KUER

TECHNICAL MANUAL

FM-10H3 10KW FM TRANSMITTER

HARRIS

GATES DIVISION

Harris Intertype Corporation

WARRANTY

Seller warrants new equipment manufactured by Gates Division of Harris Intertype Corporation against defects in material or workmanship at the time for delivery thereof, that develop under normal use within a period of one year (6 months on moving parts) from the date of shipment, of which Purchaser gives Seller prompt written notice. Other manufacturers' equipment, if any, including electron tubes, and towers shall carry only such manufacturers' standard warranty.

Seller's sole responsibility for any breach of the foregoing provision of this contract, with respect to any equipment or parts not conforming to the warranty or the description herein contained, is at its option, (a) to repair or replace such equipment or parts upon the return thereof f.o.b. Seller's factory within the period aforesaid, or (b) to accept the return thereof f.o.b. Purchasers's point of installation, whereupon Seller shall either (1) issue a credit to Purchaser's account hereunder in an amount equal to an equitable portion of the total contract price, without interest, or (2) if the total contract price has been paid, refund to Purchaser an equitable portion thereof, without interest.

If the Equipment is described as used, it is sold as is and where is. If the contract covers equipment not owned by Seller at this date it is sold subject to Seller's acquisition of possession and title.

Seller assumes no responsibility for design characteristics of special equipment manufactured to specifications supplied by or on behalf of Purchaser.

Seller shall not be liable for any expense whether for repairs, replacements, material, service or otherwise, incurred by Purchaser or modifications made by Purchaser to the Equipment without prior written consent of Seller.

EXCEPT AS SET FORTH HEREIN, AND EXCEPT AS TO TITLE, THERE ARE NO WARRANTIES, OR ANY AFFIRMATIONS OF FACT OR PROMISES BY SELLER, WITH REFERENCE TO THE EQUIPMENT, OR TO MERCHANTABILITY, INFRINGEMENT, OR OTHERWISE, WHICH EXTEND BEYOND THE DESCRIPTION OF THE EQUIPMENT ON THE FACE HEREOF.

RETURNS AND EXCHANGES

Do not return any merchandise without our written approval and Return Authorization. We will provide special shipping instructions and a code number that will assure proper handling and prompt issuance of credit. Please furnish complete details as to circumstances and reasons when requesting return of merchandise. Custom built equipment or merchandise specially ordered for you is not returnable. Where return is at the request of, or for the convenience of the customer, a restocking fee of 15% will be charged. All returned merchandise must be sent freight prepaid and properly insured by the customer. When writing to Gates Division of Harris Intertype Corporation about your order, it will be helpful if you specify the Gates Factory Order Number or Invoice Number.

WARRANTY ADJUSTMENTS

In the event of equipment failure during the warranty period, replacement or repair parts may be provided in accordance with the provisions of the Gates Warranty. In most cases you will be required to return the defective merchandise or part to Gates f.o.b. Quincy, Illinois for replacement or repair. Cost of repair parts or replacement merchandise will be billed to your account at the time of shipment and compensating credit will be issued to offset the charge when the defective items are returned.

MODIFICATIONS

Gates reserves the right to modify the design and specifications of the equipment shown in this manual without notice or to withdraw any item from sale provided, however, that any modifications shall not adversely affect the performance of the equipment so modified.

DAMAGES AND RISK OF LOSS

Purchaser assumes all responsibility for and risk of loss of, or damage to, the Equipment upon delivery at Seller's shipping point, notwithstanding the fact that Seller may have selected the carrier.

In no event shall Seller be liable under any provision of this contract for loss of business or of anticipated profits by Purchaser, outlays by Purchaser in anticipation of business, other incidental or consequential damages on account of negligence.

Purchaser agrees to indemnify Seller against all claims, whether on account of negligence or otherwise, except those asserted by Seller's employees, arising out of or resulting from the erection, operation or use of the Equipment.

HARRIS-INTERTYPE CORPORATION

GATES DIVISION: 123 HAMPSHIRE STREET • QUINCY, ILLINOIS 62301 • 217-222-8200

INSTRUCTION BOOK ADDENDUM

EQUIPMENT: FM10H3 SERIAL NO. 89293

I. B. NO. 888- 1070-001 DATE: 1-18-74

It has always been the policy of the Gates Radio Company to give our customers the advantage of the latest product improvements. This addendum insures you that the latest improvements have been incorporated in your equipment. This way we can provide up to date information without a delay due to printing new instruction manuals.

Please make the necessary corrections as listed below. Please use ink for a permanent record.

This addendum may be removed after corrections have been made.

Thank you for your cooperation.

Page/Drawing No.	Changes
	R53 changed from 100 ohm, 1 watt to 51 ohm, 1 watt for proper operation of the P.A.Overload. The screen bypassing has been increased to 5500 pf. A 8 mfd, 4KV capacitor was added from the PA screen to grid. Full winding used on T3 secondary of Bias supply. R40 was changed to (2) 1000 ohm, 10 watt resistors in parallel. A 8 mfd, 4KV capacitor was added in parallel with C44. R47 was changed to 10K ohm, 225 watt for TPO of 8000 watts. 6K ohm, tap used on R45 for TPO of 8000 watts. A 2K ohm, 20 watt resistor was added from R26 to ground. R39 in the AFC Unit changed to 750 ohm, 1 watt resistor.

INSTRUCTIONS FOR INSTALLING AND OPERATION

OF

GATES FM-10H3 - 10 kW FM TRANSMITTER

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888 1070 001

Price: $15.00

Gates Radio Company

Quincy, Illinois

SAFETY NOTICE

WARNING: THE CURRENTS AND VOLTAGES IN THIS EQUIPMENT ARE DANGEROUS AND UNDER CERTAIN CONDITIONS, COULD BE FATAL.

This Manual is intended as general guidance for trained and qualified installation, operating, maintenance and service personnel who are familiar with and aware of the dangers inherent to handling potentially hazardous electrical and/or electronic circuits. It is not intended to contain a complete statement of all safety precautions which should be observed by personnel in using this or other electronic equipment.

THE INSTALLATION, OPERATION, MAINTENANCE AND SERVICING OF THIS EQUIPMENT INVOLVES RISKS TO BOTH PERSONNEL AND EQUIPMENT, AND MUST BE PERFORMED ONLY BY PROPERLY TRAINED AND EXPERIENCED PERSONNEL EXERCISING DUE CARE. PERSONNEL MUST FAMILIARIZE THEMSELVES WITH SAFETY REQUIREMENTS, SAFE HANDLING AND OPERATING PRACTICE, AND RELATED FIRST-AID PROCEDURES (E.G., FOR ELECTRICAL BURNS AND ELECTRICAL SHOCK).

Gates shall not be responsible for injury or damage resulting from improper installation, operation, maintenance or servicing, or from the use of improperly trained or inexperienced personnel in the performance of such tasks, or from the failure of persons engaged in such tasks to exercise due care.

As with all electronic equipment, care should be taken to avoid electrical shock in all circuits where substantial currents or voltages may be present, either thru design or short circuit. Caution should also be observed in lifting and hoisting equipment, especially regarding large structures, during installation.

LIABILITY LIMITATION

The procedures outlined in this Manual are based on the information available at the time of publication and should permit the specified use with minimum risk. However, the manufacturer cannot assume liability with respect to technical application of the contents and shall, under no circumstances, be responsible for damage or injury (whether to person or property) resulting from its use.

The manufacturer is specifically not liable for any damage or injury arising out of failure to follow the instructions in this Manual or failure to exercise due care and caution during installation, operation, maintenance and service of this equipment.

CAUTIONARY NOTICE

Always disconnect power before opening covers, doors, enclosures, gates, panels or shields. Always use grounding sticks and short out high voltage points before servicing. Never make internal adjustments, perform maintenance or service when alone or when tired.

Never remove, short-circuit or tamper with interlock switches on access covers, doors, enclosures, gates, panels or shields. Keep away from live circuits, know your equipment and don't take chances. Proper training of experienced personnel and observing the above guidelines will help assure safe and continued operation of this equipment.

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SECTION 1 - GENERAL DESCRIPTION

1.1 WARRANTY AND SAFETY NOTICE

This equipment is guaranteed under the liberal Gates Warranty, terms and conditions of which are explained in the standard Gates Warranty which is printed inside the front cover of this manual.

Most Gates manufactured items are guaranteed for one year, with the exception of tubes and moving parts, which are subject to specific warranties based upon hours of usage. The Warranty does not extend to "no charge" service in the field.

Switch to Safety – This equipment employs voltages which are dangerous and may prove fatal if contacted by operating personnel. Extreme caution should be exercised when working with the equipment. Observe safety regulations. Do not change tubes or make adjustments inside equipment with any voltages ON. While your Gates transmitter is fully interlocked you should not rely on the interlock switches for removing high operating voltages. It is always best to disconnect the primary power at the building wall switch and discharge all capacitors with the grounding stick provided.

1.2 PURPOSE OF BOOK

This instruction book has been prepared to assist in the installation, operation, and maintenance of the Gates FM–10H3 10 kW FM transmitter.

1.3 PURPOSE OF EQUIPMENT

The Gates FM-10H3 is an FM broadcast transmitter with 10 kW watts output delivered to the transmission line. The operating frequency is 88–108 MHz. with characteristics exceeding those required by the Federal Communications Commission for standard FM broadcast service. The transmitter is designed for continuous broadcast operation and consists of the exciter, intermediate power amplifier, and the power amplifier, plus their associated power supplies.

1.4 DESCRIPTION

Only one cabinet is required to house the entire transmitter. This cabinet is 42" wide x 78" high x 32-¾" deep. All necessary metering is provided by four meters located on a meter panel at the top of the cabinet. Ready access to the complete transmitter is accomplished by a removable rear door, a hinged access panel, and a drop cover of the exciter unit.

Front doors are provided to offer a pleasing and symmetrical front view appearance. The following controls are located on the front panel:

(a) Filament ON
(b) Filament OFF
(c) Plate ON
(d) Plate OFF
(e) Multimeter Selector
(f) VSWR Cal
(g) PWR Cal
(h) FOR PWR/VSWR CAL/VSWR Selector
(i) IPA Screen Control
(j) PA Screen Raise/Lower Control
(k) PA Filament Control

(l) Remote/Local Switch
(m) PA Plate Tuning Control
(n) PA Output Loading Control
(p) IPA Plate Tuning Control
(r) Plus Five (5) Potentiometers for adjustment of PA Plate Current Remote Reading, Recycle Adjustment, IPA Overload, PA Plate Voltage Remote Reading, PA Overload

1.5 TECHNICAL DATA

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Power Output:	5 tp 10 kW
Frequency Range:	88 to 108 MHz
RF Output Impedance:	50 ohms
Output Termination:	Standard EIA 3-1/8" Flange
Frequency Stability:	±.001%
Harmonic Attenuation:	–80 dB
Modulation Capability:	±100 kHz
Audio Input Impedance:	600 ohms
Audio Input Level:	+10 dBm, ±2 dB
Audio Frequency Response:	±1 dB, 30–15,000 Hz
Audio Distortion:	½% or less, 30–15,000 Hz
FM Noise Level:	65 dB below 100% FM modulation
AM Noise Level:	50 dB below equivalent 100% AM modulation
Power Source:	208/250 V., 3 Phase, 60 Hz; 115 V., 1 Phase, 60 Hz
Input AC Power Requirement:	17 kW. 240 V. 300 W. 115 V.
Power Line Variation (Slow):	±5%
Power Factor:	90%
Altitude:	7500 feet
Ambient Temperature Range:	–20° C to 45° C
Maximum VSWR	1.7 to 1
Overall Cabinet Size:	42" W x 78" H x 32¾" D *
Weight:	825 pounds (Approx.)
Front Door Swing:	21"

* 32¾" is overall depth dimension. With rear door, front door handles, and meter trim strip removed minimum depth is 29¾".

1.6 VACUUM TUBE TABLE

The following tubes are employed in the transmitter:

SYMBOL	TUBE TYPE	FUNCTION
V-2	4CX300A	Intermediate Power Amplifier
V-1	4CX10,000D	Power Amplifier

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SECTION 2 - INSTALLATION

2.1 INSPECTION

The FM-10H3 is carefully packed at the Gates plant to ensure safe arrival at its destination. The equipment is packed in a number of heavy cartons and wooden crates. Open the crates and cartons carefully to avoid damaging any of the contents. Remove the packing material and search for possible small items, such as pilot lights, fuses, loose screws, and bolts.

If damage should occur during shipment, all claims should be filed promptly with the transportation company. If a claim is to be filed, the original packing case and material must be preserved. A damage report must be filed to collect for shipping damages. Gates Radio Company is not responsible for damage occuring during shipment. Parts or components shipped to replace those damaged in transportation will be billed to the customer plus transportation expenses, the cost of which should form a portion of your claim to the transportation company.

A complete visual inspection should be made of the equipment. Determine that there are no loose connections, loose components, broken insulators, etc., that may have been damaged in shipment. Make sure all relay contacts are free and in good mechanical condition. Make sure all mechanical connections are tight. Check with a screw driver or a wrench, all mechanical and electrical connections that are mechanically bolted together. All tie downs or blocking used for shipping purposes should be removed. A good overall visual inspection may save time and trouble in placing the transmitter into operating condition.

2.2 TUBE HANDLING AND OPERATING PRECAUTIONS, 4CX10,000D

Avoid bumping this tube. Due to its large mass, bumping this tube will introduce resultant stresses which may cause internal damage.

Before operating this tube, please refer to the tune-up and operating procedure given in Section 3. It is recommended procedure to adjust the equipment for operation under heavy plate loading conditions, and with only sufficient RF drive to provide the required power output and efficiency.

Extreme care should be taken during tune-up as well as in regular service to avoid, even momentarily, operation of this tube under conditions of insufficient plate loading or excessive RF drive. These operating conditions, especially at the upper end of the VHF range, will produce excessively high seal and/or bulb temperature and will result in damage to this tube.

2.3 PACKING CHECK LIST

Certain components of the transmitter have been removed for shipment and are packed separately to ensure safe handling. These parts on the FM-10H3 have been kept to a bare minimum and are plug-in units and heavy components. Tubes that are not clamped down for normal operation are also removed. The following components have been removed from the transmitter for shipping purposes:

Quantity	Part Number	Description
1	813 9383 001	Exhaust Tubing and O Rings (IPA)
1	374 0014 000	Tube, 4CX300A

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Quantity	Part Number	Description
1	374 0077 000	Tube, 4CX10,000D
1	524 0029 000	Capacitor, plug-in, C42
1 Assy.	942 3928 002	Notch Filter & RF Balun Assembly
1 Assy.	992 1600 001	Low Pass Filter
1	472 0410 000	Power Transformer, T4

As various components are removed, the wires connecting each component are numbered or tagged for placement of these parts. After determining that all these components are on hand, you are ready to proceed with the installation in an orderly manner.

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2.4 INSTALLATION

In advance of actual placement of the equipment, certain planning should be accomplished. The use of the installation drawing will assist in locating the power and audio input terminals of the transmitter.

Either side of the transmitter may be placed against a wall or other equipment. Complete accessibility for maintenance and installation is provided in the FM-10H3 by access from the front or the rear of the transmitter cabinet.

Install the plug-in capacitor in the transmitter bias supply.

Refer to the FM Exciter Installation Instructions for proper module placement in the exciter cabinet.

Unblock the blower assembly.

Mount the power transformer (T4) through the back door of the transmitter. It would be wise to remove the ceramic fuse block temporarily when doing this to prevent accidental damage to this part. Orient the transformer so that the secondary taps on the coils face inward. Connect the primary power leads from contactor, K2 to marked terminals at the top of T4. Select the proper taps on the power transformer T4 for the primary line voltage. Secondary leads are tagged for connection to their proper taps on the coils.

The RF output balun assembly installs from inside the transmitter enclosure. Before mounting, temporarily remove both monitor coupling loops from the top portion of the balun. With the inner conductor removed and the balun sleeve up, bolt the unit beneath the top of the enclosure. Insert the inner conductor from the top.

Take the notch filter and thread the stud from the balun inner conductor into the inner conductor of the notch filter. Tighten with a crescent wrench from the loading capacitor connection in the PA enclosure. Slip the filter sleeve down over the outer conductor and fasten securely with the stainless steel clamp provided.

Remount the two monitor coupling loops on the exterior vertical balun.

The lower end of the inner conductor of the balun connects to output loading capacitor C-6.

Loosen the Allen set screws on the adjustable portion of the balun. The distance that this component is positioned vertically from the tube deck varies with operating frequency. Refer to your test data sheets for the proper measurement on your assigned channel. This adjustment must be accurate within 1/8" for proper operation.

The 4CX300A IPA tube has a breechblock base. The tube must be carefully installed to prevent damage to the contacts of the tube or its socket. The tube must be seated over the center rod of the tube socket and positioned in such a way that the tube electrode rings are in line with the socket fingers. After the tube is pushed downward to the proper position, rotate the tube until all the electrode rings have completely slipped between their associated socket fingers.

Install the anode connector around the anode and tighten securely. Drop the exhaust tube through the opening of the upper deck to the top of the IPA anode connector. Hold the exhaust tube in place with O rings above and below the deck surface.

Install the 4CX10,000D carefully in its socket and push firmly until the tube is properly seated. The anode connector assembly secures with a clamp to the tube and with a bolt to the plate line. Coarse frequency tuning of the plate circuit is determined by the distance of the rotary section of the plate circuit from the 4CX10,000D tube deck. This measurement is recorded in the test data for your transmitter and should be checked before operating the transmitter. Tolerance here is approximately 1/16".

Bolt the low pass filter in the transmission line between the directional coupler and antenna coax, and your basic installation is complete. Provisions should be made at the transmitter site to have at least two supports for the filter.

2.5 WIRING CONNECTION

After the transmitter is physically in place and the components removed for shipment have been re-installed, AC power should be brought to the transmitter. The power leads from the transmitter should come from a low reactance power source of either 208, 230, or 240 volts, 60 Hz, 3 phase, with approximately a 21 kVA capacity. A power source of 115 volts, 60 Hz, with 500 watts capacity is also required.

Referring to the installation drawing, the 240 Volt, 3 phase input enters the transmitter in the lower right hand corner and connects to the 3 phase fuse block immediately to the left.

A 115 Volt, single phase fuse block is located at the center and to the rear of the transmitter with the input terminals for the 115 Volts, single phase towards the rear of the transmitter.

The audio input line enters the base of the transmitter at the center approximately 7½" from the front. The audio line connects directly to terminal board TB-1 of the FM Exciter. Terminals 1 and 3 are the audio input and terminal 2 is ground or shield connection. If stereo is used the lines are connected in accordance with the M6533 Stereo Generator instructions.

The conduit or wiring of the power leads should be in agreement with local electric codes and be able to carry the power requirements of the transmitter. Power leads and program leads should not be run in the same conduit or in the same wiring duct. If, due to necessity, the program leads are in close proximity to the power leads, the program leads should be separately shielded.

A good ground at these FM frequencies is mandatory in keeping RF currents in nearby audio equipment to a minimum. RF usually shows up in one of two ways -- feedback or high noise, and in some cases both. It should be pointed out that even a small amount of unshielded wire makes a very efficient antenna for FM frequencies. If RF from the cabinet field is transferred to the audio equipment, it is rectified and shows up as noise or feedback. We strongly recommend a single common ground point from the transmitter base to a good grounding system, such as, a water pipe or actual earthing ground.

2.6 COOLING

The transmitter is air cooled and several kilowatts of heat are developed and dissipated through the air outlet in the top of the transmitter. It may be necessary to provide a means of exhausting this air from the transmitter room or enclosure. Heat is a major factor to electronic component deterioration. A good system of removing the heated air from the transmitter and the transmitter room and providing cool air for the air inlet of the transmitter will greatly prolong the life of the transmitter and its components. Duct work, if installed, should not provide any back pressure to the power amplifier enclosure. At no point should the duct work have less of a cross sectional area than the opening at the top of the transmitter. Sharp, right angle bends are not permissible. Where it is necessary to turn a right angle, a radius type bend should be used.

There are many installation possibilities. Each and every installation is somewhat different. Therefore, it is not possible to give complete detailed information on the transmitter ducting. Only general information can be supplied. As a suggestion, contact a local heating and cooling contractor for a detailed analysis of the problem.

After the transmitter has operated at full output a number of hours, a temperature rise inside the transmitter must not exceed a rise of 20^{o} C above the ambient measured at the air intake of the blower and must not rise above 60^{o} C under any circumstances (excluding PA output air).

20^{o} C = 68^{o} F, 60^{o} C = 140^{o} F

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SECTION 3 - OPERATION

3.1 PRE–OPERATION

Before placing the FM-10H3 into operation, check once again the points covered in Section 2. Have you mounted all components physically and made these electrical connections?

1. Primary power to the 3 phase fuse block.
2. 115 Volts to the 1 phase fuse block.
3. Program line connected to the exciter.
4. 115 Volts to the exciter.
5. Transmitter connected to antenna or a suitable load.

If everything appears to be in order, then you may proceed.

3.2 TEST DATA

Your equipment has gone through many different kinds of tests at the Gates factory, and has been operated for several hours on your assigned operating frequency. This is to ensure correct adjustment and proper setting of all controls. Refer to the test data supplied with your transmitter. This data is attached to the front of the transmitter when shipped.

3.3 ADJUSTMENT

Set the dial settings to those given on the test data sheet. Turn the IPA screen voltage control fully counter-clockwise. Primary power may now be applied to the transmitter by pushing the filament ON button. The light behind the filament ON button should light. Next, the blower should begin to run and come up to speed. After the blower reaches maximum operating speed, air pressure in the PA enclosure will operate the air switch.

Run the PA screen voltage control to the lowest position (counterclockwise) on the screen rheostat.

Check the P.A. bias voltage and adjust as necessary to obtain the test data sheet measurements. During the tune-up procedure it may be necessary to increase the bias voltage to prevent the P.A. from drawing excessive plate current. The grid bias voltage on the P.A. is a combination of the developed bias from the RF and the constant voltage from the bias supply. The bias supply is set at a compromise position to obtain the desired power output and to keep the P.A. within its dissipation ratings in case of RF failure.

Closing of the air switch will turn ON the PA filament voltage which may be read with the multimeter switch on the meter panel in the filament voltage position. Set the filament voltage for 7.5 volts.

Next, place the multimeter switch on the meter panel to the IPA cathode current position (this is the UP position). If the exciter is delivering power to the IPA stage, a reading of approximately 10% will be read on the multimeter. As this meter is reading cathode current it will also read the grid current.

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The high voltage may now be applied by pushing the high voltage ON button. This supplies plate and screen voltage to the IPA stage simultaneously with the application of plate and screen voltage to the power amplifier stage. Bring the screen control for the IPA up until the IPA cathode draws approximately 50% scale reading on the multimeter. Resonate the IPA plate circuit by tuning for a dip in the IPA cathode meter reading. If the plate circuit and loading are near their operating positions, power output of the amplifier will be noticed.

During the tune-up procedure it may be necessary to increase the IPA screen voltage to prevent the P.A. from drawing excessive plate current.

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Increase the screen voltage of the power amplifier by bringing the screen control lever switch to the UP position until approximately 1.5 amperes power amplifier plate current is indicated. Resonate the plate circuit of the power amplifier by adjusting the plate tuning (L2) for a dip in plate current. Next, check the position of the output loading by rotating the output loading control to give a maximum output indication.

The power output meter is the farthest right hand meter on the meter panel. Its function is determined by the FOR PWR/VSWR CAL/VSWR Selector switch (S1) located on the upper portion of the access door. You may read:

1. Forward power.
2. Meter calibration for maximum scale reading during VSWR measurements.
3. VSWR on the transmittion line.

Check the VSWR on the transmission line. Position the Power/VSWR Selector to the VSWR Calibrate position and set the power output meter for full scale deflection with the VSWR CAL control. Turn the selector switch to VSWR and read the reflected wave. Although the transmitter will operate into a 1.7:1 mismatch it is recommended to keep the VSWR to a minimum. If a high VSWR is noticed it is generally traced to the transmission line and/or antenna problems.

Since the transmitter was checked into a 50 ohm resistive load any system with a mismatch will probably change the tuning. Therefore, the recorded test data knob readings may not agree with the actual operation.

If it is 1.5:1 or better, the screen voltage of the P.A. and the IPA stage may be increased until both are at maximum or near maximum. The plate tuning, output loading, and IPA plate tuning should be adjusted for the maximum output and the most overall efficient condition. To reduce the RF output, the amount of drive to the PA can be decreased by lowering the screen voltage of the IPA. Also, the output can be reduced by decreasing the PA screen voltage.

The multimeter switch (S10) located on the meter panel will give an indication of the amount of drive to the grid of the PA tube. This is a relative indication and is read with the meter switch in the DOWN position. It will be noticed that maximum drive condition will be very close to the same point of the IPA plate current dip. The IPA plate tuning may, at some frequencies and power levels, be different for maximum output and for minimum IPA plate current. A compromise should be made on the plate tuning of the IPA for a IPA cathode current of approximately 70% scale reading with a minimum or dip in tuning. The tuning on either side of the dip may affect PA efficiency as well as power output.

The operation of the transmitter is very simple and straight-forward, and once adjusted should require only a nominal amount of touching up the tuning at regular maintenance periods.

The overloads are set for correct operating level at the factory. The IPA plate overload is set for nearly full scale reading on the multimeter. The PA plate overload is set for approximately 2.7 amperes plate current. The adjustments for the overloads are located under a small cover plate located on the front access door. They may be referred to by symbol numbers on the schematic.

Power output of the transmitter may be increased or decreased by three controls on the transmitter. The first is the output loading. It is best to leave this control set for maximum loading on the amplifier as this will give more stable operation as recommended for any tetrode. The second control is the power amplifier screen voltage. After the loading has been adjusted for maximum power output the screen voltage may be raised or lowered for the desired operating power. The third control is the IPA screen voltage control. Reducing this to its minimum value will reduce the drive and part of the bias to the final amplifier causing it to overload and trip the plate voltage. It may be operated in its maximum position without any detrimental effects. However, to give partial control to power output and some tolerance on the power output of the IPA stage, it is recommended that it be run at approximately 80% of its full scale setting.

The output of the exciter is adjusted with a output control of the 10 watt amplifier on the exciter and is covered in the FM Exciter section of this manual.

The transmitter can easily be remotely controlled. Description of the connections is covered in Section 5.

Two controls for setting the remote plate voltage and plate current for external metering are located under the cover on the hinged access door and are shown by symbol numbers on the schematic.

The screen voltage of the power amplifier is motor controlled and is also connected to the remote control Raise/Lower function for power output.

3.4 MAINTENANCE

Maintenance of the FM-10H3 should consist of the following:

1. Keeping the transmitter clean.
2. Changing tubes when emission falls off.
3. Checking mechanical connections and fasteners.
4. Lubricating the blower motor.

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Keeping the transmitter clean from the accumulation of dust will reduce failure resulting from arcing, dirty relay contacts, and overheating of chokes, resistors, and transformers. Electrostatic fields are "dust catchers". Support insulators in the PA enclosure and other locations are the worse offenders. They must be kept clean and free of all foreign material at all times. If not, arcing may result and the insulator shattered.

The air filter should be clean at all times. The washable air filter used in the back door may be purchased from the Gates Radio Company under Part Number 827 5285 011. However, the filter may be cleaned by using warm water and a mild detergent.

Once a month the entire transmitter should be cleaned of dust. The inside of the power amplifier should be thoroughly wiped clean of dust. A small brush, soft rag, and vacuum cleaner can be used very effectively in keeping the equipment clean.

All contactors and relays should be inspected regularly for pitting and dirt. The contacts should be burnished and cleaned if required. The overload relays are telephone type with sealed contacts and should require little attention.

