

BROADCAST AND TELEVISION EQUIPMENT

INSTRUCTIONS

Type BTA-1R1 A-M Transmitter

ES-27238B

*Am Filter
20425 X2*

RADIO CORPORATION OF AMERICA
BROADCAST AND COMMUNICATIONS PRODUCTS, CAMDEN, N. J.

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TECHNICAL DATA

<i>AF Input Impedance</i> 150 or 600 ohms	<i>Power Output, Capability</i> 1100 watts
<i>AF Input Level, 100% Modulation</i> +10 \pm 2 dbm	<i>Power Supply</i> 208 v to 240 v
<i>AF Response</i> 50 to 7500 cps \pm 1 db 30 to 10,000 cps \pm 1.5 db 30 to 12,000 cps \pm 2.5 db	<i>Line Frequency</i> 60 cps
<i>AF Distortion, 95% Modulation</i> 50 to 10,000 cps 2% 50 to 12,000 cps 3%	<i>Phase</i> Single
<i>Noise, Below 100% Modulation</i> 60 db	<i>Power Consumption</i> 0% Modulation—2900 watts, approx. 100% Modulation—4200 watts, approx. Average Program Modulation—3100 watts, approx.
<i>Frequency Range</i> 535 to 1620 kc	<i>Power Factor</i> 90%
<i>Frequency Stability</i> \pm 5 cps	<i>Permissible Combined Line Voltage Variation and Regulation</i> \pm 5%
<i>Type of Output</i> Single-ended	<i>Crystal Heater Power Supply</i> 117 v, 60 cps
<i>Carrier Shift, 0 to 100% Modulation</i> 3%	<i>Altitude Range</i> 0 to 5000 feet
<i>Output Impedance</i> 40 to 250 ohms (reactive component not to exceed 10% of resistance)	<i>Ambient Temperature</i> -20°C (-4°F) Min. +45°C (113°F) Max.
<i>RF Voltage for Frequency Monitoring</i> 10 v rms, 75 ohms	<i>Dimensions and Weight</i> Height—84 inches Width—34 inches Depth—32½ inches (less door handle) Weight—1500 lbs. approx.
<i>RF Voltage for Modulation Monitoring</i> 10 v rms, 75 ohms	
<i>Power Output, Nominal</i> 1000 watts	

TUBE COMPLEMENT

<i>Symbol</i>	<i>Type</i>	<i>Function</i>	<i>Symbol</i>	<i>Type</i>	<i>Function</i>
1V101	6AK5	Oscillator	1V304	4-400A	Modulator
1V102	5763	RF Amplifier	1V601	6146	Buffer
1V301	4-400A	Power Amplifier	1V603	2E26	1st AF Amplifier
1V302	4-400A	Power Amplifier	1V604		1st AF Amplifier
1V303	4-400A	Modulator			

RECOMMENDED TEST EQUIPMENT

RCA Type WV-97A VoltOhmyst
 RCA Type WM-71A Distortion and Noise Meter
 RCA Type WA-28A Audio Push Button Oscillator
 RCA Type WO-88A Oscilloscope

RCA Type BW-11A A-M Frequency Monitor
 RCA Type BW-66F Modulation Monitor
 Dummy Load
 R-F Detector or equivalent (see figure 5)



90212

Figure 1. Type BTA-1R1 A-M Transmitter

EQUIPMENT LIST

TYPE BTA-1R1 A-M TRANSMITTER

ES-27238-B

Quantity	Description	Reference
1	BTA-1R1 A-M Transmitter	MI-27649-B
1	Set of Operating Tubes	MI-27695-A
1	Set of Frequency Determining Parts	MI-27691
1	Crystal, Type TMV-130B	MI-27493
1	Cabinet Door	MI-27645-A
1	Nameplate	MI-28180-1
1	Touch-Up Finish Kit	MI-27660-A
2	Instruction Books	IB-31500

OPTIONAL AND ACCESSORY EQUIPMENT

Set of Spare Tubes	MI-27696-A
Crystal, Type TMV-130B	
(Conelrad and/or Spare)	MI-27493
Conelrad Kit	ES-34209
Antenna Tuning Equipment	ES-27250
Remote Control System, Type BTR-11B	
Studio Control Unit	MI-27537
Transmitter Control Unit	MI-27538-A
Remote Control System, Type BTR-20B	
Studio Control Unit	MI-27539-A
Transmitter Control Unit	MI-27526-A
Remote Control Metering Panel	ES-27220

DESCRIPTION

General

The RCA Type BTA-1R1 Transmitter, shown in figure 1, is designed for high fidelity broadcasting within a frequency range of 535 kc to 1620 kc. The BTA-1R1 has a nominal rated output of 1000 watts and a maximum rated output of 1100 watts, which provides compensation for losses in the transmission line and antenna tuning equipment.

Air cooled tubes are used throughout the transmitter, and the output frequency is regulated by a crystal mounted in a thermostatically controlled, heated enclosure. The crystal heaters require a nominal operating voltage of 117 v, 60 cps, single phase. An input voltage of 208-240 volts, 60 cps, single phase, is required for transmitter operation.

The transmitter is completely self-contained in an attractively styled metal cabinet with wiring ducts, front and rear. Easy access to these ducts for interconnecting wiring is provided by removable panels. To provide maximum accessibility to all components for maintenance and service, the component chassis are mounted vertically in the cabinet.

All operating controls and meters are located on the panels on each side of the front door panel. In

figure 12 the BTA-1R1 is shown with the front door panel removed; figure 14 is a rear view with the two rear panels removed and figure 15 is a closeup rear view of the Exciter section.

Safety interlock switches are connected to all panels so that the high voltage supply line to the transmitter is opened and the high voltage buss is automatically grounded when any door or panels are opened.

Power for the blower motor is supplied through a motor starter which not only protects the blower motor but also opens the filament circuit in case the blower fails.

The transmitter is wired to permit remote control operation of all essential transmitter functions. Convenient installation of the RCA BTR-11B or BTR-20B Remote Control System can be made using the connections already provided for this purpose on the transmitter's external connections terminal board. If other than RCA remote control equipment is to be used, installation instructions should be obtained from the manufacturer or supplier of such equipment.

An additional feature of the BTA-1R1 is that it also meets the needs of broadcasters authorized to operate at 500 watts. No circuit modifications or component changes are required to operate the BTA-1R1 at a nominal rated output of 500 watts. Provision for reducing the power from 1000 to 500 or 250 watts has been incorporated in the design of the transmitter.

Circuit

The transmitter r-f circuit is a combination of four stages. The first two, consisting of a 6AK5 (1V101) crystal controlled oscillator driving a 5763 (1V102) r-f amplifier, are constructed on a printed circuit board. The output from the printed circuit combination is applied to the grid of 1V601, a 6146 class "C" buffer amplifier, which, in turn, is the driver for the power amplifier stage. The PA consists of two 4-400A type tubes (1V301, 1V302) connected in parallel. The PA is screen modulated by self-modulation, induced by the high resistance screen dropping resistor and plate modulated by the modulator.

The printed circuit oscillator can be switched to any one of three separate crystals without re-tuning. This has the advantage of putting a heated standby crystal into operation instantly without the necessity of an additional oscillator. At the same time, a Conelrad crystal can be ready for immediate operation. Any one of the three crystals can be selected from the front panel or from a remote location. This enables the operator to change crystals without loss of air time even when the transmitter is being operated remotely.

The only adjustment necessary is to trim the separate crystals of the oscillator to the assigned frequencies.

The buffer amplifier, a 6146 type tube (1V601), is designed for broadband tuning which eliminates the necessity of fine tuning adjustments. This stage is tuned by shorting a portion of the plate choke coil, 1L601. A series of taps covering the broadcast band are provided on coil 1L601 for this purpose. A sample of r-f for monitoring purposes is taken off the cathode resistor of 1V601. This sample is fed to connector 1J601 and from there applied to the station's frequency monitor.

The PA is made up of two plate modulated 4-400A's (1V301, 1V302) connected in parallel which function as class "C" amplifiers to feed the output network. The output network is a double-pi type consisting of the PA tank, 1L301, the second harmonic filter, 1L302, and a combination of six capacitors, 1C304 through 1C309. Different combinations of these capacitors are used to tune the output network to match the low impedance of the antenna or transmission line to the high impedance of the plate. The PA tank, 1L301, is tuned by a silver-plated copper slug, and is the only tuning control in the transmitter.

When the transmitter is equipped with a Conelrad Kit, the output circuit is switched to a simple parallel resonant tank circuit during Conelrad operation, with the r-f output tapped directly off the coil.

Harmonic radiation is reduced within the double pi network, and second harmonic radiation in particular is reduced still further by a trap. This trap consists of a series tuned coil, 1L304, and capacitor 1C324, which are tuned by a shorting strap on coil 1L304. The power output of the PA stage is controlled by resistor 1R405, which varies the plate and screen voltage applied to the PA stage. The harmonic filter is switched out of the circuit during Conelrad operation.

For modulation monitoring, r-f voltage at 10 volts, 75 ohms, is supplied at the taps of the modulation monitoring coil, 1L305. These taps provide for voltage adjustment, as required, when different loads and different power levels are used.

The audio system consists of a two-stage, push-pull amplifier, which uses a pair of 2E26's (1V603, 1V604) in the first stage and two 4-400A's (1V303, 1V304) in the second stage. Input coupling to the first stage is provided by the audio input transformer, 1T601, the primaries of which can be connected in parallel for 150-ohm input, or in series for a 600-ohm input. Feedback voltage from feedback ladders 1Z301 and 1Z302 is applied to the first audio stage through the

secondary of input transformer 1T601. The two 2E26 tubes (1V603, 1V604) operate in push-pull to drive the second stage, the two 4-400A tubes (1V303, 1V304). The latter, in turn, are used to modulate the plates of the PA stage, 1V301 and 1V302, another pair of 4-400A's.

DC voltage is obtained from three power supplies, all of which make use of silicon rectifiers. The high voltage supply furnishes high voltage for the PA and modulator tubes. The other two supplies are the low voltage and bias supplies. Filament voltage on all tubes may be adjusted by variable resistor 1R505, which is controlled from the front panel. Voltmeter 1M202 indicates the input voltage to the filament transformers, 1T301, 1T302, 1T602, and 1T603.

The power control circuit utilizes a time-delay relay, 1K601, to prevent application of plate power until the filament power has been applied. In addition, the plate voltage will be removed if an overload occurs. After the cause of the overload has been corrected, the transmitter may be returned to the air by operating the overload re-set switch, 1S204, on the front panel. A short occurring in any circuit will cause the transmitter to shut down. Before the transmitter can be returned to the air, corrective action must be taken to remove the cause of the short.

LAYOUT

The basic step in the installation of the BTA-1R1 Transmitter is to decide upon the equipment layout and make provisions for the necessary external connections. After the space requirements have been determined, the equipment can be unpacked, assembled, and connected as specified. Outline dimensions for the transmitter are shown in figure 11.

Inasmuch as some of the optional and associated items include their own instruction books, the installation procedure for such units will not be repeated. Instead reference should be made to the instruction books (IB's) accompanying such equipment. These books are:

BPA-11A/B Antenna Tuning Unit . . IB-30223
Remote Pickup Unit IB-30209-1
Transmission Lines,
Hangers and Accessories IB-36164-1

Factors to be considered in layout are incoming power lines, accessibility of a good station ground, and the route for the transmission line to the antenna. The room in which the transmitter is to be installed should be well-ventilated and have an abundant supply of clean, dry air. The maximum ambient temperature is listed under TECHNICAL DATA.

Separate disconnect switches and power leads must be supplied for the 208-240 volt and 110-125 volt incoming power lines. When an external circuit breaker is to be used as a disconnect switch of the 208-240 volt power line, a 40 ampere rating should be specified. The time delay characteristics should be such that a 1000% current overload will cause the breaker to trip in approximately one second. A shorter time delay may cause the external breaker to trip before the transmitter breaker in the event of a heavy overload. Residential or lighting type breakers are not normally suitable for this application. The transmitter is protected by a 25 amp line circuit breaker in the 208-240 volt incoming line. Note that the crystal ovens require a separate 110-125 volt line so that the ovens may be energized 24 hours a day without interruption.

Disconnect switches and wiring must be provided for such items as the transmitter room exhaust fan, and monitoring racks. The tower lighting circuit should also be planned, although no material is provided for this item.

Wiring to and from the transmitter should be carried in conduit or a trench terminating below the unit. The base plan of the outline drawing, figure 11, indicates where this wiring should enter the unit. The ground connection must be connected to the station ground, with a copper strap about 3 inches wide. Table 1 lists the external connections to be made.

These instructions are not intended to supersede any applicable local codes. Where these instructions conflict with any local electrical, construction, or building code, the provisions of the applicable local code should be followed.

Transmission Line

The r-f output from the transmitter terminates at the insulated fitting, as shown in figure 11. Beyond this point no lines or fittings are supplied with this transmitter, and must be ordered separately.

A coaxial or open-type transmission line with a resistive impedance of either 51.5 ohms, 72 ohms, or 230 ohms may be used. If the transmitter is to be connected directly to the antenna without a transmission line, the resistance measured at the transmitter output should be between 40 and 250 ohms, with a reactive component not exceeding 10% of the resistance. The coupling network capacitors supplied serve to match the transmitter output to a specific transmission line impedance at the operating frequency.

Where an underground transmission line is to be used, coaxial lines and fittings must be employed.

Layout information, dimensions, and installation data for the coaxial transmission lines are supplied in the transmission line instruction book.

If coaxial transmission line is used, the installation of items such as dehydrating or gassing units, if required, should not be overlooked. Data for installation of these items is supplied in the transmission line instruction book, IB-36164-1.

The RCA Type BPA-21A/B/C/D Antenna Tuning Unit is recommended for matching the antenna to the BTA-1R1 Transmitter. If desired, the unit can also be furnished to supply a rectified carrier current for remote antenna current indication.

An antenna tuning house is also desirable, especially, when multi-element arrays are used, since it offers weather protection and facilities for test and measuring units, tower lighting equipment and intercommunication components.

Before completing the layout from the transmitter to the transmission line and antenna, station engineering personnel should check the antenna system for protection against atmospheric static accumulations and electrical storms. If this is not done, the transmitter may be damaged. Refer to the next two headings for a discussion of the details involved.

Atmospheric Static Accumulations

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

Where tower lighting chokes are used and one side of the a-c supply line is grounded, the lighting choke will act as a satisfactory discharge path. When neither side of the a-c line is grounded or when a toroidal tower lighter transformer is utilized, a drain path must be provided. Such a path, however, may already exist in the transmitter output circuit or antenna coupling unit. Existence of such a path may be checked after installation and before any circuits are energized by connecting 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.

Electrical Storms

In areas subject to lightning storms, a direct electrical path from the tower to ground is required to avoid capacitor and antenna current meter burnout if lightning strikes the tower. This requirement can generally be met by installing arc-gaps across the base insulators. If these gaps are properly spaced, at the instant of discharge the gaps will present a low impedance path to ground and thus 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 the 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 more than several feet from the tower. In the latter instance, the longer lead provides the necessary higher impedance.

Antenna Current Readings

Under certain circumstances when the tower lights are on, the 60-cycle tower lighting current may cause fluctuations or inaccuracies 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 a-c lighting circuit through the tower lighting chokes to ground where one side of the a-c 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 current to be returned by 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 used, 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 the transmission line. The location depends upon the type of coupling circuit used in the line terminating unit. As a general rule, the reactance of the blocking capacitor, shown dotted in figure 2, should not be greater than approximately one-tenth of the characteristic impedance of the transmission line.

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

Unpacking

An understanding of the overall shipping system will be of assistance in unpacking the equipment and locating items. Each piece of RCA equipment is accompanied by a packing slip which lists the complete contents of the shipment by "master item" or "MI" numbers. This shipping voucher is usually packed in one of the smaller cardboard cartons, appropriately marked.

Where more than one item is listed on an MI sheet, a sub-division or "item" number is listed after the MI number. Thus, a component might carry the designation "MI-99999-2". This indicates that the part is "item 2" on the MI-99999 list. These MI sheets are essentially packing lists, and where there are two or more boxes to a major unit, the box containing the MI sheet is identified by stenciling. Thus it is possible to identify the contents of each box and systematically plan the overall uncrating. All items listed on the MI sheets should be located before crates or boxes are destroyed, to avoid loss of small items overlooked during unpacking.

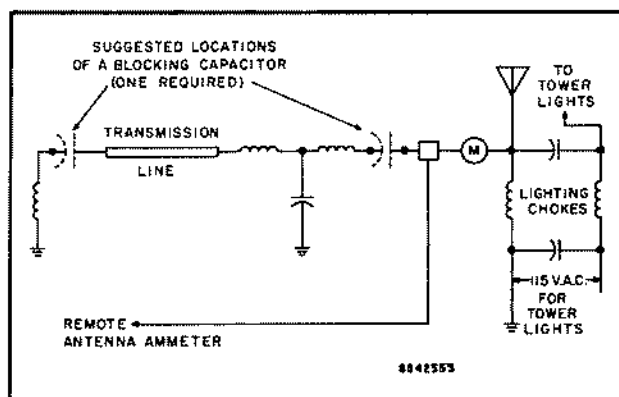


Figure 2. Typical Tower Lighting Circuit

The MI sheets, as previously noted, are of value only in locating items for assembly. The MI sheets should not be used for installation sequence nor for installation details. Refer to the appropriate drawings and the following notes for this information.

It is possible that the configuration or mechanical design of a component or part may be different in appearance or that its location may have changed from that shown in a photograph or drawing. Changes such as these are the result of manufacturing considerations or design modifications that have been incorporated during production, after the photographs and drawings have been released for publication. However, the function of any different appearing component or part is the same as that of its illustrated counterpart, unless otherwise specified.

The equipment may now be unpacked. Tubes and crystals should not be unpacked until required. In addition, the frequency-determining parts, MI-27691, should be left in their carton until installation is specified.

INSTALLATION

Be sure to remove all red metal straps supporting the larger projecting components in the transmitter cabinet before installing the components shipped separately. These straps were installed at the factory to brace these large in-place components during shipment.

Various components have been removed from the transmitter cabinet and packed separately for shipment. All such parts are individually tagged with an MI and item number. Do not remove any identification tags until all the components have been installed.

Refer to the appropriate drawings and photographs for the location and placement of these components.

Hardware required for re-assembly is shipped in place or the hardware required will be specified as needed.

Before making any connections or installing any components, place all switches and circuit breakers in the OFF position. This will prevent possible damage to the equipment if the incoming power switch is closed accidentally.

The following items are shipped separately as part of MI-27649-B.

