

**FM-20S 20 KILOWATT FM  
FMI 1405 14 KILOWATT FM + HD  
5.6 KILOWATT HD ONLY  
BROADCAST TRANSMITTER**

**September, 2010**

**IM No. 597-1012-001**



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### **FACILITY CONTACTS –**

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

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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<sup>2</sup> 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<sup>2</sup> 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.



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# SECTION I

## GENERAL INFORMATION

### 1-1. INTRODUCTION.

1-2. Information presented by this section provides a general description of the Broadcast Electronics FM-20S and FMi 1405 transmitter and lists equipment specifications.

### 1-3. FM-20S RELATED PUBLICATIONS.

PUBLICATION NUMBER	EQUIPMENT
597-1050	FX-50 Exciter Technical Manual
597-0541	FXI 60/250 Digital Exciter Technical Manual

### 1-4. FMi 1405 RELATED PUBLICATIONS.

PUBLICATION NUMBER	EQUIPMENT
597-0541	FXi 60/250 Digital Exciter Technical Manual
597-0542-002	FSi 10 IBOC Signal Generator Technical Manual
597-0551	AES Bypass Configuration Technical Manual



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**FIGURE 1-1. FM-20S TRANSMITTER**

1-5. **EQUIPMENT DESCRIPTION.**

1-6. **FM-20S GENERAL.**

- 1-7. The Broadcast Electronics FM-20S transmitter is a 20 kW solid-state FM transmitter designed for continuous operation in the 87.5 MHz to 108 MHz broadcast band (refer to FIGURE 1-1). The FM-20S transmitter is equipped with: 1) an FX-50 FM exciter, 2) eight 5kW modular switching power supply assemblies, 3) 32 modular solid-state broadband plug-in RF power amplifier modules, 4) two modular solid-state broadband plug-in IPA modules, 5) four low-pass filters, 6) two 2-way and four 8-way combiner assemblies, 7) one output combiner assembly, 8) two 600-watt reject load assemblies, 9) two 2-way IPA splitter and four 8-way motherboard splitter assemblies, 10) one reject load assembly, and 11) one microprocessor-controlled system controller and two module controllers.

Components are housed in two cabinets: a control cabinet and an auxiliary cabinet. An extensive redundancy and protection system keeps a signal on the air even in the most extreme conditions.



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**FIGURE 1-2. FMi 1405 TRANSMITTER**



## 1-8. **FMi 1405 GENERAL.**

The Broadcast Electronics FMi 1405 transmitter is a 14kW FM+IBOC and 5.6 kW IBOC only solid-state transmitter based largely on the FM-20S architecture and is designed for continuous operation in the 87.5–108MHz broadcast band (refer to FIGURE 1-2). The FMi 1405 is equipped with: 1) FXi 60 FM/IBOC Digital Exciter, 2) FSi 10 IBOC Signal Generator, 3) Eight 5kW modular switching power supplies, 4) 32 modular solid-state broadband plug-in RF power amplifier modules biased for linear operation, 5) One modular solid-state broadband plug-in IPA module with an option for a second configured for standby operation, 6) One built in 2-way combiner with built in reject load 7) Microprocessor base controller to control TX operation..

Components are housed in two cabinets: a control cabinet and an auxiliary cabinet. An extensive redundancy and protection system keeps a signal on the air even in the most extreme conditions.

Specific FM-20S/FMi 1405 features include:

- **BROADBAND DESIGN.** A broadband design eliminates tuning controls.
- **MODULAR SWITCHING POWER SUPPLY UNITS.** Eight 5 kW modular switching power supply units provide operating potentials for the RF power amplifier modules. Two separate switching power supply units provide  $\pm 12$  and +5 volt operating potentials for the controllers, RF power amplifier modules, and IPA. An auto power supply backup option allows fifth power amplifier power supply modules to be installed in each transmitter cabinet.
- **MODULAR RF AMPLIFIER UNITS.** A total of 32 modular solid-state broadband plug-in RF amplifier modules. The modules are accessible from the front of the transmitter and output 700 watts of RF power. In the event of an RF amplifier module failure, each module can be inserted or removed from the transmitter during on-air operation. RF drive for the RF amplifier modules is provided by two solid-state broadband plug-in 500 watt IPA modules.
- **SOFT-FAILURE FEATURE.** A powerful soft-failure feature. If one RF amplifier module fails, the transmitter combiner automatically re-configures to output 95% of the RF output power.
- **SYSTEM/MODULE CONTROLLERS.** One system controller and two module controllers. The module controllers monitor and control 32 RF amplifier modules and two IPA modules. The system controllers monitor and control the module controllers and system functions such as VSWR foldback.
- **OPTIONS.** Several options allow the transmitter to be equipped with: 1) an automatic exciter switcher, 2) a fifth switching power supply assembly, 3) an automatic IPA switcher, and 4) RTDS (available at a future date).
- **REDUNDANT DESIGN.** Redundant design for superior reliability. The modularity of the RF amplifier modules, power supply modules, IPA, and transmitter options allow for redundant circuitry in critical areas. If a failure occurs, this redundancy allows the transmitter to maintain on-air operation.
- **IEC 215 COMPLIANT.** IEC 215 safety compliant.

- 1-9. **FX-50 EXCITER.** The FM-20S comes standard with the FX-50 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 FX-50 is designed to accept multiple wideband composite inputs from a stereo generator or SCA generator. In addition, the FX-50 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.

The FX-50 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 3 to 50 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.

- 1-10. **FXi 60 DIGITAL EXCITER.** The FM-20S may also be equipped with the optional FXi 60 digital FM exciter. The FXi 60 is a solid-state wideband FM digital exciter providing a continuously variable RF output at any frequency within the 87.5 to 108 MHz FM broadcast band in 10 kHz increments. The FXi 60 is divided into several board assemblies. The assemblies include: 1) DSP (Digital-Signal-Processor) Modulator, 2) Controller, 3) Oscillator/Filter, 4) RF Power Amplifier, 5) Power Supply, and 6) Color GUI Interface. For an FM-20S transmitter, the FXi 60 will be equipped with a 60 watt RF power amplifier module.

The FXi 60 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, and 6) External SCA/RDS Input. The FXi 60 also has a built in stereo generator, compressor, and limiter all of which are software programmable and defeatable. The exciter can also be operated in Mono (L+R), Mono L, or Mono R modes. The digital exciter also provides modulation Directly To Channel (DTC) 87.5 - 108MHz, eliminating any analog up converter processes. The chassis of the FXi 60 requires 7 inches of a 19 inch rack cabinet. Refer to publication 597-0541 for a detailed explanation of the FXi 60 features.

- 1-11. **FXi 60 EXCITER (IBOC).** When used in a FMi 1405 the FXi 60 exciter is configured for IBOC operation with a plug in IBOC card. With the IBOC card installed the FXi 60 can be set for FM + IBOC or IBOC only mode. This mode is selectable from the front panel of the FXi 60 exciter. The FXi 60 can also be set for FM only mode in a 1405 with the power output limited at 14kW. This is also selectable from the front panel of the exciter.

- 1-12. **FSi 10 IBOC SIGNAL GENERATOR.** The FSi 10 IBOC Signal Generator is required for IBOC transmission and is standard in a FMi 1405 transmitter. The FSi 10 works in conjunction with the FXi 60 to provide the IBOC signal to the FMi 1405. In order to produce the IBOC signal you must have both the FXi 60 and FSi 10 installed and operating in the FMi 1405 TX.

- 1-13. **POWER SUPPLY.** The FM-20S/FMi 1405 transmitter is equipped with eight 5 kW modular switching power supply assemblies, 4 in each cabinet. The supplies provide DC operating potentials for the transmitter power amplifier circuitry. A separate modular switching power supply provides  $\pm 12$  and +5 volt operating potentials for the controller, IPA, and RF amplifier modules. Each supply is equipped with overload protection, over-voltage protection, high temperature protection, and a soft-start feature which minimizes in-rush currents. A fifth 5 kW modular switching power supply can be installed in each cabinet as a backup if the transmitter is equipped with the backup power supply option.

- 1-14. **RF POWER AMPLIFIER MODULES.** The FM-20S/FMi 1405 transmitter is equipped with 32 RF power amplifier modules, 16 in each cabinet. The modules are connected in two 10 kW blocks. Each block contains 16 RF power amplifier modules.

The PA and IPA modules in the FMi 1405 are solid-state amplifiers biased for linear operation. There are the same number of modules and the architecture is the same as those used in the FM-20S.

- 1-15. Each module consists of an interface circuit board, 2 RF amplifier circuit boards, and a combiner. Each RF amplifier circuit board: 1) contains a single dual MOSFET power transistor operated in a push-pull configuration and 2) outputs 350 watts of RF power. RF amplifier operations are monitored by the interface circuit board. The interface 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 each module parameter is routed to a module controller circuit board for display. The output from each RF amplifier module is combined to produce 700 watts of RF power.
- 1-16. **RF SPLITTER AND IPA MODULES.** RF power from the exciter is fed into an RF splitter, a 90-degree hybrid, which divides the input power into two RF outputs of one-half power each, but 90 degrees out-of-phase. The in-phase (0 degree) RF power is amplified for application to the RF power amplifier modules by an IPA module in the Control (right) cabinet. The quadrature phase (90 degrees) RF power is amplified for application to the RF power amplifier modules by another IPA module in the Auxiliary (left) cabinet. These modules are identical to the RF power amplifiers and output 500 watts of RF power each. The transmitter can be equipped with a second "standby IPA module" and an automatic IPA switcher in each of the two cabinets if the "Standby IPA option" is installed.
- 1-17. **CONTROLLER.** The FM-20S/FMi 1405 controller (located in the Control cabinet) consists of a supervisor circuit board, two module control circuit boards, a front-panel display circuit board, and an input/output circuit board. The controller utilizes extensive RFI filtering and 3 microprocessors 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 stable  $\pm 12$  and  $+5$  VDC supplies.
- 1-18. The supervisor controller circuit board is equipped with a Z-World(c) microprocessor module. The supervisor circuit board controls and monitors the module control circuit board and performs all system type control operations such as on/off control, power trim, automatic power control, and remote control interfacing. The automatic power control function responds to reflected power and internal temperature conditions. If the reflected power or internal temperature increases above the thresholds, the transmitter will automatically foldback the output power to maintain on-air operation. The soft-failure feature controls the combiner in response to RF module failures. In the event of an RF module failure, the controller automatically re-configures the combiner to provide maximum RF output power.
- 1-19. The supervisor circuit board controls the operation of all the controller front panel displays and switches. Transmitter forward power, reflected power, PA voltage, air inlet temperature, and exciter forward/reflected power samples are routed to the circuit board. The samples are displayed or used as status information by the microprocessor. System parameters are displayed by a 4-character LCD display. Module parameters are displayed by a 2-line 16 character LCD display.

- 1-20. The module control circuit board reports to and responds to commands from the supervisor circuit board. The module control circuit board is equipped with two 80C31 microprocessors. The circuit board provides monitoring, control, and display functions for 32 RF amplifier modules and two IPA modules. The module control circuit board is also responsible for the combiner re-configuration during soft-failure conditions. RF power amplifier module forward power, reflected power, current, voltage, and temperature samples are routed to the circuit board for monitoring and display.
- 1-21. The FM-20S/FMi 1405 can also be equipped with RTDS (available at a future date). RTDS is a system designed to monitor, control, and troubleshoot transmitter operations from a remote location using a PC. The system consists of an RTDS microprocessor module and the RTDS PC software.
- 1-22. **COMBINER.** The FM-20S/FMi 1405 is equipped with an auto-configurable combiner system. This unique system matches the combiner to the number of operating modules in the transmitter. In the event of a failure in an RF amplifier module, the combiner will automatically re-configure to provide maximum output power from the remaining modules. For example, if one RF amplifier module encounters a failure, the combiner will automatically re-configure to provide approximately 95% of the rated output power. The combiner system is controlled by the transmitter module control circuit board.
- 1-23. The combiner system consists of four 8-way combiners and three 2-way combiners. Each 8-way combiner sums the outputs of 9 RF amplifier modules to produce 5 kW output. Two 2-way combiners sum the 5 kW outputs from two 8-way combiners to produce two 10 kW outputs. The final combining is provided by the 2-way output combiner. The unique features of the combiner include: 1) very low loss, 2) broadband, and 3) no cable connections.
- 1-24. **TRANSMITTER CONFIGURATIONS.**
- 1-25. The FM-20S transmitter can be ordered in the following configurations:

Part Number	DESCRIPTION
909-1020-206	FM-20S 20 kW solid-state FM transmitter for operation in the 87.5 MHz to 108 MHz broadcast band, 196 to 252 VAC 50/60 Hz three-phase supply. Includes FX-50 FM exciter, 196 to 252 VAC 50/60 Hz.
909-1020-226 (available as customer special)	FM-20S 20 kW solid-state FM transmitter for operation in the 87.5 MHz to 108 MHz broadcast band, 196 to 252 VAC 50/60 Hz single-phase supply. Includes FX-50 FM exciter, 196 to 252 VAC 50/60 Hz.
909-1020-386	FM-20S 20 kW solid-state FM transmitter for operation in the 87.5 MHz to 108 MHz broadcast band, 341 to 435 VAC 50/60 Hz three-phase WYE supply. Includes FX-50 FM exciter, 196 to 252 VAC 50/60 Hz.

- 1-26. The FMi 1405 transmitter can be ordered in the following configurations:

Part Number	DESCRIPTION
909-1405-206	FMi 1405 HD XMTR 220V 3PH Delta
909-1405-226	FMi 1405 HD XMTR 220V 1PH
909-1405-386	FMi 1405 HD XMTR 380V 3PH 4-WIRE WYE

- 1-27. **OPTIONAL EQUIPMENT AND SPARE PARTS KITS.**

- 1-28. The following text presents the optional equipment and spare parts kits available for use with the FM-20S transmitter.

<b>Part Number</b>	<b>DESCRIPTION</b>
979-1020	Recommended spare parts kit for FM-20S/FMi 1405 solid-state transmitter. Does not include spare parts for the FX-50.
979-1021	Recommended semiconductor kit for FM-20S/FMi 1405 solid-state transmitter. Does not include semiconductors for the FX-50.
979-0600	Upgrade FXi 60 Digital FM Exciter
969-1011-001	Standby FXi 60 Digital FM Exciter
907-9091	RTDS (Remote Transmitter Diagnostic System), factory installation.
907-9091-001	RTDS (Remote Transmitter Diagnostic System), field installation.
969-1011	Main/alternate exciter switcher option, FX-50.
969-1013	Backup power supply module option.
969-1022	Main/alternate IPA switcher option.
1-29. The following list presents optional equipment and spare parts kits for use with the FMi 1405 transmitter.	
979-1020	Recommended spare parts kit for use with the FM-20S/FMi 1405 solid-state transmitter.
979-1021	Recommended semiconductor kit for FM-20S/FMi 1405 solid-state transmitter.
969-1013	Backup power supply module option.
969-1022	Main/alternate IPA switch option.
979-0551	Kit, HD Radio AES Bypass, Dual Processors.
979-0551-001	Kit, HD Radio AES Bypass, Omnia HDFM single processor.
979-0551-002	Kit, HD Radio AES Bypass, Orban HDFM single processor.
1-30. <b>EQUIPMENT SPECIFICATIONS.</b>	
1-31. Refer to TABLE 1-1 for electrical specifications or TABLE 1-2, beginning on page 1-16, for physical specifications of the FM-20S transmitter.	

**TABLE 1-1. FM-20S ELECTRICAL SPECIFICATIONS**  
(Sheet 1 of 8)

PARAMETER	SPECIFICATION
RF POWER OUTPUT	10 kW to 20 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	3 1/8 inch EIA female field flange.
MAXIMUM VSWR	Rated power into 1.4 : 1 maximum. Capable of operating into higher VSWR conditions with automatic power reduction. Open and short circuit protected at all phase angles.
EXCITER	Model FX-50, solid-state 50 watt output with digitally programmed synthesizer. 10 kHz increment programming. Optional FXi 60 digital exciter, 60 watt output, 10 kHz increment programming.
FREQUENCY STABILITY	
FX-50 Exciter	±300 Hz. 0 to 50 degrees C.
Optional FXi 60 Exciter	±300 Hz, (-10°C to +50°C). Can be locked to an external reference source such as GPS (Global Positioning System).
MODULATION TYPE	
FX-50 Exciter	Direct modulation of carrier frequency.
Optional FXi 60 Digital FM Exciter	Direct To Channel modulation.
MODULATION CAPABILITY	
FX-50 Exciter	Greater than ±350 kHz.
Optional FXi 60 Digital FM Exciter	±300 kHz maximum.
AM SIGNAL-TO-NOISE RATIO:	
Asynchronous	55 dB below a rated power reference carrier with 100% AM modulation @ 400 Hz, 75 microsecond deemphasis (no FM modulation present).
Synchronous	50 dB below a rated power reference carrier @ 100% AM modulation @ 400Hz. 75 uS deemphasis with ±75 kHz FM modulation @ 400 Hz.
IMD PROTECTION	20 dB or better turn-around-loss or mixing loss to interfering signals.
RF HARMONIC SUPPRESSION	Meets all FCC/IC requirements and CCIR recommendations.

**TABLE 1-1. FM-20S ELECTRICAL SPECIFICATIONS**  
(Sheet 2 of 8)

PARAMETER	SPECIFICATION
AC POWER REQUIREMENTS	196 to 252V ac 50/60 Hz three phase. 196 to 252V ac 50/60 Hz single phase. 341 to 435V ac 50/60 Hz three phase WYE.
AC POWER CONSUMPTION	35 kW nominal at a 20 kW RF power output, 50 Ohm resistive load, 230V ac input. 40 kW at a 20 kW RF power output, 1.4 : 1 VSWR load, 230V ac input.
POWER FACTOR	0.98 at 230 VAC. 20 kW RF output power into 50 ohm resistive load.
OVERALL EFFICIENCY	55% or greater at 230 VAC (AC line input to RF output). 20 kW RF output power into a 50 ohm resistive load, 58% typical.
SURGE PROTECTION	Tested with IEEE C62.41-1991 recommended waveforms for location categories B3 and IEC 801-4 standard waveforms for severity level 4.
RF SAMPLE OUTPUTS	5, BNC. One additional output with optional FXi 60 exciter.
DIRECTIONAL COUPLERS	
Transmitter Output	3 total, 1 forward power, 1 reflected power and 1 forward sample for modulation monitor.
Exciter Output	2 total, 1 forward power and 1 reflected power.
Low-Pass Filter Output	8 total, 1 forward power and 1 reflected power each for low-pass filter A, low-pass filter B, low-pass filter C and low-pass filter D.
RF Module Output	32 total, 1 forward power and 1 reflected power for each module.
IPA Module Output	2 total, 1 forward power and 1 reflected power.
<b>COMPOSITE OPERATION WITH FX-50 AND FXi 60</b>	
COMPOSITE INPUTS	3 total, BNC. One unbalanced, one balanced, and one front panel test. Optional FXi 60. One balanced and one unbalanced.
COMPOSITE INPUT IMPEDANCE	10 k ohms or 50 ohms nominal, resistive selectable.
COMPOSITE INPUT LEVEL	3.5 V p-p nominal for $\pm 75$ kHz deviation.
FM SIGNAL-TO-NOISE RATIO: Composite	85 dB below $\pm 75$ kHz deviation @ 400 Hz meas- ured in a 20 Hz to 30 kHz bandwidth with 75 microsecond de-emphasis.

**TABLE 1-1. FM-20S ELECTRICAL SPECIFICATIONS  
(Sheet 3 of 8)**

PARAMETER	SPECIFICATION
<b>COMPOSITE OPERATION WITH FX-50 AND FXi 60 (Con't)</b>	
DISTORTION	
Harmonic	0.02% or less at 400 Hz.
SMPTE Intermodulation Distortion	0.02% or less, 60 Hz/7 kHz, 1:1 ratio.
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.
COMPOSITE AMPLITUDE RESPONSE	±0.1 dB, 30 Hz to 53 kHz.
COMPOSITE PHASE RESPONSE	±0.25 degrees from linear phase, 30 Hz to 53 kHz.
COMPOSITE GROUP DELAY	125 nanoseconds.
COMPOSITE SLEW RATE	9 volts/microsecond (symmetrical).
<b>ANALOG L &amp; R STEREO OPERATION WITH FX-50 AND FXi 60</b>	
AUDIO INPUT IMPEDANCE	600 ohms balanced, resistive, floating. adaptable to other impedances.
AUDIO INPUT LEVEL	+10 dBm, ±1 dBm for 100% modulation At 400 Hz.
AUDIO INPUT FILTERS	15 kHz low-pass filters with delay equalization for minimum overshoot.
FREQUENCY RESPONSE	±0.5 dB, 30 Hz to 15 kHz, 75 microsecond pre-emphasis (flat, 25 or 50 microsecond selectable).
TOTAL HARMONIC DISTORTION	0.05% or less @ 400 Hz.
SMPTE INTERMODULATION DISTORTION	0.05%, 60 Hz/7 kHz; 4:1 ratio.
CCIF INTERMODULATION DISTORTION	0.05% Or Less, 15 kHz/14 kHz; 1:1 ratio.
TRANSIENT INTERMODULATION DISTORTION	0.05% (square wave/sine wave).
FM SIGNAL TO NOISE	80 dB or greater below left or right channel 100% modulation @ 400 Hz, 75 microsecond de-emphasis.



**TABLE 1-1. FM-20S ELECTRICAL SPECIFICATIONS  
(Sheet 4 of 8)**

PARAMETER	SPECIFICATION
<b><i>ANALOG L &amp; R STEREO OPERATION WITH FX-50 AND FXi 60 (Cont'd)</i></b>	
STEREO SEPARATION	50 dB or greater from 30 Hz to 15 kHz (sine wave). FXi 60 - 60 dB or better.
DYNAMIC STEREO SEPARATION	40 dB or greater from 30 Hz to 15 kHz (normal program content). FXi 60 - 50 dB or better.
LINEAR CROSSTALK (MAIN TO SUB/SUB TO MAIN DUE TO AMPLITUDE AND PHASE MATCHING OF LEFT AND RIGHT CHANNELS)	45 dB below 100% modulation, 30 Hz to 15 kHz. FXi 60 - 55 dB or better.
NON-LINEAR CROSSTALK (MAIN TO SUB/SUB TO MAIN DUE TO DISTORTION PRODUCTS).	70 dB minimum below 100% modulation.
38 kHz SUPPRESSION	80 dB minimum below 100% modulation.
PILOT STABILITY	±0.5 Hz, +32°F to +122°F (0°C to +50°C).
STEREOPHONIC SEPARATION	50 dB, 30 Hz To 15 kHz (Sinewave).
MODES OF OPERATION	Stereo, Mono L+R, Mono L, and Mono R. Remote control accessible.
<b><i>MONAURAL OPERATION WITH FX-50 and FXi 60</i></b>	
AUDIO INPUT IMPEDANCE	600 ohms balanced, resistive, adaptable to other impedances, 60 dB common mode suppression.
AUDIO INPUT LEVEL	+10 dBm nominal for ±75 kHz deviation @ 400 Hz.
AUDIO FREQUENCY RESPONSE	±0.5 dB, 30 Hz to 15 kHz, selectable flat, 25, 50 or 75 microsecond pre-emphasis.
THD PLUS NOISE	0.02% or less at 400 Hz.
SMPTE IMD	0.02% or less, 60 Hz to 7 kHz, 4:1 ratio.
CCIF IMD	0.02% or less, 15 kHz/14 kHz 1:1 ratio.
TRANSIENT IMD	0.02% or less (sine wave/square wave).
FM SIGNAL-TO-NOISE RATIO	85 dB below ±75 kHz deviation @ 400 Hz measured in a 20 Hz to 30 kHz bandwidth with 75 microsecond de-emphasis.

**TABLE 1-1. FM-20S ELECTRICAL SPECIFICATIONS  
(Sheet 5 of 8)**

PARAMETER	SPECIFICATION
<b>SCA OPERATION WITH FX-50</b>	
MODULATION TYPE	Direct FM.
SUBCARRIER FREQUENCY	67 kHz (39 to 95 kHz optional).
SUBCARRIER FREQUENCY STABILITY	$\pm 0.5\%$ (330 Hz @ 67 kHz), 0°C to +50°C
SUBCARRIER HARMONIC CONTENT	Less than 0.3%.
SUBCARRIER ENVELOPE DECAY	Greater than 100 milliseconds from 90% to 10% subcarrier level.
MODULATION CAPABILITY	$\pm 20\%$ of subcarrier frequency, maximum.
INPUT IMPEDANCE	
AUDIO	600 ohms, balanced, resistive.
DATA	75 ohms, unbalanced, resistive, DC coupled.
INPUT LEVEL	
AUDIO	Adjustable +10 dBm to -10 dBm for $\pm 6$ kHz deviation @ 400 Hz.
DATA	Adjustable 1.0 to 4.0 V p-p for $\pm 6$ kHz deviation, DC coupled.
PRE-EMPHASIS:	
AUDIO	150 microseconds standard (75 microseconds with internal jumper).
DATA	No pre-emphasis.
FREQUENCY RESPONSE:	
AUDIO	$\pm 0.5\%$ dB, 10 Hz to 10 kHz, exclusive of low pass filter.
DATA	$\pm 0.5$ dB, DC to 10 kHz.
LOW-PASS FILTER	
AUDIO	Sixth order, -3 dB at 4.3 kHz standard ( resistor changes for other values).
DATA	Sixth Order, -3 dB At 4.3 kHz standard (resistor changes for other values). May be bypassed.
TOTAL HARMONIC DISTORTION	Less than 0.5% throughout AF pass band.

**TABLE 1-1. FM-20S ELECTRICAL SPECIFICATIONS  
(Sheet 6 of 8)**

PARAMETER	SPECIFICATION
<b>SCA OPERATION WITH FX-50 (Con't)</b>	
SMPTE INTERMODULATION DISTORTION	Less than 0.5% 60 Hz/7 kHz, 1:1 ratio (low-pass and pre-emphasis filter bypassed).
CROSSTALK SCA TO STEREO	-60 dB or better below 100% modulation of left or right. 75 microsecond de-emphasis.
CROSSTALK STEREO TO SCA	-50 dB or better below $\pm 6$ kHz deviation of SCA using 150 microsecond de-emphasis and FS-30 stereo generator.
FM SIGNAL-TO-NOISE RATIO	62 dB below $\pm 6$ kHz deviation @ 400 Hz (150 microsecond de-emphasis).
<b>AES INPUT STEREO OPERATION with FXi 60</b>	
INPUT IMPEDANCE	110 Ohms, Balanced.
INPUT LEVEL	-2 dBFS for 100% modulation @ 400Hz, adjustable. (32, 44.1, 48, and 96kHz sampling rates.
CONNECTOR	Wire - XLR, Optical - Toshiba (TosLink)
FREQUENCY RESPONSE	$\pm 0.5$ dB; 20Hz to 15kHz.
THD + NOISE:	0.03%; 20Hz to 15kHz.
SMPTE IMD	0.03%; 60Hz/7kHz, 4:1 Ratio.
CCIF IMD	0.03%; 15kHz/14kHz, 1:1 Ratio.
TRANSIENT IMD	0.03%; Square Wave/Sine Wave.
FM SINGAL TO NOISE RATIO	80dB or better. 100% modulation @ 400Hz.
SEPARATION	60dB; 20Hz to 15kHz.
DYNAMIC SEPARATION	50dB; 20Hz to 15kHz.
LINEAR CROSSTALK	60dB below 100% modulation; 20Hz to 15kHz.
NON-LINEAR CROSSTALK	70dB below 100% modulation.
38kHz SUPPRESSION	.80dB below 100% modulation.
PILOT STABILITY	$\pm 0.3$ Hz.
MODES OF OPERATION	Stereo, Mono (L+R), Mono L, and Mono R.
<b>INTERNAL SCA OPERATION with FXi 60</b>	
AUDIO INPUT IMPEDANCE	600 ohms or 10k ohms selectable.
AUDIO INPUT LEVEL	+10dBm for 10% Injection, adjustable.
CONNECTOR	D-Sub. 9-position female.

**TABLE 1-1. FM-20S ELECTRICAL SPECIFICATIONS**  
(Sheet 7 of 8)

PARAMETER	SPECIFICATION
<b>INTERNAL SCA OPERATION</b> <i>with Fxi 60 (Con't)</i>	
FREQUENCY RESPONSE	±0.5 dB; 20Hz to 5kHz.
SIGNAL TO NOISE RATIO	55dB or better
FREQUENCY	20kHz to 99kHz; programmable.
PRE-EMPHASIS	0, 50, 75, and 150usec.
DEVIATION	2.5kHz to 10kHz; programmable.
INJECTION LEVEL	2% to 15%; programmable.
AUDIO INPUT IMPEDANCE	600 ohms or 10k ohms selectable.
AUDIO INPUT LEVEL	+10dBm for 10% Injection, adjustable.
CONNECTOR	D-Sub. 9-position female.
FREQUENCY RESPONSE	±0.5 dB; 20Hz to 5kHz.
SIGNAL TO NOISE RATIO	55dB or better
FREQUENCY	20kHz to 99kHz; programmable.
PRE-EMPHASIS	0, 50, 75, and 150usec.
DEVIATION	2.5kHz to 10kHz; programmable.
INJECTION LEVEL	2% to 15%; programmable.
<b>INTERNAL RDS OPERATION</b> <i>with Fxi 60</i>	
FREQUENCY	57kHz.
INJECTION LEVEL	2% to 15%; programmable.
MODES OF OPERATION	PS (Program Service Name), PI (Program Identification), PTY (Program Type), AF (Alternate Frequency List), and DI (Decoder Identification).
<b>EXTERNAL SCA/RDS OPERATION</b> <i>with Fxi 60</i>	
INPUT IMPEDANCE	10k ohms unbalanced.
INPUT LEVEL	3.5Vp-p for 10% Injection.
CONNECTOR	BNC female.
FREQUENCY RESPONSE	±0.5 dB; 50kHz to 100kHz.
19kHz OUTPUT	.25Vp-p into 50 ohms for external synch.

**TABLE 1-1. FM-20S ELECTRICAL SPECIFICATIONS**  
(Sheet 8 of 8)

PARAMETER	SPECIFICATION
<b>PHYSICAL</b>	
DIMENSIONS:	
FX-50 Exciter	Width: 19.0 inches (48.3 cm). Height: 5.25 inches (13.3 cm). Depth: 19.00 inches (48.3 cm).
Optional FXi 60 Digital Exciter	Width: 19.0 inches (48.3 cm). Height: 7.0 inches (17.78 cm). Depth: 22.5 inches (57.15 cm).
Transmitter	Width: 89 inches (225 cm). Height: 70 inches (178 cm). Depth: 26.5 inches (68 cm).
WEIGHT	
FX-50 Exciter	38 pounds (17.2 kg) unpacked.
Optional FXi 60 Digital Exciter	38 pounds (17.2 kg) unpacked.
Transmitter	1300 lbs (590 kg) standard unpacked 1370 lbs (623 kg) with optional exciter, IPA, and power supply options.
<b>SAFETY</b>	Meets IEC 215.
<b>ENVIRONMENTAL</b>	
HEAT DISSIPATION	16 kW (54,608 BTU/hr) nominal at 20 kW RF output, 50 ohm resistive load. 20 kW (68,260 BTU/hr) at 20 kW RF output into a 1.4:1 VSWR load with 230 VAC input.
COOLING AIR REQUIREMENTS	4800 CFM (135.9 cubic meters per minute) Total
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).

**TABLE 1-2. FMi 1405 ELECTRICAL SPECIFICATIONS**  
(Sheet 1 of 3)

PARAMETER	SPECIFICATION
RF POWER OUTPUT RANGE IBOC ONLY FM + IBOC	2,000–5,600W 6,000–14,000W
OUTPUT IMPEDANCE	50 ohms nominal
OUTPUT CONNECTOR	3 1/8" EIA flange, 1 5/8" flange optional.
OVERALL EFFICIENCY IBOC ONLY FM+IBOC	>30% >55%
VSWR	Rated Power into 1.4:1 VSWR . Capable of operating in to higher VSWR with automatic power reduction. Open and short circuit protected at all phase angles.
FREQUENCY RANGE	87.5MHz to 108MHz; 10kHz increments
Frequency Stability Internal 10MHz Ref. External 10MHz Ref. (GPS)	+/-300Hz, 0-50 degrees C Determined by source
Modulation Capability	+/-300kHz FM Mode
Modulation Modes	FM Only, FM + IBOC, and IBOC 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
Altitude	10,000 ft. (3048M) @ 60Hz; 7,500 ft. (2286M) @ 50Hz
Cooling Air Requirement	4800 CFM (135.9 cubic meters per minute) Total
Output Connector	3 1/8" EIA female (1 5/8" optional)
Weight	1350lbs. standard unpacked
<b>AC Input</b>	
AC Voltage Requirements 3-Phase	196 to 252VAC, 50/60Hz, 3-phase, Closed Delta or WYE (3 or 4 wire) 340 to 435VAC, 50/60Hz, 3-phase, 4 wire, WYE only
Single Phase	196 to 252VAC, 50/60Hz, Single Phase
Power Factor	0.98 at 230VAC

**TABLE 1-2. FMi 1405 ELECTRICAL SPECIFICATIONS**  
(Sheet 2 of 3)

PARAMETER	SPECIFICATION
Disconnect Size	
3-Phase	
IBOC Only	55Amp fuse disconnect recommended, per cabinet
FM + IBOC	70Amp fuse disconnect recommended, per cabinet
Single Phase	
IBOC Only	80Amp fuse disconnect recommended, per cabinet
FM + IBOC	100Amp fuse disconnect recommended, per cabinet
Actual Amperage draw at:	
3-Phase	
IBOC Only	25A average, per cabinet
FM + IBOC	35A average, per cabinet
Single Phase	
IBOC Only	40A average, per cabinet
FM + IBOC	60A average, per cabinet
AC Wire Size	
3-phase	
IBOC Only	#6 AWG, Copper, THHN or equivalent
FM + IBOC	#4 AWG, Copper, THHN or equivalent
Single Phase	
IBOC Only	#3 AWG, Copper, THHN or equivalent
FM + IBOC	#1 AWG, Copper, THHN or equivalent
AC Power Consumption	
IBOC Only	18kW @ 5.6kW RF output
FM + IBOC	26kW @ 14kW RF output
Heat Dissipation	
IBOC Only	12,400W (42,321BTU/hr) nominal at 5.6kW RF output
FM + IBOC	12,000W (40,956BTU/hr) nominal at 14kW RF output
<b>FM Audio Performance</b>	
<b>AES Input FM +IBOC Mode</b>	
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

**TABLE 1-2. FMi 1405 ELECTRICAL SPECIFICATIONS**  
(Sheet 3 of 3)

PARAMETER	SPECIFICATION
S/N Ratio	85dB or better below 100% modulation @ 400Hz
Stereo	90dB or better below 100% modulation @ 400Hz
Mono	65dB; 20Hz to 15kHz
Stereo Separation	+/-0.3Hz; 0-50 degrees C
Pilot Stability	
<b>Internal SCAs (2)</b>	
Frequency	20kHz to 99kHz software programmable
Deviation	2.5kHz to 10kHz
Injection Level	2% to 15%
Pre-Emphasis	0, 50usec, 75usec, or 150usec.



# SECTION II

## INSTALLATION

### 2-1. INTRODUCTION.

- 2-2. This section contains information required for the installation and preliminary checkout of the Broadcast Electronics FM-20S/FMi 1405 transmitter.

### 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. TABLE 1-1, beginning on page 1-8, provides environmental conditions which must be considered prior to transmitter installation. Refer to TABLE 1-1 in SECTION I, GENERAL INFORMATION and ensure the transmitter is to be installed in an acceptable environment.

### 2-8. COOLING AIR REQUIREMENTS.

- 2-9. The FM-20S/FMi 1405 transmitter requires a source of cooling air to maintain an acceptable operating temperature. The transmitter requires a cooling air flow of 5400 cubic feet per minute or 2700 cubic feet per minute per cabinet (refer to FIGURE 2-1, page 2-3). 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 5400 cubic feet of air per minute (2700 cubic feet per minute for each cabinet).
- 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 locating the document on the Transmitter Technical Data CD supplied with this manual or by contacting Broadcast Electronics Customer Service.
- ### 2-12. PRIMARY POWER.
- 2-13. The standard FM-20S/FMi 1405 transmitter operates from a three-phase AC power source. The transmitter must be connected to a closed-delta or WYE three-phase power source. Operation from an unsatisfactory power source will void the warranty on the transmitter as any resulting damage is beyond the control of the manufacturer. Before attempting installation of the transmitter, assure that the proper power source is installed. Acceptable power input configurations are shown in FIGURE 2-13, page 2-27.

- 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.**



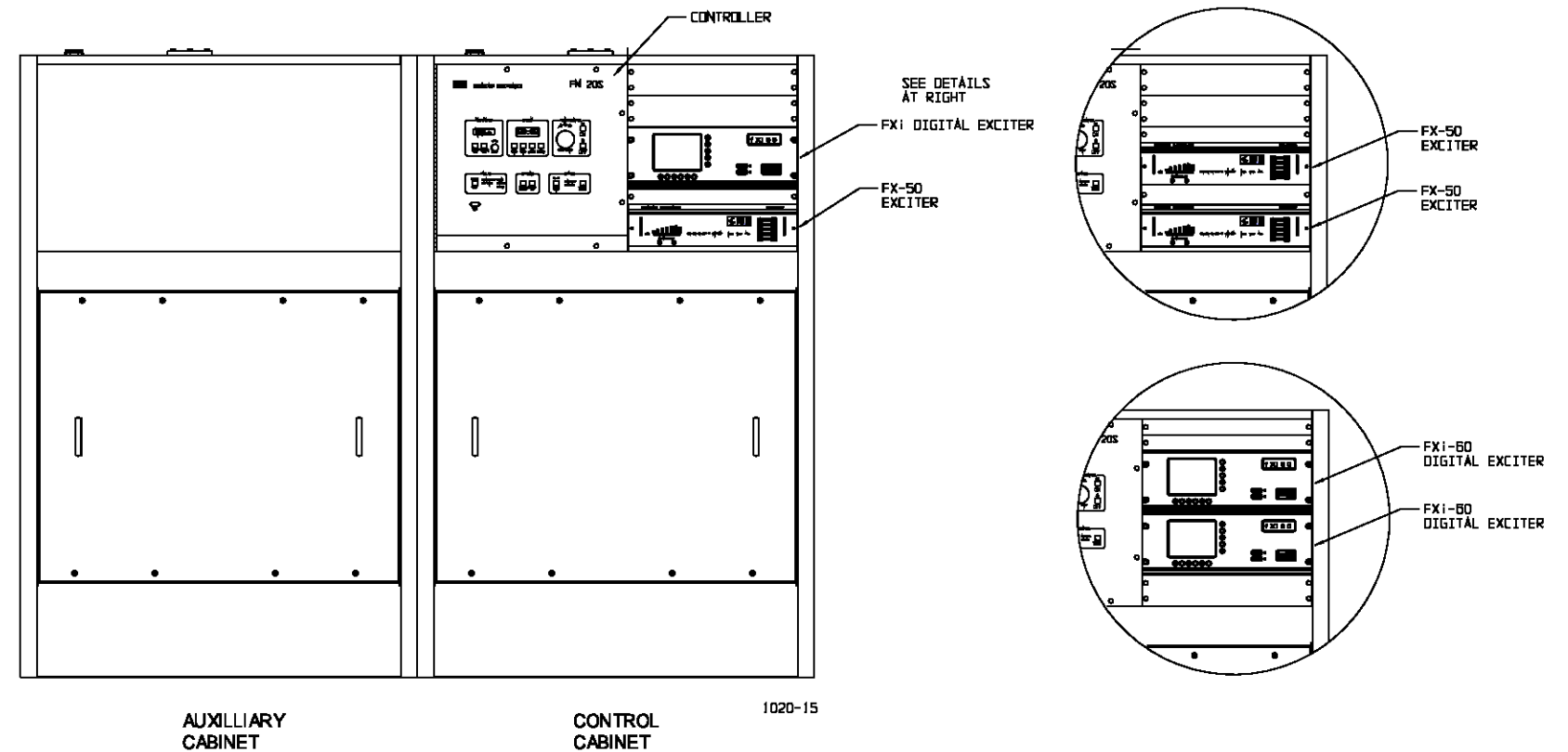
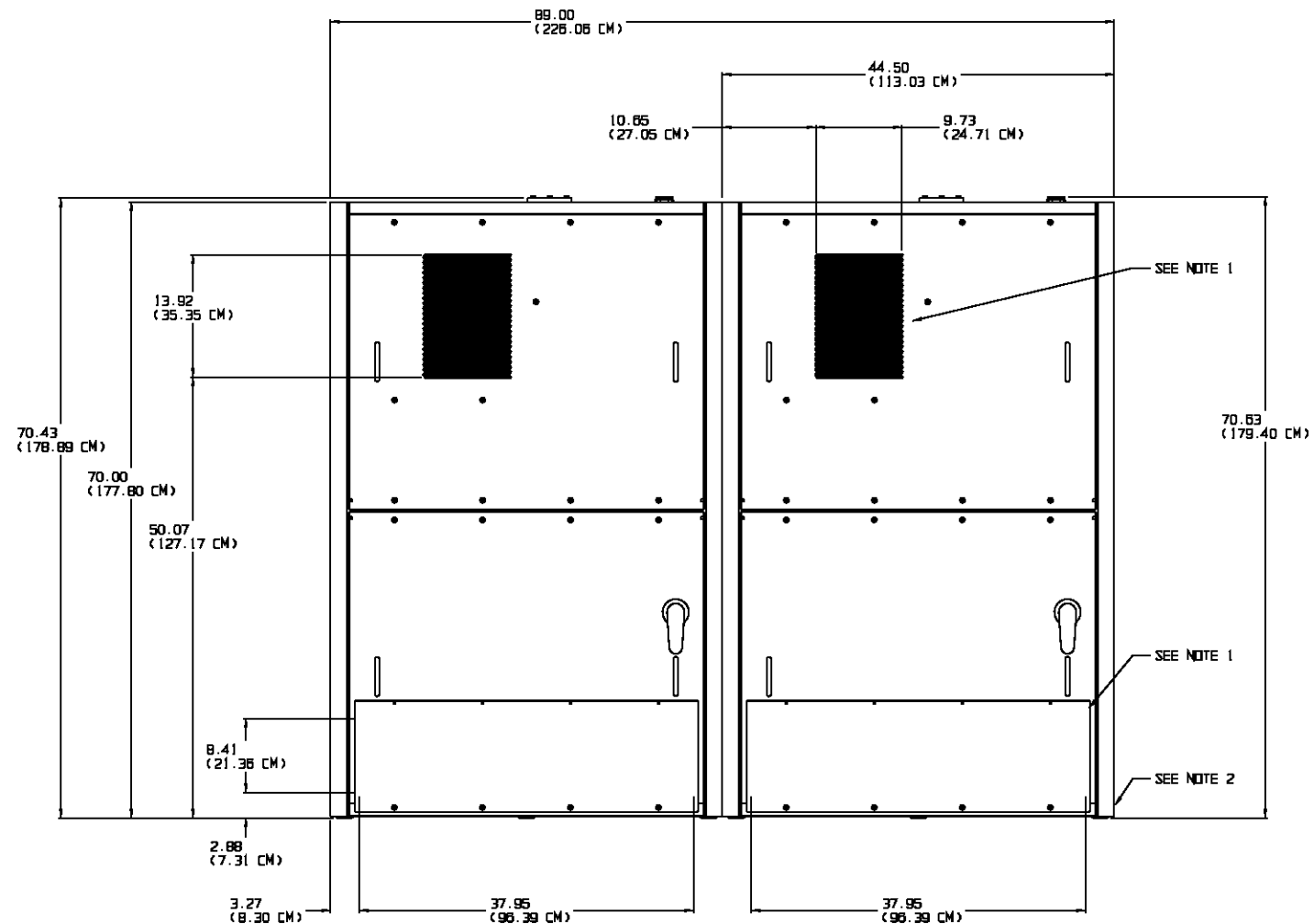
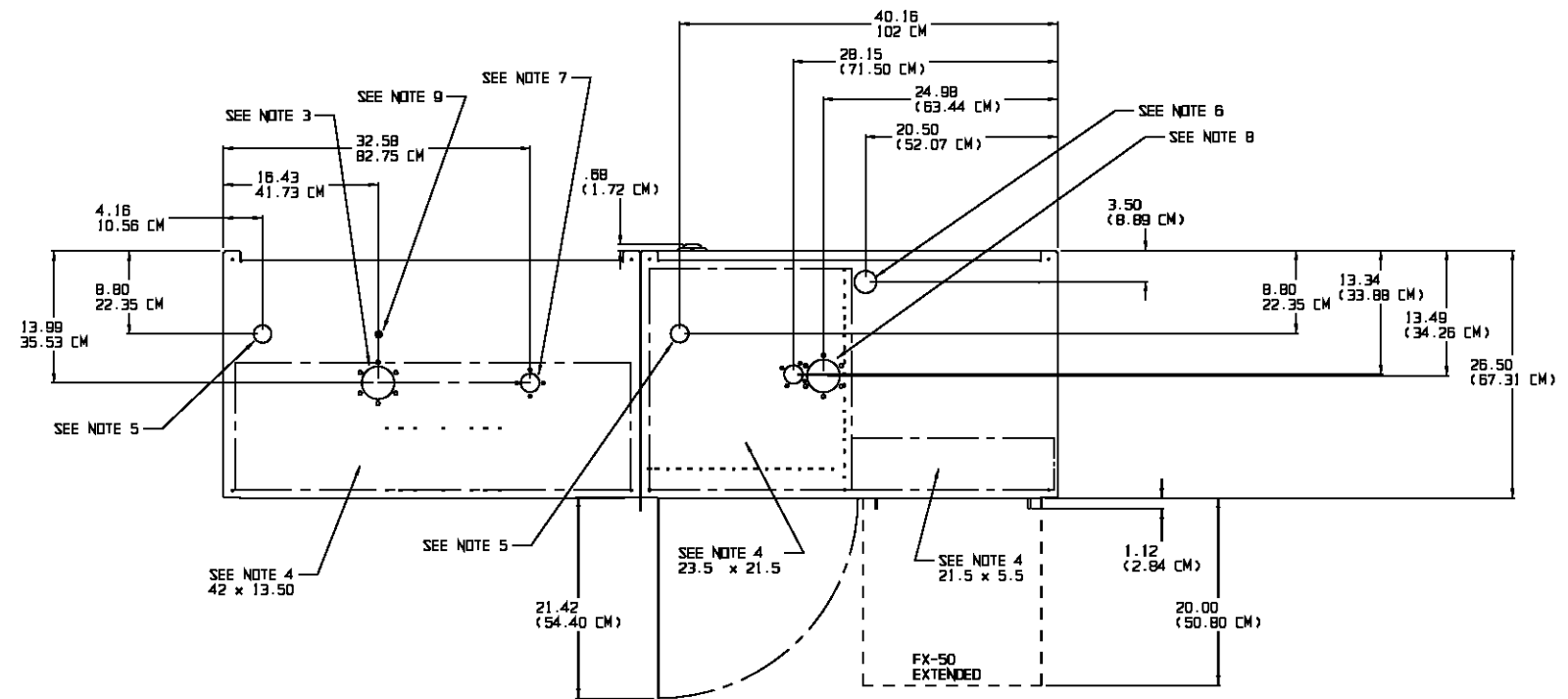
**WARNING**

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

**WARNING**

- 2-19. The FM-20S/FMi 1405 transmitter is designed with access holes in the top of the cabinet to allow for over-head ducting of AC power and control wiring (refer to FIGURE 2-1 and FIGURE 2-2, pages 2-3 and 2-5). The floor must be capable of supporting the total transmitter weight of 1400 lbs (635 kg).
- 2-20. Evaluate the installation site and determine 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.

- NOTES:
1. AIR INLET AT REAR OF EACH CABINET 2300 CFM (65.1 CUBIC METERS PER MINUTE) REUSABLE FILTERS PROVIDED.
  2. GROUND STRAP ENTRY IN LOWER RIGHT CORNER AT REAR OF EACH CABINET.
  3. RF OUTPUT CONNECTION- 3-1/8 INCH EIA 50 OHM FEMALE FIELD FLANGE
  4. AIR OUTLET AT TOP 4800 CFM (13.9 CUBIC METERS PER MINUTE) TOTAL.
  5. ACCESS FOR AC POWER THROUGH EACH CABINET TOP ACCESS HOLE.
  6. ACCESS FOR REMOTE CONTROL AND AUDIO CONNECTIONS THROUGH TOP OF CABINET.
  7. 1-5/8 INCH EIA FIELD FLANGE CONNECTION FOR EXTERNAL REJECT LOAD.
  8. COVER PLATE TO PLUG CONTROL CABINET TOP HOLES.
  9. RF SAMPLE PORT FOR MODULATION MONITOR.
  10. HEAT DISSIPATION:  
16 KW (54,608 BTU/H) NOMINAL AT A 20 KW RF OUTPUT, 50 OHM RESISTIVE LOAD.  
20 KW (68,260 BTU/H) AT A 20 KW RF OUTPUT INTO A 1.4:1 VSWR LOAD.
  11. WEIGHT: 1300 LBS (590 Kg) STANDARD UNPACKED. 1370 LBS (623 Kg) WITH OPTIONAL STANDBY EXCITER, IPA, AND POWER SUPPLY OPTIONS.
  12. AC POWER CONSUMPTION:  
36 KW NOMINAL AT A 20 KW RF OUTPUT INTO A 50 OHM RESISTIVE LOAD WITH A 230 VAC INPUT.  
40 KW AT A 20 KW RF OUTPUT INTO A 1.4:1 VSWR LOAD WITH A 230 VAC INPUT.
  13. AC POWER INPUT PER CABINET:  
196 TO 252 VAC 50/60 Hz SINGLE PHASE, 110 AMPERES (MAX. CONDITION)  
196 TO 252 VAC OR 339 TO 437 VAC THREE PHASE, 64 AMPERES (MAX. CONDITION).  
FUSE DISCONNECT SWITCH RECOMMENDED. FOR PROPER SIZING OF FUSES, REFER TO FOLLOWING TEXT, NATIONAL ELECTRIC CODE, AND LOCAL CODES.
  14. PRIMARY AC FUSED DISCONNECT PER CABINET:  
SINGLE PHASE 196 TO 252 VAC: THREE PHASE 196 TO 252 VAC:  
FUSE SIZE - 150 AMP FUSE SIZE - 100 AMP  
WIRE SIZE - 2/0 COPPER AWG. TYPE THHN WIRE SIZE - #1 COPPER AWG. TYPE THHN
  15. POWER FACTOR - 0.98 @ 230 VAC WITH A 20 KW RF OUTPUT INTO A 50 OHM LOAD.



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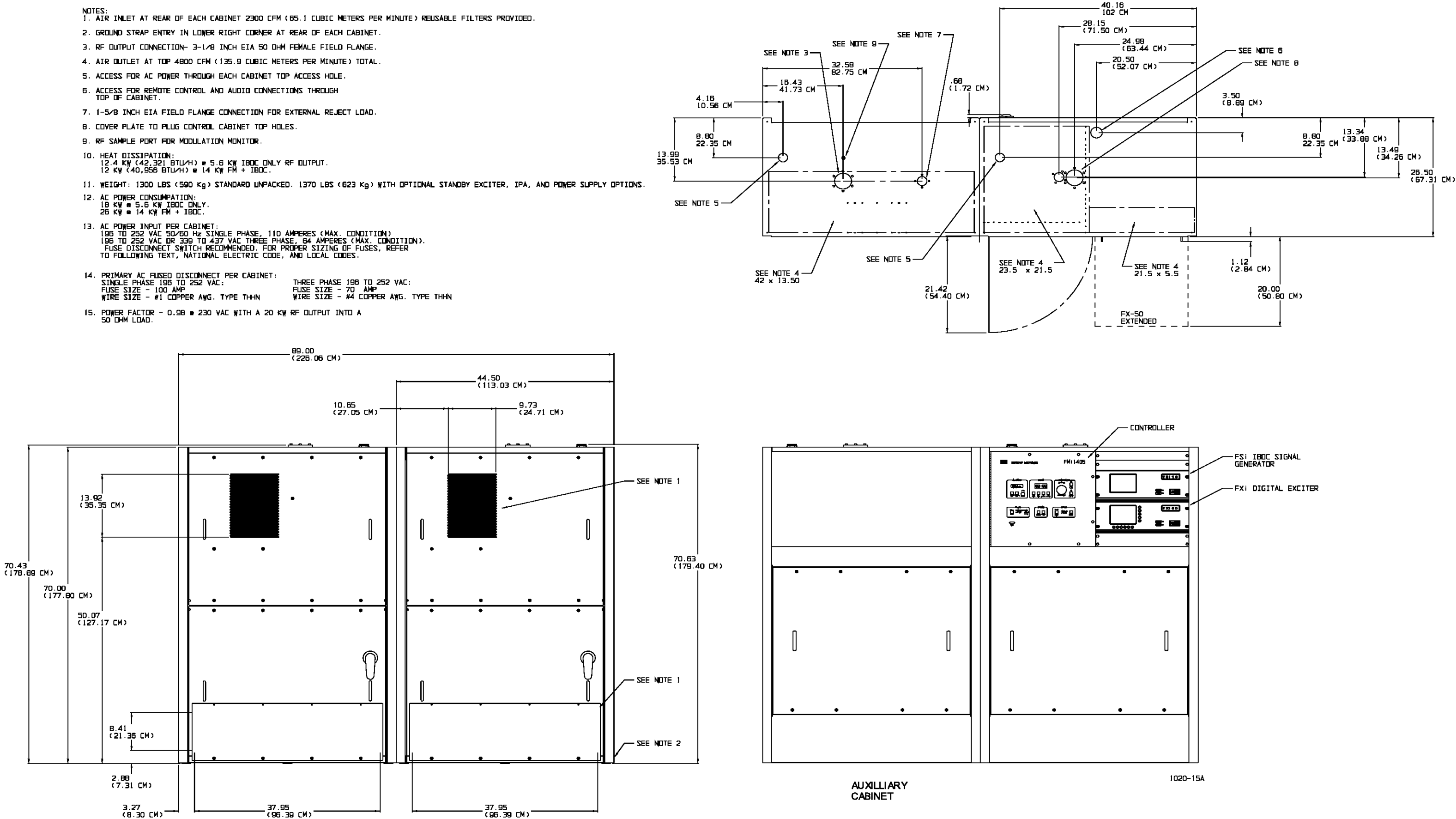
**597-1020-15**

### FIGURE 2-1. INSTALLATION DIAGRAM, FM-20S

(2-3/2-4)



- NOTES:
1. AIR INLET AT REAR OF EACH CABINET 2300 CFM (65.1 CUBIC METERS PER MINUTE) REUSABLE FILTERS PROVIDED.
  2. GROUND STRAP ENTRY IN LOWER RIGHT CORNER AT REAR OF EACH CABINET.
  3. RF OUTPUT CONNECTION- 3-1/8 INCH EIA 50 OHM FEMALE FIELD FLANGE.
  4. AIR OUTLET AT TOP 4800 CFM (135.9 CUBIC METERS PER MINUTE) TOTAL.
  5. ACCESS FOR AC POWER THROUGH EACH CABINET TOP ACCESS HOLE.
  6. ACCESS FOR REMOTE CONTROL AND AUDIO CONNECTIONS THROUGH TOP OF CABINET.
  7. 1-5/8 INCH EIA FIELD FLANGE CONNECTION FOR EXTERNAL REJECT LOAD.
  8. COVER PLATE TO PLUG CONTROL CABINET TOP HOLES.
  9. RF SAMPLE PORT FOR MODULATION MONITOR.
  10. HEAT DISSIPATION:  
12.4 KW (42,321 BTU/H) ■ 5.6 KW IBOC ONLY RF OUTPUT.  
12 KW (40,956 BTU/H) ■ 14 KW FM + IBOC.
  11. WEIGHT: 1300 LBS (590 Kg) STANDARD UNPACKED. 1370 LBS (623 Kg) WITH OPTIONAL STANDBY EXCITER, IPA, AND POWER SUPPLY OPTIONS.
  12. AC POWER CONSUMPTION:  
18 KW ■ 5.6 KW IBOC ONLY.  
26 KW ■ 14 KW FM + IBOC.
  13. AC POWER INPUT PER CABINET:  
196 TO 252 VAC 50/60 Hz SINGLE PHASE, 110 AMPERES (MAX. CONDITION)  
196 TO 252 VAC OR 339 TO 437 VAC THREE PHASE, 64 AMPERES (MAX. CONDITION).  
FUSE DISCONNECT SWITCH RECOMMENDED. FOR PROPER SIZING OF FUSES, REFER TO FOLLOWING TEXT, NATIONAL ELECTRIC CODE, AND LOCAL CODES.
  14. PRIMARY AC FUSED DISCONNECT PER CABINET:  
SINGLE PHASE 196 TO 252 VAC: FUSE SIZE - 100 AMP  
WIRE SIZE - #1 COPPER AWG. TYPE THHN  
THREE PHASE 196 TO 252 VAC: FUSE SIZE - 70 AMP  
WIRE SIZE - #4 COPPER AWG. TYPE THHN
  15. POWER FACTOR - 0.98 ■ 230 VAC WITH A 20 KW RF OUTPUT INTO A 50 OHM LOAD.



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597-1020-15

FIGURE 2-2. INSTALLATION  
DIAGRAM, FMi 1405

(2-5/2-4)



2-21. **EQUIPMENT INSTALLATION.**



**WARNING**

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

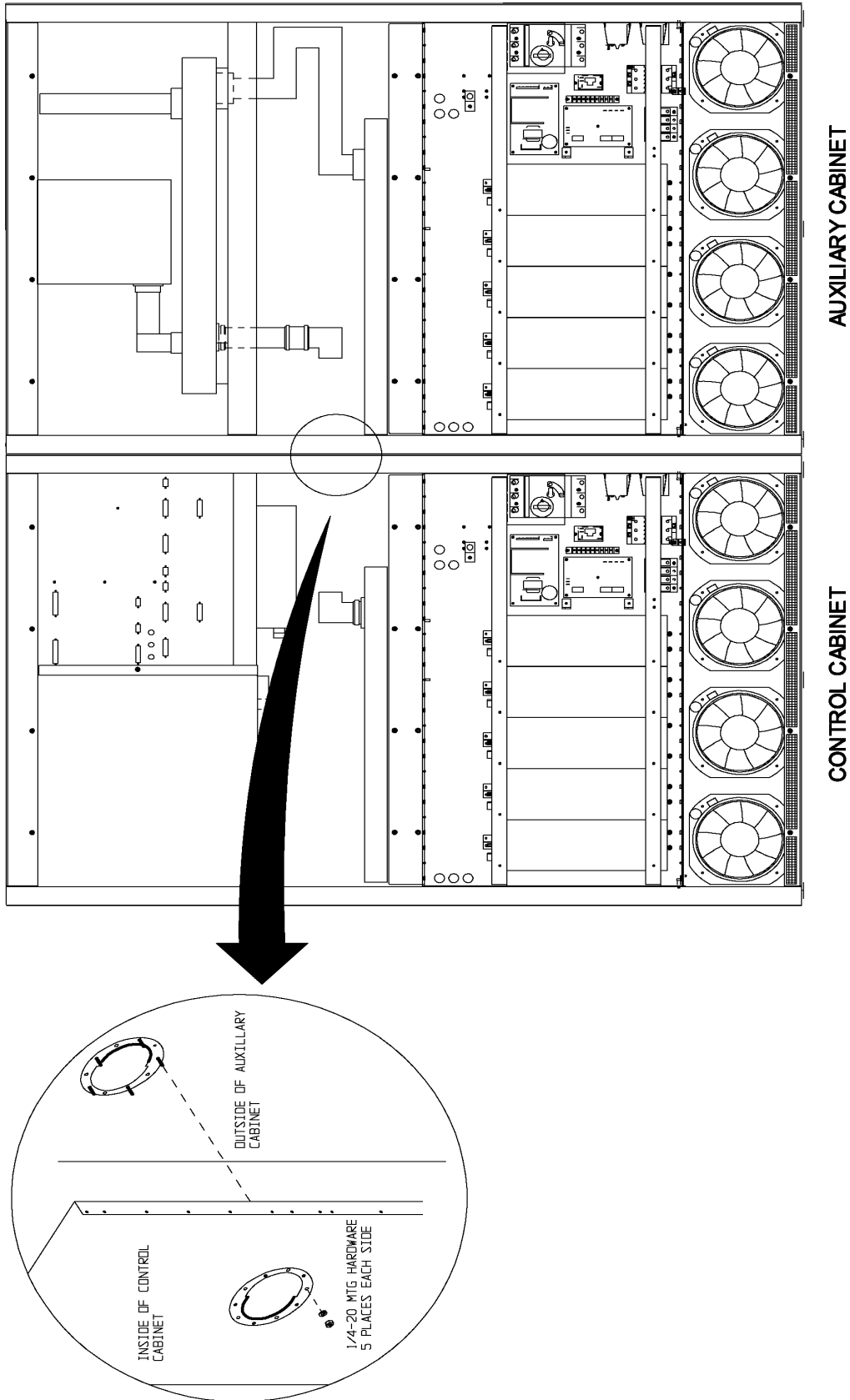
**WARNING**

2-22. **CONTROL AND AUXILIARY CABINET INSTALLATION.**

The FM-20S/FMi 1405 transmitter is shipped as two separate cabinets (control and auxiliary). The control cabinet contains the transmitter controller section and the auxiliary does not contain a controller. See FIGURE 2-3 through FIGURE 2-6, pages 2-8 through 2-11.

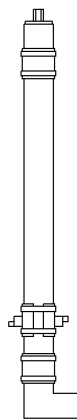
To install the control and auxiliary cabinets refer to FIGURE 2-3, through FIGURE 2-7, pages 2-8 through 2-12 and perform the following instructions.

1. Place both the control and auxiliary cabinets in their location.
2. Align the two cabinets at the transmission line access hole so the five threaded studs of the auxiliary cabinet insert through holes of the control cabinet. Refer to FIGURE 2-3, page 2-8. Apply the five lock washers and hex nuts and tighten.
3. Connect the RF transmission line. Refer to FIGURE 2-4, page 2-9.
4. Connect the data cables and RF cables on the controller rear panel. Refer to FIGURE 2-5 and FIGURE 2-6, pages 2-10 and 2-11.
5. Connect the RF drive cables #315 and #305 through the interface panel. Refer to FIGURE 2-7, page 2-12.
6. Connect the FWD and RFL cables to the transmission line. Refer to FIGURE 2-7, page 2-12.



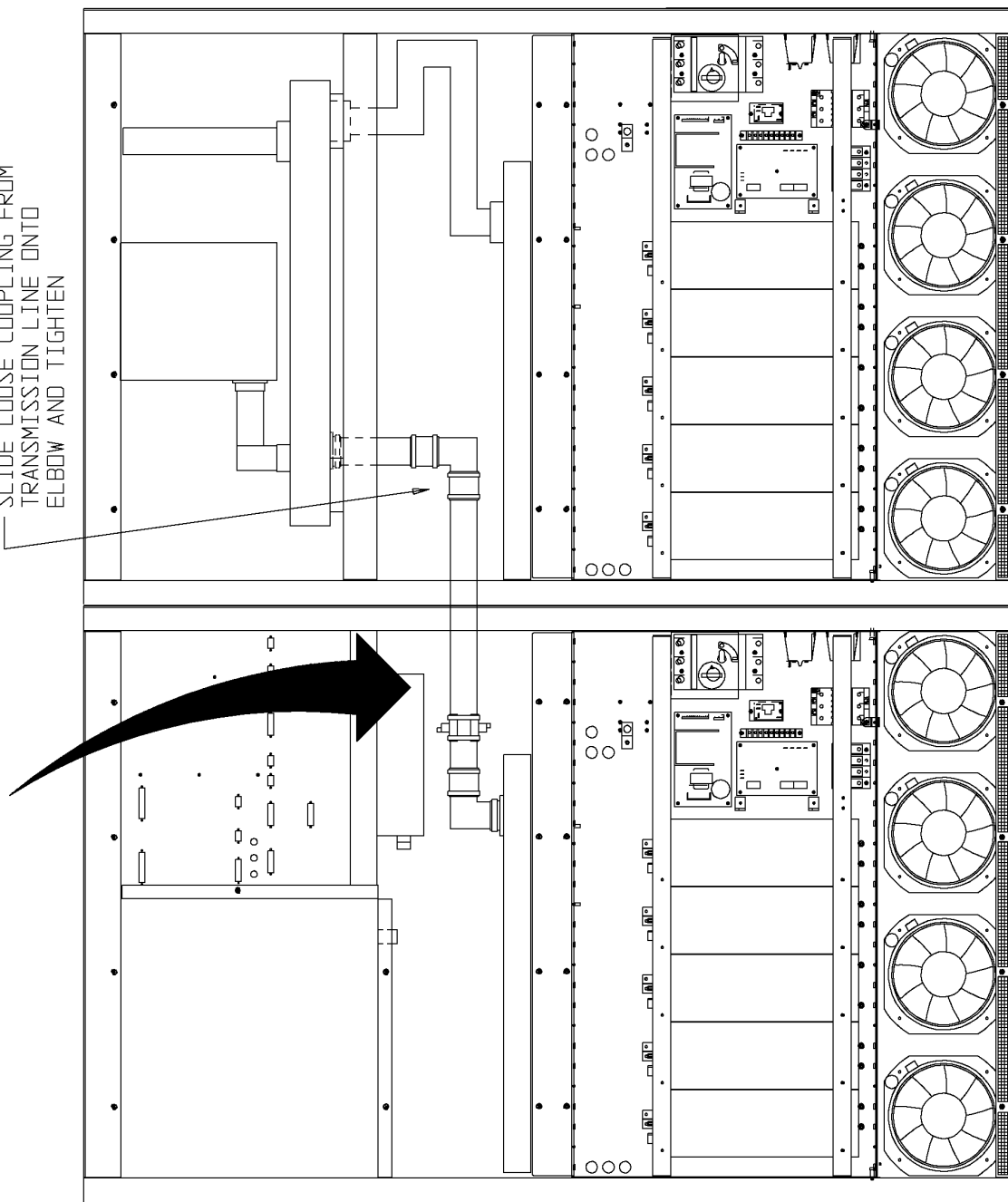
**FIGURE 2-3. CABINET CONNECTION DETAIL**





INSERT TRANSMISSION LINE BETWEEN ELBOW IN THE AUXILIARY CABINET AND THE COMBINER IN THE CONTROL CABINET. SECURE ELBOW HARDWARE.

SLIDE LOOSE COUPLING FROM TRANSMISSION LINE ONTO ELBOW AND TIGHTEN



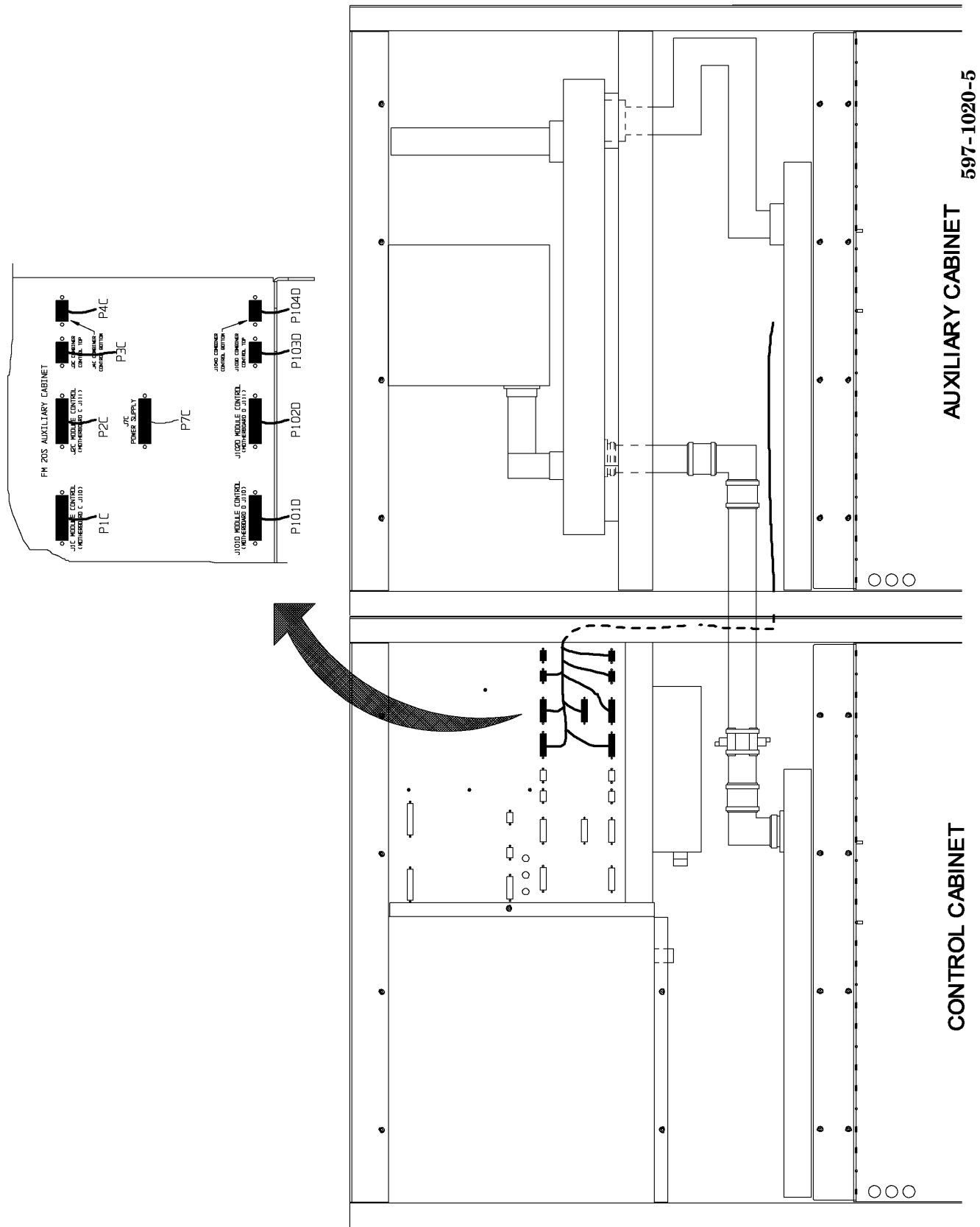
**CONTROL CABINET**

**AUXILIARY CABINET**

**597-1020-3**

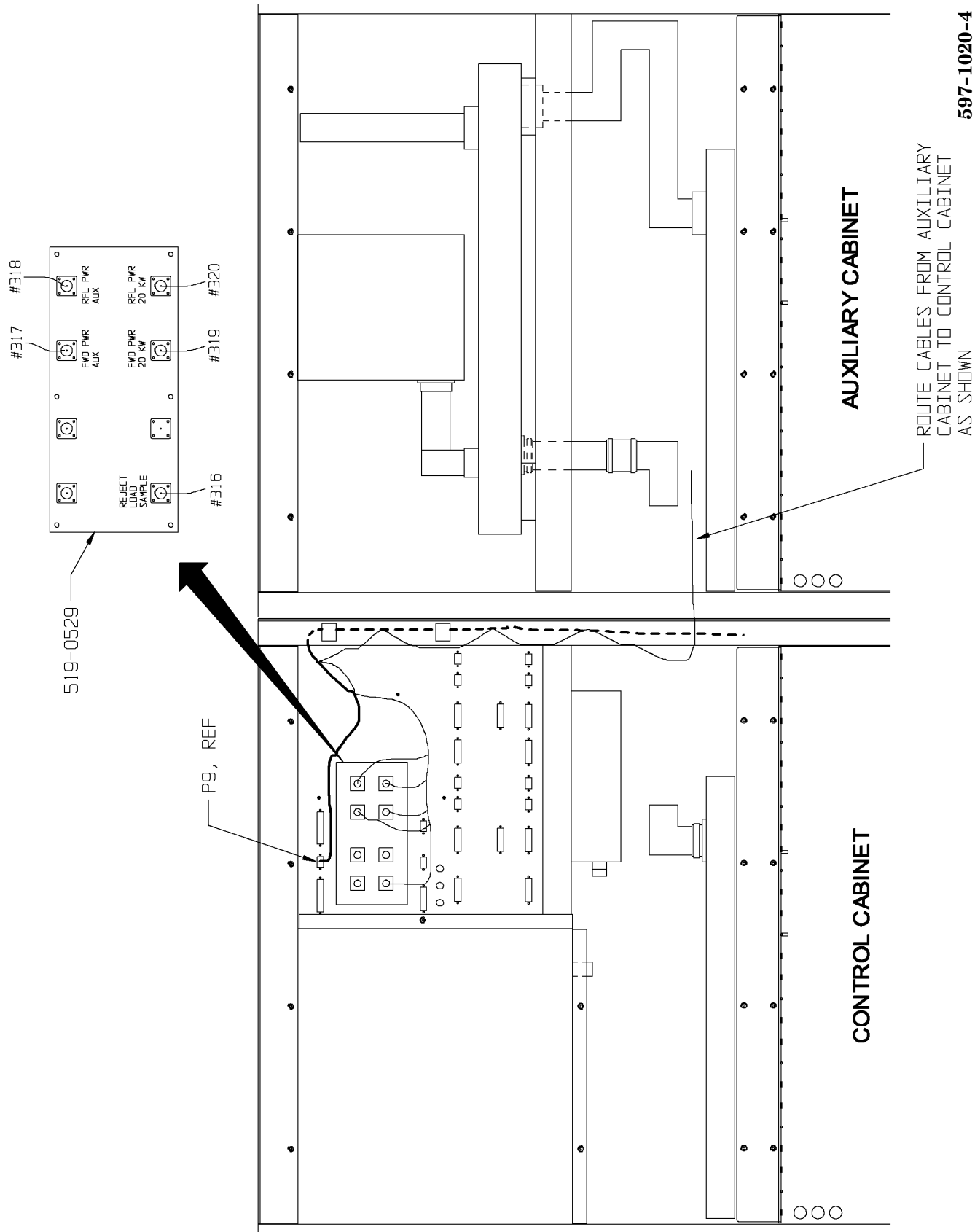
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**FIGURE 2-4. TRANSMISSION LINE CONNECTION**



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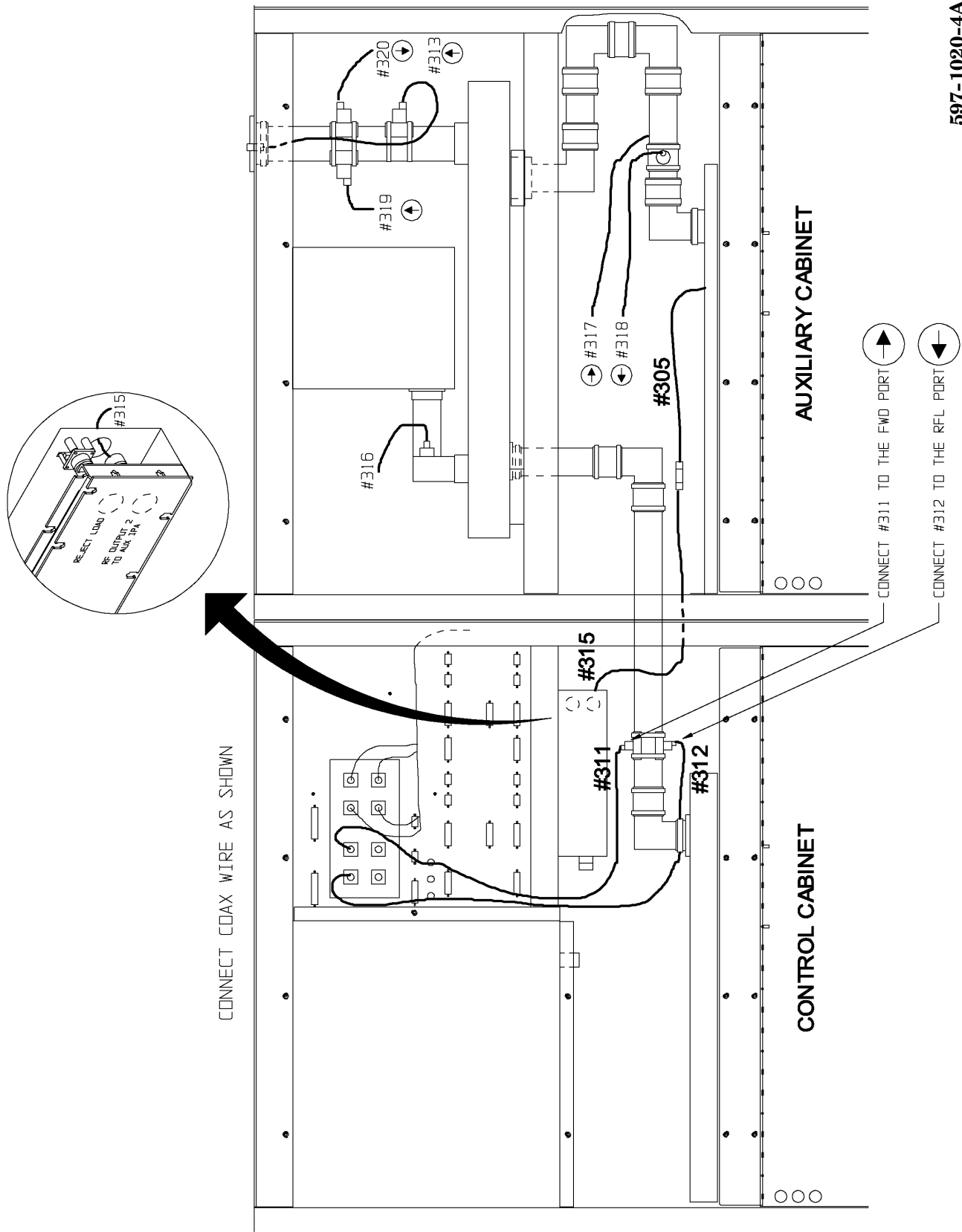
**FIGURE 2-5. DATA CABLE CONNECTIONS ON CONTROLLER REAR PANEL**



597-1020-4

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FIGURE 2-6. CONNECTIONS ON DIRECTIONAL COUPLER BOARD



**597-1020-4A**

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**FIGURE 2-7. TRANSMISSION LINE WIRING CONNECTION**

2-23. **FM Exciter Installation (FM-20S).** The transmitter may be equipped with the standard FX-50 exciter or the optional FXi 60 digital exciter. For transmitters equipped with an FX-50 or FXi 60 exciter, perform the following installation procedure.

1. Locate the FX-50 or optional FXi 60 exciter.
2. Refer to FX-50 exciter manual 597-1050 and perform the PRELIMINARY INSTALLATION PROCEDURES to unpack and configure the exciter for the desired operation. For an FXi 60, refer to exciter manual 597-0541.
3. Place the exciter on the slide-rails (FX-50 only).
4. Refer to FIGURE 2-8, page 2-14 and re-connect the FX-50 or FXi 60 wiring as shown.

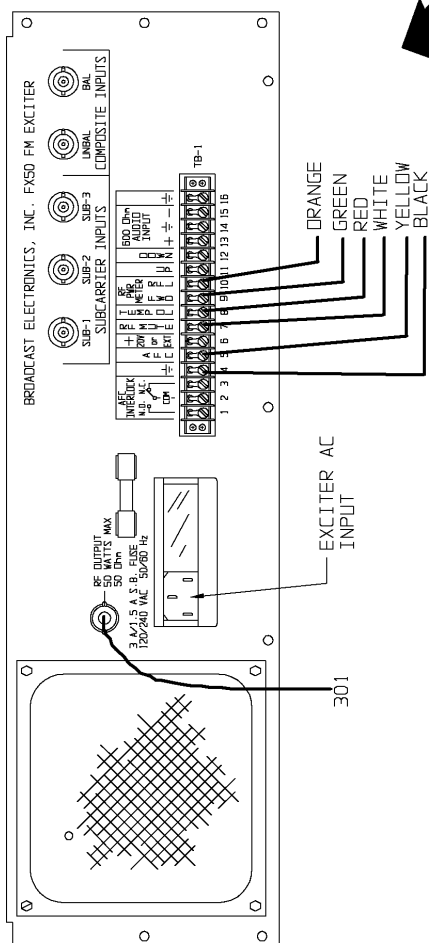


**WARNING**

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

**WARNING**

REAR VIEW OF FX-50 EXCITER



REAR VIEW OF FXI DIGITAL EXCITER

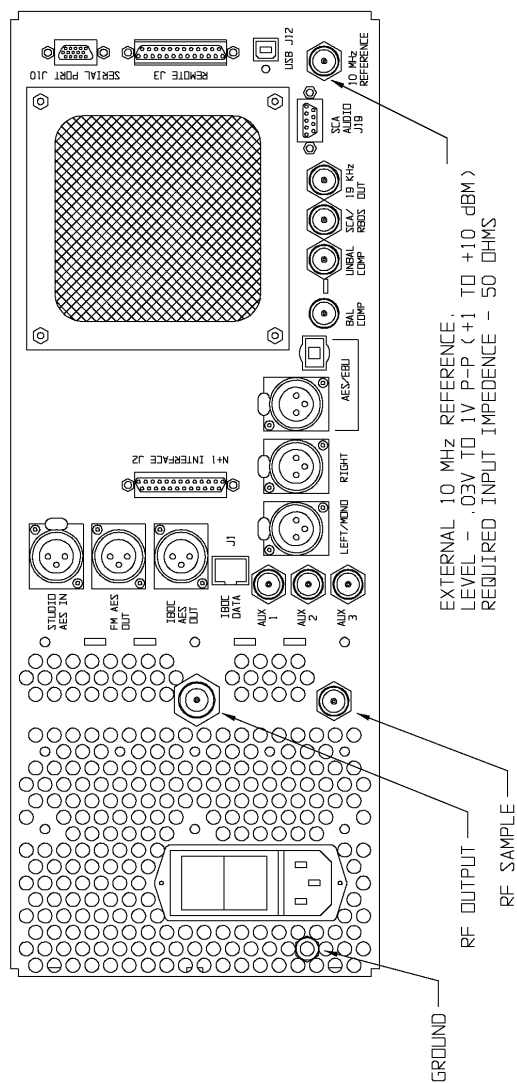


FIGURE 2-8. FX-50 WIRING

**597-1020-38**

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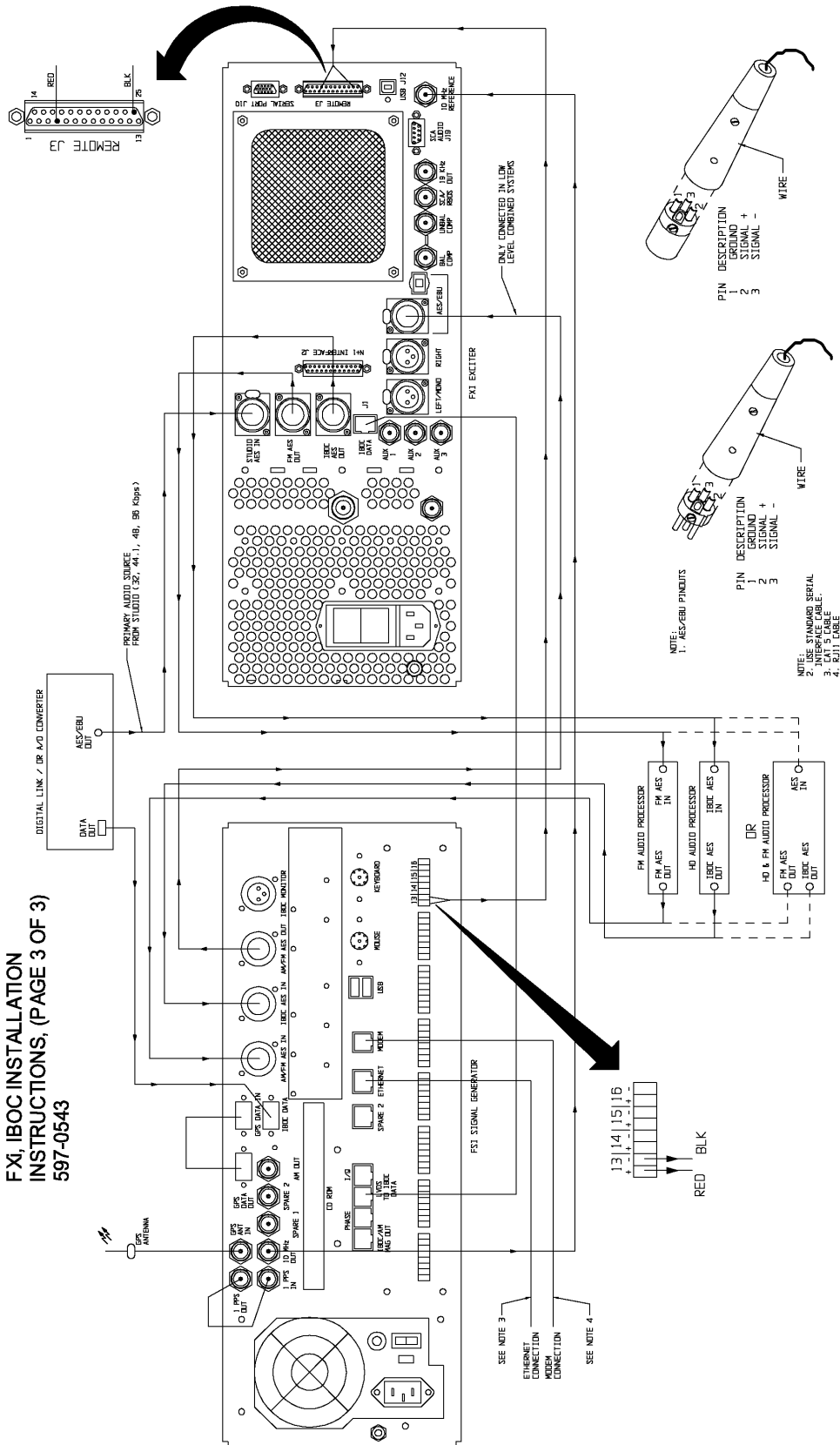
- 2-24. **HD Radio Exciter Installation.** The FMi 1405 is equipped with a FSi 10 HD Radio Signal Generator and a FXi 60 FM/HD Radio Exciter. Locate these two units and install in the transmitter. Reference FIGURE 2-2, page 2-5. Note that these can be re-arranged to allow installation of audio processing if necessary.

Utilize the following check list as well as FIGURE 2-9, page 2-16 to complete the interconnections between the FXi 60, FSi 10, and FMi 1405.

- ☐ Install FXi 60 in the transmitter.
- ☐ Install FSi 10 in the transmitter.
- ☐ Connect 1PPS Out on FSi 10 to 1PPS In on FSi 10
- ☐ Connect GPS Data Out on FSi 10 to GPS Data In on FSi 10
- ☐ Connect FSi 10 LVDS IBOC Data to FXi 60 IBOC Data
- ☐ Connect J3 on FXi 60 Exciter to J1 on the FMi 1405 Remote Interface board and to Output 13 (+/-) on the FSi 10.
- ☐ Connect 10MHz Out on FSi 10 to 10MHz Reference on FXi 60
- ☐ Connect Main Audio Feed from studio into Studio AES In on FXi 60 (This must be AES/EBU format at 32, 44.1, 48, or 96kbps).
- ☐ In a low-level combined system or when your existing FM transmitter can take AES input connect FM AES Out from FXi 60 to your FM Audio Processor AES Input. In a high-level combined or separate antenna installation where your existing transmitter requires a composite input, connect the FM AES Out from the FXi 60 directly to the AM/FM AES In on the FSi 10.
- ☐ Connect IBOC AES Out from FXi 60 to you HD Radio Audio Processor AES Input.

**Note:** When utilizing one processor for both FM and HD Radio you can use either the FM AES Out or IBOC AES Out from the FXi 60 to drive the AES input on your processor.

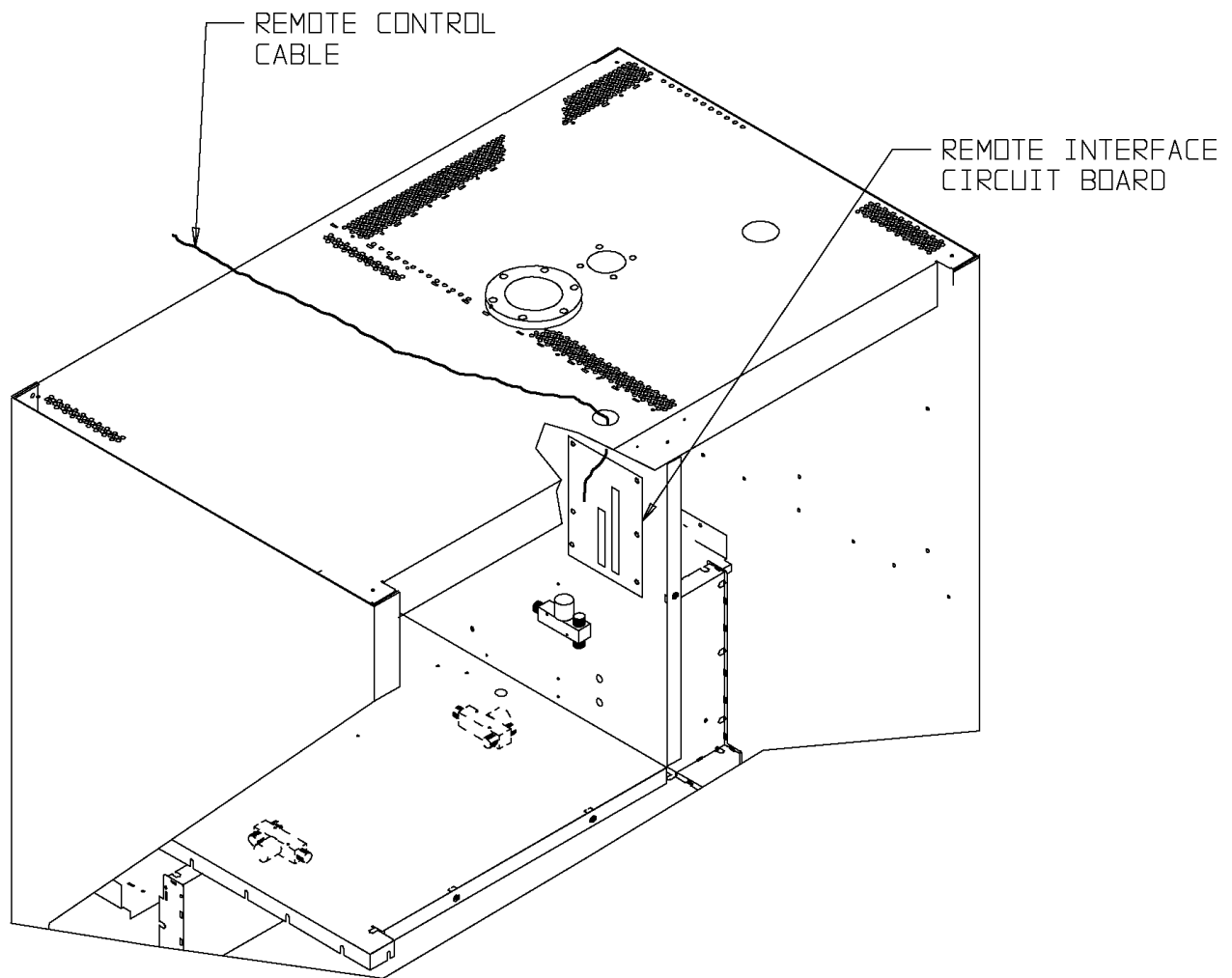
- ☐ In a low-level combined system or when your existing FM transmitter can take AES input connect the FM Audio Processor AES Out to the AM/FM AES input on FSi 10. In a high-level combined or separate antenna installation where your existing transmitter requires a composite input, connect the FM AES Out from the FXi 60 directly to the AM/FM AES In on the FSi 10.
- ☐ Connect the HD Radio Audio Processor AES Out to the IBOC AES In on FSi 10.
- ☐ In a low-level combined system connect the AM/FM AES Out to the AES/EBU input on the FXi 60. In a high-level combined or separate antenna system this output would go to your existing FM transmitter. If your existing FM transmitter requires a composite input, connect the AM/FM AES Out from the FSi 10 to the AES input on your FM Audio Processor and connect the composite output to your existing FM transmitter.
- ☐ If your Studio to Transmitter Link (STL) can support 4kbps of data you can send song artist and title information over the link. Connect the data output from the STL to the IBOC data input on the FSi 10. This type of data can also be sent via Ethernet or Modem.

FXI, IBOC INSTALLATION  
INSTRUCTIONS, (PAGE 3 OF 3)  
597-0543

**FIGURE 2-9. INTERCONNECTIONS BETWEEN Fxi 60, Fsi 10 AND Fmi 1405**



- 2-25. **REMOTE CONTROL/STATUS I/O WIRING.**
- 2-26. **REMOTE CONTROL.** The FM-20S/FMi 1405 transmitter is designed for complete remote control operation. The transmitter will interface with almost any remote control unit or a diagnostic system. The following text presents a description of the FM-20S/FMi 1405 remote control functions and indications.
- 2-27. Remote control connections are interfaced to the transmitter at TB1/TB2 on the remote interface circuit board (refer to FIGURE 2-10, page 2-18). Route and connect the cables to TB1/TB2 as shown. Refer to FIGURE 2-11, page 2-19 and the following paragraphs for detailed connections to the remote control I/O board as well as the configuration and setup.
- 2-28. The transmitter controller: 1) provides positive or negative control logic and 2) +4/+2 volt dc remote full-scale meter indications. Positive/negative control is determined by jumper J10 on the supervisor circuit board assembly. Positive control requires the use of a momentary contact to a +5 volt to +12 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 the indicators. +4/+2 volt operation is determined by header J12 on the supervisor circuit board assembly. Refer to FIGURE 2-11, page 2-19 and the following text to connect remote control equipment to the system. The transmitter is programmed from the factory for positive remote control operations and +4 volt dc remote meter indications.
- 2-29. **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 operation. The transmitter is shipped with the remote forward and reflected power meter indications programmed for +4 volt full-scale operation. The meter full-scale indication is equal to: 1) forward power: +3.92V dc = 20 kW and 2) reflected power: +2.5V dc = 500 watts. Metering ground is recommended for remote meter ground connections.
- 2-30. **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 the transmitter PA power supply bus voltage. The temperature indication monitors the transmitter inlet air temperature. The indications can be programmed for +4 VDC full-scale or +2 VDC full-scale operation. +4/+2 volt operation is determined by header J12 on the supervisor circuit board assembly. The transmitter is shipped with the remote PA power supply bus voltage/inlet temperature meter indications programmed for +4 volt full-scale operation. The meter indications are as follows: 1) Power Supply Bus Voltage + 3.48 V = 45 V and 2) Temperature + 1.25 V = 25 °C. Metering ground is recommended for remote meter ground connections.
- 2-31. **Remote PA Current Meter Indications.** The remote PA current meter indication is located at TB2-5. The PA current indication monitors the transmitter PA power supply bus current. The indication can be programmed for +4 VDC full-scale or +2 VDC full-scale operation. +4/+2 volt operation is determined by header J12 on the supervisor circuit board assembly. The transmitter is shipped with the remote PA current meter indication programmed for +4 volt full-scale operation. The meter indication is equal to 3.80 V @ 600 A. Metering ground is recommended for remote meter ground connections.
- 2-32. **Fail-Safe Out/Fail-Safe In Connection.** The FM-20S/FMi 1405 provides for two different external fail-safe loops. The fail-safe connection is used for the interfacing of an external interlock to the transmitter such as a test load interlock, motorized coaxial switch, or a remote control unit. The first fail-safe connection is provided at TB2-10 and TB2-11. The fail-safe out connection is located at TB2-10. The fail-safe in connection is located at TB2-11. If a fail-safe connection is desired, connect the device between TB2-10 and TB2-11. The second fail-safe loop has its output on TB1-11, and its return on TB1-10. If the second fail-safe loop is needed, it can be added by cutting off a jumper wire on the board in the place provided and labeled W2.