The bearings for the motor of the PA blower are sealed and normally give long trouble free operation. They are lubricated for approximately 20,000 hours of operation. After this period of operation the grease in these bearings should be changed. This is done by taking the drain plug out of the bottom of the bearing and attaching a grease fitting to the upper plug on the bearing. New grease should be applied until clean grease runs out of the drain plug at the bottom. It is suggested the blower be removed for this maintenance.

The PA tube and the IPA tube should be removed once a month and the fins cleaned of dust. Air may be blown through the fins in the reverse direction or the anode cleaned with soap and water or denatured alcohol.

This transmitter is a precision electrical device, and as such, should be kept clean at all times and free of dust and foreign material. Dust and moisture condensation will lead to possible arc overs and short conductive paths.

A good preventive maintenance schedule is always the best assurance for trouble free transmitter operation.

SECTION 4 - CIRCUIT DESCRIPTION

The FM-10H3 circuits will be described in the following sections:

Power Amplifier
Intermediate Power Amplifier (IPA)
Exciter
Power Supply
Control Circuits
Metering

4.1 POWER AMPLIFIER

The power amplifier of the FM-10H3 employs a single 4CX10,000D tetrode in a common cathode amplifier circuit. The plate circuit is inductively tuned by varying a length of inner conductor of a transmission line within the rectangular outer conductor. The plate line is approximately one-half wavelength long, being fore-shortened by the output capacity of the tube.

The large variable portion of the line is used for rough or approximate frequency setting and the end of the half-wave line is made variable for plate circuit tuning. The end is controlled from the front panel. The fine frequency control covers approximately 3 MHz at the low end of the FM band and approximately 6 MHz at the higher end of the band.

Output coupling is accomplished by capacity tuning a balun. The balun inductively couples RF power from the amplifier enclosure.

The PA grid circuit is common with the IPA plate circuit. Output capacitance of the IPA tube with the IPA variable plate inductance, L6, and the input capacitance of the PA tube form a pi circuit. The position and size of inductor L10, is used to vary the IPA loading. (A small movement of L10 will change the IPA loading appreciably.)

Bypassing of the PA screen and filaments is accomplished by using a number of high voltage ceramic capacitors with lead lengths kept as short as possible.

In some transmitters, especially at the higher operating frequencies, there may be a capacitor connected between grid and cathode of the P.A. This capacitor is usually 25 pF or 50 pF. The purpose of adding this component is to improve the overall performance of the power amplifier.

4.2 IPA

The intermediate power amplifier employs 4CX300A tetrode in a common cathode circuit. The plate circuit is common with the PA grid as previously explained.

Screen bypassing is effected with the built-in capacitance of the 4CX300A air system socket. The IPA cathode is bypassed with four ceramic button capacitors.

The grid circuit is inductively tuned and sealed at the Gates factory. Since the circuit is several megahertz wide and will not require field adjustment the variable inductors are accessible only with the bottom IPA cover off.

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Neutralization has been added to the IPA stage. A small stud protruding from a ceramic insulator adjacent to the anode of the tube provides the degenerative feedback pickup. The RF pickup is then returned to the grid input circuit to stabilize the tube's operation. After factory setting, it will not require further adjustment changes.

4.3 EXCITER

The FM exciter is described in detail in the Exciter section of this instruction book.

4.4 POWER SUPPLY

Only one high voltage power supply is used in the FM-10H3. The basic configuration of the supply is a three phase full wave bridge.

It supplies 6.6 kV for the PA plate, 2.5 kV for the IPA plate, 1000 Volt for the PA screen grid and 280 Volt for the IPA screen grid.

The reduced voltages are obtained from resistor dividers which are connected to the center tap of the transformer.

The PA screen grid voltage is variable between 600 Volt and 1000 Volt and is controlled by the Raise/Lower switch. Series limiting resistor, R47 prevents the PA screen grid from over-dissipating in case the PA has a loss of plate voltage.

The 0 to 280 Volt variable supply for the IPA screen voltage is controlled by R-26.

Silicon rectifiers for this supply consists of three doublers, each containing a number of diodes in series with proper resistors and capacitors across the diodes. The diodes are mounted in copper heat sinks.

The PA bias supply is a single phase full wave bridge circuit using silicon rectifiers. Grid bias between 125 and 225 Volts is supplied to the PA control grid. The bleeder resistor across the supply, R-41, will also provide additional bias voltage if the PA grid current due to RF drive causes grid current to flow above 40 mA with 160 Volts fixed bias. R-39 is the bias adjust control.

4.5 CONTROL CIRCUITS

The control circuits of the FM-10H3 consist of the following:

K1 — Primary Contactor — Applies voltage to the blower, PA bias supply, and the IPA filaments.

K2 — Plate Contactor — Applies primary voltage to the plate transformer. (K2 is energized after K3 closes.)

K3 — Step/Start Contactor — It closes and then K2 is energized, shorting out the contacts of K3 and the 1 ohm resistors. Step/Starting of the high voltage supply is accomplished by K3 closing first and applying voltage to the transformer primary through 1 ohm resistors, R22, R23, and R24.

K4 — Auxiliary Relay — Applies holding voltages to the Step/Start contactor K3, if the air switch and door interlocks are closed.

K5 — Recycle Relay — Energizes when either the PA overload or IPA overload relay is energized a number of times. The number of times is determined by control R-25. The two overload relay contacts are in series across the relay circuit for K5. When either overload relay energizes and the contacts open, C-36 starts to charge. If the contacts are open for a sufficient length of time for C-36 to charge to the point that the voltage will energize K5. The contacts of K5 will break the hold circuit of K4 and the plate voltage will be switched off. If K5 does not operate, the overload contacts will close after an overload and the plate contactor K2 will again energize.

K9 — Underdrive Relay — Will prevent application of plate and screen voltage to the IPA and PA until the grid current of the IPA reaches 8 mA or more. The contacts of K9 are in series with door interlocks. In case of a plate voltage trip-out due to low IPA grid current the recycle circuit will not operate.

S9 — Air Switch — Closes after the air pressure in the plenum reaches proper pressure, and switches primary voltage to the PA filament transformer.

4.6 METERING

All necessary metering of the FM-10H3 is accomplished with four meters located on the cabinet meter panel.

A multimeter provides the following:

IPA Cathode Current

PA Filament Voltage

PA Drive

A metering rectifier circuit is calibrated at the factory to give PA filament voltage read on the multimeter. A PA drive detector, coupled to the grid circuit, provides a DC voltage to the multimeter to indicate the presence of RF in the PA grid enclosure.

The second meter reads PA plate current and is located in the Plate B+ lead. The meter is properly insulated and isolated behind a protective plexiglass cover.

The third meter reads plate voltage is located on the low potential side of the meter multiplier resistor.

The fourth meter is for indicating power output and VSWR on the transmission line. This meter works in conjunction with the directional coupler mounted in the output transmission line.

SECTION 5 - ADDITIONAL INFORMATION

5.1 REMOTE CONTROL

Remote control facilities are built into the FM-10H3 and require only connection to either the Gates RDC-10AC Remote Control Unit or the Gates RDC-200A Remote Control equipment. The connections to the transmitter are made at TB-6 located in the base of the cabinet. Terminal connections for the functions are shown on the schematic.

The functions are:

1. Fail-Safe, Filament ON—OFF.
2. Momentary ON—OFF for plate voltage.
3. Raise-Lower for adjusting power output.
4. Plate voltage metering.
5. Plate current metering.
6. RF power output metering.

5.2 STEREOPHONIC OPERATION

Provision has been provided for the installation of the Gates M6533 Stereo Generator in the FM Exciter. Instructions for audio connections are given in the exciter section of this instruction book.

With the addition of the M6533 Stereo Generator the transmitter is FCC type accepted for stereophonic operation.

5.3 SECOND HARMONIC FILTER

Upon completion of installation of the transmitter a check should be made on the tightness of the Allen set screws at the adjustment end of the second harmonic trap. There are two set screws that secure the short to the center conductor. If these become loose for any reason and light contact is made between the brass short and the center conductor, heating at this point may occur, resulting in possible burning and eventual destruction of the short and other parts of the filter.

A regular check on the tightness of these screws should be made at six month intervals, as part of the preventive maintenance program for the transmitter.

FM HARMONICS IN THE TV BAND

The sharp upsurge in FM broadcasting has in some instances developed unlooked for interference with local TV reception. In every instance this interference is in so-called fringe areas for TV reception and where the strength of the TV signal is weak enough that outside highly directional home TV antennas are necessary. ----- When this condition develops, the TV viewer quickly learns from his service man that the local FM station is the offender. ----- The FM broadcaster is immediately deluged with requests to eliminate the interference. In some instances CATV (Community Antenna Television) systems are also offended as they pick up weak distant TV stations. ------- What is the FM broadcaster's responsibility? Answer: To meet FCC rules and regulations as related to harmonic radiation of his FM equipment but not to guarantee perfect TV reception.

Below is a chart showing the picture and sound frequencies of TV stations between Channels 7-13 inclusive. Channels 2-6 are not shown. FM harmonics do not fall in these Channels. In fact, commercial FM station harmonics will affect only Channels 8 and above ----- look at the chart.

TV Channel	Picture Frequency Band ---Mc---	Sound Frequency
7	175.25 to 179.50	197.75
8	181.25 to 185.50	185.75
9	187.25 to 191.50	191.75
10	193.25 to 197.50	197.75
11	199.25 to 203.50	203.75
12	205.25 to 209.50	209.75
13	211.25 to 215.50	215.75

The frequency range for commercial FM broadcasting is 92.1 Mc to 107.9 Mc: --- To determine the second harmonic of your FM frequency, just multiply your frequency by 2. Example: If your frequency is 99.9 Mc, multiplied by 2 would make a second harmonic of 199.8 Mc. By consulting the above chart, you will note the second harmonic falls in the picture portion of the TV Channel 11.

Correct FM Harmonic Radiation

The FCC stipulates that transmitters of 3000 watts power and over must have a harmonic attenuation of 80 db. For 1000 watts, 73 db., and for 250 watts, 66.9 db. All reputable manufacturers design their FM transmitters to meet or exceed these specifications.

Fringe Area TV Strength Versus FM Harmonics

Let's take a typical FM station that radiates 70,000 microvolts per meter at 1 mile. At 80 db. harmonic attenuation (as called for by FCC), this station will radiate approximately 7 microvolts per meter at 1 mile on the second harmonic. In the case of our Channel 11 example, it is estimated that a fringe area TV station from 60 to 90 miles distance would have a signal strength of from 5 to 25 microvolts per meter. It can then be easily understood that a 7 microvolt signal, well within FCC specifications, would definitely interfere with the TV signal, yet with the FM broadcaster's equipment performing normally.

This is sometimes further aggravated by the FM station being located between the TV station and the TV receivers. In this instance the TV antennas are focussed not only on the TV station but your FM station as well. The home TV antennas are beamed at your legal second harmonic as well as the fringe TV station.

What To Do

When interference occurs, it will develop ragged horizontal lines on the TV picture varying with the FM program content. If the TV sound portion is interfered with (usually not the case), then the FM signal will be heard in addition to the TV sound.

1. It is not up to the FM broadcaster to go on the defensive. He did not put the TV station 75 miles away nor did he select the TV Channel. ---- In most instances the condition is a natural phenomena that neither you, the TV station, nor the FCC can correct.

2. Do not adjust the FM harmonic or "T" notch filters supplied with the FM transmitter. These are factory adjusted and most FM stations do not have the expensive equipment necessary for correct adjustment. Tampering with this calibrated adjustment will probably make the condition worse.

3. Do not rely on TV service men's types of measuring equipment. They are not built to accurately measure harmonics and invariably give erroneous readings that invite the CATV or local service men's association to say "I told you so." Remember it is difficult to radiate harmonics if the equipment is built to suppress the harmonics and it is.

4. In many instances interference may be caused by overloading on the front end of the TV receiver. This problem usually occurs when the receiver is located close to the FM transmitter. This problem can be overcome by installing a trap tuned to the frequency of the FM carrier. The TV service man can and must learn how to do this. In most cases it works, while in some instances, if not properly installed or tuned, it will not completely eliminate the interference. In one case where interference of this type existed, a TV station put traps for the fundamental FM frequency on nearly every TV set in town. Not the FM transmitter.

Summary

The FCC is well acquainted with this nation-wide problem. If TV viewers write FCC, complaining about your FM station, remember the FCC has received a few thousand similar letters. ----- It is not the obligation of the FM broadcaster to assure fringe area reception of a TV station any more than is the obligation of the TV station to assure the FM broadcaster perfect reception in his TV city.

Probably your installation will not have problems as outlined above. If they do exist, don't blame the equipment. Every transmitting device puts out a second harmonic, even the TV stations. The fact that these harmonics legally fall into the spectrum of a TV station many miles distant is coincidental, but not your fault.

Gates Radio Company

6.0 PARTS LIST

SYMBOL NO.	GATES STOCK NO.	DESCRIPTION
A1		Neon Lamp, .25 W. (part of S4)
A2		Neon Lamp, .25 W. (part of S5)
B1	913 9392 001	Blower, 1/3 H.P. 3500 RPM, 115/230 V. (60 Hz)
B1	432 0046 000	Blower, 1/3 H.P. 2900 RPM (50 Hz)
B2	436 0013 000	Motor, 1 RPM, 115 V. a.c.
B3	430 0024 000	Fan, 3380 RPM, 115 V AC, 50/60 Hz
C6	514 0218 000	Cap., Variable, 6–50 pF
C7	516 0233 000	Cap., 500 pF., 30 kV
C8	516 0205 000	Cap., 500 pF., 5 kV
C9		Same as C8
C10		Same as C8
C11		Same as C8
C12		Same as C8
C13		Same as C8
C14		Same as C8
C15		Same as C8
C16		Same as C8
C17		Not Used
C18	516 0206 000	Cap., 1000 pF., 5 kV
C19		Same as C18
C20		Same as C18
C21		Same as C18
C22		Same as C18
C23		Same as C18.
C24	522 0071 000	Cap., 50 uF., 25 V
C25	516 0227 000	Cap., Feedthru, 500 pF., 500 V
C26	516 0201 000	Cap., 50 pF., 5 kV
C27	516 0250 000	Cap., 500 pF., 500 V
C28		Same as C27
C29	516 0200 000	Cap., 25 pF, 7.5 kV
C30		Not Used
C31		Cap., (part of tube socket)
C32	500 0852 000	Cap., 1000pF., 500 V
C33	516 0054 000	Cap., .001 uF., 1 kV
C34		Same as C33
C35	516 0043 000	Cap., 470 pF., 1 kV
C36	522 0133 000	Cap., 16 uF., 450 V
C37	516 0082 000	Cap., .01 uF., 1 kV
C38		Same as C37
C39	516 0450 000	Cap., Feedthru, 1000 pF, 500 V
C40		Same as C8
C41		Same as C8
C42	524 0029 000	Cap., plug-in, 80 uF., 450 V
C43		Not Used
C44	510 0465 000	Cap., 8 uF., 4 kV.
C45		Same as C44
C46		Same as C44
C47		Same as C37
C48		Same as C33
C49		Same as C25
C50		Same as C8

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SYMBOL NO.	GATES STOCK NO.	DESCRIPTION
C51	516 0396 000	Cap., 6200 pF., 10 kV
C52		Same as C51
C53		Same as C51
C54		Same as C7
C55		Not Used
C56	516 0210 000	Cap., 200 pF., 7.5 kV
C57		Same as C18
C58		Same as C18
C59		Not Used
C60		Not Used
C61		Same as C8
CR2	386 0016 000	Diode, Zener, 1N2974
CR3	384 0020 000	Diode, 1N2071
CR4		Same as CR3
CR5	384 0134 000	Diode, 1N914
CR6		Same as CR2
CR7		Same as CR3
DC1	927 3270 002	Coupler Unit, 12 kW
F1	398 0182 000	Fuse, 10 A., 250 V
F2		Same as F1
F3	398 0222 000	Fuse, 60 A., 250 V.
F4		Same as F3
F5		Same as F3
F6	398 0213 000	Fuse, 8 A., 250 V
F7	398 0017 000	Fuse, 1 A., 250 V
FL1	992 1600 001	Low Pass Filter
FL2	942 3928 004	Notch Filter & RF Balun Ass'y.
J2	613 0237 000	Receptacle, "BNC" (part of FL2)
J3		Same as J2
J4	612 0233 000	Receptacle "N"
K1	570 0120 000	Contactor, 4 pole, 110 V. a.c.
K2	570 0088 000	Contactor, 3 pole, 230 V.
K3	570 0119 000	Contactor, 4 pole, 208/220 V AC
K4	574 0099 000	Relay, DPDT, 120 V.
K5	574 0054 000	Relay, SPDT
K6	572 0125 000	Relay, DPDT, 6 VDC
K7		Same as K6
K8	572 0066 000	Relay, DPDT, 6 VDC
K9	572 0052 000	Relay, DPDT, 6 VDC

SYMBOL NO.	GATES STOCK NO.	DESCRIPTION
L1	913 8288 001	Variable Coupling Section (part of FL2)
L2	942 3910 001	Plate Line & Coupling Ass'y.
L3	927 4249 001	Choke, RF, PA Plate
L4	494 0004 000	Choke, RF, 7 uH
L5		Same as L4
L6		Coil, IPA Plate (Det. by Freq.)
L7	914 9991 001	Coil, IPA Grid Tuning
L8	914 9992 001	Coil, IPA Input Loading
L9	815 3829 001	Inductor, IPA Neutralizing
L10	815 3831 001	Inductor, IPA Plate Loading
L11		Not Used
L12		Not Used
L13	476 0007 000	Reactor, Bias, 6 H.
L14	476 0168 000	Reactor, H.V. 2 H.
L15	476 0296 000	Reactor, H.V. 10 H.
L16	914 7670 001	Choke, RF., 2 uH
L17		Same as L16
L18		Same as L4
L19		Same as L4
M1	632 0547 002	Multimeter, 0-300 mA 0–10 V. & 0–100 Scale
M2	632 0559 002	Meter, Plate Current 0–5 A
M3	632 0554 002	Meter, Plate Voltage 0–8 A
M4	632 0667 000	Meter,% Pwr. Output/VSWR, 200 uA Movement
R8	914 9092 001	Control, 10 K ohm, 2 W
R9	550 0067 000	Control, 10 K ohm, 2 W
R10	542 0204 000	Res., 5 ohm, 50 W
R11	550 0061 000	Control, 1 K ohm, 2 W
R12	540 0580 000	Res., 51 ohm, 2 W
R13		Same as R9
R14	540 0746 000	Res., 3300 ohm, 2 W
R15	540 0068 000	Res., 6200 ohm, ½ W
R16	540 0073 000	Res., 10 K ohm, ½ W
R17	540 0058 000	Res., 2400 ohm, ½ W
R18	550 0054 000	Control, 50 ohm, 2 W
R19	540 0603 000	Res., 470 ohm, 2 W
R20	540 0563 000	Res., 10 ohm, 2 W
R21		Same as R20
R22	542 0164 000	Res., 1 ohm, 25 W
R23		Same as R22
R24		Same as R22
R25		Same as R9
R26	552 0349 000	Rheostat, 10 K ohm, 50 W
R27	540 0611 000	Res., 1000 ohm 2 W
R28		Same as R11
R29	550 0055 000	Control, 100 ohm, 2 W

SYMBOL NO.	GATES STOCK NO.	DESCRIPTION
R30	542 0058 000	Res., 50 ohm, 10 W
R31	542 0165 000	Res., 3 ohm, 25 W
R32	548 0167 000	Res., .16 ohm, 2 W
R33	552 0380 000	Rheostat, 10 ohm, 100 W
R34	544 1613 000	Res., 100 ohm, 4 W
R35		Same as R34
R36		Same as R34
R37	542 0209 000	Res., 200 ohm, 50 W
R38	540 0833 000	Res., 100 ohm, 25 W
R39	552 0324 000	Rheostat, 5 K ohm, 25 W
R40	540 0579 000	Res., 47 ohm, 2 W
R41	542 0218 000	Res., 4 K ohm, 50 W
R42		Not Used
R43		Not Used
R44		Not Used
R45	542 1079 000	Res., 10 K ohm, 50 W tapped
R46	552 0423 000	Rheostat, 10 K ohm, 150 W
R47	542 0368 000	Res., 7.5 K ohm, 200 W
R48	914 3424 001	Meter Multiplier, 5 megohm
R49	542 0346 000	Res., 100 K ohm, 160 W
R50		Not Used
R51		Same as R11
R52	540 0628 000	Res., 5100 ohm, 2 W
R53	540 0456 000	Res., 100 ohm, 1 W
R54		Same as R47
R55		Same as R47
R56	914 3422 001	Meter Multiplier, 3 megohm
R57		Same as R47
R58	542 0222 000	Res., 7500 ohm, 50 W
R59		Same as R49
R60	542 0095 000	Res., 10 K ohm, 10 W
R61		Same as R60
R62		Same as R60
R63	542 0309 000	Res., 50 K ohm, 100 W
R64		Same as R63
S1	914 9091 001	Switch, rotary, 3 pole, 3 position
S2	604 0196 000	Switch, plunger, SPDT
S3	604 0284 000	Switch, pushbutton, N.C.
S4	604 0283 000	Switch, pushbutton, N.O.
S5	604 0286 000	Switch, pushbutton, N.C.
S6	604 0285 000	Switch, pushbutton, N.O.
S7	604 0032 000	Switch, toggle, DPDT
S8		Same as S2
S9	604 0258 000	Switch, air pressure, N.O.
S10	602 0005 000	Switch, lever, 2 pole, 3 position
S11	602 0056 000	Switch, lever, 2 pole, 3 position
S12	604 0052 000	Switch, lever, SPST
S13		Same as S12

SYMBOL NO.	GATES STOCK NO.	DESCRIPTION
T1	472 0409 000	Transformer, PA Filament
T2	472 0090 000	Transformer, IPA Filament
T3	472 0052 000	Transformer, Bias
T4	472 0509 000	Transformer, H.V. (60 Hz)
T4	472 0576 000	Transformer, H.V. (50 Hz)
TB2		Not Used
TB3	614 0071 000	Terminal Board, 4 terminal
TB4	614 0052 000	Terminal Board, 8 terminal
TB5	614 0114 000	Terminal Board, 6 terminal
TB6	614 0104 000	Terminal Board, 14 terminal
V1	374 0077 000	Tube, 4CX10,000D
V2	374 0014 000	Tube, 4CX300A
XC42	404 0016 000	Socket, Octal
XF1–2–6	402 0015 000	Fuse Block, 3 pole
XF3–4–5	402 0087 000	Fuse Block, 3 pole
XF7	402 0021 000	Fuseholder
XV1	404 0069 000	Socket, tube (4CX10,000D)
XV2	404 0074 000	Socket, tube (4CX300A)
Z1–Z2	384 0299 000	Rectifier, H.V. Supply
Z3–Z4		Same as Z1–Z2
Z5–Z6		Same as Z1–Z2
Z7	384 0121 000	Rectifier, Bias Supply

PARTS LIST

M-4845 RF OUTPUT CURRENT EXTENSION KIT

SYMBOL NO.	GATES STOCK NO.	DESCRIPTION
C1	516 0043 000	Cap., 470 pF., 1 kV
C2	516 0054 000	Cap., .001 uF., 1 kV
C3		Same as C2
CR1	384 0195 000	Diode, 1N914
CR2		Same as CR1
J1	612 0237 000	Receptacle, "BNC"
R1	540 0594 000	Res., 200 ohm, 2 W
R2		Same as R1
R3		Same as R1
R4		Same as R1
R5		Not Used
R6	550 0067 000	Potentiometer, 10 K ohm
R7	540 0070 000	Res., 7500 ohm, ½ W
TB1	614 0069 000	Terminal Board, 2 terminal

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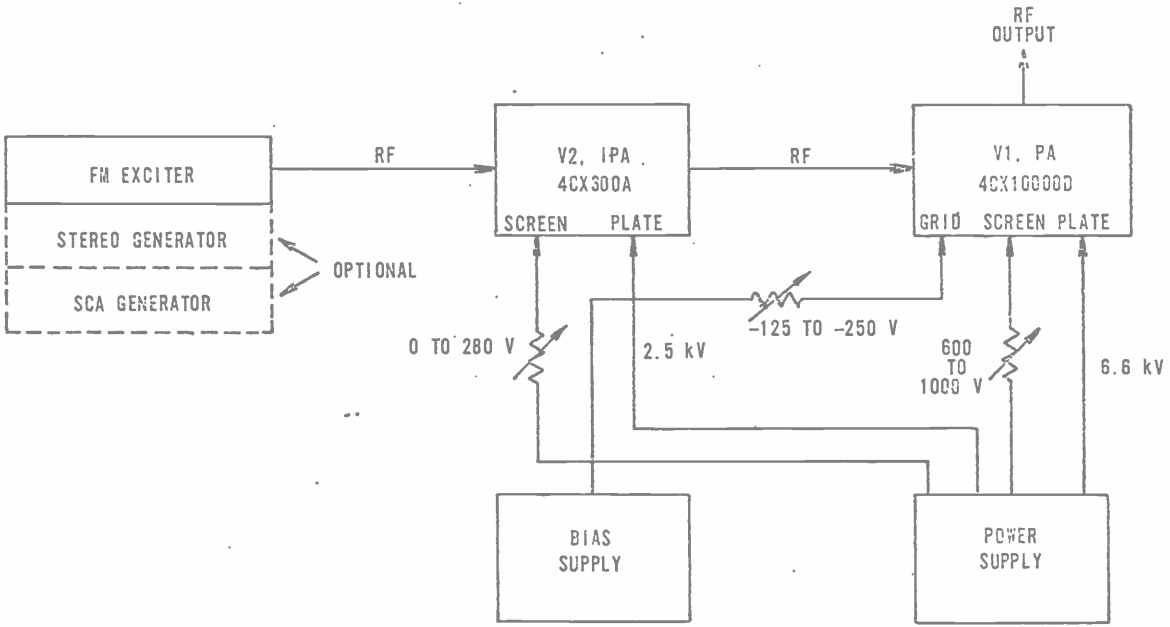
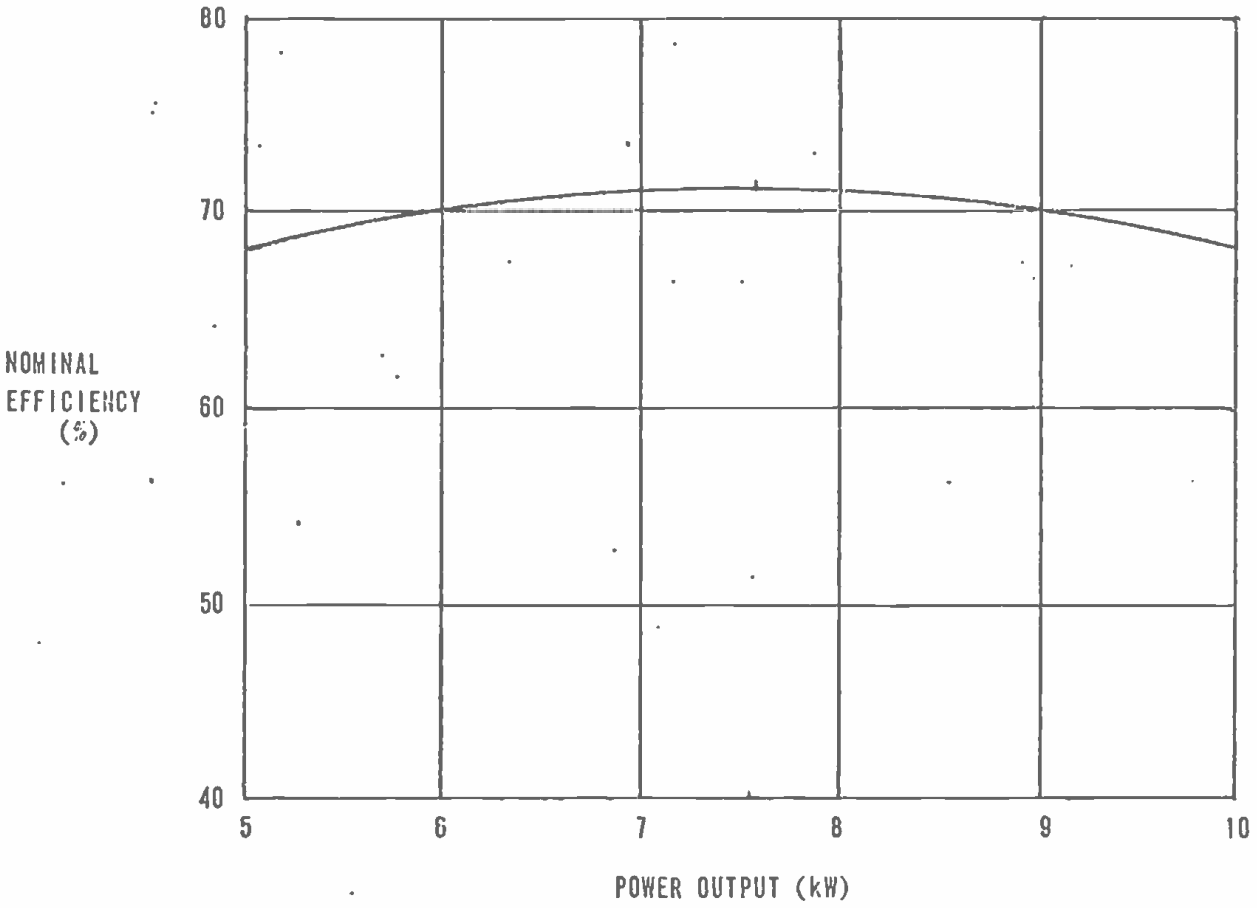


