FM–5C 5 kW FM ONLY,
FMi–402 3.5 kW FM + HD,
1.5 kW HD ONLY

FM–4C 4 kW FM ONLY,
FMi–301 2.8 kW FM + HD,
1.2 kW HD ONLY
BROADCAST TRANSMITTERS

August, 2007 **IM No. 597–5001**

IMPORTANT INFORMATION

EQUIPMENT LOST OR DAMAGED IN TRANSIT.

When delivering the equipment to you, the truck driver or carrier's agent will present a receipt for your signature. Do not sign it until you have: 1) inspected the containers for visible signs of damage and 2) counted the containers and compared with the amount shown on the shipping papers. If a shortage or evidence of damage is noted, insist that notation to that effect be made on the shipping papers before you sign them.

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

RF PRODUCT TECHNICAL ASSISTANCE – REPAIR SERVICE – REPLACEMENT PARTS.

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

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

FACILITY CONTACTS –

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

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

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

NON–EMERGENCY REPLACEMENT PARTS –

Fax: (217) 224–9609

RETURN, REPAIR, AND EXCHANGES.

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

WARRANTY ADJUSTMENT.

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

PROPRIETARY NOTICE.

MODIFICATIONS.

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

WARNING

OPERATING HAZARDS

READ THIS SHEET AND OBSERVE ALL SAFETY PRECAUTIONS

ALL PERSONS WHO WORK WITH OR ARE EXPOSED TO POWER TRANSISTORS 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 TRANSISTORS

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

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

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

C. BERYLLIUM – OXIDE POISONING – Dust or fumes from BeO ceramics used as thermal links with power transistors are highly toxic and can cause serious injury or death. 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

The transmitter operates at voltages high enough to kill through electrocution. Personnel should always break the primary circuits when access to the transmitter is required.

RADIO FREQUENCY RADIATION

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

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

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

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

BeO ceramic material is used as a thermal link to carry heat from a transistor to the heat sink. Do not perform any operation on any BeO ceramic which might produce dust or fumes, such as grinding, grit blasting, or acid cleaning. Beryllium oxide dust or fumes are highly toxic and breathing them can result in serious personal injury or death. BeO ceramics must be disposed of only in a manner prescribed by the device manufacturer.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. Information presented by this section provides a general description of the Broadcast Electronics FM-5C/FM-4C and FMi-402/FMi-301 transmitters and lists equipment specifications.

1-3. RELATED PUBLICATIONS.

1-4. The following list of publications provides data for equipment associated with the FM-5C/FM-4C transmitters.

PUBLICATION NUMBER	EQUIPMENT
597-1004	FM-250C FM Transmitter/Exciter Manual
597-0008-004	FC-30 SCA Generator Manual
597-9900	LYNX Digital Stereo Generator Manual

1-5. The following list of publications provides data for equipment associated with the FMi-402/FMi-301 transmitters.

PUBLICATION NUMBER	EQUIPMENT
597-0541	FXi-60/250 Digital Exciter Manual
597-0542-XM3	FXi & XPi Quick Installation Guide
597-0542-008	XPi-10 Operation Manual

1-6. EQUIPMENT DESCRIPTION.

1-7. FM–5C/FM–4C GENERAL.

1-8. The Broadcast Electronics FM-5C transmitter is a 5 kW solid-state FM ONLY transmitter designed for continuous operation in the 87.5 MHz to 108 MHz broadcast band (refer to Figure 1-1).

1-9. The FM-5C transmitter is equipped with: 1) an FM-250C FM exciter, 2) 6 modular switching power supply assemblies, 3) 10 modular solid-state broadband plug-in RF power amplifier modules, 4) a low-pass filter, 5) a combiner, and 6) a CMOS controller. All the components are housed in a single chassis.

1-10. The Broadcast Electronics FM-4C transmitter is a 4 kW solid-state FM ONLY transmitter designed for continuous operation in the 87.5 MHz to 108 MHz broadcast band. (refer to Figure 1-1).

1-11. The FM-4C transmitter is equipped with: 1) an FM-250C FM exciter, 2) 5 modular switching power supply assemblies, 3) 8 modular solid-state broadband plug-in RF power amplifier modules, 4) a low-pass filter, 5) a combiner, and 6) a CMOS controller. All the components are housed in a single chassis.

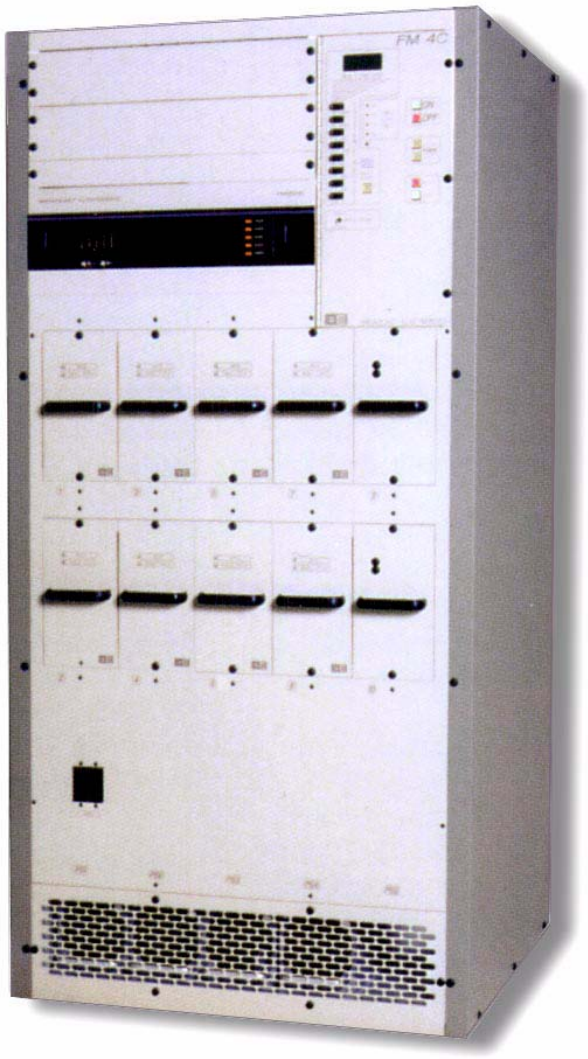
1–12. FMi–402/FMi–301 GENERAL

1-13. The Broadcast Electronics FMi-402 transmitter is a 3.5 kW solid-state FM+HD and 1.5 kW HD ONLY solid state transmitter based largely on the FM-5C architecture and is designed for continuous operation in the 87.5 MHz to 108 MHz broadcast band (refer to Figure 1-2).

1-14. The FMi-402 transmitter is equipped with: 1) an FXi-250 Digital FM Exciter, 2) an XPi-10 HD Exporter, 3) 6 modular switching power supply assemblies, 4) 10 modular solid-state broadband plug-in RF power amplifier modules, 5) a low-pass filter, 6) a combiner, and 7) a CMOS controller. All the components are housed in a single chassis.

1-15. The Broadcast Electronics FMi-301 transmitter is a 2.8 kW solid-state FM+HD and 1.2 kW HD ONLY solid state transmitter based largely on the FM-4C architecture and is designed for continuous operation in the 87.5 MHz to 108 MHz broadcast band (refer to Figure 1-2).

1-16. The FMi-301 transmitter is equipped with: 1) an FXi-250 Digital FM Exciter, 2) an XPi 10 HD Exporter, 3) 5 modular switching power supply assemblies, 4) 8 modular solid-state broadband plug-in RF power amplifier modules, 5) a low-pass filter, 6) a combiner, and 7) a CMOS controller. All the components are housed in a single chassis.



FM-5C TRANSMITTER **FM-4C TRANSMITTER**

597-5001-1

FIGURE 1-1. FM-5C/FM-4C TRANSMITTERS

FMi-402 TRANSMITTER **FMi-301 TRANSMITTER**

597-5001-2

FIGURE 1-2. FMi-402 / FMi-301 TRANSMITTERS

1–17. **FM–250C EXCITER.** The FM–250C exciter is a solid–state wideband FM exciter providing a continuously variable RF output at any frequency within the 87.5 MHz to 108 MHz broadcast band in 10 kHz increments. The FM–250C comes standard with an FM–5C/FM–4C transmitter. The FM–250C is designed to accept multiple wideband composite inputs from a stereo generator or SCA generator. In addition, the FM–250C is equipped with a 600 Ohm balanced monaural input. A tapped dual primary power transformer and a voltage selector allows operation from a wide range of ac input potentials.

1–18. The FM–250C is equipped with a digitally programmed frequency synthesizer which generates and maintains the phase and frequency of the carrier. A temperature compensated reference oscillator and a dual–speed phase–locked–loop control circuit locks the frequency of a modulated oscillator to a precision frequency oscillator allowing prompt on–frequency operation. A solid–state broadband 25 to 250 watt RF amplifier provides amplification of the FM signal. Exciter operating parameters are monitored and displayed by a front–panel digital LCD multimeter and an LED display.

1–19. **FXi–250 DIGITAL EXCITER.** The FXi–250 Digital Exciter comes standard with the FMi–402/FMi–301 transmitters. FM–5C/FM–4C transmitters may also be equipped with the FXi 250. The FXi–250 is a solid–state wideband digital FM exciter providing a constant variable RF output at any frequency within the 87.5 to 108 MHz FM broadcast band in 10 kHz increments. The FXi–250 is divided into several board assemblies. The assemblies include: 1) DSP (Digital Signal Processor) Modulator, 2) Controller, 3) Oscillator/Filter, 4) RF Amplifier, 5) Power Supply, and 6) Color GUI Interface.

1–20. The FXi–250 is highly integrated and comes with the following standard features: 1) AES Input, 2) L&R Analog Inputs, 3) Balanced and Unbalanced Composite Inputs, 4) Two Internal SCA Generators, 5) Internal RDS Generator, 6) External SCA/RDS Input. The FXi 250 also has a buit in stereo generator, compressor, and limiter all of which are software programmable and defeatable. The digital exciter also provides modulation Directly To Channel (DTC) 87.5 – 108 MHz, eliminating any analog up converter processes. The chassis of the FXi–250 requires 7 inches (height) of a 19 inch (wide) rack cabinet. Refer to publication 597–0541 for a detailed explanation of the FXi 250 features.

1–21. **FXi–250 DIGITAL EXCITER (HD SYSTEM).** When the FXi–250 Exciter is used in a FMi–402/FMi–301 transmitter the FXi is equipped with an Exgine Card. Refer to publication 597–0542–XM3 for detailed instructions for the Installation and Setup of an FXi Exciter (w/Exgine) and XPi–10 Exporter.

1–22. **XPi–10 EXPORTER (HD SYSTEM).** FMi–402/FMi–301 transmitters come standard with an XPi–10 HD Exporter. The XPi works in conjunction with the FXi (w/Exgine) to provide HD signals to the FMi–402/FMi–301 transmitter. Refer to publication 597–0542–XM3 for detailed instructions for the Installation and Setup of an FXi Exciter (w/Exgine) and XPi 10 Exporter.

1–23. **POWER SUPPLY.** FM–5C/FM–4C and FMi–402/FMi–301 transmitters are equipped with modular switching power supply assemblies. 5 switching power supplies in FM–5C/FMi–402 models and 4 switching power supplies in FM–4C/FMi–301 models provide dc operating potentials for the transmitter power amplifier circuitry. A separate modular switching power supply is provided for the controller circuitry. The transmitter power supply circuitry is equipped with overload protection, over–voltage protection, high temperature protection, and a soft–start feature which minimizes in–rush currents.

1-24. **RF POWER AMPLIFIER MODULES.** FM-5C/FMi-402 is equipped with 10 RF power amplifier modules. The FM-4C/FMi-301 is equipped with 8 RF power amplifier modules. Each module consists of a broadband solid-state RF amplifier and a logic circuit board. The RF amplifier contains two dual MOSFET power transistors operated in a push-pull configuration. Each module is designed to output 500 watts of RF power. RF amplifier operations are monitored by the logic circuit board. The logic circuit board is designed to monitor over-current, over-voltage, high reflected power, and high temperature conditions. A limit circuit is designed to limit the RF output during high reflected power, high temperature, over-current, or high forward power demand conditions. The operating status of the module is displayed by a front panel LED. The LED displays normal, fault, and limit conditions. A second module status LED displays the presence of RF drive at the module.

1-25. **CONTROLLER.** Transmitter control and monitoring operations are performed by a CMOS logic controller. The controller utilizes extensive RFI filtering and CMOS logic circuitry to ensure maximum reliability. A battery back-up system is incorporated into the design to maintain the controller memory during ac power interruptions. Operating potentials for the controller circuitry are provided by a modular switching power supply. The supply provides the controller circuitry with a stable +5 and ±15 volt dc supply.

1-26. The transmitter RF output power is controlled by a power control circuit. The circuit is designed to raise or lower the transmitter power in response to the front panel raise and lower switches. A fault circuit monitors transmitter operations for an RF power amplifier module fault, a power supply module fault, a high reflected power condition, or a high temperature condition.

1-27. The controller is also equipped with metering circuitry. Meter amplifier/buffering circuits are provided for the RF power amplifier module forward power, current, voltage, and temperature samples. Meter amplifier/buffering circuits are also provided for the transmitter forward power, reflected power, PA voltage, and air inlet temperature samples. Display of the samples is provided by an LCD multimeter. Samples are selected for application to the multimeter by a meter switch circuit board.

1-28. **COMBINER.** In FM-5C/FM-4C and FMi-402/FMi-301 transmitters, the RF power module outputs are combined using a unique combiner assembly. The FM-5C/FMi-402 is equipped with a 10 position combiner designed to produce 5 kW of RF output power. FM-4C/FMi-301 is equipped with an 8 position combiner designed to produce 4 kW of RF output power. The unique features of the combiner include: 1) very low loss, 2) broadband, 3) no cable connections and 4) operates with open or shorted inputs.

1-29. **TRANSMITTER CONFIGURATIONS.**

1-30. The FM-5C/FM-4C transmitters can be ordered in the following configurations:

P/N	DESCRIPTION
909-5001-204	FM-5C 5 kW FM Transmitter for operation in the 87.5 MHz to 108 MHz broadcast band, 196V to 252V ac 50/60 Hz single phase supply. Includes FM-250C FM exciter, 196V to 252V ac 50/60 Hz single phase operation.
909-4001-204	FM-4C 4 kW FM Transmitter for operation in the 87.5 MHz to 108 MHz broadcast band, 196V to 252V ac 50/60 Hz single phase supply. Includes FM-250C FM exciter, 196V to 252V ac 50/60 Hz single phase operation.

P/N	DESCRIPTION
909-5001-254	FM-5C 5 kW FM Transmitter with FM-250C for operation in the 87.5 MHz to 108 MHz broadcast band, 196V to 252V ac 50/60 Hz three phase supply.
909-4001-254	FM-4C 4 kW FM Transmitter with FM-250C for operation in the 87.5 MHz to 108 MHz broadcast band, 196V to 252V ac 50/60 Hz three phase supply.
909-5001-384	FM-5C 5 kW FM Transmitter with FM-250C for operation in the 87.5 MHz to 108 MHz broadcast band, 339V to 437V ac 50/60 Hz three phase supply.
909-4001-384	FM-4C 4 kW FM Transmitter with FM-250C for operation in the 87.5 MHz to 108 MHz broadcast band, 339V to 437V ac 50/60 Hz three phase supply.
909-1250	FM-5C/FM-4C Transmitter Less FM-250C Exciter.

1-31. The FMi 402/FMi 301 transmitters can be ordered in the following configurations:

P/N	DESCRIPTION
909-0402-404	FMi-402 3.5 kW FM+HD (1.5kW HD ONLY) Transmit ter with an FXi 250 Exciter and XPi 10 HD Exporter for operation in the 87.5 MHz to 108 MHz broadcast band, 196V to 252V ac 50/60 Hz single phase supply.
909-0301-404	FMi-301 2.8 kW FM+HD (1.2kW HD ONLY) Transmit ter with an FXi 250 Exciter and XPi 10 HD Exporter for operation in the 87.5 MHz to 108 MHz broadcast band, 196V to 252V ac 50/60 Hz single phase supply.
909-0402-454	FMi-402 3.5 kW FM+HD (1.5kW HD ONLY) Transmit ter with an FXi 250 Exciter and XPi 10 HD Exporter for operation in the 87.5 MHz to 108 MHz broadcast band, 196V to 252V ac 50/60 Hz three phase delta supply.
909-0301-454	FMi-301 2.8 kW FM+HD (1.2kW HD ONLY) Transmit ter with an FXi 250 Exciter and XPi 10 HD Exporter for operation in the 87.5 MHz to 108 MHz broadcast band, 196V to 252V ac 50/60 Hz three phase delta supply.
909-0402-484	FMi-402 3.5 kW FM+HD (1.5kW HD ONLY) Transmit ter with an FXi 250 Exciter and XPi 10 HD Exporter for operation in the 87.5 MHz to 108 MHz broadcast band, 339V to 437V ac 50/60 Hz three phase 4 wire WYE sup ply.
909-0301-484	FMi-301 2.8 kW FM+HD (1.2kW HD ONLY) Transmit ter with an FXi 250 Exciter and XPi 10 HD Exporter for operation in the 87.5 MHz to 108 MHz broadcast band, 339V to 437V ac 50/60 Hz three phase 4 wire WYE sup ply.

1-32. **OPTIONAL EQUIPMENT AND SPARE PARTS KITS.**

1-33. The following text presents the optional equipment and spare parts kits available for the use with FM-5C/FM-4C and FMi-402/FMi-301 transmitters.

P/N	DESCRIPTION
909-0051-204	FC-30 FM SCA Generator.
979-0414	Recommended spare parts kit for FM-5C/FM-4C and FMi-402/FMi-301 solid-state transmitters. Includes selected switches, relays, etc. Does not include spare parts for a FM-250C or FXi-250.
979-0415	Recommended semiconductor kit for FM-5C/ FM-4C and FMi-402/FMi-301 solid-state tranmitters. Does not include semiconductors for a FM-250C or FXi-250.
979-0416	100% semiconductor kit for the FM-4C/FMi-301 solid-state transmitter. Does not include semiconductors for a FM-250C or FXi-250.
979-0417	100% semiconductor kit for the FM-5C/FMi-402 solid-state transmitter. Does not include semiconductors for a FM-250C or FXi-250.
907-0016-204	VMC-16 Voice Remote Control Unit, FM-5C/ FM-4C.

1-34. **EQUIPMENT SPECIFICATIONS.**

1-35. Refer to Table 1-1 for FM-5C/FM-4C electrical specifications, Table 1-2 for FM-5C/ FM-4C Physical and Environmental specifications. Refer to Table 1-3 for FMi-402/FMi-301 electrical specifications, and Table 1-4 for FMi 402/FMi 301 Physical and Environmental specifications.

TABLE 1-1. FM-5C / FM-4C ELECTRICAL SPECIFICATIONS
(Sheet 1 of 3)

PARAMETER	SPECIFICATION
RF POWER OUTPUT FM-5C FM-4C	 2.5 kW to 5 kW (as specified). 2 kW to 4 kW (as specified).
FREQUENCY RANGE	87.5 to 108 MHz (as specified). Exciter programmable in 10 kHz increments.
RF OUTPUT IMPEDANCE	50 Ohms.
RF OUTPUT CONNECTOR	1 5/8 inch EIA female field flange.

TABLE 1-1. FM-5C / FM-4C ELECTRICAL SPECIFICATIONS
(Sheet 2 of 3)

PARAMETER	SPECIFICATION
MAXIMUM VSWR	Rated power into 1.5:1 maximum without output matching. Capable of operating into high VSWR conditions with automatic power reduction. Open and short circuit protected at all phase angles.
EXCITER	Model FM-250C, solid-state 250 watt output with digitally programmed synthesizer. 10 kHz increment programming. Optional FXi 250 digital exciter, 250 watt output, 10 kHz increment programming.
AM SIGNAL-TO-NOISE RATIO:	
Asynchronous	55 dB below an equivalent reference carrier with 100% AM modulation @ 400 Hz, 75 microsecond deemphasis (no FM modulation present).
Synchronous	
FM-5C	50 dB below an equivalent 5 kW reference carrier @ 100% AM modulation @ 400 Hz. 75 uS deemphasis with ±75 kHz FM modulation @ 400 Hz and a 5 kW output power.
FM-4C	50 dB below an equivalent 4 kW reference carrier @ 100% AM modulation @ 400 Hz. 75 uS deemphasis with ±75 kHz FM modulation @ 400 Hz and a 4 kW output power.
RF HARMONIC SUPPRESSION	Meets all FCC/DOC requirements and CCIR recommendations.
FM SIGNAL-TO-NOISE RATIO:	
Mono/Composite	85 dB below ±75 kHz deviation @ 400 Hz measured in a 20 Hz to 30 kHz bandwidth with 75 microsecond deemphasis.
Stereo	80 dB below ±75 kHz deviation @ 400 Hz measured in a 20 Hz to 30 kHz bandwidth with 75 microsecond deemphasis.
DISTORTION	
Mono/Composite	
Harmonic	0.02% or less at 400 Hz.
SMPTE Intermodulation Distortion	0.02% or less, 60 Hz/7 kHz, Ratio: 4:1 Monophonic, 1:1 Composite.
CCIF Intermodulation Distortion	0.02% or less, 15 kHz/14 kHz, 1:1 Ratio.
Transient Intermodulation Distortion	0.02% or less, sine wave/square wave.

TABLE 1-1. FM-5C / FM-4C ELECTRICAL SPECIFICATIONS
(Sheet 3 of 3)

PARAMETER	SPECIFICATION
DISTORTION (CONT'D)	
Stereo	
Harmonic	0.05% or less at 400 Hz.
SMPTE Intermodulation Distortion	0.05% or less, 60 Hz/7 kHz, 4:1 Ratio.
CCIF Intermodulation Distortion	0.05% or less, 15 kHz/14 kHz, 1:1 Ratio.
Transient Intermodulation Distortion	0.05% or less, sine wave/square wave.
STEREO SEPARATION	50 dB or better, 30 Hz to 15 kHz (sine wave).
DYNAMIC STEREO SEPARATION	40 dB or greater, 30 Hz to 15 kHz (normal program content).
LINEAR CROSSTALK (Main to Sub/Sub to Main Due to Amplitude and Phase Matching)	45 dB Minimum below 100% modulation, 30 Hz to 15 kHz.
NON-LINEAR CROSSTALK (Main to Sub/Sub to Main Due to Distortion Products)	70 dB Minimum below 100% modulation.
AC POWER REQUIREMENTS	
Standard	196 to 252V ac 50/60 Hz single phase.
Optional	196 to 252V ac 50/60 Hz or 339 to 437V ac 50/60 Hz three phase.
AC POWER CONSUMPTION	
FM-5C	10 kW typical at a 5 kW RF power output, 50 Ohm resistive load.
FM-4C	8 kW typical at a 4 kW RF power output, 50 Ohm resistive load.
OVERALL EFFICIENCY	50% or greater (AC line input to RF output)
DISCONNECT FUSE / WIRE SIZE	
FM-5C (Single Phase)	80A / #6 AWG COPPER TYPE THHN
FM-5C (Three Phase)	50A / #6 AWG COPPER TYPE THHN
FM-4C (Single Phase)	70A / #6 AWG COPPER TYPE THHN
FM-4C (Three Phase)	50A / #6 AWG COPPER TYPE THHN

TABLE 1-2. FM-5C / FM-4C PHYSICAL AND ENVIRONMENTAL SPECIFICATIONS

PARAMETER	SPECIFICATION
PHYSICAL	
DIMENSIONS:	
FM–250C Exciter	Width: 19.0 inches (48.3 cm). Height: 7.0 inches (17.8 cm). Depth: 19.0 inches (48.3 cm).
FXi 250 Exciter	Width: 19.0 inches (48.3 cm). Height: 7.0 inches (17.8 cm). Depth: 22.5 inches (57.15 cm).
Transmitter	Width: 30.6 inches (77.8 cm). Height: 64.0 inches (162.6 cm). Depth: 30.0 inches (76.2 cm).
WEIGHT (with Exciter)	
FM–5C	575 pounds (261 kg) unpacked.
FM–4C	525 pounds (238 kg) unpacked.
SAFETY	Meets IEC 215.
ENVIRONMENTAL	
HEAT DISSIPATION	
FM–5C (5 kw Output)	5.5 kW (18,805 Btu/H) at a 5 kW RF output, 50 Ohm resistive load.
FM–4C (4 kW Output)	4.5 kW (15,390 Btu/H) at a 4 kW RF output, 50 Ohm resistive load.
COOLING AIR REQUIREMENTS	2200 cubic feet per minute (62.3 m^3/min).
AMBIENT TEMPERATURE RANGE	+32°F to +122°F (0°C to +50°C).
MAXIMUM ALTITUDE	
50 Hz Operation	0 to 7,500 feet above sea level (0 to 2286 meters).
60 Hz Operation	0 to 10,000 feet above sea level (0 to 3048 meters).
MAXIMUM HUMIDITY	95%, non–condensing.

TABLE 1-3. FMi-402 / FMi-301 ELECTRICAL SPECIFICATIONS
(Sheet 1 of 3)

PARAMETER	SPECIFICATION
RF POWER OUTPUT	
FMi-402	
HD Only	1,000-1,500W
FM+HD	2,000-3,500W
FM ONLY	2,500-5,000W
FMi-301	
HD Only	750-1,200W
FM+HD	1,500-2,800W
FM ONLY	2,000-4,000W
RF OUTPUT IMPEDANCE	50 Ohms.
RF OUTPUT CONNECTOR	1 5/8 inch EIA female field flange.
OVERALL EFFICIENCY	
HD Only	>25%
FM+HD	>50%
FM ONLY	>50%
VSWR	Rated power into 1.5:1 maximum without output matching. Capable of operating into high VSWR conditions with automatic power reduction. Open and short circuit protected at all phase angles.
FREQUENCY RANGE	87.5 to 108 MHz (as specified). Exciter programmable in 10 kHz increments.
FREQUENCY STABILITY	
INTERNAL 10MHZ REF.	+/- 300Hz, 0-50 degrees C
EXTERNAL 10MHZ REF.(GPS)	Determined by source
MODULATION CAPABILITY	+/- 300kHz FM Mode
MODULATION MODES	FM Only, FM+HD, HD Only
ASYNCHRONOUS AM S/N RATIO	55dB below rated power with 100% AM at 400Hz and 75usec de-emphasis (no modulation present)
SYNCHRONOUS AM S/N RATIO	50dB below rated power with 100% AM modulation at 400Hz and 75usec de-emphasis (+/-75kHz modulation)
IMD PROTECTION	20dB or better turn-around loss or mixing loss to interfering signals.
SPURIOUS AND HARMONIC	Meets or exceeds all FCC requirements.

TABLE 1-3. FMi-402 / FMi-301 ELECTRICAL SPECIFICATIONS
(Sheet 2 of 3)

PARAMETER	SPECIFICATION
AC INPUT	
3 PHASE	196 to 252VAC, 50/60Hz, 3-phase, Closed Delta or 339 to 437VAC, 50/60Hz, 3-phase, 4 wire, WYE
SINGLE PHASE	196 TO 252VAC, 50/60Hz, Single Phase
POWER FACTOR	.99 @ 230VAC
DISCONNECT FUSE / WIRE SIZES	
FMi-402 (Single Phase)	
HD Only	35A / #8 AWG COPPER TYPE THHN
FM+HD	45A / #6 AWG COPPER TYPE THHN
FM Only	80A / #3 AWG COPPER TYPE THHN
FMi-402 (Three Phase)	
HD Only	20A / #10 AWG COPPER TYPE THHN
FM+HD	25A / #10 AWG COPPER TYPE THHN
FM Only	50A / #6 AWG COPPER TYPE THHN
FMi-301 (Single Phase)	
HD Only	30A / #8 AWG COPPER TYPE THHN
FM+HD	35A / #8 AWG COPPER TYPE THHN
FM Only	70A / #4 AWG COPPER TYPE THHN
FMi-301 (Three Phase)	
HD Only	15A / #10 AWG COPPER TYPE THHN
FM+HD	25A / #10 AWG COPPER TYPE THHN
FM Only	50A / #6 AWG COPPER TYPE THHN

TABLE 1-3. FMi-402 / FMi-301 ELECTRICAL SPECIFICATIONS
(Sheet 3 of 3)

PARAMETER	SPECIFICATION
AC POWER CONSUMPTION	
FMi 402	
HD Only	5,250W @ 1,500W RF Output
FM+HD	7,000W @ 3,500W RF Output
FMi 301	
HD Only	4,200W @ 1,200W RF Output
FM+HD	5,600W @ 2,800W RF Output
FM AUDIO PERFORMANCE	
AES INPUT FM+IBOC MODE	
Input Level	-2dBFS for 100% modulation
Input Frequency	32,44.1,48, or 96kHz; 16-24bits
Impedance	110ohms
Connector	Wire (XLR), Optical (Toslink)
Amplitude Response	+/-0.5dB; 20Hz to 15kHz
IMD Distortion	0.03% or better
THD + Noise	
Stereo	0.03% or better
Mono	0.005% or better
S/N Ratio	
Stereo	90dB or better below 100% modulation @ 400kHz
Mono	85dB or better below 100% modulation @ 400kHz
INTERNAL SCAs (2)	
Frequency	20kHz to 99kHz software programmable
Deviation	2.5kHz to 10kHz
Injection Level	2% to 15%
Pre-Emphasis	0, 50usec, 75usec, or 150usec

TABLE 1-4. FMi-402 / FMi-301 PHYSICAL AND ENVIRONMENTAL SPECIFICATIONS

PARAMETER	SPECIFICATION
PHYSICAL	
DIMENSIONS:	
FM-250C Exciter	Width: 19.0 inches (48.3 cm). Height: 7.0 inches (17.8 cm). Depth: 19.0 inches (48.3 cm).
FXi-250 Exciter	Width: 19.0 inches (48.3 cm). Height: 7.0 inches (17.8 cm). Depth: 22.5 inches (57.15 cm).
Transmitter	Width: 30.6 inches (77.8 cm). Height: 64.0 inches (162.6 cm). Depth: 30.0 inches (76.2 cm).
WEIGHT (with Exciter)	
FMi-402	575 pounds (261 kg) unpacked.
FMi-301	525 pounds (238 kg) unpacked.
SAFETY	Meets IEC 215.
ENVIRONMENTAL	
HEAT DISSIPATION	
FM ONLY:	
FMi-402	5.5 kW (18,783 Btu/H) at 5 kW RF output, 50 Ohm resistive load.
FMi-301	4.5 kW (15,368 Btu/H) at 4 kW RF output, 50 Ohm resistive load.
HD ONLY:	
FMi-402	4.5 kW (15,368 Btu/H) at 1.5 kW RF output, 50 Ohm resistive load.
FMi-301	3.6 kW (12,295 Btu/H) at 1.2 kW RF output, 50 Ohm resistive load.
FM + HD:	
FMi-402	3.5 kW (11,953 Btu/H) at 3.5 kW RF output, 50 Ohm resistive load.
FMi-301	2.8 kW (9,563 Btu/H) at 2.8 kW RF output, 50 Ohm resistive load.
COOLING AIR REQUIREMENTS	2200 cubic feet per minute (62.3 m^3/min).
AMBIENT TEMPERATURE RANGE	+32°F to +122°F (0°C to +50°C).
MAXIMUM ALTITUDE	
50 Hz Operation	0 to 7,500 feet above sea level (0 to 2286 meters).
60 Hz Operation	0 to 10,000 feet above sea level (0 to 3048 meters).
MAXIMUM HUMIDITY	95%, non-condensing.

SECTION II
INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains information required for the installation and preliminary checkout of the Broadcast Electronics FM-5C/FM-4C and FMi-402/FMi-301 transmitters.

2-3. UNPACKING.

2-4. The equipment becomes the property of the customer when the equipment is delivered to the carrier. Carefully unpack the transmitter. Perform a visual inspection to determine that no apparent damage has been incurred during shipment. All shipping materials should be retained until it is determined that the unit has not been damaged. Claims for damaged equipment must be promptly filed with the carrier or the carrier may not accept the claim.

2-5. The contents of the shipment should be as indicated on the packing list. If the contents are incomplete, or if the unit is damaged electrically or mechanically, notify both the carrier and Broadcast Electronics.

2-6. ENVIRONMENTAL REQUIREMENTS.

2-7. Tables 1-2 and 1-4 provide environmental conditions which must be considered prior to transmitter installation. Refer to Table 1-2 and 1-4 in SECTION I, INTRODUCTION and ensure the transmitter is to be installed in an acceptable environment.

2-8. COOLING AIR REQUIREMENTS.

2-9. FM-5C/FM-4C and FMi-402/FMi-301 transmitters require a source of cooling air to maintain an acceptable operating temperature. These transmitters require a cooling air flow of 2200 cubic feet per minute (refer to Figure 2-1 and 2-2). The cooling air source must be dry and well filtered.

2-10. If the heated transmitter air is to be ducted from the room, the duct system must not introduce any back-pressure on the equipment. Proper allowances for air flow will ensure that only a limited amount of heat is dissipated into the equipment interior. The duct system must allow for a minimum air flow of 2200 CFM (for a FM-5C/FM-4C) and 2700 CFM (for a FMi-402/FMi-301).

2-11. If an exhaust system is desired, an exhaust hood must be designed. A paper titled "TRANSMITTER COOLING SYSTEMS: DESIGN, OPERATION, AND MAINTENANCE " provides information on the design and maintenance of transmitter exhaust systems. The paper can be obtained by contacting the Broadcast Electronics Customer Service Department.

2-12. PRIMARY POWER.

2-13. The standard FM-5C/FM-4C and FMi-402/FMi-301 transmitters operate from a single phase ac power source. However, these transmitters may be equipped with a three-phase power supply option. If the transmitter is equipped with a three phase power supply, the transmitter must be connected to a closed-delta or wye connected three-phase power source. Operation from an unsatisfactory power source will void the warranty on the transmitter as any resultant damage is beyond the control of the manufacturer. Before attempting installation of the transmitter, assure that the proper power source is installed. Acceptable power input configurations are shown in Figures 2-2 and 2-3.

2-14. An open-delta, V to V, T to T, T to L, or Scott connected power source will provide unsatisfactory transmitter performance as transients and unstable power can damage components of the transmitter and provide degraded specifications. Any of these systems will develop a considerable imbalance between phases in voltage, phase angle, or both voltage and phase angle. These problems can result in premature failure of power supply and RF circuit components.

2-15. It is important that the local electric utility be consulted to ensure that the correct service is provided before connection of the transmitter to a primary power source. The proper power source can be readily identified by the use of three transformers with one winding each or one transformer with three windings instead of the use of two transformers as required for the unacceptable configurations.

2-16. INSTALLATION.

2-17. Each transmitter is wired, operated, tested, and inspected at the factory prior to shipment and is ready for installation when received. Prior to installation, this publication should be studied to obtain an understanding of the operation, circuitry, nomenclature, and installation requirements. Installation is accomplished as follows: 1) equipment placement, 2) equipment installation, 3) wiring, and 4) preliminary operation.

2-18. **EQUIPMENT PLACEMENT.**

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

WARNING

2-19. FM-5C/FM-4C and FMi-402/FMi-301 transmitters are designed with access holes in the top and bottom of the cabinet to allow for over-head and under-floor ducting of ac power, control, and ground strap wiring (refer to Figures 2-1 and 2-2). The floor must be capable of supporting the total transmitter weight.

2-20. Evaluate the installation site and determine the location of the transmitter. Once the location is determined, use a forklift to move the transmitter to the desired location. After the transmitter is placed in the desired location, slide the transmitter off the skid. Remove the shipping skid and slide the transmitter to the exact location.

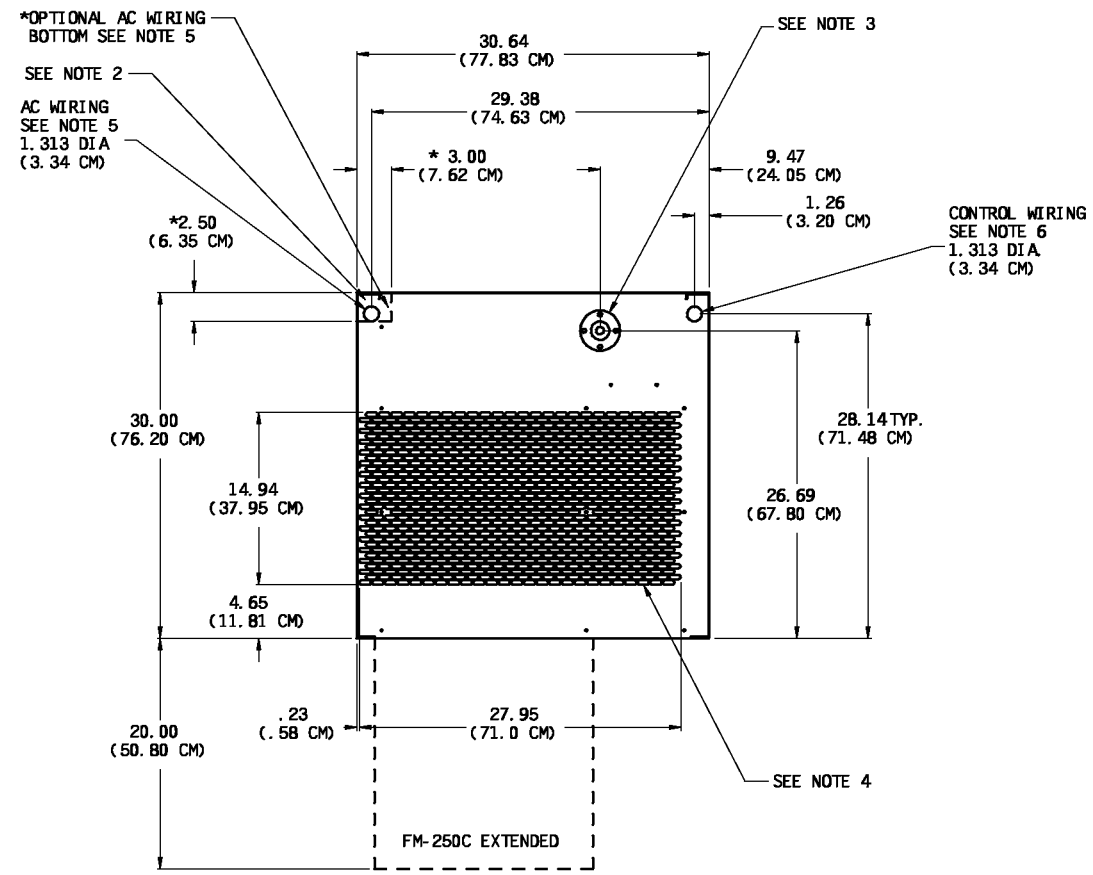
2-21. **EQUIPMENT INSTALLATION.**

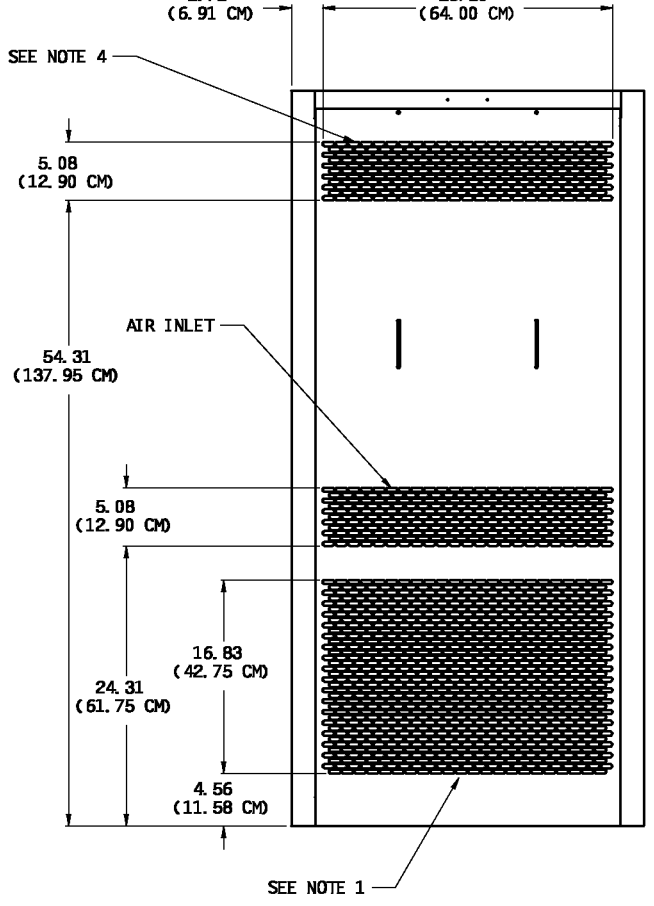
WARNING ***ENSURE NO PRIMARY POWER IS CONNECTED TO THE TRANSMITTER BEFORE PROCEEDING.***

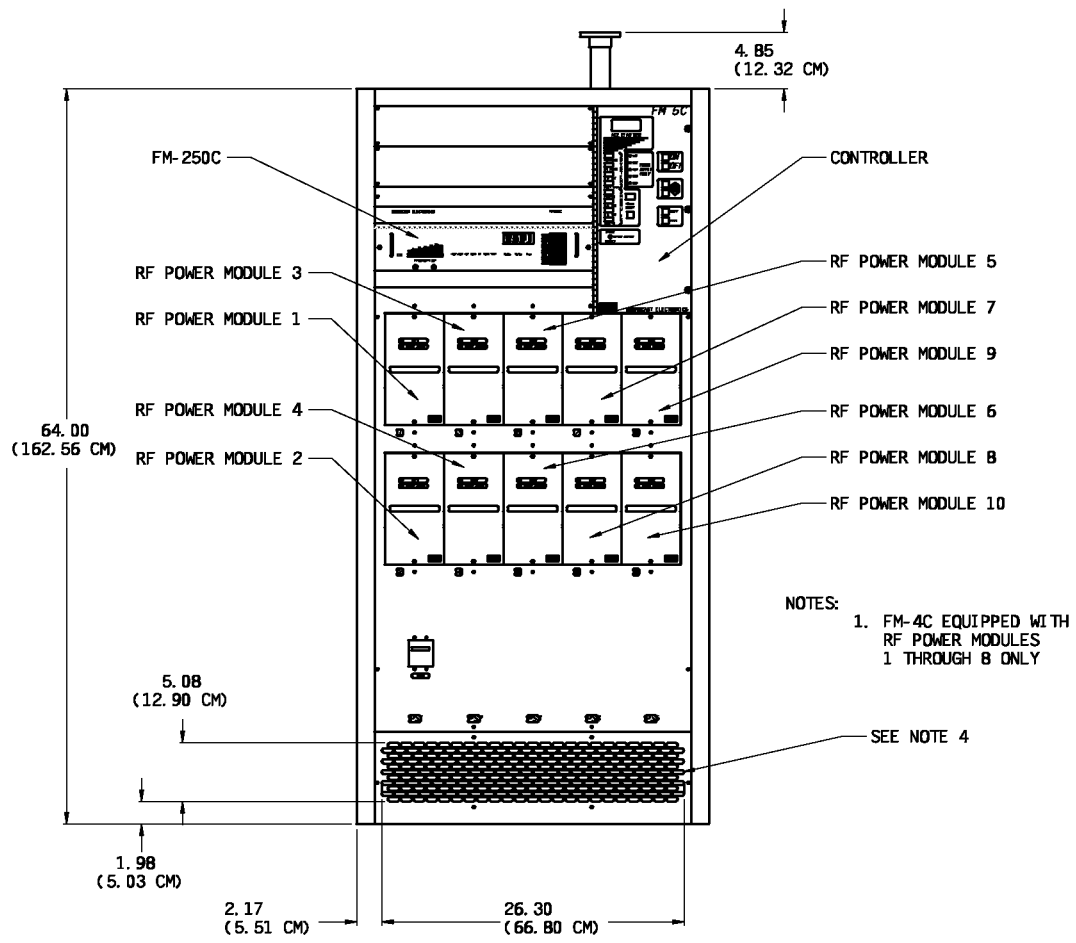
WARNING

2-22. **COMPONENT INSTALLATION.** Selected components of the transmitter have been removed to prevent damage during shipment. The components removed from the transmitter are shipped in separate containers. To re-install the FM-5C/FM-4C and FMi-402/FMi-301 components, refer to Figure 2-4 and perform the following procedures.

2-23. **Battery Installation.** The transmitter controller is equipped with a battery back-up system to maintain the controller memory during a power failure. A battery for installation in the transmitter is provided in the accessory parts kit. Locate the battery in the accessory parts kit. To install the battery, refer to Figure 2-4 and install the battery in the holder on the controller circuit board as shown.







NOTES:

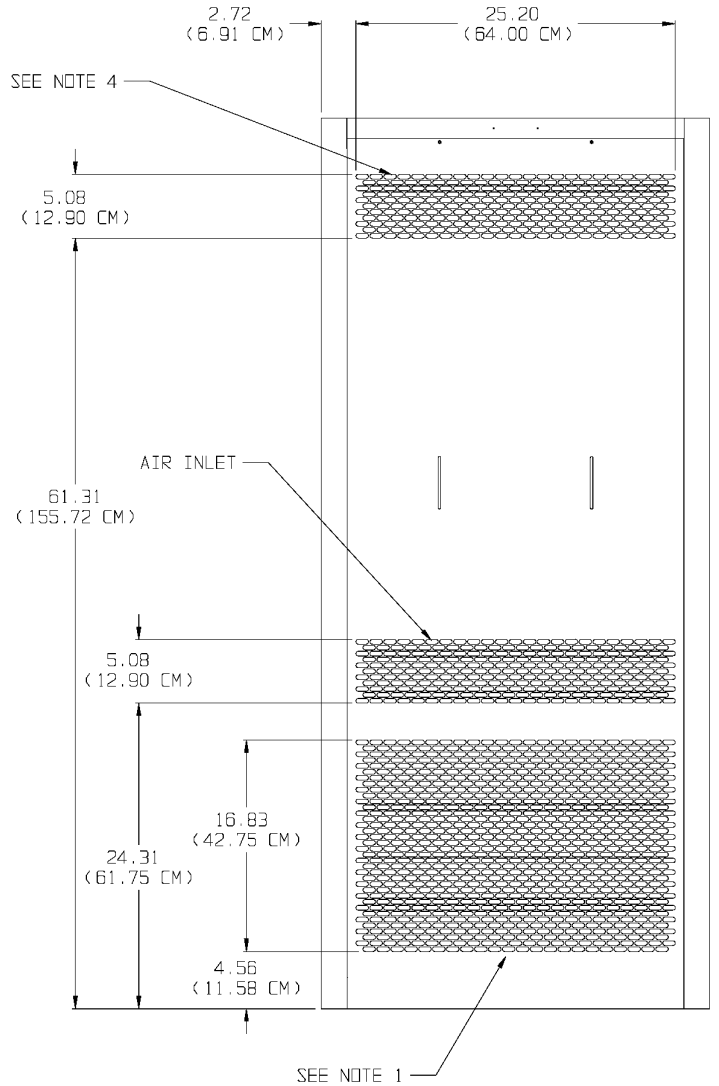
1. AIR INLET AT REAR OF CABINET-2200 CFM (62.3M³/MIN) FILTER REQUIRED.
2. GROUND STRAP ENTRY IN LOWER LEFT CORNER AT REAR OF CABINET.
3. RF OUTPUT CONNECTION- 1-5/8 INCH EIA 50 OHM FEMALE FIELD FLANGE.
4. AIR OUTLET AT TOP, FRONT AND REAR OF CABINET
5. ACCESS FOR AC POWER THROUGH CABINET TOP OR BOTTOM ACCESS HOLES.
6. ACCESS FOR REMOTE CONTROL, MODULATION MONITOR, AND AUDIO CONNECTIONS THROUGH TOP OF CABINET.
7. HEAT DISSIPATION:
   FM-5C- 5.5 KW (18,805 BTU/H) AT A 5KW RF OUTPUT, 50 OHM RESISTIVE LOAD.
   FM-4C- 4.5 KW (15,390 BTU/H) AT A 4KW RF OUTPUT, 50 OHM RESISTIVE LOAD.
8. WEIGHT:
   FM-5C- 575 LBS (261 KGS).
   FM-4C- 525 LBS (238 KGS)
9. AC POWER CONSUMPTION:
   FM-5C- 10KW AT A 5KW RF OUTPUT INTO A 50 OHM RESISTIVE LOAD WITH A 230 VAC INPUT.
   FM-4C- 8KW AT A 4KW RF OUTPUT INTO A 50 OHM RESISTIVE LOAD WITH A 230 VAC INPUT.
10. AC POWER INPUT:
    FM-5C- 196 TO 252VAC 50/60Hz SINGLE PHASE, 60 AMPERES (MAXIMUM CONDITION).
    FM-5C- 196 TO 252VAC OR 339 TO 437VAC THREE PHASE, 35 AMPERES (MAXIMUM CONDITION).
    FM-4C- 196 TO 252VAC 50/60Hz SINGLE PHASE, 50 AMPERES (MAXIMUM CONDITION).
    FM-4C- 196 TO 252VAC OR 339 TO 437VAC THREE PHASE, 30 AMPERES (MAXIMUM CONDITION).
    FUSE DISCONNECT SWITCH RECOMMENDED. FOR PROPER SIZING OF FUSES, REFER TO FOLLOWING TEXT, NATIONAL ELECTRIC CODES, AND LOCAL CODES.
11. PRIMARY AC FUSED DISCONNECT:

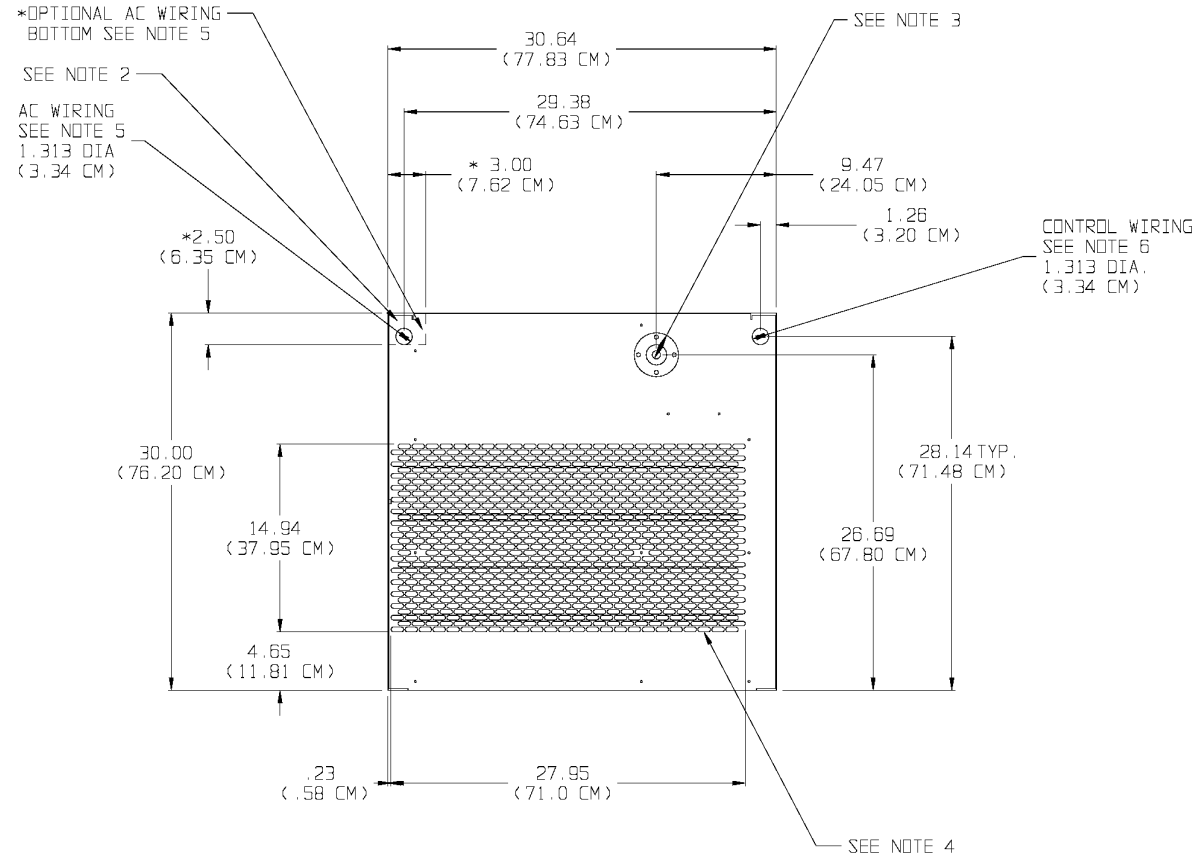
FM-5C: SINGLE PHASE: FUSE SIZE- 80 AMP WIRE SIZE- #3 COPPER AWG, TYPE THHN.	FM-5C: THREE PHASE: FUSE SIZE- 50 AMP WIRE SIZE- #6 COPPER AWG, TYPE THHN.
FM-4C: SINGLE PHASE: FUSE SIZE- 70 AMP WIRE SIZE- #4 COPPER AWG, TYPE THHN.	FM-4C: THREE PHASE: FUSE SIZE- 50 AMP WIRE SIZE- #6 COPPER AWG, TYPE THHN.

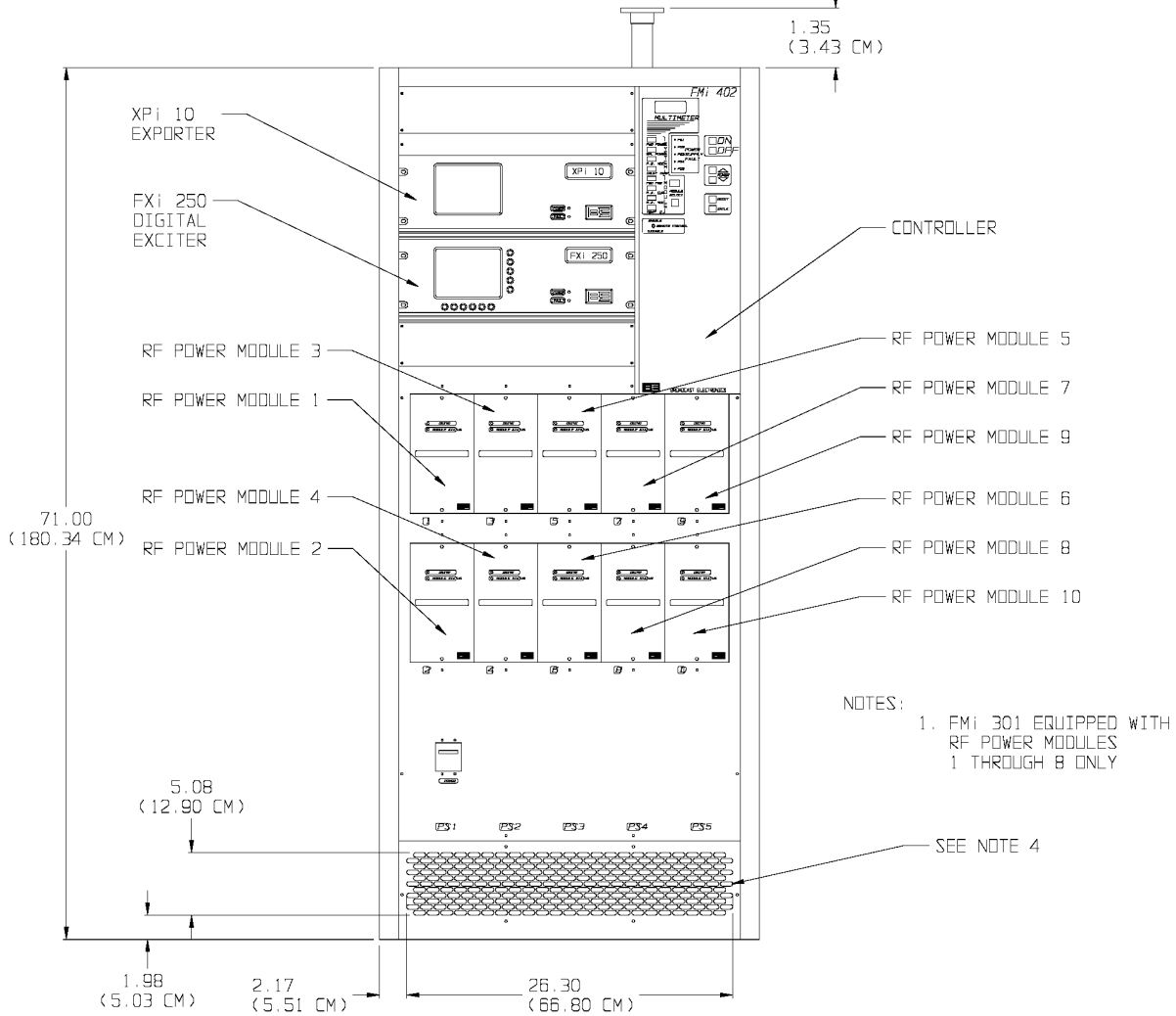
12. POWER FACTOR- BETTER THAN .99 @ 230 VAC WITH A 5KW RF OUTPUT INTO A 50 OHM LOAD.

597-5001-2

FIGURE 2-1. FM-5C/FM-4C TRANSMITTER INSTALLATION DIAGRAM
(2-3/2-4)







NOTES:

1. AIR INLET AT REAR OF CABINET- 2700 CFM (76.4 M^3/MIN) FILTER REQUIRED.
2. GROUND STRAP ENTRY IN LOWER LEFT CORNER AT REAR OF CABINET.
3. RF OUTPUT CONNECTION- 1-5/8 INCH EIA 50 OHM FEMALE FIELD FLANGE.
4. AIR OUTLET AT TOP, FRONT AND REAR OF CABINET
5. ACCESS FOR AC POWER THROUGH CABINET TOP OR BOTTOM ACCESS HOLES.
6. ACCESS FOR REMOTE CONTROL, MODULATION MONITOR, AND AUDIO CONNECTIONS THROUGH TOP OF CABINET.
7. HEAT DISSIPATION:
   - FM ONLY:
     - FMi 402: 5.5 KW (18,783 BTU/H) AT A 5KW RF OUTPUT, 50 OHM RESISTIVE LOAD.
     - FMi 301: 4.5 KW (15,368 BTU/H) AT A 4KW RF OUTPUT, 50 OHM RESISTIVE LOAD.
   - HD ONLY:
     - FMi 402: 4.5 KW (15,368 BTU/H) AT A 1.5KW RF OUTPUT, 50 OHM RESISTIVE LOAD.
     - FMi 301: 3.6 KW (12,295 BTU/H) AT A 1.2KW RF OUTPUT, 50 OHM RESISTIVE LOAD.
   - FM + HD:
     - FMi 402: 3.5 KW (11,953 BTU/H) AT A 3.5KW RF OUTPUT, 50 OHM RESISTIVE LOAD.
     - FMi 301: 2.8 KW (9,563 BTU/H) AT A 2.8KW RF OUTPUT, 50 OHM RESISTIVE LOAD.
8. WEIGHT:
   - FMi 402: 575 LBS (260 KGS).
   - FMi 301: 525 LBS (238 KGS)
9. AC POWER CONSUMPTION:
   - FM ONLY:
     - FMi 402: 10KW AT A 5KW RF OUTPUT INTO A 50 OHM RESISTIVE LOAD WITH A 230 VAC INPUT.
     - FMi 301: 8KW AT A 4KW RF OUTPUT INTO A 50 OHM RESISTIVE LOAD WITH A 230 VAC INPUT.
   - HD ONLY:
     - FMi 402: 5.25KW AT A 1.5KW RF OUTPUT INTO A 50 OHM RESISTIVE LOAD WITH A 230 VAC INPUT.
     - FMi 301: 4.2KW AT A 1.2KW RF OUTPUT INTO A 50 OHM RESISTIVE LOAD WITH A 230 VAC INPUT.
   - FM + HD:
     - FMi 402: 7KW AT A 3.5KW RF OUTPUT INTO A 50 OHM RESISTIVE LOAD WITH A 230 VAC INPUT.
     - FMi 301: 5.6KW AT A 2.8KW RF OUTPUT INTO A 50 OHM RESISTIVE LOAD WITH A 230 VAC INPUT.
10. AC POWER INPUT:
    - SINGLE PHASE:
      - FMi 402/FMi 301: 196 TO 252VAC 50/60Hz
    - THREE PHASE:
      - FMi 402/FMi 301: 340 TO 440VAC 50/60Hz

    FUSED DISCONNECT SWITCH RECOMMENDED. FOR PROPER SIZING OF FUSES, REFER TO FOLLOWING TEXT, NATIONAL ELECTRIC CODES, AND LOCAL CODES.
11. PRIMARY AC FUSED DISCONNECT:
    - FM ONLY:
      - FMi 402:
        - SINGLE PHASE:
          - FUSE SIZE- 80 AMP
          - WIRE SIZE- #3 COPPER AWG, TYPE THHN.
        - THREE PHASE:
          - FUSE SIZE- 50 AMP
          - WIRE SIZE- #6 COPPER AWG, TYPE THHN.
      - FMi 301:
        - SINGLE PHASE:
          - FUSE SIZE- 70 AMP
          - WIRE SIZE- #4 COPPER AWG, TYPE THHN.
        - THREE PHASE:
          - FUSE SIZE- 50 AMP
          - WIRE SIZE- #6 COPPER AWG, TYPE THHN.
    - HD ONLY:
      - FMi 402:
        - SINGLE PHASE:
          - FUSE SIZE- 35 AMP
          - WIRE SIZE- #8 COPPER AWG, TYPE THHN.
        - THREE PHASE:
          - FUSE SIZE- 20 AMP
          - WIRE SIZE- #10 COPPER AWG, TYPE THHN.
      - FMi 301:
        - SINGLE PHASE:
          - FUSE SIZE- 30 AMP
          - WIRE SIZE- #8 COPPER AWG, TYPE THHN.
        - THREE PHASE:
          - FUSE SIZE- 15 AMP
          - WIRE SIZE- #10 COPPER AWG, TYPE THHN.
    - FM + HD:
      - FMi 402:
        - SINGLE PHASE:
          - FUSE SIZE- 45 AMP
          - WIRE SIZE- #6 COPPER AWG, TYPE THHN.
        - THREE PHASE:
          - FUSE SIZE- 25 AMP
          - WIRE SIZE- #10 COPPER AWG, TYPE THHN.
      - FMi 301:
        - SINGLE PHASE:
          - FUSE SIZE- 35 AMP
          - WIRE SIZE- #8 COPPER AWG, TYPE THHN.
        - THREE PHASE:
          - FUSE SIZE- 20 AMP
          - WIRE SIZE- #10 COPPER AWG, TYPE THHN.
12. POWER FACTOR: .98 @ 230 VAC

FIGURE 2-2. FM-402/FMi 301 TRANSMITTER INSTALLATION DIAGRAM
(2-5/2-4)

597-5001-2A

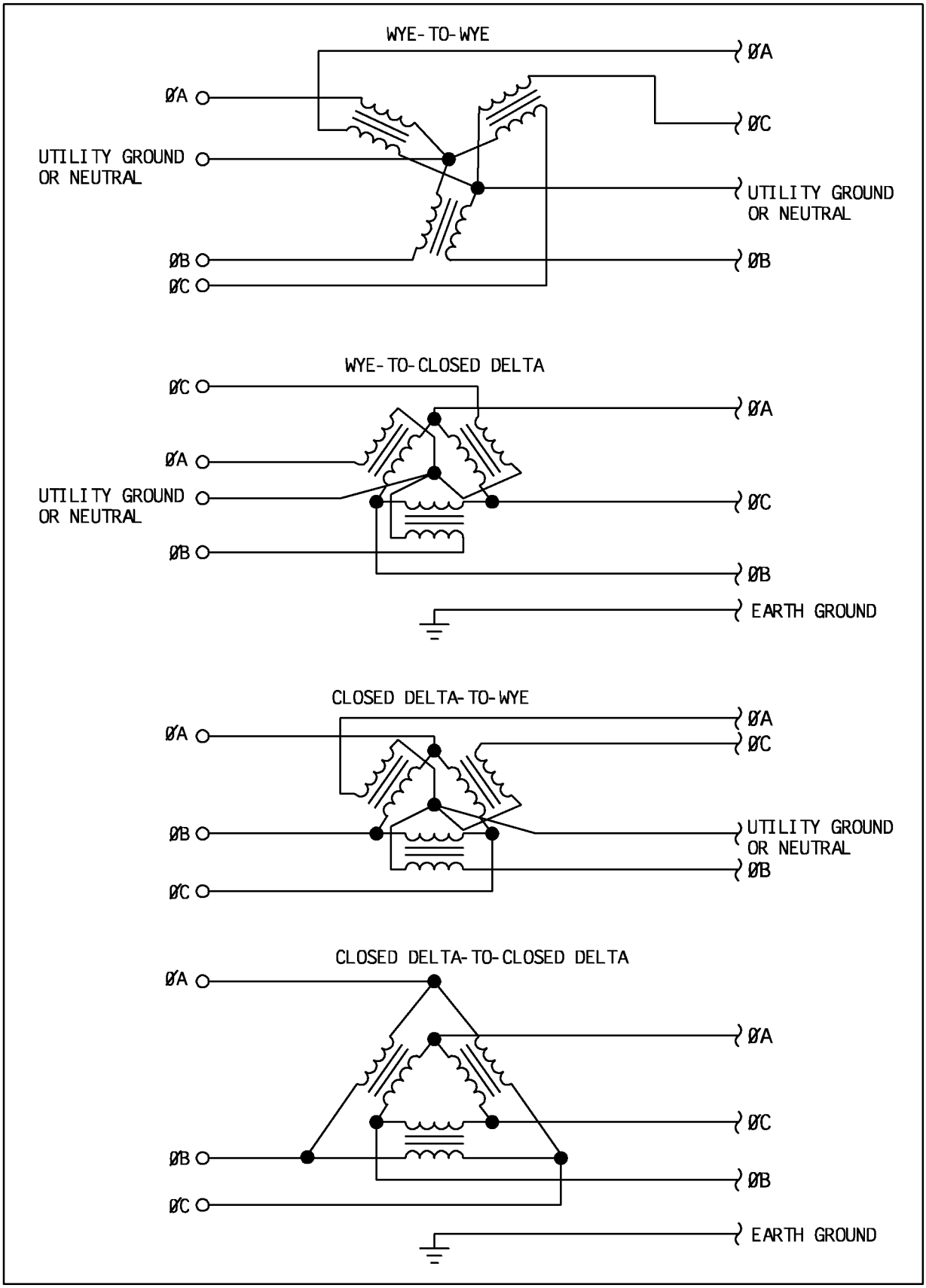
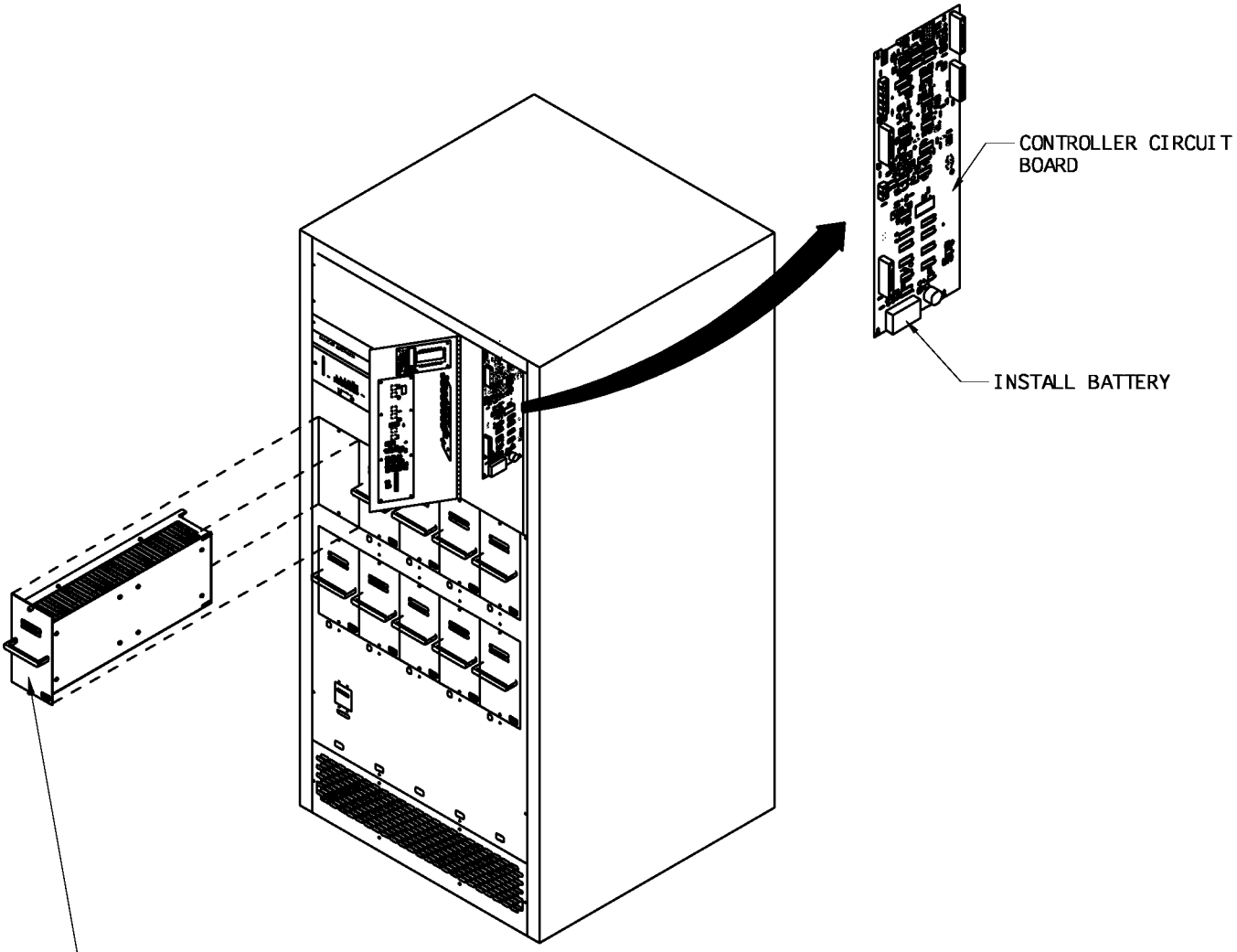


FIGURE 2-3. ACCEPTABLE AC POWER INPUT CONFIGURATIONS **597-0099-11**



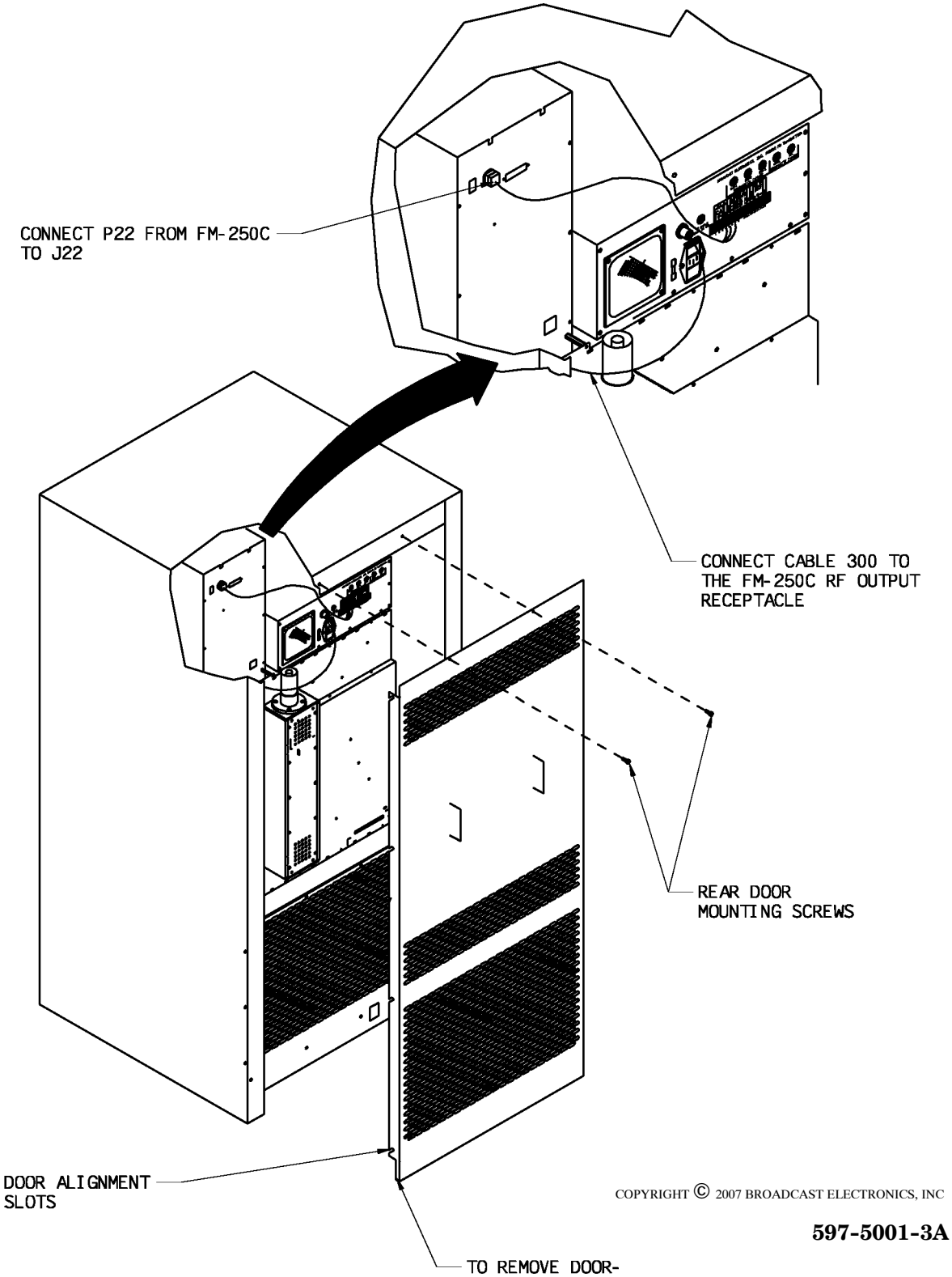
CAUTION THE TRANSMITTER MAY BE DAMAGED IF THE RF POWER MODULES ARE NOT SECURELY SEATED INTO THE MOTHERBOARD CONNECTOR.

INSTALL RF POWER MODULES:

1. ALIGN A RF POWER MODULE WITH THE GUIDES IN THE SELECTED RF POWER MODULE LOCATION.
2. INSERT AND FIRMLY PRESS THE RF POWER MODULE INTO THE MOTHERBOARD CONNECTORS.
3. SECURE THE RF POWER MODULE MOUNTING HARDWARE. THE MOUNTING HARDWARE MUST BE SECURE TO ENSURE THE MODULE IS PROPERLY SEATED IN THE CONNECTORS.

597-5001-3

FIGURE 2-4. COMPONENT INSTALLATION (SHEET 1 OF 2)



597-5001-3A

FIGURE 2-4. COMPONENT INSTALLATION (SHEET 2 OF 2)

2–24. **FM–250C Installation.** The exciter is mounted in the transmitter rack. For transmitters equipped with an FM–250C, perform the following installation procedure. For transmitters equipped with the FXi 250 Exciter, the following installation procedure is not required.

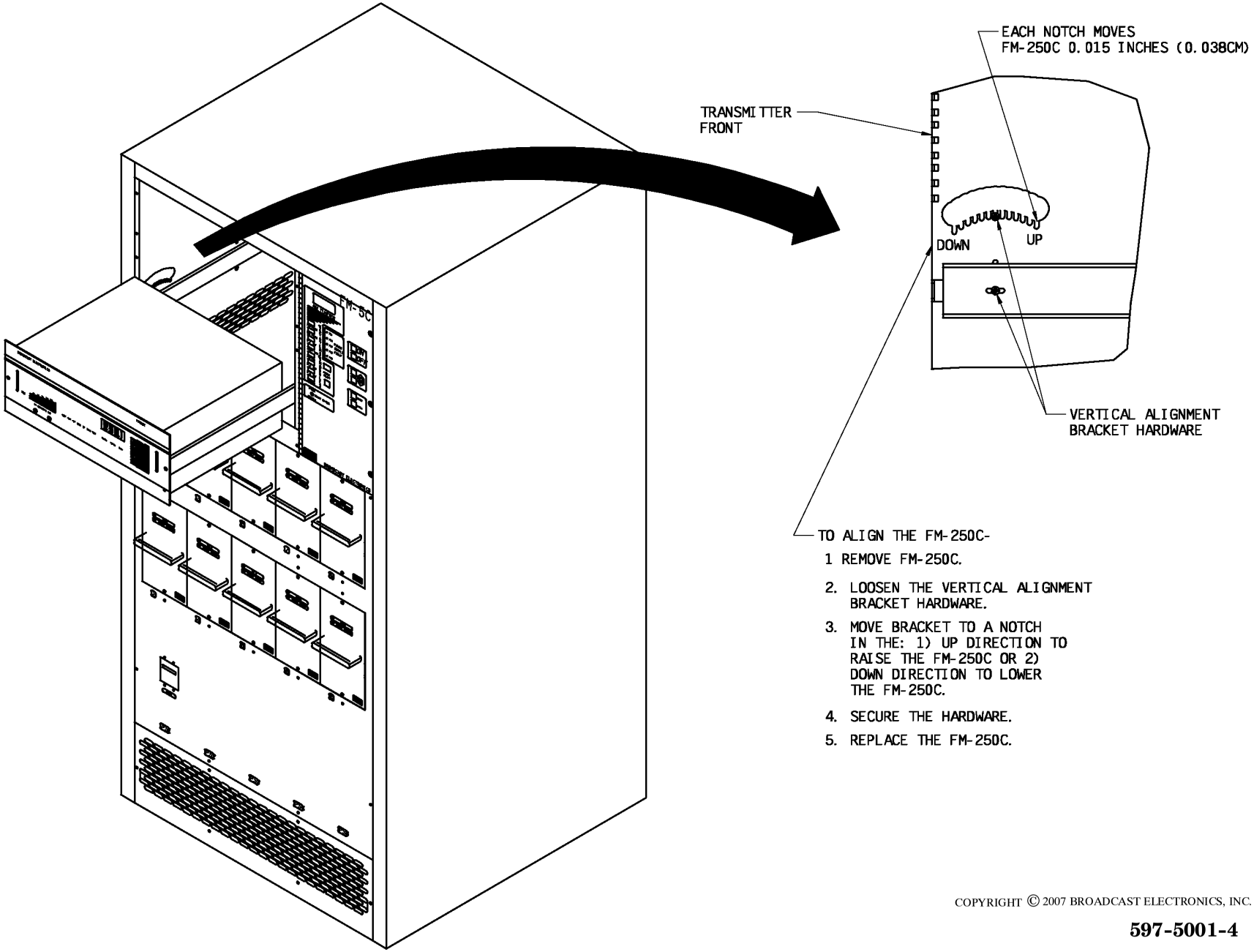
1. Locate the FM–250C exciter.
2. Refer to FM–250C exciter manual 597–1004 and perform the PRELIMINARY INSTALLATION PROCEDURES to unpack and configure the unit. Do not perform the following preliminary installation procedures: 1) placement, and 2) slide–rail installation and mounting.
3. If the FM–250C was removed for shipment, proceed as follows:
   A. Remove the shipping ties on the slide–rails.
   B. Refer to Figure 2–5 and place the unit on the slide–rails.
4. Slide the FM–250C in and out of the rack to check the movement and vertical alignment. If the FM–250C is to be moved up or down, proceed as follows:
   A. Push the FM–250C back in the rack and measure the distance the unit is to be moved.
   B. Remove the FM–250C from the transmitter rack.
   C. Adjust the FM–250C as follows:
      1. Refer to Figure 2–5 and loosen the vertical alignment bracket hardware.
      2. Refer to Figure 2–5 and move the mounting bracket to a notch in the: 1) up direction to raise the FM–250C or 2) down direction to lower the FM–250C. Each notch will move the unit 0.015 inches (0.038 cm).
      3. Secure the mounting bracket hardware.
      4. Repeat the procedure for the opposite side.
   D. Replace the FM–250C on the slide–rails.
   E. Push the FM–250C back in the rack and observe the alignment. Repeat the procedure if additional adjustment is required.
5. Refer to Figure 2–4 and connect P22 to J22 on the controller housing rear panel as shown.
6. Refer to Figure 2–4 and connect cable 300 to the FM–250C RF OUTPUT receptacle.

2–25. **RF Power Module Installation.** The FM–5C/FMi–402 is equipped with RF power modules 1 through 10. The FM–4C/FMi 301 is equipped with RF power modules 1 through 8. To install the RF modules, proceed as follows:

CAUTION THE TRANSMITTER MAY BE DAMAGED IF AN RF POWER MODULE IS NOT SECURELY SEATED CAUTION INTO THE MOTHERBOARD CONNECTORS.

CAUTION AN RF POWER MODULE IS EQUIPPED WITH REAR-PANEL MOUNTED CONNECTORS. TO PREVENT CAUTION DAMAGE TO THE CONNECTORS, INSERT/REMOVE THE MODULES CAREFULLY AND DO NOT STAND A MODULE ON THE REAR-PANEL.

1. Locate the RF power modules.
2. Ensure the packing material is removed from the RF output connector on the module rear–panel.



597-5001-4

FIGURE 2-5. FM-250C VERTICAL ALIGNMENT

3. Refer to Figure 2–4 and align an RF power module with the guides in the RF power module 1 location.

4. Insert and firmly press the RF module into the motherboard connectors.

5. Secure the RF power module mounting hardware. The mounting hardware must be secure to ensure the module is properly seated in the connectors.

6. For FM–5C/FMi 402 models, repeat the procedure for RF power modules 2 through 10.

7. For FM–4C/FMi 301 models, repeat the procedure for RF power modules 2 through 8.

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

WARNING

2–26. **WIRING.**

2–27. **REMOTE CONTROL.** The FM–5C/FM–4C and FMi–402/FMi–301 transmitters are designed for complete remote control operations (refer to Figure 2–6). The transmitters will interface with almost any remote control unit. The following text presents a description of the FM–5C/FM–4C and FMi–402/FMi–301 remote control functions and indications. The remote control connections are located on the transmitter rear–panel (refer to Figure 2–7).

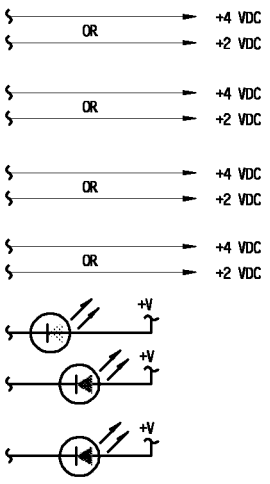
2–28. Remote control connections are interfaced to the transmitter at J20 on the transmitter rear–panel (refer to Figure 2–7). Remote control commands and indications can be interfaced to the transmitter using: 1) remote control mating connector P20 or 2) the remote control interface circuit board with remote control terminal strip TB2. The transmitter is shipped with the remote control interface circuit board installed. If the remote control interface circuit board is not desired, refer to Figure 2–7 and remove the interface circuit board.

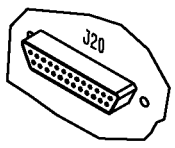
2–29. The transmitter controller: 1) provides positive or negative control logic and 2) +4/+2 volt remote full–scale meter indications. Positive/negative control is determined by jumper J1 on the controller on/off switch circuit board assembly. Positive control requires the use of a momentary contact to a +5 volt to +15 volt dc signal to activate the function. Negative control requires the use of a momentary contact to ground to activate the function. Remote indication functions: 1) require current limiting resistors and 2) provide up to 100 mA of current for indicators. Refer to Figure 2–6 and the following text to connect remote control equipment to the system. The text describes the connections using remote control interface circuit board terminal strip TB2. The pin connections for remote control interface connector J20 are identical to terminal strip TB2. The transmitter controller is factory programmed for positive remote control operations.

2–30. **Remote Forward/Reflected Power Meter Indications.** Remote transmitter forward/reflected power meter indications are located at TB2–1 and TB2–2. The indications can be programmed for +4 volt dc full–scale or +2 volt dc full–scale meter indications. The transmitter is shipped with the remote forward and reflected power meter indications programmed for +4 volt full–scale meter indications. On FM–5C/FMi–402 models, the following meter indications will be present: 1) Forward Power – 4V = 5 kW and 2) Reflected Power – 4V = 200W. On FM–4C/FMi–301 models, the following voltages will be present: 1) Forward Power – 4V = 4 kW and 2) Reflected Power – 4V = 160W. Signal ground recommended for remote metering ground connections.

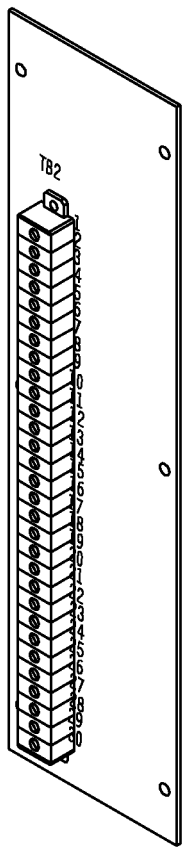
J20/TB2 PIN DESCRIPTIONS

1	FORWARD MTR	REMOTE FORWARD AND REFLECTED POWER INDICATIONS. +4 VDC FULL-SCALE WITH CONTROLLER R13 INSTALLED. +2 VDC FULL-SCALE WITH CONTROLLER R13 REMOVED. SIGNAL GROUND RECOMMENDED FOR METER CONNECTIONS.
2	REFLECTED MTR	
3	PA PWR SUP BUSS VOLT.	REMOTE PA POWER SUPPLY BUSS VOLTAGE AND INLET TEMPERATURE INDICATIONS. +4 VDC FULL-SCALE WITH CONTROLLER R13 INSTALLED. +2 VDC FULL-SCALE WITH CONTROLLER R13 REMOVED. SIGNAL GROUND RECOMMENDED FOR METER CONNECTIONS.
4	INLET TEMP METER	
5	PA MOD FORWARD POWER METER	REMOTE PA MODULE FORWARD POWER AND CURRENT INDICATIONS. +4 VDC FULL-SCALE WITH CONTROLLER R13 INSTALLED. +2 VDC FULL-SCALE WITH CONTROLLER R13 REMOVED. SIGNAL GROUND RECOMMENDED FOR METER CONNECTIONS.
6	PA MOD CURRENT METER	
7	PA MOD VOLTAGE METER	REMOTE PA MODULE VOLTAGE AND TEMPERATURE INDICATIONS. +4 VDC FULL-SCALE WITH CONTROLLER R13 INSTALLED. +2 VDC FULL-SCALE WITH CONTROLLER R13 REMOVED. SIGNAL GROUND RECOMMENDED FOR METER CONNECTIONS.
8	PA MOD TEMP METER	
9	XMTR ON STATUS	TRANSMITTER ON INDICATION. LOW (0 VDC) WHEN ACTIVE, 100 mA MAX.
10	XMTR OFF STATUS	TRANSMITTER OFF INDICATION. LOW (0 VDC) WHEN ACTIVE, 100 mA MAX.
11	XMTR FAULT STATUS	TRANSMITTER FAULT INDICATIONS. A LOW (0 VDC) WHEN: 1) A PA FAULT OCCURS, 2) A POWER SUPPLY FAULT OCCURS, 3) REFLECTED POWER IS GREATER THAN 200 WATTS FOR FM-5C MODELS OR 160 WATTS FOR FM-4C MODELS, OR 4) THE TRANSMITTER TEMPERATURE IS GREATER THAN 50 DEG. C (+122 DEG F). 100 mA MAX.
12	XMTR RMT ON COMMAND.	*TRANSMITTER ON CONTROL. POSITIVE CONTROL: MOMENTARY CONTACT TO +5 TO +15VDC REQUIRED TO OPERATE TRANSMITTER ON. NEGATIVE CONTROL: MOMENTARY CONTACT TO GROUND REQUIRED TO OPERATE TRANSMITTER ON.
13	XMTR RMT OFF COMMAND.	*TRANSMITTER OFF CONTROL. POSITIVE CONTROL: MOMENTARY CONTACT TO +5 TO 15VDC REQUIRED TO OPERATE TRANSMITTER OFF. NEGATIVE CONTROL: MOMENTARY CONTACT TO GROUND REQUIRED TO OPERATE TRANSMITTER OFF.
14	RMT RAISE POWER COMMAND.	*TRANSMITTER RAISE POWER CONTROL. POSITIVE CONTROL: CONTACT TO +5 TO +15 VDC REQUIRED TO RAISE TRANSMITTER POWER. NEGATIVE CONTROL: CONTACT TO GROUND REQUIRED TO RAISE TRANSMITTER POWER.
15	RMT LOWER POWER COMMAND.	*TRANSMITTER LOWER POWER CONTROL. POSITIVE CONTROL: CONTACT TO +5 TO +15 VDC REQUIRED TO LOWER TRANSMITTER POWER. NEGATIVE CONTROL: CONTACT TO GROUND REQUIRED TO LOWER TRANSMITTER POWER.
16	REMOTE RESET COMMAND.	*TRANSMITTER FAULT RESET CONTROL. POSITIVE CONTROL: MOMENTARY CONTACT TO +5 TO +15 VDC REQUIRED TO RESET THE FAULT CIRCUIT. NEGATIVE CONTROL: MOMENTARY CONTACT TO GROUND REQUIRED TO RESET THE FAULT CIRCUIT.
17	FAILSAFE INPUT	*REMOTE FAILSAFE INPUT. POSITIVE CONTROL: REQUIRES A +5 TO +15VDC SIGNAL TO INDICATE AN ENABLED REMOTE CONTROL UNIT. NEGATIVE CONTROL: CONTACT TO GROUND REQUIRED TO INDICATE AN ENABLE REMOTE CONTROL UNIT.
18	+5VDC OUTPUT	+5 VDC SUPPLY FROM CONTROLLER. PROVIDES A +5 VDC SUPPLY FOR REMOTE SWITCHES AND INDICATORS.
19	+5VDC OUTPUT	
20	+15VDC OUTPUT	+15VDC SUPPLY FROM CONTROLLER. PROVIDES A +15VDC SUPPLY FOR COAXIAL SWITCH RELAYS.
21	PA PWR SUP FAULT STATUS	PA POWER SUPPLY FAULT INDICATIONS. A LOW (0 VDC) WHEN A POWER SUPPLY FAULT OCCURS, 100 mA MAX.
22	PA MOD FAULT STATUS	PA MODULE FAULT INDICATIONS A LOW (0VDC) WHEN A PA MODULE FAULT OCCURS, 100 mA MAX.
23	SIGNAL GND	SIGNAL GROUND. ISOLATED CIRCUIT GROUND FOR REMOTE CONTROL CONNECTIONS. USE SIGNAL GROUND TO REMEDY GROUND LOOP OR RFI CONDITIONS.
24	CHASSIS GND	CHASSIS GROUND. CHASSIS GROUND FOR REMOTE CONTROL CONNECTIONS.
25	PA MOD SELECT COMMAND	PA MODULE SELECT COMMAND A (0VAC) REQUIRED TO SELECT PA MODULE FOR METERING OPERATIONS
26	SIGNAL GND	SIGNAL GROUND. ISOLATED CIRCUIT GROUND FOR REMOTE CONTROL CONNECTIONS. USE SIGNAL GROUND TO REMEDY GROUND LOOP OR RFI CONDITIONS.
27	SIGNAL GND	
28	NO CONNECTION	NO CONNECTION
29	NO CONNECTION	NO CONNECTION
30	CHASSIS GROUND	CHASSIS GROUND. CHASSIS GROUND FOR REMOTE CONTROL CONNECTIONS.

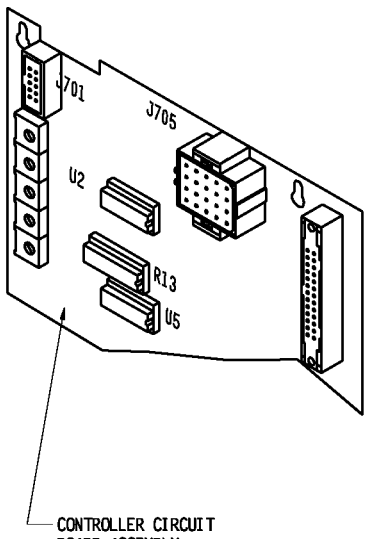




A REMOTE CONTROL INTERFACE CONNECTOR J20



B REMOTE CONTROL INTERFACE TERMINAL STRIP TB2.

