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FM-250C, FM-250E
250 WATT
FM Transmitter
Instruction Manual

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FM-250, FM-250E. 250 WATT FM Transmitter

Instruction Manual

The information in this publication is subject to improvement and change without notice. Although every effort is made to ensure the accuracy of the information in this manual, Broadcast Electronics accepts no responsibility for any errors or omissions. Broadcast Electronics reserves the right to modify and improve the design and specifications of the equipment in this manual without notice. Any modifications shall not adversely affect performance of the equipment so modified.

Proprietary Notice

Trademarks

Broadcast Electronics
Product Warranty (Two-Year Limited)

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

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

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

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

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

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

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

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

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

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

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

IMPORTANT INFORMATION

EQUIPMENT LOST OR DAMAGED IN TRANSIT -

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

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

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

RF PRODUCT TECHNICAL ASSISTANCE, REPAIR SERVICE, PARTS -

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

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

RF TECHNICAL SERVICES -

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

FACILITY CONTACTS -

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

PARTS -

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

RETURN, REPAIR, AND EXCHANGES -

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

MODIFICATIONS -

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

SAFETY PRECAUTIONS

PLEASE READ AND OBSERVE ALL SAFETY PRECAUTIONS//

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

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

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

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

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

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

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

HIGH VOLTAGE –

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

RADIO FREQUENCY RADIATION

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

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

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

HOT SURFACES –

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

Table of Contents

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1 Overview

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

1.1 RELATED PUBLICATIONS.

The following list of publications provides data for equipment and options associated with the FM-250C/E transmitter.

PUBLICATION NUMBER	EQUIPMENT
597-9900	LYNX FM Digital Stereo Generator

1.2 EQUIPMENT DESCRIPTION.

The FM-250C/E transmitter is available in several configurations. Refer to the following list for various transmitter models, spare parts kits, and available options.

MODEL	PART NO.	DESCRIPTION
----	909-0131	Optional Master Synchronous FM Booster Circuit Board.
----	909-0132	Optional Slave Synchronous FM Booster Circuit Board.
----	979-0423	Recommended spare parts kit for the FM-250C/E transmitter. Includes selected switches and assemblies, etc. Does not include semiconductors.
----	979-0424	Recommended semiconductor kit for the FM-250C/E transmitter.
----	979-0425	100% semiconductor kit for the FM-250C/E transmitter.
----	979-0152	Exciter Remote Kit for the FM250C/E. Includes 25 foot extension control and RF cables, terminal blocks, blank filler panels and hardware.

1.3 FM-250C AND FM-250E MODELS.

The FM-250C and the FM-250E FM transmitter are nearly identical in construction and features (refer to Figure 1-1). However, the FM-250E meets stringent CE standards for locations requiring CE certification. Both units contain identical control, metering, and RF amplifier circuitry. The units both exhibit excellent performance specifications. However, FM-250E models are equipped with: 1) additional input/output and ac line filtering, 2) a 25-pin D- type remote interface connector, and 3) only a single rear-panel composite audio input receptacle (unbalanced).

1.4 PHYSICAL DESCRIPTION.

The FM-250C/E chassis is equipped with slide rails to allow easy access to all assemblies when the unit is extended from the rack. Removal and installation of assemblies within the transmitter is facilitated by the semi modular mechanical construction. Each assembly is firmly mounted to the main chassis and electrically connected to the main wiring harness with plugs and jacks. Front-panel test receptacles allow measurements of the composite signal without removing the top-cover. On FM-250C units, input and output connections are routed to a rear-panel terminal strip and several BNC connectors. On FM-250E units, input and output connections are routed to a rear-panel 25-pin D-Type connector and several BNC connectors.

Figure 1-1. FM-250C/E TRANSMITTER

1.5 ELECTRICAL DESCRIPTION.

The Broadcast Electronics FM-250C/E transmitters are a solid-state wideband FM transmitter providing a continuously variable RF output from 25 to 250 watts into a 50 Ohm load at any frequency within the 87.5 to 108 MHz FM broadcast band in 10 kHz increments. The transmitter accepts multiple wideband composite inputs from a stereo generator or SCA generator in addition to a 600 Ohm balanced monaural input. A dual primary power transformer and a voltage selector allows operation from a wide range of ac input potentials.

1.5.1 METERING.

Transmitter operating parameters are monitored by a front-panel digital LCD multi-meter and an LED display. Multi-meter functions are identified by LED indicators which illuminate when a function switch is operated. The multi-meter can also be operated as a high-impedance test meter for internal measurements. In addition, a color coded moving bar LED display is incorporated to indicate peak modulation percentage in increments of 5%.

1.5.2 STATUS DISPLAYS.

The FM-250C/E transmitters are designed with front-panel LEDs to indicate the status of three main transmitter operating potentials, three preset limits, and operating frequency stabilization. Additional LEDs are incorporated on the AFC/PLL circuit board assembly to indicate the status of operating potentials and monitor reference oscillator and modulated oscillator circuit conditions.

1.5.3 AUTOMATIC FREQUENCY CONTROL.

A temperature compensated reference oscillator and a dual-speed phase-locked-loop controlling the carrier frequency locks the frequency of the modulated oscillator to the precision reference frequency oscillator. This allows prompt on-frequency operation of the transmitter from a cold start. The transmitter will achieve frequency lock from a cold start in less than five seconds.

1.5.4 CONTROL CIRCUIT.

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

1.5.5 RF AMPLIFIER.

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

1.6 EQUIPMENT SPECIFICATIONS.

Refer to Table 1-1 for electrical specifications and Table 1-2 for physical and environmental specifications of the FM-250C/E transmitters.

Table 1-1. FM-250C/E Transmitter Specifications

PARAMETER	SPECIFICATIONS
AC INPUT POWER REQUIREMENTS	
FM-250C	97 to 133V AC or 194 to 266V AC, 50/60 Hz.
FM-250E	194 to 266V AC, 50/60 Hz.
RF OUTPUT IMPEDANCE	50 Ohms.
POWER OUTPUT	25 Watts to 250 Watts, Continuously Variable. Type “N” Female Connector.
R.F. HARMONIC AND SPURIOUS SUPPRESSION (CONDUCTED)	Meets or exceeds all FCC, DOC, and CCIR standards.
FREQUENCY RANGE	87.5 MHz to 108 MHz Digitally Programmable in 10 kHz increments.
FREQUENCY STABILITY	$\pm$300 Hz, +32˚F to +122˚F (0˚C to +50˚C).
MODULATION TYPE	Direct FM at the Carrier Frequency.
MODULATION CAPABILITY	Greater than $\pm$350 kHz.
MODULATION INDICATION	Peak Reading, Color Coded, LED Display with Baseband Over-Modulation Indicator.
ASYNCHRONOUS AM SIGNAL-TO-NOISE RATIO	70 dB Below 250 Watt Reference Carrier with 100% Amplitude Modulation @ 400 Hz and 75 Microsecond De-emphasis (No FM Modulation Present).
SYNCHRONOUS AM SIGNAL-TO-NOISE RATIO	55 dB Below 250 Watt Reference Carrier with 100% Amplitude Modulation @ 400 Hz and 75 microsecond de-emphasis (FM Modulation: $\pm$75 kHz @ 400 Hz @ 250 Watts Output Power).
MULTI-METER	5 Function LCD Plus Diagnostic Aid, $\pm$3% Accurate.

TEST METERING	Internal High Input Impedance Multi-meter with Probe for Internal DC Measurements.
FRONT PANEL TEST CONNECTIONS	Composite Input and Composite Output.
AUDIO/CONTROL CONNECTIONS	
FM-250C	16 Terminal Barrier Strip and 5 BNC Connectors.
FM-250E	25-Pin D-Type Connector and 4 BNC Connectors.
VSWR	Rated Power into 1.5:1 Maximum Without Output Matching. Capable of Operating Into Higher VSWR with Automatic Power Reduction. Open and Short Circuit Protected At All Phase Angles.
PRE-EMPHASIS	FCC 75 μS, CCIR 50 μS, Dolby 25 μS, or Flat Response Selectable.
OVERALL EFFICIENCY	Greater than 40%.
WIDEBAND COMPOSITE OPERATION	
COMPOSITE INPUTS	
FM-250C	3 Total, Unbalanced (1) and Balanced (1) Plus Front Panel Test Provision (1) (BNC Connectors).
FM-250E	2 Total, Unbalanced (1) Plus Front Panel Test Provision (1) (BNC Connectors).
COMPOSITE INPUT IMPEDANCE	10 k Ohm or 50 Ohm, Nominal, Resistive, Selectable
COMPOSITE INPUT LEVEL	3.5V p-p Nominal, for $\pm$75 kHz Deviation.
COMPOSITE FM SIGNAL-TO-NOISE RATIO	85 dB Below $\pm$75 kHz Deviation @ 400 Hz. Measured within a 20 Hz to 200 kHz Bandwidth with 75 Microsecond De-emphasis.
COMPOSITE HARMONIC DISTORTION PLUS NOISE	0.01% or Less at 400 Hz.
COMPOSITE SMPTE INTER-MODULATION DISTORTION	0.01% or Less, 60 Hz/7 kHz 1:1 ratio.
COMPOSITE CCIF INTERMODULATION DISTORTION	0.01% or Less, 15 kHz/14 kHz; 1:1 Ratio.
COMPOSITE TRANSIENT IMD	0.01% or Less (Square Wave/Sine Wave.)
COMPOSITE AMPLITUDE RESPONSE	$\pm$0.1 dB, 30 Hz to 53 kHz.
COMPOSITE PHASE RESPONSE	$\pm$0.25° from Linear Phase 30 Hz to 53 kHz.
COMPOSITE GROUP DELAY VARIATION	$\pm$125 Nanoseconds.
SCA OPERATION	
MODULATION TYPE	Direct FM.

SUBCARRIER FREQUENCY	67 kHz (39 to 95 kHz optional).
SUBCARRIER FREQUENCY STABILITY	$\pm$0.5% (330 Hz @ 67 kHz), 0˚C to +50˚C
SUBCARRIER HARMONIC CONTENT	Less than 0.3%.
SUBCARRIER ENVELOPE DECAY	Greater than 100 Milliseconds from 90% to 10% Subcarrier Level.
MODULATION CAPABILITY	$\pm$20% of Subcarrier Frequency, Maximum.
INPUT IMPEDANCE	
AUDIO	600 Ohms, Balanced, Resistive.
DATA	75 Ohms, Unbalanced, Resistive, DC Coupled.
INPUT LEVEL	
AUDIO	Adjustable +10 dBm to -10 dBm for $\pm$6 kHz Deviation @ 400 Hz.
DATA	Adjustable 1.0 to 4.0 V p-p for $\pm$6 kHz Deviation (DC Coupled).
PRE-EMPHASIS:	
AUDIO	150 Microseconds (75 Microseconds with Internal Jumper).
DATA	No Pre-emphasis.
FREQUENCY RESPONSE:	
AUDIO	$\pm$0.5% dB, 10 Hz to 10 kHz, Exclusive of Lowpass Filter.
DATA	$\pm$0.5 dB, DC to 10 kHz.
LOW-PASS FILTER	
AUDIO	Sixth Order, -3 dB at 4.3 kHz (Other Filters Available On Special Order).
DATA	Sixth Order, -3 dB at 4.3 kHz (Other Filters Available On Special Order). May be Bypassed.
TOTAL HARMONIC DISTORTION	Less than 0.5% Throughout Pass Band.
SMPTE INTERMODULATION DISTORTION	Less than 0.5% 60 Hz/7 kHz, 1:1 Ratio (Low-Pass and Pre-Emphasis Filter Bypassed).
CROSSTALK SCA TO STEREO	-60 dB or Better Below 100% Modulation Of Left Or Right. 75 Microsecond De-emphasis.
CROSSTALK STEREO TO SCA	-50 dB or Better Below $\pm$6 kHz Deviation of SCA Using 150 Microsecond De-emphasis and FS-30 Stereo Generator.
STEREO OPERATION	
AUDIO INPUT IMPEDANCE	600 Ohms Balanced, Resistive, Floating. Adaptable to Other Impedances.

AUDIO INPUT LEVEL	+10 dBm ±1 dBm for 100% Modulation at 400 Hz.
AUDIO INPUT FILTERS	15 kHz Low-Pass Filters with Delay Equalization for Minimum Overshoot.
FREQUENCY RESPONSE	+0.5 dB, 30 to 15,000 Hz, 75 μS Pre-emphasis (Flat, 25 us, or 50 μS Pre-emphasis Selectable).
TOTAL HARMONIC DISTORTION	0.05% or Less @ 400 Hz.
SMPTE INTERMODULATION DISTORTION	0.05%, 60 Hz/7 kHz; 4:1 Ratio.
CCIF INTERMODULATION DISTORTION	0.05% or Less, 15 kHz/14 kHz; 1:1 Ratio.
TRANSIENT INTERMODULATION DISTORTION	0.1% (Square Wave/Sine Wave).
FM SIGNAL TO NOISE	80 dB or Greater Below Left or Right Channel, 100% Modulation @ 400 Hz, 75 μS De-emphasis.
DYNAMIC STEREO SEPARATION	40 dB or Greater From 30 to 15,000 Hz (Normal Program Content).
LINEAR CROSSTALK (MAIN TO SUB/SUB TO MAIN DUE TO AMPLITUDE AND PHASE MATCHING OF LEFT AND RIGHT CHANNELS)	45 dB Below 100% Modulation, 30 to 15,000 Hz.
NON-LINEAR CROSSTALK (MAIN TO SUB/SUB TO MAIN DUE TO DISTORTION PRODUCTS).	70 dB Minimum Below 100% Modulation.
38 kHz SUPPRESSION	80 dB Minimum below 100% Modulation.
PILOT STABILITY	±0.5 Hz, +32°F to +122°F (0°C to +50°C).
STEREOPHONIC SEPARATION	50 dB, 30 Hz to 15 kHz (Sinewave).
MODES OF OPERATION	Stereo, Mono L+R, Mono L, and Mono R. Remote Control Accessible.
MONAURAL OPERATION	
AUDIO INPUT IMPEDANCE	600 Ohms Balanced, Resistive, Adaptable to Other Impedances, 60 dB Common Mode Suppression.
AUDIO INPUT LEVEL	+10 dBm Nominal for ±75 kHz Deviation @ 400 Hz, Adaptable to Other Levels.
AUDIO FREQUENCY RESPONSE	±0.5 dB, 30 Hz to 15 kHz, Selectable Flat, 25, 50 or 75 Microsecond Pre-emphasis.
HARMONIC DISTORTION PLUS NOISE	0.01% or Less at 400 Hz.

SMPTE INTERMODULATION DISTORTION	0.01% or Less, 60 Hz to 7 kHz, 4:1 Ratio.
CCIF INTERMODULATION DISTORTION	0.01% or Less, 15 kHz/14 kHz 1:1 Ratio.
TRANSIENT INTERMODULATION DISTORTION	0.01% or Less (Square Wave/Sine Wave).
FM SIGNAL-TO-NOISE RATION	85 dB Below $\pm$75 kHz Deviation @ 400 Hz Measured in a 20 Hz to 30 kHz Bandwidth with 75 Microsecond De-emphasis.
REGULATORY	
FM-250E ONLY	Meets CE Specifications.
SAFETY	
FM-250C/FM-250E	Meets IEC 215 Specifications.

Table 1-2. PHYSICAL AND ENVIRONMENTAL SPECIFICATIONS

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

2 INSTALLATION

This section contains information required for installation and preliminary checkout of the Broadcast Electronics FM-250C/E Transmitters.

2.1 UNPACKING.

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.

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

2.2 INSTALLATION.

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

2.2.1 PRELIMINARY INSTALLATION.

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

WARNING ***ENSURE ALL TRANSMITTER POWER IS DEENERGIZED BEFORE PROCEEDING.***

WARNING

AC LINE VOLTAGE PROGRAMMING. TheFM-250C/E transmitters are programmed for the appropriate line voltage when shipped from the factory. The FM-250E can only operate from a 220V/240V ac supply. Therefore, ensure the line voltage selector is configured to 220V/240V.

For FM-250C models, the unit can be operated from a 110V or 220V ac supply. Check the ac line voltage programming as follows:

Place the transmitter on a work surface.

Remove any packing material from the outside of the transmitter.

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

LINE VOLTAGE	VOLTAGE SELECTOR PROGRAMMING
97-115V	100V
115-133V	120V
194-230V	220V
230-266V	240V

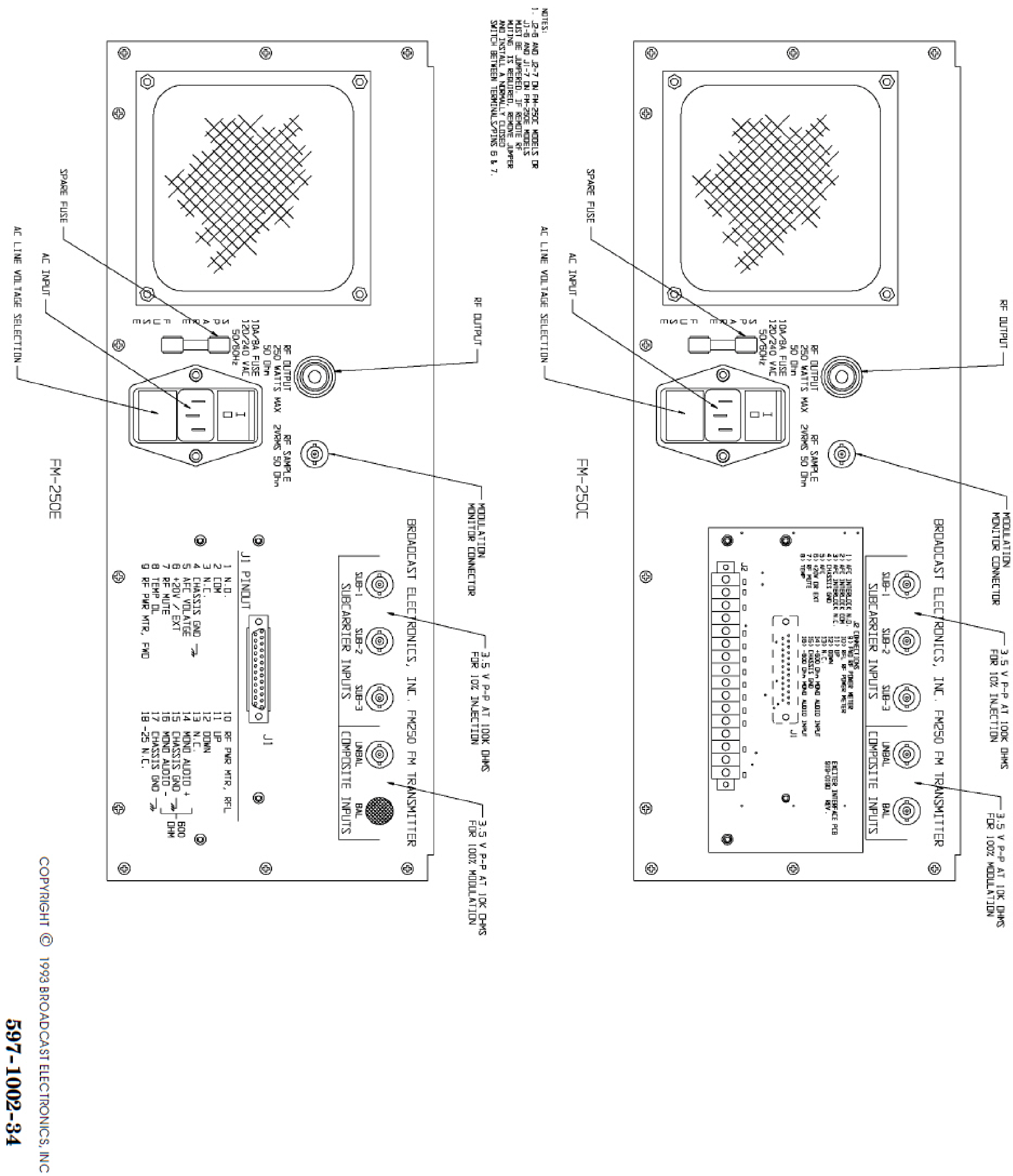


Figure 2-1. FM-250C/E REAR-PANEL CONNECTIONS (SHEET 1 OR 2)

FM-250C J2	FM-250E J1		DECRIPTION	
J2-1	J1-1	AFC N.O.	AUTOMATIC FREQUENCY CONTROL INTERLOCK RELAY. AUXILIARY SWITCHING PROVISION. RELAY ENGERGIZES WHEN AFC CIRCUIT ACHIEVES LOCK.	
J2-2	J1-2	AFC COM		
J2-3	J1-3	AFC N.C.		
J2-4	J1-4	CHASSIS GND	CHASSIS GROUND.	
J2-5	J1-5	AFC VOLTAGE	AUTOMATIC FREQUENCY CONTROL STATUS. LOCKED - 20 mA SINK DURING NORMAL (LOCKED) OPERATION. UNLOCKED - OPEN CIRCUIT IF PHASE LOCKED LOOP UNLOCKS (30V MAXIMUM).	
J2-6	J1-6	+20V / EXT	+20V / EXT DETERMINED BY S2 ON THE POWER SUPPLY / CONTROL CIRCUIT BOARD. +20V - WHEN S2 IS IN NORM, PROVIDES +20V IN SERIES WITH 240 Ohm FOR RF MUTE PULL-UP. EXT - WHEN S2 IN IN EXT, PROVIDES AN EXTERNAL RF CONTROL INPUT.	+20VDC RF CONTROL 0-6 VDC
J2-7	J1-7	RF MUTE	RF MUTE CONTROL INPUT. MUTE INPUT LOGIC IS DETERMINED BY S3 ON POWER SUPPLY / CONTROL CIRCUIT BOARD. POSITIVE - WHEN S3 IS IN POS POSITION, 0V INPUT TO MUTE EXCITER RF OUTPUT. > + 3V INPUT TO ENABLE EXCITER RF OUTPUT. NEGATIVE - WHEN S3 IS IN NEG POSITION, +5V OR OPEN INPUT TO MUTE EXCITER RF OUTPUT. 0V INPUT TO ENABLE RF OUTPUT.	0V TO MUTE +5V OR OPEN TO MUTE
J2-8	J1-8	TEMP OL	TEMPERATURE OVERLOAD STATUS. +18V IN SERIES WITH 10K Ohm LOGIC LEVEL OUTPUT WHEN EXCITER EXCEEDS A PRESET TEMPERATURE LIMIT.	+18V
J2-9	J1-9	RF FWR MTR, FWD	FORWARD POWER METER OUTPUT. +2.0 VDC = 250W.	+2.0 VDC
J2-10	J1-10	RF PWR MTR, RFL	REFLECTED POWER METER OUTPUT. +2.0 VDC = 10W.	+2.0 VDC
J2-11	J1-11	UP	REMOTE RAISE POWER CONTROL FUTURE OPTION.	
J2-12	J1-12	DOWN	REMOTE LOWER POWER CONTROL FUTURE OPTION.	
—	J1-13	N/C	NO CONNECTION.	
J2-13	J1-14	MONO AUDIO +	MONO AUDIO INPUT + 600 Ohm IMPEDANCE.	+
J2-14	J1-15	CHASSIS GROUND	AUDIO INPUT SHIELD GROUND.	SHLD
J2-15	J1-16	MONO AUDIO -	MONO AUDIO INPUT - 600 Ohm IMPEDANCE.	-
J2-16	J1-17	CHASSIS GROUND	CHASSIS GROUND.	
	J1-18	N/C	NO CONNECTION	
	J1-19	N/C		
	J1-20	N/C		
	J1-21	N/C		
	J1-22	N/C		
	J1-23	N/C		
	J1-24	N/C		
	J1-25	N/C		

597-1002-35

Figure 2-1. FM-250C/E REAR-PANEL CONNECTIONS (SHEET 2 OR 2)

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

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

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

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

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

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

CAUTION

CAUTION

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

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

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

OPTION FUNCTION PROGRAMMING. The FM-250C/E transmitters are equipped with several programmable options. Refer to Figure 2-2 and the following text and program the options as desired.

Pull the transmitter forward until the slide rail stops are encountered.

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

Remove any packing material from the inside of the transmitter.

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

1. Ensure NORM-EXT switch S1 on the power control circuit board assembly is operated to NORM. The switch allows the transmitter power to be controlled: 1) from the internal power control circuit or 2) externally using a variable +20V power source.
2. POS-MUTE-NEG switch S2 on the power control circuit board is provided to select the RF mute input logic polarity (refer to Figure 2-2). S2 must be in the POS position when the transmitter is operated as an independent unit. If the FM-250C/E is operated in association with another transmitter such as when the unit is used as an exciter, S2 may be operated to positive or negative as determined by the transmitter mute control logic. Refer to the applicable transmitter manual and determine if positive or negative mute control is required. Switch S2 is factory operated to the POS position.
3. Check the programming of rear-panel/DAC power control header J6. Ensure J6 is programmed: 1) in position 1-2 if the transmitter is not equipped with the remote raise/lower power control option or 2) in position 2-3 if the transmitter is equipped with the remote raise/lower power control option.
4. Check the programming of remote reflected power/P.A. temperature header J8. Ensure J8 is programmed: 1) in position 1-2 for reflected power indications to be displayed by the RFL switch on the transmitter multi-meter or 2) in position 2-3 for P.A. temperature indications to be displayed by the RFL switch on the transmitter multi-meter (used for diagnostics only). The transmitter is factory programmed for remote reflected power indications.

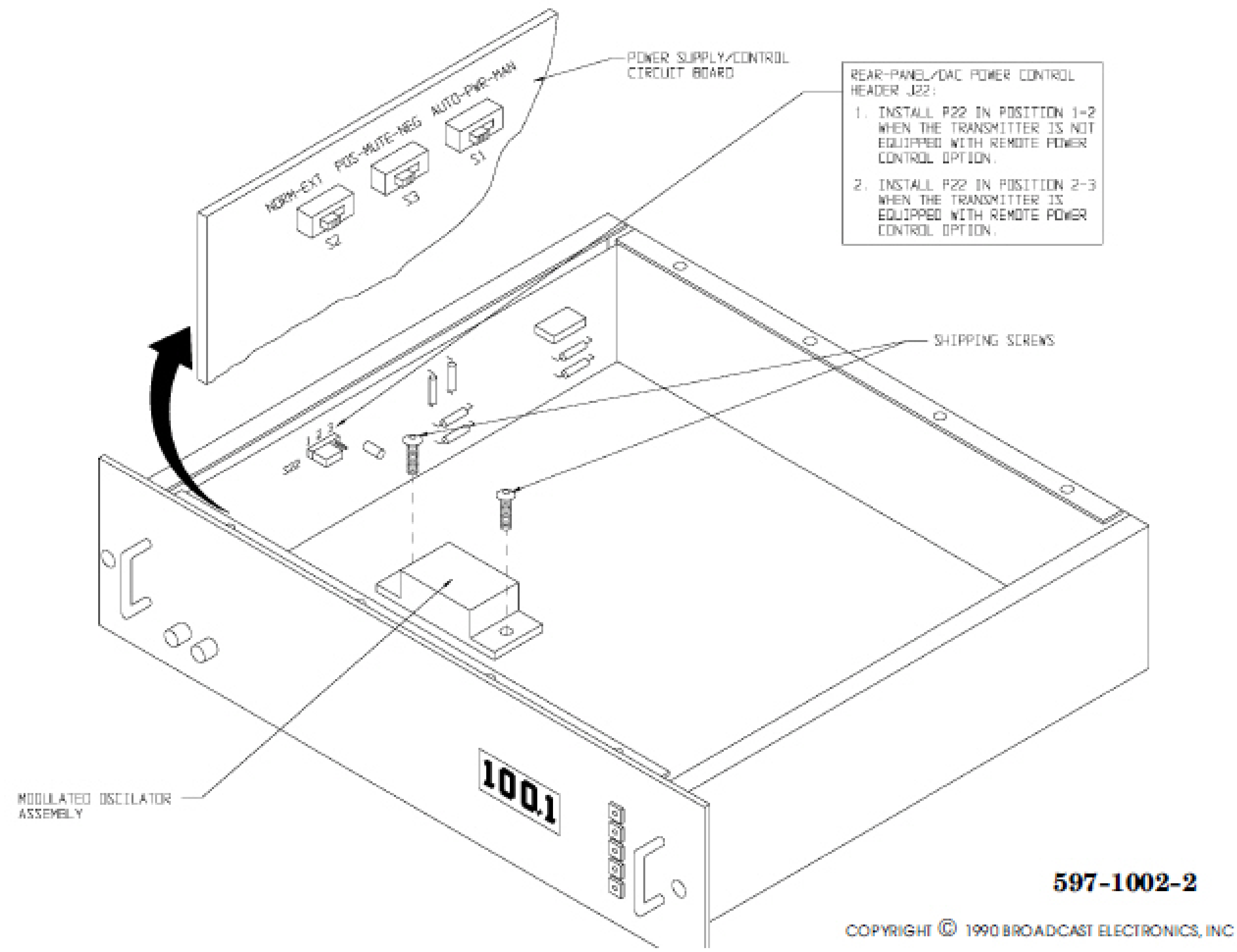


Figure 2-2. FM-250C/E COMPONENT LOCATION DIAGRAM

5. Check the programming of operation/test power control header J7. Ensure J7 is programmed: 1) in position 1-2 for normal power control operation or 2) in position 2-3 for test power control operation. The transmitter is factory programmed for normal power control operation.

Refer to the final test data sheets shipped with the transmitter and ensure the 3 SYNTHESIZER FREQUENCY SELECTION switches on the AFC/PLL assembly are correctly positioned.

GAIN SELECTION. The gain of the balanced monophonic audio processing circuit on the AFC/PLL circuit board can be programmed for input levels ranging from 0.0 dB to +10 dB. The transmitter is shipped from the factory for an input level of +10 dB. If an alternate level is required, refer to Figure 2-3 and connect the appropriate resistor between terminals E1 and E2 as determined by the following information:

INPUT LEVEL	RESISTOR VALUE
+10 dBm	OMIT
+8 dBm	39k Ohm
+4 dBm	10k Ohm
0.0 dBm	4.7k Ohm

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

WARNING

2.3 WIRING.

RF OUTPUT. The FM250C/E units are equipped with a Type N RF output connector. Refer to Figure 2-1 and connect a coaxial cable (located in the accessory kit) between the RF OUTPUT connector on the transmitter rear-panel and a 50 Ohm RF load capable of dissipating the output of the transmitter.

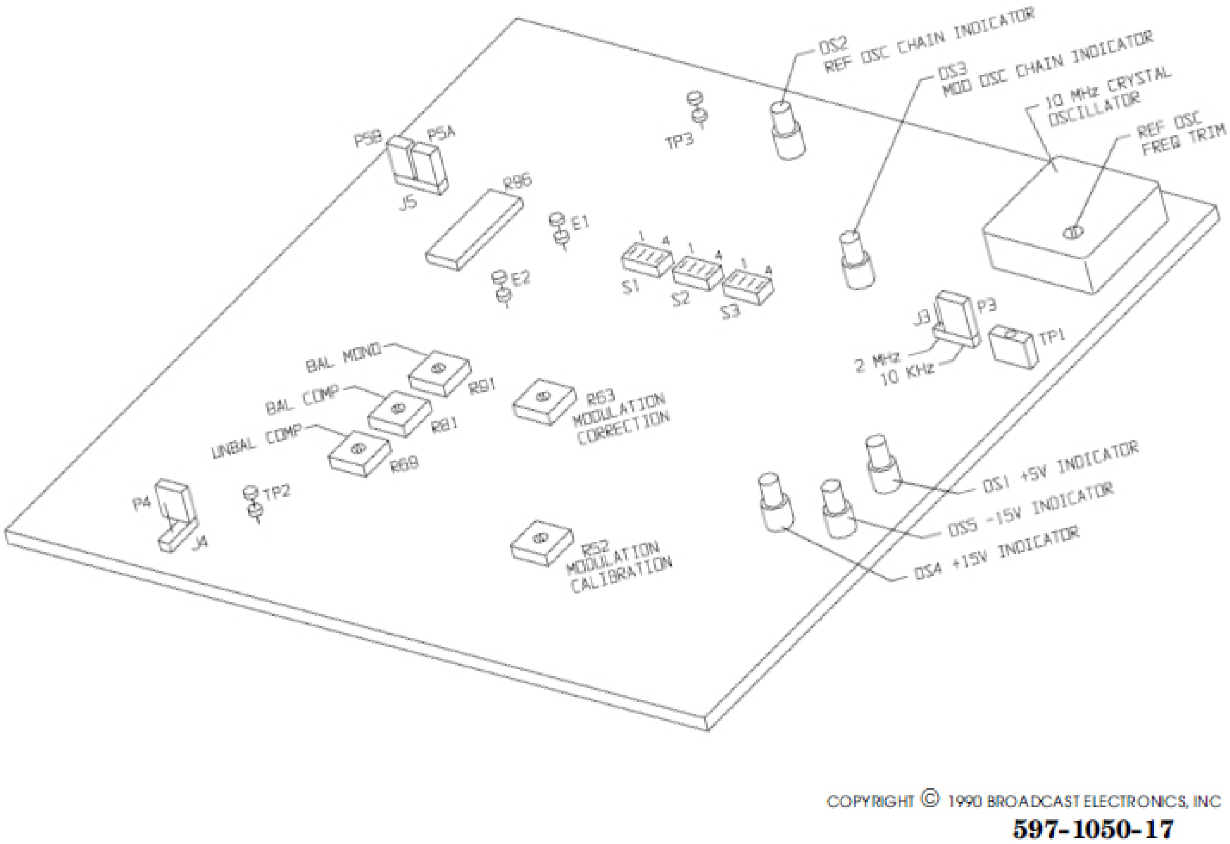


Figure 2-3. AFC/PLL CIRCUIT BOARD GAIN CONNECTIONS

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

WARNING

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

REMOTE CONTROL. The FM-250C/E transmitter are designed for remote control operation (refer to Figure 2-1). The transmitter will interface with almost any remote control unit or panel. The following text presents a description of the remote control and indicator functions.

Automatic Frequency Control Relay. An Automatic-Frequency-Control relay is provided to control equipment connected external to the transmitter. When the FM-250C/E is used as an exciter in a transmitter system, the relay is used for the connection of an interlock to disable the transmitter RF power supply. When the FM-250C/E is operating as an independent unit, the relay can be used to control an external alarm. The relay contacts are rated at 125V @ .5 Amps and are located at J2-1, J2-2, and J2-3 on FM-250C units and J1-1, J1-2, and J1-3 on FM-250E units. When the AFC circuit is locked, the relay is closed. When the AFC circuit unlocks, the relay will open.

Automatic Frequency Control Indicator. The automatic frequency control indicator pro vides a signal to indicate when the transmitter AFC circuit is locked. The AFC indicator is located at J2-5 on FM-250C units and J1-5 on FM-250E units. The indicator will be open when the AFC circuit is unlocked.

+20 Or Ext. The +20/EXT terminal functions as a +20V supply or an analog RF control in put port. When S1 on the power control board is operated to NORM, the terminal operates as a +20V supply. When S1 is operated to EXT, the terminal operates as an analog RF control input port. The control range is from 0-6 V dc. If desired, control the transmitter RF output power by: 1) constructing a remote power control circuit to output a specific DC voltage to select a transmitter power level, 2) operating switch S1to EXT, and 3) connecting the remote power supply circuit to J2-6 on FM-250C units and J1-6 on FM-250E units.

RF Mute. The FM-250C/E is equipped with an RF mute control input. Switch S2 on the power control circuit board is provided to select the RF mute input logic polarity. When S2 is operated to POS, a 0V signal is required to mute the transmitter output. When S2 is operated to NEG, a greater than +5V signal is required to mute the transmitter output. To mute the transmitter, proceed as follows:

1. Refer to Figure 2-1 and remove the jumper between J2-6 and J2-7 on FM-250C units and J1-6 and J1-7 on FM-250E units.

2. Operate switch S2 on the power control circuit board to POS.

3. Connect a normally closed switch between J2-6 and J2-7 on FM-250C units and J1-6 and J1-7 on FM-250E units.

Over-Temperature Indicator. Both the FM-250C and FM-250E are equipped with an over-temperature indicator. The indicator will output a HIGH (+18V dc) when the RF amplifier heat-sink temperature exceeds approximately 85°C. Refer to Figure 2-1 and connect wiring to J2-8 on FM-250C units and J1-8 on FM-250E units.

Remote Forward/Reflected Power Metering. The FM-250C/E units are equipped with remote forward power and reflected power meter indications. The forward power meter indication will provide a 2 VDC signal to indicate a 250 watt forward power output. The reflected power meter indication will provide a 2 VDC signal to indicate a 10 watt reflected power output. Connect the remote metering to J2-9/J2-10 on FM-250C units and J1-9/J1-10 on FM-250E units.

Remote Power Control Option. A down remote power control option is provided at J2-12 on FM-250C units and J1-12 on FM-250E units. An up remote power control option is provided at J2-11 on FM-250C units and J1-11 on FM-250E units. The option will be available at a future date.

MONOPHONIC AUDIO CONNECTIONS. The FM-250C/E transmitters are equipped with a balanced 600 ohm monophonic audio input (refer to Figure 2-1). The inputs are designed to accept a +10 dBm signal at 600 Ohms. Connect audio to the transmitter as follows:

AUDIO SIGNAL	FM-250C	FX-50E
+	J2-13	J1-14
SHIELD	J2-14	J1-15
-	J2-15	J1-16

CONNECTION OF COMPOSITE STEREO SIGNAL SOURCES. The FM-250C is equipped with one balanced and one unbalanced composite input on the rear-panel (COMPOSITE INPUT BAL and UNBAL). The FM-250E is equipped with a single unbalanced composite input (COMPOSITE INPUT UNBAL). These inputs are for the connection to a composite stereo source such as a stereo generator or composite STL receiver (refer to Figure 2-1). A front-panel COMPOSITE TEST IN connector functions in the same manner as the UNBAL composite input. A coaxial cable is provided in the accessory kit for the connections of a composite stereo or SCA signal to the transmitter.

Both the COMPOSITE INPUT UNBAL and BAL receptacles require a level of 3.5V p-p (1.24 VRMS) to modulate the carrier at ±75 kHz. These jacks may be used entirely independent of each other and will accept frequencies of less than 1 Hz to 100 kHz. If these inputs are used, the output level on the composite source must be adjusted to obtain 100% peak modulation as indicated by the FM-250C transmitter modulation display (14.5% range).

The BAL receptacle is ac coupled at the input and equipped with common mode rejection circuitry. Therefore, the BAL input must be used if ground loops and hum are present between the transmitter and composite source.

CONNECTION OF SCA SIGNAL SOURCES. SCA unbalanced input receptacles SUB-1, SUB-2, and SUB-3 are provided on the transmitter rear-panel. Each input is ac coupled and accepts frequencies from 40 kHz to 100 kHz. An input of 3.5V P-P (1.24 VRMS) will modulate the FM carrier 10% at ±7.5 kHz. A coaxial cable is provided in the accessory kit for the connections of a composite stereo or SCA signal to the transmitter.

When using an SCA input, the output level of the source must be adjusted to obtain the desired peak modulation as indicated by the transmitter modulation display (14.5% range). Each input is also compatible with any SCA generator using a dc coupled input for the transmission of data.

2.4 TRANSMITTER CHECKOUT.

Before proceeding, check the following:

A. Ensure all connections at terminal strips are secure.

B. Ensure primary power is properly programmed.

C. Ensure the chassis ground connection is secure.

D. Ensure all signal inputs are secure.

E. Ensure the RF output is properly connected.

F. Ensure all external cabling is properly dressed and secured.

2.4.1 PRIMARY AC POWER.

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

CAUTION

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

2.4.2 INITIAL OPERATION.

To initially operate the transmitter, perform the following procedure.

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

A. The fan will begin to operate.

B. The +20V, -20V, and +5V status indicators will illuminate. After approximately 5 seconds, the LOCK status indicator will illuminate.

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

Depress the multi-meter AFC switch.

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

B. The multi-meter 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.

Depress the multi-meter PAV switch.

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

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

Depress the multi-meter PAI switch.

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

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

Depress the multi-meter FWD switch.

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

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

WARNING

DISCONNECT TRANSMITTER PRIMARY POWER BEFORE PROCEEDING.

WARNING

Disconnect ac primary power from the transmitter.

Disconnect the RF load and connect the transmitter output to the antenna.

3 OPERATION

This section identifies all controls and indicators associated with the FM-250C/E FM Transmitter and provides standard operating procedures.

3.1 CONTROLS AND INDICATORS.

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

3.2 OPERATION.

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

3.2.1 TURN ON.

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

A. The flushing fan will operate.

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

C. After a delay of approximately 5 seconds, the LOCK indicator will illuminate to indicate operating frequency stabilization.

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

Observe the modulation indicator to ensure programming is applied to the transmitter.

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

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

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

3.2.2 MUTE.

For units operating as an independent transmitter with the installation of a mute switch, operate the switch to mute to disable the transmitter RF output power.

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

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

19	**PAV** Multi-meter Indicator	Illuminates to indicate the PA voltage multi-meter function is selected.
20	**Amps** Multi-meter Unit Indicator	Illuminates when the multi-meter indicates units of current.
21	**Volts** Multi-meter Unit Indicator	Illuminates when the multi-meter indicates units of voltage.
22	**Watts** Multi-meter Unit Indicator	Illuminates when the multi-meter indicates units of power.
23	Modulation Indicator	Indicates peak composite baseband modulation level. Scale is calibrated for 100% at $\pm$75 kHz deviation.
24	X10 Scale Indicator	Illuminates when modulation display input level is multiplied by 10.
25	AC Power ON/OFF Switch	Provides primary AC power control for the transmitter.

Table 3-2. POWER/VSWR CONVERSION

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

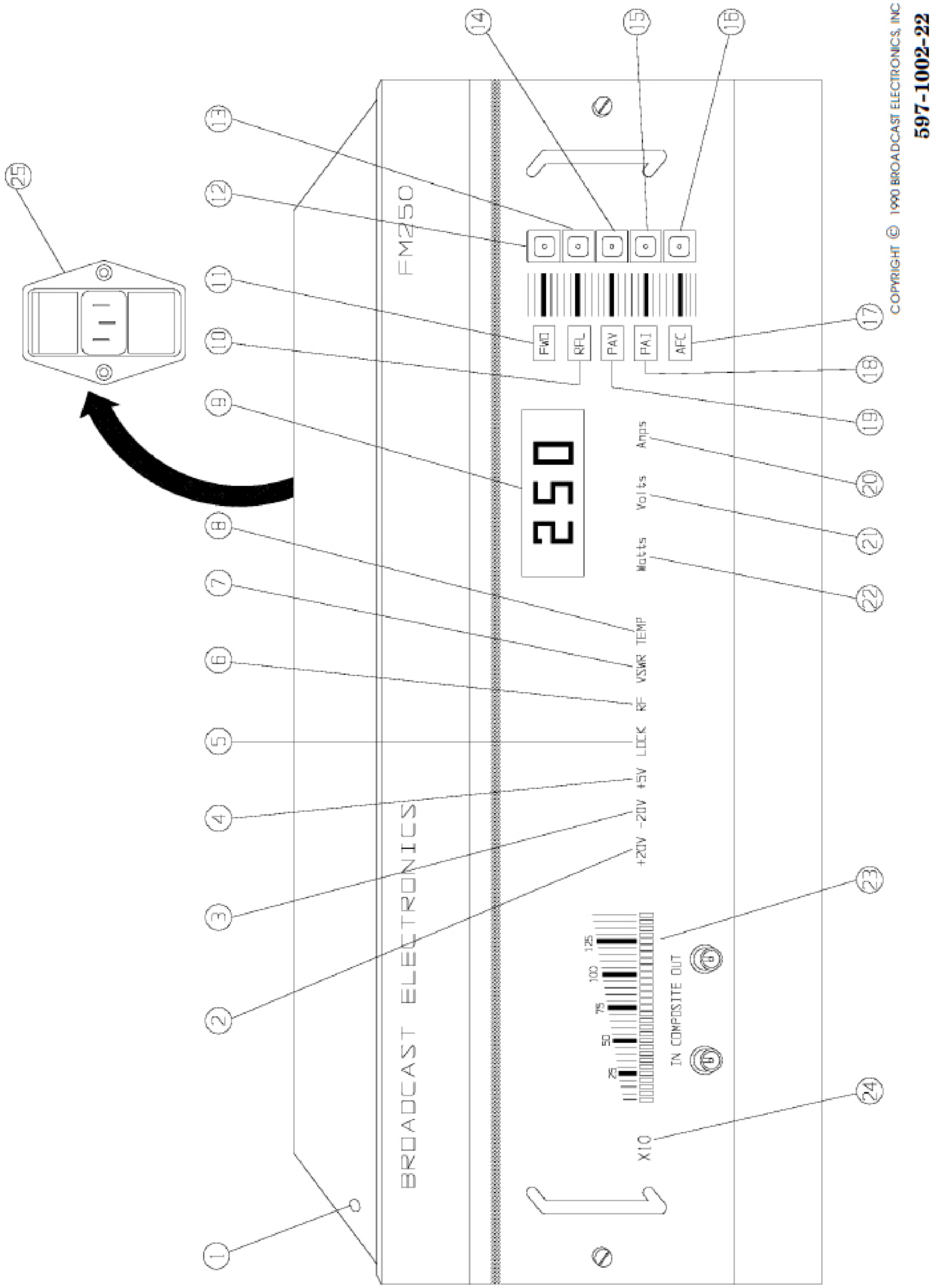


Figure 3-1. FM-250C/E CONTROLS AND INDICATORS

4 THEORY OF OPERATION

This section presents overall theory of operation for the FM-250C/E FM transmitters.

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

4.1 FUNCTIONAL DESCRIPTION.

4.1.1 POWER SUPPLY CIRCUIT.

Primary ac power is applied to the transmitter through a combination voltage selector, line filter, fuse holder, and on/off switch module. This device provides: 1) on/off control of the primary ac power, 2) overload protection for the entire transmitter, 3) allows selection of a wide range of ac input potentials, and 4) RFI filtering. On FM250E models, the ac power routed through an additional ac line filter to meet CE ac line related specifications. Power from the selector/filter/switch module is applied to a power transformer.

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

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

4.1.2 CONTROL CIRCUIT.

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

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

4.1.3 REMOTE CONTROL/STATUS INTERFACING AND RFI FILTER NETWORK.

Remote control and status interfacing is accomplished by: 1) an interface circuit board on FM-250C models and 2) a 25-pin D-Type connector on the RFI filter circuit board for FM-250E models. The RFI filter circuit board prevents interference from signals of 500 kHz and above by filtering and bypassing the audio, control, and status input and output circuits. Transient protection for the signals is provided by transorbs. The front-panel COM POSITE TEST IN and COMPOSITE TEST OUT circuits are not routed through this circuit board.

4.1.4 METERING CIRCUIT.

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

A digitally controlled moving-bar LED display constantly monitors the ac composite signal applied to the modulated oscillator. Indication of short transient peaks exceeding 100% modulation is provided by a one-shot multi-vibrator connected to the 100% digital display segment. Accuracy to 5% on signals from dc to a one-cycle burst of a 100 kHz tone is provided by a high-speed peak detector. An automatic scaling circuit provides expansion of the meter scale from 145% to 14.5% to measure SCA and pilot injection signal levels.

4.1.5 AFC/PLL CIRCUIT.

The AFC/PLL circuit synthesizes the transmitter carrier frequency and maintains the phase and frequency of the carrier. The transmitter frequency synthesizer and comparator circuit provides 2000 synthesized frequencies within the commercial FM broadcast band in 10 kHz increments.

Carrier sampled at the output of the modulated oscillator is returned to the AFC/PLL circuit as feedback. This feedback is divided and compared to a scaled-down reference frequency within a programmable frequency synthesizer and comparator logic circuit to develop a correction signal.

During normal operation, the AFC/PLL circuit constantly modifies the correction signal applied to the modulated oscillator to maintain the stability of the carrier. If the carrier is off frequency, the AFC/PLL circuit will mute the RF output and de-energize the AFC relay until the carrier is locked in phase and frequency to the reference oscillator. A dual-speed loop filter provides rapid stabilization of the carrier and allows modulation from 1 Hz to 100 kHz. When frequency stabilization is attained, a front-panel status indicator will illuminate.

As a secondary function, the assembly accepts all audio inputs, corrects the audio, and sums the corrected audio with AFC tuning bias which linearizes the modulation and adjusts the carrier frequency of the modulated oscillator.

4.1.6 MODULATED OSCILLATOR CIRCUIT.

The modulated oscillator circuit generates the final carrier frequency, frequency modulates the carrier, and amplifies the modulated RF carrier to a level sufficient to drive the RF amplifier. Additional circuitry interfaced with the AFC/PLL circuit maintains the RF carrier center frequency as part of a phase-locked-loop.

4.1.7 RF AMPLIFIER ASSEMBLY.

The RF amplifier assembly consists of three stages of amplification designed to increase the 1 milliwatt RF input signal from the modulated oscillator to an adjustable RF power level of 25 to 250 watts as required. A variable 0 to +48 dc volt dc supply for the RF amplifier assembly is provided by a switching power supply circuit on the power supply circuit board.

The first stage employs a broadband thick-film hybrid amplifier which provides an output of approximately one watt to the input of the driver stage. The driver provides 8 watts of RF power to the power amplifier which outputs an adjustable RF level of 25 to 250 watts.

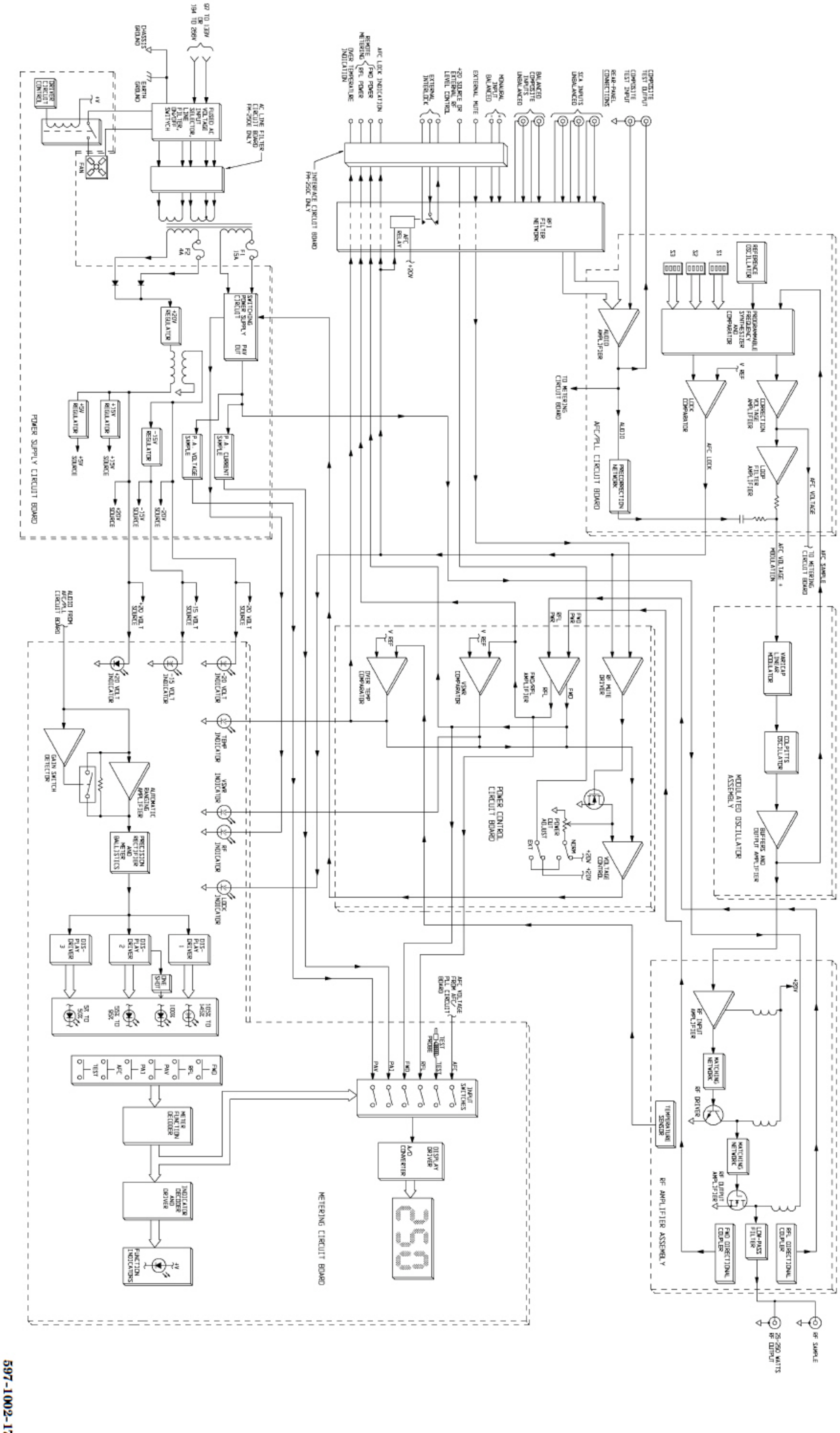


Figure 4-1. FM-250C/E OVERALL SIMPLIFIED SCHEMATIC

A microstrip directional coupler on the RF amplifier printed circuit board supplies information to the transmitter control circuitry to automatically maintain RF power output and provide protection during high VSWR operating conditions. A low-pass filter is provided between the RF amplifier circuit and the directional coupler circuit.

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

The broadband characteristic of the amplifier eliminates the necessity for adjustments at any frequency within the FM band, assures that the transmitter output is transparent to the signal generated by the modulated oscillator, and enhances amplifier stability under varying load conditions.

5 MAINTENANCE

This section provides general maintenance information, electrical adjustment procedures, and troubleshooting information for the FM-250C/E FM Transmitters.

5.1 SAFETY CONSIDERATIONS.

WARNING WARNING — THE TRANSMITTER CONTAINS GUARDS FOR HAZARDOUS VOLTAGES PRESENT AT THE AC LINE SELECTOR AND HIGH CURRENTS PRESENT AT THE POWER TRANSISTORS MOUNTED ON THE RF AMPLIFIER HEAT SINK ASSEMBLY.

WARNING WARNING — NEVER OPERATE THE TRANSMITTER WITHOUT THE GUARDS.

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

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

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

5.2 FIRST LEVEL MAINTENANCE.

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

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

5.3 SECOND LEVEL MAINTENANCE.

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

The maintenance philosophy of the FM250C/E transmitter consists of problem isolation to a specific assembly. Refer to the applicable section of this manual for detail troubleshooting information to isolate a problem to specific components. If desired, the entire assembly may be returned to Broadcast Electronics for repair or replacement.

5.3.1 ADJUSTMENTS.

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

5.4 TROUBLESHOOTING.

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

A. Transmitter Input

B. Power Supply Circuit

C. Metering Circuit

D. Modulated Oscillator Circuit

E. AFC/PLL Circuit

F. RF Amplifier

G. Control Circuit

H. Transmitter Output

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

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

A. Slide the transmitter forward and remove the top-cover.

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

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

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

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

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

Table 5-1. TYPICAL METER INDICATIONS

MULTI-METER SWITCH POSITION		MULTI-METER INDICATION		
TEST				
	+20 V	+19 to +21 V DC		
	- 20 V	- 19 to -21 V DC		
	+5 V	+4.8 to +5.2 V DC		
AFC		+2.0 to +9.0 V DC, dependent upon RF carrier frequency		
PAV	RF POWER	87.5 MHz	98.1 MHz	107.9 MHz
	62 Watts	22.8 + V DC	19.6 + V DC	19.6 + V DC
	125 Watts	32.8 + V DC	28.8 + V DC	29.0 + V DC
	187 Watts	39.9 + V DC	35.2 + V DC	35.9 + V DC
	250 Watts	46.1 + V DC	40.9 + V DC	41.3 + V DC
PAI	RF POWER	87.5 MHz	98.1 MHz	107.9 MHz
	62 Watts	3.3 Ampere	4.5 Ampere	4.8 Ampere
	125 Watts	4.7 Ampere	5.7 Ampere	5.9 Ampere
	187 Watts	6.0 Ampere	6.6 Ampere	6.8 Ampere
	250 Watts	7.4 Ampere	7.5 Ampere	7.5 Ampere
FWD		25 to 250 Watts		
RFL		Less than 6 Watts		

Table 5-2. AC POWER REQUIREMENTS

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

5.5 TRANSMITTER PREPARATION FOR SHIPMENT

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

A. Ensure the top-cover is secured to the transmitter.

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

C. Provide adequate insurance coverage.

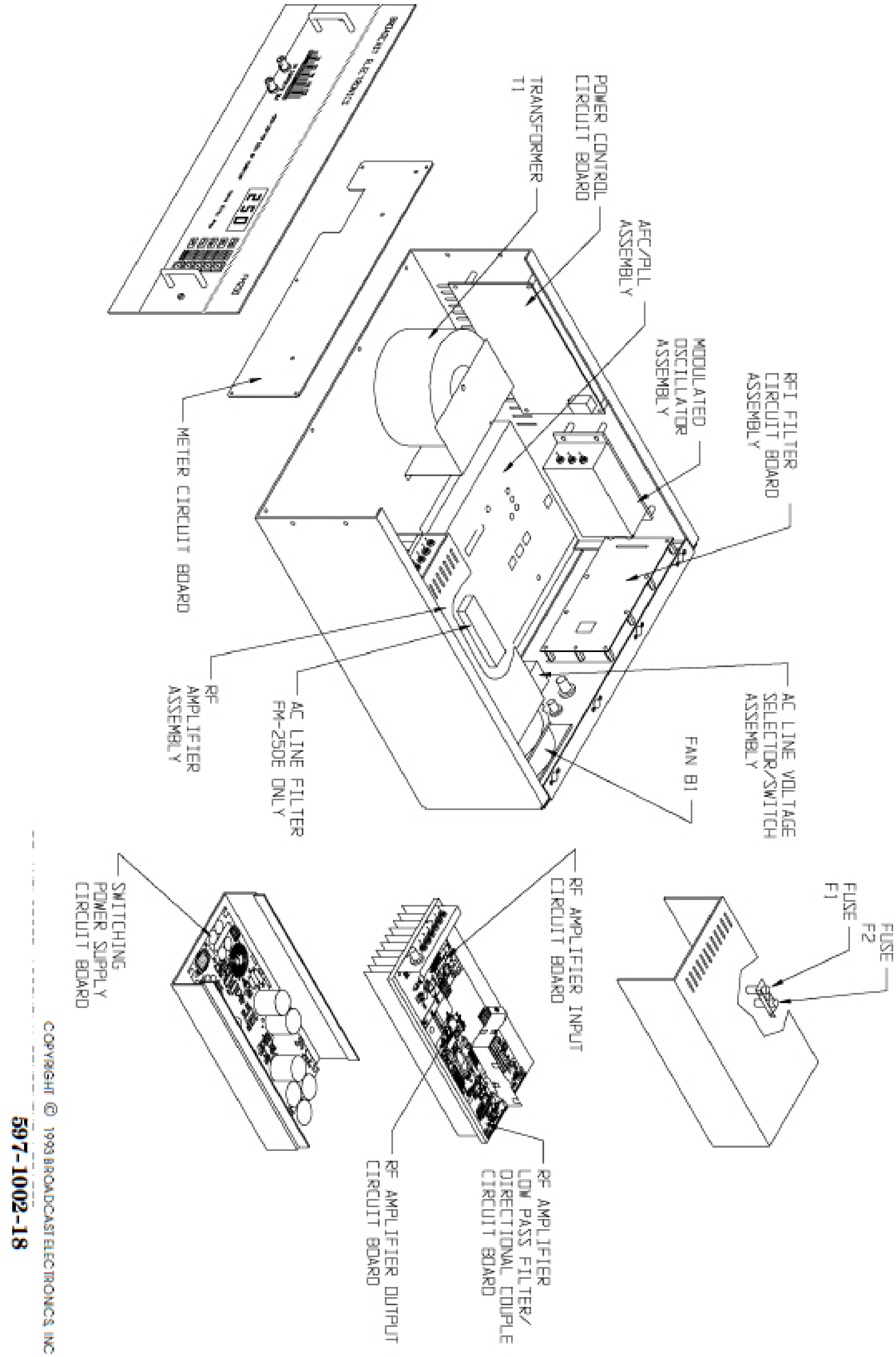


Figure 5-1. FM-250C/E TRANSMITTER COMPONENT LOCATOR

5.6 TRANSMITTER FREQUENCY CHANGE.

If modification of the transmitter frequency is required, perform the following procedures in sequence as listed.

A. FREQUENCY SELECTION procedure in the AFC/PLL section of this manual.

B. MODULATION CALIBRATION procedure in the AFC/PLL section of this manual.

C. MODULATION CORRECTION procedure in the AFC/PLL section of this manual.

D. FORWARD POWER CIRCUIT and REFKECTTED POWER CIRCUIT AND VSWR FOLDBACK procedures in the POWER CONTROL section of this manual.

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

WARNING

WARNING PORTIONS OF THE WHITE CASE MATERIAL OF THE FM-250C/E TRANSMITTER RF AMPLIFIER TRANSISTORS ARE MADE OF BeO CERAMIC MATERIAL. DO NOT PERFORM ANY OPERATION ON ANY BeO CERAMIC WHICH MIGHT PRODUCE DUST OR FUMES, SUCH AS GRINGING, GRIT BLASTING, OR ACID CLEANING. BERYLLIUM OXIDE DUST OR FUMES ARE HIGHLY TOXIC AND BREATHING THEM CAN RESULT IN SERIOUS PERSONAL INJURY OR DEATH. BeO CERAMICS MUST BE DISPOSED OF ONLY IN A MANNER PRESCRIBED BY THE DEVICE MANUFACTURER. USE CARE IN REPLACING TRANSISTORS OF THIS TYPE.

WARNING

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

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

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

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

WARNING

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, INLCUDING CIGARETTES AND SOLDER IRONS.

WARNING

WARNING

OBSERVE THE MANUFACTURER'S CAUTIONARY INSTRUCTIONS.

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

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

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

6 POWER CONTROL CIRCUIT

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

6.1 DESCRIPTION.

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

6.2 THEORY OF OPERATION

This section presents the theory of operation for the FM250C/E power control circuit board. A simplified schematic diagram of the power control circuit board is presented in Figure 6-1.

6.2.1 FUNCTIONAL DESCRIPTION.

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

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

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

6.2.2 RF MUTE CIRCUIT.

The RF mute circuit automatically inhibits transmitter RF output if the AFC circuit is unlocked or if the external mute input is activated. This circuit consists of positive/negative mute switch S2, transistors Q1 and Q2, and mute comparator U7A.

Switch S2 allows the selection of positive or negative logic external RF mute commands. When S2 is operated to positive, a positive signal is applied to transistor Q1. Q1 will be biased on. With Q1 on, transistor Q2 will be biased on. Q2 will output a HIGH to mute comparator U7A. U7A will respond by routing a HIGH to transistor Q3. The HIGH will bias Q3 on to mute the transmitter RF output. A HIGH signal will also be routed to disable the transmitter fan.

If the transmitter AFC circuit becomes unlocked, a HIGH is applied to mute comparator U7A. U7A will route a HIGH to Q3 to mute the transmitter output and disable the transmitter fan.

