RCA

BROADCAST AND COMMUNICATIONS PRODUCTS

BTE-10C FM Broadcast Exciter

and

BTE-10CT

FM Broadcast Transmitter

RADIO CORPORATION OF AMERICA

IB-31510-1

EQUIPMENT LOST OR DAMAGED IN TRANSIT

When delivering the equipment to you, the truck driver or carrier's agent will present a receipt for your signature. Do not sign it until you have (a) inspected the containers for visible signs of damage and (b) counted the containers and compared with the amount shown on the shipping papers. If a shortage or if evidence of damage is noted, insist that notation to that effect be made on the shipping papers before you sign them.

Further, after receiving the equipment, unpack it and inspect thoroughly for concealed damage. If concealed damage is discovered, immediately notify the carrier, confirming the notification in writing, and secure an inspection report. This item should be unpacked and inspected for damage WITHIN 15 DAYS after receipt. Report all shortages and damages to RCA, Broadcast and Communications Products Division, Camden, N.J. 08102.

Radio Corporation of America will file all claims for loss and damage on this equipment so long as the inspection report is obtained. Disposition of the damaged item will be furnished by RCA.

REPLACEMENT PARTS AND ENGINEERING SERVICE

RCA field engineering service is available at current rates. Requests for field engineering service may be addressed to your RCA Broadcast Field Representative or the RCA Service Company, Inc., Broadcast Service Division, Camden, N.J. 08102. Telephone: 609 WOodlawn 3-8000.

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

The part which will be supplied against an order for a replacement item may not be an exact duplicate of the original part. However, it will be a satisfactory replacement differing only in minor mechanical or electrical characteristics. Such differences will in no way impair the operation of the equipment. Parts with no stock numbers are standard components. They are not stocked by RCA and should be obtained from your local electronic parts distributor.

The following tabulations list service parts and electron tube ordering instructions according to your geographical location.

SERVICE PARTS

LOCATION	ORDER SERVICE PARTS FROM:
Continental United States, including Alaska and Hawaii	RCA Parts and Accessories Department, 2000 Clements Bridge Road, Deptford, New Jersey, 08096 or through your nearest RCA Regional Office. Emergency orders may be telephoned, telegraphed, or teletyped to RCA Emergency Service, Parts, Camden, N.J. (Telephone: 609 WO 3-8000).
Dominion of Canada	RCA Victor Company Limited, 1001 Lenoir Street, Montreal, Quebec or through your local Sales Representative or his office.
Outside of Continental United States, Alaska, Hawaii and the Dominion of Canada	RCA International Division, Clark, N.J., U.S.A. (Wire: RADIOINTER) or through your local Sales Representative.

ELECTRON TUBES

LOCATION	ORDER ELECTRON TUBES FROM:
Continental United States, including Alaska and Hawaii	Local RCA Tube Distributor.
Dominion of Canada	RCA Victor Company Limited, 1001 Lenoir Street, Montreal, Quebec or through your local Sales Representative or his office.
Outside of Continental United States, Alaska, Hawaii and the Dominion of Canada	Local RCA Tube Distributor or from: RCA International Division Clark, N.J., U.S.A. Wire, RADIOINTER

RETURN OF ELECTRON TUBES

If for any reason, it is desired to return tubes, please return them through your local RCA tube distributor, RCA Victor Co. Ltd., or RCA International Div., depending on your location.

Please do not return tubes directly to RCA without authorization and shipping instructions.

It is important that complete information regarding each tube (including type, serial number, hours of service and reason for its return) be given. When tubes are returned, they should be shipped to the address specified on the Return Authorization form. A copy of the Return Authorization and also a Service Report for each tube should be packed with the tubes.

(SEE INSIDE REAR COVER FOR LIST OF RCA SALES OFFICES)

INSTRUCTIONS

BTE-10C FM Broadcast Exciter

and

BTE-10CT

FM Broadcast Transmitter

In order to make improvements in design and effect economies in manufacture, RCA reserves the right to make changes in design, components, and specifications published herein.

RADIO CORPORATION OF AMERICA

BROADCAST AND COMMUNICATIONS PRODUCTS DIVISION

CAMDEN, NEW JERSEY

PRINTED IN U.S.A.

IB-31510-1

FIRST AID

WARNING

OPERATION OF ELECTRONIC EQUIPMENT INVOLVES THE USE OF HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE. OPERATING PERSONNEL MUST AT ALL TIMES OBSERVE ALL SAFETY REGULATIONS. DO NOT CHANGE TUBES OR MAKE ADJUSTMENTS INSIDE THE EQUIPMENT WITH VOLTAGE SUPPLY ON. UNDER CERTAIN CONDITIONS DANGEROUS POTENTIALS MAY EXIST IN CIRCUITS WITH POWER CONTROLS IN THE OFF POSITION DUE TO CHARGES RETAINED BY CAPACITORS, ETC. TO AVOID CASUALTIES, ALWAYS DISCHARGE AND GROUND CIRCUITS PRIOR TO TOUCHING THEM.

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

ARTIFICIAL RESPIRATION

(Courtesy of the American Red Cross)

If victim is not breathing, begin some form of artificial respiration at once. Wipe out quickly any foreign matter visible in the mouth, using your fingers or a cloth wrapped around your fingers.

MOUTH-TO-MOUTH (MOUTH-TO-NOSE) METHOD

Fig. 1

Tilt victim's head back. (Fig. 1). Pull or push the jaw into a jutting-out position. (Fig. 2).

Fig. 2

If victim is a small child, place your mouth tightly over his mouth and nose and blow gently into his lungs about 20 times a minute. If victim is an adult (see Fig. 3), cover the mouth with your mouth, pinch his nostrils shut, and blow vigorously about 12 times a minute.

Fig. 3

If unable to get air into lungs of victim, and if head and jaw positions are correct, suspect foreign matter in throat, To remove it, place victim in position shown in Fig. 4, and slap sharply between shoulder blades.

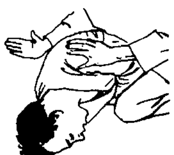


Fig. 4

Rescuers who cannot, or will not, use mouth-to-mouth or mouth-to-nose technique should use a manual method.

THE BACK PRESSURE-ARM LIFT (HOLGER-NIELSEN) METHOD

Place victim face-down, bend his elbows and place his hands one upon the other, turn his head slightly to one side and extend it as far as possible, making sure that the chin is jutting out. Kneel at the head of the victim. Place your hands on the flat of the victim's back so that the palms lie just below an imaginary line running between the armpits (Fig. 5).

Fig. 5

Rock forward until the arms are approximately vertical and allow the weight of the upper part of your body to exert steady, even pressure downward upon the hands (Fig. 6).

Fig. 6

Immediately draw his arms upward and toward you, applying enough lift to feel resistance and tension at his shoulders (Fig. 7). Then lower the arms to the ground. Repeat this cycle about 12 times per minute, checking the mouth frequently for obstruction.

Fig. 7

If a second rescuer is available, have him hold the victim's head so that the jaw continues to jut out (Fig. 8). The helper should be alert to detect any stomach contents in the mouth and keep the mouth as clean as possible at all times.

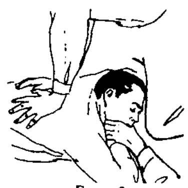


Fig. 8

RELATED INFORMATION FOR BOTH METHODS

If vomiting occurs, quickly turn the victim on his side, wipe out his mouth, and then reposition him.

When a victim is revived, keep him as quiet as possible until he is breathing regularly. Keep him from becoming chilled and otherwise treat him for shock. Continue artificial respiration until the victim begins to breathe for himself or a physician pronounces him dead or he appears to be dead beyond any doubt.

Because respiratory and other disturbances may develop as an aftermath, a doctor's care is necessary during the recovery period.

BURNS

FIRST DEGREE BURN

SKIN REDDENED. Temporary treatment—Apply baking soda or Unguentine.

SECOND DEGREE BURN

SKIN BLISTERED. Temporary treatment — Apply baking soda, wet compress, white petroleum jelly, foille jelly, olive oil, or tea.

THIRD DEGREE BURN

FLESH CHARRED. Temporary treatment — Apply baking soda, wet compress, white petroleum jelly, or foille spray. Treat for severe shock.

TABLE OF CONTENTS

BTE-10C EXCITER

SUPPLEMENT I

BTE-10CT TRANSMITTER

TABLE OF CONTENTS (cont)

SUPPLEMENT II

BTE-10C FM BROADCAST EXCITER
MODIFIED FOR USE ON UHF TELEVISION BROADCAST TRANSMITTERS

SUPPLEMENT III

BTE-10C FM BROADCAST EXCITER
MODIFIED FOR OPERATION AT 1/2 CARRIER FREQUENCY IN FM BROADCAST TRANSMITTERS

LIST OF ILLUSTRATIONS

LIST OF TABLES

TECHNICAL DATA

Electrical Characteristics

Type of Emission F3-F9
Frequency Range . . . . . 87-108 Mc/s (MHz)
Power Output . . . . . 10 watts
Output Impedance . . . . . 50 ohms
Modulation Capability . . . . . ±100 kc/s (kHz) min.
Carrier Frequency Stability . . . . . ±1000 c/s (Hz) max.
Audio Input Impedance . . . . . 600/150 ohms[1]
Audio Input Level (100% mod.) . . . . . +10 ±2 dBm[2]
Audio Frequency Response
30—15,000 c/s (Hz) . . . . . ±1.0 dB max.[3]
Harmonic Distortion 30—15,000 c/s (Hz) . . . 0.5% max.[4]
FM Noise Level
(referred to 100% FM Mod.) . . . . . —65 dB max.
AM Noise Level
(referred to carrier voltage) . . . . . —50 dB max.
SCA Subcarrier Input Level
(30% Mod. of carrier) . . . . . 5 volts max.
SCA Subcarrier Input Impedance . . . . . 15,000 ohms
Main Channel to Sub-Channel Crosstalk . . . . . —55 dB[5]
Sub-to-Main-Channel Crosstalk . . . . . —65 dB[6]
Power Line Requirements . . . . . 240/208 or 117 volts, single phase 50/60 c/s (Hz)
Slow Voltage Variations . . . . . ±5%
Power Consumption . . . . . 150 volt-amp. (approx.)
Crystal Heater . . . . 117 volts, 50/60 c/s (Hz), 7.5 watts
Altitude . . . . . 7500 ft. max.
Ambient Temperature Range . . . . . —20° to +45°C.

Mechanical Specifications

Overall Dimensions:
Height . . . . . 10½ inches
Width . . . . . 19 inches
Depth . . . . . 9 inches
Weight . . . . . 35 lbs.

[1]Audio Preemphasis 75 *us* if desired).

[2]400 cycle (hertz) tone applied to J1.

[3]Audio frequency response referred to 75 *us* preemphasis curve.

[4]Distortion includes all harmonics up to 30 kc/s (kHz) and is measured following standard 75 *us* deemphasis network.

[5]Relative to 400 c/s (Hz) tone deviating subcarrier by ±7.5 kc/s (kHz), main channel modulated 70% by 30 to 15,000 c/s (Hz) tones.

[6]Relative to 400 c/s (Hz) tone deviating main-carrier ±75 kc/s (kHz), subcarrier modulated+7.5 kc/s (kHz) by 30 to 6000 c/s (Hz) tones, main-carrier modulated 30% by subcarrier.

TUBE COMPLEMENT

Symbol	*Type*	*Function*
V1A	6922	Frequency Modulated Oscillator
V1B	6922	Cathode Follower
V2	6686	Buffer Amplifier
V3	6686	Doubler
V4	8156	Final Amplifier
V5A & B	6922	Crystal Oscillator
V6	6AS6	Mixer
V7A & B	6922	Schmitt Trigger
V8	6227	Square Wave Amplifier
V9	0G3	Reference Voltage Regulator

EQUIPMENT SUPPLIED

BTE-10C FM EXCITER (ES-560217)

Quantity	*Description*	*Reference*
1	FM Exciter	MI-560300/MI-560300-A
1	Crystal Unit	MI-560302*
**	Set of Spare Tubes	MI-560301

* See table of crystals and frequencies.
** Optional.

IC m 311850
RCA BTE 10C $10.59

BTE-10C EXCITER CRYSTALS

*MI No.**	*Carrier Frequency Mc/s (MHz)*	*Crystal Frequency Mc/s (MHz)*	*MI No.**	*Carrier Frequency Mc/s (MHz)*	*Crystal Frequency Mc/s (MHz)*
560302-1	88.1	44.18	560302-51	98.1	49.18
-2	88.3	44.28	-52	98.3	49.28
-3	88.5	44.38	-53	98.5	49.38
-4	88.7	44.48	-54	98.7	49.48
-5	88.9	44.58	-55	98.9	49.58
-6	89.1	44.68	-56	99.1	49.68
-7	89.3	44.78	-57	99.3	49.78
-8	89.5	44.88	-58	99.5	49.88
-9	89.7	44.98	-59	99.7	49.98
-10	89.9	45.08	-60	99.9	50.08
-11	90.1	45.18	-61	100.1	50.18
-12	90.3	45.28	-62	100.3	50.28
-13	90.5	45.38	-63	100.5	50.38
-14	90.7	45.48	-64	100.7	50.48
-15	90.9	45.58	-65	100.9	50.58
-16	91.1	45.68	-66	101.1	50.68
-17	91.3	45.78	-67	101.3	50.78
-18	91.5	45.88	-68	101.5	50.88
-19	91.7	45.98	-69	101.7	50.98
-20	91.9	46.08	-70	101.9	51.08
-21	92.1	46.18	-71	102.1	51.18
-22	92.3	46.28	-72	102.3	51.28
-23	92.5	46.38	-73	102.5	51.38
-24	92.7	46.48	-74	102.7	51.48
-25	92.9	46.58	-75	102.9	51.58
-26	93.1	46.68	-76	103.1	51.68
-27	93.3	46.78	-77	103.3	51.78
-28	93.5	46.88	-78	103.5	51.88
-29	93.7	46.98	-79	103.7	51.98
-30	93.9	47.08	-80	103.9	52.08
-31	94.1	47.18	-81	104.1	52.18
-32	94.3	47.28	-82	104.3	52.28
-33	94.5	47.38	-83	104.5	52.38
-34	94.7	47.48	-84	104.7	52.48
-35	94.9	47.58	-85	104.9	52.58
-36	95.1	47.68	-86	105.1	52.68
-37	95.3	47.78	-87	105.3	52.78
-38	95.5	47.88	-88	105.5	52.88
-39	95.7	47.98	-89	105.7	52.98
-40	95.9	48.08	-90	105.9	53.08
-41	96.1	48.18	-91	106.1	53.18
-42	96.3	48.28	-92	106.3	53.28
-43	96.5	48.38	-93	106.5	53.38
-44	96.7	48.48	-94	106.7	53.48
-45	96.9	48.58	-95	106.9	53.58
-46	97.1	48.68	-96	107.1	53.68
-47	97.3	48.78	-97	107.3	53.78
-48	97.5	48.88	-98	107.5	53.88
-49	97.7	48.98	-99	107.7	53.98
-50	97.9	49.08	-100	107.9	54.08

*Suffixes 1 to 100 designate channel number. Add 200 to suffix to get FCC channel number, e.g., MI-560302-75 designates FCC channel 275, frequency 102.9 Mc/s (MHz).

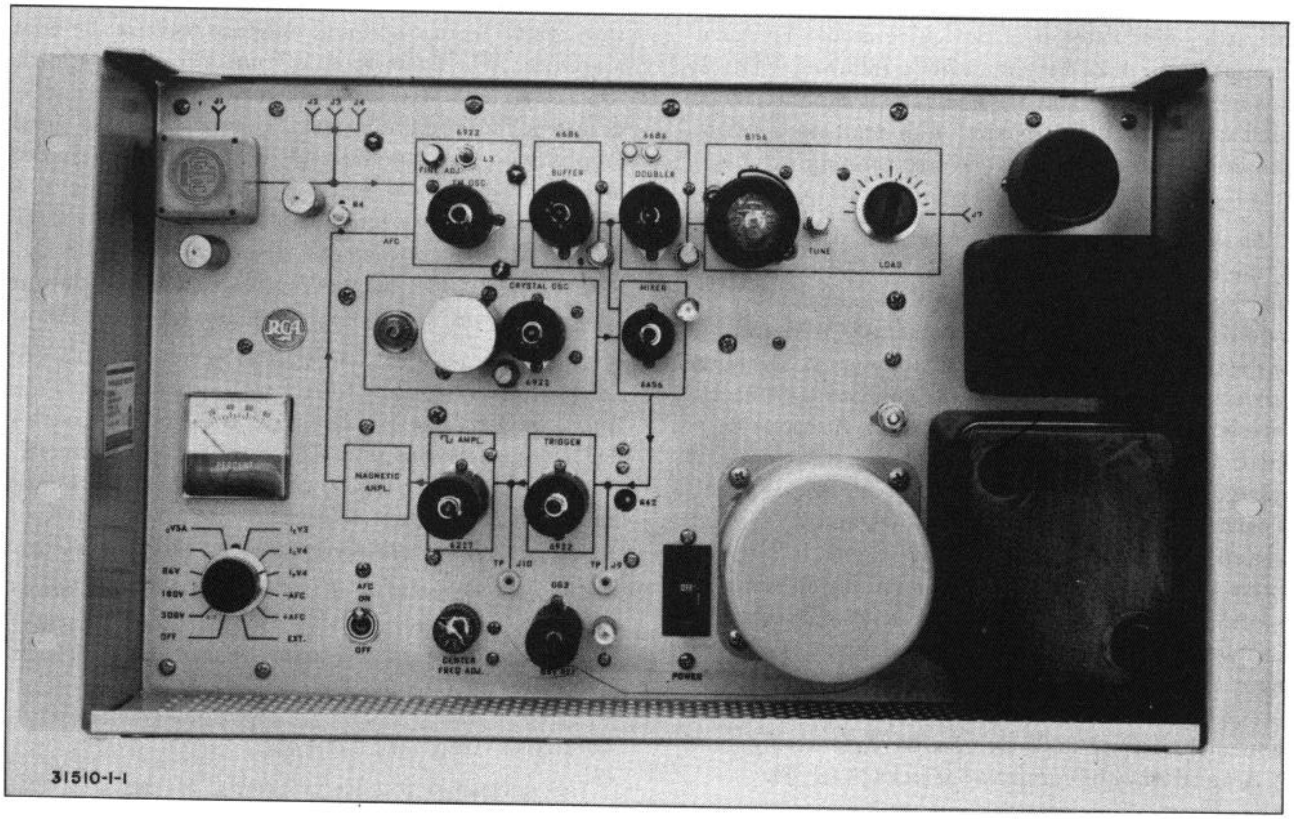


Figure 1—BTE-10C FM Broadcast Exciter

DESCRIPTION

General

The RCA BTE-10C FM Broadcast Exciter, ES-560217, shown in figure 1, is a frequency modulated exciter which provides an r-f output of ten watts at any specified frequency in the FM Broadcast band. In monophonic operation, up to two SCA subchannels may be utilized. In stereophonic operation, in compliance with FCC requirements, one additional SCA subchannel may be used. All applicable requirements of Section 73.322 of the FCC Rules and Regulations will be met when used in conjunction with the BTS-1A Stereo Subcarrier Generator.

The BTE-10C FM Broadcast Exciter can be used with any RCA FM Broadcast Transmitter. It was designed to provide superior performance under stereophonic, monophonic, and SCA conditions. In the design, particular emphasis was placed on ease of adjustment and reliable operation. All r-f stages use single tuned circuits. A built-in meter and easily accessible test points allow metering and checking during operation. A self-contained silicon power supply is used. Premium tubes, carrying a 10,000-hour guarantee have been used for reliability and long life. This exciter lends itself particularly well to unattended and remote operation.