- Modulation Transformer 1T501 (item 2)
- Plate Transformer 1T502 (item 3)
- Modulation Reactor 1L501 (item 4)
- HV Filter Reactor 1L502 (item 5)

- Modulator Blocking Capacitor 1C501 and Brackets (item 6)
- Blower 1B501 (item 7)

With the exception of the blower, 1B501 (item 7) these components are to be mounted on the floor of the transmitter. However, it may be more convenient to set the arc-gap on the HV filter reactor (item 5)

TABLE 1. EXTERNAL CONNECTIONS

<i>Point of Connection</i>	<i>External Circuit</i>
1B	Ground
2B 3B	208/240 volts, 60 cycles, power input
4B 5B	117 volts, 50/60 cycles for crystal heater
8B 9B	External plate voltage interlock connections
10B 11B	Remote control plate off
11B 12B	Remote control plate on
13B 15B	Remote control transmitter on
14B 15B	Remote control transmitter off
16B 15B	Remote control power raise
17B 15B	Remote control power lower
22B 15B	#1 crystal
19B 15B	#2 crystal
21B 15B	main crystal
20B 15B	conelrad crystal
	Remote control crystal switching
23B 24B	Remote plate voltage metering
25B 24B	Remote cathode current metering
26B 27B	Spare
28B 29B	Audio input
1J601	R-f to frequency monitor
1K302	R-f to modulation monitor

and the modulation transformer (item 2) before installing them in the cabinet. Adjust the contacts on 1L502 for a gap of 1/16 of an inch; adjust the contacts on 1T501 for a gap of 3/16 of an inch. Although this is the nominal setting for 1T501, a readjustment may be required later as part of the final operational adjustments.

Refer to figure 14 for the placement of these components and then make the required connections according to the connection tags attached to the leads and the terminals.

Refer to figure 14 and install the blower, 1B501, in the upper rear section, using the hardware in place to fasten the blower to the cabinet. Make the connections according to the connection tags attached to the leads and the terminals.

When all components, except the frequency determining parts, tubes and crystals have been installed, make the external connections required. Carefully check the wiring for accuracy. If a buzzer and battery are used for circuit checking, temporarily short-circuit all meters in the transmitter, or disconnect one side of each meter, to prevent meter damage.

Check the high-voltage grounding switches, 1S217 to 1S219 for proper operation, using a battery and buzzer or the lowest scale on an ohmmeter.

Install the nameplate, item 8 of ES-27238, on the rear panel.

Set aside the tubes, crystal, and frequency-determining parts for specific instructions given as part of the PRELIMINARY TUNING PROCEDURE.

NOTE: Be sure all electrical connections are tight before applying power to the transmitter.

Power Cutback

Reduction of power output to 500 or 250 watts is accomplished by utilizing a transformer with a tapped primary winding.

CONTROL CIRCUIT CHECK

To insure that all connections have been correctly made, the following Control Circuit Check should be made before applying plate and bias voltages to the transmitter.

1. Disconnect and tape the primary leads of 1T402 and 1T502 at terminals 36F and 37F and the primary of 1T403 at terminals 10D and 11D.

2. Switch the LINE CIRCUIT BREAKER, 1S210, to the ON position.

3. Switch the TRANS ON/OFF control, 1S203, to the ON position. This will energize the TRANS-MITTER ON latching relay, 1K604.

4. Switch the BLOWER ON/OFF control, 1S301 (located on the tube shelf near 1V304), to the ON position. This will start the blower, 1B501.

5. Switch the FILAMENT CIRCUIT BREAKER, 1S211, to the ON position. This will cause FILAMENT LINE METER, 1M202, to indicate and, a short time later, the PLATE TIME DELAY contactor, 1K601, to energize.

6. Turn the FILAMENT CONTROL, 1R505, fully clockwise and read the incoming line voltage on the FILAMENT LINE meter, 1M202. Adjust the taps on the transformer primaries to the same voltage as that of the line, or as close as possible to the line voltage if the range of transformer taps does not permit setting to the exact voltage. Refer to Table 2 for a list of the transformers and their taps. Figures 14 and 15 show the location of these transformers in the cabinet. The schematic diagram, figure 16, shows the electrical connections.

TABLE 2. TRANSFORMER PRIMARY TAPS

Transformer	208 v Line Taps			240 v Line Taps		
	-11	0	+11	-11	0	+11
1T301	197	208	219	229	240	251
1T302	197	208	219	229	240	251
1T402	197	208	219	229	240	251
1T403	—	208	—	—	240	—
1T502	197	208	219	229	240	251
1T602	197	208	219	229	240	251
1T603	197	208	219	229	240	251

7. Place the OL RESET-PLATE ON/OFF switch, 1S204, to the ON position. This will energize the PLATE ON contactor, 1K602, and cause the PLATE ON lamp, 1I201, to glow.

8. To check the operation of the interlock circuit, open and close the door and then remove the rear panels one by one, replacing the first panel before removing the second. As each door and panel is opened, the interlock switches, 1S214, 1S215 or 1S216 will operate: the PLATE ON lamp, 1I201, will go off; and the PLATE ON contactor 1K602, will de-energize. Each time 1K602 is de-energized, it will be necessary to operate 1S204 to energize 1K602.

9. Switch the TRANS ON/OFF control, 1S203, to the OFF position and re-connect the primary leads of transformers 1T402 and 1T403.

TUNING PROCEDURE

WARNING

USE EXTREME CAUTION WHEN TUNING OR CHECKING THE TRANSMITTER. THE VOLTAGES REQUIRED TO OPERATE THIS EQUIPMENT ARE SUFFICIENTLY HIGH TO CAUSE SERIOUS INJURY OR LOSS OF LIFE. TAKE CARE NOT TO TOUCH ANY CIRCUITS WHEN THE POWER IS ON. SWITCH THE PLATE OFF AND GROUND ALL CAPACITORS AND CIRCUITS BEFORE TOUCHING ANY COIL OR CAPACITOR WHEN MAKING TUNING ADJUSTMENTS OR REPAIRS.

1. Place all switches and circuit breakers in the OFF position.
2. Rotate 1R402 and 1R403 fully counterclockwise.
3. Install all tubes in the transmitter except the 4-400A modulators (1V303, 1V304). Connect a dummy load of the proper impedance to the transmitter antenna connection.
4. Place the crystal in its socket, and apply power to the crystal heaters. Allow the crystal heaters to operate for at least 30 minutes before making any adjustments.
5. Place the following switches in the ON position.
 - a. LINE CIRCUIT BREAKER, 1S210
 - b. FILAMENT CIRCUIT BREAKER, 1S211
 - c. BLOWER MOTOR BREAKER, 1S301
 - d. TRANS ON/OFF, 1S203

The blower motor will start and filament voltage will be applied to all tubes.

6. Measure the filament voltage at pins 1 and 5 of the 4-400A tubes (1V301, 1V302, 1V303, and 1V304) with an a-c voltmeter and adjust the filament control, 1R505, to obtain 5 volts across the filaments. Note that the voltage measured at the modulator sockets may be higher than normal since the tubes are not yet in their sockets.

7. Place the TRANS ON/OFF switch, 1S203, in the OFF position.

8. Connect the tap on the buffer plate coil, 1L601, to the desired frequency as shown in Table 3. Place the TRANS ON/OFF and the PLATE ON/OFF switches in the ON position. Place the 11-POSITION METER switch, 1S201, in the AMP Ig position. Note the meter reading. It may be necessary to select an

TABLE 3. BUFFER COIL 1L601 SETTINGS

Frequency in KC	Tap
535 to 620	Full Coil
630 to 810	1
820 to 1040	2
1050 to 1350	3
1360 to 1620	4

TABLE 4. BTA-1R1 FREQUENCY-DETERMINING PARTS

Output Line (Ohms)	Frequency (KC)	1C304 (μ f)	1C305 (μ f)	Connect 1C304, 1C305	1C308 (μ f)	1C309 (μ f)	Connect 1C308, 1C309	1C306 (μ f)	1C307 (μ f)	Connect 1C306, 1C307	1C324 (μ f)
51.5	535-640	1500	1500	Series	10000	—	Parallel	10000	10000	Series	620
	650-770	1300	1300	Series	8200	—		8200	8200	Series	510
	780-930	1000	1000	Series	6200	—		6200	6200	Series	510
	940-1110	100	330	Parallel	3300	2000		6200	6200	Series	360
	1120-1330	620	620	Series	10000	10000		1000	1300	Parallel	360
	1340-1620	620	620	Series	3900	—		1000	1000	Parallel	360
72	535-640	1500	1500	Series	10000	—	Parallel	10000	10000	Series	620
	650-770	1300	1300	Series	8200	—		8200	8200	Series	510
	780-930	1000	1000	Series	6200	—		6200	6200	Series	510
	940-1110	100	330	Parallel	3900	1300		6200	6200	Series	360
	1120-1330	620	620	Series	3900	—		1000	1300	Parallel	360
	1340-1620	620	620	Series	3900	—		1000	1000	Parallel	360
230	535-640	1500	1500	Series	3900	1300	Parallel	10000	10000	Series	620
	650-770	1300	1300	Series	3300	1300	Parallel	8200	8200	Series	510
	780-930	1000	1000	Series	3900	—	Parallel	6200	6200	Series	510
	940-1110	100	330	Parallel	1300	1300		6200	6200	Series	360
	1120-1330	620	620	Series	1300	1300		1000	1300	Parallel	360
	1340-1620	620	620	Series	1000	1000		1000	1000	Parallel	360

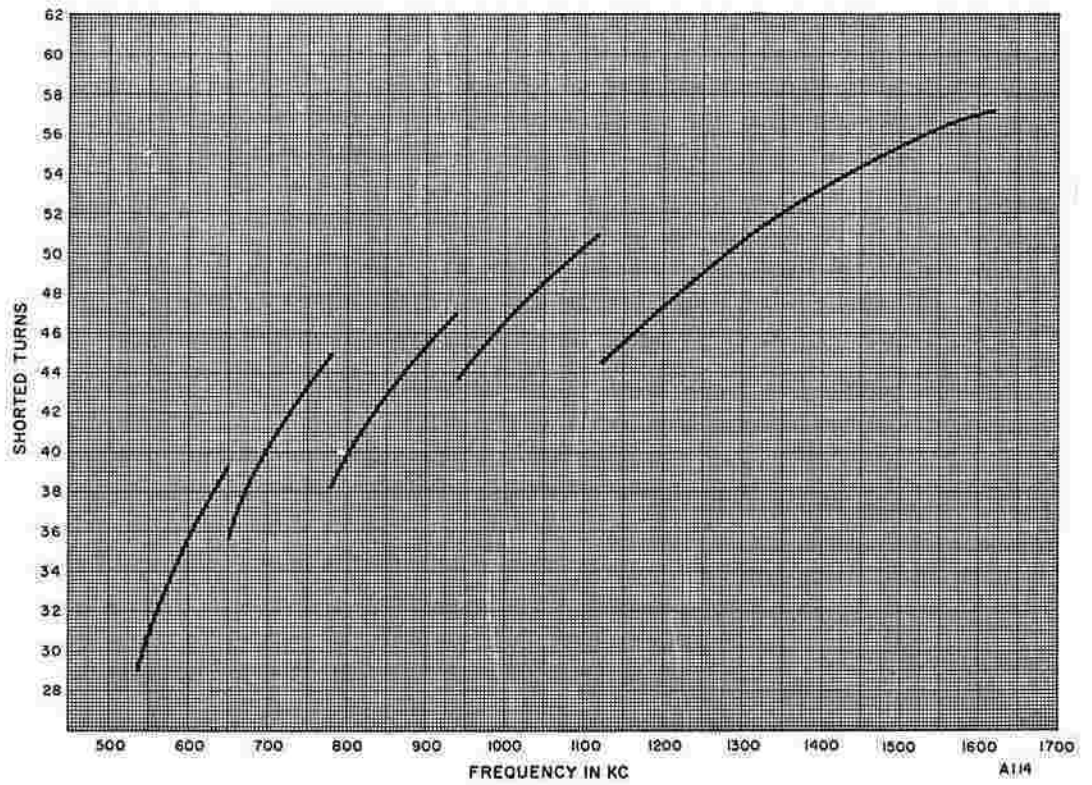


Figure 3. Tuning Chart, PA Tank, Coil 1L301 Jumper Connections

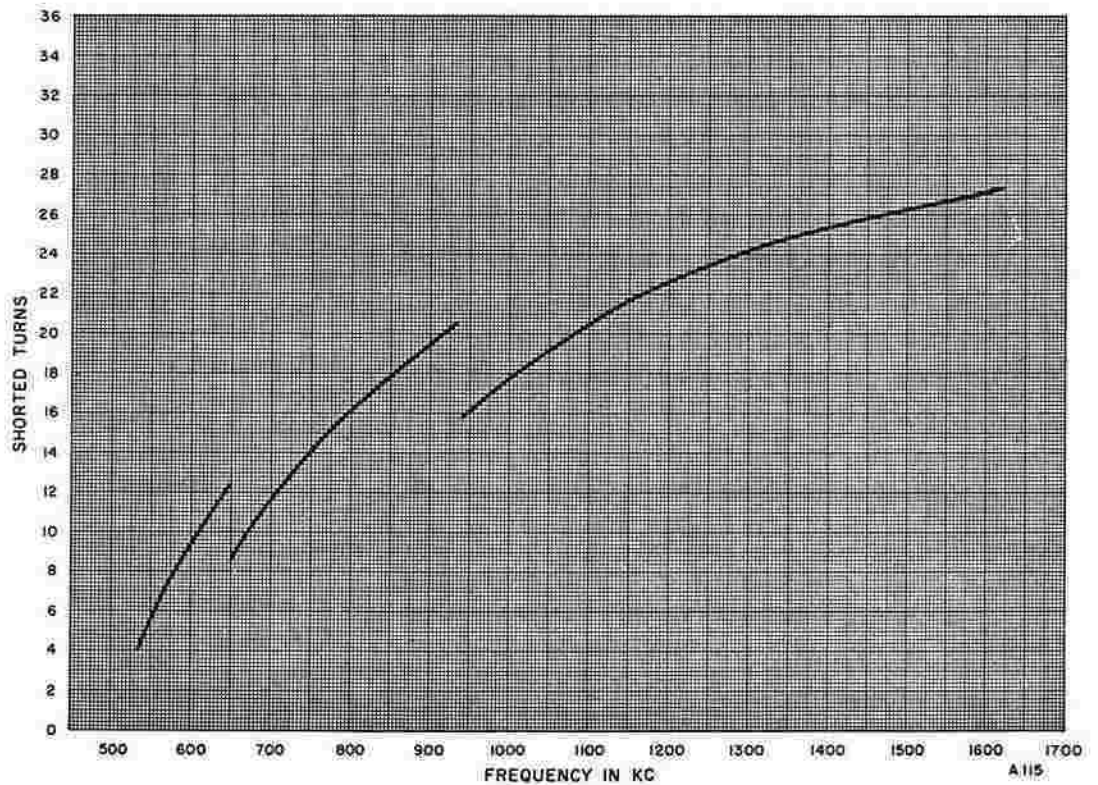


Figure 4. Tuning Chart, Second Harmonic Trap, Coil 1L304 Jumper Connections

adjacent tap on the buffer plate coil, 1L601, to obtain maximum amplifier grid current.

9. Place the PLATE ON/OFF and the TRANS ON/OFF controls in the OFF position.

10. The frequency determining capacitors are supplied under MI-27691. These capacitors must be installed in various values and combinations as listed in Table 4 according to the transmitter's frequency and load impedance. Connect them according to the schematic diagram.

11. Adjust the shorting strap on the harmonic filter coil, 1L302, to leave 5 turns in the circuit.

12. Refer to the Tuning Charts, figures 3 and 4, and adjust the shorting straps on the PA tank coil, 1L301, and the second harmonic trap coil, 1L304, according to the assigned frequency.

CAUTION: Make certain that the coil clip on the shorting strap on 1L301 does not touch the adjacent turns on the coil.

13. Place the TRANS ON/OFF switch in the ON position and operate the POWER RAISE/LOWER control, 1S202, until the motor driven power output resistor, 1R405, is at the mid-point of its travel.

14. Place the TRANS ON/OFF switch in the OFF position. Place the 4-400A modulator tubes in their sockets. Connect the plate cap on each modulator tube.

15. Refer to step 6 and check that the specified filament voltage is being maintained on all tubes.

16. For cut-back operation make the following preliminary adjustments:

Symbol	250 Watts	500 Watts
1R801	Maximum Counterclockwise Rotation	
1R802	Maximum Counterclockwise Rotation	
1R803	Lead from C801 Tapped Down 20,000 ohms	Lead from C801 Tapped Down 0 ohms (At Top)
1R804	Maximum Counterclockwise Rotation	
1R506	Lead from 1K303 Tapped Down 26,000 ohms	Lead from 1K303 Tapped Down 38,000 ohms
1T502	250W Lead on 1T502-250W	250W Lead on 1T502-500W

17. Reconnect the primary leads of transformer 1T502.

18. Tune the output network as indicated in Table 5.

19. Make final adjustments as indicated in Table 6.

CONELRAD

Impedance Matching Networks

The impedance match between the transmission line and the antenna will be disrupted when the transmitter is switched from the main frequency to a Conelrad frequency. Therefore, some switching arrangement must be provided to adjust the antenna tuning unit to match the impedance of the transmission line to the antenna, so that the transmitter, when switched to a Conelrad frequency, will operate into a resistive load of the proper value.

The impedance of the antenna must be measured at the Conelrad frequency and the antenna matching network then tuned to match the antenna to the transmission line. An R-F bridge should be used.

It may be necessary to add another capacitor and to select a different tap on the coils of the existing antenna matching network in order to tune it to the Conelrad frequency.

An R-F contactor controlled by auxiliary relays can be used to switch the antenna matching network from

the main frequency to a Conelrad frequency. Also available is an unwired set of contacts on relay 1K704 that may be connected for this purpose.

Conelrad Tuning

The addition of the Conelrad Kit components to the output circuit may cause a slight de-tuning of the transmitter on the main frequency. Therefore, before tuning to a Conelrad frequency, check the operation of the transmitter on the main frequency and make any tuning adjustments required to compensate for this de-tuning effect.

If this is the initial installation of both the transmitter and the Conelrad Kit, complete the main frequency tuning procedure first before tuning to a Conelrad frequency.

The following tuning procedure assumes that a circuit check of the Conelrad Kit installation has been made to determine if all circuits function properly.