6.2.3 P.A. TEMPERATURE CIRCUIT.

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

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

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

6.2.4 P.A. CURRENT CIRCUIT.

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

6.2.5 VSWR CIRCUIT.

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

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

6.2.6 POWER CONTROL CIRCUIT.

The power control circuit provides manual and automatic transmitter power control operation. Manual power control is when the FM250C/E output power is controlled manually using the internal power adjust control, the optional up/ down power control panel, or an external voltage source. Automatic power control is when the FM250C/E output power is controlled automatically by the power control circuit. The power control circuit will automatically maintain a constant output power in response to changing load conditions. The power control circuit also responds to high VSWR, PA over-current and over temperature conditions in both the automatic and manual modes by initiating a fold-back operation. The fold-back operation reduces the transmitter output power to protect the transmitter circuitry during the high VSWR, PA over current, and PA over temperature conditions.

Manual Power Control Operation. Automatic/manual power control operation is established by normal/test jumper J7. When J7 is in the test position, the FM250C/E output power will not automatically adjust to changing load conditions. The output power must be increased/decreased manually using the power output adjust control R67, the optional up/down power control panel, or an external voltage source. J7 is typically operated to the test position when the FM250C/E is used as an exciter in a tube-type transmitter.

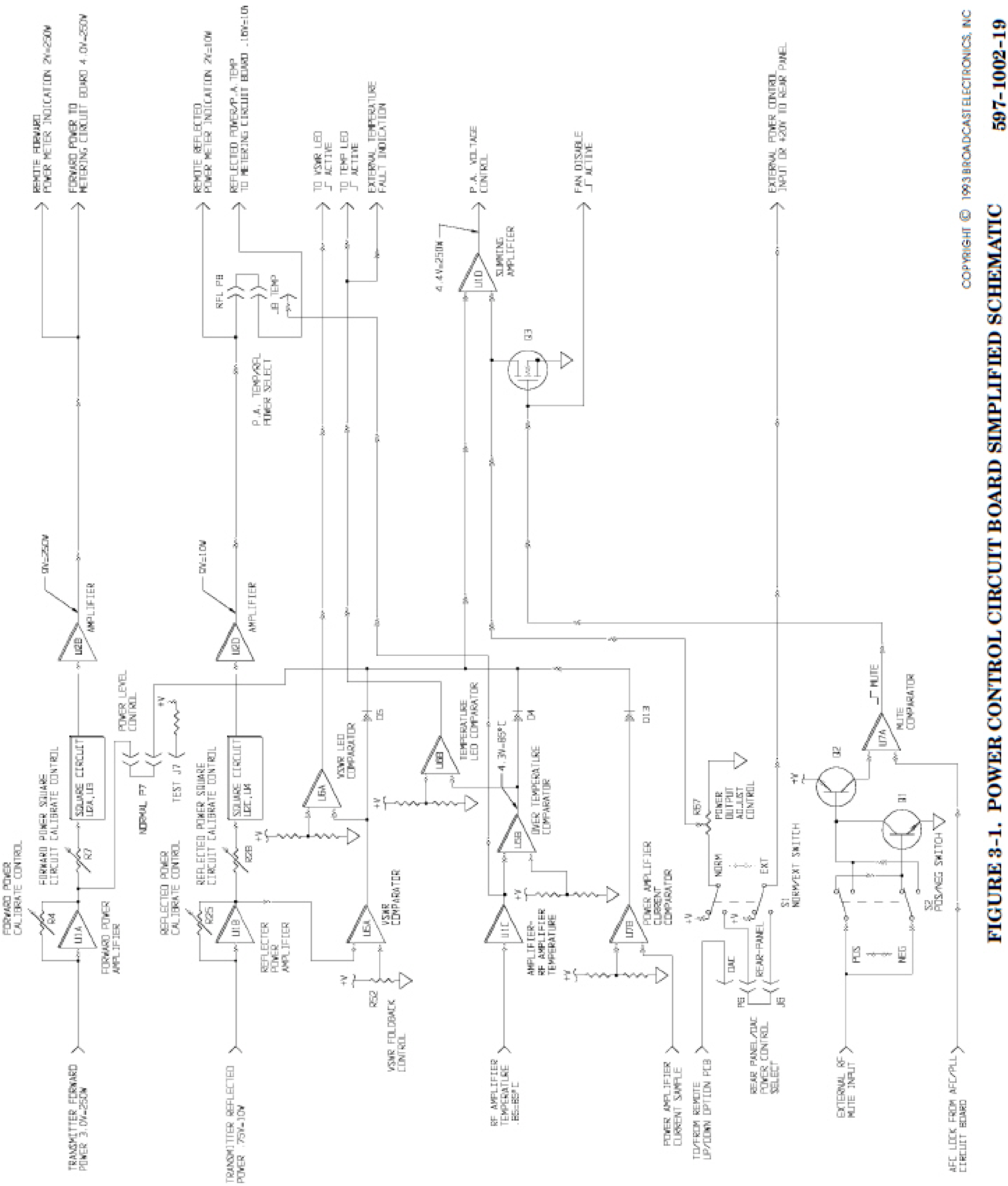


Figure 6-1. CONTROL CIRCUITRY SIMPLIFIED SCHEMATIC

Internal/External Power Control Operation. Internal/external power output control is determined by NORM/EXT switch S1. The NORM position configures the transmitter output power to be controlled by internal power output adjust control R67. The EXT position configures the transmitter output power to be controlled by an external voltage source or an optional up/down power control panel. With NORM/EXT switch S1 in the NORM position: 1) a +20V dc supply is routed to the rear-panel barrier strip and 2) the output of transmitter power output adjust control R67 is routed to summing amplifier U1D. As R67 is adjusted, the output of U1D will increase or decrease the PA output power. With the NORM/ EXT switch in the EXT position, a reference voltage can be applied to power output adjust control R67 through the rear-panel external power level control connection to control power externally.

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

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

6.3 MAINTENANCE

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

6.3.1 FORWARD POWER CIRCUIT CALIBRATION.

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

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

A. Insulated adjustment tool, shipped with the transmitter (P/N 4070083).

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

C. Coaxial Accessory Cable.

D. Calibrated 50 Ohm inline wattmeter.

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

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

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

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

WARNING

DISCONNECT TRANSMITTER PRIMARY POWER BEFORE PROCEEDING.

WARNING

C. Disconnect the transmitter primary power.

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

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

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

G. Apply primary power and operate the transmitter.

WARNING

DONOT TOUCH ANY COMPONENT WITHIN THE TRANSMITTER WITH POWER APPLIED.

WARNING

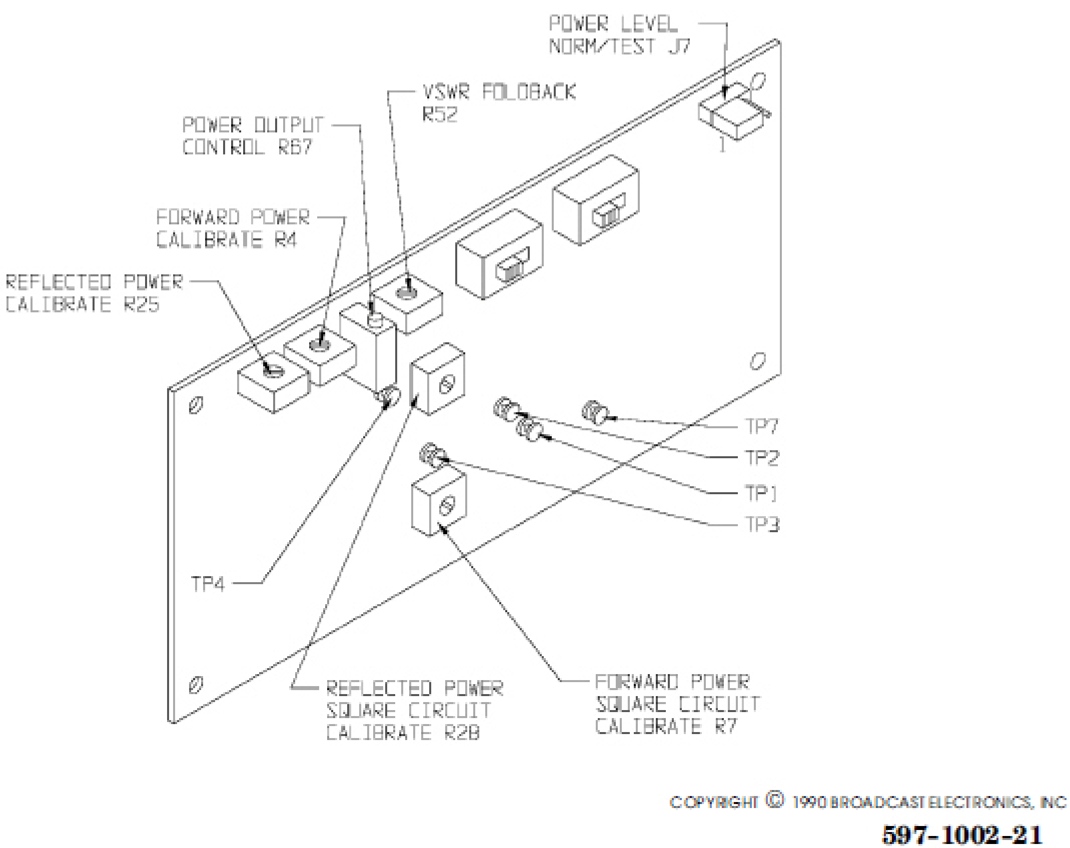


Figure 6-2. POWER CONTROL CIRCUIT BOARD CONTROLS

WARNING

DO NOT TOUCH ANY COMPONENT WITHIN THE TRANSMITTER WITH POWER APPLIED.

WARNING

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

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

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

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

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

M. Disconnect the transmitter primary power.

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

O. Apply primary power and operate the transmitter.

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

WARNING

DISCONNECT TRANSMITTER PRIMARY POWER BEFORE PROCEEDING.

WARNING

Q. Disconnect the transmitter primary power.

R. Remove the test equipment and replace the transmitter top-panel.

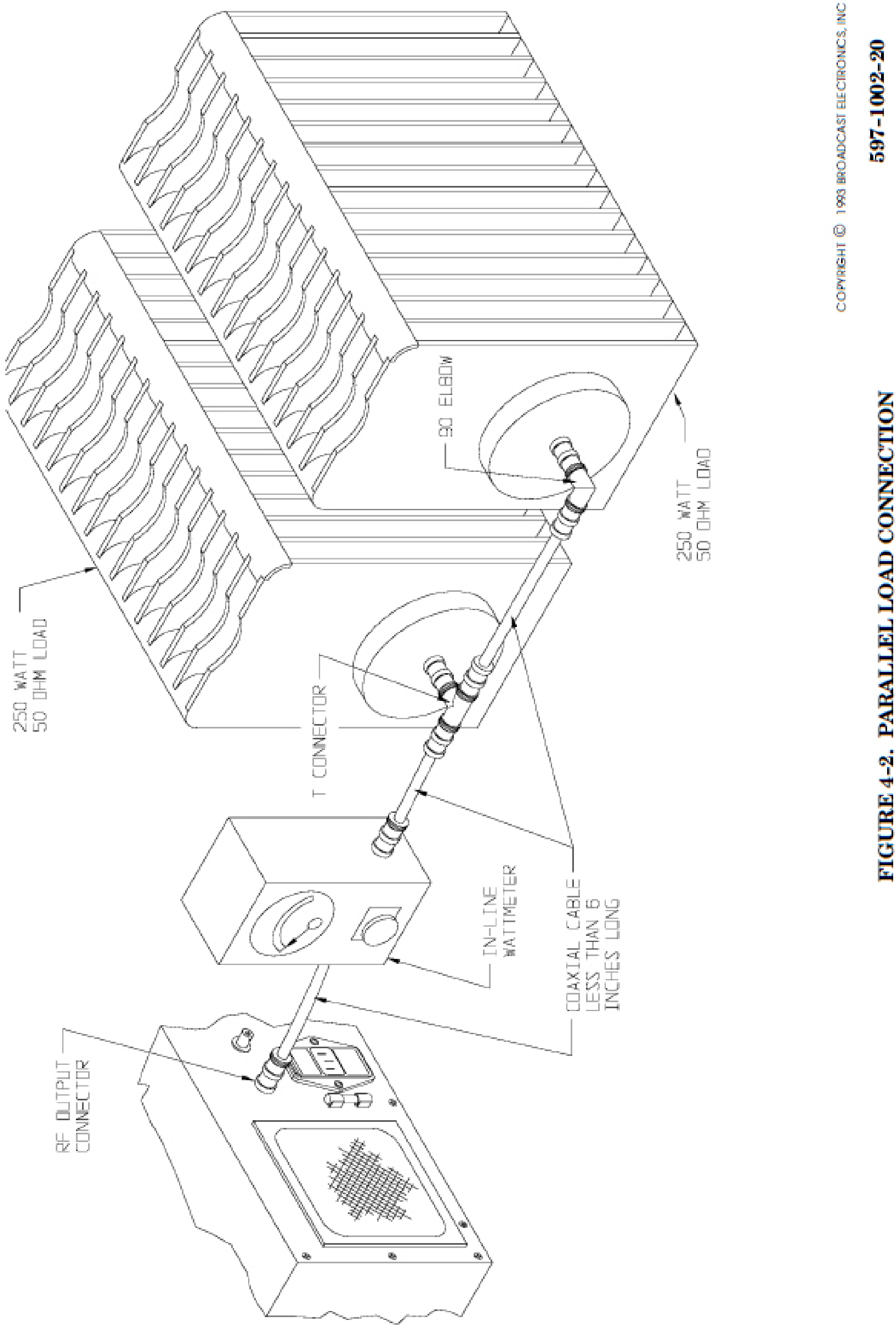


Figure 6-3. PARALLEL LOAD CONNECTION

WARNING

DONOT TOUCH ANY COMPONENT WITHIN THE TRANSMITTER WITH POWER APPLIED.

WARNING

6.3.2 REFLECTED POWER CIRCUIT AND VSWR FOLDBACI CALIBRATION.

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

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

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

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

C. Coaxial Accessory Cable.

D. Coaxial Test Cables.

E. Type N Tee.

F. Calibrated 50 Ohm inline wattmeter.

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

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

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

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

WARNING

DISCONNECT TRANSMITTER PRIMARY POWER BEFORE PROCEEDING.

WARNING

C. Disconnect the transmitter primary power.

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

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

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

G. Apply primary power and operate the transmitter.

WARNING

DONOT TOUCH ANY COMPONENT WITHIN THE TRANSMITTER WITH POWER APPLIED.

WARNING

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

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

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

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

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

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

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

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

WARNING

DISCONNECT TRANSMITTER PRIMARY POWER BEFORE PROCEEDING.

WARNING

P. Disconnect the transmitter primary power.

Q. Disconnect all test equipment.

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

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

T. Apply power and operate the transmitter.

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

WARNING

DISCONNECT TRANSMITTER PRIMARY POWER BEFORE PROCEEDING.

WARNING

V. Disconnect the transmitter primary power.

W. Remove the test equipment and replace the transmitter top-panel.

6.4 TROUBLESHOOTING THE POWER CONTROL BOARD CIRCUITRY.

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

Table 6-1. POWER CONTROL CIRCUIT BOARD TROUBLEHSOOTING

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

WARNING

DISCONNECT PRIMARY POWER FROM THE TRANSMITTER BEFORE REMOVING ANY COMPONENTS.

WARNING

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

CAUTION

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

6.5 REMOVAL AND INSTALLATION

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

6.5.1 REMOVAL PROCEEDURE

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

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

WARNING

DISCONNECT PRIMARY POWER FROM THE TRANSMITTER BEFORE REMOVING ANY COMPONENTS.

WARNING

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

6.5.2 INSTALLATION PROCEDURE.

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

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

WARNING

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

7 TRANSMITTER METERING CIRCUIT BOARD

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

7.1 DESCRIPTION.

The metering circuit board is equipped with LED status indicators for the +5 volt, +20 volt, -20 volt, TEMP, VSWR, RF, and LOCK operating parameters. Modulation percentage from 5% to 145% is indicated by a color coded moving bar LED display with an automatic ranging amplifier to convert the meter full scale indication to 14.5%.

The metering circuit board also includes a multi-meter circuit with an LCD display for measuring five steady-state operating parameters. In addition, the multi-meter can be converted into a high-impedance dc voltmeter for troubleshooting purposes.

7.2 INTERNAL VOLTMETER CHARACTERISTICS.

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

7.3 THEORY OF OPERATION

This section presents the theory of operation for the FM-250C/E metering circuit board.

7.3.1 FUNCTIONAL DESCRIPTION.

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

A. Status Indicator Circuits

B. Multi-meter Circuit

C. Modulation Display Circuit

D. Voltage Regulator Circuits

7.3.2 STATUS INDICATOR CIRCUITS.

The metering circuit board contains seven LEDs to provide transmitter status indications. DS2 through DS4 will illuminate to indicate the presence of +20V, -20V, and +5V primary operating potentials. DS5 through DS8 will illuminate to indicate frequency lock, RF amplifier malfunction, excessive VSWR, and excessive RF amplifier temperature.

7.3.3 MULTI-METER CIRCUIT.

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

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

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

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

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

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

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

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

AFC METER OPERATION. When the AFC voltage meter function is selected, input switch U6D will operate and route a sample voltage to the input of A/D converter/display driver U7.

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

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

7.3.4 MODULATION DISPLAY CIRCUIT.

The modulation display circuit and moving bar LED display provides a visual indication of the modulation percentage. A sample of the audio signal is input to gain switch amplifier U1A and automatic ranging amplifier U1C. Gain switch Q7 is normally closed for high levels of audio signal.

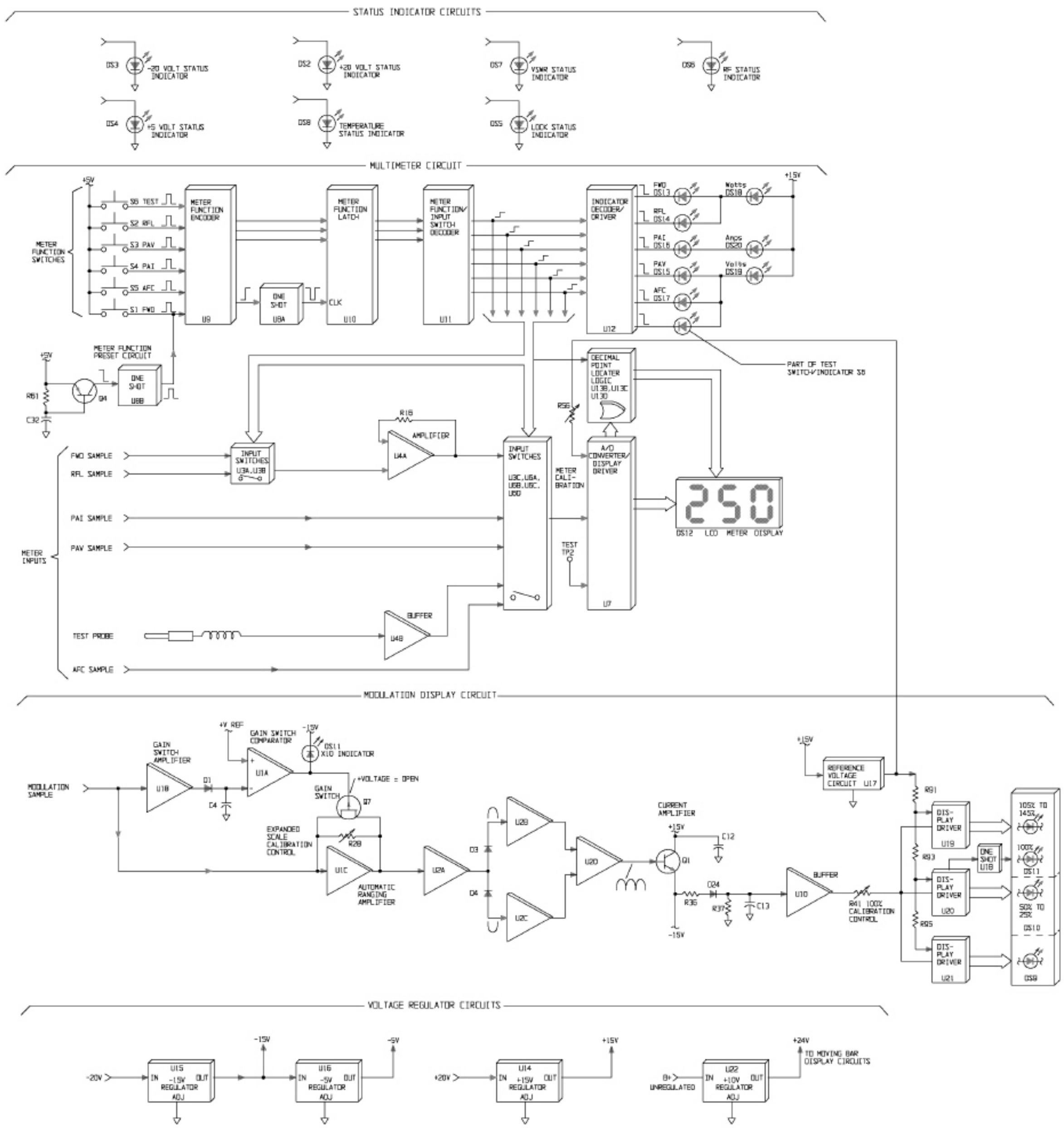
With Q7 closed, U1C operates as an inverting unity gain amplifier. The output of U1C is applied to a precision rectifier and meter ballistics circuit. This circuit consists of integrated circuit U2, diodes D3 and D4, and transistor Q1 and associated components.

The positive excursions of the signal at the output of U2A are applied to buffer U2B through diode D3. The negative excursions are applied to buffer U2C through diode D4. The output of U2B and U2C are routed to U2D which differentially amplifies the full-wave rectified signal.

The output of U2D is applied to current amplifier Q1 which transfers the positive charge on capacitor C12 to C13 through resistor R36 and diode D24. The rate at which the charge is transferred is determined by R36. C13 discharges through R37 at a slower rate to provide the display with a gradual decay time and a rapid rise time.

The signal at capacitor C13 is routed to display drivers U19, U20, and U21 through buffer U1D and 100% calibration control R41. Each display driver contains a resistive ladder network and comparator circuits which sequentially activate output lines in direct proportion to the input voltage.

The output lines of the display drivers are connected to LED displays DS9, DS10, and DS11 which illuminate when the lines are activated. An output line from U20 is routed to one shot U18 which generates a one second pulse to illuminate the 100% LED.



597-1002-28
FIGURE 3-1. SIMPLIFIED SCHEMATIC
-7/-8-

Figure 7-1. METERING BOARD SIMPLIFIED SCHEMATIC

AUTOMATIC RANGING CIRCUIT OPERATION. The automatic ranging circuit provides expanded scale meter indication for low level modulation signals. During low level signal conditions, the output of gain switch amplifier U1A insufficiently charges capacitor C4 through diode D1.

This minimal charge on C4 is applied to gain switch comparator U1B which outputs a positive voltage to bias gain switch Q7 OFF and illuminate indicator DS11. With Q7 OFF (open), expanded scale calibration control R28 operates as a feedback resistor for automatic ranging amplifier U1C. This converts the circuit into an inverting amplifier with a gain of 10.

7.3.5 VOLTAGE REGULATOR CIRCUITS.

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

Voltage regulator circuit U15 converts a -20 volt potential into a -15 volt source. This -15 volts is also applied to the input of regulator circuit U16 which provides a -5 volt potential. Voltage regulator circuit U14 converts a +20 volt potential into a +15 volt source. Finally, voltage regulator circuit U22 converts the +30 volt unregulated voltage (B+) to provide a +24 volt potential. Voltage regulator U17 converts the +15V regulated supply to +7.5 volts. The +7.5 volt supply is used as a reference for the LCD meter display and the LED bar-graph display.

7.4 MAINTENANCE

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

7.4.1 ELECTRICAL ADJUSTMENTS.

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

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

B. Digital voltmeter, Fluke 75 or equivalent.

C. Low distortion audio generator.

D. Calibrated oscilloscope.

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

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

WARNING

DISCONNECT TRANSMITTER PRIMARY POWER BEFORE PROCEEDING.

WARNING

A. Disconnect the transmitter primary power.

B. Remove the top-cover.

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

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

WARNING

DO NOT TOUCH ANY COMPONENT WITHIN THE TRANSMITTER WITH POWER APPLIED.

WARNING

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

WARNING

DISCONNECT THE PRIMARY POWER TO THE TRANSMITTER BEFORE PROCEEDING.

WARNING

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

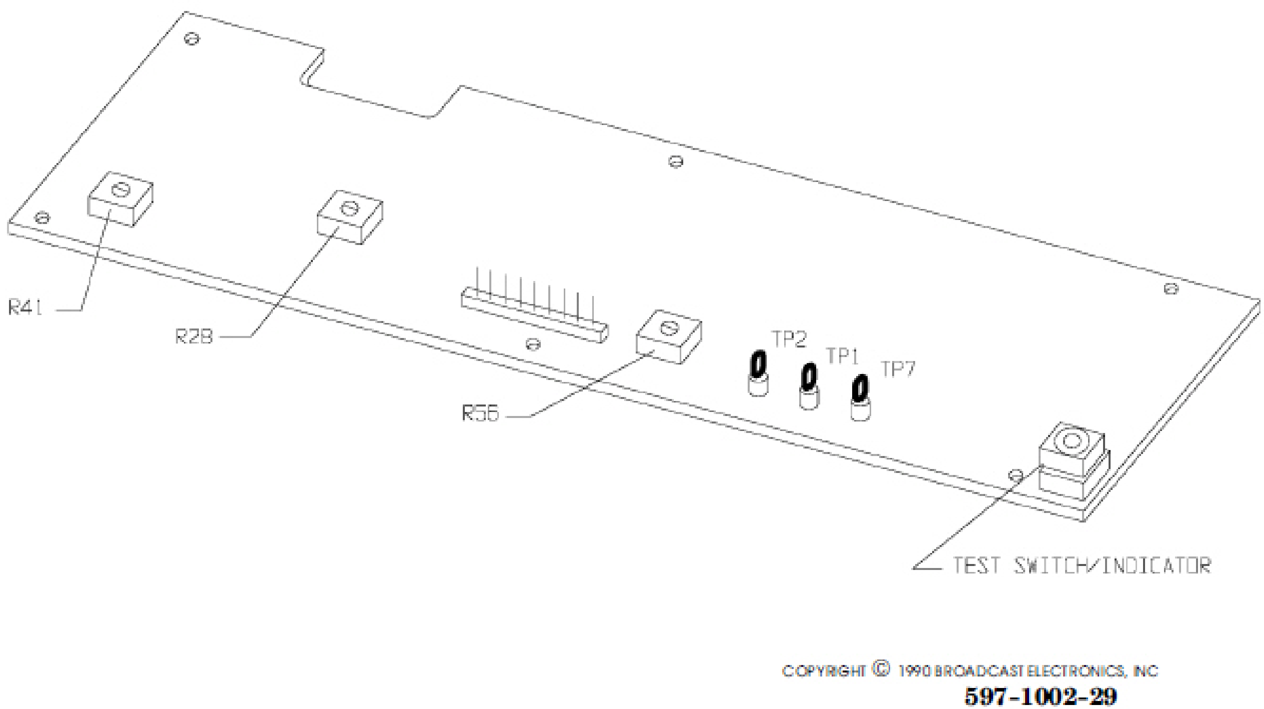


Figure 7-2. METERING CIRCUIT BOARD CONTROLS AND TEST POINTS

DISPLAY CALIBRATE (R41) AND X10 CALIBRATE (R28) CONTROLS. Display calibrate control R41 and X10 calibrate control R28 on the metering circuit board must be adjusted in proper sequence. R41 and R28 are adjusted as follows.

Procedure. To adjust R41 and R28, refer to Figure 7-2 as required and proceed as follows:

A. Remove the top-cover and connect an audio generator to the front-panel COMPOSITE IN connector.

B. Connect an oscilloscope to the front-panel COMPOSITE OUT connector.

C. Adjust the audio generator for 400 Hz at 6 volts peak-to-peak (2.12V RMS) as indicated on the oscilloscope.

WARNING

DO NOT TOUCH ANY COMPONENT WITHIN THE TRANSMITTER WITH POWER APPLIED.

WARNING

D. With an insulated adjustment tool, adjust R41 fully counterclockwise, then clockwise until the 100% modulation indicator just illuminates.

E. Adjust the audio generator for 0.6V peak-to-peak (0.212V RMS). The front-panel X10 indicator will illuminate.

WARNING

DO NOT TOUCH ANY COMPONENT WITHIN THE TRANSMITTER WITH POWER APPLIED.

WARNING

F. With an insulated adjustment tool, adjust R28 fully counterclockwise, then clockwise until the 100% modulation indicator just illuminates.

G. Remove all test equipment and replace the top-cover.

7.4.2 TROUBLESHOOTING.

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

WARNING

DISCONNECT THE POWER FROM THE TRANSMITTER BEFORE REMOVING OR REPLACING ANY COMPONENTS.

WARNING

CAUTION

CAUTION

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

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

Table 7-1. METERING CIRCUIT BOARD TROUBLESHOOTING

SYMPTOM	DEFECT/REMEDY
NO MODULATION AND MULTI-METER DISPLAY	1. Check the +15V regulator circuit U14. 2. Check the -15V regulator circuit U15. 3. Check the -5V regulator circuit U16.
NO MODULATION DISPLAY	1. Check the +24V regulator circuit U22. 2. Check integrated circuit U1C. 3. Check integrated circuit U2 and associated components. 4. Check transistor Q1 and associated components.
NO 100% MODULATION INDICATOR	1. Check integrated circuit U18. 2. Check transistors Q5 and Q6.
ENTIRE MODULATION DISPLAY IS ILLUMINATED	1. Check +7.5V reference voltage circuit U17.
NO X10 METER INDICATOR	1. Check X10 indicator DS1.
NO EXPANDED SCALE METER OPERATION	1. Check FET switch Q7 and associated components.
NO X10 METER INDICATOR AND EXPANDED SCALE METER OPERATION	1. Check integrated circuit U1A/U1B and associated components.
NO 5% TO 50% METER INDICATORS	1. Check display DS10. 2. Check display driver U20.
NO MULTI-METER FUNCTION SWITCH OPERATION	1. Check integrated circuit U8A. 2. Check integrated circuit U9. 3. Check integrated circuit U10. 4. Check integrated circuit U11.
NO PAV MULTI-METER FUNCTION	1. Check PAV switch S3. 2. Check input switch U6B.
NO FWD POWER FUNCTION SELECTED WHEN PRIMARY POWER IS APPLIED	1. Check integrated circuit U8B. 2. Check transistor Q4 and associated components.
NO MULTI-METER FUNCTION AND UNIT MEASURE INDICATORS	1. Check integrated circuit U12.
NO FWD POWER METER INDICATION	1. Check input switch U3A.
NO FWD AND RFL POWER METER INDICATION	1. Check input switch U6A. 2. Check integrated circuit U4A and associated components.
NO LCD DISPLAY	4. Check integrated circuit U7. 5. Check display DS12.

7.5 REMOVAL AND INSTALLATION

This section provides removal and installation procedures for the FM-250C/E metering circuit board assembly.

7.5.1 REMOVAL PROCEDURE.

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

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

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

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

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

WARNING

DISCONNECT TRANSMITTER PRIMARY POWER BEFORE PROCEEDING.

WARNING

A. Disconnect the primary power from the transmitter.

B. Remove the FM-250C top-cover and disconnect P14 from the metering circuit board.

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

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

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

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

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

7.5.2 INSTALLATION PROCEDURE.

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

WARNING

DISCONNECT TRANSMITTER PRIMARY POWER BEFORE PROCEEDING.

WARNING

A. Disconnect the primary power from the transmitter.

B. Follow the REMOVAL PROCEDURE in reverse order.

:

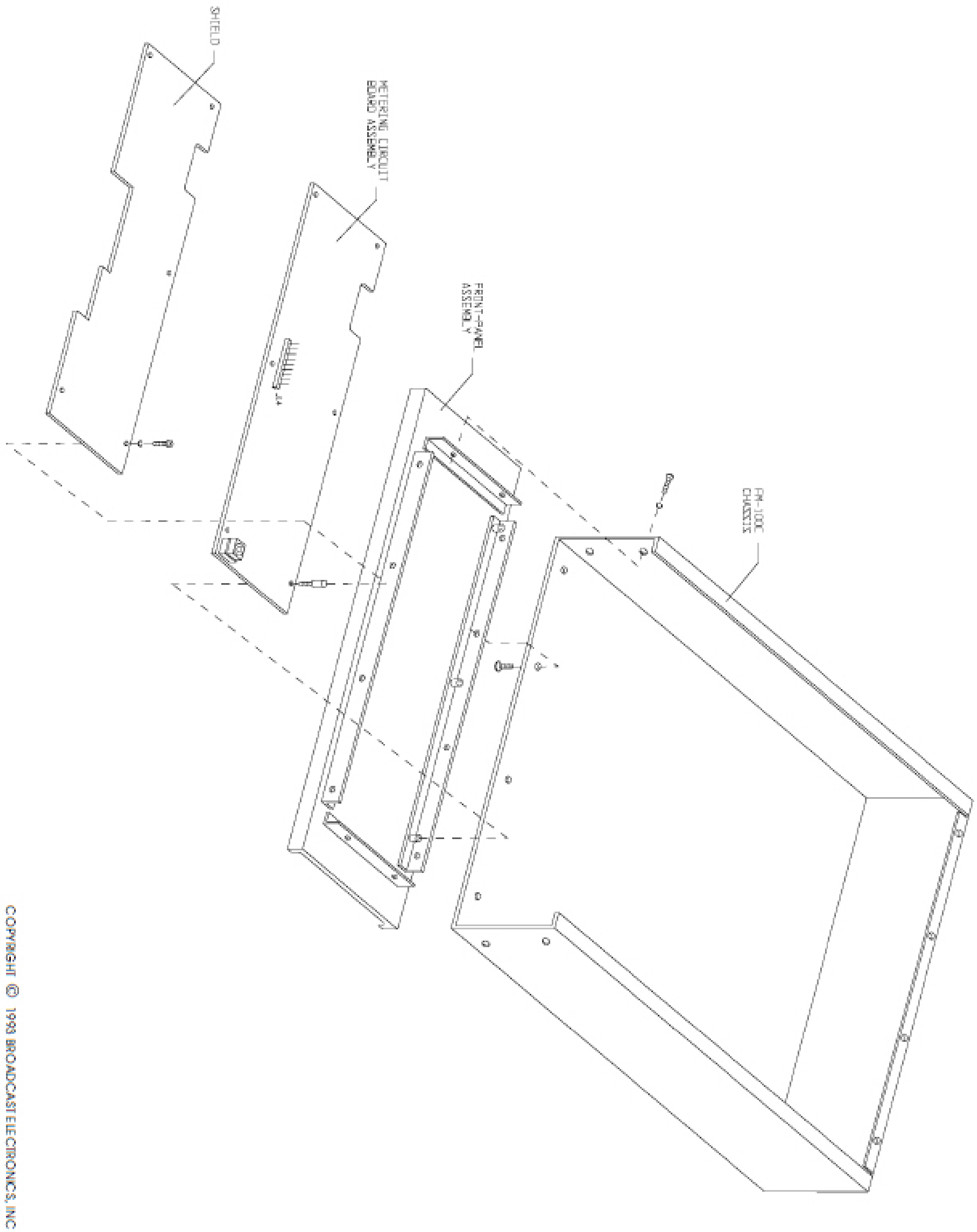


Figure 7-3. METERING CIRCUIT REMOVAL AND INSTALLATION DIAGRAM

8 Modulated Oscillator

This section provides general information and specifications relative to the operation of the modulated oscillator assembly.

8.1 DESCRIPTION.

The modulated oscillator assembly produces the carrier frequency; frequency modulates the carrier, and amplifies the modulated RF carrier to a level sufficient to drive the RF amplifier assembly. Additional circuitry is interfaced to the AFC/PLL circuit board which operates as a phase-locked loop to maintain the RF carrier center frequency.

8.2 ELECTRICAL CHARACTERISTICS.

Refer to Table 8-1 for electrical characteristics relative to the modulated oscillator assembly.

Table 8-1. ELECTRICAL CHARACTERISTICS

PARAMETER	SPECIFICATION
SIGNAL INPUTS	
MODULATION AND AFC VOLTAGE	35 m V p-p Nominal with 2.0V to 9.0V DC Dependent on the RF Center Frequency.
SIGNAL OUTPUTS	
RF	1 mW at 50 Ohms.
AFC SAMPLE	1 mW at 50 Ohms.

8.3 THEORY OF OPERATION

This section presents the theory of operation for the transmitter modulated oscillator assembly.

8.4 FUNCTIONAL DESCRIPTION.

MECHANICAL ASSEMBLY.

The modulated oscillator circuit board is enclosed in a cast aluminum housing which is secured to a heavy steel plate. Mechanical vibrations are reduced by a foam rubber pad between the steel plate and the chassis. The increased mass of the assembly also lowers the mechanical resonance below the frequency of vibrations from external sources.

In addition, a foam rubber pad attached to the inside top-cover restricts movement of circuit board components to reduce mechanically introduced noise modulation and increase the frequency stability of the oscillator.

ELECTRICAL DESCRIPTION.

Figure 8-1 presents a simplified schematic diagram of the modulated oscillator circuit board. Refer to Figure 8-1 as required for a description of the following circuits.

A. Modulator/Oscillator

B. Buffers and Output Amplifier

C. Power Supply

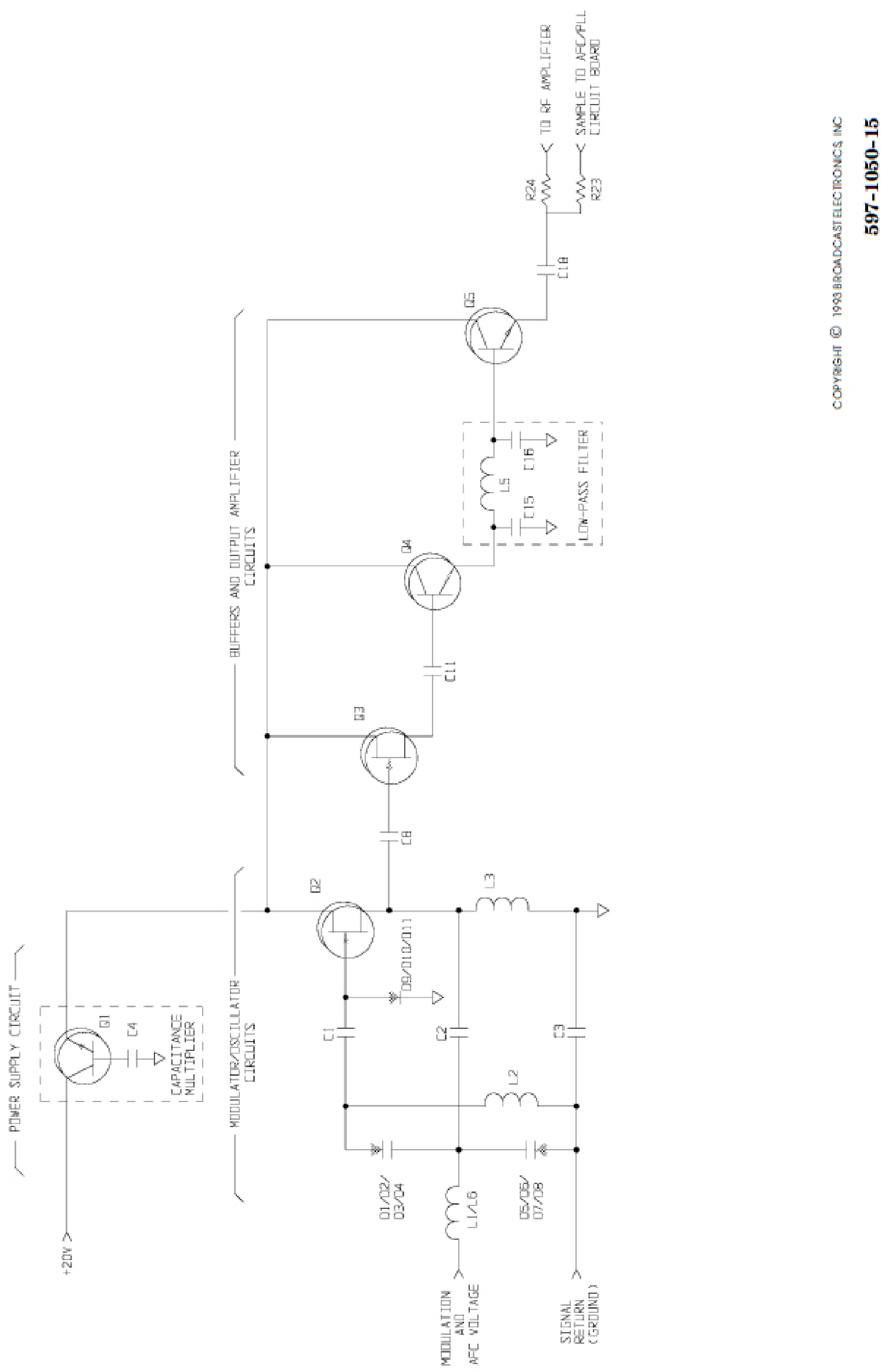


Figure 8-1. MODULATED OSCILLATOR SIMPLIFIED SCHEMATIC DIAGRAM

MODULATOR/OSCILLATOR. The oscillator section is a modified Colpits configuration consisting of transistor Q2, inductors L3 and L2, capacitors C1 and C2, and varactor diodes D1 through D8. C2 provides positive feedback to sustain oscillation. Tuning is accomplished by the 2V to 9V (dependent upon the carrier frequency) potential applied to the varactor diodes from the AFC/PLL circuit board through L1/L6.

Varactor diodes D1 through D8 also operate as a linear FM modulator. The modulation voltage applied to the diodes through L1/L6 varies the capacitance across the oscillator tank circuit to provide direct FM modulation. Capacitor C3 prevents ground loops between the AFC/PLL circuit board ground and modulated oscillator assembly ground. The oscillator output amplitude is maintained at a constant level by limit diode D9/D10/D11.

BUFFERS AND OUTPUT AMPLIFIER. Three RF stages provide isolation between the oscillator and output load, harmonic suppression, and a low output impedance.

The modulated RF at Q2 is coupled to the base of buffer/amplifier Q3 through capacitor C8. The output of Q3 is applied to buffer/amplifier Q4 through C11. The output of Q4 is applied to the base of output amplifier Q5 through a low-pass filter consisting of C15, C16, and L5. The output of Q5 is routed through C18 to resistors R23 and R24 which establish a 50 Ohm output impedance.

Two identical signals are output from the modulated oscillator assembly. The signal at R24 provides drive to the RF amplifier and the signal at R23 provides a frequency sample to the AFC/PLL circuit board.

POWER SUPPLY. +20V dc is applied to the transistors on the modulated oscillator circuit board through transistor Q1. Q1 operates as a capacitance multiplier for dc filter capacitor C4.

8.5 MAINTENANCE

This section provides maintenance and troubleshooting information for the transmitter modulated oscillator assembly.

8.5.1 MAINTENANCE.

ELECTRICAL ADJUSTMENTS.

The modulated oscillator assembly contains no controls which require adjustment or calibration.

8.6 TROUBLESHOOTING.

Field servicing the modulated oscillator assembly is not recommended. Therefore, if difficulties are encountered and the modulated oscillator is suspected as faulty, return the assembly to Broadcast Electronics for repair or replacement.

8.7 REMOVAL AND INSTALLATION

This section provides removal and installation procedures for the modulated oscillator assembly.

8.7.1 REMOVAL AND INSTALLATION PROCEDURES.

REQUIRED EQUIPMENT. A number 2 Phillips screwdriver with a 4 inch (10.16 cm) shaft is required to remove the modulated oscillator assembly from the transmitter chassis.

PROCEDURE. To remove the modulated oscillator assembly, proceed as follows:

WARNING

DISCONNECT TRANSMITTER PRIMARY POWER BEFORE PROCEEDING.

WARNING

A. Disconnect the primary power to the transmitter.

B. Remove the transmitter top-cover. Disconnect P8 from the AFC/PLL circuit board.

C. Disconnect RF sample connector P6 and RF output connector P9 from the rear of the modulated oscillator assembly.

D. Remove the four screws securing the modulated oscillator assembly to the steel mounting plate. Remove the ground strap.

8.7.2 INSTALLATION PROCEDURE.

To install the modulated oscillator assembly after repairs have been completed, proceed as follows:

WARNING

DISCONNECT TRANSMITTER PRIMARY POWER BEFORE PROCEEDING.

WARNING

A. Disconnect the primary power to the transmitter.

B. Follow the REMOVAL PROCEDURE in reverse order.

9 AFC/PLL

This section provides general information and specifications relative to the operation of the automatic frequency control/phase-locked-loop (AFC/PLL) circuit board.

9.1 DESCRIPTION.

The AFC/PLL circuit board: 1) synthesizes and maintains the desired carrier frequency to a high degree of precision, and 2) processes the audio for modulation.

A sample of the modulated oscillator output frequency is compared to a precision reference frequency in a comparator circuit which generates a correction voltage. This correction voltage is applied to the modulated oscillator to maintain the stability of the carrier frequency. If the carrier is off frequency (as when power is applied), the AFC/PLL circuitry will mute the RF output until the carrier is locked in-phase with the reference frequency. A dual speed PLL filter ensures rapid stabilization of the carrier frequency.

In addition, the AFC/PLL circuit board accepts, sums, and pre-corrects audio input signals to provide a linear response when applied to the modulated oscillator.

9.2 ELECTRICAL CHARACTERISTICS.

Refer to Table 9-1 for electrical characteristics relative to the AFC/PLL circuit board.

Table 9-1. AFC/PLL ELECTRICAL CHARACTERISTICS

PARAMETER	SPECIFICATIONS
INPUTS:	
RF SAMPLE	1 mW at 50 Ohms.
BALANCED AUDIO	+10 dBm at 600 Ohm for 100% Modulation.
COMPOSITE AUDIO	3.5V p-p (1.24V RMS) for 100% Modulation.
SCA AUDIO	3.5V p-p (1.24V RMS) for 10% Injection.
OUTPUTS:	
MODULATION	35 mV p-p, Nominal for +/- 75 kHz Deviation.
AFC	+2.0V DC to +9.0V DC, Dependent Upon RF Center Frequency.
AFC (Metering)	+2.0V DC to 9.0V DC, Dependent Upon RF Center Frequency.
AFC INTERLOCK	Open Collector Output.
EXTERNAL LOCK INDICATOR	Open Collector Output.
COMPOSITE AUDIO (Metering)	6.0V p-p at 1 k Ohm.
COMPOSITE TEST	6.0V p-p at 1 k Ohm.

9.3 THEORY OF OPERATION

This section presents the theory of operation for the transmitter AFC/PLL circuit board.

9.4 FUNCTIONAL DESCRIPTION.

The AFC/PLL circuit board contains nine circuits. Figure 9-1 presents a simplified schematic of the AFC/PLL circuit board. Refer to Figure 9-1 as required for a description of the following circuits.

A. Reference Divider Circuit

B. Reference Oscillator Activity Monitor

C. RF Sample Divider Circuit

D. Comparator Circuit

E. Loop Filter Control Circuit

F. VCO Activity Monitor

G. Audio Processing Circuits

H. Pre-modulation Control Circuit

I. Voltage Regulator Circuits

9.4.1 REFERENCE DIVIDER CIRCUIT.

This divider circuit provides an accurate and stable reference frequency for input to a comparator circuit. A 10 MHz signal from crystal oscillator Y1 is input to divide-by-five counter U1B to produce 2 MHz. These two frequencies are available at TP1 through programmable jumper J3.

The 2 MHz signal from U1B is input to divide-by-two counter U1A to produce 1 MHz. Logic circuits U2, U3, and U4A further divide the 1 MHz signal by 250 to provide 4 kHz to one shot U5. The 4 kHz signal at the QA output of U5 is applied to programmable frequency synthesizer and comparator U9.

9.4.2 REFERENCE OSCILLATOR ACTIVITY MONITOR.

This circuit provides a visual indication of the reference divider circuit output. When the 4 kHz signal is present, the QB output of U5 will go HIGH which biases LED driver transistor Q1 ON to illuminate indicator DS2.

9.4.3 RF SAMPLE DIVIDER CIRCUIT.

This divider circuit provides an RF sample frequency for input to the comparator circuit. An RF sample from the modulated oscillator is input to transformer T1 to reduce ground loop interference. The output of T1 is coupled to a low-pass filter consisting of capacitors C15, C16, and inductor L3 which eliminates any harmonics.

The sinusoidal output signal from the low-pass filter is applied to the input of counter U8. U8 will divide the sample frequency by 20 and output a digital signal to U9.

9.4.4 COMPARATOR CIRCUIT.

This circuit compares the signals from both the reference divider and RF sample divider circuits and generates an error signal when a difference exists. Logic circuit U9 is a programmable frequency synthesizer and comparator which will internally divide the 4 kHz signal at the OSC input to provide a frequency of 500 Hz.

When binary switches S1, S2, and S3 are preset for the appropriate carrier frequency, U9 will divide the RF sample signal at the F input to provide 500 Hz at the FV output which is applied to one shot U12. If an error exists, output FV will vary above or below 500 Hz. This signal and the 500 Hz from the reference division are internally compared for phase and frequency variations.

When the carrier frequency and reference frequency are equal and in phase, the PD output of U9 will be steady state at approximately +2.5 volts. If the carrier leads or is greater than the reference frequency, the output will pulse LOW. If the carrier lags or is less than the reference frequency, the output will pulse HIGH. These output pulses will vary in width directly in proportion to the degree of phase error. The pulses are applied to U11B.

Normally, the LD output of U9 will be a logic HIGH for a locked condition. If an unlocked condition exists, the output will pulse LOW. This output is applied to the D input of lock/ unlock sensor U4B. With the signal from the FV output of U9, the QA output of one shot U12 will provide a clock pulse to U4B which leads or lags the signal at the D input depending on the phase error direction.

9.4.5 LOOP FILTER CONTROL CIRCUIT.

The loop filter control circuit increases/decreases the voltage controlled oscillator (VCO) center frequency to maintain accuracy. U10B biases integrator/amplifier U11B at 2.5V to provide a voltage gain of 11 for any differential voltage within the range of the bias. The output of U11B is applied to the metering circuit board for display.

ACTIVE FILTER. The output of U11B is also applied to an active third-order 5 Hz low-pass filter consisting of capacitors C29 through C31, resistors R25 through R27, and loop filter buffer U11A. The filter removes the reference frequency component to provide a dc automatic frequency control (AFC) voltage to the modulated oscillator through resistor R31.

LOCK DRIVER. The output of lock/unlock sensor U4B normally applies a HIGH through resistor R39 to lock driver U13A for a locked-loop condition. U13A is activated by a slow charge/rapid discharge circuit consisting of resistors R39, R40, diode D2, and capacitor C42.

As long as the output of U4B is HIGH, the potential on C42 will maintain U13A output HIGH. This HIGH will: 1) illuminate front-panel LOCK indicator DS5, 2) bias transistor switch Q3/Q4 ON to remove the RF inhibit from the rear-panel terminal strip, and 3) en able the AFC relay.

If an unlock condition exists, the output of U4B will go LOW which rapidly discharges C42 through D2 and R40 and applies a LOW to U13A. When this occurs, the output of U13A will go LOW to extinguish the lock indicator, disable the AFC relay, inhibit the RF, and activate a dual rate loop driver.

DUAL RATE LOOP DRIVER. The LOW output from U13A is routed to a dual rate control network consisting of R42, R43, C44, and D3. This circuit is identical in operation to the slow charge/rapid discharge circuit previously described. The circuit forces the output of U13B HIGH which enables light dependent resistors LDR1, LDR2, and LDR3 in the active filter circuit to increase loop lock response.

LOOP LOCK RESPONSE. Increased loop lock response is accomplished by LDR1, LDR2, and LDR3. When enabled during an unlocked condition, LDR1 will shunt the 5 Hz lowpass filter and route the output from U11B directly to U11A. LDR2 will shunt resistor R31 to rapidly charge capacitor C35 through resistor R34. Modulation coupling capacitor C37 will be rapidly charged through LDR3.

LOCK UP. When the operating frequency and phase output of the modulated oscillator are sufficiently adjusted by the AFC control voltage, the output of U4B will return HIGH which changes the output state of U13A and U13B. The duration between the unlock and lock conditions is less than 5 seconds.

9.4.6 VCO ACTIVITY MONITOR.

This circuit indirectly provides a visual indication of output from the RF sample divider circuit via the FV output of U9. When the 500 Hz signal is present, the QB output of U12 will go HIGH which biases LED driver transistor Q2 ON to illuminate indicator DS3. If any component within the RF sample divider circuit or modulated oscillator circuit fails, indicator DS3 will extinguish and the QB output of U12 will issue a reset pulse to U4B which inhibits the RF.

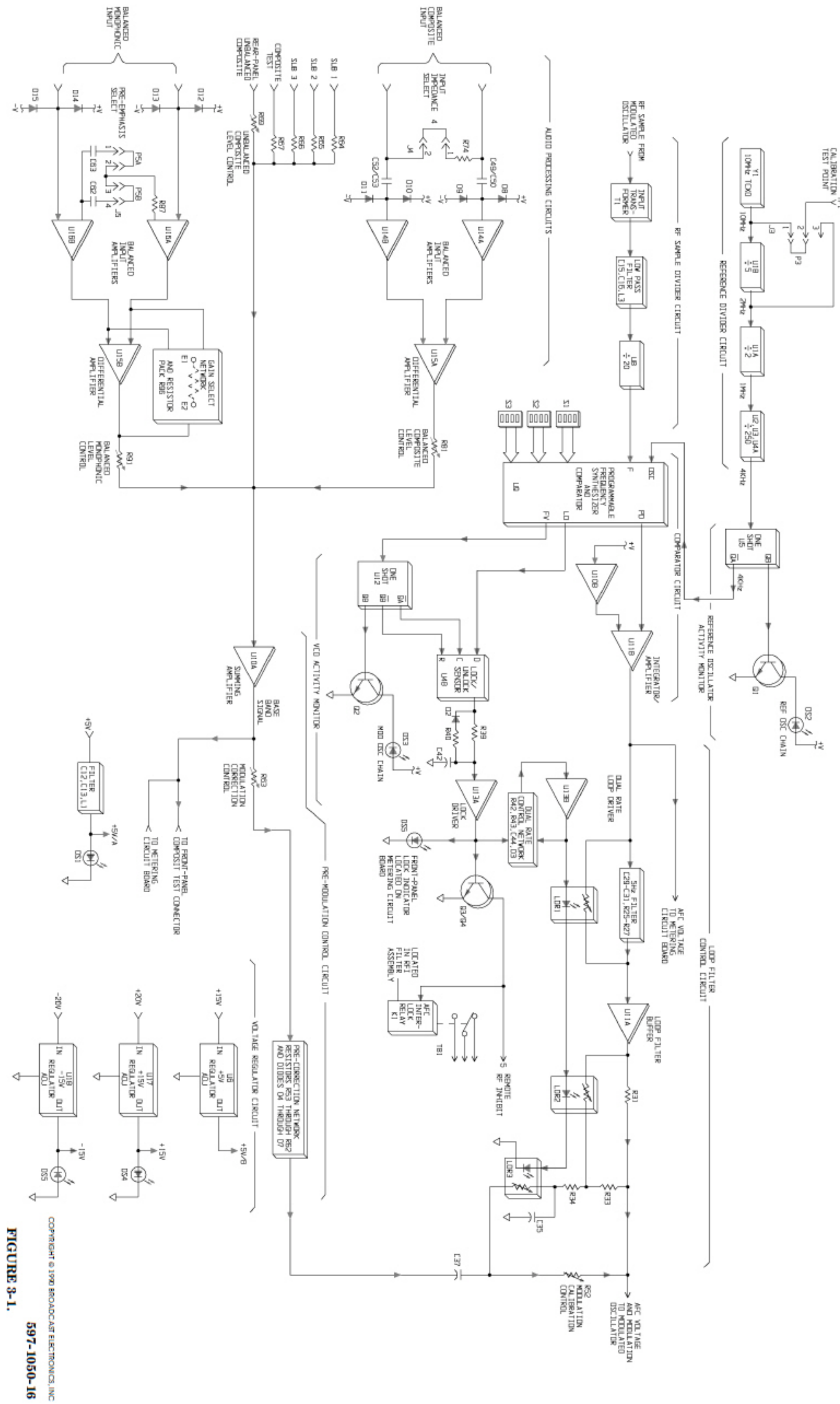


Figure 9-1. AFC/PLL CIRCUIT BOARD SIMPLIFIED SCHEMATIC

9.4.7 AUDIO PROCESSING CIRCUITS.

BALANCED INPUTS. A balanced composite audio input circuit and a balanced mono phonic audio input circuit are provided by the FM-250Ctransmitter. Audio for the composite circuit is input through a rear-panel BNC connector. Audio for the monophonic circuit is in put through rear-panel barrier strip TB1.

Composite Circuit. When programmable jumper J4 is installed, resistor R74 is connected across the input circuit to convert the impedance from 10 k Ohms to 50 Ohms. Audio from the rear-panel is ac coupled to balanced input amplifiers U14A and U14B through capacitors C49/C50 and C52/C53. Diodes D8 through D11 limit the audio input level.

The outputs of U14A and U14B are routed to differential amplifier U15A. The output of U15A is routed to summing amplifier U10A through balanced composite level control R81.

Monophonic Circuit. Audio from the rear-panel is ac coupled through capacitors in the RFI assembly to balanced input amplifiers U16A and U16B. Diodes D12 through D15 op-erate to limit the audio input level. Pre-emphasis is selected by programmable jumpers J5A and J5B which connect capacitor(s) C62 and/or C63 into the circuit through resistor R37.

The outputs of U16A and U16B are routed to differential amplifier U15B. The voltage gain for U15B is selected by a gain select network consisting of resistor pack R96 and a resistor connected between tie points E1 and E2. The output of U15B is routed to summing amplifier U10A through balanced monophonic level control R91.

UNBALANCED INPUTS. Subcarrier audio from rear-panel connectors SUB1, SUB2, and SUB3 and audio from front-panel composite test connector are input to U10A through summing resistors R64 through R67. Audio from the rear-panel unbalanced composite connector is also input to U10A through unbalanced composite level control R69.

9.4.8 PREMODULATION CONTROL CIRCUIT.

Audio signals from the balanced and unbalanced input circuits are summed at the input of summing amplifier U10A. The output of U10A is routed to the front-panel composite test connector, the metering circuit board, and a pre-correction network through modulation correction control R63.

The audio pre-correction network consisting of resistors R53 through R62 and diodes D4 through D7 adjusts the base band signal to compensate for varactor non-linearity in the modulated oscillator. The output of this network is routed to the modulated oscillator through coupling capacitor C37 and modulation calibration control R52.

9.4.9 VOLTAGE REGULATOR CIRCUITS.

The AFC/PLL circuit board contains three voltage regulator circuits. +15 volts is applied to regulator circuit U6 to provide a +5 V/B operating potential at the output. +20 volts is applied to regulator circuit U17 to provide an output potential of +15V to the circuit board and indicator DS4. -20 volts is applied to regulator circuit U18 to provide an output potential of -15V to the circuit board and indicator DS5.

In addition, +5 volts is applied to a filter circuit consisting of capacitors C12, C13, and inductor L1. The output illuminates indicator DS1 and provides a +5V/A operating potential.

9.5 MAINTENANCE

This section provides maintenance information, electrical adjustment procedures, and troubleshooting information for the transmitter AFC/PLL circuit board.

9.6 ELECTRICAL ADJUSTMENTS.

Figure 9-2 presents the AFC/PLL circuit board controls and indicators with the cover removed. The following electrical adjustment procedures do not require the cover to be removed.

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

A. Insulated adjustment tool, shipped with the transmitter (P/N 407-0038).

B. Digital voltmeter, Fluke 75 or equivalent.

C. Low distortion audio generator and distortion analyzer, Sound Technology 1710A or equivalent.

D. Calibrated oscilloscope.

E. High linearity FM demodulator, Belar FMM-2 or equivalent.

F. 20 dB power attenuator, Bird 8343-200 or equivalent.

G. Calibrated frequency counter, HP-5315B or equivalent.

9.6.1 BAL MONO (R91).

The BAL MONO level control on the AFC/PLL circuit board adjusts the output level of the balanced monophonic amplifier circuit. BAL MONO control R91 is adjusted as follows.

Procedure. To adjust BAL MONO control R91, refer to Figure 9-2 as required and proceed as follows:

WARNING

DISCONNECT PRIMARY POWER TO THE TRANSMITTER BEFORE PROCEEDING.

WARNING

A. Disconnect the transmitter primary power.

B. Remove the top-cover and connect an audio generator to the AUDIO INPUT terminals on rear-panel barrier strip.

C. Connect a digital voltmeter to the front-panel COMPOSITE OUT receptacle.

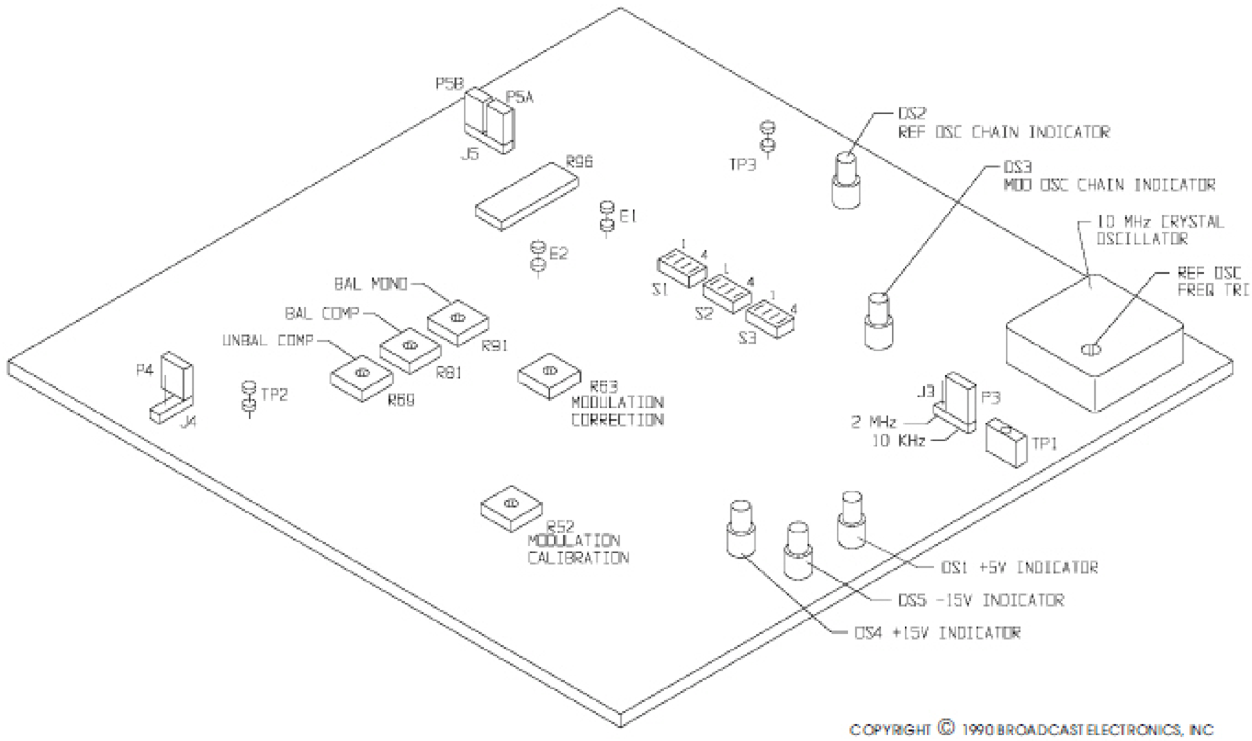


Figure 9-2. AFC/PLL CIRCUIT BOARD CONTROLS AND INDICATORS

WARNING

DISCONNECT PRIMARY POWER TO THE TRANSMITTER BEFORE PROCEEDING.

