FM-20,000E

BROADCAST TRANSMITTER

INSTRUCTION MANUAL

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CCA Electronics Corporation
716 Jersey Avenue
Gloucester City, New Jersey 08030

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The FM-20,000E Broadcast Transmitter Instruction Manual contains descriptive, operational, servicing, and installation information applicable to the FM-20,000E Broadcast Transmitter, manufactured by CCA Electronics Corporation, 716 Jersey Avenue, Gloucester City, New Jersey 08030. Inquiries regarding the use of information contained in this manual should be made to the above address.

91/1005

SAFETY

Although the FM-20,000E incorporates interlocks and other design factors consistent with safe operation, it should be realized that the Transmitter is a high power device handling high voltages. When dealing with high power electronic equipment, personal safety cannot be overemphasized. Therefore, IT IS SUGGESTED THAT DUE REGARD FOR PERSONAL SAFETY BE EXERCISED WHEN SERVICING THE TRANSMITTER AND ITS ASSOCIATED DEVICES, AND WHEN EXAMINING CIRCUITRY WITH POWER "ON".

RELATED PUBLICATIONS

The following CCA manuals (supplied by CCA when their pertinent devices are purchased) contain information related to the operation of the FM-20,000E FM Broadcast Transmitter:

FM-40E Direct FM Exciter Instruction Manual
(CCA Publication No. 91/1003

SG-1E Stereo Generator Instruction Manual
(CCA Publication No. 91/1002

NOTE:

Several diagrams and other helpful illustrations are included in this manual. However, very large drawings have been inserted in the back of the manual (or combined instructional manual binder, if Transmitter is part of a CCA system ordered as a unit). It is suggested that these drawings be kept in the back of the manual (or binder) when not in use, in order to minimize the chance of losing them.

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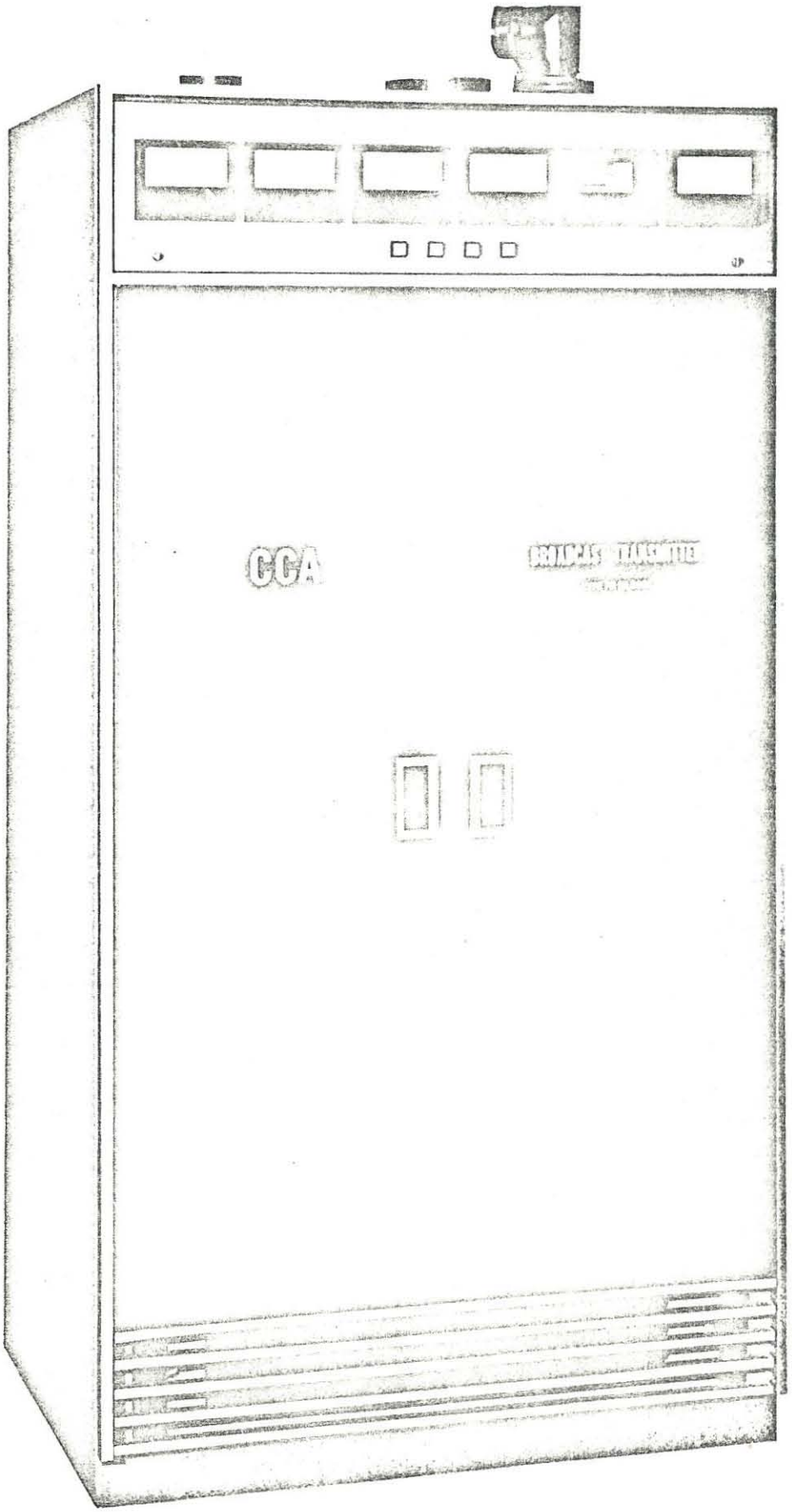


Figure i. FM-20, 000E Broadcast Transmitter
(Front View)

SECTION 1.

GENERAL DESCRIPTION AND OPERATING CHARACTERISTICS

1.1 GENERAL DESCRIPTION OF TRANSMITTER

The CCA FM-20,000E Broadcast Transmitter is a 20,000 watt FM transmitter designed for use in medium to high power broadcast facilities operating in the 88 MHz to 108 MHz band.

The FM-20,000E may be equipped with a stereo generator (CCA SG-1E Stereo Generator or equivalent) and a Subsidiary Communications Authorization (SCA) generator (CCA SCA-1E Generator or equivalent) for multiplex transmission of normal stereophonic services and private services simultaneously. As an alternative, the stereo generator may be used with the FM-20,000E for transmission of private services only.

Additionally, an optional remote control feature permits operation of the FM-20,000E in unattended installations, if this is desired. Other optional accessories, such as a "watchdog" monitor device (which turns off the transmitter automatically if reflected power exceeds a preset limit), modulation monitors, STL's and limiting amplifiers are available from CCA.

Field installation of these options generally requires little or no modification to the basic Transmitter. For example, a CCA SG-1E Stereo Generator or CCA SCA-1E Generator(s) may be added to the FM-20,000E by simply plugging these modular units into the frame of the exciter (FM-40E) that is normally used in the Transmitter.

The modular system affords versatility, convenience, and conservation of space without sacrifice of Transmitter quality of performance.

1.2 MECHANICAL DESCRIPTION

The FM-20,000E Transmitter is housed in a single medium-sized cabinet that occupies approximately 10 square feet of floor space. A harmonic filter and directional coupler are installed in the output transmission line on top of the cabinet.

The Transmitter is designed such that normal operation does not require the opening of cabinet doors. All controls are located at convenient levels, and the front panel controls are clearly visible and easily accessible.

Indicating lights describe the status of every major circuit. Overload indicator lights remain lit even after the automatic recycling circuit has restored the equipment to operation, thus permitting the operator to determine which circuit was overloaded before circuit restoration.

Six 4-1/2 inch meters located horizontally in line across the top front of the cabinet display all major functions as required by the FCC. A meter is provided to indicate incident and reflected power; and, additionally, an elapsed time meter is provided. The meter panel is constructed such that it can be hinged open through an interlocked system that permits quick access to the rear of the meters.

A 200% reserve in cooling is built into the cabinet ventilating system. All air entering the cabinet must flow through intake filters located in the rear door and in the front lower panel. Air outlet is at the top of the cabinet through a duct system that is connected to two outlet holes (one 4" and one 7" diameter) that are provided in the top of the cabinet.

1.3 ELECTRICAL DESCRIPTION

The intermediate power amplifier (IPA) stage in the FM-20,000E uses a 5CX1500A pentode. This tube has a power output capacity of 2500 watts, which is substantially more than the 1500 watts required to drive the final stage. The tube requires no neutralization, and has controls in its input and output circuits which are adjusted from the front panel to achieve maximum power.

A pi network is used to couple the IPA stage to the following power amplifier (PA) stage. The 3CX15,000A7 tube used in the PA stage is a high mu, zero bias triode. Its grid is connected directly to DC ground; thus, the problems associated with neutralization, RF bypass, and other malfunctions common to high power FM tetrode amplifier stages are eliminated.

Output power is developed across the fixed inductance of a tunable loading network. (Both output tuning and loading controls are provided.) The output is fed to a harmonic filter which attenuates all harmonics of the Transmitter output a minimum of 60 dB, and then to a directional coupler which reads both incident and reflected power to the transmission line.

All power supplies within the equipment use conservatively rated silicon rectifiers, all having associated RC circuits to prevent damage due to transients. Remote control operation and automatic overload recycling are valuable features of the Transmitter (see Sections 2. and 3. for more data.)

TABLE 1-1.

FM-20,000E TRANSMITTER TECHNICAL SPECIFICATIONS

Type of Emission	F3 FM
Frequency Range	88 MHz to 108 MHz
Rated Power Output (88 MHz to 108 MHz)	20,000 watts
RF Output Impedance	50 ohms (3-1/8")
Input Impedance (Audio)	600 ohms (Mono)
FM Noise Below ± 75 KHz	65 dB
AM Noise, RMS	55 dB below carrier
Harmonic Attenuation (Ratio of any Single Harmonic to Carrier)	At least 80 dB
Power Requirements	Primary Power: 208/230 VAC, 50/60 Hz, 3 Phase Slow Line Variations: ± 5% Fast Line Variations: ± 3%
Power Consumption (At 20 KW Output)	31,000 watts (approx.)
Power Factor	90% (approx.)
Mechanical Data	Transmitter Cabinet: Height: 76" Width: 38-1/4" Depth: 34" Harmonic Filter: Length: 90" Diam. : 6-1/8"
Environmental Data	Max. Altitude: 7,500 ft Temperature: 0° to 45° C
Input Audio Level Amplitude vs. Frequency Carrier Frequency Stability Modulation Capability Audio Frequency Distortion	See Exciter Data

SECTION 2.

TRANSMITTER
THEORY OF OPERATION

2.1 THEORY OF OPERATION

The theory of operation of the CCA FM-20,000E Broadcast Transmitter is described in this section. Operation of associated equipment (e.g., exciter, stereo generator, SCA generator) is not included in this section. Such information may be obtained from separate manuals dealing specifically with these devices. For further information in this regard, see NOTE under 2.1.1.

The FM-20,000E Broadcast Transmitter Functional Block Diagram (Figure 2-1.) and other helpful illustrations (including parts locations diagrams) are included in this manual. However, very large drawings have been inserted in the back of the manual for quick reference. If this manual is part of a combined instruction manual binder (see NOTE under 2.1.1), then the drawings will be located at the back of the binder. It is suggested that these drawings be kept in the back of the binder when not in use, in order to minimize the chance of losing them.

2.1.1 TRANSMITTER POWER SUPPLIES

The CCA FM-20,000E Broadcast Transmitter contains two independent power supplies: a low voltage power supply and a high voltage power supply.

NOTE:

> The Transmitter power supplies do not provide the DC voltages required for operation of exciter, stereo generator, or SCA generator circuits. Refer to manuals provided with these devices for power supply information pertaining to their operation. If the devices are ordered from CCA with the Transmitter, these

manuals are normally combined in one binder, entitled "CCA Broadcast Systems Instruction Manuals." (Check front cover information to see if other manuals are included in this binder.) If the devices are ordered separately, the manuals are shipped separately.

2.1.1.1 Low Voltage Power Supply

Refer to the FM-20,000E Schematic Diagram (Dwg. No. D40,159).

The low voltage power supply obtains its primary AC operating power from control transformer T1 through contacts of relay K19. Voltage on the secondary of power transformer T5 is rectified by full wave bridge rectifier Z7, and the bridge output is filtered by a choke input pi filter composed of L22, L23, C19, and C20. The 500 VDC output is applied to the screen grid of the intermediate power amplifier (IPA) tube (V1). A rheostat (R53) in the bleeder circuit of the low voltage supply serves as the power output control of the Transmitter. (R53 controls the screen voltage applied to the IPA.)

2.1.1.2 High Voltage Power Supply

Refer to the FM-20,000E Schematic Diagram (Dwg. No. D40,159).

The high voltage power supply main output is used to supply final power amplifier (PA) stage plate voltage. A half-voltage derived from the high voltage supply is used for the intermediate power amplifier (IPA) stage plate voltage.

The high voltage transformer (T2) secondary contains a full wave silicon bridge rectifier connected to a choke input filter (L1 and C4). The PA plate voltage is taken from the output of this filter. The half-voltage for the IPA plate is taken from the choke input filter composed of L2 and C6.

The AC primary boltage that supplies the high voltage transformer is connected in a "wye" configuration when the Hi-Lo switch (S4) is in the LOW position, and in a "delta" configuration when S4 is in the HIGH position. The PA plate voltage changes from about 4250 volts to 7500 volts from the LOW setting to the HIGH setting.

2.1.2 CONTROL CIRCUITRY

Refer to the FM-20,000E Schematic Diagram. (Also see the tuning information given in Section 4. for further control circuit information.)