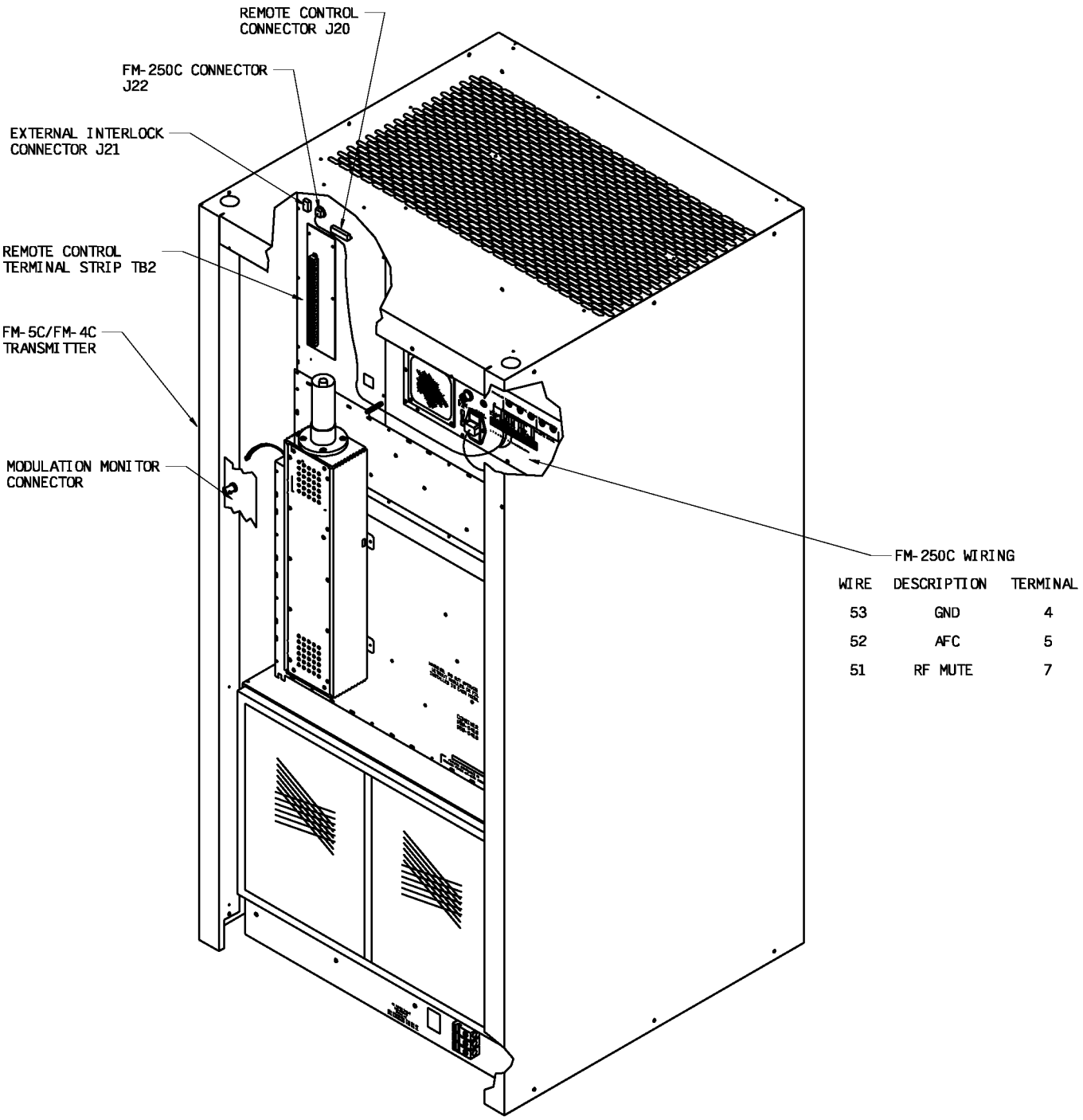


NOTES: * 1. POSITIVE CONTROL: J1 ON CONTROLLER ON-OFF CIRCUIT BOARD IN POSITION 2-3, FACTORY DEFAULT

2. NEGATIVE CONTROL: J1 ON CONTROLLER ON-OFF CIRCUIT BOARD IN POSITION 1-2.

FIGURE 2-6. REMOTE CONTROL CONNECTIONS
(2-11/2-12)

597-5001-5



597-5001-6

FIGURE 2-7. INTERLOCK, REMOTE CONTROL, AND MODULATION MONITOR WIRING

2–31. **Remote PA Power Supply Bus Voltage/Inlet Temperature Meter Indications.** Remote PA power supply bus voltage/temperature meter indications are located at TB2–3 and TB2–4. The PA power supply bus voltage indication monitors a transmitter power supply bus voltage. The temperature indication monitors the transmitter inlet air temperature. The indications can be programmed for +4 volt dc full–scale or +2 volt dc full–scale meter indications. The transmitter is shipped with the remote PA power supply bus voltage/inlet temperature meter indications programmed for +4 volt full–scale meter indications. The meter indications are as follows: 1) Power Supply Bus Voltage – 4V = 50V and 2) Temperature – 4V = 60 Degrees Celsius. Signal ground recommended for remote metering ground connections.

2–32. **Remote PA Module Forward Power/Current Meter Indications.** Remote PA module forward power/current meter indications are located at TB2–5 and TB2–6. The PA module forward power/current indications monitor forward power and current of a single module selected by the PA module select command (refer to PA Module Select Command in the following text). The indications can be programmed for +4 volt dc full–scale or +2 volt dc full–scale meter indications. The transmitter is shipped with the remote PA forward power/current meter indications programmed for +4 volt full–scale meter indications. The meter indications are as follows: 1) PA Module Forward Power – 4V = 500W and 2) PA Module Current – 4V = 20A. Signal ground recommended for remote metering ground connections.

2–33. **Remote PA Module Voltage/Temperature Meter Indications.** Remote PA module voltage/temperature meter indications are located at TB2–7 and TB2–8. The PA module voltage/temperature indications monitor voltage and temperature of a single module selected by the PA module select command (refer to PA Module Select Command in the following text). The indications can be programmed for +4 volt dc full–scale or +2 volt dc full–scale meter indications. The transmitter is shipped with the remote PA module voltage/temperature meter indications programmed for +4 volt full–scale meter indications. The meter indications are as follows: 1) PA Module Voltage – 4V = 50V and 2) Temperature – 4V = 60 Degrees Celsius. Signal ground recommended for remote metering ground connections.

2–34. **Transmitter On Indications.** The transmitter on indicator provides a signal to indicate when the transmitter is enabled. The transmitter on indicator is located at TB2–9. The indicator will go LOW (0 volts dc) to indicate when the transmitter is enabled.

2–35. **Transmitter Off Indications.** The transmitter off indicator provides a signal to indicate when the transmitter is disabled. The transmitter off indicator is located at TB2–10. The indicator will go LOW (0 volts dc) to indicate when the transmitter is disabled.

2–36. **Transmitter Fault Indications.** The transmitter fault indicator provides a signal to indicate when: 1) a PA module fault occurs, 2) a power supply module fault occurs, 3) reflected power is greater than 200 watts for an FM–5C/FMi 402 or 160 watts for an FM–4C/FMi 301, or 4) the transmitter inlet temperature is greater than 50°C (+122°F). The transmitter fault indicator is located at TB2–11. The indicator will go LOW (0 volts dc) to indicate when a PA module fault, a power supply module fault, a high reflected power, or a high temperature condition has occurred.

2–37. **Remote Transmitter On Control.** The transmitter on function is located at TB2–12. The function can be activated using positive or negative control. Positive control requires the use of a momentary contact to a +5 volt to +15 volt dc signal to operate the transmitter to on. Negative control requires the use of a momentary contact to ground to operate the transmitter to on.

2–38. **Remote Transmitter Off Control.** The transmitter off function is located at TB2–13. The function can be activated using positive or negative control. Positive control requires the use of a momentary contact to a +5 volt to +15 volt dc signal to operate the transmitter to off. Negative control requires the use of a momentary contact to ground to operate the transmitter to off.

2-39. **Remote Power Level Raise Control.** The transmitter power level raise control is located at TB2-14. The function can be activated using positive or negative control. Positive control requires the use of a momentary contact to a +5 volt to +15 volt dc signal to raise the transmitter power level. Negative control requires the use of a momentary contact to ground to raise the transmitter power level.

2-40. **Remote Power Level Lower Control.** The transmitter power level lower control is located at TB2-15. The function can be activated using positive or negative control. Positive control requires the use of a momentary contact to a +5 volt to +15 volt dc signal to lower the transmitter power level. Negative control requires the use of a momentary contact to ground to lower the transmitter power level.

2-41. **Remote Reset Control.** The reset control is designed to reset the transmitter fault circuitry. The reset control is located at TB2-16. The function can be activated using positive or negative control. Positive control requires the use of a momentary contact to a +5 volt to +15 volt dc signal to reset the transmitter fault circuitry. Negative control requires the use of a momentary contact to ground to reset the transmitter fault circuitry.

2-42. **Remote Fail–Safe Input.** The remote fail-safe input is designed for the remote control unit fail-safe control line. The input is located at TB2-17. The input can be activated using positive or negative control. Positive control requires the use of a +5 volt to +15 volt dc signal to indicate an enabled remote control unit. Negative control requires the use of a ground to indicate an enabled remote control unit.

2-43. **+5V DC Supply.** A +5 volt dc supply is provided for the remote control switches and indicators. The +5 volt dc supply is located at TB2-18 and TB2-19. The supply can provide up to 20 mA for indicator and switch operations.

2-44. **+15V DC Supply.** A +15 volt dc supply is provided for coaxial switch control relays. The +15 volt dc supply is located at TB2-20. The supply can provide up to 50 mA for control operations.

2-45. **PA Power Supply Fault Status Indications.** The PA power supply fault indicator provides a signal to indicate when a PA power supply fault has occurred. The PA power supply fault indicator is located at TB2-21. The indicator will go LOW (0 volts dc) to indicate the presence of a PA power supply fault.

2-46. **PA Module Fault Status Indications.** The PA module fault indicator provides a signal to indicate when a PA RF power module fault has occurred. The PA RF power module fault indicator is located at TB2-22. The indicator will go LOW (0 volts dc) to indicate the presence of a PA RF power module fault.

2-47. **Signal Ground.** Signal ground is an isolated circuit ground for remote control connections. Signal ground is to be used to remedy ground loops or to eliminate RFI conditions. Signal ground is located at TB2-23, TB2-26, and TB2-27.

2-48. **Chassis Ground.** Chassis ground is designed to be used for remote control connections. Chassis ground is located at TB2-24 and TB2-30.

2-49. **PA Module Select Command.** The PA module select command is located at TB2-25. The command is used to select one PA RF power module for metering operations. The control requires a momentary contact to ground to select a PA RF power module. A different module is selected each time a momentary contact to ground is applied (refer to SECTION III, OPERATION for operating information).

2-50. **No Connection.** No connection at TB2-28 and TB2-29.

2-51. **EXTERNAL INTERLOCK.** The FM-5C/FM-4C transmitters are equipped with an external interlock such as for a test load. The interlock will operate the transmitter to off when opened. The interlock is located at J21 on the transmitter rear-panel (refer to Figure 2-6). To connect an external interlock to the transmitter, refer to Figure 2-7 and disconnect external interlock connector P21. Connect the interlock wiring to P21-1 and P21-2. When wiring is complete, connect P21 to J21 on the transmitter rear-panel.

2-52. **MODULATION MONITOR RECEPTACLE.** The FM-5C/FM-4C and FMi-403/FMi-301 transmitters are equipped with a modulation monitor receptacle. The receptacle is located on the transmitter low-pass filter (refer to Figure 2-7). Refer to Figure 2-7 and connect the modulation monitor to the modulation monitor receptacle. The receptacle provides a 2V RMS sample in a 50 Ohm load at 5 kW for monitoring operations on FM-5C/FMi-402 models or 2V RMS sample in a 50 Ohm load at 4 kW for monitoring operations on FM-4C/FMi-301 models.

2-53. **AUDIO INPUT CONNECTIONS.** Audio input connections for FM-5C/FM-4C and FMi-402/FMi-301 transmitters are located on the exciter rear panel. For an FM-250C, refer to FM-250 manual 597-1004 and perform the WIRING procedures in SECTION II, INSTALLATION**.** For an FXi 250, refer to manual 597-0541 SECTION II, INSTALLATION.

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

WARNING

2-54. **RF OUTPUT TRANSMISSION LINE CONNECTION.** FM-5C/FM-4C and FMi-402/FMi-301 transmitter RF output connection is located on the transmitter's low-pass filter (refer to Figure 2-8). The connection requires a 1 5/8 inch male EIA field flange. Install the RF output transmission line as follows:

1. Insert the RF inner conductor into the bullet conductor on the low-pass filter.
2. Insert the RF outer conductor into the flange on the low-pass filter.
3. Install the 1 5/8 inch flange on the inner and outer conductors. Secure the flange by tightening the flange clamp hardware.
4. Connect the RF output transmission line to the transmitter using a 1 5/8 inch male flange as shown.

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

WARNING

WARNING ***ENSURE AN EARTH GROUND CONDUCTOR IS SECURELY CONNECTED TO THE TRANSMITTER CHASSIS GROUND LUG.***

WARNING

2-55. **GROUND.** FM-5C/FM-4C and FMi-402/FMi-301 transmitters are equipped with a chassis ground system for operating safety. The ground system requires the connection of an earth ground. Refer to Figures 2-9 through 2-11 and connect an earth ground to the chassis ground lug using a 2 inch (5.08 cm) wide copper strap. For FM-5C/FM-4C and FMi-402/FMi-301 models configured for a three phase power supply, connect the ground strap as follows:

1. Remove the ground lug and the hardware from the chassis ground terminal.
2. Connect the strap to the chassis ground terminal.
3. Connect the ground wire to the lug.
4. Replace the ground lug and secure lug to the terminal using the hardware.

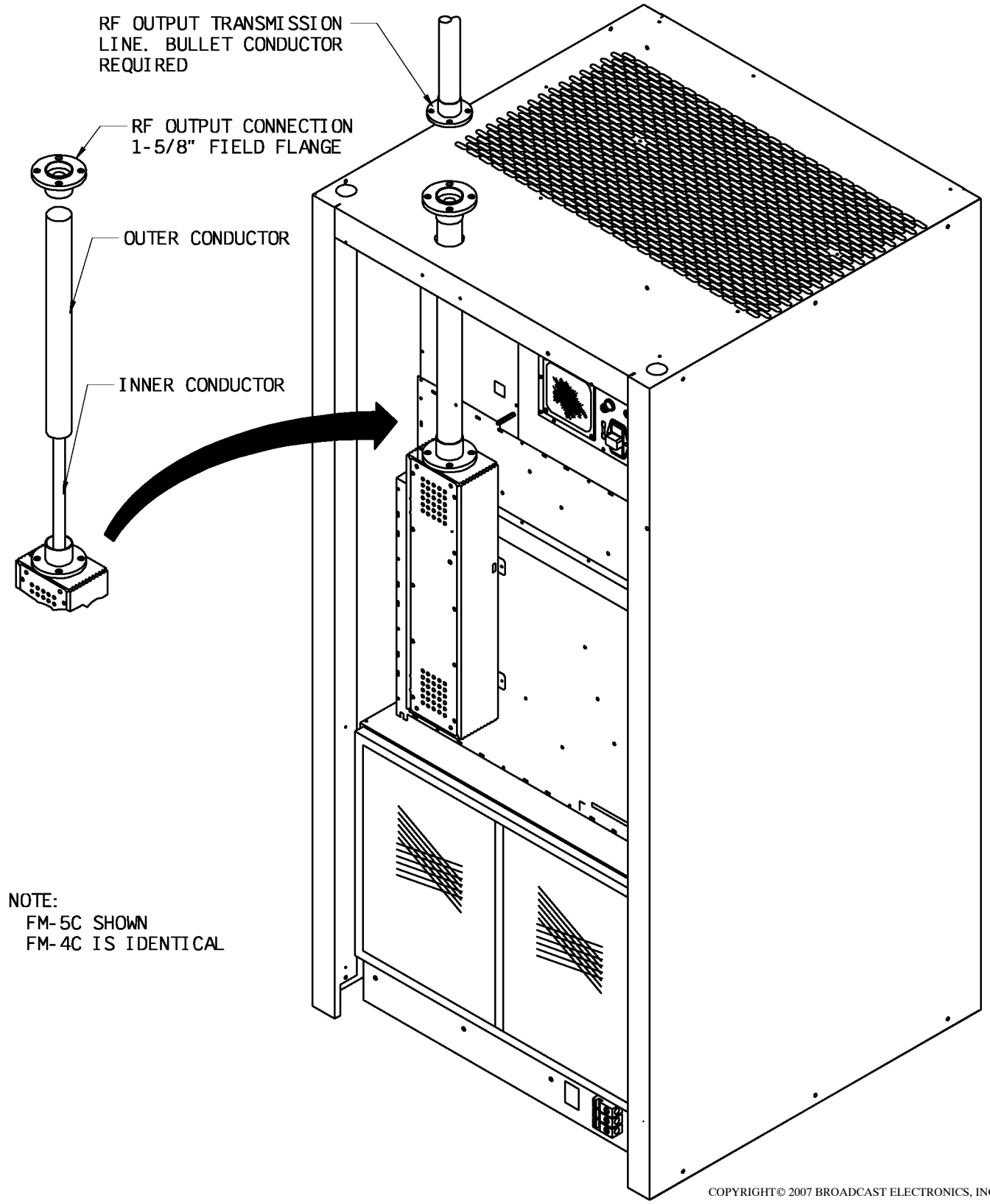


FIGURE 2-8. RF OUTPUT CONNECTIONS **597-5001-7**

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

WARNING

WARNING ***ENSURE AN EARTH GROUND CONDUCTOR IS SECURELY CONNECTED TO THE TRANSMITTER CHASSIS GROUND LUG.***

WARNING

2–56. **AC POWER CONNECTIONS.** The following text presents power source requirements for FM–5C/FM–4C and FMi–402/FMi–301 transmitters. For operating safety, the power source must be routed to the transmitter through a fused power disconnect (refer to Figures 2–9 through 2–11).

FM-5C		
Single Phase (FM Only)	196V To 252V AC, 50/60 Hz	80 Amperes
Three Phase (FM Only)	196V To 252V AC or 339V to 437V AC, 50/60 Hz	50 Amperes
FM-4C		
Single Phase (FM Only)	196V To 252V AC, 50/60 Hz	70 Amperes
Three Phase (FM Only)	196V To 252V AC or 339V to 437V AC, 50/60 Hz	50 Amperes
FMi-402		
Single Phase (HD Only)	196V To 252V AC, 50/60 Hz	35 Amperes
Single Phase (FM + HD)	196V To 252V AC, 50/60 Hz	45 Amperes
Three Phase (HD Only)	196V To 252V AC or 339V to 437V AC, 50/60 Hz	20 Amperes
Three Phase (FM + HD)	196V To 252V AC or 339V to 437V AC, 50/60 Hz	25 Amperes
FMi-301		
Single Phase (HD Only)	196V To 252V AC, 50/60 Hz	30 Amperes
Single Phase (FM + HD)	196V To 252V AC, 50/60 Hz	35 Amperes
Three Phase (HD Only)	196V To 252V AC or 339V to 437V AC, 50/60 Hz	15 Amperes
Three Phase (FM+HD)	196V To 252V AC or 339V to 437V AC, 50/60 Hz	20 Amperes

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

WARNING

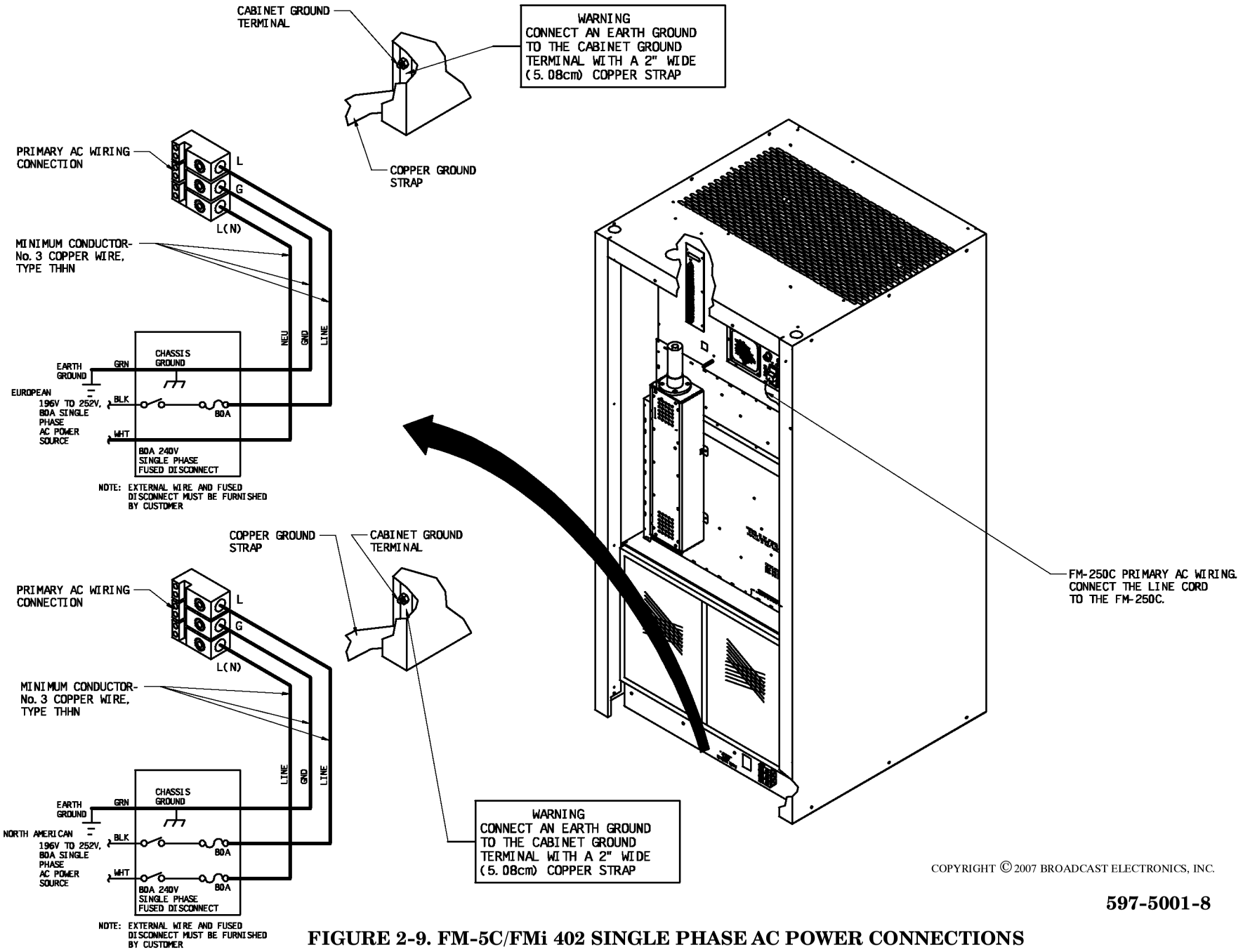
2-57. **Exciter AC Power Connections.** The exciter ac power source is provided by the transmitter. Connect the ac power cord from the transmitter to the exciter as shown. The FM-250C operates from a 194V to 266V ac source.

2-58. **Main AC Input – FM–5C Single Phase.** Refer to Figure 2-8 and connect the 80 Ampere single phase service to the ac input panel through a fused service disconnect as shown. Connect the utility company ground conductor securely to the ground terminal as shown.

2-59. **Main AC Input – FM–4C Single Phase.** Refer to Figure 2-9 and connect the 70 Ampere single phase service to the ac input panel through a fused service disconnect as shown. Connect the utility company ground conductor securely to the ground terminal as shown.

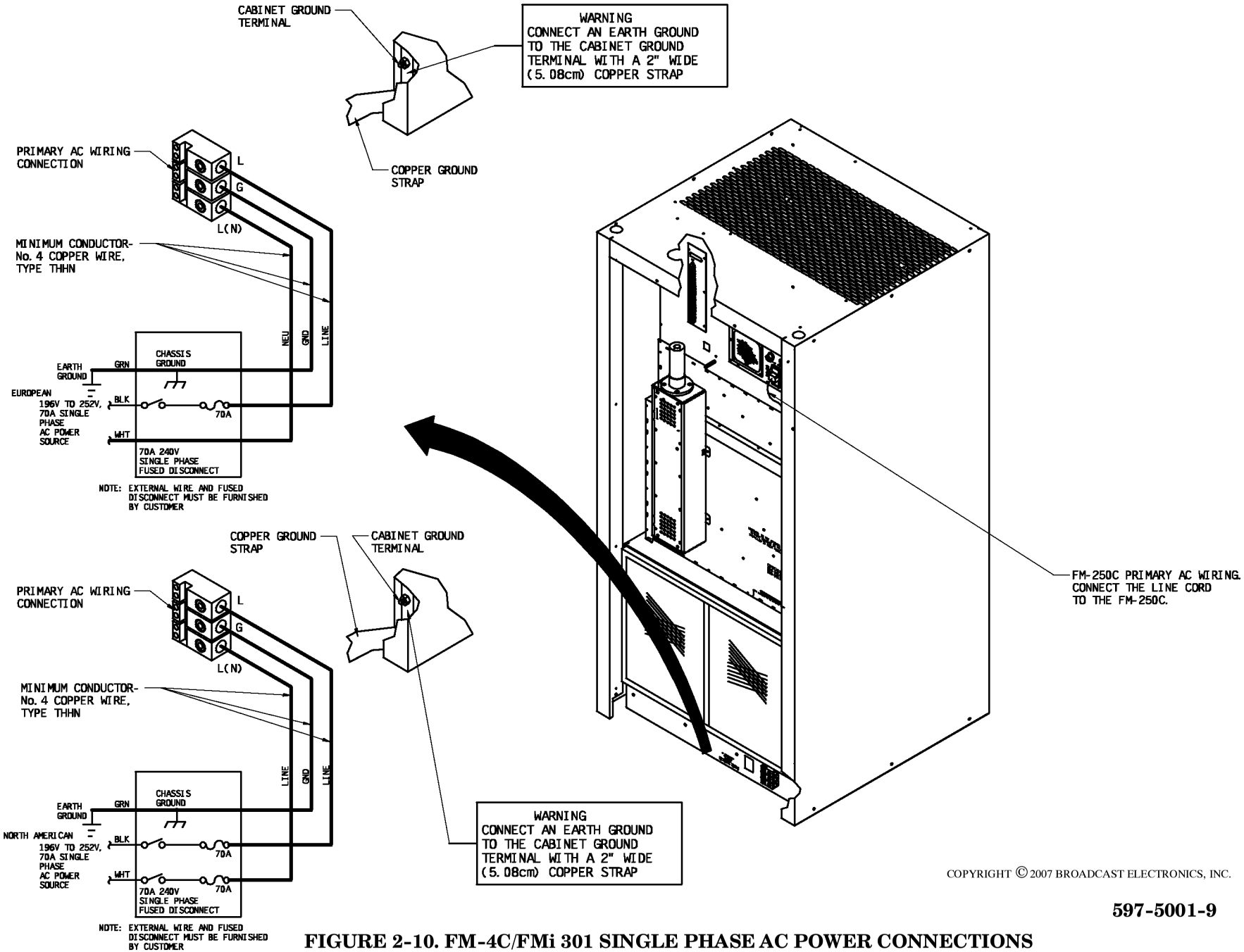
2-60. **Main AC Input – FM–5C/FM–4C Three Phase.** Refer to Figure 2-10 and connect the 50 Ampere three phase service to the ac input panel through a fused service disconnect as shown. For 380 volt systems, ensure the neutral conductor is connected to the N terminal. Connect the utility company ground conductor securely to the ground terminal as shown.

2-61. **Optional Equipment AC Power Connections.** The FM-5C/FM-4C and FMi-402/FMi-301 transmitters are designed for the installation of optional equipment such as a stereo generator, SCA generator, or a remote control system. If optional equipment is installed in the transmitter, route the optional equipment line cords through the ac line service hole in the top of the transmitter to an appropriate power source. Ensure the power source is protected by a fuse or circuit breaker.



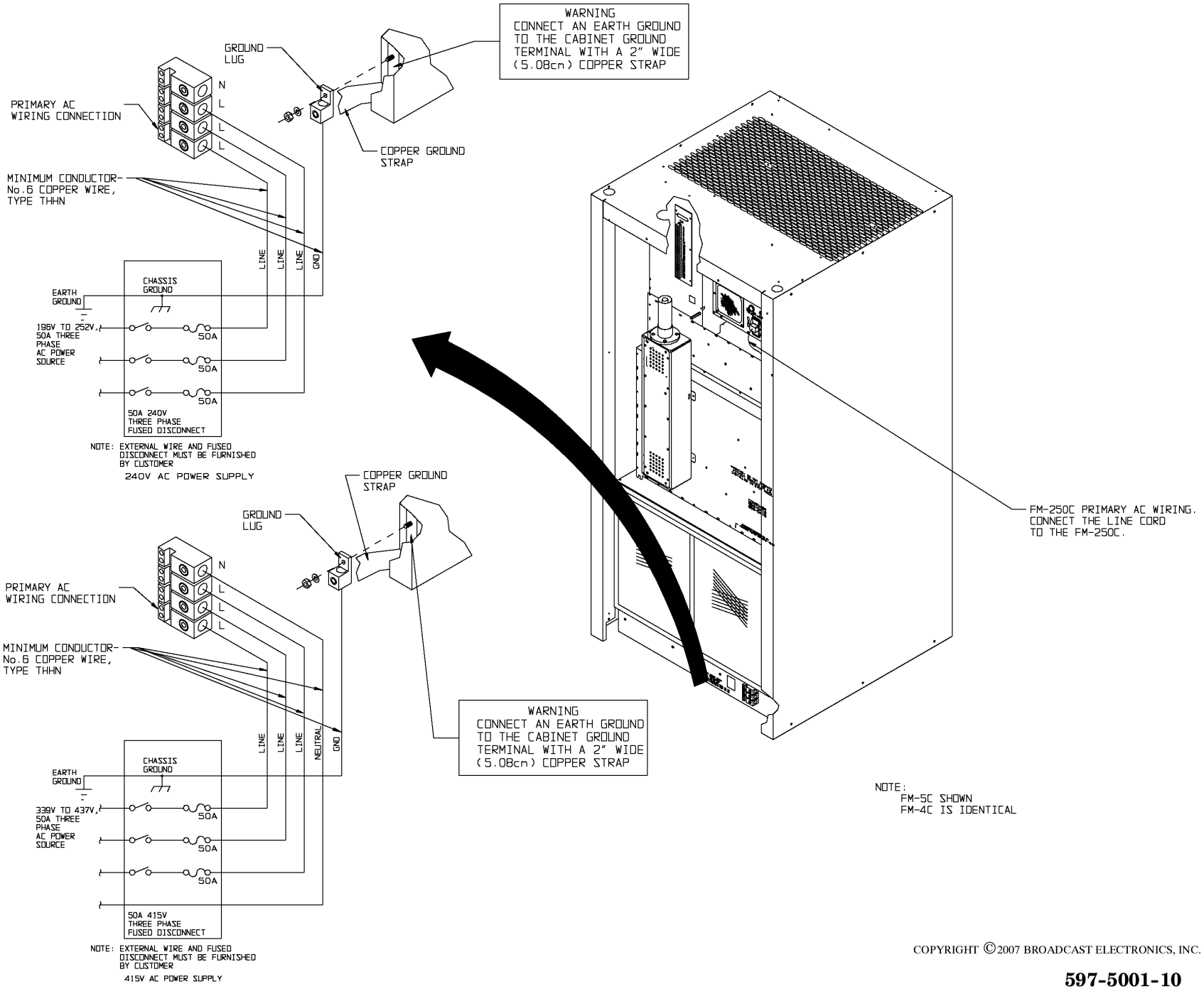
597-5001-8

FIGURE 2-9. FM-5C/FMi 402 SINGLE PHASE AC POWER CONNECTIONS



597-5001-9

FIGURE 2-10. FM-4C/FMi 301 SINGLE PHASE AC POWER CONNECTIONS



597-5001-10

FIGURE 2-11. FM-5C/FM-4C & FMi 402/FMi 301 THREE PHASE AC POWER CONNECTIONS

2-62. **PRELIMINARY OPERATION.**

NOTE

DO NOT REDUCE THE EXCITER OUTPUT POWER PRIOR TO ENABLING THE TRANSMITTER.

NOTE

2-63. The following text presents procedures for the preliminary operation of the FM-5C/FM-4C and FMi-402/FMi-301 transmitters. The procedures will reference the factory test data sheets which are shipped with the transmitter. Locate the factory test data sheets. Differences in the values obtained during actual operation may be noted due to differences in primary power and antenna systems. Refer to the following text and perform the procedures to initially operate the FM-5C/FM-4C and FMi-402/FMi-301 transmitters.

2-64. Ensure the appropriate ac power supply is applied to the transmitter.

2-65. Operate the **POWER** switch to ON. The following events will occur:

1. Each RF power module **MODULE STATUS** indicator will illuminate yellow.
2. The **INTERLOCK** indicator will illuminate.
3. The **OFF** switch/indicator will illuminate.

2-66. If the **INTERLOCK** indicator does not illuminate, perform the following procedure.

WARNING

DISCONNECT ALL TRANSMITTER PRIMARY POWER BEFORE PROCEEDING.

WARNING

1. Disconnect the ac power.
2. Remove the rear door and filter and observe the three-phase ac line monitor indicators.
3. If the indicators are illuminated, check the external interlock, the exciter AFC circuit, and the remote control failsafe. If the indicators are flashing or extinguished, refer to APPENDIX A for a description of the ac line monitor indicators and determine the fault condition. Typically, the ac line phasing must be changed. To change the ac line phasing, perform the following procedure. If the monitor detects a low or high voltage condition, check the ac line input.
   A. Reverse any two ac line phases at the ac input panel.
   B. Attempt transmitter operation.
4. Once the problem is located and repaired, continue the preliminary operation procedure.

2-67. Depress the transmitter **SYSTEM FWD POWER** switch/indicator. The **MULTIMETER** will indicate 0 watts forward power.

2-68. Depress the **ON** switch/indicator to illuminate the switch/indicator. All RF power module: 1) **MODULE STATUS** indicators will illuminate green and 2) **RF DRIVE** indicators will illuminate.

2-69. For an FM-250C, depress the exciter **MULTIMETER FWD** switch. The exciter **MULTIMETER** will indicate the forward power recorded in the factory test data sheets. controller display will indicate the forward power recorded in the factory test data sheets.

2–70. Depress and hold the transmitter **POWER** switch until the **MULTIMETER** indicates the forward power level recorded in the factory test data sheets. If the **RESET** switch/indicator illuminates or the **MODULE STATUS** indicators illuminate yellow during the increase of transmitter power, proceed as follows:

1. If the **RESET** switch/indicator illuminates, proceed as follows:

   A. Depress the transmitter **SYSTEM RFL POWER** switch/indicator to illuminate the switch/indicator.

   B. Observe the **MULTIMETER** reflected power indication. If a reflected power condition of greater than 200 watts is present for an FM–5C or 160 watts for an FM–4C, refer to SECTION V, MAINTENANCE and perform the TROUBLESHOOTING procedures to locate the problem. The transmitter will operate into a VSWR of 1.5:1.

   C. If the reflected power indication is less than 200 watts for an FM–5C or 160 watts for an FM–4C, depress the **SYSTEM PS VDC** and **INLET TEMP** switch/indicators to determine if a power supply or temperature problem is present.

   D. If no power supply or temperature problem is present, depress the **MODULE FWD PWR, P.A. CUR, P.A. VDC, TEMP,** and the **MODULE SELECT** switch/indicators to determine if an RF power module problem is present.

   E. When the problem condition is removed, reset the transmitter fault circuitry by depressing the **RESET** switch/indicator.

2. If the RF power **MODULE STATUS** indicators illuminate yellow, refer to SECTION V, MAINTENANCE and perform the TROUBLESHOOTING procedures to locate the problem.

2–71. When the desired transmitter output power is obtained, depress the following switch/indicators and compare the indications with the values recorded in the factory test data sheets. The values should be approximately equal to the values recorded in the test data sheets.

1. **RFL PWR**
2. **PS VDC**
3. **EXH TEMP**
4. **MODULE FWD PWR**
5. **MODULE P.A. CUR**
6. **MODULE P.A. VDC**
7. **MODULE TEMP**
8. **MODULE SELECT**

SECTION III
OPERATION

3-1. INTRODUCTION.

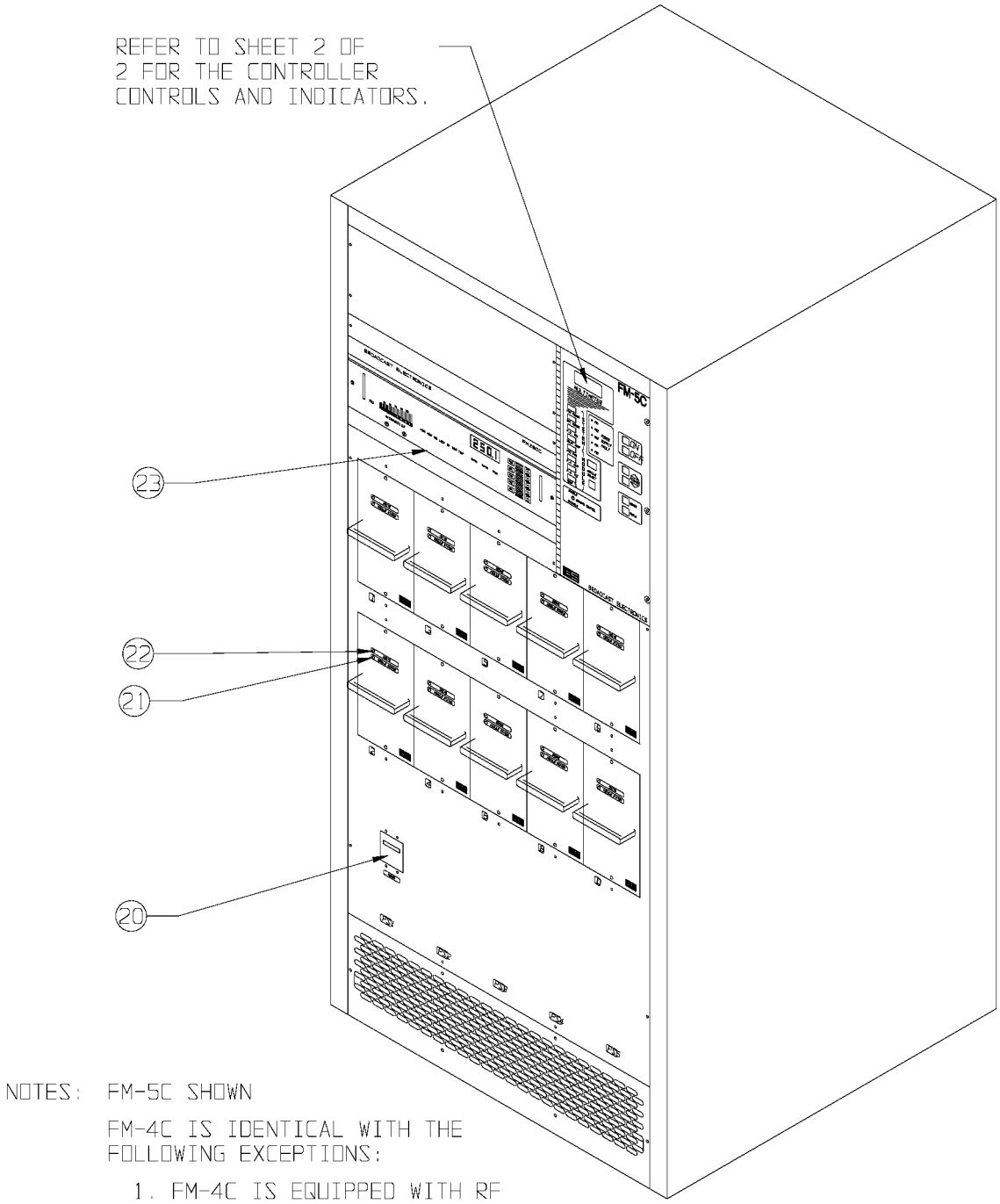
3-2. This section identifies all controls and indicators associated with the FM-5C/FM-4C and FMi-402/FMi-301 transmitters and provides standard operating procedures.

3-3. **CONTROLS AND INDICATORS.**

3-4. Figure 3-1 presents the location of all controls and indicators associated with normal operation of the FM-5C/FM-4C and FMi-402/FMi-301 transmitters. Table 3-1 presents the functions of each control or indicator. Refer to Figure 3-1 and Table 3-1 for a description of the controls and indicators associated with the FM-5C/FM-4C and FMi-402/FMi-301 transmitters.

TABLE 3-1. FM-5C/FM-4C and FMi-402/FMi-301 CONTROLS AND INDICATORS (Sheet 1 of 4)

INDEX NO.	NOMENCLATURE	FUNCTION
1	**MODULE TEMP C** Switch/Indicator	**SWITCH**: Configures the **MULTIMETER** to display RF power amplifier module temperature in degrees Centigrade. **INDICATOR**: A yellow display indicates the **MULTIMETER** is configured to present RF power amplifier module temperature.
2	**MODULE P.A. VDC** Switch/Indicator	**SWITCH**: Configures the **MULTIMETER** to display RF power amplifier module voltage. **INDICATOR**: A yellow display indicates the **MULTIMETER** is configured to present RF power amplifier module voltage.
3	**MODULE P.A. CUR** Switch/Indicator	**SWITCH**: Configures the **MULTIMETER** to display RF power amplifier module current in amperes. **INDICATOR**: A yellow display indicates the **MULTIMETER** is configured to present RF power amplifier module current.
4	**MODULE FWD PWR** Switch/Indicator	**SWITCH**: Configures the **MULTIMETER** to display RF power amplifier module forward power in watts. **INDICATOR**: A yellow display indicates the **MULTIMETER** is configured to present RF power amplifier module forward power.



NOTES: FM-5C SHOWN

FM-4C IS IDENTICAL WITH THE FOLLOWING EXCEPTIONS:

1. FM-4C IS EQUIPPED WITH RF POWER AMPLIFIER MODULES 1 THROUGH 8.
2. FM-4C IS EQUIPPED WITH POWER SUPPLY MODULES 1 THROUGH 4 AND POWER SUPPLY FAULT STATUS INDICATORS 1,2,3 AND 4.

597-5001-11

FIGURE 3-1. FM-5C/FM-4C & FMi 402/FMi 301 CONTROLS AND INDICATORS (SHEET 1 OF 2)

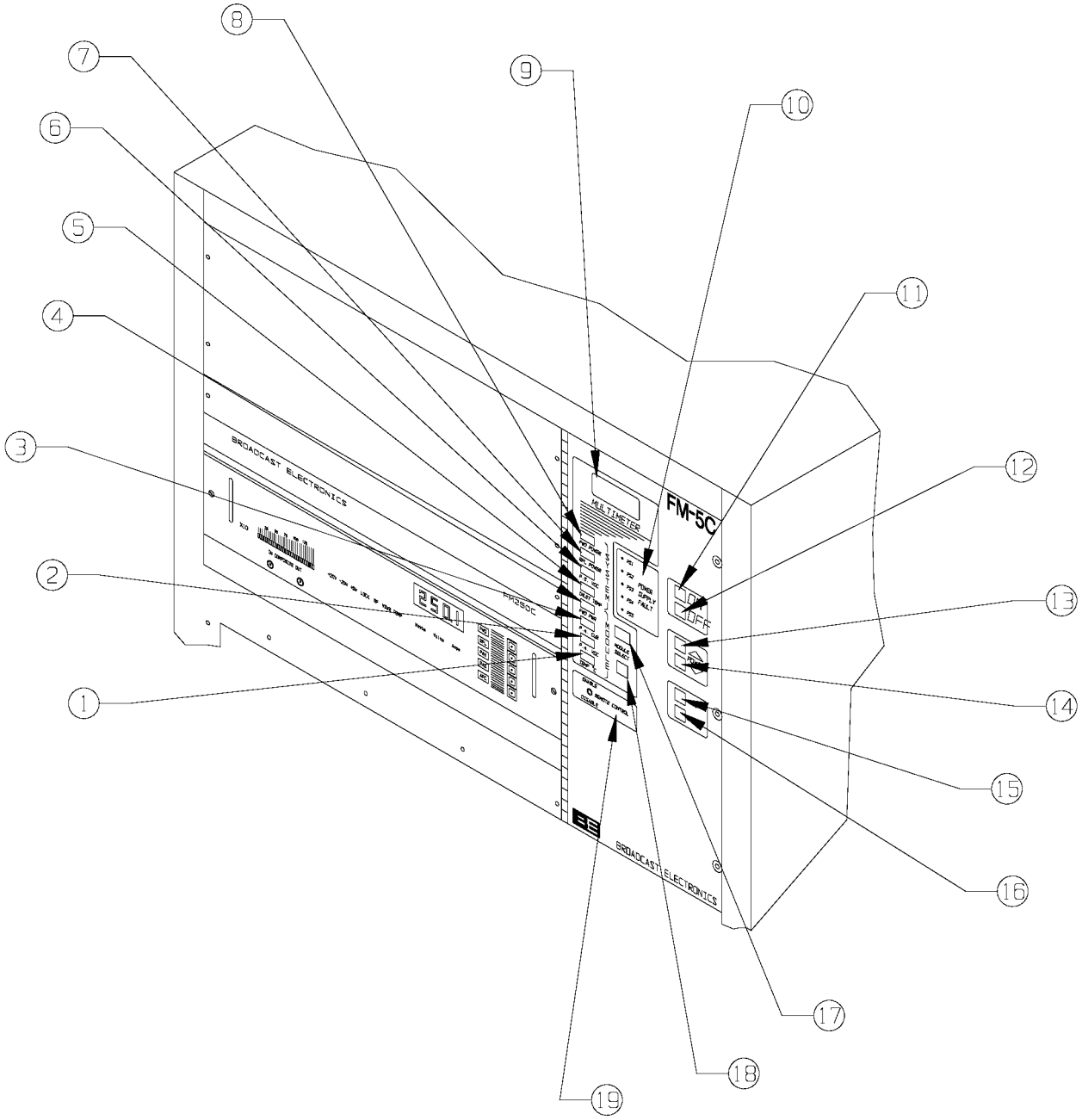


FIGURE 3-1. FM-5C/FM-4C & FMi 402/FMi 301 CONTROLS AND INDICATORS (SHEET 2 OF 2) **597-5001-11A**

TABLE 3-1. FM-5C/FM-4C & FMi-402/FMi-301 CONTROLS AND INDICATORS
(Sheet 2 of 4)

INDEX NO.	NOMENCLATURE	FUNCTION
5	**SYSTEM INLET TEMP** Switch/Indicator	**SWITCH**: Configures the **MULTIMETER** to display the transmitter inlet air temperature in degrees Centigrade. **INDICATOR**: A yellow display indicates the **MULTIMETER** is configured to present the transmitter inlet air temperature.
6	**SYSTEM P. S. VDC** Switch/Indicator	**SWITCH**: Configures the **MULTIMETER** to display the PA power supply bus voltage. **INDICATOR**: A yellow display indicates the **MULTIMETER** is configured to present the PA power supply voltage.
7	**SYSTEM RFL POWER** Switch/Indicator	**SWITCH**: Configures the **MULTIMETER** to display the transmitter reflected power in watts. **INDICATOR**: A yellow display indicates the **MULTIMETER** is configured to present the transmitter reflected power.
8	**SYSTEM FWD POWER** Switch/Indicator	**SWITCH**: Configures the **MULTIMETER** to display the transmitter forward power in kilowatts. **INDICATOR**: A yellow display indicates the **MULTIMETER** is configured to present the transmitter forward power.
9	**MULTIMETER** Display	Displays forward power, reflected power, power supply voltage, inlet air temperature, RF power module forward power, RF power module current, RF power module voltage, and RF power module temperature as selected by the **MULTIMETER SYSTEM** and **MODULE** switches.
10	**POWER SUPPLY FAULT 1, 2, 3, 4,** and **5** Indicators	The **1, 2, 3, 4,** or **5** indicator will illuminate to indicate a power supply module fault in an FM-5C. The **1, 2, 3,** or **4** indicator will illuminate to indicate a power supply fault in an FM-4C. The fault will illuminate during 1) Low/No RF Drive and 2) Power Supply Failure.
11	**TRANSMITTER ON** Switch/Indicator	**SWITCH**: Enables the transmitter RF output by unmuting the exciter, power amplifier modules, and the PA power supplies. **INDICATOR**: Illuminates to indicate the transmitter RF output is enabled.

TABLE 3-1. FM-5C/FM-4C & FMi-402/FMi-301 CONTROLS AND INDICATORS
(Sheet 3 of 4)

INDEX NO.	NOMENCLATURE	FUNCTION
12	**TRANSMITTER OFF** Switch/Indicator	**SWITCH**: Disables the transmitter RF output by muting the exciter, power amplifier modules, and the PA power supplies. **INDICATOR**: Illuminates to indicate the transmitter RF output is disabled.
13	**POWER ▲** Switch/Indicator	**SWITCH**: Instructs the system controller to raise the transmitter output power. **INDICATOR**: Illuminates to indicate the **POWER ▲** switch is selected.
14	**POWER ▼** Switch/Indicator	**SWITCH**: Instructs the system controller to lower the transmitter output power. **INDICATOR**: Illuminates to indicate the **POWER ▼** switch is selected.
15	**FAULT RESET** Switch/Indicator	**SWITCH**: Clears the transmitter fault circuitry if: 1) the switch is depressed and 2) the fault condition is removed. **INDICATOR**: Illuminates to indicate: 1) an RF power amplifier module fault, 2) a power supply module fault, 3) a high transmitter or module temperature condition, or 4) a high reflected power condition. During a high temperature condition, the transmitter will foldback the output power to maintain transmitter operation.
16	**INTLK STATUS** Switch/Indicator	**SWITCH**: No Operation. **INDICATOR**: Illuminates to indicate: 1) the external interlock is closed, 2) the exciter AFC is locked, 3) the remote control fail-safe input is closed if remote control operation is enabled, and 4) the three–phase ac line monitor is normal. Extinguishes to indicate: 1) an open external interlock, 2) the exciter AFC is unlocked, 3) an open remote control fail-safe input if remote control operation is enabled, or 4) the three–phase ac line monitor has detected the loss of a phase, incorrect ac line phasing, or a high/low ac line voltage condition.
17	**MODULE SELECT** Display	Displays the RF power amplifier module selected by the **MODULE SELECT** switch for the display of forward power, current, voltage, or temperature parameters on the **MULTIMETER.**

TABLE 3-1. FM-5C/FM-4C & FMi-402/FMi-301 CONTROLS AND INDICATORS
(Sheet 4 of 4)

INDEX NO.	NOMENCLATURE	FUNCTION
18	**MODULE SELECT** Switch/Indicator	**SWITCH:** Selects an RF power amplifier module for the display of forward power, current, voltage, or temperature parameters on the **MULTIMETER**. For FM-5C models, the switch will select RF power amplifier modules 1 through 10. For FM-4C models, the switch will select RF power amplifier modules 1 through 8. The switch is disabled when the **REMOTE CONTROL ENABLE/DISABLE** switch is operated to **ENABLE**. The switch is enabled when the **REMOTE CONTROL ENABLE/DISABLE** switch is operated to **DISABLE**. **INDICATOR**: Illuminates to indicate the **MODULE SELECT** switch is enabled. Extinguishes to indicate the module select switch is disabled. The **MODULE SELECT** switch is controlled by the **REMOTE CONTROL ENABLE/DISABLE** switch.
19	**REMOTE CONTROL ENABLE/DISABLE** Switch	Controls the transmitter remote control operations. When the switch is operated to **ENABLE**, remote control operation is enabled. When the switch is operated to **DISABLE**, remote control operation is disabled.
20	**POWER SWITCH**	Provides overload protection and primary power control for the transmitter.
21	**MODULE STATUS** Indicator	Displays the operating status of the RF power amplifier module. **RED DISPLAY**: Indicates an RF power module fault. RF power module faults include: 1) over-current, 2) over-temperature, 3) high reflected power, and 4) high forward power demand. **YELLOW DISPLAY:** Indicates an RF power module current limit, VSWR limit, high forward power demand limit, or transmitter off condition. **GREEN DISPLAY**: Indicates normal RF power module output operation. Will illuminate if no RF drive is present.
22	**MODULE DRIVE** Indicator	Illuminates to indicate the presence of RF drive at the RF power amplifier module.
23	Exciter	For transmitters equipped with an FM-250C, refer to the FM-250C exciter instruction manual for a description of the FM-250C controls and indicators. For transmitters equipped with a PREDATOR, refer to the PREDATOR instruction manual for a description of the PREDATOR controls and indicators.

3-5. OPERATION.

NOTE ***ENSURE THE TRANSMITTER IS COMPLETELY INSTALLED PRIOR TO PERFORMING THE FOLLOWING***
NOTE ***PROCEDURES.***

NOTE ***THE FM-5C/FM-4C TRANSMITTERS WILL NOT OPERATE WITH MORE THAN 3 RF POWER AMPLIFIER MOD-***
NOTE ***ULES REMOVED FROM THE CHASSIS. ENSURE NO MORE THAN 3 RF POWER AMPLIFIER MODULES ARE REMOVED FROM THE TRANSMITTER.***

3-6. **TURN–ON.**

3-7. Operate the **POWER** switch to **ON**. The flushing fans will begin operation.

3-8. Observe the transmitter front-panel indicators. The **FAULT RESET**, **INTLK STATUS**, **POWER SUPPLY FAULT**, **MODULE DRIVE**, and **MODULE STATUS** indicators will display normal operating conditions. If the **FAULT RESET** indicator displays a fault condition, depress the **FAULT RESET** switch/indicator. If the fault condition is not cleared, operate the **POWER** switch to **OFF** and locate the problem. If the **INTLK STATUS** indicator is not illuminated, operate the **POWER** switch to **OFF** and troubleshoot: 1) an open remote control fail-safe input, 2) an open external interlock, 3) an unlocked exciter AFC, or 4) the loss of a phase, incorrect ac line phasing, or high/low ac line voltage. If a **MODULE STATUS** indicator displays a fault condition, operate the **POWER** switch to **OFF** and troubleshoot the transmitter.

3-9. Depress the **ON** switch/indicator to activate the transmitter. The **ON** switch/indicator will illuminate. The RF power amplifier module **MODULE STATUS** indicators will illuminate green to indicate normal RF power output operation. The RF power amplifier module **DRIVE** indicators will illuminate to indicate the presence of RF drive at each module.

3-10. Operate the **MULTIMETER** to observe the transmitter forward and reflected power indications by performing the **MULTIMETER OPERATION** procedure in the following text.

3-11. Adjust the transmitter output power by performing the **POWER ADJUST** procedure presented in the following text.

3-12. If remote control operation is desired, operate the **REMOTE CONTROL ENABLE/DISABLE** switch to **ENABLE**. This will enable both local and remote operation. If remote control operation is to be disabled, operate the **REMOTE CONTROL ENABLE/DISABLE** switch to **DISABLE.**

3-13. **TURN–OFF.**

3-14. Operate the transmitter to **OFF** by depressing the **OFF** switch/indicator. The **OFF** switch/indicator will illuminate. The transmitter RF output will be disabled. Each RF power amplifier **MODULE STATUS** indicator will illuminate yellow and the **DRIVE** indicators will extinguish.

3-15. Operate the **POWER** switch to **OFF** to remove ac power from the transmitter.

3-16. **MULTIMETER OPERATION.**

3-17. The **MULTIMETER** is designed to display several transmitter operating parameters. To operate the multimeter, perform the following procedures.

3–18. **SYSTEM PARAMETER DISPLAY.** Operate the **SYSTEM FWD PWR, RFL PWR, P.S. VDC,** or **INLET TEMP** switch/indicators as desired to select the parameter to be displayed on the **MULTIMETER.** The parameter will be displayed on the multimeter.

3–19. **MODULE PARAMETER DISPLAY.** The display of individual RF power amplifier module parameters on the **MULTIMETER** display is accomplished by: 1) selecting the desired RF power amplifier module and 2) selecting the desired parameter. To operate the multimeter to display individual RF power amplifier module parameters, proceed as follows:

LOCAL OPERATION –

1. Operate the **REMOTE CONTROL ENABLE/DISABLE** switch to **DISABLE**.
2. Depress the **MODULE SELECT** switch until the desired RF power amplifier module number is displayed on the **MODULE SELECT** display. For FM–5C/FMi–402 models, the switch will select RF power amplifier modules 1 through 10. For FM–4C/FMi–301 models, the switch will select RF power amplifier modules 1 through 8.
3. Depress the **MODULE FWD PWR, P.A. CUR, P.A. VDC or TEMP C** switch/indicators as desired to select the parameter to be displayed on the **MULTIMETER**. The parameter will be displayed on the multimeter.
4. To display total module P.A. current, proceed as follows:
   A. Depress the **P.A. CUR.** switch/indicator to illuminate the indicator.
   B. Depress the **MODULE SELECT** switch until 0 is displayed on the **MODULE SELECT** display.
   C. Observe the multimeter display and ignore the decimal point. The display will present total module P.A. current.

REMOTE OPERATION -

1. Operate the **REMOTE CONTROL ENABLE/DISABLE** switch to **ENABLE**.
2. Depress the remote PA module select switch until the meters indicate 0 with the exception of the P.A. module current meter.
3. Depress the remote PA module select switch once to select PA RF power module 1. Depress the remote PA module select switch again to select PA RF power module 2. Repeat the procedure to select PA RF power modules 3 through 10 on FM–5C/FMi–402 models or PA RF power modules 3 and 8 on FM–4C/FMi–301 models. The selected module FWD PWR, P.A. CUR, P.A. VDC, and TEMP C parameters will be displayed on the remote meters.
4. To display total module P.A. current, proceed as follows:
   A. Depress the remote PA module select switch until the meters indicate 0 with the exception of the P.A. module current meter.
   B. Observe the multimeter display and ignore the decimal point. The display will present total module P.A. current.

3-20. **POWER ADJUST.**

NOTE ***THE POWER ▲ SWITCH WILL NOT FUNCTION DURING A FAULT CONDITION.***

NOTE

3-21. The **POWER** ▲ and ▼ switches adjust the transmitter output power. The switches adjust the transmitter power using a two-speed control feature. When a switch is depressed, the switch controls power using a normal control rate. When a switch is depressed and held, the switch controls power using a fast control rate. To adjust the transmitter output power, proceed as follows:

1. Depress the **POWER** ▲ switch to increase the transmitter output power. Depress and hold the **POWER** switch for fast raise power operation. Observe the transmitter output power indications on the **MULTIMETER**.

OR

2. Depress the **POWER** ▼ switch to decrease the transmitter output power. Depress and hold the **POWER** switch for fast lower power operation. Observe the transmitter output power indications on the **MULTIMETER**.

3-22. **EXCITER OPERATION.**

3-23. For transmitters equipped with an FM-250C, refer to the FM-250C instruction manual for a complete description of the FM-250C operating procedures. For transmitters equipped with an FXi-250, refer to the FXi-250 instruction manual.

3-24. **FAULT RESET.**

3-25. To reset a transmitter fault condition, depress the **FAULT RESET** switch/indicator. If the fault condition is remedied, the **FAULT RESET** indicator will extinguish.

3-26. If the fault condition is not remedied, operate the **POWER** switch to **OFF** and locate the problem.

3-27. Once the fault condition is remedied, depress the **FAULT RESET** switch/indicator. The indicator will extinguish.

3-28. **RF POWER MODULE STATUS AND DRIVE INDICATORS.**

3-29. The RF power **MODULE STATUS** indicator monitors the operating status of the power module. A red display indicates a power module fault. A yellow display indicates a power module limit or transmitter off condition. A green display indicates normal power module RF power output operation. If the indicator displays a fault or limit condition, refer to SECTION V, MAINTENANCE and troubleshoot the transmitter.

3-30. The RF power module **DRIVE** indicator monitors the status of RF drive from the exciter. The indicator will illuminate to indicate the presence of RF drive at the module. If an indicator is extinguished, refer to SECTION V, MAINTENANCE and troubleshoot the transmitter.

3-31. **POWER SUPPLY FAULT INDICATORS.**

3-32. The **POWER SUPPLY FAULT 1, 2, 3, 4,** and **5** indicators monitor the power supply modules in an FM-5C transmitter. The **POWER SUPPLY FAULT 1, 2, 3,** and **4** indicators monitor the power supply modules in an FM-4C transmitter. If an indicator illuminates, refer to POWER AMPLIFIER POWER SUPPLY MODULES in SECTION V, MAINTENANCE and troubleshoot the transmitter.

3–33. **THREE–PHASE AC LOSS MONITOR – FOR THREE–PHASE DELTA POWER SUPPLY MODELS ONLY.**

3–34. FM–5C/FM–4C and FMi–402/FMi–301 transmitters configured to operate from a three–phase Delta power supply are equipped with a three–phase ac line monitor. The monitor protects the power supplies from damage associated with: 1) the loss of or incorrect ac line phasing or 2) high/low ac line voltage. The monitor is connected to the transmitter interlock circuit. In the event of an improper ac line condition, the monitor will open the transmitter interlock circuit. As a result, the front panel INTERLOCK STATUS switch/indicator will extinguish. If the INTERLOCK STATUS indicator extinguishes during operation, proceed as follows:

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

WARNING

1. Disconnect the ac power.
2. Remove the rear door and filter and observe the three–phase ac line monitor indicators.
3. If the indicators are illuminated, check the external interlock, the exciter AFC circuit, and the remote control failsafe. If the indicators are are flashing or extinguished, refer to APPENDIX A for a description of the ac line monitor indicators and determine the fault condition. Typically during initial operation, the ac line phasing must be changed. To change the ac line phasing, perform the following procedure. If the monitor detects a low or high voltage condition, check the ac line input.
   A. Reverse any two ac line phases at the ac input panel.
   B. Attempt transmitter operation.

SECTION IV
THEORY OF OPERATION

4-1. INTRODUCTION.

4-2. This section presents the theory of operation for the Broadcast Electronics FM-5C/FM-4C and FMi-402/FMi-301 transmitters.

4-3. OVERALL OPERATION.

4-4. Information on overall FM-5C/FM-4C and FMi-402/FMi-301 transmitter operation is presented in Figure 4-1.

4-5. POWER SUPPLY/RF CIRCUITRY OPERATION.

4-6. A description of the FM-5C/FM-4C and FMi-403/FMi-301 transmitter power supply and RF circuitry is presented in Figure 4-2.

4-7. CONTROLLER CIRCUITRY OPERATION.

4-8. FM-5C/FM-4C and FMi-402/FMi-301 transmitter control and monitoring functions are performed by a CMOS digital controller. The transmitter controller consists of the following circuit board assemblies: 1) the on/off switch circuit board, 2) the controller circuit board, 3) the meter switch circuit board, 4) the meter display circuit board, 5) the multiplexer circuit board, and 6) the module select circuit board. The controller is designed to provide: 1) on/off control, 2) raise/lower power control, 3) automatic power control operation, and 4) metering operation.

4-9. Six switch/indicators provide transmitter control functions. An LCD multimeter presents 8 transmitter indications. The controller circuitry is designed to interface to almost any remote control device. Positive/negative control optical couplers allow the transmitter to be controlled using positive or negative control logic. DC power for controller circuitry operation is provided by a modular switching power supply unit. The power supply unit provides +5 and ±15 volt dc supplies for controller circuitry operation.

4-10. A description of the FM-5C/FM-4C and FMi-402/FMi-301 transmitter controller circuitry is presented in Figures 4-3 through 4-5. Figure 4-3 presents the controller, meter switch, and meter display circuit board information. Figure 4-4 presents the on/off switch circuit board information. Figure 4-5 presents the multiplexer and module select circuit board information.

4-11. CONTROLLER ON/OFF SWITCH CIRCUIT BOARD.

4-12. The controller on/off switch circuit board is equipped with the on/off, raise/lower, and reset switch/indicator circuitry (refer to Figure 4-4). The circuit board is designed to output control signals to the controller circuit board, the RF amplifier logic circuit board, to the exciter, and the remote control interface terminal strip.

4-13. **TRANSMITTER ON CONTROL CIRCUIT.** The transmitter can be operated to ON using remote or local control. Local ON control is provided by switch S3. When local on control is used, a LOW from on switch S3 is applied to relay K1. Remote on control is performed by optical coupler U4 and inverters U10B and U12A. U4 can be activated using positive or negative control logic. Jumper J1 programs the optical coupler circuitry for positive or negative control operation. When U4 is activated, a LOW is routed to inverters U10B and U12A. U12A will output a LOW to the on control coil of relay K1.

4-14. Relay K1 is used to: 1) disable the transmitter when the exciter Automatic-Frequency-Control (AFC) signal is disabled and 2) generate a transmitter on and a transmitter off command. With a LOW from the on circuitry, K1 will output a HIGH to transistor Q1 and inverter U11B. A HIGH at K1 will allow the transmitter on/off circuitry to initiate a transmitter on sequence. U11B will output a LOW to inverters U11C, U12F, and U11E. U11C will output a HIGH to transistor Q1, inverter U11D, inverter U12G, and transistor Q2. U12F will output a HIGH to extinguish OFF indicator S4. Q1 will output a LOW to unmute the power amplifier modules. U12G will output a LOW to enable on indicator S3. Q2 will output a LOW remote on status signal to the remote interface terminal strip. U11D will output a LOW to the automatic power control circuitry on the controller circuit board and unmute the power amplifier power supplies.

4-15. **TRANSMITTER OFF CONTROL CIRCUIT.** The transmitter off control circuitry operates in a similar manner as the on control circuitry. The transmitter off control circuitry consists of off switch S4, optical coupler U5, and inverters U10C and U12B. Local OFF control is provided by switch S4. When local off control is used, a LOW from off switch S4 is applied to relay K1. Remote off control is performed by optical coupler U5 and inverters U10C and U12B. U5 can be activated using positive or negative control logic. Jumper J1 programs the optical coupler circuitry for positive or negative control operation. When U5 is activated, a LOW is routed to inverters U10C and U12B. U12B will output a LOW to the off control coil of relay K1.

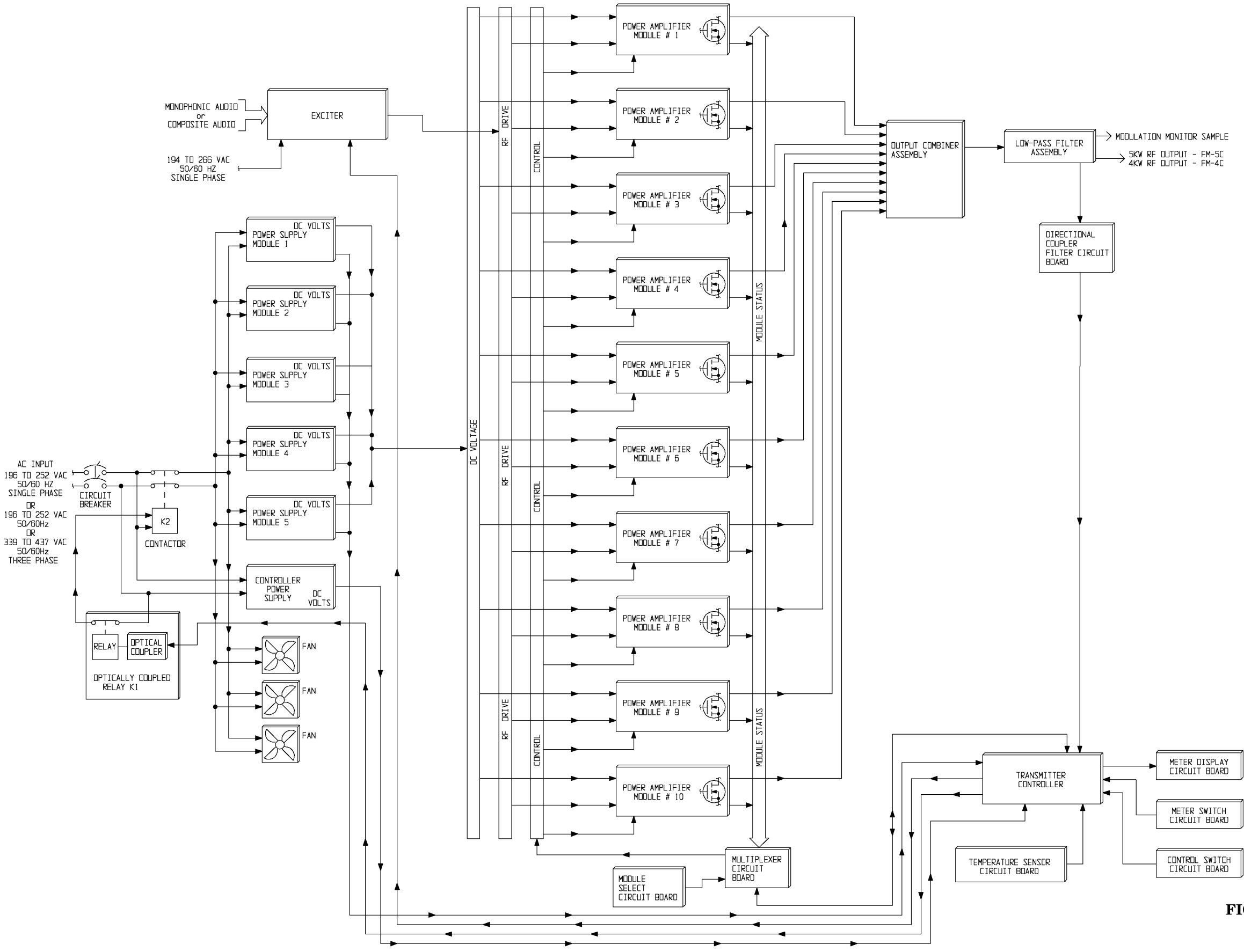
4-16. With a LOW from the off circuitry, K1 will output a LOW to transistor Q1 and inverter U11B. A LOW at K1 will allow the transmitter on/off circuitry to initiate a transmitter off sequence. U11B will output a HIGH to inverters U11C, U12F, and U11E. U11C will output a LOW to transistor Q1, inverter U11D, inverter U12G, and transistor Q2. U12F will output a LOW to enable OFF indicator S4. Q1 will output a HIGH to mute the power amplifier modules. U12G will output a HIGH to disable on indicator S3. Q3 will output a LOW remote off status signal to the remote interface terminal strip. U11D will output a HIGH to the automatic power control circuitry on the controller circuit board and mute the power amplifier power supplies.

4-17. **REMOTE CONTROL ENABLE/DISABLE CIRCUIT.** Switch S302 on the controller meter switch circuit board is designed to enable/disable the remote control circuitry. When remote control is enabled, S302 will output a HIGH to inverter U12C on the on/off control circuit board. U12C will output a LOW to U10D. U10D will output a HIGH to relay K1. A HIGH will allow the transmitter on/off circuitry to generate a transmitter on sequence. When remote control is disabled, S302 will output a LOW to U12C. U12C will output a HIGH to U10D. U10D will output a LOW to K1. The LOW prevents the on/off circuit from generating a transmitter on sequence.

4-18. **REMOTE CONTROL FAILSAFE INPUT CIRCUIT.** The controller on/off switch circuit board is equipped with a remote control failsafe input. The input is provided to configure the transmitter to off if the remote control unit is disabled. The failsafe input is applied to optical coupler U6. U6 can be activated using positive or negative control logic. Jumper J1 programs the optical coupler circuitry for positive or negative control operation.

4-19. When the remote control unit is enabled, an enabled command from the remote control unit is applied to U6. U6 will output a LOW to U10D. U10D will output a HIGH to K1. A HIGH will allow the transmitter on/off circuitry to initiate a transmitter on sequence.

4-20. When the remote control unit is disabled, a HIGH is applied to U10D. U10D will output a LOW to K1. A LOW will configure the transmitter on/off circuitry to initiate a transmitter off sequence.



NOTES:

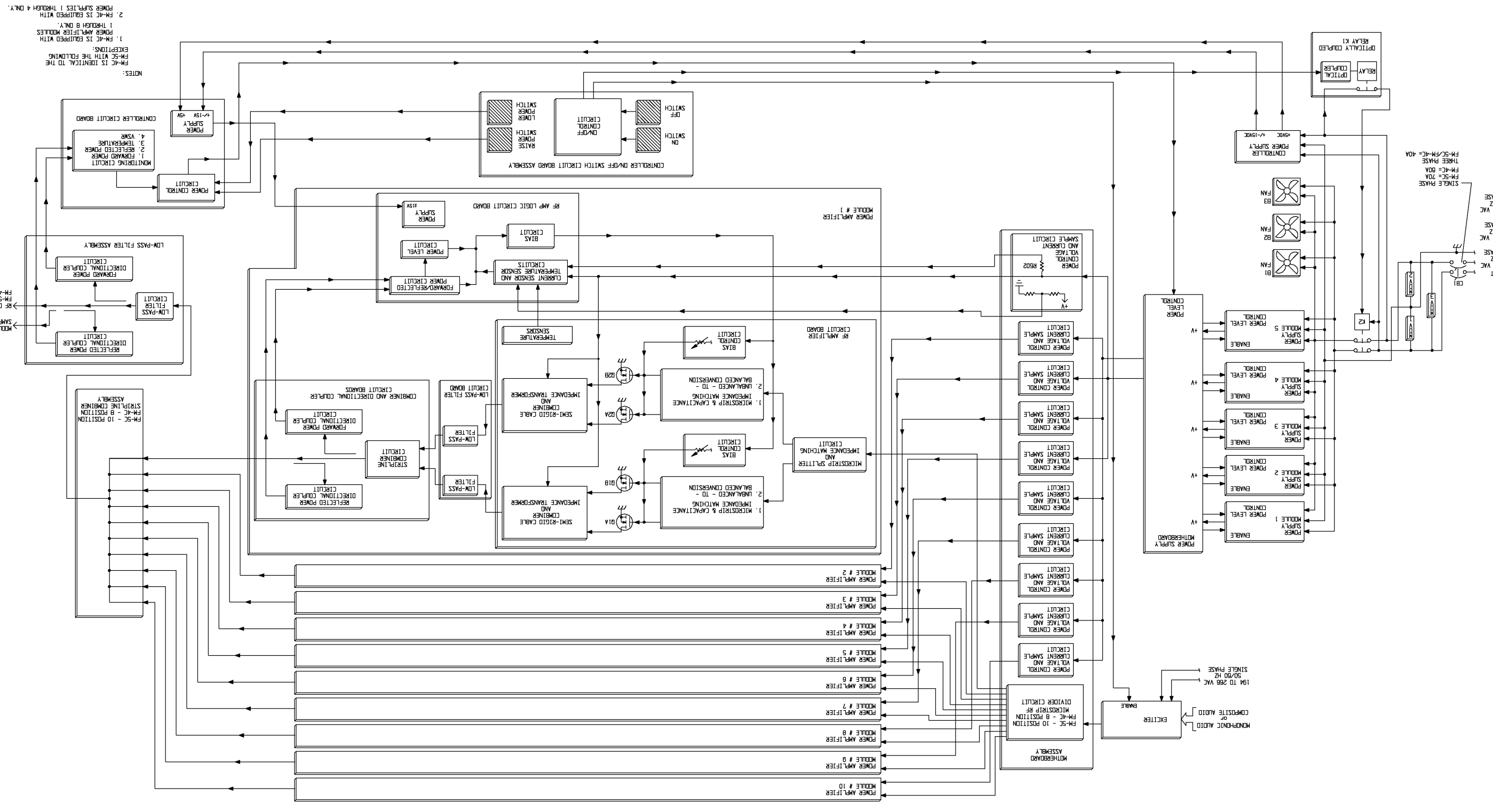
1. FM-5C SHOWN
2. FM-4C EQUIPPIED WITH POWER AMPLIFIER MODULES 1 THRU 8.
3. FM-4C EQUIPPED WITH POWER SUPPLY MODULES 1 THRU 4 ONLY.
4. SINGLE PHASE POWER SUPPLY SHOWN.

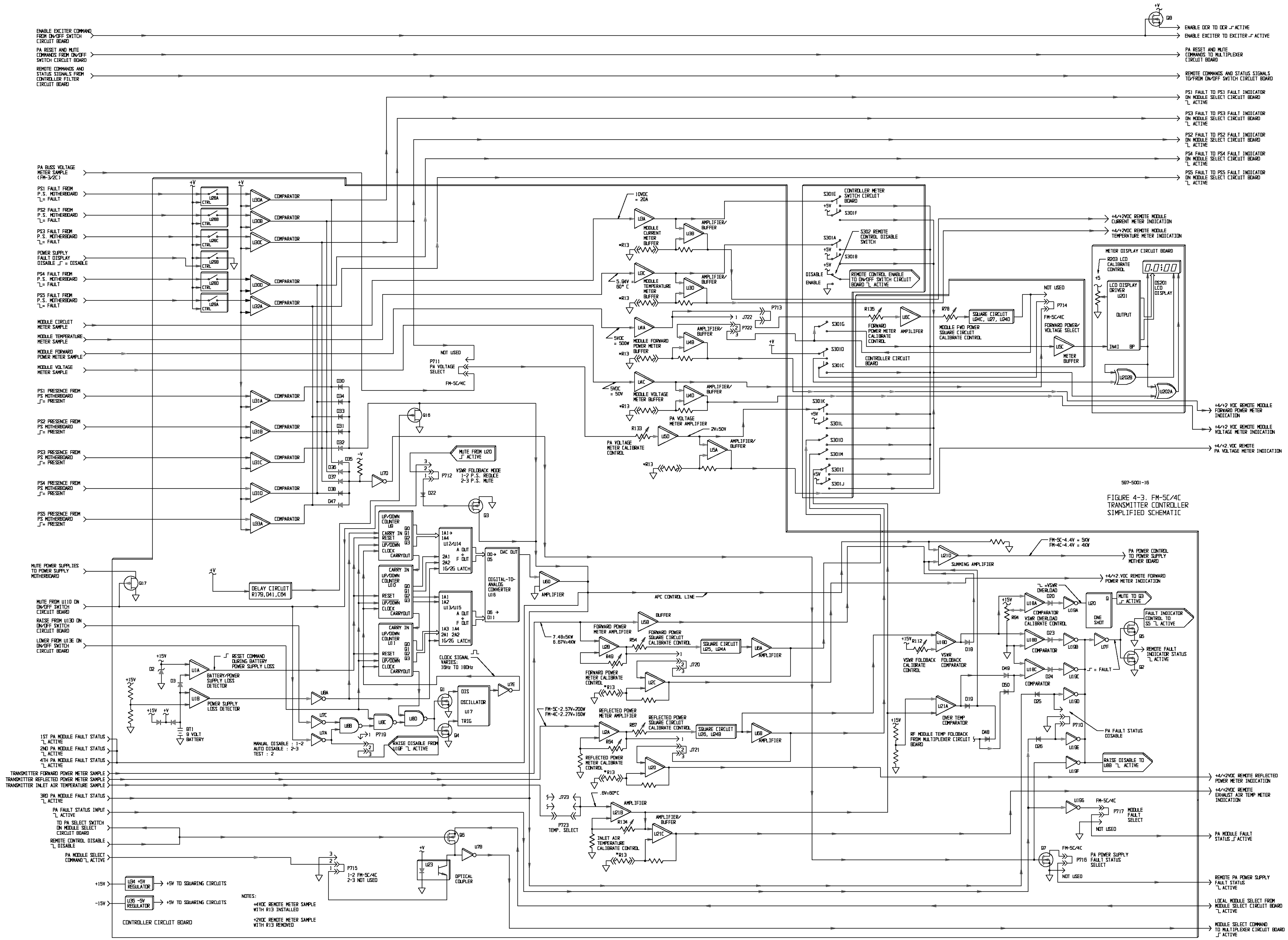
597-5001-12

FIGURE 4-1. FM-5C/FM-4C & FMi 402/FMi 301 TRANSMITTER BLOCK DIAGRAM
(4-3/4-4)

FIGURE 4-2. POWER SUPPLY/RF CIRCUIT SIMPLIFIED SCHEMATIC

(4-5/4-6)

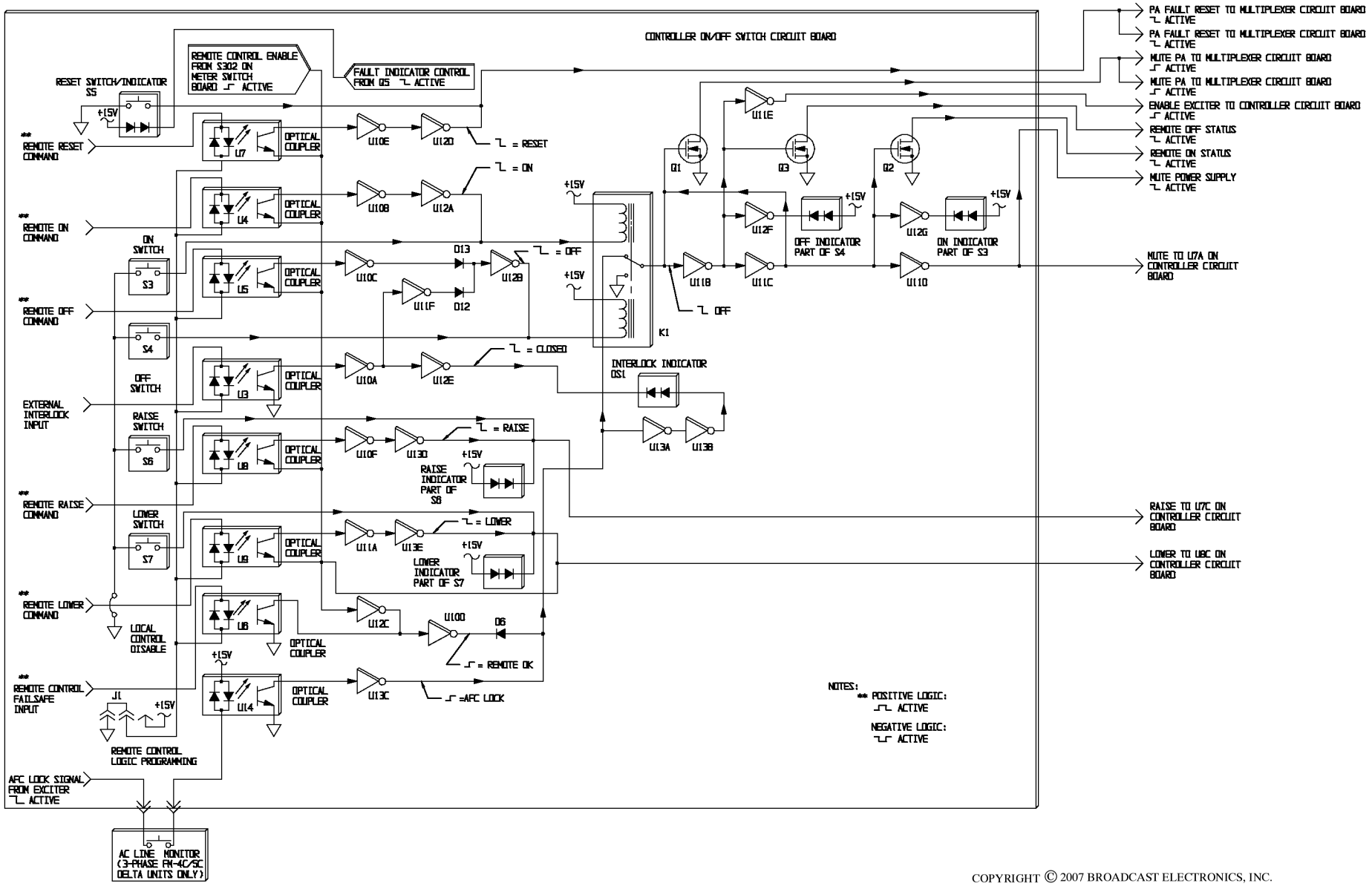




597-5001-16

FIGURE 4-3. FM-5C/FM-4C & FMi 402/FMi 301 TRANSMITTER CONTROLLER SIMPLIFIED SCHEMATIC

(4-7/4-8)



597-3002-16

FIGURE 4-4. CONTROLLER ON/OFF SWITCH CIRCUIT BOARD SIMPLIFIED SCHEMATIC

4-21. **AFC LOCK INPUT CIRCUIT.** The Automatic-Frequency-Control status signal from the exciter is applied to optical coupler U14. When the exciter frequency is locked, a LOW is applied to U14. U14 will output a LOW to inverter U13C. U13C will output a HIGH to K1. A HIGH will allow the transmitter on/off circuitry to initiate a transmitter on sequence. If the exciter frequency becomes unlocked, a HIGH is applied to U13C. U13C will output a LOW to K1 to configure the transmitter on/off circuitry to initiate a transmitter off sequence.

4-22. **RESET CIRCUIT.** A reset circuit is provided to reset the transmitter fault detection circuitry on the power amplifier modules. The reset circuit can be activated using local or remote control. Local reset operation is provided by reset switch/indicator S5. S5 will output a LOW to reset the fault detection circuitry on the RF amplifier modules. Remote reset commands are generated by optical coupler U7. U7 can be activated using positive or negative control logic. Jumper J1 programs the optical coupler circuitry for positive or negative control operation. When a remote reset command is initiated, the command is applied to U7. U7 will output a LOW to inverters U10E and U12D. U12D will output a LOW to reset the fault detection circuitry on the RF amplifier modules.

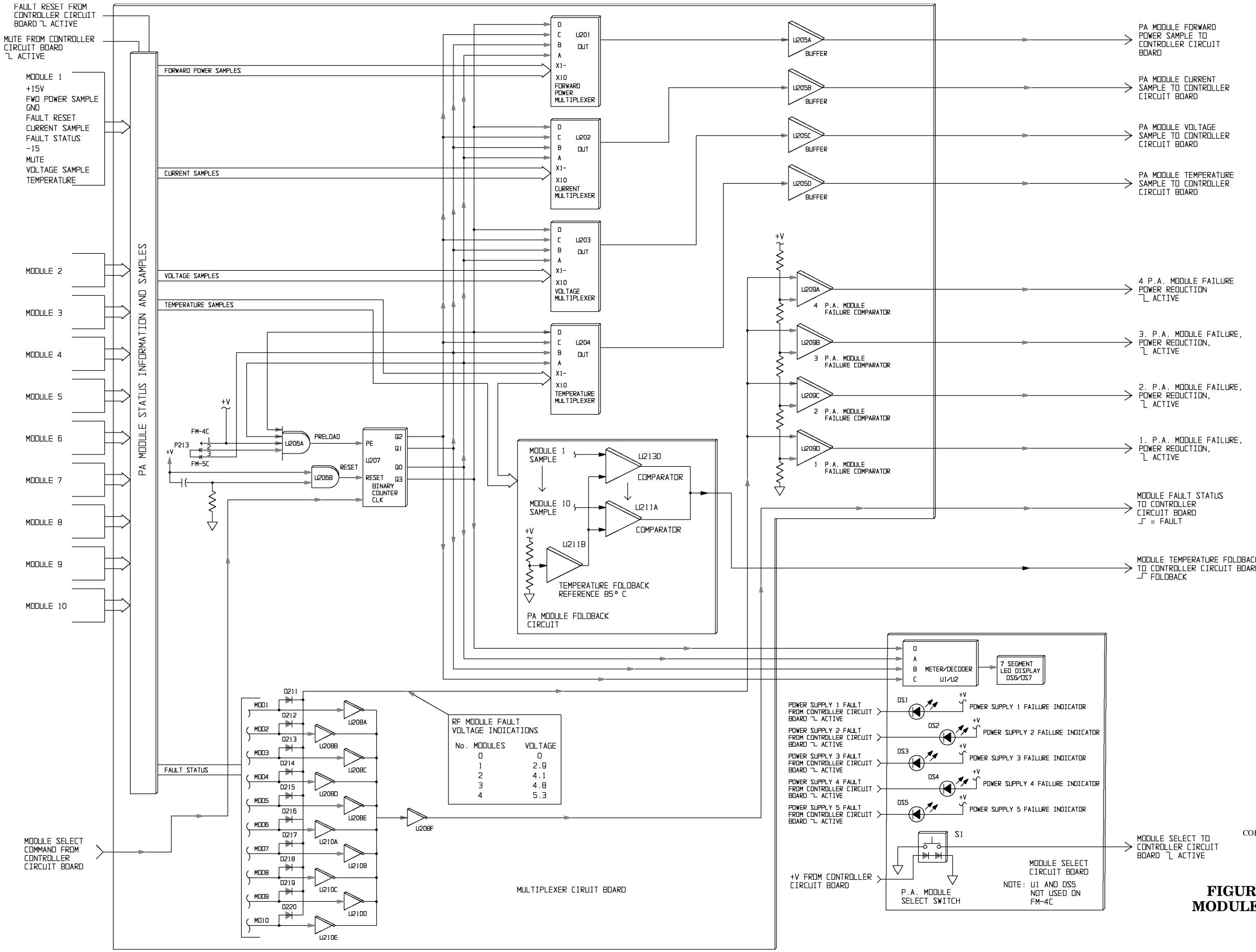
4-23. **EXTERNAL INTERLOCK CIRCUIT.** An external interlock circuit is provided for the connection of external equipment such as a test load. External interlock commands are generated by optical coupler U3. U3 can be activated using positive or negative control logic. Jumper J1 programs the optical coupler circuitry for positive or negative control operation. When the external interlock is closed, the signal is applied to U3. U3 will output a LOW to inverters U10A and U12E. U12E will output a LOW to illuminate interlock indicator DS1. When the external interlock opens, the signal is applied to U3. A HIGH is applied through inverters U10A and U11F. U11F will output a HIGH to configure the transmitter to off. U12E will output a HIGH to extinguish interlock indicator DS1.

4-24. **TRANSMITTER RAISE POWER CIRCUIT.** The transmitter raise power circuitry consists of raise switch S6, optical coupler U8, and inverters U10F and U13D. Local raise control is provided by switch S6. When local raise power control is used, a LOW from switch S6 is routed to the automatic-power-control circuitry on the controller circuit board. Remote raise control is performed by optical coupler U8 and inverters U10F and U13D. U8 can be activated using positive or negative control logic. Jumper J1 programs the optical coupler circuitry for positive or negative control operation. When U8 is activated, a LOW is routed to inverters U10F and U13D. U13D will output a LOW to the automatic-power-control circuitry on the controller circuit board.

4-25. **TRANSMITTER LOWER POWER CIRCUIT.** The transmitter lower power circuitry operates in a similar manner as the transmitter raise power circuit. The transmitter lower power circuit consists of lower switch S7, optical coupler U9, and inverters U11A and U13E. Refer to TRANSMITTER RAISE POWER CIRCUIT in the preceding text for a description of the transmitter lower power circuit operation.

4-26. **CONTROLLER CIRCUIT BOARD.**

4-27. The controller circuit board is equipped with the automatic-power-control circuitry, 8 meter amplifier/buffer circuits, and fault processing circuitry (refer to Figure 4-3). The automatic-power-control circuitry is designed to control the transmitter output power in response to local/remote control commands, high reflected power conditions, and high temperature conditions. The meter amplifier/buffer circuits process transmitter signals for application to the meter display circuit board. The fault processing circuitry monitors several transmitter parameters and generates a fault signal when a power amplifier fault, a high temperature condition, or a high reflected power condition occurs.



597-5001-17

FIGURE 4-5. MULTIPLEXER AND MODULE SELECT CIRCUIT BOARD SIMPLIFIED SCHEMATIC
(4-11/4-12)

4-28. **AUTOMATIC–POWER–CONTROL CIRCUIT.** The automatic-power-control circuit consists of up/down counters U9/U10/U11, latches U12 through U15, digital-to-analog converter U16, NAND gates U8B/U8C/U8D, inverters U8A/U7C/U7A/U7E, transistors Q1/Q4, and timer U17. The automatic-power-control circuit controls the transmitter power output in response to local/remote raise/lower commands, high reflected power conditions, and high temperature conditions.

4-29. **Raise Output Power Operation.** When the transmitter is operated to on, a LOW from U10D on the controller on/off switch circuit board is applied to inverter U7A. When a local/remote raise command is initiated, a LOW is applied to inverter U7C. U7C will output a HIGH to NAND gate U8B. U8B will output a HIGH to U8C. With no lower command present: 1) U8C will output HIGH to U8D and 2) a HIGH is applied to up/down counters U9/U10/U11 to configure the counters to count up. U8D will output a HIGH to an oscillator circuit consisting of timer U17, inverter U7E, and transistors Q1 and Q4. The oscillator is designed to provide slow/fast power level adjustment control as determined by the operation of the raise switch/indicator. When the raise switch/indicator is depressed such as during fine output power adjustment, the oscillator output will be 16 Hz. When the raise switch/indicator is depressed and held such as during coarse output power adjustment, the oscillator output will be 150 Hz.

4-30. The output of the oscillator is inverted at U7E and applied to each up/down counter clock input. The counters will respond to the raise command by counting up and routing a number to latches U12 through U15. The output of latches U12 through U15 are applied to digital-to-analog converter U16. U16 will convert the numbers to a dc output voltage. The voltage from U16 is amplified at U6D. U6D will output a dc voltage to summing amplifier U21D. In FM ONLY mode with no VSWR or over temperature conditions, U21D will output a dc power control voltage to the power amplifier power supply. The power supply will respond by routing the appropriate dc voltage to the power amplifier modules to increase the RF output power.

4-31. In IBOC or FM + IBOC mode jumpers P724 and P725 are moved to position 1 – 2. The output of U21D is routed to window comparator U22A/B, which generates a control signal for the FXi Exciter which is buffered through U36A. U22A/B has open collector outputs with pull up resistors R156, R177, R220 and R221. This output voltage will command the FXi Exciter power to raise, lower or remain constant. When the forward power sample is within the window set by R145 the output of U22A/B is 2.5V which commands the FXi Exciter power to remain constant. The action of the FXi Exciter can be summarized by the following table:

Control Voltage Range	FXi Exciter Response
< 1V	Remain Constant
1.0V – 2.0V	Lower Power
2V– 3V	Remain Constant
> 3V	Raise Power

4-32. **Lower Output Power Operation.** When the transmitter is operated to on, a LOW from U10D on the controller on/off switch circuit board is applied to inverter U7A. When a local/remote lower command is initiated, a LOW is applied to NAND gate U8C and up/down counters U9/U10/U11. The LOW configures the up/down counters to count down. U8C will respond by routing a HIGH to U8D. U8D will output a HIGH to an oscillator circuit consisting of timer U17, inverter U7E, and transistors Q1 and Q4. The oscillator is designed to provide slow/fast power level adjustment control as determined by the operation of the lower switch/indicator. When a lower switch/indicator is depressed during fine output power adjustment, the oscillator output will be 16 Hz. When a lower switch/indicator is depressed and held during coarse output power adjustment, the oscillator output will be 150 Hz.

4–33. The output of the oscillator is inverted at U7E and applied to the up/down counters. The counters will respond to the lower command by counting down and routing a number to latches U12 through U15. The output of latches U12 through U15 are applied to digital–to–analog converter U16. U16 will convert the numbers to a dc output voltage. The voltage from U16 is amplified at amplifier U6D. U6D will output a dc voltage to summing amplifier U21D. In FM ONLY mode with no VSWR or over temperature conditions, U21D will output a dc power control voltage to the power amplifier power supply. The power supply will respond by routing the appropriate dc voltage to the power amplifier modules to decrease the RF output power.

4–34. **METER AMPLIFIER/BUFFER CIRCUITS.** The controller circuit board is equipped with 8 meter amplifier/buffer circuits. The module current, module temperature, module forward power, module voltage, and the PA voltage meter circuits operate in an identical manner. Therefore, only the PA voltage amplifier/buffer circuit will be discussed.