WARNING

D. Apply primary power and operate the transmitter.

E. Adjust the audio generator for 400 Hz at +10 dBm (2.45V RMS) output.

F. With an insulated adjustment tool, adjust R91 until the voltmeter indicates 2.12V RMS.

G. Disconnect the primary power, remove all test equipment, and replace the top-cover.

9.6.2 BAL COMP (R81).

The BAL COMP level control on the AFC/PLL circuit board adjusts the output level of the balanced composite amplifier circuit. BAL COMP control R81 is adjusted as follows.

Procedure. To adjust BAL COMP control R81, refer to Figure 9-2 as required and proceed as follows:

WARNING

DISCONNECT PRIMARY POWER TO THE TRANSMITTER BEFORE PROCEEDING.

WARNING

A. Disconnect the transmitter primary power.

B. Remove the top-cover and connect an audio generator to the rear-panel BAL COMPOSITE INPUT receptacle.

C. Connect a digital voltmeter to the front-panel COMPOSITE OUT receptacle.

WARNING

DONOT TOUCH ANY COMPONENT WITHIN THE TRANSMITTER WITH POWER APPLIED.

WARNING

D. Apply primary power and operate the transmitter.

E. Adjust the audio generator for 400 Hz at 1.24V RMS output.

F. With an insulated adjustment tool, adjust R81 until the voltmeter indicates 2.12V RMS.

G. Disconnect the primary power, remove all test equipment, and replace the top-cover.

9.6.3 UNBAL COMP (R69).

The UNBAL COMP level control on the AFC/PLL circuit board adjusts the output level of the unbalanced composite amplifier circuit. UNBAL COMP control R69 is adjusted as follows.

Procedure. To adjust UNBAL COMP control R69, refer to Figure 9-2 as required and proceed as follows:

WARNING

DISCONNECT TRANSMITTER PRIMARY POWER BEFORE PROCEEDING.

WARNING

A. Disconnect the transmitter primary power.

B. Remove the top-cover and connect an audio generator to the rear-panel UNBAL COMPOSITE INPUT receptacle.

C. Connect a digital voltmeter to the front-panel COMPOSITE OUT receptacle.

WARNING

DONOT TOUCH ANY COMPONENT WITHIN THE TRANSMITTER WITH POWER APPLIED.

WARNING

D. Apply primary power and operate the transmitter.

E. Adjust the audio generator for 400 Hz at 1.24V RMS output.

F. With an insulated adjustment tool, adjust R69 until the voltmeter indicates 2.12V RMS.

G. Disconnect the primary power, remove all test equipment, and replace the top-cover.

9.6.4 MODULATION CORRECTION (R63).

The MODULATION CORRECTION control on the AFC/PLL circuit board corrects the audio signal prior to application to the modulated oscillator assembly. MODULATION CORRECTION control R63 is adjusted as follows.

Procedure. To adjust MODULATION CORRECTION control R63, refer to Figure 9-2 as required and proceed as follows:

WARNING

DISCONNECT PRIMARY POWER TO THE TRANSMITTER BEFORE PROCEEDING.

WARNING

A. Disconnect the transmitter primary power.

B. Remove the top-cover and connect an audio generator to the front-panel COMPOSITE IN receptacle. Connect a digital voltmeter to the front-panel COMPOSITE OUT receptacle.

C. Connect an FM demodulator to the transmitter RF OUTPUT receptacle through a 20 dB attenuator and a distortion analyzer to the output of the demodulator.

WARNING

DO NOT TOUCH ANY COMPONENT WITHIN THE TRANSMITTER WITH POWER APPLIED.

WARNING

D. Apply primary power and operate the transmitter.

E. Adjust the audio generator for 400 Hz at 2.12V RMS output as indicated on the voltmeter.

F. With an insulated adjustment tool, adjust R63 for minimum THD as indicated on the distortion analyzer.

G. Disconnect the primary power, remove all test equipment, and replace the top-cover.

9.6.5 MODULATION CALIBRATION (R52).

The MODULATION CALIBRATION control on the AFC/PLL circuit board adjusts the transmitter percentage of modulation. MODULATION CALIBRATION control R52 is adjusted as follows.

Procedure. To adjust MODULATION CALIBRATION control R52, refer to Figure 9-2 as required and proceed as follows:

A. Perform the BAL MONO (R91), BAL COMP (R81), and the UNBAL COMP (R69) adjustment procedures.

WARNING

DISCONNECT PRIMARY POWER TO THE TRANSMITTER BEFORE PROCEEDING.

WARNING

B. Disconnect the transmitter primary power.

C. Remove the top-cover and connect an audio generator to the front-panel COMPOSITE IN receptacle. Connect a digital voltmeter to the front-panel COMPOSITE OUT receptacle.

D. Connect an FM demodulator to the transmitter RF OUTPUT receptacle through a 20 dB attenuator.

WARNING

DO NOT TOUCH ANY COMPONENT WITHIN THE TRANSMITTER WITH POWER APPLIED.

WARNING

E. Apply primary power and operate the transmitter.

F. Adjust the audio generator for 400 Hz at 2.12V RMS output as indicated on the voltmeter.

G. With an insulated adjustment tool, adjust R52 for 100% modulation as indicated on the modulation monitor.

H. Disconnect the primary power, remove all test equipment, and replace the top-cover.

9.6.6 REF OSC FREQ TRIM.

The REF OSC FREQ TRIM control on the AFC/PLL circuit board adjusts the reference frequency. The REF OSC FREQ TRIM control is adjusted as follows.

Procedure. To adjust the REF OSC FREQ TRIM control, refer to Figure 9-2 as required and proceed as follows:

WARNING

DISCONNECT TRANSMITTER PRIMARY POWER BEFORE PROCEEDING.

WARNING

A. Disconnect the transmitter primary power.

B. Remove the transmitter top-cover and connect a frequency counter to TP1 on the AFC/ PLL circuit board.

WARNING

DONOT TOUCH ANY COMPONENT WITHIN THE TRANSMITTER WITH POWER APPLIED.

WARNING

C. Apply primary power and operate the transmitter.

D. With an insulated adjustment tool, adjust the REF OSC FREQ TRIM control until the frequency counter indicates 10 MHz ±5 Hz or 2 MHz ±1 Hz depending on programmable jumper J3.

E. Disconnect the primary power, remove all test equipment, and replace the top-cover.

9.6.7 FREQUENCY SELECTION.

The transmitter carrier frequency is established by programmable frequency synthesizer switches S1, S2, and S3 on the AFC/PLL circuit board assembly (refer to Figure 9-3). The position of each switch corresponds to a weighted binary number (refer to Table 9-2).

Table 9-2 lists standard carrier frequencies and corresponding switch binary codes for domestic and European operation. A ”1” in the code represents a switch in the ON position and a ”0” represents a switch in the OFF position. S1, S2, and S3 are programmed as follows.

Procedure. To change the transmitter carrier frequency, proceed as follows.

WARNING

DISCONNECT PRIMARY POWER TO THE TRANSMITTER BEFORE PROCEEDING.

WARNING

A. Disconnect the transmitter primary power.

B. Remove the transmitter top-cover. Refer to Table 9-2 and select the desired frequency and corresponding binary code.

C. Refer to Figure 9-3 and program four-segment switches S1, S2, and S3 for the desired frequency.

D. Replace the top-cover and return the transmitter to service.

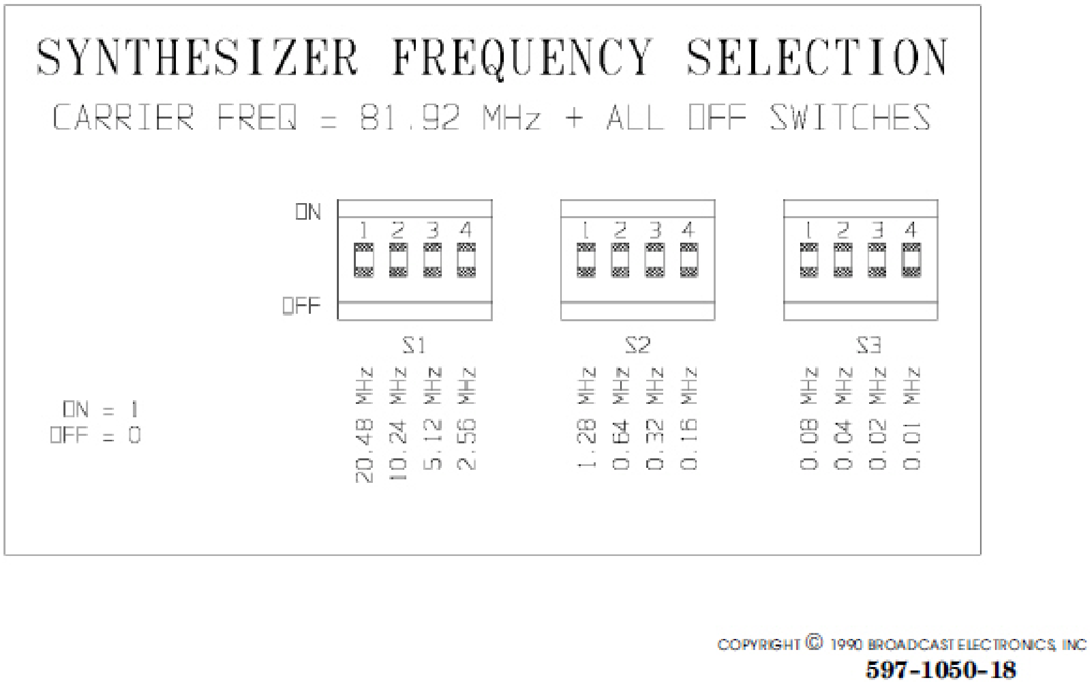


Figure 9-3. FREQUENCY SELECTION

9.6.8 PRE-EMPHASIS SELECTION.

Programmable jumpers P5A and P5B on the AFC/PLL circuit board establish the transmitter pre-emphasis. The transmitter is normally shipped with 75 microsecond pre-emphasis. If required, an alternate pre-emphasis can be selected as follows.

Procedure. To select an alternate pre-emphasis, refer to Figure 9-2 as required and proceed as follows:

WARNING

DISCONNECT TRANSMITTER PRIMARY POWER BEFORE PROCEEDING.

WARNING

A. Disconnect the transmitter primary power.

B. Remove the transmitter top-panel.

C. Refer to the following information and program P5A and P5B as required.

PRE EMPHASIS	P5A	P5B
75 μS	Install	Install
50 μS	Remove	Install
25 μS	Install	Remove

D. Replace the transmitter top-panel.

DOMESTIC

FREQUENCY IN MHZ	SWITCH S1 1 2 3 4	SWITCH S2 1 2 3 4	SWITCH S3 1 2 3 4
87.1	1 1 0 1	1 1 1 1	1 0 0 1
87.3	1 1 0 1	1 1 1 0	0 1 0 1
87.5	1 1 0 1	1 1 0 1	0 0 0 1
87.7	1 1 0 1	1 0 1 1	1 1 0 1
87.9	1 1 0 1	1 0 1 0	1 0 0 1
88.1	1 1 0 1	1 0 0 1	0 1 0 1
88.3	1 1 0 1	1 0 0 0	0 0 0 1
88.5	1 1 0 1	0 1 1 0	1 1 0 1
88.7	1 1 0 1	0 1 0 1	1 0 0 1
88.9	1 1 0 1	0 1 0 0	0 1 0 1
89.1	1 1 0 1	0 0 1 1	0 0 0 1
89.3	1 1 0 1	0 0 0 1	1 1 0 1
89.5	1 1 0 1	0 0 0 0	1 0 0 1
89.7	1 1 0 0	1 1 1 1	0 1 0 1
89.9	1 1 0 0	1 1 1 0	0 0 0 1
90.1	1 1 0 0	1 1 0 0	1 1 0 1
90.3	1 1 0 0	1 0 1 1	1 0 0 1
90.5	1 1 0 0	1 0 1 0	0 1 0 1
90.7	1 1 0 0	1 0 0 1	0 0 0 1
90.9	1 1 0 0	0 1 1 1	1 1 0 1
91.1	1 1 0 0	0 1 1 0	1 0 0 1
91.3	1 1 0 0	0 1 0 1	0 1 0 1
91.5	1 1 0 0	0 1 0 0	0 0 0 1
91.7	1 1 0 0	0 0 1 0	1 1 0 1
91.9	1 1 0 0	0 0 0 1	1 0 0 1
92.1	1 1 0 0	0 0 0 0	0 1 0 1
92.3	1 0 1 1	1 1 1 1	0 0 0 1
92.5	1 0 1 1	1 1 0 1	1 1 0 1
92.7	1 0 1 1	1 1 0 0	1 0 0 1
92.9	1 0 1 1	1 0 1 1	0 1 0 1
93.1	1 0 1 1	1 0 1 0	0 0 0 1
93.3	1 0 1 1	1 0 0 0	1 1 0 1
93.5	1 0 1 1	0 1 1 1	1 0 0 1
93.7	1 0 1 1	0 1 1 0	0 1 0 1
93.9	1 0 1 1	0 1 0 1	0 0 0 1
94.1	1 0 1 1	0 0 1 1	1 1 0 1
94.3	1 0 1 1	0 0 1 0	1 0 0 1
94.5	1 0 1 1	0 0 0 1	0 1 0 1
94.7	1 0 1 1	0 0 0 0	0 0 0 1
94.9	1 0 1 0	1 1 1 0	1 1 0 1
95.1	1 0 1 0	1 1 0 1	1 0 0 1
95.3	1 0 1 0	1 1 0 0	0 1 0 1
95.5	1 0 1 0	1 0 1 1	0 0 0 1
95.7	1 0 1 0	1 0 0 1	1 1 0 1
95.9	1 0 1 0	1 0 0 0	1 0 0 1
96.1	1 0 1 0	0 1 1 1	0 1 0 1
96.3	1 0 1 0	0 1 1 0	0 0 0 1
96.5	1 0 1 0	0 1 0 0	1 1 0 1
96.7	1 0 1 0	0 0 1 1	1 0 0 1
96.9	1 0 1 0	0 0 1 0	0 1 0 1
97.1	1 0 1 0	0 0 0 1	0 0 0 1
97.3	1 0 0 1	1 1 1 1	1 1 0 1
97.5	1 0 0 1	1 1 1 0	1 0 0 1
97.7	1 0 0 1	1 1 0 1	0 1 0 1
97.9	1 0 0 1	1 1 0 0	0 0 0 1

FREQUENCY IN MHZ	SWITCH S1 1 2 3 4	SWITCH S2 1 2 3 4	SWITCH S3 1 2 3 4
98.1	1 0 0 1	1 0 1 0	1 1 0 1
98.3	1 0 0 1	1 0 0 1	1 0 0 1
98.5	1 0 0 1	1 0 0 0	0 1 0 1
98.7	1 0 0 1	0 1 1 1	0 0 0 1
98.9	1 0 0 1	0 1 0 1	1 1 0 1
99.1	1 0 0 1	0 1 0 0	1 0 0 1
99.3	1 0 0 1	0 0 1 1	0 1 0 1
99.5	1 0 0 1	0 0 1 0	0 0 0 1
99.7	1 0 0 1	0 0 0 0	1 1 0 1
99.9	1 0 0 0	1 1 1 1	1 0 0 1
100.1	1 0 0 0	1 1 1 0	0 1 0 1
100.3	1 0 0 0	1 1 0 1	0 0 0 1
100.5	1 0 0 0	1 0 1 1	1 1 0 1
100.7	1 0 0 0	1 0 1 0	1 0 0 1
100.9	1 0 0 0	1 0 0 1	0 1 0 1
101.1	1 0 0 0	1 0 0 0	0 0 0 1
101.3	1 0 0 0	0 1 1 0	1 1 0 1
101.5	1 0 0 0	0 1 0 1	1 0 0 1
101.7	1 0 0 0	0 1 0 0	0 1 0 1
101.9	1 0 0 0	0 0 1 1	0 0 0 1
102.1	1 0 0 0	0 0 0 1	1 1 0 1
102.3	1 0 0 0	0 0 0 0	1 0 0 1
102.5	0 1 1 1	1 1 1 1	0 1 0 1
102.7	0 1 1 1	1 1 1 0	0 0 0 1
102.9	0 1 1 1	1 1 0 0	1 1 0 1
103.1	0 1 1 1	1 0 1 1	1 0 0 1
103.3	0 1 1 1	1 0 1 0	0 1 0 1
103.5	0 1 1 1	1 0 0 1	0 0 0 1
103.7	0 1 1 1	0 1 1 1	1 1 0 1
103.9	0 1 1 1	0 1 1 0	1 0 0 1
104.1	0 1 1 1	0 1 0 1	0 1 0 1
104.3	0 1 1 1	0 1 0 0	0 0 0 1
104.5	0 1 1 1	0 0 1 0	1 1 0 1
104.7	0 1 1 1	0 0 0 1	1 0 0 1
104.9	0 1 1 1	0 0 0 0	0 1 0 1
105.1	0 1 1 0	1 1 1 1	0 0 0 1
105.3	0 1 1 0	1 1 0 1	1 1 0 1
105.5	0 1 1 0	1 1 0 0	1 0 0 1
105.7	0 1 1 0	1 0 1 1	0 1 0 1
105.9	0 1 1 0	1 0 1 0	0 0 0 1
106.1	0 1 1 0	1 0 0 0	1 1 0 1
106.3	0 1 1 0	0 1 1 1	1 0 0 1
106.5	0 1 1 0	0 1 1 0	0 1 0 1
106.7	0 1 1 0	0 1 0 1	0 0 0 1
106.9	0 1 1 0	0 0 1 1	1 1 0 1
107.1	0 1 1 0	0 0 1 0	1 0 0 1
107.3	0 1 1 0	0 0 0 1	0 1 0 1
107.5	0 1 1 0	0 0 0 0	0 0 0 1
107.7	0 1 0 1	1 1 1 0	1 1 0 1
107.9	0 1 0 1	1 1 0 1	1 0 0 1
108.1	0 1 0 1	1 1 0 0	0 1 0 1
108.3	0 1 0 1	1 0 1 1	0 0 0 1
108.5	0 1 0 1	1 0 0 1	1 1 0 1
108.7	0 1 0 1	1 0 0 0	1 0 0 1
108.9	0 1 0 1	0 1 1 1	0 1 0 1

EUROPEAN

FREQUENCY IN MHZ	SWITCH S1 1 2 3 4	SWITCH S2 1 2 3 4	SWITCH S3 1 2 3 4
87.2	1 1 0 1	1 1 1 0	1 1 1 1
87.4	1 1 0 1	1 1 0 1	1 0 1 1
87.6	1 1 0 1	1 1 0 0	0 1 1 1
87.8	1 1 0 1	1 0 1 1	0 0 1 1
88.0	1 1 0 1	1 0 0 1	1 1 1 1
88.2	1 1 0 1	1 0 0 0	1 0 1 1
88.4	1 1 0 1	0 1 1 1	0 1 1 1
88.6	1 1 0 1	0 1 1 0	0 0 1 1
88.8	1 1 0 1	0 1 0 0	1 1 1 1
89.0	1 1 0 1	0 0 1 1	1 0 1 1
89.2	1 1 0 1	0 0 1 0	0 1 1 1
89.4	1 1 0 1	0 0 0 1	0 0 1 1
89.6	1 1 0 0	1 1 1 1	1 1 1 1
89.8	1 1 0 0	1 1 1 0	1 0 1 1
90.0	1 1 0 0	1 1 0 1	0 1 1 1
90.2	1 1 0 0	1 1 0 0	0 0 1 1
90.4	1 1 0 0	1 0 1 0	1 1 1 1
90.6	1 1 0 0	1 0 0 1	1 0 1 1
90.8	1 1 0 0	1 0 0 0	0 1 1 1
91.0	1 1 0 0	0 1 1 1	0 0 1 1
91.2	1 1 0 0	0 1 0 1	1 1 1 1
91.4	1 1 0 0	0 1 0 0	1 0 1 1
91.6	1 1 0 0	0 0 1 1	0 1 1 1
91.8	1 1 0 0	0 0 1 0	0 0 1 1
92.0	1 1 0 0	0 0 0 0	1 1 1 1
92.2	1 0 1 1	1 1 1 1	1 0 1 1
92.4	1 0 1 1	1 1 1 0	0 1 1 1
92.6	1 0 1 1	1 1 0 1	0 0 1 1
92.8	1 0 1 1	1 0 1 1	1 1 1 1
93.0	1 0 1 1	1 0 1 0	1 0 1 1
93.2	1 0 1 1	1 0 0 1	0 1 1 1
93.4	1 0 1 1	1 0 0 0	0 0 1 1
93.6	1 0 1 1	0 1 1 0	1 1 1 1
93.8	1 0 1 1	0 1 0 1	1 0 1 1
94.0	1 0 1 1	0 1 0 0	0 1 1 1
94.2	1 0 1 1	0 0 1 1	0 0 1 1
94.4	1 0 1 1	0 0 0 1	1 1 1 1
94.6	1 0 1 1	0 0 0 0	1 0 1 1
94.8	1 0 1 0	1 1 1 1	0 1 1 1
95.0	1 0 1 0	1 1 1 0	0 0 1 1
95.2	1 0 1 0	1 1 0 0	1 1 1 1
95.4	1 0 1 0	1 0 1 1	1 0 1 1
95.6	1 0 1 0	1 0 1 0	0 1 1 1
95.8	1 0 1 0	1 0 0 1	0 0 1 1
96.0	1 0 1 0	0 1 1 1	1 1 1 1
96.2	1 0 1 0	0 1 1 0	1 0 1 1
96.4	1 0 1 0	0 1 0 1	0 1 1 1
96.6	1 0 1 0	0 1 0 0	0 0 1 1
96.8	1 0 1 0	0 0 1 0	1 1 1 1
97.0	1 0 1 0	0 0 0 1	1 0 1 1
97.2	1 0 1 0	0 0 0 0	0 1 1 1
97.4	1 0 0 1	1 1 1 1	0 0 1 1
97.6	1 0 0 1	1 1 0 1	1 1 1 1
97.8	1 0 0 1	1 1 0 0	1 0 1 1
98.0	1 0 0 1	1 0 1 1	0 1 1 1

FREQUENCY IN MHZ	SWITCH S1 1 2 3 4	SWITCH S2 1 2 3 4	SWITCH S3 1 2 3 4
98.2	1 0 0 1	1 0 1 0	0 0 1 1
98.4	1 0 0 1	1 0 0 0	1 1 1 1
98.6	1 0 0 1	0 1 1 1	1 0 1 1
98.8	1 0 0 1	0 1 1 0	0 1 1 1
99.0	1 0 0 1	0 1 0 1	0 0 1 1
99.2	1 0 0 1	0 0 1 1	1 1 1 1
99.4	1 0 0 1	0 0 1 0	1 0 1 1
99.6	1 0 0 1	0 0 0 1	0 1 1 1
99.8	1 0 0 1	0 0 0 0	0 0 1 1
100.0	1 0 0 0	1 1 1 0	1 1 1 1
100.2	1 0 0 0	1 1 0 1	1 0 1 1
100.4	1 0 0 0	1 1 0 0	0 1 1 1
100.6	1 0 0 0	1 0 1 1	0 0 1 1
100.8	1 0 0 0	1 0 0 1	1 1 1 1
101.0	1 0 0 0	1 0 0 0	1 0 1 1
101.2	1 0 0 0	0 1 1 1	0 1 1 1
101.4	1 0 0 0	0 1 1 0	0 0 1 1
101.6	1 0 0 0	0 1 0 0	1 1 1 1
101.8	1 0 0 0	0 0 1 1	1 0 1 1
102.0	1 0 0 0	0 0 1 0	0 1 1 1
102.2	1 0 0 0	0 0 0 1	0 0 1 1
102.4	0 1 1 1	1 1 1 1	1 1 1 1
102.6	0 1 1 1	1 1 1 0	1 0 1 1
102.8	0 1 1 1	1 1 0 1	0 1 1 1
103.0	0 1 1 1	1 1 0 0	0 0 1 1
103.2	0 1 1 1	1 0 1 0	1 1 1 1
103.4	0 1 1 1	1 0 0 1	1 0 1 1
103.6	0 1 1 1	1 0 0 0	0 1 1 1
103.8	0 1 1 1	0 1 1 1	0 0 1 1
104.0	0 1 1 1	0 1 0 1	1 1 1 1
104.2	0 1 1 1	0 1 0 0	1 0 1 1
104.4	0 1 1 1	0 0 1 1	0 1 1 1
104.6	0 1 1 1	0 0 1 0	0 0 1 1
104.8	0 1 1 1	0 0 0 0	1 1 1 1
105.0	0 1 1 0	1 1 1 1	1 0 1 1
105.2	0 1 1 0	1 1 1 0	0 1 1 1
105.4	0 1 1 0	1 1 0 1	0 0 1 1
105.6	0 1 1 0	1 0 1 1	1 1 1 1
105.8	0 1 1 0	1 0 1 0	1 0 1 1
106.0	0 1 1 0	1 0 0 1	0 1 1 1
106.2	0 1 1 0	1 0 0 0	0 0 1 1
106.4	0 1 1 0	0 1 1 0	1 1 1 1
106.6	0 1 1 0	0 1 0 1	1 0 1 1
106.8	0 1 1 0	0 1 0 0	0 1 1 1
107.0	0 1 1 0	0 0 1 1	0 0 1 1
107.2	0 1 1 0	0 0 0 1	1 1 1 1
107.4	0 1 1 0	0 0 0 0	1 0 1 1
107.6	0 1 0 1	1 1 1 1	0 1 1 1
107.8	0 1 0 1	1 1 1 0	0 0 1 1
108.0	0 1 0 1	1 1 0 0	1 1 1 1
108.2	0 1 0 1	1 0 1 1	1 0 1 1
108.4	0 1 0 1	1 0 1 0	0 1 1 1
108.6	0 1 0 1	1 0 0 1	0 0 1 1
108.8	0 1 0 1	0 1 1 1	1 1 1 1
109.0	0 1 0 1	0 1 1 0	1 0 1 1

597-1050-19

Table 9-2. FREQUENCY SYNTHESIZER PROGRAMMING

9.7 TROUBLESHOOTING.

The troubleshooting philosophy for the AFC/PLL circuit board consists of isolating a problem to a specific circuit. The problem may be further isolated by referencing the following information and Figure 9-4 and Figure 9-5 which present troubleshooting information.

WARNING

DISCONNECT PRIMARY POWER FROM THE TRANSMITTER BEFORE REMOVING OR REPLACING ANY COMPONENTS.

WARNING

CAUTION

CAUTION

INADVERTENT CONTACT BETWEEN ADJACENT COMPONENTS AND CIRCUIT TRACES MAY DAMAGE THE AFC/PLL BOARD.

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

9.8 REMOVAL AND INSTALLATION

This section provides removal and installation procedures for the AFC/PLL circuit board assembly.

9.8.1 REMOVAL PROCEDURE.

REQUIRED EQUIPMENT. A number 2 Phillips screwdriver with a 4 inch (10.16 cm) shaft is required to remove the AFC/PLL circuit board assembly from the transmitter chassis.

PROCEDURE. The removal of the AFC/PLL circuit board assembly requires the unit be placed on a suitable work surface. To remove the circuit board, proceed as follows:

WARNING

DISCONNECT TRANSMITTER PRIMARY POWER BEFORE PROCEEDING.

WARNING

A. Disconnect the primary power to the transmitter.

B. Remove the transmitter top-cover. Disconnect J1, J2, and J8 from the AFC/PLL circuit board.

C. Disconnect RF sample BNC connector P6 from the output of the modulated oscillator assembly.

D. Remove the four screws securing the AFC/PLL cover to the circuit board. Remove the cover and the ground straps.

E. Remove the four screws securing the AFC/PLL circuit board to the transmitter chassis and remove the circuit board.

9.8.2 INSTALLATION PROCEDURE.

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

WARNING

DISCONNECT TRANSMITTER PRIMARY POWER BEFORE PROCEEDING.

WARNING

A. Disconnect the primary power to the transmitter.

B. Follow the REMOVAL PROCEDURE in reverse order.

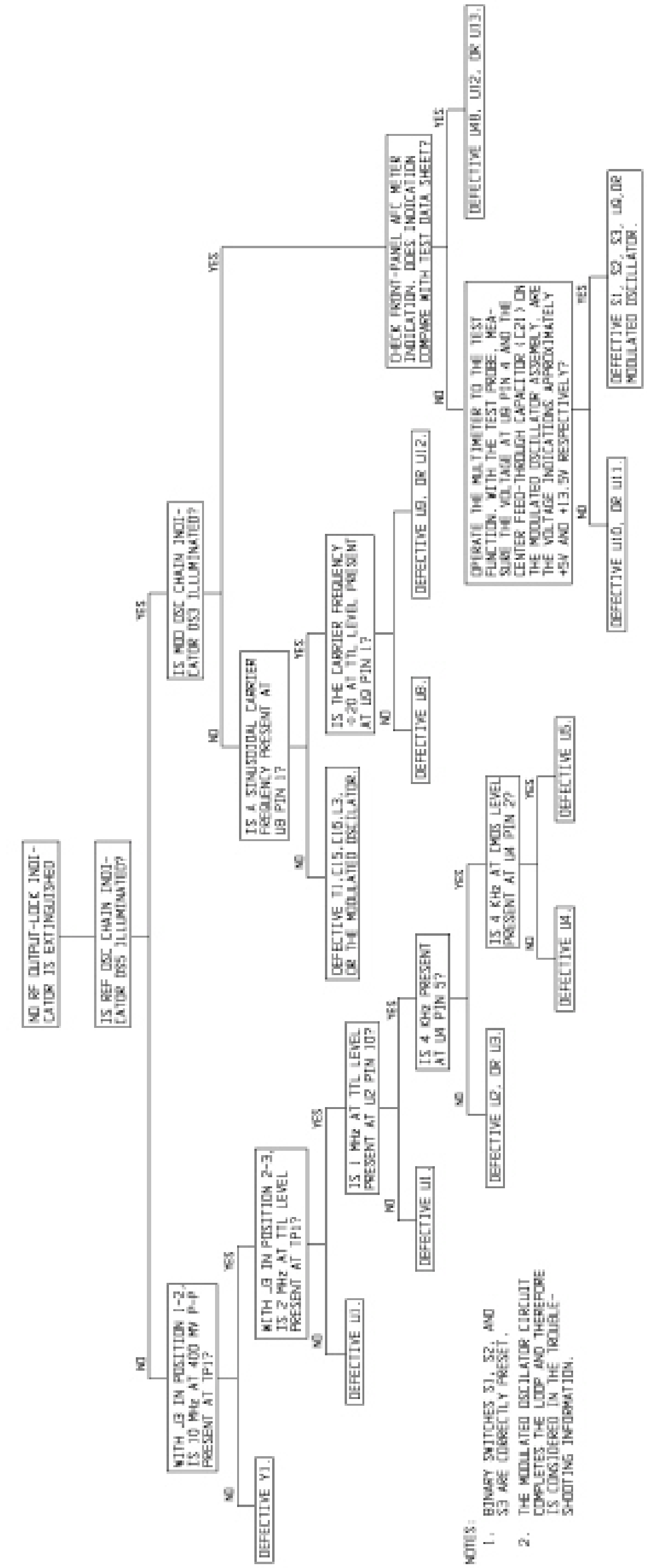


Figure 9-4. NO RF OUTPUT-LOCK IS EXTINGUISHED.

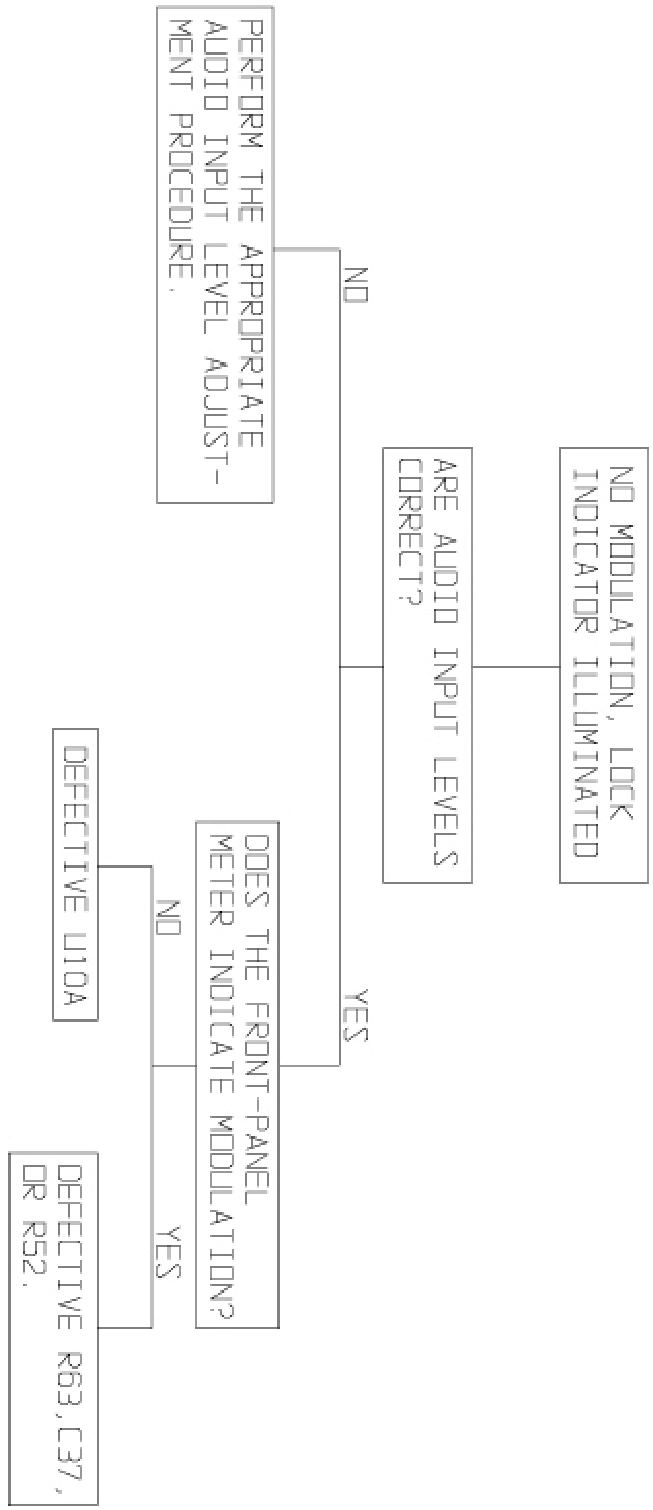


Figure 9-5. NO MODULATION, LOCK INDICATOR ILLUMINATED.

10 RF Amplifier

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

10.1 DESCRIPTION.

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

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

10.2 ELECTRICAL SPECIFICATIONS.

Refer to Table 10-1 for electrical specifications of the RF amplifier assembly.

Table 10-1. RF Amplifier Electrical Specifications

PARAMETER	SPECIFICATIONS
SIGNAL LEVELS:	
RF AMPLIFIER	
INPUT	1 mW dBm at 50 Ohms.
OUTPUT	25 to 250 Watts RF at 50 Ohms (adjustable).
DIRECTIONAL COUPLER OUTPUT	
FORWARD	3V DC = 250 Watts.
REFLECTED	0.75V DC = 10 Watts.

10.3 THEORY OF OPERATION

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

10.3.1 RF AMPLIFIER ASSEMBLY DESCRIPTION.

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

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

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

A simplified schematic diagram of the RF amplifier circuit board is presented in Figure 10-1. Refer to Figure 10-1 as required for a description of the following circuit boards:

A. RF amplifier input circuit board.

B. RF amplifier output circuit board.

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

10.3.2 RF AMPLIFIER INPUT CIRCUIT BOARD.

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

INPUT AMPLIFIER. The input amplifier consists of thick-film hybrid amplifier U1, and re-sistor pad R6 and R7. A 1 milliwatt RF input signal from the modulated oscillator is input to U1. This stage provides approximately 1 watt of output power across R6 and R7 to the following stage.

Input amplifier U1 operates from a dc potential of +20 volts which is routed through input mute transistor Q3. Inductor L1 and capacitors C7 and C8 provide power supply isolation.

DRIVER AMPLIFIER. The driver amplifier consists of transistor Q1, an impedance matching network, resistor R8, and inductor L3. The matching network converts the output of U1 to the low input impedance required by Q1. This stage provides approximately 8 watts of output power to the following stage. L3 provides a dc return path for Q1. R8 en-sures stable amplifier operation. Capacitors C43/C18 and microstrip inductor SL3 match the output impedance of Q1 to the input impedance of the next amplifier stage.

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

INPUT MUTE CIRCUIT. The input mute circuit consists of transistors Q2 and Q3. During normal operation, +20 volts is routed to input amplifier U1 through Q3. When the trans-mitter is muted, the final PAV supply is terminated. The loss of this potential will bias Q2 OFF and disable Q3 which terminates the +20 volts to U1.

10.3.3 RF AMPLIFIER OUTPUT CIRCUIT BOARD.

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

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

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

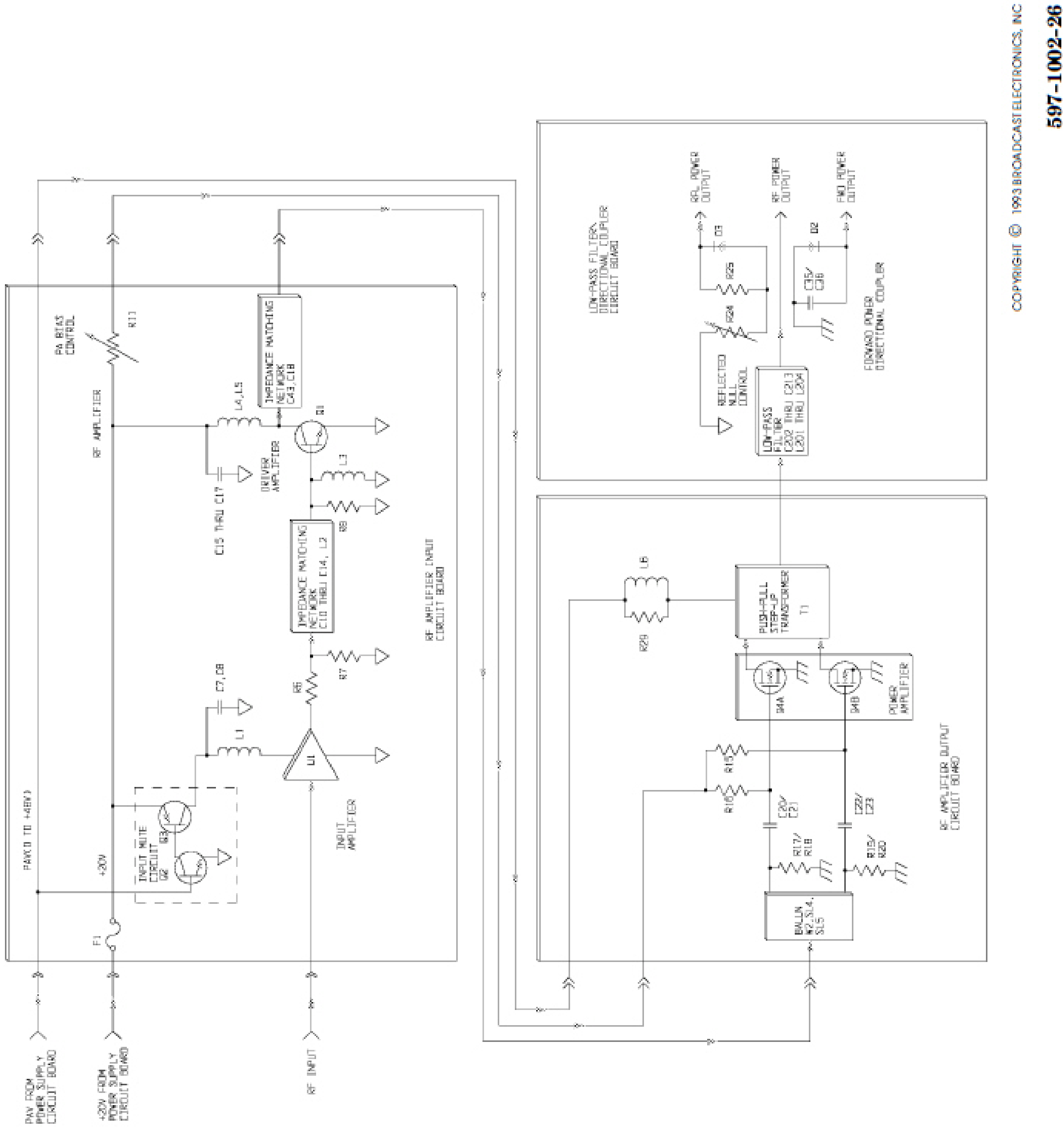


Figure 10-1. RF AMPLIFIER SIMPLIFIED SCHEMATIC

10.3.4 LOWPASS FILTER/DIRECTIONAL COUPLER CIRCUIT BOARD.

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

10.3.5 DIRECTIONAL COUPLER CIRCUITS.

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

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

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

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

10.4 POWER SUPPLY CIRCUIT BOARD DESCRIPTION.

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

10.4.1 POWER AMPLIFIER VOLTAGE SWITCHING SUPPLY CIRCUIT.

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

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

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

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

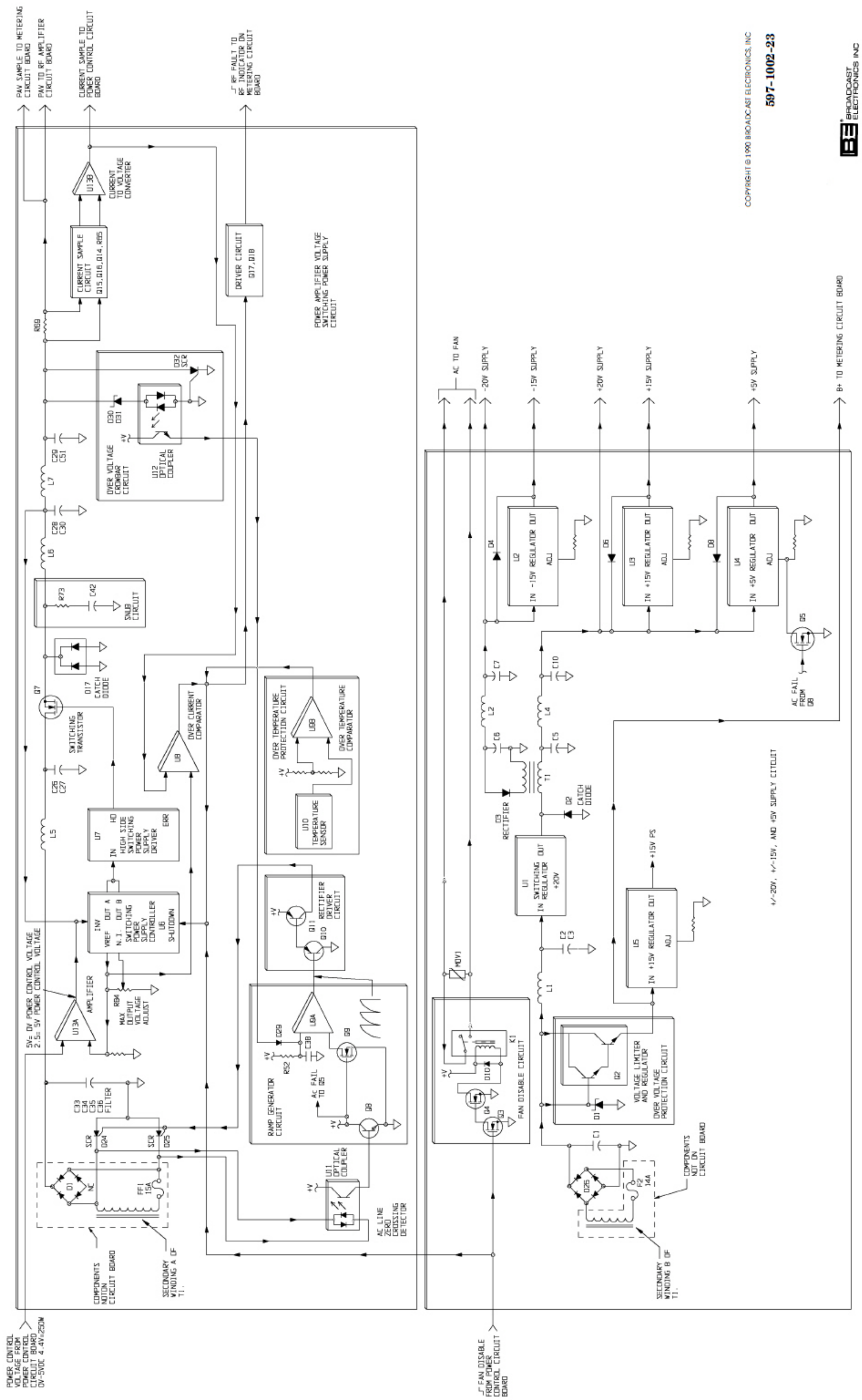


Figure 10-2. POWER SUPPLY CIRCUIT BOARD SIMPLIFIED SCHEMATIC

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

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

OVER CURRENT PROTECTION CIRCUIT. A sample voltage from current-voltage converter U13B is applied to over current comparator U8. U8 compares the sample to the PA voltage control signal. If the sample increases above the PA voltage control signal, U8A will output a HIGH. The HIGH is applied to the shutdown pin of U6 to momentarily terminate circuit operation and to illuminate the RF indicator on the metering circuit board assembly. The momentary termination is designed to allow the fault condition to be re-moved and restart circuit operation by initiating a soft-start cycle.

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

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

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

10.4.2 ±20V, ±15V, AND +5V POWER SUPPLY CIRCUIT.

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

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

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

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

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

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

10.4.3 FAN DISABLE CIRCUIT.

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

10.5 MAINTENANCE

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

10.5.1 ELECTRICAL ADJUSTMENTS.

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

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

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

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

10.5.2 RFL NULL (R208).

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

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

WARNING

DISCONNECT THE PRIMARY POWER
TO THE TRANSMITTER BEFORE PROCEEDING.

WARNING

A. Disconnect the transmitter primary power.

B. Remove the transmitter top-cover and the access hole plug at the top and rear of the RF amplifier assembly (refer to Figure 10-3).

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

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

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

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

WARNING

WARNING

USE AN INSULATED TOOL FOR ADJUSTMENT.

WARNING

F. Refer to Figure 10-3 and adjust R208 for minimum reflected power as indicated on the front-panel meter.

WARNING

DISCONNECT THE PRIMARY POWER TO THE TRANSMITTER BEFORE PROCEEDING.

WARNING

G. Disconnect the transmitter primary power.

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

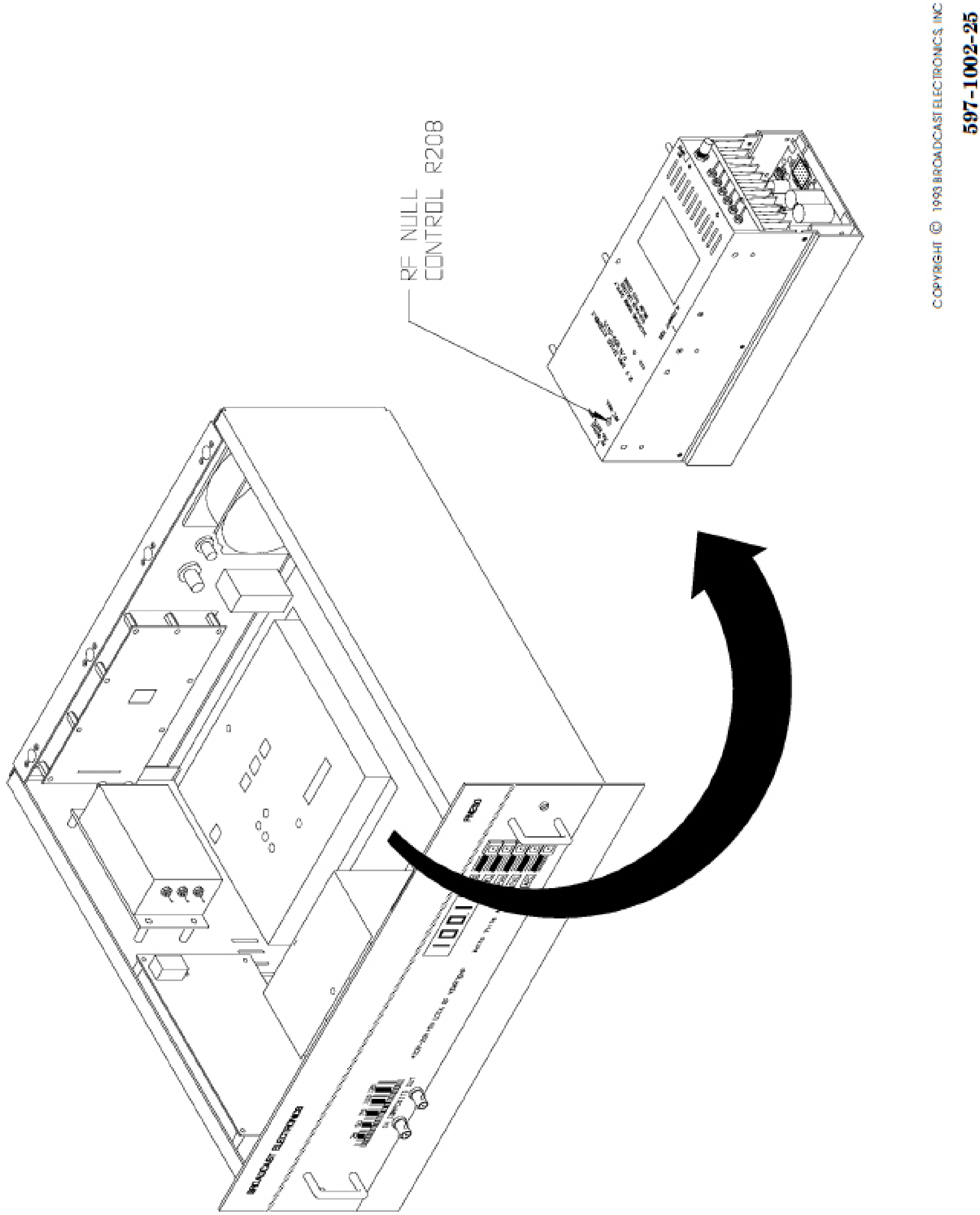


Figure 10-3. RF AMPLIFIER CIRCUIT BOARD CONTROLS.

10.5.3 PA BIAS (R11).

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

10.5.4 POWER SUPPLY CIRCUIT BOARD ELECTRICAL ADJUSTMENTS.

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

10.6 TROUBLESHOOTING.

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

WARNING

POWER AMPLIFIER MODULE TROUBLESHOOTING/REPAIR. An RF amplifier assembly problem may be isolated by referencing Figure 10-4 which presents troubleshooting information for the RF amplifier assembly. If the problem is isolated to the power amplifier module, the module requires specialized equipment for troubleshooting and repair operations. Therefore, most power amplifier module troubleshooting and repair cannot be performed in the field. If the power amplifier module is determined to be defective, the module may be exchanged (refer to Power Amplifier Module Exchange program in the following text).

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

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

WARNING

POWER SUPPLY CIRCUIT BOARD TROUBLESHOOTING/REPAIR. Do to the hazardous voltages present on the power supply circuit board with the RF amplifier assembly removed, all power supply circuit board troubleshooting must be performed using a digital voltmeter and resistance checks. Table 10-2 presents troubleshooting information for the power supply circuit board. Refer to Table 10-2 as required for troubleshooting information.

WARNING

DISCONNECT THE PRIMARY POWER TO THE TRANSMITTER BEFORE PROCEEDING.

WARNING

CAUTION

CAUTION

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

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

Table 10-2. POWER SUPPLY CIRCUIT BOARD TROUBLESHOOTING

SYMPTOM	CIRCUITRY TO CHECK
NO P.A. VOLTAGE	9. Check the crowbar circuit. Reset the crowbar circuit by: 1) operating the rear-panel ON/OFF switch to OFF for approximately 1 second and 2) then operate the unit to ON. 10. Check the power supply circuit for thermal, over-current, or crowbar shutdown. For thermal shutdown, check the fan and allow the circuit board to cool. For over-current shutdown, check for short circuit or low AC line-voltage conditions, For crowbar shutdown, operate the unit to OFF for approximately 1 second and then operate the unit to ON. 11. Operate a digital multi-meter to diode check and place the leads on the source and drain of Q7. a. If Q7 is shorted, replace Q7. b. If Q7 is not shorted, replace U6 and U7 c. If no P.A. voltage is present, contact the Broadcast Electronics Technical Services Department.
NO +20V, +15V, AND +5V SUPPLY	6. Check U1, D2, C5, C10, T1, and L4.
NO +15V SUPPLY	4. Check U3.
NO +5V SUPPLY	2. Check U4.
NO -20V AND -15V SUPPLY	2. Check T1, C6, C7, and L2.
NO -15V SUPPLY	2. Check U2.
NO UNDER VOLTAGE SHUTDOWN	1. Check D11, D12, Q5, and Q6.
NO OVER VOLTAGE SHUTDOWN	1. Check D30, D31, D32, and U12.
NO OVER CURRENT SHUTDOWN	1. Check U8.

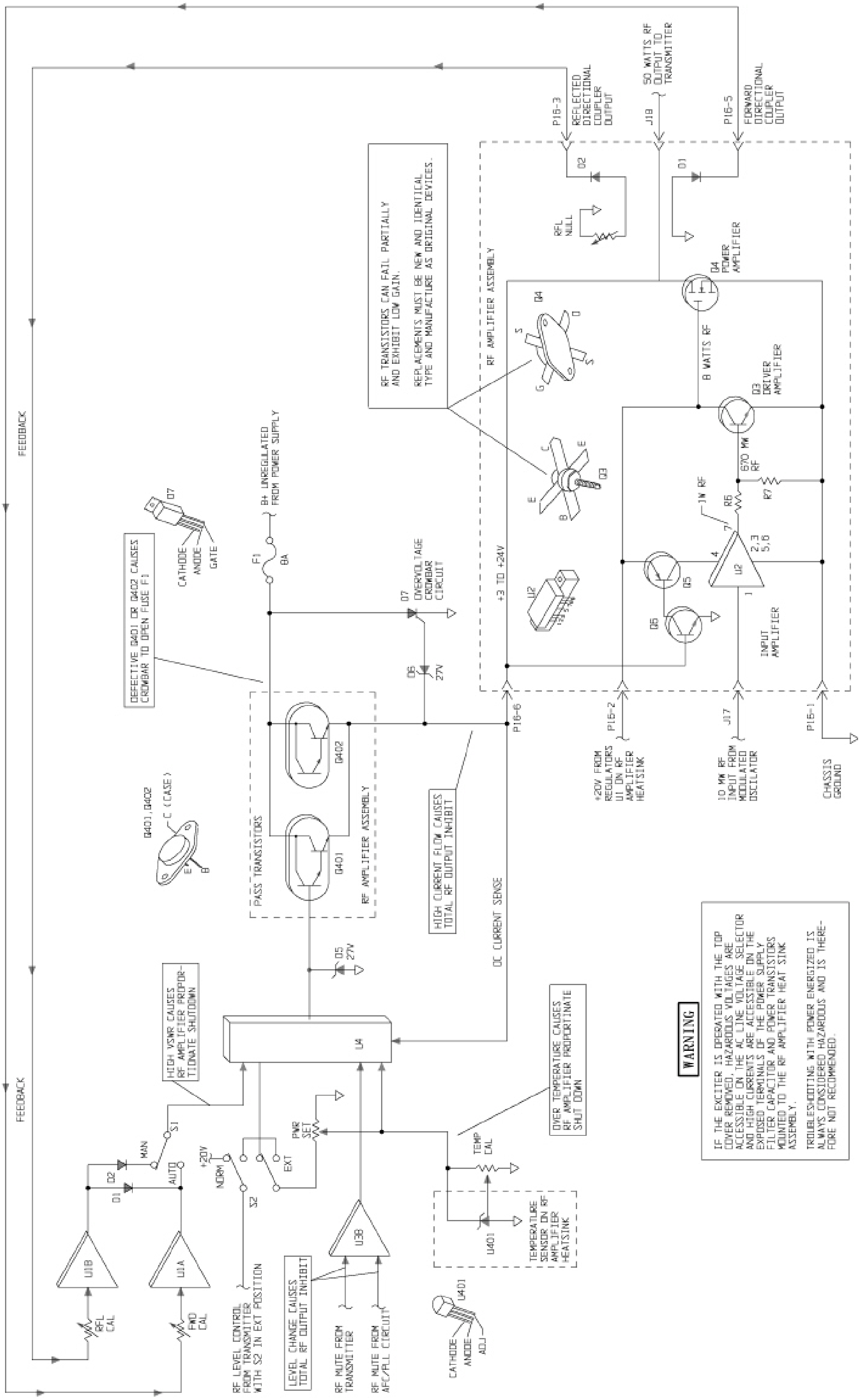


Figure 10-4. RF AMPLIFIER TROUBLESHOOTING INFORMATION.

10.7 RF AMPLIFIER REMOVAL AND INSTALLATION

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

10.7.1 REMOVAL PROCEDURE.

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

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

WARNING

DISCONNECT TRANSMITTER PRIMARY POWER BEFORE PROCEEDING.

WARNING

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

10.7.2 RF AMPLIFIER INSTALLATION PROCEDURE.

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

WARNING

DISCONNECT TRANSMITTER PRIMARY POWER BEFORE PROCEEDING.

WARNING

A. Disconnect the primary power from the transmitter.

B. Follow the REMOVAL PROCEDURE in reverse order.

10.8 POWER SUPPLY REMOVAL PROCEDURE.

10.8.1 REMOVAL PROCEDURE.

The power supply is located in the RF amplifier assembly. To remove the RF amplifier and the power supply, refer to Figure 10-5 and proceed as follows:

Remove the RF amplifier assembly as follows:

WARNING

DISCONNECT TRANSMITTER PRIMARY POWER BEFORE PROCEEDING.

WARNING

A. Disconnect the primary power from the transmitter.

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

Remove the power supply as follows:

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

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

POWER SUPPLY INSTALLATION PROCEDURE - NEW REPLACEMENT ASSEMBLY

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

WARNING

DISCONNECT TRANSMITTER PRIMARY POWER BEFORE PROCEEDING.

WARNING

A. Disconnect the primary power to the transmitter.

B. Follow the REMOVAL PROCEDURE in reverse order.

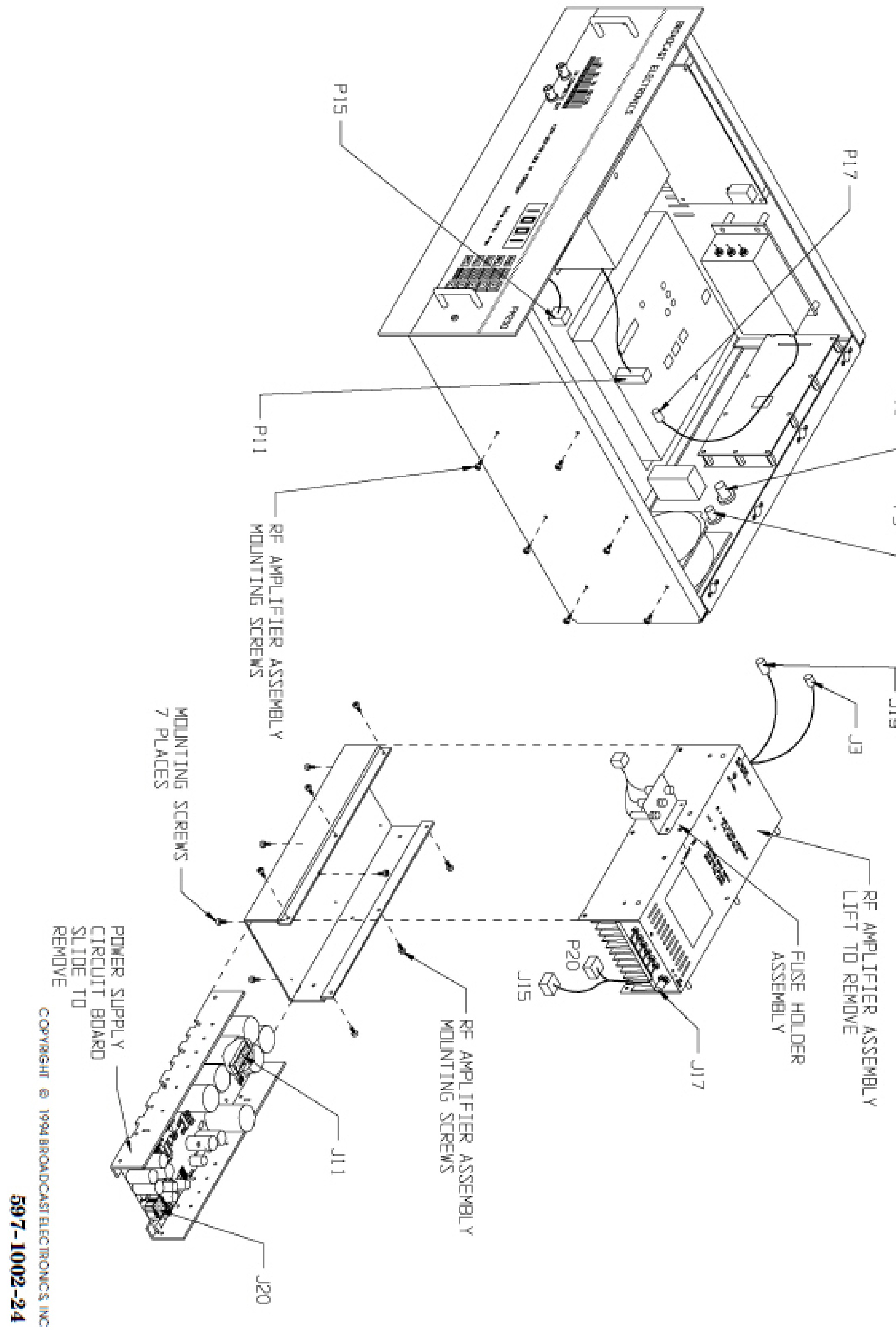


Figure 10-5. RF AMPLIFIER ASSEMBLY/POWER SUPPLY CIRCUIT BOARD REMOVAL.

