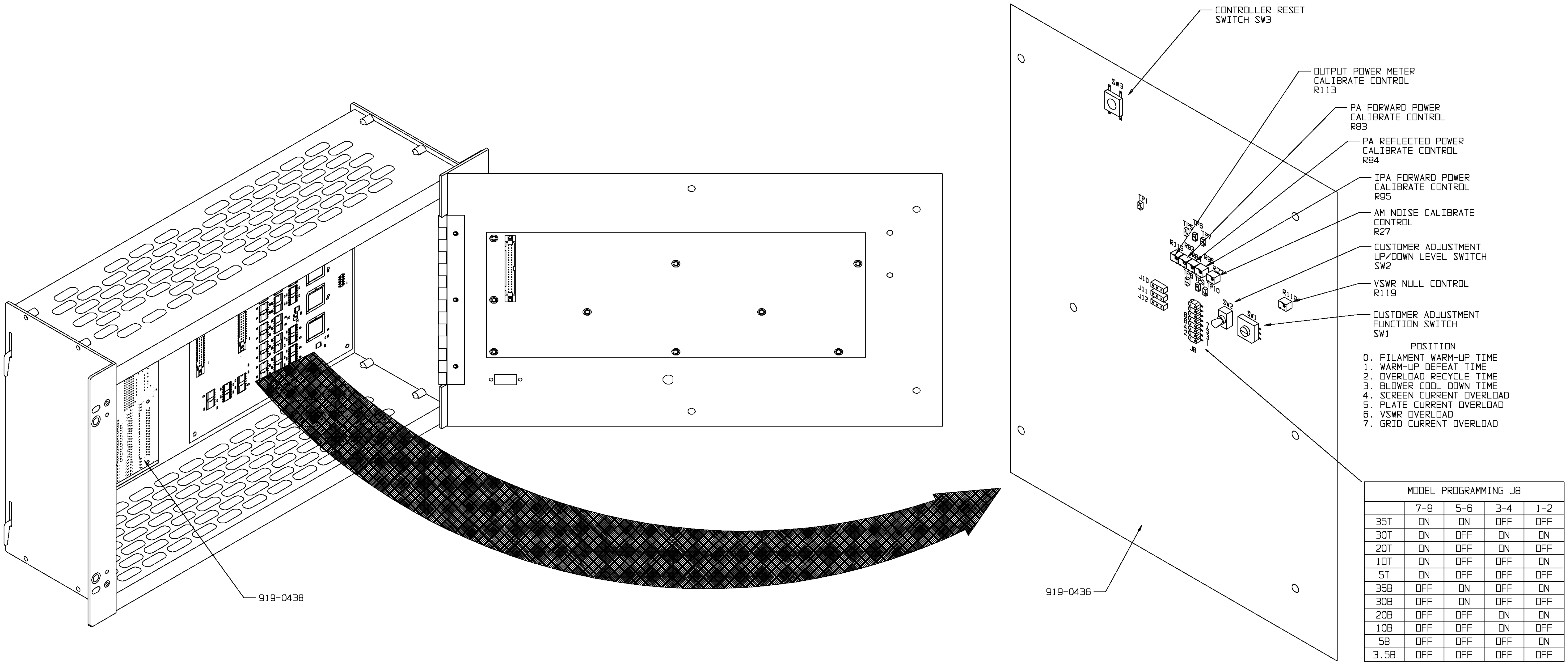
WARNING ***DISCONNECT ALL TRANSMITTER PRIMARY POWER BEFORE PROCEEDING.***

WARNING

2–25. Disconnect all transmitter primary power.

2–26. Remove the test equipment and replace the reflected power directional coupler. Ensure the reflected power directional coupler arrow is down (↓). Ensure cable 626 is re–connected to the reflected power directional coupler port.

2–27. **PLATE OVERLOAD ADJUSTMENT.** The plate overload control can be adjusted from 0.1 A to 0.75 A above a normal plate current level. The factory default is 0.5 A. To adjust the PLATE overload threshold, proceed as follows.



MODEL PROGRAMMING J8

	7-8	5-6	3-4	1-2
35T	ON	ON	OFF	OFF
30T	ON	OFF	ON	ON
20T	ON	OFF	ON	OFF
10T	ON	OFF	OFF	ON
5T	ON	OFF	OFF	OFF
35B	OFF	ON	OFF	ON
30B	OFF	ON	OFF	OFF
20B	OFF	OFF	ON	ON
10B	OFF	OFF	ON	OFF
5B	OFF	OFF	OFF	ON
3.5B	OFF	OFF	OFF	OFF

597-0220-417

FIGURE 2-1. CONTROLLER MAIN CIRCUIT BOARD CONTROLS

CAUTION ***THE OVERLOAD THRESHOLD LEVEL ADJUSTMENTS DETERMINE WHEN THE TRANSMITTER INITIATES ACTION. IF A CONTROL IS INCORRECTLY ADJUSTED THE CONTROLLER MAY NOT SENSE THE FAULT AND DAMAGE TO THE TRANSMITTER MAY RESULT.***

CAUTION

2-28. **Procedure.** To adjust the threshold level of the plate overload circuit, proceed as follows:

2-29. Apply power and operate the transmitter within specifications at the rated RF output into a proper 50 Ohm load. Record the **OUTPUT LOADING** control cyclometer indication ____________.

2-30. Refer to Figure 2-1 and select PLATE OVERLOAD as follows:

1. Operate customer adjustment function switch SW1 to position 5.
2. Depress and hold customer adjustment up/down switch S2 in the up position to raise the threshold.

2-31. Operate the **APC ON** switch/indicator to extinguish the switch/indicator.

2-32. Operate the **OUTPUT LOADING** control clockwise and the **RAISE** switch/indicator to detune the transmitter until plate current is increased by 0.5 Amperes as indicated on the **PLATE CURRENT** meter.

2-33. Refer to Figure 2-1 and use up/down switch S2 to lower the plate overload threshold until the **PLATE OVERLOAD** indicator and the **OVERLOAD RESET** switch/indicator illuminate and the transmitter cycles off.

2-34. Depress the **HIGH VOLTAGE OFF** switch then depress and hold the **LOWER** switch/indicator for approximately four seconds.

2-35. Depress the **OVERLOAD RESET** and the **HIGH VOLTAGE ON** switch/indicators.

2-36. Observe the **PLATE CURRENT** meter and operate the **RAISE** switch/indicator until the transmitter deenergizes. Correct adjustment is obtained when the transmitter deenergizes and plate current is 0.5 amperes above normal. Repeat the procedure if required.

2-37. Depress the **HIGH VOLTAGE OFF** switch and **OVERLOAD RESET** switch/indicator.

2-38. Restore the **OUTPUT LOADING** control to the cyclometer indication recorded in the preceding text and operate the **APC ON** switch/indicator to illuminate the switch/indicator.

2-39. **SCREEN OVERLOAD ADJUSTMENT.** The screen overload control can be adjusted from 100 mA to 190 mA. The factory default is 145 mA. To adjust the SCREEN overload threshold, proceed as follows.

2-40. **Required Equipment.** The following equipment is required to adjust the screen overload threshold.

A. Insulated adjustment tool, flat-tip (BE P/N 407-0083).

CAUTION ***THE OVERLOAD THRESHOLD LEVEL ADJUSTMENTS DETERMINE WHEN THE TRANSMITTER INITIATES ACTION. IF A CONTROL IS INCORRECTLY ADJUSTED THE CONTROLLER MAY NOT SENSE THE FAULT AND DAMAGE TO THE TRANSMITTER MAY RESULT.***

CAUTION

2-41. **Procedure.** To adjust the threshold level of the screen overload circuit, proceed as follows:

2–42. Apply power and operate the transmitter within specifications at the rated RF output into a proper 50 Ohm load. Record the **OUTPUT LOADING** control cyclometer indication ____________.

2–43. Refer to Figure 2–1 and select SCREEN OVERLOAD as follows:

1. Operate customer adjustment function switch SW1 to position 4.
2. Depress and hold customer adjustment up/down switch S2 in the up position to raise the threshold.

2–44. Operate the **APC ON** switch/indicator to extinguish the switch/indicator.

2–45. Operate the **MULTIMETER** to the **SCREEN CURRENT** position.

2–46. Operate the **OUTPUT LOADING** control counterclockwise and the **RAISE** switch/indicator to detune the transmitter for a screen current of 145 milliamperes as indicated on the **MULTIMETER**. If 145 milliamperes can not be obtained, increase the exciter power as follows:

1. Depress the exciter FWD switch/indicator to illuminate the switch/indicator and record the forward power indication ________.
2. Pull the exciter out of the cabinet to expose the **RF OUTPUT ADJ.** control.
3. Adjust the control until the exciter multimeter indicates approximately 250 watts.

2–47. Refer to Figure 2–1 and use up/down switch S2 to lower the screen overload threshold until the **SCREEN OVERLOAD** indicator and the **OVERLOAD RESET** switch/indicator illuminate and the transmitter cycles off.

2–48. Depress the **HIGH VOLTAGE OFF** switch/indicator then depress and hold the **LOWER** switch/indicator for approximately four seconds.

2–49. Depress the **OVERLOAD RESET** and the **HIGH VOLTAGE ON** switch/indicators.

2–50. Observe the **MULTIMETER** and operate the **RAISE** switch/indicator until the transmitter deenergizes. Correct adjustment is obtained when the transmitter deenergizes and the **MULTIMETER** indicates 145 milliamperes. Repeat the procedure if required.

2–51. Depress the **HIGH VOLTAGE OFF** switch and **OVERLOAD RESET** switch/indicator.

2–52. Restore the **OUTPUT LOADING** control to the cyclometer indication recorded in the preceding text, re–adjust the exciter output level if required, and operate the **APC ON** switch/indicator to illuminate the switch/indicator.

2–53. **GRID OVERLOAD ADJUSTMENT.** Position 7 on customer adjustment function switch SW1 adjusts the grid overload threshold. The control is adjusted at the factory and will not require re–adjustment. The control is designed in a manner which does not permit mis–adjustment in the field.

2–54. **FILAMENT WARM-UP ADJUSTMENT.** The warm–up adjustment controls the filament heating delay prior to high voltage on. The warm–up time can be adjusted from 10 seconds to 4.5 minutes. A minimum interval is preset so that incorrect adjustment cannot damage the PA tube. To adjust the warm–up time, proceed as follows.

2–55. **Required Equipment.** The following equipment is required to adjust warm–up time.

A. Wristwatch with seconds hand or stopwatch function.

2–56. **Procedure.** To adjust the warm–up time, proceed as follows.

2–57. Depress the **FILAMENT OFF** switch/indicator to illuminate the switch/indicator.

2–58. Wait approximately 15 seconds. Note the time and depress the **HIGH VOLTAGE ON** switch/indicator.

2–59. Again note the time when the plate contactor energizes.

2–60. Refer to Figure 2–1 and select the warm–up feature by operating customer adjustment function switch SW1 to position 0.

2–61. Refer to Figure 2–1 and use up/down switch S2 to increase or decrease the time delay. Check the adjustment by repeating the procedure. The control is factory set for 10 seconds.

2–62. **COOL–DOWN ADJUSTMENT.** The cool–down adjustment controls the blower run–down interval after the filament voltage is off. The cool–down time can be adjusted from 30 seconds to 4.5 minutes. A minimum interval is preset so that incorrect adjustment cannot damage the PA tube. To adjust the cool down time, proceed as follows.

2–63. **Required Equipment.** The following equipment is required to adjust cool down time.

A. Wristwatch with seconds hand or stopwatch function.

2–64. **Procedure.** To adjust the cool–down time, proceed as follows.

2–65. Apply power and operate the transmitter.

2–66. Simultaneously depress the **FILAMENT OFF** switch and note the time.

2–67. Again note the time when the blower halts operation.

2–68. Refer to Figure 2–1 and select the cool–down feature by operating customer adjustment function switch SW1 to position 3.

2–69. Refer to Figure 2–1 and use up/down switch S2 to increase or decrease the blower run–down interval. Check the adjustment by repeating the procedure. The control is factory set for 30 seconds. Each click of S2 is equal to 1 second.

2–70. **RECYCLE ADJUSTMENT.** The recycle adjustment controls the amount of time the transmitter will remain deenergized to allow an overload to dissipate. The recycle time can be adjusted from 100 milliseconds to 15 seconds. The factory default is 2 seconds. To adjust the recycle time, proceed as follows.

2–71. **Required Equipment.** The following equipment is required to adjust cool down time.

A. Wristwatch with seconds hand or stopwatch function.

2–72. **Procedure.** To adjust the recycle time, proceed as follows.

2–73. Apply power and operate the transmitter.

2–74. Simulate a screen or plate overload using the **OUTPUT LOADING** control and note the time when the transmitter attempts to return to operation.

2–75. Refer to Figure 2–1 and select the recycle feature by operating customer adjustment function switch SW1 to position 2.

2–76. Refer to Figure 2–1 and use up/down switch S2 to increase or decrease the recycle time. Check the adjustment by repeating the procedure. The control is factory set for 2 seconds. Each click of S2 is equal to 1 second.

2–77. **WARM–UP DEFEAT ADJUSTMENT.** The warm–up defeat adjustment controls the length of the interval the filaments can be off before initiating a new filament warm–up cycle. The warm–up defeat time can be adjusted from 1 second to 15 seconds. A 3 second delay is preset so that momentary power fluctuations will not initiate a new filament warm–up cycle. To adjust the warm–up defeat time, proceed as follows.

2-78. **Required Equipment.** The following equipment is required to adjust the warm-up defeat time.

A. Wristwatch with seconds hand or stopwatch function.

2-79. **Procedure.** To adjust the warm-up defeat time, proceed as follows.

2-80. Apply power and operate the transmitter.

2-81. Check the current warm-up defeat time as follows:

1. Depress the **FILAMENT OFF** switch/indicator to illuminate the switch/indicator.
2. Wait approximately 3 seconds and depress the **HIGH VOLTAGE ON** switch/indicator to illuminate the switch/indicator. With the warm-up defeat time configured at 3 seconds, the filaments will automatically re-energize.

2-82. Refer to Figure 2-1 and select the warm-up defeat feature by operating customer adjustment function switch SW1 to position 1.

2-83. Refer to Figure 2-1 and use up/down switch S2 to increase or decrease the warm-up time. Check the adjustment by repeating the procedure. The control is factory set for 3 seconds. Each click of S2 is equal to 1 second.

2-84. **FORWARD POWER CALIBRATION.** Potentiometer R83 calibrates the forward power sample circuit. Adjustment is required only if repairs have been made to the directional coupler forward port, controller main circuit board, or low-pass filter. To adjust the control, proceed as follows.

2-85. **Required Equipment.** The following equipment is required to adjust the forward power calibration control.

A. 1/16 inch jewelers screw-driver, flat-tip.

B. Digital multimeter (Fluke 77 or equivalent).

C. Test load and connecting line (50 Ohm non-inductive, 1 5/8 inch line input, 10 kW minimum).

D. Calibrated in-line wattmeter with 1 5/8 inch sampling section and cables (Bird 4720 Thruline with 10 kW element or equivalent).

2-86. **Procedure.** To adjust the control, proceed as follows.

WARNING ***DISCONNECT ALL TRANSMITTER PRIMARY POWER BEFORE PROCEEDING.***

WARNING

2-87. Disconnect the transmitter primary power.

2-88. Connect the test load and wattmeter to the transmitter output.

2-89. Connect the multimeter between TP-5 (signal) and TP-1 (ground) or to the chassis.

2-90. Apply power and operate the transmitter in the local manual mode (REMOTE DISABLE illuminated, APC ON extinguished) at the desired 100% RF power output as indicated by the in-line wattmeter.

2-91. Depress the **FWD** switch/indicator to illuminate the switch/indicator.

2-92. Refer to Figure 2-1 and adjust forward power calibrate control R83 until the multimeter indicates +4.25 volts dc.

2–93. Refer to OUTPUT POWER METER CALIBRATION in the following text and perform the procedure to calibrate the output power meter.

2–94. Remove the test equipment and return the transmitter to service.

