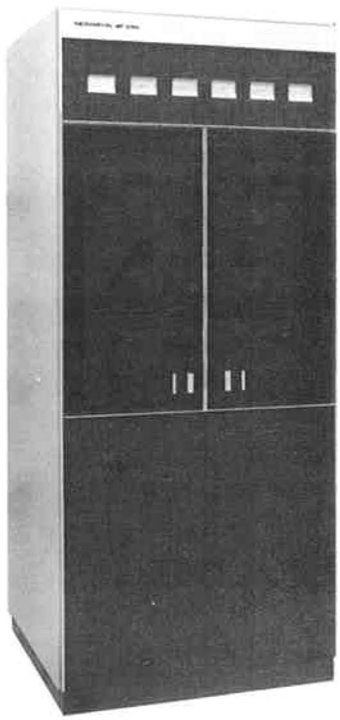
McMartin



McMartin®

BF-3.5K

3500 Watt FM TRANSMITTER

INSTRUCTION MANUAL

I. TECHNICAL SPECIFICATIONS

OPERATING RANGE .... 88 to 108 MegaHertz

RF POWER OUTPUT .... 3,500 watts maximum

RF OUTPUT IMPEDANCE ..... 50 ohms (termination EIA 1-5/8" flange)

CENTER FREQUENCY STABILITY ...... ±500 Hz

MODULATION CAPABILITY .... ±150 Hz

AUDIO INPUT IMPEDANCE ..... 600 ohms, balanced

AUDIO INPUT LEVEL .... +10, ±2, dBm

AUDIO FREQUENCY RESPONSE .... ±0.75 dB, 30-15000 Hz (Std. FCC 75 usec preemphasis)

IM DISTORTION 0.2% or less 60Hz/7kHz, 4:1 ratio

TOTAL HARMONIC DISTORTION ..... 0.3% or less, 30-15000 Hz, 100% modulation

FM NOISE .... 65 dB below 100% modulation (400 Hz)

AM NOISE .... 55 dB below carrier level

POWER REQUIREMENTS .. 208/230/240 Vac, 50/60 Hz, single phase, or 208/230/240 Vac, 3-phase

POWER CONSUMPTION (Approx.) ....
2000 watt output, ~~4500~~ watts 4400
2500 watt output, ~~5400~~ watts 5200
3000 watt output, ~~6200~~ watts 5900
3500 watt output, ~~7100~~ watts 6500

OPERATING TEMPERATURE .. 0° to 50° Celsius

ALTITUDE .... 7,500 feet above mean sea level

MECHANICAL .... 34.5"W 78.5"H 31"D (87.6 X 199 X 78.7 cm) Rear Door Swing 30" (76.2 cm)

WEIGHT .... 1,030 pounds

FINISH .... McMartin beige w/woodgrain trim

STEREO OPERATION (with B-110 Stereo Assembly)

AUDIO INPUT IMPEDANCE .... 600 ohms balanced, each channel

AUDIO INPUT LEVEL .... +10, ±2, dBm

AUDIO FREQUENCY RESPONSE .... ±0.75 dB, 30-15000 Hz, Std. FCC 75 usec, preemphasis each channel

TOTAL HARMONIC DISTORTION ..... 0.5% or less, 30-15000 Hz

STEREO SEPARATION .... 35 dB or greater, 50-15000 Hz

FM NOISE .... 60 dB or greater below 100% modulation

PILOT STABILITY ...... ±1.0 Hertz over rated temperature range

SUBCARRIER SUPPRESSION .... 55 dB or greater

CROSSTALK (L+R to L-R, L-R to L+R) ...... 42 dB or greater below 90% modulation

SCA OPERATION (with B-113 SCA Generator Module)

AUDIO INPUT IMPEDANCE ..... 600 ohms, balanced

AUDIO INPUT LEVEL .... +10, ±2, dBm

CARRIER FREQUENCY ..... 41 or 67 kHz standard (others available on request)

CARRIER STABILITY .... ±500 Hz

MODULATION CAPABILITY ..... ± 7.5 kHz

PREEMPHASIS ... 150 usec standard, 50 or 75 usec available on request

FREQUENCY RESPONSE ...... ±1.5 dB, 50-5000 Hz

CROSSTALK (main to sub, sub to main) ...... 60 dB or lower

DISTORTION (50-5000 Hz) ...... 0.75% or less with LP output filter, 2.5% or less with BP output filter

S/N NOISE .... 60 dB or greater

II. GENERAL DESCRIPTION

The McMartin BF-3.5K transmitter is designed for FM broadcast service, operating on a specific frequency in the range of 88.0 to 108.0 MegaHertz.

The BF-3.5K utilizes the Model B-910 solid-state FM exciter. Full technical details pertaining to the B-910 operation are contained in Appendix A of this manual.

The RF output of the exciter is used to drive an intermediate power amplifier (IPA) stage which employs parallel-connected type 4CX250B radial beam power tetrode tubes. This stage in turn provides RF excitation to a single type 3CX3000/A7 high-mu, zero-bias triode tube in the power amplifier (PA) stage. The PA stage operates as a Class C amplifier, in a grounded-grid configuration. A low-pass RF filter mounted within the cabinet enclosure attenuates harmonically-related frequencies at the transmitter output termination.

A single high-voltage power supply provides plate voltage for the PA and IPA stages. A separate power supply provides IPA screen voltage which is adjustable by means of a motor-driven power output control from the front panel. Independent transformers provide filament voltages to the PA and IPA tubes, with a front panel FILAMENT ADJUST control.

Inasmuch as the PA tube is a high-mu power triode specifically designed for zero grid bias, its operation in a grounded-grid mode eliminates the need for screen grid and grid bias power supplies. This permits great simplification of circuitry.

Interlocked control logic permits straightforward push-button control of all start-stop functions. These, plus telemetering samples are terminated for interconnection to remote control systems.

Automatic recycling and a memory-type LED status indicator assembly senses and indicates the cause of carrier interruptions, specifically in the event of exciter RF output, IPA or PA failure, high voltage overload or or excessive VSWR. The automatic recycling sequence consists of two pulses spaced approximately one-second apart, followed by an adjustable time interval from 3 to 20 seconds after which the two pulses are repeated. If the fault still persists, the recycling sequence is terminated. An "overcount", as well as the source of the fault is shown on the indicator panel LED. If anywhere in the recycling sequence, the transmitter is restored to normal operation, the LED indicator associated with the fault remains on until the manual RESET switch is depressed.

Adequate cooling is provided by maintenance of positive cabinet pressure. The airflow routing is through the shielded IPA compartment and upward through the PA shielded enclosure. The airflow is provided by means of a rugged, permanently-lubricated, centrifugal blower, shock-mounted on the base of the transmitter cabinet. Its outlet is ducted to the bottom of the IPA enclosure. Supplemental cooling for power supply components is provided by a small exhaust fan located in the top of the cabinet. Air entering the transmitter is filtered by dual, maintainable filters mounted on the rear door of the cabinet.

The rear door opening is protected with dual mechanical interlock switches, one of which defeats the high-voltage control circuitry. The other shorts the high-voltage plate power supply to ground. An insulated "grounding stick", located just inside the cabinet at the door opening is also provided.

III. INSTALLATION

3.1 PLANNING

It is recommended that the manual be studied in its entirety prior to final installation of the BF-3.5K. A full understanding of the controls, circuitry and input and output terminations will assist in the preplanning stage.

Figure 1 is an outline dimensional drawing of the transmitter. Provide adequate clearances for access to the transmitter through the rear. Preplan the location of the entrances for power, audio/remote control cable harnessing, external monitoring coaxial cable feed and the RF output connection to the coaxial transmission line. The BF-3.5K output termination is by means of an EIA 1-5/8" flange. This flange with a short section of 1-5/8" rigid line mates with an ungassed field coupling clamped to the output of the harmonic filter. These coaxial line components are packed separately and should be assembled to ascertain the precise physical location of the output termination.

Although cable entrances may be made through either the top or bottom of the cabinet, the preferred arrangement for ease of installation is through the bottom entrances to the cabinet for all interconnections except the output coaxial transmission line.

3.2 UNPACKING

Inspect the unit for damage which might be incurred during shipment. Particularly note condition of knobs, meters and ceramic insulators. Inspect painted surfaces for dents or scratches. If damage is detected, immediately notify the carrier and advise McMartin of steps you have taken.

The tubes will normally be packed separately. Install these in their respective sockets.

3.3 EXTERNAL CONNECTIONS

All external connections are made from the rear of the cabinet. (Directions given below, right or left, are based on rear view access.)

3.3-1 RF Output

The RF output termination is an EIA standard 1-5/8" coaxial end flange located at the top of the RF harmonic filter. The external coaxial line run should be terminated to this coupling. The external line should be secured so that excessive lateral or vertical pressure is not exerted on the output termination. The coaxial line output components are packaged separately and should be assembled prior to connection of the external transmission line.

3.3-2 Audio Input

The audio input termination strip is located at the lower left of the cabinet. Jacketed, two-conducter shielded cable should be used. Monaural or left-channel stereo input should be connected to TB-3 (3 & 4), Right-channel audio input should be connected to TB-3 (6 & 7). If SCA operation is used, the SCA audio input should be connected to TB-3 (1 & 2). Shield grounds should be made to TB-3 (5 or 8.)

3.3-3 Monitor Connections

The RF drive for FM frequency and/or modulation monitoring equipment may be taken from either of two terminations, each of which are of the BNC type. One of these is located directly above the main housing of the RF output filter. This is a fixed-probe type pick-off point. The other is located on the left side of the PA enclosure adjacent to the coaxial feed to the RF harmonic filter input port. This is the termination of a pickup loop which may be mechanically oriented in relation to the PA output connection to the filter. This loop is readily accessible for adjustment by opening the rear door of the PA stage compartment.

The coaxial cable from the pick up point is terminated on TB-2 (5 & 6); #5 ground. The external cable should be of the flexible coaxial type.

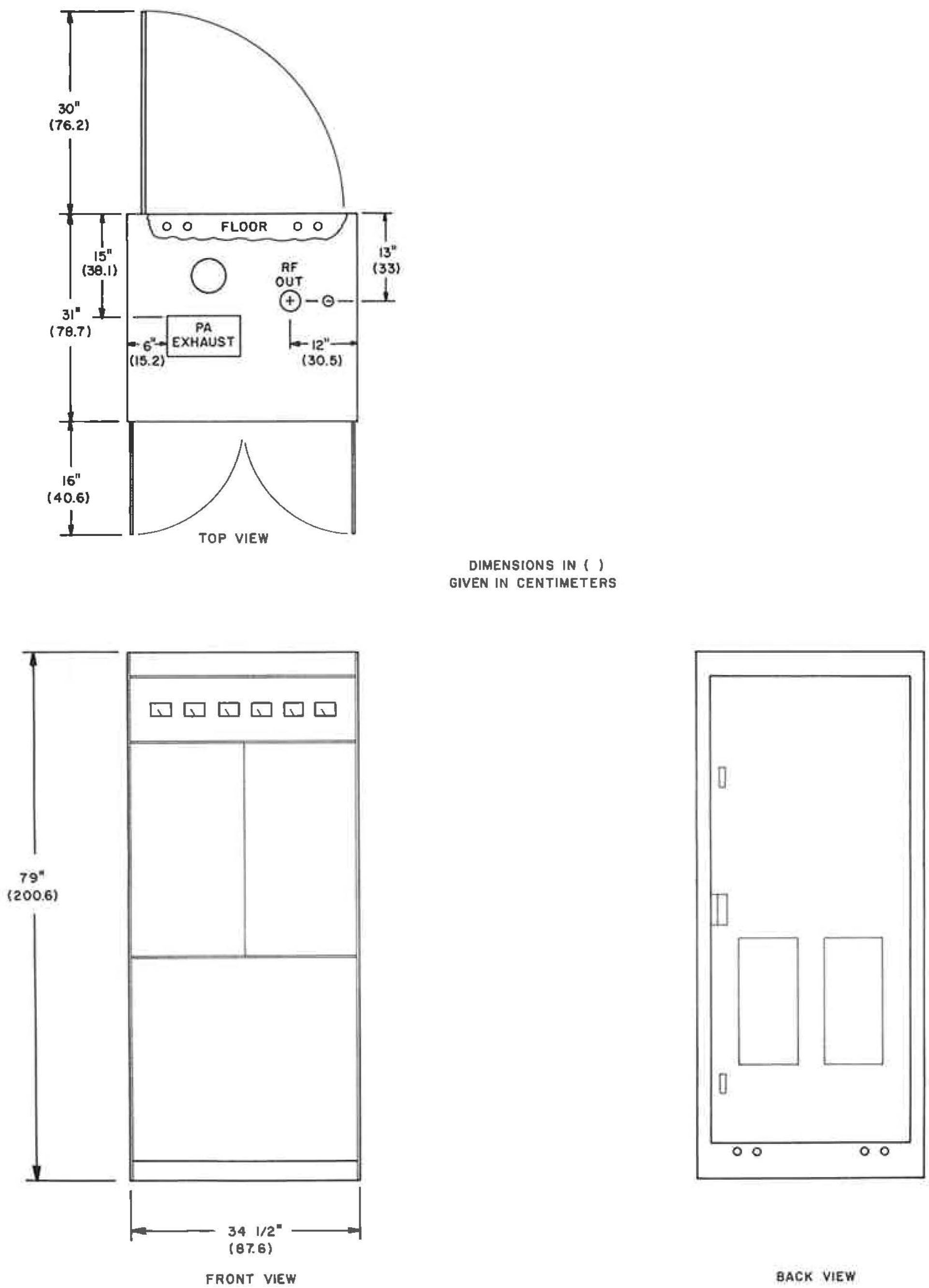


FIG. I

FIGURE 1 ▪ DIMENTIONAL OUTLINE

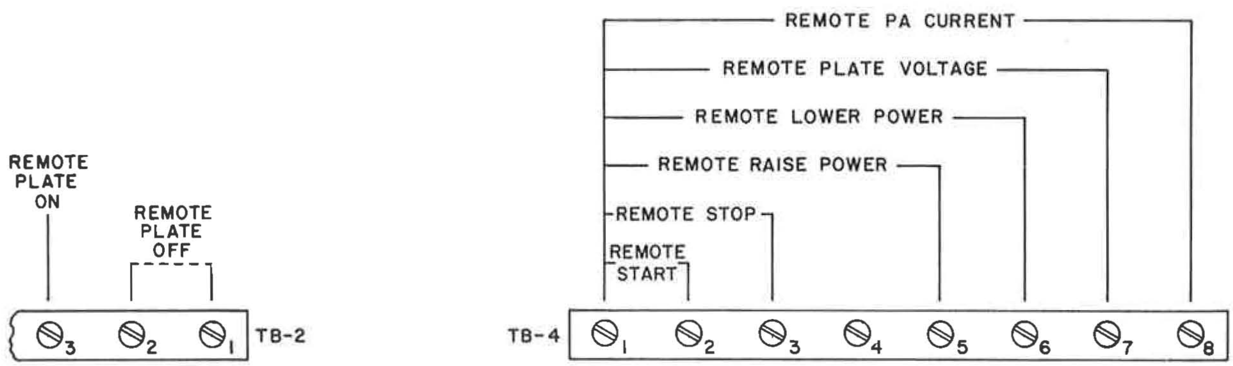


FIG. 2 REMOTE CONTROL TERMINAL BLOCKS

FIGURE 2 ■ REMOTE CONTROL TERMINAL BLOCKS

3.3-4 Power Connections

The transmitter will be equipped for either single-phase or three-phase primary power operation; whichever is specified in your order. In either case, before connecting to the power source, consult with your local utility company as to the nominal voltages available at the transmitter site.

A. Single Phase Model

Four-wire service entrance cable with minimum #8 wire size should be used. The ground lead should be secured to the ground terminal adjacent to TB-1 (located at the rear of the cabinet). Neutral lead should be connected to TB-1 (7) and the remaining conductors to TB-1 (8 & 9).

B. 3-Phase Model

Refer to the schematic diagram for interconnection of three-phase service. This version differs from the single-phase model only in the primary wiring for the plate transformer and the rectifier-stack arrangement.

3.4 REMOTE CONTROL CONNECTIONS

If the BF-3.5K is to be operated from a remote point, additional interconnection is required to TB-4. See Figure 2 for terminal board identification.

The following functions may be controlled:

1) Start
2) Stop
3) Power output

The following functions may be metered:

1) PA plate voltage
2) PA plate current
3) Power output or reflected power

3.5 INITIAL TUNE-UP PROCEDURE

The BF-3.5K is now ready for initial tune-up. The transmitter has been factory tested and tuned to your specified operating frequency and nominal output power level. These factory tests include operation into a 50-ohm non-reactive load; therefore all tuning control adjustments will approximate those you will encounter in the following tune-up procedure.

At this time you should calculate the exact transmitter output power you will require to satisfy the effective radiated power (ERP) specified in the station construction permit or license. This will be equivalent to the ERP, divided by your antenna power gain, plus losses incurred in the transmission line feeding the transmitter output to the antenna terminations.

As a guide for various power output operating levels, the following tabulation will be helpful in evaluating typical operating parameters for the PA output stage.

TABLE I

Power output:	2,000	2,500	3,000	3,500watts
PA Plate Voltage:	2.5	3.0	3.3	3.6 KV
PA Plate Current:	1.05	1.15	1.25	1.35 A
PA Cathode (Grid & Plate) Current:	1.40	1.55	1.55	1.75 A
PA Power Input:	2,625	3,450	4,125	4,860watts
Efficiency:	76.2	72.5	72.8	72.0 %

Precise PA efficiencies for your operating frequency and power are plotted in Figure 3. The transmitter output power where the indirect output power measurement is employed is the product of PA plate voltage and PA plate current multiplied by the appropriate effeciency factor from Figure 3.

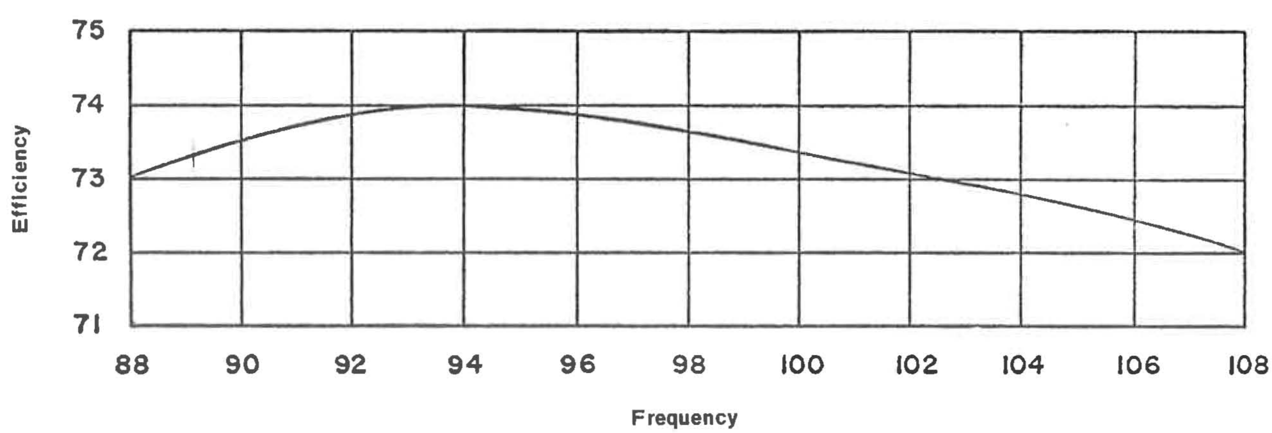
Proceed as follows with the tune-up.

1. Refer to "Appendix A", Section V - OPERATION (page 11 of B-910 Instruction Manual) for initial operation of the exciter portion of the BF-3.5K.

2. Throw the circuit-breaker switches located on left hand side of the horizontal ledge below the exciter to "ON".

3. Momentarily depress the START pushbutton. START indicator lamp will come on. This will provide primary ac power to the exciter and energize the cabinet blower, exhaust fan and the tube filaments. AIR, FILAMENT, BIAS, and 24 VAC indicator lamps will be

FIGURE 3 ▪ EFFICIENCY VS. FREQUENCY



illuminated. After approximately 2 minutes, PLATE OFF pushbutton will be illuminated. Read FILAMENT VOLTAGE panel meter and set FILAMENT ADJUST control for 7.5 volts. Confirm that correct line voltage is being supplied by operation of LINE VOLTAGE selector switch. (For single-phase installations positions 1 & 2 measure each side of the nominal 230 V supply to neutral; and for three-phase units, positions 3, 4 & 5 measure the voltage across each leg to neutral.)

4. After completing the exciter tuning procedures, turn the POWER OUTPUT control on the B-910 exciter module completely counterclockwise.

5. Place MULTIMETER select switch to IPA GRID CURRENT position. Slowly rotate the exciter POWER OUTPUT control until a reading is noted on the multimeter. Adjust IPA GRID control for a peak in the multimeter reading and adjust B-910 POWER OUTPUT control for a reading of 20 milliamperes.

6. Operate POWER OUTPUT control in LOWER position until motor drive stops. Set MULTIMETER switch to IPA 1 CATHODE CURRENT position. Apply operating voltage to the IPA and PA tubes by momentarily depressing the PLATE ON pushbutton. PLATE ON pushbutton will come on, PLATE OFF lamp will be extinguished. Confirm that PA PLATE VOLTAGE reading is in approximate agreement with the typical PA Plate Voltage Values shown in TABLE I.

7. Operate POWER OUTPUT control until IPA CATHODE CURRENT reaches approximately 100 milliamperes. Adjust IPA TUNE control for minimum cathode current. At the same time, observe the PA PLATE CURRENT meter, and during following initial adjustments, do not exceed 1.0 ampere. When PA PLATE CURRENT approaches this value, adjust PA PLATE TUNE knob for minimum PLATE CURRENT and proceed with tune-up of IPA stage.

8. Alternately adjust IPA TUNE and IPA LOAD controls so as to produce maximum PA PLATE CURRENT reading. There will be interaction between these controls. Whenever a change is made in the IPA LOAD control, readjust IPA TUNE control for minimum IPA 1 CATHODE CURRENT. As an impedance match is achieved between the IPA output and PA input circuitry, the dip in IPA cathode current will become less pronounced.

9. Place MULTIMETER switch in PA CATHODE CURRENT position. The reading will be somewhat higher in value than the PA PLATE CURRENT meter reading. The difference in value represents the PA grid current. Operate the POWER OUTPUT control until the PA CATHODE CURRENT is approximately 350 milliamperes higher than the PA PLATE CURRENT READING.

10. Place REFLECTOMETER meter switch in FWD (forward power) position. Adjust PA TUNE and PA LOAD controls for maximum reading on the REFLECTOMETER, while at all times maintaining PA PLATE CURRENT at minimum as the PA LOADING is increased. Switch REFLECTOMETER switch to REFL (reflected power) position. If the value of reflected power is more than 5% of the forward power, the external transmission line and antenna should be checked before proceeding further.

11. Operate POWER OUTPUT control in RAISE position until the PA total plate input concurs approximately with those calculated for proper operating level.

12. Check IPA operating parameters in the various pertinent MULTIMETER positions. Typical operating parameters for the Ipa stage at various transmitter output levels are:

TABLE II

Transmitter Output Levels:	2.0	2.5	3.0	3.5 KW
IPA Plate Voltage:	1.25	1.45	1.60	1.75 KV
IPA 1 Cathode Current:	180	210	190	200 milliamperes
IPA 2 Cathode Current:	170	190	160	180 milliamperes
IPA Grid Current:	20	20	20	20 milliamperes
IPA Grid Voltage:	-87	-87	-87	-87 Volts
IPA Screen Voltage:*	150	160	150	150 Volts
IPA Screen Current:	15	2	3	0 milliamperes

*The setting of the POWER OUTPUT control extablishes this voltage.

3.6 FINAL TUNE-UP PROCEDURE

For optimum overall operating efficiency upon completion of the initial tune-up, readjust IPA tuning and loading until the operating parameters of the Ipa stage approximate the values shown in TABLE II.

Adjust PA TUNE and PA LOAD controls to produce the calculated PLATE VOLTAGE and PLATE CURRENT values required to produce the necessary transmitter power output. Plate voltage may be increased or decreased by moving primary power connections located on the power transformer terminal block. These may be changed in 10% steps by this procedure.