When stereophonic operation is desired, the BTE-10C Exciter should be used with the BTS-1A Stereo Subcarrier Generator. If, in addition, SCA operation is desired, the BTX-1A Subcarrier Generator may be used.

The shielding of the exciter is such that it is unaffected by strong r-f fields. The cabinet radiation of the exciter itself is negligible.

The unit is designed for mounting in a standard 19-inch rack.

Circuits

A block diagram of the BTE-10C Exciter is shown in figure 2. The r-f circuitry consists of: A master oscillator operating at one-half ($\frac{1}{2}$) of the carrier frequency, a capacitive diode to provide frequency modulation, a buffer amplifier, a frequency doubler and a final amplifier. The AFC section consists of a mixer, a crystal reference oscillator, a Schmitt trigger, a square wave amplifier and a magnetic amplifier. The semiconductor power supply furnishes power to all of the above stages. There are inputs for monophonic operation, stereophonic operation, and two SCA channels.

The master oscillator is a series-tuned Colpitts type, frequency modulated by a capacitive diode. The oscillator acts as a load for the cathode follower, V1B. By this means a very stable plate voltage is supplied to the oscillator, such that, together with temperature compensation, the oscillator when free running exhibits a very high degree of frequency stability.

As shown in the simplified schematic diagram figure 3, the method of frequency modulation can be visualized by assuming C7 to be a switch controlled by the modulating signal, switching capacitor C8 in and out of the tuned circuit thus changing frequency. The actual process is more involved, but the comparison with the switch serves to illustrate the operation. A second capacitive diode, C39, is reverse-biased and functions as a voltage-controlled capacitance. It is through this capacitance that the SCA modulation and AFC is accomplished. With reference to the schematic diagram, figure 14, input J1 is used for monophonic operation. If operation with 50 μs preemphasis is desired, capacitor C3 must be removed. For the stereophonic mode, the input signal obtained from the BTS-1A Stereo Subcarrier Generator will be applied to J2. In this case the monaural circuitry must be opened. Refer to figure 4. SCA signals may be connected at jacks J3 and J4.

The use of different modulating paths for the main channel and SCA results in a minimum of undesirable crosstalk between main and sub-channel services. The plate supply voltage of the master oscillator is virtually independent of supply voltage variations. It is controlled by the voltage appearing at the highly stable reference tube, V9. This voltage is applied to the grid of V1B. This tube acts as a cathode follower with a voltage of approximately +87 volts appearing at the cathode. A premium frame-grid triode with a 10,000-hour guarantee is used as the master oscillator tube. Resistor, R4, and capacitor, C8, are set to provide proper deviation at minimum distortion. Coil L3 is accessible from the front panel and is used to set the oscillator to the correct center frequency. In addition, there is a FINE ADJ. control accessible from the front panel for fine adjustment of the frequency. These controls need only be set during the initial tuneup of the exciter.

Following the master oscillator is the buffer amplifier, tube V2, which is also a premium tube type 6686. This amplifier provides isolation of the oscillator from the doubler and, in addition, increases signal amplitude for proper operation of the doubler. The buffer amplifier has one adjustment, capacitor C17, which must be set for maximum grid current in the following stage, as read on the built-in meter. A small amount of signal is sampled at the plate circuit of V2, for AFC purposes. The AFC circuit will be discussed later.

The next stage, V3, a 6686 tube, is the doubler stage bringing the signal provided by V2 to the final frequency and to an amplitude sufficient to drive the final amplifier, V4. There is one front panel adjustment associated with V3, capacitor C22. This capacitor is adjusted for maximum grid current into the final amplifier as read on the built-in meter. The doubler stage is not always necessary for the various FM transmission applications. Modifications for this stage are included in Supplement II and III of this book. Where the doubler stage, V3, is deleted, the output frequency from V4 will be that of the master oscillator.

The final amplifier, V4, is an 8156 tube type. There are two controls on the front panel associated with the final amplifier. The first one, C31, is the tuning control TUNE. The second one, C36, is the LOAD control. Tuning and loading can be adjusted for maximum output power as measured by the grid current of the following stage or by an externally provided power indicator.

The cathode voltage of the final amplifier is maintained at + 20 volts, ±5%, by a breakdown (zener) diode, CR3. The plate current of the final amplifier can be read on the built-in meter.

Automatic Frequency Control

The automatic frequency control of the BTE-10C Exciter is simple, accurate and foolproof. To assist in understanding the operation of the AFC circuit described below, reference should be made to figures 2, 8 and 14. The AFC is similar to an ordinary feedback system. The loop gain determines the ratio of improvement in the controlled quantity. If the uncontrolled drift of the master oscillator were, for instance, ±20 kc/s (kHz) feedback, providing an open loop gain of 40 dB or 100, would reduce this drift by a factor of approximately 100 to ±200 cycles (hertz). The feedback action in the BTE-10C is accomplished in the following manner:

A sample of the ½ carrier frequency signal is taken from the plate circuit of tube V2 and applied to the grid, pin 1, of the mixer tube V6. A reference signal is derived from a crystal oscillator. This crystal oscillator uses a 6922 tube in a Butler circuit. The crystal itself is mounted in a temperature-controlled oven. There is a front panel adjustment, C55, connected with the oscillator. This capacitor is adjusted by observation of the indication on the built-in meter.

The highly stable reference signal is applied to grid 3, pin 7 of the mixer tube, V6, a type 6AS6. At the plate of the mixer a beat frequency appears. Under normal operating conditions, this beat signal has a frequency of 130 kc/s (kHz). Any variation of the master oscillator frequency will be reflected by a corresponding variation of this beat frequency signal. The 130 kc/s (kHz) beat frequency signal, in turn, is applied to the input of a Schmitt trigger circuit. The purpose of this trigger

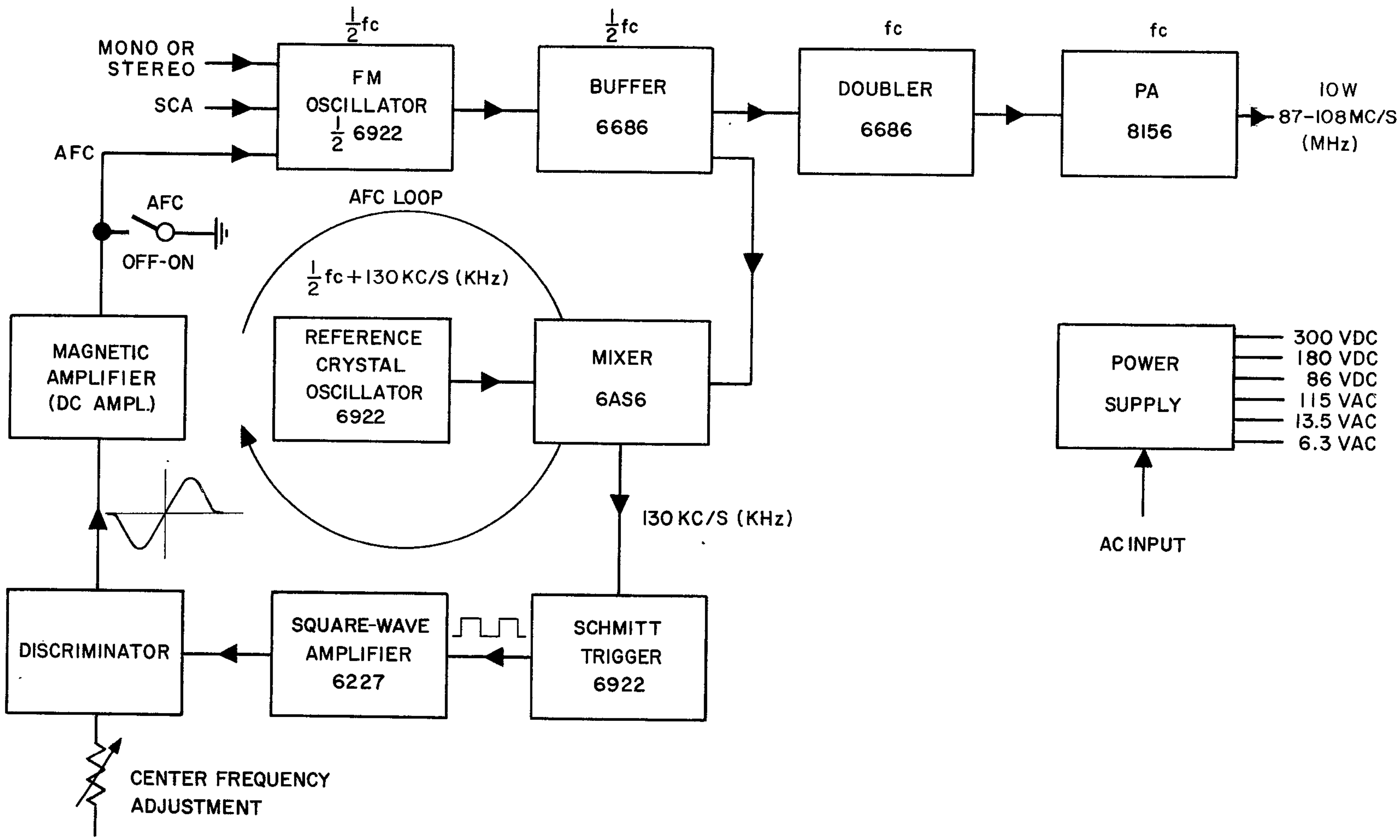


Figure 2—Block Diagram of Exciter

circuit is to transform the sine-wave input signal into a square-wave signal. The amplitude of the square-wave output of the Schmitt trigger circuit is independent of the amplitude of the sine-wave signal input provided the input exceeds the triggering limit of the circuit. If the sine wave does not exceed this input limit, no output will be available from the trigger circuit. When this occurs, the magnetic amplifier will go into saturation and cause a substantial shift in master oscillator frequency as indicated on the deviation monitor and the built-in meter.

The waveform appearing at the input of the Schmitt trigger circuit is available at test point J9 and can be observed during operation with an oscilloscope. There is one adjustment connected with the trigger circuit which is a variable resistance R42. Its purpose is mainly to make the square wave appearing at the trigger circuit output symmetrical. The trigger circuit uses a 6922 tube.

The signal appearing at the plate of V7B is applied to the grid of the square-wave amplifier, V8, a 6227 premium tube. The grid signal can be checked at test point, J10. A square-wave voltage with a peak-to-peak amplitude in excess of 86 volts appears at the plate of V8. This voltage, in turn, is applied to two clamping diodes, CR4 and CR5. The purpose of these diodes is to keep the square-wave amplitude from going negative or from exceeding 86 volts. The 86-volt reference voltage is supplied by the stable reference source, V9. Following the two clamping diodes is a counter-type FM detector consisting of capacitor, C73, and diodes, CR6 and CR7. The output of this highly-linear detector is directly proportional to frequency. Assuming a 130 kc/s (kHz) input signal to the Schmitt trigger, the counter detector will supply a constant current into the input of the magnetic amplifier. This current, however, is balanced by a current of opposite polarity derived from the 86-volt reference source through resistors, R59, R60, R62, and R63, such that, for a center frequency of 130 kc/s (kHz) the potential at the input of the magnetic amplifier is exactly zero. By variation of CENTER FREQ. ADJ. resistor, R59, this zero potential can be made to appear with any input frequency between 100 and 150 kc/s (kHz) to the Schmitt trigger circuit. In this manner, the center frequency of the transmitter can be adjusted. An error voltage appearing at the input of the magnetic amplifier will be amplified by approximately 40 dB by the magnetic amplifier and appear at its output. Depending on the magnitude and polarity of the input to the magnetic amplifier, a d-c component of up to approximately 10 volts of corresponding polarity will be produced at the output. This voltage can be measured by the built-in meter. AC components contained in the output of the magnetic amplifier will be attenuated by r-c network, R64 and C42. Consequently, a d-c voltage will appear across the capacitive diode, C39, which is proportional to the frequency deviation of the master oscillator. In this manner, the AFC loop is closed and any variations in frequency of the master oscillator will be counteracted by the action just described. The AFC can be deactivated by placing the AFC switch in the OFF position. The master oscillator will then operate as a free-running oscillator.

The modulation capabilities of the master oscillator are not affected by the AFC switch, S1. It is evident from the foregoing that the AFC system used in the exciter works in a manner similar to the AFC frequently found in FM tuners where an error voltage derived from an FM discriminator is applied to the local oscillator through a reactance tube or capacitive diode. The main difference in this system is the degree of control.

Power Supply

The power supply in the BTE-10C supplies the following voltages to the exciter:

1. 6.3 volts a-c for tubes, V1, V2, V3, V5, V6, V7 and V8.
2. 13.5 volts a-c to V4.
3. 117 volts a-c to the magnetic amplifier.
4. 300 volts d-c as plate supply for the tubes.

In addition, a breakdown diode provides a regulated voltage of 180 volts d-c and a voltage regulator tube provides a highly stable voltage of 86 volts.

INSTALLATION

Carefully unpack and inspect the equipment to make certain that no damage has occurred during shipment. Any damage or shortages should be immediately reported to RCA and to the transportation company in order that lost or damaged material may be recovered.

The BTE-10C is shipped complete in one container with all tubes installed. The crystal oven is shipped in a separate container. All internal wiring is done at the factory. Only external wiring and cables need be prepared and connected to the equipment at installation.

Reference should be made to the schematic diagram, figure 14, which designates all input and output connectors.

AC Power Line Connections

The primary of power transformer, T2, has tap terminals for operation from various voltages as given

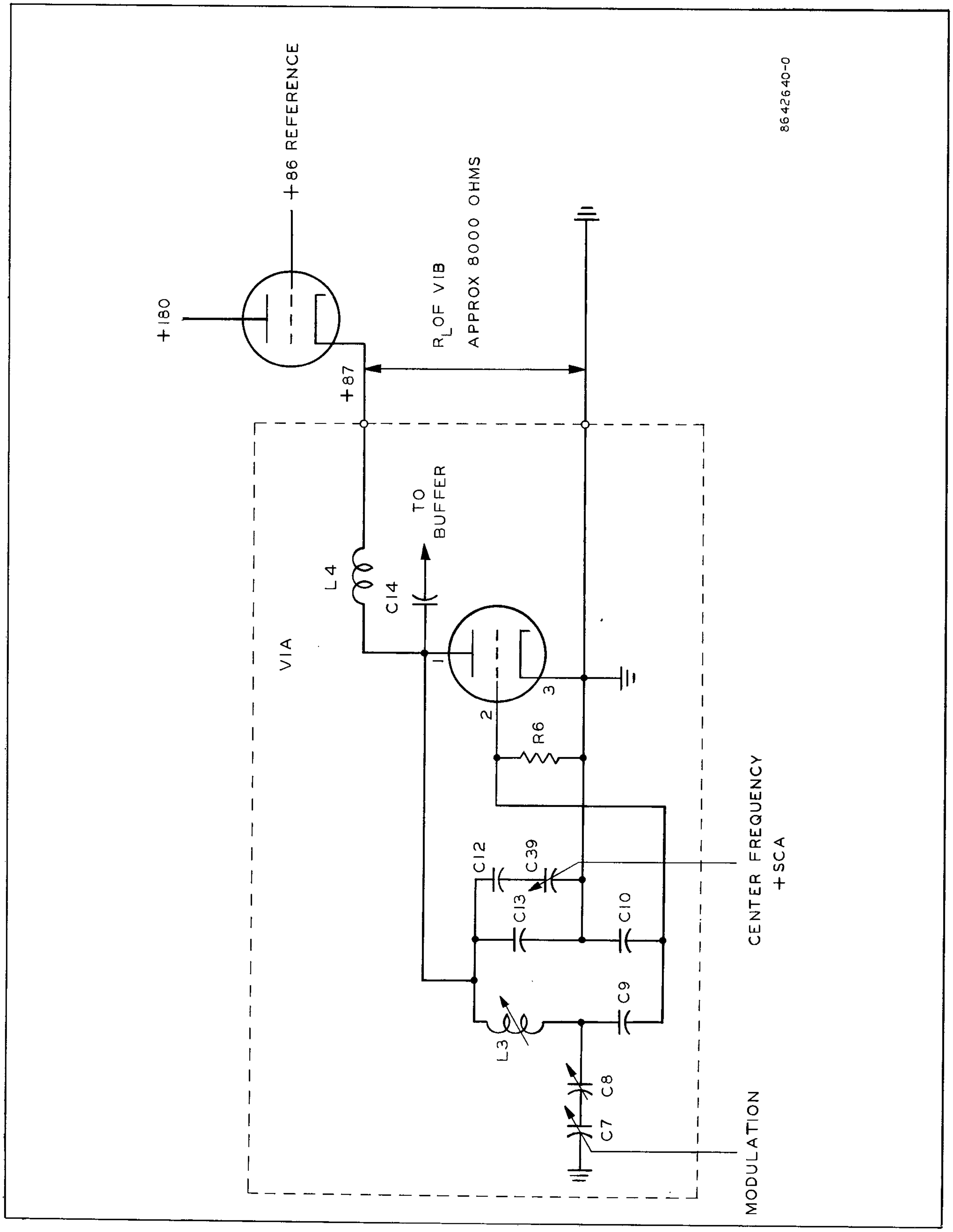


Figure 3—Simplified Schematic Diagram of FM Oscillator

TABLE 1. TRANSFORMER T2 PRIMARY TAPS

Power Line Voltage	106	117	128	197	208	219	229	240	251
Taps to be Used	3-4	2-4	1-4	3-5	2-5	1-5	3-6	2-6	1-6

in table 1. (No change is required to operate on 50 or 60 cycles.) The equipment is shipped with T2 connected for 240-volt operation. Particular care must be taken to insure that proper connections are made before power is applied to the equipment. The a-c overload switch, S2, is used as the POWER ON-OFF switch. The schematic diagram shows the connections of the power switch.

When tap 5 or 6 of the power transformer, T2, is used, the power line should be connected to terminal "B" of the POWER ON-OFF switch, S2. When tap 4 on T2 is connected, the power line should be connected to terminal "C" of S2.

Insert the crystal unit, MI-560302, in its proper socket.

Check that all tubes are properly seated. After all connections are made, a-c power can be applied to the equipment. Allow sufficient time for the crystal heater to reach operating temperature before following the tuneup procedure below. Indicator, DS1, will light when the crystal oven heater is on.

Tuneup Procedure

Proceed as follows:

1. Turn off power switch S2 and put AFC switch S1 in the OFF position. Remove tubes V1 and V6 and the cover from the inner shielded compartment. Connect a jumper wire, having an alligator clip at each end, to pin 7 of XV6, and to pin 2 of XV2. Turn the power switch to the ON position.

   NOTE: Due to crystal activity, some circuits are slow to resume oscillation. This situation may be avoided by using a meter indication of less than the prescribed "20".

2. Place meter switch S3 in the I_cV5A position and adjust C55 for a peak reading on the meter and continue turning C55 in a counter clockwise direction until the meter indication drops to 20.

3. Place meter switch S3 in I_c V3 position. Peak C17 for maximum reading of the meter.

4. Place meter switch S3 in I_c V4 position and adjust C22 for a maximum reading of the meter.

   NOTE: The versatility of this exciter enables modifications which involve the deletion of the doubler stage. In such cases, step 4 will be excluded.

5. Set LOAD capacitor C36 to approximate mid-position and adjust TUNE capacitor C31 for a dip in the plate current with the meter switch S3 in the I_p V4 position. This adjustment of the pi network of V4 should be considered tentative.

