BTA-250M

BROADCAST TRANSMITTER

RADIO CORPORATION OF AMERICA
COMMERCIAL ELECTRONIC PRODUCTS, CAMDEN, N. J.

IB-30220-1

BTA-250M

BROADCAST TRANSMITTER

INSTRUCTIONS

Manufactured by
RADIO CORPORATION OF AMERICA
ENGINEERING PRODUCTS DEPARTMENT
Camden, New Jersey, U. S. A.

Printed in U. S. A.

IB-30220-1

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FIRST AID

WARNING!

Operation of electronic equipment involves the use of high voltages which are dangerous to life. Operating personnel must at all times observe all safety regulations. Do not change tubes or make adjustments inside the equipment with voltage supply on. Under certain conditions dangerous potentials may exist in circuits with power controls in the off position due to charges retained by capacitors, etc. To avoid casualties, always discharge and ground circuits prior to touching them.

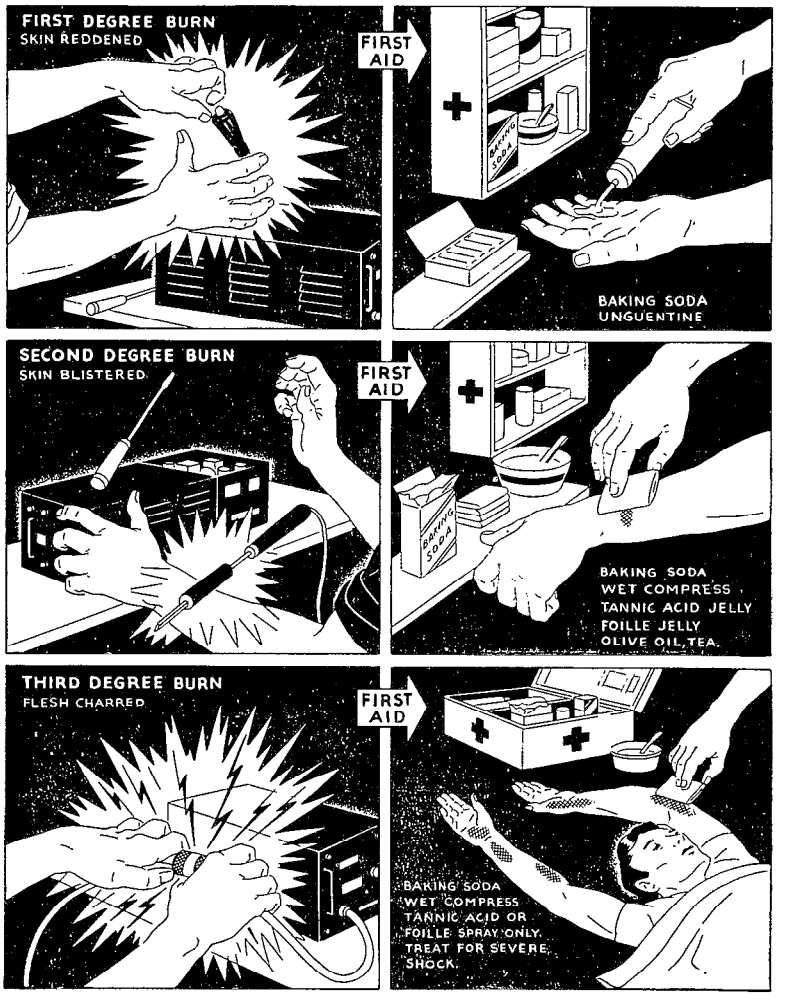
ABOUT FIRST AID

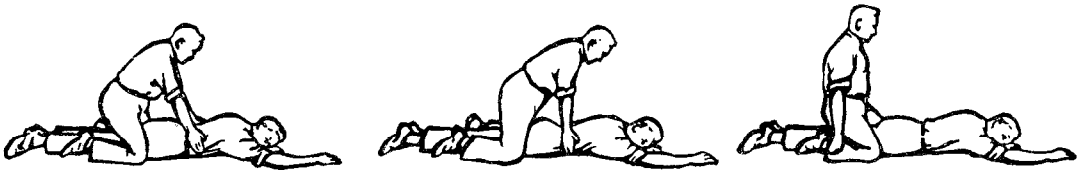
Personnel engaged in the installation, operation and maintenance of this equipment or similar equipment are urged to become familiar with the following rules both **in theory and in the practical application thereof.** It is the duty of every radioman to be prepared to give adequate First Aid and thereby prevent avoidable loss of life.

PRONE-PRESSURE METHOD OF RESUSCITATION

1. PROTECT YOURSELF with dry insulating material.
2. BREAK THE CIRCUIT by opening the power switch or by pulling the victim free of the live conductor.

DON'T TOUCH VICTIM WITH YOUR BARE HANDS UNTIL THE CIRCUIT IS BROKEN.





(A) (B) (C)

3. LAY PATIENT ON STOMACH, one arm extended, the other arm bent at elbow. Turn face outward resting on hand or forearm.
4. REMOVE FALSE TEETH, TOBACCO OR GUM from patient's mouth.
5. KNEEL STRADDLING PATIENTS THIGHS. See (A).
6. PLACE PALMS OF YOUR HANDS ON PATIENT'S BACK with little fingers just touching the lowest ribs.
7. WITH ARMS STRAIGHT, SWING FORWARD gradually bringing the weight of your body to bear upon the patient. See (B).
8. SWING BACKWARD IMMEDIATELY to relieve the pressure. See (C).
9. AFTER TWO SECONDS, SWING FORWARD AGAIN. Repeat twelve to fifteen times per minute.
10. WHILE ARTIFICIAL RESPIRATION IS CONTINUED, HAVE SOMEONE ELSE:
    (a) Loosen patient's clothing.
    (b) Send for doctor.
    (c) Keep patient warm.
11. IF PATIENT STOPS BREATHING, CONTINUE ARTIFICIAL RESPIRATION. Four hours or more may be required.
12. DO NOT GIVE LIQUIDS UNTIL PATIENT IS CONSCIOUS.

REPLACEMENT PARTS AND ENGINEERING SERVICE

When ordering replacement parts, please give symbol, description, and stock number of each item ordered.

The part which will be supplied against an order for a replacement item may not be an exact duplicate of the original part. However, it will be a satisfactory replacement, differing only in minor mechanical or electrical characteristics. Such differences will in no way impair the operation of the equipment.

Service parts may be ordered through the local Broadcast representative, his office, or directly from the Service Parts Order Service Bldg. 60, 19th and Federal Streets, Camden, N. J. Emergency orders may be phoned, telegraphed, or teletyped to RCA Emergency Service, Bldg. 60, Camden, N. J. (Telephone: Woodlawn 3-8000.)

ELECTRON TUBES

Replacement tubes should be ordered from local distributors or the nearest RCA tube warehouse.

RCA tube warehouses are located at the following addresses:

34 Exchange Place
Jersey City 2, New Jersey

589 E. Illinois Street
Chicago 11, Illinois

420 S. San Pedro Street
Los Angeles 13, California

If, for any reason, it is desired to return tubes, please return them to the place of purchase. If this is not convenient, please notify your RCA serving warehouse so that Return Authorization may be forwarded to you.

PLEASE DO NOT RETURN TUBES DIRECTLY TO RCA WITHOUT AUTHORIZATION AND SHIPPING INSTRUCTIONS.

It is important that complete information regarding each tube (including type, serial number, hours of service, and reason for its return) be given.

When tubes are returned, they should be shipped to the address specified on the Return Authorization form. A copy of the Return Authorization and also a Service Report for each tube should be packed with the tubes.

ENGINEERING SERVICE

RCA field engineering service is available at current rates. Request for field engineering service may be addressed to the local Broadcast Sales Engineer or the RCA Service Company, Inc., Communications Service Division, Camden, N. J. Telephone: Gloucester 3-4560 during working hours; emergency service is provided through Woodlawn 3-8000.

TECHNICAL SUMMARY

ELECTRICAL SPECIFICATIONS

Frequency Range	535-1620 kilocycles
Frequency Stability (assigned frequency)	± 5 cycles
Power Output	250 watts
Carrier Shift	2% maximum
Output Impedance	20-250 ohms
Type of Modulation	High level, Class "B," AM
AF Input Level (100% modulation)	+10 ±2 dbm
AF Input Impedance	150/600 ohms
AF Response (reference 1,000 cycles):	
50-7,500 cycles	±1 db
30-10,000 cycles	±1.5 db
AF Distortion (95% modulation, 50-10,000 cycles)	2% maximum
Noise Level (below 100% modulation)	–60 db
Input Power Line Requirements	110-125 volts, 50/60 cycles, single phase
Permissible Combined Line Voltage and Regulation	±5%
Power Consumption:	
Zero Modulation	1,000 watts, approx.
Average Program Modulation	1,150 watts, approx.
100% Modulation	1,400 watts, approx.
Crystal Heater Input Power	117 volts, 50/60 cycles, single phase
Crystal Heater Power Consumption	30 watts
Monitoring Outputs:	
Frequency	10 volts RMS, 75 ohms
Modulation	10 volts RMS, 75 ohms

MECHANICAL SPECIFICATIONS

Cabinet Height	84⅞ inches
Overall Height	86⅝ inches
Width	28 inches
Depth (less door handles)	20½ inches
Weight, net	600 pounds, approx.

TUBE COMPLEMENT

Crystal Oscillator	1—RCA Type 807
Buffer	1—RCA Type 807
Power Amplifier	2—RCA Type 813
First Audio	2—RCA Type 807
Modulator	2—RCA Type 813
High-Voltage Rectifier	2—RCA Type 866A

EQUIPMENT

The BTA-250M Broadcast Transmitter is identified by RCA reference ES-28937 and includes the following major items:

	RCA Reference No.
1 BTA-250M Transmitter, including UL-4392 crystal oscillator, but less tubes and crystals	MI-28053
1 Set of Tubes	MI-28049
2 Side Panels	MI-30541-G84
1 Touch-Up Finish Kit	MI-7443
1 Nameplate	MI-28180-1
1 Crystal Unit, TMV-129B	MI-7467
2 Instruction Books	IB-30220-1
– Choice of: 1 Ammeter, for Remote Pick-Up,	MI-28037-B
or 1 Ammeter, R.F. Output	MI-28048

Available Accessories:

Antenna Tuner, Type BPA-11A, including MI-28027A Remote Pick-Up Assembly and MI-7174 Antenna Ammeter	ES 28906-A
Remote Metering Kit, less meter	MI-28027-A
Spare Crystal Unit, TMV-129B	MI-7467
Kit of Tubes (Spares)	MI-28049
Kit of F. C. C. Spare Tubes	MI-28084
Electrical Side Shields, per side—	
Two	MI-30546-G28
One	MI-30546-G21
Audio Rack, Type BR-84D, less front door and side panels	MI-30951-D84
Modulation Monitor, Type BW-66E	MI-30066-A
Frequency Monitor, Type BW-11A	MI-30011-A

RECOMMENDED TEST EQUIPMENT

	RCA Reference No.
Type WA-28A Low Distortion Audio Oscillator	MI-30028-A
Type WM-71A Distortion and Noise Meter	MI-30071-A
Type WV-97A VoltOhmyst	
Type WO-56A Cathode Ray Oscilloscope	

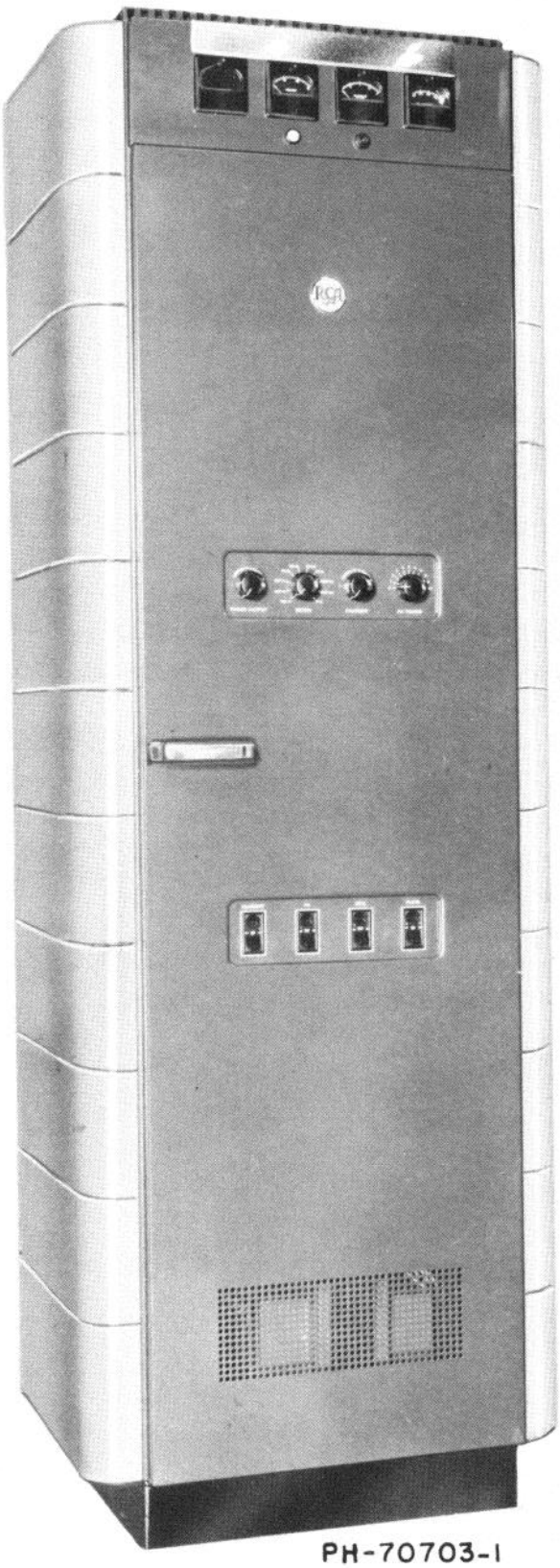


Figure 1—BTA-250M Transmitter

DESCRIPTION

The Type BTA-250M Broadcast Transmitter is a complete, self-contained unit that provides a power output of 250 watts at any frequency in the 535 to 1620 kilocycle range. Mounted in a single RCA Type BR-84 steel cabinet, as shown in Figure 1, the unit utilizes a temperature-controlled crystal for close regulation of the operating frequency.

