SUGGESTIONS FOR THE REDUCTION OF HIGH VOLTAGE SOLID-STATE RECTIFIER FAILURES

The majority of transmitter high voltage rectifier failures can be traced to transients that occur on the input power line. Line transients are short bursts of energy, generally with steep wavefronts, that occur on the power line when heavy loads are switched on and off along the line. While transients of this nature cannot be eliminated, steps can be taken to reduce their amplitude and minimize their destructive effects. These transients are generally more severe on a long and highly reactive line. To reduce the problem, the Power Company can add power factor correcting capacitors. These capacitors not only correct power factor, but also provide snubbers to integrate the short transient pulses.

In the interest of economy, some power companies are feeding radio and television stations with an open delta circuit. The open delta circuit requires only two distribution transformers for three-phase service while other types of distribution systems require three transformers. This type of service may be fine for customers with electro-mechanical machinery; however, it leaves much to be desired for transmitter use as the phase-to-phase regulation is extremely poor and is subject to high transient voltages as the interphase reactance is not balanced. In the past, use of open delta has been restricted to emergency service; (i.e., restoration of three-phase power after failure of a transformer section), but today its use is common practice by some Power Companies.

A broadcast transmitter offers a very desirable constant power load and for this reason most Power Companies will cooperate with a broadcast station to improve their service. If a station is experiencing solid-state rectifier failures, it is suggested that their power distribution system be reviewed with the power company in an effort to minimize transient voltages and improve interphase regulation.

Another source of voltage that has been known to damage solid-state rectifiers is in the form of starting transients. These transients occur when power is applied to the plate transformer of a transmitter and the resultant inrush current is not limited by sufficient line resistance or reactance.

In most transmitter installations, the power line length is usually sufficient to provide the necessary resistance to limit this current. At times, transmitter installations are adjacent to power substations and, in such cases, it is necessary to use reactors in series with the primary of the plate transformer to provide the necessary instantaneous current limiting.

RCA transmitters of 5 kW or more have these reactors provided. It is good practice to leave these reactors in the circuit unless excessive carrier shift is experienced in an AM transmitter or poor output regulation is experienced in a TV transmitter when the video signal switches from black to white. In FM service where constant current operation is normal, the reactors should be in the circuit at all times. The new "E" line FM transmitters have sufficient leakage reactance designed in the transformer to provide this current limiting and, therefore, the use of line reactors is unnecessary.

A routine program of tightening hardware particularly electrical connections to and from the rectifier is mandatory as heat is a major factor in the destruction of silicon properties. All rectifier cells should be periodically tested in the manner prescribed by the transmitter instruction book. A new test procedure for the black RCA CR-300 series stacks will give more consistent results than the use of a low voltage volt ohm meter as the testing device. A copy of this procedure is attached.

Lightning is another damaging hazard to solid-state rectifiers. Protection can best be made on the high side of the power distribution system at a point before entrance to the transmitter building. Again, the local Power Company can provide arresters to offer this protection, as much improvement has been made in these devices in recent years.

Emphasis cannot be placed too strongly on the use of a well-designed ground system. Heavy transients can develop in an inadequate ground system under fault or lightning conditions. To minimize the fault transients, all major equipment should be well bonded and a heavy ground buss should be returned to one common point to serve as the station ground.

The above suggestions, while intended to reduce solid-state rectifier failures, are good engineering practices to follow in order to obtain the maximum reliability and performance of any transmitting equipment regardless of the type of rectifiers employed.

Original Issue Date

RCA NEW LOOK

Memo for your maintenance file

TECHNICAL BULLETIN

MAINTENANCE AND MODIFICATION NOTES ON RCA BROADCAST EQUIPMENT

BROADCAST AND COMMUNICATIONS PRODUCTS DIVISION

November 10, 1966

TB-83-8 BTF-10D/20D

Issued by W. A. Culpepper/H. W. Wessenberg

SUGGESTIONS FOR ASSURING MAXIMUM HIGH VOLTAGE SOLID STATE RECTIFIER RELIABILITY

The attached information is sent to you in the interest of helping you to insure that conditions outside your transmitter are conducive to maximum silicon rectifier reliability.

/mc

Attachment

NOTES: DRESS CABLE ALONG PRESENT CABLE HARNESS TO RUN FROM IPA TO PA CABINET. CONNECT BRAID OF CABLE TO GROUND. USE UPPER-MOST TERMINAL TOWARD FRONT OF TRANSMITTER OF TERMINAL BOARD TB1. CONNECT CENTER CONDUCTOR TO TERMINAL 5 (THE LOWER ONE OF THE TWO UNUSED TERMINALS) OF SWITCH 2S13. CONNECT TERMINAL 11 to TERMINAL 9. SEE FIG. 2.

INSTALL NEW CAPACITOR (SEE FIG. 3)

USE COUPLER AS FOLLOWS:

INSERT AS MARKED (CONNECTOR MARKED LOAD TO PA, CONNECTOR MARKED TRANSMITTER TO IPA), SWITCH 2S13 TO EXTREME RIGHT POS. AND ADJUST VSWR ADJ. FOR 100 TO BE READ ON 2M3. THEN TURN COUPLER AROUND (CONNECTOR MARKED LOAD TO IPA, CONNECTOR MARKED TRANSMITTER TO PA) AND READ VSWR. TUNE 2C3 AND 2L8 TO REDUCE VSWR TO LOW VALUE (1.5 OR LESS). MAINTAIN GRID DRIVE LEVEL AT REQUIRED VALUE. RETUNE 1L2 IF NECESSARY. TURN COUPLER AROUND TO RECHECK FORWARD POWER. UNDER REGULAR OPERATION LEAVE COUPLER IN THE REVERSE POSITION AND MONITOR VSWR.

RADIO CORPORATION OF AMERICA

DIMENSIONS ARE IN INCHES AND INCLUDE THICKNESS OF PLATING. DO NOT SCALE DRAWING. ALL EXTERNAL THREADS TO BE CLASS 2A BEFORE PLATING AND CLASS 3 AFTER PLATING; ALL INTERNAL THREADS TO BE CLASS 2B, UNLESS OTHERWISE SPECIFIED

PRELIM

INSTALLATION INFORMATION

SIZE A 8523336 SHEET 3

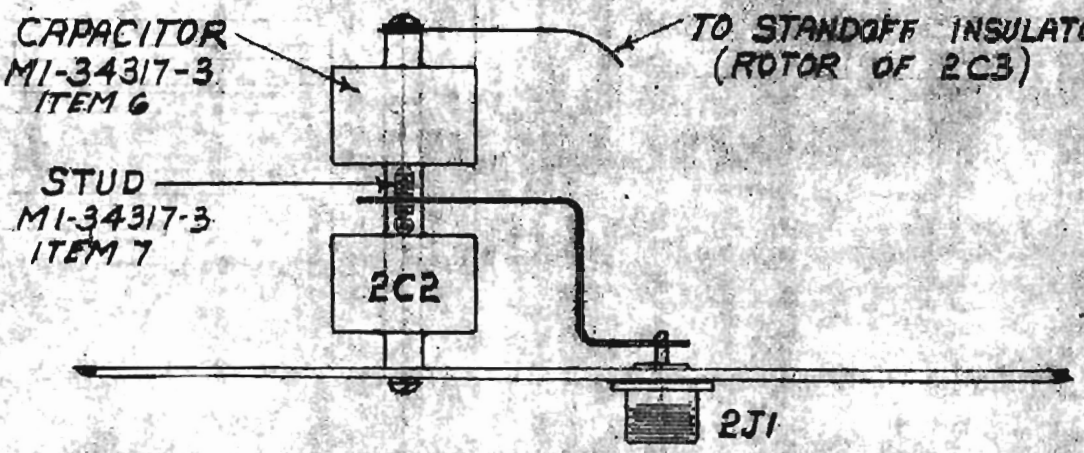
8523336

REVISIONS	
BY	
DATE	

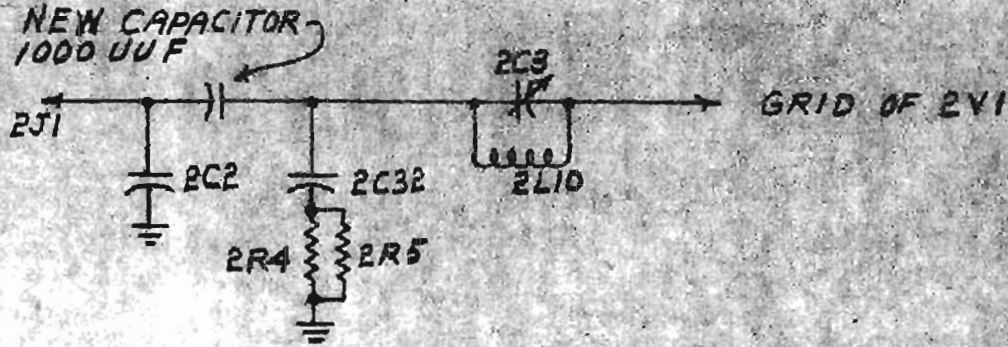
DIMENSIONS ARE IN INCHES, AND INCLUDE THICKNESS OF PLATING. DO NOT SCALE DRAWING. ALL EXTERNAL THREADS TO BE CLASS 2A BEFORE PLATING AND CLASS 1 AFTER PLATING; ALL INTERNAL THREADS TO BE CLASS 2B, UNLESS OTHERWISE SPECIFIED.

8523336

INSTALLATION OF CAPACITOR (PART OF 2V1 GRID CIRCUIT)



SCHEMATIC



Prot

FIG.-3

VARIATIONS ON FINISHED DIMENSIONS UNLESS OTHERWISE MARKED

BASIC DIMENSIONS	2 PLACE DECIMALS	3 PLACE DECIMALS
UP TO 6	±.02	±.005
ABOVE 6 TO 24	±.03	±.010
ABOVE 24	±.06	±.015

ANGULAR DIMENSIONS ±½°

SEE PURCH. SPEC. FOR STOCK TOLERANCE

INSTALLATION INFORMATION

FIRST MADE FOR MI-34317-3 USED ON

DRAWN BY C. Smith 9/11/1961

DESIGNED BY

CHECKED BY

COMMODITY CODE

A SIZE 8523336

CODE IDENT NO. 49371

PF
CM

REVISIONS	
BY R. H. Bor	O
DATE	
SHEET #2 ADDED, SH #3 WAS SH #2. INSTALL NEW CAPACITOR (SEE FIG 3.) ADDED TO NOTES SH #3. R. H. Bor	
APR 21, 1961	1

PRELIM

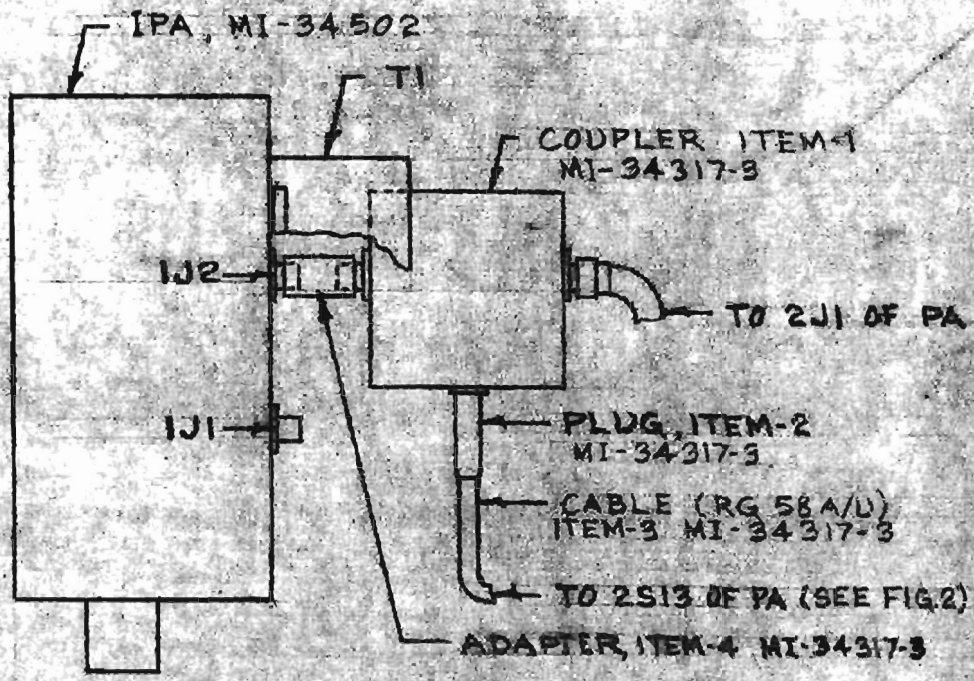


FIG. 1

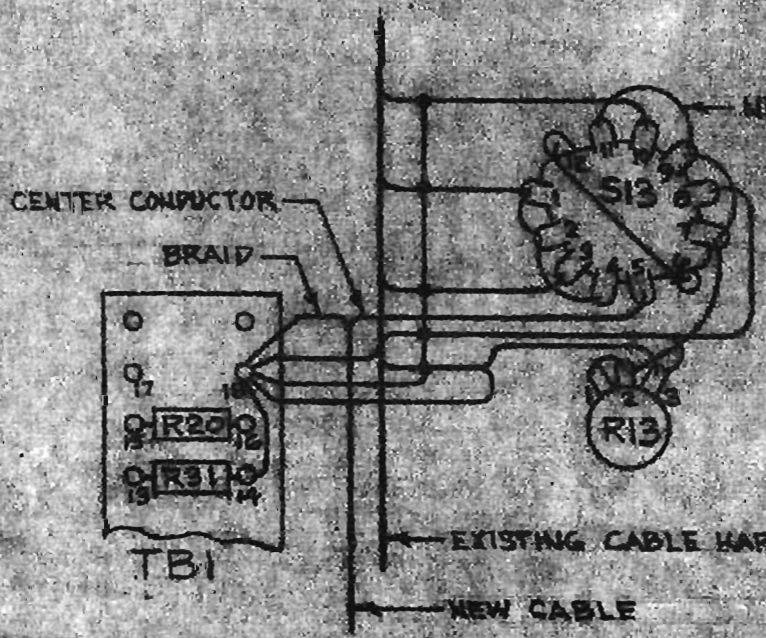


FIG. 2

DIMENSIONS ARE IN INCHES, AND INCLUDE THICKNESS OF PLATING. DO NOT SCALE DRAWING. ALL EXTERNAL THREADS TO BE CLASS 2A BEFORE PLATING AND CLASS 2 AFTER PLATING. ALL INTERNAL THREADS TO BE CLASS 2B, UNLESS OTHERWISE SPECIFIED.

RADIO CORPORATION OF AMERICA

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VARIATIONS ON FINISHED DIMENSIONS UNLESS OTHERWISE NOTED		
BASIC DIMENSIONS	2 PLACE DECIMALS	3 PLACE DECIMALS
UP TO 4"	±.02	±.005
ABOVE 4" TO 24"	±.05	±.010
ABOVE 24"	±.10	±.015
ANGULAR DIMENSIONS ±½°		

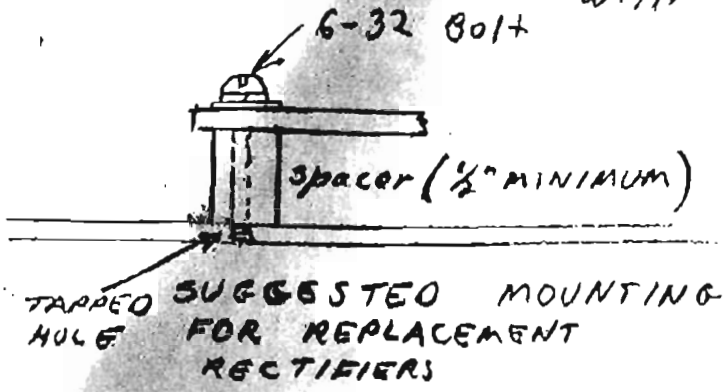
INSTALLATION INFORMATION
FIRST MADE FOR MI-34317-3 USED ON
DRAWN BY L. Caulfield DATE March 31, 1961
DESIGNED BY
CHECKED BY — DATE March 31, 1961
COMMODITY CODE

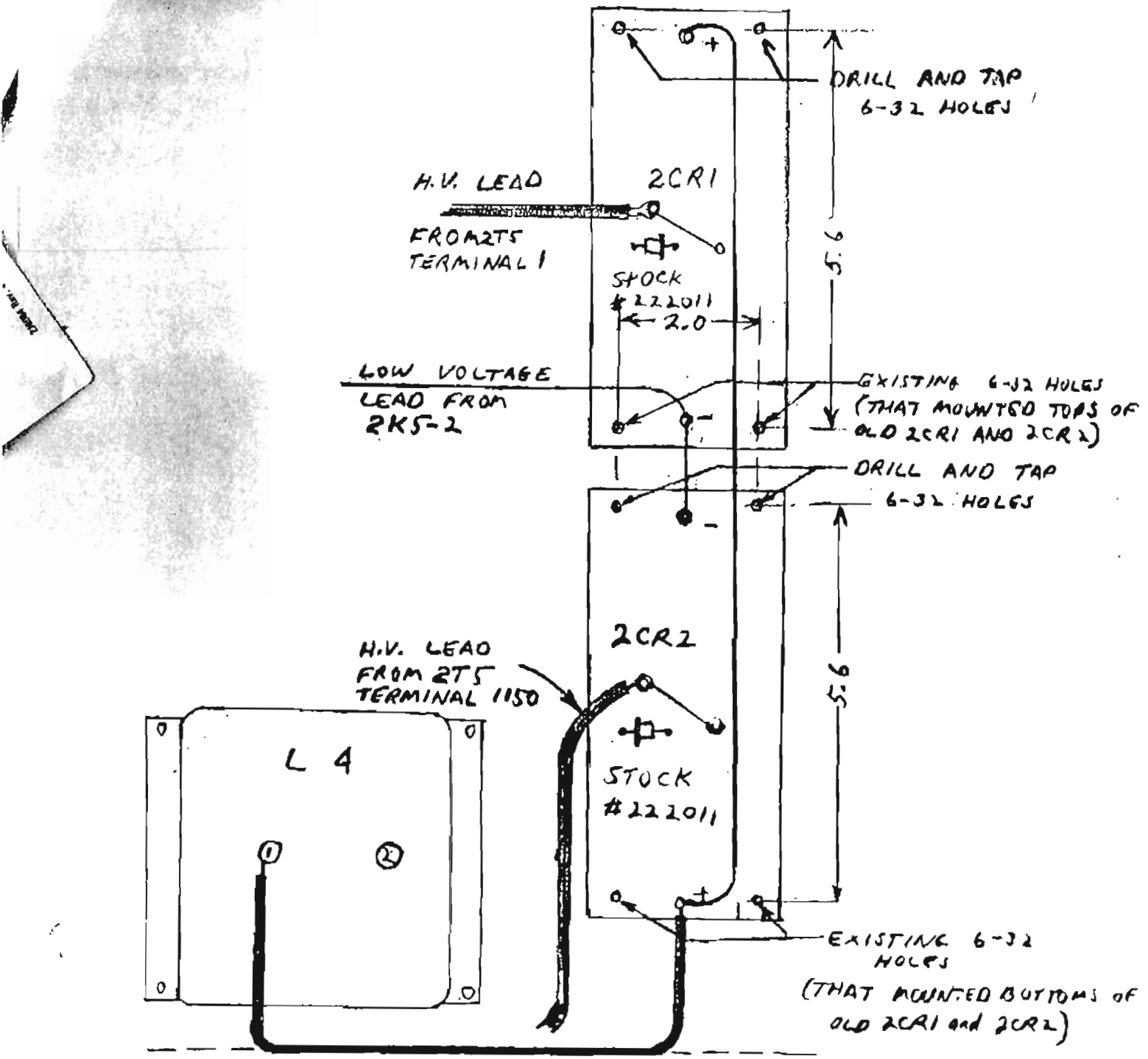
A 8523336
SIZE CODE IDENT NO. 28971 SHEET 1 OF 2

PF
CN

8523336

REPLACEMENT OF 2CR1-2CR2 IN BTF 5B, 5D, 10C, 10D, 20C and 20D WITH STOCK # 222011 RECTIFIERS





Memo for your maintenance file

TECHNICAL BULLETIN

MAINTENANCE AND MODIFICATION NOTES ON RCA BROADCAST EQUIPMENT

INDUSTRIAL ELECTRONIC PRODUCTS · BROADCAST AND TELEVISION EQUIPMENT DIVISION

TB-72-7 BTF-5B FM Transmitter
TB-84-2 BTF-5D FM Transmitter
TB-82-5 BTF-10C/20C FM Transmitters
TB-83-2 BTF-10D/20D FM Transmitters

March 30, 1962

Issued by W. D. Wenger

FM Transmitters
IPA Output and PA Input Capacitors

The subject RCA FM transmitters use a 100 mmfd variable capacitor for the IPA plate output tuning and the grid input tuning of the 4CX5000 stage.

Because of instances where arc-over of these capacitors have occurred at intervals, we are furnishing two kits to be used as replacement for the capacitors designated 1C13 and 203. The kits are numbered MI-34317-9 and MI-34317-10, respectively.

The wider spaced variable capacitors are shunted with a fixed ceramic unit and the current through the variable portion is thus reduced. This will prevent heating and distortion of the variable capacitor plates.

In installing the kits, the lead lengths should not be increased and the assembly should be readily replaceable in the space occupied by the original 100 mmfd units.

Previous dial readings will, of course, not be applicable.

Lowest VSWR should be maintained between the IPA and PA stage.

Memo for your maintenance file

TECHNICAL BULLETIN

MAINTENANCE AND MODIFICATION NOTES ON RCA BROADCAST EQUIPMENT

INDUSTRIAL ELECTRONIC PRODUCTS - BROADCAST AND TELEVISION EQUIPMENT DIVISION

TB-84-3 BTF-5D FM Transmitter
TB-83-3 BTF-10D/20D FM Transmitters

June 4, 1962

Issued by Wiley D. Wenger

Primary Surge Reactors

The high voltage plate transformer cubicle furnished with the above transmitters includes three primary reactors.

Inside the cover, a terminal board schematic diagram indicates that these reactors may be shorted out with a removable link between binding posts.

Some transmitters were shipped with the terminal links in place, so as to short out the reactors.

To obtain the greatest degree of protection to the silicon rectifiers and other components, the links should be removed so that the reactors are in the circuit. When this is done, the d-c plate voltage will be slightly lower than previously by a hundred volts or so. Transmitter power input should be readjusted slightly to compensate for this change.

Before opening the top of the transformer cubicle, be sure all primary power is removed by the building master primary power switch so that power cannot be accidentally applied until the change is completed and the cover replaced.