2–95. **OUTPUT POWER METER CALIBRATION.** This adjustment will be required only if the **OUTPUT POWER** meter or potentiometer R113 is replaced. To adjust output meter calibrate control R113, proceed as follows.

2–96. **Required Equipment.** The following equipment is required to adjust the output meter calibrate control.

A. 1/16 inch jewelers screw–driver, flat–tip.

B. Test load and connecting line (50 Ohm non–inductive, 1 5/8 inch line input, 10 kW minimum).

C. Calibrated in–line wattmeter with 1 5/8 inch sampling section and cables (Bird 4720 Thruline with 10 kW element or equivalent).

2–97. **Procedure.** To adjust the control, proceed as follows:

2–98. Check and adjust forward power calibration control R83 before proceeding (refer to FORWARD POWER CALIBRATION in the preceding text).

WARNING ***DISCONNECT ALL TRANSMITTER PRIMARY POWER BEFORE PROCEEDING.***

WARNING

2–99. Disconnect the transmitter primary power.

2–100. Connect the test load and wattmeter to the transmitter output.

2–101. Apply power and operate the transmitter in the local manual mode (REMOTE DISABLE illuminated, APC ON extinguished) at the desired 100% RF power output as indicated by the in–line wattmeter.

2–102. Refer to Figure 2–1 and adjust meter calibration control R113 to obtain a 100% **OUTPUT POWER** meter indication.

WARNING ***ASSURE ALL PRIMARY POWER IS DISCONNECTED BEFORE PROCEEDING.***

WARNING

2–103. Disconnect primary power.

2–104. Remove the test equipment and reconnect the transmitter output to the antenna load.

2–105. **REFLECTED POWER CALIBRATION.** Potentiometer R84 calibrates the reflected power sample circuit. Adjustment is required only if repairs have been made to the directional coupler reflected port, controller main circuit board, or low–pass filter. To adjust the control, proceed as follows.

2–106. **Required Equipment.** The following equipment is required to adjust the reflected power calibration control.

A. 1/16 inch jewelers screw–driver, flat–tip.

B. 10 dB attenuator, BNC connections.

C. 5/16 inch nut–driver.

2–107. **Procedure.** To adjust the control, proceed as follows.

2–108. Check and adjust output power meter calibration control R113 before proceeding (refer to OUTPUT POWER METER CALIBRATION in the preceding text).

2–109. Adjust the VSWR null control as follows:

WARNING ***DISCONNECT ALL TRANSMITTER PRIMARY POWER BEFORE PROCEEDING.***

WARNING

1. Disconnect the transmitter primary power.
2. Ensure the test load and wattmeter are connected to the transmitter output.
3. Refer to Figure 2–1 and connect the multimeter between TP–6 (signal) and TP–1 (ground) or to the chassis.
4. Apply power and operate the transmitter in the local manual mode (**REMOTE DISABLE** illuminated, **APC ON** extinguished) at the desired 100% RF power output as indicated by the in–line wattmeter.
5. Refer to Figure 2–1 and adjust VSWR null control R119 for a 0.0 volt dc indication on the multimeter.

WARNING ***DISCONNECT ALL TRANSMITTER PRIMARY POWER BEFORE PROCEEDING.***

WARNING

2–110. Disconnect the transmitter primary power.

2–111. Disconnect cable 626 from the reflected power directional coupler (↓ port) on the transmitter low–pass filter.

2–112. Using the nut–driver, loosen the clamps securing the reflected power directional coupler to to the low–pass filter.

2–113. Rotate the reflected power directional coupler 180 degrees so the arrow on the coupler is up (↑). Secure the clamps.

2–114. Connect the 10 dB attenuator to the reflected power directional coupler and connect cable 626 to the attenuator.

2–115. Apply power and operate the transmitter at the normal RF power output as indicated by the front panel **OUTPUT POWER** meter.

2–116. Depress the **VSWR** switch/indicator to illuminate the switch/indicator.

2–117. Refer to Figure 2–1 and adjust reflected power calibrate control R84 until the **OUTPUT POWER** meter indicates a VSWR condition of 1.9 : 1.

WARNING ***DISCONNECT ALL TRANSMITTER PRIMARY POWER BEFORE PROCEEDING.***

WARNING

2–118. Disconnect the transmitter primary power.

2-119. Remove the test equipment and replace the reflected power directional coupler. Ensure the reflected power directional coupler arrow is down (↓). Ensure cable 626 is re-connected to the reflected power directional coupler port.

2-120. **AM NOISE TEST RECEPTACLE CALIBRATION.** Potentiometer R27 calibrates the signal at the AM noise test receptacle. Adjustment is required only if repairs have been made to the AM noise circuitry. To adjust the control, proceed as follows.

2-121. **Required Equipment.** The following equipment is required to adjust the AM noise calibration control.

A. 1/16 inch jewelers screw-driver, flat-tip.

B. Digital multimeter (Fluke 77 or equivalent).

2-122. **Procedure.** To adjust the control, proceed as follows.

2-123. Check and adjust output power meter calibration control R113 before proceeding (refer to OUTPUT POWER METER CALIBRATION in the preceding text).

2-124. Disconnect the transmitter primary power.

2-125. Connect the multimeter between the center conductor of the AM noise test receptacle and chassis ground.

2-126. Apply power and operate the transmitter in the local manual mode (**REMOTE DISABLE** illuminated, **APC ON** extinguished) at the desired 100% RF power output as indicated by the front panel **OUTPUT POWER** meter.

2-127. Refer to Figure 2-1 and adjust AM noise calibration control R27 for a 1.09 volt dc indication on the multimeter.

2-128. Disconnect the transmitter primary power.

2-129. Remove the test equipment and return the transmitter to service.

2-130. **IPA FORWARD POWER CALIBRATION.** Potentiometer R95 calibrates the IPA forward power sample circuit. This circuit is not used in an FM-10T/FM-10TS.

2-131. **CONTROLLER RESET.** The controller is equipped with reset switch SW3. However, the microcontroller is equipped with a circuit to automatically reset the processor in the event of a lock-up condition. As a result, the switch will typically not be used.

2-132. **CUSTOMER ADJUSTMENTS - RESET.** The customer adjustments and the 100% power programming can be reset to the factory defaults if required. The reset operation is required only if the customer adjustments have been mis-adjusted. To reset the controller programming to the factory defaults, proceed as follows:

1. Depress the **HIGH VOLTAGE OFF** switch/indicator.
2. Refer to Figure 2-1 and remove the model programming jumpers from model programming header J8.
3. Refer to Figure 2-1 and re-install the model programming jumpers. Ensure the jumpers are correctly programmed for the transmitter model.
4. Depress the **HIGH VOLTAGE ON** switch/indicator and return the transmitter to service.

2–133. **TROUBLESHOOTING.**

WARNING *NEVER OPEN THE EQUIPMENT UNLESS ALL TRANSMITTER PRIMARY POWER IS DISCONNECTED. USE THE GROUNDING STICK PROVIDED TO ENSURE ALL COMPONENTS AND ALL SURROUNDING COMPONENTS ARE DISCHARGED BEFORE ATTEMPTING ANY MAINTENANCE ON ANY AREA WITHIN THE TRANSMITTER.*

WARNING

2–134. Most troubleshooting consists of visual checks. Because of the high voltages and currents in the equipment, it is considered hazardous to work with power energized. Therefore, the various transmitter indicators (meters, LEDs, and fuses) should be used to isolate the malfunction to one specific area.

2–135. Troubleshooting within the controller circuit board enclosure is not considered hazardous due to the low potentials and currents involved. Once the trouble is isolated and power is totally deenergized, it is suggested that the exact problem be located with resistance checks using the schematic diagrams and theory of operation presented throughout the text.

2–136. If a circuit is diagnosed as faulty, the circuit fault may be isolated and repaired locally or the entire device may be returned to Broadcast Electronics, Inc. for exchange, alignment, or replacement.

2–137. **CONTROLLER COMPONENT LOCATIONS.** Figure 2–2 presents the controller component locations. Refer to Figure 2–2 as required during the troubleshooting procedures to locate components within the controller.

CAUTION *TO PREVENT DAMAGE TO THE MAIN CIRCUIT BOARD, DO NOT REMOVE POWER SUPPLY CONNECTOR P5 WITH POWER ENERGIZED.*

CAUTION

2–138. **MAIN CIRCUIT BOARD POWER SUPPLY CONNECTOR P5.** The controller main circuit board is equipped with power supply connector P5. The main circuit board may be destroyed if the connector is removed with power energized. Therefore, disconnect the transmitter ac power before removing the connector.

2–139. **MICROPROCESSOR MODULE.** The transmitter controller is equipped with a microprocessor module. Figure 2–2 presents the location of the module. The module is designed to plug directly into header J1 on the main circuit board. In the event of a microprocessor failure, the module can be replaced by performing the following procedure.

CAUTION *DO NOT REMOVE THE MICROPROCESSOR MODULE WITH THE TRANSMITTER PRIMARY AC POWER ENERGIZED.*

CAUTION

2–140. Disconnect the transmitter primary power.

2–141. Open the controller door and locate the microprocessor module.

2–142. Using a Phillips screwdriver, remove the microprocessor mounting screw.

2–143. Using your hands, gently pull the module from the header.

2–144. Orient the new microprocessor module as shown and insert the module in header J1.

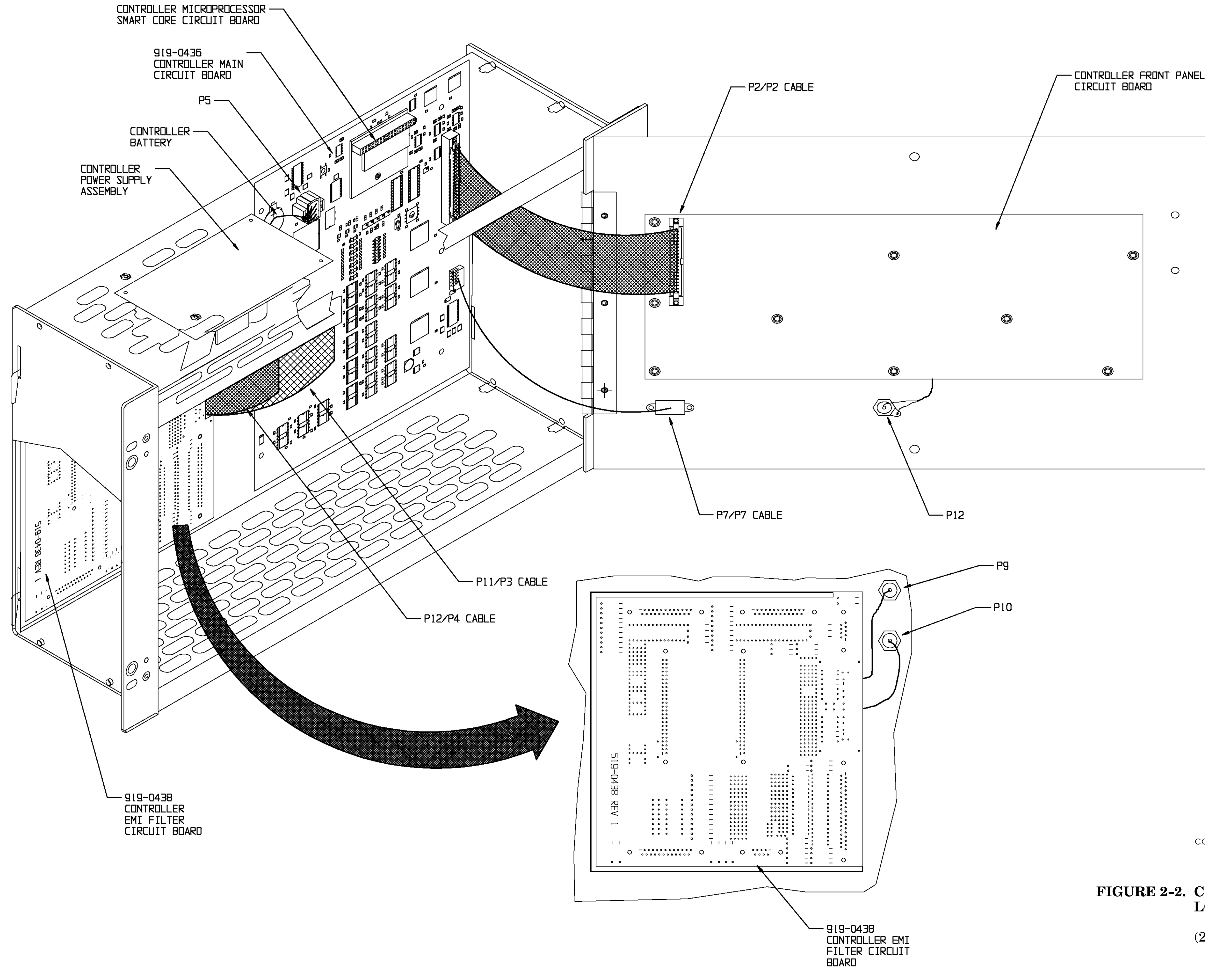
2–145. Re–install the mounting screw, close the controller door, and return the transmitter to service.

2–146. **POWER SUPPLY INDICATORS.** The controller main circuit board is equipped with three LEDs. The LEDs present the status of the power supply +15V, –15V, and +5V power supplies. Use the indicators to check the status of the power supply module.

2–147. **CONTROLLER POWER SUPPLY MODULE.** The transmitter controller is equipped with a modular switching power supply assembly. The power supply module is equipped with an ac line fuse and is not manufactured by Broadcast Electronics.

2–148. If the power supply is suspected as being faulty, check the power supply fuse. If the power supply fuse has not blown, contact the Broadcast Electronics Customer Service Department. If desired, refer to APPENDIX A and the Computer Products power supply schematic diagram for additional power supply troubleshooting information.

BLANK PAGE



597-0220-416

FIGURE 2-2. CONTROLLER COMPONENT LOCATIONS

SECTION III
PARTS LIST

3-1. INTRODUCTION.

3-2. This section provides descriptions and part numbers of electrical components, assemblies, and selected mechanical parts required for maintenance of the Broadcast Electronics FM-10T/FM-10TS Transmitter Controller. Each table entry in this section is indexed by reference designators appearing on the applicable schematic diagram.

