



HARRIS

MX-15

Maximum Signal FM Exciter

- Improved ultra linear VCO yields -80 dB FM S/N, and $.02\%$ Intermodulation Distortion for maximum signal clarity
- DSM (Digitally Synthesized Modulation) Stereo Generator provides 50 dB separation minimum—typically 60 dB midband—for increased stereo realism
- DTR* (Dynamic Transient Response) stereo generator filter maximizes modulation level without overmodulating
- Automatic stereo pilot phase control* and digital circuitry provide long term adjustment-free performance
- Balanced floating composite input minimizes system interface problems
- Available as an FCC type accepted 15 watt transmitter

* Patented



HARRIS MX-15 . . .

Continuing in its trend-setting tradition, Harris has incorporated state-of-the-art refinements in exciter technology to introduce the MX-15 FM Exciter. Using various advanced techniques, such as DRT (Dynamic Transient Response) and DSM (Digitally Synthesized Modulation), the MX-15 Exciter provides the broadcaster with new levels of excellence in audio performance.

ULTRA-LINEAR VCO

The unique VCO (Voltage Controlled Oscillator) of the MX-15 features superb linearity and extremely low signal-to-noise, not found in conventional modulated oscillator designs.

Wideband Composite Intermodulation

Distortion is an exceptionally low .02%, with all CCIF Intermodulation distortion products down at least 80 dB. This important criterion shows the quality of the VCO—the heart of any exciter. Distortion, as a result of nonlinearities, severely limits stereo and SCA performance. Composite input signals between 30 Hz and 53 kHz will not be slew limited even at maximum modulation capability of ± 100 kHz.

Equally impressive is the MX-15's -80 dB FM Signal-To-Noise Ratio specification. An exclusive externally induced hum cancellation circuit allows the exciter to achieve this low noise floor. The MX-15's exceptionally low distortion and noise provides your station with maximum signal clarity. The unique

VCO of the MX-15 features superb linearity not found in conventional modulated oscillator designs.

BALANCED FLOATING COMPOSITE INPUT

Recognizing that many FM broadcasters operate composite systems or use external stereo generators in the audio processing chain, the Harris MX-15 offers a balanced floating composite input as a standard feature. This input reduces the chance of ground loops and other system interface problems.

DIGITAL SYNTHESIZER

The MX-15 uses a 10 MHz high-stability TCXO (Temperature Compensated Reference Oscillator) and programmable divider chain in its dual-state phase



The Harris MX-15 Exciter features modular construction for maximum versatility and ease of maintenance.

NEW LEVELS OF EXCELLENCE IN FM AUDIO PERFORMANCE

locked loop AFC system. The synthesizer provides outputs at 2.5, 5, 10, 15, 20 and 25 MHz, permitting direct comparison against WWV transmissions on these frequencies. The synthesizer can be easily programmed to any carrier frequency in the 87.5 to 108 MHz band in 50 kHz increments. The dual-state AFC will acquire the VCO over a ± 10 MHz range in a maximum of five seconds, starting from an unlocked condition. Once locked, the AFC pass-band is narrowed, maximizing FM signal to noise.

DIGITALLY SYNTHESIZED MODULATION

The Harris DSM stereo generation technique provides a clean stereo composite signal. Unlike older technology, still on the market, that suffers from degraded separation at the upper and lower audio spectrum and/or poor harmonic rejection resulting in degraded crosstalk, Harris' DSM technique has neither of these shortcomings. DSM stereo generation is essentially transparent to the program material. Separation is specified at 50 dB over the 30-15,000 Hz range.

Digital circuitry employed in the generation of the DSM signal lends itself to a minimum of adjustments. These are relatively non-critical in nature and easily maintained year after year. The Harris patented automatic pilot phasing control in the DSM stereo generator makes it virtually impossible to misadjust this critical parameter.

OVERSHOOT COMPENSATION

A Dynamic Transient Response (DTR) filter, developed by Harris, holds overshoot on any program material to 2% or less. As a result, 2 to 6 dB increased loudness can be achieved with no degradation of audio quality. Controlled transient response, high stereo separation, low crosstalk and low intermodulation distortion are all maintained with the increased loudness. The DTR filter can be switched off for stations whose formats do not require maximum modulation density.

SCA OPERATION

Not only does the MX-15 Exciter's SCA operation match its other high technology features, it also provides automatic composite level adjustment. For stations utilizing the SCA channel for only part of the broadcast day, the automatic composite level adjustment allows maximum main channel modulation all the time. Here's how: when the SCA generator is activated, the composite level is automatically dropped to allow for insertion of the



The Harris DSM Stereo Generator, with Digitally Synthesized Modulation (DSM) and DTR filter, provides 50 dB stereo separation minimum, 30-15,000 Hz, and overshoot no greater than 2%.

SCA channel. The converse is also true. Stations need not compromise 10% to 30% of modulation headroom when the SCA is not used continuously.

The MX-15 Exciter's SCA generator is also equipped with a DC coupled input that minimizes distortion to slow-scan television or other critical data signals. Stations programming voice or music SCA services will find the programmable audio input low pass filter accommodating to their operational needs.

POWER AMPLIFIER

The power amplifier module is conservatively rated at 15 watts output, and requires no tuning. VSWR protection prevents accidental damage to the module.

STATUS AND MONITORING

Status and LED indicators are used throughout to aid in troubleshooting. Metering is provided to monitor 10 DC and 10 audio parameters. A peak reading audio voltmeter aids in setting up the exciter on tones, and can serve as an accurate peak program indicator, with accuracy approaching that of a modulation monitor. When fully equipped, the MX-15 contains 27 front panel status indicators for quick "go/

no-go" service checks.

ADDITIONAL BENEFITS

The MX-15 mainframe is ruggedly constructed, with all major printed circuit boards housed in their own shielded, plug-in enclosure.

A positive guidance system permits easy removal and reinsertion of all modules. All module signals and components can be checked during operation using the extender card supplied with the exciter.

Composite wideband, Mono and Stereo audio inputs are transformerless and balanced to give maximum common mode rejection while maintaining excellent response. Inputs will withstand high transients or steady state voltages above or below ground reference.

The basic MX-15 Exciter is wideband and can be used without interface, directly with a composite stereo studio/transmitter link (STL) or external stereo generator.

The exciter is configured to accept a plug-in quadraphonic FM generator, and provides metering of Left Rear and Right Rear audio inputs.

MX-15 SPECIFICATIONS

GENERAL

POWER OUTPUT: 3 watts to 15 watts continuously variable.
FREQUENCY RANGE: 87.5 MHz to 108 MHz tested to one specified frequency. (exciter programmable to 50 kHz channel spacing).
RF OUTPUT IMPEDANCE: 50 ohms, open and short circuit proof.
OUTPUT CONNECTION: Female BNC.
FREQUENCY STABILITY: ± 300 Hz 0° to 50°C temperature compensated reference oscillator.
TYPE OF MODULATION: Direct carrier frequency modulation (DCFM).
MODULATION CAPABILITY: ± 100 kHz.
AC INPUT POWER: 100 to 130 VAC or 200 to 250 VAC, 60 Hz or 50 Hz, 150 watts.
RF HARMONICS: Suppression meets all FCC requirements for 10 watt and 15 watt educational transmitter requirements.
ALTITUDE RANGE: 15,000 feet.
AMBIENT TEMPERATURE RANGE: 0° to 50°C (operational to -20°C).
OVERALL CABINET SIZE: 17.7" Wide (44 cm) \times 14" High (35 cm) \times 12" Deep (30 cm). 19" EIA rack mounting standard.
FINISH: Black.
CONSTRUCTION: Main printed circuit boards individually enclosed, plug-in modules. Module service extender board included.
AUDIO/CONTROL CONNECTIONS: Two 18 terminal barrier strips paralleled by 36 pin and socket connectors. RFI bypassing on input/output lines.
MODULATION METER: 10 position, fast rise time AC metering (adjustable to meet FCC ballistics).
MULTIMETER: 10 position, DC metering.
TOTAL METERING FUNCTIONS: 20.
REMOTE METERING PROVISIONS: PA voltage, PA current, forward power, reflected power.
STATUS INDICATION: 27 independent LED indicators (when equipped with all options).

WIDEBAND COMPOSITE OPERATION

COMPOSITE INPUT: One balanced floating input.
COMPOSITE INPUT IMPEDANCE: 2000 ohms resistive.
COMPOSITE INPUT CONNECTOR: Female BNC.
COMPOSITE INPUT LEVEL: 1.0 volt RMS nominal for ± 75 kHz deviation.
EXTERNAL SCA GENERATOR INPUTS: Up to two unbalanced inputs (optional).
COMPOSITE FM SIGNAL TO NOISE: 80 dB below 100% modulation (reference 400 Hz @ ± 75 kHz deviation with 75 microsecond de-emphasis, 20 Hz to 200 kHz bandwidth).
COMPOSITE HARMONIC DISTORTION: .08%.
COMPOSITE INTERMODULATION DISTORTION: .02% (60 Hz/7 kHz 1:1 tone pairs).
COMPOSITE CCIF INTERMODULATION DISTORTION: All distortion products below 80 dB (reference 14 kHz/15 kHz test tone pair).
COMPOSITE AMPLITUDE RESPONSE: ± 0.1 dB, 30 Hz-53 kHz.
ASYNCHRONOUS AM SIGNAL TO NOISE: 73 dB below referenced carrier AM modulation: 100% output power: 15 watts.
SYNCHRONOUS AM SIGNAL TO NOISE: 51 dB below referenced carrier with 100% AM modulation @ 400 Hz, 75 microsecond de-emphasis (FM modulation ± 75 kHz @ 400 Hz).

MONAURAL OPERATION

AUDIO INPUT IMPEDANCE: 600 ohms, balanced, resistive, transformerless, adaptable to other impedances.
INPUT FILTER: Controlled response low pass filter, defeatable.
AUDIO INPUT LEVEL: +10 dBm, ± 1 dB for 100% modulation at 400 Hz.
AUDIO FREQUENCY RESPONSE: Standard 75 microsecond FCC pre-emphasis curve ± 0.5 dB, 30 Hz-15 kHz. Selectable: flat, 25 or 50 microsecond pre-emphasis.
HARMONIC DISTORTION: 0.15%, 30 Hz to 15 kHz de-emphasized.
INTERMODULATION DISTORTION: .045%, 60 Hz/7 kHz test tone pair, 4:1 ratio.
CCIF INTERMODULATION DISTORTION: All distortion products down 70 dB (reference 14 kHz/15 kHz test tone pair).
FM SIGNAL TO NOISE RATIO: 80 dB below 100% modulation (reference 400 Hz @ ± 75 kHz deviation, measured 20 Hz to 200 kHz bandwidth, 75 microsecond de-emphasis).

STEREO OPERATION

TYPE OF MODULATION: Digitally Synthesized Modulation (DSM).
AUDIO INPUT IMPEDANCE: Left and right channels: 600 ohms, balanced, resistive, transformerless, adaptable to other impedances.
AUDIO INPUT LEVEL: +10 dBm, ± 1 dB for 100% modulation.
AUDIO FREQUENCY RESPONSE: (Left and right) standard 75 microsecond FCC pre-emphasis curve ± 0.5 dB, 30 Hz-15 kHz. Selectable: flat, 25 or 50 microsecond pre-emphasis.
INPUT FILTERING: 15 kHz low pass filter, 45 dB rejection at 19 kHz.
OVERSHOOT PROTECTION: Harris patented Dynamic Transient Response (DTR) filter. Defeatable for test purposes.
AUDIO TRANSIENT RESPONSE: 2% maximum overshoot beyond steady state.
HARMONIC DISTORTION: (Left or right) 0.2% or less, 30-15,000 Hz.
INTERMODULATION DISTORTION: (Left or right) 0.1% 60 Hz/7 kHz test tone pair, 4:1 ratio.
CCIF INTERMODULATION DISTORTION: (Left or right) all distortion products down 80 dB (reference 14 kHz/15 kHz test tone pair).
STEREO SEPARATION: 50 dB, 30 Hz-15 kHz; typically 60 dB at midband frequencies.
DYNAMIC STEREO SEPARATION: 48 dB under normal programming conditions.
LINEAR CROSSTALK: -52 dB.
NON-LINEAR CROSSTALK: -60 dB.
76 KHZ SUPPRESSION: -68 dB.
38 KHZ SUPPRESSION: -73 dB.
FM NOISE: (Left or right) -74 dB minimum below 100% modulation. Reference: 400 Hz, 75 microsecond de-emphasis, ± 75 kHz deviation, measured 30 Hz to 15 kHz bandwidth.
PILOT OSCILLATOR: Crystal controlled.
PILOT PHASE: Harris patented automatic pilot phasing circuit.
PILOT STABILITY: 19 kHz ± 1 Hz 0° to 50°C .
OPERATIONAL MODES: Stereo, mono (left and right), mono (left), mono (right) — remoteable.

SCA OPERATION

MODULATION: Direct FM.
FREQUENCY OF OPERATION: 41 or 67 kHz programmable, any frequency between 25 and 75 kHz on special order.
FREQUENCY STABILITY: ± 500 Hz.
MODULATION CAPABILITY: ± 7.5 kHz.
AUDIO FREQUENCY RESPONSE: 41 kHz and 67 kHz AC coupled input, 150 microsecond pre-emphasis ± 1 dB, standard. Selectable flat, 50 or 75 microsecond pre-emphasis. DC coupled input: No pre-emphasis: DC to 4 kHz ± 0.5 dB.
AUDIO INPUT IMPEDANCE: 600 ohms balanced (AC coupled). Also 2000 ohms DC coupled unbalanced input through rear BNC connector.
AC INPUT LEVEL: +10 dBm, ± 1 dB for 100% modulation at 400 Hz @ 600 ohms.
DC INPUT LEVEL: 1.0 volt peak for 5 kHz deviation.
INPUT FILTERING: Programmable LPF, 4.5 kHz standard. 3 kHz, 5 kHz, 7.5 kHz selectable. Low pass filter defeatable.
HARMONIC DISTORTION: 0.5%, 30-4,500 Hz ± 5 kHz deviation.
INTERMODULATION DISTORTION: 1%, 60 Hz/7 kHz, 1:1 ratio (audio low pass filter and pre-emphasis bypassed).
FM NOISE: (Main channel not modulated) -63 dB (reference: 100% modulation = ± 5 kHz deviation at 400 Hz).
CROSSTALK: (SCA to main or stereo sub-channel) -60 dB or better.
CROSSTALK: (Main or stereo sub-channel to SCA) 57 dB below ± 5 kHz deviation of SCA with mono or stereo channels modulated by frequencies 30 Hz-15 kHz, SCA demodulated with 150 microsecond de-emphasis.
CROSSTALK: SCA to SCA (41 kHz/67 kHz) 50 dB demodulated with 150 microsecond de-emphasis.
AUTOMATIC MUTE LEVEL: Variable from 0 to -30 dBm.
MUTE DELAY: Adjustable 0.5 to 20 seconds.
INJECTION LEVEL: 1% to 30% of composite level (adjustable).

Harris maintains a policy of continuous improvement on its equipment, and therefore reserves the right to change specifications without notice.

ORDERING INFORMATION

MX-15 Exciter for wideband composite operation, 19-inch rack mounted	994-7950-003
Mono option (add for mono operation)	994-8019-001
DSM Stereo Generator with DTR Filter (add one for stereo operation)	994-8020-001
SCA Generator (add one for each SCA service, specify 41 kHz or 67 kHz)	994-7992-001
External SCA Generator Jumper Card (for use with externally mounted SCA Generator)	994-8377-001

HARRIS CORPORATION BROADCAST DIVISION
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TECHNICAL MANUAL

ADDENDUM TO TECHNICAL MANUAL

888-2164-001

MX-15 FM EXCITER

994 7950 003

NOTE

The information included in this addendum is to be added to the Technical Manual to reflect changes made since the Technical Manual was last revised. The inclusion of this material will update the Technical Manual to the equipment configuration at the time of shipment.

The addendum should remain with the Technical Manual to facilitate replaceable parts service at a later date.



HARRIS CORPORATION
Broadcast Division

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ECN 27606

Make the following change in Table 6-3. BASIC - MX-15 FM EXCITER - 994 7950
004 on page 6-5:

Change part number for 2A4 from 992 5983 001 to 992 5983 002
MODULATED OSCILLATOR MOD.

888-2164-002

A-1/A-2

TECHNICAL MANUAL

MX-15 FM EXCITER

994 7950 003



HARRIS CORPORATION
Broadcast Division

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WARNING

THE CURRENTS AND VOLTAGES IN THIS EQUIPMENT ARE DANGEROUS. PERSONNEL MUST AT ALL TIMES OBSERVE SAFETY REGULATIONS.

This manual is intended as a general guide for trained and qualified personnel who are aware of the dangers inherent in handling potentially hazardous electrical/electronic circuits. It is not intended to contain a complete statement of all safety precautions which should be observed by personnel in using this or other electronic equipment.

The installation, operation, maintenance and service of this equipment involves risks both to personnel and equipment, and must be performed only by qualified personnel exercising due care. HARRIS CORPORATION shall not be responsible for injury or damage resulting from improper procedures or from the use of improperly trained or inexperienced personnel performing such tasks.

During installation and operation of this equipment, local building codes and fire protection standards must be observed. The following National Fire Protection Association (NFPA) standards are recommended as references:

- Automatic Fire Detectors, No. 72E
- Installation, Maintenance, and Use of Portable Fire Extinguishers, No. 10
- Halogenated Fire Extinguishing Agent Systems, No. 12A

WARNING

ALWAYS DISCONNECT POWER BEFORE OPENING COVERS, DOORS, ENCLOSURES, GATES, PANELS OR SHIELDS. ALWAYS USE GROUNDING STICKS AND SHORT OUT HIGH VOLTAGE POINTS BEFORE SERVICING. NEVER MAKE INTERNAL ADJUSTMENTS, PERFORM MAINTENANCE OR SERVICE WHEN ALONE OR WHEN FATIGUED.

Do not remove, short-circuit or tamper with interlock switches on access covers, doors, enclosures, gates, panels or shields. Keep away from live circuits, know your equipment and don't take chances.

WARNING

IN CASE OF EMERGENCY ENSURE THAT POWER HAS BEEN DISCONNECTED.

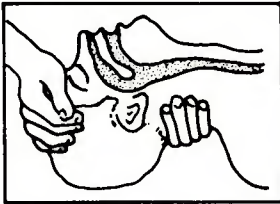
Treatment of Electrical Shock

1. If victim is not responsive follow the A-B-Cs of basic life support.

PLACE VICTIM FLAT ON HIS BACK ON A HARD SURFACE

A AIRWAY

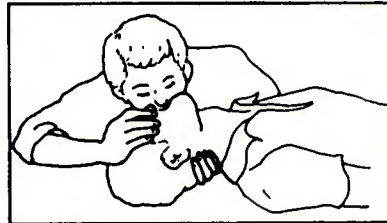
IF UNCONSCIOUS,
OPEN AIRWAY



LIFT UP NECK
PUSH FOREHEAD BACK
CLEAR OUT MOUTH IF NECESSARY
OBSERVE FOR BREATHING

B BREATHING

IF NOT BREATHING,
BEGIN ARTIFICIAL
BREATHING

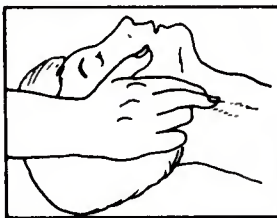


TILT HEAD
PINCH NOSTRILS
MAKE AIRTIGHT SEAL

4 QUICK FULL BREATHS

REMEMBER MOUTH TO MOUTH RESUSCITATION
MUST BE COMMENCED AS SOON AS POSSIBLE

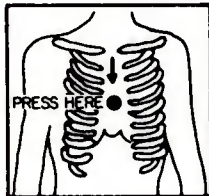
CHECK CAROTID PULSE



IF PULSE ABSENT,
BEGIN ARTIFICIAL
CIRCULATION

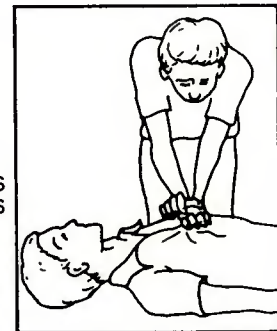
C CIRCULATION

DEPRESS STERNUM 1 1/2" TO 2"



APPROX. { ONE RESCUER
80 SEC. { 15 COMPRESSIONS
2 QUICK BREATHS

APPROX. { TWO RESCUERS
60 SEC. { 5 COMPRESSIONS
1 BREATH



NOTE: DO NOT INTERRUPT RHYTHM OF COMPRESSIONS
WHEN SECOND PERSON IS GIVING BREATH

Call for medical assistance as soon as possible.

2. If victim is responsive.
 - a. keep them warm
 - b. keep them as quiet as possible
 - c. loosen their clothing
(a reclining position is recommended)

FIRST-AID

Personnel engaged in the installation, operation, maintenance or servicing of this equipment are urged to become familiar with first-aid theory and practices. The following information is not intended to be complete first-aid procedures, it is brief and is only to be used as a reference. It is the duty of all personnel using the equipment to be prepared to give adequate Emergency First Aid and thereby prevent avoidable loss of life.

Treatment of Electrical Burns

1. Extensive burned and broken skin
 - a. Cover area with clean sheet or cloth. (Cleanest available cloth article.)
 - b. Do not break blisters, remove tissue, remove adhered particles of clothing, or apply any salve or ointment.
 - c. Treat victim for shock as required.
 - d. Arrange transportation to a hospital as quickly as possible.
 - e. If arms or legs are affected keep them elevated.

NOTE

If medical help will not be available within an hour and the victim is conscious and not vomiting, give him a weak solution of salt and soda: 1 level teaspoonful of salt and 1/2 level teaspoonful of baking soda to each quart of water (neither hot or cold). Allow victim to sip slowly about 4 ounces (a half of glass) over a period of 15 minutes. Discontinue fluid if vomiting occurs. (Do not give alcohol.)

2. Less severe burns - (1st & 2nd degree)
 - a. Apply cool (not ice cold) compresses using the cleanest available cloth article.
 - b. Do not break blisters, remove tissue, remove adhered particles of clothing, or apply salve or ointment.
 - c. Apply clean dry dressing if necessary.
 - d. Treat victim for shock as required.
 - e. Arrange transportation to a hospital as quickly as possible.
 - f. If arms or legs are affected keep them elevated.

REFERENCE: ILLINOIS HEART ASSOCIATION

AMERICAN RED CROSS STANDARD FIRST AID AND PERSONAL SAFETY MANUAL
(SECOND EDITION)

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SECTION I

GENERAL DESCRIPTION

1-1. INTRODUCTION

1-2. This technical manual contains information necessary to install, operate, maintain, and service the MX-15 FM EXCITER. Sections in this technical manual provide the following information:

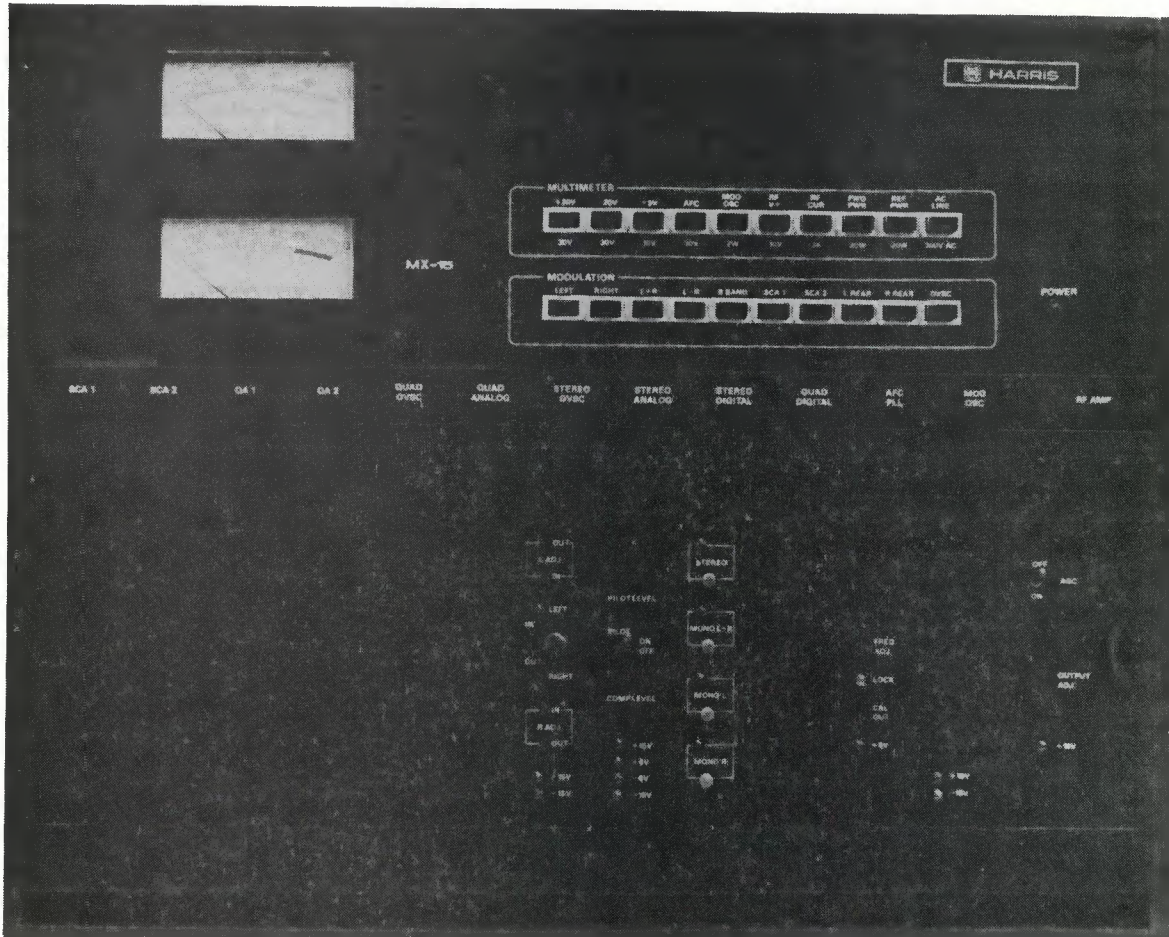
- a. SECTION I, GENERAL DESCRIPTION, provides a description of equipment features, identifies major components, and lists operating parameters and specifications.
- b. SECTION II, INSTALLATION, provides unpacking, inspection, and installation information, preoperational checks, and power on checks to ensure correct operation.
- c. SECTION III, OPERATION, identifies controls and indicators and provides equipment setup and operation.
- d. SECTION IV, PRINCIPLES OF OPERATION, provides a functional description and detailed block diagram with theory of operation.
- e. SECTION V, MAINTENANCE, provides preventive and corrective maintenance information and troubleshooting with instructions for equipment servicing.
- f. SECTION VI, PARTS LIST, provides information for ordering replacement components and assemblies.
- g. SECTION VII, DIAGRAMS, provides block, logic, schematic diagrams, and other drawings required for equipment maintenance.

1-3. EQUIPMENT PURPOSE

1-4. The HARRIS MX-15 FM EXCITER (figure 1-1) produces a 15 watt maximum frequency modulator signal into a 50 ohm load on any channel in the 87.5 MHz to 108 MHz commercial FM broadcast band. Operational modes include up to two SCA channels monophonic, stereophonic, and provisions for quadraphonic transmission.

1-5. PHYSICAL DESCRIPTION

1-6. The MX-15 FM EXCITER is both electrically and mechanically modular in concept. Each discrete function is implemented within individual plug-in modules. Each module is provided with an insertion/extraction lever to aid in module servicing. All modules are placarded with nomenclature to prevent use in the incorrect slot. A hinged front panel drops down to access the chassis mounted and non-modular components such as the input and output RFI filters, the metering circuits, and the power supply components. The entire exciter mounts in 14 vertical inches of standard 19 inch rack space.



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Figure 1-1. MX-15 FM EXCITER (Shown with Optional Stereo Generator)

1-7. FUNCTIONAL DESCRIPTION

1-8. The HARRIS MX-15 FM EXCITER produces a frequency modulated output continuously variable from three to 15 watts for any channel assignment within the 87.5 to 108 MHz commercial FM broadcast band (see figure 1-2). Servicing is simplified as the exciter is modular in concept and discrete functions are complete within individual plug-in modules. The metering panel contains a true peak reading audio meter and multimeter which monitors important audio, rf, and control voltages. Light emitting diode status indicators monitor critical functions on each plug-in module. Many design features provide operational characteristics superior to conventional FM equipment.