All operating controls are accessible from the front of the panel through the access openings provided; meters are mounted above the hinged front door. A power source of 117 volts, 50/60 cycles, single phase capable of supplying approximately 1,450 watts is required for the transmitter.

A crystal oscillator, buffer-driver, and power-amplifier comprise the r-f portion of the transmitter.

Referring to the schematic diagram, Figure 12, capacitor C1 is used for adjusting the oscillator frequency within narrow limits, and is the only variable tuning element in this stage. Pilot lamp I101 serves to indicate when the crystal heater is energized, while an extra socket, X110, provides means for storing a spare crystal. The spare crystal heater is energized at all times, permitting instant substitution of the spare for the operating crystal.

An RCA type 807 tube is used in the buffer-driver stage, V101. The plate circuit is shunt fed through coil L101. Taps on L101 enable the buffer-driver stage to be adjusted for optimum output over a wide frequency range.

The power amplifier is a plate-modulated Class "C" amplifier which uses two RCA type 813 tubes connected in parallel. The low-pass "T" filter used as output in this stage serves to match the high plate impedance to the low antenna impedance as well as acting to reduce harmonic radiation. Since screen grid tubes are employed, neutralization of the PA stage is not required.

Two push-pull stages comprise the transmitter audio system. The two type 807 tubes in the first stage operate Class "A" while the modulator uses two type 813 tubes as a Class "AB_1" amplifier. To reduce distortion, approximately 14 db of negative feedback is used on the input stage. The tapped secondary of modulation transformer T102 makes it possible to modulate the screen of the buffer-driver, V101, as well as the screens and plates of PA tubes V102 and V103.

Potentiometers R155, R158, and R159 provide means for maintaining the overall hum at minimum level.

D-c supply for the transmitter is furnished by two rectifiers. High-voltage for the modulator plates and the PA screens and plates is supplied by two type 866A mercury vapor tubes, V108 and V109, functioning as a single-phase full-wave rectifier. Selenium rectifiers SR102 to SR107 also are connected in a full-wave rectifying circuit to furnish approximately 750 volts for the type 807 tubes and a negative 200 volts for modulator bias.

Power to the transmitter is fed through the main circuit breaker S101, the trip coils of which are connected in the filament circuit. Thus a filament overload would remove all power from the transmitter. Control of filament voltage is provided by rheostat R149, in conjunction with meter rectifier SR101 and meter M104. Pilot light I102 serves to indicate the status of the filament circuit.

When filament power is applied by the closing of S101, time delay relay K101 is energized. Relay K101 closes in approximately 30 seconds de-energizing the trip coil of plate breaker S104. Plate power may then be applied manually by closing S104, energizing the rectifier plate circuits.

Circuit breakers S102 and S103 are connected in the cathode circuits of the modulator and power amplifier, respectively, protecting these stages in case of overload.

Milliammeter M104 and selector switch S105 provides facilities for checking all stages in the transmitter. Switch positions along with the various circuits involved are listed in Table 3, under INSTALLATION.

For frequency monitoring, receptacle J101, connected to the cathode of buffer-amplifier V101, provides means for sampling the voltage at this point. Output, approximately ten volts at approximately 75 ohms impedance, may be varied by potentiometer R112.

R-f output for modulation monitoring is obtained from transformer T103 which is connected to J102. Output of this circuit is designed to supply approximately ten volts at approximately 75 ohms impedance. Taps on the secondary of T103 provide means for adjusting the secondary voltage.

INSTALLATION

GENERAL

Upon receipt the unit should be unpacked and inspected for evidence of any damage that may have been incurred during transit. The tubes and crystals, which are packed separately, should not be installed at this time but left in their cartons until the unit is mounted in place and all external wiring completed.

Figure 10 shows the transmitter outline dimensions and the base slot location for making external connections. Ample working space should be provided at the front and rear of the transmitter.

The transmitter frame should be grounded with adequate, short connections. A two- or three-inch wide copper strap, approximately 0.032 inch thick, is recommended for this purpose.

INSTALLATION PRECAUTIONS

Prior to installation of the transmitter, certain installation factors should be considered in the light of possible future operating trouble and parts failure. Thus, some tower lighting circuits may cause fluctuations in the antenna current meter readings when the tower lights are operating. Also, in certain localities, provisions must be made for preventing lightning damage and dissipating static charges which may accumulate on the tower. Precautions taken during installation will prevent these operating difficulties and resultant equipment damage.

Antenna Current Readings

Under certain circumstances, when the tower lights are on, the 60-cycle tower lighting current may cause inaccuracies or fluctuation in the antenna current meter reading. This condition is created when the tower itself serves as one side of the lighting circuit and, hence, provides a common path for the tower lighting current and the r-f current. Where this situation exists it is possible to have two ground return paths for the 60-cycle lighting current—one through the antenna coupling equipment and transmitter output circuit, the other in the ac lighting circuit through the tower lighting chokes to ground where one side of the ac is grounded. A simplified schematic diagram of a typical circuit illustrating this possibility is shown in Figure 2. To prevent the meter fluctuations it is necessary for the 60-cycle tower lighting load to be returned via a path other than the r-f circuits feeding the tower.

If a toroidal tower lighting transformer is used, no antenna current meter fluctuations will occur. Where lighting chokes are utilized, the circuit should be checked for the existence of a second ground path as previously described.

Elimination of the 60-cycle return path through the coupling equipment or transmitter output circuit is achieved by inserting a blocking capacitor in the antenna feed line. The capacitor may be connected in either of two places, just ahead of the antenna current meter or between the transmitter output and transmission line. The location depends upon the type of coupling circuit used in the line terminating unit. Value of the capacitor, shown dotted on Figure 2, should be approximately 0.01 mf with a current rating equal to two or three times the normal antenna current. For low-frequency, low-impedance transmission lines, it may be necessary to use higher capacitance, so that the reactance does not exceed one-quarter of the transmission line impedance.

To determine whether antenna current meter variations are caused by the condition just described, turn on the tower lights while the transmitter is OFF. The presence of any current reading on the antenna current meter at this time indicates the need for corrective measures.

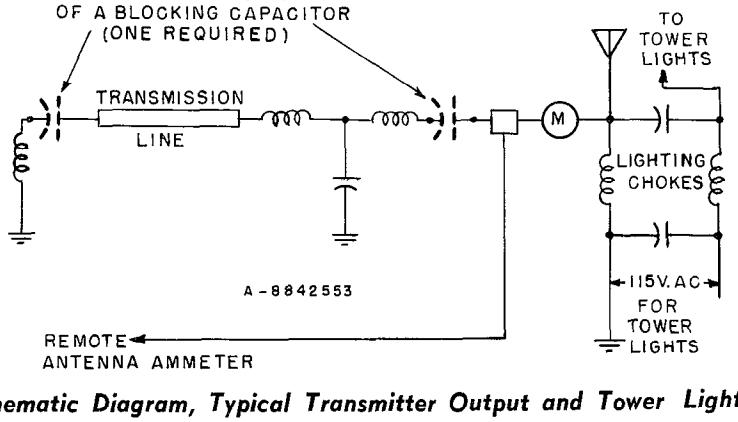


Figure 2—Simplified Schematic Diagram, Typical Transmitter Output and Tower Lighting Circuit (A-8842553)

Atmospheric Static Accumulations

In certain localities atmospheric conditions build up high static potentials on the transmitting towers, making it imperative to provide a drain path to ground for these accumulations. If no direct path is provided, the charge builds up potential until flashover occurs either across the tower base arc gap or across one of the capacitors in the coupling system.

Where tower lighting chokes are used and one side of the ac supply line is grounded, the lighting choke will act as a satisfactory discharge path. When neither side of the ac line is grounded, or when a toroidal tower lighting transformer is utilized, a drain path must be provided. Such a path already exists in the BTA-250M transmitter through L105, L106, and L107. Should it be necessary to break this path to ground, by the use of a series capacitor, for example, it may be necessary to provide an alternate path. To check for the existence of a suitable dc path to ground, turn off the transmitter and tower lighting circuit. Connect an ohmmeter between the tower and ground. Any resistance up to approximately 250,000 ohms will provide a satisfactory return circuit. When no discharge path is indicated, one may be supplied by the installation of an r-f choke or a 100,000 to 200,000-ohm Globar resistor. Connect either the choke or the resistor from the antenna feed line to ground. The line terminating unit will generally serve to house the component used.

If antenna current meter fluctuations result from the addition of the choke or resistor, it will be necessary to add the blocking capacitor discussed under the preceding heading "Antenna Current Readings."

Electrical Storms

Areas subject to lightning storms require a direct electrical path from the tower to ground, to avoid capacitor and antenna current meter burn-out by lightning striking the tower. This requirement is generally met by arc gaps installed across the base insulators. These arc gaps should be carefully adjusted during bad weather—which could be either dusty or humid conditions. Spacing of the arc gaps should be set so that flashover occurs just beyond the point of 100% sine wave modulation.

If the gaps are properly spaced, the gaps at time of discharge present a low impedance path to ground, and will carry directly to ground any current caused by the lightning striking the tower. Although there is a second path to ground, through the tuning equipment or transmitter output, the higher impedance of this second path usually prevents excessive discharge under normal conditions. In instances where the tuning house is located under the tower or directly adjacent to it, the ratio of these two impedances may not be sufficiently high to prevent appreciable discharge current through the tuning equipment to ground, with consequent destruction of coupling equipment. To increase this ratio, a one- or two-turn loop should be installed in the antenna lead from the tower to the tuning house. No such loop is required where the tuning house is several feet from the tower. The longer lead in the latter instance provides the necessary higher impedance.

Antenna Current Meters

Where thermocouple-type instruments are used for antenna current metering, the meter circuits should be equipped with make-before-break knife switches such as are incorporated in RCA line tuning units. This type switch enables one side of the meter circuit to be opened when readings are not being taken.

WIRING

Wiring to and from the transmitter should be carried in conduit or a trench terminating below the unit. The base plan indicates where this wiring should enter the unit. Table I lists the external connections that should be made to the transmitter.

TABLE I

EXTERNAL CONNECTIONS TO BTA-250M UNIT

POINT OF CONNECTION	EXTERNAL CIRCUIT
TB1	Ground
TB2, TB3	AF input
TB4	—
TB5	—
TB6	—
TB7, TB8	Remote antenna ammeter (when used)
TB9, TB10	117 volts, 50/60 cycles for crystal heater
TB11, TB12	117 volts, 50/60 cycles power input
J101	Frequency monitor
J102	Modulation monitor

A separate 117-volt source should be used for the crystal heater power supply, since this power must be supplied continuously for maintaining the crystals at the proper operating temperature.

When a six-wire, 230-ohm transmission line is used, it should be terminated at the lead-in insulators mounted on top of the cabinet.

Connections from these insulators to the bushings on the wall of the transmitter house are generally of copper tubing. When a coaxial transmission line is used, remove the lead-in insulators and bring in the transmission line through one of the holes. Fasten the outer conductor of the line securely to the equipment chassis, and scrape the paint from the chassis so that a good electrical ground is obtained.

If the MI-28048 ammeter is to be installed for reading the transmitter r-f output, the meter should be mounted behind the dummy meter case on the panel using the brackets and hardware supplied. Connect the meter as shown on the schematic diagram, Figure 12.

When the RCA BPA-11A Antenna Tuner and MI-28037-B Remote Antenna Ammeter are utilized, remove the dummy meter case, and mount the MI-28037-B Remote Antenna Meter directly on the meter panel. Wire the meter as indicated in the upper right-hand corner of the schematic diagram, Figure 12.

On reactor L110, adjust the arc gap to 0.02 inch.

After all wiring is completed install the tubes and plug the crystal holder into socket X2. Plug the spare crystal into socket X110.

PRELIMINARY ADJUSTMENTS

SAFETY WARNING

VOLTAGES USED IN THIS EQUIPMENT ARE DANGEROUS, AND CONTACT WITH LIVE PARTS MAY PROVE FATAL. OBSERVE ALL SAFETY PRECAUTIONS WHEN WORKING ON THE EQUIPMENT. (SEE FIRST AID NOTICE IN FRONT PART OF THIS BOOK.)

Before applying any power to the transmitter make sure all circuit breakers are in the OFF position. Close the FILAMENT circuit breaker, S101. The filaments of all tubes should light. When the METER switch, S105, is in position 10, meter M104 should indicate the voltage applied to the primaries of the filament transformers, T106 and T107. Therefore, if the measured voltage is other than 120 volts, open the FILAMENT breaker and reconnect the power leads on T106 and T107 to the taps next lowest to the measured voltage. Then, using an external meter of known accuracy, measure all filament voltages at the tube sockets. Adjust the FILAMENT rheostat so that the measured voltages are within two per cent of the rated value of the tubes. Record the reading on meter M104, in position 10 of S105, for future reference.

Primary taps of the plate transformers, T104 and T105, should now be adjusted by measuring the line voltage at the transformer terminals and adjusting the power leads to the taps most nearly corresponding to the measured voltage.

Note:

Before proceeding further it is important that the transmitter be permitted to operate for at least 30 minutes with **filament power only.** This warm-up period is required to properly distribute the mercury within the type 866A tubes. The procedure need be repeated during subsequent operation only if mercury is splashed on the tube elements during handling or when replacing tubes. It is suggested that all new 866A tubes be "seasoned" as described and then stored in an upright position. In case of tube failure the transmitter may thus be restored to operation with a minimum of delay.