RADIO CORPORATION OF AMERICA • CAMDEN, NEW JERSEY

Memo for your maintenance file

TECHNICAL BULLETIN

MAINTENANCE AND MODIFICATION NOTES ON RCA BROADCAST EQUIPMENT

INDUSTRIAL ELECTRONIC PRODUCTS · BROADCAST AND TELEVISION EQUIPMENT DIVISION

TB-84-7 BTF-5D Transmitter
TB-83-7 BTF-10D/20D Transmitter

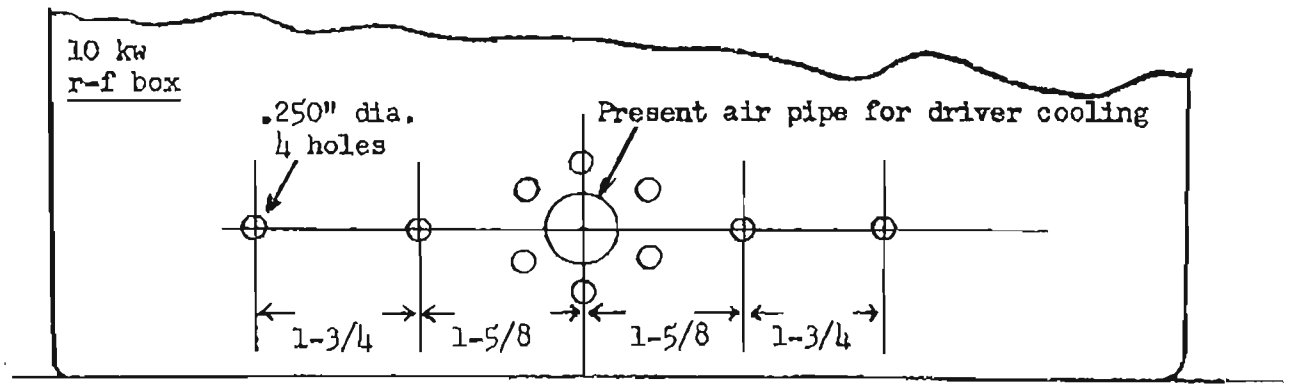
February 1, 1963

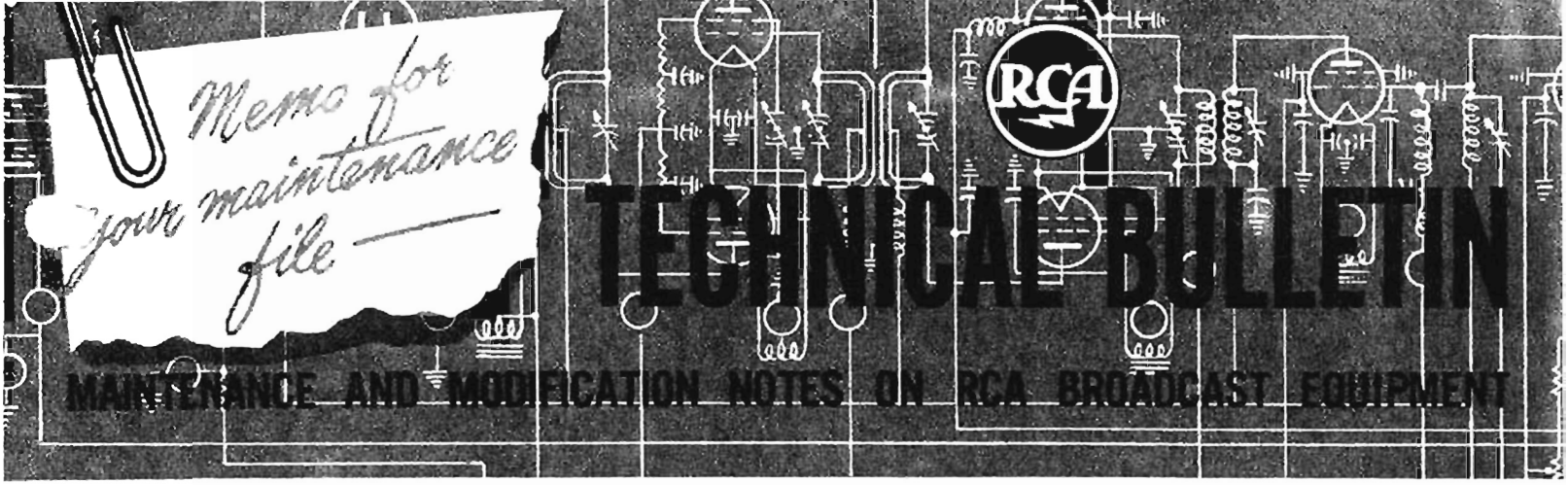
Issued by W. D. Wenger / W. B. Fletcher

Silicon Rectifier Cooling

In order to provide better cooling for the high voltage rectifiers 2CR3, 2CR4, and 2CR8 through 2CR17, it is recommended that air be blown on them from the bottom of the r-f amplifier box. Drill four .250" diameter holes on the same horizontal center line as the air pipe that provides cooling for the driver cabinet. The sketch shown below gives the exact location of the holes.

Note: These holes may be more easily drilled from the inside of the r-f box.





INDUSTRIAL ELECTRONIC PRODUCTS · BROADCAST AND TELEVISION EQUIPMENT DIVISION

TB-72-5 (BTF-5B)
TB-84-1 (BTF-5D)
TB-82-4 (BTF-10C/20C)
TB-83-1 (BTF-10D/20D)

May 18, 1961

Issued by A. H. Bott and I. H. Lubash

Improved Transmitter Performance and Reliability

I. The following three kits are being supplied to all BTF-5B, BTF-5D, BTF-10C, BTF-10D, BTF-20C, and BTF-20D FM Transmitters to improve transmitter performance and reliability.

(a) MI-34317-2. "Spark Gap". This is a device designed to conduct only when a voltage above a certain level is placed across it. When the voltage is reduced below a certain level, the "spark gap" will again appear as an open circuit. The "spark gap" is designed to protect transmitter components from high voltage surges caused by gas pings in 4CX5000A tubes. The "spark gap" is placed, electrically, from the screen of the 4CX5000A to ground.

In all high power tubes it is possible for gas pings to occur. When this happens, the grid of the tube is effectively at anode potential. When the voltage on the screen goes above 1500 volts, the "spark gap" will conduct and the high voltage will be shorted to ground. As a result, components in the grid circuits are protected from high voltage circuits.

One each of MI-34317-2 will be supplied for each PA in the transmitters listed above, except two each for the BTF-20C and BTF-20D.

Memo for your maintenance file

TECHNICAL BULLETIN

MAINTENANCE AND MODIFICATION NOTES ON RCA BROADCAST EQUIPMENT

INDUSTRIAL ELECTRONIC PRODUCTS · BROADCAST AND TELEVISION EQUIPMENT DIVISION

TB-72-9 BTF-5B FM Transmitter
TB-84-5 BTF-5D FM Transmitter
TB-82-7 BTF-10C/20C FM Transmitters
TB-83-5 BTF-10D/20D FM Transmitters

October 10, 1962

Issued by W. D. Wenger/W. B. Fletcher

Installation Information
Replacing 2CR1 and 2CR2 With Printed Circuit Rectifiers
Stock No. 222011

Improved printed circuit type rectifiers, RCA Stock No. 222011, are being shipped by Replacement Parts, superseding RCA Stock No. 217866. The new units must replace the old units in pairs. They may not be mixed.

The attached sketch gives detailed mounting and connection information. Care should be taken that the wire connecting the top of 2CR1 to the bottom of 2CR2 does not touch the rectifier or panel unless it is high voltage cable. (Spark plug h.v. ignition wire available at auto supply stores may be used.) An ohmmeter should be used to identify the four wires disconnected from the old rectifiers before reconnecting.

Memo for your maintenance file

TECHNICAL BULLETIN

MAINTENANCE AND MODIFICATION NOTES ON RCA BROADCAST EQUIPMENT

INDUSTRIAL ELECTRONIC PRODUCTS · BROADCAST AND TELEVISION EQUIPMENT DIVISION

TB-90-4 BTS-1A Stereo Generator December 20, 1962

Issued by W. D. Wenger / A. H. Bott

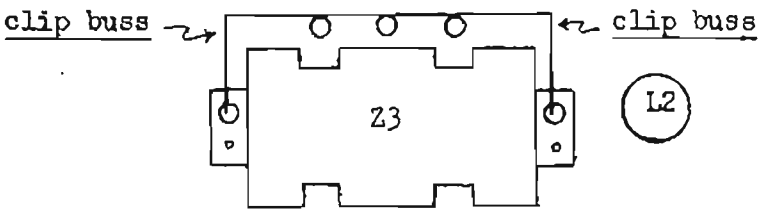
Elimination of Ground Loop

It is possible in some installations for a ground loop to exist between the mounting location of the BTS-1A stereo generator and the input jack, J104, of the BTE-10B exciter.

The effects of such a ground loop may be eliminated by following the procedure outlined below:

1. Obtain one receptacle (Amphenol 31-015, 31-022 or equivalent) and one tie point terminal (Cinch-Jones #1520 or equivalent) and 10 inches of RG-59U cable.

2. Clip both ends of ground buss at Z3.



3. Remove J4 and wire leading to center tap on R15, from J4.

4. Mount terminal under Z3 mounting screw next to L2 and connect ground side of Z3 to one lug. Connect braid of cable to the same lug. Run RG-59 cable through original mounting hole for J4 and attach Amphenol connector.

(b) MI-34317-3. Directional coupler. This unit is to be placed between the output of the IPA and the input to the PA. The reflectometer, 2M3, has an unused position to the right of the "remote" position. The position will be used to read the output of the coupler. With the use of the above it will be possible to determine by meter reading the point at which maximum transfer of power is obtained, from the IPA to the PA.

By reversing the directional coupler, reflected power and consequently VSWR on the IPA-PA interconnecting cable can be determined.

One each of MI-34317-3 will be supplied for the BTF-5B, BTF-5D, BTF-10C, and BTF-10D. Owners of the BTF-20C and the BTF-20D will not receive this directional coupler as it is already built into these transmitters.

(c) MI-34317-5. IPA modification kit. This kit is for the output of the IPA. The teflon rod on which the tuning slug travels through 1L2 is to be replaced with a brass threaded screw. The teflon or bakelite support assembly on the right will be replaced with a stainless steel unit. This will make tuning of the IPA easier and stability will be improved.

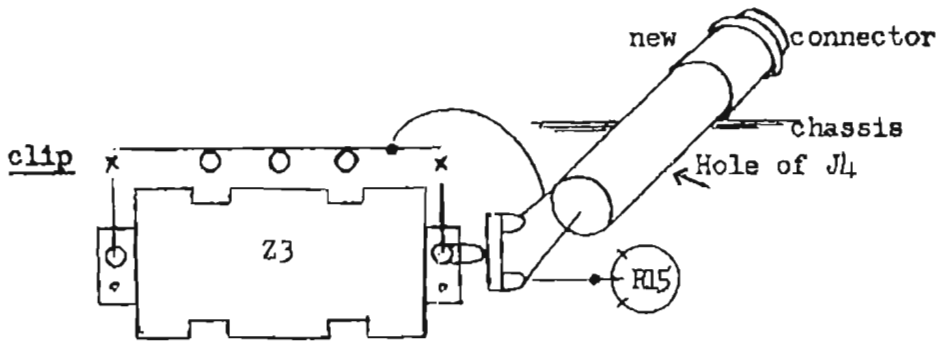
One each of MI-34317-5 will be shipped to each BTF-5B, BTF-5D, BTF-10C, BTF-10D, BTF-20C, and BTF-20D.

Complete installation instructions will accompany MI-34317-2, MI-34317-3, and MI-34317-5.

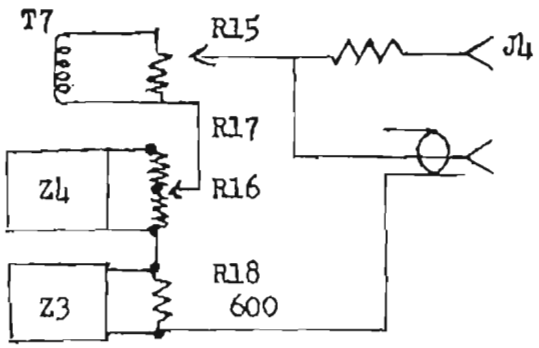
II. On some transmitters located at sea level or low altitudes, there have been reports of the air interlock switch in the IPA (1S3) fluttering. This is due to turbulence and back pressure. The turbulence can be eliminated by drilling a few quarter inch diameter holes in the back wall of the IPA assembly directly beneath the shelf and behind 1L1.

There have also been a few reports of the air interlock switch in the PA (2S19) fluttering. Generally this problem can be corrected by making certain that the boot assembly is as straight and as taut as possible. Also the clamps holding the boot at each end should be tight to prevent air leakage. If the boot bulges or if there is leakage, turbulence and back pressure may result, causing fluttering of 2S19.

5. Connect center conductor of RG-59U to the other lug of terminal strip. Connect this same lug to center tap of R15 (along with R27).



6. Correct schematic diagram of your instruction book (AG-26) as shown:



This modification will remove the output ground connection at the BTS-1A. The only ground point will now be at J104 of the BTE-10B Exciter.

RCA PARTS AND ACCESSORIES

Radio Corporation of America

RCA PARTS AND ACCESSORIES

"SPECIAL INSTRUCTIONS"

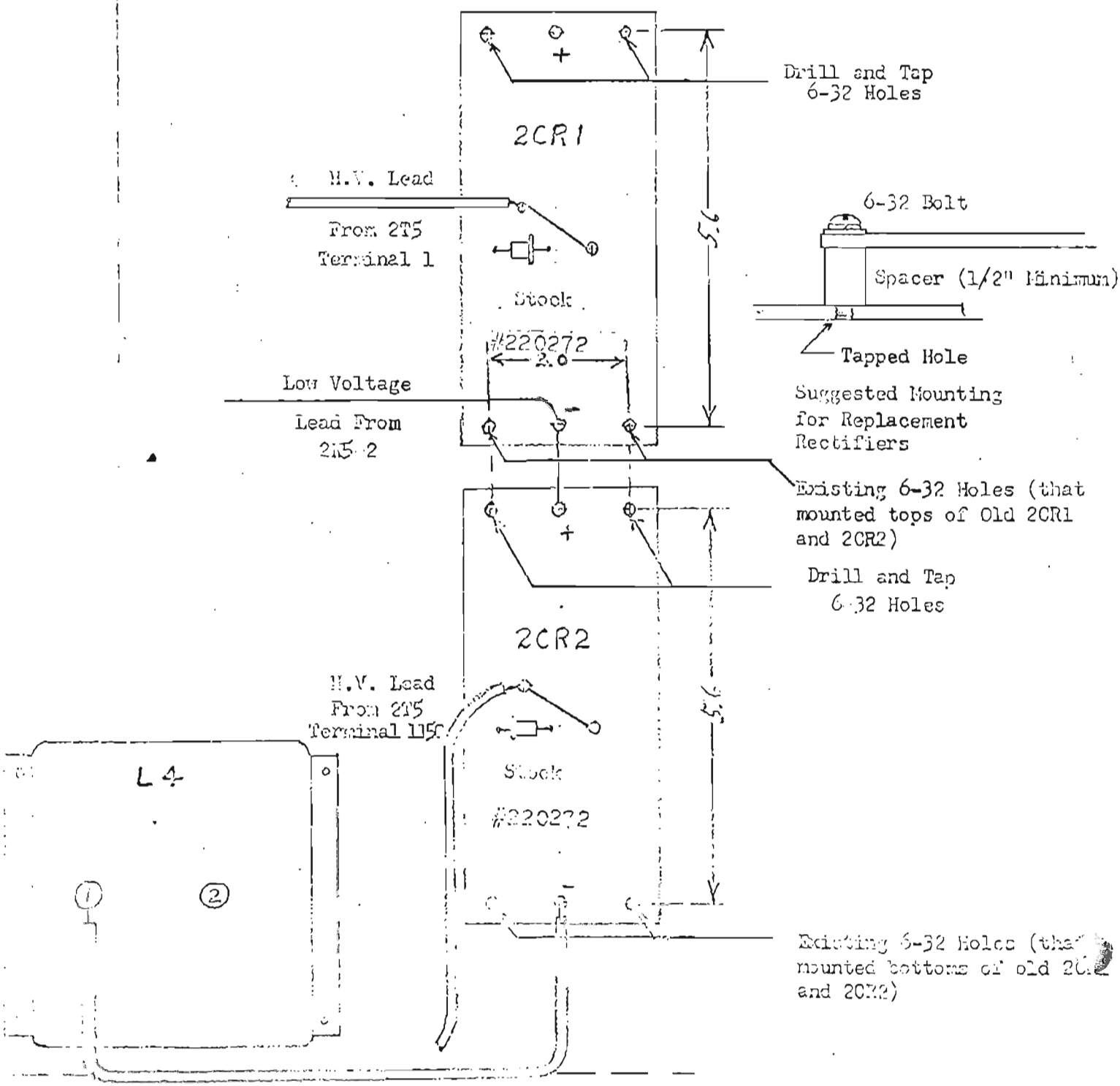
No. 1690 Date 6/67

RCA STOCK NUMBER 227887

The above stock number consists of a pair of improved printed circuit type rectifiers which supersedes stock number 217866. The new units must replace the old units in pairs. They may not be mixed. If it becomes necessary to replace these printed circuits after this change they can be replaced individually by stock number 220272. It is also possible to replace the individual diode by stock number 226058.

The attached sketch gives detailed mounting and connection information. Care should be taken that the wire connecting the top of 2CR1 to the bottom of 2CR2 does not touch the rectifier or panel unless it is high voltage cable. (Spark plug h.v. ignition wire available at auto supply stores may be used.) An ohmeter should be used to identify the four wires disconnected from the old rectifier before reconnecting.

Replacement of 2CR1-2CR2 in BTF-5E, 5D, 10C, 20D, 30C, and 20D



TB-83-8 BTF-10D/20D Transmitter

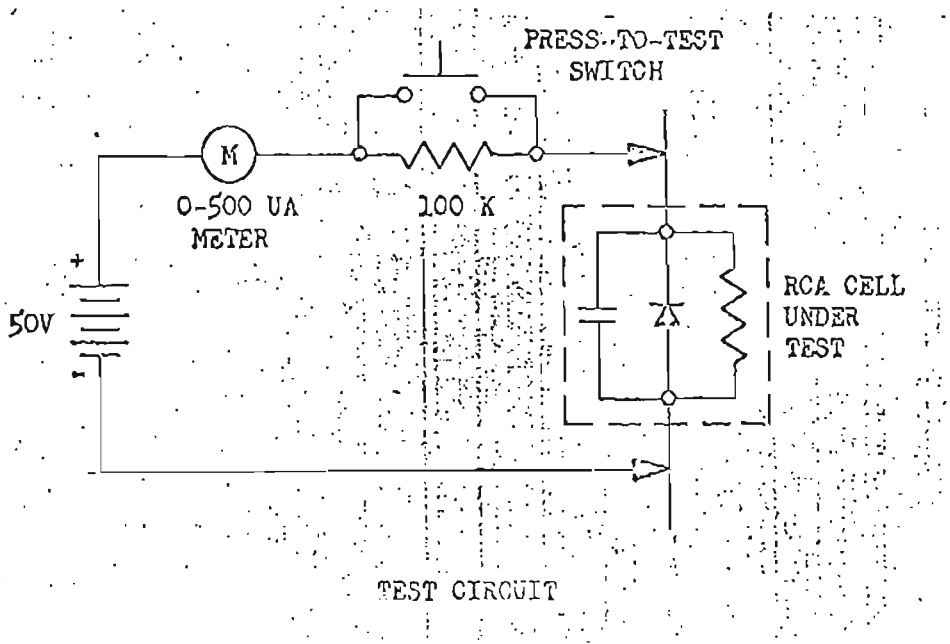
ATTACHMENT

TESTING INDIVIDUAL CELLS IN THE RCA CR300 SERIES HIGH-VOLTAGE SILICON RECTIFIER STACKS

The condition of individual cells in a RCA CR300 series stack may be checked by applying an external voltage to the individual cells and measuring the resultant current flow through the cell. A simple test circuit as shown below, can be used to perform the individual cell checks. It should be noted that some other value of voltage can be used in the test circuit; however, 50 volts was selected because it is low enough to be safe for testing, but is also sufficient to present a good indication of cell degradation. A lower voltage, such as that available in a vacuum-tube voltmeter, will not isolate defective cells unless they are almost complete shorts. Also note that the 100 kilohm resistor and the "press-to-test" switch have been included in the test circuit to protect the meter from shorted and incorrectly connected (reversed) diodes.

Connect the test circuit across the cell to be tested observing the polarity as shown in the diagram. It should be noted that an area on each of the fins of a CR300 series stack has been left unpainted to facilitate this connection. When the "press-to-test" switch is activated, a good cell will provide an indication of approximately 100 microamperes, while a cell that has degraded will indicate several hundred microamperes.

NOTE: THIS CIRCUIT IS NOT SATISFACTORY FOR CHECKING DIODES USING A VOLTAGE EQUALIZING RESISTOR BELOW 100 K. FOR TESTING DIODES IN SUCH SYSTEMS, THE EQUALIZING RESISTOR MUST BE DISCONNECTED FROM ONE END OF THE DIODE.