IV. OPERATION

The daily operation of the BF-3.5K is straightforward. Start-up procedure is as follows:

1. The circuit breaker switches at the left hand side of the horizontal ledge just below the exciter panel should be kept in their ON positions for normal operation. (These are protective devices and are placed in their OFF positions only for safety and convenience during maintenance and servicing of the transmitter).

2. Depress START button.

(START button illuminated)

(AIR indicator illuminated)

(FIL indicator illuminated)

(BIAS indicator illuminated)

(25 Vac indicator illuminated)

3. After a time delay (adjustable from 30 seconds to 2 minutes by knob setting of delay relay K-6) the PLATE OFF pushbutton will be illuminated.

4. Depress PLATE ON button (PLATE ON button illuminated). (PLATE OFF button extinguished).

   NOTE: The BF-3.5K will perform the above sequence automatically. Immediately after the START button is depressed, push the PLATE ON button. The transmitter will come on automatically as soon as the time delay relay K-6 has completed its time cycle.

Normal shut-down procedure is as follows:

1. Depress STOP pushbutton.

   The BF-3.5K will shut-down completely, in the proper sequence. First, the power will be removed from all portions of the transmitter except the cabinet blower. After approximately 2 minutes, this blower will be turned off, completing the shut-down.

   If during tune-up, or routine maintenance schedules, only the PA plate voltage is to be removed, depressing the PLATE OFF pushbutton performs this function. Filaments, exciter, etc., remain on.

V. DETAILED CIRCUIT DESCRIPTION

Reference to cited drawings will be helpful in understanding the following:

5.1 B-910 EXCITER

Refer to Appendix A, "Section IV" (pages 4 through 11 of the B-910 Instruction Manual.

5.2 IPA STAGE (Ref: Dwg. #000258)

The RF output of the B-910 exciter is fed to the IPA stage by means of 50-ohm coaxial transmission cable. An RF matching network comprised of C-12, C-15 (IPA GRID control) and L-21 provides impedance transformation between the exciter and the control grids of the parallel-connected 4CX250B IPA power tubes. Fixed grid-bias for the IPA stage is fed from a separate power supply. Additional operating grid bias is provided by the voltage drop through R-13 and R-15 generated by IPA grid current. The grid voltage is sampled through R-14 and R-48 in parallel for a MULTIMETER reading in the IPA GRID CURRENT position of the MULTIMETER selector switch. The filament voltage for the two 4CX250B tubes is provided by T-3. The primary winding of T-3 incorporates RF filtering L-5 and L-6 in conjunction with C-8 and C-9. Actual filament operating voltage is determined by the setting of the front panel FIL ADJUST control. R-9 and R-10 are mechanically ganged with a similar rheostat control for the IPA and PA stage tube filaments. The individual cathodes of the IPA tubes are RF by-passed to ground. Series resistors R-17 and R-20 in the cathode to ground circuitry generate a metering voltage in the IPA-1/IPA-2 CATHODE CURRENT positions of the MULTIMETER select switch. Precise balance of these two parameters is not necessary; however, disparities in excess of 15% will usually indicate aging of one of the tubes. Before replacement, however, it is recommended that the two tubes in use be interchanged in the socket positions. If this procedure indicates that lower cathode current results for the same tube, it should be replaced.

Plate supply voltage for the IPA is provided from a full-wave bridge, center-tapped power supply which also provides PA plate voltage. The latter voltage is obtained from the full-wave bridge rectifier D-9 through D-12 configuration; therefore, the IPA supply, fed from the secondary center tap of the plate transformer provides a voltage value essentially equal to one-half the PA plate voltage value. The IPA supply is filtered by a conventional, dual choke/capacitance filter, consisting of L-19, L-20 and C-49, C-50. IPA plate voltage is metered in the IPA PLATE VOLTAGE position of the MULTIMETER selector switch. K-9 series-connected in the IPA cathode ground return, serves as the IPA overload relay.

Screen-voltage for the parallel connected 4CX250B tubes is obtained from the rotor of the front panel POWER ADJUST potentiometer, R-7, which is motor-driven. The raise/lower control relays K-11 and K-13 are operated from the front panel RAISE/LOWER control. This control provides extremely smooth control of the transmitter power output level from essentially zero to full power output. The IPA SCREEN VOLTAGE is metered in the appropriate position of the MULTIMETER switch.

The plates of the 4CX250B IPA tubes are parallel-connected with dc plate voltage fed through L-7, the plate RF choke. C-32 and C-33 serve as RF coupling/plate blocking capacitors. A pi-L network comprised of C-34 (IPA TUNE), C-36 (IPA LOAD), L-9 and L-10 provide proper impedance transformation for coupling the RF power from the IPA stage to the filament of the 3CX3000/A7 PA output stage.

5.3 PA STAGE (Ref: Dwg. #000258)

L-11 and L-12 (of open line configuration) connected in each leg of the filament supply operate as RF chokes to maintain the filament at RF potential. The end of the lines opposite the filaments are maintained at RF ground potential by C-39 through C-42. Filament voltage is obtained from T-2. The filament voltage of the PA tube is continuously metered by the panel-mounted FILAMENT VOLTAGE METER. This voltage should be maintained at 7.5 volts to insure maximum tube life. The front panel FILAMENT ADJUST control permits maintenance of the prescribed filament operating voltage. The FIL ADJUST control operates R-9, which is a series-resistance element in the primary of T-2.

The grid of the PA tube is operated at both dc and RF ground potential. A small amount of fixed bias voltage is generated by the cathode (filament) resistors R-39 and R-40 in the centertap ground return of T-2. The voltage drop across one of these resistors, R-39 appears across K-8, the PA plate overload relay, the sensitivity of which is adjusted by the slider tap position on R-39. This is normally adjusted so that the overload relay will operate when PA plate current exceeds 15% of its normal value at the various power output levels. R-41 develops a voltage drop sample for remote metering of PA plate current.

The PA plate tank consists of a shunt shorted-line element, L-15 for PA TUNE and a series shorted-line element, L-16, for PA LOAD. The front panel PA TUNE and PA LOAD controls provide mechanical drives for the positioning of the shorting bar on L-15 and L-16, respectively.

Capacitor, C-46 is a shunt-connected capacitor which tunes out the inductive reactive component in the output tank circuit, so as to provide a nominally 50-ohm source impedance to the RF harmonic filter input port. The RF harmonic filter, of low-pass configuration, provides a minimum of 65 dB attenuation of all frequencies above the fundamental operating frequency.

A front panel REFLECTOMETER permits continuous metering of either relative forward or reverse power, by means of a panel-mounted selector switch.

5.4 CONTROL CIRCUITRY

A simplified drawing of the control switching logic is shown in Figure 4. (See page 8).

A momentary closure of the pushbutton START switch energizes the coils of K-1 and K-2 and the START push-

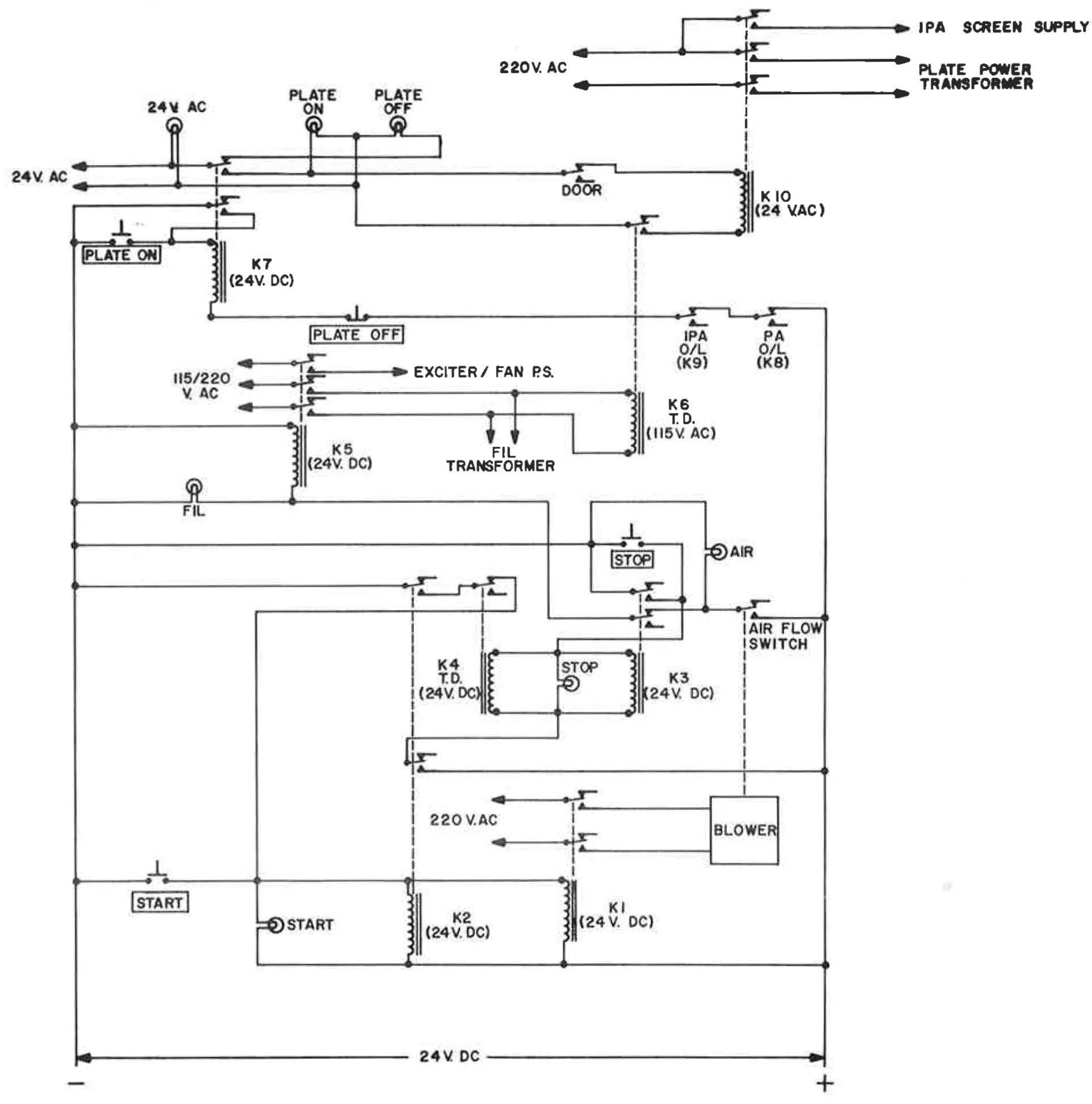


FIGURE 4 ▪ SIMPLIFIED CONTROL CIRCUIT DIAGRAM

button lamp. Note that the upper contact closure of K-2 "latches" the K-1 and K-2 relays to their "on" position, through the normally closed contacts of K-4. Simultaneously, the contact closures for K-1 provide primary voltage to the cabinet blower. As air flow is produced by the blower, the "air flow" switch closes. AIR indicator comes on. This energizes the filament control relay, K-5 and the FILAMENT 24 Vac and BIAS indicator lamps. The contact closures initiated by the K-5 coil operation perform several functions:

1. AC power is applied to the exciter portion of the transmitter. (Note: Where extremely low ambient temperatures occur during shut-down peroids, the exciter may be operated continuously. Relocate primary power leads to the exciter from TB-6 (1 & 3) to TB-6 (1 & 2);

2. The cabinet exhaust fan is energized;

3. AC power is applied to T-2 and T-3, the filament transformers for the PA and IPA stages; and

4. K-6, a 115 Vac time delay relay, initiates its time cycle (adjustable from 30 seconds to 2 minutes).

When the time duty cycle of K-6 has been completed, a contact closure on K-6 presets the energizing circuits to K-10, a 24 Vac plate contactor relay. The PLATE OFF pushbutton is illuminated. Plate voltage is applied by momentarily depressing the PLATE ON pushbutton. This operation energizes K-7. One set of contact closures operated by K-7 "latches" K-7 "on". A second set completes the 24 Vac energizing voltage to K-10, the main plate contactor, contact closures of which apply primary voltages to the IPA/PA plate power supply and the IPA screen grid power supply. The PLATE ON lamp is illuminated and the PLATE OFF lamp is extinguished.

Note that the circuitry to the coil of K-7 is series connected to the coil supply voltage through the PLATE OFF pushbutton, and the normally closed contacts of the IPA overload and PA overload relays. Also the cabinet door interlock switch is series-connected with the supply voltage to the coil of K-10.

The previous sequence described the "turn-on" control sequence.

If only the plate voltage is to be switched off, the operation is as follows:

The PLATE OFF pushbutton is depressed momentarily. This opens the circuit which energizes K-7, releasing the "latch" contacts on K-7, and releases the contact closure which had energized K-10, the plate contactor. This operation extinguishes the PLATE ON pushbutton lamp and illuminates the PLATE OFF lamp.

For complete transmitter shut-down, the following sequence takes place.

Momentarily depress the STOP pushbutton. This energizes the coils of K-3 and K-4 (the latter is a time delay relay). The upper contact closure of K-3 "latches" K-3 "on" and starts the time duty cycle of K-4. The lower contact of K-3 opens, deenergizing K-5. The associated K-5 contacts open, removing primary power from the exciter, cabinet exhaust fan, PA and IPA filament transformers and the coil of K-6. As K-6 is deenergized, its contact releases the K-10 plate contactor coil, removing plate voltage.

At this point, only the cabinet blower will remain operating. Once K-4 has completed its time cycle (approximately 2 minutes), its associated contacts (normally closed) will open. This interrupts the K-1/K-2 "latching" circuit. K-1 and K-2 release, and the power source to the cabinet blower, controlled by K-1 relay is interrupted, completing the "stop" cycle.

NOTE: As examination of Figure 4, the simplified control diagram, will indicate, the "turn-on" procedure may be simplified somewhat. The BF-3.5K will automatically apply plate voltage if during the turn-on cycle, the following simple procedure is followed:

1. Momentarily depress START button.

2. Momentarily depress PLATE ON button.

3. Step 2 energizes, and "latches" K-7 "on". As soon as time delay relay K-6 reaches its "ready" status, the transmitter will switch to its PLATE ON condition.

5.5 POWER SUPPLY (Ref: Dwg. #000258)

Plate voltages for both the PA and IPA stages are provided by a single power supply, which will have either single- or three-phase primary power source; as ordered.

The primary winding of the plate transformer, T-1, is designed to provide secondary voltages of 3 KV or 4 KV, ±10%, at three basic input line voltage values of 208, 220 or 240 Vac. These primary winding taps permit 18 selections of transformer secondary voltages by use of the appropriate primary taps.

The secondary center tapped winding feeds a full wave bridge silicon rectifier stack consisting of D-9 through D-12. The rectified PA high voltage is filtered by a dual section LC filter (L-17, L-18, C-47 and C-48). R-24 is the bleeder load for the PA plate supply. Plate voltage metering is provided by the front panel PLATE VOLTMETER. The meter multiplier resistor string for this meter consists of R-30 through R-34.

The IPA plate voltage is derived from the center-tap of the T-1 secondary winding and is filtered by L-19, L-20, C-49 and C-50.

The IPA screen voltage is obtained from a combination bias/screen supply consisting of T-4, D-1 through D-4. Filtering of the positive screen voltage is provided by L-1 and C-4. The screen voltage applied to the IPA screen grids is adjusted by a front-panel, motor driven control, R-7. Grid bias voltage for the IPA stage is derived from the same power supply. The bias voltage is filtered by R-4/R-5 and C-3/C-5.

5.6 AUTO RECYCLE/STATUS INDICATOR (Ref: Dwg. #550196/1)

The automatic recycling/status indicator display board is in simple terms a four-input/one-output reset generator.

Transistors Q-1 through Q-4 and their associated bias networks detect a transition from the normal status of any of four sensing inputs; namely: 1) exciter output; 2) IPA overload relay; 3) PA overload relay; and 4) RF output transmission line VSWR.

In their normal states, the outputs of Q-1 through Q-4 are normally "high" (approximately +5 Vdc). A change in the input status changes the Q-1 through Q-4 outputs to a "low" state. This "low" condition will trigger its associated input latch producing a "high" latch output which through its associated LED driver, Q-10 through Q-13, will illuminate the appropriate LED.

The LED's may be extinguished only by manual operation of the RESET switch.

Thus, the INPUT LATCHES serve as indicator "memories".

The Q-1 through Q-4 outputs also drive separate inputs of INPUT GATE, IC-7A, one-half of a dual four-input gate.

The second half, IC-7B, is connected as an INPUT INVERTER/GATE. A "low" appearing at any of the four inputs of IC-7A produces a "high" at its output; producing, in turn, a "low" at the output of IC-7B. This condition, applied to latch IC-3A/B, sets the latch output "low". This condition "enables" the counter/timing circuitry, by turning on dividers, IC-8 and IC-9; the RESTORER PERIOD GENERATOR, IC-10; and the LOCKOUT COUNTER, IC-11.

A 60-Hertz clock frequency, derived from the power transformer secondary is fed to IC-8, a divide-by-16 counter, to produce 3.75 pulses per second (pps) at its output.

IC-9 is a decade counter which divides by ten in two steps; first divide-by-five (IC-9A), then divide-by-two (IC-9B). The output from the divide-by-five section produces .75 pps (or one pulse every one and one-third second). These pulses, through OUTPUT GATE, IC-3C and OUTPUT INVERTER, IC-3D, feed RELAY DRIVER, Q-8, the collector load of which is a relay whose contacts provide the output START CONTACT closure. Thus whenever OUTPUT GATE IC-3C is "enabled" by its second input, START CONTACT closures will occur every 1-1/3 second.

The output of IC-9A also feeds one gate input of IC-4D, which in turn toggles the divide-by-two section, IC-9B, of the decade divider IC-9B output, at one-half its input rate, drives one input of IC-10, the RESTORER PERIOD GENERATOR. IC-10 is a 4-bit binary counter and can be programmed to count up to a preset number, representing varying elapsed time periods. Since the input toggle rate is one-half the one-pulse per 1-1/3 second rate of the output circuit gating rate, pulses occur every 2-2/3 seconds. Multiples of the 2-2/3 seconds may be produced by appropriate strapping to obtain the desired time interval between restart closures. Typically this might be approximately 5 seconds, (two input pulses); 8 seconds (three input pulses) or; 16 seconds (six input pulses).

Note that pulses from OUTPUT GATE, IC-3C also drive the RESTORER CODE GENERATOR, IC-12. After the initial two restart pulses, IC-12 is programmed through gate IC-4A to disable OUTPUT GATE IC-3C.

In the meantime, IC-10 continues to count at the slower rate. At the completion of the timed IC-10 count, the IC-4C RESTORER, operating as a "one-shot", resets IC-12 through the CODE RESET gate, IC-4B. IC-12 through IC-4A "enables" OUTPUT GATE, IC-3B, allowing two more restart pulses to pass to the relay driver circuitry.

The above action has transmitted two "restart" contact closures spaced 1-1/3 seconds apart; then after a time delay duration programmed by IC-10 has transmitted two additional "restart" contact closures, again spaced 1-1/3 seconds apart.

At the conclusion of this sequence, IC-10, having completed its timed-count period, toggles RESET gate, IC-5B. The output of IC-5B switched LATCH IC-3A/B back to its "ready" condition, since the LATCH output "disables" the divider chain, IC-8 and IC-9; the RESTORER PERIOD GENERATOR, IC-10, and the LOCKOUT COUNTER, IC-11.

Each fault, as it occurs, up to a total of four, is counted by LOCKOUT COUNTER, IC-11. Its output, through the operation of inverter IC-5C and RESET gate, IC-5B, produces a "disable" condition at the output of LATCH, IC-3A/B. When the "four" count has been reached, the OVERCOUNT LED indicator is illuminated through Q-9, a transistor switch.

After a total of four faults occur, the logic sensing circuitry is locked in its "off" condition and the transmitter may be restarted only by manual or remote control.

Q-5 and Q-7 form a Schmitt-trigger which is used as a RESET GENERATOR, in conjunction with a waveform shaping stage, Q-7 and IC-6A/IC-6B. This circuitry automatically resets all memory latches and counters whenever ac power is initially applied to the transmitter.

VI. REMOTE CONTROL

The BF-3.5K is capable of interfacing with standard remote control systems. All interconnections for control/telemetering are made to TB-4. See Figure 2.

6.1 START-STOP FUNCTION

A normally-open contact closure from the remote control system should be wired across TB-4 (1 & 2) with Terminal #1 as "common" or ground. Momentary closure of these contacts, implemented by operation of the remote control system will initiate the START cycle of the BF-3.5K.

A normally-open contact closure from the remote control system should be wired across TB-4 (1 & 3) with Terminal #1 as "common" or ground. Momentary closure of these contacts, implemented by operation of the remote control system, will initiate the STOP cycle of the BF-3.5K.

6.2 POWER OUTPUT-RAISE/LOWER FUNCTIONS

A normally-open contact closure from the remote control system should be wired across TB-4 (1 & 5). Terminal #1 is "common", or ground. Closure of these contacts implemented by operation of the remote control system, will energize the IPA screen voltage motor-driven control "raise" relay, K-12 as long as the closure is maintained. This will RAISE the BF-3.5K power output.

A normally-open contact closure from the remote control system should be wired across TB-4 (1 & 6) with Terminal #1, "common" or ground. Closure of these contacts, implemented by operation of the remote control system, will energize the IPA screen voltage motor-driven control "lower" relay, K-13 as long as the closure is maintained. This will LOWER the BF-3.5K power output.

6.3 METERING FUNCTIONS

Positive-polarity samples voltage for remote metering of the PA operating parameters appear on TB-4.

6.3-1 Remote PA Plate Voltage

A voltage sample of the PA plate voltage appears across TB-4 (1 & 7). Terminal #1 is negative and Terminal #7 is positive, for interconnection to remote control system telemetry inputs.

6.3-2 Remote PA Plate Current

A voltage sample, derived from the PA plate current, appears across TB-4 (1 & 8). Terminal #1 is negative and Terminal #8 is positive, for interconnection to remote control system telemetry inputs.

6.3-3 Forward/Reverse Reflectometer Metering

If desired, either the "reverse" or "forward" power indication of the reflectometer may be metered remotely. If "reverse" power is to be metered remotely, operate the front panel REFLECTOMETER switch in FORWARD position. Make interconnection from remote control system telemetering input to TB-8 (3 & 4). Terminal #3 is positive, Terminal #4 is negative.

If "forward" power is to be metered remotely, operate the front panel REFLECTOMETER switch in REVERSE position. Make interconnection for remote control system telemetry input to TB-8 (1 & 2). Terminal #1 is positive, Terminal #2 is negative.

NOTE: If the REFLECTOMETER reading is metered remotely, as described above, the reading of the transmitter meter will not be correct unless the pertinent positive lead connection as described above is removed from TB-8.

VII. MAINTENANCE

Routine housekeeping practice in keeping the cabinet enclosure and the internal PA and Ipa compartment areas free of dust and dirt will contribute to many years of service from the BF-3.5K.

CAUTION: PRIOR TO PERFORMING WORK WITHIN THE CABINET AREA, SWITCH OFF FRONT PANEL CIRCUIT BREAKERS AND DISENGAGE ALL PRIMARY SERVICE SWITCHES OR BREAKERS.

USING THE GROUNDING STICK PROVIDED, DISCHARGE ALL FILTER CAPACITORS BEFORE STARTING WORK. ALTHOUGH ALL HIGH VOLTAGE POWER SUPPLIES ARE EQUIPPED WITH BLEEDER RESISTORS AND THE HIGH VOLTAGE POWER SUPPLY IS AUTOMATICALLY SHORTED TO GROUND WHEN THE REAR DOOR IS OPENED, FOLLOWING THE ABOVE PROCEDURE COULD SAVE YOUR LIFE. MAKE THIS PROCEDURE A *"HABIT"!*

Although dust accumulation within the PA and IPA compartments will be minimal due to positive cabinet pressure during blower operation, it is recommended that at intervals of no less than 30 days, this area and all internal surfaces and components within the cabinet be wiped down with a clean, lint-free cloth. Collect any accumulation of wiped-down dirt or dust with a vacuum cleaner.

The dual intake filters mounted on the rear door are of the maintainable type. Visual inspection of the filters through the grille covers will indicate the presence of dust accumulation on the filter grids. Remove the captive fasteners at the top and bottom of each grille. The filter element may then be removed for cleaning. This may be done during normal transmitter operation, as baffle plates on the inside of the door prevent the filters from contacting any of the internal components or wiring.