With this step complete, the reference oscillator is operating at its proper frequency and stages V2, V3, and V4 are tuned to the frequency of the reference oscillator and are, therefore, tuned approximately 260 kc/s (kHz) higher than the assigned channel frequency. This tuning will now facilitate proper tuning of the master oscillator.

6. Remove the clip lead attached in step one and reinsert V1 and V6 in their sockets. Also, reinstall the inner cover. Allow 5 minutes for warmup of V1. Next, tune L3 until a maximum reading of the meter is obtained when the meter switch S3 is placed in the I_c V3 position. Place meter switch S3 in the + or — AFC position and adjust L3 or use the FINE ADJ. control to obtain a reading of zero in this position. There will be two positions of the tuning core of L3 where zero reading can be obtained. Select the one representing a lower frequency. To identify the lower frequency position, observe the L3 tuning rod and select the position that allows for greater penetration of the coil by its core.

7. Put the AFC switch in the ON position. Frequency control should now be established. This will be evident from an approximate zero reading of the meter in the + or — AFC position.

8. Recheck the tuning of stages V2, V3, V4 and V5A, by placing the meter switch in the proper positions and adjusting C17, C22, C31 and C36.

Adjust the CENTER FREQ. ADJ. control R59 to obtain proper center frequency as indicated on the station FM monitor. Readjust, if necessary, the FINE ADJ. control of the master oscillator for zero indication with the meter switch in the + or — AFC position and with the AFC switch in the OFF position. Then return the AFC switch to the ON position.

This completes the tuneup. The adjustments, R4 and C8, are preset at the factory. Refer to the MAINTENANCE section if there is any reason to believe that R4 and C8 should be readjusted.

If monophonic operation, with or without SCA is desired, the following connections should be made to the unit. The audio line should be connected to J1.

A level of approximately + 10 dBm, ±2 dBm at this point will cause 100% modulation of the exciter. The SCA subchannels may be connected at J3 and J4. The input voltage to J3 and J4 should be adjusted for desired subcarrier modulation percentage as indicated on

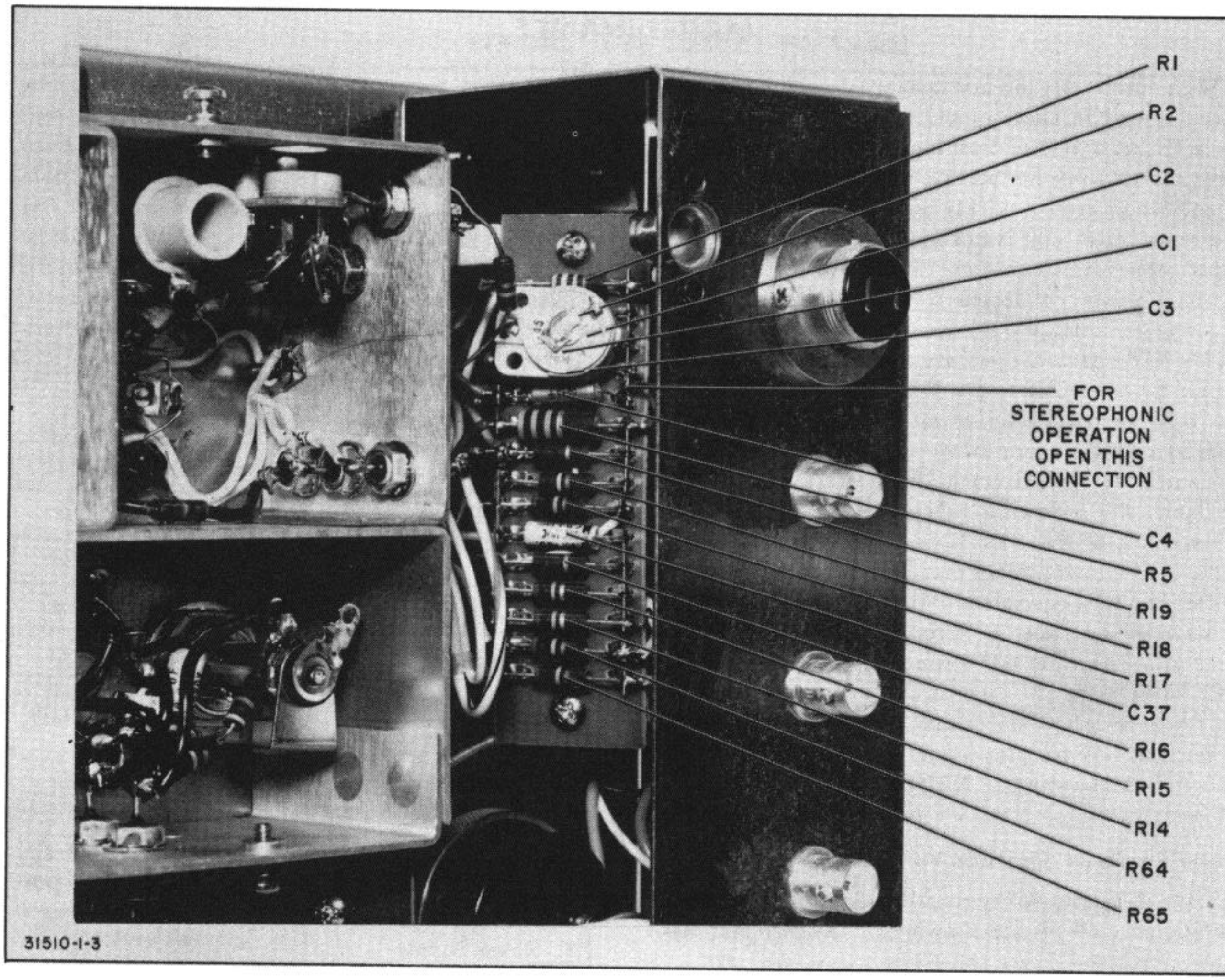


Figure 4—View of Stereo Connection

the modulation monitor such as the RCA BW-73A.

If 50 *u*s preemphasis is desired, capacitor C3 should be removed.

If stereophonic operation is desired, the output of the BTS-1A Stereo Subcarrier Generator should be connected to input J2. In this case, the connection between capacitors C3 and C4 on TB1 should be opened. This can be done by removing the connector between the two terminals, see figure 4. This disconnects the monaural input transformer and the built-in preemphasis network.

Resistor R42 is adjusted in the factory. If any adjustment is required, refer to *MAINTENANCE*.

OPERATION

In daily operation of the equipment, the crystal heater should be left connected to the 117 volt a-c supply continuously. Then, after application of power, the equipment will be ready for operation as soon as the tubes have reached proper operating temperature.

During operation, routine measurements of voltages and currents can be made using the built-in meter without affecting the performance of the equipment. If the readings are recorded and compared day by day, they can serve to indicate the ageing of tubes.

With the AFC operating, the meter indication in the + and — AFC positions should not be more than approximately 15 percent. If necessary, this reading can be corrected by adjusting L3 or the FINE ADJ. control of the master oscillator.

In case difficulty is experienced in operation, refer to the instructions under *INSTALLATION* and *MAINTENANCE*.

MAINTENANCE

With normal care, no maintenance should be required except a periodic check of all tubes. All components of the BTE-10C FM Broadcast Exciter are selected to give long, maintenance-free service. Capacitor C53 is a plug-in unit which can be quickly replaced in case of failure. If a replacement unit is not immediately available, any capacitor having a minimum of 20 mf at 400 volts may be temporarily connected to maintain service. The negative terminal should be connected to pin 1 of socket XC53 while the positive terminal of the capacitor should be connected to pin 5. Any capacitive value of less than approximately 40 mf may increase spurious hum by a small amount. Most tubes carry a 10,000-hour guarantee. If a replacement for a 6922 tube is not available, the following tubes can be used instead: 6DJ8, 7308, 6FW8, E88CC or ECC88. Instead of the 6686, the following tubes may be used: E81L or EL81. There is no tube equivalent to the 8156. For this reason, it is advisable to keep a spare 8156 tube on hand. The same applies to the 6AS6 tube. Instead of the 6227, E80L or EL80 may be used. In place of the 0G3 tube, a 5651 tube may be used. It may, however, be necessary to readjust R59 for proper center frequency. The DS1 pilot light uses a standard NE-51 bulb.

Meter Readings and Tube Voltages

Table 2 shows voltage readings at the tube pins. Additional voltages are shown on the schematic diagram.

Typical meter readings are shown in table 3.

Emergency Operation

Provision is made to maintain operation should tubes or components associated with the automatic frequency control fail. The operator will be warned of loss of control by a large shift in frequency as indicated by the carrier frequency monitor. Tube or component failure can be found in some cases by switching meter switch, S3, through its various positions. If the master oscillator and r-f chain is functioning, the output carrier frequency can be controlled manually as follows until such time as repairs can be made.

1. Switch the AFC switch, S1, to the OFF position.

2. Adjust the FINE ADJ. control of the master oscillator for correct center frequency reading on the frequency monitor. The center frequency of the master oscillator can be maintained within FCC limits by adjusting the FINE ADJ. as required. Stability of the circuit should make frequent readjustment unnecessary provided change in ambient temperature and line voltage is not excessive.

If element burn-out or thermostat failure of the crystal oven occurs, a few minor adjustments will minimize the trouble. Disconnect the crystal oven power source, J-11. After the oven has reached room temperature, readjust R-59 for the correct center frequency. If variations in temperature and line voltage are not excessive, the master oscillator will maintain the frequency within FCC limits for an interval of time; however, this emergency condition should be monitored by an operator.

Troubleshooting Hints

The following test equipment is recommended:

Equipment	*Type*
Vacuum Tube Voltmeter with RF Probe	RCA Voltohmyst WV-98C with WG-301A Probe or Equivalent
Audio Oscillator	Hewlett-Packard 206A or Equivalent
Oscilloscope	RCA WO-91A with WG-300B Probe or Equivalent
Test Oscillator	Hewlett-Packard 650 or Equivalent

The BTE-10C Exciter consists of the sub-units listed below: (Troubleshooting of the exciter should proceed in the order of the listing.)

1. Power Supply.
2. Reference Crystal Oscillator.
3. RF Amplifier Consisting of Tubes V2, V3 and V4.
4. Master Oscillator.
5. Mixer.
6. Schmitt Trigger Circuit and Square Wave Amplifier.
7. Discriminator.
8. Magnetic Amplifier.
9. Modulator.

Power Supply

With POWER switch, S2, closed, check voltages at transformer, T2, pins 8, 9, 13, and 14 to ground. All voltages should agree with the values listed on the schematic. The high voltage at the rectifier output should be 330 volts. The voltage at pin 5 of C53 should be 300 volts. The voltage across diode, CR2, should be 180 volts. If the voltage across CR2 is higher, it may be due to open circuit of CR2. If the voltage is lower or zero, the diode, CR2, may have shorted out. The voltage across reference tube, V9, measured from pin 1 to pin 7 should be between 83 and 87 volts. The a-c ripple voltage appearing at pin 5 of C53 should be approxi-

TABLE 2. TYPICAL TUBE SOCKET VOLTAGES

Pin	*V1*	*V2*	*V3*	*V4*	*V5*	*V6*	*V7*	*V8*	*V9*
1	86	Gnd	Gnd	13.5 vac	75	—2.5*	170	Gnd	86
2	—3*	0*	—30*	20	—3.2*	0.9	100	—.2	Gnd
3	Gnd	3	3.4	310	1.1*	6.3 vac	103	3.4	—
4	6.3 vac	Gnd	Gnd	310	Gnd	Gnd	Gnd	6.3 vac	Gnd
5	Gnd	6.3 vac	6.3 vac	310	6.3 vac	155	6.3 vac	Gnd	86
6	180	Gnd	Gnd	20	75	80	175	Gnd	—
7	86	180	180	180	Gnd	—1.4*	100	170	Gnd
8	87	180	180	20	1.5*		103	180	
9	Gnd	Gnd	Gnd	20	Gnd		Gnd	3.4	
10				—5.4*					
11				180					
12				Gnd					

Voltages measured from tube socket pins to chassis ground, using a vacuum-tube voltmeter. All values are d-c unless otherwise specified.

*100K ohm in series with probe.

mately 0.5 volt RMS. If proper voltages are available from the power supply, proceed to the next section.

TABLE 3. TYPICAL METER READINGS

Switch Position	*Reading*
Off	0
300	53
180	60
86	86
—	0
I_cV5A	30
I_cV3	85
I_cV4	70
I_pV4	90
—AFC	0 · · · · 10
+AFC	0 · · · · 10
Ext	0

Reference Crystal Oscillator

With the crystal inserted in the crystal oven and the oven placed in its socket, tuning of C55 should bring the oscillator into oscillation. If there is any doubt about the activity of the crystal, a half-watt composition resistor of 60 ohms with a 1 nano farad capacitor in series should be connected between pins 4 and 6 of the crystal oven socket in place of the crystal. With this resistor and capacitor in place, the oscillator should be oscillating at a frequency determined by the setting of C55. The maximum series resistance permissible for the specified crystal should be 60 ohms. Oscillation should take place with any resistance up to 60 ohms. If oscillation does not occur with the crystal in place, it may indicate that the series resistance of the crystal is too high. If oscillation does not occur with a 60-ohm resistor between pins 4 and 6, all d-c voltages in the crystal oscillator stage should be checked. To increase feedback, resistor R28 may be temporarily removed to increase the loop gain of the feedback arrangement. If oscillations can be obtained, a higher value of R28 may be selected for the particular crystal in use. Any value up to 47,000 ohms should prove practicable. For best oscillator stability, the smallest resistance which permits oscillation should be used. Care should also be taken that, during actual operation, tube, V5B, is operating into an inductive reactance. This means that capacitor C55 should be adjusted to a setting of lower capacity relative to the resonant condition. In other words, the tuned circuit L12C55 should be tuned to a frequency slightly lower than the crystal frequency. This condition will provide the best frequency stability of the crystal reference oscillator.

Following the procedure outlined above, it should be possible to obtain oscillation from the crystal reference oscillator. An r-f voltage is now available for checking the r-f amplifier consisting of tubes V2, V3 and V4.

R-F Amplifier

To check the r-f amplifier, remove tubes V1 and V6 and connect a clip-lead from pin 7 of XV6 to pin 2 of XV2. This will apply r-f drive to the buffer amplifier. A first check should be made of all d-c voltages applied to tube V2. If the d-c voltages can be confirmed, it should be possible to tune C17 for maximum grid current into the following stage. In case of doubt, connect the r-f probe of the vacuum tube voltmeter to the plate of tube V2 as an r-f voltage indicator. Once r-f voltage is obtained, drive is available to tube V3. Before proceeding, all d-c voltages applied to V3 should be checked. Then, C22 should be tuned using the grid current of V4 or the r-f probe as an indicator. Proceeding from the doubler stage, V3, grid current into the PA stage, V4, should be checked by reading the built-in meter. Also, all d-c voltages appearing at V4 should be checked. At this point, an r-f dummy load must be connected to the output connector, J4. A suitable load can be made from five composition resistors of 270 ohms, 2 watts each, connected in parallel. The r-f probe of the vacuum tube voltmeter may be connected across these resistors. An rms voltage of 22 volts across this dummy load will indicate an output power of 10 watts. Once proper operation of the r-f amplifier has been established, tube V1 can be reinserted into the circuit for check-out of the master oscillator.

Master Oscillator

With tube V1 inserted, the d-c voltage at pin 8 should be checked. This voltage should be approximately 1 volt above the voltage appearing from pin 5 to ground of V9. To check oscillation of V1A, the vacuum tube voltmeter should be used to measure the grid voltage appearing at pin 2 of V1. Connect a 1-megohm resistor with short leads between pin 2 and the VTVM for this measurement. When the oscillator is functioning normally, a voltage of approximately —2 volts d-c will appear on the grid. Adjustment of L3 should now bring the oscillator to the tuned frequency of the r-f amplifier. This becomes evident by reading I_c V3 on the built-in meter. Once drive is obtained at the approximate center frequency, the mixer should be checked.

Mixer

Reinsert the mixer tube, V6. Retune C17 for maximum I_c V3 since the presence of the mixer tube will change the capacitive loading in the plate of V2. Next check all d-c voltages appearing on tube V6. These voltages may not be exactly as given in the schematic or the list of pin voltages since the d-c voltages will depend to a certain degree on drive into grids 1 and 3 of V6. With the oscilloscope connected to test point, J9, tune the master oscillator coil, L3, until a beat frequency appears at test point, J9. The frequency, and to some degree the amplitude, of this beat frequency will depend on the difference between the frequency of the master oscillator and the frequency of the reference signal. Select a suitable sweep rate in the oscilloscope and bring this frequency to approximately 130 kc/s (kHz). Any frequency between 50 kc/s and 300 kc/s (kHz) is satisfactory at this point. Be sure to use a low capacity probe at test point, J9, to prevent excessive loading. The voltage appearing at this point should have a minimum amplitude of 4 volts peak-to-peak. The waveform should resemble figure 5a. Triggering voltage for the trigger circuit is approximately 2 volts peak-to-peak.

Schmitt Trigger and Square Wave Amplifier

Once a sine wave appears at test point J9, it should be possible to pulse the Schmitt trigger and, in turn, observe a waveform at test point, J10. When the spikes appear on the waveform at J9, as in figure 5a, it is an indication that the Schmitt trigger is operating. If the spikes do not appear, it is an indication that the d-c voltage at grid pin 2 of XV7 is incorrect. Adjust R42 to obtain triggering. Check all d-c voltages at tube V7 and compare against voltages given in the schematic and the voltage table. If the trigger circuit cannot be made to operate from the mixer, the mixer tube may be removed temporarily and an external voltage fed into test point J9. The external voltage should have a large amplitude, for instance, 30 volts peak-to-peak. It should be possible to trigger V7 and to obtain an output at J10.

The waveform appearing at test point J10 is shown in figure 5b. The square wave should be symmetrical, which means the upper and lower horizontal portions should be of equal length. Symmetry of the waveform is obtained by adjusting R42. When symmetry of the waveform is obtained, it will be noted that the spikes in figure 5a will be equally spaced about the center line. After the proper waveform has been obtained at test point J10, check the d-c voltages appearing at the terminals of tube V8. The signal appearing at the output of the square wave amplifier measured or observed with the oscilloscope at the junction of CR4 and CR5, is shown in figure 5c.

The waveform appearing at the junction of CR4 and CR5 should have a peak-to-peak value equal to the reference voltage supplied by tube V9. The waveform appearing at the cathode of tube V7 should be as shown in figure 5d. The voltage appearing at pin 7 of XV7 is shown in figure 5e.

Once the square wave is present at the junction of CR4 and CR5, proceed to step 7.

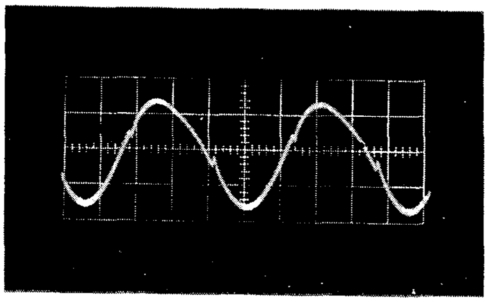
NOTES:

1. Waveforms taken with a Tektronix Type 585 Oscilloscope; Hewlett-Packard Type 130B or 150A, or equivalent.

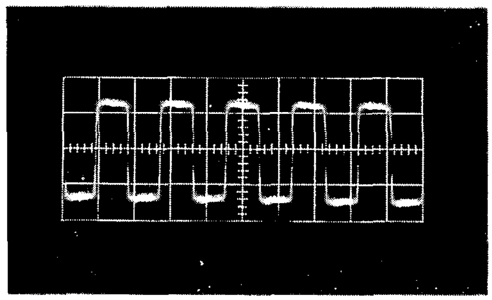
2. All waveforms taken with internal sync.