Now, before applying any plate power, open the FILAMENT breaker and adjust the oscillator plate choke, L1, to the proper tap as indicated in Table 2. The flexible lead, or jumper, on L1 should be at the setting which provides the smallest number of active turns on L1, or the lowest inductance. The crystals are factory-calibrated for tuning on the lower inductive side of resonance, hence, for proper starting and stability, the minimum number of turns should be used. Final adjustment should always be on the high-frequency side of minimum oscillator plate current.

TABLE 2

OSCILLATOR PLATE COIL TAPS

BAND COVERAGE	JUMPER CONNECTION ON L1
535-700 kc	Remove (Use full coil)
700-1000 kc	Tap 2
1000-1300 kc	Tap 3
1300-1620 kc	Tap 4

TABLE 3

TYPICAL METER READINGS

CIRCUIT	METER M102	METER M103	METER M104	
			POSITION SWITCH S105	CURRENTS CORRESPONDING TO 100% METER READING
Oscillator cathode, V1			1	30 ma
Buffer-driver grid, V101			2	3.5 ma
Buffer-driver cathode, V101			3	65 ma
PA grid, V102, V103			4	25 ma
PA cathode, V102			5	150 ma
PA cathode, V103			6	150 ma
1st AF cathode, V104, V105			7	8.5 ma
Modulator cathode, V106 (100% mod.)			8	150 ma
Modulator cathode, V107 (100% mod.)			9	150 ma
Primary, filament transformers			10	100 volts
PA plate current	250 ma			
PA plate voltage		1450 volts		

Connect the jumper on coil L103 as follows:

535-640 kc—Use full coil
640-790 kc—Tap 1
790-980 kc—Tap 2
980-1200 kc—Tap 3
1200-1420 kc—Tap 4
1420-1620 kc—Tap 5

Make sure the MOD and PA circuit breakers are in the OFF position. Remove the plate cap from one rectifier tube, type 866A. Operate the PLATE circuit breaker, S104, to the ON position. This applies plate voltage to all tubes, but plate current should flow in only the low power tubes.

Rotate the METER switch, S105, to positions 1, 2, and 3 and note the current readings on meter M104. Meter readings should be approximately 100%; however, readings from 80% to 120% are normal. If the buffer grid current is low or the crystal is sluggish in starting, shut off all power and readjust the oscillator plate choke tap. If the frequency monitor output jack, J101, is not loaded, the buffer grid current may be excessive. Current may be reduced by adjustment of R112.

After the oscillator and buffer stages are functioning satisfactorily, open the PLATE breaker. Connect the PA tank capacitors C117 and C123 and adjust L105 tank coil shorting tap as indicated in Table 4 and Figure 3. Disconnect the coupling tap on L105 and reconnect it one turn from the grounded end of the coil.

The harmonic filter and antenna coil shorting taps and the harmonic filter capacitors should now be adjusted as described under the succeeding heading, "Output Circuit." This subject is treated separately due to the calculations involved, but adjustment should be made at this point.

Having made the output circuit calculations and adjustments, operate the PA circuit breaker, S103, to the ON position and again close the PLATE breaker switch. Quickly tune the PA to minimum plate current by rotation of the PA TUNING knob. The PA PLATE CURRENT meter should indicate

TABLE 4

PA CAPACITORS C117, C123

BAND COVERAGE	CAPACITORS CONNECTED
535-600 kc	C117, C123
600-680 kc	C117
680-1200 kc	C123
1200-1620 kc	none

approximately 50 ma. After adjusting the PA plate circuit, open the PA and PLATE switches.

Replace the plate cap removed previously from the 866A tube. Set the POWER OUTPUT control to mid-position. Since the tap setting on L106 is approximate only, it is necessary to readjust this tap for maximum loading.

Shut off power and follow an adjustment procedure of moving the tap on L106 slightly in one direction and then noting the plate current when power is reapplied. Repeat this adjustment cycle, changing the direction if necessary, until maximum plate current is obtained. This maximum should be a peak reading which should drop off on either side of resonance. If resonance can not be obtained, the output coupling is excessive, and the tap setting on L105 must be changed.

After obtaining peak plate current, readjust the PA TUNING control for minimum plate current. If appreciable detuning is evident, the output coupling is excessive and must be reduced by readjusting the tap on L105.

After resonating the output circuit by readjustment of L106, output may be set at the required level by readjusting the coupling tap on L105. Slight readjustment of C118 may be required to keep the circuit at resonance.

After the output circuit has been completely adjusted, the efficiency of the power amplifier may be improved somewhat by a slight detuning of C118 in the direction of increasing output. Final adjustment of the output power may be made by adjustment of the POWER OUTPUT control. Check the PA cathode current on tubes V102 and V103 in positions 5 and 6 of the meter switch.

To adjust the modulator, open the PA and PLATE switches. Using a screwdriver, adjust the modulator bias potentiometers R151 and R152 to the maximum clockwise position, which will apply maximum bias to the modulator tubes.

Close the PLATE breaker and MOD breaker switch S102, thus applying plate voltage to the modulator stages. Observe the modulator cathode current on the panel meter, at positions 8 and 9 of the METER switch. Now adjust R151 and R152 so that the cathode currents on V106 and V107, respectively, are 30 per cent. The designation I_{k_1} refers to V106 and I_{k_2} to V107.

Open the PLATE switch and connect a 1,000-cycle audio signal of suitable level to terminals TBA-2 and TBA-3. At 100 per cent modulation, meter M104 should indicate approximately 100 per cent in positions 8 and 9 of S105.

To adjust for minimum hum, open the PLATE switch. Rotate R155 to the extreme counterclockwise position, and set R158 and R159 at the center position, i. e., the shaft screwdriver slot must be vertical. Reapply power and, using a distortion and noise meter, measure the hum level. In the sequence listed, adjust R158, R159, and then R155 for minimum hum.

When a noise meter is not available. rotate R155 to the counterclockwise position. Adjust R158 and R159 to the center position, using a scale not exceeding 10 volts maximum on an a-c voltmeter, for setting these potentiometers at the electrical center.

OUTPUT CIRCUIT

The output circuit is designed to match any impedance between 20 ohms and 250 ohms resistance. Inductor L107 is provided to cancel the capacitive component of the antenna impedance when the antenna is connected directly to the transmitter.

The circuit is normally an "L" type low-pass filter, for antenna resistances greater than 70 ohms. When the antenna resistance is less than 70 ohms, a "T" type low-pass filter circuit is used.

In determining the output circuit components, first note whether the antenna resistance is greater or less than 70 ohms. If the antenna resistance is less than 70 ohms, adjust L107 so that its reactance equals the capacitive antenna reactance; or if the antenna resistance is less than 70 ohms, the reactance of L107 should equal the antenna reactance plus 35 ohms. To determine the inductance of L107, use the formula:

$$L = \frac{159\ X_L}{f}$$

where L is the inductance in microhenries, X_L is the required reactance in ohms, and f is the operating frequency in kilocycles. Then use Figure 6 to find the number of turns to be shorted.

The adjustment of inductor L106 and the shunt capacitance may be determined from Figures 4, 5, and 6. It should be noted that curves for the inductance of L106 appear on both Figures 4 and 5. Figure 4 is to be used where the antenna resistance is greater than 70 ohms: if the antenna resistance is less than 70 ohms, Figure 5 is to be used.

Following is the procedure for tuning the output network:

1. Determine the required reactance of L107. As previously noted, the reactance should be equal to the capacitive reactance of the antenna when the

antenna resistance is greater than 70 ohms. When the antenna resistance is less than 70 ohms, the reactance of L107 should be equal to the capacitive reactance of the antenna plus 35 ohms.

2. Determine the inductance of L107 using the formula:

$$L = \frac{159\ X_L}{f}$$

3. From Figure 6, determine the number of turns to be shorted.

4. From Figure 4 or 5, determine the required inductance of L106, using the known frequency and antenna resistance.

5. Using Figure 6, determine the turns on L106 to be shorted, to obtain the inductance required in Step 4.

6. Determine the required shunt capacitance from the known frequency and antenna resistance, using Figure 7.

7. Using the capacitance from the previous step, and referring to Table 5, determine the manner of connecting C120, C121, and C122 for the closest approximation to the required value.

8. Determine the antenna current:

$$I_A = \sqrt{\frac{P}{R_A}}$$

9. Determine the voltage across the shunt capacitance:

$$E_C = I_A \sqrt{35^2 + R_A^2}$$

when R_A is less than 70 ohms

or $E_C = I_A R_A$ when R_A is greater than 70 ohms

10. Calculate the current in each capacitor used and make sure it does not exceed the rating determined from Table 6.

As an example of the preceding calculations, assume that the power output from the transmitter is 250 watts and that the transmitter is operating into an antenna whose impedance is 20 -j30 ohms. Assume the frequency to be 1250 kc.

1. The antenna resistance is less than 70 ohms, therefore, the reactance of L107 is 30 + 35 = 65 ohms.

2. The inductance of L107 is

$$L = \frac{159X_L}{f} = \frac{159\ (65)}{1250} = 8.3 \text{ microhenries.}$$

3. From Figure 6, 26 turns must be shorted.

4. From Figure 5, the inductance of L106 should be 3.8 microhenries.

5. From Figure 6, 31 turns must be shorted.

6. From Figure 7, the required shunt capacitance is 6200 mmf. Note that since the antenna resistance, 20 ohms, is less than 70 ohms, the curve marked "ANT RES. = LESS THAN 70 OHMS" on Figure 7 is to be used.

7. From Table 5, 5900 mmf is found to be the nearest approximation to the required 6200 mmf. Therefore, C120 and C121 should be connected in parallel.

8. $I_A = \sqrt{\frac{P}{R_A}} = \sqrt{\frac{250}{20}} = 3.54$ amperes

9. $E_C = I_A \sqrt{35^2 + R_A^2} = 3.54 \sqrt{35^2 + 20^2}$
$= 142$ volts

10. (C120) $I_C = 6.28 f C E_C = 6.28\ (1{,}250{,}000)$
$(2000)\ (10)^{-12}\ (142) = 2.23$ amperes

(C121) $I_C = 6.28\ (1{,}250{,}000)$
$(3900)\ (10)^{-12}\ (142) = 4.35$ amperes

Reference to Table 6 indicates that the currents are not excessive.

Check the output frequency on the frequency monitor connected to J101. Any slight frequency adjustment necessary may be made by rotation of capacitor C1 in the oscillator stage. Potentiometer R112 adjusts the level to the monitor.

Modulation may be adjusted by using the 1000-cycle input signal connected to terminals TBA-2 and TBA-3. One hundred per cent modulation may be checked in any of the usual methods. Cathode currents in the modulator are available in positions 7, 8, and 9 of the METER switch. Monitor level may be adjusted by setting the secondary taps on T103 as necessary.

When all adjustments are completed, operate all panel switches to the OFF position.

TABLE 5

CONNECTIONS, CAPACITORS C120, C121, C122
(8842552)

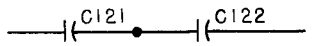
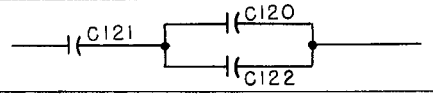
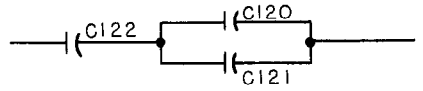
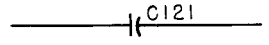
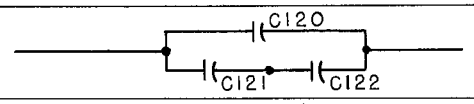
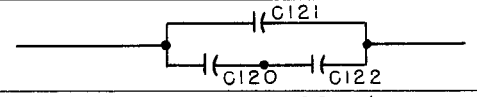
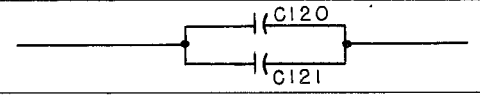
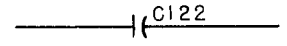
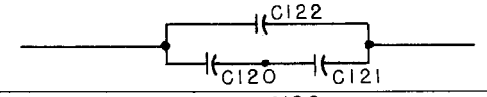
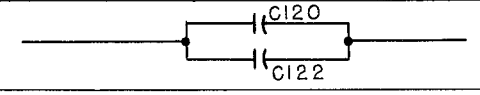
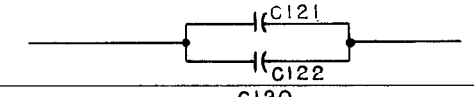
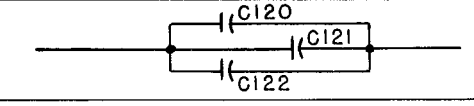
CAPACITANCE MMF	CONNECTIONS
2,650	
2,820	
3,420	
3,900	
4,650	
5,510	
5,900	
8,200	
9,520	
10,200	
12,100	
14,100	

TABLE 6
CURRENT RATING, C120, C121, C122

CAPACITOR	VALUE	AT 300 KC	AT 1,000 KC	AT 3,000 KC
C120	2,000 mmf	2.2 amps	3.7 amps	4.5 amps
C121	3,900 mmf	3.4 amps	4.5 amps	5.5 amps
C122	8,200 mmf	4.5 amps	6.0 amps	6.0 amps