TABLE 3-1. TRANSMITTER CONTROLLER PARTS LIST INDEX

TABLE 3-2. FM TRANSMITTER DIGITAL CONTROLLER ASSEMBLY - 959-0430

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Power Input Connector/RFI Filter, 3 Amperes, 250V ac, 50/60 Hz	339-0008	1
----	Fuse, 313001, 3AG, 1 Amp, Slow-Blow, 250V	334-0100	1
----	Fuse Holder, AGC	415-2012	1
----	Connector, BNC	417-0016	1
----	Receptacle, BNC	417-0017	2
----	Power Supply, NFN40-7610, SMPS, 3 Output 40W	540-0006	1
----	Main Board, Controller Circuit Board Assembly	919-0436	1
----	Front Panel, Controller Circuit Board Assembly	919-0437	1
----	I/O Board, Controller Circuit Board Assembly	919-0438	1
----	Harness, FM Digital Controller Assembly	949-0423	1
----	Software Kit, T-Series Controller	979-0443-003	1

TABLE 3-3. MAIN BOARD CONTROLLER CIRCUIT BOARD ASSEMBLY - 919-0436 (Sheet 1 of 4)

REF. DES.	DESCRIPTION	PART NO.	QTY.
BT1	Battery, 3 Volts, 190 mAh, Lithium	350-2032	1
C1, C2	Capacitor, Ceramic, 0.1 uF ±10%, 50V, SMD	007-1044	2
C3	Capacitor, Tantalum, 15 uF ±10%, 35V, SMD	070-1564	1
C4 thru C8,	Capacitor, Ceramic, 0.1 uF ±10%, 50V, SMD	007-1044	5
C9	Capacitor, Tantalum, 15 uF ±10%, 35V, SMD	070-1564	1
C10, C11	Capacitor, Ceramic, 0.1 uF ±10%, 50V, SMD	007-1044	2
C12, C13	Capacitor, Ceramic, 390 pF ±5%, 100V, SMD	007-3923	2
C14	Capacitor, Ceramic, 390 pF ±5%, 100V, SMD	007-3923	1
C15	Capacitor, Ceramic, 390 pF ±5%, 100V, SMD	007-3923	1
C16 thru C30	Capacitor, Ceramic, 1 uF ±10%, 50V, SMD	007-1054	15
C31, C32	Capacitor, Ceramic, 0.1 uF ±10%, 50V, SMD	007-1044	2
C33	Capacitor, Ceramic, 1 uF ±10%, 50V, SMD	007-1054	1
C34	Capacitor, Electrolytic, 330 uF ±20%, 25V, SMD	007-0331	1
C35, C36	Capacitor, Ceramic, 0.1 uF ±10%, 50V, SMD	007-1044	2
C37 thru C52	Capacitor, Ceramic, 390 pF ± 5%, 100V, SMD	007-3923	16
C53	Capacitor, Ceramic, 0.1 uF ±10%, 50V, SMD	007-1044	1
D1	Transzorb, P6SMB27CAT3, Case 403A-03, 27V, SMD	204-0027	1
D2	Transzorb, P6SMB15CAT3, Case 403A-03, 15V, SMD	204-0015	1
DS1 thru DS3	LED, HSMF-C655, Dual Red/Green, Low Profile, SMD	325-0250	3
J1	Receptacle, 40-Position, Two Row, PCB	417-4042	1
J2	Header, 40-Pin, .100 Centers, SMD	408-0040	1
J3, J4	Header, 50-Pin, .100 Centers, SMD	408-0050	2
J5	Receptacle, 6-Pin	417-0677	1
J6	Header, 3-Pin, .100 Centers, SIP	408-0300	1
J7	Header, 10-Pin, .100 Centers, DIP	408-1000	1
J8	Header, 16-Pin, .100 Centers, DIP	408-1600	1
J9 thru J14	Header, 3-Pin, .100 Centers	408-0300	6
OSC1	Oscillator, Crystal, 1.8432 Mhz, SMD	390-0054	1
P6, P9-P14, P8A thru P8H	Switch, Jumper Programmable, 65474-002	340-0004	15
Q1, Q2	Transistor, MMBT3904LT1, NPN, SMD	216-3904	2
R1, R2	Resistor, Chip, 1.00 k Ohm ±1%, 1/10W, SMD	102-1001	2
R3 thru R19	Resistor, Chip, 471 Ohm ±1%, 1/10W, SMD	102-4711	17
R20 thru R25	Resistor, Chip, 10.0 k Ohm ±1%, 1/10W, SMD	102-1002	6
R26	Resistor, Chip 2.00 k Ohm ±1%, 1/10W, SMD	102-2001	1
R27	Potentiometer, 100 k, Top Adjust, SMD	198-0104	1
R29	Resistor, Chip, 10.0 k Ohm ±1%, 1/10W, SMD	102-1002	1
R31 thru R45	Resistor, Chip, 10.0 k Ohm ±1%, 1/10W, SMD	102-1002	15

TABLE 3-3. MAIN BOARD CONTROLLER CIRCUIT BOARD ASSEMBLY - 919-0436
(Sheet 2 of 4)

REF. DES.	DESCRIPTION	PART NO.	QTY.
R46	Resistor, Chip 1.00 k Ohm ±1%, 1/10W, SMD	102-1001	1
R47 thru R59	Resistor, Chip, 1.00 k Ohm ±1%, 1/10W, SMD	102-1001	13
R60	Resistor, Chip, 10.0 k Ohm ±1%, 1/10W, SMD	102-1002	1
R61	Resistor, Chip 1.00 k Ohm ±1%, 1/10W, SMD	102-1001	1
R62	Resistor, Chip, 10.0 k Ohm ±1%, 1/10W, SMD	102-1002	1
R63	Resistor, Chip, 1.00 k Ohm ±1%, 1/10W, SMD	102-1001	1
R64	Resistor, Chip, 471 Ohm ±1%,1/10W, SMD	102-4711	1
R65 thru R73	Resistor, Chip, 471 Ohm ±1%, 1/10W, SMD	102-4711	9
R74	Resistor, Chip, 471 Ohm ±1%, 1/10W, SMD	102-4711	1
R75	Resistor, Chip, 10.0 k Ohm ±1%, 1/10W, SMD	102-1002	1
R76	Resistor, Chip, 41.2 k Ohm ±1%, 1/10W, SMD	102-4122	1
R77, R78	Resistor, Chip, 10.0 k Ohm ±1%, 1/10W, SMD	102-1002	2
R79	Resistor, Chip, 100 k Ohm ±1%, 1/10W	102-1003	1
R80	Resistor, Chip, 20.0 k Ohm ±1%,1/10W, SMD	102-2002	1
R81, R82	Resistor, Chip, 10.0 k Ohm ±1%,1/10W, SMD	102-1002	2
R83, R84	Potentiometer, 100 k, Top Adjust, SMD	198-0104	1
R85	Resistor, Chip, 10.0 k Ohm ±1%, 1/10W, SMD	102-1002	1
R86	Resistor, Chip, 100 k Ohm ±1%, 1/10W	102-1003	1
R87	Resistor, Chip, 2.00 k Ohm ±1%, 1/10W, SMD	102-2001	1
R88, R89	Resistor, Chip, 10.0 k Ohm ±1%,1/10W, SMD	102-1002	2
R90, R91	Resistor, Chip, 2.00 k Ohm ±1%, 1/10W, SMD	102-2001	2
R92	Resistor, Chip, 10.0 k Ohm ±1%, 1/10W, SMD	102-1002	1
R94	Resistor, Chip, 2.00 k Ohm ±1%, 1/10W, SMD	102-2001	1
R95	Potentiometer, 100 k, Top Adjust, SMD	198-0104	1
R96	Resistor, Chip, 10.0 k Ohm ±1%, 1/10W, SMD	102-1002	1
R99	Resistor, Chip, 768 Ohm ±1%,1/10W, SMD	102-7680	1
R100	Resistor, Chip, 1.00 k Ohm ±1%,1/10W, SMD	102-1001	1
R101	Resistor, Chip, 332 k Ohm ±1%,1/10W, SMD	102-3323	1
R103	Resistor, Chip, 332 k Ohm ±1%,1/10W, SMD	102-3323	1
R104	Resistor, Chip, 10.0 k Ohm ±1%,1/10W, SMD	102-1002	1
R106	Resistor, Chip, 20.0 k Ohm ±1%,1/10W, SMD	102-2002	1
R107	Resistor, Chip, 10.0 k Ohm ±1%, 1/10W, SMD	102-1002	1
R109	Resistor, Chip, 10.0 k Ohm ±1%, 1/10W, SMD	102-1002	1
R110	Resistor, Chip, 10.0 k Ohm ±1%,1/10W, SMD	102-1002	1
R112	Resistor, Chip, 33 k Ohm ±1%, 1/10W, SMD	102-3353	1
R113	Potentiometer, 100 k, Top Adjust, SMD	198-0104	1
R114	Resistor, Chip, 2.00 k Ohm, 1/10W, SMD	102-2001	1
R115, R116	Resistor, Chip, 10.0 k Ohm ±1%, 1/10W, SMD	102-1002	2
R117	Resistor, Chip, 2.00 k Ohm ±1%, 1/10W, SMD	102-2001	1
R118	Resistor, Chip, 100 k Ohm ±1%, 1/10W	102-1003	1
R119	Potentiometer, 50 k, Top Adjust, SMD	198-0503	1
R120	Resistor, Chip, 100 k Ohm ±1%, 1/10W	102-1003	1
R125 thru R131	Resistor, Chip, 10.0 k Ohm ±1%,1/10W, SMD	102-1002	7
R133 thru R140	Resistor, Chip, 10.0 k Ohm ±1%,1/10W, SMD	102-1002	8
R141 thru R143	Resistor, Chip, 49.9 Ohm ±1%, 1/10W	102-4991	3
R144	Resistor, Chip, 20.0 k Ohm ±1%, 1/10W, SMD	102-2002	1
R145	Resistor, Chip, 10.0 k Ohm ±1%,1/10W, SMD	102-1002	1
R146, R147	Resistor, Chip, 2.00 k Ohm ±1%, 1/10W	102-2001	2
R148	Resistor, Chip, 49.9 Ohm ±1%, 1/10W	102-4991	1
R149, R150	Resistor, Chip, 10.0 k Ohm ±1%, 1/10W, SMD	102-1002	2
R151 thru R156	Resistor, Chip, 49.9 Ohm ±1%, 1/10W	102-4991	6

TABLE 3-3. MAIN BOARD CONTROLLER CIRCUIT BOARD ASSEMBLY - 919-0436 (Sheet 3 of 4)

REF. DES.	DESCRIPTION	PART NO.	QTY.
R159	Resistor, Chip, 2.00 k Ohm ±1%, 1/10W	102-2001	1
R162	Resistor, Chip, 49.9 Ohm ±1%, 1/10W	102-4991	1
R165	Resistor, Chip, 49.9 Ohm ±1%, 1/10W	102-4991	1
R168	Resistor, Chip, 49.9 Ohm ±1%, 1/10W	102-4991	1
SW1	Switch, 94HCB08W, Rotary, BCD, 8 Position, SMD	342-9410	1
SW2	Switch, ETO5SD1CBE, Toggle, SPDT, MOM/OFF/MOM	340-0510	1
SW3	Switch, TL3304F160, TACT, SPST, N.O., SMD, Recessed	342-3304	1
TP1 thru TP10	Chip, Test Point, 1206, SMD	413-1206	10
U1, U2, U4	Integrated Circuit, 82C55A, Peripheral Interface, 44-Pin PLCC Package	229-8255-001	3
U7, U8	Integrated Circuit, ADC0808CCV, A/D Converter, 8-BIT, 8-Channel Multiplexer, 28-Pin Molded Chip Carrier Package	224-0808	2
U18	Integrated Circuit, ST16C552CJ68, PLCC Package, 68-Pin, Dual Universal Asynchronous Receiver/Transmitter with FIFO and Parallel Printer Port With Power Down Capability, SMD	224-0552	1
U29	Integrated Circuit, LT1491CS, OP Amp, Quad Micropower Rail-To-Rail Input and Output, 14-Pin, SO Package, SMD	224-1491	1
U31	Integrated Circuit, LT1491CS, OP Amp, Quad Micropower Rail-To-Rail Input and Output, 14-Pin SO Package, SMD	224-1491	1
U32 thru U34	Integrated Circuit, SP241ACT, RS-232 Multi-Transceiver, +5V, 28-Pin SOIC Package, SMD	224-2410	3
U35	Integrated Circuit, X9312WS, Nonvolatile Trimmer Pot, 10 k, 0-15V dc, 8-Pin SOIC Package, SMD	198-9312	1
U36	Integrated Circuit, Si9986CY, 1 Amp, Buffered Full-Bridge, 8-Pin SOIC Package, SMD	224-9986	1
U37	Integrated Circuit, LT1491CS, OP Amp, Quad Micropower Rail-To-Rail Input and Output, 14-Pin SO Package, SMD	224-1491	1
U38	Integrated Circuit, MAX505ACWG, QUAD, 8-BIT DAC, Volt Out, +5V, 24-Pin Wide SO Package, SMD	224-0505	1
U39	Integrated Circuit, N74F74D, Dual Positive Edge Triggered D-Type Flip-Flop, 14-Pin SO, SMD	224-0074	1
U40, U41	Integrated Circuit, LT1491CS, Op Amp, Quad Micropower Rail-To-Rail Input and Output, 14-Pin, SO Package, SMD	224-1491	2
U10A thru U17A	Integrated Circuit, 4N33, Optical Isolator, NPN Photo Transistor/Infared Emitting Diode Type, 1500V Isolation, Response: 30 kHz Maximum, Current: 50 mA Maximum, 6-Pin DIP	229-0033	8
U10B thru U17B	Integrated Circuit, 4N33, Optical Isolator, NPN Photo Transistor/Infared Emitting Diode Type, 1500V Isolation, Response: 30 kHz Maximum, Current: 50 mA Maximum, 6-Pin DIP	229-0033	8
U19A thru U22A	Integrated Circuit, H11AA1, AC Input Opto-Isolator, 6-Pin DIP	229-0111	4
U19B thru U22B, U25B	Integrated Circuit, H11AA1, AC Input Opto-Isolator, 6-Pin DIP	229-0111	5
U24A	Integrated Circuit, 4N33, Optical Isolator, NPN Photo Transistor/Infared Emitting Diode Type, 1500V Isolation, Response: 30 kHz Maximum, Current: 50 mA Maximum, 6-Pin DIP	229-0033	1
U25A	Integrated Circuit, H11AA1, AC Input Opto-Isolator, 6-Pin DIP	229-0111	1
U26A thru U28A	Integrated Circuit, 4N33, Optical Isolator, NPN Photo Transistor/Infared Emitting Diode Type, 1500V Isolation, Response: 30 kHz Maximum, Current: 50 mA Maximum, 6-Pin DIP	229-0033	4
U24B, U26B thru U28B	Integrated Circuit, 4N33, Optical Isolator, NPN Photo Transistor/Infared Emitting Diode Type, 1500V Isolation, Response: 30 kHz Maximum, Current: 50 mA Maximum, 6-Pin DIP	229-0033	4
XBT1	Holder, Battery For CR-2032, SMD	415-2032	1
XU3	Software, FM Control, Programmed Kit, Version 2.01	979-0443-003	1
XU5, XU6	Socket, 20-Pin, DIP, SMD	431-2000	2
XU5	Software, FM Control Programmed Kit	979-0436-005	1
XU6	Software, FM Control Programmed Kit	979-0436-006	1

TABLE 3-3. MAIN BOARD CONTROLLER CIRCUIT BOARD ASSEMBLY - 919-0436
(Sheet 4 of 4)

REF. DES.	DESCRIPTION	PART NO.	QTY.
XU10 thru XU17	Socket, 14-Pin, DIP, SMD	431-1400	8
XU18	Socket, 68-Pin, PLCC, SMD	431-6800	1
XU19 thru XU22	Socket, 14-Pin, DIP, SMD	431-1400	4
XU24 thru XU28	Socket, 14-Pin, DIP, SMD	431-1400	5
Z1	Smartcore Z1B Circuit Board Assembly	544-0006	1
----	Blank, Main Board, Controller Circuit Board	519-0436	1

TABLE 3-4. FRONT PANEL CONTROLLER CIRCUIT BOARD ASSEMBLY - 919-0437
(Sheet 1 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
C2	Capacitor, Mica, 390 pF ±5%, 100V	042-3922	1
C3	Capacitor, Ceramic, Monolythic, .1 uF ±20%, 50V	003-1054	1
DS1 thru DS4	LED, LN322GP, Green, Diffused Chimney	320-0322	4
DS5 thru DS8	LED, LN222RP, Red Diffused Chimney, P424, 70 mW, 20 mA, 4V	320-0037	4
DS9	LED, LN322GP, Green, Diffused Chimney	320-0322	1
J2	Connector Header, 40-Pin	417-0173	1
J12	Receptacle, Male, 8-Pin In-Line, Right Angle	417-0080-001	1
L1	RF Choke, 4.7 uH ±10%, 430 mA, DC Resistance: 0.55 Ohms, 0.43 Amperes Maximum, Resonant at 115 MHz	360-0022	1
R1, R2	Resistor, 10 Ohm ±1%, 1/4W	103-1021	2
R3	Resistor, 17.8 Ohm ±1%, 1/4W	103-1782	1
R4	Resistor, 10 Ohm ±1%, 1/4W	103-1021	1
R5	Resistor, 17.8 Ohm ±1%, 1/4W	103-1782	1
R6	Resistor, 10 Ohm ±1%, 1/4W	103-1021	1
R7	Resistor, 17.8 Ohm ±1%, 1/4W	103-1782	1
R8	Resistor, 10 Ohm ±1%, 1/4W	103-1021	1
R9	Resistor, 267 Ohm ±1%, 1/4W	103-2673	1
R10	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	1
R11 thru R14	Resistor, 536 Ohm ±1%, 1/4W	103-5363	4
R15 thru R18	Resistor, 150 Ohm ±1%, 1/4W	100-1531	4
R19 thru R27	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	9
R28	Resistor, 267 Ohm ±1%, 1/4W	103-2673	1
R29	Resistor, 10 Ohm ±1%, 1/4W	103-1021	1
R30	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	1
R31	Resistor, 10 Ohm ±1%, 1/4W	103-1021	1
R32	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	1
R33	Resistor, 536 Ohm ±1%, 1/4W	103-5363	1
R34	Resistor, 150 Ohm ±1%, 1/4W	100-1531	1
R35	Resistor, 442 Ohm ±1%, 1/4W	103-4423	1
SW1	Switch, TL-1251-G, Pushbutton, Momentary, LED Illuminated, Green	340-0140	1
SW2	Switch, TL-1251-Y, Pushbutton, Momentary, LED Illuminated, Yellow	340-0139	1
SW3	Switch, TL-1251-R, Pushbutton, Momentary, LED Illuminated, Red	340-0143	1
SW4	Switch, TL-1251-G, Pushbutton, Momentary, LED Illuminated, Green	340-0140	1
SW5, SW6	Switch, TL-1251-Y, Pushbutton, Momentary, LED Illuminated, Yellow	340-0139	2
SW7	Switch, TL-1251-G, Pushbutton, Momentary, LED Illuminated, Green	340-0140	1

