TECHNICAL MANUAL

FM-2.5K FM TRANSMITTER

994 8047 001

994 8047 004

HARRIS

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MANUAL REVISION HISTORY
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003	11/06/84	29204	Replaced the following pages: Title Page, Manual Revision History Page vi, 7-1/7-2, 7-11/7-12
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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.

WARNING

IF OIL FILLED OR ELECTROLYTIC CAPACITORS ARE UTILIZED IN YOUR EQUIPMENT, AND IF A LEAK OR BULGE IS APPARENT ON THE CAPACITOR CASE WHEN THE UNIT IS OPENED FOR SERVICE OR MAINTENANCE, ALLOW THE UNIT TO COOL DOWN BEFORE ATTEMPTING TO REMOVE THE DEFECTIVE CAPACITOR. DO NOT ATTEMPT TO SERVICE A DEFECTIVE CAPACITOR WHILE IT IS HOT DUE TO THE POSSIBILITY OF A CASE RUPTURE AND SUBSEQUENT INJURY.

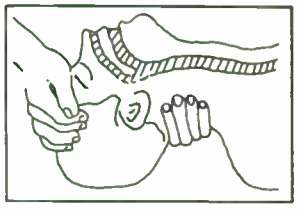
TREATMENT OF ELECTRICAL SHOCK

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

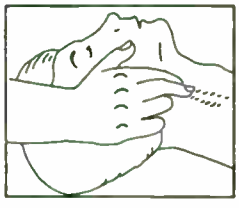
(A) AIRWAY

IF UNCONSCIOUS,
OPEN AIRWAY



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

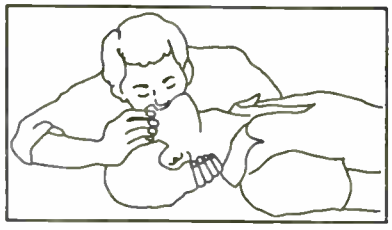
CHECK
CAROTID PULSE



IF PULSE ABSENT,
BEGIN ARTIFICIAL
CIRCULATION

(B) BREATHING

IF NOT BREATHING,
BEGIN ARTIFICIAL BREATHING



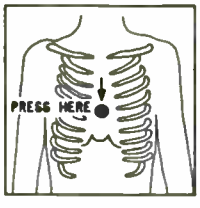
TILT HEAD
PINCH NOSTRILS
MAKE AIRTIGHT SEAL

4 QUICK FULL BREATHS

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

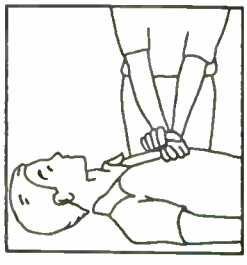
(C) CIRCULATION

DEPRESS STERNUM 1 1/2 TO 2 INCHES



APPROX. RATE OF COMPRESSIONS --80 PER MINUTE
- ONE RESCUER
- 15 COMPRESSIONS
- 2 QUICK BREATHS

APPROX. RATE OF COMPRESSIONS --60 PER MINUTE
- TWO RESCUERS
- 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
D. 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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WARNING: Disconnect primary power prior to servicing.

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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 HARRIS FM-2.5K FM BROADCAST TRANSMITTER.

1-3. RELATED PUBLICATIONS

1-4. The following publications provide information related to associated equipment.

PUBLICATION NUMBER	EQUIPMENT IDENTIFICATION
888 1742 001 OR 988 1957 001	MS-15 FM EXCITER OR MX-15 FM EXCITER

1-5. EQUIPMENT PURPOSE

1-6. The HARRIS FM-2.5K FM TRANSMITTER is a 2500-watt FM Transmitter designed for continuous broadcast operation. The transmitter uses either the HARRIS MS-15 FM Exciter or the HARRIS MX-15 FM Exciter and a two-tube amplifier to provide reliable and efficient operation in the 87.5 to 108 MHz commercial FM Broadcast Band. The FM Exciter plug-in modules provide monaural or stereophonic operation with up to two SCA channels. Plug-in module provisions for operation of a future quadraphonic transmission system are also provided in the FM Exciter.

1-7. PHYSICAL DESCRIPTION

1-8. The entire unit, including the FM Exciter, IPA, PA, associated power supplies, metering, Low-Pass Filter, and control circuits are contained in one cabinet. All required metering is provided by four meters located on a panel along the top edge of the transmitter cabinet and a filament voltage meter located behind the front door. The front door opens to expose the FM Exciter and all required operating controls necessary for normal operation in full view of all front panel indicators. Both the front and rear doors may be removed for better access. The PA and IPA area is accessed through an interlocked rear cover and the control and power supply area is accessed through the rear door.

1-9. The following controls are located on the front panels.

a. Filament ON

b. Filament OFF

c. Plate ON

WARNING: Disconnect primary power prior to servicing.

d. Plate OFF

e. Power/VSWR Selector

f. Power Calibrate

g. VSWR Calibrate

h. Multimeter Selector

i. Power Raise/Lower

j. PA Bias Adjust

k. PA Plate Tuning

l. PA Output Loading

m. PA Grid Tuning

n. PA/IPA Filament Voltage

o. PA Filament Voltage

p. IPA Filament Voltage

q. IPA Plate Tuning

r. IPA Output Loading

s. Remote/Local

t. Potentiometers (4) for adjustment of PA Plate Current Remote Reading, Recycle, PA Overload, and PA Plate Voltage Remote Reading

1-10. FUNCTIONAL DESCRIPTION

1-11. POWER SUPPLIES

1-12. Three power supplies are used for the following functions:

a. PA Bias Voltage

b. (1) IPA Plate and Screen Grid Voltage

(2) PA Screen Grid Voltage

c. PA Plate Voltage

1-13. FM EXCITER

1-14. The FM Exciter produces a frequency-modulated output continuously variable from three to 15 watts into a 50-ohm load for any channel assignment within the 87.5 to 108 MHz commercial FM Broadcast Band. Servicing is simplified as the FM 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 a multimeter which monitors important rf, audio, and control voltages. Light emitting diode (LED) status indicators monitor critical functions on each plug-in module. Operational modes include up to two SCA channels, monophonic, stereophonic, and provisions for future quadraphonic transmission.

1-15. RF CIRCUITS

1-16. The transmitter RF Chain consists of two tubes. A 4X150A tetrode IPA amplifies the FM Exciter output, as required, to drive the single-ended, Class C operated, 5CX1500A PA tube stage to output 2500 watts of RF Power. Fixed bias ensures dependable PA stage operation. Grid leak bias, protected by the control circuitry and neutralization, ensures stable IPA stage operation. Forced air cooling and an air switch arrangement ensures cool operation and long tube life.

1-17. RF Output Power is inductively coupled from the plate lines. The amplifier loading is changed by a variable output loading control. The rf output to the antenna is fed through a Low-Pass Filter arrangement (internal to the PA cavity), a 2nd Harmonic Stub Filter, and a Directional Coupler.

1-18. METERING

1-19. Two meters and an arrangement of light emitting diodes (LED) provide status indications of FM Exciter operation. Five meters monitor transmitter parameters relative to the IPA and PA stages.

1-20. CONTROL CIRCUITS

1-21. The FM-2.5K Transmitter control circuits contains an automatic recycle feature which turns off high voltage momentarily if a fault occurs, and then automatically restores the transmitter to operation. If the fault is still present, or another overload occurs, another interruption cycle is accomplished. Up to three or four recycles within a preset time interval may be attempted before the transmitter shuts down and must be manually reset.

1-22. SAFETY

1-23. If the cabinet back door is opened during operation, the high-voltage and PA screen power supplies are discharged and the ac primary voltage to both power supplies is opened. The power supplies must be manually reenergized after this sequence occurs. USE OF THE SAFETY HOOK TO DISCHARGE ALL SUPPLIES IS RECOMMENDED BEFORE SERVICING.

1-24. EQUIPMENT CHARACTERISTICS

1-25. ELECTRICAL CHARACTERISTICS

1-26. Table 1-1 lists electrical operating characteristics and parameters of the FM-2.5K Transmitter.

1-27. MECHANICAL/ENVIRONMENTAL CHARACTERISTICS

1-28. Table 1-2 lists physical and environmental characteristics of the FM-2.5K Transmitter.

NOTE

Specifications subject to change without notice.

Table 1-1. Electrical Characteristics

FUNCTION	CHARACTERISTIC
PRIMARY POWER REQUIREMENTS	
Transmitter	197/250V, 60 or 50 Hz, single phase
Exciter	115 Vac, 60 or 50 Hz, single phase
POWER CONSUMPTION (Typical for 2.5 kW RF Output)	4800 watts (approximate) transmitter 150 watts for FM Exciter
POWER FACTOR	90%
POWER LINE VARIATION (Slow)	±5%
RF POWER OUTPUT	1.0 kW to 2.5 kW (FCC Type Accepted)
RF OUTPUT IMPEDANCE	50 ohms
RF FREQUENCY RANGE	87.5 to 108 MHz
MAXIMUM VSWR	1.7 to 1
RF OUTPUT TERMINATION	1-5/8 inch (4.13 cm) EIA flange
RF HARMONIC SUPPRESSION	Meets all FCC requirements.
TUBES USED	1-4X150A (IPA) 1-5CX1500B (PA)
AM Noise	55 dB
FM Noise	80 dB (Wideband operation)
Refer to FM Exciter specifications for additional characteristics.	

Table 1-2. Mechanical/Environmental Characteristics

FUNCTION	CHARACTERISTIC
Weight (Unpacked)	Domestic 730 pounds (331.13 kg) Export 740 pounds (335.66 kg)
(Packed)	Domestic 1051 pounds (476.73 kg) in 5 pieces Export 1165 pounds(476.73 kg) in 4 pieces
Cubage (Packed)	Domestic 94.6 ft^3 (2.68 m^3) Export 103.5 ft^3 (2.93 m^3)
Size	Width, 29 inches (73.7 cm) Depth, 33 inches (84 cm) Height, 78 inches (198 cm)
Front Door Swing	29 inches (73.7 cm)
Operating Temperature Range	0° C to 45° C. Usable to -20° C with slight reduction in operating parameters.
Maximum Altitude	7500 feet (2250 meters) above sea level
Maximum Humidity	95% noncondensing
COOLING AIR REQUIREMENTS	140 CFM (3.96 M^3/Min) nominal 1.8 inches (4.57 cm) water gauge
AIR INLET SIZES	
Lower Front Panel:	20.875-inch X 7-inch X 1 inch (50.02 cm X 17.78 cm X 2.54 cm)
Lower Back Door:	24-inch X 24-inch X 1 inch (60.96 cm X 60.96 cm X 2.54 cm)
Blower:	8.5-inch X 8.5-inch X 1 inch (21.59 cm X 21.59 cm X 2.54 cm)
AIR OUTLET SIZE	18-inch (45.7cm) X 14-inch (35.6cm)
Refer to FM Exciter specifications for additional characteristics.	