When the control circuit breaker (CB2) is turned on, primary voltage is applied to the control transformer (T1). If the front panel Filament switch (S3) is turned on, voltage is applied to the start relay (K10) and K 25 applying voltage to the PA-IPA blowers (BL 1 and BL 2), and to the cabinet-mounted exhaust fan (BL3), as well as to pin 3 of relay K12. If the air interlock (S10) and the PA box front interlock (S11) are closed, the filament relay (K12) energizes, permitting 117 VAC to be applied to the IPA filament transformer (T3). When the filament circuit breaker (CB3) is turned on, 220 VAC will be applied to the PA filament transformer (T4). Also, at this time voltage from K12 will energize the 120 second, 230 volt time delay relay K1.

If the interlock associated with panels and doors, and the ground stick and external interlocks (S7, S18, S19, S12, and jumper from TB2-11 to TB2-12) are closed, the front panel Interlocks light (I2) will illuminate. After 120 seconds, time delay relay (K1) contacts close, the front panel Ready light (I3) illuminates and the Exciter is turned "ON"

If the High-Low switch (S4) is in the LOW position, then turning on the front panel Plate switch will apply voltage to relay K18, and primary voltage will be applied to the high voltage plate transformer (T2). The primaries of the plate transformer are connected in a "wye" configuration to provide minimum output voltage for the transformer. When the high voltage power supply produces output voltage, relay K19 (which is connected across a portion of the half-voltage output bleeder) energizes and allows primary voltage to be applied to transformer T5 in the low voltage plate supply. The front panel Plate light (I5) and the Lower Power light (I4) will illuminate.

Putting the High-Low switch in the HIGH position will then apply voltage to the one-second time delay relay (K4). When K4 energizes, the Lower Power light will turn off, and the Hi-Lo transfer relay (K11) will energize. Contacts of K11 complete the circuit to relay K17, and K17 contacts change the primary connection of the high voltage plate transformer from a "wye" to a "delta" configuration, thus increasing the output voltage of the high voltage power supply.

In the event of a malfunction in any of the overload circuits protected by the overload relays (K13, K14, K15, and K16), voltage from contacts

of the affected overload relay causes relay K2 to energize. The contacts of K2 are normally closed. When the relay energizes, the open contacts open the plate control circuit. The opening of the plate control circuit automatically removes high voltage and screen voltage from the power amplifier and intermediate power amplifer.

The Transmitter incorporates a three-cycle overload cycling system that automatically restores Transmitter operation within one second in the event of a fault. If the fault persists, the Transmitter recycles two additional times. However, if the fault persists with three overloads within one minute, the Transmitter will shut down and it will be necessary to operate the Reset button.

The circuit that operates the overload system also operates one of the auxiliary relays (K20, K21, K22, and K23). These are latching relays which apply a voltage to indicator lamps (I7, I8, I9, or I10) when they latch. The overload indicators remain on even though the overload has been cleared, allowing the operator to observe which circuit overloaded, even though the equipment has been restored to proper operation. The only way the overload lights can be extinguished is by operating the corresponding overload reset switch (S14, S15, S16, or S17).

NOTE:

If the High-Low switch is put in the HIGH position the transmitter will not immediately go to its high voltage. It will initially go to low voltage; and then, within one second, it will go to high voltage. This scheme reduces the surges on the filter capacitors and other components, thereby extending life expectancy.

2.1.3 POWER AMPLIFIERS

Refer to the FM-20,000E Schematic Diagram (Dwg. No. D40,159).

2.1.3.1 Intermediate Power Amplifier

The intermediate power amplifier (IPA) in the FM-20,000E uses a single 5CX1500A pentode (V1). The output of the exciter is fed to the control grid of V1. The exciter output is received at J1 and

coupled to the control grid circuit by means of a tuned pi composed of L 6, and variable capacitors C 16 and C 17.

IPA stage is operated substantially below its maximum output power capability. No neutralization is required for this stage.

2.1.3.2 Power Amplifier

The final stage power amplifier (PA) of the FM-20,000E contains a 3CX20,000A7 Eimac vacuum tube (V2). V2 is a zero bias, high mu ceramic triode that has a power gain of approximately 20 in the grounded grid configuration. The tube is rated such that, with the grid connected directly to DC ground and without any RF drive, its plate dissipation will not exceed 10% of its maximum rating. The ability to ground the grid eliminates the necessity of RF bypasses or a bias supply, and assures perfect isolation between input and output circuits. As in the case of the IPA, no neutralization is required for this stage.

In the output circuit of the power amplifier, shunt inductors (L15 and L17) are used as loading and tuning controls for transforming the output power to the 50 ohm output line. The loading and tuning controls permit smooth adjustment of output power with PA efficiencies of 75 to 80%.

2.1.4 HARMONIC FILTER

A 60 dB harmonic filter is connected to the output fitting of the Transmitter cabinet. The harmonic filter attenuates all harmonics up to 1000 MHz a minimum of 60 dB. This attenuation, in combination with the normal attenuation of the PA tuned circuits, permits an 80 dB-or-better attenuation of all harmonics, and therefore meets FCC requirements. The harmonic filter has an output power rating of more than 25 kilowatts and an insertion loss of less than 0.1 dB.

2.1.5 REMOTE CONTROL FEATURE

The FM-20,000E can be operated by remote control that includes the availability of all FCC metering and control functions in the equipment.

For remote control operation, all switches within the FM-20,000E cabinet must be in their normal positions except for the Local-Remote switch (S2), which should be in the REMOTE position. When the Local-Remote switch is in the REMOTE position, main panel controls are disconnected from the circuit. The following must be done to prepare the equipment for remote control operation:

1. To Turn on Filaments:

   A shorting conductor must be connected between TB2 terminals 1 and 2. (TB2 is located on left side of cabinet viewed from rear. See parts lists illustration in Appendix A.)

2. To Turn on Plate:

   A shorting conductor must be connected between TB2 terminals 5 and 6.

3. To Reset Overloads:

   Connection between TB2 terminals 3 and 4 must be interrupted.

4. To Meter PA Plate Voltages:

   Measure voltage from terminal TB2-14 to ground. It should be approximately 1 volt. If greater voltage is required, change the 3.9K resistor, R12, located on the plate voltage divider board, to a higher value. (Example: Where R12 is 5K, output voltage is about 5 volts.)

5. To Meter PA Cathode Current:

   Measure voltage from terminal TB2-15 to ground. This voltage can be adjusted by moving the slider on R26 to achieve the desired voltage reading.

6. To Meter Power Output:

Request from CCA a special diode kit which can be installed in the RF monitor probe circuit to produce the desired DC voltage.

7. To Raise and Lower Power Output:

Install a motor-driven rheostat (CCA Part No. CCA-MR-1D) between TB2-19 and TB2-20. Refer to the schematic diagram (Dwg. No. D40,159). Installing the rheostat as described above places it in series with the screen of the IPA tube. This permits power output control by variation of the screen grid voltage to the IPA tube (V1).

2.1.6 MISCELLANEOUS CONTROLS

The FM-20,000E contains several controls that are preset at the factory and, in general, do not require readjustment. Information on these controls is given below:

1. Exciter Controls:

See exciter instruction manual.

2. PA (Power Amplifier):

a. R19: This control is located on the underside of the meter panel, and is used to calibrate the meter. It is calibrated with the Transmitter terminated by a known power meter.

b. R20: (PA Filament) This control is located on the front right hand side of the PA box. It is used to adjust the filament voltage of the PA. It is adjusted for 6.3V as read on the PA filament voltmeter (M4). When the PA filament voltage is to be adjusted, put S13 (IPA-PA filament metering switch -- located on right hand side of PA box) to PA FILAMENT position and adjust R20 for maximum RF output consistent with minimum Filament Voltage. (This is the final adjustment to be made). You will note that your Transmitter proof sheet will give you the actual Meter Reading.

NOTE:

M4 (associated with S13) is a dual purpose meter for monitoring IPA and PA filaments.

c. R34: (IPA Filament). The IPA filament adjust is located on the screen supply panel adjacent to the exciter. Put S13 in IPA-FILAMENT position then,adjust R34 for 5V as read on meter M4. Finally you will adjust as in the case of the PA Filament for max. RF with min. Voltage; also the proof sheet will give you ideal Meter Readings.

2.1.7 VSWR WATCHDOG AND OTHER OPTIONS

The VSWR (voltage standing wave ratio) watchdog is an optional feature that monitors the reflected power from the FM-20,000E directional coupler. If the VSWR exceeds a preset limit, Transmitter plate voltage is removed. The Transmitter will remain off until the watchdog is reset, either locally or remotely.

If transmitter is shut down by VSWR Watchdog, it would be advisable to turn transmitter on in Low Power. Check VSWR making certain everything is normal before going to full power.

If a high VSWR does exist, it will be necessary to turn the transmitter off and make necessary repairs or adjustments.

It is not advisable to operate this equipment with a VSWR of more than 1.3 to 1.

The watchdog is designed for mounting in an auxiliary rack. For further information, please contact CCA.

Additional optional items, such as remote control systems, modulation monitors, STL's, and limiting amplifiers are available from CCA.

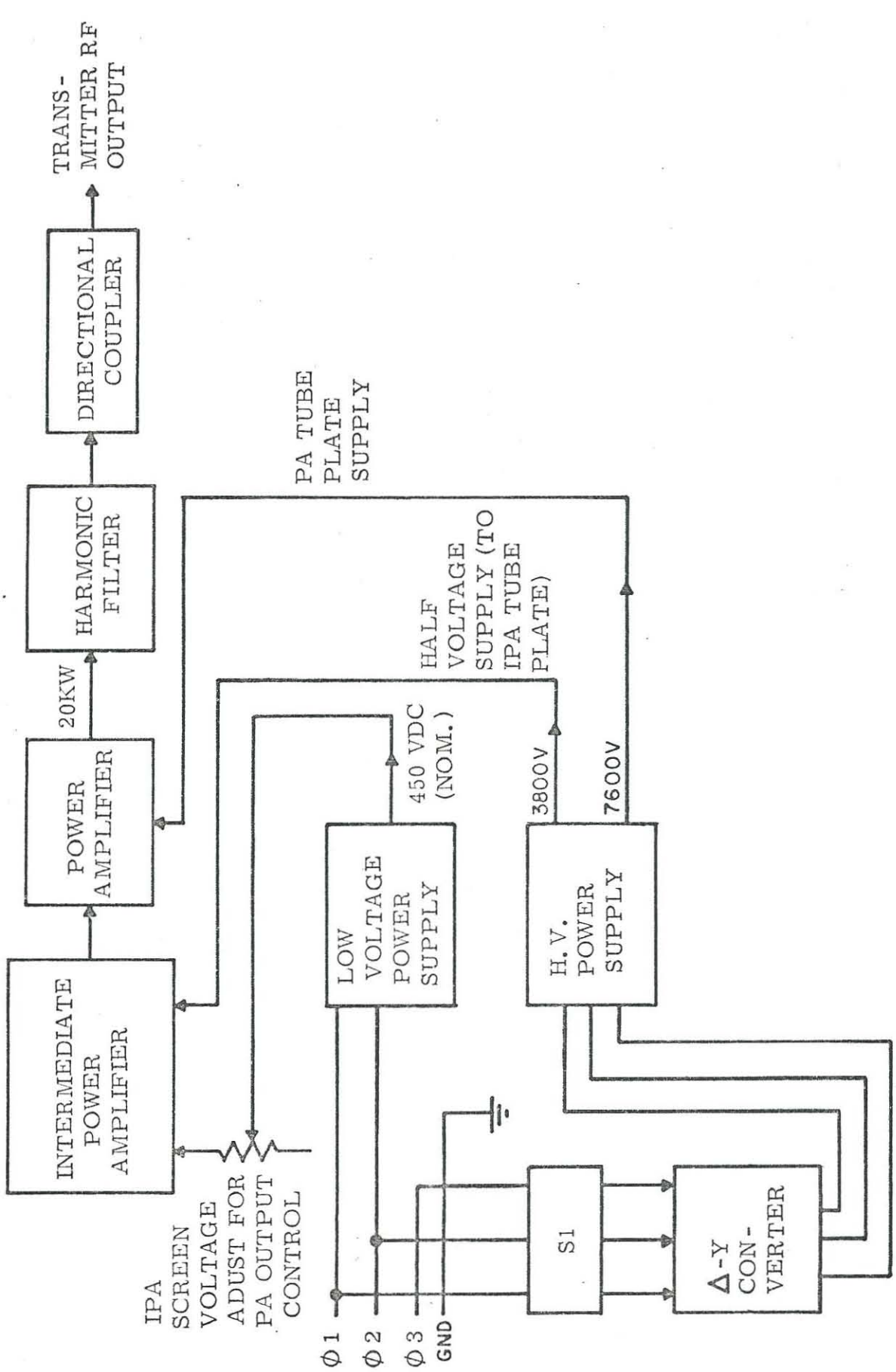


Figure 2-1. FM-20,000E Broadcast Transmitter
Functional Block Diagram

SECTION 3.

MAINTENANCE

3.1 TRANSMITTER MAINTENANCE

3.1.1 CORRECTIVE MAINTENANCE AND TROUBLESHOOTING

During a malfunction within the Transmitter, certain readily observable symptoms may be exhibited. Most Transmitter problems can be solved by correlating such symptoms with the diagnostic information given below and following the indicated corrective procedures.

NOTE:

In the event that troubleshooting fails to resolve a FM-20,000E problem, the CCA Service Department may be contacted for technical aid.