1. Make certain the PLATE ON-OFF and TRANS ON-OFF switches are in the OFF position.

TABLE 5. OUTPUT NETWORK TUNING

Step	Switches or Breakers		Component	Operation	Procedure
	Control	Position			
1	TRANS DAY- NIGHT PLATE	ON NIGHT (250W) ON	1L301	Quickly rotate the AMP TUNING control until a minimum reading is obtained on the AMP PLATE CURRENT meter.	<p>If a minimum dip cannot be obtained, place the PLATE ON/OFF control in the OFF position, while making <i>any</i> internal adjustments. Move the shorting strap on the PA Tank Coil, 1L301, one turn in either direction. It may be necessary to repeat this procedure, moving the shorting strap on 1L301 up or down until a minimum reading is obtained on the AMP PLATE CURRENT meter.</p> <p>IMPORTANT—To insure optimum transmitter efficiency, the final tuning adjustment of 1L301 should be such that minimum current is obtained with the tuning slug just out of the coil.</p> <p><i>Caution: Make certain that the coil clip on the shorting strap on 1L301 does not touch the adjacent turns on the coil.</i></p>
2	PLATE DAY- NIGHT	ON DAY			Repeat step 1.
3	TRANS PLATE	ON ON	1C324 1L304	Measure and note the RF voltage across this capacitor using an RF Detector (as shown in figure 5).	Place the PLATE ON/OFF control in the OFF position while making any internal connections or adjustments. Move the shorting strap on 1L304 up or down until maximum voltage is obtained. The 2nd Harmonic Trap, 1L304 and 1C324, will be tuned on the second harmonic of the carrier frequency when the shorting strap is connected to the coil turn giving maximum voltage output. (See Note.)
4	PLATE	OFF	1L302	Adjust shorting strap on 1L302 to obtain 95% of rated RF power, then adjust AMP TUNING control for rated power output.	Place the PLATE ON/OFF control in the OFF position while making any internal connections or adjustments. Move the shorting strap on the Harmonic Filter, 1L302, tap by tap, in the direction of increasing inductance. Note the power output. Continue to move the shorting strap and, with each change of tap, adjust the AMP TUNING control for a minimum reading on the AMP PLATE CURRENT meter. If a minimum dip in plate current cannot be obtained, repeat step 1. At the point of tuning where 95% of power is obtained simultaneously with minimum plate current, turn the AMP TUNING control counterclockwise until the rated power output is indicated on the output meter.

NOTE: Alternatively, the second harmonic trap may be adjusted by using a receiver tuned to the second harmonic and adjusting for a minimum signal.

TABLE 6. FINAL ADJUSTMENTS

Step	Switches or Breakers		Component	Operation	Procedure
	Control	Position			
1	TRANS DAY- NIGHT PLATE	ON DAY ON	1R402 1R403	Adjust bias potentiometers for a 30% indication on PERCENT meter.	Place the PERCENT meter control to 2nd AF I_{K-L} , then to 2nd AF I_{K-R} and adjust 1R402 and 1R403 so that the meter reading is identical for each position.
2	TRANS DAY- NIGHT PLATE	ON DAY ON	C101, C102 or C103	Crystal unit trimmer adjustment for carrier frequency correction.	Check the operating frequency with a frequency monitor. If a slight correction in transmitter frequency is indicated adjust trimmer C101, C102 or C103 with an insulated alignment tool. When connecting the frequency monitor to 1J601 clip out the shorting jumper across the jack. <i>Note: Whenever the station's Frequency Monitor is disconnected from the Frequency Monitor connector, 1J601, this connector should be grounded.</i>
3	TRANS DAY- NIGHT PLATE	ON NIGHT ON	1R802 (Bias)	Adjust for 30% indication on PERCENT meter.	Place the PERCENT meter control to 2nd AF I_{K-L} then 2nd AF I_{K-R} and adjust 1R802 so that the readings are approx. 30%. (They may not be identical.)
4	TRANS DAY- NIGHT PLATE	ON NIGHT ON	1R804 (Hum)	Adjust for minimum hum.	Adjust 1R804 for minimum hum. In some cases minimum hum may be obtained with 1R804 at minimum (counterclockwise).
5	TRANS DAY- NIGHT PLATE	ON NIGHT OFF	1L305	Adjust modulation monitoring coil for required output. (Reduced power.)	Connect a modulation monitor to the arm of 1K302. Connect the lead from 1K302 to Modulation Monitoring coil 1L305 to tap #1 of the coil. Place the PLATE ON/OFF control in the ON position. Check the carrier level on the monitor. It is necessary to move up one tap at a time until a point is reached giving just the required output, (100% on "CARRIER" meter of monitor) with the CARRIER LEVEL control on the monitor adjusted per instruction book.
6	TRANS DAY- NIGHT PLATE	ON DAY OFF	1L305 1R328	Adjusting modulation monitoring coil and vernier resistor for required output. (Full power.)	Connect the lead from 1R328 to 1L305 to a tap below the tap selected in step 5. Place the PLATE ON/OFF control in the ON position. Vary the tap on 1R328 until the "CARRIER" meter of the modulation monitor also reads 100%. It may be necessary to select a different tap on 1L305.
7	TRANS DAY- NIGHT PLATE	ON DAY ON		Adjusting audio input levels.	Connect output of audio oscillator to terminals 28B and 29B. Adjust 1000 cycle level until modulation monitor reads 85% modulation.
8	TRANS DAY- NIGHT PLATE	ON NIGHT ON	1R801 (Audio)		Adjust 1R801 until modulation monitor reads 85% modulation.
9	TRANS DAY- NIGHT PLATE	OFF DAY OFF	1T501	Setting arc gap on modulation transformer.	Adjust the spacing on the Modulation Transformer, 1T501, until the gaps occasionally flash over on 100% modulation peaks. Then increase the spacing slightly beyond this point.
10	TRANS PLATE	OFF OFF		Disconnect the dummy RF load and connect the antenna transmission line.	Readjust coils 1L301 and 1L302 if necessary. Record all meter readings and tap settings. Typical Panel meter readings are given in Table 7.

TABLE 7. TYPICAL PANEL METER READINGS

Meter Symbol	Panel Designation	Meter Reading	Remarks		
			Modulation Percentage	Meter 1M201 Currents	
				At Reading Indicated	At 100% Indication
1000 WATTS					
1M501 1M502 1M201	Plate Voltage Amp Plate Current Meter Amp I k-r Amp I k-l	3100 v 460 ma 105% 105%	0-100 0-100 	 240 ma 240 ma	 233 ma 233 ma
500 WATTS					
1M501 1M502 1M201	Plate Voltage Amp Plate Current Meter Amp I k-r Amp I k-l	2200 v 325 ma 75% 75%	0-100 0-100 	 175 ma 175 ma	 233 ma 233 ma
250 WATTS					
1M501 1M502 1M201	Plate Voltage Amp Plate Current Meter Amp I k-r Amp I k-l	1550 v 230 ma 52% 52%	0-100 0-100 	 120 ma 120 ma	 233 ma 233 ma
1000—500—250 WATTS					
1M201	Meter Ocs I k-1 Osc I k-2 (RF Amp) Buf Ig Buf Ip Amp Ig 1st AF I k-r 1st AF I k-l 2nd AF I k-r (Mod) 2nd AF I k-l (Mod) 2nd AF I k-c (Mod) 2nd AF I k-l (Mod)	100% 100% 65% 75% 110% 65% 65% 30% 30% 105% 105%	0-100 0-100 0-100 0-100 0-100 0-100 0-100 0 ... 0 100 ... 100	4.5 ma 50.0 ma 2.73 ma 57.0 ma 19.8 ma 4.7 ma 4.7 ma 80 ma 80 ma 280 ma 280 ma	4.5 ma 50.0 ma 4.2 ma 76.0 ma 18.0 ma 7.2 ma 7.2 ma 265 ma 265 ma 265 ma 265 ma

Note 1: Variation in the meter readings of $\pm 20\%$ may be considered normal.

Note 2: Subscripts L and R refer to the left and right tubes.

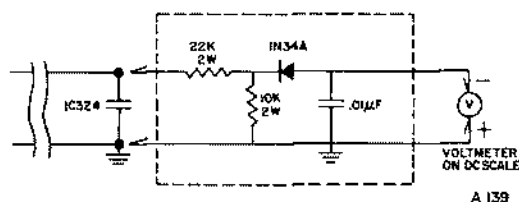


Figure 5. RF Detector, Schematic Diagram

2. Check that the Conelrad switching contactors, 1K704, is connected to the appropriate tap on coil 1L601 as indicated in Table 3.

3. Connect the Conelrad shorting tap to the appropriate turn of coil 1L301 as indicated in Table 8. Connect the Conelrad output tap near the top (ground side) of 1L301.

4. Operate the transmitter at reduced power.

5. Place the PLATE ON-OFF and TRANS ON-OFF switches in the ON position. Observe the plate current indication. Adjust the Conelrad shorting tap on 1L301 until a dip in plate current is obtained.

6. Slide the Conelrad output tap away from the ground side of 1L301 until the transmitter is loaded approximately 30%.

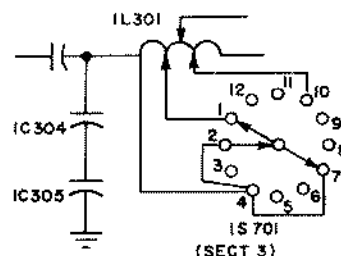
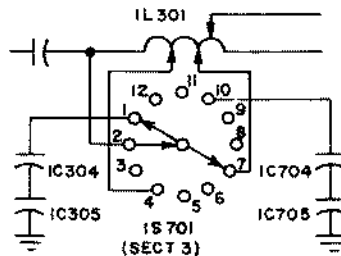
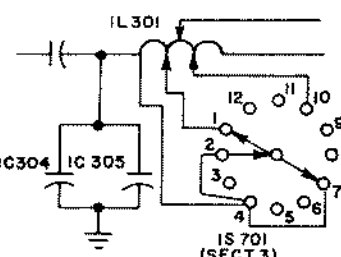
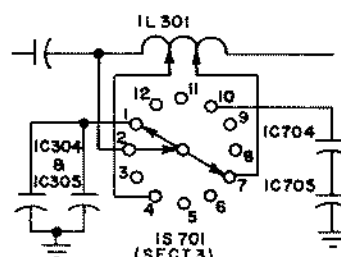
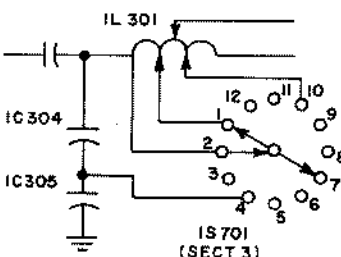
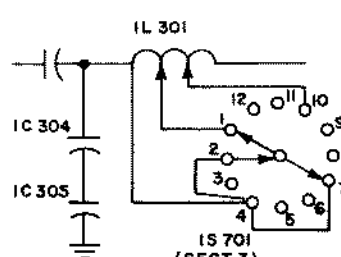
7. Restore the transmitter to full power and check the plate current.

8. Repeat steps 4, 5, and 6 until proper loading is obtained at minimum plate current.

WARNING

THE PLATE SWITCH MUST BE TURNED OFF BEFORE EACH TAP ADJUSTMENT IS MADE TO COIL 1L301.

TABLE 8. CONELRAD TANK CONNECTIONS AND SETTINGS

STANDARD BROADCAST FREQUENCY RANGE	CONELRAD 640 KC		CONELRAD 1240 KC	
	1L 301 SHORTED TURNS	CAPACITOR CONNECTIONS	1L 301 SHORTED TURNS	CAPACITOR CONNECTIONS
535 - 640 KC	39		48	
650 - 770 KC	35			
780 - 930 KC	27			
940 - 1110 KC	10		48	
1120 - 1620 KC	33		48	

A140

OPERATION

In routine operation it is necessary to operate the PLATE ON/OFF and TRANS ON/OFF switches for stopping the transmitter. All other circuit breakers and switches should be left in the ON position at the end of each shut-down.

Where unusual conditions make it desirable to employ additional heating time before applying plate voltage, operate only the TRANS switch to the ON position and after the required interval, operate the PLATE switch to the ON position. Normally, sufficient warm-up time is provided by the plate time-delay relay.

To interrupt transmission for a short interval, operate only the PLATE switch to OFF. This will maintain filament power on the tubes, and the transmitter will be returned to immediate operation when the PLATE switch is closed.

For stability, the crystal heaters are intended to be operated at all times, except when the transmitter is to be shut down for extended periods. Therefore, the external switch controlling crystal heater power should not be opened at routine shut downs. The crystal units require a minimum of 30 minutes warm-up time before operating the transmitter.

If an overload occurs, plate power will be removed from the transmitter. After the cause of the overload has been corrected, operate the overload reset switch on the front panel to place the transmitter back on the air.

Day-Night Switching

To switch the transmitter to reduced power for night operation, press the DAY-NIGHT switch on the front panel to the NIGHT position. To return the transmitter to day power output, press the DAY-NIGHT switch to the DAY position.

MAINTENANCE

General

With ordinary care a minimum of service will be required to keep the BTA-1R1 Transmitter in operation. To avoid interruptions during broadcasts, however, a regular schedule of inspection should be established. Table 9, a recommended maintenance schedule for the transmitter, should be correlated with other station equipment maintenance to insure overall peak efficiency.

Always open the LINE circuit breaker and discharge circuits with a grounding stick before touching any component.

Cleaning

Ceramic insulators and bushings should be kept clean at all times. Insulators subject to stress in high-voltage d-c fields may rupture if sufficient dust accumulates to cause corona discharge. Clean insulators by using a soft, clean cloth. Insulator details are shown in figure 10. Other pertinent insulator data, such as dimensions, stock number, etc., is given in Table 12.

Keep the tube envelopes clean to avoid possible puncture of the glass due to ion bombardment or corona. Tissue paper and alcohol are effective for this purpose.

Clean plate tank coils with a dry cloth. NEVER USE LIQUID POLISH OR STEEL WOOL ON THESE ITEMS. Avoid any scratches on the silver-plated surfaces.

Keep safety gaps clean. If gaps are pitted, polish them with crocus cloth.

Periodic inspection of circuit breakers and relays should be made, and at such time all contacts should be cleaned and adjusted if necessary.

Relay contacts should be cleaned with carbon tetrachloride applied with a soft brush, after which they should be burnished with a tool such as the RCA stock no. 22963 Contact Cleaning Tool. Finally, the contacts should be wiped with a clean piece of bond paper.

Overload Relays

The sensitivity of the overload relays is controlled by spring tension. This is set at the factory and usually no further adjustment is required. However, if the transmitter shuts down without apparently overloading, the sensitivity of the overload relays should be checked. Table 10 shows the nominal energizing voltage required to trip each relay. Refer to figure 12 for the location of the relays and to the schematic diagram for their electrical connections.

**TABLE 9. RECOMMENDED OVERALL
MAINTENANCE SCHEDULE**

— DAILY —
<ul style="list-style-type: none"> — Check and compare all meter readings at start-up. Adjust filament voltages if necessary. Take steps to correct any condition revealed by abnormal readings. — Check filament voltages every hour, for increased tube life. — Make a general visual inspection after shut-down. — If overloads have occurred, examine components concerned at shut-down, and repair or replace as necessary.
— WEEKLY —
<ul style="list-style-type: none"> — Clean internal parts of the transmitter. Use a clean, soft cloth on the insulators. Use a vacuum cleaner or hand blower for removing dust or dirt. — Test all door interlocks and grounding switches. — Check PA and output rf circuits for evidence of heating at connector or junction points. — Make an overall check of distortion and noise level.
— MONTHLY —
<ul style="list-style-type: none"> — Check spare crystal in operating crystal socket. — Check condition of relay contacts. Service if necessary. — Check and record tube socket voltages. Compare with previous readings to detect irregularities. — Inspect air filter. Clean, if necessary, using a vacuum cleaner or brush. — Inspect blower wheel blades and remove accumulation of dirt, if necessary. — Tighten all connections in transmitter.
— QUARTERLY —
<ul style="list-style-type: none"> — Lubricate all tuning drive mechanism gears and bearings. Use petrolatum, Lubriplate No. 110, or equivalent. — Clean air filter.
— SEMI-ANNUALLY —
<ul style="list-style-type: none"> — Inspect relay contacts and replace where required. — Test spare tubes.

To check the relays an external source of power is needed, along with a control network consisting of a VoltOhmyst (or similar instrument) and a variable resistor. A convenient source of power is a battery cell, capable of supplying the energizing voltage indicated in Table 10. The variable resistor, in conjunction with the voltmeter, is used to maintain the output of the battery at the levels shown in Table 10. It may be desirable to temporarily disconnect the resistor shunting the relay coil to reduce the battery current.

Before applying power to the relays, the panel meters in the relay circuits should be shorted. This will prevent possible damage to the meters should there be excessive deflection while the variable resistor is being adjusted.

TABLE 10. OVERLOAD RELAY SETTINGS

Symbol	Function	Voltage
1K401	HV Overload	1V
1K603	Modulation Overload	1V
1K605	LV Overload	$\frac{3}{4}$ V
1K606	PA Overload	1V

Ground the negative side of the battery and connect the positive side, through variable resistor to the appropriate point as indicated by the schematic.

The contacts on the overload relays should just close at the voltage values shown in Table 10. If a relay trips at a voltage other than shown, re-set the sensitivity of that relay by turning the spring tension screw to the right of the tension spring. Turning the screw in a clockwise direction reduces the spring tension, thus increasing the sensitivity; conversely, counterclockwise rotation of the screw will reduce the sensitivity of the relay.

Fuses

In addition to the overload relays and circuit breakers, two 1 amp fuses, 1F601 and 1F602, are connected in the input line to the crystal heaters.

Control Components

The components for the operating controls on each front panel are located on a sub-chassis which is bolted on the back of each front panel. The sub-chassis can be removed from inside the front of the cabinet, thus making any component that might require replacement readily accessible.

To remove the sub-chassis from the rear of the right side control panel, take the AMP TUNING and FILAMENT control knobs off their shafts and remove the handles from OL RESET switch and the CRYSTAL switches. Disconnect the AMP TUNING cable from the cable drum; then remove the six nuts from the sub-chassis mounting bolts. Be careful not to kink the control cable tubing when lifting the sub-chassis free and provide adequate support to the sub-chassis so that the wiring connected to the control components is not subjected to undue strain. When removing the left side sub-chassis follow the same procedure, first disconnecting resistor 1R202 from switch 1S201.

Tubes

Check all tubes periodically. Tube failure can be anticipated by keeping a log of tube life and replacing tubes when indicated by the log or when reduced output is apparent. Typical tube voltages are given in Table 11.