3. Squares on graticule equal one centimeter (horizontally and vertically).

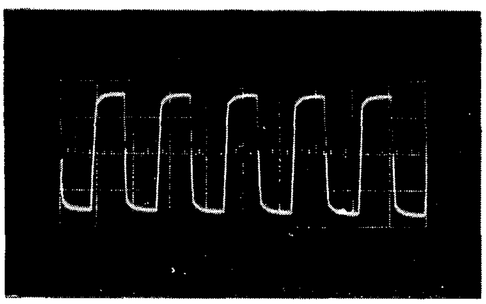
4. Volts per centimeter refers to vertical calibration, and sweep seconds per centimeter refers to sweep time base.



(a) *Waveform at TP J9. 2v/cm, 2ms/cm*



(b) *Waveform at TP J10. Output of Schmitt Trigger. 2v/cm, 5ms/cm*



(c) *Square Wave Amplifier Output 25v/cm, 5ms/cm*

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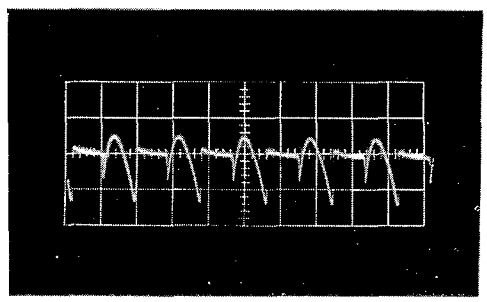


(d) *Waveform at cathode pin 3, pin 8 of XV7. 2v/cm, 5ms/cm*

Figure 5—Waveforms (Sheet 1)

Discriminator

A voltage as shown in figure 5f should appear at the junction of CR6 and CR7. The voltage appearing at the discriminator is a series of negative spikes. These spikes are integrated in R61 and C74. A current flows through R62, R60, and R59 in such a way that a zero potential will appear across capacitor C74. If, however, the frequency into the AFC amplifier, consisting of V7 and V8, is other than 130 kc/s, the voltage appearing across capacitor C74 will not be zero. If the frequency is lower than 130 kc/s (kHz) the voltage at C74 will be positive. If the frequency is higher than 130 kc/s (kHz) the voltage appearing at C74 will be negative. The exact frequency at which zero crossover occurs can be adjusted by R59. The adjustment range of R59 is such that zero crossover can be obtained for any frequency between 100 and 150 kc/s (kHz).

Magnetic Amplifier

The magnetic amplifier serves as a d-c amplifier providing a gain of approximately 40 dB. When the input frequency to the AFC portion is varied, a transfer characteristic as shown in figure 6 can be observed. It should be noted that the slope of the transition curve is such that very small variations around the center frequency will cause considerable variations in output voltage. The output voltage from the magnetic amplifier is indicated on the built-in meter in the + or — AFC position.

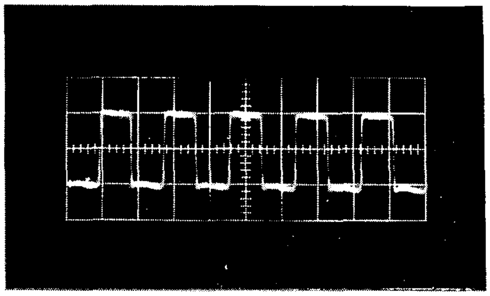
A-C components from the AFC voltage are attenuated by the r-c network, R64 and C42. A voltage of 117 volts a-c is applied to the magnetic amplifier at terminal 8. If this voltage is removed, the magnetic amplifier will not operate. The transfer characteristic as shown in figure 6 was obtained by feeding the output from a Hewlett-Packard 650A Oscillator into test point J9 with mixer tube V6 removed. The AFC voltage appearing across capacitor C42 will now follow corresponding variations of the beat frequency; however, due to the time constant of R64 and C42, a certain delay will be evident. The time constant of R64 and C42 is approximately 12 seconds. This means frequency variations appearing on the carrier frequency of shorter duration will not be corrected by AFC action. A slow acting AFC is desirable in order to provide the utmost in fidelity under stereo conditions. The speed of response of the AFC System must be considered when limiting or AGC amplifiers are introduced in the audio path leading to the exciter. If any of the amplifiers supply transient voltages during regulating action, they will be fully reproduced by the exciter and may cause the center frequency meter of the monitor to so indicate while they are present. This effect will be more pronounced in the stereo mode because of the extended frequency response when the J2 input connector is used. When the J1 connection is used under monophonic conditions, the low-frequency cut off of transformer T1 will greatly reduce any transient waveforms appearing on the audio line. With all tubes in place, L3 and the FINE ADJ. control should now be adjusted so that a zero voltage is obtained in the + or — AFC position of the meter. Of the two possible zero voltage positions of L3, the one should be selected that represents a lower frequency of the master oscillator. Once this zero voltage is obtained, AFC switch S1 may be placed in the ON (open) position which will establish AFC. If the meter does not come to rest at near zero in the + or — AFC position of S3, L3 is improperly set. Set AFC switch S1 in the OFF position and tune L3 in the clockwise direction until the next zero crossover is obtained. This should then be the proper position for AFC lock-in. Set S1 in the ON position and proceed to step 9.

Modulation Adjustment

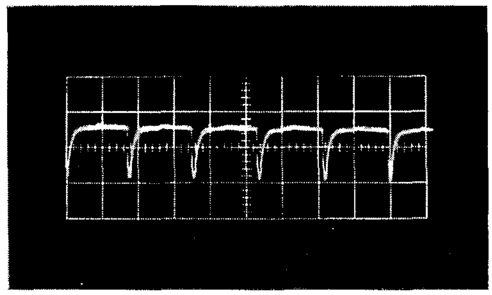
A 400-cycle (hertz) tone at + 10 dBm should be applied to J1. If the exciter is operated under stereo conditions, a 400-cycle (hertz) tone at approximately 350 millivolts may be applied to J2. With this voltage applied, the waveforms are as shown in figures 5g and 5h and may be observed at the output of the modulation monitor. This monitor should have an inherent distortion of less than 0.5%. Attach the distortion analyzer to the output of the modulation monitor. Start with C8 at the maximum capacity position and R4 at the extreme clockwise position. Adjust R4 to give 100% modulation, then set R4 and C8, which are mutually interdependent, for minimum distortion as seen on the distortion analyzer. The modulation sensitivity should be such that, with the minimum distortion setting, a modulation sensitivity of +10 dBm, ±2 dBm is maintained. A corresponding 2 dB tolerance should be allowed at the J2 terminal. Voltages of approximately +12 dB should be applied to both inputs of the BTS-1A Stereo Subcarrier Generator. In case of doubt relative to the performance of C39, make sure a voltage of +30 volts appears at the junction of R17 and R18.

Internal Metering

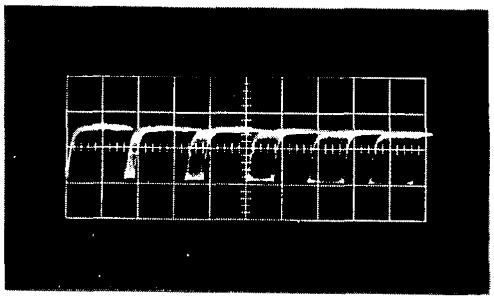
The built-in meter will allow reading of the various voltages and currents in the equipment. With the meter switch S3 in the 300V position, the full scale sensitivity of the meter is 600 volts. The 300 volt plate voltage should, therefore, cause a 50% deflection of the meter. In the 180V position, the full scale sensitivity of the meter is 300 volts. A voltage of 180 volts should, therefore, cause 60% deflection of the meter. In the 86V position, the full scale sensitivity of the meter is 100 volts. The reference voltage can, therefore, be read directly in volts on the meter scale.



(e) *Waveform at grid pin 7 of XV7. [illegible]/cm, 5ms/cm*



(f) *Waveform at junction CR6 and CR7. 25v/cm, 5ms/cm*



(g) *Waveform same as figure (f), except 400 c/s at 0 dB to J1.*

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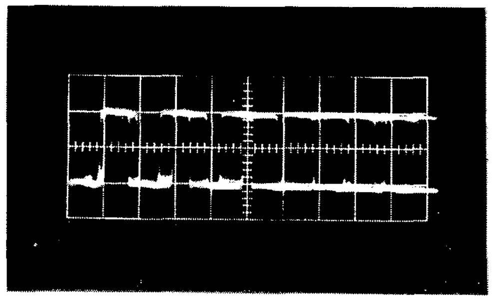


(h) *Waveform at TP J10. Same as figure "b", except 400 c/s at 0 dB applied to J1*

Figure 5—Waveforms (Sheet 2)

The next position is not used. The following positions will read:

Grid current in the cathode follower portion of the Crystal Oscillator I_c V5A, grid current of the doubler stage I_c V3, grid current in the final amplifier I_p V4, and plate current of the final amplifier I_p V4.

The readings obtained in these positions should correspond to those in the table showing typical meter readings. The next two positions measure the output voltage of the magnetic amplifier. There are two positions to allow observation of either polarity of the output voltage. Under normal operating conditions, this voltage should be maintained close to zero with a possible deviation of not more than $\pm 20\%$ of full scale.

In the last position, the meter is connected to terminals 3 and 4 of the J5 connector in order to make it available for external use. The full-scale sensitivity of the meter in this position is 100 μA.

AFC System

To visualize the operation of the AFC loop, reference should be made to figure 8. A small amount of FM oscillator drift can be simulated by applying a positive-going voltage to capacitor C39. This will increase the capacity of C39, thus lowering the frequency of the FM oscillator. The signal output from the FM oscillator will pass through the buffer and then beat against the crystal reference oscillator signal in the mixer. Since the frequency of the reference oscillator is higher than the frequency of the FM oscillator, lowering the frequency of the FM oscillator will increase the frequency of the

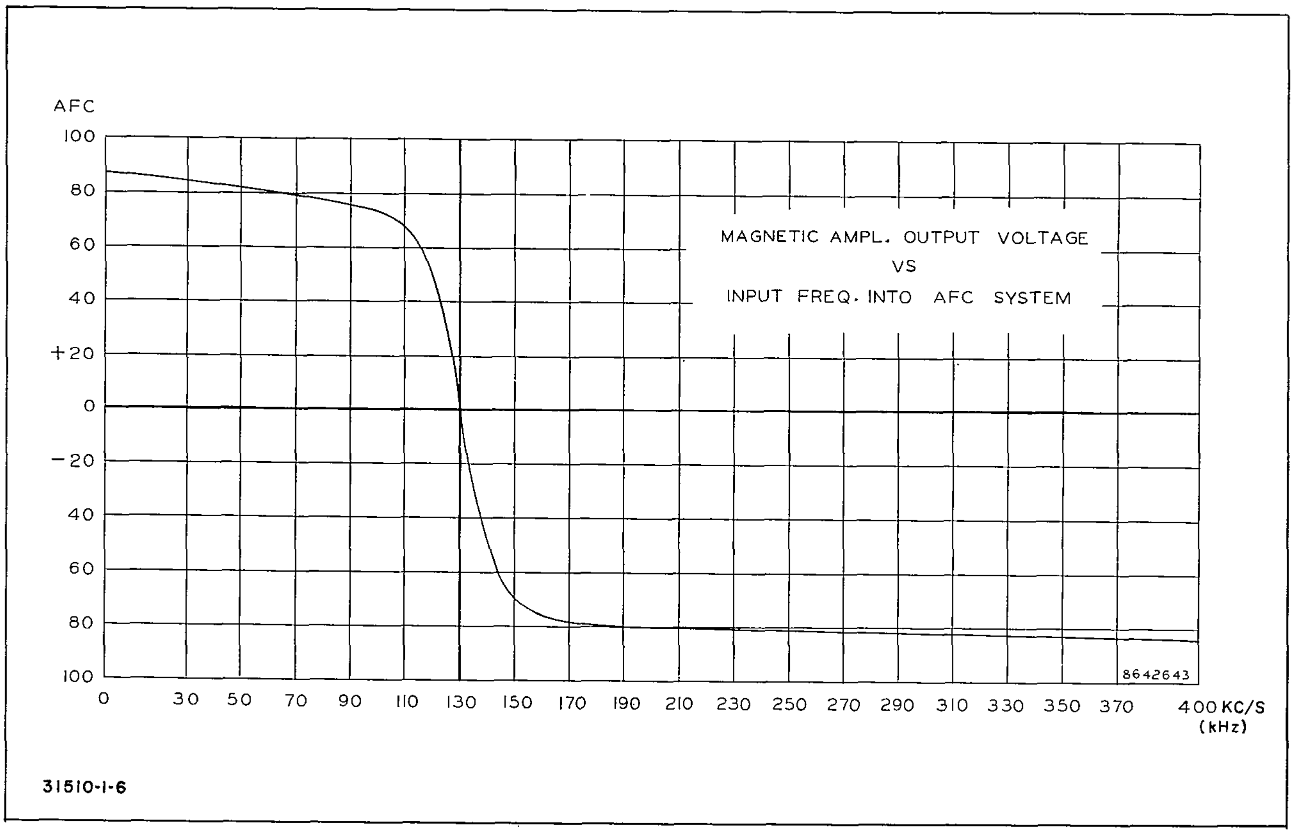


Figure 6—AFC Transfer Characteristic

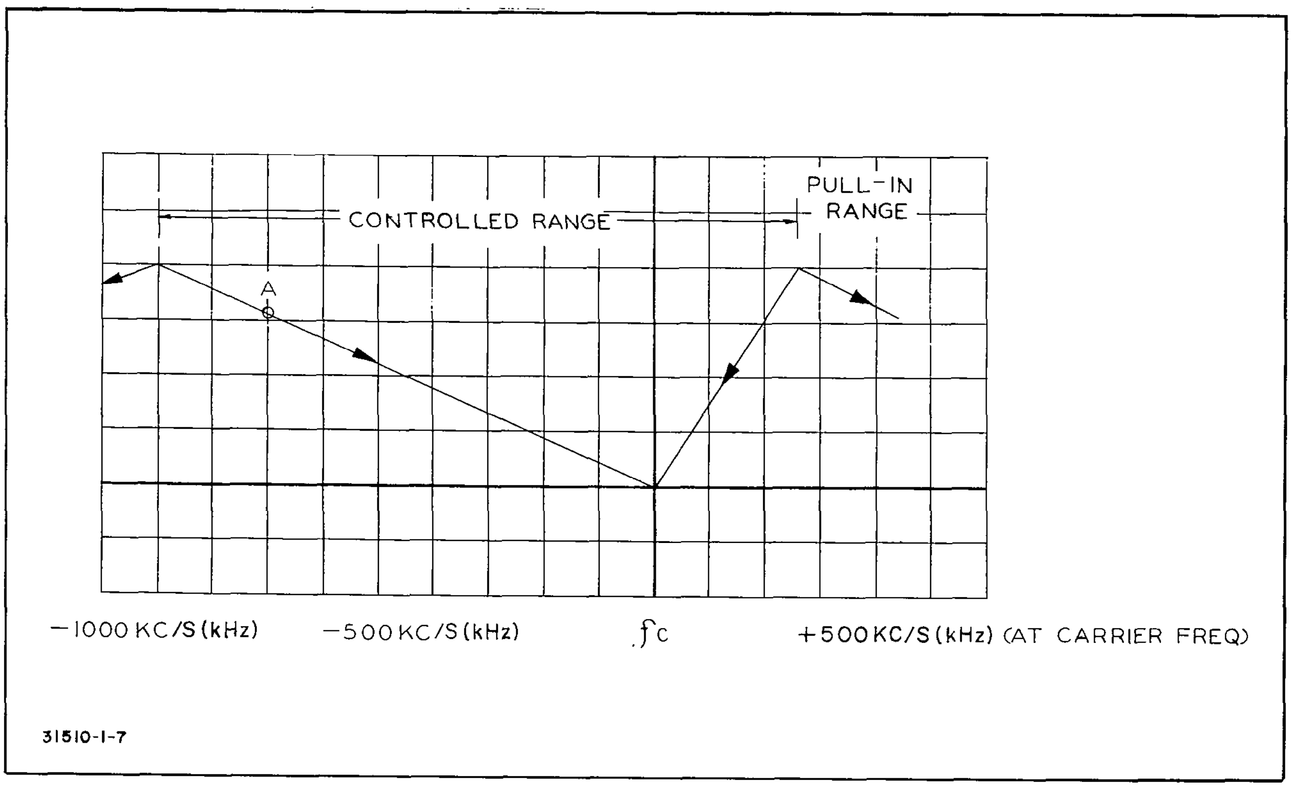


Figure 7—AFC Control Range

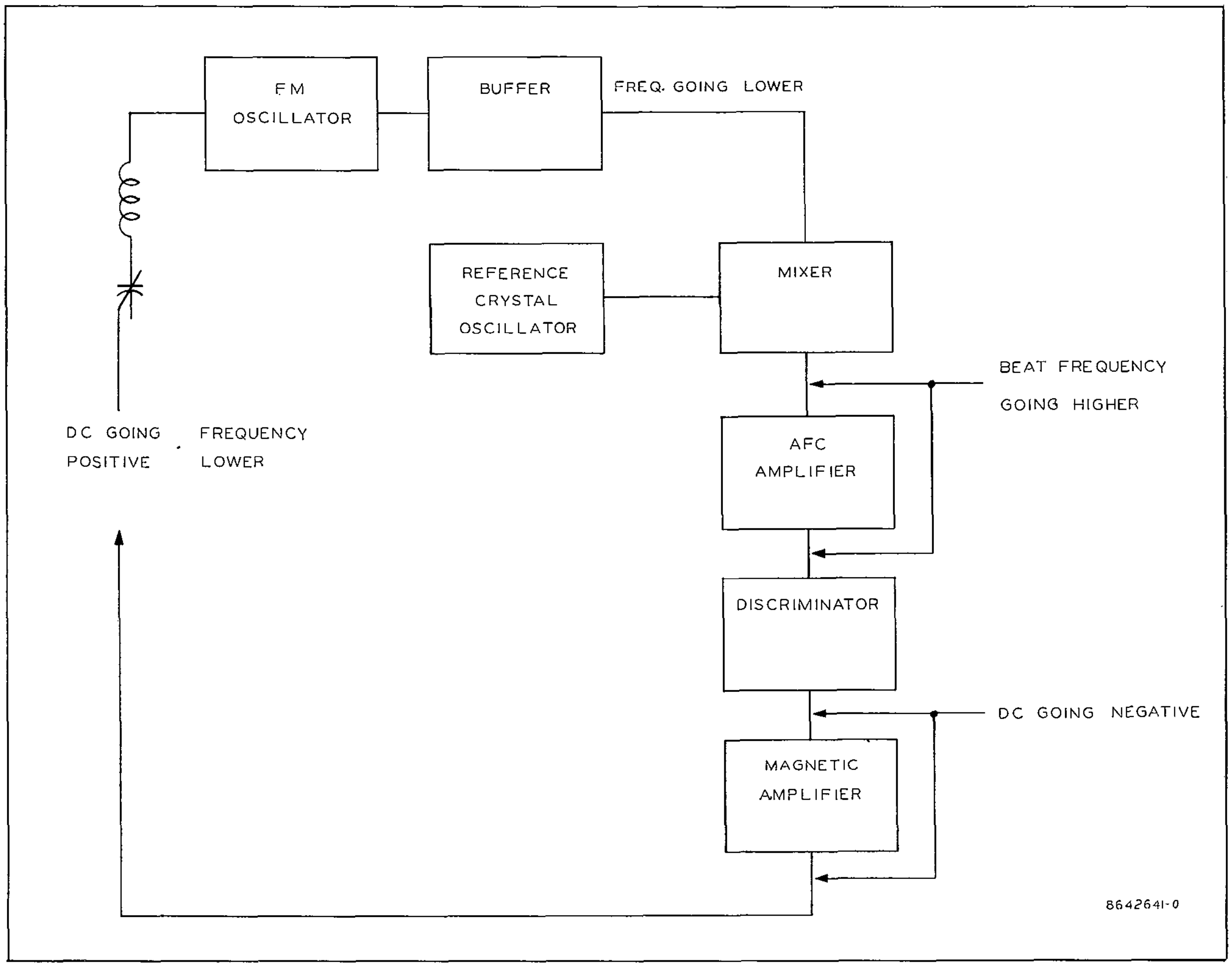


Figure 8—Block Diagram of AFC Loop

beat frequency from the mixer. Figure 6 shows the relationship between the frequency appearing at the mixer output and the voltage appearing at the output of the magnetic amplifier. This represents a transfer characteristic similar to the standard FM discriminator. From the figure it can be seen that an increase in mixer output frequency will cause a negative-going voltage from the output of the magnetic amplifier. If the AFC loop were now closed (switch S1 in the AFC ON position), this negative-going voltage would counteract the original positive-going disturbance which was applied to the FM oscillator and thus eliminate or reduce the effect of this distrubance. The pull-in range and range of AFC control is shown in figure 7. The AFC correction will always be applied in the direction of the arrows. Once, however, certain limiting amounts of FM oscillator frequency offset are exceeded, AFC action will shift the FM oscillator frequency away from the correct center frequency. This is a desirable feature since it establishes a clear criterion for proper AFC action. Control will either be properly established or defeated. The latter condition is easily identified by observing the AFC voltage which will go to saturation of the magnetic amplifier and read approximately full scale in the + or — AFC position of the meter. When proper control of the AFC is established, the meter will read approximately zero in the AFC position. When the exciter is switched on from a cold start, the magnetic amplifier will saturate due to the positive current fed into its input from the 86-volt reference voltage and shift the FM oscillator to a point A, as shown in the figure, representing a frequency that is lower than proper operating frequency. From this point to the time that all tubes reach operating temperature, the AFC action will pull the FM oscillator to its proper frequency. The upper limit of the control range is determined by the frequency off-set of the crystal oscillator. If the FM oscillator frequency exceeds the frequency of the crystal