Suggested Troubleshooting Methods and Corrective Measures:

1. In Case of a Transmitter Overload:

   a. Investigate overload indicator relays and determine which circuit is overloading. The circuit which is causing the overload will energize one of the overload relays (K13, K14, K15, or K16), which will in turn energize a corresponding relay (K20, K21, K22, or K23) that will turn on a corresponding overload indicator lamp (I7, I8, I9, or I10).

   b. Reset the Transmitter and observe metering of the circuit for which the overload is indicated. If a problem exists, there should be an obvious change in the meter readings. Investigate the following as possible causes:

(1) High Voltage Overload:

(a) Defective rectifiers

(b) Defective choke or high voltage filter capacitor

(c) Defective RF bypass capacitor (C31, C32, C46)

(d) Defective blocking capacitor

(e) Defective tube

(2) PA Overload:

(a) Defective Tube

(b) Defective antenna or transmission line.

(c) Drive present, no plate voltage on power amplifier.

(3) IPA Overload:

(a) Defective Tube

(b) Drive present, but no plate voltage.

(c) Defective blocking capacitor (C15 or C30)

(4) Low Voltage Overload:

(a) Defective rectifier (Z7)

(b) Defective filter capacitors (C19, C20, L22, L23)

(c) Defective screen bypass capacitor (part of IPA socket)

c. If currents are normal, but Transmitter continues to overload, some possible causes are:

(1) Open or high resistance value in overload sampling resistors.

(2) Incorrect setting of tension on overload relay. (Turn screw on relay counter-clockwise, to reduce sensitivity.)

(3) Defective overload relay

2. In Case of Insufficient Power Output:

a. Observe PA plate and PA cathode currents. If currents are normal or higher than normal, a problem may exist in the PA output circuit, in the harmonic filter, or in the antenna system. Turn the Incident-Reflected switch (S9) to the REFLECTED position and observe the meter indication.

(1) If the meter indication in the REFLECTED position is higher than normal, the problem is in the transmission line or antenna.

(2) If the reflected power reading is normal, readjust the PA Tuning and Loading controls (L15 and L17). It is extremely unlikely that drift has occurred in the output circuitry. If circuits require detuning it is most probably due to a prior misadjustment.

b. If PA plate and PA cathode currents are lower than normal, consider the conditions of the other currents:

(1) If all currents are normal, (as per Test Data Sheet), the problem may be due to low filament voltage or due to the fact that the tube is old.

(2) If IPA cathode current is higher than normal, suspect either:

(a) Incorrect setting of IPA Tuning and Loading controls (L14, L20), or

(b) Defective capacitors (C15, C28, C29, C30), or

(c) Defective IPA tube, or

(d) (Defective) PA tube which will not accept drive.

3. In Case of No Power Output:

If there is low cathode current and low (or no) grid current, there may be low drive from the exciter (or no drive at all) due to mistuning of the IPA input. Also, there may be no output from the exciter.

3.1.2 PREVENTIVE MAINTENANCE

DAILY: Inspect meter readings for any abnormalities.

WEEKLY: Vacuum base of cabinet.

MONTHLY: Remove covers from PA and vacuum inside of PA box. Be sure to keep the screen in the PA socket clean. Vacuum top of IPA socket.

Clean intake filters located in back door and in front lower panel. If permanent type filters (aluminum), wash and spray with special dust attractant. If fiberglass filters, remove dust (or replace filters, if required).

SECTION 4.

TRANSMITTER INSTALLATION AND TUNING

4.1 TRANSMITTER INSTALLATION

4.1.1 PRE-INSTALLATION PLANNING

Prior to installation of the FM-20,000E, a suitable location should be selected for placement of the unit. Figure 4-1. illustrates cabinet top and floor views, as well as cabinet dimensions, door swing clearances, and locations of cabinet entrance holes. It is preferable to locate the cabinet such that there is ample room to allow opening of both front and rear doors. The cabinet location must permit an adequate flow of air for the fresh air ventilation system within the unit.

Arrangements should be made to install a duct system (to be attached to the top of the cabinet) which will permit the exhaust air from the equipment to be removed from the room. The exhaust system should have a maximum static pressure drop of 0.1 inch, and the exhaust ducts should be at least 7 inches in diameter.

The equipment is built to operate safely at temperatures up to 113°F, but it is advisable to keep the ambient temperature as low as possible.

4.1.2 PRE-INSTALLATION EQUIPMENT CHECK

After the equipment is received the following checks should be performed:

1. Remove the equipment from its shipment packing. Verify that the following have been received:

    a. FM-20,000E cabinet (in major crate)

    b. High voltage plate transformer (in wooden crate)

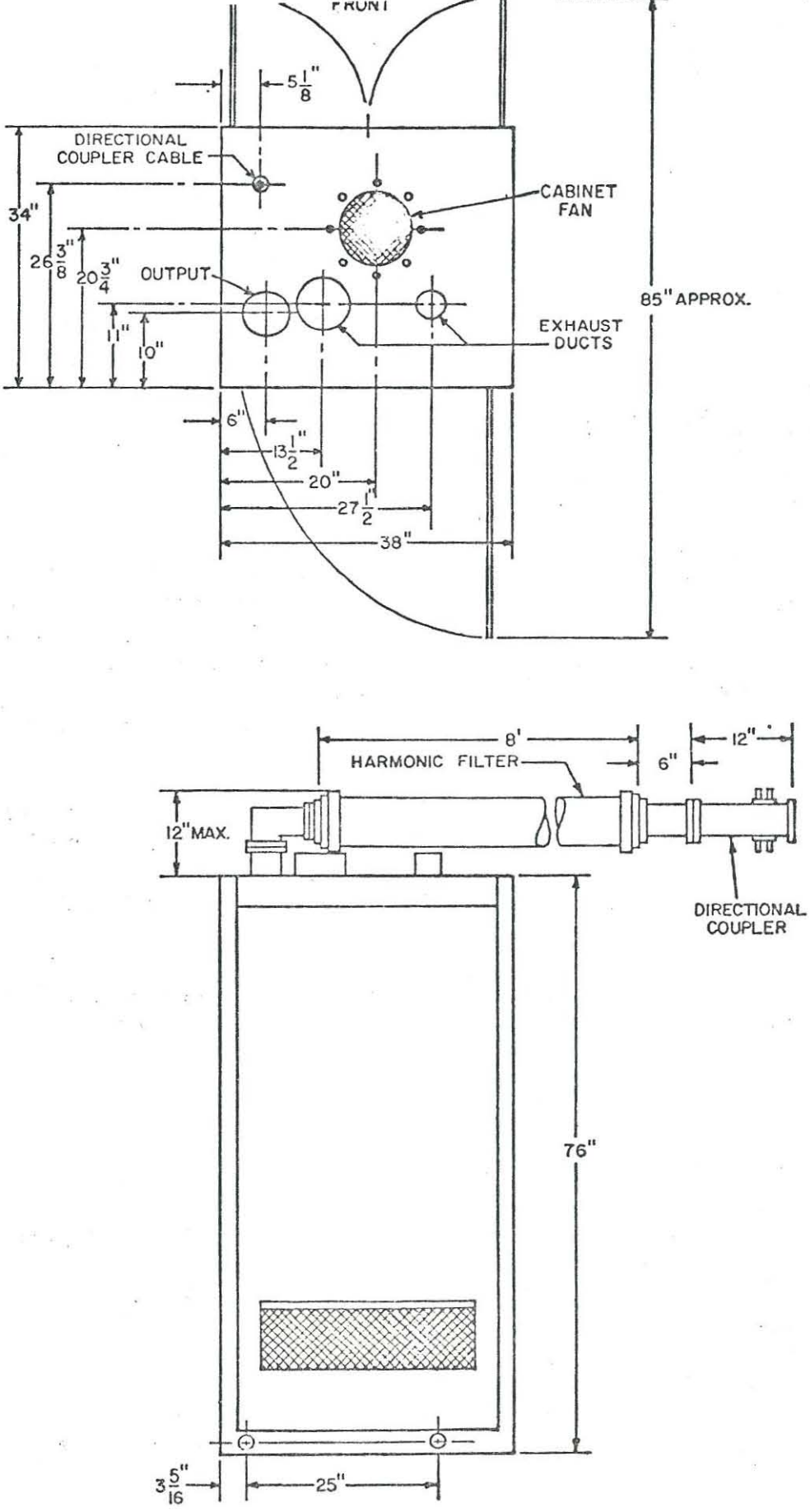


Figure 4-1. FM-20,000E Cabinet (Top and Rear Views)

c. Harmonic Filter

d. Parts removed from cabinet base for shipment (in wooden crate)

If any of the above equipment is missing, please notify CCA.

NOTE:

The PA and IPA tubes are normally shipped in place within the cabinet.

2. Carefully inspect the equipment for any apparent physical damage. If the inspection reveals equipment damage, the transportation agent should be contacted.

4.1.3 INSTALLATION

The following procedure should be used during FM-20,000E installation:

1. Using Figure 4-2. as a guide for parts location, install the following components on the cabinet base:

   a. Control transformer (T1)

   b. High voltage plate transformer (T2)

   c. High voltage filter choke (L1)

   d. High voltage filter capacitor (C4)

   e. Half voltage filter choke (L2)

   f. Half voltage filter capacitor (C6)

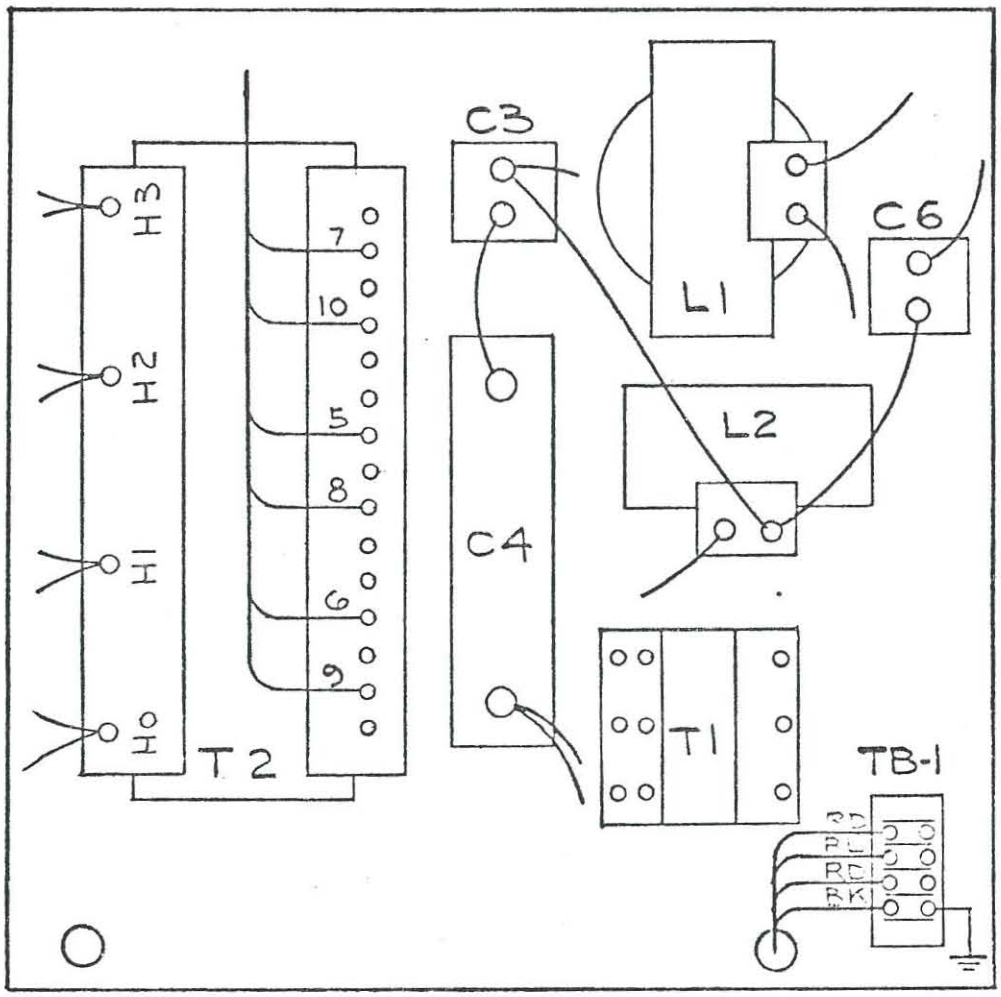


Figure 4-2. FM-20,000E Cabinet Floor (Top View)

Wires are tagged with identification symbols corresponding to terminals on the components. Connect the appropriate wires to the installed base components.

2. Connect a 3-1/8 inch elbow to the output flange on the top of the cabinet (see Figure 4-1.). Then mount the harmonic filter and directional coupler. Attach the couplings that are secured to the top of the cabinet to the appropriately colored fittings on the directional coupler.

3. Be sure that the 3cx20, 000A7 and 5CX1500A tubes are properly seated in their sockets within the PA box, and that the "clip-on" connections to the plates of these tubes are secured.

4. Only if monaural operation is desired (exciter used without stereo generator), open the rear door of the cabinet and connect the balanced audio input to TB9 terminals 1, 2 and 3 (ground). Audio required for 100 % modulation is approximately +10 dBm (±2 dBm) at 400 Hz.

5. For stereo operation, refer to installation instructions given in the exciter manual.

6. Install the three one-second time delay relays (K4, K5, and K7), the 115 VAC 60 second time delay relay (K8), and the 230 VAC 120 second time delay relay (K1) in their proper sockets on the control panel.

7. Refer to Figure 4-2. Install the high voltage plate transformer (T2) in its proper position and connect the appropriately marked wires to both primary and secondary terminals.