TABLE 11. BTA-1R1 TUBE SOCKET VOLTAGES

TUBE	TYPE	FUNCTION	PLATE PIN NO.	VOLTS DC	CATHODE PIN NO.	VOLTS DC	GRID PIN NO.	VOLTS DC	SCREEN PIN NO.	VOLTS DC	FILAMENT PIN NO.	VOLTS AC
1000 WATTS												
1V101	6AK5	OSC.	5	165	7	1	1	-	6	75	3-4	6.3
1V102	5763	RF AMP	1	220	7	1	8, 9	-	6	192	4-5	6.0
1V601	6146	BUFFER	CAP	550	1, 4, 6	-	5	-60	3	180	2-7	6.3
1V603	2E26	1st AF _R	CAP	400	1, 4, 6	40	5	21	3	165	2-7	6.3
1V604	2E26	1st AF _L	CAP	400	1, 4, 6	40	5	21	3	165	2-7	6.3
1V301	4-400A	AMP _R	CAP	3000	-	-	3	-400	2, 4	500	1-5	5
1V302	4-400A	AMP _L	CAP	3000	-	-	3	-400	2, 4	500	1-5	5
1V303	4-400A	MOD _R	CAP	3100	-	-	3	-145	2, 4	750	1-5	5
1V304	4-400A	MOD _L	CAP	3100	-	-	3	-145	2, 4	750	1-5	5
500 WATTS												
1V101	6AK5	OSC.	5	165	7	1	1	-	6	75	3-4	6.3
1V102	5763	RF AMP	1	220	7	1	8, 9	-	6	192	4-5	6.0
1V601	6146	BUFFER	CAP	550	1, 4, 6	-	5	-60	3	180	2-7	6.3
1V603	2E26	1st AF _R	CAP	400	1, 4, 6	40	5	14.7	3	180	2-7	6.3
1V604	2E26	1st AF _L	CAP	400	1, 4, 6	40	5	14.7	3	180	2-7	6.3
1V301	4-400A	AMP _R	CAP	2150	-	-	3	-400	2, 4	340	1-5	5
1V302	4-400A	AMP _L	CAP	2150	-	-	3	-400	2, 4	340	1-5	5
1V303	4-400A	MOD _R	CAP	2200	-	-	3	-150	2, 4	750	1-5	5
1V304	4-400A	MOD _L	CAP	2200	-	-	3	-150	2, 4	750	1-5	5
250 WATTS												
1V101	6AK5	OSC.	5	165	7	1	1	-	6	75	3-4	6.3
1V102	5763	RF AMP	1	220	7	1	8, 9	-	6	192	4-5	6.0
1V601	6146	BUFFER	CAP	550	1, 4, 6	-	5	-60	3	180	2-7	6.3
1V603	2E26	1st AF _R	CAP	500	1, 4, 6	32	5	10.5	3	175	2-7	6.3
1V604	2E26	1st AF _L	CAP	500	1, 4, 6	32	5	10.5	3	175	2-7	6.3
1V301	4-400A	AMP _R	CAP	1550	-	-	3	-400	2, 4	280	1-5	5
1V302	4-400A	AMP _L	CAP	1550	-	-	3	-400	2, 4	280	1-5	5
1V303	4-400A	MOD _R	CAP	1575	-	-	3	-115	2, 4	450	1-5	5
1V304	4-400A	MOD _L	CAP	1575	-	-	3	-115	2, 4	450	1-5	5

NOTE: Subscripts L and R refer to the left and right tubes.

Feedback Ladders

Excessive distortion may result if there is an unbalance in the feedback ladders, 1Z301 and 1Z302. Unbalance is usually caused by an open or a shorted capacitor or resistor in the feedback ladder network. If excessive distortion or excessive unbalanced of the 2E26 cathode current exists, a check of the feedback voltages can be made at terminals 8 and 9 of the secondary of the Audio Input Transformer, 1T601. The d-c voltage measured from each terminal to ground should be approximately 21 volts (1000 watts) and the two voltages should be balanced

within approximately 2%. If the d-c voltages are unbalanced by more than 2%, the resistors are unbalanced and the ladders should be checked for a defective resistor.

To check the feedback capacitors, apply a 1000-cycle signal to the transmitter input at approximately 50% modulation and measure the a-c voltages at terminals 8 and 9 of the input transformer, 1T601, to ground with a VoltOhmyst or other a-c voltmeter. Again, the voltage should be balanced within 2%. A balance exceeding 2% indicates a defective capacitor.

PRINTED CIRCUITS

In general, the same techniques used in servicing wired chassis work equally well in servicing printed circuit boards. Circuit analysis and trouble shooting procedures remain the same, as does the test equipment normally utilized for this purpose. However, the methods usually used in replacing components on a wired chassis must be amended slightly to suit the physical characteristics peculiar to printed circuit board construction. In addition, the board itself may, on occasion, require repairs due to surface blisters or cracks.

The following information and accompanying illustrations, figures 6, 7, 8, and 9 are intended to acquaint the reader with the accepted practices used in repairing circuit boards and replacing components.

During the actual soldering process, it is of the utmost importance that only enough heat necessary to melt the solder be applied to the printed wiring or component connection. Excessive heat or heat applied for a long duration will cause the adhesive that holds the copper foil to the board to lose its adhesive qualities. This, in turn, will cause the printed circuitry to become separated from the board.

Equipment

Low wattage soldering iron, 35 to 50 watts
 Diagonal cutters
 Long nose pliers
 Solder aid or scribe
 Small knife
 Single edge razor blade
 Small stiff bristle brush
 Camel hair brush
 Solvent, such as denatured alcohol or lacquer thinner
 Clear lacquer

Board Repair

When the crack runs under the circuit path, drill a 1/16-inch hole at each end of the crack to prevent the crack from lengthening.

To repair a break in the printed wiring, place a piece of tinned bus wire across the broken printed wiring. Hold the bus wire in place with a soldering aid or scribe. Heat the bus wire with a soldering iron and flow on low-temperature solder along the length of bus wire. Use a solvent to clean the soldered area.

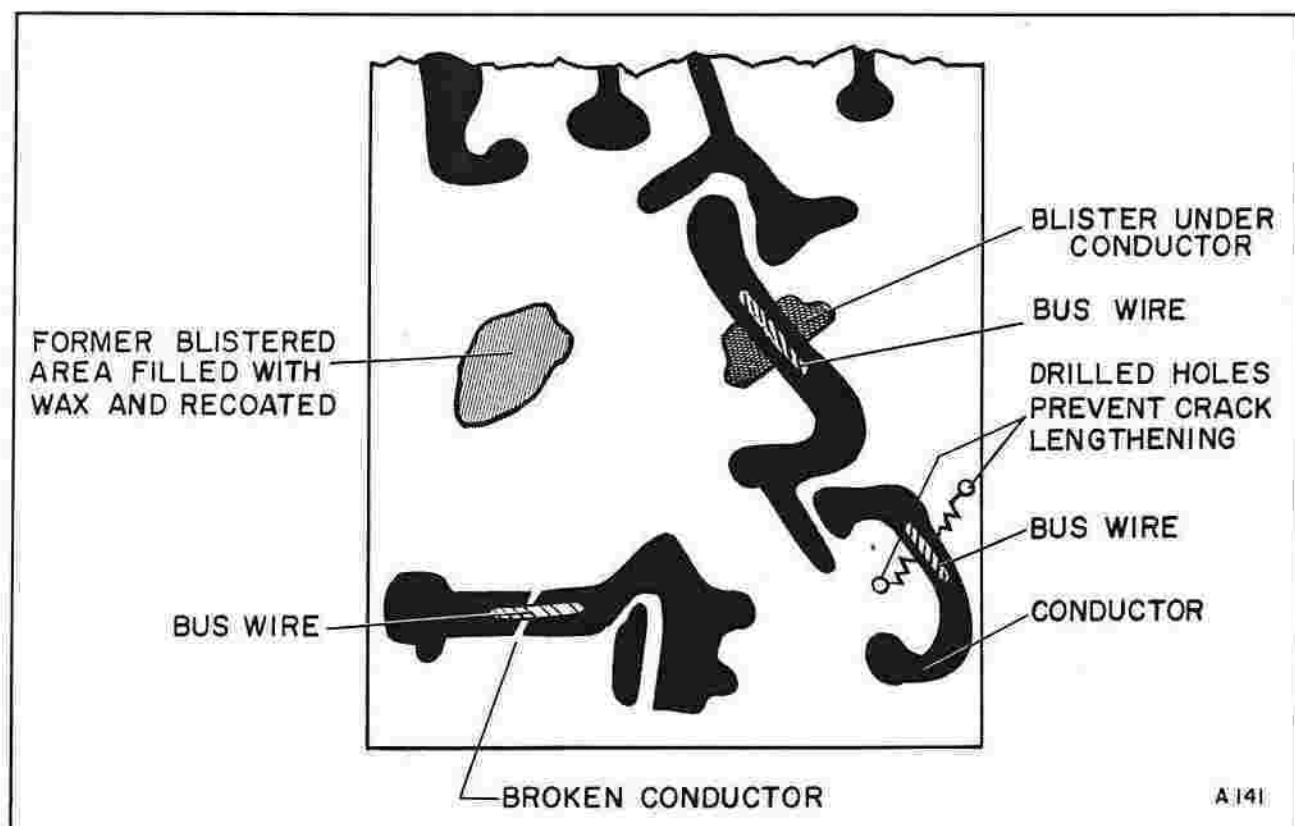


Figure 6. Repair of Surface Damage to Board and Printed Wiring

If there is a blister on an open area of the board, peel the blistered area with a razor blade. Smooth AT-N wax over this area until level with the board, and then apply a coating of lacquer over the waxed area with a camel hair brush.

If there is a severe crack in the board running through the printed wiring, a support must be used to relieve the strain. This can be done by drilling a 1/16-inch hole in each side of the crack, first making certain that there are no components or adjacent printed wiring on the side opposite the holes. Form a piece of wire into a "U" and insert it through the holes so that the loop portion is on the under side of the board. Bend the protruding ends of wire flat against the printed wiring and then solder them to the surface of the printed wiring.

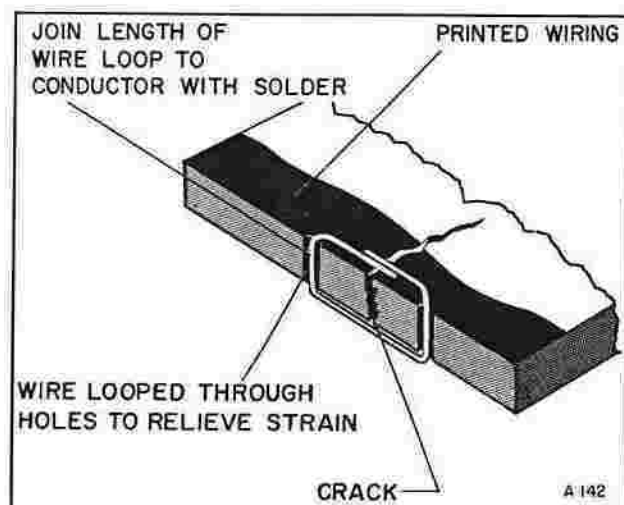


Figure 7. Repair of Severe Crack through Board and Printed Wiring

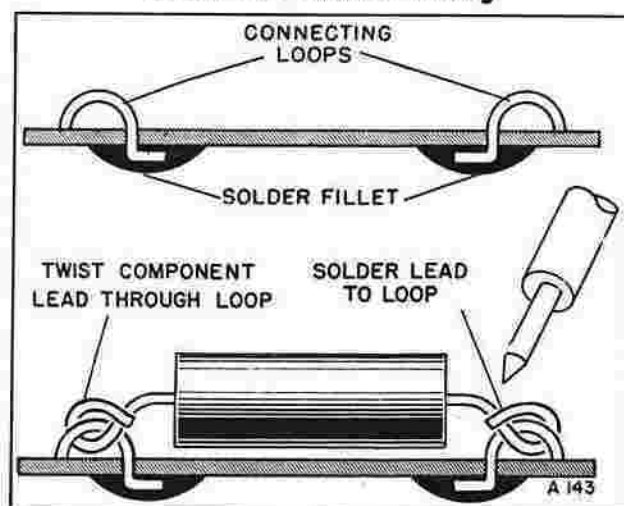


Figure 8. Replacing Double-Ended Component

Component Replacement

Remove the defective component by clipping the component leads so as to leave approximately 1/4-inch of lead protruding through the board. Form each of these wire ends into a loop with long nose pliers. Run the leads of the replacement component through

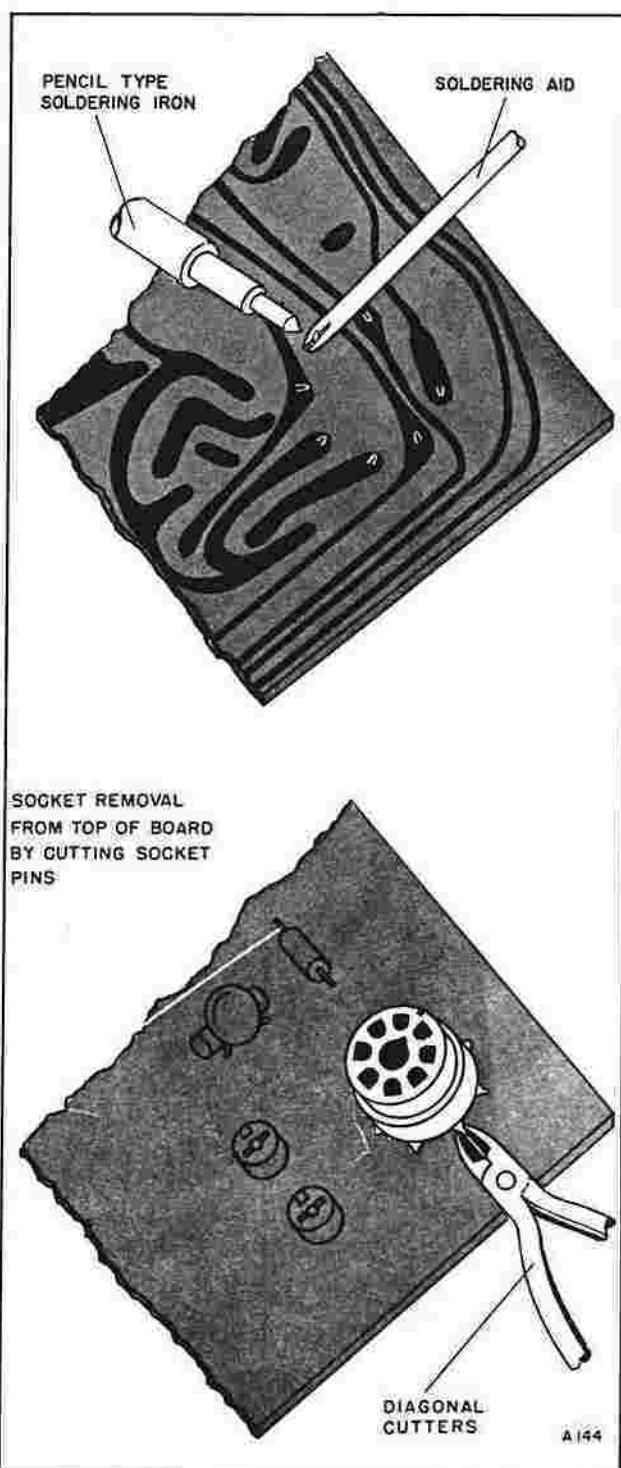


Figure 9. Removal of Multi-Element Component

the loops, twisting them to make a solid mechanical connection and then solder. Keep tension on each lead through the board while soldering so that any overheating can be quickly detected.

Particular care should be exercised when replacing single-ended components, such as transformers, coils, and electrolytic capacitors. These components are mounted vertically on the board and they must be unsoldered from the printed side of the board.

To remove a multi-element component, e.g., a socket with six or eight terminals, hold the wired side down if possible and apply heat to each terminal in

turn. When most of the excess solder has been removed, repeat the unsoldering process, this time using a knife or soldering aid to pry up the socket terminals from the printed foil. Use a small stiff brush to clean off any remaining solder from the terminals. In some instances it may be more convenient to remove the tube socket from the top of the board. Use a pair of diagonal cutters to clip the socket terminals between the base of the socket and the top of the board. Then apply just enough heat to loosen the socket terminals so they can be removed freely from the printed wiring with a pair of long nose pliers.