SECTION II

INSTALLATION

2-1. INTRODUCTION

2-2. This section contains information for installing the HARRIS FM-2.5K FM BROADCAST TRANSMITTER and performing pre-operational checks. Some components were removed from the transmitter after final test for shipment. These components will be identified with appropriate instructions for reinstallation and wiring.

2-3. UNPACKING

2-4. Carefully unpack the FM-2.5K Transmitter 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 Transmission Division.

2-5. RETURNS AND EXCHANGES

2-6. Damaged or undamaged equipment should not be returned unless written approval and a Return Authorization is received from HARRIS CORPORATION, Broadcast Transmission Division. Special shipping instructions and coding will be provided to assure proper handling. Complete details regarding circumstances and reasons for return are to be included in the request for return. Custom equipment or special order equipment is not returnable. In those instances where return or exchange of equipment is at the request of the customer, or convenience of the customer, a restocking fee will be charged. All returns will be sent freight prepaid and properly insured by the customer. When communicating with HARRIS CORPORATION, Broadcast Transmission Division, specify the Factory Order Number or Invoice Number.

2-7. INSTALLATION

2-8. Prior to installation, this Technical Manual and the appropriate FM Exciter Technical Manual should be carefully studied to obtain a thorough understanding of the principles of operation, circuitry, and nomenclature. This will facilitate proper installation and initial checkout.

2-9. COOLING AIR REQUIREMENTS

2-10. If a means of exhausting hot air from the transmitter enclosure or transmitter room is used, the duct system must not introduce any back pressure on the transmitter air exhaust. Allowances must be made for a minimum air flow of 140 CFM (3.96 m^3/minute) to ensure that only a limited amount of direct heat is dissipated into the transmitter interior. The duct work must have a cross sectional area equal to the opening at the top of the transmitter. Sharp right angle bends in the duct system are not permissible.

If it is necessary to turn a right angle, a radius-type bend must be used. The exhaust fan in the duct system must overcome any duct loss and overcome any wind pressures, if vented to the outside.

2-11. After the transmitter has operated at full output for a number of hours, the temperature rise inside the transmitter must not exceed a rise of 68°F (38°C) above the ambient temperature measured at the blower air intake. The ambient air temperature must not rise above 113°F (45°C) under any circumstance.

2-12. TRANSMITTER PLACEMENT

2-13. A certain amount of planning should be accomplished in advance of the actual placement of the equipment. Holes are provided in the base of the transmitter for entry of power, audio, and remote control wires. Also, several knockout holes are provided if other entry positions are desired. Refer to figure 7-3 Installation Layout.

2-14. Either side of the transmitter may be placed against a wall or other equipment. Complete accessibility for maintenance and installation is provided in the FM-2.5K Transmitter by access from the rear of the transmitter cabinet.

2-15. Set the FM-2.5K Transmitter in place on a smooth, level surface near power and signal cables. The sides of the transmitter may be placed against a wall or other equipment as complete accessibility for installation and maintenance is provided by the rear door. The floor must be capable of supporting a load of approximately 100 pounds per square foot (487 kg/m^2).

2-16. COMPONENT INSTALLATION

2-17. Tubes, capacitors, connectors, and cables are shipped in separate cartons. The removal of components varies due to the method and requirements of shipment. All removed items will be tagged to permit reinstallation in the transmitter. Arrange these components in separate groups according to the section from which they are removed. Parts in the interior should be installed first. The transmitter rear door and the internal access panels should be removed and left off until the installation of removed components and cabinet wiring hook up has been completed.

2-18. Items such as interconnecting wires, cables, shock mounted devices, and miscellaneous small parts may be taped or tied in for shipment. Remove all tape, string, and packing material that has been used for this purpose.

2-19. Symbol numbers and descriptions are provided on each removed component corresponding to the schematic diagram, parts list, and packing list. Symbol numbers are also stenciled near the cabinet location of each removed item. Terminals and wires carry tags with information telling how to reconnect each item. Mounting hardware will be found either in small bags, attached to each removed component, or inserted in the tapped holes where each component mounts. Reinstall each component in its proper location.

CAUTION

AVOID BUMPING THE TUBES. DUE TO THE MASS OF LARGE TUBES, BUMPING WILL INTRODUCE STRESSES WHICH MAY CAUSE INTERNAL DAMAGE.

2-20. Install time-delay relay K4.

2-21. Remove all the covers from the PA and IPA enclosures.

2-22. Loosen the four captive screws that hold the PA anode and blocking capacitor assembly to the vertical plate lines. Remove the blocking assembly from the PA enclosure.

2-23. Carefully lower the 5CX1500B tube into its socket until it rests on the socket base. Check to see that the tube contacts line up with the socket fingers and rotate the tube until it hits a stop.

2-24. Install the anode and blocking capacitor assembly over the 5CX1500B tube anode. Align the four captive screws with the press-in nuts on the plate lines and tighten securely.

2-25. Position the B+ feed connector on the 5CX1500B tube anode cap and tighten the holding screw. Dress the B+ wire to the right in a smooth radius to the tubing.

2-26. Inspect the IPA circuitry. Make certain the 4X150A tube is properly seated and the anode clamp holds the chimney against the tube socket. Install the cover on the IPA enclosure. Push the air tube from the PA enclosure down to the stenciling (Air Tube) through the grommeted hole in the IPA cover.

2-27. Install the covers on the PA enclosure.

2-28. Connect the transmission line to transmitter rf output at the Directional Coupler (DC1).

2-29. Install the FM Exciter modules that were removed for shipment.

2-30. WIRING CONNECTIONS

WARNING

BEFORE PROCEEDING, ENSURE THAT STATION PRIMARY POWER IS NOT CONNECTED TO THE TRANSMITTER.

2-31. After the transmitter is physically in place and the components removed for shipment have been reinstalled, the audio and ac power should be brought to the transmitter.

2-32. The audio input line enters the base of the transmitter near the wire channel and connects directly to the FM Exciter terminal board.

2-33. The ac input for the transmitter should come from low reactance, 50/60 Hz, single phase supply with approximately a 5500 VA capacity. A terminal board is installed on the rear left side of the transmitter base for ac connections.

2-34. The ac input wiring should be in agreement with local electrical codes and capable of supplying the transmitter power requirements. An ac primary power disconnect or means to completely deenergize the transmitter primary circuit for servicing is strongly recommended. If the program leads must be routed in close proximity to the ac power input wiring, the program leads should be separately shielded.

2-35. Connect 115 Vac to terminals 1 and 2 of terminal board TB5. This terminal board is located in front of the blower mounting.

2-36. A good ground at FM frequencies is mandatory to keep stray rf currents to a minimum. RF interference usually shows up in one of two ways, feedback or high noise (in some cases both). It should be pointed out that even a small amount of unshielded wire makes a very efficient antenna for FM frequencies. If rf from the cabinet field is transferred to the audio equipment, it can be rectified and may show up as noise or feedback. A single common ground point from the transmitter base to a good grounding system, such as a water pipe or actual earth ground is recommended. A grounding stud is located adjacent to the AC Input terminal board.

2-37. INITIAL CHECKOUT

WARNING

DISCONNECT AND LOCK OUT STATION PRIMARY POWER TO THE TRANSMITTER. USE THE GROUNDING HOOK AND DISSIPATE ANY RESIDUAL POTENTIAL FROM ALL COMPONENTS BEFORE TOUCHING THEM.

2-38. Each transmitter is thoroughly checked out during factory final test but adjustment is normally required during installation due to shipping, variations in primary power, antenna systems, or transmission line differences. A 20k ohm/volt multimeter (Simpson 260 or equivalent) is required for the checkout.

2-39. Before proceeding with the initial FM-2.5K Transmitter testing, ensure that the FM Exciter is completely installed, all parts are back in position

and correctly wired, tubes are in their sockets, the transmitter is connected to a suitable rf load, and all signal monitors are connected.

2-40. The complete transmitter should be inspected at this time. Check the following:

a. That the primary power is connected.

b. That the primary power is connected to the exciter.

c. That the audio inputs are connected to the FM Exciter.

d. That the all connections at terminal boards and components are tightened.

e. Remove any extra hardware lying within the cabinet and tighten all nuts and bolts.

f. Rotate the blower to be sure no obstructions are present.

g. Check relay and solenoid armature operation manually. Ensure all have free, unobstructed movement.

h. That all wires and cabling are dressed properly and secured.

i. That all ducts and shielding are in place.

j. That the two Allen head set screws at the adjustment end of the 2nd Harmonic Trap are tightened.

2-41. Refer to the Factory Test Data Sheets supplied with the transmitter and adjust the controls as indicated. The transmitter was checked into a 50-ohm resistive load at the Factory. Therefore, any system with a mismatch will change the tuning and loading. In this case the recorded control indications may not agree exactly with actual operation.

2-42. Set the REMOTE/LOCAL switch to LOCAL.