8. Be sure that all circuit breakers within the equipment are off. Then connect the three-phase, four-wire (208 to 240 VAC) AC input lines to terminals 1, 2, 3, and 4 (ground terminal) of terminal board TB1 within the cabinet. Use entrance holes on the rear and base of cabinet. (Be sure to connect AC ground first.)

CAUTION:

Keep wall circuit breaker off throughout the installation procedure.

9. Connect a substantial three-inch strap between a known station ground and the cabinet.

10. Before proceeding further, be sure that the Transmitter is terminated with either a 50 ohm antenna or a known 50 ohm dummy load. Following this, Transmitter installation may be considered to be completed. Transmitter tuning should be done next (see 4.2).

4.2 TRANSMITTER TUNING

To tune the Transmitter, perform the following steps sequentially:

1. Be sure that the switches on the front of the cabinet are set correctly. Proper switch settings at this point in the tuning procedure are:

    a. Filament switch (S3) in OFF position.

    b. Plate switch (S5) in OFF position.

    c. Remote-Local switch (S2) in LOCAL position.

    d. High-Low switch (S4) in LOW position.

    e. Incident-Reflected switch (S9) in INCIDENT position.

    f. All three circuit breakers (line:CB1, control:CB2, and filament:CB3) in OFF position.

    Verify that the 230 VAC three-phase power lines have been properly connected to the input terminal board (TB1) terminals. Measure the line voltage at TB1, and then turn off the voltage feeding these terminals (turn off external circuit breaker). The following transformers in the FM-20,000E require 190 VAC to 240 VAC connected to their primaries:

    a. Control transformer (T1), located on cabinet base.

    b. High voltage plate transformer (T2), located on cabinet base.

c. IPA Filament transformer (T3), located in PA box.

d. PA Filament transformer (T4), located in PA box.

With the line voltage to the equipment removed, connect the transformer primaries as follows:

LINE VOLTAGE	TAPS
208 VAC	0 & 208
230 VAC	0 & 230
240 VAC	+10 & 230
190 VAC	-10 & 208

3. After proper transformer connections have been made, restore AC line voltage to the Transmitter and turn ON the control and filament circuit breakers (both located on control panel).

4. Turn ON the Filament switch (S3 -- on control panel). This energizes the start relay (K10), which in turn causes the blowers to operate. After the blowers achieve sufficient air flow, the following events occur in listed order:

   a. The air interlock (S10) closes.

   b. If all covers are on the PA box, the filament relay (K12) will close; and, if the meter panel interlock (S7), lower front panel interlock (S18), ground stick interlock (S19), and cabinet back door interlock (S12) are closed, and the external interlock is jumpered (TB2-11 to TB2-12), the Interlocks light (I2) will illuminate.

      (Refer to FM-20,000E Schematic Diagram (Dwg. No. D40,159) for diagrammatic representation.)

5. Turn the Multimeter switch (located on PA box) to its IPA-I_G position.

6. Turn ON the filament circuit breaker (CB3 -- on control panel). Voltage will be applied immediately to the filament transformers (T3 and T4 -- see drawing D40,159), and also to the 120 second time delay relay (K1). Within 120 seconds K1 relay contacts will close and the Ready light will illuminate.

NOTE:

K24 energizing allows 110 VAC to be applied to the exciter. Also when the Filament switch is turned off, K24 de-energizes, removing AC from the exciter.

7. The closing of K 1 contacts 6 and 7 also causes relay K24 to energize.

8. The exciter (if CCA FM-40E) is pre-tuned at the factory to the customer's frequency, and requires no alignment in the field, other than resetting of the Power Output control on the front panel of the FMO.

9. Check the match between the IPA and exciter, using the following procedure:

   a. Gradually increase the Exciter Output observing that the VSWR is well below 1.2 to 1 , normally 1 to 1.

   b. If the VSWR is not normal as Exciter Power is increased re-adjust C 16 and C17 to obtain normal reading as RF Output is set to 100% maximum. If you are in doubt, turn off Exciter and call CCA for help.

CAUTION:

Under no circumstances should the exciter be operated without proper termination. Doing this will result in damage to the amplifier or other exciter components.

When conditions in (b) are met, observe IPA-I_G metering. The meter should read 30% to 60%. If the IPA input is properly tuned, a further check of the VSWR is required, when the Transmitter has been finally tuned to full power.

10. Be sure that the tuning controls for the power amplifier (PA) and intermediate power amplifier are at the settings indicated in the Test Data Sheet (supplied with the Transmitter) and that the antenna and transmission line are correctly connected to the output of the directional coupler.

11. Be sure the Hi-Low switch (S4-- on control panel) is in the LOW position. Turn ON the line circuit breaker (CB1). Voltage will indicate on the line voltmeter (M1). Rotate the Line switch (S1) and verify that all three phases are the same.

Turn ON the Plate switch (S5). AC voltages (117 VAC) will now be applied to relay contacts of K2, K11, and K17, and to the coil of relay K18. This will apply 208 VAC to 230 VAC to the primary windings of T2. The Pa voltmeter should indicate approximately 4000 volts. See NOTE below.

12. Turn the Multimeter switch to I_K position. Rotate the Power Output control (R53) to achieve 20% on the multimeter. Rotate the multimeter switch to the PA-I_K position, and then adjust IPA output tuning and loading (using L14 and L20, both located at the bottom of the PA box front panel) to achieve a maximum PA-I_K current reading.

    Turn the Incident-Reflected switch (S9) to the INCIDENT position and verify (on RF output meter -- M6) that there is a slight amount of forward power. Put S9 in the REFLECTED position. If no problems exist in the antenna or transmission lines a zero reading will be observed.

13. Adjust the PA Tuning control (L15) slightly from preset position to achieve a dip in plate current consistent with a maximum power output indication. Turn the Incident-Reflected switch to the REFLECTED position and observe the RF output meter reading. If there is an indication of reflected power of any magnitude, immediately turn OFF the Plate switch (S5). This would indicate that there is an improper RF termination ot the Transmitter. (The mismatch should not exceed 1.2 : 1.)

CAUTION:

If a mismatch exceeding a ratio of 1.2 : 1 exists, the problem should be investigated and remedied before any further operation of the Transmitter is attempted. If this is not done, damage to the antenna, transmission line, or transmitter may result.

If no mismatch exists, continue with the following steps. Retune the IPA Tuning and Loading controls (L14 and L20) for a maximum PA cathode current that is consistent with a minimum IPA I_K.

NOTE: Adjustments of Tuning and Loading in 12 and 13 should not be far off, as unit was set up at factory.

14. Turn the Hi-Low switch (S4) to the HIGH position. Rotate the RF Output control (R53) to achieve 80% full output. Readjust the PA Tuning control for a dip in PA plate current, and the Loading control to achieve the desired power output consistent with a dip in PA plate current and desired plate circuit efficiency. If full output cannot be obtained, increase the setting of the Power Output control to achieve 100% (if desired). Observe reflected power again. It should be 1.1 : 1 or less, on both reflectometers.

    The final resulting readings should compare favorably with those supplied in the Test Data Sheet. Adjust the Power Output control for the desired output setting. The output can be varied from 5% to 110%. It should be noted, however, that for a given power output a specific combination of tuning and loading is required for optimum efficiency. A minimum plate circuit efficiency of 75% should be easy to obtain.

15. After step 14. (above) has been performed, allow the Transmitter to remain undisturbed for approximately five minutes. At the end of this period adjust the PA Tuning and Loading controls to obtain a condition wherein rated power output is achieved with optimum efficiency. After 30 minutes of operation, the equipment should become temperature stable, and the settings of the controls should represent permanent positions.

    The final IPA and PA readings should correspond to the test data (on Test Data Sheet). If any major differences exist, refer to the troubleshooting information in Section 3. of this manual.

16. Turn OFF the Plate switch (S5) and the Filament switch (S3). Due to the "after-cooling" feature of the Transmitter, the blowers will remain on for a few minutes after the switches are turned OFF. This delay can be varied by a screw adjustment on relay K10 (on the bottom front of the relay).

17. The equipment may now be considered tuned. See important information on circuit breakers and equipment turn-on and turn-off in 4.3 (below).

4.3 TURNING ON AND TURNING OFF TRANSMITTER

The circuit breakers in the Transmitter are intended for back-up protection. In normal operation they should always be on. They should be turned off only when servicing the equipment.

It is recommended that in normal operation the Transmitter be turned on as follows:

1. Turn ON the Filament switch (S3). Then let the Transmitter remain in this condition for approximately five minutes.

2. Turn ON the Plate switch (S5). Within a few minutes the Transmitter should become stabilized and ready to produce rated output power.

To turn off the Transmitter, first turn OFF the Plate switch, and then turn OFF the Filament switch. "After-cooling" will be maintained until the start relay (K10) stops the blower.

TABLE 4-1.

TYPICAL FM-20,000E TEST DATA AT 94.5 MHz

POWER OUTPUT	20 kilowatts
LINE VOLTAGE	235, 240, 232 VAC
MULTIMETER READINGS:	
IPA	I_G 30 ma
	I_{SG} 26 ma
	I_K 580 ma
	E_P 94 %
PA	I_K 4.48 amperes
PA PLATE VOLTS	7700 volts
PA PLATE CURRENT	3.4 amperes

APPENDIX A.

TRANSMITTER COMPONENT LOCATIONS AND PARTS LIST

A.1 HOW TO USE LOCATIONS DIAGRAMS AND PARTS LIST

A.1.1 LOCATING A COMPONENT

The parts location illustrations (Figure A-1. through Figure A-6.), the parts list contained in this section, and the FM-20,000E Schematic Diagram (Dwg. No. D40, 159) may be used to aid in identification of parts and to determine locations of parts within the Transmitter. (Additionally, the descriptions given throughout the manual text may be helpful.)

NOTE:

It is suggested that the schematic diagram (Dwg. No. D40,159) be kept in the back of this manual (or combined instruction manual binder -- see NOTE on page ii) when it is not being used, in order to minimize the chance of losing it.

If the circuit symbol of an electrical component is known (e.g., if the symbol has been read from the schematic diagram) it is possible (in many cases) to find the physical location of the part in the Transmitter by inspecting the parts location illustrations in this section to see if the part is called out by one of the reference arrows in the illustrations. If it is, the circuit symbol will be found at the tail end of the reference arrow that points to the location of the part. If the part is not referenced by an arrow, it will probably be necessary to trace circuit wiring from known components in the Transmitter, using the schematic diagram and the parts list as a guide.

A.1.2 OBTAINING PARTS DESCRIPTIONS

If the location of a part in the Transmitter is known, but not the part name or circuit symbol description, the following identification procedure is suggested:

1. Find the illustration in this section that shows the part. If the part is referenced by an arrow, the circuit symbol given may be used to find the component description in the parts list.

2. If the part is not referenced by an arrow, it will probably be necessary to trace circuit wiring from the unknown part to connections with known parts, using the schematic diagram to obtain the circuit symbol. Once the circuit symbol is found, the description can be found in the parts list.

It is unlikely that the unreferenced components will ever need replacement; but in the event that replacement is necessary, an exact-as-possible description of the physical nature of the part and its location in the Transmitter should be given to the CCA Service Department, in order to obtain identification.

NOTE:

When ordering parts from CCA be sure to specify the circuit symbol and part description in full, wherever this is possible. Also, it is advisable to obtain minimum order information from the CCA Sales Department before ordering parts from CCA. Many of the common parts (resistors, for example) may be more conveniently obtained from local suppliers.

A.1.3 CODES USED IN PARTS LISTS

Codes used in the parts lists and their meanings are as follows:

CODE	MEANING
QTY	QUANTITY USED -- Quantity of the described part used in the Transmitter. Used in conjunction with Usage Code.

CODE	MEANING
RS	RECOMMENDED SPARES -- Denotes whether spares (duplicates) are recommended to be kept in stock for contingency use, and the quantity suggested for the described part.
USAGE CODE	USAGE CODE -- Used in this manual to signify whether a part is optional, or to call attention to supplementary information contained in a NOTE appearing below the entry for the part it pertains to in the list. See (OP) and "*" code meanings.
(OP)	OPTIONAL -- When this code appears in the Usage Code column, the listed part is optional, subject to the conditions given in the explanatory NOTE appearing below the entry for the part it pertains to in the list.
"*"	ASTERISK -- An asterisk in the Usage Code column indicates that there is important supplementary information contained in a NOTE appearing below the entry for the part the asterisk pertains to in the list.