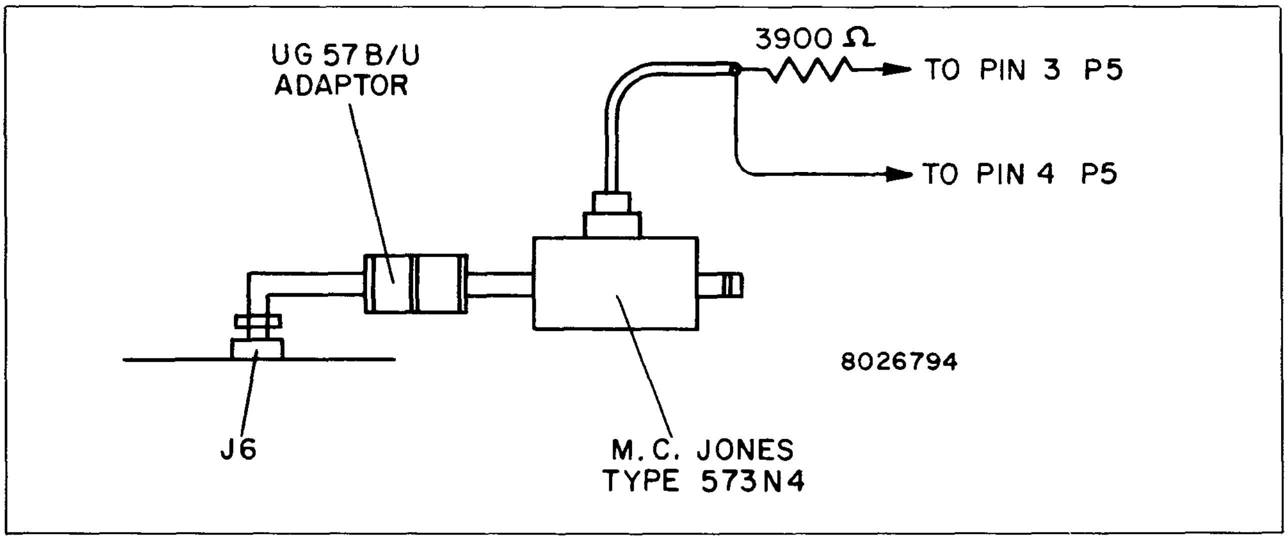


Figure 9—Connections for Power Output Measurement

reference oscillator, control will not be established and the frequency will move further away so that no output from the unit will be obtained.

Power Output Measurements

Power output indications can be obtained conveniently by use of the meter M1 and a suitable coupler such as the M. C. Jones Micromatch. With the meter switch S3 in the EXT. position, the positive terminal of the meter is connected to pin 3 of connector P5 and the negative terminal pin 4 of P5. Readings obtained will depend upon the type of coupler used. With an M. C. Jones Type 573N4 coupler and a UG57B/U adaptor, a 3900 ohm resistor in series with the meter will provide mid-scale reading of the meter at ten watts output. Connections should be made as shown in figure 9.

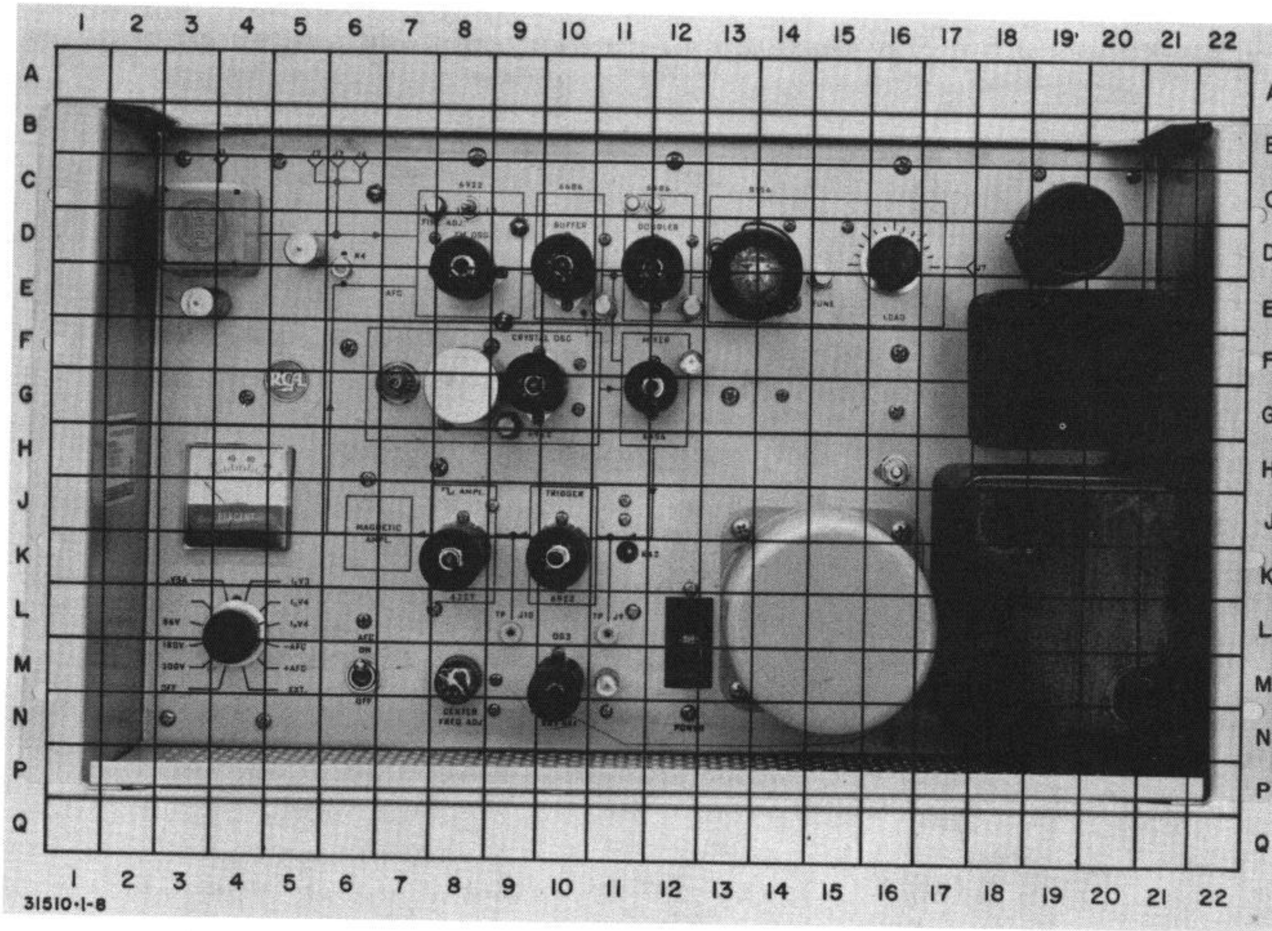


Figure 10—Front View of Exciter

COMPONENT LOCATION TABLES FOR FIGURE 10.

By Coordinates

C3-T1	D14-C31	F12-C65	L9-J10
C8-C81	D16-C36	G9-C55	L11-J9
C8-L3	E3-C44	H4-M1	L12-S2
C19-C53	E11-C17	H18-T2	M6-S1
D5-C6	E12-C22	J8-V8	M8-R59
D6-R4	E18-A1	J10-V7	M10-V9
D8-V1	F7-DS1	J11-R42	M11-C41
D10-V2	F8-Y1	J14-L11	
D11-V3	F9-V5	L4-S3	
D13-V4	F11-V6		

By Symbol Number

Cap.	C55-G9	V4-D13	J10-L9
C6-D5	C65-F12	V5-F9	L3-C8
C17-E11	*Resistor*	V6-F11	L11-J14
C22-E12	R4-D6	V7-J10	M1-H4
C31-D14	R42-J11	V8-J8	S1-M6
C36-D16	R59-M8	V9-M10	S2-L12
C41-M11	*Tubes*	*Misc.*	S3-L4
C44-E3	V1-D8	A1-E18	T1-C3
C53-C19	V2-D10	DS1-F7	T2-H18
	V3-D11	J9-L11	Y1-F8
			C-81-C8

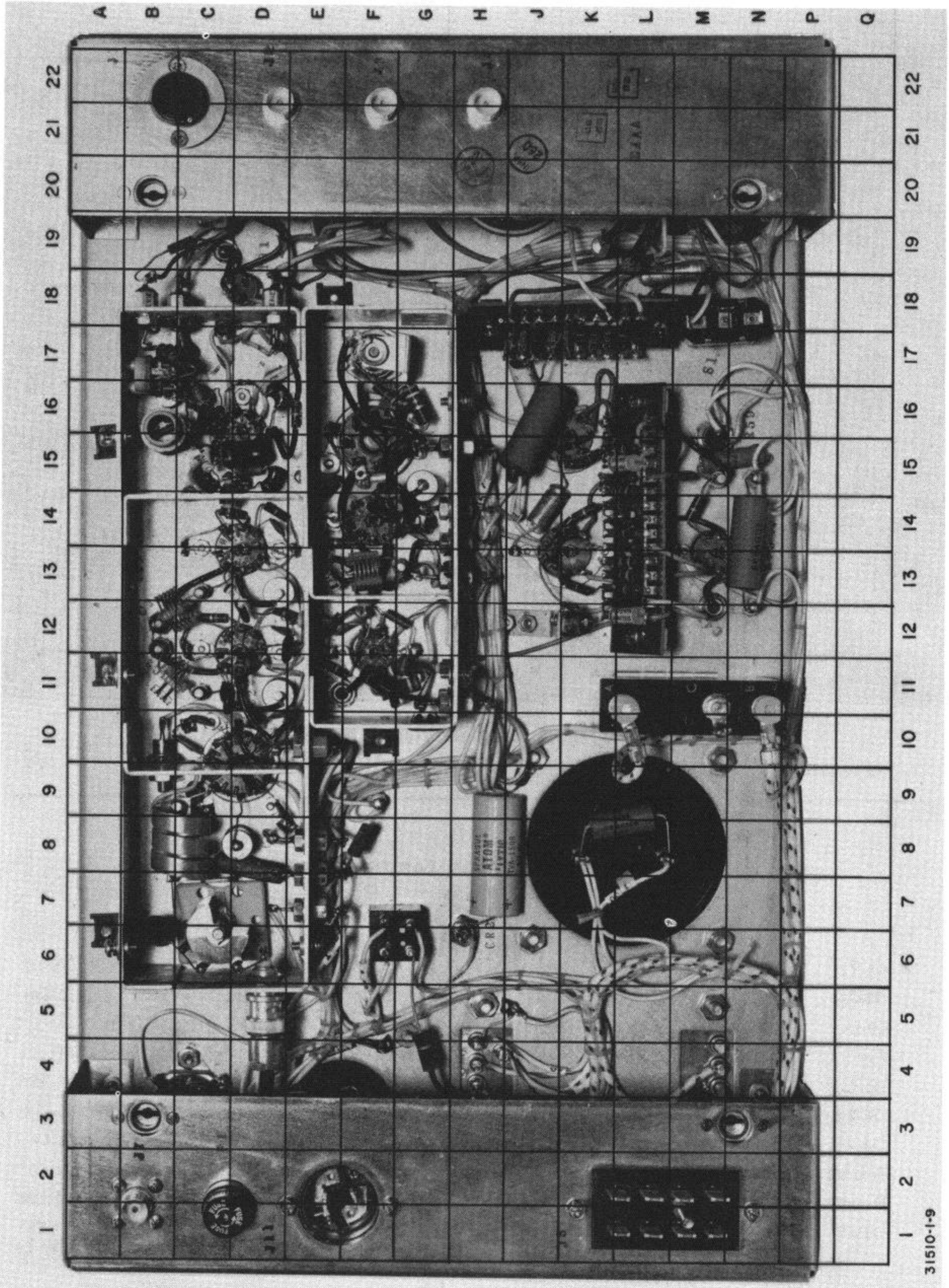


Figure 11—Rear View of Exciter

COMPONENT LOCATION TABLES FOR FIGURE 11.

By Coordinates

B1-J7	C9-C32	D10-C25	D21-R73*	F12-R34	G15-C56	K12-R42	L14-R46
B6-C35	C12-R10	D11-XV3	E1-J11	F13-L12	G16-R27	K13-R43	L14-C68
B8-L8	C15-C39	D11-C29	E2-C86*	F13-R28	H4-T2	K13-L14	L14-R47
B10-CR3	C15-C7	D11-C22	E2-C87*	F14-XV5	H6-CR2	K14-L15	L15-R44
B11-L6	C15-C12	D11-R9	E4-A1	F14-R31	H8-C43	K14-R48	L15-R49
B12-C23	C15-R6	D12-R11	E7-C24	F14-C59	H9-C83	K15-L16	L15-C69
B12-C18	C15-C14	D12-C21	E7-C34	F15-XY1	H21-J4	K15-R51	L15-R50
B12-L5	C15-C13	D12-C19	E8-C30	F16-C57	H21-R70*	K17-CR7	L16-C70
B16-L3	C15-L4	D12-C16	E10-C26	F16-R69	H21-R71*	K17-R66	L16-R52
B16-C81	C16-C9	D13-C17	E10-C20	F17-DS1	H21-R72	K17-R61	L17-R63
B17-L2	C16-C10	D13-XV2	E10-C51	F22-J3	J1-J5	K17-R62	L17-R60
B17-C8	C18-C5	D14-R7	E11-C65	G5-R22	J13-XV7	K19-R56	L18-C42
B17-L1	C18-C38	D14-R8	E11-C62	G11-C64	J14-C71	L2-C84*	L19-R55
B18-C45	C18-C40	D14-C15	E12-C63	G11-C52	J15-R53	L2-C85*	M12-C4
B18-C49	C18-R3	D15-C48	E13-C50	G11-R36	J15-XV8	L8-C82	M13-XV9
B18-C11	C19-C6	D15-XV1	E14-R26	G11-L13	J16-C72	L11-S2	M13-C54
B21-J1	D4-P6	D16-R20	E14-C61	G12-R35	J17-CR4	L12-C66	M14-R25
C4-C53	D6-J6	D16-L10	F6-CR1	G13-C60	J17-CR5	L13-C67	M15-R59
C4-XC53	D8-C31	D16-C76	F8-R13	G14-C46	J17-C73	L13-R40	M18-S1
C6-C36	D9-C27	D16-C47	F11-XV6	G14-C58	J17-CR6	L13-R39	M19-R54
C8-L9	D10-R12	D17-L1	F11-R33	G14-R30	J19-M1	L13-R41	N13-R21
C9-C28	D10-L7	D18-R4	F11-R37	G14-R32	K8-L11	L14-R45	N14-R24
C9-XV4	D10-C33	D21-J2	F11-R38	G15-C55			

By Symbol Number

Cap.	C28-C9	C56-G15	C87*-E2	P6-D4	R21-N13	R48-K14	*Sockets*
C4-M12	C29-D11	C57-F16	*Coils*	J6-D6	R22-G5	R49-L15	XV1-D15
C5-C18	C30-E8	C58-G14	L1-B17	J7-B1	R24-N14	R50-L15	XV2-D13
C6-C19	C31-D8	C59-F14	L2-B17	J11-E1	R25-M14	R51-K15	XV3-D11
C7-C15	C32-C9	C60-G13	L3-B16		R26-E14	R52-L16	XV4-C9
C8-B17	C33-D10	C61-E14	L4-C15	*Diodes*	R27-G16	R53-J15	XV5-F14
C9-C16	C34-E7	C62-E11	L5-B12	CR1-F6	R28-F13	R54-M19	XV6-F11
C10-C16	C35-B6	C63-E12	L6-B11	CR2-H6	R30-G14	R55-L19	XV7-J13
C11-B18	C36-C6	C64-G11	L7-D10	CR3-B10	R31-F14	R56-K19	XV8-J15
C12-C15	C38-C18	C65-E11	L8-B8	CR4-J17	R32-G14	R59-M15	XV9-M13
C13-C15	C39-C15	C66-L12	L9-C8	CR5-J17	R33-F11	R60-L17	XY1-F15
C14-C15	C40-C18	C67-L13	L10-D16	CR6-J17	R34-F12	R61-L17	XC53-C4
C15-D14	C42-L18	C68-L14	L11-K8	CR7-K17	R35-G12	R62-K17	*Misc.*
C16-D12	C43-H8	C69-L15	L12-F13	*Res.*	R36-G11	R63-L17	A1-E4
C17-D13	C45-B18	C70-L16	L13-G11	R3-C18	R37-F11	R66-K17	DS1-F17
C18-B12	C46-G14	C71-J14	L14-K13	R4-D18	R38-F11	R69-F16	M1-J19
C19-D12	C47-D16	C72-J16	L15-K14	R6-C15	R39-L13	R70*-H21	S1-M18
C20-E10	C48-D15	C73-J17	L16-K15	R7-D14	R40-L13	R71*-H21	S2-L11
C21-D12	C49-B18	C76-D16		R8-D14	R41-L13	R72*-H21	T2-H4
C22-D11	C50-E13	C81-B16	*Conn.*	R9-D11	R42-K12	R73*-D21	
C23-B12	C51-E10	C82-L8	J1-B21	R10-C12	R43-K13		
C24-E7	C52-G11	C83-H9	J2-D21	R11-D12	R44-L15		
C25-D10	C53-C4	C84*-L2	J3-F22	R12-D10	R45-L14		
C26-E10	C54-M13	C85*-L2	J4-H21	R13-F8	R46-L14		
C27-D9	C55-G15	C86*-E2	J5-J1	R20-D16	R47-L14		

*Not visible in photo.