2-43. CONNECTIONS TO REMOTE CONTROLS

2-44. The FM-2.5K Transmitter may be operated by remote control by installing a remote control system. If the transmitter is to be remotely controlled, it is important to initiate thorough inspection and maintenance procedures at the transmitter location. Installation of equipment to monitor temperature and humidity at the remote transmitter site is also recommended. Terminations provided in the FM-2.5K Transmitter allow remote control of the following transmitter functions by connection to terminal board TB2 when the REMOTE/LOCAL switch is set to remote. Complete the following connections to terminal board TB2:

a. POWER ON. Connect the remote power switch to terminals 1 and 2. A continuously closed contact activates the primary power circuit. This contact is maintained as a fail-safe requirement.

b. HIGH VOLTAGE OFF. Remove the jumper from terminals 3 and 4. Normally closed contacts open momentarily to turn off the plate supply voltage.

c. HIGH VOLTAGE ON. Normally open contacts which momentarily close connect to terminals 4 and 5 to activate this function.

d. RF POWER RAISE/LOWER. Normally open contacts connect between common terminal 12 and terminals 6 and 7. A contact closure between terminals 6 and 12 will energize motor B2. The direction of motor rotation will lower the PA screen potential and reduce the RF Output power. A contact closure between terminals 7 and 12 will energize motor B2 which will rotate in the opposite direction. This will raise the PA screen potential and increase the RF Output power. Power for the motor (115 Vac) is obtained from the single phase primary ac input.

e. PA PLATE VOLTAGE METERING. This circuit provides 10 Vdc maximum to operate a remote meter which connects to terminals 9 (-) and 10 (+). Adjustment potentiometer R9 matches the input requirements of the monitoring device.

f. PA PLATE CURRENT METERING. This circuit provides 10 Vdc maximum to operate a remote meter which connects to terminals 9 (-) and 11 (+). Adjustment potentiometer R12 matches the input requirements of the monitoring device.

g. RF POWER OUTPUT METERING. A remote indication of sampled RF Output power is provided by the M4845 remote RF Rectifier unit. An adjustment matches the input requirements of the monitoring device which connects to terminals 13 (+) and 14 (-).

CAUTION

USE A VACUUM CLEANER AND THOROUGHLY CLEAN THE INTERIOR OF THE TRANSMITTER PRIOR TO POWER-ON OPERATION.

2-45. Before operation, refer to the tune-up and operating procedure provided in Section III.

SECTION III

OPERATION

3-1. INTRODUCTION

3-2. This section contains Adjustment and Operation Procedures for the HARRIS FM-2.5K FM BROADCAST TRANSMITTER.

3-3. ADJUSTMENT

3-4. Refer to the FM Exciter publication and check out the FM Exciter operation. Do not turn the FM Exciter OFF when checkout is completed.

3-5. Install the rear transmitter door and activate the station ac power supply to the transmitter.

3-6. Adjust the IPA Output Loading, the PA Grid Tuning, the PA Plate Tuning, and the PA Output Loading to the settings indicated on the Factory Test Data Sheet.

3-7. Set the Local/Remote switch to Local.

3-8. Primary power may now be turned ON by depressing the FILAMENT ON pushbutton switch. The blower should begin to turn and come up to speed. After the blower reaches operating speed, air pressure in the PA enclosure will operate the air switch. The air switch closing will allow the filament voltage to be applied to the 4X150A and 5CX1500A tubes. The Filament ON pushbutton switch/indicator should illuminate.

3-9. The indication of PA or IPA filament voltage is determined by a toggle switch on the upper front panel. The voltage is read on the Filament Voltage meter. Adjust the PA filament voltage for 4.8V and the IPA filament voltage the 5.8V. (See Paragraph 5-26.)

3-10. A 180-second time-delay prevents the plate voltage from being turned ON immediately after the filaments are turned ON. This allows the tube cathodes to reach a stable operating temperature.

3-11. Check the PA bias voltage (PA E_{G1}) on the Multimeter. The voltage is read on the 0-1000 Volt Scale. Adjust the PA Bias voltage to obtain the same reading as recorded on the Factory Test Data Sheet.

3-12. Change the Multimeter Selector to read the IPA control grid current (IPA I_{G1}) on the 0 to 50 mA scale. The current range will be 5-15 mA. The control grid circuitry is several megahertz wide and will not require any adjustment.

3-13. Switch the Multimeter to the PA control grid current (PA I_{B1}) position.

WARNING: Disconnect primary power prior to servicing.

3-14. Depress the PLATE ON pushbutton switch. The pushbutton switch/-indicator will illuminate.

3-15. Adjust the PA Grid Tuning for maximum PA control grid current (PA I_{G1}) on the MULTIMETER. The current is read on the 0-50 mA scale and should be in the 10 to 30 mA range.

3-16. Adjust the IPA Tuning for a dip in IPA cathode current (IPA I_k).

3-17. Switch the multimeter to the PA screen current (PA I_{G2}) position and note the reading on the 0-250 mA scale. Adjust the PA Plate Tuning for maximum screen grid current. The screen grid current should be maintained lower than 125 mA.

3-18. Check the PA screen grid voltage (PA E_{G2}) on the 0-1000 volt scale of the Multimeter. Adjust the screen voltage as necessary with the POWER RAISE/LOWER switch to obtain the Factory Test Data Sheet value.

3-19. Check the VSWR on the transmission line. Position the POWER/VSWR Selector Switch on the front panel to the VSWR Calibrate position and set the Power Output meter for full scale deflection with the VSWR Calibrate control. Operate the selector switch to VSWR and read the reflected wave. Although the transmitter will operate into a 1.7:1 mismatch, it is recommended that the VSWR be kept to a minimum. If a high VSWR is indicated, it is generally traced to transmission line and/or antenna problems.

3-20. Because the transmitter was checked into a 50-ohm resistive load, any system with a mismatch will probably change the tuning. Therefore, the recorded test data knob settings may not agree with actual operation.

3-21. The Power Output meter should read in the green at this time. The green range is 90 to 105 percent of rated power and was adjusted at the factory so that 100 percent equals 2.5 kW output or the designated power output (Refer to paragraph 3-27).

3-22. As a "touch-up" procedure the following steps may be followed:

a. The IPA Output Loading and IPA Plate Tuning should be adjusted for the IPA I_k value indicated on the Factory Test Data Sheet. Adjust the IPA Output Loading for the level of current flowing and IPA Plate Tuning for a dip in the IPA I_k.

b. Adjust the PA Grid Tuning for maximum PA I_{G1}. This indication should be close to a peak as the IPA Plate Tuning is adjusted for resonance.

c. Switch the multimeter to the PA I_{G2} position. As the PA Plate Tuning is adjusted the PA I_{G2} will peak close to the PA plate current dip. Adjust the PA Output Loading and/or PA screen voltage to obtain 2500 watts output and then retune the PA plate circuitry. The PA should be tuned for best efficiency and overall operation at 2500 watts.

3-23. RF Drive to the IPA is controlled by the Output Control on the 15-Watt Amplifier of the FM Exciter. The drive level is set so that approximately 10 mA of IPA I_{G1} is indicated. The IPA grid drive relay must be energized before the IPA and PA high voltages can be applied.

3-24. Refer to the Factory Test Data Sheets for the performance indications that may be expect when the transmitter is operating at 2500 watts or the station designated power level.

3-25. The operation of the transmitter is very simple and once adjusted should require only a nominal amount of "touch-up" tuning at regular maintenance periods.

3-26. The overload is set for correct operating level at the HARRIS Factory. The PA plate overload is set for approximately a .950-ampere plate current. The adjustment for the overload is located under a small cover plate located on the front panel. It is referred to as symbol number R10 on the schematic.

3-27. OPERATION AT OUTPUT POWER BELOW 2500 WATTS

3-28. If specified, the transmitter will be tested at reduced power at the HARRIS Factory and the operating parameters noted on the Factory Test Data Sheets. The Power Output meter will be calibrated at the designated power and the PA efficiency recorded at 90, 100, and 105 percent power level.

3-29. The basic change at reduced power output will be changing the secondary connections of high-voltage supply transformer T4 as follows:

a. 2000 to 1700 Watts

   1. IPA power output is 45 Watts.

   2. Use terminals 1 and 4 (4700V no load).

   3. PA E_p will be approximately 4000 Vdc.

b. 1700 to 1300 Watts

   1. IPA power output is 45 Watts.

   2. Use terminals 1 and 3.

   3. PA E_p will be approximately 3300 Vdc.

c. 1300 to 1000 Watts

   1. IPA power output is 40 Watts.

   2. Use terminals 1 and 2 (330V no load).

   3. PA E_p will be approximately 2700 Vdc.

3-30. Any final "touch-up" tuning should be accomplished by varying the PA screen voltage and changing the PA plate loading with the PA Output loading control. Retune the plate and grid circuitry. Observe the PA I_{G2} carefully and do not let it exceed 100 mA during tune-up.

3-31. The PA plate overload adjustment is set for 150 mA to 200 mA above normal plate current when the amplifier is tuned to resonance.

SECTION IV

CIRCUIT DESCRIPTION

4-1. INTRODUCTION

4-2. This section contains circuit descriptions for the HARRIS FM-2.5K FM BROADCAST TRANSMITTER.

4-3. The following FM-2.5K Transmitter circuits will be described in the following sections:

a. Power Amplifier (PA)

b. Intermediate Power Amplifier (IPA)

c. FM Exciter

d. Power Supply

e. Control Circuits

f. Metering

4-4. POWER AMPLIFIER (PA). The power amplifier of the FM-2.5K Transmitter is a single 5CX1500B tube in a rf-grounded cathode amplifier circuit. The plate circuit is a shorted, one-quarter wavelength configuration with the plate line operated at dc ground potential. Coarse plate tuning is preset per operating frequency at the HARRIS Factory. The PLATE TUNING control on the front panel is used for fine tuning.

4-5. RF output power is inductively coupled from the plate lines and the amplifier loading is changed by a variable output loading control. Harmonics above the 2nd Harmonic are attenuated by a filter built into the PA enclosure output circuitry. The 2nd Harmonic is reduced by a 1/4-wavelength adjustable shorting stub.

4-6. The grid circuit is capacitively tuned from the front panel. The length and width of the grid inductor varies with the frequency so the grid tuning capacitor is always 1/2-mesh or more. The rf input is direct-coupled and connected at the HARRIS Factory for the best match between the PA input and IPA output.

4-7. The screen voltage is supplied through a motor-controlled rheostat from a 700 Vdc power supply.

4-8. A constant voltage ($\pm$ 1 percent) transformer and a rheostat provide a continuously adjustable, regulated filament voltage. The specified PA filament voltage is 5 Vac $\pm$ 5 percent. (Refer to paragraph 5-26.)

4-9. INTERMEDIATE POWER AMPLIFIER (IPA). The intermediate power amplifier uses a 4X150A tube in a rf grounded cathode amplifier circuit. The plate circuit is inductively tuned and the loading changed with a variable capacitor. RF output of this stage is set at 50 watts to obtain 2500 Watts out of the power amplifier. At lower transmitter outputs the IPA output is reduced to 45 Watts or 40 Watts.