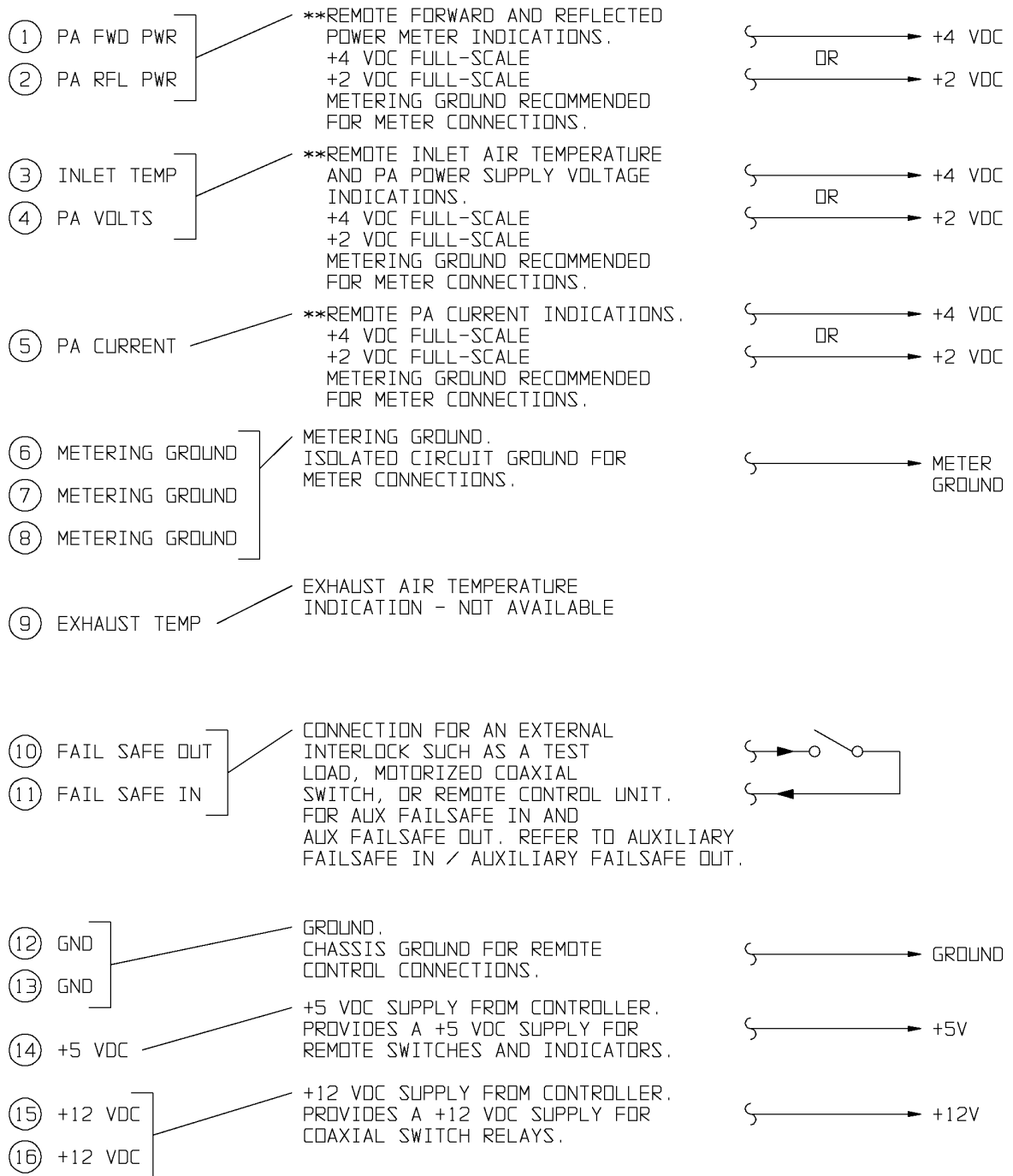


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**FIGURE 2-10. REMOTE INTERFACE CIRCUIT BOARD/CONNECTOR LOCATION**

## TB2 PIN DESCRIPTIONS



**597-1012-14A**

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**FIGURE 2-11. REMOTE CONTROL INTERFACE CONNECTIONS AND PROGRAMMING (SHEET 1 OF 4)**

# TB1 PIN DESCRIPTIONS

① STANDBY EXCITER	———	* STANDBY EXCITER ON CONTROL. POSITIVE CONTROL: MOMENTARY CONTACT TO +5 TO +12 VDC REQUIRED TO SWITCH AND ENABLE STANDBY EXCITER. NEGATIVE CONTROL: MOMENTARY CONTACT TO GROUND REQUIRED TO SWITCH AND ENABLE STANDBY EXCITER.	
② STANDBY IPA	———	* CONTROL CABINET STANDBY IPA ON CONTROL. POSITIVE CONTROL: MOMENTARY CONTACT TO +5 TO +12 VDC REQUIRED TO SWITCH AND ENABLE STANDBY IPA. NEGATIVE CONTROL: MOMENTARY CONTACT TO GROUND REQUIRED TO SWITCH AND ENABLE STANDBY IPA.	
③ AUX STBY IPA	———	* AUXILIARY CABINET STANDBY IPA ON CONTROL POSITIVE CONTROL: MOMENTARY CONTACT TO +5 TO +12 VDC REQUIRED TO SWITCH AND ENABLE STANDBY IPA. NEGATIVE CONTROL: MOMENTARY CONTACT TO GROUND REQUIRED TO SWITCH AND ENABLE STANDBY IPA.	
④ TRANSMITTER ON	———	* TRANSMITTER ON CONTROL. POSITIVE CONTROL: MOMENTARY CONTACT TO +5 TO +12 VDC REQUIRED TO OPERATE TRANSMITTER TO ON. NEGATIVE CONTROL: MOMENTARY CONTACT TO GROUND REQUIRED TO OPERATE TRANSMITTER TO ON.	
⑤ TRANSMITTER OFF	———	* TRANSMITTER OFF CONTROL. POSITIVE CONTROL: MOMENTARY CONTACT TO +5 TO +12 VDC REQUIRED TO OPERATE TRANSMITTER TO OFF. NEGATIVE CONTROL: MOMENTARY CONTACT TO GROUND REQUIRED TO OPERATE TRANSMITTER TO OFF.	
⑥ RAISE PA PWR	———	* TRANSMITTER RAISE POWER CONTROL. POSITIVE CONTROL: MOMENTARY CONTACT TO +5 TO +12 VDC REQUIRED TO RAISE TRANSMITTER POWER. NEGATIVE CONTROL: MOMENTARY CONTACT TO GROUND REQUIRED TO RAISE TRANSMITTER POWER.	
⑦ LOWER PA PWR	———	* TRANSMITTER LOWER POWER CONTROL. POSITIVE CONTROL: MOMENTARY CONTACT TO +5 TO +12 VDC REQUIRED TO LOWER TRANSMITTER POWER. NEGATIVE CONTROL: MOMENTARY CONTACT TO GROUND REQUIRED TO LOWER TRANSMITTER POWER.	
⑧ PRESET PA PWR	———	* PRESET POWER ON CONTROL. POSITIVE CONTROL: SUSTAINED CONTACT TO +5 TO +12 VDC REQUIRED TO ENABLE PRESET POWER. NEGATIVE CONTROL: SUSTAINED CONTACT TO GROUND REQUIRED TO ENABLE PRESET POWER.	
⑨ FAULT RESET	———	* TRANSMITTER FAULT RESET CONTROL. POSITIVE CONTROL: MOMENTARY CONTACT TO +5 TO +12 VDC REQUIRED TO RESET THE FAULT CIRCUIT. NEGATIVE CONTROL: MOMENTARY CONTACT TO GROUND REQUIRED TO RESET THE FAULT CIRCUIT.	

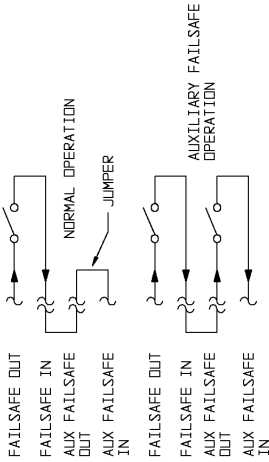
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**FIGURE 2-11. REMOTE CONTROL INTERFACE CONNECTIONS AND  
PROGRAMMING (SHEET 2 OF 4)**

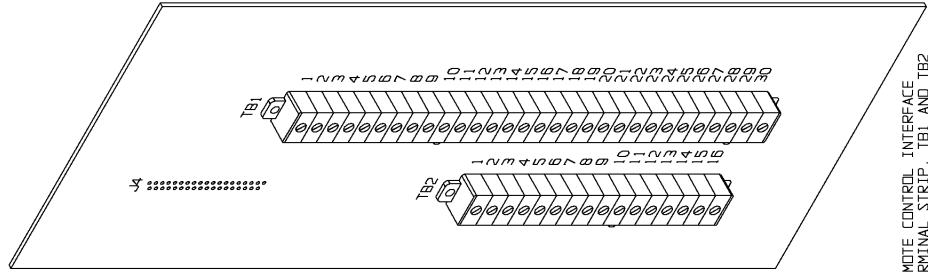
# TB1 DESCRIPTIONS

- (10) AUXILIARY FAILSAFE IN — CONNECTION FOR ADDITIONAL EXTERNAL INTERLOCKS. FOR NORMAL OPERATION, CONNECT A JUMPER BETWEEN AUXILIARY FAILSAFE IN AND AUXILIARY FAILSAFE OUT.
- (11) AUXILIARY FAILSAFE OUT



- (12) NC — NO CONNECTION
- (13) NC

- (14) AUXILIARY STANDBY IPA — AUXILIARY CABINET STANDBY IPA ENABLED INDICATION. LOW (OVDC) WHEN ACTIVE, 100mA MAX.
- (15) ON STATUS — TRANSMITTER ON INDICATION. LOW (OVDC) WHEN ACTIVE, 100 nA MAX.
- (16) OFF STATUS — TRANSMITTER OFF INDICATION. LOW (OVDC) WHEN ACTIVE, 100 nA MAX.
- (17) PRESET STATUS — TRANSMITTER PRESET POWER INDICATION. LOW (OVDC) WHEN ACTIVE, 100 nA MAX.
- (18) STANDBY EXC STATUS — STANDBY EXCITER ENABLED INDICATION. LOW (OVDC) WHEN ACTIVE, 100 nA MAX.
- (19) STANDBY IPA STATUS — CONTROL CABINET STANDBY IPA ENABLED INDICATION. LOW (OVDC) WHEN ACTIVE, 100 nA MAX.
- (20) FAULT STATUS — TRANSMITTER FAULT INDICATION. LOW (OVDC) WHEN ANY OF THE FOLLOWING FAULTS OCCUR: 1) POWER SUPPLY, 2) VSWR, 3) MODULE, 4) DRIVE, AND 5) AC POWER, 100 nA MAX.
- (21) REMOTE DISABLE STATUS — REMOTE DISABLE STATUS INDICATION. LOW (OVDC) WHEN ACTIVE, 100 nA MAX.
- (22) SPARE 1 — FOR FUTURE EXPANSION
- (23) SPARE 2
- (24) SPARE 3
- (25) NC — NO CONNECTION
- (26) POWER SUPPLY FAULT — POWER SUPPLY FAULT INDICATION. LOW (OVDC) WHEN ONE OR MORE POWER SUPPLIES ENCOUNTER A FAULT, 100 nA MAX.
- (27) VSWR FAULT — VSWR FAULT INDICATION. LOW (OVDC) WHEN 1.4:1 VSWR CONDITION OCCURS, 100 nA MAX.
- (28) MODULE FAULT — MODULE FAULT INDICATION. LOW (OVDC) WHEN ONE OR MORE POWER AMPLIFIER MODULES ENCOUNTER A FAULT, 100 nA MAX.
- (29) DRIVE FAULT — DRIVE FAULT INDICATION. LOW (OVDC) WHEN THE IPA OUTPUT IS BELOW 80 WATTS, 100 nA MAX.
- (30) AC POWER FAULT — AC POWER FAULT INDICATION. LOW (OVDC) WHEN THE AC LINE IS ABOVE 255 VOLTS OR BELOW 168 VOLTS, 100 nA MAX.

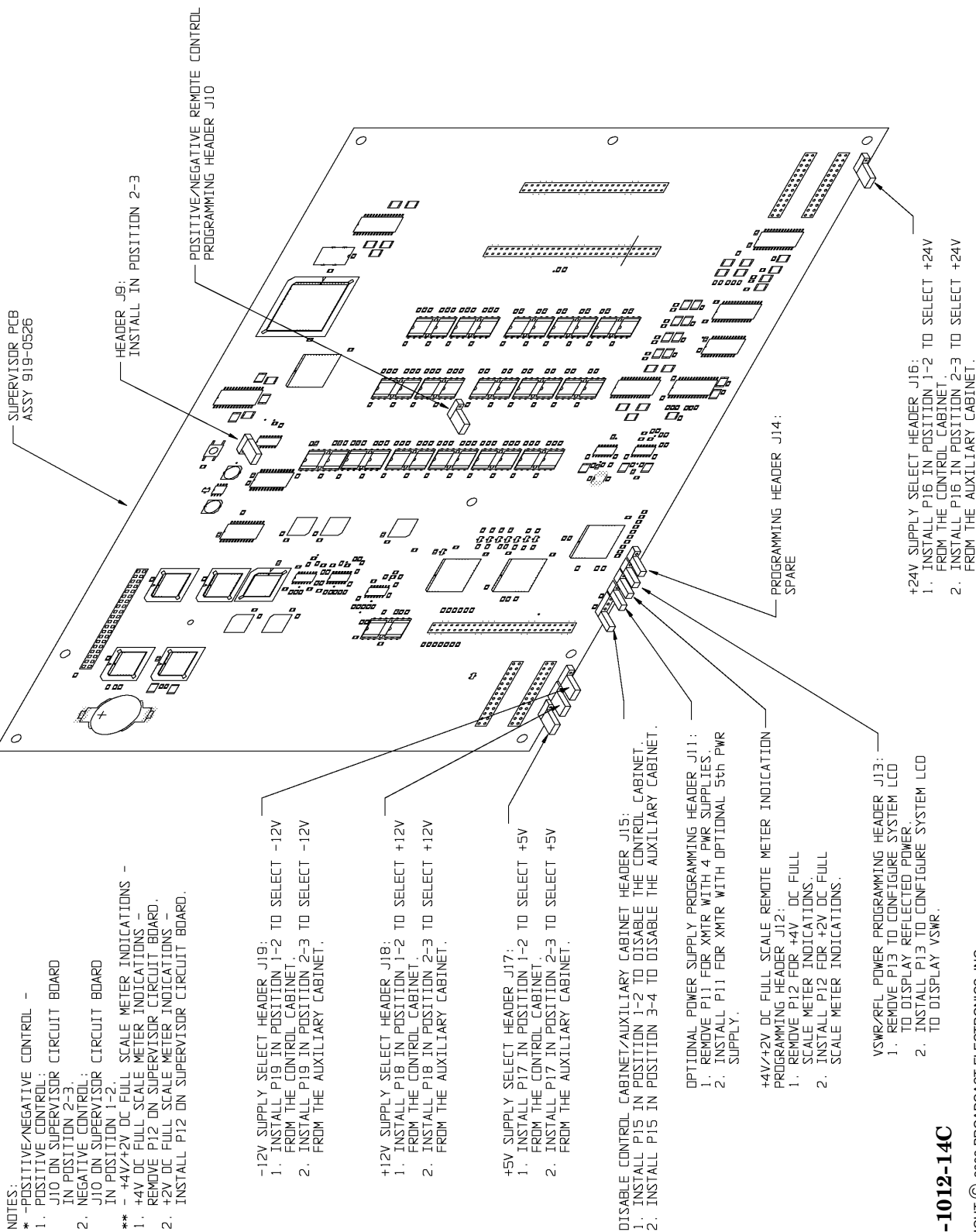


REMOTE CONTROL INTERFACE  
TERMINAL STRIP, TB1 AND TB2

597-1012-14D

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FIGURE 2-11. REMOTE CONTROL INTERFACE CONNECTIONS AND  
PROGRAMMING (SHEET 3 OF 4)



**597-1012-14C**

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**FIGURE 2-11. REMOTE CONTROL INTERFACE CONNECTIONS AND PROGRAMMING (SHEET 4 OF 4)**

- 2-33. **Remote Standby Exciter On Control.** The standby exciter on function is located at TB1-1. The function can be activated using positive or negative control. Positive control requires the use of a momentary contact to a +5 to +12 VDC signal to operate the standby exciter to on. Negative control requires the use of a momentary contact to ground to operate the standby exciter to on. Positive/negative remote control operation is determined by header J10 on the supervisor circuit board.
- 2-34. **Remote Standby IPA On Control.** Each 10 kW cabinet has its own standby IPA command and status line. Each works independent of the other. The Control standby IPA ON function is located at TB1-2. The function can be activated using positive or negative control. Positive control requires the use of a momentary contact to a +5 to +12 VDC signal to operate the standby IPA to ON. Negative control requires the use of a momentary contact to ground to operate the standby IPA to ON. Positive/negative remote control operation is determined by header J10 on the supervisor circuit board. The Auxiliary standby IPA command is on TB1-3, and the Auxiliary standby IPA status is on TB1-14.
- 2-35. **Remote Transmitter On Control.** The transmitter on function is located at TB1-4. The function can be activated using positive or negative control. Positive control requires the use of a momentary contact to a +5 to +12 VDC signal to operate the transmitter to on. Negative control requires the use of a momentary contact to ground to operate the transmitter to on. Positive/negative remote control operation is determined by header J10 on the supervisor circuit board.
- 2-36. **Remote Transmitter Off Control.** The transmitter off function is located at TB1-5. The function can be activated using positive or negative control. Positive control requires the use of a momentary contact to a +5 to +12 VDC signal to operate the transmitter to off. Negative control requires the use of a momentary contact to ground to operate the transmitter to off. Positive/negative remote control operation is determined by header J10 on the supervisor circuit board.
- 2-37. **Remote Power Level Raise Control.** The transmitter power level raise control is located at TB1-6. The function can be activated using positive or negative control. Positive control requires the use of a momentary contact to a +5 to +12 VDC signal to raise the transmitter power level. Negative control requires the use of a momentary contact to ground to raise the transmitter power level. Positive/negative remote control operation is determined by header J10 on the supervisor circuit board.
- 2-38. **Remote Power Level Lower Control.** The transmitter power level lower control is located at TB1-7. The function can be activated using positive or negative control. Positive control requires the use of a momentary contact to a +5 to +12 VDC signal to lower the transmitter power level. Negative control requires the use of a momentary contact to ground to lower the transmitter power level. Positive/negative remote control operation is determined by header J10 on the supervisor circuit board.
- 2-39. **Remote Preset PA Power Control.** The transmitter can be operated to a preset power level by using the preset PA power control function. The preset power function is located at TB1-8. The function can be activated using positive or negative control. Positive control requires the use of a sustained contact to a +5 to +12 VDC signal to operate the transmitter to a preset power level. Negative control requires the use of a sustained contact to ground to operate the transmitter to a preset power level. Positive/negative remote control operation is determined by header J10 on the supervisor circuit board.
- 2-40. **Remote Fault Reset Control.** The fault reset control is designed to reset the transmitter circuitry following a problem. The reset control is located at TB1-9. The function can be activated using positive or negative control. Positive control requires the use of a momentary contact to a +5 to +12 VDC signal to reset the transmitter fault circuitry. Negative control requires the use of a momentary contact to ground to reset the transmitter fault circuitry. Positive/negative remote control operation is determined by header J10 on the supervisor circuit board.
- 2-41. **Transmitter On Indications.** The transmitter on indicator provides a signal to indicate when the transmitter is enabled. The transmitter on indicator is located at TB1-15. The indicator will go LOW (0 VDC) to indicate when the transmitter is enabled.

- 2-42. **Transmitter Off Indications.** The transmitter off indicator provides a signal to indicate when the transmitter is disabled. The transmitter off indicator is located at TB1-16. The indicator will go LOW (0 VDC) to indicate when the transmitter is disabled.
- 2-43. **Preset Power Indications.** The transmitter preset power indicator provides a signal to indicate when the transmitter is operated to the preset power mode. The preset power indicator is located at TB1-17. The indicator will go LOW (0 VDC) to indicate when the transmitter has been operated to the preset power mode.
- 2-44. **Standby Exciter Indications.** The standby exciter indicator provides a signal to indicate when the standby exciter has been enabled. The standby exciter indicator is located at TB1-18. The indicator will go LOW (0 VDC) to indicate when the standby exciter has been enabled.
- 2-45. **Standby IPA Indications.** The standby IPA indicator provides a signal to indicate when the standby IPA has been enabled. The standby IPA indicator is located at TB1-19. The indicator will go LOW (0 VDC) to indicate when the standby IPA has been enabled. The auxiliary standby IPA indicator is located at TB1-14.
- 2-46. **Transmitter Fault Indications.** The transmitter fault indicator provides a signal to indicate when any of the following faults occur: 1) power supply, 2) VSWR, 3) module, 4) RF drive, or 5) AC power. The transmitter fault indicator is located at TB1-20. The indicator will go LOW (0 VDC) when active.
- 2-47. **Remote Disable Status Indications.** The remote disable indicator provides a signal to indicate when the transmitter remote control disable feature is active. The transmitter remote disable status indicator is located at TB1-21. The indicator will go LOW (0 VDC) when active.
- 2-48. **+5 VDC Supply.** A +5 VDC supply is provided for the remote control switches and indicators. The +5 volt dc supply is located at TB2-14. The supply can provide up to 20 mA for indicator and switch operations.
- 2-49. **+12 VDC Supply.** A +12 VDC supply is provided for coaxial switch control relays. The +12 VDC supply is located at TB2-15 and TB2-16. The supply can provide up to 50 mA for control operations.
- 2-50. **PA Power Supply Fault Indications.** The PA power supply fault indicator provides a signal to indicate when one or more power supplies encounter a fault. The PA power supply fault indicator is located at TB1-26. The indicator will go LOW (0 VDC) when active.
- 2-51. **VSWR Indications.** The VSWR fault indicator provides a signal to indicate when a 1.45 : 1 VSWR condition occurs. The VSWR fault indicator is located at TB1-27. The indicator will go LOW (0 VDC) to indicate the presence of a 1.45 : 1 VSWR condition.
- 2-52. **PA Module Fault Indications.** The PA module fault indicator provides a signal to indicate when one or more PA RF power modules encounter a fault. The PA RF power module fault indicator is located at TB1-28. The indicator will go LOW (0 VDC) when active.
- 2-53. **Drive Fault Indications.** The drive fault indicator provides a signal to indicate when the IPA output is below 80 watts. The drive fault indicator is located at TB1-29. The indicator will go LOW (0 VDC) to indicate when the IPA output is below 80 watts.
- 2-54. **AC Power Fault Indications.** The AC power supply fault indicator provides a signal to indicate when: 1) the AC line is above 255 volts or below 168 volts or 2) a loss-of-phase condition occurs. The AC power supply fault indicator is located at TB1-30. When the transmitter is re-energized following a fault, the indicator will go LOW (0 VDC) to indicate an ac power fault condition.
- 2-55. **Metering Ground.** Metering ground is an isolated circuit ground for remote control meter connections. Metering ground is to be used to remedy ground loops or to eliminate RFI conditions. Metering ground is located at TB2-6 through TB2-8.
- 2-56. **Chassis Ground.** Chassis ground is designed to be used for remote control connections. Chassis ground is located at TB2-12 and TB2-13.



- 2-57. **No Connection.** No connection at TB1-12, TB1-13, TB1-25 and TB2-9.
- 2-58. **Spare Connections.** Connections for future additional remote control or indications are located at TB1-22 through TB1-24.
- 2-59. **OPTIONAL POWER SUPPLY PROGRAMMING.** The FM-20S/FMi 1405 transmitter can be equipped with an optional power supply in each cabinet. If the unit is equipped with fifth power supply assemblies, jumper P11 on the supervisor circuit board must be installed. Refer to FIGURE 2-11, page 2-19 and ensure P11 is installed on the supervisor circuit board.
- 2-60. **VSWR/REFLECTED POWER DISPLAY PROGRAMMING.** The FM-20S/FMi 1405 transmitter output power is displayed by the SYSTEM LCD display. The LCD display presents transmitter forward power, reflected power, PA voltage, and PA current. The reflected power can be displayed using a VSWR or reflected power format. Header P13 programs the display to present reflected power or VSWR (refer to FIGURE 2-11, page 2-19). When P13 is removed, the display will present reflected power. When P13 is installed, VSWR will be displayed. The transmitter is shipped from the factory programmed for reflected power display operation.
- 2-61. **MODULATION MONITOR RECEPTACLE.** The FM-20S/FMi 1405 transmitter is equipped with a modulation monitor receptacle. The receptacle is located near the RF output transmission line. Refer to FIGURE 2-12, page 2-26 and connect the modulation monitor to the modulation monitor receptacle. The receptacle provides a 2 V RMS sample in a 50 ohm load at 20 kW for monitoring operations.
- 2-62. **AUDIO INPUT CONNECTIONS.** Audio input connections for the FM-20S/FMi 1405 transmitter are located on the exciter rear panel. For an FX-50, refer to FX-50 manual 597-1050 and perform the WIRING procedures in SECTION II, INSTALLATION. For an FXi 60, refer to manual 597-0541



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

**WARNING**

- 2-63. **RF OUTPUT TRANSMISSION LINE CONNECTION.** The FM-20S/FMi 1405 transmitter RF output connection is located on the transmitter auxiliary cabinet top-panel (refer to FIGURE 2-12, page 2-26). The connection is a 3 1/8 inch female EIA field flange. Refer to FIGURE 2-12, page 2-26 and connect the RF transmission line to the transmitter using a 3 1/8 inch male EIA field flange and a bullet.

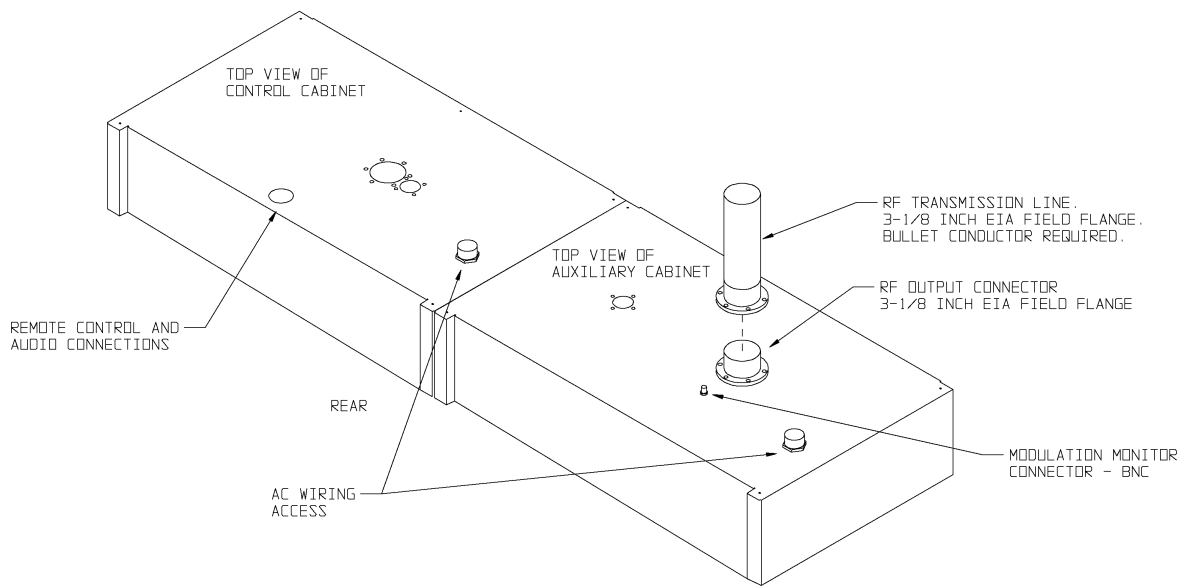


**WARNING**      ***ENSURE PRIMARY POWER IS DISCONNECTED BEFORE PROCEEDING.***



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

**WARNING**



**597-1012-14B**

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**FIGURE 2-12. MODULATION MONITOR/RF OUTPUT CONNECTIONS**

- 2-64. **GROUND.** The FM-20S/FMi 1405 transmitter is equipped with a chassis ground system for operating safety (refer to FIGURE 2-14 and FIGURE 2-15, pages 2-28 and 2-29). The ground system requires the connection of an earth ground for both sides of the chassis. Refer to FIGURE 2-14 and FIGURE 2-15, pages 2-28 and 2-29 and connect an earth ground to the chassis ground lugs using 2 inch (5.08 cm) wide copper straps.



**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**

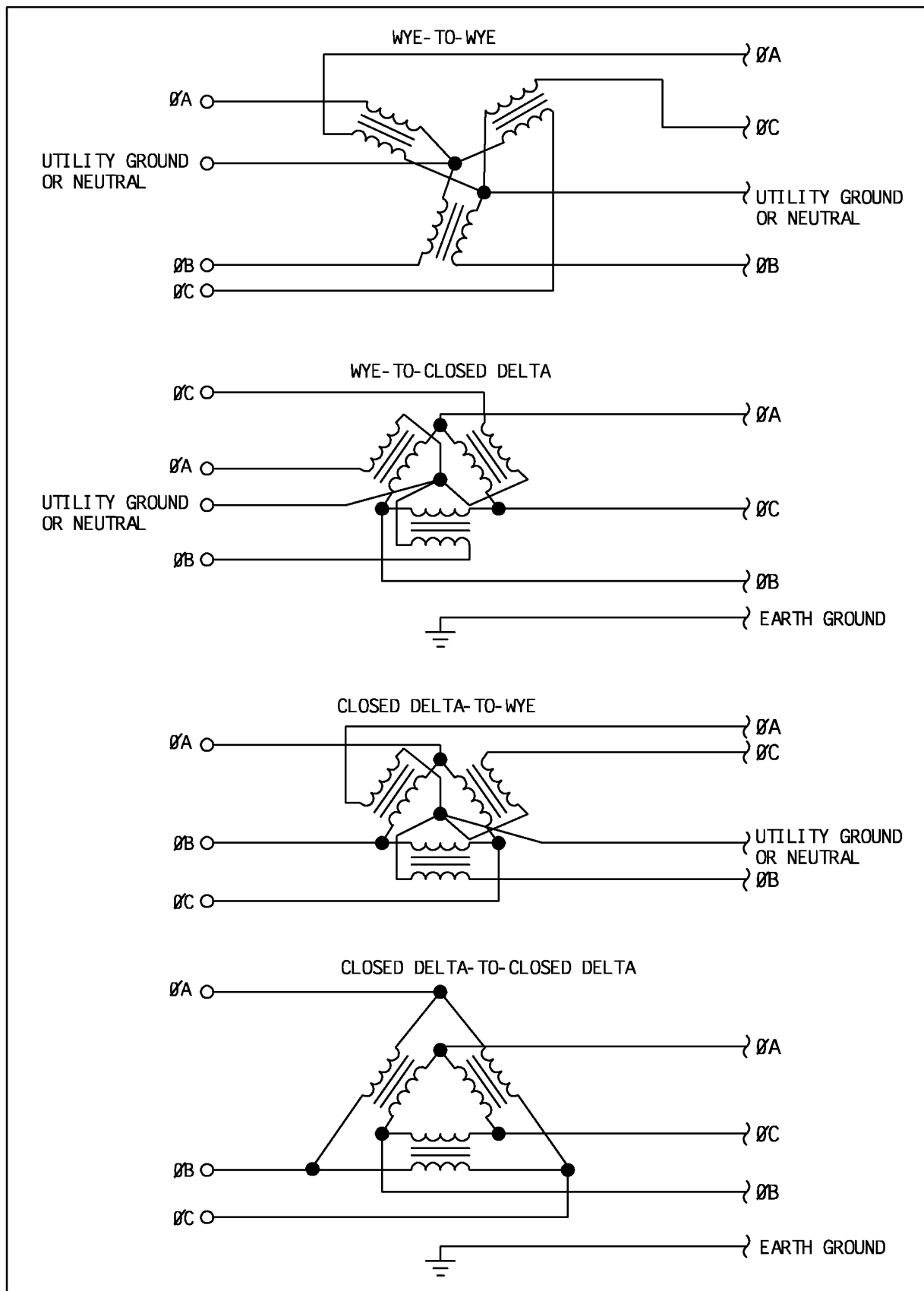
- 2-65. **AC POWER CONNECTIONS.** The FM-20S/FMi 1405 can be configured to operate from: 1) a 196 to 252 VAC three-phase closed delta or WYE supply at 100 A per phase, or 2) a 340 to 435 VAC three-phase 4-wire WYE supply at 100 A per phase. Refer to FIGURE 2-13, page 2-27. The FM-20S/FMi 1405 transmitter requires two 100 A disconnect service boxes - one for each side of the transmitter - as well as a 200 A master disconnect service box. For operating safety, the power source must be routed to the transmitter through a fused power disconnect (refer to FIGURE 2-14 and FIGURE 2-15, pages 2-28 and 2-29).



**WARNING**

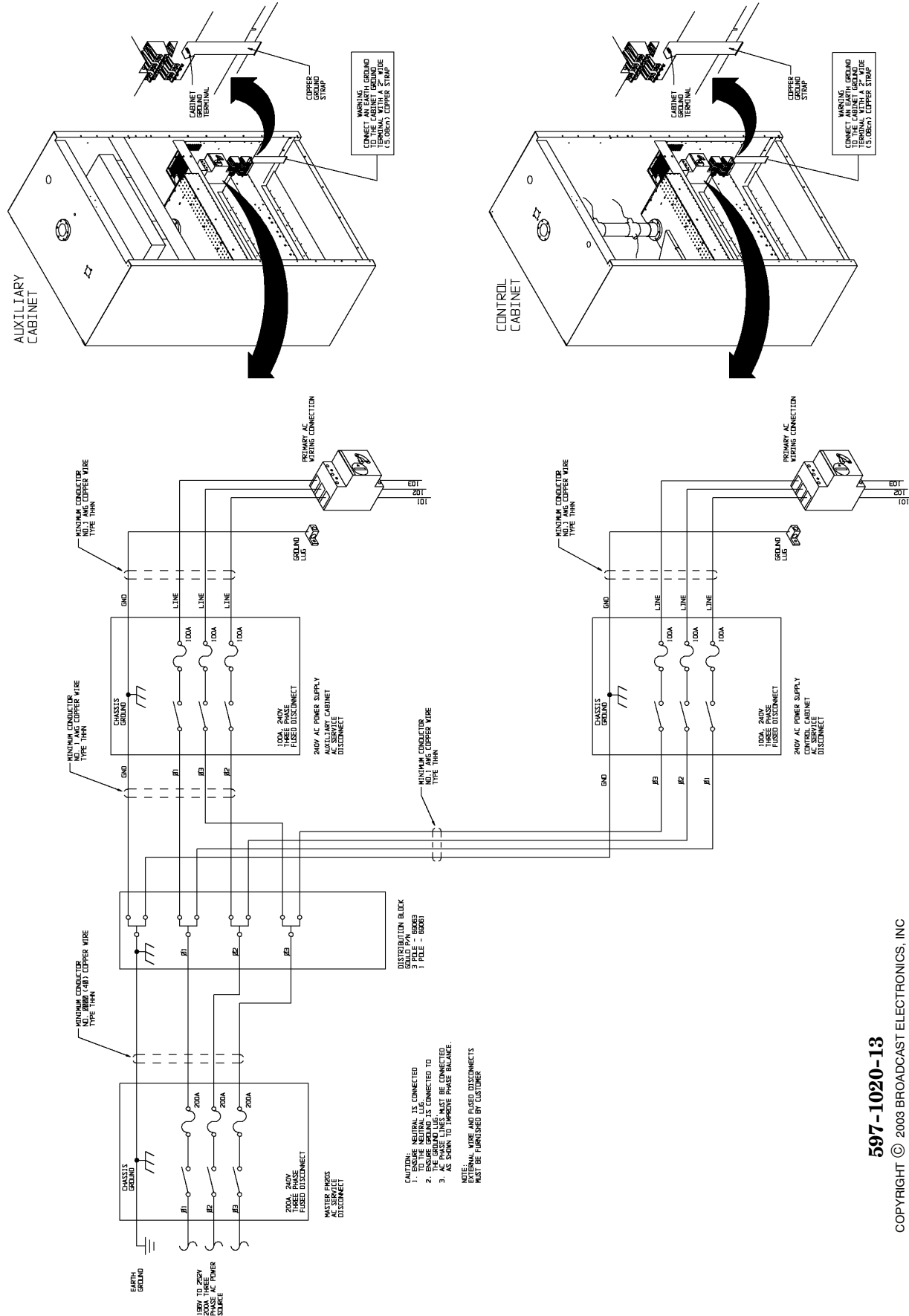
***ENSURE PRIMARY POWER IS DISCONNECTED BEFORE PROCEEDING.***

**WARNING**



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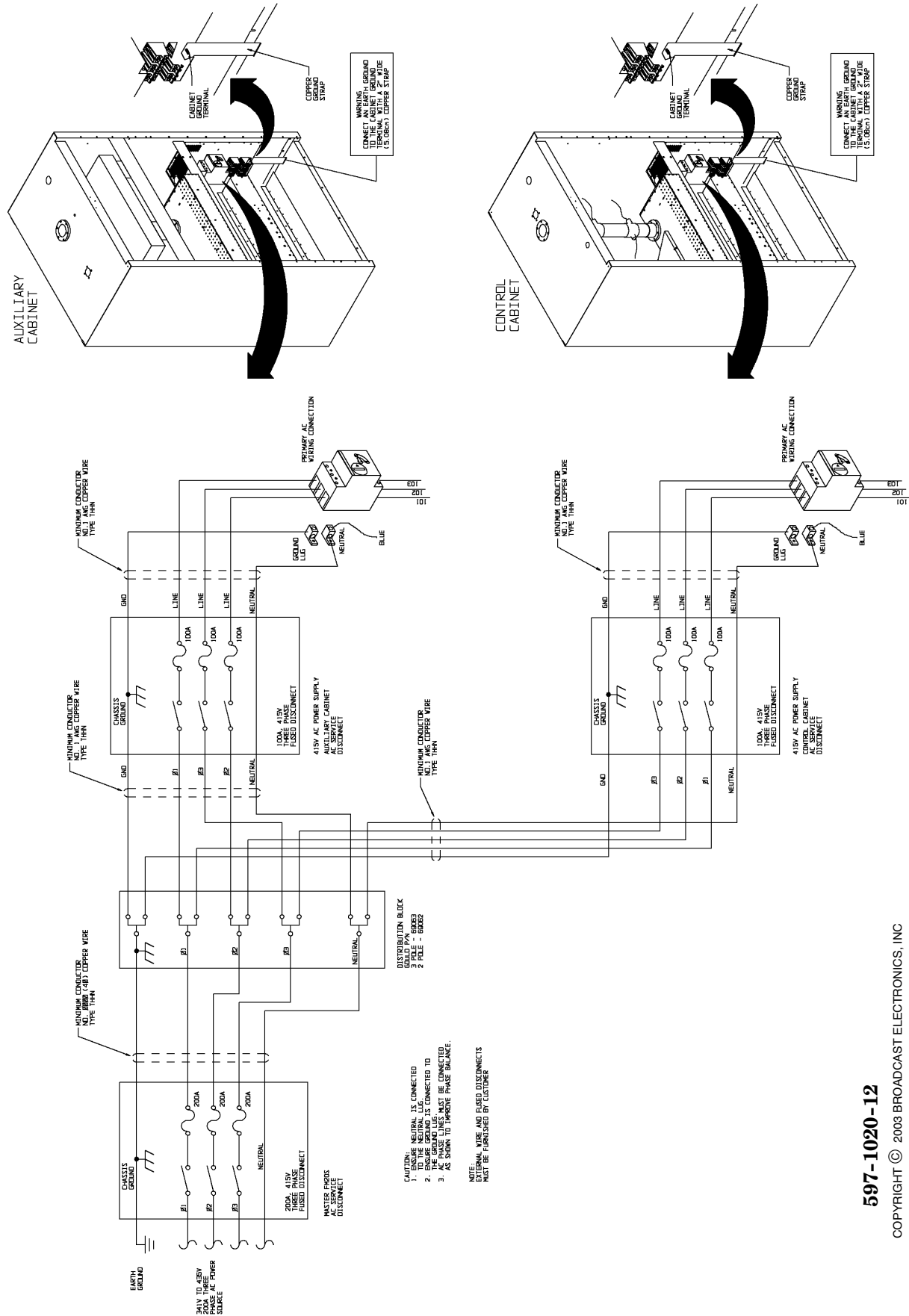
**FIGURE 2-13. ACCEPTABLE AC POWER INPUT CONFIGURATIONS** 597-0099-11



**597-1020-13**

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**FIGURE 2-14. FM-20S/FMi 1405 220V THREE-PHASE AC POWER CONNECTIONS**



**FIGURE 2-15. FM-20S/FMi 1405 380/415V 4-WIRE WYE THREE-PHASE AC POWER CONNECTIONS**

- 2-66. **Exciter AC Power Connections.** The exciter AC power source is provided by the transmitter. The line cord is located near the exciter rear-panel inside the accessory equipment enclosure. Connect the AC power cord from the transmitter to the exciter. The FX-50 operates from a 194V to 266V 50/60 Hz power source. The FXi 60 operates from a 90V to 264V 50/60 Hz power source.
- 2-67. **FSi 10 AC Power Connections.** It is recommended that the FSi 10 power source be supplied by a UPS due to the long boot-up time of this device. The FSi 10 power supply can be configured to operate on either 110VAC or 220VAC via a switch on the rear of the unit. Prior to connecting AC to this device ensure switch is in proper position for the AC power source being used. The unit comes configured from the factory with this switch set at the 220VAC position.



**WARNING**

***THE FSI 10 CAN OPERATE ON EITHER 110VAC OR 220VAC. IT IS CONFIGURED FROM THE FACTORY FOR 220VAC OPERATION.***

**WARNING**



**WARNING**

***IF YOU ARE USING A UPS TO BACK UP THE FSI 10, ENSURE THE VOLTAGE INPUT SWITCH IS IN THE PROPER POSITION PRIOR TO APPLYING POWER AND TURNING ON THE UNIT.***

**WARNING**

- 2-68. **Main AC Input – Single Phase.** Refer to FIGURE 2-14 page 2-28 and connect the 150 A 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.
- 2-69. **Main AC Input – Three Phase.** Refer to FIGURE 2-15, page 2-29 and connect the 100 A three phase service to the AC input panel through a fused service disconnect as shown. For 380 volt WYE systems, ensure the neutral conductor is connected to the **NEUTRAL** terminal. Connect the utility company ground conductor securely to the ground terminal as shown.
- 2-70. **Optional Equipment AC Power Connections.** The FM-20S/FMi 1405 transmitter is 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, connect the optional equipment line cords to the AC receptacles located near the exciter rear-panel.

2-71. **PRELIMINARY OPERATION.**



**NOTE**

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

**NOTE**

- 2-72. The following text presents procedures for the preliminary operation of the FM-20S/FMi 1405 transmitter. 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-20S/FMi 1405 transmitter.
- 2-73. Ensure the appropriate AC power supply is applied to the transmitter.

- 2-74. Operate the rear panel AC ON/OFF switch to ON. The following events will occur:
1. The **MULTIMETER MODULE MODE** switch/indicator will illuminate.
  2. The **SYSTEM FWD PWR** switch/indicator will illuminate.
  3. The **POWER CONTROL OFF** switch/indicator will illuminate.
  4. The **STATUS FAILSAFE/INTERLOCK** indicators will illuminate.
- 2-75. If no transmitter front-panel indicators illuminate, the transmitter may have detected an AC power line problem. If this condition occurs, ensure: 1) the AC power supply is between 255 and 168 volts and 2) all three AC line phases are present.
- 2-76. If the **FAIL-SAFE** indicator does not illuminate, perform the following procedure.



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

**WARNING**

1. Disconnect the AC power.
  2. Check the fail-safe switch and connection to TB2-10 and TB2-11 on the remote control interface circuit board.
  3. Once the problem is located and repaired, continue the preliminary operation procedure.
- 2-77. Ensure the transmitter **SYSTEM FWD POWER** switch/indicator is illuminated. The **MULTIMETER** will indicate 0 watts forward power.
- 2-78. Depress the **SYSTEM ON** switch/indicator to illuminate the switch/indicator.
- 2-79. For an FX-50, depress the exciter **MULTIMETER FWD** switch. The exciter **MULTIMETER** will indicate the forward power recorded in the factory test data sheets. For an FXi 60, the forward power is displayed on the GUI interface. The GUI display will indicate the forward power recorded in the factory test data sheets.
- 2-80. Adjust the **POWER CONTROL** knob until the **MULTIMETER** indicates the forward power level recorded in the factory test data sheets. If the **FAULTS RESET** switch/indicator illuminates, proceed as follows:
1. If the **RESET** switch/indicator illuminates, proceed as follows:
    - A. If the **POWER SUPPLY** indicator illuminates, the **MULTIMETER** will automatically display the number of the power supply containing the fault. Once the power supply number is determined, refer to SECTION V, MAINTENANCE and perform the TROUBLESHOOTING procedures to locate the problem.
    - B. If the **VSWR** indicator illuminates, a 1.45 : 1 **VSWR** condition or greater is present at the transmitter output. Disconnect the transmitter AC power and remove the condition from the transmitter output.
    - C. If the **MODULE** indicator illuminates, one of the transmitter RF amplifier or IPA modules contains a fault. Operate the **MULTIMETER MODULE MODE** and **FUNCTION** switches to locate the module with the fault. The **MULTIMETER** will indicate **MODULE OUT**, **HIGH CURRENT**, or **LOW POWER**.

D. If the **DRIVE** indicator illuminates, the IPA module or the exciter output power is low. Refer to SECTION V, MAINTENANCE and perform the TROUBLESHOOTING procedures to locate the problem.

2-81. 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. **SYSTEM FWD POWER**
2. **SYSTEM RFL POWER**
3. **PA VOLTAGE**
4. **PA CURRENT**



# SECTION III OPERATION

## 3-1. INTRODUCTION.

3-2. This section identifies all controls and indicators associated with the FM-20S/FMi 1405 transmitter and provides standard operating procedures.

## 3-3. CONTROLS AND INDICATORS.

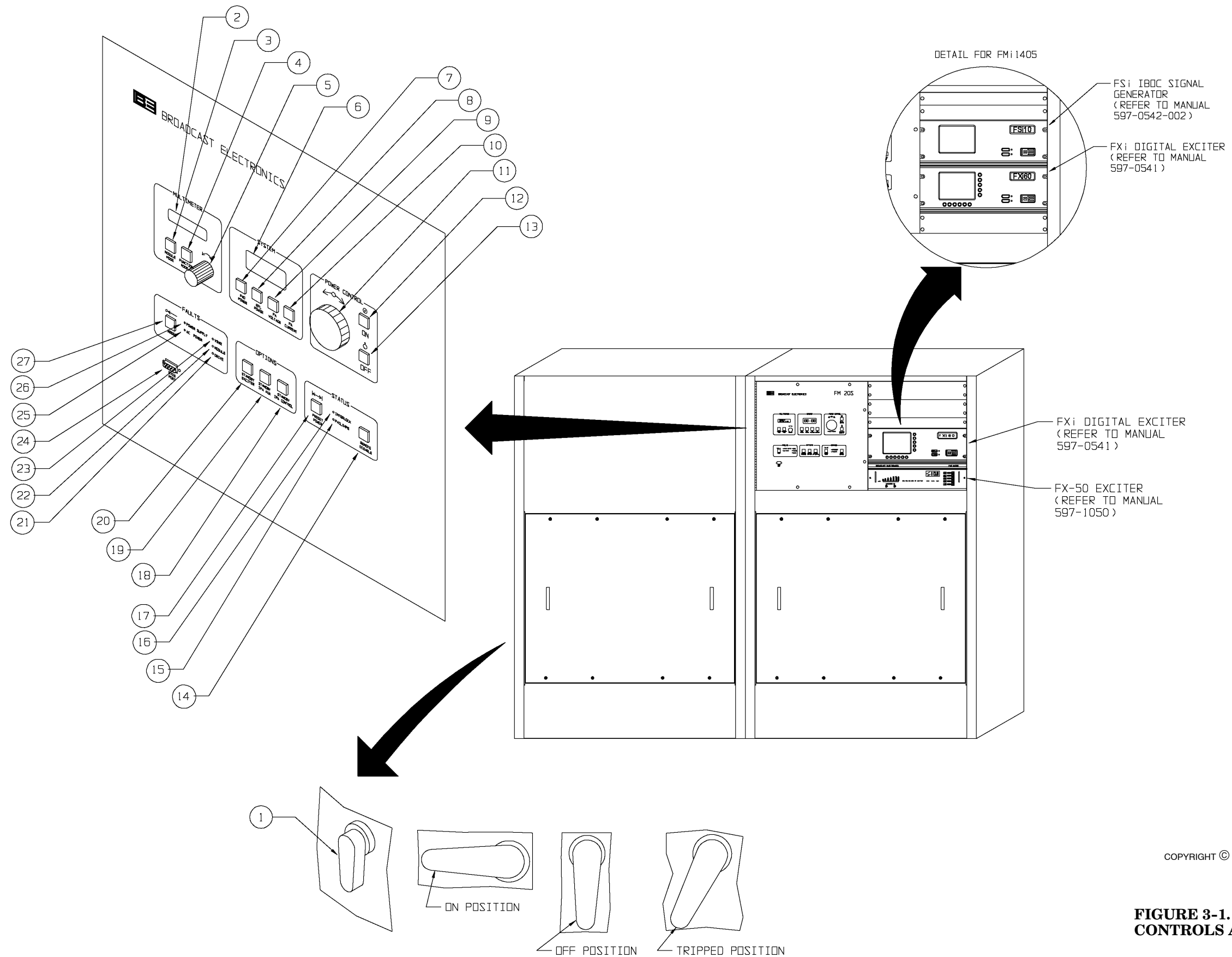
3-4. FIGURE 3-1, page 3-3, presents the location of all controls and indicators associated with normal operation of the FM-20S/FMi 1405 transmitter. TABLE 3-1 presents the function of each control or indicator. Refer to FIGURE 3-1, page 3-3, and TABLE 3-1 for a description of the controls and indicators associated with the FM-20S/FMi 1405 transmitter.

**TABLE 3-1. FM-20S/FMi 1405 CONTROLS AND INDICATORS**  
(Sheet 1 of 5)

INDEX NO.	NOMENCLATURE	FUNCTION
1	AC ON/OFF Switch/ Circuit Breaker	Controls the application of ac power to the transmitter. The switch/circuit breaker is equipped with three positions: 1) On, 2) Off, and 3) tripped.
2	<b>MULTIMETER</b> LCD	A 2-line 16 character LCD used to present the module operating parameters.
3	<b>MULTIMETER</b> <b>MODULE MODE</b>	When illuminated, used to select module 1 through 16, the on-air (R or L) IPA, the on-air exciter, the control and auxiliary PAV/PAI (R of L), the reject load, low-pass filter 1, 2, 3 or 4, right or left, combiners, or the control or auxiliary power supply 1 through 5 for display on the MULTIMETER.

**TABLE 3-1. FM-20S/FMi 1405 CONTROLS AND INDICATORS**  
(Sheet 2 of 5)

INDEX NO.	NOMENCLATURE	FUNCTION
4	<b>MULTIMETER FUNCTION MODE</b>	<p>When illuminated, used to select several operating functions for control and auxiliary cabinets (R and L) modules 1 through 16, the on-air (R and L) IPA, the on-air exciter, reject load, low-pass filter 1, 2, 3 and 4, right and left combiner and control/auxiliary power supplies 1 through 5. The following text presents the device and the functions to be displayed.</p> <p>Control and Auxiliary -  PA volts  PA current  R and L Module -  Forward Power  Reflected Power  Current  Temperature in °C  R and L IPA -  Forward Power  Reflected Power  Current  Temperature in °C  Exciter -  Forward Power  Reflected Power  Temperature (°C)-  R and L Reject Load (IPA Splitter)  Inlet  Low-Pass Filter 1, 2, 3 and 4 -  Forward Power  Right Combiner  Forward Power  Left Combiner  Forward Power  Reject Power  Control and Auxiliary Power Supply -  Selects power supply 1 through 5</p>
5	<b>MULTIMETER</b> Rotary Select Control	<p>Used to select module mode or function mode options as determined by the <b>MODULE MODE</b> and <b>FUNCTION MODE</b> switch/indicators. When the <b>MODULE MODE</b> switch/indicator is illuminated, the control can be used to select a device such as a module or the exciter. When the <b>FUNCTION MODE</b> switch/indicator is illuminated, the control can be used to select a function parameter.</p>
6	<b>SYSTEM LCD</b>	<p>A 4-digit LCD used to show system operating parameters, which include: transmitter forward power, reflected power, PA voltage, and PA current.</p>



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**FIGURE 3-1. FM-20S/FMi 1405  
CONTROLS AND INDICATORS**

(3-3/3-4)



**TABLE 3-1. FM-20S/FMi 1405 CONTROLS AND INDICATORS**  
(Sheet 3 of 5)

INDEX NO.	NOMENCLATURE	FUNCTION
7	<b>SYSTEM FORWARD POWER</b> Switch/Indicator	When illuminated, used to configure the <b>SYSTEM</b> LCD to display the transmitter forward power in kilowatts.
8	<b>SYSTEM REFLECTED POWER</b> Switch/Indicator	When illuminated, used to configure the <b>SYSTEM</b> LCD to display the transmitter reflected power in watts.
9	<b>SYSTEM PA VOLTAGE</b> Switch/Indicator	When illuminated, used to configure the <b>SYSTEM</b> LCD to display the transmitter average PA power supply voltage of right and left cabinets.
10	<b>SYSTEM PA CURRENT</b> Switch/Indicator	When illuminated, used to configure the <b>SYSTEM</b> LCD to display the total transmitter PA power supply current in amperes (sum of right and left cabinets).
11	<b>POWER CONTROL</b> Rotary <b>LOWER/RAISE</b> Control	Used to raise or lower the transmitter output power as shown on the <b>SYSTEM</b> LCD. Clockwise rotation raises the transmitter output power. Counterclockwise rotation lowers the transmitter output power.
12	<b>POWER CONTROL ON</b> Switch/Indicator	<b>SWITCH:</b> Enables the transmitter RF output by unmuting the exciter, power amplifier modules, and the PA power supplies.  <b>INDICATOR:</b> Illuminates to indicate the transmitter RF output is enabled.
13	<b>POWER CONTROL OFF</b> Switch/Indicator	<b>SWITCH:</b> Disables the transmitter RF output by muting the exciter, power amplifier modules, and the PA power supplies.  <b>INDICATOR:</b> Illuminates to indicate the transmitter RF output is disabled.
14	<b>STATUS REMOTE DISABLE</b> Switch/Indicator	<b>SWITCH:</b> Controls the transmitter remote control operations.  <b>INDICATOR:</b> Illuminates to indicate transmitter remote control operation is disabled. Extinguishes to indicate transmitter remote control operation is enabled.
15	<b>STATUS FAIL-SAFE</b> Indicator	Illuminates to indicate the fail-safe interlocks in both the right and left cabinets are closed. Equipment typically connected to the failsafe interlock include: 1) a test load, 2) a motorized coaxial switch, or 3) a remote control unit. Extinguishes to indicate the fail-safe interlocks are open.
16	<b>STATUS INTERLOCK</b>	Not used. Illuminates green.

**TABLE 3-1. FM-20S/FMi 1405 CONTROLS AND INDICATORS**  
(Sheet 4 of 5)

INDEX NO.	NOMENCLATURE	FUNCTION
17	<b>STATUS PRESET POWER</b> Switch/Indicator	<b>SWITCH:</b> Selects transmitter operation at a preset RF power output level.  <b>INDICATOR:</b> Illuminates to indicate transmitter operation at a preset RF power level (such as half power) when illuminated.
18	<b>OPTIONS STANDBY IPA CONTROL</b> Switch/Indicator	<b>SWITCH:</b> Selects and enables the transmitter control cabinet standby IPA. This is accomplished by: 1) de-energizing the main IPA, 2) operating the coaxial switch to the standby IPA position, and 3) enabling the standby IPA. <b>INDICATOR:</b> Illuminates to indicate the standby IPA is enabled.
19	<b>OPTIONS STANDBY IPA CONTROL</b> Switch/Indicator	<b>SWITCH:</b> Selects and enables the transmitter auxiliary cabinet standby IPA. This is accomplished by: 1) de-energizing the main IPA, 2) operating the coaxial switch to the standby IPA position, and 3) enabling the standby IPA. <b>INDICATOR:</b> Illuminates to indicate the standby IPA is enabled.
20	<b>OPTIONS STANDBY EXCITER</b> Switch/Indicator	<b>SWITCH:</b> Selects and enables the transmitter standby exciter. This is accomplished by: 1) de-energizing the main exciter, 2) operating the coaxial switch to the standby exciter position, and 3) enabling the standby exciter. <b>INDICATOR:</b> Illuminates to indicate the standby exciter is enabled.
21	<b>FAULTS DRIVE</b> Indicator	Illuminates to indicate IPA output is below 80 watts.
22	<b>FAULTS MODULE</b> Indicator	Illuminates to indicate a fault in one or more RF power amplifier modules.
23	<b>FAULTS VSWR</b> Indicator	Illuminates to indicate a 1.45 : 1 or greater VSWR condition is present at the RF output.
24	<b>RTDS PORT</b>	A modem port used for the connection of the Broadcast Electronics RTDS (remote transmitter diagnostic system).
25	<b>FAULTS AC POWER</b> Indicator	Illuminates to indicate: 1) the AC power supply is below 168 volts or above 255 volts or 2) a loss-of-phase condition is present. The indicator will not illuminate until ac power is returned to the transmitter.
26	<b>FAULTS POWER SUPPLY</b> Indicator	Illuminates to indicate a fault in one or more PA power supply modules.

**TABLE 3-1. FM-20S/FMi 1405 CONTROLS AND INDICATORS**  
(Sheet 5 of 5)

INDEX NO.	NOMENCLATURE	FUNCTION
27	<b>FAULTS RESET</b> Switch/Indicator	<p><b>SWITCH:</b> Clears the transmitter fault circuitry if: 1) the switch is depressed and 2) the fault condition is removed.</p> <p><b>INDICATOR:</b> Illuminates to indicate: 1) an RF power amplifier module fault, 2) a power supply module fault, 3) a high reflected power condition, 4) a drive fault, or 5) an ac power fault.</p>

### 3-5. OPERATION.



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



**NOTE**      ***THE TRANSMITTER WILL NOT OPERATE WITH MORE THAN 4 RF POWER AMPLIFIER MODULES REMOVED FROM MODULE LOCATIONS 1 THRU 8 OR 9 THRU 16. ENSURE NO MORE THAN 4 RF POWER AMPLIFIER MODULES ARE REMOVED FROM MODULE LOCATIONS 1 THRU 8 OR 9 THRU 16 IN EITHER THE RIGHT OR LEFT CABINET.***

### 3-6. TURN-ON.

3-7. Operate the rear panel AC ON/OFF switch/circuit breaker to ON. The following events will occur:

1. The **MULTIMETER MODULE MODE** switch/indicator will illuminate.
2. The **SYSTEM FWD PWR** switch/indicator will illuminate.
3. The **POWER CONTROL OFF** switch/indicator will illuminate.
4. The **STATUS FAILSAFE/INTERLOCK** indicators will illuminate.

3-8. If no front-panel indicators illuminate the transmitter may have detected an AC line problem. Refer to AC LINE INTERRUPT - HIGH/LOW AC LINE AND LOSS-OF-PHASE CONDITIONS in the following text.

3-9. Observe the transmitter front-panel switches and indicators. The transmitter switches and indicators will display normal operating conditions. If the **FAULTS RESET** indicator displays a fault condition, depress the **FAULTS RESET** switch/indicator. If the fault condition is not cleared: 1) operate the AC ON/OFF switch/circuit breaker to OFF and 2) Refer to SECTION V, MAINTENANCE and perform the TROUBLESHOOTING procedures to locate the problem.

- 3-10. Depress the **POWER CONTROL ON** switch/indicator to activate the transmitter. The **POWER CONTROL ON** switch/indicator will illuminate.
- 3-11. Operate the **SYSTEM LCD** to observe the transmitter forward and reflected power indications by performing the **SYSTEM LCD OPERATION** procedure in the following text.
- 3-12. Operate the **MULTIMETER** to observe the transmitter control and auxiliary PAV/PAI (R and L) modules, on-air (R and L) IPA, on-air exciter, low-pass filter, reject load, and control and auxiliary power supply module operating parameters by performing the **MULTIMETER OPERATION** procedure in the following text.
- 3-13. Adjust the transmitter output power by performing the **POWER ADJUST** procedure presented in the following text.
- 3-14. If remote control operation is desired, operate the **REMOTE DISABLE** switch/indicator to extinguish the switch/indicator. This will enable both local and remote operation. If remote control operation is to be disabled, operate the **REMOTE DISABLE** switch/indicator to illuminate the switch/indicator.
- 3-15. **TURN-OFF.**
- 3-16. Operate the transmitter to off by depressing the **POWER CONTROL OFF** switch/indicator. The **POWER CONTROL OFF** switch/indicator will illuminate. The transmitter RF output will be disabled.
- 3-17. Operate the AC ON/OFF switch to **OFF** to remove AC power from the transmitter.
- 3-18. **MULTIMETER OPERATION.**
- 3-19. The **MULTIMETER** is designed to display the status of several transmitter device operating parameters. To operate the multimeter, perform the following procedures.
  1. The device is selected using the: 1) **MODULE MODE** switch/indicator or 2) the **MODULE MODE** switch/indicator and the **MULTIMETER** rotary select control. Select the transmitter device such as a module or the exciter as follows:
    - A. To select a device using the **MODULE MODE** switch/indicator, proceed as follows:
      1. Depress the **MODULE MODE** switch/indicator to illuminate the switch/indicator. A device will appear on the **MULTIMETER** display.
      2. The displayed device changes each time the **MODULE MODE** switch/indicator is depressed. To locate a specific device, depress the **MODULE MODE** switch/indicator as required to locate the desired device. The following text presents the device sequence.
        1. Control
        2. Auxiliary
        3. Right module 1 through 16
        4. Left module 1 through 16
        5. Right IPA
        6. Left IPA
        7. Exciter
        8. Temperature
        9. Low-pass filter 1
        10. Low-pass filter 2
        11. Low-pass filter 3
        12. Low-pass filter 4
        13. Right combiner
        14. Left combiner
        15. Reject load
        16. Control and auxiliary power supply 1 through 5



B. To select a device using the **MODULE MODE** switch/indicator and the **MULTIMETER** rotary select control, proceed as follows:

1. Depress the **MODULE MODE** switch/indicator to illuminate the switch indicator. A device will appear on the **MULTIMETER** display.
  2. Observe the **MULTIMETER** display and operate the **MULTIMETER** rotary select control clockwise to move forward in the device sequence. Observe the **MULTIMETER** display and operate the **MULTIMETER** rotary select control counterclockwise to move backward in the device sequence.
2. Once a device is selected, a device operating parameter can be viewed. This is accomplished using the: 1) **FUNCTION MODE** switch/indicator or 2) the **FUNCTION MODE** switch/indicator and the **MULTIMETER** rotary select control. Select the operating parameter such as the forward power of a module as follows:

A. To select a device using the **FUNCTION MODE** switch/indicator, proceed as follows:

1. Depress the **FUNCTION MODE** switch/indicator to illuminate the switch indicator. A device operating parameter will appear on the **MULTIMETER** display.
2. The operating changes each time the **FUNCTION MODE** switch/indicator is depressed. To locate a specific operating parameter for a device, depress the **FUNCTION MODE** switch/indicator as required to locate the desired operating parameter. The following text presents the operating parameter sequence.
  1. Control  
PA volts  
PA current
  2. Auxiliary  
PA volts  
PA current
  3. Right module -  
Forward Power - (Wait approximately 10 seconds for a stable indication)  
Reflected Power  
Current  
Temperature in °C
  4. Left module  
Forward Power - (Wait approximately 10 seconds for a stable indication)  
Reflected Power  
Current  
Temperature in °C
  5. Right IPA -  
Forward Power - (Wait approximately 10 seconds for a stable indication)  
Reflected Power  
Current  
Temperature in °C

6. Left IPA
  - Forward Power - (Wait approximately 10 seconds for a stable indication)
  - Reflected Power
  - Current
  - Temperature in °C
7. Exciter -
  - Forward Power
  - Reflected Power
8. Temperature in °C
  - Right reject load (IPA Splitter)
  - Left reject load (IPA Splitter)
  - Inlet
9. Low-pass filter 1 -
  - Forward power
10. Low-pass filter 2 -
  - Forward power
11. Low-pass filter 3
  - Forward power
12. Low-pass filter 4
  - Forward power
13. Right combiner
  - Forward power
14. Left combiner
  - Forward power
15. Control power supply 1 through 5 -
  - Operating status - OK or FAULT
16. Auxiliary power supply 1 through 5 -
  - Operating status - OK or FAULT

B. To select a device operating parameter using the **FUNCTION MODE** switch/indicator and the **MULTIMETER** rotary select control, proceed as follows:

1. Depress the **FUNCTION MODE** switch/indicator to illuminate the switch indicator. A device operating parameter will appear on the **MULTIMETER** display.
2. Observe the **MULTIMETER** display and operate the **MULTIMETER** rotary select control clockwise to move forward in the device operating parameter sequence. Observe the **MULTIMETER** display and operate the **MULTIMETER** rotary select control counterclockwise to move backward in the device operating parameter sequence.

### 3-20. **SYSTEM LCD OPERATION.**

3-21. The **SYSTEM** LCD is used to display forward power, reflected power, PA current, and PA voltage. To select and present information on the **SYSTEM** LCD, proceed as follows:

1. To display system forward power, depress the **FWD POWER** switch/indicator to illuminate the switch/indicator. The power is displayed in kilowatts.

2. To display system reflected power, depress the **RFL POWER** switch/indicator to illuminate the switch/indicator. Reflected power can be displayed in reflected power or VSWR as determined by header J13 on the supervisor circuit board (refer to SECTION II, INSTALLATION - VSWR/REFLECTED POWER DISPLAY PROGRAMMING). When the unit is programmed for reflected power, the power is displayed in watts. Depending on the antenna, a normal reflected power indication is 150 watts.
3. To display system PA current, depress the **PA CURRENT** switch/indicator to illuminate the switch/indicator. The current is displayed in amperes. Depending on the TPO, a typical current indication is 640 A with a transmitter configured for a 20 kW RF output level and an operating frequency of 98 MHz.
4. To display system PA voltage, depress the **PA VOLTAGE** switch/indicator to illuminate the switch/indicator. The voltage is displayed in volts. A typical system voltage indication is 44.0 volts with a transmitter configured for a 20 kW RF output level and an operating frequency of 98 MHz.

### 3-22. **POWER ADJUST.**

3-23. The output power is adjusted using the **POWER CONTROL** rotary control. To adjust the transmitter output power, proceed as follows:

1. Operate the **POWER CONTROL** rotary control clockwise to increase the transmitter output power. Observe the transmitter output power indications on the **SYSTEM LCD**.
2. Operate the **POWER CONTROL** rotary control counterclockwise to decrease the transmitter output power. Observe the transmitter output power indications on the **SYSTEM LCD**.

### 3-24. **POWER CONTROL.**

3-25. Power control on the FM-20S and FMi 1405 transmitters are adjusted via the power control knob as described above. However, the implementation is very different between the two models.

Power control on the FM-20S is accomplished by varying the power supply voltage when the power control knob on the front of the unit is turned. The PAV will rise when the knob is turned clockwise and lower when the knob is turned counter clockwise. The power output from the exciter, or drive, does not change during the power control process.

Power control on the FMi 1405 is accomplished by varying the exciter power, or drive. The exciter forward power will rise when the knob is turned clockwise and lower when the knob is turned counter clockwise. The PAV on the transmitter does not change during the power control process and sets at ~42.5V.

Since the power control is accomplished in the exciter there is an interface from the transmitter to the exciter that indicates when the knob is being turned and in what direction. The supervisor board sends a voltage that goes to the I/O board. On the I/O board this voltage is on J1-7 for the main exciter and J2-7 for the standby exciter. This voltage is connected to J3-24 on the exciter.

The lower command is typically 1.5V on this pin and the range for this command is 0.5V to 2.2V. When the voltage is in this range the exciter power will lower, thus lowering the transmitter power. The raise command is typically 4.5V on this pin and the range for this command is any voltage above 2.68. When the voltage is above 2.68V the exciter power will raise, thus raising the transmitter power. There are two hold regions where the exciter does nothing. These are voltages between 2.2V and 2.68V and any voltage below 0.5V. When the voltage is in the hold range the exciter power will remain stable.

The FMi 1405 is designed for HD Radio operation which requires that the transistors be biased for Class AB operation rather than Class C. When the transistors are biased at the higher current point the drive requirements go down due to the fact that the gain of the devices goes up. Therefore, the drive requirements from the exciter are quite low and it is normal to see the exciter running between 1 and 5Watts. This is in contrast to the 25Watts when the transmitter is running in Class C mode (FM-20S).

3-26. **EXCITER OPERATION.**

3-27. For transmitters equipped with an FX-50, refer to the FX-50 instruction manual (597-1050) for a complete description of the FX-50 operating procedures. Perform the procedures to configure the FX-50 for the desired operation. For transmitters equipped with an FXi 60, refer to the FXi 60 instruction manual (597-0541) for a complete description of the FXi 60 operating procedures. Perform the procedures to configure the FXi 60 for the desired operation.

3-28. **PRESET POWER.**

3-29. The transmitter can be operated to a lower preset power level using the **PRESET POWER** switch/indicator. The preset power function is typically used when the transmitter is switched to a secondary antenna or during icing conditions. The preset power level is recorded in the factory test data sheet. To operate the transmitter to the preset power level, depress the **PRESET POWER** switch/indicator to illuminate the switch/indicator.

3-30. **REMOTE DISABLE.**

3-31. Transmitter remote operation can be disabled using the **REMOTE DISABLE** switch/indicator. To disable remote control operation, depress the **REMOTE DISABLE** switch/indicator to illuminate the switch/indicator. Local operation will remain enabled. To enable remote control operation, depress the **REMOTE DISABLE** switch/indicator to extinguish the switch/indicator. This will enable both local and remote operation.

3-32. **STANDBY EXCITER OPERATION.**

3-33. If the transmitter is equipped with a standby exciter, the exciter can be manually switched into the transmitter RF chain using the **STANDBY EXCITER** switch/indicator. To manually switch the standby exciter into the RF chain, depress the **STANDBY EXCITER** switch/indicator to illuminate the switch/indicator. To switch the normal exciter into the RF chain, depress the **STANDBY EXCITER** switch/indicator to extinguish the switch/indicator.

3-34. **STANDBY IPA OPERATION.**

3-35. If the transmitter is equipped with standby IPAs, the control or auxiliary standby IPA can be manually switched into the transmitter RF chain using the **STANDBY IPA CONTROL** or **STANDBY IPA AUXILIARY** switch/indicators. To manually switch the standby IPA into the RF chain, depress the **STANDBY IPA** switch/indicator to illuminate the switch/indicator. To switch the normal IPA into the RF chain, depress the **STANDBY IPA** switch/indicator to extinguish the switch/indicator.

3-36. **FAULT RESET AND FAULT INDICATORS.**

3-37. The transmitter is equipped with 5 fault indicators. The **VSWR** indicator will illuminate if a 1.45 : 1 or greater VSWR condition is present at the RF output. The **MODULE** indicator will illuminate if a fault occurs in one or more modules. The **DRIVE** indicator illuminates if the IPA output is below 250 watts. The **POWER SUPPLY** indicator illuminates if a fault occurs in one or more power supply modules. The **AC POWER** indicator illuminates if: 1) the AC power line is below 168 volts or above 255 volts or 2) a loss-of-phase condition has occurred. The indicator will illuminate when ac power is returned to the transmitter (refer to AC LINE INTERRUPT - HIGH/LOW AC LINE AND LOSS-OF-PHASE CONDITIONS in the following text).

- 3-38. If a fault occurs, the **FAULTS RESET** switch/indicator will illuminate. To reset a transmitter fault condition, depress the **FAULTS RESET** switch/indicator. If the fault condition is remedied, the **FAULT RESET** indicator will extinguish.
- 3-39. If the fault condition is not remedied, operate the ac switch/circuit breaker to Off and locate the problem.
- 3-40. Once the fault condition is remedied, depress the **FAULTS RESET** switch/indicator. The indicator will extinguish.
- 3-41. **AC LINE INTERRUPT – HIGH/LOW AC LINE AND LOSS-OF-PHASE CONDITIONS.**
- 3-42. The transmitter is equipped with AC line monitor circuit boards. The circuit boards will de-energize the transmitter in the event: 1) the AC power line is below 168 volts or above 255 volts or 2) a loss-of-phase condition occurs. If one of these conditions occurs, AC power will be removed from the transmitter. As a result, the transmitter output power will be disabled and all transmitter indicators will be extinguished. The transmitter will automatically re-energize when the AC line is between 168 and 255 volts or the AC line phase is restored. High/low AC line voltage or loss-of-phase on any one or more phases of the AC input is indicated by illumination of RED PHASE 1, 2 or 3 LED on the lower front panel of each cabinet. Once the transmitter re-energizes, the **FAULT AC POWER** indicator and the **FAULT RESET** switch/indicator will illuminate to indicate an AC line fault condition.
- 3-43. **FAILURE CONDITIONS.**
- 3-44. The FM-20S/FMi 1405 is designed with the ability to provide output power when power supply and RF amplifier modules fail. This “soft failure” operation allows the transmitter to remain on-the-air until the transmitter can be de-energized for repair. In the event of an RF amplifier module failure, the module can be removed from the transmitter chassis with power energized.
- 3-45. A complete description of failure mode operation is presented in SECTION V, MAINTENANCE. Refer to FAILURE MODE OPERATION for a description of transmitter performance during failure modes.



## **SECTION IV BLOCK DIAGRAMS**

### **4-1. INTRODUCTION.**

4-2. This section presents block diagrams for the Broadcast Electronics FM-20S/FMi 1405 transmitter.

### **4-3. OVERALL OPERATION.**

4-4. Information on overall FM-20S/FMi 1405 transmitter operation is presented in FIGURE 4-1, beginning on page 4-3. Refer to FIGURE 4-1 for information on overall FM-20S/FMi 1405 transmitter operation.

### **4-5. POWER SUPPLY OPERATION.**

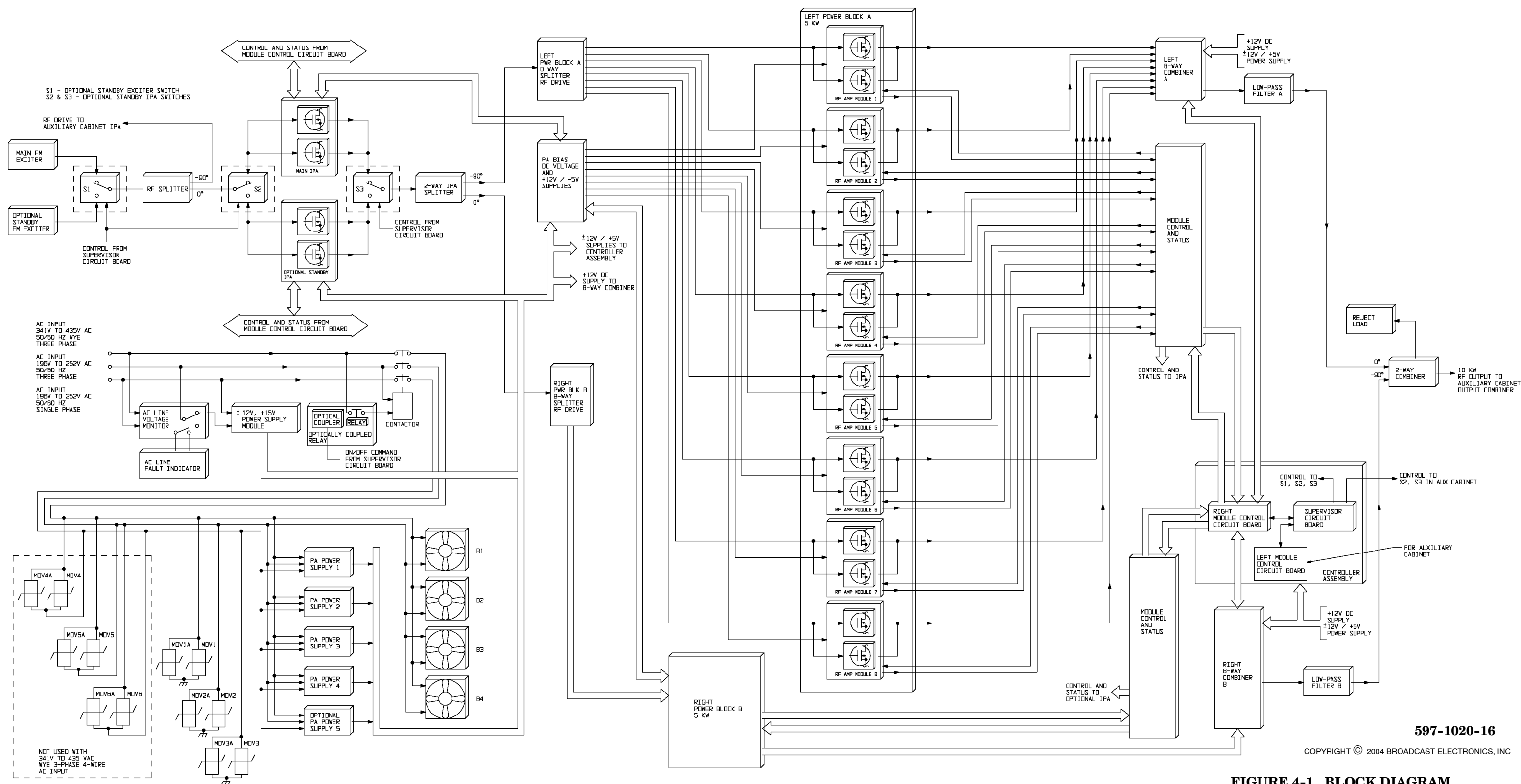
4-6. A description of the FM-20S/FMi 1405 power supply is presented in FIGURE 4-2, beginning on page 4-7. Refer to FIGURE 4-2 for FM-20S/FMi 1405 power supply information.

### **4-7. RF CIRCUIT OPERATION.**

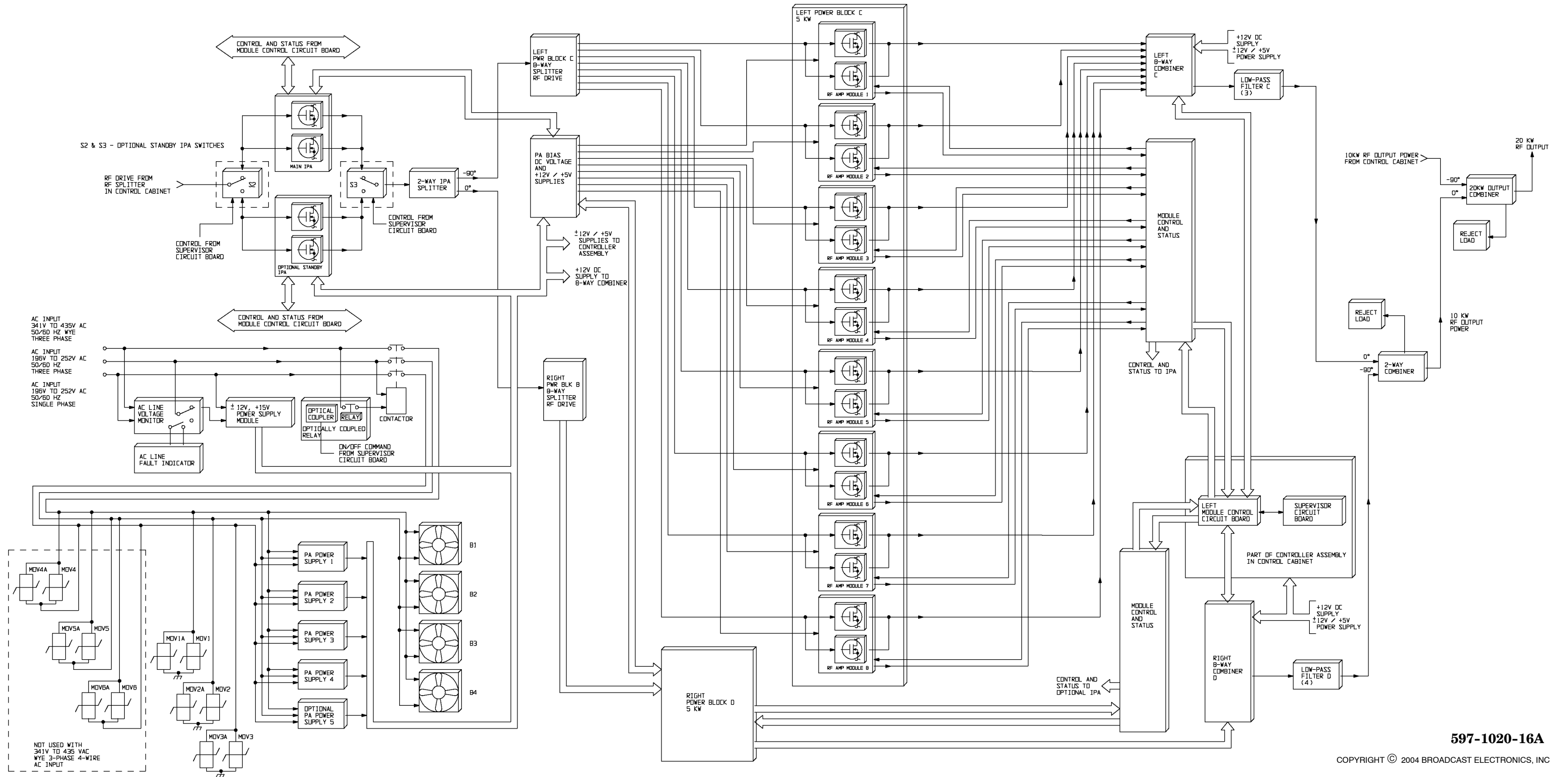
4-8. A description of the FM-20S/FMi 1405 RF circuitry is presented in FIGURE 4-3, beginning on page 4-11. Refer to FIGURE 4-3 for FM-20S/FMi 1405 RF circuitry information.











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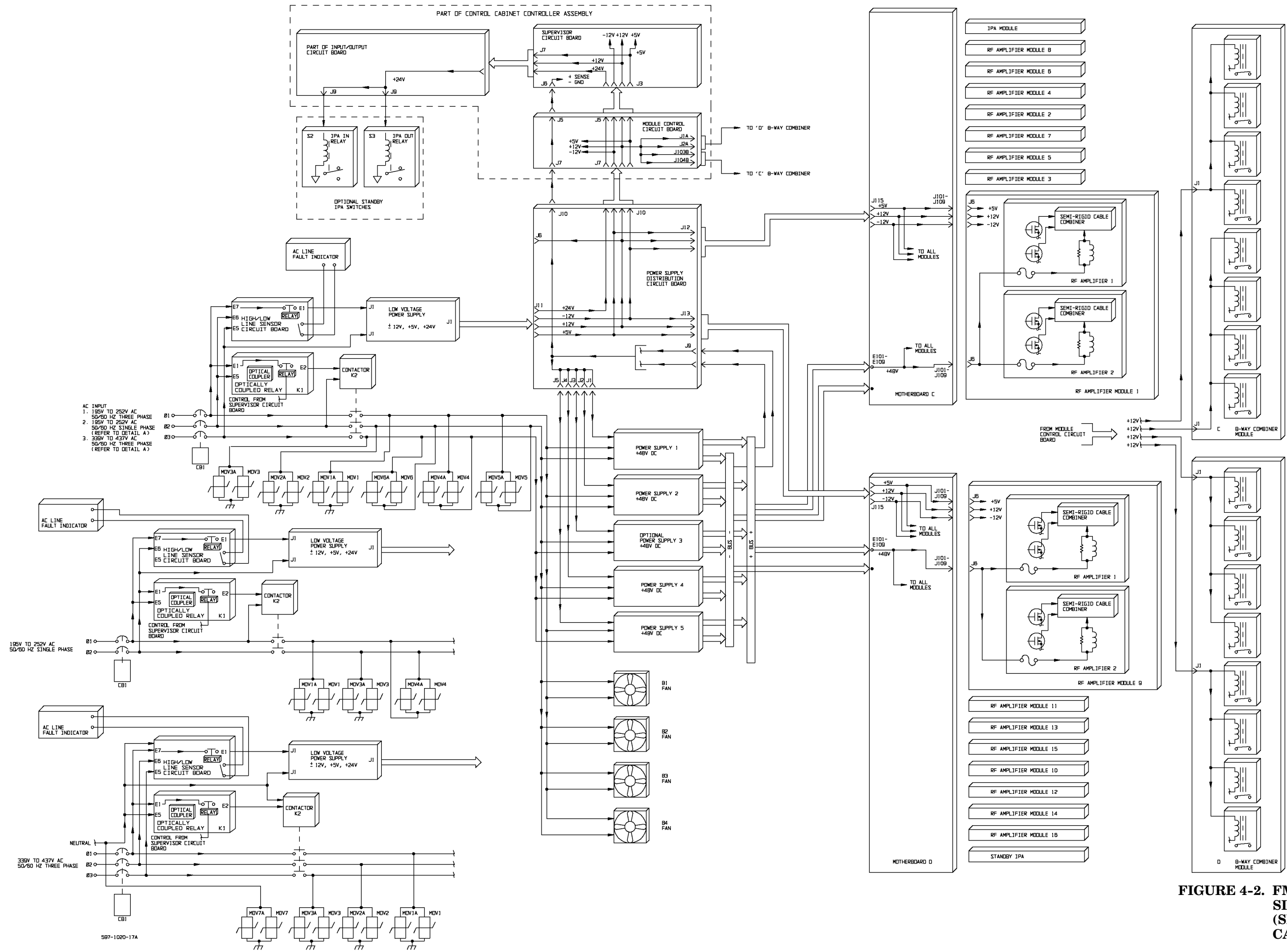
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**FIGURE 4-1. BLOCK DIAGRAM, FM-20S/FMi 1405 (SHEET 2 OF 2 - AUXILIARY CABINET) (4-5/4-6)**









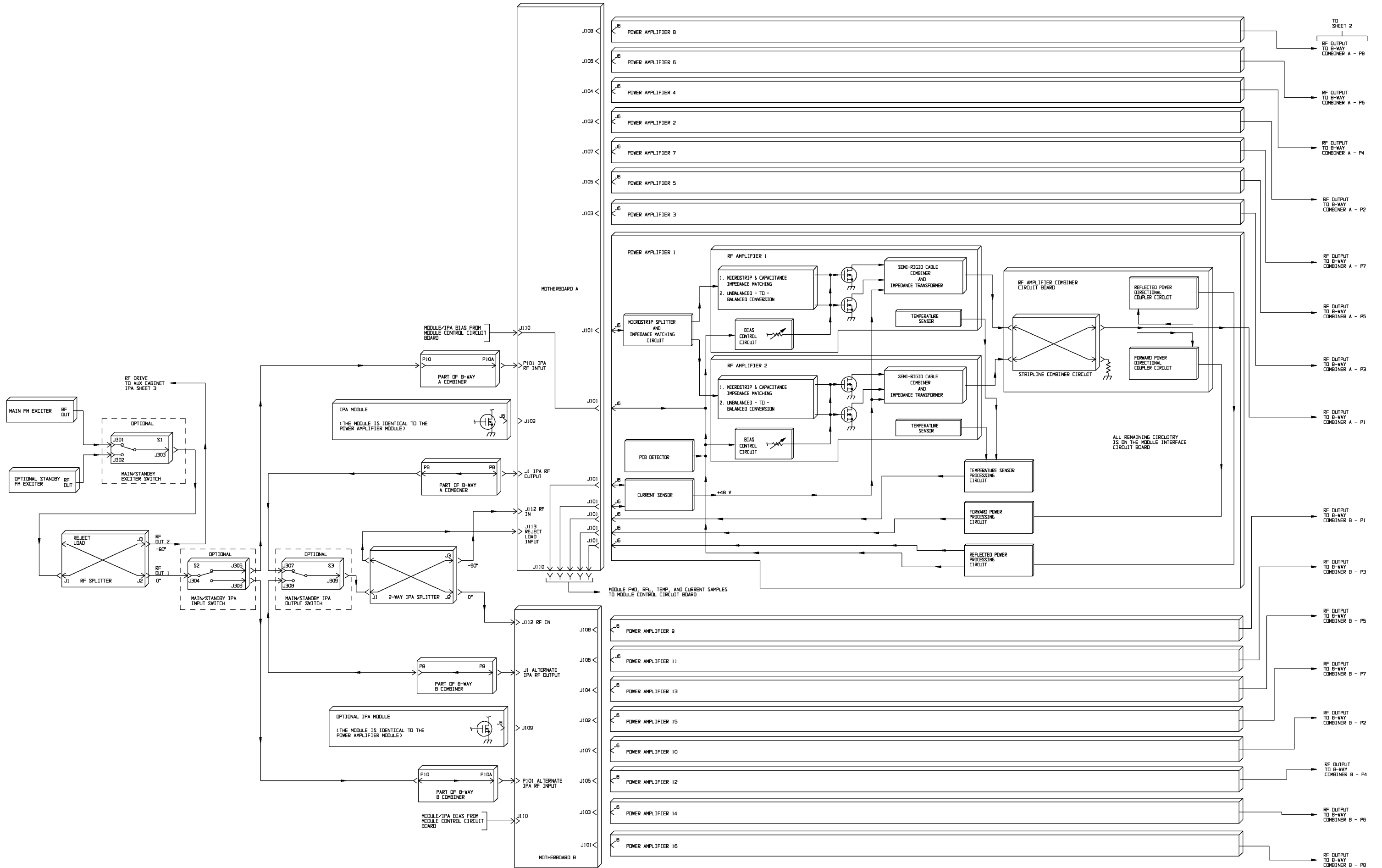
597-1020-17A

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**FIGURE 4-2. FM-20S/FMi 1405 POWER SUPPLY SIMPLIFIED SCHEMATIC (SHEET 2 OF 2 - AUXILIARY CABINET)**  
(4-9/4-10)





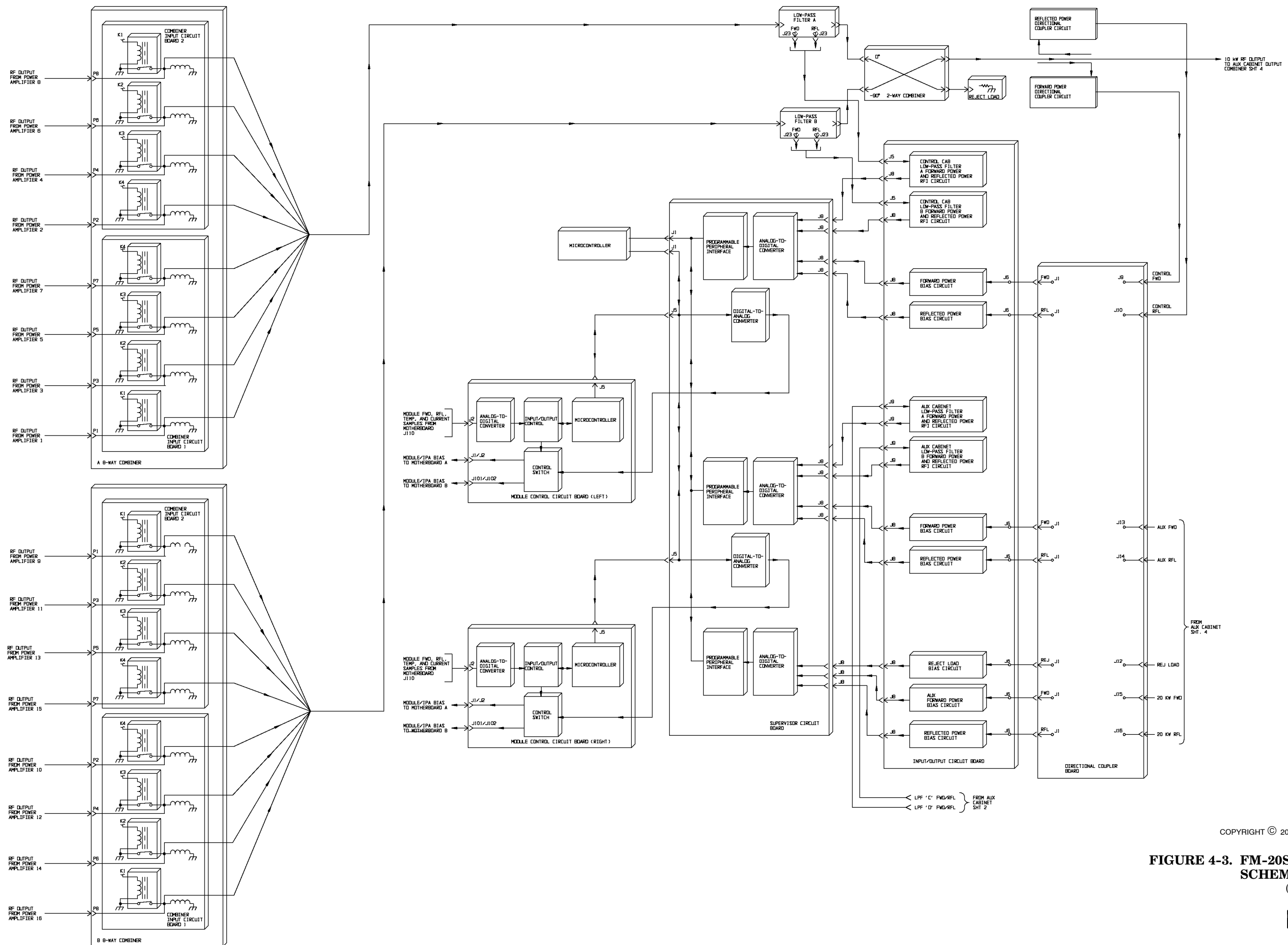


597-1020-18A

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FIGURE 4-3. FM-20S/FMi 1405 RF SIMPLIFIED SCHEMATIC (SHEET 1 OF 4)  
(4-11/4-12)



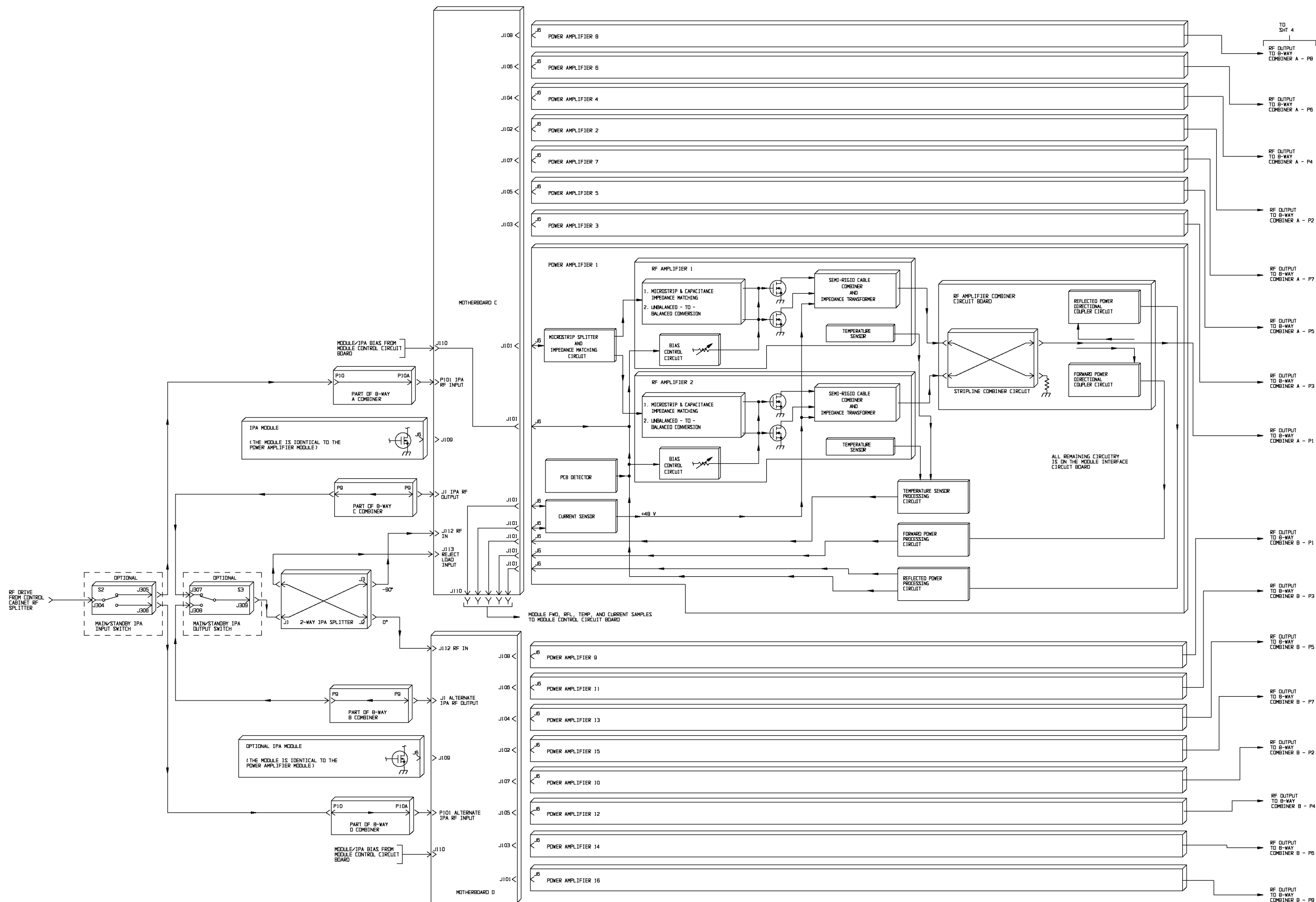


597-1020-18B

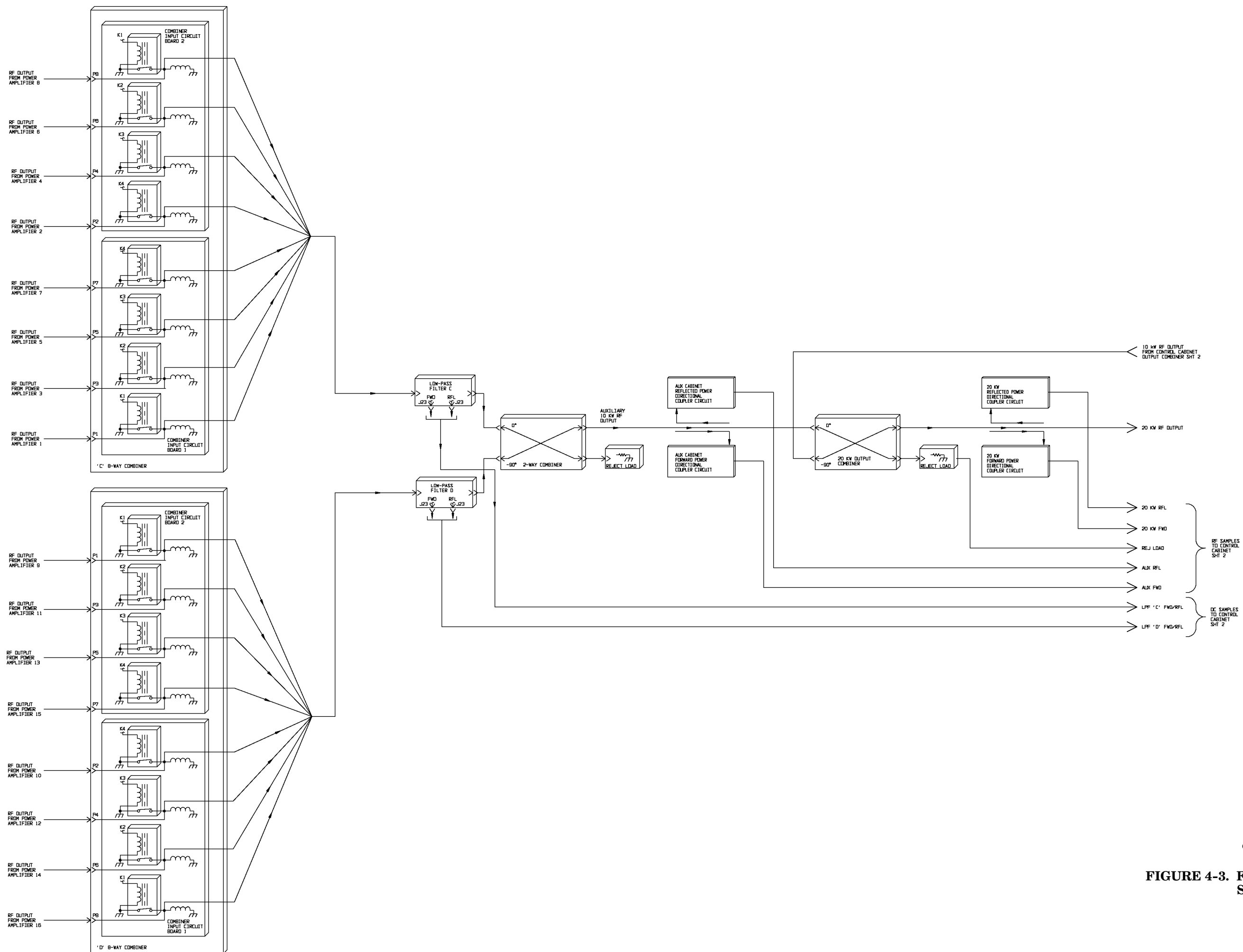
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**FIGURE 4-3. FM-20S/FMi 1405 RF SIMPLIFIED SCHEMATIC (SHEET 2 OF 4)**  
(4-13/4-14)









597-1020-18D

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**FIGURE 4-3. FM-20S/FMi 1405 RF SIMPLIFIED SCHEMATIC (SHEET 4 OF 4)**  
(4-17/4-18)





# SECTION V MAINTENANCE

## 5-1. INTRODUCTION.

5-2. This section provides maintenance information, electrical adjustment procedures, and troubleshooting information for the Broadcast Electronics FM-20S/FMi 1405 transmitter.