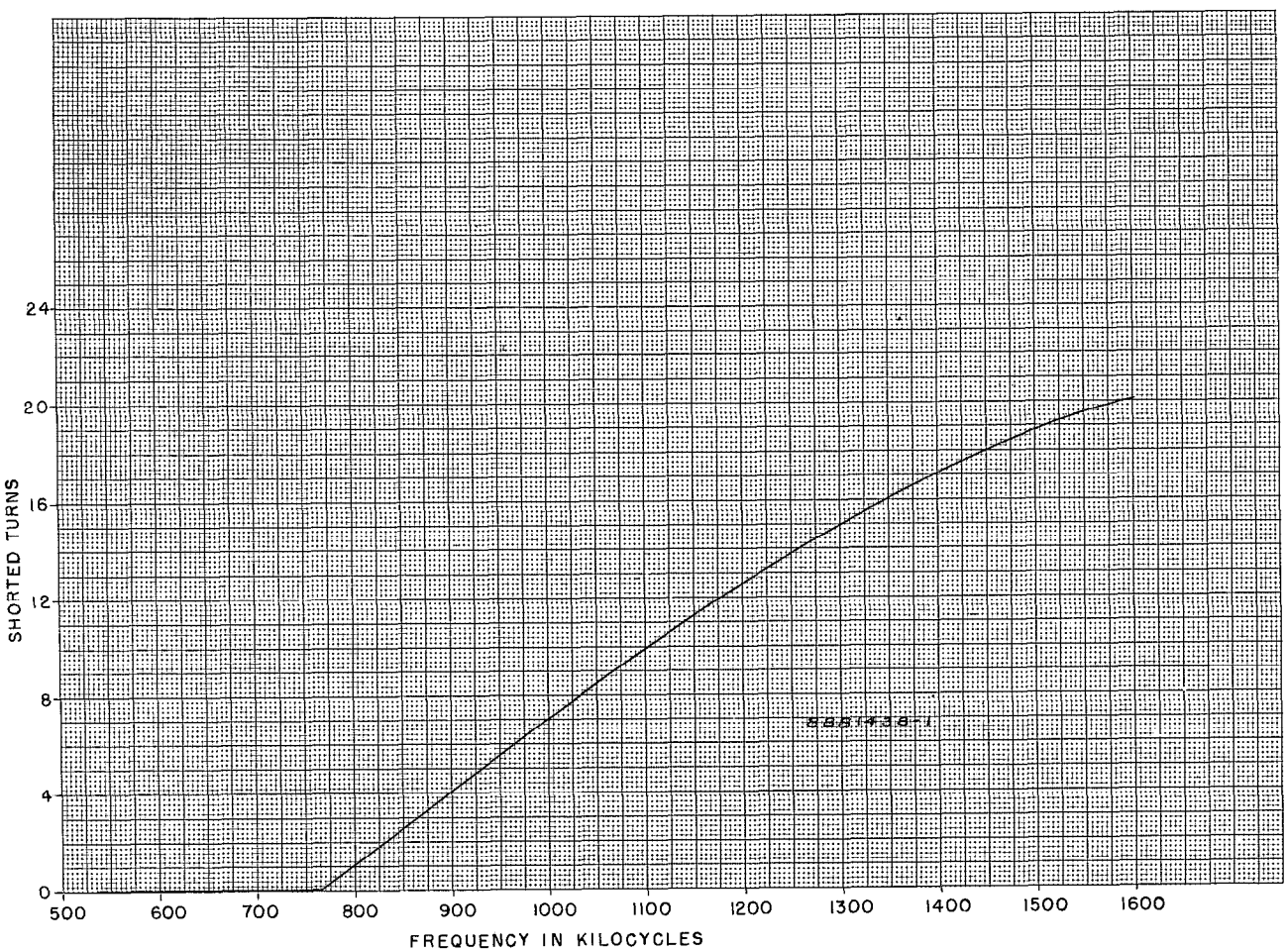


Figure 3—Coil Turns vs Frequency, L105 (8881438-1)

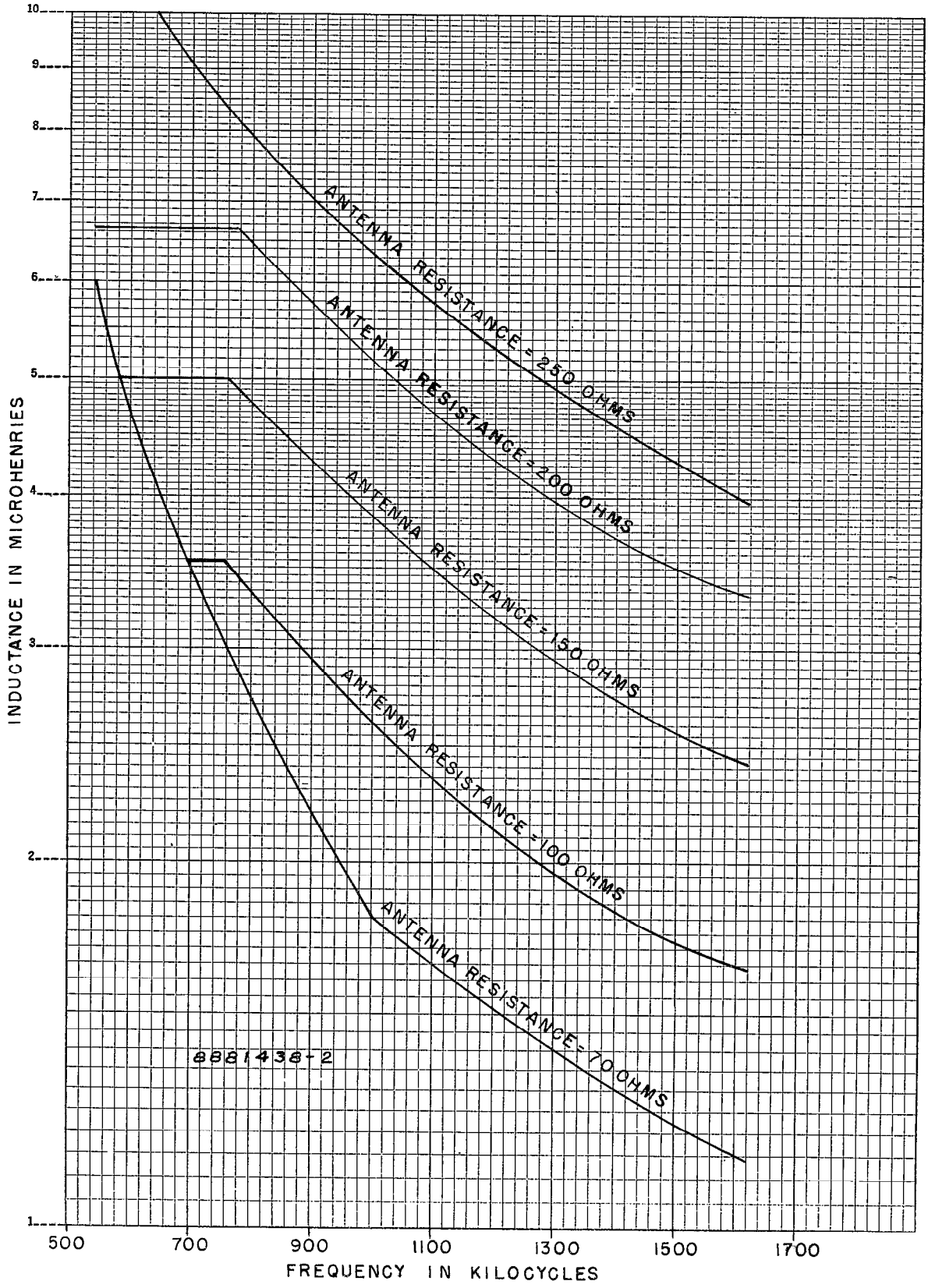


Figure 4—Inductance of L106, Antenna Resistance Above 70 Ohms (8881438-2)

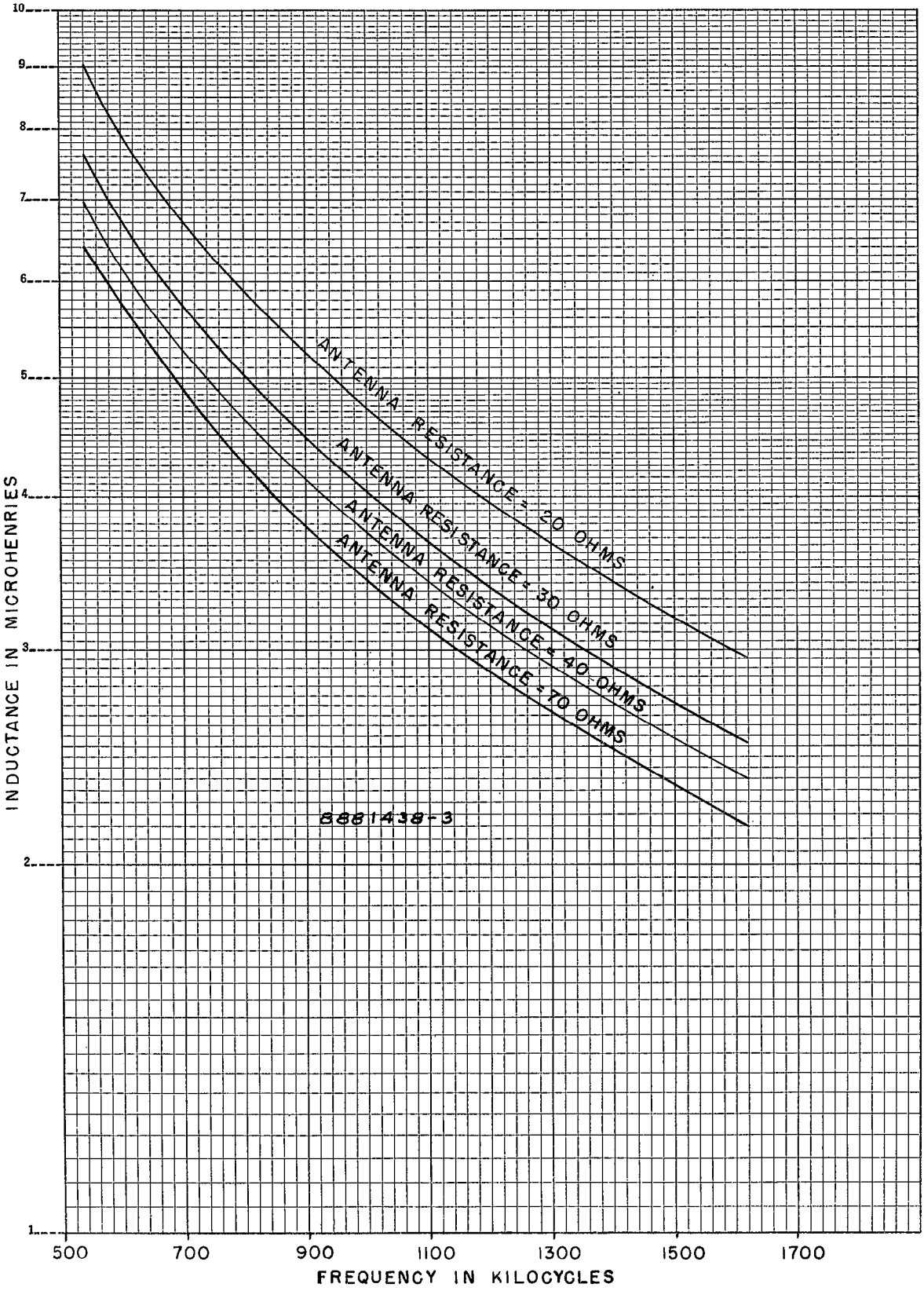


Figure 5—Inductance of L106, Antenna Resistance Below 70 Ohms (8881438-3)

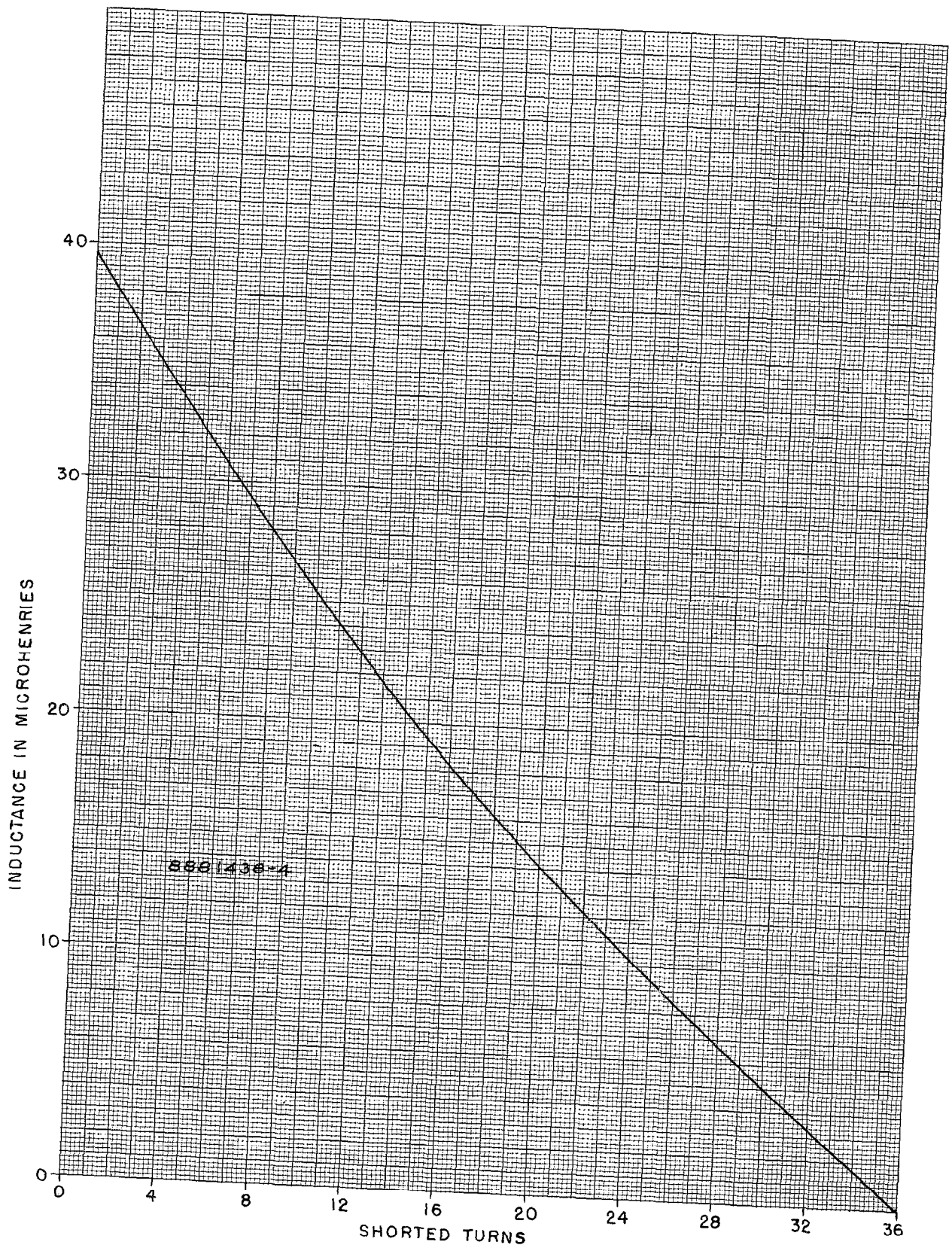


Figure 6—Coil Turns vs Inductance, L106 and L107 (8881438-4)