4-10. The grid circuit is inductively tuned and sealed at the HARRIS Factory. Because the circuit is several megahertz wide and will not require field adjustment, the variable inductors are accessible only with IPA cover removed. The rf input is direct-coupled.

4-11. Several test points are installed for voltage measurements of various tube parameters.

4-12. The screen voltage is Zener diode regulated from the 700 Vdc plate supply.

4-13. A constant voltage (± 1 percent) transformer and a rheostat provide a continuous adjustable, regulated filament voltage. The specified IPA filament voltage is 6 Vac ± 5 percent.

4-14. FM EXCITER. Refer to the FM Exciter publication.

4-15. POWER SUPPLY. The high-voltage power supply furnishes 3, 3.5, or 4.5k Vdc for the power amplifier. The basic configuration of the supply is single phase, full wave bridge circuitry with a two-section choke input filter. Primary taps on plate transformer T4 can be changed to compensate for input line voltage variations. Secondary taps are used when the power amplifier is operated at reduced power.

4-16. A 700 Vdc supply is used to provide IPA screen grid, IPA plate, and PA screen grid voltages. The supply is a single phase, full wave circuitry with a single section choke input filter. Primary taps on transformer T3 can be changed to compensate for input line voltage variation.

4-17. Power amplifier control grid bias voltage is supplied from a single phase, full wave bridge circuit with a capacitive filter. Voltage variation from -80 to -130 Vdc is available by using the PA Bias Voltage Adjustment.

4-18. CONTROL CIRCUITS

4-19. The control circuits of the FM-2.5K Transmitter consist of the following:

a. Plate Contactor K1. Applies primary voltage to transformers T3 and T4.

b. Primary Contactor K2. Applies voltage to the blower.

c. Auxiliary Relay K3. Applies holding voltage to Plate Contactor K1 if the air switch, door interlock, grid drive relay contacts, and the time-delay relay contact are closed.

d. Time-Delay Relay K4. Allows cathode of the tubes to reach operating temperature before high voltage is applied.

e. Recycle Relay K5. Energizes when the PA overload relay is energized a number of times. The number of times is determined by control potentiometer R7. The overload relay contacts are in parallel across the relay circuit for relay K5. When the relay energizes and the contacts open and capacitor C6 starts to charge. If the contacts are open for a sufficient length of time for capacitor C6 to charge to the point that the voltage will energize relay K5, the contacts of relay K5 will break the hold circuit of relay K3 and the plate voltages will be switched OFF. If relay K5 does not operate, the overload contacts will close after an overload and plate contactor K1 will again energize.

f. Plate Overload Relay K6. Adjusted to interrupt the high voltage when the plate current becomes excessive (950 mA at 2.5 kW output).

g. High-Voltage Interlock Switch S6A. Actuated by the back door. Its contacts are in the control circuit of K3.

h. High-Voltage Shorting Switch S6B. Opened by the back door. As the door is removed the 4500V and 700V supplies are grounded.

i. Air Switch S8. Closes after the air pressure in the RF Plenum reaches proper pressure. The ac circuit is then completed to the filament transformer, bias supply, and the time-delay relay.

4-20. RF FILTERING. The FCC requires the harmonics of the operating frequency to be 80 dB or 43 dB +10 X log of the power output in watts (whichever is highest) below the carrier reference. For a 2500-Watt transmitter the harmonics are required to be 77 dB below carrier.

4-21. The 2nd Harmonic Filter (FL1) is adjusted at the HARRIS Factory to appear as a short circuit for the correct frequency in the 176 to 216 mHz range.

4-22. Any frequency above the 2nd Harmonic is attenuated by the Low-Pass Filter in the PA enclosure.

4-23. METERING

4-24. Four meters are located on the cabinet meter panel and one meter on the upper front panel for measuring various parameters.

4-25. The first meter from the left is used as a Multimeter in conjunction with the Multimeter Selector on the upper front panel. The following functions may be measured:

FUNCTION	SCALE
IPA I_{G1}	0-50 mA
IPA I_K	0-250 mA
PA I_{G1}	0-50 mA
PA E_{G1}	0-1000 V
PA I_{G2}	0-250 mA
PA E_{G2}	0-1000 V

4-26. The second meter reads the PA Plate Current and is located in the ground return of the 4500 Vdc supply.

4-27. The third meter reads PA Plate Voltage and is located on the low-potential side of the meter multiplier resistor.

4-28. The fourth meter is for indicating Power Output and VSWR on the transmission line. This meter works in conjunction with the Directional Coupler, mounted in the output transmission line, and a function switch located on the upper front panel.

4-29. Calibration of the Power Output meter is accomplished against a known standard at the HARRIS Factory. Unless the meter is calibrated every six months against a known standard in the field, it cannot be used for power output recordings on the station transmitter log. The FCC accepts the indirect method of computing power output using the dc input and efficiency of the final power amplifier stage.

4-30. An ac voltmeter is mounted to the upper front panel for measuring the PA and IPA filament voltages.

4-31. Test points are installed on the IPA panel for measuring the following parameters with an external meter:

a. TP1. IPA Screen Grid Voltage

b. TP2. IPA Control Grid Voltage

c. TP3. IPA Cathode Voltage

d. TP4. Ground

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 overemphasized. 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 transmitter should be monitored (using front panel indicators) and the 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 transmitter 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 SCHEMATIC NUMBER d. COMPONENT ASSEMBLY NUMBER e. COMPONENT REFERENCE DESIGNATOR

WARNING: Disconnect primary power prior to servicing.

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

5-11. SAFETY PRECAUTIONS

5-12. It is very dangerous to attempt to make measurements or replace components with power on. The design of the transmitter provides safety features such that when a door is opened, an interlock switch removes transmitter high voltage. DO NOT SHORT OUT OR BYPASS INTERLOCK SWITCHES AS A MAINTENANCE SHORTCUT.

5-13. A grounding stick, which consists of a metal rod with a phenolic plastic handle, is provided as a safety feature. The metal end is connected to transmitter ground. Use the grounding stick to touch every part in the area or circuit on which maintenance is to be performed before attempting maintenance.

5-14. PREVENTIVE MAINTENANCE

5-15. 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 may be repeated. Inspect for:

   1. Overheating, indicated by discoloration, bulging of parts and peculiar odors.

   2. Leakage of grease and oil.

   3. Oxidation.

   4. Dirt, corrosion, rust, mildew and fungus growth.

b. Check parts for overheating, especially rotating parts such as the blower motor. The need for lubrication, 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 the normal range.

c. Tighten loose screws, bolts, and nuts. Do not tighten indiscriminately as fittings that are tightened beyond the pressure for which they are designed may be damaged or broken. A regular check on the tightness of the two Allen head set screws in the adjustment end of the second harmonic trap should be made as part of the transmitter preventive maintenance program. If these screws become loose, rf currents will cause heating at this point and result in burning and destruction of the short and other parts of the filter.

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 meshing mechanical surfaces at specified intervals with specified lubricants to prevent mechanical wear and 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 rust, worn or broken paint film.

5-16. FILTER CLEANING

5-17. One air filter is provided in the front of the cabinet and two air filters are provided in the cabinet back door. Clean the filters periodically with warm water and a mild detergent with replacement done on an as-required basis. Additional filters may be ordered from the HARRIS Factory to assist in maintenance (refer to Table 5-1).

CAUTION

DO NOT OIL THE FILTERS. THE FILTERS WILL CLOG IF OILED. ALL FILTERS ARE TO BE INSTALLED DRY.

Table 5-1. Air Filters

AIR FILTER	SIZE	HARRIS PART NO.
LOWER FRONT PANEL	20.875 in. X 7 in. X 1 in. (53.02 cm X 17.78 cm X 2.54 cm)	827 5285 015
LOWER BACK DOOR	24 in. X 24 in. X 1 in. (60.96 cm X 60.96 cm X 2.54 cm)	827 5285 013
BLOWER	8.5 in. X 8.5 in. X 1 in. (21.59 cm X 21.59 cm X 2.54 cm)	827 5285 004

5-18. BLOWER MAINTENANCE

5-19. Inspect the blower and flushing for dust accumulation periodically. Remove the dust with a vacuum cleaner and brush. Check the blower for wear. The blower motor bearings are sealed and lubricated for approximately 20,000 hours of operation to provide trouble-free operation. A blower that is noisy or shows wear will require unit replacement or replacement of the bearings. The blower mounting bolts should be checked for tightness.

5-20. Each motor is cooled by the air passing over the motor. If the ambient air temperature is too high or the air flow is restricted, the lubricant will gradually be vaporized from the motor bearings and bearing failure will occur. If very dirty air passes over the motor, the accumulation must be wiped from the motor and the dust must be blown out of the motor before the collection of dust impairs the motor cooling.

5-21. If the blower is operated to move very dusty air, the concave side of the impeller blades will collect this dust and the material will build up on the surface. If this happens, the performance of the blower will be reduced and unbalance will result with a possibility of damage to the blower.

5-22. MAINTENANCE OF COMPONENTS

5-23. The following paragraphs provide information for component maintenance.

5-24. SEMICONDUCTORS. Routine checking of semiconductors used in the FM-2.5K Transmitter is not required. The best check of semiconductor performance is actual operation in the transmitter. When semiconductors are replaced, check circuitry operation which may be affected. Replacement semiconductors should be of the original type or a recommended direct replacement. Preventive maintenance of transistor is accomplished by performing the following steps:

a. Inspect the semiconductors and surrounding area as accumulations of dirt or dust could form leakage paths.

b. Examine all semiconductors for loose connections or corrosion.

5-25. 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 oil-filled and electrolytic capacitors for leakage signs.

e. Use standard practices to repair poor solder connections with a low-wattage soldering iron.

f. Clean cases and bodies of all capacitors.

5-26. TUBES. Life of the tubes used in the FM-2.5K Transmitter is dependent upon correct filament voltage and the flow of air over the anode of the tube. If required, remove the tube and clean the fins of duct periodically to assure free airflow and long tube life. Air may be blown through the fins in the reverse direction or the anode may be cleaned with soap and water or an approved cleaning solvent.