## 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**

5-4. The FM-20S/FMi 1405 transmitter contains 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 all transmitter doors and access panels are installed. 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.

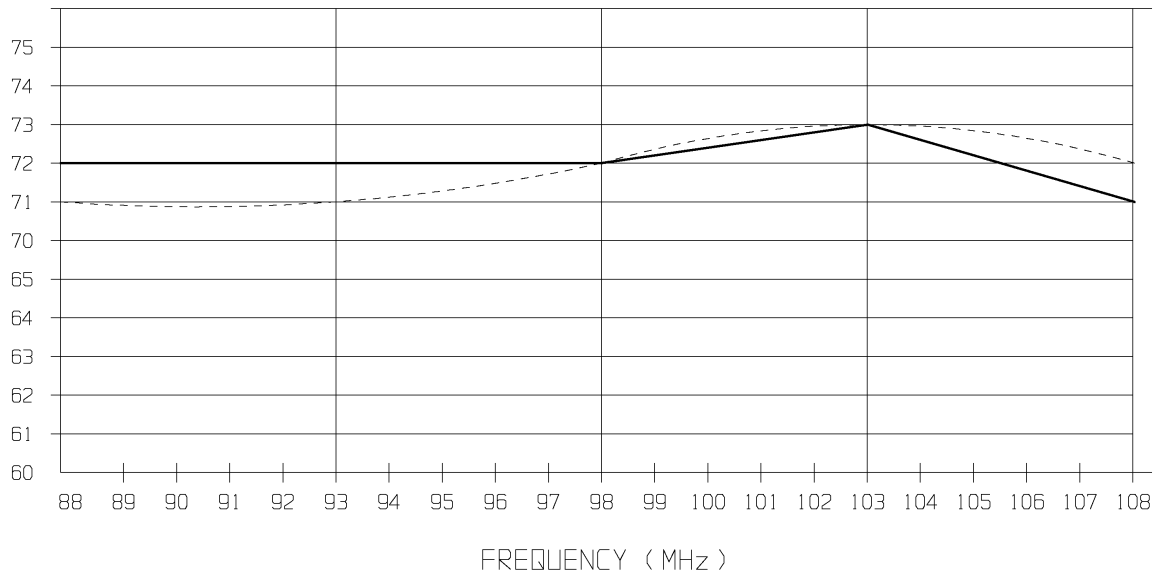
5-5. It is dangerous to measure voltages inside the cabinet or replace components with power energized. Therefore, do not measure voltages inside the cabinet or replace components with power energized. Always operate the transmitter rear door AC switch/circuit breaker to OFF prior to performing any maintenance 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-20S/FMi 1405 power amplifier stage consists of solid-state power amplifier devices. FIGURE 5-1, page 5-2, presents typical FM-20S/FMi 1405 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, page 5-2, 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.

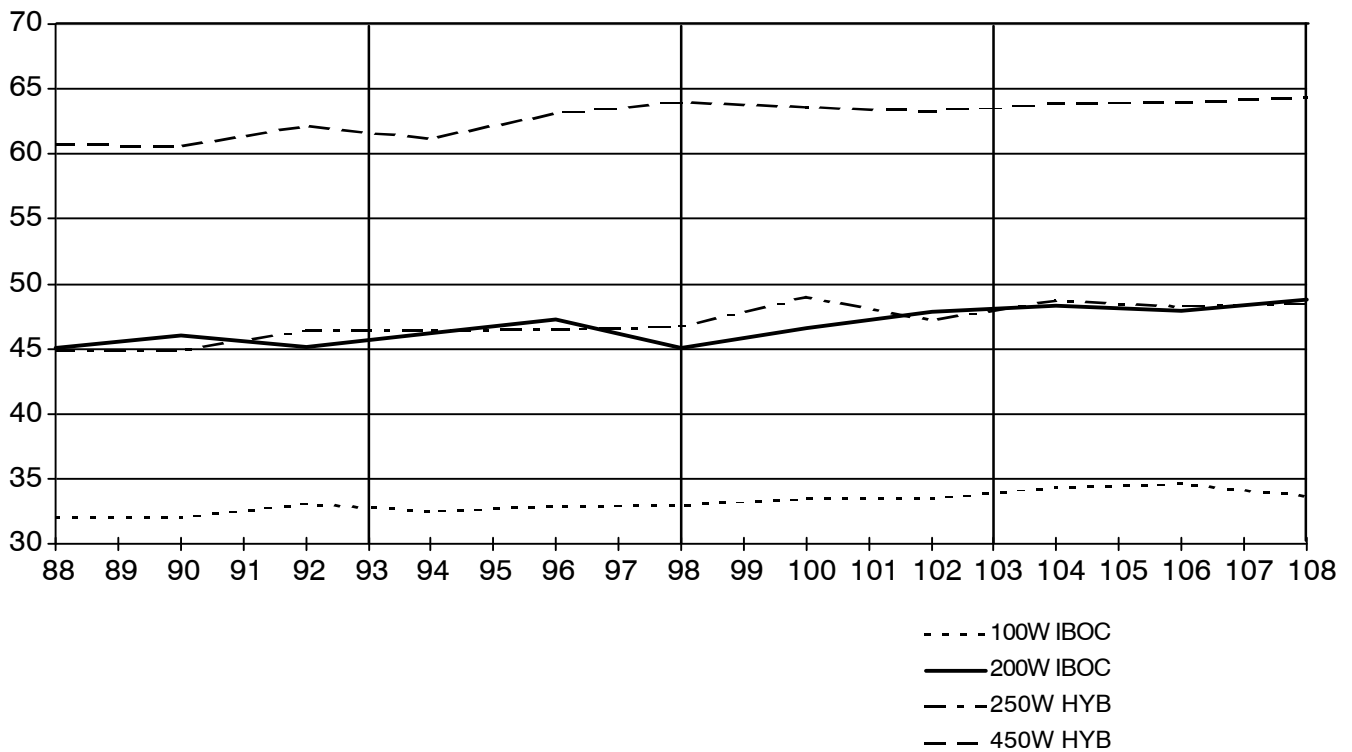


INDEX: ————— 20 kW RF OUTPUT POWER  
 - - - - - 16/18 KW RF OUTPUT POWER

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**FIGURE 5-1. FM-20S TYPICAL PA EFFICIENCY**

**597-1020-37**



**FIGURE 5-2. FMi 1405 TYPICAL PA EFFICIENCY**

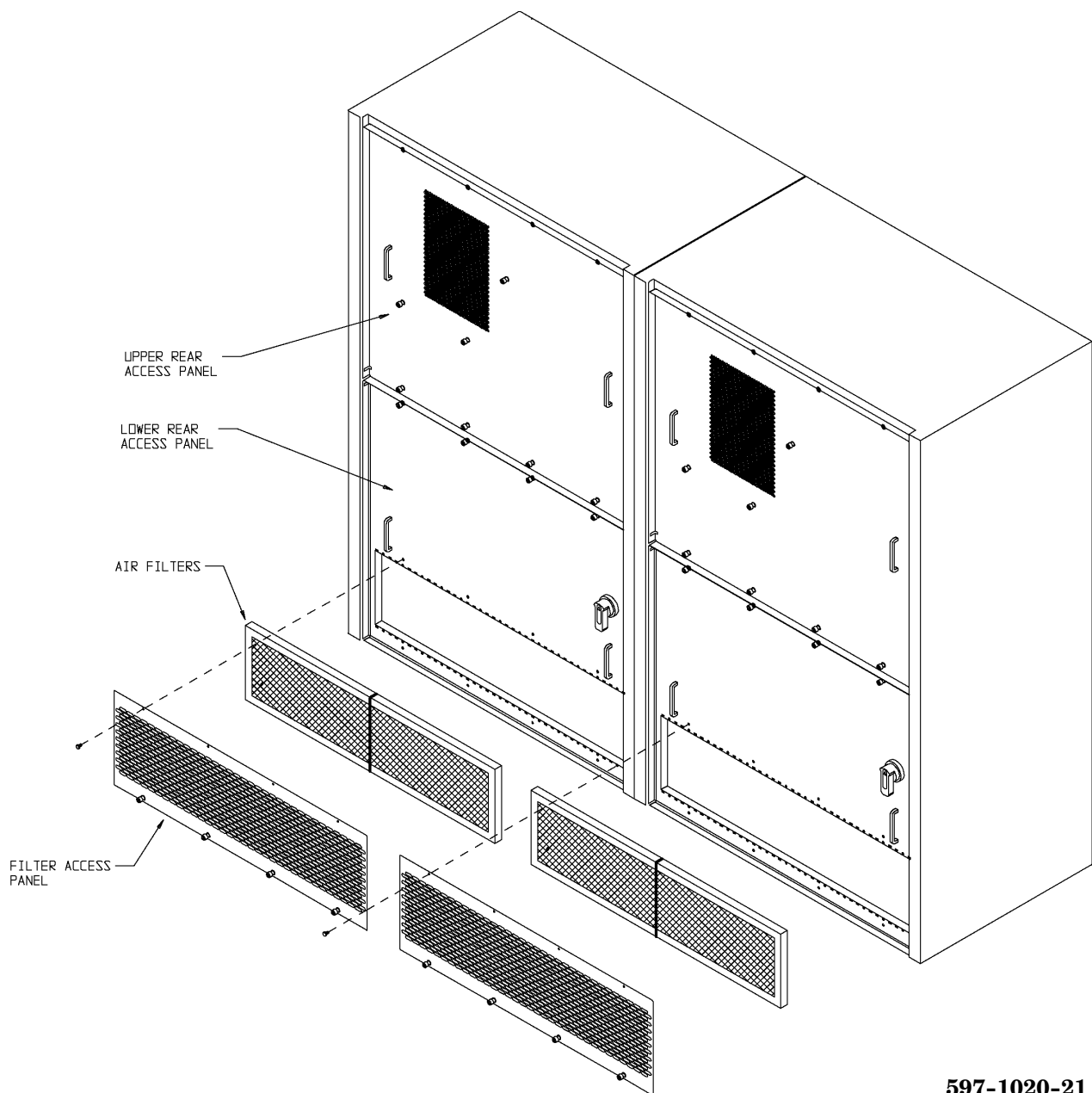
5-10. **ROUTINE MAINTENANCE.**



**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. **TRANSMITTER AIR FILTERS.** The FM-20S/FMi 1405 transmitter is equipped with four screen-type air filters (refer to FIGURE 5-3, page 5-4, ). The air filters are located on the rear-doors. Ensure the filters are installed with the air flow indicator pointing towards the flushing fans. The filters can be checked and cleaned without interrupting transmitter operation.
- 5-13. Check the filter approximately once a week. When dirt is to be removed from the filter, proceed as follows:



**597-1020-21**

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**FIGURE 5-3. AIR FILTER REMOVAL**

1. Refer to FIGURE 5-3 and remove the transmitter rear filter access panel.
2. Remove the filters from the chassis by lifting the filter from the chassis.
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 filter access panel.

- 5-14. **EXCITER AIR FILTER.** The FX-50 and the optional FXi 60 exciter are also equipped with a screen-type air filter. The FX-50 and FXi 60 air filters can be checked and cleaned without interrupting transmitter operation.
- 5-15. The FXi 60 and FX-50 air filters can be accessed from the rear of the transmitter without interrupting transmitter operation. The FX-50 filter can also be accessed by sliding the unit out-of-the-rack. To access and clean the exciter filter, proceed as follows:
1. Refer to FIGURE 5-3, page 5-4 and remove the transmitter upper rear access panel.
  2. Remove the filter from the chassis by removing the screws securing the filter to the chassis.
  3. Clean the filter using a: 1) brush and vacuum or 2) brush and soapy water.
  4. Replace the filter.
  5. Replace the rear upper access panel.
- 5-16. **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.
- 5-17. 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.
- 5-18. **CONTROLLER BATTERY.** The transmitter controller is equipped with a Lithium battery. The battery has a useful life of approximately 5 years. After approximately five years of service, replace the controller battery using BEI part number 350-2032.
- 5-19. **SECOND LEVEL MAINTENANCE.**
- 5-20. 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 consist 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**

**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.***

- 5-21. The maintenance philosophy for the FM-20S/FMi 1405 transmitter 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.

5-22. **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**

5-23. **MULTIMETER CONTRAST ADJUSTMENT.** Potentiometer R28 on the controller front panel circuit board adjusts the multimeter display contrast. The following text presents the procedure to adjust the multimeter contrast.

5-24. **Required Equipment.** The following equipment is required to adjust the multimeter display calibration control.

1. Insulated adjustment tool.

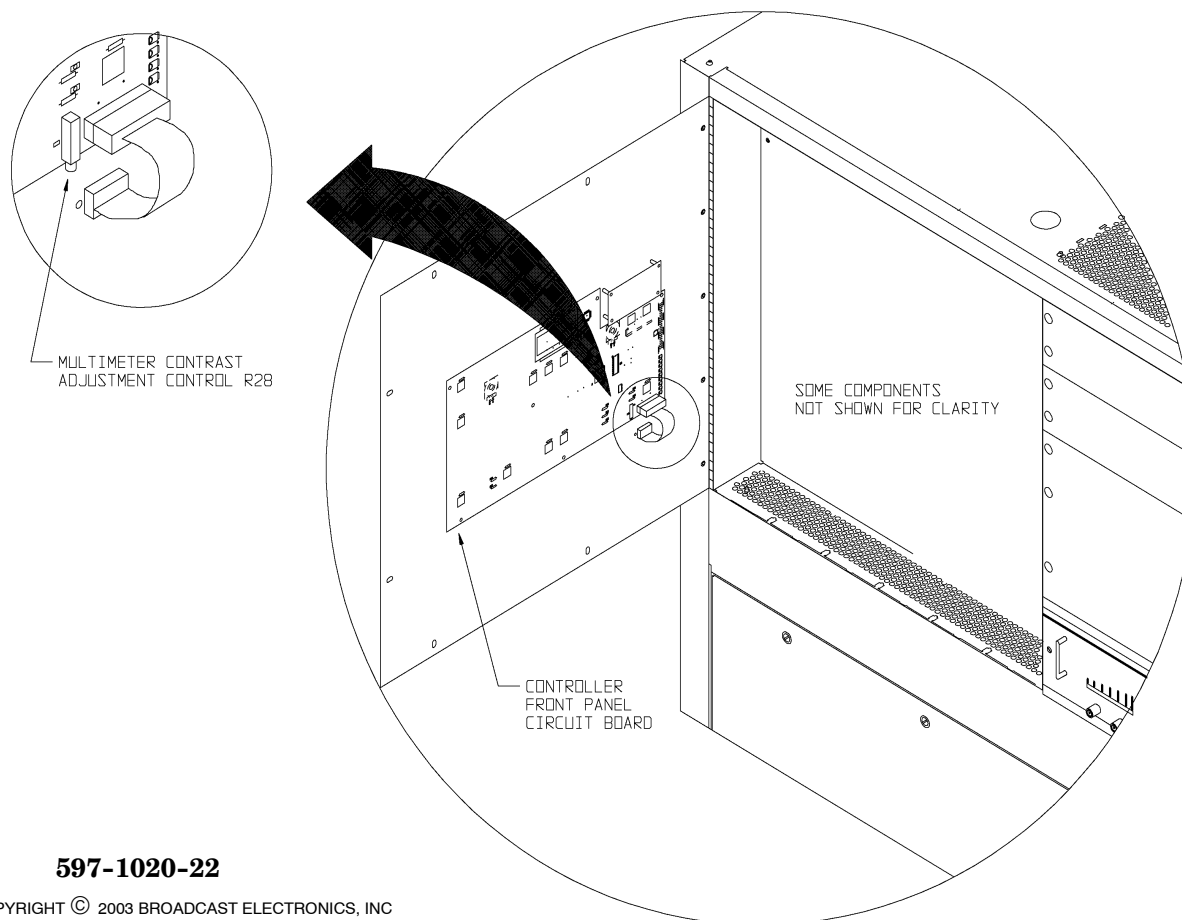
5-25. **Procedure.** To calibrate the multimeter display, proceed as follows:

5-26. Open the controller door.

5-27. Refer to FIGURE 5-4 and locate resistor R28.

5-28. Observe the MULTIMETER display and adjust R28 for the desired contrast.

5-29. Close the controller door.



**597-1020-22**

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**FIGURE 5-4. CONTROLLER FRONT PANEL CIRCUIT BOARD CONTROLS**

5-30. **MICROPROCESSOR MODULE FIRMWARE UPGRADE.**



**CAUTION**

**CAUTION**

***SOME OF THE PROCEDURES PERFORMED USING THE UTILITY PROGRAM CAN TEMPORARILY DISABLE THE TRANSMITTER. THEREFORE, CONTACT THE BROADCAST ELECTRONICS CUSTOMER SERVICE DEPARTMENT PRIOR TO PERFORMING ANY METER CALIBRATION OR FIRMWARE UPLOAD.***

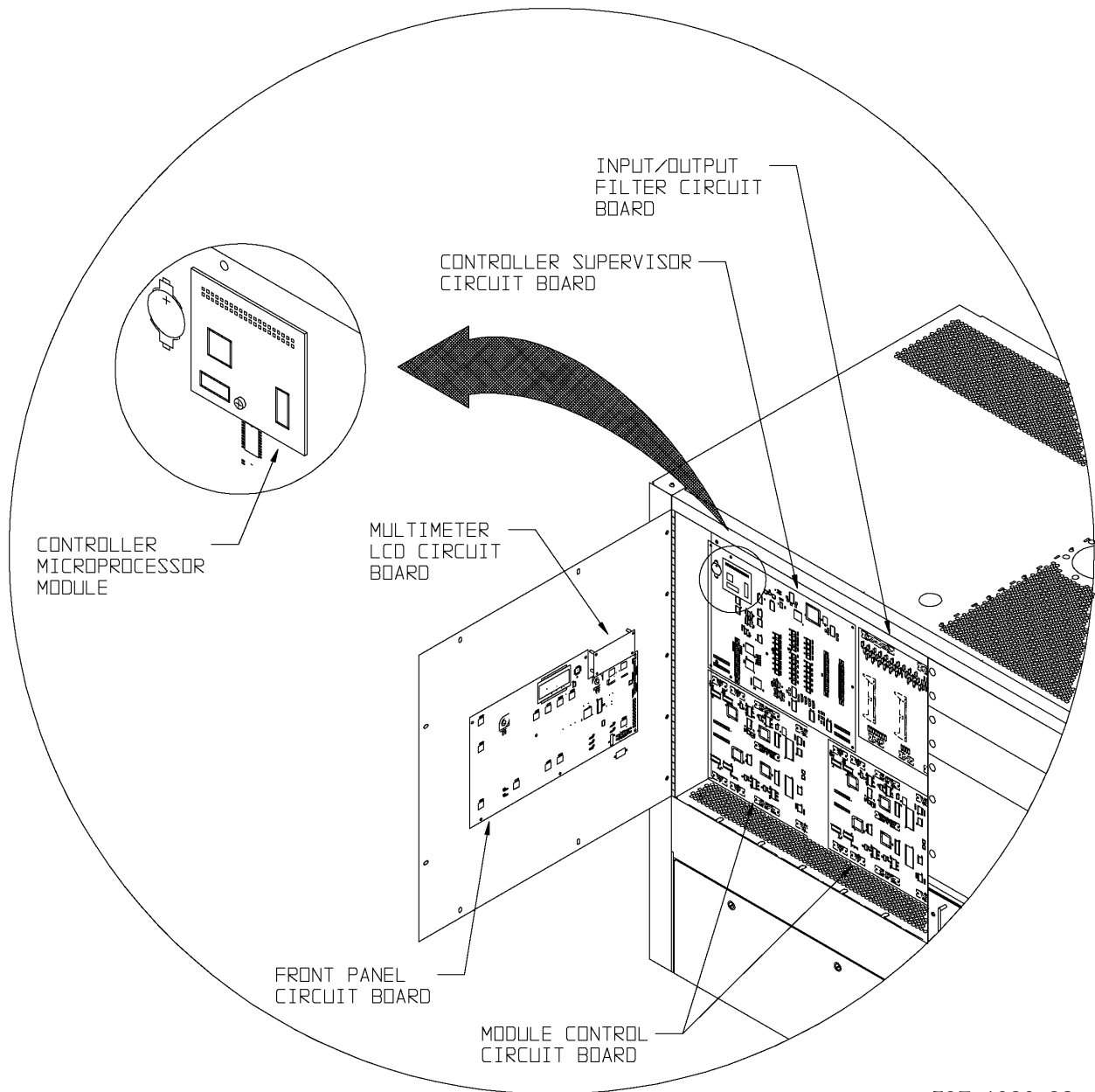


**CAUTION**

**CAUTION**

***FOR MICROPROCESSOR FIRMWARE UPGRADES, THE TRANSMITTER METER VALUES MUST BE RECORDED PRIOR TO ATTEMPTING ANY UPGRADE PROCEDURE. DO NOT PERFORM FM-20S/FMi 1405 UTILITY PROGRAM TASKS UNLESS SPECIFIED BY A PROCEDURE.***

- 5-31. **GENERAL.** The FM-20S/FMi 1405 controller is equipped with a modular microprocessor module (refer to FIGURE 5-5, page 5-8). The module is located on the supervisor circuit board and contains: 1) the main transmitter operating code and 2) transmitter calibration values. For a microprocessor module firmware upgrade, the microprocessor module must be replaced. When this is required, the controller must be re-calibrated.
- 5-32. The re-calibration process is performed using the FM-20S/FMi 1405 utility program. The utility program allows the user to calibrate the multimeter display, calibrate the system LCD display, and change the firmware in the module control circuit board. The utility program requires Windows 95 HyperTerminal (or Windows Terminal), a null modem cable, and a PC to communicate with the operator.
- 5-33. The utility program allows the user to perform the following functions: 1) set all meter calibrations to the factory defaults, 2) calibrate the multimeter parameters, 3) calibrate the system LCD display parameters, 4) upload firmware to the module control circuit board microprocessors, 5) adjust the module bias level, and 6) adjust the IPA bias level.
- 5-34. Some of the operations can be performed by the transmitter user. Some of the operations can only be performed by the user when instructed by the Broadcast Electronics Customer Service Department. Some of the operations can not be performed by the user. The following text presents the utility program operations.



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**FIGURE 5-5. CONTROLLER MICROPROCESSOR MODULE**



<b>CODE</b>	<b>DESCRIPTION</b>	<b>COMMENTS</b>
A	Dumps all TX parameters to the front panel serial port for viewing.	Allows access to all the information displayed on the multi-meter and LCD display on the front panel of the TX through at one time.
B	Adjust the module full bias level.	Do not perform unless instructed to do so by the Broadcast Electronics Customer Service Department.
D	Set the drive power fault level.	Establishes the IPA RF drive level at which the DRIVE fault indicator will illuminate.
E	Enable/Disable reflected power readings from filters.	When pressed this feature toggles between enabling or disabling the reflected power readings from the filters.
F	Resets all meter calibration parameters to the factory defaults	Can be used independently by the operator to reset all meter calibrations.
C	Set TX to FM only mode.	Sets the TX to operate in FM only mode.
G	Set TX to IBOC only mode, no FM carrier.	Sets TX to IBOC only mode and is only valid if the TX is a FMi 703 or 1405.
H	Set TX to Hybrid mode, FM + IBOC.	Sets TX to FM + IBOC mode and is only valid if the TX is a FMi 703 or 1405.
I	Adjust the IPA full bias level.	Do not perform unless instructed to do so by the Broadcast Electronics Customer Service Department.
K	Set the minimum exciter power reading for operation.	To be used by the operator only when instructed by the Broadcast Electronics Customer Service Department.
L	Calibrates the LCD display.	Do not perform unless instructed to do so by the Broadcast Electronics Customer Service Department.
M	Calibrates the multimeter display.	To be used by the operator only when instructed by the Broadcast Electronics Customer Service Department.
O	Enable/Disable standby exciter option.	When pressed this feature toggles between enabling or disabling the standby exciter option.
R	Establishes the reflected power level at which automatic power foldback will occur.	To be used by the operator only when instructed by the Broadcast Electronics Customer Service Department.
S	Enable/Disable standby IPA option.	When pressed this feature toggles between enabling or disabling the standby IPA option.
U	Uploads new firmware to the module control circuit board microprocessors.	To be used by the operator only when instructed by the Broadcast Electronics Customer Service Department.
V	Set the PA Supply Voltage when in IBOC only and FM + IBOC mode.	Do not perform unless instructed to do so by the Broadcast Electronics Customer Service Department.
Q	Terminates the utility program operations	Used to terminate the utility program operation.

- 5-35. **FIRMWARE UPGRADE – PROCEDURE.** When a firmware upgrade requires the supervisor circuit board to be replaced, the transmitter and module values must be recorded. To perform a microprocessor module firmware upgrade, proceed as follows:
- 5-36. **Step 1 – Record The Transmitter And Module Values.** Record the transmitter and module values by performing the following procedure. The re-calibration procedure requires a Bird wattmeter. Therefore, record the wattmeter values also.
- 5-37. Operate the transmitter at a normal output power.
- 5-38. Operate the **MULTIMETER** to record the following values for an RF amplifier module. Select only one module such as module 1 and record the values.

<i><b>MODE/FUNCTION</b></i>	<i><b>TRANS. METER VALUE</b></i>	<i><b>BIRD WATTMETER VALUE</b></i>
Module Forward Power		N/A
Module Reflected Power		N/A
Module Temp		N/A
Module Current		N/A
R Combiner		N/A
L Combiner		N/A
Control PAV		N/A
Auxiliary PAV		N/A
Control PAI		N/A
Auxiliary PAI		N/A

- 5-39. Operate the **SYSTEM** LCD to record the following values.

<i><b>MODE/FUNCTION</b></i>	<i><b>TRANS. METER VALUE</b></i>	<i><b>BIRD WATTMETER VALUE</b></i>
System Forward Power		
System Reflected Power		
PA Voltage		N/A
System PA Current		N/A

- 5-40. **Step 2 – Replace the Microprocessor Module.** Replace the microprocessor module as follows:



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

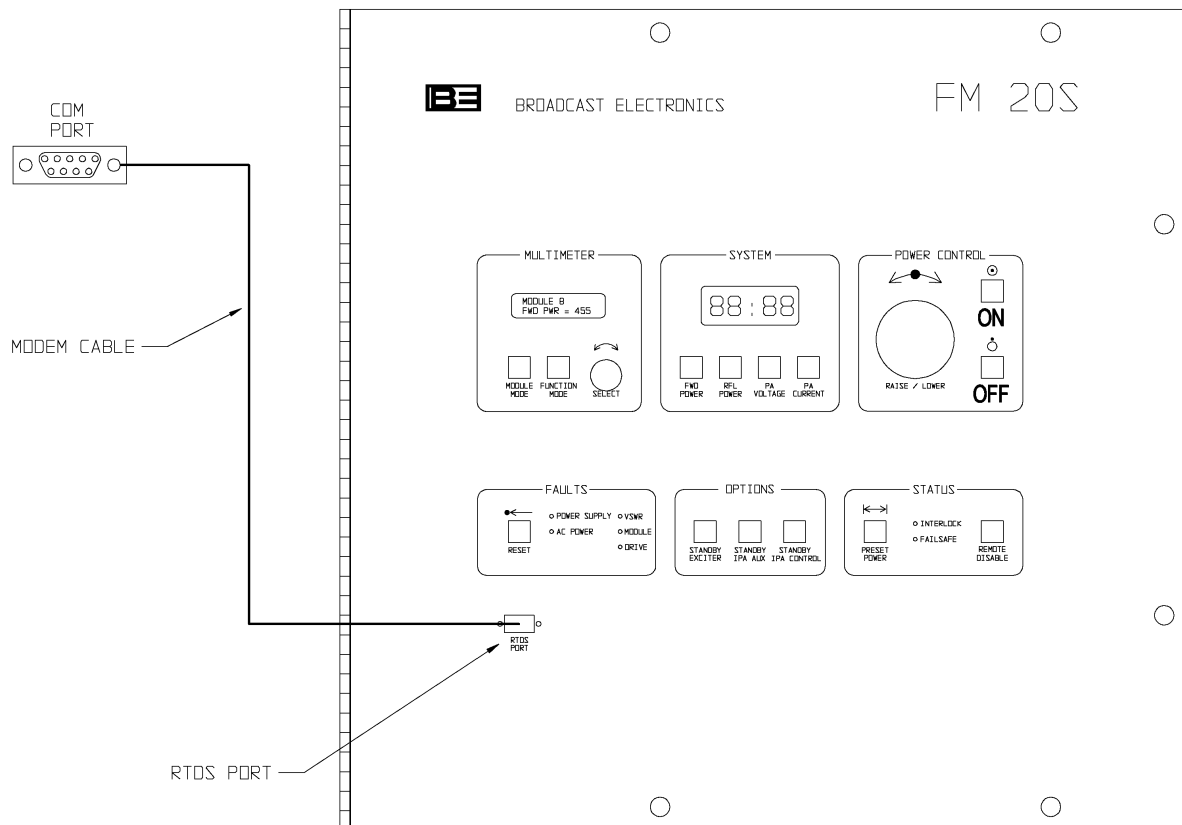
**WARNING**

- 5-41. Disconnect all transmitter primary power before proceeding.
- 5-42. Open the transmitter controller door and locate the microprocessor module (refer to FIGURE 5-5, page 5-8).

5-43. Replace the microprocessor module as follows:

1. Using a #1 Philips screwdriver, remove the microprocessor mounting screw.
2. Using your hands, gently pull the module from the header.
3. Orient the new microprocessor module as shown and insert the module in header J1 (refer to FIGURE 5-5, page 5-8).
4. Re-install the mounting screw and close the controller door.

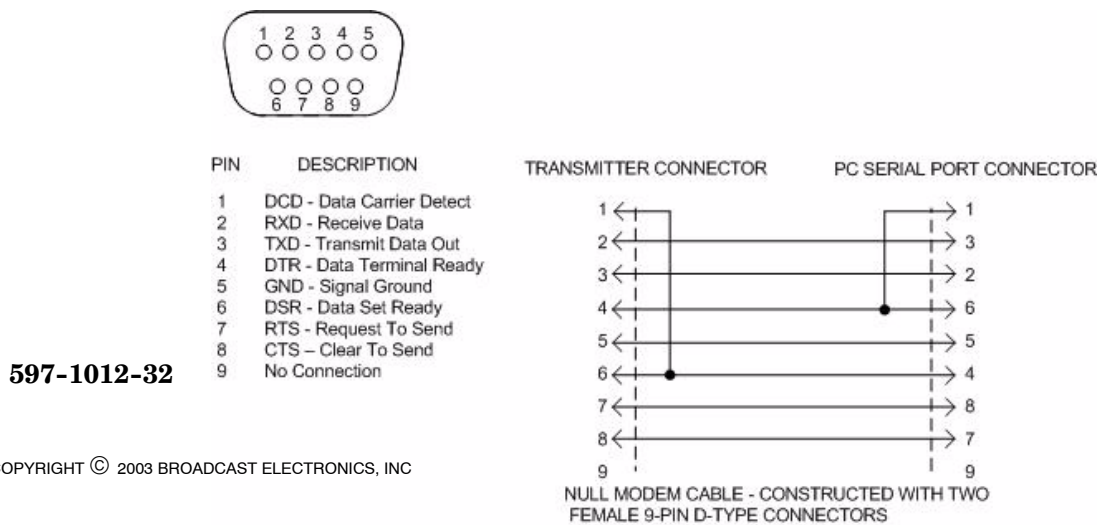
5-44. **Step 3 – PC Connections.** Once the microprocessor module is replaced, a PC must be connected to the transmitter. The utility program requires a PC and a null modem cable to communicate with the user. Refer to FIGURE 5-6, page 5-11 and connect a null modem cable between a computer COM port and the FM-20S/FMi 1405 front-panel RTDS port as shown. If a pre-constructed null modem cable cannot be located, a cable can be manufactured using 2 female D-Type connectors and an 8 conductor cable (refer to FIGURE 5-7, page 5-12).



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**FIGURE 5-6. PC CONNECTION - FM-20S/FMi 1405 UTILITY PROGRAM**



**FIGURE 5-7. NULL MODEM CABLE CONSTRUCTION**

5-45. **Step 4 – Utility Program Initial Operation.** The utility program requires Windows 95/98 HyperTerminal or Windows Terminal. To establish a connection to the FM-20S/FMi 1405 transmitter using the terminal program, proceed as follows:

1. Apply AC power and operate the transmitter.
2. Move the cursor to PROGRAMS→ACCESSORIES→HYPERTERMINAL and click the mouse.
3. Move the cursor to the HYPERTERMINAL shortcut and double-click the mouse.

*The HYPERTERMINAL program will appear.*

4. Simultaneously depress the FM-20S/FMi 1405 FORWARD POWER and PA CURRENT switch/indicators to illuminate the switch/indicators.

*The FM-20S/FMi 1405 utility program main display will appear (refer to FIGURE 5-8, page 5-13).*

**Setup menu, software version 1.0.25**

**A-All transmitter meter readings dumped to this port**

**B-Adjust the module full bias level**

**D-Set drive power fault level**

**E-Enable/disable reflected power readings from filters**

**F-Factory default values for meters calibration**

**C-Set transmitter in FM only mode**

**G-Set transmitter in IBOC only mode, no FM carrier**

**H-Set transmitter in hybrid FM plus IBOC mode**

**I-Adjust the IPA full bias level**

**K-Set the minimum exciter power reading for operation**

**L-Calibrate LCD meter parameter**

**M-Calibrate multimeter parameter**

**O-Enable/disable standby exciter option**

**R-Set reflected power reading that causes foldback**

**S-Enable/disable standby IPA option**

**U-Upload new software to module control processors**

**V-Set the PA supply voltage when in the IBOC mode**

**Q-Quit setup**

**Please type your selection now:**

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**FIGURE 5-8. UTILITY PROGRAM MAIN DISPLAY**

5-46. **Step 5 – System LCD Calibration.** All the parameters displayed by the SYSTEM LCD are calibrated by the L command. The command calibrates the function selected on the transmitter SYSTEM LCD at the time of calibration. For example, if the SYSTEM LCD is configured to display FORWARD POWER, the value entered using the L command will calibrate the forward power. To re-calibrate the SYSTEM LCD, proceed as follows:

1. To calibrate the transmitter forward power, the transmitter output power must be adjusted to normal using an external wattmeter such as a Bird 4720 Thruline with a 25 kW element. Connect the transmitter to the wattmeter and adjust the forward power as follows:



**WARNING**

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

**WARNING**

- A. Disconnect all transmitter primary power before proceeding.
  - B. Connect the wattmeter to the transmitter.
  - C. Apply AC power to the transmitter.
  - D. Enable the transmitter and operate the **POWER CONTROL** rotary switch to adjust the output power until the forward power value recorded in Step 1 is present on the external wattmeter.
2. Calibrate the forward power as follows:
    - A. On the **SYSTEM LCD**, select **FORWARD POWER**.
    - B. Depress: L

*The system calibration display will appear(refer to FIGURE 5-9).*

**Setup menu, software version 1.0.25**

**A-All transmitter meter readings dumped to this port**

**B-Adjust the module full bias level**

**D-Set drive power fault level**

**E-Enable/disable reflected power readings from filters**

**F-Factory default values for meters calibration**

**C-Set transmitter in FM only mode**

**G-Set transmitter in IBOC only mode, no FM carrier**

**H-Set transmitter in hybrid FM plus IBOC mode**

**I-Adjust the IPA full bias level**

**K-Set the minimum exciter power reading for operation**

**L-Calibrate LCD meter parameter**

**M-Calibrate multimeter parameter**

**O-Enable/disable standby exciter option**

**R-Set reflected power reading that causes foldback**

**S-Enable/disable standby IPA option**

**U-Upload new software to module control processors**

**V-Set the PA supply voltage when in the IBOC mode**

**Q-Quit setup**

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**Please type your selection now: L**

**Next, enter new reading, ignoring the decimal point:**

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**FIGURE 5-9. UTILITY PROGRAM SYSTEM CALIBRATION**

C. Enter the forward power meter value recorded in Step 1.

For example, to enter a forward power value of 20.1 kW,  
enter: 20.1.

D. Depress: Enter.

*The forward power parameter will be calibrated.*

3. Repeat the preceding forward power calibration step for reflected power and PA voltage.  
Enter the transmitter values recorded in Step 1.

5-47. **Step 6 – Multimeter Calibration.** All the parameters displayed by the **MULTIMETER** are calibrated by the M command. The command calibrates the function selected on the transmitter **MULTIMETER** LCD at the time of calibration. For example, if the **MULTIMETER** LCD is configured to display **MODULE FORWARD POWER**, the value entered using the M command will calibrate the module forward power. To re-calibrate the multimeter, proceed as follows:

1. Calibrate the module forward power as follows:

A. On the **MULTIMETER** LCD, select **MODULE FORWARD POWER**.

B. Depress: M

*The multimeter calibration display will appear(refer to FIGURE 5-10, psge 5-15).*

**Setup menu, software version 1.0.25**

**A-All transmitter meter readings dumped to this port**

**B-Adjust the module full bias level**

**D-Set drive power fault level**

**E-Enable/disable reflected power readings from filters**

**F-Factory default values for meters calibration**

**C-Set transmitter in FM only mode**

**G-Set transmitter in IBOC only mode, no FM carrier**

**H-Set transmitter in hybrid FM plus IBOC mode**

**I-Adjust the IPA full bias level**

**K-Set the minimum exciter power reading for operation**

**L-Calibrate LCD meter parameter**

**M-Calibrate multimeter parameter**

**O-Enable/disable standby exciter option**

**R-Set reflected power reading that causes foldback**

**S-Enable/disable standby IPA option**

**U-Upload new software to module control processors**

**V-Set the PA supply voltage when in the IBOC mode**

**Q-Quit setup**

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**Please type your selection now: M**

**Next, enter new reading, ignoring the decimal point:**

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#### FIGURE 5-10. UTILITY PROGRAM MULTIMETER CALIBRATION

- C. Enter the module forward power meter value recorded in Step 1. Typically, only module currents contain decimal points.

For example, to enter a current of 18.5 Amperes, enter: 18.5. To enter a forward power value of 570 watts, enter: 570.

- D. Depress: Enter.

*The module forward power parameter will be calibrated.*

2. Repeat the procedure for module reflected power, module current, L combiner, and R combiner. Enter the transmitter values recorded in Step 1.

- 5-48. **Step 7 – Quit Utility Program.** Once the values are entered, the re-calibration process is complete. Exit the utility program as follows:

1. Depress: Q

*The utility program will terminate operation.*

- 5-49. **SYSTEM LCD AND MULTIMETER RE-CALIBRATION.**



**CAUTION**

**CAUTION**

***SOME OF THE PROCEDURES PERFORMED USING THE UTILITY PROGRAM CAN TEMPORARILY DISABLE THE TRANSMITTER. THEREFORE, CONTACT THE BROADCAST ELECTRONICS CUSTOMER SERVICE DEPARTMENT PRIOR TO PERFORMING ANY METER CALIBRATION OR FIRMWARE UPLOAD.***

- 5-50. **GENERAL.** The FM-20S/FMi 1405 **SYSTEM** and **MULTIMETER** displays can be re-calibrated if required. The re-calibration is accomplished using the FM-20S/FMi 1405 utility program. A complete description of the program is presented in MICROPROCESSOR MODULE FIRMWARE UPGRADE (refer to the preceding text).
- 5-51. **SYSTEM LCD RE-CALIBRATION – PROCEDURE.** The **SYSTEM** LCD re-calibration process is described in the MICROPROCESSOR MODULE FIRMWARE UPGRADE procedure in the preceding text. To re-calibrate a **SYSTEM** LCD meter parameter, proceed as follows:
- 5-52. **Step 1 – PC Connections.** To calibrate the **SYSTEM** meter, a PC must be connected to the transmitter. The utility program requires a PC and a null modem cable to communicate with the user. Refer to FIGURE 5-6, page 5-11, and connect a null modem cable between a computer COM port and the FM-20S/FMi 1405 front-panel RTDS port as shown. If a pre-constructed null modem cable cannot be located, a cable can be manufactured using 2 female D-Type connectors and a 3 conductor cable (refer to FIGURE 5-7, page 5-12).
- 5-53. **Step 2 – Utility Program Initial Operation.** Refer to **Step 4 - Utility Program Initial Operation** in FIRMWARE UPGRADE - PROCEDURE (refer to the preceding text) to establish a connection to the FM-20S/FMi 1405 transmitter using the terminal program.
- 5-54. **Step 3 – System LCD Calibration.** All the parameters displayed by the **SYSTEM** LCD are calibrated by the L command. Typically, only the forward power, reflected power, and the PA voltage require calibration. The command calibrates the function selected on the transmitter **SYSTEM** LCD at the time of calibration. For example, if the **SYSTEM** LCD is configured to display FORWARD POWER, the value entered using the L command will calibrate the forward power. To re-calibrate the **SYSTEM** LCD, refer to **Step 5 - System LCD Calibration** in FIRMWARE UPGRADE - PROCEDURE (refer to the preceding text) to calibrate the **SYSTEM** LCD.
- 5-55. **Step 4 – Quit Utility Program.** Once the values are entered, the re-calibration process is complete. Exit the utility program as follows:
1. Depress: Q
- The utility program will terminate operation.*
- 5-56. **MULTIMETER RE-CALIBRATION – PROCEDURE.** The **MULTIMETER** re-calibration process is described in the MICROPROCESSOR MODULE FIRMWARE UPGRADE procedure in the preceding text. To re-calibrate a **MULTIMETER** parameter, proceed as follows:
- 5-57. **Step 1 – PC Connections.** To calibrate the **MULTIMETER**, a PC must be connected to the transmitter. The utility program requires a PC and a null modem cable to communicate with the user. Refer to FIGURE 5-6, page 5-11, and connect a null modem cable between a computer COM port and the FM-20S/FMi 1405 front-panel RTDS port as shown. If a pre-constructed null modem cable cannot be located, a cable can be manufactured using 2 female D-Type connectors and a 3 conductor cable (refer to FIGURE 5-7, page 5-12).
- 5-58. **Step 2 – Utility Program Initial Operation.** Refer to **Step 4 - Utility Program Initial Operation** in FIRMWARE UPGRADE - PROCEDURE (refer to the preceding text) to establish a connection to the FM-10S transmitter using the terminal program.
- 5-59. **Step 3 – Multimeter Calibration.** All the parameters displayed by the **MULTIMETER** are calibrated by the M command. The command calibrates the function selected on the transmitter **MULTIMETER** at the time of calibration. For example, if the **MULTIMETER** is configured to display **MODULE FORWARD POWER**, the value entered using the M command will calibrate the module forward power. To re-calibrate the **MULTIMETER**, refer to **Step 6 - Multimeter Calibration** in FIRMWARE UPGRADE - PROCEDURE (refer to the preceding text) to calibrate the **MULTIMETER**.



5-60. **Step 4 – Quit Utility Program.** Once the values are entered, the re-calibration process is complete. Exit the utility program as follows:

1. Depress: Q

*The utility program will terminate operation.*

5-61. **SYSTEM LCD AND MULTIMETER RESET.**



**CAUTION**  
**CAUTION**

***SOME OF THE PROCEDURES PERFORMED USING THE UTILITY PROGRAM CAN TEMPORARILY DISABLE THE TRANSMITTER. THEREFORE, CONTACT THE BROADCAST ELECTRONICS CUSTOMER SERVICE DEPARTMENT PRIOR TO PERFORMING ANY METER CALIBRATION OR FIRMWARE UPLOAD.***

5-62. **GENERAL.** In the event the meter calibrations become inadvertently mis-calibrated, the F command can be used to reset all calibration parameters to the factory defaults. The factory defaults are the values prior to the factory test setup. As a result, each system LCD or multimeter parameter must be re-entered. The values for the parameters can be located in the factory test data sheets. The SYSTEM LCD parameters include: 1) forward power, 2) reflected power, and 3) PA voltage. The MULTIMETER parameters include: 1) module forward power, 2) module reflected power, 3) module current, and 4) module temperature. The command can be used during on-air operation. The reset is accomplished using the FM-20S/FMi 1405 utility program. A complete description of the program is presented in MICROPROCESSOR MODULE FIRMWARE UPGRADE (refer to the preceding text).

5-63. **SYSTEM LCD AND MULTIMETER RESET – PROCEDURE.** To reset the **SYSTEM** LCD and **MULTIMETER** parameters, proceed as follows:

5-64. **Step 1 – PC Connections.** To reset the **SYSTEM** LCD and **MULTIMETER**, a PC must be connected to the transmitter. The utility program requires a PC and a null modem cable to communicate with the user. Refer to FIGURE 5-6, page 5-11, and connect a null modem cable between a computer COM port and the FM-20S/FMi 1405 front-panel RTDS port as shown. If a pre-constructed null modem cable cannot be located, a cable can be manufactured using 2 female D-Type connectors and a 3 conductor cable (refer to FIGURE 5-7, page 5-12).

5-65. **Step 2 – Utility Program Initial Operation.** Refer to **Step 4 - Utility Program Initial Operation** in FIRMWARE UPGRADE - PROCEDURE (refer to the preceding text) to establish a connection to the FM-20S/FMi 1405 transmitter using the terminal program.

5-66. **Step 3 – Reset And Quit.** To reset all the meter calibrations, proceed as follows:

1. Depress: F

*All meter calibration parameters will be reset to the factory defaults.*

2. Depress: Q

*The utility program will terminate operation.*

5-67. **Step 4 – Re-Enter The System LCD and Multimeter Values.** Refer to SYSTEM LCD AND MULTIMETER RE-CALIBRATION in the preceding text and perform the procedure to re-enter the meter parameter values.

5-68. **REFLECTED POWER FOLDBACK CALIBRATION.**



**CAUTION**

**CAUTION**

***SOME OF THE PROCEDURES PERFORMED USING THE UTILITY PROGRAM CAN TEMPORARILY DISABLE THE TRANSMITTER. THEREFORE, CONTACT THE BROADCAST ELECTRONICS CUSTOMER SERVICE DEPARTMENT PRIOR TO PERFORMING ANY METER CALIBRATION OR FIRMWARE UPLOAD.***

5-69. **GENERAL.** The FM-20S/FMi 1405 utility program R command establishes the reflected power level when the transmitter will begin automatic foldback operation. The factory default is 600 watts. The command: 1) is to be used only when instructed by the Broadcast Electronics Customer Service Department and 2) can be executed during on-air operation. A complete description of the program is presented in MICROPROCESSOR MODULE FIRMWARE UPGRADES (refer to the preceding text).

5-70. **REFLECTED POWER FOLDBACK CALIBRATION – PROCEDURE.** To establish the level when the transmitter will begin automatic foldback operation, proceed as follows:

5-71. **Step 1 – PC Connections.** To calibrate the reflected power foldback level, a PC must be connected to the transmitter. The utility program requires a PC and a null modem cable to communicate with the user. Refer to FIGURE 5-6, page 5-11, and connect a null modem cable between a computer COM port and the FM-20S/FMi 1405 front-panel RTDS port as shown. If a pre-constructed null modem cable cannot be located, a cable can be manufactured using 2 female D-Type connectors and a 3 conductor cable (refer to FIGURE 5-7, page 5-12).

5-72. **Step 2 – Utility Program Initial Operation.** Refer to **Step 4 - Utility Program Initial Operation** in the FIRMWARE UPGRADE - PROCEDURE (refer to the preceding text) to establish a connection to the FM-20S/FMi 1405 transmitter using the terminal program.

5-73. **Step 3 – Calibrate And Quit.** To calibrate the reflected power foldback level, proceed as follows:

1. Select the reflected power level when the transmitter is to begin automatic foldback operation.
2. Depress: R  
*The reflected power foldback level display will appear.*
3. Enter the reflected power value as directed by the Broadcast Electronics Customer Service Department. Enter the values without the decimal point. For example, to enter a reflected power value of 500 watts, enter: 500.
4. Depress: Enter.  
*The reflected power value will be saved.*

**Setup menu, software version 1.0.25**  
**A-All transmitter meter readings dumped to this port**  
**B-Adjust the module full bias level**  
**D-Set drive power fault level**  
**E-Enable/disable reflected power readings from filters**  
**F-Factory default values for meters calibration**  
**C-Set transmitter in FM only mode**  
**G-Set transmitter in IBOC only mode, no FM carrier**  
**H-Set transmitter in hybrid FM plus IBOC mode**  
**I-Adjust the IPA full bias level**  
**K-Set the minimum exciter power reading for operation**  
**L-Calibrate LCD meter parameter**  
**M-Calibrate multimeter parameter**  
**O-Enable/disable standby exciter option**  
**R-Set reflected power reading that causes foldback**  
**S-Enable/disable standby IPA option**  
**U-Upload new software to module control processors**  
**V-Set the PA supply voltage when in the IBOC mode**  
**Q-Quit setup**

**Please type your selection now: R**

**Old value is: 500**

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**Enter a new value:**

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**FIGURE 5-11. UTILITY PROGRAM MULTIMETER CALIBRATION**

5. Depress: Q

*The utility program will terminate operation.*

#### 5-74. **UPLOADING FIRMWARE TO THE MODULE CONTROL CIRCUIT BOARDS.**



**CAUTION**

**CAUTION**

***SOME OF THE PROCEDURES PERFORMED USING THE UTILITY PROGRAM CAN TEMPORARILY DISABLE THE TRANSMITTER. THEREFORE, CONTACT THE BROADCAST ELECTRONICS CUSTOMER SERVICE DEPARTMENT PRIOR TO PERFORMING ANY METER CALIBRATION OR FIRMWARE UPLOAD.***

5-75. **GENERAL.** The FM-10S utility program U command uploads new firmware to the module control microprocessors. The command: 1) is to be used only when instructed by the Broadcast Electronics Customer Service Department and 2) can be executed only during a maintenance period (no on-air broadcast). The new firmware file *MCFBIN* must be at the PC prior to beginning the upload procedure. The procedure immediately deletes the current firmware installed in the memory. When this occurs, the transmitter will not operate until the new file is installed. A complete description of the program is presented in MICROPROCESSOR MODULE FIRMWARE UPGRADE (refer to the preceding text).

5-76. **UPLOADING FIRMWARE TO THE MODULE CONTROL CIRCUIT BOARDS – PROCEDURE.** To upload new code to the module control circuit boards, proceed as follows:

- 5-77. **Step 1 – PC Connections.** To upload firmware to the module control circuit boards, a PC must be connected to the transmitter. The utility program requires a PC and a null modem cable to communicate with the user. Refer to Figure 5-5 and connect a null modem cable between a computer COM port and the FM-10S front-panel RTDS port as shown. If a pre-constructed null modem cable cannot be located, a cable can be manufactured using 2 female D-Type connectors and a 3 conductor cable (refer to Figure 5-6).
- 5-78. **Step 2 – Utility Program Initial Operation.** Refer to **Step 4 - Utility Program Initial Operation** in FIRMWARE UPGRADE – PROCEDURE (refer to the preceding text) to establish a connection to the FM-10S transmitter using the terminal program.
- 5-79. **Step 3 – Upload Firmware To The Module Control Circuit Boards And Quit.** To upload firmware to the module control microprocessors, proceed as follows:



**CAUTION**

**CAUTION**

***THE TRANSMITTER MUST BE REMOVED FROM ON-AIR OPERATION PRIOR TO PERFORMING THE UPLOAD PROCEDURE.***

***THE NEW MCF.BIN FIRMWARE FILE MUST BE AT THE PC PRIOR TO BEGINNING THE UPLOAD PROCEDURE. THE PROCEDURE IMMEDIATELY DELETES THE FIRMWARE INSTALLED IN THE MEMORY.***

1. Locate the new *MCF.BIN* firmware file to be installed.
2. Depress: U

*The upload display will appear (refer to FIGURE 5-12).*

**Setup menu, software version 1.0.25**

**A-All transmitter meter readings dumped to this port**

**B-Adjust the module full bias level**

**D-Set drive power fault level**

**E-Enable/disable reflected power readings from filters**

**F-Factory default values for meters calibration**

**C-Set transmitter in FM only mode**

**G-Set transmitter in IBOC only mode, no FM carrier**

**H-Set transmitter in hybrid FM plus IBOC mode**

**I-Adjust the IPA full bias level**

**K-Set the minimum exciter power reading for operation**

**L-Calibrate LCD meter parameter**

**M-Calibrate multimeter parameter**

**O-Enable/disable standby exciter option**

**R-Set reflected power reading that causes foldback**

**S-Enable/disable standby IPA option**

**U-Upload new software to module control processors**

**V-Set the PA supply voltage when in the IBOC mode**

**Q-Quit setup**

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**Please type your selection now: Upload will erase the software on the module control card. Are you sure this is what you want to do? Enter Y or N to respond . .**

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**FIGURE 5-12. UTILITY PROGRAM MULTIMETER CALIBRATION**

3. Move the cursor to TRANSFERS→SEND BINARY FILE and click the mouse.
4. Use the BROWSE dialog box to select the MCF.BIN file.
5. Move the cursor to OK and click the mouse.

*The download process will begin.*

6. Refer to Figure 5-12 depress the supervisor circuit board microprocessor reset switch.
7. Depress: Q

*The utility program will terminate operation.*

## 5-80. **RF POWER AMPLIFIER MODULE ADJUSTMENTS.**

- 5-81. The RF power amplifier module amplifier and interface circuit boards contain calibration controls. The power amplifier circuit board is equipped with bias level control R109 and matching control C116. The interface circuit board is equipped with forward calibration control R1, reflected power calibration control R2, current offset adjust control R26, current calibration control R27, amplifier A input match control C29, and amplifier B input match control C23. 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.

## 5-82. **LOW-PASS FILTER ADJUSTMENTS.**

- 5-83. 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.

## 5-84. **TRANSMITTER FREQUENCY RE-PROGRAMMING.**

- 5-85. The FM-20S/FMi 1405 transmitter is configured for a specific frequency when shipped from the factory. However, the transmitter can be re-programmed for a different frequency in the field if required. The following text presents the procedure to change the transmitter operating frequency.

- 5-86. **Required Equipment.** The following equipment is required to re-program the transmitter operating frequency.

1. Calibrated in-line wattmeter with 25kW element (Bird 4720 or equivalent).
2. Test load and cable (50 Ohm Non-Inductive, 3 1/8 connector).

- 5-87. **Procedure.** To re-program the transmitter operating frequency, proceed as follows:



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

**WARNING**

- 5-88. Disconnect all transmitter primary power before proceeding.
- 5-89. Connect the test load and wattmeter to the transmitter output.
- 5-90. For an FX-50 exciter, refer to SECTION 4, AFC/PLL ASSEMBLY in FX-50 publication 597-1050 and perform the FREQUENCY SELECTION procedure. For an FXi 60, refer to publication 597-0541 and follow the GUI interface for changing the frequency. Operate and test the exciter independently from the transmitter.

- 5-91. Energize the transmitter primary AC power and operate the transmitter at the desired output power level as indicated by the in-line wattmeter.
- 5-92. If a difference in values presented on the in-line wattmeter and the transmitter multimeter is observed, the transmitter forward power display may be re-calibrated. To re-calibrate the forward power meter, refer to METER CALIBRATION/FIRMWARE UPLOADING in the preceding text and perform the **System LCD Calibration** procedure. Perform the procedure to calibrate the system FWD POWER parameter. Ensure the in-line wattmeter has been recently calibrated at the factory prior to calibrating the transmitter multimeter display.



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

**WARNING**

- 5-93. Disconnect all transmitter primary power.
- 5-94. Remove the test equipment and reconnect the transmitter output to the antenna.
- 5-95. **TROUBLESHOOTING.**
- 5-96. **TYPICAL METER INDICATIONS.** Typical meter indications for the FM-20S/FMi 1405 transmitter are presented in the factory final test data sheets shipped with each transmitter. Some typical meter indications are presented in TABLE 5-1, beginning on page 5-23. For specific meter indications, refer to the factory test data sheets (located in the final text data sheet envelope).

**TABLE 5-1. FM-20S TYPICAL METER INDICATIONS - 20 kW, 98.1 MHz (Sheet 1 of 3)**

<b>MOD</b>	<b>FWD</b>	<b>RFL</b>	<b>I</b>	<b>TEMP</b>	<b>PAV</b>	<b>ACV</b>	<b>ACI</b>	<b>Power</b>	
<b>R1</b>	658	19	20.7	67					
<b>R2</b>	683	11	21.4	57					
<b>R3</b>	689	24	20.4	67					
<b>R4</b>	684	9	22.0	56					
<b>R5</b>	661	10	20.0	70					
<b>R6</b>	715	7	20.7	61					
<b>R7</b>	695	10	21.4	67					
<b>R8</b>	695	14	20.0	56					
<b>R9</b>	639	2	21.8	62					
<b>R10</b>	695	4	21.0	58					
<b>R11</b>	689	2	20.8	66					
<b>R12</b>	683	3	22.3	58					
<b>R13</b>	697	4	21.9	68					
<b>R14</b>	746	0	21.8	63					
<b>R15</b>	621	4	21.6	70					
<b>R16</b>	723	0	22.1	62					
<b>L1</b>	665	0	21.2	67					
<b>L2</b>	692	0	21.5	56					
<b>L3</b>	653	1	20.9	62					
<b>L4</b>	648	1	20.9	53					
<b>L5</b>	658	0	20.5	66					
<b>L6</b>	641	0	20.6	54					
<b>L7</b>	662	0	21.5	65					
<b>L8</b>	699	0	21.3	56					
<b>L9</b>	684	1	20.2	65					
<b>L10</b>	662	0	20.4	56					

**TABLE 5-1. FM-20S TYPICAL METER INDICATIONS - 20 kW, 98.1 MHz (Sheet 2 of 3)**

<b>MOD</b>	<b>FWD</b>	<b>RFL</b>	<b>I</b>	<b>TEMP</b>	<b>PAV</b>	<b>ACV</b>	<b>ACI</b>	<b>Power</b>	
<b>L11</b>	667	0	21.8	68					
<b>L12</b>	650	0	20.6	55					
<b>L13</b>	681	0	21.2	68					
<b>L14</b>	673	0	22.0	56					
<b>L15</b>	703	0	20.7	69					
<b>L16</b>	672	5	19.8	57					
<b>IPA1</b>	667	10	19.7	55					
<b>IPA2</b>	1	0	1.4	5					
<b>IPA3</b>	556	1	19.0	55					
<b>IPA4</b>	1	0	1.2	4					
<b><u>Filters</u></b>									
<b>FIL1</b>	4.7	38							
<b>FIL2</b>	4.8	34							
<b>FIL3</b>	5.1	0							
<b>FIL4</b>	4.9	5							
<b><u>Combiners</u></b>									
<b>Left</b>	10.1	24							
<b>Right</b>	10.3	10							
<b>Final</b>	20.1	18							
<b>Reject</b>	18								
<b><u>Exciters</u></b>									
<b>Main</b>	49.8	1.4							
<b>Aux</b>	0.0	0.0							
<b><u>PAV</u></b>									
<b>Left</b>					44.5				
<b>Right</b>					44.3				
<b><u>Current</u></b>									
<b>Left</b>			318						
<b>Right</b>			319						
<b>Total</b>			638						
<b><u>Temps</u></b>									
<b>Reject R</b>				39					
<b>Reject L</b>				39					
<b>Inlet</b>				30					



**TABLE 5-1. FM-20S TYPICAL METER INDICATIONS - 20 kW, 98.1 MHz (Sheet 3 of 3)**

<b>MOD</b>	<b>FWD</b>	<b>RFL</b>	<b>I</b>	<b>TEMP</b>	<b>PAV</b>	<b>ACV</b>	<b>ACI</b>	<b>Power</b>	
<b><u>AC Input</u></b>									
<b>L CB1 1-2</b>						207.4			
<b>R CB1 1-2</b>						208.5			
<b>L CB1 2-3</b>						208.7			
<b>R CB1 2-3</b>						208.9			
<b>L CB1 3-1</b>						207.7			
<b>R CB1 3-1</b>						206.7			
<b><u>ACI</u></b>									
<b>L CB1 1</b>			38.9						
<b>R CB1 1</b>			56.1						
<b>Tot PH 1</b>			94.5						
<b>L CB1 2</b>			57.0						
<b>R CB1 2</b>			37.8						
<b>Tot PH 2</b>			94.9						
<b>L CB1 3</b>			58.1						
<b>R CB1 3</b>			56.1						
<b>Tot PH 3</b>			111.6						
<b><u>Power</u></b>									
<b>Left</b>							18.2		
<b>Right</b>							17.9		
<b>Total</b>							36.1		

**NOTE****NOTE**

**THE TRANSMITTER WILL NOT OPERATE WITH MORE THAN 4 RF POWER AMPLIFIER MODULES REMOVED FROM MODULE LOCATIONS 1 THRU 8 OR 9 THRU 16 IN EITHER CABINET. ENSURE NO MORE THAN 4 RF POWER AMPLIFIER MODULES ARE REMOVED FROM MODULE LOCATIONS 1 THRU 8 OR 9 THRU 16 IN EITHER CABINET.**

- 5-97. **FAILURE MODE OPERATION** The FM-20S/FMi 1405 is designed with the ability to provide output power when power supply and RF amplifier modules fail. This “soft failure” operation allows the transmitter to remain on-the-air until the transmitter can be de-energized for repair. In the event of an RF amplifier module failure, the module can be removed from the transmitter chassis with power energized.

- 5-98. The output power provided during the failure mode is determined by the type and location of the failure. For example, if only one module fails on the “A” motherboard/combiner portion of the transmitter control cabinet, the transmitter output power will remain at 20.0 kW. If only one module fails on the “C” motherboard/combiner portion of the transmitter auxiliary cabinet, the transmitter will output approximately 19 kW. If two modules fail on only the “C” motherboard/combiner portion of the transmitter auxiliary cabinet, the transmitter output power will output approximately 17.4 kW. TABLE 5-2 presents the failure combinations of RF power modules in each cabinet, the total number of failed modules and the typical transmitter output power.

<b>TABLE 5-2. POWER OUTPUT WITH FAILED RF AMPLIFIER MODULES</b> (Sheet 1 of 2)					
<b>Number of Failed Power Modules</b>					
<b>Auxiliary Cabinet</b>		<b>Control Cabinet</b>		<b>Transmitter</b>	<b>Output Power kW</b>
<b>Left Side</b>	<b>Right Side</b>	<b>Left Side</b>	<b>Right Side</b>	<b>Total</b>	
0	0	0	0	0	20.0
0	0	1	0	1	20.0
1	0	0	0	1	19.2
0	1	1	0	2	18.5
1	0	1	0	2	17.5
0	0	0	0	2	17.9
2	0	0	0	2	17.4
0	2	1	0	3	16.5
0	0	3	0	3	11.8
3	0	0	0	3	11.9
1	1	1	1	4	16.8
2	0	2	0	4	14.7
1	2	1	0	4	14.7
0	0	4	0	4	8.0
4	0	0	0	4	8.1
1	2	2	0	5	13.0
1	0	4	0	5	7.8
0	0	4	1	5	4.5
1	2	0	3	6	9.4
3	0	3	0	6	7.9
2	0	4	0	6	7.9
0	0	4	2	6	4.6
1	2	4	0	7	7.5
3	0	4	0	7	5.8
0	0	4	3	7	4.5
2	2	4	0	8	7.0

<b>TABLE 5-2 POWER OUTPUT WITH FAILED RF AMPLIFIER MODULES</b> (Sheet 2 of 2)					
<b>Number of Failed Power Modules</b>					
<b>Auxiliary Cabinet</b>		<b>Control Cabinet</b>		<b>Transmitter</b>	<b>Output Power kW</b>
<b>Left Side</b>	<b>Right Side</b>	<b>Left Side</b>	<b>Right Side</b>	<b>Total</b>	
4	0	4	0	8	4.6
1	0	4	3	8	4.5
2	0	4	3	9	4.5
3	0	4	3	10	4.4
4	1	4	1	10	2.6
4	0	4	3	11	3.6
4	2	4	2	12	2.6
4	1	4	3	12	2.6
4	3	4	2	13	2.6
4	3	4	3	14	2.6
4	4	4	3	15	2.5
4	4	4	4	16	2.4
4	5	4	4	17	0.75
4	4	4	5	17	0.75

5-99. The transmitter will also output power if a power supply module fails. TABLE 5-3 presents the failure combinations of power supply modules in each cabinet, the total number of failed power supply modules and the typical transmitter output power.

<b>TABLE 5-3. POWER OUTPUT WITH FAILED POWER SUPPLY MODULES</b>			
<b>Failed Power Supplies</b>			
<b>Auxiliary Cabinet</b>	<b>Control Cabinet</b>	<b>Total Failed</b>	<b>Output Power kW</b>
0	0	0	20.0
1	0	1	15.4
0	1	1	15.5
1	1	2	12.0
2	0	2	9.0
0	2	2	9.3
3	0	3	3.3
0	3	3	3.1
2	2	4	5.7
3	3	6	1.4

**NOTE****NOTE**

**THE TRANSMITTER WILL NOT OPERATE WITH MORE THAN 4 RF POWER AMPLIFIER MODULES REMOVED FROM MODULE LOCATIONS 1 THRU 8 OR 9 THRU 16 IN EITHER CABINET. ENSURE NO MORE THAN 4 RF POWER AMPLIFIER MODULES ARE REMOVED FROM MODULE LOCATIONS 1 THRU 8 OR 9 THRU 16 IN EITHER CABINET.**

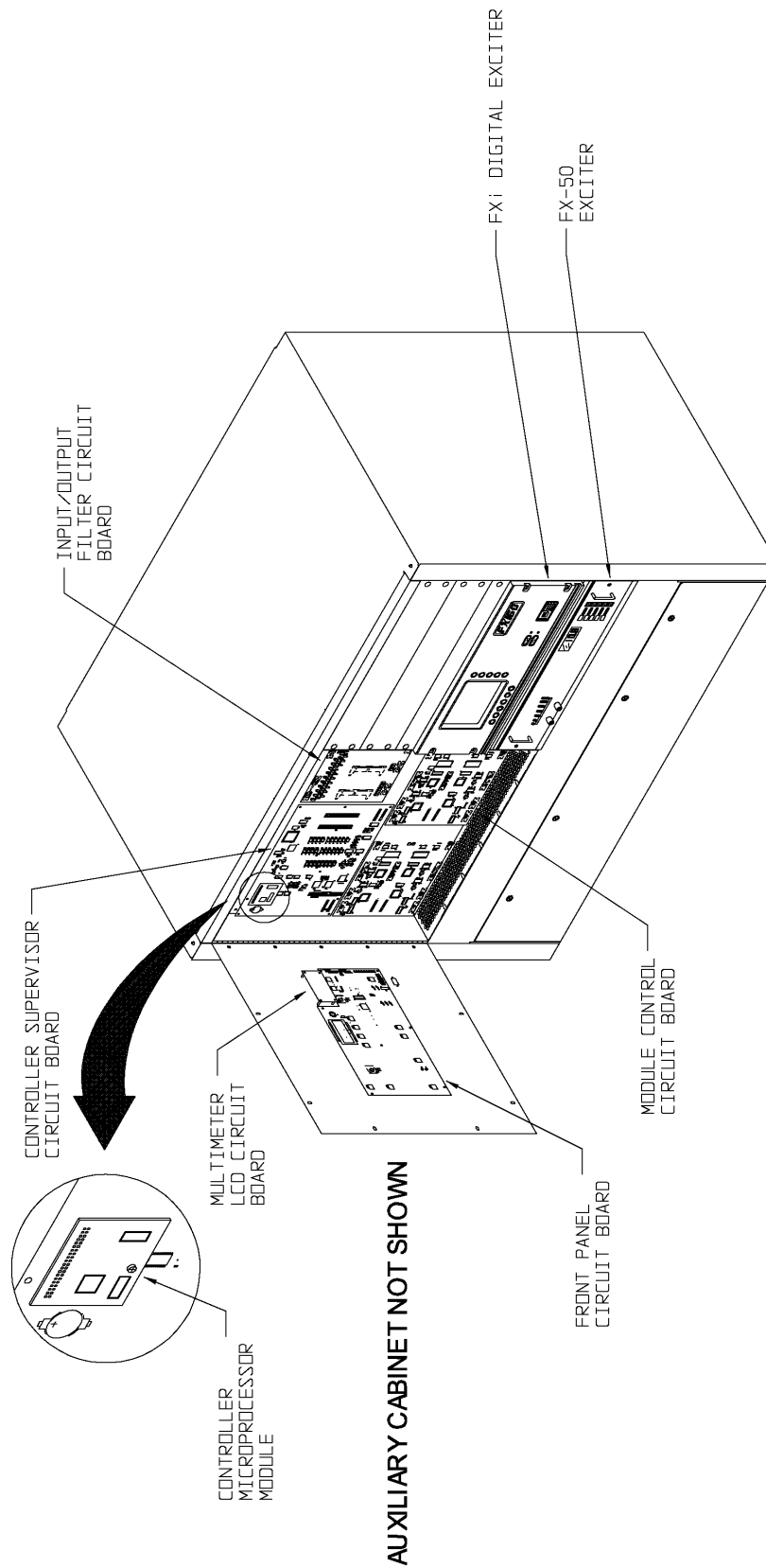
- 5-100. **TRANSMITTER TROUBLESHOOTING PROCEDURES.** TABLE 5-4 presents troubleshooting information for the FM-20S/FMi 1405 transmitter. Refer to TABLE 5-4 to isolate the problem to a specific assembly. Once the trouble is isolated, refer to the theory of operation and schematic diagrams to assist in problem resolution.
- 5-101. **TRANSMITTER COMPONENT LOCATIONS.** FIGURE 5-13, beginning on page 5-30, presents the transmitter component locations. Refer to FIGURE 5-13 as required during the troubleshooting procedures to locate components within the transmitter.

**TABLE 5-4. FM-20S/FMi 1405 TROUBLESHOOTING**  
(Sheet 1 of 2)

SYMPTOM	CIRCUITRY TO CHECK
1. TRANSMITTER OFF WITH NO FRONT PANEL INDICATIONS	<ol style="list-style-type: none"> <li>1. Ensure primary AC power is applied to the unit and ensure the ON/OFF/circuit breaker is operated to ON.</li> <li>2. If the primary AC power is on, the transmitter is in an AC line interrupt condition. In this condition, the transmitter has detected: 1) the AC line is below 168 volts or above 255 volts or 2) a loss-of-phase. During an AC line interrupt condition, AC power is removed from the transmitter. The transmitter will automatically return to operation when the AC line is between 168 and 255 volts or the AC line phase is restored. When power is returned to the unit, the front panel <b>FAULTS - AC LINE</b> indicator and the <b>FAULTS RESET</b> switch/indicator will illuminate to indicate a fault condition.</li> <li>3. If the primary AC power is with between 168 and 255 volts and all three phases are operational, check the controller power supply.</li> <li>4. The controller battery missing or defective. Replace the battery.</li> <li>5. The controller MCF.BIN file has been erased. Contact the Broadcast Electronics Customer Service Department.</li> </ol>
1. NO OUTPUT POWER 2. FX-50 LOCK INDICATOR EXTINGUISHED OR FXi 60 FAULT INDICATOR ILLUMINATED	<ol style="list-style-type: none"> <li>1. FX-50 - AFC is unlocked. FXi 60 - exciter fault. Refer to the exciter manual and troubleshoot the exciter.</li> </ol>

**TABLE 5-4. FM-20S/FMi 1405 TROUBLESHOOTING**  
(Sheet 2 of 2)

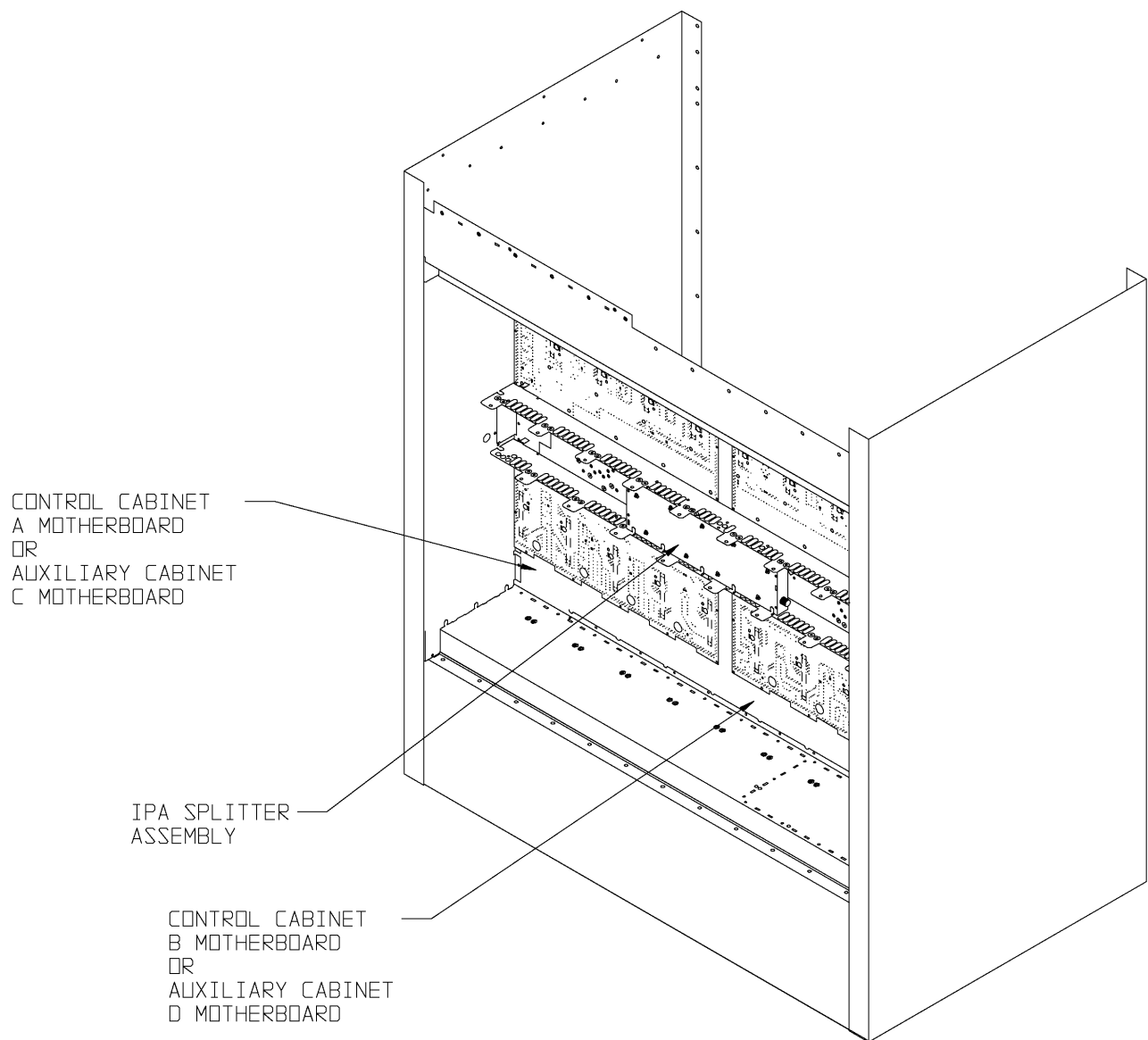
SYMPTOM	CIRCUITRY TO CHECK
1. NO OUTPUT POWER 2. STATUS FAIL-SAFE INDICATOR EXTINGUISHED	1. Check the equipment connected to the fail-safe interlock such as the test load, motorized coaxial switch, or remote control unit.
1. NORMAL OUTPUT POWER 2. FAULTS - AC POWER INDICATOR ILLUMINATED AND FAULTS - RESET SWITCH/INDICATOR ILLUMINATED	1. Indicates: 1) the AC power input is below 168 volts or above 255 volts or 2) a loss-of-phase condition has occurred. The transmitter will automatically re-energize when the AC input voltage is between 168 to 255 volts or the AC line phase is restored.
1. LOW OUTPUT POWER 2. FAULTS - DRIVE INDICATOR ILLUMINATED AND FAULTS - RESET SWITCH/INDICATOR ILLUMINATED	1. Check the exciter forward power. The forward power must be 50 watts (60 watts maximum). 2. If the exciter forward power is low, increase the exciter output power. 3. If the exciter forward power is normal, ensure cable 301 is connected between the exciter RF output and the bulk head connector on the bottom of the exciter enclosure.
1. LOW OUTPUT POWER 2. FAULTS - MODULE INDICATOR ILLUMINATED AND FAULTS - RESET SWITCH/INDICATOR ILLUMINATED	1. An RF amplifier or IPA module has a fault. Locate the failed module using the transmitter <b>MULTIMETER, MODULE MODE</b> , and <b>FUNCTION MODE</b> controls. If the failed module is the result of a defective RF amplifier circuit board, refer to POWER AMPLIFIER MODULE AND IPA MODULE RF AMPLIFIER CIRCUIT BOARD REPLACEMENT in the following text to replace the defective RF amplifier circuit board. The failed module can be removed from the chassis with the power energized if required.
1. LOW OUTPUT POWER 2. FAULTS - VSWR INDICATOR ILLUMINATED AND FAULTS - RESET SWITCH/INDICATOR ILLUMINATED	1. A greater than 1.45 : 1 VSWR condition is present at the RF output. Check the antenna.
1. LOW OUTPUT POWER 2. FAULTS - POWER SUPPLY INDICATOR ILLUMINATED	1. A power supply has a fault. Locate the failed power supply using the transmitter <b>MULTIMETER, MODULE MODE</b> , and <b>FUNCTION MODE</b> controls.
1. TRANSMITTER WILL NOT AUTOMATICALLY RETURN TO RATED POWER AFTER AN AC POWER LOSS	1. Replace the battery in the controller.
1. LOW OR NO OUTPUT POWER 2. FAULTS - NONE	1. Ensure cable from J1-7 (or J2-7 for standby exciter) on I/O board is connect to J3 pin 24 on Exciter 2. Ensure cable is connected between LVDS to IBOC Data on FSi 10 and IBOC Data on FXi exciter 3. Check RF output from the exciter



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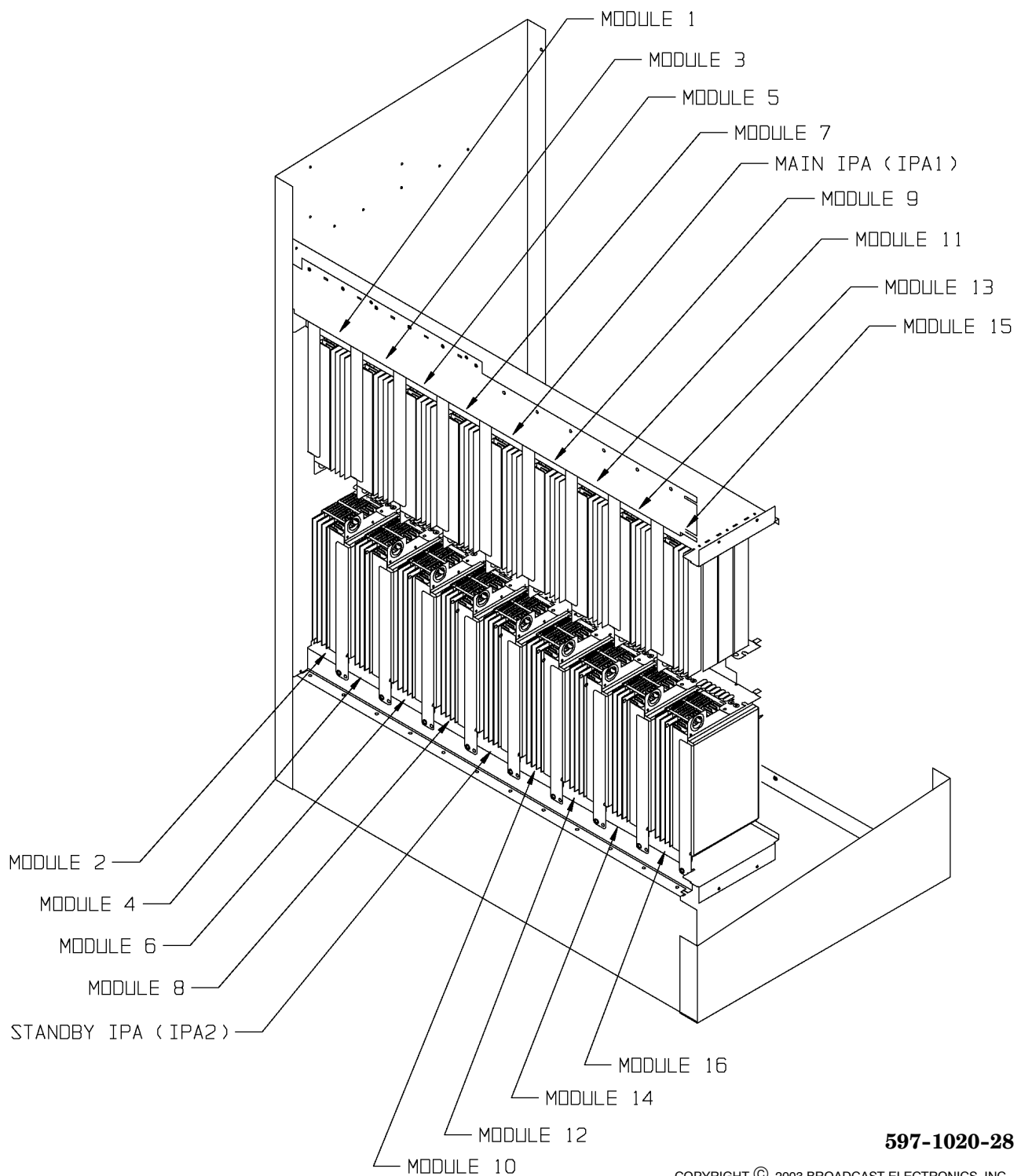
**FIGURE 5-13. FM-20S/FMi 1405 COMPONENT LOCATOR (SHEET 1 OF 11)**



**597-1020-27**

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**FIGURE 5-13. FM-20S/FMi 1405 COMPONENT LOCATOR (SHEET 2 OF 11)**

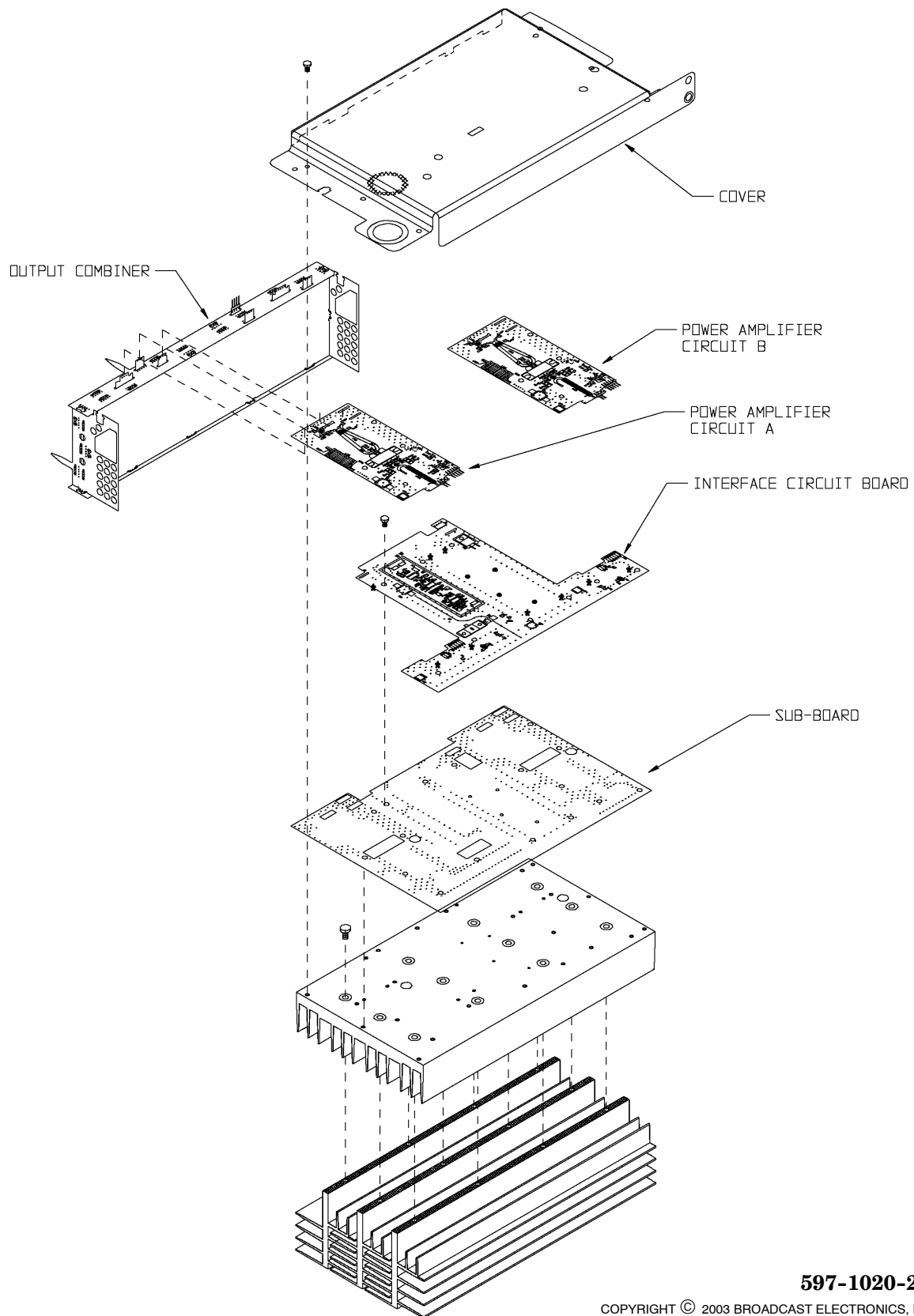


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**FIGURE 5-13. FM-20S/FMi 1405 COMPONENT LOCATOR (SHEET 3 OF 11)**

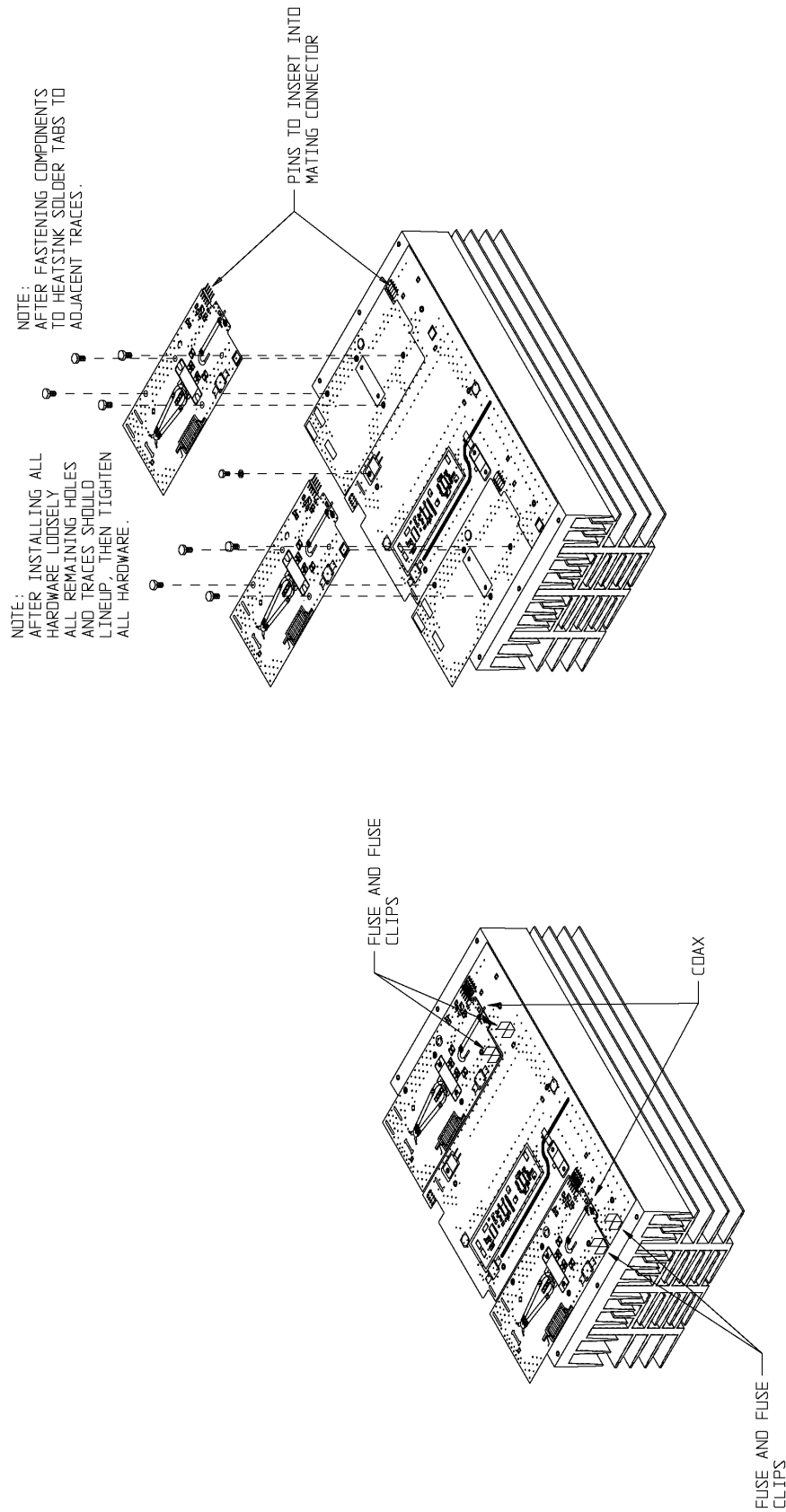




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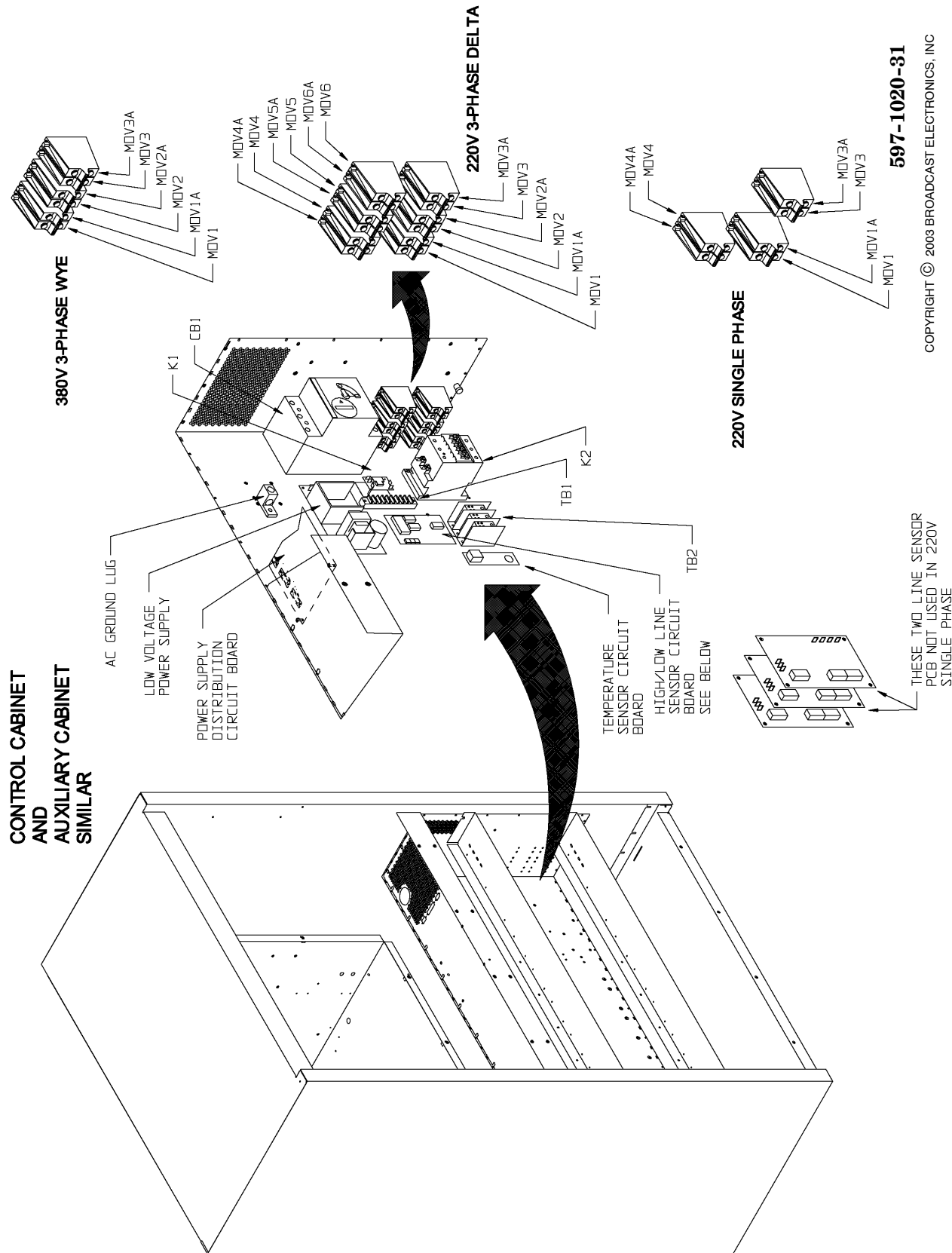
**FIGURE 5-13. FM-20S/FMi 1405 COMPONENT LOCATOR (SHEET 4 OF 11)**



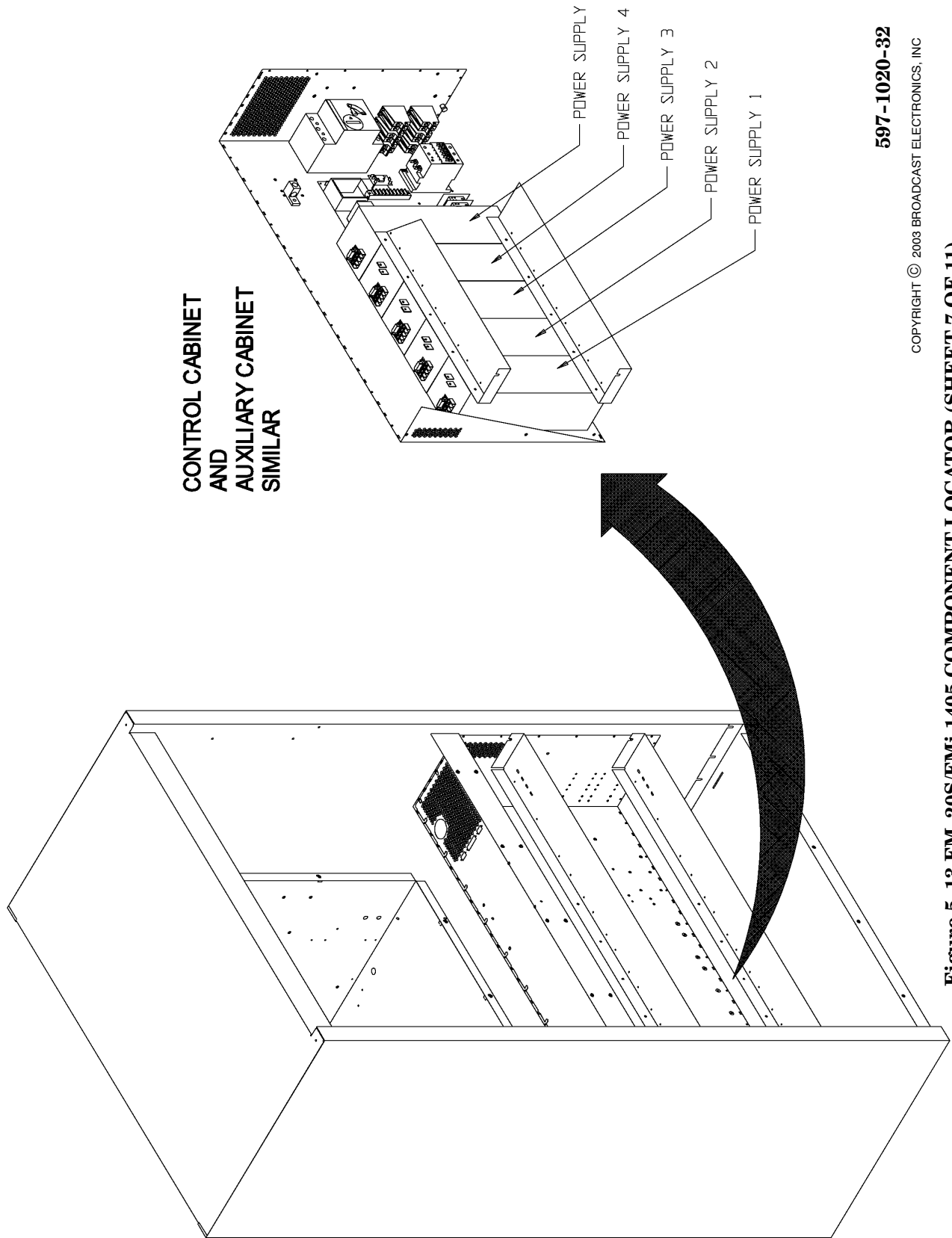
**597-1020-30**

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**Figure 5-13 FM-20S/FMi 1405 COMPONENT LOCATOR (SHEET 5 OF 11)**