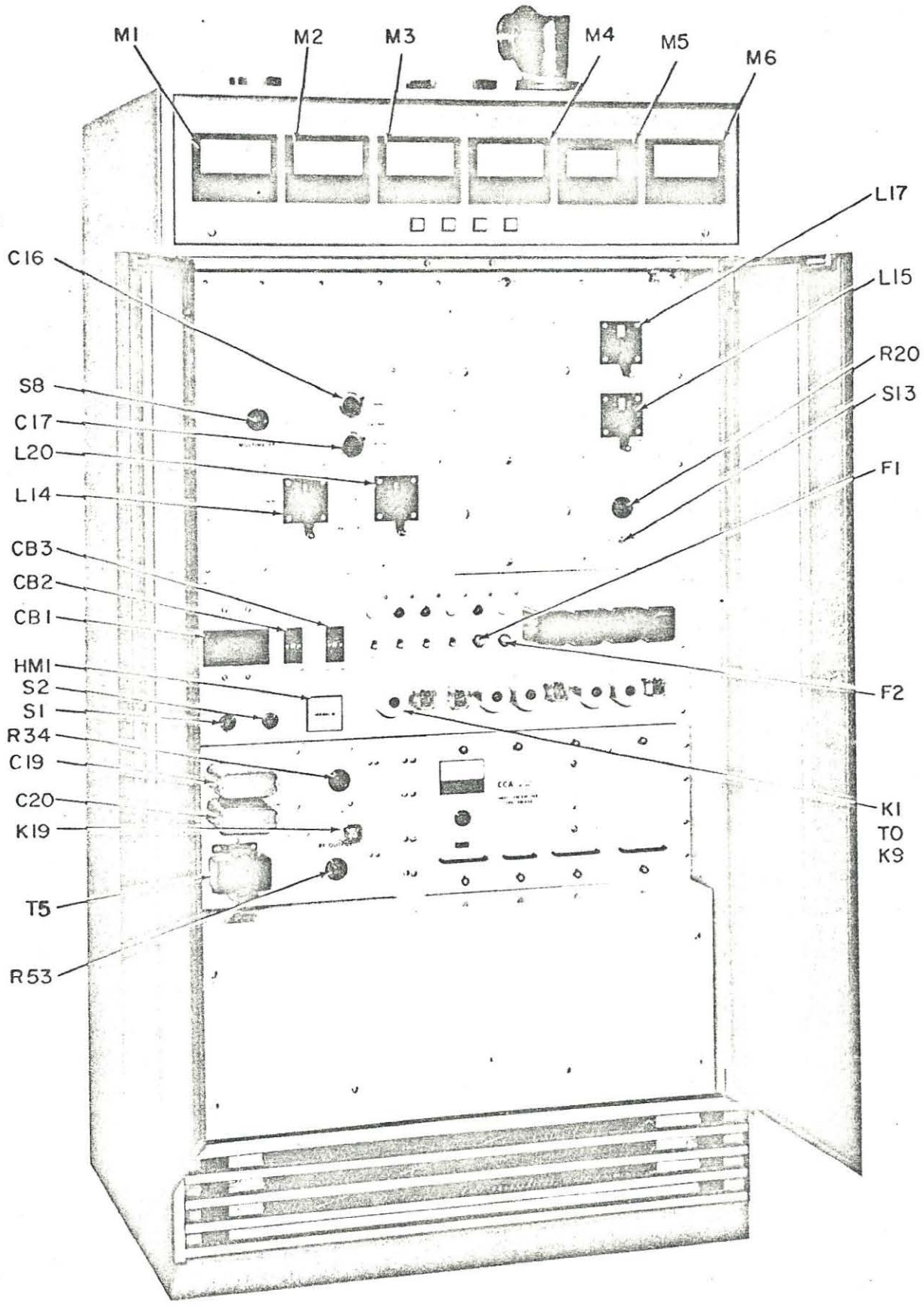


Figure A-1. FM-20,000E Broadcast Transmitter
(Front View, Doors Open)

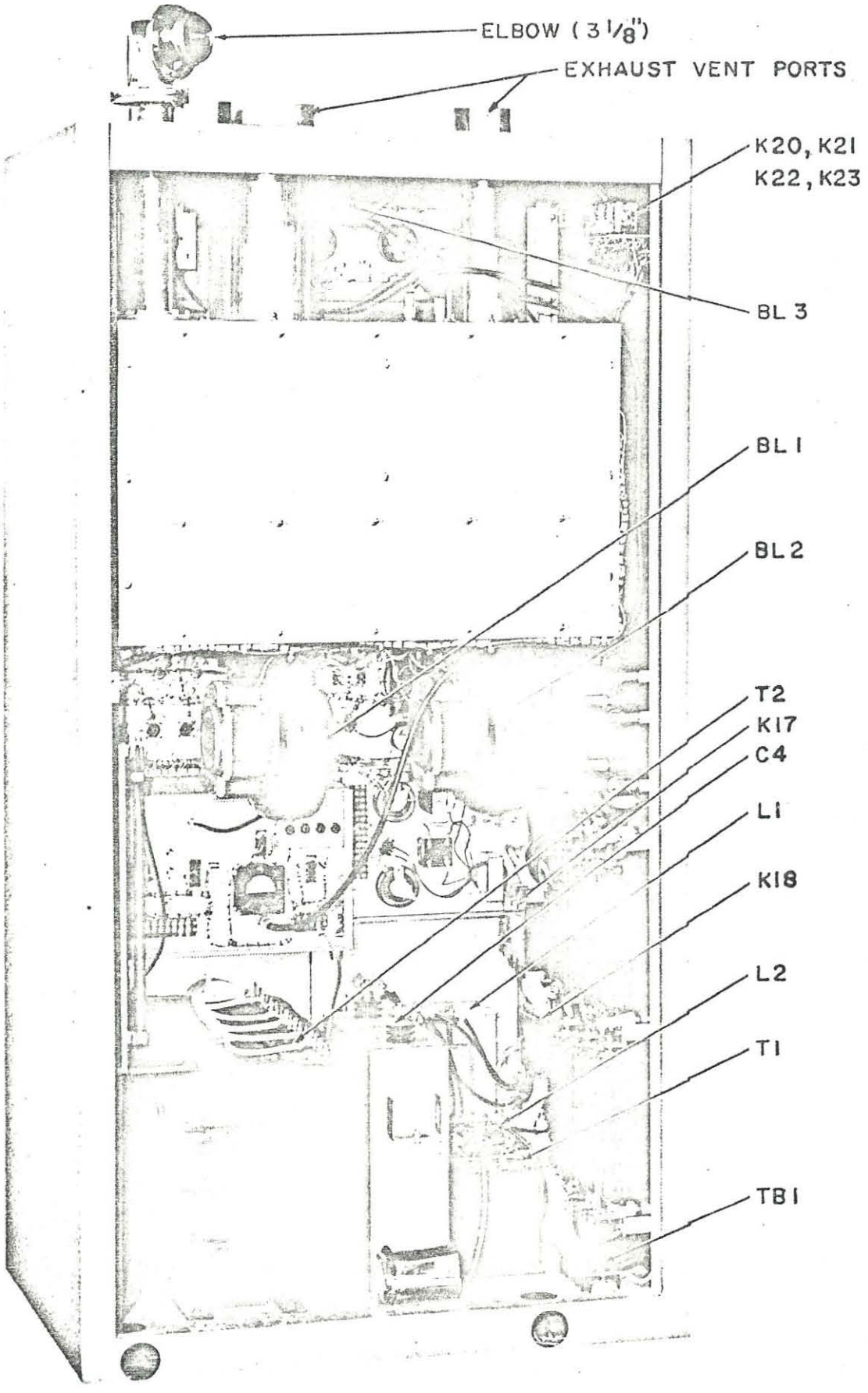


Figure A-2. FM-20,000E Broadcast Transmitter
(Rear View, Door Removed)

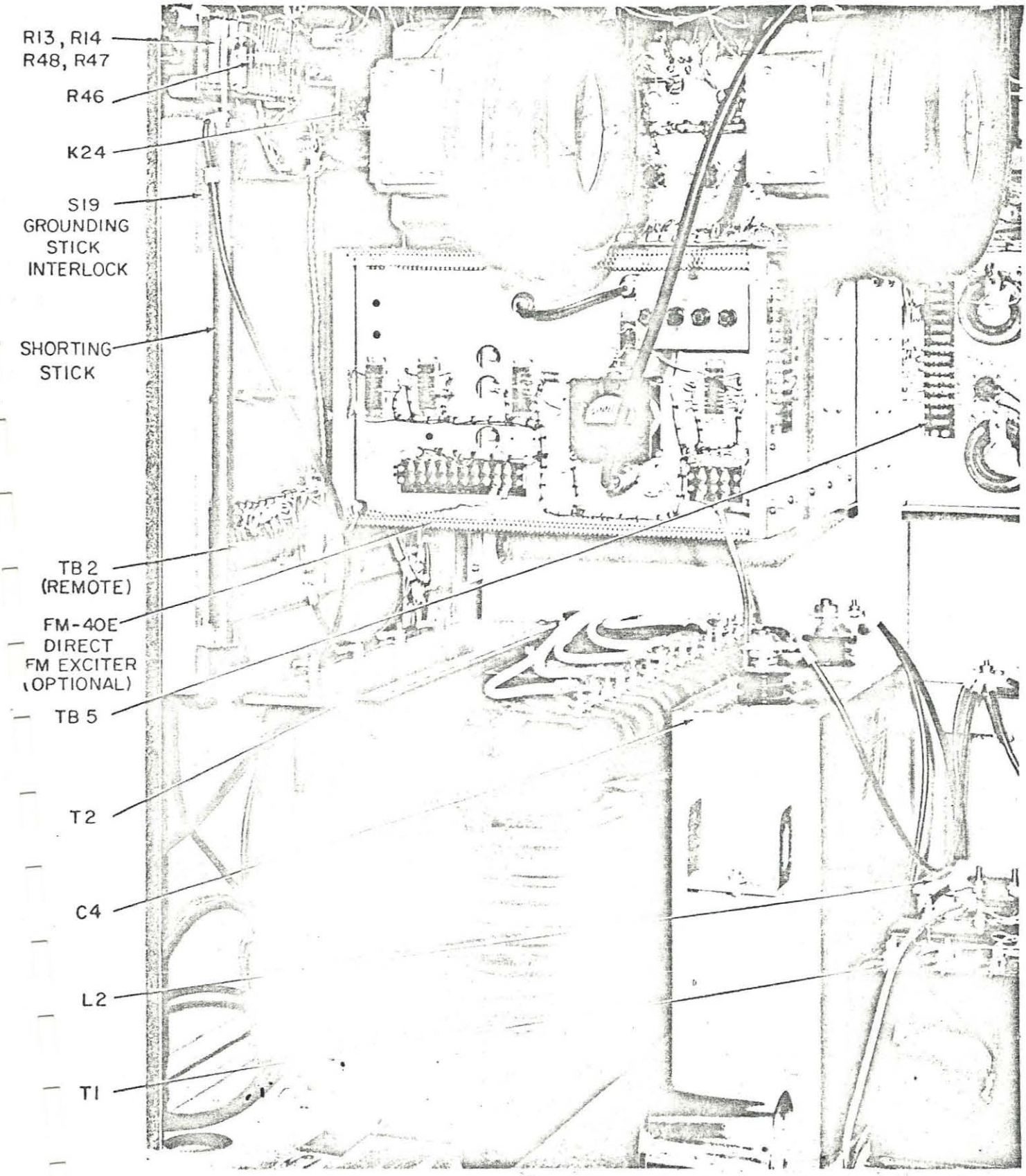


Figure A-3. FM-20,000E Broadcast Transmitter
Rear View, Bottom Section (View #1)

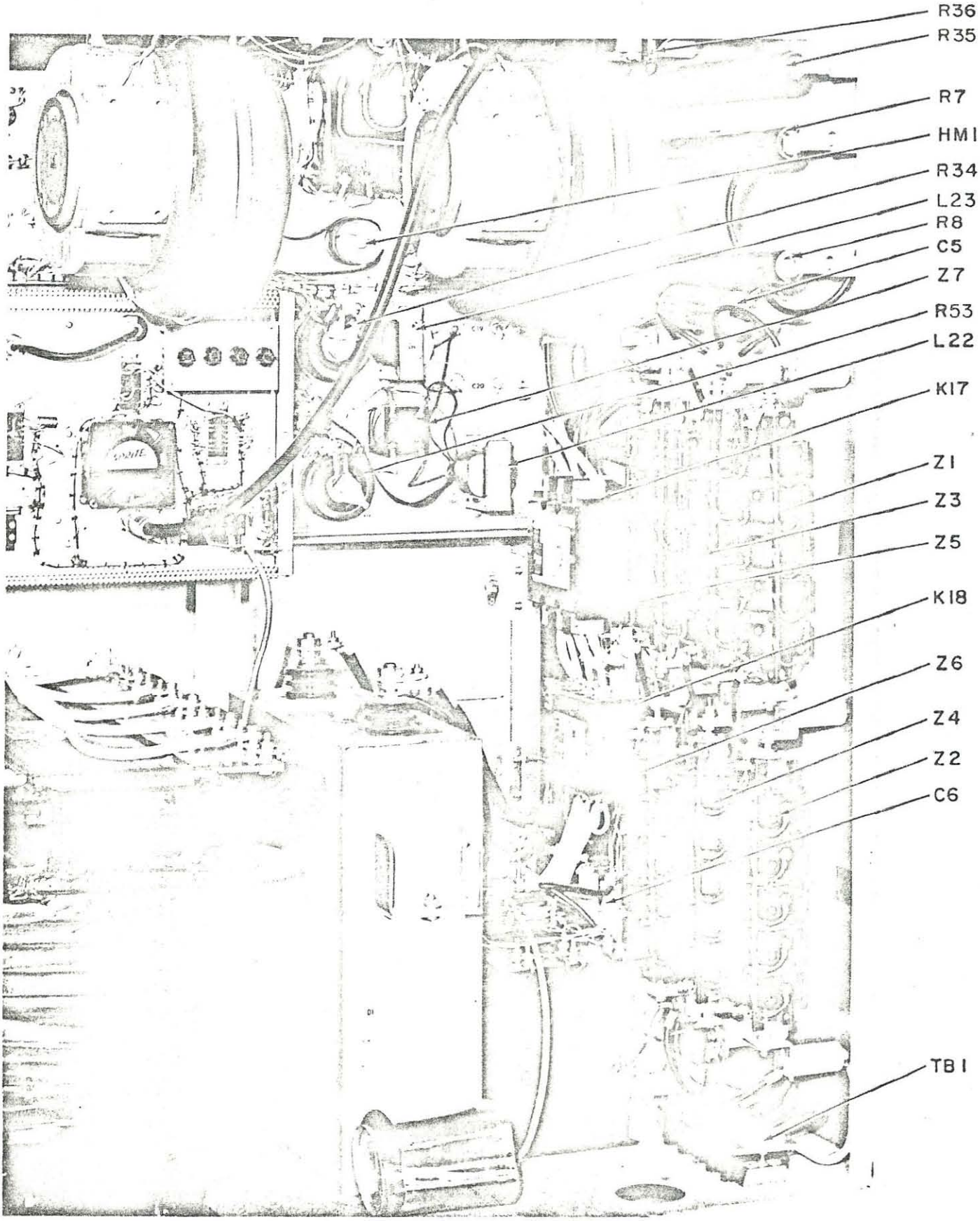


Figure A-4. FM-20,000E Broadcast Transmitter
Rear View, Bottom Section (View #2)

