INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE TC-10 POWER LINE CARRIER TRANSMITTER-RECEIVER (WIDE BAND) 30 to 300 kHz 10 WATTS – 48, 125, 250 Vdc WITH OPTIONAL VOICE

CAUTION: It is recommended that the user of this equipment become thoroughly acquainted with the information in this instruction leaflet before energizing the carrier assembly. Failure to observe this precaution may result in damage to the equipment.

If the carrier set is mounted in a cabinet, it must be bolted down to the floor or otherwise secured before swinging out the equipment rack to prevent its tipping over.

APPLICATION

The type TC-10 carrier equipment is designed for protective relaying of power transmission lines employing either of two types of blocking relaying systems: (1) directional comparison relaying, using the type KA-4 or equivalent carrier relay, or (2) phase-comparison relaying, using type SKB-TCU or SKBU-1 relay equipment.

The type TC-10 set can also be used for other functions including "push-to-talk" maintenance telephone communication, keyed carrier telemetering, and supervisory control.

CONSTRUCTION

The transmitter-receiver unit consists of a standard 19-inch wide chassis 5¼ inches (3 rack units) high. The chassis is notched for mounting on a standard relay rack. Metering jacks, fuses, power and test switches, pilot light, and the receiver gain control are accessible from the front of the chassis, See Fig. 1. The circuitry is divided into 8 plug-in modules as shown in Fig. 2 and 3. The components mounted on each printed circuit board or other sub-assembly are shown enclosed by dotted lines on the internal schematic, Fig. 18. The location of components on the eight printed circuit boards are shown on separate illustrations, Figures 4 through 17.

External connections to the assembly are made through a 36 circuit receptacle J3. The r-f output connection to the assembly is made through a coaxial cable jack J2. When voice communication is used, the hand set plugs into a receptacle on the front panel of the voice adapter module.

The input attenuator control R5 is accessible from the front of the panel. In addition, two current jacks are provided on the detector module for measuring the following quantities:

- Receiver 20-mA. output current.
- Receiver 200-mA. output current.

OPERATION

TRANSMITTER

The transmitter is made up of four main stages and a filter. The stages include two crystal oscillators operating at frequencies that differ by the desired channel center frequency, a mixer and buffer amplifier, a driver stage and a power amplifier. The output filter removes harmonics that may be generated by distortion in the power amplifier.

All possible contingencies which may arise during installation, operation, or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding his particular installation, operation or maintenance of his equipment, the local Westinghouse Electric Corporation representative should be contacted.

A single crystal designed for oscillation in the 30 kHz to 300 kHz range cannot be forced to oscillate away from its natural frequency by as much as ± 150 hz. In order to obtain this desired frequency shift, it is necessary to use crystals in the 2 MHz range. The crystals are Y1 and Y2 of Fig. 19. The frequency of Y2 is 2.00 MHz when operated with a specified amount of series capacity and the frequency of Y1 is 2.00 MHz plus the channel center frequency, or 2.03 MHz for 30 kHz center frequency. Capacitor C55 and crystal Y2 in series are connected between the positive side of the supply voltage and the base of transistor Q51, which operates in the emitter follower mode. The emitter is coupled to the base through C57. With Y2 removed, the base of Q51 would be held at approximately the midpoint of the supply voltage by R51 and R52. The crystal serves as a series resonant circuit with very high inductance and low capacitance. The circuit can be made to oscillate at other than the natural frequency of the crystal by varying the series capacitor, C55. Increasing C55 will lower the frequency of oscillations and reducing C55 will raise the frequency. This oscillator can be made to oscillate in the range of ±100 Hz from its marked frequency.

Crystal Y1 is connected in a circuit that is similar except for the addition of C53 and diodes D51 and D52. By adjustment of C52 this circuit can be made to oscillate at +100 hz from its marked frequency. The crystals taken individually have a greater variation of frequency with temperature than would be acceptable. However, by proper matching of the two crystals, the variation in their difference frequency can be kept within limits that permit holding the frequency stability of the overall transmitter to ±10Hz over a temperature range of -20 to +55°C.