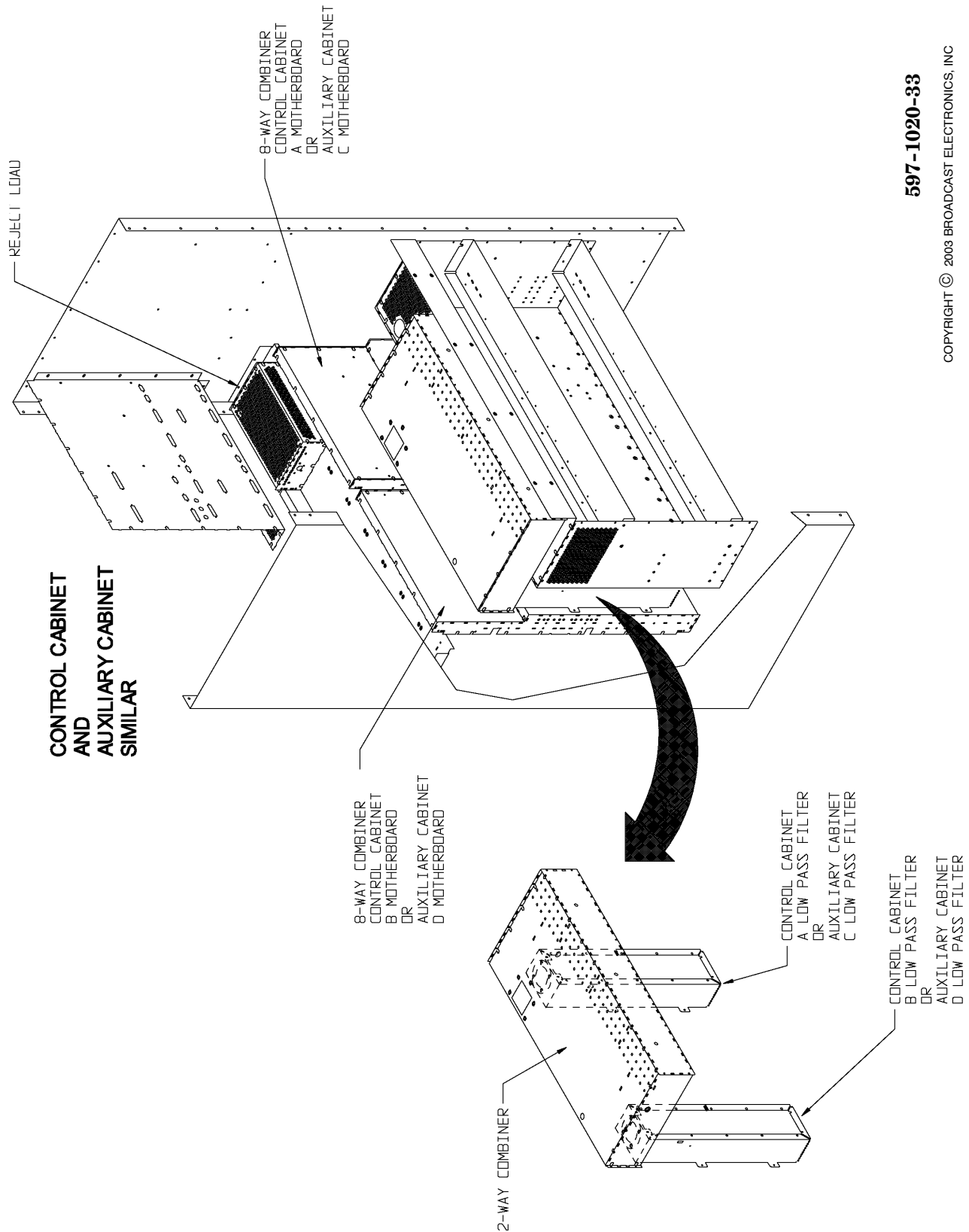
**Figure 5-13 FM-20S/FMi 1405 COMPONENT LOCATOR (SHEET 6 OF 11)**



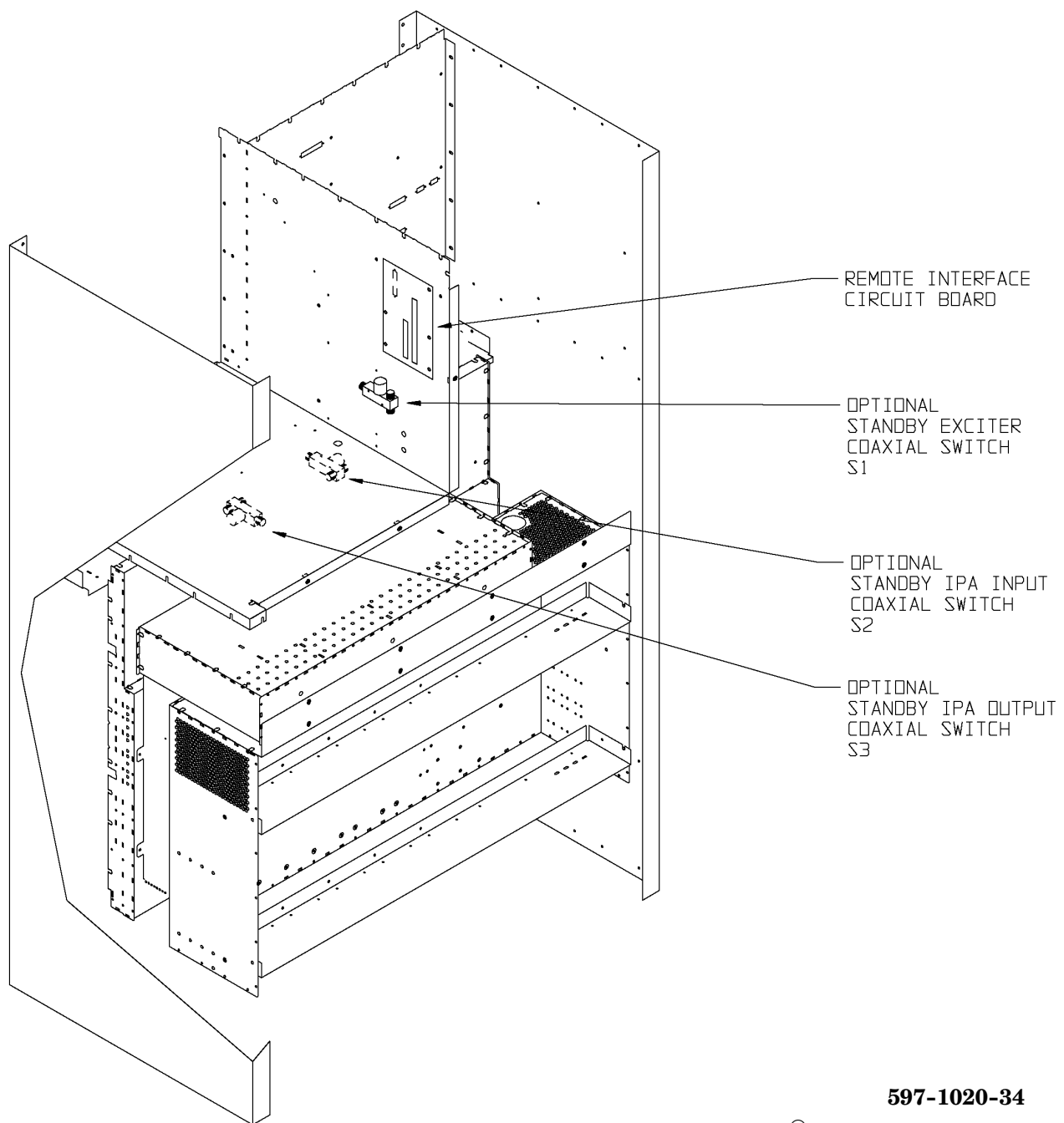
**597-1020-32**

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**Figure 5-13 FM-20S/FMi 1405 COMPONENT LOCATOR (SHEET 7 OF 11)**



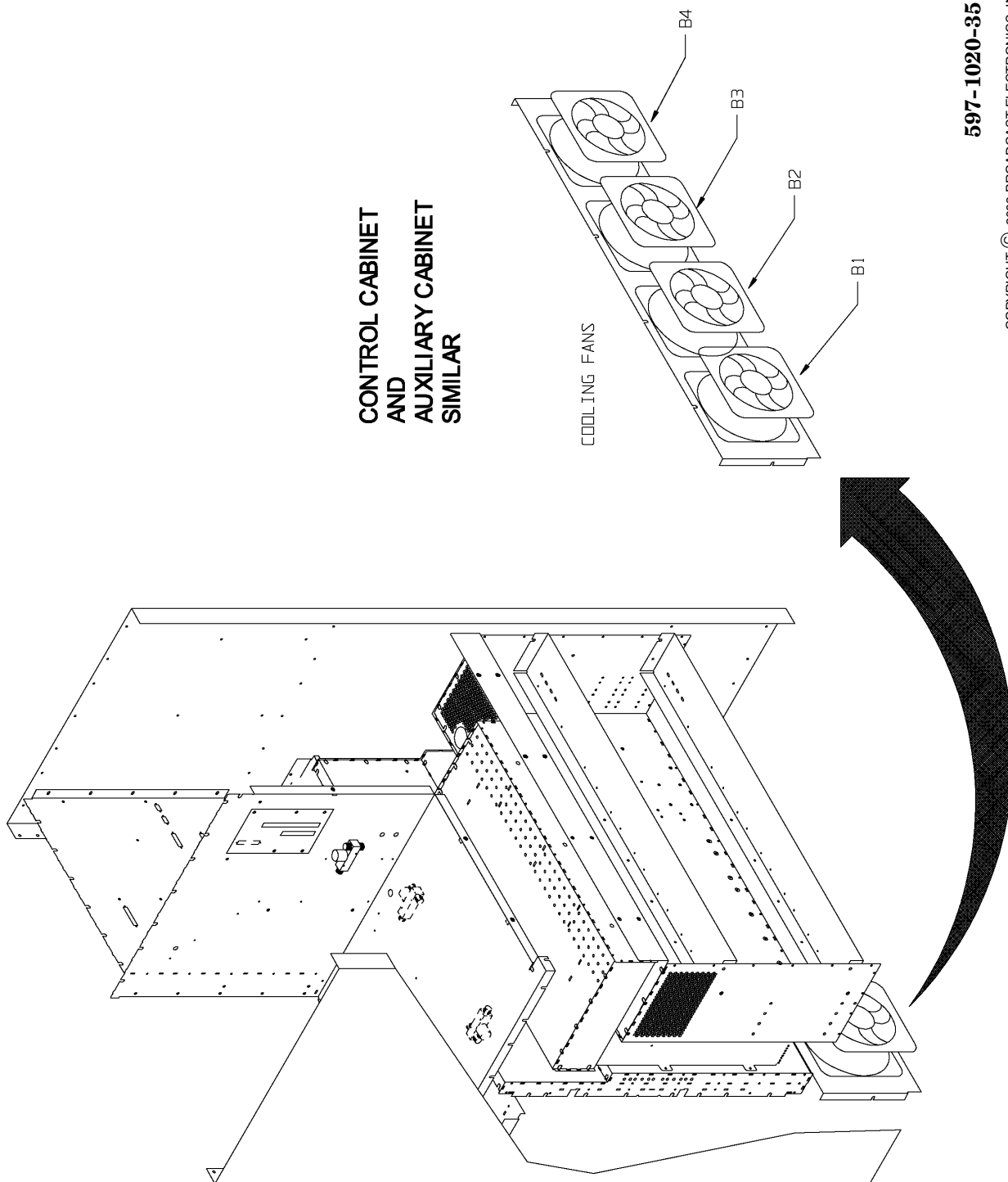
**Figure 5-13 FM-20S/FMi 1405 COMPONENT LOCATOR (SHEET 8 OF 11)**



**597-1020-34**

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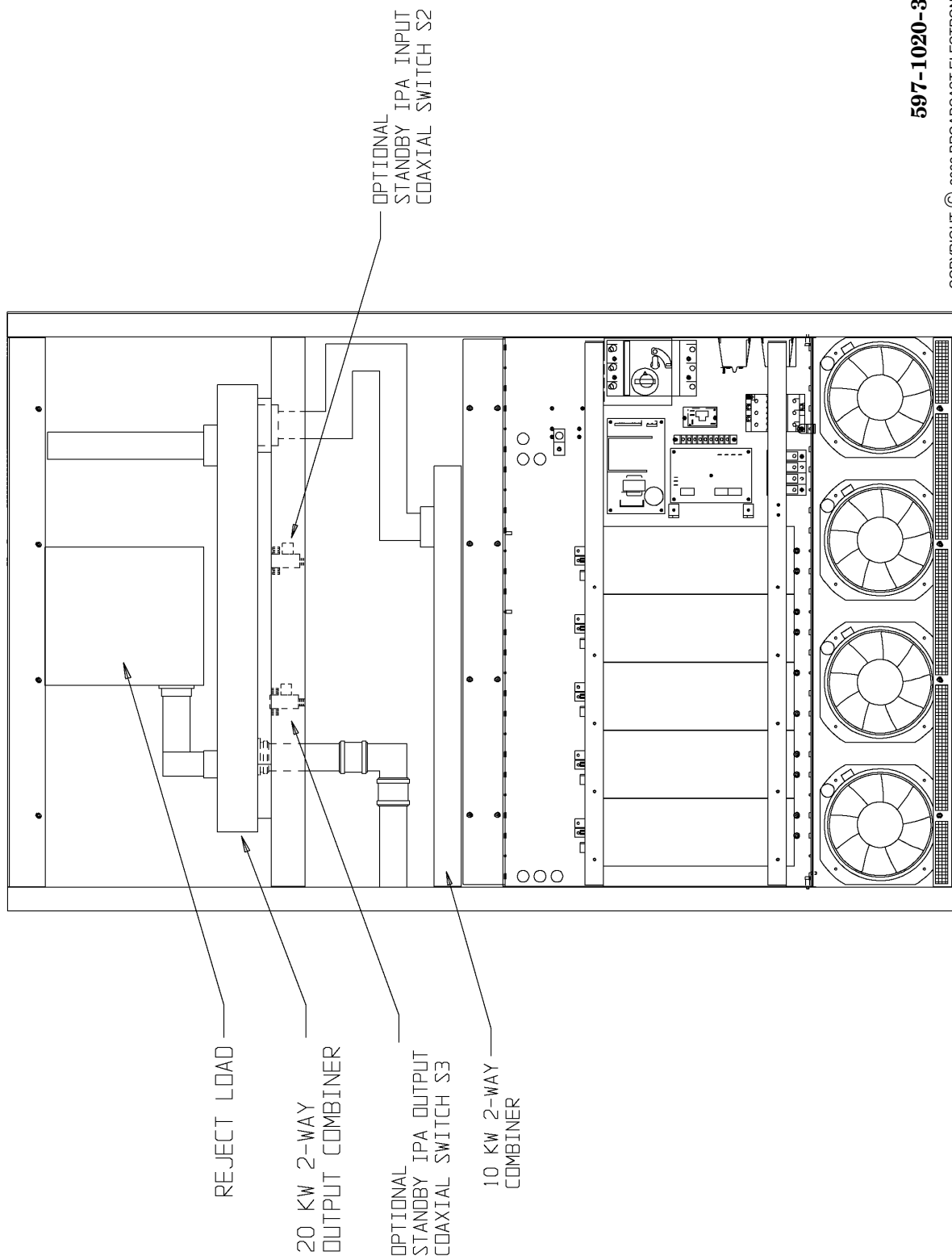
**Figure 5-13 FM-20S/FMi 1405 COMPONENT LOCATOR (SHEET 9 OF 11)**



597-1020-35

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Figure 5-13 FM-20S/FM-1405 COMPONENT LOCATOR (SHEET 10 OF 11)



**597-1020-36**

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**Figure 5-13 FM-20S/FMi 1405 COMPONENT LOCATOR (SHEET 11 OF 11)**



- 5-102. **POWER AMPLIFIER POWER SUPPLY MODULES.** The FM-20S/FMi 1405 is equipped with modular switching power supply units (refer to FIGURE 5-13, beginning on page 5-30). The power supplies are equipped with internal protection for high AC line voltage, high temperature conditions, and over-current conditions. If a supply is suspected to contain a fault, contact the Broadcast Electronics Customer Service Department.
- 5-103. **LOW VOLTAGE POWER SUPPLY.** The FM-20S/FMi 1405 transmitter low voltage power supply provides DC power for the controller circuitry (refer to FIGURE 5-13, beginning on page 5-30). The power supply is equipped with a fuse and should be checked if a failure occurs. To check the low voltage power supply module, proceed as follows:



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

**WARNING**

- 5-104. Disconnect all transmitter primary power.
- 5-105. Operate the AC switch/circuit breaker to OFF.
- 5-106. Refer to FIGURE 5-3, page 5-4 and remove the lower rear access panel.
- 5-107. Check the power supply fuse. If the power supply fuse has not blown, contact the Broadcast Electronics Customer Service Department.
- 5-108. Once the power supply troubleshooting has been completed, re-install the supply by reversing the preceding procedure.



**NOTE**      ***A POWER AMPLIFIER MODULE CAN BE REMOVED OR INSTALLED WITH POWER APPLIED TO THE TRANSMITTER. IT IS STRONGLY RECOMMENDED A MODULE BE REMOVED/INSTALLED WITH POWER ENERGIZED ONLY WHEN A MODULE HAS FAILED AND MUST BE REPAIRED DURING A NON-MAINTENANCE PERIOD.***

**NOTE**

- 5-109. **POWER AMPLIFIER AND IPA MODULE TROUBLESHOOTING.** Each transmitter power amplifier module contains circuitry requiring specialized equipment and test procedures for troubleshooting and repair operations. However, if it is determined that a power amplifier circuit board has failed, the repair can be performed in the field. For all other types of failures, contact the Broadcast Electronics Customer Service department to: 1) exchange a defective module for a reconditioned module or 2) obtain a module on loan during the repair of the defective module.
- 5-110. **POWER AMPLIFIER MODULE AND IPA MODULE RF AMPLIFIER CIRCUIT BOARD REPLACEMENT.** If a power amplifier module or IPA module is determined to be defective with a power amplifier circuit board fault, the circuit board can be replaced in the field. To replace an RF amplifier circuit board, proceed as follows:

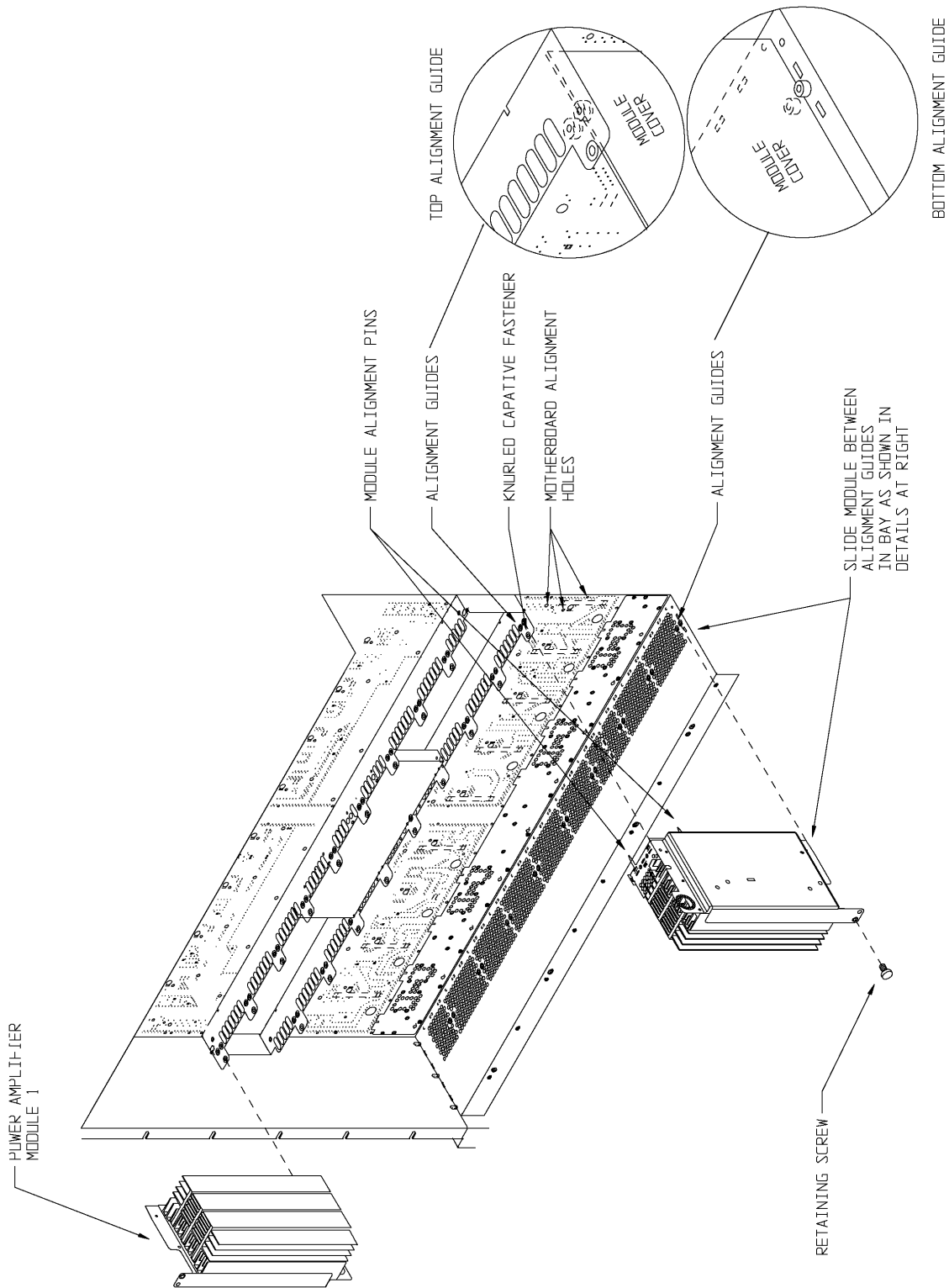


**NOTE**

**NOTE**

**A POWER AMPLIFIER MODULE CAN BE REMOVED OR INSTALLED WITH POWER APPLIED TO THE TRANSMITTER. IT IS STRONGLY RECOMMENDED A MODULE BE REMOVED/INSTALLED WITH POWER ENERGIZED ONLY WHEN A MODULE HAS FAILED AND MUST BE REPAIRED DURING A NON-MAINTENANCE PERIOD.**

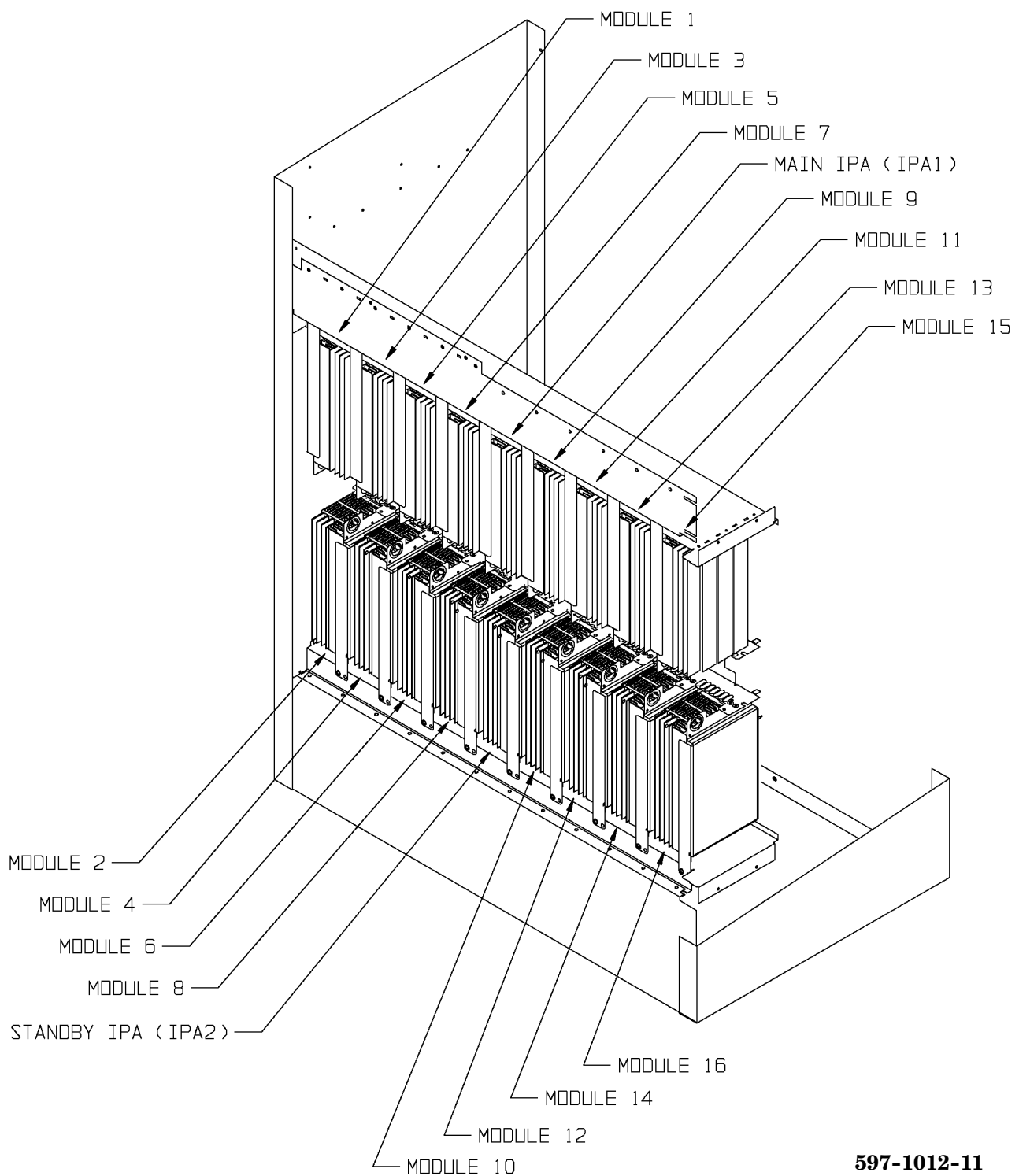
1. Refer to FIGURE 5-3, page 5-4, and determine the power amplifier module to be removed.
2. Remove the power amplifier module as follows:
  - A. Remove the retaining screw and the loosen the knurled captive fastener.
  - B. Remove the power amplifier module from the chassis.
3. Remove the 8 screws securing the cover to the power amplifier module and remove the cover.
4. Remove the defective RF amplifier circuit board as follows:
  - A. Remove the 4 screws securing the RF amplifier circuit board to the heatsink.
  - B. Remove the fuse.
  - C. Unsolder the ground and RF output tabs from the combiner. Unsolder each tab as follows:
    1. Apply heat to the tab using a soldering iron.
    2. While heating the tab, carefully insert a knife or flat-blade screwdriver between the bottom of the module circuit board and the top of the sub-circuit board. Apply pressure and carefully pry-up to separate the module circuit board from the combiner.
  - D. Slide the amplifier circuit board from J1 and J2 on the interface circuit board and remove circuit board from the module.
5. Replace the circuit board by performing the above removal procedure in reverse order.
6. Replace the module cover.
7. Refer to FIGURE 5-14, beginning on page 5-43, and replace the power amplifier module as follows:
  - A. Orient and align the module as shown between the guides. Slide the module into the chassis.
  - B. Ensure the module alignment pins are centered in the alignment holes in the motherboard and firmly push the module into the motherboard.
  - C. Secure the module to the chassis using the retaining screw and the knurled captive fastener.



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FIGURE 5-14. POWER AMPLIFIER/PA MODULE INSTALLATION (SHEET 1 OF 2)

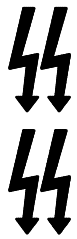


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**FIGURE 5-14. POWER AMPLIFIER/IPA MODULE INSTALLATION (SHEET 2 OF 2)**

- 5-111. **COMPONENT REPLACEMENT PROCEDURE.** Component replacement on printed circuit boards require extreme care to avoid damage to the circuit board traces. The following text describes the procedure to replace components on FM-20S/FMi 1405 circuit boards.
- 5-112. 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.
- 5-113. 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.
- 5-114. 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.**

- 5-115. 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.
- 5-116. 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.
- 5-117. **INSTRUCTIONS TO BYPASS AUXILIARY CABINET 10 KW COMBINER.**  
***THE RF OUTPUT FROM THE CONTROL CABINET 10 KW COMBINER WILL BE RE-ROUTED TO THE TRANSMITTER OUTPUT CONNECTOR FLANGE LOCATED ON TOP OF THE AUXILIARY CABINET, BYPASSING THE 20 KW OUTPUT COMBINER.***
- 5-118. INSTALL P15 IN POSITION 3-4 OF HEADER J15 ON THE CONTROLLER SUPERVISOR BOARD IN THE CONTROL CABINET.
- 5-119. Refer to FIGURE 5-15, sheet 1, page 5-47. Locate the reject load attached to the inside of the auxiliary cabinet's top cover. Note the transmission line coming from the combiner. First disconnect the end that is closest to you by loosening the clamp at the bottom of the elbow and lift the line up until clear. Disconnect the other end and remove the reject load.  
***Do not remove the flanges on the 20 kW combiner or the reject load.***
- 5-120. Refer to FIGURE 5-15, sheet 2, page 5-48. Loosen the clamps at A, B, C and D and slide sleeves to the left as far as they will go. Pull the remaining assembly of two 427-0002 and one 427-0005 to the right until it is clear and remove. Now remove the pieces that this assembly was attached to.  
***Do not remove the flange on the 10 kW combiner or the flange on the 20 kW combiner.***

- 5-121. Remove the flange E and the 463-5205 line beneath it.  
***Do not remove the flange on the 20 kW combiner.***
- 5-122. Loosen the clamps at F and G and slide sleeve to the left until clear. Loosen the clamp at H and lift 463-5201 until clear. Pull to the left until clear and remove 463-5201.  
***Do not remove the flange on the 10 kW combiner.***
- 5-123. Remove 463-5202 and the pieces attached.  
***Do not remove the flange on the 20 kW combiner.***
- 5-124. Refer to FIGURE 5-15, sheet 3, page 5-49. Replace 463-5201 as shown. Add all of the 427-0005 sleeves with bullets and 427-0002 elbows that you removed, as shown, along with 463-5205 inner and outer that you removed and 463-5207 inner and outer that is provided separately. 463-5207 outer is 9.01 inches long. 463-5207 inner is 7.48 inches long. Note that 463-5205 points to your right and towards the front of the transmitter so that it can go around the bypassed 20 kW combiner. The elbow coming down from the output flange on top should point to the front and slightly towards your left as you stand behind the transmitter.

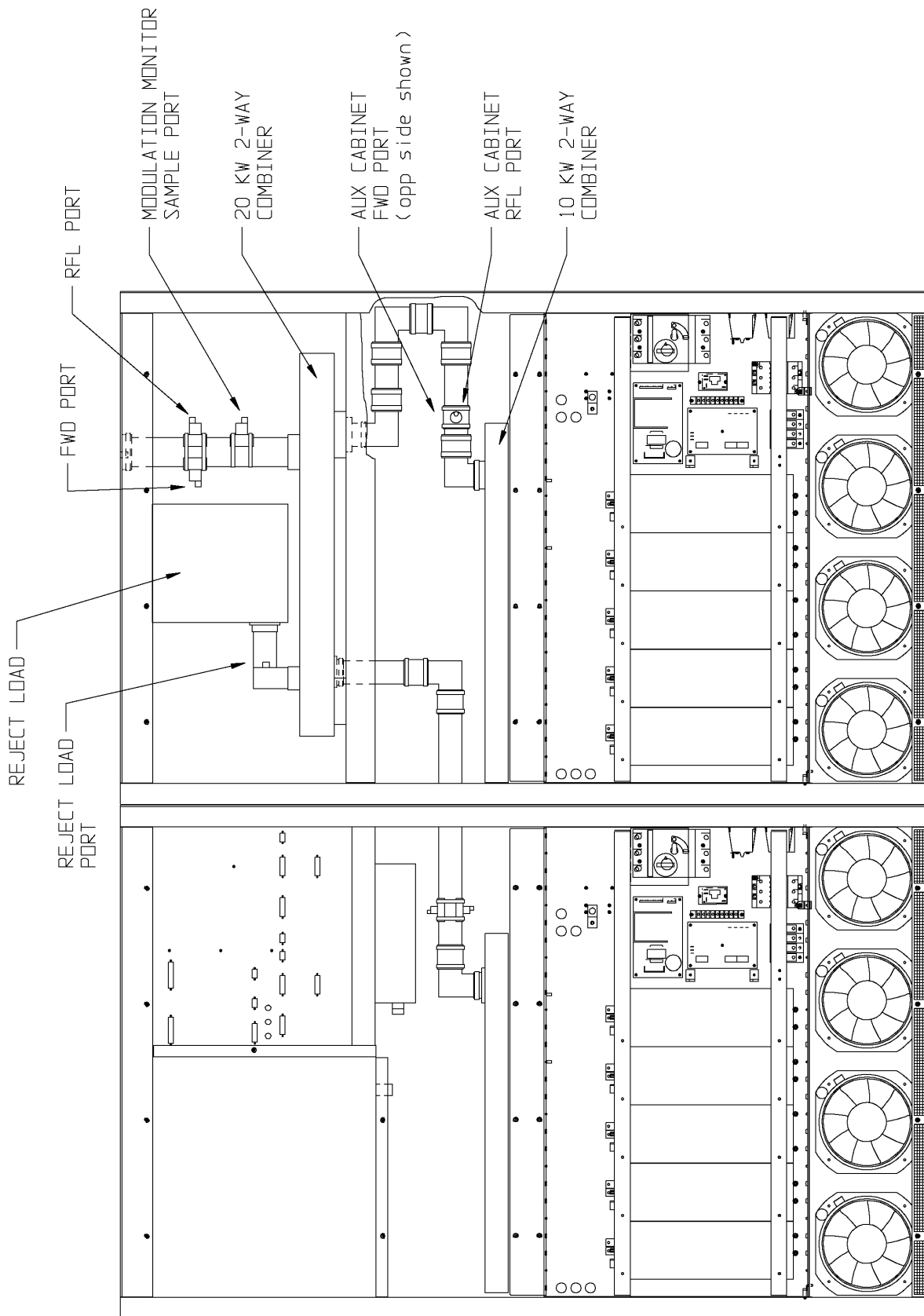
5-125. **INSTRUCTIONS TO BYPASS CONTROL CABINET 10 KW COMBINER.**



**NOTE**      ***THE RF OUTPUT FROM THE AUXILIARY CABINET WILL BE RE-ROUTED TO THE TRANSMITTER OUTPUT CONNECTOR FLANGE LOCATED ON TOP OF THE AUXILIARY CABINET, BYPASSING THE 20 KW OUTPUT COMBINER.***

**NOTE**

- 5-126. INSTALL P15 IN POSITION 1-2 OF HEADER J15 ON THE CONTROLLER SUPERVISOR BOARD IN THE CONTROL CABINET.
- 5-127. Refer to FIGURE 5-15, sheet 1, page 5-47. Locate the reject load attached to the inside of the auxiliary cabinet's top cover. Note the transmission line coming from the combiner. First disconnect the end that is closest to you by loosening the clamp at the bottom of the elbow and lift the line up until clear. Disconnect the other end and remove the reject load.  
***Do not remove the flanges on the 20 kW combiner or the reject load.***
- 5-128. Refer to FIGURE 5-15, sheet 2, page 5-48. Loosen the clamps at A, B, C and D and slide sleeves to the left as far as they will go. Pull the remaining assembly of two 427-0002 and one 427-0005 to the right until it is clear and remove. Now remove the upper pieces that this assembly was attached to. Replace the assembly of two 427-0002 and one 427-0005.  
***Do not remove the flange on the 20 kW combiner.***
- 5-129. Remove the flange E and the 463-5205 line beneath it.  
***Do not remove the flange on the 20 kW combiner.***
- 5-130. Loosen the clamps at F and G and slide sleeve to the left until clear. Loosen the clamp at H and lift 463-5201 until clear. Pull to the left until clear and remove 463-5201.  
***Do not remove the flange on the 10 kW combiner.***
- 5-131. Remove 463-5202 and the pieces attached.  
***Do not remove the flange on the 20 kW combiner.***
- 5-132. Refer to FIGURE 5-15, sheet 4, page 5-50. Add all of the 427-0005 sleeves with bullets and 427-0002 elbows that you removed, as shown, along with 463-5205 inner and outer that you removed and 463-5207 inner and outer that is provided separately. 463-5207 outer is 9.01 inches long. 463-5207 inner is 7.48 inches long. Note that 463-5205 points to your left and towards the front of the transmitter so that it can go around the bypassed 20 kW combiner. The elbow coming down from the output flange on top should point to the front and slightly towards your left as you stand behind the transmitter.



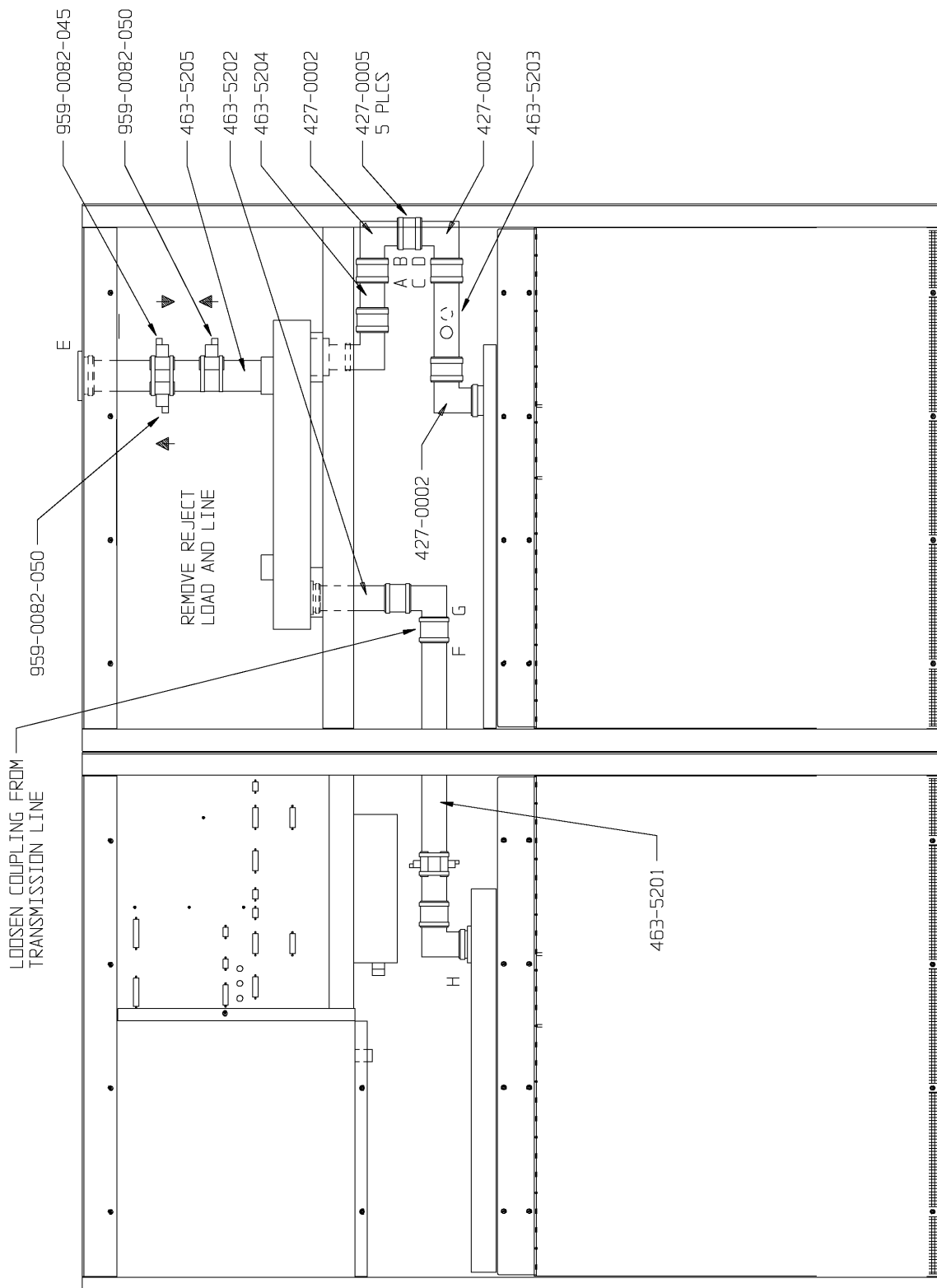
597-1020-11

# AUXILIARY CABINET

# CONTROL CABINET

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FIGURE 5-15. INSTRUCTIONS TO BYPASS CONTROL OR AUXILIARY CABINET  
10 KW COMBINER (SHEET 1 OF 4)



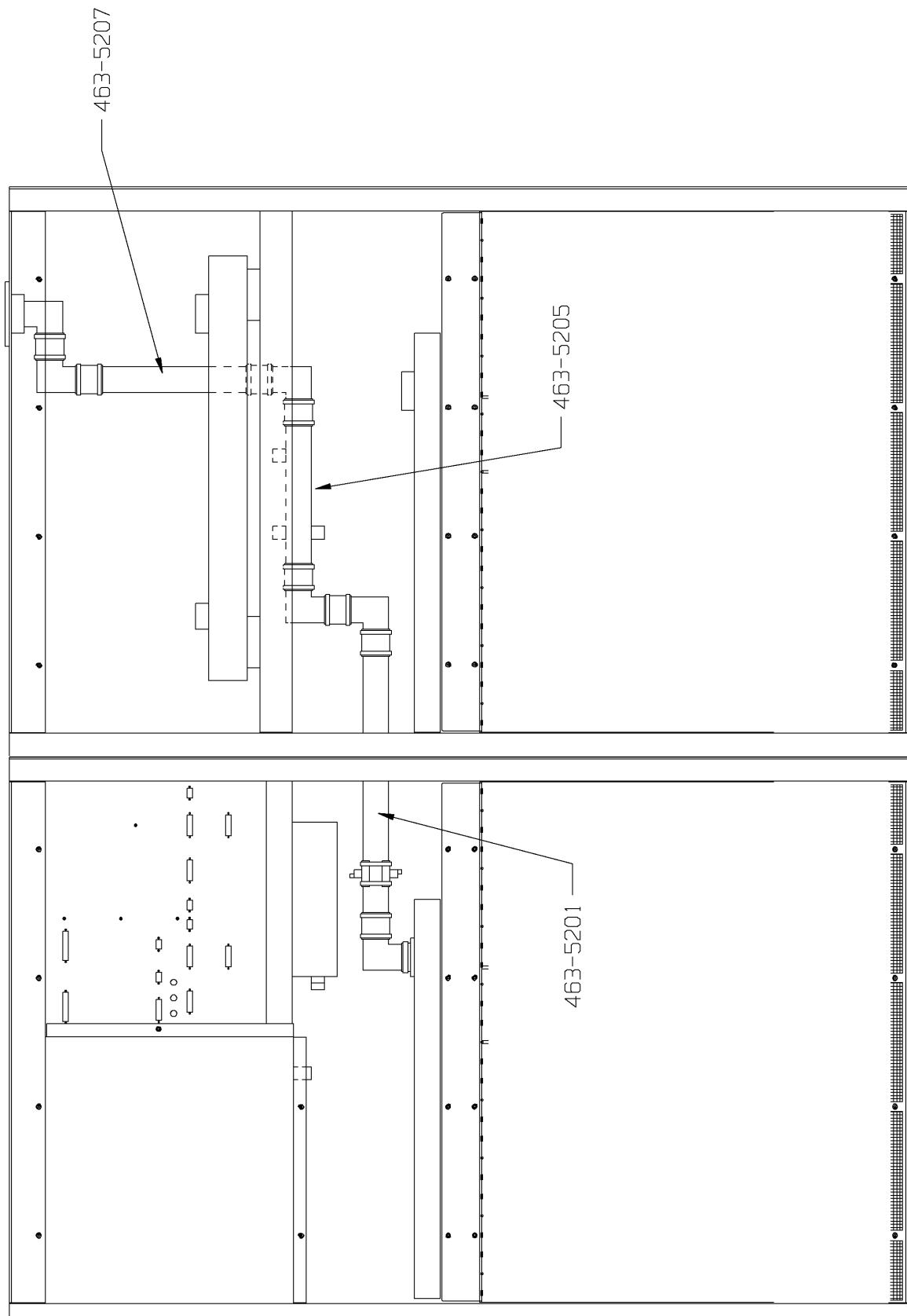
REAR VIEW

**597-1020-20A**

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**FIGURE 5-15. INSTRUCTIONS TO BYPASS CONTROL OR AUXILIARY CABINET  
10 KW COMBINER (SHEET 2 OF 4)**



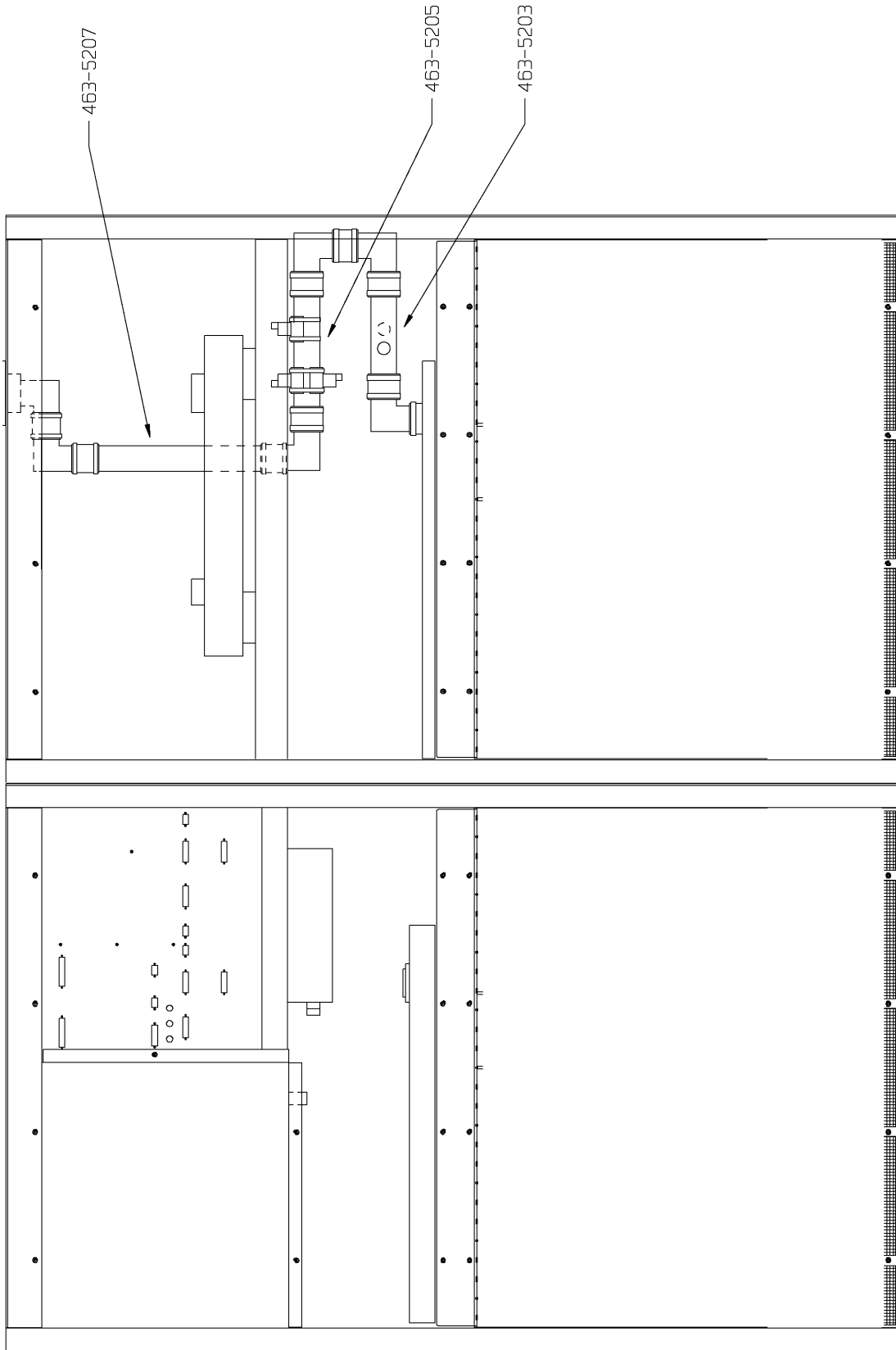


REAR VIEW

597-1020-19C

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**FIGURE 5-15. INSTRUCTIONS TO BYPASS CONTROL OR AUXILIARY CABINET  
10 KW COMBINER (SHEET 3 OF 4)**



REAR VIEW

**597-1020-20B**

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**FIGURE 5-15. INSTRUCTIONS TO BYPASS CONTROL OR AUXILIARY CABINET**

**10 KW COMBINER (SHEET 4 OF 4)**

# SECTION VI

## PARTS LIST

### 6-1. INTRODUCTION.

6-2. This section provides parts lists for the FM-20S/FMi 1405 transmitter. The parts lists provide descriptions and part numbers of electrical components, assemblies, and selected mechanical parts required for maintenance. Each parts list entry in this section is indexed by reference designators appearing on the applicable schematic diagrams.

**TABLE 6-1. FM-20S/FMi 1405 REPLACEABLE PARTS LIST INDEX**  
(Sheet 1 of 2)

TABLE	DESCRIPTION	PART NO.	PAGE
6-2	FM-20S Transmitter, 220V Three-Phase	909-1020-206	6-4
6-3	FM-20S Transmitter, 380V WYE Three-Phase	909-1020-386	6-4
6-4	FMi 1405 HD XMTR, 220V Three-Phase DELTA	909-1405-206	6-4
6-5	FMi 1405 HD XMTR, 380V Three-Phase 4Wire WYE	909-1405-386	6-4
6-6	FM-20S/FMi 1405 Control Cabinet Assembly, 220V Three-Phase	959-1020-206	6-5
6-7	FM-20S/FMi 1405 Control Cabinet Assembly, 380V Three-Phase	959-1020-386	6-6
6-8	FM-20S Auxiliary Cabinet Assembly, 220V Three-Phase	959-1021-206	6-7
6-9	FM-20S Auxiliary Cabinet Assembly, 380V Three-Phase	959-1021-386	6-8
6-10	Low Pass Filter Assembly	959-0414-002	6-8
6-11	8-Way Combiner A (Left) Assembly	959-0501	6-9
6-12	8-Way Combiner B (Right) Assembly	959-0501-001	6-9
6-13	2-Way Combiner Assembly	959-0502	6-9
6-14	20 kW 2-Way Output Combiner Assembly	959-0502-020	6-9
6-15	IPA Splitter Assembly	959-0503	6-9
6-16	RF Splitter Assembly	959-0503-020	6-10
6-17	Motherboards & IPA Splitter Assembly	959-0504/-020	6-10
6-18	Motherboard Assembly	959-0504-001	6-10
6-19	RF Amplifier Module	959-0509-313	6-13
6-20	RF Amplifier Module, No Cover	959-0509-213	6-10
6-21	RF Amplifier Module, Less Combiner	959-0509-113	6-10
6-22	RF Amplifier Module, Filter	959-0514-013	6-10
6-23	RF Amplifier Assembly	959-0505-113	6-10
6-24	RF Amplifier Module, PCB Assembly	959-0505-013	6-10
6-25	Reject Load, 2-Way Combiner Assembly	959-0506	6-11
6-23	Power Supply Assembly, 220V Three-Phase	959-0507	6-11
6-24	Power Supply Assembly, 380V WYE	959-0507-001	6-11
6-25	Auxiliary Power Supply Assembly, 220V Three-Phase	959-0507-020	6-13
6-24	Auxiliary Power Supply Assembly, 380V Three-Phase	959-0507-021	6-13
6-25	RF Amplifier Module Combiner	959-0508	6-16
6-26	RF Amplifier Module Assembly	959-0509-010	6-16
6-27	RF Amplifier Module Assembly, NoCombiner	959-0509-012	6-16

6-28	RF Amplifier Module Assembly, No Cover	959-0509-013	6-16
6-29	Reject Load Assembly	959-0510	6-16

**TABLE 6-1. FM-20S/FMi 1405 REPLACEABLE PARTS LIST INDEX**  
(Sheet 2 of 2)

TABLE	DESCRIPTION	PART NO.	PAGE
6-30	Front Panel Assembly	959-0530	6-17
6-31	Power Supply Wire Harness Assembly, 220V Three-Phase	949-0507	6-17
6-32	Power Supply Wire Harness Assembly, 380V WYE	949-0507-001	6-17
6-33	Cable Assembly, Front Panel	949-0517	6-17
6-34	Ribbon Cable Assembly	949-0425-020	6-18
6-35	DC Power & Data Cable Assembly	949-0426-020	6-18
6-36	Wire Harness Assembly	949-0427-020	6-18
6-37	RF Cable Assembly	949-0428-020	6-19
6-38	Standby Exciter Kit Cable Assembly	949-0428-001	6-19
6-39	Standby IPA Kit Cable Assembly	949-0428-022	6-19
6-40	Optically Coupled Relay Circuit Board Assembly	919-0096	6-20
6-41	Optically Coupled Relay Assembly	919-0096-001	6-20
6-42	Low Pass Filter Circuit Board Assembly	919-0421-002	6-21
6-43	Combiner Input Bottom Left Circuit Board Assembly	919-0502-001	6-21
6-44	Combiner Input Top Left Circuit Board Assembly	919-0502-002	6-22
6-45	Motherboard Circuit Board Assembly	919-0504	6-22
6-46	Motherboard RF Input Circuit Board Assembly	919-0506	6-23
6-47	Motherboard DC Connector Circuit Board	919-0510-001	6-23
6-48	Power Supply Distribution Circuit Board Assembly	919-0511	6-23
6-49	Module Control Circuit Board Assembly	919-0515	6-23
6-50	Temperature Sensor Circuit Board Assembly	919-0516-001	6-25
6-51	Heatsink Temperature Sensor Circuit Board	919-0516-002	6-25
6-52	DC Filter Circuit Board Assembly	919-0519-001	6-26
6-53	PCB, AC Line Fault Indicator Circuit Board Assembly	919-0524	6-26
6-54	Supervisor Circuit Board Assembly	919-0531	6-26
6-55	Input/Output Circuit Board Assembly	919-0527	6-28
6-56	Remote Interface Circuit Board Assembly	919-0528	6-29
6-57	Directional Coupler Circuit Board Assembly	919-0529	6-29
6-58	Front Panel Circuit Board Assembly	919-0530	6-30
6-59	Standby Exciter/IPA Coax Switch Assembly	340-0201-001	6-31
6-60	Standby Exciter, Option, FX-50, FM-20S	969-1011	6-31
6-61	Accessory Parts Kit, FM-20S/FMi 1405	969-1020	6-31
6-62	Standby IPA, Option, FM-20S/FMi 1405	969-1022	6-31
6-63	Software Kit, FM-20S Module Control PAL U4	979-0515-004	6-31
6-64	Software Kit, FM-20S Module Control ROM U5	979-0515-005	6-32
6-65	Software Kit, FM-20S Supervisor U3	979-0518-003	6-32
6-66	Software Kit, FM-20S Supervisor U4	979-0518-004	6-32
6-67	Software Kit, FM-20S Supervisor U5	979-0518-005	6-32
6-68	Software Kit, Supervisor CPU	979-0526	6-32
6-69	Software Kit, Supervisor U17	979-0523-017	6-32
6-70	Software Kit, Supervisor U2	979-0526-002	6-32

**TABLE 6-2. FM-20S TRANSMITTER, 220V THREE-PHASE - 909-1020-206**

REF. DES.	DESCRIPTION	PART NO.	QTY.
	FX-50 Exciter, 220 VAC	909-1051-325	1
	Assy, Control Cabinet, FM-20S, 3P, 3W, 220V	959-1020-206	1
	Assy, Auxiliary Cabinet, FM-20S, 3P, 3W, 220V	959-1021-206	1
	Kit, Accessory Parts, FM-20S	969-1020	1
	Kit, Software, Supervisor CPU	979-0526	1
	Assy, RF Amplifier Module	959-0509-313	34

**TABLE 6-3. FM-20S/FMi 1405 TRANSMITTER, 380V WYE THREE PHASE - 909-1020-386**

REF. DES.	DESCRIPTION	PART NO.	QTY.
	Conn, Type N Jack-to-Jack	417-3841	2
	FX-50 Exciter, 220 VAC	909-1051-325	1
	Assy, Control Cabinet, FM-20S, 3P, 3W, 220V	959-1020-206	1
	Assy, Auxiliary Cabinet, FM-20S, 3P, 3W, 220V	959-1021-206	1
	Kit, Accessory Parts, FM-20S	969-1020	1
	Kit, Software, FM-20S Supervisor CPU	979-0526	1
	Assy, RF Amplifier Module	959-0509-313	34

**TABLE 6-4. FMi 1405 HD XMTR, 220V 3-PH DELTA - 909-1405-206**

REF. DES.	DESCRIPTION	PART NO.	QTY.
	FM DTC, Digital Exciter, 60W	909-0060-001	1.0
	FM-IBOC, Signal Generator MB2.5	909-6025-1MB	1.0
	Assy, Control Cabinet, FMi 1405	959-1022-206	1.0
	Assy, Auxil Cabinet, FMi 1405	959-1023-206	1.0
	Kit, Acces Parts, FMi 1405	969-1020-200	1.0
	Kit, S/W FM-20S/FMi 1405 CPU	979-0526	1.0
	Assy, RF Amplifier Module	959-0509-313	34

**TABLE 6-5. FMi 1405 HD XMTR, 380V 3-PH 4WIRE WYE - 909-1405-386**

REF. DES.	DESCRIPTION	PART NO.	QTY.
	FM DTC, Digital Exciter, 60W	909-0060-001	1.0
	FM-IBOC, Signal Generator MB2.5	909-6025-1MB	1.0
	Assy, Control Cabinet, FMi 1405 4W	959-1022-386	1.0
	Assy, Auxil Cabinet, FMi 1405 4W	959-1023-386	1.0
	Kit, Acces Parts, FMi 1405	969-1020-200	1.0
	Kit, S/W FM-20S/FMi 1405 CPU	979-0526	1.0
	Assy, RF Amplifier Module	959-0509-313	34

**TABLE 6-6. FM-20S/FMi 1405 CONTROL CABINET ASSEMBLY, 220V THREE PHASE -  
959-1020-206/959-1022-206**

REF. DES.	DESCRIPTION	PART NO.	QTY.
	Display, LCD, 16 Charx2 Lines	320-0100-1	1
	Core, RF Transformer	375-0007	4
	Fan, W2E200-HH38-01, EBM	380-9000	4
	Connector, Set Screw, 1-1/2" EMT	401-0022	2
	Filter, Air, FXA 9.75"x10.75"x.86"	407-0168	2
	EMI Filter Assy, 18 Position, 2500 PF	411-0118	1
	Adapt, Plug-Jack Angle N UG27CU	417-0105	1
	Adapt, Jack-Jack 82-66 Amphenol	418-0035	1
	Elbow, 3-1/8, 301-025, MYAT	427-0002	1
	Coupling Assy, MYAT, 301-017	427-0005	1
	Transmission Line, Right Horizontal, FM-20S	463-5201	1
	Transmission Line, Right Vertical, FM-20S	463-5202	1
	Knob, 1.5", Rogan PT-7	481-0038/-200	1
	Knob, .75", Rogan PT-5	481-0039/-200	1
	Pwr Sply, PFC, 50 VDC Adj, 5 kW, 1-Phase	540-0016-005	4
	Assy, PCB, Module Control, FM-20S (SBCM)	919-0515	2
	Assy, AC Line Fault Indicator PCB	919-0524	1
	Assy, PCB, Supervisor, FM-20S (SBCM)	919-0526	1
	Assy, PCB, I/O, FM-20S	919-0527	1
	Assy, PCB, Remote Interface, FM-20S	919-0528	1
	Assy, PCB, Directional Coupler, FM-20S	919-0529	1
	Assy, Ribbon Cable, FM-20S (SBCM)	949-0425-020	1
	Assy, DC Power & Data Cable, FM-20S (SBCM)	949-0426-020	1
	Assy, Wire Harness, FM-20S (SBCM)	949-0427-020	1
	Assy, RF Cables, FM-20S (SBCM)	949-0428-020	1
	Assy, Directional Coupler, 40 dB	959-0082-040	1
	Assy, Directional Coupler, 45 dB	959-0082-045	1
	Assy, Low Pass Filter, FM-20S	959-0414-002	2
	Assy, 8-Way Combiner A (Left), FM-20S	959-0501	1
	Assy, 8-Way Combiner B (Right), FM-20S	959-0501-001	1
	Assy, 2-Way Combiner, FM-20S	959-0502	1
	Assy, RF Splitter, FM-20S	959-0503-020	1
	Assy, Motherbrds+IPA Splitter, FM-20S	959-0504	1
	Assy, Rej Load, 2-Way Combiner, FM-20S	959-0506	1
	Assy, Power Supply, FM-20S	959-0507	1
	Assy, RF Amp Module, FM-20S	959-0509-010	17
	Assy, Front Panel Display, FM-20S	959-0530	1

**TABLE 6-7. FM-20S/FMi 1405 CONTROL CABINET ASSEMBLY, 380V THREE PHASE -  
959-1020-386/959-1022-386**

REF. DES.	DESCRIPTION	PART NO.	QTY.
	Display, LCD, 16 Charx2 Lines	320-0100-1	1
	Core, RF Transformer	375-0007	4
	Fan, W2E200-HH38-01, EBM	380-9000	4
	Connector, Set Screw, 1-1/2" EMT	401-0022	2
	Filter, Air, FXA 9.75"x10.75"x.86"	407-0168	2
	EMI Filter Assy, 18 Position, 2500 PF	411-0118	1
	Adapt, Plug-Jack Angle N UG27CU	417-0105	1
	Adapt, Jack-Jack 82-66 Amphenol	418-0035	1
	Elbow, 3-1/8, 301-025, MYAT	427-0002	1
	Coupling Assy, MYAT, 301-017	427-0005	1
	Transmission Line, Right Horizontal, FM-20S	463-5201	1
	Transmission Line, Right Vertical, FM-20S	463-5202	1
	Knob, 1.5", Rogan PT-7	481-0038/-200	1
	Knob, .75", Rogan PT-5	481-0039/-200	1
	Handle Kit for ABB S3 Breaker	486-0019	1
	Pwr Sply, PFC, 50 VDC Adj, 5 kW, 1-Phase	540-0016-005	4
	Assy, PCB, Module Control, FM-20S (SBCM)	919-0515	2
	Assy, AC Line Fault Indicator PCB	919-0524	1
	Assy, PCB, Supervisor, FM-20S (SBCM)	919-0526	1
	Assy, PCB, I/O, FM-20S	919-0527	1
	Assy, PCB, Remote Interface, FM-20S	919-0528	1
	Assy, PCB, Directional Coupler, FM-20S	919-0529	1
	Assy, Ribbon Cable, FM-20S (SBCM)	949-0425-020	1
	Assy, DC Power & Data Cable, FM-20S (SBCM)	949-0426-020	1
	Assy, Wire Harness, FM-20S (SBCM)	949-0427-020	1
	Assy, RF Cables, FM-20S (SBCM)	949-0428-020	1
	Assy, Directional Coupler, 40 dB	959-0082-040	1
	Assy, Directional Coupler, 45 dB	959-0082-045	1
	Assy, Low Pass Filter, FM-20S	959-0414-002	2
	Assy, 8-Way Combiner A (Left), FM-20S	959-0501	1
	Assy, 8-Way Combiner B (Right), FM-20S	959-0501-001	1
	Assy, 2-Way Combiner, FM-20S	959-0502	1
	Assy, RF Splitter, FM-20S	959-0503-020	1
	Assy, Motherbrds+IPA Splitter, FM-20S	959-0504	1
	Assy, Rej Load, 2-Way Combiner, FM-20S	959-0506	1
	Assy, Power Supply, FM-20S	959-0507	1
	Assy, RF Amp Module, FM-20S	959-0509-010	17
	Assy, Front Panel Display, FM-20S	959-0530	1



**TABLE 6-8. FM-20S/FMi 1405 AUXILIARY CABINET ASSEMBLY, 220V THREE PHASE -  
959-1021-206/959-1023-206**

REF. DES.	DESCRIPTION	PART NO.	QTY.
	Core, RF Transformer	375-0007	4
	Fan, W2E200-HH38-01, EBM	380-9000	4
	Connector, Set Screw, 1-1/2" EMT	401-0022	2
	Filter, Air, FXA 9.75"x19.75"x.86"	407-0168	2
	Adapt, Plug-Jack Angle N UG27CU	417-0105	1
	Flange, 3-1/8, 301-014 MYAT	427-0001	1
	Elbow, 3-1/8, 301-025, MYAT	427-0002	5
	Coupling Assy, MYAT, 301-017	427-0005	7
	Coupling, 1-5/8+Clamps 201-017	427-0007	2
	Elbow, 1-5/8, 90 Deg, "Old-Style", Unflang	427-0060	2
	Transmission Line, Left Lower, FM-20S	463-5203	1
	Transmission Line, Left Upper, FM-20S	463-5204	1
	Transmission Line, Output, FM-20S	463-5205	1
	Transmission Line, Reject, FM-20S	463-5206	1
	Power Supply, PFC, 50 VDC Adj, 5 kW, 1 Phase	540-0016-005	4
	Assy, AC Line Fault Indicator PCB	919-0524	1
	Assy, Directional Coupler, 40 dB	959-0082-040	1
	Assy, Directional Coupler, 45 dB	959-0082-045	2
	Assy, Directional Coupler, 50 dB	959-0082-050	2
	Assy, Low Pass Filter, FM-20S	959-0414-002	2
	Assy, 8-Way Combiner A (Left), FM-20S	959-0501	1
	Assy, 8-Way Combiner B (Right), FM-20S	959-0501-001	1
	Assy, 2-Way Combiner, FM-20S	959-0502	1
	Assy, Output Combiner, FM-20S	959-0502-020	1
	Assy, Motherbrds+IPA Splitter, FM-20S	959-0504-020	1
	Assy, Rej Load, 2-Way Combiner, FM-20S	959-0506	1
	Assy, Aux Power Supply, 3P, 220V, FM-20S	959-0507-020	1
	Assy, RF Amp Module, FM-20S	959-0509-010	17
	Assy, Reject Load, FM-20S	959-0510	1

**TABLE 6-9. FM-20S AUXILIARY CABINET ASSEMBLY, 380V THREE PHASE -  
959-1021-386/959-1023-206**

REF. DES.	DESCRIPTION	PART NO.	QTY.
	Core, RF Transformer	375-0007	4
	Fan, W2E200-HH38-01, EBM	380-9000	4
	Connector, Set Screw, 1-1/2" EMT	401-0022	2
	Conduit, AC Entry, SUMO	401-0024	1
	Filter, Air, FXA 9.75"x19.75"x.86"	407-0168	2
	Adapt, Plug-Jack Angle N UG27CU	417-0105	1
	Flange, 3-1/8, 301-014 MYAT	427-0001	1
	Elbow, 3-1/8, 301-025, MYAT	427-0002	5
	Coupling Assy, MYAT, 301-017	427-0005	7
	Coupling, 1-5/8+Clamps 201-017	427-0007	2
	Elbow, 1-5/8, 90 Deg, "Old-Style", Unflang	427-0060	2
	Transmission Line, Left Lower, FM-20S	463-5203	1
	Transmission Line, Left Upper, FM-20S	463-5204	1
	Transmission Line, Output, FM-20S	463-5205	1
	Transmission Line, Reject, FM-20S	463-5206	1
	Power Supply, PFC, 50 VDC Adj, 5 kW, 1 Phase	540-0016-005	4
	Assy, AC Line Fault Indicator PCB	919-0524	1
	Assy, Directional Coupler, 40 dB	959-0082-040	1
	Assy, Directional Coupler, 45 dB	959-0082-045	2
	Assy, Directional Coupler, 50 dB	959-0082-050	2
	Assy, Low Pass Filter, FM-20S	959-0414-002	2
	Assy, 8-Way Combiner A (Left), FM-20S	959-0501	1
	Assy, 8-Way Combiner B (Right), FM-20S	959-0501-001	1
	Assy, 2-Way Combiner, FM-20S	959-0502	1
	Assy, Output Combiner, FM-20S	959-0502-020	1
	Assy, Motherbrds+IPA Splitter, FM-20S	959-0504-020	1
	Assy, Rej Load, 2-Way Combiner, FM-20S	959-0506	1
	Assy, Aux Power Supply, 3P, 220V, FM-20S	959-0507-020	1
	Assy, RF Amp Module, FM-20S	959-0509-010	17
	Assy, Reject Load, FM-20S	959-0510	1

**TABLE 6-10. LOW-PASS FILTER ASSEMBLY - 959-0414-002**

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Receptacle, BNC	417-0016	1
----	Low-Pass Filter Circuit Board Assembly	919-0421-002	1

**TABLE 6-11. 8-WAY COMBINER A (LEFT) ASSEMBLY - 959-0501**

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	BNC Receptacle, Bulkhead, UG492A/U	417-0017	2
----	Receptacle, Type-N, Female, Panel Mount	417-0392	8
----	Adapter, Type-N, Jack-To-Jack, 82-66 Amphenol	418-0035	2
----	Combiner Input Bottom Left Circuit Board Assembly	919-0502-001	1
----	Combiner Input Top Left Circuit Board Assembly	919-0502-002	1
----	Blank 8-Way Combiner Circuit Board Assembly	519-0501	1

**TABLE 6-12. 8-WAY COMBINER B (RIGHT) ASSEMBLY - 959-0501-001**

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Receptacle, Type-N, Female, Panel Mount	417-0392	8
----	Combiner Input Bottom Left Circuit Board Assembly	919-0502-001	1
----	Combiner Input Top Left Circuit Board Assembly	919-0502-002	1
----	Blank 8-Way Combiner Circuit Board Assembly	519-0501	1

**TABLE 6-13. 2- WAY COMBINER ASSEMBLY - 959-0502**

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Connector, "N" Female Bulkhead Receptacle Rear Mount Pressurized	417-0321	1
----	Connector, Output Coupling Loop	419-0034	1
----	Flange, 3 1/8 inch	427-0001	1

**TABLE 6-14. 20 kW 2-WAY OUTPUT COMBINER ASSEMBLY - 959-0502-020**

REF. DES.	DESCRIPTION	PART NO.	QTY.
	Connector, Output Coupling Loop	419-0034	3
	Flange, 3-1/8, 301-014, MYAT	427-0001	3
	Connector, Modified, 3.5 kW	427-0009-1	1
	Assy, Adaptor, 1-5/8 Flanged	427-0010	1

**TABLE 6-15. IPA SPLITTER ASSEMBLY - 959-0503**

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Connector, "N" Female Bulkhead Receptacle Rear Mount Pressurized	417-0321	1
----	Receptacle, Type-N, Female, Panel Mount	417-0392	1
----	IPA Splitter Circuit Board	519-0503	1

**TABLE 6-16. RF SPLITTER ASSEMBLY - 959-0503-020**

REF. DES.	DESCRIPTION	PART NO.	QTY.
	Res, 50 Ohm, 250W, 5%, Brazed Flange Mounting	131-0530	1
	Conn. N Type Female Bulkhead Recpt Rear Mount	417-0321	1
	Recpt, N Type Female, Panel Mount	417-0392	3
	Recpt, N Type Male Olug, Flanged, Solder	417-0397	1
	Blank, PCB, IPA Splitter, FM-20S	519-0503	2

**TABLE 6-17. MOTHERBOARDS & IPA SPLITTER ASSEMBLY - 959-0504/-020**

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Right Angle Plug-Jack, Type N	417-0105	1
----	Bulkhead Receptacle, Type N Jack-to-Jack, UG30/U	418-0035	1
----	Assembly, IPA Splitter	959-0503	1
----	Assembly, Motherboard	959-0504-001	1

**TABLE 6-18. MOTHERBOARD ASSEMBLY - 959-0504-001**

REF. DES.	DESCRIPTION	PART NO.	QTY.
J110, J111, J110, J111	Connector, D-Type, 25-Pin, Filtered, Right Angle, PCB Mount	417-1253	4
J112, J112, J113	Connector, Type N, Male To Pin, No Nut	417-0384	3
J202, J202	Connector, 10-Pin Single Row Header	417-0044	2
R101 thru R108, R101 thru R108	Resistor, 50 Ohm $\pm 5\%$ , 100 W	131-5032	16
R109, R110 R109, R110	Resistor, 100 Ohm $\pm 5\%$ , 250 W	131-5031	2
----	Motherboard Assembly	919-0504	1
----	Motherboard DC Connector Circuit Board	919-0510-001	1
----	Heatsink Temperature Sensor Circuit Board	919-0516-002	1

**TABLE 6-19. RF AMPLIFIER MODULE - 959-0509-313**

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Assembly, RF Amplifier Module, No Cover	959-0509-213	1

**TABLE 6-20. RF AMPLIFIER ASSEMBLY, NO COVER - 959-0509-213**

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Assembly, RF Amplifier Module Combiner	959-0508	1
----	Assembly, RF Amplifier Module, Less Combiner	959-0509-113	1

**TABLE 6-21. RF AMPLIFIER ASSEMBLY, LESS COMBINER - 959-0509-113**

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Transistor, RF Power Mosfet, SD 2932, 175 MHz, 50 V, 300 W	210-2932	1
----	RF Amplifier Circuit Board Assembly	919-0505-113	1
----	RF Amplifier Filter PCB Assembly	919-0514-013	1

**TABLE 6-22. RF AMPLIFIER FILTER ASSEMBLY - 959-0514-013 (Sheet 1 of 2)**

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1,C2	CAP, CHIP, .1UF, 200V, 20%, SMD	007-1044-200	2
C3	CAP,CER,0.1uF,50V,10%,SMD	007-1044	1
C4	CAP,CER,100pF,50V,2%,SMD	007-1022	1
C5 thru C10	CAP,CER,0.1uF,50V,10%,SMD	007-1044	6
C11	CAP,CER,20pF,50V,2%,SMD	007-2012	1
C12 thru C14	CAP,CER,0.1uF,50V,10%,SMD	007-1044	3
C15 thru C17	CAP,TANT,10UF,20V,10%,SMD	070-1065	3
C19	CAP,CER,0.1uF,50V,10%,SMD	007-1044	1
C20	CAP, CHIP, .1UF, 200V, 20%, SMD	007-1044-200	1
C22	CAP, CHIP, .1UF, 200V, 20%, SMD	007-1044-200	1
C23	CAP,TRMR,CER,4-25PF,SMD,NPO	090-0004	1
C24	CAP, CER CHIP, 82pF, 2%, 500V	009-8013-001	1
C25,C26	CAP,TRMR,CER,4-25PF,SMD,NPO	090-0004	2
C27	CAP,47 uF,Electrolytic,63V,SMD	006-1006	1
C28	Capacitor, Mica, Feedthru, 1000 pF +10%, 350V	046-1030	1
C30	CAP, CER CHIP, 82pF, 2%, 500V	009-8013-001	1
C31	CAP,CER CHIP,1000PF,100V,5%	009-1032	1
C32 thru C34	Capacitor, Ceramic Chip, 470 pF +5%, 200V	009-4723	3
C35	CAP, CHIP, .1UF, 200V, 20%, SMD	007-1044-200	1
C36	CAP,CER,1UF,10%,10V,X7R,0805,SMD	007-1054-001	1
C29	CAP,TRMR,CER,4-25PF,SMD,NPO	090-0004	1
D1 thru D6	DIODE,SWITCHING,MMBD914LT1,SMD	204-0914	6
D7,D8	DIODE,ZENER,4.7V,225MW,SMD,SOT23	210-1047	2
D9	DIODE,SWITCHING,MMBD914LT1,SMD	204-0914	1
FL1 thru FL4	CAP, EMI FILTER, SMD	007-2704-001	4
FL5,FL6	FERRITE,CHIP IMPEDANCE 1500OHMS @ 100MHZ MULTILAYER, 0805	366-6152	2
FL7 thru FL19	CAP, EMI FILTER, SMD	007-2704-001	13
FL20	CAP, EMI FILTER, SMD, 1000PF	007-2704-002	1
FL21,FL22	CAP, EMI FILTER, SMD	007-2704-001	2
FL23,FL24	FERRITE,CHIP IMPEDANCE 1500OHMS @ 100MHZ MULTILAYER, 0805	366-6152	2
J3	CONN,JACK,8 POS,DIP,BOT.ENTRY,SMD	417-0294	1

**TABLE 6-22. RF AMPLIFIER FILTER ASSEMBLY - 959-0514-013 (Sheet 2 of 2)**

REF. DES.	DESCRIPTION	PART NO.	QTY.
J1A	CONN, SOCKET STRIP, 5 POS, SMD	417-0293	1
J1B	CONN, SOCKET STRIP, 5 POS, SMD	417-0293	1
J2A	CONN, SOCKET STRIP, 2 POS, SMD	417-0297	1
J2B	CONN, SOCKET STRIP, 2 POS, SMD	417-0297	1
J4A	CONN, JACK, 3-PIN, SMD	417-0308	1
J4B	CONN, JACK, 3-PIN, SMD	417-0308	1
L2, L3	IND, 17.5 NH, AIR, 16MM, 5%, SMD	366-0017	2
P4A	PLUG, JUMPER SHUNT, 2-PIN	417-0309	1
P4B	PLUG, JUMPER SHUNT, 2-PIN	417-0309	1
Q1	P CHAN ENH MODE FET 60V SOT23	210-3310	1
R1, R2	TRMR, 50K, TOP ADJUST, SMD	198-0503	2
R3	RES, CHIP, 1.00M OHMS, 1/10W, 1%, SMD	102-1004	1
R4	RES, CHIP, 10.0K OHMS, 1/10W, 1%, SMD	102-1002	1
R5	RES, CHIP, 100K OHMS, 1/10W, 1%, SMD	102-1003	1
R6	RES, CHIP, 10.0K OHMS, 1/10W, 1%, SMD	102-1002	1
R7, R8	RES, CHIP, 1.00K OHMS, 1/10W, 1%, SMD	102-1001	2
R9	RES, CHIP, 10.0K OHMS, 1/10W, 1%, SMD	102-1002	1
R10	RES, CHIP, 10.0K OHMS, 1/10W, 1%, SMD	102-1002	1
R11	RES, CHIP, 2.26K OHM, 1/10W, 1%, SMD	102-2261	1
R12	RES, CHIP, 11.0K OHMS, 1/10W, 1%, SMD	102-1102	1
R13	RES, CHIP, 9.09K OHM, 1/10W, 1%	102-9094	1
R14	RES, CHIP, 4.02K OHMS, 1/10W, 1%, SMD	102-4021	1
R15	RES, CHIP, 10.0K OHMS, 1/10W, 1%, SMD	102-1002	1
R16	RES, CHIP, 1.00K OHMS, 1/10W, 1%, SMD	102-1001	1
R17, R18	RES, CHIP, 100K OHMS, 1/10W, 1%, SMD	102-1003	2
R19	RES, CHIP, 1.00K OHMS, 1/10W, 1%, SMD	102-1001	1
R21, R22	RES, CHIP, 22.1K OHMS, 1/10W, 1%, SMD	102-2212	2
R23	.003 OHM 3W CURRENT SENSE RES, SMT	111-0005	1
R24	RES, CHIP, 1.00K OHMS, 1/10W, 1%, SMD	102-1001	1
R25	RES, CHIP, 10.0K OHMS, 1/10W, 1%, SMD	102-1002	1
R27	TRMR, 10K OHMS, TOP ADJ, SMD (N)	198-1054	1
R28	RES, CHIP, 4.02K OHMS, 1/10W, 1%, SMD	102-4021	1
R29, R30	RES, CHIP, 1.00M OHMS, 1/10W, 1%, SMD	102-1004	2
R31	RES, CHIP, 1.00K OHMS, 1/10W, 1%, SMD	102-1001	1
R32	RES, CHIP, 10.0K OHMS, 1/10W, 1%, SMD	102-1002	1
R33	RES, 50 OHM, 20W, 1%, TO-220 PKG	132-5002	1
R34	RES, 50 OHM, 250W, 5%, FLANGE MOUNT	131-5030	1
R35 thru R38	RES, CHIP, 10.0K OHMS, 1/10W, 1%, SMD	102-1002	4
R40, R41	RES, THICK FILM, 0 OHM, 1/8W, 5%, SMD	101-0003	2
R42, R43, R47	RES, CHIP, 10.0K OHMS, 1/10W, 1%, SM	102-1002	2
U6	IC, Single Rail-to-Rail Op-Amp	221-0184	1
U3, U4	IC, AD824 Op-Amp	221-0824	2
U5	IC, Analog Switch	224-0351	1
----	PCB, Blank	519-0514-013	1

**TABLE 6-23. RF AMPLIFIER ASSEMBLY - 919-0505-113**

REF. DES.	DESCRIPTION	PART NO.	QTY.
C102, C103	Capacitor, Ceramic Chip, 270 pF $\pm 5\%$ , 300 V	009-2723	2
C101, C104 C109, C110	Capacitor, Ceramic Chip, 470 pF $\pm 5\%$ , 200 V	009-4723	4
C116	Capacitor, Ceramic, Trimmer, 6-50 pF, 50 V	090-5010	1
L102	Wire, Teflon, 18 AWG, 600 V, 200 C	370-0069	1
T101	Assembly, RF Amplifier Output Transformer	370-0062	1
U101	Integrated Circuit, LM35DZ, Celsius Temperature Sensor, TO-92 Case	220-0035	1
----	Assembly, RF Amplifier Input Transformer	370-0063	1
----	RF Amplifier Circuit Board Assembly	919-0505-013	1

**TABLE 6-24. RF AMPLIFIER ASSEMBLY, PCB ASSEMBLY - 919-0505-013**

REF. DES.	DESCRIPTION	PART NO.	QTY.
C120 thru C122	Capacitor, Ceramic Chip, 10 pF $\pm 2\%$ , 500 V	009-1013-001	3
C105 thru C107	Capacitor, Ceramic Chip, 1000 pF $\pm 5\%$ , 100 V	009-1032	3
C119	Capacitor, Ceramic Chip, 200 pF $\pm 5\%$ , 300 V	009-2023	1
C118	Capacitor, Ceramic Chip, 68 pF $\pm 2\%$ , 500 V	009-6813-001	1
C124	Capacitor, Electrolytic, 470 uF, 63 V	013-4784	1
C117	Capacitor, Feedthru, 1000 pF, 350 V	046-1030	1
R105 thru R107	Resistor, 2.2 k Ohm $\pm 1\%$ , 1/4 W	101-2243	3
R110	Resistor, 10 k Ohm $\pm 1\%$ , 1/10 W	102-1002	1
R101 thru R104, R111 R112	Resistor, 22 Ohm $\pm 5\%$ , 1 W	111-2223	6
R109	Potentiometer, 50k Top Adjust	198-0503	1
P1	Connector, 5-Pin SMD	417-0292	1
P2	Connector, 2-Pin SMD	417-0296	1
----	PCB, Blank	519-0505-013	1

**TABLE 6-25. REJECT LOAD, 2- WAY COMBINER ASSEMBLY - 959-0506**

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Resistor, 200 Ohm $\pm 10\%$ , 150 W	139-0200	4
----	Connector, "N" Female Bulkhead Receptacle Rear Mount Pressurized	417-0321	1

**TABLE 6-26. POWER SUPPLY ASSEMBLY, 220V THREE PHASE - 959-0507**

REF. DES.	DESCRIPTION	PART NO.	QTY.
CB1	Circuit Breaker, 3-Pole, 240 VAC, 80 Amperes	341-0072	1
K1	Contactor, 80 Amperes, 220/240 VAC, 50/60 Hz	341-0074	1
MOV1 thru MOV6, MOV1A thru MOV6A	Metal-Oxide Varistor, B40K275, 275 V, 1680 Joules	140-0021	12
PS7	Power Supply, 80 Watt, Input: 90 to 264 VAC, 50/60 Hz Output: +5 VDC @ 8 A, ±12 VDC @ 2.5 A, +24 VDC @ 2 A	540-0015-012	1
TB1	Barrier Strip, 9 Terminal	412-0090	1
TB2	Terminal Block, Gould 63133	412-0050	1.33
----	Fuse Block, 2-Pole, Buss S-8202-02	415-0003	1
----	Phase Monitor Circuit Board, Single-Phase, High/Low Off	470-0352	3
----	Fuse, MDA, 10 A, 250 V Slo-Blo	330-1000	2
----	Fuse Holder, Dual, 3AB	415-0003	1
----	Optically Coupled Relay Assembly	919-0096-001	1
----	Power Supply Distribution Circuit Board Assembly	919-0511	1
----	Temperature Sensor Circuit Board Assembly	919-0516-001	1
----	DC Filter Circuit Board Assembly	919-0519-001	12
----	Wiring Harness, Power Supply Assembly	949-0507	1

**TABLE 6-27. POWER SUPPLY ASSEMBLY, 380 VOLT WYE - 959-0507-001**

REF. DES.	DESCRIPTION	PART NO.	QTY.
CB1	Circuit Breaker, 3-Pole, 240 VAC, 80 Amperes	341-0072	1
K1	Contactor, 80 Amperes, 220/240 VAC, 50/60 Hz	341-0074	1
MOV1 thru MOV3, MOV7, MOV1A thru MOV3A, MOV7A	Metal-Oxide Varistor, B40K275, 275 V, 1680 Joules	140-0021	8
PS7	Power Supply, 80 Watt, Input: 90 to 264 VAC, 50/60 Hz Output: +5 VDC @ 8 A, ±12 VDC @ 2.5 A, +24 VDC @ 2 A	540-0015-012	1
TB1	Barrier Strip, 9 Terminal	412-0090	1
TB2	Terminal Block, Gould 63133	412-0050	0.66
TB4	Terminal Block, 4 Position, 2/0 to 12 AWG	412-0040	0.25
----	Fuse, MDA, 10 A, 250 V Slo-Blo	330-1000	2
----	Fuse Block, 2-Pole, Buss S-8202-02	415-0003	1
----	Phase Monitor Circuit Board, Single-Phase, High/Low Off	470-0352	3
----	Optically Coupled Relay Assembly	919-0096-001	1
----	Power Supply Distribution Circuit Board Assembly	919-0511	1
----	Temperature Sensor Circuit Board Assembly	919-0516-001	1
----	DC Filter Circuit Board Assembly	919-0519-001	12
----	Wiring Harness, Power Supply Assembly	949-0507-001	1
----	Fuse Holder, Dual, 3AB	415-0003	1



**TABLE 6-28. AUXILIARY POWER SUPPLY ASSEMBLY 220V THREE PHASE -  
959-0507-020**

REF. DES.	DESCRIPTION	PART NO.	QTY.
MOV1, MOV2, MOV3, MOV4 MOV5, MOV6 MOV1A, MOV2A MOV3A, MOV4A MOV5A, MOV6A	Varistor, B40K275, Siemens	140-0021	12
CB1	Circuit Breaker, 80A, 600 VAC, 3-Pole, S3 Type	341-0072	1
K1	Contact, 80A, 220/240 VAC, 50/60 Hz	341-0074	1
TB2	Term Block, Gould 63133	412-0050	1.33
TB1	Barrier Strip, 9 Position 7/16	412-0090	1
	AC High/Low Line Monitor with Indicator	470-0352	3
	Handle Kit for ABB S3 Breaker	486-0019	1
PS7	Power Supply, 80W, Univ Input, 3 Outputs	540-0015-012	1
K2	Assy, PCB, Optically Coupled Rel Note	919-0096-001	1
	Assy, PCB, Power Supply Dist, FM-20S	919-0511	1
	Assy, PCB, DC Filter	919-0519-001	12
	Assy, Power Supply Harness, FM-20S (SBCM)	949-0507	1

**TABLE 6-29. AUXILIARY POWER SUPPLY ASSEMBLY 380V THREE PHASE -  
959-0507-021**

REF. DES.	DESCRIPTION	PART NO.	QTY.
MOV1, MOV2, MOV3, MOV7 MOV1A, MOV2A MOV3A, MOV7A	Varistor, B40K275, Siemens	140-0021	8
CB1	Circuit Breaker, 80A, 600 VAC, 3-Pole, S3 Type	341-0072	1
K1	Contact, 80A, 220/240 VAC, 50/60 Hz	341-0074	1
TB4	Barrier Strip, 4-Position 2/0-12AWG	412-0040	0.25
TB2	Term Block, Gould 63133	412-0050	1.66
TB1	Barrier Strip, 9 Position 7/16	412-0090	1
	AC High/Low Line Monitor with Indicator	470-0352	3
	Handle Kit for ABB S3 Breaker	486-0019	1
PS7	Power Supply, 80W, Univ Input, 3 Outputs	540-0015-012	1
K2	Assy, PCB, Optically Coupled Rel Note	919-0096-001	1
	Assy, PCB, Power Supply Dist, FM-20S	919-0511	1
	Assy, PCB, DC Filter	919-0519-001	12
	Assy, Power Supply Harness, FM-20S (SBCM)	949-0507	1

**TABLE 6-30. RF AMPLIFIER MODULE COMBINER - 959-0508**

REF. DES.	DESCRIPTION	PART NO.	QTY.
J1	Connector, Type N, Male To Pin, No Nut	417-0384	1
P3	Receptacle Header, 12-Pin In-Line	417-1203	1
	Module Support Circuit Board	519-0509	2
	Module Combiner Breakaway Circuit Board	519-0512	1
	Module Combiner Circuit Board Assembly	919-0508	1

**TABLE 6-31. RF AMPLIFIER MODULE ASSEMBLY - 959-0509-010**

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Assembly, RF Amplifier, No Cover	959-0509-003	1

**TABLE 6-32. RF AMPLIFIER MODULE ASSEMBLY, NO COMBINER - 959-0509-012**

REF. DES.	DESCRIPTION	PART NO.	QTY.
F1, F2	Fuse, 20A, 3AB, 250 V	330-2000	2
----	Assembly, RF Amplifier	959-0505-012	1
----	Assembly, RF Amplifier Module Interface And Sub Circuit Board	919-0514-012	1

**TABLE 6-33. RF AMPLIFIER MODULE ASSEMBLY, NO COVER - 959-0509-013**

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Assembly, RF Amplifier, No Combiner	959-0509-012	1
----	Assembly, RF Amplifier Module Combiner	959-0508	1

**TABLE 6-34. REJECT LOAD ASSEMBLY - 959-0510**

REF. DES.	DESCRIPTION	PART NO.	QTY.
	Res, 200 Ohm, 300W, 10%, Non Ind	139-0201	4
	Connector, Modified, 3.5 kW	427-0009-1	1
	Assy, Adaptor 1-5/8 Flanged	427-0010	1

**TABLE 6-35. FRONT PANEL ASSEMBLY - 959-0530**

REF. DES.	DESCRIPTION	PART NO.	QTY.
	Assy, PCB, Front Panel, FM-20S (SBCM)	919-0530	1
	Harness, Front Panel, FM-20S (SBCM)	949-0517	2

**TABLE 6-36. POWER SUPPLY WIRE HARNESS ASSEMBLY, 220 VOLT THREE-PHASE - 949-0507**

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Pins, Connector	417-0053	22
----	Connector Housing, 13-Pin In-Line	417-1300	1
----	Connector Housing, 5-Pin In-Line	417-1305	1
----	Plug, Housing, 4-Pin	418-0240	2
----	Connector Housing, 2-Pin, Female	418-0701	2
----	Plug, Connector Housing, 12-Pin	418-1271	1
----	Connector Housing, 3-Pin Amp Innergy 556879-3,	418-6879-003	5

**TABLE 6-37. POWER SUPPLY WIRE HARNESS ASSEMBLY, 380 VOLT WYE - 949-0507-001**

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Pins, Connector	417-0053	22
----	Connector Housing, 13-Pin In-Line	417-1300	1
----	Connector Housing, 5-Pin In-Line	417-1305	1
----	Plug, Housing, 4-Pin	418-0240	2
----	Connector Housing, 2-Pin, Female	418-0701	1
----	Plug, Connector Housing, 12-Pin	418-1271	1
----	Connector Housing, 3-Pin Amp Innergy 556879-3,	418-6879-003	5

**TABLE 6-38. CABLE ASSEMBLY, FRONT PANEL - 949-0517**

REF. DES.	DESCRIPTION	PART NO.	QTY.
P1, P2	HSNG, 3-Pin 87499-5 Amp	417-0003-001	2
	Contact, Crimp, Mod-IV 87809-1	417-8766	6

**TABLE 6-39. RIBBON CABLE ASSEMBLY - 949-0425-020**

REF. DES.	DESCRIPTION	PART NO.	QTY.
	Connector, Female, 10-Pin	417-0180	2.350
	Connector, male, 9-Pin, 747043-4	417-0181	4.200
	Connector, Female, 50-Pin, Transition	417-0228	4.200
	Connector, 60-Pin, Ribbon	417-3334	5.750
	Connector, 26-Pin, Ribbon	418-2600	2.200

**TABLE 6-40. DC POWER & DATA CABLE ASSEMBLY - 949-0426-020**

REF. DES.	DESCRIPTION	PART NO.	QTY.
	Cable Assy, Computer, DB9, M/M, 6 ft	849-0903	4
	Cable Assy, Computer, DB9, M/F, 10 ft	849-0910	8
	Cable Assy, Computer, DB25, M/M, 10 ft	849-2510	8
	Cable, Computer Data, DB25-DB25, M/M, 2 ft	849-2525	8
	Cable Assy, Computer, DB37-DB37, M/F, 3 ft	849-3701	1

**TABLE 6-41. WIRE HARNESS ASSEMBLY - 949-0427-020**

REF. DES.	DESCRIPTION	PART NO.	QTY.
	SKT, Connector, 641294-1 Amp	417-0053	42
	Connector, 9-Pin, 1-640521-0 Amp	417-0059	1
	HSNG, Mod-IV, 4-Position, 87499-7 Amp	417-0138	4
	Pin, .050 Dia 26-22 745254-3	417-0142	38
	SKT, Pin, .050 26-22 745253-3	417-0143	17
	Keying Plug, Mod-IV 87077 Amp	417-0224	4
	Plug, 25-Pin 207464-1 Amp	417-0251	2
	Recpt, 25-Position, 207463-1 Amp	417-0252	3
	Pin, Crimp, Sub-D Connector, 20-24 AWG	417-0465	50
	SKT, Crimp, Dub-D Connector, 20-24 AWG	417-0466	50
	Plug, 15-Pin	417-1500	1
	Kit, Backshell for 15-Pin D Connector	417-1510	1
	Kit, Backshell for 25-Pin D Connector	417-2510	5
	Kit, Backshell for 37-Pin D Connector	417-3710	1
	Connector Shell, 37-Pin D, Male	417-3711	1
	Contact, Crimp, Mod-IV 87809-1	417-8766	12
	Plug, BNC Dual Crimp 1-227079-6	418-0034	4
	Plug, Female, 4-Pin	418-0240	8
	Housing, Connector, 6-Pin Female	418-0670	2

**TABLE 6-42. RF CABLE ASSEMBLY - 949-0428-020**

<b>REF. DES.</b>	<b>DESCRIPTION</b>	<b>PART NO.</b>	<b>QTY.</b>
	Connector, BNC, RG/U142 31-326 Amphenol	417-0095	19
	Plug, Straight N	417-0120	12
	Plug, N for RG-58/142B/U	418-0031	9

**TABLE 6-43. STANDBY EXCITER KIT CABLE ASSEMBLY - 949-0428-001**

<b>REF. DES.</b>	<b>DESCRIPTION</b>	<b>PART NO.</b>	<b>QTY.</b>
	SKT, Connector 641294-1 Amp	417-0053	12
	Connector, 9-Pin 1-640521-0 Amp	417-0059	1
	Connector, BNC, RG/142 31-326 Amphenol	417-0095	1
	Plug N for RG-58/142B/U	418-0031	3
	Plug, Female, 4-Pin	418-0240	1
	Housing, Connector, 6-Pin Female	418-0670	1

**TABLE 6-44. STANDBY IPA KIT CABLE ASSEMBLY - 949-0428-022**

<b>REF. DES.</b>	<b>DESCRIPTION</b>	<b>PART NO.</b>	<b>QTY.</b>
	Connector, BNC RG/U142 31-326 Amphenol	417-0095	1
	Plug, Straight N	417-0120	4
	Plug, N for RG-58/142B/U	418-0031	1

**TABLE 6-45. OPTICALLY COUPLED RELAY CIRCUIT BOARD - 919-0096**

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1	Capacitor, Ceramic, 0.001 uF, 1 kV	002-1034	1
C2	Capacitor, Electrolytic, 47 uF, 35 V	020-4773	1
C3	Capacitor, Ceramic Disc, 0.1 uF, 600 V	000-1051	1
C4	Capacitor, Ceramic, 0.001 uF, 1 kV	002-1034	1
D1	Diode, 1N4005, Silicon, 600 V @ 1 Ampere	203-4005	1
D2	Diode, Zener, 1N5359, 24 V $\pm 10\%$ , 5 W	200-5359	1
D4	Diode, 1N4005, Silicon, 600 V @ 1 Ampere	203-4005	1
D5	Bridge Rectifier, MDA970A3, 4 Amps, 50-200 V	239-0003	1
E1 thru E5	Terminal, Male Disconnect	410-0025	5
F1, F2	Fuse, 3 Amps, 250 V, Printed Circuit Board Mount	330-0055	2
K1	Relay, Printed Circuit Board Mount Coil: 24 VDC, 660 Ohm $\pm 10\%$ Contacts: SPST-NO, 0.5 to 15 A @ 12 to 240 VAC Resistance	270-0054	1
MOV1	Varistor, 27 V, V27ZA60	140-0023	1
R1	Resistor, 2 k Ohm $\pm 3\%$ , 10 W, W/W	130-2032	1
R2	Resistor, 560 Ohm $\pm 5\%$ , 1/2 W	110-5633	1
R3	Resistor, 820 Ohm $\pm 5\%$ , 1/2 W	110-8233	1
R4	Resistor, 51.1 Ohm $\pm 1\%$ , 1/4 W	103-5112	1
R5	Resistor, 2 k Ohm $\pm 3\%$ , 10 W, W/W	130-2032	1
U1	Integrated Circuit, 4N33, Optical Isolator, NPN Photo Transistor/Infared Emitting Diode Type, 1500 V 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 6-46. OPTICALLY COUPLED RELAY ASSEMBLY - 919-0096-001**

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

**TABLE 6-47. LOW-PASS FILTER CIRCUIT BOARD ASSEMBLY - 919-0421-002**

REF. DES.	DESCRIPTION	PART NO.	QTY.
C8	Capacitor, Ceramic, 68 pF $\pm 5\%$ , 50 V	003-6812	1
C9,C10	Capacitor, Mica, 390 pF $\pm 5\%$ , 100 V	042-3922	2
C11	Capacitor, Ceramic, 27 pF $\pm 2\%$ , 100 V	003-2753	1
C12,C13	Capacitor, Mica, 390 pF $\pm 5\%$ , 100 V	042-3922	2
C14,C15	Capacitor, Ceramic, 2.2 pF, $+1/-0.25$ pF, 100 V	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	Inductor, Low-Pass Filter	360-0145	1
L2	Inductor, Molded, 0.023 $\mu$ H	364-0023	1
R1	Resistor, 1 k Ohm $\pm 1\%$ , 1/4 W	100-1041	1
R2	Resistor, 665 k Ohm $\pm 1\%$ , 1/4 W	103-6654	1
R3,R4	Resistor, 124 Ohm $\pm 1\%$ , 2 W	122-1241	2
R5	Resistor, 100 k Ohm $\pm 1\%$ , 1/4 W	103-1062	1
R6	Resistor, 665 k Ohm $\pm 1\%$ , 1/4 W	103-6654	1
R7,R8	Resistor, 158 Ohm $\pm 1\%$ , 2 W	122-1581	2
R9	Potentiometer, 1 k Ohm $\pm 10\%$ , 1/2 W	177-1044	1
----	Inductor, Low-Pass Filter, FM-5C	471-5035	1
----	Blank Low-Pass Filter Circuit Board Assembly FM-3C	519-0421	1
----	Fuseable Link, 22 AWG	601-0022	----