TABLE 12. INSULATOR DATA

Type Designation	Stock No.	Drawing No.	Figure	Dimensions in Inches								Tap Size
				A	B	C	D	E	F	G	H	
NS5WP104	211423	426765-3	I	$\frac{3}{8}$	$\frac{1}{2}$	.16	—	—	—	—	—	.138-32
NS5W0108	208116	426765-12	I	$\frac{3}{8}$	1	.38	—	—	—	—	—	.138-32
NS5W0110	212086	426765-15	I	$\frac{3}{8}$	$1\frac{1}{4}$	.38	—	—	—	—	—	.138-32
NS5W0116	217752	416765-21	I	$\frac{3}{8}$	2	.38	—	—	—	—	—	.138-32
NS5W0208	210376	426766-9	I	$\frac{1}{2}$	1	$\frac{3}{8}$	—	—	—	—	—	8-32
NS5WP412	55800A	426768-6	I	1	$1\frac{1}{2}$	$\frac{1}{2}$	—	—	—	—	—	$\frac{1}{4}$ -20
NS5W1208	210084	426773-3	II	$\frac{3}{4}$	1	$\frac{3}{8}$	—	—	—	—	—	10-32
NS5W1210	209664	426773-6	II	$\frac{3}{4}$	$1\frac{1}{4}$	$\frac{3}{8}$	—	—	—	—	—	10-32
NS5W1212	209711	426773-9	II	$\frac{3}{4}$	$1\frac{1}{2}$	$\frac{3}{8}$	—	—	—	—	—	10-32
NS5W2012	51781A	426762-6	III	$\frac{1}{2}$	$1\frac{1}{2}$	$\frac{3}{8}$	1	—	—	—	—	8-32
NS5W2501	48459A	99067-6	IV	$\frac{25}{32}$	$1\frac{3}{8}$	—	$2\frac{1}{8}$	—	—	—	—	—
NS5W4101	211247	426764-3	V	$\frac{7}{8}$	$\frac{1}{4}$	$\frac{15}{16}$	$\frac{1}{2}$	.143	$\frac{3}{8}$	—	—	—
NS5W4104	210340	426764-12	V	$1\frac{15}{16}$	$\frac{9}{16}$	$\frac{47}{64}$	$1\frac{1}{8}$	.200	1	—	—	—
NS5W4201	211246	426764-53	VI	$\frac{3}{8}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{2}$	.143	$\frac{3}{8}$	—	—	—
NS5W4502	51088A	426761-12	VII	$1\frac{1}{8}$	$\frac{7}{16}$	$\frac{7}{8}$	$1\frac{3}{4}$	$\frac{1}{16}$	1	$1\frac{1}{4}$	$1\frac{17}{64}$	—

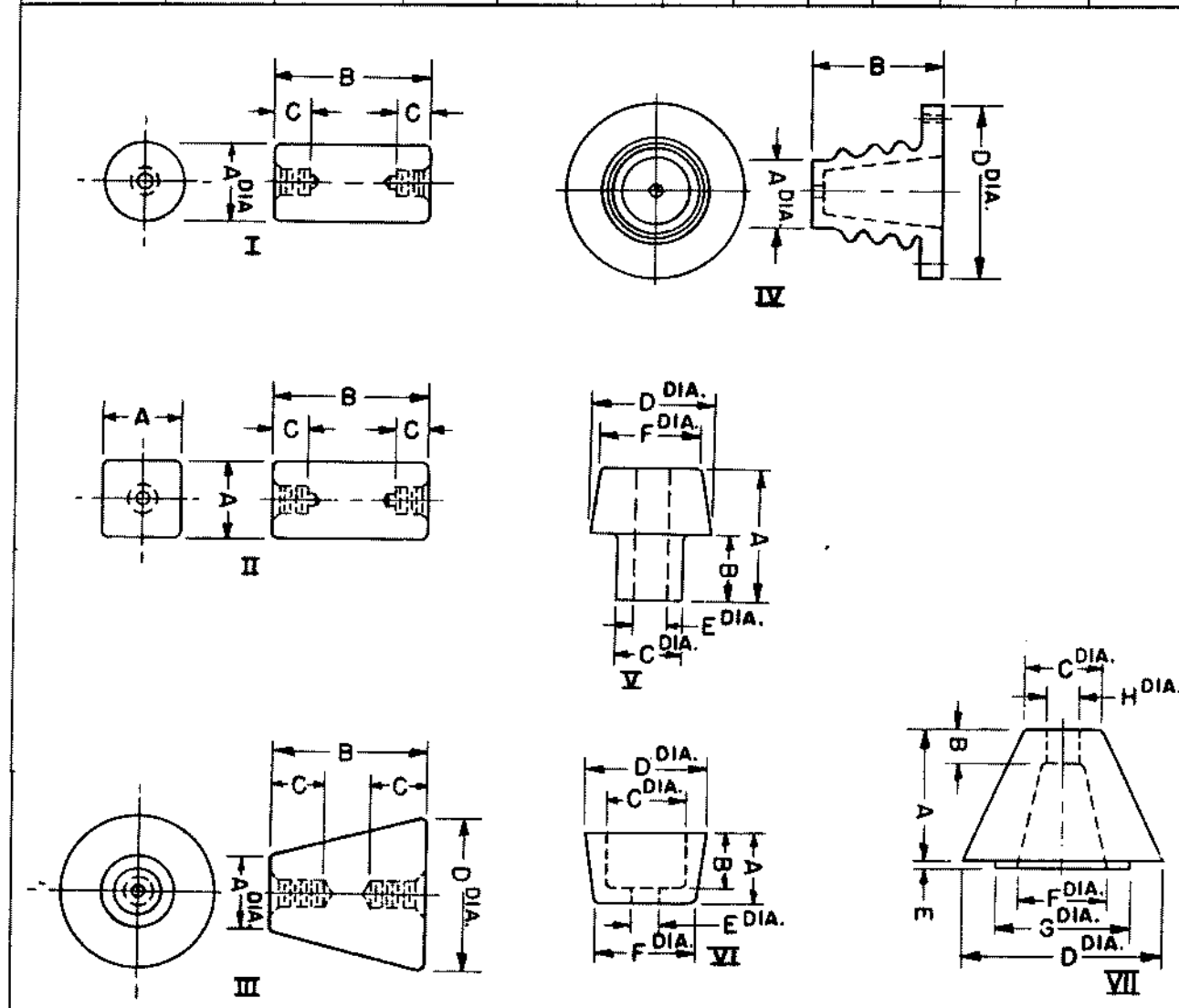


Figure 10. Insulator Details

RECOMMENDED STATION SPARE PARTS

Symbol No.	Stock No.	Drawing No.	Qty.	Description
1C201 to 1C204	610003	36655-503	1	Capacitor: meter by-pass, 0.01 mf, 1200 v
1C301, 1C302, 1C310, 1C311	217987	990701-83	2	Capacitor: filament by-pass, .033 mf, 1200 v
1C303	96173	990705-242	1	Capacitor: plate blocking, 620 mmf, $\pm 5\%$, 10,000 v
1C312	601002	728647-41	1	Capacitor: screen by-pass, 1000 mmf, $\pm 20\%$, 2500 v
1C313	215595	940173-102	1	Capacitor: plate by-pass, 500 mmf, 30 kv
1C314 to 1C317, 1C319 to 1C322	215600	8843560-17	2	Capacitor: feed-back, 300 mmf, 5000 v
1C318, 1C323	68466	728647-365	2	Capacitor: feed-back, 0.01 mf, $\pm 2\%$, 1200 v
1C601	39670	727866-165	1	Capacitor: fixed, mica, 5600 mmf, $\pm 10\%$, 500 v
1C602	39662	727866-147	1	Capacitor: fixed, mica, 1000 mmf, $\pm 10\%$, 500 v
1C603	610003	728647-65	1	Capacitor: fixed, mica, 0.01 mf, $\pm 20\%$, 2500 v
1C604	601002	728647-41	1	Capacitor: fixed, mica, 1000 mmf, $\pm 20\%$, 2500 v
1C608	18501	990193-8	1	Capacitor: fixed, paper, 10 mf, $\pm 10\%$, 600 v
1C609	56124	984678-8	1	Capacitor: fixed, paper, 1 mf, $\pm 10\%$, 600 v
1C401, 1C402	209618	990193-127	1	Capacitor: fixed, paper, 6 mf, $\pm 10\%$, 4000 v
1C403, 1C404	57017	450184-4	1	Capacitor: fixed, paper, 10 mf, 400 v
1C406	55018	863691-2	1	Capacitor: 1.2 mf
1C501	97537	990193-184	1	Capacitor: fixed, paper, 1 mf, $\pm 10\%$, 7500 v
1C502	76578	984663-21	1	Capacitor: fixed, mica, 100 mmf, $\pm 10\%$, 1000 v
1C503, 1C504	204351	990421-193	1	Capacitor: fixed, paper, 0.1 mf, $\pm 10\%$, 1000 v
1I201, 1I202	16154	459610-36	2	"Plate On" lamp
1F601, 1F602	14133	990157-8	3	Fuse: lamp, 1 amp
1K601	215614	8411073-5	1	Contact: plate time delay
1K602	216988	8412197-3	1	Relay: plate on
1K401, 1K603, 1K605, 1K606	215504	754291-3	1	Relay: overload
1K604	216181	480070-1	1	Relay: trans. on latching
1R405	217842	433747-4	1	Resistor: variable, 400 ohm, 225 w
1R402, 1R403	215554	737809-5	1	Resistor: variable, W.W., 5000 ohm, $\pm 20\%$, 3 w
1R505	216027	415724-14	1	Resistor: variable, 25 ohm, 150 w
1R310, 1R315	215588	891769-23	2	Resistor: fixed, carbon, 62,000 ohm, $\pm 1\%$
1R307 to 1R314	215599	8928565-1	2	Resistor: fixed, precision, 2.2 meg, $\pm 1\%$
1S214 to 1S216	54920	8881052-1	1	Switch: interlock
1S301	94357	8836936-16	1	Switch: blower motor
1S210	215947	482740-2	1	Circuit Breaker: line
1S211	215946	482740-1	1	Circuit Breaker: filament

LIST OF PARTS

Symbol	Stock No.	Drawing No.	Description
			M1-27632 CRYSTAL OSCILLATOR
C101	215924	8946100-1	CAPACITOR - VARIABLE, CERAMIC, 5-25 MMF
C102			SAME AS C101
C103			SAME AS C101
C104		748252-211	CAPACITOR - FIXED, MICA, 12 MMF $\pm 5\%$, 500 V
C105		737837-243	CAPACITOR - FIXED, MICA, 330 MMF $\pm 10\%$, 500 V
C106	216972	737837-245	CAPACITOR - FIXED, MICA, 390 MMF $\pm 10\%$, 500 V
C107			SAME AS C106
C108	039670	727871-165	CAPACITOR - FIXED, MICA, 5600 MMF $\pm 10\%$, 500 V
C109			SAME AS C108
C110			SAME AS C108
C111	073960	8811182-5	CAPACITOR - DISC, CERAMIC, 10,000 MMF -20 $\neq 100\%$, 450 V
C112			SAME AS C111
C113			SAME AS C111
C114			SAME AS C111
C115			SAME AS C111
C116			SAME AS C111
C117			SAME AS C111
C118			SAME AS C111
K101	215601	8410963-1	RELAY - CRYSTAL SWITCHING, 110 V 60 CYCLE
K102			SAME AS K101
L101	215920	8914343-505	COIL - PLATE CHOKE, 400 MICROHENRY
R101		90496-25	RESISTOR - FIXED, COMP., 100,000 OHM, $\pm 20\%$, 1 W
R102			SAME AS R101
R103			SAME AS R101
R104		90496-17	RESISTOR - FIXED, COMP., 4700 OHM, $\pm 20\%$, 1 W
R105		99126-82	RESISTOR - FIXED, COMP., 47,000 OHM, $\pm 10\%$, 2 W
R106		99126-79	RESISTOR - FIXED, COMP., 27,000 OHM, $\pm 10\%$, 2 W
R107	069297	458574-60	RESISTOR - FIXED, WIRE WOUND, 4000 OHM, $\pm 5\%$, 10 W
R108	104181	867970-304	RESISTOR - FIXED, WIRE WOUND, 0.39 OHM, $\pm 10\%$, 1/2 W
R109		90496-117	RESISTOR - FIXED, COMP., 18 OHM, $\pm 5\%$, 1 W
R110		90496-144	RESISTOR - FIXED, COMP., 240 OHM, $\pm 5\%$, 1 W
XV101	209285	8817695-1	SOCKET - TUBE, 7 PIN MINIATURE
XV102	209284	8817696-1	SOCKET - TUBE, 9 PIN NOVAL
XY101	207707	8817694-1	SOCKET - OCTAL
XY102			SAME AS XY101
XY103			SAME AS XY101

LIST OF PARTS (Continued)

Symbol	Stock No.	Drawing No.	Description
			MI-27634 BASIC TRANSMITTER
1C201	610003	36655-503	CAPACITOR - MICA, 0.01 MF $\pm 20\%$, 1200 V
1C202			SAME AS 1C201
1C203			SAME AS 1C201
1C204			SAME AS 1C201
1I201		459610-8	LAMP - INDICATOR, PLATE-ON
	099765	459610-31	JEWEL - RED
	016154	459610-36	LAMP
	044570	459610-41	RESISTOR
	099763	459610-46	SOCKET
1I202		459610-12	LAMP - INDICATOR, CRYSTAL ON
	099768	459610-35	JEWEL - BLUE
	016154	459610-36	LAMP
	016155	459610-40	RESISTOR
	099763	459610-46	SOCKET
1M201	215707	486165-2	METER - MULTIMETER, 0-150%
1M202	216023	459672-129	METER - FILAMENT BUS 0-300 V AC
1R201	217614	8871557-53	RESISTOR - FIXED, WIRE WOUND, 1250 OHM, $\pm 1\%$, 1 W
1R202			SAME AS 1R201
1S201	215704	480092-2	SWITCH - METER, ROTARY, WAFER TYPE
1S202	211065	738998-5	SWITCH - RAISE LOWER
1S203	211065	738998-5	SWITCH - TRANS ON-OFF
1S204	215702	738998-12	SWITCH - O.L. RESET, PLATE ON-OFF
1S205	216212	8430345-1	SWITCH - CRYSTAL
1S206			NOT USED
1S207			NOT USED
1S208			NOT USED
1S209			NOT USED
1S210	215947	482740-2	CIRCUIT BREAKER - LINE
1S211	215946	482740-1	CIRCUIT BREAKER - FILAMENT
1S212	211065	738998-5	SWITCH - DAY-NIGHT
1S213			NOT USED
1S214	054920	8881052-1	SWITCH - INTERLOCK
1S215			SAME AS 1S214
1S216			SAME AS 1S214
1S217	216022	8953364-501	SWITCH - GROUNDING
1S218			SAME AS 1S217
1S219			SAME AS 1S217
			MISCELLANEOUS
	017269	737820-501	KNOB - (FOR 1S201)
			MI-27629-A MODULATOR AND RF UNIT
			CAPACITORS
1C301	217987	990701-83	MICA, 3300 MMF $\pm 20\%$, 1200 V
1C302			SAME AS 1C301
1C303	096173	990705-242	MICA, 620 MMF $\pm 5\%$, 10,000 V
1C304			SEE FREQUENCY DET.
1C305			SAME AS 1C304
1C306			SAME AS 1C304
1C307			SAME AS 1C304
1C308			SAME AS 1C304
1C309			SAME AS 1C304
1C310			SAME AS 1C301
1C311			SAME AS 1C301
1C312	215595	940173-102	CERAMIC, 500 MMF $\pm 50\%$, 30,000 V
1C313			SAME AS 1C312
1C314	215600	8843560-17	MICA, 300 MMF $\pm 2\%$, 5000 V
1C315			SAME AS 1C314

LIST OF PARTS (Continued)

Symbol	Stock No.	Drawing No.	Description
1C316	068466	728647-365	SAME AS 1C314
1C317			SAME AS 1C314
1C318			MICA, 0.01 MF $\pm 2\%$, 1200 V
1C319			SAME AS 1C314
1C320			SAME AS 1C314
1C321			SAME AS 1C314
1C322			SAME AS 1C314
1C323			SAME AS 1C318
1C324			SAME AS 1C304
1K301			094117	458722-1	RELAY - SURGE SUPPRESSOR
	206338		COIL - 120 V DC
	206337		CONTACT - MOVABLE
	206336		CONTACT - STATIONARY
1K302	221179	8449729-1	RELAY - MODULATION MONITOR
1K303	222157	458722-5	RELAY - 110 V 50/60 CPS S.P.S.T.
1L301	215598	740486-503	COIL - TANK, INDUCTANCE 230 MH
	215597	740451-7	COIL ONLY
1L302	216296	757431-2	COIL - FILTER, INDUCTANCE 57 MICROHENRY
1L303	215593	418486-502	CHOKE - PA PLATE
1L304	093612	740230-1	COIL - INDUCTANCE 40 MICROHENRY
1L305	216788	8434008-501	COIL - MOD. MONITORING
			RESISTORS
			FIXED, COMPOSITION - UNLESS OTHERWISE SPECIFIED
1R301		99126-7	100 OHM, $\pm 20\%$, 2 W
1R302			SAME AS 1R301
1R303	217993	722393-41	VARIABLE WIRE WOUND, 50 OHM, $\pm 10\%$, 4 W
1R304	216020	8702674-507	METER MULT.
	052819	8702674-3	RESISTOR ONLY - 0.5 MEG $\pm 1\%$, 1/2 W
1R305		99126-120	24 OHM, $\pm 5\%$, 2 W
1R306	215599	8928565-1	WIRE WOUND, 2.2 MEGOHM, $\pm 1\%$, 1 W
1R307			SAME AS 1R306
1R308			SAME AS 1R306
1R309			SAME AS 1R306
1R310	215588	891769-23	CARBON, 62,000 OHM, $\pm 1\%$, 2 W
1R311			SAME AS 1R306
1R312			SAME AS 1R306
1R313			SAME AS 1R306
1R314			SAME AS 1R306
1R315			SAME AS 1R310
1R316	219649	8986541-4	WIRE WOUND, 3.75 OHM, $\pm 1\%$, 2 W
1R317			SAME AS 1R316
1R318	219648	8986541-3	WIRE WOUND, 3.16 OHM, $\pm 1\%$, 2 W
1R319			SAME AS 1R318
1R320	219647	8986541-2	WIRE WOUND, 1.5 OHM, $\pm 1\%$, 2 W
1R321			SAME AS 1R320
1R322		99126-25	100,000 OHM, $\pm 20\%$, 2 W
1R323		99126-7	100 OHM, $\pm 20\%$, 2 W
1R324			SAME AS 1R323
1R325		99126-76	15,000 OHM, $\pm 10\%$, 2 W
1R326		99126-7	100 OHM, $\pm 20\%$, 2 W
1R327			SAME AS 1R326
1R328	099803	427230-45	ADJUSTABLE WIRE WOUND, 250 OHM, 25 W
1S301	224821	8836936-16	BREAKER - CIRCUIT, LESS HEATER AND ENCLOSURE
	223791		HEATER ONLY
1T301	215591	992045-1	TRANSFORMER - FILAMENT
1T302			SAME AS 1T301
1XV301			SOCKET - TUBE
	215589	8413482-1	PLATE
	215590	8920938-1	CONTACT
			SAME AS 1XV301
1XV302			SAME AS 1XV301
1XV303			SAME AS 1XV301
1XV304			SAME AS 1XV301
1Z301	215596	482771-501	LADDER - FEED-BACK, COMPLETE, INCLUDES THE FOLLOWING - 1C314 TO 1C323, 1R306 TO 1R315

LIST OF PARTS (Continued)