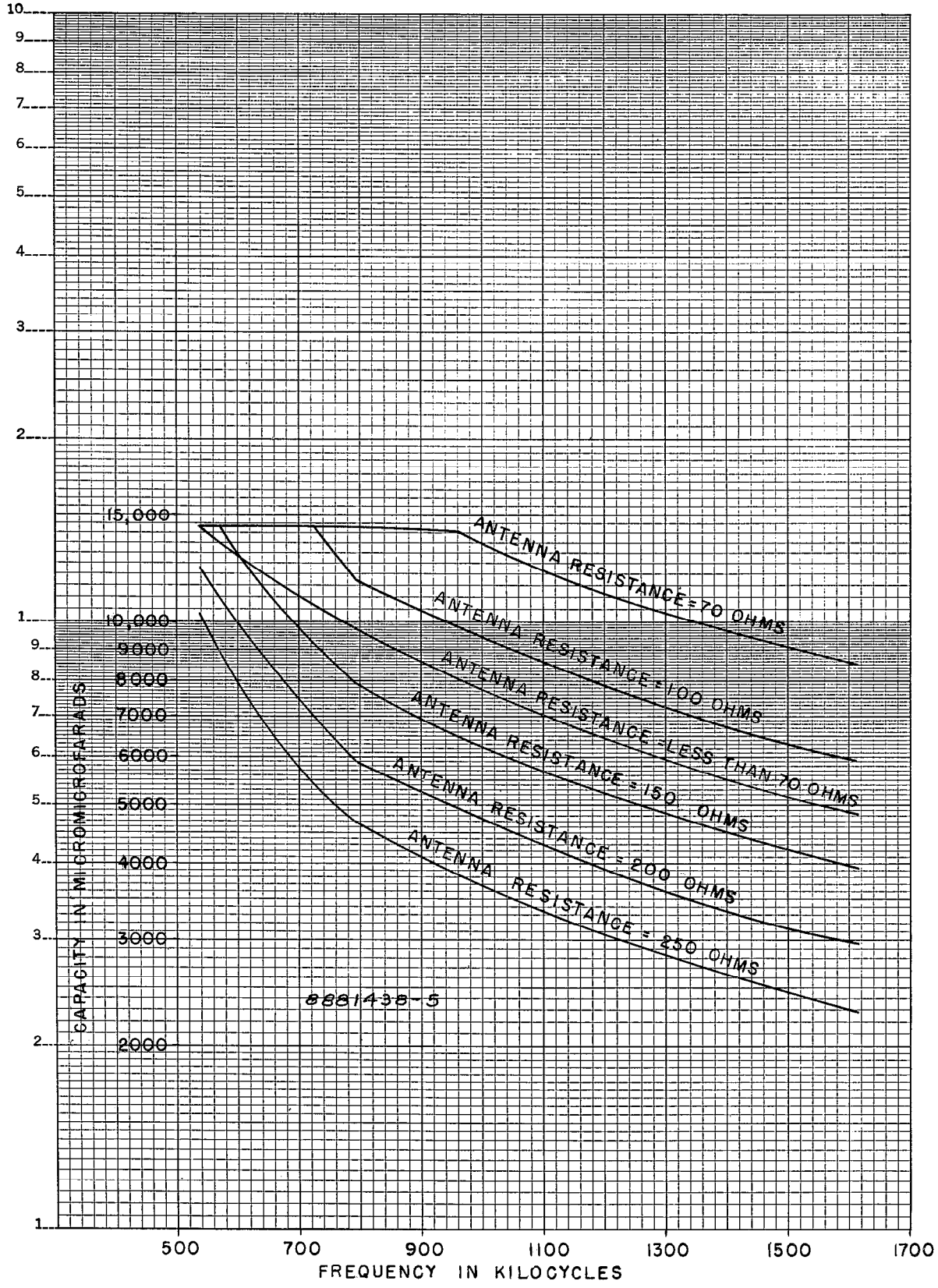


Figure 7—Capacity of C120, C121, C122 Combination (8881438-5)

OPERATION

To energize the BTA-250M transmitter, close the FILAMENT breaker switch. After the time delay relay has operated, approximately 30 seconds delay, place the PA, MOD, and PLATE switches in the ON position. The transmitter is now ready for normal operation.

To shut down the transmitter, open the FILAMENT and PLATE switches. Future applications of power may be made by simply closing these two switches.

During operation it is well to check the filament voltage occasionally on the panel meter, and to adjust the FILAMENT control as necessary to compensate for any line voltage fluctuations. Increased tube life will result by operating all tubes at their rated filament values.

Overloads may trip the PA or the MOD breakers individually, requiring manual reclosing after the difficulty has been remedied.

MAINTENANCE

To insure continuous and reliable operation it is recommended that a definite maintenance schedule be established. It is particularly important that the entire transmitter be kept free from dust and excessive moisture. Special care should be observed in the case of all insulators to avoid high resistance leaks. A small electric hand blower may be used advantageously to blow dust from inaccessible places.

The transmitter should also be inspected periodically for poor contacts and loosened connections.

As far as possible, tube failures should be anticipated by keeping a log of tube life and replacing tubes before actual breakdown.

The appearance of the transmitter and its components may be kept like new by the judicious application of the matching lacquers which are included as part of this equipment.

As an aid in servicing, Table 7 lists typical voltages at the tube sockets.

TABLE 7

TYPICAL TUBE SOCKET VOLTAGES

Tube Symbol	Tube Function	Tube Type	Plate		Cathode		Grid		Screen		Filament	
			Pin No.	Volts DC	Pin No.	Volts DC	Pin No.	Volts DC	Pin No.	Volts DC	Pin No.	Volts AC
V1	Oscillator	807	cap	225	4	20	3	—	2	245	1–5	6.3
V101	Buffer/ Driver	807	cap	530	4	42	3	–75	2	345	1–5	6.3
V102, 3	PA	813	cap	1, 515	—	—	4	–335	3	335	1–7	10
V104, 5	1st AF	807	cap	240	4	36	3	9	2	240	1–5	6.3
V106, 7	Modulator	813	cap	1, 515	—	—	4	–80	3	750	1–7	10
V108, 9	Rectifier	866/866A	cap	1, 840 AC	—	—	—	—	—	—	1–4	2.5

All voltages except filament voltages are measured to ground, using a high-resistance voltmeter.