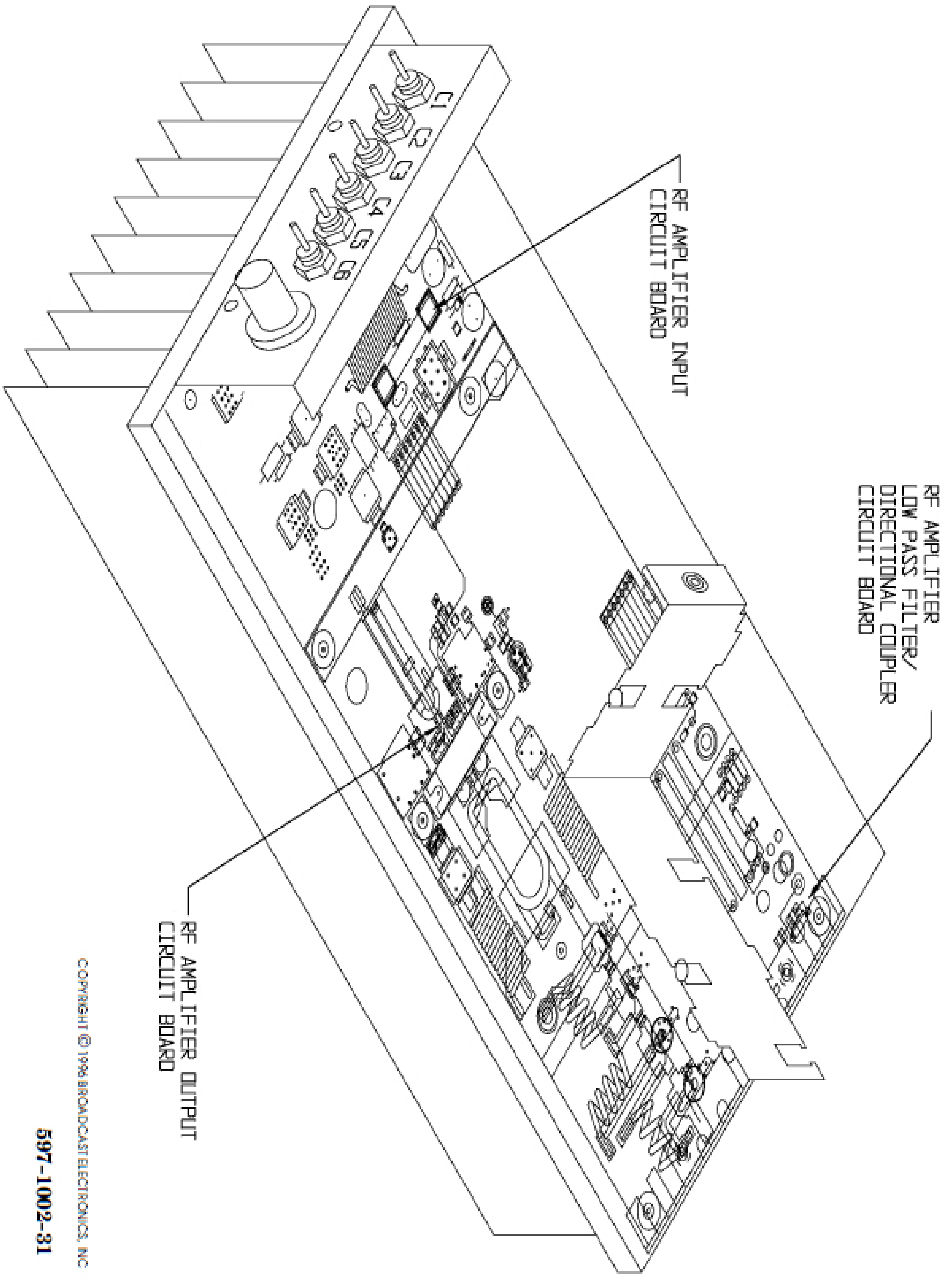


Figure 10-6. RF AMPLIFIER ASSEMBLY

11 Synchronous FM Booster

This section provides general information and specifications relative to operation of the optional synchronous FM booster system.

11.1 SYSTEM DESCRIPTION.

The synchronous FM booster system is designed to provide precise and reliable frequency locking of one or more slave FM-250C/E transmitter to a master FM-250C/E transmitter. The system features a plug-in circuit board installed in the master transmitter which generates a reference signal. This signal is transmitted to a similar circuit board installed in the slave transmitter at the booster site to synchronize a 10 MHz voltage controlled crystal oscillator (VCXO).

If transmission of the reference signal is interrupted or lost, a clamping circuit on the slave circuit board will operate to stabilize the 10 MHz VCXO. The slave transmitter will continue to operate reliably and well within the assigned frequency range.

11.2 SYSTEM CONFIGURATIONS.

The optional synchronous FM booster circuit boards may be ordered in the following con figurations:

MODEL NO.	PART NUMBER	DESCRIPTION
FM-250C/E	909-0131	Master synchronous FM booster circuit board for the FM-250C/E transmitter, factory installed.
FM-250C/E	909-0132	Slave synchronous FM booster circuit board for the FM-250C/E transmitter, factory installed.

11.3 ELECTRICAL SPECIFICATIONS.

Refer to Table 11-1 for synchronous FM booster system electrical specifications.

Table 11-1. SYNCHRONOUS FM BOOSTER SYSTEM SPECIFICATIONS

PARAMETER	SPECIFICATION
POWER REQUIREMENTS	-20V and +5V supplied by the FM-250C transmitter Power Supply/Control Circuit Board.
REFERENCE FREQUENCIES	
STANDARD	125 kHz, $\pm$0.375 Hz, 0° to 50°C, for STL Subcarrier.
ALTERNATES	100 kHz for Omega International Synchronous Repeater Systems or 90.909 kHz for Composite Subcarrier.
REFERENCE SIGNALS	
INPUT	
LEVEL	500mV to 5V p-p.
IMPEDANCE	100k Ohms, Resistive.

OUTPUT	
LEVEL	-10 to 0 dBM, with 600 Ohm load, Unbalanced, Resistive.
IMPEDANCE	600 Ohms, Resistive.
FREQUENCY STABILITY:	
MASTER	Carrier Frequency ±300 HZ, 0° TO 50°C.
SLAVE	Carrier Frequency ±300 Hz When Locked to Master. Carrier Frequency ±1000 Hz When Unlocked from Master, 0° to 50°C.

11.4 INSTALLATION

This section contains information required for installation of the Broadcast Electronics synchronous FM booster system.

This procedure is specifically for field installation kits. To install the master or slave circuit board, refer to the following information and sheet 2 of assembly drawing 909-0131, as required.

WARNING

DISCONNECT THE PRIMARY POWER TO THE TRANSMITTER BEFORE PROCEEDING.

WARNING

A. Disconnect the primary power to the transmitter.
B. Remove the transmitter top-cover. Disconnect J1, J2, and J8 from the AFC/PLL assembly.
C. Remove the four screws securing the AFC/PLL assembly cover to the circuit board. Remove the cover and ground strap.
D. Secure two card guides to the AFC/PLL assembly cover using the hardware provided.
E. Install two ribbon cable press clips on the side of the AFC/PLL assembly cover.
F. Remove and discard integrated circuit U1 from the AFC/PLL circuit board.
G. Align pin 1 of the ribbon cable connector with pin 1 of socket XU1 and insert into the socket.
H. Install the AFC/PLL assembly cover and ground strap with the hardware provided.
I. Install the booster circuit board into J1 on the AFC/PLL assembly.
J. Route the ribbon cable through the two press clips and connect to J10 on the booster circuit board.
K. Connect P1 to J1 on the booster circuit board.
L. Connect P8 to J8, and P2 to J2 on the AFC/PLL assembly.

A partially assembled three conductor cable with 5 position connector P12 will interconnect between the power supply/control circuit board and the booster circuit board. The termination of wires 81, 82, and 83 of this cable assembly is as follows.

A. Remove P13 from J13 on the power supply/control circuit board.

B. Insert wire NO. 81 into P13 pin 6.

C. Insert wire NO. 82 into P13 pin 12.

D. Insert wire NO. 83 into P13 pin 3.

M. Connect P13 to J13 on the power supply/control circuit board.
N. Connect P12 to J12 on the booster circuit board. Replace the transmitter top-cover.

11.5 INSTALLATION ADJUSTMENTS.

11.5.1 OUTPUT LEVEL ADJUSTMENT (R26).

Potentiometer R26 on the slave circuit board is adjusted fully clockwise. R26 on the master circuit board adjusts the output level from -10 to 0 dBM. To adjust R26 on the master circuit board, proceed as follows.

WARNING

DISCONNECT THE PRIMARY POWER TO THE TRANSMITTER BEFORE PROCEEDING.

WARNING

Disconnect the transmitter primary power.

Remove the top-cover and connect a 600 Ohm load and oscilloscope to the FM-250C rear panel SUB-1 connector.

Apply primary power to the transmitter.

WARNING

DO NOT TOUCH ANY COMPONENT WITHIN THE TRANSMITTER WITH POWER APPLIED.

WARNING

Refer to Figure 11-3, and adjust R26 for the level required by the transmission equipment.

Remove the test equipment and replace the top-cover.

11.6 THEORY OF OPERATION

This section presents the theory of operation for the Broadcast Electronics optional synchronous FM booster system.

11.6.1 FUNCTIONAL DESCRIPTION.

The synchronous FM booster system consists of: 1) a master circuit board which generates a reference frequency, and 2) a slave circuit board which locks to the reference frequency.

The master and slave circuit boards are plug-in modules which interface with the AFC/ PLL circuit board in the FM-250Ctransmitter.

11.6.2 SLAVE CIRCUIT BOARD.

Figure 11-1 presents a simplified schematic of the slave synchronous FM booster circuit board. Refer to Figure 11-1 as required for the following functional description.

A reference frequency is routed to input amplifier U7 from the transmitter rear-panel SUB-1 connector through programmable jumpers J3 and J4. After amplification, the output of U7 is input to a band-pass filter to remove any low frequency components. The output of the band-pass filter is applied to amplifier U8 through level control R26.

The sinusoidal output of U8 is applied to U1 which will convert the signal to a square wave for application to phase comparator U2. When this signal and a signal from one shot U6B are compared, a correction voltage is generated and applied to a reference filter network.

The reference filter network consisting of U3A and U3B removes the reference frequency component from the signal to provide a dc correction voltage to 10 MHz voltage controlled crystal oscillator Y1. The output of Y1 varies in response to the correction voltage and is applied to divide-by-ten counter U4 through programmable jumper J5.

The output of U4 provides a 1 MHz signal to the AFC/PLL circuit board and to programmable counter U5. Depending on the position of programmable jumper J11, U5 will divide 1 MHz by 8, 10, or 11. The output of U5 is applied to phase comparator U2 through one shot U6B which operates as a pulse stretcher. Duty cycle control R20 adjusts the width of the pulse.

PROTECTION CIRCUITRY. Resistors R34 and R35 operate as a voltage divider network. If phase comparator U2 fails, a clamping voltage of approximately +1.7 volts will be applied to U3A through diode D2 to maintain the output range of the VCXO within accept able limits.

If loss of reference frequency occurs, the output pulse of phase comparator U2 will exhibit a 50% duty cycle. This will generate +2.5 volts to maintain the output frequency of the VCXO at a constant 10 MHz.

11.6.3 MASTER CIRCUIT BOARD.

Figure 11-2 presents a simplified schematic of the master synchronous FM booster circuit board. Refer to Figure 11-2 as required for the following functional description.

The 10 MHz reference frequency from the AFC/PLL circuit board is applied to divide-by ten counter U4 through programmable jumper J5. The output of U4 provides a 1 MHz signal to programmable counter U5 and the AFC/PLL circuit board. Depending on the position of programmable jumper J11, U5 will divide the 1 MHz signal to provide a frequency of 125 kHz, 100 kHz, or 90.909 kHz to U6B. One shot U6B and potentiometer R20 operate as a pulse stretcher to provide an output pulse with a 50% duty cycle. This pulse is applied to input amplifier U7 through programmable jumper J4. Finally, the output of U7 is applied to amplifier U8 through a band pass filter and level control R26.

The function of the band-pass filter is to remove harmonics and convert the signal to a sinewave. The reference frequency at the output of U8 is available for application to RF communications equipment for transmission to a booster site.

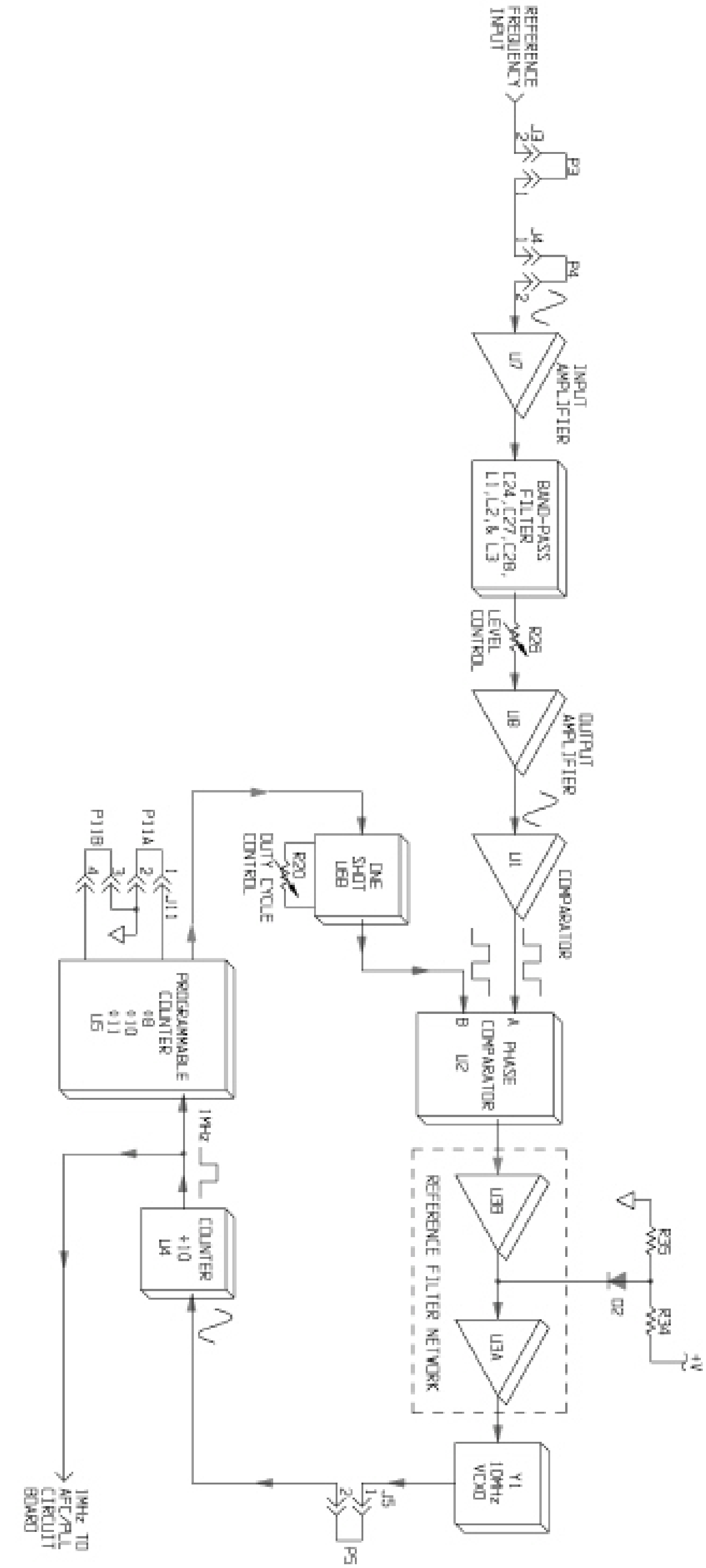


Figure 11-1. SLAVE FM BOOSTER SIMPLIIFED SCHEMATIC.

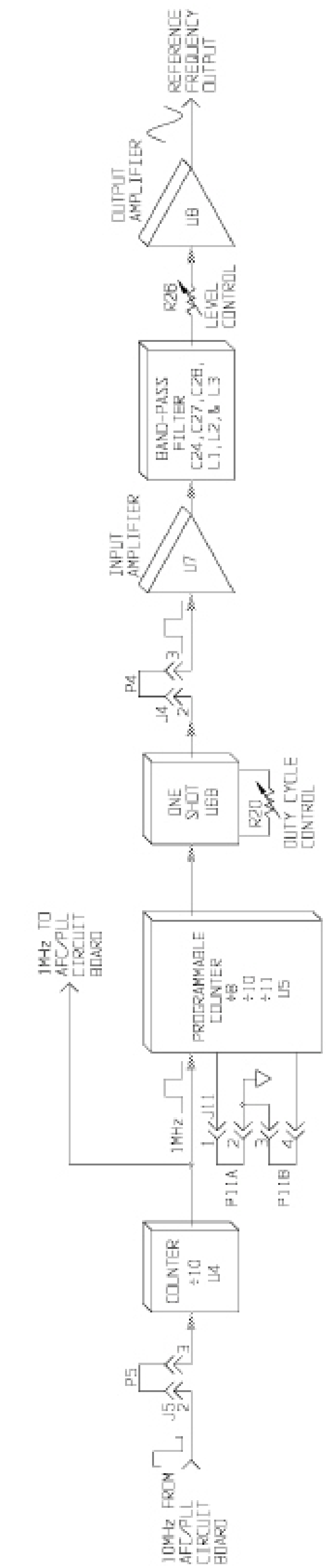


Figure 11-2. MASTER FM BOOSTER SIMPLIFIED SCHEMATIC.

11.7 MAINTENANCE

This section provides maintenance information, electrical adjustment procedures, and troubleshooting information for the synchronous FM booster circuit boards.

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

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

B. Calibrated oscilloscope.

C. Frequency counter.

11.7.1 DUTY CYCLE ADJUSTMENT (R20).

Potentiometer R20 on the slave or master circuit board adjusts the duty cycle of the reference signal. Control R20 is adjusted as follows.

Procedure. To adjust duty cycle control R20, proceed as follows:

WARNING

DISCONNECT THE PRIMARY POWER TO THE TRANSMITTER BEFORE PROCEEDING.

WARNING

A. Disconnect the transmitter primary power.

B. Remove the transmitter top-cover. Refer to Figure 11-3 and connect an oscilloscope between TP2 and ground.

C. Apply primary power to the transmitter.

WARNING

DO NOT TOUCH ANY COMPONENT WITHIN THE TRANSMITTER WITH POWER APPLIED.

WARNING

D. Refer to Figure 11-3 and adjust R20 for a 50% duty cycle as indicated on the oscilloscope.

WARNING

DISCONNECT THE PRIMARY POWER TO THE TRANSMITTER BEFORE PROCEEDING.

WARNING

E. Disconnect the transmitter primary power.

F. Remove the test equipment and replace the top-cover.

11.7.2 LOW PASS FILTER (L1, L2, L3).

Inductors L1, L2, and L3 on the slave or master circuit board adjust the sensitivity of the low-pass filter network. Inductors L1, L2, and L3 are adjusted as follows.

Procedure. To adjust L1, L2, and L3, proceed as follows:

A. Perform steps A through E of the DUTY CYCLE ADJUSTMENT procedure.

B. Refer to Figure 11-3 and operate programmable jumpers J3 and J4 to position 2-3.

C. Refer to Figure 11-3 and adjust output level control R26 to midrange position.

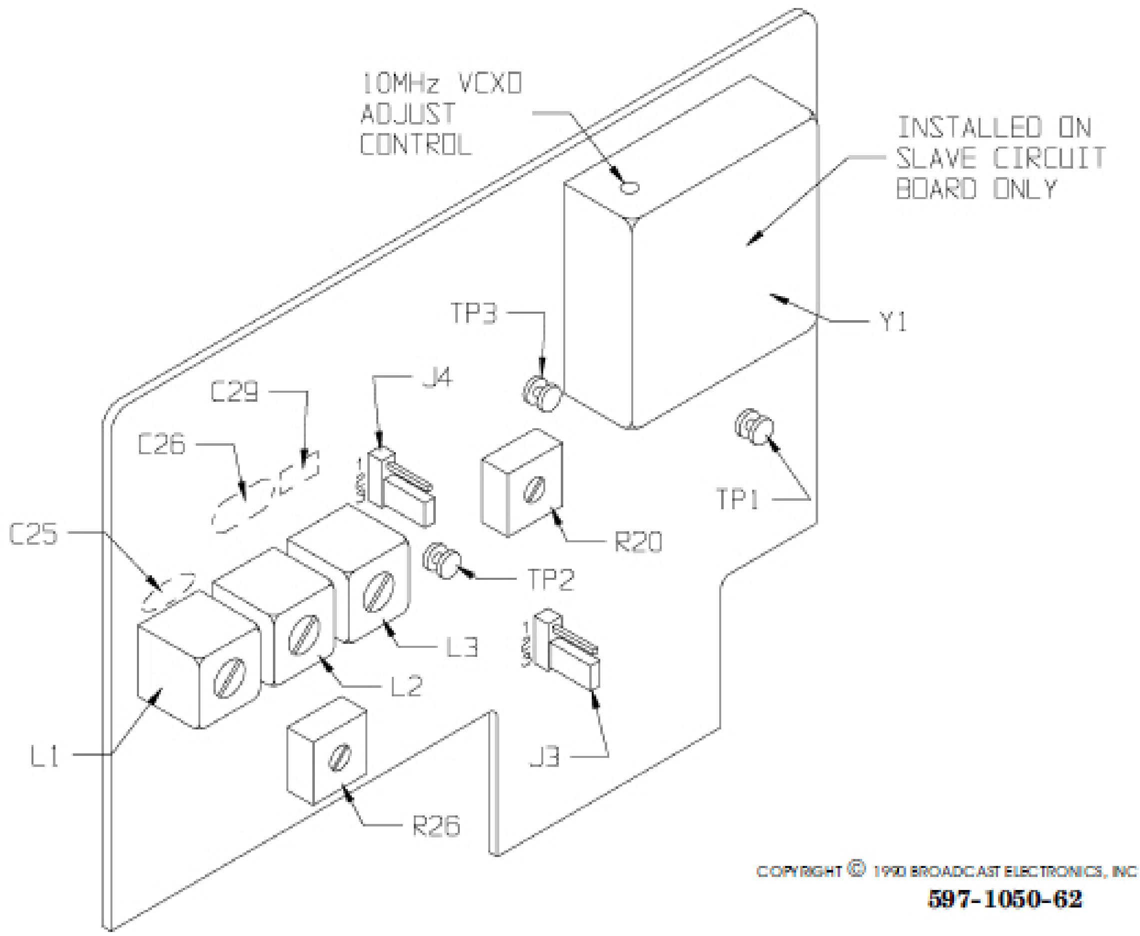


Figure 11-3. SLAVE/MASTER CIRCUIT BOARD CONTROLS

D. Refer to Figure 11-3 and connect an oscilloscope to transmitter rear-panel SUB-1 receptacle.

E. Apply primary power to the transmitter.

WARNING

DO NOT TOUCH ANY COMPONENT WITHIN THE TRANSMITTER WITH POWER APPLIED.

WARNING

F. Refer to Figure 11-3 and adjust L1, L2, and L3 for a maximum indication on the oscilloscope. Repeat if necessary.

WARNING

DO NOT TOUCH ANY COMPONENT WITHIN THE TRANSMITTER WITH POWER APPLIED.

WARNING

G. Disconnect the transmitter primary power.

H. If the unit under test is a slave circuit board, adjust R26 fully clockwise. If the unit under test is a master, refer to the OUTPUT LEVEL ADJUSTMENT procedure.

I. Remove the test equipment, restore programmable jumpers J3 and J4 to the original position, and replace the top-cover.

11.7.3 VCXO ADJUSTMENT.

Due to frequency drift of crystals with age, it is recommended the VCXO frequency on the slave circuit board be periodically checked and adjusted if required. The VCXO frequency is adjusted as follows.

Procedure. To adjust the VCXO, proceed as follows:

A. Perform the DUTY CYCLE ADJUSTMENT procedure.

WARNING

DISCONNECT THE PRIMARY POWER TO THE TRANSMITTER BEFORE PROCEEDING.

WARNING

B. Disconnect the transmitter primary power.

C. Remove the top-cover. Refer to Figure 11-3 and connect a frequency counter between TP1 and ground.

D. Remove the reference input from the rear-panel SUB-1 input connector.

E. Apply primary power to the transmitter.

WARNING

DO NOT TOUCH ANY COMPONENT WITHIN THE TRANSMITTER WITH POWER APPLIED.

WARNING

F. Refer to Figure 11-3 and adjust the 10 MHz VCXO adjust control for 10 MHz +/-5 Hz as indicated on the frequency counter.

WARNING

DISCONNECT THE PRIMARY POWER TO THE TRANSMITTER BEFORE PROCEEDING.

WARNING

G. Disconnect the transmitter primary power.

H. Remove the test equipment, replace the top-cover, and connect the reference input to the rear-panel SUB-1 receptacle.

11.7.4 REFERENCE FREQUENCY SELECTION.

The removal or installation of capacitors C25, C26, and C29 selects alternate reference frequencies. If an alternate frequency is desired, refer to Figure 11-3 and the following information and install the required combination of capacitors.

REFERENCE FREQUENCY	C25	C26	C29
125 kHz	Removed	Removed	Removed
100 kHz	Installed	Installed	Removed
90.909 kHz	Installed	Installed	Installed

12 FM-250C CANADA VERSION

This section presents information for the FM-250C Canada version. The Canada version consists of a standard FM-250C with the following additions: 1) a rear-panel on/off switch, 2) a front-panel RF sample receptacle, and 3) a fan mute circuit. Standard installation, operation, and maintenance information for an FM-250C transmitter is presented in this instruction manual.

12.1 ADDITIONS TO STANDARD FM-250C

12.1.1 REAR-PANEL AC ON/OFF SWITCH.

The FM-250C is equipped with a rear-panel ac on/off switch. Operate the switch to ON to enable the FM-250C. Operate the switch to OFF to disable the FM-250C.

12.1.2 FRONT-PANEL RF SAMPLE RECEPTACLE.

The FM-250C is equipped with a front-panel RF sample receptacle. The receptacle provides a -20 dBm sample in a 50 Ohm load at 10 watts for monitoring operations.

12.1.3 FAN MUTE.

The FM-250C is equipped with a solid-state relay to disable the fan when the transmitter RF output is muted.

12.2 DRAWINGS.

The overall schematic presents the electrical changes associated with the FM-250C modifications. Refer to the overall FM-250C schematic diagram 909-0101-204/-304/-306 for the Canada version of the FM-250C transmitter.

13 BE Part Numbers

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

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

13.1 FM-250C, EXCITER, CE, 220V

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
0	909-0251-509	FM-250C,EXCITER,220V,CE,NICKEL GRAY		
..1	140-0036	VARISTOR,V275LA20A	2	
..1	330-0401	FUSE,MDA 4A 250V CER SLO-BLO	1	
..1	330-1000	FUSE,MDA 10A 250V SLO-BLO	1	
..1	330-1500-001	FUSE, 15A, 250V, CERAMIC, SLO-BLOW	1	
..1	360-0003	FERRITE BEAD,.291 DIA	2	
..1	370-0250	XMFR,POWER,FM-250C XMTR	1	
..1	380-4600	FAN,4 1/2	1	
..1	380-5502	FILTER,FAN	1	
..1	380-6307	FINGER GUARD,FAN,4.125 CENTERS	1	
..1	400-2170	GROMMET,FOR 3/8	1	
..1	402-0000	TY-RAP	12	
..1	402-0006	MT,ADH BACKED,FOR CBL TIES	1	
..1	402-0008	MTG DEVICE,FOR #6SCR,TIE CBL	1	
..1	402-0831	CLAMP,CBL 1/2	1	
..1	410-0050	LUG,TERM,10-12GA,FEMSPADE	2	
..1	410-0051	LUG,TERM,14-16GA,FEMSPADE	3	
..1	415-1010	FUSE CLIP,LITTLEFUSE,101002	2	
..1	415-1011	FUSE CLIP,LITTLEFUSE,105002	1	
..1	415-2012	FUSEHOLDER,PANEL MOUNT, 10A	1	
..1	415-2012-020	FUSEHOLDER,PANEL MOUNT, 20A	1	

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
..1	417-0016	CONN,BNC,RF,UG1094A/U,AMPHENOL	2	
..1	417-0017	RECP,BNC,BULKHEAD,UG-492A/U	1	
..1	417-0372	CONTACT,CONN,FC112N2	4	
..1	417-0432	CONTACT, FEMALE, POWER-LOK, 20-24 AWG	4	
..1	417-6500	MODULE,IEC 5 FUNCTION	1	
..1	418-0035	ADPTR,JACK-JACK 82-66 AMPHENOL	1	
..1	420-0817	ASSY,FEMALE SCREWLOCK 205817-1	1	
..1	420-1145	SCREW,1/4-20X4.5,PPHS SST	1	
..1	420-4105	SCREW,4-40X.312,S.S. PH	2	
..1	420-4110	SCREW,4-40X.625,S.S. PH	8	
..1	420-4406	SCREW,4-40X.375,S.S. PH UC	2	
..1	420-6104	SCREW,6-32X.250,S.S. PH	6	
..1	420-6105	SCREW,6-32X.312,S.S. PH	6	
..1	420-6106	SCREW,6-32X.375,S.S. PH	25	
..1	420-6108	SCREW,6-32X.500,S.S. PH	4	
..1	420-8006	SCREW,8-32X.375,S.S. PH FLH UC	6	
..1	420-8107	SCREW,8-32X.437,S.S. PHH	8	
..1	420-8124	SCREW,8-32X1.000,S.S. PHH	4	
..1	421-1001	1/4-20 S.S. HEX NUT	3	
..1	421-1102	RIV,BLD,DOMED 3/32	2	
..1	421-1113	RIV,CLOSED-END .125 X .316L	1	
..1	421-4008	4-40 KEP NUT	12	
..1	421-6001	6-32 S.S. HEX THIN NUT	2	
..1	421-6008	6-32 KEP NUT	10	
..1	421-8028	NUT,JAM,1/2-28 UNEF-2B	4	
..1	422-6106	SCREW,SEMS 6-32 X 3/8 PAN PH. ST."	8	
..1	423-1001	1/4 FLAT .500 X .255 X .050	3	

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
..1	423-1002	1/4 LOCK SPLIT	3	
..1	423-1026	WASH,FENDER,1/4ID,1 1/4OD	1	
..1	423-3004	5/16 LOCK INT TOOTH THIN	2	
..1	423-6002	#6 LOCK SPLIT	32	
..1	423-6011	#6 FLAT .310 X .160 X .030	2	
..1	423-8002	#8 LOCK SPLIT	12	
..1	423-9002	WASH,INT TOOTH,1/2	4	
..1	441-0131	STOFF,ALUM 1/4HEX 5/16M/FEM632	6	
..1	441-8217	STOFF,ALUM 1/4HEX X 5/8 6-32	5	
..1	441-8585	SPR,3/4 X 1/4DIA,6-32 TAP	4	
..1	450-1700	PLUG,HOLE,1/2 NYL BLACK 2643	1	
..1	465-0090-101	ANGLE,UPPER FRT PNL,CE EXCITER	1	
..1	465-0091-100	ANGLE,LOWER FRT PNL,FX50	1	
..1	466-0093	ANGLE,FRONT PANEL MOUNT,FX50	2	
..1	467-0178	BOOT,INSULATING FOR 360-6504	1	
..1	467-1003	OVERLAY,FX50	1	
..1	469-0365	FINGER STOCK,1S197520A	32	
..1	469-0365-1	STRIP,RFI SHIELD	2	
....2	469-0365	FINGER STOCK,1S197520A	2.75	
..1	469-0366-1	STRIP,RFI SHIELD 1.25	4	
....2	469-0366	FINGER STOCK (NOTE!!!!!)	1.25	
..1	469-0366-2	STRIP,RFI SHIELD 4.25	6	
....2	469-0366	FINGER STOCK (NOTE!!!!!)	4.25	
..1	471-0360	COVER,AFC/PLL PCB FX50	1	
....2	471-0360-009	COVER,AFC/PLL PCB UNSCREENED	1	
..1	471-0584-100	COVER,TOP,FM250C/E	1	
..1	471-0795	SHIELD,FRONT PANEL PCB,FX-50	1	
....2	471-0795-009	SHLD,FRT PNL PCB,FX-50,UNSCRND	1	

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
..1	471-0954-301	PANEL,STATUS,FM250C,HD COLOR	1	
....2	471-0954-309	PANEL,STATUS,FM100C/FM250C,HD COLOR,UNSCREENED	1	
..1	471-0965	GUARD, AFC/PLL, FM100C	2	
..1	471-2500-100	PANEL,REAR,FM250C/E,SCREENED	1	
..1	471-2501-100	CHASSIS,FM-250C/E	1	
..1	471-2509	SHIELD,TOROID,FM-250C	1	
..1	471-2510	SHIELD,PWR CONNECTOR,FM-250C	1	
..1	471-5122	SHIELD, AFC/PLL, FM250C	1	
..1	471-5123	SHIELD, MOD OSC, FM250C	1	
..1	471-5289-003	BRACKET,FUSE HOLDER,FM250,SCREENED T	1	
....2	471-5289	BRACKET,FUSE HOLDER,FX50,FM100,FM250,UNSCREENED	1	
..1	486-0004	HANDLE 1 3/4	2	
..1	486-0014	FERRULE,BLK,FOR .25 DIA HANDLE	4	
..1	488-0010	LATCH,LO-PROFILE 27-10-501-50	2	
..1	591-0001	PLATE,FCC ID	1	
..1	594-0095	LABEL,1EC LINE RCPT 700-0152	1	
..1	594-0250	LABEL,CAUTION,TOP COVER,FM EXC	1	
..1	601-1802	WIRE,AWG18,19/30 RED (*NOTE)	0.25	
..1	611-0061	TUB,HT SHK CLEAR 3/64	0.33	
..1	611-2500	TUB,HT SHK,1/4	0.13	
..1	611-5000	TUB,HT SHK 1/2	0.167	
..1	919-0104	ASSY PCB,AFC/PLL	1	
....2	000-3302	CAP,CER,DISC,3.3PF,1000V	1	C59
....2	001-5004	CAP,CER,DISC,5PF,500V,NPO	4	C15, C16, C56, C57

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
....2	003-1054	CAP,CER,MNLY,.1uF,50V,20%	24	C1, C3, C5, C6, C7, C8, C10, C12, C13, C21, C24, C27, C32, C33, C39, C43, C51, C55, C58, C60, C61, C64, C66, C41
....2	020-4793	CAP,LYTIC,4700UF,16V,LOW LEAK	1	C35
....2	023-1076	CAP,LYTIC,10uF,50V,STDUP	5	C42, C68, C70, C72, C73
....2	023-1084	CAP,LYTIC,100MFD,35V,STDUP,RAD	11	C4, C15, C22, C23, C25, C49, C50, C52, C53, C69, C71
....2	024-1064	CAP,LYTIC,1UF,50V,RAD	1	C29
....2	024-3364	CAP,LYTIC,3.3UF,50V,NP	1	C30
....2	024-3374	CAP,LYTIC,33UF,35V,STDUP	1	C37
....2	024-4764	CAP,LYTIC,4.7UF,50V,20%,STDUP	1	C28
....2	030-1053	CAP,MYLAR FILM,.1uF,100V,RAD	1	C31
....2	030-2253	CAP,MYLAR FILM,.22UF,100V,RAD	4	C34, C38, C48, C54
....2	031-1043	CAP,MYLAR FILM,.01UF,100V,RAD	3	C9, C11, C40
....2	031-2243	CAP,MYLAR FILM,.022UF,200V,RAD	1	C26
....2	038-4753	CAP,PYST,.47UF,100V	1	C44
....2	040-2422	CAP,MICA,240PF	3	C45, C46, C47
....2	042-2531	CAP,MICA,2500PF,500V,1%	1	C62
....2	042-3312	CAP,MICA,33PF,500V,5%	2	C65, C67
....2	042-3922	CAP,MICA,390PF,100V,5%	6	C2, C17, C18, C19, C20, C36
....2	042-5031	CAP,MICA,5000PF,500V,1%	1	C63
....2	100-1031	RES,100 OHM,1/4W,1%,METAL	1	R22
....2	100-1041	RES,1K OHM,1/4W,1%	7	R10, R42, R40, R44, R23, R84, R85
....2	100-1051	RES,10K OHM,1/4W,1%	15	R6, R13, R37, R15, R16, R24, R46, R47, R48, R95, R75, R76, R50, R103, R67,

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
....2	100-1111	RES,118 OHM,1/4W,1%	1	R32
....2	100-1231	RES,121 OHM,1/4W,1%	3	R21, R97, R99
....2	100-1551	RES,15K OHM,1/4W,1%	4	R25, R26, R27, R51
....2	100-1731	RES,174 OHM,1/4W,1%	1	R59
....2	100-2723	RES,27 OHM,1/4W,5%	1	R34
....2	100-3031	RES,301 OHM,1/4W,1%	1	R57
....2	100-3951	RES,39.2K OHM,1/4W,1%	1	R9
....2	100-4773	RES,4.7MEG OHM,1/4W,5%	1	R43
....2	100-5041	RES,4.99K OHM,1/4W,1%	4	R29, R30, R88, R90
....2	100-5663	RES,560K OHM,1/4W,5%	1	R19
....2	103-1007	RES,1 MEG OHM,1/4W,1%,METAL	8	R71, R72, R79, R77, R86, R89, R70, R78
....2	103-1021	RES,10 OHM,1/4W,1%,METAL	1	R1
....2	103-1062	RES,100K OHM,1/4W,1%,METAL	5	R17, R18, R64, R65, R66
....2	103-1215	RES,12.1K OHM,1/4W,1%,METAL	1	R11
....2	103-1331	RES,1.33K OHM,1/4W,1%,METAL	2	R98, R100
....2	103-1375	RES,13.7K OHM,1/4W,1%,METAL	1	R101
....2	103-1504	RES,1.5K OHM,1/4W,1%,METAL	1	R28,
....2	103-1745	RES,17.4K OHM,1/4W,1%,METAL	1	R82
....2	103-1825	RES,18.2K OHM,1/4W,1%,METAL	1	R92
....2	103-2213	RES,221 OHM,1/4W,1%,METAL	1	R33
....2	103-2673	RES,267 OHM,1/4W,1%,METAL	5	R7, R14, R38, R93, R94
....2	103-3014	RES,3.01K OHM,1/4W,1%,METAL	1	R83
....2	103-3323	RES,332 OHM,1/4W,1%,METAL	2	R2, R8
....2	103-3324	RES,3.32K OHM,1/4W,1%,METAL	2	R4, R5
....2	103-3631	RES,365 OHM,1/4W,1%,METAL	1	R20
....2	103-3836	RES,383K OHM,,1/4W,1%,METAL	1	R39

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
....2	103-4361	RES,432K OHM,1/4W,1%,METAL	1	R53
....2	103-4753	RES,475 OHM,1/4W,1%,METAL	2	R45, R61
....2	103-4755	RES,47.5K OHM,1/4W,1%,METAL	1	R31
....2	103-4951	RES,49.9K OHM,1/4W,1%,METAL	2	R36, R12
....2	103-5112	RES,51.1 OHM,1/4W,1%,METAL	2	R3, R74
....2	103-5113	RES,511 OHM,1/4W,1%,METAL	1	R49
....2	103-5624	RES,5.62K OHM,1/4W,1%,METAL	1	R41
....2	103-6193	RES,619 OHM,1/4W,1%,METAL	1	R87
....2	103-6194	RES,6.19K OHM,1/4W,1%,METAL	2	R54, R62
....2	103-6346	RES,634K OHM,1/4W,1%,METAL	1	R60
....2	103-7326	RES,732K OHM,1/4W,1%,METAL	1	R58
....2	103-7503	RES,750 OHM,1/4W,1%,METAL	1	R55
....2	103-7541	RES,7.50K OHM,1/4W,1%,METAL	2	R68, R80
....2	103-8255	RES,82.5K OHM,1/4W,1%,METAL	1	R35
....2	103-8256	RES,825K OHM,1/4W,1%,METAL	1	R56
....2	175-1034	RES,TRMR,1K,VERT ADJ	1	R63
....2	177-5044	RES,TRMR,5K,VERT ADJ	3	R69, R81, R91
....2	177-5054	RES,TRMR,50K,VERT ADJ	1	R52
....2	200-0009	DIODE,ZENER,1N 4739A	2	D17, D19
....2	203-4005	DIODE,1N4005	2	D16, D18
....2	203-4148	DIODE,1N4148	7	D1, D2, D3, D4, D5, D6, D7,
....2	211-3904	TSTR,2N3904	4	Q1, Q2, Q3, Q4
....2	220-0317	VR,LM317LZ TO92	1	U6
....2	220-4040	IC,MC14040B 12-BIT BINARY	1	U2
....2	220-5151	IC,MC145151 SYNTHESIZER	1	U9
....2	220-8658	IC,SP8658 PRESCALER,DIVIDE/20	1	U8
....2	221-0072	AMP,OP,BIFET TLO72CP	1	U11

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
....2	221-0358	AMP,DUAL OP,LM358	1	U13
....2	221-5532-001	IC,NE-5532AN	4	U10, U14, U15, U16
....2	226-0392	RES NETWORK, 10K	2	R73, R96
....2	227-0317	VR,LM317T,LM317KC	1	U17
....2	227-0337	VOLTAGE REGULATOR,3 TERM, NEG	1	U18
....2	228-0290	IC, 74LS90N (N)	1	U1
....2	228-4013	IC,MC14013B	1	U4
....2	228-4073	IC,MC14073B	1	U3
....2	228-4538	IC,MC14538B NATL SEMICONDUCTOR	2	U5, U12
....2	323-7345	LDR,LED TYPE,VACTEC VTL 5C2	3	LDR1, LDR2, LDR3
....2	323-9224	IND,LED,GRN,521-9270	5	DS1, DS2, DS3, DS4, DS5
....2	340-0002	SW,4 POS,SPST,8-PIN DIP	3	S1, S2, S3
....2	340-0004	SW,JUMPER PROGRAMMABLE	5	P3, P4, P5A, P5B, P10
....2	360-2200	CHOKE,RF 2.2UH 550MA	2	L1, L2
....2	364-0047	COIL, MOLDED .47UH	1	L3
....2	370-0002	XMFR,RF,MCL,T4-1 (NOTE)	1	T1
....2	390-0001	OSC,XTAL PC MT TCXO 10MHZ	1	Y1
....2	402-0000	TY-RAP	2	
....2	407-0074	SPR,LED .25 ODX.147 1D X.22L	5	
....2	413-1597	TERM,TURRET,2 SHLDR,.219,GOLD FLASH	5	
....2	417-0003	CONN,HEADER 3 PIN	3	J3.J4, J10
....2	417-0004	JACK,TEST,RIGHT ANGLE PC MT	1	TP1
....2	417-0200	CONN,HEADER 20 PIN	2	J5, J8, J2, J1,
....2	417-0804	SOCKET,8-PIN DIP,BURNDY	6	XU10, XU11, XU13, XU14, XU15, XU16
....2	417-1404	SOCKET,14-PIN DIP	3	XU1, XU3, XU4
....2	417-1604	SKT,16-PIN,DIP	5	XU2, XU5, XU12, XR73, XR96

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
....2	417-2804	SOCKET,IC 28-PIN,DIP,HI RELIABILITY	1	XU9
....2	420-6104	SCREW,6-32X.250,S.S. PH	2	
....2	423-6002	#6 LOCK SPLIT	2	
....2	426-6000	PEM NUT,#6-32 KFS2-632	6	
....2	519-0104	PCB,BLANK,AFC/PLL (scan)	1	
....2	700-0148	TAPE,JOINING 3/4	0.001	
....2	949-1050-001	ASSY, CABLE, AFC-PLL (SBCM)	1	
......3	402-0051	TY-RAP, W/FLAG	1	
......3	418-0034	PLUG,BNC DUAL CRIMP 1-227079-6	1	
......3	621-1359	CBL,COAX,RG316/U,50 OHM	1.25	
......3	690-0023	TUB,PVC105/7 BLK,ALPHA	1.25	
..1	919-0108-250	ASSY,PCB,METERING,FM-250	1	
....2	001-5004	CAP,CER,DISC,5PF,500V,NPO	2	C8, C11,
....2	003-1054	CAP,CER,MNLY,.1uF,50V,20%	33	C2, C3, C4, C9, C10, C15, C17, C18, C19, C24, C27, C28, C30, C31, C34, C35, C36, C37, C38, C39, C40, C41, C42, C43, C44, C45, C50, C52, C54, C56, C57, C61, C63,
....2	020-1085	CAP,LYTIC,100UF,50V,STDUP,NP	1	C1,
....2	023-1076	CAP,LYTIC,10uF,50V,STDUP	9	C12, C32, C33, C51, C53, C55, C58, C60, C62,
....2	023-1084	CAP,LYTIC,100MFD,35V,STDUP,RAD	4	C46, C47, C48, C49
....2	024-2274	CAP,LYTIC,22UF,100V,STDUP	1	C59,
....2	030-3353	CAP,POLY FILM,.033UF,200V,10%	1	C29,
....2	031-1043	CAP,MYLAR FILM,.01UF,100V,RAD	1	C13,
....2	040-5013	CAP,MICA,50PF,500V,5%	1	C26,
....2	042-3312	CAP,MICA,33PF,500V,5%	1	C14,

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
....2	042-3922	CAP,MICA,390PF,100V,5%	5	C6, C7, C16, C23, C25,
....2	100-1013	RES,1 OHM,1/4W,5%	2	R113, R114,
....2	100-1041	RES,1K OHM,1/4W,1%	16	R16, R18, R20, R44, R47, R51, R98, R99, R100, R101, R102, R103, R104, R105, R106, R107
....2	100-1051	RES,10K OHM,1/4W,1%	14	R8, R19, R23, R29, R38, R42, R52, R60, R66, R67, R68, R69, R70, R71,
....2	100-1083	RES,10MEG OHM,1/4W,5%	1	R26,
....2	100-1111	RES,118 OHM,1/4W,1%	1	R110,
....2	100-1231	RES,121 OHM,1/4W,1%	4	R78, R80, R82, R88, R108,
....2	100-1551	RES,15K OHM,1/4W,1%	1	R57,
....2	100-2041	RES,2K OHM,1/4W,1%	1	R40,
....2	100-2283	RES,22MEG OHM,1/4W,5%	2	R21, R37,
....2	100-3161	RES,316K OHM,1/4W,1%	1	R10,
....2	100-3373	RES,3.3MEG OHM,1/4W,5%	1	R59,
....2	100-3951	RES,39.2K OHM,1/4W,1%	1	R48,
....2	100-6031	RES,604 OHM,1/4W,1%	1	R89,
....2	103-1007	RES,1 MEG OHM,1/4W,1%,METAL	3	R9, R39, R54,
....2	103-1021	RES,10 OHM,1/4W,1%,METAL	3	R33, R34, R36,
....2	103-1024	RES,1.02K OHM,1/4W,1%,METAL	2	R46, R49,
....2	103-1062	RES,100K OHM,1/4W,1%,METAL	8	R5, R31, R53, R64, R65, R87, R97, R111,
....2	103-1105	RES,11K OHM,1/4W,1%,METAL	2	R7, R50,
....2	103-1214	RES,1.21K OHM,1/4W,1%,METAL	3	R90, R92, R94,
....2	103-1331	RES,1.33K OHM,1/4W,1%,METAL	2	R79, R81,
....2	103-1504	RES,1.5K OHM,1/4W,1%,METAL	1	R25,

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
....2	103-1826	RES,182K OHM,1/4W,1%,METAL	1	R58,
....2	103-2003	RES,200 OHM,1/4W,1%,METAL	2	R75, R76,
....2	103-2264	RES,2.26K OHM,1/4W,1%,METAL	1	R109,
....2	103-2495	RES,24.9K OHM,1/4W,1%,METAL	1	R45,
....2	103-2673	RES,267 OHM,1/4W,1%,METAL	1	R63,
....2	103-2675	RES,26.7K OHM,1/4W,1%,METAL	3	R22, R84, R86,
....2	103-3061	RES,301K OHM,1/4W,1%,METAL	1	R24,
....2	103-3631	RES,365 OHM,1/4W,1%,METAL	1	R83,
....2	103-4755	RES,47.5K OHM,1/4W,1%,METAL	4	R61, R62, R85, R96,
....2	103-4951	RES,49.9K OHM,1/4W,1%,METAL	1	R55,
....2	103-4993	RES,499 OHM,1/4W,1%,METAL	3	R91, R93, R95,
....2	103-5112	RES,51.1 OHM,1/4W,1%,METAL	1	R77,
....2	103-5141	RES,5.11K OHM,1/4W,1%,METAL	1	R35,
....2	103-6193	RES,619 OHM,1/4W,1%,METAL	3	R72, R73, R74,
....2	103-6343	RES,634 OHM,1/4W,1%,METAL	1	R1,
....2	103-6984	RES,6.98K OHM,1/4W,1%,METAL	1	R43,
....2	103-7503	RES,750 OHM,1/4W,1%,METAL	1	R3,
....2	103-8254	RES,8.25K OHM,1/4W,1%,METAL	1	R30,
....2	103-8255	RES,82.5K OHM,1/4W,1%,METAL	1	R27,
....2	103-9314	RES,9.31K OHM,1/4W,1%,METAL	1	R17,
....2	177-1054	RES,TRMR,10K,VERT ADJ	1	R56,
....2	177-2044	RES,TRMR,2K,VERT ADJ	1	R41,
....2	177-2054	RES,TRMR,20K,VERT ADJ	1	R28,
....2	200-4742	DIODE,ZENER,1N4742A	2	D18, D19,
....2	201-2800	DIODE,HOT CARRIER	3	D3, D4, D24,
....2	203-4005	DIODE,1N4005	3	D20, D21, D23,
....2	203-4148	DIODE,1N4148	9	D1, D2, D8, D9, D15, D16, D22, D26, D27,

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
....2	210-0271	TSTR,FET J271	1	Q7,
....2	210-3906	2N3906 PNP 40V 2A .35W 250MHZ	2	Q4, Q5,
....2	211-3904	TSTR,2N3904	2	Q1, Q6,
....2	220-0317	VR,LM317LZ TO92	1	U17,
....2	220-7136	A/D,3-1/2 DIGIT LCD,ICL7136CPL	1	U7,
....2	221-0074	AMP,OP,BIFET TLO74CW	2	U1, U2,
....2	221-4227	AMP,DUAL OP	1	U4,
....2	225-0004	IC,CD4066BE	2	U3, U6,
....2	226-0392	RES NETWORK, 10K	1	R32,
....2	226-2004	MC1416,ULN2004 7-DRLNGTNS DP16	1	U12,
....2	227-0317	VR,LM317T,LM317KC	2	U14, U22,
....2	227-0337	VOLTAGE REGULATOR,3 TERM, NEG	2	U15, U16,
....2	228-4028	IC,MC14028B	1	U11,
....2	228-4071	IC,MC14070 QUAD EXCLUSIVE OR	1	U13,
....2	228-4076	IC,MC14076 QUAD REGISTER	1	U10,
....2	228-4532	IC,MC14532B 8-BIT PRIOR ENCOD	1	U9,
....2	228-4538	IC,MC14538B NATL SEMICONDUCTOR	1	U8,
....2	229-0555	IC,TIMER,NE555N	1	U18,
....2	229-3914	DRIVER,DOT/BAR DISPLAY LM3914N	3	U19, U20, U21,
....2	320-0016	LED,GRN PANEL INDICATOR	7	DS2, DS3, DS4, DS5, DS18, DS19, DS20,
....2	320-0017	LED,RED MV57173 I OR H	9	DS1, DS6, DS7, DS8, DS13, DS14, DS15, DS16, DS17,
....2	320-0021	DISP,LCD,4-DIGIT,0.7	1	DS12,
....2	320-4164	LED ARRAY,GRN,10 BAR	2	DS9, DS10,
....2	320-7164	LED ARRAY RED MV57164 INTEN G OR H	1	DS11,
....2	340-0107	KEYSWITCH,SI20601H1 SECME (NOTE)	6	S1, S2, S3, S4, S5, S6,

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
....2	402-0000	TY-RAP	1	
....2	413-0106	TERM,TEST POINT,OVAL,RED	8	E1, TP1, TP2, TP3, TP4, TP5, TP6, TP7,
....2	417-0172	SKT, 20 PIN SINGLE ROW,SAMTEC	2	
....2	417-0200	CONN,HEADER 20 PIN	1	J14,
....2	417-0804	SOCKET,8-PIN DIP,BURNDY	3	XU4, XU18, XU5
....2	417-1404	SOCKET,14-PIN DIP	5	XU1, XU2, XU3, XU6, XU13,
....2	417-1604	SKT,16-PIN,DIP	6	XU8, XU9, XU10, XU11, XU12, XR32,
....2	417-1804	SOCKET,18-PIN,DIP,HIGH RELIABILITY	3	XU19, XU20, XU21,
....2	417-4005	SOCKET,40-PIN,DIP,HIGH RELIABILITY	1	XU7
....2	420-6104	SCREW,6-32X.250,S.S. PH	4	
....2	423-6002	#6 LOCK SPLIT	4	
....2	426-6000	PEM NUT,#6-32 KFS2-632	4	
....2	449-0006	TEST CLIP,COILED	1	
....2	519-0108-250	PCB,BLANK,METERING (scan)	1	
..1	919-0429	ASSY,PCB, SWITCHING P.S. FM-250C	1	
....2	002-2013	CAP,CER,DISC,20PF,1KV,10%	4	C16, C41, C46, C56,
....2	003-1054	CAP,CER,MNLY,.1uF,50V,20%	15	C4, C20, C24, C25, C30, C31, C32, C39, C40, C43, C44, C45, C54, C55, C60,
....2	003-4712	CAP,CER,47PF,50V,5%	1	C63
....2	003-4733	CAP,MONO CER,.047uF,50V,5%	1	C53,
....2	003-4743	CAP,CER MNLY,.47uF,50V,10%	2	C61, C62
....2	020-1026	CAP,LYTIC,1000UF,35,RADIAL	4	C5, C6, C7, C10,
....2	020-2273	CAP,LYTIC,22UF,35V,RADIAL	1	C21,
....2	020-4785	CAP,LYTIC,470UF,100V,20%,STDUP	6	C2, C3, C28, C29, C50, C51,
....2	020-4795	CAP,LYTIC,4700UF,100V,20%,SNAP MT	7	C1, C26, C27, C33, C34, C35, C36,

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

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

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

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

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

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

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

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
....2	221-0358	AMP,DUAL OP,LM358	3	U5, U6, U7,
....2	227-7905-A	IC,VR,MC79L05,-5V,T0-92 CASE	1	U9
....2	229-0336	IC,VOLT REF DIODE LM336Z-2.5	1	D3
....2	340-0004	SW,JUMPER PROGRAMMABLE	7	P1, P2, P3, P4, P6, P7, P8,
....2	345-0863	SW,SLD,DPDT,SWCFT C56206L2	2	S1, S2,
....2	413-0106	TERM,TEST POINT,OVAL,RED	15	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15,
....2	417-0003	CONN,HEADER 3 PIN	7	J6, J7, J8,
....2	417-0169	CONN 15 PIN 640503-1 AMP	2	J12, J13,
....2	417-0200	CONN,HEADER 20 PIN	0.3	J5,
....2	417-0804	SOCKET,8-PIN DIP,BURNDY	3	XU5, XU6, XU7,
....2	417-1276	CONN,PCB,12 PIN	1	J10,
....2	417-1404	SOCKET,14-PIN DIP	2	XU1, XU2,
....2	417-1604	SKT,16-PIN,DIP	2	XU3, XU4,
....2	418-0900	CONN,9 PIN 640501-5 AMP	1	J21,
....2	519-0430	PCB,MACH,POWER CONTROL BD,FM-(scan)	1	
..1	919-0445-309	ASSY,PCB,RFI FILTER,CE	1	
....2	417-0039-VLX	CONN,BNC,PCB,VERT MOUNT,VALOX BODY	-1	REMOVE J305
....2	417-2502-FER	RCPT,25 PIN D,FEMALE,FERITE FILTER	-1	REMOVE J1
....2	417-2502-FIL	RCP, 25 PIN D, FEMALE, PI FILTER	1	J1
....2	420-4105	SCREW,4-40X.312,S.S. PH	2	
....2	423-4002	#4 LOCK S.S. SPLIT	2	
....2	441-4000	STOFF,4-40 X .50L,3/16 HEX ALUM	2	
....2	919-0445	ASSY,PCB,RFI FILTER (SBCM)	1	
......3	002-1034	CAP,CER,DISC,.001UF,1000V	3	C301, C302, C303

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	003-1054	CAP,CER,MNLY,.1uF,50V,20%	8	C304, C305, C306, C307, C308, C309, C310, C311
......3	031-2033	CAP,MYLAR FILM,.0022uF,100V,10%	2	C312, C313,
......3	038-4750	CAP,POLY,.47MFD,50V,10% OR BETTER	2	C324, C325
......3	040-1022	CAP,MICA,100PF,500V,RAD	10	C314, C316, C318, C320, C322, C326, C327, C328, C329, C330
......3	047-1035	CAP,FIL,EMI SUPPR,1000pF,3-PIN	3	FL312, FL313, FL319
......3	100-1041	RES,1K OHM,1/4W,1%	3	R302, R306, R307,
......3	100-1051	RES,10K OHM,1/4W,1%	1	R303,
......3	100-6031	RES,604 OHM,1/4W,1%	1	R308,
......3	103-5112	RES,51.1 OHM,1/4W,1%,METAL	2	R310, R311
......3	103-8254	RES,8.25K OHM,1/4W,1%,METAL	2	R304, R305,
......3	130-2423	RES,240 OHM,2W,5%	2	R301, R309,
......3	201-0012	ZENER VOLTAGE SUPPRESSOR,+/-12V	12	D310, D311, D312, D313, D314, D315, D316, D317, D318, D319, D320, D321
......3	201-0027	ZENER VOLTAGE SUPPRESSOR,+/-27V	4	D302, D303, D304, D305
......3	201-0040	ZENER VOLTAGE SUPPRESSOR,+/-18V	4	D306, D307, D308, D309
......3	203-4005	DIODE,1N4005	1	D301,
......3	270-0065	REL,SPDT,12VDC,DIP	1	K301,
......3	340-0004	SW,JUMPER PROGRAMMABLE	2	P308, P309
......3	364-4662	INDU,1.0MH	2	L303, L305,

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	411-0001	FILTER,EMI 10,000PF 3PIN	21	FL301, FL302, FL303, FL304, FL305, FL306, FL307, FL308, FL309, FL310, FL311, FB312, FB313, FL314, FL315, FL316, FL319, FL320, FL321, FL322, FL323
......3	417-0003	CONN,HEADER 3 PIN	2	J308, J309
......3	417-0039-VLX	CONN,BNC,PCB,VERT MOUNT,VALOX BODY	5	J305, J301, J302, J303, J304
......3	417-0200	CONN,HEADER 20 PIN	1	J307,
......3	417-1276	CONN,PCB,12 PIN	1	J306
......3	417-2502-FER	RCPT,25 PIN D,FEMALE,FERITE FILTER	1	J1
......3	420-6105	SCREW,6-32X.312,S.S. PH	10	
......3	423-6002	#6 LOCK SPLIT	20	
......3	426-6000	PEM NUT,#6-32 KFS2-632	10	
......3	441-0184	STOFF,6-32,MALE-FEMALE,3/8	10	
......3	519-0445-001	PCB,MACH,RFI FILTER	1	
........4	519-0445	PCB,MACH,RFI FILTER BREAKAWAY	0.5	
......3	519-0445-002	PCB,MACH,RFI FILTER SHIELD	1	
........4	519-0445	PCB,MACH,RFI FILTER BREAKAWAY	0.5	
..1	919-0446	ASSY, PCB, AC LINE FILTER	1	
....2	339-7818	FILTER, EMC, AC LINE, 250V, 6.3 AMP	1	F1
....2	418-0255	CONN,MALE,4PIN	2	J1, J2
....2	420-4106	SCREW,4-40X.375,S.S. PH	4	
....2	423-4002	#4 LOCK S.S. SPLIT	4	
....2	519-0446	PCB, RAW, AC LINE FILTER	1	
..1	949-0413-001	WIRE HARNESS, FM-250E	1	
....2	402-0000	TY-RAP	40	

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
....2	402-0051	TY-RAP, W/FLAG	12	
....2	410-0015	LUG,TERM #8 RING CRIMP 12-10	1	
....2	410-1553	LUG,TERM #10 RING CRIMP 16-22	1	
....2	417-0036	PIN CONN,AMP,350967-1	18	
....2	417-0053	SKT,CONN 641294-1 AMP	43	
....2	417-0059	CONN,9 PIN 1-640521-0 AMP	1	P21,
....2	417-0122	HSNG,20 POS MOD IV 3-87499-7	2	
....2	417-0123	HSNG,16 POS MOD IV 2-87499-9	1	
....2	417-0148	HSNG,10 POS MOD 1V 1-87499-7	1	
....2	417-0175	CONN, HOUSING, 20 PIN	1	
....2	417-0224	KEYING PLUG MOD IV 87077 AMP	2	
....2	417-0371	CONN,FEM,PLB12F0000,POSITRONIC	1	
....2	417-0372	CONTACT,CONN,FC112N2	3	
....2	417-0381	CONTACT,CONN,MC112N 7690	4	
....2	417-0421	CONN, MALE, 4 POSITION, POWER-LOK, WIRE	1	
....2	417-2379	CONN,155OC HOUSING,AMP,MR	2	P13, P12,
....2	417-8500	PLUG AND CORD ET,AM500 FAN	1	
....2	417-8766	CONTACT,CRIMP,MOD-IV 87809-1	52	
....2	418-0034	PLUG,BNC DUAL CRIMP 1-227079-6	2	
....2	418-0240	PLUG,FEM,4PIN	1	
....2	418-1271	CONN,HOUSING,12PIN	2	P306, P10,
....2	601-1202	WIRE,AWG12 19/25 RED	1	
....2	601-1604	WIRE,AWG16, 19/29 YEL	2.2	
....2	601-1604-006	WIRE,AWG 16,STRANDED,LIGHT BLUE	0.3	
....2	601-1800	WIRE,AWG18 19/30 BLK	17	
....2	601-1800-006	WIRE,AWG 18,STRANDED,LIGHT BLUE	1.5	
....2	601-1800-054	WIRE,AWG 18,STRANDED,GREEN/YELLOW	3	

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
....2	601-2209	WIRE,AWG22,7/30 WHT	79.5	
....2	611-1875	TUB,HT SHK,3/16	1.6	
....2	621-1359	CBL,COAX,RG316/U,50 OHM	6	
....2	622-8451	WIRE,BELD 8451,SHIELD,1PR	10.5	
..1	959-0203	ASSY MODL,MODLTD. OSC. (SBCM)	1	
....2	008-1020	CAP,FEEDTHRU,100PF 20% 250V	1	C21
....2	008-1033	CAP,FEEDTHRU,1000PF,20%,500V	2	C19, C20
....2	040-6223	CAP,MICA,620PF,300V,5%	1	C23
....2	360-0003	FERRITE BEAD,.291 DIA	3	
....2	364-0002	CHOKE,VK200-20/4B FERROXCUBE	1	L7
....2	402-0000	TY-RAP	5	
....2	402-0006	MT,ADH BACKED,FOR CBL TIES	1	
....2	402-0008	MTG DEVICE,FOR #6SCR,TIE CBL	1	
....2	410-1419	LUG,SOLDER 7/8	1	
....2	417-0016	CONN,BNC,RF,UG1094A/U,AMPHENOL	2	J6, J9
....2	420-4404	SCREW,4-40X.250,S.S. SHCS	7	
....2	420-4504	SCREW,4-40X.250,S.S. PH	1	
....2	420-4506	SCREW,4-40X.375,BR FLH SC	4	
....2	423-4004	#4 LOCK EXT TOOTH	7	
....2	470-0328	BRKT,BNC,MOD OSC	1	
....2	479-6443-003	BOX,MOD.,MODULATED OSC FX50	1	
....2	601-0022	WIRE,AWG22,BUSS	0.166	
....2	611-2500	TUB,HT SHK,1/4	0.083	
....2	693-0220	TUB,TEFLON,TW,AWG22 NTL	0.249	
....2	919-0106	ASSY PCB,MODLTD.OSC FX-50	1	
......3	000-3302	CAP,CER,DISC,3.3PF,1000V	1	C16
......3	001-5004	CAP,CER,DISC,5PF,500V,NPO	1	C15
......3	009-4723	CAP,CER CHIP,470PF,200V,5%	2	C3, C22