TABLE 3-4. FRONT PANEL CONTROLLER CIRCUIT BOARD ASSEMBLY - 919-0437 (Sheet 2 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
SW8	Switch, TL-1251-R, Pushbutton, Momentary, LED Illuminated, Red	340-0143	1
SW9	Switch, TL-1251-Y, Pushbutton, Momentary, LED Illuminated, Yellow	340-0139	1
SW10	Switch, TL-1251-R, Pushbutton, Momentary, LED Illuminated, Red	340-0143	1
SW11, SW12	Switch, TL-1251-Y, Pushbutton, Momentary, LED Illuminated, Yellow	340-0139	2
----	Blank, Front Panel Controller Circuit Board	519-0437	1

TABLE 3-5. I/O BOARD CONTROLLER CIRCUIT BOARD ASSEMBLY - 919-0438 (Sheet 1 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1	Capacitor, Polyester, 0.0022 uF ±10%, 100V	031-2033	1
C2 thru C12	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	11
C13	Capacitor, Polyester, 0.0022 uF ±10%, 100V	031-2033	1
C14 thru C33	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	19
C34, C35	Capacitor, Polyester, 0.0022 uF ±10%, 100V	031-2033	2
C36	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	1
C37	Capacitor, Polyester, 0.0022 uF ±10%, 100V	031-2033	1
C38 thru C45	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	8
C46, C47	Capacitor, Polyester, 0.0022 uF ±10%, 100V	031-2033	2
C48 thru C52	Capacitor, Mica, 390 pF ±5%, 100V	042-3922	5
C53 thru C57	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	5
C58	Capacitor, Mica, 390 pF ±5%, 100V	042-3922	1
C59	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	1
C60	Capacitor, Polyester, 0.0022 uF ±10%, 100V	031-2033	1
C61 thru C69	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	9
C70	Capacitor, Polyester, 0.0022 uF ±10%, 100V	031-2033	1
C71 thru C83	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	13
D1 thru D4	Diode, HP5082-2800, High Voltage, Schottky Barrier Type, 70V, 15 mA	201-2800	4
D5 thru D48	Bidirectional Zener Transient Voltage Suppressor, P6KE15CA-RL, +/-15V	201-0015	44
D51 thru D73	Bidirectional Zener Transient Voltage Suppressor, P6KE15CA-RL, +/-15V	201-0015	23
D74, D75	Bidirectional Zener Transient Voltage Suppressor, P6KE27CA-RL, +/-27V	201-0027	2
D76, D77	Bidirectional Zener Transient Voltage Suppressor, P6KE15CA-RL, +/-15V	201-0015	2
FL1 thru FL44	Filter, EMI, 10,000 pF, 3-Pin	411-0001	44
FL47 thru FL69	Filter, EMI, 10,000 pF, 3-Pin	411-0001	23
J1	Connector, DB37F, Vertical, PCB	417-3703	1
J2, J3	Receptacle, 25-Pin	417-2500	2
J5, J6	Connector, DB9M, Vertical, PCB	417-9001	2
J7	Receptacle, 25-Pin	417-2500	1
J11, J12	Header, 50-Pin, Right Angle, .100 Centers	417-5017	2
L1 thru L6	RF Choke, 4.7 uH ±10%, 430 mA, DC Resistance: 0.55 Ohms, 0.43 Amperes Maximum, Resonant at 115 MHz	360-0022	6
R1	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	1
R2 thru R6	Resistor, 100 Ohm ±1%, 1/4W	100-1031	5
R7	Resistor, 51.1 Ohm ±1%, 1/4W	103-5112	1
R8, R9	Resistor, 100 Ohm ±1%, 1/4W	100-1031	2

TABLE 3-5. I/O BOARD CONTROLLER CIRCUIT BOARD ASSEMBLY - 919-0438
(Sheet 2 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
R10, R11	Resistor, 51.1 Ohm ±1%, 1/4W	103-5112	2
R12	Resistor, 100 Ohm ±1%, 1/4W	100-1031	1
R14 thru R21	Resistor, 51.1 Ohm ±1%, 1/4W	103-5112	8
R24 thru R31	Resistor, 51.1 Ohm ±1%, 1/4W	103-5112	8
R34	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	1
R37 thru R39	Resistor, 51.1 Ohm ±1%, 1/4W	103-5112	3
R45	Resistor, 56 Ohm ±5%, 2W	130-5621	1
R46 thru R48	Resistor, 51.1 Ohm ±1%, 1/4W	103-5112	3
R54	Resistor, 475 Ohm ±1%, 1/4W	103-4753	1
R55, R56	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	2
R57	Resistor, 475 Ohm ±1%, 1/4W	103-4753	1
R58	Resistor, 56 Ohm ±5%, 2W	130-5621	1
R60	Resistor, 21 k Ohm ±1%, 1/4W	103-2105	1
R64 thru R66	Resistor, 51.1 Ohm ±1%, 1/4W	103-5112	3
R67	Resistor, 8.66 k Ohm ±1%, 1/4W	100-8641	1
R68	Resistor, 4.32 k Ohm ±1%, 1/4W	103-4324	1
R73, R75,	Resistor, 51.1 Ohm ±1%, 1/4W	103-5112	2
R76, R77	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	2
R79	Resistor, 4.32 k Ohm ±1%, 1/4W	103-4324	1
R82	Resistor, 8.66 k Ohm ±1%, 1/4W	100-8641	1
R90 thru R92	Resistor, 51.1 Ohm ±1%, 1/4W	103-5112	3
R94 thru R98	Resistor, 51.1 Ohm ±1%, 1/4W	103-5112	5
----	Blank, I/O Board Controller Circuit Board	519-0438	1

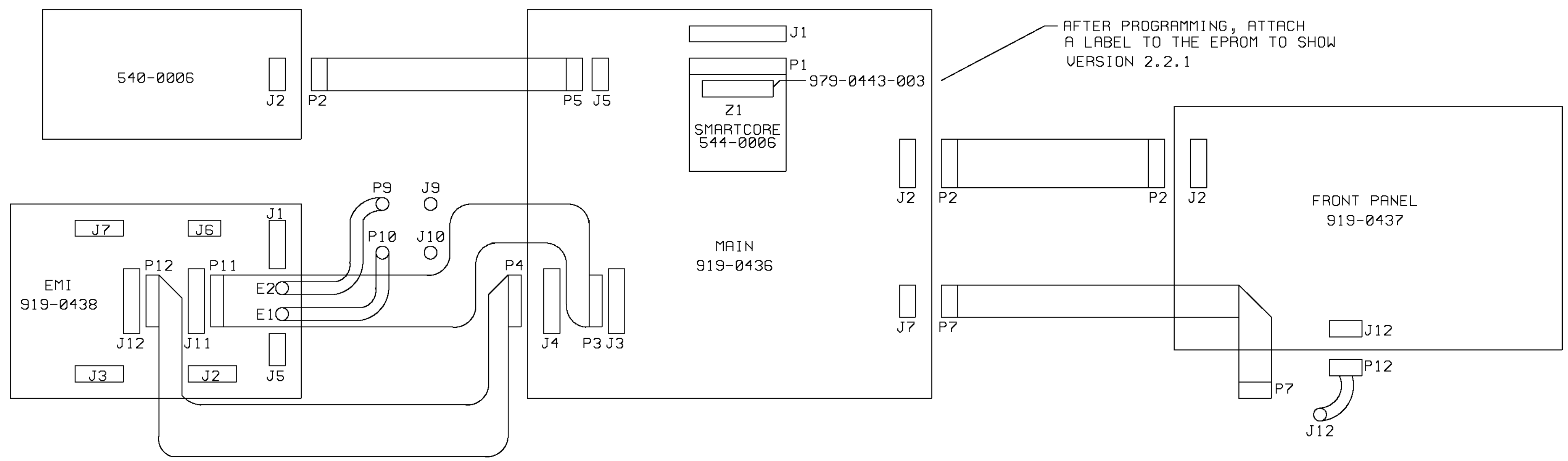
TABLE 3-6. HARNESS, FM DIGITAL CONTROLLER ASSEMBLY - 949-0423

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Connector, Male, 9-Pin	417-0181	1
----	Socket, Connector, 50-Pin	417-0228	4
----	Housing, SL-156, 3 Position	417-0306	1
----	Plug, Housing, 2-Pin	417-0499	1
----	Housing, SL-156, 6 Position	417-0606	1
----	Pins, Crimp Type	417-8766	2
----	Connector Housing, 6-Pin	418-0670	1
----	Plug, 40-Pin Dual In-Line	418-4001	2
----	Varistor, V250LA20A GE, Model Size 14	140-0008	2
----	Socket, Connector, 641294-1 Amp	417-0053	6
----	Socket, Connector, 10-Pin	417-1003	1
----	Plug, BNC Dual Crimp 1-227079-6	418-0034	2

SECTION IV
DRAWINGS

4-1. INTRODUCTION.

4-2. This section provides assembly drawings, schematic diagrams, and wiring diagrams as indexed below for the FM-10T/FM-10TS transmitter controller.



919-0438

REMOTE I/O J1

1	R_FIL_ON_OUT
2	R_DISABLR_LED
3	R_HV_ON_OUT
4	R_PLATE_OL_LED
5	R_SCREEN_OL_LED
6	R_GRID_OL_LED
7	R_VSWR_OL_LED
8	R_OL_LED
9	R_INTLK_LED
10	R_AIR_PSI_LED
11	R_FIL_LED
12	R_HV_LED
13	R_PRESET_LED
14	R_IPA_F_PWR_OUT
15	R_APC_LED
16	CHASIS_GND
17	NO CONNECTION
18	FAILSAFE_IN
19	FAILSAFE_OUT
20	R_FIL_ON_IN
21	R_FIL_OFF_IN
22	R_HV_ON_IN
23	R_HV_OFF_IN
24	R_RAISE_PWR_IN
25	R_LOWER_PWR_IN
26	R_PRESET_PWR_IN
27	R_OL_RST_IN
28	NO CONNECTION
29	P_PA_F_PWR_OUT
30	R_PA_R_PWR_OUT
31	GND
32	R_PLATE_E_OUT
33	R_PLATE_I_OUT
34	R_APC_ON_IN
35	NO CONNECTION
36	R_FAILSAFE_LED
37	R_PWR_+15V

TRANSMITTER J2

1	EXCTR_F_PWR_IN
2	KEY
3	EXCTR_R_PWR_IN
4	EXCTR_TEMP_IN
5	AFC_UNLOCK_IN
6	EXCTR_MUTE_OUT
7	AIR_PSI_IN
8	INTERLOCK_OUT
9	INTERLOCK_IN
10	PLATE_I_IN
11	PLATE_E_IN
12	SCREEN_I_IN
13	SCREEN_E_IN
14	GRID_I_IN
15	GRID_E_IN
16	CHASIS_GND
17	FIL_ON_SSR
18	BLWR_ON_SSR
19	S/S_ON_SSR
20	HV_ON_SSR
21	PA_TEMP_IN
22	GND
23	GND
24	NO CONNECTION
25	PA_TEMP_OUT

TRANSMITTER J3

1	KEY
2	IPA_TEMP_IN
3	IPA_F_PWR_IN
4	IPA_R_PWR_IN
5	IPA_E_IN
6	IPA_I_IN
7	IPA_MOD_FAULT_IN
8	IPA_RESET_OUT
9	IPA_PWR_FALT_IN
10	IPA_PWR_CNTRL_OUT
11	NO CONNECTION
12	NO CONNECTION
13	GND
14	NO CONNECTION
15	GND
16	LOWER_PWR_IND_IN
17	IPA_FALT_STAT_IN
18	NO CONNECTION
19	NO CONNECTION
20	RAISE_PWR_IND_IN
21	FWD/VSWR_OUT
22	NO CONNECTION
23	RAISE_PA_PWR_OUT
24	LOWER_PA_PWR_OUT
25	NO CONNECTION

LOCAL PORT J6

1	NO CONNECTION	
2	RECIEVE DATA	(RX)
3	TRANSMIT DATA	(TX)
4	NO CONNECTION	
5	SIGNAL GROUND	(GND)
6-9	NO CONNECTION	

MODEM PORT 2 J5

1	DATA CARRIER DETECT	(DCD)
2	RECIEVE DATA	(RX)
3	TRANSMIT DATA	(TX)
4	DATA TERMINAL READY	(DTR)
5	SIGNAL GROUND	(GND)
6	DATA SET READY	(DSR)
7	REQUEST TO SEND	(RTS)
8	CLEAR TO SEND	(CTS)
9	RING INDICATOR	(RI)

PRINTER PORT J7

1	STROBE
2	DATA BIT 0
3	DATA BIT 1
4	DATA BIT 2
5	DATA BIT 3
6	DATA BIT 4
7	DATA BIT 5
8	DATA BIT 6
9	DATA BIT 7
10	ACKNOWLEDGE
11	BUSY
12	OUT OF PAPER
13	SELECT
14	AUTO FEED
15	I/O ERROR
16	INITIALIZE PRINTER
17	SELECT IN
18-25	GROUND

J11/P11 ◄──► P3/J3

1	+15V	1
2	R_HV_ON_OPT	2
3	R_FIL_ON_OPT	3
4	R_OL_OPT	4
5	R_PLATE_OL_OPT	5
6	R_SCREEN_OL_OPT	6
7	R_GRID_OL_OPT	7
8	R_VSWR_OL_OPT	8
9	R_INTLK_OPT	9
10	R_AIR_PSI_OPT	10
11	R_FIL_OPT	11
12	R_HV_OPT	12
13	R_FIL_ON_IN_OPT	13
14	R_FIL_OFF_OPT	14
15	R_HV_ON_IN_OPT	15
16	R_HV_OFF_OPT	16
17	R_OL_RST_OPT	17
18	R_RAISE_PWR_OPT	18
19	R_LOWER_PWR_OPT	19
20	R_PRESET_PWR_OPT	20
21	R_DISABLE_OPT	21
22	R_PA_F_PWR_MTR	22
23	R_PA_R_PWR_MTR	23
24	R_PLATE_E_MTR	24
25	R_PLATE_I_MTR	25
26	FWD/VSWR_MTR	26
27	EXCTR_F_PWR_SMP	27
28	EXCTR_R_PWR_SMP	28
29	EXCTR_TEMP	29
30	AFC_UNLOCK	30
31	EXCTR_MUTE_OPT	31
32	FIL_ON_OPT	32
33	BLWR_ON_OPT	33
34	S/S_ON_OPT	34
35	HV_ON_OPT	35
36	PLATE_I_SMP	36
37	PLATE_E_SMP	37
38	SCREEN_I_SMP	38
39	SCREEN_E_SMP	39
40	GRID_I_SMP	40
41	GRID_E_SMP	41
42	PA_TEMP_SMP	42
43	GND	43
44	RAISE_PA_PWR	44
45	RAISE_PWR_LED	45
46	LOWER_PA_PWR	46
47	LOWER_PWR_LED	47
48	PA_F_PWR_SMP	48
49	PA_R_PWR_SMP	49
50	R_PRESET_LED_OPT	50