All drive motors, blowers and fans are of the permanently lubricated type and require no service.

All relay contact closures are of the wiping type and protected by covers. Contact burnishing is not required.

Semi-annually, the IPA and PA tubes should be removed from their respective sockets. Using a soft brush, remove dust accumulation around the socket areas.

It is recommended that the cabinet outer surfaces be kept clean of finger marks by cleaning periodically with a mild detergent. Meter faces and the front plexiglass panels should be gently wiped clean using standard plexiglass cleaner or a mild detergent. Use a clean, soft cloth.

VIII. PARTS LIST

A large number of the components are of standard values and tolerances generally available through local electronics parts suppliers. Those of unusual values or tolerances are listed below. Refer to APPENDIX A for parts information on components utilized in the B-910 Exciter portion of the BF-3.5K transmitter.

Symbol	Part Number	Description
C-12	660033	Capacitor, variable, 55-300 pf
C-15	660047	Capacitor, variable, 6.5-50 pf (IPA grid)
C-23, C-44	660042	Capacitor, 200 pf, 7.5 KV
C-24, C-32, C-33, C-37, C-38	658963	Capacitor, 1000 pf, 5 KV
C-30, C-31	650077	Capacitor, mica .001 mf, 2 KV
C-34	660043	Capacitor, variable, 9-38 pf, 4.5 KV (IPA tune)
C-36	660041	Capacitor, variable, 50 pf (IPA load)
C-43	660046	Capacitor, feed through; 1000 pf, 10 KV
C-47, C-48	660044	Capacitor, 6 MF/5 KV
C-49, C-50	660045	Capacitor, 8 mf/3 KV
D-1 to D-4, D-13 to D-16	210008	Diode, Rectifier, Type 1N4006
D-5 to D-8,	210010	Diode, Rectifier, Type 1N40111 (Control Voltage Supply)
D-9 to D-12	210016	Diode, Rectifier, RS-3.5-24-12S (High Voltage Supply)
K-1, K-2, K-3, K-7, K-9	470034	Relay, DPDT; 24 Vdc coil

PARTS LIST, continued

Symbol	Part Number	Description
K-4 K-4	470038	Relay, time delay, 120 sec.; 24 Vdc coil
K-5	470035	Relay, 3PDT; 24 Vdc coil
K-6	470037	Relay, adj. time delay; 120 Vdc coil
K-8	470036	Relay, DPDT; 6 Vdc coil
K-10	470039	Relay, 3-pole, N.O.
K-11	470011	Relay, DPST, 6 mA.
K-12, K-13	470013	Relay, DPDT; 5 K-ohm coil
L-1	928960	Choke, 9 Henry
K-17, L-18	935035	Choke, filter reactor; 10 Hy; 1.75 A dc
L-19	931010	Choke, swinging 4-20 Hy; 550 mA.
L-20	931011	Choke, 8 Hy; 550 mA.
--	700054	Meter and lens kit 0-5/0-10 scale (Multimeter)
--	700058	Meter and lens kit 0-300 Vac scale (Line Voltage)
--	700059	Meter and lens kit 0-10 Vac scale (Fil. Voltage)
--	700060	Meter and lens kit 0-2 scale (40 div) (PA Plate Current)
--	700061	Meter and lens kit 0-5 scale (50 div) (PA Plate Voltage)
--	700062	Meter, elapsed time.
R-1	533005	Resistor, bathtub; 2.5 ohms, 5-W, 10%
R-4, R-5, R-6	535009	Resistor, tubular; 3 K ohms, 10 W, 10%
R-7	404001	Resistor, variable; 7.5 K ohm; 25 W
R-9	404002	Resistor, variable; 15 ohm; 150 W
R-10	404003	Resistor, variable; 80 ohm, 25 W
R-11	402004	Resistor, variable, 2.5 K ohm, 2 W
R-13, R-15	533010	Resistor, bathtub; 47 ohm, 5 W, 10%
R-16, R-19	404004	Resistor, variable; 50 ohms, 25 W
R-17, R-20	533024	Resistor, bathtub; 0.27 ohm, 5 W, 20%
R-18, R-21	402006	Resistor, variable; 250 ohms, 2W
R-22	539003	Resistor, tubular, adj.; 100 ohm, 100 W
R-23	539006	Resistor, tubular; 50 K ohm, 225 W
R-24	540101	Resistor, tubular; 100 K ohm 115 W
R-25 to R-34, R-42 to R-45	505183	Resistor; 1 megohm, 4 W, 1%
R-36	539007	Resistor, tubular, adj.; 10 ohm, 100 W
R-39	539004	Resistor, tubular; adj.; 5 ohm, 175 W
R-40, to R-41	540107	Resistor, tubular, adj.; 10 ohm, 50 W
R-47	539005	Resistor, tubular, adj.; 50 ohm, 225 W
T-1	920036	Transformer, High-voltage Plate supply
T-2	920037	Transformer, PA Fil.; 7.5 Vac, C.T.; 51 A
T-3	920035	Transformer, IPA Fil.; 6.3 Vac; 6 A
T-4	900013	Transformer, screen/bias supply
T-5	918965	Transformer, control voltage supply (RT-206)
Z-1	220039	Diode, Zener, Type 1N3338B
Z-2, Z-3, Z-4	220011	Diode, Zener, 24V
--	897324	PA line, shorting bar assy.
--	149012	Right angle drive assy.
--	149013	Sprocket, ladder chain
--	149015	Ladder chain
--	897315	Cabinet exhaust fan
--	897323	Cabinet centrifugal blower
--	897319	Circuit breaker, AM2-A8-A-35-3
--	897320	Circuit breaker, AM2-A8-A-6-8
--	897321	Circuit breaker, AM1-A8-A-2-3
--	897310	Motor, control, with brake

PARTS LIST, continued

STATUS INDICATOR/AUTO RECYCLE ASSY

Symbol	Part Number	Description
D-1 to D-5	220006	Diode, type 1N87
D-6 to D-9	210008	Diode, type 1N4006
IC-1 to IC-6	230009	Integrated circuit, type MC946
IC-7	230012	Integrated circuit, type MC930
IC-8, IC-10 to IC-12	230008	Integrated circuit, type SN7493N
IC-9	230007	Integrated circuit, type SN7490N
K-1	470026	Relay
LED-1 to LED-5	220034	Diode, light-emitting, Type MV5054
T-1	900063	Transformer, power

WARRANTY

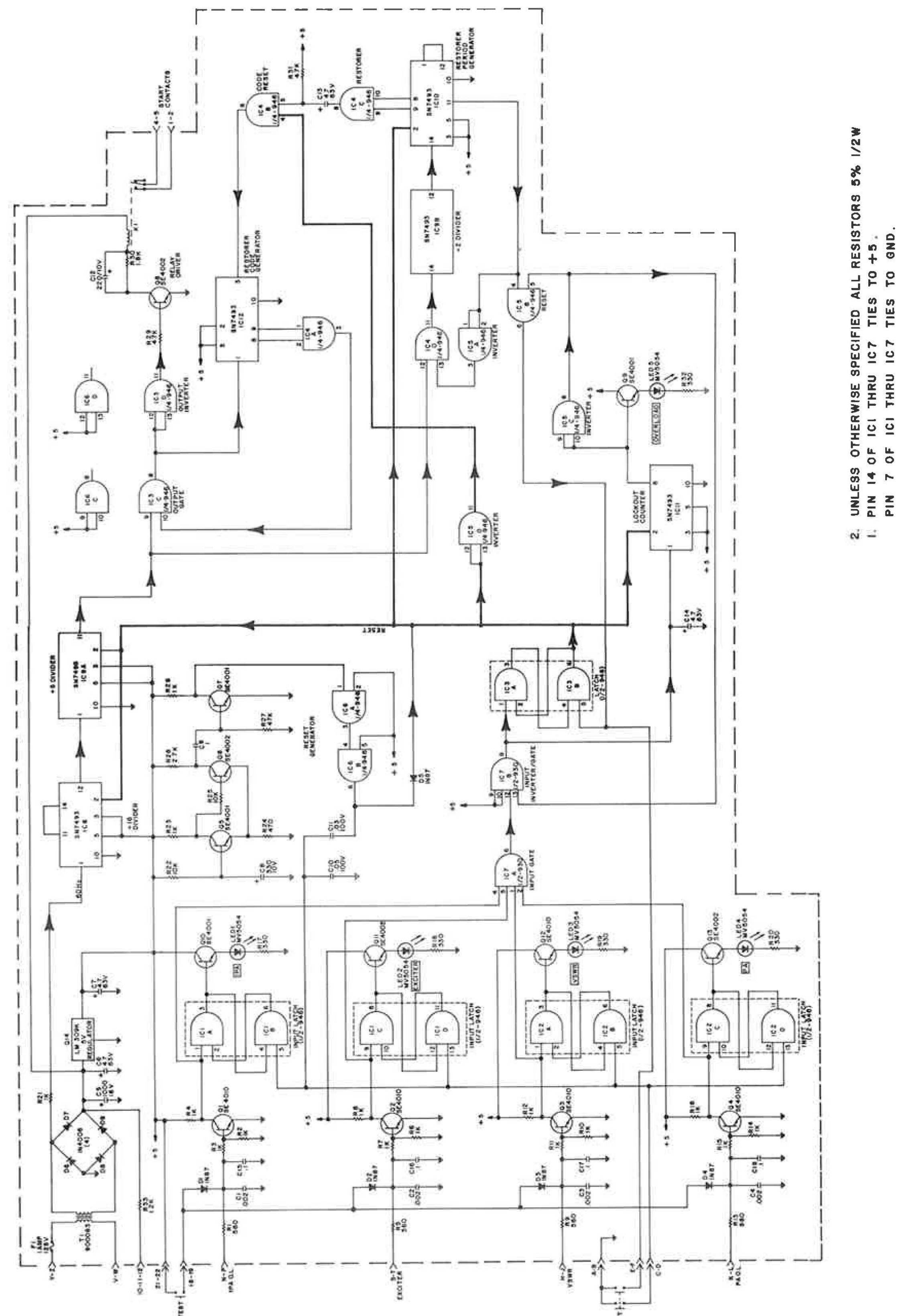
McMartin products are warranted to be free from defects and workmanship for a period of one year after shipping date, when subjected to normal usage and service. All warranties are void if (a) equipment has been altered or repaired by others without McMartin's specific prior authorization; or (b) equipment is operated under environmental conditions or circumstances other than those specifically described in McMartin literature or instruction manuals.

Upon notification within the applicable warranty period, McMartin agrees without charge, to repair, replace, or supply replacement parts for any properly maintained equipment or parts that are defective as to design, materials or workmanship and that are returned in accordance with McMartin's instructions to the Buyer. At McMartin's sole discretion, the Buyer may be requested to return the defective part of equipment to McMartin, FOB Omaha, Nebraska. Parts or equipment may be returned only with McMartin's prior authorization and must be identified by a return authorization number issued by McMartin's Customer Service Department. All merchandise so returned must be sent transportation prepaid, at Buyer's risk. Full details of the failure or malfunction should be included so as to expedite repair or replacement. Repair parts or repaired or replaced equipment will be returned to the Buyer, FOB factory.

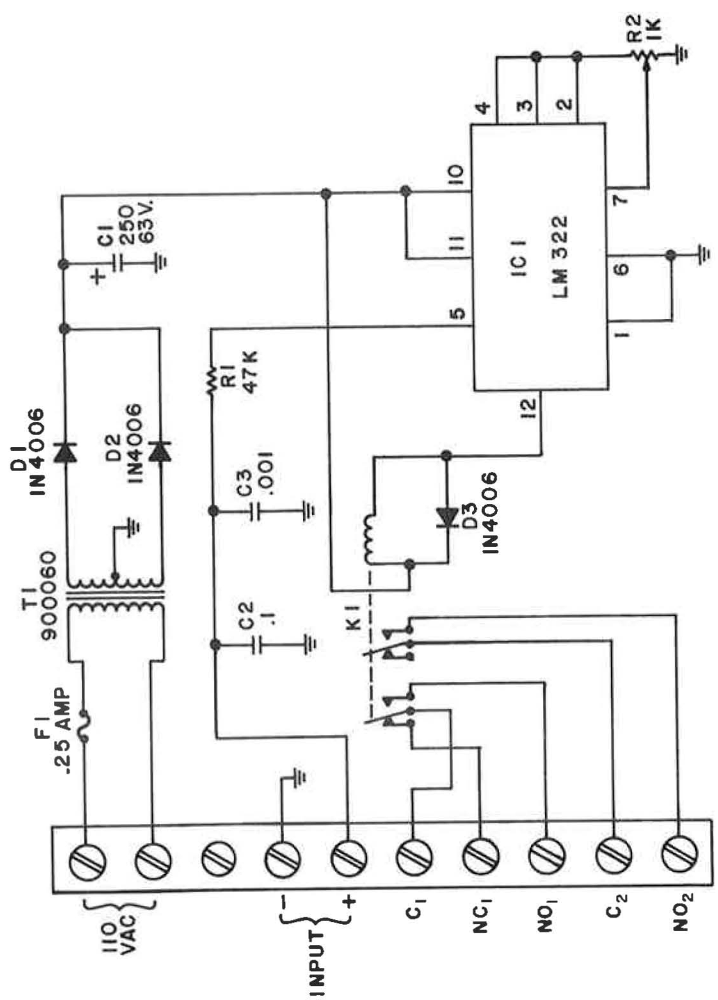
The above warranty does not extend to other equipment, as tubes, lamps or fuses manufactured by others, which are subject to only such adjustment as McMartin may obtain from the suppliers thereof. McMartin shall not be liable for consequential damages resulting from the use of, or the inability to use, the equipment; nor for any loss, damage or expense incurred thereby; nor from any other cause.

IX. SCHEMATIC DIAGRAMS

* folded blueprint



PCB STATUS INDICATOR
AUTO RECYCLING
P/N 550196/1



VSWR DETECTOR
P/N 550204/1

INSTRUCTION MANUAL

B-910 series

10 watt FM Exciter/Transmitter

The B-910 and B-910T are type accepted for use under part 73 of the FCC Rules and Regulations for monaural operation, and with the addition of the B-110 and/or B-113 Stereo/SCA assemblies, this equipment is further type accepted for stereophonic and/or SCA operation.

I. TECHNICAL SPECIFICATIONS

OPERATING RANGE: .... Specified frequency in 88 to 108 MHz range.

RF OUTPUT POWER: .... B-910 Exciter: 2-15W continuously adjustable. B-910T 10 watt transmitter: 10 watts nominal.

RF OUTPUT IMPEDANCE: .... 50 ohms

CENTER FREQUENCY STABILITY: .... ± 500 Hz

MODULATION CAPABILITY: .... ± 150 kHz

AUDIO INPUT IMPEDANCE: .... 600 ohms, balanced

AUDIO INPUT LEVEL: .... + 10, ± 2 dBm

AUDIO FREQUENCY RESPONSE: .... ± 0.5 db 30 Hz – 15 kHz (75 usec pre-emphasis)

TOTAL AF HARMONIC DISTORTION: .... 0.3%, 30 Hz – 15 kHz

FM NOISE: .... 68 dB below 100% modulation

AM NOISE: .... 65 dB below carrier level

POWER REQUIRED: .... 115 VAC or 230 VAC, ± 15%, 50 – 60 Hz 50 watts

OPERATING TEMPERATURE: .... – 20° to + 50° Celsius

MECHANICAL:

B-910 Exciter .... (W) 19″ (EIA Std. Rack Mount)
(H) 10½″
(D) 17¾″

B-910T Transmitter .... (W) 20″
(H) 11¾″
(D) 18″

WEIGHT: .... 25 lbs. (B-910)
30 lbs. (B-910T)

FINISH: .... McMartin beige with woodgrain trim front access panel

STEREO

EMISSION: 300 F9

AUDIO INPUT IMPEDANCE: .... Left Channel 600 ohms, balanced
Right Channel 600 ohms, balanced

AUDIO INPUT LEVEL: .... + 10, ± 2 dBm

AUDIO FREQUENCY RESPONSE: .... ± 0.5 dB, 30 – 15,000 Hz Left or Right Channel

DISTORTION: .... 0.5% or less, 30 – 15,000 Hz

STEREO SEPARATION: .... 39 dB or greater, module only 35 dB through exciter (50 – 15000 Hz)

FM NOISE: .... Greater than 65 dB below 100% modulation

PILOT STABILITY RANGE: .... ± 1 Hz over rated temperature range

SUBCARRIER SUPPRESSION: .... 55 dB or greater

CROSSTALK: .... 47 dB or greater, less 15 kHz LP filters; 50 dB (30-5000 Hz); 45 dB (5-10 kHz); 40 dB (10-15 kHz) with filters.

SCA

AUDIO INPUT LEVEL: .... + 10, ± 2 dBm

INPUT IMPEDANCE: .... 600 ohms

SCA CARRIER FREQUENCY: .... 41 kHz or 67 kHz standard (other frequencies are available on special order)

SCA CARRIER STABILITY: .... ± 500 Hz

MODULATION CAPABILITY: .... ± 7.5 kHz (100%)

PRE-EMPHASIS: .... 150 microseconds, standard; 50 or 75 usec available on request

FREQUENCY RESPONSE: .... ± 1.5 dB, 50 – 5000 Hz

CROSSTALK – MAIN INTO SUBCHANNEL .... 60 dB or greater below program levels

CROSSTALK – SUBCHANNEL INTO MAIN .... 60 dB or greater below program level

DISTORTION: .... 0.75% or less, 50 – 5,000 Hz LP filter
2.5% or less, 50 – 5,000 Hz BP filter

FM NOISE: .... 60 dB below 100% modulation (± 6 kHz deviation) 150 usec de-emphasis

AUTOMATIC MUTE: ... Adjustable to any level between 100% modulation and 3% modulation, with variable mute delay

REMOTE CONTROL: .. SCA subcarrier may be held on by a front panel switch or by a remote control closure

II. INTRODUCTION

The McMartin B-910 modular FM exciter and B-910T 10 watt FM broadcast transmitter designs incorporate the most recent direct FM solid state technology. The modular design allows complete flexibility in operating modes. All possible combinations of monaural, stereo, and SCA operating modes presently authorized by the Federal Communications Commission may be accommodated by use of optional plug-in modules.

Electrical parameters conservatively meet or exceed the requirements of Part 73 of the Commission Rules and Regulations. A list of minimum broadcast standards will be found in the rear of this manual for the purpose of aiding the broadcaster in checking the performance of the B-910 equipment.

A tabulation of actual performance measurements for the equipment received is shipped with the unit. This table will serve as a reference for operating parameters in the event trouble occurs.

The B-910T consists of a B-910 exciter, plus a low-pass output filter and cabinet.

Monaural Operation
The standard B-910 unit is equipped with modules for monaural operation. (See Figure 1--Plug-in module locator diagram.) The B-910 exciter main frame is pre-wired for later conversion to stereo or stereo/SCA operation by insertion of appropriate modules. This includes six of the nine possible modules as standard equipment.

SCA Operation
When operating in the monaural mode, two optional SCA channels are available. The standard SCA sub-carrier frequencies available are 41 kHz and 67 kHz. Modules for other subcarrier frequencies are available on special order. The individual SCA generators may be turned on or off remotely through rear chassis terminals. 150 microsecond preemphasis is standard. 50 or 75 microsecond preemphasis is available on request.

Stereo Operation
Stereo operation employs a plug-in Stereo Generator Module in Position # 2 and a Dual Audio Module in place of the single module used in the monaural version in Position # 1. The dual audio module is used to process the left and right channel audio signals for modulation. When operating in the stereo mode, an additional 67 kHz sub channel option may be accommodated. The 41 kHz sub channel is not available while operating stereo since this part of the composite spectrum is used by the L-R stereo information. The 19 kHz pilot subcarrier is controlled by a switch provided on the front of the stereo generator module or by a simple contact closure on the rear of the exciter for remote control operation. See Fig. 3, System Block Functional Diagram.

Alarm/Control Circuitry
Automatic off-frequency detection is accomplished in two ways. First, by sampling the AC component of the high frequency phase comparator, and secondly, comparing the output frequency to a crystal controlled frequency detector and utilizing the resulting IF signal. For deviations in excess of 100 kHz, the absence of an IF signal removes the DC collector supply voltage from the power amplifier module.

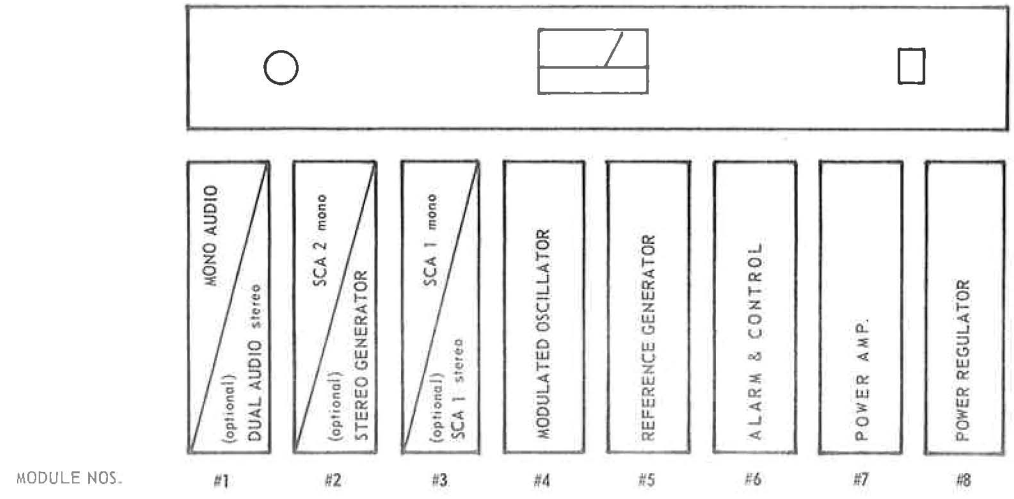


FIG. 1 FRONT VIEW PLUG IN MODULE LOCATOR DIAGRAM

III. INSTALLATION AND UNPACKING

After unpacking the FM exciter, a thorough inspection should be conducted to reveal any shipping damage. If any damage is noticed, immediately notify the shipping agency and advise McMartin Industries, Inc. of said action. Check to see that all modules are securely positioned in their respective locations. Figure 1, the Plug-in Module Locator Diagram, should be used for this purpose.

Module Complement

	Stereo	Monaural
#1	Dual Audio	Mono Audio
#2	Stereo Generator	SCA #2 (If used)
#3	SCA #1 (if used)	SCA #1 (If used)
#4	Modulated Oscillator	Modulated Oscillator
#5	Reference Generator	Reference Generator
#6	Alarm and Control	Alarm and Control
#7	RF Power Amplifier	RF Power Amplifier
#8	Power Supply Regulator	Power Supply Regulator

In addition to the above items each B-910 FM Exciter includes a module extender card (P/N 555009) for test and repair purposes.

McMartin Industries recommends that installation personnel completely familiarize themselves with the exciter before proceeding with installation. Early planning based on good engineering practices will contribute to stable and reliable operation of the B-910 exciter.

Mechanical

The modular approach used in the B-910 provides easy removal of practically all components for service or routine inspection and maintenance. Each module is easily removed by exerting a forward pull on the handle provided. Access to the rear of the cabinet is by removal of the screws securing the rear panel. The top cover is removable for access to the meter switch and meter amplifier.

All wiring to the B-910 should be installed in conduit using shielded wire to prevent RF pick up.

Power Requirements

The power transformer located on the top rear of the exciter may be operated from either 115 or 230 VAC single-phase sources. Factory wiring is for 110V operation. For 230V operation, refer to Figure 2 below for proper transformer primary connection. Replace the front panel fuse with a 1/2A slo-blo fuse.