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	023-1076	CAP,LYTIC,10uF,50V,STDUP	1	C6
......3	023-1084	CAP,LYTIC,100MFD,35V,STDUP,RAD	2	C4, C7
......3	040-1213	CAP,MICA,12PF,500V,5%	1	C2
......3	042-3312	CAP,MICA,33PF,500V,5%	2	C1, C8
......3	042-3922	CAP,MICA,390PF,100V,5%	9	C5, C9, C10, C11, C12, C13, C14, C17, C18
......3	100-1031	RES,100 OHM,1/4W,1%,METAL	2	R12, R6
......3	100-1041	RES,1K OHM,1/4W,1%	3	R7, R13, R14
......3	100-1111	RES,118 OHM,1/4W,1%	1	R22
......3	100-4561	RES,453K OHM,1/4W,1%	1	R10
......3	103-1007	RES,1 MEG OHM,1/4W,1%,METAL	1	R9
......3	103-1021	RES,10 OHM,1/4W,1%,METAL	4	R1, R11, R15, R20
......3	103-1062	RES,100K OHM,1/4W,1%,METAL	1	R5
......3	103-2213	RES,221 OHM,1/4W,1%,METAL	5	R4, R17, R18, R19, R21
......3	103-2673	RES,267 OHM,1/4W,1%,METAL	1	R8
......3	103-2744	RES,2.74K OHM,1/4W,1%,METAL	1	R16
......3	103-3324	RES,3.32K OHM,1/4W,1%,METAL	1	R3
......3	103-5112	RES,51.1 OHM,1/4W,1%,METAL	2	R23, R24
......3	201-2800	DIODE,HOT CARRIER	3	D9, D10, D11
......3	203-4005	DIODE,1N4005	1	D12
......3	205-0109	DIODE,VARI-CAP TUNING	6	D2, D3, D4, D6, D7, D8
......3	205-3201	DIODE,VARACTOR,KV3201 2-11PF	2	D1, D5
......3	211-0006	MPS-A06 NPN 80V .5A .3W 100MHZ	1	Q1
......3	211-5109	TSTR,RF 2N5109 NPN	2	Q4, Q5
......3	212-0310	TSTR,FET N CHAN RF J3100	2	Q2, Q3
......3	360-3300	CHOKE,RF,3.3UH,380MA,9230-32	3	L1, L3, L6
......3	364-0047	COIL, MOLDED .47UH	2	L4, L5

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	370-0106	COIL, MOD OSC., L2	1	L2
........4	555-0106	LABOR, 370-0106	1	
........4	610-0026	SMALL TRANS LINE	0.708	
......3	409-0012	PAD,TSTR 520-021 BIVAR TO-5	2	
......3	413-1597	TERM,TURRET,2 SHLDR,.219,GOLD FLASH	6	E1, E2, E3, E4, E5, E6
......3	440-0018	STOFF,ANTI ROT 7/32 RND X 1/4	4	
......3	519-0106	PCB,BLANK,MODLTD.OSC. (scan)	1	
....2	949-1050	ASSY, CABLE, MOD OSC. (SBCM)	1	
......3	402-0051	TY-RAP, W/FLAG	1	
......3	417-0165	HSNG,5POS MOD IV S.ROW 87499-9	1	
......3	417-0224	KEYING PLUG MOD IV 87077 AMP	1	
......3	417-8766	CONTACT,CRIMP,MOD-IV 87809-1	4	
......3	611-1250	TUB,HT SHK,1/8	2	
......3	621-1359	CBL,COAX,RG316/U,50 OHM	2	
..1	959-0415	ASSY,RF AMP,FM-250C	1	
....2	008-1033	CAP,FEEDTHRU,1000PF,20%,500V	5	
....2	009-1513	CAP,CER CHIP,15PF,500V,5%	1	C44,
....2	009-4723	CAP,CER CHIP,470PF,200V,5%	4	C27, C28, C29, C30
....2	130-3333	RES,330 OHM,2W,5%	1	R1
....2	210-0151	TSTR,RF PWR MOSFET,MRF-151G	1	Q4
....2	213-6198	TSTR,RF PWR,2N6198	1	Q1
....2	229-2830	AMP,RF,HYBRID,MHW5342A	1	U1
....2	360-0003	FERRITE BEAD,.291 DIA	17	
....2	370-0052	XFMR,RF AMP OUTPUT,FM-3C	1	T1
....2	370-0721	INPUT TRANSFORMER	1	W2
....2	400-0207	STRIP,QUIET SHIELD,.250x.375""	0.22	
....2	402-0000	TY-RAP	2	

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
....2	402-0835	CLAMP,CBL,3/8	1	
....2	407-0119	MOUNT,PUSH,CBL TIE PM-1	2	
....2	407-0186	TOOL,ADJ 8 T000/5 SPECTROL	1	
....2	415-1010	FUSE CLIP,LITTLEFUSE,101002	2	
....2	417-0017	RECP,BNC,BULKHEAD,UG-492A/U	1	
....2	417-0133-001	WIRE STUFFER CAP,#230707-1,AMP	1	
....2	420-0305	SCREW,4-40X.375,BR PH SC	2	
....2	420-0504	SCREW,6-32X.375,BR PH SC	6	
....2	420-0509	SCREW,10-32X.500,BR SL PAN HD	1	
....2	420-4105	SCREW,4-40X.312,S.S. PH	2	
....2	420-6104	SCREW,6-32X.250,S.S. PH	1	
....2	420-6105	SCREW,6-32X.312,S.S. PH	1	
....2	420-6106	SCREW,6-32X.375,S.S. PH	16	
....2	420-6108	SCREW,6-32X.500,S.S. PH	4	
....2	420-6131	SCREW,6-32X.875,BR PH SC	2	
....2	420-6604	SCREW,6-32X.250,S.S. PH FH UC	2	
....2	420-8109	SCREW,8-32X.250,BR PH	4	
....2	421-0801	#10-32 BR HEX NUT	1	
....2	421-6908	SHEET EDGE CONNECTOR 6-32	7	
....2	421-8002	8-32 HEX NUT, BRASS	1	
....2	423-0005	#10 LOCK SPLIT (BRONZE)	1	
....2	423-1012	#4 LOCK INT TOOTH (BRONZE)	2	
....2	423-6002	#6 LOCK SPLIT	27	
....2	423-6004	#6 LOCK SPLIT (BRONZE)	8	
....2	423-6011	#6 FLAT .310 X .160 X .030	8	
....2	423-8005	#8 LOCK SPLIT	4	
....2	450-0651	PLUG,HOLE,5/16	2	
....2	455-0049-003	HEATSINK,RF AMP,FM250C	1	

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	455-0049-001	HEATSINK,RF AMP,FX50	1	
......3	555-0049-003	COST,LABOR 455-0049-003	1	
....2	471-2504	COVER,RF AMP, FM-250C	1	
......3	471-2504-009	COVER,RF AMP (UNSCREENED) FM-250C	1	
....2	471-2505	PLATE, BACK, RF AMP, FM-250C	1	
....2	471-2506	SHIELD,LOW PASS FILTER, FM-250C	1	
....2	471-2511	SHIELD,LOW PASS FILTER,RF AMP	1	
....2	471-2513	STRIP,CLIP-ON,RF AMP	1	
....2	474-0301	PLATE,FRT,RF AMP PCB COVER	1	
....2	594-0500	LABEL,DANGER	1	
....2	919-0410-025	ASSY,PCB,RF AMP INPUT,FM-250C	1	
......3	003-1523	CAP,MONO CER,.0015uF,100V,5%	2	C44, C45,
......3	024-2274	CAP,LYTIC,22UF,100V,STDUP	2	C16, C42,
......3	038-4753	CAP,PYST,.47UF,100V	1	C17,
......3	040-5612	CAP,MICA,56PF,350V,10%	1	C43,
......3	040-6813	CAP,MICA,68PF,500V,5%	1	C9,
......3	042-2000	CAP,MICA,200PF,350V,10%	2	C10, C11,
......3	042-3922	CAP,MICA,390PF,100V,5%	6	C5, C6, C7, C8, C15, C24,
......3	046-0003	CAP,MICA,RF,80PF,350V,10%	2	C13, C14,
......3	046-0005	CAP,MICA,150PF,350V,10%	1	C12,
......3	046-0022	CAP,MICA,RF,22PF	1	C18,
......3	100-1051	RES,10K OHM,1/4W,1%	2	R4, R2,
......3	100-1231	RES,121 OHM,1/4W,1%	1	R27,
......3	100-2041	RES,2K OHM,1/4W,1%	2	R5, R12,
......3	103-1021	RES,10 OHM,1/4W,1%,METAL	2	R28, R14,
......3	103-2212	RES,22.1 OHM,1/4W,1%,METAL	1	R8,
......3	103-2945	RES,29.4K OHM,1/4W,1%,METAL	1	R10,

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	103-4755	RES,47.5K OHM,1/4W,1%,METAL	1	R3,
......3	103-5112	RES,51.1 OHM,1/4W,1%,METAL	1	R7,
......3	110-3623	RES,36 OHM,1/2W,5%	1	R6,
......3	130-2223	RES,22 OHM,2W,5%	1	R9,
......3	177-1055	RES,TRMR,10K,10 TURN TOP ADJ	1	R11,
......3	211-3904	TSTR,2N3904	1	Q2,
......3	218-0032	TSTR,TIP32A,2N6125	1	Q3
......3	330-0200	FUSE,3AG,2 AMP	1	F1,
......3	364-0002	CHOKE,VK200-20/4B FERROXCUBE	2	L1, L4,
......3	364-0010	CHOKE,MOLDED RF 10UHY 10%	1	L3,
......3	364-0051	COIL,MOLDED .051UH	1	L2,
......3	410-0025	TERM,MALE DISCONNECT PC .25TAB	1	E101,
......3	415-2068	CLIP,FUSE,15AMP,LITTLEFUSE,102071	2	
......3	417-0677	CONN,PCB MT,6PIN MALE	1	J16,
......3	417-5022	SKT,LEAD .020 D,SAMTEC SEP-266	1	XU1,
......3	519-0426	PCB,MACH,RF AMP INPUT, FM-100C	1	
......3	640-1800	WIRE AWG 18 EN MAGNET	0.031	L5,
....2	919-0427	ASSY,PCB,RF AMP OUTPUT BD,FM-250C	1	
......3	009-1032	CAP,CER CHIP,1000PF,100V,5%	3	C19, C20, C21,
......3	009-1033	CAP,CER CHIP,1000PF,500V,5%	1	C38,
......3	046-1030	CAP,METAL FEED,1000PF,350V,10%	1	C31
......3	101-2243	RES,CHIP,2.2K OHM,1/4W,5%	3	R15, R16, R17,
......3	111-2223	RES,CHIP,22 OHM,1W,5%	4	R18, R19, R20, R21,
......3	130-1023	RES,10 OHM,2W,5%	1	R29,
......3	220-0035	IC,LM35DZ CELSIUS TEMP SENSOR	1	U2,
......3	360-0146	CHOKE,RF AMP DECOUPLING,FM-1C	1	L6
........4	640-1400	WIRE,14GA,MAGNET	0.04	
......3	410-0025	TERM,MALE DISCONNECT PC .25TAB	1	E102,

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	417-0133	TERM,BARREL .125 552699-4 AMP	1	E103,
......3	519-0427	PCB,MACH,RF AMP OUTPUT BD,FM-250C	1	
......3	600-0008	FLEXSTRIP, 7 COND 1	1	P24,
....2	919-0428	ASSY,PCB,LPF/COUPLER BD,FM-250C	1	
......3	003-3312	CAP,CER,33PF,100V,5%	2	C220, C221,
......3	009-1013-001	CAP,CER CHIP,10pF,500V,2%	3	C201, C212, C213,
......3	009-1032	CAP,CER CHIP,1000PF,100V,5%	5	C215, C216, C217, C218, C219,
......3	009-1503	CAP,CER CHIP,1.5pF,500V,+1-.250pF	2	C222, C214,
......3	009-1513-001	CAP,CER CHIP,15pF,500V,2%	4	C204, C205, C209, C208,
......3	009-5613	CAP,CER CHIP,56PF,500V,5%	1	C223,
......3	009-8003-001	CAP,CER CHIP,8.2pF,500V,3%	4	C203, C206, C202, C207,
......3	096-0010	CAP,TRMR,CER,2-8PF,350V,LUG MNT,NPO	1	C211,
......3	100-1051	RES,10K OHM,1/4W,1%	4	R204, R205, R209, R203,
......3	100-1231	RES,121 OHM,1/4W,1%	1	R210,
......3	103-1561	RES,150K OHM,1/4W,1%,METAL	1	R207,
......3	103-4996	RES,499K OHM,1/4W,1%,METAL	1	R201,
......3	103-5141	RES,5.11K OHM,1/4W,1%,METAL	1	R202,
......3	103-6040	RES,60.4 OHM,1/4W,1%,METAL	1	R206,
......3	177-1035	RES,TRMR,100 0HM,25T TOP 3299W	1	R208,
......3	201-2800	DIODE,HOT CARRIER	3	D201, D202, D203,
......3	360-0145	COIL,L1,FM-1C LPF (SBCM)	1	L204,
........4	640-1200	WIRE,12GA,MAGNET	0.035	
......3	360-0147	COIL,3.5 TURNS,LPF,FM100C (SBCM)	1	L203,
........4	601-0111	12 AWGBUSS .080 FLOOR STOCK FT	0.45	
......3	360-0148	COIL,4.5 TURNS,LPF,FM100C (SBCM)	2	L202, L201,
........4	601-0111	12 AWGBUSS .080 FLOOR STOCK FT	0.51	

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	400-1259	GROMMET,3/8 OD X 5/32 ID #1259	1	
......3	402-0000	TY-RAP	2	
......3	519-0428	PCB,MACH,LPF/COUPLER BD,FM-250C	1	
......3	600-0008	FLEXSTRIP, 7 COND 1	1	J201,
......3	949-0415	WIRE HARNESS LPF FM-250C (SBCM)	1	
........4	402-0051	TY-RAP, W/FLAG	2	
........4	417-8029	CONN,JACK,BULKHEAD,SMA,HEX CRIMP	1	
........4	417-8031	CONN,PLUG,STRAIGHT,SMA,HEX CRIMP	1	
........4	418-0031	PLUG,N FOR RG-58/142B/U	1	
........4	418-0034	PLUG,BNC DUAL CRIMP 1-227079-6	1	
........4	611-1250	TUB,HT SHK,1/8	1.75	
........4	621-0001	CBL,COAX TEFLON RG 142B/U BELD	1	
........4	621-1359	CBL,COAX,RG316/U,50 OHM	1	
....2	949-0414	WIRE HARNESS,RF AMP, FM-250C (SBCM)	1	
......3	402-0000	TY-RAP	12	
......3	402-0051	TY-RAP, W/FLAG	3	
......3	410-0051	LUG,TERM,14-16GA,FEMSPADE	2	
......3	410-0060	LUG,TERM,#10 RING CRIMP 10-12G	1	
......3	410-1553	LUG,TERM #10 RING CRIMP 16-22	1	
......3	417-0053	SKT,CONN 641294-1 AMP	46	
......3	417-0176	CONN,20 PIN FEM,AMP 1-350245-9	2	P15, P20,
......3	418-0026	PLUG,KEYING 350591-1 AMP	1	
......3	418-0034	PLUG,BNC DUAL CRIMP 1-227079-6	1	W1
......3	418-0670	HOUSING,CONN,6PIN FEM	1	P16
......3	601-1604	WIRE,AWG16, 19/29 YEL	0.75	
......3	601-1800	WIRE,AWG18 19/30 BLK	17	
......3	601-2209	WIRE,AWG22,7/30 WHT	12	
......3	621-1359	CBL,COAX,RG316/U,50 OHM	0.65	

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
..1	969-0007-100	KIT, HARDWARE RACK FM-100C/250C	1	
....2	402-0001	TY-RAP,T+B TY24M,1-1/4 DIA	4	
....2	420-0108	SCREW,10-32X.500,S.S. PHH	4	
....2	420-0508	SCREW,10-32X.500,S.S. FLH	8	
....2	420-8110	SCREW,8-32X.625,S.S. PHH	4	
....2	421-0102	10-32 KEP NUT	8	
....2	423-0001	WASHER,FLAT,#10 SST,.438 X .203 X .065	8	
....2	459-0138	RETAINER,SLIDE BRKT	2	
....2	469-0415	SLIDE, EXCITER CHASSIS	1	
....2	470-0238	BRKT,MTG,APC+IPA,FM1.5A	4	
....2	701-0005	ANTISTATIC ZIPLOC BAG 4X6 4MIL	1	
..1	979-0250-309	KIT, ACCESSORY PARTS, FM-250E	1	
....2	682-0003	CORD,PWR EUROPEAN RIGHT ANGLE, 6'	1	
....2	701-0001	ENVELOPE,COIN 2-1/2 X 4-1/4	1	
....2	701-0019	ANTISTATIC ZIPLOC BAG 13X18 4M	1	
....2	947-0020	ASSY,CBL BNC ACCESS (SBCM)	2	
......3	417-0094	CONN,BNC RG/U58 31-320 AMPH	2	
......3	622-0050	CBL,SH,50 OHM,RG-58/CU	2.5	
....2	979-9984	KIT,BIND+MAN,FM-250C	1	
......3	597-1004	INSTRUCTION MANUAL, FM 250C FM EXCITER/TRANSMITTER	1	
......3	598-0010-001	BINDER,1 IN, BLUE,W CD POCKET	1	

13.2 FM-250C, 220V

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
0	909-1251-504	FM-250C,50 TO 250 WATT,220V,NICKEL GRAY		
..1	330-0800-001	FUSE,8A,250V,3AG,SLO-BLO	2	

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
..1	330-1000	FUSE,MDA 10A 250V SLO-BLO	-2	
..1	682-0001	CORD LINE,3 COND,DETACH 7.5FT	-1	
..1	682-0003	CORD,PWR EUROPEAN RIGHT ANGLE, 6'	1	
..1	909-1251-404	FM-250C,50 TO 250 WATT FM XMTR W/EXCITER & LPF,NICKEL GRAY	1	
....2	140-0036	VARISTOR,V275LA20A	2	
....2	330-0401	FUSE,MDA 4A 250V CER SLO-BLO	1	
....2	330-1000	FUSE,MDA 10A 250V SLO-BLO	1	
....2	330-1500-001	FUSE, 15A, 250V, CERAMIC, SLO-BLOW	1	
....2	360-0003	FERRITE BEAD,.291 DIA	2	
....2	370-0250	XMFR,POWER,FM-250C XMTR	1	
....2	380-4600	FAN,4 1/2	1	
....2	380-5502	FILTER,FAN	1	
....2	380-6307	FINGER GUARD,FAN,4.125 CENTERS	1	
....2	400-2170	GROMMET,FOR 3/8	1	
....2	402-0000	TY-RAP	12	
....2	402-0006	MT,ADH BACKED,FOR CBL TIES	1	
....2	402-0008	MTG DEVICE,FOR #6SCR,TIE CBL	1	
....2	402-0051	TY-RAP, W/FLAG	1	
....2	402-0831	CLAMP,CBL 1/2	1	
....2	410-0050	LUG,TERM,10-12GA,FEMSPADE	2	
....2	410-0051	LUG,TERM,14-16GA,FEMSPADE	3	
....2	415-1010	FUSE CLIP,LITTLEFUSE,101002	2	
....2	415-1011	FUSE CLIP,LITTLEFUSE,105002	1	
....2	415-2012	FUSEHOLDER,PANEL MOUNT, 10A	1	
....2	415-2012-020	FUSEHOLDER,PANEL MOUNT, 20A	1	
....2	417-0016	CONN,BNC,RF,UG1094A/U,AMPHENOL	2	
....2	417-0017	RECP,BNC,BULKHEAD,UG-492A/U	1	

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
....2	417-0372	CONTACT,CONN,FC112N2	4	
....2	417-0420	CONN, FEM, 4 POSITION, POWER-LOK, WIRE	1	
....2	417-0432	CONTACT, FEMALE, POWER-LOK, 20-24 AWG	4	
....2	417-6500	MODULE,IEC 5 FUNCTION	1	
....2	418-0035	ADPTR,JACK-JACK 82-66 AMPHENOL	1	
....2	420-0817	ASSY,FEMALE SCREWLOCK 205817-1	1	
....2	420-1145	SCREW,1/4-20X4.5,PPHS SST	1	
....2	420-4105	SCREW,4-40X.312,S.S. PH	2	
....2	420-4110	SCREW,4-40X.625,S.S. PH	4	
....2	420-4406	SCREW,4-40X.375,S.S. PH UC	2	
....2	420-6104	SCREW,6-32X.250,S.S. PH	7	
....2	420-6105	SCREW,6-32X.312,S.S. PH	6	
....2	420-6106	SCREW,6-32X.375,S.S. PH	24	
....2	420-6108	SCREW,6-32X.500,S.S. PH	3	
....2	420-8006	SCREW,8-32X.375,S.S. PH FLH UC	4	
....2	420-8107	SCREW,8-32X.437,S.S. PHH	8	
....2	420-8124	SCREW,8-32X1.000,S.S. PHH	4	
....2	421-1001	1/4-20 S.S. HEX NUT	3	
....2	421-1102	RIV,BLD,DOMED 3/32	2	
....2	421-1113	RIV,CLOSED-END .125 X .316L	1	
....2	421-4008	4-40 KEP NUT	8	
....2	421-6001	6-32 S.S. HEX THIN NUT	2	
....2	421-6008	6-32 KEP NUT	11	
....2	421-8028	NUT,JAM,1/2-28 UNEF-2B	5	
....2	422-6106	SCREW,SEMS 6-32 X 3/8 PAN PH. ST."	12	
....2	422-6107	SCREW,SEMS 6-32 X 7/16 PAN PH.ST."	1	
....2	423-1001	1/4 FLAT .500 X .255 X .050	3	

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
....2	423-1002	1/4 LOCK SPLIT	3	
....2	423-1026	WASH,FENDER,1/4ID,1 1/4OD	1	
....2	423-3004	5/16 LOCK INT TOOTH THIN	2	
....2	423-6002	#6 LOCK SPLIT	31	
....2	423-6011	#6 FLAT .310 X .160 X .030	2	
....2	423-8002	#8 LOCK SPLIT	12	
....2	423-9002	WASH,INT TOOTH,1/2	5	
....2	441-0131	STOFF,ALUM 1/4HEX 5/16M/FEM632	6	
....2	441-8217	STOFF,ALUM 1/4HEX X 5/8 6-32	5	
....2	465-0090-101	ANGLE,UPPER FRT PNL,CE EXCITER	1	
....2	465-0091-100	ANGLE,LOWER FRT PNL,FX50	1	
....2	466-0093	ANGLE,FRONT PANEL MOUNT,FX50	2	
....2	467-0178	BOOT,INSULATING FOR 360-6504	1	
....2	467-1003	OVERLAY,FX50	1	
....2	469-0365	FINGER STOCK,1S197520A	32	
....2	469-0365-1	STRIP,RFI SHIELD	2	
......3	469-0365	FINGER STOCK,1S197520A	2.75	
....2	469-0366-1	STRIP,RFI SHIELD 1.25	4	
......3	469-0366	FINGER STOCK (NOTE!!!!!)	1.25	
....2	469-0366-2	STRIP,RFI SHIELD 4.25	6	
......3	469-0366	FINGER STOCK (NOTE!!!!!)	4.25	
....2	471-0360	COVER,AFC/PLL PCB FX50	1	
......3	471-0360-009	COVER,AFC/PLL PCB UNSCREENED	1	
....2	471-0584-100	COVER,TOP,FM250C/E	1	
....2	471-0795	SHIELD,FRONT PANEL PCB,FX-50	1	
......3	471-0795-009	SHLD,FRT PNL PCB,FX-50,UNSCRND	1	
....2	471-0954-301	PANEL,STATUS,FM250C,HD COLOR	1	

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	471-0954-309	PANEL,STATUS,FM100C/FM250C,HD COLOR,UNSCREENED	1	
....2	471-0965	GUARD, AFC/PLL, FM100C	2	
....2	471-2500-100	PANEL,REAR,FM250C/E,SCREENED	1	
....2	471-2501-100	CHASSIS,FM-250C/E	1	
....2	471-2509	SHIELD,TOROID,FM-250C	1	
....2	471-2510	SHIELD,PWR CONNECTOR,FM-250C	1	
....2	471-5122	SHIELD, AFC/PLL, FM250C	1	
....2	471-5123	SHIELD, MOD OSC, FM250C	1	
....2	471-5289-003	BRACKET,FUSE HOLDER,FM250,SCREENED T	1	
......3	471-5289	BRACKET,FUSE HOLDER,FX50,FM100,FM250,UNSCREENED	1	
....2	486-0004	HANDLE 1 3/4	2	
....2	486-0014	FERRULE,BLK,FOR .25 DIA HANDLE	4	
....2	488-0010	LATCH,LO-PROFILE 27-10-501-50	2	
....2	591-0001	PLATE,FCC ID	1	
....2	594-0095	LABEL,1EC LINE RCPT 700-0152	1	
....2	594-0250	LABEL,CAUTION,TOP COVER,FM EXC	1	
....2	601-1802	WIRE,AWG18,19/30 RED (*NOTE)	0.25	
....2	611-0061	TUB,HT SHK CLEAR 3/64	0.33	
....2	611-2500	TUB,HT SHK,1/4	0.13	
....2	611-5000	TUB,HT SHK 1/2	0.417	
....2	690-1200	TUB,BLK,PVC 105C,1/2	0.02	
....2	919-0104	ASSY PCB,AFC/PLL	1	
......3	000-3302	CAP,CER,DISC,3.3PF,1000V	1	C59
......3	001-5004	CAP,CER,DISC,5PF,500V,NPO	4	C15, C16, C56, C57

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	003-1054	CAP,CER,MNLY,.1uF,50V,20%	24	C1, C3, C5, C6, C7, C8, C10, C12, C13, C21, C24, C27, C32, C33, C39, C43, C51, C55, C58, C60, C61, C64, C66, C41
......3	020-4793	CAP,LYTIC,4700UF,16V,LOW LEAK	1	C35
......3	023-1076	CAP,LYTIC,10uF,50V,STDUP	5	C42, C68, C70, C72, C73
......3	023-1084	CAP,LYTIC,100MFD,35V,STDUP,RAD	11	C4, C15, C22, C23, C25, C49, C50, C52, C53, C69, C71
......3	024-1064	CAP,LYTIC,1UF,50V,RAD	1	C29
......3	024-3364	CAP,LYTIC,3.3UF,50V,NP	1	C30
......3	024-3374	CAP,LYTIC,33UF,35V,STDUP	1	C37
......3	024-4764	CAP,LYTIC,4.7UF,50V,20%,STDUP	1	C28
......3	030-1053	CAP,MYLAR FILM,.1uF,100V,RAD	1	C31
......3	030-2253	CAP,MYLAR FILM,.22UF,100V,RAD	4	C34, C38, C48, C54
......3	031-1043	CAP,MYLAR FILM,.01UF,100V,RAD	3	C9, C11, C40
......3	031-2243	CAP,MYLAR FILM,.022UF,200V,RAD	1	C26
......3	038-4753	CAP,PYST,.47UF,100V	1	C44
......3	040-2422	CAP,MICA,240PF	3	C45, C46, C47
......3	042-2531	CAP,MICA,2500PF,500V,1%	1	C62
......3	042-3312	CAP,MICA,33PF,500V,5%	2	C65, C67
......3	042-3922	CAP,MICA,390PF,100V,5%	6	C2, C17, C18, C19, C20, C36
......3	042-5031	CAP,MICA,5000PF,500V,1%	1	C63
......3	100-1031	RES,100 OHM,1/4W,1%,METAL	1	R22
......3	100-1041	RES,1K OHM,1/4W,1%	7	R10, R42, R40, R44, R23, R84, R85
......3	100-1051	RES,10K OHM,1/4W,1%	15	R6, R13, R37, R15, R16, R24, R46, R47, R48, R95, R75, R76, R50, R103, R67,

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	100-1111	RES,118 OHM,1/4W,1%	1	R32
......3	100-1231	RES,121 OHM,1/4W,1%	3	R21, R97, R99
......3	100-1551	RES,15K OHM,1/4W,1%	4	R25, R26, R27, R51
......3	100-1731	RES,174 OHM,1/4W,1%	1	R59
......3	100-2723	RES,27 OHM,1/4W,5%	1	R34
......3	100-3031	RES,301 OHM,1/4W,1%	1	R57
......3	100-3951	RES,39.2K OHM,1/4W,1%	1	R9
......3	100-4773	RES,4.7MEG OHM,1/4W,5%	1	R43
......3	100-5041	RES,4.99K OHM,1/4W,1%	4	R29, R30, R88, R90
......3	100-5663	RES,560K OHM,1/4W,5%	1	R19
......3	103-1007	RES,1 MEG OHM,1/4W,1%,METAL	8	R71, R72, R79, R77, R86, R89, R70, R78
......3	103-1021	RES,10 OHM,1/4W,1%,METAL	1	R1
......3	103-1062	RES,100K OHM,1/4W,1%,METAL	5	R17, R18, R64, R65, R66
......3	103-1215	RES,12.1K OHM,1/4W,1%,METAL	1	R11
......3	103-1331	RES,1.33K OHM,1/4W,1%,METAL	2	R98, R100
......3	103-1375	RES,13.7K OHM,1/4W,1%,METAL	1	R101
......3	103-1504	RES,1.5K OHM,1/4W,1%,METAL	1	R28,
......3	103-1745	RES,17.4K OHM,1/4W,1%,METAL	1	R82
......3	103-1825	RES,18.2K OHM,1/4W,1%,METAL	1	R92
......3	103-2213	RES,221 OHM,1/4W,1%,METAL	1	R33
......3	103-2673	RES,267 OHM,1/4W,1%,METAL	5	R7, R14, R38, R93, R94
......3	103-3014	RES,3.01K OHM,1/4W,1%,METAL	1	R83
......3	103-3323	RES,332 OHM,1/4W,1%,METAL	2	R2, R8
......3	103-3324	RES,3.32K OHM,1/4W,1%,METAL	2	R4, R5
......3	103-3631	RES,365 OHM,1/4W,1%,METAL	1	R20
......3	103-3836	RES,383K OHM,,1/4W,1%,METAL	1	R39

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	103-4361	RES,432K OHM,1/4W,1%,METAL	1	R53
......3	103-4753	RES,475 OHM,1/4W,1%,METAL	2	R45, R61
......3	103-4755	RES,47.5K OHM,1/4W,1%,METAL	1	R31
......3	103-4951	RES,49.9K OHM,1/4W,1%,METAL	2	R36, R12
......3	103-5112	RES,51.1 OHM,1/4W,1%,METAL	2	R3, R74
......3	103-5113	RES,511 OHM,1/4W,1%,METAL	1	R49
......3	103-5624	RES,5.62K OHM,1/4W,1%,METAL	1	R41
......3	103-6193	RES,619 OHM,1/4W,1%,METAL	1	R87
......3	103-6194	RES,6.19K OHM,1/4W,1%,METAL	2	R54, R62
......3	103-6346	RES,634K OHM,1/4W,1%,METAL	1	R60
......3	103-7326	RES,732K OHM,1/4W,1%,METAL	1	R58
......3	103-7503	RES,750 OHM,1/4W,1%,METAL	1	R55
......3	103-7541	RES,7.50K OHM,1/4W,1%,METAL	2	R68, R80
......3	103-8255	RES,82.5K OHM,1/4W,1%,METAL	1	R35
......3	103-8256	RES,825K OHM,1/4W,1%,METAL	1	R56
......3	175-1034	RES,TRMR,1K,VERT ADJ	1	R63
......3	177-5044	RES,TRMR,5K,VERT ADJ	3	R69, R81, R91
......3	177-5054	RES,TRMR,50K,VERT ADJ	1	R52
......3	200-0009	DIODE,ZENER,1N 4739A	2	D17, D19
......3	203-4005	DIODE,1N4005	2	D16, D18
......3	203-4148	DIODE,1N4148	7	D1, D2, D3, D4, D5, D6, D7,
......3	211-3904	TSTR,2N3904	4	Q1, Q2, Q3, Q4
......3	220-0317	VR,LM317LZ TO92	1	U6
......3	220-4040	IC,MC14040B 12-BIT BINARY	1	U2
......3	220-5151	IC,MC145151 SYNTHESIZER	1	U9
......3	220-8658	IC,SP8658 PRESCALER,DIVIDE/20	1	U8
......3	221-0072	AMP,OP,BIFET TLO72CP	1	U11

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	221-0358	AMP,DUAL OP,LM358	1	U13
......3	221-5532-001	IC,NE-5532AN	4	U10, U14, U15, U16
......3	226-0392	RES NETWORK, 10K	2	R73, R96
......3	227-0317	VR,LM317T,LM317KC	1	U17
......3	227-0337	VOLTAGE REGULATOR,3 TERM, NEG	1	U18
......3	228-0290	IC, 74LS90N (N)	1	U1
......3	228-4013	IC,MC14013B	1	U4
......3	228-4073	IC,MC14073B	1	U3
......3	228-4538	IC,MC14538B NATL SEMICONDUCTOR	2	U5, U12
......3	323-7345	LDR,LED TYPE,VACTEC VTL 5C2	3	LDR1, LDR2, LDR3
......3	323-9224	IND,LED,GRN,521-9270	5	DS1, DS2, DS3, DS4, DS5
......3	340-0002	SW,4 POS,SPST,8-PIN DIP	3	S1, S2, S3
......3	340-0004	SW,JUMPER PROGRAMMABLE	5	P3, P4, P5A, P5B, P10
......3	360-2200	CHOKE,RF 2.2UH 550MA	2	L1, L2
......3	364-0047	COIL, MOLDED .47UH	1	L3
......3	370-0002	XMFR,RF,MCL,T4-1 (NOTE)	1	T1
......3	390-0001	OSC,XTAL PC MT TCXO 10MHZ	1	Y1
......3	402-0000	TY-RAP	2	
......3	407-0074	SPR,LED .25 ODX.147 1D X.22L	5	
......3	413-1597	TERM,TURRET,2 SHLDR,.219,GOLD FLASH	5	
......3	417-0003	CONN,HEADER 3 PIN	3	J3.J4, J10
......3	417-0004	JACK,TEST,RIGHT ANGLE PC MT	1	TP1
......3	417-0200	CONN,HEADER 20 PIN	2	J5, J8, J2, J1,
......3	417-0804	SOCKET,8-PIN DIP,BURNDY	6	XU10, XU11, XU13, XU14, XU15, XU16
......3	417-1404	SOCKET,14-PIN DIP	3	XU1, XU3, XU4
......3	417-1604	SKT,16-PIN,DIP	5	XU2, XU5, XU12, XR73, XR96

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	417-2804	SOCKET,IC 28-PIN,DIP,HI RELIABILITY	1	XU9
......3	420-6104	SCREW,6-32X.250,S.S. PH	2	
......3	423-6002	#6 LOCK SPLIT	2	
......3	426-6000	PEM NUT,#6-32 KFS2-632	6	
......3	519-0104	PCB,BLANK,AFC/PLL (scan)	1	
......3	700-0148	TAPE,JOINING 3/4	0.001	
......3	949-1050-001	ASSY, CABLE, AFC-PLL (SBCM)	1	
........4	402-0051	TY-RAP, W/FLAG	1	
........4	418-0034	PLUG,BNC DUAL CRIMP 1-227079-6	1	
........4	621-1359	CBL,COAX,RG316/U,50 OHM	1.25	
........4	690-0023	TUB,PVC105/7 BLK,ALPHA	1.25	
....2	919-0108-250	ASSY,PCB,METERING,FM-250	1	
......3	001-5004	CAP,CER,DISC,5PF,500V,NPO	2	C8, C11,
......3	003-1054	CAP,CER,MNLY,.1uF,50V,20%	33	C2, C3, C4, C9, C10, C15, C17, C18, C19, C24, C27, C28, C30, C31, C34, C35, C36, C37, C38, C39, C40, C41, C42, C43, C44, C45, C50, C52, C54, C56, C57, C61, C63,
......3	020-1085	CAP,LYTIC,100UF,50V,STDUP,NP	1	C1,
......3	023-1076	CAP,LYTIC,10uF,50V,STDUP	9	C12, C32, C33, C51, C53, C55, C58, C60, C62,
......3	023-1084	CAP,LYTIC,100MFD,35V,STDUP,RAD	4	C46, C47, C48, C49
......3	024-2274	CAP,LYTIC,22UF,100V,STDUP	1	C59,
......3	030-3353	CAP,POLY FILM,.033UF,200V,10%	1	C29,
......3	031-1043	CAP,MYLAR FILM,.01UF,100V,RAD	1	C13,
......3	040-5013	CAP,MICA,50PF,500V,5%	1	C26,
......3	042-3312	CAP,MICA,33PF,500V,5%	1	C14,

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	042-3922	CAP,MICA,390PF,100V,5%	5	C6, C7, C16, C23, C25,
......3	100-1013	RES,1 OHM,1/4W,5%	2	R113, R114,
......3	100-1041	RES,1K OHM,1/4W,1%	16	R16, R18, R20, R44, R47, R51, R98, R99, R100, R101, R102, R103, R104, R105, R106, R107
......3	100-1051	RES,10K OHM,1/4W,1%	14	R8, R19, R23, R29, R38, R42, R52, R60, R66, R67, R68, R69, R70, R71,
......3	100-1083	RES,10MEG OHM,1/4W,5%	1	R26,
......3	100-1111	RES,118 OHM,1/4W,1%	1	R110,
......3	100-1231	RES,121 OHM,1/4W,1%	4	R78, R80, R82, R88, R108,
......3	100-1551	RES,15K OHM,1/4W,1%	1	R57,
......3	100-2041	RES,2K OHM,1/4W,1%	1	R40,
......3	100-2283	RES,22MEG OHM,1/4W,5%	2	R21, R37,
......3	100-3161	RES,316K OHM,1/4W,1%	1	R10,
......3	100-3373	RES,3.3MEG OHM,1/4W,5%	1	R59,
......3	100-3951	RES,39.2K OHM,1/4W,1%	1	R48,
......3	100-6031	RES,604 OHM,1/4W,1%	1	R89,
......3	103-1007	RES,1 MEG OHM,1/4W,1%,METAL	3	R9, R39, R54,
......3	103-1021	RES,10 OHM,1/4W,1%,METAL	3	R33, R34, R36,
......3	103-1024	RES,1.02K OHM,1/4W,1%,METAL	2	R46, R49,
......3	103-1062	RES,100K OHM,1/4W,1%,METAL	8	R5, R31, R53, R64, R65, R87, R97, R111,
......3	103-1105	RES,11K OHM,1/4W,1%,METAL	2	R7, R50,
......3	103-1214	RES,1.21K OHM,1/4W,1%,METAL	3	R90, R92, R94,
......3	103-1331	RES,1.33K OHM,1/4W,1%,METAL	2	R79, R81,
......3	103-1504	RES,1.5K OHM,1/4W,1%,METAL	1	R25,

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	103-1826	RES,182K OHM,1/4W,1%,METAL	1	R58,
......3	103-2003	RES,200 OHM,1/4W,1%,METAL	2	R75, R76,
......3	103-2264	RES,2.26K OHM,1/4W,1%,METAL	1	R109,
......3	103-2495	RES,24.9K OHM,1/4W,1%,METAL	1	R45,
......3	103-2673	RES,267 OHM,1/4W,1%,METAL	1	R63,
......3	103-2675	RES,26.7K OHM,1/4W,1%,METAL	3	R22, R84, R86,
......3	103-3061	RES,301K OHM,1/4W,1%,METAL	1	R24,
......3	103-3631	RES,365 OHM,1/4W,1%,METAL	1	R83,
......3	103-4755	RES,47.5K OHM,1/4W,1%,METAL	4	R61, R62, R85, R96,
......3	103-4951	RES,49.9K OHM,1/4W,1%,METAL	1	R55,
......3	103-4993	RES,499 OHM,1/4W,1%,METAL	3	R91, R93, R95,
......3	103-5112	RES,51.1 OHM,1/4W,1%,METAL	1	R77,
......3	103-5141	RES,5.11K OHM,1/4W,1%,METAL	1	R35,
......3	103-6193	RES,619 OHM,1/4W,1%,METAL	3	R72, R73, R74,
......3	103-6343	RES,634 OHM,1/4W,1%,METAL	1	R1,
......3	103-6984	RES,6.98K OHM,1/4W,1%,METAL	1	R43,
......3	103-7503	RES,750 OHM,1/4W,1%,METAL	1	R3,
......3	103-8254	RES,8.25K OHM,1/4W,1%,METAL	1	R30,
......3	103-8255	RES,82.5K OHM,1/4W,1%,METAL	1	R27,
......3	103-9314	RES,9.31K OHM,1/4W,1%,METAL	1	R17,
......3	177-1054	RES,TRMR,10K,VERT ADJ	1	R56,
......3	177-2044	RES,TRMR,2K,VERT ADJ	1	R41,
......3	177-2054	RES,TRMR,20K,VERT ADJ	1	R28,
......3	200-4742	DIODE,ZENER,1N4742A	2	D18, D19,
......3	201-2800	DIODE,HOT CARRIER	3	D3, D4, D24,
......3	203-4005	DIODE,1N4005	3	D20, D21, D23,
......3	203-4148	DIODE,1N4148	9	D1, D2, D8, D9, D15, D16, D22, D26, D27,

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	210-0271	TSTR,FET J271	1	Q7,
......3	210-3906	2N3906 PNP 40V 2A .35W 250MHZ	2	Q4, Q5,
......3	211-3904	TSTR,2N3904	2	Q1, Q6,
......3	220-0317	VR,LM317LZ TO92	1	U17,
......3	220-7136	A/D,3-1/2 DIGIT LCD,ICL7136CPL	1	U7,
......3	221-0074	AMP,OP,BIFET TLO74CW	2	U1, U2,
......3	221-4227	AMP,DUAL OP	1	U4,
......3	225-0004	IC,CD4066BE	2	U3, U6,
......3	226-0392	RES NETWORK, 10K	1	R32,
......3	226-2004	MC1416,ULN2004 7-DRLNGTNS DP16	1	U12,
......3	227-0317	VR,LM317T,LM317KC	2	U14, U22,
......3	227-0337	VOLTAGE REGULATOR,3 TERM, NEG	2	U15, U16,
......3	228-4028	IC,MC14028B	1	U11,
......3	228-4071	IC,MC14070 QUAD EXCLUSIVE OR	1	U13,
......3	228-4076	IC,MC14076 QUAD REGISTER	1	U10,
......3	228-4532	IC,MC14532B 8-BIT PRIOR ENCOD	1	U9,
......3	228-4538	IC,MC14538B NATL SEMICONDUCTOR	1	U8,
......3	229-0555	IC,TIMER,NE555N	1	U18,
......3	229-3914	DRIVER,DOT/BAR DISPLAY LM3914N	3	U19, U20, U21,
......3	320-0016	LED,GRN PANEL INDICATOR	7	DS2, DS3, DS4, DS5, DS18, DS19, DS20,
......3	320-0017	LED,RED MV57173 I OR H	9	DS1, DS6, DS7, DS8, DS13, DS14, DS15, DS16, DS17,
......3	320-0021	DISP,LCD,4-DIGIT,0.7	1	DS12,
......3	320-4164	LED ARRAY,GRN,10 BAR	2	DS9, DS10,
......3	320-7164	LED ARRAY RED MV57164 INTEN G OR H	1	DS11,
......3	340-0107	KEYSWITCH,SI20601H1 SECME (NOTE)	6	S1, S2, S3, S4, S5, S6,

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	402-0000	TY-RAP	1	
......3	413-0106	TERM,TEST POINT,OVAL,RED	8	E1, TP1, TP2, TP3, TP4, TP5, TP6, TP7,
......3	417-0172	SKT, 20 PIN SINGLE ROW,SAMTEC	2	
......3	417-0200	CONN,HEADER 20 PIN	1	J14,
......3	417-0804	SOCKET,8-PIN DIP,BURNDY	3	XU4, XU18, XU5
......3	417-1404	SOCKET,14-PIN DIP	5	XU1, XU2, XU3, XU6, XU13,
......3	417-1604	SKT,16-PIN,DIP	6	XU8, XU9, XU10, XU11, XU12, XR32,
......3	417-1804	SOCKET,18-PIN,DIP,HIGH RELIABILITY	3	XU19, XU20, XU21,
......3	417-4005	SOCKET,40-PIN,DIP,HIGH RELIABILITY	1	XU7
......3	420-6104	SCREW,6-32X.250,S.S. PH	4	
......3	423-6002	#6 LOCK SPLIT	4	
......3	426-6000	PEM NUT,#6-32 KFS2-632	4	
......3	449-0006	TEST CLIP,COILED	1	
......3	519-0108-250	PCB,BLANK,METERING (scan)	1	
....2	919-0190	ASSY,PCB,FM EXITER INTERFACE	1	
......3	103-5141	RES,5.11K OHM,1/4W,1%,METAL	1	R1
......3	340-0004	SW,JUMPER PROGRAMMABLE	1	P3Replaced 417-0309 on 06/21/2007 12:49:19
......3	412-1600	BARR STP,16 POS,BEAU	1	J2
......3	417-0003	CONN,HEADER 3 PIN	1	J3
......3	417-2503	RCPT,25 PIN D, MALE	1	J1
......3	519-0190	PCB,MACH,FM EXCITER INTERFACE	1	
....2	919-0429	ASSY,PCB, SWITCHING P.S. FM-250C	1	
......3	002-2013	CAP,CER,DISC,20PF,1KV,10%	4	C16, C41, C46, C56,
......3	003-1054	CAP,CER,MNLY,.1uF,50V,20%	15	C4, C20, C24, C25, C30, C31, C32, C39, C40, C43, C44, C45, C54, C55, C60,

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	003-4712	CAP,CER,47PF,50V,5%	1	C63
......3	003-4733	CAP,MONO CER,.047uF,50V,5%	1	C53,
......3	003-4743	CAP,CER MNLY,.47uF,50V,10%	2	C61, C62
......3	020-1026	CAP,LYTIC,1000UF,35,RADIAL	4	C5, C6, C7, C10,
......3	020-2273	CAP,LYTIC,22UF,35V,RADIAL	1	C21,
......3	020-4785	CAP,LYTIC,470UF,100V,20%,STDUP	6	C2, C3, C28, C29, C50, C51,
......3	020-4795	CAP,LYTIC,4700UF,100V,20%,SNAP MT	7	C1, C26, C27, C33, C34, C35, C36,
......3	023-1076	CAP,LYTIC,10uF,50V,STDUP	12	C8, C9, C11, C12, C13, C14, C15, C17, C18, C22, C38, C58,
......3	024-1064	CAP,LYTIC,1UF,50V,RAD	1	C49,
......3	030-1043	CAP,CER MOLDED,.01uF,200V,RAD	2	C37, C52,
......3	040-1522	CAP,MICA,150PF,500V,RAD	1	C57
......3	040-2223	CAP,MICA,220PF,500V,RAD	1	C23
......3	041-1031	CAP,MICA,1000PF,100V,1%	5	C19, C42, C47, C48, C59,
......3	100-1051	RES,10K OHM,1/4W,1%	9	R2, R12, R13, R38, R42, R54, R85, R17, R63
......3	100-1231	RES,121 OHM,1/4W,1%	8	R6, R8, R10, R21, R29, R75, R77, R78,
......3	100-1841	RES,1.82K OHM,1/4W,1%	1	R32,
......3	100-2713	RES,2.7 OHM,1/4W,5%	2	R14, R15
......3	100-3051	RES,30.1K OHM,1/4W,1%	2	R50, R98
......3	100-3373	RES,3.3MEG OHM,1/4W,5%	3	R47, R74, R76,
......3	103-1007	RES,1 MEG OHM,1/4W,1%,METAL	4	R43, R51, R24, R56
......3	103-1056	RES,105K OHM,1/4W,1%,METAL	1	R90,
......3	103-1062	RES,100K OHM,1/4W,1%,METAL	2	R89, R94
......3	103-1215	RES,12.1K OHM,1/4W,1%,METAL	1	R28,

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	103-1331	RES,1.33K OHM,1/4W,1%,METAL	6	R7, R9, R22, R57, R80, R82,
......3	103-1376	RES,137K OHM,1/4W,1%,M	1	R100
......3	103-1404	RES,1.40K OHM,1/4W,1%,METAL	2	R71, R72,
......3	103-1693	RES,169 OHM,1/4W,1%,METAL	1	R92,
......3	103-2054	RES,2.05K OHM,1/4W,1%,METAL	1	R91,
......3	103-2211	RES,22.1K OHM,1/4W,1%,METAL	2	R4, R64,
......3	103-2212	RES,22.1 OHM,1/4W,1%,METAL	2	R33, R93
......3	103-2494	RES,2.49K OHM,1/4W,1%,METAL	6	R36, R39, R44, R45, R46, R27
......3	103-2495	RES,24.9K OHM,1/4W,1%,METAL	1	R68,
......3	103-2744	RES,2.74K OHM,1/4W,1%,METAL	2	R3, R5,
......3	103-3014	RES,3.01K OHM,1/4W,1%,METAL	10	R20, R25, R19, R37, R48, R53, R67, R81, R41, R99
......3	103-3631	RES,365 OHM,1/4W,1%,METAL	1	R11
......3	103-3922	RES,39.2 OHM,1/4W,1%,METAL	2	R34, R96
......3	103-4741	RES,4.75K OHM,1/4W,1%,METAL	2	R1, R30,
......3	103-4951	RES,49.9K OHM,1/4W,1%,METAL	3	R49, R52, R40,
......3	103-4996	RES,499K OHM,1/4W,1%,METAL	2	R66, R16,
......3	103-5112	RES,51.1 OHM,1/4W,1%,METAL	1	R31
......3	103-5141	RES,5.11K OHM,1/4W,1%,METAL	1	R18
......3	103-5764	RES,5.76K OHM,1/4W,1%,METAL	3	R86, R87, R88,
......3	103-5765	RES,57.6K OHM,1/4W,1%,METAL	1	R23,
......3	103-6813	RES,681 OHM,1/4W,1%,METAL	2	R83, R97
......3	110-2223	RES,22 OHM,1/2W,5%	1	R55,
......3	130-1033-300	RES,100 OHM,3W,1%	1	R79
......3	130-1053	RES,10K OHM,2W,5%	1	R95
......3	130-1843	RES,1.8K OHM,2W,5%	4	R59, R60, R61, R62,
......3	130-2223	RES,22 OHM,2W,5%	1	R73,

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	132-0114	RES,1.5 OHM,10W,5%,WW	1	R26,
......3	139-0007	RES,.005 OHM,5W,3%,WW	3	R35, R58, R69,
......3	140-0006	VARISTOR,V130LA10A,GE	1	MOV1,
......3	177-2035	RES,TRMR,200 OHM,25T TOP ADJ	1	R65,
......3	177-2045	RES,TRMR,2K,10T,TOP ADJ 3299W	1	R84
......3	200-0015	DIODE,ZENER,15V,1W,1N4744A	1	D34
......3	200-0024	DIODE,ZENER,24V,1W,5%,1N4749A	1	D30,
......3	200-0027	DIODE,ZENER,1N4750A,27V	1	D31,
......3	200-1620	DIODE,FAST RECOVERY,16JPF20	1	D17,
......3	200-4751	DIODE,ZENER,IN4751A 30V 1W	1	D1,
......3	203-4005	DIODE,1N4005	5	D4, D6, D8, D22, D23,
......3	203-4148	DIODE,1N4148	16	D5, D7, D9, D10, D11, D14, D15, D16, D18, D19, D20, D21, D27, D28, D29, D33
......3	210-0120	TSTR,TIP120 NPN SILICON PWR	1	Q2,
......3	210-0250	TSTR,IRFP250,MOSFET	1	Q7,
......3	210-0511	TSTR,IRF511,POWER MOSFET	1	Q13,
......3	210-6520	TSTR,PNP,300V TO-92,.5A	3	Q10, Q11, Q12,
......3	210-7000	TSTR,2N7000,MOSFET	7	Q3, Q4, Q9, Q5, Q6, Q17, Q18
......3	211-0006	MPS-A06 NPN 80V .5A .3W 100MHZ	4	Q1, Q8, Q15, Q16,
......3	219-0031	TSTR,TIP31A	1	Q19
......3	220-0035	IC,LM35DZ CELSIUS TEMP SENSOR	1	U10,
......3	220-0311	IC,LT311 LINEAR	1	U8,
......3	220-3799	IC,MPQ3799,TRANS ARRAY,PNP	1	Q14,
......3	221-0072	AMP,OP,BIFET TLO72CP	1	U13,
......3	221-0393	IC,LM393N,VOLT COMPARATOR	1	U9,
......3	226-0500	RES NET,5K 16-PIN DIP 1%	1	R70,

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	227-0317	VR,LM317T,LM317KC	3	U3, U4, U5,
......3	227-0337	VOLTAGE REGULATOR,3 TERM, NEG	1	U2,
......3	227-1074	IC,DC-DC CONVERTER,5A,60V,TO-220	1	U1,
......3	227-2125	IC,IR2125 HIGH SIDE DRVR, 500V	1	U7,
......3	228-3525	IC,SG3525AN,PWM CONTROL	1	U6,
......3	229-0111	IC,AC INPUT OPTO-ISOLATOR	2	U11, U12,
......3	229-0336	IC,VOLT REF DIODE LM336Z-2.5	1	D35
......3	230-0015	RECT,SILC,MR2406	2	D12, D13
......3	230-0020	RECT,ULTRAFAST,MUR820 8A 200V TO220	2	D2, D3,
......3	237-6508	SCR,2N6508	3	D24, D25, D32,
......3	239-0003	BRDG RECT,6PH20 EDI	1	D26,
......3	270-0065	REL,SPDT,12VDC,DIP	1	K1,
......3	360-2201	COIL,(L6),SWITCHING PWR SUPPLY (SBCM)	1	L6
........4	360-7157	TOROID,IRON PWDR,T157-52	1	
........4	555-2201	LABOR ONLT, 360-2201	1	
........4	640-1400	WIRE,14GA,MAGNET	0.174	
......3	360-2202	COIL,(L5),SWITCHING PWR SUPPLY (SBCM)	2	L5, L7,
........4	360-7068	TOROID,IRON PWDR,T68-52D	1	
........4	555-2202	LABOR ONLY 360-2202	1	
........4	640-1400	WIRE,14GA,MAGNET	0.014	
......3	364-0001	CHOKE,WBC2.5/A-3B1	3	L1, L2, L4,
......3	370-4701	XMFR,TOROID,(T1),SW PWR SUPPLY (SBCM)	1	T1
........4	360-7068	TOROID,IRON PWDR,T68-52D	1	
........4	555-4701	LABOR ONLY 370-4701	1	
........4	640-2200-1	WIRE,AWG 22,MAGNET,GRN	0.009	
........4	640-2200-2	WIRE,AWG 22,MAGNET,RED	0.009	
......3	402-0001	TY-RAP,T+B TY24M,1-1/4 DIA	2	

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	407-0132	WASH,SHOULDER #4 .215 OD POLY	10	
......3	409-0247	INSULATOR,TO-218/247,ADHESIVE BACK	2	
......3	413-0025	TERM,TURRET,2 SHLDR,.360,GOLD FLASH	2	XR69
......3	413-0106	TERM,TEST POINT,OVAL,RED	6	TP1, TP2, TP3, TP4, TP5, TP6
......3	417-0230	CONN,20-PIN,MR SERIES,PCB,AMP	1	J20,
......3	417-0370	CONN,MALE,PCB MT,PLB127690 (NOTE)	1	J11,
......3	417-0600	SKT,IC 6 PIN	2	XU11, XU12,
......3	417-0804	SOCKET,8-PIN DIP,BURNDY	3	XU7, XU8, XU9,
......3	417-1604	SKT,16-PIN,DIP	1	XU6,
......3	420-4107	SCREW,4-40X.437,S.S. PH	10	
......3	420-4108	SCREW,4-40X.500,S.S. PH	2	
......3	420-6106	SCREW,6-32X.375,S.S. PH	3	
......3	420-6108	SCREW,6-32X.500,S.S. PH	7	
......3	420-6110	SCREW,6-32X.625,S.S. PH	1	
......3	421-4001	4-40 S.S. HEX NUT	12	
......3	421-6001	6-32 S.S. HEX THIN NUT	1	
......3	421-6008	6-32 KEP NUT	3	
......3	421-6908	SHEET EDGE CONNECTOR 6-32	6	
......3	423-4001	#4 FLAT SS .250 X .125 X .018	10	
......3	423-4002	#4 LOCK S.S. SPLIT	12	
......3	423-6002	#6 LOCK SPLIT	11	
......3	423-6011	#6 FLAT .310 X .160 X .030	2	
......3	441-0009	SPR,PHENOLIC 1/4RND X 1/2 #6	14	
......3	455-0071	HEATSINK,CLIP-ON,PCB MT,TO-220	3	XD32, XU2, XU3,
......3	471-2507	HEATSINK,PCB,SWITCHING POWER SUPPLY	1	
......3	471-2514	HEATSINK,LT,SWITCHING PWR SPLY	1	
......3	471-2515	BRKT,HEATSINK SUPT,SW PWR SPLY	1	

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	519-0429	PCB,MACH,SWITCHING P.S. FM-25(scan)	1	
......3	700-0063	RTV,SEALANT 738 3 OZ DOW	0.001	
......3	DB68027	Sil Pad TO220 .75x.5" ADHSV Berquist 3223-07AC-58"	10	
....2	919-0430-250	ASSY,PCB,POWER CONTROL BD,FM-250C	1	
......3	003-1054	CAP,CER,MNLY,.1uF,50V,20%	19	C1, C2, C4, C5, C6, C7, C9, C10, C11, C12, C14, C15, C16, C19, C23, C27, C29, C30, C31,
......3	003-4743	CAP,CER MNLY,.47uF,50V,10%	1	C33,
......3	023-1084	CAP,LYTIC,100MFD,35V,STDUP,RAD	5	C22, C24, C25, C26, C28
......3	024-1064	CAP,LYTIC,1UF,50V,RAD	2	C17, C21,
......3	031-1043	CAP,MYLAR FILM,.01UF,100V,RAD	2	C18, C20,
......3	042-3322	CAP,MICA,330PF,500V,5%	2	C3, C8,
......3	100-1013	RES,1 OHM,1/4W,5%	1	R95,
......3	100-1024	RES,10 OHM,1/4W,5%,CARBON COMP	2	R64, R69,
......3	100-1031	RES,100 OHM,1/4W,1%,METAL	1	R3,
......3	100-1041	RES,1K OHM,1/4W,1%	12	R5, R21, R26, R38, R45, R55, R81, R82,
......3	100-1051	RES,10K OHM,1/4W,1%	6	R41, R51, R60, R75, R76, R84,
......3	100-1841	RES,1.82K OHM,1/4W,1%	1	R40,
......3	100-2041	RES,2K OHM,1/4W,1%	4	R13, R19, R30, R36,
......3	103-1007	RES,1 MEG OHM,1/4W,1%,METAL	4	R17, R34, R77, R83,
......3	103-1062	RES,100K OHM,1/4W,1%,METAL	10	R44, R46, R54, R56, R63, R65, R66, R79, R87, R88,
......3	103-1105	RES,11K OHM,1/4W,1%,METAL	2	R58, R61,
......3	103-1244	RES,1.24K OHM,1/4W,1%,METAL	1	R20,
......3	103-1261	RES,121K OHM,1/4W,1%,METAL	1	R70,

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	103-1551	RES,15.4K OHM,1/4W,1%,METAL	1	R2,
......3	103-1561	RES,150K OHM,1/4W,1%,METAL	2	R14, R31,
......3	103-2054	RES,2.05K OHM,1/4W,1%,METAL	1	R23,
......3	103-2241	RES,2.21K OHM,1/4W,1%,METAL	1	R80,
......3	103-2495	RES,24.9K OHM,1/4W,1%,METAL	3	R15, R32, R50,
......3	103-3014	RES,3.01K OHM,1/4W,1%,METAL	4	R6, R27, R39, R89,
......3	103-3325	RES,33.2K OHM,1/4W,1%,METAL	1	R78,
......3	103-3405	RES,34K OHM,1/4W,1%,METAL	1	R49,
......3	103-4024	RES,4.02K OHM,1/4W,1%,METAL	2	R62, R68,
......3	103-4224	RES,4.22K OHM,1/4W,1%,METAL	1	R86,
......3	103-4441	RES,4.42K OHM,1/4W,1%,METAL	3	R59, R92, R93,
......3	103-4755	RES,47.5K OHM,1/4W,1%,METAL	4	R71, R72, R73, R74,
......3	103-4874	RES,4.87K OHM,1/4W,1%,METAL	1	R43,
......3	103-4951	RES,49.9K OHM,1/4W,1%,METAL	1	R85,
......3	103-4996	RES,499K OHM,1/4W,1%,METAL	2	R1, R22,
......3	103-5495	RES,54.9K OHM,1/4W,1%,METAL	1	R37,
......3	103-6814	RES,6.81K OHM,1/4W,1%,METAL	1	R24,
......3	103-6984	RES,6.98K OHM,1/4W,1%,METAL	2	R18, R35,
......3	103-7505	RES,75K OHM,1/4W,1%,METAL	1	R53,
......3	103-7541	RES,7.50K OHM,1/4W,1%,METAL	1	R94,
......3	103-8663	RES,866 OHM,1/4W,1%,METAL	1	R42,
......3	103-9315	RES,93.1K OHM,1/4W,1%,METAL	2	R8, R29,
......3	110-1043	RES,1K OHM,1/2W,5%	3	R47, R48, R57,
......3	177-1054	RES,TRMR,10K,VERT ADJ	2	R7, R28,
......3	178-1054	RES,TRMR,10K,HORZ ADJ	2	R4, R25,
......3	178-2044	RES,TRMR,2K,HORZ ADJ	1	R52,
......3	178-5046	RES,TRMR,5K,1/2W,MT	1	R67,
......3	200-0015	DIODE,ZENER,15V,1W,1N4744A	1	D9,

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	200-4733	DIODE,ZENER,1N4733A, 5%	2	D7, D12,
......3	203-4005	DIODE,1N4005	2	D6, D11,
......3	203-4148	DIODE,1N4148	7	D1, D2, D4, D5, D8, D10, D13,
......3	210-3906	2N3906 PNP 40V 2A .35W 250MHZ	1	Q2,
......3	210-7000	TSTR,2N7000,MOSFET	1	Q3,
......3	211-3904	TSTR,2N3904	1	Q1
......3	220-3183	IC,CA3183 5 TRANS ARRAY NPN	2	U3, U4,
......3	221-0074	AMP,OP,BIFET TLO74CW	2	U1, U2,
......3	221-0358	AMP,DUAL OP,LM358	3	U5, U6, U7,
......3	227-7905-A	IC,VR,MC79L05,-5V,T0-92 CASE	1	U9
......3	229-0336	IC,VOLT REF DIODE LM336Z-2.5	1	D3
......3	340-0004	SW,JUMPER PROGRAMMABLE	7	P1, P2, P3, P4, P6, P7, P8,
......3	345-0863	SW,SLD,DPDT,SWCFT C56206L2	2	S1, S2,
......3	413-0106	TERM,TEST POINT,OVAL,RED	15	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15,
......3	417-0003	CONN,HEADER 3 PIN	7	J6, J7, J8,
......3	417-0169	CONN 15 PIN 640503-1 AMP	2	J12, J13,
......3	417-0200	CONN,HEADER 20 PIN	0.3	J5,
......3	417-0804	SOCKET,8-PIN DIP,BURNDY	3	XU5, XU6, XU7,
......3	417-1276	CONN,PCB,12 PIN	1	J10,
......3	417-1404	SOCKET,14-PIN DIP	2	XU1, XU2,
......3	417-1604	SKT,16-PIN,DIP	2	XU3, XU4,
......3	418-0900	CONN,9 PIN 640501-5 AMP	1	J21,
......3	519-0430	PCB,MACH,POWER CONTROL BD,FM-(scan)	1	
....2	919-0445	ASSY,PCB,RFI FILTER (SBCM)	1	
......3	002-1034	CAP,CER,DISC,.001UF,1000V	3	C301, C302, C303