FWD POWER E2 ◄──► P9/J9

1	CONDUCTOR	1
2	SHIELD	2

J12/P12 ◄──► P4/J4

1	+5V	1
2	IPA_FALT_STAT	2
3	IPA_F_PWR_SMP	3
4	IPA_R_PWR_SMP	4
5	IPA_E_SMP	5
6	IPA_I_SMP	6
7	IPA_PWR_CNTL	7
8	IPA_PWR_FALT	8
9	IPA_RESET_OPT	9
10	IPA_MOD_FALT	10
11	IPA_TEMP	11
12	FAILSAFE_OPT	12
13	INTERLOCK_OPT	13
14	AIR_PSI_OPT	14
15	NO CONNECTION	15
16	SLCT	16
17	ERROR	17
18	PE	18
19	/SLCTIN	19
20	INIT	20
21	/AUTOFDXT	21
22	/STROBE	22
23	ACK	23
24	/BUSY	24
25	PD_0	25
26	PD_1	26
27	PD_2	27
28	PD_3	28
29	PD_4	29
30	PD_5	30
31	PD_6	31
32	PD_7	32
33	TXCO	33
34	RXCI	34
35	TXBO	35
36	RXBI	36
37	/RIBI	37
38	/CDBI	38
39	/DSRBO	39
40	/DTRBO	40
41	/RTSBO	41
42	/CTSBI	42
43	GND	43
44	R_FAILSAFE_OPT	44
45	NO CONNECTION	45
46	R_APC_ON_IN_OPT	46
47	R_APC_LED_OPT	47
48	R_IPA_F_PWR_MTR	48
49	NO CONNECTION	49
50	CHASIS_GND	50

RFL POWER E1 ◄──► P10/J10

1	CONDUCTOR	1
2	SHIELD	2

J1 ◄──► P1

1	GND	1
2	+5	2
3	VBAT	3
4	PFI	4
5	D1	5
6	/RESET	6
7	D2	7
8	NO CONNECTION	8
9	D3	9
10	NO CONNECTION	10
11	D4	11
12	/CS1	12
13	D5	13
14	NO CONNECTION	14
15	D6	15
16	D0	16
17	NO CONNECTION	17
18	A0	18
19	A1	19
20	NO CONNECTION	20
21	/INT1	21
22	/INT0	22
23	A3	23
24	A2	24
25	NO CONNECTION	25
26	A4	26
27	D7	27
28	A5	28
29	/WR	29
30	/IORQ	30
31	NO CONNECTION	31
32	/RD	32
33	NO CONNECTION	33
34	TX1	34
35	NO CONNECTION	35
36	RX0	36
37	TX0	37
38	RX1	38
39	E	39
40	GND	40

J2/P2 ◄──► P5/J5

1	+15
2	+5
3	+5
4	GND
5	GND
6	-15

J2/P2 ◄──► P2/J2

1	+15V	1
2	+5V	2
3	APC_ON_LED	3
4	APC_ON_SW	4
5	FIL_ON_LED	5
6	FIL_ON_SW	6
7	PRESET_LED	7
8	PRESET_SW	8
9	FIL_OFF_LED	9
10	FIL_OFF_SW	10
11	RM_DIS_LED	11
12	RM_DIS_SW	12
13	OL_RST_LED	13
14	OL_RST_SW	14
15	HV_ON_LED	15
16	HV_ON_SW	16
17	HV_OFF_LED	17
18	HV_OFF_SW	18
19	LOWER_PWR_LED	19
20	LOWER_PWR_SW	20
21	RAISE_PWR_LED	21
22	RAISE_PWR_SW	22
23	FWD_PWR_LED	23
24	FWD_PWR_SW	24
25	VSWR_LED	25
26	VSWR_SW	26
27	INTERLOCK_OPT	27
28	AIR_PSI_OPT	28
29	FIL_ON_OPT_A	29
30	HV_ON_OPT_A	30
31	V_OVRLD	31
32	P_OVRLD	32
33	S_OVRLD	33
34	G_OVRLD	34
35	GND	35
36	FAILSAFE_OPT	36
37	PA_F_PWR	37
38	NO CONNECTION	38
39	GND	39
40	NO CONNECTION	40

MODEM PORT 1 J7/P7 ◄──► P7

1	DATA CARRIER DETECT	(DCD)	1
2	RECIEVE DATA	(RX)	2
3	TRANSMIT DATA	(TX)	3
4	DATA TERMINAL READY	(DTR)	4
5	SIGNAL GROUND	(GND)	5
6	DATA SET READY	(DSR)	6
7	REQUEST TO SEND	(RTS)	7
8	CLEAR TO SEND	(CTS)	8
9	RING INDICATOR	(RI)	9
10	NO CONNECTION		10

AM NOISE TEST J12/P12 ◄──► J12

1	CONDUCTOR	1
2	SHIELD	2

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

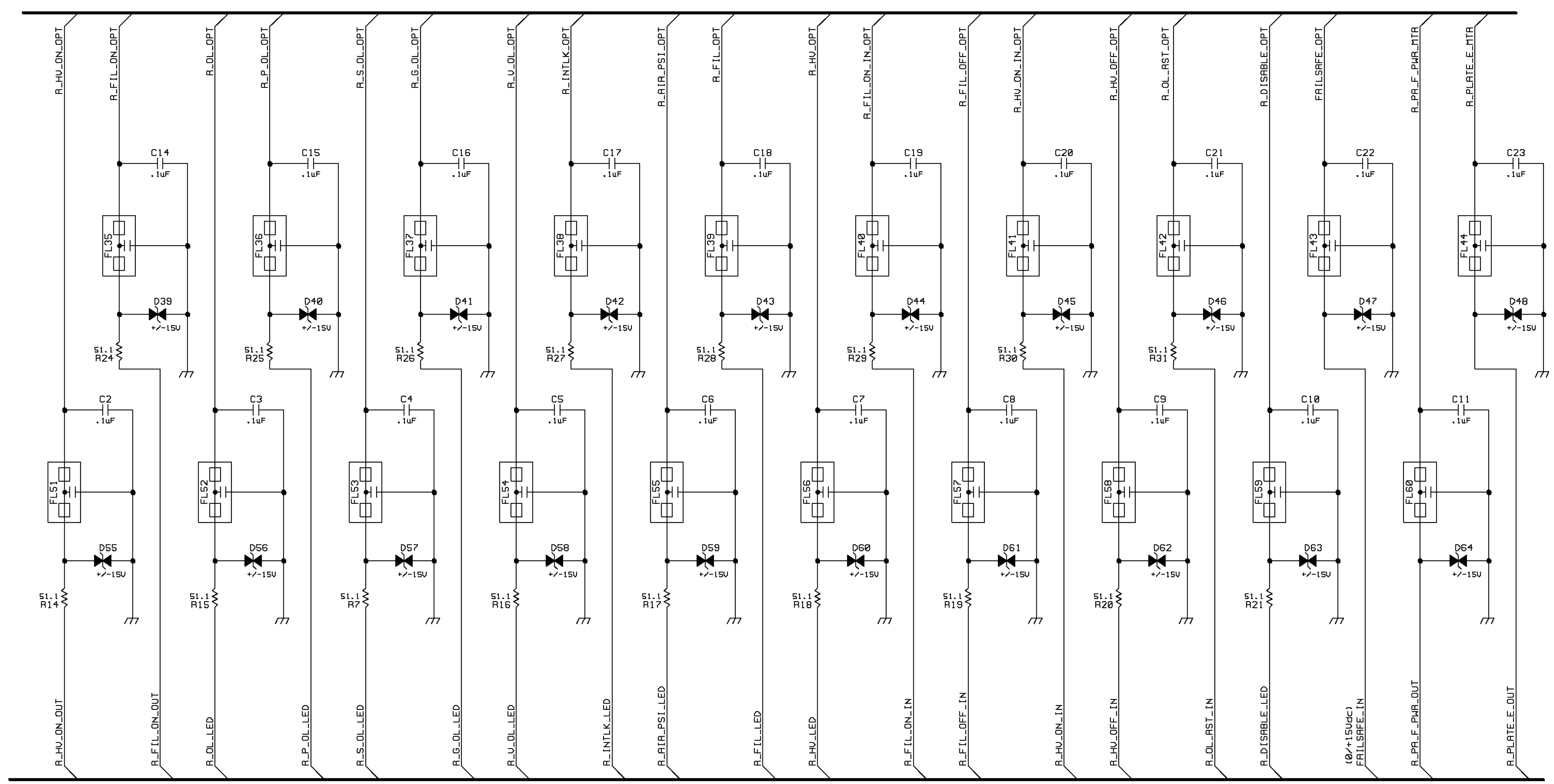
DWN. BY 4-24-97 K. TERWELP
DESIGNER(S)
PROJ. LEADER
MFG.
MATERIAL
FINISH
NEXT ASSY.

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

TITLE T-SERIES CONTROLLER OVERALL SCHEMATIC

TYPE	SIZE	DWG. NO.	REV
S	B	959-0430	C

MODEL SCALE NONE SHEET 1 OF 1

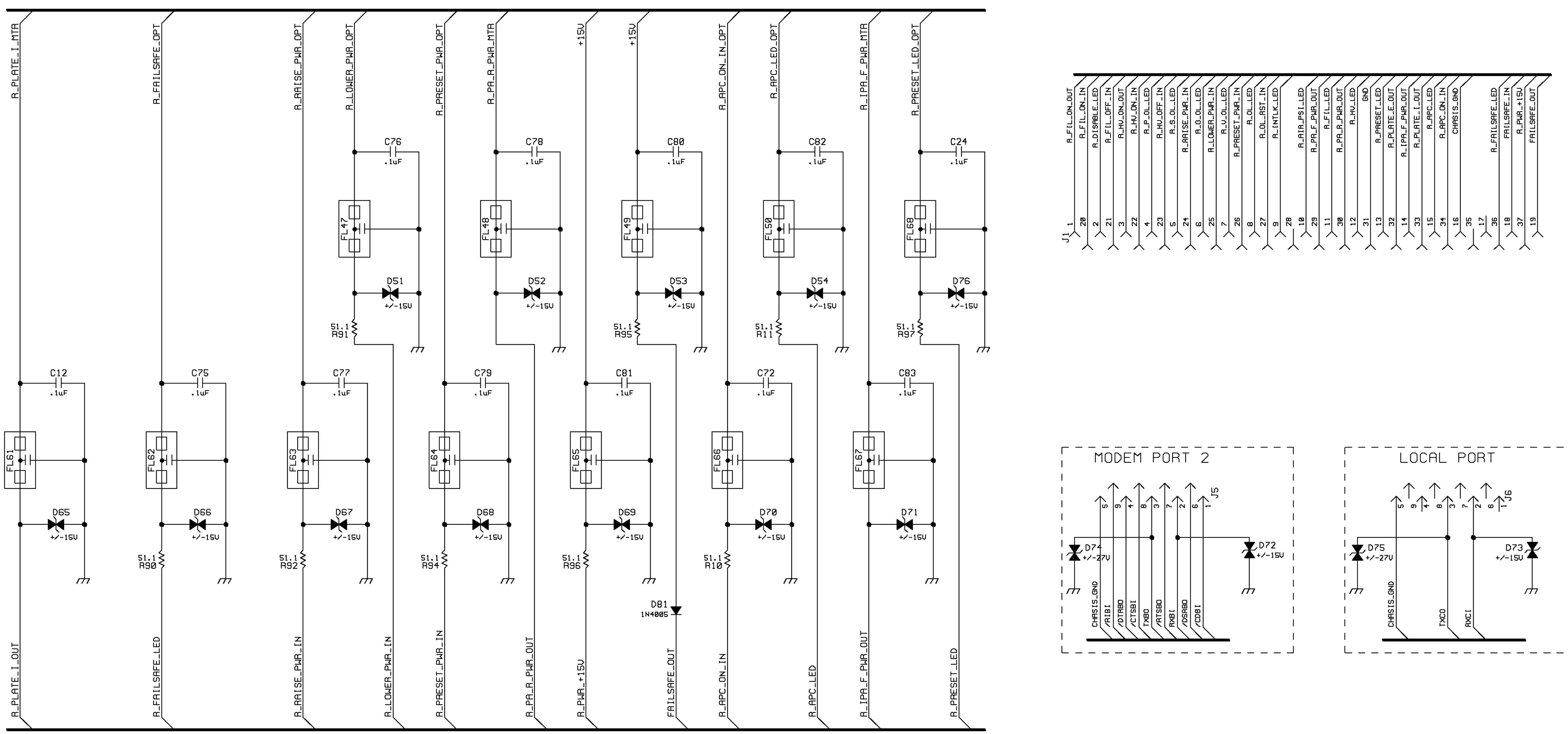


NOTES:

1. ALL RESISTORS IN OHMS; 1/4W, 1% UNLESS OTHERWISE SPECIFIED.
2. LAST COMPONENT USED: C87,D81,E2,FL71,J12,L8 & R98.
3. COMPONENTS NOT USED: J4,J8-J10,R22,R23,R32,R33,R35,R36, R49-R52,R59,R61-R63,R69-R72,R74,R78,R80,R81, R83-R89 & R93.
4. SEE ASSEMBLY: AC919-0438.

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

DWN. BY 1-8-97 K.TERWELP	MATERIAL SEE BOM 919-0438	BROADCAST ELECTRONICS INC. 4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305 217/224-9600 FAX 217/224-9607	
DESIGNER(S)	FINISH	TITLE EMI BOARD	
PROJ. LEADER R.E.BROWN		TYPE S SIZE B DWG. NO. 919-0438	REV C
MFG.	NEXT ASSY.	MODEL T-SERIES XMTR SCALE NONE	SHEET 1 OF 4



COPYRIGHT © 1997 BROADCAST ELECTRONICS, INC.

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

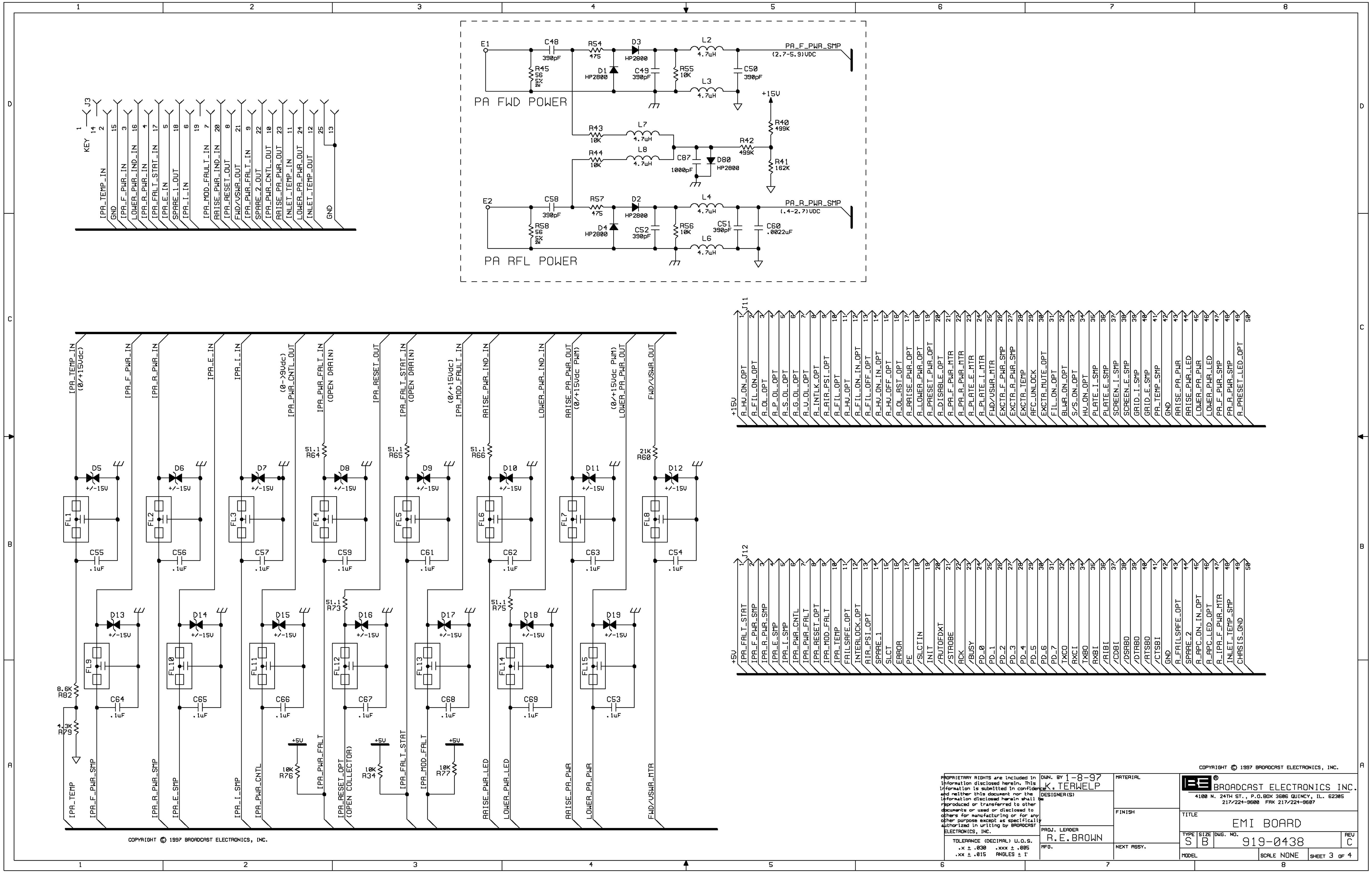
DWN. BY	1-8-97 K.TERWELP
DESIGNER(S)	
PROJ. LEADER	R.E.BROWN
MFG.	
MATERIAL	
FINISH	
NEXT ASSY.	