4–35. **PA Voltage Meter Amplifier/buffer Circuit.** A PA voltage sample from the PA motherboard assembly is applied through potentiometer R133 to amplifier U5D. Potentiometer R133 is provided to calibrate the PA voltage meter sample. U5D is a non–inverting amplifier with a gain of approximately 1. The output of U5D is applied to: 1) meter switch S301 on the controller meter switch circuit board and 2) amplifier/buffer U5A. U5A is a non–inverting amplifier with a gain determined by resistor R13. R13 is a resistor network designed to be installed/removed as determined by the desired remote meter voltage indication. For a +4 volt equals 50 V dc remote full–scale PA voltage meter indication, R13 is installed. As a result, U5A will be programmed for a gain of approximately 2. For a +2 volt remote full–scale meter indication, R13 is removed. As a result U5A will be programmed for a gain of approximately 1. The output of U5A is routed to the controller RFI filter circuit board.

4–36. **INLET AIR TEMPERATURE CIRCUIT.** A dc sample voltage from the inlet air temperature sensor circuit board is applied to non–inverting amplifier U21B. The gain of U21B is controlled by potentiometer R134. R134 is provided to calibrate the inlet air temperature circuitry. The output of U21B is applied to: 1) the controller meter switch circuit board, 2) over–temperature comparator U21A, and 3) amplifier/buffer U21C. U21C is a non–inverting amplifier with a gain determined by resistor R13. R13 is a resistor network designed to be installed/removed as determined by the desired remote meter voltage indication. For a +4 volt equals 60 degrees Celsius remote full–scale temperature meter indication, R13 is installed. As a result, U21C will be programmed for a gain of approximately 2. For a +2 volt remote full–scale meter indication, R13 is removed. As a result U21C will be programmed for a gain of approximately 1. The output of U21C is routed to the controller RFI filter circuit board.

4-37. **REFLECTED POWER METER CIRCUIT.** A dc reflected power sample voltage from the low-pass filter assembly is applied to non-inverting meter amplifier U2A. The gain of U2A is controlled by potentiometer R64. R64 is provided to calibrate the reflected power circuitry. The output of U2A is applied to a squaring circuit consisting of integrated circuits U26 and U24B. U26 and U24B function to convert the voltage sample to a power sample. The output of the squaring circuit is routed to: 1) amplifier U6B, 2) VSWR foldback comparator U18D, and 3) amplifier/buffer U2D. U2D is a non-inverting amplifier with a gain determined by resistor R13. R13 is a resistor network designed to be installed/removed as determined by the desired remote meter voltage indication. For a +4 volt equals 200W/160W remote full-scale reflected power meter indication, R13 is installed. As a result, U2D will be programmed for a gain of approximately 2. For a +2 volt remote full-scale meter indication, R13 is removed. As a result, U2D will be programmed for a gain of approximately 1. The output of U2D is routed to the controller RFI filter circuit board. U6B is a non-inverting amplifier. The output of U6B is routed to the controller meter switch circuit board. Jumper P721 selects the feed back path for the circuit. Position 2-3 of P721 selects a power sample for application to the remote meter terminal.

4-38. **FORWARD POWER METER CIRCUIT.** A dc forward power sample voltage from the low-pass filter assembly is applied to non-inverting meter amplifier U2B. The gain of amplifier U2B is controlled by potentiometer R49. R49 is provided to calibrate the forward power circuitry. The output of U2B is applied to a squaring circuit consisting of integrated circuits U25 and U24A. U25 and U24A function to convert the voltage sample to a power sample. The output of the squaring circuit is routed to: 1) amplifier U6A, and 2) amplifier/buffer U2C. U2C is a non-inverting amplifier with a gain determined by resistor R13. R13 is a resistor network designed to be installed/removed as determined by the desired remote meter voltage indication. For a +4 volt equals 5 kW/4 kW remote full-scale forward power meter indication, R13 is installed. As a result, U2C will be programmed for a gain of approximately 2. For a +2 volt remote full-scale meter indication, R13 is removed. As a result, U2C will be programmed for a gain of approximately 1. The output of U2C is routed to the controller RFI filter circuit board. U6A is a non-inverting amplifier. The output of U6A is routed to the controller meter switch circuit board. The dc forward power sample voltage is also routed to buffer U5B. The output of U5B is applied to summing amplifier U21D. The signal is used to determine the transmitter output power level. Jumper P720 selects the feed back path for the circuit. Position 2-3 of P720 selects a power sample for application to the remote meter terminal.

4-39. **TRANSMITTER FAULT DETECTION CIRCUITRY.** The transmitter fault detection circuit consists of VSWR foldback comparator U18D, over-temperature comparator U21A, VSWR overload comparator U18A, comparators U18B/U18C, inverters U19A/U19B/U19C/U19D/U19E/U7F, one shot U20, and transistors Q5/Q2. The circuitry is designed to monitor the transmitter power amplifier modules, transmitter temperature, and reflected power for fault conditions. When a fault is determined, the circuitry will respond by enabling the fault indicator and muting or reducing the transmitter output power.

4-40. **Over-Temperature Comparator.** A dc temperature sample from U21B is applied to over-temperature comparator U21A. U21A compares the dc voltage to a reference voltage. When the dc temperature sample is above the reference voltage, U21A will: 1) output a +0.7 to +15.0 dc voltage to comparator U18C and 2) output a voltage to summing amplifier U21D. U21D will respond by reducing the transmitter output power to: 1) maintain on-air operation and 2) reduce the transmitter temperature. With a positive voltage at U18C from U21A, the output of U18C will go HIGH. The HIGH is routed through inverters U19C and U7F to transistors Q5/Q2. Q5/Q2 will output a LOW to enable the local and remote fault indicators.

4–41. Module temperature conditions are monitored by circuitry on the multiplexer circuit board (refer to Figure 4–5). The circuitry consists of temperature comparator circuits for each module in the transmitter. If a module temperature exceeds the reference, the multiplexer circuit board will output a HIGH to diode D48 on the controller circuit board. The HIGH is applied to summing amplifier U21D to foldback the transmitter output power. The HIGH is also applied through diode D50 to comparator U18C. The output of U18C will go HIGH to enable both the local and remote fault indicators.

4–42. **VSWR Comparator.** A dc reflected power sample from U2A is applied to VSWR comparator U18D. U18D compares the dc voltage to a reference voltage from VSWR foldback calibrate control R112. When the dc reflected power sample is above the reference voltage, U18D will: 1) output a +0.7 to +15.0 dc voltage to comparator U18B, 2) output a +0.7 to +15.0 dc voltage to comparator U18A, and 3) output a voltage to summing amplifier U21D. U21D will respond by reducing the transmitter output power. With a positive voltage at U18B, the output of U18B will go HIGH. The HIGH is routed through inverters U19B and U7F to enable the local and remote fault indicators. The positive voltage routed to U18A is compared to a reference voltage from VSWR overload calibrate control R94. When the dc output from U18D is above the reference voltage, U18A will output a HIGH to inverter U19A. U19A will output a LOW to enable one–shot U20. U20 will output a HIGH to transistor Q3 to mute the transmitter output.

4–43. **PA Module Fault Circuit.** A HIGH PA module fault signal from the multiplexer circuit board is applied to inverter U19E. U19E will output a LOW to inverter U7F. U7F will output a HIGH to transistors Q5/Q2. Q5/Q2 will output a LOW to enable the local and remote fault indicators.

4–44. **Power Supply Fault.** In the event of a power supply fault such as in power supply 1, a LOW is applied through switch U29A to comparator U30A. U30A will output a LOW to inverter U7D. U7D will output a HIGH to inverter U19F. U19F will output a LOW to NAND gate U8B to disable any raise power commands. Jumper P719 allows the selection of a manual or automatic raise disable. Automatic raise disable allows the controller circuitry to disable raise power operation in response to reflected power and fault conditions. In the manual raise disable mode, the controller circuitry is disabled to allow the raise power function to be controlled manually. Ensure the jumper is placed in the automatic disable position.

4–45. **CONTROLLER METER SWITCH CIRCUIT BOARD.**

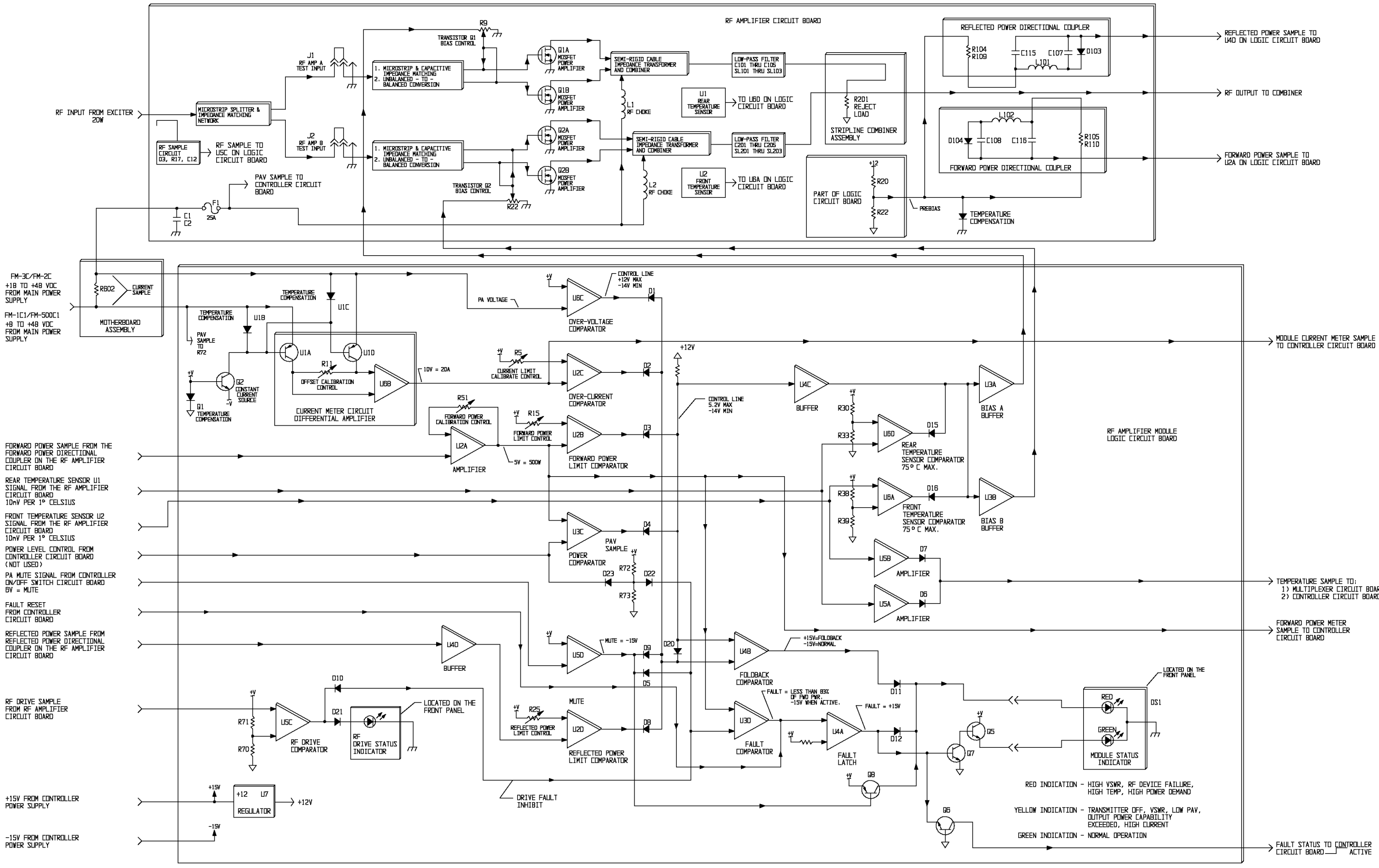
4–46. The controller meter switch circuit board is equipped with meter switch S301 and remote control enable/disable switch S302. S301 is an interlocked 8–position switch designed to route samples to the meter display circuit board when a switch is depressed. When the module forward power switch section is depressed, the forward power sample is applied through forward power meter calibrate control R135 to non–inverting amplifier U6C on the controller circuit board. The output of U6C is routed through R78 to a squaring circuit consisting of integrated circuits U24C/D and U27. U24C/D and U27 convert the voltage sample to a power sample. The output of the squaring circuit is returned to switch S301. S301 routes the forward power sample through meter buffer U5C to the meter display circuit board. S302 is configured to enable/disable the remote control inputs. A HIGH enables the remote control inputs. A LOW disables the remote control inputs.

4–47. **METER DISPLAY CIRCUIT BOARD.**

4–48. The controller meter display circuit board is equipped with an LCD meter display and meter driver circuitry. Meter samples from U5C on the controller circuit board are routed to integrated circuit U201. U201 is an LCD display driver. Calibration of U201 is provided by potentiometer R203. The output of U201 is applied to LCD display DS201. Exclusive OR gate U202A controls the LCD decimal display.

4-49. RF AMPLIFIER CIRCUITRY OPERATION.

4-50. A description of the FM-5C/FM-4C and FMi-402/FMi-301 transmitter RF amplifier circuitry is presented in Figure 4-6.



597-3002-14

FIGURE 4-6. RF AMPLIFIER MODULE SIMPLIFIED SCHEMATIC
(4-18/4-18)

SECTION V
MAINTENANCE

5-1. INTRODUCTION.

5-2. This section provides maintenance information, electrical adjustment procedures, and troubleshooting information for the Broadcast Electronics FM-5C/FM-4C and FMi-402/FMi-301 transmitters.

5-3. SAFETY CONSIDERATIONS.

WARNING ***NEVER OPEN THE EQUIPMENT UNLESS ALL TRANSMITTER PRIMARY POWER IS DISCONNECTED. ENSURE ALL TRANSMITTER PRIMARY POWER IS DISCONNECTED BEFORE ATTEMPTING MAINTENANCE ON ANY AREA WITHIN THE TRANSMITTER.***

WARNING

WARNING ***HIGH RF VOLTAGE IS PRESENT AT THE TYPE N CONNECTOR WHEN AN RF POWER MODULE IS REMOVED FOR SERVICE. NEVER OPERATE THE TRANSMITTER UNLESS AN RF POWER MODULE OR A MODULE COVER PANEL IS INSTALLED IN EACH TRANSMITTER MODULE LOCATION.***

WARNING

5-4. The FM-5C/FM-4C and FMi-402/FMi-301 transmitters contain high voltages and currents. If safety precautions are not practiced, contact with the high voltages and currents could cause serious injury or death. Never operate the transmitter unless: 1) all transmitter safety guards and cover panels are installed and 2) an RF power module or cover panel is installed in each RF power module location. The transmitter is equipped with built-in safety features, however good judgement, care, and common sense must be practiced to prevent accidents. The maintenance procedures contained in this section should be performed only by trained and experienced maintenance personnel.

5-5. It is dangerous to measure voltages inside the cabinet or replace components with power energized. Therefore, do not measure voltages inside the cabinet or replace components with power energized. Always operate the transmitter POWER circuit breaker to OFF prior to performing any maintenance within the transmitter. Measurements with the power energized can be performed in the controller enclosure if required.

5-6. POWER AMPLIFIER EFFICIENCY.

5-7. The FM-5C/FM-4C and FMi-402/FMi-301 power amplifier stage consists of solid-state power amplifier devices. Figure 5-1 presents typical FM-5C/FM-4C PA stage efficiency values. The PA stage efficiency will vary slightly from the values presented in Figure 5-1 due to component tolerances. Refer to Figure 5-1 as required for typical PA stage efficiency values.

5-8. FIRST LEVEL MAINTENANCE.

5-9. First level maintenance consists of procedures applied to the equipment to prevent future failures. The procedures are performed on a regular basis and the results recorded in a maintenance log. Preventive maintenance of the transmitter consists of good housekeeping and checking performance levels using the meters and various indicators built into the equipment.

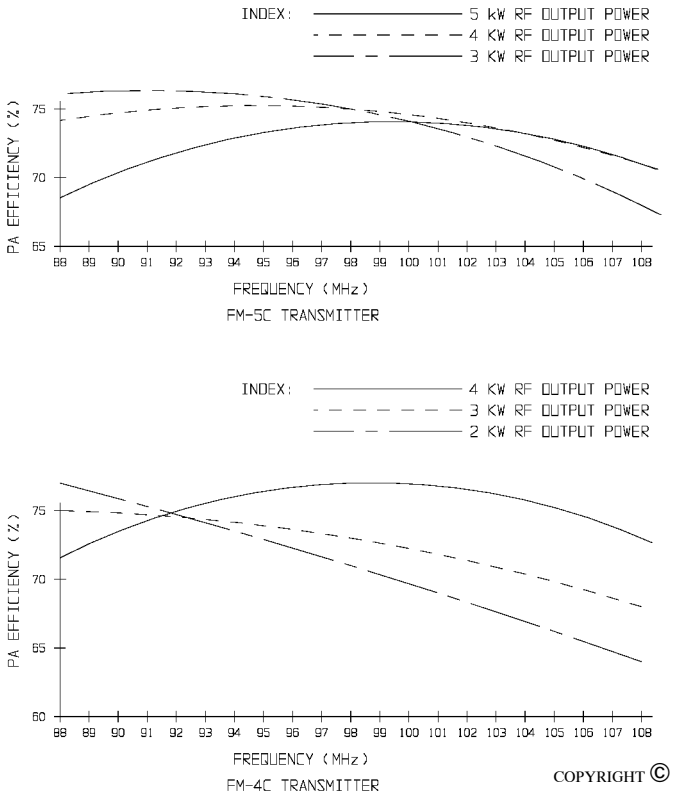


FIGURE 5-1. FM-5C/FM-4C TYPICAL PA EFFICIENCY **597-5001-19**

5-10. **ROUTINE MAINTENANCE.**

WARNING ***NEVER OPEN THE EQUIPMENT UNLESS ALL TRANSMITTER PRIMARY POWER IS DISCONNECTED. ENSURE ALL TRANSMITTER PRIMARY POWER IS DISCONNECTED BEFORE ATTEMPTING MAINTENANCE ON ANY AREA WITHIN THE TRANSMITTER.***

WARNING

5-11. **INSPECTION AND CLEANING.** On a regular basis, clean the equipment of accumulated dust using a brush and vacuum cleaner. Inspect the RF amplifier modules and the power supplies for damage caused by component overheating. Overheated components are identified by circuit board discoloration near the component leads. Inspect the circuit boards for loose hardware as required.

5-12. **CONTROLLER BATTERY.** Periodically, the battery on the controller circuit board should be checked. If the battery is defective, a good-quality Alkaline battery is recommended for replacement. Typically, it is recommended the controller battery be replaced annually.

5-13. **AIR FILTERS.** The FM-5C/FM-4C and FMi-402/FMi-301 transmitters are equipped with a screen-type air filter. The air filter is located inside the rear-access panel (refer to Figure 5-2) and is equipped with an air flow indicator. Ensure the filter is installed with the air flow indicator pointing towards the flushing fans. The filter can be checked and cleaned without interrupting transmitter operation.

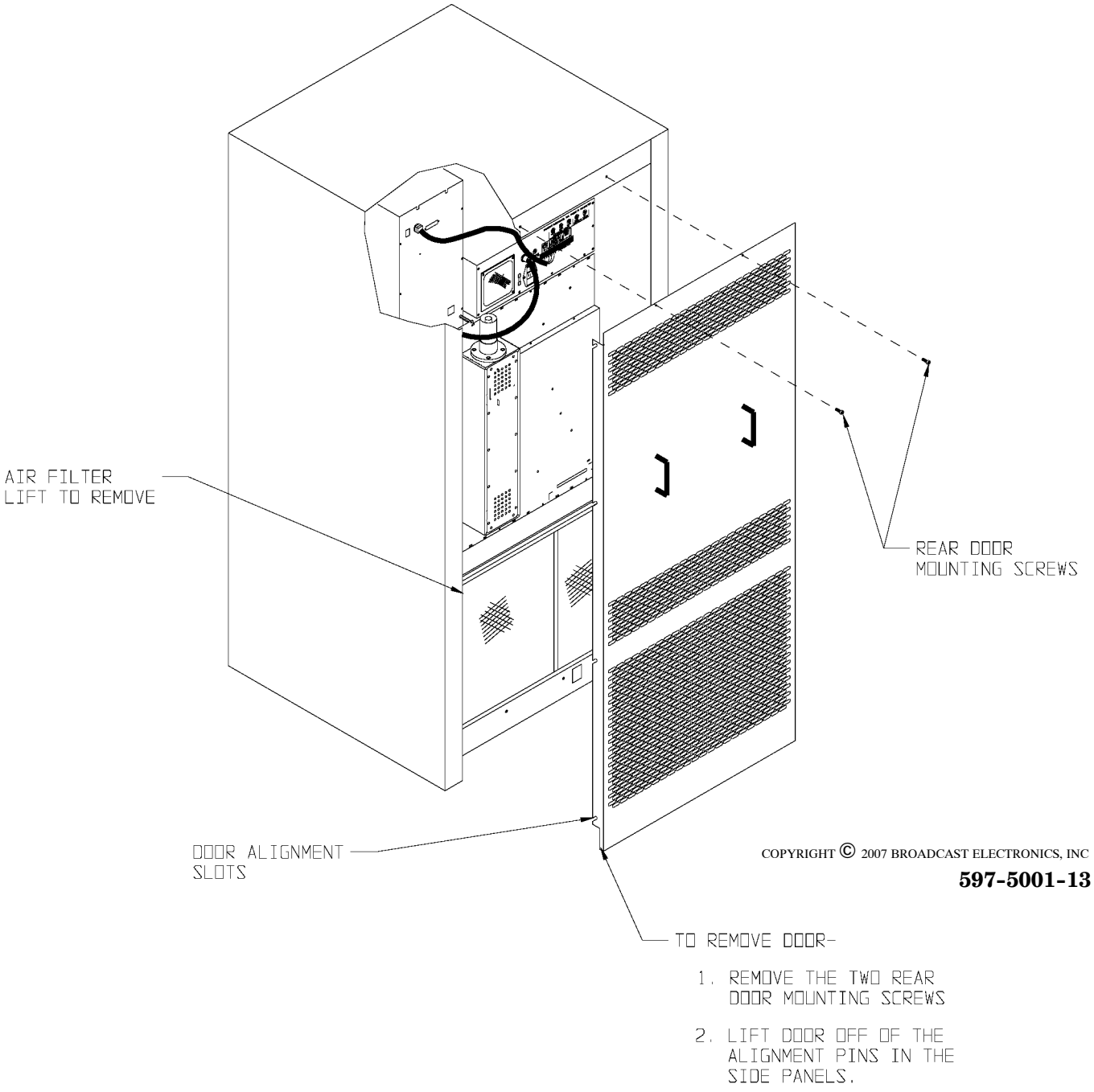


FIGURE 5-2. AIR FILTER REMOVAL

5-14. Check the filter approximately once a week. When dirt is to be removed from the filter, refer to Figure 5-2 and proceed as follows:

1. Remove the transmitter rear-access panel.
2. Remove the filter from the chassis by lifting the filter from the retaining hardware.
3. Clean the filter using a: 1) brush and vacuum or 2) brush and soapy water.
4. Replace the filter with the air flow indicator pointing towards the flushing fans.
5. Replace the rear-access panel.

5–15. **FLUSHING FANS.** Inspect the transmitter flushing fans for dust accumulation and periodically clean the fans using a brush and vacuum cleaner. The fans are cooled by air passing around each motor. If dust is allowed to accumulate on the motors, the ambient air temperature will increase due to restricted air flow. When the ambient air temperature increases, the fan motor bearing lubricant will gradually vaporize and bearing failure will occur.

5–16. It is recommended the flushing fan mounting hardware be periodically checked. The flushing fans are equipped with sealed bearings which do not permit lubrication. If a bearing fails, the motor must be replaced.

5–17. SECOND LEVEL MAINTENANCE.

5–18. Second level maintenance consists of procedures required to adjust the transmitter circuitry or restore the transmitter to operation after a fault has occurred. The procedures consists of electrical adjustments, troubleshooting, and component replacement procedures. All electrical adjustments with the exception of the transmitter frequency re–programming procedure are required only when components are replaced in the transmitter circuitry.

WARNING ***NEVER OPEN THE EQUIPMENT UNLESS ALL TRANSMITTER PRIMARY POWER IS DISCONNECTED. ENSURE ALL TRANSMITTER PRIMARY POWER IS DISCONNECTED BEFORE ATTEMPTING MAINTENANCE ON ANY AREA WITHIN THE TRANSMITTER.***

WARNING

5–19. The maintenance philosophy for the FM–5C/FM–4C and FMi–402/FMi–301 transmitters consists of isolating a problem to a specific area. Once the specific area is located, subsequent troubleshooting using the information in the following text will assist in problem isolation to a replaceable assembly or component. If required, the replaceable assembly may be: 1) returned to the factory for repair or exchange or 2) repaired locally.

5–20. **ELECTRICAL ADJUSTMENTS.**

WARNING ***NEVER OPEN THE EQUIPMENT UNLESS ALL TRANSMITTER PRIMARY POWER IS DISCONNECTED. ENSURE ALL TRANSMITTER PRIMARY POWER IS DISCONNECTED BEFORE ATTEMPTING MAINTENANCE ON ANY AREA WITHIN THE TRANSMITTER.***

WARNING

5–21. **MULTIMETER DISPLAY CALIBRATION.** Potentiometer R203 on the controller meter display circuit board calibrates the multimeter display. The following text presents the procedure to calibrate the multimeter display.

5–22. **Required Equipment.** The following equipment is required to adjust the multimeter display calibration control.

1. Insulated adjustment tool.
2. Digital voltmeter (Fluke 77 or equivalent).

5–23. **Procedure.** To calibrate the multimeter display, proceed as follows:

5–24. Depress the transmitter **OFF** switch/indicator to illuminate the switch/indicator and operate the **POWER SWITCH** to OFF.

5-25. Open the controller door.

5-26. Remove integrated circuit U5 from the controller circuit board.

5-27. Refer to Figure 5-3 and construct a voltage source for the calibration procedure. Adjust the voltage source for a 2.000 volt dc output.

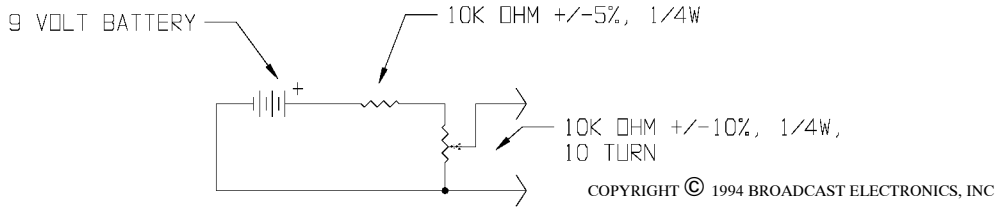


FIGURE 5-3. ADJUSTABLE VOLTAGE SOURCE **597-3002-21**

5-28. Connect the voltage source between TP204 on the controller meter display circuit board and TP203 ground.

5-29. Operate the **POWER SWITCH** to ON.

5-30. Refer to Figure 5-4 and adjust multimeter display calibration control R203 on the meter display circuit board for a 1000 indication on the transmitter multimeter. Check the voltage source to ensure the voltage is at 2.000.

5-31. Operate the **POWER SWITCH** to OFF.

5-32. Remove the test equipment, replace integrated circuit U5, and close the controller door.

5-33. **REFLECTED POWER METER, VSWR FOLDBACK, AND VSWR OVERLOAD CALIBRATION.** Potentiometer R64 on the controller circuit board calibrates the reflected power meter display. Potentiometer R112 on the controller circuit board determines the VSWR level for foldback operations. Potentiometer R94 on the controller circuit board determines the VSWR level for overload operations. The following text presents the procedure to adjust the reflected power meter calibrate, the VSWR foldback, and the VSWR overload controls.

5-34. **Required Equipment.** The following equipment is required to adjust the reflected power meter, VSWR foldback, and VSWR overload calibration controls.

1. Insulated adjustment tool.
2. Adjustable voltage source.
3. Digital voltmeter (Fluke 77 or equivalent).

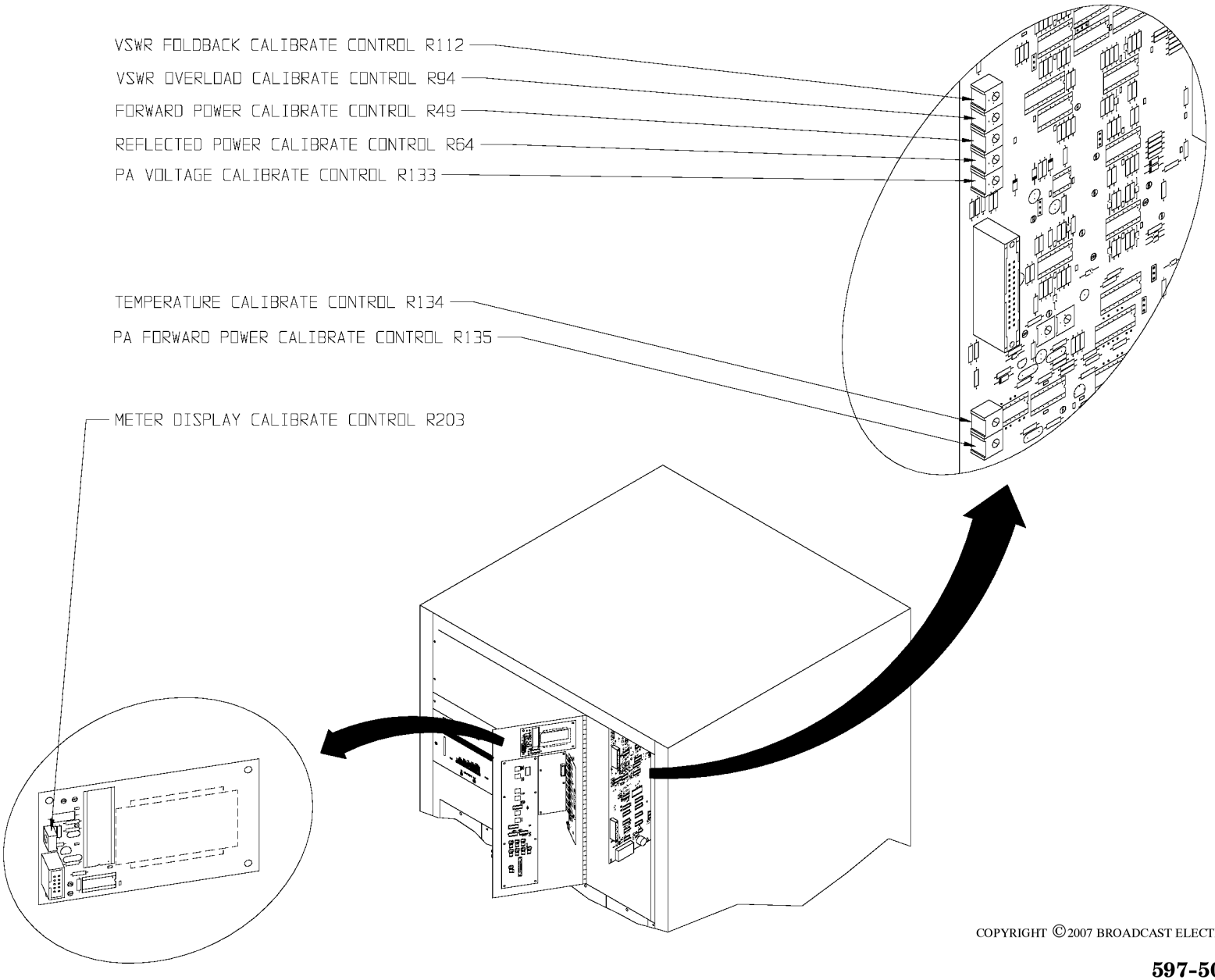
5-35. **Procedure.** To adjust the reflected power meter, VSWR foldback, and VSWR overload calibration controls, proceed as follows:

5-36. The transmitter MULTIMETER must be calibrated prior to adjusting the reflected power meter, VSWR foldback, and VSWR overload calibration controls. Refer to MULTIMETER DISPLAY CALIBRATION in the preceding text and perform the procedure to calibrate the display.

5-37. Depress the transmitter **OFF** switch/indicator to illuminate the switch/indicator and operate the **POWER SWITCH** to OFF.

5-38. Refer to Figure 5-3 and construct a voltage source for the calibration procedure. Adjust the voltage source for a 2.57 volt dc output for FM-5C/FMi 402 models or a 2.27 volt dc output for FM-4C/FMi 301 models.

5-39. Disconnect directional coupler input connector J302 on the transmitter rear panel.



597-5001-14

FIGURE 5-4. CONTROLLER AND METER DISPLAY CIRCUIT BOARD CONTROLS

5–40. Connect the voltage source between P302–3 (ground) and P302–4 (RFL).

5–41. Depress the transmitter SYSTEM RFL PWR switch/indicator.

5–42. Open the controller door.

5–43. Connect the digital voltmeter between the high signal side of R176 (end of R176 near TP5) and ground on the controller circuit board.

5–44. Operate the **POWER SWITCH** to ON. Ensure the transmitter **OFF** switch/indicator is illuminated.

5–45. Observe the digital voltmeter and ensure a 2.57 volt dc output for FM–5C/FMi–402 models or a 2.27 volt dc output for FM–4C/FMi 301 models is present at R176. Adjust the voltage source if required.

5–46. Refer to Figure 5–4 and adjust reflected power meter calibrate control R64 on the controller circuit board for: 1) a 200 watt indication on the transmitter multimeter for FM–5C/FMi–402 models or 2) a 160 watt indication on the transmitter multimeter for FM–4C/FMi–301 models.

5–47. Connect the digital voltmeter between TP–1 and ground on the controller circuit board.

5–48. Refer to Figure 5–4 and adjust VSWR foldback control R112 on the controller circuit board for a 4.3 volt indication on the digital voltmeter. The **FAULT RESET** switch/indicator may illuminate.

5–49. Connect the digital voltmeter between TP–17 and ground on the controller circuit board.

5–50. Adjust the voltage source to obtain a: 1) 300 watt indication on the transmitter multimeter for FM–5C/FMi–402 models or 2) 240 watt indication on the transmitter multimeter for FM–4C/FMi–301 models.

5–51. Refer to Figure 5–4 and adjust VSWR overload control R94 on the controller circuit board until the voltage at TP–17 goes positive.

5–52. Operate the **POWER SWITCH** to OFF.

5–53. Remove the test equipment, re–connect P302 on the transmitter rear panel, and close the controller door.

5–54. **FORWARD POWER CALIBRATION.** Potentiometer R49 on the controller circuit board calibrates the forward power detector circuitry. The following text presents the procedure to calibrate the forward power detector circuitry.

5–55. **Required Equipment.** The following equipment is required to adjust the forward power calibration control.

1. Insulated adjustment tool.
2. Calibrated in–line wattmeter with a 5 kW element for FM–5C/FMi–402 models or a 4 kW element for FM–4C/FMi 301 models (Bird 43 or equivalent).
3. Test load and cable (50 Ohm Non–Inductive, 5 kW minimum for FM–5C/FMi–402 models or 4 kW minimum for FM–4C/FMi–301 models.

5–56. **Procedure.** To adjust the forward power calibration control, proceed as follows:

5–57. The transmitter MULTIMETER must be calibrated prior to adjusting the forward power detector circuitry. Refer to MULTIMETER DISPLAY CALIBRATION in the preceding text and perform the procedure to calibrate the display.

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

WARNING

5-58. Disconnect all transmitter primary power before proceeding.

5-59. Open the controller door.

5-60. Connect the test load and wattmeter to the transmitter output.

5-61. Energize the transmitter primary ac power and operate the transmitter at the desired output power level as indicated by the in-line wattmeter.

5-62. Depress the transmitter SYSTEM FWD PWR switch/indicator.

5-63. Refer to Figure 5-4 and adjust FORWARD POWER CAL control R49 on the controller circuit board until the transmitter MULTIMETER display is equal to the value presented on the in-line wattmeter. Ensure the in-line wattmeter power level and frequency correction charts are used during this calibration procedure.

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

WARNING

5-64. Disconnect all transmitter primary power.

5-65. Remove the test equipment, close the controller door, and reconnect the transmitter output to the antenna.

5-66. **PAV CALIBRATION.** Potentiometer R133 on the controller circuit board calibrates the PA voltage detector circuitry. The following text presents the procedure to calibrate the PA voltage detector circuitry.

5-67. **Required Equipment.** The following equipment is required to adjust the PA voltage calibration control.

1. Insulated adjustment tool.
2. Digital voltmeter (Fluke 77 or equivalent).

5-68. **Procedure.** To adjust the PA voltage calibration control, proceed as follows:

5-69. The transmitter MULTIMETER must be calibrated prior to adjusting the PA voltage detector circuitry. Refer to MULTIMETER DISPLAY CALIBRATION in the preceding text and perform the procedure to calibrate the display.

5-70. Operate the transmitter to on.

5-71. Depress the LOWER switch/indicator to obtain: 1) a 1 kW indication on the MULTIMETER display for FM-5C/FMi 402 models and 2) a 500 W indication on the MULTIMETER display for FM-4C/FMi 301 models.

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

WARNING

5-72. Disconnect all transmitter primary power before proceeding.

5–73. Open the controller door.

5–74. Remove PA power supply module 1 and connect the voltmeter between TP402 (dc +) and TP404 (ground) on the power supply motherboard.

5–75. Energize the transmitter primary ac power.

5–76. Depress the transmitter SYSTEM PS VDC switch/indicator.

5–77. Refer to Figure 5–4 and adjust PAV CAL control R133 on the controller circuit board until the transmitter MULTIMETER display is equal to the value presented on the digital voltmeter.

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

WARNING

5–78. Disconnect all transmitter primary power.

5–79. Remove the test equipment, replace the PA power supply module, close the controller door, and return the transmitter to the normal output power level.

5–80. **TEMPERATURE CALIBRATION.** Potentiometer R134 on the controller circuit board calibrates the temperature detector circuitry. The following text presents the procedure to calibrate the temperature detector circuitry.

5–81. **Required Equipment.** The following equipment is required to adjust the temperature calibration control.

1. Insulated adjustment tool.
2. Digital voltmeter (Fluke 77 or equivalent).
3. Fluke 80T–150 temperature probe or equivalent Celsius indicating temperature probe.

5–82. **Procedure.** To adjust the temperature calibration control, proceed as follows:

5–83. The transmitter MULTIMETER must be calibrated prior to adjusting the temperature detector circuitry. Refer to MULTIMETER DISPLAY CALIBRATION in the preceding text and perform the procedure to calibrate the display.

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

WARNING

5–84. Disconnect all transmitter primary power before proceeding.

5–85. Open the controller door.

5–86. Locate the temperature sensor circuit board and place the temperature probe near the transistor temperature sensor.

5–87. Energize the transmitter primary ac power. Allow the transmitter to operate for approximately 5 minutes.

5–88. Depress the transmitter SYSTEM INLET TEMP switch/indicator.

5–89. Refer to Figure 5–4 and adjust TEMP CAL control R134 on the controller circuit board until the transmitter MULTIMETER display is equal to the value presented on the digital voltmeter.

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

WARNING

5-90. Disconnect all transmitter primary power.

5-91. Remove the test equipment and close the controller door.

5-92. **PA MODULE FORWARD POWER CALIBRATION.** Potentiometer R135 on the controller circuit board calibrates the PA module forward power detector circuitry. The following text presents the procedure to calibrate the PA module forward power detector circuitry.

5-93. **Required Equipment.** The following equipment is required to adjust the PA module forward power calibration control.

1. Insulated adjustment tool.
2. Digital voltmeter (Fluke 77 or equivalent).

5-94. **Procedure.** To adjust the PA module forward power calibration control, proceed as follows:

5-95. The transmitter MULTIMETER must be calibrated prior to adjusting the PA module forward power detector circuitry. Refer to MULTIMETER DISPLAY CALIBRATION in the preceding text and perform the procedure to calibrate the display.

5-96. Open the controller door.

5-97. Depress the transmitter **OFF** switch/indicator to illuminate the switch/indicator.

5-98. Connect the digital voltmeter between TP8 on the controller circuit board and ground.

5-99. Energize the transmitter primary ac power and operate the transmitter.

5-100. Depress the transmitter **RAISE** or **LOWER** switch/indicator to obtain a +5.0 volt dc indication on the digital voltmeter.

5-101. Depress the transmitter MODULE SELECT switch/indicator to select a module. The module selected will be presented on the MODULE SELECT display.

5-102. Depress the transmitter MODULE PA FWD POWER switch/indicator.

5-103. Refer to Figure 5-4 and adjust PA FWD CAL control R135 on the controller circuit board until the transmitter MULTIMETER display equals 500 watts.

5-104. Depress the transmitter **OFF** switch/indicator to illuminate the switch/indicator.

5-105. Remove the test equipment and close the controller door.

5-106. **CONTROLLER SQUARING CIRCUIT ADJUSTMENTS.** The controller circuit board squaring circuitry contains calibration controls. The calibration controls consist of: 1) transmitter forward power squaring circuit calibrate control R54, 2) transmitter reflected power squaring circuit calibrate control R67, and 3) module forward power squaring circuit calibrate control R78. Due to the critical nature and specialized test equipment required to adjust the controls, the controls are not considered field adjustable. If the controls are to be adjusted, contact the Broadcast Electronics Customer Service Department.

5–107. **RF POWER AMPLIFIER MODULE ADJUSTMENTS.** The RF power amplifier module amplifier circuit board and the power amplifier logic circuit board contain calibration controls. The power amplifier circuit board is equipped with bias level controls R9 and R22. The RF amplifier logic circuit board contains current offset control R11, current limit control R5, forward power calibration control R51, forward power limit control R15, and reflected power limit control R25. Due to the critical nature and specialized test equipment required to adjust the controls, the controls are not considered field adjustable. If the controls are to be adjusted, contact the Broadcast Electronics Customer Service Department.

5–108. **LOW–PASS FILTER.** The low–pass filter is equipped with a reflected power null control. Due to the critical nature and specialized test equipment required to adjust the control, the control is not considered field adjustable. If the control is to be adjusted, contact the Broadcast Electronics Customer Service Department.

5–109. **TRANSMITTER FREQUENCY RE–PROGRAMMING.** The FM–5C/FM–4C and FMi–402/FMi–301 transmitters are configured for a specific frequency when shipped from the factory. However, the transmitters can be re–programmed for a different frequency in the field if required. The following text presents the procedure to change an FM–5C/FM–4C or FMi–402/FMi–301 transmitter's operating frequency.

5–110. **Required Equipment.** The following equipment is required to re–program the transmitter operating frequency.

1. Calibrated in–line wattmeter with 5 kW element for FM–5C/FMi–402 models or a 4 kW element for FM–4C/FMi–301 models (Bird 43 or equivalent).
2. Test load and cable (50 Ohm Non–Inductive, 1 5/8 connector, 5 kW for FM–5C/FMi 402 models or 4 kW for FM–4C/FMi 301 models minimum).

5–111. **Procedure.** To re–program the transmitter operating frequency, proceed as follows:

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

WARNING

5–112. Disconnect all transmitter primary power before proceeding.

5–113. Connect the test load and wattmeter to the transmitter output.

5–114. For an FM–250C exciter, refer to SECTION 4, AFC/PLL ASSEMBLY in FM–250C publication 597–1004 and perform the FREQUENCY SELECTION procedure. For an FXi– 250 refer to publication 597–0541 SECTION 3, CARRIER FREQUENCY SELECTION. Operate and test the exciter independently from the transmitter.

5–115. Energize the transmitter primary ac power and operate the transmitter at the desired output power level as indicated by the in–line wattmeter.

5–116. If a difference in values presented on the in–line wattmeter and the transmitter multimeter is observed, the transmitter forward power display may be calibrated if desired by performing the following procedure. Typically, the transmitter forward power display on the multimeter will be more accurate than the in–line wattmeter. Ensure the in–line wattmeter has been recently calibrated at the factory prior to calibrating the transmitter multimeter display.

1. Depress the transmitter SYSTEM FWD PWR switch/indicator.
2. Refer to Figure 5-4 and adjust FORWARD POWER CAL control R49 on the controller circuit board until the transmitter MULTIMETER display is equal to the value presented on the in-line wattmeter.

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

WARNING

5-117. Disconnect all transmitter primary power.

5-118. Remove the test equipment, close the controller door, and reconnect the transmitter output to the antenna.

5-119. **TROUBLESHOOTING.**

5-120. **TYPICAL METER INDICATIONS.** Typical meter indications for the FM-5C/FM-4C and FMi 402/FMi 301 transmitters are presented in the factory final test data sheets shipped with each transmitter. Refer to the factory test data sheets for typical meter indications.

CAUTION ***REMOVING OR INSTALLING A POWER AMPLIFIER POWER SUPPLY WITH THE TRANSMITTER ENERGIZED MAY RESULT IN DAMAGE TO THE SUPPLY. DO NOT REMOVE/INSERT A POWER AMPLIFIER POWER SUPPLY WITH THE TRANSMITTER ENERGIZED.***

CAUTION

5-121. **POWER AMPLIFIER POWER SUPPLY MODULES.** The FM-5C/FM-4C and FMi-402/FMi-301 transmitters are equipped with modular switching power supply units. The FM-5C/FMi-402 is equipped with a modular switching power supply for the controller and 5 modular switching power supplies for the power amplifier circuitry. The FM-4C/FMi-301 is equipped with a modular switching power supply for the controller and 4 modular switching power supplies for the power amplifier circuitry. Each power amplifier power supply module contains a fuse and a cooling fan.

5-122. When a power supply module fault indicator illuminates, check the following:

1. The PA power supply modules are equipped with temperature overload protection. If a power supply module temperature overload occurs, the modules must be reset. To reset a power supply module, proceed as follows:
   A. Depress the transmitter **OFF** switch/indicator.
   B. Wait approximately 1 minute.
   C. Depress the transmitter **ON** switch/indicator. The module will return to operation if the problem was associated with a temperature overload.
2. If the power supply module does not return to operation, check the following:
   A. Depress the SYSTEM P.S. VDC switch/indicator and check the power supply voltage. During a power supply failure, the voltage will be less than the normal operating voltage and greater than 0.0 volts dc.
   B. Check the rotation of the defective power supply module fan. Ensure the fan is operating.
3. If system power supply voltage is normal and the fan is not operating, proceed as follows:

CAUTION

CAUTION

A POWER AMPLIFIER POWER SUPPLY MODULE WILL BE DAMAGED IF A MODULE IS REMOVED OR INSTALLED WITH POWER ENERGIZED. DISCONNECT ALL TRANSMITTER POWER PRIOR TO REMOVING OR INSTALLING A POWER AMPLIFIER MODULE.

A. Disconnect all transmitter primary power.

B. Loosen the lock knob on the front panel of the defective power supply module.

C. Remove and re-insert the power supply module and secure the lock knob.

D. Apply power and depress the transmitter **ON** switch/indicator to illuminate the switch/indicator. The module will return to operation if the problem is associated with improper module seating.

4. If the power supply module problem remains, refer to APPENDIX A and locate the Pioneer Magnetics Troubleshooting Guide for the PM3329BP-5 power supply. Use the guide to locate the problem.

5-123. **CONTROLLER POWER SUPPLY.** The FM-4C/FM-5Cand FMi-402/FMi-301 transmitter controller power supply is located on a panel behind the air filter (refer to Figure 5-5). The power supply is equipped with a fuse and should be checked if a failure occurs. To check the controller power supply module, proceed as follows:

WARNING

WARNING

DISCONNECT ALL TRANSMITTER PRIMARY POWER BEFORE PROCEEDING.

5-124. Disconnect all transmitter primary power.

5-125. Refer to Figure 5-2 and remove the rear door.

5-126. Remove the air filter.

5-127. Refer to Figure 5-5 and remove the access panel.

5-128. Disconnect the wiring, remove the 4 mounting screws, and remove the controller power supply module.

5-129. Check the power supply fuse. If the power supply fuse has not blown, contact the Broadcast Electronics Customer Service Department. If desired, refer to APPENDIX A and the Computer Products power supply schematic diagram for additional power supply troubleshooting information.

5-130. Once the power supply troubleshooting has been completed, re-install the supply by reversing the preceding procedure.

CAUTION

CAUTION

REMOVING OR INSTALLING A POWER AMPLIFIER MODULE WITH THE TRANSMITTER ENERGIZED MAY RESULT IN DAMAGE TO THE MODULE. DO NOT REMOVE/INSERT A POWER AMPLIFIER MODULE WITH THE TRANSMITTER ENERGIZED.

5-131. **POWER AMPLIFIER MODULE TROUBLESHOOTING/REPAIR.** Each transmitter power amplifier module contains circuitry requiring specialized equipment and test procedures for troubleshooting and repair operations. Therefore, almost all power amplifier module troubleshooting and repair can not be performed in the field. If a power amplifier module is determined to be defective, contact the Broadcast Electronics Customer Service department for: 1) troubleshooting information and 2) information on a power amplifier module exchange program (refer to the following text).

NOTE

NOTE

THE FM-5C/FM-4C & FMi-402/FMi-301 TRANSMITTERS WILL NOT OPERATE WITH MORE THAN 3 RF POWER AMPLIFIER MODULES REMOVED FROM THE CHASSIS. ENSURE NO MORE THAN 3 RF POWER AMPLIFIER MODULES ARE REMOVED FROM THE TRANSMITER.

CAUTION

CAUTION

REMOVING OR INSTALLING A POWER AMPLIFIER MODULE WITH THE TRANSMITTER ENERGIZED MAY RESULT IN DAMAGE TO THE MODULE. DO NOT REMOVE/INSERT A POWER AMPLIFIER MODULE WITH THE TRANSMITTER ENERGIZED.

5-132. **POWER AMPLIFIER MODULE TROUBLESHOOTING/REPAIR.** Each transmitter power amplifier module requires specialized equipment for troubleshooting and repair operations. Therefore, almost all power amplifier module troubleshooting and repair can not be performed in the field. If a power amplifier module is determined to be defective, contact the Broadcast Electronics Customer Service department for: 1) troubleshooting information and 2) information on a power amplifier module exchange program (refer to the following text).

WARNING

WARNING

HIGH RF VOLTAGE IS PRESENT AT THE TYPE N CONNECTOR ON THE PA MOTHERBOARD WHEN AN RF POWER AMPLIFIER MODULE IS REMOVED FOR SERVICE. ENSURE A MODULE COVER PANEL IS INSTALLED IN THE MODULE LOCATION WHEN A MODULE IS REMOVED FOR SERVICE.

5-133. **Power Amplifier Module Cover Panel Installation.** If a power amplifier module is removed from the transmitter, a module cover panel must be installed in the module location. The panels are located in the transmitter accessory kit. The installation of the panel will maintain adequate air flow in the transmitter and prevent access to the RF power at the Type N connector on the PA motherboard.

5–134. **Power Amplifier Module Exchange Program.** If a 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 Customer Service Department.

WARNING ***NEVER OPEN THE EQUIPMENT UNLESS ALL TRANSMITTER PRIMARY POWER IS DISCONNECTED. ENSURE ALL TRANSMITTER PRIMARY POWER IS DISCONNECTED BEFORE ATTEMPTING MAINTENANCE ON ANY AREA WITHIN THE TRANSMITTER.***

5–135. **TRANSMITTER TROUBLESHOOTING PROCEDURES.** Table 5–1 presents troubleshooting information for the FM–5C/FM–4C and FMi–402/FMi–301 transmitters. Refer to Table 5–1 to isolate the problem to a specific assembly. Once the trouble is isolated, refer to the theory of operation and schematic diagrams to assist in problem resolution.

5–136. **TRANSMITTER COMPONENT LOCATIONS.** Figure 5–5 presents the transmitter component locations. Refer to Figure 5–5 as required during the troubleshooting procedures to locate components within the transmitter.

5–137. **Transmitter Access Panels.** Figure 5–5 presents the transmitter access panels. Refer to Figure 5–5 and remove the panels as required to access transmitter components.

TABLE 5-1. FM-5C/FM-4C & FMi-402/FMi-301 TROUBLESHOOTING
(Sheet 1 of 6)

SYMPTOM	CIRCUITRY TO CHECK
1. NO OUTPUT POWER 2. INTERLOCK INDICATOR EXTINGUISHED 3. MODULE RF DRIVE INDICATORS EXTINGUISHED 4. FM-250C LOCK INDICATOR EXTINGUISHED OR FXi 60 FAULT INDICATOR ILLUMINATED	1. FM-250C - AFC is unlocked. FXi-250 exciter fault. Refer to the exciter manual and troubleshoot the exciter.
1. NO OUTPUT POWER 2. INTERLOCK INDICATOR EXTINGUISHED	1. Operate the remote control switch to disable. A. If the interlock indicator is extinguished, check the external interlock. B. If the interlock indicator illuminates, check the remote control unit.
1. LOW OUTPUT POWER 2. MODULE DRIVE INDICATORS W EXTINGUISHED	1. Check the exciter forward power. The forward power must be: 1) 220 W for the FM-5C/FMi-402 and 2) 175 for the FM-4C/FMi-301. 2. If the exciter forward power is low, increase the exciter output power. 3. If the exciter forward power is normal, ensure the exciter RF output cable is connected to the splitter on the motherboard.
1. LOW OUTPUT POWER 2. MODULE STATUS INDICATORS ILLUMINATE YELLOW	1. Defective low-pass filter or combiner.

TABLE 5-1. FM-5C/FM-4C & FMi-402/FMi-301 TROUBLESHOOTING
(Sheet 2 of 6)

SYMPTOM	CIRCUITRY TO CHECK
1. RESET INDICATOR ILLUMINATED	1. Depress the reset switch. 2. If the reset indicator does not display normal indications, depress the SYSTEM FWD POWER switch. The transmitter forward power must be equal to the TPO. 3. If the transmitter forward power is high, depress the LOWER switch to lower the output power to the TPO level. 4. If the transmitter forward power is low or equal to the TPO, depress the multimeter TEMP switch. The temperature must be less than 50 °C. The transmitter will foldback power if the temperature is greater than 50 °C. 5. If the temperature is high, check the flushing fans and the filter. 6. If the temperature is normal, check each module temperature. The transmitter will foldback RF output power when a module temperature exceeds 85°C. 7. If the module temperature is normal, depress the SYSTEM RFL PWR switch/indicator. The reflected power must be less than 300 watts on FM-5C/FMi-402 models and 240 watts on FM-4C/FMi-301 models. 8. If the reflected power is high, check the output transmission line and the antenna. 9. If the reflected power is normal, check the low-pass filter and the reflected power directional coupler.
1. A RED MODULE STATUS INDICATOR 2. RESET INDICATOR ILLUMINATED (SHT 1 OF 2)	1. Depress the reset switch. 2. If the module status and reset indicators do not display normal indications, depress the multimeter TEMP switch. The temperature should be less than 50 °C. 3. If the temperature is high, check the flushing fans and the filter. 4. If the temperature is normal, check the module temperature. The module temperature must be less than 95 °C. 5. If the module temperature is normal, label the defective module and record the location. Interchange the module with another module in the transmitter.

TABLE 5-1. FM-5C/FM-4C & FMi-402/FMi-301 TROUBLESHOOTING
(Sheet 3 of 6)

SYMPTOM	CIRCUITRY TO CHECK
1. A RED MODULE STATUS INDICATOR 2. RESET INDICATOR ILLUMINATED (SHT 2 OF 2)	6. If the module inserted into the location recorded in the preceding step displays a red MODULE STATUS indicator, check the transmitter combiner. 7. If the MODULE STATUS indicator on the module recorded in the preceding step remains red, the module is defective. Contact the Broadcast Electronics Customer Service Department.
1. TRANSMITTER WILL NOT AUTOMATICALLY RETURN TO RATED POWER AFTER AN AC POWER LOSS	1. Replace the battery in the controller.
1. TRANSMITTER OFF WITH NO FRONT PANEL INDICATIONS	1. Ensure primary ac power is applied to the unit and ensure the POWER switch is operated to on. 2. If the primary ac power is on, defective controller power supply.
1. TRANSMITTER OFF 2. NO OFF INDICATOR 3. NO INTERLOCK INDICATOR 4. NO MODULE STATUS INDICATORS	1. Defective controller power supply +15V output.
1. TRANSMITTER OFF WITH FRONT PANEL INDICATIONS 2. NO MULTIMETER DISPLAY 3. MODULE STATUS INDICATORS ILLUMINATE YELLOW	1. Defective controller power supply +5V output.
1. TRANSMITTER OFF WITH FRONT PANEL INDICATIONS 2. MODULE STATUS INDICATORS ILLUMINATE YELLOW	1. Defective controller power supply –15V output.
1. A MODULE STATUS INDICATOR ILLUMINATES YELLOW	1. Label the defective module and record the location. Interchange the module with another module in the transmitter. 2. If the module inserted into the location recorded in the preceding step displays a yellow MODULE STATUS indicator, check the transmitter combiner. 3. If the MODULE STATUS indicator on the module recorded in the preceding step remains yellow, the module is defective. Troubleshoot the module.

TABLE 5-1. FM-5C/FM-4C & FMi-402/FMi-301 TROUBLESHOOTING
(Sheet 4 of 6)

SYMPTOM	CIRCUITRY TO CHECK
1. ERRATIC POWER CONTROL	1. Depress the RAISE switch and check for a HIGH at U7 pin 6 on the controller circuit board. 2. If the HIGH is present, check U6D, U9, U10, U11, U12, U13, U14, U15, U16, U7E, U17, Q1, Q4, U8C, U8D, and U8B on the controller circuit board. 3. If the HIGH is not present, check U7C on the controller circuit board and S7 on the controller on/off circuit board.
1. NO POWER CONTROL	1. Check for a dc voltage at TP3 on the controller circuit board. 2. If the voltage at TP3 is present, check U3C, U3A, U3B, and U4C on each RF power module logic circuit board. 3. If the voltage at TP3 is not present, check for a 4.4 volt dc signal at U21 pin 12 on the controller circuit board. 4. If the 4.4 volt signal is present, check U21 on the controller circuit board. 5. If the 4.4 volt signal is not present, check for a 8.7 volt dc signal at U6 pin 14 on the controller circuit board. 6. If the 8.7 volt signal is present, check Q3, U20, U19A, U18A, and U18D on the controller circuit board. Check U11D, U11C, U11B, K1, U10D, U13C, U6 and U14 on the controller on/off circuit board. 7. If the 8.7 volt signal is not present, check U6D, U9, U10, U11, U12, U13, U14, U15, U16, U7E, U17, Q1, Q4, U8D, U8C, and U7C on the controller circuit board.
1. TRANSMITTER OPERATES 2. NO MULTIMETER OPERATION	1. Depress the SYSTEM P.S. VDC switch/indicator and check for a dc voltage at TP204 on the meter display circuit board. 2. If the voltage at TP204 is present, check for: 1) +5 volts dc at TP201, 2) –5 volts dc at U201 pin 26, and 3) approximately 2.0 volts at U201 pin 36. 3. If the voltages are not present, check the ±5 volt supplies, D201, and R202 on the meter display circuit board. 4. If the voltages are present, check U201 and DS201 on the meter display circuit board. 5. If the voltage at TP204 is not present, check U5C on the controller circuit board.

TABLE 5-1. FM-5C/FM-4C & FMi-402/FMi-301 TROUBLESHOOTING
(Sheet 5 of 6)

SYMPTOM	CIRCUITRY TO CHECK
1. TRANSMITTER OPERATES 2. NO FORWARD POWER METER DISPLAY	1. Check for a 7.48 VDC signal for a 5 kW output on FM–5C models or a 6.67 VDC signal for a 4 kW output on FM–4C models at U2 pin 5 on the controller circuit board. 2. If the voltage is not present, check the directional coupler. 3. If the voltage is present, check for a 3 volt dc signal at TP4 and a 9 volt dc signal at TP14 on the controller circuit board. Do not adjust R54. 4. If the voltages at TP4/TP14 are not present, check U2B, U24A, U25A/B/C/D/E, U6A , and D8 on the controller circuit board. 5. If the voltages at TP4/TP14 are present, check S301 on the meter switch circuit board.
1. TRANSMITTER OPERATES WITH NORMAL INDICATIONS 2. RATED POWER CAN NOT BE OBTAINED.	1. Check the exciter output power. The forward power must be: 1) FM–5C/FMi 402 = 220 W 2) FM–4C/FMi 301 = 175 W 2. If the exciter output power is less than 10 W: 1) Operate the transmitter to OFF, 2) wait approximately 10 seconds, and 3) operate the transmitter to ON. 3. If the exciter output power is normal, check U5B on the controller circuit board.
1. TRANSMITTER OPERATES 2. NO REFLECTED POWER METER DISPLAY	1. Check for a voltage at U2 pin 3 on the controller circuit board. 2. If the voltage is not present, check the directional coupler. 3. If the voltage is present, check for a voltage at TP10 and TP15 on the controller circuit board. Do not adjust R67. 4. If the voltages at TP10/TP15 are not present, check U2A, U24B, U26A/B/C/D/E, U6B, and D8 on the controller circuit board. 5. If the voltages at TP10/TP15 are present, check S301 on the meter switch circuit board.
1. CIRCUIT BREAKER OPERATION	1. Check the MOVs, PA power supply modules, controller power supply, and the circuit breaker.
1. NO PA MODULE FORWARD POWER METER INDICATION (SHT 1 OF 2)	1. Ensure PA module 0 is not presented on the module status display. 2. Check U201 and U205A on the multiplexer circuit board. 3. Check for the following voltages on the controller circuit board: 1) approximately 5.0 volts (500W) at TP8, 2) 3 volts dc at TP11, and 3) 9 volts dc at TP16.

TABLE 5-1. FM-5C/FM-4C & FMi-402/FMi-301 TROUBLESHOOTING
(Sheet 6 of 6)

SYMPTOM	CIRCUITRY TO CHECK
NO PA MODULE FORWARD POWER METER INDICATION (SHT 2 OF 2)	4. If the voltages at TP8/TP11/TP16 are not present, check U4A, U6C, U24C, U27A/B/C/D/E, U24D, and D8. 5. If the voltages at TP8/TP11/TP16 are present, check S301 on the meter switch circuit board.
1. NO PA MODULE CURRENT POWER METER INDICATION	1. Ensure PA module 0 is not presented on the module status display. 2. Check U202 and U205B on the multiplexer circuit board. 3. Check U3A on the controller circuit board.
1. NO PA MODULE VOLTAGE POWER METER INDICATION	1. Ensure PA module 0 is not presented on the module status display. 2. Check U203 and U205C on the multiplexer circuit board. 3. Check U4C on the controller circuit board.
1. NO PA MODULE TEMPERATURE POWER METER INDICATION	1. Ensure PA module 0 is not presented on the module status display. 2. Check U204 and U205D on the multiplexer circuit board. 3. Check U3C on the controller circuit board.
1. NO PA MODULE SELECTION	1. Ensure P715 on the controller circuit board is installed in position 1-2. 2. Check S1 on the module select circuit board. 3. Check U23 and U7B on the controller circuit board. 4. Check U206 and U207 on the multiplexer circuit board. 5. Check U1 on the module select circuit board.
1. ALL FRONT PANEL INDICATORS FLASHING	1. Check the controller power supply outputs.
1. NO TRANSMITTER INDICATORS 2. NO TRANSMITTER OPERATION	1. On 220V ac three-phase models, the 3-phase ac voltage monitor has been enabled. Check the 3-phase supply. 2. On single-phase models, no ac power source. Check the transmitter ac input.
1. POWER SUPPLY FAULT INDICATOR(S) ILLUMINATED	1. Check the RF drive to the transmitter. Ensure the exciter output is: 1) FM-5C/FMi 402 = 220W 2) FM-4C/FMi 301 = 175W
2. RESET INDICATOR ILLUMINATED	2. Check the Power Supply.
1. NO OUTPUT POWER 2. INTERLOCK INDICATOR EXTINGUISHED 3. THREE-PHASE AC LOSS MONITOR INDICATORS FLASHING/EXTINGUISHED	1. Refer to APPENDIX A for a description of the ac line monitor indicators and determine the fault condition. 2. For incorrect ac line phasing during initial operation, disconnect ac power and reverse any two ac line phases at the ac input panel. For high/low voltage and loss of phase conditions, check the ac input.

5-138. **COMPONENT REPLACEMENT PROCEDURE.** Component replacement on printed circuit boards requires extreme care to avoid damage to the circuit board traces. The following text describes the procedure to replace components on FM-5C/FM-4C and FMi-402/FMi-301 circuit boards.

5-139. On all circuit boards, the adhesive securing the copper trace to the board melts at almost the same temperature at which 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.

5-140. To remove a component from a circuit board, cut the leads from the body of the defective component while the device is still soldered to the board.

5-141. Grip each component lead, one at a time, with long-nose pliers. Rotate the circuit board and touch a soldering iron to the lead at the solder connection. When the solder begins to melt, push the lead through the back side of the board. Each lead may now be heated independently and pulled out of each hole. The holes may be cleared of solder by carefully re-heating each hole with a low wattage iron and removing the residual solder with a soldering vacuum tool.

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 SUCH AS FROM A SOLDERING IRON OR SMOKING MATERIALS. OBSERVE THE MANUFACTURER'S CAUTIONARY INSTRUCTIONS.***

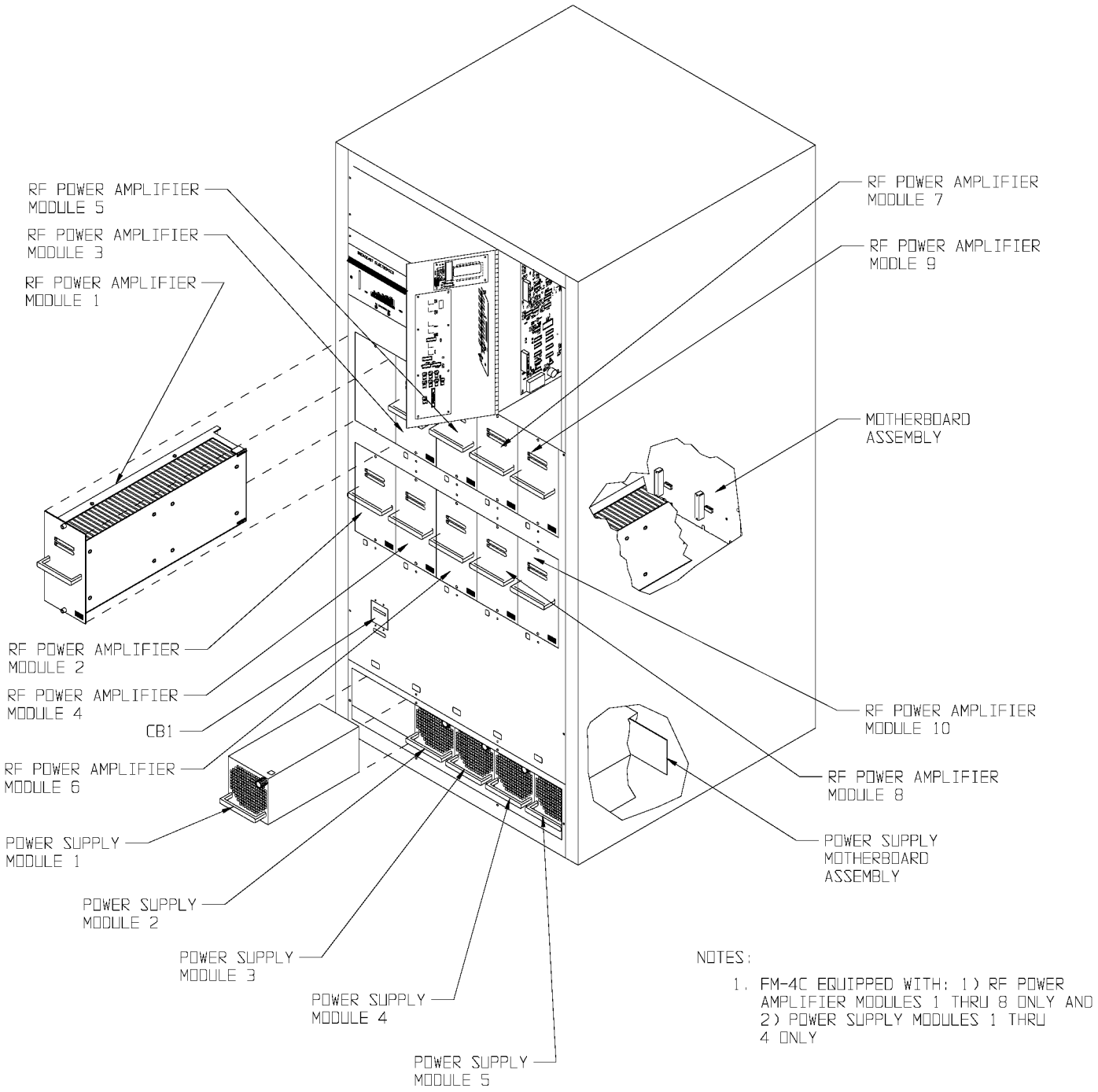
WARNING

WARNING

WARNING

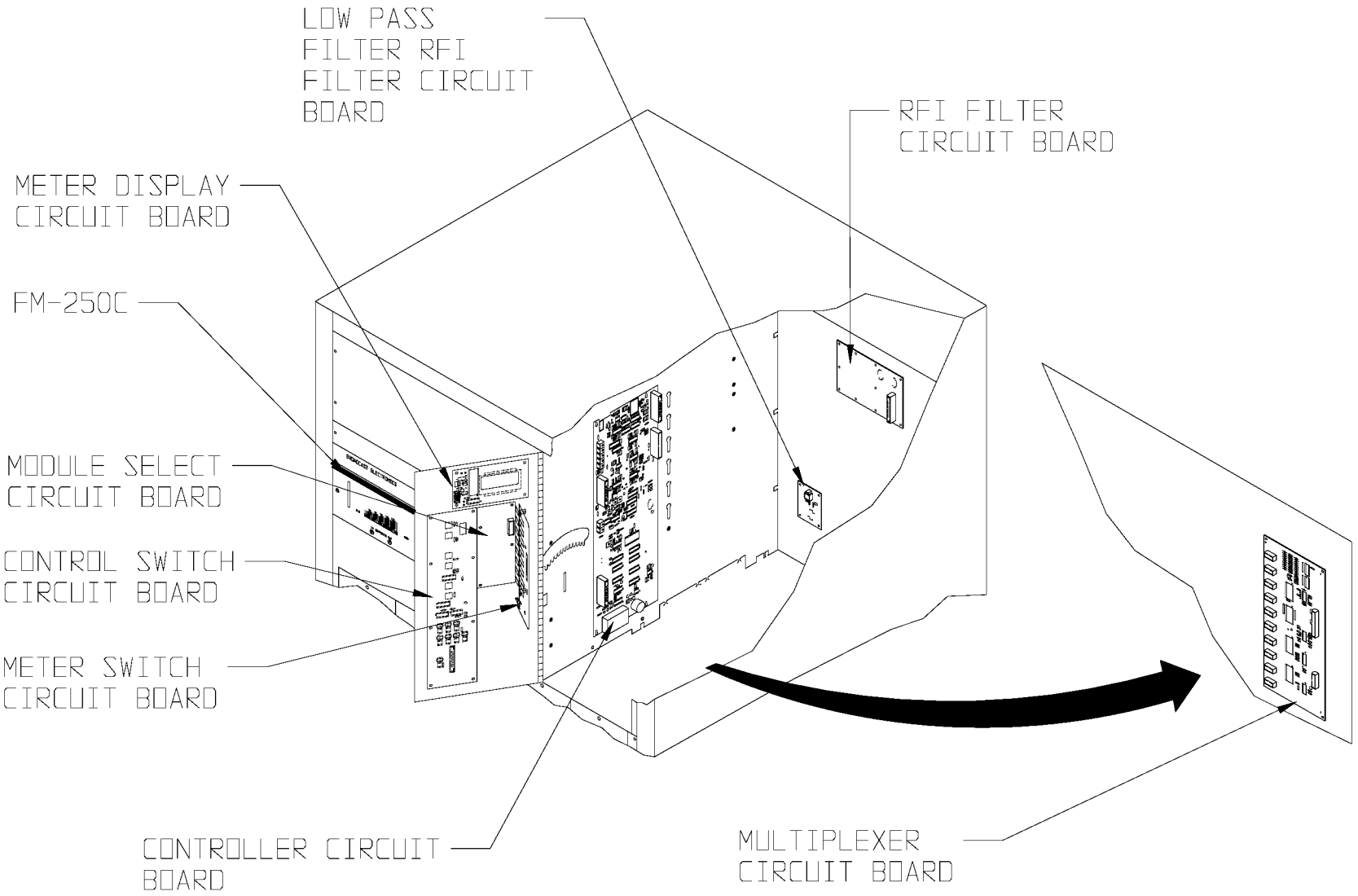
5-142. Install the new component and apply solder from the bottom side of the circuit board. After soldering, remove flux with a cotton swab moistened with a suitable solvent. Rubbing alcohol is highly diluted and is not effective.

5-143. The board should be checked to ensure the flux has been removed and not just smeared. Rosin flux is not normally corrosive, but rosin will absorb enough moisture in time to become conductive and cause problems.



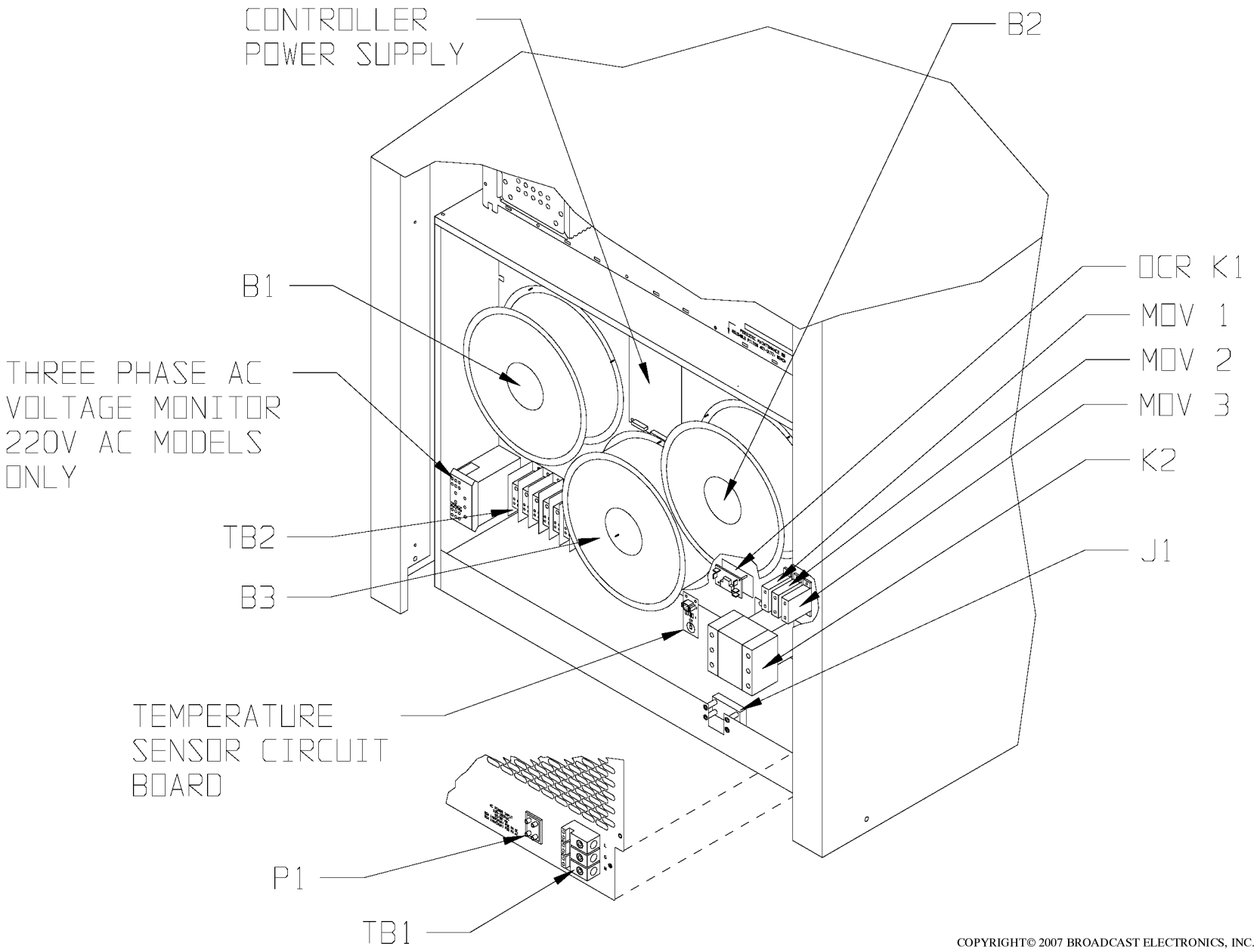
597-5001-15

FIGURE 5-5. FM-5C/FM-4C & FMi 402/FMi 301 COMPONENT LOCATOR (SHEET 1 OF 4)



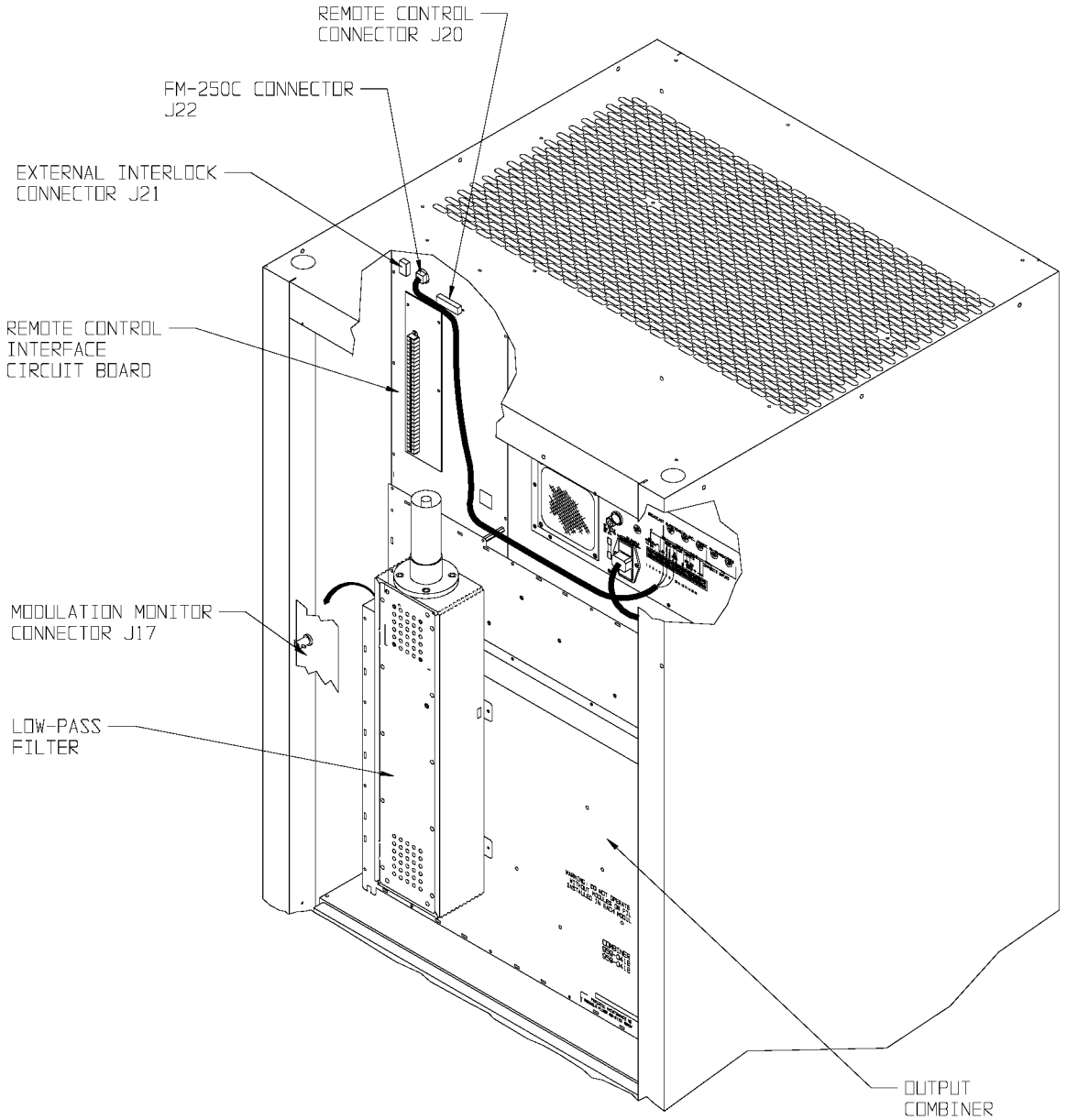
597-5001-15A

FIGURE 5-5. FM-5C/FM-4C & FMi 402/FMi 301 COMPONENT LOCATOR (SHEET 2 OF 4)



597-5001-15B

FIGURE 5-5. FM-5C/FM-4C & FMi 402/FMi 301 COMPONENT LOCATOR (SHEET 3 OF 4)



597-5001-15C

FIGURE 5-5. FM-5C/FM-4C & FMi 402/FMi 301 COMPONENT LOCATOR (SHEET 4 OF 4)

SECTION VI
PARTS LIST

6-1. INTRODUCTION.

6-2. This section provides parts lists for the FM-5C/FM-4C and FMi-402/FMi-301 transmitters. 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.