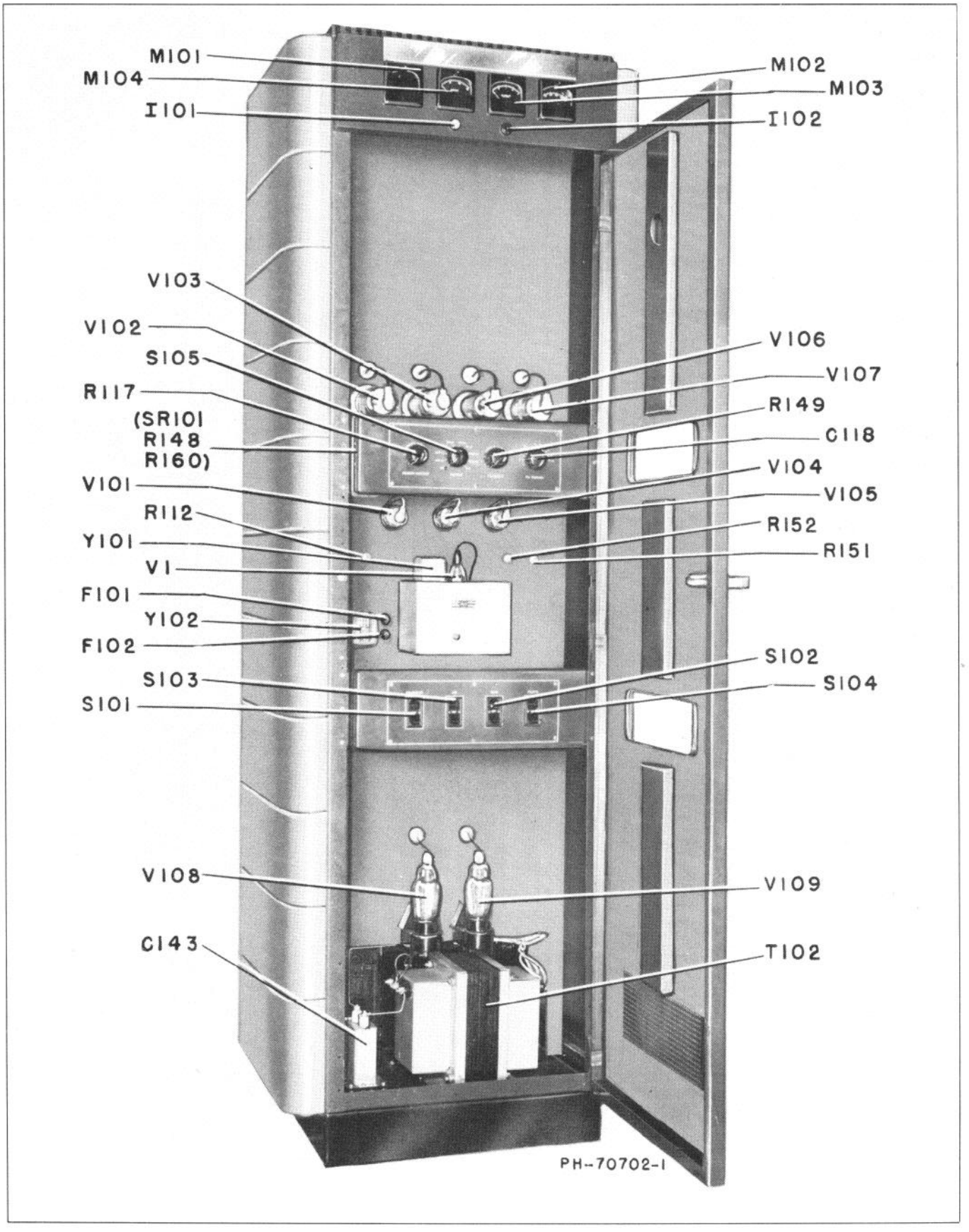


Figure 8—Transmitter, Front View—Door Open

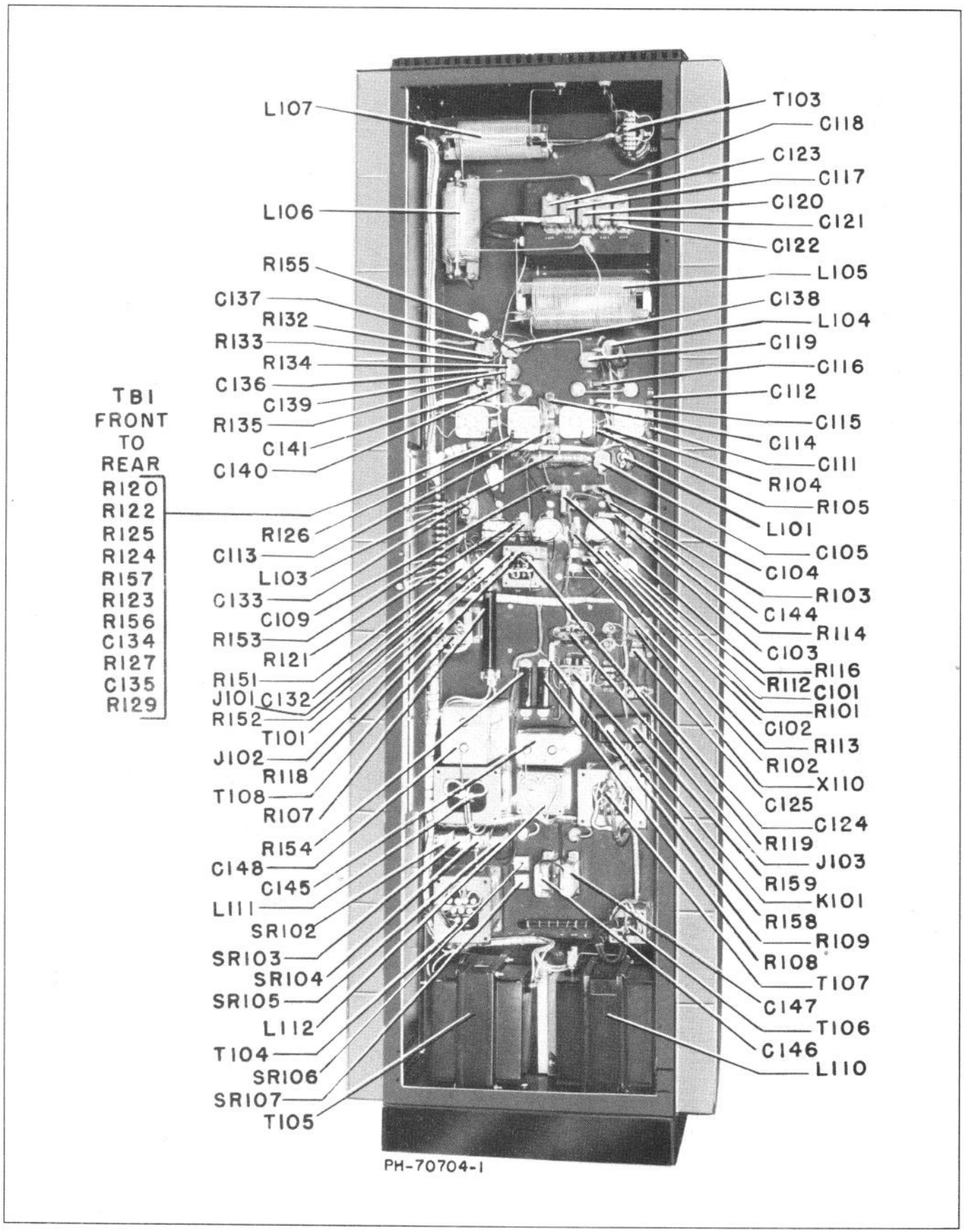


Figure 9—Transmitter, Rear View—Door Open

PARTS LIST

FOR ORDERING INFORMATION SEE PAGE 5

BTA-250M TRANSMITTER

Symbol No.	Description	Stock No.
C1	Capacitor; air, variable, 4.5-2.0 mmfd, crystal tuning	16890
C2, C3	Capacitor; fixed, mica, 0.01 mfd ±10%, 1200 volt, by-pass	610003
C4	Capacitor; fixed, mica, 47 mmfd ±5%, 2500 volt, output coupling	50358
C5	Capacitor, fixed, mica, 0.002 mfd ±5%, 2500 volt, filter	602002
C6	Capacitor; headed, lead type, 1 mmfd ±10% 500 volt, feedback	55331
C7 to C100	Not used	
C101 to C104	Capacitor; fixed, mica, 0.01 mfd ±20%, 1200 volt	610004
C105	Capacitor; fixed, mica, 150 mmfd ±10%, 2500 volt	600153
C106 to C108	Not used	
C109	Capacitor; same as C101	
C110	Not used	
C111 to C114	Capacitor; fixed, mica, 3300 mmfd ±20%, 2500 volt, PA filament	94171
C115	Capacitor; fixed, mica, 200 mmf ±5%, 2500 volt	95011
C116	Capacitor; fixed, mica, 300 mmf ±5%, 5000 volt	93619
C117	Capacitor; fixed, mica, 510 mmf ±5%, 5000 volt	93620
C118	Capacitor; variable, 24 plates, 250 mmf, shaft ¼" x 1½" lg.	93621
C119	Capacitor; fixed, mica, 510 mmf ±5%, 5000 volt	93622
C120	Capacitor; fixed, mica, 2000 mmfd ±5%, 5000 volt	553054
C121	Capacitor; fixed, mica, 3900 mmfd ±5%, 3000 volt	93623
C122	Capacitor; fixed, mica, 8200 mmfd ±5%, 2000 volt	93624
C123	Capacitor; fixed, mica, 240 mmfd ±5%, 5000 volt	93625
C124	Capacitor; oil, 0.05-0.05 mfd +20 -10%, 600 volt	93626
C125	Capacitor; fixed, mica, 2700 mmfd ±10%, 500 volt	39662
C126 to C129	Not used	
C130, C131	Not used	
C132	Capacitor; fixed, paper, 1.0 mfd +20%, -10%, 600 volt	56124
C133	Capacitor; fixed, paper, 2.0 mfd ±20%, 600 volt	17660
C134, C135	Capacitor; paper, tubular, 0.1 mfd ±10%, 600 volt	73557
C136	Capacitor; fixed, mica, 250 mmfd ±2%, 5000 volt	93627
C137, C138	Capacitor; fixed, mica, 0.03 mfd ±5%, 600 volt	50787
C139	Capacitor; same as C136	
C140, C141	Capacitor; fixed, mica, 1000 mmf ±2%, 2500 volt	601004
C142	Not used	
C143	Capacitor; fixed, paper, 1.0 mfd ±10%, 4000 volt	93628
C144	Capacitor; same as C132	
C145	Capacitor; fixed, paper, 15.0 mfd ±20%, 1000 volt	56384
C146, C147	Capacitor; fixed, oil filled, 10.0 mfd, 400 volt	57017
C148	Capacitor; fixed, paper, 15.0 mfd ±20%, 2000 volt	93629
C149 to C152	Capacitor; fixed, mica, 0.005 mfd ±20%	805004
F101, F102	Fuse; crystal heater, 1 amp.	19335
J1	Connector; 8 contact, male, power	47317
J101, J102	Connector; single contact, male, rf freq. mon.	51800
J103	Connector; 8 contact, male, crystal osc.	19656
K101	Relay; time delay, coil 115 volt, 0.080 amp.	93630
L1	Reactor; air core, complete with 8 coils, terminal board, brkt. mtg., plate tank	50360
L2 to L100	Not used	
L101	Coil; choke, buffer plate	16892
L102	Not used	
L103	Coil; choke, PA grid	93610
L104	Coil; choke, PA plate	19185
L105	Coil; inductor, pa tank	93611
L106, L107	Coil; inductor, pa loading	93612
L108	Not used	
L109	Not used	
L110	Reactor; 50 hy 30 cy. 0.30 amp. d-c, modulation	93657
L111	Reactor; 400 ma, 10 hy, 100/120 cy. 0.40 amp. d-c, 70 ohms, HV filter	93658
L112	Reactor; 200 ma, 10 hy, 100/120 cy. 0.20 amp. d-c, 120 ohms, LV filter	93659
M101	Meter; MI-28048 RF Output Ammeter or MI-28037-B Remote RF Antenna Ammeter —scale range as required	
M102	Meter; 0-500 ma d-c, calib. for 3/32 steel panel, round case, sq. front, stud mtg., PA plate current	94156
M103	Meter; 0-2.0 kv d-c, calib. for 3/32 steel panel, round case, sq. front, stud mtg, pa plate voltmeter	94157
M104	Meter; 0-1.0 ma, d-c, calib. for 3/64 steel panel, sq. front, rd. case, stud mtg., special scale	93614

PARTS LIST—Continued

FOR ORDERING INFORMATION SEE PAGE 5

BTA-250M TRANSMITTER

Symbol No.	Description	Stock No.
P101, P102	Connector; cable, male, single contact, rf freq. monitor	66344
R1	Resistor; fixed, comp, 150,000 ohms ±5%, 1 watt	50361
R2	Resistor; fixed, comp, 680 ohms ±5%, 2 watt	50362
R3	Resistor; fixed, comp, 12 ohms ±10%, 1 watt	28973
R4 to R100	Not used	
R101	Resistor; fixed, comp, 47 ohms ±10%, 2 watt	11834
R102	Resistor; fixed, comp, 22,000 ohms ±10%, 2 watt	58239
R103	Resistor; fixed, ww, 10,000 ohms ±10%, 10 watt	53363
R104, R105	Resistor; same as R101	
R106	Resistor; fixed, ww, 3300 ohms ±5%, 10 watt	93631
R107	Resistor; fixed, ww, ferrule type, 25,000 ohms ±10%, 95 watt	93632
R108	Resistor; fixed ww, 7500 ohms, 55 watt	93633
R109	Resistor; fixed, ww, 15,000 ohms ±5%, 10 watt	93634
R110	Resistor; fixed, ww, 2 meg ±1%, 2 watt	93635
R111	Resistor; fixed, comp, 100,000 ohms ±20%, 2 watt	28738
R112	Resistor; variable, ww, 200 ohms ±10%, 3 watt	93636
R113	Resistor; fixed, ww, 560 ohms ±5%, 5 watt	93615
R114	Resistor; same as R103	
R115	Resistor; same as R106	
R116	Resistor; fixed, ww, 12,500 ohms ±10%, 10 watt	94158
R117	Resistor; variable, 500 ohms, 75 watt	93637
R118, R119	Resistor; fixed, comp, 33,000 ohms ±5%, 1 watt	38895
R120	Resistor; fixed, comp, 5600 ohms ±10%, 2 watt	48965
R121, R122	Resistor; fixed, comp, 47,000 ohms ±10%, 2 watt	44211
R123, R124	Resistor; fixed, comp, 150,000 ohms ±5%, 10 watt	522415
R125	Resistor; fixed, ww, 10,000 ohms ±5%, 10 watt	53363
R126	Resistor; same as R101	
R127	Resistor; fixed, comp, 100,000 ohms ±5%, 1 watt	72635
R128	Resistor; same as R101	
R129	Resistor; same as R127	
R130	Resistor; fixed, comp, 2.2 meg ±1%, 2 watt	93638
R131, R132	Resistor; fixed, comp, 13,000 ohms ±1%, 2 watt	95012
R133	Resistor; same as R130	
R134, R135	Resistor; fixed, ww, with mtg. brkt, 2500 ohms ±5%, 10 watt	93640
R136	Resistor; fixed, ww, 58 ohms ±1%, 1 watt	93641
R137	Resistor; fixed, ww, 600 ohms ±1%, 1 watt	93642
R138	Resistor; fixed, ww, 26.5 ohms ±1%, 1 watt	93643
R139	Resistor; fixed, ww, 68 ohms ±1%, 1 watt	95024
R140, R141	Resistor; fixed, ww, 11.5 ohms ±1%, 1 watt	93644
R142	Resistor; fixed, ww, 220 ohms ±1%, 1 watt	93645
R143, R144	Resistor; same as R140	
R145	Resistor; fixed, ww, 2500 ohms ±1%, 1 watt	93646
R146	Resistor; fixed, comp, 33 ohms ±5%, 5 watt	523039
R147	Resistor; fixed, comp, 27 ohms ±5%, 5 watt	95016
R148	Resistor; fixed, comp, 39,000 ohms ±1%, 2 watt	95013
R149	Resistor; variable, 5 ohms, 75 watt	93648
R150	Resistor; fixed, comp, 1000 ohms ±10%, 2 watt	37496
R151, R152	Resistor; variable, ww, 5000 ohms, 3 watt	51194
R153	Resistor; fixed, ww, 2700 ohms ±5%, 5 watt	53969
R154	Resistor; fixed, ww, 1600 ohms, 55 watt	93649
R155	Resistor, variable, 6 ohms, 4 watt, hum bucker	95021
R156, R157	Same of R123	
R158, R159	Resistor, variable, 60 ohms, 4 watt, hum adjust	95017
R160	Resistor, fixed, 1000 ohms ±1%, 2 watt	95014
R161	Resistor, fixed, 250,000 ohms ±10%, 200 watt	96315
S101	Switch; circuit breaker, 2 pole, 4 amp, 230 volt a-c, 50/60 cy.	93616
S102, S103	Switch; circuit breaker, single pole, 100 ma, 410 volt d-c	93617
S104	Switch; circuit breaker, 2 pole, 15 amp, 230 volt a-c, 50/60 cy.	93618
S105	Switch; rotary, 10 pos, 2 sec, 2 circuit	93650
S106, S107	Switch; door interlock	54920
SR101	Rectifier; full wave, bridge connected, 100 ma	93651
SR102 to SR105	Rectifier; selenium, ½ wave, 390 volt d-c, 500 volt a-c	95018
SR106, SR107	Rectifier; selenium, ½ wave, 380 volt peak inverse, 130 volt rms, 100 ma	93653
T101	Transformer; audio input	93800
T102	Transformer; modulation	93661
T103	Transformer; modulation monitor	93662
T104	Transformer; LV rectifier	93663

Symbol No.	Description	Stock No.
T105	Transformer; HV rectifier plate	93664
T106	Transformer; HV rectifier filament	93665
T107	Transformer; Mod and PA filament	93666
T108	Transformer; LP af and rf filament	93667
X1	Socket; tube, 5 contact	9920
X2	Socket; crystal unit, 6 contact	16889
X3 to X100	Not used	
X101	Socket; tube, 5 contact, molded, 1-27/32 mtg. centers	9920
X102, X103	Socket; tube, 7 contact, molded, 1-7/8 mtg. centers	9929
X104, X105	Socket; same as X101	
X106, X107	Socket; same as X102	
X108, X109	Socket; tube, HV rectifier	93654
X110	Socket; spare crystal, 6 contact	55336
X111, X112	Holder; crystal oven fuse	58933
	MISCELLANEOUS	
	Clip, coil	95509
	Knob; Control, round, fluted, fits 1/4" shaft	17268
	Insulator; Lead-in bushing, steatite, 1 3/4" O.D. x 1 1/8" H x 1 1/4" O.D. shoulder x 1/16" H	51088
	Insulator; Square pillar type, steatite, 3/8" O.D. x 0.500 H, #6-32 tap both ends x 5/32" D	54687
	Insulator; Cylindrical pillar type, steatite, 3/8" O.D. x 0.500 H, #6-32 tap both ends x 5/32" D	92075
	Insulator; Lead-in bushing, steatite, 1 1/4" O.D. x 7/8" H, 3/4" O.D. shoulder x 1/32" H	92007
	Insulator; Lead - thru bushing, steatite, 5/8" O.D. x 3/8" H, 23/64" O.D. shoulder x 1/4" H	52111
	Insulator; Lead - thru bushing, steatite, 5/8" O.D. x 3/8" H	51517
	Insulator; Cylindrical pillar type, steatite, 3/4" x 1.0" H, #10-32 tap both ends x 3/8" D	51086
	Insulator; Lead - thru bushing, steatite, head 7/8" O.D. x 1/2" H, body 31/64" O.D. x 3/8" H	51783
	Insulator; Lead - thru bushing, steatite, 7/8" O.D. x 1/2" H	51784
	Insulator; Cylindrical pillar type, steatite, 3/4" O.D. x 1.5" H, #10-32 tap both ends x 3/8" D	51087
	Jewel; White, for indicator lamp assem.	44135
	Jewel; Green, for indicator lamp assem.	44136
	Lamp; For indicator lamp assem.	16154
	Receptacle; For indicator lamp assem.	44997
	Resistor; For indicator lamp assem.	16155