The frequencies produced by the two oscillators are coupled to the base of mixer transistor Q53 through C62 and C63. The sum of the two frequencies is so high that a negligible amount appears on the secondary of transformer T51, but the difference frequency is accepted and amplified by Q53 and Q54.

When the keying control is closed, it increases the output power to 10 watts. This is effected by reducing the emitter resistance of buffer-amplifier transistor Q54. When the keying control is open, transistor Q55 receives no base current and is nonconducting. Emitter resistor R70 Therefore is effectively open-circuited. The level of output power is adjusted to 1 watt by means of R64. When Q55 is made conductive by closing the keying control circuit, R70 is placed in parallel with R68 and the amount of emitter resistance unbypassed by C66 can be adjusted as required to obtain a 10-watt output level.

As shown on the Internal Schematic, Fig. 18, the voltage for the keying circuit is obtained from the 43-volt regulated supply in the transmitter.

The driver stage consists of transistors Q56 and Q57 connected in a conventional push-pull circuit with input supplied from the collector of Q54 through transformer T52.

The power amplifier uses two series-connected power transistors, Q2 and Q4, operating as a class B push-pull amplifier with single-ended output. Diodes D2 and D4 provide protection for the base-emitter junctions of the power transistors. Zener diodes Z2 and Z4 protect the collector-emitter junctions from surges that might come in from the power line through the coaxial cable.

Terminals #17 and 18 on J3 are connected across a 2 ohm resistor R6, located on the power-amp module. When the transmitter is operating (carrier-on), approximately .5 amperes (dc) of current flows through R6 developing approximately 1 volt (dc) for 48V units and 0.25 amps (dc) of current developing 0.5V dc for 125V and 250V units. This voltage (or current) can be used to drive an indicating device such as an oscillograph or indicating relay for carrier-on indication. The value of input impedance of the device connected to these terminals will have no effect on the transmitter operation, provided that R6 remains as a shunt resistor. R6 should not be removed or value increased, in an effort to provide a higher current level for driving the indicating device, as this could jeopardize carrier-start operation.

The output transformer T3 couples the power transistors to the output filter FL102. The output

filter includes two trap circuits (L102, C1, C2, L103, C3 and C4) which are factory tuned to the second and third harmonics of the transmitter frequency. Capacitor C5, C6 approximately cancels the inductive reactance of the two trap circuits at the operating frequency. Protective gap G1 is a small lightning arrester to limit the magnitude of switching surges or other line disturbances reaching the carrier set through the line tuner and coaxial cable. Auto-transformer T4 matches the filter impedance to coaxial cable of 50, 60 or 70 ohms.

The series resonant circuit composed of L105 and C7 is tuned to the transmitter frequency, and aids in providing resistive termination for the output stage. Jack J102 is mounted on the panel of FL102 and is used for measuring the r.f. output current of the transmitter into the coaxial cable. It should be noted that the filter contains no shunt reactive elements, thus providing a reverse impedance that is free of possible "across-the-line" resonances.

When keyed for voice by the voice adapter, transistor Q55 is keyed into class A operation so that its conduction can be modulated by the voice input from the voice adapter. Potentiometer R82 and R41 are adjusted so that the nominal output of carrier is 3.25 watts (14 volts across 60 ohms). The voice input modulates the carrier through this transistor by varying the amount of conduction of Q55 so that the output power of carrier varies with the voice amplitude following the voice frequency components. Since with Q55 completely nonconducting, R64 has been set to produce a 1 watt output, maximum modulation on the side to shut off Q55 will not result in an output level of less than 1 watt carrier at any time. Also since the output level has been set at 10 watts with Q55 completely conducting by the adjustment of R70, the maximum modulation on the side of turn on of Q55 will not result in a carrier output level of greater than 10 watts at any time.

The buffer keying board in addition to providing proper buffering also contains logic for the proper keying of output level in regards to protective relaying operation and voice adapter operation.

RECEIVER

The receiver is a superheterodyne type to facilitate obtaining constant bandwidth regardless of the channel frequency. The major stages include an input filter, attenuator (gain control), crystal oscillator, mixer, i.f. filters and i.f. amplifiers, diode detector, dc amplifier, and dc power output stage.