TABLE 6-1. FM-5C/FM-4C & FMi-402/FMi-301 REPLACEABLE PARTS LIST INDEX (Sheet 1 of 2)

TABLE 6-1. FM-5C/FM-4C & FMi-402/FMi-301 REPLACEABLE PARTS LIST INDEX
(Sheet 2 of 2)

TABLE 6-2. SINGLE PHASE FM-5C TRANSMITTER, 220VAC - 909-5001-204

REF. DES.	DESCRIPTION	PART NO.	QTY.
B1 Thru B3	Fan, 10.00" Diameter, 230V ac	380-0024	3
CB1	Circuit Breaker, 70A, 250V ac, 2 Pole, E-Frame	341-0067	1
J1	Connector, Male, EDP20891-A	417-0388	1
K1	Optically Coupled Relay Circuit Board Assembly	919-0096-001	1
K2	Contactor, 2 Pole, 75A, 240V, 60 Hz, DP	341-0069	1
MOV1 Thru MOV3	Metal-Oxide Varistor, B40K275, 275V, 1680 Joules	140-0021	3
P1	Connector, Female, EDS10891-A	417-0387	1
P21	Connector Housing, 2-Pin, Male	418-0702	3
----	Air Filter, FXA 17.50"x 26.50"x.86"	407-0172	1
----	Circuit Board Guide, 6 inch	409-0026	50
----	Bulkhead Receptacle, Type N. Jack-to-Jack, UG30/U	418-0035	10
----	Contact, Pin, AMP 350967-1	417-0036	6
----	Adapter, 1 5/8 Inch EIA Flanged to Unflanged	427-0010	1
----	Power Supply, Computer Products, NFS80-7606, ±15V, +5%, +24 V, 85V to 264V Operation, 80W	540-0015	1
----	Power Supply, Pioneer Magnetics, PM33210BP-5	540-0016-001	5
----	48D40-2F-6B-127-R, 48V Adjustable, 2 kW, Power Factor Corrected		
----	FM-250C 250 Watt FM Transmitter/Exciter	909-1251-304	1
----	Control Switch Circuit Board Assembly	919-0406-101	1
----	Display Circuit Board Assembly	919-0406-102	1
----	Meter Switch Circuit Board Assembly	919-0406-103	1
----	Temperature Sensor Circuit Board Assembly	919-0406-105	1
----	RFI Filter Circuit Board Assembly	919-0562	1
----	Low-Pass Filter Input/RFI Filter Circuit Board Assembly	919-0415-003	1
----	Remote Interface Barrier Strip	919-0415-005	1
----	Power Supply Distribution Assembly	919-0415-500	1
----	Module Select Circuit Board Assembly	919-0415-501	1
----	Multiplexer Circuit Board Assembly	919-0415-502	1
----	Controller Assembly	919-0563-500	1
----	Motherboard Circuit Board Assembly	919-0513	1
----	Wire Harness	949-0416	1
----	RF Amplifier Module Assembly	959-0412-013	10
----	Low-Pass Filter Assembly	959-0414-001	1
----	Combiner Assembly	959-0418	1
----	Accessory Parts Kit, FM5C/4C	979-0413	1
----	Battery, 9V Alkaline	350-0002	1

TABLE 6-3. SINGLE PHASE FM-4C TRANSMITTER, 220VAC - 909-4001-204

REF. DES.	DESCRIPTION	PART NO.	QTY.
B1 Thru B3	Fan, 10.00" Diameter, 230V ac	380-0024	3
CB1	Circuit Breaker, 60A, 250V ac, 2 Pole, E-Frame	341-0068	1
J1	Connector, Male, EDP20891-A	417-0388	1
K1	Optically Coupled Relay Circuit Board Assembly	919-0096-001	1
K2	Contactor, 2 Pole, 75A, 240V, 60 Hz, DP	341-0069	1
MOV1 Thru MOV3	Metal-Oxide Varistor, B40K275, 275V, 1680 Joules	140-0021	3
P1	Connector, Female, EDS10891-A	417-0387	1
P21	Connector Housing, 2-Pin, Male	418-0702	3
----	Air Filter, FXA 17.50"x 26.50"x.86"	407-0172	1
----	Circuit Board Guide, 6 inch	409-0026	50
----	Bulkhead Receptacle, Type N. Jack-to-Jack, UG30/U	418-0035	10
----	Contact, Pin, AMP 350967-1	417-0036	6
----	Adapter, 1 5/8 Inch EIA Flanged to Unflanged	427-0010	1
----	Power Supply, Computer Products, NFS80-7606, ±15V, +5%, +24 V, 85V to 264V Operation, 80W	540-0015	1
----	Power Supply, Pioneer Magnetics, PM33210BP-5	540-0016-001	4
----	48D40-2F-6B-127-R, 48V Adjustable, 2 kW, Power Factor Corrected		
----	FM-250C 250 Watt FM Transmitter/Exciter	909-1251-304	1
----	Control Switch Circuit Board Assembly	919-0406-101	1
----	Display Circuit Board Assembly	919-0406-102	1
----	Meter Switch Circuit Board Assembly	919-0406-103	1
----	Temperature Sensor Circuit Board Assembly	919-0406-105	1
----	RFI Filter Circuit Board Assembly	919-0435	1
----	Low-Pass Filter Input/RFI Filter Circuit Board Assembly	919-0415-003	1
----	Remote Interface Barrier Strip	919-0415-005	1
----	Power Supply Distribution Assembly	919-0415-400	1
----	Module Select Circuit Board Assembly	919-0415-401	1
----	Multiplexer Circuit Board Assembly	919-0415-402	1
----	Controller Assembly	919-0563-400	1
----	Motherboard Circuit Board Assembly	919-0513-001	1
----	Wire Harness	949-0416	1
----	RF Amplifier Module Assembly	959-0412-013	8
----	Low-Pass Filter Assembly	959-0414-001	1
----	Combiner Assembly	959-0418-001	1
----	Accessory Parts Kit, FM5C/4C	979-0413	1
----	Battery, 9V Alkaline	350-0002	1

TABLE 6-4. THREE PHASE FM-5C TRANSMITTER, 220VAC - 909-5001-254

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	FM-5C, 5 kW Transmitter, 220V, 50/60 Hz	909-5001-204	1
	DELETE PARTS		
----	Circuit Breaker, 70A, 250V ac, 2 Pole, E-Frame	341-0067	1
----	Contactor, 2 Pole, 75A, 240V, 60 Hz, DP	341-0069	1
	ADD PARTS		
----	Fuse, AGC, 250V, 1/2 Ampere	330-0050	3
----	Contactor Coil: 208/240V ac 60 Hz or 190/220V ac 50 Hz Contacts: 3-Pole, 600V ac, 40 Amperes	341-0053	1
----	Circuit Breaker, 40A, 480VAC, 3 Pole, E-Frame	341-0070	1
----	AC Phase Monitor Relay, EUY C 240	270-0068	1
----	Barrier Strip, 3 Position, 4AWG	412-0049	1
----	Fuse Holder, Single 350329 Littelfuse	415-0004	3
----	Harness, Add-On, FM-5C, Three Phase, Delta, 220V	949-0416-254	1

TABLE 6-5. THREE PHASE FM-4C TRANSMITTER, 220VAC - 909-4001-254

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	FM-4C, 4 kW Transmitter, 220V, 50/60Hz	909-4001-204	1
	DELETE PARTS		
----	Circuit Breaker, 70A, 250V ac, 2 Pole, E-Frame	341-0067	1
----	Contactor, 2 Pole, 75A, 240V, 60 Hz, DP	341-0069	1
	ADD PARTS		
----	Fuse, AGC, 250V, 1/2 Ampere	330-0050	3
----	AC Phase Monitor Relay, EUY C 240	270-0068	1
----	Contactor Coil: 208/240V ac 60 Hz or 190/220V ac 50 Hz Contacts: 3-Pole, 600V ac, 40 Amperes	341-0053	1
----	Circuit Breaker, 40A, 480VAC, 3 Pole, E-Frame	341-0070	1
----	Barrier Strip, 3 Position, 4AWG	412-0049	1
----	Fuse Holder, Single 350329 Littelfuse	415-0004	3
----	Harness, Add-On, FM-5C, Three Phase, Delta, 220V	949-0416-254	1

TABLE 6-6. THREE PHASE FM-5C TRANSMITTER, 380VAC - 909-5001-384

REF. DES.	DESCRIPTION	PART NO.	QTY.
——	FM-5C, 5 kW Transmitter, 220V, 50/60 Hz	909-5001-204	1
	DELETE PARTS		
----	Circuit Breaker, 70A, 250V ac, 2 Pole, E-Frame	341-0067	1
----	Contactor, 2 Pole, 75A, 240V, 60 Hz, DP	341-0069	1
	ADD PARTS		
----	Contactor Coil: 208/240V ac 60 Hz or 190/220V ac 50 Hz Contacts: 3-Pole, 600V ac, 40 Amperes	341-0053	1
----	Circuit Breaker, 40A, 480VAC, 3 Pole, E-Frame	341-0070	1
----	Terminal, Male, 0.25 Tab	410-0064	1
----	Barrier Strip, 4 Terminal	412-0011	1
----	Barrier Strip, 3 Position, 4AWG	412-0049	1
----	Add-On Harness, FM-5C, Three Phase, WYE, 380V	949-0416-384	1

TABLE 6-7. THREE PHASE FM-4C TRANSMITTER, 380VAC - 909-4001-384

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	FM-4C, 4 kW Transmitter, 220V, 50/60Hz	909-4001-204	1
	DELETE PARTS		
----	Circuit Breaker, 70A, 250V ac, 2 Pole, E-Frame	341-0067	1
----	Contactor, 2 Pole, 75A, 240V, 60 Hz, DP	341-0069	1
	ADD PARTS		
----	Contactor Coil: 208/240V ac 60 Hz or 190/220V ac 50 Hz Contacts: 3-Pole, 600V ac, 40 Amperes	341-0053	1
----	Circuit Breaker, 40A, 480V ac, 3 Pole, E-Frame	341-0070	1
----	Terminal, Male, 0.25 Tab	410-0064	1
----	Barrier Strip, 4 Terminal	412-0011	1
----	Barrier Strip, 3 Position, 4AWG	412-0049	1
----	Add-On Harness, FM-5C, Three Phase, WYE, 380V	949-0416-384	1

TABLE 6-8. SINGLE PHASE FMi-402 TRANSMITTER, 220VAC - 909-0402-404

REF. DES.	DESCRIPTION	PART NO.	QTY.
B1 Thru B3	Fan, 10.00" Diameter, 230V ac	380-0124	3
CB1	Circuit Breaker, 70A, 250V ac, 2 Pole, E-Frame	341-0067	1
J1	Connector, Male, EDP20891-A	417-0388	1
K1	Optically Coupled Relay Circuit Board Assembly	919-0096-001	1
K2	Contactor, 2 Pole, 75A, 240V, 60 Hz, DP	341-0069	1
MOV1 Thru MOV3	Metal-Oxide Varistor, B40K275, 275V, 1680 Joules	140-0021	3
P1	Connector, Female, EDS10891-A	417-0387	1
P21	Connector Housing, 2-Pin, Male	418-0702	3
----	Air Filter, FXA 17.50"x 26.50"x.86"	407-0172	1
----	Circuit Board Guide, 6 inch	409-0026	50
----	Bulkhead Receptacle, Type N. Jack-to-Jack, UG30/U	418-0035	10
----	Contact, Pin, AMP 350967-1	417-0036	6
----	Adapter, 1 5/8 Inch EIA Flanged to Unflanged	427-0010	1
----	Power Supply, Computer Products, NFS80-7606, ±15V, +5%, +24 V, 85V to 264V Operation, 80W	540-0015	1
----	Power Supply, Pioneer Magnetics, PM33210BP-5	540-0016-001	5
----	48D40-2F-6B-127-R, 48V Adjustable, 2 kW, Power Factor Corrected		
----	FXi 250 Watt FM Transmitter/Exciter	909-9250	1
----	XPi 10 HD Exporter	909-6027-MB3	1
----	Control Switch Circuit Board Assembly	919-0406-101	1
----	Display Circuit Board Assembly	919-0406-102	1
----	Meter Switch Circuit Board Assembly	919-0406-103	1
----	Temperature Sensor Circuit Board Assembly	919-0406-105	1
----	RFI Filter Circuit Board Assembly	919-0562	1
----	Low-Pass Filter Input/RFI Filter Circuit Board Assembly	919-0415-003	1
----	Remote Interface Barrier Strip	919-0415-005	1
----	Power Supply Distribution Assembly	919-0415-500	1
----	Module Select Circuit Board Assembly	919-0415-501	1
----	Multiplexer Circuit Board Assembly	919-0415-502	1
----	Controller Assembly	919-0563-500	1
----	Motherboard Circuit Board Assembly	919-0513	1
----	Wire Harness	949-0416	1
----	RF Amplifier Module Assembly	959-0412-213	10
----	Low-Pass Filter Assembly	959-0414-001	1
----	Combiner Assembly	959-0418	1
----	Accessory Parts Kit, FMi 402/FMi 301	979-0413-200	1
----	Battery, 9V Alkaline	350-0002	1

TABLE 6-9. SINGLE PHASE FMi-301 TRANSMITTER, 220VAC - 909-0301-404

REF. DES.	DESCRIPTION	PART NO.	QTY.
B1 Thru B3	Fan, 10.00" Diameter, 230V ac	380-0124	3
CB1	Circuit Breaker, 60A, 250V ac, 2 Pole, E-Frame	341-0068	1
J1	Connector, Male, EDP20891-A	417-0388	1
K1	Optically Coupled Relay Circuit Board Assembly	919-0096-001	1
K2	Contactor, 2 Pole, 75A, 240V, 60 Hz, DP	341-0069	1
MOV1 Thru MOV3	Metal-Oxide Varistor, B40K275, 275V, 1680 Joules	140-0021	3
P1	Connector, Female, EDS10891-A	417-0387	1
P21	Connector Housing, 2-Pin, Male	418-0702	3
----	Air Filter, FXA 17.50"x 26.50"x.86"	407-0172	1
----	Circuit Board Guide, 6 inch	409-0026	50
----	Bulkhead Receptacle, Type N. Jack-to-Jack, UG30/U	418-0035	10
----	Contact, Pin, AMP 350967-1	417-0036	6
----	Adapter, 1 5/8 Inch EIA Flanged to Unflanged	427-0010	1
----	Power Supply, Computer Products, NFS80-7606, ±15V, +5%, +24 V, 85V to 264V Operation, 80W	540-0015	1
----	Power Supply, Pioneer Magnetics, PM33210BP-5	540-0016-001	4
----	48D40-2F-6B-127-R, 48V Adjustable, 2 kW, Power Factor Corrected		
----	FXi 250 Watt FM Transmitter/Exciter	909-9250	1
----	XPi 10 HD Exporter	909-6027-MB3	1
----	Control Switch Circuit Board Assembly	919-0406-101	1
----	Display Circuit Board Assembly	919-0406-102	1
----	Meter Switch Circuit Board Assembly	919-0406-103	1
----	Temperature Sensor Circuit Board Assembly	919-0406-105	1
----	RFI Filter Circuit Board Assembly	919-0562	1
----	Low-Pass Filter Input/RFI Filter Circuit Board Assembly	919-0415-003	1
----	Remote Interface Barrier Strip	919-0415-005	1
----	Power Supply Distribution Assembly	919-0415-400	1
----	Module Select Circuit Board Assembly	919-0415-401	1
----	Multiplexer Circuit Board Assembly	919-0415-402	1
----	Controller Assembly	919-0563-400	1
----	Motherboard Circuit Board Assembly	919-0513-001	1
----	Wire Harness	949-0416	1
----	RF Amplifier Module Assembly	959-0412-213	10
----	Low-Pass Filter Assembly	959-0414-001	1
----	Combiner Assembly	959-0418-001	1
----	Accessory Parts Kit, FMi 402/FMi 301	979-0413-200	1
----	Battery, 9V Alkaline	350-0002	1

TABLE 6-10. THREE PHASE FMi-402 TRANSMITTER, 220VAC - 909-0402-454

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	FM 402 Transmitter, SINGLE PHASE, 220V, 50/60 Hz	909-5001-204	1
	DELETE PARTS		
----	Circuit Breaker, 70A, 250V ac, 2 Pole, E-Frame	341-0067	1
----	Contactor, 2 Pole, 75A, 240V, 60 Hz, DP	341-0069	1
	ADD PARTS		
----	Fuse, AGC, 250V, 1/2 Ampere	330-0050	3
----	Contactor Coil: 208/240V ac 60 Hz or 190/220V ac 50 Hz Contacts: 3-Pole, 600V ac, 40 Amperes	341-0053	1
----	Circuit Breaker, 40A, 480VAC, 3 Pole, E-Frame	341-0070	1
----	AC Phase Monitor Relay, EUY C 240	270-0068	1
----	Fuse Holder, Single 350329 Littelfuse	415-0004	3
----	Harness, Add-On, FM-5C, Three Phase, Delta, 220V	949-0416-254	1

TABLE 6-11. THREE PHASE FMi-301 TRANSMITTER, 220VAC - 909-0301-454

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	FMi 301 Transmitter, 220V, 50/60Hz	909-0301-404	1
	DELETE PARTS		
----	Circuit Breaker, 70A, 250V ac, 2 Pole, E-Frame	341-0067	1
----	Contactor, 2 Pole, 75A, 240V, 60 Hz, DP	341-0069	1
	ADD PARTS		
----	Fuse, AGC, 250V, 1/2 Ampere	330-0050	3
----	AC Phase Monitor Relay, EUY C 240	270-0068	1
----	Contactor Coil: 208/240V ac 60 Hz or 190/220V ac 50 Hz Contacts: 3-Pole, 600V ac, 40 Amperes	341-0053	1
----	Circuit Breaker, 40A, 480VAC, 3 Pole, E-Frame	341-0070	1
----	Fuse Holder, Single 350329 Littelfuse	415-0004	3
----	Harness, Add-On, FM-5C, Three Phase, Delta, 220V	949-0416-254	1

TABLE 6-12. THREE PHASE FMi-402 TRANSMITTER, 380VAC - 909-0402-484

REF. DES.	DESCRIPTION	PART NO.	QTY.
——	FMi 402 Transmitter, 220V, 50/60 Hz	909–0402–404	1
	DELETE PARTS		
----	Circuit Breaker, 70A, 250V ac, 2 Pole, E–Frame	341–0067	1
----	Contactor, 2 Pole, 75A, 240V, 60 Hz, DP	341–0069	1
	ADD PARTS		
----	Contactor Coil: 208/240V ac 60 Hz or 190/220V ac 50 Hz Contacts: 3–Pole, 600V ac, 40 Amperes	341–0053	1
----	Circuit Breaker, 40A, 480VAC, 3 Pole, E–Frame	341–0070	1
----	Terminal, Male, 0.25 Tab	410–0064	1
----	Barrier Strip, 4 Terminal	412–0011	1
----	Add–On Harness, FM–5C, Three Phase, WYE, 380V	949–0416–384	1

TABLE 6-13. THREE PHASE FMi-301 TRANSMITTER, 380VAC - 909-0301-484

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	FMi 301 Transmitter, 220V, 50/60Hz	909-0301-404	1
	DELETE PARTS		
----	Circuit Breaker, 70A, 250V ac, 2 Pole, E-Frame	341-0067	1
----	Contactor, 2 Pole, 75A, 240V, 60 Hz, DP	341-0069	1
	ADD PARTS		
----	Contactor Coil: 208/240V ac 60 Hz or 190/220V ac 50 Hz Contacts: 3-Pole, 600V ac, 40 Amperes	341-0053	1
----	Circuit Breaker, 40A, 480V ac, 3 Pole, E-Frame	341-0070	1
----	Terminal, Male, 0.25 Tab	410-0064	1
----	Barrier Strip, 4 Terminal	412-0011	1
----	Barrier Strip, 3 Position, 4AWG	412-0049	1
----	Add-On Harness, FM-5C, Three Phase, WYE, 380V	949-0416-384	1

TABLE 6-14. OPTICALLY COUPLED RELAY CIRCUIT BOARD ASSEMBLY - 919-0096-001

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Optically Coupled Relay Circuit Board Assembly	919–0096	1
	DELETE PARTS		
C3	Capacitor, Ceramic Disc, 0.1 uF, 600V	000–1051	1
R2	Resistor, 560 Ohm ±5%, 1/2W	110–5633	1

TABLE 6-15. OPTICALLY COUPLED RELAY CIRCUIT BOARD ASSEMBLY - 919-0096

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1	Capacitor, Ceramic, 0.001 uF, 1 kV	002–1034	1
C2	Capacitor, Electrolytic, 47 uF, 35V	020–4773	1
C3	Capacitor, Ceramic Disc, 0.1 uF, 600V	000–1051	1
C4	Capacitor, Ceramic, 0.001 uF, 1 kV	002–1034	1
D1	Diode, 1N4005, Silicon, 600V @ 1 Ampere	203–4005	1
D2	Diode, Zener, 1N5359, 24V ±10%, 5W	200–5359	1
D4	Diode, 1N4005, Silicon, 600V @ 1 Ampere	203–4005	1
D5	Bridge Rectifier, MDA970A3, 4 Amps, 50–200V	239–0003	1
E1 thru E5	Terminal, Male Disconnect	410–0025	5
F1, F2	Fuse, 3 Amps, 250V, Printed Circuit Board Mount	330–0055	2
K1	Relay, Printed Circuit Board Mount Coil: 24V dc, 660 Ohm ±10% Contacts: SPST–NO, 0.5 to 15A @ 12 to 240V ac Resistance	270–0054	1
MOV1	Varistor, 27V, V27ZA60	140–0023	1
R1	Resistor, 2 k Ohm ±3%, 10W, W/W	130–2032	1
R2	Resistor, 560 Ohm ±5%, 1/2W	110–5633	1
R3	Resistor, 820 Ohm ±5%, 1/2W	110–8233	1
R4	Resistor, 51.1 Ohm ±1%, 1/4W	103–5112	1
R5	Resistor, 2 k Ohm ±3%, 10W, W/W	130–2032	1
U1	Integrated Circuit, 4N33, Optical Isolator, NPN Photo Transistor/Infared Emitting Diode Type, 1500V Isolation, Response: 30 kHz Maximum, Current: 50 mA Maximum, 6–Pin DIP	229–0033	1
XU1	Socket, 6–Pin DIP	417–0600	1
----	Cover, Dust Relay, 35C620A	270–0054–001	1
----	Blank, Optically Coupled Relay Circuit Board	519–0096	1

TABLE 6-16. CONTROL SWITCH CIRCUIT BOARD ASSEMBLY - 919-0406-101

REF. DES.	DESCRIPTION	PART NO.	QTY.
C8 thru C14	Capacitor, Mica, 470 pF ±1%, 500V	040–4721	7
C15, C16	Capacitor, Monolythic Ceramic, 0.1 uF 20%, 50V	003–1054	2
C17	Capacitor, Mica, 470 pF ±1%, 500V	040–4721	1
D6, D12, D13, D15, D16	Diode, 1N4005, Silicon, 600V @ 1 Ampere	203–4005	5
DS1	Switch, PB, Momentary, LED Illuminated, Green	340–0140	1
J1	Receptacle, Male, 3–Pin In–line	417–0003	1
J101	Receptacle, 26–Pin Dual In–line	418–2602	1
K1	Relay, Coil: 12V dc Contact: DPDT, 120V ac @ 1 Ampere	270–0058	1
P1	Jumper, Programmable, 2–Pin	340–0004	1
Q1 thru Q3	Transistor, 2N7000, Mosfet, TO–92 Case	210–7000	3
R8	Resistor, 3.3 Meg Ohm ±5%, 1/4W	100–3373	1
R9, R10	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	2
R11	Resistor, 3.3 Meg Ohm ±5%, 1/4W	100–3373	1
R12	Resistor, 3.01 k Ohm ±1%, 1/4W	103–3014	1
R13	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R14	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R15	Resistor, 3.3 Meg Ohm ±5%, 1/4W	100–3373	1
R16	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R17	Resistor, 3.3 Meg Ohm ±5%, 1/4W	100–3373	1
R18	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R19	Resistor, 3.3 Meg Ohm ±5%, 1/4W	100–3373	1
R20 thru R22	Resistor, 715 Ohm ±1%, 1/4W	100–7132	3
R23, R24	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	2
R26	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R27	Resistor, 3.3 Meg Ohm ±5%, 1/4W	100–3373	1
R28, R29	Resistor, 715 Ohm ±1%, 1/4W	100–7132	2
R30	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R31	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R32	Resistor, 3.3 Meg Ohm ±5%, 1/4W	100–3373	1
S3	Switch, PB, Momentary, LED Illuminated, Green	340–0140	1
S4, S5	Switch, Pushbutton, Momentary, LED Illuminated, Red	340–0143	2
S6, S7	Switch, Pushbutton, Momentary, LED Illuminated, Yellow	340–0139	2
U3 thru U9	Integrated Circuit, H11AA1, Optical Isolator, AC Input NPN Phototransistor, 6–Pin Dual In–Line Package.	229–0111	7
U10, U11	Integrated Circuit, MC14106BP, Hex Schmitt Trigger, 14–Pin	228–4106	2
U12, U13	Integrated Circuit, ULN2004, 7 NPN Darlington Driver Pack, 16–Pin DIP	226–2004	2
U14	Integrated Circuit, H11AA1, Optical Isolator, AC Input NPN Phototransistor, 6–Pin Dual In–Line Package.	229–0111	1
XU3 thru XU9	Socket, 6–Pin DIP	417–0600	7
XU10, XU11	Socket, 14–Pin DIP	417–1404	2
XU12, UX13	Socket, 16–Pin DIP	417–1604	2
XU14	Socket, 6–Pin DIP	417–0600	1
----	Blank Control Switch Circuit Board Assembly	519–0406–101	1

TABLE 6-17. DISPLAY CIRCUIT BOARD ASSEMBLY - 919-0406-102

REF. DES.	DESCRIPTION	PART NO.	QTY.
C201	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	1
C202	Capacitor, Mica, 50 pF ±5%, 500V	040–5013	1
C203	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	1
C204	Capacitor, Mica, 390 pF ±5%, 100V	042–3922	1
C205	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	1
C206	Capacitor, Polyester Film, 0.033 uF ±10%, 200V	030–3353	1
C208 thru C213	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	6
D1	Integrated Circuit, LM3362Z–2.5, Precision Voltage Reference, 2.5V ±4%, –0 to +70°C, TO–92 Case	229–0336	1
DS201	Display, FE0502W–DU LCD 4 Digit, 0.7" High	320–0021	1
J201	Connector, Printed Circuit Board Mounting, 10–PIN (Dual 5)	418–1003	1
R201	Resistor, 1 Meg Ohm ±1%, 1/4W	103–1007	1
R202	Resistor, 4.02 k Ohm ±1%, 1/4W	103–4024	1
R203	Potentiometer, 2 k Ohm ±10%, 1/2W	178–2044	1
R204	Resistor, 19.1 k Ohm ±1%, 1/4W	103–1915	1
R205	Resistor, 182 k Ohm ±1%, 1/4W	103–1826	1
R206	Resistor, 3.3 Meg Ohm ±5%, 1/4W	100–3373	1
R207 thru R209	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	3
R210	Resistor, 2.49 k Ohm ±1%, 1/4W	103–2494	1
U201	Integrated Circuit, ICL7136CPL, 3–1/2–Digit A/D Converter,	220–7136	1
U202	Integrated Circuit, MC14070BCP, Quad Exclusive OR Gate, CMOS 14–Pin DIP	228–4071	1
XU201	Socket, 40–Pin DIP	417–4005	1
XU202	Socket, 14–Pin DIP	417–1404	1
----	Blank Display Circuit Board	519–0406–102	1

TABLE 6-18. METER SWITCH CIRCUIT BOARD ASSEMBLY - 919-0406-103

REF. DES.	DESCRIPTION	PART NO.	QTY.
J301	Receptacle, 26–Pin Dual In–line	418–2602	1
R301 thru R304	Resistor, 1 Ohm ±5%, 1/4W	100–1013	4
S301	Switch, 8 Section, 2PDT Pushbutton, Black/Yellow Indication	340–0124	1
S302	Switch, Toggle, SPDT, 5A @ 125V ac & 28V dc	348–0123	1
----	Blank, Meter Switch Circuit Board	519–0406–103	1

TABLE 6-19. TEMPERATURE SENSOR CIRCUIT BOARD ASSEMBLY - 919-0406-105

REF. DES.	DESCRIPTION	PART NO.	QTY.
C501	Capacitor, Mica, 390 pF ±5%, 100V	042–3922	1
C502	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	1
C503	Capacitor, Mica, 390 pF ±5%, 100V	042–3922	1
C504	Capacitor, Ceramic, 0.001 uF, 1 kV	002–1034	1
C505	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	1
C506	Capacitor, Ceramic, 0.001 uF, 1 kV	002–1034	1
J501	Socket, 4–Pin	418–0255	1
R501	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R502	Resistor, 2.21 k Ohm ±1%, 1/4W	103–2241	1
U501	Integrated Circuit, LM35DZ, Celsius Temperature Sensor, TO–92 Case	220–0035	1
----	Blank, Temperature Sensor Circuit Board	519–0406–105	1

TABLE 6-20. RFI FILTER CIRCUIT BOARD ASSEMBLY - 919-0562
(Sheet 1 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
C201 thru C218	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	18
C221 thru C228	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	8
D1 thru D8	Bidirectional Zener Transient Voltage Suppressor, Motorola SA13CA, +/–13V	201–0039	8
D9 thru D17	Bidirectional Zener Transient Voltage Suppressor, Motorola SA18C, Or SA18CA, +/–18V	201–0040	9
D18	Bidirectional Zener Transient Voltage Suppressor, Motorola SA13CA, +/–13V	201–0039	1
D19 thru D25	Bidirectional Zener Transient Voltage Suppressor, Motorola SA18C Or SA18CA, +/–18V	201–0040	7
FL1 thru FL25	EMI Suppression Filter, 10,000 pF ±30%, 3–Pin	411–0001	25
J19	Connector, PC 26 Positions, ANSLEY 609–2624	418–2602	1
J20	Receptacle, 25–Pin	417–2500	1
J21	Connector, 2–Pin	417–0700	1
J22	Socket, 4–Pin	418–0255	1
R201 thru R211	Resistor, 51.1 Ohm ±1%, 1/4W	103–5112	11
R212 thru R217	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	6
R218 thru R220	Resistor, 100 Ohm ±5%, 1/2W	110–1033	3
R221 thru R223	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	3
R224, R225	Resistor, Power, 47 Ohm ±5%, 3 1/4W, W/W	132–4721	2
R226, R227	Resistor, 51.1 Ohm ±1%, 1/4W	103–5112	2

TABLE 6-20. RFI FILTER CIRCUIT BOARD ASSEMBLY - 919-0435
(Sheet 2 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
R228	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	1
----	Blank, RFI Filter Board Circuit Board	519–0435	1

TABLE 6-21. LOW-PASS FILTER INPUT/RFI FILTER CIRCUIT BOARD ASSEMBLY - 919-0415-003

REF. DES.	DESCRIPTION	PART NO.	QTY.
C301, C302	Capacitor, Mica, 390 pF ±5%, 100V	042–3922	2
J301	Socket, 4–Pin	418–0255	1
J302	Receptacle, 6–Pin	417–0677	1
R301, R302	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	2
----	Blank, Low Pass Filter Input/RFI Filter Circuit Board	519–0415–003	1

TABLE 6-22. REMOTE INTERFACE BARRIER STRIP CIRCUIT BOARD ASSEMBLY - 919-0415-005

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	1
P20	Plug, 205737–1 AMP, Printed Circuit Board Mount, 25–PIN	417–2501	1
TB2	Barrier Strip, 30 Position, BEAU61–5–30–50	412–3000	1
----	Label, Remote Interface Circuit Board FM–5C	594–0415	1

TABLE 6-23. FM-5C/FMi 402 POWER SUPPLY DISTRIBUTION ASSEMBLY - 919-0415-500 FM-4C/FMi 301 POWER SUPPLY DISTRIBUTION ASSEMBLY - 919-0415-400

REF. DES.	DESCRIPTION	PART NO.	QTY.
	For 919-0415-500 ASSEMBLY		
C401 thru C407	Capacitor, Monolythic Ceramic, .47 uF ±10%, 50V	003–4743	7
	For 919-0415-400 ASSEMBLY		
C401 thru C404	Capacitor, Monolythic Ceramic, .47 uF ±10%, 50V	003–4743	4
C406, C408	Capacitor, Monolythic Ceramic, .47 uF ±10%, 50V	003–4743	2
	For 919-0415-500 ASSEMBLY		
J401 thru J405	Connector For Pioneer Power Supplies, 29–Pin	417–2900	5
	For 919-0415-400 ASSEMBLY		
J401 thru J404	Connector For Pioneer Power Supplies, 29–Pin	417–2900	4
J406	Connector, 20–Pin, MR Series, PCB	417–0230	1
R401	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
	For 919-0415-500 ASSEMBLY		
R402 thru R406	Resistor, 10 Ohm ±1%,1/4W	103–1021	5
	For 919-0415-400 ASSEMBLY		
R402 thru R405	Resistor, 10 Ohm ±1%,1/4W	103–1021	4
TP401 thru TP404	Terminal, Test Point, Oval, Red	413–0106	4
----	Busbar, Power Supply, FM–5C	471–5031	2
----	Blank Power Supply Motherboard, Main, FM–4C/FM–5C	519–0415–504	1
----	Blank, Power Supply Motherboard, SUB, FM–4C/FM–5C	519–0415–505	1

TABLE 6-24. FM-5C/FMi-402 MODULE SELECT CIRCUIT BOARD ASSY - 919-0415-501
FM-4C/FMi-301 MODULE SELECT CIRCUIT BOARD ASSEMBLY - 919-0415-401
(Sheet 1 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
	For 919-0415-501 ASSEMBLY		
C1 thru C3	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	3
	For 919-0415-401 ASSEMBLY		
C2, C3	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	2
	For 919-0415-501 ASSEMBLY		
DS1 thru DS5	Led, Red Diffused Chimney, P424, 70 mW, 20 mA, 4V	320–0037	5
	For 919-0415-401 ASSEMBLY		
DS1 thru DS4	Led, Red Diffused Chimney, P424, 70 mW, 20 mA, 4V	320–0037	4
DS6, DS7	LED, HD1107G, Green, 7–Segment High Efficiency Common Cathode	320–0022	2
J1	Connector, Header, 16–Pin, Printed Circuit Board Mount	417–1606	1
Q1	Transistor, 2N27000, FET, N–Channel, TO–92 Case	210–7000	1
	For 919-0415-501 ASSEMBLY		
R1 thru R20	Resistor, 1 k Ohm ±5%, 1/2W	110–1043	20
	For 919-0415-401 ASSEMBLY		
R1 thru R5	Resistor, 1 k Ohm ±5%, 1/2W	110–1043	5
R14 thru R20	Resistor, 1 k Ohm ±5%, 1/2W	110–1043	7
	For 919-0415-501 ASSEMBLY		
R21 thru R23	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	3
	For 919-0415-401 ASSEMBLY		
R22, R23	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	2
S1	Switch, Pushbutton, Momentary, LED Illuminated, Yellow	340–0139	1
	For 919-0415-501 ASSEMBLY		
TP1 thru TP3	Terminal, Test Point, Oval, Red	413–0106	3
	For 919-0415-401 ASSEMBLY		
TP1, TP3	Terminal, Test Point, Oval, Red	413–0106	2
	For 919-0415-501 ASSEMBLY		
U1, U2	Integrated Circuit, MC14511BCP, Seven Segment Driver	220–4511	2

TABLE 6-24. FM-5C/FMi-402 MODULE SELECT CIRCUIT BOARD ASSY - 919-0415-501
FM-4C/FMi-301 MODULE SELECT CIRCUIT BOARD ASSEMBLY - 919-0415-401
(Sheet 2 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
	For 919-0415-401 ASSEMBLY		
U2	Integrated Circuit, MC14511BCP, Seven Segment Driver	220–4511	1
U3	Integrated Circuit, CD4081B, Quad 2–Input AND Gate, CMOS, 14–Pin DIP	225–0008	1
	For 919-0415-501 ASSEMBLY		
XU1, XU2	Socket, 16–Pin DIP	417–1604	2
	For 919-0415-401 ASSEMBLY		
XU2	Socket, 16–Pin DIP	417–1604	1
XU3	Socket, 14–Pin DIP	417–1404	1
----	Blank Module Select Circuit Board	519–0415–501	1

TABLE 6-25. FM-5C/FMi-402 MULTIPLEXER CIRCUIT BOARD ASSY - 919-0415-502
FM-4C/FMi-301 MULTIPLEXER CIRCUIT BOARD ASSEMBLY - 919-0415-402
(Sheet 1 of 4)

REF. DES.	DESCRIPTION	PART NO.	QTY.
C201 thru C208	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	8
C209	Capacitor, Electrolytic, 1 uF, 50V	024–1064	1
C214 thru C218	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	5
C219	Capacitor, Monolythic Ceramic, .47 uF ±10% 50V	003–4743	1
C220	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	1
C221, C222	Capacitor, Electrolytic, 100 uF, 35V	020–1084	2
C223 thru C233	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	11
C234	Capacitor, Electrolytic, 100 uF ±10%, 35V	023–1085	1
C235	Capacitor, Electrolytic, 1 uF, 50V	020–1064	1
	For 919-0415-502 ASSEMBLY		
D201 thru D234	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203–4148	34
	For 919-0415-402 ASSEMBLY		
D201 thru D208	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203–4148	8
D211 thru D218	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203–4148	8
D221 thru D232	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203–4148	12

TABLE 6-25. FM-5C/FMi-402 MULTIPLEXER CIRCUIT BOARD ASSY - 919-0415-502
FM-4C/FMi-301 MULTIPLEXER CIRCUIT BOARD ASSEMBLY - 919-0415-402
(Sheet 2 of 4)

REF. DES.	DESCRIPTION	PART NO.	QTY.
D235, D236	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203–4148	2
	For 919-0415-502 ASSEMBLY		
J201 thru J210	Connector, Printed Circuit Board Mounting, 10–PIN(DUAL 5)	418–1003	10
	For 919-0415-402 ASSEMBLY		
J201 thru J208	Connector, Printed Circuit Board Mounting, 10–PIN(DUAL 5)	418–1003	8
J211	Connector, Header, 34–Pin, Male Printed Circuit Board Mount	417–3402	1
J212	Connector, Header, 16–Pin, Printed Circuit Board Mount	417–1606	1
J213	Receptacle, Male, 3–Pin In–line	417–0003	1
J214	Connector, Header, 2–Pin	417–4004	1
P213, P214	Jumper, Programmable, 2–Pin	340–0004	2
Q201	Transistor, 2N7000, Mosfet, TO–92 Case	210–7000	1
R201, R202	Resistor Network, 10 k Ohm ±2%, 1W Resistors, 8–Pin Single In–Line Package	226–1051	2
R203	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R204	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R205	Resistor, 1 Meg Ohm ±1%, 1/4W	103–1007	1
R206	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
	For 919-0415-502 ASSEMBLY		
R207 thru R216	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	10
	For 919-0415-402 ASSEMBLY		
R207 thru R214	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	8
	For 919-0415-502 ASSEMBLY		
R217, R218	Resistor, 10 Ohm ±1%, 1/4W	103–1021	2
	For 919-0415-402 ASSEMBLY		
R219, R220	Resistor, 10 Ohm ±1%, 1/4W	103–1021	2
R221	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R222	Resistor, 9.76 k Ohm ±1%, 1/4W	103–9764	1
R223	Resistor, 634 Ohm ±1%, 1/4W	103–6343	1
R224	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	1
R225	Resistor, 1.40 k Ohm ±1%, 1/4W	103–1404	1
R226	Resistor, 2 k Ohm ±1%, 1/4W	100–2041	1
R227	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R228	Resistor, 10 Ohm ±1%, 1/4W	103–1021	1
R229	Resistor, 10 M Ohm ±5%, 1/4W	100–1083	1
R230	Resistor, 10 Ohm ±1%, 1/4W	103–1021	1

TABLE 6-25. FM-5C/FMi-402 MULTIPLEXER CIRCUIT BOARD ASSY - 919-0415-502
FM-4C/FMi-301 MULTIPLEXER CIRCUIT BOARD ASSEMBLY - 919-0415-402
(Sheet 3 of 4)

REF. DES.	DESCRIPTION	PART NO.	QTY.
R231	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R232	Resistor, 10 Ohm ±1%, 1/4W	103–1021	1
R233	Resistor, 1 Meg Ohm ±1%, 1/4W	103–1007	1
R234	Resistor, 10 Ohm ±1%, 1/4W	103–1021	1
R235 thru R239	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	5
R240, R241	Resistor Network, 7–6.8 k Ohm 1% Resistors, 8–Pin Single In–Line Package	226–6800	2
	For 919-0415-402 ASSEMBLY		
R242 thru R247	Resistor, 10 Ohm ±1%, 1/4W	103–1021	6
R249	Resistor, 20.0 k Ohm ±1%, 1/4W	103–2051	1
R250	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R251	Resistor, 20.0 k Ohm ±1%, 1/4W	103–2051	1
R252	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R253	Resistor, 20.0 k Ohm ±1%, 1/4W	103–2051	1
R254	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R255	Resistor, 20.0 k Ohm ±1%, 1/4W	103–2051	1
R256	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R257	Resistor, 20.0 k Ohm ±1%, 1/4W	103–2051	1
R258	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R259	Resistor, 20.0 k Ohm ±1%, 1/4W	103–2051	1
R260	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R261	Resistor, 20.0 k Ohm ±1%, 1/4W	103–2051	1
R262	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R263	Resistor, 20.0 k Ohm ±1%, 1/4W	103–2051	1
R264	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R265	Resistor, 20.0 k Ohm ±1%, 1/4W	103–2051	1
	For 919-0415-502 ASSEMBLY		
R266	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R267	Resistor, 20.0 k Ohm ±1%, 1/4W	103–2051	1
R268	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R269	Resistor, 6.04 k Ohm ±1%, 1/4W	103–6044	1
R270	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
	For 919-0415-502 ASSEMBLY		
R271 thru R280	Resistor, 1 M Ohm ±1%, 1/4W	103–1007	10
	For 919-0415-402 ASSEMBLY		
R271 thru R278	Resistor, 1 M Ohm ±1%, 1/4W	103–1007	8
R281	Resistor, 499 k Ohm ±1%, 1/4W	103–4996	1
R282	Resistor, 5.1 M Ohm ±5%, 1/4W	100–5173	1

TABLE 6-25. FM-5C/FMi-402 MULTIPLEXER CIRCUIT BOARD ASSY - 919-0415-502
FM-4C/FMi-301 MULTIPLEXER CIRCUIT BOARD ASSEMBLY - 919-0415-402
(Sheet 4 of 4)

REF. DES.	DESCRIPTION	PART NO.	QTY.
R283	Resistor, 100 Ohm ±1%, 1/4W	100–1031	1
R284	Resistor, 4.99 k Ohm ±1%, 1/4W	100–5041	1
R285	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R286	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R287	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R288	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
U201 thru U204	Integrated Circuit, MC14067, 16 Channel Analog Multiplexer	228–4067	4
U205	Integrated Circuit, TLO74CN, Quad JFET–Input Operational Amplifier, 14–Pin DIP	221–0074	1
U206	Integrated Circuit, MC14082B, Dual, 4–Input, And Gate	220–4082	1
U207	Integrated Circuit, MC14516B, Binary Up/Down Counter, CMOS, 16–Pin DIP	228–4516	1
U208	Integrated Circuit, ULN2004, 7 NPN Darlington Driver Pack, 16–Pin DIP	226–2004	1
U209	Integrated Circuit, LM324N, Quad Operational Amplifier, 14–Pin DIP	220–0324	1
U210	Integrated Circuit, ULN2004, 7 NPN Darlington Driver Pack, 16–Pin DIP	226–2004	1
U211 thru U213	Integrated Circuit, TLO74CN, Quad JFET–Input Operational Amplifier, 14–Pin DIP	221–0074	3
XU201 thru XU204	Socket, 24–Pin DIP	417–2404	4
XU205, XU206	Socket, 14–Pin DIP	417–1404	2
XU207, XU208	Socket, 16–Pin DIP	417–1604	2
XU209	Socket, 14–Pin DIP	417–1404	1
XU210	Socket, 16–Pin DIP	417–1604	1
XU211 thru XU213	Socket, 14–Pin DIP	417–1404	3
----	Blank, Multiplexer Circuit Board	519–0415–502	1

TABLE 6-26. FM-5C/FMi-402 CONTROLLER CIRCUIT BOARD - 919-0563-500
(Sheet 1 of 7)

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1	Capacitor, Electrolytic, 10 uF, 50V	023–1076	1
C2	Capacitor, Electrolytic, 1000 uF ±20%, 35V	024–1000	1
C3	Capacitor, Electrolytic, 1 uF, 50V	024–1064	1
C4	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	1
C5	Capacitor, Electrolytic, 10 uF, 50V	023–1076	1
C6 thru C33	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	28
C34	Capacitor, Mica, 390 pF ±5%, 100V	042–3922	1
C35	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	1
C36	Capacitor, Poly, 0.33uF ±10%, 63V	030–3300	1
C37 thru C39	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	3
C40	Capacitor, Electrolytic, 10 uF, 50V	023–1076	1
C41 thru C44	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	4
C45, C46	Capacitor, Electrolytic, 1 uF, 50V	024–1064	2
C47 thru C49	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	3
C50,C51	Capacitor, Electrolytic, 1 uF, 50V	024–1064	1
C52,C53	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	2
C54	Capacitor, Electrolytic, 1 uF, 50V	024–1064	1
C55 thru C58	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	4
C59 thru C61	Capacitor, Mica, 330 pF ±°%, 500V	042–3322	3
C62, C63	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	2
C64	Capacitor, Electrolytic, 10 uF, 50V	023–1076	1
C65 thru C72	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	8
C73,C74	Capacitor, Monolythic Ceramic, 0.47uF, ±10%, 50V	003–4743	2
C75	Capacitor, Electrolytic, 10 uF, 50V	023–1076	1
C76 thru C80	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	5
D1, D2	Diode, Zener, 1N4733A, 5.1V ±5%, 1W	200–4733	2
D3	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203–4148	1
D4, D5	Diode, 1N4005, Silicon, 600V @ 1 Ampere	203–4005	2
D6, D7	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203–4148	2
D8	Diode, Volt Ref, LM336Z–2.5	229–0336	1
D9 thru D11	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203–4148	3
D13	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203–4148	1
D17	Diode, 1N4005, Silicon, 600V @ 1 Ampere	203–4005	1
D18 thru D20	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203–4148	1
D21	Diode, Zener, 1N4733A, 5.1V ±5%, 1W	200–4733	1
D22	Diode, 1N4005, Silicon, 600V @ 1 Ampere	203–4005	1
D23, D24	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203–4148	1
D26, D27	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203–4148	1
D29	Diode, 1N4005, Silicon, 600V @ 1 Ampere	203–4005	1
D30 thru D38	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203–4148	9
D39	Diode, 1N4005, Silicon, 600V @ 1 Ampere	203–4005	1
D40	Diode, Zener, 1N4733A, 5.1V ±5%, 1W	200–4733	1
D41	Diode, 1N4005, Silicon, 600V @ 1 Ampere	203–4005	1
D42 thru D46	Diode, Schotky, 20V, 1N5817	200–0019	5
D47 thru D51	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203–4148	5
J701	Connector, Printed Circuit Board Mounting, 10–PIN(DUAL 5)	418–1003	1
J702	Receptacle, 26–Pin Dual In–line	418–2602	1
J703	Connector, Header, 34–Pin, Male, Printed Circuit Board Mount	417–3402	1

TABLE 6-26. FM-5C/FMi-402 CONTROLLER CIRCUIT BOARD - 919-0563-500
(Sheet 2 of 7)

REF. DES.	DESCRIPTION	PART NO.	QTY.
J704	Socket, 4-Pin	418-0255	1
J705	Connector, Printed Circuit Board, MR, Male, 24-Pin	417-2401	1
J706, J707	Receptacle, 26-Pin Dual In-line	418-2602	2
J710 thru J717	Receptacle, Male, 3-Pin In-line	417-0003	8
J719 thru J722	Receptacle, Male, 3-Pin In-line	417-0003	4
J723	Receptacle, Header, Dual In-Line 8-Pin	417-1603	1
J724 thru J725	Receptacle, Male, 3-Pin In-line	417-0003	4
J726	Connector, 2 Pin	417-0700	1
J727, J728	Receptacle, Header, Dual In-Line 8-Pin	417-1603	2
P710 thru P717	Jumper, Programmable, 2-Pin	340-0004	8
P719 thru P725	Jumper, Programmable, 2-Pin	340-0004	7
P727, P728	Jumper, Programmable, 2-Pin	340-0004	2
Q1 thru Q10	Transistor, 2N27000, FET, N-Channel, TO-92 Case	210-7000	10
Q16, Q17	Field Effect Transistor, J270, P-Channel J-FET, TO-92 Case	210-0270	2
R1	Resistor, 470 Ohm ±5%, 1/2W	110-4733	1
R2	Resistor, 4.99 k Ohm ±1%, 1/4W	100-5041	1
R3	Resistor, 1 Meg Ohm ±1%, 1/4W	103-1007	1
R4	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	1
R5	Resistor, 34 k Ohm ±1%, 1/4W	103-3405	1
R6	Resistor, 10 Meg Ohm ±5%, 1/4W	100-1083	1
R7	Resistor, 49.9 k Ohm ±1%, 1/4W	103-4951	1
R8	Resistor, 102 k Ohm ±1%, 1/4W	103-1026	1
R9	Resistor, 4.87 k Ohm ±1%, 1/4W	103-4874	1
R10	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	1
R11, R12	Resistor, 2 k Ohm ±1%, 1/4W	100-2041	2
R13	Resistor Network, 8-10 k Ohm ±1%, 1/4W, 16-Pin DIP	226-1055	1
R14	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	1
R15	Resistor, 1 k Ohm ±1%, 1/4W	100-1041	1
R16	Resistor, 49.9 k Ohm ±1%, 1/4W	103-4951	1
R17	Resistor, 16.2 k Ohm ±1%, 1/4W	103-1625	1
R18	Resistor, 34 k Ohm ±1%, 1/4W	103-3405	1
R19	Resistor, 1.33 k Ohm ±1%, 1/4W	103-1331	1
R20	Resistor, 2 k Ohm ±1%, 1/4W	100-2041	1
R21	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	1
R22	Resistor, 1 k Ohm ±1%, 1/4W	100-1041	1
R23	Resistor, 100 k Ohm ±1%, 1/4W	103-1062	1
R24	Resistor, 24.9 k Ohm ±1%, 1/4W	103-2495	1
R25	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	1
R26	Resistor, 4.02 k Ohm ±1%, 1/4W	103-4024	1
R27	Resistor, 1 k Ohm ±1%, 1/4W	100-1041	1
R28	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	1
R29	Resistor, 1 k Ohm ±1%, 1/4W	100-1041	1
R30	Resistor, 39.2 k Ohm ±1%, 1/4W	100-3951	1

TABLE 6-26. FM-5C/FMi-402 CONTROLLER CIRCUIT BOARD - 919-0563-500
(Sheet 3 of 7)

REF. DES.	DESCRIPTION	PART NO.	QTY.
R31	Resistor, 20.0 k Ohm ±1%, 1/4W	103–2051	1
R32	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R33	Resistor, 1.33 k Ohm ±1%, 1/4W	103–1331	1
R34	Resistor, 2 k Ohm ±1%, 1/4W	100–2041	1
R35	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R36	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	1
R37	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R38	Resistor, 30.1 k Ohm ±1%, 1/4W	100–3051	1
R39	Resistor, 20.0 k Ohm ±1%, 1/4W	103–2051	1
R40	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R41	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	1
R42	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R43	Resistor, 30.1 k Ohm ±1%, 1/4W	100–3051	1
R44	Resistor, 20.0 k Ohm ±1%, 1/4W	103–2051	1
R45	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R46, R47	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	2
R48	Resistor, 2 k Ohm ±1%, 1/4W	100–2041	1
R49	Potentiometer, 10 k Ohm, 12 Turn	177–1058	1
R50	Resistor, 60.4 k Ohm ±1%, 1/4W	103–6045	1
R51	Resistor, 20 k Ohm ±1%, 1/4W	103–2051	1
R52	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R53	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	1
R54	Potentiometer, 10 k Ohm ±10%, 1/2W	177–1054	1
R55	Resistor, 97.6 k Ohm ±1%, 1/4W	100–9751	1
R56	Resistor, 2 k Ohm ±1%, 1/4W	100–2041	1
R57	Resistor, 150 k Ohm ±1%, 1/4W	103–1561	1
R58	Resistor, 24.9 k Ohm ±1%, 1/4W	103–2495	1
R59	Resistor, 1 Meg Ohm ±1%, 1/4W	103–1007	1
R60	Resistor, 8.06 k Ohm ±1%, 1/4W	103–8064	1
R61	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	1
R62	Resistor, 499 Ohm ±5%, 1/4W	103–4993	1
R63	Resistor, 3.01 k Ohm ±5%, 1/4W	103–3014	1
R64	Potentiometer, 10 k Ohm, 12 Turn	177–1058	1
R65	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R66	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	1
R67	Potentiometer, 10 k Ohm ±10%, 1/2W	177–1054	1
R68	Resistor, 97.6 k Ohm ±1%, 1/4W	100–9751	1
R69	Resistor, 2 k Ohm ±1%, 1/4W	100–2041	1
R70	Resistor, 150 k Ohm ±1%, 1/4W	103–1561	1
R71	Resistor, 24.9 k Ohm ±1%, 1/4W	103–2495	1
R72	Resistor, 2 k Ohm ±1%, 1/4W	100–2041	1
R73	Resistor, 1 Meg Ohm ±1%, 1/4W	103–1007	1
R74	Resistor, 9.09 k Ohm ±1%, 1/4W	103–9041	1
R75	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	1
R76	Resistor, 4.99 k Ohm ±1%, 1/4W	100–5041	1
R77	Resistor, 15 k Ohm ±5%, 1/4W	100–1551	1
R78	Potentiometer, 10 k Ohm ±10%, 1/2W	177–1054	1
R79	Resistor, 97.6 k Ohm ±1%, 1/4W	100–9751	1

TABLE 6-26. FM-5C/FMi-402 CONTROLLER CIRCUIT BOARD - 919-0563-500
(Sheet 4 of 7)

REF. DES.	DESCRIPTION	PART NO.	QTY.
R80	Resistor, 2 k Ohm ±1%, 1/4W	100–2041	1
R81	Resistor, 150 k Ohm ±1%, 1/4W	103–1561	1
R82	Resistor, 24.9 k Ohm ±1%, 1/4W	103–2495	1
R83	Resistor, 1 Meg Ohm ±1%, 1/4W	103–1007	1
R84	Resistor, 8.06 k Ohm ±1%, 1/4W	103–8064	1
R85	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	1
R86, R87	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	2
R88	Resistor, 12.7 k Ohm ±1%, 1/4W	103–1275	1
R89	Resistor, 34 k Ohm ±1%, 1/4W	103–3405	1
R90, R91	Resistor, 51.1 Ohm ±1%, 1/4W	103–5112	2
R92	Resistor, 2.43 k Ohm ±1%, 1/4W	103–2434	1
R93	Resistor, 4.32 k Ohm ±1%, 1/4W	103–4324	1
R94	Potentiometer, 5 k	177–5044	1
R95	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R96	Resistor, 1 Meg Ohm ±1%, 1/4W	103–1007	1
R97	Resistor, 36.5 k Ohm ±1%, 1/4W	103–3655	1
R98	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R99	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R100	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R101	Resistor, 1 Meg Ohm ±1%, 1/4W	103–1007	1
R102	Resistor, 196 k Ohm ±1%, 1/4W	103–1966	1
R103	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R104, R105	Resistor, 1 Meg Ohm ±1%, 1/4W	103–1007	2
R107	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R108	Resistor, 715 Ohm ±1%, 1/4W	100–7132	1
R109, R110	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	2
R111	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	1
R112	Potentiometer, 10 k Ohm, 12 Turn	177–1058	1
R113	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	1
R114	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R115	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R116	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R118	Resistor, 576 Ohm ±1%, 1/4W	103–5761	1
R119	Resistor, 4.99 k Ohm ±1%, 1/4W	100–5041	1
R120	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R121	Resistor, 34k Ohm ±1%, 1/4W	103–3405	1
R122, R123	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	2
R124	Resistor, 1 Meg Ohm ±1%, 1/4W	103–1007	1
R125	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	1
R126	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R129	Resistor, 4.99 k Ohm ±1%, 1/4W	100–5041	1
R130	Resistor, 3.01 k Ohm ±1%, 1/4W	103–3014	1
R131, R132	Resistor, 1 Meg Ohm ±1%, 1/4W	103–1007	2
R133 thru R135	Potentiometer, 10 k Ohm ±10%, 1/2W	177–1054	3
R136	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R137	Resistor, 4.02 k Ohm, ±1%, 1/4W	103–4024	1
R138, R139	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	2

TABLE 6-26. FM-5C/FMi-402 CONTROLLER CIRCUIT BOARD - 919-0563-500
(Sheet 5 of 7)

REF. DES.	DESCRIPTION	PART NO.	QTY.
R140, R141	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	2
R142	Resistor, 100 Ohm ±1%, 1/4W	100–1031	1
R143	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R144	Resistor, 100 Ohm ±1%, 1/4W	100–1031	1
R145, R146	Potentiometer, 5 k Ohm, 20 Turn	178–5045	2
R147	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R148	Resistor, 2 k Ohm ±1%, 1/4W	100–2041	1
R149	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	1
R150	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R151 thru R155	Resistor, 82.5 k Ohm ±1%, 1/4W	103–8255	5
R156	Resistor, 4.99 k Ohm ±1%, 1/4W	100–5041	1
R157	Resistor, 105 k Ohm ±1%, 1/4W	103–1056	1
R158	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R159	Resistor, 51.1 k Ohm ±1%, 1/4W	103–5115	1
R160	Resistor, 178 k Ohm ±1%, 1/4W	103–1761	1
R162	Resistor, 140 Ohm ±1%, 1/4W	103–1403	1
R163,R164	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	2
R165	Resistor, 66.5 k Ohm ±1%, 1/4W	103–6655	1
R166	Resistor, 1 Meg Ohm ±1%, 1/4W	103–1007	1
R167	Resistor, 150 k Ohm ±1%, 1/4W	103–1561	1
R171	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R172	Resistor, 20.0 k Ohm ±1%, 1/4W	103–2051	1
R173	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R175	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R176	Resistor, 732 k Ohm ±1%, 1/4W	103–7326	1
R177	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R178	Resistor, 10 Ohm ±5%, 1/4W	100–1024	1
R179	Resistor, 1 Meg Ohm ±1%, 1/4W	103–1007	1
R180	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R181	Resistor, 2.49 k Ohm ±1%, 1/4W	103–2494	1
R182	Resistor, 12.4 k Ohm ±1%, 1/4W	103–1245	1
R183 thru R187	Resistor, 100 Ohm ±1%, 1/4W	100–1031	5
R188 thru R192	Resistor, 1 Ohm ±5%, 1/4W	100–1013	5
R193	Resistor, 6.98 k Ohm ±1%, 1/4W	103–6984	1
R194	Resistor, 2 k Ohm ±1%, 1/4W	100–2041	1
R195	Resistor, 6.98 k Ohm ±1%, 1/4W	103–6984	1
R196	Resistor, 2 k Ohm ±1%, 1/4W	100–2041	1
R197	Resistor, 6.98 k Ohm ±1%, 1/4W	103–6984	1
R198	Resistor, 2 k Ohm ±1%, 1/4W	100–2041	1
R203	Resistor, 1 Ohm ±5%, 1/4W	100–1013	1
R205	Resistor, 1 Ohm ±5%, 1/4W	100–1013	1
R209	Resistor, 4.32 k Ohm ±1%, 1/4W	103–4324	1
R210	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R211	Resistor, 4.99 k Ohm ±1%, 1/4W	103–5041	2

TABLE 6-26. FM-5C/FMi-402 CONTROLLER CIRCUIT BOARD - 919-0563-500
(Sheet 6 of 7)

REF. DES.	DESCRIPTION	PART NO.	QTY.
R212 thru R214	Resistor, 4.42 k Ohm ±1%, 1/4W	103-4441	3
R215	Resistor, 4.87 k Ohm ±1%, 1/4W	103-4874	1
R216	Resistor, 1.40 k Ohm ±1%, 1/4W	103-1404	1
R217	Resistor, 100 k Ohm ±1%, 1/4W	103-1062	1
R218	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	1
R219	Resistor, 100 k Ohm ±1%, 1/4W	103-1062	1
R220	Resistor, 11 k Ohm ±1%, 1/4W	103-1105	1
R221	Resistor, 100 k Ohm ±1%, 1/4W	103-1062	1
R222	Resistor, 51.1 Ohm ±1%, 1/4W	103-5112	1
R223	Resistor, 100 k Ohm ±1%, 1/4W	103-1062	1
R224, R225	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	2
R226	Resistor, 51.1 Ohm ±1%, 1/4W	103-5112	1
R227	Resistor, 28.7 k Ohm ±1%, 1/4W	103-2851	1
R228	Resistor, 11.5 k Ohm ±1%, 1/4W	103-1155	1
R229	Resistor, 33.2 k Ohm ±1%, 1/4W	103-3325	1
R230	Resistor, 13.7 k Ohm ±1%, 1/4W	103-1375	1
RN1, RN2	Resistor, Network, 100 K, 8-Pin Single-In-Line Package	226-1061	2
TP1 thru TP18	Terminal, Test Point, Oval Red	413-0106	17
U1	Integrated Circuit, Low Power OP Amp, 17 uA, 8-Pin DIP	220-0078	1
U2 thru U6	Integrated Circuit, TLO74CN, Quad JFET-Input Operational Amplifier, 14-Pin DIP	221-0074	5
U7	Integrated Circuit, MC14106BCP, Hex Schmitt Trigger, 14-Pin	228-4106	1
U8	Integrated Circuit, MC14011BCP, Quad 2-Input NAND Gate, CMOS, 14-Pin DIP	228-4011	1
U9 thru U11	Integrated Circuit, MC14516B, Binary Up/Down Counter, CMOS, 16-Pin DIP	228-4516	3
U12, U13	Integrated Circuit, MC14503B, Hex Non-Inverting 3-State Buffer, CMOS, 16-Pin DIP	228-4503	2
U14, U15	Integrated Circuit, 14505, Hex Level Shifter, TTL to CMOS, 16-Pin DIP	228-4504	2
U16	Integrated Circuit, AD565AJ, 12-Bit Digital/Analog Converter, 24-Pin DIP	220-0565	1
U17	Integrated Circuit, NE555N, Timer, 8-Pin DIP	229-0555	1
U18	Integrated Circuit, TLO74CN, Quad JFET-Input Operational Amplifier, 14-Pin DIP	221-0074	1
U19	Integrated Circuit, ULN2004, 7 NPN Darlington Driver Pack, 16-Pin DIP	226-2004	1
U20	Integrated Circuit, NE555N, Timer, 8-Pin DIP	229-0555	1
U21	Integrated Circuit, TLO74CN, Quad JFET-Input Operational Amplifier, 14-Pin DIP	221-0074	1
U22	Integrated Circuit, LM339AN, Quad Comparator, 14-Pin DIP	221-0339	1
U23	Integrated Circuit, 4N33, Optical Isolator, NPN Photo Transistor/Infared Emitting Diode Type, 1500V Isolation, Response: 30 kHz Maximum, Current: 50 mA Maximum, 6-Pin DIP	229-0033	1
U24	Integrated Circuit, TLO74CN, Quad JFET-Input Operational Amplifier, 14-Pin DIP	221-0074	1
U25 thru U27	Integrated Circuit, CA3183E, Five Transistor Array, NPN, 16-Pin DIP	220-3183	3

TABLE 6-26. FM-5C/FMi-402 CONTROLLER CIRCUIT BOARD - 919-0563-500
(Sheet 7 of 7)

REF. DES.	DESCRIPTION	PART NO.	QTY.
U28, U29	Integrated Circuit, CD4066BE, Quad Bilateral Switch, CMOS, 14–Pin DIP	225–0004	2
U30, U31	Integrated Circuit, LM339AN, Quad Comparator, 14–Pin DIP	221–0339	2
U32, U33	Voltage Comparator, LM393N	221–0393	2
U34	Voltage Regulator, 7805, ±5V, TO–92 Package	227–7805–1	1
U35	Integrated Circuit, Voltage Regulator, –12V, MC79L05, T0–92 CASE	227–7905–A	1
U36	Operational Amplifier, TL072CP	221–0072	1
XBT1	Battery Holder, 9 Volt Rectangular	415–0002	1
XR13	Socket, 16–Pin DIP	417–1604	1
XU1	Socket, 8–Pin DIP	417–0804	1
XU2 thru XU8	Socket, 14–Pin DIP	417–1404	7
XU9 thru XU15	Socket, 16–Pin DIP	417–1604	7
XU16	Socket, 24–Pin DIP	417–2404	1
XU17	Socket, 8–Pin DIP	417–0804	1
XU18	Socket, 14–Pin DIP	417–1404	1
XU19	Socket, 16–Pin DIP	417–1604	1
XU20	Socket, 8–Pin DIP	417–0804	1
XU21, XU22	Socket, 14–Pin DIP	417–1404	2
XU23	Socket, 6–Pin DIP	417–0600	1
XU24	Socket, 14–Pin DIP	417–1404	1
XU25 thru XU27	Socket, 16–Pin DIP	417–1604	3
XU28 thru XU31	Socket, 14–Pin DIP	417–1404	4
XU32, XU33, XU36	Socket, 8–Pin DIP	417–0804	1
----	Blank, Controller Circuit Board	519–0563	1

TABLE 6-27. FM-4C/FMi-301 CONTROLLER CIRCUIT BOARD - 919-0563-400
(Sheet 1 of 7)

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1	Capacitor, Electrolytic, 10 uF, 50V	023–1076	1
C2	Capacitor, Electrolytic, 1000 uF ±20%, 35V	024–1000	1
C3	Capacitor, Electrolytic, 1 uF, 50V	024–1064	1
C4	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	1
C5	Capacitor, Electrolytic, 10 uF, 50V	023–1076	1
C6 thru C33	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	28
C34	Capacitor, Mica, 390 pF ±5%, 100V	042–3922	1
C35	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	1
C36	Capacitor, Poly, 0.33uF ±10%, 63V	030–3300	1
C37 thru C39	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	3
C40	Capacitor, Electrolytic, 10 uF, 50V	023–1076	1
C41 thru C44	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	4
C45, C46	Capacitor, Electrolytic, 1 uF, 50V	024–1064	2
C47 thru C49	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	3
C50,C51	Capacitor, Electrolytic, 1 uF, 50V	024–1064	1
C52,C53	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	2
C54	Capacitor, Electrolytic, 1 uF, 50V	024–1064	1
C55 thru C58	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	4
C59 thru C61	Capacitor, Mica, 330 pF ±°%, 500V	042–3322	3
C62, C63	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	2
C64	Capacitor, Electrolytic, 10 uF, 50V	023–1076	1
C65 thru C69	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	5
C71	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	1
C73,C74	Capacitor, Monolythic Ceramic, 0.47uF, ±10%, 50V	003–4743	2
C75	Capacitor, Electrolytic, 10 uF, 50V	023–1076	1
C76 thru C80	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	5
D1, D2	Diode, Zener, 1N4733A, 5.1V ±5%, 1W	200–4733	2
D3	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203–4148	1
D4, D5	Diode, 1N4005, Silicon, 600V @ 1 Ampere	203–4005	2
D6, D7	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203–4148	2
D8	Diode, Volt Ref, LM336Z–2.5	229–0336	1
D9 thru D11	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203–4148	3
D13	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203–4148	1
D17	Diode, 1N4005, Silicon, 600V @ 1 Ampere	203–4005	1
D18 thru D20	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203–4148	1
D21	Diode, Zener, 1N4733A, 5.1V ±5%, 1W	200–4733	1
D22	Diode, 1N4005, Silicon, 600V @ 1 Ampere	203–4005	1
D23, D24	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203–4148	1
D26, D27	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203–4148	1
D29	Diode, 1N4005, Silicon, 600V @ 1 Ampere	203–4005	1
D30 thru D38	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203–4148	9
D39	Diode, 1N4005, Silicon, 600V @ 1 Ampere	203–4005	1
D40	Diode, Zener, 1N4733A, 5.1V ±5%, 1W	200–4733	1
D41	Diode, 1N4005, Silicon, 600V @ 1 Ampere	203–4005	1
D43 thru D46	Diode, Schotky, 20V, 1N5817	200–0019	4
D48 thru D51	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203–4148	4
J701	Connector, Printed Circuit Board Mounting, 10–PIN(DUAL 5)	418–1003	1
J702	Receptacle, 26–Pin Dual In–line	418–2602	1

TABLE 6-27. FM-4C/FMi-301 CONTROLLER CIRCUIT BOARD - 919-0563-400
(Sheet 2 of 7)

REF. DES.	DESCRIPTION	PART NO.	QTY.
J703	Connector, Header, 34-Pin, Male, Printed Circuit Board Mount	417-3402	1
J704	Socket, 4-Pin	418-0255	1
J705	Connector, Printed Circuit Board, MR, Male, 24-Pin	417-2401	1
J706, J707	Receptacle, 26-Pin Dual In-line	418-2602	2
J710 thru J717	Receptacle, Male, 3-Pin In-line	417-0003	8
J719 thru J722	Receptacle, Male, 3-Pin In-line	417-0003	4
J723	Receptacle, Header, Dual In-Line 8-Pin	417-1603	1
J724, J725	Receptacle, Male, 3-Pin In-line	417-0003	2
J726	Connector, 2 Pin	417-0700	1
J727, J728	Connector, 26-Pin	417-2600	2
P710 thru P717	Jumper, Programmable, 2-Pin	340-0004	8
P719 thru P725	Jumper, Programmable, 2-Pin	340-0004	7
P727, P728	Jumper, Programmable, 2-Pin	340-0004	2
Q1 thru Q10	Transistor, 2N27000, FET, N-Channel, TO-92 Case	210-7000	10
Q16, Q17	Field Effect Transistor, J270, P-Channel J-FET, TO-92 Case	210-0270	2
R1	Resistor, 470 Ohm ±5%, 1/2W	110-4733	1
R2	Resistor, 4.99 k Ohm ±1%, 1/4W	100-5041	1
R3	Resistor, 1 Meg Ohm ±1%, 1/4W	103-1007	1
R4	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	1
R5	Resistor, 34 k Ohm ±1%, 1/4W	103-3405	1
R6	Resistor, 10 Meg Ohm ±5%, 1/4W	100-1083	1
R7	Resistor, 49.9 k Ohm ±1%, 1/4W	103-4951	1
R8	Resistor, 102 k Ohm ±1%, 1/4W	103-1026	1
R9	Resistor, 4.87 k Ohm ±1%, 1/4W	103-4874	1
R10	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	1
R11, R12	Resistor, 2 k Ohm ±1%, 1/4W	100-2041	2
R13	Resistor Network, 8-10 k Ohm ±1%, 1/4W, 16-Pin DIP	226-1055	1
R14	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	1
R15	Resistor, 1 k Ohm ±1%, 1/4W	100-1041	1
R16	Resistor, 49.9 k Ohm ±1%, 1/4W	103-4951	1
R17	Resistor, 16.2 k Ohm ±1%, 1/4W	103-1625	1
R18	Resistor, 34 k Ohm ±1%, 1/4W	103-3405	1
R19	Resistor, 1.33 k Ohm ±1%, 1/4W	103-1331	1
R20	Resistor, 2 k Ohm ±1%, 1/4W	100-2041	1
R21	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	1
R22	Resistor, 1 k Ohm ±1%, 1/4W	100-1041	1
R23	Resistor, 100 k Ohm ±1%, 1/4W	103-1062	1
R24	Resistor, 24.9 k Ohm ±1%, 1/4W	103-2495	1
R25	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	1
R26	Resistor, 4.02 k Ohm ±1%, 1/4W	103-4024	1
R27	Resistor, 1 k Ohm ±1%, 1/4W	100-1041	1
R28	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	1
R29	Resistor, 1 k Ohm ±1%, 1/4W	100-1041	1
R30	Resistor, 39.2 k Ohm ±1%, 1/4W	100-3951	1

TABLE 6-27. FM-4C/FMi-301 CONTROLLER CIRCUIT BOARD - 919-0563-400
(Sheet 3 of 7)

REF. DES.	DESCRIPTION	PART NO.	QTY.
R31	Resistor, 20.0 k Ohm ±1%, 1/4W	103–2051	1
R32	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R33	Resistor, 1.33 k Ohm ±1%, 1/4W	103–1331	1
R34	Resistor, 2 k Ohm ±1%, 1/4W	100–2041	1
R35	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R36	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	1
R37	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R38	Resistor, 30.1 k Ohm ±1%, 1/4W	100–3051	1
R39	Resistor, 20.0 k Ohm ±1%, 1/4W	103–2051	1
R40	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R41	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	1
R42	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R43	Resistor, 30.1 k Ohm ±1%, 1/4W	100–3051	1
R44	Resistor, 20.0 k Ohm ±1%, 1/4W	103–2051	1
R45	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R46, R47	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	2
R48	Resistor, 2 k Ohm ±1%, 1/4W	100–2041	1
R49	Potentiometer, 10 k Ohm, 12 Turn	177–1058	1
R50	Resistor, 60.4 k Ohm ±1%, 1/4W	103–6045	1
R51	Resistor, 20 k Ohm ±1%, 1/4W	103–2051	1
R52	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R53	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	1
R54	Potentiometer, 10 k Ohm ±10%, 1/2W	177–1054	1
R55	Resistor, 97.6 k Ohm ±1%, 1/4W	100–9751	1
R56	Resistor, 2 k Ohm ±1%, 1/4W	100–2041	1
R57	Resistor, 150 k Ohm ±1%, 1/4W	103–1561	1
R58	Resistor, 24.9 k Ohm ±1%, 1/4W	103–2495	1
R59	Resistor, 1 Meg Ohm ±1%, 1/4W	103–1007	1
R60	Resistor, 10.2 k Ohm ±1%, 1/4W	103–1025	1
R61	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	1
R62	Resistor, 499 Ohm ±5%, 1/4W	103–4993	1
R63	Resistor, 3.01 k Ohm ±5%, 1/4W	103–3014	1
R64	Potentiometer, 10 k Ohm, 12 Turn	177–1058	1
R65	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R66	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	1
R67	Potentiometer, 10 k Ohm ±10%, 1/2W	177–1054	1
R68	Resistor, 97.6 k Ohm ±1%, 1/4W	100–9751	1
R69	Resistor, 2 k Ohm ±1%, 1/4W	100–2041	1
R70	Resistor, 150 k Ohm ±1%, 1/4W	103–1561	1
R71	Resistor, 24.9 k Ohm ±1%, 1/4W	103–2495	1
R72	Resistor, 2 k Ohm ±1%, 1/4W	100–2041	1
R73	Resistor, 1 Meg Ohm ±1%, 1/4W	103–1007	1
R74	Resistor, 11.5 k Ohm ±1%, 1/4W	103–1155	1
R75	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	1
R76	Resistor, 4.99 k Ohm ±1%, 1/4W	100–5041	1
R77	Resistor, 15 k Ohm ±5%, 1/4W	100–1551	1
R78	Potentiometer, 10 k Ohm ±10%, 1/2W	177–1054	1
R79	Resistor, 97.6 k Ohm ±1%, 1/4W	100–9751	1

TABLE 6-27. FM-4C/FMi-301 CONTROLLER CIRCUIT BOARD - 919-0563-400
(Sheet 4 of 7)

REF. DES.	DESCRIPTION	PART NO.	QTY.
R80	Resistor, 2 k Ohm ±1%, 1/4W	100–2041	1
R81	Resistor, 150 k Ohm ±1%, 1/4W	103–1561	1
R82	Resistor, 24.9 k Ohm ±1%, 1/4W	103–2495	1
R83	Resistor, 1 Meg Ohm ±1%, 1/4W	103–1007	1
R84	Resistor, 8.06 k Ohm ±1%, 1/4W	103–8064	1
R85	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	1
R86, R87	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	2
R88	Resistor, 12.7 k Ohm ±1%, 1/4W	103–1275	1
R89	Resistor, 34 k Ohm ±1%, 1/4W	103–3405	1
R90, R91	Resistor, 51.1 Ohm ±1%, 1/4W	103–5112	2
R92	Resistor, 2.43 k Ohm ±1%, 1/4W	103–2434	1
R93	Resistor, 4.32 k Ohm ±1%, 1/4W	103–4324	1
R94	Potentiometer, 5 k	177–5044	1
R95	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R96	Resistor, 1 Meg Ohm ±1%, 1/4W	103–1007	1
R97	Resistor, 43.2 k Ohm ±1%, 1/4W	103–4325	1
R98	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R99	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R100	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R101	Resistor, 1 Meg Ohm ±1%, 1/4W	103–1007	1
R102	Resistor, 232 k Ohm ±1%, 1/4W	103–2326	1
R103	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R104, R105	Resistor, 1 Meg Ohm ±1%, 1/4W	103–1007	2
R107	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R108	Resistor, 715 Ohm ±1%, 1/4W	100–7132	1
R109, R110	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	2
R111	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	1
R112	Potentiometer, 10 k Ohm, 12 Turn	177–1058	1
R113	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	1
R114	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R115	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R116	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R118	Resistor, 576 Ohm ±1%, 1/4W	103–5761	1
R119	Resistor, 4.99 k Ohm ±1%, 1/4W	100–5041	1
R120	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R121	Resistor, 34k Ohm ±1%, 1/4W	103–3405	1
R122, R123	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	2
R124	Resistor, 1 Meg Ohm ±1%, 1/4W	103–1007	1
R125	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	1
R126	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R129	Resistor, 4.99 k Ohm ±1%, 1/4W	100–5041	1
R130	Resistor, 3.01 k Ohm ±1%, 1/4W	103–3014	1
R131, R132	Resistor, 1 Meg Ohm ±1%, 1/4W	103–1007	2
R133 thru R135	Potentiometer, 10 k Ohm ±10%, 1/2W	177–1054	3
R136	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R137	Resistor, 4.02 k Ohm, ±1%, 1/4W	103–4024	1
R138, R139	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	2

TABLE 6-27. FM-4C/FMi-301 CONTROLLER CIRCUIT BOARD - 919-0563-400
(Sheet 5 of 7)

REF. DES.	DESCRIPTION	PART NO.	QTY.
R140, R141	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	2
R142	Resistor, 100 Ohm ±1%, 1/4W	100–1031	1
R143	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R144	Resistor, 100 Ohm ±1%, 1/4W	100–1031	1
R145, R146	Potentiometer, 5 k Ohm, 20 Turn	178–5045	2
R147	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R148	Resistor, 2 k Ohm ±1%, 1/4W	100–2041	1
R149	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	1
R150	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R151 thru R154	Resistor, 82.5 k Ohm ±1%, 1/4W	103–8255	4
R156	Resistor, 4.99 k Ohm ±1%, 1/4W	100–5041	1
R157	Resistor, 105 k Ohm ±1%, 1/4W	103–1056	1
R158	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R159	Resistor, 51.1 k Ohm ±1%, 1/4W	103–5115	1
R160	Resistor, 178 k Ohm ±1%, 1/4W	103–1761	1
R162	Resistor, 140 Ohm ±1%, 1/4W	103–1403	1
R163,R164	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	2
R165	Resistor, 66.5 k Ohm ±1%, 1/4W	103–6655	1
R166	Resistor, 1 Meg Ohm ±1%, 1/4W	103–1007	1
R167	Resistor, 150 k Ohm ±1%, 1/4W	103–1561	1
R171	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R172	Resistor, 20.0 k Ohm ±1%, 1/4W	103–2051	1
R173	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R175	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R176	Resistor, 732 k Ohm ±1%, 1/4W	103–7326	1
R177	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R178	Resistor, 10 Ohm ±5%, 1/4W	100–1024	1
R179	Resistor, 1 Meg Ohm ±1%, 1/4W	103–1007	1
R180	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R181	Resistor, 2.49 k Ohm ±1%, 1/4W	103–2494	1
R182	Resistor, 12.4 k Ohm ±1%, 1/4W	103–1245	1
R183 thru R186	Resistor, 100 Ohm ±1%, 1/4W	100–1031	4
R188 thru R191	Resistor, 1 Ohm ±5%, 1/4W	100–1013	4
R193	Resistor, 6.98 k Ohm ±1%, 1/4W	103–6984	1
R194	Resistor, 2 k Ohm ±1%, 1/4W	100–2041	1
R195	Resistor, 6.98 k Ohm ±1%, 1/4W	103–6984	1
R196	Resistor, 2 k Ohm ±1%, 1/4W	100–2041	1
R197	Resistor, 6.98 k Ohm ±1%, 1/4W	103–6984	1
R198	Resistor, 2 k Ohm ±1%, 1/4W	100–2041	1
R203	Resistor, 1 Ohm ±5%, 1/4W	100–1013	1
R205	Resistor, 1 Ohm ±5%, 1/4W	100–1013	1
R209	Resistor, 4.32 k Ohm ±1%, 1/4W	103–4324	1
R210	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R211	Resistor, 4.99 k Ohm ±1%, 1/4W	100–5041	1

TABLE 6-27. FM-4C/FMi-301 CONTROLLER CIRCUIT BOARD - 919-0563-400
(Sheet 6 of 7)

REF. DES.	DESCRIPTION	PART NO.	QTY.
R212 thru R214	Resistor, 4.42 k Ohm ±1%, 1/4W	103–4441	3
R215	Resistor, 4.87 k Ohm ±1%, 1/4W	103–4874	1
R216	Resistor, 1.40 k Ohm ±1%, 1/4W	103–1404	1
R217	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R218	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R219	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R220	Resistor, 11 k Ohm ±1%, 1/4W	103–1105	1
R221	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R222	Resistor, 51.1 Ohm ±1%, 1/4W	103–5112	1
R223	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R224, R225	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	2
R226	Resistor, 51.1 Ohm ±1%, 1/4W	103–5112	1
R227	Resistor, 36.5 k Ohm ±1%, 1/4W	103–3655	1
R228	Resistor, 15.4 k Ohm ±1%, 1/4W	103–1551	1
R229	Resistor, 17.4 k Ohm ±1%, 1/4W	103–1745	1
R230	Resistor, 41.2 k Ohm ±1%, 1/4W	103–4125	1
RN1, RN2	Resistor, Network, 100 K, 8–Pin Single–In–Line Package	226–1061	2
TP1 thru TP18	Terminal, Test Point, Oval Red	413–0106	17
U1	Integrated Circuit, Low Power OP Amp, 17 uA, 8–Pin DIP	220–0078	1
U2 thru U6	Integrated Circuit, TLO74CN, Quad JFET–Input Operational Amplifier, 14–Pin DIP	221–0074	5
U7	Integrated Circuit, MC14106BCP, Hex Schmitt Trigger, 14–Pin	228–4106	1
U8	Integrated Circuit, MC14011BCP, Quad 2–Input NAND Gate, CMOS, 14–Pin DIP	228–4011	1
U9 thru U11	Integrated Circuit, MC14516B, Binary Up/Down Counter, CMOS, 16–Pin DIP	228–4516	3
U12, U13	Integrated Circuit, MC14503B, Hex Non–Inverting 3–State Buffer, CMOS, 16–Pin DIP	228–4503	2
U14, U15	Integrated Circuit, 14505, Hex Level Shifter, TTL to CMOS, 16–Pin DIP	228–4504	2
U16	Integrated Circuit, AD565AJ, 12–Bit Digital/Analog Converter, 24–Pin DIP	220–0565	1
U17	Integrated Circuit, NE555N, Timer, 8–Pin DIP	229–0555	1
U18	Integrated Circuit, TLO74CN, Quad JFET–Input Operational Amplifier, 14–Pin DIP	221–0074	1
U19	Integrated Circuit, ULN2004, 7 NPN Darlington Driver Pack, 16–Pin DIP	226–2004	1
U20	Integrated Circuit, NE555N, Timer, 8–Pin DIP	229–0555	1
U21	Integrated Circuit, TLO74CN, Quad JFET–Input Operational Amplifier, 14–Pin DIP	221–0074	1
U22	Integrated Circuit, LM339AN, Quad Comparator, 14–Pin DIP	221–0339	1
U23	Integrated Circuit, 4N33, Optical Isolator, NPN Photo Transistor/Infared Emitting Diode Type, 1500V Isolation, Response: 30 kHz Maximum, Current: 50 mA Maximum, 6–Pin DIP	229–0033	1
U24	Integrated Circuit, TLO74CN, Quad JFET–Input Operational Amplifier, 14–Pin DIP	221–0074	1
U25 thru U27	Integrated Circuit, CA3183E, Five Transistor Array, NPN, 16–Pin DIP	220–3183	3

TABLE 6-27. FM-4C/FMi-301 CONTROLLER CIRCUIT BOARD - 919-0563-400
(Sheet 7 of 7)

REF. DES.	DESCRIPTION	PART NO.	QTY.
U28, U29	Integrated Circuit, CD4066BE, Quad Bilateral Switch, CMOS, 14–Pin DIP	225–0004	2
U30, U31	Integrated Circuit, LM339AN, Quad Comparator, 14–Pin DIP	221–0339	2
U34	Voltage Regulator, 7805, ±5V, TO–92 Package	227–7805–1	1
U35	Integrated Circuit, Voltage Regulator, –12V, MC79L05, T0–92 CASE	227–7905–A	1
U36	Operational Amplifier, TL072CP	221–0072	1
XBT1	Battery Holder, 9 Volt Rectangular	415–0002	1
XR13	Socket, 16–Pin DIP	417–1604	1
XU1	Socket, 8–Pin DIP	417–0804	1
XU2 thru XU8	Socket, 14–Pin DIP	417–1404	7
XU9 thru XU15	Socket, 16–Pin DIP	417–1604	7
XU16	Socket, 24–Pin DIP	417–2404	1
XU17	Socket, 8–Pin DIP	417–0804	1
XU18	Socket, 14–Pin DIP	417–1404	1
XU19	Socket, 16–Pin DIP	417–1604	1
XU20	Socket, 8–Pin DIP	417–0804	1
XU21, XU22	Socket, 14–Pin DIP	417–1404	2
XU23	Socket, 6–Pin DIP	417–0600	1
XU24	Socket, 14–Pin DIP	417–1404	1
XU25 thru XU27	Socket, 16–Pin DIP	417–1604	3
XU28 thru XU31	Socket, 14–Pin DIP	417–1404	4
XU36	Socket, 8–Pin DIP	417–0804	1
----	Blank, Controller Circuit Board	519–0563	1

TABLE 6-28. FM-5C/FMi-402 MOTHERBOARD CIRCUIT BOARD ASSEMBLY - 919-0513
FM-4C/FMi-301 MOTHERBOARD ASSEMBLY - 919-0513-001
(Sheet 1 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
C601	Capacitor, Mylar, 0.1 uF ±10%, 100V	030–1053	1
C602	Capacitor, Electrolytic, 47 uF, 35V	020–4770	1
C603	Capacitor, Mylar, 0.1 uF ±10%, 100V	030–1053	1
C604	Capacitor, Electrolytic, 47 uF, 35V	020–4770	1
C605	Capacitor, Mylar, 0.1 uF ±10%, 100V	030–1053	1
C606	Capacitor, Electrolytic, 47 uF, 35V	020–4770	1
C607	Capacitor, Mylar, 0.1 uF ±10%, 100V	030–1053	1
C608	Capacitor, Electrolytic, 47 uF, 35V	020–4770	1
C609	Capacitor, Mylar, 0.1 uF ±10%, 100V	030–1053	1
C610	Capacitor, Electrolytic, 47 uF, 35V	020–4770	1
C611	Capacitor, Mylar, 0.1 uF ±10%, 100V	030–1053	1
C612	Capacitor, Electrolytic, 47 uF, 35V	020–4770	1
C613	Capacitor, Mylar, 0.1 uF ±10%, 100V	030–1053	1
C614	Capacitor, Electrolytic, 47 uF, 35V	020–4770	1
C615	Capacitor, Mylar, 0.1 uF ±10%, 100V	030–1053	1
C616	Capacitor, Electrolytic, 47 uF, 35V	020–4770	1
	For 919-0513-001 ASSEMBLY		
C617	Capacitor, Mylar, 0.1 uF ±10%, 100V	030–1053	1
C618	Capacitor, Electrolytic, 47 uF, 35V	020–4770	1
C619	Capacitor, Mylar, 0.1 uF ±10%, 100V	030–1053	1
C620	Capacitor, Electrolytic, 47 uF, 35V	020–4770	1
C621	Capacitor, Ceramic Chip, 68 pF ±5%, 500V	009–6813	1
C622	Capacitor, Trimmer, Ceramic, 5.5–18 pF, NPO, 350V	096–0011	1
	For 919-0513 ASSEMBLY		
C623 thru C632	Capacitor, Ceramic Chip, 56 pF ±5%, 500V	009–5613	10
	For 919-0513-001 ASSEMBLY		
C623 thru C630	Capacitor, Ceramic Chip, 56 pF ±5%, 500V	009–5613	10
	For 919-0513 ASSEMBLY		
J601 thru J610	Connector, Printed Circuit Board Mounting, 10–Pin (Dual 5)	418–1003	10
	For 919-0513-001 ASSEMBLY		
J601 thru J608	Connector, Printed Circuit Board Mounting, 10–Pin (Dual 5)	418–1003	8
	For 919-0513 ASSEMBLY		
J611 thru J620	Connector, PCB D, RF/Logic/Power	417–0322	10

TABLE 6-28. FM-5C/FMi-402 MOTHERBOARD CIRCUIT BOARD ASSEMBLY - 919-0513
FM-4C/FMi-301 MOTHERBOARD ASSEMBLY - 919-0513-001
(Sheet 2 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
	For 919-0513-001 ASSEMBLY		
J611 thru J618	Connector, PCB D, RF/Logic/Power	417–0322	8
R601	Resistor, 57.6 k Ohm ±1%, 1/4W	103–5765	1
R602	Resistor, .005 Ohm ±3%, 5W,	139–0007	1
R603, R604	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	2
R605	Resistor, 57.6 k Ohm ±1%, 1/4W	103–5765	1
R606	Resistor, .005 Ohm ±3%, 5W	139–0007	1
R607, R608	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	2
R609	Resistor, 57.6 k Ohm ±1%, 1/4W	103–5765	1
R610	Resistor, .005 Ohm ±3%, 5W	139–0007	1
R611, R612	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	2
R613	Resistor, 57.6 k Ohm ±1%, 1/4W	103–5765	1
R614	Resistor, .005 Ohm ±3%, 5W	139–0007	1
R615, R616	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	2
R617	Resistor, 57.6 k Ohm ±1%, 1/4W	103–5765	1
R618	Resistor, .005 Ohm ±3%, 5W	139–0007	1
R619, R620	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	2
R621	Resistor, 57.6 k Ohm ±1%, 1/4W	103–5765	1
R622	Resistor, .005 Ohm ±3%, 5W	139–0007	1
R623, R624	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	2
R625	Resistor, 57.6 k Ohm ±1%, 1/4W	103–5765	1
R626	Resistor, .005 Ohm ±3%, 5W	139–0007	1
R627, R628	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	2
R629	Resistor, 57.6 k Ohm ±1%, 1/4W	103–5765	1
R630	Resistor, .005 Ohm ±3%, 5W	139–0007	1
R631, R632	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	2
	For 919-0513 ASSEMBLY		
R633	Resistor, 57.6 k Ohm ±1%, 1/4W	103–5765	1
R634	Resistor, .005 Ohm ±3%, 5W	139–0007	1
R635, R636	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	2
R637	Resistor, 57.6 k Ohm ±1%, 1/4W	103–5765	1
R638	Resistor, .005 Ohm ±3%, 5W	139–0007	1
R639, R640	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	2
R641 thru R650	Resistor, 50 Ohm ±5% , 40W, Flange Mount	131–5029	10
	For 919-0513-001 ASSEMBLY		
R641 thru R648	Resistor, 50 Ohm ±5% , 40W, Flange Mount	131–5029	8
----	Blank, Motherboard, Main, Circuit Board	519–0513	1
----	Blank, Motherboard, SUB, Circuit Board	519–0513–001	1
----	Blank, Motherboard Input Circuit Board	519–0513–002	1
----	Motherboard Cable Assembly	949–0418	1

TABLE 6-29. WIRE HARNESS - 949-0416

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Wire Harness	949–0416	1

TABLE 6-30. RF AMPLIFIER MODULE ASSEMBLY - 959-0412-013

REF. DES.	DESCRIPTION	PART NO.	QTY.
C13, C16, C27, C30	Capacitor, Ceramic Chip, 470 pF ±5%, 200V	009–4723	4
C14, C15, C28, C29	Capacitor, Ceramic Chip, 270 pF ±5%, 300V	009–2723	4
C39, C40,	Capacitor, Ceramic Chip, 47 pF ±5%, 500V	009–4713	2
C41, C42	Capacitor, Ceramic Chip, 15 pF ±5%, 500V	009–1513	2
Q1, Q2	Transistor, RF Power, SD2932	210–2932	2
R1	Resistor, 50 Ohm ±1%, 20W	132–5002	1
R201	Resistor, 50 Ohm, 250W	131–5030	1
T1, T2	Transformer, RF Amplifier Output	370–0052	2
----	RF Amplifier Module Logic Circuit Board Assembly	919–0417–012	1
----	RF Amplifier Circuit Board Assembly	919–0416–213	1
----	RF Amplifier Module Low Pass Filter/Directional Coupler Circuit Board Assembly	919–0418–011	1
----	RF Amplifier Module Low–Pass Filter Circuit Board Assembly	919–0418–002	1
----	Blank, Module Combiner Shield Circuit Board	519–0419	1
----	Blank, Module Combiner Circuit Board	519–0420	2

TABLE 6-31. RF AMPLIFIER MODULE ASSEMBLY - 959-0412-213

REF. DES.	DESCRIPTION	PART NO.	QTY.
C13, C16, C27, C30	Capacitor, Ceramic Chip, 470 pF ±5%, 200V	009–4723	4
C14, C15, C28, C29	Capacitor, Ceramic Chip, 270 pF ±5%, 300V	009–2723	4
C39, C40,	Capacitor, Ceramic Chip, 47 pF ±5%, 500V	009–4713	2
C41, C42	Capacitor, Ceramic Chip, 15 pF ±5%, 500V	009–1513	2
Q1, Q2	Transistor, RF Power, SD2932	210–2932	2
R1	Resistor, 50 Ohm ±1%, 20W	132–5002	1
R201	Resistor, 50 Ohm, 250W	131–5030	1
T1, T2	Transformer, RF Amplifier Output	370–0052	2
----	RF Amplifier Module Logic Circuit Board Assembly	919–0417–012	1
----	RF Amplifier Circuit Board Assembly	919–0416–213	1
----	RF Amplifier Module Low Pass Filter/Directional Coupler Circuit Board Assembly	919–0418–011	1
----	RF Amplifier Module Low–Pass Filter Circuit Board Assembly	919–0418–002	1
----	Blank, Module Combiner Shield Circuit Board	519–0419	1
----	Blank, Module Combiner Circuit Board	519–0420	2

TABLE 6-32. RF AMPLIFIER LOGIC CIRCUIT BOARD ASSEMBLY - 919-0417-012 (Sheet 1 of 3)

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1	Capacitor, Ceramic Disc, 20 pF ±10%, 1kV	002–2013	1
C2	Capacitor, Monolythic Ceramic, .047 uF ±5% 50V	003–4733	1
C3, C4	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	2
C5, C6	Capacitor, Monolythic Ceramic, .047 uF ±5% 50V	003–4733	2
C7 thru C10	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	4
C11	Capacitor, Monolythic Ceramic, .047 uF ±5% 50V	003–4733	1
C12 thru C14	Capacitor, Ceramic Disc, 20 pF ±10%, 1kV	002–2013	3
C15	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	1
C16 thru C18	Capacitor, Electrolytic, 10 uF, 50V	023–1076	3
C19	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	1
C20	Capacitor, Electrolytic, 10 uF, 50V	023–1076	1
C21	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	1
C22	Capacitor, Electrolytic, 10 uF, 50V	023–1076	1
C23, C24	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003–1054	2
C25, C26	Capacitor, Ceramic Disc, 20 pF ±10%, 1kV	002–2013	2
D1 thru D16	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203–4148	16
D17	Diode, Zener, 1N4742A, 12V ±5%, 1W	200–4742	1
D19 thru D21	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203–4148	3
D22, D23	Diode, HP5082–2800, High Voltage, Schottky Barrier Type, 70V, 15 mA	201–2800	2
D24, D25	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203–4148	2

TABLE 6-32. RF AMPLIFIER LOGIC CIRCUIT BOARD ASSEMBLY - 919-0417-012
(Sheet 2 of 3)

REF. DES.	DESCRIPTION	PART NO.	QTY.
P801	Receptacle, 40-Pin Dual In-line	417-4041	1
Q1, Q2, Q5 thru Q7	Transistor, MPSA06, NPN, TO-92 Case	211-0006	5
Q8	Transistor, 2N3906, PNP, Silicon, TO-92 Case	210-3906	1
R1	Resistor Network, 5 k Ohm ±1%, 1/4W, 16-Pin DIP	226-0500	1
R2	Resistor, 499 k Ohm, ±1%, 1/4W	103-4996	1
R3	Resistor, 2.74 k Ohm ±1%, 1/4W	103-2744	1
R4	Resistor, 499 k Ohm, ±1%, 1/4W	103-4996	1
R5	Potentiometer, 10 k Ohm ±10% 1/2W	178-1054	1
R6 thru R8	Resistor, 22.1 k Ohm ±1%, 1/4W	103-2211	3
R9	Resistor, 182 k Ohm ±1%, 1/4W	103-1826	1
R10	Resistor, 22.1 k Ohm ±1%, 1/4W	103-2211	1
R11	Potentiometer, 200 Ohm ±10%, 1/2W	177-2035	1
R12	Resistor, 499 k Ohm, ±1%, 1/4W	103-4996	1
R13	Resistor, 2.74 k Ohm ±1%, 1/4W	103-2744	1
R14	Resistor, 8.25 k Ohm ±1%, 1/4W	103-8254	1
R15	Potentiometer, 10 k Ohm ±10% 1/2W	178-1054	1
R12	Resistor, 499 k Ohm, ±1%, 1/4W	103-4996	1
R16	Resistor, 499 k Ohm ±1%, 1/4W	103-4996	1
R17	Resistor, 2.74 k Ohm ±1%, 1/4W	103-2744	1
R18	Resistor, 499 k Ohm, ±1%, 1/4W	103-4996	1
R19	Resistor, 240 Ohm ±1%, 1/4W	103-2431	1
R20	Resistor, 499 k Ohm, ±1%, 1/4W	103-4996	1
R21	Resistor, 22.1 k Ohm ±1%, 1/4W	103-2211	1
R22	Resistor, 162 k Ohm ±1%, 1/4W	103-1626	1
R23	Resistor, 332 k Ohm, ±1%, 1/4W	103-3326	1
R24	Resistor, 22.1 k Ohm ±1%, 1/4W	103-2211	1
R25	Potentiometer, 10 k Ohm ±10% 1/2W	178-1054	1
R26	Resistor, 2.74 k Ohm ±1%, 1/4W	103-2744	1
R27	Resistor, 499 k Ohm, ±1%, 1/4W	103-4996	1
R28, R29	Resistor, 1 k Ohm ±1%, 1/4W	100-1041	2
R30	Resistor, 15.8 k Ohm ±1%, 1/4W	103-1585	1
R31, R32	Resistor, 499 k Ohm, ±1%, 1/4W	103-4996	2
R33	Resistor, 1.33 k Ohm ±1%, 1/4W	103-1331	1
R34	Resistor, 5.11 k Ohm ±1%, 1/4W	103-5141	1
R35	Resistor Network, 8-22 k Ohm 1/4W Resistors, 16-Pin DIP	226-2250	1
R36	Resistor, 221 k Ohm ±1%, 1/4W	103-2216	1
R37	Resistor, 1 k Ohm ±1%, 1/4W	100-1041	1
R38	Resistor, 15.8 k Ohm ±1%, 1/4W	103-1585	1
R39	Resistor, 1.33 k Ohm ±1%, 1/4W	103-1331	1
R40	Resistor, 1 k Ohm ±1%, 1/4W	100-1041	2
R41	Resistor, 9.09 k Ohm ±1%, 1/4W	103-9041	1
R42	Resistor, 499 k Ohm, ±1%, 1/4W	103-4996	1
R43	Resistor, 1 k Ohm ±1%, 1/4W	100-1041	1
R44, R45	Resistor, 22.1 k Ohm ±1%, 1/4W	103-2211	2
R46, R47	Resistor, 1 k Ohm ±1%, 1/4W	100-1041	2
R48	Resistor, 7.68 k Ohm, ±1%, 1/4W	103-7684	1
R49	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	2

TABLE 6-32. RF AMPLIFIER LOGIC CIRCUIT BOARD ASSEMBLY - 919-0417-012
(Sheet 3 of 3)

REF. DES.	DESCRIPTION	PART NO.	QTY.
R51	Potentiometer, 20 k Ohm ±10%, 1/2W	178–2054	1
R52	Resistor, 162 k Ohm ±1%, 1/4W	103–1626	1
R50, R53	Resistor, 5.11 k Ohm ±1%, 1/4W	103–5141	1
R54	Resistor, 47.5 k Ohm ±1%, 1/4W	103–4755	1
R55	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	1
R56	Resistor, 100 k Ohm ±1%, 1/4W	100–1062	1
R57, R58	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	2
R59, R60	Resistor, 51.1 Ohm ±1%, 1/4W	103–5112	2
R61	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	1
R62	Resistor, 5.11 k Ohm ±1%, 1/4W	103–5141	1
R63	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	1
R64	Resistor, 5.11 k Ohm ±1%, 1/4W	103–5141	1
R65	Resistor, 499 k Ohm, ±1%, 1/4W	103–4996	1
R66	Resistor, 47.5 k Ohm, ±1%, 1/4W	103–4755	1
R67	Resistor, 2.2 M Ohm ±5%, 1/4W	100–2273	1
R68	Resistor, 20.5 k Ohm ±1%, 1/4W	103–2055	1
R69	Resistor, 22.1 k Ohm ±1%, 1/4W	103–2211	1
R70	Resistor, 8.25 k Ohm ±1%, 1/4W	103–8254	1
R71	Resistor, 90.9 k Ohm ±1%, 1/4W	103–9095	1
R72	Resistor, 499 k Ohm, ±1%, 1/4W	103–4996	1
R73	Resistor, 78.7 k Ohm ±1%, 1/4W	103–7875	1
R74	Resistor, 2.05 k Ohm ±1%, 1/4W	103–2054	1
R75, R76	Resistor, 5.11 k Ohm ±1%, 1/4W	103–5141	1
R77	Resistor, 10 k Ohm ±1%, 1/4W	100–1051	1
R78	Resistor, 19.1 k Ohm ±1%, 1/4W	103–1915	1
R79	Resistor, 332 k Ohm ±1%, 1/4W	103–3326	1
R80	Resistor, 162 k Ohm ±1%, 1/4W	103–1626	1
R81	Resistor, 24.9 k Ohm ±1%, 1/4W	103–2495	1
R82	Resistor, 11 k Ohm ±1%, 1/4W	103–1105	1
R83	Potentiometer, 100 k Ohm, 15 Turn	179–1045	1
TP1, TP2, TP3	Terminal, Test Point, Oval Red	413–0106	3
U1	Integrated Circuit, MPQ3799, Quad Amplifier, PNP, 14–Pin DIP	220–3799	1
U2 thru U6	Integrated Circuit, TLO74CN, Quad JFET–Input Operational Amplifier, 14–Pin DIP	221–0074	5
U7	Integrated Circuit, LM317LZ, Adjustable Positive Voltage Regulator, 1.2 to 37V @ 0.1 Ampere, TO–92 Case	220–0317	1
----	Blank RF Amplifier Logic Circuit Board	519–0417–012	1

TABLE 6-33. RF AMPLIFIER CIRCUIT BOARD ASSEMBLY - 919-0416-213

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1, C2	Capacitor, Electrolytic, 47 uF, 63V	020–4770	2
C3, C4	Capacitor, Ceramic, Variable, 4 to 25 pF, 100V	090–0004	2
C5, C8	Capacitor, Ceramic Chip, 470 uF, 63V	013–4784	2
C6, C7	Capacitor, Ceramic Chip, 1000 pF ±5%, 100V	009–1032	2
C9	Capacitor, Ceramic Chip, 33 pF ±5%, 500V	009–3313	1
C10	Capacitor, Ceramic, Variable, 4 to 25 pF, 100V	090–0004	1
C11, C12	Capacitor, Ceramic Chip, 1000 pF ±5%, 100V	009–1032	2
C17	Capacitor, Mica, Feedthru, 1000 pF ±10%, 350V	046–1030	1
C18 thru C21	Capacitor, Ceramic Chip, 1000 pF ±5%, 100V	009–1032	2
C23	Capacitor, Ceramic Chip, 33 pF ±5%, 500V	009–3313	1
C24	Capacitor, Ceramic, Variable, 4 to 25 pF, 100V	090–0004	1
C25	Capacitor, Ceramic Chip, 1000 pF ±5%, 100V	009–1032	1
C31	Capacitor, Mica, Feedthru, 1000 pF ±10%, 350V	046–1030	1
C34	Capacitor, Ceramic Chip, 470 pF ±5%, 200V	009–4723	1
C35, C36	Capacitor, Ceramic Chip, 1000 pF ±5%, 100V	009–1032	2
C38	Capacitor, Ceramic Chip, 470 pF ±5%, 200V	009–4723	1
C43	Capacitor, Ceramic Chip, 1000 pF ±5%, 100V	009–1032	1
C45, C47	Capacitor, Ceramic Chip, 470 pF ±5%, 200V	009–4723	2
C51, C55	Capacitor, Ceramic Chip, 100 pF ±5%, 500V	009–1023	2
D1, D2	Diode, Switching, MMBD914LT1, TO–236AB	204–0914	2
D3	Diode, MMBD701LT1, High Voltage, Schottky Barrier Type, 70V, Surface Mount	201–2801	1
DS1, DS2	LED, Tri–Color, Common Cathode	320–0031	2
F1	Fuse, ATC, 25A	334–2500	1
L3, L4	Inductor, 17.5NH	366–0017	2
J1 thru J4	Receptacle, Male, 3–Pin In–Line	408–0300	4
J801	Connector, Header, 40–Pin Dual–In–Line	417–4040	1
P1 thru P4	Jumper, Programmable, 2–Pin	340–0004	4
R2	Resistor, Chip, 2.2 k Ohm ±5%, 1/4W	101–2243	1
R3	Potentiometer, 10 k Ohm ±10%, 1/4W	198–1054	1
R4	Resistor, 47.5 k Ohm ±1%, 1/4W	101–0475	1
R5 thru R8	Resistor, Chip, 22 Ohm ±5%, 1/2W	111–2223	4
R9	Potentiometer, 10 k Ohm ±10%, 1/4W	198–1054	1
R10	Resistor, Chip, 2.2 k Ohm ±5%, 1/4W	101–2243	1
R11	Resistor, 267 k Ohm ±1%, 1/4W	101–2670	1
R12	Potentiometer, 10 k Ohm ±10%, 1/4W	198–1054	1
R13	Resistor, Chip, 2.2 k Ohm ±5%, 1/4W	101–2243	1
R14	Resistor, Chip, 499 k Ohm ±1%, 1/4W	101–4990	1
R15	Resistor, Chip, 2.2 k Ohm ±5%, 1/4W	101–2243	1
R17	Resistor, Chip, 2.2 k Ohm ±5%, 1/4W	101–2243	1
R18 thru R21	Resistor, Chip, 22 Ohm ±5%, 1/2W	111–2223	4
R22	Potentiometer, 10 k Ohm ±10%, 1/4W	198–1054	1
R23, R26	Resistor, Chip, 2.2 k Ohm ±5%, 1/4W	101–2243	2
R27, R28	Resistor, 22 Ohm ±5%, 4W	130–2243	2
U1, U2	Integrated Circuit, LM35DZ, Celsius Temperature Sensor, TO–92 Case	220–0035	1
----	Blank RF Amplifier Circuit Board	519–0416	1
----	RF Amplifier Circuit Board Wire Harness	949–0405	1
----	Fuse Holder, ATC Type, PCB Mount	415–0015	2

TABLE 6-34. MODULE LOW PASS FILTER/DIRECTIONAL COUPLER CIRCUIT BOARD ASSEMBLY -919-0418-011

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Assembly, PCB, Low Pass Filter/Directional Coupler	919-0418-012	1
----	Assembly, PCB, Module Low Pass Filter	919-0418-013	1

TABLE 6-35. MODULE LOW PASS FILTER/DIRECTIONAL COUPLER CIRCUIT BOARD ASSEMBLY -919-0418-012

REF. DES.	DESCRIPTION	PART NO.	QTY.
C101	Capacitor, Ceramic Chip, 10 pF ±5%, 500V	009-1013	1
C102	Capacitor, Ceramic Chip, 15 pF ±5%, 500V	009-1513	1
C103	Capacitor, Ceramic Chip, 6.8 pF, 500V	009-6810	1
C104, C105	Capacitor, Ceramic Chip, 10 pF ±5%, 500V	009-1013	2
C106	Capacitor, Ceramic Chip, 1000 pF ±5%, 100V	009-1032	1
C107	Capacitor, Ceramic, 47 pF ±5%, 50V	003-4712	1
C108	Capacitor, Ceramic, 56 pF ±5%, 500V	009-4713	1
C109	Capacitor, Ceramic, 47 pF ±5%, 500V	009-5613	
C112 thru C114	Capacitor, Ceramic Chip, 1000 pF ±5%, 100V	009-1032	3
C115	Capacitor, Ceramic Chip, 15 pF ±5%, 500V	009-1513	1
C117, C118	Capacitor, Ceramic, 47 pF ±2%, 50V	007-4702-500	2
C119, C120	Capacitor, Ceramic, 0.1uF ±10%, 50V	007-1044	2
C121	Capacitor, Ceramic Chip, 0.001 uF ±10%, 50V	007-1024	1
C122	Capacitor, Ceramic Chip, 10 uF, 10V	007-1075-100	1
C123	Capacitor, Ceramic Chip, 0.001 uF ±10%, 50V	007-1024	1
C124, C125	Capacitor, Ceramic, 0.1uF ±10%, 50V	007-1044	2
D103, D105	Diode, HP5082-2800, High Voltage, Schottky Barrier Type, 70V, 15 mA	201-2800	2
L101	Coil, Molded, .11 uH, 1A	364-0011	1
L103, L104	Inductor, Molded, 68 uH	360-0106	2
L105	Coil, Molded, 100NH	366-0100	1
R104, R105	Resistor, 66.5 Ohm ±1%, 1/4W	103-6652	2
R109	Resistor, 1 k Ohm ±1%, 1/4W	100-1041	1
R111	Resistor, 64.9 Ohm ±1%, 1/10W	102-6409	1
R112	Resistor, 130 Ohm ±1%, 1/10W	102-1300	1
R113, R114	Resistor, 64.9 Ohm ±1%, 1/10W	102-6409	2
R115	Resistor, 15 Ohm ±1%, 1/10W	102-1510	1
R117, R118	Resistor, 0 Ohm	102-0000	2
U101	Integrated Circuit, True Average Power Detector	221-8361	1
U102	Voltage Regulator, 78LO5AC	231-7805	1
----	Blank RF Amplifier Directional Coupler Circuit Board	519-0418-012	1

TABLE 6-36. MODULE LOW PASS FILTER/DIRECTIONAL COUPLER CIRCUIT BOARD ASSEMBLY -919-0418-013

REF. DES.	DESCRIPTION	PART NO.	QTY.
C201	Capacitor, Ceramic Chip, 10 pF ±5% 500V	009–1013	1
C202	Capacitor, Ceramic Chip, 15 pF ±5%, 500V	009–1513	1
C203	Capacitor, Ceramic Chip, 6.8 pF, 500V	009–6810	1
C204, C205	Capacitor, Ceramic Chip, 10 pF ±5%, 500V	009–1013	1
C206	Capacitor, Ceramic Chip, 56 pF ±5%, 500V	009–5613	1
C207	Capacitor, Ceramic Chip, 47 pF ±5%, 500V	009–4713	1
----	Blank RF Amplifier Module Low–Pass Filter Circuit Board	519–0418–013	1

TABLE 6-37. LOW PASS FILTER ASSEMBLY - 959-0414-001

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Receptacle, BNC	417–0016	1
----	Connector, Anchor Insulator, Bullet, Silver Plated For 1 5/8 Line	427–0009–1	1
----	Adapter, 1 5/8 Inch EIA Flanged to Unflanged	427–0010	1
----	Low Pass Filter Assembly	919–0421–001	1

TABLE 6-38. LOW-PASS FILTER CIRCUIT BOARD ASSEMBLY - 919-0421-001

REF. DES.	DESCRIPTION	PART NO.	QTY.
C8	Capacitor, Ceramic, 68 pF ±5%, 50V	003–6812	1
C9, C10	Capacitor, Mica, 390 pF ±5%, 100V	042–3922	2
C11	Capacitor, Ceramic, 27 pF ±2%,100V	003–2753	1
C12, C13	Capacitor, Mica, 390 pF ±5%, 100V	042–3922	2
C14, C15	Capacitor, Ceramic, 2.2 pF, 100V, +/–0.25 pF	003–2201	2
D1, D2	Diode, HP5082–2800, High Voltage, Schottky Barrier Type, 70V, 15 mA	201–2800	2
J23	Receptacle, Male, Right Angle, 20–Pin In–Line	417–0214	1
L1	Coil	360–0145	1
L2	Coil, Molded, .023 uH, 22 AWG	364–0023	1
R1	Resistor, 1 k Ohm ±1%, 1/4W	100–1041	1
R2	Resistor, 665 k Ohm ±1%, 1/4W	103–6654	1
R3, R4	Resistor, 124 Ohm ±1%, 2W	122–1241	2
R5	Resistor, 100 k Ohm ±1%, 1/4W	103–1062	1
R6	Resistor, 665 k Ohm ±1%, 1/4W	103–6654	1
R7, R8	Resistor, 158 Ohm ±1%, 2W	122–1581	2
R9	Potentiometer, 1 k Ohm ±10%, 1/2W	177–1044	1
----	Inductor, Low Pass Filter	471–5035	1
----	Low Pass Filter	519–0421	1

TABLE 6-39. FM-5C/FMi 402 COMBINER ASSEMBLY - 959-0418
FM-4C/FMi 301 COMBINER ASSEMBLY - 959-0418-001

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Coil, Shunt Indicator, Combiner, FM–5C	360–0155	10
----	Connector, “N” Type, Male To Pin, No Nut	417–0384	10
----	Blank, Output Combiner Circuit Board	519–0431	2

SECTION VII
DRAWINGS

7-1. INTRODUCTION.