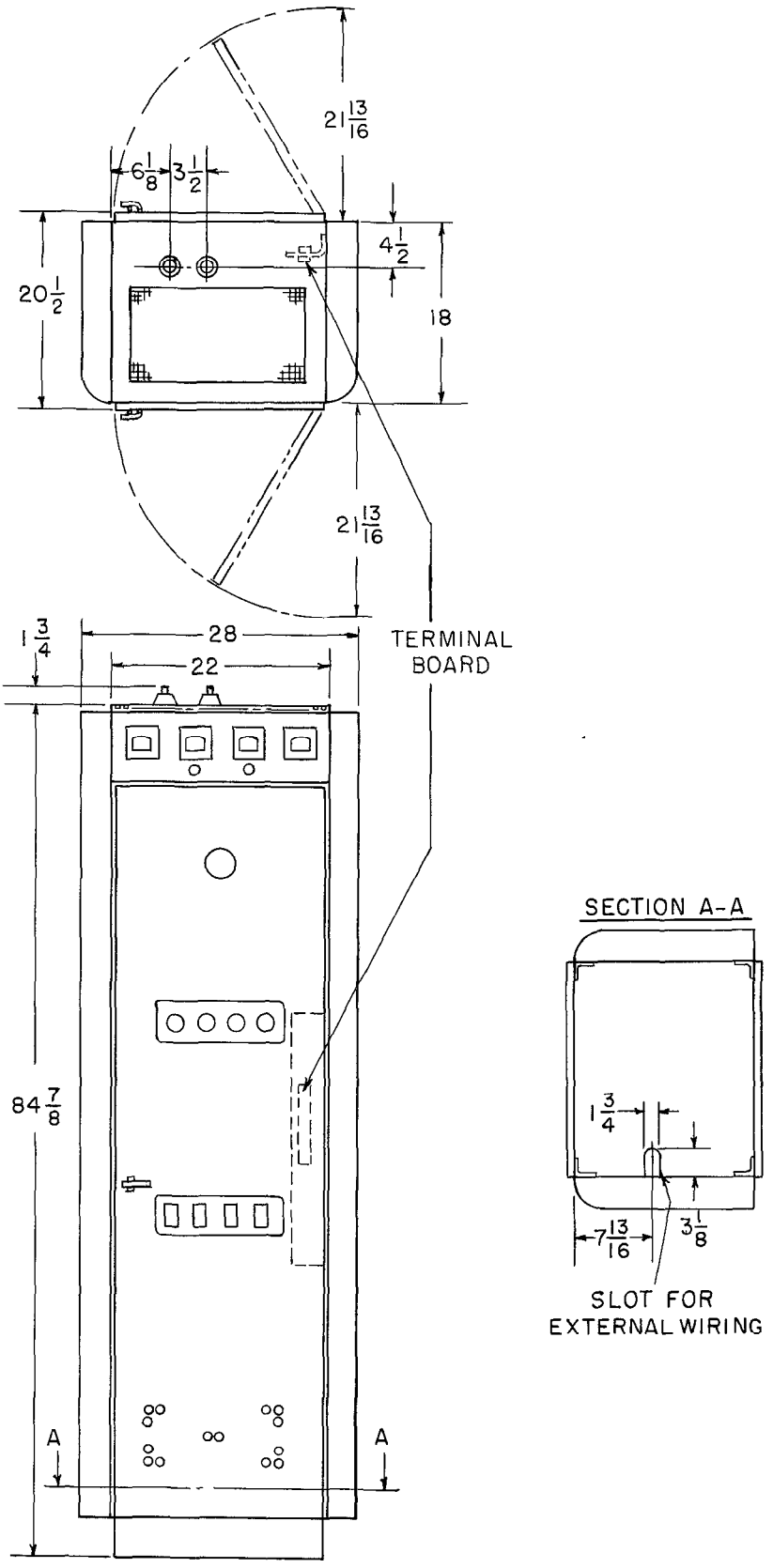


Figure 10—Outline, Transmitter (B-453333)

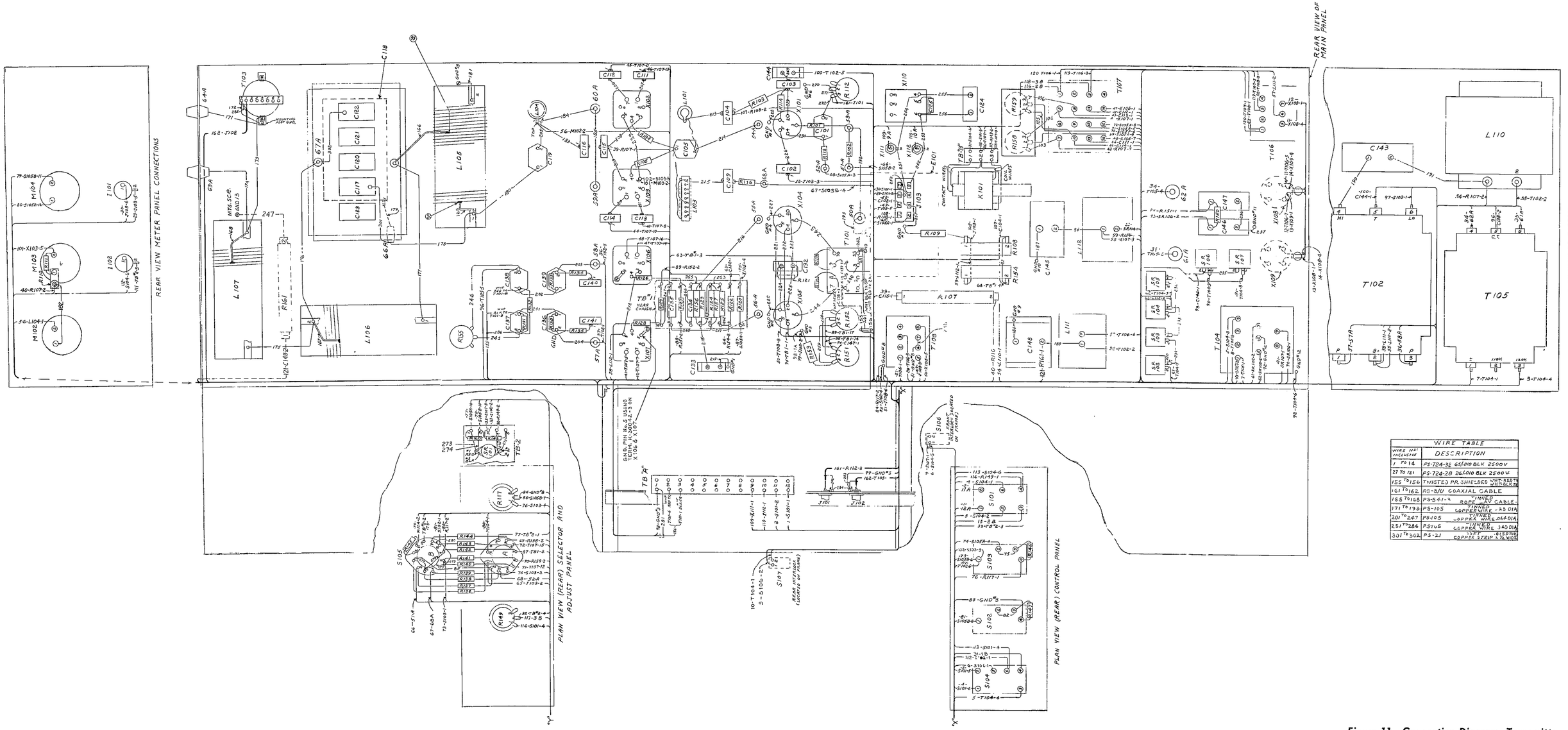


Figure 11—Connection Diagram, Transmitter (EE-311102)

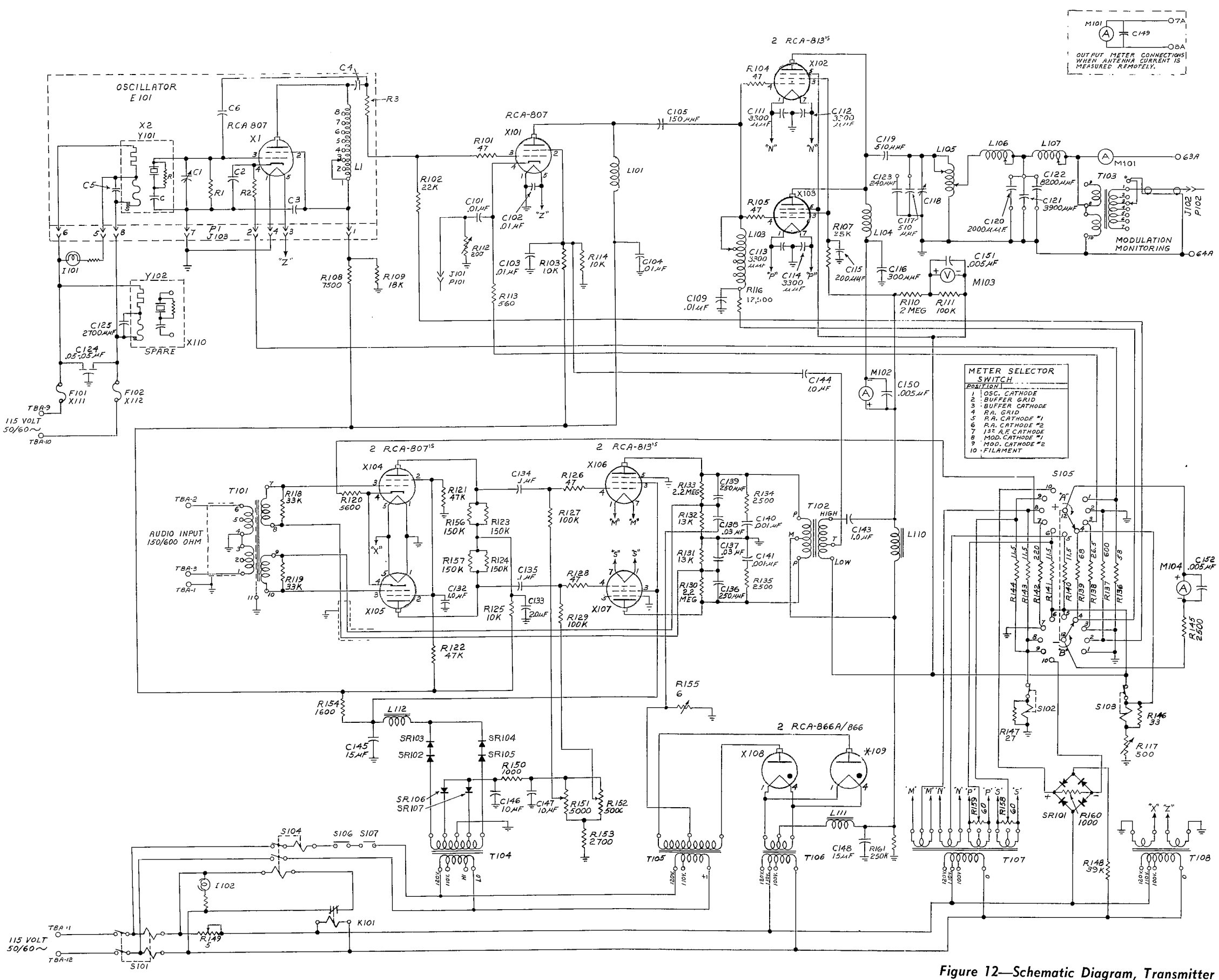


Figure 12—Schematic Diagram, Transmitter (E-311343)

ADDENDA TO IB-30220-1

INSTRUCTION BOOK FOR BTA-250M BROADCAST TRANSMITTER

Disposition: To be inserted in and become part of IB-30220-1.

Make the following changes in the subject instruction book at the places indicated:

1. On page 9, in the eighth line of the second paragraph from top of the page, in the right-hand column, change 750 to 1000.

2. On page 22, in Table 7, change 750 to 1000 in the Volts DC column under Screen.

3. On pages 25, 26, and 27, delete the PARTS LIST and note that the Parts List furnished with this addenda is to be used henceforth.

4. On the Schematic Diagram, Figure 12, make the following changes:

a. Delete the connection between terminal 8 of T103 and the M101 side of L107; then draw a connection between terminal 8 of T103 and the junction of L106 and L107.

b. Draw a capacitor between the junction of SR103 and SR104 and ground. Label this capacitor C153, 1.0 mf.

c. Change the symbol number R154 to R163.

d. Draw a resistor in series with the line running between the resistor now labeled R163 and resistor R108. Label this resistor R154, 1600.

e. Change the values of the following components as indicated:

Symbol No.	New Value
R120	1800 ohms
R121	15,000 ohms
R122	50,000 ohms

Manufactured by
RADIO CORPORATION OF AMERICA
ENGINEERING PRODUCTS DIVISION
Camden, New Jersey, U.S.A.