TEST CIRCUIT

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (Continued)

LIST OF EQUIPMENT

BTF-10D, 10 KW, FM TRANSMITTER (ES-34223)

Quantity		*Reference*
1	BTE-10 B, FM Exciter Unit	MI-34501
1	Crystal Unit	MI-34509
1	Set of Operating Tubes	MI-34510
1	250-Watt Driver	MI-34502-A
1	10 KW Amplifier	MI-34554
1	Plate Transformer	MI-34555
1	Blower	MI-34556
1	Installation Material Kit	MI-34553
1	Side Panel (End Shield)	MI-34531-2
1	Finish Touch-up Kit	MI-27660
1	Tool Kit	MI-27088
1	Set of Operating Tubes (4CX5000A, 7034)	MI-34704, MI-34511
1	Harmonic Filter	MI-27967-1 or 2
2	Doors (color as specified)	MI-27645-D-* or-E-*
1	Nameplate	MI-28180-1
1	1⅝" to 3⅛" Adapter	MI-19112-7
2	Couplings	MI-19112-8
2	Instruction Books, BTF-10D	IB-30280

INSTALLATION MATERIAL KIT (MI-34553)

Item	*Quantity*	*Description*	*Reference*
1	1	Logotype (FM Broadcast)	8708450-1
2	1	Logotype (Type BTF-10D)	8700106-11
3	1	RCA Monogram	8430354-1
4	12	Retainer (Spares Included)	990502-108
5	4	Clamp, Hose	8824489-8
6	1	Screen	8907769-13
7	1	Duct Assembly	8723450-502
8	4	Clamp	8917199-8
9	1	Boot	8820789-4
10	6	Plate	8973856-1
11	2	Crank Assembly	8918002-501
12	2	Arm Assembly	887449-501
13	1	Directional Coupler, 2Z1	8434079-3
14	1	Monitor Assembly	8442950-503
15	1	Elbow, Miter	8829487-3
16	1	Escutcheon	8314777-2
17	1	Trim Strip	8448474-501
18	1	Plug Button	8872221-105

LIST OF EQUIPMENT (Continued)

INSTALLATION MATERIAL KIT (MI-34553) (Continued)

Item	*Quantity*	*Description*	*Reference*
19	1	Capacitor, 2C21	990194-51
20	6	Rectifier Assembly, 2CR12 thru 2CR17	8720774-502
21	1	Reactor, 2L3	900431-4
22	1	Suitable Container Containing Hardware (Spares Included):	
23	1	Wire, #6 AWG, 150', 600 V, Grey	2010702-838
24	1	Wire, #14, AWG, 200', 15,000 V, Black	883852-1
25	1	Strap, Copper, 25, 1.5 In. Wide	8812985-6
26	1	Suitable Container Containing (Spacer Included):	
		(A) 10 Terminal	818337-2
		(B) 8 Terminal	8898696-54
27	1	Cable Harness:	
		(A)	8616018-502
		(B)	757412-507
28	1	Cable Assembly	8460367-501
29	1	Cable Assembly	8460367-503
30	1	Instruction Book BTF-10D Transmitter	IB-30280

RECOMMENDED SPARE PARTS

10 KW AMPLIFIER (DRIVER AND POWER AMPLIFIER)

Description	*Symbol*	*Quantity*	*Stock No.*
Capacitor, Var. 4.5–102 $\mu\mu f$	1C1, 1C13, 2C3	1	217634
Capacitor, ceramic, 25 $\mu\mu f$	1C2	1	215859
Capacitor, feed thru, 470 $\mu\mu f$	1C3, 1C5, 1C7, 1C11, 1C15–1C18	1	217636
Capacitor, silver mica	1C6, 1C8, 1C10	2	95707
Screw, lead, teflon	part of 1L1 and 1L2	1	219131
Belt, drive	part of blower, 2B1	1	221587
Capacitor, ceramic, 1000 $\mu\mu f$	1C14, 2C4, 2C15, 2C28–2C30, 2C32, 2C33	1	211186
Capacitor, ceramic, 50 $\mu\mu f$	2C10, 2C25	1	217653
Capacitor, feed thru, 1000 $\mu\mu f$	2C5, 2C11	1	211140
Mica	part of 2C12	1	217645
Rectifier circuit	2CR7	1	220285
Bulb		5	16154
Resistor, wire wound, 4 ohm	2R16	1	217615
Contact Assembly	part of 2L8	1	217650
Contact Assembly	part of 2L6 and 2L7	2	217649
Filter	air filter	1	95160

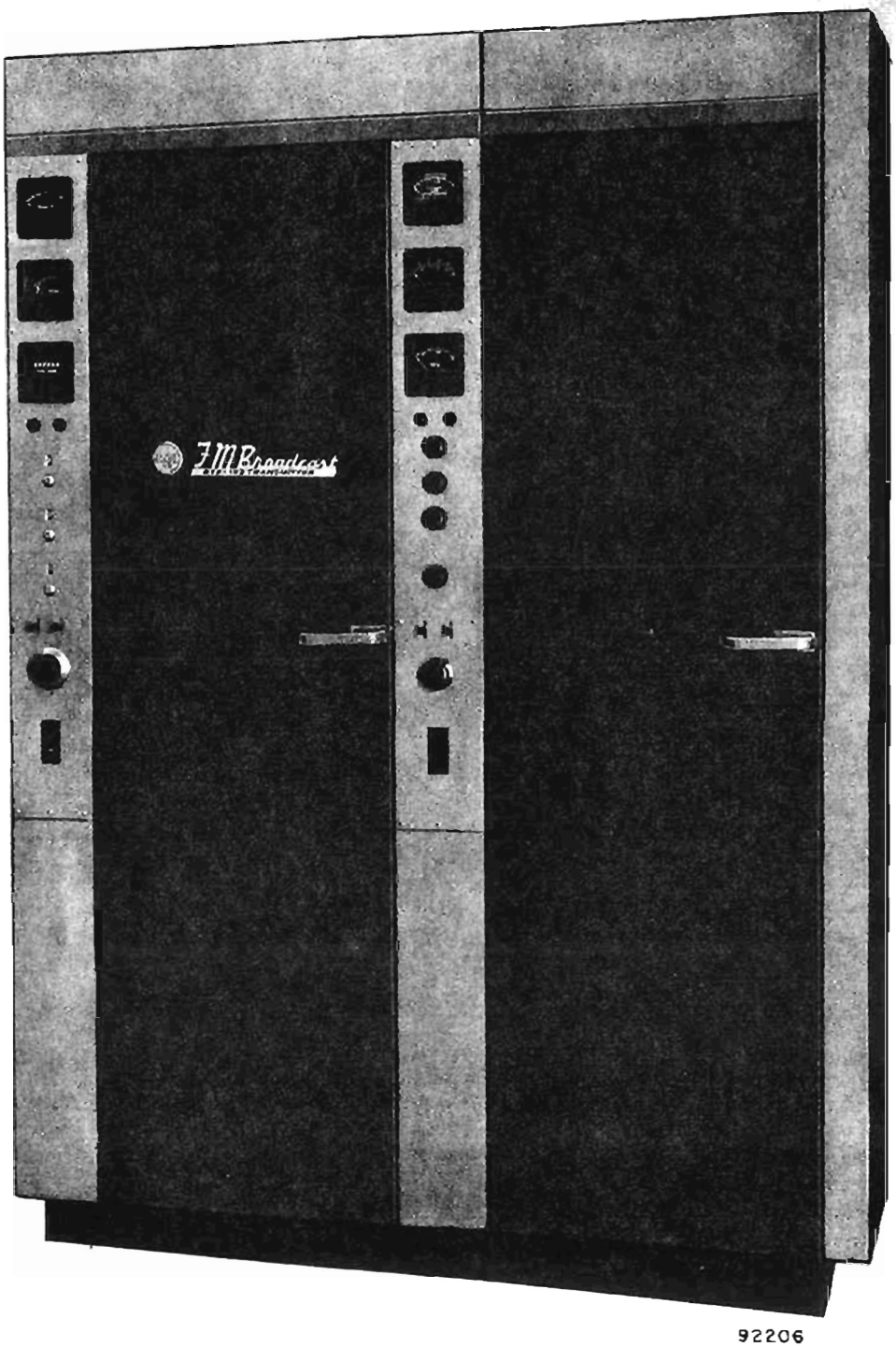


Figure T-1. RCA BTF-10D 10KW FM Transmitter

DESCRIPTION

The RCA Type BTF-10D FM Transmitter (Figure 1) is designed for high fidelity FM broadcasting on any frequency between 88 and 108 megacycles, with a power output of 10,000 watts.

The transmitter employs the new BTE-10B FM Exciter. This exciter incorporates a subcarrier modulator and can be used with the BTX-1A Subcarrier Generator to provide for various applications of FM multiplex such as background music and, if it becomes authorized, stereophonic sound broadcasting. Incorporating simplified circuitry and improved mechanical layout, the BTF-10D is a compact, high-power transmitter designed to provide long trouble-free service with maximum operational ease and efficiency.

Air-cooled tubes are employed in all stages of the transmitter which consist of the FM exciter unit, 250-watt driver and 10 kw power amplifier. The exciter utilizes miniature tubes and incorporates a subcarrier modulator stage for the multiplexing of one or more FM channels on one r-f carrier. The BTX-1A Subcarrier Generator is available as an accessory for this type service.

The BTF-10D is conservatively designed for unattended operation. Functions such as starting and stopping of the transmitter, resetting overload relays, metering of all power amplifier circuits and monitoring power output can be performed at a remote location as well as at the transmitter by the addition of available remote control accessories.

Construction

The transmitter is housed in two steel cabinets which are bolted together at installation. One cabinet contains the exciter, r-f driver and the subcarrier generator (if used), the other cabinet contains the power amplifier, blower, power supplies and control circuits. The plate transformer is housed in its own external enclosure.

Circuitry and mechanical layout of the transmitter are arranged to permit maximum accessibility. Vertical chassis type construction is employed, with surface mounting of components and wiring for easy and speedy tracing of circuits during servicing. Doors and removable panels provide access to all components of the transmitter. Meters and indicator lights are grouped with tuning and switching controls at convenient height on the front of the transmitter. An additional cabinet (ES-34211-A) which matches the appearance of the 250-watt driver cabinet may be added to the left side of the transmitter to house accessory units for frequency and modulation monitoring, multiplexing, and remote control.

Safety of operating personnel has been given special consideration in the design of the transmitter. All access doors to compartments containing high voltages are equipped with automatic interlock switches. When these doors are opened all rectifiers are immediately de-energized. In addition, each compartment containing high voltage is equipped with a mechanically operated grounding bar which is automatically released when the door is opened, or panels are removed.

Forced air cooling for the intermediate amplifier and power amplifier tubes is provided by a blower (2B1) located in the bottom of the left hand cubicle. Air is fed through a canvas boot into the bottom of the power amplifier compartment. Air for the 7034 IPA tube is fed by a 2 inch hose from the power amplifier compartment (through the wall of the cabinet) to the bottom of the IPA chassis. Air interlock switches in both stages remove plate and screen voltages if the air supply is interrupted.

Circuits

A block diagram of the BTF-10D transmitter is shown in Figure 2. High gain tetrodes are employed in the IPA and PA stages following the exciter which has a rated power output of ten watts. The IPA utilizes a 7034 tetrode delivering approximately 250 watts of r-f power. The final power amplifier employs a type 4CX5000A tetrode which supplies up to 10 kw of cw power to the 1⅝ inch antenna feed line. Both tubes operate in grounded cathode circuits. A variable output screen supply, common to the IPA and PA stages provides a means for obtaining any desired output power from one to ten kilowatts.

Frequency modulation is accomplished in the BTE-10B FM exciter by a "direct modulation" process requiring less components and fewer tubes and tube types. This process, which eliminates numerous multipliers and converter stages (resulting in low noise and minimum distortion), utilizes push-pull reactance tubes connected across the frequency determining circuit of the master oscillator. The center frequency of this oscillator is precisely maintained by a temperature controlled reference crystal in the exciter.

All power supplies employ semi-conductor rectifiers. The high voltage supply furnishes 6300 volts to the final stage and 2000 volts to the plate of the IPA. Another power supply furnishes screen voltages for these stages. The exciter unit as well as the accessory subcarrier generator are equipped with built-in power supplies.

Control circuits provide a 45-second starting sequence which prevents the application of plate voltage until the blower is in operation, tube filaments have reached operating temperature and the exciter has become stabilized. These circuits also provide overload protection and off-frequency shutdown. The overload circuit automatically returns the transmitter to the air on the first two overloads after a clearing time of two seconds. If the overload persists for the third time, manual reserting is required. Overload relays are located in the high voltage and screen supplies and in the cathode circuits of the IPA and power amplifier. Terminal board connections are available for transmitter remote control and metering functions. Only two fuses are used in the transmitter. These are installed in the crystal heater circuits on the exciter chassis.

BTE-10B FM Exciter

The BTE-10B Exciter provides a frequency modulated r-f output of ten watts at the specified carrier frequency. The exciter incorporates a subcarrier modulator stage which can be fed from the RCA Type BTX-1A Subcarrier Generator to provide for multiplexing one or two subcarriers on the main FM channel. For detailed information on the exciter unit, refer to the BTE-10B Exciter Section of this book.

Intermediate Power Amplifier

The intermediate power amplifier, which employs a 7034 tetrode, is a panel and chassis type unit and is mounted vertically in the right-hand cabinet of the transmitter, above the exciter. All controls are located on the front panel and consist of two crank-handle operated adjustments labeled INPUT TUNING (1L1) and OUTPUT TUNING (1L2), and two screwdriver-adjusted capacitors labeled INPUT LOADING (1C1) and OUTPUT LOADING (1C13). These adjustments are accessible when the front door of the cabinet is open.

Output from the exciter is fed to the grid circuit of the IPA through a 50-ohm coaxial cable from an r-f output jack (1P1) located on the rear of the chassis. Forced air, conveyed from the blower by a two-inch diameter hose, enters the bottom of the chassis and is expelled through louvres in the rear plate. A-C and D-C connections to the unit are made to a terminal strip on the rear of the chassis.

Circuits of the intermediate power amplifier are shown in the simplified schematic diagram of Figure 3. The input and output tuning circuits are conventional "pi" networks utilizing the input and output capacitance of the tube. The tuning slugs in inductances 1L1 and 1L2 move longitudinally by threaded teflon driving lead screws which are mechanically linked to the crank handle adjustments on the front panel. These slugs are brass with a silver plating. Their operation differs from that of the usual tuning slug in that the effective inductance of the coil is decreased as the slug is moved toward the coil center. No neutralization is required in this stage. Bias for the tube is obtained from grid and cathode resistances.

Power Amplifier

The power amplifier is located in a compartment in the lefthand cubicle of the transmitter with the power supplies, blower and control circuits. This stage utilizes a Type 4CX5000A forced-air cooled tetrode which provides a power output of 10 kw to the 51.5-ohm transmission line.

All controls for tuning and loading of the amplifier are located at convenient height on the lefthand vertical front panel of the transmitter. These consist of the GRID LOADING control (2C3), GRID TUNING (2L8), PLATE TUNING (2L6), and PLATE LOADING (2L7). R-F power from the 250-watt driver is fed through a 50-ohm cable to a coaxial jack (2J1) in the bottom of the PA compartment. R-F output is coupled to a 51.5-ohm transmission line which enters the top of the compartment.

Power amplifier circuits are shown schematically in Figure 4. The input circuit is a modified pi network in that the input capacity of the tube is shunted by an inductive line (2L8) which reduces the effective input capacity of the stage. Inductance (2L10), which is varied by means of a capacitor (2C3) in parallel with the coil, also provides the means for adjustment of input loading. The output circuit of this stage is also a pi network with the tube capacity shunted by the variable inductance 2L6. Loading and tuning are accomplished by variation of the two inductive line components 2L6 and 2L7. Mechanical simplicity was obtained in this circuit by inverting the pi network, thus placing one end of the inductance at ground potential as shown. This eliminates the mechanical and electrical problems of insulating the variable component from ground. It is necessary that the output line parallel the inductance to bring it to ground potential. This is achieved by the extension of the output line down one side of the inductive line. Neutralization of the power amplifier is accomplished by adjusting the spacing of neutralizing slides located at the base of the tube.

In addition to grid leak bias, a separate bias supply is incorporated in the power amplifier. This bias supply consists of a silicon bridge rectifier assembly (2CR7) and a choke input filter circuit which supplies 40 to 50 ma. to bias the grid of the PA tube.

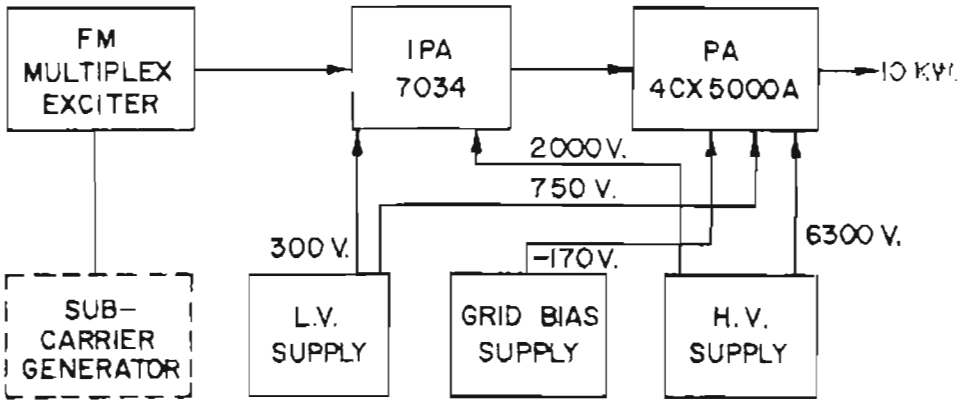


Figure T-2. Block Diagram, BTF-10D FM Transmitter

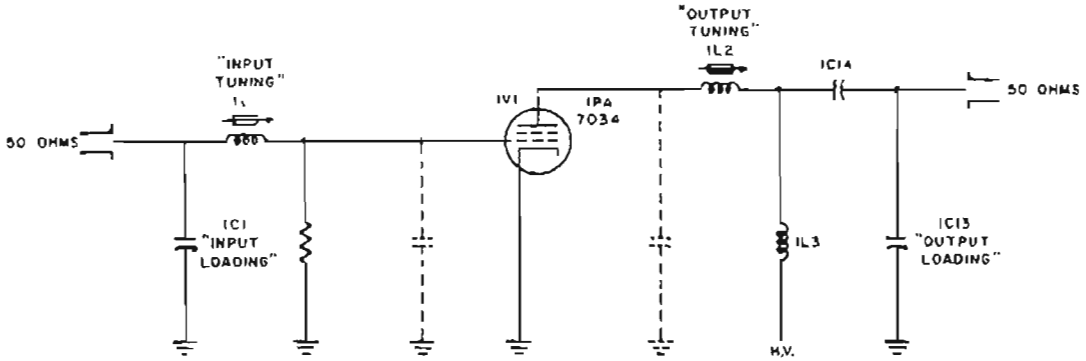


Figure T-3. Simplified Schematic Diagram, Intermediate Power Amplifier

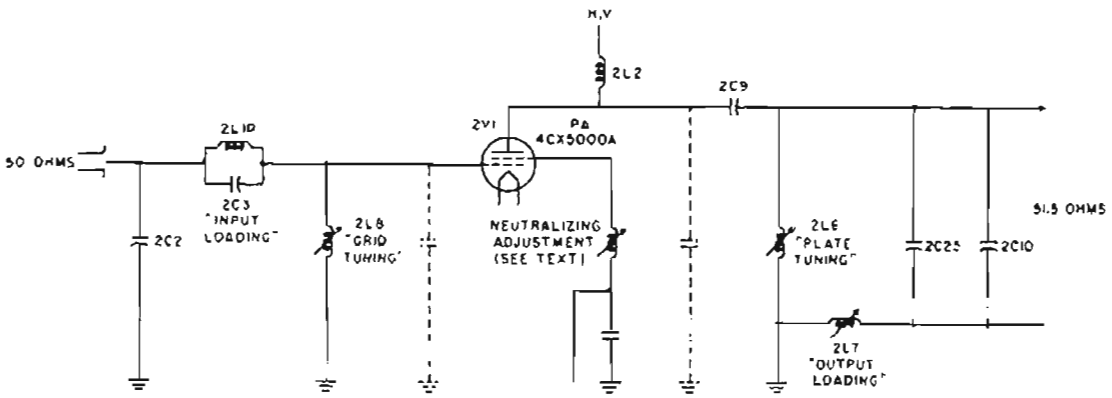


Figure T-4. Simplified Schematic Diagram, Power Amplifier

Power Supplies and Control Circuits

The power supplies and control circuits are shown on the overall schematic diagram of Figure 27. The high voltage supply is a 3-phase full-wave circuit utilizing six banks of silicon rectifiers. A single section, choke-input filter (2L3 and 2C21) supplies 6300 volts at approximately 2.3 amperes to the plate of the power amplifier (2V1). The half-voltage center tap of the high voltage transformer (2T1) supplies the plate of the intermediate power amplifier (1V1) through a double section r-c filter which effectively filters and at the same time reduces the voltage to approximately 2000 volts.

A second power supply utilizing germanium rectifiers (2CR1, 2CR2) in a bridge circuit, and a double section choke input filter (2L4, 2L5, 2C23, 2C24) supplies screen voltage to both the IPA and PA stages. The primary of this transformer (2T5) is fed from a motor-driven variable transformer (2T6) which provides manual control of screen voltage, and thus power output, for tune-up and other purposes. This SCREEN RAISE/LOWER control (2S12) is located on the front panel of the transmitter.

Power is applied from the 208/240-volt 3-phase line by the circuit breaker (2S1) located at the bottom of the right-hand vertical panel. From 2S1, power is fed to four other circuit breakers. The first of these breakers (2S3) is located at the bottom of the left-hand vertical panel and controls power for the blower, transmitter control circuits, amplifier filaments, transmitter exciter unit and the subcarrier generator (if used). Application of power to these circuits is controlled by the TRANS ON switch as described later. The second circuit breaker (2S2) is located at the base of the power amplifier compartment and controls power, through contacts of the plate contactor relay (2K9), to the plate transformer (2T1) and through the third and adjacently located breaker (2S4), to the screen supply transformer (2T5). The fourth circuit breaker (2S5) controls power through contacts of relay 2K15 to the blower (2B1). The filament line passes through buck-boost transformers 2T3 and 2T4 which permit exact adjustment of the line voltage to that required by the taps used on the primary of the filament transformers.

With all breakers turned ON and all door interlocks closed, power is applied to the various circuits of the transmitter by the TRANS ON and PLATE ON switches (2S10 and 2S9, respectively) mounted on the vertical panels. The TRANS ON switch (2S10) energizes relay 2K15 which starts the blower. Air passing into the IPA and PA compartments actuate vane-operated air interlocks (1S3 and 2S19), energizing filament relay 2K11 which in turn applies power to the exciter, subcarrier generator, IPA and PA filament transformers (1T1 and 2T7) and to the 45-second time delay relay (2K4). This is evidenced by the lighting of the TRANS ON indicator (2DS4) on the front panel. After sufficient time has elapsed, contacts of time delay relay (2K4) close, completing the circuit through the closed door interlock switches (1S4, 1S1, 2S8, 2S6 and 2S7), through the normally closed contacts of the two-second time delay relay (2K7), through the stepping relay contacts (2K8) and the OFF FREQUENCY interlock relay in the exciter, up to the starting relay (2K10). This is indicated by the energizing of the READY indicator light (2DS3) on the front panel. Operation of the PLATE ON switch (2S9) then energizes 2K10 and the plate contactor relay (2K9) which in turn applies power to the high-voltage and screen-supply transformers and energizes the PLATE ON indicator light (2DS2).

Protective overload relays are installed in principal circuits throughout the transmitter as follows: Relay 2K1 is located in the ground return of the high-voltage rectifier. Relay 2K15 is in the cathode circuit of the power amplifier 2V1, and relay 2K6 is in the cathode of the IPA tube (1V1). Relay 2K5 is in the screen voltage supply.

Normally-open contacts on each of these relays are connected in series with the 2-second time delay relay (2K7). The closing of any of these contacts, as the result of an overload, energizes 2K7 which in turn opens the circuit to the plate contactor (2K9) and removes plate and screen voltages from the amplifier stages. At the same time another set of contacts on 2K7 energizes the 3-step relay (2K8) which advances one step and energizes the OVERLOAD indicator (2DS1). The second pair of contacts on 2K8, which are in the plate contactor circuit, remain closed. After a 2-second interval the time delay relay returns to its normal position which again energizes plate contactor 2K9 and applies plate and screen voltages to the power amplifier circuits.

If a second overload is present, the cycle repeats; relay 2K7 is again actuated, opening the circuit to 2K9 and advancing 2K8 to its second step position. In this position of 2K8, contacts in the OVERLOAD indicator and plate contactor circuits remain closed.

With a third such overload, however, stepping relay 2K8 is advanced to its final position, opening contacts in the plate contactor circuit. To restart the transmitter at this stage requires that the OVERLOAD RESET switch (2S11) be pressed. This energizes a second winding on 2K8 which returns the

relay to its normal position, closing the plate contactor circuit and opening the OVERLOAD indicator circuit.

The transmitter can be turned on and off by the TRANS ON (2S10) and PLATE ON (2S9) spring return key switches located on the front panel.

INSTALLATION

General

Basic steps in the installation of the RCA BTF-10D FM Transmitter consist of planning the equipment layout and making provisions for transmitter-room power and light, transmission line runs, and connections to the equipment. The units then can be unpacked, assembled and wired as specified in these instructions. Space for items not supplied, such as auxiliary input equipment, or line dehydrating units should not be overlooked in the planning. Before locating the transmitter, reference should be made to the instruction books supplied with these equipments.

> NOTE: The instructions contained in these books are not intended to supersede applicable local codes. On points where conflict is evident, the local code should be followed.

A harmonic filter (MI-27967-1 or 2) is supplied with the BTF-10D transmitter and is designed to effectively attenuate second through seventh harmonic radiations from FM transmitters. The filter is constructed of coaxial transmission line and is the reflective type, i.e., the rejected energy is not absorbed. The filter is inserted in the transmission line at the top of the transmitter.

Electrically, each filter consists of an M-derived half-T section, several low-pass filter sections, and a constant-K, half-T section as shown in Figure 21. The M-derived section provides rapid cut-off in the second harmonic region, and a termination impedance at one end of the filter of 50 ohms. Attenuation of the harmonics is accomplished by the low-pass filter sections, while the constant-K, half-T section serves to give a termination impedance of 50 ohms at the other end of the unit.