7-2. This section provides schematic and assembly diagrams as indexed below for the Broadcast Electronics FM-5C/FM-4C & FMi 402/FMi 301 transmitters.

FIGURE	TITLE	NUMBER
7-1	OVERALL SCHEMATIC DIAGRAM, FM-5C/FM-4C & FMi-402/FMi-301 TRANSMITTER	SD909 -/5001-204 -/4001-204
7-2	OVERALL SCHEMATIC DIAGRAM, THREE PHASE 220V AC FM-5C/FM-4C & FMi-402/FMi-301 TRANSMITTER	SD909 -/5001-254 -/4001-254
7-3	OVERALL SCHEMATIC DIAGRAM, THREE PHASE 380V AC FM-5C/FM-4C & FMi-402/FMi-301 TRANSMITTER	SD909 -/5001-384 -/4001-384
7-4	SCHEMATIC DIAGRAM, MOTHERBOARD	SB919-0513/-001
7-5	ASSEMBLY DIAGRAM, MOTHERBOARD	AD919-0513/-001
7-6	SCHEMATIC DIAGRAM, CONTROLLER CIRCUIT BOARD	SB919-0432-400 /-500
7-7	ASSEMBLY DIAGRAM, CONTROLLER CIRCUIT BOARD	AD919-0432-400 /-500
7-8	SCHEMATIC DIAGRAM, RFI FILTER CIRCUIT BOARD	SB919-0435
7-9	ASSEMBLY DIAGRAM, RFI FILTER CIRCUIT BOARD	AB919-0435
7-10	SCHEMATIC DIAGRAM, CONTROLLER ON/OFF SWITCH CIRCUIT BOARD	SB919-0406-101
7-11	SCHEMATIC DIAGRAM, CONTROLLER METER DISPLAY	SB919-0406-102
7-12	SCHEMATIC DIAGRAM, CONTROLLER METER SWITCH	SB919-0406-103
7-13	SCHEMATIC DIAGRAM, TEMPERATURE SENSOR	SA919-0406-105
7-14	ASSEMBLY DIAGRAM, CONTROLLER CIRCUIT BOARDS	AD919-0406-101 thru -105
7-15	SCHEMATIC DIAGRAM, REMOTE INTERFACE BARRIER STRIP	SB919-0415-005
7-16	ASSEMBLY DIAGRAM, REMOTE INTERFACE BARRIER STRIP	AB919-0415-005
7-17	SCHEMATIC DIAGRAM, MODULE SELECT CIRCUIT BOARD	SB919-0415-501 /-401
7-18	ASSEMBLY DIAGRAM, MODULE SELECT, MULTIPLEXER, LPF RFI INPUT, PS MOTHERBOARD, AND RMT INTERFACE BARRIER STRIP CIRCUIT BOARDS	AB919-0415-501 /-401
7-19	SCHEMATIC DIAGRAM, MULTIPLEXER CIRCUIT BOARD	SB919-0415-502 /-402
7-20	ASSEMBLY DIAGRAM, MULTIPLEXER BOARD	AC919-0415-502 /402
7-21	SCHEMATIC DIAGRAM, LOW-PASS FILTER INPUT RFI FILTER CIRCUIT BOARD	SA919-0415-003
7-22	ASSEMBLY DIAGRAM, LPF RFI INPUT	AA919-0415-003

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	6-19-95	FM-5C MODEL BUILD RELEASE.	JLF	MBS	----
2	9-19-95	ADDED AC LINE LOSS DETECTOR PCB.	JLF	MBS	----
A	10-12-95	ENGINEERING RELEASE W/O CHG.	JLF	MBS	----
B	3-21-97	CHANGED 919-0407-102 TO 919-0435.	KT	DL	9770
C	5-27-97	DELETED J802 & P802	MSE	DL	9804
D	5-6-04	ADD P24-P726 WIRE; UPDATE PCBS; ADD FSI ASSY	KT		11129

CABLE W101 J703 <--> J211

1	GND
2	GND
3	REMOTE CLOCK CONTROL
4	PS#1 FAULT
5	RF MODULE MUTE
6	3RD RF MODULE FAILURE
7	-15V
8	RF MODULE TEMPERATURE
9	GND
10	2ND RF MODULE FAILURE
11	+15V
12	RF MODULE VOLTAGE
13	RF MODULE FAULT RESET
14	PS#2 FAULT
15	-15V
16	RF MODULE CURRENT
17	GND
18	1ST RF MODULE FAILURE
19	+15V
20	RF MODULE FORWARD POWER
21	RF MODULE FAULT RESET
22	RF MODULE FAULT DRIVE
23	RF MODULE MUTE
24	PS#3 FAULT
25	LOCAL/REMOTE MODE SELECT
26	RF MODULE SELECT
27	4th RF MODULE FAILURE
28	GND
29	PS#4 FAULT
30	PS#5 FAULT
31	RF MODULE TEMP FOLDBACK
32	+15V
33	GND
34	-15V

CABLE W102 J706 <--> J19

1	FORWARD POWER
2	REFLECTED POWER
3	PA PWR SUP BUSS VOLTAGE
4	REMOTE TEMPERATURE (INLET)
5	PA MOD FWD PWR
6	PA MOD CURRENT
7	PA MOD VOLTAGE
8	PA MOD TEMPERATURE
9	XMTR ON STATUS
10	XMTR OFF STATUS
11	XMTR FAULT STATUS
12	XMTR ON CMD
13	XMTR OFF CMD
14	RAISE PWR CMD
15	LOWER PWR CMD
16	RESET CMD
17	FAILSAFE
18	INTERLOCK
19	ENABLE EXCITER
20	+5V
21	+15V
22	PA PWR SUP FAULT STATUS
23	PA MOD FAULT STATUS
24	GND
25	N/C
26	PA MOD SEL COMM

CABLE W201-210 J201-210 <--> J601-610

1	TEMPERATURE
2	VOLTAGE SAMPLE
3	MUTE
4	-15V
5	FAULT STATUS
6	CURRENT SAMPLE
7	FAULT RESET
8	GND
9	FWD PWR SAMPLE
10	+15V

CABLE W103 J701 <--> J201

1	GND
2	N/C
3	GND
4	ANALOG METER SAMPLE
5	GND
6	DECIMAL POINT 3 ENABLE
7	GND
8	-5V
9	DECIMAL POINT 2 ENABLE
10	+5V

CABLE W104 J702 <--> J301

1	+5V
2	NOT USED
3	NOT USED
4	+5V
5	XMTR FORWARD POWER
6	XMTR REFLECTED POWER
7	PA BUSS VOLTAGE
8	XMTR EXHAUST TEMPERATURE
9	PA MODULE FWD PWR
10	PA MODULE CURRENT
11	PA MODULE VOLTAGE
12	PA MODULE TEMPERATURE
13	DECIMAL POINT 2 ENABLE
14	NOT USED
15	NOT USED
16	ANALOG METER SAMPLE
17	+15V
18	DECIMAL POINT 3 ENABLE
19	GND
20	REMOTE CONTROL DISABLE
21	+5V
22	N/C
23	N/C
24	N/C
25	N/C
26	N/C

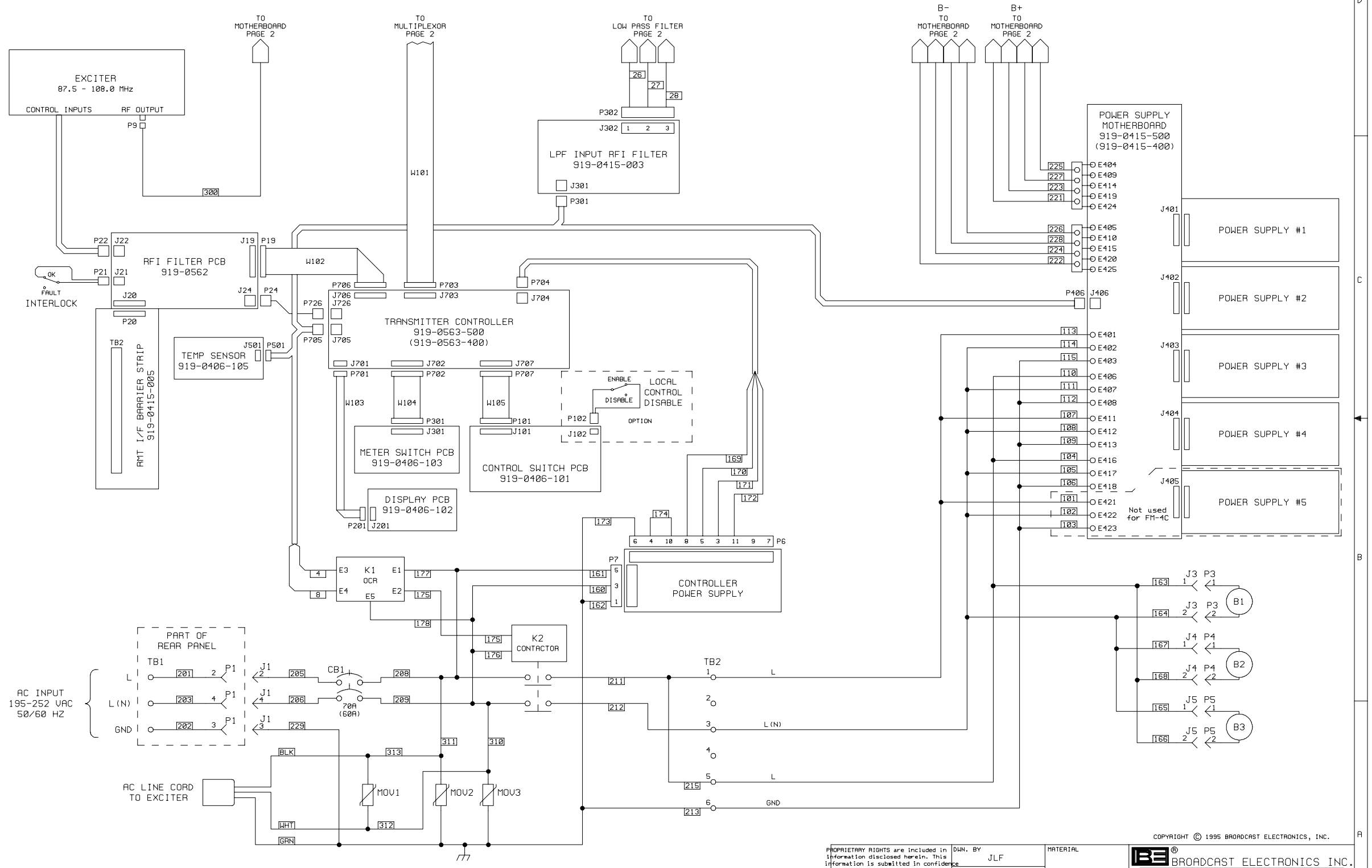
CABLE W106 J212 <--> J101

1	+15V, REMOTE ENABLE
2	+15V, LOCAL ENABLE
3	GND
4	PS#1 FAULT LED
5	PS#2 FAULT LED
6	PS#3 FAULT LED
7	PS#4 FAULT LED
8	PS#5 FAULT LED
9	GND
10	"A" DISPLAY DECODER INPUT
11	"B" DISPLAY DECODER INPUT
12	"C" DISPLAY DECODER INPUT
13	"D" DISPLAY DECODER INPUT
14	GND
15	MODULE SELECT
16	GND

CABLE W105 J707 <--> J101

1	FAILSAFE
2	AMT OFF CMD
3	AMT ON CMD
4	INTERLOCK
5	GND
6	+15V
7	REMOTE CONTROL DISABLE
8	PA2 FAULT RESET
9	PA1 FAULT RESET
10	FAULT RESET INDICATOR
11	
12	
13	RAISE
14	AMT RESET CMD
15	
16	
17	AFC LOCK
18	GND
19	+15V
20	ENABLE EXCITER
21	MUTE POWER SUPPLY
22	MUTE PA1
23	MUTE PA2
24	ON STATUS
25	OFF STATUS
26	LOWER

FROM	SIGNAL	TO	WIRE
J705 - 1	FWD PWR SAMPLE	J301 - 1	1
J705 - 2	GND	J301 - 3	2
J705 - 3	RFL PWR SAMPLE	J301 - 4	3
J705 - 4	OCR DRIVE	K1-E3	4
J705 - 5	+15V	J501 - 1	5
J705 - 6	TEMP SAMPLE	J501 - 2	6
J705 - 7	GND	J501 - 4	7
J705 - 8	OCR RETURN	K1-E4	8
J705 - 9	MUTE PS	J406 - 1	9
J705 - 10	GND	J406 - 4	10
J705 - 11	BUSS VOLTAGE	J406 - 2	11
J705 - 12	PS AMT CNTL	J406 - 3	12
J705 - 13	PS #1 FAULT	J406 - 5	13
J705 - 14	PS #2 FAULT	J406 - 6	14
J705 - 15	PS #3 FAULT	J406 - 7	15
J705 - 16	GND	J406 - 10	16
J705 - 17	PS #1 PRESENT	J406 - 11	17
J705 - 18	PS #2 PRESENT	J406 - 12	18
J705 - 19	PS #3 PRESENT	J406 - 13	19
J705 - 20	GND	J406 - 16	20
J705 - 21	PS #4 PRESENT	J406 - 14	21
J705 - 22	PS #5 PRESENT	J406 - 15	22
J705 - 23	PS #4 FAULT	J406 - 8	23
J705 - 24	PS #5 FAULT	J406 - 9	24
J302 - 1	FWD PWR SAMPLE	J23 - 4	26
J302 - 3	GND	J23 - 3	27
J302 - 4	RFL PWR SAMPLE	J23 - 1	28
J22 - 1	ENABLE EXCITER	EXCITER TB1-7	51
J22 - 2	AFC LOCK	EXCITER TB1-5	52
J22 - 3	GND	EXCITER TB1-4	53
P6 - 8	+15V	J704 - 1	169
P6 - 5	GND	J704 - 2	170
P6 - 3	+5V	J704 - 3	171
P6 - 11	-15V	J704 - 4	172
P6 - 6	CHASSIS GND	TB2 - 6	173
P6 - 4	RETURN	P6 - 10	174



NOTES :
1. PART #'s & VALUES IN PARENTHESES ARE FOR FM-4C & FM-302.

DWN. BY	JLF
DESIGNER(S)	MBS 9-22-95
PROJ. LEADER	
MFG.	
MATERIAL	
FINISH	
NEXT ASSY.	

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

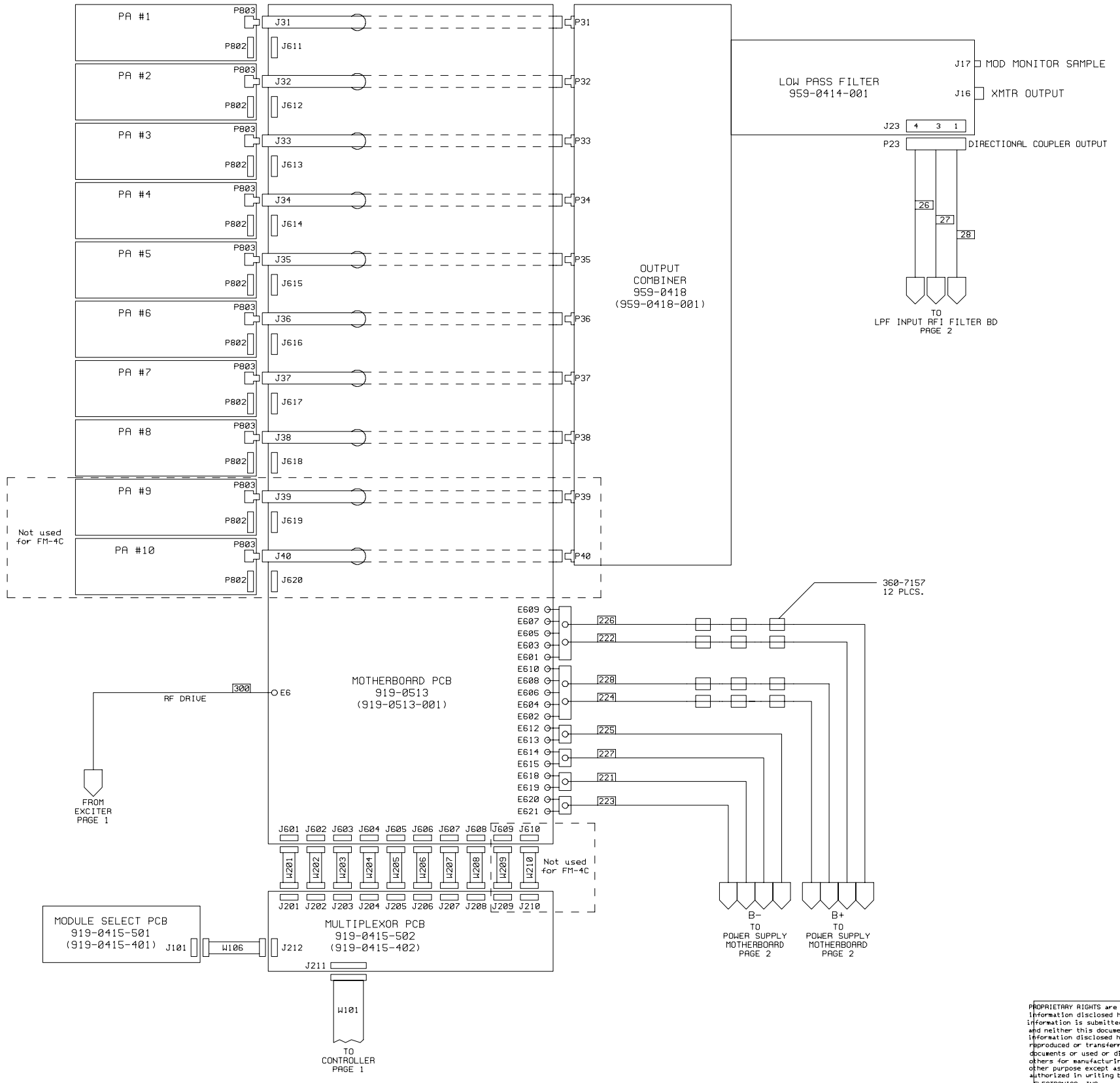
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305
217/224-9600 FAX 217/224-9607

TITLE: FM-4C/5C, FMi-301/402 OVERALL SCHEMATIC

TYPE	SIZE	DWG. NO.	REV
S	D	909-0301-204/0402-204 909-4001-204/5001-204	D

MODEL (FM-4C) FM-5C | SCALE N/A | SHEET 1 OF 2

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	6-19-95	FM-5C MODEL BUILD RELEASE.	JLF	MBS	----
2	9-19-95	ADDED AC LINE LOSS DETECTOR PCB.	JLF	MBS	----
A	10-12-95	ENGINEERING RELEASE W/O CHG.	JLF	MBS	----
B	3-21-97	SEE SHEET 1.	KT	DLL	9770
C	5-27-97	DELETED J802 & P802	MSE	DLL	9804
D	5-6-04	ADDED 12 360-7157; CHGD WIRES 221-228	KT		11129



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

DWN. BY: JLF
DESIGNER(S): MBS 9-22-95
PROJ. LEADER:
MFG.

MATERIAL:
FINISH:
NEXT ASSY.:

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

TITLE: FM-4C/5C, FMi-301/402 OVERALL SCHEMATIC

TYPE	SIZE	DWG. NO.	REV
S	D	909-0301-204/0402-204 909-4001-204/5001-204	D

MODEL (FM-4C) FM-5C | SCALE N/A | SHEET 2 OF 2

blank

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
A	1-18-95	CHGED POWER SUPPLY TO A DELTA CONFIGURATION.	AEB	MBS	----
B	3-11-95	ENGINEERING RELEASE WITH CHANGES.	AEB	MBS	----
C	5-22-97	ADDED AC LINE LOSS/AFC INTERLOCK	MSE	DL	9804
D	5-7-04	ADDED J24-P726 WIRE; UPDATED PCBS; ADD FS1 ASSY	KT	DL	11129

CABLE W101
J703 <--> J211

1 GND
2 GND
3 REMOTE CLOCK CONTROL
4 PS#1 FAULT
5 RF MODULE MUTE
6 3RD RF MODULE FAILURE
7 -15V
8 RF MODULE TEMPERATURE
9 GND
10 2ND RF MODULE FAILURE
11 +15V
12 RF MODULE VOLTAGE
13 RF MODULE FAULT RESET
14 PS#2 FAULT
15 -15V
16 RF MODULE CURRENT
17 GND
18 1ST RF MODULE FAILURE
19 +15V
20 RF MODULE FORWARD POWER
21 RF MODULE FAULT RESET
22 RF MODULE FAULT DRIVE
23 RF MODULE MUTE
24 PS#3 FAULT
25 LOCAL/REMOTE MODE SELECT
26 RF MODULE SELECT
27 4th RF MODULE FAILURE
28 GND
29 PS#4 FAULT
30 PS#5 FAULT
31 RF MODULE TEMP FOLDBACK
32 +15V
33 GND
34 -15V

CABLE W102
J706 <--> J19

1 FORWARD POWER
2 REFLECTED POWER
3 PA PWR SUP BUSS VOLTAGE
4 REMOTE TEMPERATURE (INLET)
5 PA MOD FWD PWR
6 PA MOD CURRENT
7 PA MOD VOLTAGE
8 PA MOD TEMPERATURE
9 XMTR ON STATUS
10 XMTR OFF STATUS
11 XMTR FAULT STATUS
12 XMTR ON CMD
13 XMTR OFF CMD
14 RAISE PWR CMD
15 LOWER PWR CMD
16 RESET CMD
17 FAILSAFE
18 INTERLOCK
19 ENABLE EXCITER
20 +5V
21 +15V
22 PA PWR SUP FAULT STATUS
23 PA MOD FAULT STATUS
24 GND
25 N/C
26 PA MOD SEL COMM

CABLE W201-210
J201-210 <--> J601-610

1 TEMPERATURE
2 VOLTAGE SAMPLE
3 MUTE
4 -15V
5 FAULT STATUS
6 CURRENT SAMPLE
7 FAULT RESET
8 GND
9 FWD PWR SAMPLE
10 +15V

CABLE W103
J701 <--> J201

1 GND
2 N/C
3 GND
4 ANALOG METER SAMPLE
5 GND
6 DECIMAL POINT 3 ENABLE
7 GND
8 -5V
9 DECIMAL POINT 2 ENABLE
10 +5V

CABLE W106
J212 <--> J101

1 +15V, REMOTE ENABLE
2 +15V, LOCAL ENABLE
3 GND
4 PS#1 FAULT LED
5 PS#2 FAULT LED
6 PS#3 FAULT LED
7 PS#4 FAULT LED
8 PS#5 FAULT LED
9 GND
10 "A" DISPLAY DECODER INPUT
11 "B" DISPLAY DECODER INPUT
12 "C" DISPLAY DECODER INPUT
13 "D" DISPLAY DECODER INPUT
14 GND
15 MODULE SELECT
16 GND

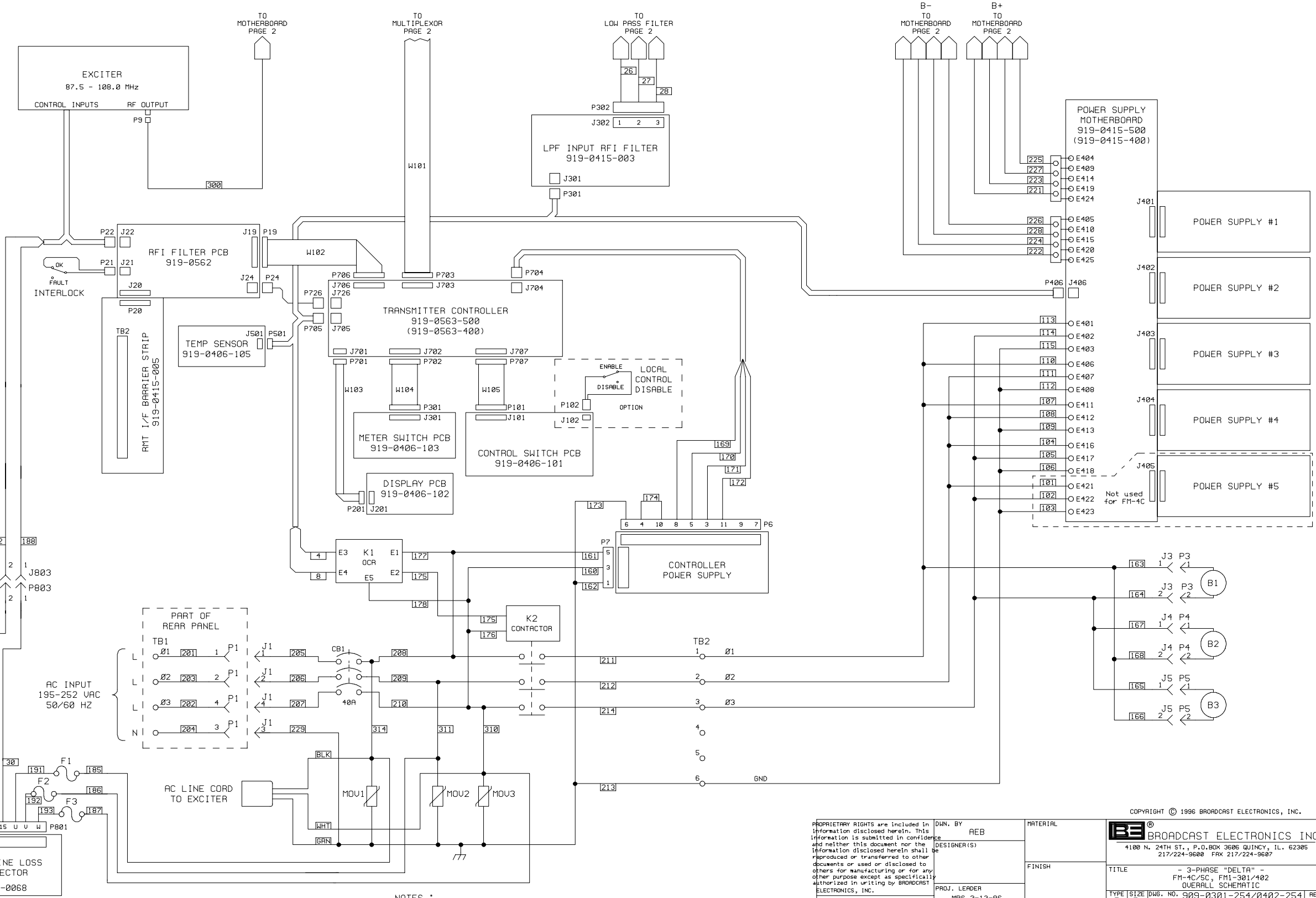
CABLE W104
J702 <--> J301

1 +5V
2 NOT USED
3 NOT USED
4 +5V
5 XMTR FORWARD POWER
6 XMTR REFLECTED POWER
7 PA BUSS VOLTAGE
8 XMTR EXHAUST TEMPERATURE
9 PA MODULE FWD PWR
10 PA MODULE CURRENT
11 PA MODULE VOLTAGE
12 PA MODULE TEMPERATURE
13 DECIMAL POINT 2 ENABLE
14 NOT USED
15 NOT USED
16 ANALOG METER SAMPLE
17 +15V
18 DECIMAL POINT 3 ENABLE
19 GND
20 REMOTE CONTROL DISABLE
21 +5V
22 N/C
23 N/C
24 N/C
25 N/C
26 N/C

CABLE W105
J707 <--> J101

1 FAILSAFE
2 XMT OFF CMD
3 XMT ON CMD
4 INTERLOCK
5 GND
6 +15V
7 REMOTE CONTROL DISABLE
8 PA2 FAULT RESET
9 PA1 FAULT RESET
10 FAULT RESET INDICATOR
11
12
13 RAISE
14 XMT RESET CMD
15
16
17 AFC LOCK
18 GND
19 +15V
20 ENABLE EXCITER
21 MUTE POWER SUPPLY
22 MUTE PA1
23 MUTE PA2
24 ON STATUS
25 OFF STATUS
26 LOWER

FROM	SIGNAL	TO	WIRE
J705 - 1	FWD PWR SAMPLE	J301 - 1	1
J705 - 2	GND	J301 - 3	2
J705 - 3	RFL PWR SAMPLE	J301 - 4	3
J705 - 4	OCR DRIVE	K1-E3	4
J705 - 5	+15V	J501 - 1	5
J705 - 6	TEMP SAMPLE	J501 - 2	6
J705 - 7	GND	J501 - 4	7
J705 - 8	OCR RETURN	K1-E4	8
J705 - 9	MUTE PS	J406 - 1	9
J705 - 10	GND	J406 - 4	10
J705 - 11	BUSS VOLTAGE	J406 - 2	11
J705 - 12	PS AMT CNTL	J406 - 3	12
J705 - 13	PS #1 FAULT	J406 - 5	13
J705 - 14	PS #2 FAULT	J406 - 6	14
J705 - 15	PS #3 FAULT	J406 - 7	15
J705 - 16	GND	J406 - 10	16
J705 - 17	PS #1 PRESENT	J406 - 11	17
J705 - 18	PS #2 PRESENT	J406 - 12	18
J705 - 19	PS #3 PRESENT	J406 - 13	19
J705 - 20	GND	J406 - 16	20
J705 - 21	PS #4 PRESENT	J406 - 14	21
J705 - 22	PS #5 PRESENT	J406 - 15	22
J705 - 23	PS #4 FAULT	J406 - 8	23
J705 - 24	PS #5 FAULT	J406 - 9	24
J302 - 1	FWD PWR SAMPLE	J23 - 4	26
J302 - 3	GND	J23 - 3	27
J302 - 4	RFL PWR SAMPLE	J23 - 1	28
P803 - 1	AC LINE LOSS/AFC INTERLOCK	P801 - 15	30
P803 - 2	AC LINE LOSS/AFC INTERLOCK	P801 - 28	31
J22 - 1	ENABLE EXCITER	EXCITER TB1-7	51
J22 - 3	GND	EXCITER TB1-4	53
P6 - 8	+15V	J704 - 1	169
P6 - 5	GND	J704 - 2	170
P6 - 3	+5V	J704 - 3	171
P6 - 11	-15V	J704 - 4	172
P6 - 6	CHASSIS GND	TB2 - 6	173
P6 - 4	RETURN	P6 - 10	174
J803 - 1	AC LINE LOSS/AFC INTERLOCK	EXCITER TB1 - 5	188
J22 - 2	AC LINE LOSS/AFC INTERLOCK	J803 - 2	52



NOTES :
1. PART #'s & VALUES IN PARENTHESES ARE FOR FM-4C & FM1-301.

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

DWN. BY: AEB
DESIGNER(S):
PROJ. LEADER: MBS 3-13-96
MFG.:
MATERIAL:
FINISH:
NEXT ASSY.:

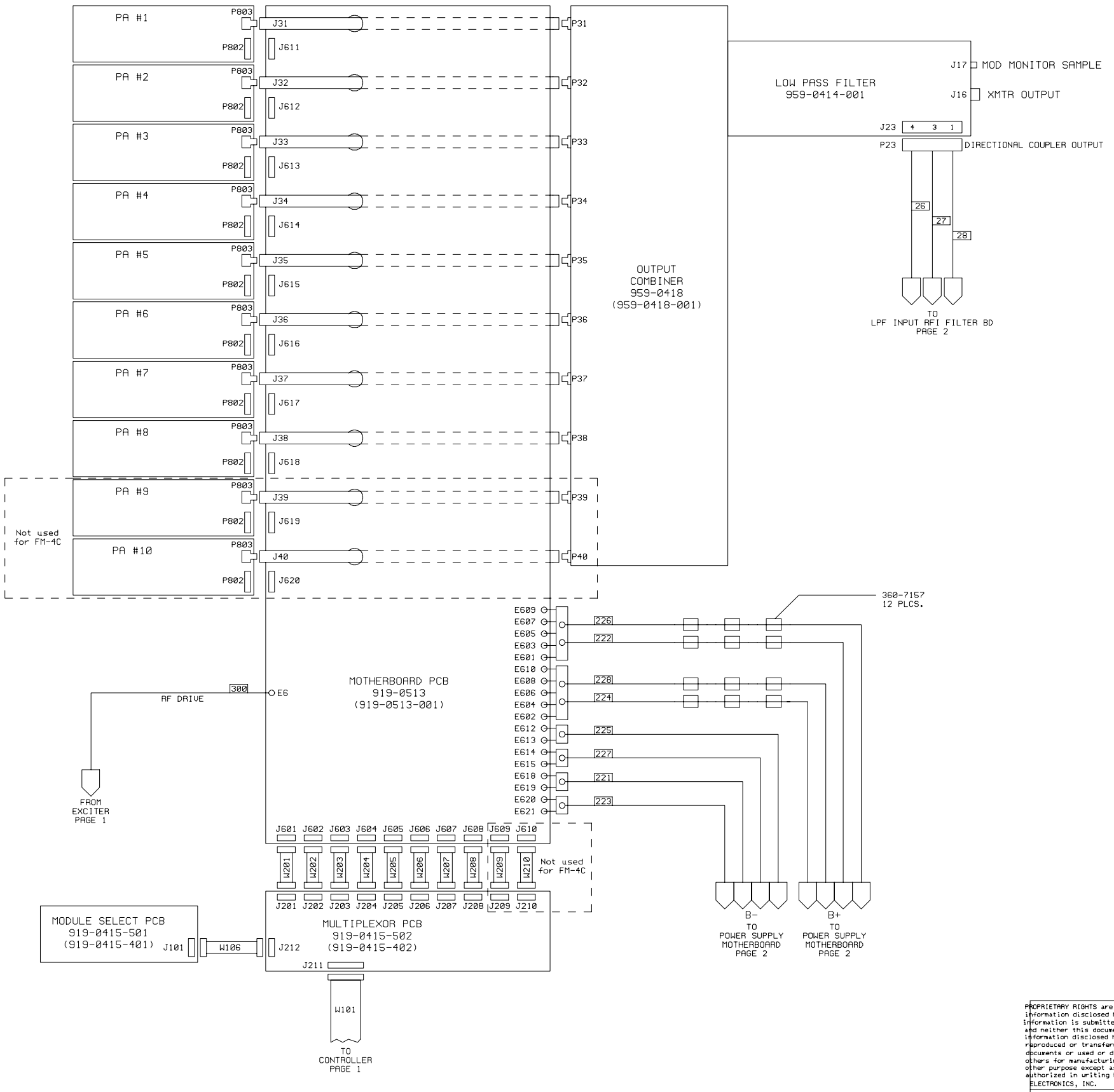
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305
217/224-9600 FAX 217/224-9687

TITLE: - 3-PHASE "DELTA" - FM-4C/5C, FM1-301/402 OVERALL SCHEMATIC

TYPE	SIZE	DWG. NO.	REV
S	D	909-0301-254/0402-254 909-4001-254/5001-254	D

MODEL (FM-4C) FM-5C | SCALE N/A | SHEET 1 OF 2

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
A	1-18-96	-SEE SHEET 1-	AEB	MBS	----
B	3-11-96	ENGINEERING RELEASE WITH CHANGES.	AEB	MBS	----
C	5-22-97	SHT. 1 ADDED AC LINE LOSS/AFC INTERLOCK	MSE	DL	9804
D	5-6-04	ADDED 12 360-7157; CHGD WIRES 221-228	KT		11129



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

DWN. BY: AEB
DESIGNER(S):
PROJ. LEADER: MBS 3-13-96
MFG.

MATERIAL
FINISH
NEXT ASSY.

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

TITLE: - 3-PHASE "DELTA" - FM-4C/5C, FMi-301/402 OVERALL SCHEMATIC

TYPE	SIZE	DWG. NO.	REV
S	D	909-0301-254/0402-254 909-4001-254/5001-254	D

MODEL (FM-4C) FM-5C | SCALE N/A | SHEET 2 OF 2

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
A	1-18-96	CHANGED POWER SUPPLY TO A WYE CONFIGURATION.	AEB	MBS	----
B	3-11-96	ENGINEERING RELEASE WITH CHANGES.	AEB	DL	----
C	5-27-97	DELETED J802 & P802	MSE	DL	9804
D	5-7-04	ADDED P24-P726 WIRE: UPDATED PCBS; ADD FM1 ASSY	KT	DL	11129

CABLE W101
J703 <--> J211

1 GND
2 GND
3 REMOTE CLOCK CONTROL
4 PS#1 FAULT
5 RF MODULE MUTE
6 3RD RF MODULE FAILURE
7 -15V
8 RF MODULE TEMPERATURE
9 GND
10 2ND RF MODULE FAILURE
11 +15V
12 RF MODULE VOLTAGE
13 RF MODULE FAULT RESET
14 PS#2 FAULT
15 -15V
16 RF MODULE CURRENT
17 GND
18 1ST RF MODULE FAILURE
19 +15V
20 RF MODULE FORWARD POWER
21 RF MODULE FAULT RESET
22 RF MODULE FAULT DRIVE
23 RF MODULE MUTE
24 PS#3 FAULT
25 LOCAL/REMOTE MODE SELECT
26 RF MODULE SELECT
27 4th RF MODULE FAILURE
28 GND
29 PS#4 FAULT
30 PS#5 FAULT
31 RF MODULE TEMP FOLDBACK
32 +15V
33 GND
34 -15V

CABLE W103
J701 <--> J201

1 GND
2 N/C
3 GND
4 ANALOG METER SAMPLE
5 GND
6 DECIMAL POINT 3 ENABLE
7 GND
8 -5V
9 DECIMAL POINT 2 ENABLE
10 +5V

CABLE W104
J702 <--> J301

1 +5V
2 NOT USED
3 NOT USED
4 +5V
5 XMTR FORWARD POWER
6 XMTR REFLECTED POWER
7 PA BUSS VOLTAGE
8 XMTR EXHAUST TEMPERATURE
9 PA MODULE FWD PWR
10 PA MODULE CURRENT
11 PA MODULE VOLTAGE
12 PA MODULE TEMPERATURE
13 DECIMAL POINT 2 ENABLE
14 NOT USED
15 NOT USED
16 ANALOG METER SAMPLE
17 +15V
18 DECIMAL POINT 3 ENABLE
19 GND
20 REMOTE CONTROL DISABLE
21 +5V
22 N/C
23 N/C
24 N/C
25 N/C
26 N/C

CABLE W102
J706 <--> J19

1 FORWARD POWER
2 REFLECTED POWER
3 PA PWR SUP BUSS VOLTAGE
4 REMOTE TEMPERATURE (INLET)
5 PA MOD FWD PWR
6 PA MOD CURRENT
7 PA MOD VOLTAGE
8 PA MOD TEMPERATURE
9 XMTR ON STATUS
10 XMTR OFF STATUS
11 XMTR FAULT STATUS
12 XMTR ON CMD
13 XMTR OFF CMD
14 RAISE PWR CMD
15 LOWER PWR CMD
16 RESET CMD
17 FAILSAFE
18 INTERLOCK
19 ENABLE EXCITER
20 +5V
21 +15V
22 PA PWR SUP FAULT STATUS
23 PA MOD FAULT STATUS
24 GND
25 N/C
26 PA MOD SEL COMM

CABLE W106
J212 <--> J101

1 +15V, REMOTE ENABLE
2 +15V, LOCAL ENABLE
3 GND
4 PS#1 FAULT LED
5 PS#2 FAULT LED
6 PS#3 FAULT LED
7 PS#4 FAULT LED
8 PS#5 FAULT LED
9 GND
10 "A" DISPLAY DECODER INPUT
11 "B" DISPLAY DECODER INPUT
12 "C" DISPLAY DECODER INPUT
13 "D" DISPLAY DECODER INPUT
14 GND
15 MODULE SELECT
16 GND

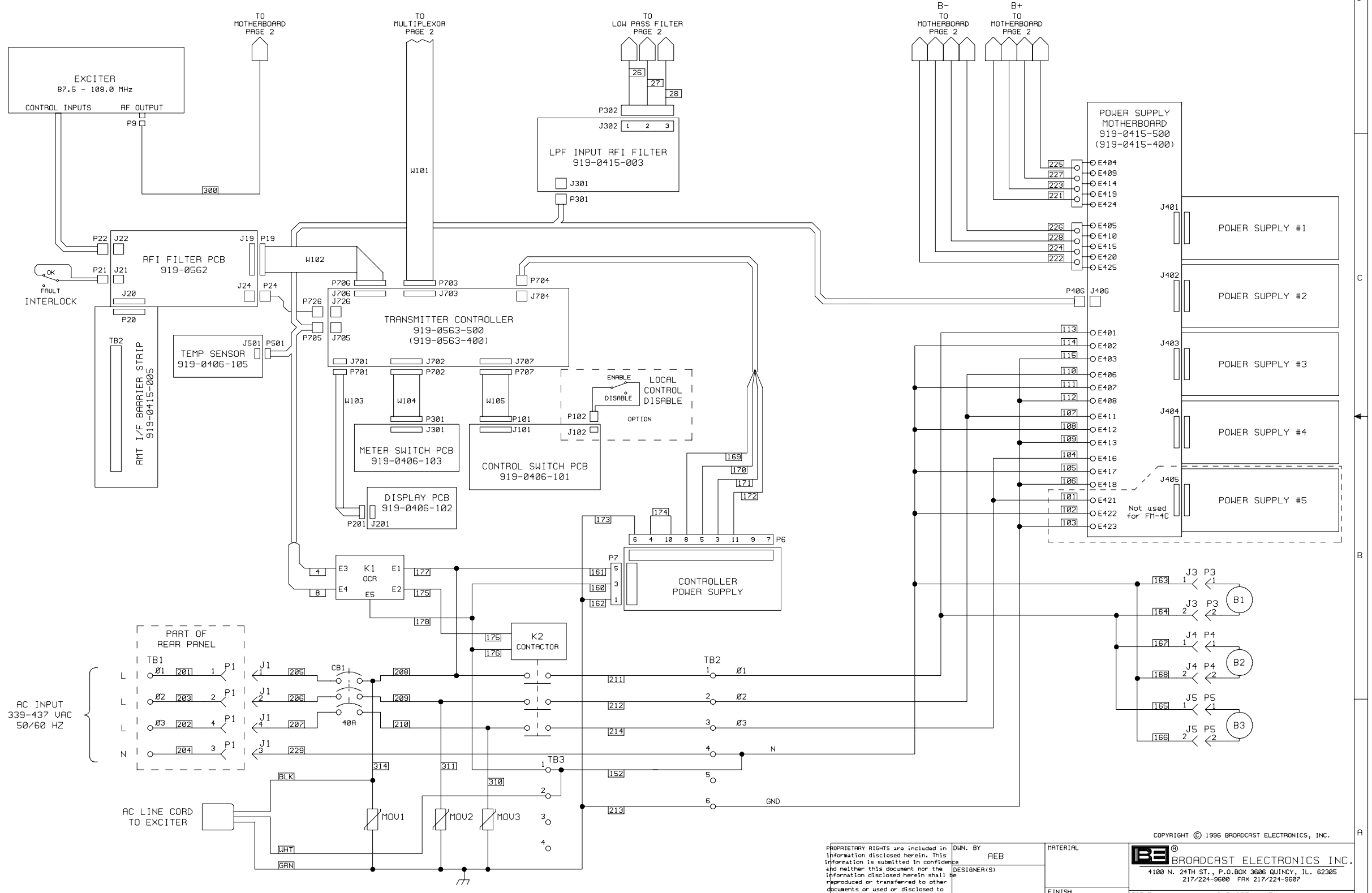
CABLE W105
J707 <--> J101

1 FAILSAFE
2 RMT OFF CMD
3 RMT ON CMD
4 INTERLOCK
5 GND
6 +15V
7 REMOTE CONTROL DISABLE
8 PA2 FAULT RESET
9 PA1 FAULT RESET
10 FAULT RESET INDICATOR
11
12
13 RAISE
14 RMT RESET CMD
15
16
17 AFC LOCK
18 GND
19 +15V
20 ENABLE EXCITER
21 MUTE POWER SUPPLY
22 MUTE PA1
23 MUTE PA2
24 ON STATUS
25 OFF STATUS
26 LOWER

CABLE W201-210
J201-210 <--> J601-610

1 TEMPERATURE
2 VOLTAGE SAMPLE
3 MUTE
4 -15V
5 FAULT STATUS
6 CURRENT SAMPLE
7 FAULT RESET
8 GND
9 FWD PWR SAMPLE
10 +15V

FROM	SIGNAL	TO	WIRE
J705 - 1	FWD PWR SAMPLE	J301 - 1	1
J705 - 2	GND	J301 - 3	2
J705 - 3	RFL PWR SAMPLE	J301 - 4	3
J705 - 4	OCR DRIVE	K1-E3	4
J705 - 5	+15V	J501 - 1	5
J705 - 6	TEMP SAMPLE	J501 - 2	6
J705 - 7	GND	J501 - 4	7
J705 - 8	OCR RETURN	K1-E4	8
J705 - 9	MUTE PS	J406 - 1	9
J705 - 10	GND	J406 - 4	10
J705 - 11	BUSS VOLTAGE	J406 - 2	11
J705 - 12	PS RMT CNTL	J406 - 3	12
J705 - 13	PS #1 FAULT	J406 - 5	13
J705 - 14	PS #2 FAULT	J406 - 6	14
J705 - 15	PS #3 FAULT	J406 - 7	15
J705 - 16	GND	J406 - 10	16
J705 - 17	PS #1 PRESENT	J406 - 11	17
J705 - 18	PS #2 PRESENT	J406 - 12	18
J705 - 19	PS #3 PRESENT	J406 - 13	19
J705 - 20	GND	J406 - 16	20
J705 - 21	PS #4 PRESENT	J406 - 14	21
J705 - 22	PS #5 PRESENT	J406 - 15	22
J705 - 23	PS #4 FAULT	J406 - 8	23
J705 - 24	PS #5 FAULT	J406 - 9	24
J302 - 1	FWD PWR SAMPLE	J23 - 4	26
J302 - 3	GND	J23 - 3	27
J302 - 4	RFL PWR SAMPLE	J23 - 1	28
J802 - 2	MUTE PS	J406 - 1	29
J22 - 1	ENABLE EXCITER	EXCITER TB1-7	51
J22 - 2	AFC LOCK	EXCITER TB1-5	52
J22 - 3	GND	EXCITER TB1-4	53
P6 - 8	+15V	J704 - 1	169
P6 - 5	GND	J704 - 2	170
P6 - 3	+5V	J704 - 3	171
P6 - 11	-15V	J704 - 4	172
P6 - 6	CHASSIS GND	TB2 - 6	173
P6 - 4	RETURN	P6 - 10	174



NOTES :
1. PART #'s & VALUES IN PARENTHESES ARE FOR FM-4C & FM1-301.

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

DWN. BY AEB
DESIGNER(S)
PROJ. LEADER
MFG.
MATERIAL
FINISH
NEXT ASSY.

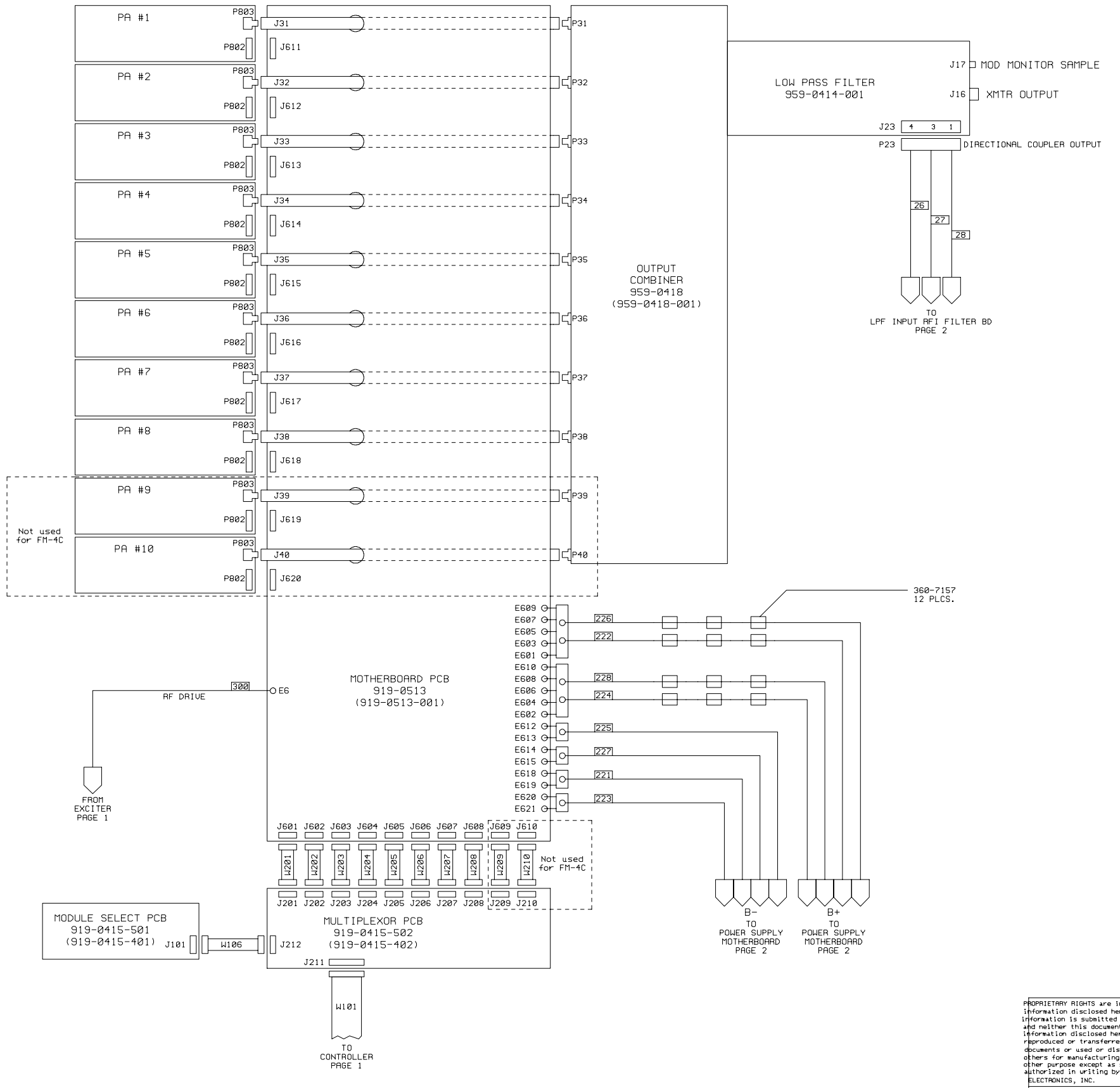
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305
217/224-9600 FAX 217/224-9607

TITLE - 3-PHASE "WYE" - FM-4C/5C, FM1-301/402 OVERALL SCHEMATIC

TYPE S | SIZE D | DWG. NO. 909-0301-384/0402-384 | REV D
909-4001-384/5001-384

MODEL (FM-4C) FM-5C | SCALE N/A | SHEET 1 OF 2

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
A	1-18-96	-SEE SHEET 1-	AEB	MBS	----
B	3-11-96	ENGINEERING RELEASE WITH CHANGED.	AEB	DLL	----
C	5-27-97	DELETED J802 & P802	MSE	DLL	9804
D	5-6-04	ADDED 12 360-7157: CHGD WIRES 221-228	KT		11129



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

DWN. BY AEB
DESIGNER(S)
PROJ. LEADER
MFG.
MATERIAL
FINISH
NEXT ASSY.

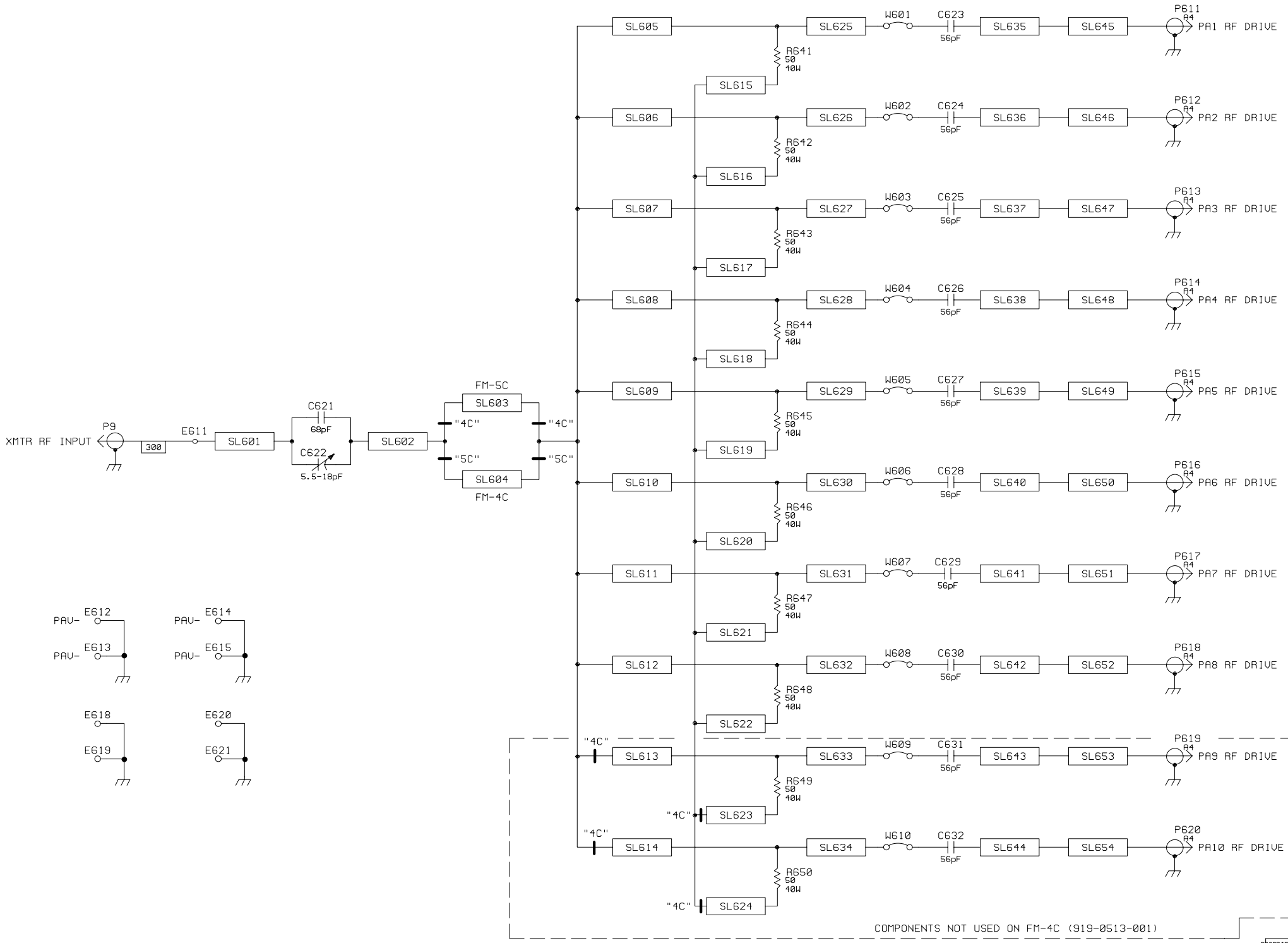
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305
217/224-9600 FAX 217/224-9607

TITLE – 3-PHASE "WYE" – FM-4C/5C, FMi-301/402 OVERALL SCHEMATIC

TYPE S | SIZE D | DWG. NO. 909-0301-384/0402-384 | REV D
909-4001-384/5001-384

MODEL (FM-4C) FM-5C | SCALE N/A | SHEET 2 OF 2

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	8-4-95	PROTOTYPE RELEASE.	MH	RMD	----
A	10-11-95	ENGINEERING RELEASE WITHOUT CHANGE.	MH		----



NOTES:

1. "SL#" INDICATES MICRO-STRIPLINE ETCHED ON PCB.
2. FOR FM-4C (ASSY #919-0513-001) CUT AND REMOVE TRACES MARKED "4C" (6 PLACES).
   FOR FM-5C (ASSY #919-0513) CUT AND REMOVE TRACES MARKED "5C" (2 PLACES).
3. COMPONENTS C617-C620, C631-C632, E609-E610, J609-J610, J619-J620, R633-R640, R649-R650, & W609-W610 NOT INSTALLED ON ASSEMBLY #919-0513-001 FOR FM-4C.
4. LAST COMPONENTS USED: C632, E621, J620, R650, W610.
5. COMPONENTS NOT USED: E616, E617.
6. SEE ASSEMBLY: AD919-0513 (FM-5C)
   AD919-0513-001 (FM-4C)

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

DWN. BY 8-4-95
M. HAYDEN
DESIGNER(S)
PROJ. LEADER
MFG.

MATERIAL
FINISH
SEE DWG RA592-0000
NEXT ASSY.

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

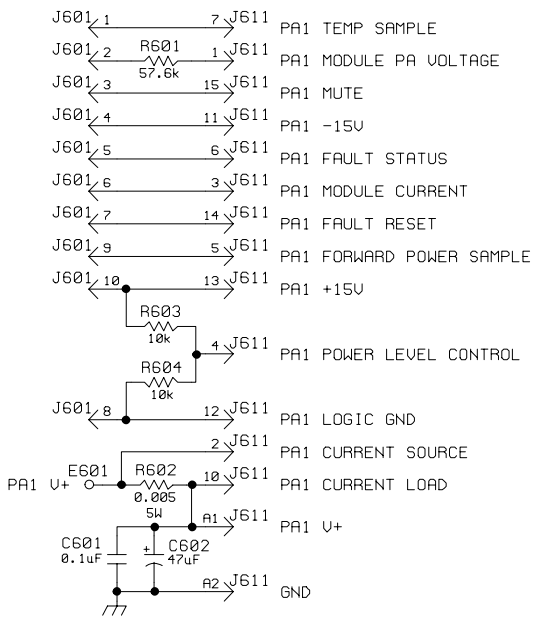
TITLE
SCHEMATIC
MOTHERBOARD,FM-4C/FM-5C

TYPE	SIZE	DWG. NO.	REV
S	B	919-0513/-001	A

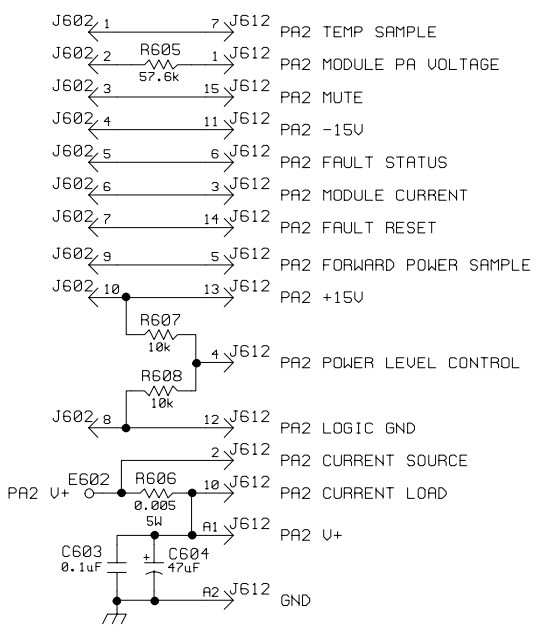
MODEL FM-4C/5C | SCALE NONE | SHEET 1 OF 2

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	8-4-95	PROTOTYPE RELEASE.	MH	RMD	----
A	10-11-95	ENGINEERING RELEASE WITHOUT CHANGE.	MH		----

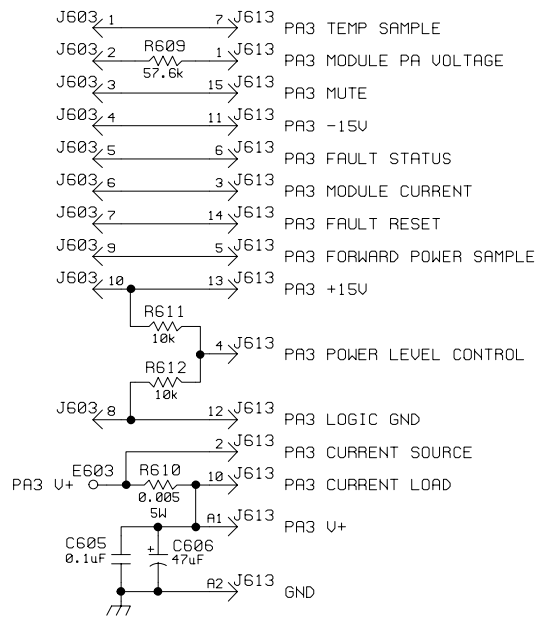
MODULE 1



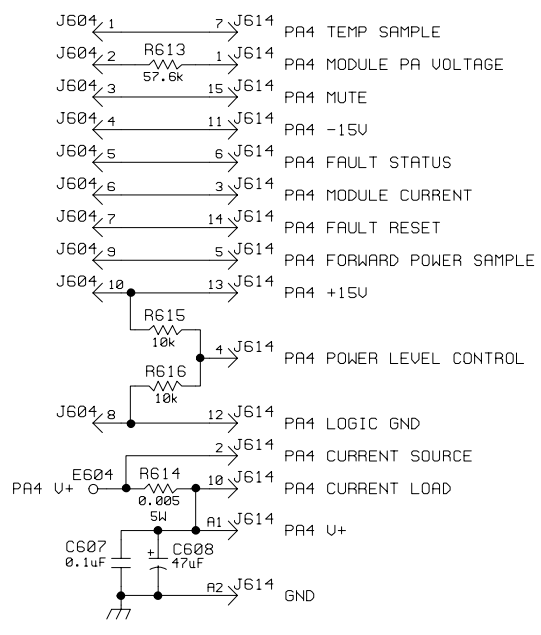
MODULE 2



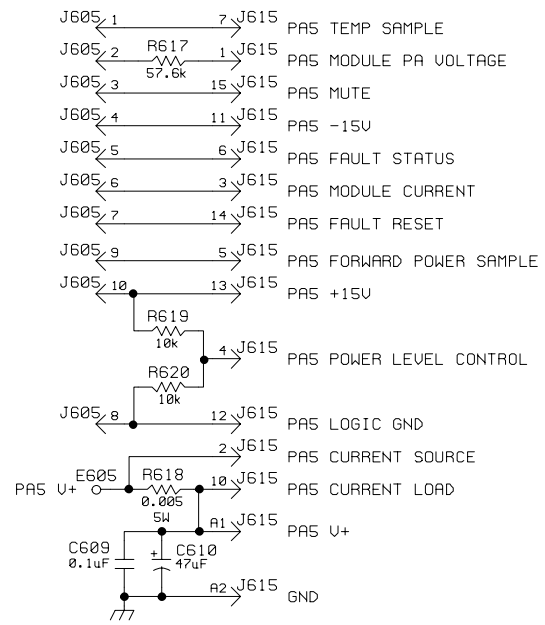
MODULE 3



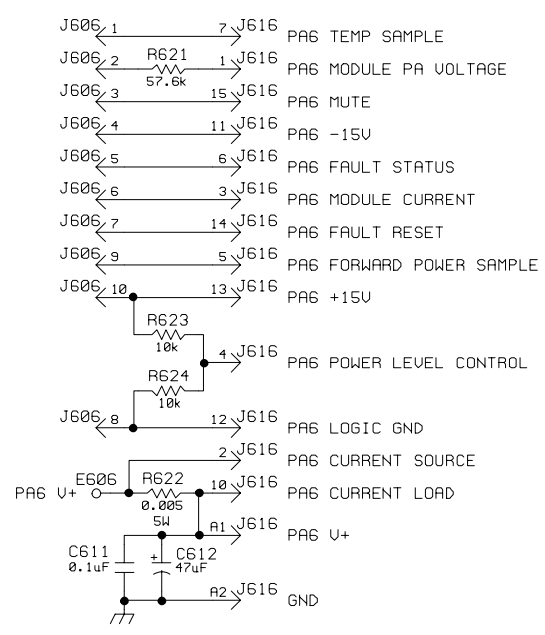
MODULE 4



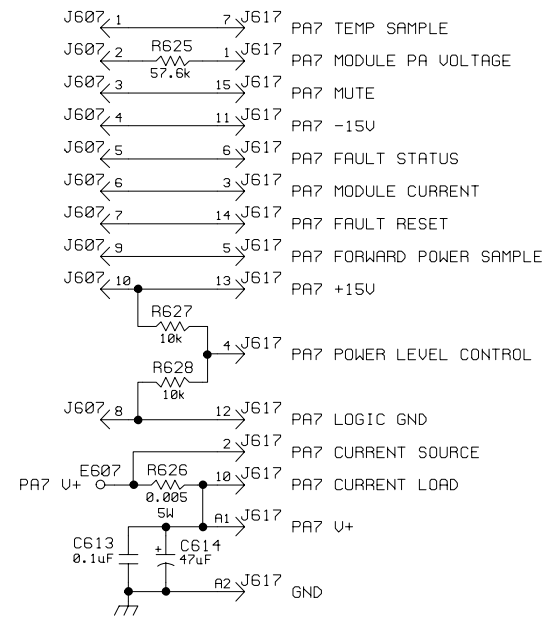
MODULE 5



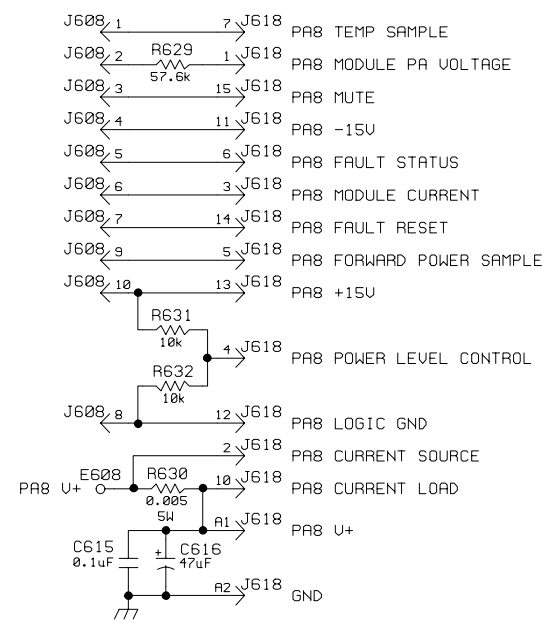
MODULE 6



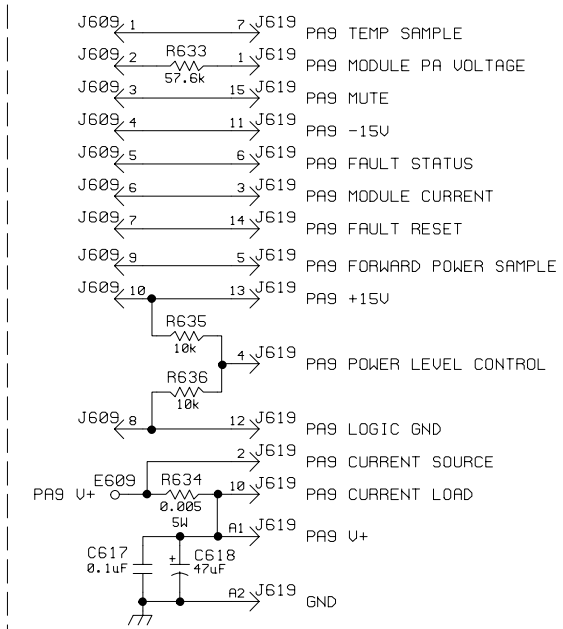
MODULE 7



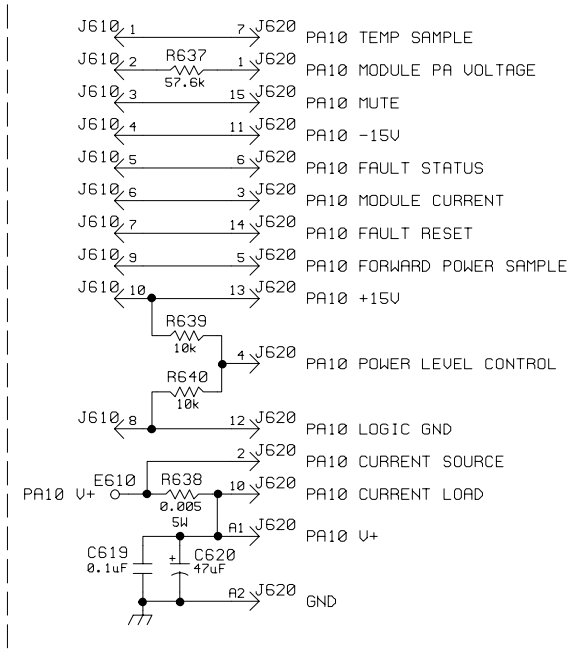
MODULE 8



MODULE 9



MODULE 10



COMPONENTS NOT USED ON FM-4C (919-0513-001)

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

DWN. BY 8-4-95 M. HAYDEN
DESIGNER(S)
PROJ. LEADER
MFG.
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 MOTHERBOARD, FM-4C/5C

TYPE	SIZE	DWG. NO.	REV
S	B	919-0513/-001	A

MODEL FM-4C/5C SCALE NONE SHEET 2 OF 2

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	7-28-95	PROTOTYPE RELEASE.	MH	WHB	----
2	9-12-95	UDATED VIEW OF COMPONENT TRACES (SHEETS 1&3).	MH	WHB	9549
A	10-11-95	ENGINEERING RELEASE WITHOUT CHANGE.	MH	MBS	----
B	8-15-96	SEE SHEET 3.	MH	DL	9686
C	7-22-98	ADD STANDOFFS (441-7967) 6 PLCS.	MSE	DL	10000
D	5-23-05	DELETED 949-0418 FROM BOM	KT		11293

NOTE:
BEFORE SOLDERING 519-0513 & 519-0513-002 TOGETHER, TEMPORARILY ALIGN THE TWO PCB´s WITH 2 #6 SCREWS & NUTS MOUNTED AT "*".

SOLDER 519-0513-002 TO 519-0513 THROUGH THE INSIDE OF THIS HOLE

SOLDER 519-0513-002 TO 519-0513 AS INDICATED ALONG THESE TWO EDGES

SOLDER EDGES OF THIS CUTOUT ON 519-0513 TO GROUND PLANE ON BOTTOM OF 519-0513-002

C622 TO BE INSTALLED WITH ARROW ON SIDE ORIENTED TOWARDS TOP EDGE OF PCB

SEE DETAIL "B"

519-0513-002

SOLDER 519-0513-002 TO 519-0513 HERE

SEE NOTE 2

SOLDER 519-0513-002 TO 519-0513 THROUGH THE INSIDE OF THESE TWO HOLES

SEE NOTE 3

E612 E613

INSTALL 426-8007 FROM OPPOSITE SIDE AND SOLDER INTO PLACE 4 PLCS (E612-E615)
ENOUGH SOLDER MUST BE USED IN THE FILLET SO THAT THE BOTTOM OF THE PEM STUD IS NOT VISIBLE AFTER SOLDERING

MOTHERBOARD, FM-4C/FM-5C
ASSEMBLY 919-0513 (-001) REV D

SEE NOTE 1

519-0513

INSTALL JUMPER WIRE #601-0022 WITH TEFLON SLEEVING #693-0220. JUMPER WIRE TO BE AS SHORT AND STRAIGHT AS POSSIBLE WITH LEADS TRIMMED FLUSH TO PCB ON OPPOSITE SIDE.
5 PLCS (W605 THRU W610 ON 919-0513)
4 PLCS (W605 THRU W608 ON 919-0513-001)

ATTACH LABEL (594-0019) ON OPPOSITE SIDE AS INDICATED BY DASHED OUTLINE
7 PLCS (919-0513)
5 PLCS (919-0513-001)

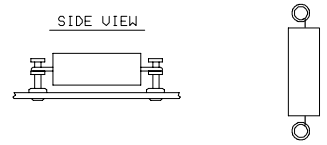
SEE NOTE 4

INSTALL 426-8008 FROM OPPOSITE SIDE AND SOLDER INTO PLACE.
6 PLCS (E605-E610)
AFTER SOLDERING MOUNT STANDOFFS (441-7967) 6 PLCS, TORQUE 15 IN LBS, THEN CHECK FOR SOLDER BREAKS.

SEE DETAIL "A"

MODULE 9 (NOT USED ON FM-4C)
MODULE 7
MODULE 5
MODULE 10 (NOT USED ON FM-4C)
MODULE 8
MODULE 6

FRONT VIEW
SIDE VIEW

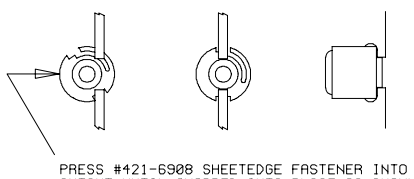


INSTALL (2) TURRETS #413-0025 AND SOLDER INTO PLACE TOP & BOTTOM. MOUNT RESISTOR #139-0007 TO TURRETS AS SHOWN - NOTE THAT RESISTOR MOUNTS TO RIGHT SIDE OF TURRETS AS SHOWN IN FRONT VIEW. RESISTOR LEADS SHOULD BE AS SHORT AND STRAIGHT AS POSSIBLE WITHOUT BENDING TURRETS.

DETAIL "A"
6 PLCS

(FOR FM-4C ASSY #919-0513-001 : INSTALL TURRETS IN ALL 12 LOCATIONS BUT DO NOT INSTALL R634 OR R638)

SIDE VIEW START | SIDE VIEW FINISH | FRONT VIEW



PRESS #421-6908 SHEETEDGE FASTENER INTO CUTOUT UNTIL SNAPPED INTO PLACE AS SHOWN

DETAIL "B"
14 PLCS

NOTES:
1. COMPONENTS SHOWN WITH DASHED OUTLINES ARE INSTALLED ON OPPOSITE SIDE OF BOARD.
2. WHEN BUILDING 919-0513 CUT AND REMOVE TRACES MARKED "5C" (2 PLACES) ON 519-0513-002).
   WHEN BUILDING 919-0513-001 CUT AND REMOVE TRACES MARKED "4C" (4 PLACES ON 519-0513 AND 2 PLACES ON 519-0513-002).
3. "MODULE 9" AND "MODULE 10" COMPONENTS ARE NOT USED ON 919-0513-001 (FM-4C). ALSO NOT USED ON FM-4C ARE C631, C632,W609,W610 AND QTY 2 OF 594-0019 THAT ARE SHOWN JUST ABOVE "MODULE 9" AND "MODULE 10" ON SOLDER SIDE OF BOARD.
4. MOUNT J615-J620 TO PCB WITH QTY 2 EACH 441-0187 AND QTY 2 EACH 423-4002 BEFORE SOLDERING INTO PLACE (J619 & J620 NOT USED ON 919-0513-001).
5. SEE SCHEMATIC: SB919-0513 (FM-5C)
   SB919-0513-001 (FM-4C).

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

DWN. BY 7-28-95 M. HAYDEN
DESIGNER(S) WARREN H. BRAKENSIEK 10-13-95
PROJ. LEADER 10-13-95 MAKUNDA B. SHRESTHA
MFG.

MATERIAL SEE BOM'S 919-0513 919-0513-001
FINISH
NEXT ASSY.

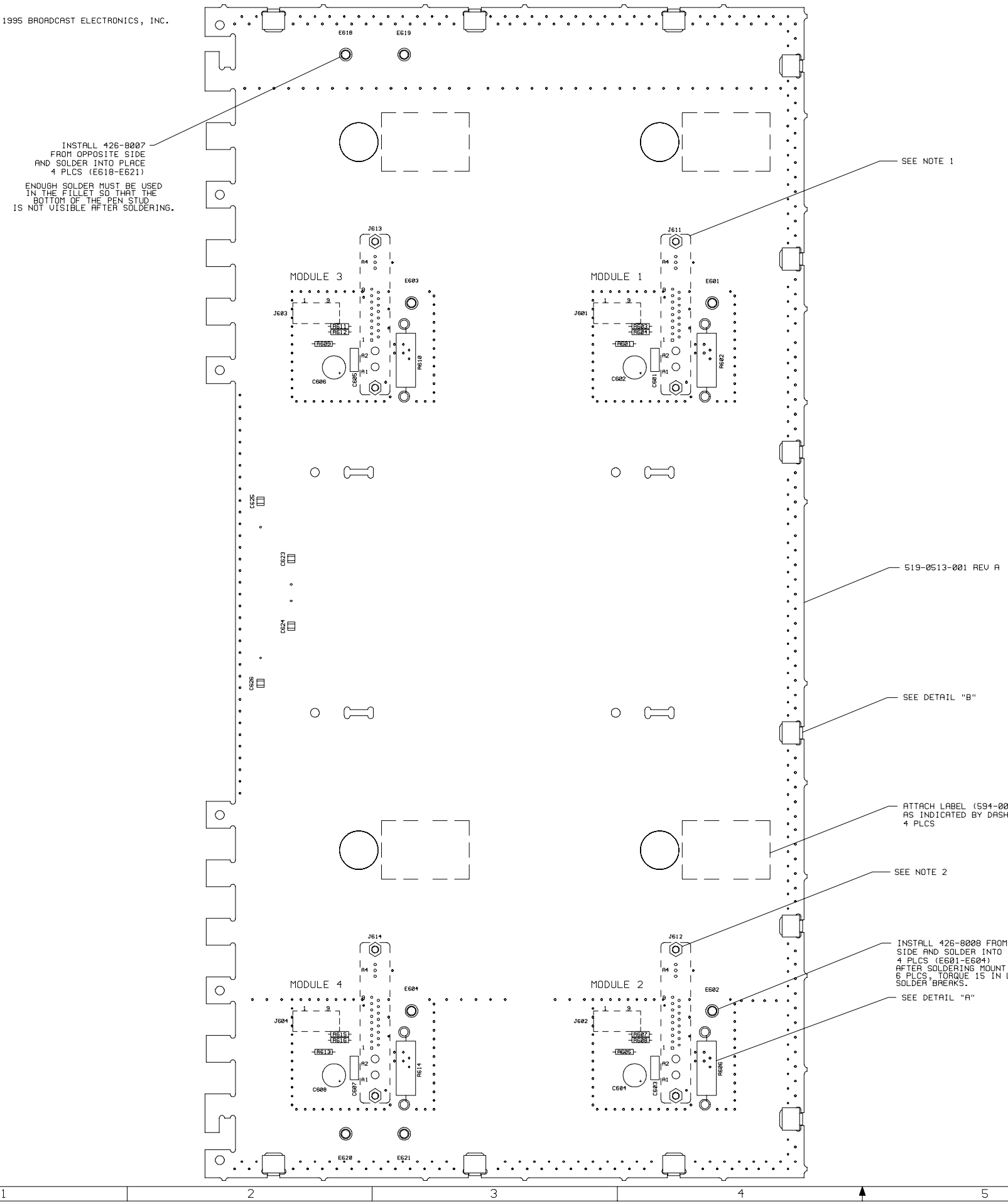
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST. P.O.BOX 3606 QUINCY,IL. 62305
217/224-9600 FAX 217/224-9607

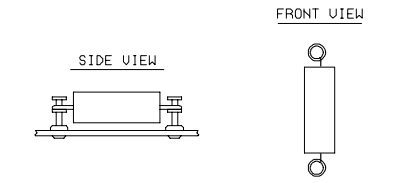
TITLE ASSEMBLY MOTHERBOARD

TYPE	SIZE	DWG No.	REV
A	D	919-0513 919-0513-001	D

MODEL FM-4C/5C | SCALE 1/1 | SHEET 1 OF 3

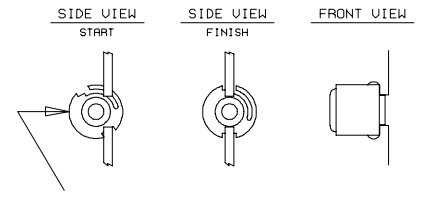
REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	7-29-95	PROTOTYPE RELEASE.	MH	RMD	----
A	10-11-95	ENGINEERING RELEASE WITHOUT CHANGE.	MH	MBS	----
C	7-22-98	ADD STANDOFFS (441-7967), 6 PLCS.	MSE	DL	10000





INSTALL (2) TURRETS #413-0025 AND SOLDER INTO PLACE TOP & BOTTOM. MOUNT RESISTOR #139-0007 TO TURRETS AS SHOWN - NOTE THAT RESISTOR MOUNTS TO RIGHT SIDE OF TURRETS AS SHOWN IN FRONT VIEW. RESISTOR LEADS SHOULD BE AS SHORT AND STRAIGHT AS POSSIBLE WITHOUT BENDING TURRETS.

DETAIL "A"
4 PLCS



PRESS #421-6908 SHEETEDGE FASTENER INTO CUTOUT UNTIL SNAPPED INTO PLACE AS SHOWN

DETAIL "B"
12 PLCS

NOTES:

1. COMPONENTS SHOWN WITH DASHED OUTLINES ARE INSTALLED ON OPPOSITE SIDE OF BOARD.
2. MOUNT J611-J614 TO PCB WITH QTY 2 EACH 441-0187 AND QTY 2 EACH 423-4002 BEFORE SOLDERING INTO PLACE.
3. SEE SCHEMATIC: SB919-0513 (FM-5C)
   SB919-0513-001 (FM-4C).

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

DWN. BY 7-29-95
M. HAYDEN
DESIGNER(S)
WARREN H. BRAKENSIEK
10-13-95
PROJ. LEADER 10-13-95
MAKUNDA B. SHRESTHA
MFG.

MATERIAL
SEE BOM'S
919-0513
919-0513-001
FINISH
NEXT ASSY.

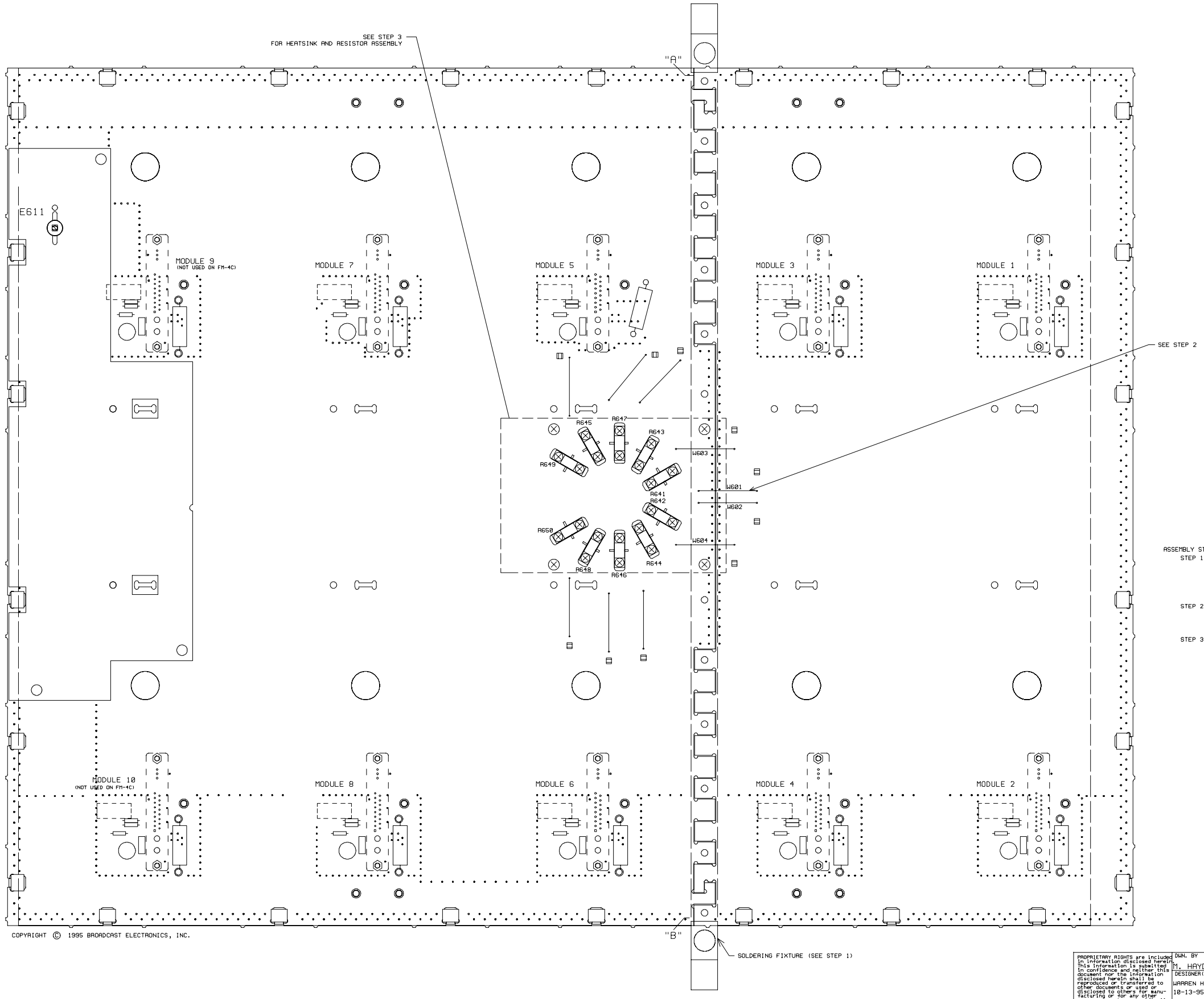
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST. P.O.BOX 3606 QUINCY,IL. 62305
217/224-9600 FAX 217/224-9607

TITLE
ASSEMBLY
MOTHERBOARD

TYPE	SIZE	DWG No.	REV
A	D	919-0513 919-0513-001	D

MODEL FM-4C/5C | SCALE 1/1 | SHEET 2 OF 3

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	8-1-95	PROTOTYPE RELEASE.	MH	WHB	----
2	9-12-95	UPDATED VIEW OF COMPONENT TRACES.	MH	WHB	9549
A	10-11-95	ENGINEERING RELEASE WITHOUT CHANGE.	MH	MBS	----
B	8-15-96	IN ASSY STEP 3 CHGD 420-6106 TO 422-6106 AND DELETED (4) 423-6002.	MH	DL	9686
C	5-23-05	DELETED 949-0418	KT		11293



ASSEMBLY STEPS FOR SHEET 3:

STEP 1 -
ALIGN BOARDS 519-0513 & 519-0513-001 IN SOLDERING FIXTURE BY ALIGNING PINS/MOUNTING HOLES IN FIXTURE WITH MOUNTING HOLES IN BOARDS. USE #6 SCREWS IN THE FIXTURE MOUNTING HOLES (8 PLCS) TO SECURE/ALIGN BOTH BOARDS BEFORE SOLDERING. SOLDER THE TWO BOARDS TOGETHER ON THE COMPONENT SIDE BETWEEN POINTS LABELED "A" AND "B".