1-9. STEREOPHONIC OPTION

1-10. The stereophonic option consists of the STEREO DIGITAL module, the STEREO ANALOG module, and the STEREO OVSC module. Features of the stereophonic option are discussed in the following text.

1-11. DIGITALLY SYNTHESIZED MODULATION (DSM) STEREOPHONIC GENERATOR. The STEREO ANALOG and STEREO DIGITAL modules comprising the DSM stereophonic generator eliminate the compromise existing between other popular types of stereophonic generators. The switching type of stereophonic modulator produces poor separation at high frequencies. Poor harmonic rejection and SCA crosstalk are problems experienced with the balanced modulator type of stereophonic generator. The HARRIS developed DSM stereophonic generator typically produces 50 dB of stereophonic signal separation from 30 Hz to 15 kHz with an exceptionally clean baseband signal which promotes minimal interaction between stereophonic and SCA service. An automatic phase control circuit adjusts the stereophonic pilot phase to maintain stereophonic signal separation. Selectable FLAT, 25, 50, and 75 microsecond pre-emphasis is provided for use as desired.

1-12. DYNAMIC TRANSIENT RESPONSE (DTR) FILTER. A HARRIS developed low-pass filter comprising the STEREO OVSC module operates independently of limiters or stereophonic generators to limit the overshoot on FM stereophonic or future quadrasonic transmission to two percent maximum on any input program material processed by any limiter. The filter is transparent to audio within ± 0.5 dB of its passband of 30 Hz to 15 kHz and provides over 50 dB of attenuation at 19 kHz and above. The filter inaudibly reduces modulation overshoots to less than two percent. Typically, elimination of overshoot allows a two to six dB increase in loudness with no other audible effect.

1-13. MONOPHONIC OPTION

1-14. When the monaural option is used, the three stereophonic modules must be removed and the MONO module plugged into the STEREO ANALOG module position. Solid state input circuitry provides high common mode rejection and selectable pre-emphasis similar to the stereophonic module is provided. A built-in defeatable linear-phase low-pass filter provides optimal linear control of overshoot and protects the 41 kHz and/or 67 kHz SCA channels.

1-15. SCA OPTION

1-16. High quality SCA is provided by dual frequency SCA generators which operate at frequencies of 41 kHz or 67 kHz. The filter includes a seven pole Butterworth audio low-pass filter which allows use of full 150 micro-second pre-emphasis without degrading SCA to stereophonic isolation. Band-pass filters allow both the 41 kHz and 67 kHz SCA channels to be operated simultaneously without harmonic interference. Modulation can be dc coupled to allow SSTV and data transmission without special outboard units. Selectable manual or automatic variable level muting and selectable pre-emphasis are provided. An optional External SCA Generator Jumper Card is available which allows an external SCA generator to be connected to the MX-15. This card can be plugged into slot marked SCA 1 or SCA 2 dependent upon frequency of external SCA generator (67 kHz for SCA 1 and 41 kHz for SCA 2).

1-17. FREQUENCY SYNTHESIZER

1-18. All FM channels are synthesized from a highly stable 10.0 MHz temperature compensated crystal oscillator (TCXO) in the AFC/PLL module which eliminates requirements for an oven, thereby reducing warmup time to zero. Channel frequency is field programmable in 50 kHz increments to accommodate future domestic or international channel assignments. As the frequency reference is obtained from 10.0 MHz, stations may compare their frequency directly with a broadcast frequency standard such as WWV for calibration. A front panel test point provides a convenient point for frequency comparisons using a short-wave receiver.

1-19. A phase locked loop with dual characteristics provides frequency correction and reduces frequency lockup time to a minimum. The loop employs high rate feedback control when power is turned on as the loop is initially unlocked. As soon as the lock detector perceives lock, loop correction is slowed for optimum transmission of low frequencies.

1-20. The broadbanded MOD OSC module VCO assembly and a synthesizer with a wide lockup range delete the requirement for a center frequency adjustment. A predistortion network modifies the incoming signal and linearizes the VCO output to less than 0.1% distortion. The VCO assembly output is amplified to a 250 milliwatt level as required to drive the RF AMP module.

1-21. AUTOMATIC LEVEL SWITCHING

1-22. With many comparable systems, main channel loudness is sacrificed when the SCA channels mute or when the transmission mode is switched between monaural and stereophonic service. With the HARRIS automatic level switching circuit, discrepancies in total modulation caused by pilot and SCA injection are noiselessly compensated by an automatic composite gain switcher in the MOD OSC module which maintains 100% peak modulation for all standard combinations of stereophonic, monaural, L, R, or L+R, and 0, 1, or 2 SCA channels. Automatic level switching only occurs with the MX-15's plug in SCA Generator. This feature is not applicable if the optional External SCA Generator Jumper Card is used to connect an external SCA generator to the MX-15.

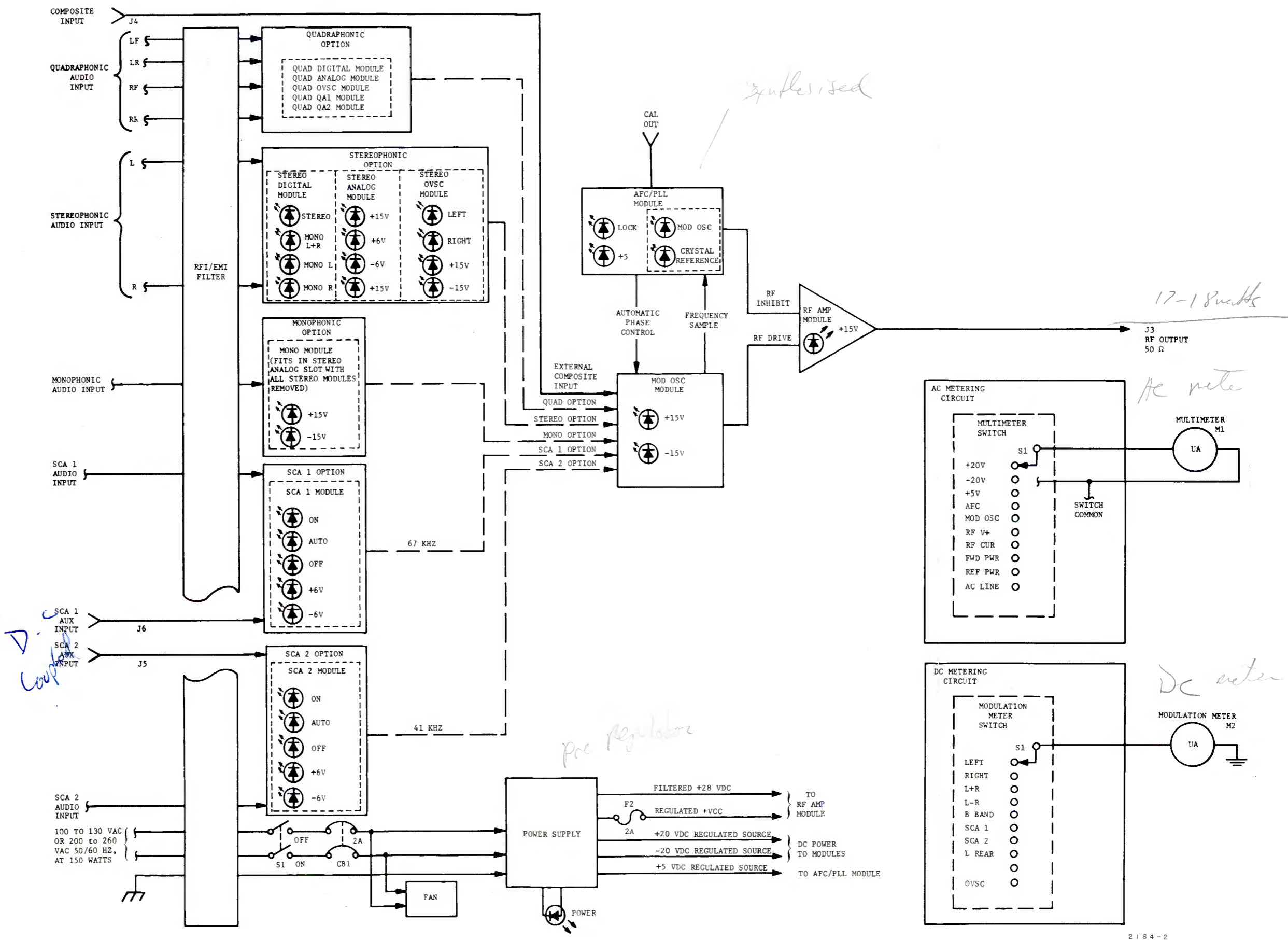


FIGURE 1-2. SIMPLIFIED BLOCK DIAGRAM

1-23. QUADRAPHONIC OPTION

1-24. Because of the extremely clean baseband provided by the DSM system of stereo generation and the stable digitally synthesized nature of the system, compatibility with any of the proposed discrete quadraphonic transmission systems is assured. The MX-15 FM EXCITER mainframe is already wired for plug-in quadraphonic modules, facilitating the transition from stereophonic to quadraphonic transmission.

1-25. POWER AMPLIFIER

1-26. The RF AMP module is broadbanded from 87.5 MHz to 108 MHz and requires no tuning. An AGC circuit stabilizes the output power to a level which is adjustable from three watts to 15 watts. A VSWR circuit senses load faults and provides shutdown to protect the power amplifier from load mismatch. Off frequency transmission is prevented by a circuit which automatically inhibits rf output whenever the frequency synthesizer loop is in an unlocked condition.

1-27. POWER SUPPLY CIRCUIT

1-28. All exciter inputs and outputs, including the power supply ac input, are buffered by the RFI/EMI filter with the exception of the SCA-1 AUX INPUT (J6), SCA-2 AUX INPUT (J5), COMPOSITE INPUT (J4), and the exciter RF OUTPUT (J3) which interface via coaxial (shielded) lines.

1-29. Switch S1 and circuit breaker CB1 provide power supply overload protection and control. A fan which operates when power is on provides cooling of internal high power components. The power supply develops a positive 34 Vdc potential fused at three amperes which operates the RF AMP module. Pre-regulated ± 20 Vdc potentials and a regulated positive five volt dc potential are also produced to operate the remaining portion of the exciter internal circuitry.

1-30. EQUIPMENT CHARACTERISTICS

1-31. Refer to the MX-15 MAXIMUM SIGNAL FM EXCITER brochure at the front of this technical manual for pertinent electrical and mechanical characteristics of the MX-15 FM EXCITER.

NOTE

Specifications subject to change without notice.

SECTION II

INSTALLATION

2-1. INTRODUCTION

2-2. This section contains information required to unpack, inspect, and install the MX-15 FM EXCITER. Preoperational checks and power on checks will ensure correct exciter operation. Components or modules removed from the exciter after final test, for transport, are tagged and provided with appropriate instructions for reinstallation.

2-3. UNPACKING

2-4. Carefully unpack the MX-15 FM EXCITER and perform a visual inspection to determine that no apparent damage was incurred during shipment. Retain the shipping materials until it has been determined that the unit is not damaged. 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 the carrier and HARRIS CORPORATION Broadcast Division.

2-5. All packing materials must be removed from the equipment and the modules. The removal of components varies due to the method and requirements for shipment. All removed components are tagged to permit easy reinstallation in the equipment. Symbol numbers and descriptions are provided on each removed component corresponding to the schematic diagram, parts list, packing list and reference designator or nomenclature stenciled at the cabinet location of each removed item. Cables and small parts may be taped or tied in place for shipment. Remove all tape, string, and packing materials used for this purpose. Install any removed components in the interior of the cabinet and arrange the modules in a separate container according to the order in which each module installs in the equipment.

2-6. INSTALLATION

2-7. Prior to installation, the manual should be carefully studied to get a thorough understanding of the principles of operation, circuitry and nomenclature. This will facilitate proper installation and initial checkout. Installation of the MX-15 FM EXCITER will be accomplished in four steps: 1) exciter placement, 2) module installation, 3) exciter wiring, and 4) preliminary checkout.

2-8. EXCITER PLACEMENT

2-9. The HARRIS MX-15 FM EXCITER is manufactured to directly retrofit the HARRIS TE-3 FM exciter or any similar FM exciter. The exciter requires 14 vertical inches of standard 19 inch rack space and should be placed in a location which provides convenient access to the rear panel near power, rf, and control cables. As cooling air enters the equipment through vents in the bottom panel, the exciter should not be placed directly above heat generating equipment such as an amplifier stage. The equipment is thoroughly RFI shielded and no special isolation precautions are required.

2-10. MODULE INSTALLATION

2-11. Several modules required jumper-plug programming which initializes the module to operate in a predetermined mode at power application. Refer to table 2-1 and ensure each jumper listed is correctly installed in each respective module to produce the desired mode of operation. After the module programming is completed, each module should be inserted in its respective slot in the exciter case.

2-12. EXCITER WIRING

2-13. External wiring of the exciter will differ between units depending upon the options purchased with each individual exciter. Refer to table 2-2 and figure 2-1 for information required to connect inputs, remote control lines, and monitoring equipment to the FM exciter.

2-14. After wiring of the inputs, control lines, and monitoring equipment is completed, the following additional external connections must be made. Power connections will be wired last.

- a. GROUND: Connect the GND LUG terminal on the rear of the exciter to station ground.
- b. RF LOAD: Connect the exciter load to the RF OUTPUT 50 ohm terminal (J3) on the rear of the exciter.
- c. COMPOSITE INPUT: If a composite input is to be used with the exciter, connect the input to the COMPOSITE INPUT terminal (J4) on the rear of the exciter.
- d. SCA AUXILIARY INPUT: If an auxiliary SCA input such as teletype is required, connect the inputs to SCA-1 AUX INPUT (J6) and SCA-2 AUX INPUT (J5) as necessary when the MX-15 is equipped with optional SCA Generator. If the optional External SCA Generator Jumper Card is used, the auxiliary input must be applied to the external SCA generator.

WARNING

DO NOT APPLY POWER TO THE EXCITER IN STEP e.

- e. PRIMARY AC: Prepare plug P2 for connection to either 115 Vac or 230 Vac as shown in figure 2-2. After the plug is correctly wired to either the 115 Vac or the 230 Vac configuration, connect plug P2 to the AC POWER input on the exciter rear (J2). Do not connect the power cord to the ac source at this time.

Table 2-1. Module Programming

MODULE	JUMPER	NOMENCLATURE	PURPOSE
SCA 1 and SCA 2	J1	41 KHZ/67 KHZ	Selects SCA frequency.
	J2	41 KHZ/67 KHZ	Selects SCA filter freq.
STEREO DIGITAL	J3	41 KHZ/67 KHZ	Selects SCA filter freq.
	J4	POWER UP: OFF/ON/AUTO	Determines operational status at power application
	J5	150/75/50/0	PREMPH: Selects SCA input pre-emphasis
STEREO DIGITAL	J1	POWER UP: STEREO/LEFT/ RIGHT/L+R	Selects the mode in which the module will initialize when power is applied
	J2	SCA INTERLOCK L+R/LEFT/RIGHT	Selects monaural mode STEREO DIGITAL Module will enter if simultaneous 41 KHZ SCA and stereophonic operation is attempted.
STEREO ANALOG	J1	FLAT/25/50/75	Selects stereo input pre-emphasis.
	J2	FLAT/25/50/75	Selects stereo input pre-emphasis.
	J3	DTR/INT	Selects the internal low pass filter or enables the DTR filter.
	J4	DTR/INT	Selects the internal low pass filter or enables DTR filter.
	J5	DTR/INT	Selects the internal low pass filter or enables the DTR filter.
	J6	DTR/INT	Selects the internal low pass filter or enables the DTR filter.

Table 2-1. Module Programming (Continued)

MODULE	JUMPER	NOMENCLATURE	PURPOSE
MONO	J1	A/B/C/D	Selects mono input pre-emphasis. A: 75 us B: 50 us C: 25 us D: FLAT
	J2	A/B/C/D	Enables or bypasses the linear phase low pass filter. Enable: A to B, C to D. Bypass: A to C, B to D.

Table 2-2. Exciter Wiring

TERMINAL	NOMENCLATURE	SIGNAL
TBI PIN 1 2 3	LEFT FRONT +	(red)
	LEFT FRONT $\frac{+}{-}$	(shield)
	LEFT FRONT -	(black)
4 5 6	RIGHT FRONT +	(red)
	RIGHT FRONT $\frac{+}{-}$	(shield)
	RIGHT FRONT -	(black)
7 8 9	SCA-1 +	(red)
	SCA-1 $\frac{+}{-}$	(shield)
	SCA-1 -	(black)
10 11 12	SCA-2 OR LEFT REAR +	(red)
	SCA-2 OR LEFT REAR $\frac{+}{-}$	(shield)
	SCA-2 OR LEFT REAR -	(black)
13 14 15	RIGHT REAR +	(red)
	RIGHT REAR $\frac{+}{-}$	(shield)
	RIGHT REAR -	(black)
16	ST.	(STEREO MODE) A momentary contact to ground will cause the equipment to transmit in the stereo mode.*
17	L+R	(STEREO MODE) A momentary contact to ground will cause the equipment to transmit a mono signal from both stereo channels.*

* See Note 1

Table 2-2. Exciter Wiring (Continued)

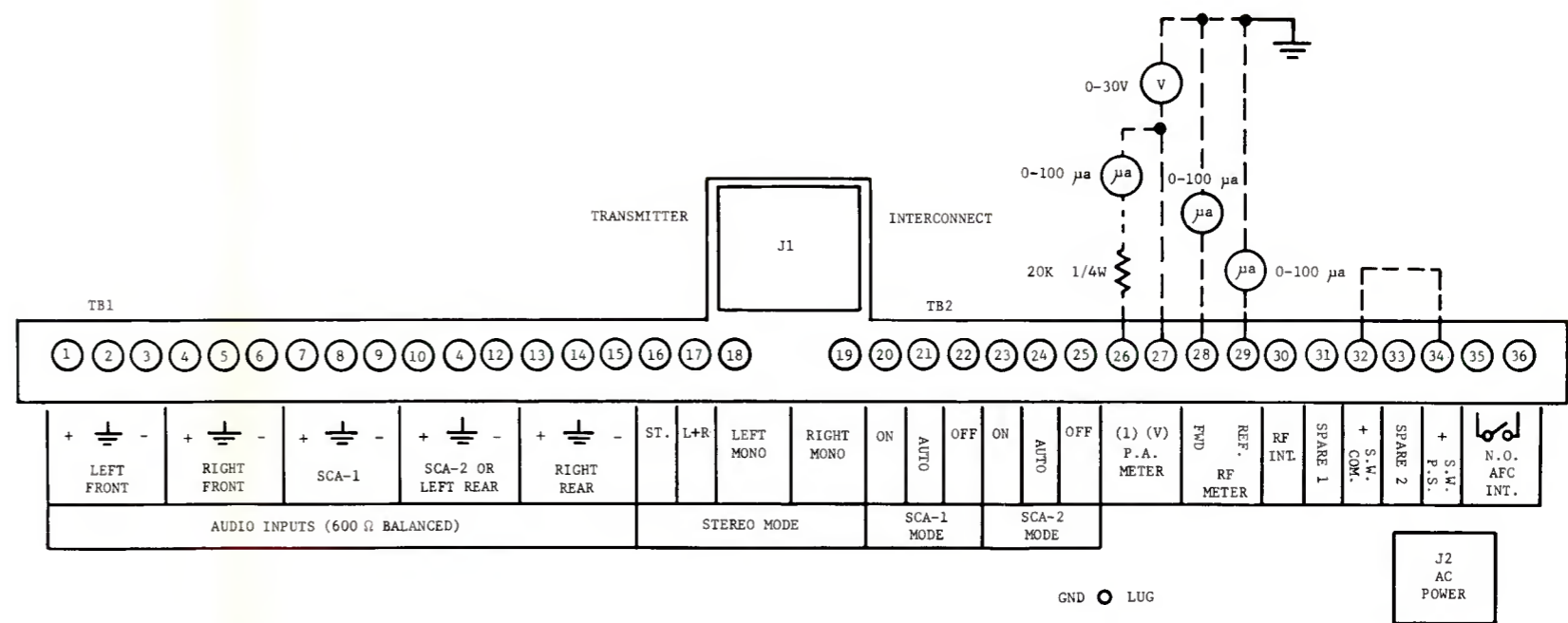
TERMINAL	NOMENCLATURE	SIGNAL
18	LEFT MONO	(STEREO MODE) A momentary contact to ground will cause the equipment to transmit a mono signal from the left stereo channel and mute the right stereo channel. *
TB2 PIN 19	RIGHT MONO	(STEREO MODE) A momentary contact to ground will cause the equipment to transmit a mono signal from the right stereo channel and mute the left stereo channel.*
20	ON	(SCA-1 MODE) A momentary contact to ground will enable SCA channel No. 1.*
21	AUTO	(SCA-1 MODE) A momentary contact to ground will enable the SCA-1 module automatic muting function. (See note 1)
22	OFF	(SCA-1 MODE) A momentary contact to ground will mute SCA channel No. 1 at all times.*
23	ON	(SCA-2 MODE) A momentary contact to ground will enable SCA channel No. 2 whenever power is on.*
* See Note 1		

Table 2-2. Exciter Wiring (Continued)

TERMINAL	NOMENCLATURE	SIGNAL
24	AUTO	(SCA-2 MODE) A momentary contact ground will enable the SCA-2 module automatic muting function. (See note 1.)
25	OFF	(SCA-2 MODE) A momentary contact to ground will mute SCA channel No. 2 at all times.
TB2 PIN 26	(I)	(P.A. METER) Provision to monitor sampled power amplifier collector current. A 20k ohm, 1/4 watt resistor and a 0-100 microammeter are required (see figure 2-1). Three amperes of supply current will produce full scale meter deflection.
27	(V)	(P.A. METER) Provision to monitor the power amplifier supply voltage. A 0-30 voltmeter is required (see figure 2-1).
28	FWD	(R.F. METER) Provision to monitor the exciter forward power output sensed by the directional coupler. A 0-100 microammeter is required (see figure 2-1).
* See Note 1.		

Table 2-2. Exciter Wiring (Continued)

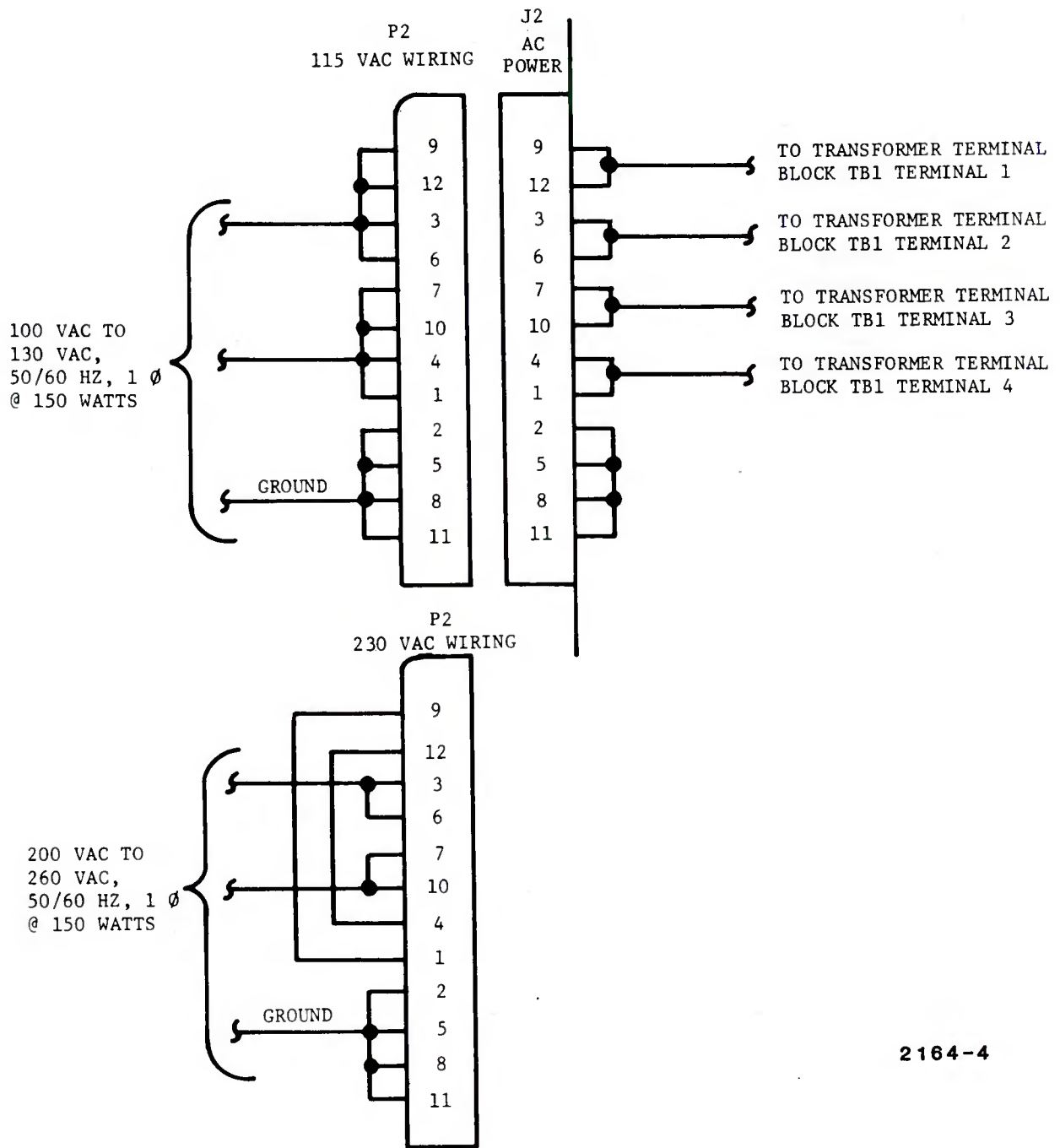
TERMINAL	NOMENCLATURE	SIGNAL
29	REF.	(R.F. METER) Provision to monitor the exciter reflected power sensed by the directional coupler. A 0-100 microammeter is required (see figure 2-1).
30	R.F. INT.	A contact to ground will inhibit the exciter carrier output until the ground is removed.
31	SPARE 1	Spare contact.
TB2 PIN 32	S.W. COM. +	A jumper from TB2 pin 34 provides a 20 Vdc potential to operate the remote mode switching circuits (see figure 2-3). If remote mode switching is not desired, the jumper may be removed.
33	SPARE 2	Spare contact.
34	S.W.P.S. +	Provides a 20 Vdc potential to operate the remote mode switching circuits through a jumper to TB2 pin 32 (see figure 2-3). If remote mode switching is not desired, the jumper may be removed.
35	N.O.AFC.INT.	Provides one set of normally open contacts or relay 2A1A4K1 which close when the AFC/PLL module achieves frequency lock. The contacts are rated at three amperes at 120 Vac.
36	N.O.AFC.INT.	
<p>* NOTES</p> <p>1. Remote control requires that terminal 34 (+ S. W. P. S.) be jumpered to terminal 32 (+ S. W. COM.) or a positive 12 Vdc to 28 Vdc potential must be jumpered between the desired terminal and terminal 32 (S. W. COM.).</p>		



2164-4

FIGURE 2-1. EXCITER WIRING

2-9/2-10



2164-4

Figure 2-2. Primary AC Wiring

WARNING

ENSURE POWER IS NOT APPLIED TO THE EXCITER BEFORE PROCEEDING.

2-15. The complete exciter should be inspected at this time. Check the following:

- a. Ensure all connections at terminal boards and components are tight and secure and all wires are dressed properly.
- b. Remove any extra hardware or wire from the area. Ensure all packing materials are removed.
- c. Rotate the fan manually to be sure no obstructions are present.

2-16. Ensure the exciter POWER ON/OFF switch (2A1S1) is set to OFF and connect the power cord to the ac source.

2-17. PRELIMINARY CHECKOUT

2-18. Adjust the RF AMP module OUTPUT ADJ control (2A2R13) fully counterclockwise (zero power output).