PARTS LIST

SYMBOL NO.	DESCRIPTION	DRAWING NO.	STOCK NO.
	TRANSMITTER, MI-28053		
C101 to C104	Capacitor: fixed, mica, 0.01 mf ±20%, 1200 v	728647-65	610003
C105	Capacitor: fixed, mica, 150 mmf ±10%, 2500 v	728647-121	600153
C106 to C108	Not Used		
C109	Capacitor: fixed, mica, 0.01 mf ±20%, 1200 v. Same as C101	728647-65	610003
C110	Not Used		
C111 to C114	Capacitor: fixed, mica, 3300 mmf ±20%, 2500 v	728647-53	94171
C115	Capacitor: fixed, mica, 200 mmf ±5%, 5000 v	8843560-9	95011
C116	Capacitor: fixed, mica, 300 mmf ±5%, 5000 v	8843560-2	93619
C117	Capacitor: fixed, mica, 510 mmf ±5%, 5000 v	32221-605	93620
C118	Capacitor: variable, 34-250 mmf	8843561-1	93621
C119	Capacitor: fixed, mica, 510 mmf ±5%, 5000 v	8843560-6	209619
C120	Capacitor: fixed, mica, 2000 mmf ±5%, 5000 v	32222-574	553054
C121	Capacitor: fixed, mica, 3900 mmf ±5%, 3000 v	32222-659	93623
C122	Capacitor: fixed, mica, 8200 mmf ±5%, 5000 v	32223-556	93624
C123	Capacitor: fixed, mica, 240 mmf ±5%, 5000 v	32221-508	93625
C124	Capacitor: fixed, paper, 0.05/0.05 mf +20% -10%, 600 v	984618-572	93626
C125	Capacitor: fixed, mica, 2700 mmf ±10%, 500 v	727876-157	39662
C126 to C131	Not Used		
C132	Capacitor: fixed, paper, 1.0 mf +20% -10%, 600 v	984688-58	56124
C133	Capacitor: fixed, paper, 2.0 mf ±20%, 600 v	990193-4	17660
C134, C135	Capacitor: fixed, paper, 0.1 mf ±10%, 600 v	735718-275	73557
C136	Capacitor: fixed, mica, 250 mmf ±20%, 5000 v	8843560-4	93627
C137, C138	Capacitor: fixed, mica, 0.03 mf ±5%, 600 v	728647-276	50787
C139	Capacitor: fixed, mica, 250 mmf ±20%, 5000 v. Same as C136	8843560-4	93627
C140, C141	Capacitor: fixed, mica, 1000 mmf ±10%, 5000 v	99371-1	52648
C142	Not Used		
C143	Capacitor: fixed, paper, 1.0 mf ±10%, 4000 v	990193-124	93628
C144	Capacitor: fixed, paper, 1.0 mf +20% -10%, 600 v. Same as C132	984688-58	56124
C145	Capacitor: fixed, paper, 15.0 mf ±10%, 1000 v	990193-31	211133
C146, C147	Capacitor: fixed, oil filled, 10.0 mf, 400 v	450184-4	57017
C148	Capacitor: fixed, paper, 1.0 mf ±10%, 1500 v	990193-71	99538
C149 to C152	Capacitor: fixed, mica, 0.005 mf ±20%	36091-520	805004-4
C153	Capacitor: fixed, paper, 1.0 mf ±10%, 1500 v	990193-44	96779
F101, F102	Fuse; crystal heater, 1 amp	850339-6	19335
I101	Light: indicator, "crystal heater No. 1"	459610-11	
	Jewel: white		99738
	Lamp		16154
	Resistor		16155
	Socket		99763
I102	Light: indicator, "power on"	459610-9	
	Jewel: green		99766
	Lamp		16154
	Resistor		16155
	Socket		99763
J101, J102	Connector: R. F. frequency monitor, single-contact, male chassis mtg	255223-2	51800
J103	Connector: Crystal oscillator, 8-contact, male chassis mtg.	860899-1	19656
K101	Relay: time delay, coil 115 v., 0.080 amps., 50/60-cycles, 1-contact, normally closed	429587-22	93630
L101	Coil: buffer plate choke	412784-501	16892
L102	Not Used		
L103	Coil: choke	429932-502	209621
L104	Coil: P. A. plate choke	418486-501	19185
L105	Coil: P. A. tank inductor	740229-1	93611
L106, L107	Coil: P. A. loading inductor	740230-1	93612
L108	Not Used		
L109	Coil: splatter filter choke	453383-502	96930
L110	Reactor: modulation	949252-1	93657
L111	Reactor: H. V. filter	949251-1	93658
L112	Reactor: L. H. filter	949250-1	93659
M101	Meter: ammeter, R. F.		
M102	Meter: milliammeter, P. A. plate	457507-7	94156
M103	Meter: voltmeter, P. A. plate	457507-8	94157
M104	Meter: D. C., 0-1.0 ma	457507-9	93614
P101, P102	Connector: cable, male, single-contact, R. F. frequency monitor	252868-1	66344
R101	Resistor: fixed, composition, 47 ohm ±10%, 2 w	99126-46	522047
R102	Resistor: fixed, composition, 22,000 ohm ±10%, 2 w	99126-78	58239

SYMBOL NO.	DESCRIPTION	DRAWING NO.	STOCK NO.
R103	Resistor: fixed, wire wound, 10,000 ohm ±5%, 10 w	458574-70	205837
R104, R105	Resistor: fixed, composition, 47 ohm ±10%, 2 w. Same as R101	99126-46	522047
R106	Not Used		
R107	Resistor: fixed, wire wound, ferrule type, 25,000 ohm ±10%, 95 w	99033-45	93632
R108	Resistor: fixed, wire wound, 7500 ohm, 55 w	8843569-3	97810
R109	Resistor: fixed, wire wound, 15,000 ohm ±5%, 10 w	458574-77	96214
R110	Resistor: fixed, wire wound, 2 meg ±1%, 2 w	8843570-1	93635
R111	Resistor: fixed, composition, 100,000 ohm ±20%, 2 w	99126-86	522410
R112	Resistor: variable, wire wound, 200 ohm ±10%, 3 w	737847-1	93636
R113	Resistor: fixed, wire wound, 560 ohm ±5%, 5 w	443853-66	93615
R114	Resistor: fixed, wire wound, 10,000 ohm ±5%, 10 w. Same as R103	458574-70	205837
R115	Not Used		
R116	Resistor: fixed, wire wound, 12,500 ohm ±10%, 10 w	458574-73	206503
R117	Resistor: variable, 500 ohm, 75 w	8851676-4	93637
R118, R119	Resistor: fixed, composition, 33,000 ohm ±5%, 1 w	90496-195	512333
R120	Resistor: fixed, composition, 1800 ohm ±10%, 2 w	99126-165	522218
R121	Resistor: fixed, wire wound, 15,000 ohm ±5%, 5 w	458572-84	53658
R122	Resistor: fixed, wire wound, 50,000 ohm ±5%, 10 w	458574-89	211055
R123, R124	Resistor: fixed, composition, 150,000 ohm ±5%, 2 w	99126-211	522415
R125	Resistor: fixed, wire wound, 10,000 ohm ±5%, 10 w. Same as R103	458574-70	205837
R126	Resistor: fixed, composition, 47 ohm ±10%, 2 w. Same as R101	99126-46	522047
R127	Resistor: fixed, composition, 100,000 ohm ±5%, 1 w	90496-207	512410
R128	Resistor: fixed, composition, 47 ohm ±10%, 2 w. Same as R101	99126-46	522047
R129	Resistor: fixed, composition, 100,000 ohm ±5%, 1 w. Same as R127	90496-207	512410
R130	Resistor: fixed, composition, 2.2 meg ±1%, 2 w	891769-4	93638
R131, R132	Resistor: fixed, composition, 13,000 ohm ±1%, 2 w	891769-8	95012
R133	Resistor: fixed, composition, 2.2 meg ±1%, 2 w. Same as R130	891769-4	93638
R134, R135	Resistor: fixed, wire wound, 2500 ohm ±5%, 10 w	899837-7	93640
R136	Resistor: fixed, wire wound, 58 ohm ±1%, 1 w	8871557-12	93641
R137	Resistor: fixed, wire wound, 600 ohm ±1%, 1 w	8871557-13	93642
R138	Resistor: fixed, wire wound, 26.5 ohm ±1%, 1 w	8871557-14	93643
R139	Resistor: fixed, wire wound, 68 ohm ±1%, 1 w	8871557-23	95024
R140, R141	Resistor: fixed, wire wound, 11.5 ohm ±1%, 1 w	8871557-15	93644
R142	Resistor: fixed, wire wound, 220 ohm ±1%, 1 w	8871557-16	93645
R143, R144	Resistor: fixed, wire wound, 11.5 ohm ±1%, 1 w. Same as R140	8871557-15	93644
R145	Resistor: fixed, wire wound, 2500 ohm ±1%, 1 w	8871557-9	93646
R146, R147	Resistor: fixed, wire wound, 75 ohm ±5%, 10 w	458574-17	209620
R148	Resistor: fixed, composition, 18,000 ohm ±5%, 2 w	99126-189	522318
R149	Resistor: fixed, composition, 5 ohm, 75 w	8851676-3	93648
R150	Resistor: fixed, composition, 1000 ohm ±10%, 2 w	99126-62	522210
R151, R152	Resistor: variable, wire wound, 5000 ohm ±20%, 3 w	737809-5	57134
R153	Resistor: fixed, wire wound, 2700 ohm ±5%, 5 w	443853-14	53969
R154	Resistor: fixed, wire wound, 1600 ohm, 55 w	8843569-2	93649
R155	Resistor: variable, 6 ohm ±10%, 4 w	737847-9	95021
R156, R157	Resistor: fixed, composition, 150,000 ohm ±5%, 2 w. Same as R123	99126-211	522415
R158, R159	Resistor: variable, 60 ohm ±10%, 4 w	737847-11	95017
R160	Resistor: fixed, composition, 1000 ohm ±1%, 2 w	891769-10	95014
R161	Resistor: fixed, composition, 250,000 ohm ±10%, 20 w	8825308-2	96315
R162	Resistor: variable, wire wound, 500 ohm, 3 w	845139-26	59933
R163	Resistor: fixed, wire wound, 1600 ohm, 55 w	8843569-2	93649
S101	Switch: circuit breaker, 4 amp, 230 v ac, 50/60-cycle, 2-pole	445089-19	93616
S102, S103	Switch: circuit breaker, 100 ma, 410 v dc, single-pole	894303-6	93617
S104	Switch: circuit breaker, 15 amps, 230 v ac, 50/60-cycle, 2 pole	445089-20	93618
S105	Switch: rotary, 10-position, 2-section, 2-circuit	453388-1	93650
S106, S107	Switch: door interlock		
SR101	Rectifier: meter	8829332-1	93651
SR102 to SR105	Rectifier: selenium	459484-2	95018
SR106, SR107	Rectifier: selenium	8843562-1	77519
T101	Transformer: input	949347-1	93800
T102	Transformer: audio	949270-1	93661
T103	Transformer: R. F. modulation monitoring	737585-501	93662
T104	Transformer: L. V. rectifier plate	949279-1	93663
T105	Transformer: H. V. rectifier plate	949258-1	93664
T106	Transformer: H. V. rectifier filament	949248-1	93665
T107	Transformer: filament (10 v)	949247-1	93666
T108	Transformer: filament (6.3 v)	949249-1	93667
X101	Socket: tube, 5 contacts	843314-2	9920
X102, X103	Socket: tube, 7 contacts	418317-1	9929
X104, X105	Socket: tube, 5-contact. Same as X101	843314-2	9920

SYMBOL NO.	DESCRIPTION	DRAWING NO.	STOCK NO.
X106, X107	Socket: tube, 7-contact. Same as X102	418317-1	9929
X108, X109	Socket: tube, H.V. rectifier	8843563-1	93654
X110	Socket: crystal, 6-contact	835375-501	55336
X111, X112	Holder: fuse	867236-1	58933
Y101, Y102	Crystal Unit		
	MISCELLANEOUS		
	Insulator: lead-in bushing, steatite, 1-3/4" O.D. x 1-1/8" H., 1-1/4" O.D. shoulder x 1/16" H.	426761-10	51088
	Insulator: square-pillar type, steatite, 3/8" O.D. x 1/2" H., No. 6-32 tap both ends x 5/32" D.	426771-2	54687
	Insulator: cylindrical-pillar type, steatite, 3/8" O.D. x 1/2" H., No. 6-32 tap both ends x 5/32" D.	426765-2	92075
	Insulator: lead-in bushing, steatite, 1-1/4 " O.D. x 7/8" H., 3/4" O.D. shoulder x 1/32" H.	426761-4	92007
	Insulator: lead-thru bushing, steatite, 5/8" O.D. x 3/8" H., 23/64" O.D. shoulder x 1/4" H.	426764-5	52111
	Insulator: lead-thru bushing, steatite, 5/8" O.D. x 3/8" H.	426764-55	51517
	Insulator: cylindrical-pillar type, steatite, 3/4" x 1" H., No. 10-32 tap both ends x 3/8" D.	426767-2	51086
	Insulator: lead-thru bushing, male, steatite, 7/8" O.D. x 7/8" H., 3/4" O.D. shoulder x 3/8" H.	426764-8	51783
	Insulator: lead-thru bushing, female, steatite, 7/8" O.D. x 1/2" H.	426764-58	51784
	Insulator: cylindrical-pillar type, steatite, 3/4" O.D. x 1-1/2" H., No. 10-32 tap both ends x 3/8" D.	426767-8	51087
	Knob: control, round, fluted, fits 1/4" shaft, (black)	712336-505	17268
	CRYSTAL OSCILLATOR UNIT, MI-19458		
C1	Capacitor: air, variable, 5.3-20 mmf, crystal tuning	823075-3	16890
C2, C3	Capacitor: fixed, mica, 0.01 mf ±10%, 1200 v, bypass	32203-591	610003
C4	Capacitor: fixed, mica, 47 mmf ±5%, 2500 v, output coupling	32200-515	50358
C5	Capacitor: fixed, mica, 0.002 mf ±5%, 2500 v, filter	32202-558	602002
C6	Capacitor: headed, lead type, 1.0 mmf ±10%, 500 v, feedback	99327-12	55331
L1	Inductor: plate tank	429932-501	50360
R1	Resistor: fixed, composition, 150,000 ohm ±5%, 1 w	722337-211	512415
R2	Resistor: fixed, composition, 680 ohm ±5%, 2 w	722357-155	522168
R3	Resistor: fixed, composition, 12 ohm ±10%, 1 w	727836-39	512012
X1	Socket: tube, 5-contact	843314-2	9920
X2	Socket: crystal unit, 6-contact	409582-501	16889

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