Symbol	Stock No.	Drawing No.	Description
			MISCELLANEOUS
	051089	7862770-4	CLIP - FUSE, FOR 1 1/16 IN. DIA. FERRULE
	096480	8833154-1	CLIP - FOR 1L302
	211323	893090-2	CLIP - FOR 1L304
	216709	8833154-2	CLIP - FOR 1L301
	095590	8899056-4	CONNECTOR - TUBE
			MI-27631-A H.V. RECTIFIER UNIT
			NOT USED
1B401			MOTOR - 115 V 60 CPS
1B402	215552	480051-1	CAPACITOR - PAPER, 6 MF $\pm 10\%$, 4000 V
1C401	209618	990193-127	SAME AS 1C401
1C402			CAPACITOR - PAPER, 10 MF $\pm 10\%$, 400 V
1C403	219175	450184-4	SAME AS 1C403
1C404			NOT USED
1C405			CAPACITOR - PAPER, 1.2 MF 220 V AC
1C406	055018	863691-2	RECTIFIER ASSEMBLY - COMPLETE WITH SILICON DIODES
1CR401	220285	8722935-501	DIODES ONLY
	223323		RELAY - H.V. OVERLOAD
1K401	215504	754291-3	RESISTOR - WIRE WOUND, 1000 OHM, $\pm 5\%$, 10 W
1R401	048568	458574-47	RESISTOR - VARIABLE WIRE WOUND, 5000 OHM, $\pm 20\%$, 3 W
1R402	215554	737809-5	SAME AS 1R402
1R403			RESISTOR - WIRE WOUND, 2500 OHM, $\pm 5\%$, 10 W
1R404	045515	458574-56	RESISTOR - VARIABLE WIRE WOUND, 400 OHM, 225 W
1R405	217842	433747-4	RESISTOR - WIRE WOUND, 0.75 OHM, $\pm 1\%$, 2 W
1R406	219670	8986541-1	RESISTOR - WIRE WOUND, 5 OHM, $\pm 5\%$, 10 W
1R407		993008-35	NOT USED
1T401			TRANSFORMER - PLATE
1T402	215553	482736-1	TRANSFORMER - PLATE
1T403	215558	482737-1	TRANSFORMER - CONTROL
1T404	215557	8413415-1	
1Z401			RECTIFIER ASSEMBLY - COMPLETE WITH COMPONENTS
TO			DIODE - SILICON
1Z408	220287	643383-501	RESISTOR - WIRE WOUND, 20 OHM, $\pm 10\%$, 10 W
	223323		RESISTOR - FIXED, COMP., 27,000 OHM, $\pm 5\%$, 2 W
	095880	993008-47	RECTIFIER ASSEMBLY - COMPLETE WITH COMPONENTS
		722362-193	DIODE ONLY
1Z409	222011	8722934-501	RESISTOR - FIXED, COMP., 470,000 OHM, $\pm 10\%$, 1/2 W
	226058		
		727834-94	MISCELLANEOUS
	051781A	426762-6	INSULATOR - STEATITE, PILLAR, 1 IN. DIA. X 1 1/2 IN. LONG
	213360	426773-15	INSULATOR - STEATITE, 3/4 IN. SQ. X 2 1/2 IN. LG.
	225979	8879208-3	PAD - FELT, 1 9/32 X 5/8 X 1/8 THK.
			MI-27639-A POWER DETERMINING COMPONENTS
1B501	215696	8702683-1	BLOWER - 230 V 50/60 CPS
1C501	097537	990193-184	CAPACITOR - PAPER, 1 MF $\pm 10\%$, 7500 V
1C502	076578	984663-21	CAPACITOR - MICA, 100 MMF $\pm 10\%$, 1000 V
1C503	204351	990421-193	CAPACITOR - PAPER, 0.1 MF $\pm 10\%$, 1000 V
1C504			SAME AS 1C503
1L501	208210	900289-1	REACTOR - MODULATION
1L502	052038A	900304-2	REACTOR - H.V. FILTER
1M501	216024	482744-23	METER - 0-4 KV, DC, P.A. PLATE
1M502	211715	482744-4	METER - 0-1 AMP. DC, P.A. PLATE
			RESISTORS
			FIXED, COMPOSITION - UNLESS OTHERWISE SPECIFIED
1R501	019688	99027-39	WIRE WOUND, 6300 OHM, $\pm 10\%$, 25 W
1R502	054626	99031-36	WIRE WOUND, 3150 OHM, $\pm 10\%$, 55 W
1R503	215698	99029-44	WIRE WOUND, 20,000 OHM, $\pm 10\%$, 45 W
1R504	047267	99031-42	WIRE WOUND, 12,000 OHM, $\pm 10\%$, 55 W

LIST OF PARTS (Continued)

Symbol	Stock No.	Drawing No.	Description
1R505	216027	415724-14	VARIABLE, 25 OHM, 150 W
1R506	225354	890015-20	TAPPED, WIRE WOUND, 50,000 OHM $\pm 5\%$, 200 W
1R507	215698	99029-44	WIRE WOUND, 20,000 OHM $\pm 10\%$, 45 W
1R508		99126-207	100,000 OHM, $\pm 5\%$, 2 W
1R509			SAME AS 1R508
1R510			SAME AS 1R508
1R511			SAME AS 1R508
1R512		99126-86	100,000 OHM, $\pm 10\%$, 2 W
1R513			SAME AS 1R512
1T501	215700	486140-1	TRANSFORMER - MODULATION
1T502	223970	8442994-1	TRANSFORMER - PLATE
			MISCELLANEOUS
	217144	8898735-3	BOX - TELEFLEX CONTROL
	095160	888488-3	FILTER - AIR
	209711	426773-9	INSULATOR - STEATITE, 3/4 IN. SQ. X 1.5 IN. LG.
	017269	737820-501	KNOB - CONTROL, FOR 1R505 AND TELEFLEX CONTROL
	216154	8955437-1	MOUNT - SHOCK
			MI-27643-A EXCITER
			CAPACITORS
1C601	039670	727866-165	MICA, 5600 MMF $\pm 10\%$, 500 V
1C602	039652	727866-147	MICA, 1000 MMF $\pm 10\%$, 500 V
1C603	610003	728647-65	MICA, .01 MF $\pm 20\%$, 2500 V
1C604	601002	728647-41	MICA, 1000 MMF $\pm 20\%$, 2500 V
1C605			NOT USED
1C606			NOT USED
1C607	211133	990193-31	PAPER, 15 MF $\pm 10\%$, 1000 V
1C608	018501	990193-8	PAPER, 10 MF $\pm 10\%$, 600 V
1C609	056124	984678-8	PAPER, 1 MF $\pm 10\%$, 600 V
1C610			NOT USED
1C611			NOT USED
1C612	039664	727866-159	MICA, 3300 MMF $\pm 10\%$, 500 V
1F601	014133	990157-8	FUSE - 1 AMP. 250 V
1F602			SAME AS 1F601
1J601	051800	255223-2	CONNECTOR - COAXIAL
1K601	226057	8533702-1	RELAY - PLATE, TIME DELAY
1K602	216988	8412197-3	CONTACTOR - PLATE ON
1K603	215504	754291-3	RELAY - MOD. OVERLOAD
1K604	216181	480070-1	RELAY - TRANS. ON LATCHING
1K605	215504	754291-3	RELAY - L.V. OVERLOAD
1K606	215504	754291-3	RELAY - P.A. OVERLOAD
1L601	209621	429932-502	COIL - BUF. PLATE
1L602	093659	949250-1	REACTOR - L.V. FILTER
1P602	216156	8415018-1	CONNECTOR - FEMALE, 18 CONTACTS
1P603		8949731-1	CONNECTOR - PHONE TIP
			RESISTORS
			FIXED, COMPOSITION - UNLESS OTHERWISE SPECIFIED
1R601		99126-58	470 OHM, $\pm 10\%$, 2 W
1R602	093644	8871557-15	WIRE WOUND, 11.5 OHM, $\pm 1\%$, 1 W
1R603		99126-79	27,000 OHM, $\pm 10\%$, 2 W
1R604	215507	8871557-45	WIRE WOUND, 260 OHM, $\pm 1\%$, 1 W
1R605		99126-20	15,000 OHM, $\pm 20\%$, 2 W
1R606	097134	458574-82	WIRE WOUND, 25,000 OHM, $\pm 5\%$, 10 W
1R607	215509	8871557-47	WIRE WOUND, 51 OHM, $\pm 1\%$, 1 W
1R608	219648	8986541-3	WIRE WOUND, 3.16 OHM, $\pm 1\%$, 2 W
1R609		90496-195	33,000 OHM, $\pm 5\%$, 1 W
1R610			SAME AS 1R609
1R611		90496-50	100 OHM, $\pm 10\%$, 1 W
1R612			SAME AS 1R611
1R613	215511	8871557-48	WIRE WOUND, 132 OHM, $\pm 1\%$, 1 W
1R614		99126-175	4700 OHM, $\pm 5\%$, 2 W

LIST OF PARTS (Continued)

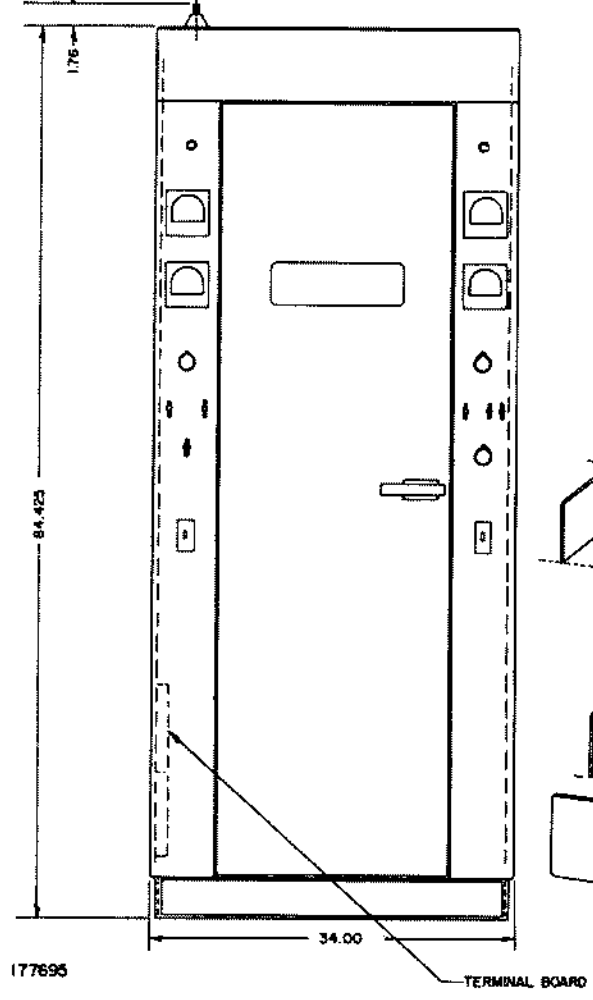
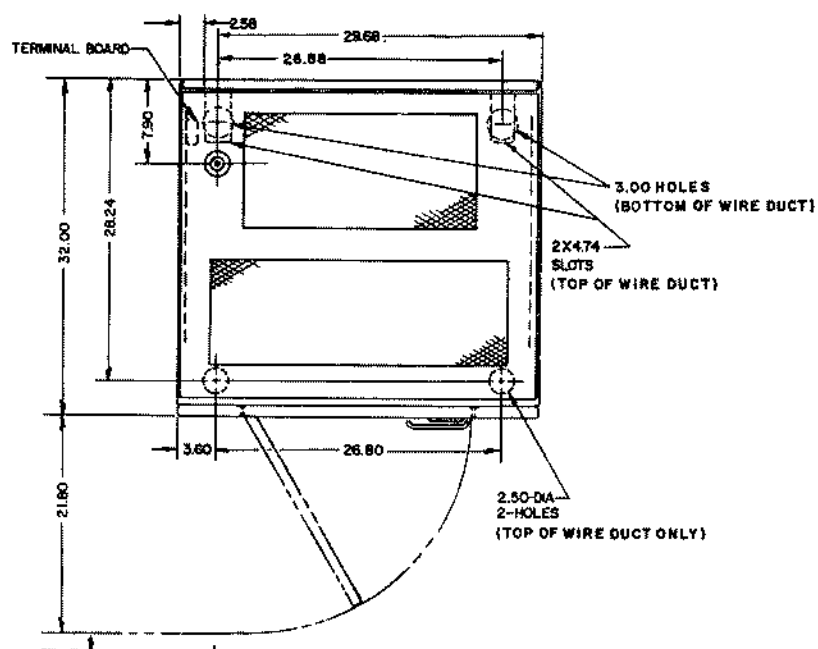
Symbol No.	Stock No.	Drawing No.	Description
SERIES OF FREQUENCY DETERMINING KITS, MI-27691			
535-640 KC 51.5 Ohm Line, MI-27691-1			
1C304, 1C305	96176	990705-251	Capacitor: fixed, mica, 1500 μmf $\pm 5\%$, 10,000 v
1C306 to 1C308	96181	990705-271	Capacitor: fixed, mica, 10,000 μmf $\pm 5\%$, 5000 v
1C324	53389	990704-242	Capacitor: fixed, mica, 620 μmf $\pm 5\%$, 6000 v
535-640 KC 72 Ohm Line, MI-27691-2			
1C304, 1C305	96176	990705-251	Capacitor: fixed, mica, 1500 μmf $\pm 5\%$, 10,000 v
1C306 to 1C308	96181	990705-271	Capacitor: fixed, mica, 10,000 μmf $\pm 5\%$, 5000 v
1C324	53389	990704-242	Capacitor: fixed, mica, 620 μmf $\pm 5\%$, 6000 v
535-640 KC 230 Ohm Line, MI-27691-3			
1C304, 1C305	96176	990705-251	Capacitor: fixed, mica, 1500 μmf $\pm 5\%$, 10,000 v
1C306, 1C307	96181	990705-271	Capacitor: fixed, mica, 10,000 μmf $\pm 5\%$, 5000 v
1C308	217365	990704-261	Capacitor: fixed, mica, 3900 μmf $\pm 5\%$, 6000 v
1C309	217367	990704-250	Capacitor: fixed, mica, 1300 μmf $\pm 5\%$, 6000 v
1C324	53389	990704-242	Capacitor: fixed, mica, 620 μmf $\pm 5\%$, 6000 v
650-770 KC 51.5 Ohm Line, MI-27691-4			
1C304, 1C305	96175	990705-250	Capacitor: fixed, mica, 1300 μmf $\pm 5\%$, 10,000 v
1C306 to 1C308	96180	990705-269	Capacitor: fixed, mica, 8200 μmf $\pm 5\%$, 5000 v
1C324	93928	990704-240	Capacitor: fixed, mica, 510 μmf $\pm 5\%$, 6000 v
650-770 KC 72 Ohm Line, MI-27691-5			
1C304, 1C305	96175	990705-250	Capacitor: fixed, mica, 1300 μmf $\pm 5\%$, 10,000 v
1C306 to 1C308	96180	990705-269	Capacitor: fixed, mica, 8200 μmf $\pm 5\%$, 5000 v
1C324	93928	990704-240	Capacitor: fixed, mica, 510 μmf $\pm 5\%$, 6000 v
650-770 KC 230 Ohm Line, MI-27691-6			
1C304, 1C305	96175	990705-250	Capacitor: fixed, mica, 1300 μmf $\pm 5\%$, 10,000 v
1C306, 1C307	96180	990705-269	Capacitor: fixed, mica, 8200 μmf $\pm 5\%$, 5000 v
1C308	217366	990704-259	Capacitor: fixed, mica, 3300 μmf $\pm 5\%$, 6000 v
1C309	217367	990704-250	Capacitor: fixed, mica, 1300 μmf $\pm 5\%$, 6000 v
1C324	93928	990704-240	Capacitor: fixed, mica, 510 μmf $\pm 5\%$, 6000 v
780-930 KC 51.5 Ohm Line, MI-27691-7			
1C304, 1C305	96174	990705-247	Capacitor: fixed, mica, 1000 μmf $\pm 5\%$, 10,000 v
1C306 to 1C308	96179	990705-266	Capacitor: fixed, mica, 6200 μmf $\pm 5\%$, 5000 v
1C324	93928	990704-240	Capacitor: fixed, mica, 510 μmf $\pm 5\%$, 6000 v
780-930 KC 72 Ohm Line, MI-27691-8			
1C304, 1C305	96174	990705-247	Capacitor: fixed, mica, 1000 μmf $\pm 5\%$, 10,000 v
1C306 to 1C308	96179	990705-266	Capacitor: fixed, mica, 6200 μmf $\pm 5\%$, 5000 v
1C324	93928	990704-240	Capacitor: fixed, mica, 510 μmf $\pm 5\%$, 6000 v
780-930 KC 230 Ohm Line, MI-27691-9			
1C304, 1C305	96174	990705-247	Capacitor: fixed, mica, 1000 μmf $\pm 5\%$, 10,000 v
1C306, 1C307	96179	990705-266	Capacitor: fixed, mica, 6200 μmf $\pm 5\%$, 5000 v
1C308	96178	990705-261	Capacitor: fixed, mica, 3900 μmf $\pm 5\%$, 8000 v
1C324	93928	990704-240	Capacitor: fixed, mica, 510 μmf $\pm 5\%$, 6000 v

LIST OF PARTS (Continued)

Symbol	Stock No.	Drawing No.	Description
1R615	215511	8871557-48	WIRE WOUND, 132 OHM, $\pm 1\%$, 1 W
1R616	219511	458574-80	WIRE WOUND, 20,000 OHM, $\pm 5\%$, 10 W
1R617	053702	458574-90	WIRE WOUND, 56,000 OHM, $\pm 5\%$, 10 W
1T601	093800	949347-1	TRANSFORMER - INPUT
1T602	215512	8412123-1	TRANSFORMER - FILAMENT
1T603			SAME AS 1T602
1XF601	048894	99088-2	HOLDER - FUSE
1XF602			SAME AS 1XF601
1XV601	068590	99391-1	SOCKET - OCTAL
1XV602			NOT USED
1XV603			SAME AS 1XV601
1XV604			SAME AS 1XV601
1Z601			OSCILLATOR - CRYSTAL (MI-27632)
1Z602	222011	8722934-502	RECTIFIER ASSEMBLY - INCLUDES PRINTED BOARD AND
	226058		DIODE IN PLACE
		727834-94	DIODE ONLY
			RESISTOR - FIXED, COMP., 470,000 OHM, $\pm 10\%$, 1/2 W
			MISCELLANEOUS
	042736	99045-4	CLIP - FOR 13/16 IN. DIA. FERRULE
	053325	99045-5	CLIP - FOR 9/16 IN. DIA. FERRULE
	097745	486041-14	INSULATOR - .96 IN. X .14 IN. (THREADED INSERT)
			DOUBLE TURRET
	209664	426773-6	INSULATOR - 1 1/4 IN. X 3/4 IN. STEATITE (SQ. POST)
	210376	426766-9	INSULATOR - 1 IN. X 1/2 IN. STEATITE (CYLINDRICAL)
	211246	426764-53	INSULATOR - .38 IN. X 1/2 IN. STEATITE (BUSHING)
	211247	426764-3	INSULATOR - .62 IN. X 1/2 IN. STEATITE (BUSHING)
	211423	426765-3	INSULATOR - 1/2 IN. X 3/8 IN. STEATITE (CYLINDRICAL)
	217752	426765-21	INSULATOR - 2 IN. X 3/8 IN. STEATITE (CYLINDRICAL)
	215612	8928515-1	KNOB - BRASS, 1 1/4 LG. X 3/8 IN. DIA.
	057692	899617-3	MOUNT - SHOCK
			MI-27649-B
			TRANSMITTER
1C801	018023	990193-24	CAPACITOR - PAPER, 1 MF $\pm 10\%$, 1000 V
1K801	223858	8467689-1	RELAY - LATCHING
1K802	223857	8412197-6	CONTACTOR - 115 V 60 CPS, 30 AMP.
1K803			SAME AS 1K802
1K804	058970	8980567-1	RELAY - 115 V 50/60 CPS D.P.D.T.
1K805	019641	8836923-3	RELAY - 110 V 50/60 CPS D.P.D.T.
1R801	207172	8744934-1	RESISTOR - T PAD, 600 OHM, 10 W
1R802	225355	415457-34	RESISTOR - VARIABLE, 7500 OHM, 25 W
1R803	225356	890014-21	RESISTOR - TAPPED, 25,000 OHM, $\pm 5\%$, 150 W
1R804	225357	737847-62	RESISTOR - VARIABLE, WIRE WOUND, 6 OHM, $\pm 10\%$, 4 W
		755773-501	EQUALIZER ASSEMBLY
C1		990417-124	CAPACITOR - PAPER, 0.068 MF $\pm 10\%$, 200 V
C2		722031-513	CAPACITOR - MICA, 0.01 MF $\pm 5\%$, 300 V
L1	210804	862943-12	CHOKE - 5 MILLIHENRY
L2	210805	8913168-1	CHOKE - 60 MILLIHENRY
R1		722320-57	RESISTOR - FIXED, COMP., 390 OHM, $\pm 10\%$, 1/2 W
R2			SAME AS R1
R3		722320-63	RESISTOR - FIXED, COMP., 1200 OHM, $\pm 10\%$, 1/2 W
R4			SAME AS R3
R5			SAME AS R3
R6			SAME AS R3
R7		722320-65	RESISTOR - FIXED, COMP., 1800 OHM, $\pm 10\%$, 1/2 W