GATES RADIO COMPANY
QUINCY, ILLINOIS

TITLE: BLOCK DIAGRAM
FM-10H, FM-10H3

814 6639 001

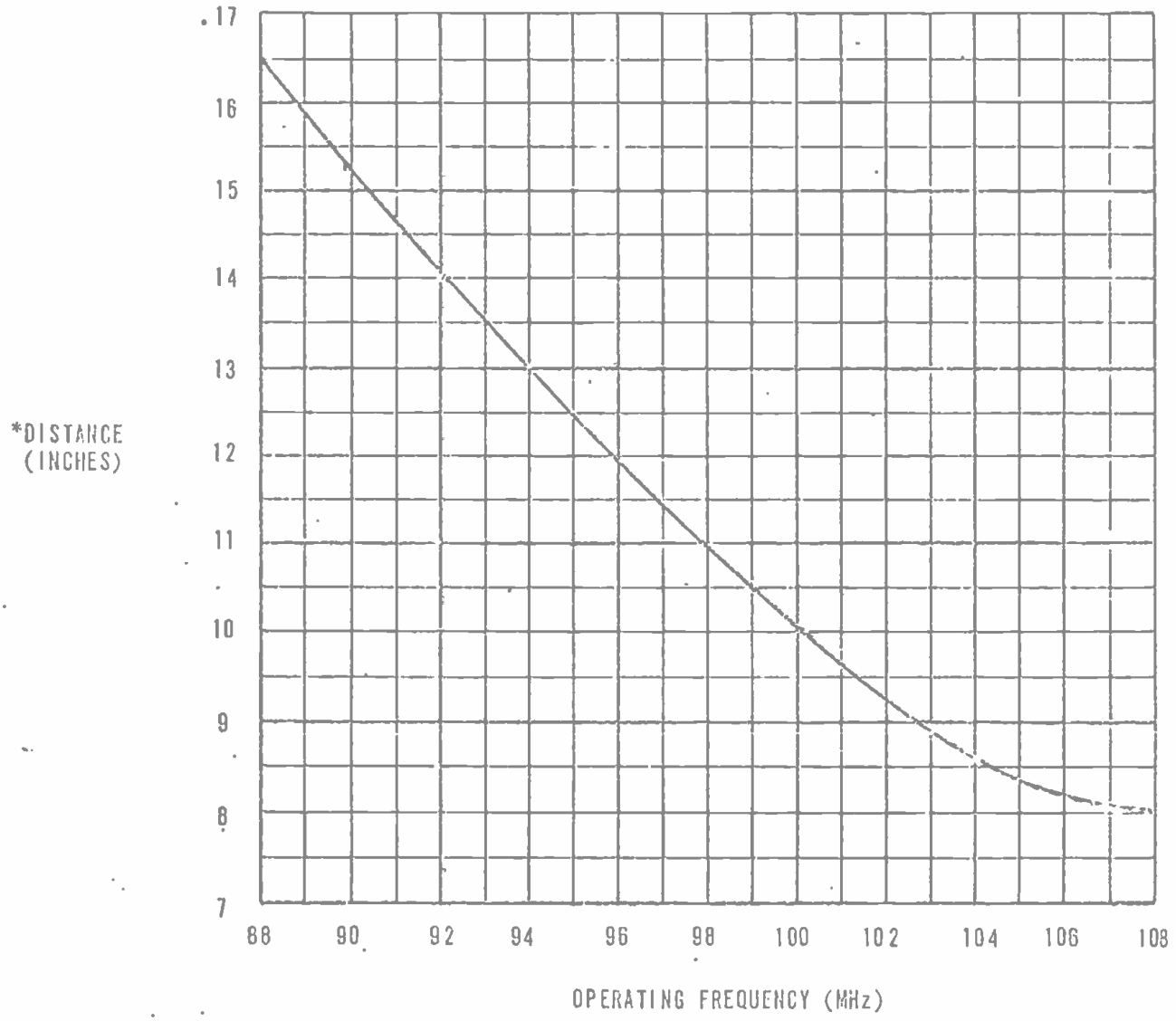


REFER TO TRANSMITTERS FACTORY TEST DATA FOR THE EFFICIENCY FACTOR DETERMINED ON FINAL TEST

GRAPH-PA EFFICIENCY
FM-10G
FM-10H

814 1920 001

(REVISED 7-16-69)
(REVISED 9-6-69)



*DISTANCE FROM THE PA TUBE DECK TO THE BOTTOM OF THE ROTARY SECTION OF THE PLATE CIRCUIT

REDRAWN 1-20-70

GATES RADIO COMPANY
QUINCY, ILLINOIS

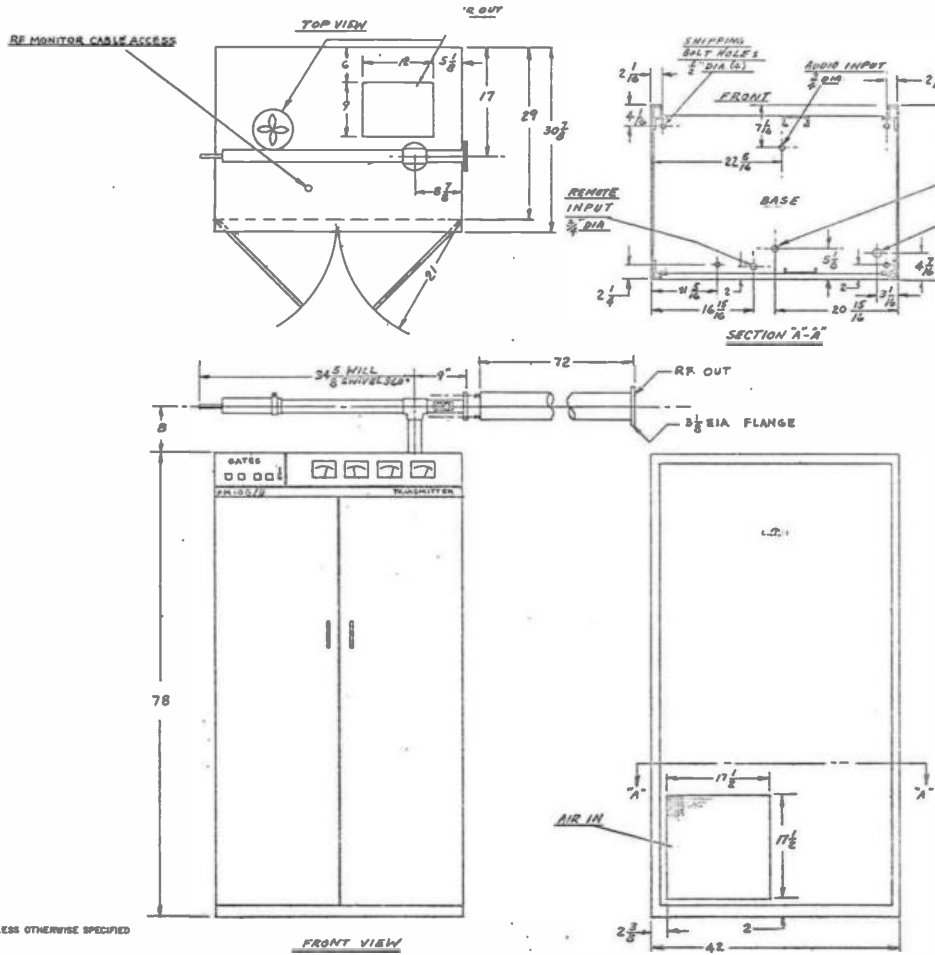
TITLE: GRAPH - PA COARSE TUNING FM TRANSMITTER

014-1733-001

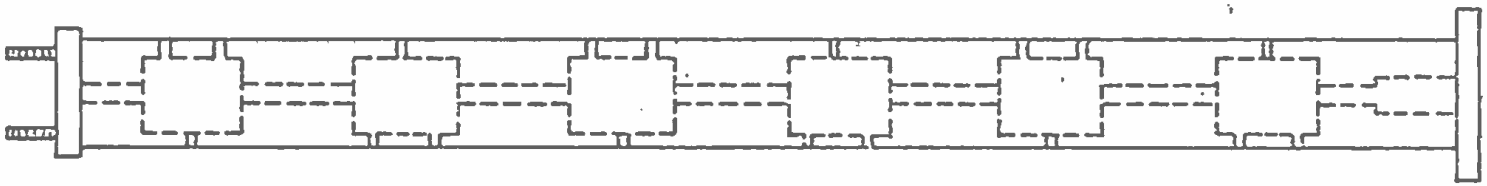
FJA

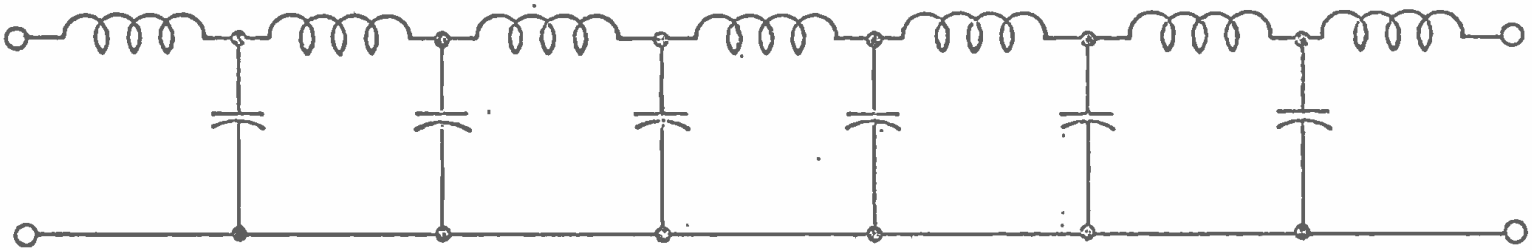
GATES RADIO COMPANY - QUINCY, ILLINOIS
A DIVISION OF HARRIS-INTERTYPE CORPORATION

INSTALLATION LAYOUT
FM-10G/H
838 1602 001



TOLERANCES UNLESS OTHERWISE SPECIFIED
FRACTIONS ± 1/64
DECIMAL ± .005
ANGLES ± 1°
FOLD DIMENSIONS ± 1/32
ALL √ INDICATES 125 MICROINCHES FINISH

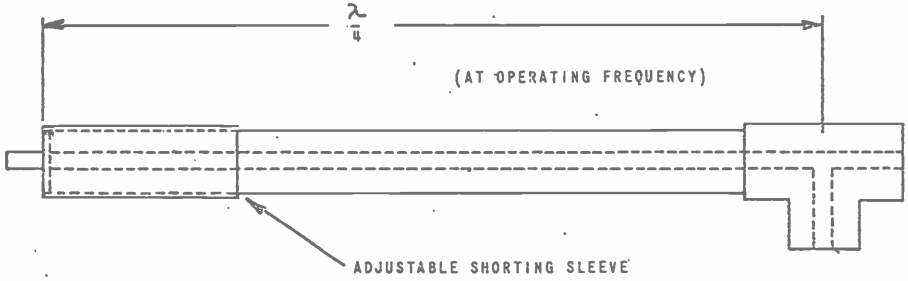


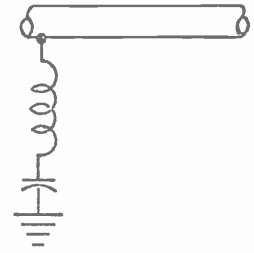


EQUIVALENT CIRCUIT-LOW PASS FILTER

· 3 1/8" TRANSMISSION LINE, OVERALL LENGTH 72 1/8".

LOW PASS FILTER
FM TRANSMITTERS





APPEARANCE OF NOTCH FILTER
AT SECOND HARMONIC

AT FREQUENCIES BELOW RESONANCE
THE "STUB" APPEARS AS AN INDUCTANCE.

AT FREQUENCIES ABOVE RESONANCE THE
"STUB" APPEARS AS A CAPACITY.

AT THE SECOND HARMONIC FREQUENCY,
THE "STUB" APPEARS AS A SERIES
RESONANT CIRCUIT OR DEAD SHORT.

2nd HARMONIC FILTER -
FM TRANSMITTERS

TECHNICAL
MANUAL

TE-3
SOLID STATESMAN
FM EXCITER

HARRIS
GATES DIVISION
Harris-Intertype Corporation

SAFETY NOTICE

WARNING: THE CURRENTS AND VOLTAGES IN THIS EQUIPMENT ARE DANGEROUS AND UNDER CERTAIN CONDITIONS, COULD BE FATAL.

This Manual is intended as general guidance for trained and qualified installation, operating, maintenance and service personnel who are familiar with and aware of the dangers inherent to handling potentially hazardous electrical and/or electronic circuits. It is not intended to contain a complete statement of all safety precautions which should be observed by personnel in using this or other electronic equipment.

THE INSTALLATION, OPERATION, MAINTENANCE AND SERVICING OF THIS EQUIPMENT INVOLVES RISKS TO BOTH PERSONNEL AND EQUIPMENT, AND MUST BE PERFORMED ONLY BY PROPERLY TRAINED AND EXPERIENCED PERSONNEL EXERCISING DUE CARE. PERSONNEL MUST FAMILIARIZE THEMSELVES WITH SAFETY REQUIREMENTS, SAFE HANDLING AND OPERATING PRACTICE, AND RELATED FIRST-AID PROCEDURES (E.G., FOR ELECTRICAL BURNS AND ELECTRICAL SHOCK).

Gates shall not be responsible for injury or damage resulting from improper installation, operation, maintenance or servicing, or from the use of improperly trained or inexperienced personnel in the performance of such tasks, or from the failure of persons engaged in such tasks to exercise due care.

As with all electronic equipment, care should be taken to avoid electrical shock in all circuits where substantial currents or voltages may be present, either thru design or short circuit. Caution should also be observed in lifting and hoisting equipment, especially regarding large structures, during installation.

LIABILITY LIMITATION

The procedures outlined in this Manual are based on the information available at the time of publication and should permit the specified use with minimum risk. However, the manufacturer cannot assume liability with respect to technical application of the contents and shall, under no circumstances, be responsible for damage or injury (whether to person or property) resulting from its use.

The manufacturer is specifically not liable for any damage or injury arising out of failure to follow the instructions in this Manual or failure to exercise due care and caution during installation, operation, maintenance and service of this equipment.

CAUTIONARY NOTICE

Always disconnect power before opening covers, doors, enclosures, gates, panels or shields. Always use grounding sticks and short out high voltage points before servicing. Never make internal adjustments, perform maintenance or service when alone or when tired.

Never remove, short-circuit or tamper with interlock switches on access covers, doors, enclosures, gates, panels or shields. Keep away from live circuits, know your equipment and don't take chances. Proper training of experienced personnel and observing the above guidelines will help assure safe and continued operation of this equipment.

INTRODUCTION

This Technical Manual provides the necessary information for the application, installation, operation, adjustment and maintenance of the TE-3 Exciter.

Price: $15.00

888 1042 001

TABLE OF CONTENTS

SECTION 1 - DESCRIPTION

1.1 GENERAL

The TE-3 Exciter consists of five basic, interconnected, modular units; Power Supply, Power Amplifier, Modulated Oscillator, Automatic Frequency Control, and Audio Section. See Fig. 1.1.

The frequency range of the exciter is from 87.5 MHz to 108 MHz and it is factory tuned to the customer specified frequency.

The exciter is completely self-contained. The oscillator of the exciter operates at the carrier output frequency eliminating frequency multipliers. This insures improved carrier stability and excellent frequency response when the power level is increased in conjunction with high power transmitters. The output power of the exciter is 10 to 15 watts.

1.2 OPTIONAL EQUIPMENT

The TE-3 exciter has provisions for three optional plug in modules; two SCA Generators, and one Stereo Generator. Figure 1.1 shows the TE-3 with Stereo Generator and SCA Generator installed.

1.3 TECHNICAL CHARACTERISTICS

1.3.1 MECHANICAL:

Width:	19" (Fits standard rack mount)	
Height:	14"	
Depth:	12 ¼"	
Weight:	(Uncrated)	52 lbs. (monaural only) 3 lbs. (SCA generator) 6 lbs. (stereo generator)
Finish:	Beige	

Semiconductors used throughout.

1.3.2 ELECTRICAL: (Monaural Operation)

Frequency Range:	87.5 to 108 MHz
Power Output:	10 Watts
RF Harmonics:	Suppression meets or exceeds all FCC requirements
RF Output Impedance:	50 ohms (BNC connector)
Frequency Stability:	.001% or better
Modulation Capability:	Capable of ±100 kHz (±75 kHz=100% modulation)
Audio Input Impedance:	600 ohms balanced
Audio Input Level:	+10 dBm ±2 dB for 100% modulation at 400 Hz

Audio Frequency Response:	Standard 75 microsecond FCC pre-emphasis curve, ±1 dB, 30-15,000 Hz
Distortion:	.5%, 30 to 15,000 Hz
FM Noise:	65 dB below 100% modulation (ref. 400 Hz)
AM Noise:	70 dB below reference carrier AM modulated 100%
Temperature:	-20° to +50° C
Altitude:	7,500 feet
Power Requirements:	117 V AC, single phase, 60 Hz, 85 watts

1.3.3 ELECTRICAL: (Stereophonic Operation)

Pilot Oscillator:	Crystal controlled
Pilot Stability:	19 kHz ±1 Hz, 0° to 50° C
Audio Input Impedance (Left and Right):	600 ohms balanced
Audio Input Level: (Left and Right):	+10 dBm ±1 dB for 100% modulation at 400 Hz
Audio Frequency Response (Left and Right):	Standard 75 microsecond, FCC pre-emphasis curve, ±1 dB, 50-15,000 Hz
Distortion (Left and Right):	1% or less, 50-15,000 Hz
FM Noise (Left and Right):	60 dB (minimum) below 100% modulation (ref. 400 Hz)
Stereo Separation (Left to Right or Right to Left Channel):	35 dB (minimum) 50 to 15,000 Hz
Sub-Carrier Suppression (With or without modulation present):	42 dB (minimum) below 90% modulation
* Crosstalk (Main channel to sub-channel or sub-channel to main channel):	42 dB (minimum) below 90% modulaton, 50-15,000 Hz
Sub-Carrier 2nd Harmonic Suppression (76 kHz):	60 dB or better below 100% modulation

NOTE: Stereophonic measurements to be made with an FCC approved monitor.

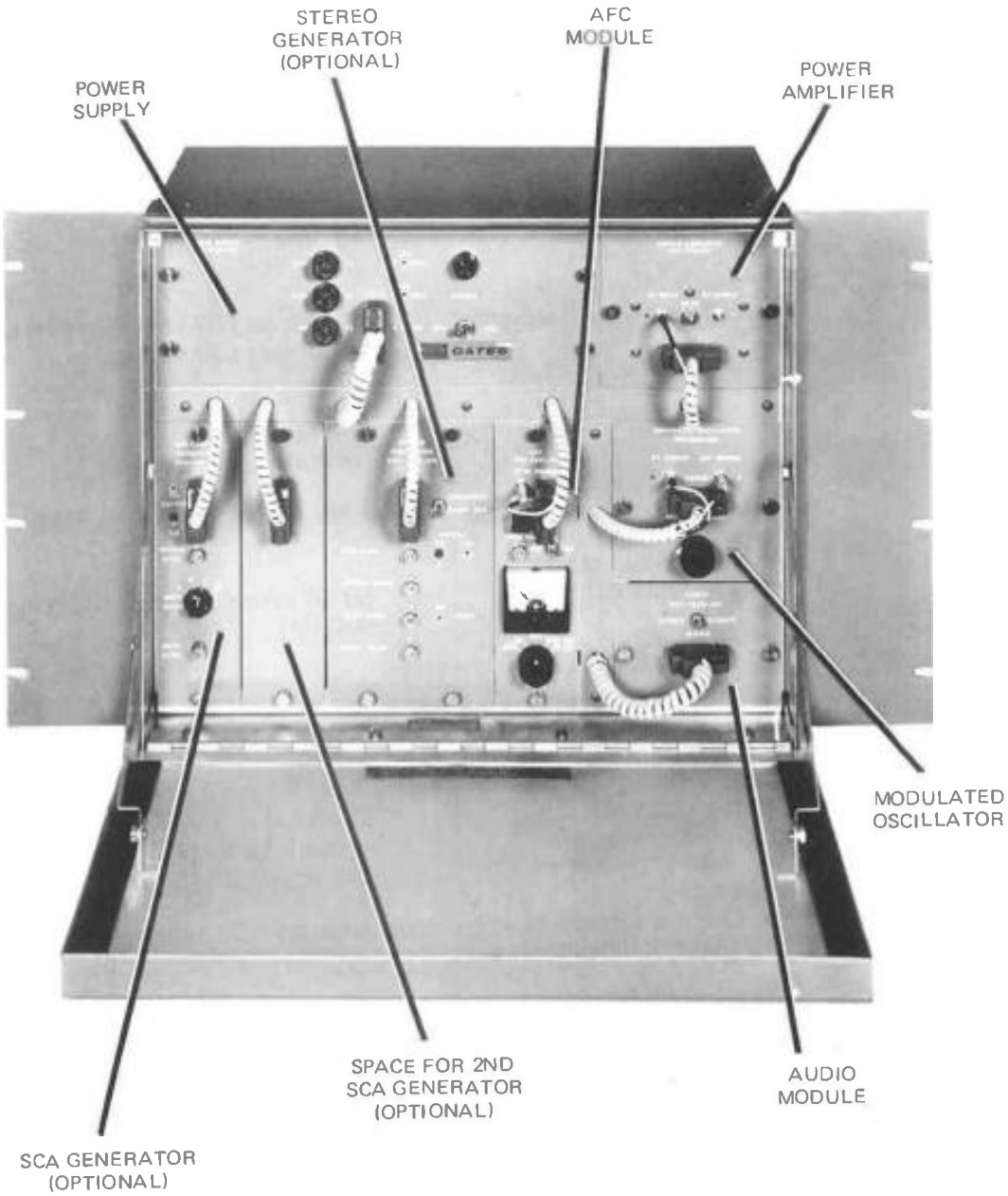
* Measurement to be made using an L=R signal for sub-channel crosstalk and an L=-R signal for main channel crosstalk.