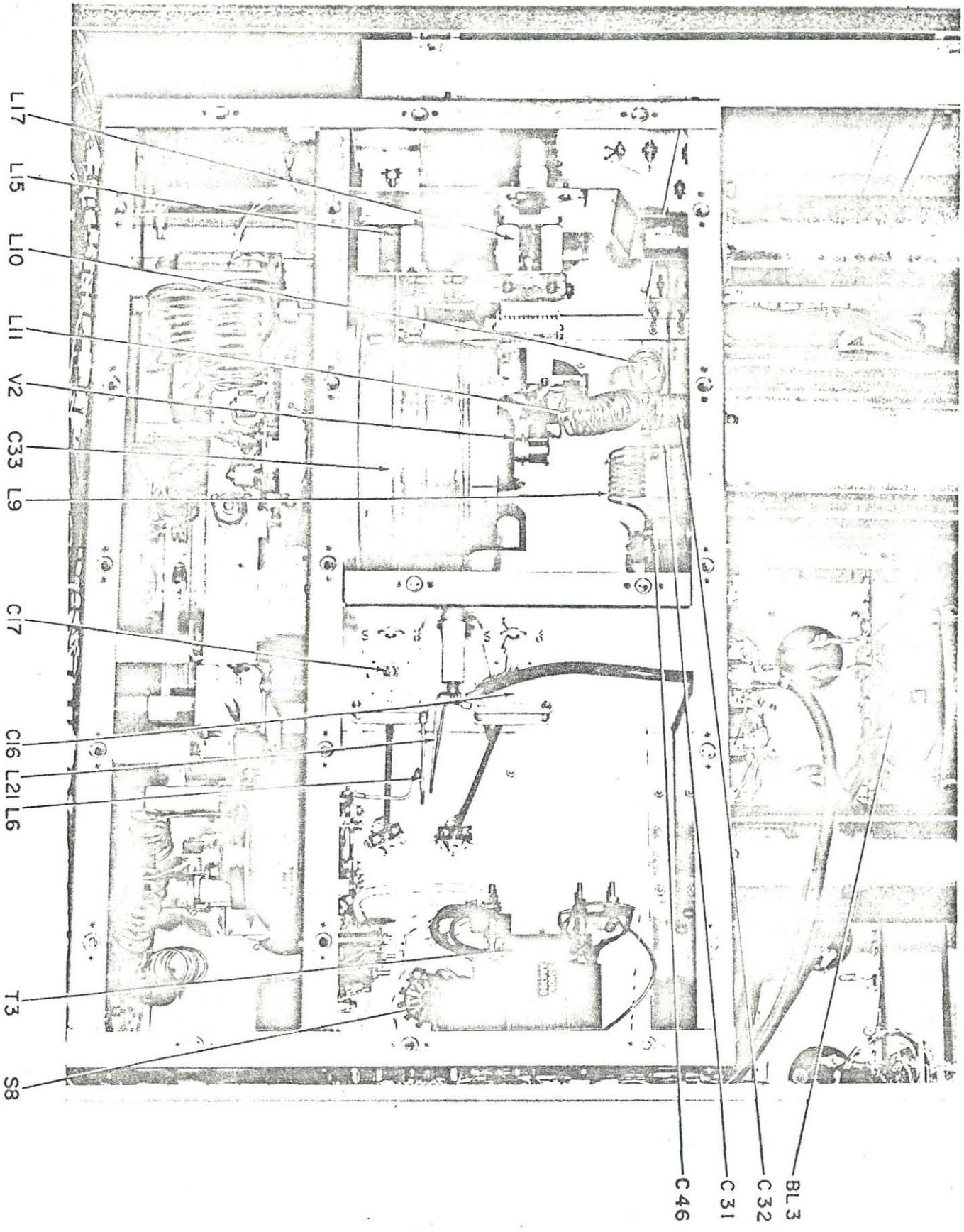


Figure A-5. FM-20,000E Broadcast Transmitter
Rear View, Top Section (View #1)

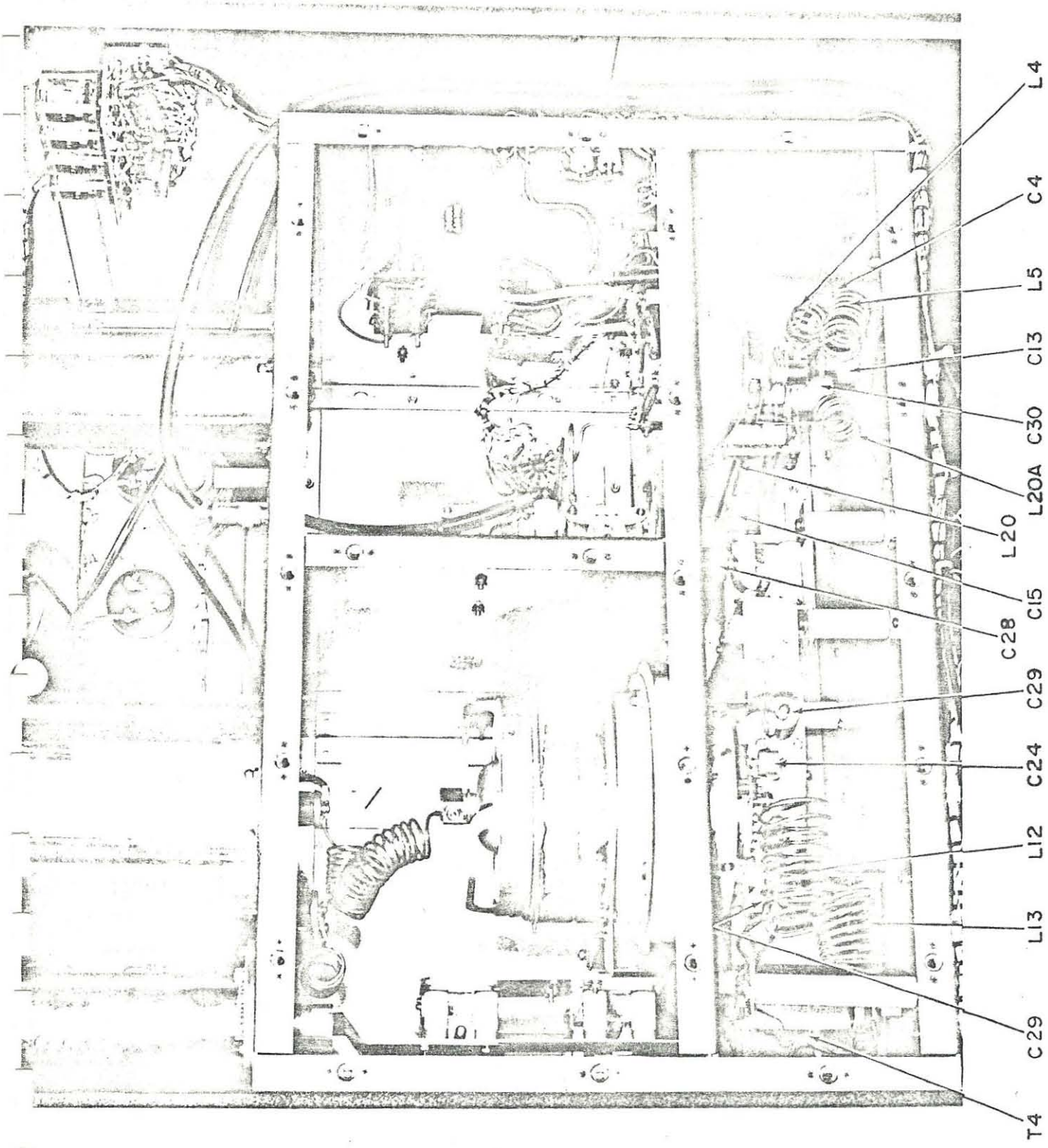


Figure A-6. FM-20,000E Broadcast Transmitter
Rear View, Top Section (View #2)

FIGURE NO. AND SYMBOL	DESCRIPTION	QTY	USAGE CODE	RS
	PARTS LIST. FM-20,000E FM BROADCAST TRANSMITTER			
BL1, BL2	BLOWER, 115V AC, 60C, ROTRON	2		
BL3	FAN, KOOLTRONIC KB803B	1		
C3	CAPACITOR, OIL PAPER, 4 MFD, 5KV, SANGAMO	1		
C4	CAPACITOR, OIL PAPER, 12 MFD, 10KV, SANGAMO 702013-3602	1		
C5	CAPACITOR, PLASTIC, .1, 10KV, PLASTIC CAP OF 100-104	1		
C6	CAPACITOR, OIL PAPER, 8 MFD, 4KV, SANGAMO 702012-9102	1		
C7, C8, C9, C10, C11, C12 C64, C65, C66	CAPACITOR, CER. DISC., .01 MFD, 20%, 1KV, CENTRALAB 2DDH63N103MAA	9		
C13, C14 C30, C31 C32, C46 C67, C60, C61	CAPACITOR, CER. STUD, 100 PF, 15KV, CENTRALAB 857-100 MMF	9		
C15	CAPACITOR, CER. STUD, 200 PF, 7.5KV, CENTRALAB	1		
C16, C17	CAPACITOR, VARIABLE AIR, E. F. JOHNSON	2		
C18, C21 C42, C43 C44, C45 C50, C51 C52, C53 C54, C55 C56, C57 C58, C59	CAPACITOR, CER. FEEDTHRU, 1000 PF, 500V, CENTRALAB 2DFH22L102MAA	16		

FIGURE NO. AND SYMBOL	DESCRIPTION	QTY	USAGE CODE	RS
	PARTS LIST. FM-20,000E FM BROADCAST TRANSMITTER (Continued)			
C19, C20	CAPACITOR, PAPER OIL, 10 MFD, 1KV, CORNELL DUBILLIER T10 100	2		
C22, C23 C24, C25 C26, C27 C47, C48	CAPACITOR, CER. DISC., .001 MFD, 1KV, CENTRALAB 2DDH63N102MAA	8		
C28, C29 C62	CAPACITOR, CER. STUD, FD CENTRALAB 857FD	3		
C33	CAPACITOR, BLOCKER, CCA	1		
C34, C35 C36, C37 C38, C39 C40, C41 C49	CAPACITOR, CER. STUD, 1000 PF, 5KV, CENTRALAB 858S-1000	9		
CB1	CIRCUIT BREAKER, 3 PHASE, 230V, 125A, HEINEMANN CJ3 CURVE 9	1		
CB2, CB3	CIRCUIT BREAKER, 1 PHASE, 230V, 10A, HEINEMANN 2263S CURVE 1	2		
DC1	DIRECTIONAL COUPLER, 20KW, 3-1/8, CCA RF (P.D.)	1		
F1	FUSE, 3 AMP, BUSS 3AG	1		
F2	FUSE, 3 AMP, BUSS3AG	1		
XF1, XF2	FUSE POST, INDICATING, 3AG, BUSS HKL-100-250	2		
HM1	ELAPSED TIME INDICATOR, G.T. EF 2735 115V	1		

FIGURE NO. AND SYMBOL	DESCRIPTION	QTY	USAGE CODE	RS
	PARTS LIST. FM-20,000E FM BROADCAST TRANSMITTER (Continued)			
I1, I2, I3 I4, I5, I6	LAMP, INDICATOR, FILAMENT (HOLDER) DRAKE 5100-822	6		
I7	LAMP, 28V (PART OF S14), CHICAGO MIN. #327	1		
I8	LAMP, 28V (PART OF S15), CHICAGO MIN. #327	1		
I9	LAMP, 28V, (PART OF S16), CHICAGO MIN. #327	1		
I10	LAMP, 28V (PART OF S17), CHICAGO MIN. #327	1		
	LAMP, 6 VOLTS, GE-47	6		
	LENS, WHITE (FILAMENT), DRAKE 304	1		
	LENS, BLUE (INTERLOCK) DRAKE 304	1		
	LENS, GREEN (READY, DRAKE 304	1		
	LENS, RED (PLATE), DRAKE 304	1		
	LENS, AMBER (LOW POWER), DRAKE 304	1		
	LENS, YELLOW (OVERLOAD) DRAKE 304	1		
J1	CONNECTOR, IPA INPUT TYPE "N" PANEL MOUNT, UG-58A/U	1		
J2	RECEPTACLE, BNC PANEL BUSHING, UG657A/U	1		
J3	3-1/8" DIA. TRANSMISSION LINE WITH OUTPUT CONN., 1-318-50-14	1		