2-19. Depress the MULTIMETER AC LINE switch.

CAUTION

ENSURE THE EXCITER OUTPUT IS CONNECTED TO A PROPER 50 OHM LOAD.

2-20. Set the exciter POWER ON/OFF switch (2A1S1) to ON and note the following indications. If trouble is experienced, refer to Section V, Maintenance.

- a. The MULTIMETER (2A1M1) must indicate 115 Vac \pm 15 Vac or 230 Vac \pm 30 Vac, as wired. If the primary ac voltage is out of tolerance, it must be corrected before proceeding.
- b. The front panel POWER indicator (3A1DS1) will illuminate.
- c. All the module front panel power indicators (+5V, +6V, -6V, +15V, and -15V) will illuminate.

2-21. Adjust the RF AMP module OUTPUT ADJ control (2A2R13) to obtain a three watt rf output. Refer to table 2-3 and check the MULTIMETER (2A1M1) and MODULATION (2A1M2) meter indications listed. If trouble is experienced, refer to Section V, Maintenance.

Table 2-3. Preliminary Meter Indications

MULTIMETER SWITCH POSITION	MULTIMETER INDICATION*
+20V	+22V
-20V	+22V
+5 V	+5 V
AFC	+3V to +12V**
MOD OSC	250 mW \pm 100 mW
RF V+	+7.5V
RF CUR	0.9 Amperes
FWD PWR	3W
REF PWR	0.5W

*APPROXIMATE VALUES -- DEPENDENT ON MODULE COMPLEMENT

**DEPENDENT UPON EXCITER FREQUENCY.

2-22. The audio inputs should be checked to ensure correct wiring. Depress the MODULATION switch (2A1A2S1) corresponding to each option purchased with the equipment and check for activity on the MODULATION meter (2A1M2). The monaural audio input may be checked by depressing the MODULATION LEFT or MODULATION RIGHT meter switch and noting activity on the MODULATION meter.

2-23. Set the POWER ON/OFF switch (2A1S1) to OFF.

SECTION III

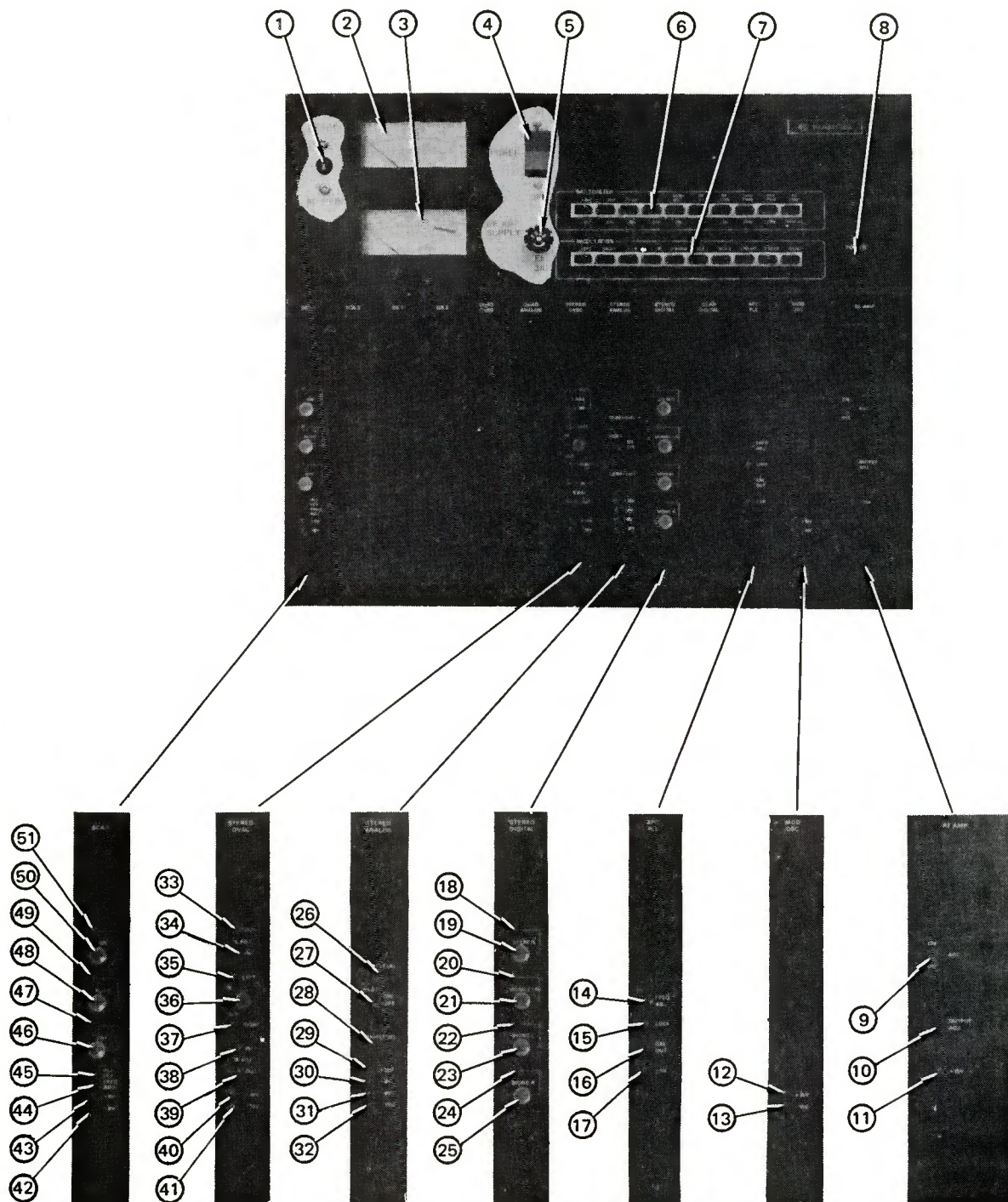
OPERATION

3-1. INTRODUCTION

3-2. This section contains information pertaining to identification, location and function of the controls and indicators of the MX-15 FM EXCITER, setup, and operation procedures.

3-3. CONTROLS AND INDICATORS

3-4. Figure 3-1 shows the location of each control or indicator associated with the MX-15 FM EXCITER and table 3-1 lists each control or indicator with a description of each item listed.



2164-5

Figure 3-1. Controls and Indicators

Table 3-1. Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	AC MAIN RESET circuit breaker (2A1CB1)	Controls primary power and provides overload protection for the exciter power supply.
2	MULTIMETER (2A1M1)	Displays voltage, current or power as selected by the MULTIMETER switch (2A1A1S1).
3	MODULATION meter (2A1M2)	Displays the modulation signals as selected by the MODULATION meter switch (2A1A2S2).
4	POWER ON/OFF switch (2A1S1)	Controls primary power to the exciter power supply.
5	RF AMP SUPPLY fuse (2A1F1)	Provides overload protection for the rf amplifier power supply.
6	MULTIMETER switch (2A1A1S1)	Selects the desired point to monitor exciter voltage, current or power as displayed by the MULTIMETER (2A1M1).
7	MODULATION meter switch (2A1A2S1)	Selects the desired exciter modulation to be monitored on the MODULATION meter (2A1M2).
8	POWER indicator (2A1DS1)	Illuminates to indicate power is applied to the exciter power supply.
<u>RF AMP MODULE</u>		
9	AGC ON/OFF switch (2A2S1)	Enables the power amplifier automatic output level control.
10	OUTPUT ADJUST control (2A2R13)	Adjusts the power amplifier output level.
11	+15V indicator (2A2CR5)	Illuminates to indicate the RF AMP module +15 volt regulator is operational.

Table 3-1. Controls and Indicators (Continued)

REF.	CONTROL/INDICATOR	FUNCTION
<u>MOD OSC MODULE</u>		
12	+15V indicator (2A4CR5)	Illuminates to indicate the MOD OSC module +15 volt regulator is operational.
13	-15V indicator (2A4CR6)	Illuminates to indicate the MOD OSC module -15 volt regulator is operational.
<u>AFC PLL MODULE</u>		
14	FREQ ADJ control (2A3R18)	Adjusts the FM carrier frequency.
15	LOCK indicator (2A3CR8)	Illuminates to indicate the exciter is operating within tolerance of the assigned frequency.
16	CAL OUT test point	Provides frequency components at 2.5 MHz, 5.0 MHz, 10.0 MHz, 15.0 MHz, 20.0 MHz, and 25.0 MHz for direct frequency comparisons between the internal frequency standard and broadcast frequency standard such as WWV using a communications receiver.
17	+5V indicator (2A3CR2)	Illuminates to indicate application of the +5 volt supply to the AFC/PLL module.
<u>STEREO DIGITAL MODULE</u>		
18	STEREO indicator (3A2CR6)	Indicates stereo mode of operation is enabled when illuminated.
19	STEREO switch (3A2S4)	Enables stereo mode of operation.

Table 3-1. Controls and Indicators (Continued)

REF.	CONTROL/INDICATOR	FUNCTION
20	MONO L+R indicator (3A2CR5)	Indicated mono L+R mode of operation is enabled when illuminated.
21	MONO L+R switch (3A2S3)	Enables the mono L+R mode to transmit a mono signal from both stereo channels.
22	MONO L indicator (3A2CR4)	Indicates mono L mode of operation is enabled when illuminated.
23	MONO L switch (3A2S2)	Enables mono L mode to transmit a mono signal from the left stereo channel and mute the right stereo channel.
24	MONO R indicator (3A2CR3)	Indicates the mono R mode of operation is enabled when illuminated.
25	MONO R switch (3A2S1)	Enables the mono R mode to transmit a mono signal from the right stereo channel and mute the left stereo channel.
<u>STEREO ANALOG MODULE</u>		
26	PILOT LEVEL control (3A1R41)	Adjusts the modulation level of the pilot subcarrier.
27	PILOT ON/OFF switch	Enables or inhibits the pilot subcarrier. For test purposes. Pilot is automatically disabled in any of the three monaural modes.
28	COMP LEVEL control (3A1R27)	Adjusts the composite signal level output from the STEREO ANALOG module.
29	+15V indicator (3A1CR9)	Illuminates to indicate the STEREO ANALOG MODULE +15 volt regulator is operational.
30	+6V indicator (3A1CR10)	Illuminates to indicate the STEREO ANALOG module +6 volt regulator is operational.

Table 3-1. Controls and Indicators (Continued)

REF.	CONTROL/INDICATOR	FUNCTION
31	-6V indicator (3A1CR11)	Illuminates to indicate the STEREO AN- ALOG module -6 volt regulator is oper- ational.
32	-15V indicator (3A1CR12)	Illuminates to indicate the STEREO AN- ALOG module -15 volt regulator is op- erational.
<u>STEREO OVSC MODULE</u>		
33	L ADJ OUT control (3A3R87)	Adjusts the left channel output thresh- old of the STEREO OVSC module.
34	L ADJ IN control (3A3R64)	Adjusts the left channel input thresh- old of the STEREO OVSC module.
35	LEFT indicator (3A3CR27)	Indicates left channel overshoot con- trol when illuminated.
36	IN/OUT switch (3A3S1)	IN position: Enables operation of the DTR filter. OUT position: Enables the convention- al low pass filter.
37	RIGHT indicator (3ACR28)	Indicates right channel overshoot con- trol when illuminated.
38	R ADJ IN control (3A3R10)	Adjusts the right channel input thresh- old of the STEREO OVSC module.
39	R ADJ OUT control (3A3R33)	Adjusts the right channel output threshold of the STEREO OVSC module.
40	+15V indicator (3A3CR26)	Illuminates to indicate the STEREO OVSC module +15 volt regulator is opera- tional.
41	-15V indicator (3A3CR25)	Illuminates to indicate the STEREO OVSC module -15 volt regulator is opera- tional.

Table 3-1. Controls and Indicators (Continued)

REF.	CONTROL/INDICATOR	FUNCTION
<u>SCA 1/SCA 2 MODULE(S)</u>		
42	ON indicator (4A1CR6)	Indicates the presence of SCA subcarrier when illuminated.
43	ON switch (4A1S1)	Enables the SCA carrier.
44	AUTO indicator (4A1CR10)	Indicates the SCA AUTO mode of operation is enabled when illuminated.
45	AUTO switch (4A1S2)	Enables the SCA module automatic muting function.
46	OFF indicator (4A1CR14)	Indicates the SCA channel is muted when illuminated.
47	OFF switch (4A1S3)	Inhibits operation of the SCA channel.
48	INJ LEV control (4A1R16)	Adjusts the injection level of the SCA subcarrier.
49	FREQ ADJ control (4A1R12)	Adjusts the center frequency of the SCA subcarrier.
50	+6V indicator (4A1CR7)	Illuminates to indicate the SCA module +6 volt regulator is operational.
51	-6V indicator (4A1CR8)	Illuminates to indicate the SCA module -6 volt regulator is operational.
<u>MONO MODULE</u>		
52	-15V indicator (5A1CR6)	Illuminates to indicate the MONO module -15 volt regulator is operational.
53	+15V indicator (5A1CR5)	Illuminates to indicate the MONO module +15 volt regulator is operational.

Table 3-2. AC and DC Metering

DC METERING

MULTIMETER SWITCH POSITION	SIGNAL DISPLAYED
+20V	Pre-regulated +20 volt dc bus to all module power supply regulators.
-20V	Pre-regulated -20 volt dc bus to all module power supply regulators.
+5V	Regulated +5 volt dc supply to TTL circuitry on the AFC/PLL module.
AFC	AFC/PLL module AFC voltage to MOD OSC module.
MOD OSC	MOD OSC module output power.
RF CUR	RF AMP module final amplifier collector current.
FWD PWR	FM exciter output power.
REF PWR	FM exciter reflected power.
AC LINE	AC input to FM exciter.

Table 3-2. AC and DC Metering (Continued)

AC METERING

MODULATION METER SWITCH POSITION	SIGNAL DISPLAYED
LEFT	Pre-emphasized audio input for mono, left channel pre-emphasized audio input for stereo, or left front pre-emphasized audio input for quad transmission.
RIGHT	Pre-emphasized audio input for mono, right channel pre-emphasized audio input for stereo, or right front pre-emphasized audio input for quad transmission.
L+R	Sum of left channel and right channel stereo audio inputs.
L-R	Difference between left channel and right channel stereo audio inputs.
B BAND	Total modulation signal applied to VCO.
SCA 1	SCA channel No. 1 data or pre-emphasized audio input.
SCA 2	SCA channel No. 2 data or pre-emphasized audio input.
L REAR	Left rear pre-emphasized audio input for quad transmission.
R REAR	Right rear pre-emphasized audio input for quad transmission.
OVSC	Overshoot compensation indication.

3-5. OPERATION

3-6. Exciter power on-off is controlled by a single switch accessible from behind the exciter meter panel. As all critical functions in the exciter are stabilized by automatic control circuits and feedback loops, the only adjustments required on a daily basis are the mode controls if the mode of operation must be changed. All mode switching is remoteable from connections on the rear of the exciter.

3-7. MONITORING CAPACITY

3-8. The metering functions are contained within the modular dc and peak reading audio metering circuits. The metering functions are listed in table 3-2.

3-9. MODE SWITCHING

3-10. STEREOPHONIC/MONAUROAL SWITCHING. Modes of operation available with the MX-15 FM EXCITER are STEREO, MONO L, MONO R, and MONO L+R which are selected by switches on the STEREO DIGITAL module. Indicators on the module illuminate to indicate the selected mode of operation. MONO L or MONO R allows stations which use stereophonic operation as a standard mode to broadcast in monaural if one audio channel fails during stereophonic operation or if it is desired to broadcast from a separate monaural studio feed. The MONO L+R capability is an exclusive MX-15 feature which allows monaural transmission by both stereophonic channels without changing limiters or studio consoles. Stereophonic programming in the MONO L+R mode is transmitted as monaural by mixing both stereophonic channels.

3-11. SCA SWITCHING

3-12. Either or both of the SCA channels may be operated automatically in the AUTO mode or manually in the ON or OFF modes by switches on each respective SCA module. Indicators on each SCA module illuminate to indicate the selected mode of operation. In the AUTO mode, SCA subcarrier presence is determined by the presence of audio. An adjustable signal threshold from 0 dBm to -30 dBm enables the SCA, and SCA delay time is adjustable from 0.5 to 20 seconds. For manual operation, the SCA ON and SCA OFF switches control the presence of the SCA subcarrier.

3-13. DYNAMIC TRANSIENT RESPONSE FILTER

3-14. The Dynamic Transient Response (DTR) filter is activated by the OVSC module IN/OUT switch when set to the IN position. When the OVSC module IN/OUT switch is set to the OUT position, filtering is accomplished by a conventional sharp-cutoff low-pass filter which is subject to considerable overshoot. For all programming situations with all types of FM limiters, use of the DTR filter is recommended to eliminate overshoot. This switch is not a normal operating control and is provided to bypass the DTR filter for the following reasons:

- a. Allow comparisons between the conventional filter and the DTR filter for exciter setup.
- b. Proof of performance measurements. (The DTR filter should be disabled to measure crosstalk. All other measurements may be made with the DTR filter enabled).
- c. The DTR filter must be disabled for FM stations which use no peak limiting, or that use a limiter which does not compensate for pre-emphasis characteristics. Thresholds internal to the DTR filter require that the input signal must be peak limited with pre-emphasis protection to prevent audio distortion.

SECTION IV

PRINCIPLES OF OPERATION

4-1. INTRODUCTION

4-2. This section contains principles of operation of the MX-15 FM EXCITER. An overall block diagram and exciter description identifies and describes each modular function and sub-system operation. Additional block diagrams and descriptions are provided in this section for all non-modular components and modules mounted to the mainframe. A detailed description of each plug-in module is provided by each applicable module publication.

4-3. FUNCTIONAL DESCRIPTION

4-4. The electrical functions of the HARRIS MX-15 FM EXCITER can be divided into the following twelve modular sections (see figure 4-1). The description assumes all options have been purchased for use.

4-5. RFI/EMI FILTER (2A1A4)

4-6. The RFI filter ensures electromagnetic compatibility by filtering and bypassing the input and output connections of audio inputs, control lines, status lines, and the ac power input. The SCA auxiliary inputs, the composite signal input, and the exciter rf output lines are shielded coaxial lines and are not routed through the filter.

4-7. Interference by the commercial AM broadcast band to each 600 ohm balanced audio input is rejected by a three pole Butterworth filter (see figure 4-2). The filter RC output section provides loading, padding, and additional rf attenuation through one GHz. The control and status lines are filtered by a low-pass RC filter which prevents external rf interference with the exciter control and status functions. The ac input is RFI filtered by a pi section LC filter. All RFI filter sections provide attenuation between 500 kHz and one GHz. The variable coils in each audio input should be adjusted to obtain the best high frequency crosstalk at 15 kHz.

4-8. POWER SUPPLY (2A1A5)

4-9. Power for each module is provided by individual module monolithic voltage regulators from the power supply pre-regulated +20 Vdc distribution busses. Additionally, the power supply distributes +34 Vdc to the RF AMP module and positive five volts dc to the logic devices on the AFC/PLL module.

4-10. AC input power is applied through the AC POWER receptacle (J2) and the RFI filter to the AC MAIN RESET circuit breaker and the POWER ON/OFF switch which provide overload protection and power supply control (see figure 4-3). Fan B1 and transformer T1 have dual primary windings which allow operation from either 115 Vac or 230 Vac. The fan and transformer are connected so that the fan will operate whenever primary ac is applied to the power transformer. Connections from the primary of T1 to the dc meter module allow monitoring of the primary ac input voltage.

4-11. POSITIVE FIVE VOLT SUPPLY. Full wave rectifier CR1 provides a positive 13 volt dc potential from one of the secondary windings of transformer T1. This voltage is filtered by capacitor C1 and regulated by monolithic regulator U1 to provide a stable five volt source to operate the logic circuitry on the AFC/PLL module. To ensure adequate heat dissipation, U1 is mounted on the power supply side heat sink assembly in the direct air flow from the fan. Diode CR3 provides reverse current protection for regulator U1 if a fault should occur on the input side of the regulator device.

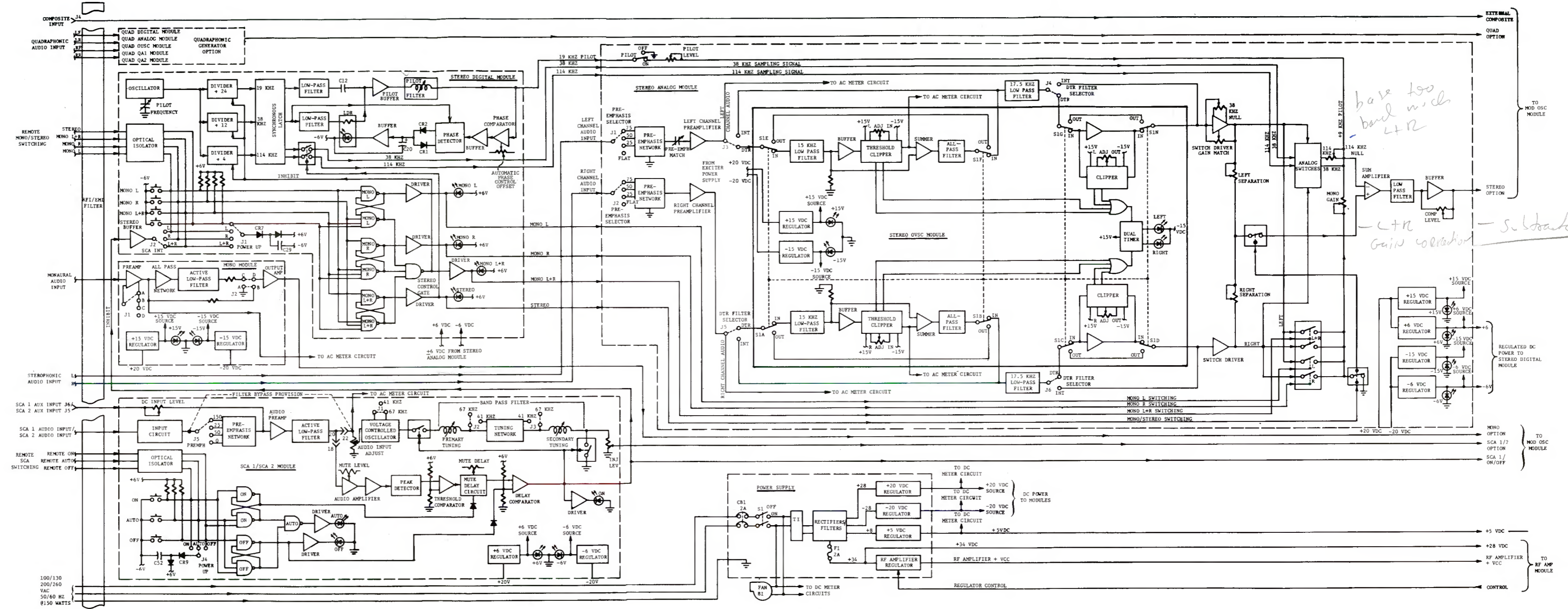
4-12. POSITIVE 34 VOLT SUPPLY. Full wave rectifier CR2 develops a 34 volt dc potential from the second secondary winding of transformer T1. The voltage is filtered by a pi section filter consisting of C2, L1, and C4. Overload protection is provided by the RF AMP SUPPLY fuse (F1). A filtered source of 34 Vdc is applied directly to the RF AMP module to power the internal monolithic +15 volt regulator and an AGC circuit. The output of the RF AMP module AGC circuit is adjusted by the OUTPUT ADJ control (R13) and applied to the base of the power supply +28 Vdc regulator (Q1). Transistor Q1 outputs a positive VCC potential to operate the amplifiers in the RF AMP module. As the RF AMP module OUTPUT ADJ control (R13) is adjusted, the output voltage of transistor Q1 varies which controls the exciter RF output level. Current limiting is provided by circuitry in the RF AMP module which monitors the rf amplifier supply current. Zener diode CR4 provides over voltage protection for the rf output devices. To ensure adequate heat dissipation, Q1 mounts on the power supply rear heatsink assembly in the direct air flow from the fan.

4-13. POSITIVE AND NEGATIVE 20 VOLT SUPPLIES. Positive and negative 34 Vdc is applied to the +20 Vdc regulator circuits from full wave bridge rectifier CR2. Diodes CR5 and CR6 establish a stable reference to operate the regulators (Q3 and Q4) at the correct positive and negative 20 Vdc output level. Transistors Q5 and Q6 provide foldback current limiting for the regulators by conducting whenever the voltage drop across R4 or R14 reaches a point which causes the respective transistor to turn on. Diodes CR7 and CR8 provide power supply reverse voltage protection for the exciter circuitry. The Darlington output stages (Q3 and Q4) are mounted on the front power supply heatsink assembly in the direct air flow of the fan to ensure adequate cooling. The exciter POWER indicator (2A1DS1) is connected from the negative 20 Vdc supply to ground to indicate power supply operation.

4-14. METERING CIRCUITS

4-15. The metering circuits provide dc, ac, and peak reading audio measurements of selected critical functions. Using built-in metering functions only, peak audio levels may be established without use of external type approved monitors.