1.3.4 ELECTRICAL: (SCA Operation)

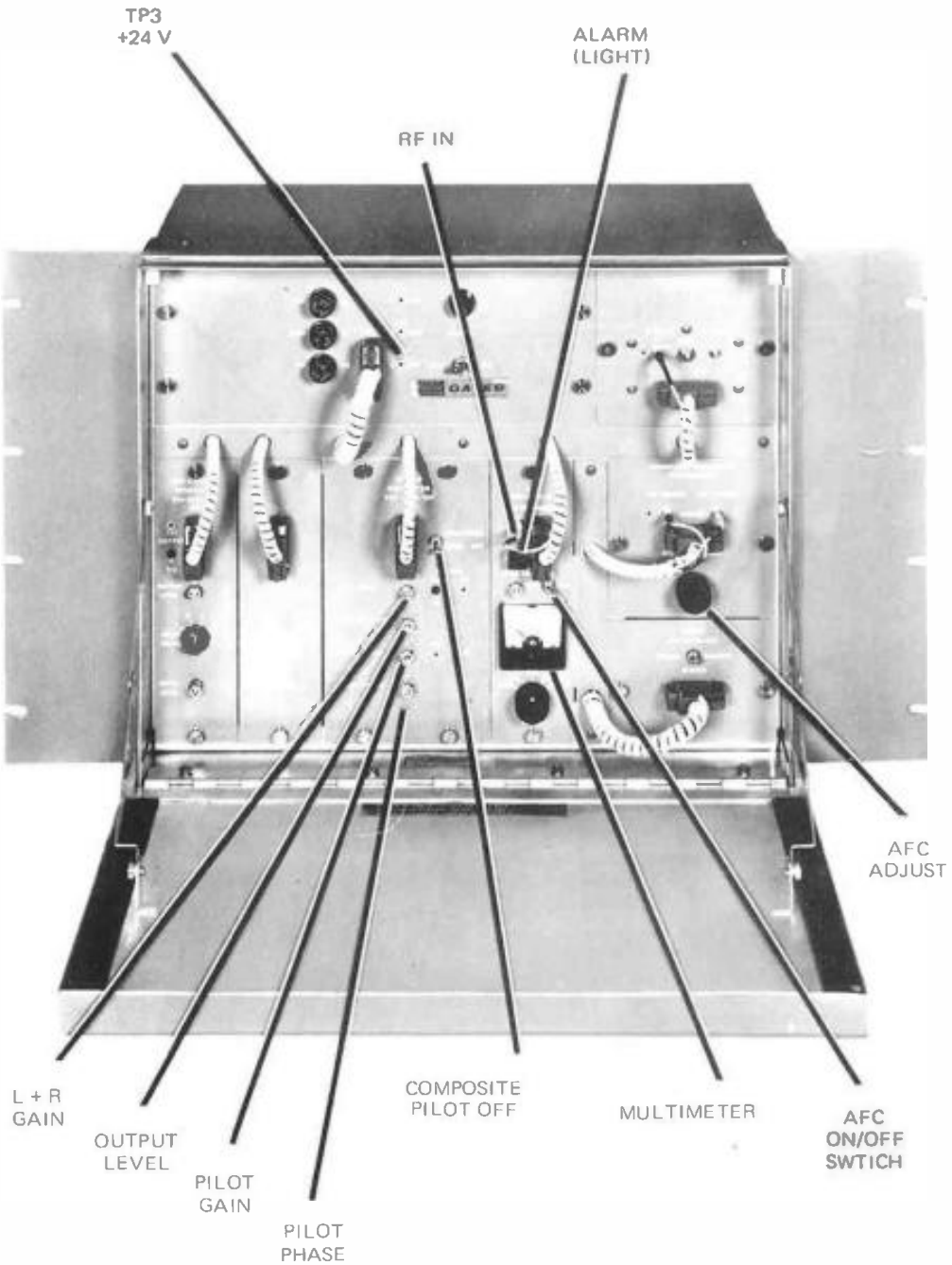
Frequency:	Any SCA channel between 25 and 75 kHz
Frequency Stability:	±500 Hz
Oscillator Type:	Two Colpitts heterodyned to produce desired output frequency
Modulation:	Direct FM
Modulation Capability:	Capable of ±7.5 kHz (±5 kHz considered 100% modulation)
Audio Input Impedance:	600 ohms balanced
Audio Input Level:	+8 dBm, ±3 dB for 100% modulation at 400 Hz
Audio Frequency Response:	41 kHz and 67 kHz, 50 microsecond, modified pre-emphasis 67 kHz response modified for proper operation when used with stereo to conform to FCC specs
Distortion:	1.5% (or better) 30-7,000 Hz
FM Noise (Main channel not modulated):	55 dB minimum (ref. 100% modulation 400 Hz)
Crosstalk (Sub-channel to main channel and stereophonic sub-channel):	-60 dB or better
** Crosstalk (Main channel to sub-channel):	50 dB below 100% modulation (ref. 400 Hz) with main channel modulated 70% by frequencies 30-15,000 Hz

** Crosstalk measurements to be made from an FCC approved monitor using 75 microsecond de-emphasis.

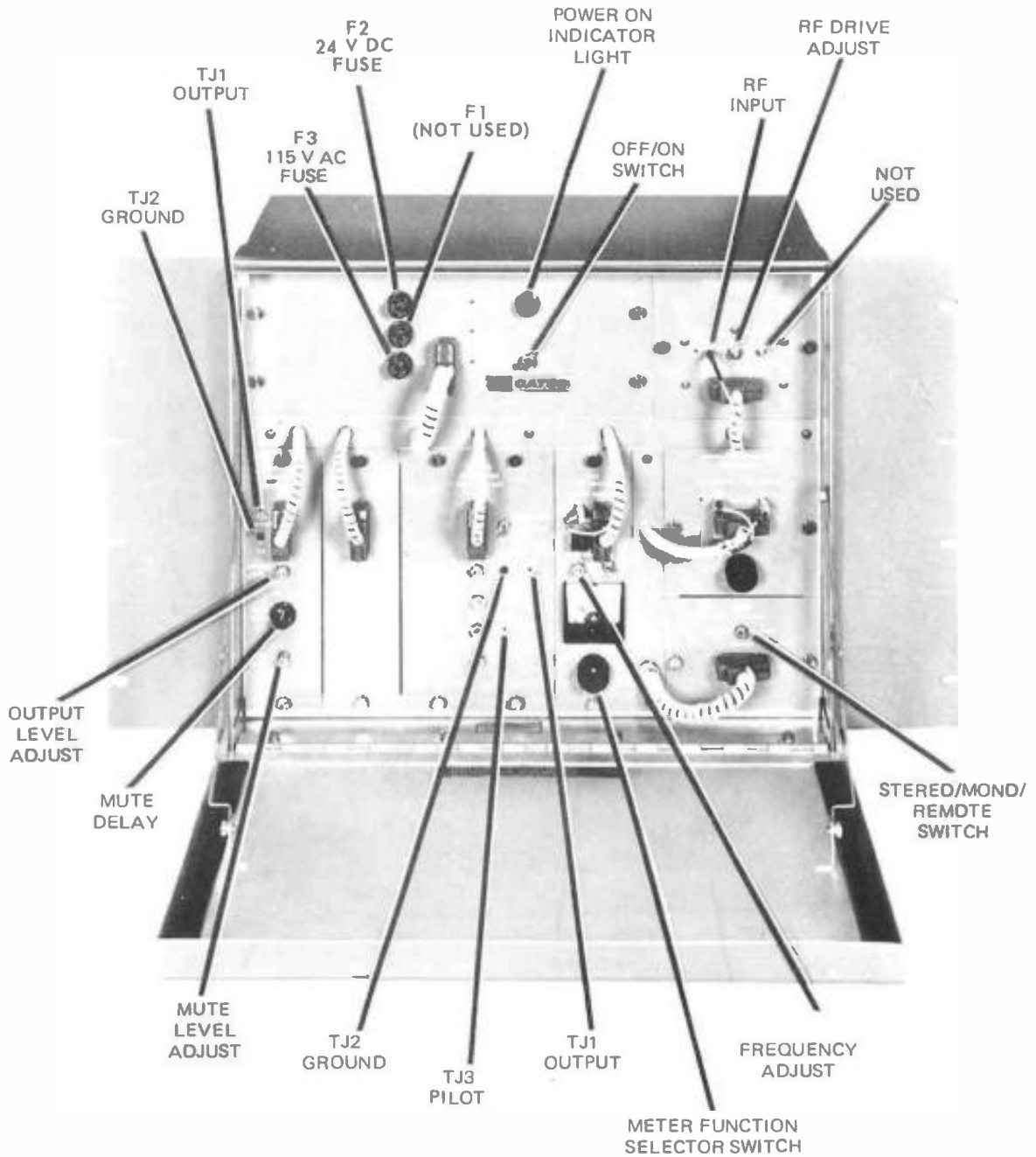
Automatic Mute Level:	Variable from 0 to 40 dB below 100% modulation
Remote Control:	Exciter is internally equipped to be locally or remotely switched from monaural to stereo operation. On monaural operation, normal right audio input connections are switched to the 41 kHz SCA position, if used. Remote functions are accomplished by a single set of external relay contacts, (closure required for stereo operation). An external relay must provide a holding function.



FRONT
VIEW
FIG. 1.1



FRONT
VIEW
FIG. 1.2



FRONT
VIEW
FIG. 1.3

SECTION 2 - INSTALLATION

2.1 DAMAGE CLAIM INFORMATION

In case of damage, notify the delivering carrier at once. After he has approved the damage report order new part(s) from Gates Radio Company, using the parts list for description and individual identification.

2.2 UNPACKING AND INSPECTION

The container and packing should be removed only after a careful examination of the outside of the carton for indications of possible mishandling.

Retain packing material until installation is complete and the TE-3 is placed in operation.

2.3 UNPACKING CHECK LIST

When the TE-3 is shipped as a separate unit, the following items are furnished and packed separately:

EQUIPMENT	GATES PART NO.
Basic	
TE-3 Cabinet	992 1726 001
Modulated Oscillator (Module)	992 2696 001
Audio Unit (Module)	992 1830 001
AFC Control (Module)	992 2697 001
Power Amplifier (Module)	992 1715 001
Technical Manual	888 1042 001
Optional	
SCA Generator 1 or 2 Modules(s)	994 6507 001
Stereo Generator (Module)	994 6533 001

2.4 MECHANICAL DETAILS

The modular design assures easy access to all parts during inspection, routine maintenance and repair. Each module may be released from the chassis by means of thumb screws, and operated external to the chassis.

The exciter output may be connected into a dummy load, antenna, or a following amplifier stage.

2.5 POWER REQUIREMENTS & CONNECTION

A 117 V AC, 60 Hz, single phase, 85 watt, fuse or circuit breaker protected, power source is required. No additional equipment is necessary for operation.

Connect the input power to terminals 7 & 8 of TB1. See Fig. 2.1.

When the AC input is 117 VAC, the black and green/black primary leads of the transformer T1 should be used. If the AC input voltage is less than 105 VAC, the black and white/black primary leads should be used. If the AC input voltage is greater than 125 VAC, the black and white primary leads should be used.

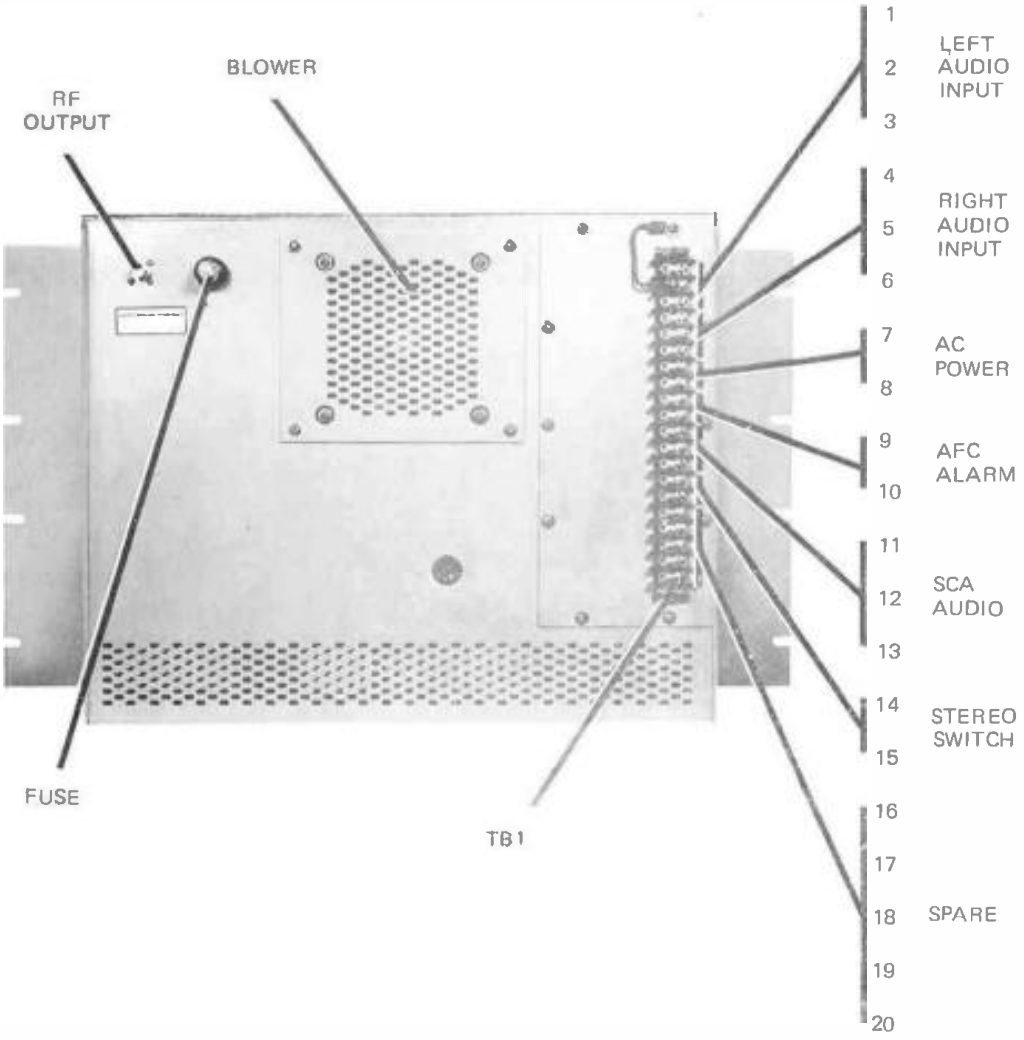
2.6 R.F. OUTPUT CONNECTION

The R.F. connection to the exciter is a BNC connector (J1) on the rear of the unit. See Fig. 2.1. Use coaxial cable type RG58A/U.

2.7 ADDITIONAL CONNECTIONS - See Fig. 2.1

Additonal connections are located on the terminal board TB1 on the rear of the exciter. They are as follows:

1–2–3:	Left Audio Input	(2 is shield)
4–5–6:	Right Audio Input or SCA	(5 is shield)
7–8:	AC Input	
9–10:	AFC Alarm	(N.C.)
11–12–13:	SCA Audio	(12 is shield)
14–15:	Stereo-Mono Switch	
16–17–18–19–20:	Spare	



REAR
VIEW
FIG. 2.1

SECTION 3 - OPERATION & ADJUSTMENT

3.1 FRONT PANEL CONTROLS

The following table gives the identification and function of the front panel controls, (See Fig. 1.1 for basic modules).

TABLE 3.1
FUSES & TEST POINTS
LOCATION AND IDENTIFICATION

IDENTIFICATION	TYPE	FUNCTION
Power Supply		
F2	3 Amp Fuse	Protect +24 Volt circuits
F3	2 Amp Fuse	Protect 115 V AC circuits
S1	Toggle Switch	Energize/De-energize unit
A1	Green Light	Indicates unit energized
Power Amplifier		
R11	Potentiometer	DRIVE Adjust
Modulated Oscillator		
R29	Knob controlled Pot.	AFC Adjust
Audio Unit		
	Toggle Switch	STEREO/MONO/REMOTE SELECT
AFC Unit		
S1	Toggle Switch	AFC - ON/OFF
R48	Potentiometer	FREQ. ADJUST
M1	DC Microammeter	Indicates indexed function
S2	5 position knob controlled switch	Indicates meter function
Stereo Generator		
S1	Toggle Switch	COMPOSITE/PILOT OFF
TJ1	Jack (Test)	COMPOSITE OUTPUT
TJ2	Jack (Test)	GROUND
R68	Potentiometer	L + R GAIN Adjust
R53	Potentiometer	OUTPUT LEVEL Adjust
R27	Potentiometer	PILOT GAIN Adjust
R24	Potentiometer	PILOT PHASE Adjust
SCA Generator		
TJ1	Jack (Test)	OUTPUT
TJ2	Jack (Test)	GROUND
R30	Potentiometer	OUTPUT LEVEL Adjust
S1	4 position knob	MUTE DELAY Select
R32	Potentiometer	MUTE LEVEL Adjust

3.2 TURN ON PROCEDURE

INITIAL

Connect input, output, and power leads as outlined in Section 2.

Turn on main power switch S-1 on the power supply and allow approximately thirty seconds warmup. Set the AFC "OFF/ON" switch to the "ON" position. The red "Alarm" lamp should be extinguished.

NOTE: If it is not, slowly rotate the "AFC Adjust" control on the modulator until it is extinguished.

Adjust the "DRIVE" control on the Power Amplifier for required output.

Select stereo or mono operation with the toggle switch on the audio unit.

30 min Warmup.

After approximately 30 minutes adjust the frequency by rotating R-48 "FREQ ADJ" on the AFC unit for correct frequency as read on a frequency monitor or counter.

The TE-3 is now ready for operation.

NOTE: In routine operation it is recommended that the TE-3 be left on at all times.

3.3 MODULATED OSCILLATOR ADJUSTMENT - See Fig. 4.3

The front panel control "AFC ADJUSTMENT" is a vernier frequency adjustment. Two additional factory adjustments, coarse frequency adjustment (L3) and the modulator bias adjustment (R6) are located on the shock mounted chassis.

Turn the "AFC ADJUSTMENT" control to a mid-range position and turn the meter switch on the AFC unit to the "AFC" position. Turn the AFC switch to "ON".

NOTE: Within a few seconds the "Alarm" lamp should extinguish and the AFC meter should read on scale.

Adjust the "AFC ADJUSTMENT" on the modulated oscillator for a reading between 29 and 31 on the AFC meter.

NOTE: The recommended operating range of the "AFC" position of the meter switch is from 22 to 35. Operation within this range will assure that the modulated oscillator is always within the capture range of the automatic frequency control unit. This will assure that the automatic frequency control will regain a locked condition after a power failure or other interruption of power.

3.4 ALARM CIRCUITS ADJUSTMENT

The operation of the AFC alarm system may be verified in the following manner.

Momentarily disconnect the RF connector from the "AFC" input jack on the modulated oscillator. Note that the "ALARM" lamp lights immediately. Re-insert the connector and note that the lamp extinguishes within a few seconds.

Note that the AFC meter is in the "AFC" position and rotate the "AFC ADJUSTMENT" fully counterclockwise. Note that the meter reading has decreased to approximately 15. Momentarily turn the "AFC" switch off and on. Note that the "ALARM" lamp illuminates and the meter returns to mid-scale. Rotate the "AFC ADJUSTMENT" clockwise until the "ALARM" lamp is extinguished. Set the "AFC ADJUSTMENT" for a reading between 29 and 31 on the AFC meter.

3.5 AFC MULTIMETER

POSITION	INDICATION
"Mod"	Output of Modulator Frequency Divider Chain. Nominal Reading: 35-45
"Ref"	Output of Reference Frequency Divider Chain. Nominal Reading: 35-45
"AFC"	AFC Buss Voltage. Nominal Reading: 25-35
"Mod Out"	Power Output of Modulator. Nominal Reading: Refer to Final Test Data supplied with exciter.
"PA Out"	Power Output of Exciter. Nominal Reading: Refer to Final Test Data supplied with exciter.

SECTION 4 - THEORY OF OPERATION

4.1 GENERAL

The TE-3 Exciter is self-contained with capabilities in excess of minimum FCC specifications.

Each exciter is factory tested on the customer's frequency and satisfactory operation is verified.

4.2 POWER SUPPLY - See Fig. 7.3 Schematic & Fig. 4.1 Photograph

The power supply consists of a two section unit. The two sections supply a regulated 24 DC volts and a regulated 150 DC volts respectively. Both sections receive AC voltage from a common power transformer.

NOTE: The 150 volt section is not used in the TE-3.

In the 24 volt supply, the AC voltage supplied by transformer T1, is rectified by diodes CR6 through CR9. The rectified voltage is applied to filter section C3, C4, and R7. Q4 is a series control transistor that regulates the 24 volt supply. A sample of the output voltage is compared with a reference voltage in Q7. The reference voltage is supplied by temperature compensated diodes CR10 and CR11. Any change in the output voltage is amplified by Q5 and Q6. This amplified output causes series control Q4 to return the output voltage to the value set by R11.

NOTE: The output voltages will remain relatively constant over a temperature range of -20 to +70° C. The output voltages will remain constant as the line voltage is varied from 85 to 115% of normal 117 volt AC supply. Normal load variations will cause no voltage change in these supplies.

4.3 POWER AMPLIFIER - See Fig. 7.6 Schematic & Fig. 4.2 Photograph

The power amplifier is a four stage amplifier. Transistors Q1, Q2, and Q3 are single stage amplifiers. Q4 and Q5 are paralleled to obtain the desired output level.

Maximum power is 10 to 15 watts. Power output is determined by the setting of R11, the input drive control. Transformers T1 and T2, along with the associated capacitors C4 and C7 match the output impedance of these stages to the low input impedance of the following stages. Inductors L1, L2, and capacitors C14 and C15 match the output impedance of Q3 to the low impedance of Q4 and Q5. The output circuit of Q4 and Q5 is a modified Pi type of circuit consisting of L5, L6, and C19 and C20.

4.4 AUDIO UNIT - See Fig. 7.7 Schematic & Fig. 4.5 Photograph

The audio unit supplies the modulated oscillator with all main channel modulation (excluding SCA). When the function switch is in the "MONO" position, left audio input is filtered and pre-emphasized and applied directly to the modulated oscillator unit. The composite stereo signal including the pilot is completely removed from the modulation input of the modulated oscillator.

If the function switch is in the "STEREO" position, left and right audio inputs are filtered, pre-emphasized and applied to a resistive matrix. They then connect to the stereo generator. The composite stereo signal including pilot returns through the audio unit for application to the modulation input of the modualted oscillator.

Left audio input circuitry consists of three fundamental types of circuits. First, is a 19 kHz notch filter consisting of L1 and C1.

Resistors R1 through R5 and capacitors C2, C3, C4 along with inductor L2 form a 75 microsecond pre-emphasis section.

The primary and secondary impedance of T1 is 600 ohms. Right audio input circuitry is exactly identical to left audio input circuitry.

When selector switch S1 is in the STEREO position, output of the left pre-emphasis section is connected to the primary of T1. The secondary of T1 connects into the matrix consisting of R13 through R18. At the same time, right audio input signals are routed through the right 19 kHz filter, pre-emphasis network and T2. The secondary of T2 is also connected into the resistive matrix.

Output of the matrix then produces the L—R and L + R signals for application to the signal unit of the stereo generator. At the same time the composite signal along with the 19 kHz pilot is connected through the relay to the input terminals of the modulated oscillator.

When S1 is placed in the MONO position, audio input signals connected to the left audio input, again pass through a 19 kHz notch filter and the left pre-emphasis network. There the signal terminates in R11. R11 may be adjusted to produce the desired modulation level for a given level of audio input.

Also with S1 in the MONO position the normal right stereo input terminals are connected through relay contacts K1 for application to the input of a 41 kHz sub-carrier generator unit if it is used. The 41 kHz SCA (if used) is muted when audio is not applied.

The stereo generator is completely bypassed when S1 is in the MONO position and no stereo signals (or pilot) can modulate the main carrier.

When S1 is in the REMOTE position the mono to stereo functions may be performed by the contacts of a remote control relay. This relay must perform a holding function.

4.5 MODULATED OSCILLATOR - See Fig. 7.4 Schematic & Fig. 4.3 Photograph

The modulated oscillator accepts monaural, composite stereo, and SCA signals and generates a stable, low distortion, frequency modulated signal in the standard FM broadcast band of 87.5 to 108 MHz.

The modulated oscillator consists of three sections; a stable oscillator, a buffer amplifier, and a power supply regulator.

There are four inputs to the modulated oscillator; baseband for monaural or composite stereo, two isolated SCA inputs, and an automatic frequency control input.

Three outputs from the modulated oscillator are as follows: An RF output of approximately 500 millivolts into a fifty ohm load for automatic frequency control (J-2). An RF output of 20 milliwatts to drive a power amplifier (J-3) and a DC output proportional to the RF output level that provides a convenient means of monitoring the RF output of the modulator (J1-9).

4.5.1 OSCILLATOR

The oscillator is a modified "CLAPP" circuit operating at the assigned carrier frequency at a power level of approximately 150 milliwatts.

The oscillator frequency is adjusted by L3 and R29. L3 is an internal coarse frequency adjustment used to set the oscillator frequency within the adjustment range of the vernier frequency adjustment R29.

NOTE: L3 is factory adjusted and should not be reset in the field.

Resistor R29 is a ten turn potentiometer located on the front panel. See Fig. 1.1. R29 provides a reverse bias voltage to CR3, a voltage variable capacitor, used as an electrically adjustable frequency control. A DC control voltage from the automatic frequency control unit maintains the electrical adjustment and is the frequency controlling element in the system.

Diodes CR1 and CR2 are connected to the oscillator tank circuit and are biased to the linear region by resistor R6, the "Modulator Bias" control. See Fig. 4.3.

Modulation from the audio unit, or SCA generators, or stereo generator is applied to the junction of diodes CR1 and CR2.

4.5.2 BUFFER AMPLIFIER

A broadband matching network consisting of L4 and C12 matches the collector circuit of the oscillator transistor Q1 to the attenuator network, R13, R14, and R15. The attenuator provides a nonreactive load and isolation for the signal. Transistor Q2 amplifies the oscillator output to approximately 500 milliwatts.

A broadband low pass filter comprised of C23, C24, and L6 matches the collector circuit of Q2 to the output attenuator, R20, R21, and R22.

The attenuator network reduces the output level of the buffer stage to a level sufficient to drive the power amplifier and provides additional isolation for the oscillator circuit.

A sample of the RF output of the buffer stage is directed to the automatic frequency control system. An additional sample of the RF output is rectified by diode CR8. The DC voltage derived from diode CR8 is used to provide a meter reading on the AFC unit proportional to the RF output of the modulated oscillator.

NOTE: The oscillator and buffer transistors are low noise silicon "overlay" transistors designed specifically for VHF oscillator and amplifier applications.

4.5.3 POWER SUPPLY REGULATOR

The power supply regulator is a conventional pass transistor type using a zener, regulated reference voltage applied to the base of Q3. The reference voltage is temperature compensated by diode CR7.

4.6 AUTOMATIC FREQUENCY CONTROL UNIT

See Fig. 7.5 Schematic & Fig. 4.4 Photograph

The automatic frequency control unit is designed to operate in conjunction with the modulated oscillator to provide a stable, automatically controlled, FM broadcast signal in the standard FM broadcast band of 87.5 to 108 MHz.

The automatic frequency control unit is divided into five sections: Reference oscillator, frequency dividers, phase detector, power supply regulator, and alarm circuitry.

The AFC unit operates on the principle of the phase locked loop. The input signal frequency from the modulated oscillator is phase locked to an internal crystal controlled reference.

The AFC unit is energized from the FM exciter main frame with 24 V DC at 300 milliamps. In addition, 500 millivolts of RF at the carrier frequency is necessary for operation.

A multimeter is incorporated (see Fig. 1.2), to monitor five parameters associated with the AFC unit, the modulated oscillator, and the power amplifier. A red pilot light will indicate any malfunctions and a front panel switch disables the AFC unit during initial tune-up and in case of malfunction.

Exact center frequency adjustment is assured by a vernier frequency control.

4.6.1 REFERENCE OSCILLATOR

The reference oscillator is a standard crystal controlled oscillator utilizing an integrated circuit, Z12. The oscillator frequency is adjusted with capacitor C27 and diode CR10.

The first two transistors of the integrated circuit Z12 form an emitter coupled amplifier and the third transistor is a buffer amplifier to isolate the load from the crystal oscillator. The crystal is a high stability unit enclosed in a temperature controlled oven. The oven temperature is maintained at 60^{o} C by the closed loop system consisting of integrated circuit Z13, a differential amplifier, thermistor RT1, transistor Q6, and resistor R38. R38 is used as the oven heater element. The oven temperature is evaluated by thermistor RT1. The output of RT1 controls the bias voltage at the base of Z13B. The bias voltage is compared with the reference setting at the base of Z13A and the difference between the two voltages is amplified and applied to the base of control transistor Q5. Q5 regulates the current through the heater resistor R38 and controls the oven temperature.

4.6.2 FREQUENCY DIVIDERS

Two frequency divider systems are incorporated in the AFC unit, one for the modulated oscillator output and one for the reference oscillator output.

The modulated oscillator divider consists of integrated circuits Z1 through Z7 and divides the input frequency by 16,384. This is necessary to eliminate the phase shift in the incoming signal caused by the frequency modulation. The large division ratio permits full range modulation from twenty hertz upward without upsetting the phase detector function.

All of the integrated circuits are bi-stable multi-vibrators or "Flip Flops". The resultant output of either side of the flip flops is a frequency one half of the input frequency. The output at test point TP1 is 1/16th of the incoming frequency.

Transistor Q1 is a buffer amplifier used to isolate and amplify the output of Z4 to a level sufficient to drive Z5. Integrated circuits Z5, Z6, Z8, and Z9 divide each incoming signal by sixteen. Integrated circuit Z7 divides the incoming signal by four.

The reference oscillator frequency divider consists of integrated circuits Z8 and Z9 and divides the frequency of the reference oscillator by 256. This is done in order to operate the crystal in the most stable range.

4.6.3 PHASE DETECTOR

The phase detector consists of integrated circuit Z10. The IC is a flip-flop circuit with the toggle input connected to the reference oscillator frequency divider which keys alternate sides of the flip-flop. The resultant output of the phase detector is a square wave with a duty cycle of fifty percent. The output of the modulated oscillator frequency dividers is also a square wave. This signal is differentiated by capacitor C9 and resistor R5 to form a sharp pulse. The pulse is used to "set" the flip-flop Z10.

> *NOTE: If the frequencies at the input of the phase detector are exactly equal, the output of the phase detector will be a square wave with a duty cycle proportional to the relative phase of the two input signals.*

The square wave output of the phase detector is amplified by transistor Q2 to a level of approximately twenty volts peak to peak. The signal is then filtered by resistors R9 and R10 and capacitors C13 and C14 to remove the reference frequency component of the signal. The amplitude of the remaining DC component is then proportional to the phase difference of the input signals and is used to control the modulated oscillator frequency.

4.6.4 ALARM CIRCUITS

Five circuits are monitored by the alarm circuits, three directly and two indirectly. The alarm output, indicating functional failures, is displayed on the front panel by indicator lamp DS-1. The alarm output is also available in the form of normally open and normally closed relay contacts through the power connector.

The circuits directly monitored by the alarm system are the reference and modulated oscillator frequency dividers and the "out of lock" condition. The circuits indirectly monitored are the reference oscillator output and the modulated oscillator output through their respective dividers.