The fixed input filter rejects undesired signals while accepting a wide enough band of frequencies to assure fast operation. The receiver sensitivity is adjusted by means of the continuously variable input attenuator control R5. The receiver oscillator is basically the same type as the transmitter oscillator but uses an operational amplifier. The oscillator frequency is 20kHz above the incoming signal frequency. The receiver channel frequency is determined by the input filter and the oscillator crystal.

Mixing is accomplished by feeding the incoming signal to the emitter, and the receiver oscillator signal to the base of the mixer Q211. Injection into two separate elements, base and emitter, provides a circuit capable of handling greater signal level variations than one in which injection is made into only a single element such as the base. This receiver uses an intermediate frequency of 20 kHz. Typical characteristics of both filters and the complete receiver are shown on curves, Fig. 29 and 30.

The 20 kHz i.f. signal is rectified by diodes D2 and D3. The resulting dc output is amplified by transistors Q2 and Q3, giving a receiver output current of nominally 200 mA. for a 30-ohm external relay coil circuit. Where a second output current of 20 mA. is desired, an external 2000 ohm relay circuit can be connected to the receiver output as shown in Fig. 31. If only a 20-mA output is desired, a 33 ohm resistor and diode must still be connected into the circuit as shown.

Voice Adapter Module

Voice Receiver Circuit – The voice adapter receiver consists of three r-f amplifier stages Q1, Q2 and Q3, a diode detector and an audio amplifier Q5. The receiver features automatic

volume control whereby, if the received r-f input level varies, due to line switching or weather conditions, there will be a minimal effect on listening volume and the volume control need not be readjusted. This is accomplished using a field effect transistor Q10 connected in series with C4 across the emitter resistor R8 of the second r-f amplifier stage Q2. The drain to source resistance of Q10 varies directly with the dc voltage applied between its gate and source (TP-A to TP-B). Therefore, controlling the dc voltage between TP-A and TP-B will affect the drain-source resistance, thereby controlling the effective emitter bypass impedance and the gain of Q2. The dc voltage applied to TP-A is maintained proportional to the signal level at the output of the detector stage. Q4 serves as a dc amplifier for feedback to the F.E.T. Fig. 41 illustrates the A.V.C. response of the receiver circuitry. Plotted simultaneously is the feedback dc voltage (TP-A to TP-B).

The demodulated audio signal is present across volume control R14. It is then fed through C11 to the audio amplifier stage Q5. The collector load of Q5 is one half of the primary winding of T2 which is used to match the impedance of the handset receiver.

Speech-Amplifier Circuit

The speech amplifier circuit is a three stage audio amplifier using transistor Q6, Q8 and Q9. The circuit features automatic level control whereby the output, applied to modulate the TC-10 Transmitter, is held at a constant level while the microphone input level can vary up to 25db in amplitude. This is accomplished by controlling the gain of the first amplifier stage Q6, by placing a field effect transistor Q11 in series with C18 across the Q6 emitter resistor R24. The effective drain to source resistance of Q11 varies in proportion to the dc voltage applied to its gate (TP-2). Therefore, controlling this dc voltage will affect the drain source resistance, thereby controlling the effective emitter bypass impedance, and the gain of Q6. The dc voltage at TP2 is maintained proportional to the audio signal level at the collector of the second amplifier stage Q8. This signal is applied to the base of Q7 which when turned on by the negative going peaks will cause current to flow through D3 and charge C19 applying a dc voltage to the gate of the F.E.T. (Q11) in proportion to the signal level. The audio signal is applied through C21 to the third amplifier Q9. The final output level can be adjusted using R37.

POWER SUPPLY

The power supply is a series-type transistorized dc voltage regulator which has a very low stand-by current drain when there is no output current demand. The zener diode Z1 holds a constant base-to-negative voltage on the series-connected power darlington transistor Q1. Depending on the load current, the dc voltage drop through transistor Q1 and resistor R2 varies to maintain a constant nominal 100 volt output. The Zener diode Z2 is used in a second series regulator to supply a nominal 43V for use with the keying circuit, receiver, and the voice adapter. It is placed in a series regulator circuit (Q2 & R1) so that it does not draw current unless called upon by the receiver and voice adapter. Capacitor C3 provides a low carrier-frequency impedance across the dc output voltage. Capacitors C1 and C2 by pass r.f. or transient voltages to ground, thus preventing damage to the transistor circuit.