In selecting a location for the transmitter, care should be taken to allow sufficient space for the filter which is approximately 10 to 12 feet in length (depending on frequency).

The room in which the transmitter is installed should be well ventilated and provided with an abundant supply of clean, dry air. The maximum ambient temperature for proper operation is given in the specifications. A transmitter room layout can be prepared by reference to the floor plan diagram in Figure 24 (8616031), which gives the overall dimensions of equipment. A minimum clearance of 24 inches for the opening of doors is required at the front of the transmitter, and a similar space should be provided at the rear for access to transmitter components and circuits. Floor ducts can be installed for power wiring and remote control interconnection (if desired), or conduit may be run above the floor to the transmitter wire ducts at the base of the cabinets. If wiring is to be placed in floor ducts, the floor ducts should be laid out so that cables can leave the duct and enter holes provided in the bottom of the transmitter wire duct.

Most of the internal wiring of the BTF-10D has been completed at the factory prior to shipment. Since the exciter-driver and power amplifier cabinets are packed separately, it will be necessary to bolt these cabinets together and install the wiring cable interconnecting the two units. Other items to be installed are the exciter, subcarrier generator (if used), the high voltage plate transformer, blower and blower hoses. The 250-watt driver unit is shipped in the smaller of the two cabinets.

Unpacking

An understanding of the shipping system will be of assistance in unpacking the equipment and locating items. Each RCA equipment is accompanied by a shipping voucher which lists the complete contents of the shipment by "Equipment Schedule" or "ES" numbers and "Master Item" or "MI" numbers. This shipping voucher is usually packed in one of the smaller cardboard cartons, appropriately marked. Where there are two or more packages to a major item, the package containing the MI list is identified by stenciling.

The complete equipment for the BTF-10D FM Transmitter is listed on ES-34225 and ES-27278 which references the major items of the shipment and their MI number. These Equipment Schedules, together with the list of items contained on MI-34553 (Installation Material Kit) are reproduced in the front of this book.

The equipment should be carefully unpacked and inspected to make certain that no damage has been incurred during shipment. Any damage or shortages should be reported immediately to RCA and to the transportation company so that lost or damaged material can be recovered. Tubes should not be unpacked until all equipment is installed and all preliminary adjustments have been made.

Assembly

Reference should be made to the installation drawing, Figure 24 (8616031) which will aid in the assembly of the transmitter cabinets, and in the installation of the plate transformer (2T1), blower (2B1) and blower boot. Position the cabinets and bolt them together using the hardware supplied as items 22-D, H, J and N of the MI-34553 Installation Kit.

Place the plate transformer in position and make connections as shown in Figure 26.

> NOTE: Due to the weight of the transformer it is unnecessary to bolt it to the floor.

After the plate transformer connections have been made, install and bolt the blower on the mounting pads as shown in Figure 13, and make the two connections to the blower motor terminals. Install the boot (item 9) contained in the installation kit (MI-34553) between the blower and the bottom of the PA cabinet, using the hose clamp and corner clamps supplied as item 8 with hardware items 22-A, F, and L. Also install the 2-inch hose through the hole in the cabinet wall, clamping one end to the outlet at the side of the PA compartment and the other to the inlet on the bottom of the IPA chassis. (Use the item 5 clamp of MI-34553.) Ascertain that the hose is clear of obstructions which would impede normal air flow. (See *Blower Adjustment* under *OPERATION*.)

Mount the front doors, end shields, logotypes and monogram, using the retainers supplied (MI-34553 items 1, 2, 3, and 4). The MI-28180-1 nameplate should be mounted on the top rear access panel of the amplifier rack.

Harmonic Filter Installation

Install the harmonic filter, MI-27967-1 or 2 as determined by the building layout, using the MI-19112-7 reducer. The filter should be located in a position which permits a reasonable amount of ventilation. Under no circumstances should the filters be located outdoors where "breathing" of the unit due to temperature changes may lead to condensation.

When installing the harmonic filter, refer to the Harmonic Filter *Technical Summary* and schematic diagram in Figures 20 and 21. Keep in mind the clearances necessary for the various size transmission line inner and outer conductors. Clearance of 1/8-inch must be allowed for each joint in all outer conductors. Inner conductors of 3 1/8-inch lines require a clearance of 3/16-inch at each joint, while inner conductors of 1 5/8-inch lines require a clearance of 1/8-inch at each joint. Ascertain that the harmonic filter is adequately supported from the ceiling to avoid excessive strain on the output line.

Once installed, the harmonic filter is ready for operation since it requires no tuning or adjustment.

The optional accessory equipment rack may be connected to the amplifier rack in the same manner as that employed for the driver rack. (Order ES-34211-A.)

R-F Monitor Assembly

To install the R-F Monitor Assembly (items 14 and 15 of MI-34553), connect the miter elbow (15) to the top of the output line. Position the r-f pickup saddle assembly over the hole in the side of the elbow so that the r-f pickup coil enters the hole without touching the sides. Position and secure the saddle clamps (MI-34553, item 5) around the elbow.

> NOTE: The r-f pickup coil may be positioned for best signal pickup by removing the four screws which hold the coaxial connector in place and rotating it in either direction for maximum pickup (consistent with alignment of the mounting holes).

Equipment Wiring

Equipment wiring is accomplished by first making the interconnections between the transmitter cabinets and then making external connections between the transmitter and power source, and to any remote control circuits that may be used. Interconnections between terminal boards 1E and 2E in the cabinets are facilitated by a cable assembly supplied in the installation kit (item 27); connections to be made are specified on the connection diagrams of Figures 23 (8616018) and 25 (8616072). External connections are listed in TABLE I.

TABLE I. EXTERNAL CONNECTIONS

PLATE TRANSFORMER (Figure 26)	
	Terminals
Primary H1	2E75
H2	2E76
H3	2E77
Secondary R1	2E80
R2	2E79
R3	2E78
N	2E81
REMOTE CONTROL CONNECTIONS	
Remote Control Function	*Terminals*
Transmitter ON	2E25 — 2E26
Transmitter OFF	2E25 — 2E27
Plate OFF	2E28 — 2E30
Plate ON	2E29 — 2E30
Overload Reset	2E30 — 2E31
Power Output—Raise	2E23 — 2E25
Power Output—Lower	2E24 — 2E25

TABLE I. EXTERNAL CONNECTIONS
(Continued)

Remote Meter Reading Function	*Terminals*
PA Plate Voltage	2E34 — 2E36 (ground)
PA Cathode Current	2E33 — 2E36 (ground)
Power Output (2S13 in REMOTE)	2E35 — 2E36 (ground)
External Overload Relay Connections	*Terminals*
Relay 2K1	2E17 — 2E16 (common)
Relay 2K15	2E22 — 2E16
Relay 2K5	2E20 — 2E16
Relay 2K6	2E21 — 2E16
CRYSTAL HEATER VOLTAGE CONNECTIONS	
	Terminals
Located in PA cabinet	1E4 — 1E5 (to 117 v-ac)
RF MONITOR CONNECTIONS	
Refer to RF Monitor under *ASSEMBLY* in the *INSTALLATION* section.	
POWER INPUT	
208/240 v a-c, 3 phase	Connect to terminals 2E72, 2E73 and 2E74

Transformer Primary Taps

The primaries of all filament and plate transformers, except 2T3, are provided with taps which permit operation of the equipment over a wide range of a-c line voltages. These taps are set at the factory for operation at a line voltage of 240 volts a-c. However, if the source line voltage is different, connections should be changed from the present taps to those designated for operation at the voltage closest to that measured.

NOTE. Transformer T113 in the exciter unit provides 117 volts between terminals 2 and 4. The black leads connected to these terminals should not be removed when adjusting the 230-volt line input taps. These black leads furnish power to the 117-volt primary of transformer T112. With these leads connected to terminals 2 and 4 of T113, the voltage supplied will be correct when the proper line taps on T113 have been connected to the source voltage.

The primary taps of all transformers are identified on the transformer and on the schematic diagram of Figure 27.

WARNING

BEFORE MAKING CONNECTIONS TO POWER CIRCUITS, ALL SWITCHES AND CIRCUIT BREAKERS SHOULD BE TURNED TO THE *OFF* POSITION TO PREVENT POSSIBLE INJURY TO PERSONNEL, OR EQUIPMENT DAMAGE SHOULD POWER BE APPLIED ACCIDENTALLY TO THE CIRCUITS DURING INSTALLATION.

Remote Control Connections

The BTF-10D Transmitter may be remotely controlled by means of a BTR-11B or BTR-20A accessory Remote Control System. This system consists of an MI-27538-A Transmitter Control Unit and an MI-27537 Studio Control Unit for the BTR-11B System and the MI-27526 Transmitter Control and the MI-27539 Studio Control Unit for the BTR-20A System. The BTR-11B or BTR-20A may be connected directly to terminals in the BTF-10D to provide the remote control and remote meter reading functions shown in TABLE I. Designated terminals will be found on the 2E terminal board located in the larger cabinet and are indicated on the overall schematic diagram. All metering positions are designed to deliver approximately 1 volt into 5000 ohms.

Remote control of tower lights can be accomplished by utilizing an accessory Light Control Unit (MI-27519). Remote reading of the frequency and modulation monitor is accomplished by placing the monitor in the studio, and feeding an off-air signal into it through an antenna and r-f preamplifier which are also available as accessories.

After completion of wiring, check all connections for accuracy. Cover the wire duct openings by installing the wire duct covers using the hardware supplied. Place the blower circuit breaker (2S5), located at rear of large cabinet, in the ON position and replace the rear shield.

External Overload Connections

Terminals are available on terminal board 2E to facilitate the use of external overload relays. See TABLE I.

Preliminary Adjustments

The BTF-10D is shipped with an inductance strap (2L9) connected between the filament center tap of the 4CX5000A power amplifier tube and the ground side of the grid capacitors 2C28, 2C29 and 2C30. (See Figure 19.) The purpose of 2L9, which effectively parallels the grid circuit, is to extend the upper frequency limit of the grid tuning circuit. If the transmitting frequency is to be in the lower part of the band, i.e., between approximately 88 and 100 mc, remove 2L9 from the circuit. If operation will be in the range between 100 and 108 mc, do not remove 2L9 since it will be required for proper tuning.

Overload Relay Adjustment

Before power is applied to the transmitter, it is necessary to adjust the sensitivity of the overload relays 2K1, 2K5, 2K6 and 2K15, located inside the left-hand cubicle beside the PA compartment, so that they will pull-in at the current specified for each in TABLE II.

This can be accomplished by use of an ammeter of the proper range and a d-c supply which is adjustable from 0.5 to 1.5 volts and capable of delivering 2.5 amperes. An "A" battery, such as an RCA Type VS069, used with a series rheostat of between 5 and 10 ohms resistance, is a convenient supply for making this adjustment. Remove the relay covers with the rheostat set for minimum output voltage, connect the supply across the coil of the relay to be adjusted with the ammeter connected in series. Slowly increase the voltage to obtain the ammeter reading given in the table. Adjust the spring tension on the relay so that it just pulls in at the specified current. After adjustment, decrease and increase the current several times to check for proper operation. Replace the relay covers after adjustments have been made.

TABLE II. OVERLOAD RELAY SETTINGS

Relay	*Circuit*	*Pull-in Current*
2K15	4CX5000A Cathode	2.5 A.
2K1	H.V. Rectifier	3.0 A.
2K5	Screen Rectifier	300.0 MA.
2K6	7034 Cathode	250.0 MA.

Unpack and carefully install tubes and the exciter crystals in their proper sockets as directed in the Exciter Section of this book.

Blower Adjustment

The blower motor was adjusted at the factory for 60-cycle operation at elevations up to 2500 feet. For other conditions, adjust the blower motor as described in the *Blower Adjustment Table* for 60-cycle or 50-cycle operation, respectively.

If the sheaves require adjustment, loosen the four (4) machine screws holding the motor to the base, then slide the motor toward the fan shaft to obtain sufficient belt slack for sheave adjustment.

Adjust either sheave by loosening the setscrew in the adjustable flange, and rotating the flange as specified in the Table. Sheaves can be positioned to either one of two positions 180° apart. Tighten the setscrew making sure the setscrew bears on the flat and NOT on the adjusting threads of the fixed flange.

After the sheaves have been adjusted, reposition the motor on the mounting base. Check the position of the motor to be sure the motor shaft is parallel with the fan shaft. Then tighten the four motor-mounting machine screws.

Check the belt slack, which should be ¾" to 1" with the belt taut on the side opposite the measurement side.

Control Circuit Check

To insure that all connections have been made correctly, the following control circuit check should be made before installing tubes and applying plate and screen voltages to the transmitter.

1. Switch the following circuit breakers to the ON position: LINE (2S1) and FILAMENT (2S3) located on the front panel, and the blower circuit breaker (2S5) located in the rear of the cabinet. Leave the SCREEN and PLATE circuit breakers (2S4 and 2S2) in the OFF position. Replace panels and close all doors.

2. Operate the momentary contact TRANS ON/OFF switch (2S10) to the ON position. This should energize the filament transformers and time-delay relay. The blower should start at this time, and the TRANS ON indicator should go on as soon as the blower reaches operating speed. The READY indicator should light in approximately 45 seconds.

BTF-10D BLOWER ADJUSTMENT TABLE

Altitude	*Fan Speed*			*60 Cycle*		*50 Cycle*	
				Motor Sheave	*Fan Sheave*	*Motor Sheave*	*Fan Sheave*
Feet	*R.P.M.*	*Inches W.G.*	*C.F.M.*	*No. Turns Out*	*No. Turns Out*	*No. Turns Out*	*No. Turns Out*
SEA LEVEL	2820	3.0	315	5½	0	2½	2½
2500	2950	3.3	327	5	½	2	3
5000	3200	4.3	361	4	1½	1	4
7500	3400	4.6	395	3	2½	½	5

3. Turn the LINE switch (2S15) on the front panel to each of its four positions while reading the voltage for each on the AC VOLTMETER (2M5). The voltage readings in each of the four positions should be approximately that for which the transformer taps are adjusted. With the LINE switch in the FIL LINE position, adjust the FIL LINE control, if necessary, to bring the line voltage reading closest to the value for which the taps on filament transformers 1T1 and 2T7 are set.

4. Switch circuit breakers LINE and FILAMENT to the OFF position.

Tube Installation

Insert the 7034 and 4CX5000A tubes in their respective sockets. The fit of the 4CX5000A PA tube in its socket is very tight (see Figure 16) and special attention should be given to its installation to ascertain that it is properly seated. Proper seating can be determined by observation; the top of the screen ring will be flush with the top of the screen contact when the tube is seated against the stops. Reference should be made to the special instructions stenciled on the inside of the r-f compartment door.

TUNING

RECOMMENDED MEASURING EQUIPMENT

(In addition to equipment listed in the Exciter Section)

1. Directional Coupler (M. C. Jones Type 576N6 for use with external meter, or Type 706N with built-in meter).
2. IPA dummy load (M. C. Jones 636N).
3. PA dummy load (RCA MI-19193L).

The initial tuning procedure consists of adjustments to be made to the exciter and subcarrier generator, adjustment of the IPA and PA screen voltages and adjustment of the PA neutralizing circuit. Instructions for tuning-up the exciter and subcarrier generator are contained in the instruction book supplied with the units (IB-30262). (Exciter data also contained in the Exciter Section of this book.

Presetting of Controls

The tuning and loading controls of the IPA and PA stages must be preset to their approximate tune-up positions as given in the following steps and with reference to the IPA and PA tuning curves:

1. Set the IPA INPUT LOADING (1C1) and OUTPUT LOADING (1C13) capacitors to their half open positions. Set the INPUT TUNING (1L1) and OUTPUT TUNING (1L2) controls to the dial positions given in Figure 5, for the frequency to be used.

2. Set the PA GRID TUNING (2L5) control to the dial position given in Figure 6 for the frequency to be used; and set the GRID LOADING (2C3) control for a dial reading of 35.

3. Set the PLATE TUNING (2L6) control and the PLATE LOADING (2L7) control to the respective dial positions given in Figure 7 for the frequency to be used.

PA Neutralizing Adjustment

Neutralization of the PA circuit is obtained by the correct positioning of eight angular slides located in guide slots at the four corners of the PA tube base. (See Figure 18.) In making this adjustment, reference should be made to the curve of Figure 8, which gives the proper setting of these slides for the frequency to be used. As indicated on the curve, measurements are made from the outer edge of the slide to the outer ends of the guide slots. For example, if operation is to be on 88 mc, the eight slides should be positioned at the outer ends of the slots, i.e., at the farthest point from the tube base. It will be necessary to remove the PA tube to adjust the rear slides. After these slides are adjusted in accordance with Figure 8, the PA tube can be replaced. Adjustment of the slides for the frequency to be used, in accordance with Figure 8, normally provides complete neutralization, and no further adjustments are necessary.

CAUTION: Ascertain that the PA tube is properly seated in its socket. See Figure 16.

Exciter Warm-Up

Adequate warm-up time for the exciter circuits must be allowed before tuning adjustments can be made. To energize the exciter circuits proceed as follows:

1. Switch the FIL OVERLOAD (S104) and PLATE OVERLOAD (S103) breakers located on the exciter chassis to the ON position.

2. Apply 117 volts a-c power to the crystal heater circuits of the exciter. The crystal heater indicator lights DS101 and DS102 should light and remain lighted until the crystal heaters have reached operating temperature.

3. Switch circuit breakers LINE (2S1) and FILAMENT (2S3) to the ON position, and turn the TRANS ON/OFF switch to the ON position. This will apply a-c power to the exciter circuits.

Allow approximately ten minutes warm-up time and then proceed with the exciter tune-up as described in the Exciter Section of this instruction book.

Amplifier Tuning

With the exciter tuned as previously described, and PA neutralizing adjustments completed, the screen voltage should be adjusted and final tuning of the transmitter accomplished in accordance with the following procedure:

1. Place exciter circuit breakers FIL OVERLOAD (S104) and PLATE OVERLOAD (S103) in their OFF positions.

2. Switch the circuit breakers LINE (2S1), FILAMENT (2S3), PLATE (2S2) and SCREEN (2S4) to their ON positions.

3. Operate the TRANS ON/OFF switch (2S10) to the ON position. Before proceeding with the next step, allow 30 minutes warm-up time to permit the 8008 high voltage rectifiers to vaporize mercury deposits.

4. Operate the SCREEN RAISE/LOWER switch (2S12) to the LOWER position and hold this position until the motor (2B2) reaches the end of its travel. This should be the zero screen voltage setting.

5. Turn the MULTI-METER switch (2S14) to the SCREEN 0-500V position.

6. Operate the PLATE ON/OFF switch (2S9) to the ON position.

7. Operate the SCREEN RAISE/LOWER switch to the RAISE position to bring the screen voltage to approximately 200 volts as read on the MULTI-METER. At this setting the PLATE CURRENT meter (2M1) should indicate 0 plate current.

8. Turn the MULTI-METER switch to the SCREEN 0-1000V position and read the PA screen voltage on the MULTI-METER. This should read approximately 520 volts.

9. Operate the PLATE ON/OFF switch to the OFF position.

10. Switch the exciter circuit breakers FIL OVERLOAD (S104) and PLATE OVERLOAD (S103) to the ON positions, and allow a few minutes time for warm-up.

11. Operate the PLATE ON/OFF switch to the ON position.

12. Turn the MULTI-METER switch to the GRID 0-50 MA position, and adjust the IPA INPUT TUNING and INPUT LOADING controls for maximum grid current reading on the MULTI-METER.

13. Turn the MULTI-METER switch to the GRID 0-100 MA position, and adjust the IPA OUTPUT TUNING and OUTPUT LOADING controls for maximum grid current. Make a note of this reading.

14. Set the PA GRID LOADING control so that the dial reads 30, and readjust IPA OUTPUT LOADING and OUTPUT TUNING for maximum PA grid current as read on the MULTI-METER. If this reading is higher than that obtained in Step 13, decrease the GRID LOADING slightly, and again tune the IPA loading and tuning controls for maximum grid current; repeat until maximum grid current is obtained. If the grid current obtained with the dial set at 30 was lower than the reading noted in Step 13, repeat the above procedure by increasing the dial setting rather than decreasing, until maximum grid current is obtained. (See Figure 6 for 2L8 setting.)

NOTE: *IPA Output/PA Input Tuning*—Interaction between the output of the 7034 IPA stage and the input of the 4CX5000A PA stage results in power transfer over a wide range of control settings.

The most efficient setting is obtained when the following conditions prevail:

1. The coaxial cable connecting the two stages is terminated in its 50 ohm characteristic impedance.

2. No reactive energy circulates between the two stages.

3. No hot spots occur along the cable.

4. The circulating current in the 7034 stage is at a minimum, and the circuit runs cooler.

To check transmitter tuning for proximity to the proper setting, the following procedure is recommended:

1. Reduce the 4CX5000A screen voltage to 400 volts. Turn off the transmitter power and remove the r-f cable from the output of the 7034 stage at the rear of the box (1J2). Note all readings.

2. Turn ON the transmitter power and tune the 7034 output tuning control (1L2) for maximum 7034 screen current. If the maximum occurs within one-quarter turn of the controls operating position, the transmitter is propecly tuned.

3. If improper tuning is indicated, leave 1L2 in its new position, turn OFF the power and reconnect the r-f cable. Turn ON the power and retune the transmitter for power output by readjusting the 7034 loading and the 4CX5000A input loading and tuning.

4. Check the new tuning by repeating the above steps.

An alternate method of adjusting the circuit is to tune the 7034 stage into an r-f load, then tune the 4CX5000A input for maximum drive without retuning the 7034 stage.

If a directional coupler is available, a quicker and more accurate check can be made. This is done by placing the coupler in the line so that it indicates reflected power. The reflected power can then be adjusted to minimum under operating conditions.

15. Turn the reflectometer control to POWER position, and adjust the PA. PLATE TUNING and OUTPUT LOADING controls for maximum power output reading on the reflectometer. In adjusting these controls, operate them individually for maximum readings. As maximum reading is being reached, take each control past the maximum reading to where the reading drops about 5%. This will compensate for interaction of controls. Finally, controls should be peaked for maximum.

16. Raise screen voltage on PA to 700 volts. Touch up PA and IPA controls (in the reverse order from the initial tuning procedure) for maximum grid drive on both stages and maximum power output.

17. Now, adjust PA screen voltage for the rated 10 kw output. Refer to the PA Efficiency Curve, Figure 9.

NOTE: It is imperative that the power amplifier is operated under optimum matching conditions. To assure this condition turn PA LOADING one-half turn to left, repeak PA TUNING and read power output. Turn PA LOADING another one-half turn, repeak PA TUNING, read power and compare with previous reading. Repeat above steps and note whether power output increases or decreases. If it increases, keep going until a point is reached beyond which power is decreasing again.

Should power decrease, however, reverse procedure and make one-half turns of PA LOADING to the right.

During these adjustments the PA screen voltage should not be changed. Whenever the screen voltage is changed *more than* about ±10%, PA LOADING and PA TUNING should again be optimized.

Power output of the transmitter is proportional to the screen voltage, but at a certain point, the output power will not increase further in spite of further increase in screen voltage. (See Figure 10.) Care should be taken not to operate beyond this point since PA efficiency will decrease rapidly if screen voltage is raised further. With sufficient drive, the tapering-off should occur at an output in excess of 10 kw at screen voltages of 800 V or more. However, insufficient drive may cause this point to shift to power levels less than 10 kw and lower screen voltages.