LIST OF PARTS (Continued)

Symbol No.	Stock No.	Drawing No.	Description
940-1110 KC 51.5 Ohm Line, MI-27619-10			
1C304	211956	990705-223	Capacitor: fixed, mica, 100 μf $\pm 5\%$, 10,000 v
1C305	211957	990705-235	Capacitor: fixed, mica, 330 μf $\pm 5\%$, 10,000 v
1C306, 1C307	96179	990705-266	Capacitor: fixed, mica, 6200 μf $\pm 5\%$, 5000 v
1C308, 1C309	217366	990704-259	Capacitor: fixed, mica, 3300 μf $\pm 5\%$, 6000 v
1C324	217368	990704-236	Capacitor: fixed, mica, 360 μf $\pm 5\%$, 6000 v
940-1110 KC 72 Ohm Line, MI-27691-11			
1C304	211956	990705-223	Capacitor: fixed, mica, 100 μf $\pm 5\%$, 10,000 v
1C305	211957	990705-235	Capacitor: fixed, mica, 330 μf $\pm 5\%$, 10,000 v
1C306, 1C307	96179	990705-266	Capacitor: fixed, mica, 6200 μf $\pm 5\%$, 5000 v
1C308	217365	990704-261	Capacitor: fixed, mica, 3900 μf $\pm 5\%$, 6000 v
1C309	217367	990704-250	Capacitor: fixed, mica, 1300 μf $\pm 5\%$, 6000 v
1C324	217368	990704-236	Capacitor: fixed, mica, 360 μf $\pm 5\%$, 6000 v
940-1110 KC 230 Ohm Line, MI-27691-12			
1C304	211956	990705-223	Capacitor: fixed, mica, 100 μf $\pm 5\%$, 10,000 v
1C305	211957	990705-235	Capacitor: fixed, mica, 330 μf $\pm 5\%$, 10,000 v
1C306, 1C307	96179	990705-266	Capacitor: fixed, mica, 6200 μf $\pm 5\%$, 5000 v
1C308, 1C309	217367	990704-250	Capacitor: fixed, mica, 1300 μf $\pm 5\%$, 6000 v
1C324	217368	990704-236	Capacitor: fixed, mica, 360 μf $\pm 5\%$, 6000 v
1120-1330 KC 51.5 Ohm Line, MI-27691-13			
1C304, 1C305	96173	990705-242	Capacitor: fixed, mica, 620 μf $\pm 5\%$, 10,000 v
1C306	96174	990705-247	Capacitor: fixed, mica, 1000 μf $\pm 5\%$, 10,000 v
1C307	96175	990705-250	Capacitor: fixed, mica, 1300 μf $\pm 5\%$, 10,000 v
1C308, 1C309	217364	990704-271	Capacitor: fixed, mica, 10,000 μf $\pm 5\%$, 4000 v
1C324	217368	990704-236	Capacitor: fixed, mica, 360 μf $\pm 5\%$, 6000 v
1120-1330 KC 72 Ohm Line, MI-27691-14			
1C304, 1C305	96173	990705-242	Capacitor: fixed, mica, 620 μf $\pm 5\%$, 10,000 v
1C306	96174	990705-247	Capacitor: fixed, mica, 1000 μf $\pm 5\%$, 10,000 v
1C307	96175	990705-250	Capacitor: fixed, mica, 1300 μf $\pm 5\%$, 10,000 v
1C308	217365	990704-261	Capacitor: fixed, mica, 3900 μf $\pm 5\%$, 6000 v
1C324	217368	990704-236	Capacitor: fixed, mica, 360 μf $\pm 5\%$, 6000 v
1120-1330 KC 230 Ohm Line, MI-27691-15			
1C304, 1C305	96173	990705-242	Capacitor: fixed, mica, 620 μf $\pm 5\%$, 10,000 v
1C306	96174	990705-247	Capacitor: fixed, mica, 1000 μf $\pm 5\%$, 10,000 v
1C307	96175	990705-250	Capacitor: fixed, mica, 1300 μf $\pm 5\%$, 10,000 v
1C308, 1C309	217367	990704-250	Capacitor: fixed, mica, 1300 μf $\pm 5\%$, 6000 v
1C324	217368	990704-236	Capacitor: fixed, mica, 360 μf $\pm 5\%$, 6000 v
1340-1620 KC 51.5 Ohm Line, MI-27691-16			
1C304, 1C305	96173	990705-242	Capacitor: fixed, mica, 620 μf $\pm 5\%$, 10,000 v
1C306, 1C307	96174	990705-247	Capacitor: fixed, mica, 1000 μf $\pm 5\%$, 10,000 v
1C308	96178	990705-261	Capacitor: fixed, mica, 3900 μf $\pm 5\%$, 8000 v
1C324	217368	990704-236	Capacitor: fixed, mica, 360 μf $\pm 5\%$, 6000 v
1340-1620 KC 72 Ohm Line, MI-27691-17			
1C304, 1C305	96173	990705-242	Capacitor: fixed, mica, 620 μf $\pm 5\%$, 10,000 v
1C306, 1C307	96174	990705-247	Capacitor: fixed, mica, 1000 μf $\pm 5\%$, 10,000 v
1C308	96178	990705-261	Capacitor: fixed, mica, 3900 μf $\pm 5\%$, 8000 v
1C324	217368	990704-236	Capacitor: fixed, mica, 360 μf $\pm 5\%$, 6000 v
1340-1620 KC 230 Ohm Line, MI-27691-18			
1C304, 1C305	96173	990705-242	Capacitor: fixed, mica, 620 μf $\pm 5\%$, 10,000 v
1C306 to 1C309	96174	990705-247	Capacitor: fixed, mica, 1000 μf $\pm 5\%$, 10,000 v
1C324	217368	990704-236	Capacitor: fixed, mica, 360 μf $\pm 5\%$, 6000 v



TRANSMITTER WIRE DUCT DETAILS

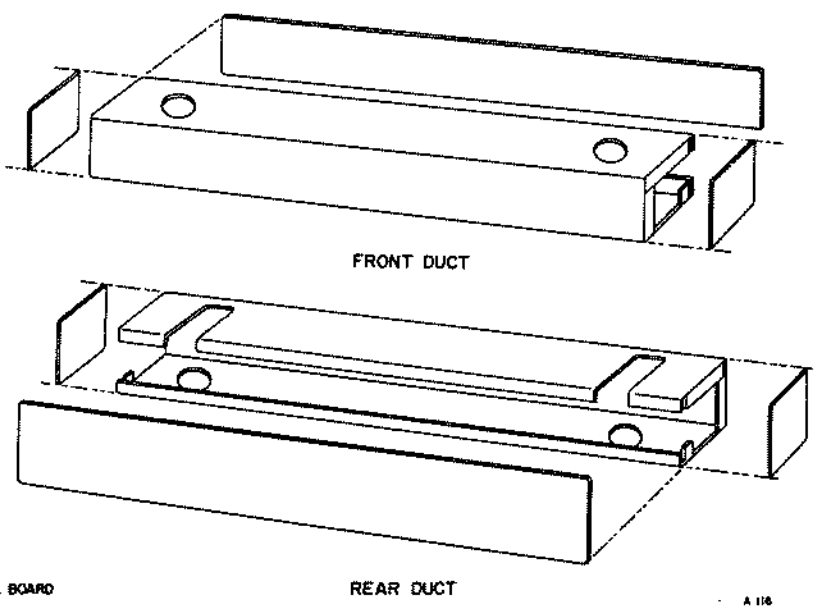


Figure 11. BTA-1R1, Outline Drawing

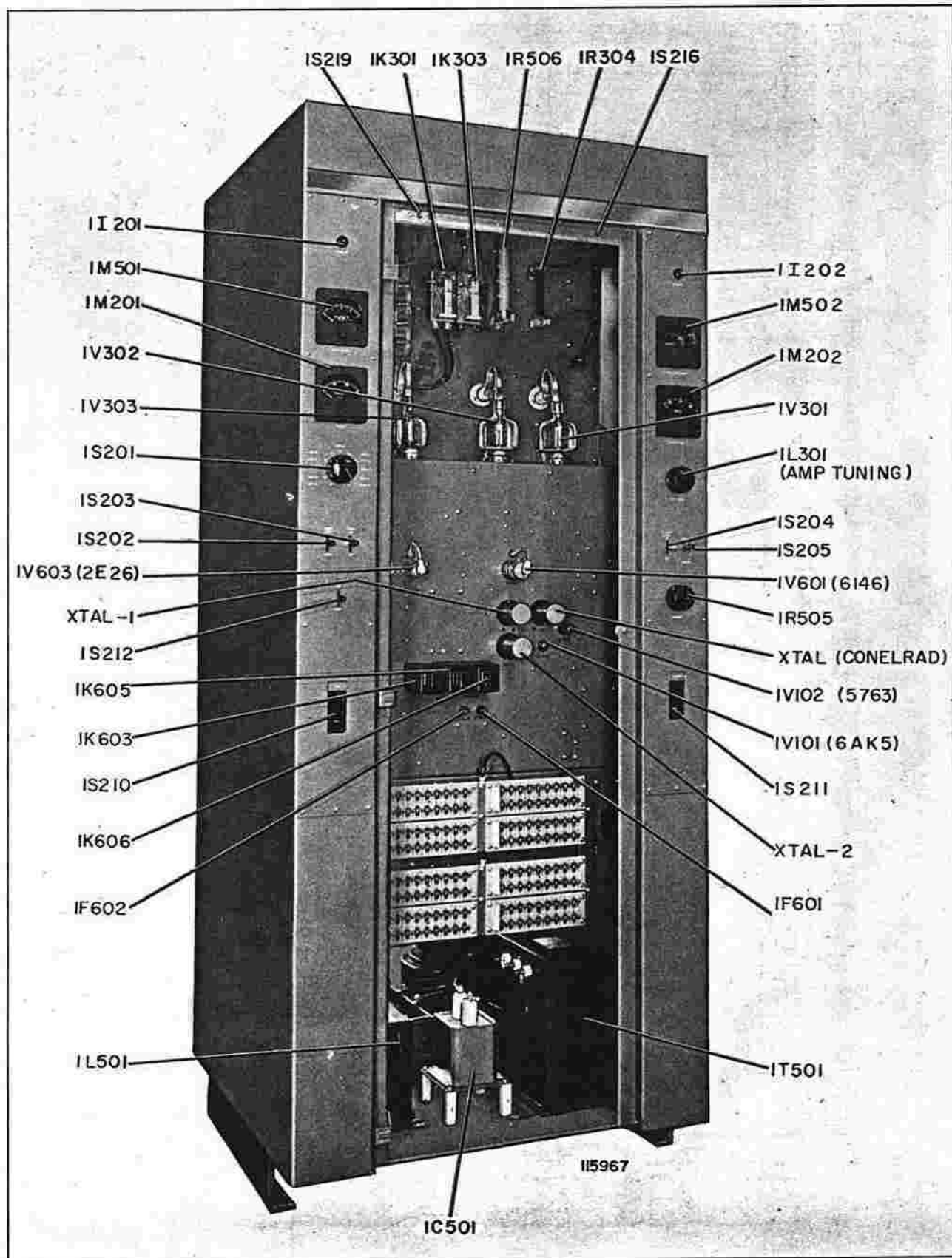
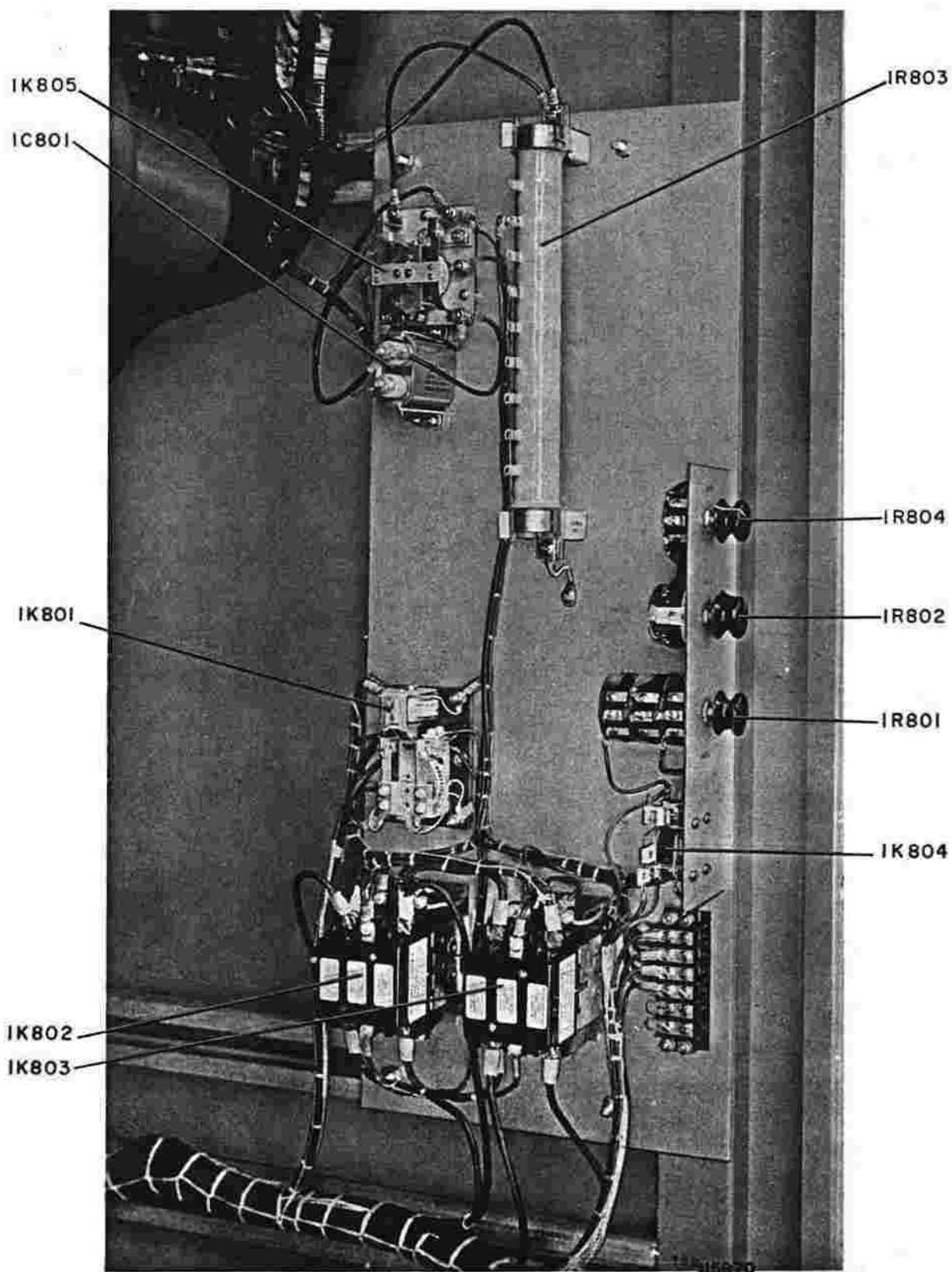