For a 250-volt dc supply, the circuit of Fig. 35 is used. This consists of an external voltage-dropping resistor assembly in conjunction with a 125V TC-10 set chassis connected in series. The resistor assembly (see Fig. 34) must be mounted at the top of a cabinet or an open rack. Because of the heat dissipated, no transistorized equipment should be mounted above the resistor panel. The 250 volt TC-10 set has a constant current drain of 1.1 amperes dc, and uses 2 amp fuses in the resistor panel.

When the TC-10 set is used with solid-state protective relays (such as the SKBU-11), power switch S1, and fuses F1 and F2 are omitted from the assembly. See Figures 1 and 2. Instead, the dc power for the complete relaying assembly is controlled from a single switch and set of fuses. This is done to prevent an incorrect tripping or blocking output which might result from interruption of one or both sides of the dc supply to the carrier set or protective relays. For solid-state relaying applications, there are no connections to J3 terminals 7 or 6 (normally fused positive and fused negative). See Fig. 18.

RELAYING CONTROL CIRCUITS

The carrier control circuit for KDar relaying is shown in elementary form in Fig. 28. The "Transmitter Control" circuit is normally held at fused negative potential through the normally-closed carrier test pushbutton and the phase and ground carrier-start relay contacts. Opening of any of these contacts allows current to flow from fused positive through resistor R_C and the Diode D_1 to the transmitter control terminal TC 10/9 thus starting carrier transmission at full output. The reception of carrier from either the local or remote transmitter normally causes a saturated current mA. to flow in the alarm and holding coils (AL and RRH) in the type KA-4 (or equivalent) receiver auxiliary relay.

If the protective relays call for stopping the transmission of carrier, closing of CSP or CSG contact connects the transmitter control circuit back to fused negative, thus stopping any carrier transmission regardless of how it was started.

If a relaying carrier channel is also used for an auxiliary function such as telemetering or supervisory control, the keying contact for this function is connected into the carrier-start circuit in series with the carrier test pushbutton. Such a contact must be normally closed (in the non-operating condition). An auxiliary relay in the receiver output, usually in place of the alarm relay, energizes the telemetering or supervisory control equipment through contacts on the auxiliary relay.

CARRIER CONTROL FOR OTHER FUNCTIONS

If a type TC-10 set is keyed on-off for telemetering or supervisory control only (no protective relaying), one of the circuits shown in Fig. 42 can be used. Arrangements are shown for either a normally-closed or normally-open carrier-start contact. In the former case, a diode is required to allow using the Voice Adapter for push-to-talk voice communication between stations. Note that continuous telemetering must be interrupted when it is desired to use the carrier channel for voice communication.

The receiver output can be connected for either 200 mA, or 20 mA operation as shown in Fig. 31. The 200 mA output is preferable (if a choice is available) because of a slightly better time constant in the 200 mA receiver output circuit. In some cases, both the 200-mA and the 20-mA outputs may be used together. For exa ple, the 200 mA output can be used with a standard carrier auxiliary relay (for directional-comparison relaying), while the 20 mA output feeds a 2000 ohm receiver relay used with supervisory control equipment. The connections shown in Fig. 31 would be used for this case, with the receiver relay holding coil (RRH) in place of the RRH and AL coils shown. The alarm function would be provided by the supervisory control equipment.