With the transmitter tuned and adjusted for 10 kw output, and the reflectometer switch (2S13) in the POWER position, the reflectometer (2M3) should be adjusted to read 100%. This is obtained by adjustment of the potentiometer 2R14. 2R14 is the left-hand one of two potentiometers located on a panel below the overload relays. The right-hand potentiometer is 2R15 which is used for adjustment of the remote meter with 2S13 in the REMOTE position.

TABLE III. TYPICAL "MULTI-METER" READINGS

Position of "MULTI-METER" Switch	*Reading*
OFF	0
7034	
GRID 0-50MA	9.5 ma (approx.)
CATHODE 0-500MA	220 ma (approx.)
SCREEN 0-50MA	7 ma (approx.)
SCREEN 0-500V	250 to 300 vdc
4CX5000A	
GRID 0-100MA	40 to 50 ma
SCREEN 0-500MA	50 to 140 ma
SCREEN 0-1000V	700 to 800 vdc

To read transmission line VSWR on the reflectometer, proceed as follows:

1. Turn reflectometer switch, (2S13) to VSWR CAL position, and adjust the reflectometer control (2R13) until the reflectometer reads 100%.

2. Switch reflectometer switch to VSWR position, and read directly on VSWR scale of reflectometer.

After the necessary adjustments have been made for the correct reading of the reflectometer, operate the PLATE ON/OFF control to the OFF position.

At this point the PA circuit can be checked for proper neutralization in the following manner:

1. Remove resistor 2R9 plate resistor from its mounting clips, and disconnect the 4CX5000A screen lead from feed through capacitor 2C11. See Figure 13 for the location of these components.

2. With a dummy load connected to the transmitter output, operate the PLATE ON/OFF switch to the ON position. Measure the power output of the transmitter with the SCREEN RAISE/LOWER switch adjusted to provide 300 volts on the screen of the 7034 driver tube. If the power output is greater than three watts, further adjustments of the neutralizing slides at the front of the PA tube will be required until the power output is not more than two or three watts.

WARNING

MAKE CERTAIN THAT THE PLATE CIRCUIT BREAKER (2S2) IS IN THE OFF POSITION BEFORE MAKING ANY ADJUSTMENTS INSIDE THE TRANSMITTER.

3. Disconnect the dummy load and connect the transmission line to the output of the transmitter.

OPERATION

In normal transmitter operation, the circuit breakers LINE (2S1), FILAMENT (2S3), SCREEN (2S4) and PLATE (2S2) should be left in the ON position and the crystal heaters left running continuously, unless the transmitter is to be shut down for extended periods of time. This way, it is possible to start and stop the transmitter by operating only the filament and plate circuit switches TRANS ON/OFF (2S10) and PLATE ON/OFF (2S9), respectively.

To interrupt transmission for a short interval, the PLATE ON/OFF switch should be depressed to its OFF position. This will remove plate voltage from the transmitter circuits but the filament power will remain on the tubes. The transmitter can then be returned to immediate operation when the PLATE ON/OFF switch is again closed.

> NOTE: One button control of the transmitter may be achieved by leaving the PLATE ON/OFF switch in the ON position and operating the filament ON/OFF switch. Operated in this manner the transmitter will automatically go through the necessary starting steps including time delay relay operation.

Normally, the time delay relay provides sufficient warm-up time (approximately 45 seconds) after which plate voltage can be applied. The crystal heater units, from a cold start, require several minutes warm-up time before the transmitter is operated.

If the exciter is off-frequency for any reason, the off-frequency interlock prevents application of plate voltage, by opening the circuit to the plate contactor (2K9).

Performance of the FM exciter can be checked by observing the patterns on the built-in oscilloscope while the transmitter is on the air. For typical oscilloscope patterns refer to Figure 7 in the Exciter Section of this book. These oscilloscope patterns may be observed during regular operation without affecting performance of the transmitter.

Overload Resetting

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 (2S11) on the front panel to place the transmitter back on the air.

MAINTENANCE

With ordinary care a minimum of service will be required to keep the BTF-10D in operation. However, a regular schedule of inspection and service as outlined in the Maintenance Schedule will help to avoid interruptions to broadcasts, greatly extend the life of components and contribute in large measure to overall peak efficiency in operation.

WARNING

ALWAYS OPEN THE LINE CIRCUIT BREAKER, AND DISCHARGE CIRCUITS WITH A GROUNDING STICK BEFORE TOUCHING ANY COMPONENT INSIDE THE TRANSMITTER.

Emergency Operation

Tube or component failure can be located in some cases by switching the MULTI-METER switch (2S14) on the front panel and the METER switch (S102) in the exciter to each of their positions until an abnormal reading is found, identifying the difficulty.

Failure of automatic frequency control due to a tube or other component will be evidenced by operation of the relay K101 in the exciter off-frequency control circuit which will open the plate contactor circuit of the transmitter, removing plate voltage. If the master oscillator is functioning, the output carrier frequency can be controlled manually as follows until such time as repairs can be made:

1. Remove the 2D21 OFF-FREQUENCY control tube (V116).
2. Turn the AFC-OFF switch (S101) to the OFF position.
3. Slowly rotate the top adjustment screw of T103 in first one direction and then the other to bring the output frequency to its assigned value as indicated by the station frequency monitor.

Stability of the master oscillator without afc is such that it maintains frequency to ± 1 kc (at the final frequency) for short periods of time. Possible drift can be corrected by adjustment of the top screw of T103.

> NOTE: The voltage of the filament d-c power supply in the exciter will vary with load. Therefore, care should be taken not to remove more than two of the tubes having d-c on the filament. Otherwise, damage to the remaining d-c heated tubes or to C202 in the exciter unit may result.

Emergency 4CX5000A Plate Lead

If necessary, the teflon plate lead for the 4CX5000A PA tube can be replaced by a length of RG-58/U coax cable with the outer cover and braid shielding removed.

Troubleshooting Hints

NO PA DRIVE — Check the coax cable and connections between the IPA and PA (1J2-1P2 and 2P1-2J1) for continuity and for hot spots. The cable

should be near ambient temperature. Examine capacitors 2C4, 2C15 and 2C33 for hairline cracks. If cracks are found, the capacitor is defective and should be replaced.

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 a corona discharge. Clean insulators by using a soft clean cloth and Chlorothene.*

Circuit Breakers and Relays

Periodic inspection of circuit breakers and relays should be made, and at such time, contacts should be cleaned and adjusted if necessary. Relay contacts should be cleaned with Chlorothene 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, contacts should be wiped with a clean piece of bond paper.

Tubes

All tubes should be checked periodically. Tube failure can be anticipated by keeping a log of tube life, and replacing tubes as indicated by the log or when reduced output is apparent.

Silicon Rectifiers

The condition of the silicon rectifiers may be checked by measuring the resistance of each cell of the high voltage rectifiers with an ohmmeter. The forward resistance of each cell should measure approximately 25 ohms while the reverse resistance should measure 20,000 ohms $\pm 5\%$. Unless the reverse resistance reading of a cell is abnormally low, the 22,000 ohm resistor shunting each one need not be disconnected. The condition of an entire cell bank may be checked simply by measuring the resistance of one cell as directed above, then multiplying this value by the number of cells in the bank. Measure the resistance across the bank; if the measured total differs appreciably from the computed figure, one or more defective cells are indicated. To determine which cell (or cells) is defective, follow the above procedure for checking individual cells.

* Because of the toxic effects of carbon tetrachloride, the use of Chlorothene is recommended. Chlorothene is a Dow Chemical Co. Product, and is available through that company's outlets.

Recommended Maintenance Schedule

Daily

1. Check and compare all meter readings at start-up. Adjust filament voltages if necessary. Correct any conditions revealed by abnormal readings.
2. Check filament voltages every hour for increased tube life.
3. Make general visual inspection after shut-down.
4. If overloads have occurred, examine at shut-down, components involved. Repair or replace as necessary.

Weekly

1. Clean internal parts of transmitter. Use clean soft cloth on insulators. Use vacuum cleaner or hand blower for removing dust and dirt.
2. Test all door interlocks and grounding switches.
3. Check PA and output r-f circuits for evidence of heating at connector or junction points.
4. Make overall check of distortion and noise level.

Monthly

1. Check spare crystal in operating crystal socket.
2. Check condition of relay contacts. Service if necessary.
3. Check tube socket voltages in exciter. Compare with previous readings.
4. Inspect air filter. Clean if necessary, using vacuum cleaner or brush.

Quarterly

Lubricate tuning drive mechanism gears and bearings. Use petrolatum, Lubriplate No. 110, or equivalent.

Semi-Annually

1. Inspect relay contacts and replace where required.
2. Test spare tubes.
3. Tighten all connections in transmitter.

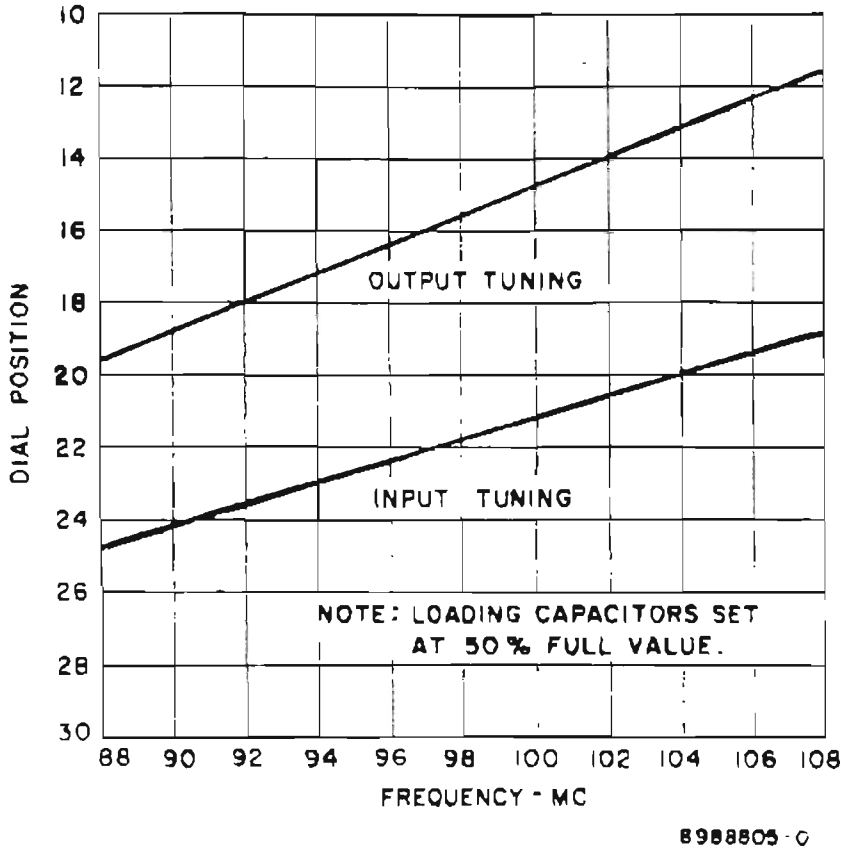


Figure T-5. IPA Tuning Curve

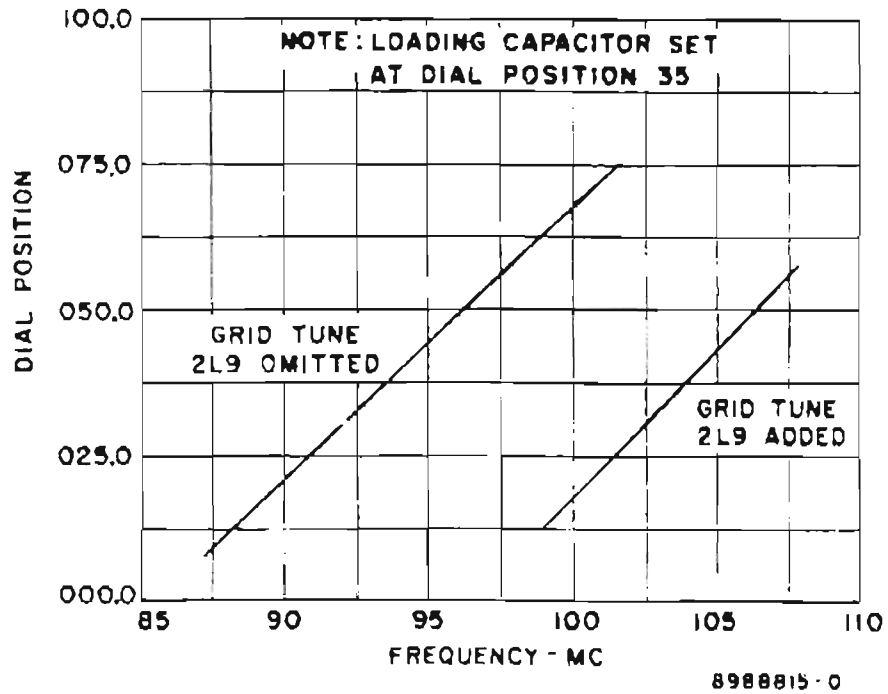


Figure T-6. PA Grid Tuning Curve (2L8)

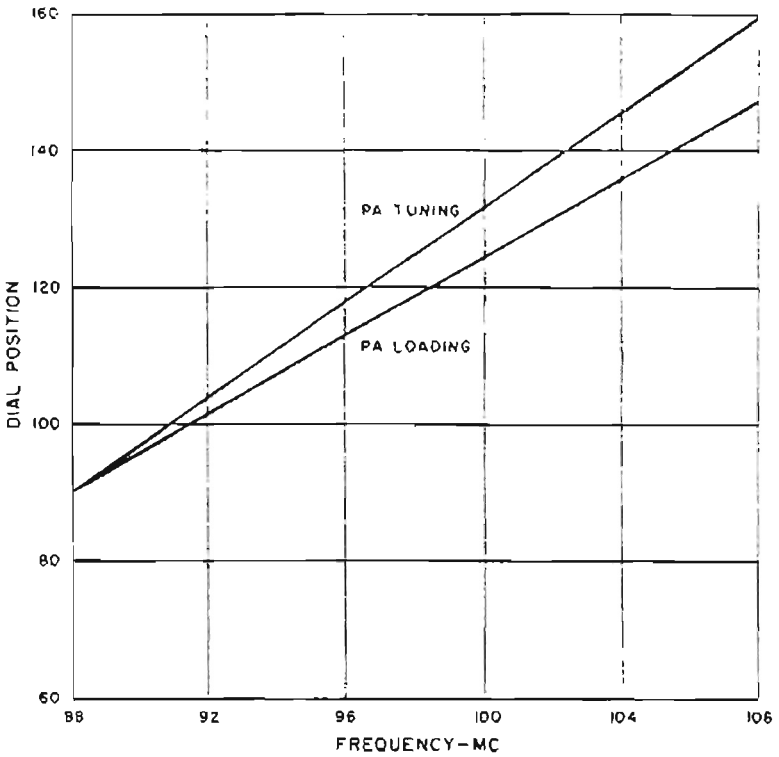


Figure T-7. PA Plate Tuning and Plate Loading Curve

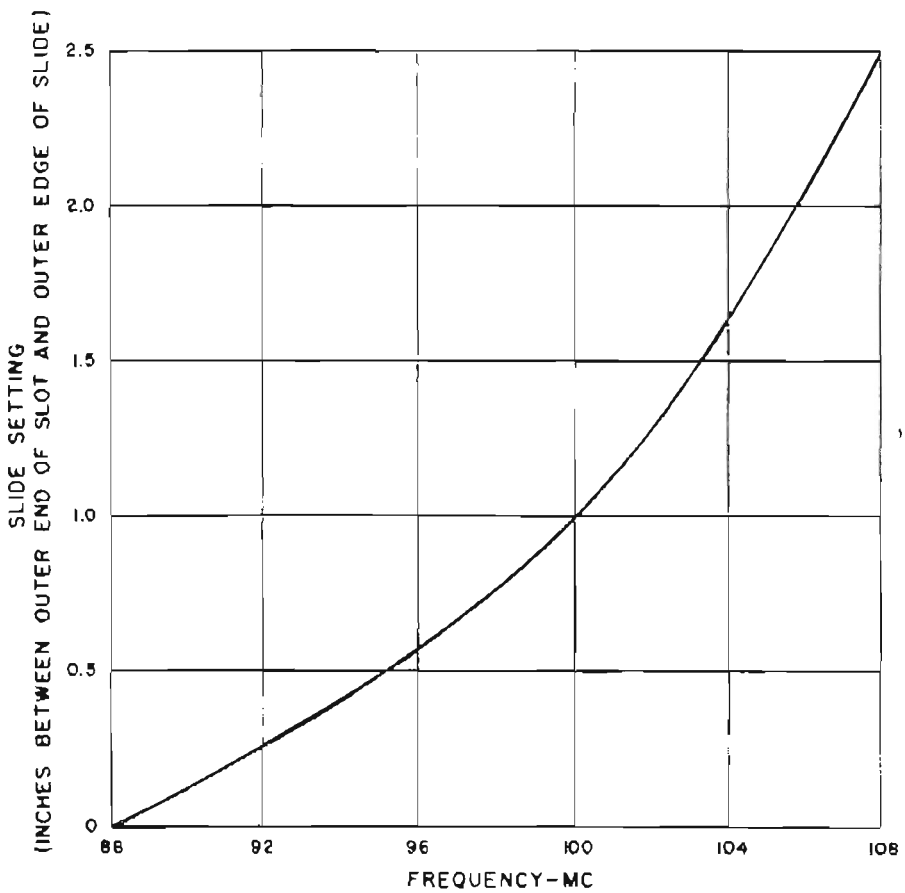


Figure T-8. PA Screen Neutralizing Adjustment

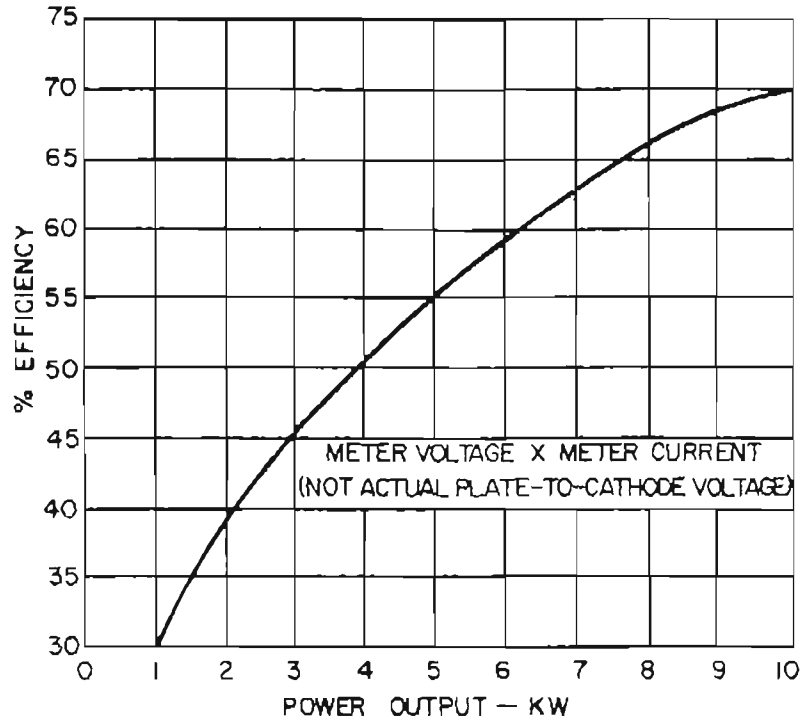


Figure T-9. PA Efficiency Curve

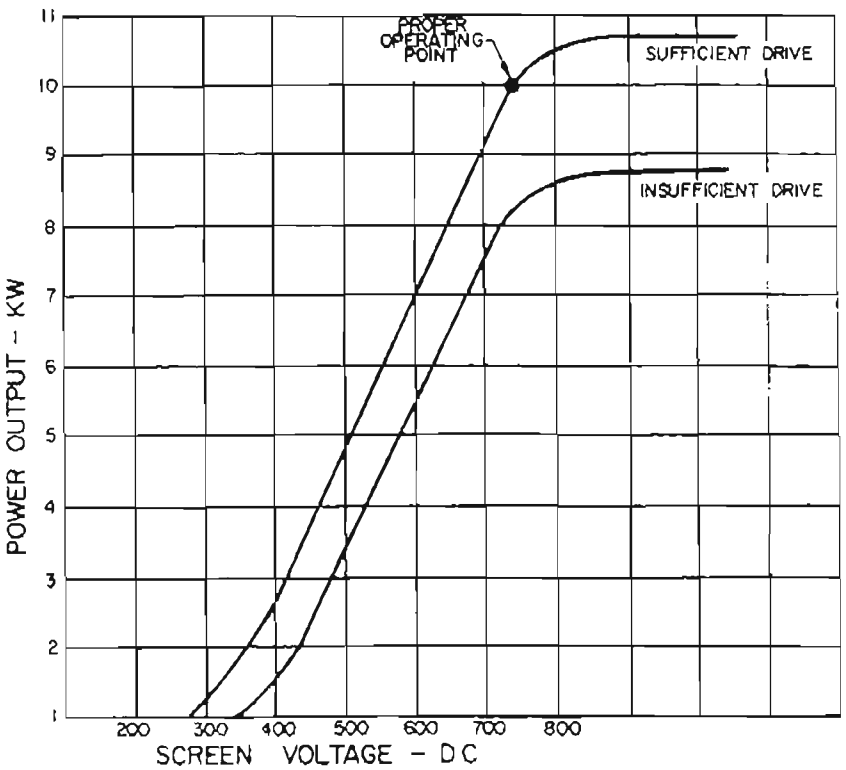


Figure T-10. Screen Voltage vs. Power Output Curve

LIST OF PARTS

Symbol No.	Stock No.	Drawing No.	Description
			250 WATT R.F. UNIT, MI-34502-A
			CAPACITORS:
1C1	217634	8971908-1	variable, 4.5-102 μμf
1C2	215859	8821367-1	HV ceramic, 25 μμf ±5%, 7500 v
1C3	217636	8825449-2	ceramic, feed-thru, 470 μμf ±20%, 500 v
1C4	95707	984002-361	silver mica, 1000 μμf ±10%, 500 v
1C5	217636	8825449-2	ceramic, feed-thru, 470 μμf ±20%, 500 v
1C6	95707	984002-361	silver mica, 1000 μμf ±10%, 500 v
1C7	217636	8825449-2	ceramic, feed-thru, 470 μμf ±20%, 500 v
1C8	95707	984002-361	silver mica, 1000 μμf ±10%, 500 v
1C9			Capacitor (part of 1XV1)
1C10	95707	984002-361	silver mica, 1000 μμf ±10%, 500 v
1C11	217636	8825449-2	ceramic, feed-thru, 470 μμf ±20%, 500 v
1C12	221716	8889785-2	ceramic, feed-thru, 1000 μμf ±20%, 3000 v
1C13	217634	8971908-1	variable, 4.5-102 μμf
1C14	211186	479072-1	ceramic, 1000 μμf -20 +40%, 2500 v
1C15 to 1C18	217636	8825449-2	ceramic, feed-thru, 470 μμf ±20%, 500 v
1J1, 1J2	92180	433647-1	Receptacle: female
1L1	217633	8956317-2	Coil: 3 turns 3/16 O.D. tubing, silver plated
1L2	217632	8956317-1	Coil: 4 turns, 3/16 O.D. tubing, silver plated
1L3	222952	898552S-501	Choke: R.F.
1P104	32661	878243-1	Connector: female
1P105	55808	727969-8	Connector: female
1R1		99126-69	Resistor: fixed, comp., 3900 ohms, ±5%, 2 w
1R2	217635	8871557-63	Resistor: fixed, wire wound, 40 ohms, ±1%, 2 w
1R3	96728	8857185-8	Resistor: fixed, wire wound, 200 ohms, ±5%, 25 w
1R4	217615	8871557-64	Resistor fixed, wire wound, 4 ohms, ±1%, 2 w
1R5	210366	99033-38	Resistor: fixed, wire wound, 5000 ohms, ±10%, 95 w
1R6	207818	99033-36	Resistor: fixed, wire wound, 3150 ohms, ±10%, 95 w
1R7	217635	8871557-63	Resistor: fixed, wire wound, 40 ohms, ±1%, 2 w
1R8		99126-51	Resistor: fixed, comp., 120 ohms, ±10%, 2 w
1S1, 1S4	54920	8881052-1	Switch: interlock
1S2	217631	8953364-502	Switch: grounding
1S3	95677	8822758-2	Switch: airflow
	221810		Switch - only 250 v A.C.
1S5	216022	8953364-501	Switch: grounding
1T1	215512	8412123-1	Transformer: fil., single phase 208/240 v, 50/60 cy.
1XV1	215844	464586-2	Socket: air system
	99933	464586-3	Chimney only
			Miscellaneous:
		757412-506	Cable Assembly
	96579	146978-502	Connector - male coaxial
	212885	8905991-1	Connector - male coaxial
	211104	477946-502	Contact Assembly: front panel, horizontal mounted
	215855	8413444-502	Contact Assemoly: front panel, vertical mounted
	217665	8822780-31	Hose: flexible, rubber 47½" lg. x 1½" I.D.
	94641	8914329-1	Receptacle: female, turnlock fastener
	219131	8510265-1	Screw: lead, teflon (for 1L1 and 1L2)
	223100	8518085-501	Support Assembly
			10 KW AMPLIFIER, MI-34554
2B1		8616009-1	Blower - (MI-34556)
	221586	8616009-2	Motor - 3/4 H.P. 3450 RPM 230 V 50/60 cycles
	221587	8616009-5	Belt - drive
	221588	8616009-4	Pulley - 5/8" dia. bore
	221589	8616009-5	Pulley - 3/4" dia. bore
	221590	8616009-7	Mounting - Shock (See plate, stock no. 222330, below)
	222330	8989877-2	Plate - (order with 221590 shock mounts for early BTF-10C Transmitters only)
2B2	215552	480051-1	Motor: 115 v, 60 cycle
			CAPACITORS:
2C1	55018	863691-2	motor circuit, 1.2 μf, 220 v