5-27. It is good practice to determine in the field for each particular combination of equipment and operating power level, the nominal filament voltage for best tube life. This is best done in the field by measuring some important parameter of performance such as plate current, power output, or distortion while filament voltage on the power tube is reduced. At some point in a filament voltage there will be a noticeable reduction in plate current, or power output, or an increase in distortion. Operation may safely be at a filament voltage slightly higher than that point at which performance appeared to deteriorate. A recheck should be made in 12 to 24 hours to make certain that emission is stable.

5-28. Initial setting may be approximately 4.8 Volts for the PA tube. As the tube ages the filament voltage should be raised to increase the emission for satisfactory operation.

5-29. The filament voltage for the IPA is not as critical and it should be set for 6 Volts.

5-30. IPA GRID CIRCUIT

5-31. The IPA grid circuit is tuned initially for the best match between the IPA input and the FM Exciter output. The reflected power should be 1/2W or less with 6W forward power as indicated by the exciter wattmeter. Adjustment of L9 and L10 will have a minimal effect.

5-32. FIXED RESISTORS. Preventive maintenance of fixed resistors is accomplished by the following steps:

a. When inspecting a chassis, printed-circuit board, or discrete component assembly, examine resistors for dirt or signs of overheating. Discolored, bulging, cracked, or chipped components indicate a possible overload.

b. When replacing a resistor ensure the replacement value corresponds to the component designated by the schematic diagram.

c. Clean dirty resistors with a small brush.

5-33. VARIABLE RESISTORS. Preventive maintenance of variable resistors follows:

a. Inspect and tighten all loose mountings, connections and control knob set screws (do not disturb knob alignment).

b. If necessary, clean components with a dry brush or cloth.

c. When dirt is difficult to remove, clean with a cloth moistened with an approved cleaning solvent.

5-34. 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 flash-overs. Insulating compound or oil around the base of a transformer indicates overheating or leakage.

c. Tighten loose mounting lugs, terminals, or rivets.

d. Clean with a dry cloth. Use an approved cleaning solvent if required.

e. Clean corroded contacts or connections with crocus cloth.

f. Replace defective transformers.

5-35. 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. If necessary tighten fuse clips and connections to the clips. The tension of the fuse clips may be increased by carefully pressing the clip sides closer together.

e. Dust fuses and clips with a small brush.

5-36. Preventive maintenance of the meters is accomplished as follows:

a. Inspect meters for loose, dirty, or corroded mountings and connections.

b. Examine leads for frayed insulation and broken strands.

c. Check for cracked or broken plastic cases and cover glasses.

d. Tighten loose mountings or connections. Exercise care to prevent breakage of the plastic meter cases.

e. Clean meter cases and glass cover with a dry cloth.

f. Remove dirt from mountings and connections with a stiff brush.

g. Remove corrosion with crocus cloth.

5-37. RELAYS. Replace hermetically sealed relay 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.

5-38. 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. Do not disassemble switches.

c. Inspect accessible contact switches for dirt, corrosion, looseness of mountings and connections.

d. Check contacts for pitting, corrosion, or wear.

e. Operate the switches to determine if each moves freely and is positive in action. In gang and wafer switches, the rotor should make good contact with the stationary member.

f. Tighten all loose connections and mountings.

g. Adjust contact tension.

h. Clean dirty or corroded terminal connection or switch section with crocus cloth.

i. Replace defective switches.

5-39. INDICATORS AND INDICATOR SWITCHES. Preventive maintenance of indicator lamps and indicator switches is accomplished by checking the following:

a. Examine indicator sockets for corrosion, loose nuts and condition of rubber grommets.

b. Examine indicator switch by pulling the plastic cover (indicator assembly) from the case.

c. Inspect indicator assemblies for broken or cracked covers, loose envelopes, loose mounting screws, and loose or dirty connections.

d. Tighten loose mounting screws and solder loose connections. If connections are dirty or corroded, clean with crocus cloth before soldering.

e. Clean indicator covers, bases, and glass bulbs with a dry cloth.

f. Clean corroded socket contacts and connections with crocus cloth. Low operating voltages require clean contacts and connections.

5-40. 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 a vacuum cleaner and a brush as required.

e. Use standard practices to repair solder connections with a low-wattage soldering iron.

5-41. CORRECTIVE MAINTENANCE

5-42. Corrective maintenance for the transmitter is limited by the objective of minimum time downtime. Maintainability and care are considerably simplified for operation and maintenance personnel as the transmitter is designed and built with highly reliable and proven elements to minimize downtime. If the need to remove and replace a defective component arises, refer to Section II, Installation. Reverse the sequence of installation to remove the component and reinstall as described.

5-43. TROUBLESHOOTING

5-44. Most troubleshooting consists of visual checks. Because of high voltages present in the transmitter, it is not safe to work with power energized. The meters, indicators, and fuses should be used to determine which stage is malfunctioning. The meters which indicate transmitter operating parameters are located across the front of the cabinet. All tuning controls are adjustable in view of the meters. Internal components may be accessed from both the front and rear.

5-45. In event of problems, isolate the trouble area to one of the following with the meters and indicators for each section:

a. Antenna and Feedline

b. Power Supply and Control Circuits

c. IPA Section

d. PA Section

e. Exciter

5-46. 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. In event parts are required, refer to Section VI, Parts List.

5-47. As aids to troubleshooting, schematic diagrams are provided in Section VII.

5-48. Prior to starting a troubleshooting procedure check all switches, power cord connections, connecting cables, and power fuses.

5-49. TECHNICAL ASSISTANCE

5-50. HARRIS Technical and Troubleshooting assistance is available from HARRIS Field Service during normal business hours (8:00 AM - 5:00 PM Central Time). Emergency service is available 24 hours a day. Telephone 217/-222-8200 to contact the Field Service Department or address correspondence to Field Service Department, HARRIS CORPORATION, Broadcast Transmission 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).

WARNING: Disconnect primary power prior to servicing.

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 HARRIS FM-2.5K FM TRANSMITTER. 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 individual equipment are identified by a HARRIS part number and FM-2.5K FM Transmitter assembly 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 Transmission 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 6-2. FM2.5K 2.5KW FM XMTR - 994 8047 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
V1	374 0170 000	TUBE, 5CX1500B	1.0	
V2	374 0018 000	TUBE, 4X150A	1.0	
	994 6871 002	XMTR BASIC FM2.5H3	1.0	
	994 7950 001	FM EXCITER MS15	1.0	
	994 7983 001	BLANK MODULE	0	
		10 REQ LESS		
		1 MONO		
		1 SCA41		
		1 SCA67		
		3 STEREO		

WARNING: Disconnect primary power prior to servicing.

Table 6-3. XMTR FM-2.5K 2.5KW - 994 8047 004

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
	374 0018 000	TUBE, 4X150A	1	
	374 0170 000	TUBE, 5CX1500B	1	
	994 6871 002	XMTR BASIC FM2.5H3	1	
	994 7950 004	BASIC - MX-15 FM EXCITER	1	

WARNING: Disconnect primary power prior to servicing.

Table 6-4. XMTR BASIC FM2.5H3 - 994 6871 002

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
B1	432 0261 000	BLOWER 208-230VAC 50/60HZ	1.0	
B3	436 0004 000	MOTOR, FAN 1/100 HP	1.0	
C9	516 0382 000	CAP 2200 PF 15KV	1.0	
C12,C13	524 0155 000	CAP 220UF 450V	2.0	
C14,C15	510 0557 000	CAP 6UF 5KV 10%	2.0	
C53	510 0329 000	CAP .25 UF 1000V	1.0	
FL1	942 5822 001	T-NOTCH FILTER ASSY	1.0	
L1,L2	476 0306 000	CHOKE, FLTR 10HY 1A	2.0	
L3	476 0304 000	REACTOR, FLTR, 10HY	1.0	
R26,R27	542 0099 000	RES 15.0K OHM 10W	2.0	
R28,R29	542 0341 000	RES 40.0K OHM 160W	2.0	
R30	542 0149 000	RES 25.0K OHM 20W	1.0	
R32	914 3424 001	METER MULTIPLIER MM5	1.0	
R53	542 0214 000	RES 1.5K OHM 50W	1.0	
S6	927 3931 001	HV INTERLOCK SWITCH	1.0	
TB2	614 0104 000	TERM BOARD 14 TERM	1.0	
TB3	614 0223 000	TERM BOARD 2 TERM	1.0	
TB4,TB5	614 0092 000	TERM BOARD 2 TERM	2.0	
T1	472 0687 000	XFMR FIL	1.0	
T3	472 0712 000	XFMR, PLATE	1.0	
T4	472 0711 000	XFMR, PLATE	1.0	
T5	472 0677 000	XFMR, CONSTANT VOLT	1.0	
Z2,Z3	384 0268 000	RECT LOW VOLTAGE	2.0	
Z4,Z5,Z6,Z7	384 0582 000	RECT, SILICON EFT-15H20	4.0	
#B3	430 0003 000	FAN BLADE, 8 IN	1.0	
	827 5285 004	FILTER AIR 8.5 X 8.5	1.0	
	827 5285 013	AIR FILTER	1.0	
	827 5285 015	FILTER	1.0	
	927 7535 001	CABLE HIGH VOLTAGE	1.0	
	927 8599 002	MAIN CABLE	1.0	
	937 9501 017	COAX CABLE ASSY	2.0	
	937 9501 018	COAX CABLE ASSY	1.0	
	992 2703 001	SCRN MOTOR ASSY	1.0	
	992 2704 001	SW. PNL. ASSY	1.0	
	992 2705 001	METER PNL ASSY	1.0	
	992 2706 001	FRNT. PNL ASSY	1.0	
	992 2707 001	PA ENCLOSURE ASSY	1.0	
	992 2708 001	SHELF ASSY	1.0	
	992 2709 001	IPA ASSY	1.0	
	992 3295 001	PNL ASSY	1.0	
	994 4845 001	FM PWR OUTPUT KIT	1.0	

WARNING: Disconnect primary power prior to servicing.

Table 6-5. SCRN MOTOR ASSY - 992 2703 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
B2	436 0106 000	MOTOR, SYN 2RPM	1.0	
R14	542 0084 000	RES 3.0K OHM 10W	1.0	
R19	552 0371 000	RHEOSTAT 5K OHM 75W	1.0	
S9,S10	604 0052 000	SW, PRECISION SPNC	2.0	

Table 6-6. SW. PNL. ASSY - 992 2704 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
DS1,DS2	396 0182 000	LAMP, .2A 6.3V 381	2.0	
S2,S3,S4,S5	604 0445 000	SW, PB LESS LENS CAP	4.0	
	598 0118 000	LENS CAP SW GREEN	2.0	
	598 0119 000	LENS CAP, SW, RED	2.0	
	814 2843 001	WINDOW METER	1.0	

WARNING: Disconnect primary power prior to servicing.