STEP 2 -
INSTALL JUMPER WIRE #601-0022 WITH TEFLON SLEEVING #693-0220. JUMPER WIRE TO BE AS SHORT AND STRAIGHT AS POSSIBLE WITH LEADS TRIMMED FLUSH TO PCB ON OPPOSITE SIDE.
4 PLCS (W601 - W604).

STEP 3 -
MOUNT HEATSINK 471-5029 TO OPPOSITE SIDE OF 519-0513 AS SHOWN USING QTY 4 422-6106.
APPLY A THIN COAT OF #700-0028 THERMAL GREASE UNDER RESISTORS R641-R650 (FOR 919-0513) OR R641-R648 (FOR 919-0513-001) AND MOUNT TO HEATSINK AS SHOWN USING QTY 2 EACH OF #20-4106 FOR EACH RESISTOR.
TORQUE RESISTOR MOUNTING HARDWARE TO 5-6 IN-LBS.
SOLDER RESISTOR TABS TO COMPONENT SIDE OF 519-0513 AS SHOWN.

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

DWN. BY 8-1-95
M. HAYDEN
DESIGNER(S)
WARREN H. BRAKENSIEK
10-13-95
PROJ. LEADER 10-13-95
MAKUNDA B. SHRESTHA
MFG.

MATERIAL
SEE BOM'S
919-0513
919-0513-001
FINISH
NEXT ASSY.

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

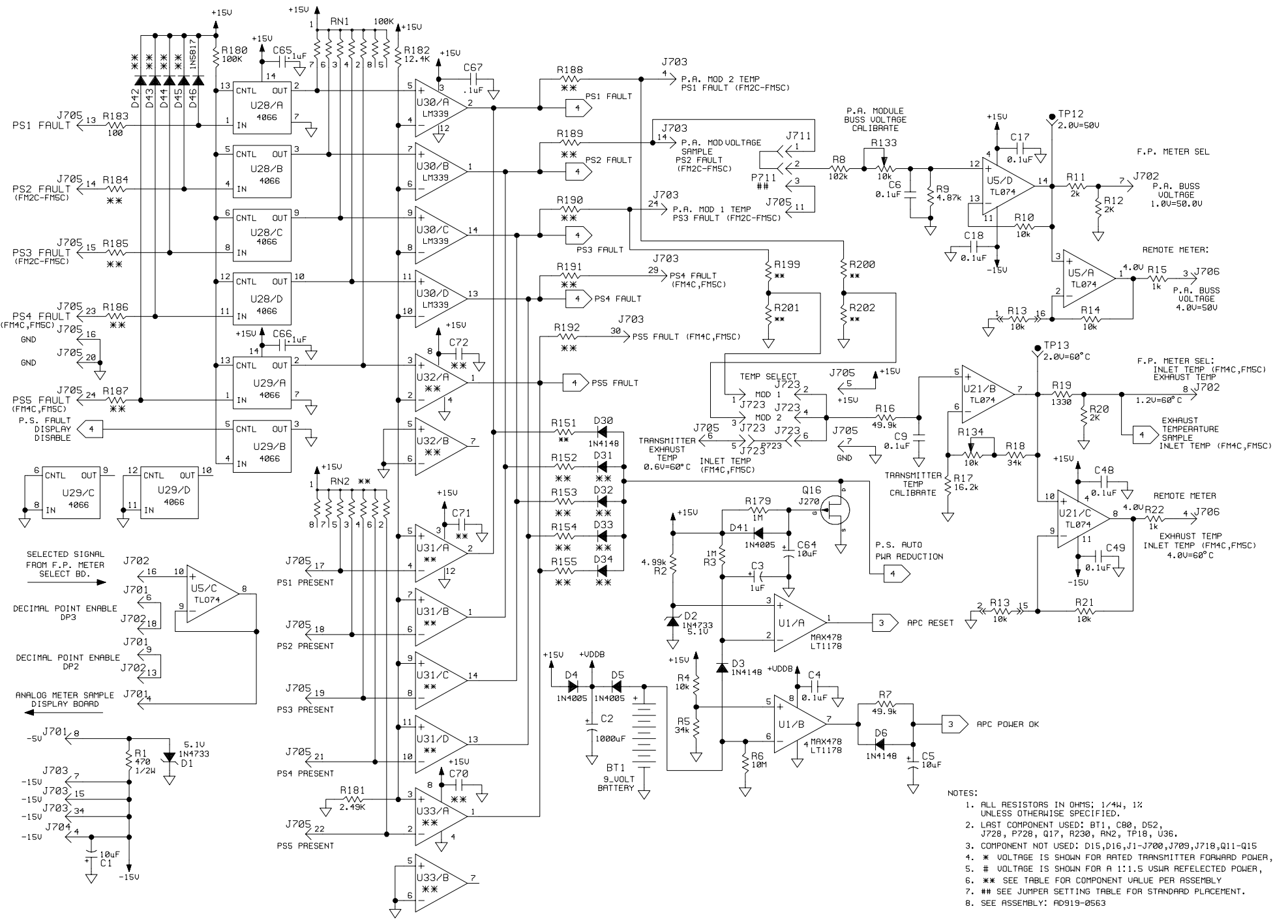
TITLE
ASSEMBLY
MOTHERBOARD

TYPE A | SIZE D | DWG No. 919-0513
919-0513-001 | REV D

MODEL FM-4C/5C | SCALE NONE | SHEET 3 OF 3

REF DES	919-0563-050 VALUE	919-0563-100 VALUE	919-0563-200 VALUE	919-0563-300 VALUE	919-0563-400 VALUE	919-0563-500 VALUE
C55	NOT USED	NOT USED	0.1uF	0.1uF	0.1uF	0.1uF
C58	NOT USED	NOT USED	0.1uF	0.1uF	0.1uF	0.1uF
C70	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	0.1uF
C71	NOT USED	NOT USED	0.1uF	0.1uF	0.1uF	0.1uF
C72	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	0.1uF
D12	1N4148	1N4148	NOT USED	NOT USED	NOT USED	NOT USED
D13	NOT USED	1N4148	1N4148	1N4148	1N4148	1N4148
D14	1N4148	1N4148	NOT USED	NOT USED	NOT USED	NOT USED
D25	1N4148	1N4148	NOT USED	NOT USED	NOT USED	NOT USED
D26	NOT USED	1N4148	1N4148	1N4148	1N4148	1N4148
D28	1N4148	1N4148	NOT USED	NOT USED	NOT USED	NOT USED
D31	NOT USED	NOT USED	1N4148	1N4148	1N4148	1N4148
D32	NOT USED	NOT USED	NOT USED	1N4148	1N4148	1N4148
D33	NOT USED	NOT USED	NOT USED	NOT USED	1N4148	1N4148
D34	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	1N4148
D36	NOT USED	NOT USED	1N4148	1N4148	1N4148	1N4148
D37	NOT USED	NOT USED	NOT USED	1N4148	1N4148	1N4148
D38	NOT USED	NOT USED	NOT USED	NOT USED	1N4148	1N4148
D42	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	1N5817
D43	NOT USED	NOT USED	NOT USED	NOT USED	1N5817	1N5817
D44	NOT USED	NOT USED	NOT USED	1N5817	1N5817	1N5817
D45	NOT USED	NOT USED	1N5817	1N5817	1N5817	1N5817
D47	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	1N4148
D48	NOT USED	NOT USED	NOT USED	NOT USED	1N4148	1N4148
D50	NOT USED	NOT USED	NOT USED	NOT USED	1N4148	1N4148
D52	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
J708	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
J710	417-0003	NOT USED	417-0003	417-0003	417-0003	417-0003
Q6	NOT USED	NOT USED	2N7000	2N7000	2N7000	2N7000
R102	NOT USED	1.1M	402K	287K	232K	196K
R106	10K	10K	NOT USED	NOT USED	NOT USED	NOT USED
R107	NOT USED	10K	10K	10K	10K	10K
R117	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
R118	576 OHM	576 OHM	681 OHM	681 OHM	576 OHM	576 OHM
R127	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
R128	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
R137	NOT USED	NOT USED	4.02K	4.02K	4.02K	4.02K
R138	NOT USED	NOT USED	1K	1K	1K	1K
R139	NOT USED	NOT USED	1K	1K	1K	1K
R140	NOT USED	NOT USED	100K	100K	100K	100K
R142	NOT USED	NOT USED	100 OHM	100 OHM	100 OHM	100 OHM
R151	100 OHM	100 OHM	82.5K	82.5K	82.5K	82.5K
R152	NOT USED	NOT USED	82.5K	82.5K	82.5K	82.5K
R153	NOT USED	NOT USED	NOT USED	82.5K	82.5K	82.5K
R154	NOT USED	NOT USED	NOT USED	NOT USED	82.5K	82.5K
R155	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	82.5K
R157	NOT USED	NOT USED	1K	1K	105K	105K
R159	NOT USED	NOT USED	53.6K	53.6K	51.1K	51.1K
R160	NOT USED	NOT USED	75K	75K	178K	178K
R161	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
R165	NOT USED	NOT USED	NOT USED	NOT USED	66.5K	66.5K
R168	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
R169	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
R170	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
R174	100K	100K	NOT USED	NOT USED	NOT USED	NOT USED
R184	NOT USED	NOT USED	100 OHM	100 OHM	100 OHM	100 OHM
R185	NOT USED	NOT USED	NOT USED	100 OHM	100 OHM	100 OHM
R186	NOT USED	NOT USED	NOT USED	NOT USED	100 OHM	100 OHM
R187	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	100 OHM
R188	NOT USED	NOT USED	1 OHM	1 OHM	1 OHM	1 OHM
R189	NOT USED	NOT USED	1 OHM	1 OHM	1 OHM	1 OHM
R190	NOT USED	NOT USED	NOT USED	1 OHM	1 OHM	1 OHM
R191	NOT USED	NOT USED	NOT USED	NOT USED	1 OHM	1 OHM
R192	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	1 OHM
R199	8.06K	8.06K	NOT USED	NOT USED	NOT USED	NOT USED
R200	8.06K	8.06K	NOT USED	NOT USED	NOT USED	NOT USED
R201	1K	1K	NOT USED	NOT USED	NOT USED	NOT USED
R202	1K	1K	NOT USED	NOT USED	NOT USED	NOT USED
R203	NOT USED	1 OHM	1 OHM	1 OHM	1 OHM	1 OHM
R204	1 OHM	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
R205	NOT USED	1 OHM	1 OHM	1 OHM	1 OHM	1 OHM
R206	NOT USED	1 OHM	NOT USED	NOT USED	NOT USED	NOT USED
R207	1 OHM	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
R208	NOT USED	1 OHM	NOT USED	NOT USED	NOT USED	NOT USED
R210	NOT USED	NOT USED	NOT USED	NOT USED	100K	100 K
R227	29K	14K	75K	48.7K	36.5K	28.7K
R228	11.5K	5.49K	32.4K	20K	15.4K	11.5K
R229	332K	162K	82.5K	56.2K	41.2K	33.2K
R230	147K	71.5K	34.8K	23.2K	17.4K	13.7K
R30	100K	100K	39.2K	39.2K	39.2K	39.2K
R31	24.9K	24.9K	20K	20K	20K	20K
R33	4.02K	4.02K	1.33K	1.33K	1.33K	1.33K
R34	1K	1K	2K	2K	2K	2K
R60	8.06K	3.48K	21.5K	14K	10.2K	8.06K
R74	100K	49.9K	24.3K	15.8K	11.5K	9.09K
R75	1.02K	1.02K	1K	1K	1K	1K
R97	1.3M	249K	82.5K	53.6K	43.2K	36.5K
RN2	NOT USED	NOT USED	100K	100K	100K	100K
U23	NOT USED	NOT USED	4N33	4N33	4N33	4N33
U31	NOT USED	NOT USED	LM339A	LM339A	LM339A	LM339A
U32	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	LM393N
U33	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	LM393N

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	3-7-03	PROTOTYPE RELEASE	KT	JT	----
2	3-24-03	SEE SHEET 2	KT	TH	----
A	3-26-03	ENGINEERING RELEASE	KT	TH/JT	----
B	6-23-03	CHGD VALUE OF R227 & R228	KT	TH	10994
C	10-14-03	SEE SHEET 3	KT	DL	11048
D	11-14-03	SEE SHEETS 2 & 4	KT	DL	11072
E	1-6-05	CHGD VALUES FOR R74,R229,R230; SEE SHEETS 2 & 4	KT	TH	11227



NOTES:
1. ALL RESISTORS IN OHMS; 1/4W, 1% UNLESS OTHERWISE SPECIFIED.
2. LAST COMPONENT USED: BT1, C80, D52, J728, P728, Q17, R230, RN2, TP18, U36.
3. COMPONENT NOT USED: D15,D16,J1-J700,J709,J718,Q11-Q15
4. * VOLTAGE IS SHOWN FOR RATED TRANSMITTER FORWARD POWER,
5. # VOLTAGE IS SHOWN FOR A 1:1.5 VSWR REFELECTED POWER,
6. ** SEE TABLE FOR COMPONENT VALUE PER ASSEMBLY
7. ## SEE JUMPER SETTING TABLE FOR STANDARD PLACEMENT.
8. SEE ASSEMBLY: AD919-0563

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

DWN. BY	KT 3-7-03
DESIGNER(S)	TH/JT 4-1-03
PROJ. LEADER	
MFG.	
MATERIAL	SEE BOMS 919-0563*
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: CONTROLLER

TYPE	SIZE	DWG. NO	REV
S	D	919-0563-50/100/200 919-0563-300/400/500	E

MODEL NNNN | SCALE NONE | SHEET 1 OF 4

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	3-7-03	PROTOTYPE RELEASE	KT		----
2	3-24-03	ADDED JP727,JP728,R227-R230;CHGD R47,R48,R62,R63	KT	TH	----
D	11-14-03	ADDED C80	KT	DL	11072
E	1-6-05	CHGD R49,R64,R149	KT	TH	11227

FM ONLY IBOC ONLY FM+ IBOC

MOD 1 CURRENT 10.0V=20.0A

MOD 2 CURRENT 10.0V = 20.0A

MOD TEMP (FM2C-5C) 5.94V=60° C

MOD 1 FORWARD POWER 5.0V=500W

MOD 2 FORWARD POWER 5.0V=500W

MODULE VOLTAGE (FM2C-5C) 5.0V=50.0V

F.P. METER SELECT:
MODULE #1 CURRENT
0.4V=20A

F.P. METER SELECT:
MODULE #2 CURRENT
0.4V = 20A

MOD TEMP (FM2C-5C)
1.2V=60° C

FM TRANSMITTER REFLECTED POWER
FM500C1 = 0.54V = 20W
FM1C1 = 0.89V = 40W
FM2C = 1.53V = 80W
FM3C = 1.93V = 120W
FM4C = 2.27V = 160W
FM5C = 2.57V = 200W

REMOTE METER:
MODULE #1 CURRENT

REMOTE METER:
MODULE #2 CURRENT
MOD TEMP (FM2C-5C)

FM TRANSMITTER FORWARD POWER
2.1V = 500W
2.78V = 1KW
4.43V = 2KW
5.74V = 3KW
6.67V = 4KW
7.46V = 5KW

FORWARD POWER SAMPLE

TRANSMITTER FWD PWR CALIBRATE

REMOTE METER:
TRANSMITTER FWD PWR

TRANSMITTER REF PWR CALIBRATE

REFLECTED POWER SAMPLE

REMOTE METER:
TRANSMITTER REF PWR

MODULE FWD PWR CALIBRATE

TO MTR SEL
MOD #1 FWD PWR

TO MTR SEL
MOD #2 FWD PWR

REMOTE METER:
MOD #1 FWD PWR

REMOTE METER:
MOD #2 FWD PWR
MOD VOLTAGE (FM2C-5C)

FROM MTR SEL
MOD FWD PWR

F.P. METER SEL:
XMTR FWD PWR

1.0V = 500W
2.0V = 1KW
0.4V = 2KW
0.6V = 3KW
0.8V = 4KW
1.0V = 5KW

F.P. METER SEL:
MODULE #1 FORWARD POWER
1.0V=500W

F.P. METER SEL:
MODULE #2 FORWARD POWER
1.0V=500W
PA VOLTAGE (FM2C-5C)
1.0V=50.0V

F.P. METER SEL:
XMTR REF PWR
0.04V = 20W = FM500C1
0.08V = 40W = FM1C1
0.16V = 80W = FM2C
0.24V = 120W = FM3C
0.32V = 160W = FM4C
0.40V = 200W = FM5C

JUMPER SETTINGS

ASSEMBLY	P710	P711	P712	P713	P714	P715	P716	P717	P720	P721	P722	P723
919-0563-050	1-2	1-2	1-2	2-3	1-2	2-3	1-2	1-2	2-3	2-3	1-2	5-6
919-0563-100	NU	1-2	1-2	2-3	1-2	2-3	1-2	1-2	2-3	2-3	1-2	5-6
919-0563-200	2-3	2-3	1-2	1-2	2-3	1-2	1-2	1-2	2-3	2-3	2-3	5-6
919-0563-300	2-3	2-3	1-2	1-2	2-3	1-2	1-2	1-2	2-3	2-3	2-3	5-6
919-0563-400	2-3	2-3	1-2	1-2	2-3	1-2	1-2	1-2	2-3	2-3	2-3	5-6
919-0563-500	2-3	2-3	1-2	1-2	2-3	1-2	1-2	1-2	2-3	2-3	2-3	5-6

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

DWN. BY	KT 3-7-03
DESIGNER(S)	TH/JT 4-1-03
PROJ. LEADER	
MFG.	
MATERIAL	SEE BOMS 919-0563*
FINISH	
NEXT ASSY.	

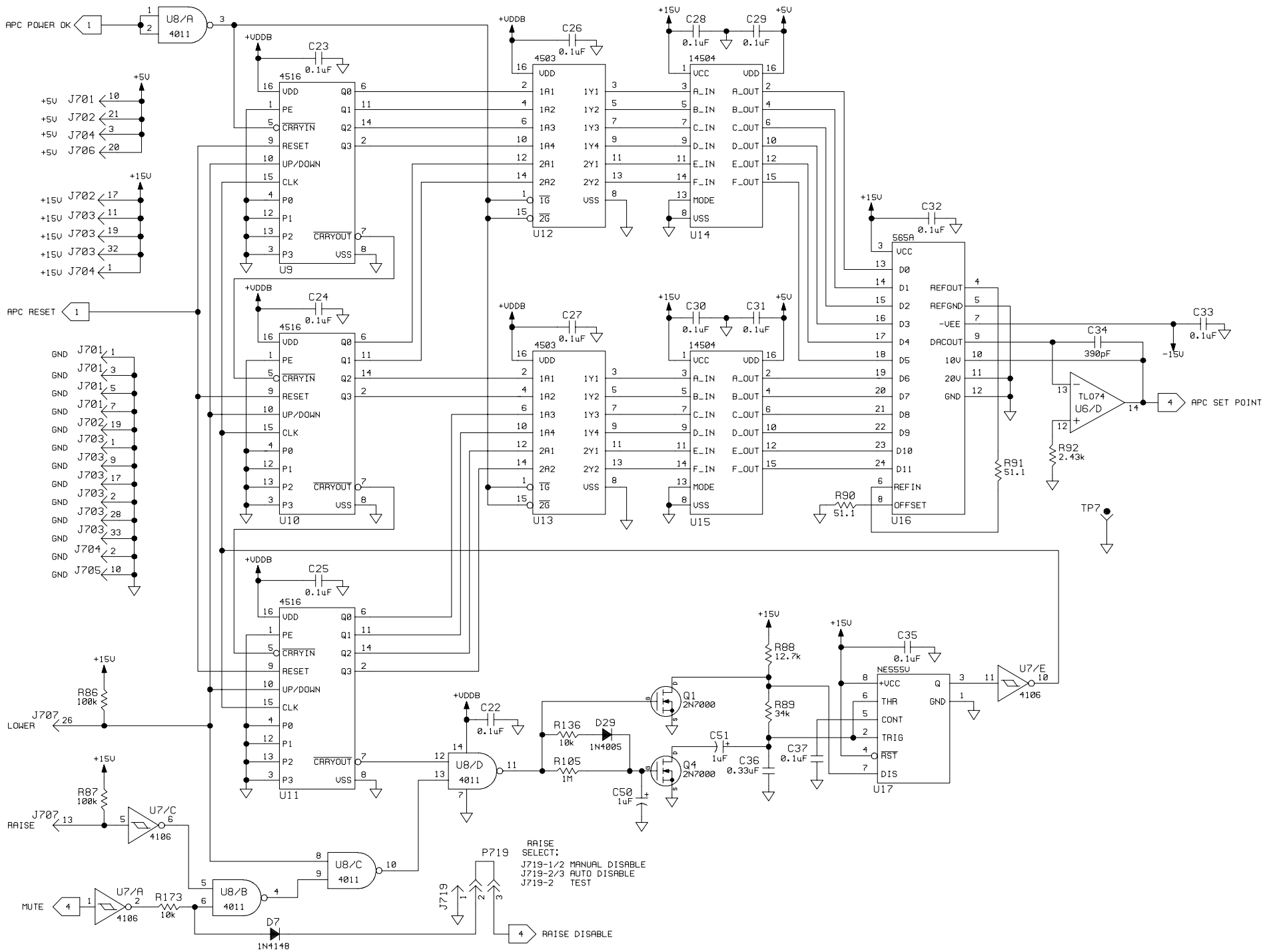
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305
217/224-9600 FAX 217/224-9607

TITLE: CONTROLLER

TYPE	SIZE	DWG. NO	REV
S	D	919-0563-50/100/200 919-0563-300/400/500	E

MODEL NNNN | SCALE NONE | SHEET 2 OF 4

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	3-7-03	PROTOTYPE RELEASE	KT		----
C	10-14-03	CHGD C36 FROM .1uF TO .33uF	KT	DL	11048



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

DWN. BY: KT 3-7-03
DESIGNER(S): TH/JT 4-1-03
PROJ. LEADER:
MFG.

MATERIAL: SEE BOMS 919-0563*
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: CONTROLLER

TYPE S | SIZE D | DWG. NO 919-0563-50/100/200 919-0563-300/400/500 | REV E

MODEL NNNN | SCALE NONE | SHEET 3 OF 4

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	3-7-03	PROTOTYPE RELEASE	KT	TH	----
D	11-14-03	ADDED C79	KT	DL	11072
E	1-6-05	CHGD R93,R94,R111-R114,R215	KT	TH	11227

@: SET R94 FOR HIGH AT TP17 WITH:
RFL PWR OF 60W FOR FM1C1,
RFL PWR OF 30W FOR FM500C1,
RFL PWR OF 120W FOR FM2C,
RFL PWR OF 180W FOR FM3C,
RFL PWR OF 240W FOR FM4C,
RFL PWR OF 300W FOR FM5C,
AFTER R112 IS ADJUSTED.

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

DWN. BY	KT 3-7-03
DESIGNER(S)	TH/JT 4-1-03
PROJ. LEADER	
MFG.	
MATERIAL	SEE BOMS 919-0563*
FINISH	
NEXT ASSY.	

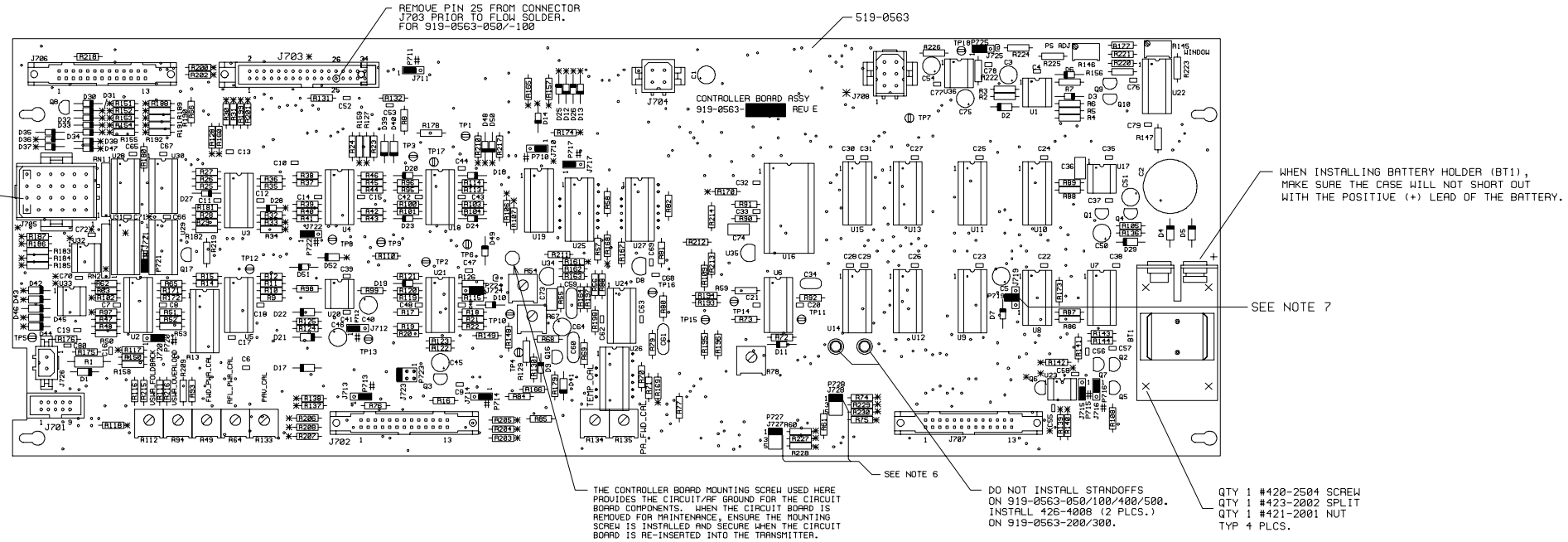
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305
217/224-9600 FAX 217/224-9607

TITLE: CONTROLLER

TYPE	SIZE	DWG. NO.	REV
S	D	919-0563-50/100/200 919-0563-300/400/500	E

MODEL NNNN | SCALE NONE | SHEET 4 OF 4

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	3-10-03	PROTOTYPE RELEASE	KT	JT	----
2	3-28-03	ADD JP727,JP728,R227-R230; CHGD R47,R78,R62,R63	KT	TH	----
A	4-1-03	ENGINEERING RELEASE	KT	TH/JT	----
B	6-23-03	CHGD R227 & R228; MOVED PARTS AWAY FROM CLEAR AREAS	KT	TH	10994
C	10-14-03	CHGD C36 FROM 003-1054 TO 030-3300	KT	DL	11048
D	11-14-03	ADDED C79 & C80	KT	DL	11072
E	1-6-05	CHGD R49,R64,R74,R93,R94,R111-R114,R149,R215,R229,R230	KT		11227



NOTES:

1. COMPONENTS SHOWN WITH DASHED LINES TO BE INSTALLED ON OPPOSITE SIDE.
2. # SEE PROGRAMMABLE JUMPER TABLE FOR STANDARD PLACEMENT.
3. SEE SCHEMATICS: SB919-0563 (CONTROLLER BD.).
4. SEE BOMS: 919-0563-050/-100/-200/-300/-400/-500.
5. * INDICATES SEE TABLE FOR COMPONENTS USED ON EACH ASSEMBLY.
6. INSTALL P727 ON J727 & P728 ON J728 AS FOLLOWS:
   ON PINS 1-2 FOR FM ONLY
   ON PINS 3-4 FOR IBOC ONLY
   ON PINS 5-6 FOR FM + IBOC
7. INSTALL P719 ON J719 AS FOLLOWS:
   ON PINS 1-2 FOR MANUAL DISABLE
   ON PINS 2-3 FOR AUTO DISABLE
   ON PIN 2 ONLY FOR TEST
8. @ INSTALL P724 ON J724 & P725 ON J725 AS FOLLOWS:
   ON PINS 1-2 FOR IBOC
   ON PINS 2-3 FOR FM ONLY

REF DES	919-0563-050 PART #	919-0563-100 PART #	919-0563-200 PART #	919-0563-300 PART #	919-0563-400 PART #	919-0563-500 PART #
C55	NOT USED	NOT USED	003-1054	003-1054	003-1054	003-1054
C58	NOT USED	NOT USED	003-1054	003-1054	003-1054	003-1054
C70	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	003-1054
C71	NOT USED	NOT USED	003-1054	003-1054	003-1054	003-1054
C72	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	003-1054
D12	203-4148	203-4148	NOT USED	NOT USED	NOT USED	NOT USED
D13	NOT USED	203-4148	203-4148	203-4148	203-4148	203-4148
D14	203-4148	203-4148	NOT USED	NOT USED	NOT USED	NOT USED
D25	203-4148	203-4148	NOT USED	NOT USED	NOT USED	NOT USED
D26	NOT USED	203-4148	203-4148	203-4148	203-4148	203-4148
D28	203-4148	203-4148	NOT USED	NOT USED	NOT USED	NOT USED
D31	NOT USED	NOT USED	203-4148	203-4148	203-4148	203-4148
D32	NOT USED	NOT USED	NOT USED	203-4148	203-4148	203-4148
D33	NOT USED	NOT USED	NOT USED	NOT USED	203-4148	203-4148
D34	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	203-4148
D36	NOT USED	NOT USED	203-4148	203-4148	203-4148	203-4148
D37	NOT USED	NOT USED	NOT USED	203-4148	203-4148	203-4148
D38	NOT USED	NOT USED	NOT USED	NOT USED	203-4148	203-4148
D42	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	200-0019
D43	NOT USED	NOT USED	NOT USED	NOT USED	200-0019	200-0019
D44	NOT USED	NOT USED	NOT USED	200-0019	200-0019	200-0019
D45	NOT USED	NOT USED	200-0019	200-0019	200-0019	200-0019
D47	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	203-4148
D48	NOT USED	NOT USED	NOT USED	NOT USED	203-4148	203-4148
D50	NOT USED	NOT USED	NOT USED	NOT USED	203-4148	203-4148
D62	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
J703	418-2602	418-2602	418-2602	418-2602	417-2402	417-2402
J705	417-0230	417-0230	417-0230	417-0230	417-2401	417-2401
J708	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
J718	417-2003	417-2003	417-2003	417-2003	417-2003	417-2003
Q6	NOT USED	NOT USED	210-7000	210-7000	210-7000	210-7000
R102	NOT USED	100-1173	103-4026	103-2861	103-2326	103-1966
R106	100-1051	100-1051	NOT USED	NOT USED	NOT USED	NOT USED
R107	NOT USED	100-1051	100-1051	100-1051	100-1051	100-1051
R117	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
R118	103-5761	103-5761	103-6813	103-6813	103-5761	103-5761
R127	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
R128	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
R137	NOT USED	NOT USED	103-4024	103-4024	103-4024	103-4024
R138	NOT USED	NOT USED	100-1041	100-1041	100-1041	100-1041
R139	NOT USED	NOT USED	100-1041	100-1041	100-1041	100-1041
R140	NOT USED	103-1062	103-1062	103-1062	103-1062	103-1062
R142	NOT USED	NOT USED	100-1031	100-1031	100-1031	100-1031
R151	100-1031	100-1031	103-8255	103-8255	103-8255	103-8255
R152	NOT USED	NOT USED	103-8255	103-8255	103-8255	103-8255
R153	NOT USED	NOT USED	NOT USED	103-8255	103-8255	103-8255
R154	NOT USED	NOT USED	NOT USED	NOT USED	103-8255	103-8255
R155	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	103-8255
R157	NOT USED	NOT USED	100-1241	100-1241	103-1056	103-1056
R159	NOT USED	NOT USED	103-5365	103-5365	103-5115	103-5115
R160	NOT USED	NOT USED	103-7505	103-7505	103-1761	103-1761
R161	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
R165	NOT USED	NOT USED	NOT USED	NOT USED	103-6655	103-6655
R168	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
R169	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
R170	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
R174	103-1062	103-1062	NOT USED	NOT USED	NOT USED	NOT USED
R184	NOT USED	NOT USED	100-1031	100-1031	100-1031	100-1031
R185	NOT USED	NOT USED	NOT USED	100-1031	100-1031	100-1031
R186	NOT USED	NOT USED	NOT USED	NOT USED	100-1031	100-1031
R187	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	100-1031
R188	NOT USED	NOT USED	100-1013	100-1013	100-1013	100-1013
R189	NOT USED	NOT USED	100-1013	100-1013	100-1013	100-1013
R190	NOT USED	NOT USED	NOT USED	100-1013	100-1013	100-1013
R191	NOT USED	NOT USED	NOT USED	NOT USED	100-1013	100-1013
R192	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	100-1013
R193	103-8064	103-8064	NOT USED	NOT USED	NOT USED	NOT USED
R200	103-8064	103-8064	NOT USED	NOT USED	NOT USED	NOT USED
R201	100-1041	100-1041	NOT USED	NOT USED	NOT USED	NOT USED
R202	100-1041	100-1041	NOT USED	NOT USED	NOT USED	NOT USED
R203	NOT USED	100-1013	103-1013	100-1013	100-1013	100-1013
R204	100-1013	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
R205	NOT USED	100-1013	103-1013	100-1013	100-1013	100-1013
R206	NOT USED	100-1013	NOT USED	NOT USED	NOT USED	NOT USED
R207	100-1013	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
R208	NOT USED	100-1013	NOT USED	NOT USED	NOT USED	NOT USED
R218	NOT USED	NOT USED	NOT USED	NOT USED	103-1062	103-1062
R227	103-2945	103-1405	103-7505	103-4875	103-3655	103-2851
R228	103-1155	103-5494	103-3245	103-2051	103-1551	103-1155
R229	103-3325	103-1626	103-8255	103-5651	103-4126	103-3325
R230	103-1476	103-7155	103-3485	103-2325	103-1745	103-1375
R30	103-1062	103-1062	100-3951	100-3951	100-3951	100-3951
R31	103-2495	103-2495	103-2051	103-2051	103-2051	103-2051
R33	103-4024	103-4024	103-1331	103-1331	103-1331	103-1331
R34	100-1041	100-1041	100-2041	100-2041	100-2041	100-2041
R60	103-8064	103-3484	103-2151	103-1405	103-1025	103-8064
R74	103-1062	103-4951	103-2435	103-1585	103-1155	103-9041
R75	103-1024	103-1024	100-1041	100-1041	100-1041	100-1041
R97	100-1373	103-2496	103-8255	103-5365	103-4325	103-3655
RN2	NOT USED	NOT USED	226-1061	226-1061	226-1061	226-1061
U23	NOT USED	NOT USED	229-0033	229-0033	229-0033	229-0033
U31	NOT USED	NOT USED	221-0339	221-0339	221-0339	221-0339
U32	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	221-0393
U33	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	221-0393

PROGRAMMABLE JUMPER SETTINGS

REF DES	919-0563-050 PINS	919-0563-100 PINS	919-0563-200 PINS	919-0563-300 PINS	919-0563-400 PINS	919-0563-500 PINS
P710	1-2	NOT USED	2-3	2-3	2-3	2-3
P711	1-2	1-2	2-3	2-3	2-3	2-3
P712	1-2	1-2	1-2	1-2	1-2	1-2
P713	2-3	2-3	1-2	1-2	1-2	1-2
P714	1-2	1-2	2-3	2-3	2-3	2-3
P715	2-3	2-3	1-2	1-2	1-2	1-2
P716	1-2	1-2	1-2	1-2	1-2	1-2
P717	1-2	1-2	1-2	1-2	1-2	1-2
P720	2-3	2-3	2-3	2-3	2-3	2-3
P721	2-3	2-3	2-3	2-3	2-3	2-3
P722	1-2	1-2	2-3	2-3	2-3	2-3
P723	5-6	5-6	5-6	5-6	5-6	5-6

PROPRIETARY RIGHTS are included in information disclosed herein. This information is submitted in confidence and neither this information nor the information disclosed herein shall be reproduced or transferred to other documents used or disclosed to others for manufacturing or for any other purpose except as specifically authorized in writing by BROADCAST ELECTRONICS, INC.

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

DWN. BY: KT 3-10-03
DESIGNER(S): TH/JT 4-1-03
PROJ. LEADER:
MFG.

MATERIAL: SEE NOTE 4
FINISH:
NEXT ASSY.

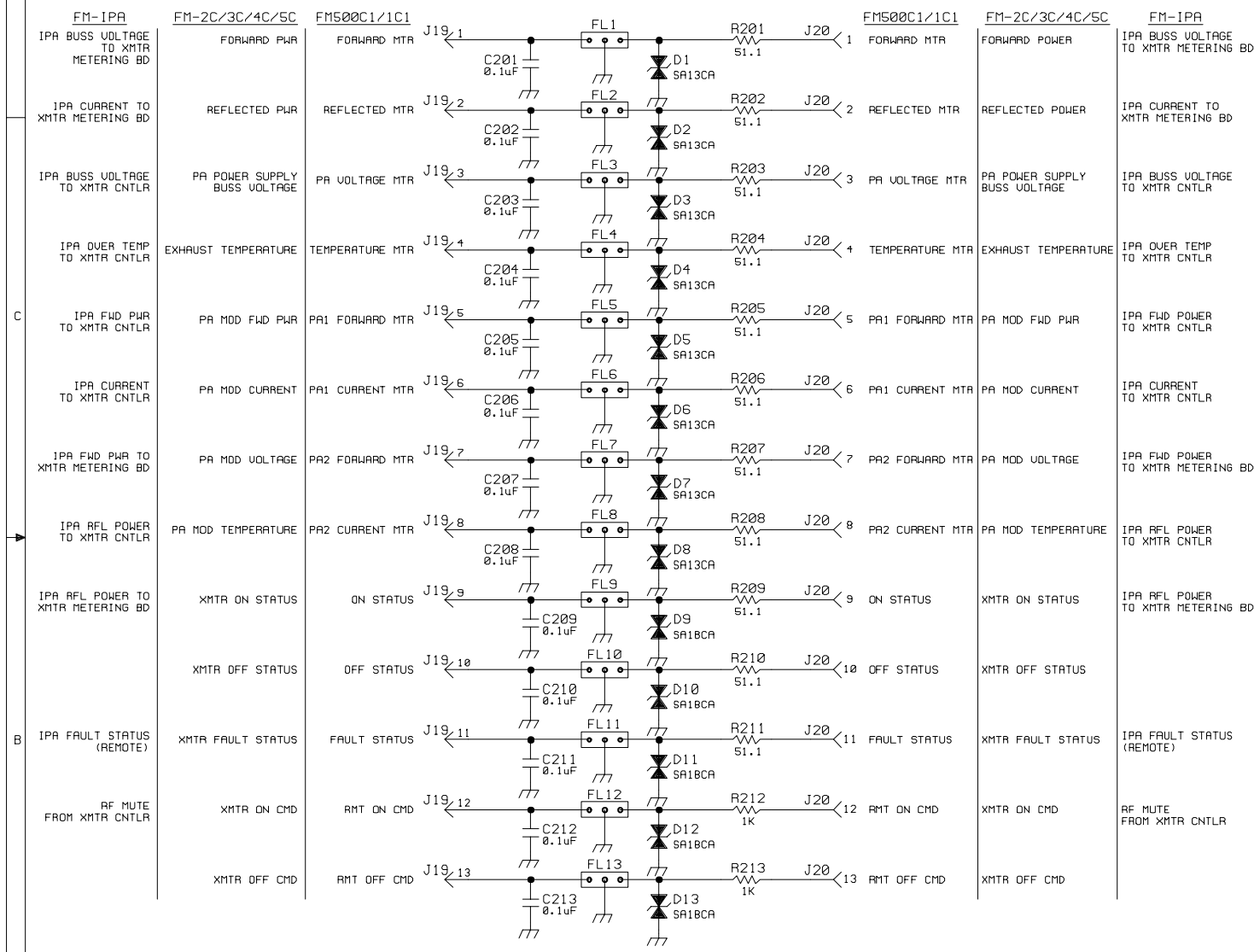
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST. P.O.BOX 3606 QUINCY,IL. 62305
217/224-9600 FAX 217/224-9607

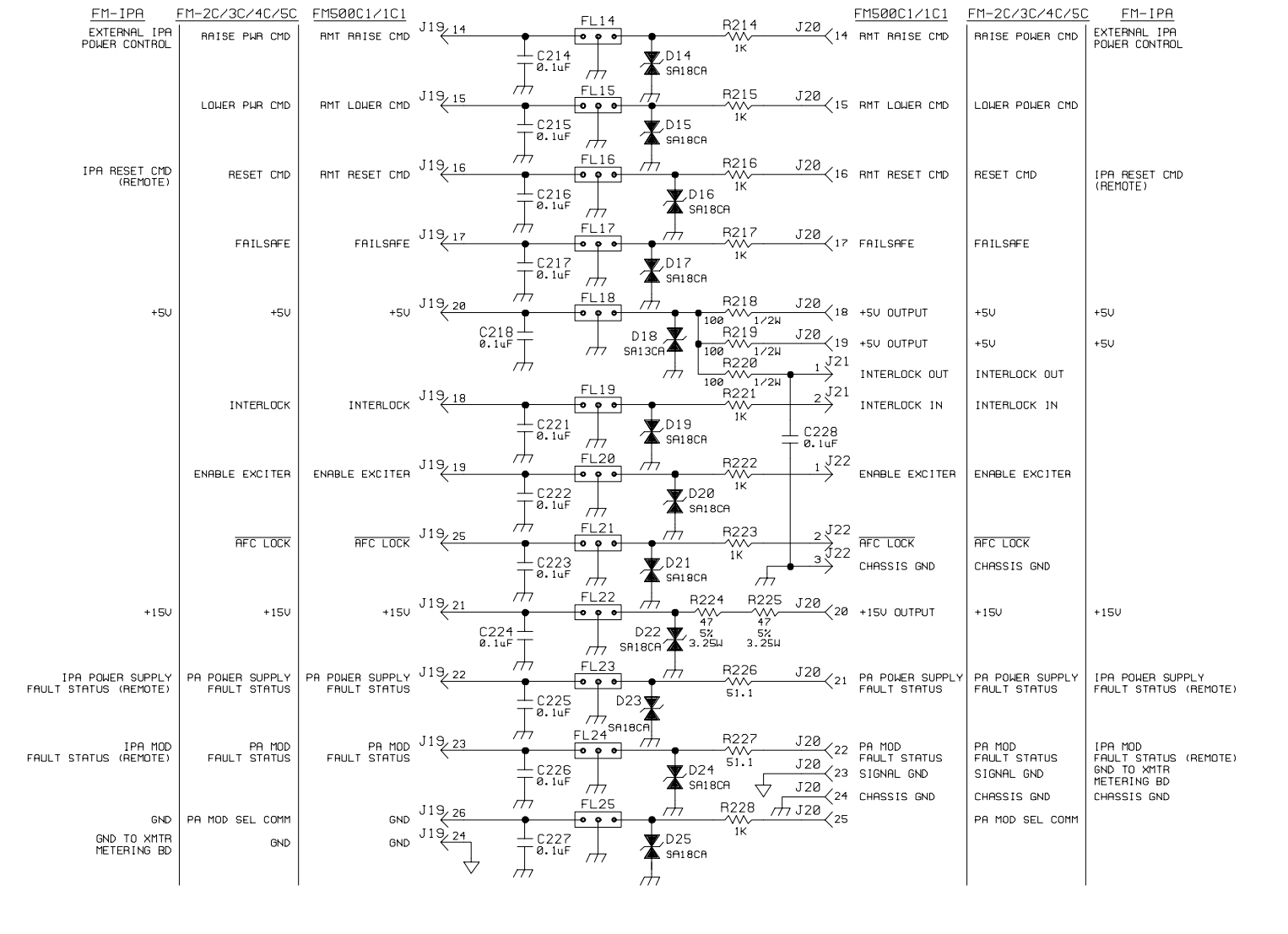
TITLE: PCB ASSEMBLY CONTROLLER

TYPE	SIZE	DWG No.	REV
A	D	919-0563-050/100 919-0563-200/300/400/500	E

MODEL: C SERIES | SCALE: 1/1 | SHEET 1 OF 1

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	5-14-96	PROTOTYPE RELEASE	MH	WHB	----
2	5-21-96	UPDATED INSTANCES OF NOTES 5 & 6; UPDATED VALUES OF D9-D17 & D19-D25.	MH	WHB	----
3	5-30-96	DELETED R229-R243;CHGD R212-R217 & R228 TO 1K.	MH	WHB	----
4	8-18-96	DELETED 919-0435-001 AND NOTES 5 & 6.	MH	WHB	----
A	1-24-97	ENGINEERING RELEASE WITHOUT CHANGE.	MH	MBS	----
B	2-4-99	CHGD J19 TO A 418-2602.	KT		10093





NOTES:

1. ALL RESISTORS IN OHMS; 1/4W, 1%, UNLESS OTHERWISE SPECIFIED.
2. LAST COMPONENT USED: C228, D25, FL25, J22, R228.
3. COMPONENTS NOT USED: C219, C220, J1-J18
4. SEE ASSEMBLY: AB919-0435.

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

DWN. BY 5-14-96 M. HAYDEN
DESIGNER(S)
PROJ. LEADER MBS 1-24-97
MFG.

MATERIAL SEE BOM 919-0435
FINISH
~~SEE DWG RA592-0000~~
NEXT ASSY.

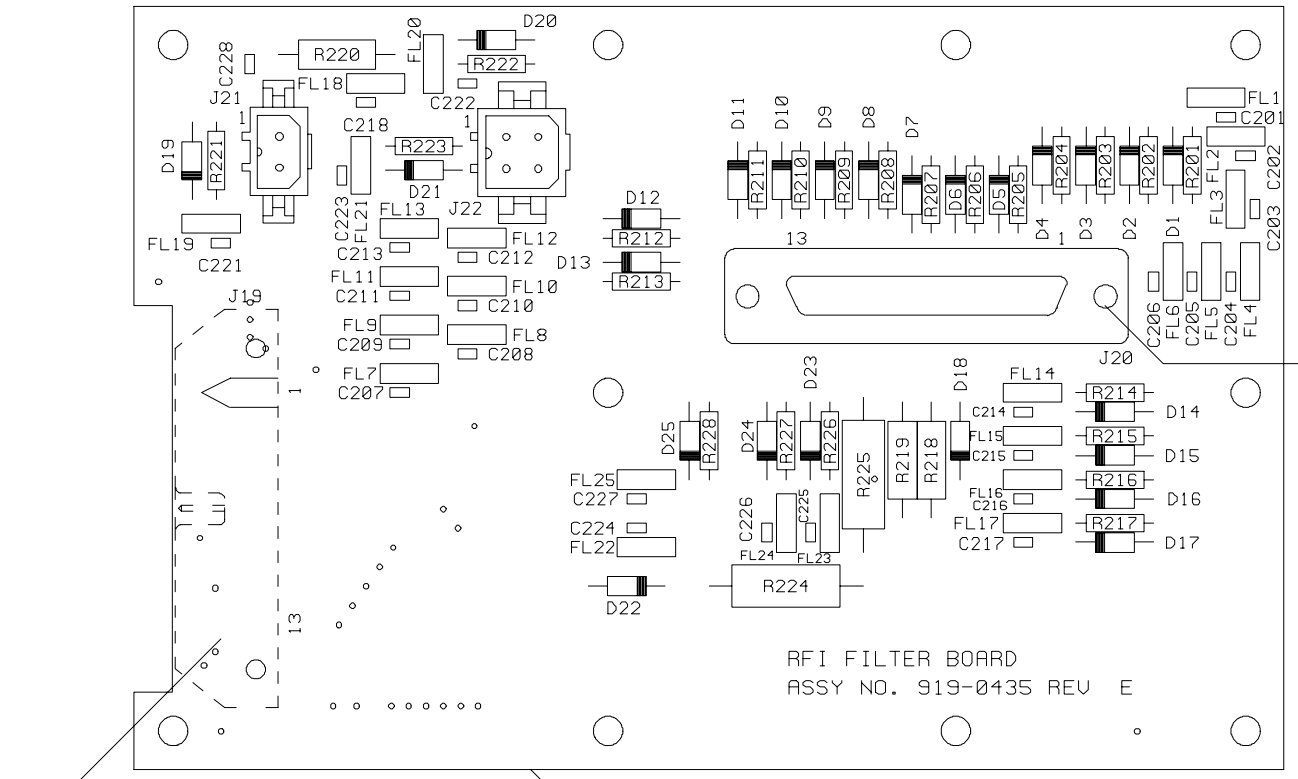
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305 217/224-9600
TELEX 250142 CABLE BROADCAST FAX 217/224-9607

TITLE SCHEMATIC RFI FILTER BOARD

TYPE	SIZE	DWG. NO.	REV
S	B	919-0435	B

MODEL FM-IPA SCALE NONE SHEET 1 OF 1

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	6-12-96	PROTOTYPE RELEASE.	MH	MBS	----
2	8-22-96	MAJOR COMPONENT MOVES;CHGD PINOUT ON J19.	MH	MBS	----
A	1-24-97	ENGINEERING RELEASE WITHOUT CHANGE.	MH	MBS	----
B	3-21-97	DREW DETAIL "A" & ADDED NOTES TO BOARD.	KT	DLL	9797
C	12-1-97	MOVED J19 TO BOTTOM OF BOARD & ADDED NOTES.	KT	DLL	9904
D	7-16-98	NEEDED TO MOVE TRACES WHEN J19 MOVED.	MSE	DLL	9991
E	2-4-99	CHGD J19 TO A 418-2602.	KT		10093



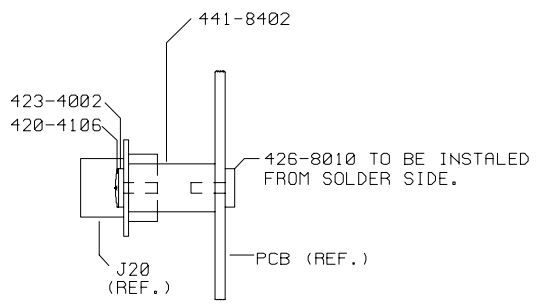
SEE DETAIL "A"

J19 IS SOLDERED ON TO THE BACK SIDE

519-0435

NOTES:

1. SEE SCHEMATIC SB919-0435.



DETAIL "A"
TYPICAL 2 PLCS.

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

DWN. BY 6-12-96
M. HAYDEN
DESIGNER(S)
PROJ. LEADER
MFG.

MATERIAL
SEE BOM'S
919-0435
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
RFI FILTER BOARD

TYPE	SIZE	DWG No.	REV
A	B	919-0435	E

MODEL FM-IPA | SCALE 1/1 | SHEET 1 OF 1

REVISIONS					
REV	DATE	DESCRIPTION	DFTSMN	ENGR	ECN
1	5-25-94	PROTOTYPE RELEASE	MH	RMD	----
A	9-21-94	ENGINEERING RELEASE WITHOUT CHANGE.	MH		----

NOTES:
1. ALL RESISTORS IN OHMS; 1/4W, 1%, UNLESS OTHERWISE SPECIFIED.
2. LAST COMPONENT USED: C17, D16, DS1, J101, K1, Q3, R32, S7, U14
3. COMPONENTS NOT USED: C1-7, D1-5, D14 J2-100, S1-2, R1-7, U1-2
4. SEE ASSEMBLY: AD919-0406-101.

PROPRIETARY RIGHTS are included in information disclosed herein. This information is submitted in confidence and neither this document nor the information disclosed herein shall be reproduced or transferred to other documents or used or disclosed to others for manufacturing or for any other purpose except as specifically authorized in writing by BROADCAST ELECTRONICS, INC.

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

DWN. BY 5-25-94 M. HAYDEN	MATERIAL SEE B/M 919-0406-101	BROADCAST ELECTRONICS INC.
CHKD		4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305 217/224-9600
ME	FINISH	TELEX 250142 CABLE BROADCAST FAX 217/224-9607
PROJ. ENGR.	~~SEE DWG RAS92-0000~~	TITLE SCHEMATIC CONTROLLER ON-OFF
MFG.	NEXT ASSY.	TYPE S SIZE B DWG. NO. 919-0406-101 REV A
		MODEL FM-2C/3C SCALE NONE SHEET 1 OF 1

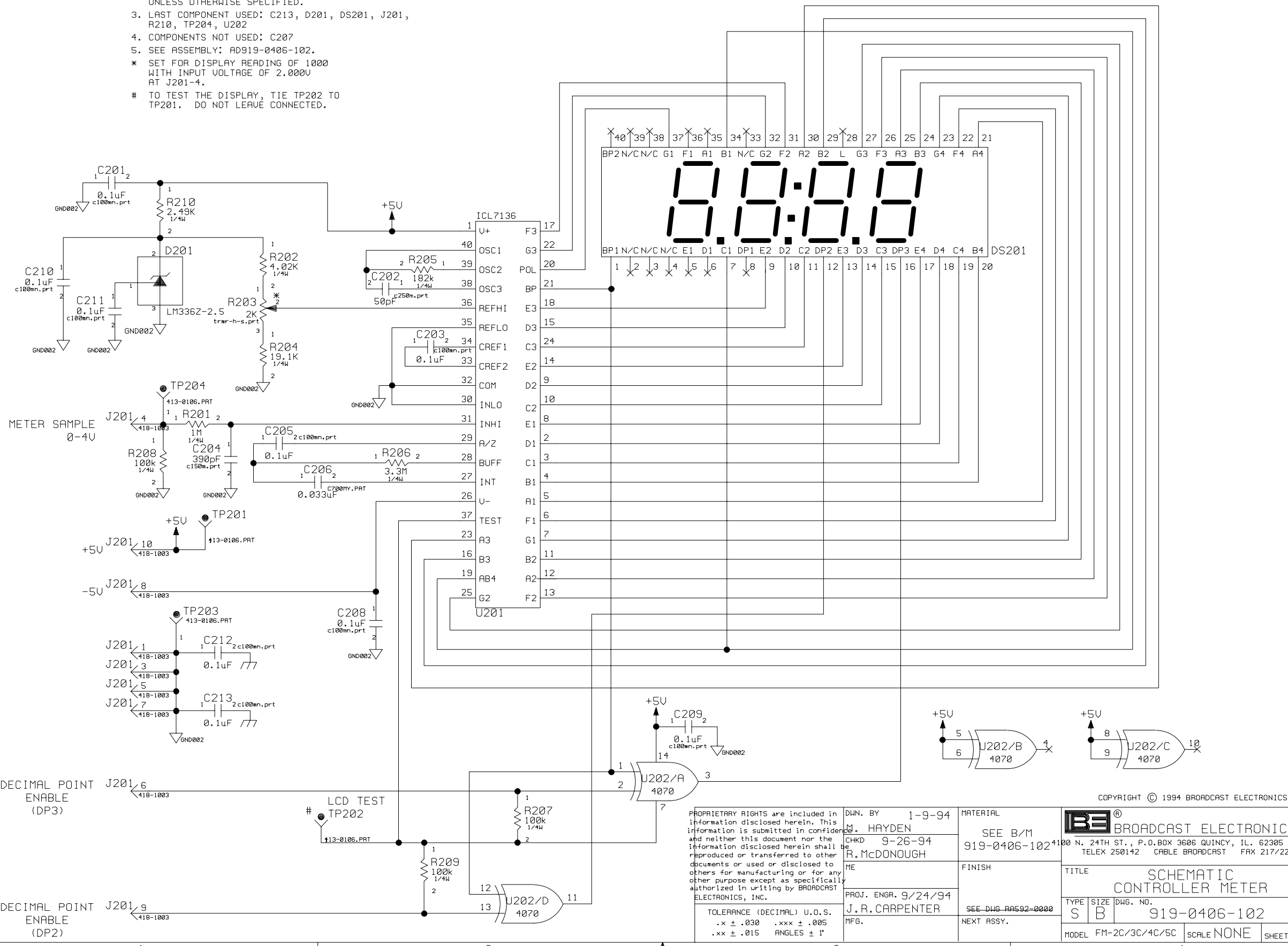
NOTES:

1. ALL REFERENCE DESIGNATORS START AT 201.
2. ALL RESISTORS IN OHMS; 1/4W, 1%, UNLESS OTHERWISE SPECIFIED.
3. LAST COMPONENT USED: C213, D201, DS201, J201, R210, TP204, U202
4. COMPONENTS NOT USED: C207
5. SEE ASSEMBLY: AD919-0406-102.

* SET FOR DISPLAY READING OF 1000 WITH INPUT VOLTAGE OF 2.000V AT J201-4.

\# TO TEST THE DISPLAY, TIE TP202 TO TP201. DO NOT LEAVE CONNECTED.

REVISIONS					
REV	DATE	DESCRIPTION	DFTSMN	ENGR	ECN
1	1-9-94	PROTOTYPE RELEASE	MH	RMD	----
2	4-18-94	CHGD VALUE OF C206,R202-R204&R206;ADDED D1 & R210; DELETED C207 & TP205;MOVED TP203 & TP204.	MH	RMD	----
A	9-21-94	ENGINEERING RELEASE WITHOUT CHANGE.	MH	RMD	----
B	6-22-95	ADDED C210 - C213 AND CHASSIS GROUND.	MH		9343



PROPRIETARY RIGHTS are included in information disclosed herein. This information is submitted in confidence and neither this document nor the information disclosed herein shall be reproduced or transferred to other documents or used or disclosed to others for manufacturing or for any other purpose except as specifically authorized in writing by BROADCAST ELECTRONICS, INC.

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

DWN. BY	1-9-94	M. HAYDEN
CHKD	9-26-94	R.McDONOUGH
ME		
PROJ. ENGR.	9/24/94	J.R.CARPENTER
MFG.		

MATERIAL: SEE B/M 919-0406-102
FINISH: ~~SEE DWG RA592-0000~~
NEXT ASSY.

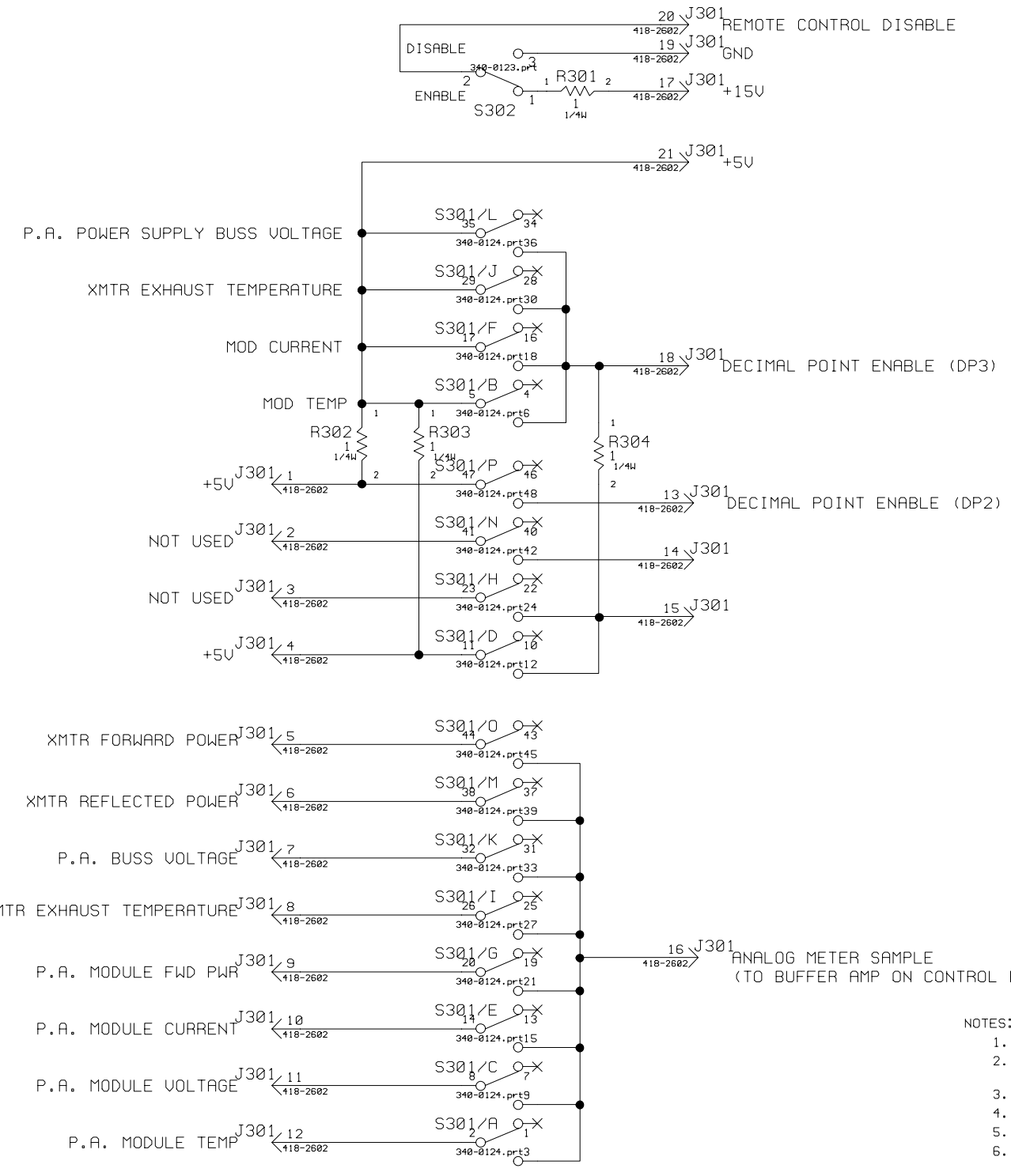
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305 217/224-9600
TELEX 250142 CABLE BROADCAST FAX 217/224-9607

TITLE: SCHEMATIC CONTROLLER METER

TYPE	SIZE	DWG. NO.	REV
S	B	919-0406-102	B

MODEL FM-2C/3C/4C/5C | SCALE NONE | SHEET 1 OF 1

REVISIONS					
REV	DATE	DESCRIPTION	DFTSMN	ENGR	ECN
1	1-9-94	PROTOTYPE RELEASE	MH	RMD	----
A	9-21-94	ENGINEERING RELEASE WITHOUT CHANGE.	MH		----



NOTES:

1. ALL REFERENCE DESIGNATORS START AT 301.
2. ALL RESISTORS IN OHMS; 1/4W, 1%
   UNLESS OTHERWISE SPECIFIED.
3. LAST COMPONENT USED: J301, R304, S302
4. COMPONENTS NOT USED:
5. SEE ASSEMBLY: AD919-0406-103.
6. S301 SECTIONS A&B, C&D, E&F, etc, ARE GANGED
   SWITCHES AND INTERLOCKED.

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

DWN. BY M. HAYDEN 1-9-94
CHKD
ME
PROJ. ENGR.
MFG.

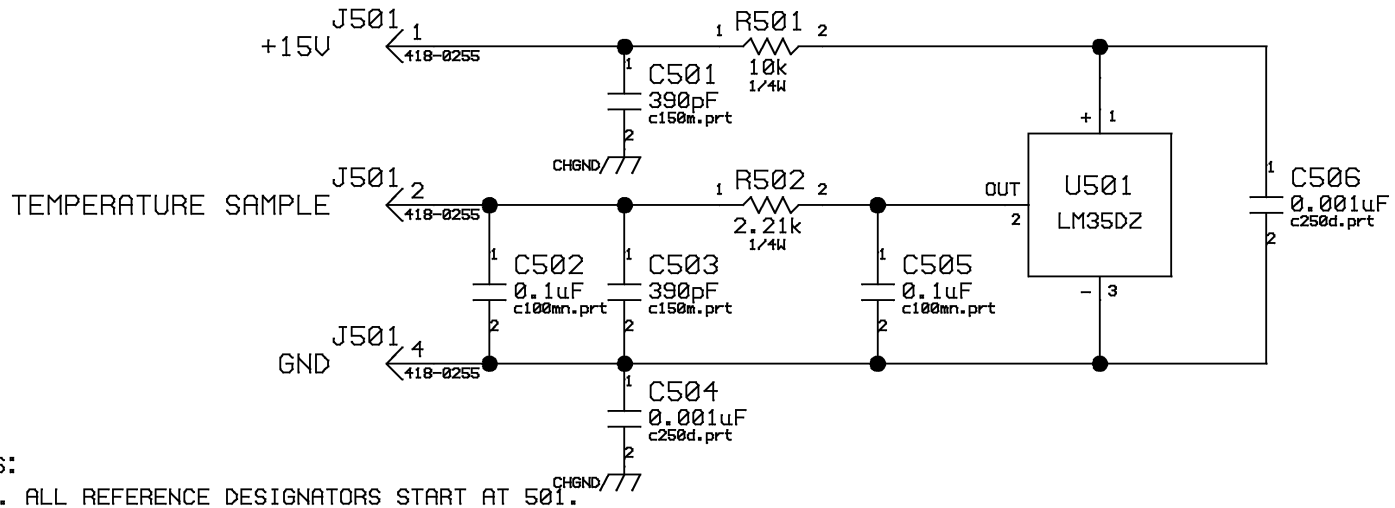
MATERIAL SEE B/M 919-0406-103
FINISH ~~SEE DWG RA592-0000~~
NEXT ASSY.

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
CONTROLLER METER SWITCH

TYPE	SIZE	DWG. NO.	REV
S	B	919-0406-103	A

MODEL FM-2C/3C SCALE NONE SHEET 1 OF 1



NOTES:

1. ALL REFERENCE DESIGNATORS START AT 501.
2. ALL RESISTORS IN OHMS; 1/4W, 1% UNLESS OTHERWISE SPECIFIED.
3. LAST COMPONENT USED: C506, J501, R502, U501
4. COMPONENTS NOT USED:
5. SEE ASSEMBLY: AD919-0406-105.

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

DWN. BY 5-25-94
M. HAYDEN

CHKD

ME

PROJ. ENGR.

MFG.

MATERIAL
SEE BOM
919-0406-105

FINISH

SEE DWG RA592-0000

NEXT ASSY.

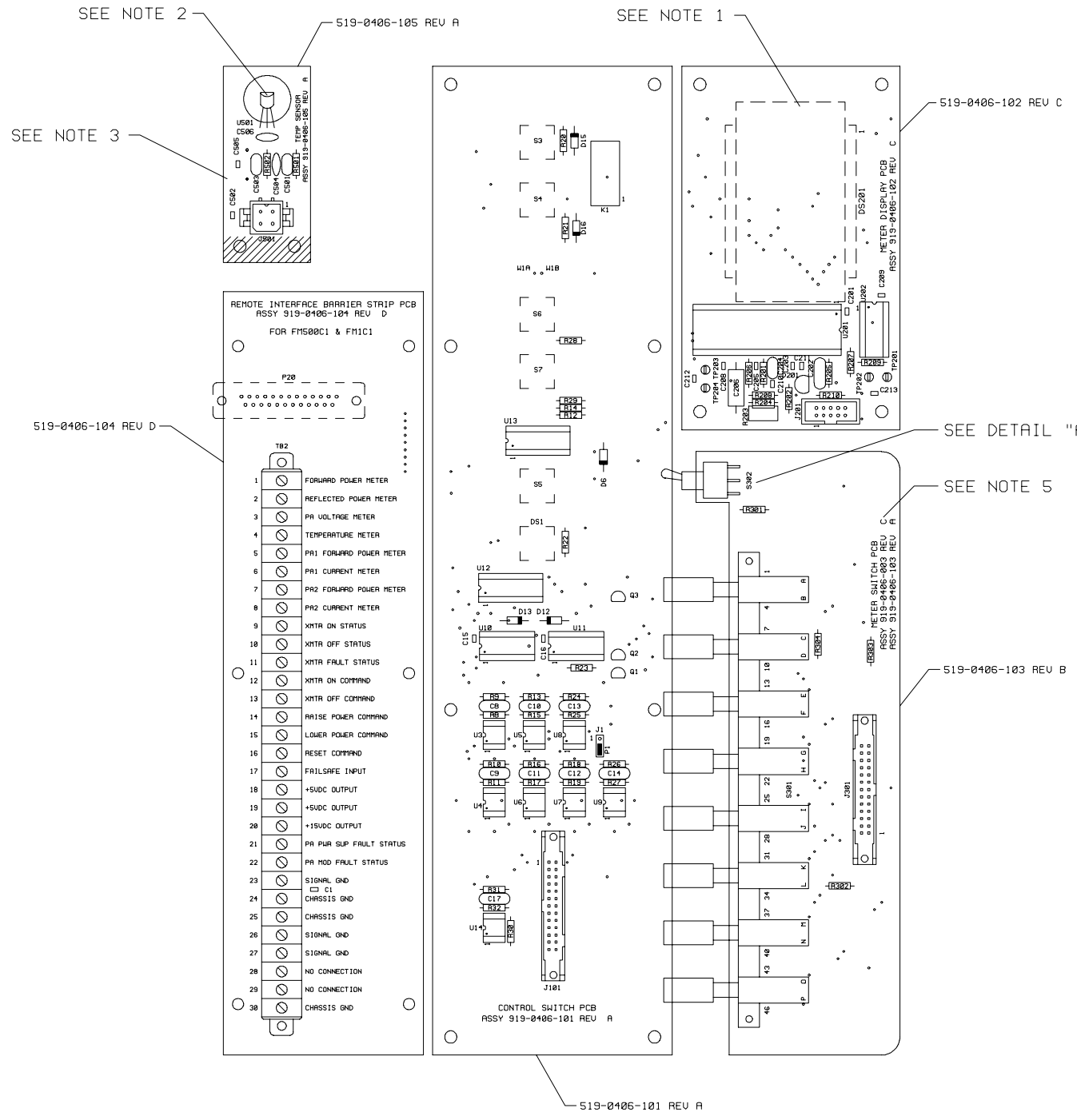
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305 217/224-9600
TELEX 250142 CABLE BROADCAST FAX 217/224-9607

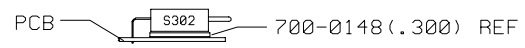
TITLE
SCHEMATIC
TEMPERATURE SENSOR PCB

TYPE	SIZE	DWG. NO.	REV
S	A	919-0406-105	A

MODEL FM-3C | SCALE NONE | SHEET 1 OF 1

REVISIONS					
REV	DATE	SUFFIX/REV	DESCRIPTION	DRAFTER	APPROVED	ECN
1	1-11-94	101-105/1	PROTOTYPE RELEASE	MH	RMD	----
2	5-4-94	102/2	CHGD VALUE OF C206,R202-R204&R206;ADDED D1 & R210; DELETED C207 & TP205;MOVED TP203 & TP204 (919-0406-102).	MH	RMD	----
A	9-21-94	101-105/A	ENGINEERING RELEASE WITHOUT CHANGE.	MH	RMD	----
B	12-19-94	104 / B	ADDED C1.	MH	RMD	9332
C	6-22-95	102 / C	ADDED C210 - C213 AND CHASSIS GROUND.	MH	DLL	9343
D	6-23-95	104 / D	ADDED "FOR FM500C1 & FM1C1" TO SILKSCREEN.	MH	DLL	9476
E	7-6-95	003 / C	ADDED ANOTHER ASSY.# TO ASSEMBLY 919-0406-103A.	AEB	TW	9370
F	2-15-07	003 / C	ADD DETAIL "A"	JTB		11518





DETAIL "A"

NOTES:

1. ALL PARTS SHOWN WITH DASHED LINES TO BE MOUNTED FROM OPPOSITE SIDE.
2. U501 TO BE CENTERED IN .650 HOLE WITH ROUNDED SIDE OF DEVICE POINTING UP.
3. TEMP SENSOR PCB #919-0406-105 IS TO RECEIVE CONFORMAL COATING AFTER ASSEMBLY. SEE COATING INSTRUCTIONS.
4. SEE SCHEMATICS: SB919-0406-003, SB919-0406-101, SB919-0406-102, SB919-0406-103, SB919-0406-104, & SA919-0406-105.
5. COMPONENT R302, R303 & R304 ARE NOT USED ON ASSEMBLY 919-0406-003C.

COATING INSTRUCTIONS: (919-0406-105 PCB ONLY)

1. MASK BODY OF DEVICE U501 COMPLETELY. INSERT 418-0240 DUMMY PLUG INTO J501. MASK BOTH SIDES OF PCB AT MOUNTING HOLES AS SHADED.
2. APPLY ONE COAT OF URETHANE CONFORMAL COATING (700-0126), TO BOTH SIDES OF PCB, PER VENDOR INSTRUCTIONS; THEN REMOVE MASKING.
3. ALLOW 15 MINUTES DRYING TIME.

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

DWN. BY 1-11-94 M. HAYDEN
CHKD 9-26-94 A.McDONOUGH
ME
PROJ. ENGR. 9/26/94 J.R.CARPENTER
MFG.

MATERIAL SEE BOMs 919-0406-003, 919-0406-101 THRU 919-0406-105
FINISH
~~SEE DWG RA592-0000~~
NEXT ASSY.

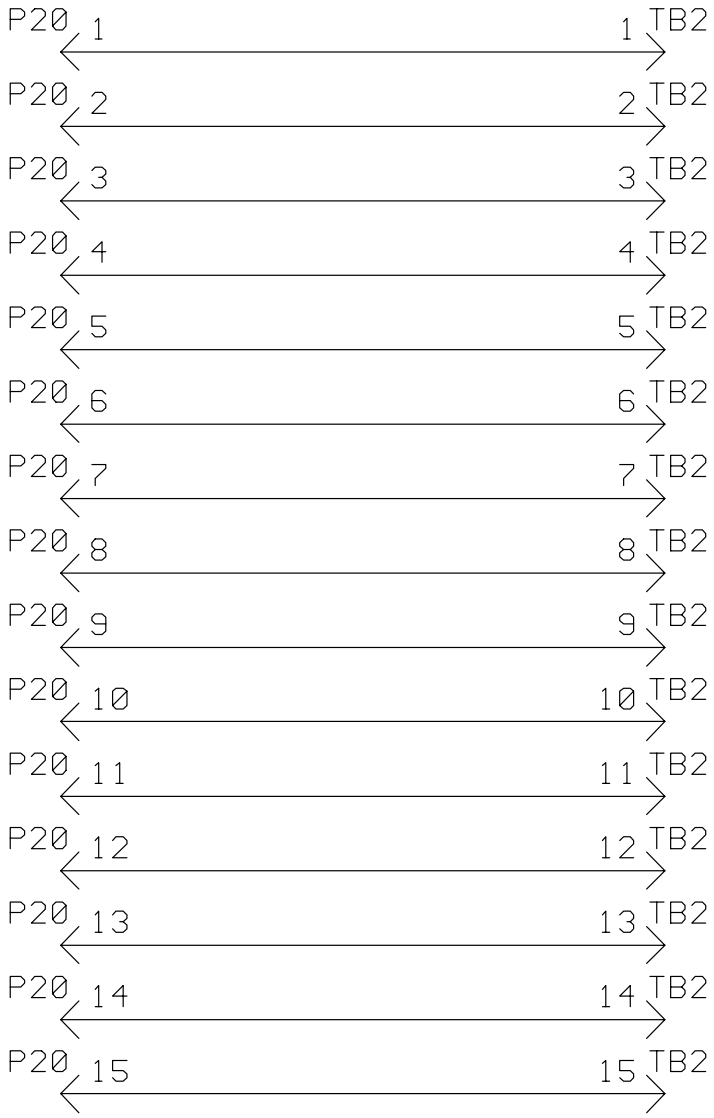
BROADCAST ELECTRONICS INC.
4100 N.24TH ST. P.O.BOX 3606 QUINCY,IL. 62305 PH. 217/224-9600
TELEX 250142 CABLE BROADCAST FAX 217/224-9607

TITLE PCB ASSEMBLY CONTROL BREAKAWAY

TYPE	SIZE	DWG No.	REV
A	D	919-0406-003 919-0406-101/105	F

MODEL FM-2C/3C/4C/5C FM500C1/1C1 SCALE 1/1 SHEET 1 OF 1

REVISIONS					
REV	DATE	DESCRIPTION	DFTSMN	ENGR	ECN
1	6-3-94	PROTOTYPE RELEASE	MH	RMD	----
A	9-21-94	ENGINEERING RELEASE WITHOUT CHANGE.	MH	RMD	----
B	12-19-95	ADDED C1.	MH	RMD	9598



FORWARD POWER METER

REFLECTED POWER METER

PA PWR SUP BUSS VOLT

EXHAUST TEMP METER

PA MOD FORWARD POWER METER

PA MOD CURRENT METER

PA MOD VOLTAGE METER

PA MOD TEMP METER

XMTR ON STATUS

XMTR OFF STATUS

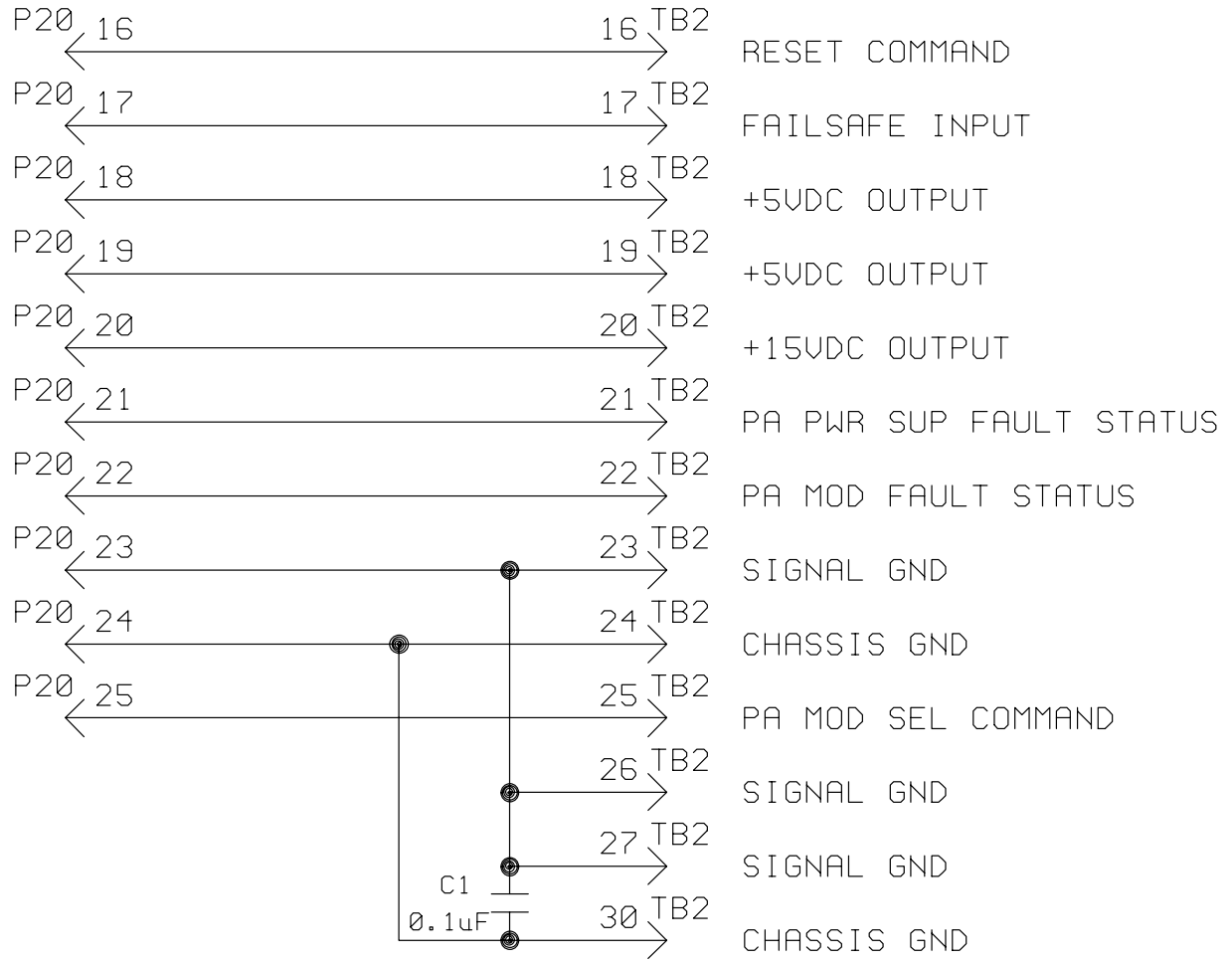
XMTR FAULT STATUS

XMTR ON COMMAND

XMTR OFF COMMAND

RAISE POWER COMMAND

LOWER POWER COMMAND



RESET COMMAND

FAILSAFE INPUT

+5VDC OUTPUT

+5VDC OUTPUT

+15VDC OUTPUT

PA PWR SUP FAULT STATUS

PA MOD FAULT STATUS

SIGNAL GND

CHASSIS GND

PA MOD SEL COMMAND

SIGNAL GND

SIGNAL GND

CHASSIS GND

NOTES:

1. SEE ASSEMBLY: AB919-0415-005.

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

DWN. BY 6-3-94 M. HAYDEN
CHKD 9-26-94 R. McDONOUGH
ME
PROJ. ENGR. 9/26/94 J.R.CARPENTER
MFG.

MATERIAL SEE BOM 919-0415-005
FINISH SEE DWG RA592-0000
NEXT ASSY.

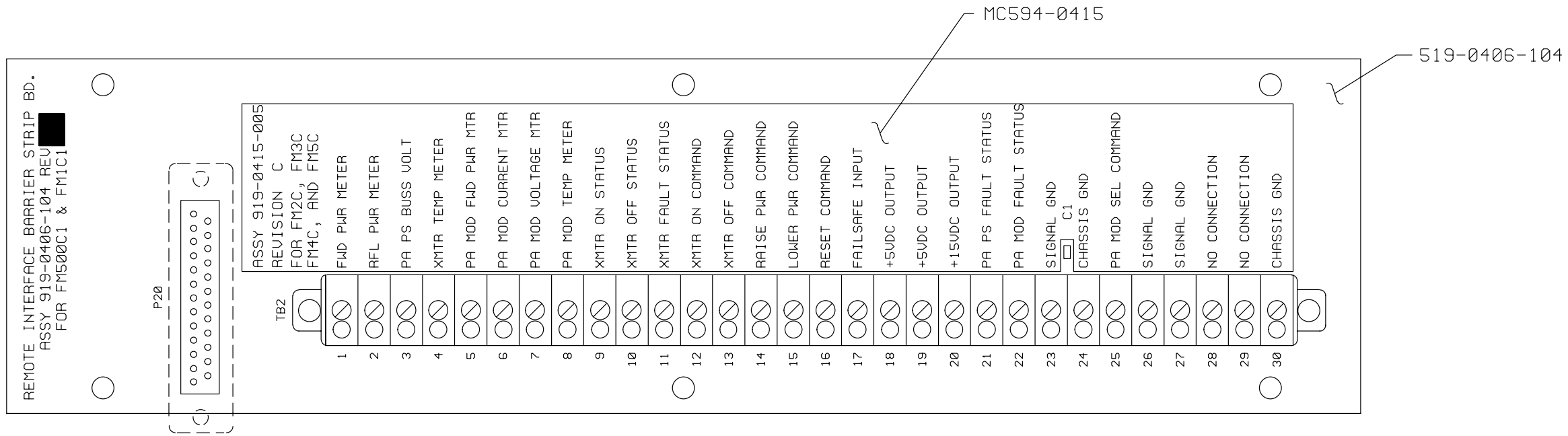
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305 217/224-9600
TELEX 250142 CABLE BROADCAST FAX 217/224-9607

TITLE SCHEMATIC
REMOTE I/F BARRIER STRIP

TYPE	SIZE	DWG. NO.	REV
S	B	919-0415-005	B

MODEL FM-2C/3C/4C/5C SCALE NONE SHEET 1 OF 1

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
C	6-19-95	REMOVED FROM BREAKAWAY ASSEMBLY.	MH		9476



NOTES:

1. COMPONENTS IN DASHED LINES ARE INSTALLED FROM OPPOSITE SIDE SHOWN.
2. SEE SCHEMATIC SB919-0415-005.

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

DWN. BY 6-19-95
M. HAYDEN

DESIGNER(S)

PROJ. LEADER

MFG.

MATERIAL
SEE BOM
919-0415-005

FINISH

NEXT ASSY.

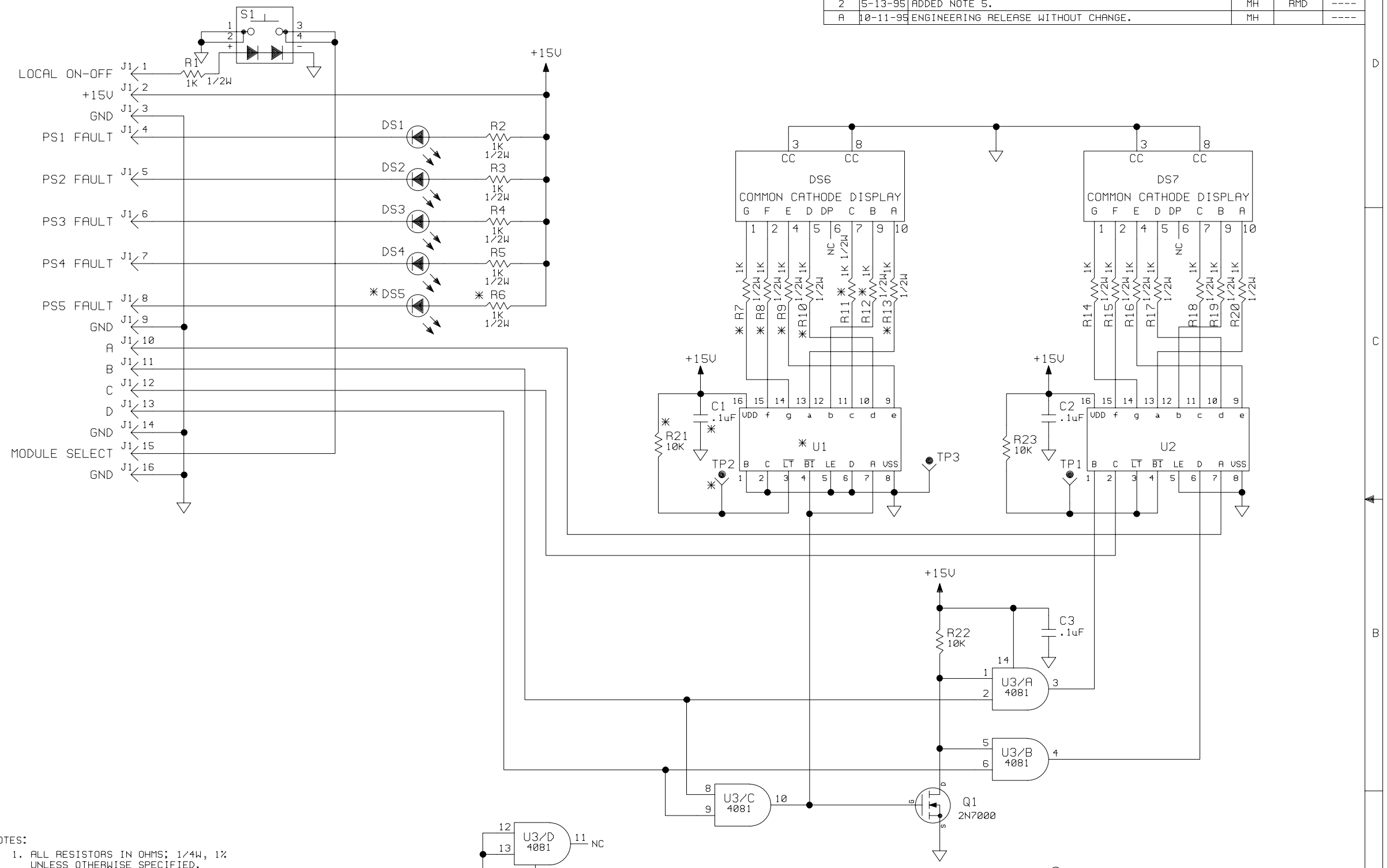
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST. P.O.BOX 3606 QUINCY,IL. 62305
217/224-9600 FAX 217/224-9607

TITLE
PCB ASSEMBLY
REMOTE I/F BARRIER STRIP

TYPE	SIZE	DWG No.	REV
A	B	919-0415-005	C

MODEL FM-2C/3C/4C/5C | SCALE 1/1 | SHEET 1 OF 1

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	1/1/95	PROTOTYPE RELEASE	MH	RMD	----
2	5-13-95	ADDED NOTE 5.	MH	RMD	----
A	10-11-95	ENGINEERING RELEASE WITHOUT CHANGE.	MH		----



NOTES:

1. ALL RESISTORS IN OHMS; 1/4W, 1%
   UNLESS OTHERWISE SPECIFIED.
2. LAST COMPONENT USED: C3,DS7,J1,Q1,R23,S1,TP3 & U3.
3. COMPONENTS NOT USED:
4. SEE ASSEMBLY: AC919-0415-401/501.
5. * INDICATES COMPONENTS NOT USED ON 919-0415-401 (FM-4C).

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

DWN. BY M. HAYDEN 1/1/95
DESIGNER(S)
PROJ. LEADER
MFG.

MATERIAL SEE B/M
919-0415-401
919-0415-501
FINISH
NEXT ASSY.

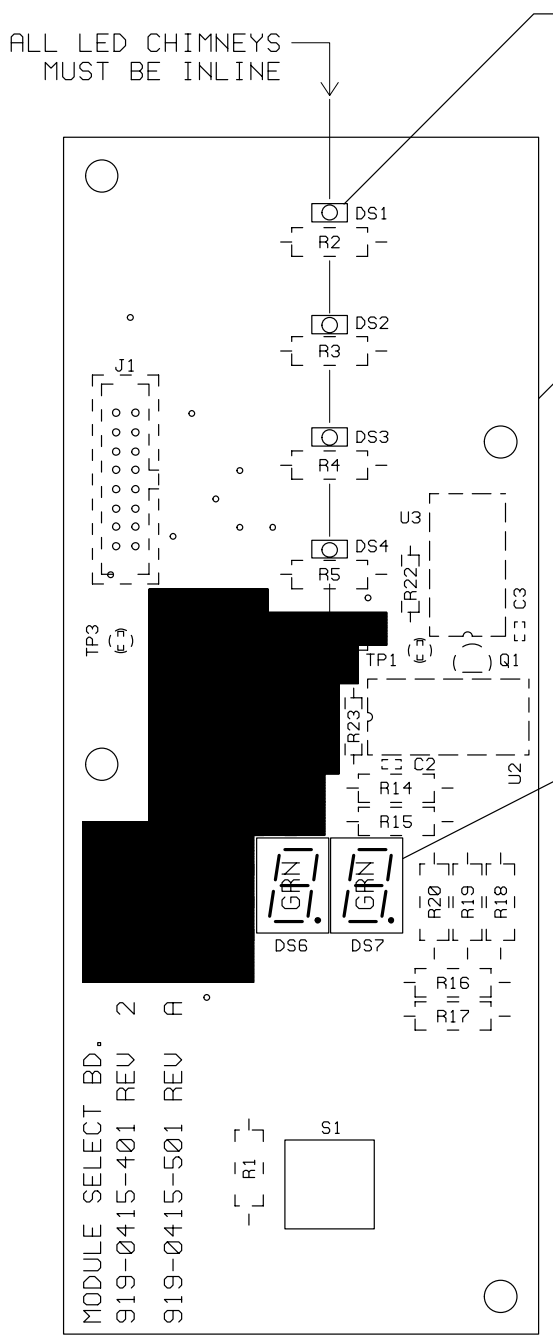
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305
217/224-9600 FAX 217/224-9607

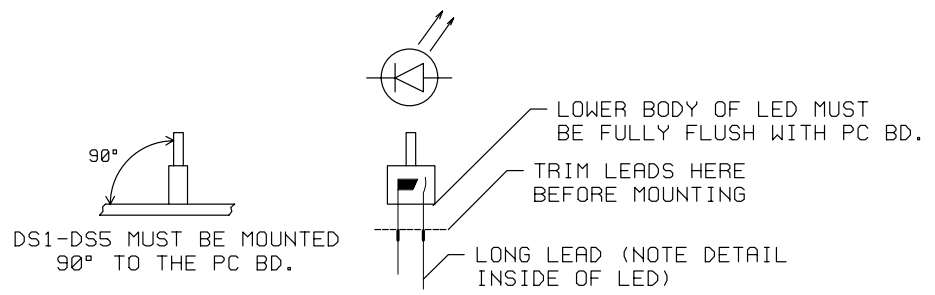
TITLE SCHEMATIC
MODULE SELECT

TYPE	SIZE	DWG. NO.	REV
S	B	919-0415-401/501	A

MODEL FM-4C/5C | SCALE NONE | SHEET 1 OF 1

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	1-8-95	PROTOTYPE RELEASE.	MH	RMD	----
2	4-5-95	ADDED NOTE 3; CLARIFIED DETAIL "A"; ADDED NOTE FOR ALIGNMENT OF LED'S.	MH	RMD	----
A	10-11-95	ENGINEERING RELEASE WITHOUT CHANGE.	MH		----





DETAIL "A"
DS1 THRU DS5

NOTES:

1. COMPONENTS SHOWN WITH DASHED OUTLINE ARE MOUNTED ON SOLDER SIDE OF BOARD.
2. SEE SCHEMATIC: SB919-0415-401/501.
3. [redacted] INDICATES COMPONENTS NOT USED ON 919-0415-401 (FM-4C).

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

DWN. BY 1-8-95
M. HAYDEN
DESIGNER(S)
PROJ. LEADER
MFG.