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

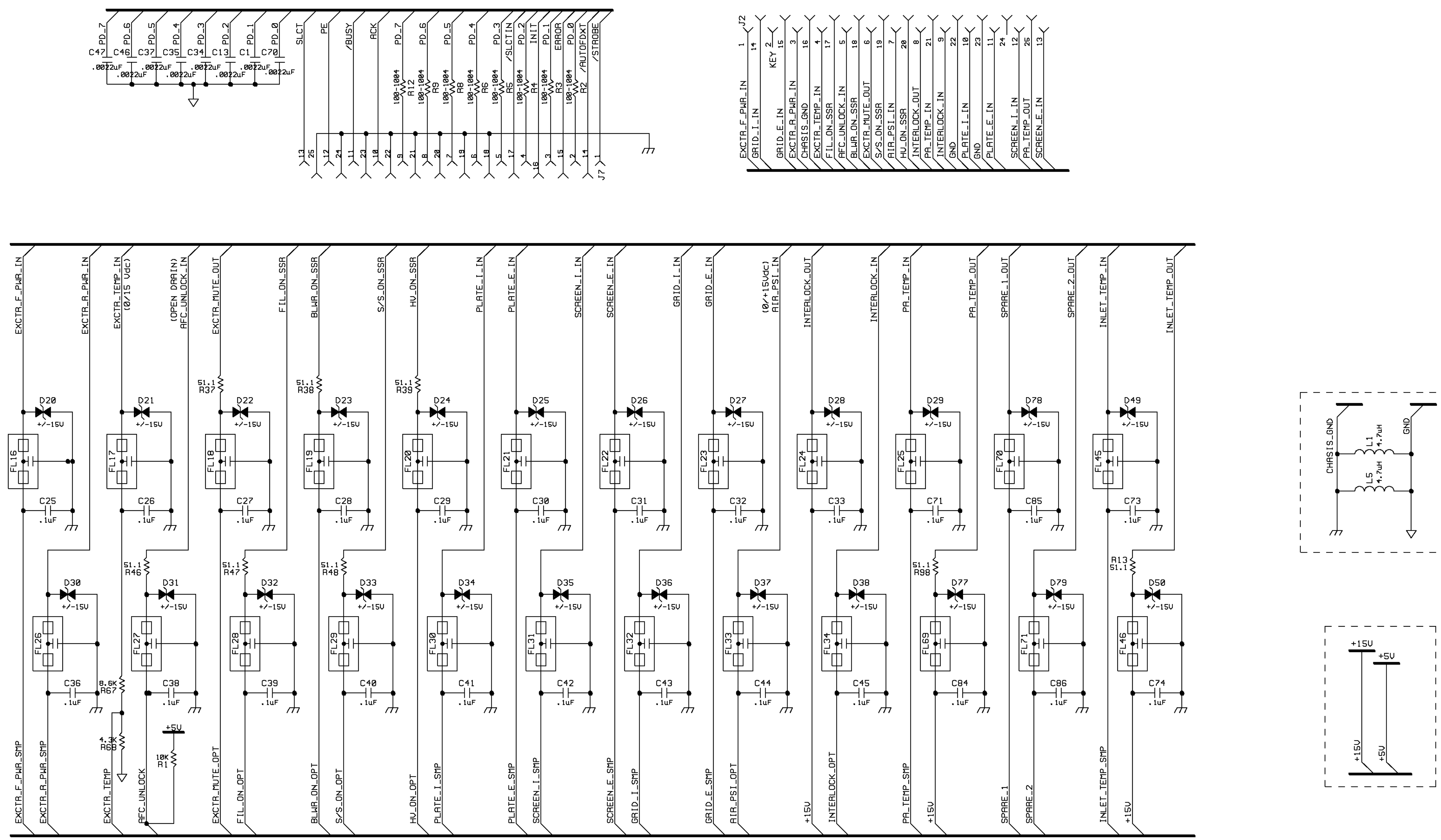
TITLE EMI BOARD

TYPE	SIZE	DWG. NO.	REV
S	B	919-0438	C

MODEL | SCALE NONE | SHEET 2 OF 4



PA FWD POWER
PA RFL POWER
PA_F_PWR_SMP
(2.7-5.9)VDC
PA_R_PWR_SMP
(.4-2.7)VDC
COPYRIGHT © 1997 BROADCAST ELECTRONICS, INC.
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305
217/224-9600 FAX 217/224-9607
DWN. BY 1-8-97 K.TERWELP
PROJ. LEADER R.E.BROWN
TOLERANCE (DECIMAL) U.O.S.
TITLE
EMI BOARD
TYPE S SIZE B DWG. NO. 919-0438 REV C
SCALE NONE
SHEET 3 OF 4



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

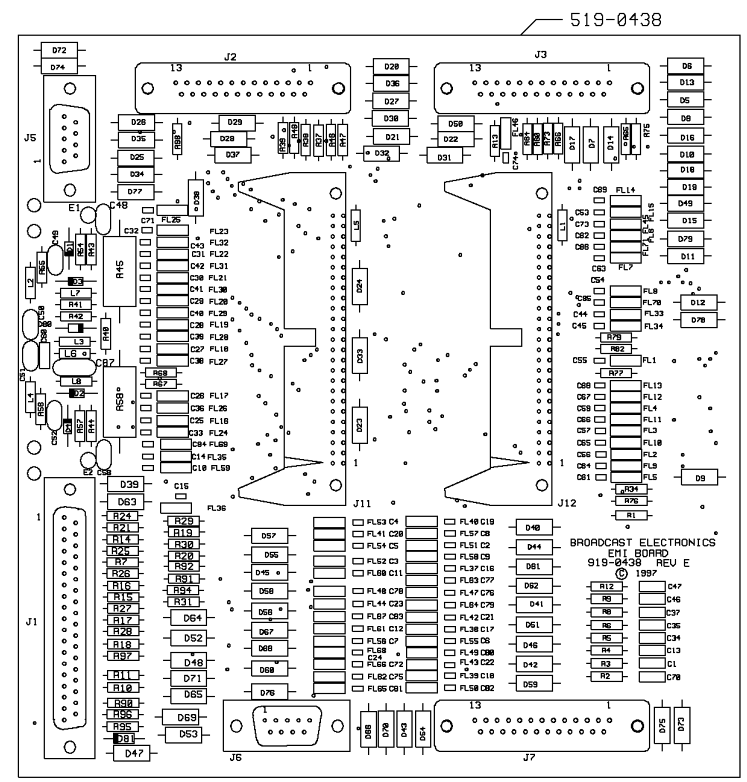
DWN. BY 1-8-97 K.TERWELP
DESIGNER(S)
PROJ. LEADER R.E.BROWN
MFG.
MATERIAL
FINISH
NEXT ASSY.

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

TITLE EMI BOARD

TYPE	SIZE	DWG. NO.	REV
S	B	919-0438	C

MODEL
SCALE NONE
SHEET 4 OF 4



NOTES:

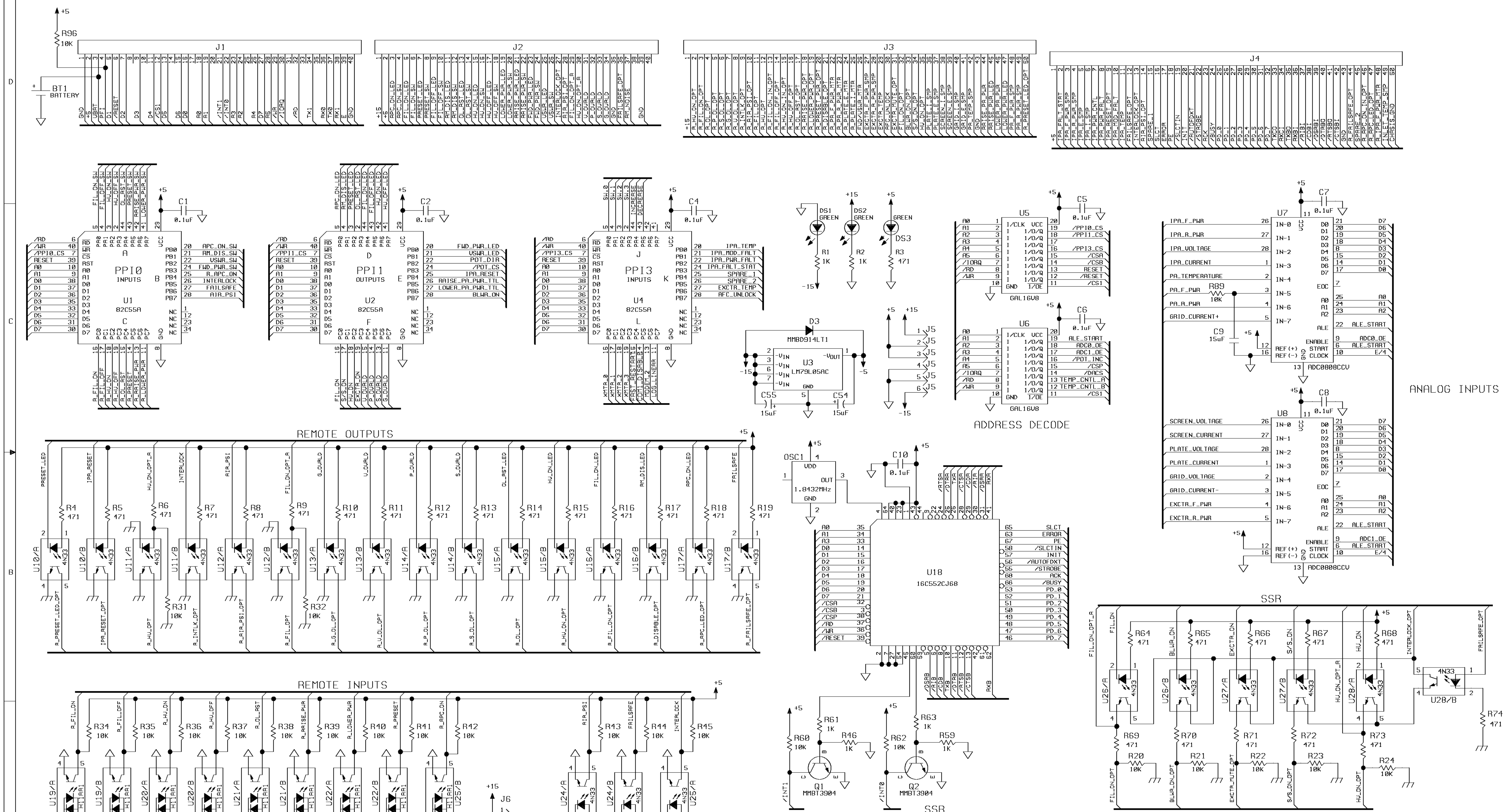
1) LAST COMPONENTS USED: C87,D81,E2,FL71,J12, L8, & R98.
2) COMPONENTS NOT USED: J4,J8-J10, R22,R23,R32,R33,R35,R36,R49,R50-R53, R59,R61-R63,R69-R72,R74,R78,R80,R81, R83-R89,R93.
3) SEE SCHEMATIC: SB919-0438.

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

DWN. BY	2-18-97 K. TERWELP
DESIGNER(S)	
PROJ. LEADER	R. E. BROWN
MFG.	
MATERIAL	SEE BOM 919-0438
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 EMI BOARD
TYPE	A
SIZE	C
DWG No.	919-0438
REV	E
MODEL	T-SERIES XMTR
SCALE	1/1
SHEET	1 OF 1



NOTES:

1. ALL RESISTORS IN OHMS; 1/10W, 1% UNLESS OTHERWISE SPECIFIED.
2. LAST COMPONENT USED: C63,D7,J14,R168, SW4,TP10,U40
3. COMPONENTS NOT USED: C58,R28,R29,R30,R33, R93,R102,R105,R108,R111,R121-R124, R157,R158,R160,R161,R163,R164,R166,R167, U3,U9,U30.
4. SEE ASSEMBLY: AC919-0436
5. U3 USED ON 544-0006

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

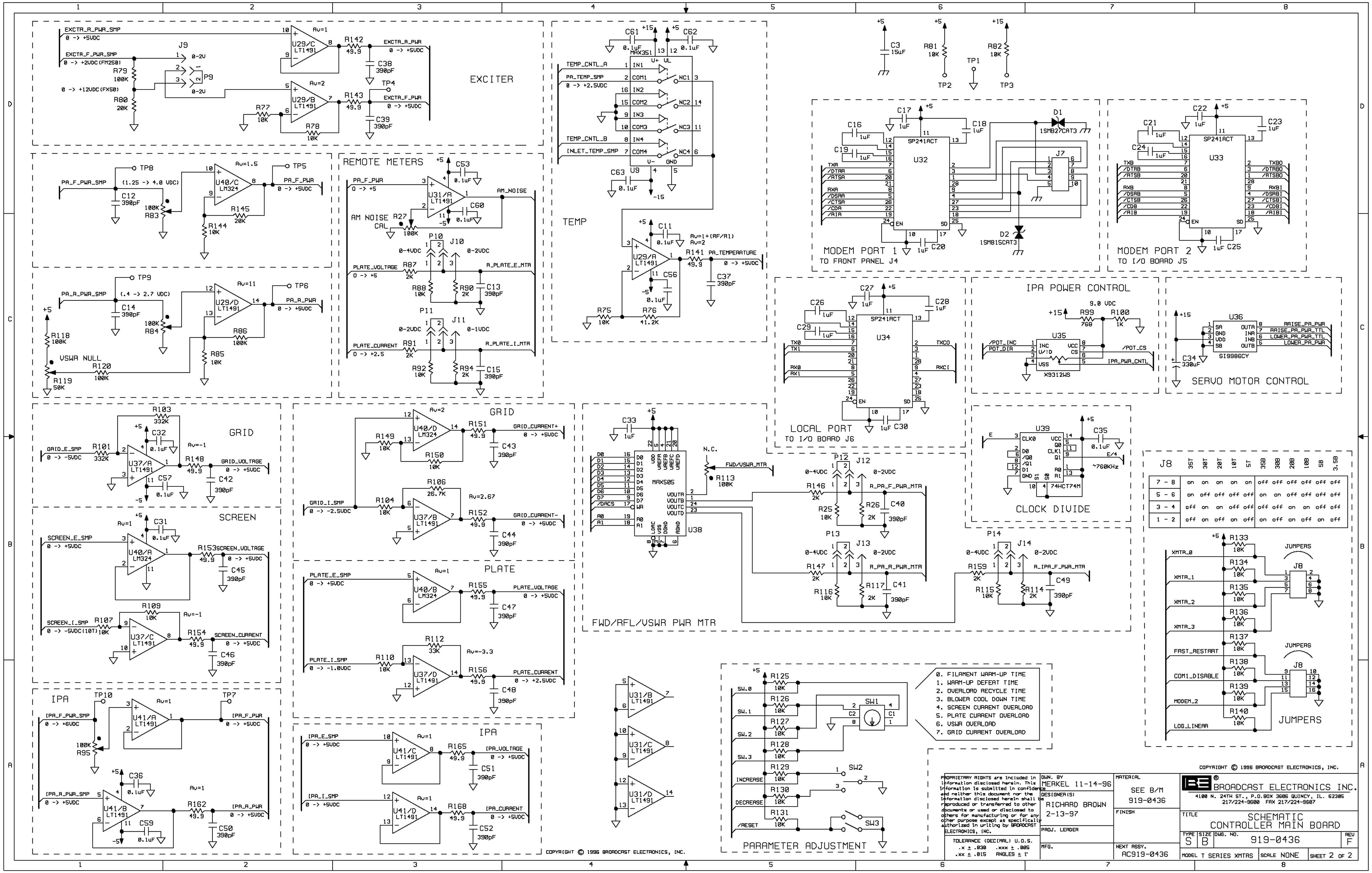
DWN. BY	MERKEL 11-14-96
DESIGNER(S)	RICHARD BROWN 2-13-97
PROJ. LEADER	
MFG.	
MATERIAL	SEE B/M 919-0436
FINISH	
NEXT ASSY.	AC919-0436