Symbol No.	Stock No.	Drawing No.	Description
2C2	214696	8821367-4	hi-voltage, 100 μμf ±5%, 5000 v ceramic
2C3	217634	8971908-1	variable, 4.5-102 μμf
2C4	211186	479072-1	ceramic, 1000 μμf +40 -20%, 2500 v
2C5	221716	8889785-2	grid feed-thru, 1000 μμf ±20%, 2000 v
2C6, 2C7	54643	8881825-1	fil. feed-thru, .01 μf ±20%, 250 v
2C8	810004-4	36091-523	amp. meter by-pass 0.01 μf ±20%
2C9	217651	8973315-501	plate, by-pass
	217658	8436554-501	contact assembly
2C10	217653	8971927-2	ceramic, 50 μμf, 15,000 v
2C11	221716	8889785-2	grid feed-thru, 1000 μμf ±20%, 2000 v
2C12			mica, 0.005 thk, test voltage 2000 v
	217645	8971914-1	mica only
2C13, 2C14	810004-4	36091-523	by-pass 0.01 μf ±20%
2C15	211186	479072-1	ceramic, 1000 μμf +40 -20%, 2500 v
2C16	810004-4	36091-523	amp. meter by-pass 0.01 μf ±20%
2C17, 2C18, 2C19	209037	990193-108	paper, 8 μf ±10%, 3000 v
2C20	810004-4	36091-523	amp. meter by-pass 0.01 μf ±20%
2C21	220328	990194-51	3 μf ±10%, 7500 v (paper)
2C22			Not Used
2C23, 2C24	52758	990193-46	paper, 4 μf ±10%, 500 v
2C25	217653	8971927-2	ceramic, 50 μμf, 15,000 v
2C26			Fil., by-pass
	217647	8708499-501	plate assembly
	217643	8971960-1	mica only
2C27			Fil., by-pass
	217647	8708499-501	plate assembly
	217644	8971960-2	mica only
2C28 to 2C30	211186	479072-1	ceramic, 1000 μμf +40 -20%, 2500 v
2C31	97151	8889035-2	ceramic, 390 μμf ±10%, 8000 v
2C32, 2C33	211186	479072-1	ceramic, 1000 μμf +40 -20%, 2500 v
2C34	218954	8976374-1	paper, .001 μf, 10,000 v
2C35	219175	450184-4	paper, 10 μf, 400 v
2C36		990167-19	ceramic, 10,000 μμf +100 -0%, 500 v
2CR1, 2CR2	217866	8462374-1	Rectifier: single phase, center tap
2CR3, 2CR4			Not Used
2CR5, 2CR6	67876		Part of 2Z1 (1N21B)
2CR7	220285	8722935-502	Rectifier low voltage (complete with diodes)
2CR8 to 2CR11		8720774-501	Rectifier: assembly
	218347	8438545-1	Rectifier: silicon (10 req'd. per assem.)
	218346	8438545-2	Rectifier: silicon (10 req'd. per assem.)
2CR12 to 2CR17		8720774-502	Rectifier Assem.
	218347	8438545-1	Rectifier: silicon
	218346	8438545-2	Rectifier: silicon
2DS1		459610-10	Light: indicator overload
	99767	459610-33	Jewel - yellow
	16154	459610-36	Lamp
	16155	459610-40	Resistor
	99763	459610-46	Socket
2DS2		459610-8	Light - indicator plate on
	99765	459610-31	Jewel - red
	16154	459610-36	Lamp
	16155	459610-40	Resistor
	99763	459610-46	Socket
2DS3		459610-12	Light - Indicator interlock
	99768	459610-35	Jewel - Blue
	16154	459610-36	Lamp
	16155	459610-40	Resistor
	99763	459610-46	Socket
2DS4		459610-9	Light - Indicator filament
	99766	459610-32	Jewel - Green
	16154	459610-36	Lamp
	16155	459610-40	Resistor
	99763	459610-46	Socket
2J1	92180	433647-1	Receptacle: female connector
2K1	210404	754291-1	Relay - H.V. overload
2K2, 2K3			Not Used
2K4	215614	8411073-5	Relay - 45 sec. time delay filament
2K5	210404	754291-1	Relay - screen supply overload

Symbol No.	Stock No.	Drawing No.	Description
2K6	210404	754291-1	Relay: 7034 ov[illegible]d
2K7	217619	458561-8	Relay: 2 sec. time delay overload
2K8	216987	486126-2	Relay: notching
2K9	216989	482711-6	Connector: plate
2K10	216991	480003-4	Relay: plate latching
2K11	216988	8412197-1	Contactor - filament
2K12	217606	627511-49	Contactor - Control
2K13	216934	8412197-2	Contactor - Blower
2K14	216991	480003-4	Relay - filament latching
2K15	210404	754291-1	Relay - 4CX5000A overload
2K16	217572	627511-55	Relay - Bias interlock
2L1			Not Used
2L2			Choke:- plate
2L3	95316	900431-4	Choke:- plate filter
2L4, 2L5	93658	949251-1	Reactor - 10 henrys
2L6 to 2L9			Part of plate tuning, plate loading, grid tuning assemblies and grid tuning inductor respectively
2L10		8976344-501	Coil: bus wire 3½ turns 1.06" O.D. 128" dia.
2L11	221173	8449712-1	Reactor - filter
2M1	217732	482744-10	Meter - plate 0-3 amps
2M2	220321	482744-32	Meter - plate 0-10 KV
2M3	217528	8436526-1	Meter - reflecto meter
2M4	217359	8959099-1	Meter - multiplier
2M5	216023	459672-129	Meter - line
2M6	217527	8971909-1	Meter - hour
			RESISTORS:
			Fixed, Composition - Unless Otherwise Specified
2R1	220324	993007-9	0.25 ohm, ±10%, 5 w
2R2			Not Used
2R3	217609	867971-327	wirewound, 3.6 ohm, ±10%, 1 w
2R4, 2R5	217652	8917168-2	150 ohm, ±5%, 70 w
2R6	54624	99031-31	1000 ohm, ±5%, 55 w
2R7	217616	8871557-65	wire wound, 20 ohm, ±1%, 2 w
2R8 to 2R10	204309	8888772-22	wire wound, 20 ohm, ±10%, 200 w
2R11	220319	8702674-512	Resistor assembly
	52819	8702674-3	resistors only 500,000 ohm ±1%, ½ w
2R12		90496-82	47,000 ohm, ±5%, 1 w
2R13	205064	433196-6	variable, 10,000 ohm, ±10%, 2 w
2R14	217618	433196-14	variable, 10,000 ohm, ±10%, 2 w
2R15	215733	433196-51	variable, 1000 ohm, ±10%, 2 w
2R16	217615	8871557-64	wire wound, 4 ohm, ±10%, 2 w
2R17	52819	8702674-3	0.5 megohm, ±1%, ½ w
2R18			Not Used
2R19	52819	8702674-3	0.5 megohm, ±10%, ½ w
2R20	217617	8871557-66	wire wound, 2000 ohm, ±1%, 2 w
2R21	216026	99037-47	wire wound, 40,000 ohm, ±10%, 200 w
2R22	220326	99037-36	wire wound, 3100 ohm, ±10%, 200 w
2R23	45983	99037-33	wire wound, 1600 ohm, ±10%, 200 w
2R24	220325	99037-32	wire wound, 1200 ohm, ±10%, 200 w
2R25	217612	99029-55	wire wound, .5 ohm, ±10%, 45 w
2R26 to 2R29			Not Used
2R30	52819	8702674-3	.5 meg, ±10%, ½ w
2R31, 2R32		90496-82	47,000 ohm, ±5%, 1 w
2R33	61011	867971-329	wire wound, 4.3 ohm, ±10%, 1 w
2R34	220327	8871557-56	940 ohm, ±1%, 1 w
2R35	211616	993007-100	9000 ohm, ±5%, wire wound, 5 w
2R36	48568	993008-81	1000 ohm, ±5%, wire wound, 10 w
2R37	220286	99029-36	3100 ohm, ±5%, 45 w
2R38	217608	993007-18	wire wound, 0.71 ohms, ±10%, 5 w
2R39	217614	8871557-53	wire wound, 1250 ohms, ±1%, 1 w
2R40		90496-50	100 ohms, ±10%, 1 w
2S1	220323	8434081-3	Breaker - 100 A
2S2	220322	8434081-2	Breaker - 70 A
2S3	217622	482740-5	Breaker - 15 A, 2 pole, 240 v, 50/60 cycle

Symbol No.	Stock No.	Drawing No.	Description
2S4	215946	482740-1	Breaker - 5 A, 2 pole, 240 v, 50/60 cycle
2S5	211742	8836936-11	Thermoswitch - overload (less heaters)
	217664		heater only (style - 1532948)
2S6 to 2S8	54920	8881052-1	Switch - interlock, 2 pole, 110 v, ac, 15 amps
2S9 to 2S12	211065	738998-5	Switch - key lever, power type, 1" F contact, 2 way
2S13	217607	426010-10	Switch - 1 sec., 5 pos. reflecto meter
2S14	217625	480092-3	Switch - rotary, 5 sec., 8 pos. multiplier meter
2S15	217621	4610205-8	Switch - rotary, 2 sec., 4 pos.
2S16 to 2S18	216022	8953364-501	Switch - Assembly H.V. grounding
	221848	8953366-501	Spring assem.
	220313	8953372-1	Contact
	210281	426767-9	Insulator
2S19		8822758-1	Switch - air flow, interlock
	221810		Switch
	221811		Vane - #1800
2T1	221266	8448402-1	Transformer - plate
2T2	215944	8415073-4	Transformer - control
2T3	212937	992085-1	Transformer - B.B.
2T4	90148	457084-1	Transformer - powerstat
2T5	215553	482736-1	Transformer - screen
2T6	90148	457084-1	Transformer - powerstat screen
2T7	217021	8411065-2	Transformer - 4CX5000A filament
2T8 to 2T13			Not Used
2T14	217550	8436506-1	Transformer - bias
2XV1	217037	644382-1	Socket - 4CX5000A consisting of:
	220957	644382-3	Contact - screen grid
	220958	644382-4	Contact - control grid
	220959	644382-5	Contact - outer filament
	220960	644382-6	Contact - inner filament
2Z1	220320	8434079-3	Coupler - Directional
			Miscellaneous:
	214657	885655-10	Bearing
	214658	188183-12	Bearing
	42736	99045-4	Clip - for .812" dia. ferrule
	52717	7862770-1	Clip - for 1-1/8" dia. ferrule
	211161	8904324-1	Contact
	217650	8971916-503	Contact Assembly - 2L8
	217646	8971915-501	Contact Assembly - screen cont cts, 4CX5000A
	217649	8971916-502	Screen Contact - 4CX5000A - 2L6 /2L7
	57339	880947-1	Coupling - insulated
	215847	477962-1	Drive - right angle
	95160	888488-3	Filter
	97459	426763-3	Insulator - .425" lg. x 3/4" dia. steatite bushing
	217657	426771-12	Insulator - 1" lg. x 3/8" sq. post
	208116	426765-12	Insulator - 1" lg. x 3/8" dia. steatite, cylindrical
	97457	426767-3	Insulator - 1" lg. x 3/4" dia. steatite, cylindircal
	210281	426767-9	Insulator - 1-1/2" lg. x 3/4" dia. steatite cylindrical
	209711	426773-9	Insulator - 1-1/2" lg. x 3/4" sq. steatite square post
	209929	426773-12	Insulator - 2" lg. x 3/4" sq. steatite, square post
	51781-4	426762-6	Insulator - 1-1/2" lg. x 1" x 1.2" steatite, conical
	208116	426767-12	Insulator - 2" lg. x 3/4" dia. steatite cylindrical
	208005	426775-12	Insulator - 2" lg. x 1" sq. steatite square post
	99043	426762-9	Insulator - 2" lg. x 1-1/8" x 5 8" steatite conical
	215877	737820-505	Knob - for 2H13, 2S13, 2S14
	17269	737820-501	Knob - for 2S15
	58057	737820-506	Knob - for 2T4
	206706	8879208-2	Pad
	94641	8914329-1	Receptacle - Fastener
	217655	8944292-8	Screw - lead
	217654	8944292-7	Screw - lead
	98480	8886047-3	Washer - retaining
	99376	449642-28	Fastener only
	223103	8814044-2	Wire - teflon, silver coated 7-20 .285 O.D. (3" lg.)
INSTALLATION MATERIAL, MI-34553			
2CR12 to 2CR17		8720774-502	Rectifier Assembly

Symbol No.	Stock No.	Drawing No.	Description
	218347	8438545-1	Rectifier, silicon (3 req'd. per assem.
	218346	8438545-2	Rectifier: silicon (3 req'd. per assem.)
	57077	887449-501	Arm - assembly, crank
	221127	8820789-4	Boot
	55913	8824489-8	Clamp - hose
	211286	8918002-501	Crank - assembly tuning
	53592	877065-1	Knob -(for crank assembly)
	223103		Cable - teflon (high voltage lead)