The output of the reference frequency dividers is detected and converted to a DC voltage by diodes CR1 and CR2. The detected voltage is amplified by Z11C and Z11D.

NOTE: Both amplifier stages are biased in a saturated condition or cut off.

In normal operation both stages are saturated and there is no output from Z11D. If a failure occurs in this section, the voltage at the collector of Z11D will increase toward five volts. Diode CR5 will conduct, turning on Z14B and Q3. When Q3 conducts, alarm lamp DS-1 illuminates and relay K1 is energized. This action disables the associated transmitter.

The modulated oscillator and its associated frequency dividers are monitored in an identical manner by Z11A and Z11B and their associated components.

An "out of lock" condition exists when the modulated oscillator is operating at a frequency outside the lock in range of the phase detector and the automatic frequency control circuit. When this condition occurs the phase detector output will contain a large AC component in addition to the normal comparison frequency and DC component. The AC component is directly proportional to the frequency error between the two signals. The AC component is amplified by Z14A and detected by diodes CR11 and CR12. The resultant DC voltage turns on Z14B and Q3 in a manner identical to the presentation in the previous section.

The comparison frequency present in the normal output of the phase detector is removed by the filtering action of R27, R28, C20, and C21.

NOTE: The frequency response of the amplifier is such that it will not respond to all signals outside the capture range of the phase detector.

4.7 STEREO GENERATOR

A 19 kHz pilot signal is generated by a crystal controlled oscillator Q1 for the composite stereo. Q2 isolates this signal and the 19 kHz signal is applied to the 19 kHz tuned amplifier stage Q3. The secondary of transformer T1 is connected to a push-pull doubler circuit consisting of transistors Q4 and Q5.

This stage in conjunction with transformer T2 generates a 38 kHz signal. The 38 kHz signal is applied to the balanced sub-carrier modulator circuit consisting of transformers T3 and T4 and diodes CR1 through CR4.

An L-R input signal from the audio unit is also applied to the balanced sub-carrier modulator.

An L-R double sideband suppressed carrier signal appears at the output of T4. Harmonics of this signal are reduced by forward biasing of diodes CR1 through CR4 and by adjusting the harmonic null control R37. Sub-carrier null control R48 balances out the residual 38 kHz sub-carrier to a level of approximately -45 dB.

NOTE: Second harmonics of the double sideband signal fall into the band pass of the normal 67 kHz SCA signal. If these second harmonic signals are not attenuated, crosstalk from the stereo signal will interfere with the sub-carrier channel.

The L+R input signal from the audio unit is combined with the L-R double sideband signal at the junction of C22, R53, and R60. A circuit consisting of L3 through L6 and capacitors C29 and C30 adjusts the time delay of the L+R input to match the L-R signal. A composite stereo signal appears at the junction of C22, R53, and R60. This signal is applied to the emitter follower Q12 from the output level control R53.

The composite stereo signal is amplified by Q13 and applied to the base of emitter follower Q14.

The total composite signal with 10% 19 kHz pilot signal appears at the emitter of Q14.

A pilot signal from terminal 4 of transformer T1 is applied to emitter follower Q6. Maximum separation is maintained by the adjustment of the pilot phase by the phase control between Q6 and emitter follower Q7. A pilot gain control is incorporated at the emitter of transistor Q7. The pilot signal is added to the composite output by connecting R27 to the emitter resistor of Q14.

The second harmonic signal from R53 via Q8 is amplified and inverted by Q9. This signal is applied to emitter follower Q10 and from Q10 to the amplifier Q13, thus cancelling the harmonics.

NOTE: Crosstalk null control R33 cancels any remaining cross-talk.

4.8 SUB-CARRIER GENERATOR

The sub-carrier generator generates the sub-carrier frequencies (41 or 67 kHz) by utilizing two self-excited oscillators.

Q1 and Q2 are the individual Colpitts oscillators. Q1 oscillates at 900 kHz and Q2 oscillates at 941 or 967 kHz.

The outputs from Q1 and Q2 are mixed by diodes CR1 and CR2. Filter network L5, C13, and C14 remove all undesired frequencies.

The sub-carrier frequency is amplified by Q3 and applied to a tunable low pass filter. The filter consists of L6, L7, L8, C19, C20, C21, and C22, and removes all harmonics of the sub-carrier frequency.

By variation of the base bias voltage the oscillators are frequency modulated at an audio rate. The audio modulation is applied to the oscillators Q1 and Q2 by the push-pull audio transformer T1.

NOTE: An audio shaping network is connected prior to the primary of T1. The network is adjusted so that the audio response will increase several dB at 5 kHz with respect to the 400 Hz reference. The response will roll-off above 5 kHz.

When this generator is used as a 67 kHz sub-carrier unit for use with stereo, capacitors C1 and C2 are disconnected. The circuit then functions as a de-emphasis circuit. The roll-off is above 3 kHz to avoid generating side bands that would interfere with the stereo signal.

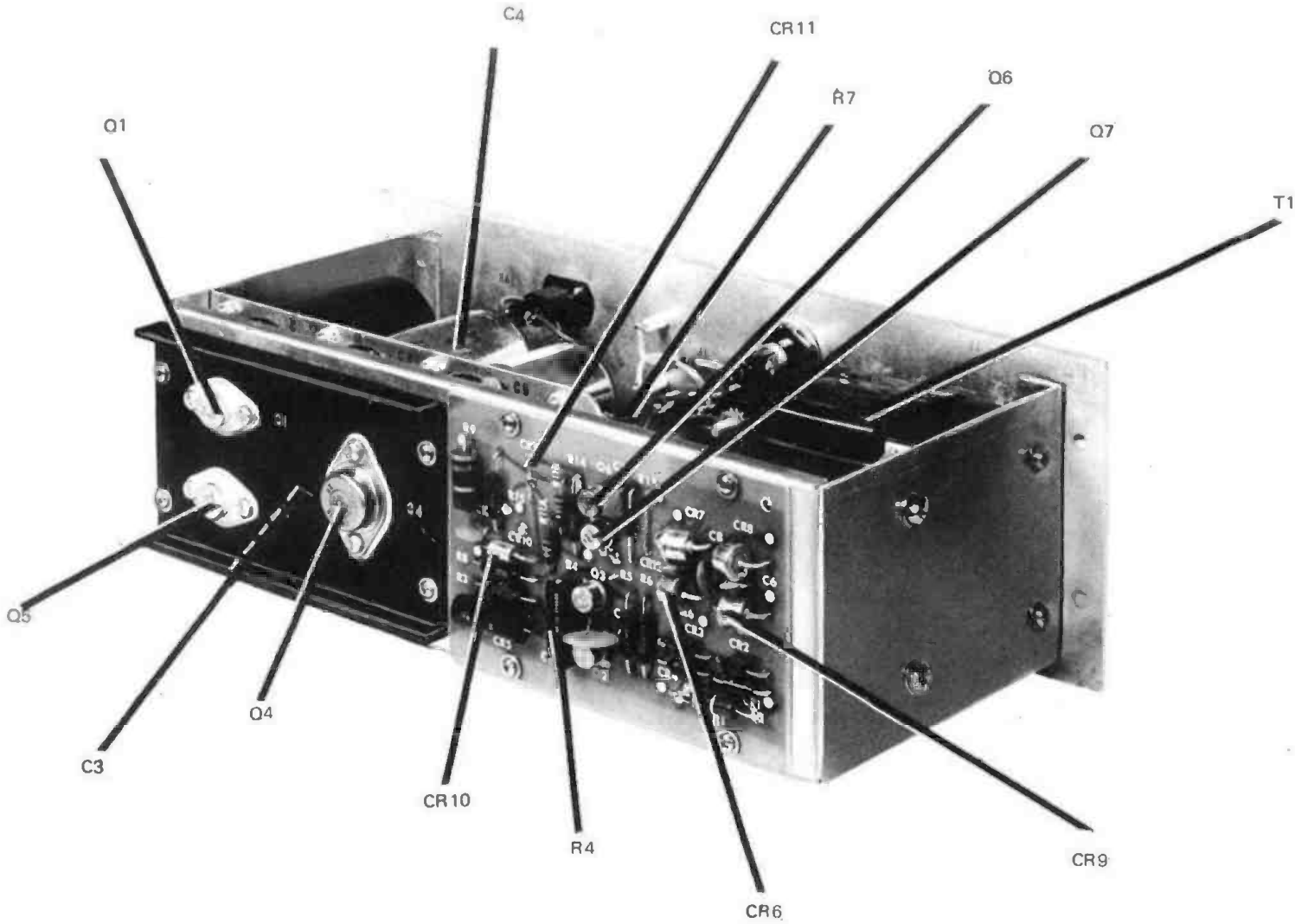
A portion of the audio input is applied to a muting circuit consisting of Q4, Q5, Q6, and Q7. Q4 and Q5 amplify and square the input audio. The resulting square wave signal is rectified by diodes CR3 and CR4.

When audio is applied to Q6 the DC level at the base of Q6 and the bias of Q7 keeps Q6 and Q7 from conducting.

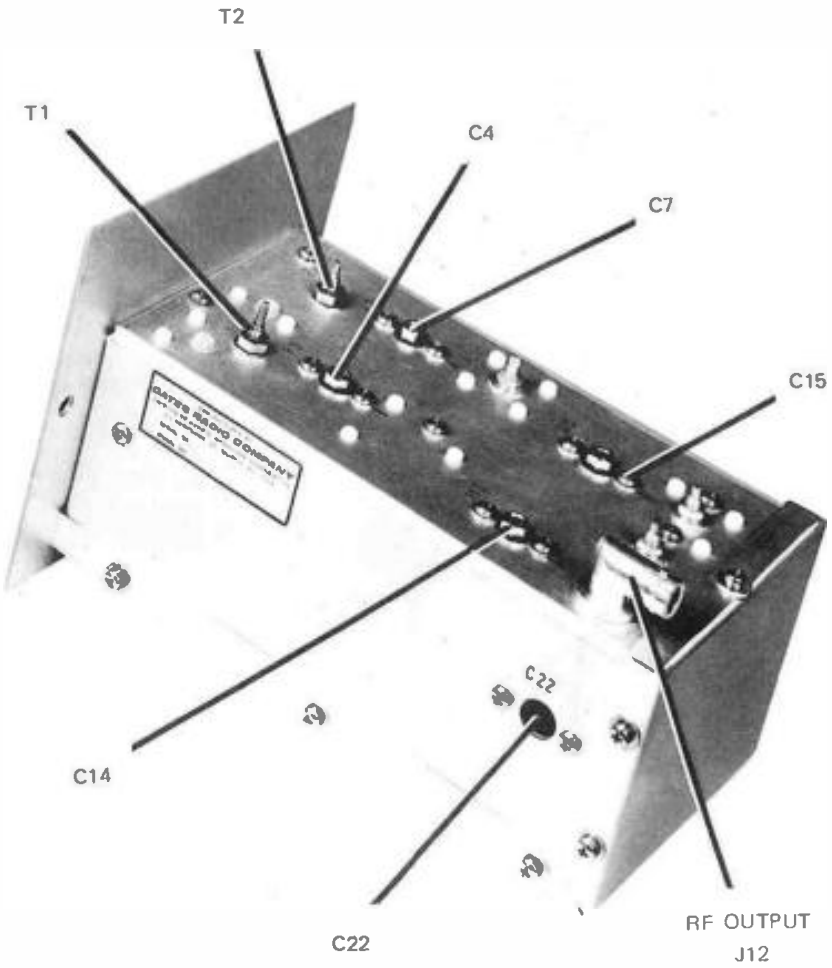
When audio input is removed, Q6 and Q7, conduct causing the impedance from the junction of C17 and C18 to chassis ground to drop to a few ohms. This causes the sub-carrier output to be attenuated approximately 50 to 60 dB.

NOTE: The length of time between sub-carrier shut off and when the audio is removed from Q4 is determined by a capacitor network at the base of Q6 in conjunction with the mute time constant switch S1.

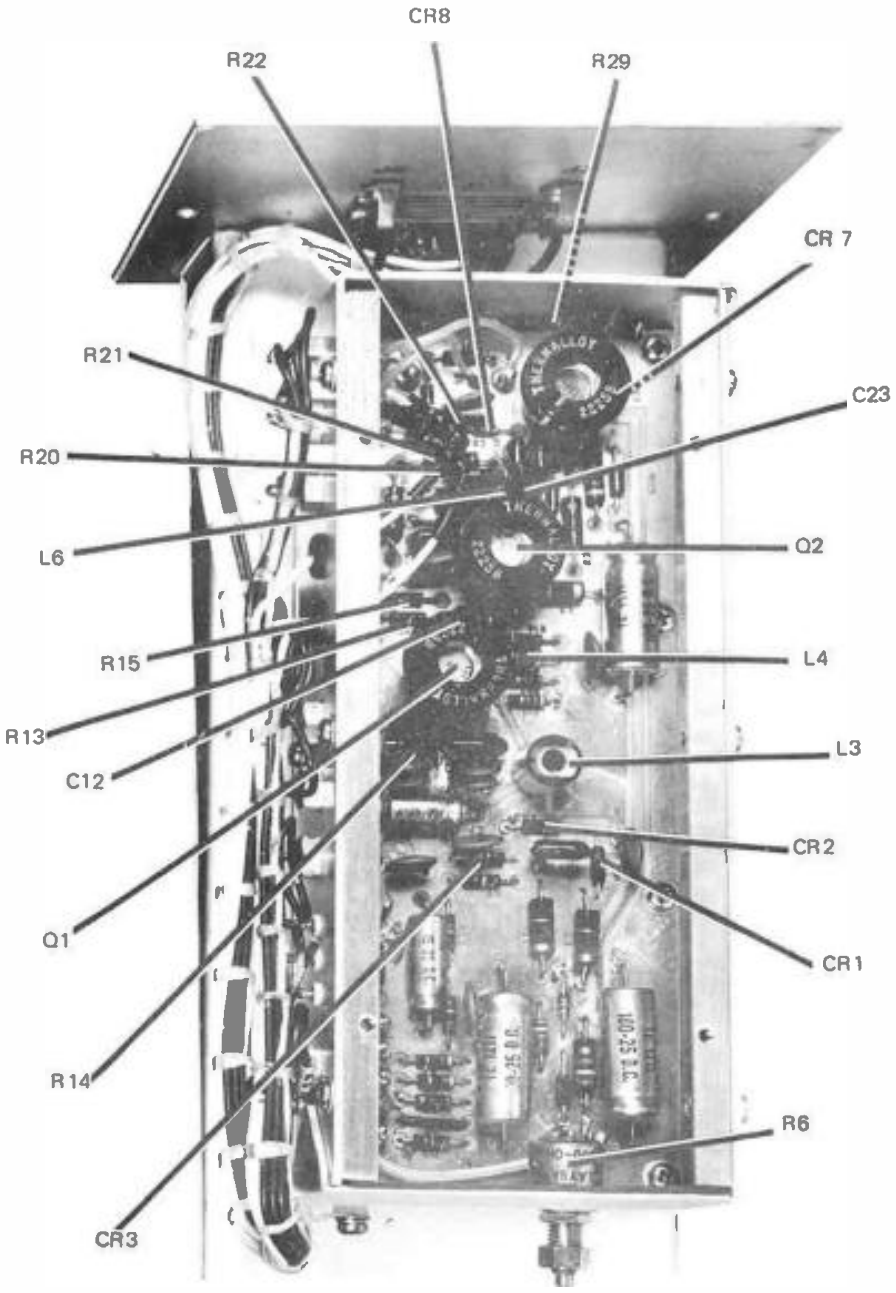
The Mute Level control, R32, determines the audio level required to turn OFF the sub-carrier.



INTERNAL VIEW
POWER SUPPLY
FIG. 4.1

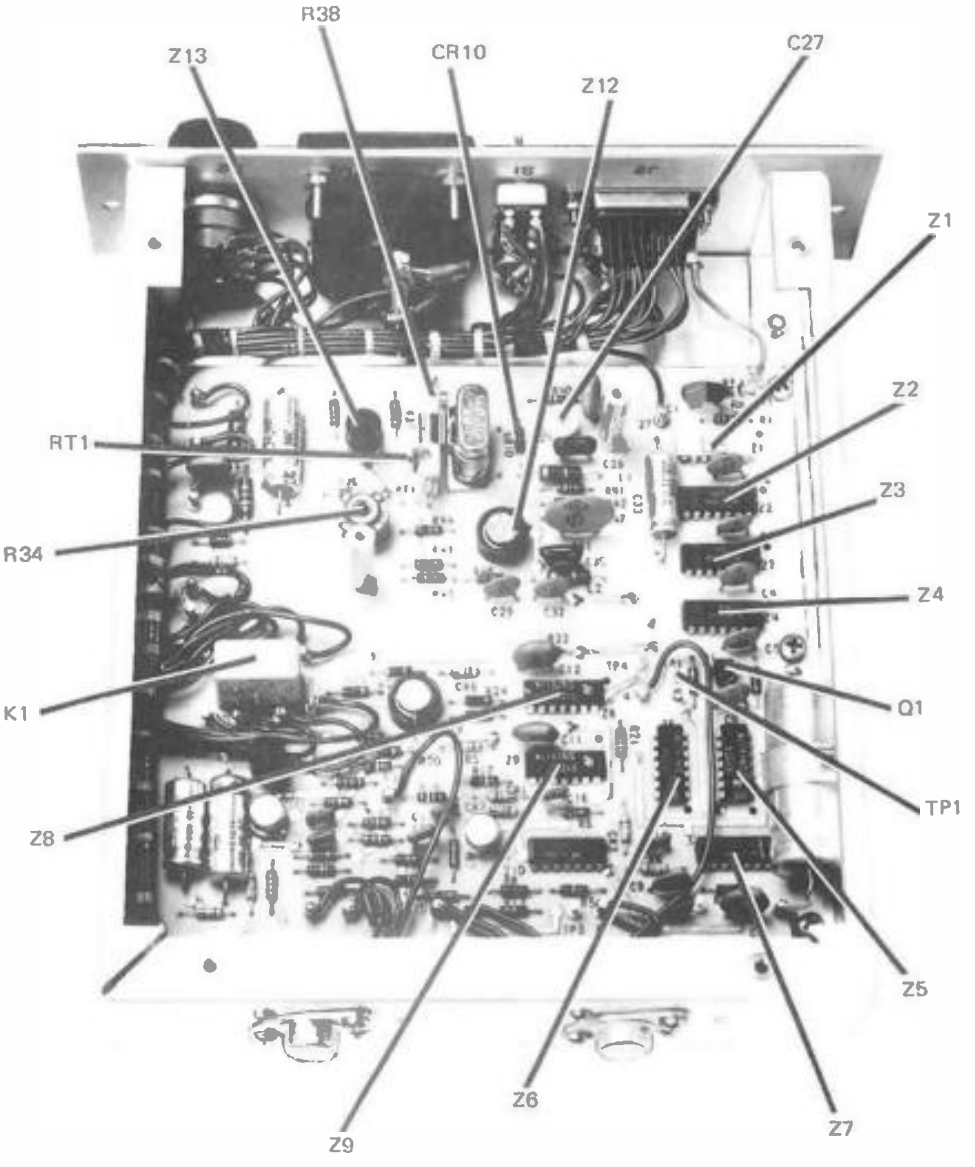


POWER AMPLIFIER
FIG. 4.2

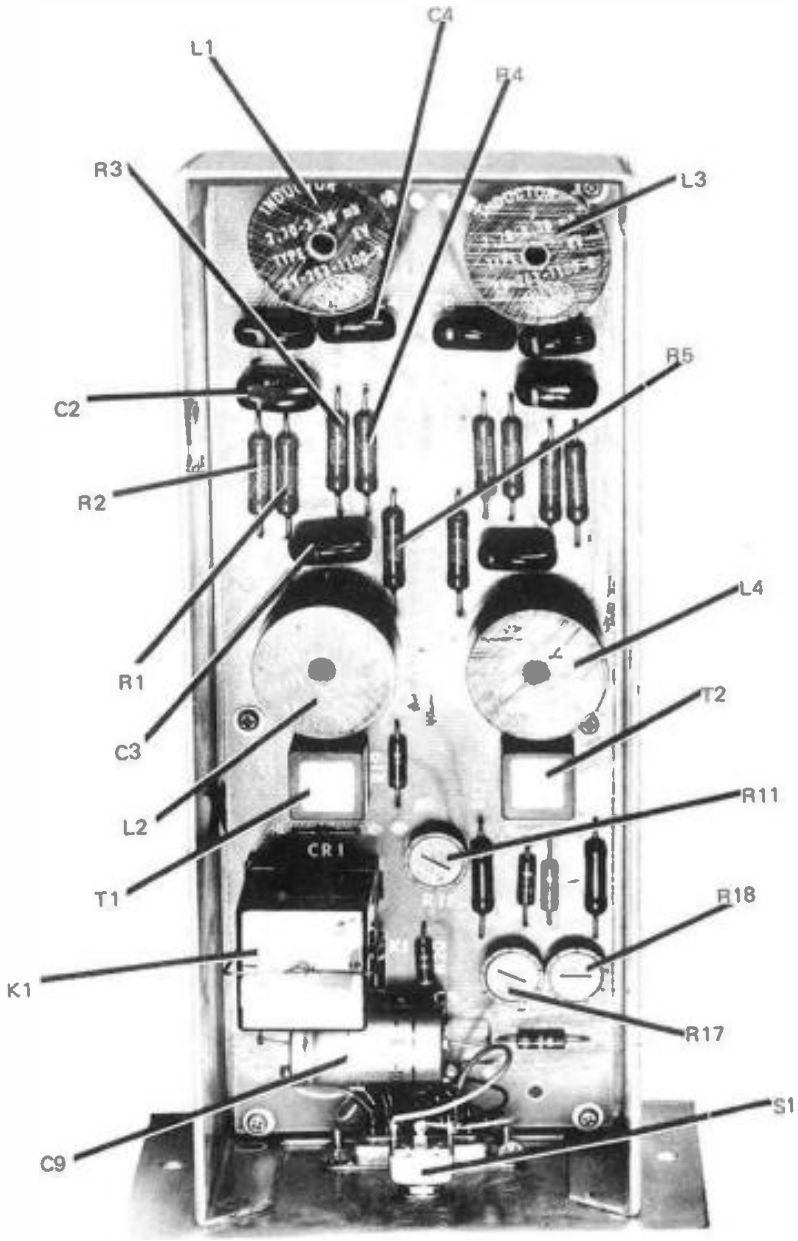


INTERNAL VIEW
MODULATED OSCILLATOR

FIG. 4.3

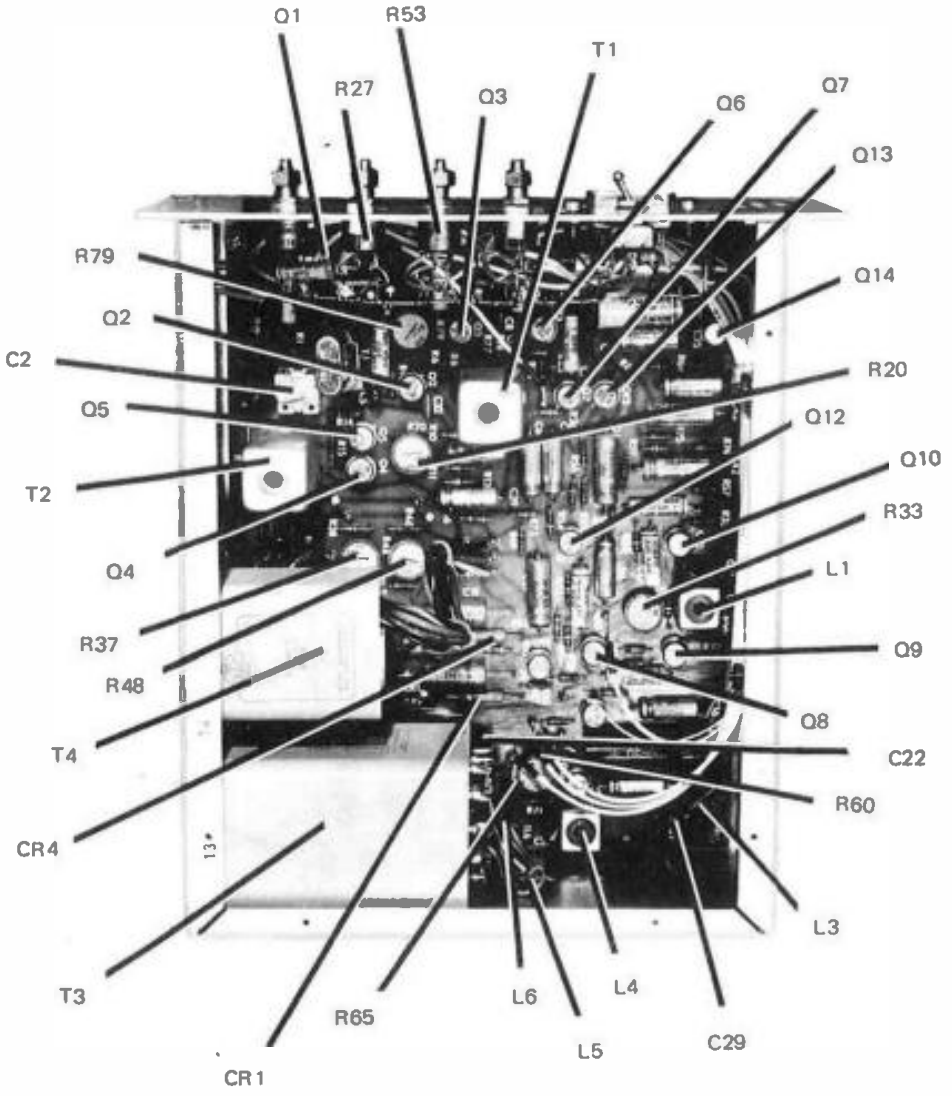


INTERNAL VIEW
(OVEN COVER REMOVED)
AFC UNIT
FIG. 4.4

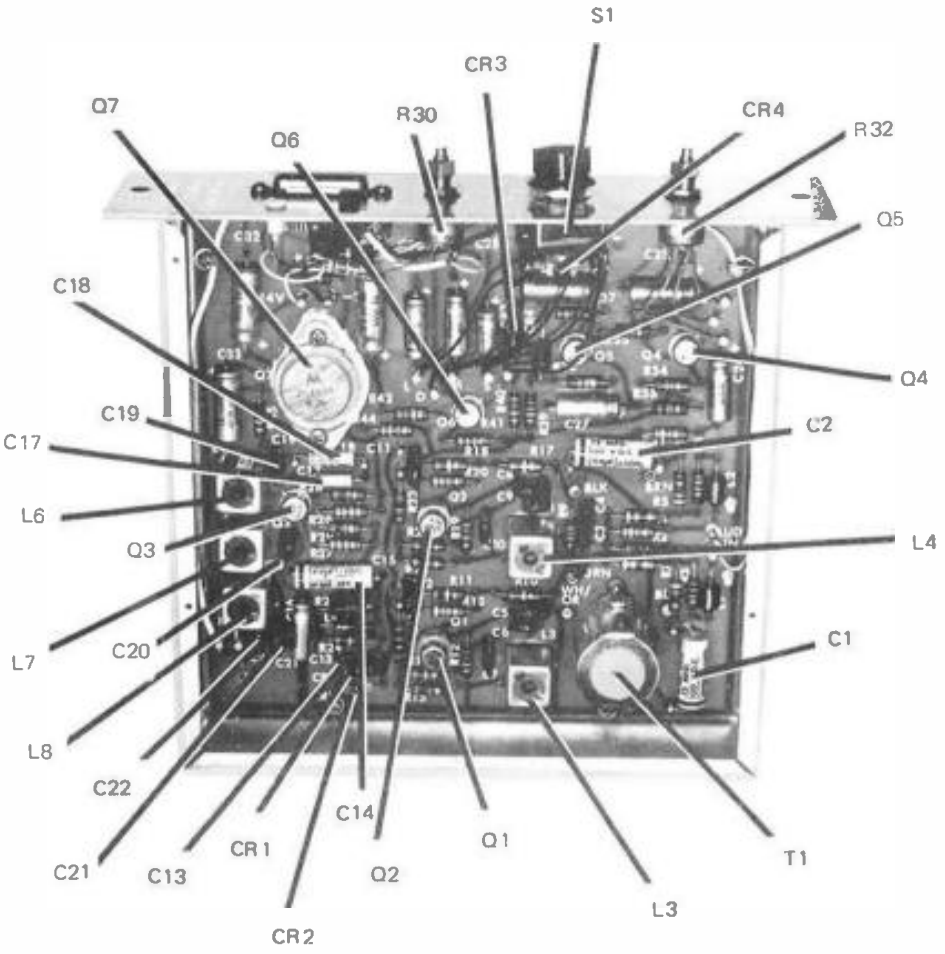


INTERNAL VIEW
AUDIO UNIT

FIG. 4 - 5



INTERNAL VIEW
STEREO GENERATOR
FIG. 4 - 6



INTERNAL VIEW
SCA GENERATOR
FIG. 4 - 7

SECTION 5 - TROUBLESHOOTING

5.1 GENERAL

Each individual unit is thoroughly tested on the customer frequency before shipment. If any unit fails to operate properly, insure that all connectors fit properly into the respective receptacles on each individual module.