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

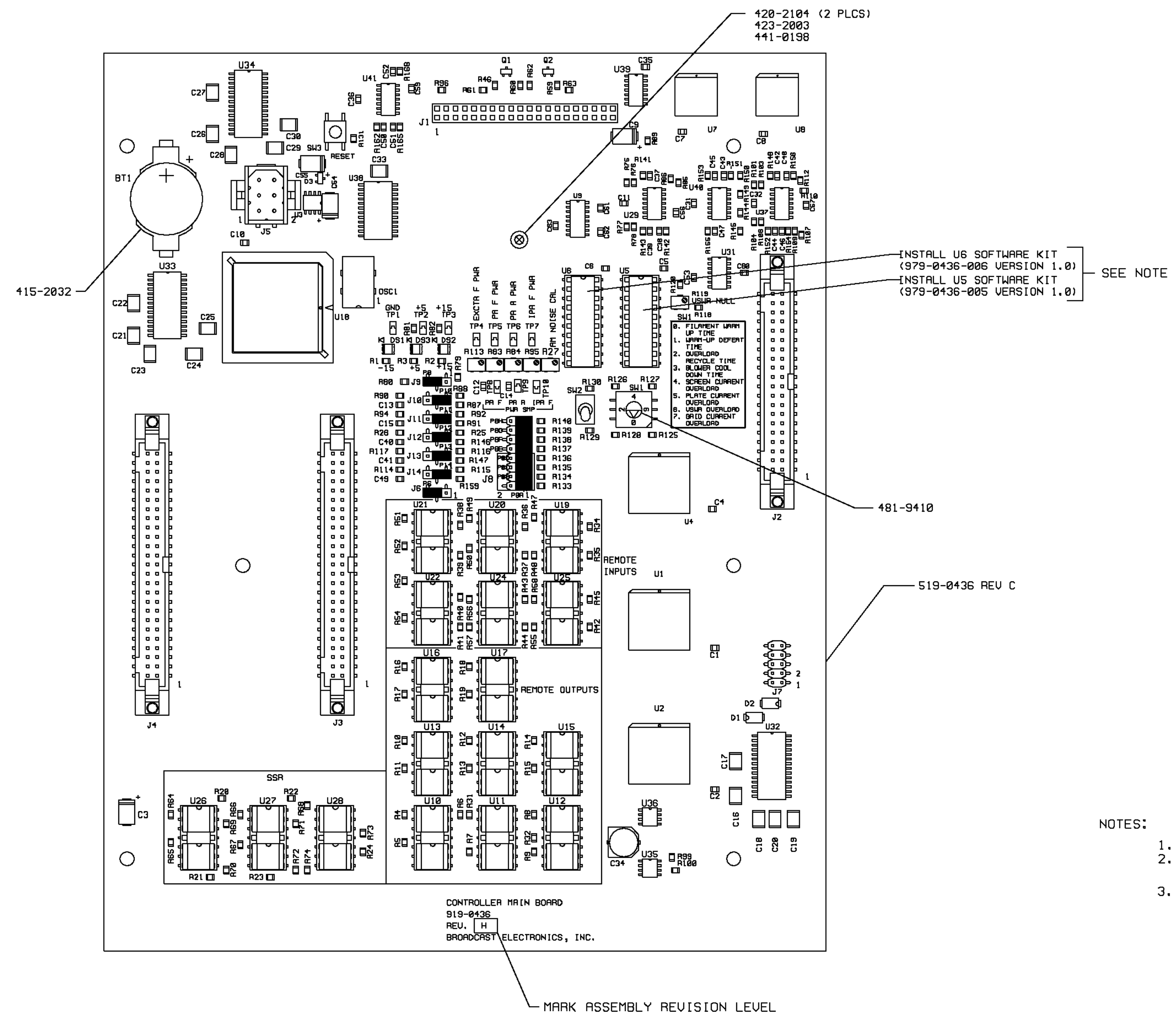
TITLE: SCHEMATIC CONTROLLER MAIN BOARD

TYPE	SIZE	DWG. NO.	REV
S	B	919-0436	F

MODEL T SERIES XMTRS | SCALE NONE | SHEET 1 OF 2



EXCITER
REMOTE METERS
TEMP
MODEM PORT 1
TO FRONT PANEL J4
MODEM PORT 2
TO I/O BOARD J5
LOCAL PORT
TO I/O BOARD J6
IPA POWER CONTROL
SERVO MOTOR CONTROL
CLOCK DIVIDE
GRID
SCREEN
PLATE
IPA
FWD/RFL/VSWR PWR MTR
PARAMETER ADJUSTMENT
JUMPERS
0. FILAMENT WARM-UP TIME
1. WARM-UP DEFEAT TIME
2. OVERLOAD RECYCLE TIME
3. BLOWER COOL DOWN TIME
4. SCREEN CURRENT OVERLOAD
5. PLATE CURRENT OVERLOAD
6. VSWR OVERLOAD
7. GRID CURRENT OVERLOAD
COPYRIGHT © 1996 BROADCAST ELECTRONICS, INC.
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.
TOLERANCE (DECIMAL) U.O.S.
.x ± .030 .xxx ± .005
.xx ± .015 ANGLES ± 1°
DWN. BY MERKEL 11-14-96
DESIGNER(S) RICHARD BROWN 2-13-97
PROJ. LEADER
MFG.
MATERIAL SEE B/M 919-0436
FINISH
NEXT ASSY. AC919-0436
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305
217/224-9600 FAX 217/224-9607
TITLE SCHEMATIC CONTROLLER MAIN BOARD
TYPE S
SIZE B
DWG. NO. 919-0436
REV F
MODEL T SERIES XMTRS
SCALE NONE
SHEET 2 OF 2



NOTES:

1. SEE SCHEMATIC SB919-0436.
2. MARK EPROM SOFTWARE REVISION LEVEL WITH A LABEL ON EACH PROGRAMMABLE IC.
3. BOARDS ARE TO BE FUNCTIONALLY TESTED USING A 544-0006 MODULE, AND THE MODULE REMOVED BEFORE SHIPMENT TO BEI OR TURNED INTO STOCK AT BEI.

DWN. BY	MERKEL 12-3-96
DESIGNER(S)	
PROJ. LEADER	RICHARD BROWN 12-3-96
MFG.	
MATERIAL	SEE B/M 919-0436
FINISH	
NEXT ASSY.	

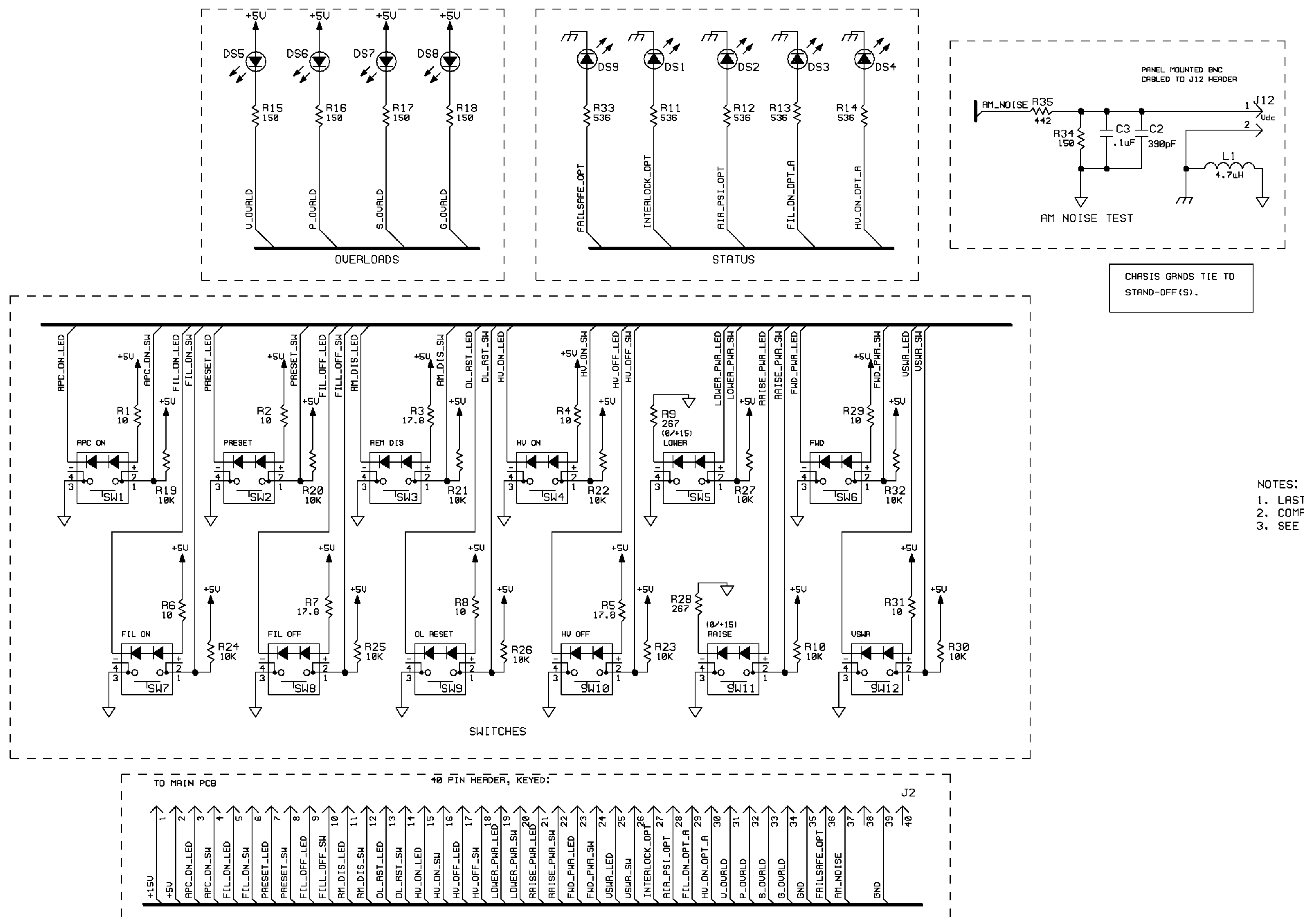
TOLERANCE (DECIMAL) U.O.S.
.X ± .030 .XXX ± .005
.XX ± .015 ANGLES ± 1°

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

TITLE: PCB ASSEMBLY CONTROLLER MAIN BOARD

TYPE	SIZE	DWG No.	REV
A	C	919-0436	H

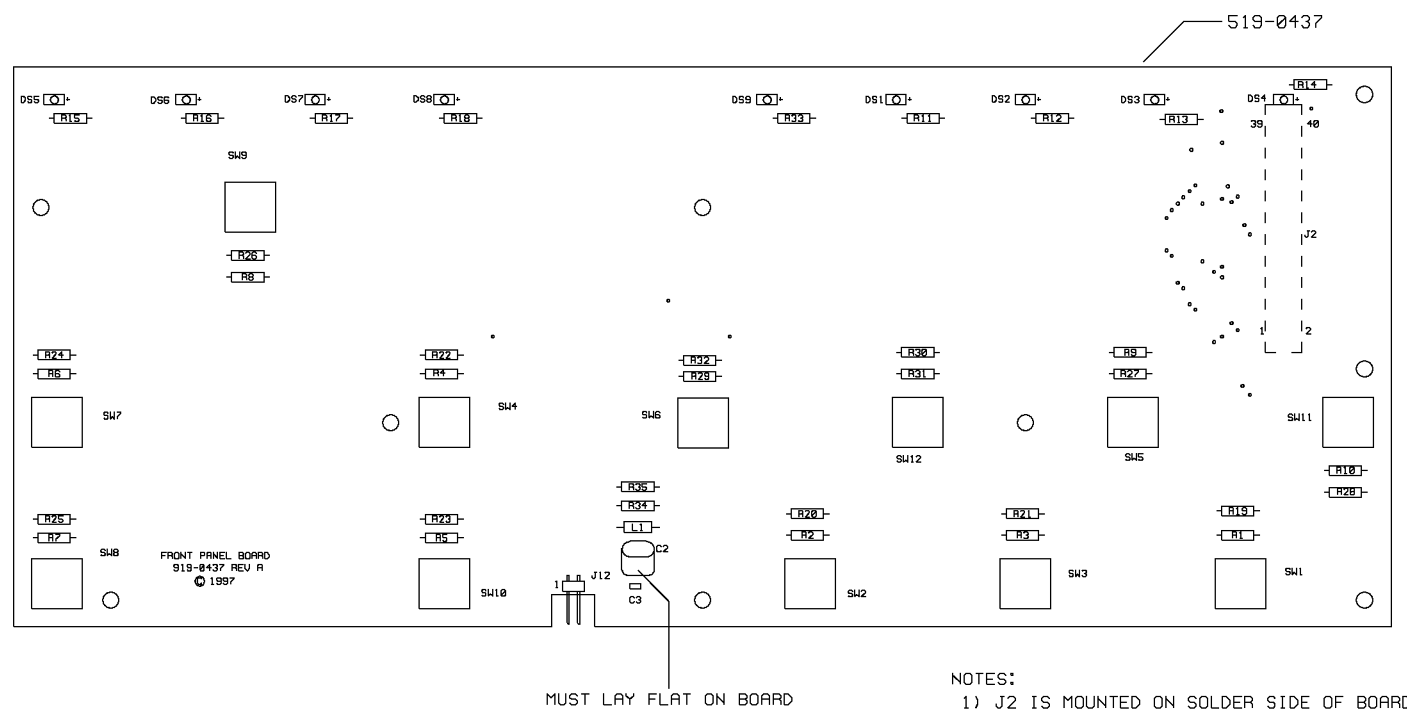
MODEL T SERIES XMTRS | SCALE 1/1 | SHEET 1 OF 1



NOTES:
1. LAST COMPONETS USED C3,DS9,J12,L1,R35 & SW12.
2. COMPONETS NOT USEDC1,J1, & J3-J11.
3. SEE ASSEMBLY AC919-0437.

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

DWN. BY 12-17-96 K. TERWELP	MATERIAL SEE BOM 919-0437	BROADCAST ELECTRONICS INC. 4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305 217/224-9600 FAX 217/224-9607	
DESIGNER(S)	FINISH	TITLE SCHEMATIC FRONT PANEL BOARD	
PROJ. LEADER		TYPE S SIZE B DWG. NO. 919-0437	REV B
MFG.	NEXT ASSY.	MODEL DIGITAL CNTRL SCALE NONE	SHEET 1 OF 1



NOTES:

1) J2 IS MOUNTED ON SOLDER SIDE OF BOARD.
2) LAST COMPONET USED;C3,D9,J12,L1,R36 & SW12.
3) COMPONETS NOT USED; C1,J1 & J3-J11.
4) LED'S (DS1-DS9) FIT FLUSH ON PCB.
5) SEE SCHEMATIC SB919-0437.