FIGURE NO. AND SYMBOL	DESCRIPTION	QTY	USAGE CODE	RS
	PARTS LIST. FM-20,000E FM BROADCAST TRANSMITTER (Continued)			
K1	RELAY, T.D., 120 SEC, 230V, HEINEMANN HB1-533-XBX	1		
K2, K3 K6, K9 K20, K21 K22, K23 K24	RELAY, DPDT, STRUTHERS-DUNN 214XBX48P	9		
K4, K7	RELAY, T.D., 1 SEC, 115V, DPDT, HEINEMANN HB1-522XBX	2		
K5, K8	RELAY, T.D., 60 SEC, DPDT, HEINEMANN HB1-S33XBX	2		
K10	RELAY, 120 SEC. TDO, AB 849-20D321	1		
K11/K25	RELAY, ARROW HART ACC 230U-20	2		
K12	RELAY, ARROW HART ACC 330U	1		
K13, K14 K15, K16	RELAY, DPDT, C. P. CLARE A268880	4		
K17	RELAY, HI, ARROW HART ACC-1230-U20	1		
K18	RELAY, LO, ARROW HART ACC-730-U20-S3	1		
K19	RELAY, 10,000 OHM, POTTER BRUMFIELD KCP-11	1		
L1	CHOKE, 2H, 5 AMP, EP 4017 OR HITRAN AP0095	1		
L2	CHOKE, 10H, 600 MILS, EP 2980	1		
L3	CHOKE, LIGHTING, MILLER 7871	1		

FIGURE NO. AND SYMBOL	DESCRIPTION	QTY	USAGE CODE	RS
	PARTS LIST. FM-20,000E FM BROADCAST TRANSMITTER (Continued)			
L4, L5 L9, L10	COIL, 8 TURNS, 1/8" COPPER TUBING, 1" I.D., CCA	4		
L6	COIL, 3½ turns, #12 WIRE 2½" WIDE 1" I.D., CCA	1		
L7	CHOKE, OHMITE Z144	1		
L8	CHOKE, OHMITE Z50	1		
L11	COIL,7or9TURNS, 1/8 COPPER TUBING, 1" I.D., CCA	1		
L13	COIL, 8 TURNS, 9/32 SILVER PLTD WIRE, 1-3/4" I.D., CCA	2		
L14	COIL, IPA TUNING ASSEMBLY, CCA	1		
L15, L17 L20	COIL, TUNING ASSEMBLY, CCA	3		
L16	SHUNT	1		
L18	RF OUTPUT STRAP #3	1		
L19	LOOP, MONITOR OUTPUT #18 WIRE, CCA	1		
L21	CHOKE, 2 TURNS, 1/8" COPPER TUBING, 1" I.D., CCA	1		
L22, L23	CHOKE, 4H, 250 MA, STANCOR #C2717	2		
M1	METER, LINE 0-300V AC, JEWELL MOD. 45	1		
M2	METER, MULTIMETER 0-100%, JEWELL MODEL 45	1		

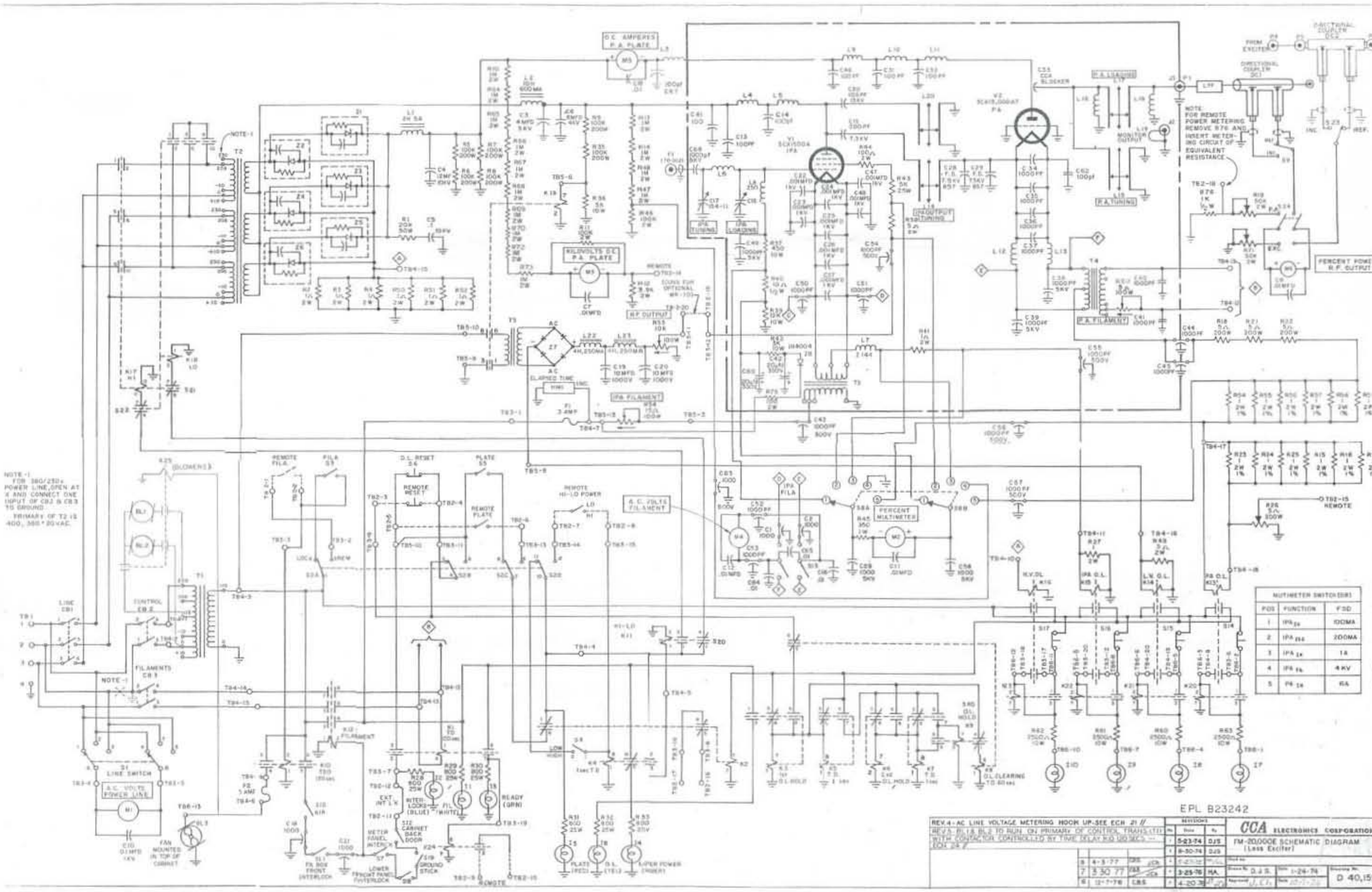
FIGURE NO. AND SYMBOL	DESCRIPTION	QTY	USAGE CODE	RS
	PARTS LIST. FM-20,000E FM BROADCAST TRANSMITTER (Continued)			
M3	METER, PLATE VOLTS, 0-8 KILOVOLTS DC JEWELL MODEL 45	1		
M4	METER, PLATE CAT 0-6 AMP DC, JEWELL MODEL 45	1		
M5	METER, PLATE, 0-4 AMP DC, JEWELL MODEL 45	1		
M6	METER, RF OUTPUT, 0-110%, JEWELL MODEL 45	1		
R1	RESISTOR, WIREWOUND, 20K, 50W, TRU-OHM FRL 50-20K	1		
R2, R3 R4, R15 R16, R17 R23, R24 R25, R27 R50, R51 R52, R54 R55, R56 R57, R58 R59	RESISTOR, WIREWOUND, 1 OHM, 1%, 2W, OHMITE 3860	19		
R5, R6 R7, R8 R9, R21 R22, R35	RESISTOR, WIREWOUND, 100K, 200W, 5%, OHMITE 0925	8		
R10, R13 R14, R47 R48, R64 R65, R66 R67, R68 R69, R70 R72, R73 R71	RESISTOR, FILM, 1 M, 2W, 1%, ALLEN BRADLEY RN80B1004F	15		

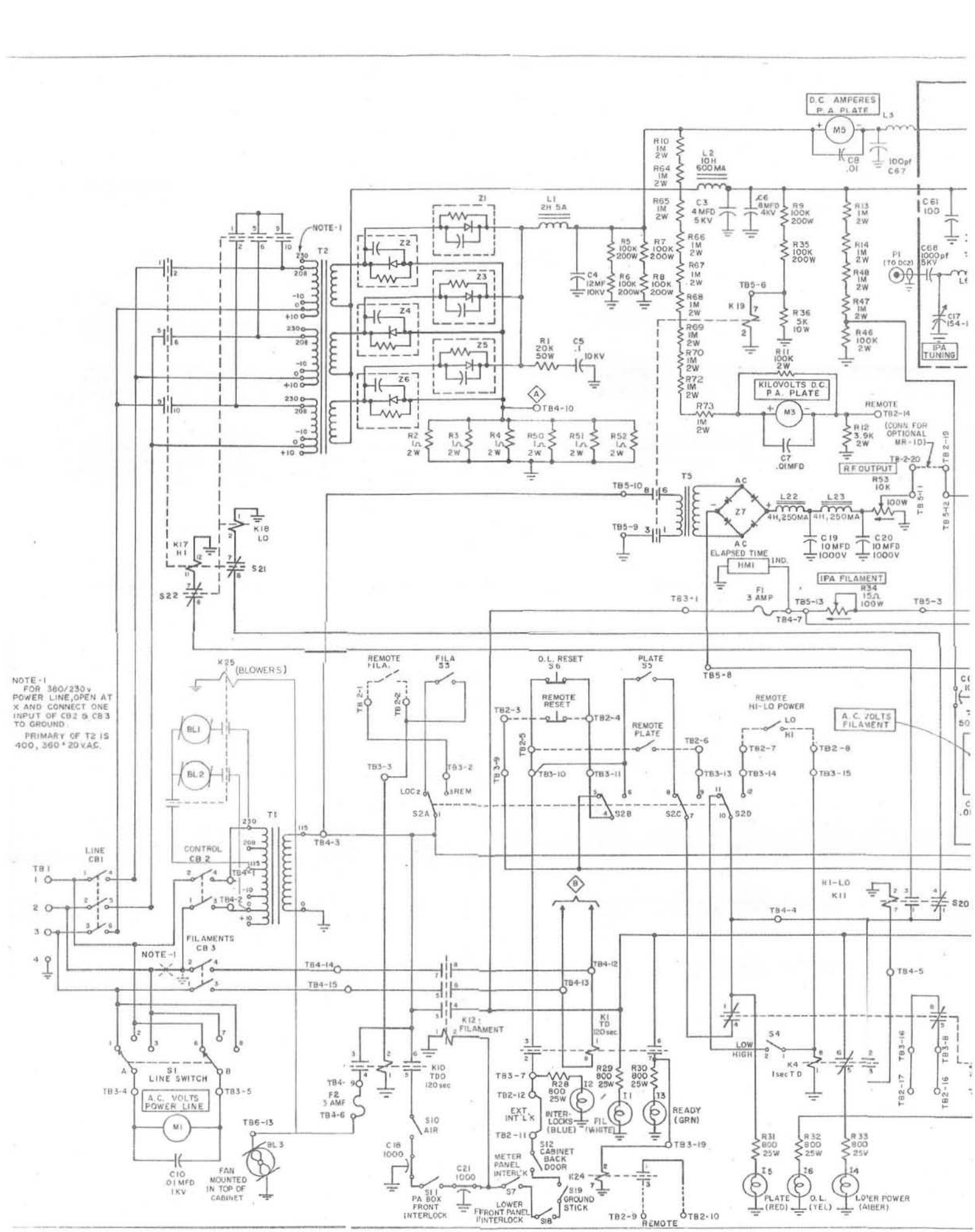
FIGURE NO. AND SYMBOL	DESCRIPTION	QTY	USAGE CODE	RS
	PARTS LIST. FM-20,000E FM BROADCAST TRANSMITTER (Continued)			
R11, R46	RESISTOR, CARBON, 100K, 2W, 10%, ALLEN BRADLEY	2		
R12	RESISTOR, CARBON, 3.9K, 2W, 10%, ALLEN BRADLEY	1		
R18	RESISTOR, WIREWOUND, 5 OHM FIXED, 200W, MEMCOR FR200-5 OHM	1		
R19	RESISTOR, POTENTIOMETER, 50K, 2W, ALLEN BRADLEY TYPE JLU	1		
R20	RESISTOR, VARIABLE POT., 5 OHM, 100W, TRU-OHM FRL-100-5	1		
R26	RESISTOR, WIREWOUND, ADJ., 5 OHM, 200W, OHMITE 1356	1		
R28, R29 R30, R31 R32, R33	RESISTOR, WIREWOUND, 800 OHM, 25W, TRU-OHM FRL-25-800	6		
R34	RESISTOR, VARIABLE, 15 OHM, 100W, TRU-OHM FRL-100-25	1		
R36	RESISTOR, WIREWOUND, 5K, 10W, TRU-OHM FRL-10-5K	1		
R37	RESISTOR, WIREWOUND 450 OHM, 10W, TRU-OHM FRL-10-450	1		
R38	RESISTOR, COMPOSITION, 5 OHM, 1%, 2W, ALLEN BRADLEY	1		
R39	RESISTOR, WIREWOUND, 4000 OHM, 10W TRU-OHM FRL-10-4K	1		