Isolate a problem to an individual module by referring to the overall block diagram Fig. 7.1. Refer to the appropriate schematic of the module in question.

5.2 NO CARRIER OUTPUT

Check that the power supply is providing 24 V DC. If the pilot lamp on the power supply is extinguished, insure that S1 on the power supply is "ON". Determine the condition of the 117 V AC connections at the terminals on the rear of the exciter. Check the condition of F3, the 117 volt fuse on the power supply. Check fuse F1 located on the rear of the cabinet.

If the pilot lamp on the power supply lights; check F2, the 24 V fuse on the power supply.

If the power supply is providing the proper voltages, check the output coax of the exciter for a short or open circuit.

Determine if the modulated oscillator is providing output by listening to an FM Receiver tuned to the operating frequency. Check the output level of the modulated oscillator as read on the AFC meter.

If the modulated oscillator is functioning properly and is providing power output to the 10 watt amplifier, trace the RF signal through the amplifier stages and compare AC and DC voltages with the schematic values.

5.3 CARRIER OFF FREQUENCY

Measure the "Locked" and "Unlocked" frequency. If the frequency is further away from the correct value when the AFC defeat switch is on, the fault is probably in the AFC unit. Determine if the fine frequency control knob has been misadjusted. Check the power supply voltages.

If the AFC unit isn't functioning, the AFC switch may be turned off and the modulated oscillator tuned to carrier frequency and operated temporarily without AFC.

NOTE: Drift must be checked at short intervals when operating in this mode.

NOTE: Some types of frequency monitors will display a nearly "ON FREQUENCY" reading when the carrier is several hundred kHz off frequency. The correct frequency is the point where the AFC "Locks" instead of kicking the frequency monitor off scale.

5.4 HIGH DISTORTION

Units other than the transmitter will usually be responsible for high distortion; especially the console, amplifier, limiters, and audio lines. There are no active elements present in the exciter at audio frequencies.

5.5 HIGH NOISE

First establish the noise as to type. If the noise is 120 Hz ripple, check the power supply. Disconnect the audio lines. If the noise originates from the audio lines, check that the center tap of the audio output transformer of the audio equipment is not grounded. In a remote controlled system, check all isolation devices. Determine if the modulated oscillator is causing the noise by disconnecting the audio unit and any SCA generators used.

5.6 EXCESSIVE CROSSTALK (Main & Stereo Channel to SCA Channel)

Determine if crosstalk is present on the audio input lines. The most common cause of high crosstalk is in the detector and IF strip of the SCA monitor or SCA receiver. Determine if high crosstalk is present on more than one receiver.

NOTE: Crosstalk may occur in improperly tuned stages in either the transmitter or receiver. The tuned stages of the exciter amplifier are very broad and should not cause trouble.

5.7 POOR STEREO SEPARATION

Check the wave form at the output of the stereo generator and at the output of the monitor or receiver detector. Determine if the pilot is on and is modulating the main carrier 8 to 10%. Check the pilot phase.

5.8 POWER AMPLIFIER TUNING

All internal adjustments are tuned for maximum power output. R11, the input "DRIVE" control on the front panel is then set for the desired power output.

5.9 AUDIO UNIT ALIGNMENT - See Fig. 4.5

S1 is placed in the "Mono" position to adjust the audio unit.

A 400 Hz, +10 dBm signal is applied to the left audio input. Adjust R11 for 100% carrier modulation.

A "Left=Right" signal of 400 Hz is applied to the left and right audio inputs and S1 is switched to the stereo mode. Adjust R18 for a minimum 400 Hz signal level at J11-10 (L-R out).

A "Left=Minus Right" signal of 400 Hz is then connected into the left and right audio inputs. Switch S1 to the stereo mode position and adjust R17 for a minimum 400 Hz signal level at J11-6 (L+R out).

Apply a 19 kHz audio signal to the left audio input terminal and adjust L1 for a minimum 19 kHz output signal at J11-6 (L+R out). Apply a 19 kHz audio signal to the right audio input terminal and adjust L3 for a minimum 19 kHz output signal at J11-6 (L+R out). Adjust L2 and L4 for a 16.8 dB increase in output level at 15 kHz as compared to a 400 Hz reference signal. Measure this signal at J11-6 (L+R out).

Connect the L=R and L=R signals into the exciter input terminals. Adjust L1 through L4 for minimum L+R to L-R crosstalk at 15 kHz. Measure at the L-R and L+R terminals of the matrix.

5.10 STEREO GENERATOR ALIGNMENT - See Fig. 4.6

C2 is adjusted to set the pilot frequency as observed on a frequency counter or monitor.

R20, the doubler balance control, is adjusted for minimum 19 kHz ripple on the composite output signal, This adjustment is performed without a pilot signal.

The sub-carrier null control, R48, is adjusted for a minimum 38 kHz output. Harmonic null control, R37 is adjusted for minimum second harmonic output from the balanced modulator.

NOTE: The adjustment of R48 and R37 may be observed on an approved stereo monitor, wave analyzer, or ultrasonic display.

R53, the output level control, is adjusted to modulate the main carrier 90% with a 400 Hz left or right audio input signal of +10 dBm. This level excludes the pilot.

L1 is tuned to the second harmonic of the 38 kHz double sideband signal and R33, the crosstalk null control, is adjusted to cancel out the 76 kHz component remaining at the output of the stereo generator.

The pilot gain control R27 is adjusted to modulate the main carrier 10%. The pilot phase control, R24 is adjusted for best separation as read on a stereo monitor.

5.11 SUB–CARRIER GENERATOR SETTING - See Fig. 4.7

The first SCA generator adjustments consist of tuning the output filter so that there are essentially no harmonics of the sub-carrier present in the output of the SCA generator.

L6 and L8 are adjusted for maximum attenuation of the second harmonic of the SCA frequency. L7 is adjusted to minimize ripple over the sub-carrier passband.

NOTE: The passband is considered to be the sub-carrier frequency $\pm$15 kHz.

L3 is adjusted for an approximate output frequency of 900 kHz and L4 for approximately 900 kHz plus the sub-carrier frequency. The L4 frequency is generally 941 or 967 kHz. L3 or L4 is then fine tuned for the exact SCA frequency.

NOTE: The SCA frequency must be compared to a frequency standard. A non-metallic tool with narrow screwdriver type blade is necessary for this adjustment.

The output level control, R30, is set to modulate the main carrier at the required level.

The Mute Level control, R32, is adjusted to turn off the sub-carrier output if the audio input signal disappears.

NOTE: Optimum setting is 30 to 40 dB below 100% modulation of the sub-carrier.

Connect an audio signal at 400 Hz to the proper SCA input terminals of the exciter and modulate the sub-carrier 100%. Reduce the level of the audio input 30 or 40 dB and adjust R32 so the sub-carrier output disappears.

NOTE: S1, the mute delay, is adjusted to whatever muting speed is desired after the audio is removed from the input.

SECTION 6 - PARTS LIST

6.1 - CHASSIS

SYMBOL	DESCRIPTION	GATES PART NO.
B1	Fan 115 V AC 50/60 Hz	430 0037 000
F1	Fuse 4 Amp 250 V Type-AGC	398 0021 000
J1	Panel Jack, BNC UG291/U	612 0418 000
P12	Plug BNC UG88/U	610 0238 000
Y1	Crystal, NE6A (Freq. Determined by Customer)	444 000
XF1	Fuse Holder	402 0074 000
	RF Weather Strip	358 0834 000
	Shock Mount	426 0003 000

6.2 - POWER SUPPLY

SYMBOL	DESCRIPTION	GATES PART NO.
A1	Lamp 3W 120 V	396 0163 000
C1	Cap 200 uF 250 V	524 0125 000
C2	Same as C1	
C3	Cap 1000 uF 50 V	524 0104 000
C4	Same as C3	
C5	Cap 500 uF 50 V	524 0094 000
C6	Cap 470 pF 1 kV	516 0043 000
C7	Same as C6	
C8 thru C14	Cap .01 uF 50 V	516 0375 000
C15	Cap 2 uF 200 V	506 0085 000
C16	Cap .01 uF 1 kV	516 0082 000
C17	Same as C16	
CR1 thru CR4	Diode 1N2070	384 0019 000
CR5	Zener Diode 1N4061	386 0189 000
CR6 thru CR9	Diode 1N4720	384 0165 000
CR10	Zener Diode 1N3582	386 0047 000
CR11	Diode 1N914	384 0134 000
CR12	Zener Diode 1N4749A	386 0077 000
CR13	Same as CR11	
F1	Fuse 3/10A 250 V AGC	398 0012 000
F2	Fise 3A 250 V MTH	398 0020 000
F3	Fuse 2A 250 V AGC	398 0019 000

SECTION-6 - PARTS LIST - CONT'D.

6.2 - POWER SUPPLY - CONT'D.

SYMBOL	DESCRIPTION	GATES PART NO.
J1	Panel Connector	610 0419 000
Q1	Transistor 2N3054	380 0041 000
Q2	Transistor 2N4036	380 0045 000
Q3	Transistor 2N3440	380 0058 000
Q4	Transistor 2N3055	380 0043 000
Q5	Transistor 2N3054	380 0041 000
Q6	Transistor 40319	380 0044 000
Q7	Transistor 2N697	380 0098 000
R1	Res 10 ohms 1 W 5%	540 0284 000
R2	Res 30 ohms 2 W 5%	540 0574 000
R3	Res 2.2 K ohms 3 W 1%	548 0189 000
R4	Pot 1 K ohm ½ W	552 0775 000
R5	Res 17.5 K ohms 3 W 1%	548 0190 000
R6	Same as R5	
R7	Res 2 ohms 25 W	542 0438 000
R8	Res 1 K ohm 3 W 1%	548 0192 000
R9	Res 68 ohms 2 W 5%	540 0583 000
R10	Not Used in Power Supply	
R11A	Res 510 ohms	540 0042 000
R11B	Same as R11-A	
R12	Not Used in Power Supply	
R13	Not Used in Power Supply	
R14	Res 1.6 K ohms 3 W 1%	548 0197 000
R15	Same as R8	
R16 thru R18	Res 10 K ohms ¼ W 5%	540 0936 000
S1	Switch Toggle SPST, 6A, 125 V	604 0005 000
T1	Transformer Power	472 0536 000
XA1	Lamp Socket (Less Lens)	406 0367 000
XF1 thru XF3	Fuseholder	402 0013 000
XQ1	Not Used in Power Supply	
XQ2 thru XQ3	Transipad for TO-5 Case	404 0198 000
XQ4 thru XQ5	Not Used in Power Supply	
XQ6 thru XQ7	Same as XQ2	
	Heat Sink	814 3250 701
	Lens, Green	406 0378 000

6.3 - 10 W POWER AMPLIFIER

SYMBOL	DESCRIPTION	GATES PART NO.
C1 thru C3	Cap .001 uF 1 kV	516 0054 000
C4	Cap Var 3.9 to 50 pF	520 0116 000
C5	Same as C1	
C6	Same as C1	
C7	Same as C4	
C8	Not Used	
C9	Same as C1	
C10	Same as C1	
C11	Cap 3.9 uF, 35 V	526 0012 000
C12	Not Used	
C13	Cap 22 pF 500 V	500 0809 000
C14	Same as C4	
C15	Same as C4	
C16	Same as C13	
C17	Cap .01 uF, 1 kV	516 0082 000
C18	Same as C1	
C19	Cap 82 pF 500 V	500 0823 000
C20	Cap 30 pF 500 V	500 0812 000
C21	Same as C1	
C22	Cap Var 1.5 to 9.1 pF	520 0341 000
C23 thru C24	Not Used in Power Amplifier	
C25	Same as C1	
CR1	Diode 1N914	384 0134 000
FL1 thru FL2	Filter	484 0065 000

SYMBOL	DESCRIPTION	GATES PART NO.
J1	Not Used in Power Amplifier	
J2	Panel Connector	610 0419 000
J3 thru J4	Receptacle Panel Male, 50 ohms	620 0355 000
J5 thru J11	Not Used in Power Amplifier	
J12	Right Angle Receptacle	612 0403 000
L1	Inductor	814 9577 001
L2	Inductor	814 9578 001
L3	RF Choke .68 uH	494 0164 000
L4	Same as L3	
L5	Inductor	814 3244 001
L6	Same as L5	
Q1	Transistor PT3134A	380 0036 000
Q2	Transistor PT3134B	380 0037 000
Q3	Transistor PT3134C	380 0038 000
Q4 thru Q5	Transistor PT3134E (Matched Pair)	380 0039 000
	Transistor Kit PT3134 (Containing Q1 thru Q5)	380 0040 000
R1	Res 1.1 K ohms ½ W 5%	540 0050 000
R2	Res 11 K ohms ½ W 5%	540 0074 000
R3	Res 56 ohms ½ W 5%	540 0019 000
R4	Res 470 ohms ½ W 10%	540 0174 000
R5	Res 2.7 K ohms ½ W 10%	540 0183 000

6.3 - 10 W POWER AMPLIFIER - CONT'D.

SYMBOL	DESCRIPTION	GATES PART NO
R6	Res 33 ohms 1 W 5%	540 0296 000
R7	Same as R4	
R8	Res 2.2 K ohms ½ W 10%	540 0182 000
R9	Res 27 ohms ½ W 5%	540 0011 000
R10	Same as R9	
R11	Pot 100 ohms ½ W	550 0001 000
R12	Res 1 K ohm ½ W 5%	540 0049 000
R13	Res 4.7 K ohms ½ W 5%	540 0065 000
R14	Res 47 K ohms ½ W 5%	540 0089 000

SYMBOL	DESCRIPTION	GATES PART NO
T1	Transformer Bifilar	914 3246 001
T2	Transformer Bifilar	914 3247 001
XQ1 thru XQ2	Heat Sink (For TO-5 Case)	404 0196 000

PLATE LINE SUPPORT BAR (MYKROY) #837-9734-001

6.4 - AUDIO UNIT

SYMBOL	DESCRIPTION	GATES PART NO.
C1	Cap .025 uF 100 V	508 0308 000
C2 thru C4	Cap .03 uF 100 V	508 0307 000
C5	Same as C1	
C6 thru C8	Same as C2	
C9	Cap 1000 uF 16 V	522 0391 000
C10	Cap .005 uF, 1 kV	516 0074 000
CR1	Diode 1N914	384 0134 000
J1 thru J10	Not Used in Audio Unit	
J11	Panel Connector	610 0419 000

SYMBOL	DESCRIPTION	GATES PART NO
K1	Relay	572 0134 000
L1 thru L4	Inductor 2.7 to 3.3 mH	492 0328 000
R1 thru R4	Res 270 ohms ½ W 1%	548 0139 000
R5	Res 110 ohms ½ W 1%	548 0217 000
R6 thru R9	Same as R1	
R10	Same as R5	
R11	Trim Pot 500 ohms 1 W	552 0800 000

6.4 - AUDIO UNIT - CONT'D.

SYMBOL	DESCRIPTION	GATES PART NO.
R12	Res 10 K ohms ½ W 5%	540 0073 000
R13	Res 600 ohms ½ W 1%	548 0218 000
R14	Same as R13	
R15	Res 560 ohms ½ W 5%	540 0043 000
R16	Same as R15	
R17	Trim Pot 100 ohms 1 W	552 0797 000
R18	Same as R17	
R19	Res 750 ohms ½ W 5%	540 0046 000
R20	Res 300 ohms ½ W 5%	540 0036 000
S1	Switch SPDT Center Off	604 0336 000
T1 thru T2	Input Transformer (Matched Pair)	914 8783 001
XK1	Relay Socket	404 0209 000

6.5 - MODULATED OSCILLATOR

SYMBOL	DESCRIPTION	GATES PART NO.
C1	Cap 100 uF 25 V	522 0246 000
C2	Cap .001 uF 1 kV	516 0054 000
C3	Same as C2	
C4	Not Used in Modulated Oscillator	
C5	Cap 27 pF 500 V (88-98 MHz)	500 0811 000
C5	Cap 18 pF 500 V (98-108 MHz)	500 0807 000
C6	Cap 15 uF 25 V	522 0240 000
C7	Same as C2	
C8	Same as C2	
C9	Cap 2 uF 25 V	522 0233 000
C10A	Cap 47 pF	516 0459 000
C10B	Cap 47 pF 500 V (88-98 MHz)	516 0459 000
C10B	Cap 47 pF 500 V (98-108 MHz)	500 0817 000
C10C	Cap 68 pF 500 V (88-98 MHz)	500 0821 000
C11A	Same as C10A	
C11B	Cap 47 pF 500 V (88-98 MHz)	516 0459 000
C11B	Cap 47 pF 500 V (98-108 MHz)	500 0817 000
C11C	Same as C10C	
C12	Cap 18 pF 500 V	500 0807 000
C13 thru C15	Same as C2	
C16	Cap 3 pF 500 V	500 0802 000
C17	Same as C2	
C18	Cap 5 pF 500 V	500 0803 000

6.5 - MODULATED OSCILLATOR - CONT'D.

SYMBOL	DESCRIPTION	GATES PART NO.
C19	Same as C1	
C20	Same as C1	
C21	Same as C2	
C22	Cap 100 uF 25 V	522 0246 000
C23	Cap 22 pF 500 V	500 0809 000
C24	Cap 39 pF 500 V	500 0815 000
C25 thru C31	Cap 1000 pF 500 V	516 0319 000
CR1 thru CR3	Diode Varicap MV1650	528 0010 000
CR4	Diode Zener 1N4747A	386 0100 000
CR5	Diode 1N914	384 0134 000
CR6	Diode Zener 1N4744A	386 0082 000
CR7	Same as CR5	
CR8	Same as CR5	
J1	Connector, Power	610 0419 000
J2	Receptacle, Coax	620 0355 000
J3	Same as J2	
L1	Inductor 10 uH	494 0231 000
L2	Same as L1	
L3	Inductor Variable	492 0366 000
L4	Inductor .47 uH	494 0230 000
L5	Same as L1	
L6	Inductor .1 uH	494 0229 000

SYMBOL	DESCRIPTION	GATES PART NO.
Q1	Transistor 2N5109	380 0114 000
Q2	Same as Q1	
Q3	Transistor 2N3053	380 0049 000
R1	Not Used in Modulated Oscillator	
R2	Res 10 K ohms ¼ W 5%	540 0936 000
R3	Res 4.7 K ohms ¼ W 5%	540 0928 000
R4	Same as R3	
R5	Res 2.2 K ohms ¼ W 5%	540 0920 000
R6	Pot 10 K ohms ½ W	550 0009 000
R7	Res 39 K ohms ¼ W 5%	540 0950 000
R8	Res 68 K ohms ¼ W 5%	540 0956 000
R9	Res 100 K ohms ¼ W 5%	540 0960 000
R10	Res 100 ohms ¼ W 5%	540 0888 000
R11	Res 470 ohms ¼ W 5%	540 0904 000
R12	Same as R5	
R13	Res 15 ohms ¼ W 5%	540 0868 000
R14	Res 68 ohms ¼ W 5%	540 0884 000
R15	Same as R13	
R16	Res 1.5 K ohms ¼ W 5%	540 0916 000
R17	Res 270 ohms ¼ W 5%	540 0898 000
R18	Res 15 ohms ½ W 5%	540 0005 000
R19	Res 1 K ohm ¼ W 5%	540 0912 000
R20	Res 27 ohms ½ W 5%	540 0011 000

6.5 - MODULATED OSCILLATOR - CONT'D.

SYMBOL	DESCRIPTION	GATES PART NO.
R21	Same as R20	
R22	Res 39 ohms ¼ W 5%	540 0015 000
R23	Res 39 K ohms ¼ W 5%	540 0950 000
R24	Res 470 ohms ½ W 5%	540 0041 000
R25	Res 10 ohms ½ W 5%	540 0001 000
R26	Same as R2	
R27	Same as R9	
R28	Res 180 ohms ½ W 5%	540 0031 000
R29	Pot 5 K ohms 3 W	552 0818 000
R30	Res 6.8 K ohms ½ W 5%	540 0069 000
R31	Res 22 K ohms ¼ W,5%	540 0944 000
XQ1 thru XQ3	Socket, Transistor	404 0281 000

6.6 - AFC UNIT

SYMBOL	DESCRIPTION	GATES PART NO.
C1	Cap 220 pF 500 V	500 0754 000
C2 thru C6	Cap .001 uF 1 kV	516 0054 000
C7	Cap .05 uF 100 V	516 0435 000
C8	Not Used in AFC Unit	
C9	Same as C2	
C10	Not Used in AFC Unit	
C11	Cap .05 uF 100 V	516 0435 000
C12	Same as C11	
C13	Cap .22 uF 100 V	516 0475 000
C14	Same as C13	
C15	Cap 100 uF 50 V	522 0394 000
C16 thru C22	Cap .1 uF 100V	516 0453 000
C23	Cap 100 uF 25 V	522 0246 000
C24	Cap 250 uF 3 V	522 0164 000
C25	Same as C23	
C26	Same as C7	
C27	Cap Variable 2.5 to 11 pF	518 0047 000
C28	Cap 120 pF 500 V	500 0826 000
C29	Same as C2	
C30	Cap 82 pF 500 V	500 0823 000
C31	Cap .01 uF 1 kV	516 0081 000
C32	Same as C2	
C33	Cap 100 uF 12 V	522 0210 000
C34	Cap 1000 uF 10 V	522 0422 000
CR1 thru CR7	Diode 1N914	384 0318 000
CR8	Diode Zener 1N4733A	386 0135 000
CR9	Same as CR1	
CR10	Varicap MV1626	528 0017 000

6.6 - AFC UNIT - CONT'D.

SYMBOL	DESCRIPTION	GATES PART NO.
CR11	Same as CR1	
CR12	Same as CR1	
DS1	Lamp	396 0060 000
J1	Connector, Coax	620 0355 000
J2	Connector, Power	610 0419 000
K1	Relay, DPDT 26.5 V.	578 0010 000
L1 thru L3	Inductor 100 uH	494 0233 000
M1	Meter 0-50 uA DC	632 0663 000
Q1	Transistor 2N3702	380 0087 000
Q2	Transistor 2N3053	380 0049 000
Q3	Transistor 2N4037	380 0146 000
Q4	Transistor 2N3054	380 0041 000
Q5	Transistor 2N3740	380 0066 000
R1	Res 82 ohms ¼ W 5%	540 0886 000
R2	Res 100 ohms ¼ W 5%	540 0888 000
R3	Res 470 ohms ¼ W 5%	540 0904 000
R4	Res 2.2 K ohm ¼ W 5%	540 0920 000
R5	Res 10 K ohm ¼ W 5%	540 0936 000
R6	Res 1.5 K ohms ¼ W 5%	540 0916 000
R7	Same as R4	
R8	Same as R2	
R9	Same as R5	
R10	Same as R5	
R11	Res 330 K ohms ¼ W 5%	540 0972 000
R12	Same as R6	
R13	Res 1.3 K ohms ¼ W 5%	540 0915 000
R14	Res 22 K ohms ¼ W 5%	540 0944 000
R15	Not Used in AFC Unit	
R16	Res 39 K ohms ¼ W 5%	540 0950 000
R17	Res 220 K ohms ¼ W 5%	540 0968 000
R18	Res 1 K ohm ¼ W 5%	540 0912 000
R19	Same as R18	
R20	Res 4.7 K ohms ¼ W 5%	540 0928 000
R21	Same as R16	
R22	Same as R17	
R23	Same as R18	
R24	Same as R18	
R25	Same as R20	
R26	Res 47 K ohms ¼ W 5%	540 0952 000

6.6 - AFC UNIT - CONT'D.