**TABLE 6-48. COMBINER INPUT BOTTOM LEFT CIRCUIT BOARD ASSEMBLY - 919-0502-001**

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1 thru C9	Capacitor, Ceramic, 0.1 $\mu$ F $\pm 10\%$ , 50 V	003-1066	9
D1 thru D4	Diode, 1N4005, Silicon, 600V @ 1 Ampere	203-4005	4
FL1 thru FL5	Filter, EMI 10,000 pF Capacitor, 3-Pin In-Line	411-0001	5
J1	Receptacle, D-Type, 9-Pin, Straight, PCB Mount	417-1094	1
K1 thru K4	Relay, PCB Mount Coil: 12 VDC, 180 Ohm Contacts: SPST-NO, 15A @ 240 VAC or 24 VDC	270-1255	4
L1 thru L4	Coil, Combiner Input Circuit Board, FM-20S	360-0158	4
----	Blank Combiner Input Bottom Left Circuit Board	519-0502	1

**TABLE 6-49. COMBINER INPUT TOP LEFT CIRCUIT BOARD ASSEMBLY - 919-0502-002**

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1 thru C9	Capacitor, Ceramic, 0.1 uF $\pm 10\%$ , 50 V	003-1066	9
D1 thru D4	Diode, 1N4005, Silicon, 600 V @ 1 Ampere	203-4005	4
FL1B thru FL5B	Filter, EMI 10,000 pF Capacitor, 3-Pin In-Line	411-0001	5
J1B	Receptacle, D-Type, 9-Pin, Straight, PCB Mount	417-1094	1
K1 thru K4	Relay, PCB Mount Coil: 12 VDC, 180 Ohm Contacts: SPST-NO, 15 A @ 240 VAC or 24 VDC	270-1255	4
L1 thru L4	Coil, Combiner Input Circuit Board, FM-20S	360-0158	4
----	Blank Combiner Input Bottom Left Circuit Board	519-0502	1

**TABLE 6-50. MOTHERBOARD CIRCUIT BOARD ASSEMBLY - 919-0504**

REF. DES.	DESCRIPTION	PART NO.	QTY.
C101	Capacitor, Electrolytic, 47 uF, 35 V	020-4770	1
C102	Capacitor, Mylar, 0.1 uF $\pm 10\%$ , 100 V	030-1053	1
C103	Capacitor, Electrolytic, 47 uF, 35 V	020-4770	1
C104	Capacitor, Mylar, 0.1 uF $\pm 10\%$ , 100 V	030-1053	1
C105	Capacitor, Electrolytic, 47 uF, 35 V	020-4770	1
C106	Capacitor, Mylar, 0.1 uF $\pm 10\%$ , 100 V	030-1053	1
C107	Capacitor, Electrolytic, 47 uF, 35 V	020-4770	1
C108	Capacitor, Mylar, 0.1 uF $\pm 10\%$ , 100 V	030-1053	1
C109	Capacitor, Electrolytic, 47 uF, 35 V	020-4770	1
C110	Capacitor, Mylar, 0.1 uF $\pm 10\%$ , 100 V	030-1053	1
C111	Capacitor, Electrolytic, 47 uF, 35 V	020-4770	1
C112	Capacitor, Mylar, 0.1 uF $\pm 10\%$ , 100 V	030-1053	1
C113	Capacitor, Electrolytic, 47 uF, 35 V	020-4770	1
C114	Capacitor, Mylar, 0.1 uF $\pm 10\%$ , 100 V	030-1053	1
C115	Capacitor, Electrolytic, 47 uF, 35 V	020-4770	1
C116	Capacitor, Mylar, 0.1 uF $\pm 10\%$ , 100 V	030-1053	1
C117	Capacitor, Electrolytic, 47 uF, 35 V	020-4770	1
C118	Capacitor, Mylar, 0.1 uF $\pm 10\%$ , 100 V	030-1053	1
C123 thru C130	Capacitor, Ceramic Chip, 47 pF $\pm 5\%$ , 500 V	009-4713	8
C131	Capacitor, Ceramic, 4.7PF, $\pm 0.1$ pF, 500 V	009-4710-001	1
----	Blank Motherboard Circuit Board	519-0504	1
----	Motherboard Shield	519-0510-002	1
----	Motherboard RF Input Circuit Board Assembly, FM-20S	919-0506	1



**TABLE 6-51. MOTHERBOARD RF INPUT CIRCUIT BOARD ASSEMBLY - 919-0506**

REF. DES.	DESCRIPTION	PART NO.	QTY.
C119	Capacitor, Ceramic Chip, 47 pF $\pm 5\%$ , 500 V	009-4713	1
C120	Capacitor, Ceramic, Trimmer, 5.5-18 pF, 350 V, NPO	096-0011	1
----	Blank Motherboard RF Input Circuit Board Assembly	519-0506	1

**TABLE 6-52. MOTHERBOARD DC CONNECTOR CIRCUIT BOARD - 919-0510-001**

REF. DES.	DESCRIPTION	PART NO.	QTY.
C201 thru C204	Capacitor, Ceramic, 0.1 uF $\pm 10\%$ , 50 V	003-1066	4
J201	Connector, D-Type, 9-Pin, Filtered, Right Angle, PCB Mount	417-1093	1
J202	Receptacle, Male, 20-Pin In-Line	417-0200	1
----	Blank Motherboard DC Connector Circuit Board	519-0510-001	1

**TABLE 6-53. POWER SUPPLY DISTRIBUTION CIRCUIT BOARD ASSEMBLY - 919-0511**

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1	Capacitor, Monolythic Ceramic, 0.1 uF $+20\%$ , 50 V	003-1054	1
J1 thru J5	Receptacle, D-Type, 25-Pin, Female	417-2502	5
J6	Socket, 4-Pin	418-0255	1
J7 thru J9	Connector, 2-Pin	417-0700	3
J10	Receptacle, D-Type, 25-Pin, Female	417-2502	1
J11	Receptacle, 12-Pin	417-1276	1
J12,J13	Receptacle, D-Type, 9-Pin, Female	417-0903	2
R1 thru R5	Resistor, 10 Ohm $\pm 1\%$ , 1/4 W	103-1021	5
R8	Resistor, 18.2 k Ohm $\pm 1\%$ , 1/4 W	103-1825	1
R9	Resistor, 17.8 k Ohm $\pm 1\%$ , 1/4 W	103-1785	1
R10	Resistor, 1 k Ohm $\pm 1\%$ , 1/4 W	100-1041	1
R11,R12	Resistor, 25 Ohm $\pm 5\%$ , 5 W, W/W	132-2523	2
----	Blank Power Supply Distribution Circuit Board	519-0511	1

**TABLE 6-54. MODULE CONTROL CIRCUIT BOARD ASSEMBLY - 919-0515 (Sheet 1 of 3)**

REF. DES.	DESCRIPTION	PART NO.	QTY.
C14,C15,C16,C17	Capacitor, Lytic, 10 uF, 50 V 20% SMD	006-1075	4
C1 thru C13, C18 thru C43, C45 thru C143, C145 thru C159, C162 thru C176, C200 thru C203, C214 thru C217	Capacitor, Ceramic, 0.1 uF 10%, 50 V SMD	007-1044	175
C204 thru C211	Capacitor, .01 uF	007-1034	8
C212, C213	Capacitor, 10 uF	006-1075	2

**TABLE 6-54. MODULE CONTROL CIRCUIT BOARD ASSEMBLY - 919-0515 (Sheet 2 of 3)**

REF. DES.	DESCRIPTION	PART NO.	QTY.
R2	Res. Chip, 100 ohms, 1/10 W, 1%, SMD	102-1000	1
R11,R111,R50 thru R57, R148 thru R155, R76 thru R79, R176 thru R179, R13, R15, R17, R19, R21, R23, R25, R27, R115, R117, R119, R121, R123, R125, R127	Res. Chip, 1.0K ohms, 1/10 W, 1%, SMD	102-1001	42
R3,R5,57,R9,R10, R28 thru R36, R103,R105,R107,R109,R110, R128 thru R136, R37,R39,R40,R41, R137,R138,R139, R68 thru R75, R160 thru R175, R103, R105, R107, R109, R110, R37, R39, R40, R41, R60 thru R67	Res. Chip, 10.0K ohms, 1/10 W, 1%, SMD	102-1002	67
R1,R12,R14,R16,R18,R20,R22,R24 R26,R112,R114,R116,R118,R120,	Res. Chip, 100K ohms, 1/10 W, 1%, SMD	102-1003	18
R42 thru R49, R140 thru R147 R58,R158	Res. Chip, 150K ohms, 1/10 W, 1%, SMD	102-1500	16
	Res. Chip, 2.0K ohms, 1/10 W, 1%, SMD	102-2001	2
	Res. Chip, 20.0K ohms, 1/10 W, 1%, SMD	102-2002	4
R11,R111,R50 thru R57, R4,R104	Res. Chip, 1.0K ohms, 1/10 W, 1%, SMD	102-1001	18
	Res. Chip, 22.1K ohms, 1/10 W, 1%, SMD	102-2212	2
D1,D2	Diode, switching, MMBD914LT1, SMD	204-0914	2
Q1,Q2,Q3,Q101,Q102	TSTR, 3906, SMD	210-3906-001	5
U11	IC, 74HC14, Schmitt Trig Invert	224-0014	1
U10	IC, Dual D-Flip-Flop, Pos Edge, SMD	224-0074	1
U18,U118	IC, 74HC244, Octal/Line Drivers, SMD	224-0244	2
U14,U15,U114,U115	IC, Analog Switch	224-0351	4
U16,U17,U116,U117, U19, U119	IC, OP AMP, Quad, Rail-To-Rail, SMD	224-1491	4
U3,U103	IC, 74HC373, 8-Latch, SMD	224-7473	2
U9,U109	IC, A/D and MUX, SMD	229-0158	2
U6,U106	IC, 32K x 8 RAM, SMD	229-0256-001	2
U12,U13,U112,U113	IC, ULN2003A MC1413P	229-2003	4
U2,U102	IC, Microprocessor, High PRFM, 8032, PLCC Pkg	229-8032-001	2
U8,U108	IC, 82C55A, Periph I/F, PLCC	229-8255-001	2
U20	IC, LM79L05AC, Negative Voltage Reulator, SMD	231-7905	1
U7,U107	EC, Flash Memory, 64K x 8, PLCC	229-8512	2
DS1 thru DS9, DS101, DS109 thru DS116	LED, Dual Red/Green, Low Profile, SMD	325-0250	18
U1	Osc. Crystal, 11.0592 MHz, SMD	390-0055	1
TP1 thru TP15, TP101 thru TP109	Chip, Test Point, 1206, SMD	413-1206	24
J5,J105	Connector, Header, 26-Pin	417-2600	2
XU5,XU105	Socket, 28-Pin IC, SMD	417-2804-001	2
J8	Connector, Header, 2-Pin	417-4004	1
J3,J4,J103,J104	Connector, 9-Pin D, Female, Filtered	417-8809	4
J1,J2,J101,J102	Connector, 25-Pin D, Female, Filtered	417-8825	4
J6	Connector, Male, 4-Pin	418-0255	1
J7	Connector, 25-Pin D, Male, Filtered	418-8825	1
XU12,XU13,XU112,XU113	Socket, 16-Pin, DIP, SMD	431-1600	4
XU4,XU104	Socket, 20-Pin, DIP, SMD	431-2000	2

**TABLE 6-54. MODULE CONTROL CIRCUIT BOARD ASSEMBLY - 919-0515 (Sheet 2 of 3)**

REF. DES.	DESCRIPTION	PART NO.	QTY.
XU7,XU107	Socket, 32-Pin, PLCC, SMD	431-3200	2
XU2,XU8,XU102,XU108	Socket, 44-Pin, PLCC, SMD	431-4400	4
U4,U104	Kit, Software, FM-20S Mod Control PAL U4	979-0515-004	2
U5,U105	Kit, Software, FM-20S Mod Control ROM U5	979-0515-005	2
	Blank Module Control Circuit Board, FM-20S	519-0515	1

**TABLE 6-55. TEMPERATURE SENSOR CIRCUIT BOARD ASSEMBLY - 919-0516-001**

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1	Capacitor, Monolythic Ceramic, 0.1 uF $\pm 20\%$ , 50 V	003-1054	1
C2	Capacitor, Mica, 390 pF $\pm 5\%$ , 100 V	042-3922	1
C3	Capacitor, Mica, 47 pF $\pm 5\%$ , 500 V	040-4713	1
C4	Capacitor, Monolythic Ceramic, 0.1 uF $\pm 20\%$ , 50 V	003-1054	1
C5	Capacitor, Mica, 47 pF $\pm 5\%$ , 500 V	040-4713	1
C6,C7	Capacitor, Monolythic Ceramic, 0.1 uF $\pm 20\%$ , 50 V	003-1054	2
C8	Capacitor, Mica, 390 pF $\pm 5\%$ , 100 V	042-3922	1
J1	Socket, 4-Pin	418-0255	1
R1, R3	Resistor, 10 Ohm $\pm 1\%$ , 1/4 W	103-1021	2
R4	Resistor, 4.02 k Ohm $\pm 1\%$ , 1/4 W	103-4024	1
R5	Resistor, 1 k Ohm $\pm 1\%$ , 1/4 W	100-1041	1
R6	Resistor, 10 k Ohm $\pm 1\%$ , 1/4 W	100-1051	1
U1	Integrated Circuit, TLC072, High Output Drive Operational Amplifier, Single Supply, 8-Pin DIP	220-0072	1
U2	Integrated Circuit, LM35DZ, Celsius Temperature Sensor, TO-92 Case	220-0035	1
----	Blank Exhaust Air Temperature Sensor Circuit Board	519-0516-001	1

**TABLE 6-56. HEATSINK TEMPERATURE SENSOR CIRCUIT BOARD - 919-0516-002**

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1	Capacitor, Monolythic Ceramic, 0.1 uF $\pm 20\%$ , 50 V	003-1054	1
C2	Capacitor, Mica, 390 pF $\pm 5\%$ , 100 V	042-3922	1
C3	Capacitor, Mica, 47 pF $\pm 5\%$ , 500 V	040-4713	1
C4	Capacitor, Monolythic Ceramic, 0.1 uF $\pm 20\%$ , 50 V	003-1054	1
C5	Capacitor, Mica, 47 pF $\pm 5\%$ , 500 V	040-4713	1
C6,C7	Capacitor, Monolythic Ceramic, 0.1 uF $\pm 20\%$ , 50 V	003-1054	2
C8	Capacitor, Mica, 390 pF $\pm 5\%$ , 100 V	042-3922	1
J1	Socket, 4-Pin	418-0255	1
R1, R3	Resistor, 10 Ohm $\pm 1\%$ , 1/4 W	103-1021	2
R4	Resistor, 4.02 k Ohm $\pm 1\%$ , 1/4 W	103-4024	1
R5	Resistor, 1 k Ohm $\pm 1\%$ , 1/4 W	100-1041	1
R6	Resistor, 10 k Ohm $\pm 1\%$ , 1/4 W	100-1051	1
U1	Integrated Circuit, TLC072, High Output Drive Operational Amplifier, Single Supply, 8-Pin DIP	220-0072	1
U2	Integrated Circuit, LM35DZ, Celsius Temperature Sensor,	220-0035	1

**TABLE 6-57. HEATSINK TEMPERATURE SENSOR CIRCUIT BOARD - 919-0516-002**

REF. DES.	DESCRIPTION	PART NO.	QTY.
———	TO-92 Case Blank Heatsink Temperature Sensor Circuit Board	519-0516-001	1

**TABLE 6-58. DC FILTER CIRCUIT BOARD ASSEMBLY - 919-0519-001**

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1 thru C3	Capacitor, Ceramic, 1000 pF $\pm 5\%$ , 100 V	009-1032	3
-----	Blank DC Filter Circuit Board	519-0519-001	1

**TABLE 6-59. PCB, AC LINE FAULT INDICATOR ASSEMBLY - 919-0524**

REF. DES.	DESCRIPTION	PART NO.	QTY.
DS1, DS2, DS3	Indicator, LED, RED 521-9240	323-9217	3
XDS1, XDS2	SPR, LED, .25 ODX .147 1D X .22 L	407-0074	3
XDS3			
J1	Connector, PCB MT, 6-Pin Male	417-0677	1
	Blank, PCB, AC Line Fault Indicator	519-0524	1

**TABLE 6-60. SUPERVISOR CIRCUIT BOARD ASSEMBLY - 919-0531 (Sheet 1 of 3)**

REF. DES.	DESCRIPTION	PART NO.	QTY.
C114,C115	Cap, Lytic, 10uF, 50V, 20%, SMD	006-1075	2
C19,C20,C21,C22,C23,C24,C25	Cap, Cer, 100pF, 50V, 2%, SMD	007-1022	34
C26,C85,C86,C87,C88,C89,C90			
C91,C92,C96,C97,C98,C99,C100			
C101,C102,C103			
C1,C2,C3,C4,C5,C6,C7,C10,C11	Cap, Cer, 0.1uF, 50V, 10%, SMD	007-1044	48
C12,C13,C14,C15,C16,C17,C18			
C27,C28,C45,C46,C47,C52,C53			
C54,C55,C56,C57			
C8,C9,C29,C30,C31,C32,C33,C34	Cap, Cer, 1uF, 50V, 10%, SMD	007-1054	46
C35,C36,C37,C38,C39,C40,C41			
C42,C43			
C49,C50,C51,C110	Cap, Cer, 390pF, 100V, 5%, SMD	007-3923	4
D1	IC, Volt Ref, 2.5V, 8-Pin SOIC	231-0136	1
D2,D3,D4	Diode, Switching, MMBD914LT1, SMD	204-0914	3
J1	Receptacle, 40-Pos, 2-Row, S.S. PH SC	417-4042	1
J2,J8	Header, 50-Pin, .100 centers, SMD	408-0050	2
J3,J4,J5,J6	Connector, Header, 26-Pin	417-2600	4

**TABLE 6-60. SUPERVISOR CIRCUIT BOARD ASSEMBLY - 919-0531 (Sheet 2 of 3)**

REF. DES.	DESCRIPTION	PART NO.	QTY.
J9,J10,J15,J16,J17,J18,J19	Header, 3-Pin, .100 centers, SIP	408-0300	7
J7	Connector, Header, 60-Pin, SMD	408-6000	1
J11,J12,J13,J14,J15	Connector, Header, 20-Pin	417-0200	1
P9,P10,P11,P15,P16,P17,P18,P19	SW, Jumper Programmable	340-0004	8
Q1,Q2,Q3,Q4,Q5,Q6,Q7,Q8,Q9	IC, MOSFET, 2N7002LT1, SMD	216-7002	9
R58,R153,R154,R207,R208,R209	Res, Chip, 100Ohms, 1/10W, 1%, SMD	102-1000	7
R210			
R6,R7,R16,R17,R18,R19,R104	Res, Chip, 1.00K Ohms, 1/10W, 1%, SMD	102-1001	16
R105,R106,R107,R108,R109,R110			
R111,R224,R231			
R1,R2,R3,R4,R5,R12,R13,R14,R15	Res, Chip, 10.0K Ohms, 1/10W, 1%, SMD	102-1002	97
R20,R23,R28,R29,R30,R31,R32			
R33,R34,R37,R40,R43,R46,R52			
R55,R63 THRU R90, R96, R97,			
R100, R102, R103, R112 THRU			
R119, R156, R157, R158, R166,			
R167, R172 THRU R189, R213,			
R214, R217, R223, R225, R226,			
R227, R228			
R8,R91	Res, Chip, 100K Ohms, 1/10W, 1%, SMD	102-1003	2
R25,R26,R94,R95,R168,R169	Res, Chip, 1.33K Ohms, 1/10W, 1%, SMD	102-1331	6
R9,R21,R35,R38,R41,R44,R47	Res, Chip, 2.0K Ohms, 1/10W, 1%, SMD	102-2001	37
R50,R53,R56,R129,R130,R131			
R132,R133,R134,R135,R136,R137			
R138,R139,R140			
R205,R211,R212,R230	Res, Chip, 20.0K Ohms, 1/10W, 1%, SMD	102-2002	4
R60,R61,R62,R163	Res, Chip, 2.43K Ohms, 1/10W, 1%, SMD	102-2431	4
R36,R39,R42,R45,R48,R51,R54	Res, Chip, 3.3M Ohms, 1/10W, 10%, SMD	102-3304	34
R57,R120,R121,R122,R123,R124			
R125,R126,R127,R141,R142,R143			
R144,R145			
R92,R93,R160,R161,R164,R165	Res, Chip, 33.2K Ohms, 1/10W, 10%, SMD	102-3322	6
R128	Res, Chip, 4.42K Ohms, 1/10W, 10%, SMD	102-4421	1
R11,R22,R98,R99,R101,R170	Res, 4.99K Ohms, 1/10W, 1%	102-5041	9
R171,R203,R204			
R229	Res, Chip, 6.34K Ohms, 1/10W, 10%, SMD	102-6341	1
S1	SW,Tact, SPST, N.O., SMD, Recessed	342-3304	1
U1	IC, Analog Switch	224-0351	1
U2	Kit, Software, FM-20S Supervisor U2 (SBCM)	979-0526-002	1
U3	Kit, Software, FM-20S Supervisor U3	979-0518-003	1
U4	Kit, Software, FM-20S Supervisor U4	979-0518-004	1
U5	Kit, Software, FM-20S Supervisor U5	979-0518-005	1
U14,U15,U27,U31,U32	IC, TL074CD, Quad OP Amp, SMD	216-0074	5
U17	Kit, Software, FM-20S Supervisor U17	979-0523-017	1
U18	OSC, Crystal, 1.8432 MHz, SMD	390-0054	1

**TABLE 6-60. SUPERVISOR CIRCUIT BOARD ASSEMBLY - 919-0531 (Sheet 3 of 3)**

REF. DES.	DESCRIPTION	PART NO.	QTY.
U19	IC, Dual Uart, Fifo, Printer Port, SMD	224-0552	1
U20,U21,U22	IC, RS-232 Multi-Transceiver, +5V, SMD	224-2410	3
U33,U34,U47	IC, Quad D/A, 8-Bit, TLC7225CDW	224-7225	3
U8,U24,U25,U26	IC, D/A Converter, 12-Bit, PLCC	224-7548	4
U10A,U10B,U11A,U11B,U12A U12B,U13A,U13B,U16A,U16B U40A,U40B,U41A,U41B,U42A U42B,U43A,U43B,U44A,U44B	IC, Options, 4N33	229-0033	25
U35A,U35B,U36A,U36B,U37A U37B,U38A,U38B,U48B	IC, AC Input Opto-Isolator	229-0111	9
U28,U29,U30	IC, A/D and MUX, SMD	229-0158	3
U6,U7,U9,U39	IC, 82D55A,Periph I/F, PLCC	229-8255-001	4
U46	VR, LM79L05AC, Neg Volt, 100mA, SMD	231-7905	1
XU2,XU3,XU4,XU5,XU17	Socket, 28-Pin, PLCC, SMD	431-2800	5
XU19	Socket, 68-Pin, PLCC, SMD	431-6800	1
----	PCB, Mach, Supervisor, FM-20S	519-0526	1
----	Socket, 14-Pin, DIP, SMD	431-1400	15
----	Holder, Battery for CR-2032, SMD	415-2032	1
----	Cell, Battery, 3V, 190MAH, Lithium	350-2032	1

**TABLE 6-61. INPUT/OUTPUT CIRCUIT BOARD ASSEMBLY - 919-0527**

REF. DES.	DESCRIPTION	PART NO.	QTY.
C9 THRU C16	Cap, Mylar, 0.0022 uF, 100V, 10%	031-2033	8
D1 THRU D6	Zener, +-7.5V	201-0007	6
D7 THRU D44	Zener, +-7.5V	201-0015	38
FL1 THRU FL71	Filter, EMI, 10000 pF 3 Pin	411-0001	71
J1,J2	Connector, 9-Pin	417-0902	2
J3	Connector, 25-Pin D	417-2502	1
J4, J5	Connector, 37-Pin, D, Male	417-3704	2
J6	Socket, 20-Pin,	417-2010	1
J7	Header, 60-Pin	417-5018	1
J8	Header, 50-Pin	417-5017	1
J9	Connector, 15-Pin D	417-1513	1
R12 thru R21	Res, 100 Ohm, 1/4W, 1%,	100-1031	10
R22 thru R26	Res, 10 Ohm, 1/4W, 1%,	103-1021	5
	Blank, PCB, Remote Interface, FM-20S	519-0527	1

**TABLE 6-62. REMOTE INTERFACE CIRCUIT BOARD ASSEMBLY - 919-0528**

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1	Cap, Cer, Mnly, 0.1uF, 50V, 20%	003-1054	1
TB2	Barrier Strip, 16-Position, BEAU	412-1600	1
TB1	Barrier Strip, 30-Position, BEAU61-5-30-50	412-3000	1
J3	Connector, PCB Mt, 6-Pin Male	417-0677	1
J1,J2	Connector, 9-Pin 640501-5 Amp	418-0900	2
J4	Connector, 37-Pin, D, Male, FER Filter	418-3704-FER	1
J5	Connector, 25-Pin, D, Male, Filtered	418-8825	1
	Blank, PCB, Remote Interface, FM-20S	519-0528	1

**TABLE 6-63. DIRECTIONAL COUPLER CIRCUIT BOARD ASSEMBLY - 919-0529**

REF. DES.	DESCRIPTION	PART NO.	QTY.
C8,C16,C23,C28,C31	Cap, Mylar Film, .0022uF, 100V, 10%	031-2033	5
C1	Cap, Mica, 1000pF, 100V, 1%	041-1031	1
C2,C3,C4,C5,C6,C7,C10,C12,C15	Cap, Mica, 390pF, 100V, 5%	042-3922	21
C17,C18,C19,C20,C21,C22,C24			
C25,C26,C27,C29,C30			
R6,R7,R10,R11,R15,R19,R22,R23	Res, 10K Ohm, 1/4W, 1%	100-1051	14
R26,R27,R30,R31,R34,R35			
R2	Res, 162K Ohm, 1/4W, 1%, Metal	103-1626	1
R8,R9,R17,R24,R25,R32,R33	Res, 475Ohm, 1/4W, 1%, Metal	103-4753	7
R1,R3	Res, 499K Ohm, 1/4W, 1%, Metal	103-4996	2
R4,R5,R13,R20,R21,R28,R29	Res, 56 Ohm, 2W, 5%	130-5621	7
D43,D44,D45,D46,D47,D50,D51	Diode, Hot Carrier HP2800	201-2800	15
D52,D53,D54,D55,D56,D57,D58,D59			
L1,L2,L3,L4,L5,L6,L10,L11,L12	Choke, RF, 430MA Res, Freq 115 MHz	360-0022	21
L13,L14,L15,L16,L17,L18,L19			
L20,L21,L22,L23,L24			
J9,J10,J12,J13,J14,J15,J16	Connector, BNC, PCB Mount	417-0259	7
J1	Socket, Strip, 20-Position, Single Row	417-2010	1
	Blank, PCB, Directional Coupler, FM-20S	519-0529	1

**TABLE 6-64. FRONT PANEL CIRCUIT BOARD ASSEMBLY - 919-0530 (Sheet 1 of 2)**

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1,C2,C4,C5,C6,C7,C10,C11,C12 C13,C14,C15	Cap, Cer, 0.1uF, 50V, 10%, SMD	007-1044	12
C3	Cap, Tant, 10uF, 35V, 20%, SMD	070-1064	1
R1,R2,R3,R4,R5,R6,R7	Res, 150 Ohm, 1/4W, 1%	100-1531	7
R8,R9	Res, Chip, 1.0K Ohm, 1/10W, 1%, SMD	102-1001	2
R23,R24,R25,R26,R27	Res, Chip, 10.0K Ohm, 1/10W, 1%, SMD	102-1002	5
R10,R12,R14,R15,R16,R17,R18 R19,R21,R22,R30	Res, 10 Ohm, 1/4W, 1% Metal	103-1021	11
R29	Res, Metal Film, 12.1 Ohm, 1/4W, 1%	103-1212	1
R11,R13,R20	Res, 17.8Ohm, 1/4W, 1% Metal	103-1782	3
R28	Res, Trimmer, 10K 10 Turn	179-1053	1
D1,2,D3,D4,D5,D6,D7,D8,D9	Transzorb, 15V, SMD	204-0015	9
U5	IC, Driver, ULN2003A, SMD	224-2003	1
U4	IC, CD4070 Quad XOR, CMOS, SMD	224-4070	1
U3	IC, 4-Digit LCD Driver, ICM7211	224-7211	1
U2	IC, ISPGAL22V10C-7LJ, PLCC	229-2210-001	1
U1	IC, 82C55A, Periph I/F, PLCC	229-8255-001	1
DS1	Disp, LCD, 4-Digit, o.7	320-0021	1
DS2,DS3,DS4,DS5,DS6	LED, Red, Diffused Chimney	320-0037	5
DS7,DS8	LED, Green, Diffused Chimney	320-0322	2
P4,P5	SW, Jumper Programmable	340-0004	2
S1	SW, PB, MOM, LED, Illuminated, Yellow	340-0140	1
S2,S4,S11	SW, PB, MOM, LED, Illuminated, Green	340-0143	3
S3,S5,S6,S7,S8,S9,S10,S12,S13 S16	SW, PB, MOM, LED, Illuminated, Red	340-0139	10
S14,S15	Switch, Encoder, Rotary, Grayhill	340-2522	2
TP1	Chip, Test Point, 1206, SMD	413-1206	1
J1,J2,J5	Connector, Header, 3-Pin	417-0003	3
J12	Header, 10-Pin	417-0179	1
J4,J10	Connector, Header, 20-Pin	417-0200	1
J11	Connector, Header, 50-Pin Male	417-0227	1
J3	Header, 8-Pin, 100" Right-Angle Locking	417-2837	1
	Blank, PCB, Front Panel, FM-20S	519-0530	1



**TABLE 6-65. STANDBY EXCITER/IPA COAX SWITCH ASSEMBLY - 340-0201-001**

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Cap, Cer, Mnly, 0.1uF, 50V, 10%	003-1066	1
----	Diode, 1N4005	203-4005	1
----	SW, Coax Spdt, Type N, 28V Relay	340-0201	1
----	Pin Connector, 4P, 1-640509-Amp	418-0036	3
----	Hsng Connector, 4P, 1-640509-Amp	418-0233	1

**TABLE 6-66. STANDBY EXCITER OPTION - 969-1011**

REF. DES.	DESCRIPTION	PART NO.	QTY.
969-1011	Assy, Coax SW, Standby Exciter/IPA Option	340-0201-001	1
969-1011	FX-50 Exciter, 220 VAC	909-1051-325	1
969-1011	Cable Assy, Standby Exciter Option, FX-50, FM-20S	949-0428-001	1

**TABLE 6-67. FM-20S/FMi 1405 ACCESSORY PARTS KIT - 969-1020**

REF. DES.	DESCRIPTION	PART NO.	QTY.
F1,F2	Fuse, MDA 10A, 250V, SLO-BLO	330-1000	2
	Fuse, 20A, 250V	330-2000	8
	Transmission Line, Bypass, FM-20S	463-5207	1
	Air Dam, Medium, SUMO	471-5263	4

**TABLE 6-68. STANDBY IPA OPTION - 969-1022**

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Assy, Coax SW, Standby Exciter/IPA Option	340-0201-001	4
----	Adapt, Plug-Jack Angle N UG27CU	417-0105	2
----	Assy, Cable, Standby IPA FM-20S	949-0428-022	1
----	Assy, RF Amp Module, FM-20S	959-0509	2

**TABLE 6-69. KIT, SOFTWARE, FM-20S MODULE CONTROL PAL U4 - 979-0515-004**

REF. DES.	DESCRIPTION	PART NO.	QTY.
U4, U104	Integrated Circuit, PLD, 64 X 32 AND-ARRAY, GAL16V8D-7LP	220-0050	2

**TABLE 6-70. KIT, SOFTWARE, FM-20S MODULE CONTROL ROM U5 - 979-0515-005**

REF. DES.	DESCRIPTION	PART NO.	QTY.
U5, U105	Integrated Circuit, AM27C256-155, 32K X 8 EPROM, CMOS, 28-Pin	229-7256	2

**TABLE 6-71. KIT, SOFTWARE, FM-20S SUPERVISOR U3 - 979-0518-003**

REF. DES.	DESCRIPTION	PART NO.	QTY.
U3	Integrated Circuit, PAL, GAL22V10-7LJ, 28-Pin PLCC, SMD	229-2210-2	1

**TABLE 6-72. KIT, SOFTWARE, FM-20S SUPERVISOR U4 - 979-0518-004**

REF. DES.	DESCRIPTION	PART NO.	QTY.
U4	Integrated Circuit, PAL, GAL22V10-7LJ, 28-Pin PLCC, SMD	229-2210-2	1

**TABLE 6-73. KIT, SOFTWARE, FM-20S SUPERVISOR U5 - 979-0518-005**

REF. DES.	DESCRIPTION	PART NO.	QTY.
U5	Integrated Circuit, PAL, GAL22V10-7LJ, 28-Pin PLCC, SMD	229-2210-2	1

**TABLE 6-74. SOFTWARE KIT, SUPERVISOR CPU - 979-0526**

REF. DES.	DESCRIPTION	PART NO.	QTY.
979-0526	PCB Assy, Smartcore with Flash	544-7220	1

**TABLE 6-75. SOFTWARE KIT, SUPERVISOR U17- 979-0523-017**

REF. DES.	DESCRIPTION	PART NO.	QTY.
U17	IC, Pal Erasable 22V10-7LJ	229-2210-2	1

**TABLE 6-76. SOFTWARE KIT, SUPERVISOR U2- 979-0526-002**

REF. DES.	DESCRIPTION	PART NO.	QTY.
U2	IC, Pal Erasable 22V10-7LJ	229-2210-2	1

# SECTION VII

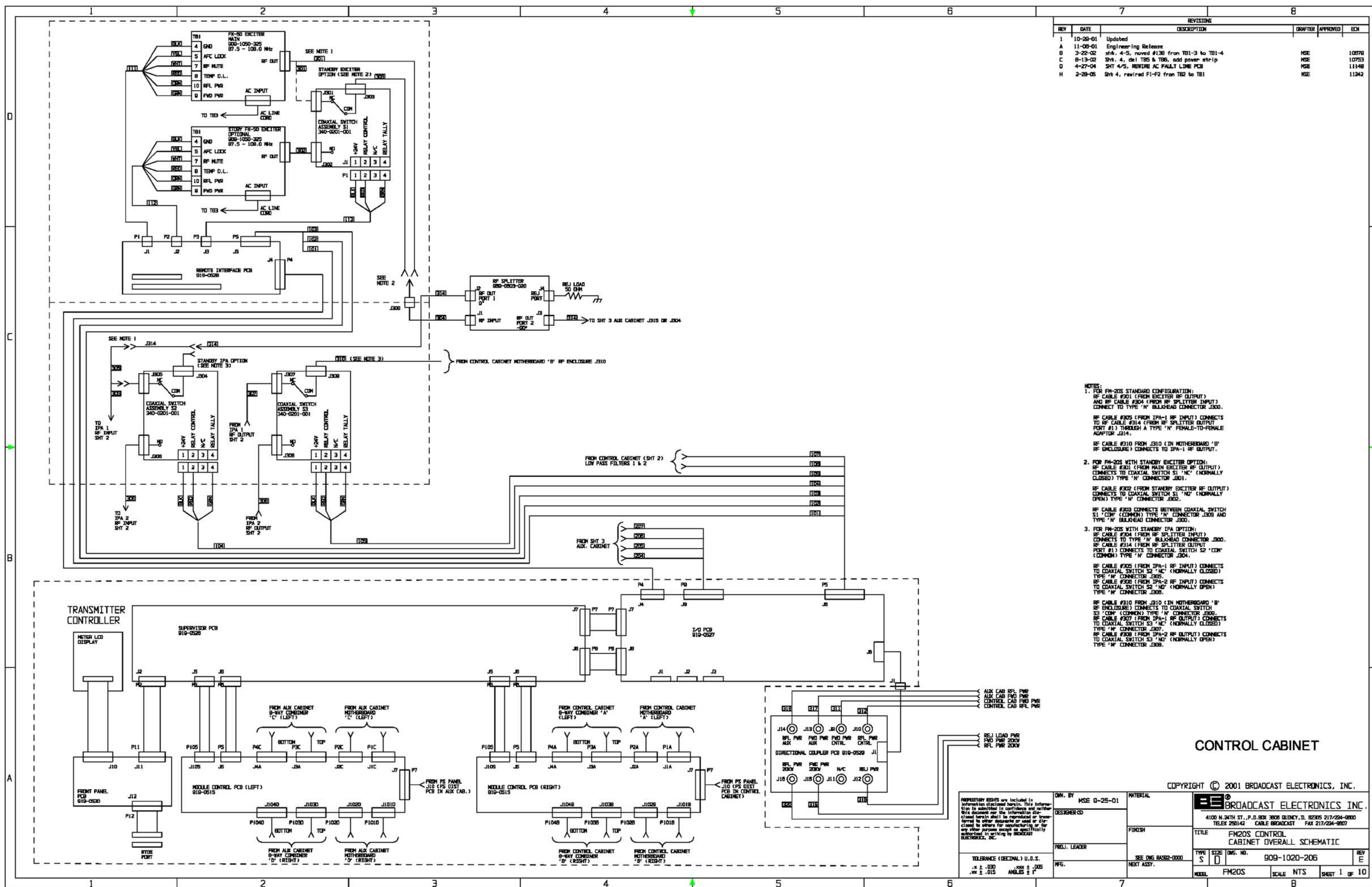
## DRAWINGS

### 7-1. INTRODUCTION.

7-2. This section provides schematic and assembly diagrams as indexed below for the Broadcast Electronics FM-20S transmitter.

FIGURE	TITLE	NUMBER
7-1	OVERALL SCHEMATIC DIAGRAM, FM-20S TRANSMITTER 220V 50/60 HZ THREE PHASE OPERATION	SD909-1020-206
7-2	OVERALL SCHEMATIC DIAGRAM, FM-20S TRANSMITTER 380V 50/60 HZ THREE PHASE WYE OPERATION	SD909-1020-386
7-3	OVERALL SCHEMATIC DIAGRAM, FMi 1405 TRANSMITTER 220V 50/60 HZ THREE PHASE OPERATION	SD909-1405-206
7-4	OVERALL SCHEMATIC DIAGRAM, FMi 1405 TRANSMITTER 380v 50/60 HZ THREE PHASE WYE OPERATION	SD909-1405-386
7-5	ASSEMBLY DIAGRAM, DC FILTER CIRCUIT BOARD	AB919-0519/-001
7-6	SCHEMATIC DIAGRAM, COMBINER INPUT CIRCUIT BOARD	SB919-0502
7-7	ASSEMBLY DIAGRAM, COMBINER INPUT CIRCUIT BOARD	AC919-0502-001/ -002
7-8	SCHEMATIC DIAGRAM, MOTHERBOARD AND IPA SPLITTER	SB919-0504
7-9	ASSEMBLY DIAGRAM, MOTHERBOARD AND IPA SPLITTER	AD919-0504
7-10	ASSEMBLY DIAGRAM, MOTHERBOARD RF INPUT	AB919-0506
7-11	SCHEMATIC DIAGRAM, MOTHERBOARD DC CONNECTOR	SB919-0510-001
7-12	ASSEMBLY DIAGRAM, MOTHERBOARD DC CONNECTOR	AB919-0510-001
7-13	SCHEMATIC DIAGRAM, POWER SUPPLY DISTRIBUTION CIRCUIT BOARD	SB919-0511
7-14	ASSEMBLY DIAGRAM, POWER SUPPLY DISTRIBUTION CIRCUIT BOARD	AC919-0511
7-15	SCHEMATIC DIAGRAM, MODULE CONTROL CIRCUIT BOARD	SB919-0515
7-16	ASSEMBLY DIAGRAM, MODULE CONTROL CIRCUIT BOARD	AC919-0515
7-17	SCHEMATIC DIAGRAM, TEMPERATURE SENSOR CIRCUIT BOARD	SB919-0516/-001 -002
7-18	ASSEMBLY DIAGRAM, TEMPERATURE SENSOR CIRCUIT BOARD	AC919-0516/-001 -002
7-19	SCHEMATIC DIAGRAM, FRONT PANEL CIRCUIT BOARD	SB919-0530
7-20	ASSEMBLY DIAGRAM, FRONT PANEL CIRCUIT BOARD	AC919-0530
7-21	SCHEMATIC DIAGRAM, SUPERVISOR CIRCUIT BOARD	SB919-0531
7-22	ASSEMBLY DIAGRAM, SUPERVISOR CIRCUIT BOARD	AC919-0531
7-23	SCHEMATIC DIAGRAM, REMOTE INTERFACE CIRCUIT BOARD	SB919-0528

<b>FIGURE</b>	<b>TITLE</b>	<b>NUMBER</b>
7-24	ASSEMBLY DIAGRAM, REMOTE INTERFACE CIRCUIT BOARD	AC919-0528
7-25	SCHEMATIC DIAGRAM, RF AMPLIFIER CIRCUIT BOARD	SC919-0505/-012
7-26	ASSEMBLY DIAGRAM, RF AMPLIFIER CIRCUIT BOARD	AB919-0505/-012
7-27	SCHEMATIC DIAGRAM, RF AMPLIFIER COMBINER CIRCUIT BOARD	SB919-0508
7-28	ASSEMBLY DIAGRAM, RF AMPLIFIER COMBINER CIRCUIT BOARD	AC919-0508
7-29	SCHEMATIC DIAGRAM, RF AMPLIFIER INTERFACE CIRCUIT BOARD	SB919-0514-012
7-30	ASSEMBLY DIAGRAM, RF AMPLIFIER INTERFACE CIRCUIT BOARD	AC919-0514-012
7-31	SCHEMATIC DIAGRAM, I/O CIRCUIT BOARD	SB919-0527/-100
7-32	ASSEMBLY DIAGRAM, I/O CIRCUIT BOARD	AC919-0527/-100
7-33	SCHEMATIC DIAGRAM, DIRECTIONAL COUPLER CIRCUIT BOARD	SB919-0529
7-34	ASSEMBLY DIAGRAM, DIRECTIONAL COUPLER CIRCUIT BOARD	AB919-0529/-001
7-35	ASSEMBLY DIAGRAM, RF AMPLIFIER	AB959-0505-001/ -002
7-36	SCHEMATIC DIAGRAM, LOW-PASS FILTER	SB959-0414/-001/ -002
7-37	ASSEMBLY DIAGRAM, LOW-PASS FILTER CIRCUIT BOARD	AC919-0421/-001/ -002
7-38	SCHEMATIC DIAGRAM, OPTICALLY-COUPLED-RELAY (OCR) CIRCUIT BOARD	SB919-0096/-001
7-39	ASSEMBLY DIAGRAM, OPTICALLY-COUPLED-RELAY (OCR) CIRCUIT BOARD	AB919-0096/-001
7-40	SCHEMATIC DIAGRAM, AC LINE FAULT INDICATOR CIRCUIT BOARD	SA919-0524/-100
7-41	ASSEMBLY DIAGRAM, AC LINE FAULT INDICATOR CIRCUIT BOARD	AA919-0524/-100



REVISIONS				
REV	DATE	DESCRIPTION	DRAFTER	APPROVED
1	10-20-01	Updated		
A	11-09-01	Engineering Release		
B	3-22-02	shv. 4-5, moved #136 from TB1-3 to TB1-4	KSE	10578
C	8-13-02	shv. 4, del TB5 & TB6, add power strip	KSE	10753
D	4-27-04	shv 4-5, REWIRE AC FAULT LINE PCB	KSE	11148
H	2-29-05	shv 4, rewired FI-F2 from TB2 to TB1	KSE	11242

- NOTES:
- FOR FM-20S STANDARD CONFIGURATION:  
RF CABLE #301 (FROM EXCITER RF OUTPUT) AND RF CABLE #304 (FROM RF SPLITTER INPUT) CONNECT TO TYPE 'N' BULKHEAD CONNECTOR J300.  
RF CABLE #305 (FROM IPA-1 RF INPUT) CONNECTS TO RF CABLE #314 (FROM RF SPLITTER OUTPUT PORT #1) THROUGH A TYPE 'N' FEMALE-TO-FEMALE ADAPTOR J314.  
RF CABLE #310 FROM J310 (IN MOTHERBOARD 'B' RF ENCLOSURE) CONNECTS TO IPA-1 RF OUTPUT.
  - FOR FM-20S WITH STANDBY EXCITER OPTION:  
RF CABLE #301 (FROM MAIN EXCITER RF OUTPUT) CONNECTS TO COAXIAL SWITCH S1 'NC' (NORMALLY CLOSED) TYPE 'N' CONNECTOR J301.  
RF CABLE #302 (FROM STANDBY EXCITER RF OUTPUT) CONNECTS TO COAXIAL SWITCH S1 'NO' (NORMALLY OPEN) TYPE 'N' CONNECTOR J302.  
RF CABLE #303 CONNECTS BETWEEN COAXIAL SWITCH S1 'COM' (COMMON) TYPE 'N' CONNECTOR J303 AND TYPE 'N' BULKHEAD CONNECTOR J300.  
3. FOR FM-20S WITH STANDBY IPA OPTION:  
RF CABLE #304 (FROM RF SPLITTER INPUT) CONNECTS TO TYPE 'N' BULKHEAD CONNECTOR J300.  
RF CABLE #314 (FROM RF SPLITTER OUTPUT PORT #1) CONNECTS TO COAXIAL SWITCH S2 'COM' (COMMON) TYPE 'N' CONNECTOR J304.  
RF CABLE #305 (FROM IPA-1 RF INPUT) CONNECTS TO COAXIAL SWITCH S2 'NC' (NORMALLY CLOSED) TYPE 'N' CONNECTOR J305.  
RF CABLE #306 (FROM IPA-2 RF INPUT) CONNECTS TO COAXIAL SWITCH S2 'NO' (NORMALLY OPEN) TYPE 'N' CONNECTOR J306.  
RF CABLE #310 FROM J310 (IN MOTHERBOARD 'B' RF ENCLOSURE) CONNECTS TO COAXIAL SWITCH S3 'COM' (COMMON) TYPE 'N' CONNECTOR J307.  
RF CABLE #307 (FROM IPA-1 RF OUTPUT) CONNECTS TO COAXIAL SWITCH S3 'NC' (NORMALLY CLOSED) TYPE 'N' CONNECTOR J307.  
RF CABLE #308 (FROM IPA-2 RF OUTPUT) CONNECTS TO COAXIAL SWITCH S3 'NO' (NORMALLY OPEN) TYPE 'N' CONNECTOR J308.

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TOLERANCE (DECIMAL) U.D.S.  
INCHES ± .030  
MILLIMETERS ± .005

OWN. BY  
DESIGNER  
PROJ. LEADER  
MFG.

MSE 0-25-01

MATERIAL  
FINISH  
SEE ENG BASED-0000  
NEXT ASSY.

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**BROADCAST ELECTRONICS, INC.**  
4100 N. 24TH ST., P.O. BOX 3008 GAITHERSBURG, MD 20878-2008  
TELE 281442 CABLE BROADCAST FAX 217/224-9907

TITLE  
FM20S CONTROL CABINET OVERALL SCHEMATIC

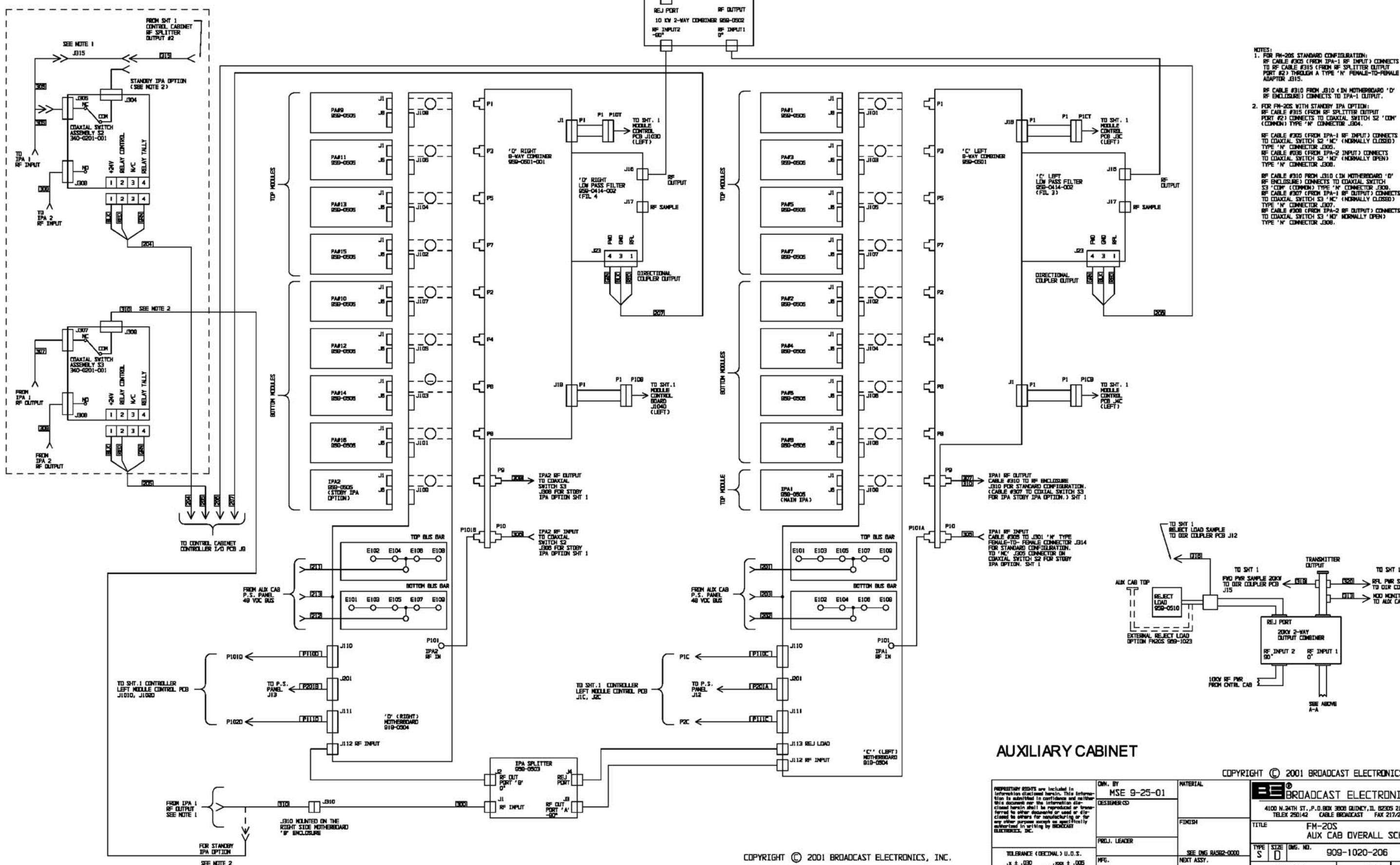
TYPE S D  
SIZE D  
ENG. NO. 909-1020-206  
REV E

MODEL FM20S  
SCALE NTS  
SHEET 1 OF 10





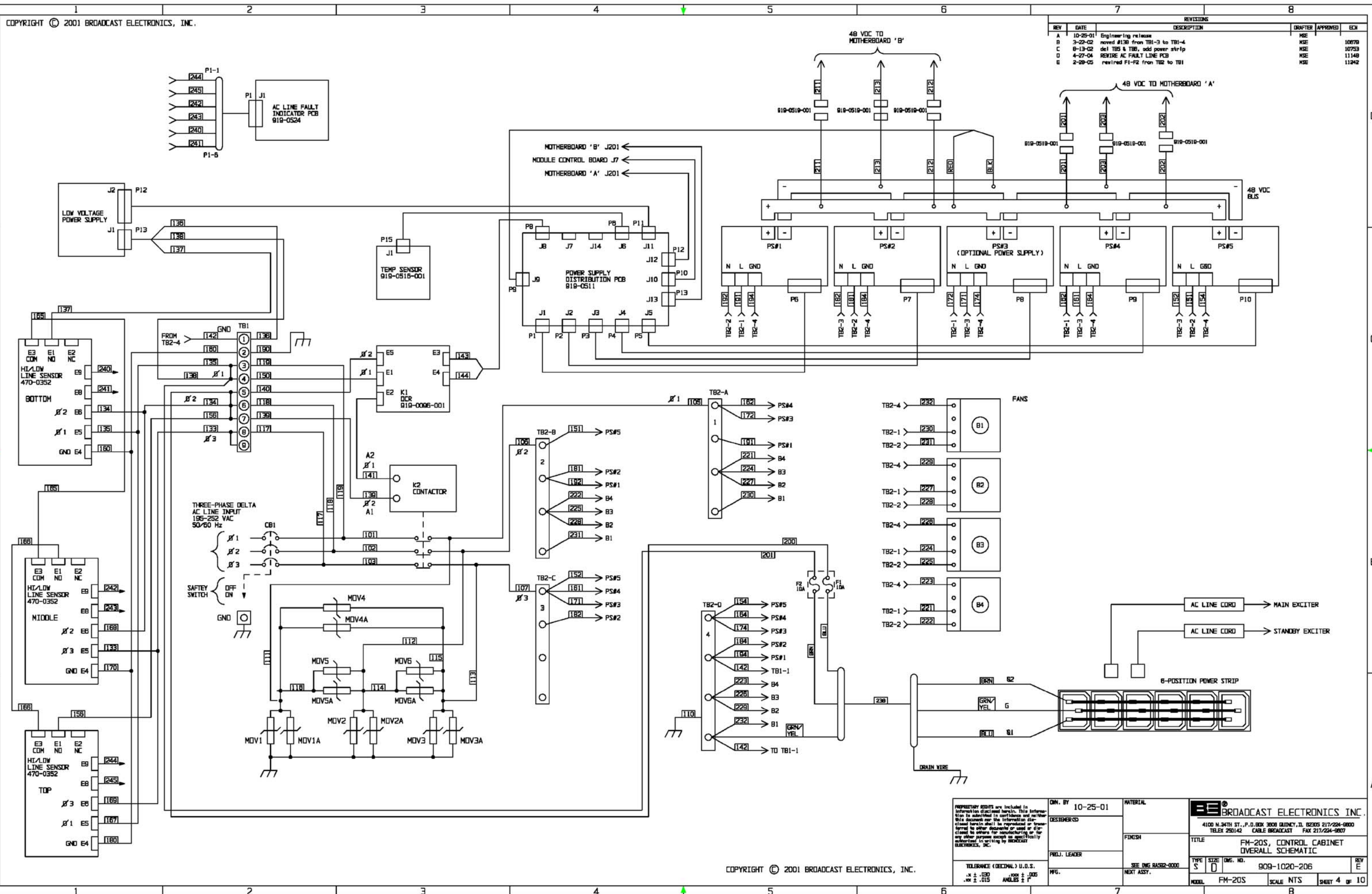
REVISIONS							
REV	DATE	DESCRIPTION			DRAFTER	APPROVED	ECN
1	10-25-01	Updated					
A	11-09-01	Engineering Release					




- NOTES:
- FOR FM-20S STANDARD CONFIGURATION:  
RF CABLE #305 (FROM IPA-1 RF INPUT) CONNECTS TO RF CABLE #315 (FROM RF SPLITTER OUTPUT PORT #2) THROUGH A TYPE 'N' FEMALE-TO-FEMALE ADAPTOR J315.
  - FOR FM-20S WITH STANDBY IPA OPTION:  
RF CABLE #315 (FROM RF SPLITTER OUTPUT PORT #2) CONNECTS TO COAXIAL SWITCH S2 'COM' (COMMON) TYPE 'N' CONNECTOR J304.
  - RF CABLE #305 (FROM IPA-1 RF INPUT) CONNECTS TO COAXIAL SWITCH S2 'NC' (NORMALLY CLOSED) TYPE 'N' CONNECTOR J305.
  - RF CABLE #306 (FROM IPA-2 INPUT) CONNECTS TO COAXIAL SWITCH S2 'NO' (NORMALLY OPEN) TYPE 'N' CONNECTOR J306.
  - RF CABLE #310 (ON MOTHERBOARD 'D' RF ENCLOSURE) CONNECTS TO COAXIAL SWITCH S3 'COM' (COMMON) TYPE 'N' CONNECTOR J308.
  - RF CABLE #307 (FROM IPA-1 RF OUTPUT) CONNECTS TO COAXIAL SWITCH S3 'NC' (NORMALLY CLOSED) TYPE 'N' CONNECTOR J307.
  - RF CABLE #308 (FROM IPA-2 RF OUTPUT) CONNECTS TO COAXIAL SWITCH S3 'NO' (NORMALLY OPEN) TYPE 'N' CONNECTOR J308.

### AUXILIARY CABINET

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TOLERANCE (DECIMAL) U.O.S. .x ± .030 .x00 ± .005 .xx ± .015 ANGLES ± 1°	DESIGNER PROJ. LEADER MFG.	FINISH SEE ENG. BASK-0000 NEXT ASSY.	TITLE FM-20S AUX CAB OVERALL SCHEMATIC
TYPE S	SIZE D	QMG. NO. 909-1020-206	REV E
MODEL FM-20S	SCALE NTS	SHEET 3 OF 10	

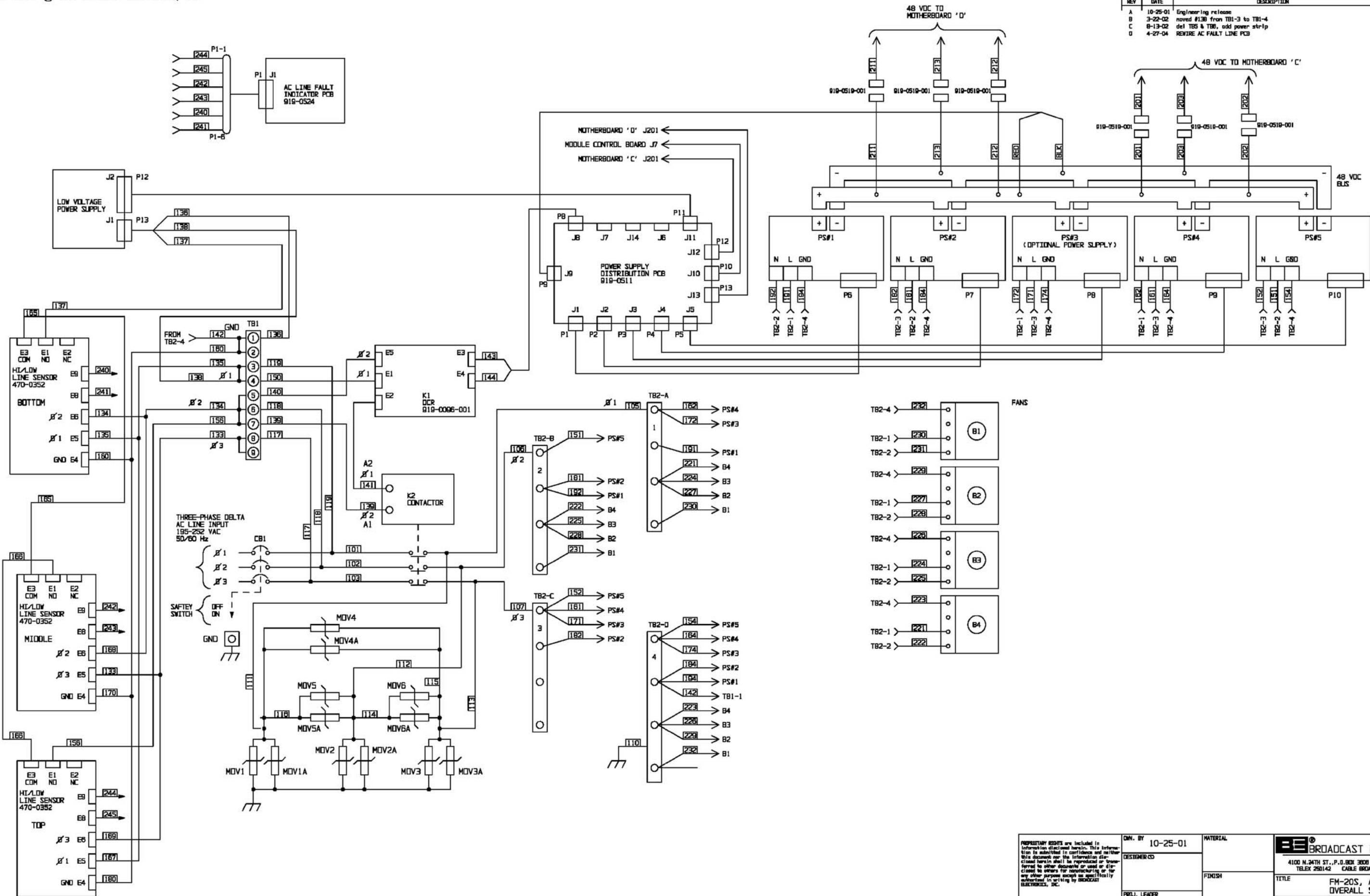



REVISIONS				DRAFTER	APPROVED	ECN
REV	DATE	DESCRIPTION				
A	10-25-01	Engineering release		KSE		10870
B	3-22-02	moved #136 from TB1-3 to TB1-4		KSE		10753
C	8-13-02	del TB5 & TB6, add power strip		KSE		11148
D	4-27-04	REVISE AC FAULT LINE PCB		KSE		11242
E	2-28-05	revise F1-F2 from TB2 to TB1		KSE		

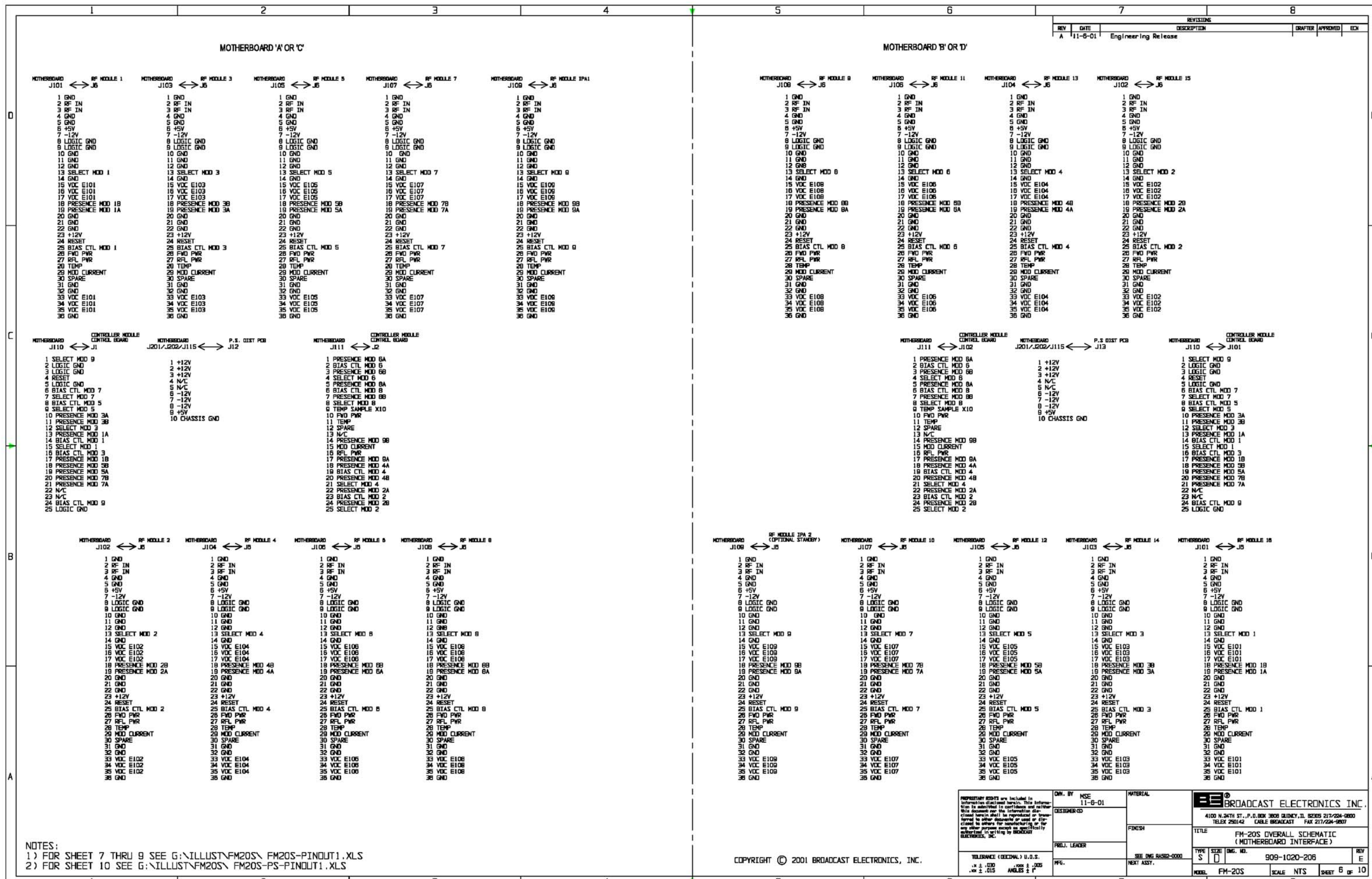
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	DESIGNER		FINISH	
TOLERANCE (DECIMAL) U.S.S. .X ± .030 .X ± .015	PROJECT LEADER		SEE DMS RAS22-0000	TITLE FM-20S, CONTROL CABINET OVERALL SCHEMATIC
PFG.			NEXT ASSY.	TYPE S
				SIZE D
				DWG. NO. 909-1020-206
				MODEL FM-20S
				SCALE NTS
				SHEET 4 OF 10



REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	EON
A	10-25-01	Engineering release	NSE		
B	3-22-02	novel #138 from TB1-3 to TB1-4	NSE		10079
C	6-13-02	del TB5 & TB6, add power strip	NSE		10753
D	4-27-04	REQUIRE AC FAULT LINE PCB	NSE		11148



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	DESIGNED BY		
TOLERANCE (DECIMAL) U.O.S. .XX ± .030 .XXX ± .005 .XX ± .015 ANGLES ± °	PROJ. LEADER	FINISH	TITLE FM-20S, AUXILIARY CABINET OVERALL SCHEMATIC
	MFG.	SEE DWS 04562-0000 NEXT ASSY.	TYPE S SIZE D QNG. NO. 909-1020-206 REV
		MODEL FM-20S	SCALE NTS SHEET 5 OF 10





FM-20S OVERALL SCHEMATIC SHT. 7 OF10 (PAGE 1 OF 2)			CONTROLLER I/O BOARD AND WIRE HAR- NESS				37-PIN SUB-D CONNECTOR PIN- OUTS			
						MAIN	STAND- BY	EXC	IPA IN	IPA OUT
CON- TROL- LER	WIRE	CIRCUIT FUNCTION	CON- TROL- LER	CON- TROL- LER	WIRE	FX-50	FX-50	RELAY	RELAY	RELAY
I/O BOARD	HARNESS		RMTE I/F BD	RMTE I/F BD	HAR- NESS	EXCITER	EXCITER	S1	S2	S3
J5 -- P5	WIRE NO.		J5 - P5		WIRE NO.	TB1	TB1	J1 -- P1	J1 -- P1	J1 -- P1
1	102-WHT	STBY EXC RF MUTE	12	J2-3	P2/112-WHT		7			
2	102-YEL	STBY EXC AFC LOCK	13	J2-4	P2/112-Y EL		5			
3	104-RED	IPA IN RELAY CONTROL							2	
4	105-RED	IPA OUT RELAY CONTROL								2
5	103-RED	EXC OUT RELAY CON- TROL	20	J3-2	P3/113-R ED			2		
6	103 GRN	EXC RELAY TALLY	21	J3-3	P3/113-G RN			4		
7	104-GRN	IPA IN RELAY TALLY							4	
8	JUMPER	INTERLOCK RETURN								
9	101-RED	MAIN EXC OVER TEMP	5	J1-5	P1/111-R ED	8				
10	101-YEL	MAIN EXC AFC LOCK	4	J1-4	P1/111-Y EL	5				
11	105-GRN	IPA OUT RELAY TALLY								4
12										
13										
14	101-GRN	MAIN EXC FWD PWR	1	J1-4	P1/111-G RN	9				
15	101-ORN	MAIN EXC RFL PWR	2	J1-2	P1/111-O RN	10				
16	101-WHT	MAIN EXC RF MUTE	3	J1-3	P1/111- WHT	7				
17	106-GRN	FILTER A (1) FWD PWR								
18	106-RED	FILTER A (1) RFL PWR								
19	107-GRN	FILTER B (2) FWD PWR								
20	107-RED	FILTER B (2) RFL PWR								
21										
22										
23										
24										
25	JUMPER	INTERLOCK OUT								
26	104-BLK	+24V' TO IPA IN RELAY							1	
27	105-BLK	+24V' TO IPA OUT RELAY								1
28	103-BLK	+24V' TO EXC RELAY	19	J3-1	P3/113-B LK			1		

FM-20S OVERALL SCHEMATIC SHT. 7 OF 10 (PAGE 2 OF 2)

29	102-GRN	STBY EXC FWD PWR	10	J2-1	P2/112-G RN		9			
30	102-ORN	STBY EXC RFL PWR	11	J2-2	P2/112-O RN		10			
31	102-RED	STBY EXC OVER TEMP	14	J2-5	P2/111-R ED		8			
32	101-BLK	GND TO MAIN EXC	6	J1-6	P1/111-B LK	4				
33	102-BLK	GND TO STBY EXC	15	J2-6	P2/112-B LK		4			
34	106-BLK	FILTER A (1) GND RETURN								
35	107-BLK	FILTER B (2) GND RETURN								
36										
37										
CONTROLLER I/O BOARD AND WIRE HARNESS										
15-PIN SUB-D CONNECTOR PIN-OUTS										
CON- TROL- LER	WIRE	CIRCUIT FUNCTION	AUX IPA IN	AUX IPA OUT						
I/O BOARD	HARNESS		RELAY S2	RELAY S3						
J9 ----- P9	WIRE NO.		J1 ----- P1	J1 ----- P1						
1	204-GRN	AUX IPA IN RELAY TALLY	4							
2	204-RED	AUX IPA IN RELAY CON- TROL	2							
3	204-BLK	+24V' to AUX IPA IN RELAY	1							
4										
5										
6	207-GRN	FILTER D (4) FWD PWR								
7	206-BLK	FILTER C (3) GND RETURN								
8	206-GRN	FILTER C (3) FWD PWR								
9	205-GRN	AUX IPA OUT RELAY TALLY	4							
10	205-RED	AUX IPA OUT RELAY CONTROL	2							
11	205-BLK	+24V' to AUX IPA OUT RELAY	1							
12										
13	207-RED	FILTER D (4) RFL PWR								
14	207-BLK	FILTER D (4) GND RETURN								
15	206-RED	FILTER C (3) RFL PWR								

FM-20S OVERALL SCHEMATIC SHT. 8 OF 10 (PAGE 1 OF 3)

CONTROL AND AUXILIARY CABINET

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MOTHERBOARD AND CONTROLLER MODULE CONTROL BOARD

25-PIN SUB-D CONNECTOR PIN-OUTS

		DATA	CONTROLLER	CONTROLLER
MOTHERBOARD CONNECTORS		CABLE	CHASSIS	MODULE CONTROL BD
J110	CONTROL CAB MOTHERBD "A" LEFT	P110A/P1A	J1A	J1
J110	CONTROL CAB MOTHERBD "B" RIGHT	P110B/P101B	J101B	J101
J110	AUX CAB MOTHERBD "C" LEFT	P110C/P1C	J1C	J1
J110	AUX CAB MOTHERBD "D" RIGHT	P110D/P101D	J101D	J101
1	SELECT MODULE 9	1	1	1
2	LOGIC GND	2	2	2
3	LOGIC GND	3	3	3
4	RESET	4	4	4
5	LOGIC GND	5	5	5
6	BIAS CONTROL MODULE 7	6	6	6
7	SELECT MODULE 7	7	7	7
8	BIAS CONTROL MODULE 5	8	8	8
9	SELECT MODULE 5	9	9	9
10	PRESENCE MODULE 3A	10	10	10
11	PRESENCE MODULE 3B	11	11	11
12	SELECT MODULE 3	12	12	12
13	PRESENCE MODULE 1A	13	13	13
14	BIAS CONTROL MODULE 1	14	14	14
15	SELECT MODULE 1	15	15	15
16	BIAS CONTROL MODULE 3	16	16	16
17	PRESENCE MODULE 1B	17	17	17
18	PRESENCE MODULE 5B	18	18	18
19	PRESENCE MODULE 5A	19	19	19
20	PRESENCE MODULE 7B	20	20	20
21	PRESENCE MODULE 7A	21	21	21
22	N/C	22	22	22
23	N/C	23	23	23
24	BIAS CONTROL MODULE 9	24	24	24
25	LOGIC GND	25	25	25

## FM-20S OVERALL SCHEMATIC SHT. 8 OF 10 (PAGE 2 OF 3)

## CONTROL AND AUXILIARY CABINET

MOTHERBOARD AND CONTROLLER MODULE CONTROL BOARD				
25-PIN SUB-D CONNECTOR PIN-OUTS CONTD_				
		DATA	CONTROLLER	CONTROLLER
MOTHERBOARD CONNECTORS		CABLE	CHASSIS	MODULE CONTROL BD
J111	CONTROL CAB MOTHERBD "A" LEFT	P111A/P2A	J2A	J2
J111	CONTROL CAB MOTHERBD "B" RIGHT	P111B/P102B	J102B	J102
J111	AUX CAB MOTHERBD "C" LEFT	P111C/P2C	J2C	J2
J111	AUX CAB MOTHERBD "D" RIGHT	P111D/P102D	J102D	J102
1	PRESENCE MODULE 6A	1	1	1
2	BIAS CONTROL MODULE 6	2	2	2
3	PRESENCE MODULE 6B	3	3	3
4	SELECT MODULE 6	4	4	4
5	PRESENCE MODULE 8A	5	5	5
6	BIAS CONTROL MODULE 8	6	6	6
7	PRESENCE MODULE 8B	7	7	7
8	SELECT MODULE 8	8	8	8
9	TEMP SAMPLE X 5 (IPA REJ LOAD)	9	9	9
10	MODULE FORWARD POWER	10	10	10
11	MODULE TEMPERATURE	11	11	11
12	SPARE	12	12	12
13	N/C	13	13	13
14	PRESENCE MODULE 9B	14	14	14
15	MODULE CURRENT	15	15	15
16	MODULE REFLECTED POWER	16	16	16
17	PRESENCE MODULE 9A	17	17	17
18	PRESENCE MODULE 4A	18	18	18
19	BIAS CONTROL MODULE 4	19	19	19
20	PRESENCE MODULE 4B	20	20	20
21	SELECT MODULE 4	21	21	21
22	PRESENCE MODULE 2A	22	22	22
23	BIAS CONTROL MODULE 2	23	23	23
24	PRESENCE MODULE 2B	24	24	24
25	SELECT MODULE 2	25	25	25

FM-20S OVERALL SCHEMATIC SHT. 8 OF 10 (PAGE 3 OF 3)			
CONTROL AND AUXILIARY CABINET			
MOTHERBOARD AND IPA SPLITER REJECT LOAD TEMPERATURE SENSOR BOARD			
4-PIN CONNECTOR PIN-OUTS			
MOTHERBOARD "A"			TEMP SENSOR BOARD
OR "C" CONNECTOR	WIRE HARNESS	CIRCUIT FUNCTION	(IPA REJECT LOAD)
J114	P114/P1		J1
1	RED	+12V	1
2	N/C	TEMP SAMPLE (.01V/DEG.C)	2
3	BLACK	TEMP SAMPLE X 5	3
4	SHIELD	GND	4

FM-20S OVERALL SCHEMATIC SHT. 9 OF 10 (PAGE 1 OF 2)						
CONTROL OR AUXILIARY CABINET						
8-WAY COMBINER "A" LEFT OR "C" LEFT						
9-PIN SUB-D CONNECTOR PINOUTS						
TOP COMBINER INPUT CONTROL BOARD		RIBBON	DATA	CONTROL- LER		
9-PIN SUB-D CONNECTOR		CABLE	CABLE	CHASSIS	CONTROLLER MODULE CON- TROL BD	
J1B	CONTROL CAB 8-WAY COMBINER "A"	P1	P1AT/P3A	J3A	J3	9-PIN SUB-D CONNECTOR
J1B	AUX CAB 8-WAY COMBINER "C"	P1	P1CT/P3C	J3C	J3	9-PIN SUB-D CONNECTOR
1	RELAY K4 PIN 2 COIL (-) RETURN	1	1	1	1	MODULE 1 FAULT - GROUND
2	RELAY K3 PIN 2 COIL (-) RETURN	2	2	2	2	MODULE 3 FAULT - GROUND
3	RELAYS K1 THRU K4 PIN 1 COIL (+)	3	3	3	3	DC +12V TO RELAY COILS
4	RELAY K2 PIN 2 COIL (-) RETURN	4	4	4	4	MODULE 5 FAULT - GROUND
5	RELAY K1 PIN 2 COIL (-) RETURN	5	5	5	5	MODULE 7 FAULT - GROUND
6	LOGIC GROUND	6	6	6	6	LOGIC GROUND
7	LOGIC GROUND	7	7	7	7	LOGIC GROUND
8	LOGIC GROUND	8	8	8	8	LOGIC GROUND
9	LOGIC GROUND	9	9	9	9	LOGIC GROUND
BOTTOM COMBINER INPUT CONTROL BOARD		RIBBON	DATA	CONTROL- LER		
9-PIN SUB-D CONNECTOR		CABLE	CABLE	CHASSIS	CONTROLLER MODULE CON- TROL BD	
J1	CONTROL CAB 8-WAY COMBINER "A"	P1	P1AB/P4A	J4A	J4	9-PIN SUB-D CONNECTOR
J1	AUX CAB 8-WAY COMBINER "C"	P1	P1CB/P4C	J4C	J4	9-PIN SUB-D CONNECTOR
1	RELAY K4 PIN 2 COIL (-) RETURN	1	1	1	1	MODULE 2 FAULT - GROUND
2	RELAY K3 PIN 2 COIL (-) RETURN	2	2	2	2	MODULE 4 FAULT - GROUND
3	RELAYS K1 THRU K4 PIN 1 COIL (+)	3	3	3	3	DC +12V TO RELAY COILS
4	RELAY K2 PIN 2 COIL (-) RETURN	4	4	4	4	MODULE 6 FAULT - GROUND
5	RELAY K1 PIN 2 COIL (-) RETURN	5	5	5	5	MODULE 8 FAULT - GROUND
6	LOGIC GROUND	6	6	6	6	LOGIC GROUND
7	LOGIC GROUND	7	7	7	7	LOGIC GROUND
8	LOGIC GROUND	8	8	8	8	LOGIC GROUND
9	LOGIC GROUND	9	9	9	9	LOGIC GROUND



FM-20S OVERALL SCHEMATIC SHT. 9 OF 10 (PAGE 2 OF 2)						
CONTROL OR AUXILIARY CABINET						
8-WAY COMBINER "B" RIGHT OR "D" RIGHT						
9-PIN SUB-D CONNECTOR PINOUTS						
TOP COMBINER INPUT CONTROL BOARD		RIBBON	DATA	CONTROL- LER		
9-PIN SUB-D CONNECTOR		CABLE	CABLE	CHASSIS	CONTROLLER MODULE CON- TROL BD	
J1	CONTROL CAB 8-WAY COMBINER "B"	P1	P1BT/ P103B	J103B	J103	9-PIN SUB-D CONNECTOR
J1	AUX CAB 8-WAY COMBINER "D"	P1	P1DT/ P103D	J103D	J103	9-PIN SUB-D CONNECTOR
1	RELAY K4 PIN 2 COIL (-) RETURN	1	1	1	1	MODULE 15 FAULT - GROUND
2	RELAY K3 PIN 2 COIL (-) RETURN	2	2	2	2	MODULE 13 FAULT - GROUND
3	RELAYS K1 THRU K4 PIN 1 COIL (+)	3	3	3	3	DC +12V TO RELAY COILS
4	RELAY K2 PIN 2 COIL (-) RETURN	4	4	4	4	MODULE 11 FAULT - GROUND
5	RELAY K1 PIN 2 COIL (-) RETURN	5	5	5	5	MODULE 9 FAULT - GROUND
6	LOGIC GROUND	6	6	6	6	LOGIC GROUND
7	LOGIC GROUND	7	7	7	7	LOGIC GROUND
8	LOGIC GROUND	8	8	8	8	LOGIC GROUND
9	LOGIC GROUND	9	9	9	9	LOGIC GROUND
BOTTOM COMBINER INPUT CONTROL BOARD		RIBBON	DATA	CONTROL- LER		
9-PIN SUB-D CONNECTOR		CABLE	CABLE	CHASSIS	CONTROLLER MODULE CON- TROL BD	
J1B	CONTROL CAB 8-WAY COMBINER "B"	P1	P1BB/P104 B	J104B	J104	9-PIN SUB-D CONNECTOR
J1B	AUX CAB 8-WAY COMBINER "D"	P1	P1DB/P104 D	J104D	J104	9-PIN SUB-D CONNECTOR
1	RELAY K4 PIN 2 COIL (-) RETURN	1	1	1	1	MODULE 10 FAULT - GROUND
2	RELAY K3 PIN 2 COIL (-) RETURN	2	2	2	2	MODULE 12 FAULT - GROUND
3	RELAYS K1 THRU K4 PIN 1 COIL (+)	3	3	3	3	DC +12V TO RELAY COILS
4	RELAY K2 PIN 2 COIL (-) RETURN	4	4	4	4	MODULE 14 FAULT - GROUND
5	RELAY K1 PIN 2 COIL (-) RETURN	5	5	5	5	MODULE 16 FAULT - GROUND
6	LOGIC GROUND	6	6	6	6	LOGIC GROUND
7	LOGIC GROUND	7	7	7	7	LOGIC GROUND
8	LOGIC GROUND	8	8	8	8	LOGIC GROUND
9	LOGIC GROUND	9	9	9	9	LOGIC GROUND

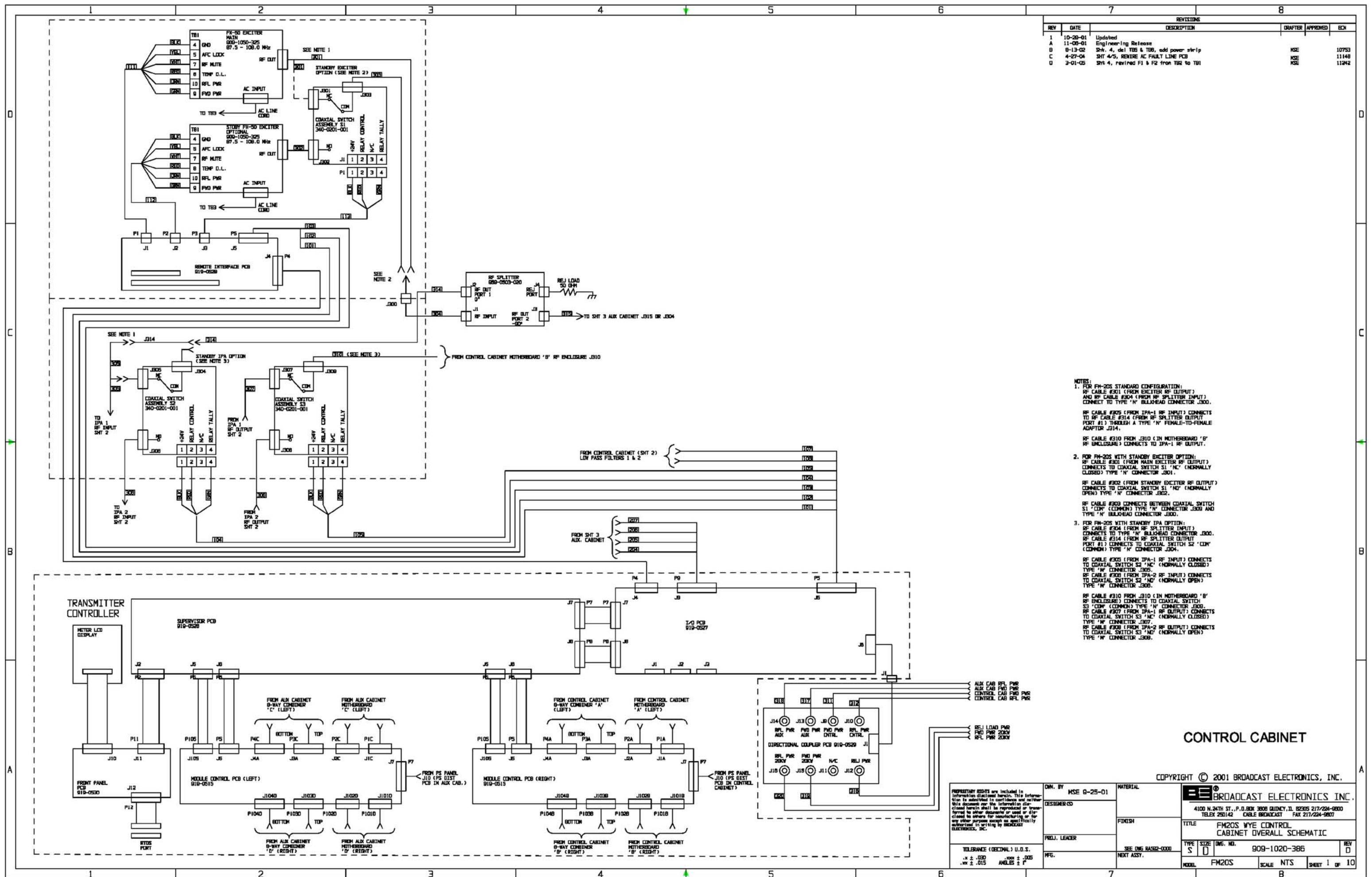
FM-20S OVERALL SCHEMATIC SHT. 10 OF 10 (PAGE 1 OF 4)			909-1020-206
CONTROL OR AUXILIARY CABINET			
P.S. DISTRIBUTION BOARD AND P.S. HARNESS			
CONNECTOR PIN-OUTS			
P.S. DISTRIB. BOARD			5KW POWER SUPPLY
CONNECTOR	DATA CABLE	CIRCUIT FUNCTION	PS# 1 THRU PS#5
J1 THRU J5	P1/P6 THRU P5/P10		J1
1	1	SENSE + (DC OUT SAMPLE)	1
2	2	VC+ (CONTROL VOLTAGE)	2
3	3	FAULT	3
4	4	VC_GND	4
9	9	LOGIC GND	9
10	10	CURRENT SHARE	10
13	13	P.S. INHIBIT	13
P.S. DISTRIB. BOARD			TEMP SENSOR BOARD
CONNECTOR	WIRE HARNESS	CIRCUIT FUNCTION	(INLET)
J6	P6/P15		J1
1	145	+12V	1
2	N/C	TEMP SAMPLE (.01V/DEG.C)	2
3	146	TEMP SAMPLE X 5	3
4	147	GND	4
P.S. DISTRIB. BOARD			
CONNECTOR	WIRE HARNESS	CIRCUIT FUNCTION	OCR
J8	P8		K1
1	143	OCR CONTROL (+12V)	E3
2	144	LOGIC GND	E4
P.S. DISTRIB. BOARD			
CONNECTOR	WIRE HARNESS	CIRCUIT FUNCTION	5KW POWER SUPPLY
J9	P9		PS# 1 THRU PS#5
1	RED	SENSE + (DC OUT SAMPLE)	DC OUTPUT BUS +
2	BLACK	VC_GND	DC OUTPUT BUS -

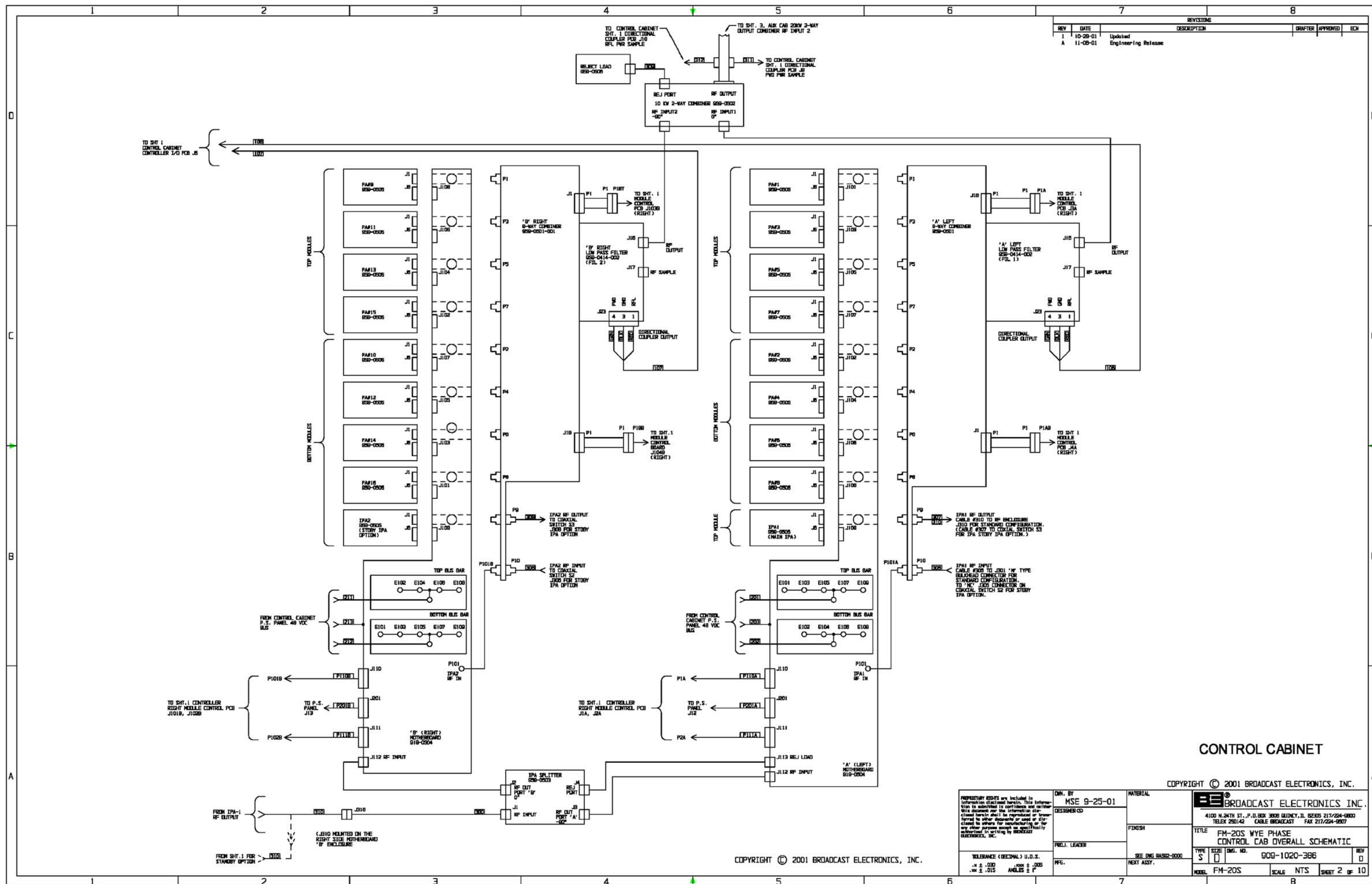
FM-20S OVERALL SCHEMATIC SHT. 10 OF 10 (PAGE 2 OF 4)			909-1020-206
CONTROL OR AUXILIARY CABINET			
P.S. DISTRIBUTION BOARD AND P.S. HARNESS			
CONNECTOR PIN-OUTS CONTD_			
P.S. DISTRIB. BOARD			CONTROLLER
CONNECTOR	WIRE HARNESS	CIRCUIT FUNCTION	MODULE CONTROL BOARD
J10	P10/P7A		J7
1	BLACK	VC+	1
2	RED	VC GND	2
3	GREEN	P.S.FAULT 1	3
4	WHITE	LOGIC GND	4
5	BROWN	P.S.INHIBIT	5
6	BLUE	P.S.FAULT 2	6
7	ORANGE	P.S.FAULT 3	7
8	YELLOW	P.S.FAULT 4	8
9	VIOLET	P.S.FAULT 5	9
10	GRAY	TEMP SAMPLE X 5 (INLET)	10
11	PINK	HI/LO AC LINE SENSOR	11
12	TAN	OCR CONTROL (+12V)	12
13	RED/GREEN	+24V	13
14	RED/YELLOW	+48V (DC OUT SAMPLE)	14
15	RED/BLACK	+5V	15
16	WHITE/BLACK	+5V	16
17	WHITE/RED	+5V	17
18	WHITE/GREEN	GND	18
19	WHITE/YELLOW	GND	19
20	WHITE/BLUE	GND	20
21	WHITE/BROWN	GND	21
22	WHITE/ORANGE	-12V	22
23	WHITE/GRAY	-12V	23
24	WHITE/VIOLET	+12V	24
25	BLACK/RED	+12V	25

FM-20S OVERALL SCHEMATIC SHT. 10 OF 10 (PAGE 3 OF 4)			909-1020-206	
CONTROL OR AUXILIARY CABINET				
P.S. DISTRIBUTION BOARD AND P.S. HARNESS				
CONNECTOR PIN-OUTS CONTD_				
P.S. DISTRIB. BOARD				LOW VOLTAGE
CONNECTOR	WIRE HARNESS	CIRCUIT FUNCTION	WIRE HARNESS	POWER SUPPLY
J11	P11		P12	J2
1	132	+5V	132	1
2	131	+5V	131	2
3	130	+5V	130	3
4	129	GND	129	4
5	128	GND	128	5
6	127	GND	127	6
7	126	GND	126	7
8	125	+12V	125	8
9	124	+12V	124	9
10	123	GND	123	10
11	122	-12V	122	11
12	121	+24V	N/C	12
			121	13
				LOW VOLTAGE
		CIRCUIT FUNCTION	WIRE HARNESS	POWER SUPPLY
			P13	J1
		GND	136	1
			N/C	2
		AC LINE PHASE 1	138	3
			N/C	4
		AC LINE PHASE 2 (SWITCHED)	137	5

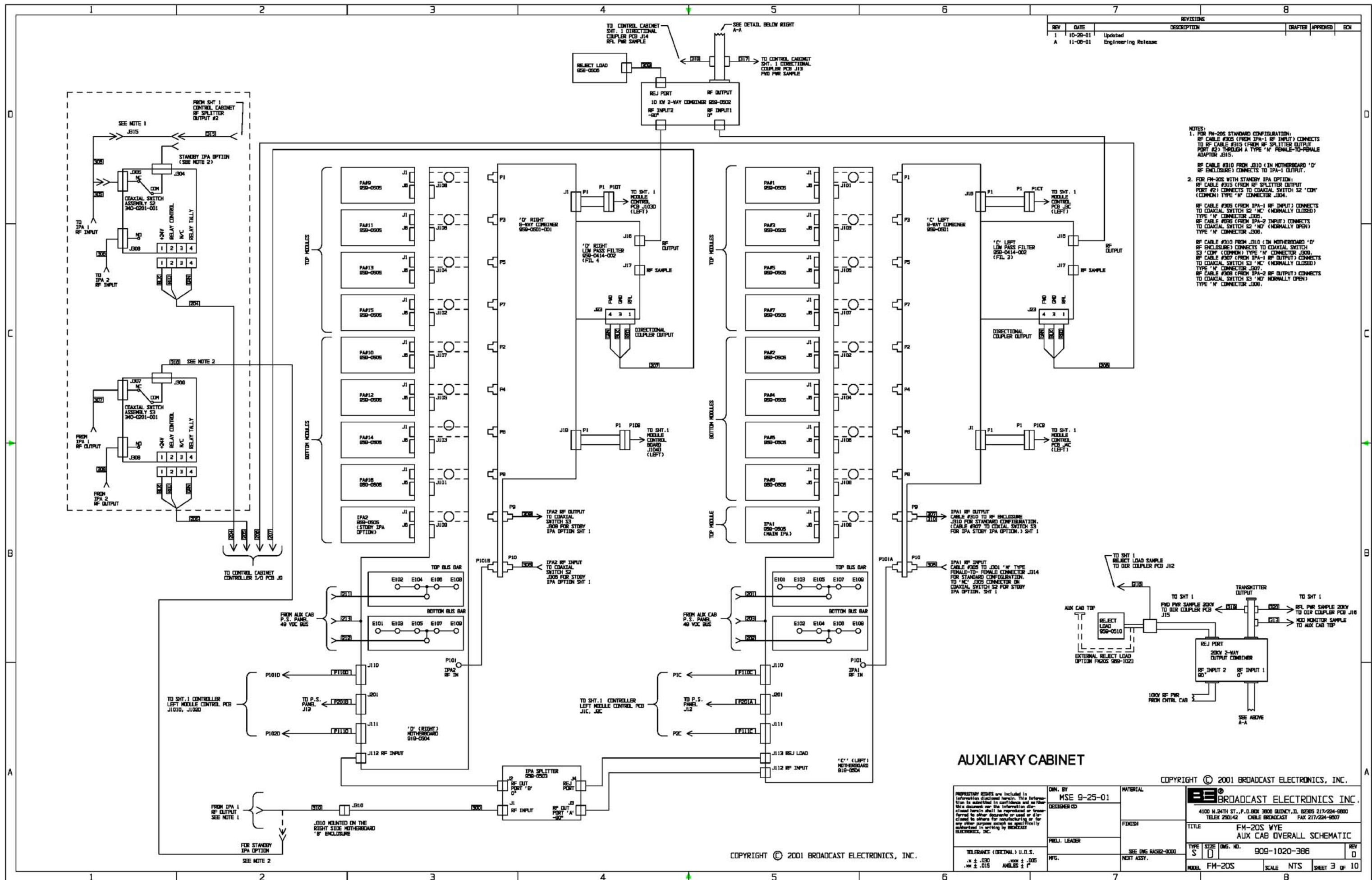
FM-20S OVERALL SCHEMATIC SHT. 10 OF 10 (PAGE 4 OF 4)			909-1020-206		
CONTROL OR AUXILIARY CABINET					
P.S. DISTRIBUTION BOARD AND P.S. HARNESS					
CONNECTOR PIN-OUTS CONTD_					
P.S. DISTRIB. BOARD	DATA CABLE		MOTHERBOARD "A"/"C" OR "B"/"D"		
CONNECTOR	P12/P201A OR	CIRCUIT FUNCTION	DC CONNECTOR BOARD		MOTHER-BOARD
J12 OR J13	P13/P201B		J201	J202	J115
1	1	+12V	1	1	1
2	2	+12V	2	2	2
3	3	N/C	3	4	4
4	4	-12V	4	6	6
5	5	+5V	5	9	9
6	6	+12V	6	3	3
7	7	N/C	7	5	5
8	8	-12V	8	7	7
9	9	-12V	9	8	8
SHELL	SHIELD	CHASSIS GND	CHASSIS GND	10	10
POWER SUPPLY HARNESS		CIRCUIT FUNCTION	AC LINE FAULT IND. BOARD		
CONNECTOR P1	WIRE NO.		J1		
1	242	LOSS OF AC LINE PHASE 1-2	1		
2	243	LOGIC GND	2		
3	240	LOSS OF AC LINE PHASE 2-3	3		
4	241	LOGIC GND	4		
5	244	LOSS OF AC LINE PHASE 3-1	5		
6	245	LOGIC GND	6		











- NOTES:
- FOR FM-20S STANDARD CONFIGURATION:  
RF CABLE #305 (FROM IPA-1 RF INPUT) CONNECTS TO RF CABLE #315 (FROM RF SPLITTER OUTPUT PORT #2) THROUGH A TYPE 'N' FEMALE-TO-FEMALE ADAPTOR J315.
  - FOR FM-20S WITH STANDBY IPA OPTION:  
RF CABLE #315 (FROM RF SPLITTER OUTPUT PORT #2) CONNECTS TO COAXIAL SWITCH S2 'COM' (COMMON) TYPE 'N' CONNECTOR J304.
  - RF CABLE #305 (FROM IPA-1 RF INPUT) CONNECTS TO COAXIAL SWITCH S2 'NC' (NORMALLY CLOSED) TYPE 'N' CONNECTOR J305.
  - RF CABLE #305 (FROM IPA-2 INPUT) CONNECTS TO COAXIAL SWITCH S2 'NO' (NORMALLY OPEN) TYPE 'N' CONNECTOR J306.
  - RF CABLE #310 (FROM J310 (IN MOTHERBOARD 'D' RF ENCLOSURE) CONNECTS TO IPA-1 OUTPUT.
  - RF CABLE #315 (FROM RF SPLITTER OUTPUT PORT #2) CONNECTS TO COAXIAL SWITCH S2 'COM' (COMMON) TYPE 'N' CONNECTOR J308.
  - RF CABLE #307 (FROM IPA-1 RF OUTPUT) CONNECTS TO COAXIAL SWITCH S3 'NC' (NORMALLY CLOSED) TYPE 'N' CONNECTOR J307.
  - RF CABLE #308 (FROM IPA-2 RF OUTPUT) CONNECTS TO COAXIAL SWITCH S3 'NO' (NORMALLY OPEN) TYPE 'N' CONNECTOR J308.