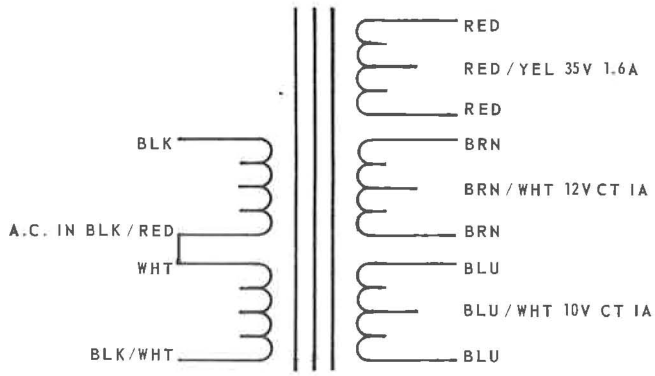


FIG. 2

Power Transformer Connections

The B-910 will operate satisfactorily with a line voltage of 117 VAC, ± 15% AC. Power connection is made to TB-1 terminals 1 and 2. Terminal 3 is chassis ground.

Input-Output Connections

TB-1

1		115VAC
2		115 VAC
3		Chassis Ground
4		
5		
6)		(Normally Closed
7)	Phase Lock Indicator	(Normally Open
8)		(Pole

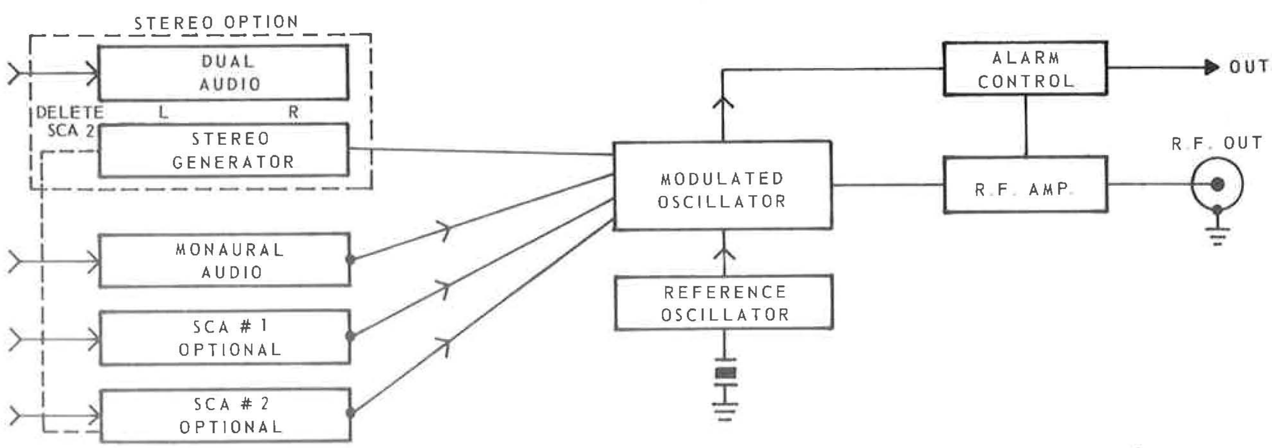


FIG. 3 SIMPLIFIED BLOCK FUNCTIONAL DIAGRAM

TB-2	
1	RF power amp DC voltage interrupt
2	RF power amp DC voltage interrupt
3	SCA # 1 Audio Input
4	SCA # 1 Audio Input
5	SCA # 2 Audio Input
6	SCA # 2 Audio Input
7	Connect to ground for stereo operation
8	Ground
TB-3	
1	Monaural audio input - red
2	Monaural audio input - black
3	SCA # 1 Remote Control (+)
4	SCA # 1 Remote Control (Ground)
5	Stereo left audio input - red
6	Stereo left audio input - black
7	Stereo right audio input - red
8	Stereo right audio input - black

Stereo Generator Assembly

Exciters which include the B-110 Stereo Generator Assembly as part of an original order are ready for stereophonic operation when received.

If the Stereo Generator Assembly is ordered at a later date, the assembly will consist of a B-111 Dual Audio Module, a B-112 Stereo Generator Module and a Band Pass Filter. See Figure 1 for the proper module location of the B-111 and B-112 modules.

To install the Band Pass Filter, remove the rear cover of the B-910. Remove the small plate located on the top of the unit, by removing the four machine screws holding it in place. Directly below the plate location are Cables No. 34 and 35. Solder the black leads of these two cables to the "GND" terminal of the filter. Connect the red lead of cable 34 to the "OUT" terminal, and the red lead of cable 35 to the "IN" terminal of the filter. Secure the filter to the top of the exciter and replace the rear cover of the unit. The exciter is now equipped for stereophonic operation.

IV. GENERAL CIRCUIT DESCRIPTION

The B-910 exciter system uses a free-running direct FM oscillator operating at one-half the specified output frequency. The center frequency of the oscillator is precisely maintained by phaselock techniques. The oscillator frequency is doubled and amplified to approximately 0.25-watt level. This operating frequency signal is sampled and divided by 10,000 to produce a frequency in the 8.8 to 10.8 kiloHertz range (one ten-thousandths of the specified operating frequency in the 88 to 108 MHz FM broadcast spectrum). This divider output frequency is compared with a frequency in the 8.8 to 10.8 kHz range generated by dividing by 1000 the output frequency of a temperature-controlled reference crystal oscillator operating in the 8.8 to 10.8 MHz (one-tenth the operating frequency) range. The two frequencies in the 8.8 to 10.8 KHz range, one derived from the modulated oscillator, the other from the reference oscillator, are fed to a phase comparator and phase-to-voltage converter. The DC output of the converter provides a correction voltage to voltage-variable-capacitor circuitry in the frequency determining tank circuit of the modulated oscillator. This "locks" the oscillator frequency precisely to one-half the output frequency.

The phaselock loop will respond only to submultiples of the operating and reference frequencies appearing at the phase comparator inputs. If malfunctions occur in the divider circuitry, the control voltage will disappear and the modulated oscillator will revert to a "free-running" condition. When this occurs, automatic sensing circuitry in the B-910 may be used to trigger an external aural alarm, indicating loss of phaselock. The exciter center frequency can be manually controlled pending circuit repair.

To further insure against operating beyond the center frequency deviation limits established by the FCC, the B-910 incorporates an additional channel loss alarm circuit. The B-910 is automatically disabled by interruption of PA collector voltage if the unit is operated at a frequency more than 100 kiloHertz removed from the center frequency.

The RF signal is amplified to a nominal 10-watt output level into a 50-ohm unbalanced load.

Module Circuit Descriptions

Electrical components in each module are accessible **by removal of the individual module cover plates.** Ele-

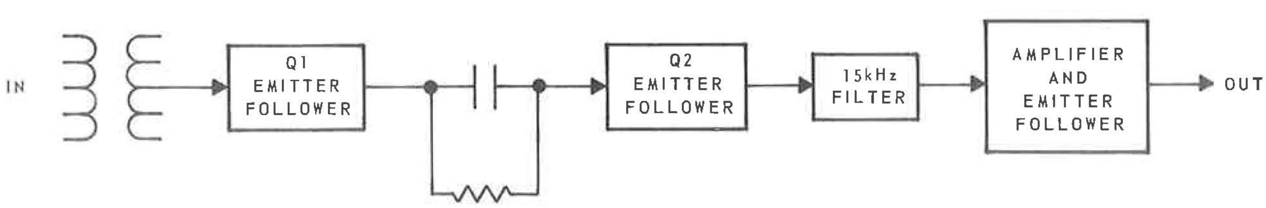


FIG. 4 BLOCK FUNCTIONAL DIAGRAM MONAURAL AUDIO

ctrical components should be replaced only with components of equal value and ratings. Polarity of tantalum and electrolytic capacitors must be maintained.

Audio Module (Monaural)
The audio module serves two functions. It provides proper pre-emphasis of the audio input signal and amplifies the incoming signal level to properly match the modulator audio input requirement.

Refer to Figure 4 and the monaural audio schematic diagram (Drawing #552072/1) at the rear of the manual.

The incoming audio signal from TB-3, 1 and 2 (approximately + 10 dBm, ± 2 dB at 400 Hz) is fed to the input line transformer located on the monaural audio card. The transformer provides excellent frequency response and converts the balanced configuration to unbalanced input. A resistive pad (R1, 2, and 3) partially by-passed with a high frequency compensating capacitor, C1, is driven by the transformer secondary. Signal then flows through Q-1, an emitter follower used as a low source impedance to feed the pre-emphasi network consisting of three precision resistors, (R7, 8, and 9) and one capacitor, C6. The pre-emphasis capacitor can be switched in or out by the switch SW-1 mounted on the front of the module. This capacitor is normally switched in. However, for certain tests, it is more convenient to remove the pre-emphasis network. The output of the pre-emphasis R-C network drives another emitter follower stage. This provides isolation between the network and a 15 kHz low pass filter. The filter is followed by a low noise amplifier/follower combination, Q-3, Q-4. The signal level from Q-4, the last emitter follower, is substantially higher than that required to drive the modulated oscillator. The signal is attenuated at the modulated oscillator card to minimize RF and noise interference. If it should become necessary to alter the pre-emphasis curve, changing the value of the switched pre-emphasis capacitor, C-6, will alter the response characteristics. CAUTION: Do not attempt to alter or adjust the 15 kHz low pass filter, FL-1. The inductors are epoxy sealed and require no adjustment.

Module Circuit Descriptions, Audio Module (Monaural)
Verification of proper operation of this module is accomplished by connecting a 600 ohm balanced audio source of 400 Hz to the line input terminals. Observing the wave form of the output signal, the voltage measured at the output terminals of the audio module should be 5 to 7V rms for a +10 dBm input.

Dual Audio Module (Drawing # 559047/1)
The dual audio card combines the circuitry of two monaural audio cards on one plug-in module. Performance of both sections is identical. The input attenuator of the right channel is composed of two variable resistors, R-20 and R-21 to balance the gain of the left and right channel amplifiers. Each amplifier utilizes a high frequency variable peaking capacitor to compensate for slight differences in high frequency gain. Proper adjustment of these components is covered in the calibration section of the manual.

Modulated Oscillator Module (Drawing #554021/1)
See Figure 5, Block Functional Diagram and schematic diagram, (Drawing #554021/1). The modulated oscillator module is the heart of the FM exciter. A simple LC oscillator, Q-1, operates at exactly one-half the output frequency.
The oscillator is loosely coupled to a doubler stage, Q-2, which multiplies the oscillator frequency. The output frequency voltage is then amplified by three stages of RF amplification, Q-3, Q-4 and Q-5, to approximately a 0.25 watt level. The RF amplifier stages are tightly coupled to provide adequate broadband characteristics to accommodate all of the FM sidebands. The low impedance RF output of the modulated oscillator is fed to a push-on coaxial connector, J-1, on the

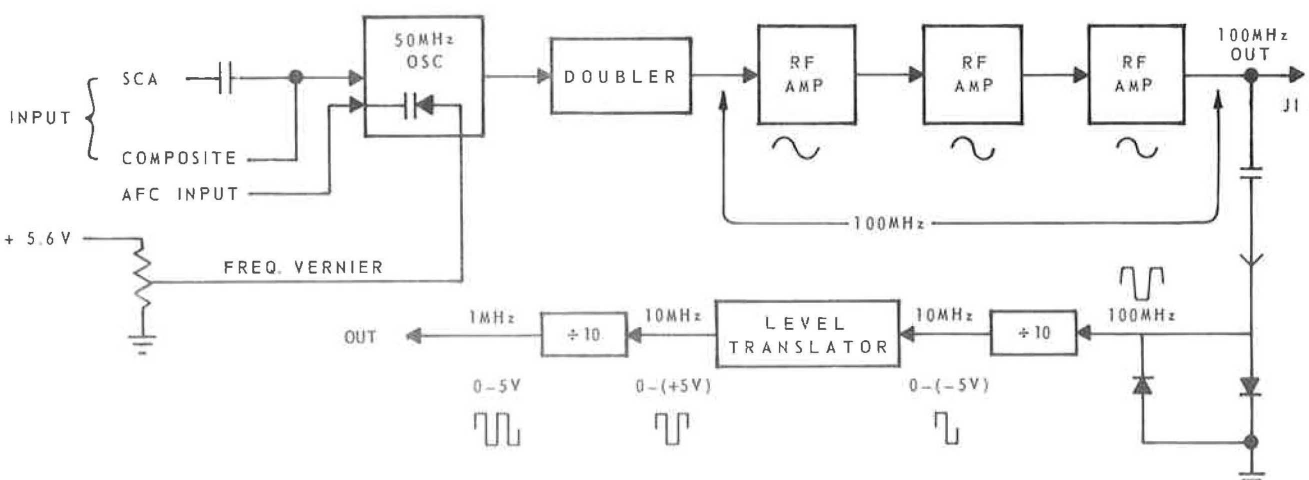


FIG. 5 BLOCK FUNCTIONAL DIAGRAM MODULATED OSCILLATOR

rear of the module. When inserting and removing the modulated oscillator module, make certain that J-1 mates with its chassis-mounted connector to prevent damage. The RF output from the Q-5 amplifier stage also feeds, through C38, a frequency divider chain, consisting of IC-1, Q-6 and IC-2. This circuitry drives the phase comparator sections of the reference generator module. IC-1 is a divide by 10, high frequency integrated circuit. Q-6 is a level translator to adapt the high frequency integrated circuit output frequency (one-tenth of the operating frequency) to a standard low-speed TTL divide-by-10, device IC-2. The output frequency (880 kHz - 1079 kHz range) of IC-2 is precisely 1/100th of the operating frequency and is fed to the phase comparator circuitry on the reference generator module.

The 50 MHz LC oscillator, Q-1, has two DC inputs and two composite inputs. One of the DC inputs is applied to both sides of the frequency control, voltage-variable capacitor-diode, VVC1, and is the voltage derived from the 50 MHz oscillator frequency adjust pot, R-30. This control is used to set the free-running frequency within the phase lock range. The other DC input to the cathode side of the VVC1 diode is the amplified output of the phase comparator, from the reference generator module. The AC inputs consist of the monaural or stereo composite input and the SCA input. These modulating signals are fed to a pair of back-to-back varicap modulators VVC2 and VVC3. Two VVC's are used as the modulator to increase the linear range of the voltage-capacitors transfer curve, thus lowering the harmonic distortion. The modulation varicaps have a DC bias applied through two 82K ohm voltage dividing resistors, R 3 and R 7, to select the most linear portion of the operating range .

Each control and modulation input to the modulated oscillator incorporates either RC or RLC filtering to prevent stray signals from modulating the oscillator. The filters also prevent oscillator voltage from feeding back into the external wiring. VVCI is AC coupled to the oscillator through C9. This allows the external DC voltages to vary without affecting the quiescent condition of Q-1. Increasing the anode voltage with respect to cathode of the diode increases the capacitance. This change in capacitance is minimized by the series reactance of the 5 pf capacitor, C9, coupling VVCI to the collector of Q-1. The resultant increase in capacitance will lower the frequency. The action of the modulation varicaps is similar to the control varicap; however the composite or AC signal applied to the modulator results in only instantaneous shift in frequency. The modulating frequency response of the modulated oscillator and varicap is limited only by the shunt capacitance of the varicaps, which is very low. The response extends into the megaHertz range.

Reference Generator Module

See Figure 6 and schematic diagram (Drawing #553031-/1). In addition to a temperature-controlled reference crystal oscillator and its associated divider circuitry, this module contains: a)two phase comparators, one for the operating frequency phaselock circuitry, and a second for the phaselock loss alarm circuits; b) a phase-to-voltage converter and additional dividers for the carrier frequency-derived chain.

The reference oscillator operates at one-tenth the specified exciter output frequency. Assuming a specified carrier frequency of 99.1 MHz, the reference oscillator crystal frequency would be 9.91 MHz. Q-1 operates as a conventional oscillator whose frequency is crystal controlled, stabilized in a 75 degree Centigrade oven located on the front of the module. Fine adjustment of the crystal frequency is made be adjusting a front panel control, R37 which varies a DC voltage applied to a voltage-variable-capacitor, VVCI. This control is utilized for periodic correction of operating frequency as measured by an external monitoring service.

Oven status is shown by two front panel light-emitting diode (LED) indicator lamps.

The output of Q-1 is amplified and buffered by Q-2.

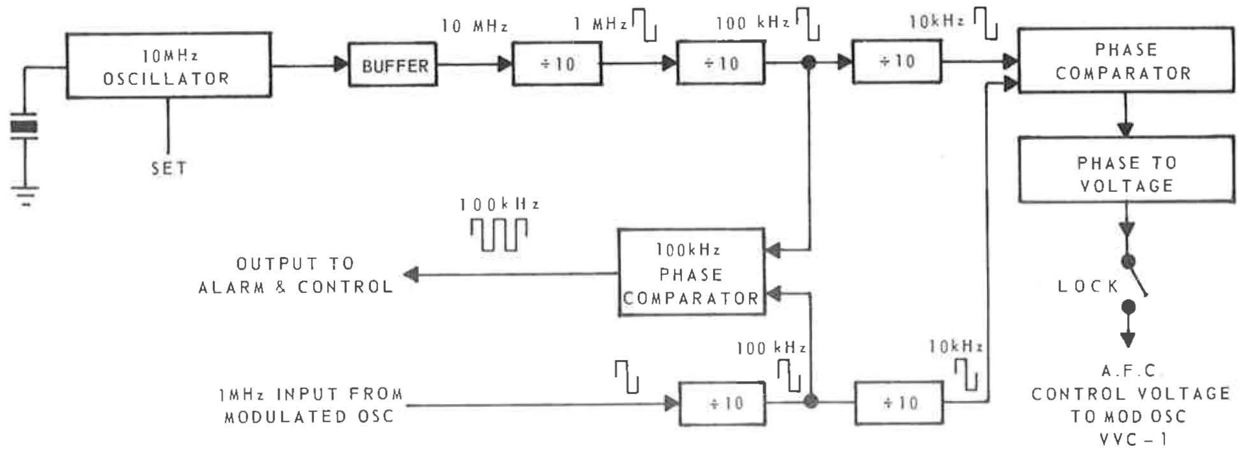


FIG. 6 BLOCK FUNCTIONAL DIAGRAM REFERENCE OSCILLATOR GENERATOR

Q-3 is a shaping amplifier which changes the essentially sinewave output of Q-2 to square wave output, compatible with the TTL circuitry which follows. Q-3 is heavily driven. Its grounded-emitter configuration produces square wave output and drives IC-1, a decade counter. The output of IC-1 (880-1080 kHz range) drives IC-2, another decade counter. Its output frequency is in the 88-108 kHz range. This signal is fed to one of the inputs of the phaselock-loss alarm phase comparator as well as to a third decade divider, IC-3, in the reference oscillator divider chain. The output of IC-3 is in the 8.8 to 10.8 kiloHertz range and is the reference input to Q-4 of the main channel phase comparator. Decade dividers IC-4 and IC-5 divide the 880-1080 kHz range carrier-frequency-derived pulses from the modulated oscillator module to the 8.8-10.8 kHz range and is the carrier derived input to Q-5 of the main channel phase comparator. Q-4 and Q-5, connected as a NAND gate, comprise the main channel phase comparator. Both Q-4 and Q-5 are heavily overdriven by the respective reference-derived frequency and carrier-frequency derived input pulses and produce symmetrical square waves at the paralleled collector output.

When the carrier-derived pulses are exactly in phase with the reference generator pulses, the output of Q-4 and Q-5 will be a perfect, 50% duty cycle, square wave varying from 0 to 5 volts, or averaging 2.5 volts. Any departure from exact phase coincidence between the two input signals will produce a square wave output of greater or lower than 50% duty cycle. This results in an average output voltage above or below the 2.5 volt value.

This comparator DC output voltage feeds a combination phase-to-voltage converter and loop filter, consisting of Q-6, Q-7, Q-8, and Q-9. Q-7 acts as a constant current source which charges C-14 to generate a ramp. Q-6 operates as a switch to set the initial voltage on C-14 at zero. Q-8 switches the current source on or off when the input signal goes high or low, respectively. Q-9 serves as an output emitter follower. It minimizes the loading on C-14 while charging the output filter. Thus the Q-6, Q-7, Q-8 and Q-9 circuitry operates as a DC loop filter or integrator, converting phase differentials at the phase comparator input into a DC output voltage. This output voltage is fed through the "lock" switch, SW-1, to the modulated oscillator frequency control input and corrects any difference between the reference-oscillator-derived and the modulated-oscillator-derived comparison frequencies.

The modulated oscillator "free-running" frequency may be adjusted by the front mounted frequency vernier control, (R-30 on modulated oscillator module) by placing the front panel lock switch in its off position.

Q-10 and Q-11 comprise the phase comparator for the phase lock loss alarm circuit. It operates at 100 kHz (carrier-derived input from IC-4 and reference-oscillator-derived input from IC-2) in an identical manner to the 10 kHz phase comparator, Q-4 and Q-5. However, the output of the Q-10, Q-11 comparator is not filtered to DC. When the two 100 kHz input signals are precisely in phase, 100 kHz square waves appear at the output of the comparator. If the frequency or phase of the input signals vary, the resultant 100 kHz pulses are modulated by the AC component resulting from the difference in the input frequencies. As an example, assume a departure of 1.0 kiloHertz from an operating frequency of 100 MHz. This would represent 0.1 Hertz ($1 \times 10^3 \div 1 \times 10^4 = 1 \times 10^{-1}$) difference at the main channel phase comparator operating at 10 kHz. This normally would result in a correction voltage to return the modulated oscillator to produce a precise 100 MHz output. If, for some reason, this does not occur, the 100 kHz comparator would produce a slip frequency of ten times 0.1 Hertz or 1.0 Hertz ($10^3 \div 10^3 = 1 \times 10^0$). The 100 kHz square wave signal, interrupted at a 1.0 Hertz rate would be fed to the alarm module, the circuitry of which responds to input frequencies up to 7,500 Hertz representing a carrier frequency error of 7.5 MHz at the 100 MHz operating frequency.

Alarm and Control Module

See Figure 7 and schematic Diagram Dwg. # 550161/1. The alarm and control module contains circuitry to

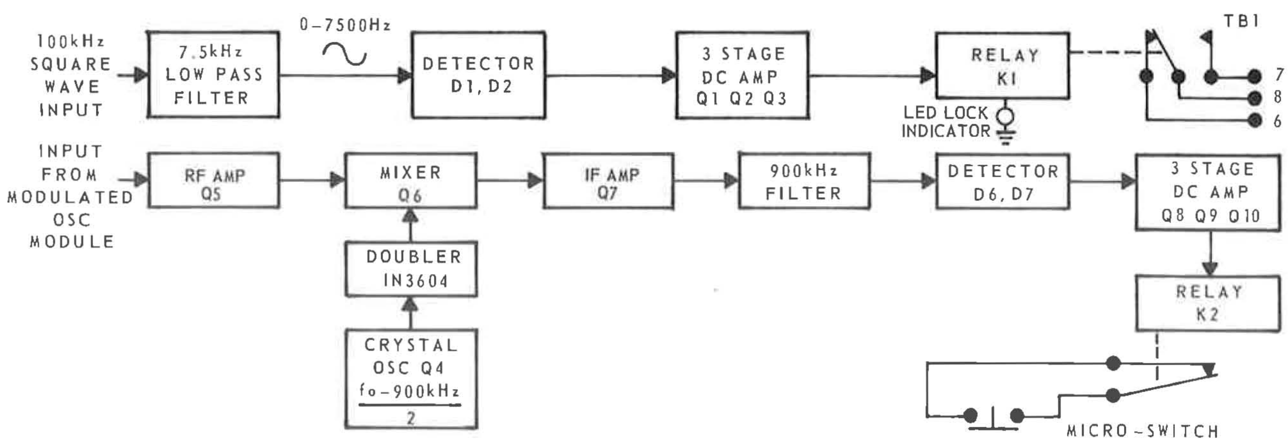


FIG. 7 BLOCK FUNCTIONAL DIAGRAM ALARM & CONTROL MODULE

alert the operator to loss of phase lock and to disable the unit if a frequency deviation in excess of 100 kHz occurs.