PARTS LIST

Symbol	Stock No.	Drawing No.	Description
			BTE-10C (MI-560300A) FM BROADCAST EXCITER
A1	230027	8489388- 1	MAGNETIC AMPLIFIER
			CAPACITORS
C1	54221	8886252- 3	VARIABLE, 7-45 PF, 500 V
C2	300237	993026-437	MICA, 100 PF ±5%, 500 V
C3	215197	993026-433	MICA, 68 PF ±5%, 500 V
C4	226675	1510051-333	TANTALUM, 10 MF ±10% 20 V
C5	229913	8539054- 1	FEED-THRU, 150 PF 500 V
C6	239742	8528127-201	ELECTROLYTIC, 1 MF 150 V
C7	229917	8537370- 1	SILICON - VOLTAGE VARIABLE
C8	204812	8519908- 1	VARIABLE, 1.5-7 PF, 350 V
C9	230881	8540176- 2	CERAMIC, 28 PF ±2% 500 V
C10	222384	993026-645	MICA, 220 PF ±2%, 500 V
C11	231320	8539054- 2	FEED THRU, 1 NF ±20%, 500 V
C12	300237	993026-237	MICA, 100 PF ±10%, 500 V
C13	921779	993026-629	MICA, 47 PF ±2%, 500 V
C14	105781	993013-103	CERAMIC, 1 PF ±.25 PF, 500 V
C15	224570	8537367- 1	CERAMIC, 10 NF, 50 V
C16	105781	993013-103	CERAMIC, 1 PF ±.25 PF, 500 V
C17	235343	3455040- 1	VARIABLE, 0.7 MMF - 30.0 MMF
C18	214638	8864187- 5	STAND-OFF, 1NF ±20%, 500 V
C19	219744	993026-231	MICA, 56 PF ±10%, 500 V
C20	231320	8539054- 2	FEED THRU, 1 NF, 500 V
C21	224570	8537367- 1	CERAMIC, 10 NF, 50 V
C22	235343	3455040- 1	VARIABLE, 0.7 MMF - 30.0 MMF
C23	214638	8864187- 5	STAND-OFF, 1 NF ±20%, 500 V
C24	231320	8539054- 2	FEED THRU, 1 NF ±20%, 500 V
C25	215198	993026-225	MICA, 33 PF ±10%, 500 V
C26	231320	8539054- 2	FEED THRU, 1 NF ±20%, 500 V
C27	224570	8537367- 1	CERAMIC, 10 NF, 50 V
C28	224570	8537367- 1	CERAMIC, 10 NF, 50 V
C29	224570	8537367- 1	CERAMIC, 10 NF, 50 V
C30	231320	8539054- 2	FEED THRU, 1 NF ±20%, 500 V
C31	235343	3455040- 1	VARIABLE, 0.7 MMF - 30.0 MMF
C32	205656	1510003- 37	CERAMIC, 10 NF 500 V
C33	205656	1510003- 37	CERAMIC, 10 NF 500 V
C34	231320	8539054- 2	FEED THRU, 1 NF ±20%, 500 V
C35	208631	3455039- 1	CERAMIC, 2.2 NF ±10% 1000 V
C36	215869	8946284- 2	VARIABLE, 6-142 PF, 600 V
C37	232892	990786-251	PLASTIC, 1000 PF ±10% 200 V
C38	229913	8539054- 1	FEED THRU, 150 PF ±20%, 500 V
C39	230874	3455563- 2	SILICON - VOLTAGE VARIABLE
C40	231320	8539054- 2	FEED THRU, 1 NF ±20%, 500 V
C41	229911	984615-333	PAPER, .1 MF ±10%, 200 V
C42	230031	8540114- 1	TANTALUM, 40 MF, 15 V.N.P.
C43	207757	442901- 64	ELECTROLYTIC, 20 MF 250 V
C44	229909	984615-319	PAPER, 1 MF ±10%, 100 V
C45	231320	8539054- 2	FEED THRU, 1 NF ±20%, 500 V
C46	231320	8539054- 2	FEED THRU, 1 NF ±20%, 500 V
C47	215198	993026-225	MICA, 33 PF ±10%, 500 V
C48	300586	993026-451	MICA, 390 PF ±5%, 500 V
C49	231320	8539054- 2	FEED THRU, 1 NF ±20%, 500 V
C50	77688	993013-208	CERAMIC, 5 PF ±.5 PF 500 V
C51	231320	8539054- 2	FEED THRU, 1 NF ±20%, 500 V
C52	231320	8539054- 2	FEED THRU, 1 NF ±20%, 500 V
C53	96618	449619- 12	ELECTROLYTIC, 80 MF, 450 V
C54	230032	8528127-211	ELECTROLYTIC, 18 MF, 150 V
C55	235343	3455040- 1	VARIABLE, 0.7 MMF - 30.0 MMF
C56	231320	8539054- 2	FEED THRU, 1 NF ±20%, 500 V
C57	230877	990786-268	PLASTIC, .027 MF ±10% 200 V
C58	231320	8539054- 2	FEED THRU, 1 NF ±20%, 500 V
C59	300185	993026-241	MICA, 150 PF ±10%, 500 V
C60	231320	8539054- 2	FEED THRU, 1 NF ±20%, 500 V
C61	205656	1510003- 37	CERAMIC, 10 NF, 500 V
C62	219668	993026-213	MICA, 10 PF ±10%, 500 V
C63	230033	8528127- 27	ELECTOLYTIC, 20 MF, 6 V

Symbol	Stock No.	Drawing No.	Description
C64	231320	8539054- 2	FEED THRU, 1 NF ±20%, 500 V
C65	225140	984615-335	PAPER, .22 MF ±10%, 200 V
C66	218777	990786-265	PLASTIC, 15 NF ±10%, 200 V
C67	219744	993026-231	MICA, 56 PF ±10%, 500 V
C68	216971	993026-221	MICA, 22 PF ±10%, 500 V
C69	218777	990786-265	PLASTIC, 15 NF ±10%, 200 V
C70	300188	993026-247	MICA, 270 PF ±10%, 500 V
C71	229914	8528127- 29	ELECTROLYTIC, 40 MF, 6 V
C72	227706	990786-369	PLASTIC, 33 NF ±10%, 400 V
C73	213496	993026-629	MICA, 47 PF ±2%, 500 V
C74	226980	990786-163	PLASTIC, 10 NF ±10%, 100 V
C75	205656	1510003- 37	CERAMIC, 10 NF, 500 V
C76	300196	993026-261	MICA, 1000 PF ±10%, 500 V
C77	231320	8539054- 2	FEED THRU, 1 NF 500 V
C78	232909	3455621-101	PLASTIC, 13.25 NF ±1% 200 V
C79	232909	3455621-101	PLASTIC, 13.25 NF ±1% 200 V
C80	232910	3455621-102	PLASTIC, 26.5 NF ±1% 200 V
C81	232911	3455804- 1	VARIABLE, .6-5 PF
C82	234848	3455621- 7	FILM, 0.1 MF ±10% 600 V
C83	205656	1510003- 37	CERAMIC, 10 NF 500 V
C84	222720	8513629- 29	CERAMIC, 10 NF 2 KV
C85	222720	8513629- 29	CERAMIC, 10 NF 2 KV
C86	222720	8513629- 29	CERAMIC, 10 NF 2 KV
C87	222720	8513629- 29	CERAMIC, 10 NF 2 KV
CR1	230034	8483890- 3	RECTIFIER - QUAD
CR2	230044		DIODE - TYPE 1N3014B
CR3	225413		DIODE - TYPE 1N2984B
CR4	224109		DIODE - TYPE 1N629
CR5	224109		DIODE - TYPE 1N629
CR6	224109		DIODE - TYPE 1N629
CR7	224109		DIODE - TYPE 1N629
DS1	101857	872291- 9	LAMP - PILOT
F1	3748	990157- 6	FUSE - 1/2 AMPERE, 250 V
J1	211510	481799- 2	CONNECTOR - FEMALE, 2 CONDUCTOR
J2	223973	1510013-181	CONNECTOR - FEMALE, COAXIAL
J3	223973	1510013-181	CONNECTOR - FEMALE, COAXIAL
J4	223973	1510013-181	CONNECTOR - FEMALE, COAXIAL
J5	55806	727969- 7	CONNECTOR - MALE, 8 CONTACT
J6	223973	1510013-181	CONNECTOR - MALE
J7	226550	1510013-133	CONNECTOR - MALE
J9	208983	8825493- 7	CONNECTOR - TIP JACK
J10	208983	8825493- 7	CONNECTOR - TIP JACK
J11	54472	889482- 3	CONNECTOR - FEMALE, 2 CONTACT
L1	230036	8886161- 5	CHOKE, 50 MICROHENRY
L2	230036	8886161- 5	CHOKE, 50 MICROHENRY
L3	229923	8539079- 1	COIL - OSCILLATOR
L4	229922	8701589-257	CHOKE, 22 MICROHENRY
L5		8914884- 33	COIL - 5 TURNS, 1/2 IN. ID
L6		8914884- 21	COIL - 2 TURNS, 1/2 IN. ID
L7	229921	8701589-241	CHOKE, 4.7 MICROHENRY
L8		8533751- 1	COIL - 3 TURNS, 0.75 ID
L9	57259	8886161- 7	CHOKE, 7 MICROHENRY
L10	209846	8926266- 1	BEAD - FERRITE
L11	217278	8486394- 1	REACTOR, 10 HENRY
L12		8914884- 34	COIL - 6 TURNS, 1/2 IN. ID
L13	230036	8886161- 5	CHOKE, 50 MICROHENRY
L14	209846	8926266- 1	BEAD - FERRITE
L15	209846	8926266- 1	BEAD - FERRITE
L16	209846	8926266- 1	BEAD - FERRITE
M1	230037	8494084- 1	METER
P1	211509	481799- 1	CONNECTOR - MALE, 2 CONTACT
P2	921359	1510013-101	CONNECTOR - FEMALE, COAXIAL
P3	921359	1510013-101	CONNECTOR - FEMALE, COAXIAL
P4	921359	1510013-101	CONNECTOR - FEMALE, COAXIAL
P5	55808	727969- 8	CONNECTOR - FEMALE, 8 CONTACT
P6	921359	1510013-101	CONNECTOR - FEMALE, COAXIAL
P7	921359	1510013-101	CONNECTOR - FEMALE, COAXIAL
P11			CONNECTOR - PART OF MI-560300

Symbol	Stock No.	Drawing No.	Description
			RESISTOR FIXED COMPOSITION UNLESS NOTED
R1	502339	82283-197	39,000 OHMS ±5% 1/2 W
R2	502447	82283-223	470,000 OHM ±5%, 1/2 W
R3	502312	82283- 75	12,000 OHMS ±10% 1/2 W
R4	228997	8868256- 44	VARIABLE, 5000 OHMS
R5	512333	90496- 80	33,000 OHM ±10%, 1 W
R6	229918	990404-253	FILM, 15,000 OHM ±5%, 1/2 W
R7	502382	82283- 85	82,000 OHM ±10%, 1/2 W
R8	502122	82283- 54	220 OHM ±10%, 1/2 W
R9	502468	82283- 96	680,000 OHMS ±10% 1/2 W
R10	502382	82283- 85	82,000 OHM ±10%, 1/2 W
R11	502122	82283- 54	220 OHM ±10%, 1/2 W
R12	512251	90496-176	5100 OHM ±5%, 1 W
R13	217602	99316- 3	WIREWOUND, 5 OHM ±1%, 1/2 W
R14	502315	82283- 76	15,000 OHM ±10%, 1/2 W
R15	502315	82283- 76	15,000 OHM ±10%, 1/2 W
R16	502222	82283- 66	2200 OHM ±10%, 1/2 W
R17	502410	82283-207	100,000 OHMS ±5% 1/2 W
R18	502422	82283-215	220,000 OHMS ±5% 1/2 W
R19	502222	82283- 66	2200 OHMS ±10% 1/2 W
R20	502082	82283- 49	82 OHM ±10%, 1/2 W
R21	210153	993007- 95	WIREWOUND, 5000 OHM ±5%, 5 W
R22	512010	90496- 38	10 OHM ±10%, 1 W
R23	300113	878434- 8	WIREWOUND, 1000 OHM ±5%, 20 W
R24	214877	942988-152	FILM, 13,000 OHM ±5%, 3 W
R25	502022	82283- 42	22 OHMS ±10% 1/2 W
R26	502112	82283- 51	120 OHM ±10%, 1/2 W
R27	502347	82283- 23	47,000 OHMS ±20% 1/2 W
R28	502239	82283- 69	3900 OHM ±10%, 1/2 W
R29	502215	82283- 64	1500 OHM ±10%, 1/2 W
R30	502215	82283- 64	1500 OHM ±10%, 1/2 W
R31	502356	82283- 83	56,000 OHM ±10%, 1/2 W
R32	502112	82283- 51	120 OHM ±10%, 1/2 W
R33	502410	82283- 86	100,000 OHM ±10%, 1/2 W
R34	502410	82283- 86	100,000 OHM ±10%, 1/2 W
R35	502122	82283- 54	220 OHM ±10%, 1/2 W
R36	502310	82283- 74	10,000 OHM ±10%, 1/2 W
R37	512322	90496- 78	22,000 OHM ±10%, 1 W
R38	512339	90496- 81	39,000 OHM ±10%, 1 W
R39	229926	990407-253	FILM, 15,000 OHM ±5%, 1 W
R40	502422	82283- 90	220,000 OHM ±10%, 1/2 W
R41	229927	990407-255	FILM, 18,000 OHM ±5%, 1 W
R42	229915	8537361- 2	VARIABLE, W.W., 10,000 OHM ±10%, 1/2 W
R43	502112	82283- 51	120 OHM ±10%, 1/2 W
R44	229928	990407-263	FILM, 39,000 OHM ±5%, 1 W
R45	502227	82283-169	2700 OHM ±5%, 1/2 W
R46	224260	990404-273	FILM, 100,000 OHM ±5%, 1/2 W
R47	229924	990404-277	FILM, 150,000 OHM ±5%, 1/2 W
R48	502112	82283- 51	120 OHM ±10%, 1/2 W
R49	502224	82283-168	2400 OHM ±5%, 1/2 W
R50	502468	82283- 96	680,000 OHM ±10%, 1/2 W
R51	502112	82283- 51	120 OHM ±10%, 1/2 W
R52	502082	82283-133	82 OHM ±5%, 1/2 W
R53	230039	993007- 91	WIREWOUND, 3100 OHM ±5%, 5 W
R54	230878	8515214-601	FILM, 1 MEG ±1% 1 W
R55	230879	8515214-647	FILM, 3.01 MEG ±1% 1 W
R56	230880	8515214-676	FILM, 6.04 MEG ±1% 1 W
R57	215176	990186-359	FILM, 4020 OHM ±1%, 1/2 W
R58	502415	82283- 88	150,000 OHM ±10%, 1/2 W
R59	230041	8539000- 2	VARIABLE, W.W., 50,000 OHM ±5%, 1.5 W
R60	228707	990404-276	FILM, 130,000 OHM ±5%, 1/2 W
R61	227104	990404-263	FILM, 39,000 OHM ±5%, 1/2 W
R62	227104	990404-263	FILM, 39,000 OHM ±5%, 1/2 W
R63	228716	990404-249	FILM, 10,000 OHM ±5%, 1/2 W
R64	502382	82283-205	82,000 OHMS ±5% 1/2 W
R65	502410	82283- 86	100,000 OHM ±10%, 1/2 W
R66	228716	990404-249	FILM, 10,000 OHM ±5%, 1/2 W
R69	259938	90496-528	3.9 OHMS ±10% 1 W
R70	260040	1510136-401	FILM, 10,000 OHMS ±1% 1/2 W

Symbol	Stock No.	Drawing No.	Description
R71	232907	1510136-430	FILM, 20,000 OHMS ±1% 1/2 W
R72	232907	1510136-430	FILM, 20,000 OHMS ±1% 1/2 W
R73	502218	82283- 65	1800 OHMS ±10% 1/2 W
S1	269100	990780- 1	SWITCH - TOGGLE
S2	229906	8489397- 1	BREAKER - CIRCUIT, 250 V, 60 CPS
S3	229907	8489349- 1	SWITCH - ROTARY, 12 POS. 2 SEC.
T1	205662	8486302- 1	TRANSFORMER - AUDIO
T2	229908	8486301- 1	TRANSFORMER - PLATE AND FILAMENT
XC53	68590	99100- 4	SOCKET - CAPACITOR
XF1	230876	99088- 4	HOLDER - FUSE
XV1	94880	737870- 18	SOCKET - TUBE, 9 PIN
XV2	94880	737870- 18	SOCKET - TUBE, 9 PIN
XV3	94880	737870- 18	SOCKET - TUBE, 9 PIN
XV4	230042	8540105- 1	SOCKET - COMPACTRON, 12 PIN
XV5	94880	737870- 18	SOCKET - TUBE, 9 PIN
XV6	97879	737867- 18	SOCKET - TUBE, 7 PIN
XV7	94880	737870- 18	SOCKET - TUBE, 9 PIN
XV8	94880	737870- 18	SOCKET - TUBE, 9 PIN
XV9	94879	737867- 18	SOCKET - TUBE, 7 PIN
XY1	68590	99100- 4	SOCKET - CRYSTAL OVEN
Y1			CRYSTAL - MI-560302
Z1			BRIDGED TEE FILTER
			MISCELLANEOUS
	57751	990789- 6	HOLDER - LAMP, WITH BUSHING
	216637	990788-402	JEWEL - GREEN
	230043	1510924-508	KNOB - CONTROL, FOR C36 AND S3

SUPPLEMENT I

BTE-10CT FM BROADCAST TRANSMITTER

BTE-10CT FM BROADCAST TRANSMITTER

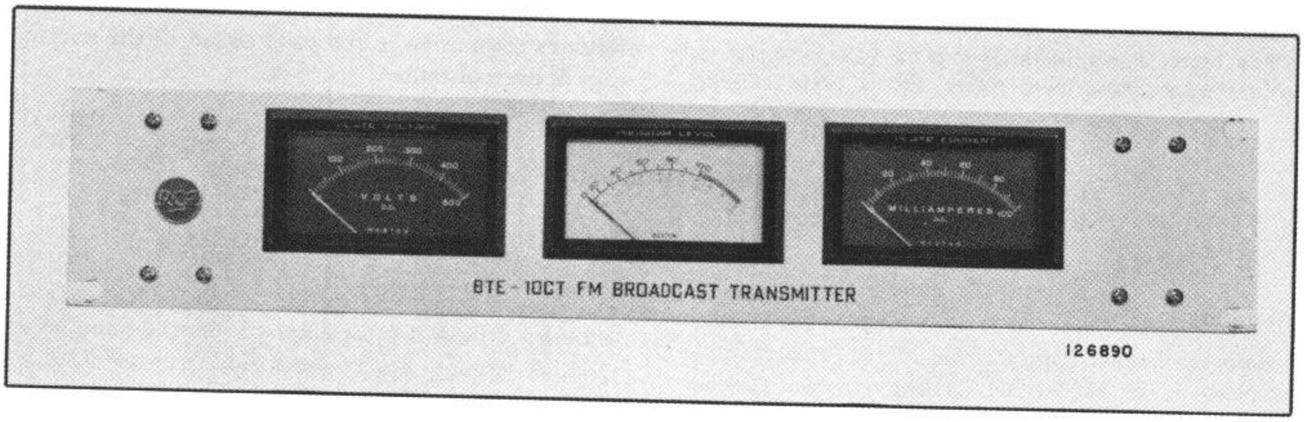


Figure 12—Front View of Meter Panel

EQUIPMENT SUPPLIED

BTE-10CT FM BROADCAST TRANSMITTER, ES-560236

Quantity	*Description*	*Reference*
1	FM Broadcast Exciter	MI-560300-A
1	Crystal Unit	MI-560302*
**	Set of Spare Tubes	MI-560301
1	Meter Panel	MI-560303
1	Directional Coupler	MI-562000
**	Cabinet	MI-560304

* Crystal Unit to be ordered to suit customers assigned frequency.
** Optional.