### AUXILIARY CABINET

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TOLERANCE (DECIMAL) U.O.S. .XX ± .030 .XX ± .015		PROJ. LEADER MFG.	TITLE FM-20S WYE AUX CAB OVERALL SCHEMATIC TYPE S D SIZE 11.5 DIM. NO. 909-1020-386 MODEL FM-20S SCALE NTS SHEET 3 OF 10

REV	DATE	DESCRIPTION	DRAFTER	APPROVED	EON
A	11-06-01	Engineering Release			
B	8-13-02	Del TBS & TBS, add power strip	KSE		10753
C	4-27-04	REVISE AC FAULT LINE PCB	KSE		11148
D	3-01-05	Revired F1 & F2 from TBS to TBI	KSE		11242

48 VDC TO MOTHERBOARD 'A'

48 VDC BUS

PS#4      PS#5

N L GND      N L GND

TBS-5 TBS-3 TBS-4      TBS-5 TBS-2 TBS-4

P8      P9      P10

6-POSITION POWER STRIP

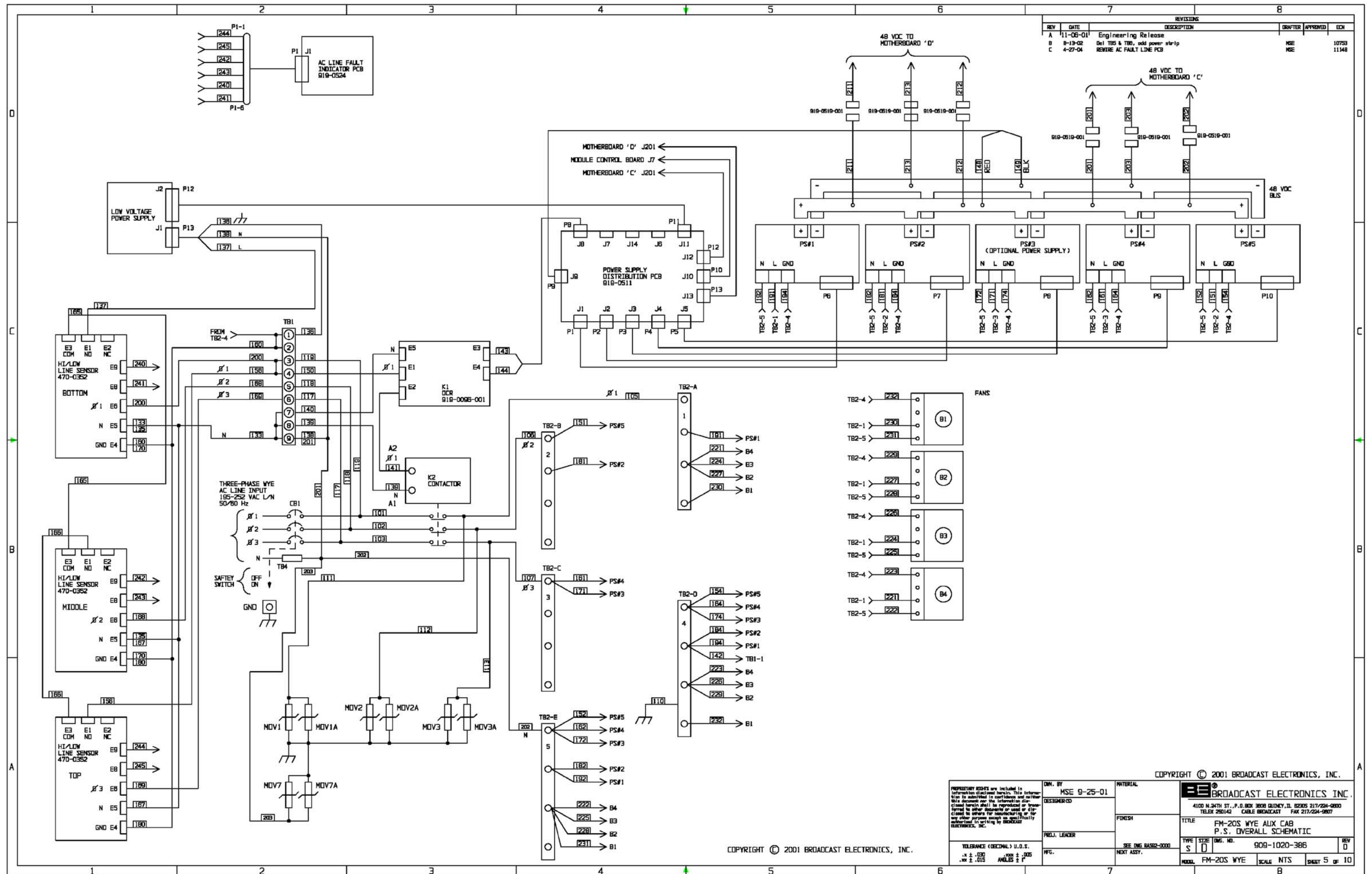
FANS

B1      B2      B3      B4

AC LINE CORD      MAIN EXCITER

AC LINE CORD      STANDBY EXCITER





REV	DATE	DESCRIPTION	DRAWN	APPROVED	EDN
A	11-06-01	Engineering Release			
B	8-13-02	Del TB5 & TB6, add power strip	MSE		10753
C	4-27-04	REVISE AC FAULT LINE PCB	MSE		11148

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OWN. BY  
MSE 9-25-01

DESIGNER  
PROJ. LEADER  
MFG.

MATERIAL  
FINISH  
SEE DWG. BASED-0000  
NEXT ASSY.

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BROADCAST ELECTRONICS INC.  
4100 N. 24TH ST., P.O. BOX 3008 GUILDFORD, IL 62505 217/224-0800  
TELEX 250142 CABLE BROADCAST FAX 217/224-9807

TITLE  
FM-20S WYE AUX CAB  
P.S. OVERALL SCHEMATIC

TYPE  
S

DWG. NO.  
909-1020-386

REV  
0

MODEL  
FM-20S WYE

SCALE  
NTS

SHEET  
5 OF 10

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
A	11-6-01	Engineering Release			

MOTHERBOARD J101	RF MODULE 1 J6	MOTHERBOARD J103	RF MODULE 3 J6	MOTHERBOARD J105	RF MODULE 5 J6	MOTHERBOARD J107	RF MODULE 7 J6	MOTHERBOARD J109	RF MODULE 9 J6
1 GND		1 GND		1 GND		1 GND		1 GND	
2 RF IN		2 RF IN		2 RF IN		2 RF IN		2 RF IN	
3 RF IN		3 RF IN		3 RF IN		3 RF IN		3 RF IN	
4 GND		4 GND		4 GND		4 GND		4 GND	
5 GND		5 GND		5 GND		5 GND		5 GND	
6 +5V		6 +5V		6 +5V		6 +5V		6 +5V	
7 -12V		7 -12V		7 -12V		7 -12V		7 -12V	
8 LOGIC GND		8 LOGIC GND		8 LOGIC GND		8 LOGIC GND		8 LOGIC GND	
9 LOGIC GND		9 LOGIC GND		9 LOGIC GND		9 LOGIC GND		9 LOGIC GND	
10 GND		10 GND		10 GND		10 GND		10 GND	
11 GND		11 GND		11 GND		11 GND		11 GND	
12 GND		12 GND		12 GND		12 GND		12 GND	
13 SELECT MOD 1		13 SELECT MOD 3		13 SELECT MOD 5		13 SELECT MOD 7		13 SELECT MOD 9	
14 GND		14 GND		14 GND		14 GND		14 GND	
15 VCC E101		15 VCC E103		15 VCC E105		15 VCC E107		15 VCC E109	
16 VCC E101		16 VCC E103		16 VCC E105		16 VCC E107		16 VCC E109	
17 VCC E101		17 VCC E103		17 VCC E105		17 VCC E107		17 VCC E109	
18 PRESENCE MOD 1B		18 PRESENCE MOD 3B		18 PRESENCE MOD 5B		18 PRESENCE MOD 7B		18 PRESENCE MOD 9B	
19 PRESENCE MOD 1A		19 PRESENCE MOD 3A		19 PRESENCE MOD 5A		19 PRESENCE MOD 7A		19 PRESENCE MOD 9A	
20 GND		20 GND		20 GND		20 GND		20 GND	
21 GND		21 GND		21 GND		21 GND		21 GND	
22 GND		22 GND		22 GND		22 GND		22 GND	
23 +12V		23 +12V		23 +12V		23 +12V		23 +12V	
24 RESET		24 RESET		24 RESET		24 RESET		24 RESET	
25 BIAS CTL MOD 1		25 BIAS CTL MOD 3		25 BIAS CTL MOD 5		25 BIAS CTL MOD 7		25 BIAS CTL MOD 9	
26 FWD PWR		26 FWD PWR		26 FWD PWR		26 FWD PWR		26 FWD PWR	
27 RFL PWR		27 RFL PWR		27 RFL PWR		27 RFL PWR		27 RFL PWR	
28 TEMP		28 TEMP		28 TEMP		28 TEMP		28 TEMP	
29 MOD CURRENT		29 MOD CURRENT		29 MOD CURRENT		29 MOD CURRENT		29 MOD CURRENT	
30 SPARE		30 SPARE		30 SPARE		30 SPARE		30 SPARE	
31 GND		31 GND		31 GND		31 GND		31 GND	
32 GND		32 GND		32 GND		32 GND		32 GND	
33 VCC E101		33 VCC E103		33 VCC E105		33 VCC E107		33 VCC E109	
34 VCC E101		34 VCC E103		34 VCC E105		34 VCC E107		34 VCC E109	
35 VCC E101		35 VCC E103		35 VCC E105		35 VCC E107		35 VCC E109	
36 GND		36 GND		36 GND		36 GND		36 GND	

NOTHERBOARD	CONTROLLER MODULE CONTROL BOARD	NOTHERBOARD	P.S. DIST PCB
J110	↔ J1	J201/J202/J115	↔ J12
1 SELECT MOD 9		1 +12V	
2 LOGIC GND		2 +12V	
3 LOGIC GND		3 +12V	
4 RESET		4 N/C	
5 LOGIC GND		5 N/C	
6 BIAS CTL MOD 7		6 -12V	
7 SELECT MOD 7		7 -12V	
8 BIAS CTL MOD 5		8 -12V	
9 SELECT MOD 5		9 +5V	
10 PRESENCE MOD 3A		10 CHASSIS GND	
11 PRESENCE MOD 3B			
12 SELECT MOD 3			
13 PRESENCE MOD 1A			
14 BIAS CTL MOD 1			
15 SELECT MOD 1			
16 BIAS CTL MOD 3			
17 PRESENCE MOD 1B			
18 PRESENCE MOD 5B			
19 PRESENCE MOD 5A			
20 PRESENCE MOD 7B			
21 PRESENCE MOD 7A			
22 N/C			
23 N/C			
24 BIAS CTL MOD 9			
25 LOGIC GND			

NOTHING TO DO	CONTROLLER MODULE CONTROL BOARD
J11	J2
1 PRESENCE MOD 5A	
2 BIAS CTL MOD 6	
3 PRESENCE MOD 6B	
4 SELECT MOD 6	
5 PRESENCE MOD 8A	
6 BIAS CTL MOD 8	
7 PRESENCE MOD 8B	
8 SELECT MOD 8	
9 TEMP SAMPLE X10	
10 FWD PHR	
11 TEMP	
12 SPARE	
13 N/C	
14 PRESENCE MOD 9B	
15 MOD CURRENT	
16 RFL PHR	
17 PRESENCE MOD 9A	
18 PRESENCE MOD 4A	
19 BIAS CTL MOD 4	
20 PRESENCE MOD 4B	
21 SELECT MOD 4	
22 PRESENCE MOD 2A	
23 BIAS CTL MOD 2	
24 PRESENCE MOD 2B	
25 SELECT MOD 2	

NORTHERD BOARD J102 ↔ J6		NORTHERD BOARD J104 ↔ J8		NORTHERD BOARD J106 ↔ J8		NORTHERD BOARD J108 ↔ J8	
1	GND	1	GND	1	GND	1	GND
2	RF IN	2	RF IN	2	RF IN	2	RF IN
3	RF IN	3	RF IN	3	RF IN	3	RF IN
4	GND	4	GND	4	GND	4	GND
5	GND	5	GND	5	GND	5	GND
6	+5V	6	+5V	6	+5V	6	+5V
7	-12V	7	-12V	7	-12V	7	-12V
8	LOGIC GND	8	LOGIC GND	8	LOGIC GND	8	LOGIC GND
9	LOGIC GND	9	LOGIC GND	9	LOGIC GND	9	LOGIC GND
10	GND	10	GND	10	GND	10	GND
11	GND	11	GND	11	GND	11	GND
12	GND	12	GND	12	GND	12	GND
13	SELECT MOD 2	13	SELECT MOD 4	13	SELECT MOD 8	13	SELECT MOD 8
14	GND	14	GND	14	GND	14	GND
15	VOC E102	15	VOC E104	15	VOC E106	15	VOC E108
16	VOC E102	16	VOC E104	16	VOC E106	16	VOC E108
17	VOC E102	17	VOC E104	17	VOC E106	17	VOC E108
18	PRESSENCE MOD 2B	18	PRESSENCE MOD 4B	18	PRESSENCE MOD 6B	18	PRESSENCE MOD 6B
19	PRESSENCE MOD 2A	19	PRESSENCE MOD 4A	19	PRESSENCE MOD 6A	19	PRESSENCE MOD 6A
20	GND	20	GND	20	GND	20	GND
21	GND	21	GND	21	GND	21	GND
22	GND	22	GND	22	GND	22	GND
23	+12V	23	+12V	23	+12V	23	+12V
24	RESET	24	RESET	24	RESET	24	RESET
25	BIAS CTL MOD 2	25	BIAS CTL MOD 4	25	BIAS CTL MOD 6	25	BIAS CTL MOD 6
26	FWD PWR	26	FWD PWR	26	FWD PWR	26	FWD PWR
27	RFL PWR	27	RFL PWR	27	RFL PWR	27	RFL PWR
28	TEMP	28	TEMP	28	TEMP	28	TEMP
29	MOD CURRENT	29	MOD CURRENT	29	MOD CURRENT	29	MOD CURRENT
30	SPARE	30	SPARE	30	SPARE	30	SPARE
31	GND	31	GND	31	GND	31	GND
32	GND	32	GND	32	GND	32	GND
33	VOC E102	33	VOC E104	33	VOC E106	33	VOC E108
34	VOC E102	34	VOC E104	34	VOC E106	34	VOC E108
35	VOC E102	35	VOC E104	35	VOC E106	35	VOC E108
36	GND	36	GND	36	GND	36	GND

MOTHERBOARD J108 <=> J6	RF MODULE 8	MOTHERBOARD J106 <=> J6	RF MODULE 11	MOTHERBOARD J104 <=> J6	RF MODULE 13	MOTHERBOARD J102 <=> J6	RF MODULE 15
1 GND		1 GND		1 GND		1 GND	
2 RF IN		2 RF IN		2 RF IN		2 RF IN	
3 RF IN		3 RF IN		3 RF IN		3 RF IN	
4 GND		4 GND		4 GND		4 GND	
5 GND		5 GND		5 GND		5 GND	
6 +5V		6 +5V		6 +5V		6 +5V	
7 -12V		7 -12V		7 -12V		7 -12V	
8 LOGIC GND		8 LOGIC GND		8 LOGIC GND		8 LOGIC GND	
9 LOGIC GND		9 LOGIC GND		9 LOGIC GND		9 LOGIC GND	
10 GND		10 GND		10 GND		10 GND	
11 GND		11 GND		11 GND		11 GND	
12 GND		12 GND		12 GND		12 GND	
13 SELECT MOD 8		13 SELECT MOD 6		13 SELECT MOD 4		13 SELECT MOD 2	
14 GND		14 GND		14 GND		14 GND	
15 VDC E108		15 VDC E106		15 VDC E104		15 VDC E102	
16 VDC E108		16 VDC E106		16 VDC E104		16 VDC E102	
17 VDC E108		17 VDC E106		17 VDC E104		17 VDC E102	
18 PRESENCE MOD 8B		18 PRESENCE MOD 8B		18 PRESENCE MOD 4B		18 PRESENCE MOD 2B	
19 PRESENCE MOD 8A		19 PRESENCE MOD 6A		19 PRESENCE MOD 4A		19 PRESENCE MOD 2A	
20 GND		20 GND		20 GND		20 GND	
21 GND		21 GND		21 GND		21 GND	
22 GND		22 GND		22 GND		22 GND	
23 +12V		23 +12V		23 +12V		23 +12V	
24 RESET		24 RESET		24 RESET		24 RESET	
25 BIAS CTL MOD 8		25 BIAS CTL MOD 6		25 BIAS CTL MOD 4		25 BIAS CTL MOD 2	
26 FWD PWR		26 FWD PWR		26 FWD PWR		26 FWD PWR	
27 RFL PWR		27 RFL PWR		27 RFL PWR		27 RFL PWR	
28 TEMP		28 TEMP		28 TEMP		28 TEMP	
29 MOD CURRENT		29 MOD CURRENT		29 MOD CURRENT		29 MOD CURRENT	
30 SPARE		30 SPARE		30 SPARE		30 SPARE	
31 GND		31 GND		31 GND		31 GND	
32 GND		32 GND		32 GND		32 GND	
33 VDC E108		33 VDC E106		33 VDC E104		33 VDC E102	
34 VDC E108		34 VDC E106		34 VDC E104		34 VDC E102	
35 VDC E108		35 VDC E106		35 VDC E104		35 VDC E102	
36 GND		36 GND		36 GND		36 GND	