The output of the 100 kHz phase comparator, located in the reference generator module is fed to a 7.5 kHz low pass filter, FLI. This filter eliminates any 100 kHz components produced by the 100 kHz phase comparator and passes only the low frequency slip frequency, which would be present in the event of loss of the phase lock condition. The low frequency sine wave output of the filter is detected and converted to a DC voltage which turns off transistor Q-1. This action switches Q-2 on and Q-3 off. When Q-3 is turned off, collector current de-energizes relay K-1 and turns the LED lock indicator "off". The contacts of K-1 (rated at 1.0A, 28 VDC), appear on the rear terminal barrier strip of the exciter. This termination may be used to operate an external visual or aural alarm, indicating a loss of phase lock. Alarm loads in excess of 25 watts should be operated by a slave relay actuated by the exciter relay contact closure. R-5 is a sensitivity control permitting adjustment of the threshold condition of DC amplifier, Q-1, Q-2, Q-3, to a point sufficiently sensitive to insure early detection of loss of phase lock. Loss of phase lock does not necessarily result in an out-of-tolerance operating frequency. However, the center frequency should be closely monitored in the absence of phaselock and frequency corrections should be made manually. The 100 kHz comparison frequency represents a division of the carrier frequency by a factor of 1000 times. A carrier frequency error of 1000 Hz produces a 1 Hz signal at the output of the 7.5 kHz low pass filter. The detector responds to a loss of lock condition of 7500 x 1000 or an error of up to 7.5 MHz at the carrier frequency. Since it is possible to operate on frequencies which when divided by 10,000 produce submultiples suitable for phase lock, a second backup system is employed to prevent off-frequency operation. Refer to the Alarm Module Block Diagram, Fig. 7. A crystal oscillator, Q-4, operates at a frequency of $\frac{\text{carrier frequency - 900 kHz}}{2}$.

The oscillator output frequency is doubled, then mixed with an operating frequency signal fed from the modulated oscillator module. The RF input from the modulated oscillator module is amplified by the field effect transistor, Q-5, and fed to mixer, Q-6. The 900 kHz intermediate frequency output of Q-6 is amplified by Q-7. Q-7 drives a 900 kHz band pass filter. The filter provides a 900 kHz IF output signal to the diode detector, D-6, D-7. If the operating frequency should shift by 100 kHz or more (resulting in a mixer output frequency 100 kHz removed from the normal 900 kHz, IF), the voltage at the filter output will decrease sufficiently to allow Q-8 to turn on. If Q-8 turns on, Q-9 is turned off and Q-10 is turned on. The collector current of Q-10 energizes relay K-2 and opens the relay contacts appearing on connector terminals 8 and 10. The normally closed contacts, 8 and 10, connect DC supply voltage to the power amplifier module. This relay contact closure is by-passed by a microswitch, mounted on the main frame, which operates if the alarm module is removed from the mounting frame for service or maintenance.

RF Power Amplifier Module

See Figure 8 and schematic diagram Dwg. # 552073/1. The two-stage RF power amplifier increases the approximately 0.25 watt output level of the modulated oscillator module to a rated 10 watts output level, and typically will deliver up to 15 watts output power into a properly matched 50 ohm load.

The RF input to the first stage, Q-1, is fed through the drive control, R-1 and an impedance matching network comprised of C1, C2 and L1. The output circuitry of Q-1 matches the input impedance of Q-2, the final output stage. The RF output from Q-2 appears at a push-on coaxial output connector at the rear of the module. RF output is sampled by diodes D1 and D2 to provide a relative power output level indication. The total collector current of Q-1 and Q-2 passes through a .47 ohm resistor, R4. The voltage developed across this resistor is fed to the front panel meter when the DC meter switch is in the Ipa position.

The RF output power is adjustable by R1 over a range of approximately 2 to 15 watts by varying the RF input level from the modulated oscillator module. An RF on/standby switch SW-1 is provided on the front panel of the RF module. This permits removal of RF power from the equipment following the exciter without disabling the complete exciter. The + 24V DC supply voltage for the RF power amplifier can be interrupted

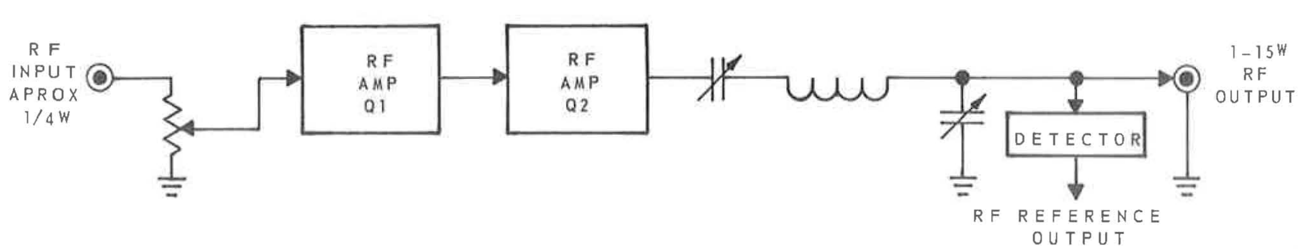


FIG. 8 BLOCK FUNCTIONAL DIAGRAM RF POWER AMPLIFIER

at several points in the exciter system, as shown on the Main Functional Block Diagram.

1) The rear terminals TB-2, 1 and 2;
2) Channel-loss relay contacts on the alarm and control module;
3) Main frame-mounted microswitch (actuated when alarm module is removed);
4) Standby switch on the RF power amplifier Module.

CAUTION: 1) Although the RF power amplifier can operate under normal conditions without a 50 ohm RF load, good engineering practice dictates that the RF amplifier be operated with a suitable RF load with a voltage standing wave ratio of less than 2:1. This VSWR represents a transmission efficiency of 89%; 2) Use extreme care in inserting or removing the RF Amplifier Module to avoid damage to the push-on coax connectors. If misalignment occurs, remove the rear panel of the exciter and realign the connectors on their respective mounting bracket by loosening the connectors mounting hardware. Carefully insert the module, then retighten the hardware securing the coaxial connectors to the frame.

Power Supply Regulator Module

See Figure 9 and schematic diagram (Dwg. # 552074/1). The power supply regulator provides all the required DC supply voltages. Four separate regulators are incorporated in the module. These include a +5 volt supply for all logic devices and phase comparators. A-5.2 volt supply feeds the high speed 100 MHz decade divider, IC-1, of the modulated oscillator module. A +15 volt supply powers all other modules except the RF power amplifier. Power to the RF power amplifier is supplied from a +24 volt source.

Transistors Q-1 and Q-2 act as a Darlington regulator with an overload current protection circuit, consisting of D-1, D-2, and D-3. Current drawn through the 0.27 ohm series resistor, R-11 develops a voltage drop sufficient to allow current at the base of Q-1 to be drained from the base through the load, thus preventing the Darlington combination Q-1, Q-2 from being turned on. The two forward biased diodes, D6 and D7 in series with the 5.6 volt zener diode, Z-3, increase the reference voltage sufficiently to overcome the DC voltage loss of Q-1, Q-2. The DC output voltage should be 5V, ± 10%, as measured with a high quality DC voltmeter. The DC meter provided on the front panel of the exciter should be used as a reference. In the event of a discrepancy between the front panel meter reading and the specified +5 volts, verify the reading by measurement of the actual voltage at the modules.

The operation of the −5.2 volt supply, with Q-3, Q-4 regulators, is similar in operation to the +5 volt supply with the exception of the current shutdown. Refer to the schematic diagram for nominal voltage values.

The +15 volt supply uses regulator circuitry similar to that used in the +5V supply. This supply is a relatively high current supply. The output voltage should be measured with all modules properly inserted. Transistor Q-6, an NPN power device, is mounted on the metal chassis of the power supply regulator and is insulated from the chassis with a mica washer.

Q-7 and Q-8 operate as Darlington pass transistors in the +24 volt supply. These transistors are mounted on the external heat sink located on the top of the main chassis. Q-7 and Q-8 receive a base reference voltage from Z-1. The 24 volt supply is current limited at approximately 1.25A, well above the maximum current requirements of the RF power amplifier. A 1.5A fuse, F1, is provided between the rectifier diodes and the regulator to protect the power transformer if a failure occurs in the regulator section. All voltages to the power module are supplied by a common power transformer with three separate secondary winding. See the Main Block Functional Diagram for the proper power transformer connections and power supply interconnection wiring.

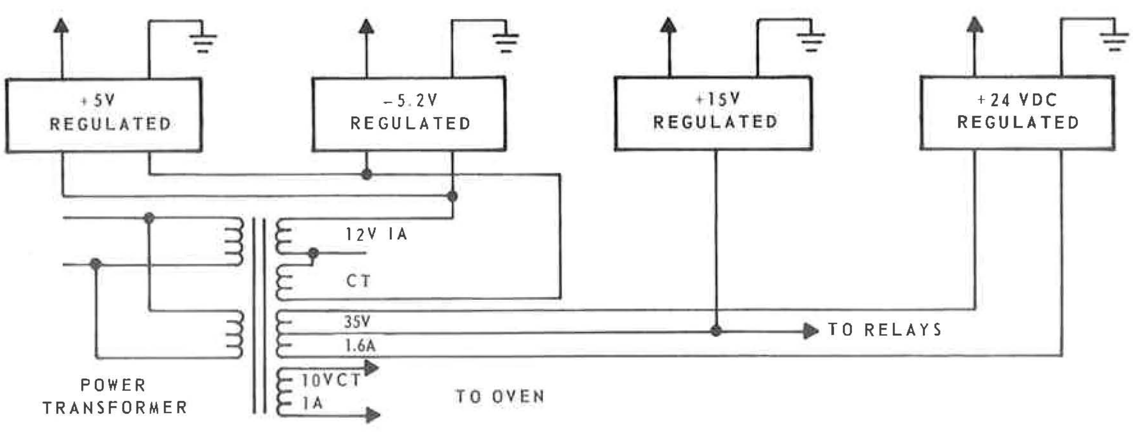


FIG. 9 BLOCK FUNCTIONAL DIAGRAM POWER SUPPLY REGULATOR

Meter Amplifier and Switching

See Figure 10 and schematic diagram (Dwg. #551049/1). The meter amplifier, located behind the front meter panel, is used to amplify the various audio frequency modulation signals sufficiently to drive the front panel VU meter. This is accessible by removal of the top cover plate.

Q-1 provides amplification to drive the emitter follower, Q-2. Q-3 functions as a DC meter drive amplifier. Rectification of the DC signal takes place in the base circuit of Q-3. The transistor operates as an emitter follower with the meter connected to a tap on the emitter resistor. Since the meter is DC coupled, a small amount of DC flows through the meter to ground. To compensate for this voltage, a reverse voltage is applied to the opposite side of the meter through the adjustable 1K ohm, zero adjust potentiometer, R-14.

The input calibrate control, R-1, sets the overall gain of the amplifier so that 100% modulation corresponds to a zero VU reading on the meter.

Model B-112 Stereo Generator Module (Dwg. #559048/1)

The stereo generator module utilizes a switching method of generating a stereo composite signal. The prime advantage of this method is simplicity of adjustment and excellent stereo separation. Transistor Q-6, a crystal oscillator, operates at 76 kHz. Its output is loosely coupled to Q-7, a buffer stage, operating as an emitter follower. The output of Q-7 drives a shaping amplifier, Q-8. Q-8 is heavily overdriven, resulting in square wave output. The collector voltage of Q-8 changes from the full supply voltage value to zero voltage at a 76 kHz rate. This square wave 76 kHz signal drives switching integrated circuit, IC-1. IC-1 provides a dual function. It divides the 76 kHz signal by four to 19 kHz for pilot carrier output and secondly, provides two 38 kHz signals which are precisely 180 degrees out of phase. The two 38 kHz out-of-phase square wave voltages drive Q-1 and Q-2. Q-1 and Q-2 operate as high impedance shunting switches. They alternately switch out a segment of the audio input signal coming from the input terminals of the module. When Q-1 is turned on, Q-2 is turned off. When Q-1 is in its "on" state, the input signal from terminals 9 and 10 is shunted to ground, hence cannot reach the composite amplifier, Q-3. During the same time interval, Q-2 is turned off and an input signal on terminals 13-14 can reach Q-3. 250 ohm controls, R-11 and R-12, in the collector leads of Q-1 and Q-2, serve to balance the attenuation of the two transistor switches. Correct setting of these controls will be covered in the Calibration and Operation section of the manual. The combined signal in Q-3 consists of the chopped signal from terminals 13-14; the 19 kHz pilot which is now a sine wave derived from IC-1 through a 19 kHz filter; plus many harmonics generated in the square wave switching process of Q-1 and Q-2. The composite signal out of Q-3 is filtered by a 53 kHz low pass filter, located on the lower top cover of the unit. This filter is properly matched by the input and output circuits to produce a constant group delay over the frequency range of the filter. The output of the filter is connected to Q-4, a simple gain stage, and Q-5, an emitter follower, providing a low impedance output to drive the modulator. A front panel pilot phase control, R46, adjusts the phase of the transmitted 19 kHz pilot. This function insures proper timing of the transmitted pilot and the transmitted 38 kHz switched composite signal. The amplitude of the pilot is normally set at 1/10th the level of the composite signal. Thus 100% total modulation would include 10% injection of the 19 kHz pilot carrier. This amplitude is established by a front panel pilot amplitude control, R-47.

The 19 kHz pilot carrier may be disabled by a front panel switch, SW-1, placing the system in a monaural mode. In monaural operation, the audio input signals at terminals 9-10 and 13-14 are resistively combined, adjusted in level and connected directly to Q-4 and Q-5 to feed the monaural signal to the modulated oscillator module. The above switching is accomplished by a relay located on the module itself. The relay can

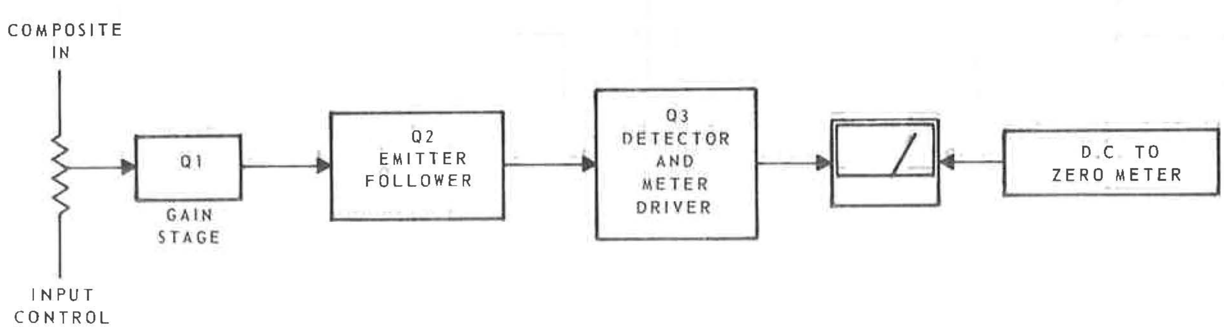


FIG. 10 BLOCK FUNCTIONAL DIAGRAM METER AMPLIFIER

be controlled by the front panel switch, or remotely by an externally connected switch closure across terminals TB-2, 7 and 8. The front panel control must be in the mono position for remote selection of the mono/stereo modes.

Model B-113 SCA Generator (Dwg. # 559049/1)
The SCA Generator (Module position 2 or 3) is available on two standard frequencies, either 41 kHz or 67 kHz. Dual transistor Q-3 (a matched silicon pair) functions as the free-running master oscillator. The frequency is primarily determined by the time constant of R-16, R-20, C-5, C-8 and the voltage applied by the position of R-10, the coarse adjustment, and R-11 the front panel fine adjustment. The audio modulating signal is also applied to the bases of Q-3. The audio is frequency bandwidth limited by filter FL-1, The output of FL-1 is connected to a 1K ohm potentiometer, R-3, which acts both as a load to the filter and as the modulation level control. The following two stages, Q-1 and Q-2, serve as an amplifier and emitter follower to provide the necessary level and pre-emphasis to properly modulate Q-3. C-2 produces the necessary pre-emphasized frequency response by increasing the gain of Q-1 as the modulation frequency is increased.

The output of Q-3 is a 41 kHz or 67 kHz square wave frequency modulated signal which is coupled to emitter follower Q-4, through a DC voltage controlled switch consisting of R-21, R-22, R-23, and D-6, D7. The resistor diode switch is used to provide a silent muting circuit. The 67 or 41 kHz square wave signal out of emitter follower Q-4 must be filtered by FL-2 before being transmitted. FL-2 eliminates the unwanted square wave harmonics and produces a clean subcarrier consisting only of a frequency modulated sinusoidal waveform. To prevent undesirable loading of the low pass filter, Q-5, an emitter follower provides the necessary isolation. The output level from Q-5 is controlled by potentiometer R-29 to vary the SCA sub carrier injection level.

The emitter of Q-2 is connected to a 2.5K control, R-9, and adjusts the modulation voltage level to the input of Q-7. Q-7 functions as a limiter amplifier. Q-7 provides 40 dB of limiting to the sampled modulating voltage. The limiter output voltage is rectified. The rectified DC output voltage is used to turn on the electronic mute switch, R-21, R-23, D-6, and D-7. The mute voltage is bled off to ground through the R-44, C-21 combination which functions as a variable mute delay circuit. The presence of the mute voltage turns transistor Q-8 on, allowing current to flow through the LED indicating lamp mounted external to the SCA module.

The 35-40 volt unregulated source voltage is filtered and regulated by transistor Q-6.

V. OPERATION

Turning on Exciter
Place the PA drive control located on the RF Power Amplifier module in its extreme counterclockwise position. Connect AC power to terminals TB-1, 1 and 2. Connect a 50 ohm load to the exciter RF output jack. Actuate power switch. Check DC meter readings by switching to the +5V, −5V, +15V, and +24V positions to insure proper operation of the power supplies.

Obtaining Phaselock
Rotate the meter switch to the phase lock position. In this position, the output of the 10 kHz phase comparator is connected to the meter through a 4.7 K calibration resistor, R-14A. Turn the exciter off momentarily while observing the phase lock meter. Once again, turn on the exciter. The meter should come up to near 100%. Within 15 seconds, the meter will quiver as the modulated oscillator approaches the lock frequency. Slow oscillation of the meter needle is due to the presence of the AC slip frequency signal. As lock is automatically attained, the quivering will stop abruptly and the LED indicator on the alarm module will come on a few seconds later. To verify proper phase lock, adjust the 50 MHz vernier frequency control R-30 (located on the modulated oscillator module front panel) slowly to the left, then to the right. The meter should follow the control negatively, then positively. If phase lock is not attained, the meter will not follow the vernier control. Check to be certain the phase lock switch on the reference generator is in the lock position. If the vernier frequency control has been improperly adjusted or the unit is extremely cold, continue to slowly adjust the vernier frequency control from one extreme to the other until lock is attained and the meter follows the rotation of the control. After lock is attained, rotate the control to position the meter at 100%. This will assume good relock if a loss of AC power occurs. After a few hours of operation, recheck the phase lock position for 100% reading.

Setting the Station Frequency
No attempt to adjust the station frequency should be made until the system is phase locked, and has been in operation long enough to reach normal operating temperature. Allow 30 minutes for the crystal oven temperature to stabilize. The front panel frequency control on the reference oscillator module is used to adjust the frequency to a properly calibrated frequency monitor or to concur with measurements taken by a frequency measuring service.

Adjusting the RF Output
With a properly matched 50 ohm load connected to the output of the B-910 FM exciter, flip the RF on/standby

switch located on the RF Power Amplifier Module to the "on" position.

Adjust the PA drive control clockwise while monitoring the Ipa meter position.

The meter is a 0-1 ampere meter in this position, 100% corresponding to 1A. As the PA drive is increased, the RF output will increase. Advance the drive control until the desired RF output is achieved. In no case should the final current reading exceed 1 ampere. Normally an RF output of 10 watts is achieved with approximately 600-900 milliamperes of PA current. The PA position scales the meter to a 0-28 volt DC meter and is only used as a reference. After the proper output is obtained, either connect an in-line RF wattmeter in series with the output coaxial line and adjust the PA tune-loading controls for maximum RF output power, or adjust the loading control for minimum Ipa current. Either procedure will result in a resonant condition for the power amplifier output network.

Monaural Audio

Connect a 400 Hertz audio source to the proper input terminals located on the rear of the exciter. The audio signal level feeding the exciter should be approximately +10dbm. Position the flat/pre-emphasis switch located on the front of the module to the pre-emphasis position. Adjust the audio level to the exciter for the desired percentage of modulation as indicated on an FCC type-approved modulation monitor. Alternatively, position the front panel meter switch in the audio position and adjust the level accordingly. The meter is a semi-peak reading device and is calibrated to display 100% modulation with a sine wave audio input signal. When feeding complex wave program material, allowance must be made to maintain modulation peaks below the 100% modulation point since a semi-peak meter cannot respond to intermittent peaks of short duration, as experienced with normal program material.

Stereo Operation

Audio

Connect suitable sources of audio to the left- and right-channel terminals on the rear of the B-910 exciter; left input, TB-3, 5 and 6; right input, TB-3, 7 and 8. Adjust the levels as described in the monaural section.

Pilot Level

Remove the audio from the exciter. With a properly adjusted FCC type-approved modulation monitor capable of measuring the 19 kHz pilot injection, adjust the pilot level, located on the front panel of the stereo generator module for 8-10%.

VI. CALIBRATION PROCEDURES

REFERENCE GENERATOR MODULE (Reference Oscillator)

Place the reference generator module on the module extender card.

1. Turn meter switch to the Reference Oscillator position.
2. Adjust inductor L-1 for maximum reference oscillator voltage.
3. Position the frequency adjustment control on the front of the module to its mid-position.
4. Connect a frequency counter to the collector of Q-3 or observe the frequency of the exciter with an FCC type-approved frequency monitor. The frequency should be within 1 kHz of the desired frequency. If the frequency deviation is greater than 1 kHz; rotate the slug in inductor L-1 in the appropriate direction to bring the frequency closer to the desired frequency. This will insure sufficient tuning range with the front control, to permit long-term frequency correction.
5. Adjust the Reference Oscillator calibration pot R-10 (100K) for a 100% reading on the front panel meter.

REFERENCE GENERATOR MODULE (Phase to Voltage Converter)

1. Connect an oscilloscope to the .005 tantalum charging capacitor, C-14.
2. With the system in phase lock, observe the wave form across the capacitor. Slowly advance the 50 MHz oscillator vernier until the system loses lock, Just prior to phase lock loss, the wave form should be similar to Fig. 11 below.

   If the observed wave form is more similar to that shown in Fig. 12, adjust the ramp voltage control, R-19, slightly in the direction which lowers the ramp amplitude until the glitch on the leading edges is eliminated, as phase lock is lost. This control normally will operate in its full clockwise position.

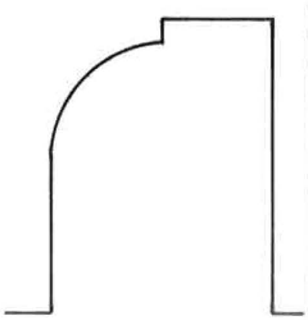


FIG. 11

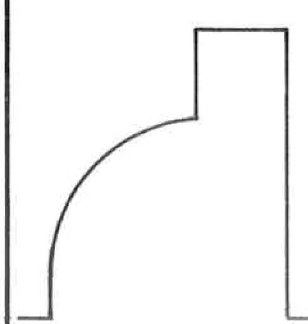


FIG. 12

MODULATED OSCILLATOR MODULE

Place the modulated oscillator module on the extender card.

1. Turn phase lock switch off (located on reference generator module).
2. Position the vernier frequency control, R-30, in its mid-position.
3. Position meter switch in phase lock position.
4. Connect a suitable 100 MHz frequency counter to the RF output jack (J-1). CAUTION: A pad may be required between the exciter output and the counter to prevent damage to the latter unit.
5. Position all coil slugs (L-2, L-6, L-8, L-11, L-14) near their mid-position.
6. Connect a 100 MHz oscilloscope or RF voltmeter to the RF output jack.
7. Slowly adjust the oscillator coil, L-2, and watch the phase lock meter for a low frequency beat. Turn the coil slug very slowly as it is possible to miss the beat. Set the slug as close to the zero beat indication as possible.
8. Flip the phase lock switch on. The meter should snap to a steady position indicating phase lock and the LED lock indicator on the alarm/control module should come on after a few seconds.
9. Observe the output voltage of the module. Adjust the doubler coil, L-6, for maximum 100 MHz output.
10. Adjust the three remaining slugs in inductors L-8, L-11, and L-14, for maximum output. The tuning of these inductances will be extremely broad.
11. Observe the frequency on the counter or the frequency monitor. The frequency should be the desired carrier operating frequency.
12. Remove the counter and replace with a 47 ohm, 1-watt non-inductive resistor.
13. Adjust the series output coupling capacitor, C-37, for maximum output. The final RF voltage output should be between 3 and 5 volts across the 47 ohm resistive load.