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	003-1054	CAP,CER,MNLY,.1uF,50V,20%	8	C304, C305, C306, C307, C308, C309, C310, C311
......3	031-2033	CAP,MYLAR FILM,.0022uF,100V,10%	2	C312, C313,
......3	038-4750	CAP,POLY,.47MFD,50V,10% OR BETTER	2	C324, C325
......3	040-1022	CAP,MICA,100PF,500V,RAD	10	C314, C316, C318, C320, C322, C326, C327, C328, C329, C330
......3	047-1035	CAP,FIL,EMI SUPPR,1000pF,3-PIN	3	FL312, FL313, FL319
......3	100-1041	RES,1K OHM,1/4W,1%	3	R302, R306, R307,
......3	100-1051	RES,10K OHM,1/4W,1%	1	R303,
......3	100-6031	RES,604 OHM,1/4W,1%	1	R308,
......3	103-5112	RES,51.1 OHM,1/4W,1%,METAL	2	R310, R311
......3	103-8254	RES,8.25K OHM,1/4W,1%,METAL	2	R304, R305,
......3	130-2423	RES,240 OHM,2W,5%	2	R301, R309,
......3	201-0012	ZENER VOLTAGE SUPPRESSOR,+/-12V	12	D310, D311, D312, D313, D314, D315, D316, D317, D318, D319, D320, D321
......3	201-0027	ZENER VOLTAGE SUPPRESSOR,+/-27V	4	D302, D303, D304, D305
......3	201-0040	ZENER VOLTAGE SUPPRESSOR,+/-18V	4	D306, D307, D308, D309
......3	203-4005	DIODE,1N4005	1	D301,
......3	270-0065	REL,SPDT,12VDC,DIP	1	K301,
......3	340-0004	SW,JUMPER PROGRAMMABLE	2	P308, P309
......3	364-4662	INDU,1.0MH	2	L303, L305,

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	411-0001	FILTER,EMI 10,000PF 3PIN	21	FL301, FL302, FL303, FL304, FL305, FL306, FL307, FL308, FL309, FL310, FL311, FB312, FB313, FL314, FL315, FL316, FL319, FL320, FL321, FL322, FL323
......3	417-0003	CONN,HEADER 3 PIN	2	J308, J309
......3	417-0039-VLX	CONN,BNC,PCB,VERT MOUNT,VALOX BODY	5	J305, J301, J302, J303, J304
......3	417-0200	CONN,HEADER 20 PIN	1	J307,
......3	417-1276	CONN,PCB,12 PIN	1	J306
......3	417-2502-FER	RCPT,25 PIN D,FEMALE,FERITE FILTER	1	J1
......3	420-6105	SCREW,6-32X.312,S.S. PH	10	
......3	423-6002	#6 LOCK SPLIT	20	
......3	426-6000	PEM NUT,#6-32 KFS2-632	10	
......3	441-0184	STOFF,6-32,MALE-FEMALE,3/8	10	
......3	519-0445-001	PCB,MACH,RFI FILTER	1	
........4	519-0445	PCB,MACH,RFI FILTER BREAKAWAY	0.5	
......3	519-0445-002	PCB,MACH,RFI FILTER SHIELD	1	
........4	519-0445	PCB,MACH,RFI FILTER BREAKAWAY	0.5	
....2	949-0413-002	WIRE HARNESS,FM250 (SBCM)	1	
......3	402-0000	TY-RAP	40	
......3	402-0051	TY-RAP, W/FLAG	12	
......3	410-0015	LUG,TERM #8 RING CRIMP 12-10	1	
......3	410-1552	LUG,TERM #8 RING CRIMP 16-22	1	
......3	410-1553	LUG,TERM #10 RING CRIMP 16-22	1	
......3	417-0036	PIN CONN,AMP,350967-1	18	
......3	417-0053	SKT,CONN 641294-1 AMP	41	

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	417-0059	CONN,9 PIN 1-640521-0 AMP	1	P21,
......3	417-0122	HSNG,20 POS MOD IV 3-87499-7	2	
......3	417-0123	HSNG,16 POS MOD IV 2-87499-9	1	
......3	417-0148	HSNG,10 POS MOD 1V 1-87499-7	1	
......3	417-0175	CONN, HOUSING, 20 PIN	1	
......3	417-0224	KEYING PLUG MOD IV 87077 AMP	2	
......3	417-0371	CONN,FEM,PLB12F0000,POSITRONIC	1	
......3	417-0372	CONTACT,CONN,FC112N2	3	
......3	417-0381	CONTACT,CONN,MC112N 7690	4	
......3	417-0421	CONN, MALE, 4 POSITION, POWER-LOK, WIRE	1	
......3	417-2379	CONN,155OC HOUSING,AMP,MR	2	P13, P12,
......3	417-8500	PLUG AND CORD ET,AM500 FAN	1	
......3	417-8766	CONTACT,CRIMP,MOD-IV 87809-1	52	
......3	418-0034	PLUG,BNC DUAL CRIMP 1-227079-6	2	
......3	418-1271	CONN,HOUSING,12PIN	2	P306, P10,
......3	601-1202	WIRE,AWG12 19/25 RED	1	
......3	601-1604	WIRE,AWG16, 19/29 YEL	2.2	
......3	601-1604-006	WIRE,AWG 16,STRANDED,LIGHT BLUE	0.3	
......3	601-1800	WIRE,AWG18 19/30 BLK	17	
......3	601-1800-006	WIRE,AWG 18,STRANDED,LIGHT BLUE	1.5	
......3	601-1800-054	WIRE,AWG 18,STRANDED,GREEN/YELLOW	3	
......3	601-2209	WIRE,AWG22,7/30 WHT	79.5	
......3	611-1875	TUB,HT SHK,3/16	1.6	
......3	621-1359	CBL,COAX,RG316/U,50 OHM	6	
......3	622-8451	WIRE,BELD 8451,SHIELD,1PR	10.5	
....2	959-0203	ASSY MODL,MODLTD. OSC. (SBCM)	1	
......3	008-1020	CAP,FEEDTHRU,100PF 20% 250V	1	C21

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	008-1033	CAP,FEEDTHRU,1000PF,20%,500V	2	C19, C20
......3	040-6223	CAP,MICA,620PF,300V,5%	1	C23
......3	360-0003	FERRITE BEAD,.291 DIA	3	
......3	364-0002	CHOKE,VK200-20/4B FERROXCUBE	1	L7
......3	402-0000	TY-RAP	5	
......3	402-0006	MT,ADH BACKED,FOR CBL TIES	1	
......3	402-0008	MTG DEVICE,FOR #6SCR,TIE CBL	1	
......3	410-1419	LUG,SOLDER 7/8	1	
......3	417-0016	CONN,BNC,RF,UG1094A/U,AMPHENOL	2	J6, J9
......3	420-4404	SCREW,4-40X.250,S.S. SHCS	7	
......3	420-4504	SCREW,4-40X.250,S.S. PH	1	
......3	420-4506	SCREW,4-40X.375,BR FLH SC	4	
......3	423-4004	#4 LOCK EXT TOOTH	7	
......3	470-0328	BRKT,BNC,MOD OSC	1	
......3	479-6443-003	BOX,MOD.,MODULATED OSC FX50	1	
......3	601-0022	WIRE,AWG22,BUSS	0.166	
......3	611-2500	TUB,HT SHK,1/4	0.083	
......3	693-0220	TUB,TEFLON,TW,AWG22 NTL	0.249	
......3	919-0106	ASSY PCB,MODLTD.OSC FX-50	1	
........4	000-3302	CAP,CER,DISC,3.3PF,1000V	1	C16
........4	001-5004	CAP,CER,DISC,5PF,500V,NPO	1	C15
........4	009-4723	CAP,CER CHIP,470PF,200V,5%	2	C3, C22
........4	023-1076	CAP,LYTIC,10uF,50V,STDUP	1	C6
........4	023-1084	CAP,LYTIC,100MFD,35V,STDUP,RAD	2	C4, C7
........4	040-1213	CAP,MICA,12PF,500V,5%	1	C2
........4	042-3312	CAP,MICA,33PF,500V,5%	2	C1, C8
........4	042-3922	CAP,MICA,390PF,100V,5%	9	C5, C9, C10, C11, C12, C13, C14, C17, C18

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
........4	100-1031	RES,100 OHM,1/4W,1%,METAL	2	R12, R6
........4	100-1041	RES,1K OHM,1/4W,1%	3	R7, R13, R14
........4	100-1111	RES,118 OHM,1/4W,1%	1	R22
........4	100-4561	RES,453K OHM,1/4W,1%	1	R10
........4	103-1007	RES,1 MEG OHM,1/4W,1%,METAL	1	R9
........4	103-1021	RES,10 OHM,1/4W,1%,METAL	4	R1, R11, R15, R20
........4	103-1062	RES,100K OHM,1/4W,1%,METAL	1	R5
........4	103-2213	RES,221 OHM,1/4W,1%,METAL	5	R4, R17, R18, R19, R21
........4	103-2673	RES,267 OHM,1/4W,1%,METAL	1	R8
........4	103-2744	RES,2.74K OHM,1/4W,1%,METAL	1	R16
........4	103-3324	RES,3.32K OHM,1/4W,1%,METAL	1	R3
........4	103-5112	RES,51.1 OHM,1/4W,1%,METAL	2	R23, R24
........4	201-2800	DIODE,HOT CARRIER	3	D9, D10, D11
........4	203-4005	DIODE,1N4005	1	D12
........4	205-0109	DIODE,VARI-CAP TUNING	6	D2, D3, D4, D6, D7, D8
........4	205-3201	DIODE,VARACTOR,KV3201 2-11PF	2	D1, D5
........4	211-0006	MPS-A06 NPN 80V .5A .3W 100MHZ	1	Q1
........4	211-5109	TSTR,RF 2N5109 NPN	2	Q4, Q5
........4	212-0310	TSTR,FET N CHAN RF J3100	2	Q2, Q3
........4	360-3300	CHOKE,RF,3.3UH,380MA,9230-32	3	L1, L3, L6
........4	364-0047	COIL, MOLDED .47UH	2	L4, L5
........4	370-0106	COIL, MOD OSC., L2	1	L2
..........5	555-0106	LABOR, 370-0106	1	
..........5	610-0026	SMALL TRANS LINE	0.708	
........4	409-0012	PAD,TSTR 520-021 BIVAR TO-5	2	
........4	413-1597	TERM,TURRET,2 SHLDR,.219,GOLD FLASH	6	E1, E2, E3, E4, E5, E6

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
........4	440-0018	STOFF,ANTI ROT 7/32 RND X 1/4	4	
........4	519-0106	PCB,BLANK,MODLTD.OSC. (scan)	1	
......3	949-1050	ASSY, CABLE, MOD OSC. (SBCM)	1	
........4	402-0051	TY-RAP, W/FLAG	1	
........4	417-0165	HSNG,5POS MOD IV S.ROW 87499-9	1	
........4	417-0224	KEYING PLUG MOD IV 87077 AMP	1	
........4	417-8766	CONTACT,CRIMP,MOD-IV 87809-1	4	
........4	611-1250	TUB,HT SHK,1/8	2	
........4	621-1359	CBL,COAX,RG316/U,50 OHM	2	
....2	959-0415	ASSY,RF AMP,FM-250C	1	
......3	008-1033	CAP,FEEDTHRU,1000PF,20%,500V	5	
......3	009-1513	CAP,CER CHIP,15PF,500V,5%	1	C44,
......3	009-4723	CAP,CER CHIP,470PF,200V,5%	4	C27, C28, C29, C30
......3	130-3333	RES,330 OHM,2W,5%	1	R1
......3	210-0151	TSTR,RF PWR MOSFET,MRF-151G	1	Q4
......3	213-6198	TSTR,RF PWR,2N6198	1	Q1
......3	229-2830	AMP,RF,HYBRID,MHW5342A	1	U1
......3	360-0003	FERRITE BEAD,.291 DIA	17	
......3	370-0052	XFMR,RF AMP OUTPUT,FM-3C	1	T1
......3	370-0721	INPUT TRANSFORMER	1	W2
......3	400-0207	STRIP,QUIET SHIELD,.250x.375""	0.22	
......3	402-0000	TY-RAP	2	
......3	402-0835	CLAMP,CBL,3/8	1	
......3	407-0119	MOUNT,PUSH,CBL TIE PM-1	2	
......3	407-0186	TOOL,ADJ 8 T000/5 SPECTROL	1	
......3	415-1010	FUSE CLIP,LITTLEFUSE,101002	2	
......3	417-0017	RECP,BNC,BULKHEAD,UG-492A/U	1	
......3	417-0133-001	WIRE STUFFER CAP,#230707-1,AMP	1	

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	420-0305	SCREW,4-40X.375,BR PH SC	2	
......3	420-0504	SCREW,6-32X.375,BR PH SC	6	
......3	420-0509	SCREW,10-32X.500,BR SL PAN HD	1	
......3	420-4105	SCREW,4-40X.312,S.S. PH	2	
......3	420-6104	SCREW,6-32X.250,S.S. PH	1	
......3	420-6105	SCREW,6-32X.312,S.S. PH	1	
......3	420-6106	SCREW,6-32X.375,S.S. PH	16	
......3	420-6108	SCREW,6-32X.500,S.S. PH	4	
......3	420-6131	SCREW,6-32X.875,BR PH SC	2	
......3	420-6604	SCREW,6-32X.250,S.S. PH FH UC	2	
......3	420-8109	SCREW,8-32X.250,BR PH	4	
......3	421-0801	#10-32 BR HEX NUT	1	
......3	421-6908	SHEET EDGE CONNECTOR 6-32	7	
......3	421-8002	8-32 HEX NUT, BRASS	1	
......3	423-0005	#10 LOCK SPLIT (BRONZE)	1	
......3	423-1012	#4 LOCK INT TOOTH (BRONZE)	2	
......3	423-6002	#6 LOCK SPLIT	27	
......3	423-6004	#6 LOCK SPLIT (BRONZE)	8	
......3	423-6011	#6 FLAT .310 X .160 X .030	8	
......3	423-8005	#8 LOCK SPLIT	4	
......3	450-0651	PLUG,HOLE,5/16	2	
......3	455-0049-003	HEATSINK,RF AMP,FM250C	1	
........4	455-0049-001	HEATSINK,RF AMP,FX50	1	
........4	555-0049-003	COST,LABOR 455-0049-003	1	
......3	471-2504	COVER,RF AMP, FM-250C	1	
........4	471-2504-009	COVER,RF AMP (UNSCREENED) FM-250C	1	
......3	471-2505	PLATE, BACK, RF AMP, FM-250C	1	
......3	471-2506	SHIELD,LOW PASS FILTER, FM-250C	1	

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	471-2511	SHIELD,LOW PASS FILTER,RF AMP	1	
......3	471-2513	STRIP,CLIP-ON,RF AMP	1	
......3	474-0301	PLATE,FRT,RF AMP PCB COVER	1	
......3	594-0500	LABEL,DANGER	1	
......3	919-0410-025	ASSY,PCB,RF AMP INPUT,FM-250C	1	
........4	003-1523	CAP,MONO CER,.0015uF,100V,5%	2	C44, C45,
........4	024-2274	CAP,LYTIC,22UF,100V,STDUP	2	C16, C42,
........4	038-4753	CAP,PYST,.47UF,100V	1	C17,
........4	040-5612	CAP,MICA,56PF,350V,10%	1	C43,
........4	040-6813	CAP,MICA,68PF,500V,5%	1	C9,
........4	042-2000	CAP,MICA,200PF,350V,10%	2	C10, C11,
........4	042-3922	CAP,MICA,390PF,100V,5%	6	C5, C6, C7, C8, C15, C24,
........4	046-0003	CAP,MICA,RF,80PF,350V,10%	2	C13, C14,
........4	046-0005	CAP,MICA,150PF,350V,10%	1	C12,
........4	046-0022	CAP,MICA,RF,22PF	1	C18,
........4	100-1051	RES,10K OHM,1/4W,1%	2	R4, R2,
........4	100-1231	RES,121 OHM,1/4W,1%	1	R27,
........4	100-2041	RES,2K OHM,1/4W,1%	2	R5, R12,
........4	103-1021	RES,10 OHM,1/4W,1%,METAL	2	R28, R14,
........4	103-2212	RES,22.1 OHM,1/4W,1%,METAL	1	R8,
........4	103-2945	RES,29.4K OHM,1/4W,1%,METAL	1	R10,
........4	103-4755	RES,47.5K OHM,1/4W,1%,METAL	1	R3,
........4	103-5112	RES,51.1 OHM,1/4W,1%,METAL	1	R7,
........4	110-3623	RES,36 OHM,1/2W,5%	1	R6,
........4	130-2223	RES,22 OHM,2W,5%	1	R9,
........4	177-1055	RES,TRMR,10K,10 TURN TOP ADJ	1	R11,
........4	211-3904	TSTR,2N3904	1	Q2,

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
........4	218-0032	TSTR,TIP32A,2N6125	1	Q3
........4	330-0200	FUSE,3AG,2 AMP	1	F1,
........4	364-0002	CHOKE,VK200-20/4B FERROXCUBE	2	L1, L4,
........4	364-0010	CHOKE,MOLDED RF 10UHY 10%	1	L3,
........4	364-0051	COIL,MOLDED .051UH	1	L2,
........4	410-0025	TERM,MALE DISCONNECT PC .25TAB	1	E101,
........4	415-2068	CLIP,FUSE,15AMP,LITTLEFUSE,102071	2	
........4	417-0677	CONN,PCB MT,6PIN MALE	1	J16,
........4	417-5022	SKT,LEAD .020 D,SAMTEC SEP-266	1	XU1,
........4	519-0426	PCB,MACH,RF AMP INPUT, FM-100C	1	
........4	640-1800	WIRE AWG 18 EN MAGNET	0.031	L5,
......3	919-0427	ASSY,PCB,RF AMP OUTPUT BD,FM-250C	1	
........4	009-1032	CAP,CER CHIP,1000PF,100V,5%	3	C19, C20, C21,
........4	009-1033	CAP,CER CHIP,1000PF,500V,5%	1	C38,
........4	046-1030	CAP,METAL FEED,1000PF,350V,10%	1	C31
........4	101-2243	RES,CHIP,2.2K OHM,1/4W,5%	3	R15, R16, R17,
........4	111-2223	RES,CHIP,22 OHM,1W,5%	4	R18, R19, R20, R21,
........4	130-1023	RES,10 OHM,2W,5%	1	R29,
........4	220-0035	IC,LM35DZ CELSIUS TEMP SENSOR	1	U2,
........4	360-0146	CHOKE,RF AMP DECOUPLING,FM-1C	1	L6
..........5	640-1400	WIRE,14GA,MAGNET	0.04	
........4	410-0025	TERM,MALE DISCONNECT PC .25TAB	1	E102,
........4	417-0133	TERM,BARREL .125 552699-4 AMP	1	E103,
........4	519-0427	PCB,MACH,RF AMP OUTPUT BD,FM-250C	1	
........4	600-0008	FLEXSTRIP, 7 COND 1	1	P24,
......3	919-0428	ASSY,PCB,LPF/COUPLER BD,FM-250C	1	
........4	003-3312	CAP,CER,33PF,100V,5%	2	C220, C221,
........4	009-1013-001	CAP,CER CHIP,10pF,500V,2%	3	C201, C212, C213,

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
........4	009-1032	CAP,CER CHIP,1000PF,100V,5%	5	C215, C216, C217, C218, C219,
........4	009-1503	CAP,CER CHIP,1.5pF,500V,+1-.250pF	2	C222, C214,
........4	009-1513-001	CAP,CER CHIP,15pF,500V,2%	4	C204, C205, C209, C208,
........4	009-5613	CAP,CER CHIP,56PF,500V,5%	1	C223,
........4	009-8003-001	CAP,CER CHIP,8.2pF,500V,3%	4	C203, C206, C202, C207,
........4	096-0010	CAP,TRMR,CER,2-8PF,350V,LUG MNT,NPO	1	C211,
........4	100-1051	RES,10K OHM,1/4W,1%	4	R204, R205, R209, R203,
........4	100-1231	RES,121 OHM,1/4W,1%	1	R210,
........4	103-1561	RES,150K OHM,1/4W,1%,METAL	1	R207,
........4	103-4996	RES,499K OHM,1/4W,1%,METAL	1	R201,
........4	103-5141	RES,5.11K OHM,1/4W,1%,METAL	1	R202,
........4	103-6040	RES,60.4 OHM,1/4W,1%,METAL	1	R206,
........4	177-1035	RES,TRMR,100 0HM,25T TOP 3299W	1	R208,
........4	201-2800	DIODE,HOT CARRIER	3	D201, D202, D203,
........4	360-0145	COIL,L1,FM-1C LPF (SBCM)	1	L204,
..........5	640-1200	WIRE,12GA,MAGNET	0.035	
........4	360-0147	COIL,3.5 TURNS,LPF,FM100C (SBCM)	1	L203,
..........5	601-0111	12 AWGBUSS .080 FLOOR STOCK FT	0.45	
........4	360-0148	COIL,4.5 TURNS,LPF,FM100C (SBCM)	2	L202, L201,
..........5	601-0111	12 AWGBUSS .080 FLOOR STOCK FT	0.51	
........4	400-1259	GROMMET,3/8 OD X 5/32 ID #1259	1	
........4	402-0000	TY-RAP	2	
........4	519-0428	PCB,MACH,LPF/COUPLER BD,FM-250C	1	
........4	600-0008	FLEXSTRIP, 7 COND 1	1	J201,
........4	949-0415	WIRE HARNESS LPF FM-250C (SBCM)	1	
..........5	402-0051	TY-RAP, W/FLAG	2	

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
..........5	417-8029	CONN,JACK,BULKHEAD,SMA,HEX CRIMP	1	
..........5	417-8031	CONN,PLUG,STRAIGHT,SMA,HEX CRIMP	1	
..........5	418-0031	PLUG,N FOR RG-58/142B/U	1	
..........5	418-0034	PLUG,BNC DUAL CRIMP 1-227079-6	1	
..........5	611-1250	TUB,HT SHK,1/8	1.75	
..........5	621-0001	CBL,COAX TEFLON RG 142B/U BELD	1	
..........5	621-1359	CBL,COAX,RG316/U,50 OHM	1	
......3	949-0414	WIRE HARNESS,RF AMP, FM-250C (SBCM)	1	
........4	402-0000	TY-RAP	12	
........4	402-0051	TY-RAP, W/FLAG	3	
........4	410-0051	LUG,TERM,14-16GA,FEMSPADE	2	
........4	410-0060	LUG,TERM,#10 RING CRIMP 10-12G	1	
........4	410-1553	LUG,TERM #10 RING CRIMP 16-22	1	
........4	417-0053	SKT,CONN 641294-1 AMP	46	
........4	417-0176	CONN,20 PIN FEM,AMP 1-350245-9	2	P15, P20,
........4	418-0026	PLUG,KEYING 350591-1 AMP	1	
........4	418-0034	PLUG,BNC DUAL CRIMP 1-227079-6	1	W1
........4	418-0670	HOUSING,CONN,6PIN FEM	1	P16
........4	601-1604	WIRE,AWG16, 19/29 YEL	0.75	
........4	601-1800	WIRE,AWG18 19/30 BLK	17	
........4	601-2209	WIRE,AWG22,7/30 WHT	12	
........4	621-1359	CBL,COAX,RG316/U,50 OHM	0.65	
....2	969-0007-100	KIT, HARDWARE RACK FM-100C/250C	1	
......3	402-0001	TY-RAP,T+B TY24M,1-1/4 DIA	4	
......3	420-0108	SCREW,10-32X.500,S.S. PHH	4	
......3	420-0508	SCREW,10-32X.500,S.S. FLH	8	
......3	420-8110	SCREW,8-32X.625,S.S. PHH	4	
......3	421-0102	10-32 KEP NUT	8	

BOM LEVEL	PART NO.	DESCRIPTION	QTY	REF. DES.
......3	423-0001	WASHER,FLAT,#10 SST,.438 X .203 X .065	8	
......3	459-0138	RETAINER,SLIDE BRKT	2	
......3	469-0415	SLIDE, EXCITER CHASSIS	1	
......3	470-0238	BRKT,MTG,APC+IPA,FM1.5A	4	
......3	701-0005	ANTISTATIC ZIPLOC BAG 4X6 4MIL	1	
....2	979-0250	KIT,ACCESSORY PARTS,FM-250C	1	
......3	330-0401	FUSE,MDA 4A 250V CER SLO-BLO	1	
......3	330-1000	FUSE,MDA 10A 250V SLO-BLO	1	
......3	330-1500-001	FUSE, 15A, 250V, CERAMIC, SLO-BLOW	1	
......3	682-0001	CORD LINE,3 COND,DETACH 7.5FT	1	
......3	701-0001	ENVELOPE,COIN 2-1/2 X 4-1/4	3	
......3	701-0019	ANTISTATIC ZIPLOC BAG 13X18 4M	1	
......3	947-0020	ASSY,CBL BNC ACCESS (SBCM)	2	
........4	417-0094	CONN,BNC RG/U58 31-320 AMPH	2	
........4	622-0050	CBL,SH,50 OHM,RG-58/CU	2.5	
......3	979-9984	KIT,BIND+MAN,FM-250C	1	
........4	597-1004	INSTRUCTION MANUAL, FM 250C FM EXCITER/TRANSMITTER	1	
........4	598-0010-001	BINDER,1 IN, BLUE,W CD POCKET	1	

14 RF Technical Services Contact Information

RF Technical Services -

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

15 Drawings

The following pages present the FM-250C/E Transmitter drawings.

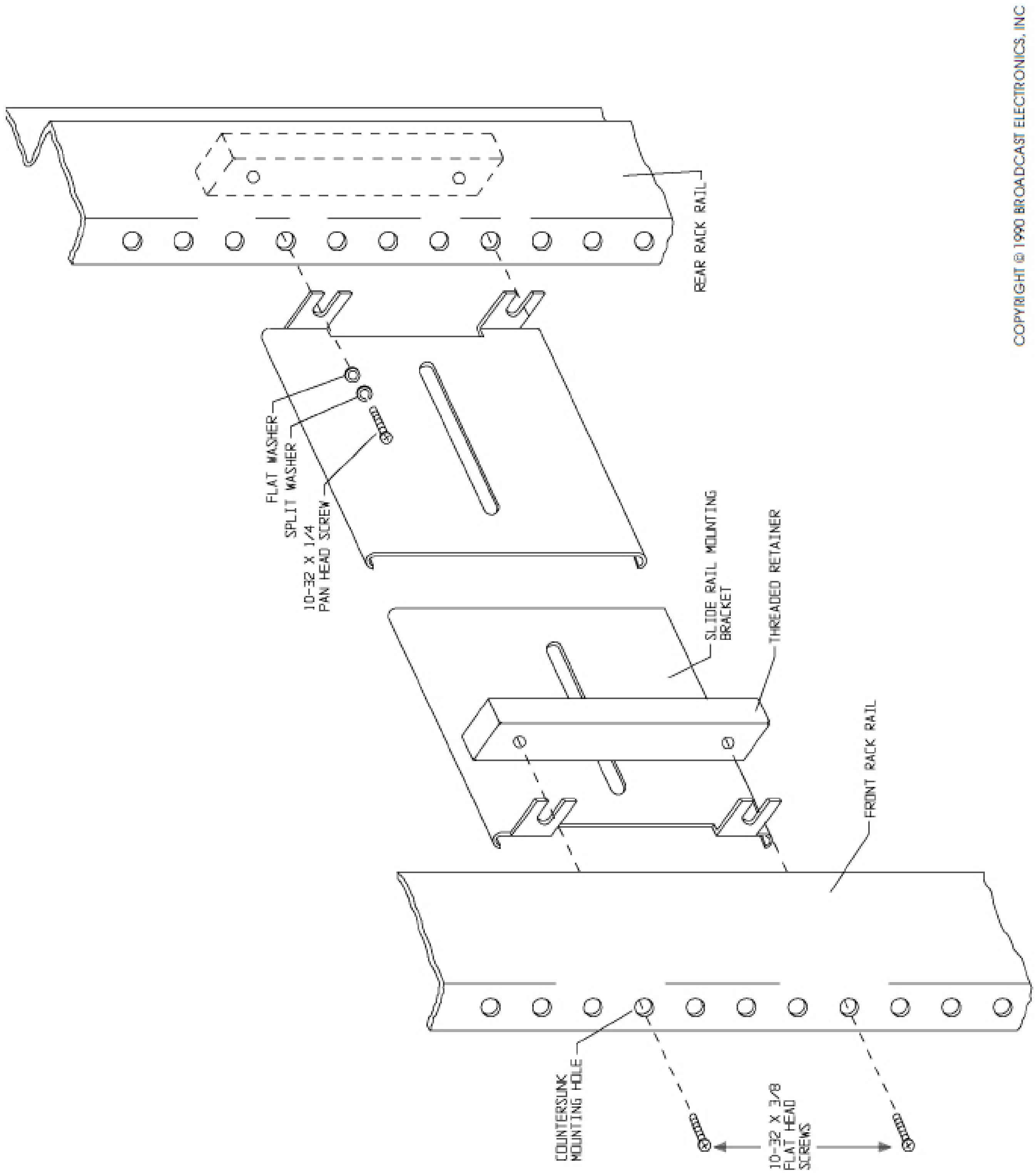
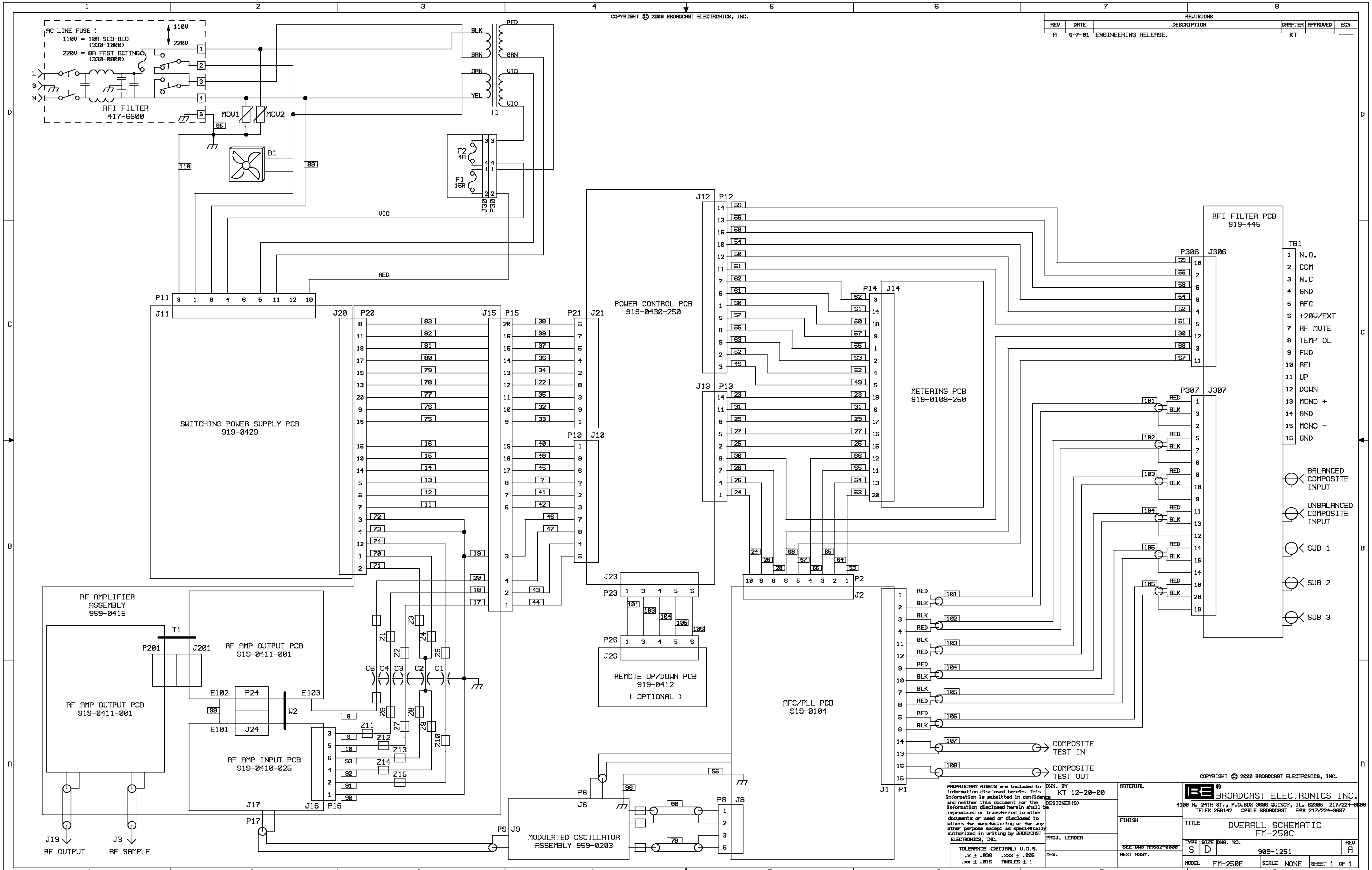


Figure 15-1. TRANSMITTER FRONT RAIL MOUNTING APPLICATIONS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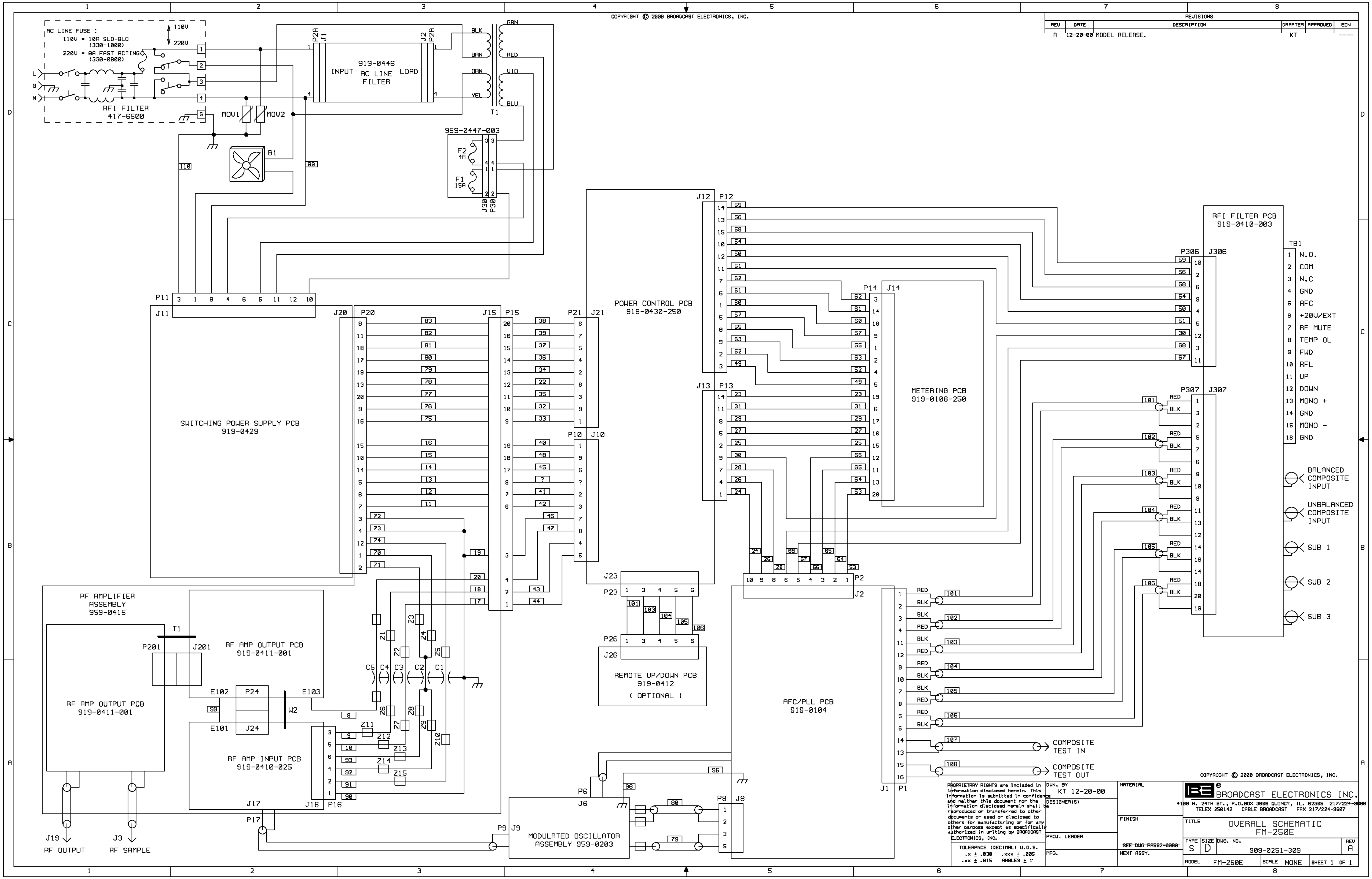
REVISIONS
REV DATE DESCRIPTION DRAFTER APPROVED ECN
A 5-7-01 ENGINEERING RELEASE. KT
AC LINE FUSE :
110V = 10A SLO-BLO (330-1000)
220V = 8A FAST ACTING (330-0800)
110V
220V
RFI FILTER
417-6500
MOV1
MOV2
B1
T1
BLK
BRN
ORN
YEL
RED
GRN
VIO
F2 4A
F1 15A
J30
P30
SWITCHING POWER SUPPLY PCB
919-0429
POWER CONTROL PCB
919-0430-250
METERING PCB
919-0108-250
RFI FILTER PCB
919-445
TB1
N.O.
COM
N.C
GND
AFC
+20V/EXT
RF MUTE
TEMP OL
FWD
RFL
UP
DOWN
MONO +
GND
MONO -
GND
BALANCED COMPOSITE INPUT
UNBALANCED COMPOSITE INPUT
SUB 1
SUB 2
SUB 3
RF AMPLIFIER ASSEMBLY
959-0415
RF AMP OUTPUT PCB
919-0411-001
RF AMP INPUT PCB
919-0410-025
REMOTE UP/DOWN PCB
919-0412
(OPTIONAL)
AFC/PLL PCB
919-0104
MODULATED OSCILLATOR ASSEMBLY 959-0203
COMPOSITE TEST IN
COMPOSITE TEST OUT
J19
RF OUTPUT
J3
RF SAMPLE
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
FM-250C
DWN. BY KT 12-20-00
PROJ. LEADER
TYPE S SIZE D DWG. NO. 909-1251 REV A
MODEL FM-250E SCALE NONE SHEET 1 OF 1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REVISIONS
REV DATE DESCRIPTION DRAFTER APPROVED ECN
A 12-20-00 MODEL RELEASE. KT ----
AC LINE FUSE :
110V = 10A SLO-BLO (330-1000)
220V = 8A FAST ACTING (330-0800)
110V
220V
RFI FILTER 417-6500
MOV1
MOV2
INPUT
919-0446 AC LINE FILTER
LOAD
T1
959-0447-003
F2 4A
F1 15A
B1
SWITCHING POWER SUPPLY PCB 919-0429
POWER CONTROL PCB 919-0430-250
METERING PCB 919-0108-250
RFI FILTER PCB 919-0410-003
TB1
N.O.
COM
N.C
GND
AFC
+20V/EXT
RF MUTE
TEMP OL
FWD
RFL
UP
DOWN
MONO +
GND
MONO -
GND
BALANCED COMPOSITE INPUT
UNBALANCED COMPOSITE INPUT
SUB 1
SUB 2
SUB 3
RF AMPLIFIER ASSEMBLY 959-0415
RF AMP OUTPUT PCB 919-0411-001
RF AMP OUTPUT PCB 919-0411-001
RF AMP INPUT PCB 919-0410-025
REMOTE UP/DOWN PCB 919-0412 (OPTIONAL)
AFC/PLL PCB 919-0104
MODULATED OSCILLATOR ASSEMBLY 959-0203
COMPOSITE TEST IN
COMPOSITE TEST OUT
J19 RF OUTPUT
J3 RF SAMPLE
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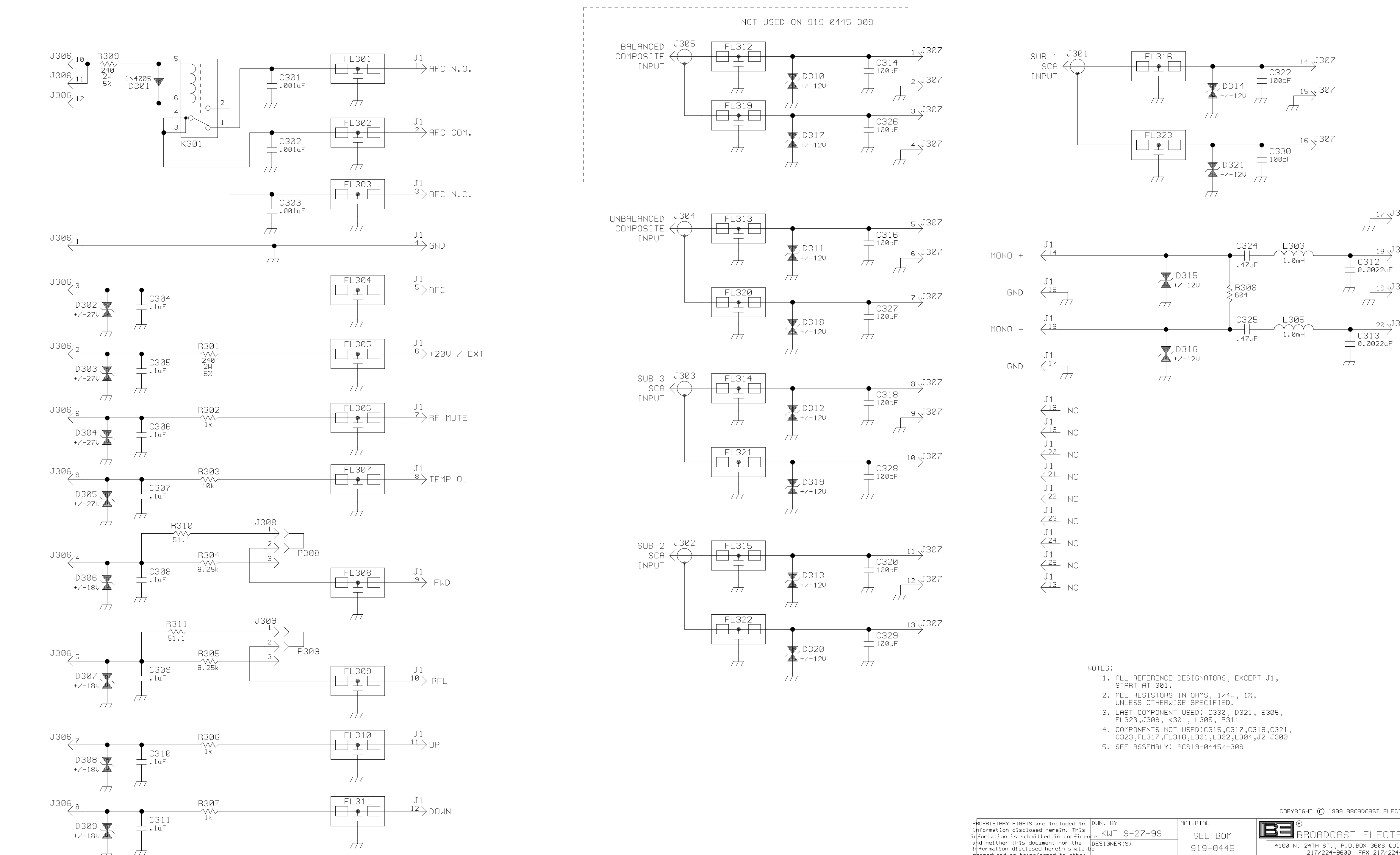
TOLERANCE (DECIMAL) U.O.S.
.x ± .030 .xxx ± .005
.xx ± .015 ANGLES ± 1°
DWN. BY KT 12-20-00
DESIGNER(S)
PROJ. LEADER
MFG.
MATERIAL
FINISH
NEXT ASSY.
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305 217/224-9600
TELEX 250142 CABLE BROADCAST FAX 217/224-9607
TITLE OVERALL SCHEMATIC FM-250E
TYPE S SIZE D DWG. NO. 909-0251-309 REV A
MODEL FM-250E SCALE NONE SHEET 1 OF 1

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	9-27-99	PROTOTYPE RELEASE.	KT		----
A	2-19-01	ENGINEERING RELEASE WITHOUT CHANGE	KT		----
B	7-10-01	ADDED C327-330,D318-321,FL320-323;DEL FL317-318	KT	DDL	10476
C	2-20-03	CORRECTED VALUE OF R310 & R311	KT	DDL	10889



NOTES:

1. ALL REFERENCE DESIGNATORS, EXCEPT J1, START AT 301.
2. ALL RESISTORS IN OHMS, 1/4W, 1%, UNLESS OTHERWISE SPECIFIED.
3. LAST COMPONENT USED: C330, D321, E305, FL323,J309, K301, L305, R311
4. COMPONENTS NOT USED:C315,C317,C319,C321, C323,FL317,FL318,L301,L302,L304,J2-J300
5. SEE ASSEMBLY: AC919-0445/-309

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

DWN. BY KWT 9-27-99
DESIGNER(S)
PROJ. LEADER
MFG.

MATERIAL SEE BOM 919-0445
FINISH
NEXT ASSY.

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

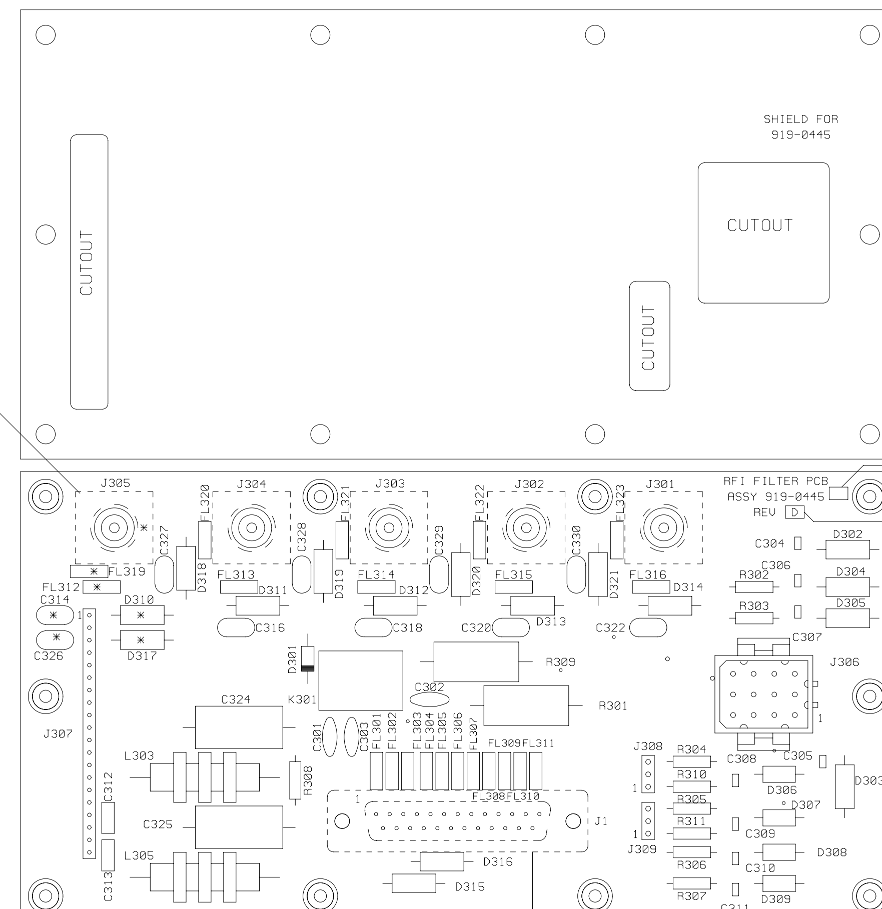
TITLE RFI FILTER PCB

TYPE	SIZE	DWG. NO.	REV
S	B	919-0445/-309	C

MODEL NNNN | SCALE NONE | SHEET 1 OF 1

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	10-4-99	PROTOTYPE RELEASE.	KT		----
2	11-3-00	ADDED DETAIL "A" AND NOTE 3	KT		----
3	2-6-01	ADDED DETAIL "B"	KT		----
A	2-19-01	ENGINEERING RELEASE	KT		----
B	7-10-01	ADDED C327-330,D318-321,FL320-323;DEL FL317-318	KT	DDL	10476
C	8-28-02	UPDATED BOM TO MATCH ASSEMBLY	KT	DDL	10743
D	4-23-07	ADD NOTE 4	JTB		11543

J305 ONLY ON 919-0445

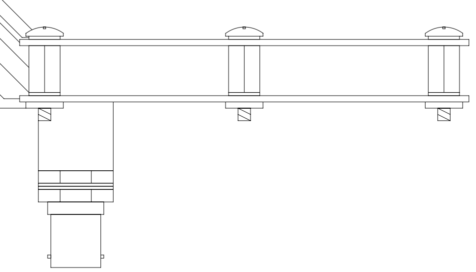


ADD LABEL WITH VERSION OF BOARD

WRITE REV. OF BOARD IN WHITE BOX

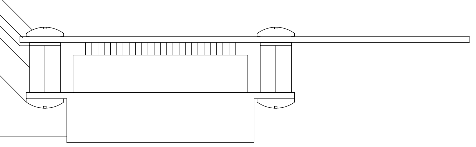
SEE DETAIL "B"
FOR -309 VERSION ONLY

420-6105
423-6002
519-0445-002
441-0184
423-6002
919-0445
426-6000
(TYP. 10 PLCS)



DETAIL "A"

420-4105
519-0445
423-4002
441-4000
420-4105*
(TYP. 2 PLCS.)
417-2502-FIL
(J1 REF)



DETAIL "B"

* INDICATES SCREWS TO BE REMOVED AFTER INSTALLATION OF J1.

NOTES:

1) J1,J301,J302,J303,J304 & J305 ARE MOUNTED ON THE SOLDER SIDE OF PCB.
2) PEM NUTS ARE PRESSED INTO SOLDER SIDE OF PCB; SEE DETAIL A FOR ASSEMBLY OF SHIELD PCB (519-0445-002) TO 919-0445-309.
3) * INDICATES PARTS NOT USED ON ASSEMBLY 919-0445-309. (C314,C326,D310,D317,FL312, FL319,J305)
4) TO BUIL A 919-0445-309
   A) START WITH A COMPLETED 919-0445
   B) REMOVE ALL PARTS LISTED IN NOTE (3)
   C) REMOVE J1 (417-2502-FER)
   D) ADD J1 (417-2502-FIL),NOTE DETAIL "B" FOR MOUNTING INSTRUCTIONS.

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

DWN. BY: KWT 10-4-99
DESIGNER(S):
PROJ. LEADER:
MFG.:

MATERIAL: SEE BOM 919-0445 919-0445-309
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: RFI FILTER PCB

TYPE	SIZE	DWG No.	REV
A	C	919-0445/-309	D

MODEL NNNN | SCALE 1/1 | SHEET 1 OF 1

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	11-7-00	PROTOTYPE RELEASE	KT		-----
A	2-19-01	ENGINEERING RELEASE WITHOUT CHANGE	KT		-----

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

DWN. BY KT 11-7-00
DESIGNER(S)
PROJ. LEADER
MFG.

MATERIAL SEE BOM 919-0446
FINISH
NEXT ASSY.

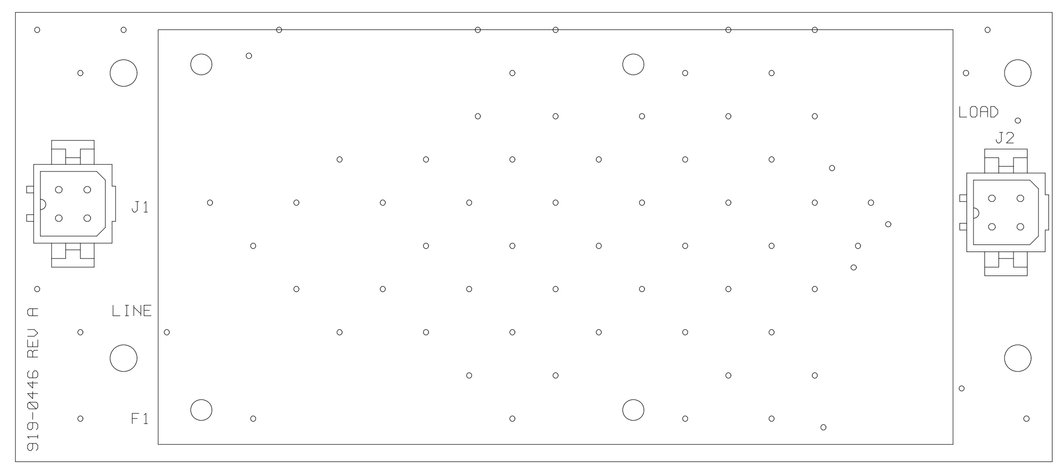
BE® BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305
217/224-9600 FAX 217/224-9607

TITLE
AC LINE FILTER

TYPE	SIZE	DWG. NO.	REV
S	B	919-0446	A

MODEL NNNN | SCALE NONE | SHEET 1 OF 1

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	11-8-00	PROTOTYPE RELEASE	KT		-----
A	2-19-01	ENGINEERING RELEASE WITHOUT CHANGE	KT		-----



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

DWN. BY KT 11-8-00

DESIGNER(S)

PROJ. LEADER

MFG.

MATERIAL SEE BOM 919-0446

FINISH

NEXT ASSY.

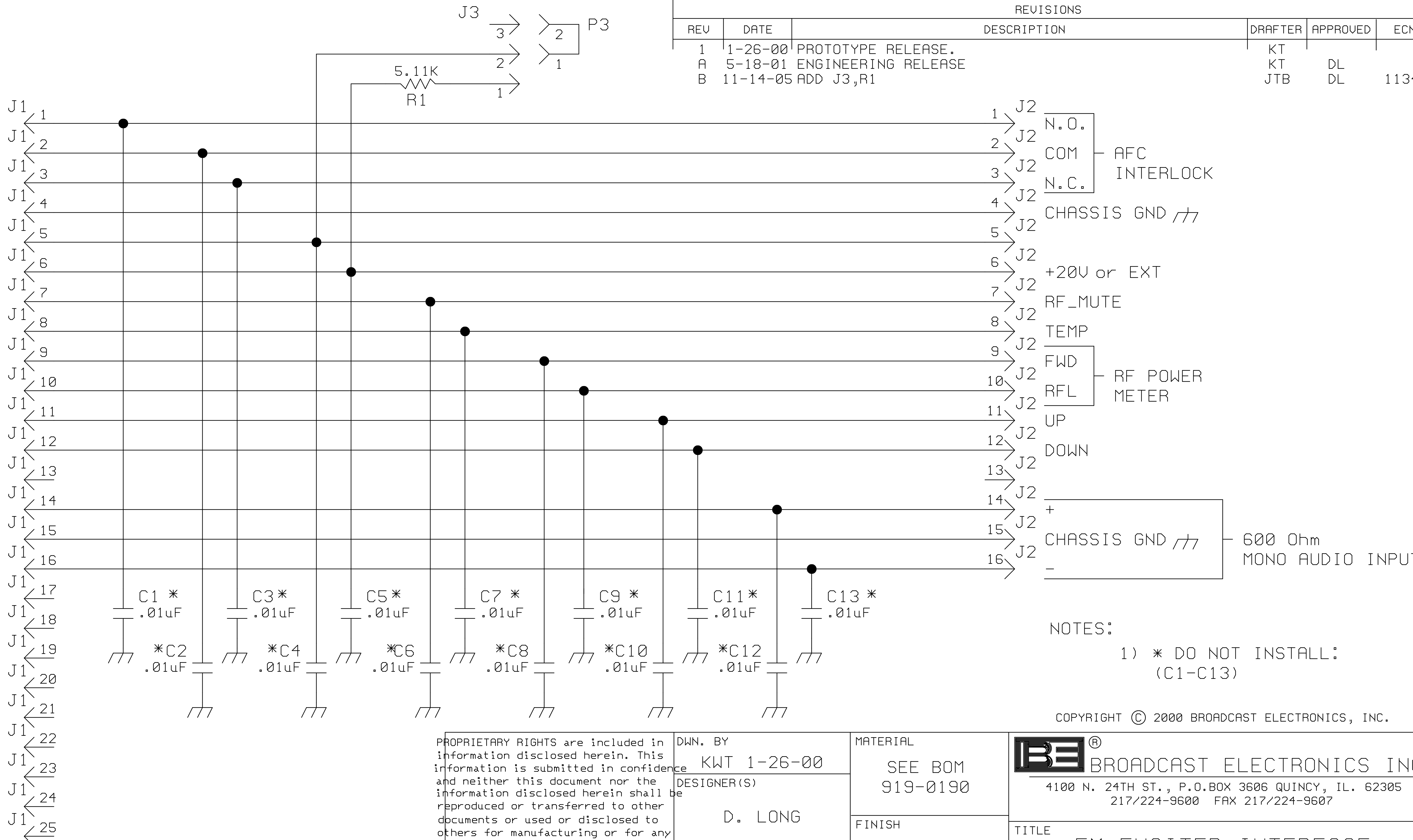
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST. P.O.BOX 3606 QUINCY,IL. 62305
217/224-9600 FAX 217/224-9607

TITLE AC LINE FILTER

TYPE	SIZE	DWG No.	REV
A	B	919-0446	A

MODEL FM-250C | SCALE 1/1 | SHEET 1 OF 1

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	1-26-00	PROTOTYPE RELEASE.	KT		
A	5-18-01	ENGINEERING RELEASE	KT	DL	
B	11-14-05	ADD J3,R1	JTB	DL	11340



NOTES:

1) * DO NOT INSTALL: (C1-C13)

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

DWN. BY: KWT 1-26-00
DESIGNER(S): D. LONG
PROJ. LEADER:
MFG.:
MATERIAL: SEE BOM 919-0190
FINISH:
NEXT ASSY.:

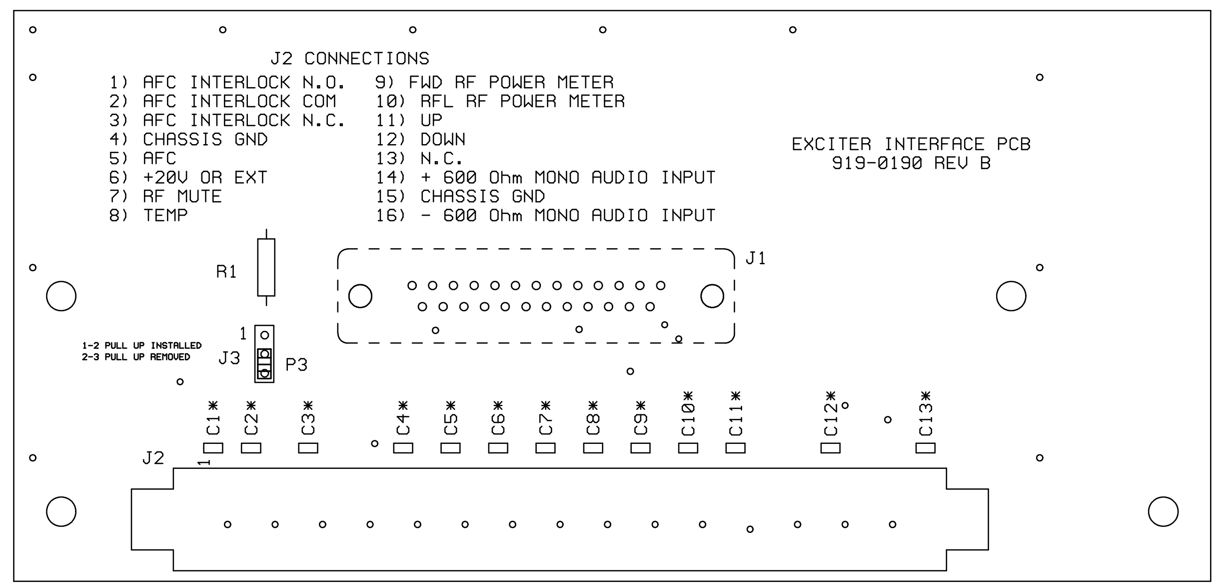
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305
217/224-9600 FAX 217/224-9607

TITLE: FM EXCITER INTERFACE

TYPE: S | SIZE: B | DWG. NO. 919-0190 | REV: B

MODEL: EXCITERS | SCALE: NONE | SHEET 1 OF 1

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	3-17-00	PROTOTYPE RELEASE.	KT		-----
2	9-6-00	MOVED C12 & C13	KT		-----
3	10-5-00	CHANGED BOARD OUTLINE	KT		-----
A	5-18-01	ENGINEERING RELEASE	KT	DL	-----
B	11-11-05	ADD J3,R1	JTB	DL	11340



NOTES:

1) * DO NOT INSTALL (C1-C13)

2) P3 POS 1-2 FOR S-SERIES
P3 POS 2-3 FOR C & T SERIES

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

DWN. BY: KWT 3-17-00
DESIGNER(S): D. LONG
PROJ. LEADER:
MFG.:

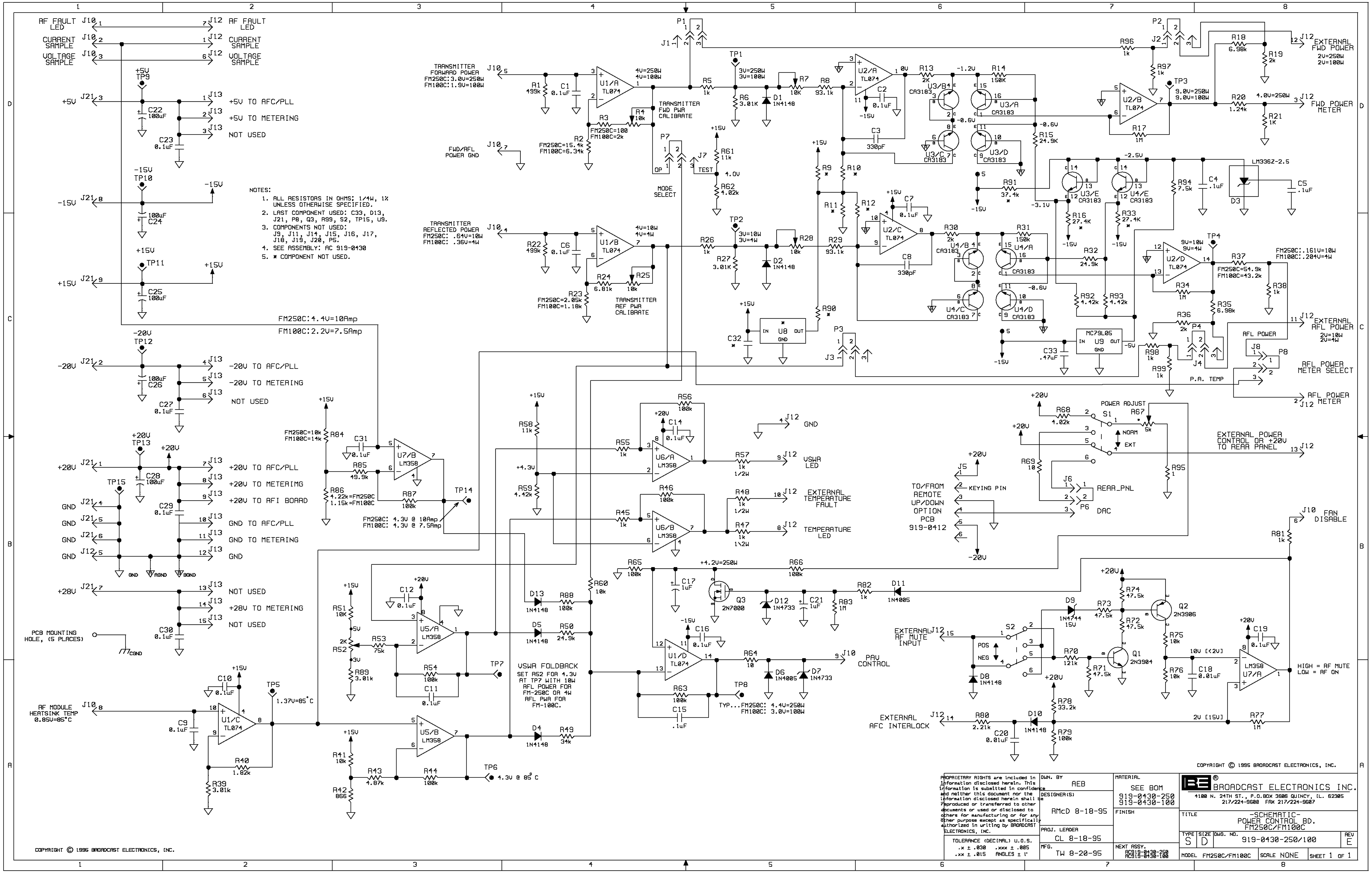
MATERIAL: SEE BOM 919-0190
FINISH:
NEXT ASSY.:

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

TITLE: EXCITER INTERFACE PCB

TYPE	SIZE	DWG No.	REV
A	B	919-0190	B

MODEL NNNN | SCALE 1/1 | SHEET 1 OF 1


RF FAULT LED
CURRENT SAMPLE
VOLTAGE SAMPLE
+5V TO AFC/PLL
+5V TO METERING
NOT USED
-20V TO AFC/PLL
-20V TO METERING
+20V TO AFC/PLL
+20V TO METERING
+20V TO AFI BOARD
GND TO AFC/PLL
GND TO METERING
GND
+28V TO METERING
PCB MOUNTING HOLE, (5 PLACES)
TRANSMITTER FORWARD POWER FM250C:3.0V=250W FM100C:1.9V=100W
FWD/RFL POWER GND
TRANSMITTER REFLECTED POWER FM250C: .64V=10W FM100C: .36V=4W
TRANSMITTER FWD PWR CALIBRATE
TRANSMITTER REF PWR CALIBRATE
MODE SELECT
NOTES:
1. ALL RESISTORS IN OHMS: 1/4W, 1% UNLESS OTHERWISE SPECIFIED.
2. LAST COMPONENT USED: C33, D13, J21, P8, Q3, R99, S2, TP15, U9.
3. COMPONENTS NOT USED: J9, J11, J14, J15, J16, J17, J18, J19, J20, P5.
4. SEE ASSEMBLY: AC 919-0430
5. ✱ COMPONENT NOT USED.
FM250C:4.4V=10Amp
FM100C:2.2V=7.5Amp
EXTERNAL FWD POWER 2V=250W 2V=100W
FWD POWER METER
EXTERNAL RFL POWER 2V=10W 2V=4W
RFL POWER METER SELECT
RFL POWER METER
P.A. TEMP
POWER ADJUST
NORM
EXT
EXTERNAL POWER CONTROL OR +20V TO REAR PANEL
TO/FROM REMOTE UP/DOWN OPTION PCB 919-0412
KEYING PIN
REAR_PNL
DAC
VSWR LED
EXTERNAL TEMPERATURE FAULT
TEMPERATURE LED
FAN DISABLE
VSWR FOLDBACK SET R52 FOR 4.3V AT TP7 WITH 10W RFL POWER FOR FM-250C OR 4W RFL PWR FOR FM-100C.
RF MODULE HEATSINK TEMP 0.85V=85°C
1.37V=85°C
4.3V @ 85°C
PWR CONTROL
EXTERNAL RF MUTE INPUT
EXTERNAL AFC INTERLOCK
HIGH = RF MUTE LOW = RF ON
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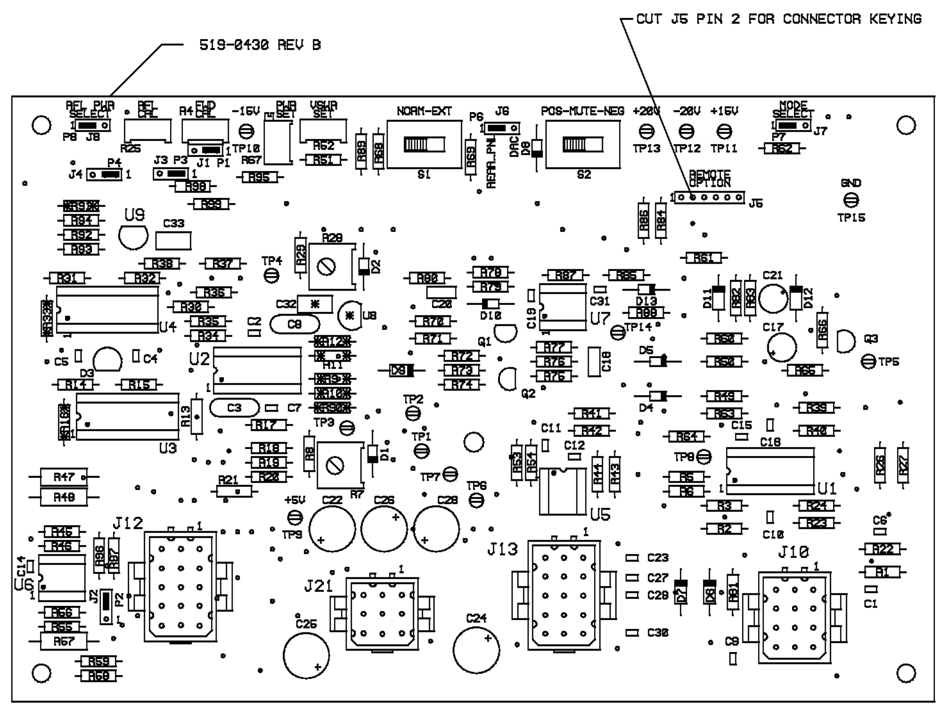
TOLERANCE (DECIMAL) U.O.S. .x ± .030 .xxx ± .005 .xx ± .015 ANGLES ± 1°
DWN. BY AEB
DESIGNER(S) RMcD 8-18-95
PROJ. LEADER CL 8-18-95
MFG. TW 8-20-95
MATERIAL SEE BOM 919-0430-250 919-0430-100
FINISH
NEXT ASSY. AC919-0430-250 AC919-0430-100
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305 217/224-9600 FAX 217/224-9607
TITLE -SCHEMATIC- POWER CONTROL BD. FM250C/FM100C
TYPE S SIZE D DWG. NO. 919-0430-250/100 REV E
MODEL FM250C/FM100C SCALE NONE SHEET 1 OF 1



NOTES:

1. COMPONENTS MARKED WITH "*" ARE NOT INSTALLED.
2. LAST COMPONENTS USED: C33, D13, J21, P8, Q3, R99, S2, TP15, U9.
3. COMPONENTS NOT USED: J9, J11, J14, J15, J16, J17, J18, J19, J20, P5.
4. SEE SCHEMATIC: SD919-0430-250/100

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

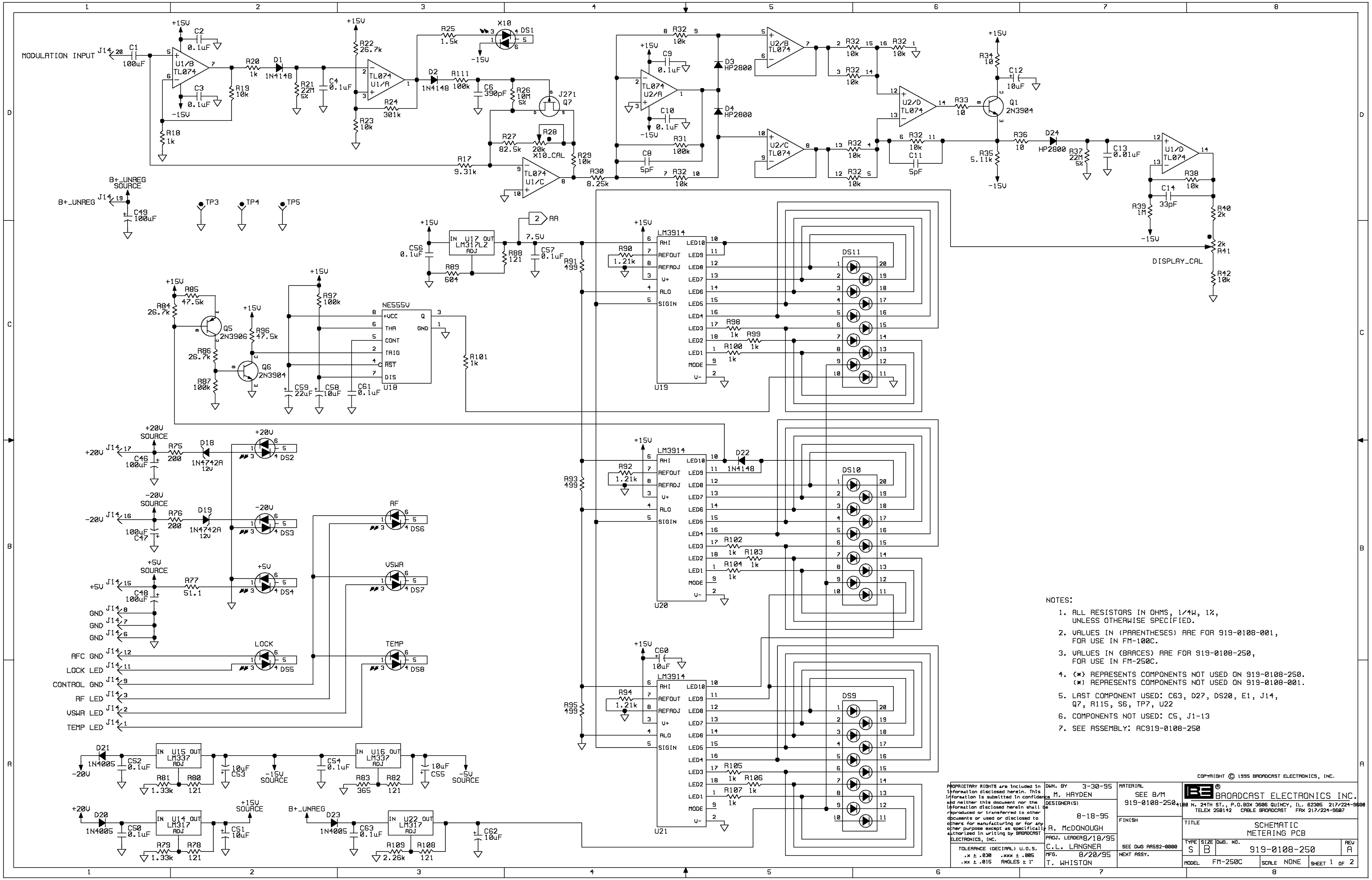
DWN. BY	AEB
DESIGNER(S)	8-18-95 RMcD
PROJ. LEADER	CL 8-18-95
MFG.	TW 8-20-95
MATERIAL	SEE BOMs 919-0430-250 919-0430-100
FINISH	
NEXT ASSY.	MC519-0430

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

TITLE -PCB ASSEMBLY- POWER CONTROL BD. FM250C/FM100C

TYPE	SIZE	DWG No.	REV
A	C	919-0430-250/100	F

MODEL FM-250C/FM100C | SCALE 1/1 | SHEET 1 OF 1



NOTES:

1. ALL RESISTORS IN OHMS, 1/4W, 1%, UNLESS OTHERWISE SPECIFIED.
2. VALUES IN (PARENTHESES) ARE FOR 919-0108-001, FOR USE IN FM-100C.
3. VALUES IN {BRACES} ARE FOR 919-0108-250, FOR USE IN FM-250C.
4. (*) REPRESENTS COMPONENTS NOT USED ON 919-0108-250. (⋇) REPRESENTS COMPONENTS NOT USED ON 919-0108-001.
5. LAST COMPONENT USED: C63, D27, DS20, E1, J14, Q7, R115, S6, TP7, U22
6. COMPONENTS NOT USED: C5, J1-13
7. SEE ASSEMBLY: AC919-0108-250

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

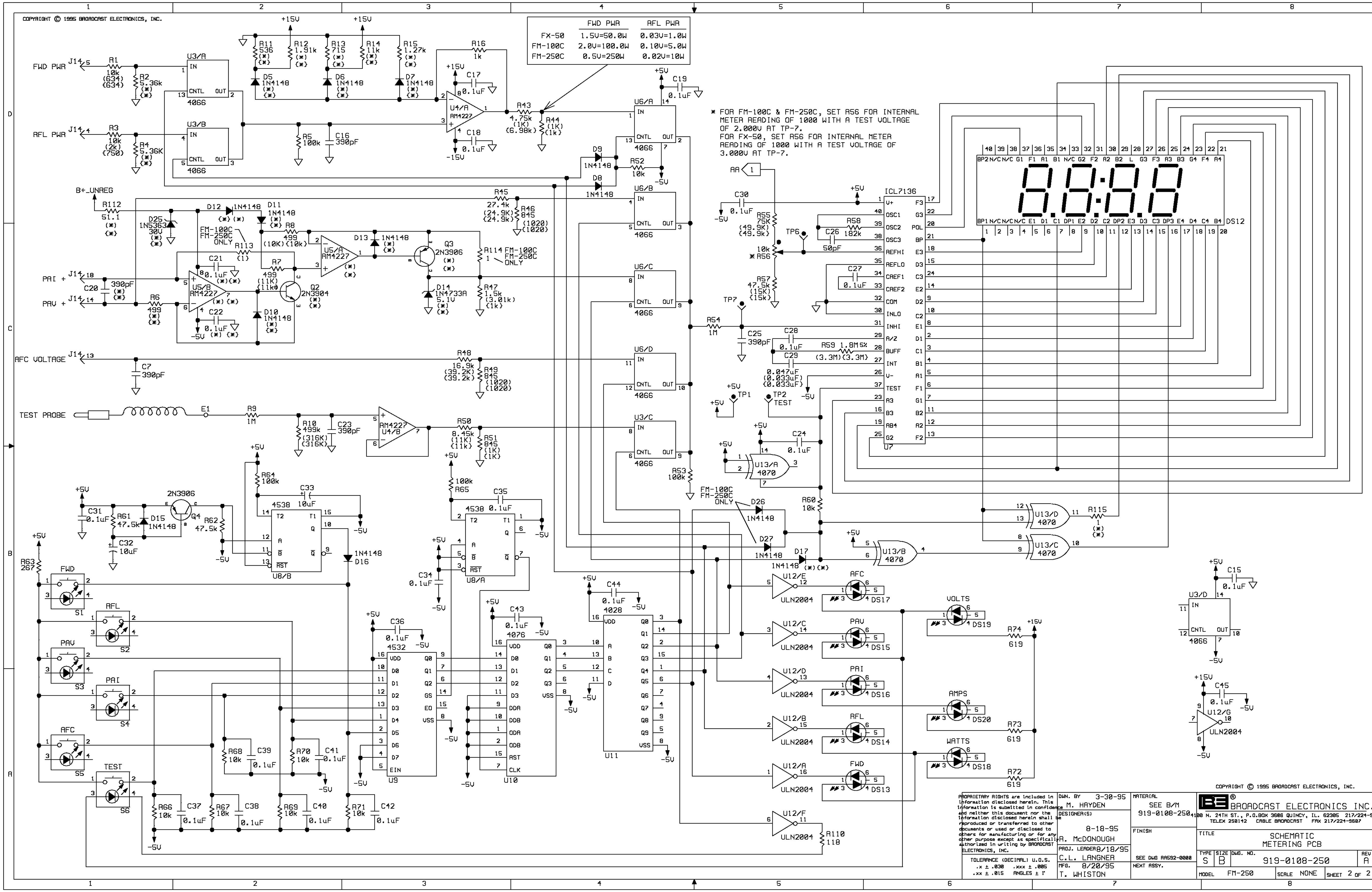
DWN. BY	M. HAYDEN 3-30-95
DESIGNER(S)	R. McDONOUGH 8-18-95
PROJ. LEADER	C.L. LANGNER 8/18/95
MFG.	T. WHISTON 8/20/95
MATERIAL	SEE B/M 919-0108-250
FINISH	SEE DWG AAS92-0000
NEXT ASSY.	

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

TITLE: SCHEMATIC METERING PCB

TYPE	SIZE	DWG. NO.	REV
S	B	919-0108-250	A

MODEL FM-250C SCALE NONE SHEET 1 OF 2



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FWD PWR | RFL PWR
FX-50 1.5V=50.0W 0.03V=1.0W
FM-100C 2.0V=100.0W 0.10V=5.0W
FM-250C 0.5V=250W 0.02V=10W
* FOR FM-100C & FM-250C, SET R56 FOR INTERNAL METER READING OF 1000 WITH A TEST VOLTAGE OF 2.000V AT TP-7.
FOR FX-50, SET R56 FOR INTERNAL METER READING OF 1000 WITH A TEST VOLTAGE OF 3.000V AT TP-7.
FWD PWR
RFL PWR
B+_UNREG
PAI +
PAV +
AFC VOLTAGE
TEST PROBE
ICL7136
DS12
FWD
RFL
PAV
PAI
AFC
TEST
VOLTS
AMPS
WATTS
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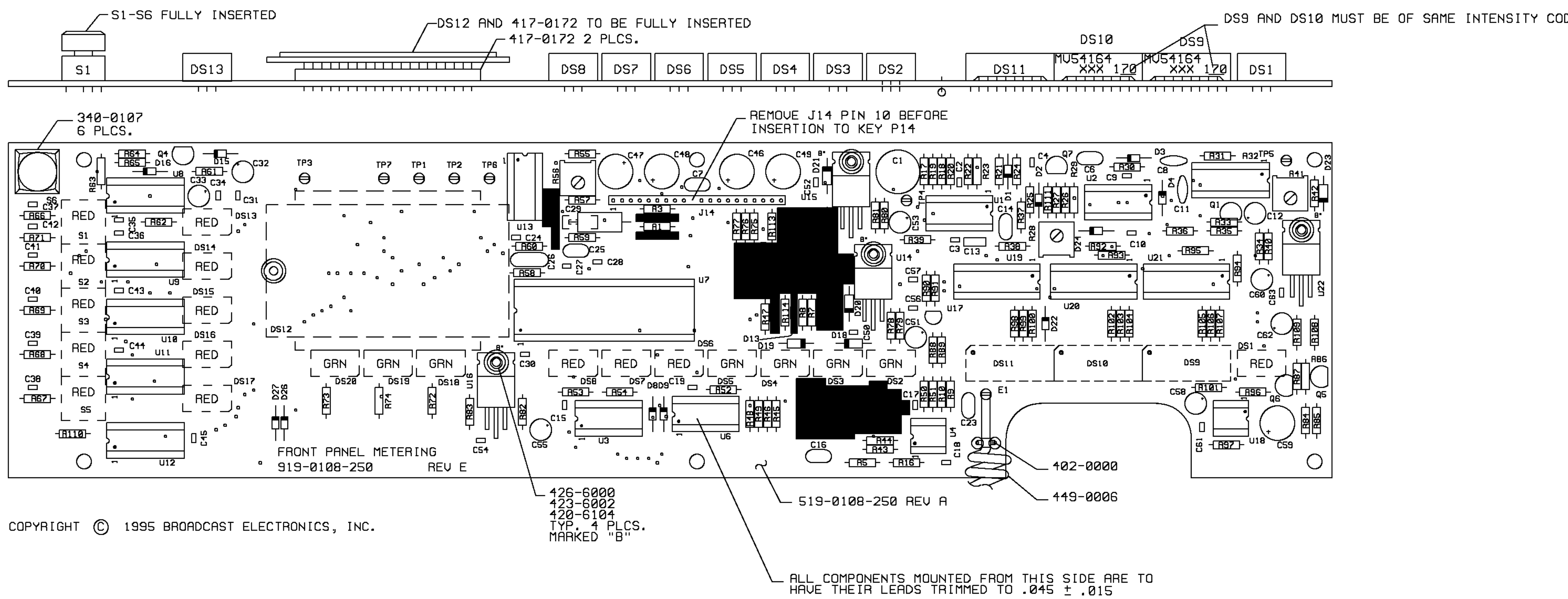
TOLERANCE (DECIMAL) U.O.S. .x ± .030 .xxx ± .005 .xx ± .015 ANGLES ± 1°
DWN. BY 3-30-95 M. HAYDEN
DESIGNER(S) 8-18-95 R. McDONOUGH
PROJ. LEADER 8/18/95 C.L. LANGNER
MFG. 8/20/95 T. WHISTON
MATERIAL SEE B/M 919-0108-250
FINISH
SEE DWG RA592-0000
NEXT ASSY.
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305 217/224-9600
TELEX 250142 CABLE BROADCAST FAX 217/224-9607
TITLE SCHEMATIC METERING PCB
TYPE S SIZE B DWG. NO. 919-0108-250 REV A
MODEL FM-250 SCALE NONE SHEET 2 OF 2



NOTES:

1. [black box] INDICATES COMPONENTS NOT USED ON 919-0108-250 (FM-250C).
2. SEE SCHEMATICS: AB919-0108-250 (FM-250C)

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

DWN. BY 5-12-95 M. HAYDEN
CHKD 8-18-95 R. McDONOUGH
ME
PROJ. ENGR. 8/18/95 C.L. LANGNER
MFG. 8/20/95 T. WHISTON

MATERIAL SEE B/M 919-0108-250
FINISH
~~SEE DWG AA592-0000~~
NEXT ASSY.

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

TITLE PCB ASSEMBLY FRONT PANEL METERING BD

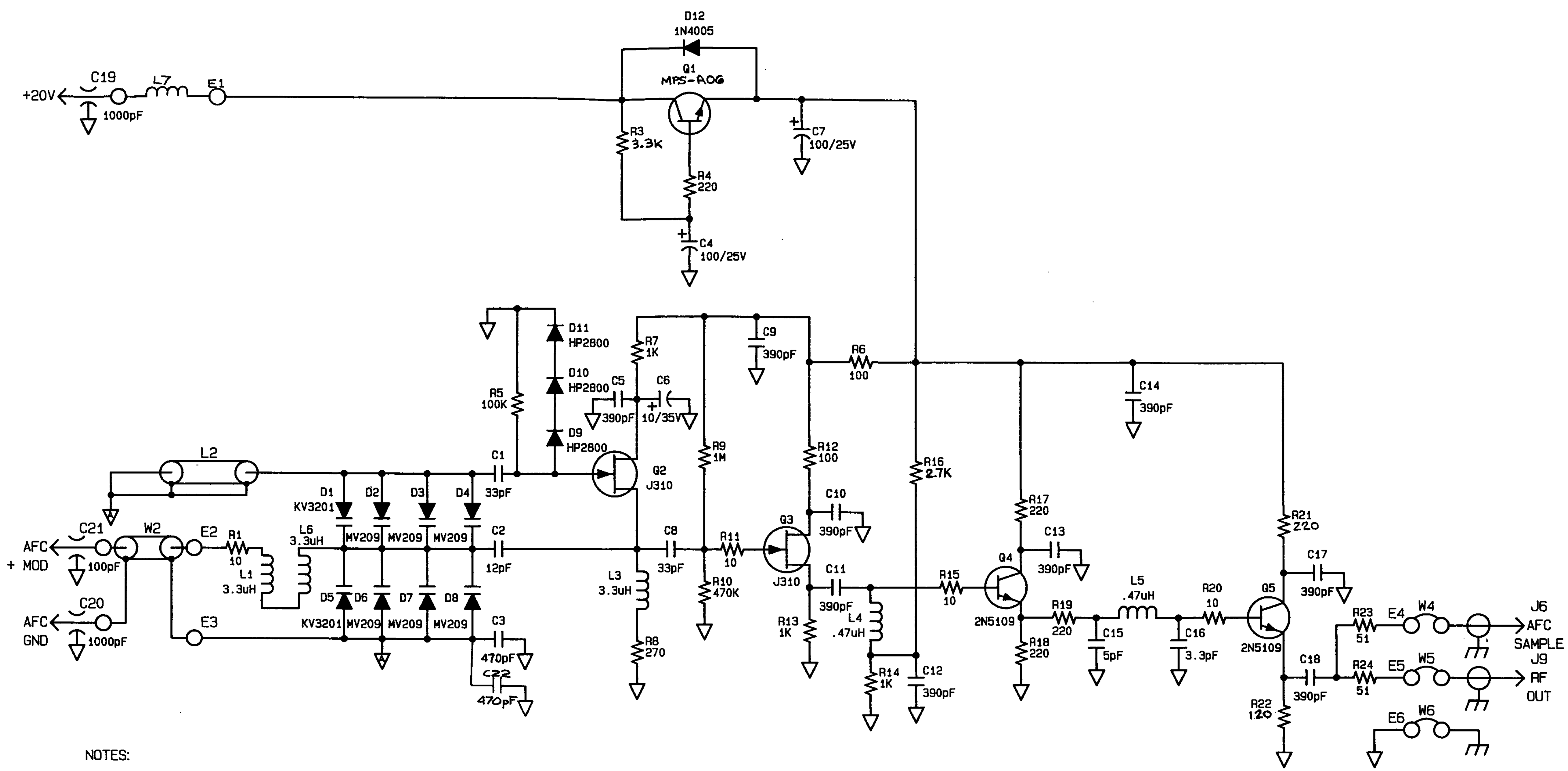
TYPE A SIZE C DWG No. 919-0108-250 REV E

MODEL FM-250C SCALE 1=1 SHEET 1 OF 1

REF	ZONE	REF	ZONE	REF	ZONE	REF	ZONE	REF	ZONE	REF	ZONE	REF	ZONE
C1	C6	C49	C5	DS6	B4-B5	R22	C6	R69	B1	S1	C1		
C2	C6	C50	B5-B6	DS7	B4	R23	C6	R70	C1	S2	C1		
C3	C6	C51	B6	DS8	B4	R24	C6	R71	C1	S3	B1-C1		
C4	C6	C52	C5	DS9	B7-B8	R25	C6	R72	B3	S4	B1		
C6	C7	C53	C6	DS10	B7	R26	C7	R73	B3	S5	B1		
C7	C5	C54	B3-B4	DS11	B6-B7	R27	C7	R74	B3	S6	C1		
C8	C7	C55	B4	DS12	B2-C2,	R28	C7	R75	C5	TP1	C3		
C9	C7	C56	B6		B3-C3,	R29	C7	R76	C5	TP2	C3-C4		
C10	C7	C57	C6		B4-C4	R30	C7	R77	C5	TP3	C3		
C11	C7	C58	B7	DS13	C2	R31	C7-C8	R78	B6	TP4	C6		
C12	C8	C59	B8	DS14	C2	R32	C7-C8	R79	B6	TP5	C8		
C13	C6	C60	C8	DS15	B2	R33	C7-C8	R80	C6	TP7	C8		
C14	C6	C61	B7	DS16	B2	R34	C8	R81	C6	U1	C6		
C15	B4	C62	B8	DS17	B2	R35	C7-C8	R82	B4	U2	C7		
C16	B5	C63	B8-C8	DS18	B3	R36	C7	R83	B3	U3	B4		
C17	B6	D1	C6	DS19	B3	R37	C6	R84	B8	U4	B6		
C18	B6	D2	C7	DS20	B3	R38	C6	R85	B8	U	C5		
C19	B5	D3	C7	E1	B6	R39	C6	R86	B8	U6	B5		
	C5	D4	C7	J14	C4-C5	R40	C8	R87	B8	U7	B4-B5,		
	C5		B6	Q1	C8	R41	C8	R88	B6	U	C4-C5		
	C5		B6	Q2	C5	R42	C8	R89	B6	U8	C1-C2		
C23	B6		B6	Q3	C5	R43	B6	R90	B6-C6	U9	C1-C2		
C24	C4	D8	B4	Q4	C2	R44	B6	R91	B6-C6	U10	B1-B2		
C25	C4	D9	B4	Q5	B8	R45	B5	R92	C7	U11	B1-B2		
C26	C4		C5	Q6	B8	R46	B5	R93	C7	U12	B1-B2		
C27	C4		B5	Q7	C7	R47	B5	R94	C8	U13	C4		
C28	C4		B5	R1	C4	R48	B5	R95	C7	U14	B6-C6		
C29	C4		B5		C4	R49	B5	R96	B8	U15	C5-C6		
C30	B4		B5	R3	C4	R50	B6	R97	B7-B8	U16	B3-B4		
C31	C2	D15	C2		C4	R51	B6	R98	B6	U17	B6		
C32	C2	D16	C2	R5	B6	R52	B5	R99	B6	U18	B7-B8		
C33	C2		C4		C5	R53	B4	R100	B6	U19	B6-C6		
C34	C2	D18	B5-B6	R7	B5	R54	B4	R101	B7	U20	B7-C7		
C35	C2	D19	B5	R8	B5	R55	C4	R102	B7	U21	B7-C7		
C36	C2	D20	B5	R9	B6	R56	C4	R103	B7	U22	C8		
C37	C1	D21	C5	R10	B6	R57	C4	R104	B7				
C38	B1	D22	B7		B5	R58	C4	R105	B7				
C39	B1	D23	C8		B5	R59	C4	R106	B7				
C40	B1	D24	C7		B5	R60	C4	R107	B7				
C41	C1		C5		B5	R61	C2	R108	B8				
C42	C1	D26	C5		B5	R62	C2	R109	B8				
C43	C2	D27	C5	R16	B6	R63	C1	R110	B1				
C44	B2	DS1	B8	R17	C6	R64	C2	R111	C7				
C45	B2	DS2	B6	R18	C6	R65	C2		C5				
C46	C5	DS3	B5-B6	R19	C6	R66	C1	R113	C5				
C47	C4	DS4	B5	R20	C6	R67	B1	R114	C5				
C48	C4-C5	DS5	B5	R21	C6	R68	B1	R115	C5				

597-1050-71

FIGURE 5-3. METERING CIRCUIT BOARD COMPONENT LOCATORS



NOTES:

1. ALL RESISTORS IN OHMS, 1/4W, 5%: ALL CAPACITORS IN MICROFARADS, UNLESS OTHERWISE SPECIFIED.
2. LAST COMPONENTS USED: R24, C22, D12, Q5, L7, E6, W6.
3. SEE PCB ASSEMBLY 959-0203
4. COMPONENTS NOT USED: W3, R2, W1

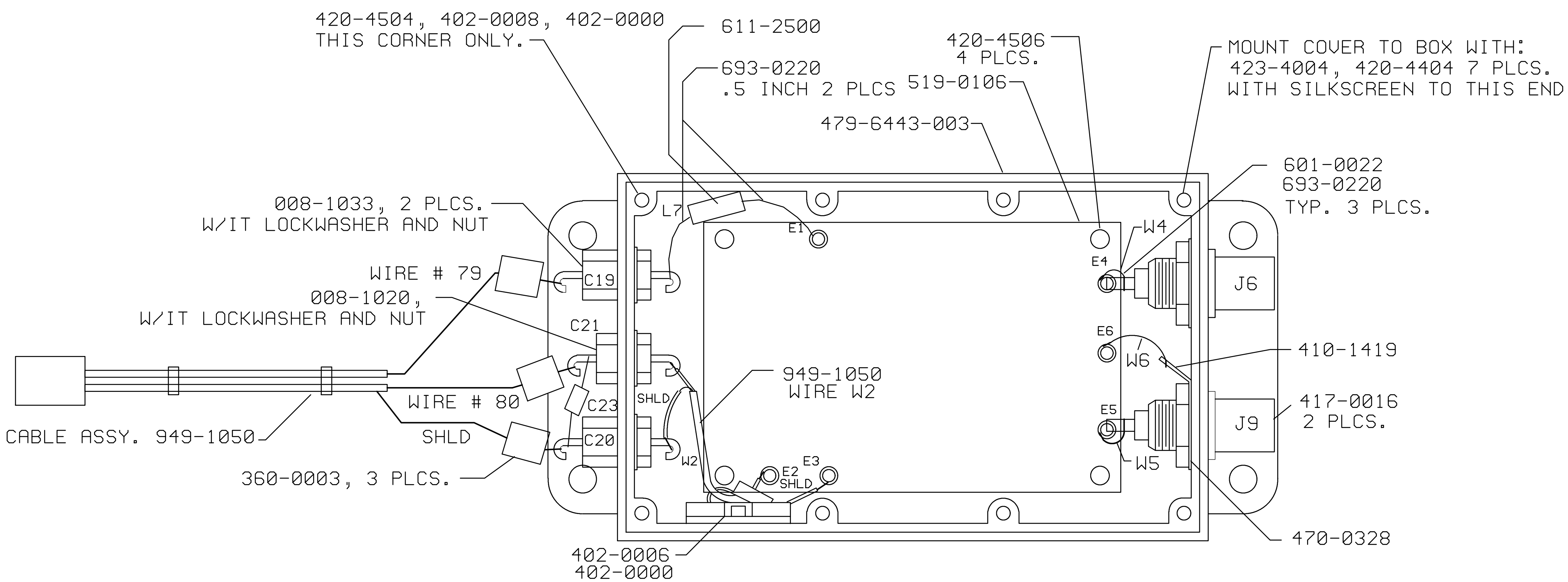
TOLERANCE DECIMAL U.O.S.
.X ± .030 .XXX ± .005
.XX ± .015 ANGLES ± 1°

DWN BY KLS	DATE 6-2-87	MATERIAL SEE B/M 959-0203	BROADCAST ELECTRONICS INC. 4100 N. 24TH ST. QUINCY, IL. 62305 217/224-9600 TELEX 250142 CABLE "BROADCAST"
CHKD MH	6-14-88		
ME		FINISH	TITLE SCHEMATIC MODULATED OSCILLATOR BOARD
PROJ ENGR E. ANTHONY 6-13-88			TYPE S · SIZE C · DWG.NO. 959-0203 · REV J
MFG D. NEWLON 6-14-88		NEXT ASSY 909-1050-000	MODEL FX-50 · SCALE · SHEET 1 OF 1

REV	DATE	DESCRIPTION	DFTSMN	ENGR	ECN
K	4-6-90	ADDED C22,L7; REMOVED W1,REMOVED "*" NEAR C3	ELP	EJA	8240
L	5-21-91	ADDED 470-0328	JAH	JHS	8527
M	1-30-92	TELESIS TO PCAD CONVER MOVED PINS OF Q1 IN LINE	JAH	EJA	8582
N	3-14-94	LENGTH OF 621-1359 (2 PLCS) WAS 8"	MH	BG	9168
P	10-27-94	ADDED 360-0003, 3 PLCS.	MH	JRC	9254
R	10-30-95	CHGD Q1 FROM 211-0005(MPS-U95) TO 211-0006(MPS-A06)	MERK		9561
S	12-3-96	12" LG WAS 10" LG, ADD 420-4504, 402-0008, 402-0000.	MSE	DL	9685
T	3-26-97	MOVED 420-4504, 423-0008, 402-0000 TO OPP CORNER	MSE	DL	9774

REVISIONS

REV	DATE	DESCRIPTION	DFTSMN	ENGR	ECN
U	12-1-99	SEPERATED 919-0106 ASSEMBLY FROM THIS ONE.	KT	DL	10223
V	1-3-00	CHGD NOTES.	KT	DL	10246
W	10-3-00	ADDED 949-1050 NOTES	KT	DL	10362
Y	8-16-01	ADDED C23	KT		10457
Z	6-7-10	ADD 611-2500(HEATSHRINK NOTE)	JTB		11773



WIRING OF P8 417-0165	
PIN NO.	WIRE NO.
1	80
2	80 SHLD
3	79 SHLD
4	KEY
5	79

NOTES:

1. WIRES W4,W5, AND W6 TO BE CUT AS SHORT AS POSSIBLE.
2. CUT LEADS ON L7 AS SHORT AS POSSIBLE

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

DWN. BY JAH 1-29-92
CHKD MH 6-14-88
ME JHS 6-20-88
PROJ. ENGR. EJA 6-13-88
MFG. DBN 6-14-88

MATERIAL SEE B/M 959-0203
FINISH
SEE DWG RA592-0000
NEXT ASSY. 909-1050-000

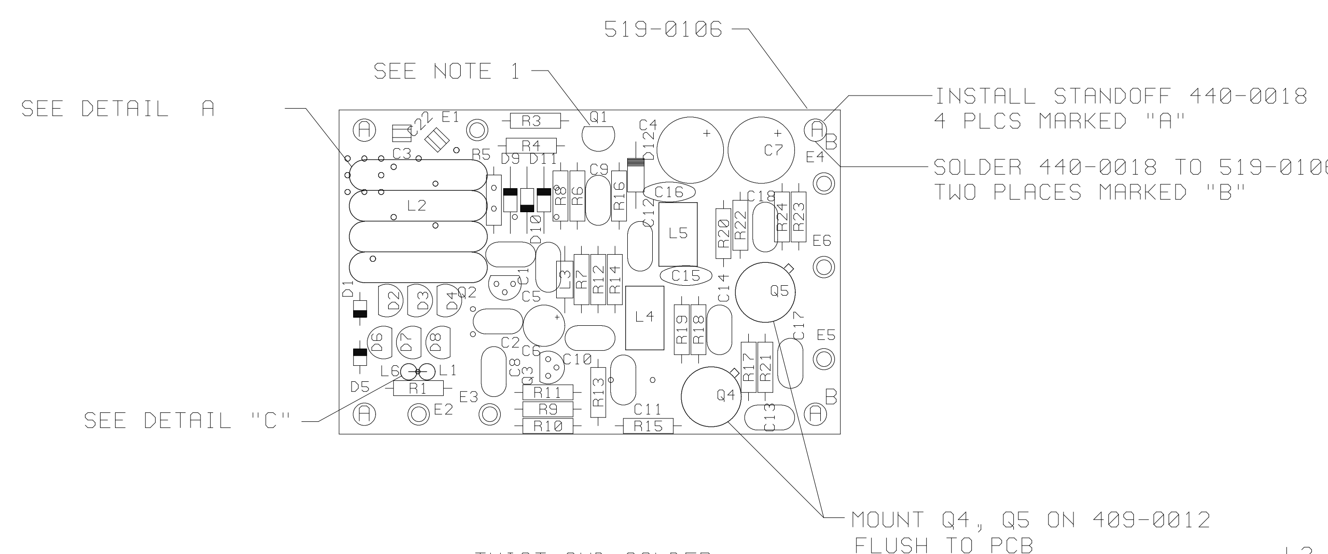
BE ® BROADCAST ELECTRONICS INC.
4100 N.24TH ST. P.O.BOX 3606 QUINCY,IL. 62305 PH. 217/224-9600
TELEX 250142 CABLE BROADCAST FAX 217/224-9607

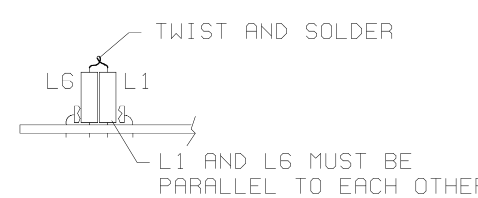
TITLE PCB ASSEMBLY MODULATED OSCILLATOR BD

TYPE A | SIZE B | DWG No. 959-0203 | REV Z

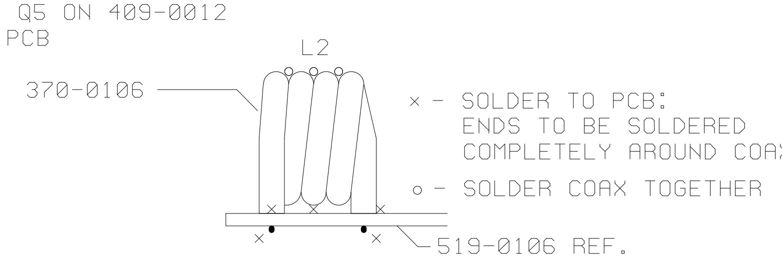
MODEL FX-50/FM-100C | SCALE 1=1 | SHEET 1 OF 1

REVISIONS					
REV	DATE	DESCRIPTION	DFTSMN	ENGR	ECN
A	11-3-99	ENGINEERING RELEASE	MH	DDL	10223
B	1-3-00	ADDED STANDOFF NOTE	KT	DDL	10246
C	8-23-02	REMOVED 370-0106 PART DETAIL FROM DRAWING	KT	DDL	10767





DETAIL "C"



DETAIL "A"

NOTES:

1. STANDOFFS ON LEADS ON Q1-Q3, D2-D4 AND D6-D8 SHOULD BE PUSHED DOWN AGAINST PCB.
2. SEE SCHEMATIC AC959-0203

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

DWN. BY 11-3-99 M. HAYDEN
CHKD
ME
PROJ. ENGR.
MFG.

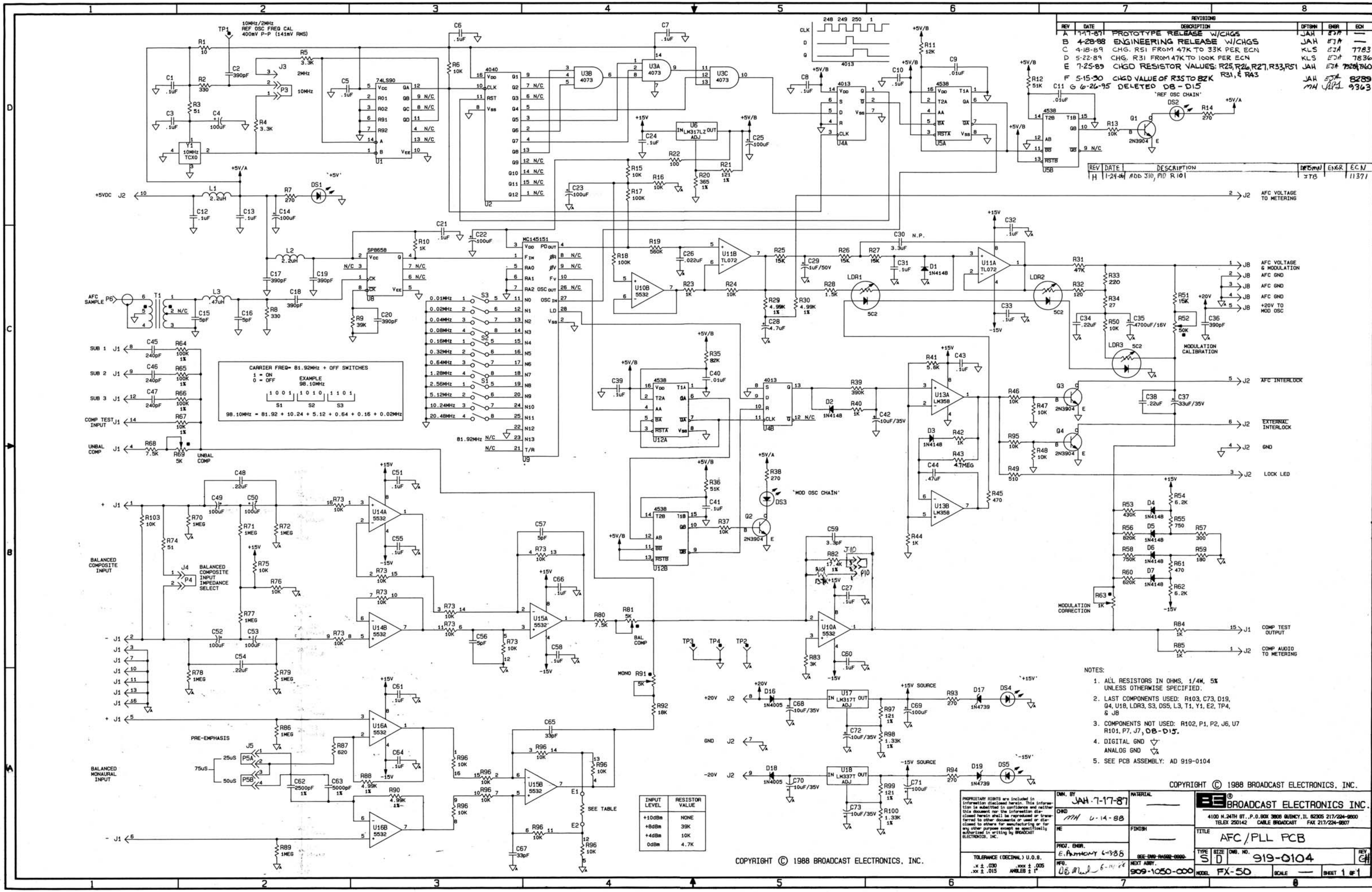
MATERIAL SEE B/M 919-0106
FINISH
~~SEE DWG AA592-0000~~
NEXT ASSY. 959-0203

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 MODULATED OSCILLATOR BD

TYPE	SIZE	DWG No.	REV
A	B	919-0106	C

MODEL FX-50/FM-100C SCALE 1=1 SHEET 1 OF 1



REVISIONS
REV | DATE | DESCRIPTION | DFTSMN | ENGR | ECN
A 7-17-87 PROTOTYPE RELEASE W/CHGS JAH EJA —
B 4-28-88 ENGINEERING RELEASE W/CHGS JAH EJA —
C 4-18-89 CHG. R51 FROM 47K TO 33K PER ECN KLS EJA 7783
D 5-22-89 CHG. R31 FROM 47K TO 100K PER ECN KLS EJA 7836
E 7-25-89 CHGD RESISTOR VALUES: R25,R26,R27,R33,R51 R31,& RA3 JAH EJA 7920/7960
F 5-15-90 CHGD VALUE OF R35 TO 82K JAH EJA 8289
G 6-26-95 DELETED D8-D15 MH 9363
H 1-24-06 ADD J10, P10 R101 JTB 11371
CARRIER FREQ= 81.92MHz + OFF SWITCHES
1 = ON
0 = OFF
EXAMPLE 98.10MHz
98.10MHz = 81.92 + 10.24 + 5.12 + 0.64 + 0.16 + 0.02MHz
'REF OSC CHAIN'
'MOD OSC CHAIN'
10MHz/2MHz REF OSC FREQ CAL 400mV P-P (141mV RMS)
AFC VOLTAGE TO METERING
AFC VOLTAGE & MODULATION
AFC GND
+20V TO MOD OSC
MODULATION CALIBRATION
AFC INTERLOCK
EXTERNAL INTERLOCK
LOCK LED
COMP TEST OUTPUT
COMP AUDIO TO METERING
MODULATION CORRECTION
BALANCED COMPOSITE INPUT
BALANCED COMPOSITE INPUT IMPEDANCE SELECT
BALANCED MONAURAL INPUT
PRE-EMPHASIS
AFC SAMPLE
+5VDC
SEE TABLE
INPUT LEVEL | RESISTOR VALUE
+10dBm | NONE
+8dBm | 39K
+4dBm | 10K
0dBm | 4.7K
NOTES:
1. ALL RESISTORS IN OHMS, 1/4W, 5% UNLESS OTHERWISE SPECIFIED.
2. LAST COMPONENTS USED: R103, C73, D19, Q4, U18, LDR3, S3, DS5, L3, T1, Y1, E2, TP4, & J8
3. COMPONENTS NOT USED: R102, P1, P2, J6, U7 R101, P7, J7, D8-D15.
4. DIGITAL GND
ANALOG GND
5. SEE PCB ASSEMBLY: AD 919-0104
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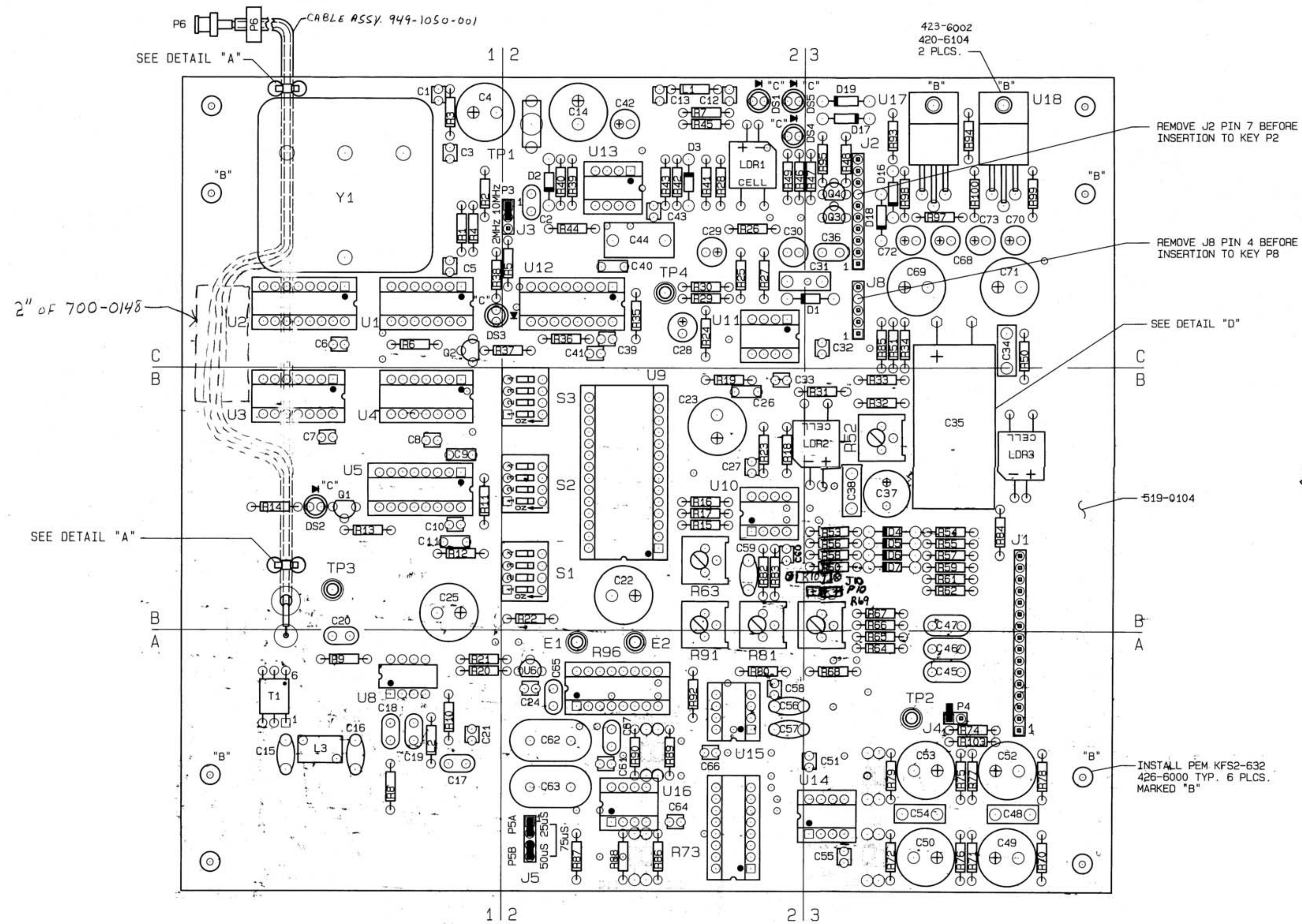
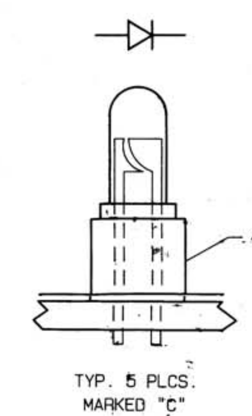
BROADCAST ELECTRONICS INC.
4100 N.24TH ST., P.O. BOX 3606 QUINCY, IL 62305 217/224-9600 TELEX 250142 CABLE BROADCAST FAX 217/224-9607
TITLE AFC/PLL PCB
DWN. BY JAH 7-17-87
CHKD MH 6-14-88
PROJ. ENGR. E. ANTHONY 6-13-88
TYPE S SIZE D DWG. NO. 919-0104 REV G H
NEXT ASSY. 909-1050-000
MODEL FX-50
SHEET 1 OF 1
TOLERANCE (DECIMAL) U.O.S. .x ± .030 .xx ± .015 .xxx ± .005 ANGLES ± 1°
COPYRIGHT © 1988 BROADCAST ELECTRONICS, INC.

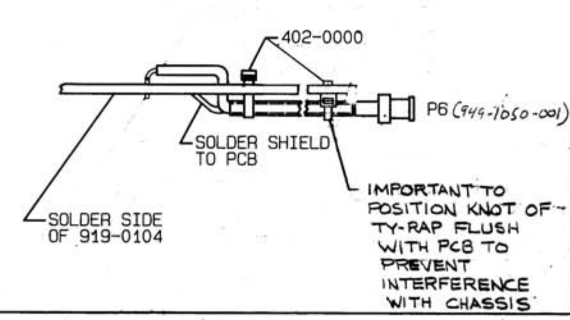
REVISIONS					
REV	DATE	DESCRIPTION	DFTM	ENGR	ECN
A	6-16-87	PROTOTYPE RELEASE W/CHGS.	KLS	EJA	—
B	6-13-88	ENGINEERING RELEASE W/CHGS.	KLS	EJA	—
C	4-18-89	UPDATE REV. PER R51 VALUE CHG.	KLS	EJA	7783
D	5-22-89	UPDATE REV. PER R31 VALUE CHG.	KLS	EJA	7836
E	7-25-89	CHGD VALUE OF RESISTORS: R25, R26, R27, R33, R51 R31, & R43	JAH	EJA	7928 & 7960
F	5-15-90	CHGD VALUE OF R35 TO 82K	JAH	EJA	8285
G	2-14-92	CHGD DETAIL A	JAH	EJA	8696
H	8-24-93	CABLE IN DETAIL A WAS 9" LG.	JLF		9029
J	6/26/95	DELETED D8 - D15	MH	ADJ	9363
K	3-14-97	C4, C14, C22, C23, C25, C49, C50, C52, C53 C69, C71	MSE		9783
L	2-3-99	ADDED 2" OF 700-0148 + MOVED COAX AWAY FROM IC'S.	KT		10084
M	10-3-00	CHANGED DETAIL "A" TO CALL OUT 949-1050-001	KT		10362
N	1-25-06	ADD P10, J10, R101	JTB		11371



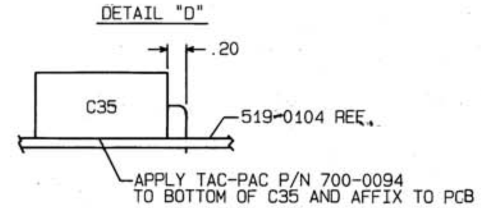


NOTES:
1. LAST COMPONENT USED: R103, C73, Q4, L3, S3, D19, DS5, LDR3, U18, J8, TP4, T1, Y1, E2.
2. COMPONENTS NOT USED: U7, P1, P2, J6, P7, J7, R101, R102.
3. SEE SCHEMATIC SD919-0104

DETAIL "A"



DETAIL "D"



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

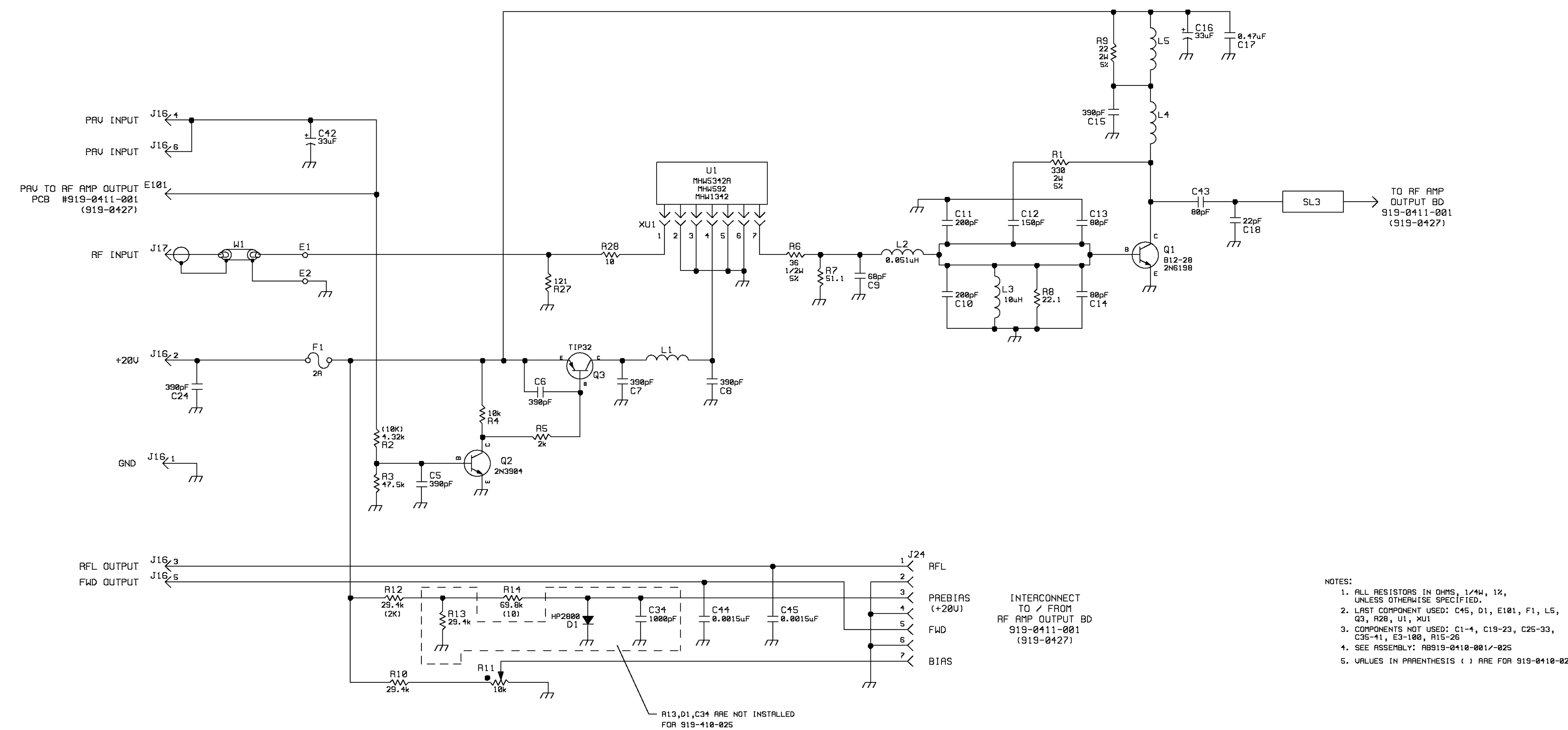
DWN BY KLS	DATE 3-18-87	MATERIAL SEE B/M 919-0104	BROADCAST ELECTRONICS INC. 4100 N. 24TH ST. QUINCY, IL. 62305 217/224-9600 TELEX 250142 CABLE "BROADCAST"
CHKD MH 6-14-88		FINISH	TITLE PCB ASSEMBLY- AFC/PLL
ME 06-20-88			TYPE A, SIZE D, DWG.NO. 919-0104, REV N
PROJ ENGR E. ANTHONY 6-13-88		NEXT ASSY 909-1050-000	MODEL FX-50, SCALE 2/1, SHEET 1 OF 1
MFG 6-14-86			

BROADCAST ELECTRONICS INC

REF	ZONE	REF	ZONE	REF	ZONE	REF	ZONE	REF	ZONE	REF	ZONE	REF	ZONE	REF	ZONE
C1	C1	C41	C2	DS2	B1	R15	B2	R55	B3	R95	C3				
C2	C2	C42	C2	DS3	C1-C2	R16	B2	R56	B3	R96	A2				
C3	C1	C43	C2	DS4	C2	R17	B2	R57	B3	R97	C3				
C4	C1-C2	C44	C2	DS5	C2	R18	B2	R58	B3	R98	C3				
C5	C1	C45	A3	E1	A2	R19	B2	R59	B3	R99	C3				
C6	C1	C46	A3	E2	A2	R20	A1	R60	B3	R100	C3				
C7	B1	C47	B3-A3	J1	B3-A3	R21	A1	R61	B3	R103	A3				
C8	B1	C48	A3	J2	C3	R22	B2	R62	B3	S1	B2				
C9	B1	C49	A3	J3	C2	R23	B2	R63	B2	S2	B2				
C10	B1	C50	A3	J4	A3	R24	C2	R64	A3	S3	B2				
C11	B1	C51	A3	J5	A2	R25	C2	R65	A3	T1	A1				
C12	C2	C52	A3	J8	C3	R26	C2	R66	B3	TP1	C2				
C13	C2	C53	A3	L1	C2	R27	C2	R67	B3	TP2	A3				
C14	C2	C54	A3	L2	A1	R28	C2	R68	A3	TP3	B1				
C15	A1	C55	A3	L3	A1	R29	C2	R69	A3-B3	TP4	C2				
C16	A1	C56	A2-A3	LDR1	C2	R30	C2	R70	A3	U1	C1				
C17	A1	C57	A2-A3	LDR2	B2-B3	R31	B3	R71	A3	U2	C1				
C18	A1	C58	A2	LDR3	B3	R32	B3	R72	A3	U3	B1				
C19	A1	C59	B2	P3	C2	R33	B3	R73	A2	U4	B1				
C20	A1-B1	C60	B2	P4	A3	R34	C3	R74	A3	U5	B1				
C21	A1	D1	C2-C3	P5A	A2	R35	C2	R75	A3	U6	A2				
C22	B2	D2	C2	P5B	A2	R36	C2	R76	A3	U8	A1				
C23	B2	D3	C2	Q1	B1	R37	C1-C2	R77	A3	U9	B2				
C24	A2	D4	B3	Q2	C1	R38	C1	R78	A3	U10	B2				
C25	A1-B1	D5	B3	Q3	C3	R39	C2	R79	A3	U11	C2				
C26	B2	D6	B3	Q4	C3	R40	C2	R80	A2	U12	C2				
C27	B2	D7	B3	R1	C1	R41	C2	R81	B2-A2	U13	C2				
C28	C2	D8	A3	R2	C1	R42	C2	R82	B2	U14	A2-A3				
C29	C2	D9	A3	R3	C1	R43	C2	R83	B2	U15	A2				
C30	C2-C3	D10	A3	R4	C1	R44	C2	R84	B3	U16	A2				
C31	C2-C3	D11	A3	R5	C2	R45	C2	R85	C3	U17	C3				
C32	C3	D12	A2	R6	C1	R46	C2	R86	A2	U18	C3				
C33	B2	D13	A2	R7	C2	R47	C3	R87	A2	Y1	C1				
C34	C3-B3	D14	A2	R8	A1	R48	C3	R88	A2						
C35	B3-C3	D15	A2	R9	A1	R49	C2	R89	A2						
C36	C3	D16	C3	R10	A1	R50	B3-C3	R90	A2						
C37	B3	D17	C3	R11	B1	R51	C3	R91	B2-A2						
C38	B3	D18	C3	R12	B1	R52	B3	R92	A2						
C39	C2	D19	C3	R13	B1	R53	B3	R93	C3						
C40	C2	DS1	C2	R14	B1	R54	B3	R94	C3						

FIGURE 5-3. AFC/PLL CIRCUIT BOARD COMPONENT LOCATORS

597-1050-70



NOTES:

1. ALL RESISTORS IN OHMS, 1/4W, 1%, UNLESS OTHERWISE SPECIFIED.
2. LAST COMPONENT USED: C45, D1, E101, F1, L5, Q3, R28, U1, XU1
3. COMPONENTS NOT USED: C1-4, C19-23, C25-33, C35-41, E3-100, R15-26
4. SEE ASSEMBLY: AB919-0410-001/-025
5. VALUES IN PARENTHESIS ( ) ARE FOR 919-0410-025.