MATERIAL
SEE BOM
919-0415-401
919-0415-501
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
MODULE SELECT

TYPE	SIZE	DWG No.	REV
A	B	919-0415-401/501	A

MODEL FM-4C/5C | SCALE 1/1 | SHEET 1 OF 1

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	1-25-95	PROTOTYPE RELEASE.	MERK	RMD	----
2	5-13-95	ADDED NOTES; UPDATED VALUES.	MH	RMD	----
3	5-18-95	SEE SHEET 2	MH	RMD	----
4	6-23-95	SEE SHEET 2	MH	RMD	----
A	10-10-95	ENGINEERING RELEASE WITHOUT CHANGE.	MH	RMD	----
B	12-20-95	ADDED R271-R281,CHGD R229 TO 10M : SEE SHEET 2	MERK	RMD	9597
C	7-20-04	CHGD R281 TO NOT PLACED	KT		11186

FWD PWR SAMPLE

MOD 1 J201
MOD 2 J202
MOD 3 J203
MOD 4 J204
MOD 5 J205
MOD 6 J206
MOD 7 J207
MOD 8 J208
MOD 9 J209
MOD 10 J210

MOD1 J201 THRU MOD10 J210

+15V
-15V
R281 $ 499K

R242 * 10
R243 * 10

4067 U201
X0 VDD 24 — C201 0.1uF
X1 A 10
X2 B 11
X3 C 14
X4 D 13
X5 INH 15
X6 OUT 1
X7 VSS 12
X8
X9
X10
X11
X12
X13
X14
X15

R227 100K
U205/A TL074
C207 0.1uF
C208 0.1uF
R228 10
$ C210
FORWARD POWER
J211 5.0V=500W

C223 0.1uF
C224 0.1uF
C225 0.1uF
C226 0.1uF
C227 0.1uF

CURRENT SAMPLE

MOD 1 J201
MOD 2 J202
MOD 3 J203
MOD 4 J204
MOD 5 J205
MOD 6 J206
MOD 7 J207
MOD 8 J208
MOD 9 J209
MOD 10 J210

R271 1M
R272 1M
R273 1M
R274 1M
R275 1M
R276 1M
R277 1M
R278 1M
R279 1M
R280 1M

4067 U202
C202 0.1uF

R229 10M
U205/B TL074
R230 10
$ C211
P.A. CURRENT
J211 10.0V=20A

MOD1 J201 THRU MOD10 J210 — FAULT RESET
R244 * 10
R245 * 10

MOD1 J201 THRU MOD10 J210 — MUTE

2 A
2 B
2 C
2 D
2 INH

R221 10K
C219 .47uF
+15V

MOD 1 J201 — R207 10K — D211 1N4148 — D201 1N4148
MOD 2 J202 — R208 10K — D212 1N4148 — D202 1N4148
MOD 3 J203 — R209 10K — D213 1N4148 — D203 1N4148
MOD 4 J204 — R210 10K — D214 1N4148 — D204 1N4148
MOD 5 J205 — R211 10K — D215 1N4148 — D205 1N4148
MOD 6 J206 — R212 10K — D216 1N4148 — D206 1N4148
MOD 7 J207 — R213 10K — D217 1N4148 — D207 1N4148
MOD 8 J208 — R214 10K — D218 1N4148 — D208 1N4148
MOD 9 J209 — # R215 10K — D219 1N4148 — D209 #
MOD 10 J210 — # R216 10K — D220 1N4148 — D210 #

R201 10K (1 of 8)
R202 10K (1 of 6)

U208/A ULN2004 (L)
U208/B ULN2004 (L)
U208/C ULN2004 (L)
U208/D ULN2004 (L)
U208/E ULN2004 (L)
U210/A ULN2004 (L)
U210/B ULN2004 (L)
U210/C ULN2004 (L)
U210/D ULN2004 (L)
U210/E ULN2004 (L)

R217 # 10
R218 # 10
R219 * 10
R220 * 10

U208/F ULN2004 (H) → (L)
R201 10K (8 of 8)
MODULE FAULT DRIVE → J211

R248 $
U210/F ULN2004

FAULT VOLTAGE
# OF RF MODULES
1=2.9V
2=4.1V
3=4.8V
4=5.3V

RF MODULE FAULT DETECTOR STATUS CODING:
( ) STATUS IS SHOWN FOR NORMAL OPERATION
L=LOW
H=HIGH
A FAILURE WILL RESULT IN REVERSE LOGIC STATUS

R222 9.76K
C218 0.1uF
U209/A LM324
4TH RF MOD FAIL D221 1N4148 → J211

C214 0.1uF
R223 634
U209/B LM324
3RD RF MOD FAIL D222 1N4148 → J211

C215 0.1uF
R224 1K
U209/C LM324
2ND RF MOD FAIL D223 1N4148 → J211

C216 0.1uF
R225 1.4K
U209/D LM324
1ST RF MOD FAIL D224 1N4148 → J211

C217 0.1uF
R226 2K

NOTES:
1. SEE PCB ASSEMBLY AC919-0415-402/502.
2. COMPONENTS NOT USED:
   # R215 THRU R218, R265, R267, R279, R280, D209, D210, D219, D220, D233 & D234 NOT USED ON FM-4C
   * R219, R220, R242-R247 NOT USED IN FM-5C
   $ C210-C213, R248, R281 NOT USED ON FM-4C/5C
3. LAST COMPONENTS USED: C235, D236, J214, P214, Q201, R288 & U213.
4. ALL REFERENCE DESIGNATORS ARE NUMBERED IN 200 SERIES.

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

DWN. BY MERKEL 1-25-95
DESIGNER(S) R. McDONOUGH 10-13-95
PROJ. LEADER 10-13-95 M. SHRESTHA
MFG.

MATERIAL SEE B/M 919-0415-402 919-0415-502
FINISH
NEXT ASSY.

BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305
217/224-9600 FAX 217/224-9687

TITLE SCHEMATIC MULTIPLEXER BOARD
TYPE S SIZE B DWG. NO. 919-0415-402/502 REV C
MODEL FM-4C/5C SCALE NONE SHEET 1 OF 2

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
3	5-18-95	ADDED U211-213,C228-C233,D225-D234 & R249-R270.	MH	AMD	----
4	6-23-95	R233 WAS 100K,R269 WAS 6.49K & R270 WAS 8.45K.	MH	AMD	----
A	10-10-95	ENGINEERING RELEASE WITHOUT CHANGE.	MH	AMD	----
B	12-20-95	ADDED R283-288,C234-235,D235-236,J214,P214,Q201	MERK	AMD	9597

TEMPERATURE

MOD 1 J201 — U213/D, R249 20K, R250 100K, C228 0.1uF, C229 0.1uF, +15V, -15V, D225 1N4148
MOD 2 J202 — U213/B, R251 20K, R252 100K, D226 1N4148
MOD 3 J203 — U213/A, R253 20K, R254 100K, D227 1N4148
MOD 4 J204 — U212/C, R255 20K, R256 100K, D228 1N4148
MOD 5 J205 — U212/D, R257 20K, R258 100K, D229 1N4148
MOD 6 J206 — U212/A, R259 20K, R260 100K, C230 0.1uF, C231 0.1uF, D230 1N4148
MOD 7 J207 — U212/B, R261 20K, R262 100K, D231 1N4148
MOD 8 J208 — U211/D, R263 20K, R264 100K, D232 1N4148
MOD 9 J209 — U213/C, R265 # 20K, R266 100K, D233 # 1N4148
MOD 10 J210 — U211/A, R267 # 20K, R268 100K, C232 0.1uF, C233 0.1uF, D234 # 1N4148

VOLTAGE SAMPLE

MOD 1 J201
MOD 2 J202
MOD 3 J203
MOD 4 J204
MOD 5 J205
MOD 6 J206
MOD 7 J207
MOD 8 J208
MOD 9 J209
MOD 10 J210

R240 6.8K, R241 6.8K

U203 4067 — C203 0.1uF +15V
U204 4067 — C204 0.1uF +15V
R246 10, R247 10

U205/C — R231 100K, R232 10, $ C212 — P.A. VOLTAGE — J211 12, 5.0V=50V
U205/D — R233 1M, R234 10, $ C213 — P.A. TEMPERATURE — J211 8, 5.94V=60°C

INH, D, C, B, A (1)

R235 100K, R236 100K, R237 100K, R238 100K, R239 100K

R282 5.1M, R283 100, Q201 2N7000, C234 100uF
FM-4C = 1/2
FM-5C = 2/3
P213, J213
MODULE # RESET TO "0"
U206/A 4082 — C205 0.1uF, R203 100K, C220 0.1uF
U207 4516 — VDD, PE, CARYIN, RESET, UP/DOWN, CLK, P0, P1, P2, P3, Q0, Q1, Q2, Q3, CARYOUT, VSS

J211 31 RF MODULE TEMPERATURE FOLDBACK

P214 AUTO RESET TO "0" DISABLE, J214
U206/B 4082 — C206 0.1uF — POWER UP RESET TO "0"
D235 1N4148, D236 1N4148
R206 100K, R204 10K, R205 1M, C209 1uF/50V
R287 10K, R286 100K, R288 100K
U211/C — C235 1uF N.P.

R284 4.99K, R285 9.35V 10K, R269 6040, R270 10K
U211/B — SET FOR 85°C FOLDBACK

J212 LOCAL/REMOTE
1 +15V
2 GROUND
3 PS1 FAULT
4 PS2 FAULT
5 PS3 FAULT
6 PS4 FAULT
7 PS5 FAULT
8 GROUND
9 A CONTROL
10 B CONTROL
11 C CONTROL
12 D CONTROL
13 GROUND
14 MOD SELECT
15 GROUND
16

J211
26 MOD SELECT
30 PS5 FAULT
29 PS4 FAULT
24 PS3 FAULT
14 PS2 FAULT
4 PS1 FAULT
25 LOCAL/REMOTE
3 RMT COUI

C221 100uF, C222 100uF
J211 11, 19, 32, 7, 15, 34, 1, 9, 17, 2, 28, 33

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

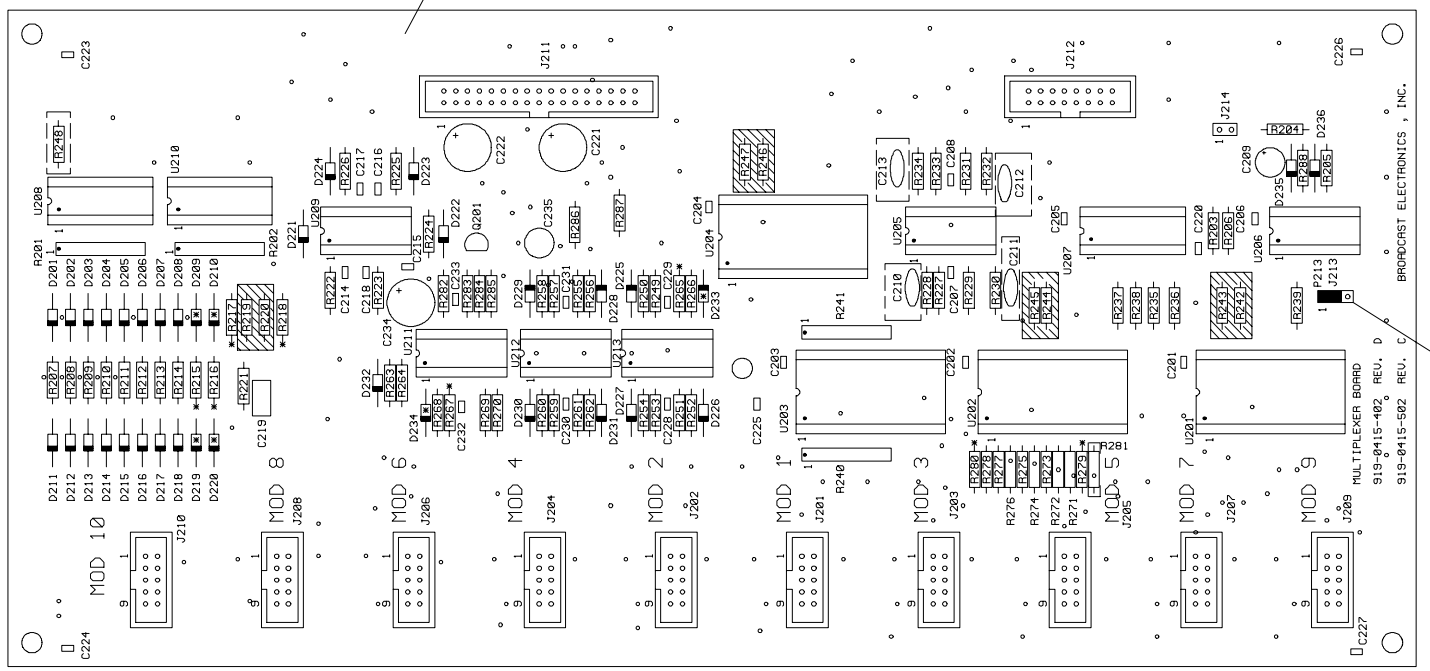
DWN. BY 5-18-95 M. HAYDEN
DESIGNER(S) R. McDONOUGH 10-13-95
PROJ. LEADER 10-13-95 M. SHRESTHA
MFG.
MATERIAL
FINISH
NEXT ASSY.

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

TITLE: SCHEMATIC MULTIPLEXER BOARD
TYPE S B | SIZE | DWG. NO. 919-0415-402/502 | REV C
MODEL FM-4C/5C | SCALE NONE | SHEET 2 OF 2

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	2-6-95	PROTOTYPE RELEASE	MERKEL	RMD	----
2	5-13-95	ADDED NOTES 1-3.	MH	RMD	----
3	5-25-95	ADDED U211-213,R249-270,C228-233,D225-234;	MERKEL	RMD	----
4	6-26-95	ADDED P213 AND NOTE 4.	MH	RMD	----
5	7-1-95	ADDED NOTE 1 SHADING FOR D233,D234,R265&R267	MH	RMD	----
A	10-10-95	ENGINEERING RELEASE WITHOUT CHANGE.	MH	RMD	----
B	12-28-95	ADDED R271-288,C234-235,D235-236,J214,P214,Q201	MERK	RMD	9597
C	3-14-97	C221, C222 WERE 020-1083	MSE	RMD	9783
D	7-20-04	MARKED R281 NOT STUFFED	KT		11186

519-0415-502 REV B



NOTES:

1. * INDICATES COMPONENTS NOT USED ON 919-0415-402 (FM-4C).
2. ▨ INDICATES COMPONENTS NOT USED ON 919-0415-502 (FM-5C).
3. [ ] INDICATES COMPONENTS NOT USED ON EITHER ASSEMBLY.
4. INSTALL P213 ON J213 PINS 1 & 2 FOR 919-0415-402 (FM-4C).
   INSTALL P213 ON J213 PINS 2 & 3 FOR 919-0415-502 (FM-5C).

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

DWN. BY MERKEL 2-6-95
DESIGNER(S) R. McDONOUGH 10-13-95
PROJ. LEADER M. SHRESTHA 10-13-95
MFG.

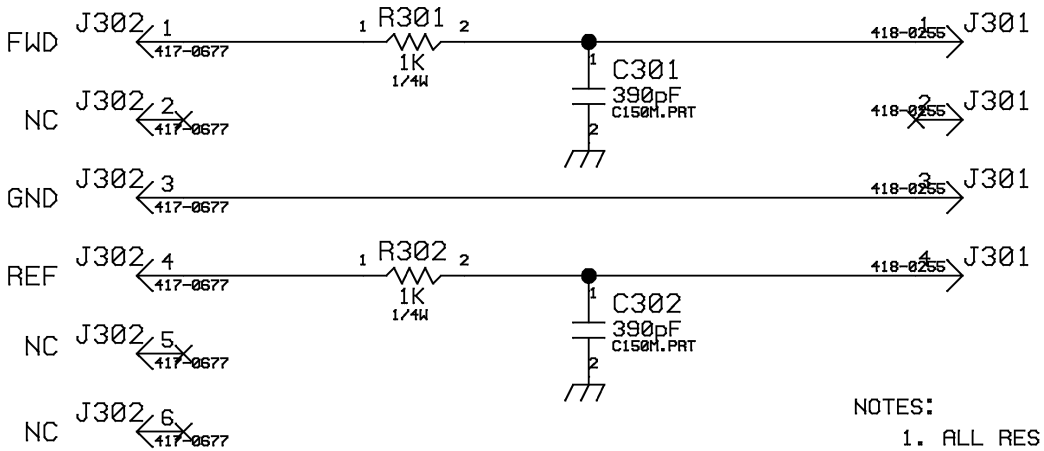
MATERIAL SEE B/M 919-0415-402 919-0415-502
FINISH
NEXT ASSY.

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

TITLE PCB ASSEMBLY MULTIPLEXER BOARD

TYPE	SIZE	DWG No.	REV
A	C	919-0415-402/502	D

MODEL FM-4C/5C SCALE 1/1 SHEET 1 OF 1



NOTES:

1. ALL RESISTORS IN OHMS; 1/4W, 1% UNLESS OTHERWISE SPECIFIED.
2. LAST COMPONENT USED:C302,R302,J302.
3. COMPONENTS NOT USED:
4. SEE ASSEMBLY: AA 919-0415-003.

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

DWN. BY 2-11-94
M. HAYDEN

DESIGNER(S)

PROJ. LEADER

MFG.

MATERIAL
SEE B/M
919-0415-003

FINISH

~~SEE DWG AA592-0000~~

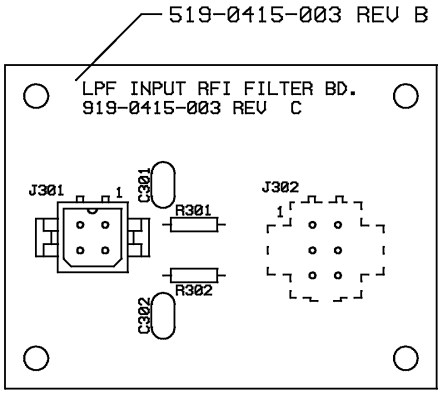
NEXT ASSY.

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
LPF INPUT RFI FILTER BD.

TYPE	SIZE	DWG. NO.	REV
S	A	919-0415-003	A

MODEL FM-2C/3C/4C/5C | SCALE NONE | SHEET 1 OF 1



NOTES:

1. COMPONENTS IN DASHED LINES ARE INSTALLED FROM OPPOSITE SIDE SHOWN.
2. SEE SCHEMATIC SA919-0415-003.

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

DWN. BY 6-19-95
M. HAYDEN

DESIGNER(S)

PROJ. LEADER

MFG.

MATERIAL
SEE BOM
919-0415-003

FINISH

NEXT ASSY.

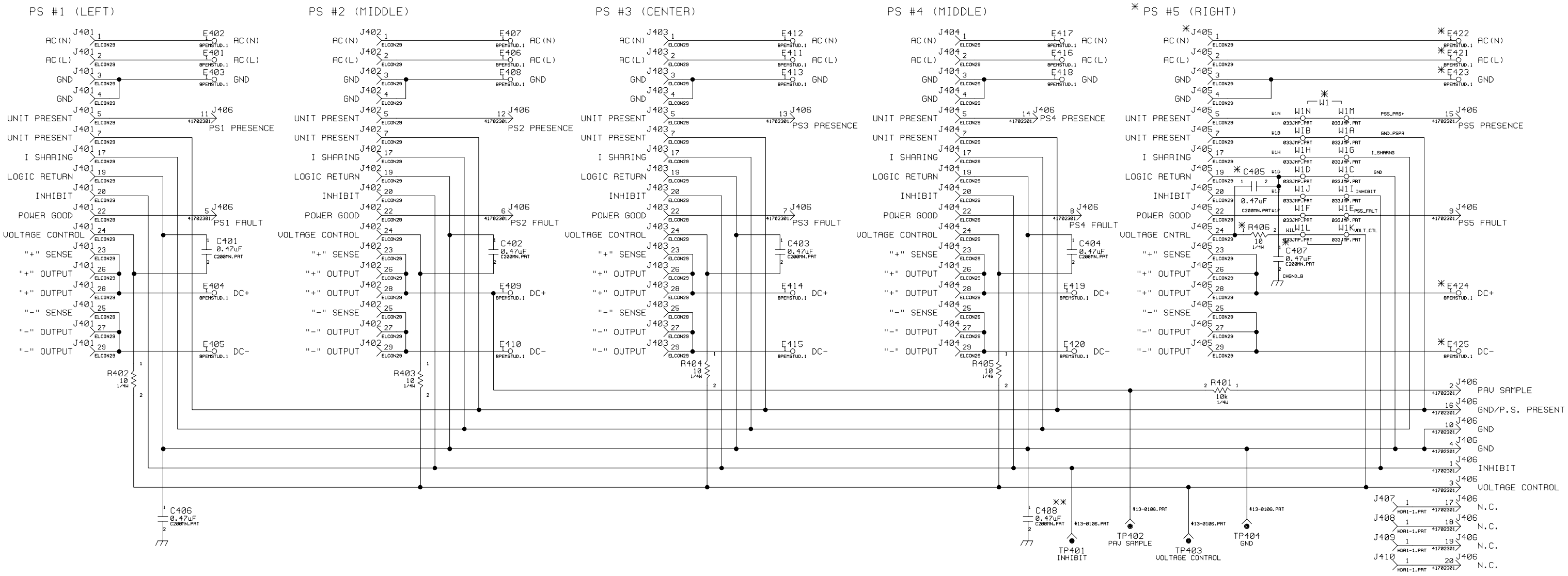
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST. P.O.BOX 3606 QUINCY,IL. 62305
217/224-9600 FAX 217/224-9607

TITLE
PCB ASSEMBLY
LPF INPUT RFI FILTER

TYPE	SIZE	DWG No.	REV
A	A	919-0415-003	C

MODEL FM-2C/3C/4C/5C | SCALE 1/1 | SHEET 1 OF 1

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	3-5-95	PROTOTYPE RELEASE.	MH	RMD	----
2	5-2-95	DELETED J407 - J413.	MH	RMD	----
3	5-30-95	ADDED C401-C408 & R402-R406 AND NOTE 6.	MH	RMD	----
A	10-10-95	ADDED NOTE 7; ENGINEERING RELEASE.	MH		----



NOTES:

1. ALL REFERENCE DESIGNATORS START AT 401.
2. ALL RESISTORS IN OHMS, 1/4W, 1%, UNLESS OTHERWISE SPECIFIED.
3. LAST COMPONENT USED: C408, E425, J410, R406, TP404, W1.
4. COMPONENTS NOT USED:
5. SEE ASSEMBLY: AD919-0415-400 (FM-4C). AD919-0415-500 (FM-5C).
6. * INDICATES COMPONENTS NOT USED ON 919-0415-400 (FM-4C).
7. ** INDICATES COMPONENTS USED ONLY 919-0415-400 (FM-4C).

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

DWN. BY M. HAYDEN 3-5-95
DESIGNER(S)
PROJ. LEADER
MFG.

MATERIAL: SEE B/M 919-0415-400 919-0415-500
FINISH
NEXT ASSY.

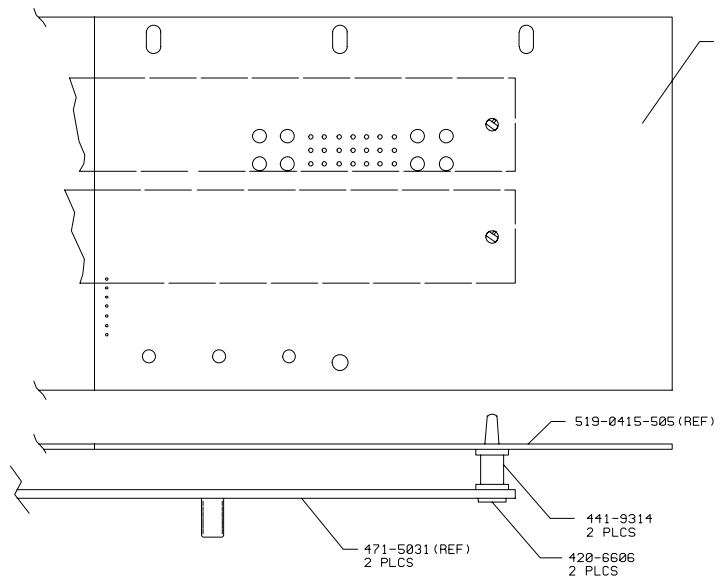
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305
217/224-9600 FAX 217/224-9607

TITLE: SCHEMATIC POWER SUPPLY MOTHERBOARD

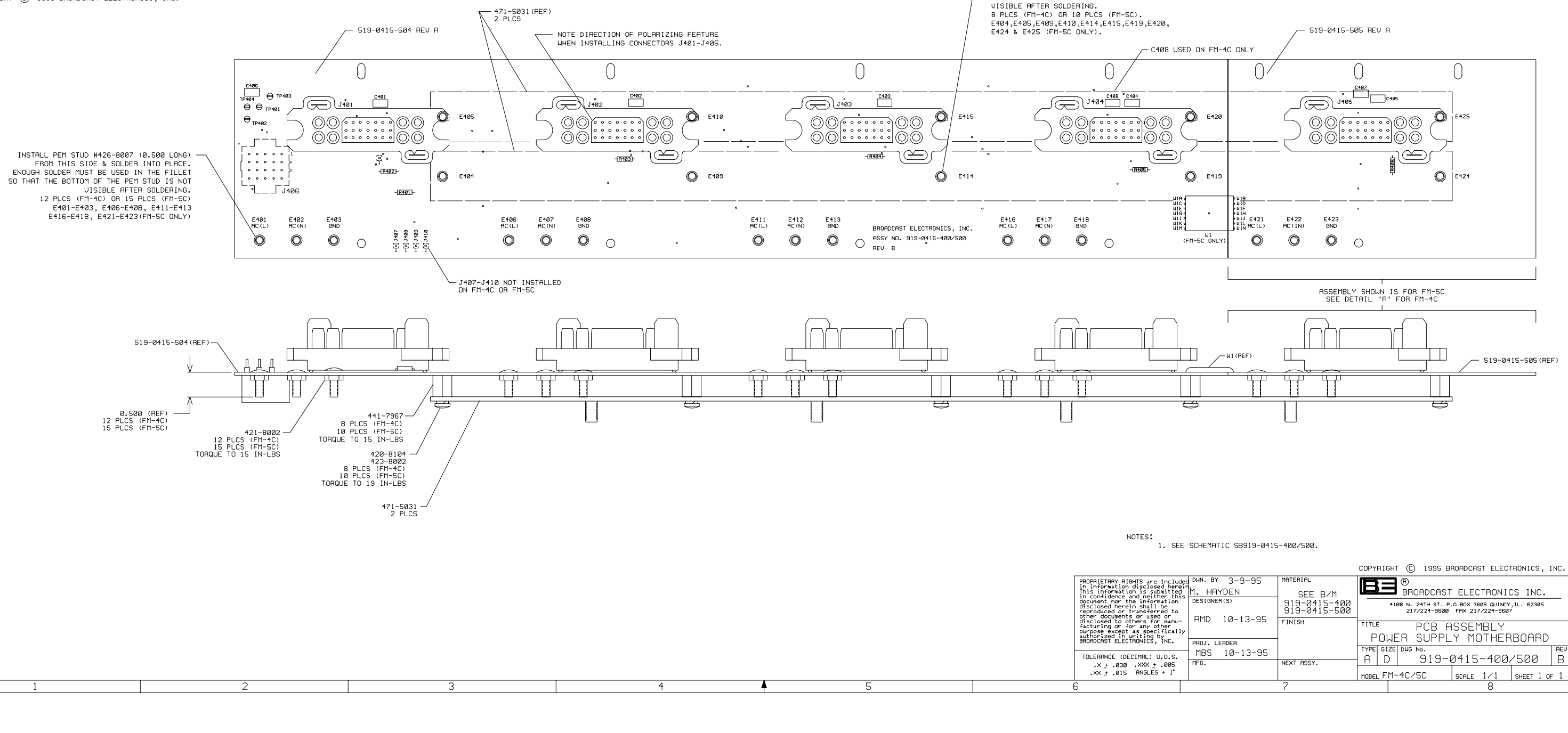
TYPE S | SIZE B | DWG. NO. 919-0415-400/500 | REV A

MODEL FM-4C/5C | SCALE NONE | SHEET 1 OF 1

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	3-9-95	PROTOTYPE RELEASE	MH	RMD	----
2	5-2-95	UPDATED ASSEMBLY VIEWS.	MH	RMD	----
3	6-5-95	ADDED C401-C408,R402-R406 & 2 SLOTS ON 519-0415-505	MH	RMD	----
A	10-10-95	ENGINEERING RELEASE WITHOUT CHANGE.	MH	RMD	----
B	8-27-96	HARDWARE CHANGE (420-8104 WAS 420-8105)	JLF		9677



DETAIL "A"
ASSEMBLY SHOWN IS FOR FM-4C



NOTES:
1. SEE SCHEMATIC SB919-0415-400/500.

PROPRIETARY RIGHTS are included in information disclosed herein. This information is submitted in confidence and neither this document nor the information disclosed herein shall be reproduced or transferred to other documents or used or disclosed to others for manufacturing or for any other purpose except as specifically authorized in writing by BROADCAST ELECTRONICS, INC.

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

DWN. BY 3-9-95
M. HAYDEN
DESIGNER(S)
RMD 10-13-95
PROJ. LEADER
MBS 10-13-95
MFG.

MATERIAL
SEE B/M
919-0415-400
919-0415-500
FINISH
NEXT ASSY.

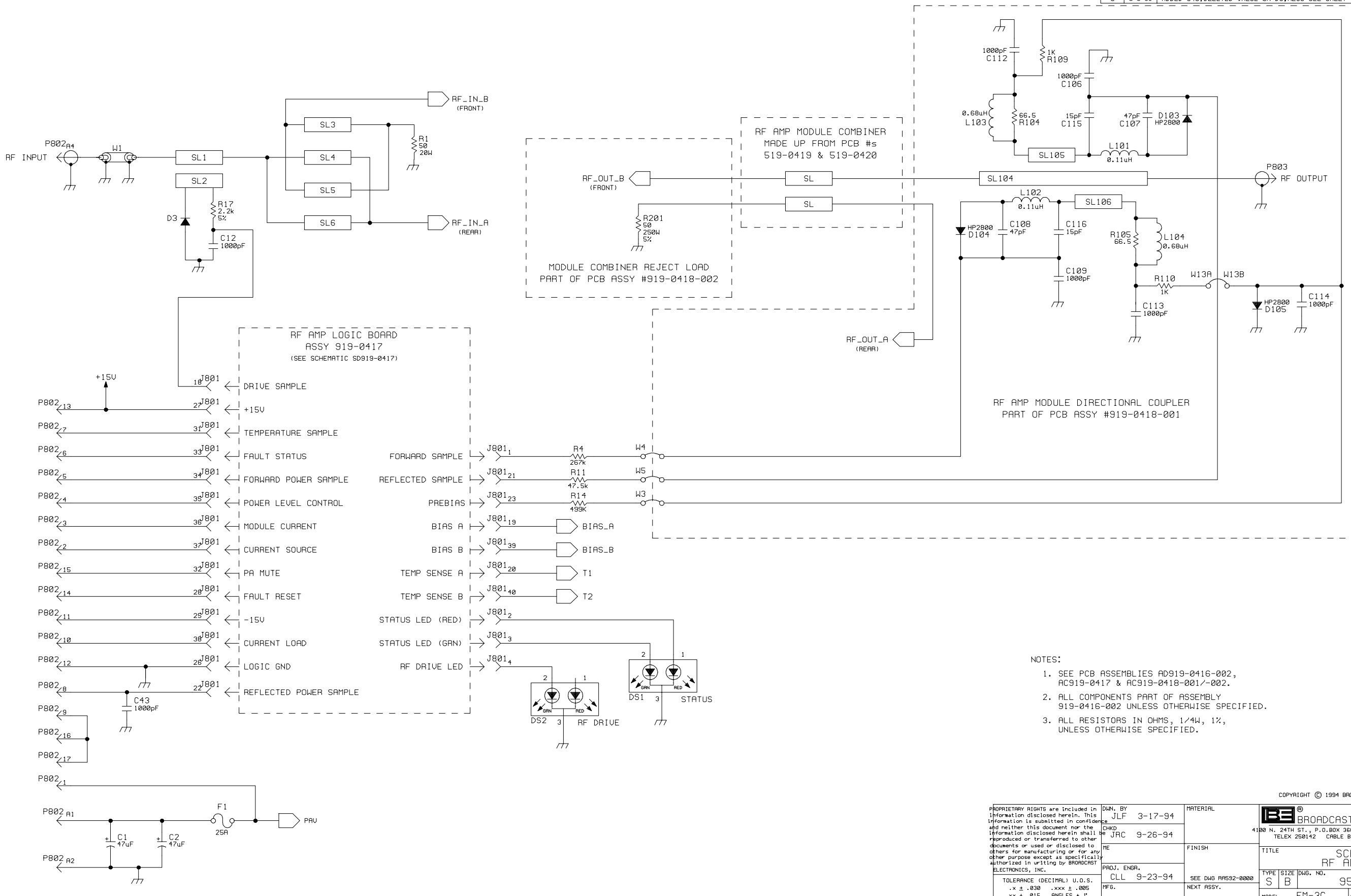
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST. P.O.BOX 3606 QUINCY,IL. 62305
217/224-9600 FAX 217/224-9607

TITLE
PCB ASSEMBLY
POWER SUPPLY MOTHERBOARD

TYPE	SIZE	DWG No.	REV
A	D	919-0415-400/500	B

MODEL FM-4C/5C | SCALE 1/1 | SHEET 1 OF 1

REV	DATE	DESCRIPTION	DFTSMN	ENGR	ECN
D	10-31-20	SEE SHEET 2.	KT		10815
1	3-17-94	PROTOTYPE RELEASE.	JLF	CLL	----
2	5-9-94	REMOVED C105,C110,R3,R16. ADDED L103-104. CHGD D1-2.	JLF	CLL	----
3	7-15-94	ADDED PCB #519-0420 TO MODULE COMBINER. CHGS TO SHT2. MODEL RELEASE W/CHGS.	JLF	CLL	----
A	9-23-94	ENGINEERING RELEASE W/CHGS.	JLF	CLL	9296
B	8-28-95	SEE SHEET 2.	AEB	WHB	9489
C	8-8-96	ADDED C43;DELETED VALUE ON D3;ALSO SEE SHEET 2.	MH		9691



NOTES:

1. SEE PCB ASSEMBLIES AD919-0416-002, AC919-0417 & AC919-0418-001/-002.
2. ALL COMPONENTS PART OF ASSEMBLY 919-0416-002 UNLESS OTHERWISE SPECIFIED.
3. ALL RESISTORS IN OHMS, 1/4W, 1%, UNLESS OTHERWISE SPECIFIED.

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

DWN. BY JLF 3-17-94
CHKD JRC 9-26-94
ME
PROJ. ENGR. CLL 9-23-94
MFG.

MATERIAL
FINISH
SEE DWG RAS92-0000
NEXT ASSY.

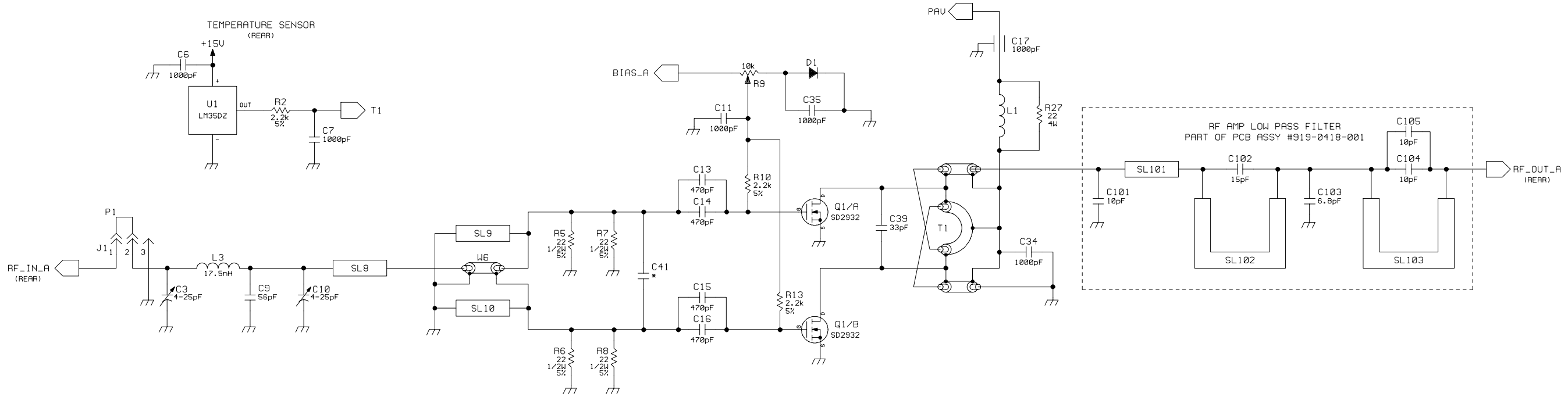
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305 217/224-9600
TELEX 250142 CABLE BROADCAST FAX 217/224-9607

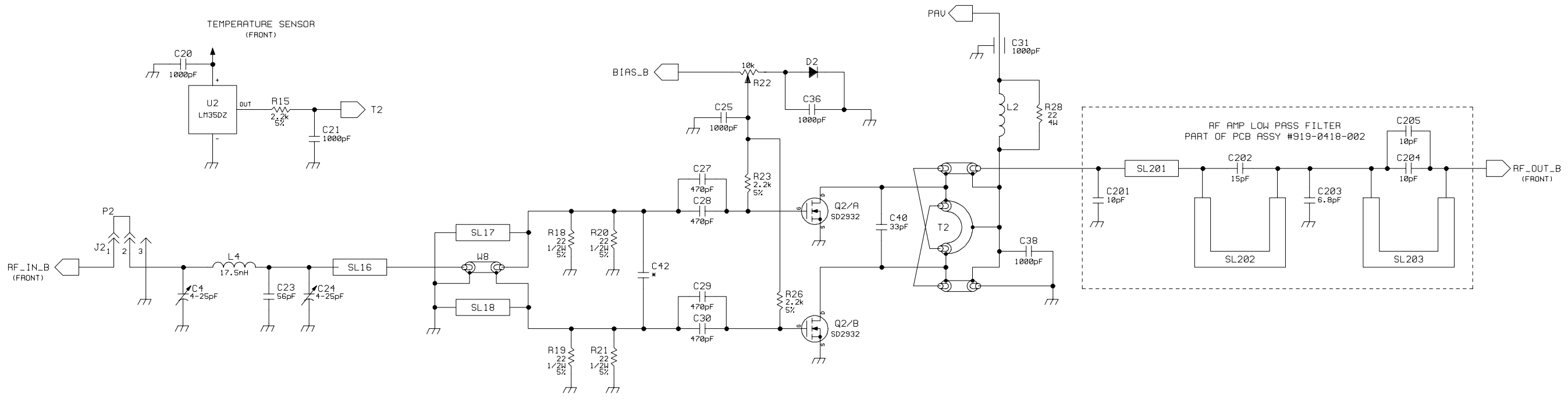
TITLE: SCHEMATIC RF AMP MODULE

TYPE S | SIZE B | DWG. NO. 959-0412 | REV D

MODEL FM-3C | SCALE NONE | SHEET 1 OF 2

REVISIONS					
REV	DATE	DESCRIPTION	DFTSMN	ENGR	ECN
1	3-17-94	PROTOTYPE RELEASE.	JLF	CLL	----
2	5-9-94	REMOVED R3,R16. D1-2 WERE 1N4148.	JLF	CLL	----
3	7-15-94	MOVED C101/201. ADDED C105/205. C104/204 WERE 10pF. MODEL RELEASE W/CHGS.	JLF	CLL	----
A	9-23-94	ENGINEERING RELEASE W/CHGS.	JLF	CLL	9296
B	8-28-95	ADDED RESISTORS R27 AND R28.	AEB	WHB	9489
C	8-8-96	CHGD VALUE OF C10 & C24;DELETED VALUE OF D1 & D2.	MH		9691
D	10-31-02	ADDED C3,C4,L3,L4;CHGD Q1 & Q2 TO SD2932 & C39,C40	KT		10815





* VALUE FOR C41 AND C42 TO BE FACTORY SELECTED DURING MODULE TEST.

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

DWN. BY	JLF 3-17-94
CHKD	JRC 9-26-94
ME	
PROJ. ENGR.	CLL 9-23-94
MFG.	
MATERIAL	
FINISH	SEE DWG RA592-0000
NEXT ASSY.	

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

TITLE: SCHEMATIC
RF AMP MODULE

TYPE	SIZE	DWG. NO.	REV
S	B	959-0412	D

MODEL FM-3C | SCALE NONE | SHEET 2 OF 2

POWER CONTROL AND FOLDBACK CONTROL

REVISIONS					
REV	DATE	DESCRIPTION	DFTSMN	ENGR	ECN
1	1-5-94	PROTOTYPE RELEASE.	JLF		----
2	5-10-94	VALUE CHGS R19,R21,R41,R53,R70.ADDED D22-23,R72-74,U7.	JLF		----
3	6-16-94	R11 WAS 100 OHM. MODEL BUILD RELEASE.	JLF		----
A	9-23-94	R33 & R39 WERE 1k. ENGINEERING RELEASE.	JLF	CLL	----
B	7-12-95	CHGD R33 & R39 TO 1.33k,AND ADDED R75 & D24.	AEB	WHB	9490
C	9-1-95	ADDED D25 & R76.	AEB	WHB	9537
D	8-11-96	ADDED R77.	MH	WHB	9691
E	4-16-03	CHGD R36,R49,R50,R56,R67,R71; ADD R78-R82,J1-J5,P1-P5	KT		10942

P801 CURRENT SENSE LOAD 38
P801 CURRENT SENSE SOURCE 37
+12V R48 7.68k
Q1 MPSA06
Q2 MPSA06
U1/A U1/B U1/C U1/D MPQ3799
5k R1 (R1-R16)
OFFSET ADJ 200 R11
P801 -15V 25 R21 22.1k C19 0.1uF
+12V R6 22.1k R9 182k R7 22.1k R8 22.1k
+15V C23 0.1uF U6/C TL074 D1 1N4148
+12V 22k R35 11
CURRENT LIMIT 10k R5 TP3
+12V +15V C3 0.1uF U2/C TL074 D2 1N4148
U6/B TL074 R3 2.74k R4 499k C2 0.047uF R2 499k C1 20pF
P801 TEMP_A (REAR) 20 R28 1k C8 0.1uF
P801 TEMP_B (FRONT) 40 R29 1k C9 0.1uF
U5/A TL074 D6 1N4148
R41 9.09k C25 20pF R40 1k
U5/B TL074 D7 1N4148
R61 1k P801 31 TEMPERATURE SAMPLE
R57 1k P801 36 MODULE CURRENT
TP2 R75 5.11k D24 1N4148
+12V R24 22.1k R25 10k RFL PWR LIMIT
+15V C21 0.1uF U2/D TL074 D8 1N4148
P801 Vrfl 21 (47k OHM IN SERIES) C14 20pF R23 499k
U4/D TL074 R26 2.74k R27 499k C11 0.047uF
R77 10k P801 22 RFL PWR SAMPLE
+12V R10 22.1k V_BIAS
U4/C TL074 R55 1k C10 0.1uF -15V
+12V R14 8.25k FWD PWR LIMIT R15 10k TP1
P801 Vfwd 1 (47k OHM IN SERIES) C13 20pF R12 499k
U2/A TL074 R49 10k R50 5.11k R51 20k FWD PWR CAL
U2/B TL074 D3 1N4148 R13 2.74k R16 499k C5 0.047uF
+12V R30 15.8k R31 499k R33 1.33k U6/D TL074 THERMAL SHUTDOWN
+12V R38 15.8k R39 1.33k R32 499k U6/A TL074
R35 22k D15 1N4148 R35 22k D16 1N4148
+15V U3/A TL074 R59 51.1 P801 19 BIAS_A (REAR) C4 0.1uF
U3/B TL074 R60 51.1 P801 39 BIAS_B (FRONT)
R58 1k P801 34 FORWARD POWER
P801 POWER LEVEL 35 R72 499k R73 78.7k D22 HP2800 D23 HP2800
P3 J3 P2 J2 R80 162k R79 332k R67 1M R34 5.11k C7 0.1uF
U3/C TL074 D4 1N4148 R17 2.74k R18 499k C6 0.047uF R68 16.9k
1N4148 D20 U4/B TL074 1N4148 D11
P4 J4 R81 24.9k R36 221k U3/D TL074 R42 499k R52 162k R53 5.11k -15V
+15V D13 1N4148 R56 100k J5 P5 R82 11k D17 1N4742A
R20 499k P801 23 PREBIAS R22 162k
+15V R54 47.5k C22 10uF R44 22.1k FAULT LATCH TL074 U4/A R45 22.1k D12 1N4148
D25 1N4148 D14 1N4148 C17 10uF C18 10uF -15V R76 5.11k
+15V R46 1k P801 2 STATUS LED (RED) R64 5.11k Q5 MPSA06
Q7 MPSA06 R47 1k P801 3 STATUS LED (GREEN)
P801 +15V 27 U7 LM317 ADJ R19 243 C20 10uF R74 2.04k C15 0.1uF C16 10uF +12V
P801 GND 26
+12V R35 22k R35 22k R35 22k R35 22k MUTE U5/D TL074 C12 20pF D5 1N4148 D9 1N4148
P801 PA_MUTE 32
P801 FAULT RESET 28 D19 1N4148 R43 1k
+15V 2N3906 Q8 R69 22.1k R66 47.5k
R62 5.11k P801 33 FAULT STATUS Q6 MPSA06
P1 J1 R78 16.9k R70 8.25k R71 182k C26 20pF
+12V +15V U5/C TL074 D10 1N4148 D21 1N4148 R63 1k P801 4 RF DRIVE LED
P801 DRIVE SAMPLE 18 R37 1k R65 499k C24 0.1uF -15V

NOTES:
1. ALL RESISTORS IN OHMS, 1/4W, 1%, UNLESS OTHERWISE SPECIFIED.
2. LAST COMPONENT USED: C26, D25, J5,P801, Q8, R82, TP3, U7,
3. COMPONENTS NOT USED: D18, P6-800
4. SEE ASSEMBLY: AB919-0417

JUMPER PIN SETTINGS

MODE	P1	P2	P3	P4	P5
FM ONLY	1-2	1-2	1-2	1-2	1-2
IBOC ONLY	1	1	1-2	1	1
FM + IBOC	1	1-2	1	1	1

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

DWN. BY JLF 1-5-94
DESIGNER(S)
PROJ. LEADER
MFG.

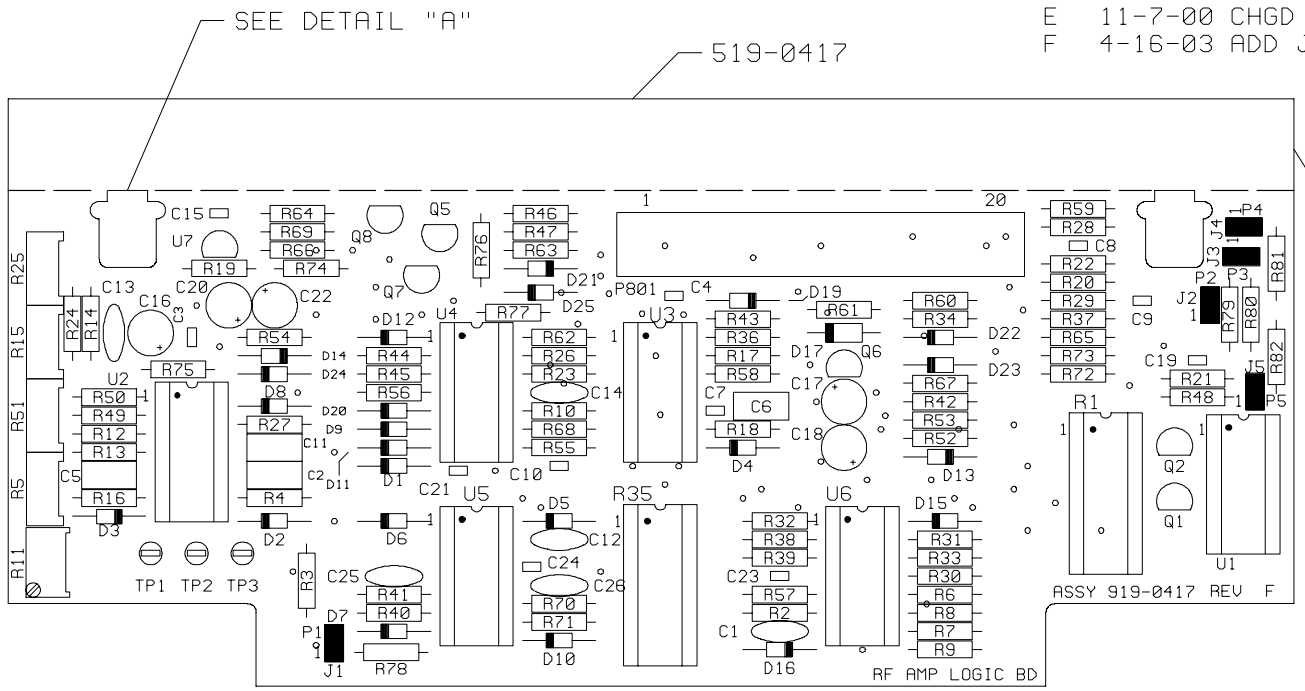
MATERIAL SEE BOM 919-0417
FINISH SEE DWG AA592-0000
NEXT ASSY. 959-0412

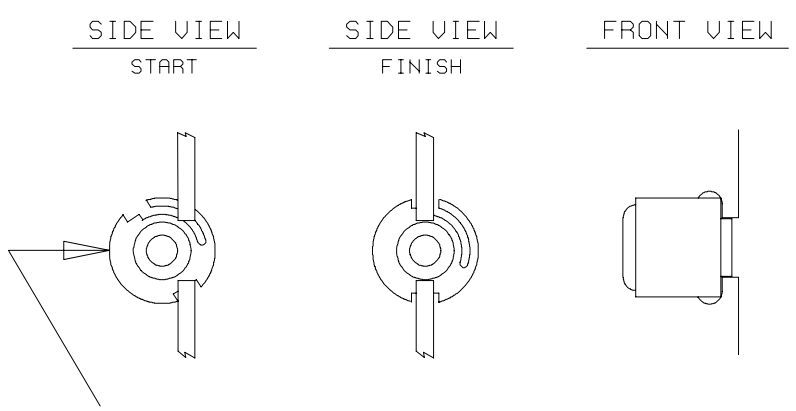
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305 217/224-9600
TELEX 250142 CABLE BROADCAST FAX 217/224-9607

TITLE SCHEMATIC
RF AMP LOGIC PCB

TYPE S | SIZE B | DWG. NO. 919-0417 | REV E
MODEL FM-3C FM-2C | SCALE NONE | SHEET 1 OF 1

REVISIONS					
REV	DATE	DESCRIPTION	DFTSMN	ENGR	ECN
1	1-5-94	PROTOTYPE RELEASE.	JLF	CLL	----
2	5-10-94	VALUE CHGS R19,R21,R41,R53,R70. ADDED D22-23,R72-74,U7.	JLF	CLL	----
3	6-16-94	R11 WAS 100 OHM (177-1035). MODEL BUILD RELEASE.	JLF	CLL	----
A	9-23-94	R33 & R39 WERE 1k. ENGINEERING RELEASE.	JLF	CLL	----
B	7-17-95	CHGD THE VALUE OF R33 & R39 AND ADDED D24 & R75.	AEB	WHB	9490
C	9-4-95	ADDED R76 AND D25.	AEB	WHB	9537
D	8-11-96	ADDED R77 & BREAKAWAY TAB AT TOP OF BOARD.	MH	WHB	9691
E	11-7-00	CHGD HOLE SIZES OF SEVERAL COMPONENTS	KT	DDL	10388
F	4-16-03	ADD J1-J5,P1-P5,R78-R82; CHGD R36,R49,R50,R56,R67,R71	KT		10942





JUMPER PIN SETTINGS

MODE	P1	P2	P3	P4	P5
FM ONLY	1-2	1-2	1-2	1-2	1-2
IBOC ONLY	1	1	1-2	1	1
FM + IBOC	1	1-2	1	1	1

NOTES:

1. SEE SCHEMATIC SB919-0417

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

DWN. BY JLF 1-5-94

DESIGNER(S) C.LANGNER 9-23-94

PROJ. LEADER R.CARPENTER 9-26-94

MFG.

MATERIAL SEE BOM 919-0417

FINISH SEE DWG RA592-0000

NEXT ASSY. 959-0412

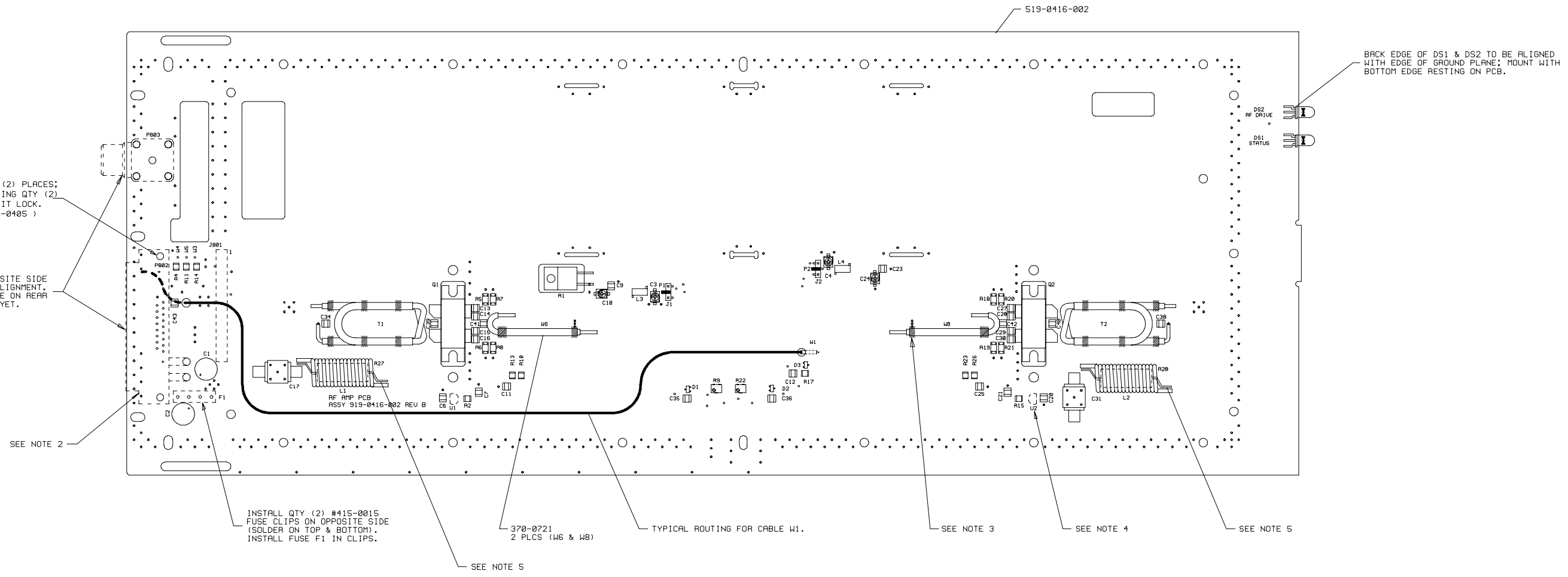
BROADCAST ELECTRONICS INC.
4100 N.24TH ST. P.O.BOX 3606 QUINCY,IL. 62305 PH. 217/224-9600
TELEX 250142 CABLE BROADCAST FAX 217/224-9607

TITLE
PCB ASSEMBLY
RF AMP LOGIC BOARD

TYPE	SIZE	DWG No.	REV
A	B	919-0417	F

MODEL FM-3C SCALE 1/1 SHEET 1 OF 1

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
A	4-16-02	ENGINEERING RELEASE	KT	TH	----
B	10-31-02	CHGD C39 & C40 TO 33pF (009-3313)	KT	DL	10815



NOTES:

1. FOLLOWING COMPONENTS TO BE INSTALLED DURING RF AMP MODULE FINAL ASSEMBLY: AND ARE SHOWN HERE FOR REFERENCE ONLY: C13-16, C27-30, C39-42, Q1-2, P802-803, R3, T1-2, W3-5
2. COMPONENTS SHOWN WITH DASHED LINES TO BE INSTALLED ON OPPOSITE SIDE.
3. OUTER CONDUCTOR OF T1, T2, W6, & W8 TO BE SOLDERED TO PCB WHERE INDICATED BY SHADING.
4. COMPONENTS U1 & U2 TO BE MOUNTED ON OPPOSITE SIDE OF PCB WITH A MAXIMUM COMPONENT HEIGHT OF 0.28".
5. R27 & R28 TO BE INSERTED INSIDE OF L1 & L2 RESPECTIVELY AND SOLDERED AS SHOWN.
6. FOLLOWING COMPONENTS TO BE INSTALLED DURING ASSEMBLY OF 919-0416-001 R27, R28, L1, L2, W6, W8, P802, P803, W1
7. SEE SCHEMATIC 959-0412.

TOLERANCE (DECIMAL) U.O.S.
.X ± .030 .XXX ± .005
.XX ± .01S ANGLES ± 1°

DWN. BY: KWT 4-16-02
DESIGNER(S): TED HEA 4-16-02
PROJ. LEADER:
MFG.

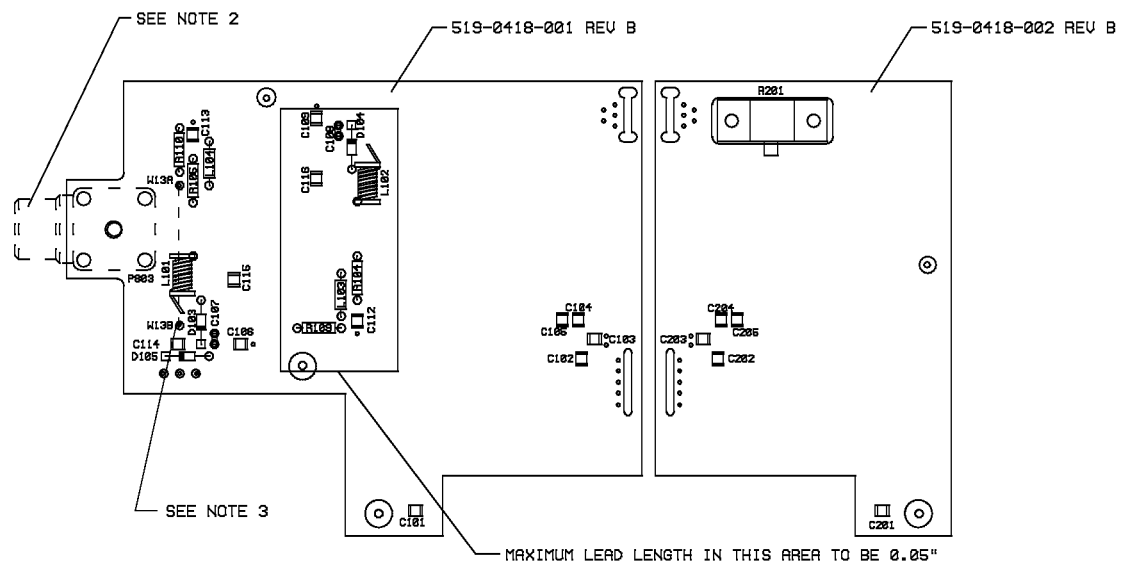
MATERIAL: SEE BOM 919-0416-002
FINISH: ----
NEXT ASSY.: 959-0412

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, MAIN BD, ST MICRO

TYPE	SIZE	DWG No.	REV
A	D	919-0416-001/-002	B

MODEL FM-3C | SCALE 1/1 | SHEET 1 OF 1



NOTES:

1. SEE SCHEMATIC SB959-0412.
2. P803 & R201 SHOWN FOR REFERENCE ONLY; TO BE INSTALLED DURING RF AMP MODULE FINAL ASSEMBLY.
3. JUMPER WIRE W13 TO BE INSTALLED ON SOLDER SIDE USING WIRE 601-0022 INSULATED WITH TEFLON TUBING 693-0220.

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

DWN. BY 1-9-94 M. HAYDEN
CHKD
ME
PROJ. ENGR. 1-10-94 CL LANGNER
MFG.

MATERIAL SEE BOM 919-0418-001/002
FINISH ~~SEE DWG RA602-0000~~
NEXT ASSY. 959-0412

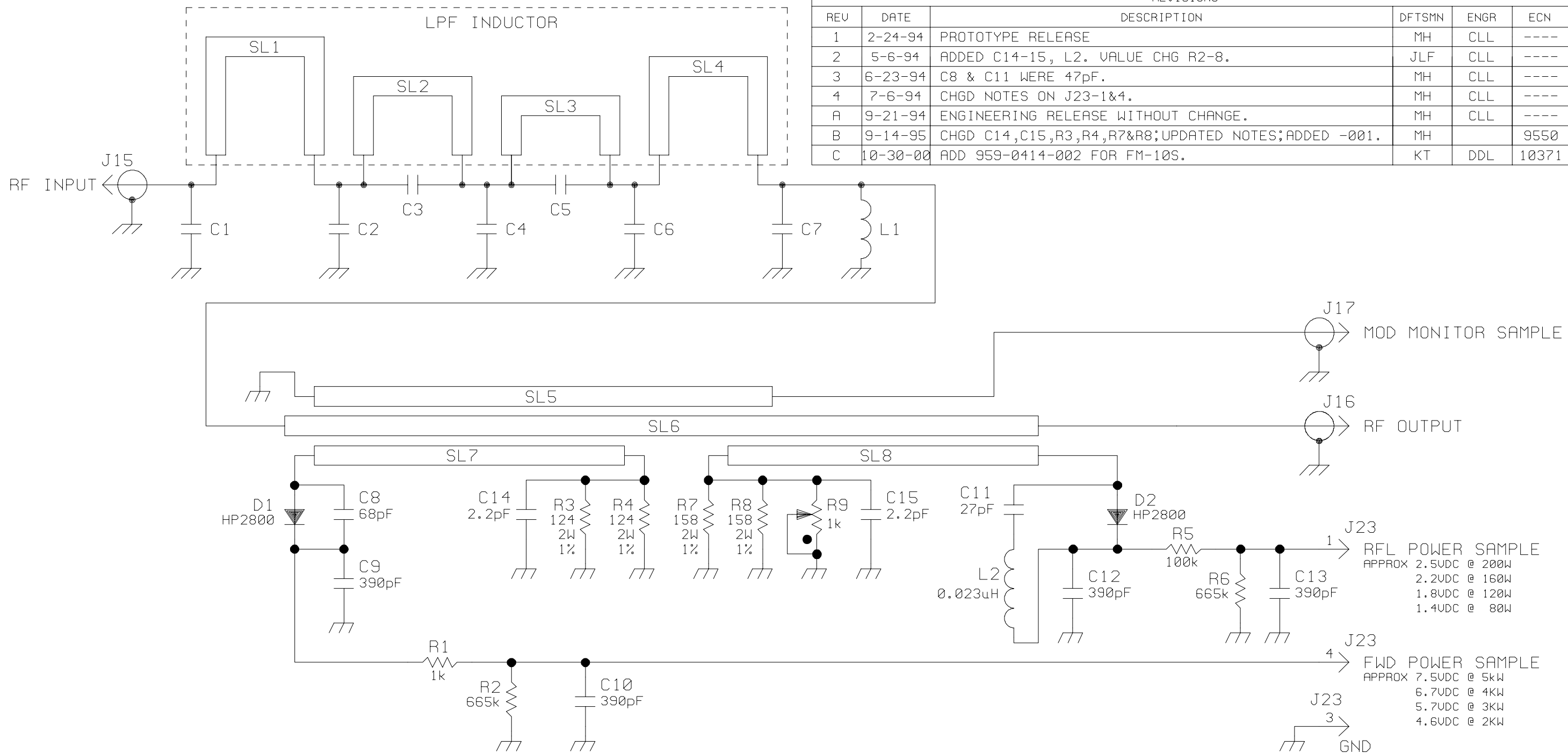
BROADCAST ELECTRONICS INC.
4100 N.24TH ST. P.O.BOX 3606 QUINCY,IL. 62305 PH. 217/224-9600
TELEX 250142 CABLE BROADCAST FAX 217/224-9607

TITLE PCB ASSEMBLY
AMP LPF / DIRECTIONAL COUPLER

TYPE	SIZE	DWG No.	REV
A	C	919-0418-001/002	A

MODEL FM-3C SCALE 1/1 SHEET 1 OF 1

REVISIONS					
REV	DATE	DESCRIPTION	DFTSMN	ENGR	ECN
1	2-24-94	PROTOTYPE RELEASE	MH	CLL	----
2	5-6-94	ADDED C14-15, L2. VALUE CHG R2-8.	JLF	CLL	----
3	6-23-94	C8 & C11 WERE 47pF.	MH	CLL	----
4	7-6-94	CHGD NOTES ON J23-1&4.	MH	CLL	----
A	9-21-94	ENGINEERING RELEASE WITHOUT CHANGE.	MH	CLL	----
B	9-14-95	CHGD C14,C15,R3,R4,R7&R8;UPDATED NOTES;ADDED -001.	MH		9550
C	10-30-00	ADD 959-0414-002 FOR FM-10S.	KT	DDL	10371



NOTES:

1. "SL" INDICATES ETCHED STRIPLINE ON PCB.
2. C1-C7 ARE ETCHED ON PCB.
3. ALL RESISTORS IN OHMS, 1/4W, 1%, UNLESS OTHERWISE SPECIFIED.
4. SEE PCB ASSEMBLY DRAWING AC919-0421/-001/-002.

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

DWN. BY 2-24-94 M. HAYDEN
CHKD 9/27/94 C.L. LANGNER
ME
PROJ. ENGR. 9/27/94 J.R. CARPENTER
MFG.

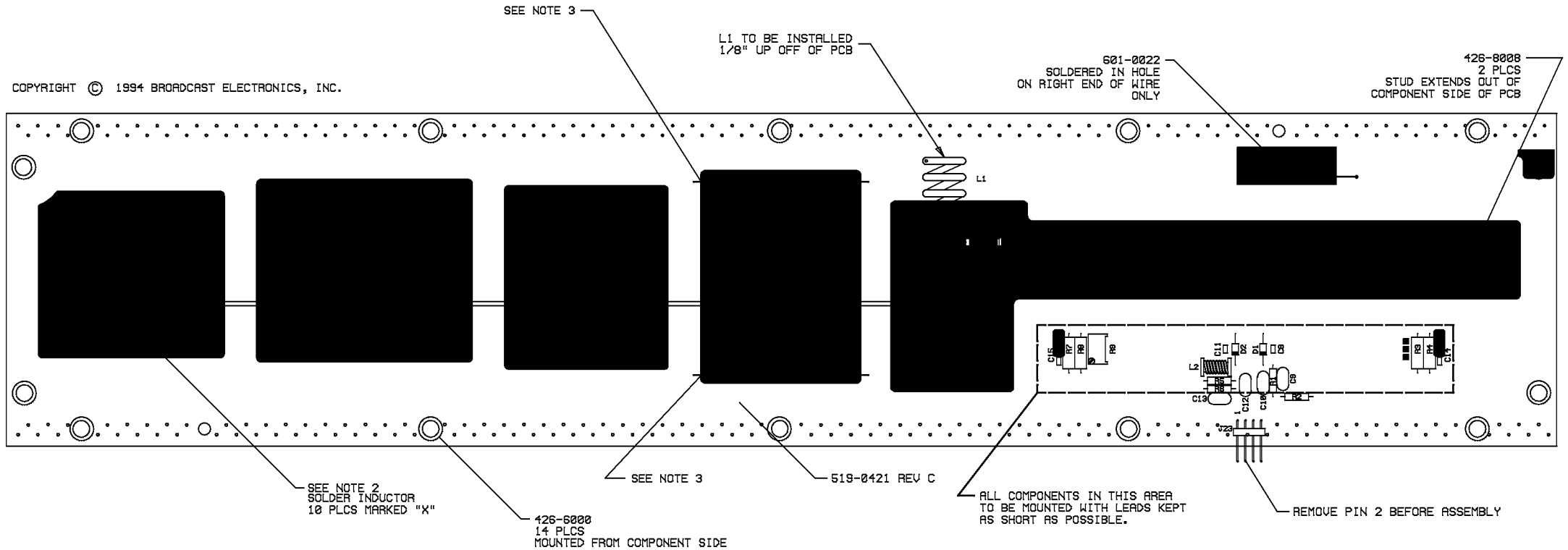
MATERIAL
FINISH
SEE DWG RA592-0000
NEXT ASSY.

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

TITLE
SCHEMATIC
LOW PASS FILTER ASSEMBLY

TYPE	SIZE	DWG. NO.	REV
S	B	959-0414/-001/-002	C

MODEL FM-2C/3C/4C/5C/10S SCALE NONE SHEET 1 OF 1



NOTES:

1. SEE SCHEMATIC SB959-0414.
2. USE 471-0976 ON 919-0421 (FM-2C/3C)
   USE 471-5035 ON 919-0421-001 (FM-4C/5C).
3. FOR FM-2C/3C REMOVE COMPONENT SIDE COPPER OUTSIDE OF DASHED LINES (2 PLCS.).

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

DWN. BY 2-9-94 M. HAYDEN
DESIGNER(S) 9/27/94 C.L. LANGNER
PROJ. LEADER 9/27/94 J.R. CARPENTER
MFG.

MATERIAL SEE BOM 919-0421/-001
FINISH
~~SEE DWG AA502-0000~~
NEXT ASSY. 959-0414/-001

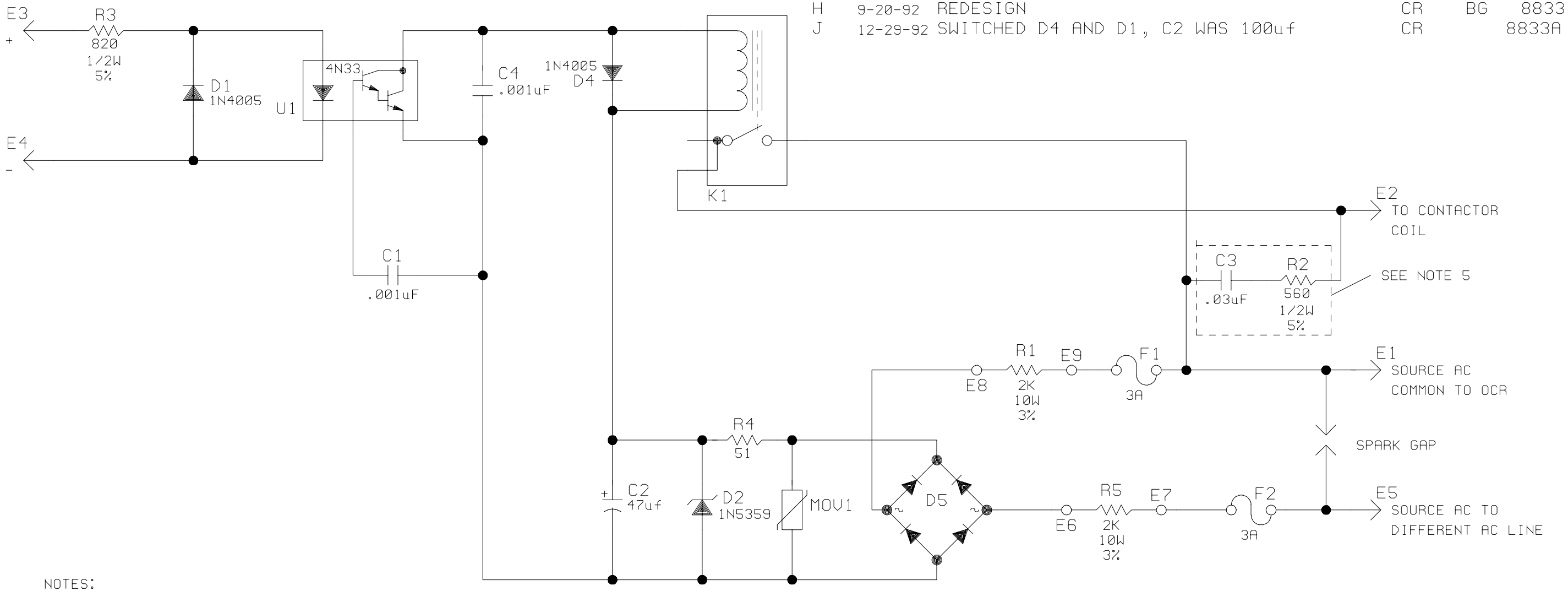
BROADCAST ELECTRONICS INC.
4100 N.24TH ST. P.O.BOX 3606 QUINCY,IL. 62305 PH. 217/224-9600
TELEX 250142 CABLE BROADCAST FAX 217/224-9607

TITLE PCB ASSEMBLY LOW PASS FILTER

TYPE	SIZE	DWG No.	REV
A	C	919-0421/-001	D

MODEL FM-2C/3C/4C/5C | SCALE 1/1 | SHEET 1 OF 1

REVISIONS					
REV	DATE	DESCRIPTION	DFTSMN	ENGR	ECN
C	7-14-86	ENGINEERING RELEASE	MSE	JHS	6434
D	9-23-86	ADDED 919-0096-001	MSE	DBM	6540
E	1-28-87	SWITCHED "TO..., & SOURCE..."	MSE	DBM	6727
F	8-27-87	PER ECN	MERK	MBS	6960
G	7-6-88	CHGD R1 FROM 4K TO 2K	JAH	TJL	7419
H	9-20-92	REDESIGN	CR	BG	8833
J	12-29-92	SWITCHED D4 AND D1, C2 WAS 100uf	CR		8833A



NOTES:

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

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

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

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

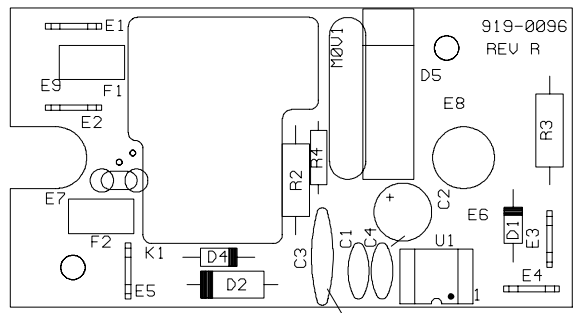
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305 217/224-9600
TELEX 250142 CABLE BROADCAST FAX 217/224-9607

TITLE
OPTICALLY COUPLED RELAY

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

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

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
C	7-14-86	ENGINEERING RELEASE	MSE	JHS	6434
D	9-23-86	ADDED 919-0096-001	MSE	DBM	6540
E	2-4-87	MOVED E4 90 DEG.	MSE	DBM	6741
F	8-27-87	REVISED PER ECN	MERK	MBS	6960
G	7-6-88	CHG'D P/N OF RESISTOR FROM 130-4044	JAH	TJL	7419
H	1-12-89	MOVED 24" WIRE AND LUG	PRD	DBM	7620
J	9-20-92	REDESIGN	JAH/CR	BG	8833
K	2-4-93	CHANGED SIZE OF MOUNTING HOLE TO .343 DIA	CR	BG	8885
L	6-15-93	ADDED .125" TO LEFT & RIGHT SIDES OF BOARD.	MH	BG	8989
M	3-26-97	ADDED R2 AND C3 NOTE	MSE		9673
N	8-29-97	SHT. 2, ADDED WIRE LENGTH NOTE	MSE		9836
P	11-7-00	CHGD HOLE SIZE OF SEVERAL COMPONENTS	KT	DDL	10388
R	6-20-02	MOVED PARTS, ADDED ASSY NUMBER	KT		10717



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

PROPRIETARY RIGHTS are included in information disclosed herein. This information is submitted in confidence and neither this document nor the information disclosed herein shall be reproduced or transferred to other documents or used or disclosed to others for manufacturing or for any other purpose except as specifically authorized in writing by BROADCAST ELECTRONICS, INC.

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

DWN. BY: JAH 12-13-91
DESIGNER(S):
PROJ. LEADER: J.TUCKER 7-14-86
MFG.: J.STEINKAMP 7-14-86

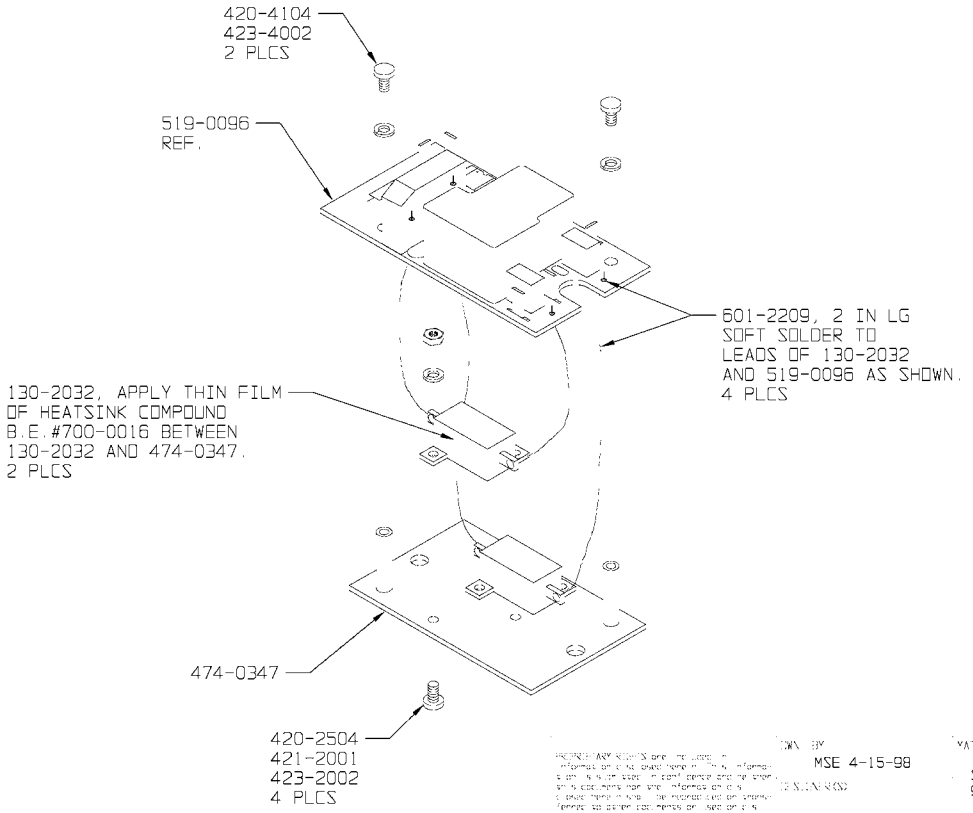
MATERIAL: SEE B/M 919-0096 919-0096-001
FINISH: ~~SEE DWG AA592-0000~~
NEXT ASSY.:

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

TITLE: PCB ASSEMBLY
OPTICALLY COUPLED RELAY BD.

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

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



DWN BY
MSE 4-15-98

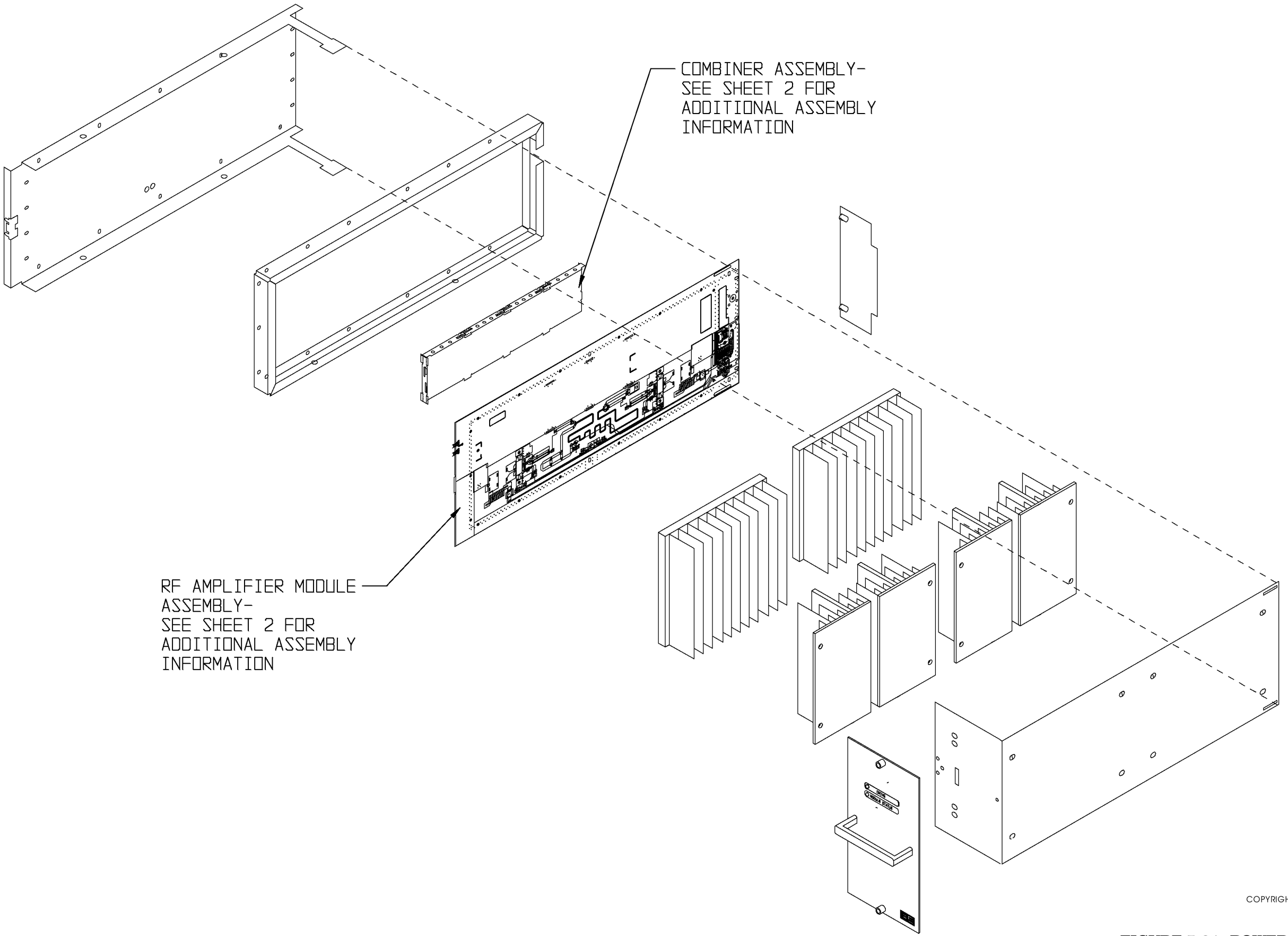
MATERIAL
SEE BOM
919-0096, -001

BROADCAST ELECTRONICS INC

ASSY, PCB OPTICALLY
COUPLED RELAY (OCR)

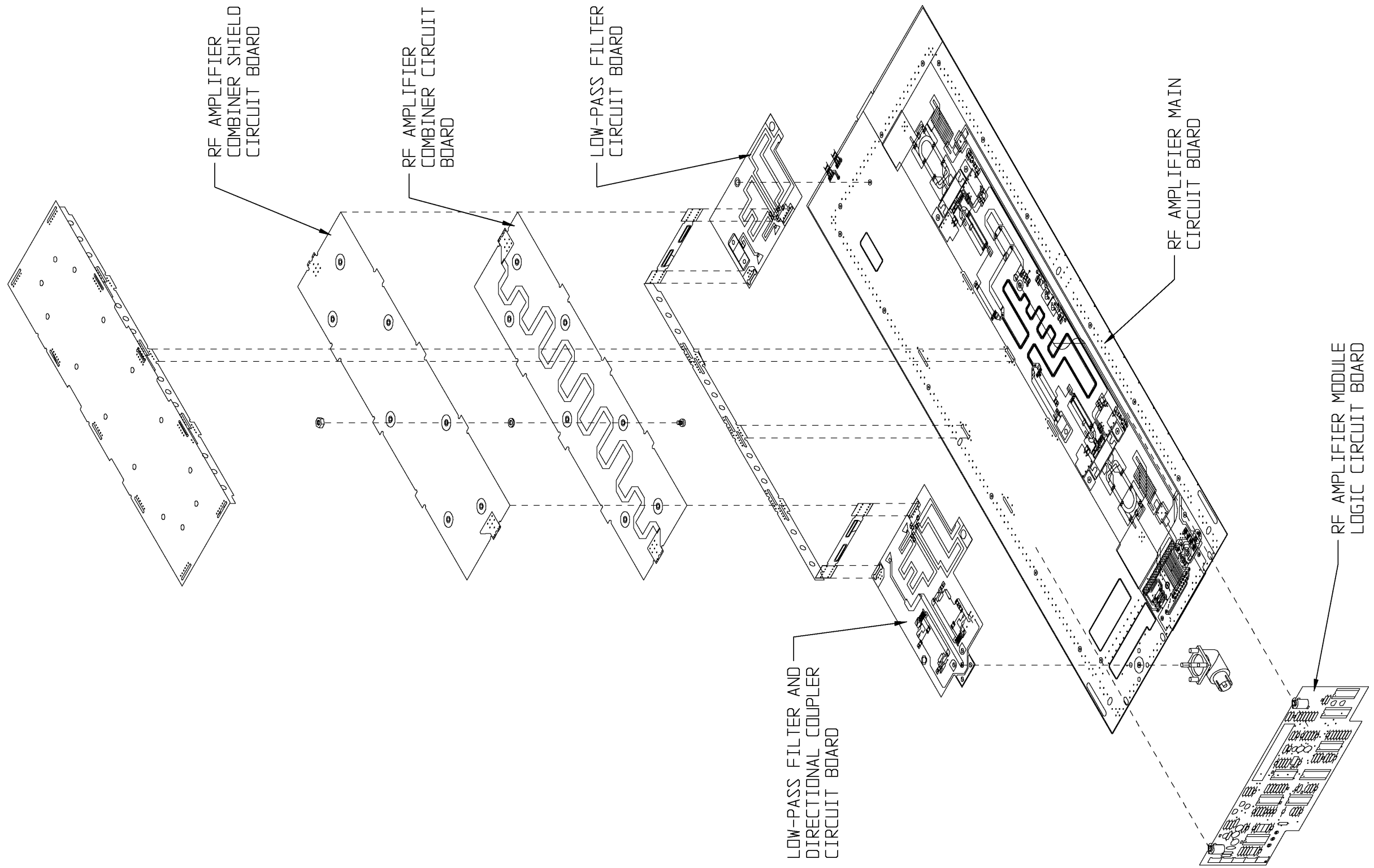
SIZE A
919-0096, -001
REV N

NEXT ASSY
XMTRS
SCALE 1/1
SHEET 2 OF 2



597-3002-23

FIGURE 7-34. POWER AMPLIFIER MODULE ASSEMBLY DIAGRAM (SHEET 1 OF 2)



597-3002-23A

FIGURE 7-34. POWER AMPLIFIER MODULE ASSEMBLY DIAGRAM (SHEET 2 OF 2)

APPENDIX A
MANUFACTURERS DATA

A-1. INTRODUCTION.

A-2. This appendix provides technical data associated with the operation and maintenance of the FM-5C/FM-4C transmitters. The information contained in this appendix is presented in the following order.

A. Technical data, Electromatic 3-Phase AC Voltage Monitor.

B. Pioneer Magnetics, Troubleshooting Guide For The PM3329BP-5.

C. Computer Products Schematic Diagram, Model NFS 80-7606/7606 HM Power Supply.

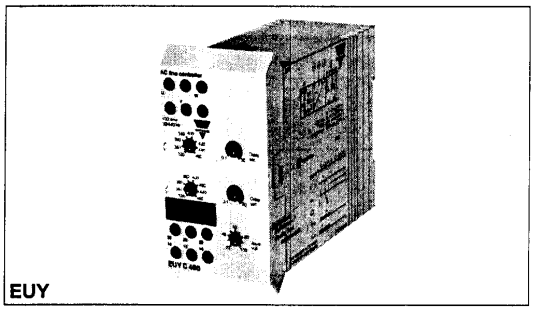
TECHNICAL DATA
ELECTROMATIC 3-PHASE AC VOLTAGE MONITOR

A-3. INTRODUCTION.

A-4. The FM-5C/FM-4C 220V ac 3-phase transmitters are equipped with a 3-phase ac line voltage monitor. The following text presents the standard operating adjustments and operating information.

UPPER VOLTAGE LIMIT (upper set of voltage controls on the unit)	250V
LOWER VOLTAGE LIMIT (lower set of voltage controls on the unit)	192
ASYMMETRY	12%
TIME	0.1 SEC.

True RMS 3-Phase Over/Under Voltage Asymmetry and Phase Loss/Sequence Monitoring Relay Type EUY


EUY

- True RMS measuring on own power supply
- Frequency range 45-440 Hz
- Monitoring relay and 3-phased measuring relay for over/under voltage control (closed circuit)
- Monitors phase asymmetry
- Monitors phase loss/phase sequence
- Measures if all 3 phase-phase voltages are within set limits
- Upper and lower limits separately adjustable
- Adjustable asymmetry
- 2 separately adjustable time functions (0.1-30 s)
- Output: 2 x 5 A SPDT relays (one relay for each level)
- For mounting on DIN-rail in accordance with DIN/EN 50 022
- 45 mm Euronorm housing
- LED-indication for power supply ON
- Two LED's indicating fault and/or status of the 2 relay outputs (flashing when timing)

Product Description

True RMS 3-phase monitoring relay for separate over and under voltage, asymmetry and phase failure control. The advantage of true RMS measuring is that correct values are always obtained irrespective of the waveform of the measuring voltage, i.e. the EUY measures the correct RMS value of a normal sinusoidal power supply as well as of a disorted power supply. Frequency range 45 to 440 Hz. With relays measuring average value (EUB, EUC) correct values are only obtained for true sinusoidal power supplies. Often used in motor applications where it is important to detect the reliability of the electrical power.

Ordering Key

EUY C 400

Housing
Function
Type
Output
Power supply

Type Selection

Mounting	Output	Supply: 220 VAC	Supply: 240 VAC	Supply: 400 VAC	Supply: 480 VAC	Supply: 600 VAC
For DIN-rail	SPDT	**EUY C 220**	**EUY C 240**	**EUY C 400**	**EUY C 480**	**EUY C 600**

Input Specifications

Input U, V, W		L1 - L2 - L3 measures on own supply phase sequence not arbitrary
Frequency range		45-440 Hz
Measuring ranges (True RMS)	220	176-253 VAC
	240	192-276 VAC
	400	320-460 VAC
	480	384-552 VAC
	600	480-690 VAC
Range		
Upper level (sep. adjustable)		80 - 115%
Lower level (sep. adjustable)		80 - 115%
Asymmetry (sep. adjustable)		5-25% of nominal range
Phase loss		70% of nominal range

Output Specifications

Output		2 x SPDT relay
Rated insulation voltage		250 VAC (contact/elect.)
Upper limit		terminals 25/26/28
Lower limit		terminals 15/16/18
Contact ratings (AgCdO)		µ (micro gap)
Resistive loads	AC 1	5 A, 250 VAC
	DC 1	5 A, 24 VDC
Small inductive loads	AC 11	2 A, 250 VAC
	DC 11	3 A, 24 VDC
Mechanical life		≥ 40 x 10^6 operations
Electrical life		≥ 10^5 operations (at max. load)
Operating frequency		≤ 7200 operations/h
Dielectric strength		
Dielectric voltage		2 kVAC (RMS)
Rated impulse withstand volt.		4 kV (1.2/50 µs)

Supply Specifications

Power supply		Overvoltage cat. III IEC (664)
Rated operational voltage through term. U, V, W	220	(IEC 38) 220 VAC, -20/+15% 45-440 Hz
	240	240 VAC, -20/+15% 45-440 Hz
	400	400 VAC, -20/+15% 45-440 Hz
	480	480 VAC, -20/+15% 45-440 Hz
	600	600 VAC, -20/+15% 45-440 Hz
Voltage interruption		≤ 40 ms
Dielectric voltage		none
Rated impulse withstand voltage	up to 480 VAC	4 kV (1.2/50 µs)
	up to 600 VAC	6 kV (1.2/50 µs)
Rated operational power		5 VA
Supplied from		L1, L3

General Specifications

Power ON delay	5 s
Reaction time	
Switching out	≤ 1.5 s
Switching in	≤ 3.0 s
Accuracy	
Range	≤ 5%
Temperature drift	≤ 0.1%/°C
Delay (upper/lower level)	30 s, ±5% on max. < 0.1 s on min.
Temperature drift	≤ 0.05%/°C (≤ 0.06%/°F)
Hysteresis	
Level	< 2.0%
Asymmetry	< 3.0%
Indication for	
Power supply ON	LED, green
Output/error condition	2 x LED's, yellow (see LED table)
Environment	
Degree of protection	IP 20
Pollution degree	3
Operating temperature	-10 to +50°C (-4 to +122°F)
Storage temperature	-50 to +85°C (-58 to +185°F)
Weight	280 g
Screw terminals	
Tightening torque	Max. 0.5 Nm acc. to IEC 947
Approvals	UL, CSA, SEV

Mode of Operation

Connected to the 3 phases, the EUY operates and the two output relays are energized when all three phases are present at the same time, the phase sequence is correct, the measured asymmetry is below set value and the 3 phase-phase voltages are within set limits. This is indicated by the two LED's. If one or more of the phase-phase voltages rises above, or if the measured asymmetry exceeds the set level, then the centre (yellow) LED starts to flash, and the output relay (terminals 25/26/28) releases after the set time period. If one or more of the phase-phase voltages drops below the set level, then the left (yellow) LED starts to flash, and the output relay (terminals 15/16/18) releases after the set time period. If the phase sequence is wrong or one phase is lost, then the two built-in output relays will release immediately. No time function will occur. The failure will be indicated by the two yellow LED's. At phase loss both LED's will flash. At wrong phase sequence the LED's will flash alternately (see LED table).

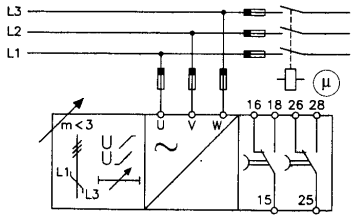
Example 1
Mains network monitoring
The relay monitors over and under voltage, phase loss, correct phase sequence and that the phase asymmetry is within the adjusted level.

Example 2
Starting and operating load monitoring
The EUY ensures correct starting and operating conditions. The relay controls the voltage level, phase sequence, asymmetry and the correct direction of motor rotation.