4-16. DC METERING CIRCUITS (2A1A1). All inputs are externally connected to each respective circuit for voltage or current measurements as shown in figure 4-4. A ten position pushswitch assembly (S1) selects the specific dc signal to be displayed by the MULTIMETER (M1). All inputs consist of dc



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FIGURE 4-1. OVERALL BLOCK DIAGRAM (SHEET 1 OF 2)

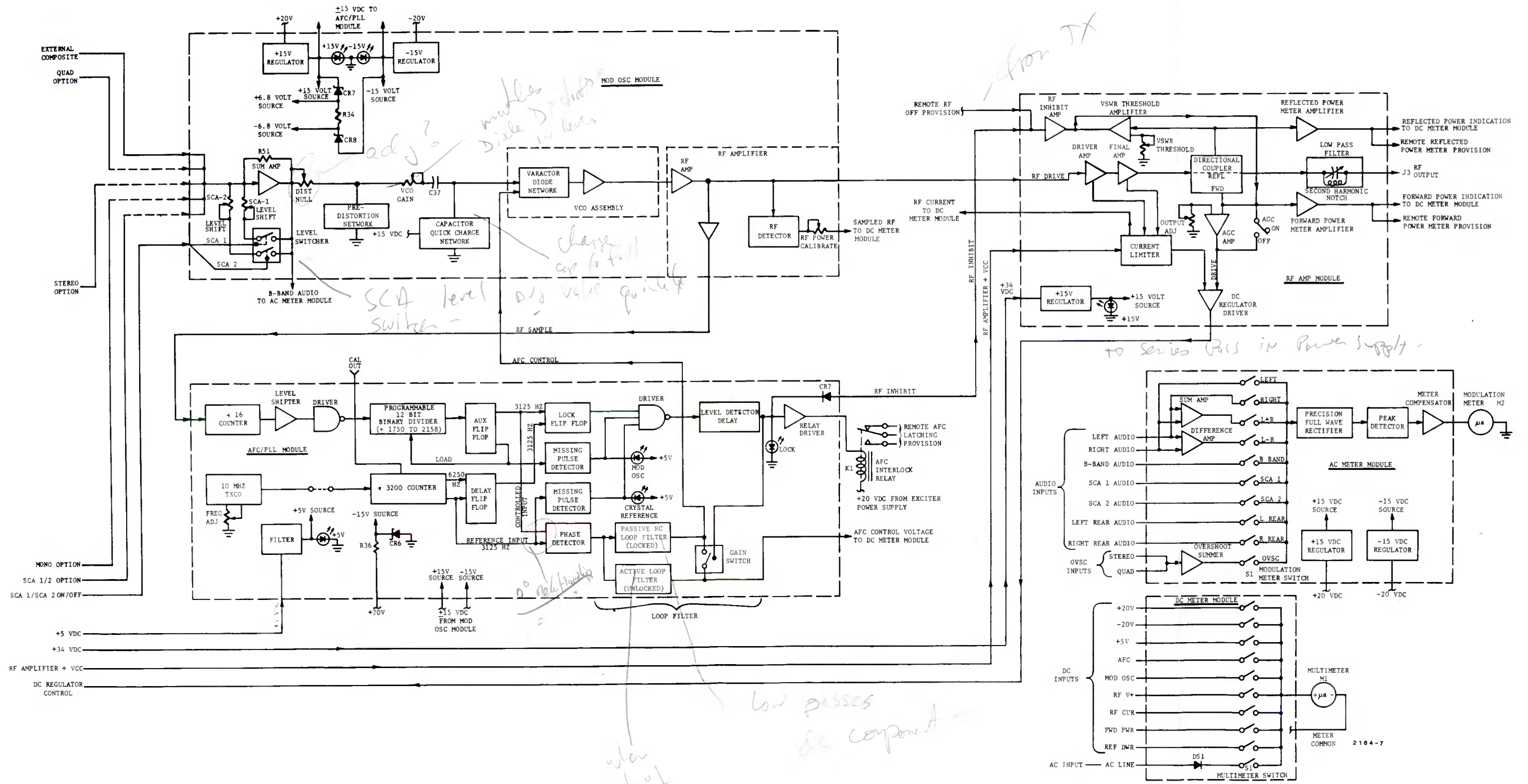


FIGURE 4-1. OVERALL BLOCK DIAGRAM (SHEET 2 OF 2)

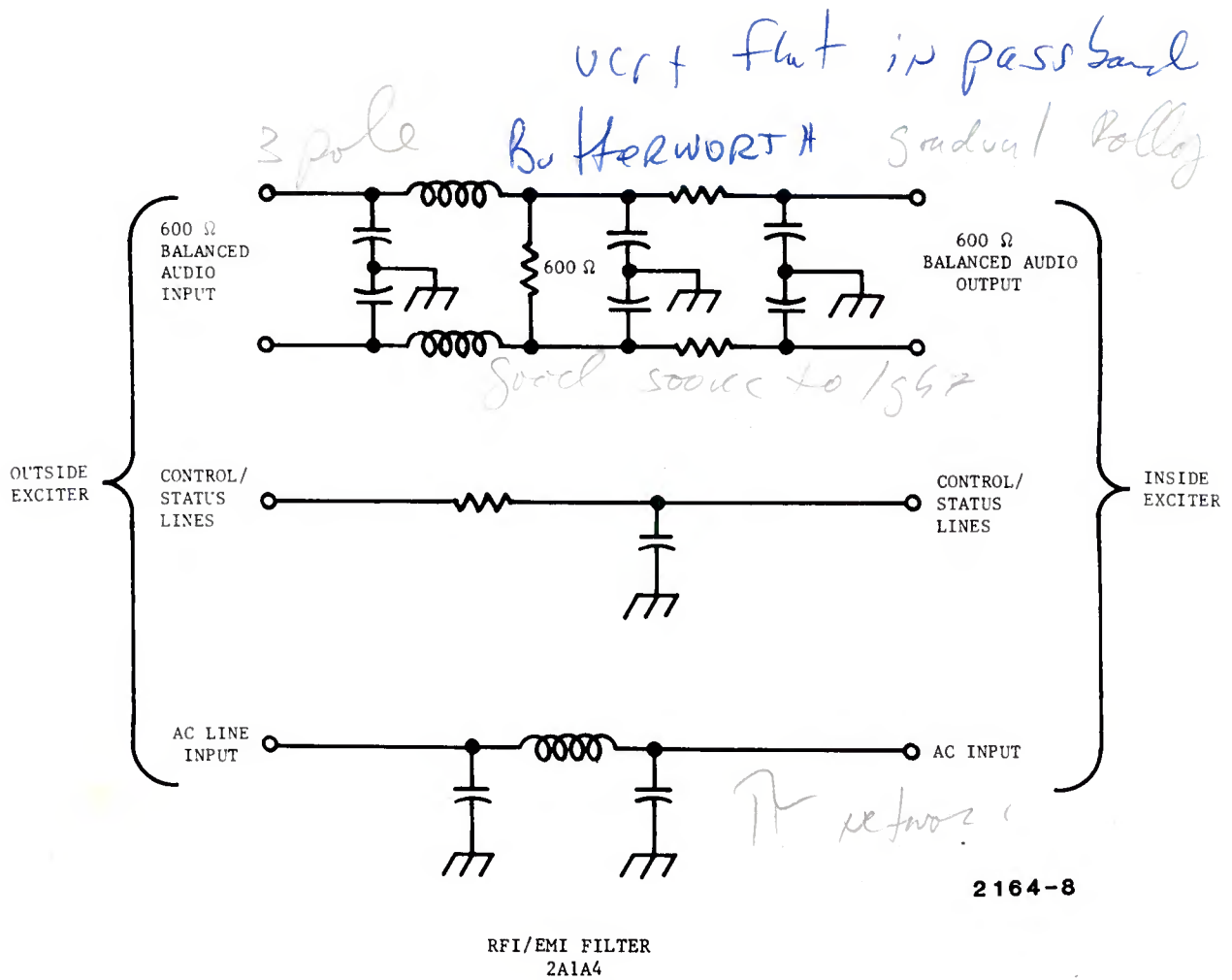


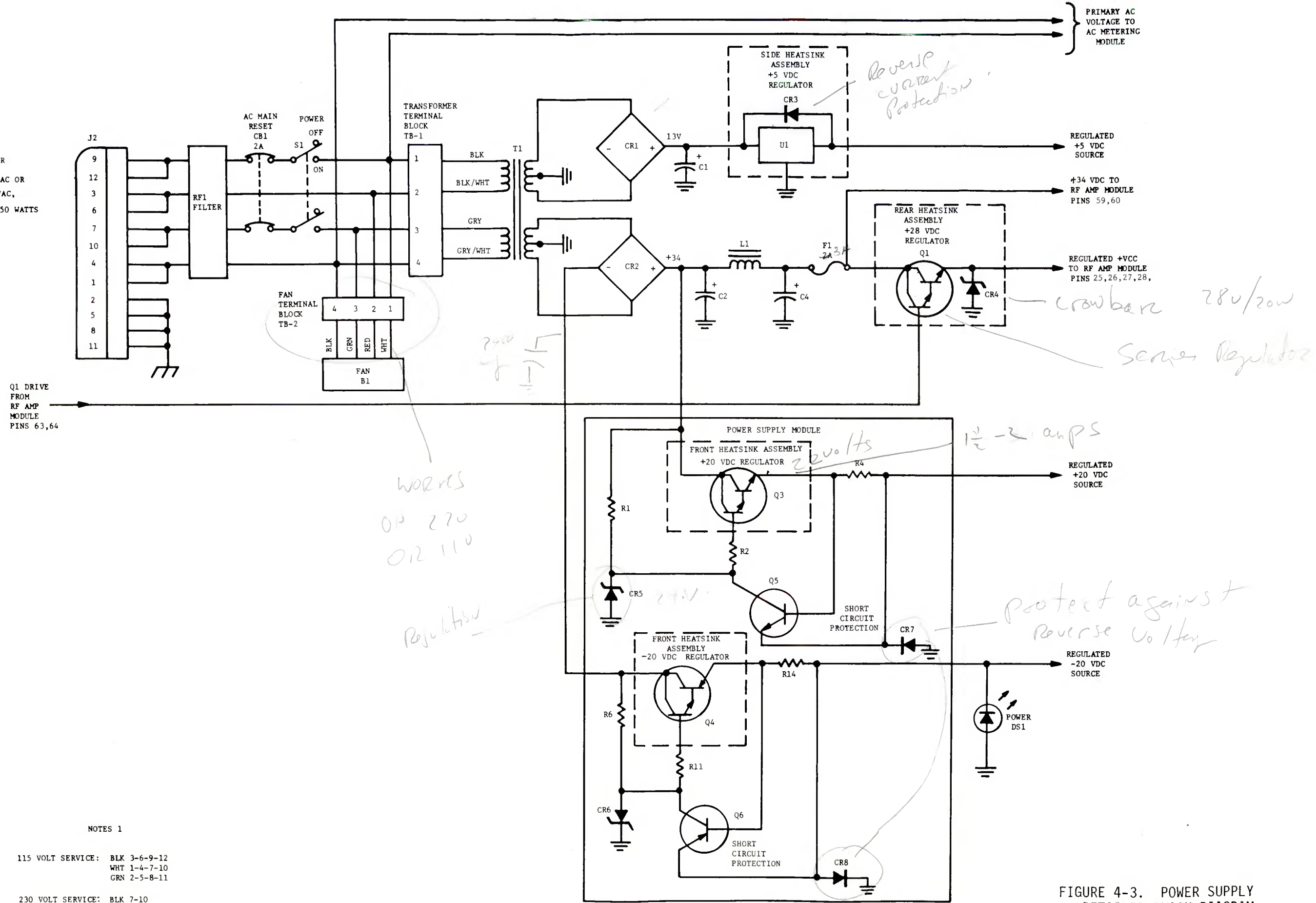
Figure 4-2. RFI Filter Detailed Block Diagram

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4-7/4-8

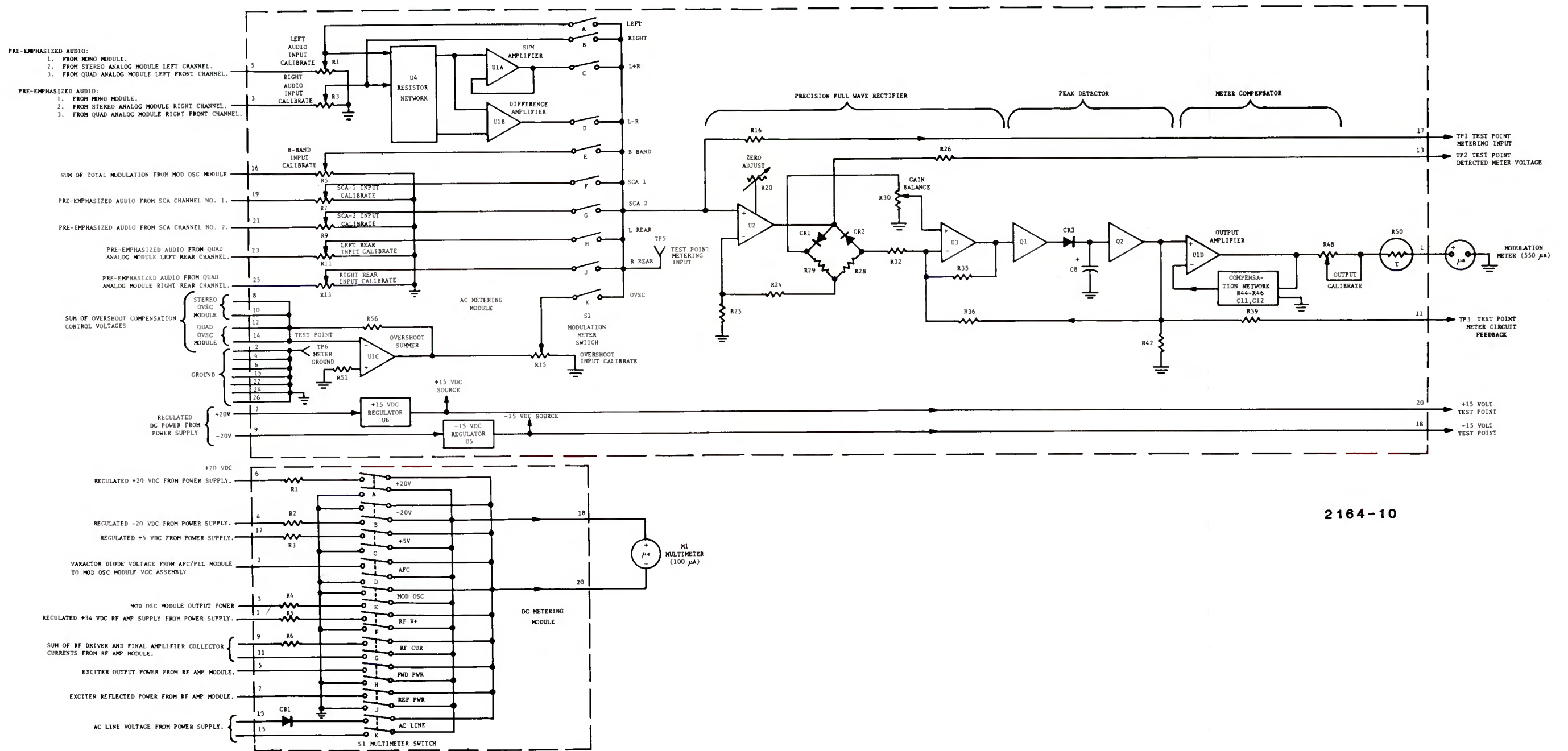
WARNING: Disconnect primary power prior to servicing.

AC POWER
100 TO 130 VAC OR
200 TO 260 VAC,
50/60 HZ @ 150 WATTS



NOTES 1
115 VOLT SERVICE: BLK 3-6-9-12
WHT 1-4-7-10
GRN 2-5-8-11
230 VOLT SERVICE: BLK 7-10
WHT 3-6
GRN 2-5-8-11
JUMPER 1-9, 4-12

FIGURE 4-3. POWER SUPPLY DETAILED BLOCK DIAGRAM



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FIGURE 4-4. METERING CIRCUITS DETAILED BLOCK DIAGRAM

circuits except the ac line voltage from the power supply which is rectified by diode CR1 for application to the meter circuit. A 100 uA meter movement provides high sensitivity and accuracy.

4-17. AC METERING CIRCUITS (2A1A2). All input signals to the ac metering circuits are connected to each respective source as shown in figure 4-4.

4-18. INPUT CIRCUITS. Each input is provided with a potentiometer to calibrate each function. The left front and right front quadraphonic inputs which function as the left channel and right channel inputs are adjusted for level and directed to the MODULATION meter switch (S1) and to the resistor network (U4) which proportions the input signals between the sum amplifier (U1A) and the difference amplifier (U1B). The sum amplifier (U1A) produces the L + R signal and the difference amplifier (U1B) produces the L - R signal. The remaining audio inputs are adjusted for level and applied to the MODULATION meter switch. The OVSC (overshoot compensator) inputs from either the STEREO OVSC or QUAD OVSC module are summed by amplifier U1C, level adjusted, and applied to the MODULATION meter switch.

4-19. SIGNAL PROCESSING. The signal selected by the MODULATION meter switch is applied to a precision full wave rectifier circuit consisting of U2, CR1, CR2, U3, and associated components. As CR1 and CR2 are enclosed in the U2 feedback loop, the forward turn on voltage characteristic of each diode is compensated. The positive going half cycles appear across R28 and the negative going half cycles appear across R29 with no diode thresholds. Control R21 adjusts the offset voltage of U1 to zero. The rectified signal is applied from the anode of CR2 to the inverting input of U3 and from the cathode of CR1 to the noninverting input of U3. Resistor R30 in the inverting input of U3 provides an adjustment to equalize the positive and negative inputs to U3. The signal is peak detected and amplified by a peak detector comprising Q1, CR3, C8, and Q2. Negative dc feedback is obtained from the output of amplifier Q2 and applied to U3. This provides fast and accurate charging of capacitor C8 in response to voltage peaks. The output amplifier (U1D) acts as a meter compensation amplifier to improve the mechanical response characteristics of the meter. Resistor R48 provides a master gain calibration control for the meter and thermistor R50 provides circuit temperature compensation to maintain meter accuracy over the entire range of operating temperatures.

4-20. POWER. Inputs of positive and negative regulated 20 Vdc are re-regulated into positive and negative 15 Vdc sources to operate the ac meter module internal circuitry.

4-21. MOTHER BOARD ASSEMBLY (2A1A3)

4-22. The mother board provides power, signal, and control inputs, interconnections, and outputs for all plug-in modules through strip connectors soldered to the mother board. RF interconnections are provided by 50 ohm micro-strips etched onto the circuit board.

4-23. MONO MODULE (5A1)

4-24. The MONO module accepts an audio input through the RFI filter and provides selectable pre-emphasis and defeatable linear phase low-pass filtering. The resultant signal drives the MOD OSC module.

4-25. INPUT CIRCUIT. A solid state input circuit used in place of a conventional input transformer provides high common mode hum rejection. Pre-emphasis selectable by J1 provides 75 us, 50 us, 25 us, or flat pre-emphasis characteristics. Pre-emphasized monaural audio is applied to the ac meter module and subsequent low-pass filter sections.

4-26. FILTER CIRCUIT. A linear phase low-pass filter comprising an allpass network (phase equalizer) and an eight pole Butterworth low-pass filter are provided following the input preamplifier. The filters can be used to protect the SCA subcarrier and eliminate ultrasonic audio components or the filter may be jumpered out of the circuit with J2 as desired. The all-pass network has a flat frequency response and tailors the phase characteristics so that the algebraic sum of the phase functions of the all-pass network and the low-pass filter will approximate linear phase. The active low-pass filter protects the SCA channels from high frequency interference and the delay compensator minimizes filter overshoot. A unity gain amplifier provides buffering to drive the MOD OSC module.

4-27. POWER. Inputs of positive and negative regulated 20 Vdc are re-regulated to positive and negative 15 Vdc sources to operate the MONO module internal circuitry. Light emitting diodes provide status indications for the positive (+15V) and negative (-15V) power supplies.

4-28. SCA MODULE (4A1)

4-29. The SCA module includes a dual frequency (41 kHz or 67 kHz) FM subcarrier generator. AC and dc coupled inputs allow audio inputs and SSTV or data transmission on the SCA channels without special additional units. Each SCA module includes a seven pole Butterworth active low-pass filter which allows the use of 150 microsecond pre-emphasis without degrading SCA to stereo crosstalk specifications and allows both the 41 kHz and 67 kHz SCA channels to be operated simultaneously without harmonic interference. Variable automatic or manual muting and remote or local mode switching is also provided.

4-30. INPUT CIRCUIT. Two inputs are available for each SCA module. An ac coupled input through the RFI filter is applied through the input circuit to the pre-emphasis selector (J5) which allows selection of 150, 75, 50 microsecond pre-emphasis or flat response. The dc coupled input bypasses the RFI filter and pre-emphasis network and is level adjusted by the DC INPUT LEVEL control. Both audio signals are applied to the audio preamplifier and processed by the low-pass filter. Pre-emphasis audio from the low-pass filter is applied to the ac meter circuit, the audio muting amplifiers, and the voltage controlled oscillator. The filter may be bypassed if desired for special SCA applications.

4-31. FM CIRCUIT. The input signal is level adjusted by the AUDIO INPUT LEVEL control and applied to the voltage controlled oscillator which produces a 41 kHz or 67 kHz frequency modulated rf output as programmed by jumper J1. The FM signal is applied to a doubly tuned band-pass filter in which J2 and J3 determine the filter coupling and center frequency. The INJ LEV control allows adjustment of the module output to the 100 millivolt RMS level required to drive the MOD OSC module. When the SCA is disabled, CMOS switches disconnect the input of the filter and short the filter output to ground.

4-32. MUTE CIRCUIT. Amplification of the low level audio signal from the active low-pass filter to the level required to drive the SCA muting circuit is provided by a two stage high gain amplifier. After amplification, the audio is peak detected and operates a threshold comparator which is referenced to a fixed dc level. As long as the detected peak level of the audio is greater than the comparator dc reference, an output is applied to the mute delay circuit and operates the delay comparator which is also referenced to a fixed dc level. As long as the mute delay circuit outputs a dc level, the delay comparator feeds an SCA ON signal to the MOD OSC module, operates a driver which illuminates the ON indicator, and activates the CMOS control switches. The SCA ON signal from SCA module No. 2 is also applied to the STEREO DIGITAL module to prevent simultaneous 41 kHz SCA and stereophonic operation. The SCA channel is given priority in this situation.

4-33. If the audio input level falls below the threshold comparator dc reference or the audio input is interrupted for longer than the time constant for the delay circuit, the delay comparator will inhibit SCA operation and the ON indicator will go out. The SCA threshold is adjusted by the MUTE level control and the SCA delay is adjusted by the MUTE DELAY control.

4-34. MODE SELECTION. Mode selection is performed by two dc flip flops implemented by four cross-coupled NAND gates. The dc flip flops are controlled by levels rather than transitions.

4-35. When mode is selected, either by depressing a mode switch or applying a positive 18 to 24 Vdc potential on the selected remote control input, the respective flip flop will latch and inhibit all other functions. The condition will persist until another mode is selected.

4-36. When the ON mode is selected, a connection from the ON flip flop to the mute delay circuit will inhibit the automatic muting function, illuminate the ON indicator and activate the CMOS switches in the FM circuit. When the OFF function is selected, a connection from the OFF flip flop to the mute delay comparator inhibits SCA operation. In the AUTO mode, both flip flops are reset and the muting delay circuitry will control the module operation. Light emitting diodes provide indications of the ON, AUTO, and OFF modes.

4-37. Power Up Mode Selection. When power is applied, capacitor C52 is initially discharged. Charging current through jumper J4 will produce a LOW condition until the capacitor is charged on the mode selection line selected

by the position of J4, initializing the SCA module in the desired mode. Diode CR9 functions as a disconnect diode which allows manual mode switching after capacitor C52 is charged.

4-38. INDICATORS. Light emitting diodes connected to the control gates through drivers illuminate to indicate selection of a specific mode. The ON indicator illuminates to indicate selection of the ON mode and functions as a mute circuit status indicator when the AUTO mode is selected.

4-39. POWER. Inputs of positive and negative regulated 20 Vdc are re-regulated into positive and negative six Vdc sources to operate the SCA generator internal circuitry.

4-40. STEREO DIGITAL MODULE (3A2)

4-41. The STEREO DIGITAL module produces the signals required to generate the digitally synthesized modulated stereophonic signal, generates the phase controlled 19 kHz pilot signal, and provides stereophonic/monaural mode switching.

4-42. SAMPLING SIGNALS. All frequencies used in the STEREO DIGITAL module are derived from a 456 kHz crystal oscillator. The PILOT FREQUENCY control provides an oscillator frequency adjustment. Synchronous dividers divide the oscillator signal by 24, 12, and 4 to respectively produce the 19 kHz pilot signal and the 38 kHz and 114 kHz sampling signals. The correct phase relationship of each signal is ensured by a synchronous latch. The 38 kHz and 114 kHz signals are output from the module through a CMOS switch which is closed by the stereo-on signal from the module control circuitry.

4-43. PILOT SIGNAL. The 19 kHz pilot frequency is differentially applied to two low-pass filters. Outputs are obtained across capacitor C12 and light dependent resistor. The sum of the two voltages produces a constant voltage at the input to the pilot buffer amplifier with the pilot signal phase shift controlled by the resistance of the light dependent resistor. The pilot frequency is buffered and applied to a second low-pass filter to ensure that the pilot frequency output will be pure sinewave. The center frequency of the second low-pass filter is adjusted by the PILOT FILTER control.

4-44. Pilot Phase Control. The pilot frequency output is sampled by a phase comparator in which the dc offset is adjusted by the AUTOMATIC PHASE CONTROL OFFSET adjustment. The phase comparator senses zero voltage crossings of the pilot signal and generates a square wave with the same phase. The signal is amplified and applied to a phase detector. As long as the phase of the generated square wave and the reference obtained from the synchronous latch remains the same, neither CR1 or CR2 will conduct. If the phase of the pilot lags the reference, CR2 will conduct and charge C20. If the pilot leads the reference, CR1 will conduct. The charge on C20 is buffered by an amplifier which drives the light dependent resistor and produces a phase shift at the input to the pilot buffer amplifier. Pulses from CR1 or CR2 will continue to charge C20 and operate the light dependent resistor until the pilot phase is corrected.

4-45. CONTROL CIRCUITS. Stereophonic and monaural switching is controlled by three dc flip flops implemented by six cross coupled NAND gates. The flip flops are controlled by levels rather than transitions. When a monaural or stereophonic mode is selected, either by depressing a mode switch or by applying a positive 18 to 24 Vdc potential on the selected remote control input, the respective flip flop latches and resets all other functions. Mode selection for the STEREO ANALOG module is provided by the STEREO DIGITAL module control circuits.

4-46. If the MONO L switch is depressed, the Mono L flip flop will set and reset the remaining flip flops. The remaining flip flops are controlled in a similar manner and remain reset until another mode is selected. The output of each flip flop is applied to the stereo control gate which outputs a LOW condition that inhibits output of the stereo sampling signals to the STEREO ANALOG module and halts the synchronous divider. When the STEREO switch is depressed all the gates are reset and the inhibit from the stereo control gate is removed. This enables stereophonic operation and stereo sampling signals are output to the STEREO ANALOG module. Individual logic levels output from the STEREO DIGITAL module provide automatic mono/stereo mode switching for the STEREO ANALOG module circuitry.

4-47. SCA-2 Interlock. Operation of two SCA channels (67 kHz and 41 kHz) during stereophonic programming is not desired as interaction between the stereophonic signal and the 41 kHz SCA channel will produce mutual interference. If operation of the SCA-2 module (41 kHz) is attempted during stereophonic programming, a positive six volt dc potential from the SCA-2 module applied to the SCA INTERLOCK (J2) circuit of the STEREO DIGITAL module will cause the stereo generator to default to the monaural mode programmed by J2. Operation of the module mode selection circuit is inhibited until SCA-2 is switched off. Then the STEREO DIGITAL module may be manually switched to the desired monaural or stereo mode.

4-48. Power Up Mode Selection. When power is applied, capacitor C29 is initially discharged. Charging current through jumper J1 will produce a LOW condition until the capacitor is charged on the mode selection line selected by the position of J1, initializing the SCA module in the desired mode. Diode CR7 functions as a disconnect diode which allows manual mode switching after capacitor C29 is charged.

4-49. INDICATORS. Light emitting diodes connected to the control gates through drivers illuminate to indicate the mode of operation.

4-50. POWER. Inputs of positive and negative six Vdc from regulators in the STEREO ANALOG module function as voltage sources to operate the STEREO DIGITAL module internal circuitry.

4-51. STEREO ANALOG MODULE (3A1)

4-52. The STEREO ANALOG module accepts the stereophonic audio inputs and generates the stereophonic composite signal with switching and pilot signals input from the stereo digital module. Solid state circuits used in place of conventional input transformers provide high common mode hum rejection and

selectable pre-emphasis. Dynamic transient response (DTR) low-pass filtering is accomplished by the STEREO OVSC module and the two conventional 17.5 kHz audio low-pass filters in the STEREO ANALOG module. The digitally synthesized modulation sampling circuits and the composite filters are also included within the module.

4-53. INPUT CIRCUIT. The two stereo audio signals are input through the RFI filter to individual preamplifiers. A solid state input circuit used in place of conventional input transformer provides high common mode hum rejection. Pre-emphasis of 75 us, 50 us, 25 us, or flat response is selectable by J1 for left channel and by J2 for the right channel. The PRE-EMPH MATCH control in the input to the left channel preamplifier allows adjustment of the left channel pre-emphasis circuit to match the right channel pre-emphasis characteristics for stereo crosstalk adjustments.

4-54. FILTER CIRCUIT. Normally the STEREO ANALOG module will be used with a STEREO OVSC module in which the STEREO ANALOG module filters are used as part of the DTR filtering process. However, the STEREO ANALOG module includes its own audio low-pass filters and can function without the STEREO OVSC module if desired. The pre-emphasized audio from the input preamplifiers is applied to the ac meter circuit and the DTR filter selectors (J3 and J4 for the right channel and J5 and J6 for the left channel). The DTR filter selectors select the OVSC MODULE DTR filter circuitry or allow use of the STEREO ANALOG module 17.5 kHz low-pass filters as desired.

4-55. The pre-emphasized and filtered audio is next applied to the switch driver in each channel. The gain of the left channel driver is adjustable with the GAIN MATCH control. The 38 KHZ NULL control minimizes amplifier dc offset between the left and right channel switch drivers. The LEFT SEPARATION and RIGHT SEPARATION controls allow adjustment to obtain maximum channel separation.

4-56. OUTPUT CIRCUIT. The output of the switch drivers is applied to the analog switches. The 114 kHz and 38 kHz signals from the STEREO DIGITAL module controls the analog switches which generate the DSM sampling function. The 114 KHZ NULL control adjusts the 114 kHz switch output to cancel the third harmonic component of the 38 kHz switch (114 kHz). The 19 kHz pilot signal from the STEREO DIGITAL module is controlled by the PILOT ON/OFF switch and level adjusted by the PILOT LEVEL control. The DSM sampling signal and the pilot signal are applied to the inverting input of the sum amplifier. A portion of the L + R signal obtained from the separation controls is applied to the non-inverting input of the sum amplifier which in turn drives the composite low-pass filter to eliminate the fifth harmonic and higher ordered harmonics of the 38 kHz signal. The output buffer provides signal amplification and isolation. The COMP LEVEL control adjusts the composite signal level output to suit the input requirements of the MOD OSC module.