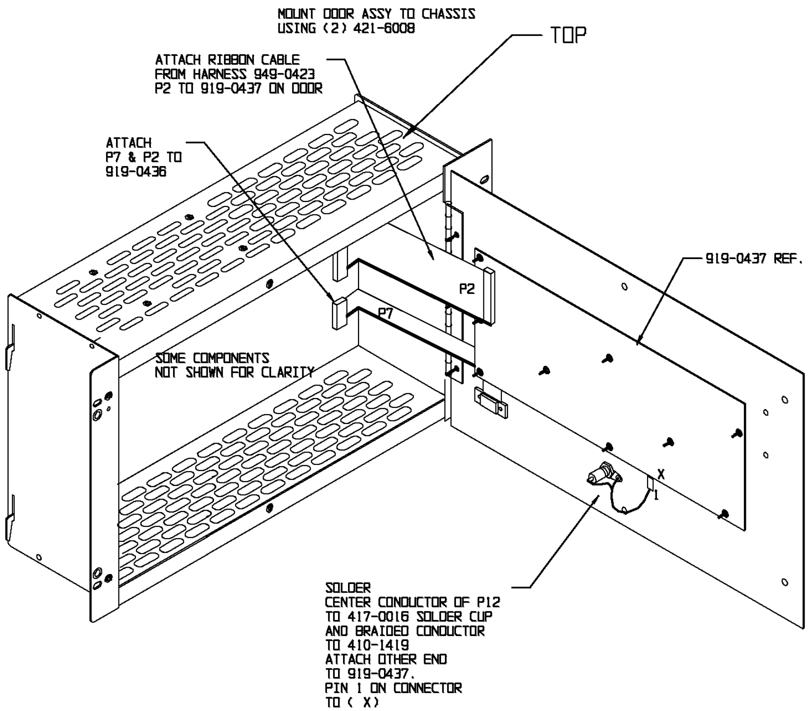
TOLERANCE (DECIMAL) U.O.S.
.X ± .030 .XXX ± .005
.XX ± .015 ANGLES ± 1°

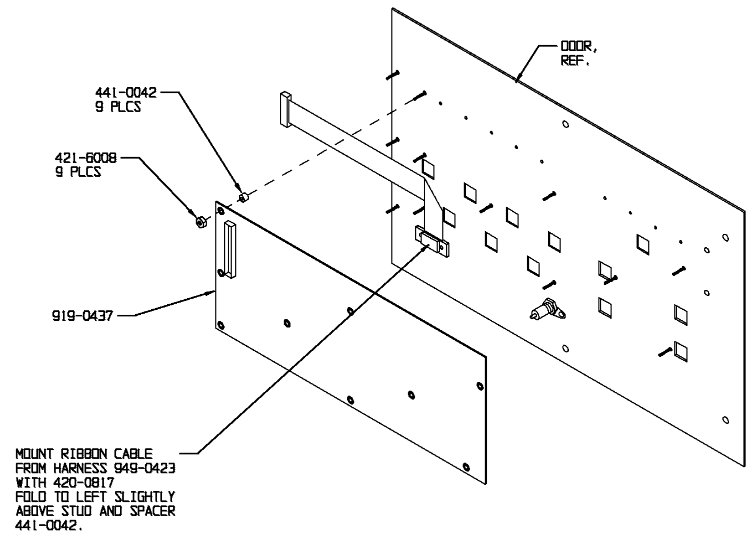
DWN. BY	2-4-97 K. TERWELP
DESIGNER(S)	
PROJ. LEADER	R. E. BROWN
MFG.	
MATERIAL	SEE BOM 919-0437
FINISH	
NEXT ASSY.	

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

TITLE	PCB ASSEMBLY DIGITAL CONTROLLER FRONT BOARD
TYPE	A
SIZE	C
DWG No.	919-0437
REV	B
MODEL	DIGITAL CNTRL
SCALE	1/1
SHEET	1 OF 1

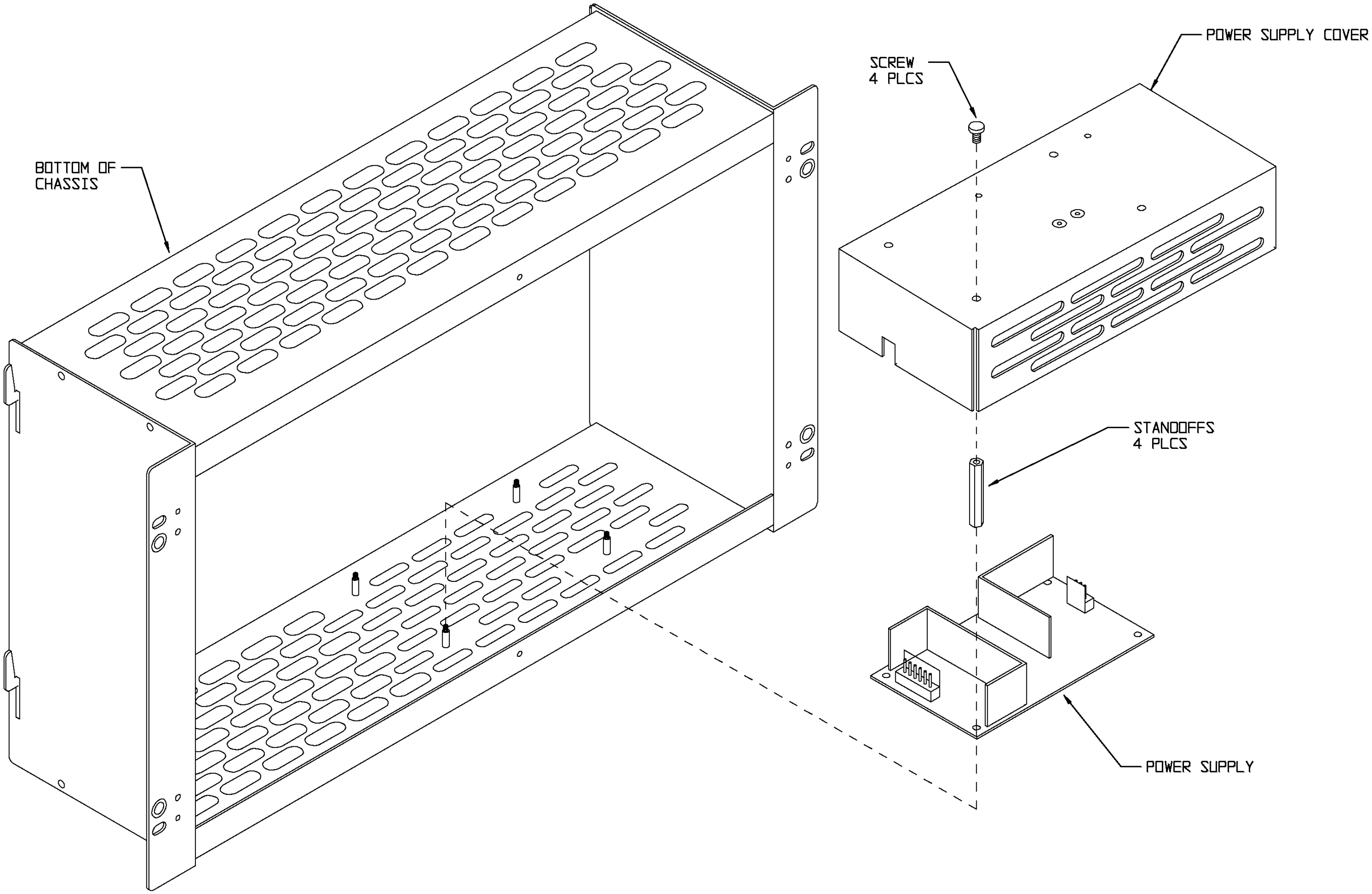
1997 BROADCAST ELECTRONICS, INC. © COPYRIGHT





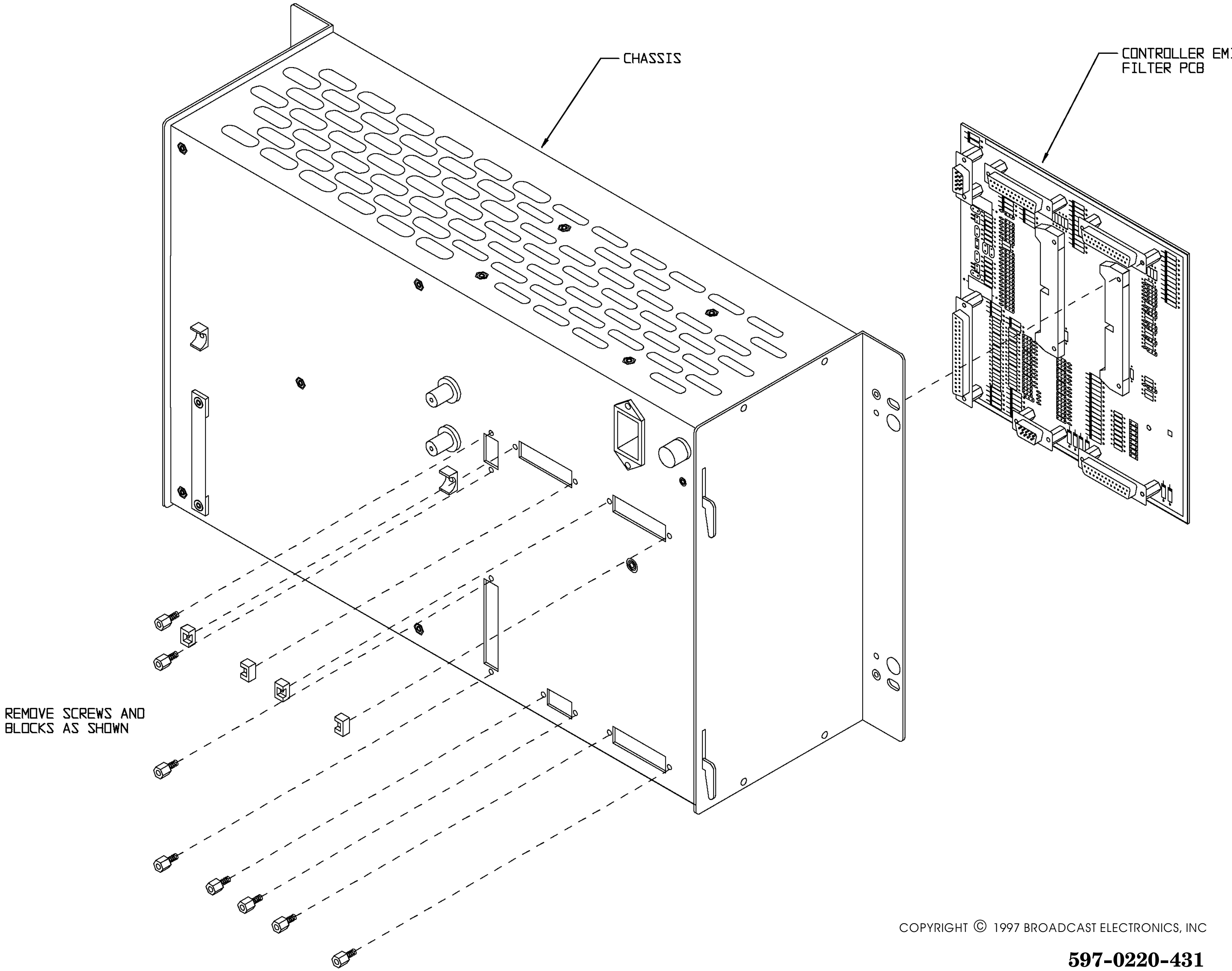
597-0220-429

FIGURE 4-8. ASSEMBLY DIAGRAM, TRANSMITTER CONTROLLER (Sheet 1 of 4)



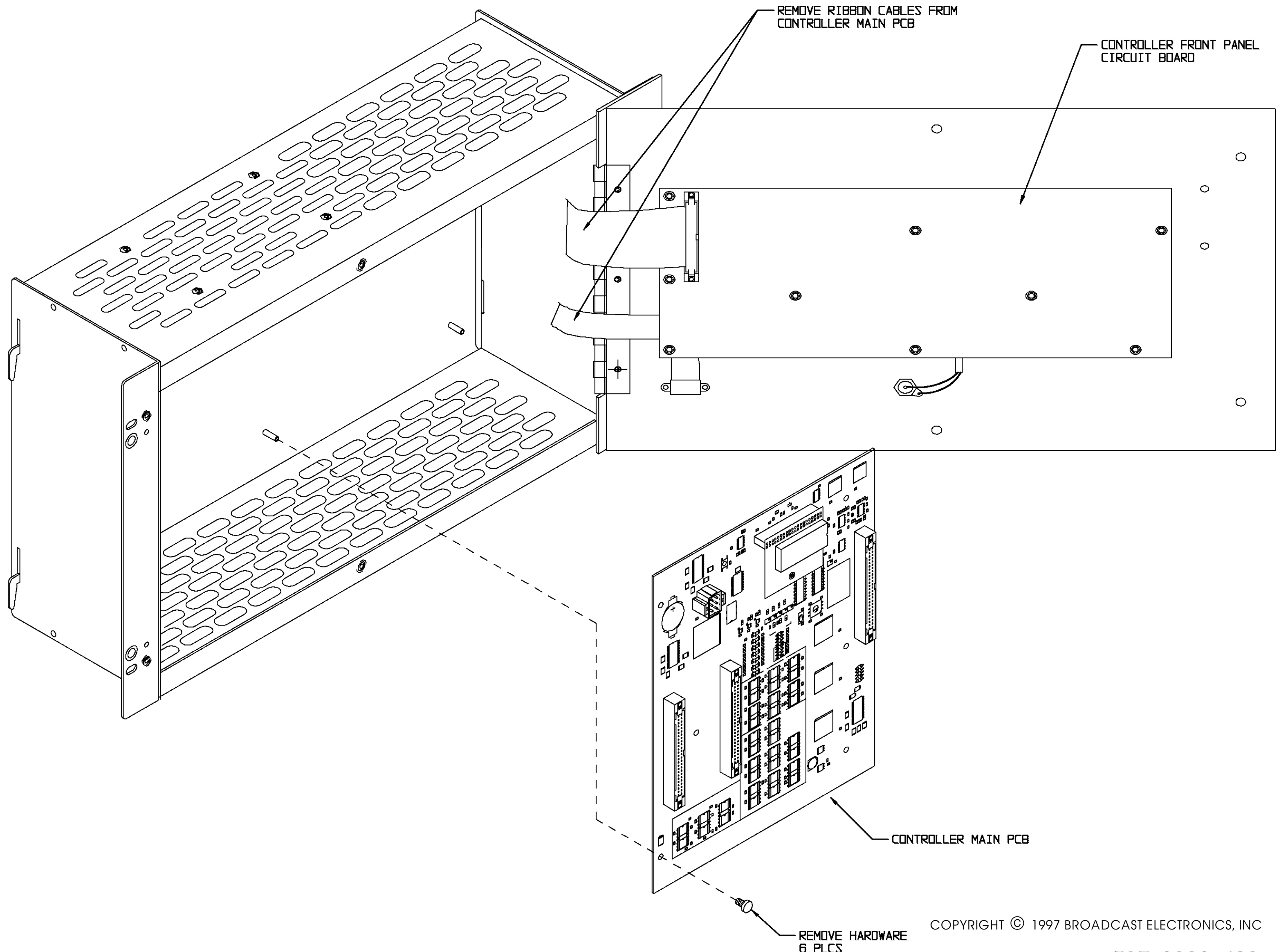
597-0220-430

FIGURE 4-8. ASSEMBLY DIAGRAM, TRANSMITTER CONTROLLER (Sheet 2 of 4)



597-0220-431

FIGURE 4-8. ASSEMBLY DIAGRAM, TRANSMITTER CONTROLLER (Sheet 3 of 4)



597-0220-432

FIGURE 4-8. ASSEMBLY DIAGRAM, TRANSMITTER CONTROLLER (Sheet 4 of 4)