SYMBOL	DESCRIPTION	GATES PART NO.
R27	Same as R26	
R28	Same as R14	
R29	Same as R17	
R30	Same as R5	
R31	Same as R4	
R32	Res 220 ohms ¼ W 5%	540 0896 000
R33	Same as R20	
R34	Pot 5 K ohms	550 0257 000
R35	Res 2.7 K ohms ¼ W 5%	540 0922 000
R36	Same as R26	
R37	Res 3.3 K ohms ¼ W 5%	540 0924 000
R38	Res 50 ohms 5 W	542 1143 000
R39	Res 750 ohm 1 W 5%	540 0329 000
R40	Same as R26	
R41	Res 6.8 K ohms ¼ W 5%	540 0932 000
R42	Same as R37	
R43	Same as R2	
R44	Same as R2	
R45	Same as R41	
R46	Same as R37	
R47	Same as R3	
R48	Pot 10 K ohms (Locking)	550 0007 000
R49	Res 10 K ohms ¼ W 5%	540 0936 000
R50	Res 51 ohms ¼ W 5%	540 0881 000
R51	Same as R3	
RT1	Thermistor 45TG-2	559 0002 000

SYMBOL	DESCRIPTION	GATES PART NO.
S1	Switch Toggle DPDT	604 0320 000
S2	Switch SP 5 Pos	600 0477 000
XDS1	Socket, Lamp	406 0376 000
	Lens, Red	406 0374 000
XQ1	Not Used in AFC Unit	
XQ2	Transipad for TO-5 Case	404 0198 000
XQ3	Same as XQ2	
XQ4	Socket, Transistor	404 0206 000
XQ5	Same as XQ4	
XY1	Socket, Crystal	404 0132 000
Z1	Integrated Circuit MC-1027P	382 0032 000
Z2 thru Z4	Integrated Circuit MC-1013L	382 0033 000
Z5	Integrated Circuit SN7493N	382 0034 000
Z6	Same as Z5	
Z7	Integrated Circuit MC-853P	382 0035 000
Z8	Same as Z5	
Z9	Same as Z5	
Z10	Integrated Circuit MC-848P	382 0016 000
Z11	Integrated Circuit CA-3018	382 0018 000
Z12	Same as Z11	
Z13	Differential Amp TD–101	382 0020 000
Z14	Same as Z13	

6.7 - FILTER ASSEMBLY

SYMBOL	DESCRIPTION	GATES PART NO.
C1 thru C20	Cap .001 uF 500 V	516 0319 000
C21 thru C24	Cap .025 uF 500 V ±20%	516 0393 000
TB1	Terminal Board	614 0087 000
L1 thru L6	Choke 100 uH	494 0233 000
L7 thru L10	Coil	814 4837 001
L11 thru L20	Choke 3.3 uH	494 0110 000

6.8 - ISOLATION PAD, 3 dB

SYMBOL	DESCRIPTION	GATES PART NO.
J5	Receptacle "BNC"	612 0237 000
J6	Receptacle "N"	612 0233 000
R1	Res 300 ohm 7 W	546 0229 000
R2	Res 20 ohm 5 W	546 0230 000
R3	Same as R1	

6.9 - STEREO GENERATOR

SYMBOL	DESCRIPTION	GATES PART NO.
C1	Cap 100 uF 50 V	522 0322 000
C2	Cap Var 2-27 pF	520 0342 000
C3	Cap .008 uF 600 V	508 0291 000
C4	Cap .1 uF 200 V	506 0088 000
C5	Cap 100 pF 500 V	500 0877 000
C6	Same as C4	
C7	Cap 5 uF 50 V	522 0251 000
C8	Same as C4	
C9	Cap 2000 pF 500 V	500 0845 000
C10 thru C13	Same as C4	
C14	Cap 2500 pF 500 V	500 0879 000
C15	Not Used in Stereo Generator	
C16	Cap 15 uF 25 V	522 0240 000
C17 thru C20	Cap 1000 uF 6 V	526 0058 000
C21	Cap 20 uF 50 V	522 0256 000
C22	Cap 250 uF 15 V	522 0336 000
C23	Same as C16	
C24	Cap 50 uF 25 V	522 0244 000
C25	Cap 35 uF 25 V	522 0243 000
C26	Not Used in Stereo Generator	
C27	Cap 1 uF 200 V	506 0087 000
C28	Cap .01 uF 200 V	506 0001 000
C29	Cap 470 pF 300 V	500 0835 000
C30	Same as C29	
C31	Cap 1000 uF 25 V	522 0306 000
C32	Cap 1000 pF 1 kV	516 0054 000
C33 thru C34	Not Used in Stereo Generator	
C35	Same as C16	
C36	Same as C16	
C37	Same as C1	
C38	Same as C4	
C39 thru C41	Same as C16	
C42	Same as C24	
C43	Same as C24	
C44	Same as C16	
C45	Cap 1000 uF 16 V	522 0391 000
C46	Cap 470 pF 300 V	500 0835 000
C47	Cap .1 uF 200 V	506 0088 000
C48	Cap .50 pF 500 V	500 0818 000
CR1 thru CR4	Diode Quad Assy	915 0064 001
J7	Panel Connector	610 0419 000
L1	Adjustable RF Coil 1.3 - 3 mH	492 0331 000
L2	Not Used in Stereo Generator	
L3	RF Choke 300 uH	494 0153 000
L4	Adjustable RF Coil .65 - 1.3 mH	492 0332 000

6.9 - STEREO GENERATOR - CONT'D.

SYMBOL	DESCRIPTION	GATES PART NO.
L5	Same as L1	
L6	Same as L3	
Q1	Transistor, FET	380 0060 000
Q2 thru Q16	Transistor 2N697	380 0098 000
R1	Res 5.1 Megohms ¼ W 5%	540 1001 000
R2	Res 10 K ohms ¼ W 5%	540 0936 000
R3	Res 15 K ohms ¼ W 5%	540 0940 000
R4	Res 470 K ohms ¼ W 5%	540 0976 000
R5	Res 390 ohms ¼ W 5%	540 0902 000
R6	Res 620 ohms ¼ W 5%	540 0907 000
R7	Res 8.2 K ohms ¼ W 5%	540 0934 000
R8	Res 100 K ohms ¼ W 5%	540 0960 000
R9	Res 1 K ohm ¼ W 5%	540 0912 000
R10	Same as R2	
R11	Same as R2	
R12	Res 2.2 K ohms ¼ W 5%	540 0920 000
R13	Same as R8	
R14	Res 100 ohms ¼ W 5%	540 0888 000
R15	Same as R14	
R16	Res 4.7 K ohms ¼ W 5%	540 0928 000
R17	Res 2.4 K ohms ½ W 1%	548 0211 000
R18	Res 150 K ohms ¼ W 5%	540 0964 000
R19	Res 51 K ohms ¼ W 5%	540 0953 000
R20	Pot 10 K ohms 1 W	552 0795 000
R21	Same as R8	
R22	Res 2 K ohms ¼ W 5%	540 0919 000
R23	Res 510 ohms ¼ W 5%	540 0905 000
R24	Pot 50 K ohms ½ W	550 0009 000
R25	Same as R8	
R26	Res 3.3 K ohms ¼ W 5%	540 0924 000
R27	Pot 5 K ohms ½ W	550 0006 000
R28	Same as R8	
R29	Same as R22	
R30	Same as R4	
R31	Same as R8	
R32	Res 22 K ohms ¼ W 5%	540 0944 000
R33	Pot 5 K ohms 1 W	552 0796 000
R34	Same as R8	
R35	Same as R22	
R36	Res 200 ohms ¼ W 5%	540 0895 000
R37	Pot 100 ohms 1 W	552 0797 000
R38	Same as R36	
R39	Res 5.1 K ohms ¼ W 5%	540 0929 000
R40	Res 9.1 K ohms ¼ W 5%	540 0935 000

6.9 - STEREO GENERATOR - CONT'D.

SYMBOL	DESCRIPTION	GATES PART NO.
R41 thru R44	Res 4.75 K ohms ½ W 1%	548 0199 000
R45	Not Used in Stereo Generator	
R46	Res 10 ohms ¼ W 5%	540 0864 000
R47	Same as R46	
R48	Same as R37	
R49	Same as R9	
R50	Same as R4	
R51	Same as R22	
R52	Same as R23	
R53	Same as R27	
R54	Same as R8	
R55	Res 1.5 K ohms ¼ W 5%	540 0916 000
R56	Res 240 ohms ¼ W 5%	540 0897 000
R57	Same as R22	
R58	Same as R3	
R59	Res 120 K ohms ¼ W 5%	540 0962 000
R60	Same as R23	
R61	Same as R2	
R62	Same as R23	
R63	Res Assembly	915 3312 001
R64	Same as R8	
R65	Pot Trim 1 K ohm 1 W	552 0802 000
R66	Same as R9	
R67	Same as R4	
R68	Pot 1 K ohm ½ W	550 0004 000
R69	Same as R9	
R70	Same as R4	
R71	Same as R9	
R72	Same as R2	
R73	Same as R4	
R74	Same as R59	
R75	Same as R12	
R76	Same as R4	
R77	Same as R12	
R78	Res 10 Megohms ¼ W 5%	540 1008 000
R79	Res 500 ohms 1 W	552 0800 000
R80	Res 1200 ohms ¼ W 5%	540 0914 000
R81	Res 10 K ohms ¼ W 5%	540 0936 000
R82 thru R85	Res 100 ohms ½ W 1%	548 0049 000
R86	Same as R19	
R87	Same as R19	
R88	Res 100 ohms ½ W 5%	540 0025 000
RT1	Thermistor 1 K ohm	559 0006 000
S1	Switch Subminiature Toggle, SPDT	604 0366 000
T1	Transformer 19 kHz	478 0269 000
T2	Transformer 38 kHz	478 0270 000
T3	Transformer	478 0026 000
T4	Transformer	478 0220 000

6.9 - STEREO GENERATOR - CONT'D.

SYMBOL	DESCRIPTION	GATES PART NO.
TJ1	Test Point Jack White	612 0312 000
TJ2	Test Point Jack Black	612 0311 000
TJ3	Same as TJ1	
XQ1	Transipad	404 0197 000
XQ2 thru XQ16	Transipad	404 0198 000
XY1	Crystal Socket	404 0132 000
Y1	Crystal 19 kHz	444 1129 000

SECTION 6 - PARTS LIST - CONT'D.

6.10 - SCA GENERATOR

SYMBOL	DESCRIPTION	GATES PART NO.
C1	Cap .15 uF Mylar 100 V	508 0286 000
C2	Same as C1	
C3 thru C5	Cap 100 pF 100 V	500 0844 000
C6	Cap 220 pF 500 V	500 0873 000
C7	Cap 62 pF 500 V 5%	500 0820 000
C8	Same as C3	
C9	Same as C6	
C10	Same as C7	
C11	Cap 100 pF 500 V	500 0759 000
C12	Same as C11	
C13	Cap 1500 pF 500 V	500 0878 000
C14	Same as C13	
C15	Cap .1 uF Mylar 100 V	508 0278 000
C16	Cap 15 uF 25 V	522 0240 000
C17	Cap .01 uF Mylar 100 V	508 0298 000
C18	Same as C17	
C19	Cap 250 pF 500 V	500 0831 000
C20	Cap 330 pF 100 V	500 0874 000
C21	Same as C20	
C22	Same as C19	
C23	Cap .01 uF Mylar 100 V	508 0298 000
C24	Cap 25 uF 6 V	522 0178 000
C25	Same as C24	
C26	Cap 100 uF 12 V	522 0210 000
C27	Same as C16	
C28	Cap 2 uF 25 V	522 0233 000
C29	Same as C16	
C30	Cap 25 uF 25 V	522 0242 000
C31	Cap 50 uF 25 V	522 0244 000
C32	Same as C31	
C33	Cap 20 uF 50 V	522 0256 000
CR1	Diode 1N270	384 0128 000
CR2	Same as CR1	
CR3	Rectifier 1N2069	384 0018 000
CR4	Same as CR3	
J5	Receptacle	610 0419 000
L1	Choke 4.7 mH	494 0175 000
L2	Same as L1	
L3	Choke Adjustable .28 - .65 mH	492 0321 000
L4	Same as L3	
L5	Choke 2.2 mH	494 0165 000
L6	Coil Adjustable 8 - 20 mH	492 0322 000
L7	Coil Adjustable 15 - 40 mH	492 0323 000
L8	Same as L6	
Q1 thru Q6	Transistor 2N697	380 0098 000
Q7	Transistor 2N1539	380 0016 000

SECTION 6 - PARTS LIST - CONT'D.

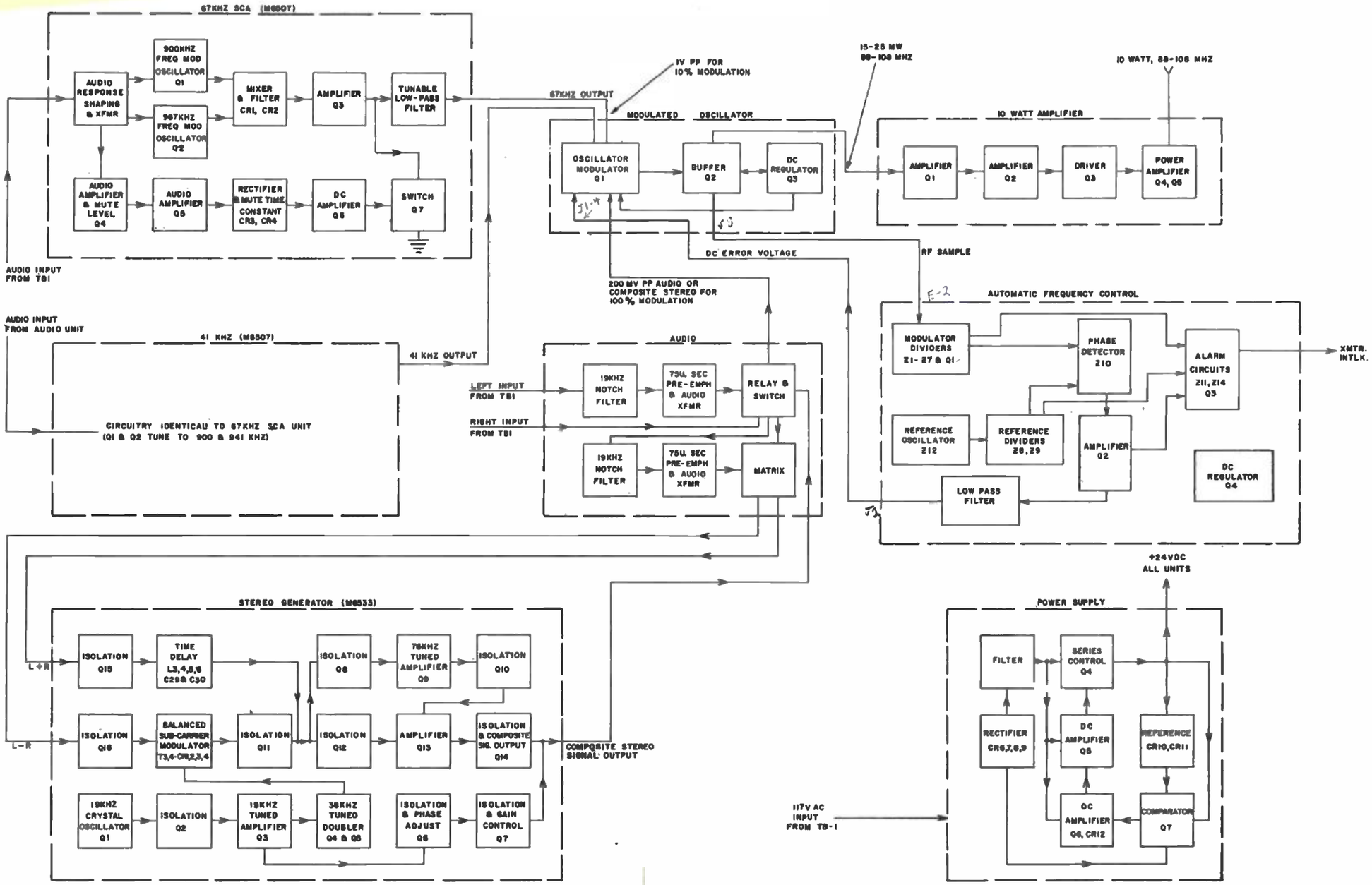
SCA GENERATOR - CONT'D.

SYMBOL	DESCRIPTION	GATES PART NO.
R1	Res 1.8 K ohms ½ W 5%	540 0055 000
R2	Res 1.5 K ohms ½ W 5%	540 0053 000
R3	Res 270 ohms ½ W 5%	540 0035 000
R4	Same as R3	
R5 thru R8	Res 47 ohms ½ W 5%	540 0017 000
R9	Res 62 K ohms ½ W 5%	540 0092 000
R10	Res 51 K ohms ½ W 5%	540 0090 000
R11	Res 100 K ohms ½ W 5%	540 0097 000
R12	Res 82 K ohms ½ W 5%	540 0095 000
R13	Res 4.7 K ohms ½ W 5%	540 0065 000
R14	Res 10 K ohms ½ W 5%	540 0073 000
R15	Res 1 K ohm ½ W 5%	540 0049 000
R16	Res 100 ohms ½ W 5%	540 0025 000
R17	Same as R10	
R18	Same as R11	
R19	Same as R12	
R20	Same as R13	
R21	Same as R14	
R22	Same as R15	
R23	Same as R16	
R24	Same as R14	
R25	Same as R14	
R26	Res 33 K ohms ½ W 5%	540 0085 000
R27	Same as R26	
R28	Res 2 K ohms ½ W 5%	540 0056 000
R29	Same as R28	
R30	Pot Min 10 K ohm ½ W Linear Taper	550 0007 000
R31	Res 6.8 K ohms ½ W 5%	540 0069 000
R32	Same as R30	
R33	Res 120 K ohms ½ W 5%	540 0099 000
R34	Res 5.1 K ohms ½ W 5%	540 0066 000
R35	Same as R28	
R36	Res 1.1 K ohms ½ W 5%	540 0050 000
R37	Res 680 ohms ½ W 5%	540 0045 000
R38	Res 510 ohms	540 0042 000
R39	Res 16 K ohms ½ W 5%	540 0078 000
R40	Same as R12	
R41	Same as R26	
R42	Res 12 K ohms ½ W 5%	540 0075 000
R43	Same as R28	
R44	Res 3.3 K ohms ½ W 5%	540 0061 000
R45	Same as R14	
S1	Switch 4 Pos. Modified	600 0421 000

SCA GENERATOR - CONT'D.

SYMBOL	DESCRIPTION	GATES PART NO.
T1	Transformer Input	478 0145 000
TJ1	Test Point Jack White	612 0312 000
TJ2	Test Point Jack Black	612 0311 000
XQ1	Transistor Socket	404 0066 000
XQ2	Same as XQ1	
XQ3 thru XQ6	Transipad for TO-5 Case	404 0198 000

SECTION 7 - DRAWINGS



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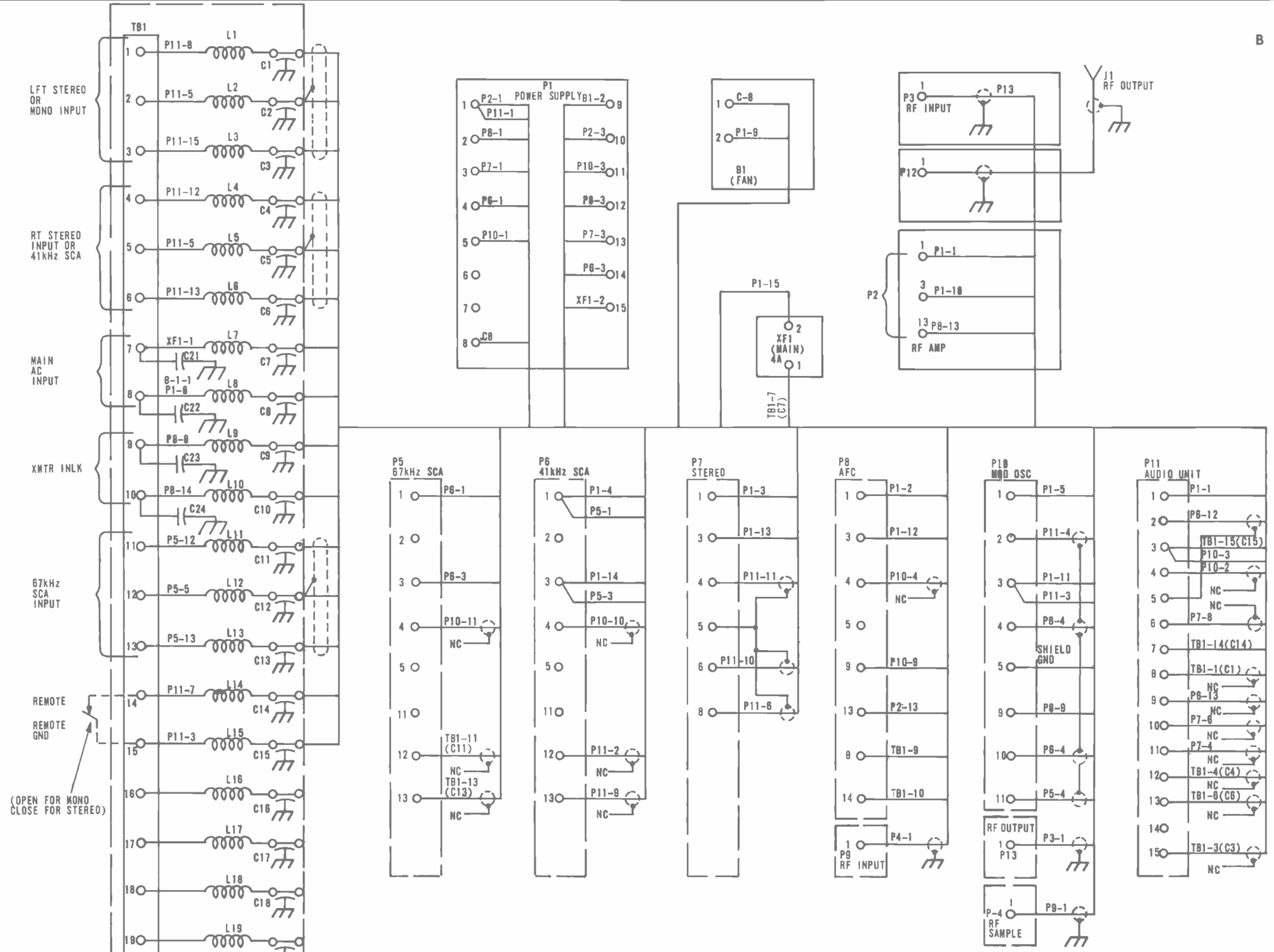
BLOCK DIAGRAM
FIG. 7.1
842 5878 001



838 4199 001

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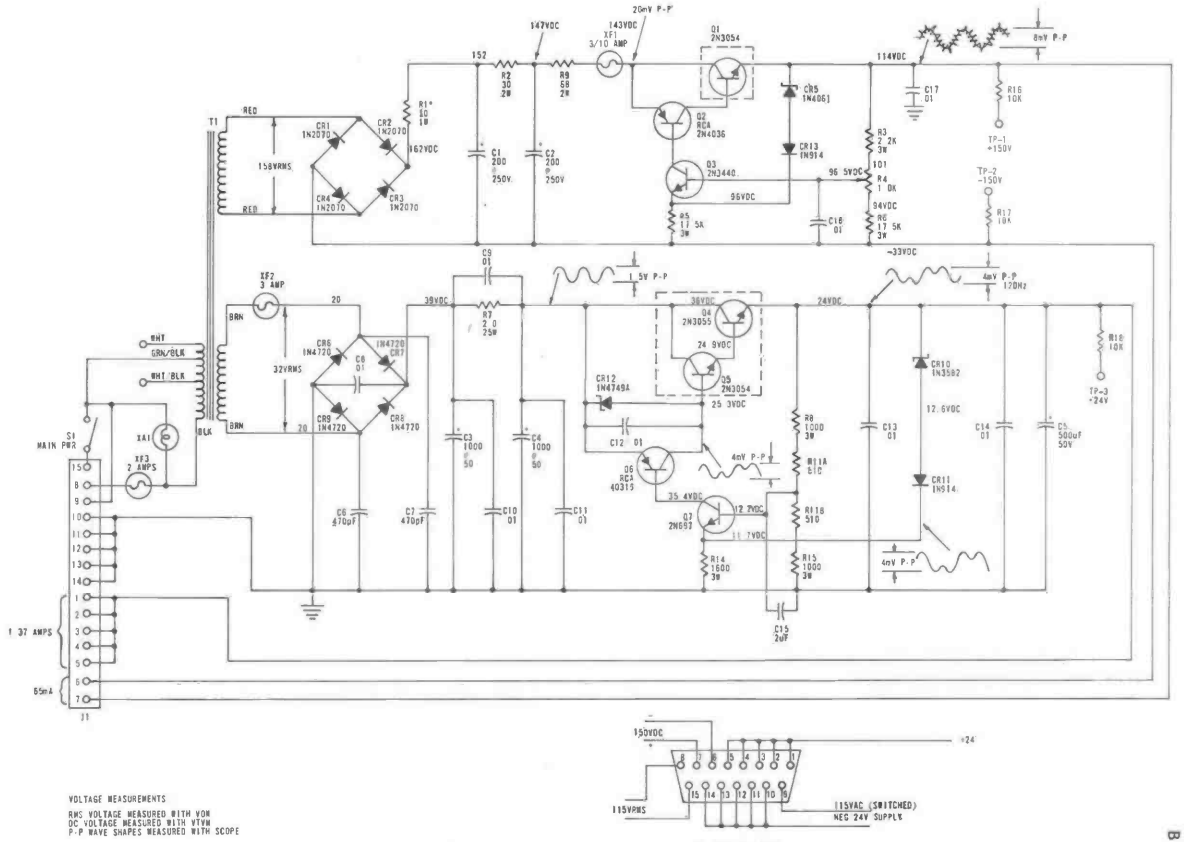
INTERCONNECTING DIAGRAM
FIG. 7.2

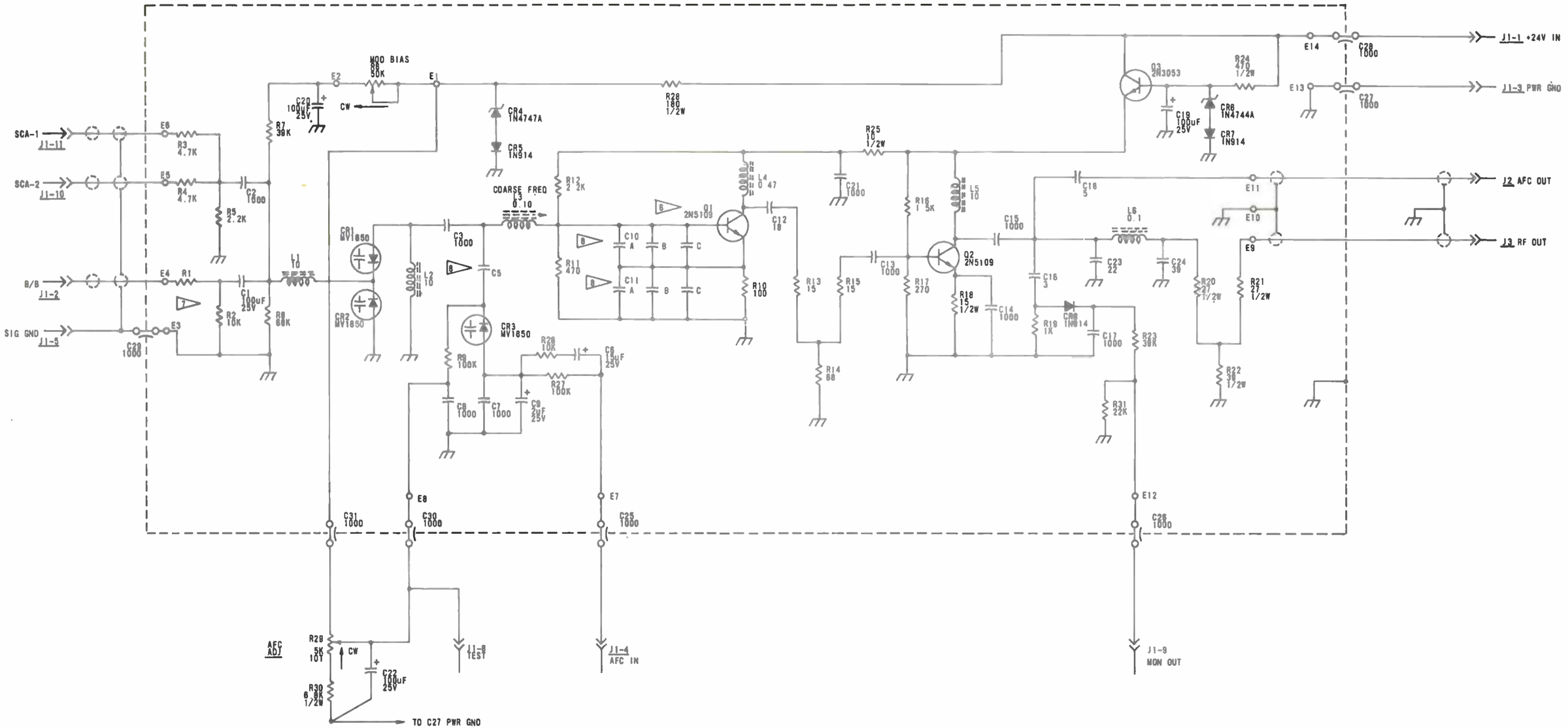


VOLTAGE MEASUREMENTS

RMS VOLTAGE MEASURED WITH VOM
DC VOLTAGE MEASURED WITH VTVM
P-P WAVE SHAPES MEASURED WITH SCOPE

* = SUBJECT TO VARIATION

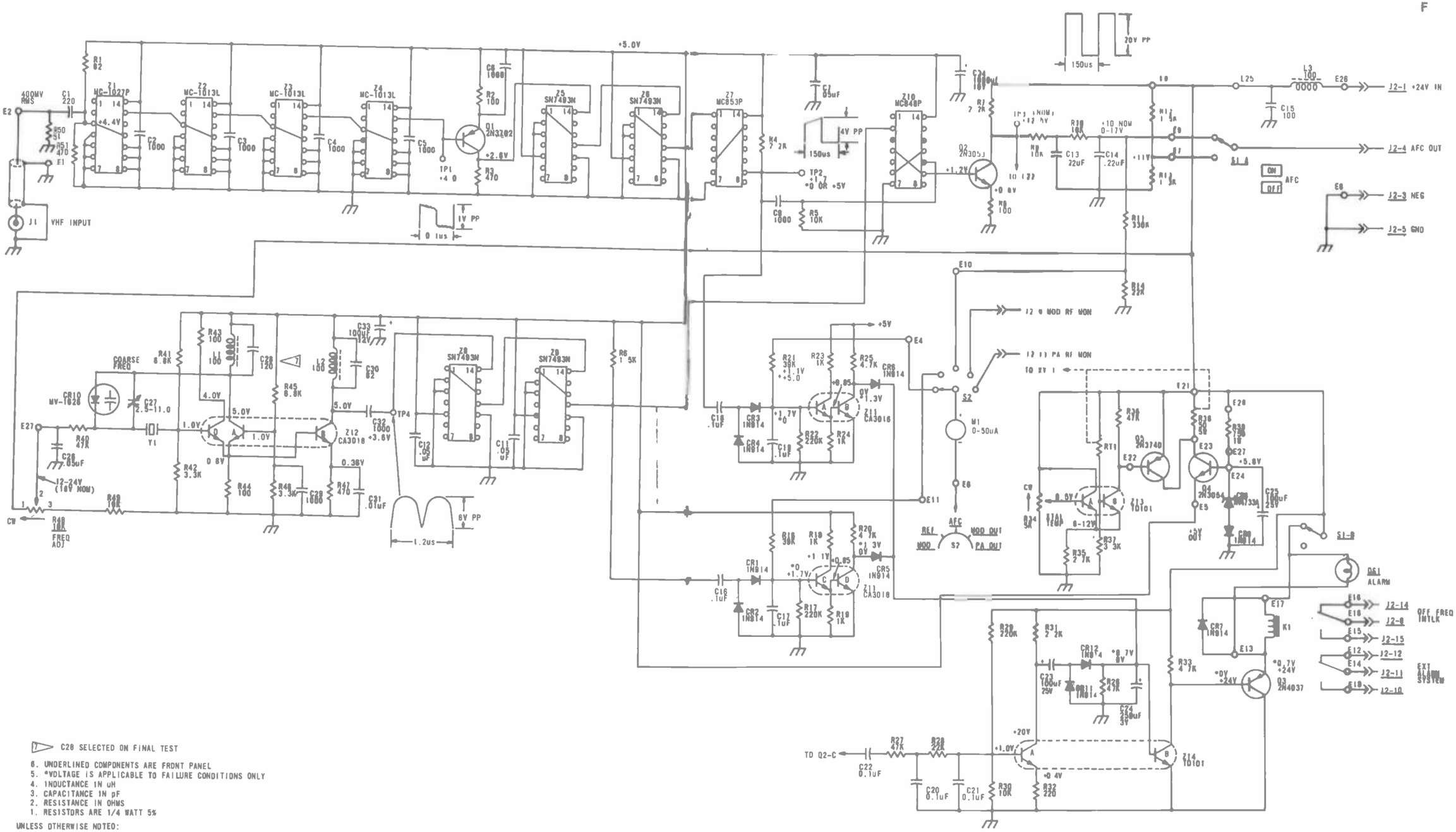
POWER SUPPLY
FIG. 7.3
838 1955 001



FREQ RANGE	C10 A	B	C	C11 A	B	C	C5
88–100 MHz	47 N750	47 N750	68 5%	47 N750	47 N750	68 5%	27pF 5%
98–108 MHz	47 N750	47 5%	NOT USED	47 N750	47 5%	NOT USED	18pF 5%