CHARACTERISTICS

Frequency Range	30-300 kHz (50-300 kHz for phase comparison relaying.
Transmitter Output	10 watts into 50 to 70 ohm resistive load
Harmonics	55 db below 10 watts
Receiver Sensitivity	40 mV input for 180 mA minimum output current
Receiver Selectivity	1500 Hz bandwidth (3db down); 80 db at $\pm$3kHz.
Transmitter-Receiver Channel Rating	50 db
Input Voltage	48, 125, or 250V dc
Supply Voltage Variation	42-56V, 105-140V, 210-280V
Battery Drain: 48V dc	0.5 amp standby, 1.35 amp transmitting
125V dc	0.25 amp standby, 0.6 amp transmitting
250V dc	0.75 amp standby or transmitting (with external resistor Panel)
Temperature Range	-20 to +55°C around chassis

FREQUENCY SPACING

The minimum recommended frequency spacing between two type TC-10 carrier sets operated in parallel without hybrid units is shown on the curve of Fig. 32. For example, at 100 kHz, the minimum spacing is 8 kHz. Closer spacing would result in the generation of inter-modulation products caused by the non-linear load presented by each transmitter to the other one.

The minimum frequency spacing between a TC-10 carrier channel and an adjacent transmitter signal keyed on-off at a rate of 60 pulses per second can be determined from the nomograph of Fig. 33. Using the example shown by the dashed line, consider a type TC-10 set used on a channel with a normal attenuation of 15 decibels. The TC-10 receiver would be set to give a margin of 15db below the normal received signal, or for a sensitivity of -30db (relative to a 24.5 volt, 10-watt signal). The interfering signal is assumed to be a 10-watt transmitter at the same location. To determine the minimum frequency spacing of the TC-10 receiver from this interfering signal, lay a straight edge between the -30 db point on the receiver sensitivity scale and the zero dc point on the interfering transmitter scale. The resulting line crosses the channel spacing scale between 3 and 4 kHz. For this example, a channel spacing of at least 4kHz should be used. (In order not to conflict with the limits of Fig. 32, an r-f hybrid may be needed between the TC-10 set and the other transmitter, depending on the actual application.)

For protective relaying applications to 3-terminal lines, the transmitter frequencies are offset 100 hertz to prevent a slow beat or cancellation of the received signal when two transmitters send blocking signals to the third terminal. The three transmitters operate at fc, fc + 100 Hz. and fc - 100 Hz. All receivers operate at the channel center frequency (fc).

INSTALLATION

The type TC-10 transmitter-receiver is generally supplied in a cabinet or on a relay rack as part of a complete carrier assembly. The location must be free from dust, excessive humidity, vibration, corrosive fumes, or heat. The maximum ambient temperature around the chassis must not exceed 55°C.

ADJUSTMENTS

TRANSMITTER

The TC-10 transmitter is shipped with the power output controls R64, R82, R41 and R70, set for outputs of 1 watt, 3.2 watts and 10 watts into a 60 ohm load. If it is desired to check the adjustments or if repairs have made readjustment necessary, the coaxial cable should be disconnected from the assembly terminals and replaced with a 50 to 70 ohm non-inductive resistor of at least a 10 watt rating. Use the value of the expected input impedance of the coaxial cable and line tuner. If this is not known, assume 60 ohms. Connect the T4 output lead to the corresponding tap. Connect an ac vacuum tube voltmeter (VTVM) across the load resistor. Turn power output control R64 to minimum (full counter-clockwise). Key for reserve signal detector by jumpering terminals 21 &11 on keying module. Turn on the power switch on the panel and note the dc voltage across terminals 3 & 35 on keying module. If this is in the range of 40 to 46 volts, rotate R64 clockwise to obtain 4 or 5 volts across the load resistor used. At this point check the adjustment of the series output tuning coil L105 by loosening the knurled shaft-locking nut and moving the adjustable core in and out a small amount from its initial position. Leave it at the point of maximum voltage across the load resistor used. Then rotate R64 farther clockwise to obtain the correct voltage for 1 watt in the load resistor, as shown in the following table.

Then change to relaying output by connecting together terminals 5 to 3 on keying module, and rotate R70 until the voltage across the load resistor is as shown in the following table for a 10 watt output. Recheck the adjustment of L105 for maximum output voltage and readjust R70 for a 10 watt output if necessary. Tighten the locking nut on L105. Open the power switch and remove the jumper used to key the transmitter to the 10 watt level. Key for voice by connecting terminal 1 to 31 on voice adapter module. Turn the power back on. Adjust "C"(R41) on the voice adapter module for a 3.2 watt output

across the load resistor (14V across 60 ohms). Open the power switch, remove connections to terminals of J3, remove the load resistor, and reconnect the coaxial cable circuit to the transmitter. Note on frequencies above 200 kHz, L105 adjustment is a screw-driver adjustment. There is no kurled shaft-locking nut.