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MOTHERBOARD          CONTROLLER MOD
J111  ↔  J102
1 PRESENCE MOD BA
2 BIAS CTL MOD B
3 PRESENCE MOD GB
4 SELECT MOD B
5 PRESENCE MOD BA
6 BIAS CTL MOD B
7 PRESENCE MOD GB
8 SELECT MOD B
9 TEMP SAMPLE X10
10 FWD PWR
11 TEMP
12 SPARE
13 N/C
14 PRESENCE MOD GB
15 MOD CURRENT
16 RFL PWR
17 PRESENCE MOD GA
18 PRESENCE MOD AA
19 BIAS CTL MOD 4
20 PRESENCE MOD 4B
21 SELECT MOD 4
22 PRESENCE MOD 2A
23 BIAS CTL MOD 2
24 PRESENCE MOD 2B
25 SELECT MOD 2

```


NOTED BOARD P.S DIST  
J2017.202/J115 ← → J13

1 +12V  
2 +12V  
3 +12V  
4 N/C  
5 N/C  
6 -12V  
7 -12V  
8 -12V  
9 +5V  
10 CHASSIS GND

RF MODULE 10 J6	NOTHERBOARD J105 ↔ J6	RF MODULE 12 J6	NOTHERBOARD J103 ↔ J6	RF MODULE 14 J6	NOTHERBOARD J101 ↔ J6	RF MODULE 16 J6
	1 GND	1 GND	1 GND	1 GND	1 GND	1 GND
	2 RF IN	2 RF IN	2 RF IN	2 RF IN	2 RF IN	2 RF IN
	3 RF IN	3 RF IN	3 RF IN	3 RF IN	3 RF IN	3 RF IN
	4 GND	4 GND	4 GND	4 GND	4 GND	4 GND
	5 GND	5 GND	5 GND	5 GND	5 GND	5 GND
	6 +5V	6 +5V	6 +5V	6 +5V	6 +5V	6 +5V
	7 -12V	7 -12V	7 -12V	7 -12V	7 -12V	7 -12V
	8 LOGIC GND	8 LOGIC GND	8 LOGIC GND	8 LOGIC GND	8 LOGIC GND	8 LOGIC GND
	9 LOGIC GND	9 LOGIC GND	9 LOGIC GND	9 LOGIC GND	9 LOGIC GND	9 LOGIC GND
	10 GND	10 GND	10 GND	10 GND	10 GND	10 GND
	11 GND	11 GND	11 GND	11 GND	11 GND	11 GND
	12 GND	12 GND	12 GND	12 GND	12 GND	12 GND
MOD 7	13 SELECT MOD 5	13 SELECT MOD 3	13 SELECT MOD 3	13 SELECT MOD 3	13 SELECT MOD 1	13 SELECT MOD 1
	14 GND	14 GND	14 GND	14 GND	14 GND	14 GND
07	15 VDC E105	15 VDC E103	15 VDC E103	15 VDC E103	15 VDC E101	15 VDC E101
07	16 VDC E105	16 VDC E103	16 VDC E103	16 VDC E103	16 VDC E101	16 VDC E101
07	17 VDC E105	17 VDC E103	17 VDC E103	17 VDC E103	17 VDC E101	17 VDC E101
CE MOD 7B	18 PRESENCE MOD 5B	18 PRESENCE MOD 3B	18 PRESENCE MOD 3B	18 PRESENCE MOD 3B	18 PRESENCE MOD 1B	18 PRESENCE MOD 1B
CE MOD 7A	19 PRESENCE MOD 5A	19 PRESENCE MOD 3A	19 PRESENCE MOD 3A	19 PRESENCE MOD 3A	19 PRESENCE MOD 1A	19 PRESENCE MOD 1A
	20 GND	20 GND	20 GND	20 GND	20 GND	20 GND
	21 GND	21 GND	21 GND	21 GND	21 GND	21 GND
	22 GND	22 GND	22 GND	22 GND	22 GND	22 GND
	23 +12V	23 +12V	23 +12V	23 +12V	23 +12V	23 +12V
	24 RESET	24 RESET	24 RESET	24 RESET	24 RESET	24 RESET
CTL MOD 7	25 BIAS CTL MOD 5	25 BIAS CTL MOD 3	25 BIAS CTL MOD 3	25 BIAS CTL MOD 3	25 BIAS CTL MOD 1	25 BIAS CTL MOD 1
R	26 FWD PWR	26 FWD PWR	26 FWD PWR	26 FWD PWR	26 FWD PWR	26 FWD PWR
R	27 RFL PWR	27 RFL PWR	27 RFL PWR	27 RFL PWR	27 RFL PWR	27 RFL PWR
	28 TEMP	28 TEMP	28 TEMP	28 TEMP	28 TEMP	28 TEMP
CURRENT	29 MOD CURRENT	29 MOD CURRENT	29 MOD CURRENT	29 MOD CURRENT	29 MOD CURRENT	29 MOD CURRENT
	30 SPARE	30 SPARE	30 SPARE	30 SPARE	30 SPARE	30 SPARE
	31 GND	31 GND	31 GND	31 GND	31 GND	31 GND
	32 GND	32 GND	32 GND	32 GND	32 GND	32 GND
07	33 VDC E105	33 VDC E103	33 VDC E103	33 VDC E103	33 VDC E101	33 VDC E101
07	34 VDC E105	34 VDC E103	34 VDC E103	34 VDC E103	34 VDC E101	34 VDC E101
07	35 VDC E105	35 VDC E103	35 VDC E103	35 VDC E103	35 VDC E101	35 VDC E101
	36 GND	36 GND	36 GND	36 GND	36 GND	36 GND

NOTES:  
1) FOR SHEET 7 THRU 9 SEE G:\ILLUST\FM20S\FM20S-PINOUT1.XLS  
2) FOR SHEET 10 SEE G:\ILLUST\FM20S\FM20S-PS-PINOUT1.XLS

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	DESIGNER	FINISH	4100 N.24TH ST., P.O. BOX 3008 GAITHERSBURG, MD 20878 217/294-9800 TELEX 250142 CABLE BROADCAST FAX 217/294-9807			
	PROJ. LEADER	SEE DWG RAS20-0000	TITLE FM-20S OVERALL SCHEMATIC (MOTHERBOARD INTERFACE)			
	MG.	NEXT ASSY.	TYPE S <input type="checkbox"/> SIZE D <input checked="" type="checkbox"/> DWG. NO. 909-1020-386			
TOLERANCE (DECIMAL) U.D.S. X .01 .030 Y .005 X .02 .015 ANGLES ± 1°			MODEL FM-20S	SCALE NTS	SHEET 6 OF 6	



FM-20S OVERALL SCHEMATIC SHT. 7 OF10 (PAGE 1 OF 2)			CONTROLLER I/O BOARD AND WIRE HAR- NESS				37-PIN SUB-D CONNECTOR PIN- OUTS			
						MAIN	STAND- BY	EXC	IPA IN	IPA OUT
CON- TROL- LER	WIRE	CIRCUIT FUNCTION	CON- TROL- LER	CON- TROL- LER	WIRE	FX-50	FX-50	RELAY	RELAY	RELAY
I/O BOARD	HARNESS		RMTE I/F BD	RMTE I/F BD	HAR- NESS	EXCITER	EXCITER	S1	S2	S3
J5 -- P5	WIRE NO.		J5 - P5		WIRE NO.	TB1	TB1	J1 -- P1	J1 -- P1	J1 -- P1
1	102-WHT	STBY EXC RF MUTE	12	J2-3	P2/112-WHT		7			
2	102-YEL	STBY EXC AFC LOCK	13	J2-4	P2/112-Y EL		5			
3	104-RED	IPA IN RELAY CONTROL							2	
4	105-RED	IPA OUT RELAY CONTROL								2
5	103-RED	EXC OUT RELAY CON- TROL	20	J3-2	P3/113-R ED			2		
6	103 GRN	EXC RELAY TALLY	21	J3-3	P3/113-G RN			4		
7	104-GRN	IPA IN RELAY TALLY							4	
8	JUMPER	INTERLOCK RETURN								
9	101-RED	MAIN EXC OVER TEMP	5	J1-5	P1/111-R ED	8				
10	101-YEL	MAIN EXC AFC LOCK	4	J1-4	P1/111-Y EL	5				
11	105-GRN	IPA OUT RELAY TALLY								4
12										
13										
14	101-GRN	MAIN EXC FWD PWR	1	J1-4	P1/111-G RN	9				
15	101-ORN	MAIN EXC RFL PWR	2	J1-2	P1/111-O RN	10				
16	101-WHT	MAIN EXC RF MUTE	3	J1-3	P1/111- WHT	7				
17	106-GRN	FILTER A (1) FWD PWR								
18	106-RED	FILTER A (1) RFL PWR								
19	107-GRN	FILTER B (2) FWD PWR								
20	107-RED	FILTER B (2) RFL PWR								
21										
22										
23										
24										
25	JUMPER	INTERLOCK OUT								
26	104-BLK	+24V' TO IPA IN RELAY							1	
27	105-BLK	+24V' TO IPA OUT RELAY								1
28	103-BLK	+24V' TO EXC RELAY	19	J3-1	P3/113-B LK			1		

FM-20S OVERALL SCHEMATIC SHT. 7 OF 10 (PAGE 2 OF 2)

[illegible]

CONTROLLER I/O BOARD AND WIRE HARNESS

## 15-PIN SUB-D CONNECTOR PIN-OUTS

CON- TROL- LER	WIRE	CIRCUIT FUNCTION	AUX IPA IN	AUX IPA OUT							
I/O BOARD	HARNESS		RELAY S2	RELAY S3							
J9 ----- P9	WIRE NO.		J1 ----- P1	J1 ----- P1							
1	204-GRN	AUX IPA IN RELAY TALLY	4								
2	204-RED	AUX IPA IN RELAY CON- TROL	2								
3	204-BLK	+24V' to AUX IPA IN RELAY	1								
4											
5											
6	207-GRN	FILTER D (4) FWD PWR									
7	206-BLK	FILTER C (3) GND RETURN									
8	206-GRN	FILTER C (3) FWD PWR									
9	205-GRN	AUX IPA OUT RELAY TALLY	4								
10	205-RED	AUX IPA OUT RELAY CONTROL	2								
11	205-BLK	+24V' to AUX IPA OUT RELAY	1								
12											
13	207-RED	FILTER D (4) RFL PWR									
14	207-BLK	FILTER D (4) GND RETURN									
15	206-RED	FILTER C (3) RFL PWR									

FM-20S OVERALL SCHEMATIC SHT. 8 OF 10 (PAGE 1 OF 3)

CONTROL AND AUXILIARY CABINET

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MOTHERBOARD AND CONTROLLER MODULE CONTROL BOARD

25-PIN SUB-D CONNECTOR PIN-OUTS

		DATA	CONTROLLER	CONTROLLER

MOTHERBOARD CONNECTORS	CABLE	CHASSIS	MODULE CONTROL BD
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J110	CONTROL CAB MOTHERBD "A" LEFT	P110A/P1A	J1A	J1
J110	CONTROL CAB MOTHERBD "B" RIGHT	P110B/P101B	J101B	J101
J110	AUX CAB MOTHERBD "C" LEFT	P110C/P1C	J1C	J1
J110	AUX CAB MOTHERBD "D" RIGHT	P110D/P101D	J101D	J101
1	SELECT MODULE 9	1	1	1
2	LOGIC GND	2	2	2
3	LOGIC GND	3	3	3
4	RESET	4	4	4
5	LOGIC GND	5	5	5
6	BIAS CONTROL MODULE 7	6	6	6
7	SELECT MODULE 7	7	7	7
8	BIAS CONTROL MODULE 5	8	8	8
9	SELECT MODULE 5	9	9	9
10	PRESENCE MODULE 3A	10	10	10
11	PRESENCE MODULE 3B	11	11	11
12	SELECT MODULE 3	12	12	12
13	PRESENCE MODULE 1A	13	13	13
14	BIAS CONTROL MODULE 1	14	14	14
15	SELECT MODULE 1	15	15	15
16	BIAS CONTROL MODULE 3	16	16	16
17	PRESENCE MODULE 1B	17	17	17
18	PRESENCE MODULE 5B	18	18	18
19	PRESENCE MODULE 5A	19	19	19
20	PRESENCE MODULE 7B	20	20	20
21	PRESENCE MODULE 7A	21	21	21
22	N/C	22	22	22
23	N/C	23	23	23
24	BIAS CONTROL MODULE 9	24	24	24
25	LOGIC GND	25	25	25

FM-20S OVERALL SCHEMATIC SHT. 8 OF 10 (PAGE 2 OF 3)

CONTROL AND AUXILIARY CABINET

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MOTHERBOARD AND CONTROLLER MODULE CONTROL BOARD

25-PIN SUB-D CONNECTOR PIN-OUTS CONTD\_

		DATA	CONTROLLER	CONTROLLER
MOTHERBOARD CONNECTORS		CABLE	CHASSIS	MODULE CONTROL BD
J111	CONTROL CAB MOTHERBD "A" LEFT	P111A/P2A	J2A	J2
J111	CONTROL CAB MOTHERBD "B" RIGHT	P111B/P102B	J102B	J102
J111	AUX CAB MOTHERBD "C" LEFT	P111C/P2C	J2C	J2
J111	AUX CAB MOTHERBD "D" RIGHT	P111D/P102D	J102D	J102
1	PRESENCE MODULE 6A	1	1	1
2	BIAS CONTROL MODULE 6	2	2	2
3	PRESENCE MODULE 6B	3	3	3
4	SELECT MODULE 6	4	4	4
5	PRESENCE MODULE 8A	5	5	5
6	BIAS CONTROL MODULE 8	6	6	6
7	PRESENCE MODULE 8B	7	7	7
8	SELECT MODULE 8	8	8	8
9	TEMP SAMPLE X 5 (IPA REJ LOAD)	9	9	9
10	MODULE FORWARD POWER	10	10	10
11	MODULE TEMPERATURE	11	11	11
12	SPARE	12	12	12
13	N/C	13	13	13
14	PRESENCE MODULE 9B	14	14	14
15	MODULE CURRENT	15	15	15
16	MODULE REFLECTED POWER	16	16	16
17	PRESENCE MODULE 9A	17	17	17
18	PRESENCE MODULE 4A	18	18	18
19	BIAS CONTROL MODULE 4	19	19	19
20	PRESENCE MODULE 4B	20	20	20
21	SELECT MODULE 4	21	21	21
22	PRESENCE MODULE 2A	22	22	22
23	BIAS CONTROL MODULE 2	23	23	23
24	PRESENCE MODULE 2B	24	24	24
25	SELECT MODULE 2	25	25	25



FM-20S OVERALL SCHEMATIC SHT. 8 OF 10 (PAGE 3 OF 3)			
CONTROL AND AUXILIARY CABINET			
MOTHERBOARD AND IPA SPLITER REJECT LOAD TEMPERATURE SENSOR BOARD			
4-PIN CONNECTOR PIN-OUTS			
MOTHERBOARD "A"			TEMP SENSOR BOARD
OR "C" CONNECTOR	WIRE HARNESS	CIRCUIT FUNCTION	(IPA REJECT LOAD)
J114	P114/P1		J1
1	RED	+12V	1
2	N/C	TEMP SAMPLE (.01V/DEG.C)	2
3	BLACK	TEMP SAMPLE X 5	3
4	SHIELD	GND	4

FM-20S OVERALL SCHEMATIC SHT. 9 OF 10 (PAGE 1 OF 2)						
CONTROL OR AUXILIARY CABINET						
8-WAY COMBINER "A" LEFT OR "C" LEFT						
9-PIN SUB-D CONNECTOR PINOUTS						
TOP COMBINER INPUT CONTROL BOARD		RIBBON	DATA	CONTROL- LER		
9-PIN SUB-D CONNECTOR		CABLE	CABLE	CHASSIS	CONTROLLER MODULE CON- TROL BD	
J1B	CONTROL CAB 8-WAY COMBINER "A"	P1	P1AT/P3A	J3A	J3	9-PIN SUB-D CONNECTOR
J1B	AUX CAB 8-WAY COMBINER "C"	P1	P1CT/P3C	J3C	J3	9-PIN SUB-D CONNECTOR
1	RELAY K4 PIN 2 COIL (-) RETURN	1	1	1	1	MODULE 1 FAULT - GROUND
2	RELAY K3 PIN 2 COIL (-) RETURN	2	2	2	2	MODULE 3 FAULT - GROUND
3	RELAYS K1 THRU K4 PIN 1 COIL (+)	3	3	3	3	DC +12V TO RELAY COILS
4	RELAY K2 PIN 2 COIL (-) RETURN	4	4	4	4	MODULE 5 FAULT - GROUND
5	RELAY K1 PIN 2 COIL (-) RETURN	5	5	5	5	MODULE 7 FAULT - GROUND
6	LOGIC GROUND	6	6	6	6	LOGIC GROUND
7	LOGIC GROUND	7	7	7	7	LOGIC GROUND
8	LOGIC GROUND	8	8	8	8	LOGIC GROUND
9	LOGIC GROUND	9	9	9	9	LOGIC GROUND
BOTTOM COMBINER INPUT CONTROL BOARD		RIBBON	DATA	CONTROL- LER		
9-PIN SUB-D CONNECTOR		CABLE	CABLE	CHASSIS	CONTROLLER MODULE CON- TROL BD	
J1	CONTROL CAB 8-WAY COMBINER "A"	P1	P1AB/P4A	J4A	J4	9-PIN SUB-D CONNECTOR
J1	AUX CAB 8-WAY COMBINER "C"	P1	P1CB/P4C	J4C	J4	9-PIN SUB-D CONNECTOR
1	RELAY K4 PIN 2 COIL (-) RETURN	1	1	1	1	MODULE 2 FAULT - GROUND
2	RELAY K3 PIN 2 COIL (-) RETURN	2	2	2	2	MODULE 4 FAULT - GROUND
3	RELAYS K1 THRU K4 PIN 1 COIL (+)	3	3	3	3	DC +12V TO RELAY COILS
4	RELAY K2 PIN 2 COIL (-) RETURN	4	4	4	4	MODULE 6 FAULT - GROUND
5	RELAY K1 PIN 2 COIL (-) RETURN	5	5	5	5	MODULE 8 FAULT - GROUND
6	LOGIC GROUND	6	6	6	6	LOGIC GROUND
7	LOGIC GROUND	7	7	7	7	LOGIC GROUND
8	LOGIC GROUND	8	8	8	8	LOGIC GROUND
9	LOGIC GROUND	9	9	9	9	LOGIC GROUND

FM-20S OVERALL SCHEMATIC SHT. 9 OF 10 (PAGE 2 OF 2)						
CONTROL OR AUXILIARY CABINET						
8-WAY COMBINER "B" RIGHT OR "D" RIGHT						
9-PIN SUB-D CONNECTOR PINOUTS						
TOP COMBINER INPUT CONTROL BOARD		RIBBON	DATA	CONTROL- LER		
9-PIN SUB-D CONNECTOR		CABLE	CABLE	CHASSIS	CONTROLLER MODULE CON- TROL BD	
J1	CONTROL CAB 8-WAY COMBINER "B"	P1	P1BT/ P103B	J103B	J103	9-PIN SUB-D CONNECTOR
J1	AUX CAB 8-WAY COMBINER "D"	P1	P1DT/ P103D	J103D	J103	9-PIN SUB-D CONNECTOR
1	RELAY K4 PIN 2 COIL (-) RETURN	1	1	1	1	MODULE 15 FAULT - GROUND
2	RELAY K3 PIN 2 COIL (-) RETURN	2	2	2	2	MODULE 13 FAULT - GROUND
3	RELAYS K1 THRU K4 PIN 1 COIL (+)	3	3	3	3	DC +12V TO RELAY COILS
4	RELAY K2 PIN 2 COIL (-) RETURN	4	4	4	4	MODULE 11 FAULT - GROUND
5	RELAY K1 PIN 2 COIL (-) RETURN	5	5	5	5	MODULE 9 FAULT - GROUND
6	LOGIC GROUND	6	6	6	6	LOGIC GROUND
7	LOGIC GROUND	7	7	7	7	LOGIC GROUND
8	LOGIC GROUND	8	8	8	8	LOGIC GROUND
9	LOGIC GROUND	9	9	9	9	LOGIC GROUND
BOTTOM COMBINER INPUT CONTROL BOARD		RIBBON	DATA	CONTROL- LER		
9-PIN SUB-D CONNECTOR		CABLE	CABLE	CHASSIS	CONTROLLER MODULE CON- TROL BD	
J1B	CONTROL CAB 8-WAY COMBINER "B"	P1	P1BB/P104 B	J104B	J104	9-PIN SUB-D CONNECTOR
J1B	AUX CAB 8-WAY COMBINER "D"	P1	P1DB/P104 D	J104D	J104	9-PIN SUB-D CONNECTOR
1	RELAY K4 PIN 2 COIL (-) RETURN	1	1	1	1	MODULE 10 FAULT - GROUND
2	RELAY K3 PIN 2 COIL (-) RETURN	2	2	2	2	MODULE 12 FAULT - GROUND
3	RELAYS K1 THRU K4 PIN 1 COIL (+)	3	3	3	3	DC +12V TO RELAY COILS
4	RELAY K2 PIN 2 COIL (-) RETURN	4	4	4	4	MODULE 14 FAULT - GROUND
5	RELAY K1 PIN 2 COIL (-) RETURN	5	5	5	5	MODULE 16 FAULT - GROUND
6	LOGIC GROUND	6	6	6	6	LOGIC GROUND
7	LOGIC GROUND	7	7	7	7	LOGIC GROUND
8	LOGIC GROUND	8	8	8	8	LOGIC GROUND
9	LOGIC GROUND	9	9	9	9	LOGIC GROUND

FM-20S OVERALL SCHEMATIC SHT. 10 OF 10 (PAGE 1 OF 4)			909-1020-386
CONTROL OR AUXILIARY CABINET			
P.S. DISTRIBUTION BOARD AND P.S. HARNESS			
CONNECTOR PIN-OUTS			
P.S. DISTRIB. BOARD			5KW POWER SUPPLY
CONNECTOR	DATA CABLE	CIRCUIT FUNCTION	PS# 1 THRU PS#5
J1 THRU J5	P1/P6 THRU P5/P10		J1
1	1	SENSE + (DC OUT SAMPLE)	1
2	2	VC+ (CONTROL VOLTAGE)	2
3	3	FAULT	3
4	4	VC_GND	4
9	9	LOGIC GND	9
10	10	CURRENT SHARE	10
13	13	P.S. INHIBIT	13
P.S. DISTRIB. BOARD			TEMP SENSOR BOARD
CONNECTOR	WIRE HARNESS	CIRCUIT FUNCTION	(INLET)
J6	P6/P15		J1
1	145	+12V	1
2	N/C	TEMP SAMPLE (.01V/DEG.C)	2
3	146	TEMP SAMPLE X 5	3
4	147	GND	4
P.S. DISTRIB. BOARD			
CONNECTOR	WIRE HARNESS	CIRCUIT FUNCTION	OCR
J8	P8		K1
1	143	OCR CONTROL (+12V)	E3
2	144	LOGIC GND	E4
P.S. DISTRIB. BOARD			
CONNECTOR	WIRE HARNESS	CIRCUIT FUNCTION	5KW POWER SUPPLY
J9	P9		PS# 1 THRU PS#5
1	RED	SENSE + (DC OUT SAMPLE)	DC OUTPUT BUS +
2	BLACK	VC_GND	DC OUTPUT BUS -

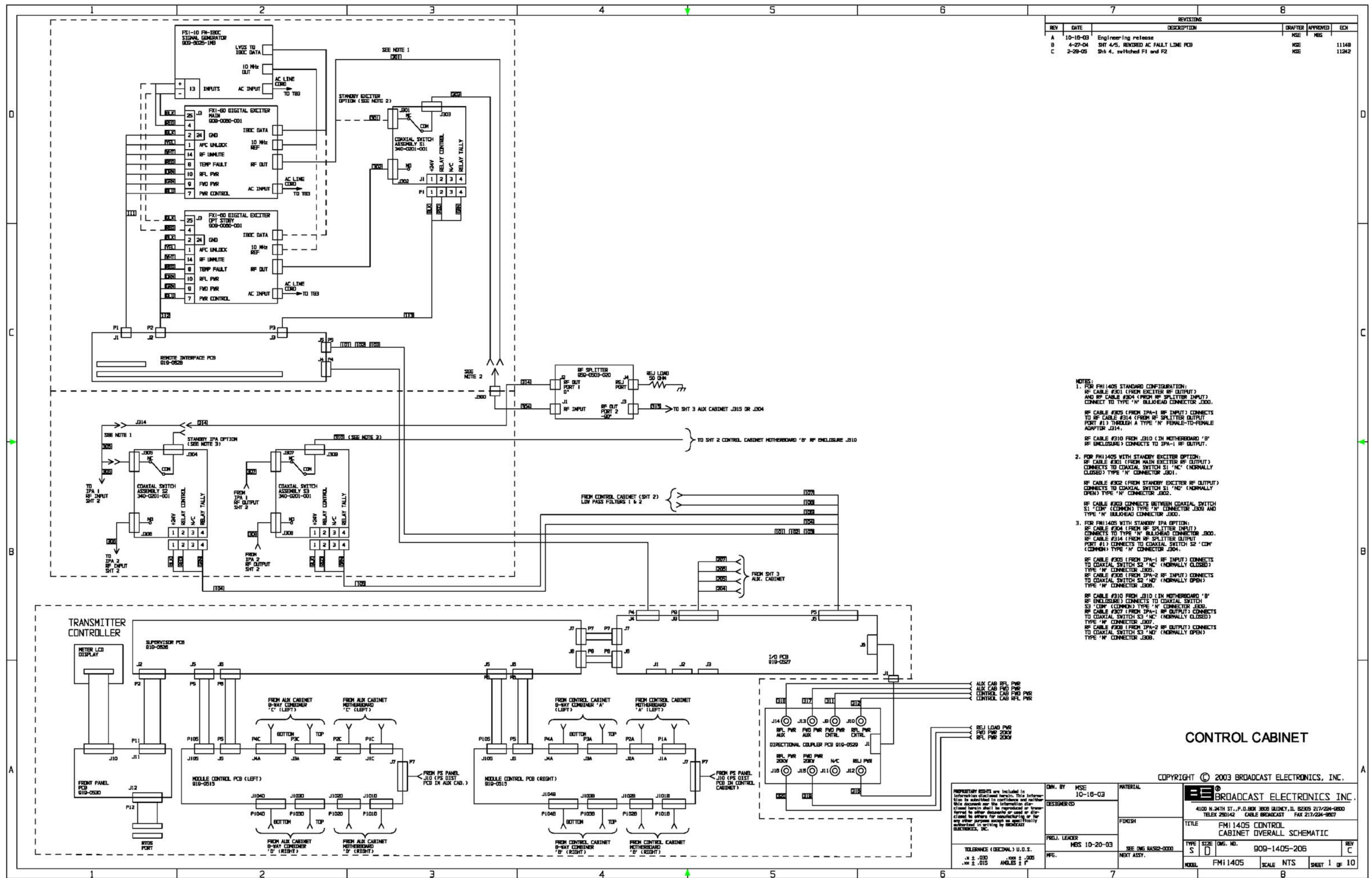
FM-20S OVERALL SCHEMATIC SHT. 10 OF 10 (PAGE 2 OF 4)			909-1020-386
CONTROL OR AUXILIARY CABINET			
P.S. DISTRIBUTION BOARD AND P.S. HARNESS			
CONNECTOR PIN-OUTS CONTD_			
P.S. DISTRIB. BOARD			CONTROLLER
CONNECTOR	WIRE HARNESS	CIRCUIT FUNCTION	MODULE CONTROL BOARD
J10	P10/P7A		J7
1	BLACK	VC+	1
2	RED	VC GND	2
3	GREEN	P.S.FAULT 1	3
4	WHITE	LOGIC GND	4
5	BROWN	P.S.INHIBIT	5
6	BLUE	P.S.FAULT 2	6
7	ORANGE	P.S.FAULT 3	7
8	YELLOW	P.S.FAULT 4	8
9	VIOLET	P.S.FAULT 5	9
10	GRAY	TEMP SAMPLE X 5 (INLET)	10
11	PINK	HI/LO AC LINE SENSOR	11
12	TAN	OCR CONTROL (+12V)	12
13	RED/GREEN	+24V	13
14	RED/YELLOW	+48V (DC OUT SAMPLE)	14
15	RED/BLACK	+5V	15
16	WHITE/BLACK	+5V	16
17	WHITE/RED	+5V	17
18	WHITE/GREEN	GND	18
19	WHITE/YELLOW	GND	19
20	WHITE/BLUE	GND	20
21	WHITE/BROWN	GND	21
22	WHITE/ORANGE	-12V	22
23	WHITE/GRAY	-12V	23
24	WHITE/VIOLET	+12V	24
25	BLACK/RED	+12V	25

FM-20S OVERALL SCHEMATIC SHT. 10 OF 10 (PAGE 3 OF 4)			909-1020-386	
CONTROL OR AUXILIARY CABINET				
P.S. DISTRIBUTION BOARD AND P.S. HARNESS				
CONNECTOR PIN-OUTS CONTD_				
P.S. DISTRIB. BOARD				LOW VOLTAGE
CONNECTOR	WIRE HARNESS	CIRCUIT FUNCTION	WIRE HARNESS	POWER SUPPLY
J11	P11		P12	J2
1	132	+5V	132	1
2	131	+5V	131	2
3	130	+5V	130	3
4	129	GND	129	4
5	128	GND	128	5
6	127	GND	127	6
7	126	GND	126	7
8	125	+12V	125	8
9	124	+12V	124	9
10	123	GND	123	10
11	122	-12V	122	11
12	121	+24V	N/C	12
			121	13
				LOW VOLTAGE
		CIRCUIT FUNCTION	WIRE HARNESS	POWER SUPPLY
			P13	J1
		GND	136	1
			N/C	2
		AC LINE NEUTRAL	138	3
			N/C	4
		AC LINE PHASE 2 (SWITCHED)	137	5

FM-20S OVERALL SCHEMATIC SHT. 10 OF 10 (PAGE 4 OF 4)			909-1020-386		
CONTROL OR AUXILIARY CABINET					
P.S. DISTRIBUTION BOARD AND P.S. HARNESS					
CONNECTOR PIN-OUTS CONTD_					
P.S. DISTRIB. BOARD	DATA CABLE		MOTHERBOARD "A"/"C' OR "B"/"D"		
CONNECTOR	P12/P201A OR	CIRCUIT FUNCTION	DC CONNECTOR BOARD		MOTHERBOARD
J12 OR J13	P13/P201B		J201	J202	J115
1	1	+12V	1	1	1
2	2	+12V	2	2	2
3	3	N/C	3	4	4
4	4	-12V	4	6	6
5	5	+5V	5	9	9
6	6	+12V	6	3	3
7	7	N/C	7	5	5
8	8	-12V	8	7	7
9	9	-12V	9	8	8
SHELL	SHIELD	CHASSIS GND	CHASSIS GND	10	10
POWER SUPPLY HARNESS		CIRCUIT FUNCTION	AC LINE FAULT IND. BOARD		
CONNECTOR P1	WIRE NO.		J1		
1	240	LOSS OF AC LINE PHASE 1	1		
2	241	LOGIC GND	2		
3	242	LOSS OF AC LINE PHASE 2	3		
4	243	LOGIC GND	4		
5	244	LOSS OF AC LINE PHASE 3	5		
6	245	LOGIC GND	6		





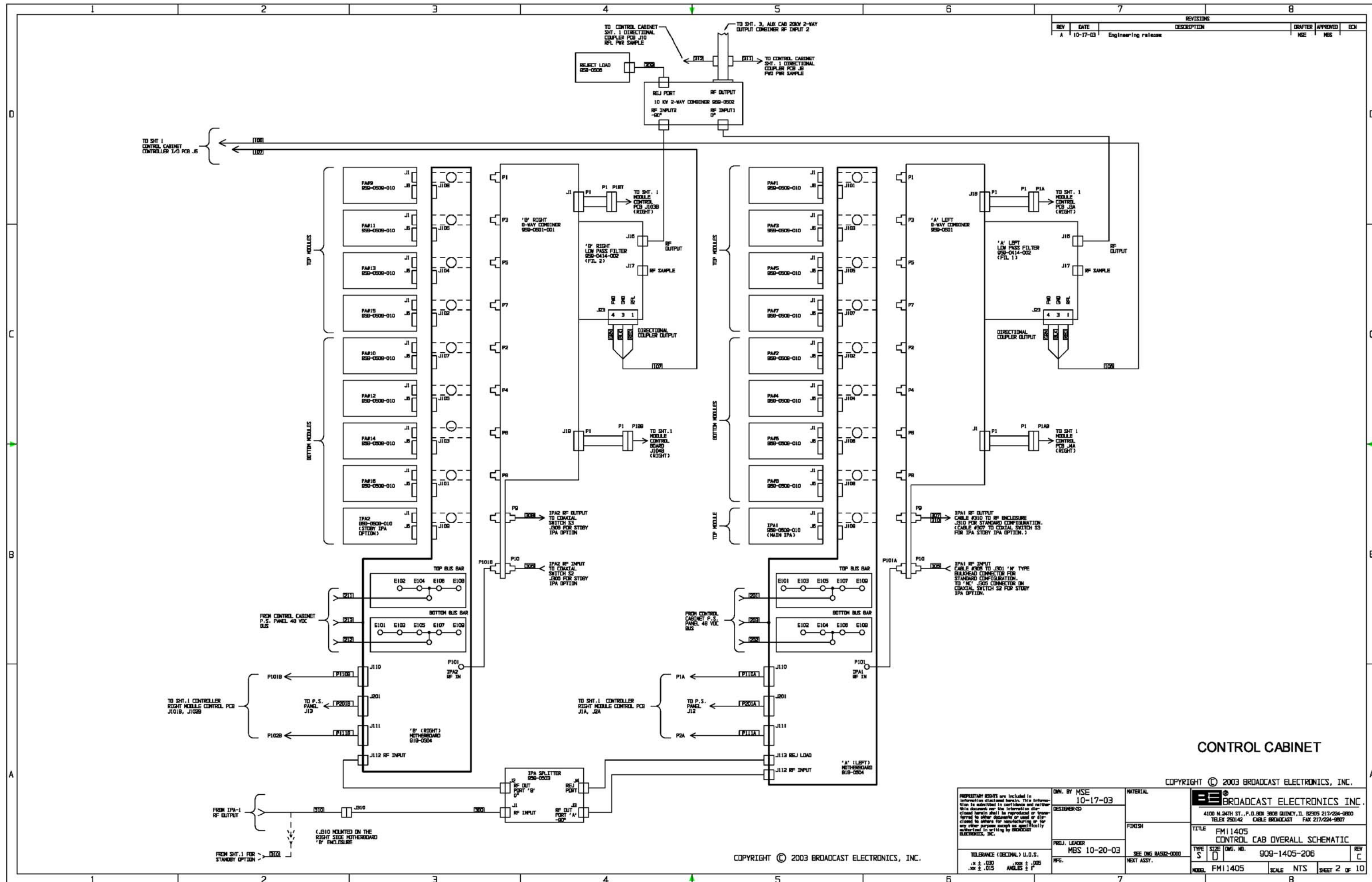


REVISIONS				
REV	DATE	DESCRIPTION	DRAFTER	APPROVED
A	10-18-03	Engineering release	KSE	HBS
B	4-27-04	SHT 4/5, REVISED AC FAULT LINE PCB	KSE	
C	2-29-05	Sht 4, switched F1 and F2	KSE	

- NOTES:
- FOR FM1140S STANDARD CONFIGURATION:  
RF CABLE #301 (FROM EXCITER RF OUTPUT) AND RF CABLE #304 (FROM RF SPLITTER INPUT) CONNECT TO TYPE 'N' BULKHEAD CONNECTOR J300.  
RF CABLE #305 (FROM IPA-1 RF INPUT) CONNECTS TO RF CABLE #314 (FROM RF SPLITTER OUTPUT PORT #1) THROUGH A TYPE 'N' FEMALE-TO-FEMALE ADAPTOR J314.  
RF CABLE #310 (FROM J310 (IN MOTHERBOARD 'B' RF ENCLOSURE) CONNECTS TO IPA-1 RF OUTPUT.
  - FOR FM1140S WITH STANDBY EXCITER OPTION:  
RF CABLE #301 (FROM MAIN EXCITER RF OUTPUT) CONNECTS TO COAXIAL SWITCH S1 'NC' (NORMALLY CLOSED) TYPE 'N' CONNECTOR J301.  
RF CABLE #302 (FROM STANDBY EXCITER RF OUTPUT) CONNECTS TO COAXIAL SWITCH S1 'NO' (NORMALLY OPEN) TYPE 'N' CONNECTOR J302.  
RF CABLE #303 CONNECTS BETWEEN COAXIAL SWITCH S1 'COM' (COMMON) TYPE 'N' CONNECTOR J303 AND TYPE 'N' BULKHEAD CONNECTOR J300.  
RF CABLE #304 (FROM RF SPLITTER INPUT) CONNECTS TO TYPE 'N' BULKHEAD CONNECTOR J300.  
RF CABLE #314 (FROM RF SPLITTER OUTPUT PORT #1) CONNECTS TO COAXIAL SWITCH S2 'COM' (COMMON) TYPE 'N' CONNECTOR J304.  
RF CABLE #305 (FROM IPA-1 RF INPUT) CONNECTS TO COAXIAL SWITCH S2 'NC' (NORMALLY CLOSED) TYPE 'N' CONNECTOR J305.  
RF CABLE #306 (FROM IPA-2 RF INPUT) CONNECTS TO COAXIAL SWITCH S2 'NO' (NORMALLY OPEN) TYPE 'N' CONNECTOR J306.  
RF CABLE #310 (FROM J310 (IN MOTHERBOARD 'B' RF ENCLOSURE) CONNECTS TO COAXIAL SWITCH S3 'COM' (COMMON) TYPE 'N' CONNECTOR J303.  
RF CABLE #307 (FROM IPA-1 RF OUTPUT) CONNECTS TO COAXIAL SWITCH S3 'NC' (NORMALLY CLOSED) TYPE 'N' CONNECTOR J307.  
RF CABLE #308 (FROM IPA-2 RF OUTPUT) CONNECTS TO COAXIAL SWITCH S3 'NO' (NORMALLY OPEN) TYPE 'N' CONNECTOR J308.

CONTROL CABINET

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DESIGNER MES 10-20-03		PROJ. LEADER MES 10-20-03	TITLE FM1140S CONTROL CABINET OVERALL SCHEMATIC	
TOLERANCE (DECIMAL) U.O.S. INCHES ± .030 ANGLES ± 1°		REV. C	TYPE S SIZE D ENG. NO. 909-1405-206	
NEXT ASSY.		SCALE NTS	SHEET 1 OF 10	



REVISIONS			DRAFTER			APPROVED			ECN		
REV	DATE	DESCRIPTION	MSE	MBS							
A	10-17-03	Engineering release									

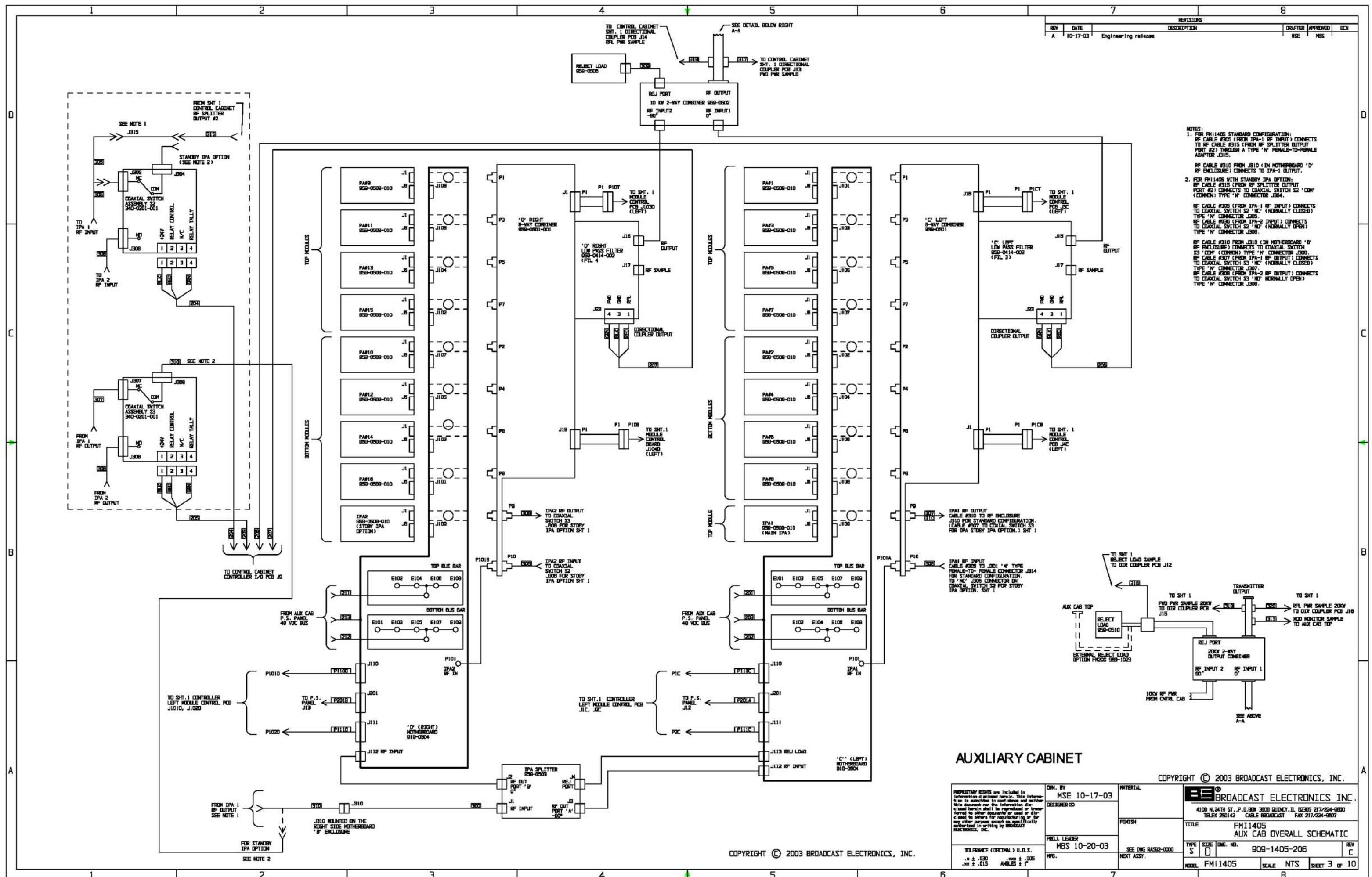
# CONTROL CABINET

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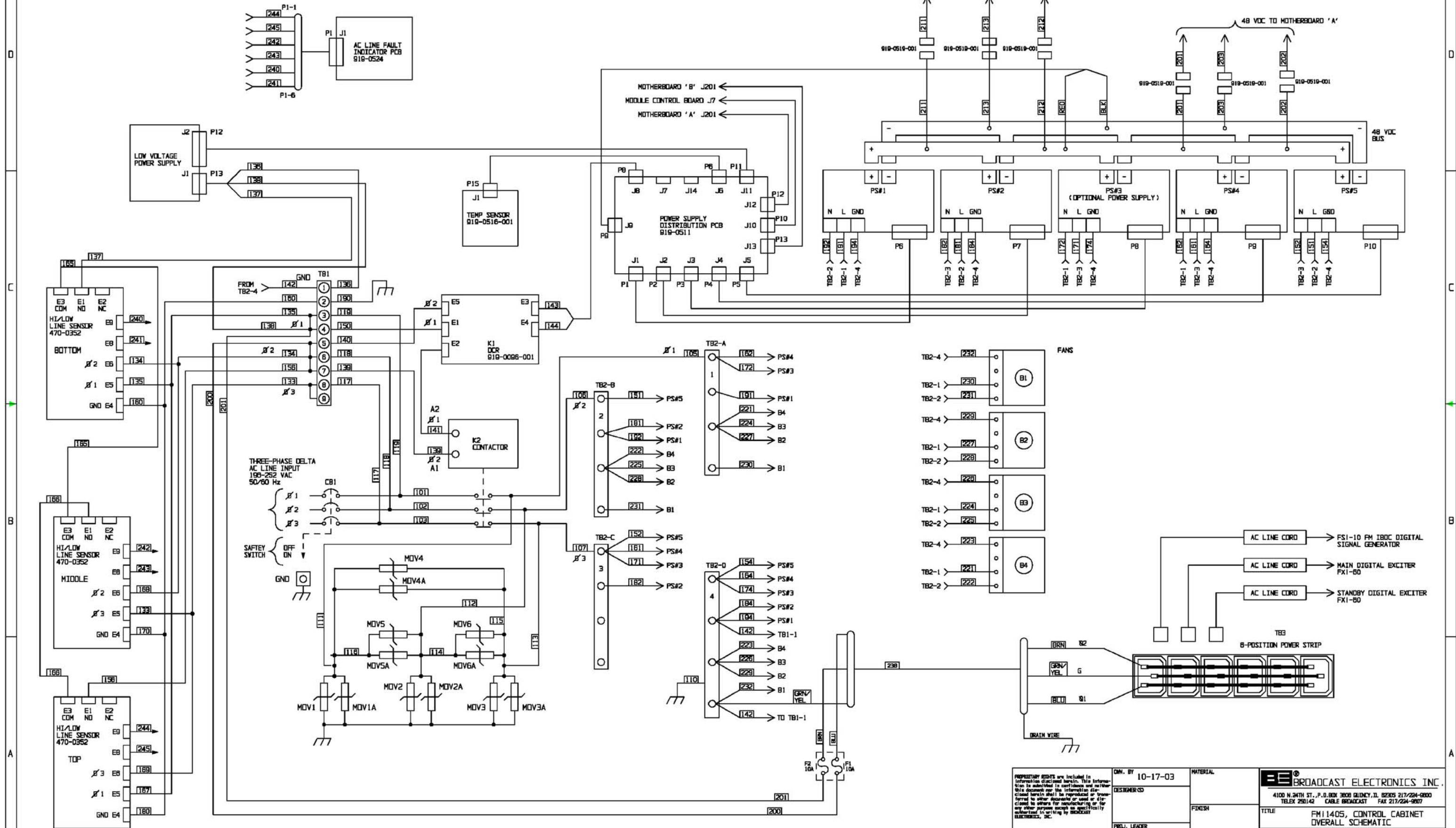
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		DESIGNER MBS 10-20-03		SEE ENG BMSR-0000 NEXT ASSY.	
TOLERANCE (DECIMAL) U.D.S. .XX ± .030 .XX ± .015		PROJ. LEADER MBS 10-20-03		TITLE FM11405 CONTROL CAB OVERALL SCHEMATIC	
ANGLES ± 1°		TYPE S		SIZE D	
MODEL FM11405		SCALE NTS		SHEET 2 OF 10	

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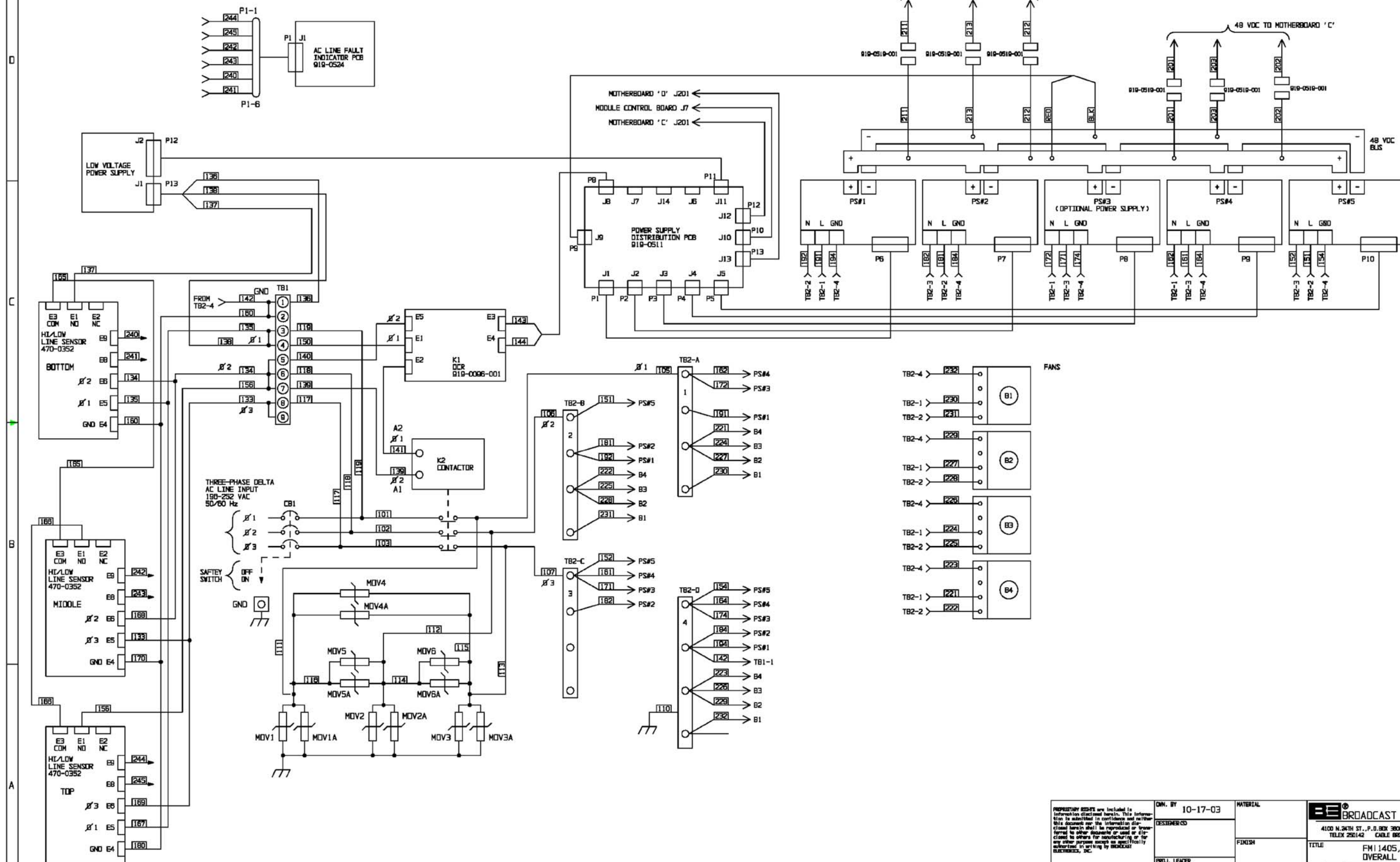
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	EDN
A	10-17-03	Engineering release	NSE	MBS	11148
B	4-27-04	REVISED AC FAULT LINE PCB	NSE		11242
C	2-28-05	Switched F1 and F2	NSE		




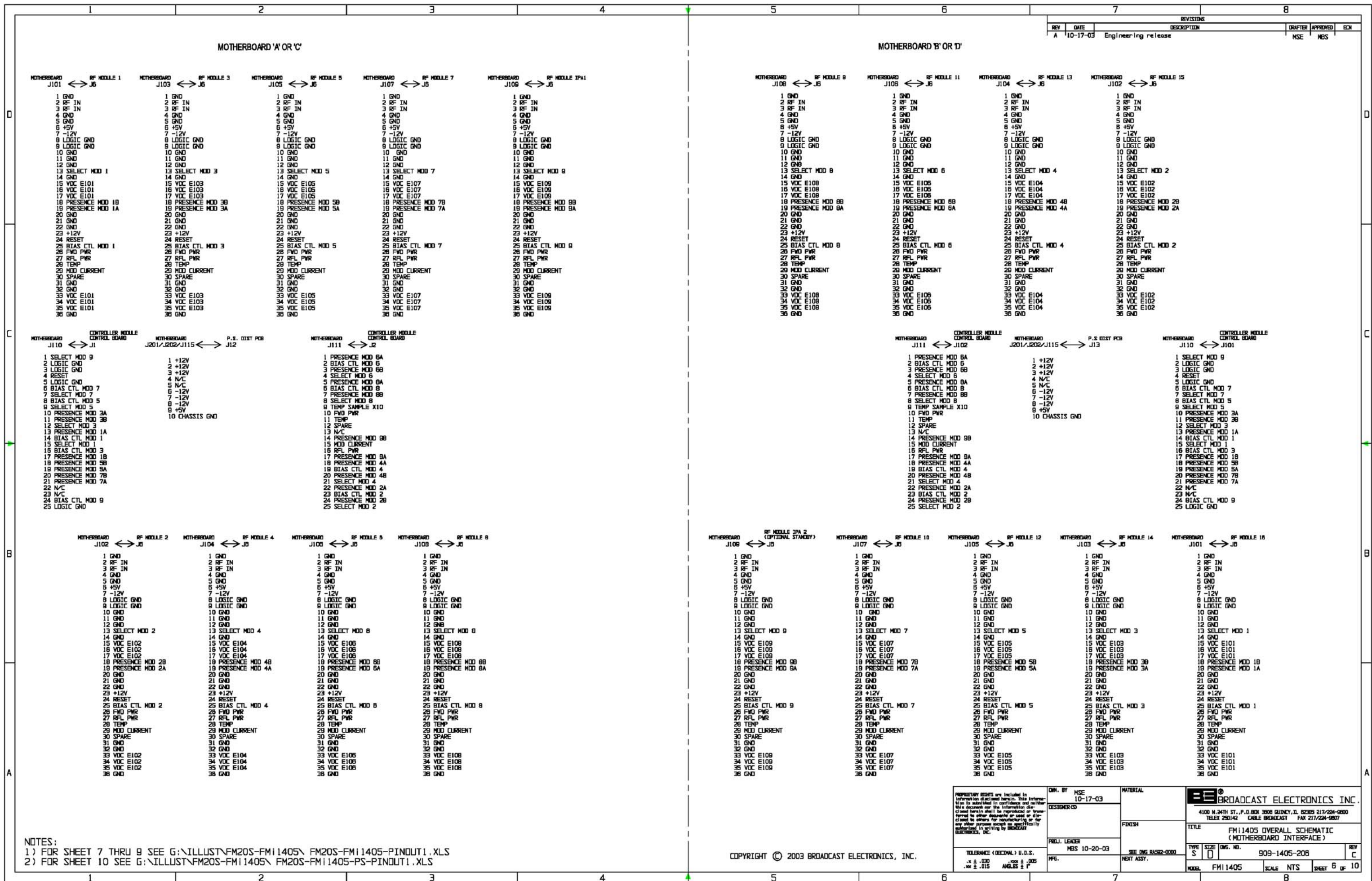
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DESIGNER CS	FINISH	FILED, LEADER MBS 10-20-03	SEE DWG BASED-0001	TITLE FM1405, CONTROL CABINET OVERALL SCHEMATIC	
TOLERANCE (DECIMAL) U.O.S. .X ± .030 .XX ± .015	ANGLES ± 1°	REV C	TYPE S	SIZE D	DWG. NO. 908-1405-206
MODEL FM1405	SCALE NTS	SHEET 4 OF 10			



REV		DATE	DESCRIPTION	DRAWN	APPROVED	ECN
A	10-17-03	Engineering release		RSE	MBS	11148
B	4-27-04	REVISED AC FAULT LINE PCB		RSE		



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	DESIGNER CD			
TOLERANCE (DECIMAL) U.S.S. .X ± .030 .XXX ± .005 .XX ± .015 ANGLES ± 1°	PROJ. LEADER MBS 10-20-03	SEE DWS RAS02-0000	TITLE FM1140S, AUXILIARY CABINET OVERALL SCHEMATIC	
	PFG.	NEXT ASSY.		TYPE S SIZE 0 DWG. NO. 909-1405-206 REV C
		MODEL FM1140S	SCALE NTS	SHEET 5 OF 10





FM-20S/FMi1405 OVERALL SCHEMATIC SHT. 7 OF10 (PAGE 1 OF 3)			CONTROLLER I/O BOARD AND WIRE HARNESS				37-PIN SUB-D CONNECTOR PIN-OUTS			
						MAIN	STAND- BY	EXC	IPA IN	IPA OUT
CON- TROL- LER	WIRE	CIRCUIT FUNCTION	CON- TROL- LER	CON- TROL- LER	WIRE	FX-50	FX-50	RELAY	RELAY	RELAY
I/O BOARD	HAR- NESS		RMTE I/F BD	RMTE I/F BD	HAR- NESS	EXCIT- ER	EXCIT- ER	S1	S2	S3
J5-- P5	WIRE NO.		J5 ----- P5		WIRE NO.	TB1	TB1	J1 ----- P1	J1 ----- P1	J1 ----- P1
1	102-WHT	STBY EXC RF MUTE	12	J2-3	P2/112 -WHT		7			
2	102-YEL	STBY EXC AFC LOCK	13	J2-4	P2/112 -YEL		5			
3	104-RED	IPA IN RELAY CONTROL							2	
4	105-RED	IPA OUT RELAY CONTROL								2
5	103-RED	EXC OUT RELAY CON- TROL	20	J3-2	P3/113 -RED			2		
6	103 GRN	EXC RELAY TALLY	21	J3-3	P3/113 -GRN			4		
7	104-GRN	IPA IN RELAY TALLY							4	
8	JUMPER	INTERLOCK RETURN								
9	101-RED	MAIN EXC OVER TEMP	5	J1-5	P1/111- RED	8				
10	101-YEL	MAIN EXC AFC LOCK	4	J1-4	P1/111- YEL	5				
11	105-GRN	IPA OUT RELAY TALLY								4
12	101-BLU	NOT USED	7	J1-7	P1/111- BLU					
13	102-BLU	NOT USED	16	J2-7	P2/112 -BLU					
14	101-GRN	MAIN EXC FWD PWR	1	J1-4	P1/111- GRN	9				
15	101-ORN	MAIN EXC RFL PWR	2	J1-2	P1/111- ORN	10				
16	101-WHT	MAIN EXC RF MUTE	3	J1-3	P1/111- WHT	7				
17	106-GRN	FILTER A (1) FWD PWR								
18	106-RED	FILTER A (1) RFL PWR								
19	107-GRN	FILTER B (2) FWD PWR								

[illegible]



[illegible]

FM-20S/FMi-1405 OVERALL SCHEMATIC SHT. 7 OF 10 (PAGE 3 OF 3)			CONTROLLER I/O BOARD AND WIRE HARNESS				37-PIN SUB-D CONNECTOR PIN-OUTS				
37-PIN			25-PIN			MAIN	STAND-BY	EXC	IPA IN	IPA OUT	LOW
CON-TROL-LER	WIRE	CIRCUIT FUNC-TION	CON-TROL-LER	CON-TROL-LER	WIRE	FXI-60	FXI-60	RELAY	RELAY	RELAY	PASS
I/O BOARD	HAR-NESS		RMTE I/F BD	RMTE I/F BD	HAR-NESS	EXCIT-ER	EXCIT-ER	S1	S2	S3	FIL-TER
J5 ----- P5	WIRE NO.		J5 ----- P5		WIRE NO.	J3	J3	J1 ----- P1	J1 ----- P1	J1 ----- P1	J23
1	102-WHT	STBY EXC RF UN-MUTE	12	J2-3	P2/112 -WHT		14				
2	102-YEL	STBY EXC AFC UNLOCK	13	J2-4	P2/112 -YEL		1				
3	104-RED	IPA IN RELAY CONTROL							2		
4	105-RED	IPA OUT RELAY CONTROL								2	
5	103-RED	EXC OUT RELAY CONTROL	20	J3-2	P3/113 -RED			2			
6	103 GRN	EXC RELAY TALLY	21	J3-3	P3/113 -GRN			4			
7	104-GRN	IPA IN RELAY TALLY							4		
8	JUMPER	INTERLOCK RETURN									
9	101-RED	MAIN EXC OVER TEMP	5	J1-5	P1/111 -RED	8					
10	101-YEL	MAIN EXC AFC UNLOCK	4	J1-4	P1/111 -YEL	1					
11	105-GRN	IPA OUT RELAY TALLY								4	
12	101-BLU	MAIN EXC PWR CONTROL	7	J1-7	P1/111 -BLU	7					
13	102-BLU	STBY EXC PWR CONTROL	16	J2-7	P2/112 -BLU		7				
14	101-GRN	MAIN EXC FWD PWR	1	J1-4	P1/111 -GRN	9					
15	101-ORN	MAIN EXC RFL PWR	2	J1-2	P1/111 -ORN	10					
16	101-WHT	MAIN EXC RF UN-MUTE	3	J1-3	P1/111 -WHT	14					
17	106-GRN	FILTER A (1) FWD PWR									4
18	106-RED	FILTER A (1) RFL PWR									1
19	107-GRN	FILTER B (2) FWD PWR									4

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FM-20S/FMi-1405 OVERALL SCHEMATIC SHT. 8 OF 10 (PAGE 1 OF 3)								
CONTROL AND AUXILIARY CABINET								
MOTHERBOARD AND CONTROLLER MODULE CONTROL BOARD								
25-PIN SUB-D CONNECTOR PIN-OUTS								
		DATA	CONTROLLER	CONTROLLER				
MOTHERBOARD CONNECTORS		CABLE	CHASSIS	MODULE CON- TROL BD				
J110	CONTROL CAB MOTHERBD "A" LEFT	P110A/P1A	J1A	J1				
J110	CONTROL CAB MOTHERBD "B" RIGHT	P110B/P101B	J101B	J101				
J110	AUX CAB MOTHERBD "C" LEFT	P110C/P1C	J1C	J1				
J110	AUX CAB MOTHERBD "D" RIGHT	P110D/P101D	J101D	J101				
1	SELECT MODULE 9	1	1	1				
2	LOGIC GND	2	2	2				
3	LOGIC GND	3	3	3				
4	RESET	4	4	4				
5	LOGIC GND	5	5	5				
6	BIAS CONTROL MODULE 7	6	6	6				
7	SELECT MODULE 7	7	7	7				
8	BIAS CONTROL MODULE 5	8	8	8				
9	SELECT MODULE 5	9	9	9				
10	PRESENCE MODULE 3A	10	10	10				
11	PRESENCE MODULE 3B	11	11	11				
12	SELECT MODULE 3	12	12	12				
13	PRESENCE MODULE 1A	13	13	13				
14	BIAS CONTROL MODULE 1	14	14	14				
15	SELECT MODULE 1	15	15	15				
16	BIAS CONTROL MODULE 3	16	16	16				
17	PRESENCE MODULE 1B	17	17	17				
18	PRESENCE MODULE 5B	18	18	18				
19	PRESENCE MODULE 5A	19	19	19				
20	PRESENCE MODULE 7B	20	20	20				
21	PRESENCE MODULE 7A	21	21	21				
22	N/C	22	22	22				
23	N/C	23	23	23				
24	BIAS CONTROL MODULE 9	24	24	24				
25	LOGIC GND	25	25	25				

## CONTROL AND AUXILIARY CABINET

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## MOTHERBOARD AND CONTROLLER MODULE CONTROL BOARD

## 25-PIN SUB-D CONNECTOR PIN-OUTS CONTD\_

		DATA	CONTROLLER	CONTROLLER			
MOTHERBOARD CONNECTORS		CABLE	CHASSIS	MODULE CONTROL BD			
J111	CONTROL CAB MOTHERBD "A" LEFT	P111A/P2A	J2A	J2			
J111	CONTROL CAB MOTHERBD "B" RIGHT	P111B/P102B	J102B	J102			
J111	AUX CAB MOTHERBD "C" LEFT	P111C/P2C	J2C	J2			
J111	AUX CAB MOTHERBD "D" RIGHT	P111D/P102D	J102D	J102			
1	PRESENCE MODULE 6A	1	1	1			
2	BIAS CONTROL MODULE 6	2	2	2			
3	PRESENCE MODULE 6B	3	3	3			
4	SELECT MODULE 6	4	4	4			
5	PRESENCE MODULE 8A	5	5	5			
6	BIAS CONTROL MODULE 8	6	6	6			
7	PRESENCE MODULE 8B	7	7	7			
8	SELECT MODULE 8	8	8	8			
9	TEMP SAMPLE X 5 (IPA REJ LOAD)	9	9	9			
10	MODULE FORWARD POWER	10	10	10			
11	MODULE TEMPERATURE	11	11	11			
12	SPARE	12	12	12			
13	N/C	13	13	13			
14	PRESENCE MODULE 9B	14	14	14			
15	MODULE CURRENT	15	15	15			
16	MODULE REFLECTED POWER	16	16	16			
17	PRESENCE MODULE 9A	17	17	17			
18	PRESENCE MODULE 4A	18	18	18			
19	BIAS CONTROL MODULE 4	19	19	19			
20	PRESENCE MODULE 4B	20	20	20			
21	SELECT MODULE 4	21	21	21			
22	PRESENCE MODULE 2A	22	22	22			
23	BIAS CONTROL MODULE 2	23	23	23			
24	PRESENCE MODULE 2B	24	24	24			
25	SELECT MODULE 2	25	25	25			

FM-20S/FMi-1405 OVERALL SCHEMATIC SHT. 8 OF 10 (PAGE 3 OF 3)									
CONTROL AND AUXILIARY CABINET									
MOTHERBOARD AND IPA SPLITER REJECT LOAD TEMPERATURE SENSOR BOARD									
4-PIN CONNECTOR PIN-OUTS									
MOTHERBOARD "A"			TEMP SENSOR BOARD						
	□	□	□	□	□	□	□	□	□
OR "C" CON-NECTOR	WIRE HAR-NESS	CIRCUIT FUNCTION	(IPA REJECT LOAD)						
J114	P114/P1		J1						
1	RED	+12V	1						
2	N/C	TEMP SAMPLE (.01V/DEG.C)	2						
3	BLACK	TEMP SAMPLE X 5	3						
4	SHIELD	GND	4						

FM-20S/FMi-1405 OVERALL SCHEMATIC SHT. 9 OF 10 (PAGE 1 OF 2)						
CONTROL OR AUXILIARY CABINET						
8-WAY COMBINER "A" LEFT OR "C" LEFT						
9-PIN SUB-D CONNECTOR PINOUTS						
TOP COMBINER INPUT CONTROL BOARD		RIB- BON	DATA	CON- TROL- LER		
9-PIN SUB-D CONNECTOR		CABLE	CABLE	CHAS- SIS	CON- TROLLER MODULE CONTROL BD	
J1B	CONTROL CAB 8-WAY COMBINER "A"	P1	P1AT/P3A	J3A	J3	9-PIN SUB-D CON- NECTOR
J1B	AUX CAB 8-WAY COMBINER "C"	P1	P1CT/P3C	J3C	J3	9-PIN SUB-D CON- NECTOR
1	RELAY K4 PIN 2 COIL (-) RETURN	1	1	1	1	MODULE 1 FAULT - GROUND
2	RELAY K3 PIN 2 COIL (-) RETURN	2	2	2	2	MODULE 3 FAULT - GROUND
3	RELAYS K1 THRU K4 PIN 1 COIL (+)	3	3	3	3	DC +12V TO RELAY COILS
4	RELAY K2 PIN 2 COIL (-) RETURN	4	4	4	4	MODULE 5 FAULT - GROUND
5	RELAY K1 PIN 2 COIL (-) RETURN	5	5	5	5	MODULE 7 FAULT - GROUND
6	LOGIC GROUND	6	6	6	6	LOGIC GROUND
7	LOGIC GROUND	7	7	7	7	LOGIC GROUND
8	LOGIC GROUND	8	8	8	8	LOGIC GROUND
9	LOGIC GROUND	9	9	9	9	LOGIC GROUND
BOTTOM COMBINER INPUT CONTROL BOARD		RIB- BON	DATA	CON- TROL- LER		
9-PIN SUB-D CONNECTOR		CABLE	CABLE	CHAS- SIS	CON- TROLLER MODULE CONTROL BD	
J1	CONTROL CAB 8-WAY COMBINER "A"	P1	P1AB/P4A	J4A	J4	9-PIN SUB-D CON- NECTOR

J1	AUX CAB 8-WAY COMBINER "C"	P1	P1CB/P4C	J4C	J4	9-PIN SUB-D CONNECTOR
1	RELAY K4 PIN 2 COIL (-) RETURN	1	1	1	1	MODULE 2 FAULT - GROUND
2	RELAY K3 PIN 2 COIL (-) RETURN	2	2	2	2	MODULE 4 FAULT - GROUND
3	RELAYS K1 THRU K4 PIN 1 COIL (+)	3	3	3	3	DC +12V TO RELAY COILS
4	RELAY K2 PIN 2 COIL (-) RETURN	4	4	4	4	MODULE 6 FAULT - GROUND
5	RELAY K1 PIN 2 COIL (-) RETURN	5	5	5	5	MODULE 8 FAULT - GROUND
6	LOGIC GROUND	6	6	6	6	LOGIC GROUND
7	LOGIC GROUND	7	7	7	7	LOGIC GROUND
8	LOGIC GROUND	8	8	8	8	LOGIC GROUND
9	LOGIC GROUND	9	9	9	9	LOGIC GROUND



FM-20S/FMi-1405 OVERALL SCHEMATIC SHT. 9 OF 10 (PAGE 2 OF 2)						
CONTROL OR AUXILIARY CABINET						
8-WAY COMBINER "B" RIGHT OR "D" RIGHT						
9-PIN SUB-D CONNECTOR PINOUTS						
TOP COMBINER INPUT CONTROL BOARD		RIB-BON	DATA	CON-TROL-LER		
9-PIN SUB-D CONNECTOR		CABLE	CABLE	CHAS-SIS	CON-TROLLER MODULE CONTROL BD	
J1	CONTROL CAB 8-WAY COMBINER "B"	P1	P1BT/P103B	J103B	J103	9-PIN SUB-D CONNECTOR
J1	AUX CAB 8-WAY COMBINER "D"	P1	P1DT/P103D	J103D	J103	9-PIN SUB-D CONNECTOR
1	RELAY K4 PIN 2 COIL (-) RETURN	1	1	1	1	MODULE 15 FAULT - GROUND
2	RELAY K3 PIN 2 COIL (-) RETURN	2	2	2	2	MODULE 13 FAULT - GROUND
3	RELAYS K1 THRU K4 PIN 1 COIL (+)	3	3	3	3	DC +12V TO RELAY COILS
4	RELAY K2 PIN 2 COIL (-) RETURN	4	4	4	4	MODULE 11 FAULT - GROUND
5	RELAY K1 PIN 2 COIL (-) RETURN	5	5	5	5	MODULE 9 FAULT - GROUND
6	LOGIC GROUND	6	6	6	6	LOGIC GROUND
7	LOGIC GROUND	7	7	7	7	LOGIC GROUND
8	LOGIC GROUND	8	8	8	8	LOGIC GROUND
9	LOGIC GROUND	9	9	9	9	LOGIC GROUND
BOTTOM COMBINER INPUT CONTROL BOARD		RIB-BON	DATA	CON-TROL-LER		
9-PIN SUB-D CONNECTOR		CABLE	CABLE	CHAS-SIS	CON-TROLLER MODULE CONTROL BD	
J1B	CONTROL CAB 8-WAY COMBINER "B"	P1	P1BB/P104B	J104B	J104	9-PIN SUB-D CONNECTOR

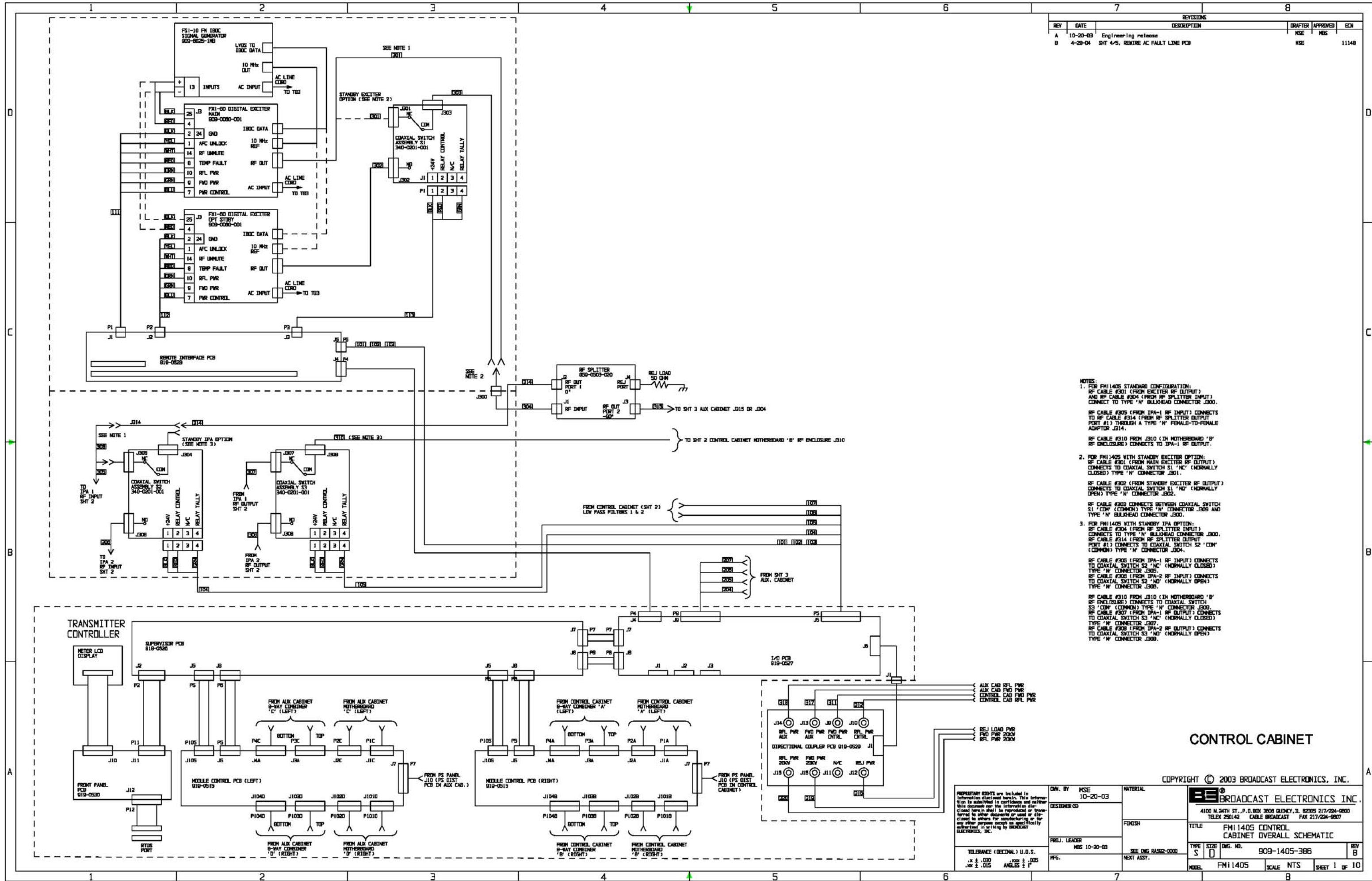
J1B	AUX CAB 8-WAY COMBINER "D"	P1	P1DB/P104D	J104D	J104	9-PIN SUB-D CONNECTOR
1	RELAY K4 PIN 2 COIL (-) RETURN	1	1	1	1	MODULE 10 FAULT - GROUND
2	RELAY K3 PIN 2 COIL (-) RETURN	2	2	2	2	MODULE 12 FAULT - GROUND
3	RELAYS K1 THRU K4 PIN 1 COIL (+)	3	3	3	3	DC +12V TO RELAY COILS
4	RELAY K2 PIN 2 COIL (-) RETURN	4	4	4	4	MODULE 14 FAULT - GROUND
5	RELAY K1 PIN 2 COIL (-) RETURN	5	5	5	5	MODULE 16 FAULT - GROUND
6	LOGIC GROUND	6	6	6	6	LOGIC GROUND
7	LOGIC GROUND	7	7	7	7	LOGIC GROUND
8	LOGIC GROUND	8	8	8	8	LOGIC GROUND
9	LOGIC GROUND	9	9	9	9	LOGIC GROUND

FM-20S/FMi-1405 OVERALL SCHEMATIC SHT. 10 OF 10 (PAGE 1 OF 4)			909-1020-206 / 909-1405-206
CONTROL OR AUXILIARY CABINET			
P.S. DISTRIBUTION BOARD AND P.S. HARNESS			
CONNECTOR PIN-OUTS			
P.S. DISTRIB. BOARD			5KW POWER SUPPLY
CONNECTOR	DATA CABLE	CIRCUIT FUNCTION	PS# 1 THRU PS# 5
J1 THRU J5	P1/P6 THRU P5/P10		J1
1	1	SENSE + (DC OUT SAMPLE)	1
2	2	VC+ (CONTROL VOLTAGE)	2
3	3	FAULT	3
4	4	VC_GND	4
9	9	LOGIC GND	9
10	10	CURRENT SHARE	10
13	13	P.S. INHIBIT	13
P.S. DISTRIB. BOARD			TEMP SENSOR BOARD
	□	□	□
CONNECTOR	WIRE HARNESS	CIRCUIT FUNCTION	(INLET)
J6	P6/P15		J1
1	145	+12V	1
2	N/C	TEMP SAMPLE (.01V/DEG.C)	2
3	146	TEMP SAMPLE X 5	3
4	147	GND	4
P.S. DISTRIB. BOARD			
CONNECTOR	WIRE HARNESS	CIRCUIT FUNCTION	OCR
J8	P8		K1
1	143	OCR CONTROL (+12V)	E3
2	144	LOGIC GND	E4
P.S. DISTRIB. BOARD			
CONNECTOR	WIRE HARNESS	CIRCUIT FUNCTION	5KW POWER SUPPLY
J9	P9		PS# 1 THRU PS# 5
1	RED	SENSE + (DC OUT SAMPLE)	DC OUTPUT BUS +
2	BLACK	VC_GND	DC OUTPUT BUS -

FM-20S/FMi-1405 OVERALL SCHEMATIC SHT. 10 OF 10 (PAGE 2 OF 4)			909-1020-206 / 909-1405-206
CONTROL OR AUXILIARY CABINET			
P.S. DISTRIBUTION BOARD AND P.S. HARNESS			
CONNECTOR PIN-OUTS CONTD_			
P.S. DISTRIB. BOARD			CONTROLLER
CONNECTOR	WIRE HARNESS	CIRCUIT FUNCTION	MODULE CONTROL BOARD
J10	P10/P7A		J7
1	BLACK	VC+	1
2	RED	VC GND	2
3	GREEN	P.S.FAULT 1	3
4	WHITE	LOGIC GND	4
5	BROWN	P.S.INHIBIT	5
6	BLUE	P.S.FAULT 2	6
7	ORANGE	P.S.FAULT 3	7
8	YELLOW	P.S.FAULT 4	8
9	VIOLET	P.S.FAULT 5	9
10	GRAY	TEMP SAMPLE X 5 (INLET)	10
11	PINK	HI/LO AC LINE SENSOR	11
12	TAN	OCR CONTROL (+12V)	12
13	RED/GREEN	+24V	13
14	RED/YELLOW	+48V (DC OUT SAMPLE)	14
15	RED/BLACK	+5V	15
16	WHITE/BLACK	+5V	16
17	WHITE/RED	+5V	17
18	WHITE/GREEN	GND	18
19	WHITE/YELLOW	GND	19
20	WHITE/BLUE	GND	20
21	WHITE/BROWN	GND	21
22	WHITE/ORANGE	-12V	22
23	WHITE/GRAY	-12V	23
24	WHITE/VIOLET	+12V	24
25	BLACK/RED	+12V	25

FM-20S/FMi-1405 OVERALL SCHEMATIC SHT. 10 OF 10 (PAGE 3 OF 4)			909-1020-206 / 909-1405-206	
CONTROL OR AUXILIARY CABINET				
P.S. DISTRIBUTION BOARD AND P.S. HARNESS				
CONNECTOR PIN-OUTS CONTD_				
P.S. DISTRIB. BOARD				LOW VOLTAGE
CONNECTOR	WIRE HARNESS	CIRCUIT FUNCTION	WIRE HARNESS	POWER SUP-PLY
J11	P11		P12	J2
1	132	+5V	132	1
2	131	+5V	131	2
3	130	+5V	130	3
4	129	GND	129	4
5	128	GND	128	5
6	127	GND	127	6
7	126	GND	126	7
8	125	+12V	125	8
9	124	+12V	124	9
10	123	GND	123	10
11	122	-12V	122	11
12	121	+24V	N/C	12
			121	13
				LOW VOLTAGE
		CIRCUIT FUNCTION	WIRE HARNESS	POWER SUP-PLY
			P13	J1
		GND	136	1
			N/C	2
		AC LINE PHASE 1	138	3
			N/C	4
		AC LINE PHASE 2 (SWITCHED)	137	5

FM-20S/FMi-1405 OVERALL SCHEMATIC SHT. 10 OF 10 (PAGE 4 OF 4)			909-1020-206 / 909-1405-206		
CONTROL OR AUXILIARY CABINET					
P.S. DISTRIBUTION BOARD AND P.S. HARNESS					
CONNECTOR PIN-OUTS CONTD_					
P.S. DISTRIB. BOARD	DATA CABLE		MOTHERBOARD "A"/"C" OR "B"/"D"		
CONNECTOR	P12/P201A OR	CIRCUIT FUNC- TION	DC CONNECTOR BOARD		MOTHER- BOARD
	□	□	□	□	□
J12 OR J13	P13/P201B		J201	J202	J115
1	1	+12V	1	1	1
2	2	+12V	2	2	2
3	3	N/C	3	4	4
4	4	-12V	4	6	6
5	5	+5V	5	9	9
6	6	+12V	6	3	3
7	7	N/C	7	5	5
8	8	-12V	8	7	7
9	9	-12V	9	8	8
SHELL	SHIELD	CHASSIS GND	CHASSIS GND	10	10
POWER SUPPLY HARNESS		CIRCUIT FUNC- TION	AC LINE FAULT IND. BOARD		
	□	□	□	□	□
CONNECTOR P1	WIRE NO.		J1		
1	242	LOSS OF AC LINE PHASE 1-2	1		
2	243	LOGIC GND	2		
3	240	LOSS OF AC LINE PHASE 2-3	3		
4	241	LOGIC GND	4		
5	244	LOSS OF AC LINE PHASE 3-1	5		
6	245	LOGIC GND	6		



REVISIONS							
REV	DATE	DESCRIPTION			DRAFTER	APPROVED	ECN
A	10-20-03	Engineering release			MSE	MBS	
B	4-29-04	SHT 4/5, REMOVE AC FAULT LINE PCB			MSE		11148

- NOTES:
- FOR FM1405 STANDARD CONFIGURATION:  
RF CABLE #301 (FROM EXCITER RF OUTPUT) AND RF CABLE #304 (FROM RF SPLITTER INPUT) CONNECT TO TYPE 'N' BULKHEAD CONNECTOR J300.
  - FOR FM1405 WITH STANDBY EXCITER OPTION:  
RF CABLE #301 (FROM MAIN EXCITER RF OUTPUT) CONNECTS TO COAXIAL SWITCH S1 'NC' (NORMALLY CLOSED) TYPE 'N' CONNECTOR J301.  
RF CABLE #302 (FROM STANDBY EXCITER RF OUTPUT) CONNECTS TO COAXIAL SWITCH S1 'NO' (NORMALLY OPEN) TYPE 'N' CONNECTOR J302.  
RF CABLE #303 CONNECTS BETWEEN COAXIAL SWITCH S1 'COM' (COMMON) TYPE 'N' CONNECTOR J303 AND TYPE 'N' BULKHEAD CONNECTOR J300.
  - FOR FM1405 WITH STANDBY IPA OPTION:  
RF CABLE #304 (FROM RF SPLITTER INPUT) CONNECTS TO TYPE 'N' BULKHEAD CONNECTOR J300.  
RF CABLE #304 (FROM RF SPLITTER OUTPUT PORT #1) CONNECTS TO COAXIAL SWITCH S2 'COM' (COMMON) TYPE 'N' CONNECTOR J304.  
RF CABLE #305 (FROM IPA-1 RF INPUT) CONNECTS TO COAXIAL SWITCH S2 'NC' (NORMALLY CLOSED) TYPE 'N' CONNECTOR J305.  
RF CABLE #306 (FROM IPA-2 RF INPUT) CONNECTS TO COAXIAL SWITCH S2 'NO' (NORMALLY OPEN) TYPE 'N' CONNECTOR J306.  
RF CABLE #310 (FROM J310 (IN MOTHERBOARD 'B' RF ENCLOSURE) CONNECTS TO COAXIAL SWITCH S3 'COM' (COMMON) TYPE 'N' CONNECTOR J309.  
RF CABLE #307 (FROM IPA-1 RF OUTPUT) CONNECTS TO COAXIAL SWITCH S3 'NC' (NORMALLY CLOSED) TYPE 'N' CONNECTOR J307.  
RF CABLE #308 (FROM IPA-2 RF OUTPUT) CONNECTS TO COAXIAL SWITCH S3 'NO' (NORMALLY OPEN) TYPE 'N' CONNECTOR J308.

## CONTROL CABINET

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	DESIGNER	CD						
TOLERANCE (DECIMAL) U.O.S. X ± .030 X ± .015	PROJ. LEADER	MBS	10-20-03	SEE ENG BASED-0000	TITLE FM1405 CONTROL CABINET OVERALL SCHEMATIC			
	MFG.					TYPE S	SIZE D	DWG. NO. 909-1405-386
				NEXT ASST.	MODEL FM1405	SCALE NTS	SHEET 1	OF 10







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10-20-03 Engineering release  
4-29-04 REVISE AC FAULT LINE PCB

REVISIONS

DRAWN BY MSE 10-20-03  
DESIGNED BY  
PWLJ. LEADER MBS 10-20-03  
PFG.

MATERIAL

FINISH

SEE DWS RAS2-0000

NEXT ASSY.

4100 N. 24TH ST., P.O. BOX 3000 GULF BAY, FL 33705 217/224-8000  
TELEX 250142 CABLE BROADCAST FAX 217/224-9007

TITLE FM11405 WYE CNTRL CAB  
P.S. OVERALL SCHEMATIC

TYPE S D  
SIZE DWS. NO. 909-1405-386  
REV B

MODEL FM11405 SCALE NTS SHEET 4 OF 10

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10-20-03 Engineering release  
4-29-04 REVISE AC FAULT LINE PCB

REVISIONS

DRAFTER MSE  
APPROVED MMS  
ECL 11148

48 VDC TO MOTHERBOARD 'B'

48 VDC TO MOTHERBOARD 'A'

48 VDC BUS

PS#1 PS#2 PS#3 (OPTIONAL POWER SUPPLY) PS#4 PS#5

N L GND

TB2-5 TB2-4 TB2-3 TB2-2 TB2-1

FANS

TB2-4 TB2-1 TB2-5 TB2-4 TB2-1 TB2-5 TB2-4 TB2-1 TB2-5 TB2-4 TB2-1 TB2-5

AC LINE CORD

PS1-10 FM 180C SIGNAL GENERATOR

AC LINE CORD

MAIN DIGITAL EXCITER FX1-60

AC LINE CORD

STANDBY DIGITAL EXCITER FX1-60

TB3 6-POSITION POWER STRIP

DRAIN WIRE

TO TB1-1

MOV1 MOV2 MOV3 MOV7 MOV1A MOV2A MOV3A MOV7A