TECHNICAL DATA

Mechanical Specifications

Height .... 14 inches
Width .... 19 inches
Weight .... 40 pounds

DESCRIPTION

General

The BTE-10CT FM Broadcast Transmitter consists of the BTE-10C FM Broadcast Exciter, MI-560300-A, and a Meter Panel, MI-560303. A Cabinet, MI-560304, is optional equipment.

The transmitter provides an r-f output of ten watts at any specified frequency in the FM Broadcast band. It may be used for transmission of monophonic or stereophonic and SCA signals. Low distortion, wide frequency response, ease of adjustment, and reliable operation are characteristic of the transmitter.

The BTE-10CT is designed to conform to FCC requirements for educational transmitters.

When stereophonic operation is desired, the BTE-10CT Transmitter may be used with the BTS-1A Stereo Subcarrier Generator. If, in addition, SCA operation is desired, the BTX-1A Subcarrier Generator may be used.

Refer to the *DESCRIPTION* in the front of the book for information on the BTE-10C FM BROADCAST EXCITER.

Meter Panel

The Meter Panel includes a plate voltage meter, a calibrated program level meter and a plate current meter. The plate voltage meter, M101, indicates the plate voltage of the final stage. The program level meter, or "VU" meter, M102, serves to indicate the degree of modulation. The plate current meter, M103, indicates the current in the plate circuit of the output stage of the transmitter.

INSTALLATION

Mounting

Both the Exciter Unit and the Meter Panel may be mounted in the MI-560304 Cabinet designed for the purpose, or they may be mounted in a standard rack.

Interconnections

Make connections to the Meter Panel and the Exciter Unit according to the schematic diagram figure 13.

Clip out resistors R13 and R57. Resistor R13 is connected to a feed-thru capacitor on one side and to a stand-off terminal at the other side. Resistor R57 is mounted at meter switch S3. The built-in meter will now show no reading in the I_p V4 position.

Do not remove plug P101 of the meter panel when the exciter is energized. Removal of the plug with the unit energized will lead to the destruction of the screen grid of tube V4.

SETUP

Connect an audio frequency signal generator to connector, P103, on the meter panel. Adjust the signal generator for 400 cycles (hertz) output. Adjust the level for 100% modulation (±75 kc/s-kHz deviation), 10 dBm ±2 dBm. Adjust resistor, R102, for 100% indication on the program level meter, M102.

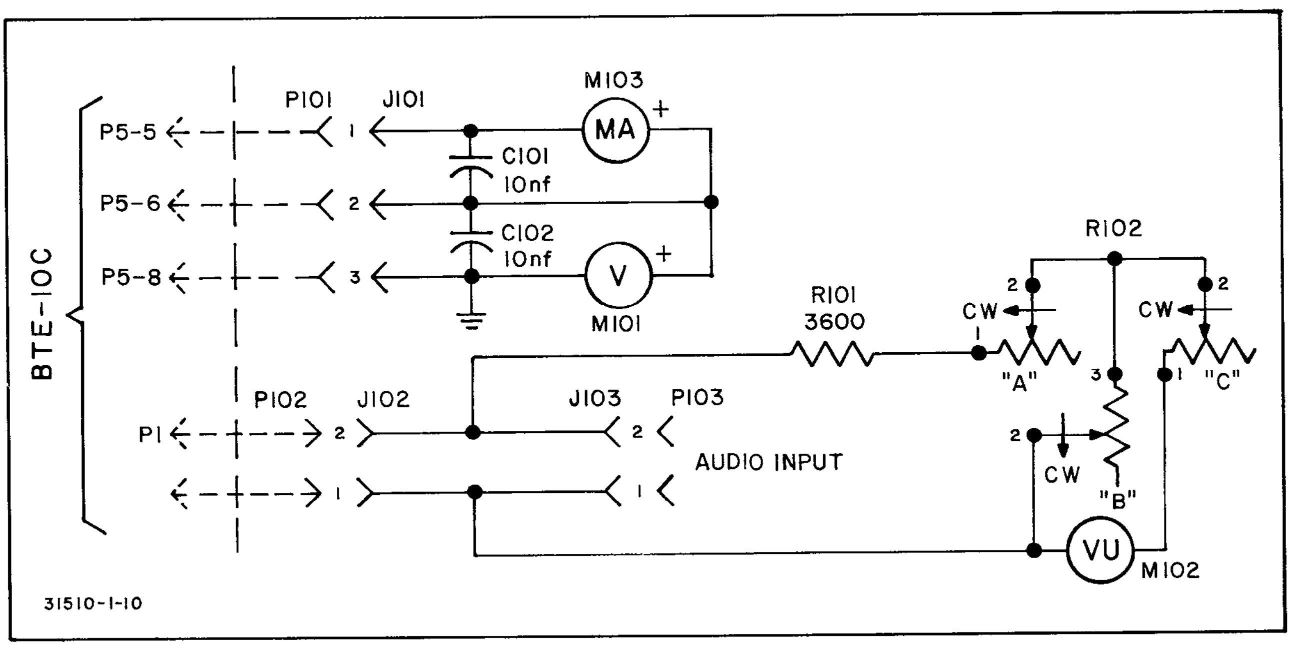


Figure 13—Schematic Diagram of Meter Panel

PARTS LIST

Symbol	Stock No.	Drawing No.	Description
			BTE-10CT (MI-560303) FM BROADCAST TRANSMITTER METER PANEL
C101	205656	1510003- 37	CAPACITOR - CERAMIC, 10 MF 500 V
C102	205656	1510003- 37	CAPACITOR - CERAMIC, 10 MF 500 V
J101	48255	449613- 9	CONNECTOR - MALE, 3 CONTACT
J102	211510	481799- 2	CONNECTOR - FEMALE, 2 CONTACT
J103	211510	481799- 2	CONNECTOR - FEMALE, 2 CONTACT
M101	232528	993073-117	METER - 0-500 VDC
M102	232529	993082- 2	METER - VU
M103	232527	993071-113	METER - 0-100 MA
P102	211509	481799- 1	CONNECTOR - MALE, 2 CONTACT
P101	48836	878364- 1	CONNECTOR FEMALE, 2 CONTACT POLARIZED
P101	48836	878364- 1	CONNECTOR - FEMALE, 2 CONTACT POLARIZED
P103	211509	481799- 1	CONNECTOR - MALE, 2 CONTACT
R101	232526	990407-238	RESISTOR - 3600 OHMS ±5% 1 W
R102	232530	8544736- 1	RESISTOR - VAR., WIREWOUND, 3900 OHMS ±20%

SUPPLEMENT II

BTE-10C FM BROADCAST EXCITER MODIFIED FOR USE ON UHF TELEVISION BROADCAST TRANSMITTERS:

TTU-2A

TTU-10A

TTU-30A

TTU-50C

BTE-10C FM BROADCAST EXCITER

MODIFIED FOR USE ON UHF TELEVISION BROADCAST TRANSMITTERS

EQUIPMENT SUPPLIED

MODIFIED BTE-10C FM BROADCAST EXCITER

Quantity	*Description*	*Reference*
1	FM Exciter	MI-560300A
1	TV Conversion For BTE-10C	MI-560381
1	Crystal Unit	MI-560384

DESCRIPTION

General

The RCA BTE-10C FM Exciter must be modified to prepare it for use on the RCA series of UHF television broadcast transmitters. Characteristics of the basic frequency modulated exciter are explained in detail at the front of this book. In a modified condition, the exciter develops a stable, high quality, direct frequency modulated aural signal for the UHF television channels 14 to 83 (bands IV and V). Design features of this equipm ent facilitate modification and installation.

Circuit

The circuit of the BTE-10C FM Broadcast Exciter modified for television application is shown in figure 16. As illustrated, the modification involves the deletion of the doubler stage, V3; thus, the output frequency is the same as that of the master oscillator, V1. The frequency modulated aural signal developed by the exciter (BTE-10C) is heterodyned with the crystal controlled frequency of the Exciter/Modulator Unit, MI-560382-A. This results in the basic frequency necessary for producing the aural carrier in television transmission.

INSTALLATION

All components necessary for modification of the exciter are contained in conversion kit MI-560381. The number of modifications to be made is determined by the assigned station channel. All modifications detailed below are indicated on figure 16.

Regardless of the assigned station channel, the doubler stage V3, tube 6686, must be removed from its socket. Insert the 100 picofarad capacitor (item 4 of MI-560381) between the plate (pin 7) of tube V2 and the control grid (pin 10) of tube V4. In addition, remove coil L8 from the exciter and replace it with the power amplifier coil (item 3).

If the assigned station channel is 21 to 36 or 61 to 83, no further modifications need to be made.

If channels 14 to 20, 470-512 Mc/s (MHz), or channels 37 to 60, 608-752 Mc/s (MHz), are to be used, the following additional modifications must be made to the exciter circuitry:

1. Remove coil L3 from the exciter and replace it with the oscillator coil (item 1).
2. Remove coil L5 from the exciter and replace it with the amplifier coil (item 2).
3. Insert the 47 picofarad capacitor (item 5) in parallel with capacitor C36.

After all the necessary circuit modifications have been made, refer to table 4 to ensure that the correct crystal for the assigned station channel has been received. For crystal frequencies other than those specified, refer to the formulas of table 5. Insert the crystal into socket XY1.

The primary of power transformer T2 is designed with tap terminals to permit operation on various line voltages. Refer to *AC Power Line Connections* under *INSTALLATION* in the front section of this book for transformer T2 connection procedure.

Check that all tubes are properly seated, with the exception of V3 which was previously removed from the exciter. Install the exciter into its designated location and connect the cable plugs to the receptacles located on the rear of the assembly.

Operation and maintenance are explained in detail in the basic exciter section of this book except for the modifications involving the deletion of the frequency doubler stage. The sequence of operations, such as: voltage checks, adjustments, and tuning, is stated in the instructions accompanying a specific television transmitter.

TABLE 4. FM EXCITER CRYSTALS

MI No *	*CRYSTAL Freq. Mc/s (MHz)*	*AURAL CARRIER Freq. Mc/s (MHz)*	*MI No.* *	*CRYSTAL Freq. Mc/s (MHz)*	*AURAL CARRIER Freq. Mc/s (MHz)*
560384-14	40.88000	475.75	560384-49	40.48526	685.75
-15	41.34154	481.75	-50	40.80105	691.75
-16	41.80308	487.75	-51	41.11684	697.75
-17	42.26462	493.75	-52	41.43263	703.75
-18	42.72615	499.75	-53	41.74842	709.75
-19	43.18769	505.75	-54	42.06421	715.75
-20	43.64923	511.75	-55	42.38000	721.75
-21	44.11077	517.75	-56	42.69579	727.75
-22	44.57231	523.75	-57	43.01158	733.75
-23	45.03385	529.75	-58	43.32737	739.75
-24	45.49538	535.75	-59	43.64316	745.75
-25	45.95692	541.75	-60	43.95894	751.75
-26	46.41846	547.75	-61	44.27474	757.75
-27	46.88000	553.75	-62	44.59053	763.75
-28	47.34154	559.75	-63	44.90632	769.75
-29	47.80308	565.75	-64	45.22211	775.75
-30	48.26462	571.75	-65	45.53789	781.75
-31	48.72615	577.75	-66	45.85364	787.75
-32	49.18769	583.75	-67	46.16947	793.75
-33	49.64923	589.75	-68	46.48526	799.75
-34	50.11077	595.75	-69	46.80105	805.75
-35	50.57231	601.75	-70	47.11684	811.75
-36	51.03385	607.75	-71	47.43263	817.75
-37	36.69579	613.75	-72	47.74842	823.75
-38	37.01159	619.75	-73	48.06421	829.75
-39	37.32737	625.75	-74	48.38000	835.75
-40	37.64316	631.75	-75	48.69579	841.75
-41	37.95895	637.75	-76	49.01158	847.75
-42	38.27474	643.75	-77	49.32737	853.75
-43	38.59053	649.75	-78	49.64316	859.75
-44	38.90632	655.75	-79	49.95895	865.75
-45	39.22211	661.75	-80	50.27474	871.75
-46	39.53789	667.75	-81	50.59053	877.75
-47	39.85368	673.75	-82	50.90632	883.75
-48	40.16947	679.75	-83	51.22211	889.75

*Suffixes designate channel number

TABLE 5. FORMULA FOR CALCULATING CRYSTAL OPERATING FREQUENCY

Channel Frequency	*Formula*	*Carrier Separation Mc/s (MHz)*
470 to 606 Mc/s (MHz)	$F_{crystal} = \frac{F_{visual\ carrier}}{13} + 4.63\ (MHz)$	4.5
	$F_{crystal} = \frac{F_{visual\ carrier}}{13} + 5.63\ (MHz)$	5.5
606 to 890 Mc/s (MHz)	$F_{crystal} = \frac{F_{visual\ carrier}}{19} + 4.63\ (MHz)$	4.5
	$F_{crystal} = \frac{F_{visual\ carrier}}{19} + 5.63\ (MHz)$	5.5

PARTS LIST

Symbol	Stock No.	Drawing No.	Description
			BTE-10C (MI-560381) T-V CONVERSION
	221678	993026-229	CAPACITOR - MICA, 47 MMF ±5% 500 V
	300237	993026-437	CAPACITOR - MICA, 100 MMF ±5% 500 V
	230690	8914884- 47	COIL - AMPLIFIER, 7 TURNS, 3/4 IN ID
	232375	8539079- 2	COIL - OSCILLATOR, ADJUSTABLE
	232376	8914884- 51	COIL - POWER AMPLIFIER

SUPPLEMENT III

BTE-10C FM BROADCAST EXCITER MODIFIED FOR OPERATION AT 1/2 CARRIER FREQUENCY IN FM BROADCAST TRANSMITTERS:

BTF-20/20E	When Specified:
BTF-10/10E	BTF-20E
BTF-5/5E	BTF-10E
BTF-40E	BTF-5E

BTE-10C FM BROADCAST EXCITER

MODIFIED FOR OUTPUT AT 1/2 CARRIER FREQUENCY IN FM BROADCAST TRANSMITTERS

EQUIPMENT SUPPLIED

MODIFIED BTE-10C FM BROADCAST EXCITER

Quantity	*Description*	*Reference*
1	FM Exciter	MI-560300A
1	Conversion for ½ Carrier Frequency Operation	MI-560504

DESCRIPTION

General

The RCA BTE-10C FM Exciter must be modified to prepare it for ½ carrier frequency operation on several FM broadcast transmitters. As described in the front portion of this book, the exciter is normally operated at an output frequency in the range of 88 to 108 Mc/s (MHz), figure 2. The design features of the BTE-10C Exciter are such that operation can be attained at ½ carrier frequency (44 to 54 Mc/s-MHz) by making minor modifications. This involves the deletion of the frequency doubler stage. In the modified condition, the exciter retains previous ease of adjustment and reliable operation. Additionally, the modified exciter is compatible with the following FM broadcast transmitters:

BTF-20/20E	BTF-20E	Applicable only when transmitter driver stage is operated as a doubler.
BTF-10/10E	BTF-10E	
BTF-5/5E	BTF- 5E	
BTF-40E		

Circuit

The circuit of the BTE-10C FM Broadcast Exciter modified for ½ carrier frequency is shown in figure 17. The doubler stage is deleted and bridged by a coupling capacitor. A detailed explanation of the circuit is given in the basic exciter section of this book and applies to this application with the exception of the doubler stage, V3, description.

The modulated FM signal output (½ carrier) from the modified exciter is coupled to the tuned grid circuit of the transmitter driver stage. At this point, the signal frequency is doubled and results in improved performance of the above specified FM transmitters.

INSTALLATION

All components necessary for modification of the exciter are contained in conversion kit MI-560504. Refer to wiring diagram, figure 15, and to the modification schematic, figure 17. Perform the following steps to complete the modification:

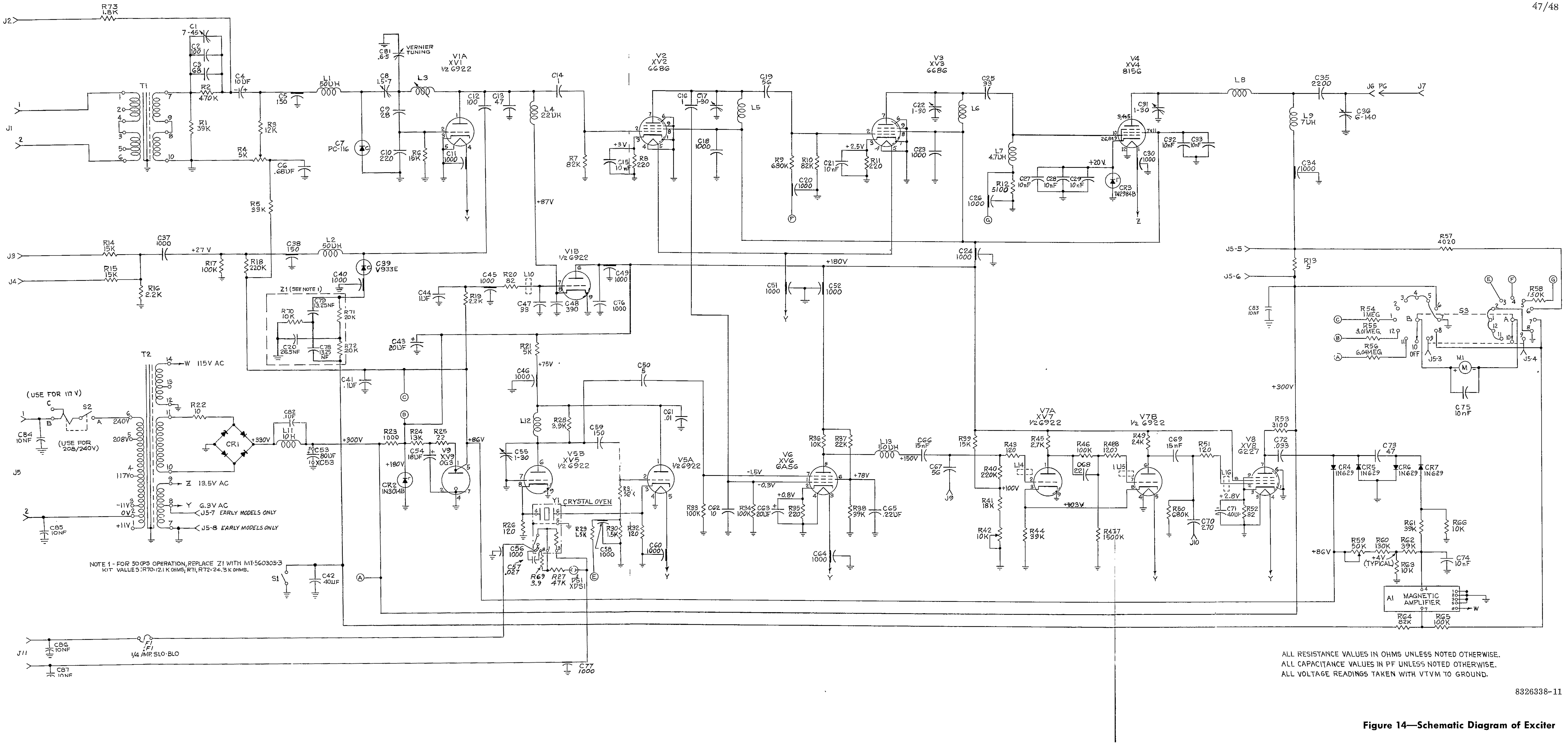
1. Remove all power to the exciter unit. Remove the protective rear cover and perforated cover which encloses the r-f circuits.
2. Disconnect and remove coil L8 from the plate circuit of V4. Install the coil supplied (item 1) in its place.
3. Disconnect and remove capacitors C19 and C25. Install the 100 picofarad capacitor (item 2) between socket V2 (terminal 7) and socket V4 (terminal 10). Remove doubler stage V3, tube 6686, and lay aside.
4. Install the 47 picofarad capacitor (item 3) in parallel with output loading capacitor C36. After all the necessary circuit modifications have been made, refer to the BTE-10C Exciter Crystal table in the front of this book to ensure that the correct crystal for the assigned channel has been received. Insert the crystal into socket XY1.