4-57. In monaural operation the sampling signals and the pilot signal are inhibited. The mode switching arrangement selects the desired monaural signal. The monaural level is adjusted by the MONO GAIN control.

4-58. MODE SWITCHING. Mode switching is accomplished by CMOS dc flip flops controlled by discrete individual inputs for stereo, mono left, mono right, and mono left plus right.

4-59. Stereophonic Operation. If stereophonic operation is selected, a positive six volt dc level output from the STEREO DIGITAL module closes two CMOS switches between the separation controls which applies a portion of the L + R signal required for stereo operation to the non-inverting input of the sum amplifier. A second CMOS switch pair inhibits monaural operation by grounding the monaural audio line. The 114 kHz and 38 kHz sampling signals and the pilot signal are enabled in the STEREO DIGITAL module.

4-60. Monaural Operation. If a monaural mode is selected, a LOW placed on the stereo line will open the stereo sampling switches. A HIGH output from the STEREO DIGITAL module on the selected monaural mode line will close the appropriate CMOS switch and connect the selected audio source to the sum amplifier input through the MONO GAIN control. The 114 kHz and 38 kHz sampling signals and the pilot signal are automatically inhibited by control circuitry in the STEREO DIGITAL module which prevents stereo sampling.

4-61. POWER. Inputs of positive and negative regulated 20 Vdc are re-regulated into positive and negative fifteen and six Vdc sources to operate the STEREO ANALOG module internal circuitry. Positive and negative six Vdc is applied to the STEREO DIGITAL module internal circuitry. The STEREO DIGITAL module CMOS logic operates between the positive and negative six Vdc potentials and is not referenced to common ground. The +15V, -15V, +6V, -6V light emitting diodes indicate operation of each power supply.

4-62. STEREO OVSC MODULE

4-63. The STEREO OVSC (overshoot compensator) module provides 15 kHz low-pass filtering of the left and right channel audio signals to prevent interference with the 19 kHz pilot signal and eliminates interference between the L + R and L - R signals. A special filtering process limits overshoot to a maximum of two percent to prevent overmodulation. This minimum overshoot allows high levels of modulation to be maintained without degrading signal quality. Indicators on the module front panel and outputs to the ac meter module aid in level setup and provide overshoot limiting indications during operation.

4-64. Normally the STEREO ANALOG module will be used with a STEREO OVSC module in which the STEREO ANALOG module filters are used as part of the DTR filtering process. However, the STEREO ANALOG module includes its own audio low-pass filters and can function without the STEREO OVSC module. The IN/-OUT switch (S1) is provided on the STEREO OVSC module to bypass the overshoot control circuitry and provide conventional low-pass filtering if desired.

4-65. INPUT THRESHOLD. Transformerless input amplifiers on the STEREO ANALOG module drive a dual 15 kHz low-pass filter on the STEREO OVSC module. The low-pass filter output is amplified by a buffer and applied to a threshold clipper which contains an active programmable zener diode. The active

zener voltage is adjusted by the L ADJ IN or R ADJ IN controls to the peak voltage level corresponding to 100% modulation. The threshold clipper passes only peaks exceeding 100% modulation (overshoots). The sum amplifier subtracts from the 15 kHz low-pass filter output. The sum is applied to an all-pass filter phase equalizer which is flat in frequency response but produces a phase shift dependent upon frequency.

4-66. OUTPUT THRESHOLD. The output of the all-pass filter is looped out of the STEREO OVSC module, through the STEREO ANALOG module 17.5 kHz low-pass filter, and back to the STEREO OVSC module. The all-pass filter phase characteristic is added to the 17.5 kHz low-pass filter phase characteristic to yield linear phase. The filtered audio drives a clipper circuit containing an active programmable zener diode which is adjusted by the L ADJ OUT and R ADJ OUT controls to pass audio levels corresponding to less than 100% modulation only. The overshoot compensated audio is then output to the STEREO ANALOG module.

4-67. INDICATORS. Outputs from the left and right clipper circuits are applied to wired OR comparators. Whenever an overshoot limiting condition exists, an output from the respective OR circuit will drive half of the dual timer used as a one shot to illuminate the LEFT and RIGHT indicators.

4-68. POWER. Inputs of positive and negative regulated 20 Vdc are re-regulated into positive and negative fifteen volt dc sources to operate the STEREO OVSC module internal circuitry.

4-69. AFC/PLL MODULE

4-70. The AFC/PLL module provides phase locked control of and 50 kHz channel frequency between 87.5 MHz and 108 MHz. All FM channels are synthesized from a stable 10 MHz temperature compensated crystal oscillator (TCXO). As the frequency reference is established at 10.0 MHz, the station frequency may be compared directly with a broadcast frequency standard such as WWV using a communications receiver and the front panel CAL OUT test point. Channel spacing is field programmable in 50 kHz increments to accommodate any domestic or international channel assignment. The AFC/PLL module interfaces with the MOD OSC module for accurate frequency control.

4-71. INTERNAL REFERENCE. A frequency reference is provided by a 10.0 MHz temperature compensated crystal oscillator (TCXO). The unit comprises a sealed modular oscillator with a matched compensation network to ensure accuracy throughout a wide range of ambient temperatures. The TCXO frequency is adjusted by the FREQ ADJ control. A wire jumper allows substitution and isolation of the TCXO for troubleshooting purposes.

4-72. The TCXO drives a divide by 3200 counter. Frequency multiples of 2.5 MHz up to 25.0 MHz are available at the CAL OUT front panel jack to assist in calibration. The divider outputs two 3125 Hz square waves in quadrature. The leading signal is used as a reference for the phase detector and the crystal reference missing pulse detector. The 90° lagging signal is used by the lock detector flip-flop to determine when the carrier is correctly locked on frequency.

4-73. RF FREQUENCY DIVIDERS. An on-frequency rf output from the MOD OSC module is input to the divide by 16 counter which divides the input frequency down to the 6 MHz range. A level shifter couples the emitter-coupled-logic (ECL) signal to transistor-transistor logic (TTL) levels.

4-74. Programmable Divider. A 12 bit programmable binary divider provides division of the 6 MHz signal to 3125 Hz. The counter is programmable with wire jumpers to the flip-flop data inputs to divide the input by a programmable factor between 1750 and 2158. The counter is originally set to the programmed number. When the counter fills to all ONES, a pulse is output to the auxiliary flip-flop. On the next clock pulse, an output from the auxiliary flip-flop resets the counter to the number entered at the data inputs by the wire program jumpers. The counter begins its count again with the succeeding clock pulse.

4-75. LOCK CIRCUIT. Three requirements must be met before the lock detector will recognize a frequency locked condition. The programmable divider chain must be producing a signal, the reference divider chain must be producing a signal, and the two chains must have less than the 90° phase difference. After these three conditions are achieved for five seconds, the lock circuit will indicate a locked condition exists.

4-76. Lock Detector. The 90° delay pulse from the delay flip-flop (reference) is input to the lock flip-flop D input and the output of the auxiliary flip-flop (programmable divider) operates as the lock flip-flop clock. As long as the leading 3125 Hz reference and the programmable divider negative transitions are separated 0° + 90° in phase, the output of the lock flip-flop remains HIGH. If the loop becomes unlocked, the signal from the programmable divider will drift in phase with respect to the reference. If the clock occurs when the delayed 3125 Hz signal is LOW, the lock flip-flop will output a LOW state and signal a frequency unlocked condition.

4-77. Missing Pulse Detectors. A dual retriggerable one-shot used as the missing pulse detectors watches the programmable divider reset line and the crystal reference divider. As long as pulses are present at the inputs to the detectors, the one-shots will remain HIGH. If missing pulses occur in either source, the respective one-shot will not be retriggered and output a LOW condition to signal a frequency unlocked condition. The MOD OSC and the CRYSTAL REFERENCE indicators provide visual indications of the status of the two divider chains.

4-78. Output Circuit. The outputs of the lock flip-flop and the missing pulse detectors are applied to a NAND gate. If all the inputs are present at the NAND gate, the output of the level detector/delay circuit will illuminate the LOCK indicators to signify a frequency locked condition. The output also operates the AFC interlock relay (K1) which provides remote AFC latching. Any missing input to the NAND gate will be detected by the level detector/delay circuit. If a frequency unlocked condition is detected, the level detector delay circuit immediately outputs an inhibit signal which turns off the LOCK indicator, deenergizes the AGC interlock relay, and provides a signal to the RF AMP module which inhibits the exciter rf output.

4-79. PHASE LOCKED LOOP. The phase detector is a flip-flop type with a three state output. If both reference and controlled inputs have zero phase difference, the output is high impedance (open circuit). If the controlled input lags in phase, the phase detector will output zero-volt pulses with the pulse width proportional to the lagging phase angle. If the controlled input leads in phase, the phase detector will generate positive 15 volt pulses with the pulse width proportional to the leading phase angle. The pulses are filtered and applied to the dc meter module and the MOD OSC module VCO assembly varactor diodes which control the exciter rf frequency. A positive voltage to the MOD OSC module will increase the frequency and a negative voltage to the MOD OSC module will decrease the frequency. The phase locked loop is closed by the connection from the MOD OSC module output to the AFC/PLL module divide by 16 counter input.

4-80. Bistable Loop. The phase locked loop used in the module has bistable characteristics which reduce lock-up time to a minimum. When the loop is out of lock, a CMOS switch arrangement operated by the lock detector enables a high rate of correction. When the lock detector senses a locked condition the loop correction characteristic is slowed for optimum transmission of low frequencies.

4-81. POWER. An input of positive five volts dc from the exciter power supply is internally filtered to operate the logic circuitry. The +5V indicator provides an indication of the operation of the five volt source. An additional input of +20 Vdc applied through R36 is stabilized by zener diode CR6 to +15 Vdc. Re-regulated +15 Vdc inputs from the MOD OSC module provide +15 Vdc potentials to operate the AFC/PLL module loop filter circuitry.

4-82. MOD OSC MODULE (2A4)

4-83. The MOD OSC module contains the voltage controlled oscillator (VCO) assembly which generates the frequency modulated rf carrier from a composite signal input. The rf output frequency is controlled by a dc control voltage obtained from the AFC/PLL module as part of the phase locked loop. The module also provides automatic level switching for different combinations of SCA, stereophonic, and monaural operation.

4-84. INPUT CIRCUIT. The dc coupled quadraphonic, stereophonic, or monaural composite signals and the ac coupled SCA and external composite signals are input to the module and combined in the summing amplifier to obtain a total modulation signal. Whenever an SCA module is enabled, a corresponding CMOS switch is closed by a positive six volt potential on the appropriate control line from the specific SCA module. The CMOS switches shunt the feedback resistor (R23) with additional resistance to reduce the gain of the amplifier. The gain reduction is adjusted to the injection level of the particular SCA signal to maintain 100% total modulation for all combinations of SCA, stereophonic, or monaural modes.

4-85. PREDISTORTION NETWORK. The modulating signal from the composite amplifier is applied to a diode-resistor predistortion network. The total modulation signal is slightly stretched in the positive direction and

slightly compressed in the negative direction. This effect is required to cancel the slightly nonlinear characteristics of the VCO assembly. The amount of predistortion is adjusted by the DIST. NULL control.

4-86. VCO ASSEMBLY (2A4A1). The voltage controlled oscillator comprises a varactor diode tuned oscillator using field effect devices in a shielded subassembly. The unit accepts inputs of predistorted total modulation and an AFC signal from the AFC/PLL module and generates an FM signal on the operating frequency.

4-87. Modulation Input. Predistorted total modulation is applied to the VCO GAIN control which compensates for VCO modulation sensitivity variations and is coupled through capacitor C1 in the VCO subassembly. As the time constant of capacitor C1 is many times the AFC/PLL module lockup time, the capacitor must be quickly charged to ensure a stable locked condition. When power is first applied, C1 is quickly charged to a potential very close to the steady state value by a fast charge circuit. The circuit then decouples itself from the modulation circuit and presents a high impedance input to the varactor diode network.

4-88. AFC Input. The frequency output of the VCO is determined by the AFC voltage to the VCO assembly from the AFC/PLL. If the VCO frequency is lower than the internal reference in the AFC/PLL module, a positive going potential is input to the VCO assembly to increase the output frequency. If the VCO frequency is higher than the internal reference in the AFC/PLL module, a negative going potential is input to the VCO assembly to decrease the output frequency. A steady dc potential on the correction line indicates the VCO frequency and the frequency of the internal reference agree.

4-89. Output Circuit. A frequency modulated rf carrier is output from the oscillator stage, buffered, and applied to rf amplifier hybrid U7.

4-90. OUTPUT. Two rf outputs from the module are provided. One output drives the RF AMP module input circuitry. The remaining output provided by isolation amplifier Q2 drives the AFC/PLL modules divide by 16 counter. An rf detector circuit samples the rf drive voltage to provide an indication of the rf output level. The RF POWER CALIBRATE control provides an adjustment to calibrate the meter indication.

4-91. POWER. Inputs of positive and negative regulated 20 Vdc are re-regulated into +15 Vdc sources to operate the MOD OSC module and the AFC/PLL module internal circuitry. Light emitting diodes provide a status indication of the operation of the positive (+15V) and negative (-15V) fifteen volt power supplies. Additionally, positive and negative 6 Vdc sources are produced from a series circuit consisting of R7, R34, and R8 from the +15 volt potentials to operate the CMOS level switching circuits.

4-92. RF AMP MODULE

4-93. The RF AMP module comprises two class C stages which accept an rf input from the MOD OSC module and provide a continuously variable three to fifteen watt rf output. An internal AGC circuit ensures a stable rf output level. Automatic VSWR shutdown, off frequency inhibit provisions, and power supply current limiting provide automatic module operation.

4-94. RF CIRCUIT. Drive is input to the rf amplifier from the MOD OSC module at a level of 250 milliwatts. The rf amplifier provides approximately 20 dB of gain to output a continuously adjustable level from three to fifteen watts. Amplifier tuning is not required as wideband impedance matching is used through the amplifier circuits. The rf is output along a microstrip through a directional coupler and low-pass filter implemented with microstrip techniques. The low-pass filter is tuned by the SECOND HARMONIC NOTCH adjustment to reduce rf harmonics to a minimum level. The rf carrier is output from J3 on the rear of the exciter at an impedance of 50 ohms.

4-95. DIRECTIONAL COUPLER. The rf power amplifier includes a directional coupler produced in printed circuit form using microstrip techniques which samples the forward and reflected power. The power is detected and coupled to the metering circuits. The forward and reflected power indications may be remotely monitored from connections on the rear of the exciter.

4-96. AMPLIFIER INHIBIT. The directional coupler reflected power output is monitored by an adjustable threshold device. Whenever the reflected power exceeds a preset level, the rf amplifier output is limited to prevent over-dissipation of the rf amplifier devices. If a frequency unlock condition exists between the AFC/PLL module and the MOD OSC module, an input from the AFC/PLL module will inhibit the rf output until the frequency is again within tolerance. The rf shutdown provision is remoteable from connections on the rear of the exciter.

4-97. RF AMPLIFIER AGC. The directional coupler forward power output applies a dc voltage proportional to forward power output to the AGC amplifier inverting input. The AGC reference applied to the non-inverting input is adjusted by the OUTPUT ADJ control. As the rf output power increases or decreases, the AGC amplifier output to the dc regulator will decrease or increase proportionally. The dc regulator compares the drive from the AGC amplifier with a sample of the rf amplifier collector voltage and drives the transistor in the exciter power supply which in turn lowers or raises the voltage to the rf amplifier. A current limiting stage samples rf amplifier current and initiates limiting at two amperes of supply current. The automatic level control is disabled by the AGC ON/OFF switch which allows manual carrier level control.

4-98. POWER. Filtered positive 34 Vdc obtained from the exciter power supply is regulated into a positive 15 Vdc source to operate the RF AMP module internal circuitry. The +15V indicator provides a status indication of the internal power supply.

SECTION V
MAINTENANCE

5-1. INTRODUCTION

5-2. This section provides preventive maintenance checks, cleaning, corrective maintenance and troubleshooting information.

5-3. PURPOSE

5-4. The information contained in this section is intended to provide guidance to establish a comprehensive maintenance program to promote operational readiness and eliminate downtime. Particular emphasis is placed on preventive maintenance and record keeping functions.

5-5. STATION RECORDS

5-6. The importance of keeping station performance records cannot be over-emphasized. Separate logbooks should be maintained by operation and maintenance activities. These records can provide data for predicting potential problem areas and analyzing equipment malfunctions.

5-7. TRANSMITTER LOGBOOK

5-8. As a minimum performance characteristic, the exciter should be monitored (using front panel indicators) and results recorded in the transmitter logbook at each shift change or at least once per day.

5-9. MAINTENANCE LOGBOOK

5-10. The maintenance logbook should contain a complete description of all maintenance activities required to keep the exciter operational. A list of maintenance information to be recorded and analyzed to provide a data base for a failure reporting system is as follows:

DISCREPANCY	Describe the nature of the malfunction. Include all observable symptoms and performance characteristics.
CORRECTIVE ACTION	Describe the repair procedure used to correct the malfunction.
DEFECTIVE PART(S)	List all parts and components replaced or repaired. Include the following details: a. COMPONENT TIME IN USE b. COMPONENT PART NUMBER c. COMPONENT MAJOR ASSEMBLY d. COMPONENT REFERENCE DESIGNATOR

SYSTEM ELAPSED TIME	Total exciter time on.
NAME OF REPAIRMAN	Person who actually made the repair.
STATION ENGINEER	Indicates chief engineer noted and approved the repair.

5-11. SAFETY PRECAUTIONS

5-12. The exciter design provides safety features which ensure that no potentials are accessible to operational personnel from the front panel with the access door closed. Additionally, no high voltage points are readily accessible to personnel unless the exciter case is disassembled. Low voltages are used throughout the module circuitry, however maintenance with power energized is always hazardous and caution should be observed. This is particularly true of the rf amplifier module where high rf potentials exist at high impedance points. It is possible to receive painful but usually not injurious rf burns from the 15 watt output stage. Component or module replacement with power on is not recommended.

5-13. PREVENTIVE MAINTENANCE

5-14. Preventive maintenance is a systematic series of operations performed periodically on equipment. As these procedures cannot be applied indiscriminately, specific instructions are necessary.

- a. Visual inspection is the most important preventive maintenance operation because it determines the necessity for the others. Become thoroughly acquainted with normal operating conditions in order to recognize and identify abnormal conditions readily. The remedy for most visible defects is obvious, however care must be taken if heat damaged components are located. Overheating is usually a symptom of trouble. It is essential to determine the actual cause of overheating before the heat damaged component is replaced, otherwise the damage will be repeated.
- b. Check parts for overheating, especially mechanical parts such as the fan. The lack of proper ventilation or the existence of some defect can be detected and corrected before serious trouble occurs. Become familiar with operating temperatures in order to recognize deviations from normal temperature.
- c. Tighten loose hardware. Do not tighten indiscriminately as fittings may be damaged or broken when they are tightened beyond the pressure for which they are designed.
- d. Clean parts when inspection shows that cleaning is required.
- e. Make adjustments when inspection shows that adjustments are necessary to maintain normal operation.

- f. Lubricate mechanical surfaces to prevent wear and to keep the equipment operating normally. Do not over lubricate.
- g. Paint surfaces with the original type of paint (use prime coat if necessary) when inspection shows worn or broken paint film.

5-15. FAN MAINTENANCE

5-16. Inspect the fan and equipment for dust accumulation monthly. Remove dust with a vacuum cleaner and brush. Check the fan for wear. The fan bearings are sealed and fans which are noisy or show wear require replacement of the fan.

5-17. MAINTENANCE OF COMPONENTS

5-18. The following paragraphs provide information for component maintenance.

5-19. SEMICONDUCTORS. The best check of semiconductor performance is actual circuit operation. When semiconductors are replaced, the operation of associated circuits may be affected and should be checked. Replacement semiconductors should be of the original type or a recommended direct replacement. Preventive maintenance of semiconductors is accomplished by performing the following steps:

- a. Inspect the semiconductors and surrounding area for accumulations of dirt or dust.
- b. Use compressed dry air and a brush to remove dust from the area.
- c. Examine all semiconductors for loose connections or corrosion.

5-20. CAPACITORS. Preventive maintenance of capacitors is accomplished as follows:

- a. Examine all capacitor terminals for loose connections or corrosion.
- b. Ensure that component mountings are tight.
- c. Examine the body of each capacitor for swelling, discoloration or other evidence of breakdown.
- d. Inspect electrolytic capacitors for signs of leakage.
- e. Use compressed dry air and a brush to remove dust from the area.

5-21. FIXED RESISTORS. Preventive maintenance of fixed resistors is accomplished by the following steps:

- a. Examine resistors for dirt or signs of overheating. Discolored, cracked or chipped components indicate a possible overload.

- b. When replacing a resistor ensure the replacement value corresponds to the original component.
- c. Use compressed air and a brush to remove dust from the area.

5-22. VARIABLE RESISTORS. Preventive maintenance of variable resistors follows:

- a. Inspect and tighten all loose mountings and connections.
- b. If necessary, clean components with a brush and dry compressed air.

5-23. TRANSFORMERS. Preventive maintenance of transformers is accomplished by performing the following:

- a. Feel each transformer soon after power removal for signs of overheating.
- b. Inspect each transformer for dirt, loose mounting brackets and rivets, loose terminal connections and insecure connecting lugs. Dust, dirt or moisture between terminals may cause flashovers.
- c. Tighten loose mounting lugs, terminals or rivets.
- d. Use compressed air and a brush to remove dirt from the area.

5-24. FUSES. Preventive maintenance of fuses is accomplished by the following:

- a. When a fuse blows determine the cause before installing a replacement.
- b. Inspect fuse caps and mounts for charring and corrosion.
- c. Examine fuse clips for dirt, improper tension, and loose connections.
- d. Dust with a small brush if cleaning is required.

5-25. METERS. Preventive maintenance of meters is accomplished as follows:

- a. Inspect meters for loose, dirty or corroded mountings and connections.
- b. Check for defective cases and cover glasses.
- c. Tighten loose mountings or connections. Since meter cases are made of plastic, exercise care to prevent breakage.
- d. Clean meter cases and glass cover with a dry cloth.

- e. Remove dirt from mountings and connections with a brush if required.

5-26. RELAYS. Replace hermetically sealed relays if defective. Non-hermetically sealed relays are considered normal if:

- a. The relay is mounted securely.
- b. Connecting leads are not frayed and the insulation is not damaged.
- c. Terminal connections are tight and clean.
- d. Moving parts travel freely.
- e. Spring tension is correct.
- f. Contacts are clean, adjusted properly, and make good contact.
- g. The coil shows no signs of overheating.
- h. The assembly parts are clean and not corroded.

5-27. SWITCHES. Preventive maintenance of switches is accomplished by checking the following:

- a. Inspect switches for defective mechanical action or looseness of mounting and connections.
- b. Examine cases for chips or cracks.
- c. Operate the switches to determine if each moves freely and is positive in action. In gang and wafer switches, the wiper should make good contact with the stationary member.
- d. Tighten all loose connections and mountings.
- e. Clean any dirty connection or switch with dry compressed air and a brush as required.

5-28. PRINTED CIRCUIT BOARDS. Preventive maintenance of printed circuit boards is accomplished by checking the following:

- a. Inspect the printed circuit boards for cracks or breaks.
- b. Inspect the wiring for open circuits or raised foil.
- c. Check components for breakage or discoloration due to overheating.
- d. Clean off dust and dirt with dry compressed air and a brush as required.
- e. Use standard practices to repair solder connections with a low wattage soldering iron.

5-29. CORRECTIVE MAINTENANCE

5-30. The maintenance philosophy of the MX-15 FM EXCITER consists of problem isolation to a specific area or replaceable module and subsequent isolation and replacement of the defective component or module. Further troubleshooting in each applicable module publication provides isolation to specific components.

5-31. Corrective maintenance for the transmitter is limited by the objective of minimum down time. Maintainability and care are considerably simplified for operation and maintenance personnel as the MX-15 FM EXCITER is designed and built with highly reliable and proven elements to minimize down time. All controls are adjustable in view of the meters. Internal components may be accessed through the front panel and the removable top and rear panels. An extender board (HARRIS PN 992 4989 001) is provided with the exciter to assist in troubleshooting.

5-32. TROUBLESHOOTING

5-33. In event of problems, the trouble area must first be isolated to an exciter input, the MX-15 power supply, an exciter module, or the exciter load. Most troubleshooting consists of visual checks. The MODULATION meter, MULTIMETER, fuse F1, circuit breaker CB1, and the indicators should be used to determine in which area the malfunction exists. All module power supplies are equipped with LEDs to indicate the module power supply status. If all LEDs are out or a consistent pattern of dark LEDs exists, a power supply malfunction or distribution bus fault exists. If a single LED is out, either the monolithic voltage regulator on the module has failed in the open condition or short exists on the module and the module regulator is in the current limiting mode.

5-34. Once the trouble is isolated to a specific area, refer to the theory section of this manual for circuit discussion to aid in problem resolution. Table 5-1 lists typical trouble symptoms pertaining to the overall exciter operation with references to fault isolation diagrams listing probable causes and corrective actions. A corrective action given for a trouble symptom is not necessarily the only answer to a problem, it only tends to lead the repairman into the area that may be causing the trouble. If a particular MX-15 module is determined faulty, a reference to the individual module maintenance publication will be listed. In event parts are required, refer to Section VI, Parts List.

5-35. COMPONENT REPLACEMENT. The circuit boards used in the MX-15 are of the double-sided plated-through type. This means that there are traces on both sides of the board and the through-holes contain a metallic plating. Because of the plated-through holes, solder creeps up into the hole. This requires a more sophisticated technique for component removal in order to avoid damage to the traces on the board. Excessive heat of any point on the board will cause damage.

5-36. To remove a component from a double-sided board, the leads of the defective component should be cut from the body while the leads are still soldered to the board. The component is then discarded and each lead is heated independently and pulled out of the hole. Each hole may then be cleared of solder by carefully heating with a low wattage iron and removing the residual solder with a solder vacuum tool.

5-37. The new component is installed in the usual way and soldered from the bottom side of the board. If no damage has been done to the plated-through hole, soldering of the top side is not required. However, if the removal procedure did not progress smoothly, each lead should be soldered at the top side to prevent potential intermittent problems.

5-38. After soldering remove residual flux. There are solvents available in electronic supply houses which are useful. The board should then be checked to ensure the defluxing operation has removed the flux and not just smeared it about so that it is less visible. While rosin flux is not normally corrosive, it will absorb moisture and become conductive enough to cause deterioration in specifications over a period of time.