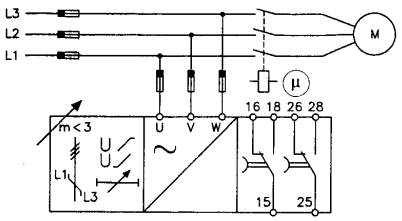
Frequent failures are fuse break-down, asymmetry, and incorrect voltage level. In case of fuse blowing the motor will regenerate a voltage in the interrupted phase. The EUY will detect the failure and react immediately due to excessive imbalance between the phases.

Wiring Diagrams

Example 1



Example 2



Asymmetry/Level/Time Setting

Level setting
Upper left knob:
Setting of upper limit on absolute scale.

Lower left knob:
Setting of lower limit on absolute scale.

Time 1 setting (lower level)
Centre right knob:
Setting of time delay on absolute scale (0.1-30 s).

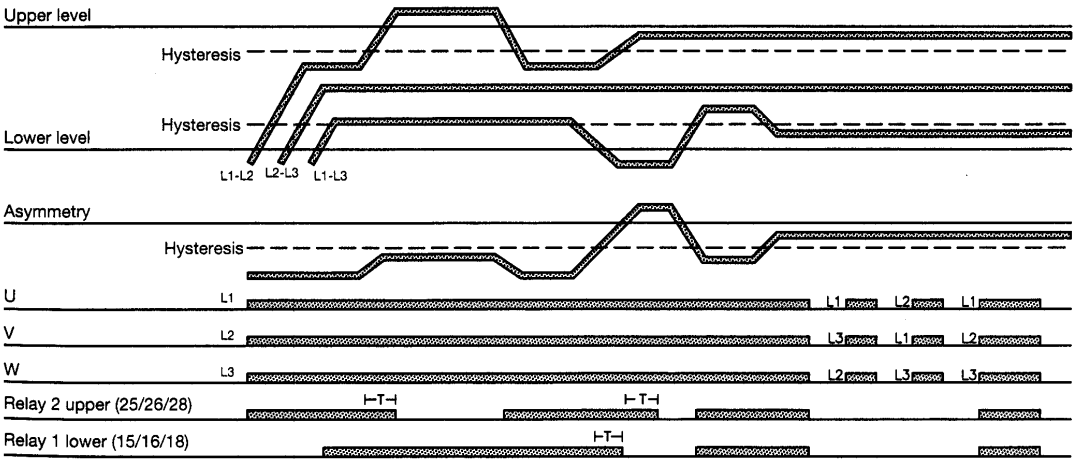
Time 2 setting (upper level)
Upper right knob:
Setting of time delay on absolute scale (0.1-30 s).

Asymmetry setting
Lower right knob:
Setting of asymmetry level on absolute scale.

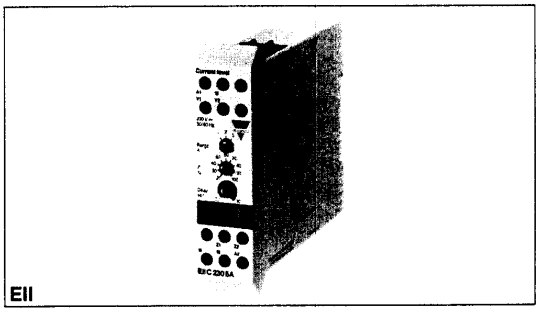
Table for Relay Position and LED-indication

Failure	Relay for lower level term. 15/16/18	Relay for upper level term. 25/26/28	Time delay	Left yellow LED (1) for lower level indication	Centre yellow LED (2) for upper level indication	Right green LED for power ON indication
The voltage rises above the UL set value	Remains ON	Switches OFF	Time 2 UL Time delay Adj. 0.1-30 s	Remains ON	LED starts flashing (during the time period) when the measured voltage exceeds the set value. Frequency 1 Hz. Switches off after delay.	Remains ON
The voltage drops below the LL set value	Switches OFF	Remains ON	Time 1 LL Time delay Adj. 0.1-30 s	LED starts flashing (during the time period) when the measured voltage drops below the set value. Frequency 1 Hz. Switches off after delay.	Remains ON	Remains ON
Asymmetry exceeds set level	Remains ON	Switches OFF	Time 2 UL Time delay Adj. 0.1-30 s	Switches OFF	LED starts flashing (during the time period) when the measured asymmetry exceeds the set value. Frequency 8 Hz. Switches off after delay.	Remains ON
Phase loss voltage drops below 70% of nom. range	Switches OFF	Switches OFF	No time delay	Both LED's flash in phase. Frequency 3 Hz. If L2 or L3 are lost no LED indication will occur. (L2 and L3 are supplying the system).	Both LED's flash in phase. Frequency 3 Hz. If L2 or L3 are lost no LED indication will occur. (L2 and L3 are supplying the system).	Remains ON
Phase sequence If phase sequence is wrong	Switches OFF	Switches OFF	No time delay	Both LED's flash alternately. Frequency 3 Hz.	Both LED's flash alternately. Frequency 3 Hz.	Remains ON
Overlapping of LL and UL set level	Switches OFF	Switches OFF	No time delay	Indicating actual fault.	Indicating actual fault.	Green LED starts flashing. Frequency 3 Hz.

Operation Diagram



1-Phase AC/DC Over Current Metering Relay Type EII



EII

- AC/DC over current metering (open circuit) relay
- Current measuring through internal shunt
- 3 position rotary switch for selection of measuring range
- Measuring ranges: 0.4 mA - 5 A
- Adjustable current limit on relative scale
- Adjustable time function (0.1-10 s)
- Adjustable hysteresis
- Programmable latching at set level
- Output: 5 A SPDT
- For mounting on DIN-rail in accordance with DIN/EN 50 022
- 22.5 mm Euronorm housing
- LED-indication for relay and power supply ON
- Galvanically separated power supply

Product Description

EII is a precise AC/DC over current metering relay and often used in applications where small loads have to be controlled. The advantage of using the latch function is that the output relay can be kept energized so that e.g. a short overload can be detected.

Ordering Key

EII C 230 20mA

- Housing
- Function
- Type
- Output
- Power supply
- Measuring range

Type Selection

Mounting	Output	Measuring range	Supply: 24 VAC	Supply: 115 VAC	Supply: 230 VAC
For DIN-rail	SPDT	0.4 - 20 mA	**EII C 024 20mA**	**EII C 115 20mA**	**EII C 230 20mA**
	SPDT	10 - 500 mA	**EII C 024 500mA**	**EII C 115 500mA**	**EII C 230 500mA**
	SPDT	0.2 - 5 A	**EII C 024 5A**	**EII C 115 5A**	**EII C 230 5A**

Input Specifications

Input Through terminals Y1 & Y2		current level	
Measuring ranges		**Internal resist.**	**Max. curr.**
20 mA type			
Rotary	1: 0.4 - 2 mA	50 Ω	50 mA
Switch	2: 1 - 5 mA	50 Ω	50 mA
Position	3: 4 - 20 mA	50 Ω	50 mA
500 mA type			
Rotary	1: 10 - 50 mA	3.9 Ω	600 mA
Switch	2: 40 - 200 mA	3.9 Ω	600 mA
Position	3: 100 - 500 mA	3.9 Ω	600 mA
5 A type			
Rotary	1: 0.2 - 1 A	0.05 Ω	6 A
Switch	2: 0.4 - 2 A	0.05 Ω	6 A
Position	3: 1 - 5 A	0.05 Ω	6 A

Output Specifications

Output		SPDT relay
Rated insulation voltage		250 VAC (contact/elect.)
Contact ratings (AgCdO)		μ (micro gap)
Resistive loads	AC 1	5 A, 250 VAC
	DC 1	5 A, 24 VDC
Small inductive loads	AC 11	2 A, 250 VAC
	DC 11	3 A, 24 VDC
Mechanical life		≥ 40 x 10^6 operations
Electrical life		≥ 10^5 operations (at max. load)
Operating frequency		≤ 7200 operations/h
Dielectric strength		
Dielectric voltage		2 kVAC (RMS)
Rated impulse withstand volt.		4 kV (1.2/50 μs)

Supply Specifications

Power supply		Overvoltage cat. III (IEC 664) (IEC 38)
Rated operational voltage through pins A1 & A2	024	24 VAC, -10/+15%
	115	115 VAC, -10/+15%
	230	230 VAC, -10/+15%
Voltage interruption		≤ 40 ms
Dielectric voltage		≥ 2 kVAC (RMS)
Rated impulse withstand voltage		4 kV (1.2/50 µs)
Rated operational power		1.5 VA

General Specifications

Power ON delay	< 2 s
Power OFF delay	> 200 ms
Reaction time	τ < 200 ms worst case reaction time may be up to 5 x τ Adjustable delay on operate built-in (0.1-10 s).
Accuracy	
Input	±10% (DC/AC @ 50 Hz)
ON delay	10 s, -1/+3 s on max. < 0.1 s on min.
Temperature drift	≤ 0.2%/°C (≤ 0.11%/°F)
Indication for	
Power supply ON	LED, green
Output ON	LED, yellow
Environment	
Degree of protection	IP 20
Pollution degree	3
Operating temperature	-20 to +50°C (-4 to +122°F)
Storage temperature	-50 to +85°C (-58 to +185°F)
Weight	140 g
Screw terminals	
Tightening torque	Max. 0.5 Nm acc. to IEC 947
Approvals	UL, CSA, SEV

Mode of Operation

EII measures both AC and DC over current through an internal shunt.

Example 1
(no connection between terminals Z1 & Z2)

The relay operates when the measured value exceeds the set level for more than the set delay time.

The relay releases when the current drops min. 5% below the set level (see hysteresis), or when power supply is interrupted.

Example 2
(connection between terminals Z1 & Z2)

The relay operates and latches in operating position when the measured value exceeds the set level for more than the set delay time.

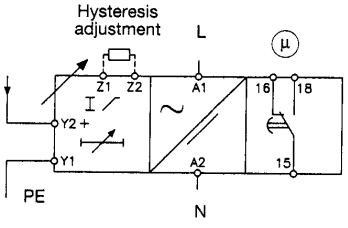
Provided that the voltage has dropped min. 5% below the set point (see hysteresis), the relay will release when the interconnection between terminals Z1 & Z2 is interrupted, or power supply is interrupted.

If the measured value is above the set level when power supply is applied, the relay will operate immediately with no time delay.

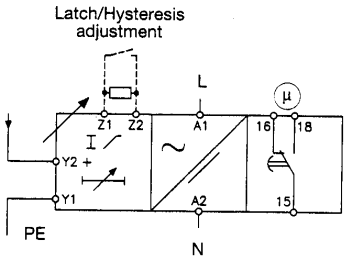
The yellow LED is flashing until the delay-time has expired or the measured value drops below the fixed hysteresis (5%) again.

Wiring Diagrams

Example 1



Example 2



Range/Level/Time Setting

Upper knob:
Setting of current range on rotary switch.

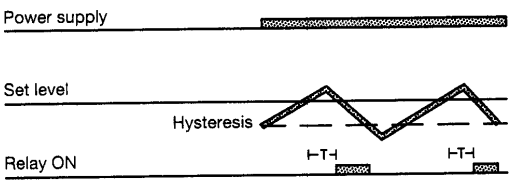
Centre knob:
Current level setting on relative scale.

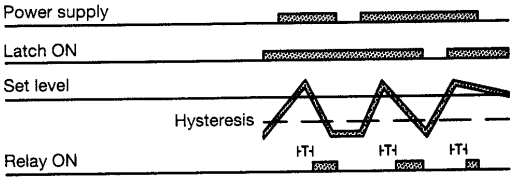
Lower knob:
Setting of ON delay on absolute scale(0.1-10 s).

Hysteresis
Normally 5%. The hysteresis can be extended by inserting a resistor between terminals Z1 & Z2.

Approx.
10%: 39 kΩ
25%: 12 kΩ
50%: 4.7 kΩ
75%: 2.2 kΩ
Latch: <500 Ω

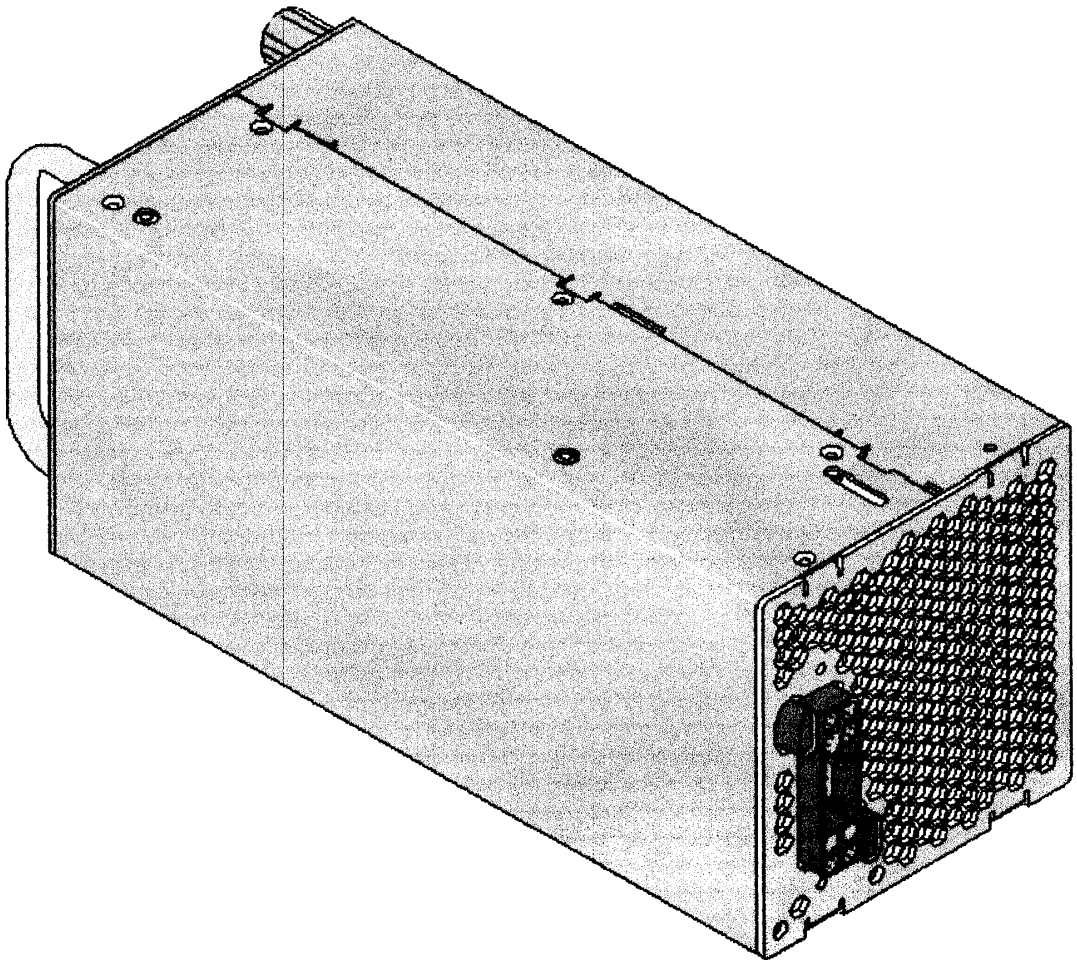
Operation Diagrams





Pioneer Magnetics

Troubleshooting Guide for the PM3329BP-5



Troubleshooting Guide for the PM3329BP-5

Products of Pioneer Magnetics Inc. are covered by
U.S. and foreign patents and/or pending patents.

PM3329BP-5 Troubleshooting Guide

Pioneer Magnetics Inc.
1745 Berkeley Street
Santa Monica, California 90404

Telephone: (800) 233-1745
(310) 829-6751
Fax: (310) 4533929

Pioneer Magnetics

Troubleshooting Guide for the PM3329BP-5

Table of Contents

Pioneer Magnetics

Troubleshooting Guide for the PM3329BP-5

List of Illustrations

Pioneer Magnetics

Troubleshooting Guide for the PM3329BP-5

List of Illustrations (continued)

Troubleshooting Guide for the PM3329BP-5

INSTALLATION INSTRUCTIONS

MOUNTING CONSIDERATIONS

The power supply is intended for use in commercial and industrial, controlled environment applications.

A reasonably dust-proof enclosure must be provided in the end use system, machine or equipment.

Ambient temperature less than 50°C, relative humidity less than 95%.

At installation, do not block the airflow generated by its internal ventilator fan.

Maximum mounting screw penetration is 3/32 inches (2.28mm), care should be exercised not to reduce internal creepage and clearance distances, nor to cause internal damages due to excessive penetration.

CAUTION:

The available energy at the secondary output studs exceeds 240 VA. Consideration is required for added operator accessibility.

INPUT VOLTAGE SELECTOR

The power supply is provided with dedicated input voltage as marked. The power supply has no on-off switch provision and is activated by the application of input power as rated, make sure that all output connections are properly made before application of input power.

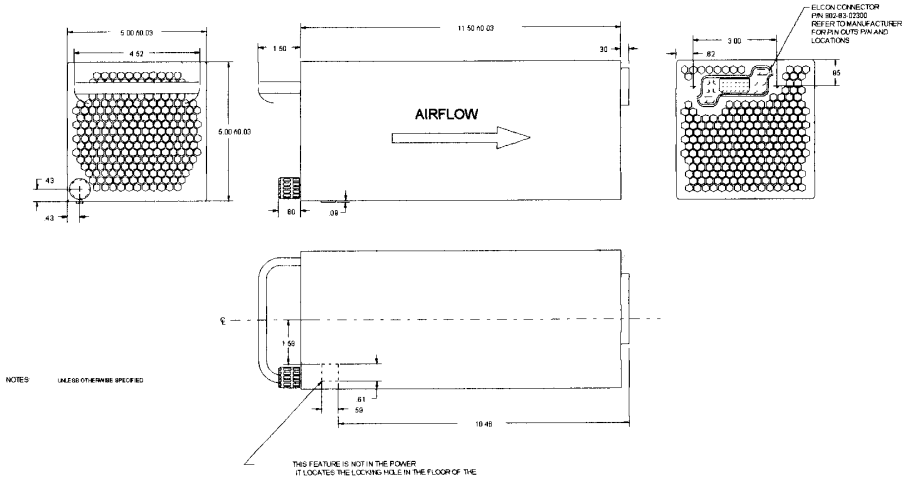
INPUTS AND OUTPUTS

After the supply has been installed mechanically, the connections to the input and output terminals are made by connecting cables of suitable gauge to the input and output terminals.

Note that main output terminals are connected internally to voltage sense circuitry and provide automatic local sense when no connection is made to the remote sense terminals provided at the Elcon connector.

VOLTAGE ADJUSTMENT

To verify output voltage, place a digital voltmeter across the output terminals. Do not install a load. Energize unit. When voltage appears, correct level by turning the voltage adjust pot to specified output voltage (clockwise to increase).



Pioneer Magnetics

Troubleshooting Guide for the PM3329BP-5

SPECIFICATIONS

OPTIONS

RANGE: 180 to 264 VAC. Frequency: 47 to 63 Hertz.
INPUT CURRENT: FULL LOAD: 12 Amps RMS.
INRUSH CURRENT: 25 Amps averaged over ½ cycle.
INPUT LEAKAGE: Input leakage current to ground 25 ma.
POWER FACTOR: 0.99 @ full power.
HARMONIC CURRENT: <5%.
Efficiency: Typically 80% at 185 VAC.
HOLD UP TIME: Minimum of 86 watt-seconds are available upon loss of input.
FUSING: Internal fuse located in input line.

OUTPUT

VOLTAGE: 48 VDC.
OUTPUT VOLTAGE ADJUSTMENT RANGE: ±10% of nominal output voltage.
POLARITY: Output is fully isolated and regulated. It may be referenced plus or minus as required.
CURRENT: 0 to 42 Amps.
REMOTE SENSING: Provides correct voltage at load with up to 0.5 volt total loop drop in the output line.
STATIC REGULATION: Line: ±0.25% over full line range. Load: See droop curve.
VOLTAGE STABILITY: ±0.1% after 30 minutes warm-up for a 24 hour period.
TEMPERATURE COEFFICIENT: ±0.2% ° FROM 0°C TO 50°C, P-P.
RIPPLE AND NOISE: Differential: 1% of 500 mV; (20 Hz to 20 MHz bandwidth) Common mode: 1.5 V p-p.
MINIMUM LOAD: No minimum load is required.
TURN ON DELAY: 1sec, maximum from application of AC line (when greater than or equal to 220 VAC.
OVERVOLTAGE PROTECTION: The standard OVP setting is 125% ±5% of nominal. OVP sensing is done at the output terminals.
OVERCURRENT PROTECTION: Constant current limiting set at 105% of rated output current.

ENVIRONMENTAL

OVERTEMPERATURE PROTECTION: Automatically shuts down and latches the unit the event of an over temperature condition.
AUDIBLE NOISE: 60 dBA maximum at 1 meter.
TEMPERATURE: Operating: 0°C to 50 °C at full load. Storage: -55°C to + 85°C.
HUMIDITY: 20% TO 95% non-condensing.
ALTITUDE: Operating: To 8,000 feet. Non-operating: To 30,000 feet.
VIBRATION: Operating: From 5 to 27Hz, 0.02 in double amplitude; from 27 to 500Hz, 0.75 G, 3 axes, 5 min per octave sweep, dwell 1 min at resonance. Non-operating: From 5 to 17Hz, 0.01 in double amplitude, from 17 to 500Hz, 1.5G peak; 3 axes, 5 min per octave sweep; dwell 0 min at resonance.
SHOCK: Operating: 5G, half sine, 11 mSec, 3 axes. Non-operating: 15G, half sine, 11 mSec, 3 axes.
COOLING: Forced air, internal fan. Airflow enters at the connector end.
EMI: Conducted: VDE071, Level A, 150KHz to 30MHz. Radiated: VDE0871, Level A.
SAFETY: UL 1950, CSA22.2 No. 950, TUV to EN60-950.

MECHANICAL

DIMENSIONS: Case 5" x 5" x 11.5" plus 0.30" for I/O connectors and 1.5" for handle.
WEIGHT: 9 lb.
MOUNTING: Designed to lock into matching rack.
I/O CONNECTORS: Elcon Lower Drawer Connector™ provides hot plug operation.

OPTIONS

POWER FAIL - TTL signal goes low at least 5 mSec before loss of regulation.
LOGIC INHIBIT and enable system can be turned on or off with a TTL compatible signal low switch contact.
CURRENT SHARING: Single wire current sharing.
UNDERVOLTAGE DETECTION: Monitors the output voltage when it drops below a specified level.

Troubleshooting Guide for the PM3329BP-5

Introduction to the PM3329BP-5 Power Supply

Reference Schematics: PFC Board - 122220 Main Converter - 122217

The input board is called the PFC (Power Factor Corrector) module, and the main converter board is called the Main module. The PFC module, utilizing a boost converter provides the 380 volt DC bus for the main module through connectors J9 and J8. The PFC module also provides the operating voltages for the fan and for the option circuits. The power supply uses a DC fan, so that the wide range of the (PFC) Power Factor Corrected AC input voltage does not affect the fan speed or air flow intensity.

Let's begin with the PFC board, since everything starts with the AC input voltage.

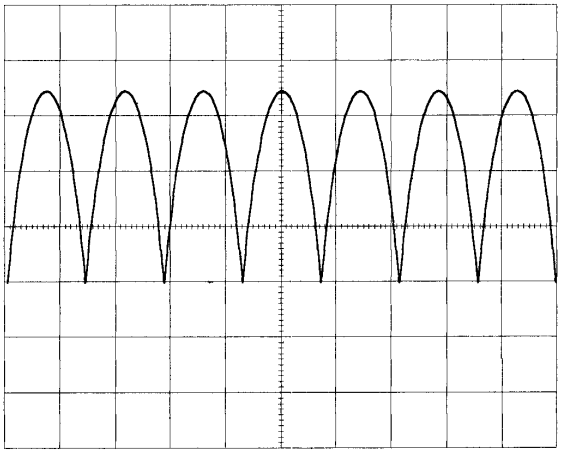


Figure 2-1

V(humps)

Scope probe to L3, pin 1
Scope Ground to 380 volt bus return

Time = 5 uSec/div
Amplitude = 50 v/div

This is the rectified unfiltered signal from the bridge rectifier BR!

The turn-on sequence begins with the charging up of the input capacitors, C11, C112, and C113, through the input bridge rectifier, BR1. The initial charging current of the input capacitors is limited by the inrush resistors, R7 and R21. When the voltage on the input caps reaches approximately 100 Volts, or the voltage across the inrush resistors reaches 30 volts, the Relay K1, closes, forcing the charging current through the relay contacts to prevent the inrush resistors from overheating and burning. During this time, the auxiliary circuit of the PFC provides an isolated 24 volts DC to the DC fan which begins turning. It also provides 15 volts DC for the control circuit of the main converter.

Introduction to the PM3329BP-5 Power Supply (continued)

The main converter does not turn on until the low line inhibit /enable sees about 300 volts on the 380 volt DC bus. The enable circuit senses the DC bus, and when the bus reaches 300 volts, an enable signal is sent from the PFC controller hybrid Z1, pin 17 (CE+) through the opto-coupler (U1) through J3, pin 1, turning on the main converter. Note that the returns of the PFC and the main converter are isolated by use of the opto-coupler. At this time the power supply will have regulated output.

To facilitate troubleshooting the PFC module, several critical waveforms are illustrated. The first four illustrations show the waveforms of the boost converter. The rest show the signals of the aux circuits.

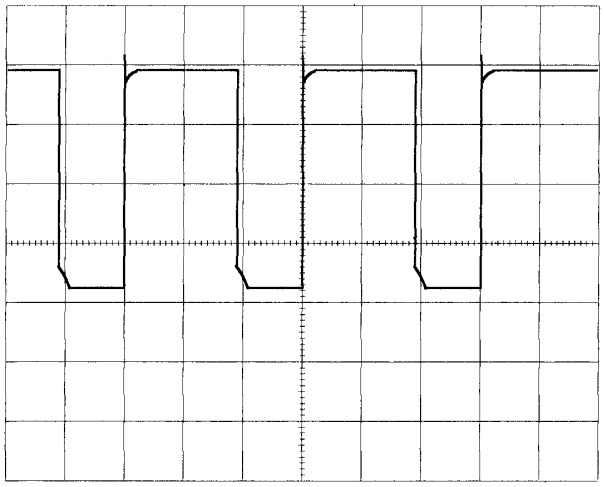


Figure 2-2

FET GATE DRIVE SIGNAL

Scope probe to base of Q2 & Q3
Scope ground to 380V bus return

- 0 volts

Time = 5uSec/div
Amplitude = 5 v/div

The FET gate drive signal is generated by the PFC controller hybrid, Z1-14 (GD). This signal uses the negative swing to -4 volts or so to ensure that the FET Q4, fully dumps the FET charge on turn off. This enhances the operation of the boost converter and protects the FET from excessive stress, which in turn means more reliability. If the FET gate drive signal is distorted or looks much different than pictured, the hybrid Z1 would be suspect.

Pioneer Magnetics

Troubleshooting Guide for the PM3329BP-5

Introduction to the PM3329BP-5 Power Supply (continued)

Speaking of the "hybrid" circuits, there are two on each module. They provide all of the controlling signals for the entire power supply. Special care must used when replacing them. Only recommended soldering procedures are to be used, especially in putting a new one in place. Excessive heat can kill many of the miniature components embedded on the hybrids. At this moment, note that it is extremely important that all of the components that are in this power supply be obtained from Pioneer Magnetics; see replacement part recommendations at the end of this document. Each component has been selected carefully for optimum performance and reliability. Z1 is the PFC controller. Z2 is the controller for the auxiliary circuit. Also a sync signal is generated at the clock, pin 10 of Z1 which is used both on the PFC board and the main converter. This sync signal keeps everything between different commons and levels throughout the entire power supply including the option circuits. The clock signal is illustrated in Figure 2-4 on the next page.

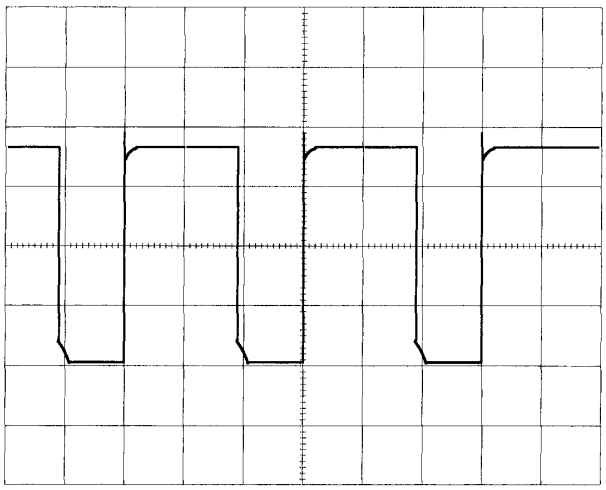


Figure 2-3

FET DRIVE SIGNAL

Scope probe to emitter of Q3
Scope ground to C15 negative

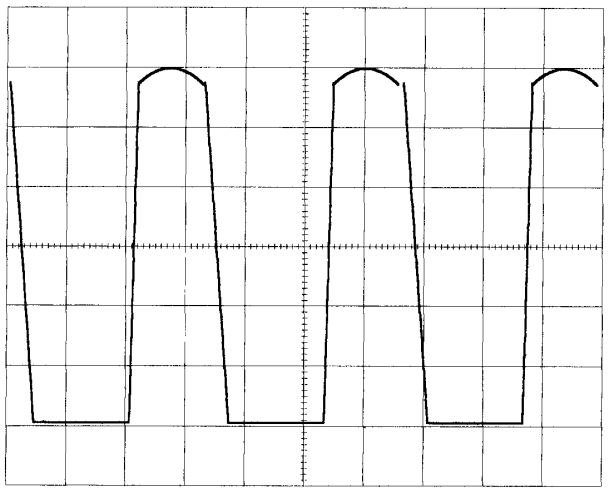
Time = 5uSec/div
Amplitude = 0.5v/div

← 0 volts

Even though every component on the PFC board is important ,and the failure of any one of them would jeopardize the functionality of the whole power supply, some of these components are extremely critical. Of course, the PFC controller hybrid must be functioning properly in order for anything else to respond accordingly. In troubleshooting the PFC board, as it is in any electronic device, it is sometimes very difficult to verify which is the cause of the failure because most electronic circuits are just a bunch of loops.

Introduction to the PM3329BP-5 Power Supply (continued)

We therefore have to look first at the component that is supposed to be the controlling device. In this case, it is definitely the PFC controller hybrid. I am not suggesting that you replace Z1 automatically, however it is a good starting point. The telltale distortion of the (V(humps) see figure 2-1) would probably indicate a defective bridge rectifier (BR1) or possibly one of the components of the EMI filter circuit. Also, if the fuse (F3) is open or if the inrush resistors (R21 & R7) are burned, then we would suspect the relay (K1) or again, the PFC controller hybrid. The critical components on the PFC board are: (*not necessarily in order of importance*) the PFC controller hybrid (Z1), the bridge rectifier (BR1), the FET (Q4), the FET (Q1), the aux supply hybrid (Z2), and the opto-coupler (U1). Also we need to include the diodes D1, D4, D5, and especially D9.



CLOCK SIGNAL

Figure 2-4

Scope probe to pin 10 of Z1
Scope ground to 380 V bus return

Time = 5uSec/div
Amplitude = 0.5v/div

← 0 volts

Another waveform which should be monitored is the FET switching signal at Q4. See Figure 2-5 on next page.

Another item to check is the + 5 volt DC reference from the PFC controller hybrid, Z1, at pin 16. This is directly connected to the auxiliary supply hybrid, Z2, at pin 9.

Introduction to the PM3329BP-5 Power Supply (continued)

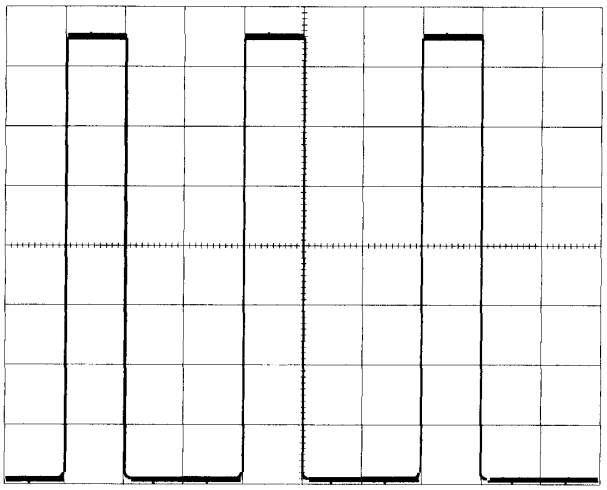


Figure 2-5

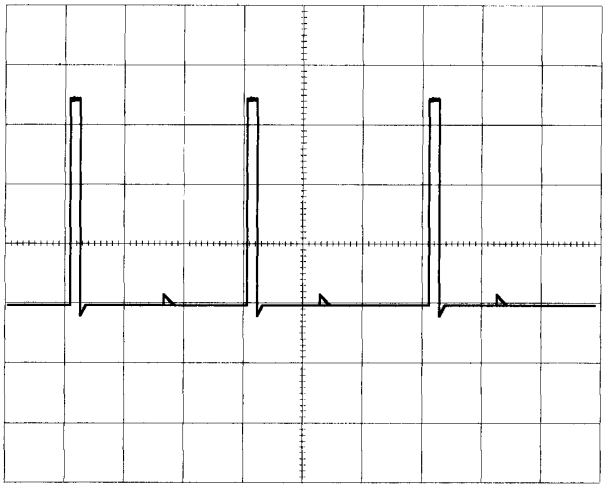
FET Switching Signal

Scope probe to the drain of Q4
Scope ground to the source of Q4

Time = 5 uSec/div
Amplitude = 50 v/div

← 0 volts

The auxiliary supply hybrid "aux", is responsible for the generation of the auxiliary voltages for the main converter board. Initially a 5 volt reference is provided by Z1 at startup; before the main converter can be turned on, it must have a 7 ½ volt enable level.



AUXILIARY DRIVE SIGNAL

Figure 2-6

Scope probe to pin 4 of Z2
Scope ground to the 380 V bus return

← 0 volts

Time = 5 uSec/div
Amplitude = 5 v/div

Troubleshooting Guide for the PM3329BP-5

Introduction to the PM3329BP-5 Power Supply (continued)

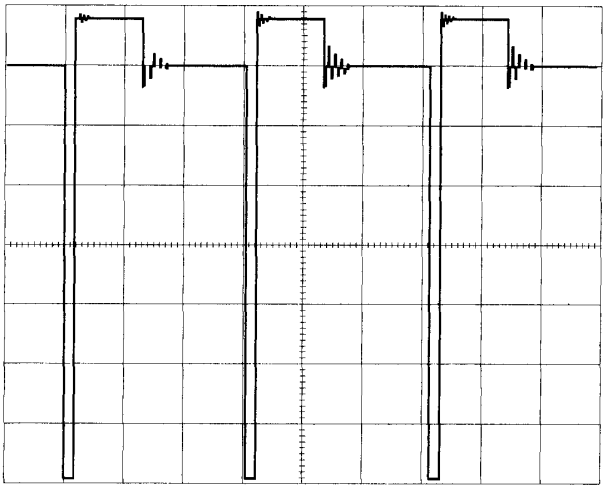


Figure 2-7

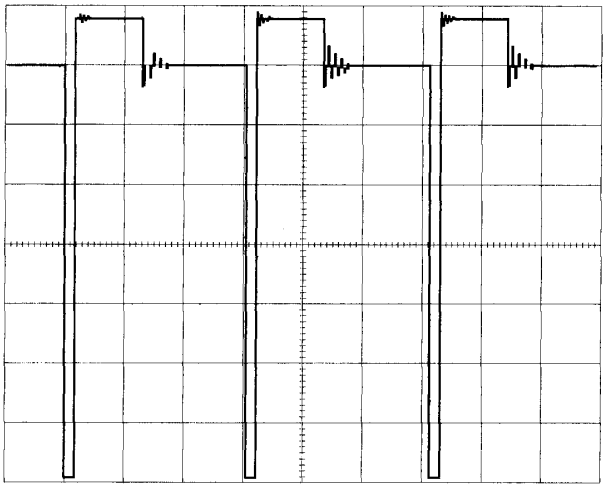
← 0 volts

AUXILIARY (AC) SUPPLY

Scope probe to the anode of D6
Scope ground to the cathode of D6

Time = 5 uSec/div

Amplitude = 20 v/div



AUXILIARY SUPPLY

Figure 2-8

Scope probe to the drain of Q1
Scope ground to the source of Q1

Time = 5 uSec/div
Amplitude = 50 v/div

← 0 volts

Introduction to the PM3329BP-5 Power Supply (continued)

The main converter module uses the 380 volt DC bus from the PFC module for primary power. The 380 volt DC bus connects via the connectors P9 [+] and P8 [-] to the sources of the power FETs, Q101 through Q104. These FETs are connected as two sets of switches. One set of FETs is turned on which causes current flow in the power transformer (T101) in one direction, then after some dead time, the other FETs are turned on causing current flow in the power transformer in the reverse direction. Note the waveform in Figure 2-9. The "dead time" between the sets of FETs is deliberate to prevent the situation in which both sets of FETs will be conducting at the same time. If this happens, something will be sure to fail, causing a small catastrophe in other parts of the main converter board and even on the PFC board.

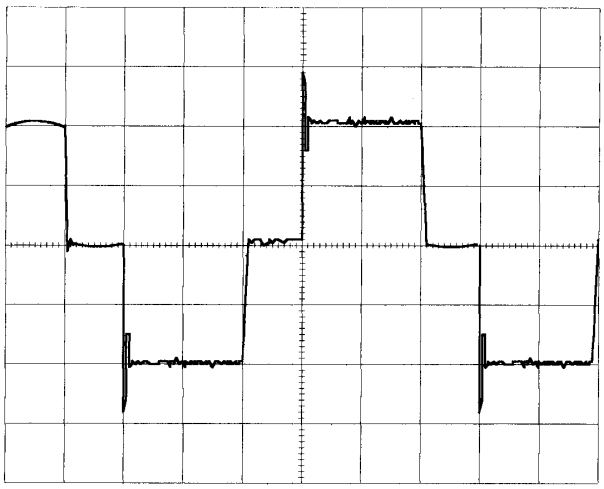


Figure 2-9

POWER TRANSFORMER OUTPUT

Scope probe to T101-5
Scope ground to T101-6

← 0 volts

Time = 5 uSec/div
Amplitude = 50 v/div

The power FETs (Q101 through Q104) are being driven by the flip-flop (U101); actually the drive signal is developed by the pulse width modulator which is one of the functions of the hybrid Z101. The flip-flop only acts basically as a steering circuit for the drive signal. See the power FET drive signals in Figure 2-11. The waveforms in this troubleshooting guide are close approximations of the way the waveforms that actually appear. They are mostly to show some semblance of the time and amplitude. You may find that if and when you look at these waveforms on your scope, that you think the power supply is not functioning properly.

Introduction to the PM3329BP-5 Power Supply (continued)

Figure 2-10

FET Switching Signal

Scope probe to the drain of Q101
Scope ground to the source of Q101

Time = 10 uSec/div
Amplitude = 50 v/div

← 0 volts

Figure 2-11

Power FET Drive Signals

Scope probe to pin 6 of U101
Scope ground to aux return

← 0 volts

Scope probe to pin 11 of U101

← 0 volts

Introduction to the PM3329BP-5 Power Supply (continued)

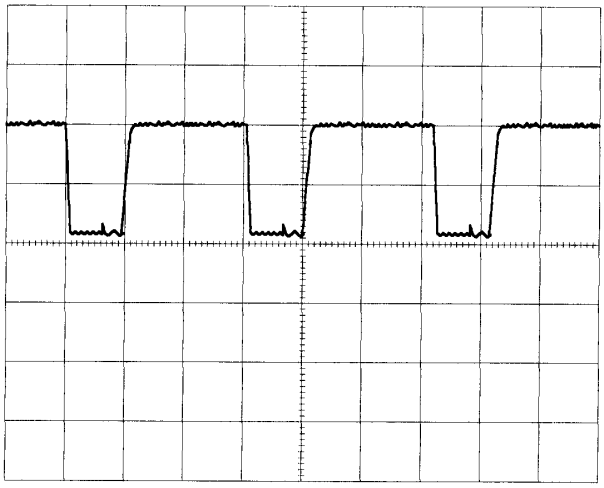


Figure 2-12

Power Pulses

Scope probe to pin 3 of U101
Scope ground to aux return

← 0 volts

Time = 5 uSec/div
Amplitude = 2 v/div

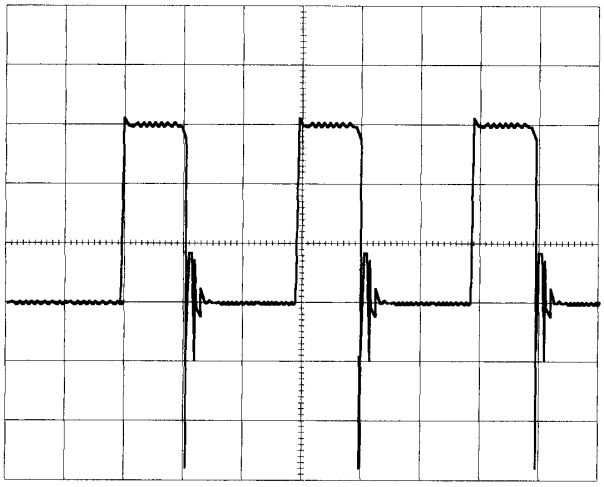


Figure 2-13

Output Choke Signal

← 0 volts

Scope probe to pin 1 of L101
Scope ground to aux return

Time = 5 uSec/div
Amplitude = 20 v/div

Introduction to the PM3329BP-5 Power Supply (continued)

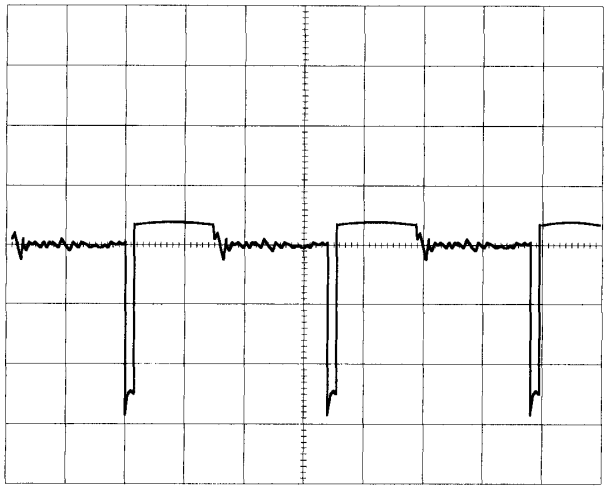


Figure 2-14

Auxiliary (aux) Flyback

← 0 volts

Scope probe to the anode of D110
Scope ground to aux return

Time = 5 uSec/div
Amplitude = 50 v/div

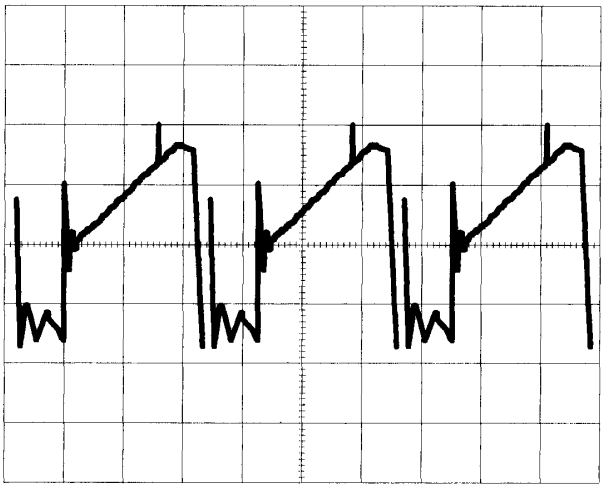


Figure 2-15

Burden Resistor Waveform
(used as a ramp)

Scope probe to pin 23 of Z101 (R106)
Scope ground to aux return

Time = 5 uSec/div
Amplitude = 0.2 v/div
← 0 volts

Introduction to the PM3329BP-5 Power Supply (continued)

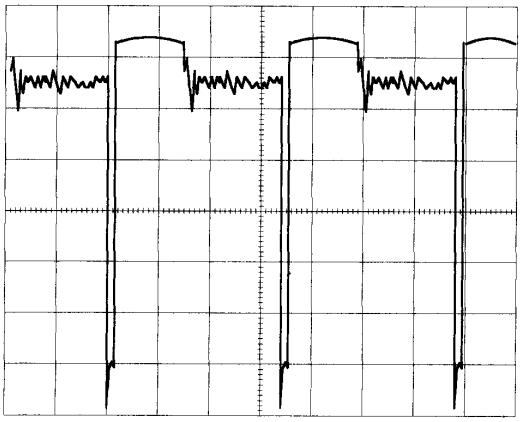


Figure 2-16

← 0 volts

Option (AC) Supply

Scope probe to Cathode of D112
Scope ground to logic return

Time = 5 uSec/div
Amplitude = 50 v/div

The options circuit which includes undervoltage detection, and logic inhibit, is not referenced to the return of the output bus because it requires a floating return for isolation for external connections.

The control for the functions on the main converter board are handled by the two hybrids, Z101 and Z102. The following functions for each hybrid are shown below.

Z101	Z102
current mode pulse modulator	undervoltage detection -128
current ramp signal	5 volt reference for the option
remote sense amplifier	logic inhibit
current sharing -6B disconnect	special voltage adjust -127
voltage ratio amplifier	
low line inhibit control	
current amplifier	
sync circuit	
current limiting	
overvoltage protection	

Pioneer Magnetics

Troubleshooting Guide for the PM3329BP-5

Bring-up Procedures for the PFC Board

1. Visual Inspection

    1.1 Check the PFC board closely for any evidence of physical damage: such as, broken connections, broken or damaged wires, damaged or burned pcb traces, loose or damaged connectors, poor solder joints or solder bridges. Ensure that the board is mechanically sound before testing. This board should be tested after any failure or repair on either the main (base board) or the PFC board.

2. Isolation Tests

    2.1 Measure the resistance between INPUT and OUTPUT, between INPUT and CHASSIS, and between OUTPUT and CHASSIS. Each resistance measurement must exceed 2 megohms. These tests should be performed again when the power supply has been reassembled with the case. To ensure compliance with universal safety standards, a High-Pot test should be performed on the complete power supply before placing the power supply into the rack.

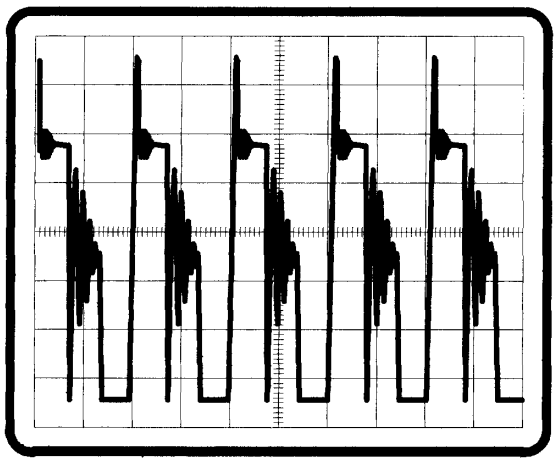
3. PFC Test

    3.1 Apply 60 volts DC from a "CURRENT LIMITED" DC power supply to the PFC input; the positive lead to E3 and the negative lead to E5.

    3.2 Connect the scope probe to the heatsink (drain) of Q1, with the ground clip to pin 1 of J8 (380 volt bus return). Check waveform for frequency and amplitude. See Figure 2-17.

    3.3 If the waveform is distorted, and the DC power supply is drawing excessive current, check the auxiliary drive signal at Z2, pin 4. If there is no signal or if the signal is very low, replace the hybrid module Z2. If the problem persists, replace the FET, Q1.

    3.4 If the waveform checks out approximately like the one in Figure 2-17, go to Part 2 on the next page.



Waveform at the drain of the FET, Q4

5 uSec/div

20 volts/div

The time should be approximately 11 ms

The amplitude should be approximately 150 volts

Figure 2-17

Bring-up Procedures for the PFC Board Part 2

4. Connect the DC fan to the connector at J3.

    4.1 If possible, use the DC fan that is connected to the power supply case.

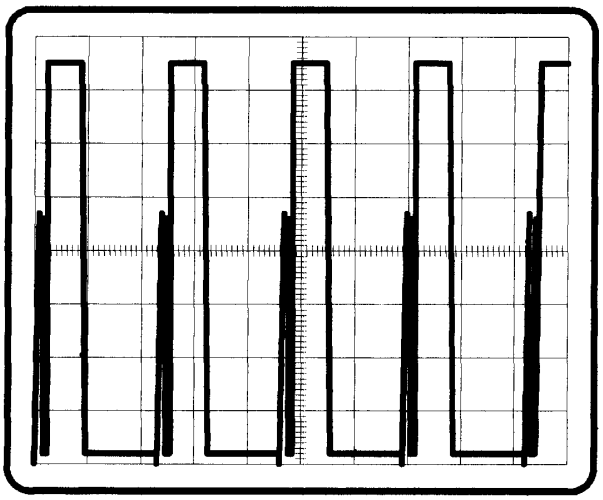
5. Solder connector at pins 1, 6, and 20 of Z1.

6. Apply 60 volts DC to the PFC input at E3 & #5.

7. Check the wave form at the FET Q4 (on screw #3). See Figure 2-18 on next page.

    7.1 Measure the PFC output at C11; should be approximately 375 volts DC.

    7.2 The waveform shown is only an approximation of the actual signal.



Waveform at Q4

5uSecs/div

50volts/div

The time is approximately 13 milliseconds. The amplitude approximately 375 VDC.

Figure 2-18

If the PFC board performs according to the prior tests, the next step is to connect the PFC board to the base board. It is extremely important that the PFC board function properly before connecting to the base board.

Comments

Troubleshooting Guide for the PM3329BP-5

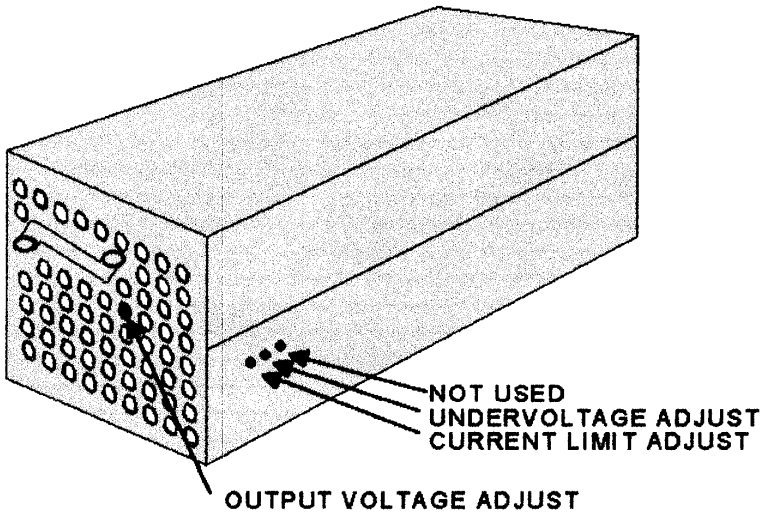


Figure 3-1

Incoming Test Procedures

1. Test Equipment Requirements

1.1 Variable AC source 0 to 270 VAC 3 KVA - typical - ®Powerstat
1.2 True RMS Digital AC Ammeter
1.3 True RMS Digital AC Voltmeter
1.4 Dual Trace Oscilloscope with 1 times 10 scope probe
1.5 Times ripple probe to be connected to the Elcon connector ... see number 1.11
1.6 Current probe to monitor input current waveform
1.7 Variable DC power supplies 0 to 60 VDC 0 to 2 amps with series diode
1.8 Digital DC Voltmeter
1.9 Digital DC Ammeter
1.10 Multimeter - typical - Tripplett
1.11 Elcon connector (female) model 298-08-01100
1.12 Dynamic Active Load Bank - 2500 Watt - typical - Transistor Devices

Incoming Test Procedures continued

2. Isolation Resistance Test - *This test must be done before any connections are made.*

2.1 Using an ohmmeter set to the times 10 ohms scale:
2.1.1 Measure for continuity between Chassis Pins 3 and 4 to any exposed part of the chassis, such as the handle.
2.1.2 Measure across the AC input pins 1 and 2 to verify that the input is not shorted.
2.1.3 Measure across the output pins 26/28 and 27/29 to verify that the output is not shorted.

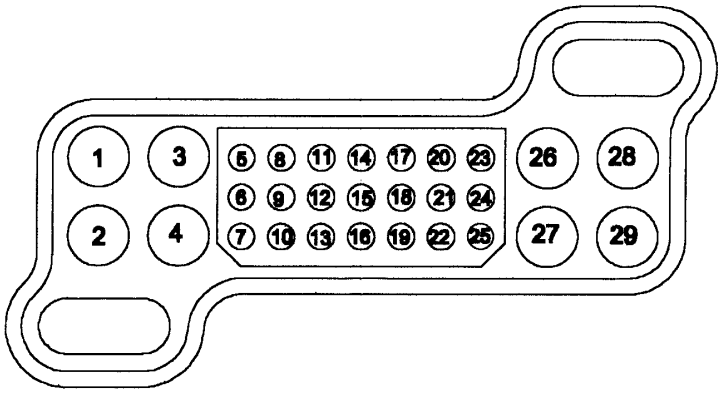
2.2 Using an ohmmeter set to the times 100K scale:
2.21 Measure from any part of the chassis to either input pin; must measure greater than 200K.
2.22 Measure from either input pin to either output pin; must measure greater than 200K
2.23 Measure from either output pin to the chassis; must measure greater than 200K.

Check to see that none of the pins on the Elcon connector are bent or damaged.

If you already have an incoming inspection procedure set up, you have the option to use either method.

Troubleshooting Guide for the PM3329BP-5

Incoming Test Procedures continued



Connector Pinouts:

48D42-2f-4d-6b-127-128-R

Elcon Lower Drawer Part No. 297-08-01100

Figure 3-2

Pinouts

Pin 1:	Input AC (Neutral)
Pin 2:	Input AC
Pin 3:	Chassis Ground
Pin 4:	Chassis Ground
Pin 6:	Unit Present Indication
Pin 7:	Unit Present Indication
Pin 17:	-6B, Current Sharing
Pin 18:	Not Used
Pin 19:	Logic Return
Pin 20:	-2F, Logic Inhibit

Pin 21:	Dummy Pin
Pin 22:	-128, Undervoltage Signal
Pin 23:	Remote Sense, Positive
Pin 24:	-127, Voltage Adjust
Pin 25:	Remote Sense, Negative
Pin 26:	Output Positive
Pin 27:	Output Negative
Pin 28:	Output Positive
Pin 29:	Output Negative

Options List

-2F	Logic Inhibit
-4D	Overtemperature Thermal Switch
-6B	Single Wire Current Sharing
-127	Special Voltage Adjust
-128	Undervoltage Detection Signal
-R	Reverse Airflow

Incoming Test Procedures continued

Connect the test equipment to the power supply under test. A test adapter for connecting to the Elcon connector will have to made, including scope probe connection. A current probe for the input current waveform is not shown, however, a "clamp-on" type of current probe may be used.

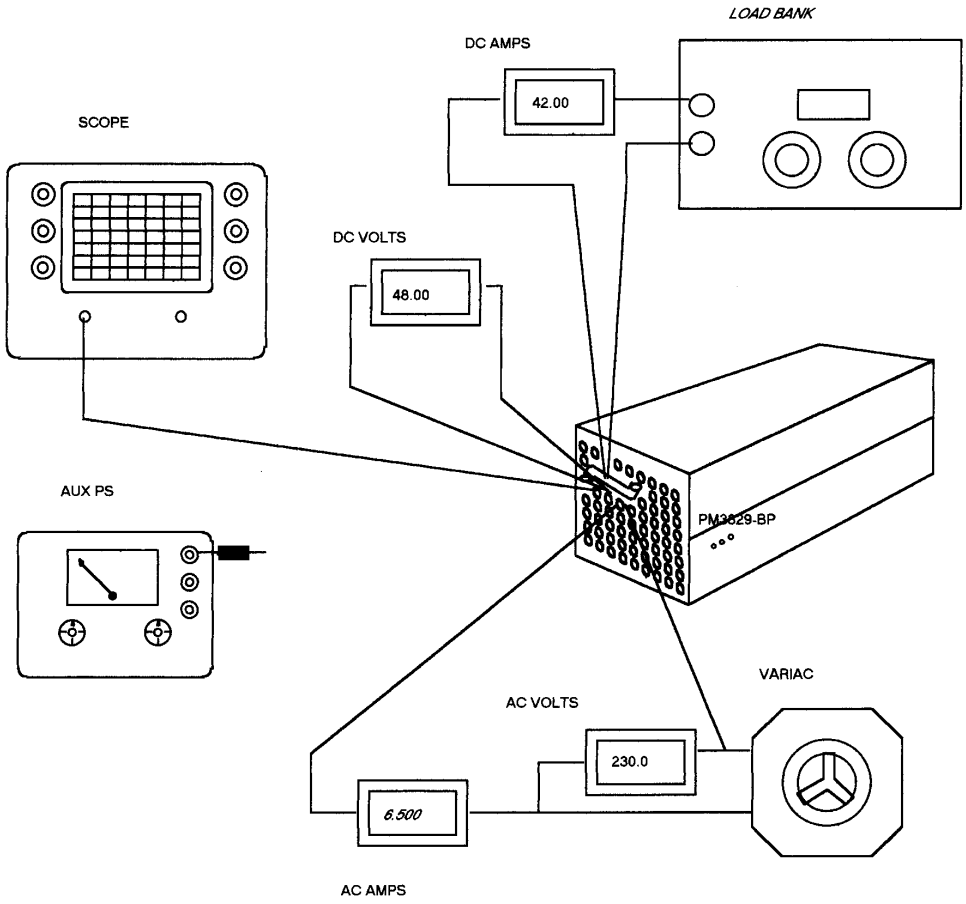


Figure 3-3

Incoming Test Procedures continued

3.1 Once all of the connections have been made on the unit under test , verify that all connections are secure and of the correct polarities.

3.2 Adjust the output load to 0 amps.

3.3 While monitoring the AC input current, turn on the switch of the variable AC source and gradually increase the input voltage ... the fan should start turning at about 100 volts AC in ... if the input current is normal, continue adjusting the input voltage ... the output should come on at approximately 170 volts .... continue increasing the input AC voltage to nominal, 230 volts AC.

3.4 Apply a small load and verify and adjust the output voltage to nominal value, always observing the AC input current. This is a good indicator if anything is drastically wrong.

3.5 Increase the load current to the rated level (42 amps). Check each meter and the scope waveform for anything out of the ordinary .... the input current should not exceed 10 amps. Once the AC input voltage is at nominal, verify that the output voltage does not change significantly with changes in load or line.

3.6 Test 1: Overload Test - Set the AC input to 230 volts.

3.6.1 Adjust the load current to maximum and verify that the output current does not exceed 48.3 amps.

3.7 Test 2: Low Line Test - Set the load current to 42.0 amps.

3.7.1 Lower the AC input to 175 volts and verify that the output voltage does not drop below 47.0 volts.

3.8 Test 3: Voltage Adjust Range - Set the AC input to 230 volts - adjust the load current to 30 amps.

3.8.1 Verify that the output voltage will adjust to 47.0 volts and to 49.0 volts. Set the output voltage back to 48.0 volts after the voltage adjust range test.

Incoming Test Procedures continued

3.9 Test 4: Regulation and Ripple.

3.9.1 Adjust the load current to minimum load (0.3 amps).

3.9.2 Set the AC input to 180 volts; measure and record the output voltage and output ripple and spikes.

3.9.3 Set the AC input to 264 volts; measure and record the output voltage and output ripple and spikes

3.9.4 Adjust the load current to nominal (42.0 amps).

3.9.5 Set the AC input to 180 volts; measure and record the output voltage and output ripple and spikes.

3.9.6 Set the AC input to 264 volts; measure and record the output voltage and output ripple and spikes.

3.9.7 The output ripple spikes should not exceed 480 millivolts peak to peak under all of the above conditions.

3.9.8 Subtract the lowest output voltage measurement from the highest output voltage measurement. The maximum output deviation should not exceed 250 millivolts.

3.10 Test 5: Dynamic Test: Set the AC input to 230 volts.

3.10.1 Set the static load to 31.5 amps - Step load to 10.5 amps.

3.10.2 Switch between the static load and full load (42.0 amps) and verify that neither the positive or negative overshoot exceeds 960 millivolts.

3.11 Test 6: Overvoltage Protection - Set AC input to 230 volts - set the load current to 0.3 amps.

Incoming Test Procedures continued

3.11.1 Monitor closely while increasing the output voltage until it reaches the overvoltage trip point and drops to 0 volts. The output should trip between 52.0 and 54.0 volts. It may be necessary to connect a current limited DC power supply across the Elcon pins 24 and 27. Note the special voltage adjust (-127 option). After the overvoltage trips, the power supply will have to recycled; turn off the AC input, remove the overvoltage condition, wait 30 seconds and turn the power supply back on. Verify that the output comes up normal.

3.12 Test 7: Logic Inhibit.

3.12.1 Apply + 2.0 volts to the inhibit, Elcon pin 20, the return to logic return, pin 19, and verify that the output is disabled.

3.12.2 Remove the voltage to the inhibit, Elcon pin 20, and verify that the output is disabled.

3.12.3 Short Elcon pin 20 to pin 19, and verify that the output is enabled.

3.13 Test 8: Current Sharing Check (-6B).

3.13.1 Open circuit voltage test - Adjust the AC input to 230 volts and adjust the load current to 0.3 amps.

3.13.2 Measure the voltage between the -6B output on Elcon pin 17, and the output negative remote sense on Elcon pin 25. Verify that the -6B output is between 2.57 and 2.67 volts.

3.13.3 Adjust the load current to 42.0 amps and verify that the -6B output is between 4.95 and 5.05 volts.

3.13.4 Quick disconnect test - connect a 7.5K, 1% resistor between the -6B output, with the load current at 42.0 amps and the AC input at 230 volts, turn of the input power and measure the resistance between pin 17 and pin 25 of the Elcon connector. The resistance should read 7.5K, ± 5%.

Incoming Test Procedures continued

3.14 Test 9: Special Voltage Adjust (-127).

3.14.1 Connect the external current limited DC power supply positive lead to pin 24 of the Elcon connector, with the negative lead to the negative output pin 27 or 29.

3.14.2 Adjust the external DC power supply to 0 volts and verify that the output of the unit under test measures between 11.85 and 12.15 volts.

3.14.3 Adjust the external DC power supply to 2.5 volts and verify that the output of the unit under test measures between 29.90 and 30.10 volts.

3.14.4 Adjust the external DC power supply to 5.0 volts and verify that the output of the unit under test measures between 47.90 and 48.10 volts.

3.15 Test 10: Undervoltage Warning Signal (-128).

315.1 Adjust the load current to 1 amp, set the AC input to 230 volts.

315.2 Apply 2.0 volts to pin 20 of the Elcon connector with the return to pin 19.

315.3 Monitor pin 22 of the Elcon connector and verify that the signal goes from "logic high" to "logic low" when the unit is disabled.

3.16 Test 11: Power Factor Corrector Operational Test.

3.16.1 Set the AC input to 230 volts, adjust the load current to 42.0 amps.

3.16.2 Using a current probe on one lead of the AC input line measure and observe the input current waveform. The input current waveform should be a smooth waveform. See examples in figure 3-4 on the next page.

This concludes the incoming test. Remember to set the output voltage to 48.0 volts.

Incoming Test Procedures continued

Input Current Waveform

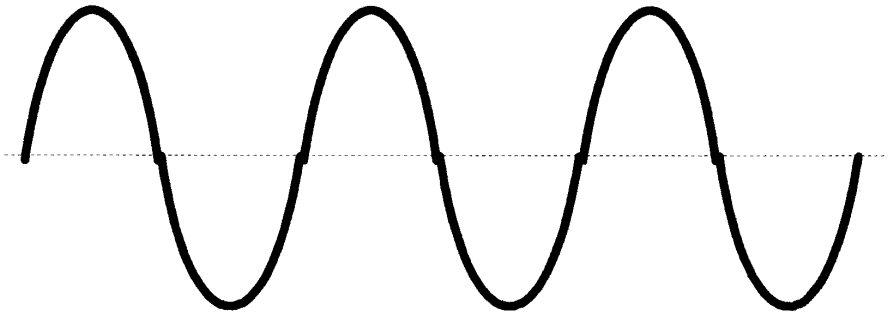
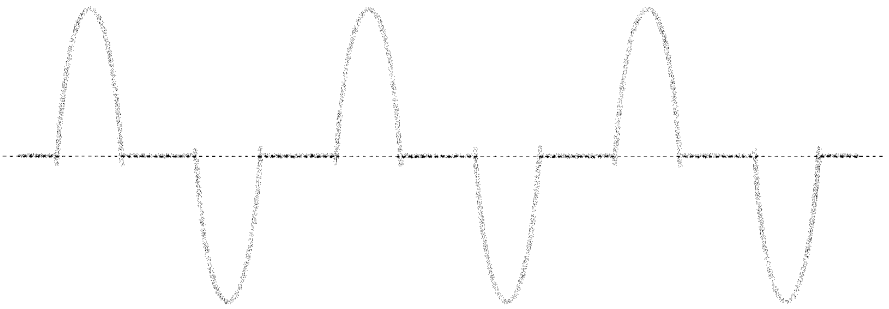


Figure 3-4

GOOD



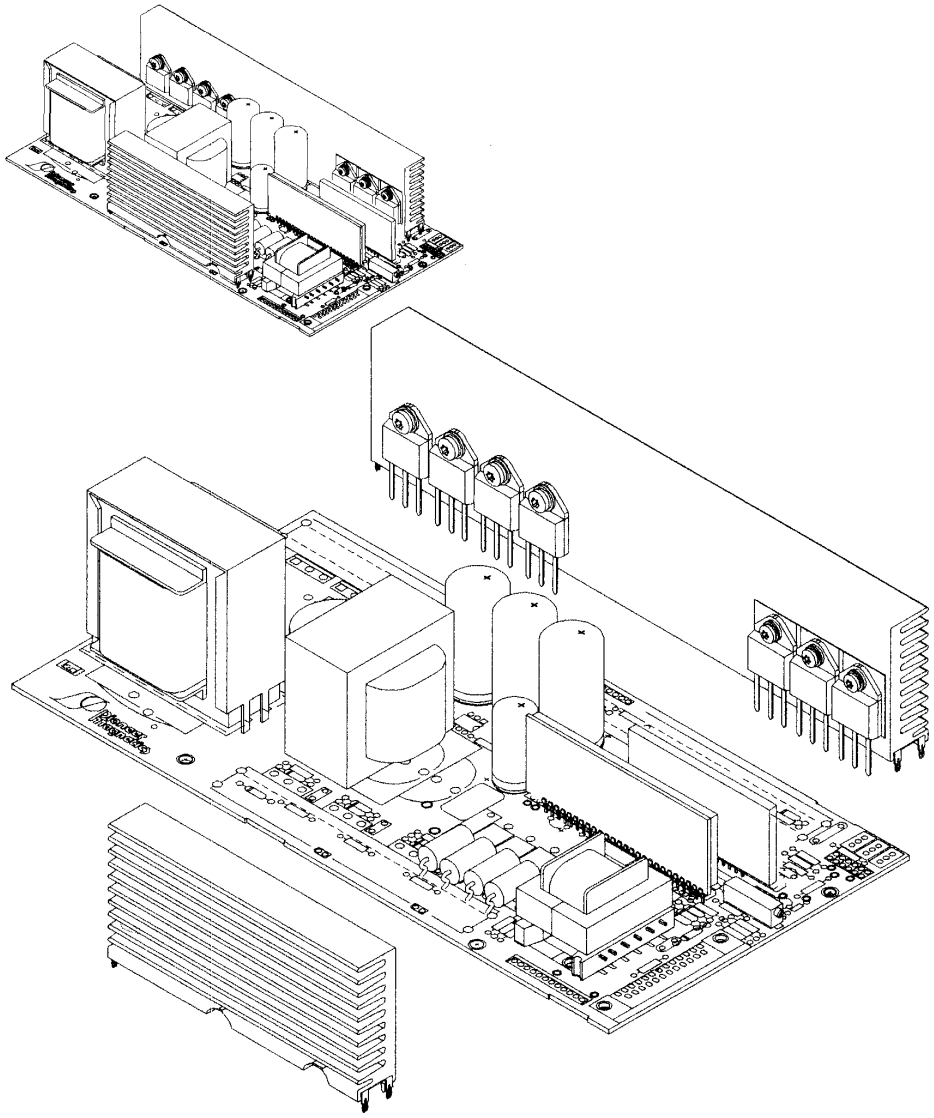
BAD

Troubleshooting Guide for the PM3329BP-5

Troubleshooting Tips

"Let's look inside this power supply" Figure 4-1

Main Converter



Troubleshooting Guide for the PM3329BP-5

Troubleshooting Tips (continued)

Figure 4-2 Main Converter PCB

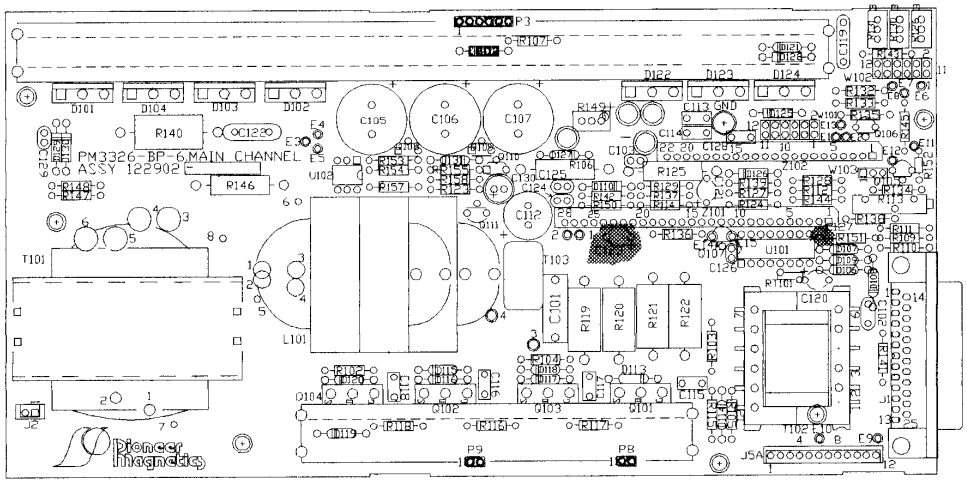
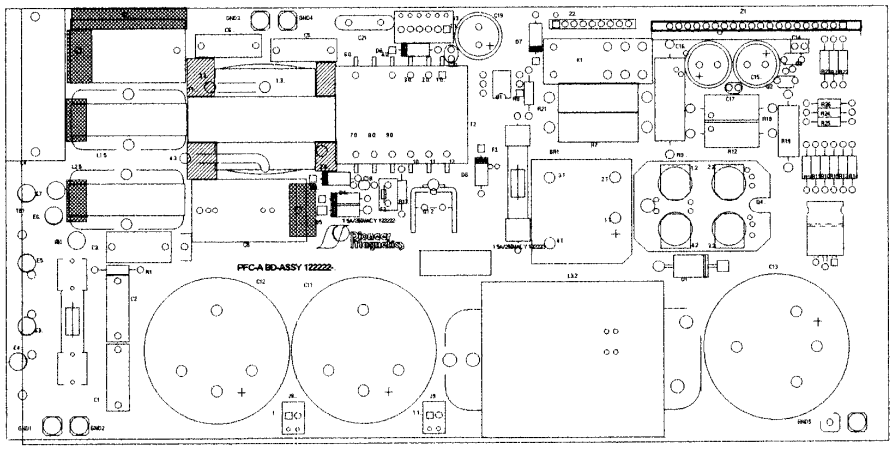


Figure 4-3 PFC PCB



Troubleshooting Tips (continued)

Reference Schematics: Base -122217 PFC - 122220

It has been said, that successful troubleshooting is a special talent. I know some technicians who can't tell the difference between forward drop and leakage current, but can "smell out" the problem in an amazingly short time. The point here is that good troubleshooter utilizes all of his senses The sound, the smell, the feel of the air flow, or the sight of watching a meter needle pinned against the manufacturer's label, all of the senses that a person possesses can be used in troubleshooting.

In the power supply, the PM3329BP-5, the failures though few, usually are something mechanical; something loose, a piece of foreign material inside the unit, a broken terminal or an installation problem. These are the first things that are noticed, long before a defective diode or IC. However, the purpose of this troubleshooting guide is not to show how to troubleshoot, but to point out some of the most likely failures based on the symptoms.

Looking a some of the mechanical considerations;

First of all, all of the screws that are used on this power supply are torx screws. When they are removed for troubleshooting or inspection, a new torx screw of the same size and length shall be used. Do not under any circumstances, reuse any of the torx screws or replace it with another type of screw.

Screw Size and Description	Where used
FLAT HEAD TORX M4-0.7 X 8 MM	FOR Q4 ON THE PFC BOARD
FLAT HEAD TORX 4-40 X 3/16	FOR THE POWER SUPPLY COVER
FLAT HEAD TORX 4-40 X 5/32	USED ON THE PFC BOARD
PAN HEAD TORX 4-40 X ¼	USED ON THE MAIN CONVERTER BOARD

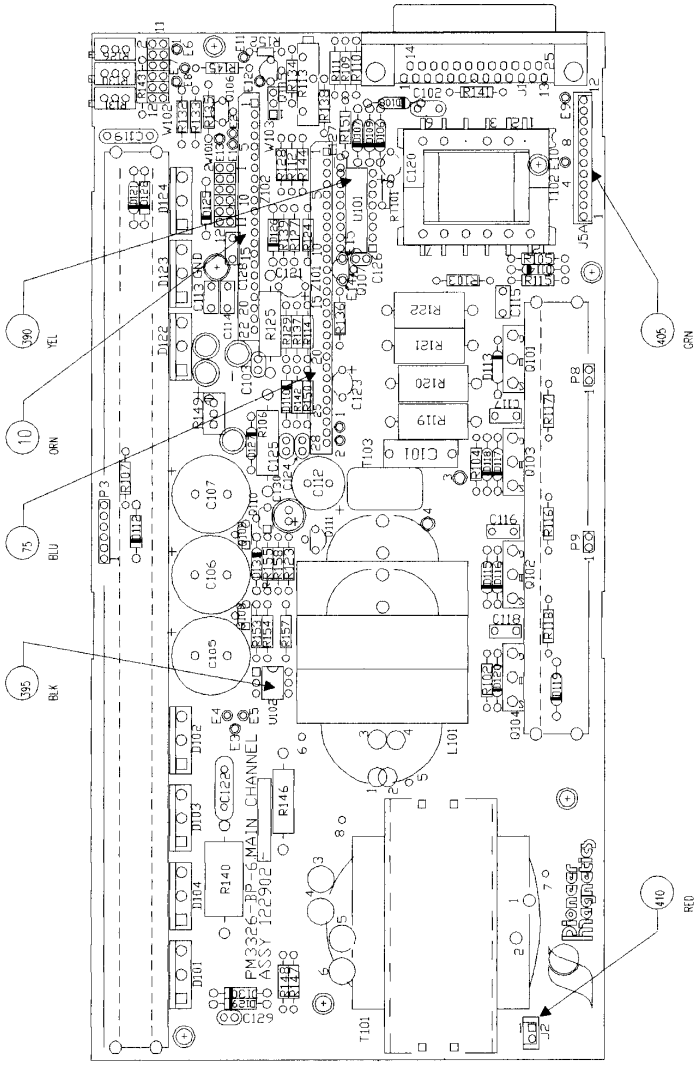
The case contains a number of special insulators. If one of these insulators has to be removed, make sure that the insulator does not get torn or distorted. It is extremely important that the insulators as well as any other materials that were installed in the power supply be replaced in a good condition and properly located.

See figure 4-4, and figure 4-5 on the following pages for some of the mechanical layouts.

Troubleshooting Guide for the PM3329BP-5

Troubleshooting Tips (continued)

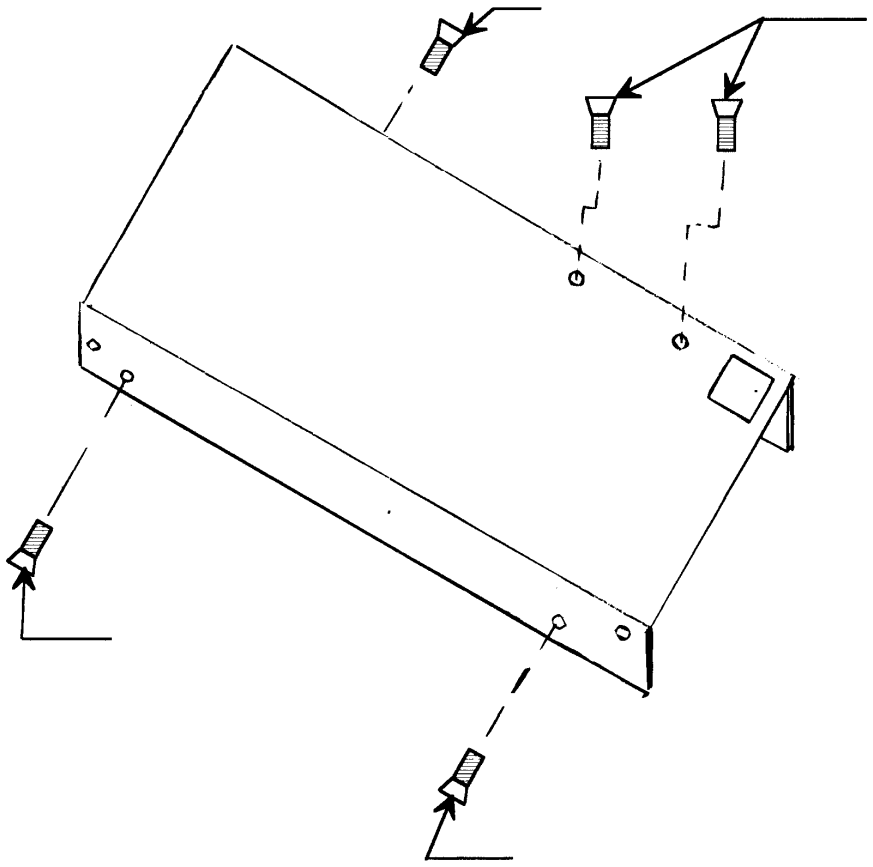
Figure 4-4



Troubleshooting Tips (continued)

Figure 4-5

1. INSTALL SCREWS TO SECURE PFC ASSY TO CHASSIS AS SHOWN.
2. TORQUE ALL SCREWS TO 6 INCH POUNDS.



Troubleshooting Guide for the PM3329BP-5

Troubleshooting Tips (continued)

Power Supply With the Cover on

Failure	Suggestions	Board
Output Regulation	Loose connection on the output busbar, check for bent pins at the remote sense pins on the Elcon connector, check that there is solid contact between the unit and the receptacle. Make sure that the fan is turning and the airflow is normal. Check the input voltage and the input current. If all of these are OK, the unit should be moved to an area where the cover can be removed.	Elcon
Draws High Input Current, more than 10 amps.	Check to see that the input voltage is at the proper level, this power supply requires 230 volts AC. Check for burning smell. Check for strange noises. Is the current pulsing?	
Fan noisy	Fan blade possibly hitting the insulator or the fan wires. This will have to be opened to verify.	Main Board
Output won't come up or comes on briefly, then shuts off.	Check the output voltage adjustment pot. Turn the pot all the way counter-clock-wise and recycle the unit. Also check the remote sense connections at pins 23 and 25 of the Elcon connector.	Main Board
The power supply shuts off after being on for some period of time	Check the fan, this is a sign that the unit is overheating. If the fan seems to be OK, something inside the power supply is probably overheating or the thermal switch is faulty. This unit will have to be opened to verify	Unit
Fan not turning	Check for fan blade being hindered by something like the insulator or fan wires	
Audible noise	Check for loose connections	Unit

Troubleshooting Guide for the PM3329BP-5

Troubleshooting Tips (continued)

Power Supply With the Cover Off

Failure	Suggestions	Board
Output regulation	Check for loose connection at the output busbar. Check for loose screws on the output capacitors. Loosen the output cap screws, then secure. Check the FET switching signal at the drain of the FET, Q101, while varying the output load current. See the waveform example in figure 2-5 on page 5. If the signal is low or distorted, check the power FET drive signals at U101, pins 6 and 11. If this looks OK, replace Q101.	Main Board
Draws high input current	Check D110, D106, D109, and U101. Also check Q101-Q104.	Main Board
High output	Check U102, replace Z101	Main Board
Current limit out of range	Replace Z101	Main Board
High output ripple	Check connections on output caps, C105-C107	Main Board
Fan not turning	Loose connection at J2 and P2. Check voltage across C19 at D8. Check the signals at Q1 and the anode of D6	PFC
Fan noisy	Check to see if the fan blade is touching the fan wires or the insulator.	Main Board
Power section failure	Check the power FETs, Q101-Q104, diodes D113-D120. Check D1, D11, D14, Q4 and Q5 on the PFC board	Main Board

Troubleshooting Tips (continued)

Power Supply With the Cover Off

Failure	Suggestions	Board
Audible noise	Check for loose connections, especially the output caps.	Main Board
Output won't come up or comes on briefly, then shuts off	This is more than likely an overvoltage problem. If the voltage pot did not fix the problem This is sometimes called output runaway. Check the thermal switch. Replace Z101.	Main Board
The power supply shuts off after being on for some period of time	Check the thermal switch. Replace Z101	Main Board
No output, burning smell	Usually an inrush problem, check for burned resistors R21 and R7. Check to see if F3 is open. If the resistors are burned, it means that the relay (K1) is not operating or if the relay is OK, then replace Z1. Also check BR1, the input bridge rectifier.	PFC
380 volt Bus low	Check the bridge rectifier, BR1, check Q2 and Q3, Check Q4, and D9. Also check the diode D1. Disconnect the PFC from the main converter see if the bus is still low, if not, check Q101-Q104 on the main board	PFC or Main Board
Logic inhibit does not work	If connections are OK, replace Z102.	Main Board

Troubleshooting Guide for the PM3329BP-5

Troubleshooting Tips (continued)

Please note that most of the failures are caused by mechanical problems as opposed to component failures. Many times the components that fail are usually being subjected to unnecessary stresses due to blocking of air flow, dirty environments and just plain bad handling. Following is a quick reference guide of places and parts on this power supply that will be the most likely cause of the failure.

Where is the problem?

Current limit	hybrid Z101
Undervoltage Detection	hybrid Z102
Overvoltage Detection	hybrid Z101
Overheating	Thermal switch
Regulation	hybrid Z101
Logic Inhibit	hybrid Z102
Output ripple and noise	output capacitors
Current sharing	hybrid Z101
Special voltage adjust -127	hybrid Z102
Power section failures	Q101-Q104, D113-D120

Telephone Support during business hours 8:00 A.M. to 4:00 P.M. PCT

Doug Hansen	Telephone: (310) 828-0390	Fax: (310) 453-3929
Spare Parts	Telephone: (310) 829-6751	Fax: (310) 453-3929

Pioneer Magnetics

Troubleshooting Guide for the PM3329BP-5

Recommended Spare Part List Part 1 PFC Board

Note: *Quantities are listed per 50 power supplies*

Component	Designator	PMI Part No	Quantity
PFC Control Hybrid	Z1	122104-3	5
PFC Aux Supply Hybrid	Z2	122105	5
Capacitor 470uF 450V	C11, C12, C13	512108	6
Capacitor 120pf 1000V	C18	515064-104	5
Capacitor 0.1uF 1000V	C21	515064-121	5
Diode 1A 600V	D3,D4,D6,D7,D8	500177	10
Diode 3A 600V	D1	522044	5
Diode Heatsink Assy	D9 & BR1	122391	5
Zener Diode 75V 35W	D5	525095	5
Fuse 20A 250V	F1	533033	5
Fuse 1.5A	F3	533047	10
Relay 20A 12V Coil	K1	537010	5
FET Heatsink Assy	Q4	122425	5
Transistor NPN	Q2	547066	5
Transistor PNP	Q3	547067	5
Resistor 5W 10% 7.5 ohms	R7, R21	542001	10
IC (H11AV1A)	U1	528149	5

Note 2: *All screws used on the PM3329BP-5 must be torx screws; these screws are not to be reused under any circumstances, if any screws are removed, throw them away.*

Troubleshooting Guide for the PM3329BP-5

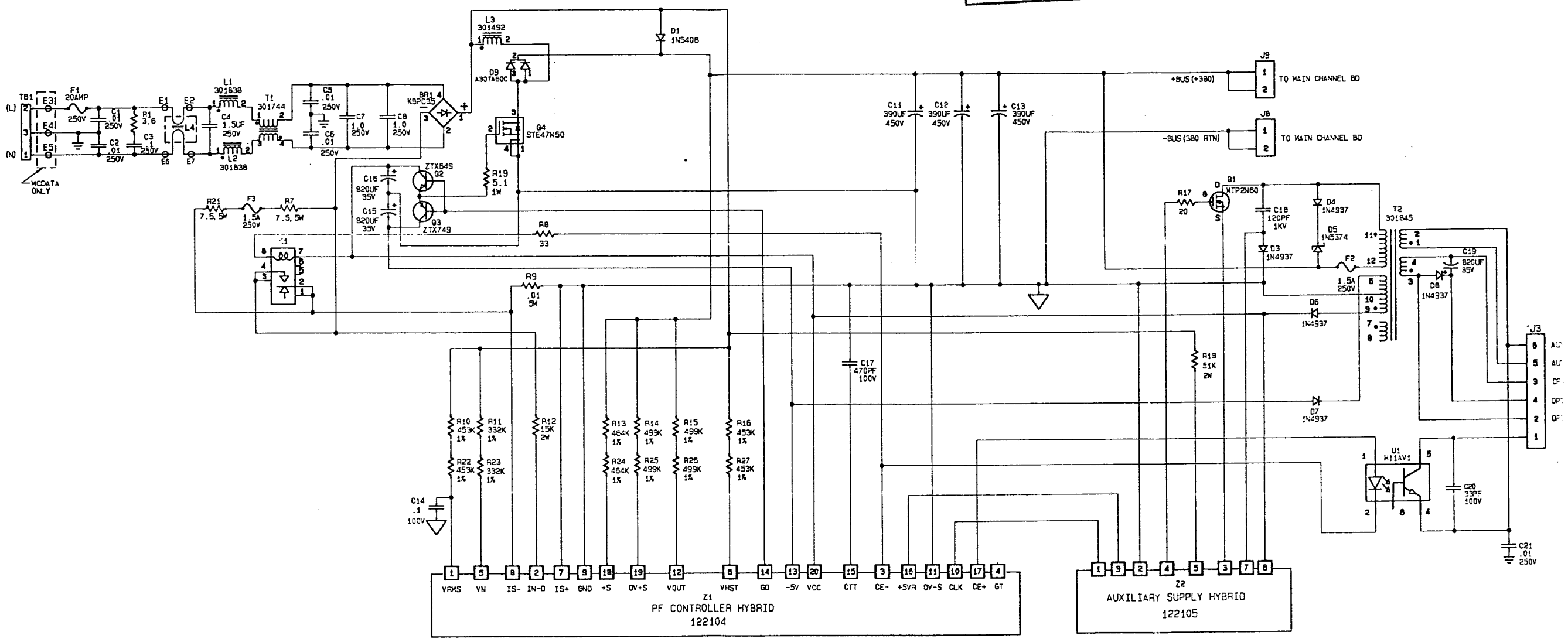
Recommended Spare Part List Part 2 Main Converter

Note: *Quantities are listed per 50 power supplies*

Component	Designator	PMI Part No	Quantity
Control Hybrid	Z101	122160	5
Option Hybrid	Z102	122161	5
Capacitor 1000 uF63V	C105, C106, C107	514079-108	6
Capacitor 680 pF 500V	C101	515070-681	5
Diode Heatsink Assy	D101-D104	122537	5
FET Heatsink Assy	Q101-Q104	123023	5
Diode 1A 20V	D106-D109, D127	522048	6
Diode 1A 600V	D110, D129, D130	500177	6
Diode/Resistor Assy	D112	117627	5
Zener Diode 15V 1W	D113-D120	525075	20
Thermistor PTC 33 ohms	RT101	545012	5
IC (UC3706N)	U101	528386	5
IC (4N28)	U102	528112	5

REVISIONS

REV	ECO		DATE	APPR
A		PRODUCTION RELEASE	9-15-93	J.S.
B	19218	SEE ECO	1-10-94	C.L.
C	19305	SEE ECO	3-15-94	C.L.
D	19389	SEE ECO	5-31-94	C.L.



NOTES: UNLESS OTHERWISE SPECIFIED

1. CAPACITOR VALUES ARE IN MICROFARADS.
2. RESISTOR VALUES ARE IN OHMS, 1/4W, 5%.

SIGNATURES	DATE
DRAWN CARMENZA LARSEN	9-15-93
CHECKED	
ENGR BRUCE WILKINSON	9-15-93
ENGR	
PROJ ENG	
OTHER	

Pioneer Magnetics
SANTA MONICA, CA 90404

TITTLE: SCHEMATIC, PM3386 PFC, A BOARD

SIZE	CODE IDENT NO.	DRAWING NO.
B	08676	122220 D

SCALE ——— SHT

REVISIONS				
REV	ECO	DESCRIPTION	DATE	APPROVED
A		PRODUCTION RELEASE	1-14-94	
B	19395	SEE ECO	6-15-94	C.L.
C	20233	SEE ECO	2-12-95	C.L.

PRIMARY | SECONDARY

D114-D120 ARE 1N4744A

P9 BUS+ 6A — 380VDC INPUT

P8 BUS- 6A — FROM PFC BD

Q101-104 IRFP460

T101 PWR XFMR

T102 301939 DRIVER XMR

T103 301035

L101 301955

Z101 MAIN CONTROL HYBRID 122160

Z102 MAIN OPTION HYBRID 122161

U101 UC3706

AT101 PTC.33

Q107 ZTX649

U102 4N28

D101 MUR3060PT

D102 MUR3060PT

D103 MUR3060PT

D104 MUR3060PT

D122 MUR3060PT

D123 MUR3060PT

D124 MUR3060PT

D105-D109 1N5817

D110 1N4937

D111 1N4937

D112 1N4937 (-170V)

D125 1N4148

D126 1N4148

D127 1N5817

D128 1N4148

D121 1N4751

J1

J5A

P3 — FROM PFC BD

J2 — FAN+ / FAN RTN

E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11 E12 E13

W101 (-2XX) W102 (-BXX) W103

CUT TRACE FOR 8uV

MAIN CHANNEL

3. ALL CAPACITORS ARE IN UF, 100V.
2. ALL RESISTORS ARE IN OHMS, 1/4W, 5%
1. ALL PARTS MARKED * ARE EXCEPTIONS. VALUES SHOWN ARE FOR 48 VOUT.

UNLESS OTHERWISE SPECIFIED.

APPROVALS	DATE
DRAWN CARMENZA LARSEN	1-14-94
CHECKED BRUCE WILKINSON	1-14-94
ENG. BRUCE WILKINSON	1-14-94
PROJ. ENG.	
OTHER	

Pioneer Magnetics
SANTA MONICA, CA 90404

SCHEMATIC, PM3329 - D2 BOARD
MAIN CHANNEL CONVERTER

SIZE	CODE IDENT NO.	DRAWING NO.	REV
B	08676	122217	C

SCALE : NONE — SHEET 1 OF 1

REV.	ECO.	DESCRIPTION	DATE	APPD
9A		PRELIMINARY RELEASE	8/1/90	
9B	15539	ADDED NEW SAFETY LABEL	9/5/90	
9C	15585	CHANGED SAFETY LABEL DASH NUMBERS	11/9/90	
9D	15590	RESISTOR CHANGES AND INCORP T-9140	11/4/90	
A	15760	RELEASE TO MANUFACTURING	4/22/91	
B	15805A	SAFETY REQUIREMENTS	4/22/91	
C	16267	ADD CR18 & CR19A	11/9/91	
D	FEP20077	UPGRADE FM LL4718 TO LL4750	3/3/92	
E	FEP20080	INCORP. LBM	3/6/92	
F	FEP20081	INCORP.	3/20/92	
G	FEP20086	CHANGE DESCRIPTION	3/31/92	
H	FEP20087	CHANGE PER ECO	4/21/92	

MAY 16 1997

NOT A CONTROLLED ISSUE
WILL NOT BE KEPT UP TO DATE

CHECKED
ISSUED JAN. 17, 96

NOTES: UNLESS OTHERWISE SPECIFIED.
1. ALL CAPACITANCE VALUES ARE IN MICROFARADS. VOLTAGE RATINGS IN D.C.
2. DIODES ARE 1N4448.
3. ALL RESISTANCE VALUES ARE IN OHMS, ¼W 5%.

OUT		R42	
BAT		RT1	
VR6	VR8	JP2	JP4
C40	C25	F1	
LAST USED	NOT USED	J2	
		T2	
		L8	
		LAST USED	NOT USED

720140-02 USED ON | NFS80-7606 MODEL NO.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: ANGLES ±1°

DO NOT SCALE DRAWING

THE INFORMATION CONTAINED HEREIN IS THE EXCLUSIVE PROPERTY OF CDI CORPORATION, INC. THE REPRODUCTION OF THIS DRAWING WITHOUT:
1. TO MANUFACTURE THIS EQUIPMENT OR COMPONENT
2. HOW TO REPRODUCE OR COPY IT, OR
3. HOW TO REVEAL OR DISCLOSE IT TO VISIBLE OR IN PART

MATERIAL | NAME
KEITH K. SANTO 7/15/92
APPROVED
DRAWN
CHECKED
ENGINEER
QUALITY

CDI COMPUTER PRODUCTS

SCHEMATIC
POWER SUPPLY
NFS80-7606/-7606M

SIZE D | DWG. NO. 730160-02/-254 | REV. H
SCALE NONE | SHEET 1 OF 1