1. SEE CHART
2. R1 IS NOT USED IN STO MODEL TE-3 EXCITER
3. Q1 MAY BE SELECTED FOR MINIMUM NOISE AND/OR DISTORTION

UNLESS OTHERWISE NOTED:
5. UNDERLINED COMPONENTS ON FRONT PANEL
4. INDUCTANCE IN uH
3. CAPACITANCE IN pF
2. RESISTANCE IN OHMS
1. RESISTORS ARE 1/4 WATT 5%



▽ C28 SELECTED ON FINAL TEST

6. UNDERLINED COMPONENTS ARE FRONT PANEL
5. *VOLTAGE IS APPLICABLE TO FAILURE CONDITIONS ONLY
4. INDUCTANCE IN uH
3. CAPACITANCE IN pF
2. RESISTANCE IN OHMS
1. RESISTORS ARE 1/4 WATT 5%

UNLESS OTHERWISE NOTED:

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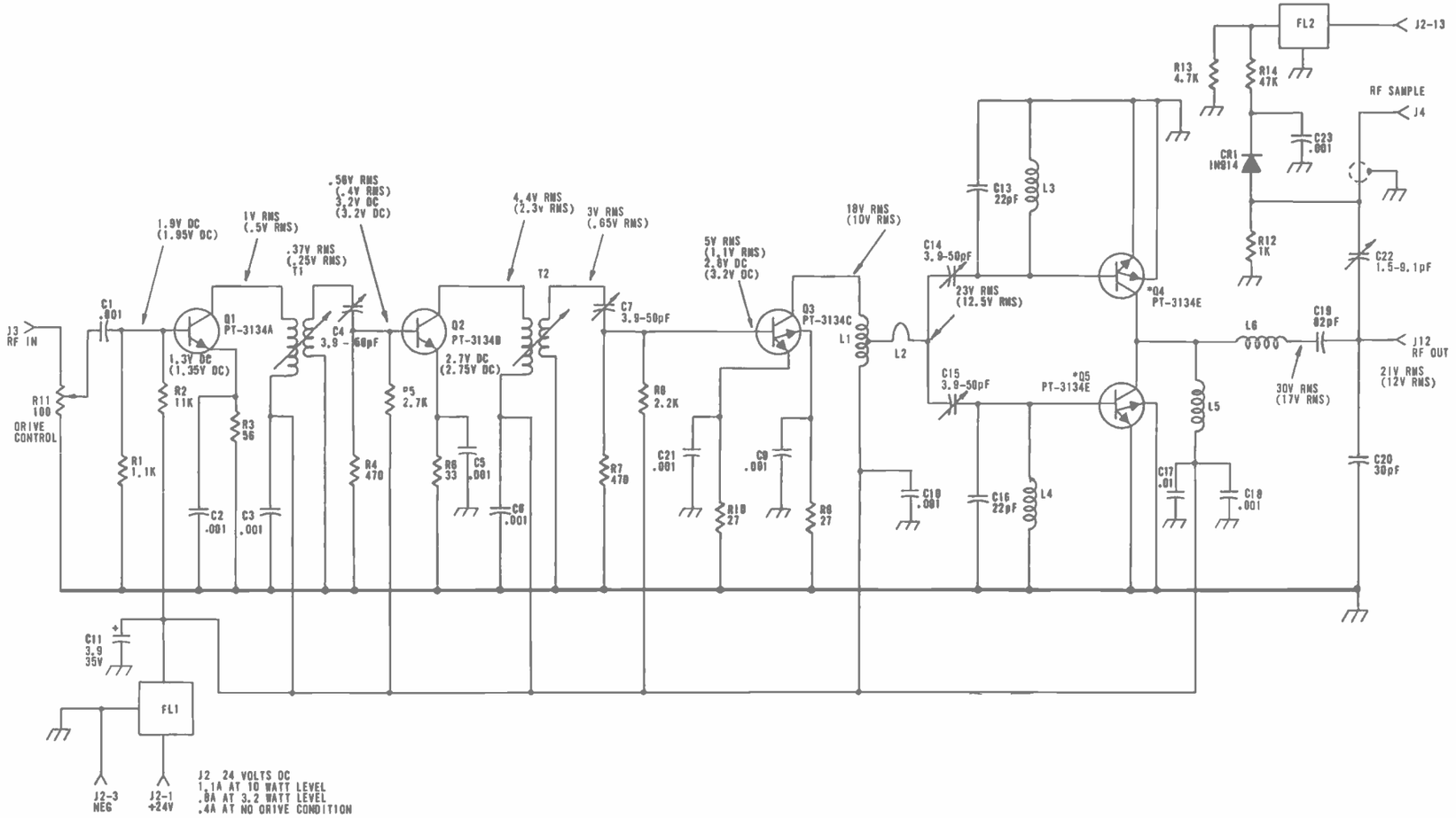
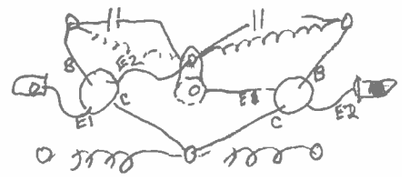
AUTOMATIC FREQ. CONTROL
FIG. 7.5 842 5828 001



NOTE:

ALL CAPACITORS IN uF UNLESS OTHERWISE STATED
VOLTAGE MEASUREMENTS WITH HP-410B VTVM USING
RF PROBE FOR RMS VALUES
VOLTAGES IN (---) ARE AT 3W OUTPUT LEVEL
OTHERWISE 10W OUT
*Q4 & Q5 ARE A MATCHED PAIR



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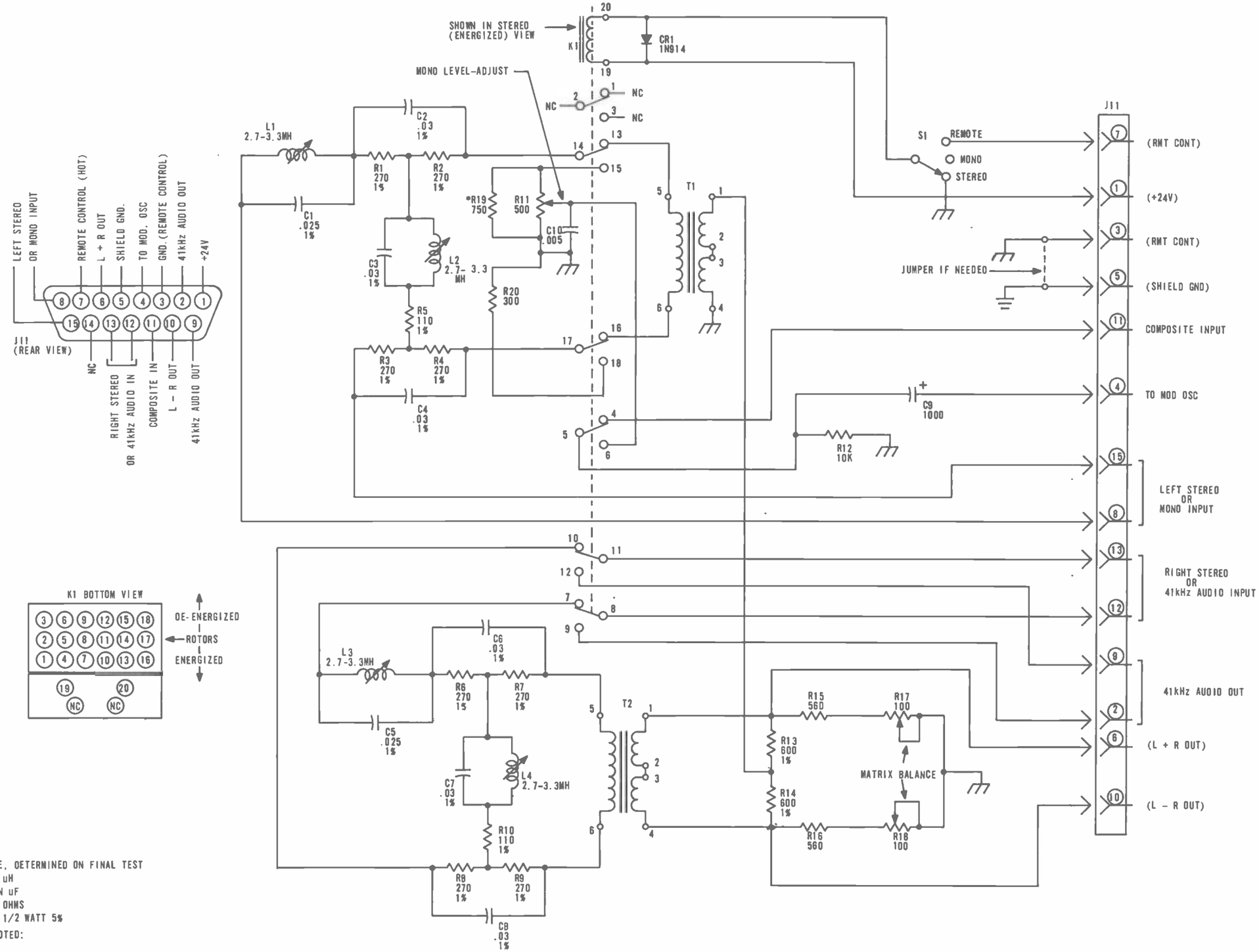
10W AMPLIFIER
FIG. 7.6
838 4204 001



5. *NOMINAL VALUE, DETERMINED ON FINAL TEST
4. INDUCTANCE IN uH
3. CAPACITANCE IN uF
2. RESISTANCE IN OHMS
1. RESISTORS ARE 1/2 WATT 5%

UNLESS OTHERWISE NOTED:

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AUDIO UNIT
FIG. 7.7
838 2575 001

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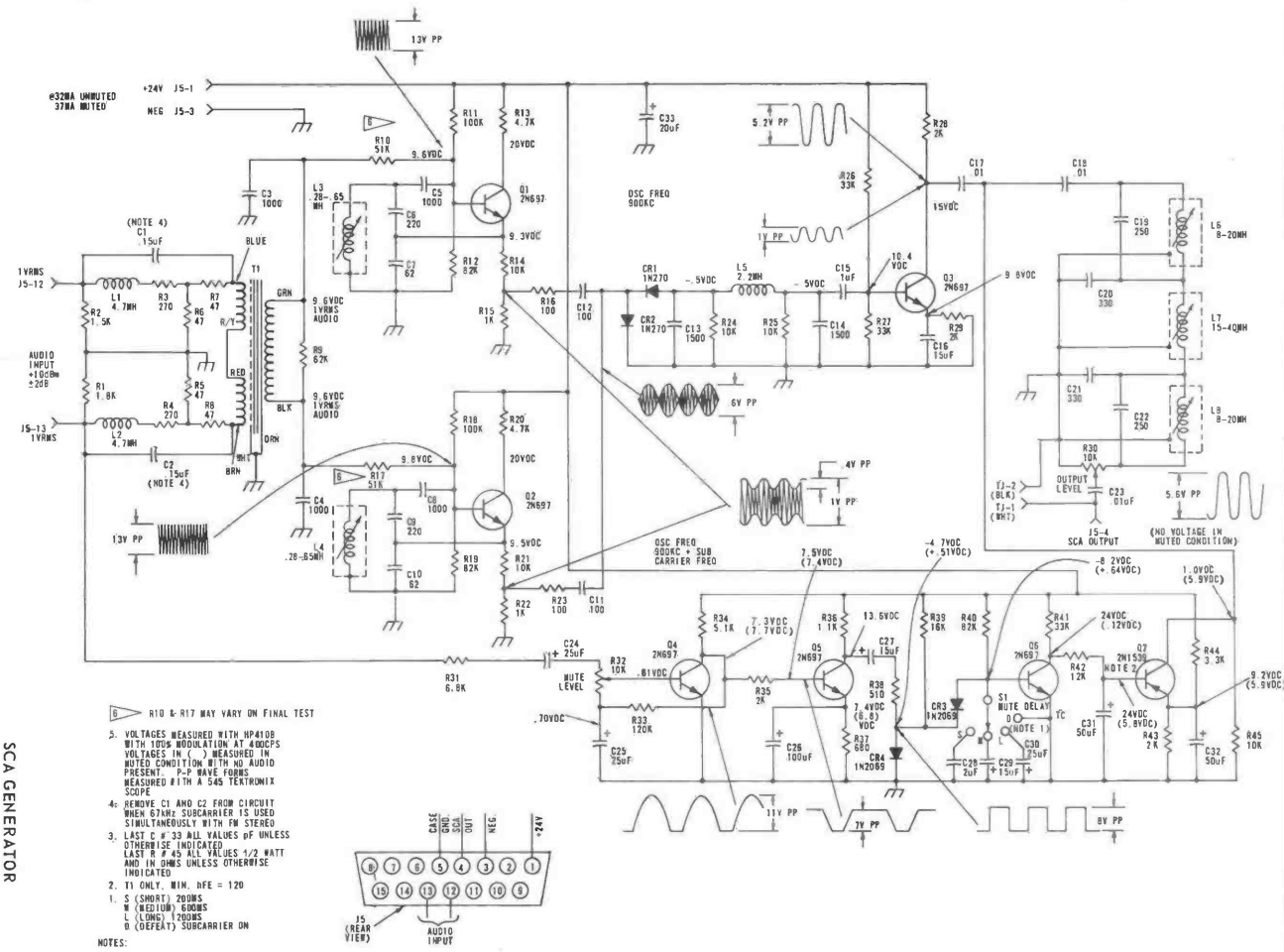
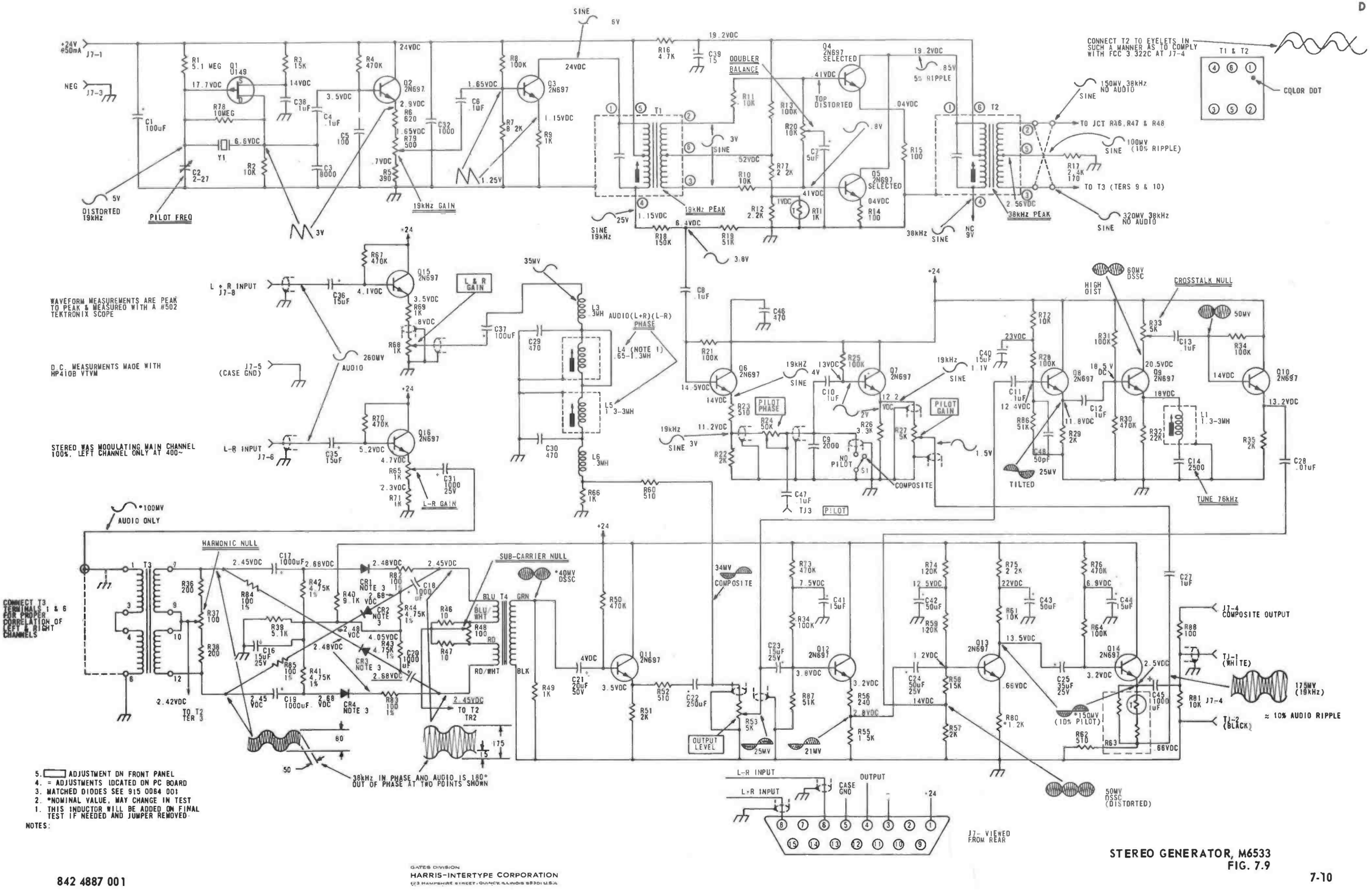


SCA GENERATOR
FIG. 7.8



NOTES:

5. ▭ ADJUSTMENT ON FRONT PANEL
4. = ADJUSTMENTS LOCATED ON PC BOARD
3. MATCHED DIODES SEE 915 0064 001
2. *NOMINAL VALUE, MAY CHANGE IN TEST
1. THIS INDUCTOR WILL BE ADDED ON FINAL TEST IF NEEDED AND JUMPER REMOVED

842 4887 001

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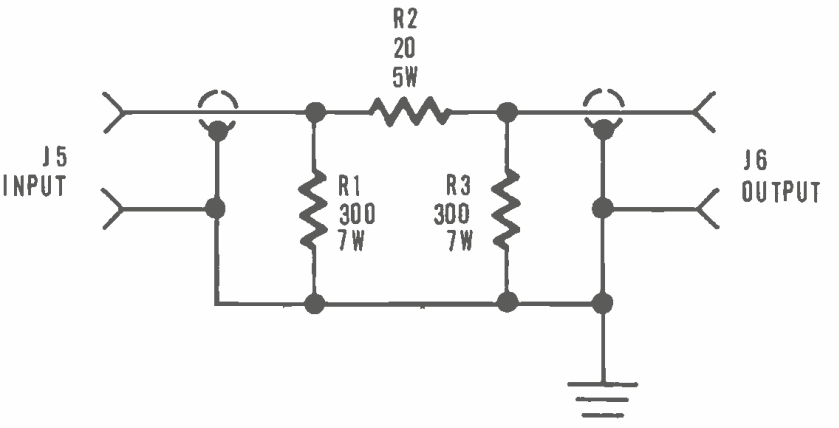
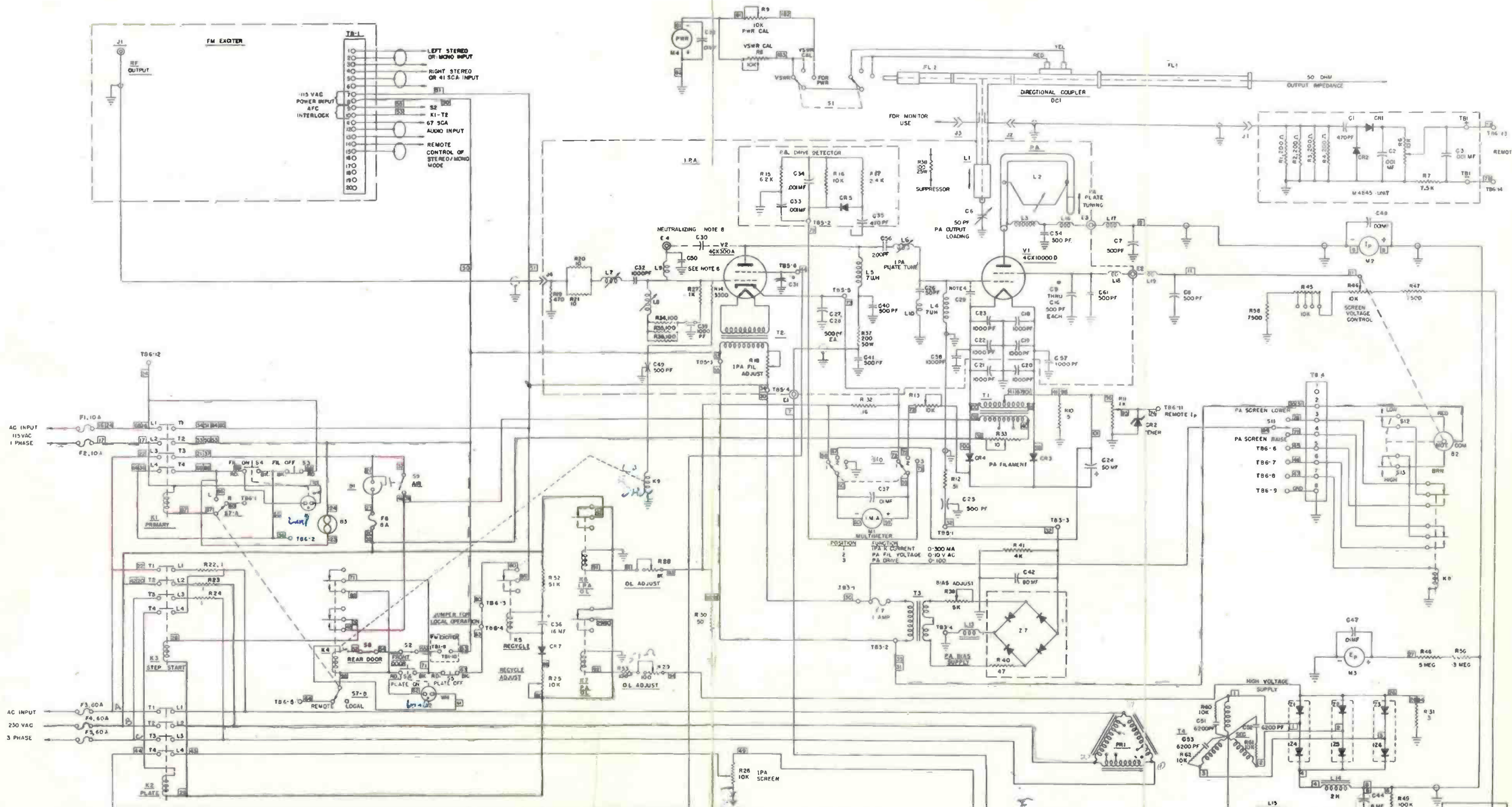
STEREO GENERATOR, M6533
FIG. 7.9





1. * C9 THRU C16 AND C31 LOCATED IN TUBE SOCKET
2. THE ABOVE INDICATES A WIRE NUMBER
   TB 501-8
3. THE ABOVE INDICATES A TERMINAL BOARD NUMBER
4. RESISTANCE VALUES ARE IN OHMS
5. ALL RELAYS AND SWITCHES SHOWN IN NORMAL READY TO START POSITION.
6. DETERMINED BY FREQUENCY
7. T3 HAS UNUSED WINDINGS
8. C30 FORMED BY STRAY CAPACITY FROM V2 ANODE TO STUD OF E4

TERMINAL BOARD	LOCATION
TB-1	REMOTE R.F. RECTIFIER (M4845)
TB-2	NOT USED
TB-3	PA BIAS SUPPLY
TB-4	PA SCREEN CONTROL
TB-5	PA ENCLOSURE
TB-6	REMOTE CONTROL (BASE)
TB-1	EXCITER

Note: Refer to Modified Transmitter Wiring - AC restart Circuit. This partial schematic shows changes to This diagram. Added is K601 mechanical latch relay and K602 overload auxiliary relay and S601 AC restart switch. This diagram is essentially correct when S601 is in the off position. With S601 off, K601 is energized off and the hold contacts on relay K4 are wired as in This original diagram.

Remote PaPu off
Remove Jumper
TB6-(63-86) 3-4 (Re Relay Goes in Place)
Connect to TB6-4 and Bottom of K4 - (98).

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