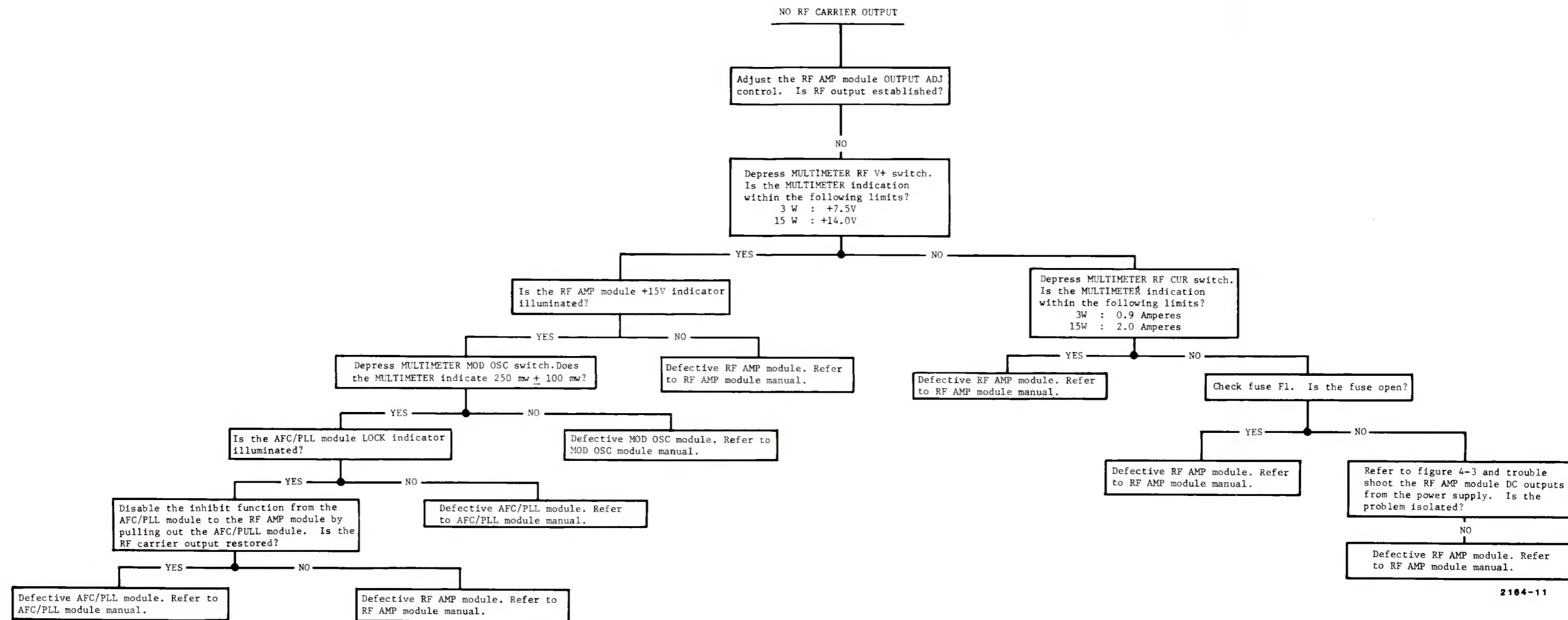
5-39. Prior to starting a troubleshooting procedure check all switches, power cord connections, connecting cables, and power fuses.

5-40. TECHNICAL ASSISTANCE

5-41. HARRIS Technical and Troubleshooting assistance is available from HARRIS Field Service Department 24 hours a day. Telephone 217/222-8200 to contact the Field Service Department or address correspondence to Field Service Department, HARRIS CORPORATION, Broadcast Division, P.O. Box 4290, Quincy, Illinois 62305-4290, USA. The HARRIS factory may also be contacted through a TWX facility (910-246-3312) or a TELEX service (40-4347).

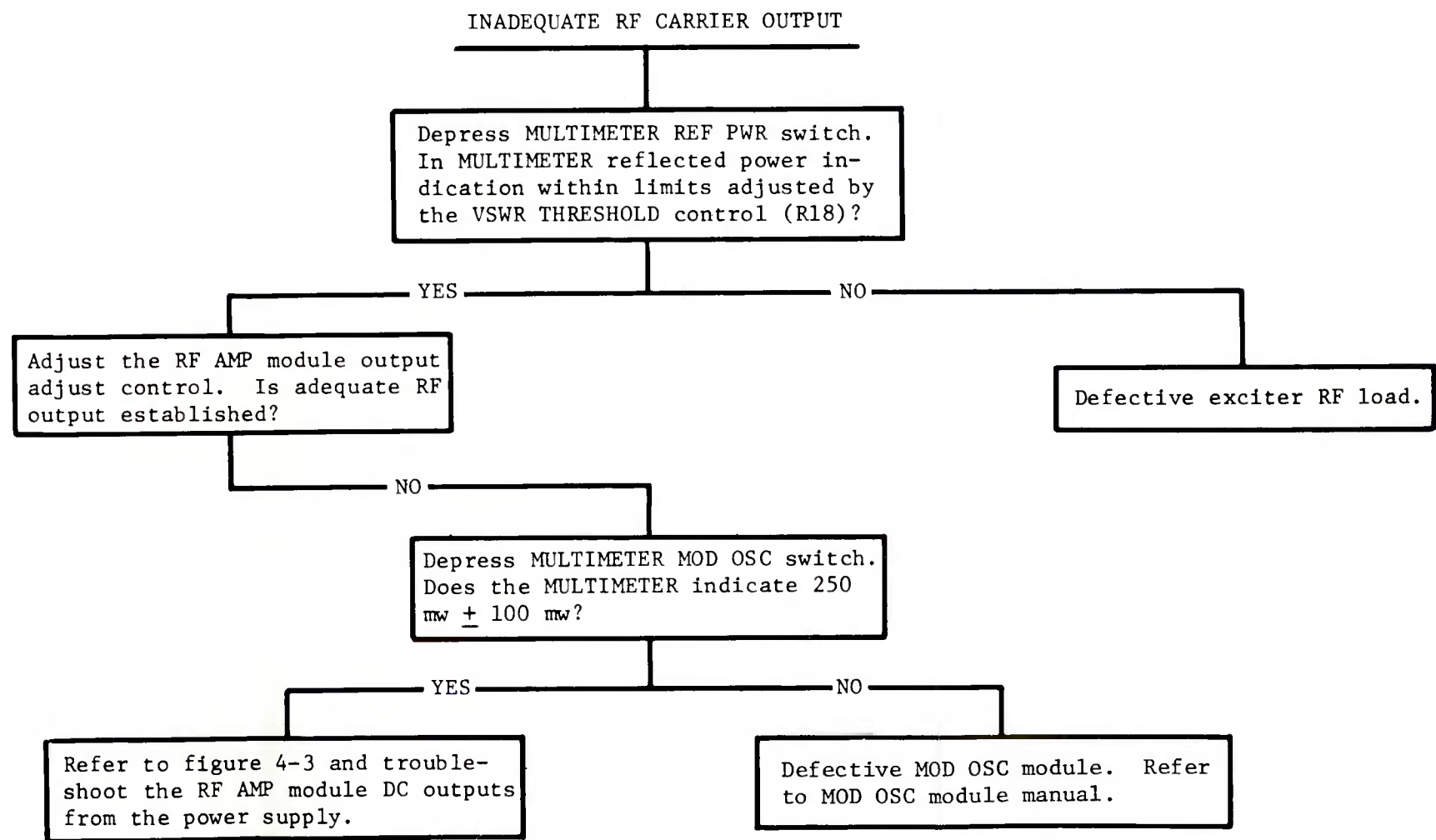
Table 5-1. MX-15 Fault Isolation Index

SYMPTOM	DEFECT/REFERENCE
NO RF CARRIER OUTPUT	Figure 5-1
RF CARRIER LEVEL WILL NOT ADJUST	Defective RF AMP. module. Refer to RF AMP Module Technical Manual.
INADEQUATE CARRIER LEVEL OUTPUT	Figure 5-2
FREQUENCY CONTROL CIRCUIT WILL NOT LOCK (AFC/PLL MODULE LOCK INDICATOR NOT ILLUMINATED).	Figure 5-3
EXCITER OFF FREQUENCY (AFC/PLL MODULE LOCK INDICATOR ILLUMINATED).	Defective AFC/PLL module. Refer to AFC/PLL Module Technical Manual.
HIGH AUDIO DISTORTION IN BOTH STEREO CHANNELS	Figure 5-4
HIGH AUDIO DISTORTION IN ONE STEREO CHANNEL	Defective STEREO ANALOG module. Refer to Stereo Analog Technical Manual.
NOISY AUDIO	Figure 5-5
AM NOISE ON RF CARRIER	Figure 5-6
NO MODULATION	Figure 5-7
CIRCUIT BREAKER CB-1 OPENS	Figure 5-8



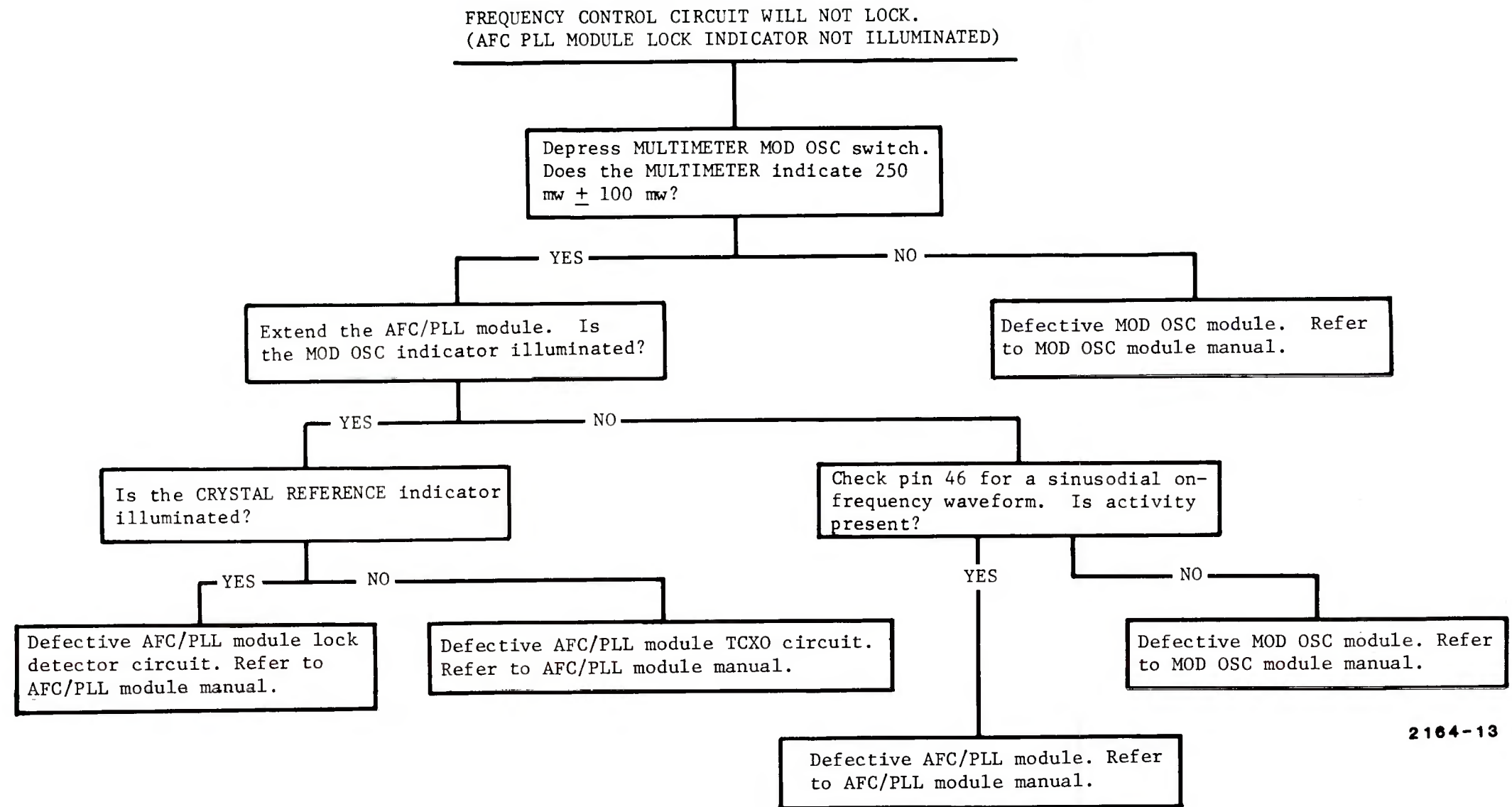
2104-11

FIGURE 5-1. NO RF CARRIER OUTPUT



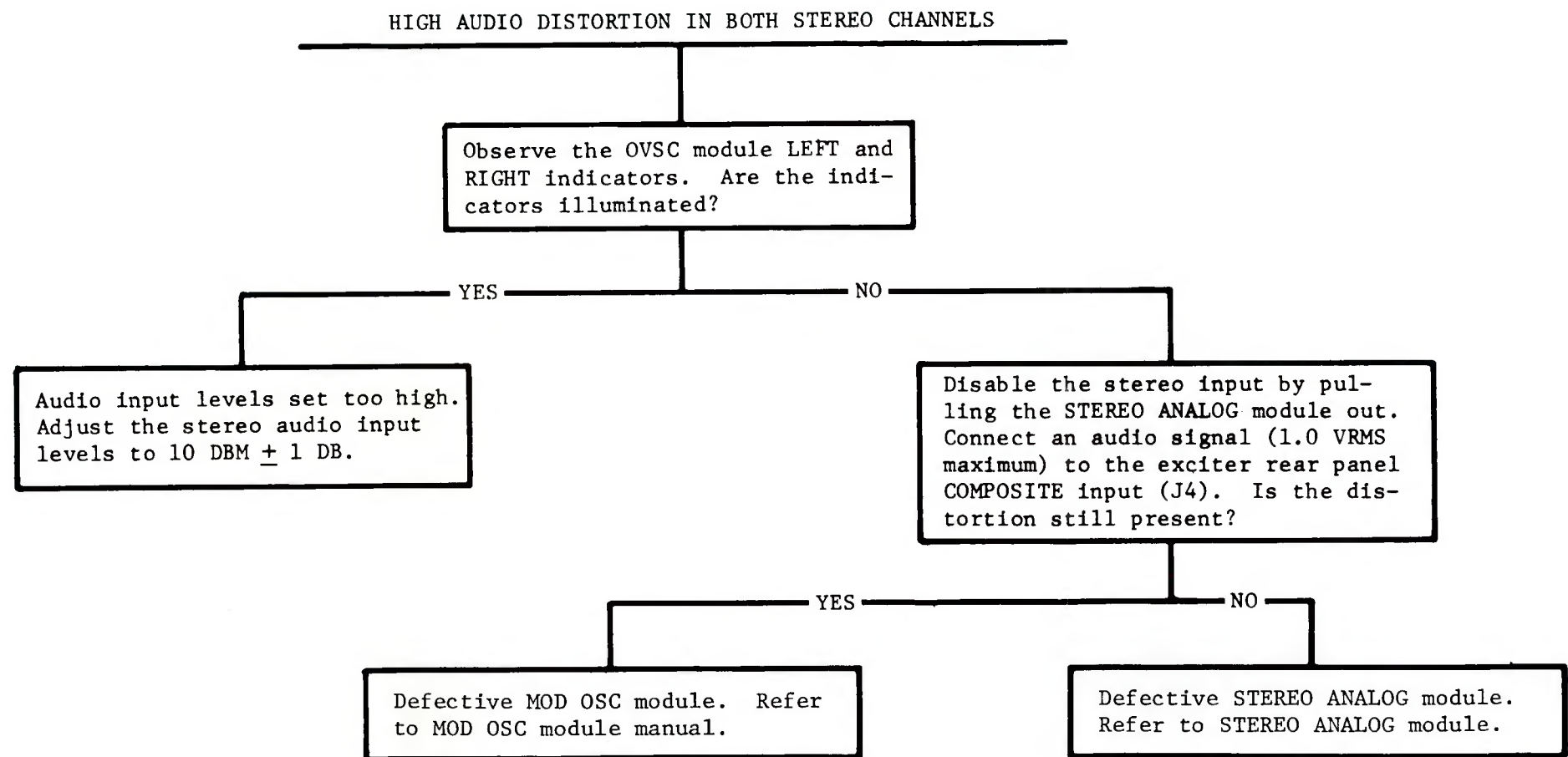
2164-12

FIGURE 5-2. INADEQUATE RF CARRIER LEVEL OUTPUT



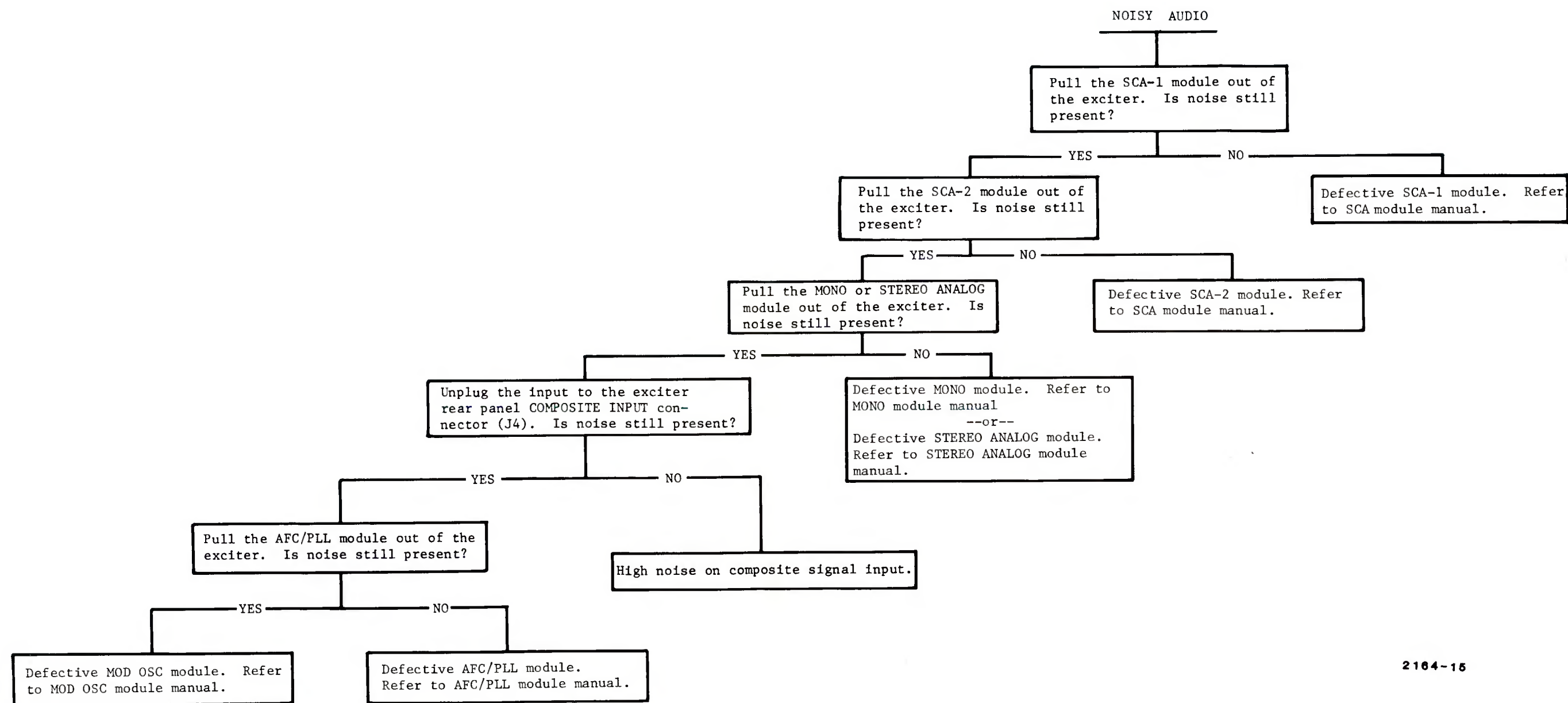
2164-13

FIGURE 5-3. FREQUENCY CONTROL CIRCUIT WILL NOT LOCK
(AFC/PLL MOCULE LOCK INDICATOR NOT ILLUMINATED)



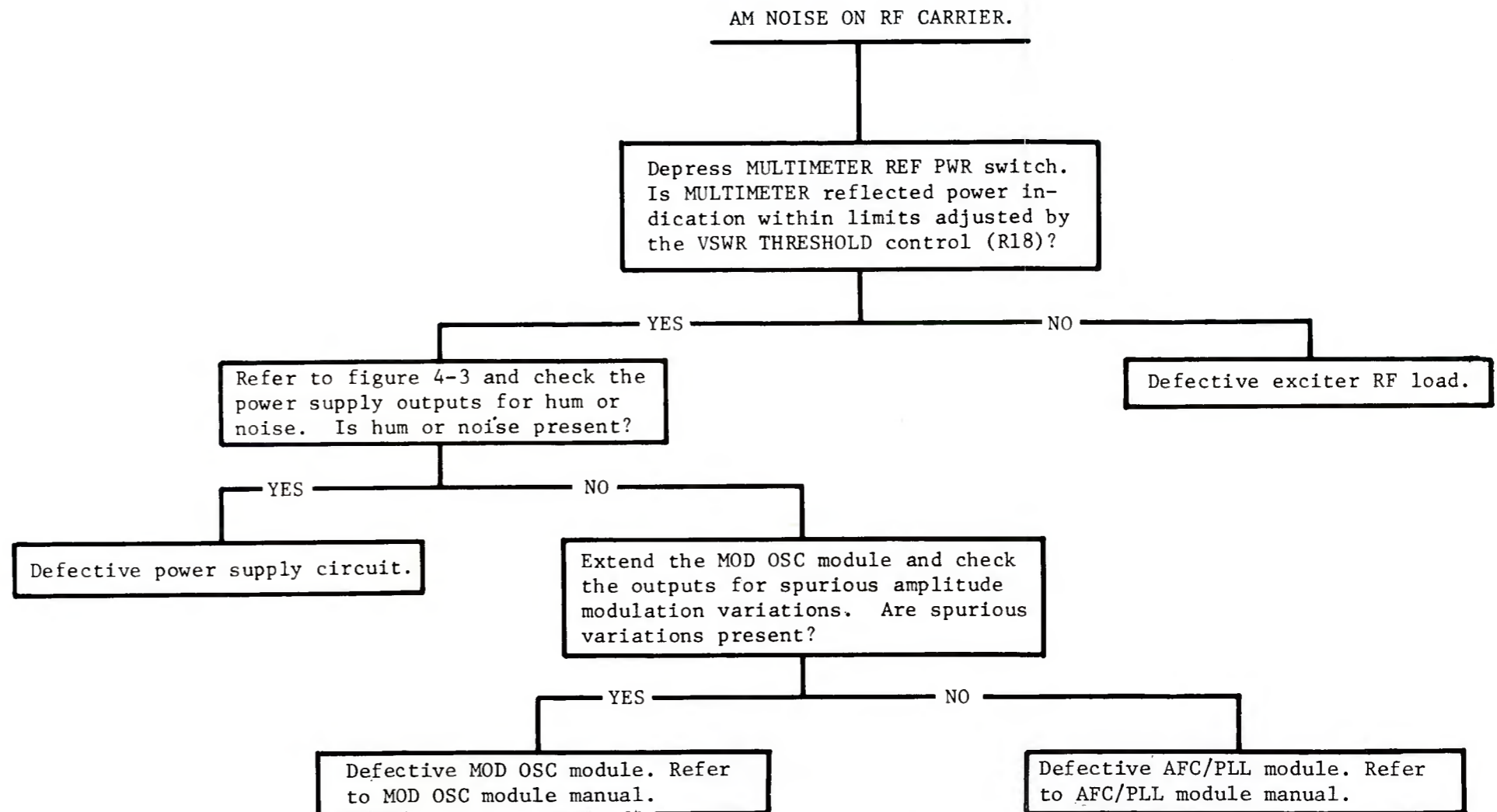
2164-14

FIGURE 5-4. HIGH AUDIO DISTORTION IN BOTH STEREO CHANNELS



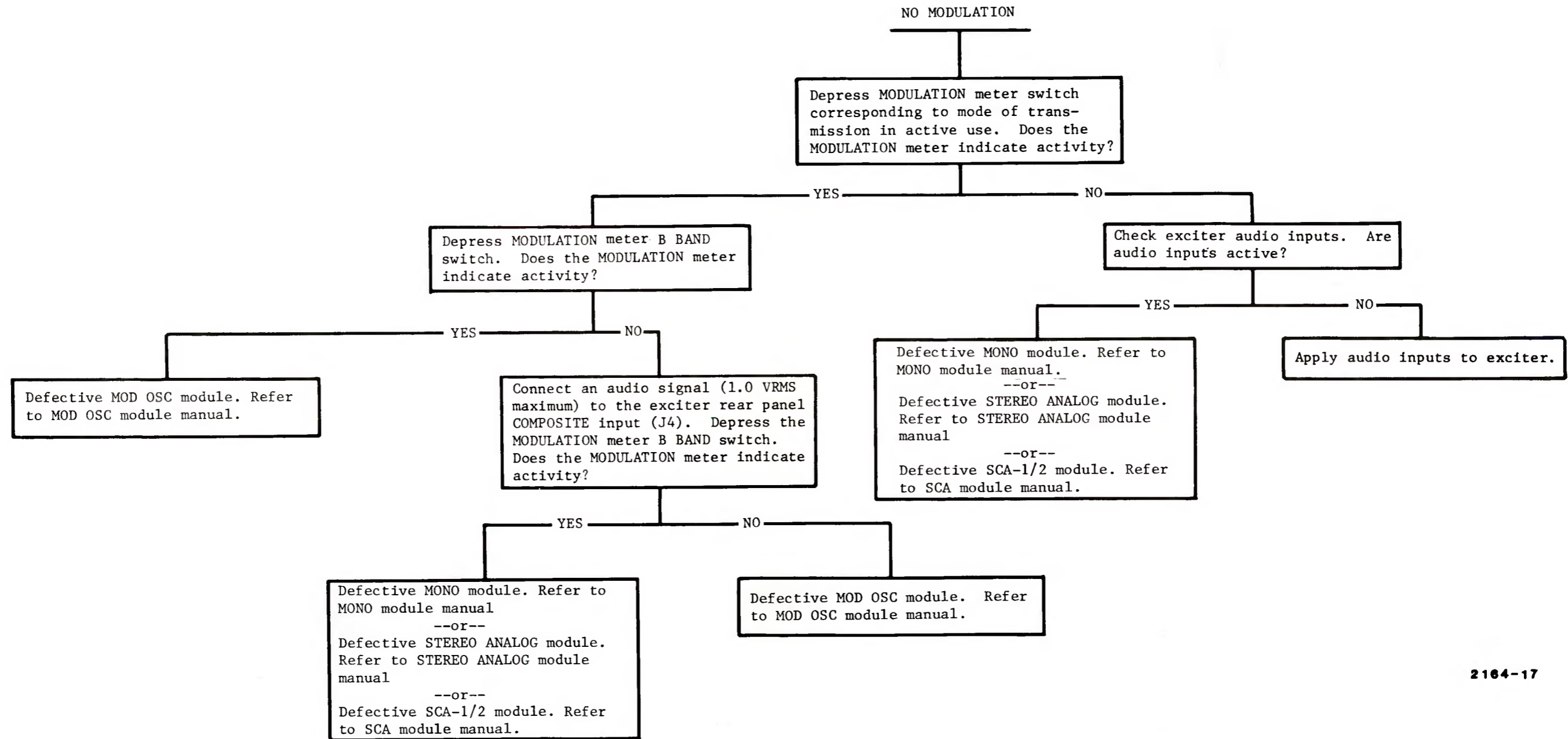
2164-16

FIGURE 5-5. NOISY AUDIO



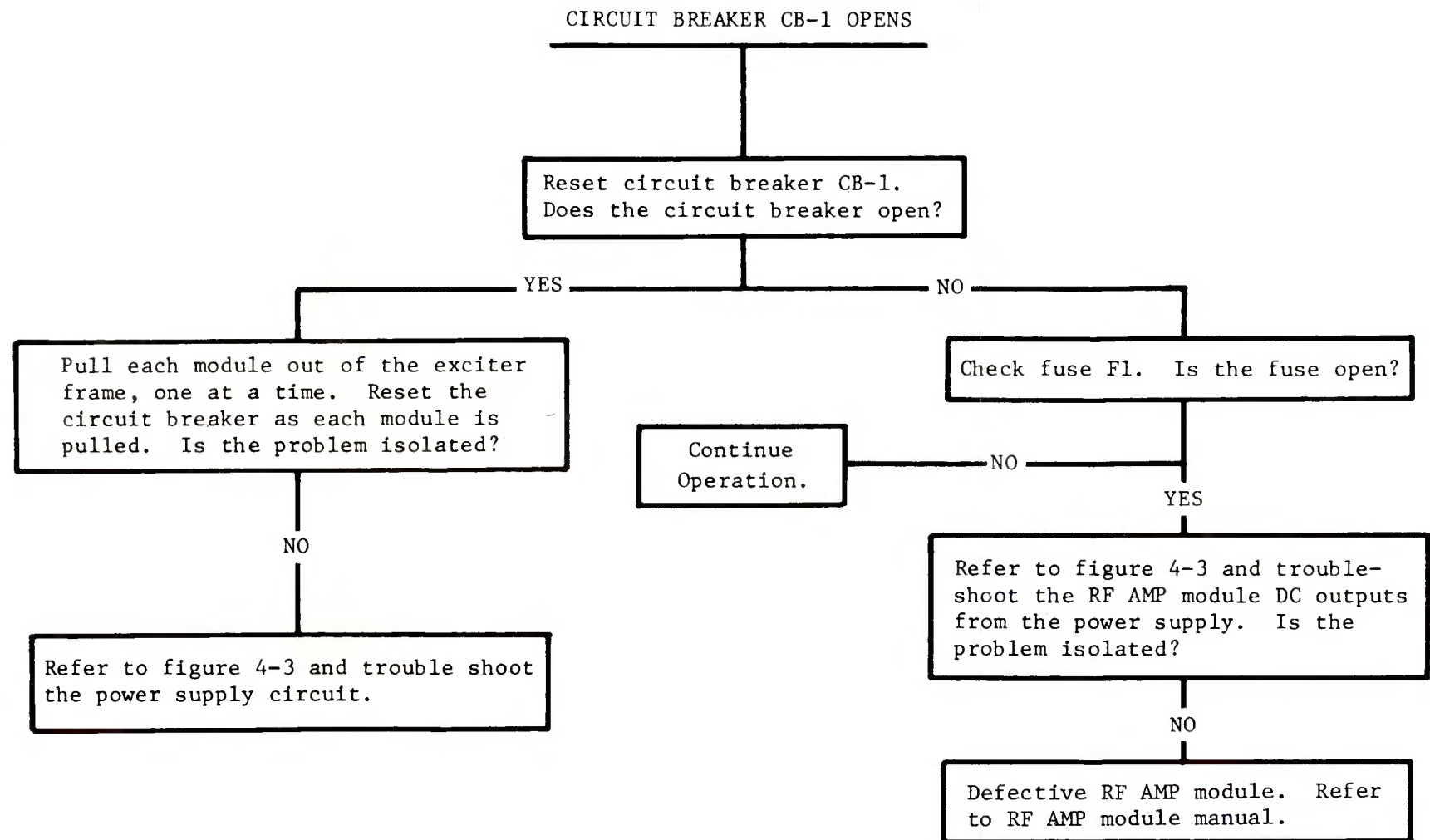
2164-16

FIGURE 5-6. AM NOISE ON RF CARRIER



2164-17

FIGURE 5-7. NO MODULATION



2164-18

FIGURE 5-8. CIRCUIT BREAKER CB-1 OPENS

SECTION VI

PARTS LIST

6-1. INTRODUCTION

6-2. This section provides a description, reference designator and part number for selected replaceable parts and assemblies required for proper maintenance of the MX-15 FM EXCITER. Table 6-1 lists assemblies having replaceable parts, the table number listing the parts, and the page number on which the table is located. Identity of the assembly nomenclature in table 6-1 signifies the equipment level within the overall equipment configuration.