The primary of power transformer T2 is tapped to permit operation on various line voltages. Refer to *AC Power Line Connections* under *INSTALLATION* in the front of this book for transformer T2 connection procedure.

Use the tuning procedure in the *INSTALLATION* section of this book with the exception of references to the doubler stage. Since C22 and V3 are no longer used, C17 is now adjusted for maximum meter indication with the meter switch set to the I_c V4 position.

PARTS LIST

Symbol	Stock No.	Drawing No.	Description
			BTE-10C (MI-560504) CONVERSION OF BTE-10C EXCITER FOR 1/2 FREQUENCY OPERATION
	232376	8914884- 51	COIL - 4 3/4 TURNS 5/8 LG 5/8 I.D.
	300237	727860-123	CAPACITOR - MICA, 100 PF ±10% 500 V
	221678	727860-115	CAPACITOR - MICA, 47 PF ±10% 500 V



ALL RESISTANCE VALUES IN OHMS UNLESS NOTED OTHERWISE.
ALL CAPACITANCE VALUES IN PF UNLESS NOTED OTHERWISE.
ALL VOLTAGE READINGS TAKEN WITH VTVM TO GROUND.

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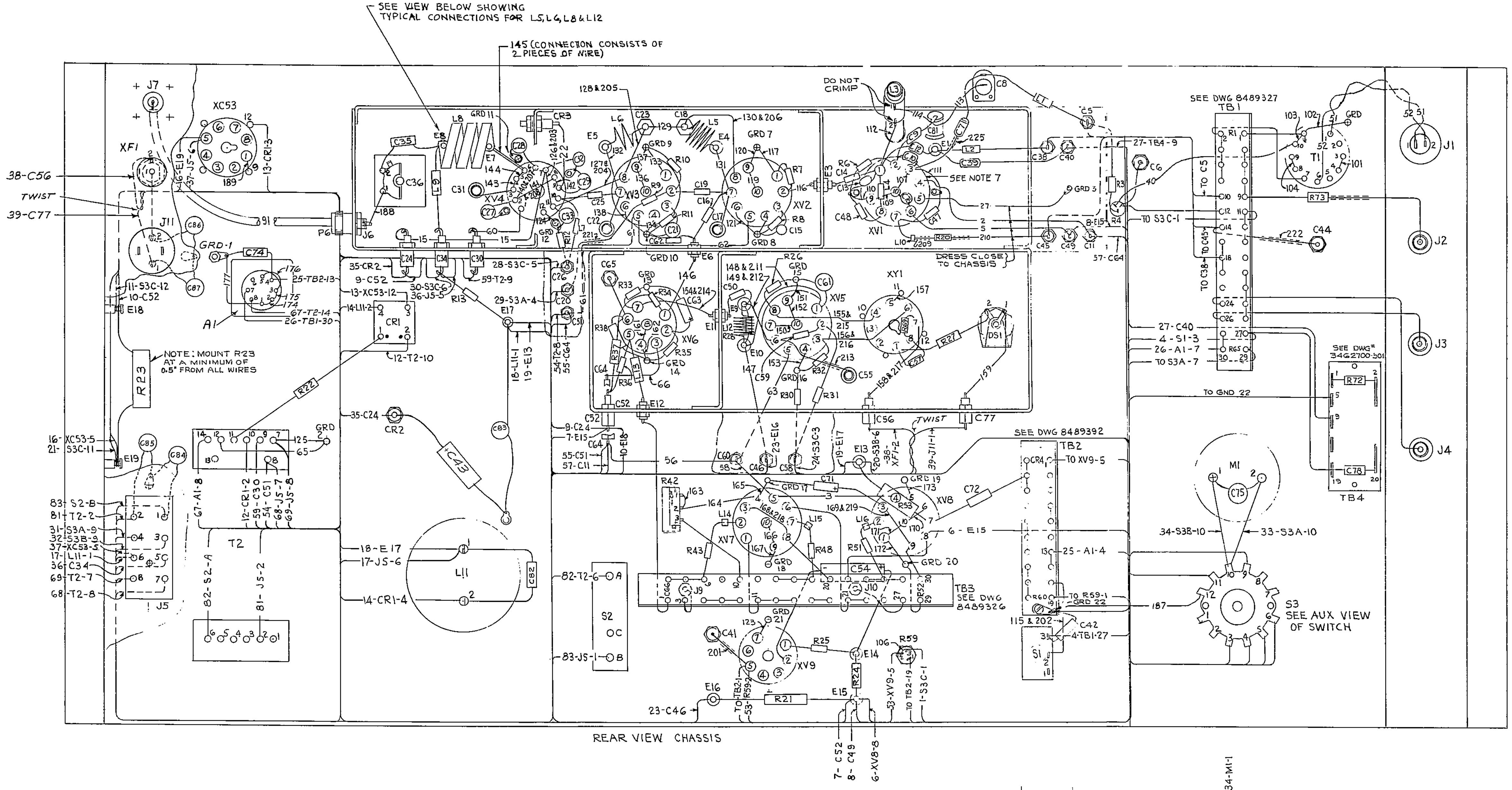
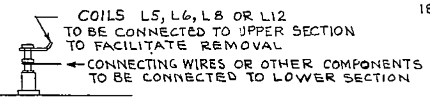
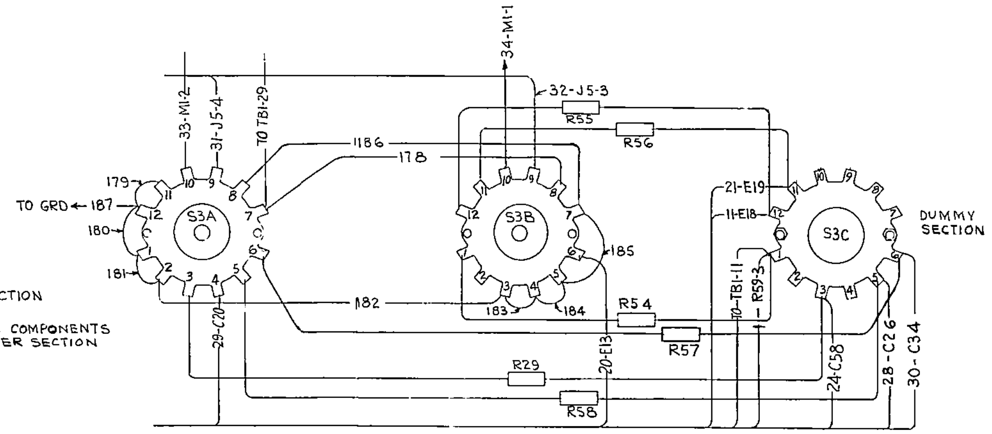
Figure 14—Schematic Diagram of Exciter



REAR VIEW CHASSIS



TYPICAL METHOD OF CONNECTIONS FOR L5, L6, L8 & L12.



AUX VIEW S3
REAR VIEW OF SECTIONS

WIRE TABLE		8540115		
WIRE NOS. INCL	DESCRIPTION COLOR & CONDUCTOR	PARTS LIST ITEM NO.	RCA DWG OR PS NO.	WIRE NOS. NOT USED
1 TO 40	#22 7/.010 WHT / YEL TR	44	990945-94	
51 TO 69	#18 16/.010 WHT / GRN TR	45	990933-95	64
81 TO 83	#16 26/.010 WHT / BLK TR	46	990860-90	
91	RG-58 C/U COAX CABLE	47	1510023-1	
101 TO 189	#20 .032 DIA TINNED COPPER	48	2010105-20	122 139 160 118, 135,
201 TO 223	.042 I.D. INSULATING SLEEVING BLK	49	2010823-803	

NOTES

1- FORM LEADS INTO CABLE AND LACE USING ITEM 42. WIRES NOT NUMBERED, AS AT TB2-1, MARKED "TO XV9-5" ARE PART OF TERMINAL BOARDS (TB1, TB2, TB3, OR TB4) ALL WIRING TO BE IN ACCORDANCE WITH RCA STD. PRACTICE.

2- CODING IN WIRES INDICATE NUMBER AND DESTINATION OF WIRES THUS 82- T2-6 INDICATES WIRE 82 TERMINATES AT T2-TERM. 6.

3- ASSEMBLE L10 AT XV1, L14 & L15 AT XV7 & L16 AT XV8 AS CLOSE AS POSSIBLE TO TUBE SOCKET TERMINAL.

4- CUT LEADS OF C10 & C13, AT XV1, TO ¼" BEFORE INSERTION. CUT LEADS OF C15, C21, C27, C28, C29, C32, & C33 FOR SHORTEST POSSIBLE CONNECTION BETWEEN POINTS SHOWN.

5- MARK ELECTRICAL ITEM SYMBOLS AND TERMINAL BOARD NUMBERS NEAR RESPECTIVE PARTS USING BLACK PRINTERS INK (RCA DWG 78712-35). MARK USING STD 1/8 HIGH CHARACTERS.

6-

TERMINAL DWG.	TERMINAL PARTS	AWG. #	INSULATION DIA. MAX.	COLOR
8982998	1-6	22-26	.082	Yel.
8982998	10-21	16-22	.136	Red
8982998	25-32	14-16	.170	Blue
8982998	[illegible]	10-12	.275	Yel.
8982998	[illegible]	14-15	.275	Yel.

CAUTION:
TERMINAL SIZE MUST BE SELECTED BY REFERENCE TO BOTH AWG WIRE SIZE AND INSULATION DIAMETER, IN ACCORDANCE WITH THIS TABLE.

IF WIRING REQUIREMENTS CANNOT BE MET BY ABOVE, AN APPROVED SOLDER TYPE TERMINAL SHOULD BE USED.

7- WIRE COMPONENTS AROUND XV1 TO XV6 BEFORE INSTALLING SHIELD ASSY, ITEM 11 OF PARTS LIST 8540115.
RUN WIRES AND COMPONENTS AROUND XV1 TO XV6 AS DIRECT AS POSSIBLE.
RUN WIRE 154 SUCH THAT COUPLING TO PIN 1 OF XV6 AND WIRE 146 IS SMALL. DRESS WIRE 146 CLOSE TO CHASSIS (XV6).
RUN WIRE 155 & 156 ABOUT 0.5" AWAY FROM CHASSIS, IN THE SHORTEST POSSIBLE WAY & CLEAR OF OTHER COMPONENTS & WIRES

8- USING ITEM 64 OF PARTS LIST 8540115, SECURE THE FOLLOWING COMPONENTS TO THE CHASSIS BY APPLYING SMALL BEADS OF CEMENT: R6, C48, R20, C47, C10, C12 & C13. CEMENT L4 & C76 AGAINST NEARBY COMPONENTS ON WIRES. CEMENT C9 TO COIL BODY OF L3 & CEMENT C7 BETWEEN C9 & STANDOFF TERMINAL E1. CEMENT C39 TO L2. SECURE L1 AGAINST MTG OF C8 & C5. (THE OBJECT OF THE ABOVE PROCEDURE IS TO RESTRICT MECHANICAL MOVEMENT OF THESE COMPONENTS)

9- THE FOLLOWING COMPONENTS MUST BE CLEAR (.1" MIN) OF METAL PARTS & CHASSIS: C35, L9, C72, R53, R24, R21

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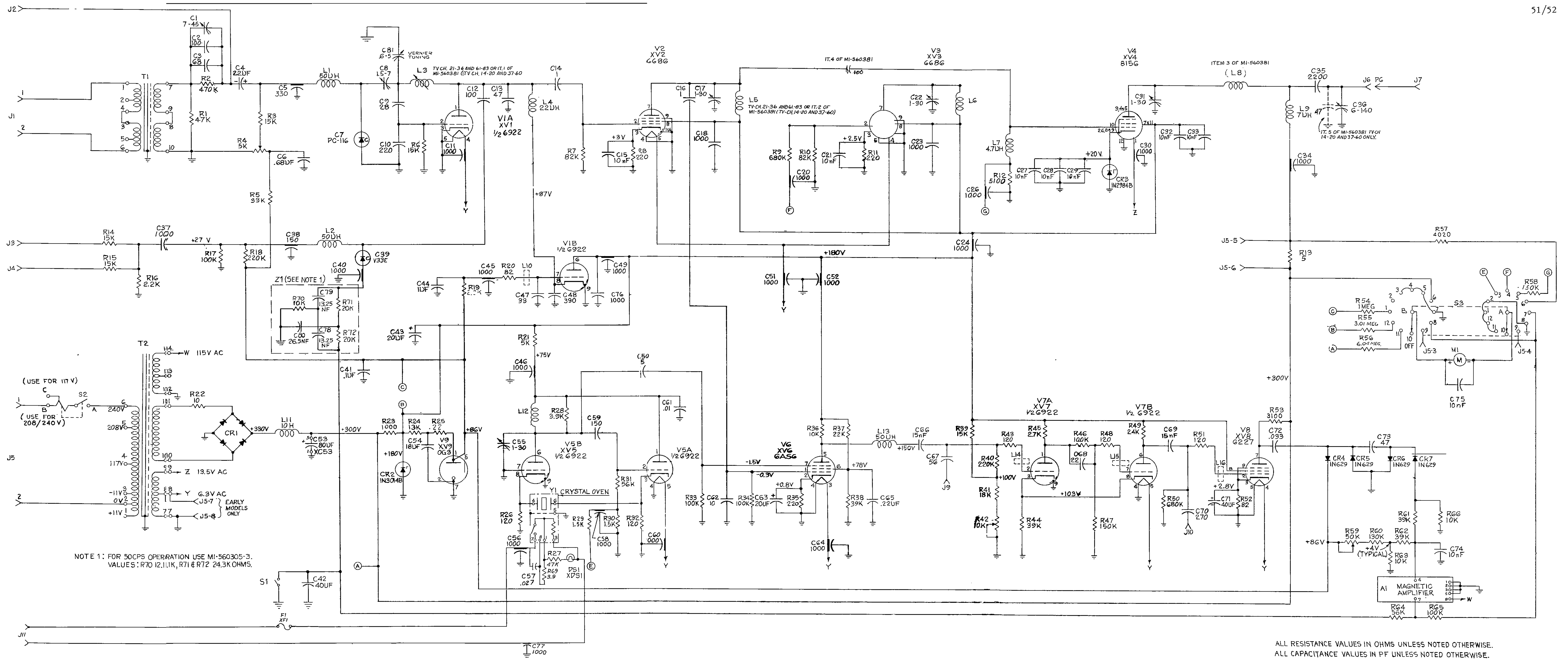
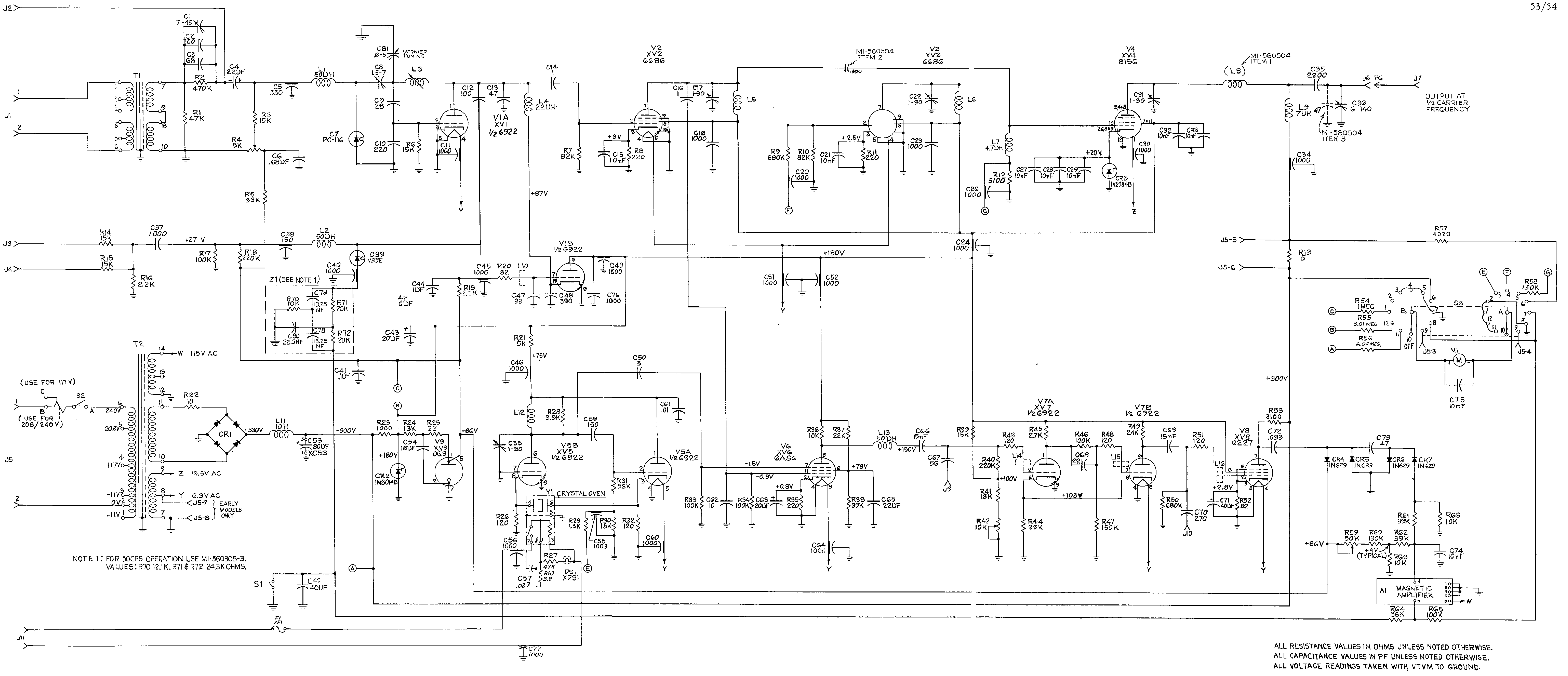
Figure 15—Wiring Diagram of BTE-10C Exciter



ALL RESISTANCE VALUES IN OHMS UNLESS NOTED OTHERWISE.
ALL CAPACITANCE VALUES IN PF UNLESS NOTED OTHERWISE.
ALL VOLTAGE READINGS TAKEN WITH VTVM TO GROUND.

3475518-2

Figure 16—Schematic Diagram of Modified BTE-10C Exciter (TV Use)



3476919-0

Figure 17—Schematic Diagram of Modified BTE-10C Exciter (FM Use)

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