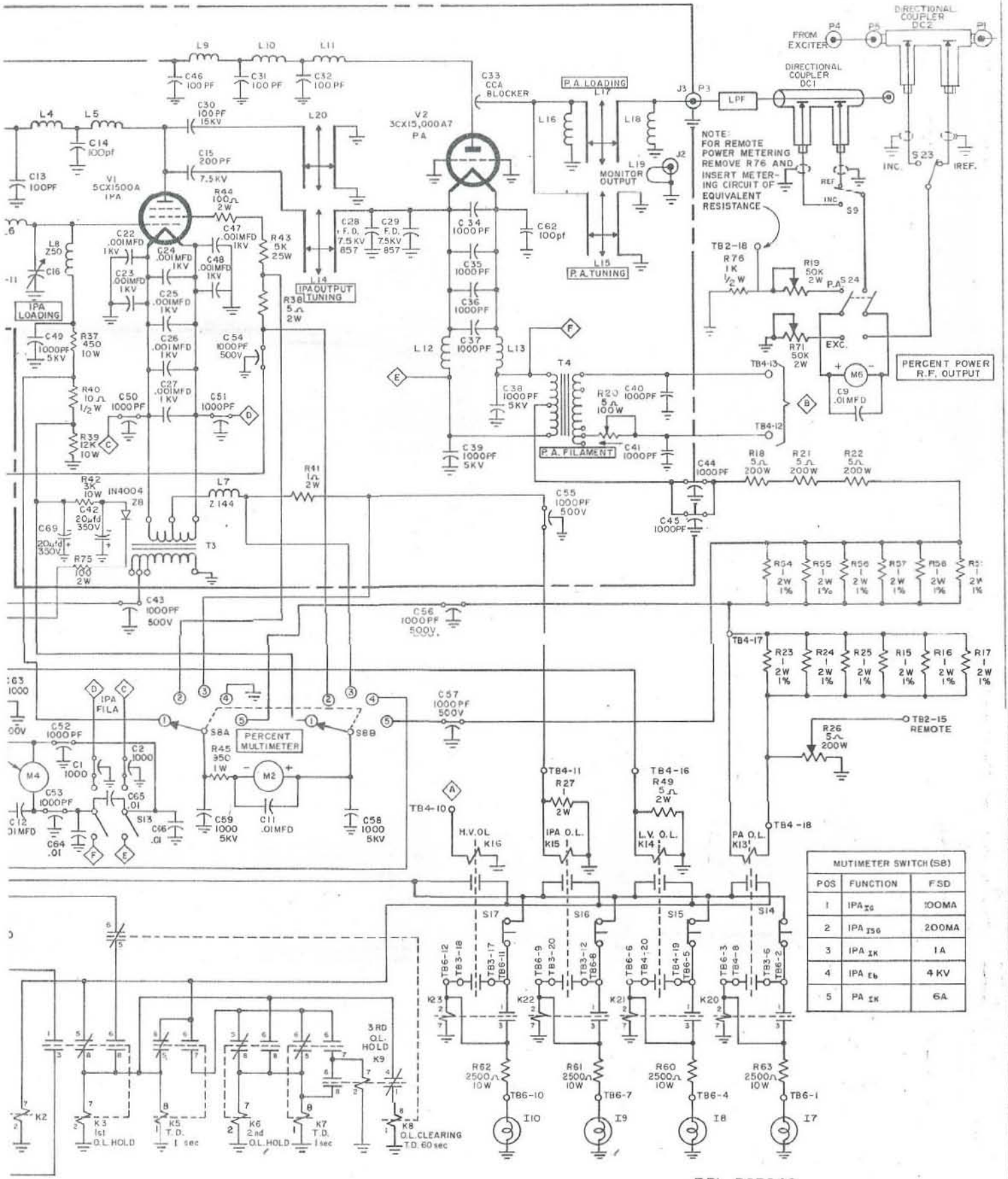
FIGURE NO. AND SYMBOL	DESCRIPTION	QTY	USAGE CODE	RS
	PARTS LIST. FM-20,000E FM BROADCAST TRANSMITTER (Continued)			
R40	RESISTOR, COMPOSITION, 10 OHM, 5%, 1/2W, DALE RS-2A	1		
R41	RESISTOR, CARBON, 1 OHM, 1%, 2W, ALLEN BRADLEY	1		
R42	RESISTOR, WIREWOUND, 100 OHM, 10%, 25W, TRU-OHM FRL-10-100	1		
R43	RESISTOR, WIREWOUND, 3K, 25W, TRU-OHM FRL-25-3K	1		
R44	RESISTOR, COMPOSITION, 100 OHM, 10%, 2W, ALLEN BRADLEY	1		
R45	RESISTOR, FILM, 950 OHM, 1%, 1W, SPRAGUE RN70D	1		
R49	RESISTOR, WIREWOUND, 5 OHM, 2W, OHMITE	1		
R53	RESISTOR, VARIABLE POT., 10K, 100W, TRU-OHM FRL-100-10K	1		
R60, R61 R62, R63	RESISTOR, WIREWOUND, 2500 OHM, 10W, TRU-OHM FRL-10-2.5K	4		
S1	SWITCH, ROTARY, 2 POLE, 5 POS., MALLORY 1315L	1		
S2 S9, S23	SWITCH, 4 POLE, 2 POS., MALLORY 1312L	1		
S3, S5	SWITCH, SPST, CUTLER HAMMER ST42A	4		
S13, S24	SWITCH, DPDT, CUTLER HAMMER ST42E	2		

FIGURE NO. AND SYMBOL	DESCRIPTION	QTY	USAGE CODE	RS
	PARTS LIST. FM-20,000E FM BROADCAST TRANSMITTER (Continued)			
S6	SWITCH, SPST, MOM. OFF, CUTLER HAMMER ST42B	1		
S7, S11 S12, S18 S19	SWITCH, INTERLOCK, MICROSWITCH 23AC2	5		
S10	SWITCH, SPST, INTERLOCK, ROTRON 2A-1000	1		
S14, S15 S16, S17	SWITCH, PUSHBUTTON MOMENTARY, COMPULITE 11-118	4		
T1	TRANSFORMER, EPCO 2984	1		
T2	TRANSFORMER, HITRAN A0137	1		
T3	TRANSFORMER, EPCO EP3560	1		
T4	TRANSFORMER, EPCO EP3049	1		
T5	TRANSFORMER, 3299H, HITRAN AA0375	1		
TB1	TERMINAL BOARD, 4 TERMINAL, CINCH JONES 4-152	1		
TB2, TB3, TB4, TB5	TERMINAL BOARD, 20 TERMINAL, CINCH JONES 20-141	4		
TB6	TERMINAL BOARD, 13 TERMINAL, CINCH JONES 13-141	1		
TB8	TERMINAL BOARD, 3 TERMINAL, CINCH JONES 141-3	1		

FIGURE NO. AND SYMBOL	DESCRIPTION	QTY	USAGE CODE	RS
	PARTS LIST. FM-20,000E FM BROADCAST TRANSMITTER (Continued)			
V1	TUBE, WESTINGHOUSE 5CX1500A	1		
V2	TUBE, WESTINGHOUSE 3CX15000A7	1		
XV1	SOCKET, EMIC SK820	1		
XV2	SOCKET, EMIC SK1300			
XK1, XK2 XK3, XK4 XK5, XK6 XK7, XK8 XK9, XK19, XK20, XK21, XK22, XK23, XK24	SOCKET, 8 PIN OCTAL, ALLEN BRADLEY	15		
XK13, XK14, XK15, XK16	COVER FOR RELAY, C. P. CLARE RP649B	4		
Z1, Z2 Z3, Z4 Z5, Z6	RECTIFIER, CCA	6		
Z7	BRIDGE RECTIFIER, 35 CCA	1		


EPL B23242
REV.4 - AC LINE VOLTAGE METERING HOOK UP-SEE ECN 21 //
REV.5 - BL1 & BL2 TO RUN ON PRIMARY OF CONTROL TRANS (T1) WITH CONTACTOR CONTROLLED BY TIME DELAY K10 (20 SECS) — ECN 24 //
REVISIONS
5-23-74 DJS
8-30-74 DJS
3-25-76 HA.
4-3-77
3 30 77
12-7-76 CBS
CCA ELECTRONICS CORPORATION
FM-20,000E SCHEMATIC DIAGRAM
(Less Exciter)
D.J.S.
1-24-74
D 40,159
D.C. AMPERES P.A. PLATE
KILOVOLTS D.C. P.A. PLATE
PERCENT POWER R.F. OUTPUT
PERCENT MULTIMETER
A.C. VOLTS FILAMENT
A.C. VOLTS POWER LINE
MULTIMETER SWITCH (S8)
NOTE-1 FOR 380/230v POWER LINE, OPEN AT X AND CONNECT ONE INPUT OF CB2 & CB3 TO GROUND. PRIMARY OF T2 IS 400, 380 ± 20 VAC.
NOTE: FOR REMOTE POWER METERING REMOVE R76 AND INSERT METERING CIRCUIT OF EQUIVALENT RESISTANCE


D.C. AMPERES P.A. PLATE
M5
L3
C8 .01
100pf C67
R10 1M 2W
R64 1M 2W
R65 1M 2W
R66 1M 2W
R67 1M 2W
R68 1M 2W
R69 1M 2W
R70 1M 2W
R72 1M 2W
L2 10H 600MA
C3 4MFD 5KV
C6 8MFD 4KV
R9 100K 200W
R35 100K 200W
R36 5K 10W
R11 100K 2W
R73 1M 2W
R13 1M 2W
R14 1M 2W
R48 1M 2W
R47 1M 2W
R46 100K 2W
C61 100
C68 1000pf 5KV
P1 (TO DC2)
L4
C17 154-1
IPA TUNING
KILOVOLTS D.C. P.A. PLATE
M3
REMOTE TB2-14
(CONN FOR OPTIONAL MR-10)
R12 3.9K 2W
C7 .01MFD
TB2-19
TB2-20
RF OUTPUT
R53 10K
TB5-11
TB5-12
100W
L22 4H, 250MA
L23 4H, 250MA
C19 10MFD 1000V
C20 10MFD 1000V
T5
Z7
AC
AC
TB5-10
TB5-9
ELAPSED TIME HMI IND.
IPA FILAMENT
R34 15Ω 100W
F1 3 AMP
TB3-1
TB5-13
TB4-7
TB5-3
TB5-8
Z1
Z2
Z3
Z4
Z5
Z6
L1 2H 5A
R5 100K 200W
R6 100K 200W
R7 100K 200W
R8 100K 200W
C4 12MF 10KV
R1 20K 50W
C5 .1 10KV
TB4-10
R2 1Ω 2W
R3 1Ω 2W
R4 1Ω 2W
R50 1Ω 2W
R51 1Ω 2W
R52 1Ω 2W
T2
NOTE-1
K17 HI
K18 LO
S21
S22
K25 (BLOWERS)
BL1
BL2
T1
LINE CB1
CONTROL CB2
FILAMENTS CB3
NOTE-1
TB1
TB4-1
TB4-2
TB4-3
TB4-4
TB4-14
TB4-15
TB4-12
TB4-13
TB4-5
TB4-6
S1 LINE SWITCH
A.C. VOLTS POWER LINE
M1
TB3-4
TB3-5
TB6-13
BL3
C10 .01 MFD 1KV
FAN MOUNTED IN TOP OF CABINET
REMOTE FILA.
FILA 33
O.L. RESET S6
PLATE S5
REMOTE RESET
REMOTE PLATE
REMOTE HI-LO POWER
LO
HI
A.C. VOLTS FILAMENT
TB2-1
TB2-2
TB2-3
TB2-4
TB2-5
TB2-6
TB2-7
TB2-8
TB3-2
TB3-3
TB3-9
TB3-10
TB3-11
TB3-13
TB3-14
TB3-15
LOC
REM
S2A
S2B
S2C
S2D
K12 FILAMENT
K10 TDO 120 sec
F2 3 AMP
S10 AIR
C18 1000
C21 1000
S11 PA BOX FRONT INTERLOCK
METER PANEL INTERLK
S7 LOWER FRONT PANEL INTERLOCK
S18
S19 GROUND STICK
K24
TB2-9
REMOTE
TB2-10
K1 TD 120 sec
R28 800 25W
R29 800 25W
R30 800 25W
I2
I1
I3
TB3-7
TB2-12
EXT INT'LK
INTERLOCKS (BLUE)
FIL (WHITE)
READY (GRN)
TB2-11
S12 CABINET BACK DOOR
TB3-19
K11 HI-LO
S20
S4
LOW
HIGH
K4 1 sec TD
TB3-16
TB3-8
TB2-17
TB2-16
R31 800 25W
R32 800 25W
R33 800 25W
I5
I6
I4
PLATE (RED)
O.L. (YEL)
LOWER POWER (AMBER)
NOTE-1
FOR 380/230 v POWER LINE, OPEN AT X AND CONNECT ONE INPUT OF CB2 & CB3 TO GROUND.
PRIMARY OF T2 IS 400, 360 * 20 V.A.C.



MUTIMETER SWITCH (S8)		
POS	FUNCTION	FSD
1	IPA I_G	100MA
2	IPA I_{SG}	200MA
3	IPA I_K	1A
4	IPA E_b	4 KV
5	PA I_K	6A

EPL B23242

REV.4-AC LINE VOLTAGE METERING HOOK UP-SEE ECN 21 //
REV.5-BL1 & BL2 TO RUN ON PRIMARY OF CONTROL TRANS.(T1) WITH CONTACTOR CONTROLLED BY TIME DELAY K10 120 SECS — ECN 24 //

REVISIONS			
No	Date	By	
1	5-23-74	DJS	
2	8-30-74	DJS	
3	5-27-75	HA/NL	
4	3-25-76	HA	
5	4-20-76	JT/JCh	
6	12-7-76	C.B.S.	
7	3 30 77	C&S / JCh	
8	4-3-77	CBS. J.Ch.	

CCA ELECTRONICS CORPORATION

FM-20,000E SCHEMATIC DIAGRAM (Less Exciter)

Used on:

Drawn By D. J. S. Date 1-24-74

Approved J. Ch. Date 10-7-76

Drawing No. D 40,159