NOTE

Actual component values may vary slightly from component values listed on schematics and parts lists. Due to industry-wide shortages, it is sometimes necessary to use parts other than those specified. In every case, however, a substitute part is selected for conformance to overall design specifications so that equipment performance is not affected. Components that are frequency determined or peculiar to an individual exciter are identified by a HARRIS part number and MX-15 component number on the final test addendum sheets shipped with the equipment.

6-3. REPLACEABLE PARTS SERVICE

6-4. Replacement parts are available 24 hours a day, seven days a week from the HARRIS Service Parts Department. Telephone 217/222-8200 to contact the service parts department or address correspondence to Service Parts Department, HARRIS CORPORATION, Broadcast Division, P.O. Box 4290, Quincy, Illinois 62305-4290, USA. The HARRIS factory may also be contacted through a TWX facility (910-246-3312) or a TELEX service (40-4347).

Table 6-1. REPLACEABLE PARTS LIST INDEX

TABLE NO.	UNIT NOMENCLATURE	PART NO.	PAGE
6-2	MX-15 FM EXCITER	994 7950 003	6-4
6-3	BASIC - MX-15 FM EXCITER	994 7950 004	6-5
6-4	MAIN FRAME	992 4980 003	6-6
6-5	PC BOARD	992 4981 001	6-9
6-6	PC BOARD	992 4982 001	6-10
6-7	MOTHER BOARD	992 4983 001	6-14
6-8	PC BOARD	992 4984 001	6-15
6-9	POWER SUPPLY BOARD	992 5000 001	6-18
6-10	RIBBON CABLE,20 COND	929 2191 001	6-19
6-11	RIBBON CABLE ASSY	929 2192 001	6-20
6-12	RIBBON CABLE,40 COND	929 2193 001	6-21
6-13	CABLE, MAIN	929 2440 001	6-22
6-14	COAX CABLE	938 3828 126	6-23
6-15	COAX CABLE	938 3828 130	6-24
6-16	EXTENDER BOARD	939 3524 001	6-25
6-17	EXTENDER BOARD ASSY	943 2258 001	6-26
6-18	ACCESS CABLES	992 4990 001	6-27
6-19	WIDE BAND OPTION (6)	994 7983 001	6-28
6-20	STEREO OPTION (3)	994 8020 001	6-29
6-21	SCA OPTION (4)	994 7992 001	6-30
6-22	MONO OPTION (5)	994 8019 001	6-31

Table 6-1. REPLACEABLE PARTS LIST INDEX (Continued)

TABLE NO.	UNIT NOMENCLATURE	PART NO.	PAGE
6-23	EXTERNAL SCA GENERATOR JUMPER CARD (FOR USE WITH EXTERNALLY MOUNTED SCA GENERATOR)	994 8377 001	6-32

Table 6-2. MX-15 FM EXCITER - 994 7950 003

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
UNIT2	994 7950 004	BASIC - MX-15 FM EXCITER	1

Table 6-3. BASIC - MX-15 FM EXCITER - 994 7950 004

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
2A1	992 4980 003	MAIN FRAME	1
2A2	992 6204 001	RF PWR AMP MODULE	1
2A3	992 5981 001	AUTO FREQ CONTROL MOD.	1
2A4	992 5983 001	MODULATED OSCILLATOR MOD.	1
2A5	939 3524 001	EXTENDER BOARD	1
2A6	992 4990 001	ACCESS CABLES	1
	356 0094 000	ADHESIVE CABLE CLIP	1
	410 0232 000	INSULATOR, MICA	3
	464 0026 000	TOOL, ALIGNMENT 5284	1
	992 5988 001	PACKING CHECK LIST	1

Table 6-4. MAIN FRAME - 992 4980 003

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
B1	430 0098 000	FAN, TUBEAXIAL	1
CB1	606 0547 000	CIRCUIT BREAKER 2A	1
CR1,CR2	384 0564 000	RECT., BRIDGE 6A 600	2
CR3	384 0020 000	RECTIFIER IN4005	1
CR4	386 0391 000	DIODE ZENER 1N2821A	1
CR5	406 0479 000	LIGHT, INDICATOR RED	1
C1	524 0223 000	CAP 4900UF 30V	1
C2	524 0337 000	CAP 5100 UF 50V	1
C3	524 0336 000	CAP 2900 UF 50V	1
C4	524 0337 000	CAP 5100 UF 50V	1
C5,C6,C7,C8	516 0082 000	CAP, DISC .01UF 1KV GMV	4
C9,C14	526 0351 000	CAP 6.8UF 50V 20%	2
C15,C16,C17	516 0082 000	CAP, DISC .01UF 1KV GMV	3
F1	398 0020 000	FUSE 3AG FAST 3A 250	1
L1	476 0399 000	CHOKE, FILTER 5 MH	1
M1	632 0961 000	MULTIMETER	1
M2	632 0962 000	METER, MODULATION	1
Q1,Q3	380 0187 000	TRANSISTOR 2N6055	2
Q4	380 0571 000	TRANSISTOR	1
R7	548 1437 000	RES 665K OHM 1/4W 1%	1
R8,R9	548 0314 000	RES 75K OHM 1/4W 1%	2
R10	548 1437 000	RES 665K OHM 1/4W 1%	1

Table 6-4. MAIN FRAME - 992 4980 003 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
S1	604 0868 000	SW, ROCKER DPDT	1
TB1, TB2	614 0004 000	TERM BOARD 4 TERM	2
TB3	614 0147 000	TERM STRIP 6 TERM	1
T1	472 1117 000	XFMR, POWER	1
U1	382 0527 000	IC 340K-5/7805K +5V REG	1
XCR4	404 0661 000	SOCKET, TRANSISTOR	1
XF1	402 0023 000	FUSE HOLDER 342004	1
XQ1, XQ2, XQ3, XQ4	404 0661 000	SOCKET, TRANSISTOR	4
2A1A1	992 4981 001	PC BOARD	1
2A1A2	992 4982 001	PC BOARD	1
2A1A3	992 4983 001	MOTHER BOARD	1
2A1A4	992 4984 001	PC BOARD	1
2A1A5	992 5000 001	POWER SUPPLY BOARD	1
	829 1959 001	HEAT SINK, PWR SUP.	1
	829 1959 002	HEATSINK, PWR. SUP.	1
	829 2901 001	FINGERSTOCK	22
	829 2901 002	FINGERSTOCK	2
	829 3171 001	FILTER, FAN	1
	829 7850 001	COVER SAFETY	1
	929 1982 002	PANEL ASSY, METER FRONT	1
	929 2191 001	RIBBON CABLE, 20 COND	1
	929 2192 001	RIBBON CABLE ASSY	1

Table 6-4. MAIN FRAME - 992 4980 003 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
	929 2193 001	RIBBON CABLE,40 COND	1
	929 2440 001	CABLE, MAIN	1
	938 3828 126	COAX CABLE	3
	938 3828 130	COAX CABLE	1

Table 6-5. PC BOARD - 992 4981 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
CR1	384 0321 000	DIODE 5082-2800/1N5711	1
R1,R2	548 0317 000	RES 301K OHM 1/4W 1%	2
R3	548 0932 000	RES 100K OHM 1/4W 1%	1
R4	540 1109 000	RES .5W 33K OHM 5PCT	1
R4	548 0932 000	RES 100K OHM 1/4W 1%	1
R5	548 0317 000	RES 301K OHM 1/4W 1%	1
R6	548 0997 000	RES 20K OHM 1/4W 1%	1
S1	604 0862 000	SWITCH, PB 10 POS	1
	610 0746 000	HEADER ASSY 20 PIN	1
	839 2835 001	SCHEMATIC	1
	839 2836 001	PRINTED BOARD	1

Table 6-6. PC BOARD - 992 4982 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
CR1,CR2,CR3	384 0321 000	DIODE 5082-2800/1N5711	3
CR4 thru CR7	384 0431 000	RECT. 1N4001	4
C1	526 0049 000	CAP 6.8UF 35V 20%	1
C2	500 0813 000	CAP MICA 33UUF 500V	1
C3	526 0049 000	CAP 6.8UF 35V 20%	1
C4	500 0817 000	CAP MICA 47UUF 500V	1
C5,C6	526 0049 000	CAP 6.8UF 35V 20%	2
C8	526 0340 000	CAP 1 UF 35V 10%	1
C9,C10	526 0049 000	CAP 6.8UF 35V 20%	2
C11	526 0342 000	CAP 2.7UF 35V 10%	1
C12	526 0106 000	CAP 27UF 35V 10%	1
C13 thru C16	526 0049 000	CAP 6.8UF 35V 20%	4
Q1,Q2	380 0319 000	TRANSISTOR MPS A14	2
R1	550 0913 000	POT, 5K OHM	1
R2	540 1113 000	RES .5W 18K OHM 5PCT	1
R3	550 0913 000	POT, 5K OHM	1
R4	540 1113 000	RES .5W 18K OHM 5PCT	1
R5	550 0398 000	POT 1K OHM 1/2W 10%	1
R6	540 1179 000	RES 1/2W 3600 OHM 5%	1
R7	550 0928 000	POT 20K OHM 1/2W	1
R8	540 1165 000	RES 1/2W 3300 OHM 5%	1
R9	550 0928 000	POT 20K OHM 1/2W	1

Table 6-6. PC BOARD - 992 4982 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R10	540 1165 000	RES 1/2W 3300 OHM 5%	1
R11	550 0913 000	POT, 5K OHM	1
R12	540 1113 000	RES .5W 18K OHM 5PCT	1
R13	550 0913 000	POT, 5K OHM	1
R14	540 1113 000	RES .5W 18K OHM 5PCT	1
R15	550 0928 000	POT 20K OHM 1/2W	1
R16	540 1160 000	RES .5W 22K OHM 5%	1
R17	540 1328 000	RES 560K OHM .5W	1
R18	540 1111 000	RES .5W 10K OHM 5PCT	1
R19	540 1151 000	RES .5W 10 OHM 5%	1
R20	540 1144 000	RES .5W 200K OHM 5%	1
R21	550 0930 000	POT 200K OHM 1/2W	1
R22	540 1105 000	RES .5W 5100 OHM 5%	1
R23	540 1151 000	RES .5W 10 OHM 5%	1
R24	540 1251 000	RES 300K OHM .5W 5%	1
R25,R26	540 1159 000	RES .5W 100K OHM 5%	2
R27	540 1129 000	RES .5W 1500 OHM 5%	1
R28,R29	540 1111 000	RES .5W 10K OHM 5PCT	2
R30	550 0935 000	POT 2K OHM 1/2W 10%	1
R31	540 1145 000	RES .5W 6800 OHM 5%	1
R32	540 1111 000	RES .5W 10K OHM 5PCT	1
R33,R34	540 1151 000	RES .5W 10 OHM 5%	2

Table 6-6. PC BOARD - 992 4982 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R35	540 1162 000	RES 1/2W 1 MEGOHM 5%	1
R36	540 1111 000	RES .5W 10K OHM 5PCT	1
R37	540 1134 000	RES .5W 33 OHM 5%	1
R38	540 1160 000	RES .5W 22K OHM 5%	1
R39	540 1159 000	RES .5W 100K OHM 5%	1
R40	540 1337 000	RES 12 MEGOHM 1/2W 5%	1
R41	540 1160 000	RES .5W 22K OHM 5%	1
R42	540 1114 000	RES .5W 4700 OHM 5%	1
R43	540 1165 000	RES 1/2W 3300 OHM 5%	1
R44	540 1210 000	RES 1/2W 150K OHM 5%	1
R45	540 1107 000	RES .5W 20K OHM 5PCT	1
R46	540 1104 000	RES .5W 2000 OHM 5%	1
R47	540 1201 000	RES 1/2W 910 OHM 5%	1
R48	550 0935 000	POT 2K OHM 1/2W 10%	1
R49	540 1129 000	RES .5W 1500 OHM 5%	1
R50	559 0043 000	THERMISTOR 2K OHM	1
R51	540 1107 000	RES .5W 20K OHM 5PCT	1
R52,R53,R54,R55	548 1148 000	RES 100K OHM 1/4W 1%	4
R56,R57,R58	540 1159 000	RES .5W 100K OHM 5%	3
R59	540 1129 000	RES .5W 1500 OHM 5%	1
S1	604 0862 000	SWITCH, PB 10 POS	1
U1	382 0415 000	CKT, INT 324	1

Table 6-6. PC BOARD - 992 4982 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
U2,U3	382 0472 000	CKT, INTEGRATED	2
U4	540 1332 000	RES NETWORK 100K OHM	1
U5	382 0360 000	IC, 7915	1
U6	382 0359 000	IC, 7815	1
XU1	404 0674 000	SOCKET, IC 14 CONT	1
XU2,XU3	404 0673 000	SOCKET, IC 8 CONT	2
XU4	404 0675 000	SOCKET, IC 16 CONT	1
	610 0747 000	HEADER ASSY 26 PIN	1
	843 2118 001	SCHEMATIC	1
	939 2851 001	PC BOARD ASSY.	1

Table 6-7. MOTHER BOARD - 992 4983 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
P1 thru P13	612 0887 000	CONN, PC BD 72 CONT	13
R1,R2,R3,R4,R5	540 0864 000	RES .25W 10 OHM 5%	5
	610 0746 000	HEADER ASSY 20 PIN	1
	610 0747 000	HEADER ASSY 26 PIN	1
	610 0748 000	HEADER ASSY 40 PIN	1
	620 0515 000	RECP 50-051-0000	4
	852 8415 001	SCHEMATIC	1
	952 8329 001	PRINTED BOARD	1

Table 6-8. PC BOARD - 992 4984 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
CR1	384 0020 000	RECTIFIER IN4005	1
C1,C2	516 0370 000	CAP .005UF 500V 10%	2
C3	500 0756 000	CAP, MICA 330PF 500V 5%	1
C4,C5	516 0370 000	CAP .005UF 500V 10%	2
C6	500 0756 000	CAP, MICA 330PF 500V 5%	1
C7,C8	516 0370 000	CAP .005UF 500V 10%	2
C9	500 0756 000	CAP, MICA 330PF 500V 5%	1
C10,C11	516 0370 000	CAP .005UF 500V 10%	2
C12	500 0756 000	CAP, MICA 330PF 500V 5%	1
C13,C14	516 0370 000	CAP .005UF 500V 10%	2
C15	500 0756 000	CAP, MICA 330PF 500V 5%	1
C16,C17	516 0370 000	CAP .005UF 500V 10%	2
C18	500 0756 000	CAP, MICA 330PF 500V 5%	1
C19,C20	516 0370 000	CAP .005UF 500V 10%	2
C21	500 0756 000	CAP, MICA 330PF 500V 5%	1
C22,C23	516 0370 000	CAP .005UF 500V 10%	2
C24	500 0756 000	CAP, MICA 330PF 500V 5%	1
C25,C26	516 0370 000	CAP .005UF 500V 10%	2
C27	500 0756 000	CAP, MICA 330PF 500V 5%	1
C28,C29	516 0370 000	CAP .005UF 500V 10%	2
C30	500 0756 000	CAP, MICA 330PF 500V 5%	1
C31 thru C46	516 0074 000	CAP, DISC .005UF 1KV 20%	16

Table 6-8. PC BOARD - 992 4984 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C47	516 0084 000	CAP DISC .02UF 600V	1
C48	516 0074 000	CAP, DISC .005UF 1KV 20%	1
C49 thru C52	516 0084 000	CAP DISC .02UF 600V	4
C53 thru C61	516 0074 000	CAP, DISC .005UF 1KV 20%	9
J1	610 0740 000	HEADER, PIN 36CKT	1
J2	610 0748 000	HEADER ASSY 40 PIN	1
J3	610 0739 000	HEADER, PIN 12CKT	1
K1	574 0162 000	RELAY 4PDT 24VDC	1
L1	494 0419 000	CHOKE RF 1000.0UH	1
L2	492 0627 000	INDUCTOR, VARIABLE	1
L3	494 0419 000	CHOKE RF 1000.0UH	1
L4	492 0627 000	INDUCTOR, VARIABLE	1
L5,L6,L7	494 0419 000	CHOKE RF 1000.0UH	3
L8	492 0627 000	INDUCTOR, VARIABLE	1
L9	494 0419 000	CHOKE RF 1000.0UH	1
L10	492 0627 000	INDUCTOR, VARIABLE	1
L11 thru L14	414 0212 000	TORROID, SELECTED	4
R1	540 0900 000	RES .25W 330 OHM 5%	1
R2	540 0915 000	RES .25W 1300 OHM 5%	1
R3,R4	540 0900 000	RES .25W 330 OHM 5%	2
R5	540 0915 000	RES .25W 1300 OHM 5%	1
R6,R7	540 0900 000	RES .25W 330 OHM 5%	2

Table 6-8. PC BOARD - 992 4984 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R8	540 0915 000	RES .25W 1300 OHM 5%	1
R9,R10	540 0900 000	RES .25W 330 OHM 5%	2
R11	540 0915 000	RES .25W 1300 OHM 5%	1
R12,R13,R14	540 0900 000	RES .25W 330 OHM 5%	3
R15 thru R24	540 0920 000	RES .25W 2200 OHM 5%	10
R25,R26	548 0263 000	RES 1K OHM 1/8W 1%	2
R27,R28	540 0920 000	RES .25W 2200 OHM 5%	2
R29	540 0912 000	RES .25W 1000 OHM 5%	1
R30	540 0880 000	RES .25W 47 OHM 5PCT	1
R31	540 0017 000	RES .5W 47 OHM 5%	1
R32	540 0912 000	RES .25W 1000 OHM 5%	1
R33	540 0017 000	RES .5W 47 OHM 5%	1
R34	540 0915 000	RES .25W 1300 OHM 5%	1
TB1,TB2	614 0040 000	TERM BOARD 18 TERM	2
XK1	404 0161 000	SOCKET RELAY 9KH2	1
	843 1714 001	SCHEMATIC	1
	943 1715 001	PRINTED BOARD	1

Table 6-9. POWER SUPPLY BOARD - 992 5000 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
CR5,CR6	386 0077 000	DIODE, ZENER 1N4749A, 24V	2
CR7,CR8	384 0020 000	RECTIFIER IN4005	2
C10 thru C13	526 0349 000	CAP 2.2UF 50V 20%	4
Q5	380 0189 000	TRANSISTOR 2N3904	1
Q6	380 0190 000	TRANSISTOR 2N3906	1
R1	540 0339 000	RES 1W 2000 OHM 5%	1
R2	540 1102 000	RES .5W 100 OHM 5PCT	1
R3	540 1216 000	RES 1/2W 330 OHM 5%	1
R4	542 0002 000	RES. 2 OHM 5W	1
R5	540 1137 000	RES .5W 3900 OHM 5%	1
R6	540 0339 000	RES 1W 2000 OHM 5%	1
R11	540 1102 000	RES .5W 100 OHM 5PCT	1
R12	540 1137 000	RES .5W 3900 OHM 5%	1
R13	540 1216 000	RES 1/2W 330 OHM 5%	1
R14	542 0002 000	RES. 2 OHM 5W	1
R15	540 0332 000	RES 1W 1000 OHM 5%	1
	843 2119 001	SCHEMATIC	1
	929 2219 001	PRINTED BOARD	1

Table 6-10. RIBBON CABLE,20 COND - 929 2191 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
	250 0268 000	RIBBON CABLE 20 COND	1.5 FT
	612 0895 000	RECP CONN KIT 20 PIN	2

Table 6-11. RIBBON CABLE ASSY - 929 2192 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
	250 0270 000	RIBBON CABLE 26 COND	1.5 FT
	612 0896 000	RECP CONN KIT 26 PIN	2

Table 6-12. RIBBON CABLE,40 COND - 929 2193 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
	250 0269 000	RIBBON CABLE 40 COND	.5 FT
	612 0897 000	RECP CONN KIT 40 PIN	2

Table 6-13. CABLE, MAIN - 929 2440 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
	843 2021 001	CABLE LAYOUT	1
	252 0003 000	WIRE STRD 20AWG WHT	41.9 FT
	253 0074 000	CABLE, 4-C #22AWG	4.1 FT
	253 0093 000	CABLE 4-C 20 AWG	2.2 FT
	253 0059 000	CABLE, AUD 2C 22AWG	2.9 FT
	354 0630 000	PIN, CONNECTING	2
	354 0001 000	TERM LUG RED RING 6	14
	354 0003 000	TERM LUG RED RING 10	13
	296 0253 000	TUBG, SHRINKABLE 3/16	.2 FT
	296 0263 000	TUBG SHRINKABLE .375	.3 FT
	296 0265 000	TUBG SHRINKABLE 1/16	1.9 FT

Table 6-14. COAX CABLE - 938 3828 126

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
	618 0213 000	COAX CABLE RG188A/U	2.1 FT
	620 0566 000	PLUG, RT ANGLE UG1466/U	3
	620 1510 000	JACK, BULKHEAD, BNC	3

Table 6-15. COAX CABLE - 938 3828 130

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
	620 0566 000	PLUG, RT ANGLE UG1466/U	1
	618 0213 000	COAX CABLE RG188A/U	.7 FT
	414 0212 000	TORROID, SELECTED	1
	296 0263 000	TUBG SHRINKABLE .375	.1 FT
	620 1510 000	JACK, BULKHEAD, BNC	1

Table 6-16. EXTENDER BOARD - 939 3524 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
J1	612 0916 000	CONN PC BD 72 CONT.	1
	943 2258 001	EXTENDER BOARD ASSY	1
	939 3386 001	PLATE ASSY.	1
	829 2920 001	CATCH, EXTENDER	1
	829 2920 002	CATCH, EXTENDER	1
	456 0082 000	SPRING LC-026C-5	2
	335 0007 000	WASHER NYLON .175 ID	6
	310 0016 000	WASHER FLAT #4	10
	302 0052 000	SCR 4-40 X 1/4	10
	314 0003 000	WASHER SPLIT 4	10
	302 0364 000	SCR 4-40 X 3/16	2
	999 1763 001	HARDWARE LIST	1

Table 6-17. EXTENDER BOARD ASSY - 943 2258 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
	843 2261 001	EXTENDER	1
	354 0310 000	TERM SLDR 3653-3-01	70

Table 6-18. ACCESS CABLES - 992 4990 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
	929 2816 001	CORD, AC POWER	1

Table 6-19. WIDE BAND OPTION (6) - 994 7983 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
	994 7983 001	BLANK MODULE	5

Table 6-20. STEREO OPTION (3) - 994 8020 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
3A1	994 7989 001	STEREO ANALOG MODULE	1
3A2	994 7990 001	STEREO DIGITAL MODULE	1
3A3	994 7991 001	STEREO OVERSHOOT MODULE	1

Table 6-21. SCA OPTION (4) - 994 7992 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
	992 4977 001	PC BOARD ASSEMBLY	1

Table 6-22. MONO OPTION (5) - 994 8019 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
5A1	994 7988 001	MONAURAL MODULE	1
	994 7983 001	BLANK MODULE	2

Table 6-23. EXTERNAL SCA GENERATOR JUMPER CARD - 994 8377 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
	843 3292 001	PC BOARD	1
	550 0913 000	POT, 5K OHM	1

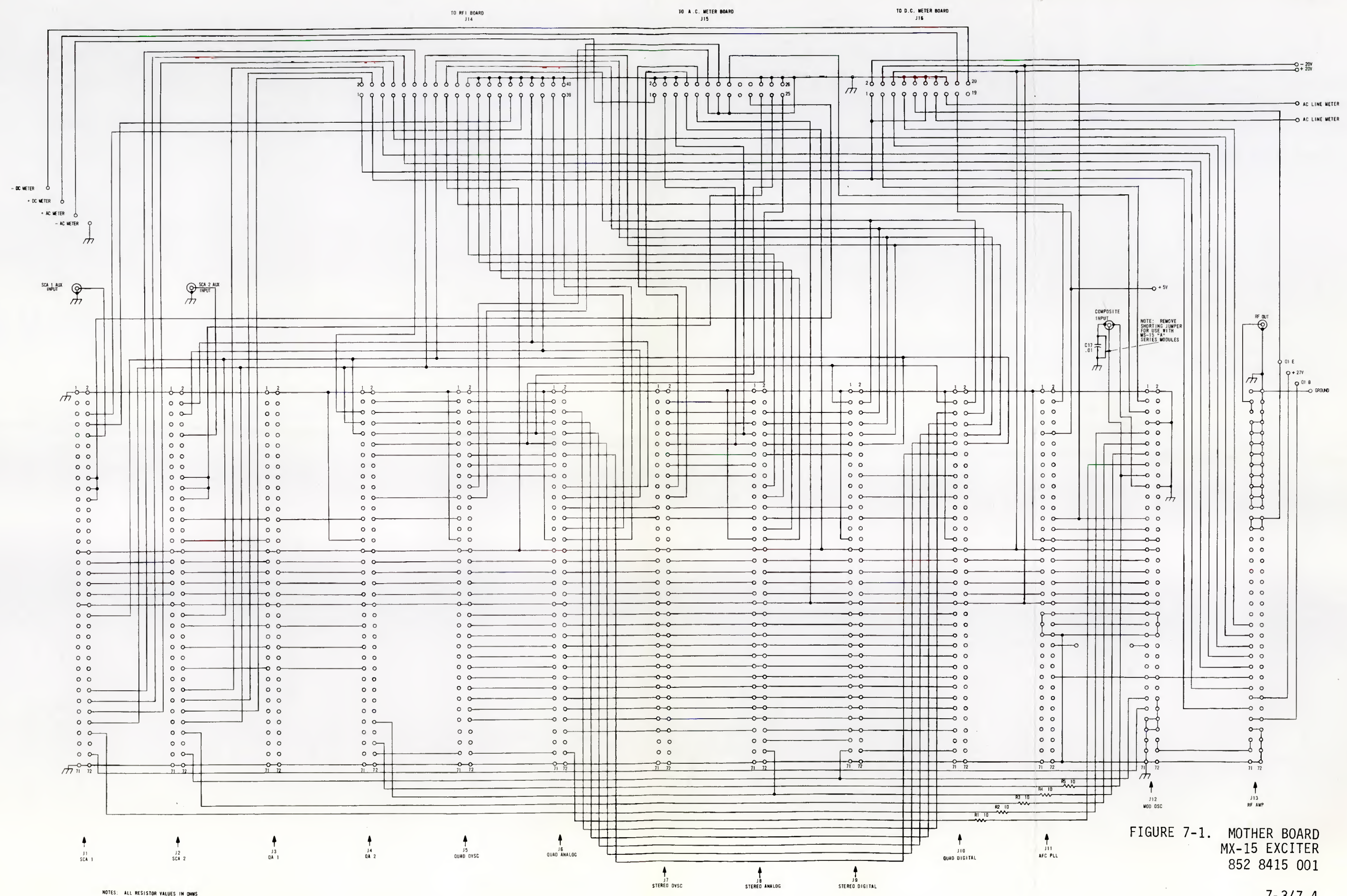
SECTION VII

DIAGRAMS

7-1. INTRODUCTION

7-2. This section provides schematic, interconnectionn, and wiring diagrams required for maintenance of the MX-15 FM EXCITER. The following diagrams are contained in this section:

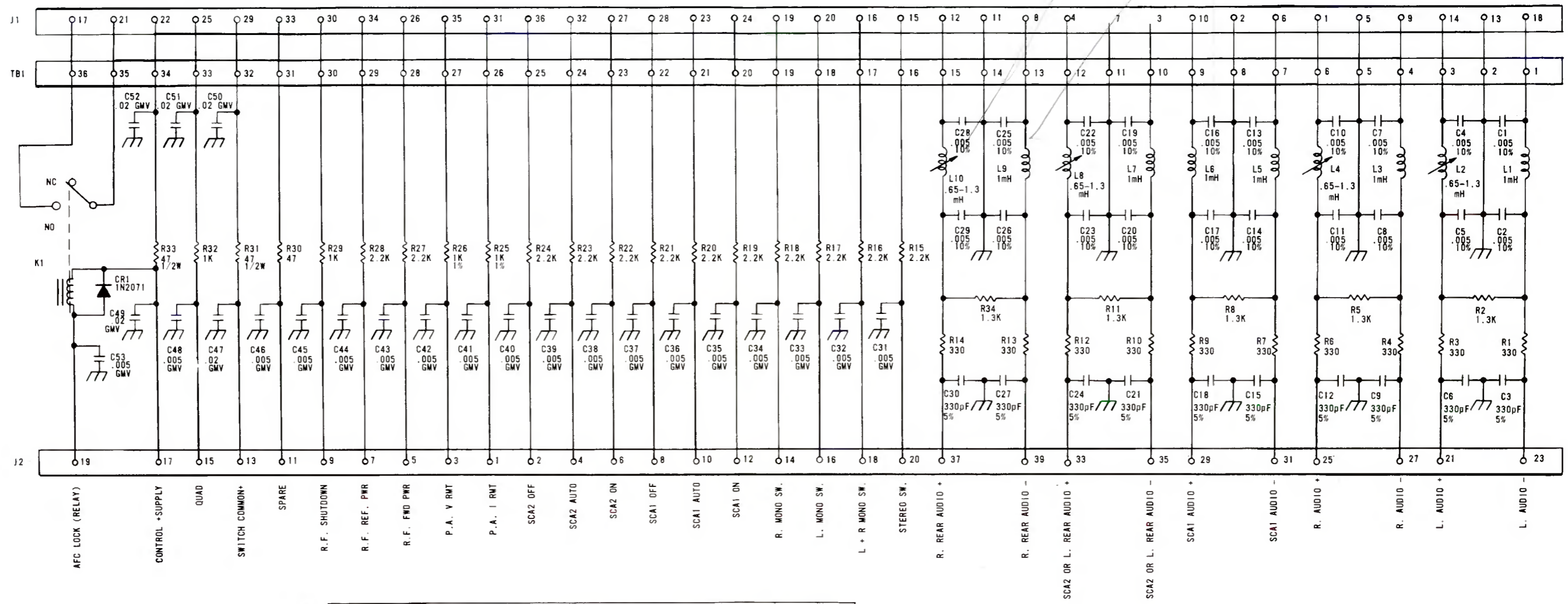
<u>Figure</u>	<u>Title</u>	<u>Number</u>	<u>Page</u>
7-1	Mother Board, MX-15 Exciter	852 8415 001	7-3/7-4
7-2	RFI Filter, FM Exciter	843 1714 001	7-5/7-6
7-3	Power Supply, FM Exciter	843 2119 001	7-7/7-8
7-4	DC Meter Board, FM Exciter	839 2835 001	7-9/7-10
7-5	Modulation Meter Board, FM Exciter	843 2118 001	7-11/7-12



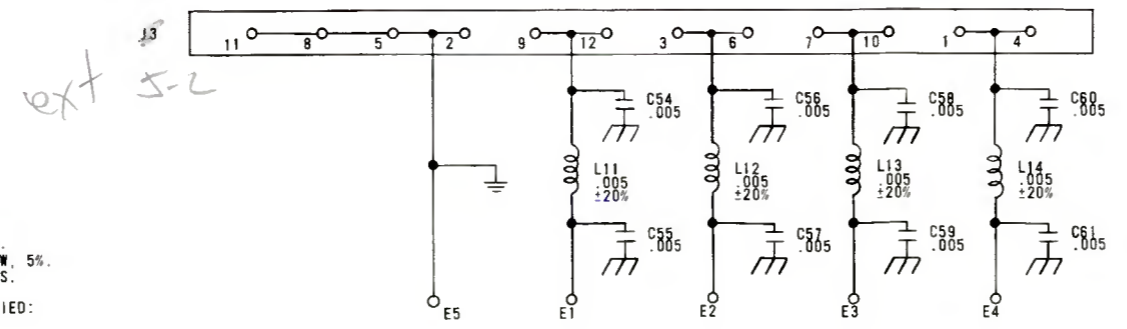
NOTES: ALL RESISTOR VALUES IN OHMS

FIGURE 7-1. MOTHER BOARD
MX-15 EXCITER
852 8415 001

Factory adjust set for x-talk at 15 kHz - Also RFI Filtering



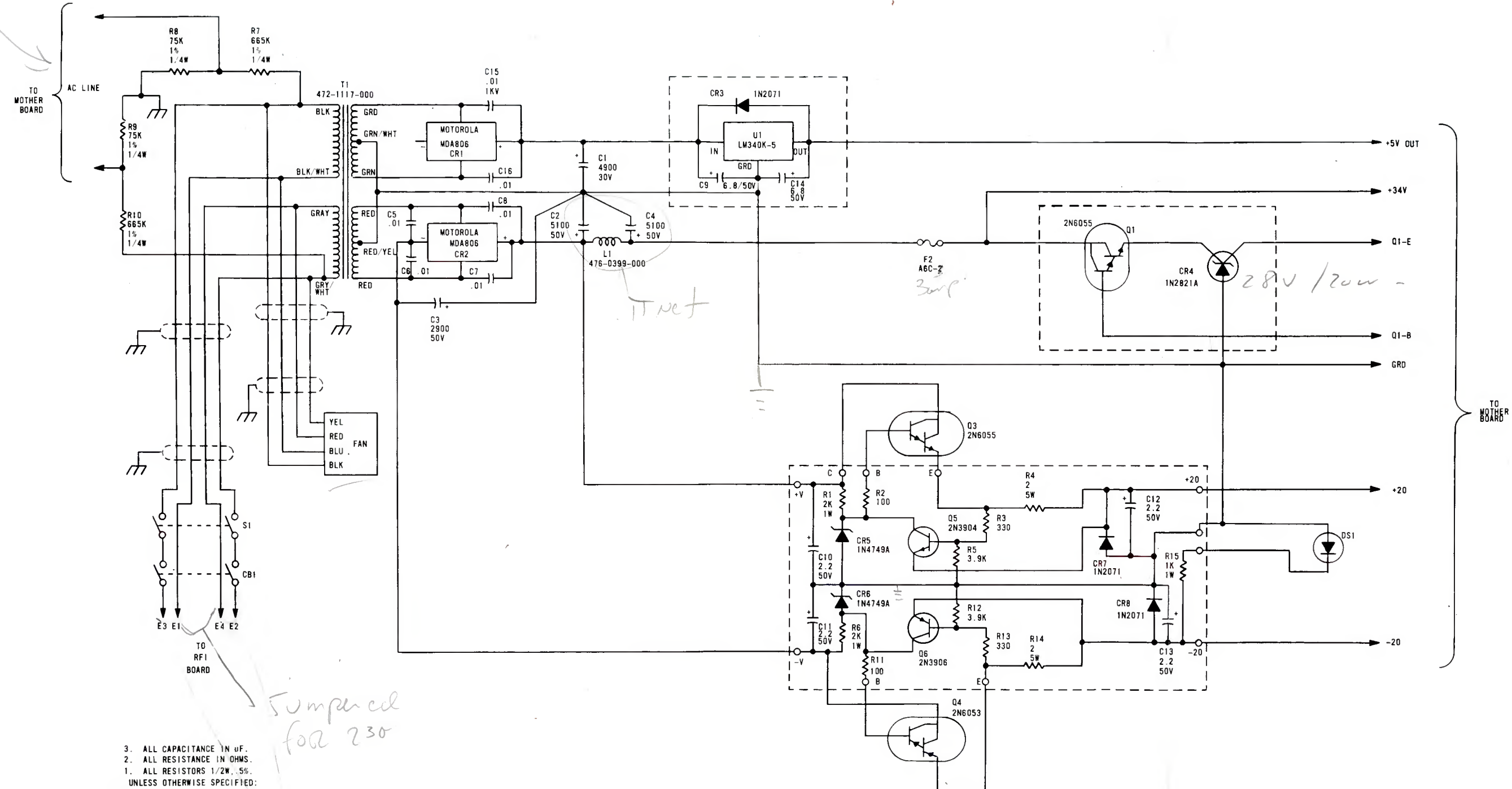
- UNLESS OTHERWISE SPECIFIED:
NOTES:
4. ALL INDUCTANCE IN uH.
 3. ALL CAPACITANCE IN uF.
 2. ALL RESISTORS ARE 1/4W, 5%.
 1. ALL RESISTANCE IN OHMS.



Power inputs

FIGURE 7-2. RFI FILTER FM EXCITER 843 1714 001

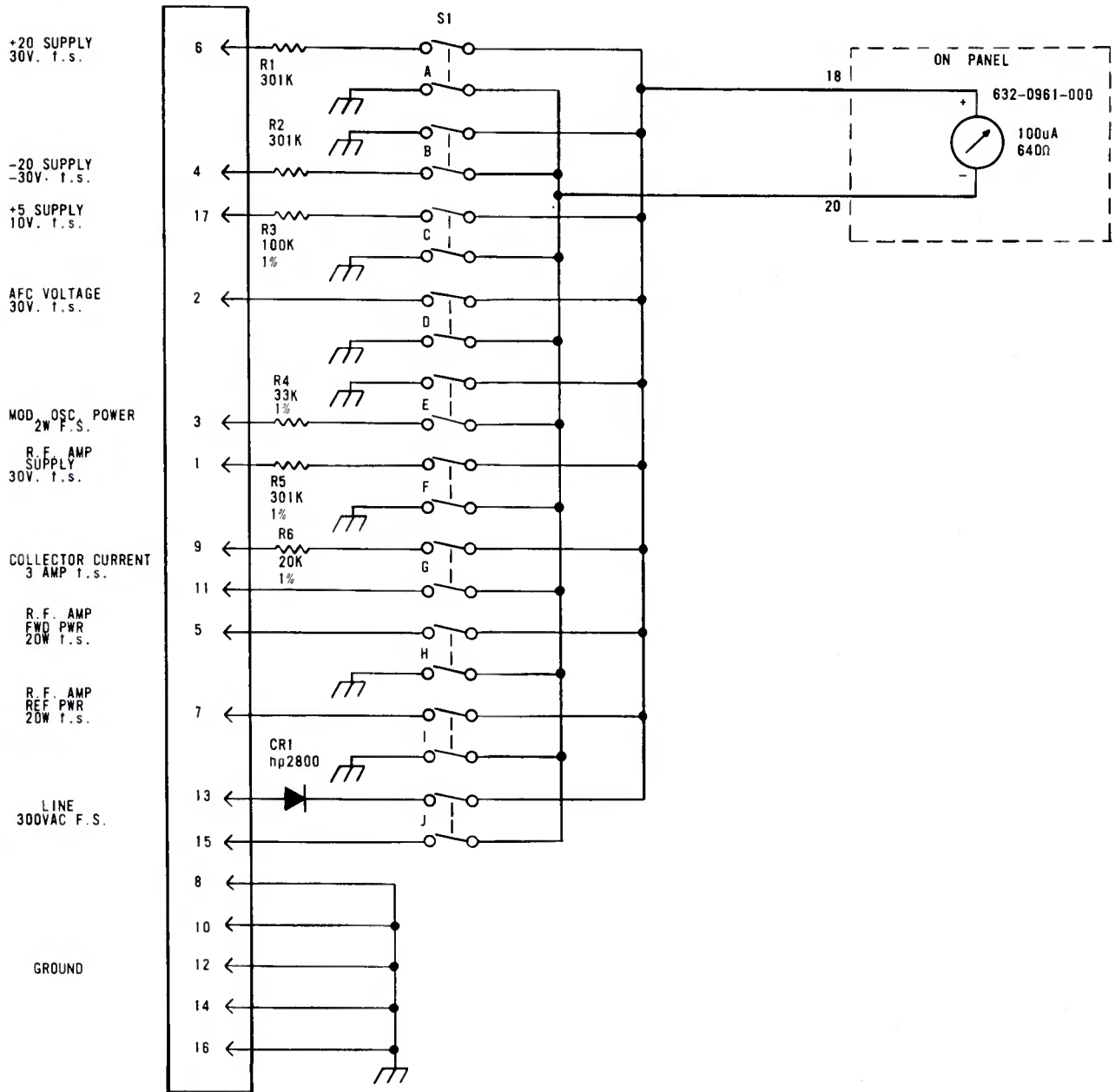
To Motherboard



- 3. ALL CAPACITANCE IN UF.
 - 2. ALL RESISTANCE IN OHMS.
 - 1. ALL RESISTORS 1/2W, 5%.
- UNLESS OTHERWISE SPECIFIED:
NOTES:

Temped for 230

FIGURE 7-3. POWER SUPPLY
FM EXCITER
843 2119 001

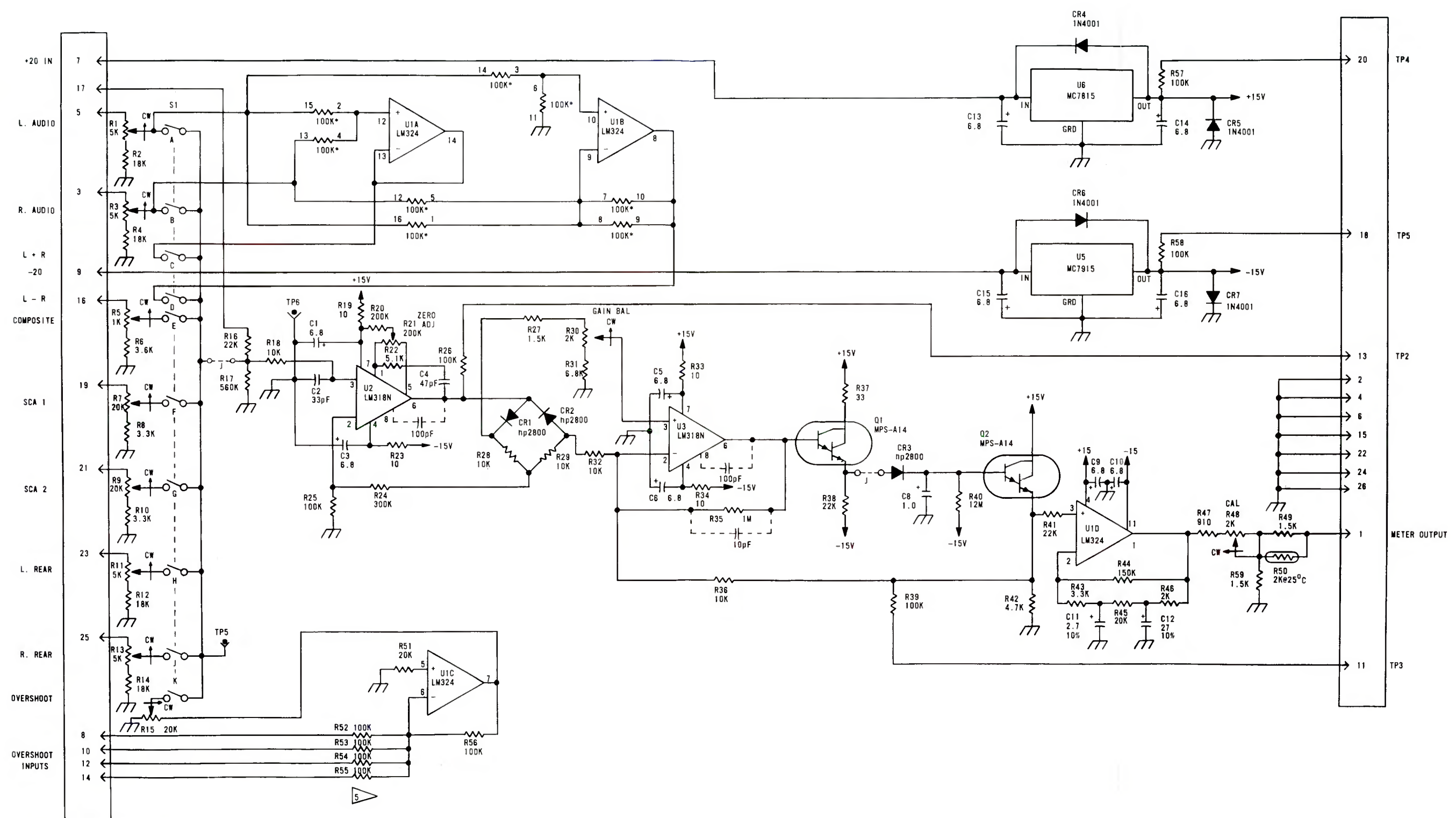


2. RESISTANCE IN OHMS.
 1. RESISTORS ARE 1/4W 1%
 NOTES:

FIGURE 7-4. DC METER BOARD
 FM EXCITER
 839 2835 001

7-9/7-10

WARNING: Disconnect primary power prior to servicing.



- 5 R52, R53, R54, R55 ARE 1/4W, 1%.
4. * = PART OF U4, RA08-100KN
3. ALL CAPACITANCE IN μ F.
2. ALL RESISTANCE IN OHMS.
1. ALL RESISTORS ARE 1/2 W, 5%, LOW NOISE.
- UNLESS OTHERWISE SPECIFIED:
- NOTES:

FIGURE 7-5. MODULATION METER BOARD
FM EXCITER
843 2118 001

APPENDIX A
MANUFACTURERS DATA

888-2164-001

A-1

WARNING: Disconnect primary power prior to servicing.

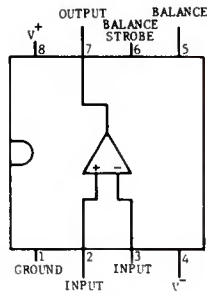
APPENDIX A

MANUFACTURERS DATA

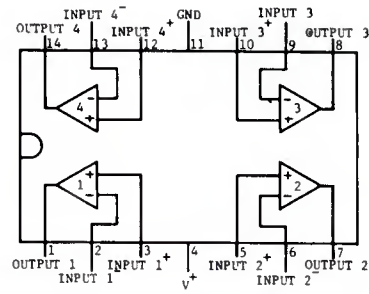
A-1. INTRODUCTION

A-2. This appendix consists of the following technical data which identifies operating characteristics and parameters for various replaceable items used throughout the MX-15 FM EXCITER circuitry.

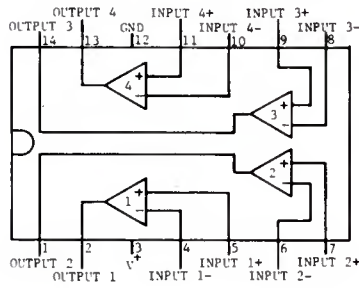
1. Integrated Circuit Connection Diagrams
2. Technical Data Sheet, AD521-JD Instrumentation Amplifier
3. Technical Data Sheet, XR2206 CP Function Generator
4. Technical Data Sheet, HA-4741 Quad Operational Amplifier
5. Technical Data Sheet, ILQ74 Quad Optical Isolator
6. Technical Data Sheet, LM318-N Operational Amplifier
7. Technical Data Sheet, DM-74LS161 Programmable Divider
8. Technical Data Sheet, TL430C Programmable Zener Diode
9. Technical Data Sheet, 74C932N Phase Detector
10. Engineering Report, A New Filtering Process For Optimal Overshoot Control.



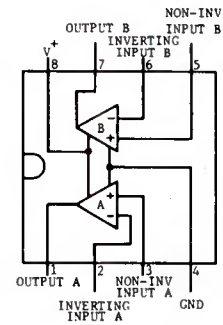
LM311N
VOLTAGE COMPARATOR



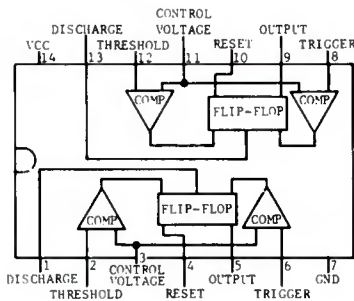
LM324N
QUAD OPERATIONAL AMPLIFIER



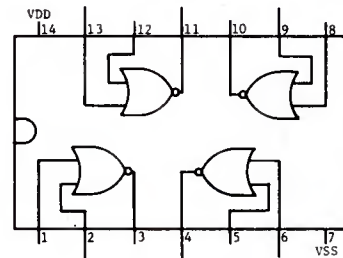
LM339N
QUAD VOLTAGE COMPARATOR



LM358N
DUAL OPERATIONAL AMPLIFIER

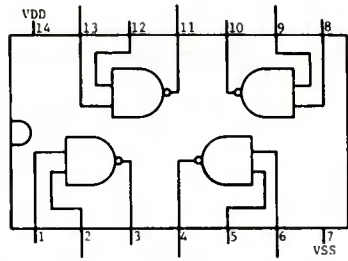


LM556CN
DUAL TIMER

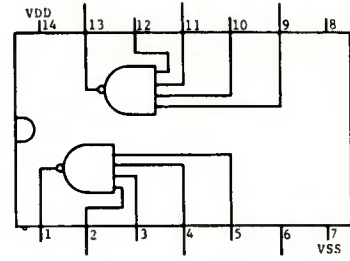


4001B
QUAD 2-INPUT NOR GATE

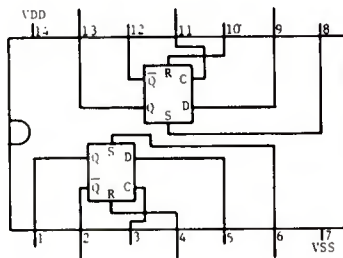
INTEGRATED CIRCUIT CONNECTION DIAGRAMS (SHEET 1 OF 3)



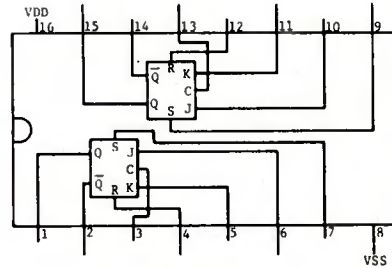
4011B
QUAD 2-INPUT NAND GATE



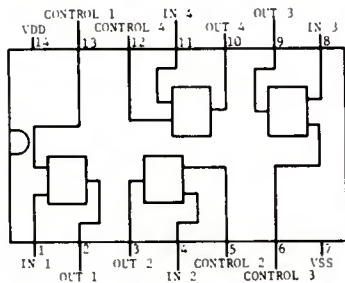
4012B
DUAL 4-INPUT NAND GATE



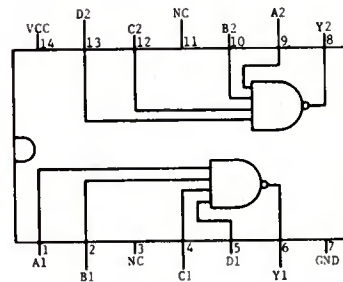
4013B
DUAL D FLIP-FLOP



4027B
DUAL J-K FLIP-FLOP



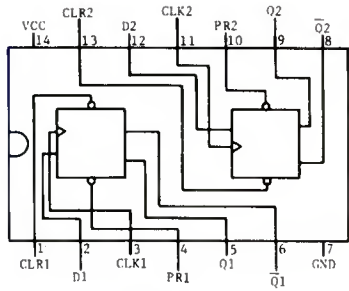
4066B
QUAD ANALOG SWITCH/MULTIPLEXER



7420N
DUAL 4-INPUT NAND GATE

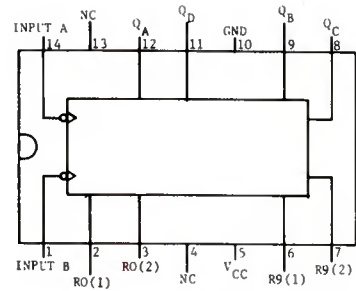
INTEGRATED CIRCUIT CONNECTION DIAGRAMS (SHEET 2 OF 3)

WARNING: Disconnect primary power prior to servicing.



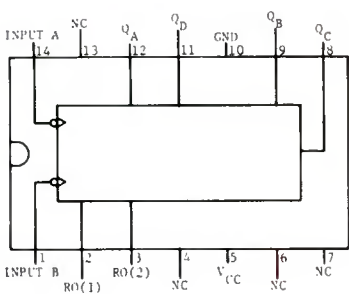
7474N

POSITIVE EDGE TRIGGERED
DUAL D FLIP-FLOP WITH
PRESET AND CLEAR



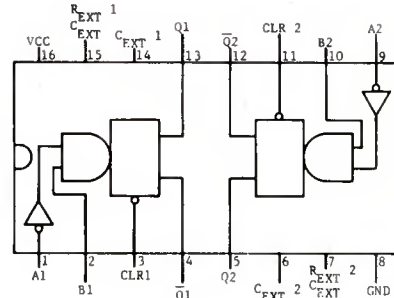
7490AN

DIVIDE BY 10 COUNTER



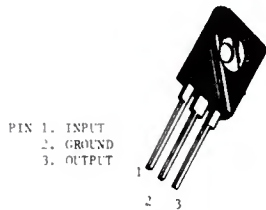
7493AN

DIVIDE BY 16 COUNTER



74123N

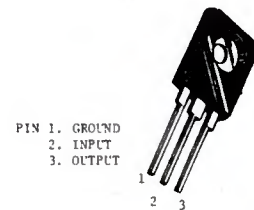
DUAL RETRIGGERABLE ONE SHOT



PIN 1. INPUT
2. GROUND
3. OUTPUT

MC7806CT-POSITIVE 6 VOLT FIXED
VOLTAGE REGULATOR

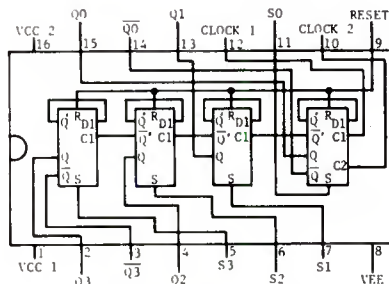
MC7815CT-POSITIVE 15 VOLT FIXED
VOLTAGE REGULATOR



PIN 1. GROUND
2. INPUT
3. OUTPUT

MC7906CT-NEGATIVE 6 VOLT FIXED
VOLTAGE REGULATOR

MC7915CT-NEGATIVE 15 VOLT FIXED
VOLTAGE REGULATOR



MC10178L

DIVIDE BY 16 COUNTER

INTEGRATED CIRCUIT CONNECTION DIAGRAMS (SHEET 3 OF 3)

WARNING: Disconnect primary power prior to servicing.