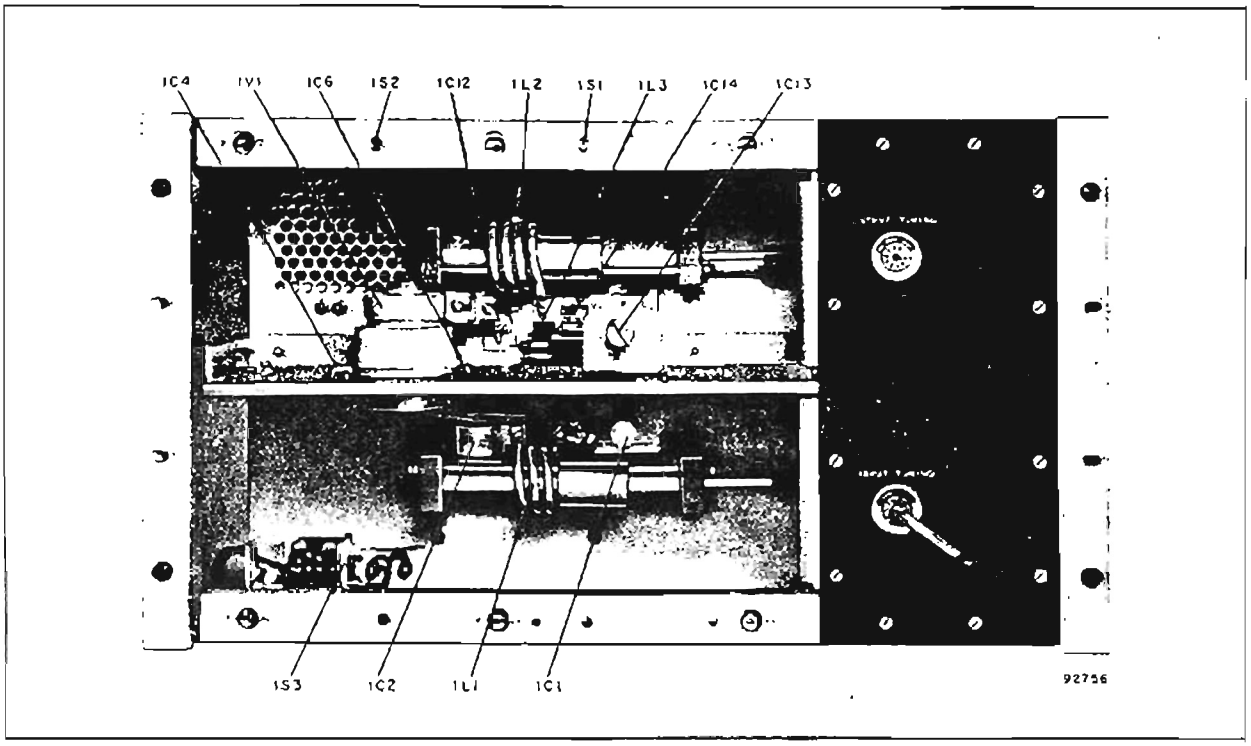


Figure T-15. BTF-10D 250-Watt IPA, Front Panel Removed

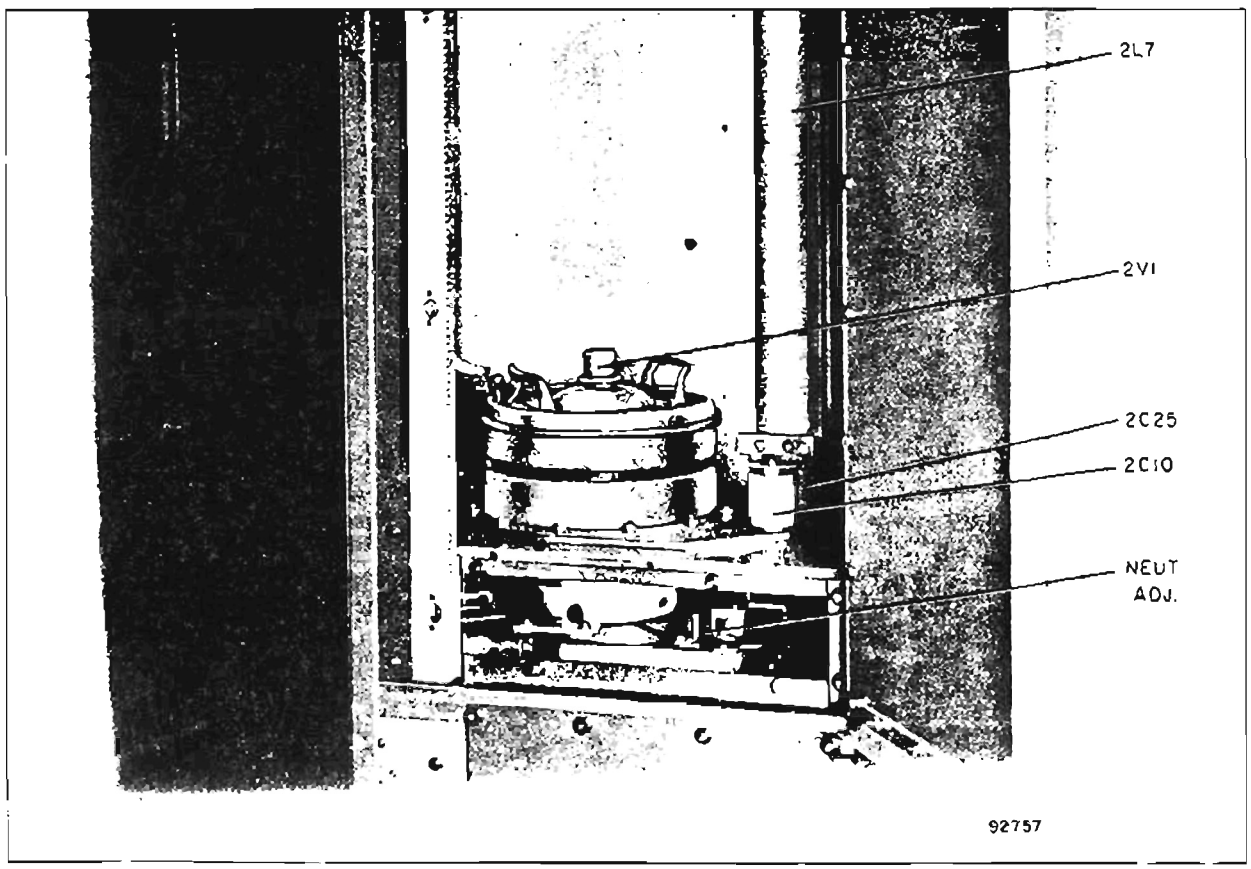


Figure T-16. BTF-10D Power Amplifier, Open Door View

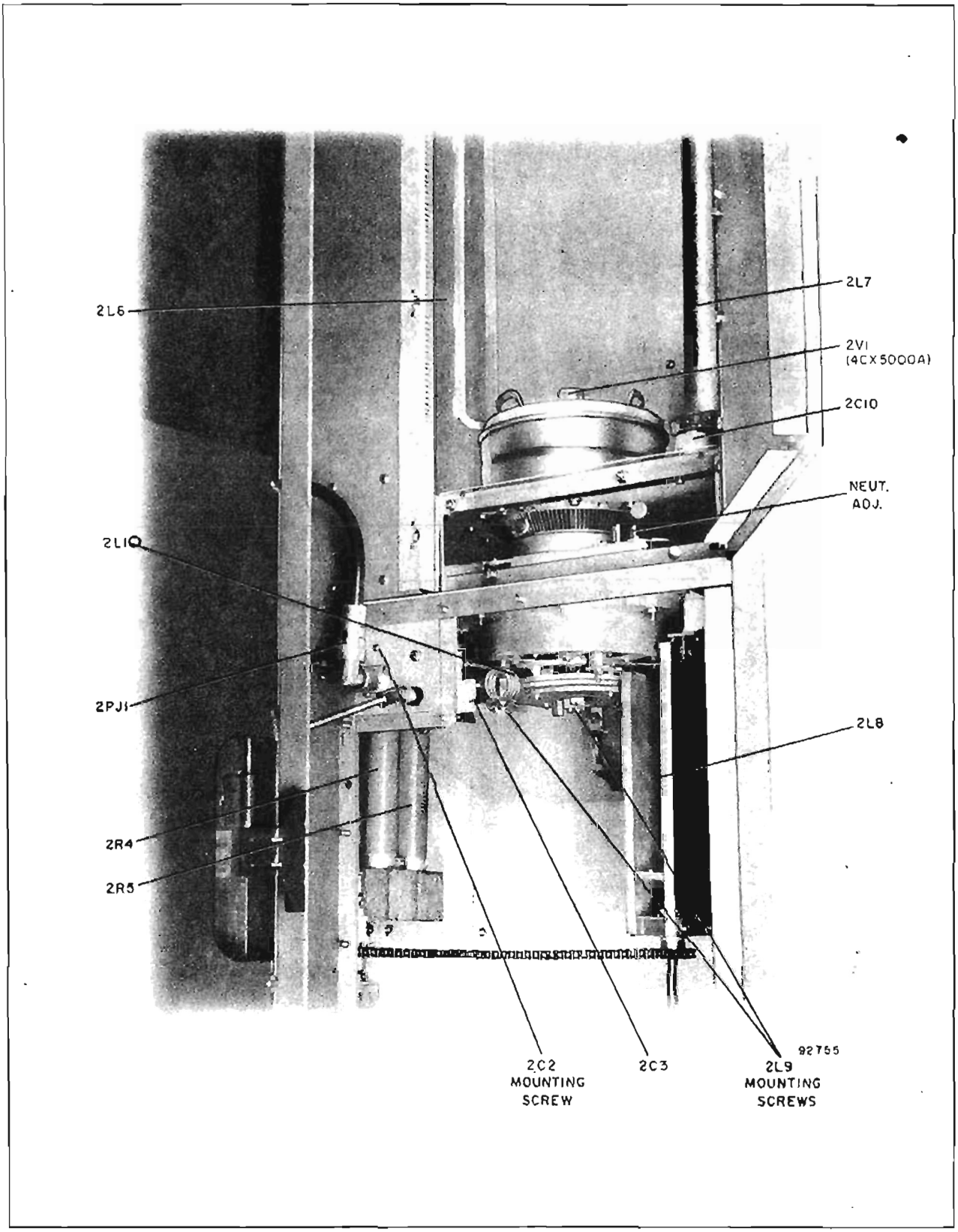


Figure T-17. BTF-10D Power Amplifier, Door Open, Panel Removed

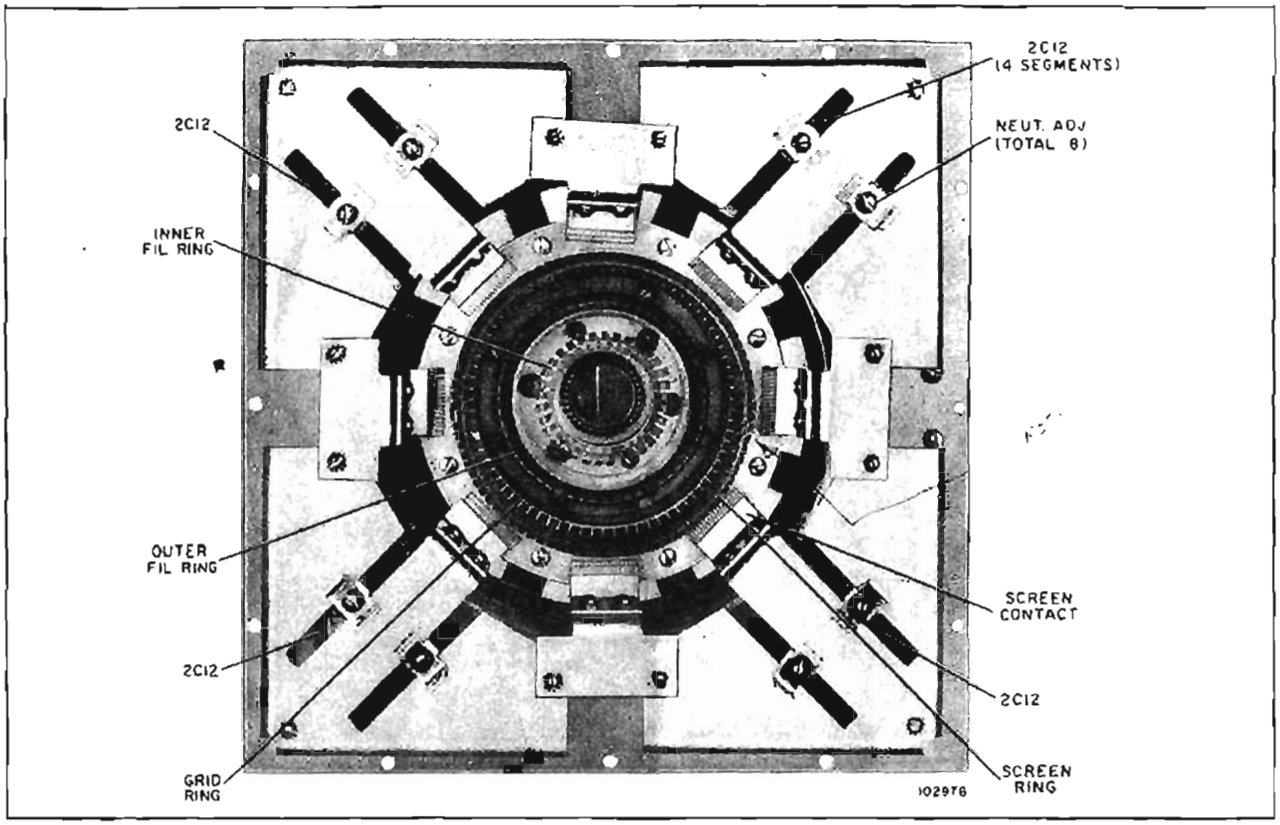


Figure T-18. PA Tube Socket, Top View

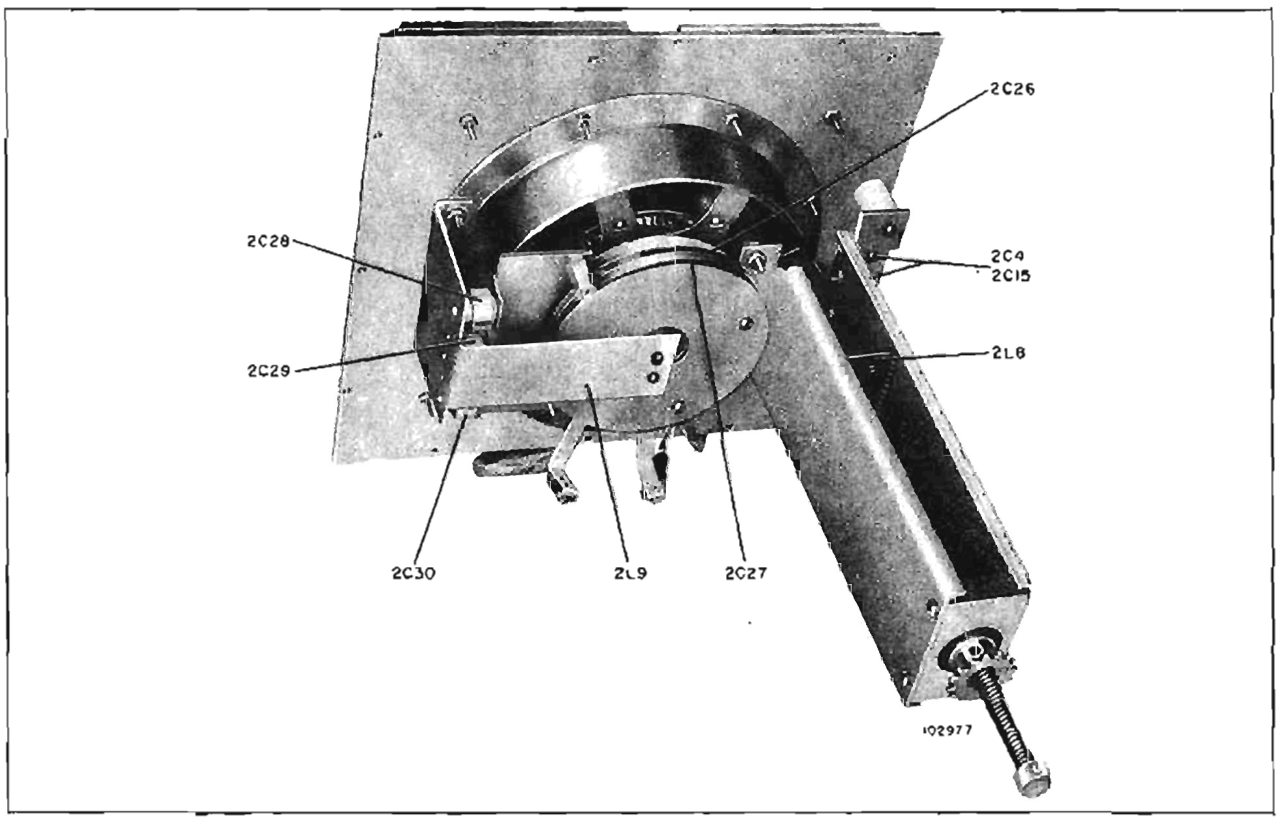
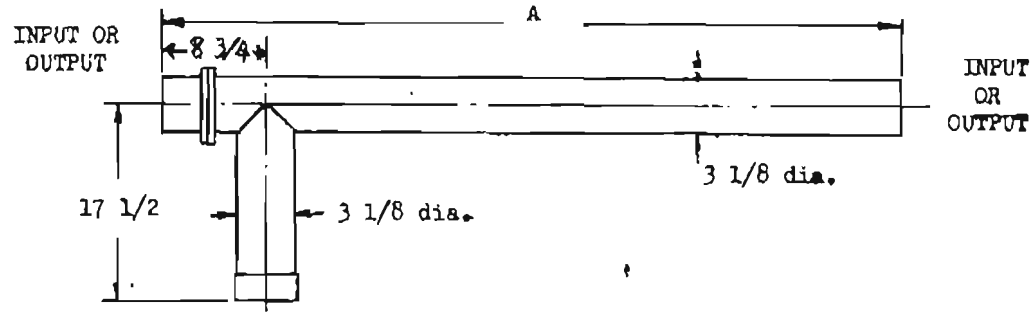


Figure T-19. PA Tube Socket, Bottom View

MI-27967 FM HARMONIC FILTER



Mechanical Specifications

Mounting:	Horizontal position recommended. Recommended location near transmitter output.
Ambient Temperature:	45°C max.
Weight	64 lbs.

Frequency	*A*	*Designation*
88 to 98 MC	140.29	MI-27967-1
98 to 108 MC	129.38	MI-27967-2

Electrical Specifications

Frequency:	88 to 108 MC
Max. Power:	10 KW (7500 ft. max. altitude)
Input & Output:	50 ohms, 3-1/8 coaxial line MI-27912
VSWR:	1.10 or better
Attenuation:	30 db through seventh harmonic
Effenciency at Assigned Frequency:	98%

Accessories

Reducer 3-1/8 to 1-5/8 coaxial line - MI-19113-C-7
Coupling, straight 3-1/8 coaxial line - MI-27912-4
Insert - MI-19313-10

8-8438590

Figure T-20. Harmonic Filter, Technical Summary

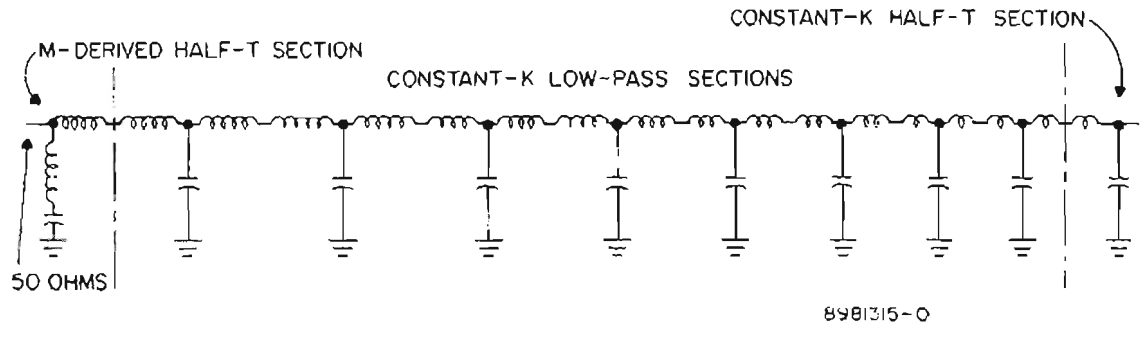
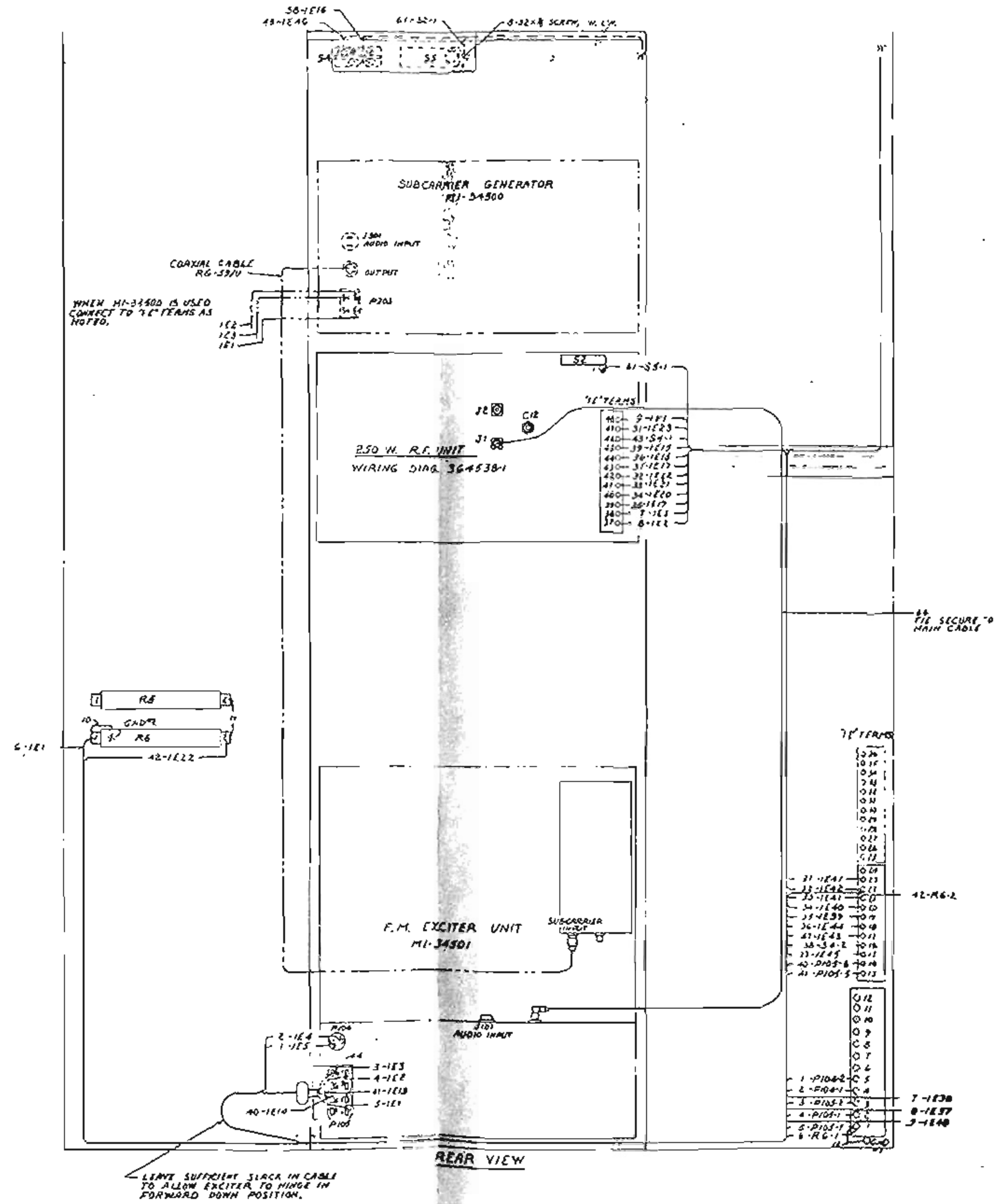


Figure T-21. Harmonic Filter, Schematic Diagram



WIRE TABLE			
WIRE NO. INCLUSIVE	DESCRIPTION	REF. NOTE ITEM NO.	WIRE NUMBERS NOT USED
1 TO 12	WIRE [illegible]	69	
31 TO 44	WIRE BLK [illegible]	70	
61	WIRE [illegible]	71	

Figure T-22. Interconnection Diagram, BTF-10D (364539)

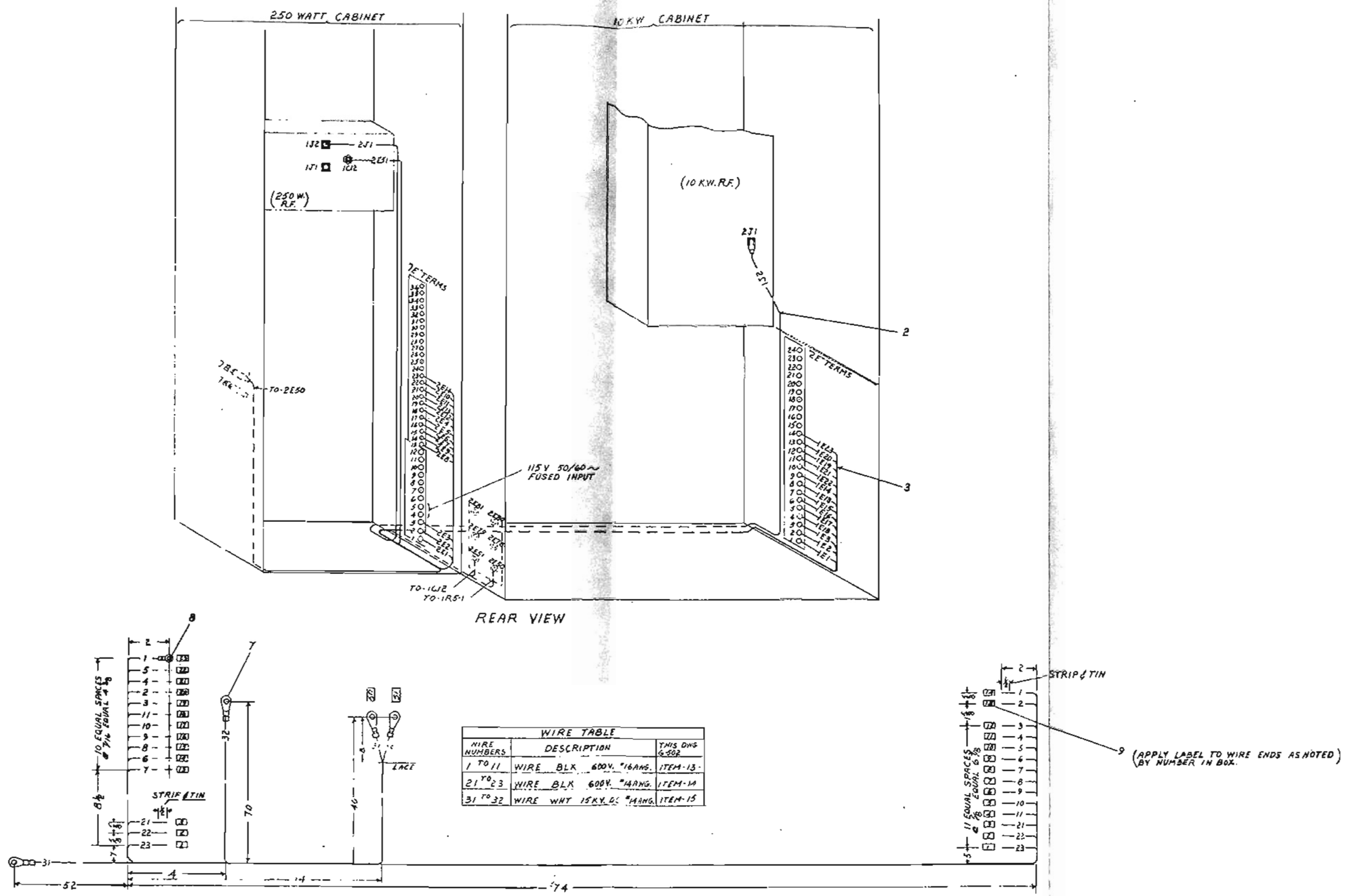


Figure T-23. Cable Assembly and Connections (86160181)

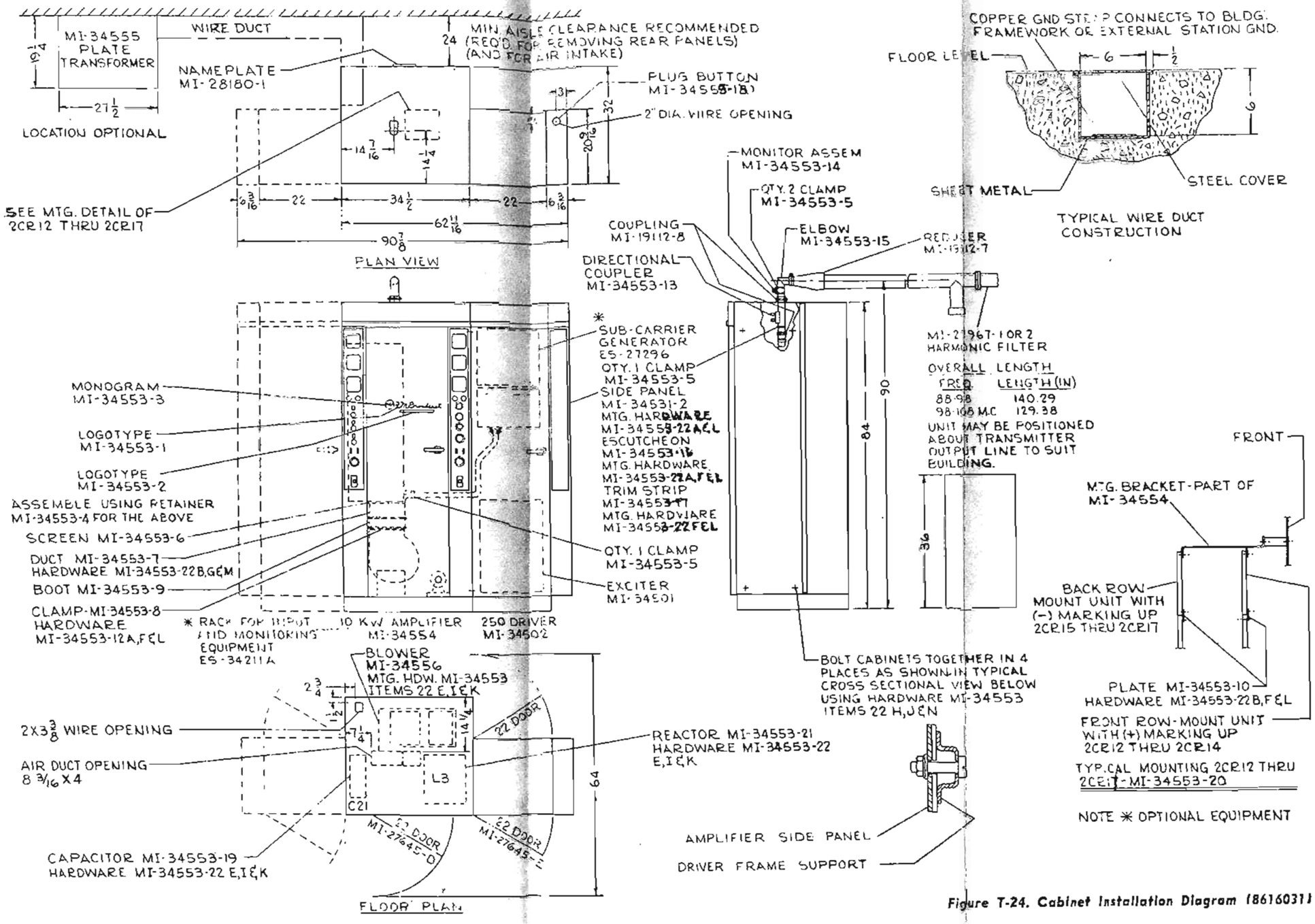


Figure T-24. Cabinet Installation Diagram (8616031)