MONAURAL AUDIO MODULE

1. Connect an accurate signal generator with either internal or external calibrated attenuator to the input terminals and an output voltmeter of flat frequency response over a 50 to 15,000 Hz range, to the output terminals.
2. Adjust the input level at 250 Hz to +10 dBm.
3. Set an output level reference.
4. Vary the input frequency between 50 and 15,000 Hz, recording the attenuation of the input signal necessary to maintain a constant output voltage. The attenuation settings should follow closely the standard 75 microsecond pre-emphasis curve as shown in section 73.333 of the FCC Rules and Regulations. A reproduction of the standard pre-emphasis curve is included following this section.
5. If the measured response does not follow the prescribed curve, the pre-emphasis may be altered slightly by varying the value of the nominal 1500 pf capacitor, C-6, in series with the pre-emphasis switch, SW-1.
6. Do not alter the adjustment of the 15 kHz low pass filter. This is an extremely stable filter, precisely adjusted at the factory. The tuning slugs in the inductors are epoxied in place after final factory adjustment.

ALARM AND CONTROL MODULE

Connect the alarm and control module to the extender card. Check for proper frequency crystal in the alarm module. Use the formula below for determining the proper frequency of the crystal.

$$Fc(MHz) = \frac{fo+900kHz}{2} \quad \text{or} \quad Fc(MHz) = \frac{fo-900\ kHz}{2}$$

Oscillator Adjustments

1. Connect a voltmeter with a 5 volt range to the test point TP-1, located between the oscillator and doubler coils, L-3 and L-2.
2. Adjust the slug in the oscillator coil, L-3, for maximum voltage at the test point. Rotate the slug in a direction to increase inductance for maximum voltage reading. Adjust the slug for a reading approximately 10-15% below the maximum voltage obtained. This will insure reliable crystal starting whenever the unit is turned on.

Doubler Adjustment

1. Adjust the doubler coil, L-2, for a noticeable dip in the output voltage observed at the above test point. Set the slug for the exact minimum reading. The final voltage reading will be between 1 and 2 volts DC.

RF Coil Adjustment

1. Connect an oscilloscope to the collector of transistor, Q-6, (the mixer), Observe the 900 kHz intermediate frequency. Adjust the RF coil, L-1, for maximum 900 kHz output, which is typically 2 volts, peak-to-peak.

Off Frequency Detector Threshold

1. Temporarily remove the crystal, Xtal-1, from its socket. Adjust the K-2 threshold control, R-33, to the point where the coil of K-2 just energizes. Reinsert the crystal. K-2 contacts should then reopen, (relay de-energizes.)

Phase Lock Loss Threshold

1. Turn the phase lock switch to the off position. Rotate the vernier frequency control on the modulated oscillator module to the extreme counterclockwise position.
2. Adjust the loss of lock threshold control, R-5, until relay K-1 is de-energized.
3. Turn the phase lock switch to its on position. Adjust the modulated oscillator vernier frequency control for phase lock. After approximately 3 seconds, relay K-1 should energizes.

RF POWER AMPLIFIER MODULE

Remove the RF Power Amplifier cover, reinsert the module, remove the Reference Oscillator module and the Alarm and Control module to gain access to the RF Amplifier.

1. Connect a calibrated RF wattmeter to the RF output jack (J-1) on the rear of the exciter.
2. Connect a high frequency oscilloscope to the RF output Jack, adjust C-1, C-2, C-7, C-8, C-13, and C-14 for a maximum signal as shown on the wattmeter, and simultaneously observe the oscilloscope to ascertain at the same time that the sinusoidal RF waveform as displayed shows the minimal amount of harmonics and spurious signals.
3. Switch the DC Meter function switch to Ipa, a reading of between 600 and 900 millamperes should be indicated.
4. Switch the DC Meter switch to Ipa, a reading of between 22 and 24 volts DC should be indicated. (If correct Ipa and Epa readings are not obtained, repeat step 2 until correct readings are obtained.)
5. Return the DC Meter switch to Epa and adjust the front panel RF Drive control until a reading of 800 milliamperes is indicated. The RF output at this reading is between 8 and 12 watts.
6. Observe the indication of RF output power on the wattmeter and adjust C-13 for maximum RF output.
7. An RF output power of 10 watts should be obtained with a total Ipa current of less than 900 milliamperes.
8. Adjust the front panel RF Drive control for the desired RF output power (10 watts for a B-910T or the recommended required RF drive for the transmitter for which a B-910 is being used as an exciter).
9. Switch the DC Meter switch to the RF position and adjust the RF Sample Calibration control, R-6 for a 100% reading on the meter. The RF output meter reading is relative. It is a sampling of RF voltage and is not a precise indication of RF power. A calibrated RF wattmeter terminated with a non-inductive 50 ohm load should be used whenever absolute RF power readings are to be made.

POWER REGULATOR MODULE

All output DC voltages from the Power Regulator Module are zener diode referenced and no calibration adjustments are required or possible.

NOTE: A 1½ Amp fuse, F-1, is located inside of the module protecting the RF Power amplifier.

STEREO GENERATOR MODULE

1. Place the stereo generator module on the extender card provided.
2. Connect an FCC Type Approved stereo modulation and pilot frequency Monitor to the output of the B-910.
3. Locate the left and right-channel audio input terminals located on the rear apron of the exciter.
4. Connect an audio source of 250 Hz at a +10 dBm level to the left-channel audio input terminals and adjust the composite output level control for 100% left channel modulation indicated by 100% on the total modulation monitor and 90% on the left channel meter of the stereo modulation monitor.
5. Switch the stereo modulation monitor to monitor the 19 kHz pilot injection. Adjust the 19 kHz pilot level control located on the front of the module for 10% pilot injection.
6. Switch the signal generator to 100 Hz. Parallel the left- and right-channel audio input terminals in a manner which will have the right channel out-of-phase with the left (L = –R).
7. Adjust the level for 100% total modulation.
8. Connect an oscilloscope to the composite output terminals of the stereo generator module. (This can be readily connected to the arm of the output level control, R-31).
9. Observe the bow-tie waveform and adjust the 19-38 kHz phasing control, located on the front of the stereo generator module, to phase the horizontal arrow heads exactly horizontal to each other as shown below in Fig. 13. (Fig. 14, incorrect adjustment).

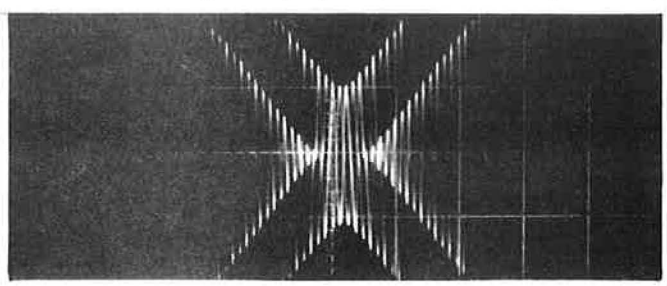


FIG. 13

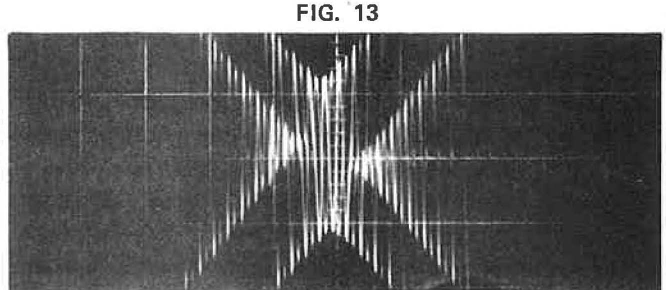


FIG. 14

10. Feed a 400 Hz signal to the left channel input.
11. Adjust the oscilloscope to properly synchronize on the composite waveform. Adjust the left channel amplitude switch control for minimum curvature in the base line as shown in Fig. 15.

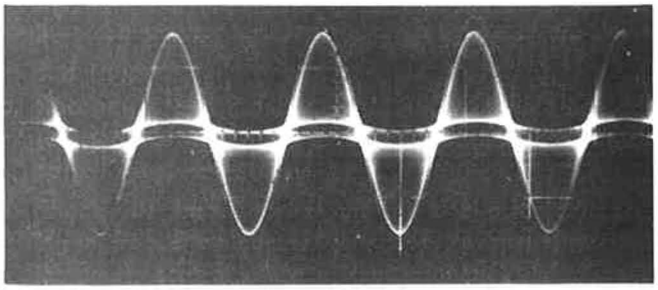


FIG. 15

12. Repeat steps 9 and 10 with the signal generator connected to the right channel input terminals. Adjust the right channel amplitude control.
13. Select an audio frequency near 10 kHz. Observe the base line of the composite wave form. Alternately adjust the filter-matching series and shunt trimmers, R-20, and R-24 for minimum phase error and straight base lines as shown in Fig. 16. (Fig. 17, improper adjustment).

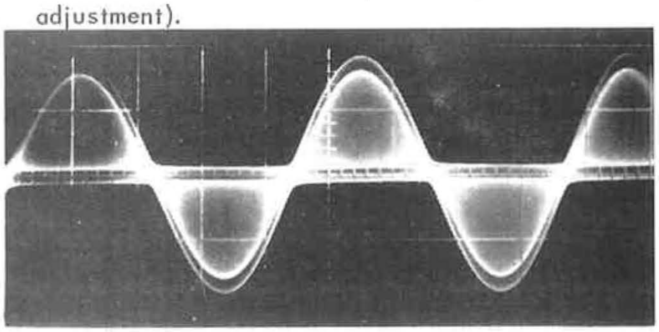


FIG. 16

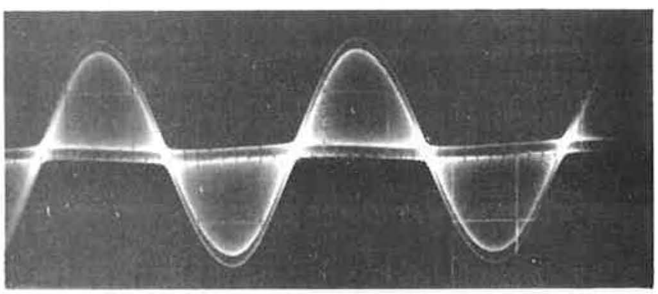


FIG. 17

14. Check the stereo audio separation using the stereo modulation monitor for both left into right and right into left measurements. Separation should be greater than 35 dB for all frequencies between 50 Hertz and 15 kHz.
15. Recheck steps 3 and 4. This will be the final adjustment of the pilot level control and composite output level adjustment.
16. Check the frequency of the 19 kHz pilot connecting a frequency counter to the pilot amplitude adjustment control. Adjust the frequency (if necessary) of the 19 kHz signal for exactly 19,000 Hz, ± 0 Hz, with the trimmer, C-11.
17. Connect the signal generator to the rear audio terminals of the exciter in a manner which will feed in-phase signals to the left and the right channels, L = + R. Measure the crosstalk of the L + R channel into the L − R channel using the stereo monitor for measurements. Complete the above across the 50 - 15,000 Hz spectrum.
18. Repeat step 16 except, connect the generator to feed L= − R signals, and measure the crosstalk of L - R into L + R.
19. Measure the suppressed 38 kHz carrier level. This should be below 1%.
20. Position the front panel stereo-mono switch in the mono position.
21. Adjust the monaural gain trimmer control, R-2, for 100% reading on the main channel monitor with a +10 dBm, 1000 Hz signal connected to the left channel input terminals.

Front Panel Modulation Meter

Remove top cover. The meter amplifier located in the compartment directly behind the meter panel has two calibration adjustments.

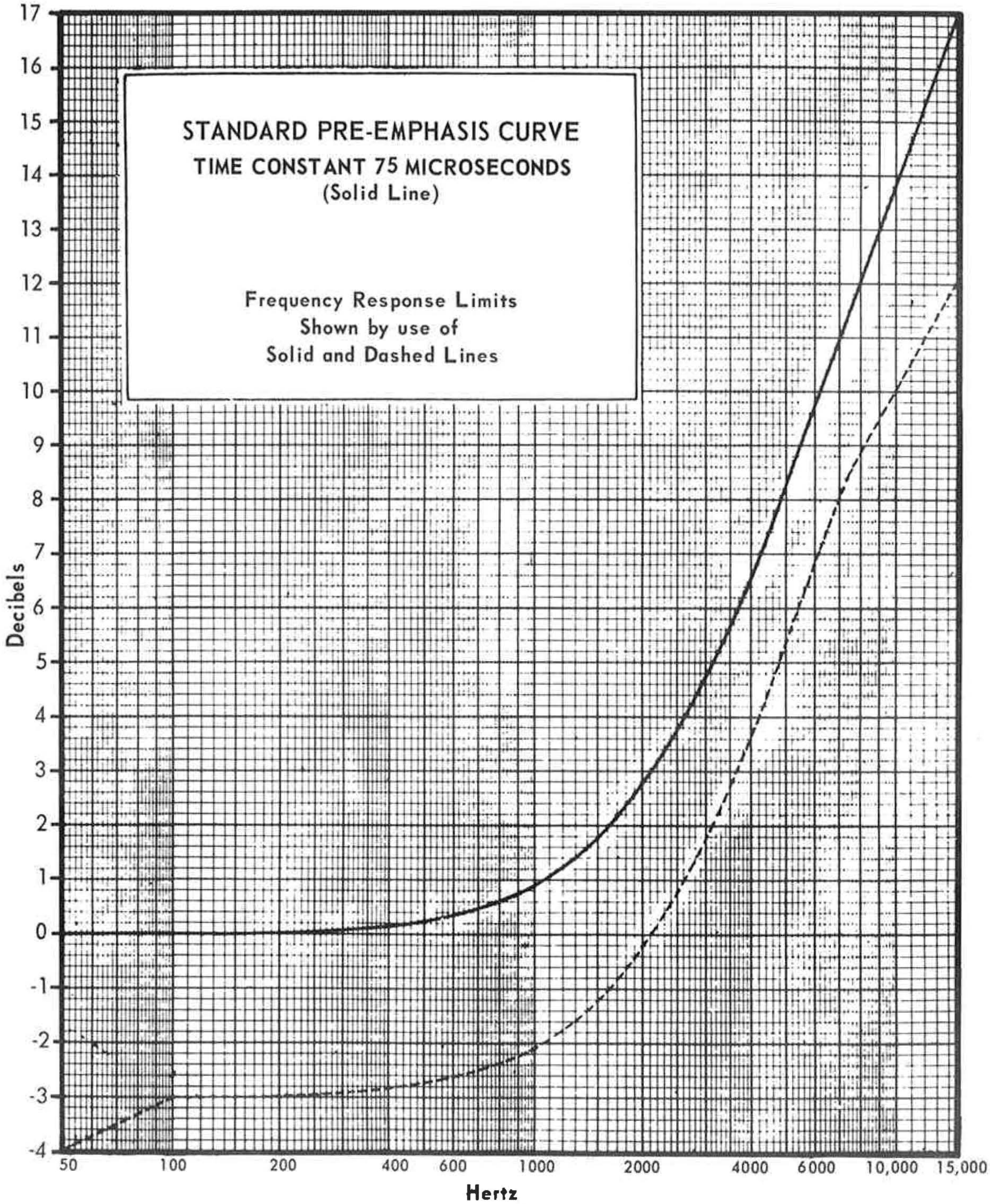
1. Remove all input audio signals.
2. Place the meter select switch in the Audio position.
3. Temporarily remove the stereo generator module, if used.
4. Adjust the DC balance control, R-14, located on the meter amplifier card, for zero reading on the meter.
5. Re-insert the stereo generator module if used, and modulate the transmitter 100% with a 1,000 Hz sinewave signal as indicated by a calibrated modulation monitor.
6. Adjust the input calibration control R-1 for exactly 100% as indicated on the front panel meter.

B-113 SCA GENERATOR

1. Position the SCA generator module on an extender card.
2. Connect an FCC Type Approved SCA frequency and modulation monitor to the output of the B-910 exciter.
3. Adjust R-10, the coarse frequency control for exactly 67 kHz with the front panel fine frequency control positioned approximately in the mid-position.
4. Position the flat/pre-emphasis switch in the "flat" position.
5. Connect an audio signal source of 1000 Hz, +10, ±2, dBm, to the rear audio input terminals.
6. Adjust R-29, the Injection Level control for 8-10% modulation as indicated on the SCA monitor.
7. Adjust R-3, the Modulation Level control for 100% subcarrier modulation.

8. Reduce the input signal level by 40 dB and adjust the Mute level control R-9, while observing the waveform at the output of Q-7 until the wave form peaks just start to clip. This will prevent noise from holding the SCA carrier on and will avoid unwanted dropouts of carrier.
9. Remove the audio input signal and observe the time delay for the carrier to squelch. Adjust R-44, the mute delay potentiometer for the desired delay period.

VII. STANDARD PRE-EMPHASIS CURVE



VIII. FCC STANDARDS

BROADCAST (FCC R & R, Section 73.317, Nov., 1972)

MODULATION .... ± 75 kHz = 100%

AUDIO FREQUENCY REQUIREMENTS .... 50 – 15,000 Hz

PRE-EMPHASIS CURVE .... 75 microseconds

TOTAL HARMONIC DISTORTION FOR 25%, 50% and 100%

50% and 100%	50 - 100 Hz	3.5%
	100 - 7500 Hz	2.5%
	7500 - 15,000 Hz	3.0%

The transmitter should not produce over ½ of the above maximum distortion figures.

FM S/N (50 Hz-15kHz) .... Greater than 60 dB below 100% FM Modulation
AM S/N (50 Hz-15kHz) .... Greater than 50 dB below 100% AM Modulation

CARRIER FREQUENCY DEVIATION .... ± 2000 Hz

All unwanted emissions must be 43 + 10 Log (Power in Watts) below the carrier power.

STEREO

PILOT FREQUENCY .... 19,000 Hz, ± 2 Hz

PILOT INJECTION .... 8 – 10%

STEREO SUB CARRIER SUPPRESSION LESS THAN 1% MODULATION .... 1% = – 40 dB

SUB CARRIER FREQUENCY RESPONSE .... 50 – 15,000 Hz

MAXIMUM L – R MODULATION .... 45% of total

MAXIMUM L + R (MAIN CHANNEL) .... 45% of total

STEREO SEPARATION
Left into Right .... 29.7 dB minimum
Right into Left .... 29.7 dB minimum
(FOR ALL FREQUENCIES BETWEEN 50 AND 15,000 Hz)

Cross talk: Main into Subchannel, or Subchannel into Main shall be greater than 40 dB below 90% modulation.

When monaural main channel programming is used, the SCA carrier must be between 20-74 kHz. Total of all SCA subcarriers shall not exceed 30% modulation of carrier. If engaged in stereo, the SCA carrier frequency shall be between 53 to 75 kHz. Total of subcarriers shall not exceed 10% modulation of the main carrier.

Crosstalk of the SCA subcarrier into the main channel shall be greater than 60 dB below 100% modulation for the frequency range of 50 - 15,000 Hz.

IX. PARTS LIST

The majority of the components used are of standard values and tolerances generally available from local electronics jobbers. Those components of unusual tolerances or of McMartin Manufacture are listed here.

MODULE # 1, MONAURAL AUDIO CARD

SYMBOL	P/N	DESCRIPTION
R-7, 8, 10	540001	10K ohm, 1%, metal film resistor
R-9	540019	3010 ohm, 1%, metal film resistor
C-2, 7, 11	670002	3.3 mf, 35V, 10% tantalum capacitor
C-5, 8	600027	20 mf, 16V, electrolytic capacitor
C-10	600019	1000 mf, 16V, electrolytic capacitor
Q-1, 2, 3	201050	SE-4010 transistor
Q-4	201056	2N3569 transistor
SW-1	480004	Single pole, double throw switch
T-1	910046	600 ohm audio transformer
FL-1		15 kHz low pass filter

MODULE # 1, STEREO AUDIO (OPTIONAL)

SYMBOL	P/N	DESCRIPTION
R-7, 8, 8A, 26, 27, 28A	540001	10K ohm, 1%, ½W metal film resistor
R-9, 28	540019	3010 ohm, 1%, ½W metal film resistor
R-20	400059	250 ohm, trim pot
R-21	400041	1K ohm, trim pot
C-2, 8, 12, 16, 22, 26	670002	3.3 mf, 35V, 10% tantalum capacitor
C-6, 20	660015	5.5 - 18 pf, variable capacitor
C-14	600019	1000 mf, 16V, electrolytic capacitor
C-13, 27	600009	160 mf, 25V, electrolytic capacitor
Q-1, 2, 3, 5. 6, 7	201050	SE-4010 transistor
Q-4, 8	201056	2N3569 transistor
SW-1	480026	Double pole, double throw switch
T-1, 2	910046	600 ohm, audio transformer
FL-1, 2		15 kHz low pass filter

MODULE # 2, STEREO GENERATOR (OPTIONAL)

SYMBOL	P/N	DESCRIPTION
R-2, 31	400053	2.5K ohm, trim pot
R-4, 5	540001	10K ohm, 1%, ½W metal film resistor
R-6, 9	540021	4750 ohm, 1%, ½W metal film resistor
R-11, 12, 20, 24	400050	250 ohm, trim pot
R-46	401012	5K ohm, pot
R-47	401017	100K ohm, pot
C-3, 4, 5	670005	220 mf, 10V, tantalum capacitor
C-7	600019	1000 mf, 16V, electrolytic capacitor
C-11	660026	5-25 pf, variable capacitor
C-15	670004	2.2 mf, 20V, tantalum capacitor
C-18	670011	3.9 mf, 35V, 10% tantalum capacitor
C-20, 22	116049	6800 pf, 33V, polystyrene capacitor
C-21	116104	12000 pf, 33V, polystyrene capacitor
SW-1	480004	Single Pole, double throw switch
D-1	210008	IN-4006 rectifier diode
RLY-1	470027	5000 ohm relay
Q-1, 2	201088	2N709 transistor
Q-3, 4, 6, 7, 8	201050	SE-4010 transistor
Q-5	201056	2N3569 transistor
IC-1	230041	MC7473P integrated circuit
L-1, 2	932041	12.0 mh pot core inductor
Xtal-1	090018	76 kHz crystal
Z-1	220007	13V SIR 13B Zener diode

MODULE # 2 or 3, SCA GENERATOR (OPTIONAL)

SYMBOL	P/N	DESCRIPTION
R-3	400041	1K ohm, trim pot
R-9	400053	2.5K ohm, trim pot
R-10	400055	10K ohm, trim pot
R-11	402006	250 ohm, Pot
R-16, 20	540017	68380 ohm, 1%, ½W metal film resistor

MODULE # 2 or 3 (continued)

SYMBOL	P/N	DESCRIPTION
R-44	400038	1 megohm , trim pot
D-1, 2, 3	210008	IN-4006 diode
D-5 through D-10	220005	IN-3604 diode
Q-1, 4, 5	201049	SE-4002 transistor
Q-2, 8	201056	2N3569 transistor
Q-3, 7	201074	2N2060 transistor
Q-6	201024	2N3053 transistor
Q-9	201055	2N4355 transistor
Z-1, 2	220019	5.6V Zener diode
Z-3, 5	220018	6.8V Zener diode
Z-4	220011	24V Zener diode
SW-1, 2	480004	Single pole, double throw switch
T-1	910046	Audio input - 600 ohm transformer

MODULE # 4, MODULATED OSCILLATOR

SYMBOL	P/N	DESCRIPTION
R-30	402003	5K ohm, pot
C-2	600019	1000 mf, 16V electrolytic capacitor
C-3 , 4, 22, 23, 24, 25	660030	.001 mf, 500V, feed-through capacitor
C-5	670015	30 mf, 25V, 10% tantalum capacitor
C-8	640040	18 pf, N470, disc ceramic capacitor
C-13, 16	670014	18 mf, 20V, 10% tantalum capacitor
C-37	660032	7-100 pf, variable capacitor
C-39, 41	670004	2.2 mf, 35V, 10% tantalum capacitor
L-1	930099	25 uH, rf choke
L-2	930100	50 MHz oscillator coil
L-3, 4, 7, 10, 13	930010	3 uH, rf choke
L-5, 9, 12	930011	10 uH, rf choke
L-6, 8, 11	930101	100 MHz doubler coil
L-14	930102	100 MHz amplifier coil
L-15	930029	.85 uH, rf choke
Q-1, 2, 6	201065	MPS 6539 transistor
Q-3	201079	2N5179 transistor
Q-4, 5	201081	2N3866 transistor
IC-1	230042	95H90 integrated circuit
IC-2	230050	SN5490N - integrated circuit
VVC-1, 2, 3	660034	MV2205 voltage variable capacitor
D-1, 2	220005	IN 3604 diode
Z-1,	220019	IN5232 5.6 V zener diode
Z-2	220007	S1R 13B zener
J-1	173022	RF output jack