VOLTAGE

	RESERVE SIGNAL	VOICE	RELAYING OUTPUT
T106 TAP	1 WATT OUTPUT	3.2 WATTS OUTPUT	10 WATTS OUTPUT
50	7.1	12.7	22.4
60	7.8	14	24.5
70	8.4	15	26.5

Follow the procedure outlined in the line tuner instructions for its adjustment.

Normally the output filter (FL102) will require no readjustment except as noted above. It is factory tuned for maximum second and third harmonic rejection, and for series resonance (maximum output at the fundamental frequency) with a 60-ohm load. A small amount of reactance in the transmitter output load circuit may be tuned out by readjustment of the movable core of L105. This may be necessary with some types of line coupling equipment. The adjustable cores of L102 and L103 have been set for maximum harmonic rejection and no change should be made in these settings unless suitable instruments are available for measuring the second and third harmonic present in the transmitter output.

The operating frequencies of crystals Y1 and Y2 have been carefully adjusted at the factory and good stability can be expected. If it is desired to check the frequencies of the individual crystals, this can be done by inserting a crystal in its proper socket with the other crystal unconnected. A sensitive frequency counter with a range of at least 2.3 MHz can be connected from TP51 to TP54. (Connection to TP54 rather than to TP53 provides a better signal to the counter and avoid some error from the effect of the counter input capacitance on the oscillator circuit.) While measurement of the oscillator crystals individually is necessary for the initial adjustment of the oscillators, generally any subsequent checks may be made with a lower range counter connected at the transmitter output. If any minor adjustment of the frequencies should be needed, the adjustment should be made with capacitor C52.

RECEIVER

The receiver has two controls: one is the if input control R_2 which is factory set for 180 mA DC output at J_2 (200 mA) on detector board with an input of 40mV, at rated frequency, into J1 (Receiver Input) with R_5 (Input Attenuator) on input board set for minimum attenuation. The input attenuator R_5 is the other receiver control and is front-panel mounted on the input-module. It is recommended that the receiver normally be set for a 15-db operating margin to allow for reasonable variations in receiver input signal level without affecting the output blocking current. This adjustment can be made in two ways, as follows:

1. First, measure the normal received signal from the remote terminal (after the line tuners have been adjusted) by starting the remote transmitter and measuring the voltage across the coaxial cable at the receiving terminal. This signal should preferably be measured with a tuned voltmeter such as the Sierra carrier-frequency voltmeter. If a simple VTVM reading is used, have the remote transmitter turned on and off several times to be sure the VTVM reading is actually the remote signal. Note the reading. Now disconnect the coaxial cable, and feed a signal into the carrier assembly at the coaxial terminals from a separate signal generator. Set the signal generator to the received frequency at a level 15db below the previous measured incoming signal. With a 0-250 mA. (mimimum) dc milliammeter plugged into the 200 mA output jack on the detector module, adjust the input attenuator R_5 until an output current of about 100 mA is obtained. As this point is on the steep portion of the receiver output-input curve, it may be difficult to set R_5 for exactly 100 mA. This is not necessary, however, as the signal is not normally at this value. This is the operating setting of the input attenuator. Return the coaxial cable connections to nor-

mal. NOTE: Do not energize the local transmitter when making the foregoing adjustment as the signal generator may be damaged.

2. As an alternate procedure if no signal generator is available, the local transmitter itself may be used as the signal generator. First detemine the normal received signal from the remote terminal as explained previously under (1). Then turn off the remote transmitter. Now turn on the local transmitter and reduce its output to a value 15 db below the normal received signal level. Then adjust the receiver gain control to gain 100 mA. output as before. When this adjustment has been made, reset the local transmitter to its normal 10-watt output level.