Table 6-7. METER PNL ASSY - 992 2705 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
C8,C10,C11,C17	516 0082 000	CAP, DISC .01UF 1KV GMV	4.0	
M1	632 0575 002	MTR 0 5000 VDC SCALE	1.0	
M2	632 0661 000	METER, VSWR % POWER	1.0	
M3	632 0026 002	MTR 0 1 ADC	1.0	
M4	632 0662 000	MULTIMETER	1.0	

WARNING: Disconnect primary power prior to servicing.

Table 6-8. FRNT. PNL ASSY - 992 2706 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
C54	516 0082 000	CAP, DISC .01UF 1KV GMV	1.0	
K2	570 0158 000	CONTACTOR 4 POLE	1.0	
K3	574 0099 000	RELAY DPDT 110VAC	1.0	
M5	630 0169 000	METER 0-10 VAC	1.0	
R7	550 0065 000	POT 5K OHM 2W 10%	1.0	
R9	550 0068 000	POT, 15K OHM 2W	1.0	
R10	550 0061 000	POT, 1K OHM 2W	1.0	
R11	542 0168 000	RES 15.0 OHM 25W	1.0	
R12	550 0059 000	POT, 500 OHM 2W	1.0	
R13	552 0381 000	RHEOSTAT 16 OHM 100W	1.0	
R17	552 0321 000	RHEO, 1500 OHM 25W	1.0	
R20	542 1149 000	RES 1.8 OHM 2W 5%	1.0	
R21	542 1148 000	RES .36 OHM 2W 5%	1.0	
R22	548 0125 000	RES 1M OHM 3W 1%	1.0	
R23	542 1149 000	RES 1.8 OHM 2W 5%	1.0	
R24	542 1148 000	RES .36 OHM 2W 5%	1.0	
R25	548 0125 000	RES 1M OHM 3W 1%	1.0	
R35	914 9092 001	CONTROL, MODIFIED	1.0	
R36	550 0067 000	POT 10K OHM 2W 10%	1.0	
R50	552 0973 000	RHEO 200 OHM 12.5W	1.0	
S1	604 0032 000	SW, TGL DPDT	1.0	
S7	602 0056 000	SW, LEV 2P 3 POS	1.0	
S11	914 9091 002	SWITCH ROTARY	1.0	
S12	914 9091 001	SELECTOR SWITCH (MOD	1.0	
S13	604 0032 000	SW, TGL DPDT	1.0	
	650 0018 000	KNOB RD SKIRT 1.75	2.0	
	650 0021 000	KNOB RD SKIRT .911	5.0	
	650 0104 000	KNOB, CRANK	1.0	
	650 0129 000	KNOB 813 6081 001	1.0	

WARNING: Disconnect primary power prior to servicing.

Table 6-9. PA ENCLOSURE ASSY - 992 2707 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
C16,C18	516 0205 000	CAP HV 500 UUF 5000V	2.0	
C19	520 0155 000	CAP VAR 5.3-102PF	1.0	
C20	516 0204 000	CAP HV 100 UUF 5000V	1.0	
C21	516 0361 000	CAP FEEDTHRU 1000PF	1.0	
C22,C23,C24,C25 C26,C27	516 0205 000	CAP HV 500 UUF 5000V	6.0	
C28	516 0361 000	CAP FEEDTHRU 1000PF	1.0	
C30,C31,C32,C33	516 0210 000	CAP 200 PF 7500V 10%	4.0	
C34	915 0770 001	MODIFIED CAP 6-12PF	1.0	
C35,C36	516 0200 000	CAP, HV 25PF 7500V 10%	2.0	
C51,C52	516 0205 000	CAP HV 500 UUF 5000V	2.0	
J2	612 0317 000	RECEPTACLE BNC UG-1094/U	1.0	
L4	814 9994 001	INDUCTOR, PA GRID	1.0	
L5,L6	942 5768 001	INDUCTOR	2.0	
L7	815 0067 001	INDUCTOR	1.0	
L8	915 0089 001	PA OUTPUT INDUCTOR	1.0	
R31	546 0170 000	RES 50 OHMS 100 WATT	1.0	
R33	540 0579 000	RES 47.0 OHM 2W 5%	1.0	
R34,R43	540 0626 000	RES 4.3K OHM 2W 5%	2.0	
S8	604 0258 000	SW, PRESS.	1.0	
T7	472 0709 000	XFMR ISOLATION	1.0	
XCH1	404 0157 000	CHIMNEY TUBE SK806	1.0	
XV1	927 5241 001	TUBE SOCKET, PA MODI	1.0	
	452 0025 000	GEAR MITER 16 TEETH	1	
	452 0026 000	GEAR MITER 16 TEETH	1	

Table 6-10. SHELF ASSY - 992 2708 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
CR3	384 0020 000	RECTIFIER IN4005	1.0	
C6	522 0105 000	CAP 50 UF 150V	1.0	
C7	524 0162 000	CAP 530UF 250V	1.0	
K4	576 0088 000	RELAY, TIME DELAY 180 SEC	1.0	
K5	574 0153 000	RLY 41F-10000-S/SIL	1.0	
K6	572 0125 000	RELAY TEL AK12670	1.0	
K7	572 0052 000	RELAY TEL AK12175	1.0	
R8	540 0618 000	RES 2.0K OHM 2W 5%	1.0	
R16	542 0030 000	RES 1.0K OHM 5W	1.0	
R18	542 0036 000	RES 2.0K OHM 5W	1.0	
T2	472 0208 000	TRANSFORMER ISOLATIO	1.0	
XK4	404 0016 000	SOCKET, TUBE 8 PIN OCTAL	1.0	
Z1	384 0121 000	RECT BLOCK SILICON	1.0	

WARNING: Disconnect primary power prior to servicing.

Table 6-11. IPA ASSY - 992 2709 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
CR4	386 0155 000	ZENER, 1N3015A 200V	1.0	
C37	500 0852 000	CAP 1000 PF 500V	1.0	
C38	516 0450 000	CAP 1000PF 500V 20%	1.0	
C39,C40,C41,C42	516 0361 000	CAP FEEDTHRU 1000PF		
C43			5.0	
C44,C45,C46,C47	516 0457 000	CAP 1000 PF 600V	4.0	
C48	516 0361 000	CAP FEEDTHRU 1000PF	1.0	
C49	516 0205 000	CAP HV 500 UUF 5000V	1.0	
C50	520 0155 000	CAP VAR 5.3-102PF	1.0	
J5,J6	612 0317 000	RECEPTACLE BNC UG-1094/U	2.0	
L9	914 9991 001	COIL ASS'Y, GRID TUN	1.0	
L10	914 9992 001	COIL ASS'Y,INPUT LOA	1.0	
L11	494 0004 000	CHOKE R F 7 UH	1.0	
L12	914 9993 001	COIL ASS'Y, PLATE TU	1.0	
R37	550 0054 000	POT, 50 OHM 2W	1.0	
R38,R39	540 0563 000	RES 10.0 OHM 2W 5%	2.0	
R40	540 0603 000	RES 470.0 OHM 2W 5%	1.0	
R41,R42	544 1613 000	RES 100.0 OHM 4W 5%	2.0	
R45	540 0611 000	RES 1.0K OHM 2W 5%	1.0	
R46	540 0603 000	RES 470.0 OHM 2W 5%	1.0	
R47	540 0601 000	RES 390.0 OHM 2W 5%	1.0	
R48	542 0060 000	RES 100.0 OHM 10W	1.0	
R49	542 0193 000	RES 15.0K OHM 25W	1.0	
TP1,TP2,TP3	612 0312 000	JACK TEST POINT,WH	3.0	
TP4	612 0311 000	JACK TEST POINT, BLK	1.0	
T6	472 0090 000	TRANSFORMER FIL	1.0	
XCH2	404 0073 000	CHIMMEY AIR SOCKET	1.0	
XV2	404 0251 000	SOCKET, TUBE 8 PIN	1.0	
	358 0187 000	RCPTCL 82 SPRING	5.0	
	650 0028 000	KNOB RD SKIRT 1.135	1.0	
	915 1150 001	KNOB - MODIFICATION	1.0	

WARNING: Disconnect primary power prior to servicing.

Table 6-12. PNL ASSY - 992 3295 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
DS3,DS4	406 0358 000	PILOT LIGHT AMBER	2.0	
F1	398 0049 000	FUSE,SLOW CART .500A 250V	1.0	
F2,F3	398 0056 000	FUSE,SLOW CART 1.50A 250V	2.0	
F4,F5	398 0319 000	FUSE, SLOW CART 35A 250V	2.0	
K1	570 0158 000	CONTACTOR 4 POLE	1.0	
XF1,XF2,XF3	402 0074 000	FUSEHLDR INDICATING	3.0	
	402 0118 000	FUSEHOLDER 2 POLE	1.0	

WARNING: Disconnect primary power prior to servicing.

Table 6-13. METER MULTIPLIER - 938 4433 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY	UM
R001,R002,R003	548 0373 000	RES 249K OHM 1/2W 1%		
R004,R005,R006				
R007,R008,R009				
R010,R011,R012				
R013,R014,R015				
R016,R017,R018				
R019,R020			20.0	
	838 4432 001	PRINTED CKT.	1	
	827 6002 001	PRINTED CIRCUIT	1	

WARNING: Disconnect primary power prior to servicing.

SECTION VII

DIAGRAMS

7-1. INTRODUCTION

7-2. This section provides schematic, Interconnection and wiring diagrams necessary for maintaining the HARRIS FM-2.5K TRANSMITTER. The following diagrams are contained in this section:

WARNING: Disconnect primary power prior to servicing.