THREE-PHASE WYE AC LINE INPUT 330-437 VAC L/L 196-252 VAC L/N 50/60 Hz

SAFETY SWITCH OFF ON

K2 CONTACTOR

E2K1 OCR 918-0096-001

TEMP SENSOR 919-0516-001

AC LINE FAULT INDICATOR PCB 919-0524

LOW VOLTAGE POWER SUPPLY

HI/LOW LINE SENSOR 470-0352 BOTTOM

HI/LOW LINE SENSOR 470-0352 MIDDLE

HI/LOW LINE SENSOR 470-0352 TOP

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TOLERANCE (DECIMAL) U.S.S.  
IN ± .030  
W ± .015

OWN. BY MSE 10-20-03  
DESIGNER CD  
PROJ. LEADER MBS 10-20-03  
PFG.

MATERIAL  
FINISH  
SEE ENG. DRAWING 0000  
NEXT ASSY.

BROADCAST ELECTRONICS INC.  
4100 N. 24TH ST., P.O. BOX 3000 GULF BAY, FL 33705 217/224-8000  
TELEX 250142 CABLE BROADCAST FAX 217/224-9007

TITLE FM11405 WYE CNTRL CAB  
P.S. OVERALL SCHEMATIC

TYPE S  
SIZE D  
QWS. NO. 909-1405-386  
REV B

MODEL FM11405 SCALE NTS SHEET 4 OF 10

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REVISIONS

REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECH
A	10-20-03	Engineering release	MSE	MES	11148
B	4-29-04	REVISE AC FAULT LINE PCB	MSE		

FM11405 P.S. OVERALL SCHEMATIC

4100 N. 24TH ST., P.O. BOX 3000 GUNN, IL 62305 217/224-8000  
TELEX 250142 CABLE BROADCAST FAX 217/224-9007

TITLE: FM11405 WYE CNTRL CAB  
P.S. OVERALL SCHEMATIC  
TYPE: S  
SIZE: D  
DWS. NO.: 909-1405-386  
REV: B  
MODEL: FM11405  
SCALE: NTS  
SHEET: 4 OF 10

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REVISIONS

REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECH
A	10-20-03	Engineering release	MSE	MES	11148
B	4-29-04	REVISE AC FAULT LINE PCB	MSE		

FM11405 P.S. OVERALL SCHEMATIC

4100 N. 24TH ST., P.O. BOX 3000 GUNN, IL 62305 217/224-8000  
TELEX 250142 CABLE BROADCAST FAX 217/224-9007

TITLE: FM11405 WYE CNTRL CAB  
P.S. OVERALL SCHEMATIC  
TYPE: S  
SIZE: D  
DWS. NO.: 909-1405-386  
REV: B  
MODEL: FM11405  
SCALE: NTS  
SHEET: 4 OF 10

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REVISIONS

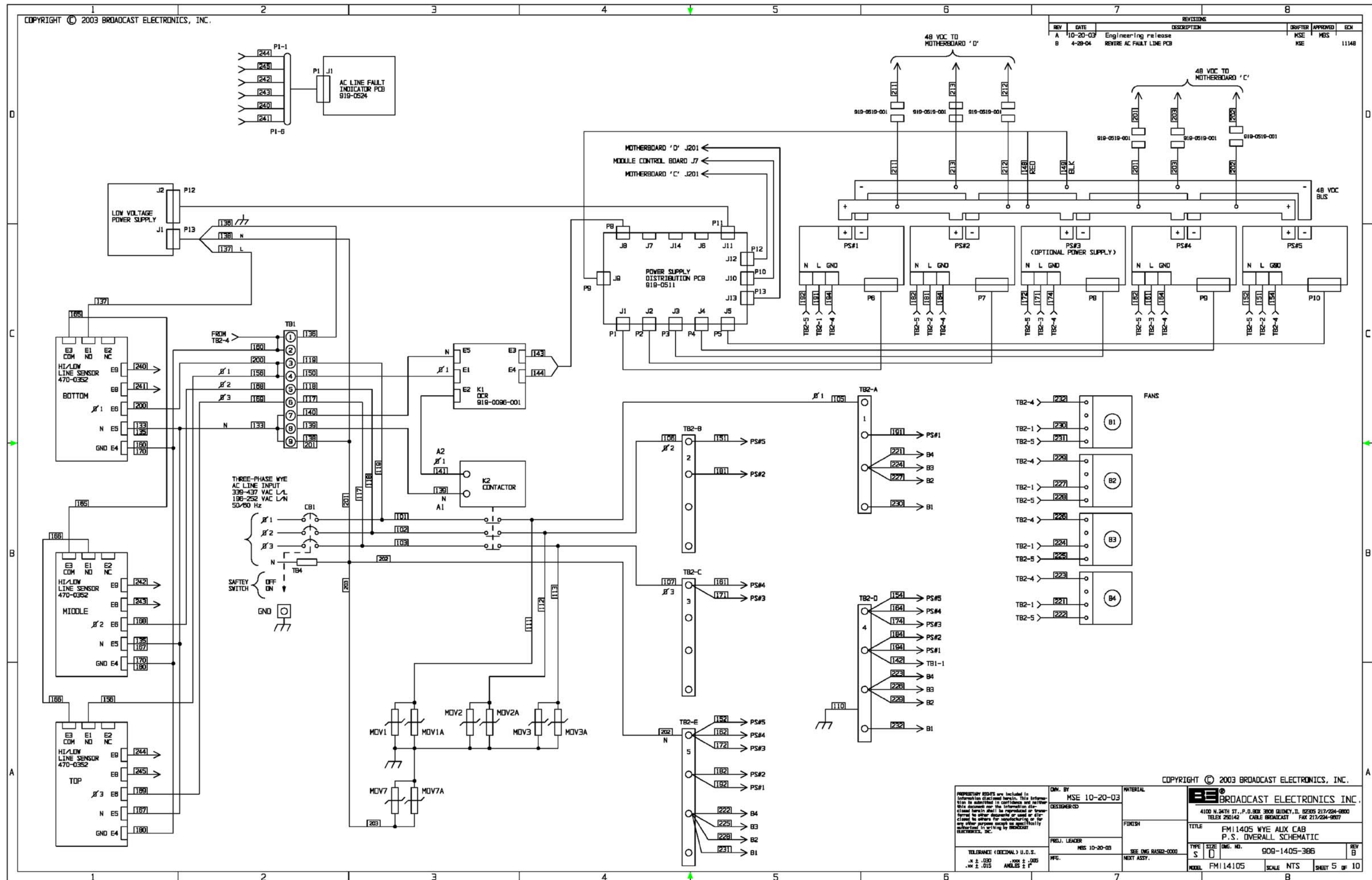
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECH
A	10-20-03	Engineering release	MSE	MES	11148
B	4-29-04	REVISE AC FAULT LINE PCB	MSE		

FM11405 P.S. OVERALL SCHEMATIC

4100 N. 24TH ST., P.O. BOX 3000 GUNN, IL 62305 217/224-8000  
TELEX 250142 CABLE BROADCAST FAX 217/224-9007

TITLE: FM11405 WYE CNTRL CAB  
P.S. OVERALL SCHEMATIC  
TYPE: S  
SIZE: D  
DWS. NO.: 909-1405-386  
REV: B  
MODEL: FM11405  
SCALE: NTS  
SHEET: 4 OF 10





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QCN. BY: MSE 10-20-03  
DESIGNER: CS  
PROJ. LEADER: MSE 10-20-03  
MFG.

TOLERANCE (DECIMAL) U.O.S.  
X ± .030  
X ± .015

FINISH: SEE DMS RAS22-0000  
NEXT ASSY.

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**BROADCAST ELECTRONICS, INC.**  
4100 N. 34TH ST., P.O. BOX 3808 GROUND, IL 62305 217/224-9800  
TELEX 250142 CABLE BROADCAST FAX 217/224-9807

TITLE: FM11405 WYE AUX CAB P.S. OVERALL SCHEMATIC  
TYPE: S  
SIZE: D  
DWG. NO.: 909-1405-386  
REV: B


MODEL: FM11405  
SCALE: NTS  
SHEET: 5 OF 10

## MOTHERBOARD 'B' OR 'D'

MOTHERBOARD J108	RF MODULE 9 J6	MOTHERBOARD J108	RF MODULE 11 J6	MOTHERBOARD J104	RF MODULE 13 J6	MOTHERBOARD J102	RF MODULE 15 J6
1 GND		1 GND		1 GND		1 GND	
2 RF IN		2 RF IN		2 RF IN		2 RF IN	
3 RF IN		3 RF IN		3 RF IN		3 RF IN	
4 GND		4 GND		4 GND		4 GND	
5 GND		5 GND		5 GND		5 GND	
6 +5V		6 +5V		6 +5V		6 +5V	
7 -12V		7 -12V		7 -12V		7 -12V	
8 LOGIC GND		8 LOGIC GND		8 LOGIC GND		8 LOGIC GND	
9 LOGIC GND		9 LOGIC GND		9 LOGIC GND		9 LOGIC GND	
10 GND		10 GND		10 GND		10 GND	
11 GND		11 GND		11 GND		11 GND	
12 GND		12 GND		12 GND		12 GND	
13 SELECT MOD 8		13 SELECT MOD 6		13 SELECT MOD 4		13 SELECT MOD 2	
14 GND		14 GND		14 GND		14 GND	
15 VDC E108		15 VDC E106		15 VDC E104		15 VDC E102	
16 VDC E108		16 VDC E106		16 VDC E104		16 VDC E102	
17 VDC E108		17 VDC E106		17 VDC E104		17 VDC E102	
18 PRESENCE MOD 8B		18 PRESENCE MOD 6B		18 PRESENCE MOD 4B		18 PRESENCE MOD 2B	
19 PRESENCE MOD 8A		19 PRESENCE MOD 6A		19 PRESENCE MOD 4A		19 PRESENCE MOD 2A	
20 GND		20 GND		20 GND		20 GND	
21 GND		21 GND		21 GND		21 GND	
22 GND		22 GND		22 GND		22 GND	
23 +12V		23 +12V		23 +12V		23 +12V	
24 RESET		24 RESET		24 RESET		24 RESET	
25 BIAS CTL MOD 8		25 BIAS CTL MOD 6		25 BIAS CTL MOD 4		25 BIAS CTL MOD 2	
26 FWD PWR		26 FWD PWR		26 FWD PWR		26 FWD PWR	
27 RFL PWR		27 RFL PWR		27 RFL PWR		27 RFL PWR	
28 TEMP		28 TEMP		28 TEMP		28 TEMP	
29 MOD CURRENT		29 MOD CURRENT		29 MOD CURRENT		29 MOD CURRENT	
30 SPARE		30 SPARE		30 SPARE		30 SPARE	
31 GND		31 GND		31 GND		31 GND	
32 GND		32 GND		32 GND		32 GND	
33 VDC E108		33 VDC E106		33 VDC E104		33 VDC E102	
34 VDC E108		34 VDC E106		34 VDC E104		34 VDC E102	
35 VDC E108		35 VDC E106		35 VDC E104		35 VDC E102	
36 GND		36 GND		36 GND		36 GND	

[illegible]

MOTHERBOARD J108 ↔ JB	MOTHERBOARD J107 ↔ JB	MOTHERBOARD J105 ↔ JB	MOTHERBOARD J103 ↔ JB	MOTHERBOARD J101 ↔ JB
1 GND	1 GND	1 GND	1 GND	1 GND
2 RF IN	2 RF IN	2 RF IN	2 RF IN	2 RF IN
3 RF IN	3 RF IN	3 RF IN	3 RF IN	3 RF IN
4 GND	4 GND	4 GND	4 GND	4 GND
5 GND	5 GND	5 GND	5 GND	5 GND
6 +5V	6 +5V	6 +5V	6 +5V	6 +5V
7 -12V	7 -12V	7 -12V	7 -12V	7 -12V
8 LOGIC GND	8 LOGIC GND	8 LOGIC GND	8 LOGIC GND	8 LOGIC GND
9 LOGIC GND	9 LOGIC GND	9 LOGIC GND	9 LOGIC GND	9 LOGIC GND
10 GND	10 GND	10 GND	10 GND	10 GND
11 GND	11 GND	11 GND	11 GND	11 GND
12 GND	12 GND	12 GND	12 GND	12 GND
13 SELECT MOD 9	13 SELECT MOD 7	13 SELECT MOD 5	13 SELECT MOD 3	13 SELECT MOD 1
14 GND	14 GND	14 GND	14 GND	14 GND
15 VDC E109	15 VDC E107	15 VDC E105	15 VDC E103	15 VDC E101
16 VDC E109	16 VDC E107	16 VDC E105	16 VDC E103	16 VDC E101
17 VDC E109	17 VDC E107	17 VDC E105	17 VDC E103	17 VDC E101
18 PRESENCE MOD 9B	18 PRESENCE MOD 7B	18 PRESENCE MOD 5B	18 PRESENCE MOD 3B	18 PRESENCE MOD 1B
19 PRESENCE MOD 9A	19 PRESENCE MOD 7A	19 PRESENCE MOD 5A	19 PRESENCE MOD 3A	19 PRESENCE MOD 1A
20 GND	20 GND	20 GND	20 GND	20 GND
21 GND	21 GND	21 GND	21 GND	21 GND
22 GND	22 GND	22 GND	22 GND	22 GND
23 +12V	23 +12V	23 +12V	23 +12V	23 +12V
24 RESET	24 RESET	24 RESET	24 RESET	24 RESET
25 BIAS CTL MOD 9	25 BIAS CTL MOD 7	25 BIAS CTL MOD 5	25 BIAS CTL MOD 3	25 BIAS CTL MOD 1
26 FWD PWR	26 FWD PWR	26 FWD PWR	26 FWD PWR	26 FWD PWR
27 RFL PWR	27 RFL PWR	27 RFL PWR	27 RFL PWR	27 RFL PWR
28 TEMP	28 TEMP	28 TEMP	28 TEMP	28 TEMP
29 MOD CURRENT	29 MOD CURRENT	29 MOD CURRENT	29 MOD CURRENT	29 MOD CURRENT
30 SPARE	30 SPARE	30 SPARE	30 SPARE	30 SPARE
31 GND	31 GND	31 GND	31 GND	31 GND
32 GND	32 GND	32 GND	32 GND	32 GND
33 VDC E109	33 VDC E107	33 VDC E105	33 VDC E103	33 VDC E101
34 VDC E109	34 VDC E107	34 VDC E105	34 VDC E103	34 VDC E101
35 VDC E109	35 VDC E107	35 VDC E105	35 VDC E103	35 VDC E101
36 GND	36 GND	36 GND	36 GND	36 GND

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TOLERANCE (DECIMAL) U.O.S. .XX ± .030 .XXX ± .005 .XX ± .015 ANGLES ± 1°		PROJ. LEADER MBS 10-20-03  MFG.	SEE DWG. BASED-0000  NEXT ASSY.	TITLE FMI1405 OVERALL SCHEMATIC (MOTHERBOARD INTERFACE)  TYPE S SIZE D DIM. M. 909-1405-386 REV B  MODEL FMI 1405 SCALE NTS SHEET 6 OF 10



FM-20S/FMi-1405 OVERALL SCHEMATIC SHT. 10 OF 10 (PAGE 1 OF 4)			909-1020-386 / 909-1405-386
CONTROL OR AUXILIARY CABINET			
P.S. DISTRIBUTION BOARD AND P.S. HARNESS			
CONNECTOR PIN-OUTS			
P.S. DISTRIB. BOARD			5KW POWER SUPPLY
CONNECTOR	DATA CABLE	CIRCUIT FUNCTION	PS# 1 THRU PS# 5
J1 THRU J5	P1/P6 THRU P5/P10		J1
1	1	SENSE + (DC OUT SAMPLE)	1
2	2	VC+ (CONTROL VOLTAGE)	2
3	3	FAULT	3
4	4	VC_GND	4
9	9	LOGIC GND	9
10	10	CURRENT SHARE	10
13	13	P.S. INHIBIT	13
P.S. DISTRIB. BOARD			TEMP SENSOR BOARD
	□	□	□
CONNECTOR	WIRE HARNESS	CIRCUIT FUNCTION	(INLET)
J6	P6/P15		J1
1	145	+12V	1
2	N/C	TEMP SAMPLE (.01V/DEG.C)	2
3	146	TEMP SAMPLE X 5	3
4	147	GND	4
P.S. DISTRIB. BOARD			
CONNECTOR	WIRE HARNESS	CIRCUIT FUNCTION	OCR
J8	P8		K1
1	143	OCR CONTROL (+12V)	E3
2	144	LOGIC GND	E4
P.S. DISTRIB. BOARD			
CONNECTOR	WIRE HARNESS	CIRCUIT FUNCTION	5KW POWER SUPPLY
J9	P9		PS# 1 THRU PS# 5
1	RED	SENSE + (DC OUT SAMPLE)	DC OUTPUT BUS +
2	BLACK	VC_GND	DC OUTPUT BUS -

FM-20S/FMi-1405 OVERALL SCHEMATIC SHT. 10 OF 10 (PAGE 2 OF 4)			909-1020-386 / 909-1405-386
CONTROL OR AUXILIARY CABINET			

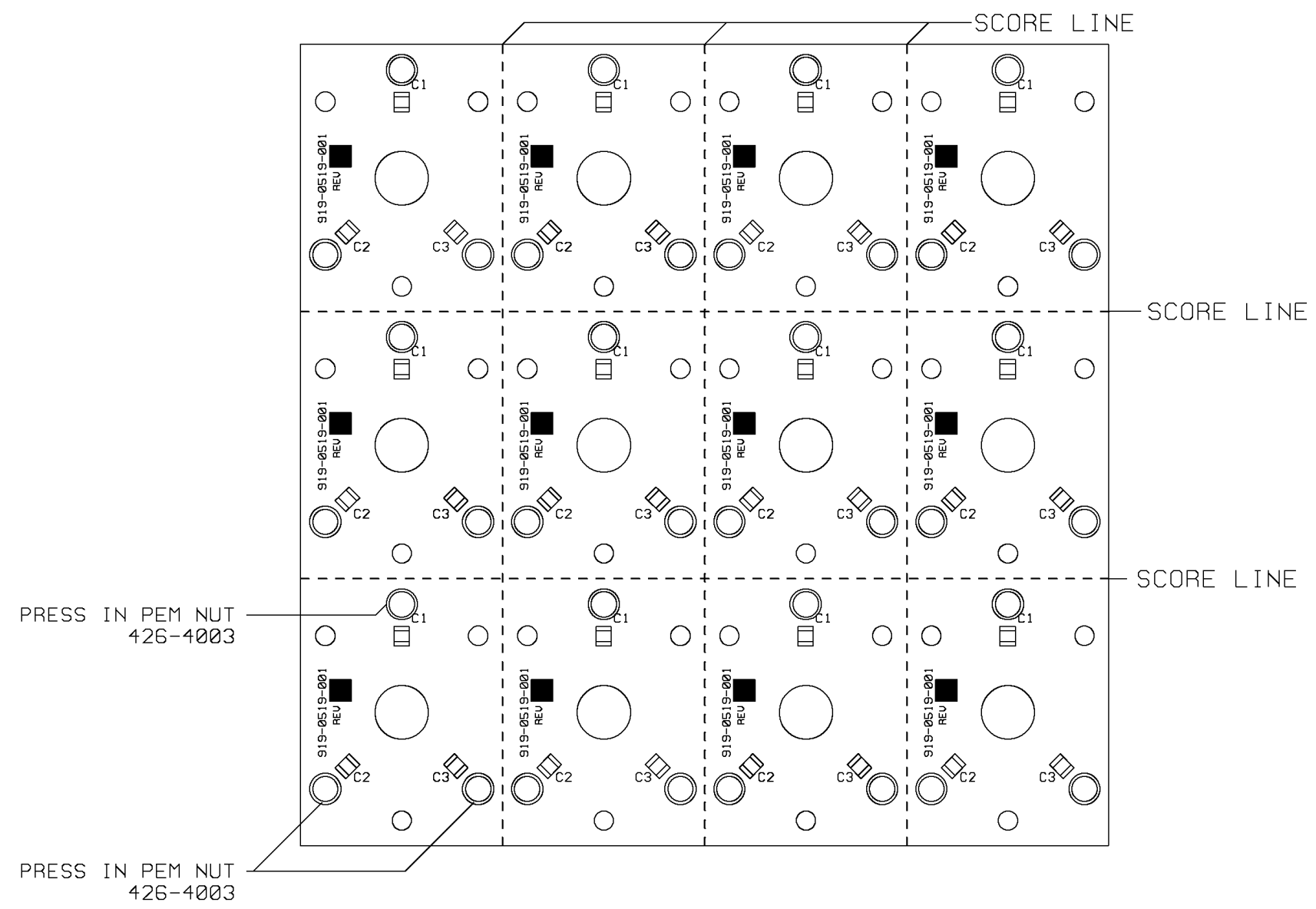
P.S. DISTRIBUTION BOARD AND P.S. HARNESS			
CONNECTOR PIN-OUTS CONTD_			
P.S. DISTRIB. BOARD			CONTROLLER
CONNECTOR	WIRE HARNESS	CIRCUIT FUNCTION	MODULE CONTROL BOARD
J10	P10/P7A		J7
1	BLACK	VC+	1
2	RED	VC GND	2
3	GREEN	P.S.FAULT 1	3
4	WHITE	LOGIC GND	4
5	BROWN	P.S.INHIBIT	5
6	BLUE	P.S.FAULT 2	6
7	ORANGE	P.S.FAULT 3	7
8	YELLOW	P.S.FAULT 4	8
9	VIOLET	P.S.FAULT 5	9
10	GRAY	TEMP SAMPLE X 5 (INLET)	10
11	PINK	HI/LO AC LINE SENSOR	11
12	TAN	OCR CONTROL (+12V)	12
13	RED/GREEN	+24V	13
14	RED/YELLOW	+48V (DC OUT SAMPLE)	14
15	RED/BLACK	+5V	15
16	WHITE/BLACK	+5V	16
17	WHITE/RED	+5V	17
18	WHITE/GREEN	GND	18
19	WHITE/YELLOW	GND	19
20	WHITE/BLUE	GND	20
21	WHITE/BROWN	GND	21
22	WHITE/ORANGE	-12V	22
23	WHITE/GRAY	-12V	23
24	WHITE/VIOLET	+12V	24
25	BLACK/RED	+12V	25

FM-20S/FMi-1405 OVERALL SCHEMATIC SHT. 10 OF 10 (PAGE 3 OF 4)			909-1020-386 / 909-1405-386	
CONTROL OR AUXILIARY CABINET				
P.S. DISTRIBUTION BOARD AND P.S. HARNESS				
CONNECTOR PIN-OUTS CONTD_				
P.S. DISTRIB. BOARD				LOW VOLTAGE
CONNECTOR	WIRE HARNESS	CIRCUIT FUNCTION	WIRE HARNESS	POWER SUPPLY
J11	P11		P12	J2
1	132	+5V	132	1
2	131	+5V	131	2
3	130	+5V	130	3
4	129	GND	129	4
5	128	GND	128	5
6	127	GND	127	6
7	126	GND	126	7
8	125	+12V	125	8
9	124	+12V	124	9
10	123	GND	123	10
11	122	-12V	122	11
12	121	+24V	N/C	12
			121	13
				LOW VOLTAGE
		CIRCUIT FUNCTION	WIRE HARNESS	POWER SUPPLY
			P13	J1
		GND	136	1
			N/C	2
		AC LINE NEUTRAL	138	3
			N/C	4
		AC LINE PHASE 2 (SWITCHED)	137	5

FM-20S/FMi-1405 OVERALL SCHEMATIC SHT. 10 OF 10 (PAGE 4 OF 4)			909-1020-386 / 909-1405-386		
CONTROL OR AUXILIARY CABINET					
P.S. DISTRIBUTION BOARD AND P.S. HARNESS					
CONNECTOR PIN-OUTS CONTD_					
P.S. DIS-TRIB. BOARD	DATA CABLE		MOTHERBOARD "A"/"C" OR "B"/"D"		
CON-NECTOR	P12/P201A OR	CIRCUIT FUNCTION	DC CONNECTOR BOARD		MOTHER-BOARD
	□	□	□	□	□
J12 OR J13	P13/P201B		J201	J202	J115
1	1	+12V	1	1	1
2	2	+12V	2	2	2
3	3	N/C	3	4	4
4	4	-12V	4	6	6
5	5	+5V	5	9	9
6	6	+12V	6	3	3
7	7	N/C	7	5	5
8	8	-12V	8	7	7
9	9	-12V	9	8	8
SHELL	SHIELD	CHASSIS GND	CHASSIS GND	10	10
POWER SUPPLY HARNESS		CIRCUIT FUNCTION	AC LINE FAULT IND. BOARD		
	□	□	□	□	□
CON-NECTOR P1	WIRE NO.		J1		
1	240	LOSS OF AC LINE PHASE 1	1		
2	241	LOGIC GND	2		
3	242	LOSS OF AC LINE PHASE 2	3		
4	243	LOGIC GND	4		
5	244	LOSS OF AC LINE PHASE 3	5		
6	245	LOGIC GND	6		

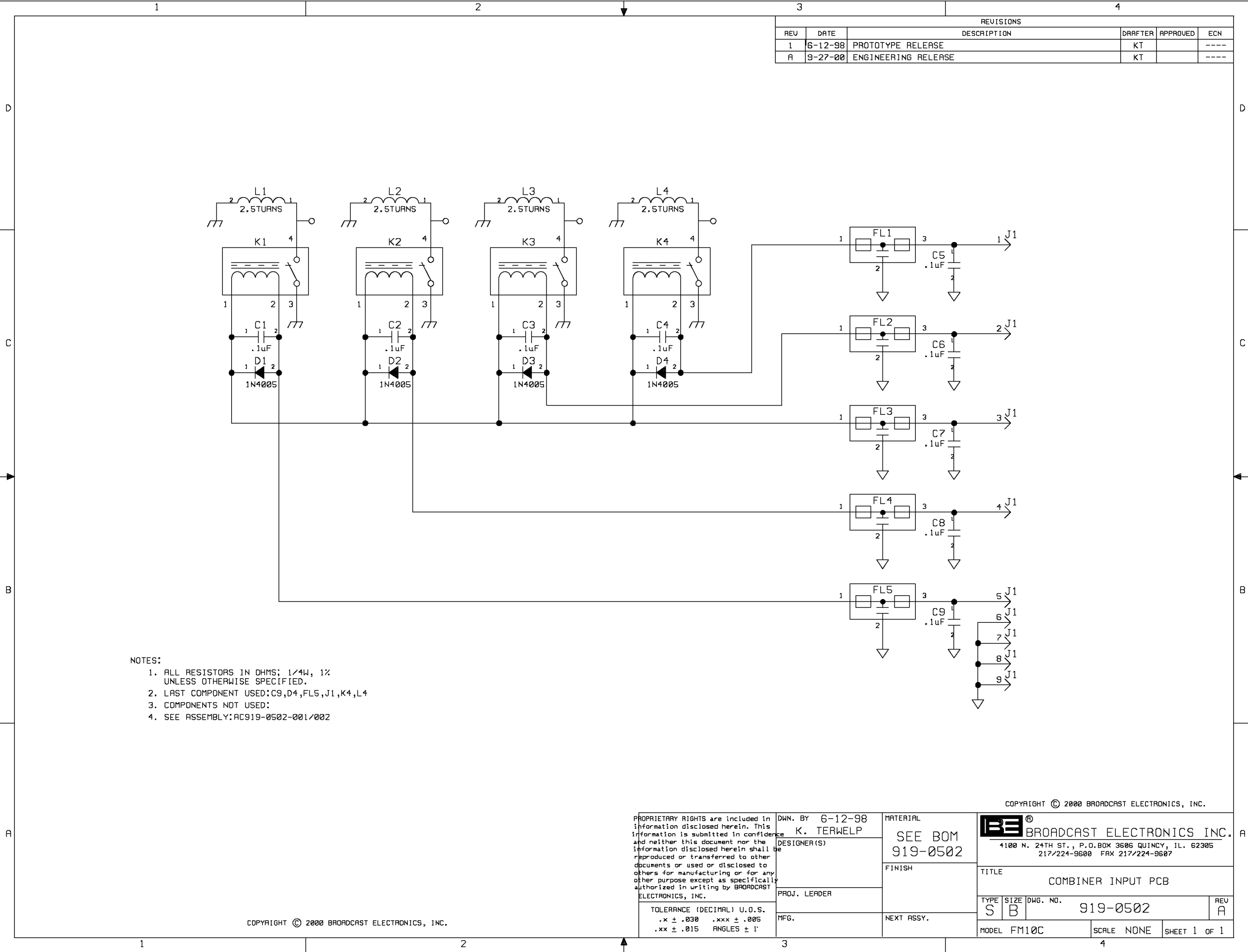


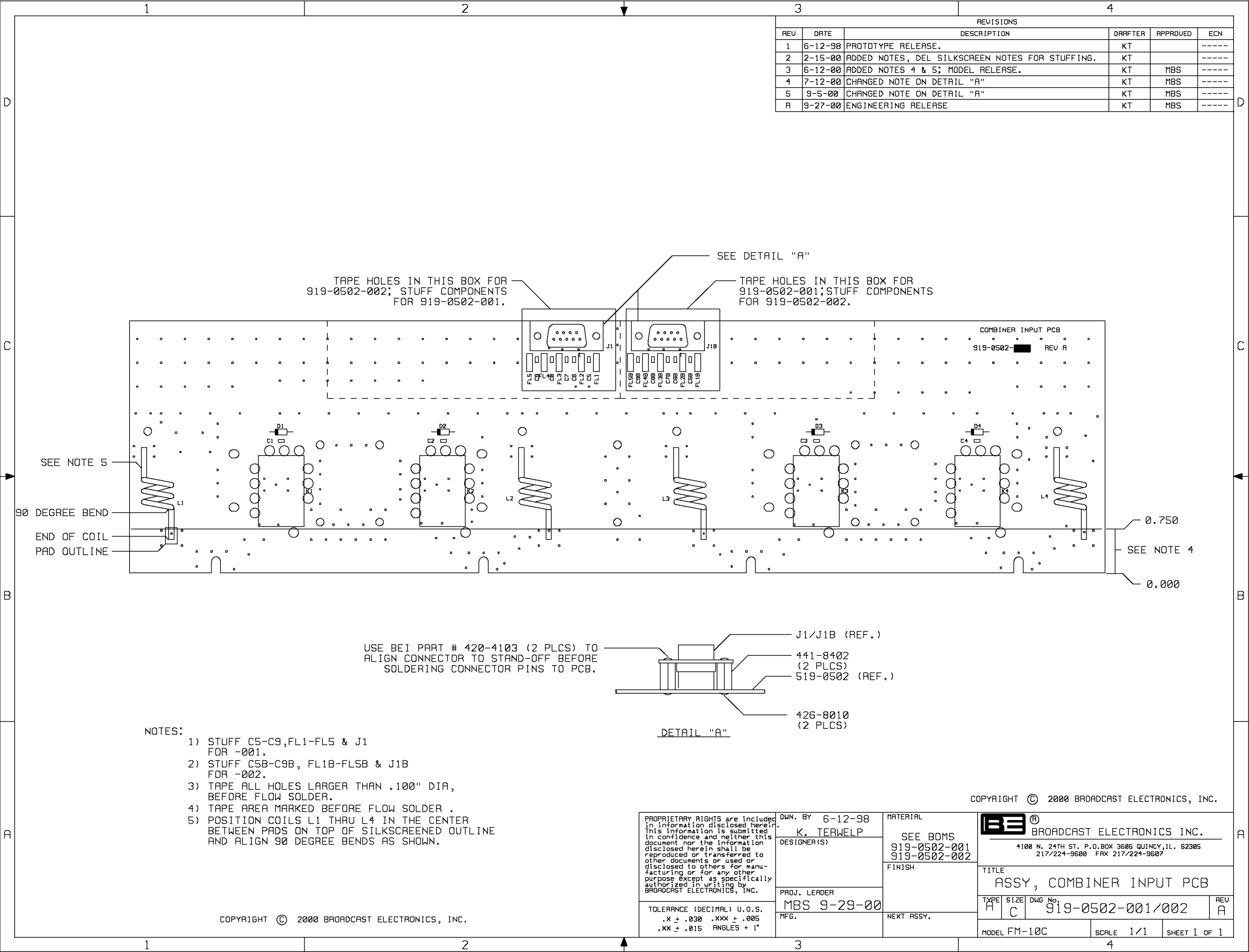
2	8-21-00	CHGD CAPS TO A 009-1033	KT	JW	----	REVISIONS					
3	8-31-00	CHGD CAPS TO A 009-1032	KT	RPM	----	REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
A	9-27-00	ENGINEERING RELEASE	KT	RPM	----	1	4-12-00	PROTOTYPE RELEASE./MODEL RELEASE 5-31-00	KT	RPM	-----

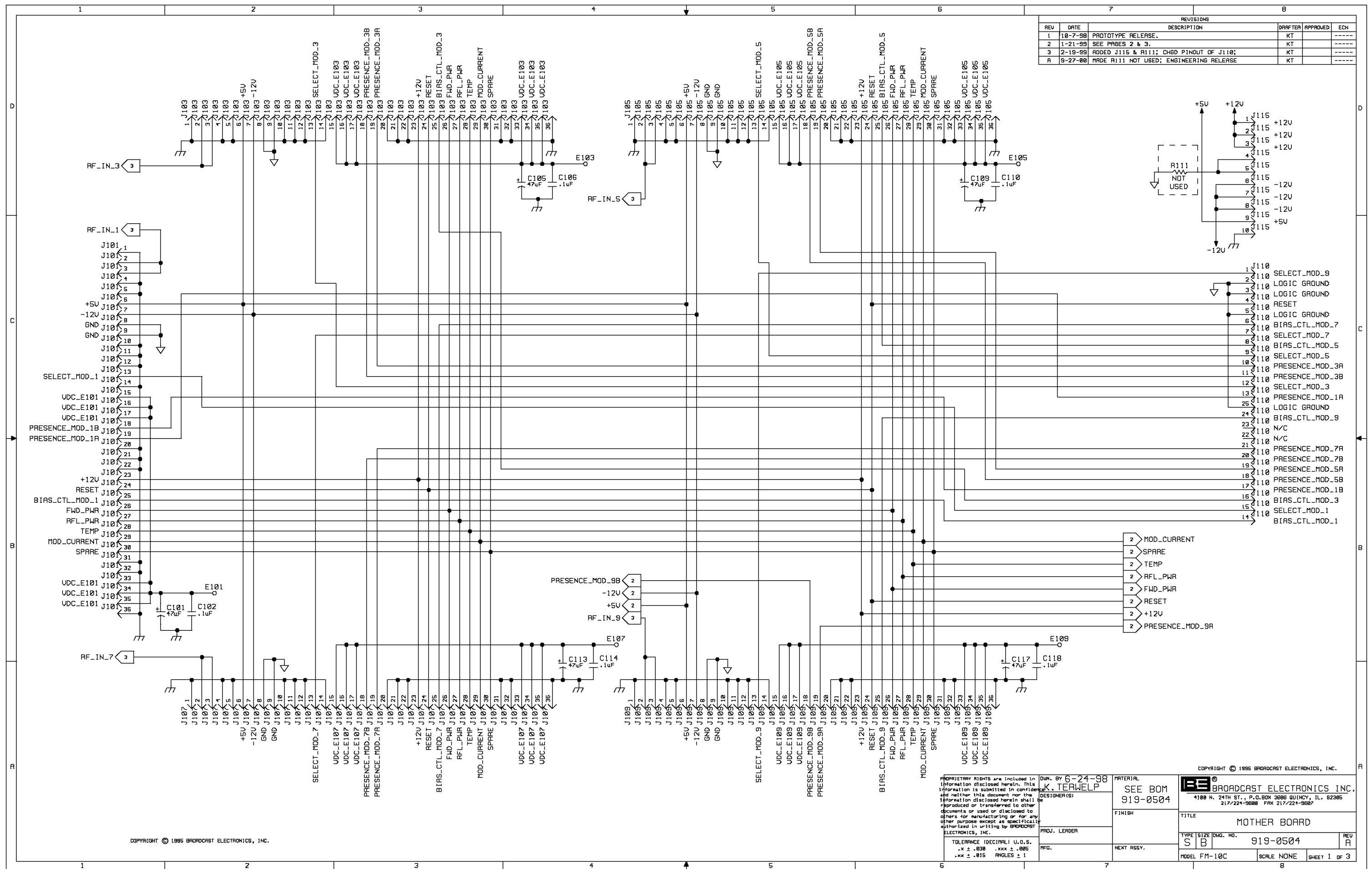


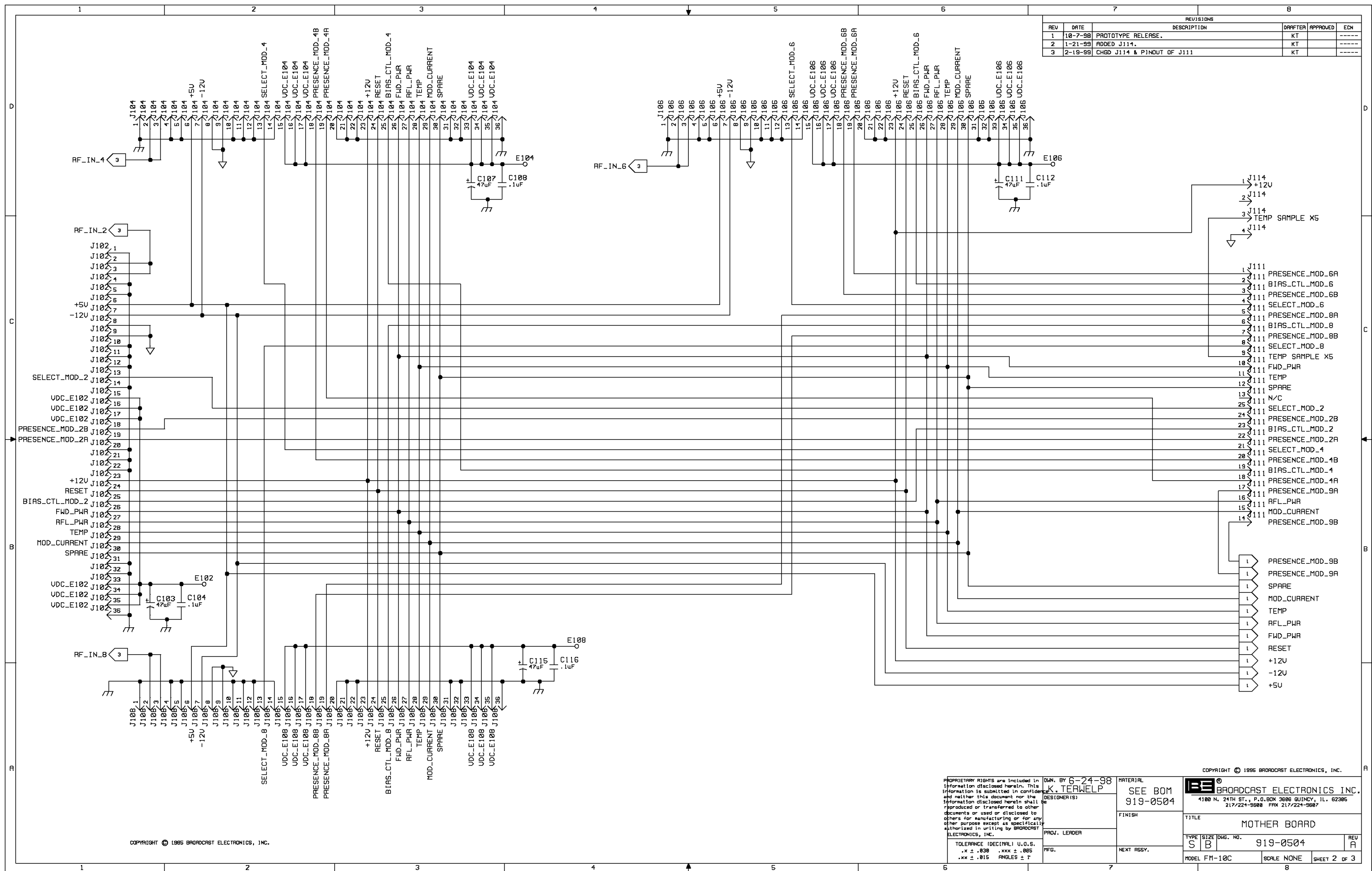
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	DESIGNER(S) RPM 9-29-00					
	PROJ. LEADER MBS 9-29-00	FINISH NEXT ASSY.	TITLE DC FILTER			
	MFG.		TYPE A	SIZE B	DWG No. 919-0519/-001	REV A
TOLERANCE (DECIMAL) U.O.S. .X ± .030 .XXX ± .005 .XX ± .015 ANGLES + 1°		MODEL FM-10S/AM-10E		SCALE 1/1	SHEET 1 OF 1	

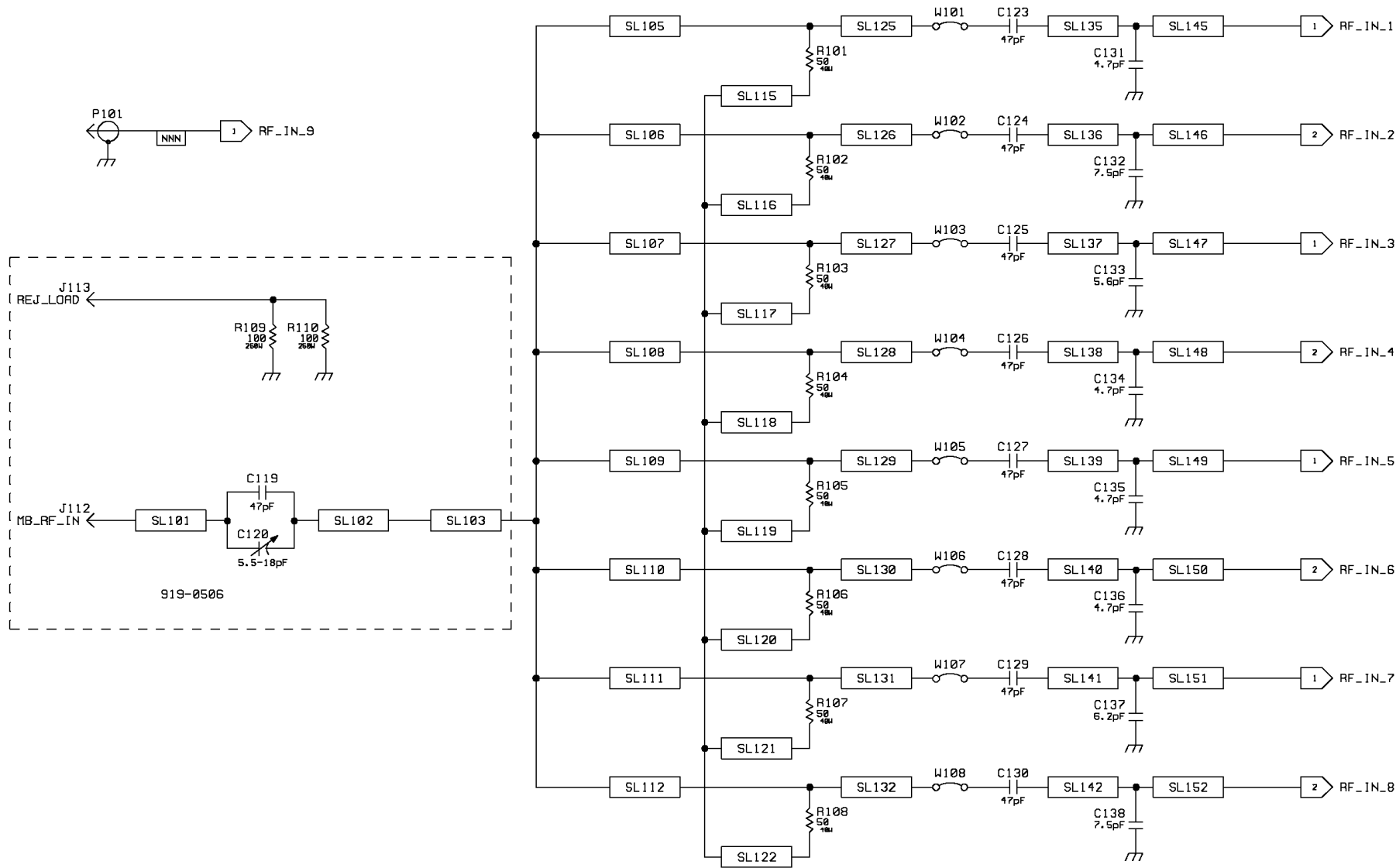








		REVISIONS			
REV	DATE	DESCRIPTION	DRAWN	APPROVED	ECN
1	10-7-98	PROTOTYPE RELEASE.	KT		-----
2	1-21-99	ADDED C131-C138; C119,C123-C130 WERE 56pF.	KT		-----
3	2-19-99	ADDED R110; R109 WAS 50 OHM; DEL E114-E117.	KT		-----
A	9-27-00	CHGD C132,C133,C137 & C138; ENGINEERING RELEASE	KT		-----



- NOTES:
1. ALL RESISTORS IN OHMS: 1/4W, 1% UNLESS OTHERWISE SPECIFIED.
  2. LAST COMPONENT USED: C138, E109, J115, P101, R111, W108
  3. COMPONENTS NOT USED: C121, C122
  4. SEE ASSEMBLYS: AD919-0504, AB919-0506
  5. 

SL105-SL112	=	.048	X	17.00
SL115-SL122	=	.150	X	1.70
SL125-SL132	=	.031	X	1.00
SL135-SL142	=	.030	X	1.10
SL145-SL152	=	.080	X	14.00

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DWN. BY 6-24-98

K. TERWELP

DESIGNER(S)

PROJ. LEADER

MFG.

MATERIAL

SEE BOMS

919-0504

919-0506

FINISH

NEXT ASSY.

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BROADCAST ELECTRONICS, INC.

4100 N. 24TH ST., P.O. BOX 3606 QUINCY, IL. 62305

217/224-9600 FAX 217/224-9607

TITLE

MOTHER BOARD

TYPE SIZE DUG. NO.

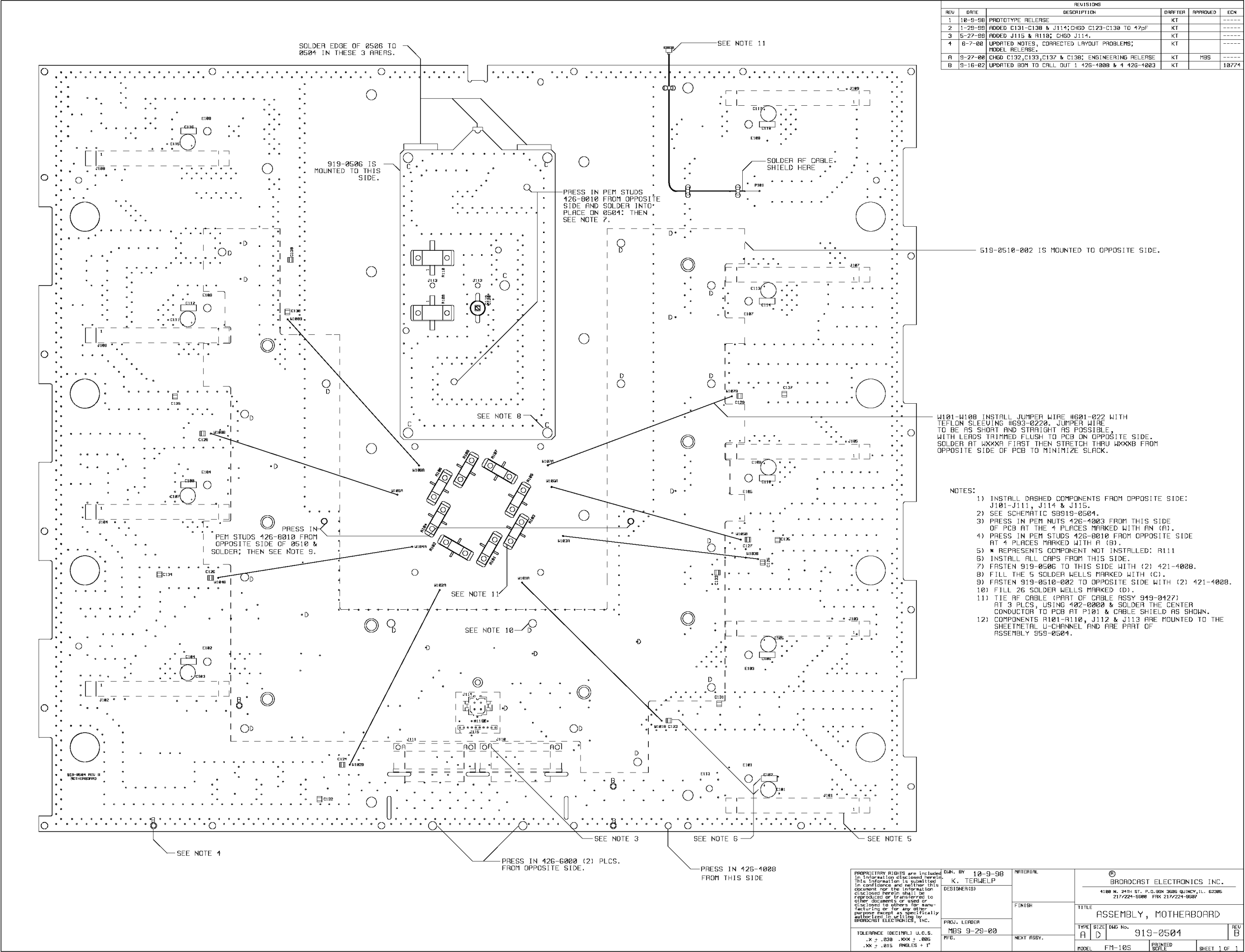
S B 919-0504

REV A

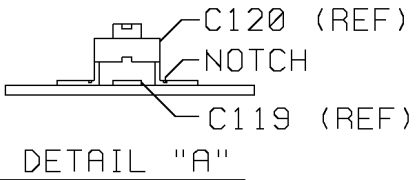
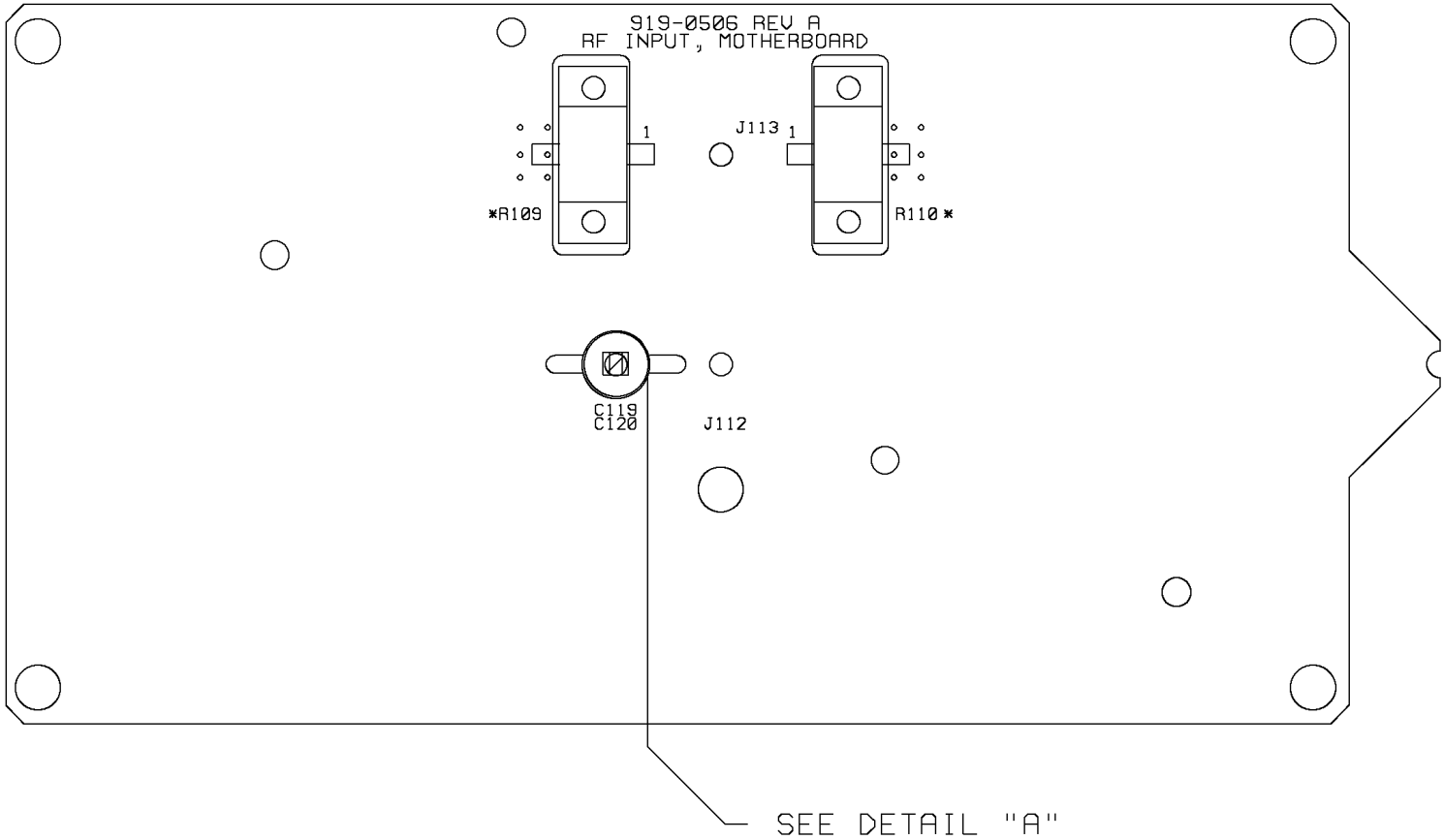
MODEL FM-10C

SCALE NONE

SHEET 3 OF 3



REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	11-3-98	PROTOTYPE RELEASE	KT		-----
2	5-27-99	ADDED NOTES.	KT		-----
3	5-31-00	CHGD SILKSCREEN; MODEL RELEASE.	KT		-----
4	6-21-00	ADDED NOTES	KT		-----
A	9-27-00	ENGINEERING RELEASE	KT		-----

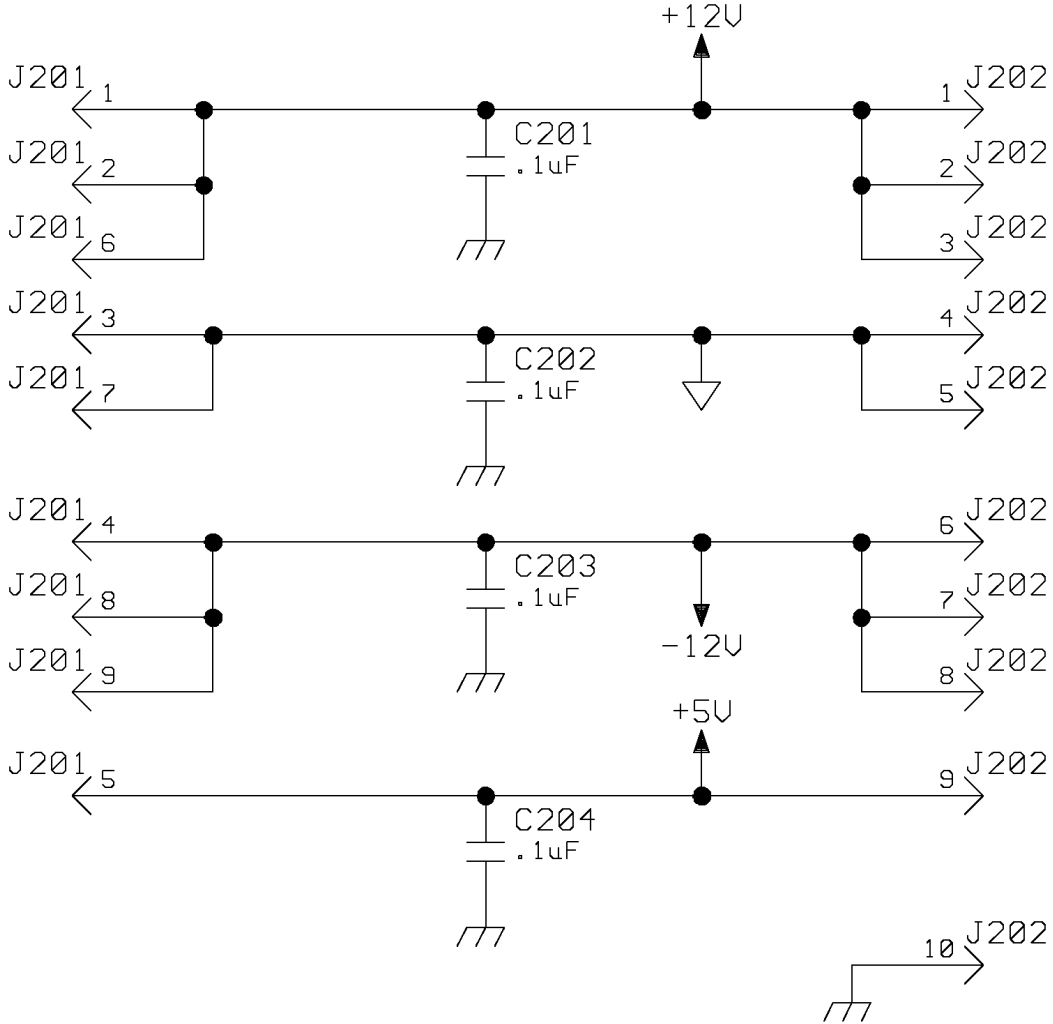


- NOTES:
- 1) SOLDER C119 IN PLACE.
  - 2) SOLDER C120 WITH ARROW UP FACING J112.
  - 3) \* R109 & R110 ARE PART OF ASSY. 959-0504-001
  - 4) \* FOR R109 & R110 PIN 1 IS ALWAYS USED.
  - 5) SEE SCHEMATIC SB919-0504.

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		K. TERWELP		SEE BOM 919-0506					
		DESIGNER(S)		FINISH		TITLE  RF INPUT, MOTHER BOARD			
		PROJ. LEADER		NEXT ASSY.					
TOLERANCE (DECIMAL) U.O.S. .X ± .030 .XXX ± .005 .XX ± .015 ANGLES + 1°		MFG.				TYPE A	SIZE B	DWG No. 919-0506	REV A
						MODEL FM-10S		SCALE 1/1	SHEET 1 OF 1




REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	2-18-99	PROTOTYPE RELEASE.	KT		-----
A	9-29-00	ENGINEERING RELEASE.	KT	MBS	-----



- NOTES:
1. LAST COMPONENT USED:C204,J202
  2. COMPONENTS NOT USED:C1-C200, J1-J200
  3. SEE ASSEMBLY:AC919-0510

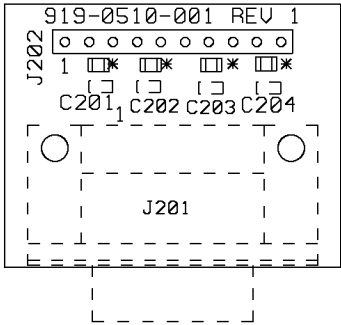
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	DESIGNER(S)		FINISH		TITLE MOTHER BOARD DC CONNECTOR				
	PROJ. LEADER				TYPE S		SIZE B	DWG. NO. 919-0510-001	REV A
	MFG.		NEXT ASSY. 919-0510		MODEL FM10SS		SCALE NONE		SHEET 1 OF 1
TOLERANCE (DECIMAL) U.O.S. .x ± .030 .xxx ± .005 .xx ± .015 ANGLES ± 1°									

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	3-6-99	PROTOTYPE RELEASE.	KT		----
2	6-1-99	MADE RAW BOARD A BREAKAWAY PIECE ON 519-0510.	KT		----
3	6-7-00	MODEL RELEASE.	KT		----
A	9-27-00	ENGINEERING RELEASE	KT		----

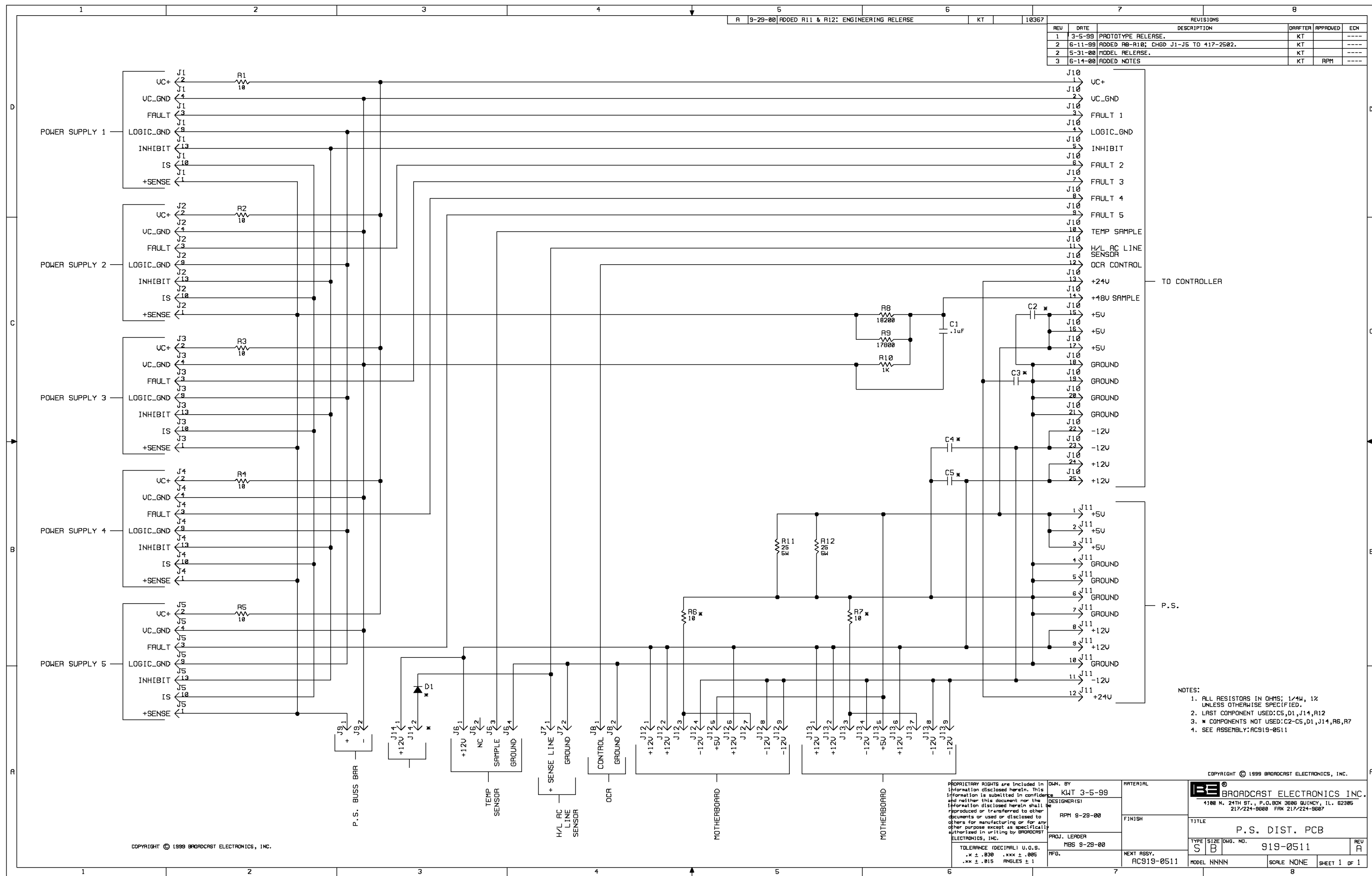
NOTES:

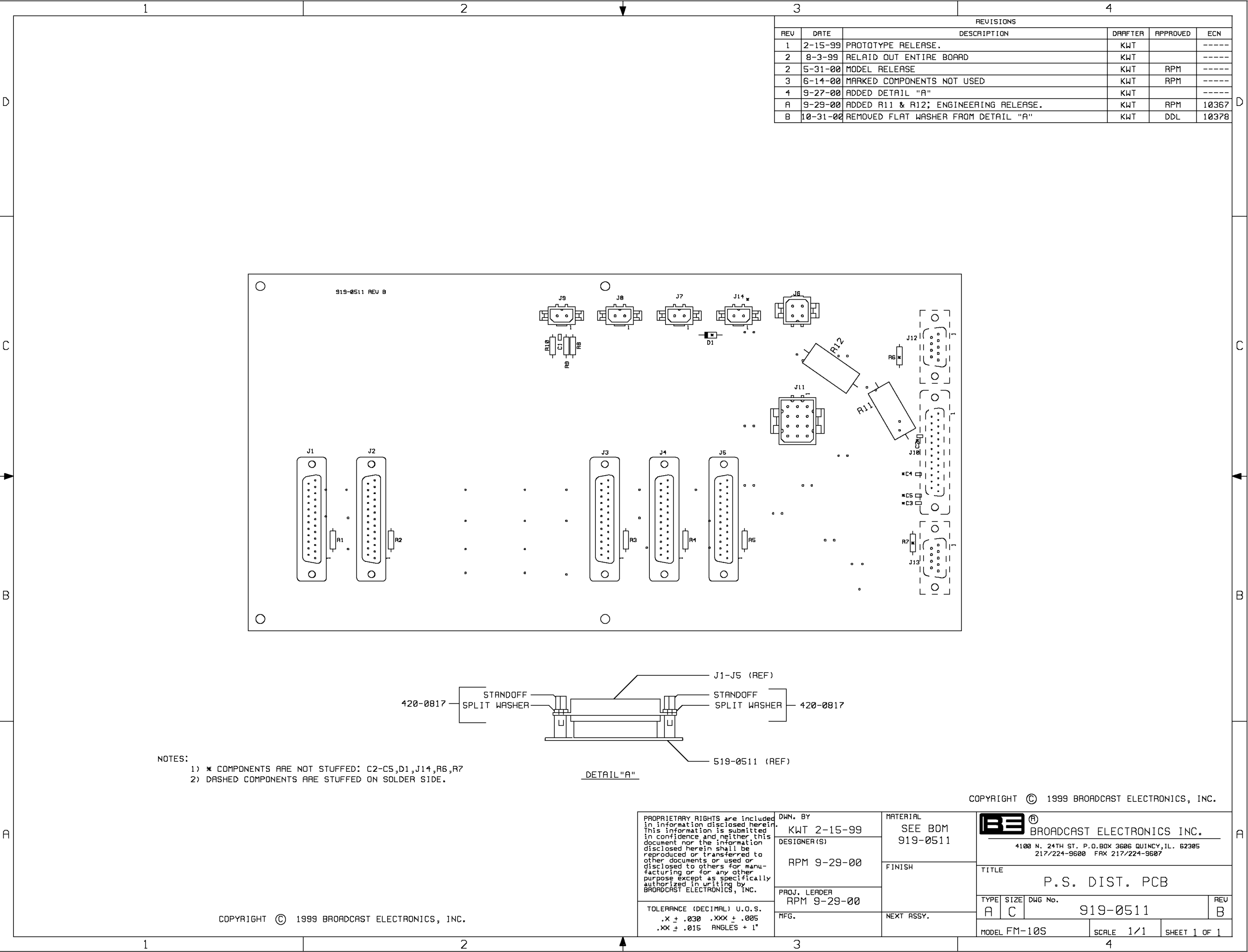
- 1) STUFF J201 & C201-C204 ON  
SOLDER SIDE OF PCB.
- 2) \* DESIGNATES PARTS NOT  
STUFFED.



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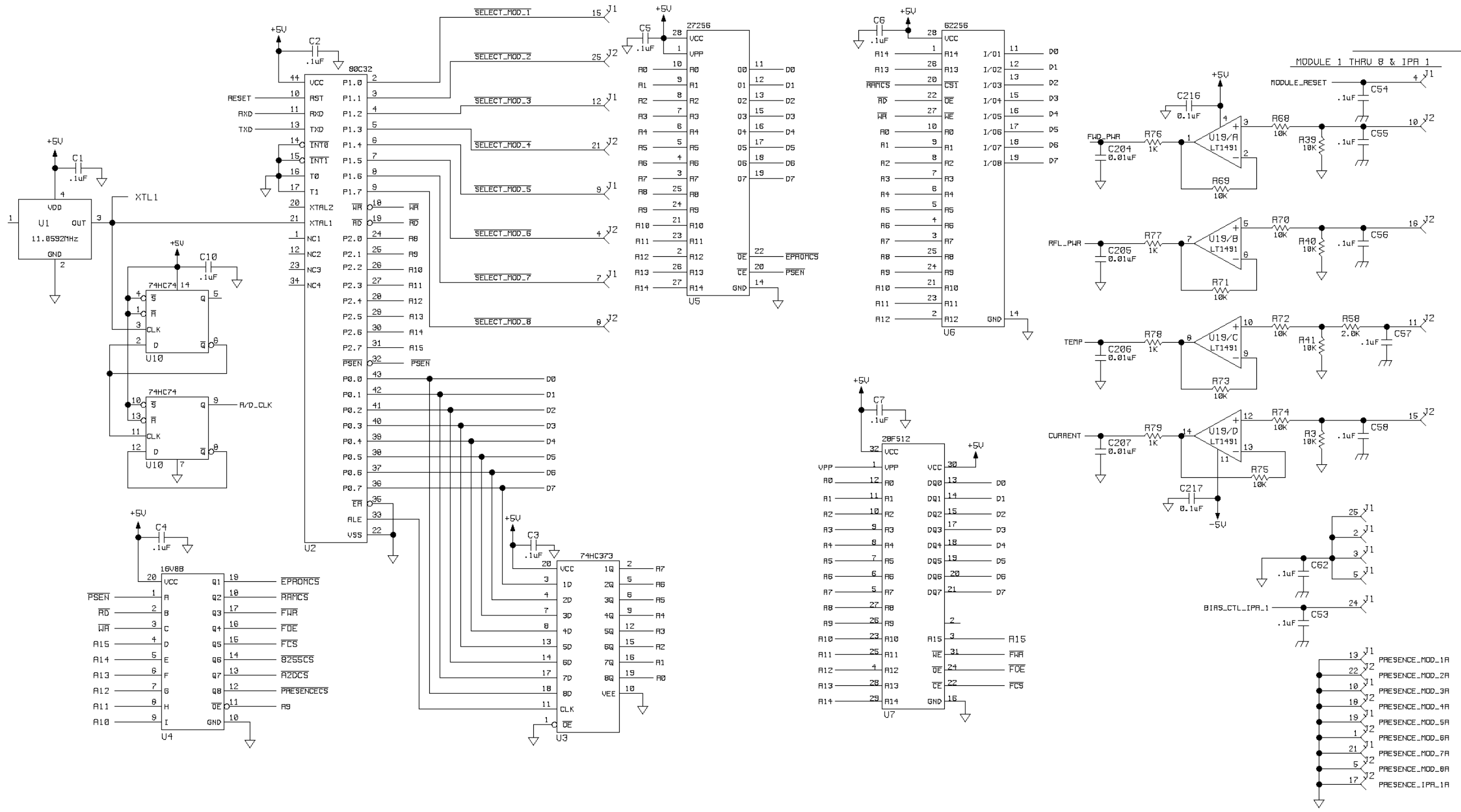
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	DESIGNER(S)				
	PROJ. LEADER	FINISH	TITLE MOTHERBOARD DC CONNECTOR		
	MFG.	NEXT ASSY.	TYPE A	SIZE A	DWG No. 919-0510-001
TOLERANCE (DECIMAL) U.O.S. .X ± .030 .XXX ± .005 .XX ± .015 ANGLES + 1°			MODEL FM10S	SCALE 1/1	REV A
				SHEET 1 OF 1	





B	9-25-00	CHGD U2 TO A 80C32; SEE SHEET 4 ALSO	KT	DL	10357
D	8-9-01	ADDED R58, SEE PAGE 4 ALSO	KT	DL	10498
E	2-23-04	SEE SHEETS 2 & 5	KT	DL	10498
F	6-10-04	ADD C204-C207,C212,C213,C216,C217,R68-R79,U19,U20	KT		11159

REVISIONS						
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN	
1	3-29-99	PROTOTYPE RELEASE.	KT	JT		
2	9-29-99	SEVERAL PROTOTYPE CHANGES ON ALL SHEETS.	KT	JT		
3	5-5-00	CHGD U7, HOOKED UP U5-1 & U7-3; MODEL RELEASE	KT	JT		
4	8-9-00	SEE SHEET 5; ENGINEERING RELEASE.	KT	JT	10339	

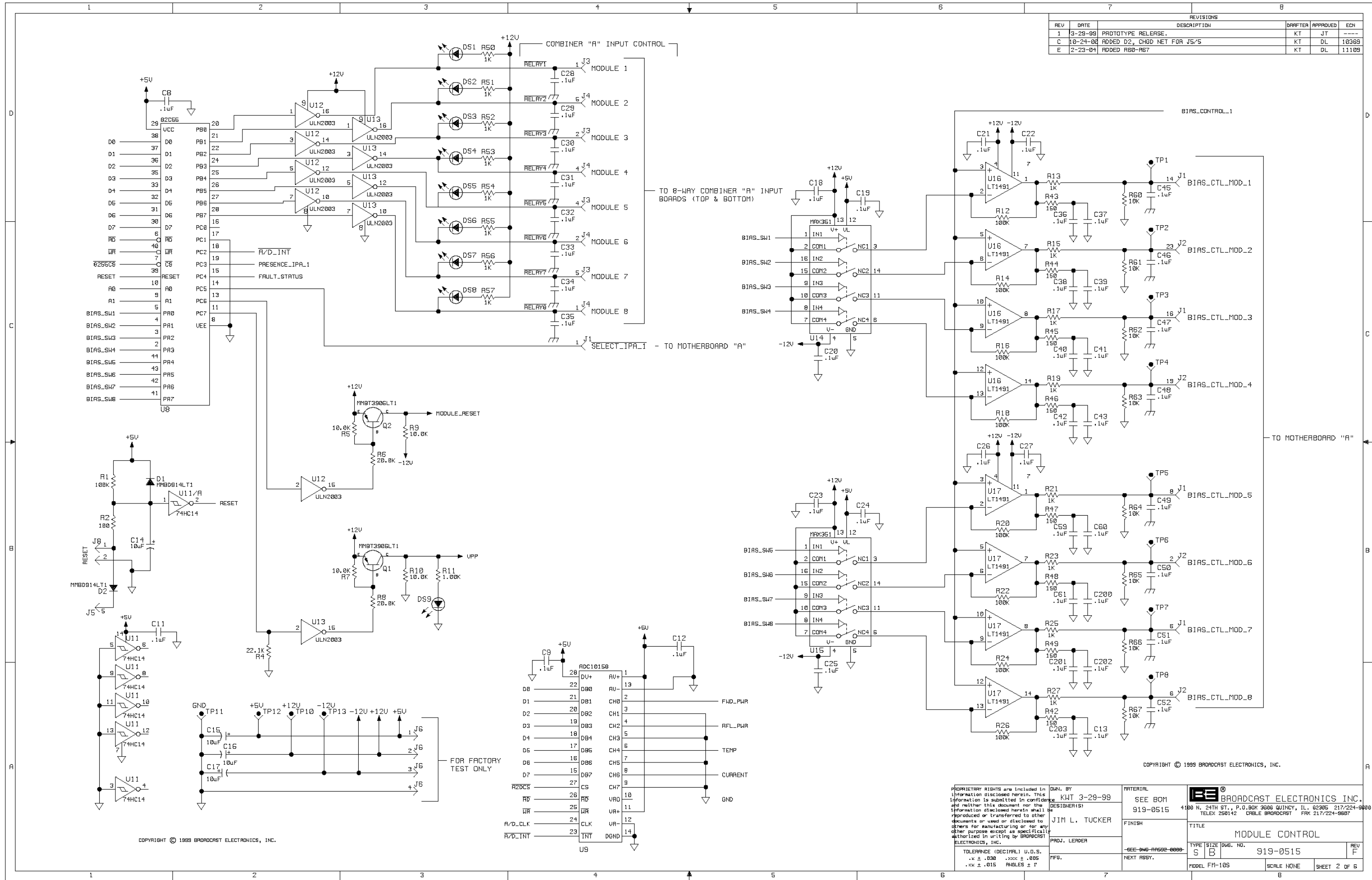


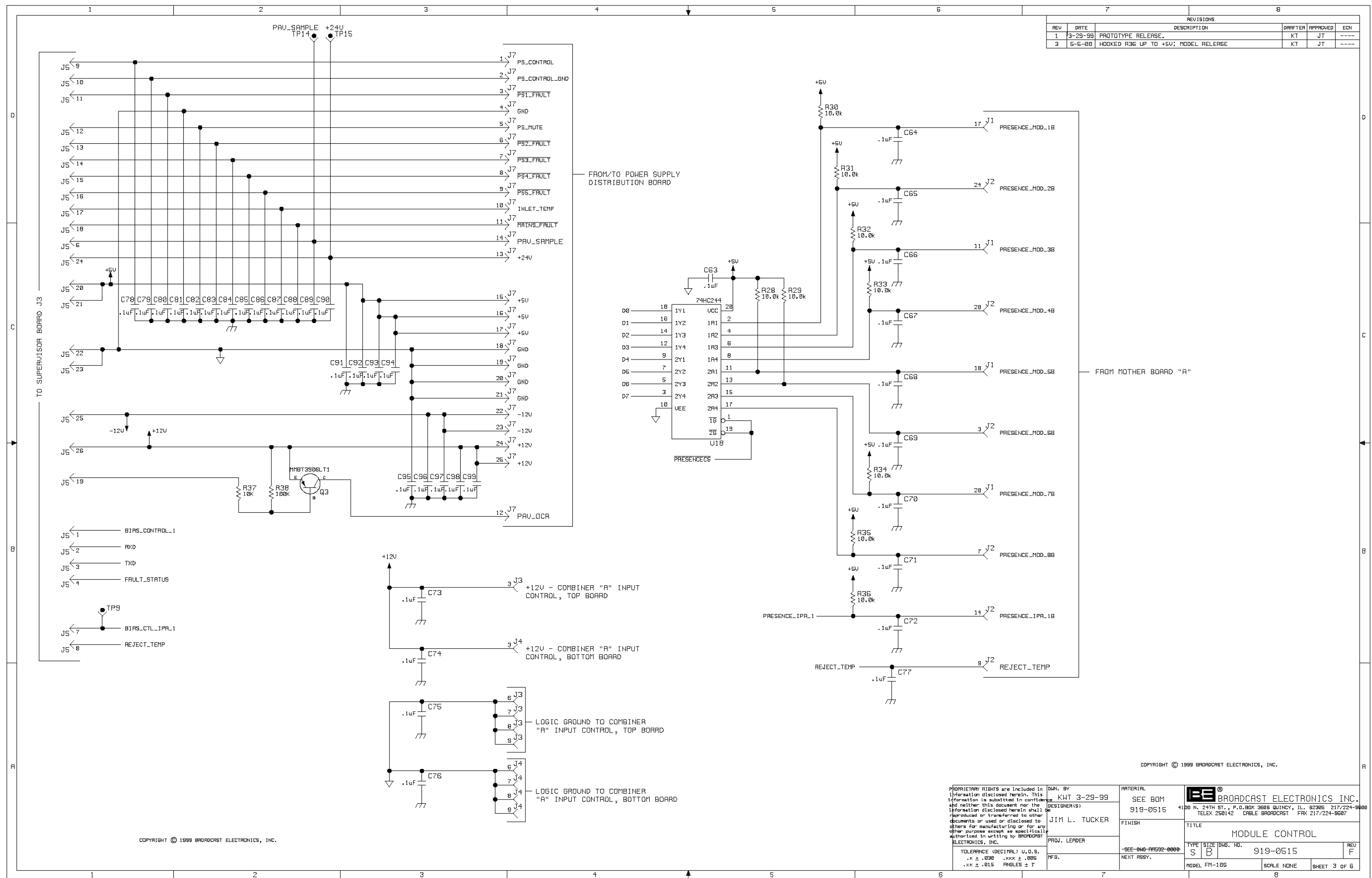
- NOTES:
- ALL RESISTORS IN OHMS: 1/4W, 1% UNLESS OTHERWISE SPECIFIED.
  - LAST COMPONENT USED: C217, D2, DS116, J105, Q102, R179, TP109, U119.
  - COMPONENTS NOT USED: C14, C100, C101, C144, C160, C161, C177-C199, DS10-DS100, DS102-DS108, J9-J100, Q4-Q100, R59, R80-R102, R156, R157, R159, TP16-TP100, U21-U101, U110, U111.
  - SEE ASSEMBLY: AC919-0515

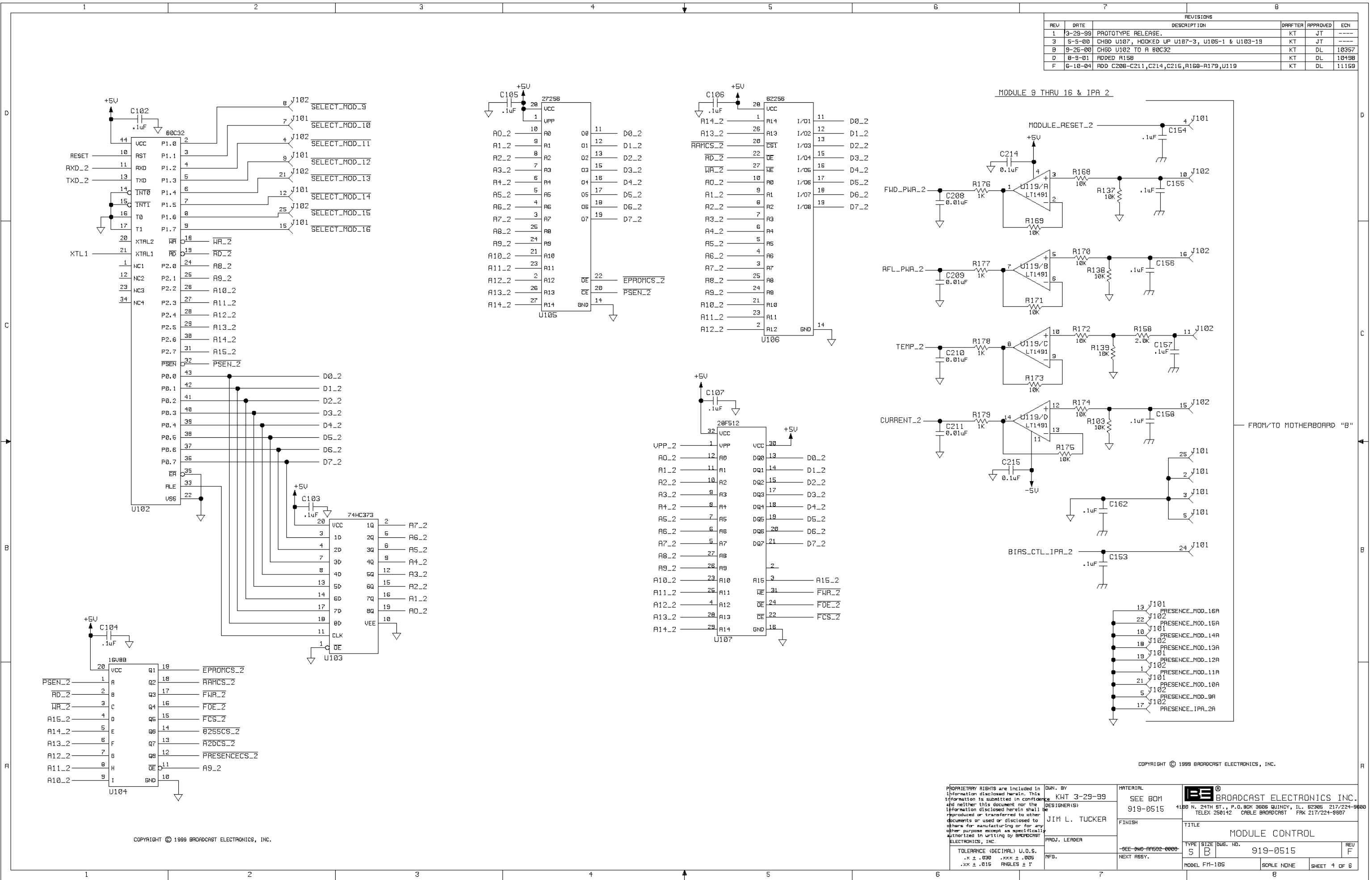
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TOLERANCE (DECIMAL) U.O.S. .X ± .030 .XX ± .015 ANGLES ± 1°		TITLE MODULE CONTROL		TYPE SIZE DWG. NO. S B 919-0515 REV F
MODEL FM-105		SCALE NONE		SHEET 1 OF 6

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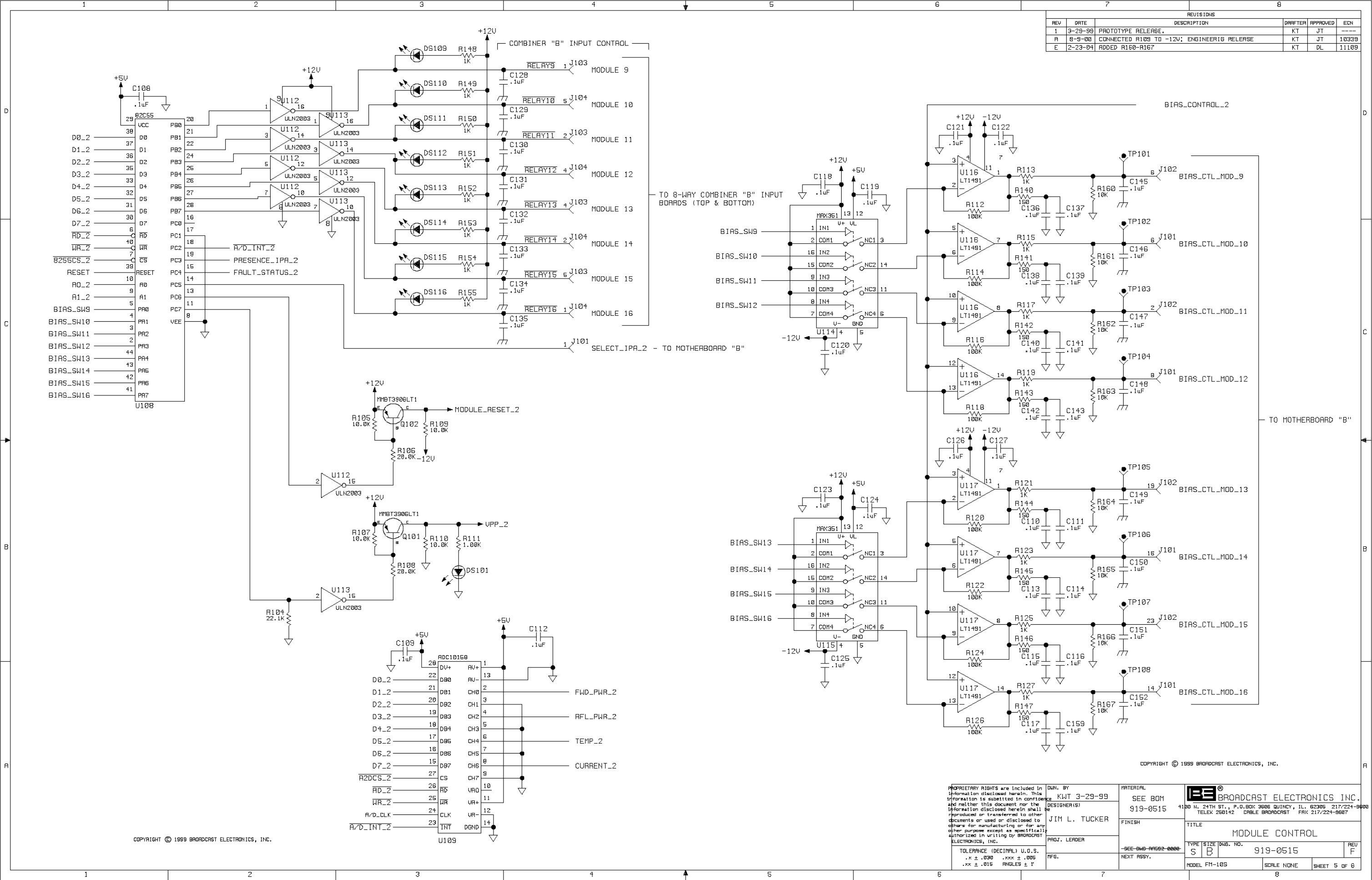






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--	--	--	---	--

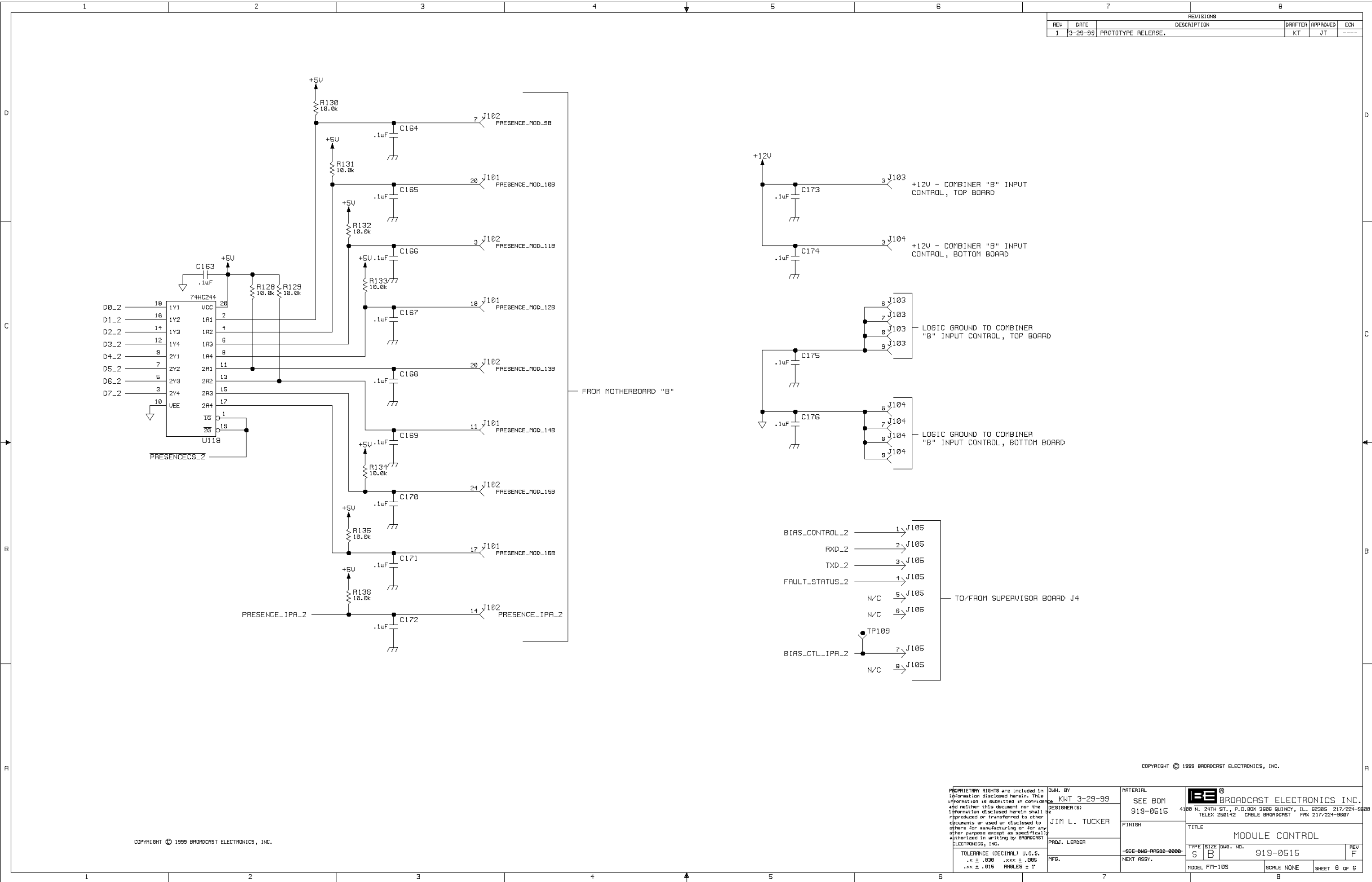




REVISIONS				DRAWN	APPROVED	ECN
REV	DATE	DESCRIPTION				
1	3-29-99	PROTOTYPE RELEASE.		KT	JT	---
A	8-9-00	CONNECTED R109 TO -12V; ENGINEERING RELEASE		KT	JT	10339
E	2-23-04	ADDED R160-R167		KT	DL	11109

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TOLERANCE (DECIMAL) U.O.S. .XX ± .030 .XXX ± .005 .XX ± .015 ANGLES ± 1°		JIM L. TUCKER					
MFG.		PROJ. LEADER	NEXT ASSY.		MODEL FM-105		



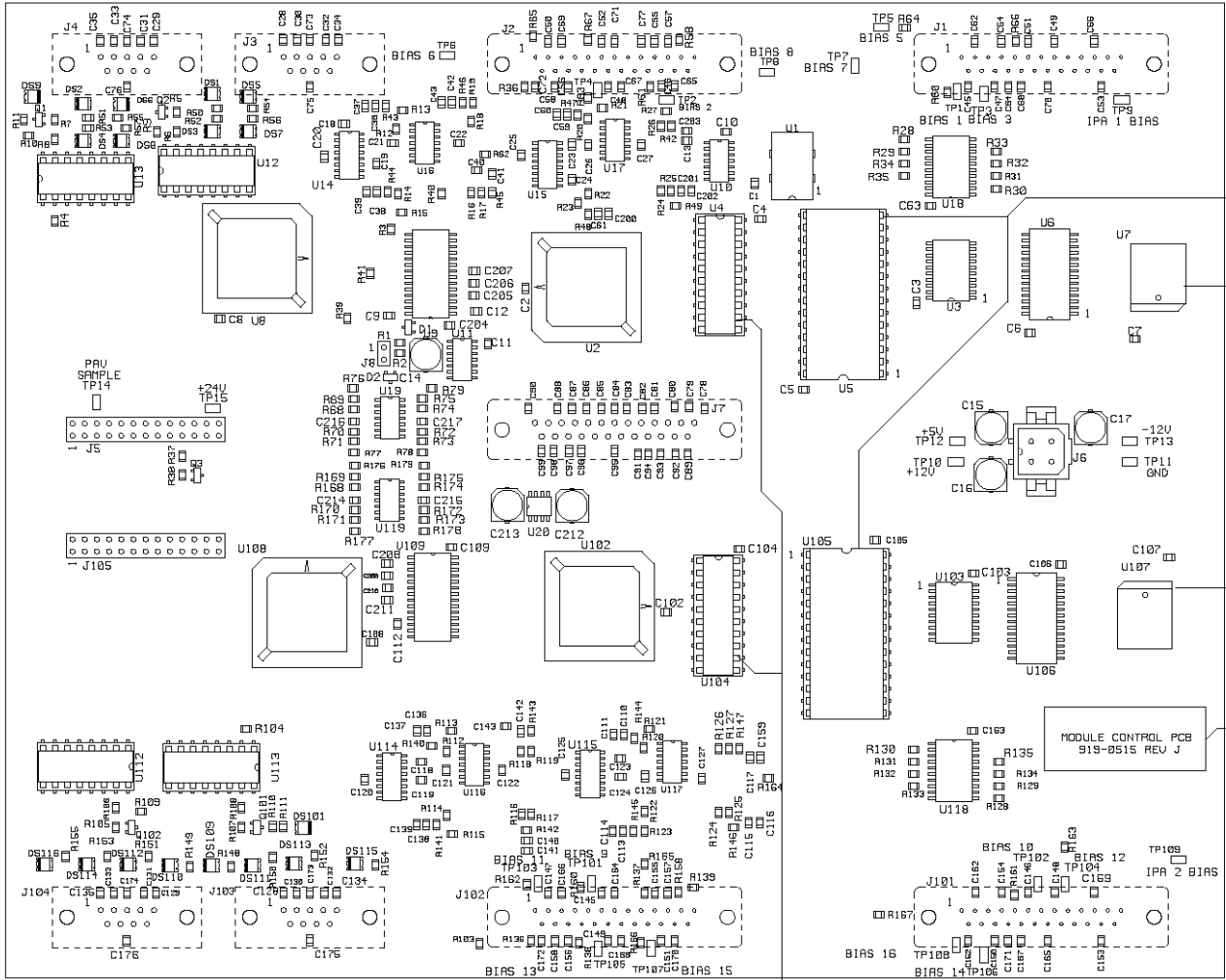
REVISIONS					DRAWN	APPROVED	ECN
REV	DATE	DESCRIPTION	DRAWN	APPROVED	ECN		
1	3-29-99	PROTOTYPE RELEASE.	KT	JT	----		

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	KWT 3-29-99	SEE BOM					
	DESIGNER(S)	919-0515					
	JIM L. TUCKER	FINISH					TITLE
	PROJ. LEADER	-SEE-BOM-91902-0000-					MODULE CONTROL
TOLERANCE (DECIMAL) U.O.S. .X ± .030 .XXX ± .005 .XX ± .015 ANGLES ± 1°	MFG.	NEXT ASSY.	TYPE	SIZE	DWG. NO.	REV	
			S	B	919-0515	F	
			MODEL FM-105	SCALE NONE	SHEET 6 OF 6		

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	3-26-99	PROTOTYPE RELEASE.	KT		----
2	9-23-99	MAJOR CHANGES ACROSS BOARD.	KT		----
3	5-9-00	MADE ALL IC'S SURFACE MOUNT ABLE; MODEL RELEASE.	KT	JLT	----
A	8-9-00	FIXED DISJOINTED NETS; ENGINEERING RELEASE.	KT	JLT	10339
B	9-28-00	CHGD U2 & U102 TO 229-8032-001	KT	DL	10357
C	10-24-00	ADDED D2; MOVED D1.	KT	DL	10369
D	8-9-01	ADDED R58 & R158	KT	DL	10498
E	12-5-01	UPDATED SOFTWARE 979-0515-007 TO VER 1.05	KT	DL	10575
F	2-23-04	ADD R60-R67,R160-R167; CHGD 102-0100 TO 102-1001	KT	DL	11109
G	5-7-04	UPDATED SOFTWARE 979-0515-007 TO REV 1.07	KT	DL	11138
H	6-14-04	ADDED C204-C217,R68-R79,R168-R179,U19,U20,U119	KT	DL	11159
J	5-22-07	UPDATED SOFTWARE VERSIONS	JTB		11556



INSTALL SOFTWARE 979-0515-005 ON U5 & U105, BEFORE BOARD ASSEMBLY. ADD LABEL TO TOP OF U5 & U105 INDICATING : **REV 1.02**

INSTALL SOFTWARE 979-0515-007 ON U7 & U107, DURING BOARD TESTING. ADD LABEL TO TOP OF U7 & U107 INDICATING : **REV 1.09**

SEE NOTE 3

- NOTES:
- 1) SEE SCHEMATIC SB919-0515.
  - 2) J1-J4,J7 & J101-J104 TO BE STUFFED ON THE SOLDER SIDE OF THE PCB.
  - 3) IN THE BLACK WHITE BOX WRITE THE REV. LETTER OF THAT APPEARS ON THE CURRENT ASSEMBLY DRAWING.

INSTALL SOFTWARE 979-0515-004 ON U4 & U104, BEFORE BOARD ASSEMBLY. ADD LABEL TO TOP OF U4 & U104 INDICATING : **REV 1.0**

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

DWN. BY  
KWT 3-26-99  
DESIGNER(S)  
  
JIM TUCKER  
  
PROJ. LEADER  
  
MFG.

MATERIAL

SEE BOM  
919-0515

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

MODULE CONTROL

TYPE

SIZE

DWG No.

MODEL FM10S

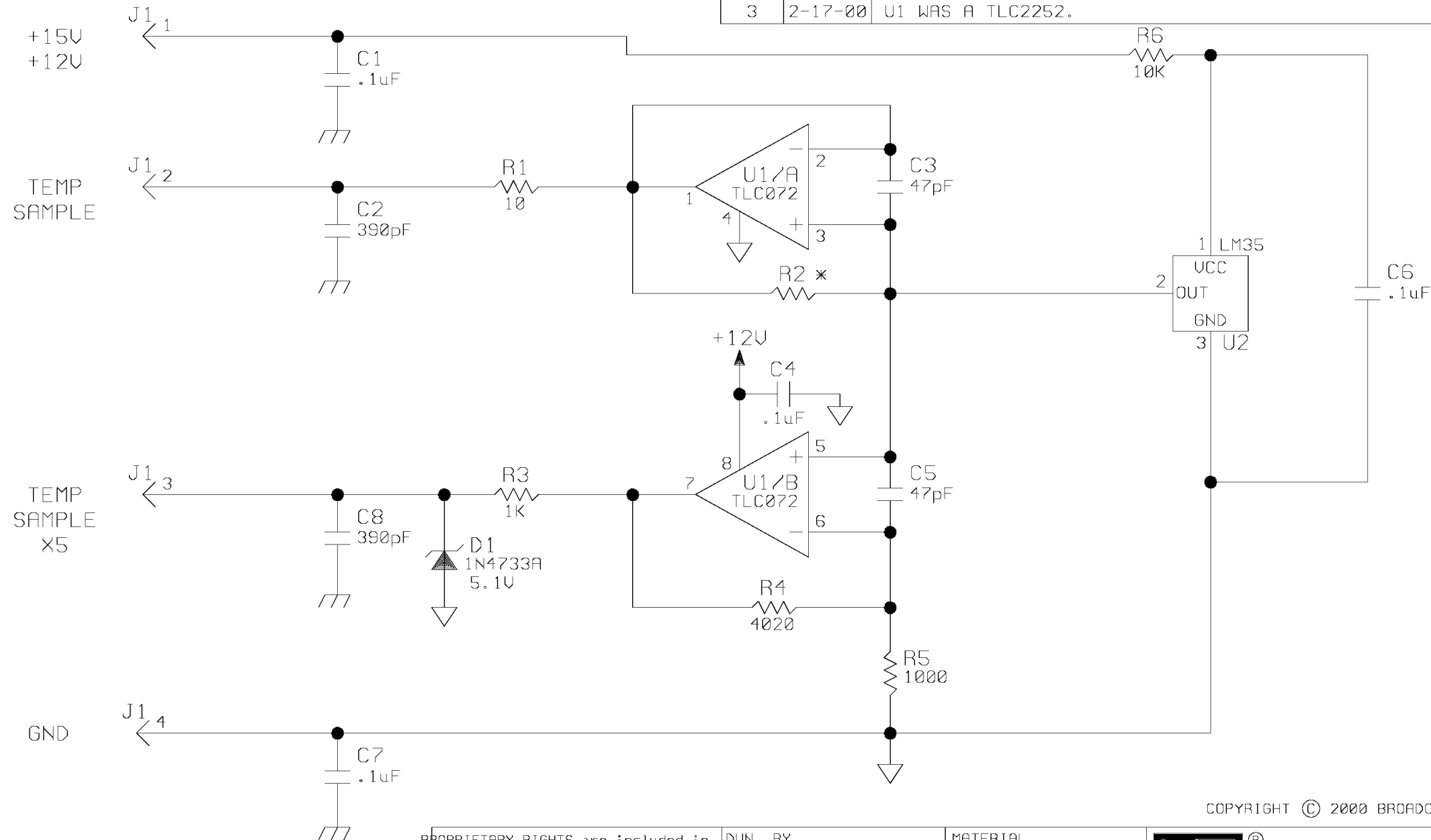
SCALE 1/1

SHEET 1 OF 1

REV


J

4	8-30-00	R4 WAS 9090 OHM; TEMP SAMPLE WAS X10	KT		----	REVISIONS					
A	9-27-00	ENGINEERING RELEASE	KT	RPM	----	REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
B	7-10-03	CHGD R3; ADDED D1	KT		11005	1	2-12-99	PROTOTYPE RELEASE	KT		----
						2	3-30-99	C3 & C5 WERE 390pF, U1 WAS A TL092.	KT		----
						3	2-17-00	U1 WAS A TLC2252.	KT		----



NOTES:

- ALL RESISTORS IN OHMS; 1/4W, 5%, UNLESS OTHERWISE SPECIFIED.
- LAST COMPONENT USED: C8, D1, J1, R6, U2
- SEE PCB ASSEMBLY AB919-0516.
- \* INDICATES PART NOT USED (R2)

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	DESIGNER(S) RPM 9-29-00					
	PROJ. LEADER MBS 9-29-00	FINISH	TITLE SCHEMATIC , TEMPERATURE SENSOR, PCB			
	TOLERANCE (DECIMAL) U.O.S. .x ± .030 .xxx ± .005 .xx ± .015 ANGLES ± 1°	MFG.	NEXT ASSY.	TYPE S	SIZE B	DWG. NO. 919-0516-001/-002
			MODEL FM-10S	SCALE NONE	SHEET 1 OF 1	

919-0516 REV

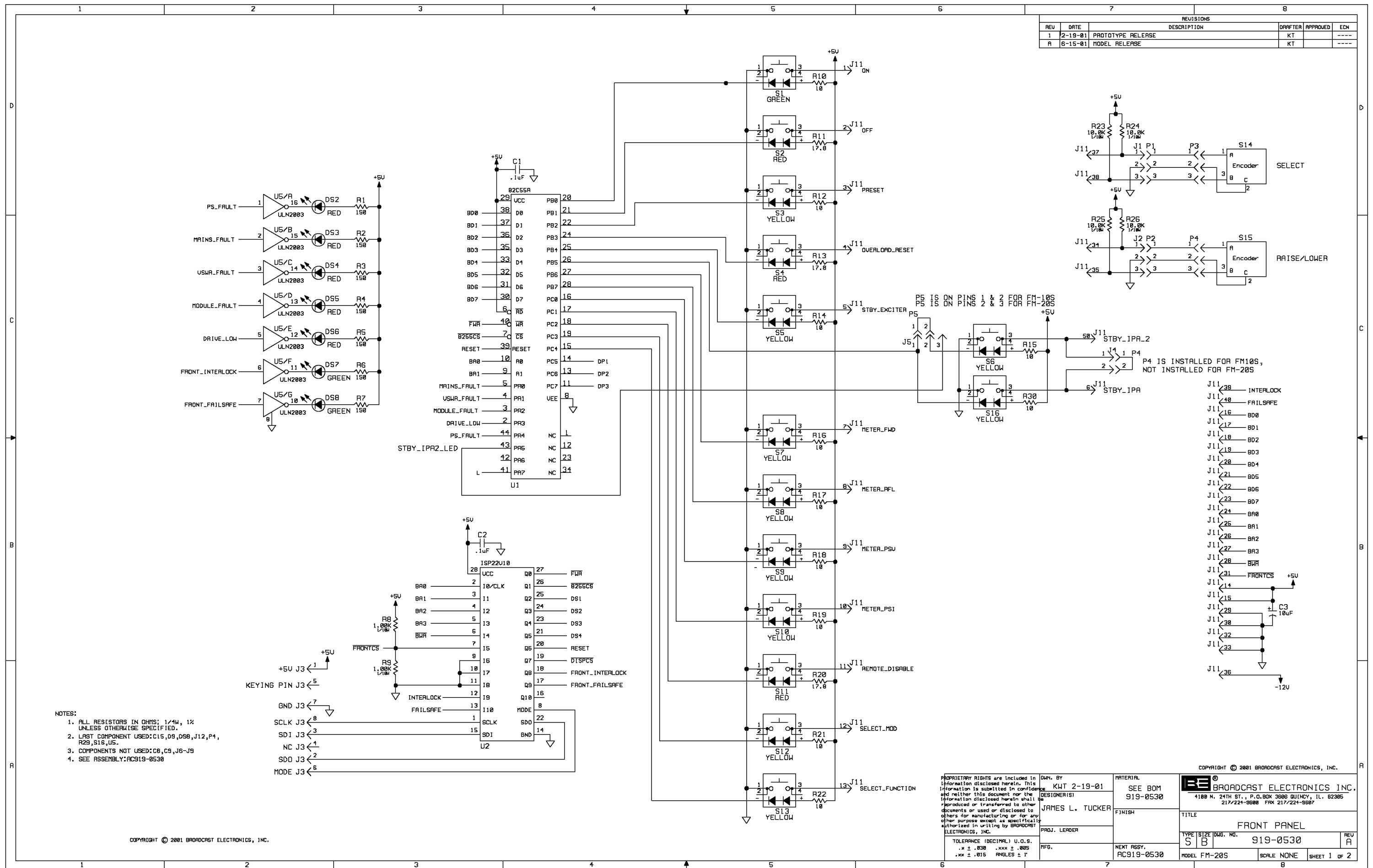
DETAIL "A"

FOR 919-0516-001  
U2 IS MOUNTED ON  
COMPONENT SIDE &  
CENTERED OVER .625  
HOLE, WITH FLAT SIDE DOWN.

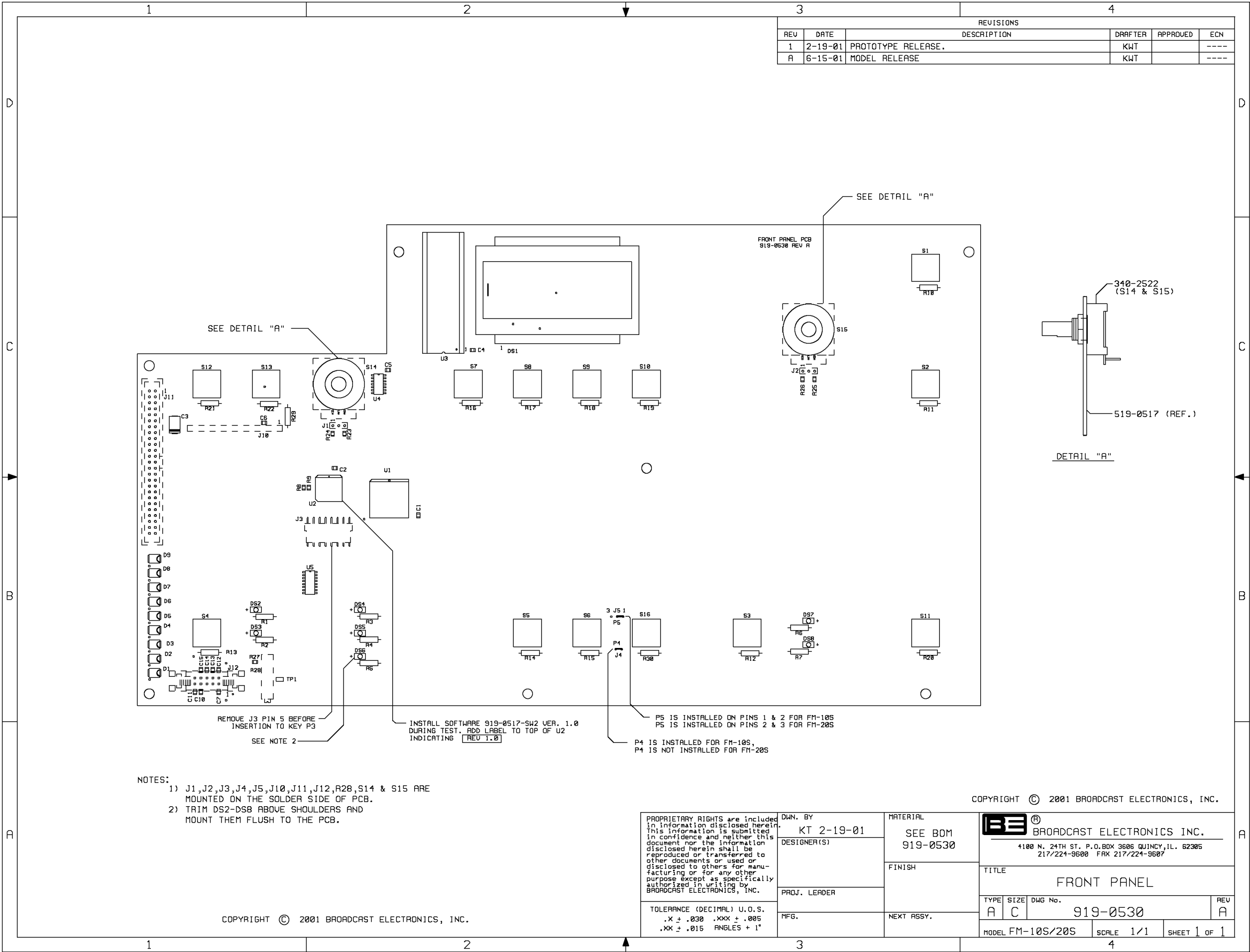
SOLDER SIDE VIEW

FOR 919-0516-002  
U2 IS MOUNTED ON  
SOLDER SIDE, WITH  
ROUND SIDE FACING  
.625 HOLE.

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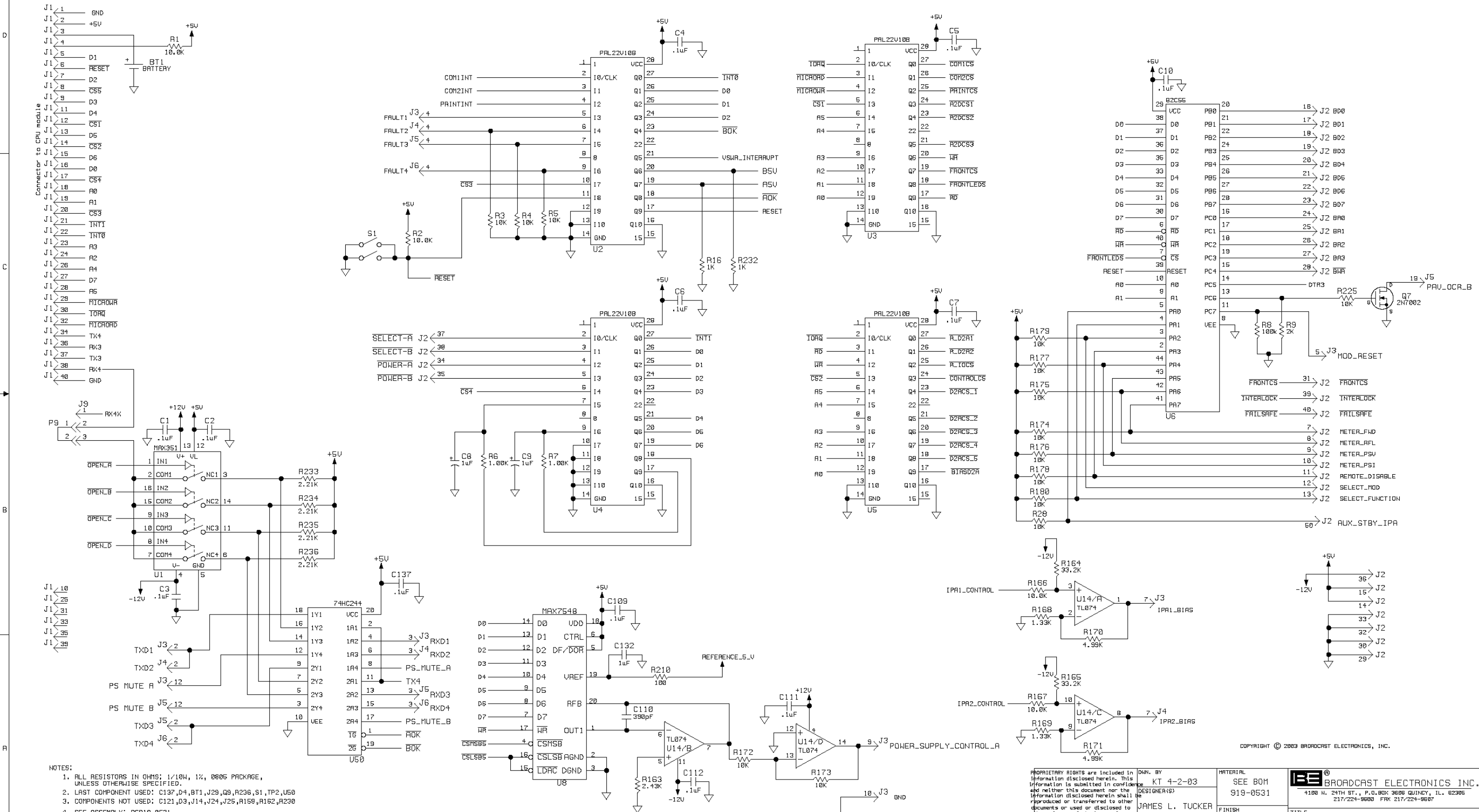









REVISIONS				
REV	DATE	DESCRIPTION	DRAFTER	APPROVED
A	4-2-03	ENGINEERING PROTO	KT	-----
B	7-3-03	SEE SHEETS 3-5	KT	JT
C	12-28-04	SEE SHEET 5	KT	-----

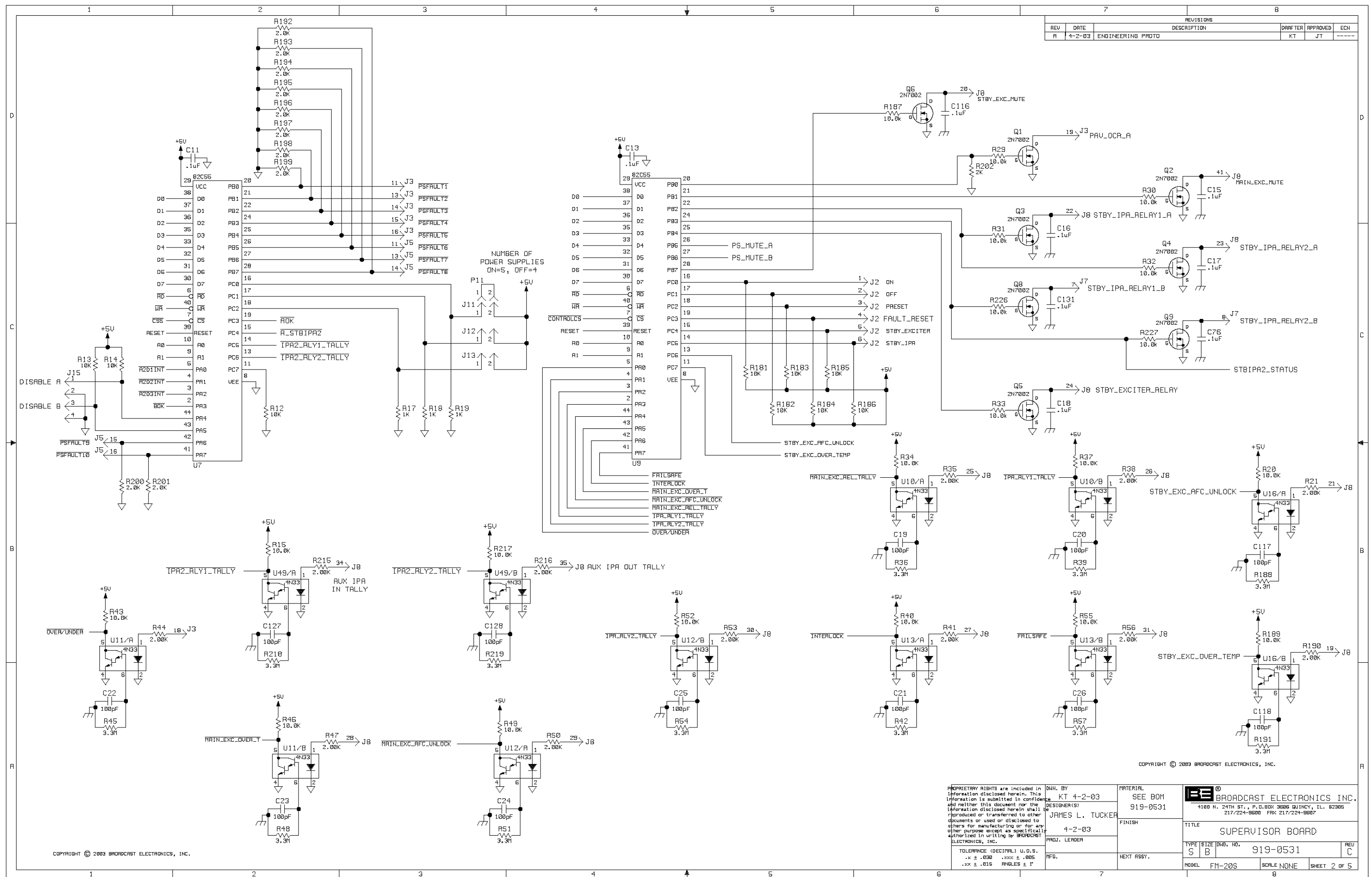


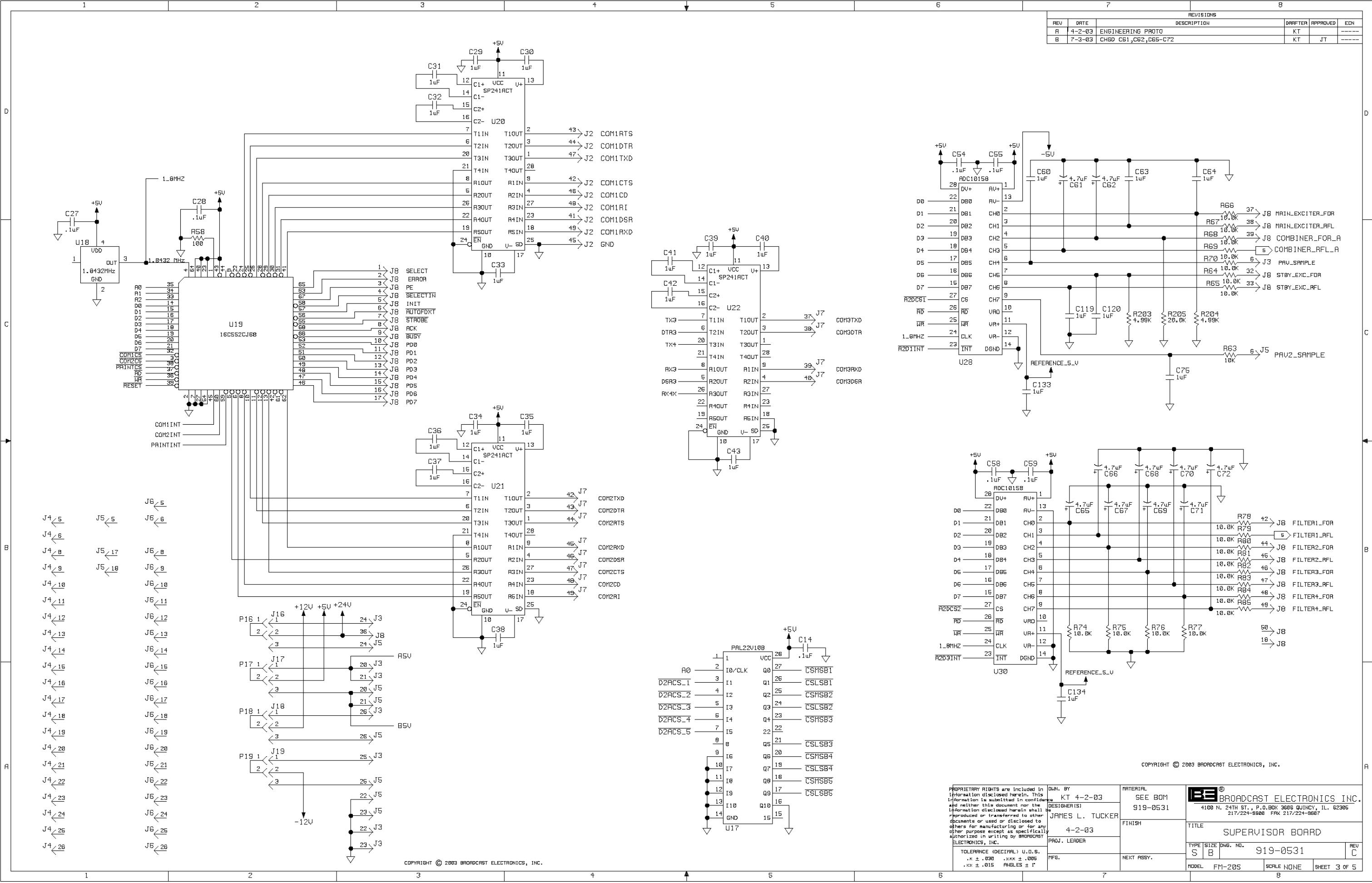
- NOTES:
1. ALL RESISTORS IN OHMS: 1/10W, 1%, 0805 PACKAGE, UNLESS OTHERWISE SPECIFIED.
  2. LAST COMPONENT USED: C137,D4,BT1,J29,Q9,A236,S1,TP2,U50
  3. COMPONENTS NOT USED: C121,D3,J14,J24,J25,A159,A162,A230
  4. SEE ASSEMBLY: AC919-0531

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TOLERANCE (DECIMAL) U.O.S. .XX ± .030 .XX ± .035 .XX ± .015 ANGLES ± 1°			NEXT ASSY.	
TYPE SIZE DIM. NO. 919-0531 REV C		TITLE SUPERVISOR BOARD		MODEL FM-20S SCALE NONE SHEET 1 OF 5

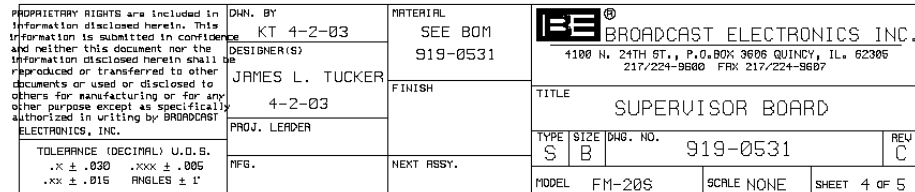
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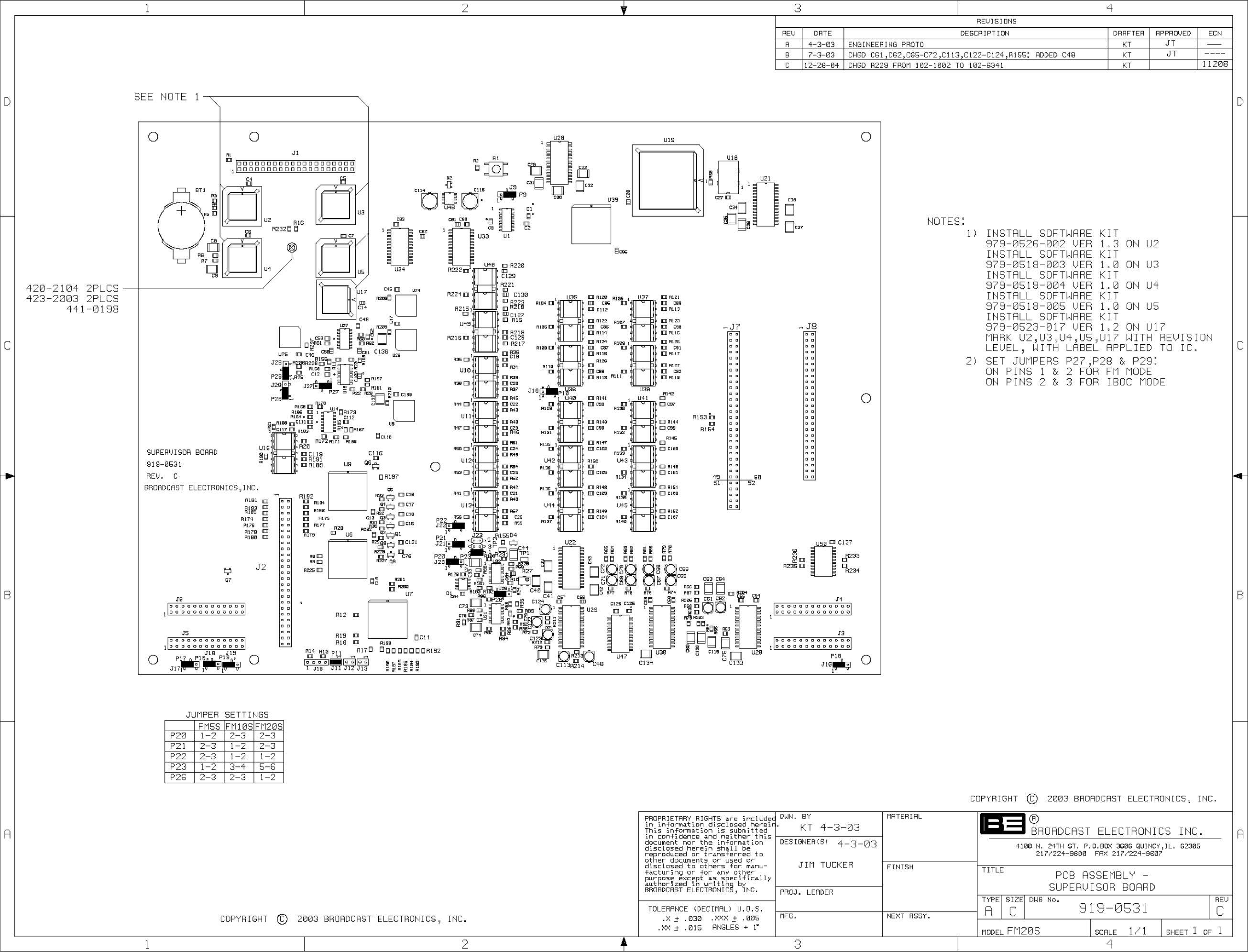


REVISIONS					
REV	DATE	DESCRIPTION	DRAWN	APPROVED	ECN
A	4-2-03	ENGINEERING PROTO	KT	JT	----
B	7-3-03	CHGD C61,C62,C65-C72	KT	JT	----

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		DESIGNER(S) JAMES L. TUCKER	FINISH	
TOLERANCE (DECIMAL) U.S.S. .X ± .030 .XXX ± .005 .XX ± .015 ANGLES ± 1°		4-2-03 PAJ. LEADER	NEXT ASSY.	TITLE SUPERVISOR BOARD
		FIG.	SCALE NONE	REV C
				TYPE SIZE DWG. NO. S B 919-0531
				MODEL FM-205 SCALE NONE SHEET 3 OF 5







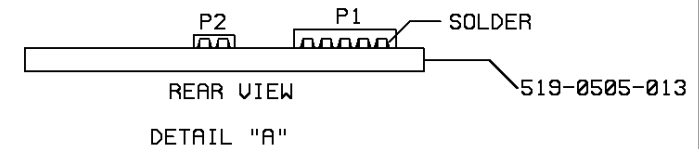
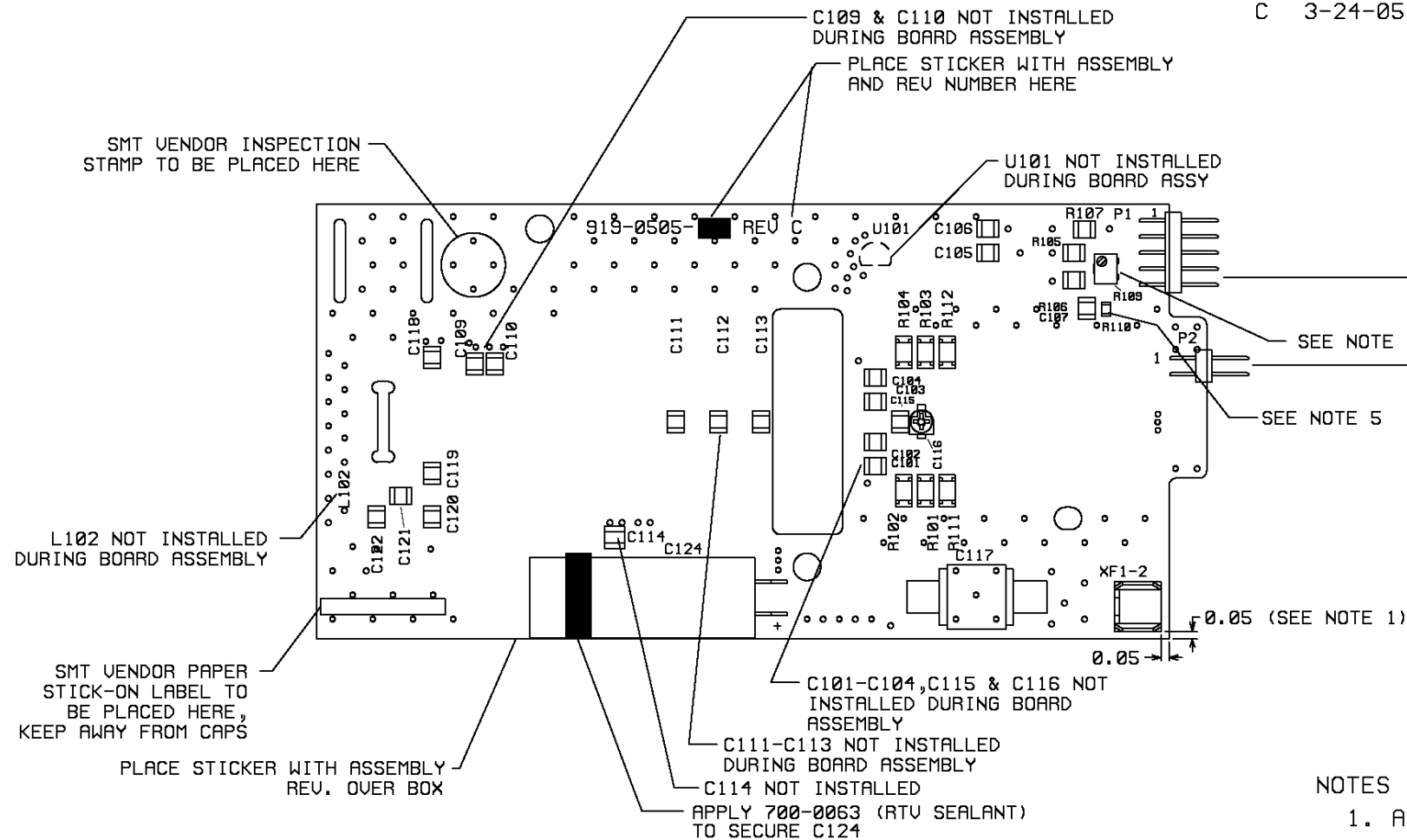









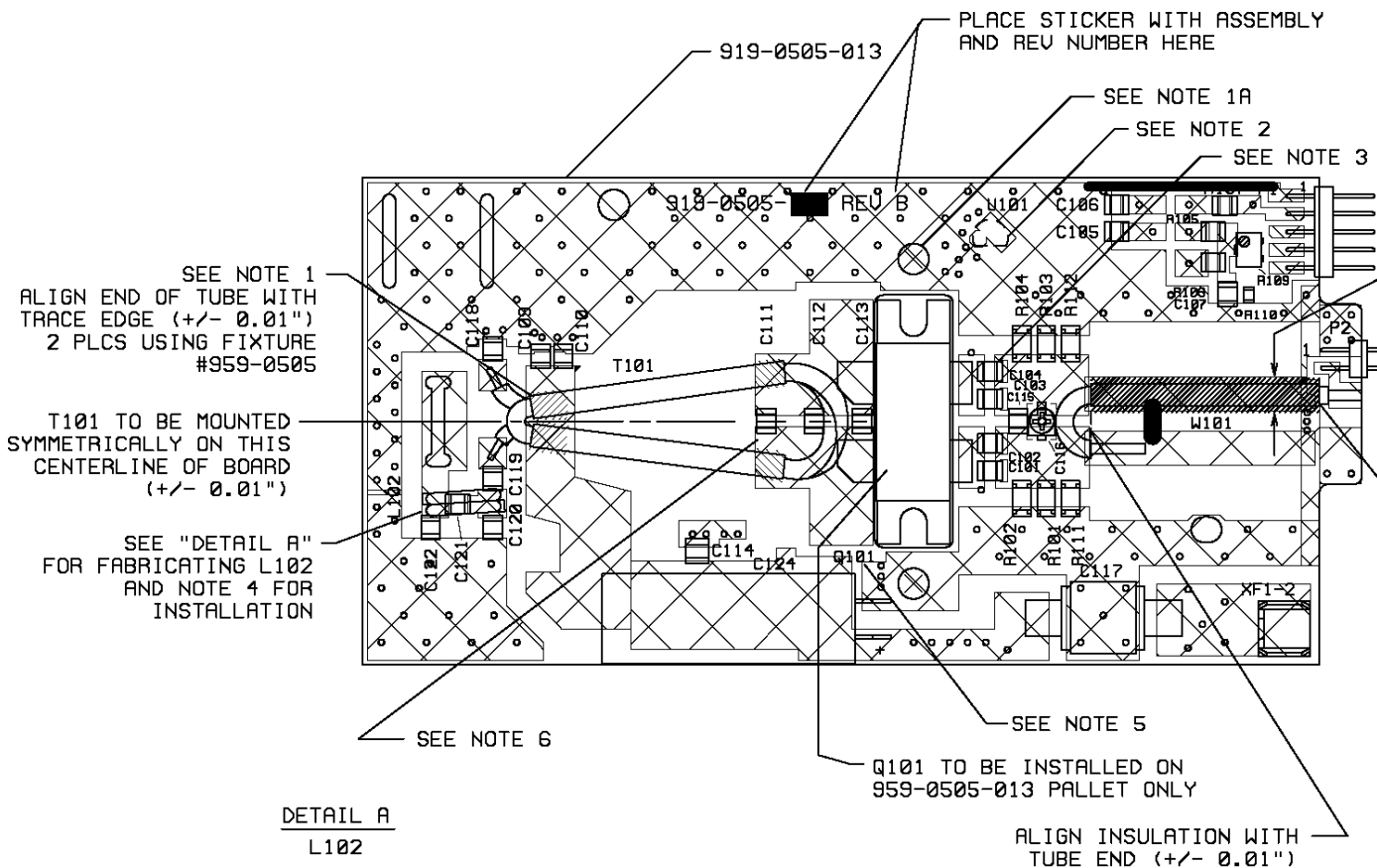
REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	4-15-04	PROTOTYPE RELEASE	KT	TH	----
A	12-16-04	DEL C108,C123,L103,L104; ADD C124; MOVED C114	KT	TH	----
B	1-31-05	CHGD SILKSCREEN, MOVED ASSEMBLY NUMBER LOCATION	KT	TH	11253
C	3-24-05	ADDED NOTE TO NOT INSTALL C114	KT		11273



- NOTES FOR 919-0505-013 ASSY:
1. ALIGN XF1-2 PER DIMENSIONS SHOWN.
  2. INSTALL COMPONENTS WITH COMPONENT MARKING VISIBLE.
  3. REMOVE SEALING COMPOUND FROM COMPONENT TRIM POTS AFTER WASH.
  4. P1 & P2 SHOULD BE SOLDERED AFTER REFLOW TO ASSURE EFFECTIVE AMOUNT OF SOLDER IS APPLIED TO JOINT SEE DETAIL "A".

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	KT 4-15-04	SEE BOM 919-0505-013				
	DESIGNER(S)	FINISH	TITLE PCB SUB-ASSEMBLY RF AMPLIFIER			
	PROJ. LEADER					
TOLERANCE (DECIMAL) U.O.S. .X ± .030 .XXX ± .005 .XX ± .015 ANGLES + 1°	MFG.	NEXT ASSY. 919-0505-113	TYPE A	SIZE B	DWG No. 919-0505-013	REV C
			MODEL FM-10S/20S		SCALE 1/1	SHEET 1 OF 1

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	4-15-04	PROTOTYPE RELEASE	KT	TH	----
A	12-16-04	ENGINEERING RELEASE	KT	TH	----
B	1-31-05	CHGD DRAWING NUMBER AND NOTES	KT	TH	11253



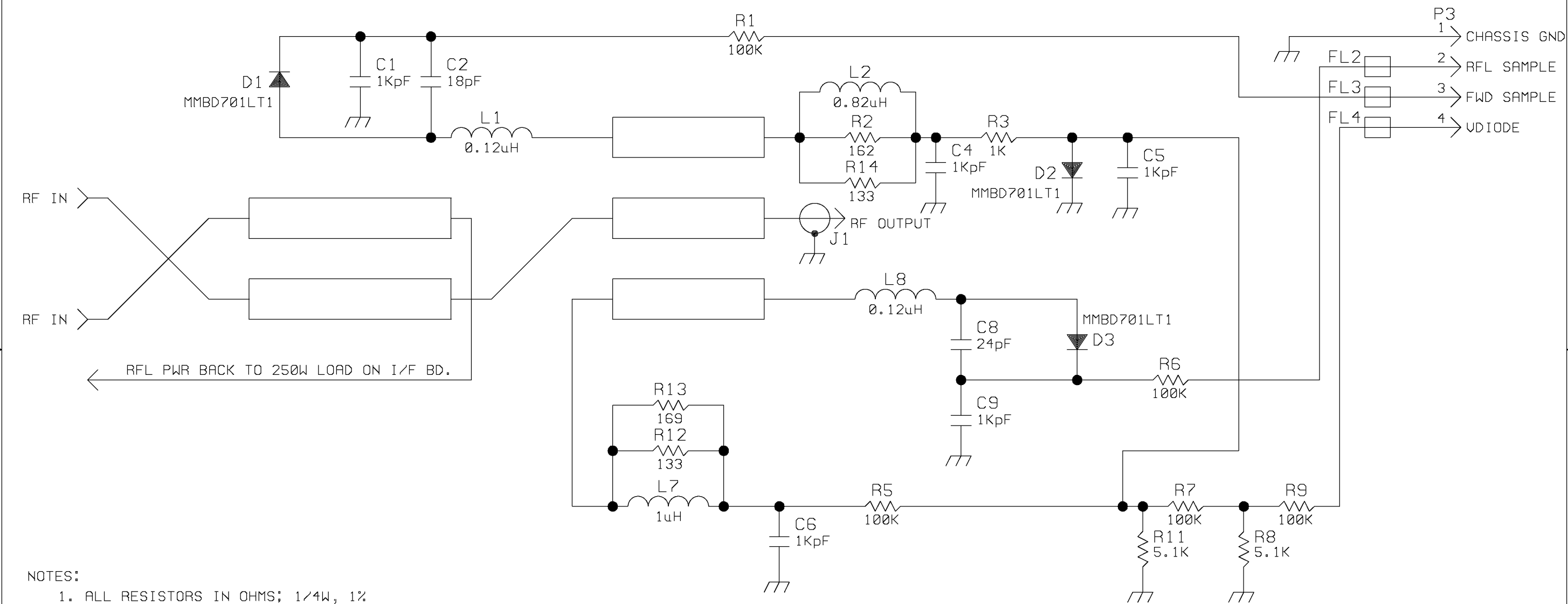
- NOTES:
1. INSTALL T101(#370-0062) & W101(#370-0063) FIRST PER INSTRUCTIONS ON DRAWING. OUTER CONDUCTORS OF T101 & W101 TO BE SOLDERED TO PCB WHERE INDICATED BY SHADING. SOLDER INNER CONDUCTORS OF T101 & W101 AS SHOWN.
  - 1A. FIXTURE 959-0505 IS USED TO INSTALL T101 & W101.
  2. U101 TO BE MOUNTED ON OPPOSITE SIDE OF PCB ( 0.30" HEIGHT FROM BOARD SURFACE TO TOP OF COMPONENT).
  3. INSTALL CAPACITORS C101-C104, C109, C110 & C116 AS SHOWN. C101-C104 & C116 MUST BE POSITIONED IN BETWEEN LOCATOR MARKS SHOWN ON SILKSCREEN.
  4. L102 TO BE SOLDERED OVER C121 AS SHOWN.
  5. FOR 959-0505-013 PALLET ONLY, Q101 DRAIN LEADS (ANGLE CUT) TO BE PRE-TREATED BY IMMERSION IN FLOW SOLDER FOR 5-7 SECONDS. GATE LEADS (STRAIGHT CUT) TO BE TRIMMED TO A LENGTH OF 0.12" FROM THE BODY OF THE PART. INSTALL Q101 & ATTACH LEADS TO PCB USING SN 96.3 AG 3.7 SILVER SOLDER (#700-0170).
  6. THE INSTALLATION AND VALUES OF C111-C113 & C115 TO BE DETERMINED DURING TESTING. USE SN 96.3 AG 3.7 SILVER SOLDER (#700-0170) TO INSTALL C111-C113, IF NEEDED.
  7. INSTALL BRADY LABEL FOR 959-0505-013 PALLET OR 919-0505-113 BOARD (LESS Q101) AS APPLICABLE.

1. CUT WIRE (610-2401) TO 2.40" LENGTH.
2. STRIP BOTH ENDS 0.15".
3. WIND COIL 1 1/2 TURNS ON 8/32" I.D. AS SHOWN USING FIXTURE #L102.
4. BEND LEAD AT BOTH ENDS AS SHOWN.

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	DESIGNER(S)				
	PROJ. LEADER	FINISH	TITLE PCB ASSEMBLY RF AMPLIFIER, ST MICRO		
	MFG.	NEXT ASSY.	TYPE A	SIZE B	DWG No. 919-0505-113/959-0505-013
TOLERANCE (DECIMAL) U.O.S. .X ± .030 .XXX ± .005 .XX ± .015 ANGLES + 1°			REV B		
			MODEL FM-10S/20S		SCALE 1/1
			SHEET 1 OF 1		

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	4-13-99	PROTOTYPE RELEASE.	MH	SJ	----
2	6-2-99	ADDED R11-R14;DELETED C1,C8,L3-L7;VALUE CHGS.	MH	SJ	----
3	4-18-00	ADDED C2,C8,L7;DELETED C3,C7,FL1;CHGD VALUE OF D1-D3,L2,R2,R12,R13.	MH	MBS	----
A	8-7-00	CHGD R12 TO 133; ENGINEERING RELEASE.	MH	JL	----



- NOTES:
1. ALL RESISTORS IN OHMS; 1/4W, 1% UNLESS OTHERWISE SPECIFIED.
  2. LAST COMPONENT USED:C9,D3,FL4,J1,L8,P3,R14.
  3. COMPONENTS NOT USED:C3,C7,FL1,L3-L6,P1,P2,R4,R10.
  4. SEE ASSEMBLY:AC919-0508.

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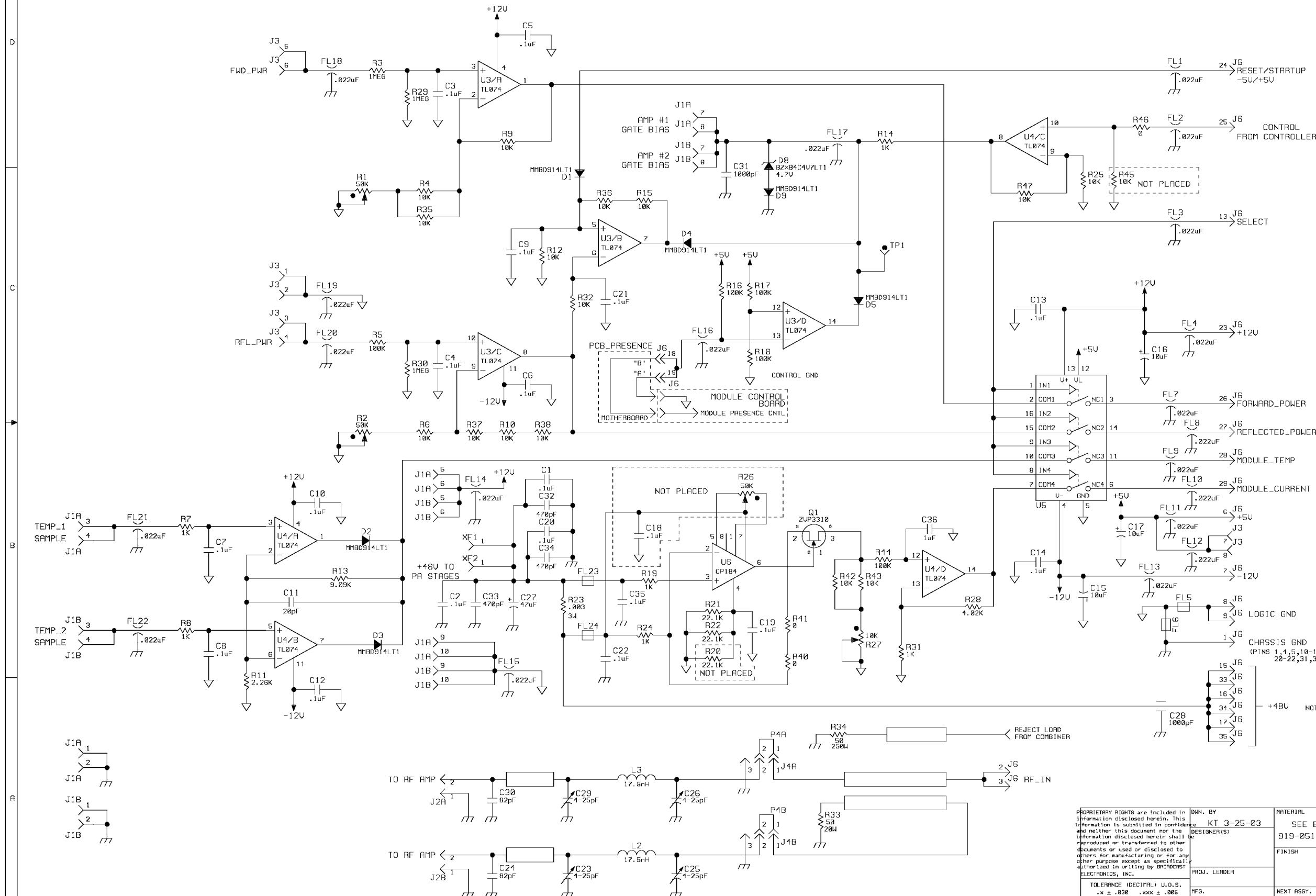
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	M. HAYDEN		SEE BOM		4100 N. 24TH ST., P.O.BOX 3606 QUINCY, IL. 62305		
	DESIGNER(S)	8-7-00	919-0508		217/224-9600 FAX 217/224-9607		
	JAY LINDERER		FINISH		TITLE		
	PROJ. LEADER	8-7-00	NEXT ASSY.		SCHEMATIC		
TOLERANCE (DECIMAL) U.O.S.	M. SHRESTHA			TYPE	SIZE	DWG. NO.	REV
.x ± .030 .xxx ± .005	MFG.			S	B	919-0508	A
.xx ± .015 ANGLES ± 1°				MODEL FM-10S		SCALE NONE	SHEET 1 OF 1

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	9-8-98	PROTOTYPE RELEASE.	MH	SJ	----
2	3-31-99	MAJOR CHANGES.	MH	SJ	----
3	5-26-99	MAJOR COMPONENT MOVE.	MH	SJ	----
4	4-29-00	MINOR COMPONENT CHANGES.	MH		----
5	5-9-00	UPDATED ASSY NOTES FOR P3 AND 426-0010.	MH		----
6	5-18-00	ADDED "DO NOT INSTALL." NOTES FOR 4 COMPONENTS.	MH		----
7	5-31-00	ADDED NOTES INDICATING LOCATION OF SMT VENDOR'S INSPECTION STAMP & STICK-ON LABEL; DELETED OUTLINE FOR 4 COMPONENTS NOT INSTALLED; ADDED NOTE 1.	MH	MBS	----
A	6-13-00	UPDATED PEM STUD INSTALLATION NOTE; MODEL BUILD RELEASE.	MH	MBS	----
B	8-7-00	R12 CHGD TO 133; ENGINEERING RELEASE.	MH	JL	----



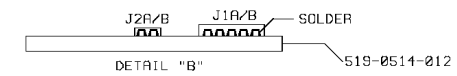
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	PROJ. LEADER 8-7-00 M. SHRESTHA MFG.	FINISH NEXT ASSY.	
	TITLE PCB ASSEMBLY MODULE COMBINER		
TOLERANCE (DECIMAL) U.O.S. .X ± .030 .XXX ± .005 .XX ± .015 ANGLES ± 1°	TYPE SIZE DWG No. REV A C 919-0508 B		MODEL FM10S SCALE 1/1 SHEET 1 OF 1

REVISIONS			DRAFTER	APPROVED	ECN
REV	DATE	DESCRIPTION			
A	3-25-03	ENGINEERING RELEASE	KT		---




- NOTES:
1. ALL RESISTORS IN OHMS: 1/10W, 1% UNLESS OTHERWISE SPECIFIED.
  2. LAST COMPONENT USED: C36, D9, FL24, J6, L3, Q1, R47, TP1, U6, XF2.
  3. COMPONENTS NOT USED: D6, D7, J5, L1, R33, R39, U1, U2.
  4. SEE ASSEMBLY: AC919-0514-012.

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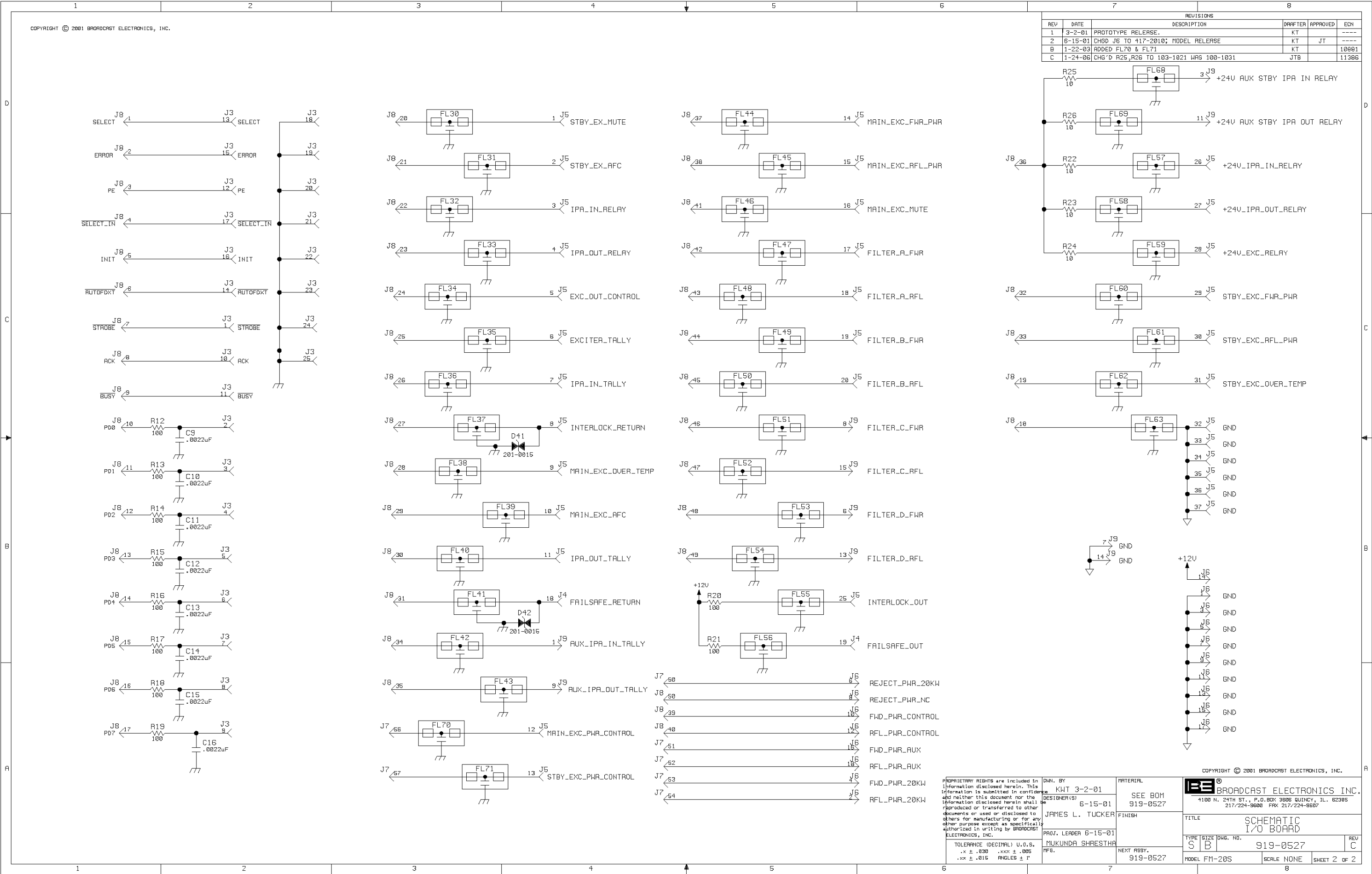


- NOTES:
1. SEE SCHEMATIC SB919-0514-012.
  2. INSTALL COMPONENTS WITH COMPONENT MARKING VISIBLE.
  3. REMOVE SEALING COMPOUND FROM COMPONENT TRIM POTS AFTER WASH.
  4. PLACE J3 AFTER REFLOW.
  5. J1A,J1B,J2A & J2B SHOULD BE SOLDERED AFTER REFLOW TO ASSURE EFFECTIVE AMOUNT OF SOLDER IS APPLIED TO JOINT, SEE DETAIL "B".
  6. \* INDICATES PART NOT PLACED (C18,R20,R26,R45)

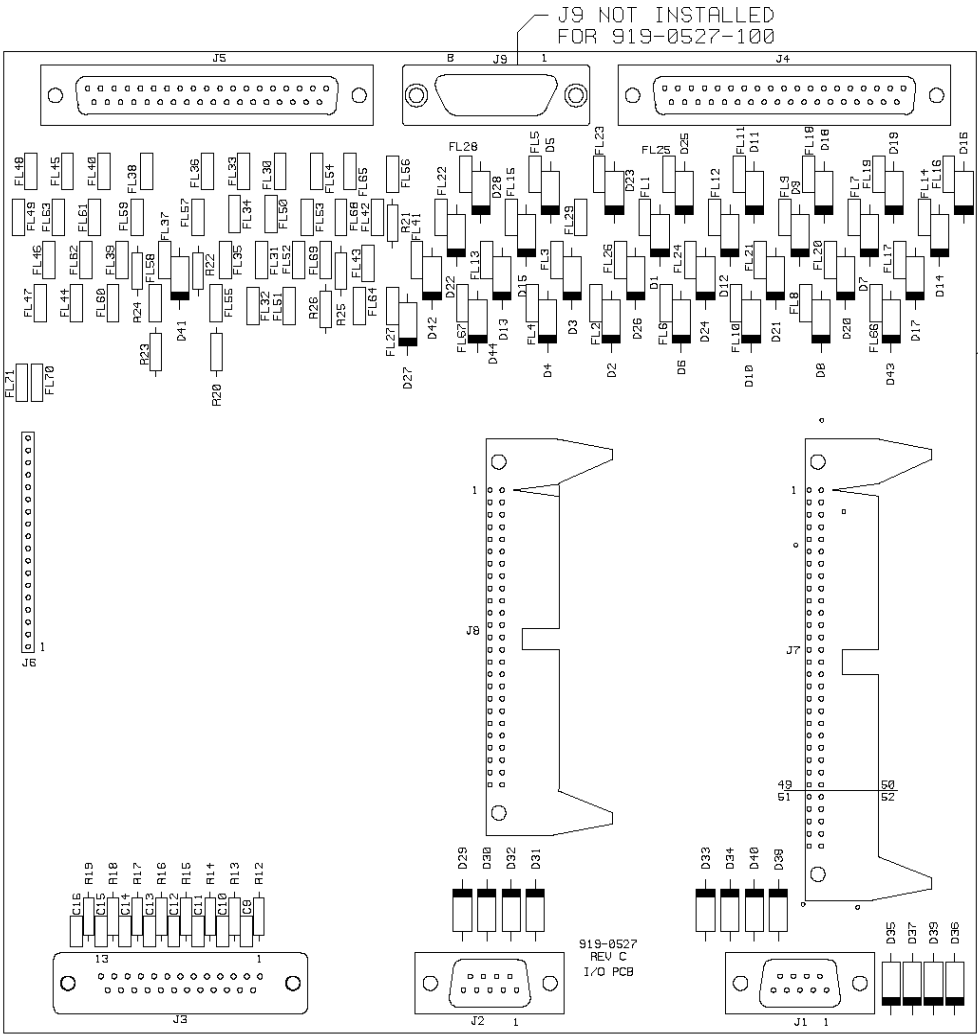
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	DESIGNER(S)  PROJ. LEADER			FINISH  TITLE PCB ASSEMBLY RF AMP INTERFACE, FM10S/FM1 ST MICRO							
TOLERANCE (DECIMAL) U.O.S. .X ± .030 .XXX ± .005 .XX ± .015 ANGLES + 1°	MFG.	NEXT ASSY.	<table border="1"> <tr> <td>TYPE A</td> <td>SIZE C</td> <td>DWG No. 919-0514-012</td> <td>REV A</td> </tr> <tr> <td colspan="2">MODEL FM-10S/20S</td> <td>SCALE 1/1</td> <td>SHEET 1 OF 1</td> </tr> </table>	TYPE A	SIZE C	DWG No. 919-0514-012	REV A	MODEL FM-10S/20S		SCALE 1/1	SHEET 1 OF 1
TYPE A	SIZE C	DWG No. 919-0514-012	REV A								
MODEL FM-10S/20S		SCALE 1/1	SHEET 1 OF 1								








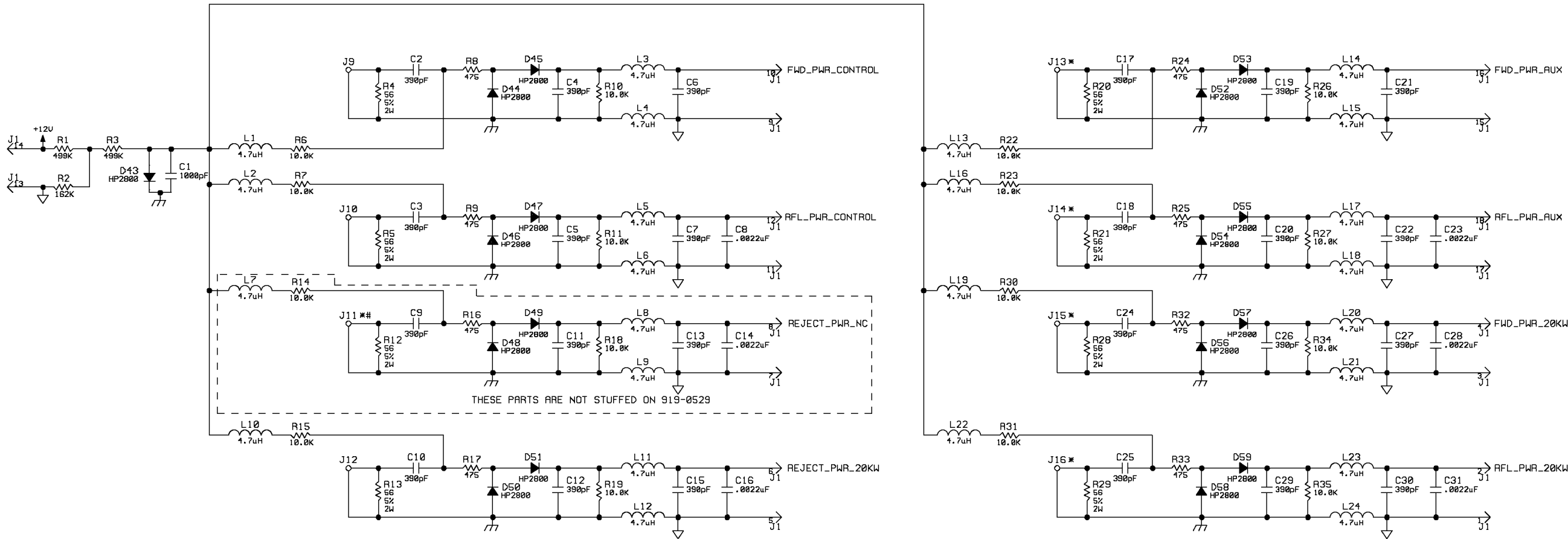
REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	3-5-01	PROTOTYPE RELEASE.	KT		----
2	6-11-01	MOVED J7,D35,D36,D37 & D39	KT		----
3	6-15-01	CHANGED J6 TO 417-2010; MODEL RELEASE	KT		----
A	10-23-01	ENGINEERING RELEASE WITHOUT CHANGE	KT	JT	----
B	1-22-03	ADDED FL70 & FL71	KWT	JT	10881
C	5-23-03	ADDED -100 ASSEMBLY AND NOTE	KWT	JT	10981
D	1-24-06	CHG'D R25,R26 TO 103-1021 WAS 100-1031	JTB		11386



NOTES:  
1. REFERENCE SCHEMATIC SB919-0527.

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	DESIGNER(S) 6-15-01 JIM L. TUCKER		FINISH		TITLE PCB ASSEMBLY I/O BOARD				
	PROJ. LEADER 6-15-01 MUKUNDA SHRESTHA		NEXT ASSY.		TYPE SIZE DWG No.		REV		
	MFG.				A C 919-0527/-100		D		
TOLERANCE (DECIMAL) U.O.S. .X ± .030 .XXX ± .005 .XX ± .015 ANGLES + 1°				MODEL FM-20S		SCALE 1/1		SHEET 1 OF 1	

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	3-6-01	PROTOTYPE RELEASE	KT		-----
2	6-15-01	INDICATED PARTS NOT STUFFED: MODEL RELEASE	KT		-----
A	10-23-01	ENGINEERING RELEASE WITHOUT CHANGE	KT		-----



- NOTES:
1. ALL RESISTORS IN OHMS: 1/4W, 1% UNLESS OTHERWISE SPECIFIED.
  2. LAST COMPONENT USED: C31,D59,J16,L24,R35.
  3. COMPONENTS NOT USED:D1-D42,J2-J8
  4. SEE ASSEMBLY: AC919-0529/-001
  5. \* INDICATES PARTS NOT STUFFED ON 919-0529-001 FOR FM-10S (J11,J13,J14,J15,J16)
  6. # INDICATES PARTS NOT STUFFED ON 919-0529 FOR FM-20S (J11)

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DWN. BY  
KT 3-6-01  
DESIGNER(S)  
MBS 5-15-01  
PROJ. LEADER  
MBS 5-15-01  
MFG.

MATERIAL  
SEE BOM  
919-0529  
FINISH  
NEXT ASSY.

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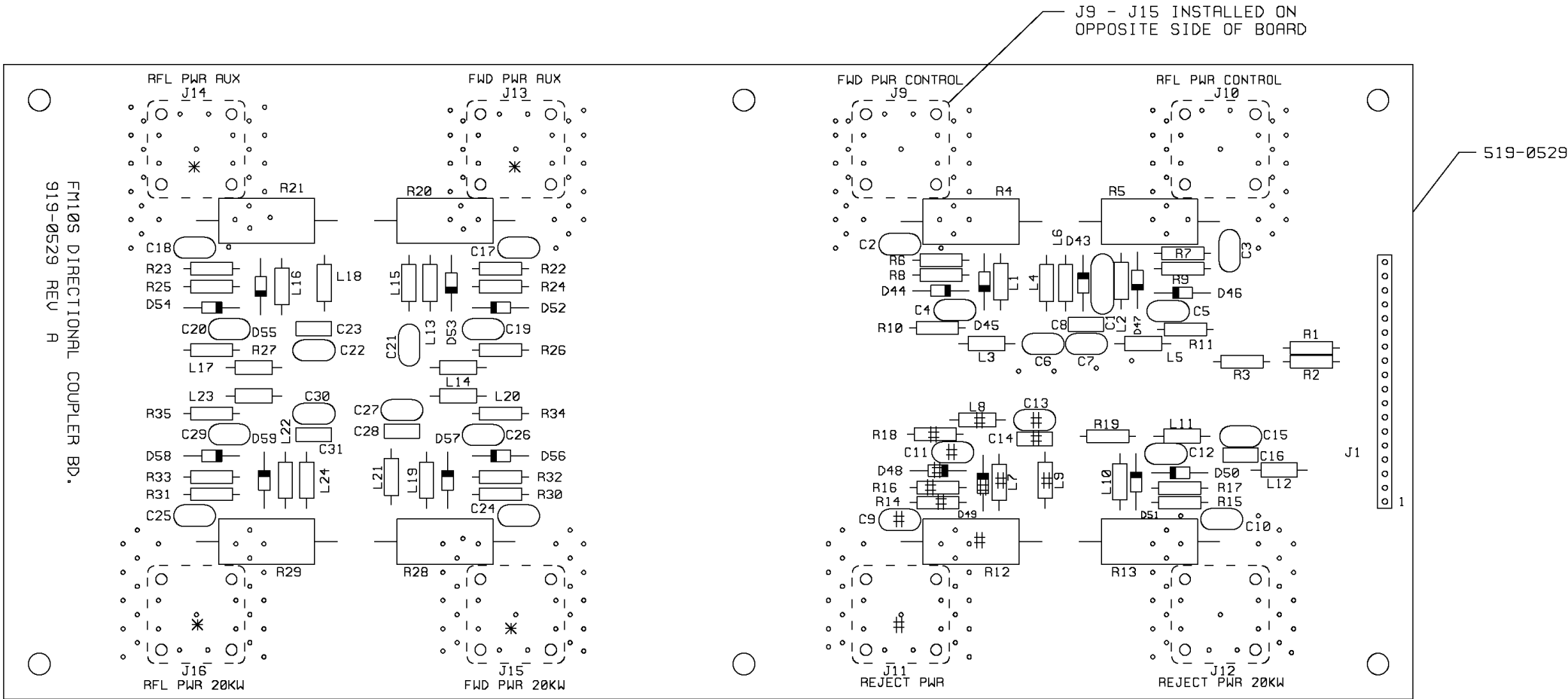
**BROADCAST ELECTRONICS, INC.**  
4100 N. 24TH ST., P.O. BOX 3606 QUINCY, IL. 62306  
217/224-9688 FAX 217/224-9687

TITLE  
DIRECTIONAL COUPLER

TYPE SIZE DWG. NO. REV  
S B 919-0529 A

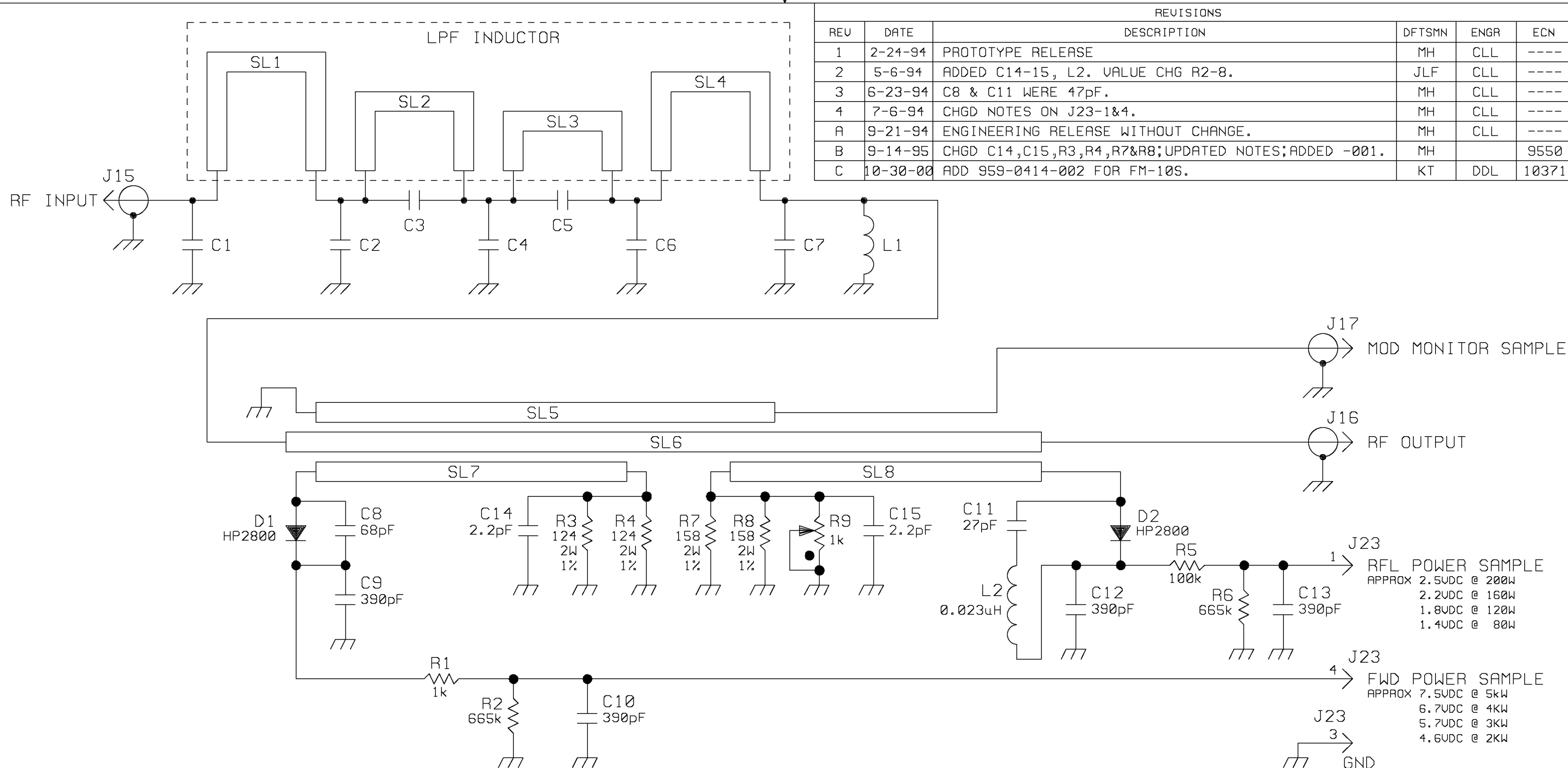
MODEL FM-20S SCALE NONE SHEET 1 OF 1

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	3-6-01	PROTOTYPE RELEASE.	KT		----
2	6-15-01	INDICATED PARTS NOT STUFFED,CHGD J1:MODEL RELEASE	KT	MBS	----
3	8-17-01	CHGD NOTE 2	KT		----
A	10-23-01	ENGINEERING RELEASE WITHOUT CHANGE	KT		----



- NOTES:
1. REFERENCE SCHEMATIC SB919-0529.
  2. \* INDICATES COMPONENTS NOT STUFFED ON 919-0529-001 (J13-J16)
  3. # INDICATES COMPONENTS NOT STUFFED ON 919-0529 & 919-0529-001 (C9,C11, C13,C14,D48,D49,J11,L7,L8,L9,R12, R14,R16,R18)

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	DESIGNER(S) MBS 5-15-01				
	PROJ. LEADER MBS 5-15-01	FINISH	TITLE PCB ASSEMBLY DIRECTIONAL COUPLER		
	MFG.	NEXT ASSY.	TYPE A	SIZE B	DWG No. 919-0529/-001 REV A
TOLERANCE (DECIMAL) U.O.S. .X ± .030 .XXX ± .005 .XX ± .015 ANGLES + 1°		MODEL FM-10S/20S		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:

- "SL" INDICATES ETCHED STRIPLINE ON PCB.
- C1-C7 ARE ETCHED ON PCB.
- ALL RESISTORS IN OHMS, 1/4W, 1%, UNLESS OTHERWISE SPECIFIED.
- SEE PCB ASSEMBLY DRAWING AC919-0421/-001/-002.

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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.

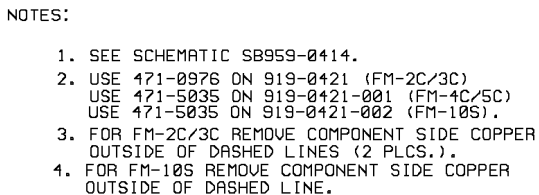
4100 N. 24TH ST., P.O. BOX 3606 QUINCY, IL. 62305 217/224-9600  
 TELEX 250142 CABLE BROADCAST FAX 217/224-9607


TITLE  
 SCHEMATIC  
 LOW PASS FILTER ASSEMBLY

TYPE	SIZE	DWG. NO.	REV
S	B	959-0414/-001/-002	C

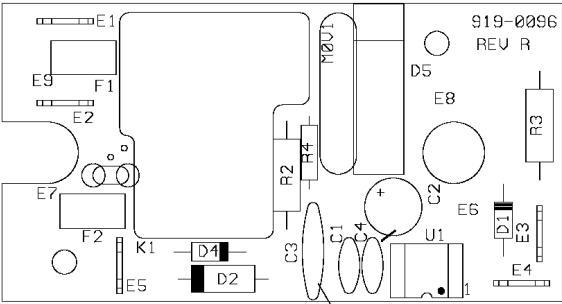
MODEL FM-2C/3C/4C/5C/10S	SCALE NONE	SHEET 1 OF 1
--------------------------	------------	--------------

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	2-9-94	PROTOTYPE RELEASE.	MH	CLL	----
2	5-4-94	ADJUSTED CAPS. ADDED C14-15, & L2. VALUE CHG R2-8.	JLF	CLL	----
3	6-23-94	CHGD VALUE OF C8 & C11.	MH	CLL	----
4	9-9-94	ADDED VIEW OF INDUCTOR, PEM STUDS & NUTS AND BUSS WIRE.	MH	CLL	----
A	9-27-94	ADDED COMPONENT LEAD LENGTH NOTE AND SOLDERING NOTE FOR 471-0976;ENGINEERING RELEASE.	MH	CLL	----
B	9-14-95	CHGD C14,C15,R3,R4,R7&R8;ADDED NOTE 2.	MH	MBS	9550
C	1-26-96	ADDED NOTE 3; CORRECTED SURFACE SOLDERING POINT FOR L1.	MH	WHB	9611
D	9-22-97	CHGD ALL 103-1041 RES. TO 100-1041 RES.	KT	DDL	9863
E	10-30-00	ADDED NOTE 4 & 919-0421-002	KT	DDL	10371



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	9/27/94 C.L. LANGNER	FINISH	TITLE PCB ASSEMBLY LOW PASS FILTER							
	PROJ. LEADER 9/27/94 J.R. CARPENTER	-SEE DWG AR502-0000- NEXT ASSY. 959-0414/-001/-002	<table border="1"> <tr> <td>TYPE</td> <td>SIZE</td> <td>DWG No.</td> <td>REV</td> </tr> <tr> <td>A</td> <td>C</td> <td>919-0421/-001/-002</td> <td>E</td> </tr> </table>	TYPE	SIZE	DWG No.	REV	A	C	919-0421/-001/-002
TYPE	SIZE	DWG No.	REV							
A	C	919-0421/-001/-002	E							
TOLERANCE (DECIMAL) U.O.S. .X ± .030 .XXX ± .005 .XX ± .015 ANGLES ± 1°		<table border="1"> <tr> <td>MODEL</td> <td>FM-2C/3C/4C/5C/10S</td> <td>SCALE</td> <td>1/1</td> <td>SHEET</td> <td>1 OF 1</td> </tr> </table>	MODEL	FM-2C/3C/4C/5C/10S	SCALE	1/1	SHEET	1 OF 1		
MODEL	FM-2C/3C/4C/5C/10S	SCALE	1/1	SHEET	1 OF 1					





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

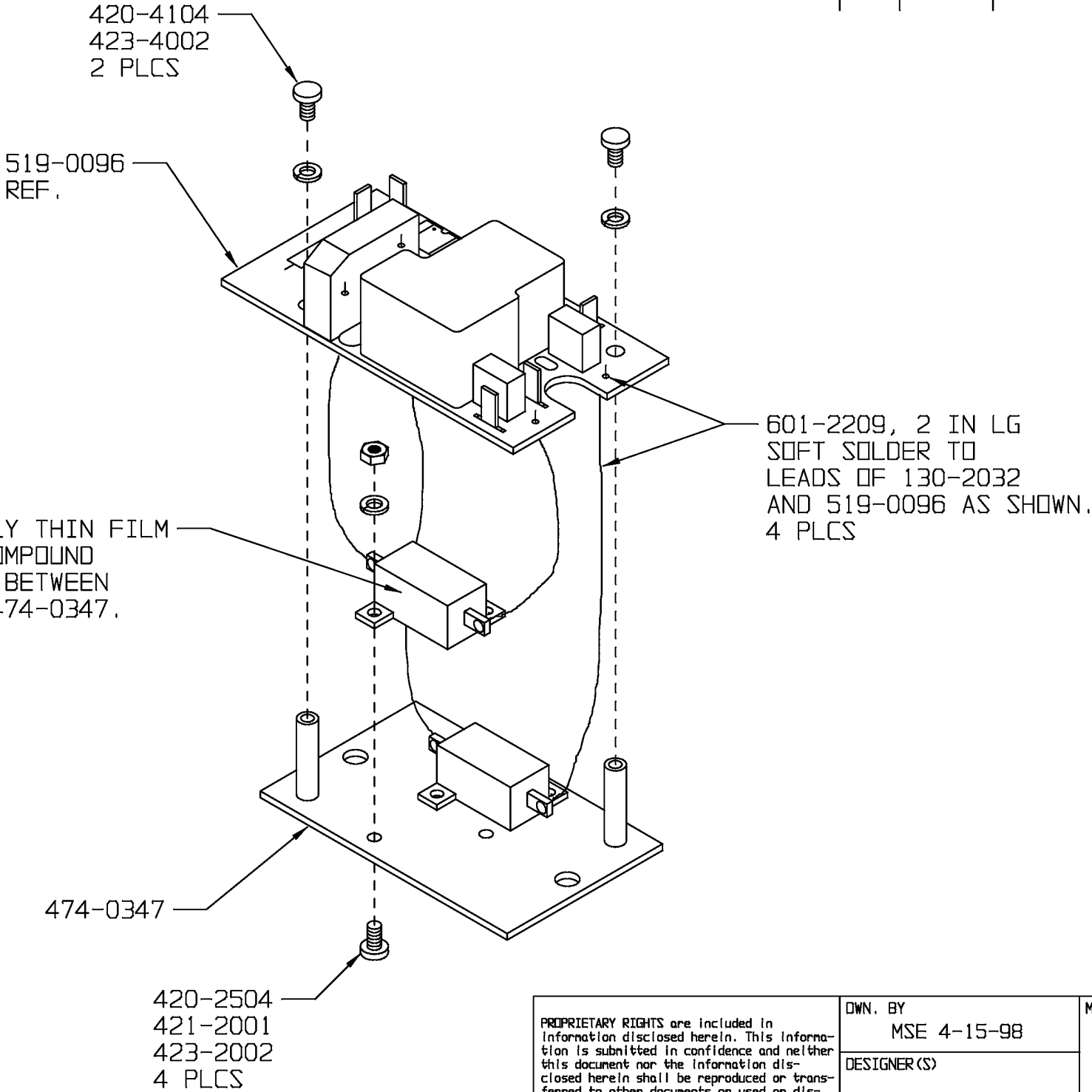
REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
C	7-14-86	ENGINEERING RELEASE	MSE	JHS	6434
D	9-23-86	ADDED 919-0096-001	MSE	DBM	6540
E	2-4-87	MOVED E4 90 DEG.	MSE	DBM	6741
F	8-27-87	REVISED PER ECN	MERK	MBS	6960
G	7-6-88	CHG'D P/N OF RESISTOR FROM 130-4044	JAH	TJL	7419
H	1-12-89	MOVED 24" WIRE 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

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	JAH 12-13-91	SEE B/M	TITLE PCB ASSEMBLY OPTICALLY COUPLED RELAY BD.			
	DESIGNER(S)	919-0096 919-0096-001				
	PROJ. LEADER	FINISH	TYPE A			
	J. TUCKER 7-14-86	SEE DWG RA592-0000				
MFG.	NEXT ASSY.	SIZE B				
J. STEINKAMP 7-14-86						
TOLERANCE (DECIMAL) U.O.S. .X ± .030 .XXX ± .005 .XX ± .015 ANGLES + 1°			DWG No. 919-0096, 919-0096-001		REV R	
			MODEL TRANSMITTERS		SCALE 1=1	SHEET 1 OF 2



REVISIONS				
REV	DATE	DESCRIPTION	DRAFTER	APPROVED



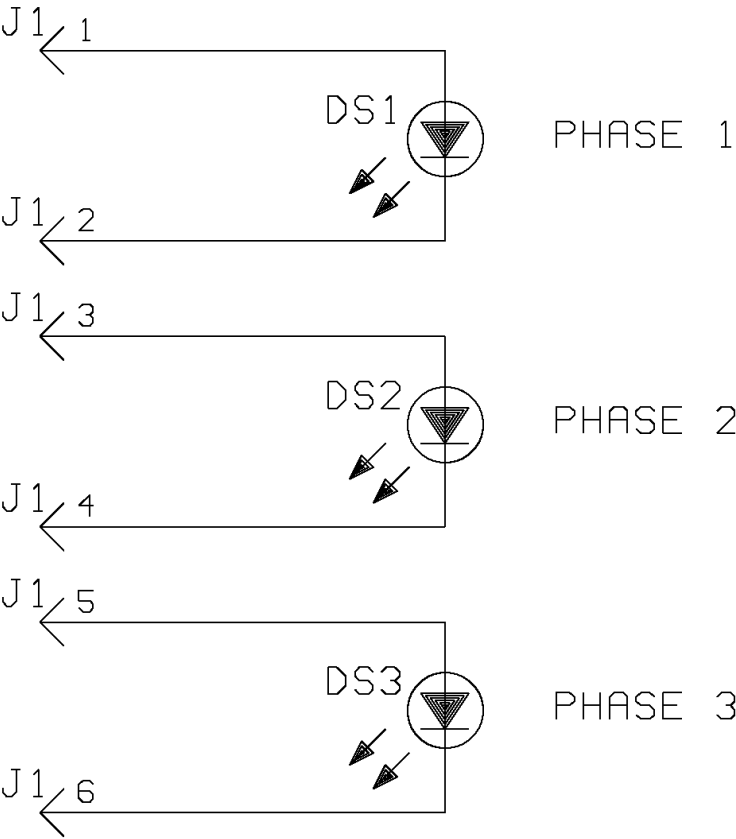
130-2032, APPLY THIN FILM  
OF HEATSINK COMPOUND  
B.E.#700-0016 BETWEEN  
130-2032 AND 474-0347,  
2 PLCS

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	DESIGNER(S)	FINISH	TITLE ASSY, PCB OPTICALLY COUPLED RELAY (OCR)		
	PROJ. LEADER	SEE DWG RA592-0000	TYPE A	SIZE B	DWG. NO. 919-0096, -001
	MFG.	NEXT ASSY.	MODEL XMTRS	SCALE 1/1	REV R
TOLERANCE (DECIMAL) U.O.S. .x ± .030 .xxx ± .005 .xx ± .015 ANGLES ± 1°		SHEET 2 OF 2			

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	11-10-00	PROTOTYPE RELEASE	KT		----
A	5-9-01	ADDED -100: ENGINEERING RELEASE	KT		----



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DWN. BY  
KT 11-10-00

DESIGNER(S)

PROJ. LEADER

MFG.

MATERIAL

SEE BOMS  
919-0524  
919-0524-100

FINISH

NEXT ASSY.

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

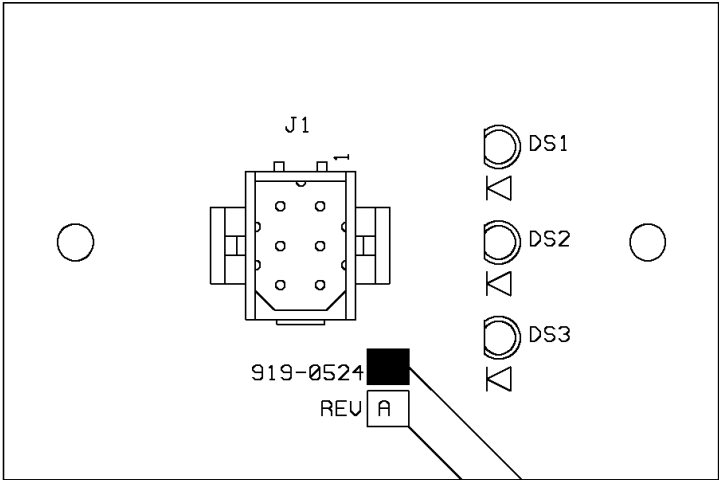
TITLE AC LINE FAULT INDICATOR/  
PS VOLTAGE STATUS

TYPE	SIZE	DWG. NO.	REV
S	A	919-0524/-100	A

MODEL FM-10S/PNP-1K	SCALE NONE	SHEET 1 OF 1
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TOLERANCE (DECIMAL) U.O.S.  
.x ± .030 .xxx ± .005  
.xx ± .015 ANGLES ± 1°

REVISIONS					
REV	DATE	DESCRIPTION	DRAFTER	APPROVED	ECN
1	11-20-00	PROTOTYPE RELEASE	KT		----
A	5-9-01	ADDED -100; ENGINEERING RELEASE	KT		----



WRITE -100 IN BOX FOR 919-0524-100  
LEAVE BLANK FOR 919-0524  
WRITE REV LEVEL IN BOX

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	DESIGNER(S)	FINISH	TITLE AC LINE FAULT INDICATOR/ PS VOLTAGE STATUS			
	PROJ. LEADER	NEXT ASSY.	TYPE A	SIZE A	DWG No. 919-0524/-100	REV A
	MFG.		MODEL FM-10S/PNP-1K		SCALE 1/1	SHEET 1 OF 1
TOLERANCE (DECIMAL) U.O.S. .X ± .030 .XXX ± .005 .XX ± .015 ANGLES + 1°						