MODULE # 5, REF. FREQUENCY AND CONTROL AFC GENERATOR

SYMBOL	P/N	DESCRIPTION
R-10	400043	100K ohm, trim pot
R-19	400042	50K ohm, trim pot
R-37	402013	1K ohm, pot
C-2	650033	15 pf, N750, mica capacitor
C-14	670016	.005 mf, 10%, tantalum capacitor

MODULE 5 (continued)

SYMBOL	P/N	DESCRIPTION
C-20A	670017	12 mf, 25V, 10%, tantalum capacitor
VVC-1	220023	MV1876 voltage variable capacitor
L-1	930016	Oscillator coil
L-2	930095	33 uH rf choke
L-3	930029	.85 uH rf choke
Q-1, 2, 3	201065	MPS 6539 transistor
Q-4, 5, 10, 11	201022	SE-4001 transistor
Q-6, 8, 9	201056	2N3569 transistor
Q-7	201055	2N4355 transistor
IC-1, 2, 3, 4, 5	230050	SN5490N - integrated circuit
D-1	220004	1N542, diode
D-2, 3	220003	1N462, diode
Z-1, 2	220007	S1R 13B, 13V, zener diode
LED-1m,2	220034	MV5054-1 (mounted on front panel)
X-tal oven	700031	75° C, 7.5 watt, 12V, crystal oven
X-tal	090001	8 to 10 MHz crystal
SW-1	480004	Single pole, double throw switch

MODULE # 6, ALARM AND CONTROL

SYMBOL	P/N	DESCRIPTION
R-5, 33	400043	100K ohm, trim pot
D-1, 2, 6, 7	220004	1N542, diode
D-3, 5	210008	1N4006, diode
D-4	220005	1N3604, diode
LED-1	220034	MV5054-1, phase lock indicator
K-1, 2	470027	5000 ohm, 29V, relay
L-1	930080	Mixer coil
L-2	930076	Doubler coil
L-3	930083	Oscillator coil
X-tal, 1	090011	Crystal HC-6 holder
Q-1, 2. 7. 8. 9	201050	SE-4010, transistor
Q-3, 10	201033	2N2102, transistor
Q-4	201022	SE-4001, transistor
Q-5	201062	2N5246, field effect transistor
Q-6	201079	2N5179, transistor
Z-1	220007	S1R 13B, 13V, zener diode

MODULE # 7, RF POWER AMPLIFIER

SYMBOL	P/N	DESCRIPTION
R-1	402002	100 ohm, pot
R-6	400042	50K ohm trim pot
C-1, 7, 8	660033	55-300 mfd variable capacitor
C-2, 13, 14	660032	7-100 mfd variable capacitor
L-1, 5, 6	930103	RF coil

MODULE 7 (continued)

SYMBOL	P/N	DESCRIPTION
L-2	930104	RF choke
L-3	930105	RF choke
L-4, 8, 10, 12, 13	930106	RF toroidal choke
L-7	930107	RF choke
L-9	930108	RF choke
L-11	930109	RF coil
D-1, 2	220005	1N3604 diode
Q-1	201090	B3-28 CTC RF transistor
Q-2	201089	B-25-28 CTC RF transistor
SW-1	480004	Single pole double throw switch
J-1, 2	173022	RF jack

MODULE # 8, POWER SUPPLY

SYMBOL	P/N	DESCRIPTION
R-1	512003	1.5K ohm, 10%, 1W resistor
Q-1, 2	201024	2N3053, transistor
Q-3, 4	201055	2N4355, transistor
Q-5	201033	2N2102, transistor
Q-6	201068	MJE2801, transistor
Q-7, 8	201039	2N3055, transistor (located on heat sink)
D-1 through D-7, D-12, 13, 14 15, 16, 17, 18	210008	1N4006, rectifier diode
D-8, 9, 10, 11	210009	1N4142, rectifier diode
Z-1	220011	24V, 1 W, Zener Diode
Z-2	220012	15V, 1 W, Zener Diode
Z-3	220019	5.6 V, 1 W, Zener Diode
Z-4	220018	6.8 V, 1 W, Zener Diode

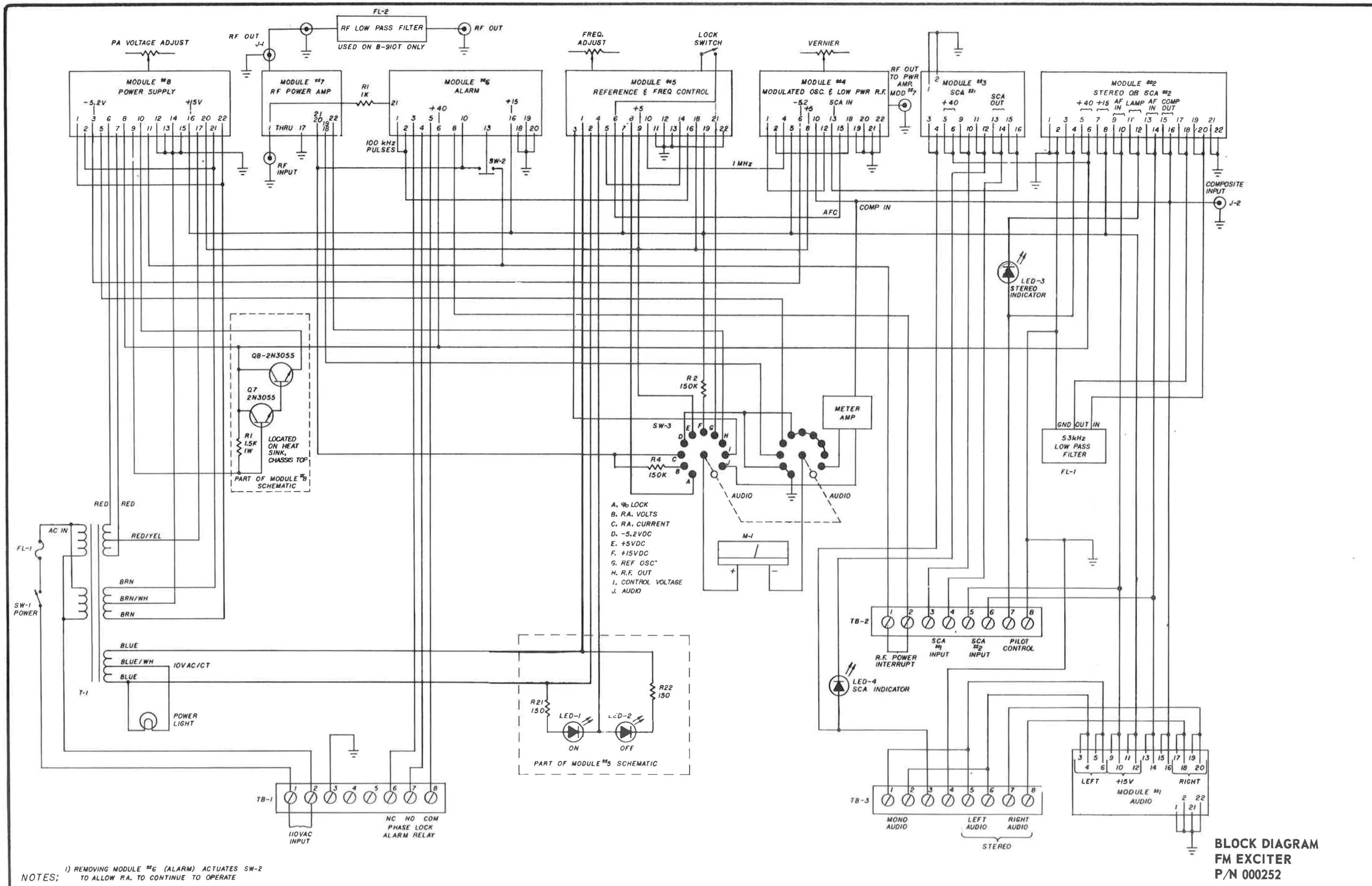
METER AMPLIFIER

SYMBOL	P/N	DESCRIPTION
R-1	400042	50K ohm, input calibrate pot
R-14	400041	1K ohm, DC balance pot
Q-1	201050	SE-4010, transistor
Q-2, 3	201056	2N3569, transistor
D-1	220004	1N542, diode
Z-1	220007	S1R 13B, 13V, zener diode

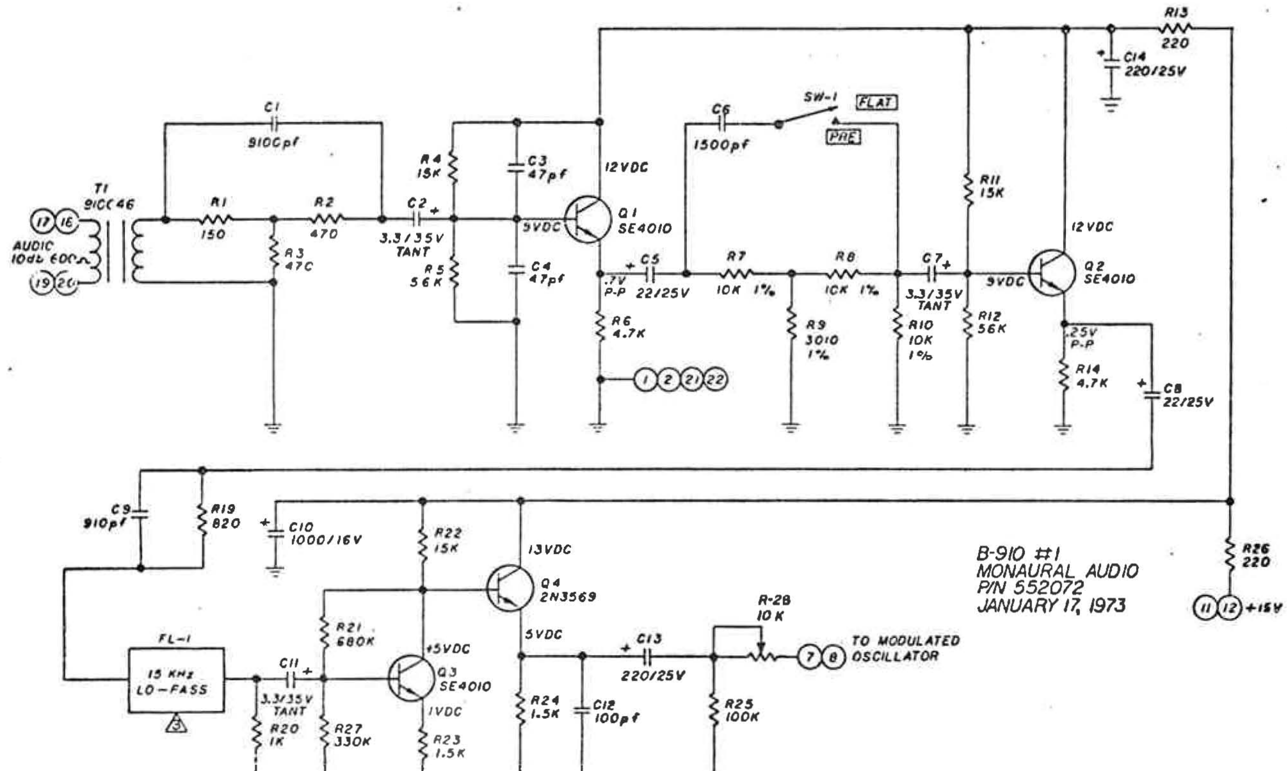
BLOCK INTER-CONNECT

SYMBOL	P/N	DESCRIPTION
F-1	280002	1 amp slow blow fuse
LED-3, 4	220034	MV-5054-1 indicator
M-1	700047	Meter
SW-1	484024	Push button on-off switch
T-1	900063	Power transformer

SCHEMATIC DIAGRAMS



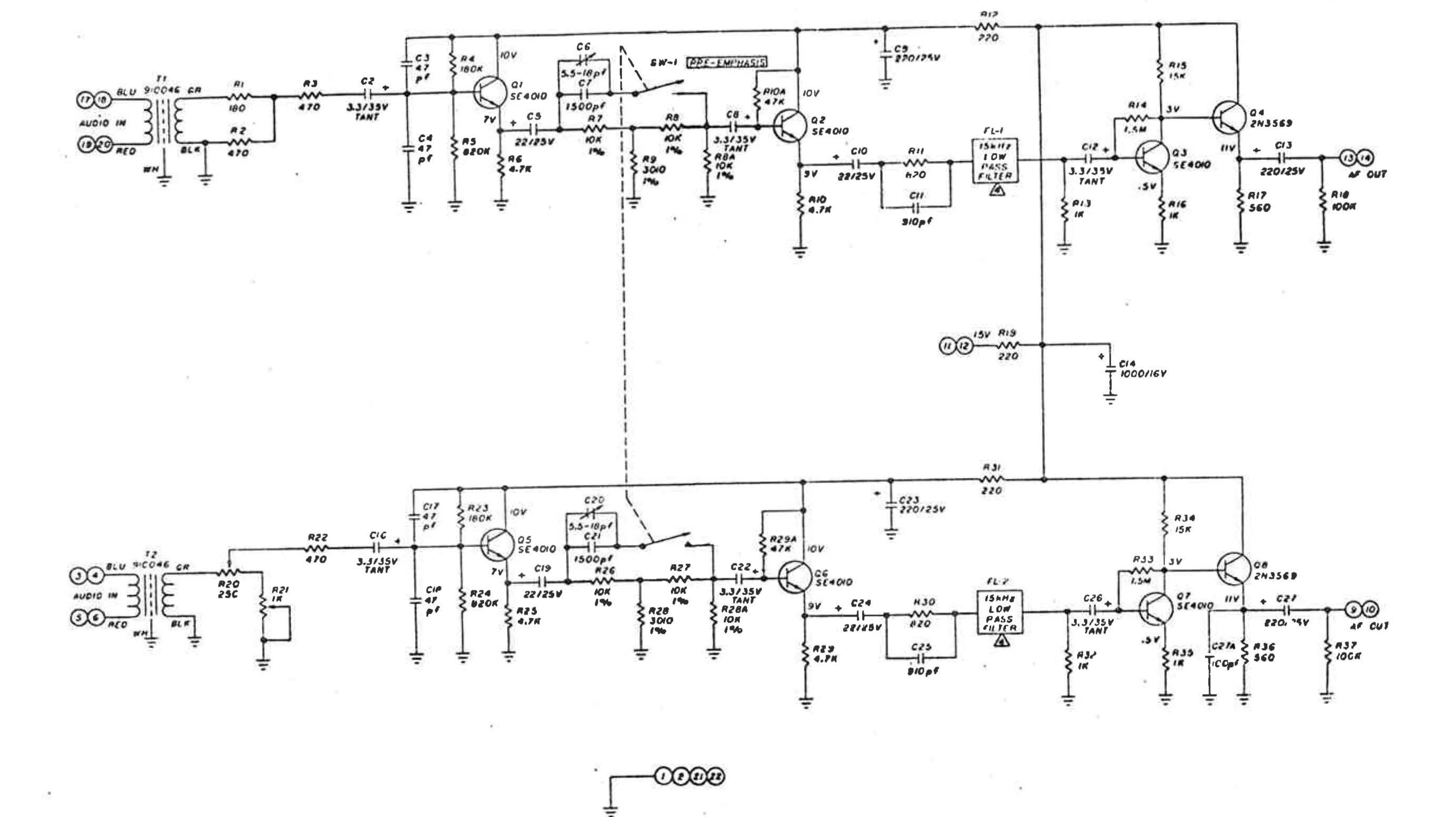
BLOCK DIAGRAM
FM EXCITER
P/N 000252



NOTES:
2) FRONT PANEL FUNCTION
1) UNLESS OTHERWISE SPECIFIED:
ALL CAPACITORS IN MFD
ALL RESISTORS 1/2 WATT 5%

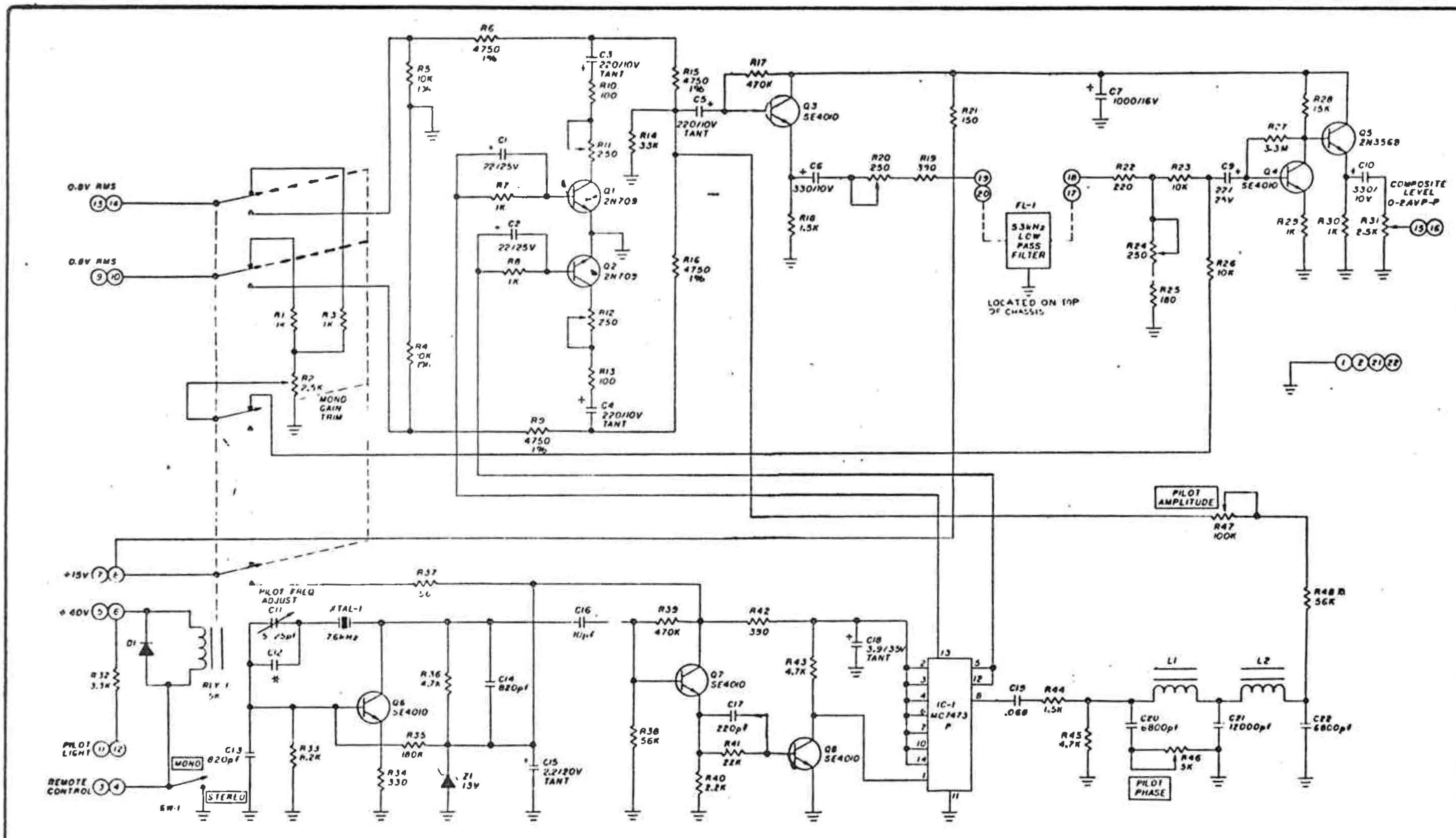
3 SEE DWG. A-1997 FOR SCHEMATIC

MODULE 1
MONAURAL AUDIO
P/N 552072



4. SEE DWG A-1997 FOR SCHEMATIC.
3. [ ] FRONT PANEL SWITCH
2. ALL VOLTAGES SHOWN ARE DC UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS 1/2 WATT 5%
ALL CAPACITORS IN MFD

MODULE 1 (optional)
DUAL AUDIO (STEREO)
P/N 559047



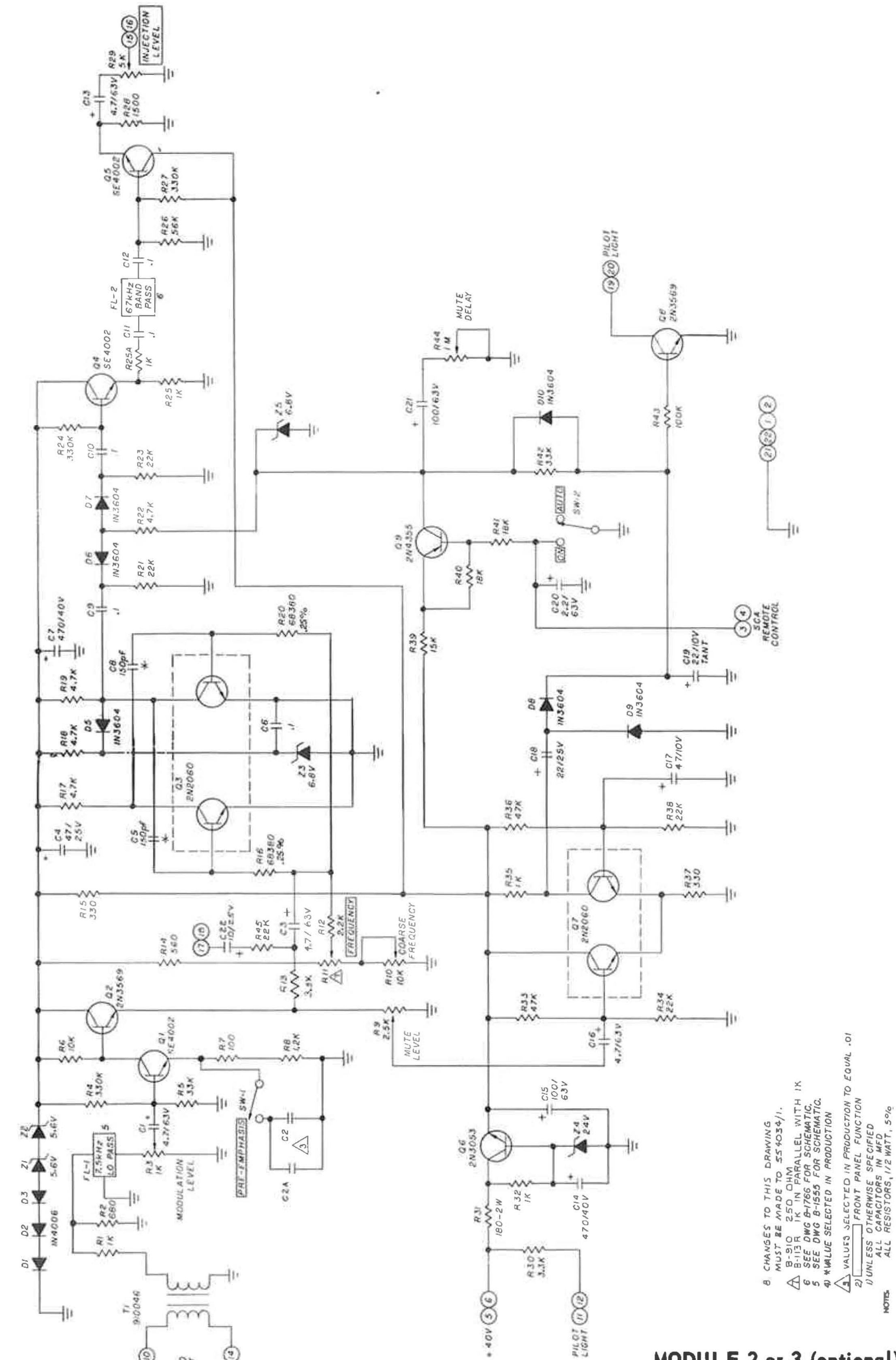
NOTES:

3) STARRED VALUES SELECTED IN PRODUCTION

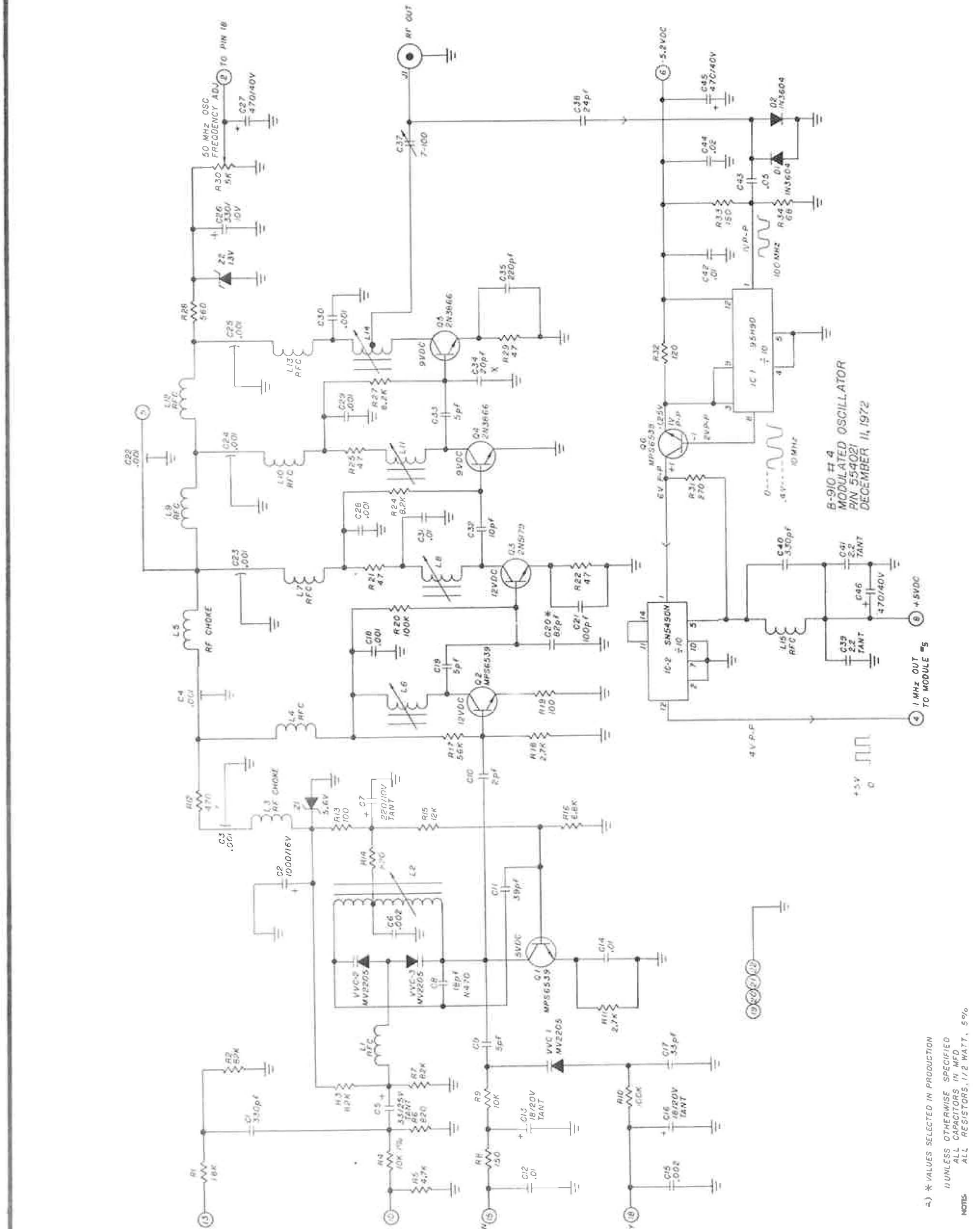
2) [ ] FRONT PANEL FUNCTION

1) UNLESS OTHERWISE SPECIFIED
ALL CAPACITORS IN MFD
ALL RESISTORS, 1/2 WATT, 5%

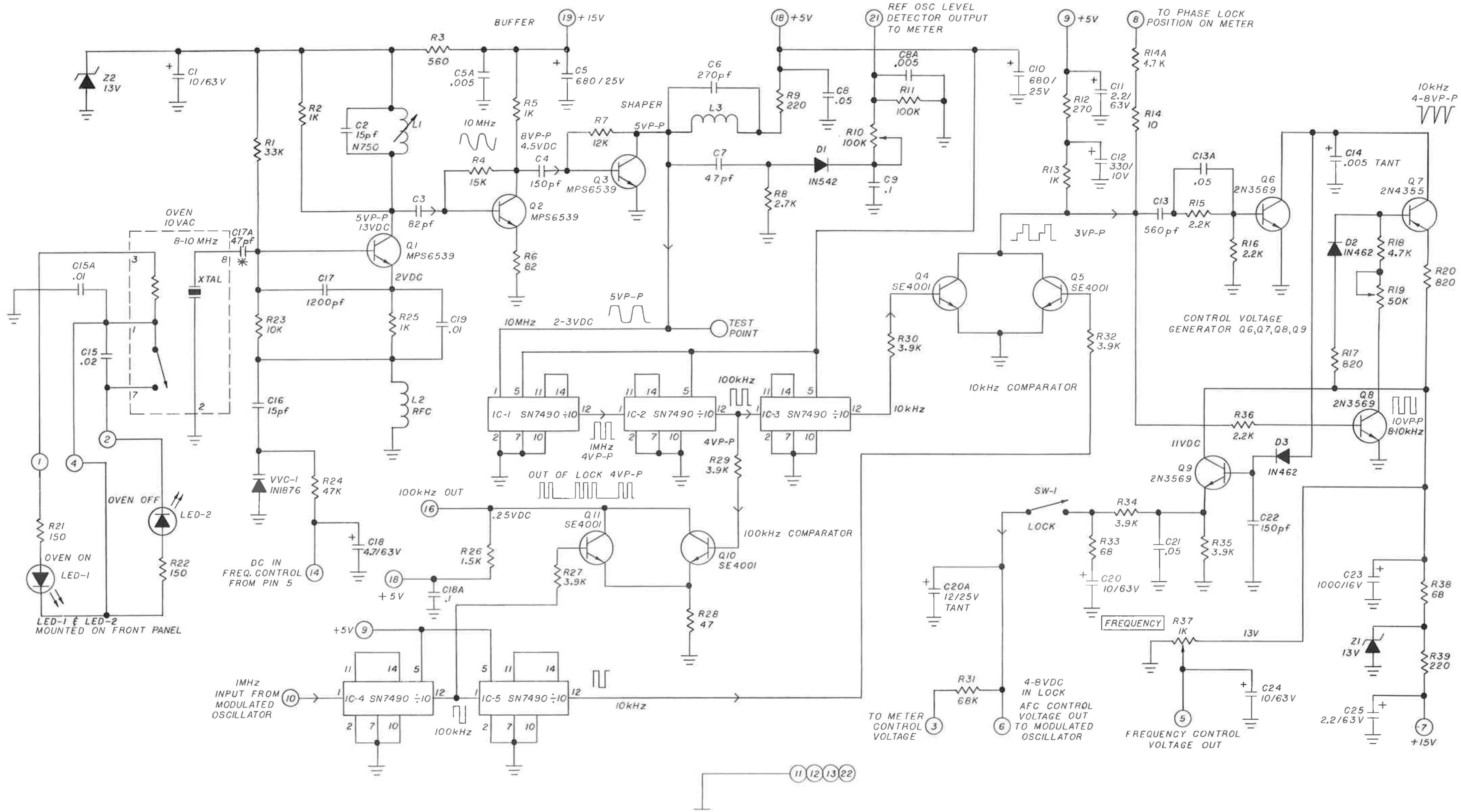
MODULE 2 (optional)
STEREO GENERATOR
P/N 559048



MODULE 2 or 3 (optional)
SCA GENERATOR
P/N 559049



MODULE 4
MODULATED OSCILLATOR
P/N 554021

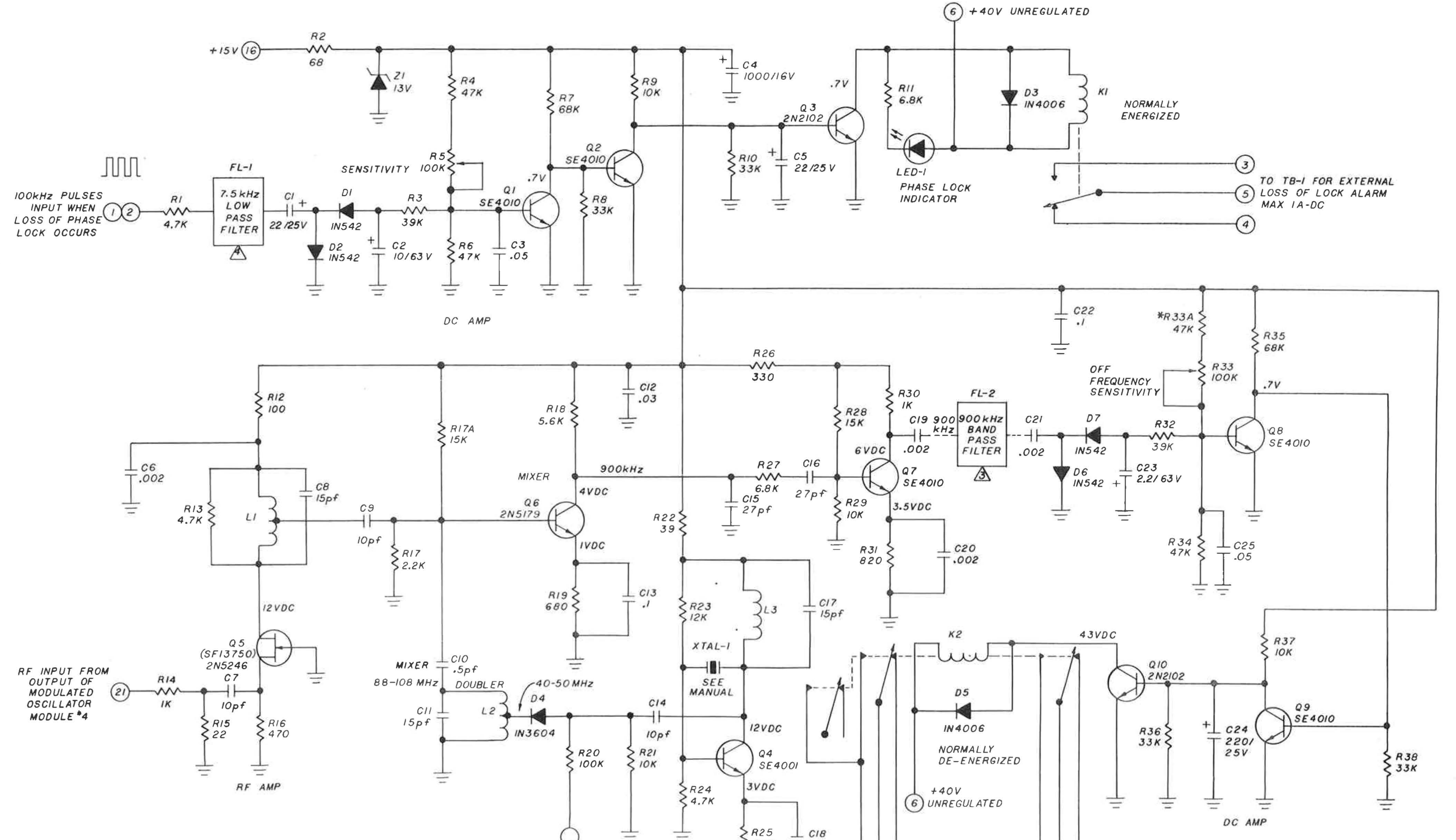


3) SELECTED IN PRODUCTION.

2) [ ] FRONT PANEL FUNCTION

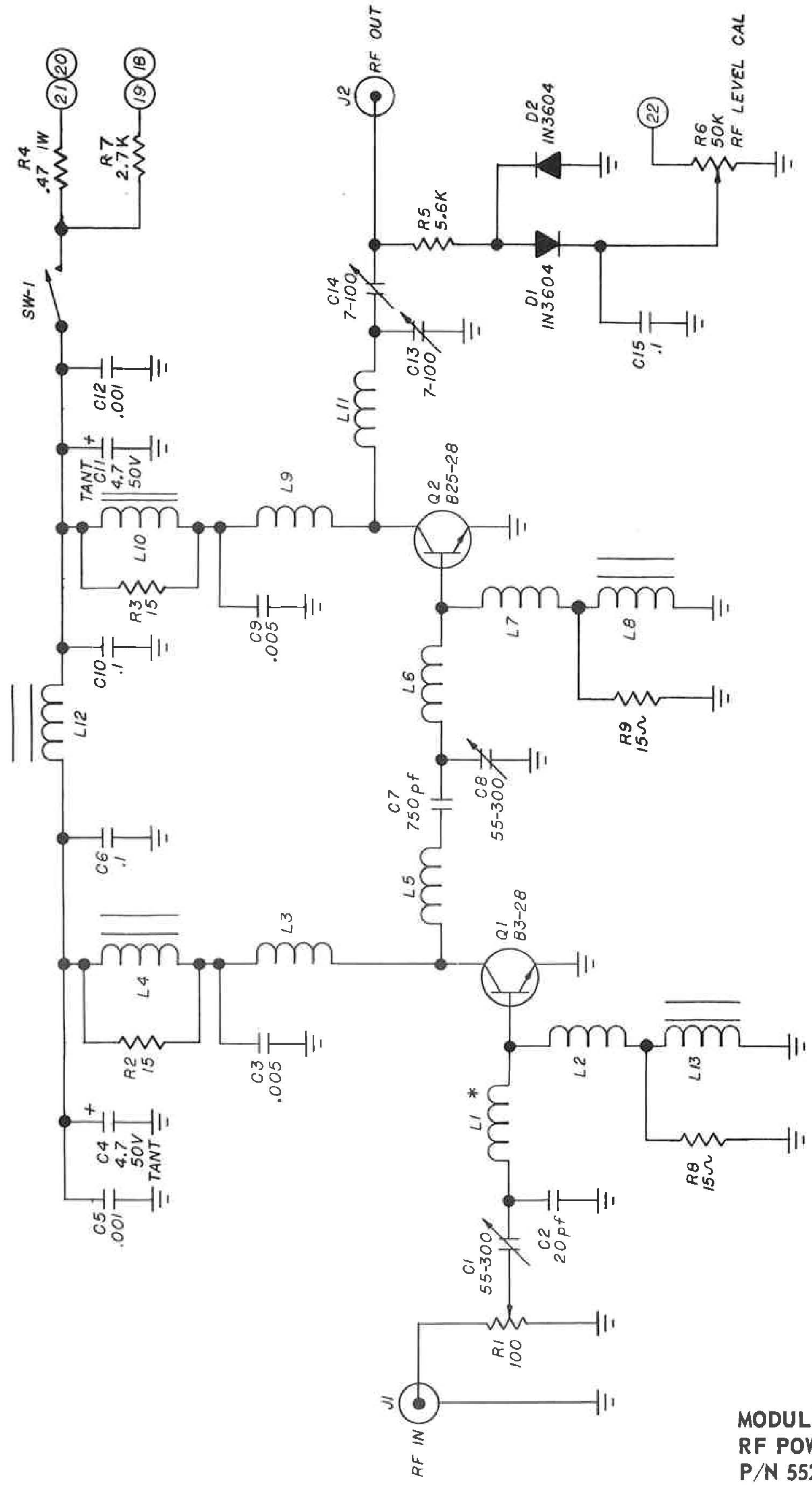
NOTES: 1) UNLESS OTHERWISE SPECIFIED ALL RESISTORS 1/2 WATT 5% ALL CAPACITORS IN MFD

MODULE 5
REFERENCE OSCILLATOR
P/N 553031

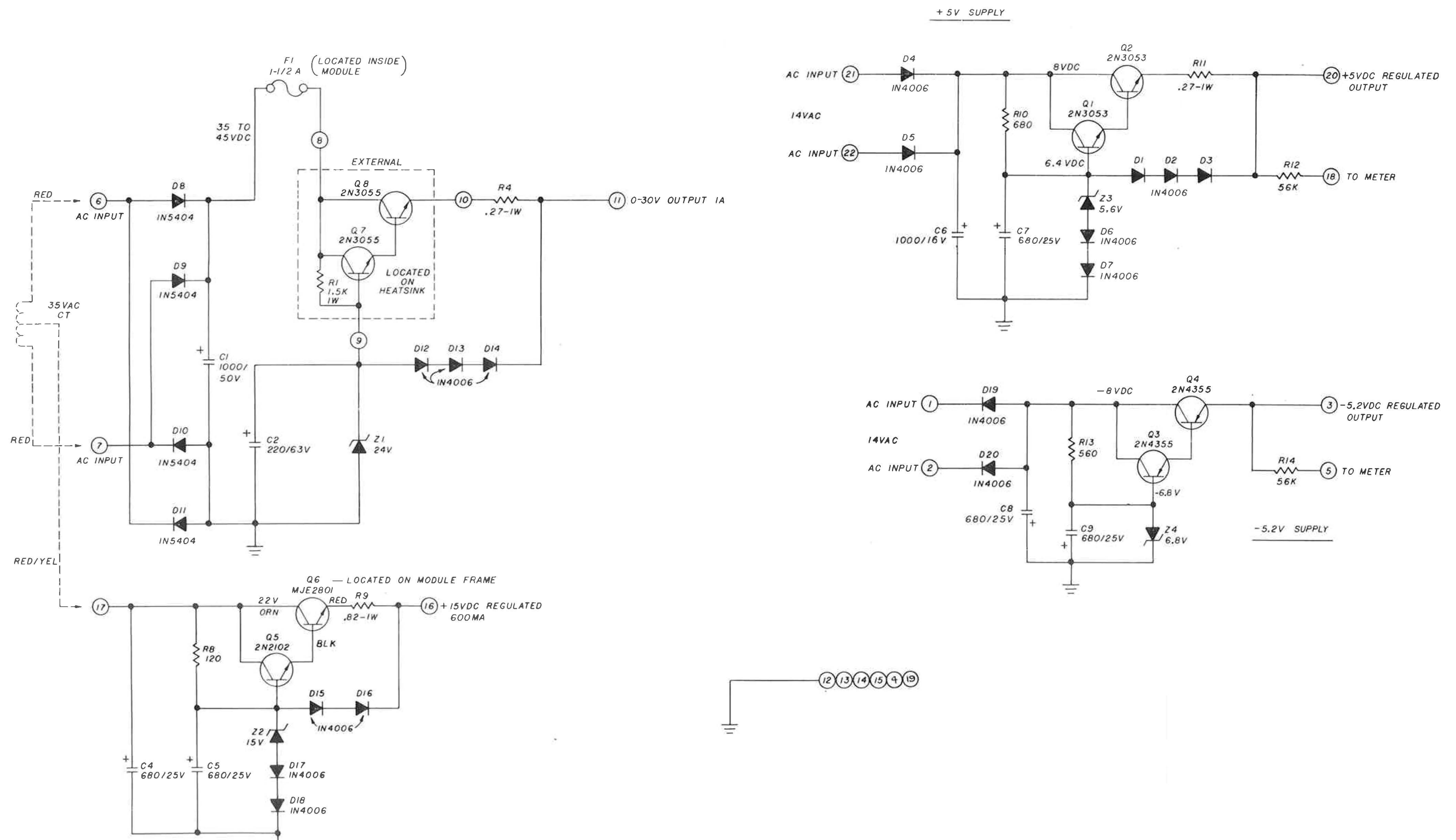


4 SEE DWG B-1555 FOR SCHEMATIC.
3 FILTER PREASSEMBLED AND MOUNTED ON P.C. BOARD AS A UNIT. SEE DWG B-2024 FOR SCHEMATIC.
2) *VALUES SELECTED IN PRODUCTION
NOTES: 1) UNLESS OTHERWISE SPECIFIED ALL CAPACITORS IN MFD ALL RESISTORS, 1/2 WATT, 5%

MODULE 6
ALARM AND CONTROL
P/N 550161



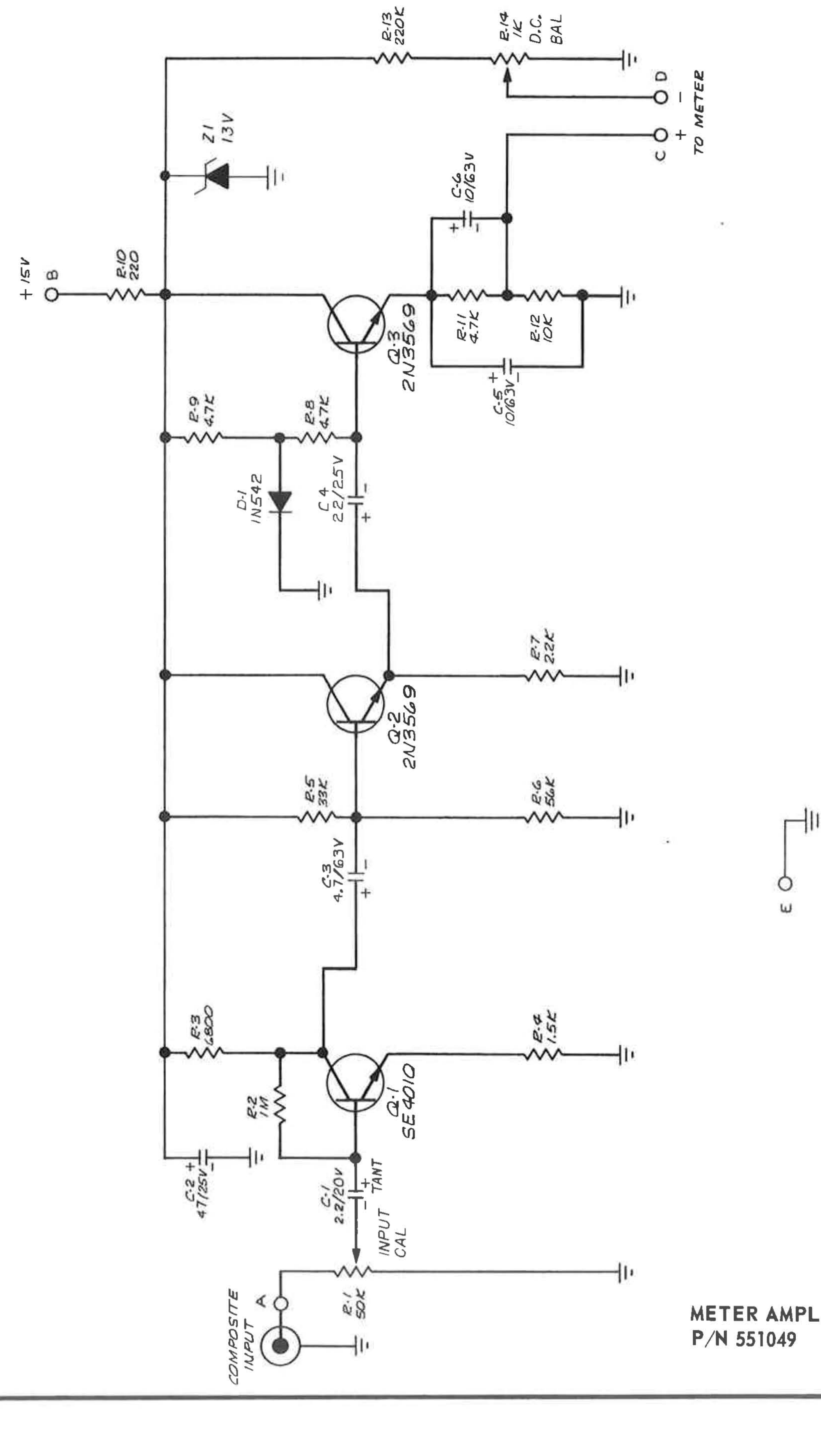
MODULE 7
RF POWER AMPLIFIER
P/N 552073



NOTES:

2) UNLESS OTHERWISE SPECIFIED
ALL CAPACITORS IN MFD
ALL RESISTORS, 1/2W, 5%

MODULE 8
POWER SUPPLY REGULATOR
P/N 552074



METER AMPLIFIER
P/N 551049