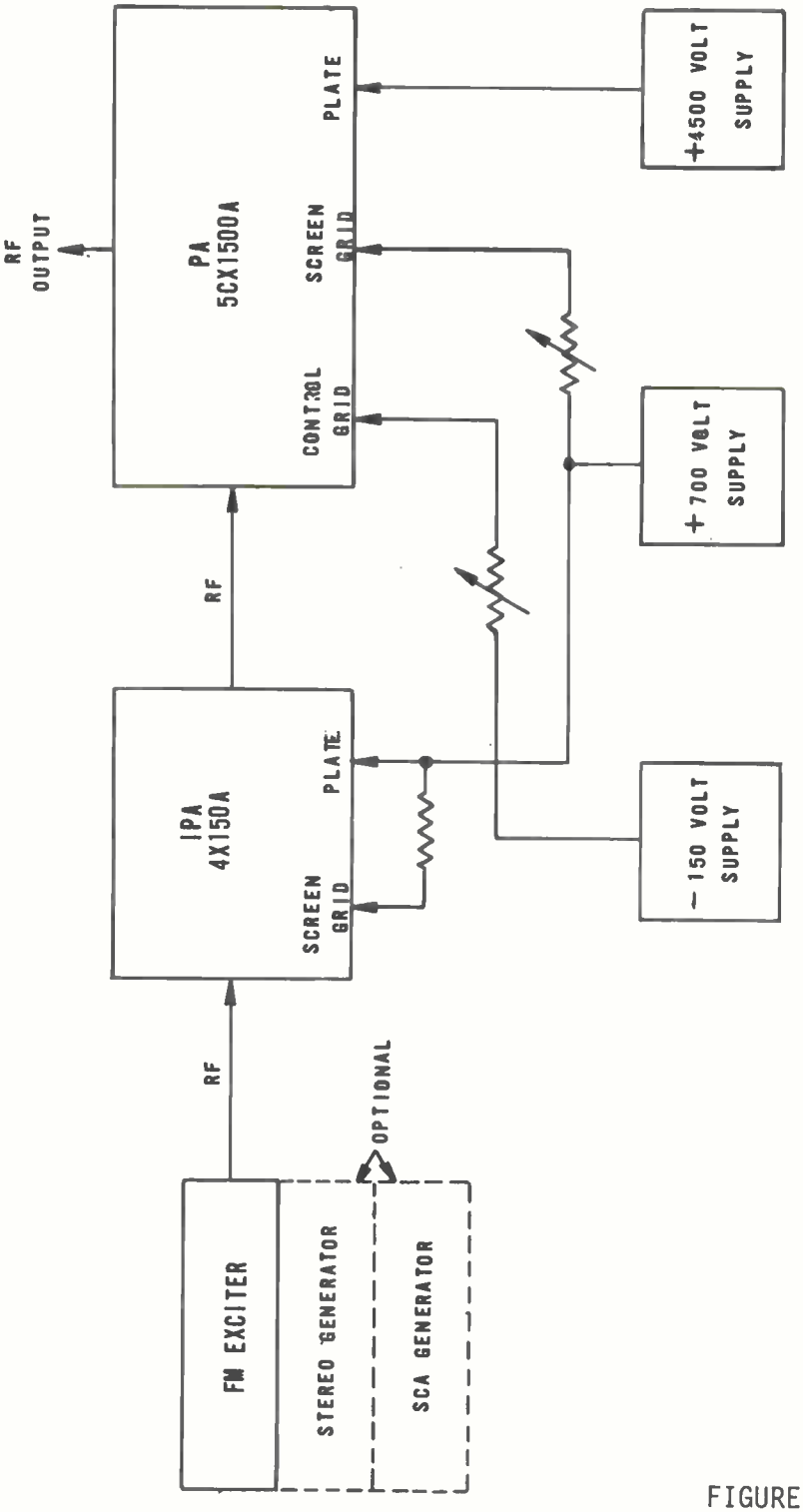


FIGURE 7-1. BLOCK DIAGRAM
FM-2.5K
815 3522 001

WARNING: Disconnect primary power prior to servicing.

POSITION OF COARSE TUNING SHORTING LINE ALONG PLATE LINE L5	
HOLE NUMBER FROM TOP	FREQUENCY RANGE (MHz)
LINE REMOVED	87.5 - 88.1
1	88.3 - 88.9
2	89.1 - 89.9
3	90.1 - 91.7
4	91.9 - 93.3
5	93.5 - 95.9
6	96.1 - 98.9
7	99.1 - 101.9
8	102.1 - 105.9
9	106.1 - 107.1
10	107.3 - 107.9
11	

FIGURE 7-2. COARSE PLATE TUNING CHART FM-2.5K 815 0206 001

WARNING: Disconnect primary power prior to servicing.

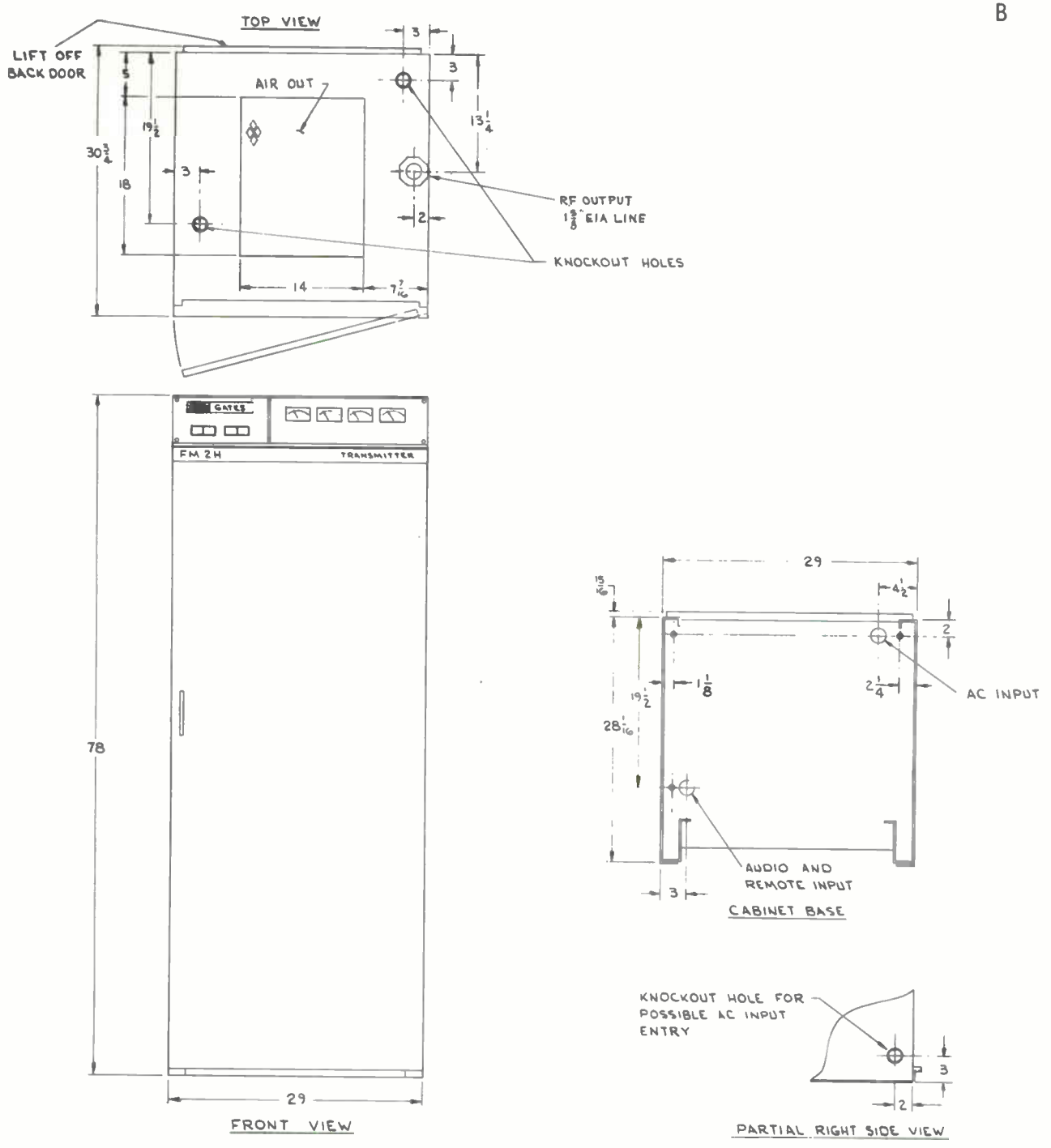


FIGURE 7-3. INSTALLATION LAYOUT
FM-2.5K
838 4123 001

7-7/7-8

WARNING: Disconnect primary power prior to servicing.