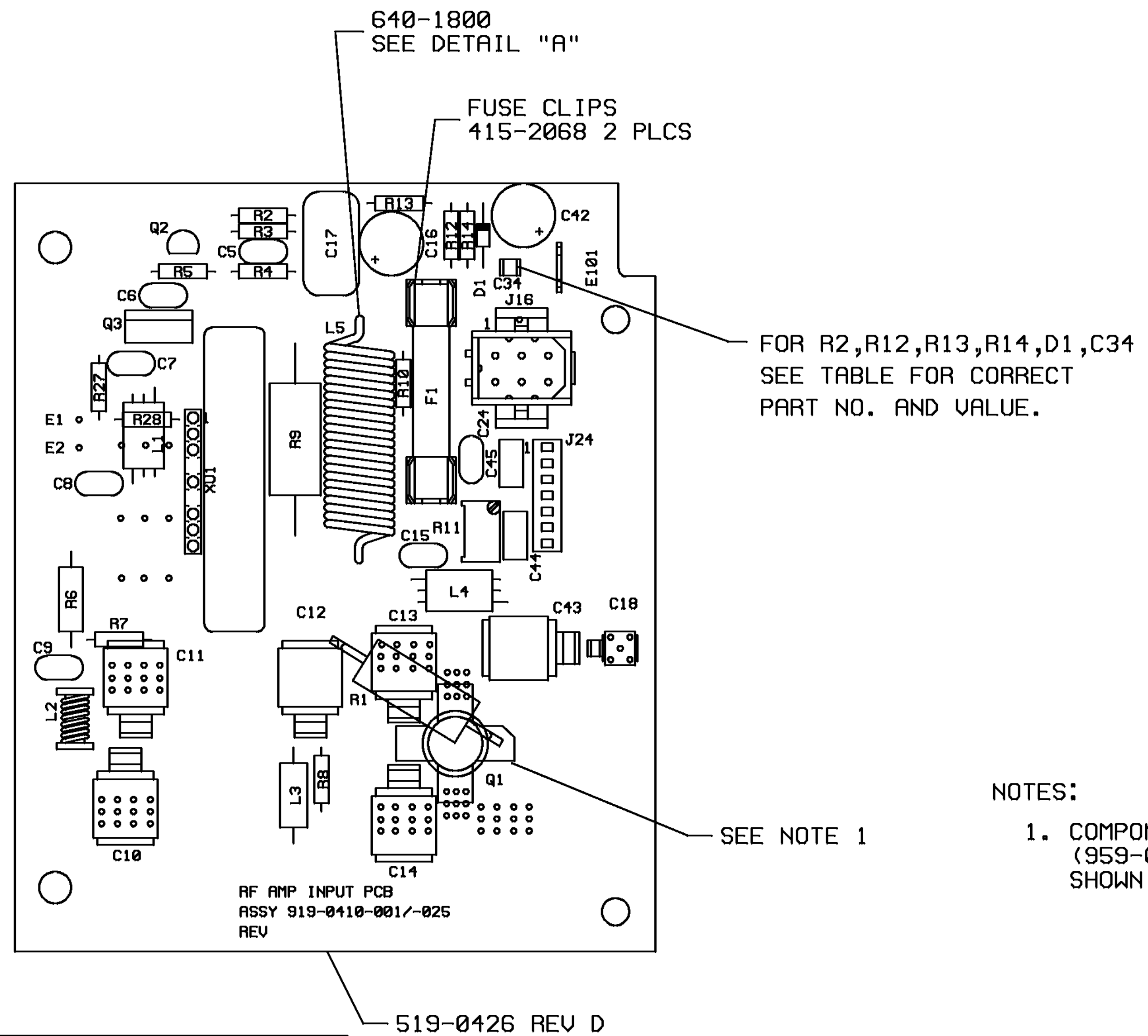
TOLERANCE (DECIMAL) U.O.S.
.x ± .030 .xxx ± .005
.xx ± .015 ANGLES ± 1°

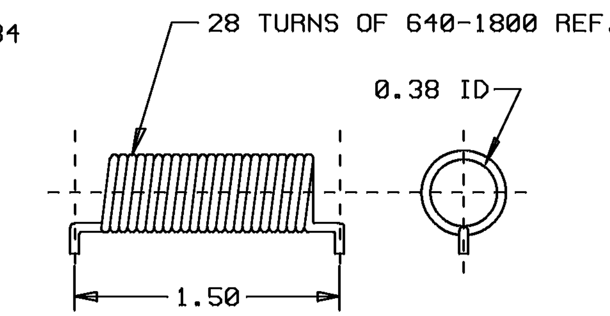
DWN. BY JLF 8-27-93
DESIGNER(S) CLL 8-31-93
PROJ. LEADER 10/9/93 C.L.LANGNER
MFG. D.RUST 10-9-93
MATERIAL
FINISH
SEE DWG AA592-0000
NEXT ASSY.

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 SCHEMATIC
RF AMP INPUT PCB

TYPE S | SIZE B | DWG. NO. 919-0410-001/(-025) | REV B
MODEL FM-100C (FM-250C) | SCALE NONE | SHEET 1 OF 1





DETAIL "A"

SCALE = 1:1

NOTES:

1. COMPONENTS Q1 & R1 ARE INSTALLED DURING RF AMP (959-0411/959-0415) FINAL ASSEMBLY, AND ARE SHOWN HERE FOR REFERENCE ONLY.

REF. DES.	ASSEMBLY 919-0410-001	ASSEMBLY 919-0410-025
R2	103-4324(4.32K,1%)	100-1051(10K,1%)
R12	103-2945(29.4K,1%)	100-2041(2K,1%)
R13	103-2945(29.4K,1%)	N/A
R14	103-6985(69.8K,1%)	103-1021(10,1%)
D1	201-2800(HP2800)	N/A
C34	009-1032(1000pF)	N/A

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

DWN. BY: JLF 7-13-93
DESIGNER(S): CLL 8-4-93
PROJ. LEADER: CLL 10-8-93
MFG.: D. RUST 10-8-93

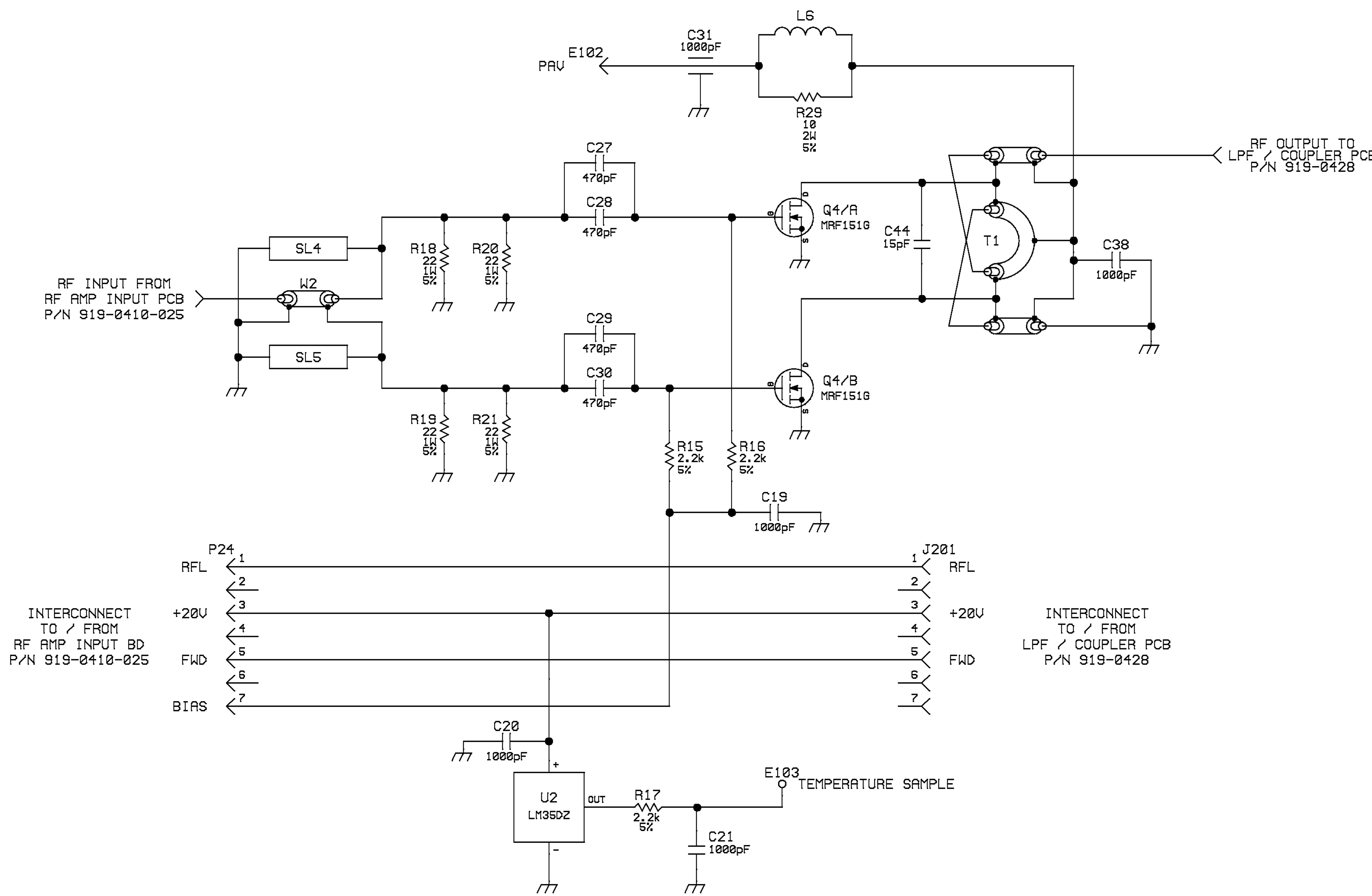
MATERIAL: SEE BOM 919-0410-001 919-0410-025
FINISH:
NEXT ASSY.: 959-0415 959-0411

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

TITLE: PCB ASSEMBLY RF AMP INPUT BD

TYPE	SIZE	DWG No.	REV
A	B	919-0410-001/-025	H

MODEL FM-100C/FM-250C | SCALE 1:1 | SHEET 1 OF 1



NOTES:

1. ALL RESISTORS IN OHMS, 1/4W, 1%, UNLESS OTHERWISE SPECIFIED.
2. LAST COMPONENT USED: C44, E103, J201, L6, P24, Q4, R21, SL5, T1, U2, W2
3. COMPONENTS NOT USED: C1-19, C22-26, C32-37, C39-43, E1-101, J1-200, L1-5, P24, Q1-3, R1-14, R22-28, SL1-3, U1, W1
4. SEE ASSEMBLY: AB919-0427

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

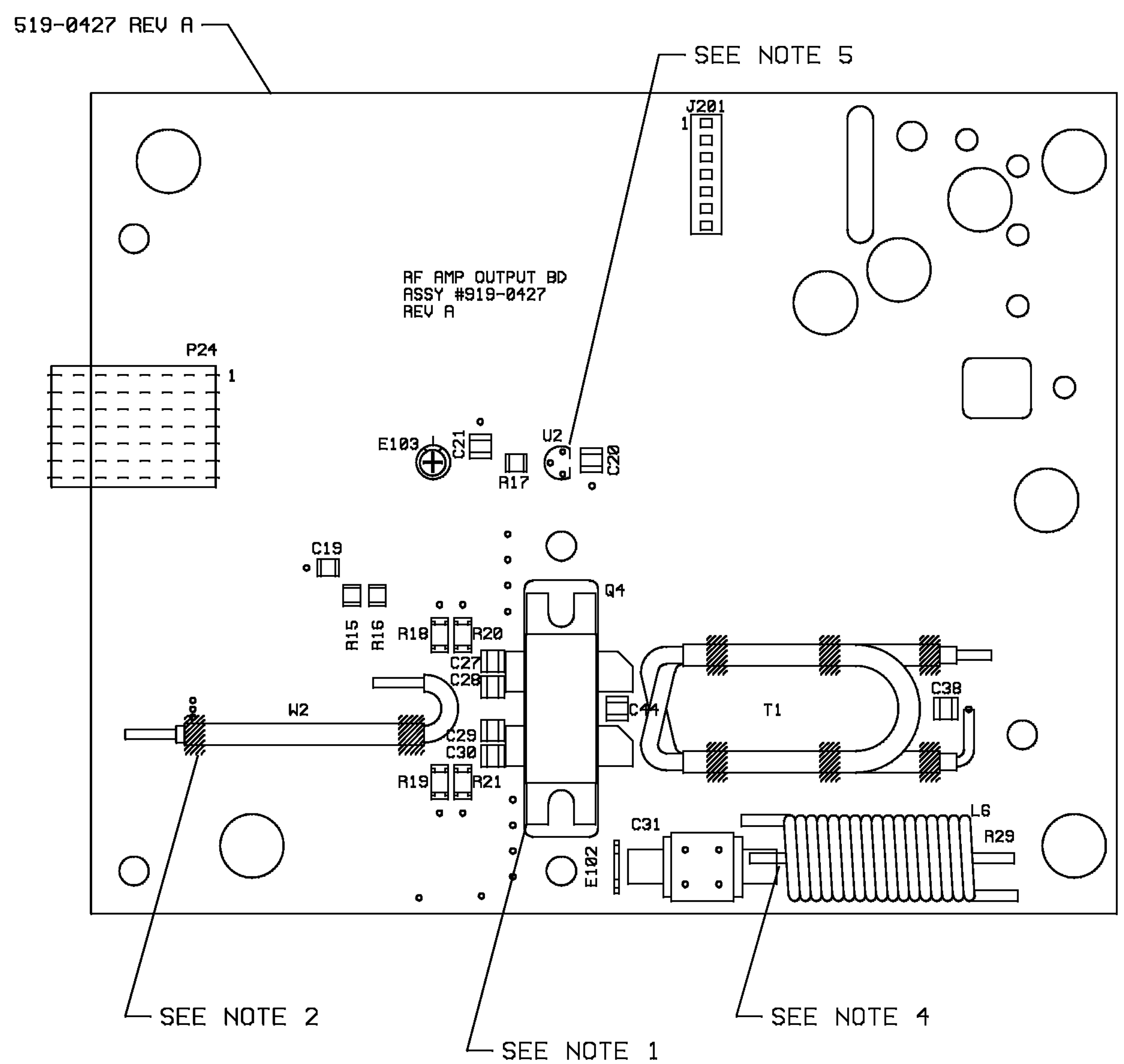
DWN. BY	JLF 2-7-95
DESIGNER(S)	CLL 6-15-95
PROJ. LEADER	
MFG.	
MATERIAL	
FINISH	
NEXT ASSY.	959-0415

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

TITLE SCHEMATIC RF AMP OUTPUT BD

TYPE	SIZE	DWG. NO.	REV
S	C	919-0427	A

MODEL FM-250C | SCALE NONE | SHEET 1 OF 1



NOTES:

1. COMPONENTS SHOWN FOR REFERENCE ONLY: C27, C28, C29, C30, Q4, T1, & W2.
2. OUTER CONDUCTOR OF T1 & W2 TO BE SOLDERED TO PCB WHERE INDICATED BY SHADING DURING RF AMP (959-0415) FINAL ASSEMBLY.
3. SEE SCHEMATIC: SC919-0427
4. R29 TO BE ROUTED THRU THE CENTER OF L6 AND SURFACE SOLDERED TO PCB AFTER INSTALLING C31.
5. U2 TO BE MOUNTED ON OPPOSITE SIDE OF PCB WITH A MAXMIMUM COMPONENT HEIGHT OF 0.220".

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

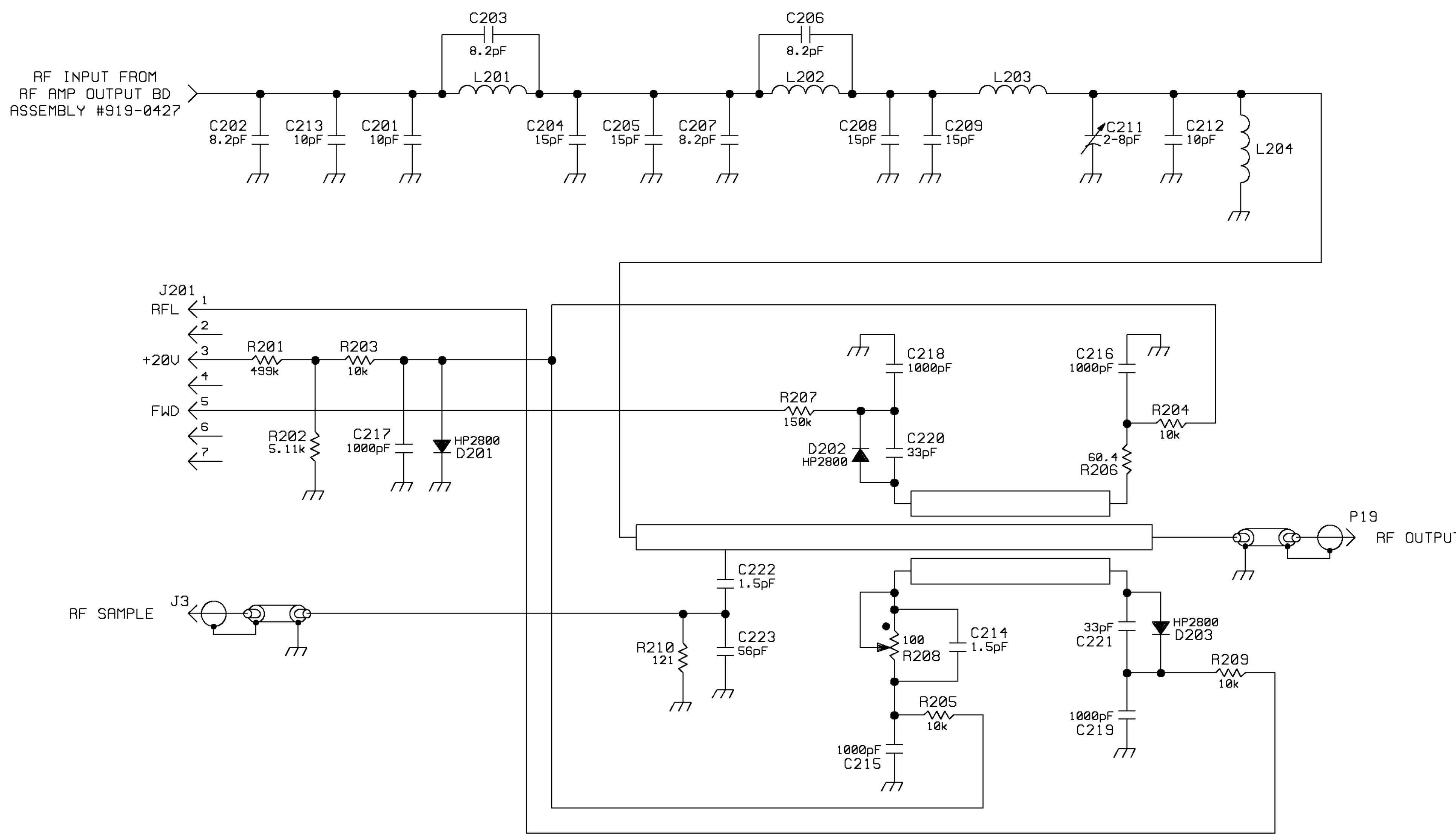
DWN. BY	JLF 1-15-95
DESIGNER(S)	CLL 6-15-95
PROJ. LEADER	
MFG.	
MATERIAL	SEE BOM 919-0427
FINISH	
NEXT ASSY.	959-0415

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

TITLE
PCB ASSEMBLY
RF AMP OUTPUT BD

TYPE	SIZE	DWG No.	REV
A	B	919-0427	A

MODEL FM-250C | SCALE 1:1 | SHEET 1 OF 1



NOTES:

1. ALL RESISTORS IN OHMS; 1/4W, 1% UNLESS OTHERWISE SPECIFIED.
2. LAST COMPONENT USED: C223, D203, J201, L204, P19, R210
3. COMPONENTS NOT USED: P1-2, P4-18, J1,J2,J4-200
4. SEE ASSEMBLY: AB919-0428

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

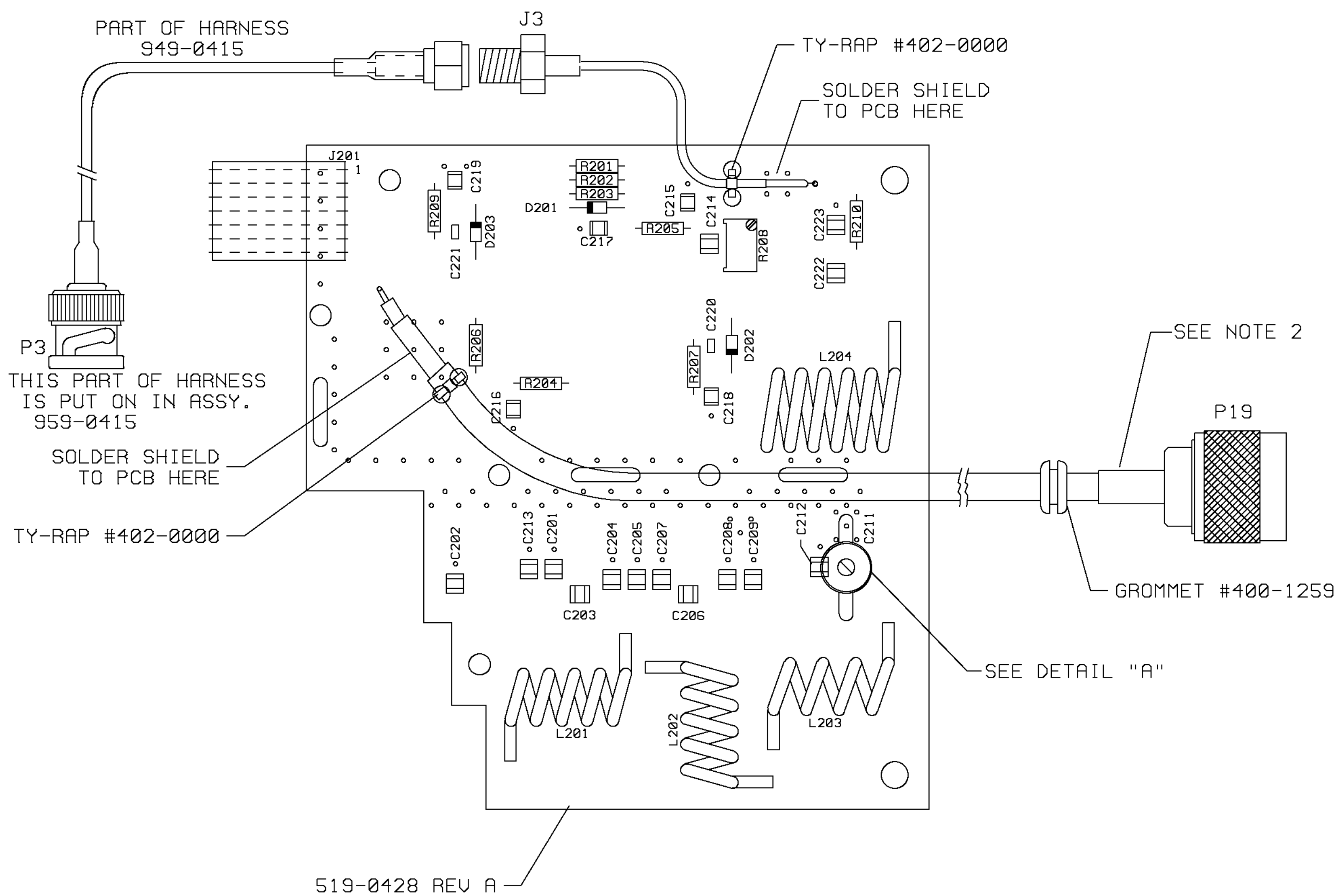
DWN. BY: JLF 1-15-95
DESIGNER(S): CLL 6-16-95
PROJ. LEADER:
MFG.:
MATERIAL:
FINISH:
NEXT ASSY.: 959-0415

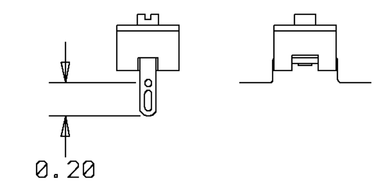
BE® BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305
217/224-9600 FAX 217/224-9607

TITLE: SCHEMATIC LPF / COUPLER BD

TYPE	SIZE	DWG. NO.	REV
S	C	919-0428	B

MODEL FM-250C | SCALE NONE | SHEET 1 OF 1





FORM LEADS AS SHOWN
FOR BEI P/N 096-0010

DETAIL "A"

SCALE = 1:1
TYP 2 PLCS

NOTES:
1. SEE SCHEMATIC: SC919-0428
2. CABLES WITH P3 & P19 ARE FROM WIRE HARNESS #949-0415.

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

DWN. BY: JLF 1-15-95
DESIGNER(S): CLL 6-16-95
PROJ. LEADER:
MFG.:
MATERIAL: SEE BOM 919-0428
FINISH:
NEXT ASSY.: 959-0415

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

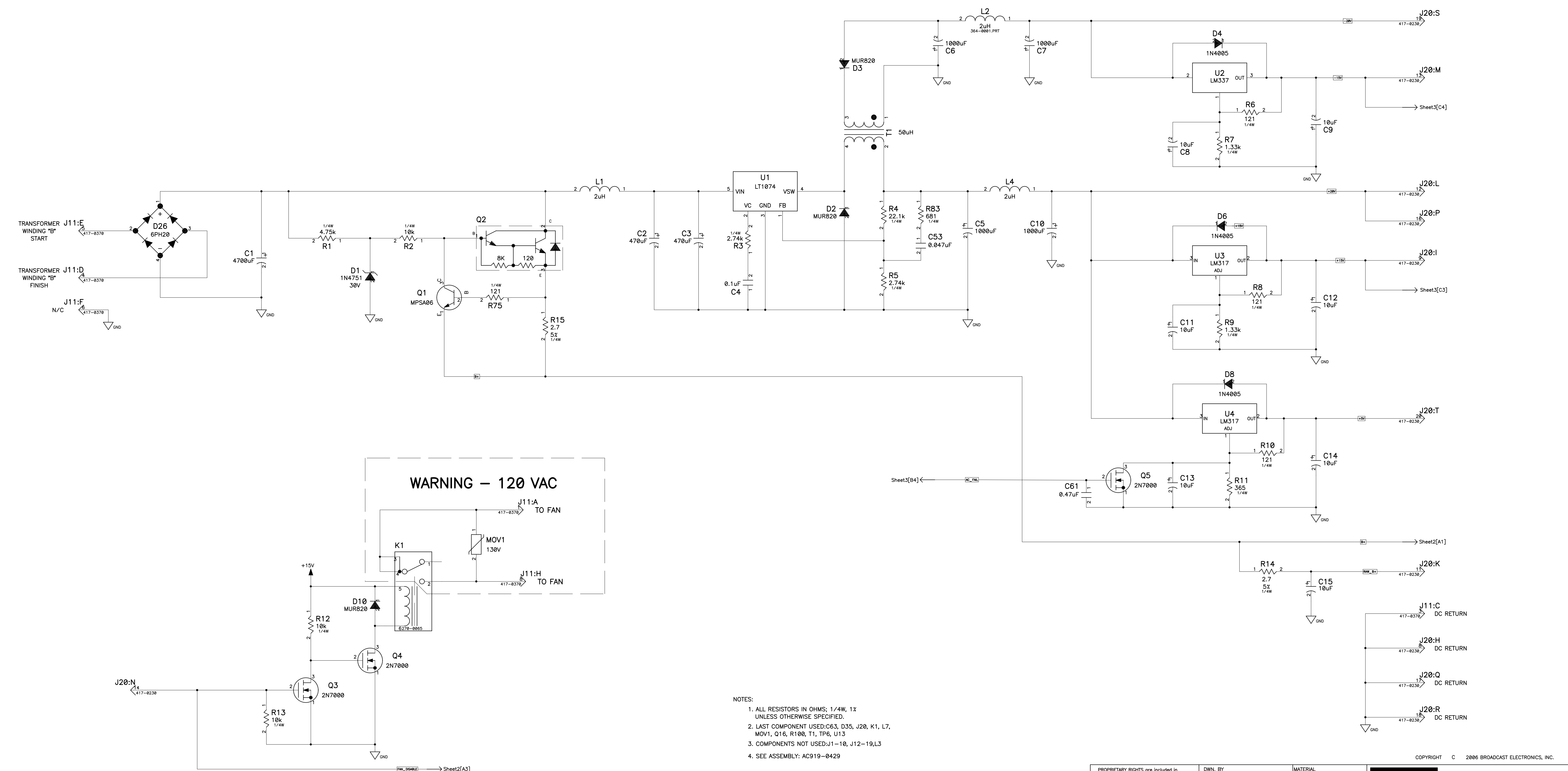
TITLE: PCB ASSEMBLY LPF / COUPLER BD

TYPE	SIZE	DWG No.	REV
A	B	919-0428	B

MODEL FM-250C | SCALE 1:1 | SHEET 1 OF 1

REVISIONS

REV	DATE	DESCRIPTION	DFTSMN	ENGR	ECN
1	2-27-95	PROTOTYPE RELEASE.	JLF		----
2	6-13-95	ADDED C53,C61,Q5,R83. C4 WAS 0.01uF. SEE SHTS 2 & 3. MODEL RELEASE.	JLF	CLL	----
A	8-18-95	ENGINEERING RELEASE W/O CHG.	JLF	CLL	----
B	11-7-95	CHGD U1 TO LT1074;SEE SHEETS 2 & 3 FOR CHANGES	MERK	DL	9565
C	5-7-96	ADDED TP6 (SHT2).	JLF	DL	9661
D	6-23-97	SHT. 3, R79 WAS 2W NOW 3W	MSE	DL	9807
E	9-27-06	CHG'D C23 TO (040-2223)	JTB		11458



NOTES:

1. ALL RESISTORS IN OHMS; 1/4W, 1% UNLESS OTHERWISE SPECIFIED.
2. LAST COMPONENT USED:C63, D35, J20, K1, L7, MOV1, Q16, R100, T1, TP6, U13
3. COMPONENTS NOT USED:J1-10, J12-19,L3
4. SEE ASSEMBLY: AC919-0429

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

DWN. BY JLF 2-27-95
DESIGNER(S) CLL 6-15-95
DATE CL LANGNER 8/18/95
MFG. T WHISTON 8/18/95
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

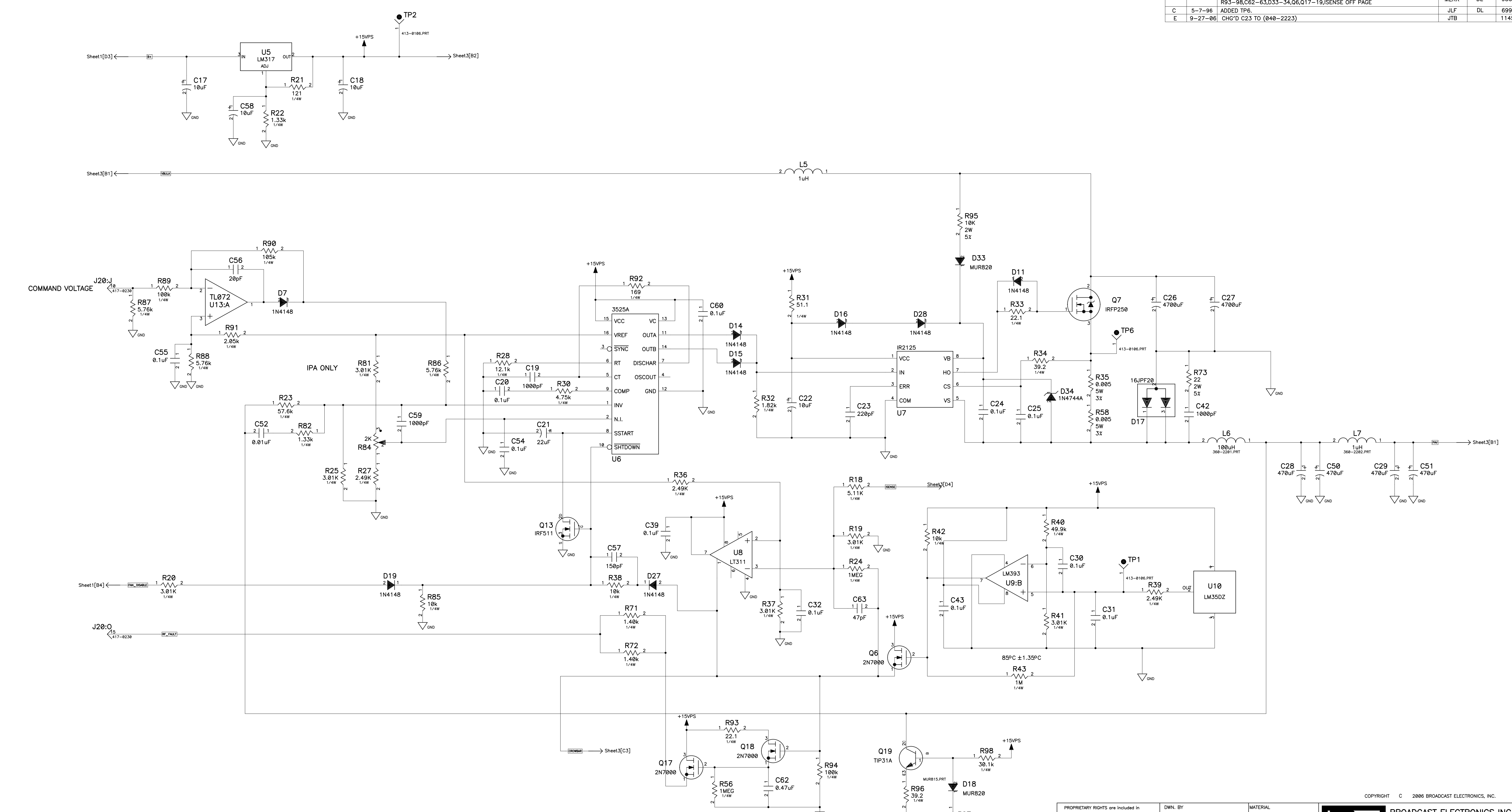
TITLE SCHEMATIC SWITCHING POWER SUPPLY

TYPE S | SIZE D | DWG. NO. 919-0429 | REV E

MODEL FM-250C | SCALE NONE | SHEET 1 OF 3

REVISIONS

REV	DATE	DESCRIPTION	DFTSMN	ENGR	ECN
1	2-27-95	PROTOTYPE RELEASE. DEL D11-13,Q5-6,R16-19,R24,R56. USED U13/B. ADDED C52.	JLF		----
2	6-13-95	C54-60,D7,D11,Q13,R82,R84-92. CHGD C20-21,C23,R28,R30, R32,R34,R40-41,R90. MODEL RELEASE.	JLF	CLL	----
A	8-18-95	ENGINEERING RELEASE W/O CHG.	JLF	CLL	----
B	11-7-95	CHGD VALUE R84,R27,R31: ADDED TP2,R18-19,R24,R56, R93-98,C62-63,D33-34,Q6,Q17-19,ISENSE OFF PAGE	MERK	DL	9565
C	5-7-96	ADDED TP6.	JLF	DL	6991
E	9-27-06	CHG'D C23 TO (040-2223)	JTB		11458



* Note: U8 input polarities are functionally the opposite of that shown, due to the use of Pin 1 as output. See data sheet for further detail.

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

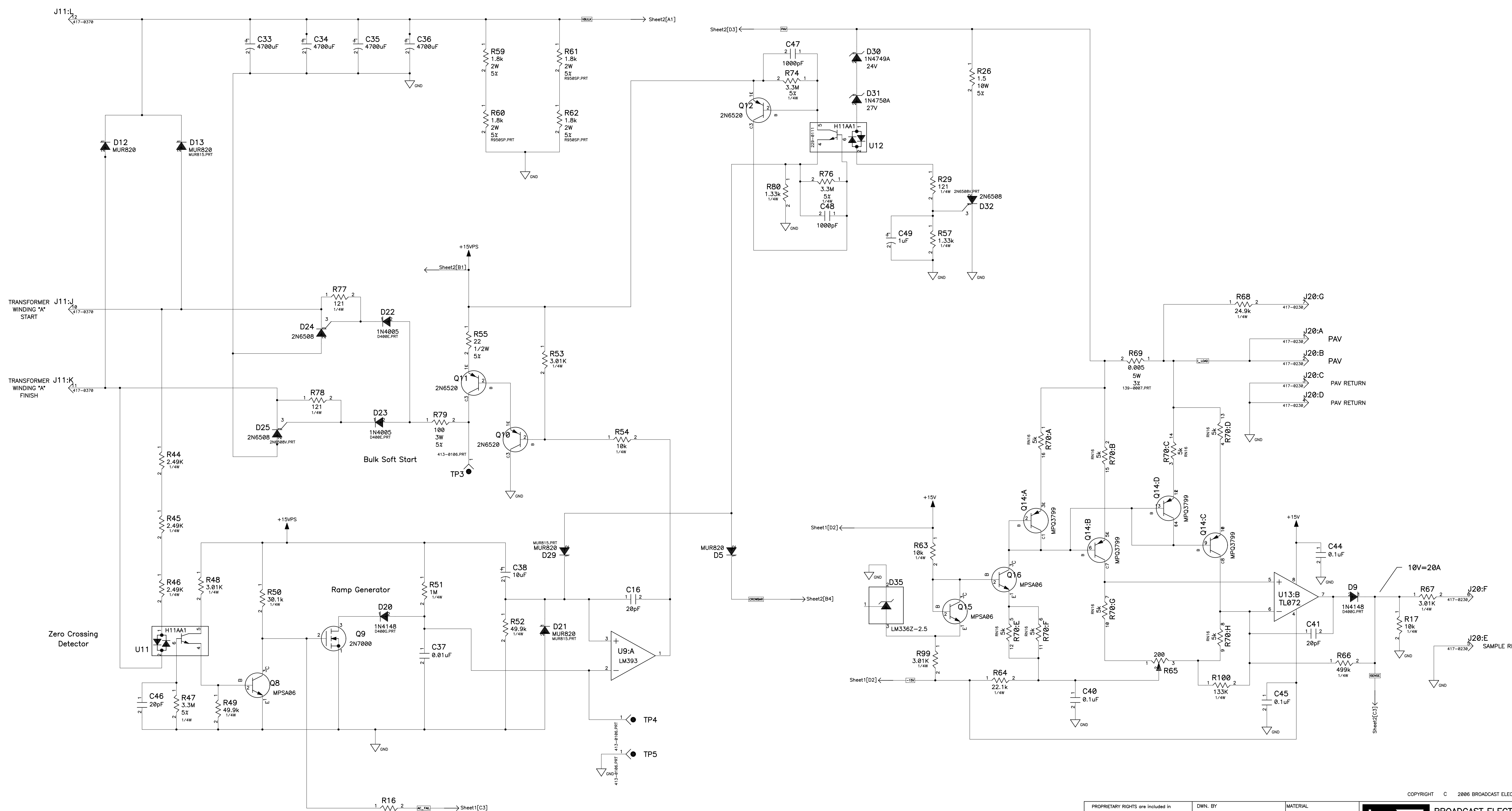
DWN. BY JLF 2-27-95
DESIGNER(S) CLL 6-15-95
DATE 8/18/95 CL LANGNER
MFG. 8/20/95 T WHISTON
MATERIAL
FINISH
NEXT ASSY.

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

TITLE SCHEMATIC SWITCHING POWER SUPPLY

TYPE S | SIZE D | DWG. NO. 919-0429 | REV E
MODEL FM-250C | SCALE NONE | SHEET 2 OF 3

REVISIONS					
REV	DATE	DESCRIPTION	DFTSMN	ENGR	ECN
1	2-27-95	PROTOTYPE RELEASE.	JLF	CLL	----
2	6-13-95	ADDED D5, D9, R16-17. MOVED R44-1 CONNECTION FROM J11-12 TO J11-10. MODEL RELEASE.	JLF	CLL	----
A	8-18-95	ENGINEERING RELEASE W/O CHG.	JLF	DL	----
B	11-7-95	CHGD VALUE R63; ADDED D12-13,D35,R99-100,TP3-5, ADDED ISENSE OFF PAGE	MERK	DL	9565
D	6-23-97	R79 WAS 2W NOW 3W	MSE	DL	9807
E	9-27-06	CHG'D C23 TO (040-2223)	JTB		11458



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

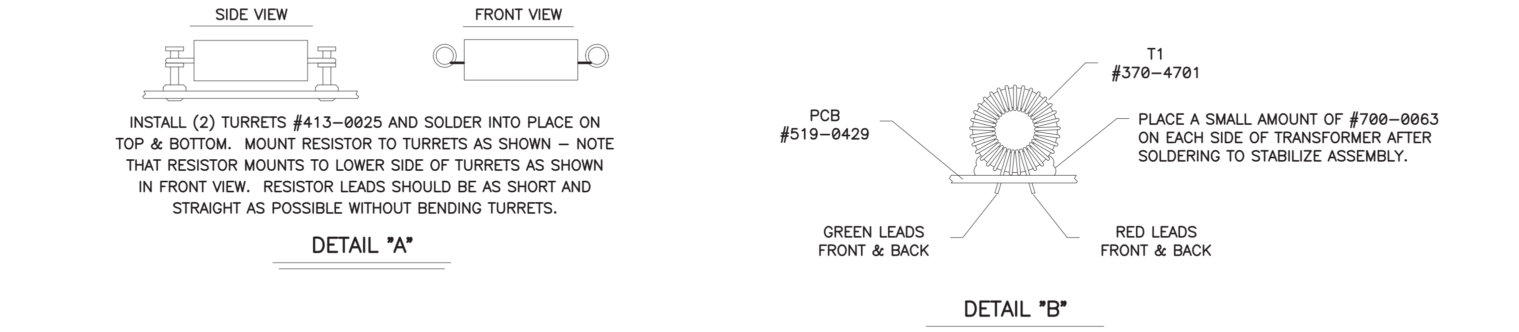
DWN. BY JLF 2-27-95
DESIGNER(S) CLL 6-15-95
DATE CL LANGNER 8/18/95
MFG. T WHISTON 8/18/95
MATERIAL
FINISH
NEXT ASSY.

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

TITLE SCHEMATIC SWITCHING POWER SUPPLY

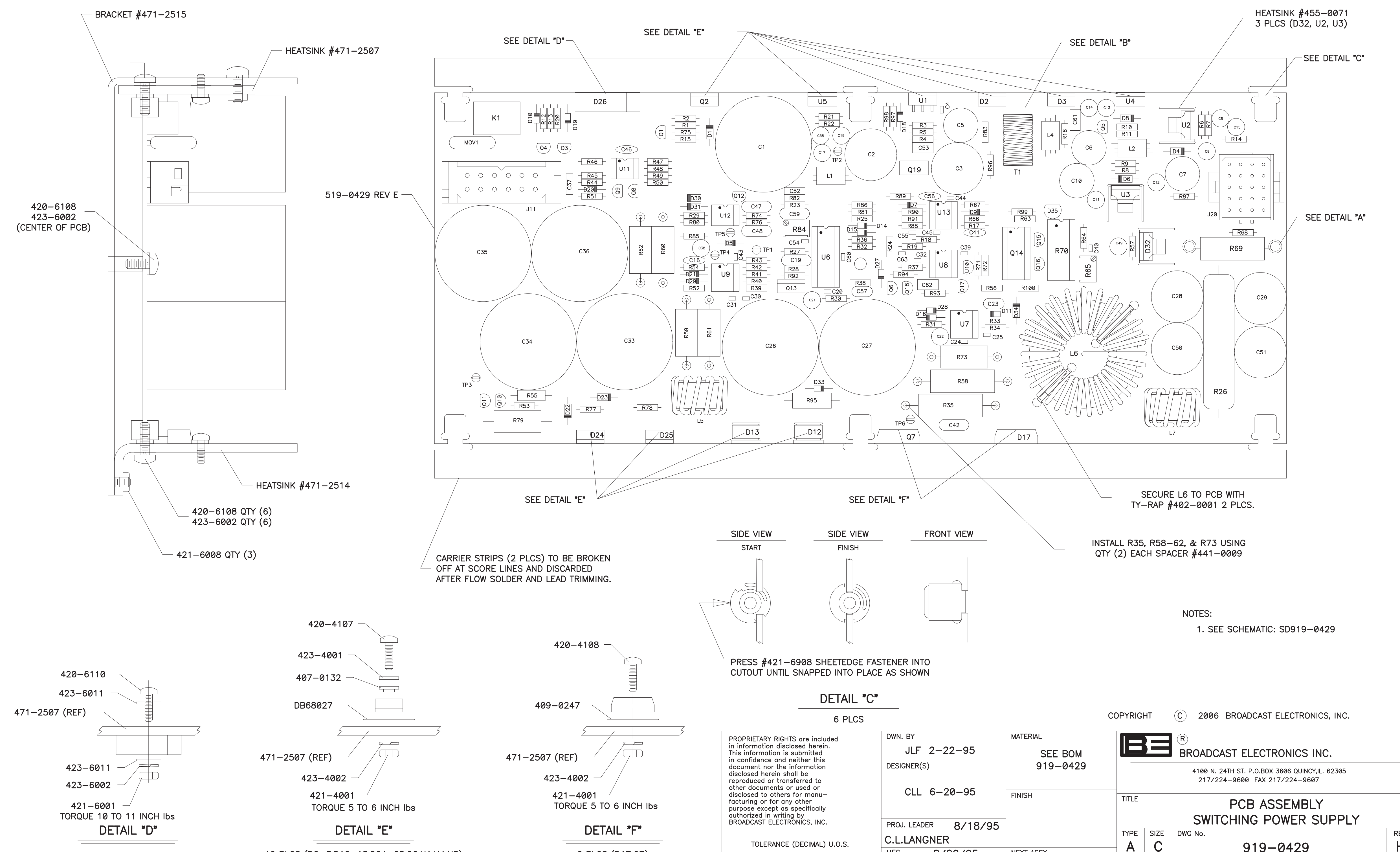
TYPE S | SIZE D | DWG. NO. 919-0429 | REV E

MODEL FM-250C | SCALE NONE | SHEET 3 OF 3



REVISIONS

REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	2-23-95	PROTOTYPE RELEASE.	JLF		----
2	6-20-95	MODEL RELEASE.	JLF	CLL	----
A	8-15-95	UPDATED NOTES. ENGINEERING RELEASE.	JLF	CLL	----
B	11-10-95	CHGD VALUE R27,31,63,84: ADDED C62-63,D12-13,D33-D35,R18-19,24,56,93-100,Q6,17-19,TP2-5: REMOVED SLEEVING NOTE FOR L1,L2 & L4	MERK	DL	9565
C	5-7-96	CHGD PCB OUTLINE FOR EASE OF ASSY. REMOVED TURRETS AND ADDED SPACERS FOR R35,58-62,&73. ADDED TP6.	JLF	DL	9661
D	6-24-97	R79 WAS 2W, NOW 3W	MSE	DL	9807
E	8-25-97	#441-0009 WAS #441-9406, 420-6108 & 423-6002 WAS QTY (9)	MSE	DL	9841
F	10-8-03	ADDED TORGUE SPEC	KT	DL	11038
G	10-20-03	CHGD INSULATOR 409-247 TO DB68027 ON DETAIL "E"	KT	DL	11053
H	9-27-06	CHGD C23 TO (040-2223)	JTB		11458



NOTES:

1. SEE SCHEMATIC: SD919-0429

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

DWN. BY: JLF 2-22-95
DESIGNER(S): CLL 6-20-95
PROJ. LEADER: C.L.LANGNER 8/18/95
MFG.: T. WHISTON 8/20/95

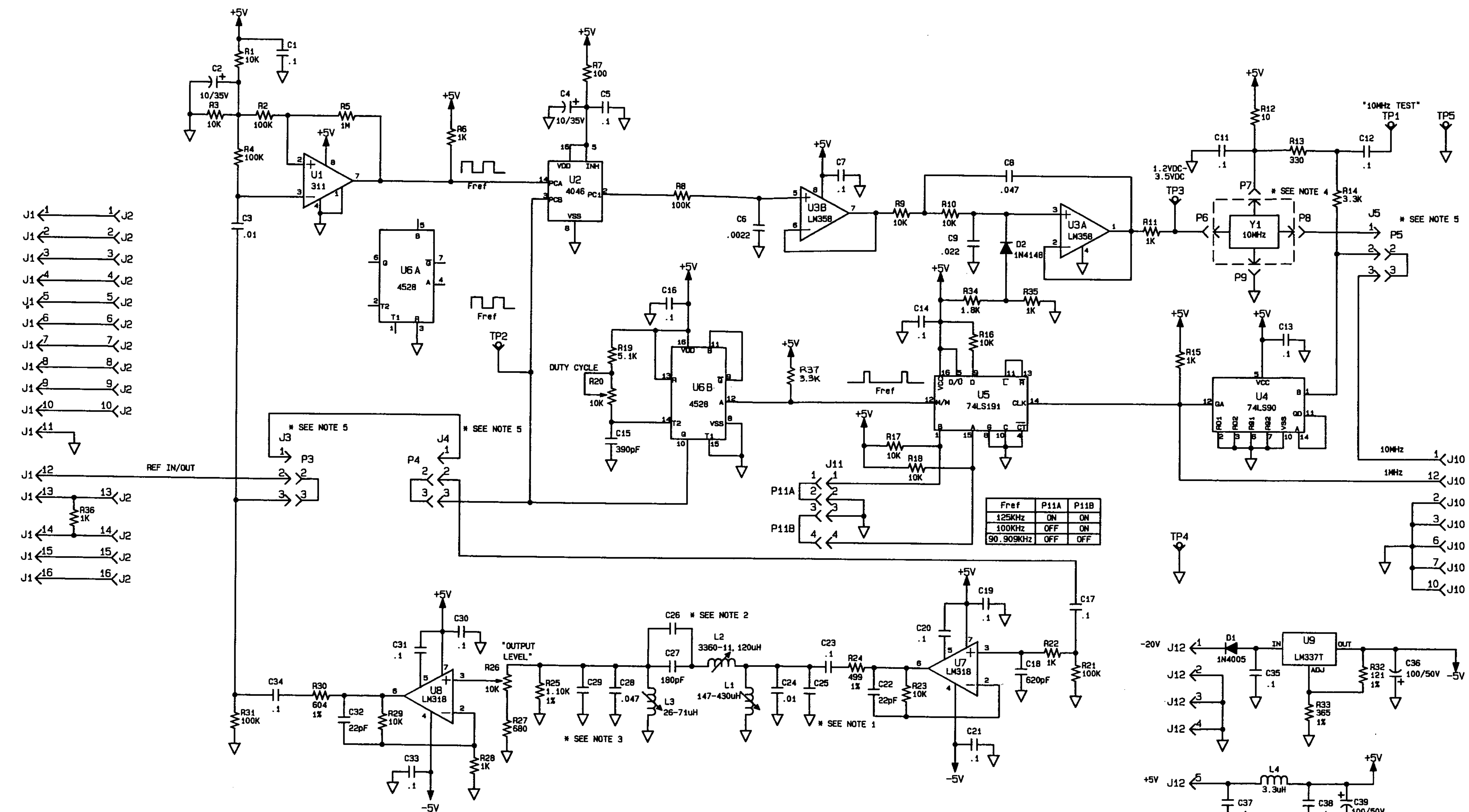
MATERIAL: SEE BOM 919-0429
FINISH:
NEXT ASSY.: -

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

TITLE: PCB ASSEMBLY SWITCHING POWER SUPPLY

TYPE: A SIZE: C DWG No.: 919-0429 REV: H

MODEL: FM-250C SCALE: 1:1 SHEET 1 OF 1



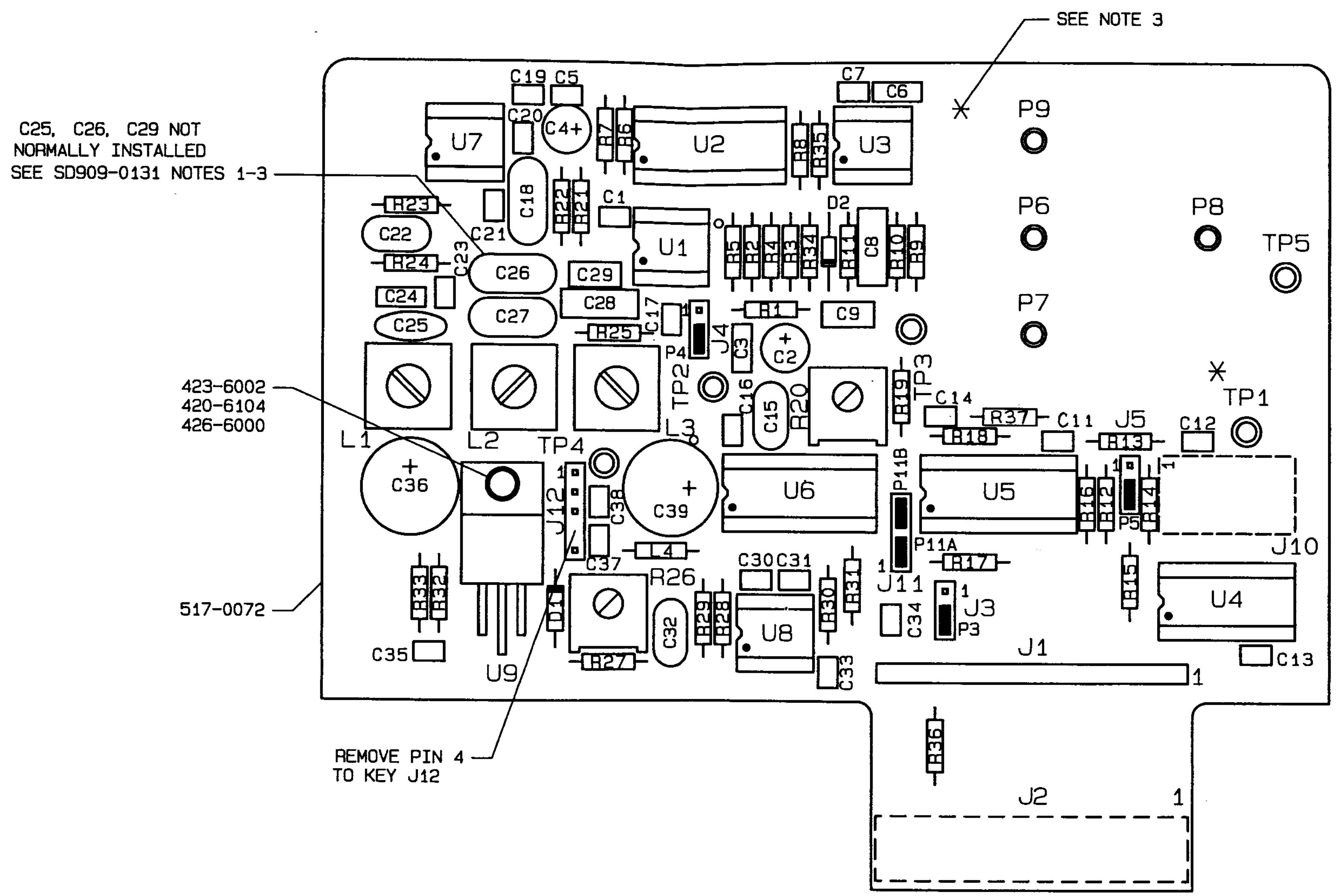
Fref	P11A	P11B
125KHz	ON	ON
100KHz	OFF	ON
90.909KHz	OFF	OFF

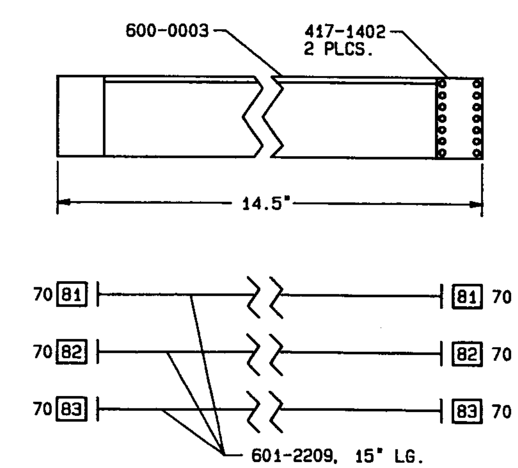
NOTES:

1. FOR Fref=100KHz OR 90.909KHz, ADD C25 .005uF. B.E. P/N 000-5034
2. FOR Fref=100KHz, ADD C26 82pF. B.E. P/N 042-8212
   FOR Fref=90.909KHz, ADD C26 240pF. B.E. P/N 040-2422
3. FOR Fref=90.909KHz, ADD C29 .022uF. B.E. P/N 031-2243
4. Y1 NOT INSTALLED WHEN UNIT IS CONFIGURED AS "MASTER".
5. CONFIGURE P3, P4, P5: 1-2 FOR "SLAVE", 2-3 FOR "MASTER".
6. ALL RESISTORS IN OHMS, 1/4W, 5%. ALL CAPACITORS IN MICROFARADS, UNLESS OTHERWISE SPECIFIED.
7. LAST COMPONENTS USED: R37, C39, D2, U9, L4, TP4, J12, P9.
8. SEE PCB ASSEMBLY AC909-0131
9. COMPONENTS NOT USED: C10

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

DWN BY KLS 7-25-88	MATERIAL SEE B/M 909-0131	BROADCAST ELECTRONICS INC.	
CHKD MH 10-12-88	FINISH	TITLE PCB SCHEMATIC-FX-50 BOOSTER OPTION BD.	
ME			
PROJ. ENGR. 10-12-88			
MFG.	NEXT ASSY	TYPE S SIZE D DWG.NO. 909-0131	REV A
		MODEL FX-50 SCALE NTS	SHEET 1 OF 1





P12	417-0165
PIN NO.	WIRE NO.
1	81
2	82
3	OPEN
4	KEY
5	83

✱KEYING PLUG P/N 417-0224

NOTES:

1. SEE SCHEMATIC SD909-0131
2. LAST COMPONENT USED: R37, C39, D2, U9, L4, TP5, J12, P9.
3. INSTALL Y1 P/N 390-0023 ON VERSION 909-0132 AND SOLDER WHERE INDICATED BY ✱. CUT LEADS TO 0.3".
4. COMPONENTS NOT USED: C10
5. FOR FREF=100KHz OR 90.909KHz, ADD C25 .005uF BE P/N 000-5034.
6. FOR FREF=100KHz, ADD C26 82pF BE P/N 042-8212. FOR FREF=90.909KHz, ADD C26 240pF BE P/N 040-2422.
7. FOR FREF=90.909KHz, ADD C29 .022uF BE P/N 031-2243.

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

DWN BY KLS 8-4-88
CHKD MH 10-12-88
ME [illegible] 10-12-88
PROJ. ENGR. E. Anthony 10-12-88
MFG. [illegible]

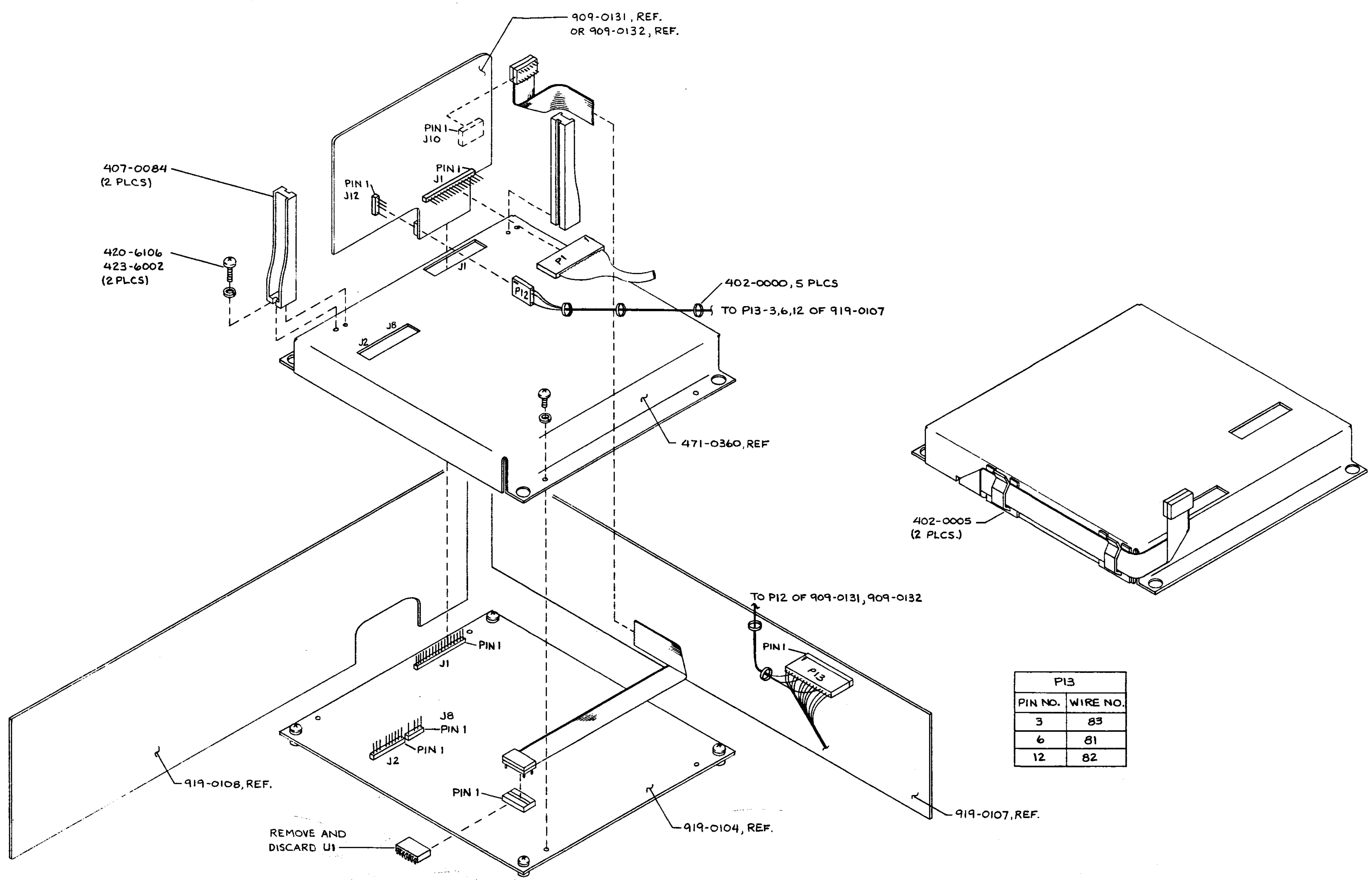
MATERIAL SEE B/M 909-0131
FINISH
NEXT ASSY

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 PCB ASSEMBLY– FX-50 BOOSTER OPTION BD.

TYPE	SIZE	DWG. NO.	REV
A	C	909-0131	D

MODEL FX-50 SCALE 2/1 SHEET 1 OF 2



P13	
PIN NO.	WIRE NO.
3	83
6	81
12	82

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

DWN. BY	KLS 10-11-88
CHKD	MH 10-12-88
ME	[signature] 10-12-88
PROJ. ENGR.	E Hutton 10-12-88
MFG.	[signature] 10-13-88
MATERIAL	SEE B/M 909-0131
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

TITLE PCB ASSEMBLY
FX-50 BOOSTER OPTION ASSY.

TYPE	SIZE	DWG. NO.	REV
A	C	909-0131	D

MODEL FX-50 | SCALE .5=1 | SHEET 2 OF 2