Figure 12. BTA-1R1, Front View, Door Removed



**Figure 13. BTA-1R1, Rear View, Power Cutback
Components Chassis**

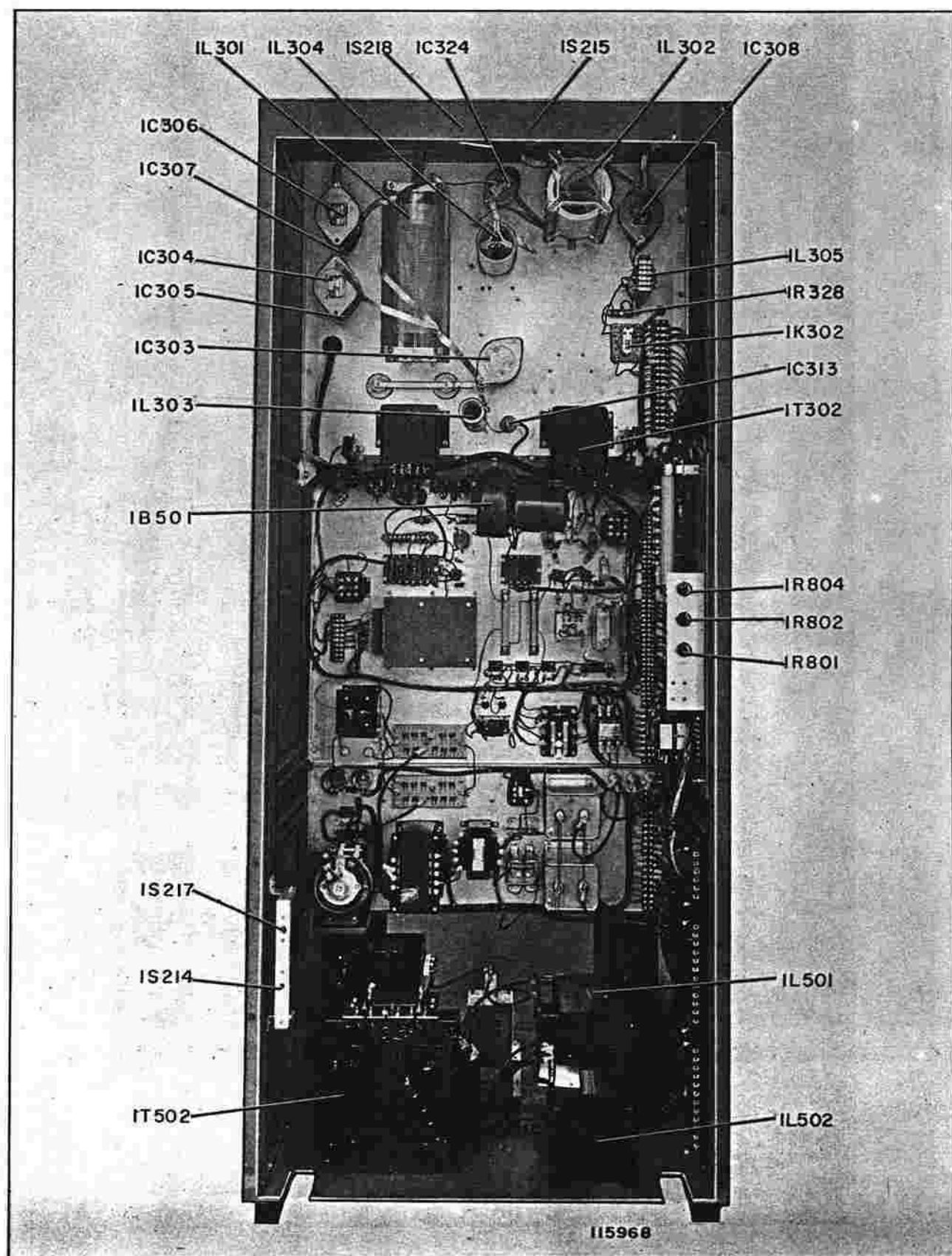


Figure 14. BTA-1R1, Rear View, Panels Removed

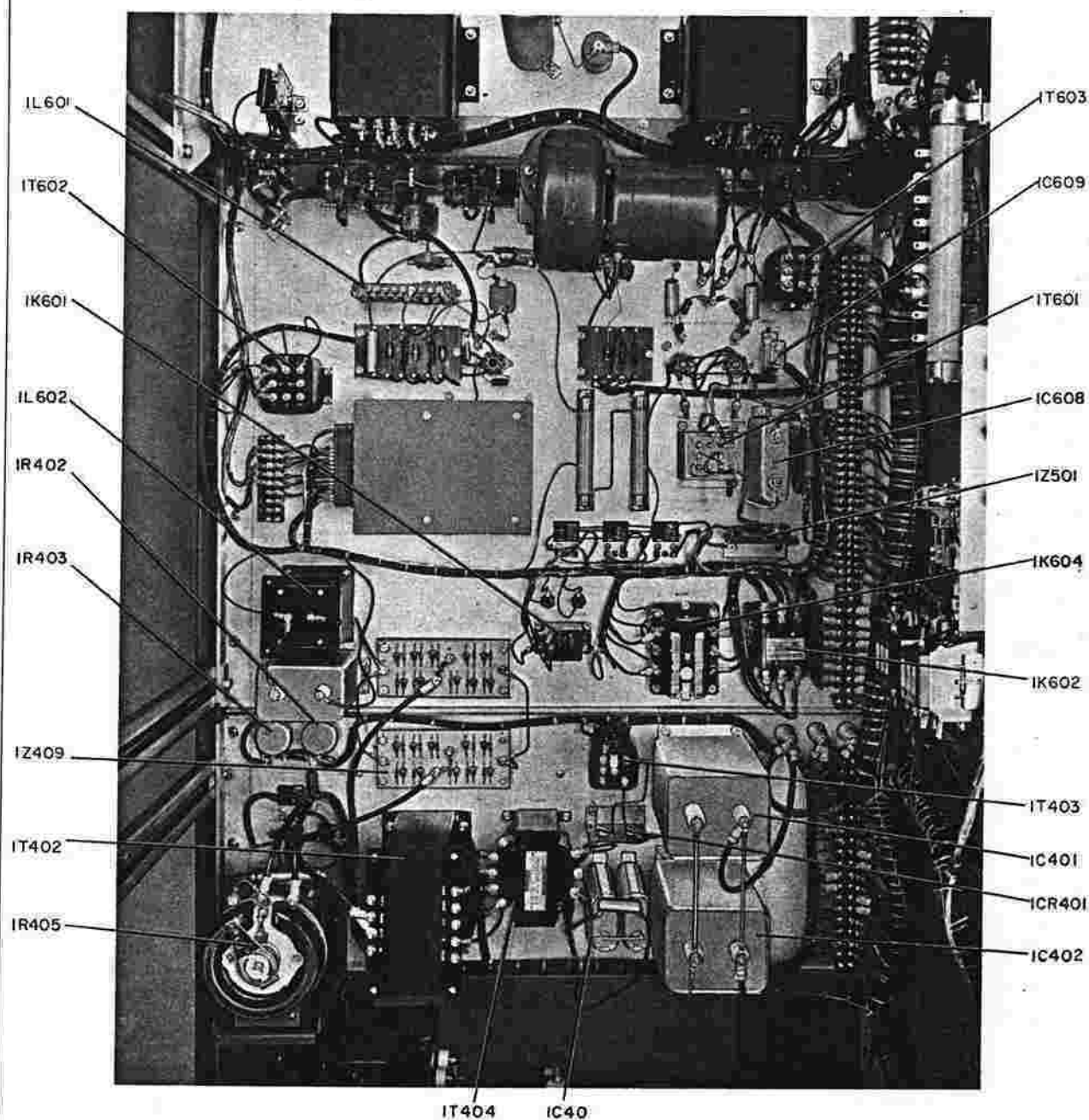
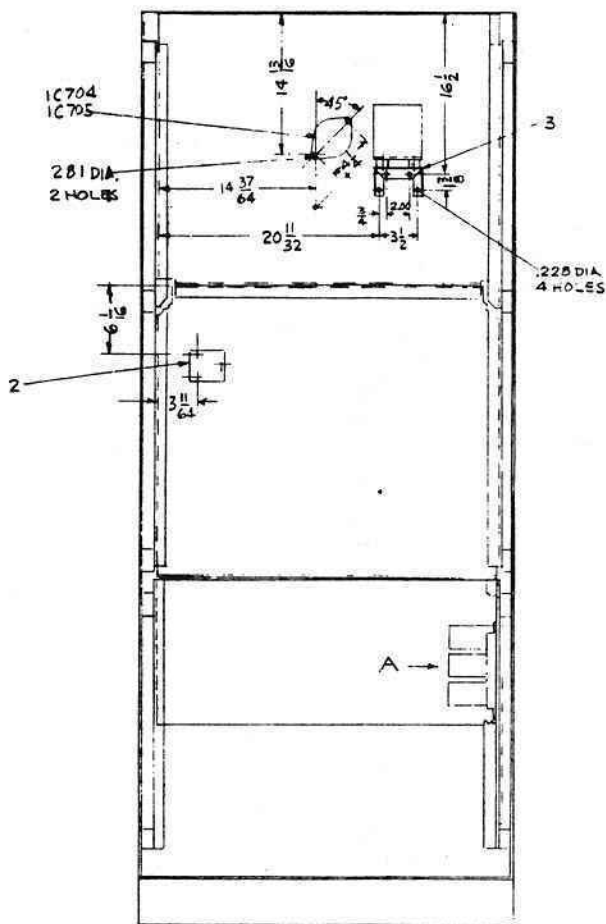
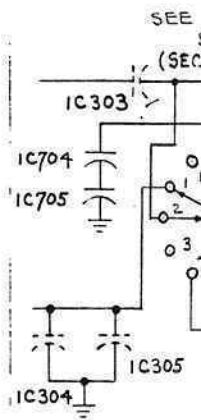
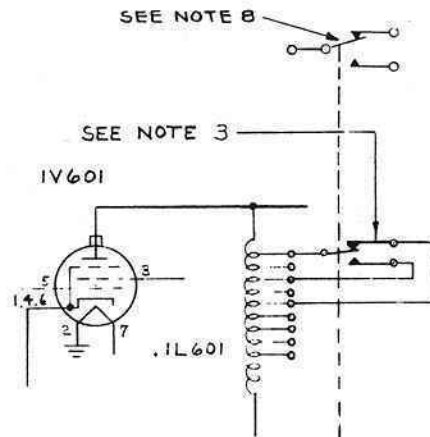
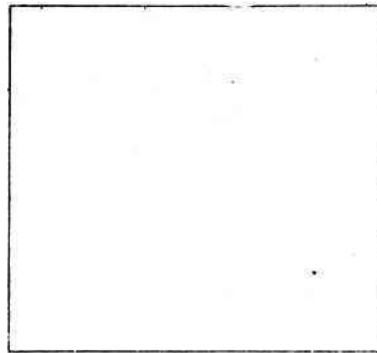
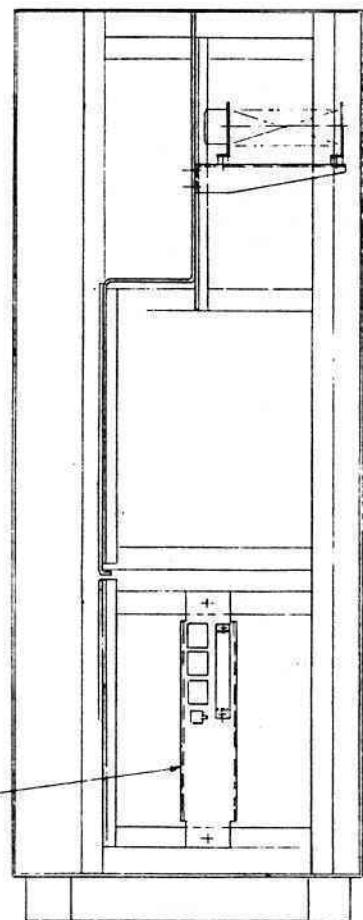


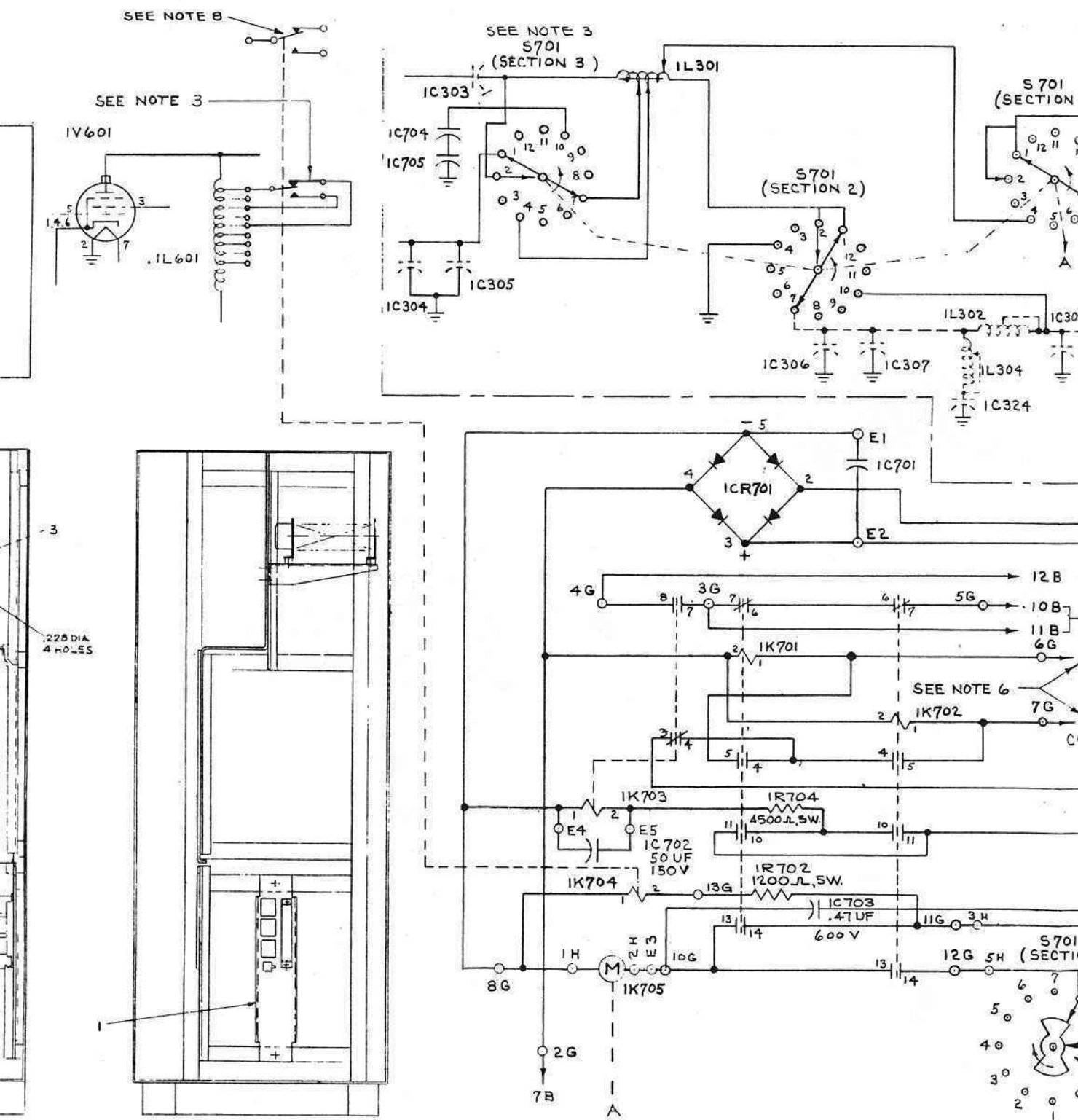
Figure 15. BTA-1R1, Rear View, Exciter and Rectifier Chassis

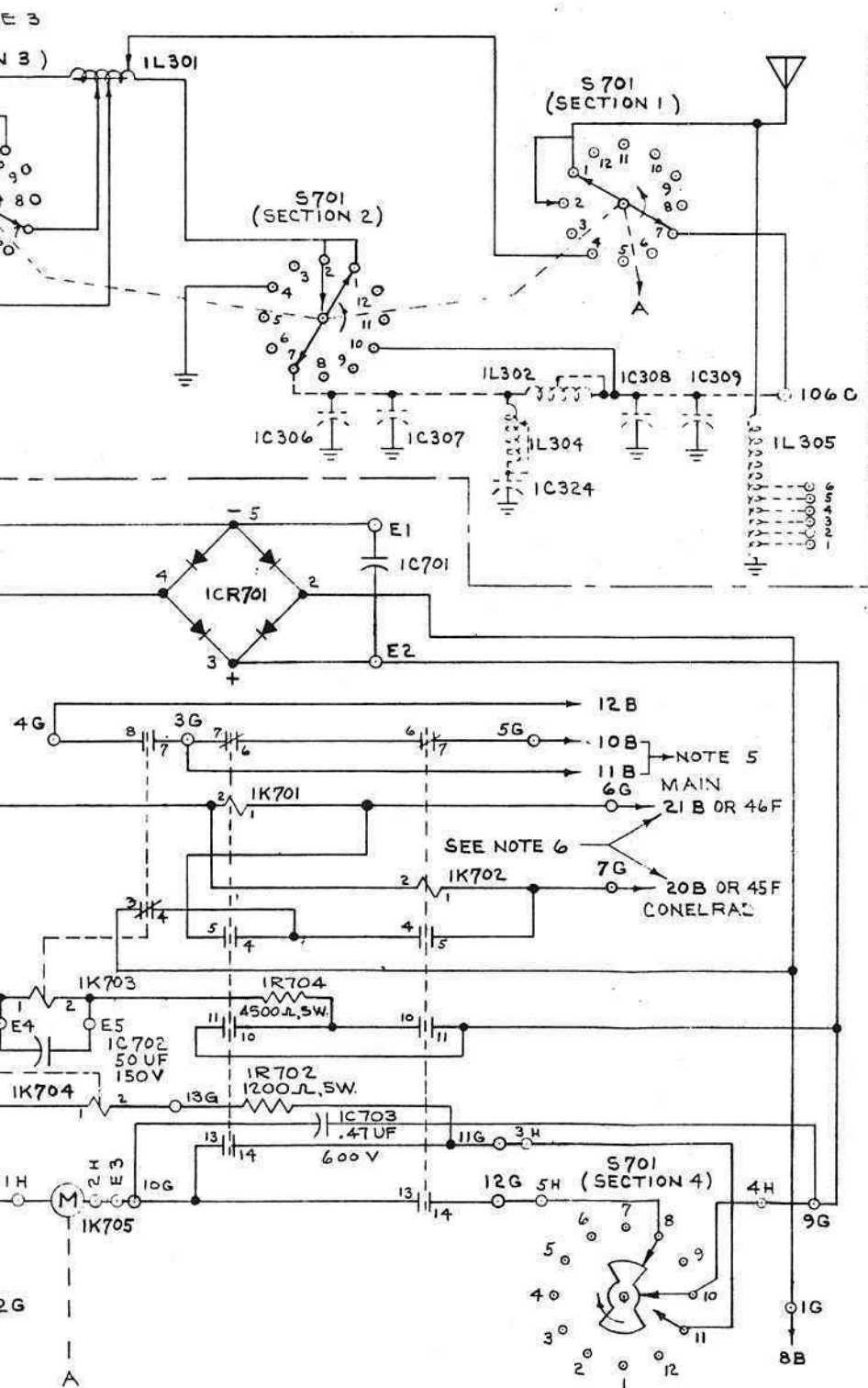


REAR VIEW (COVER REMOVED)



VIEW IN DIRECTION ARROW "A"





SCHEMATIC

NOTES

- 1:- ALL 300 SERIES COMPONENTS ARE LOCATED IN TRANSMITTER, 700 SERIES ARE SUPPLIED WITH KIT.
- 2:- IF CAPACITORS C704 AND C705 ARE NOT SUPPLIED, NO CONNECTIONS ARE REQUIRED TO S701- SEC 4, TERMS 10 AND 1.
- 3:- FOR CONNECTIONS OF PA PLATE TANK AT VARIOUS FREQUENCY COMBINATIONS SEE CHART IN INSTALLATION INFORMATION 8959063.
- 4:- ALL SWITCH SECTIONS SHOWN IN MAIN FREQUENCY POSITION.
- 5:- REMOVE JUMPER WIRE BETWEEN TRANSMITTER TERMINALS 10B AND 11B BEFORE WIRING TO TERMINALS 5G AND 3G ON CONTROL UNIT.
- 6:- REFER TO INSTALLATION INFORMATION SUPPLIED AS DRAWING N° 8959063.
- 7:- NUMBERS & SYMBOLS REFER TO MI- 34309-5
- 8:- AVAILABLE AMPERE CONTACTS TO CONTROL.

Figure 16. Conelrad Kit, Schematic Diagram (648254-2)