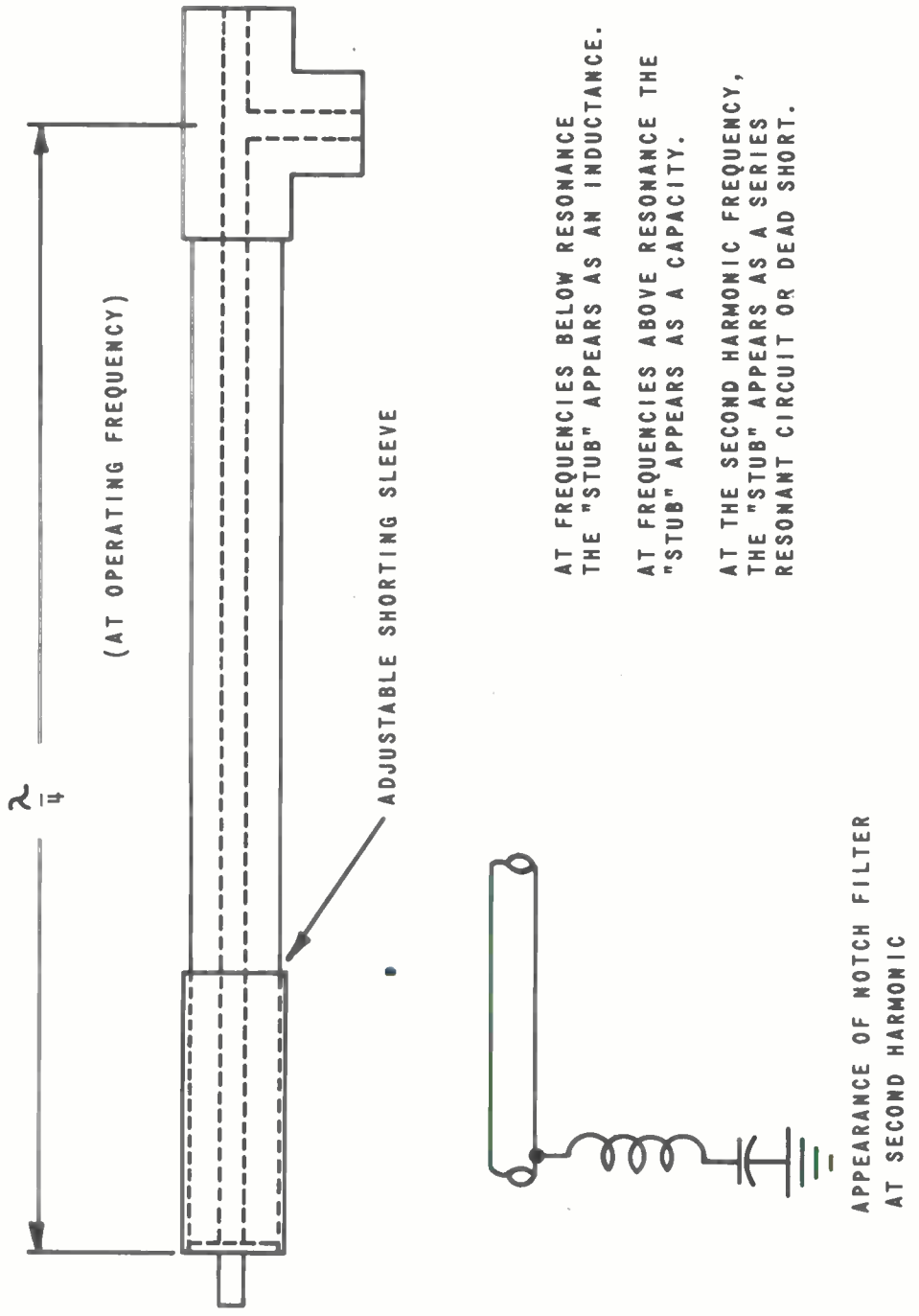
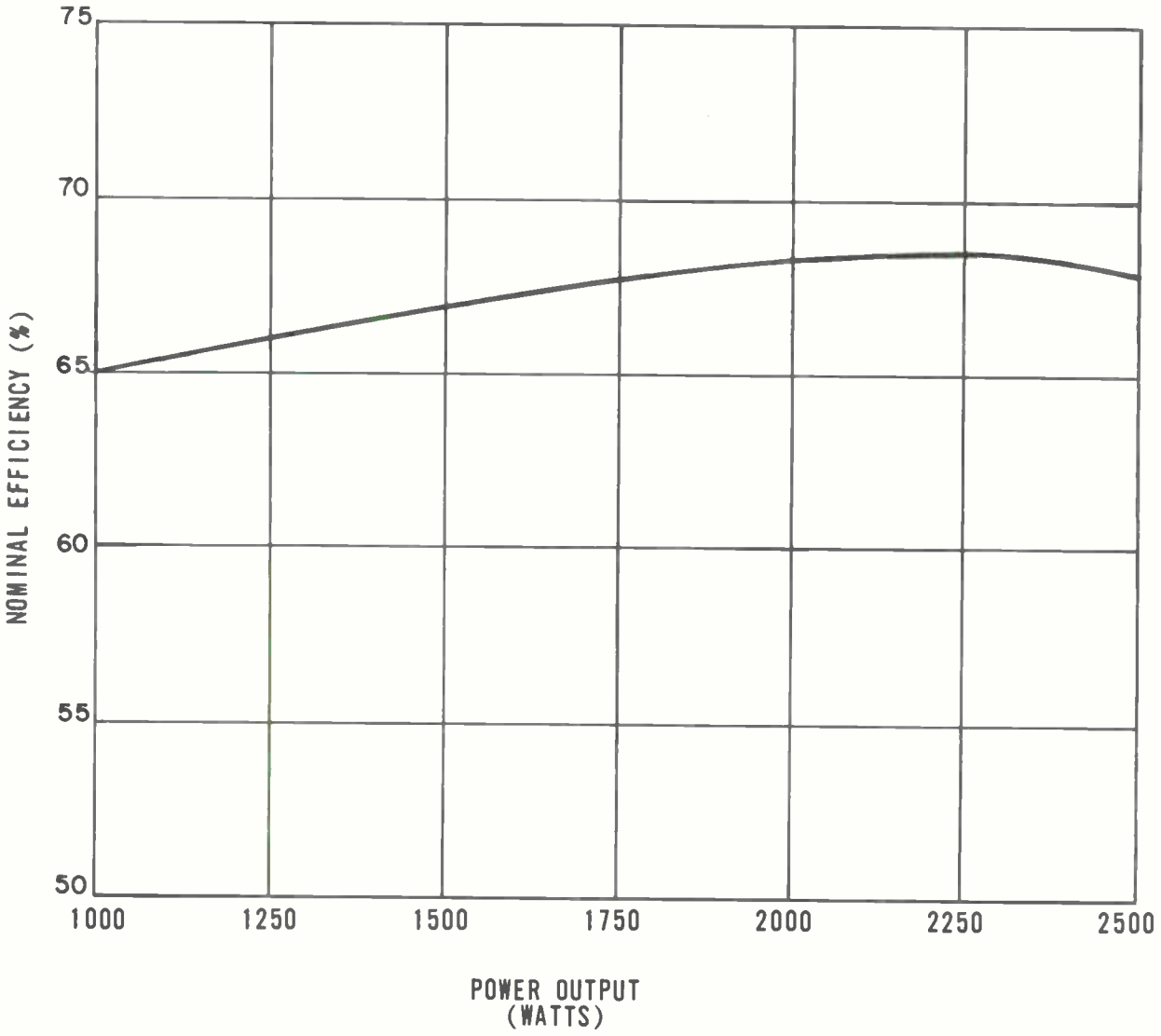


FIGURE 7-4. 2ND HARMONIC FILTER
FM TRANSMITTERS
814 8554 001

7-9/7-10

WARNING: Disconnect primary power prior to servicing.



REFER TO TRANSMITTER FACTORY TEST DATA FOR THE EFFICIENCY FACTOR DETERMINED ON FINAL TEST

FIGURE 7-5. PA EFFICIENCY CURVE
FM-2.5H3/FM-2.5K
815 3518 001-C

888-1759-003
7-11/7-12

WARNING: Disconnect primary power prior to servicing.

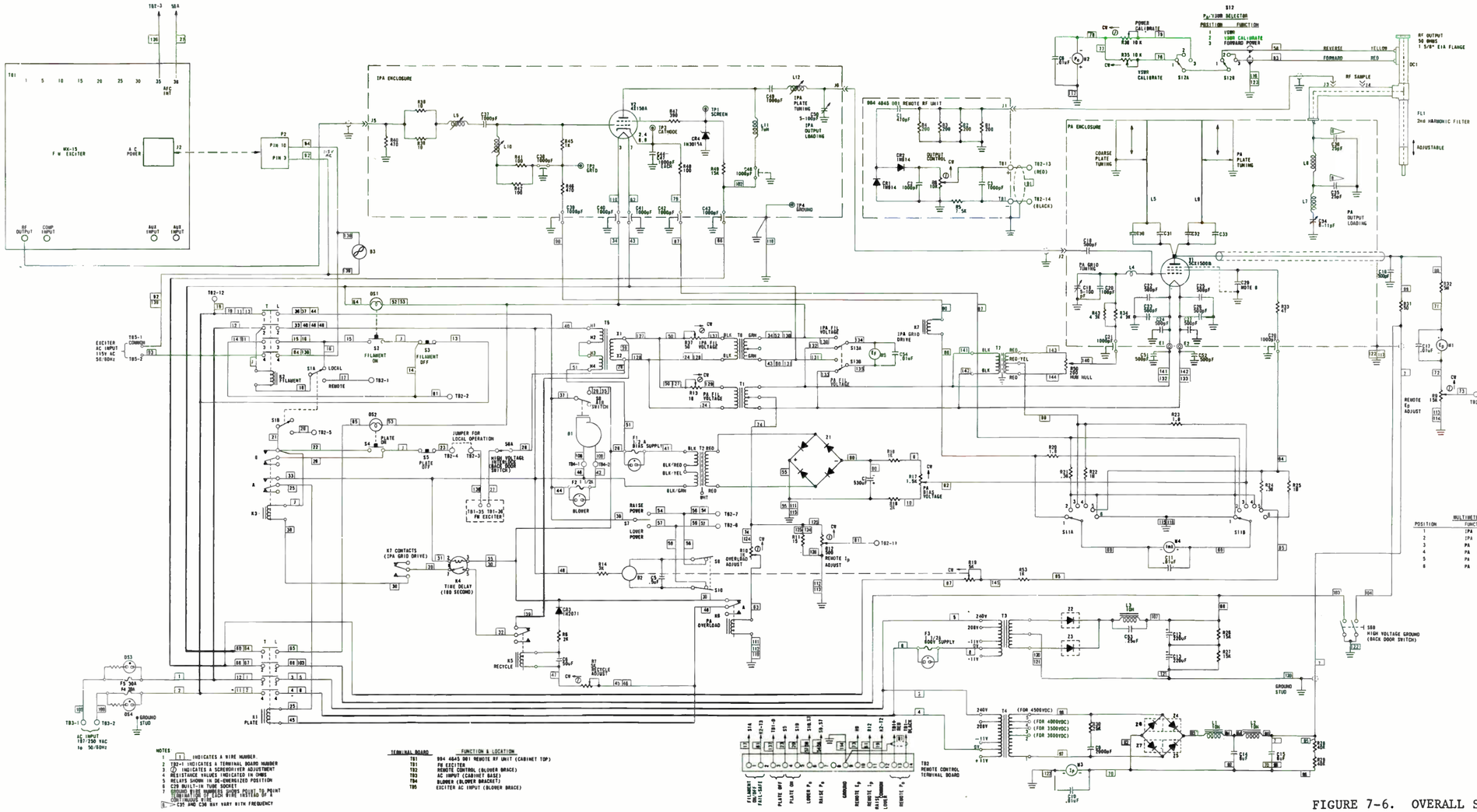


FIGURE 7-6. OVERALL SCHEMATIC
FM-2.5K
852 6671 002-D

888-1759-004
7-13/7-14