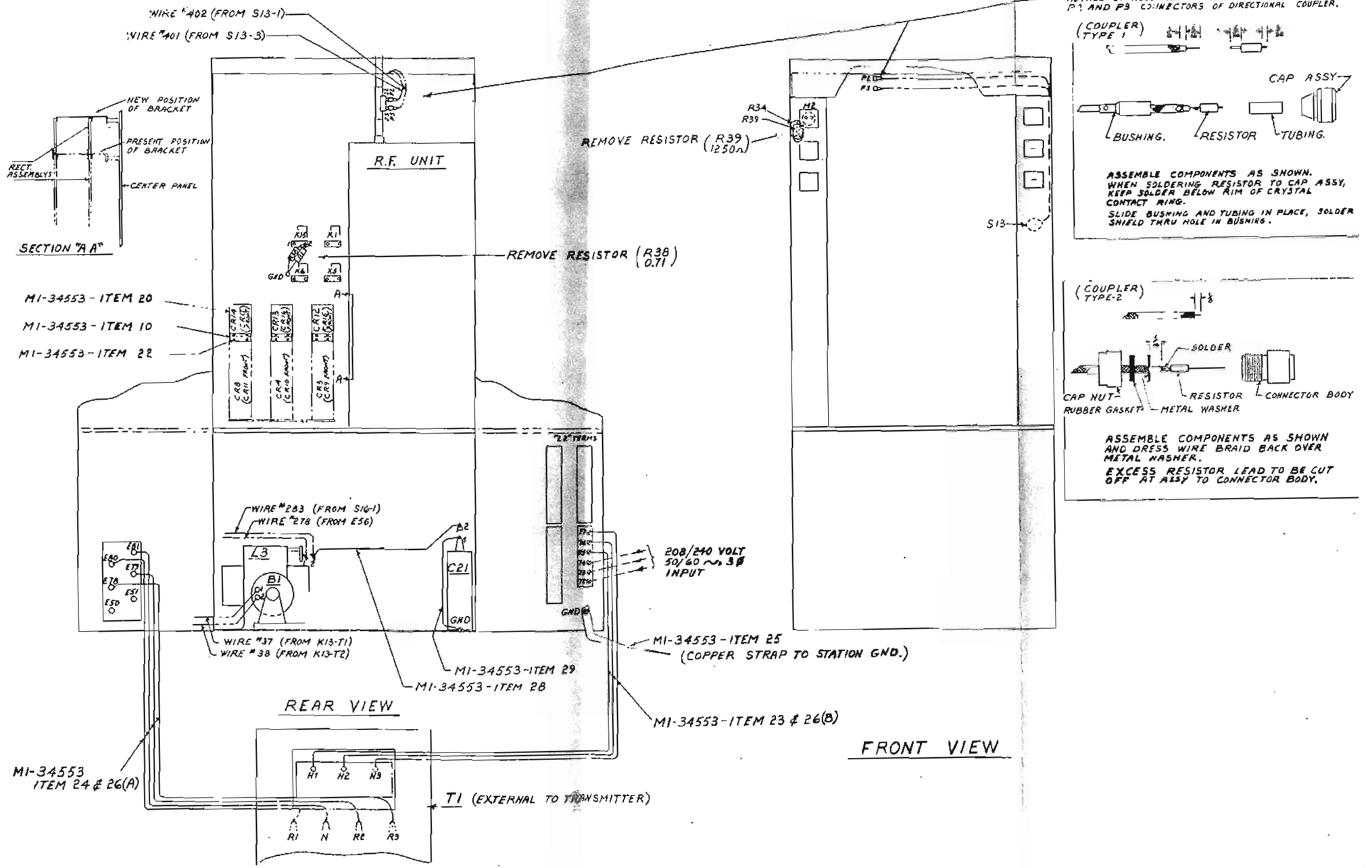


Figure T-25. Installation Wiring 186160721

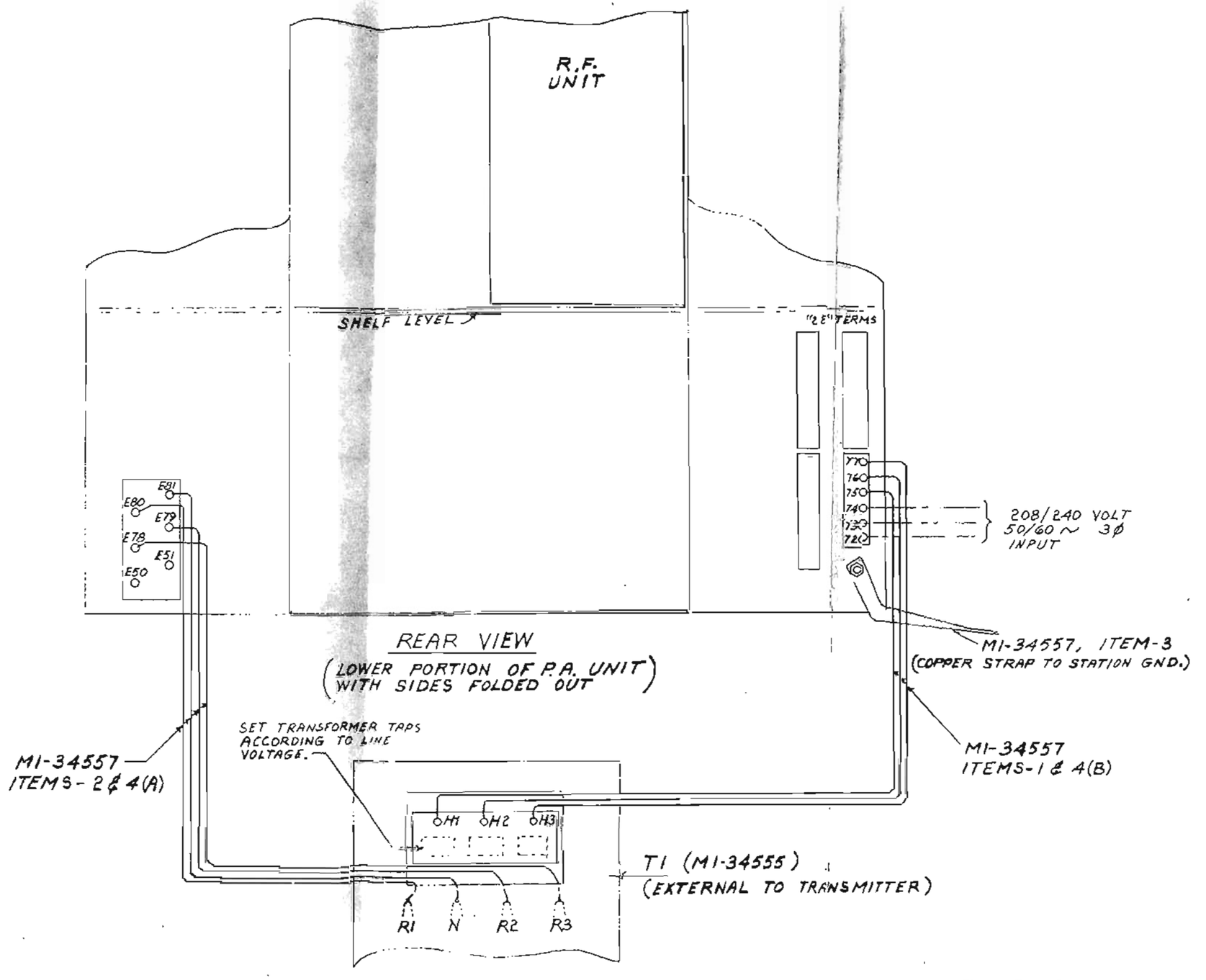


Figure T-26. Installation/Wiring, Plate Transformer (87296011)

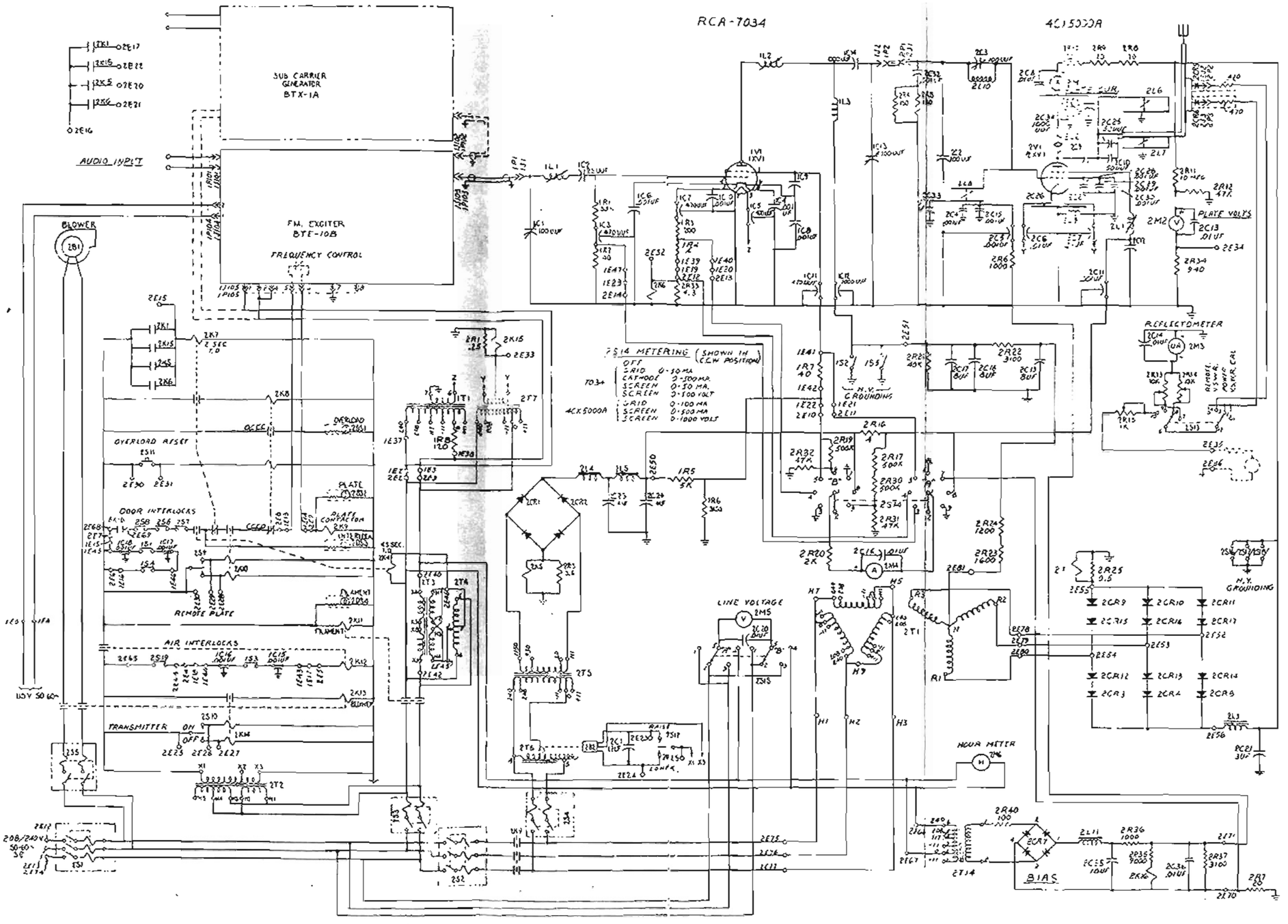


Figure T-27. Overall Schematic Diagram, BTF-10D (8312960)

Symbol No.	Stock No.	Drawing No.	Description
P104	32661	878243-1	Connector - female
P105	55808	727969-8	Connector - female
P106	214186	427992-1	Connector - coaxial, male
			RESISTORS:
			Fixed, Composition - unless otherwise specified
R101, R102		82283-141	180 ohms ±5%, ½ w
R103		82283-147	330 ohms ±5%, ½ w
R104, R105		82283-141	180 ohms ±5%, ½ w
R106, R107		82283-133	82 ohms ±5%, ½ w
R108		82283-76	15,000 ohms ±10%, ½ w
R109, R110		82283-66	2200 ohms ±10%, ½ w
R111		82283-76	15,000 ohms ±10%, ½ w
R112, R113		82283-67	2700 ohms ±10%, ½ w
R114		90496-63	1200 ohms ±10%, 1 w
R115		82283-147	330 ohms ±5%, ½ w
R116		82283-77	18,000 ohms ±10%, ½ w
R117		90496-86	100,000 ohms ±10%, 1 w
R118		82283-80	33,000 ohms ±10%, ½ w
R119		82283-79	27,000 ohms ±10%, ½ w
R120		82283-74	10,000 ohms, ±10%, ½ w
R121		82283-64	1500 ohms ±10%, ½ w
R122		90496-85	82,000 ohms ±10%, 1 w
R123		99126-55	270 ohms ±10%, 2 w
R124	55186	867970-305	wire wound, 0.43 ohms ±10%, ½ w
R125		90496-76	15,000 ohms ±10%, 1 w
R126		90496-85	82,000 ohms ±10%, 1 w
R127		82283-163	1500 ohms ±5%, ½ w
R128		99126-55	270 ohms ±10%, 2 w
R129		90496-76	15,000 ohms ±10%, 1 w
R130		90496-79	27,000 ohms ±10%, 1 w
R131		82283-159	1000 ohms ±5%, ½ w
R132	93933	458574-36	wire wound, 400 ohms ±5%, 10 w
R133	217563	458572-85	wire wound, 16,000 ohms ±5%, 5 w
R134		90496-121	27 ohms ±5%, 1 w
R135		82283-74	10,000 ohms ±10%, ½ w
R136	217602	99316-3	wire wound, 5 ohm ±1%, ½ w
R137	55186	867970-305	wire wound, 0.43 ohms ±10%, ½ w
R138		99126-1	10 ohms ±20%, 2 w
R139	217604	990185-395	film, 9530 ohms ±1%, ½ w
R140		82283-62	1000 ohms ±10%, ½ w
R141		99126-73	8200 ohms ±10%, 2 w
R142		82283-62	1000 ohms ±10%, ½ w
R143		99126-73	8200 ohms ±10%, 2 w
R144		82283-66	2200 ohms ±10%, ½ w
R145		99126-73	8200 ohms ±10%, 2 w
R146		82283-66	2200 ohms ±10%, ½ w
R147		99126-73	8200 ohms ±10%, 2 w
R148		82283-82	47,000 ohms ±10%, ½ w
R149		82283-84	68,000 ohm ±10%, ½ w
R150		82283-98	1 meg ohm ±10%, ½ w
R151		82283-86	100,000 ohms ±10%, ½ w
R152		82283-72	6800 ohms ±10%, ½ w
R153		82283-56	330 ohms ±10%, ½ w
R154		82283-66	2200 ohms ±10%, ½ w
R155		99126-73	8200 ohms ±10%, 2 w
R156		82283-82	47,000 ohms ±10%, ½ w
R157		82283-84	68,000 ohms ±10%, ½ w
R158	78907	941799-17	wire wound, 4000 ohms ±5%, 5 w
R159	93466	458572-97	wire wound, 40,000 ohms ±5%, 5 w
R160 to R162		82283-50	100 ohms ±10%, ½ w
R163		82283-86	100,000 ohms ±10%, ½ w
R164, R165		82283-59	560 ohms ±10%, ½ w
R166		82283-50	100 ohms ±10%, ½ w
R167		82283-86	100,000 ohms ±10%, ½ w

Symbol No.	Stock No.	Drawing No.	Description
R168		82283-98	1 meg ohm ±10%, ½ w
R169, R170		82283-183	10,000 ohms ±5%, ½ w
R171		82283-90	220,000 ohms ±10%, ½ w
R172, R173		82283-86	100,000 ohms ±10%, ½ w
R174	56596	458575-108	varibale, carbon, 2500 ohms ±10%, 2 w
R175		82283-92	330,000 ohms ±10%, ½ w
R176		82283-82	47,000 ohms ±10%, ½ w
R177	217546	8914834-3	wire wound, 2000 ohms ±3%, 25 w
R178		82283-82	47,000 ohms ±10%, ½ w
R179		82283-92	330,000 ohms, ±10%, ½ w
R180		82283-78	22,000 ohms ±10%, ½ w
R181		90496-81	39,000 ohms ±10%, 1 w
R182		82283-61	820 ohms ±10%, ½ w
R183	206044	433196-3	variable, .25 meg ohms ±10%, 2 w
R184		82283-88	150,000 ohms ±10%, ½ w
R185	52837	433196-5	variable, 50,000 ohms ±10%, 2 w
R186		82283-98	1 meg ohm ±10%, ½ w
R187, R188		82283-100	1.5 meg ohm ±10%, ½ w
R189		82283-95	560,000 ohm ±10%, ½ w
R190	217603	990185-468	carbon, film, 49,900 ohms ±1%, ½ w
R191	214810	990187-668	film, 4.99 megohms ±1%, 1 w
R192		82283-175	4700 ohm ±5%, ½ w
R193		82283-206	91,000 ohm ±5%, ½ w
R194		90496-50	100 ohm ±10%, 1 w
R195		82283-82	47,000 ohms ±10%, ½ w
R196		82283-74	10,000 ohm ±10%, ½ w
R197		82283-82	47,000 ohms ±10%, ½ w
R198		82283-74	Resistor - fixed, composition, 10,000 ohms ±10%, ½ w
S101	211166	8907253-2	Switch: toggle
S102	217560	8436501-1	Switch: rotary
S103	217566	849370-8	Switch: D.C. O.L.
S104	217552	8434096-1	Switch: A.C. O.L.
S105	52980	442389-2	Switch: rotary
S106	217559	8436500-1	Switch: rotary
T101	52685	902022-1	Transformer: input
T102	211180	897903-502	Coil Assembly
T103	219740	727590-507	Coil Assembly
T104	51738	728446-17	Transformer: 42.8 microhenry
T105	211182	728446-13	Transformer: 471 microhenry
T106	211183	728446-14	Transformer: 5652 microhenry
T107 to T109	211184	728446-15	Transformer: 34,500 microhenry
T110, T111	51734	442511-1	Transformer: input
T112	210660	481743-1	Transformer: power
T113	217362	8434093-1	Transformer: plate
T114	217357	8434095-1	Transformer: filament
T115	211184	728446-15	Transformer: 34,500 microhenry
XC202	217561	99390-3	Socket: octal, red
XDS101, XDS102		8856946-2	Socket: lamp
	94121		Jewel only
	56610		Socket only
XF101, XF102	48894	99088-2	Holder: fuse
XV101 to XV103	94879	737867-18	Socket: 7 pin miniature
XV104 to XV106	94880	737870-18	Socket: 9 pin miniature
XV107	54414	99390-1	Socket: octal
XV108 to XV113	94879	737867-18	Socket: 7 pin miniature
XV114	94880	737870-18	Socket: 9 pin miniature
XV115, XV116	94879	737867-18	Socket: 7 pin miniature
XV117	54414	99390-1	Socket: octal
XV118	217548	8944202-1	Socket: 11 pin
XY101, XY102	75061	746002-7	Socket: crystal
Y101, Y102			Crystal
XZ101	59919	746048-1	Socket: vector
Z101	219730	481755-3	Network: pre-emphasis
			Miscellaneous:
	219742	8815313-9	Connector: plate cap

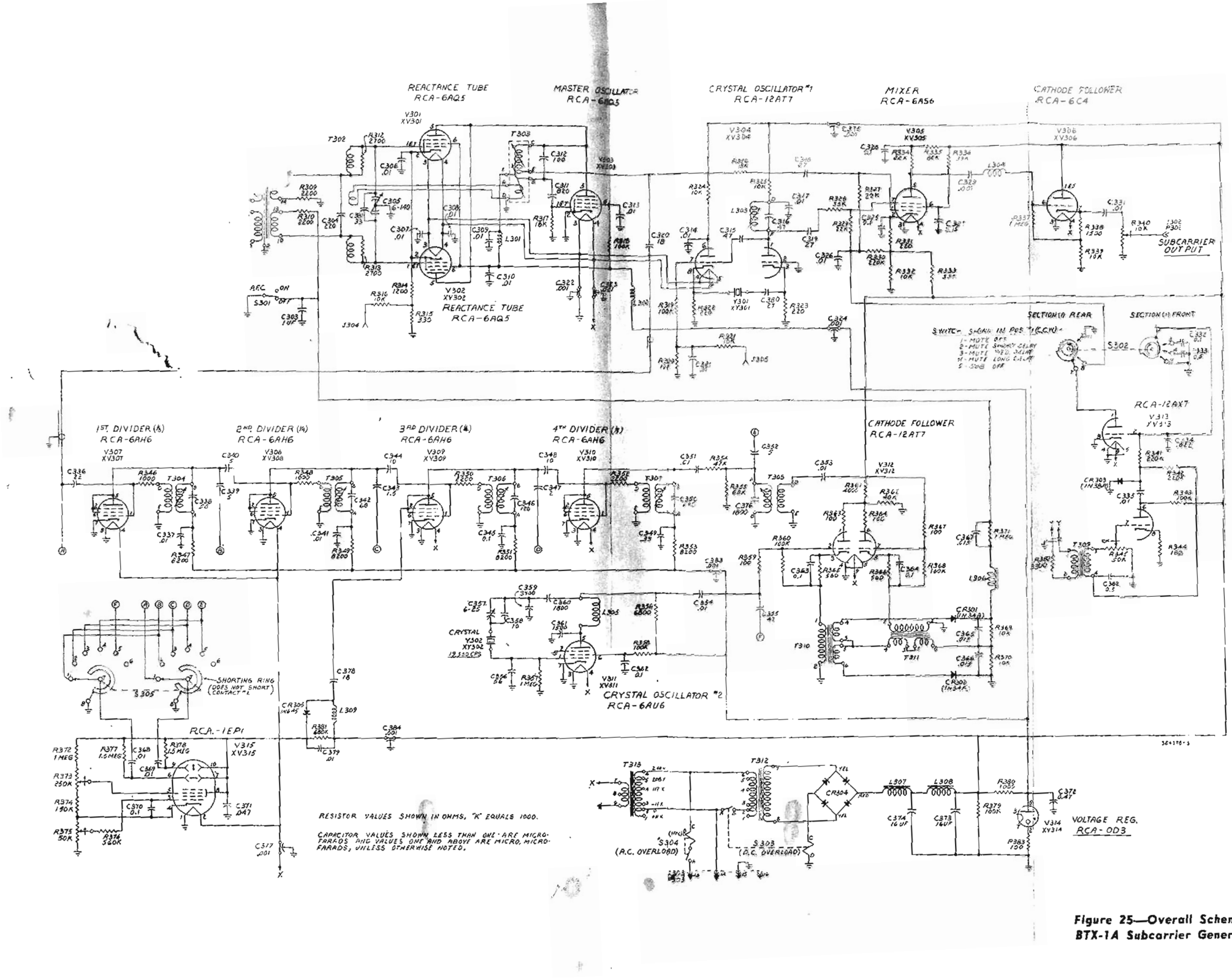


Figure 25—Overall Schematic Diagram, BTX-1A Subcarrier Generator (364378)