In applications where the line attenuation is low and a strong signal is received, the adjustment of the input attenuator becomes critical. For such applications, the setting of i-f gain control R2 may be reduced to lower the overall receiver gain. The front-panel control R5 will then have a smoother and more gradual control as the knob is rotated, making it easier to obtain the 15db margin setting. For such a strong-signal condition, it is recommended that with R5 at maximum, the i-f gain control R2 be adjusted to give 100 mA receiver output current from an input r-f voltage 25 db below the normal received signal level. Then the front panel input attenuator R5 is set for the normal 15-db margin as previously described.

Carrier Level Indicator

Connect a signal generator to J_1 receiver input and adjust for rated frequency and input voltages listed below. Adjust detector module as follows:

220mV input, adjust R27 CLI level for 100mV at TP9 to TP11

700mV input, adjust R36 span adjust for 3.00 volts at TP9 to TP11

22mV input, adjust R47 (full scale adjust) for 0 db on internal instrument
+ Adjust R50 for external instrument.

VOICE ADAPTER MODULE

NOTE: Before attempting to make any settings on the voice adapter module the associated TC-10 transmitter and receiver must be set properly as follows:

1. Using the adjustment procedures outlined previously, the output power levels under reserve signal detector, relaying, and voice conditions must be set accurately to obtain proper voice modulation.

Voice Receiver Sensitivity

The voice receiver sensitivity must be set using the sensitivity control (R1) labeled "Sens." located on the front of the module.

1. Set the remote TC-10 Transmitter for a power output level of 1-watts.
2. Connect a DC voltmeter (0-10 volts **min. sensitivity of 15,000 ohms per volt**) between TP-A and TP-B on the front of the voice adapter module.
3. Starting with "Sens." (R1) Voice adapter module at max. counterclockwise slowly turn R1 clockwise, while observing the voltmeter, to a point (Fig. 41 point A) where the voltage begins to increase rapidly. This is the proper setting of the receiver sensitivity. When the TC-10 transmitter operates at the voice power level of 3.25 watts the voice receiver sensitivity will be set at point B Fig. 41.

Speech Amplifier Output

The speech-amp output level is adjusted using modulating adjustment labeled "Mod." (R37) mounted on the front of the circuit board. The procedure is as follows:

1. Connect an oscilloscope and an ac VTVM across the TC-10 Transmitter output terminals.
2. Plug in the telephone handset. The voltmeter should indicate a transmitter output level of 3.25 watts (14 volts across 60 ohms).
3. Connect an audio signal generator set at 1000 Hz. at a level of 1 volt (rms) between TP5 and circuit board terminal 17 (D.C. neg.) of the speech-amp module.
4. Adjust "Mod." (R37) on the speech-amp board. Starting from max. CCW., increase the level slowly while observing the modulation pattern on the scope until a point of maximum undistorted modulation is reached. This is the proper setting.

Receiver Volume Control

The "Receiver Level" volume control R14 is located on the front of the voice adapter module. It has a knob on it and is adjusted for a comfortable listening level. This naturally differs according to each person's preference or needs.

ACCESSORIES

1) Telephone Handset
   a) Westinghouse style - 204C892H01 - noise canceling microphone.
   b) Westinghouse style - 204C892G01 - non-/noise canceling microphone.
2) Remote Hookswitch - Handset Assembly (for surface mounting)
   a) Westinghouse style - 205C246G01 - with noise canceling handset.
   b) Westinghouse style - 205C246G02 - with non/noise canceling handset.
3) Remote Hookswitch - Handset Assembly (for panel mounting)
   a) Westinghouse style - 205C266G01 - with noise canceling handset.
   b) Westinghouse style -204C266G02 - with non/noise canceling handset.

For mounting and wiring details of the above accessories see Figs. 36 thru 39.

MAINTENANCE

Periodic checks of the received carrier signal will indicate impending failure so that the equipment can be taken out of service for correction. At regular maintenance intervals, any accumulated dust should be removed, particularly from the heat sinks. It is also desirable to check the transmitter power output and receiver sensitivity at such times, making any necessary readjustments to return the equipment to its initial settings.

Voltage values should be recorded after readjustment in order to establish reference values which will be useful when checking the apparatus. The readings will remain fairly constant over an indefinite period unless a failure occurs. However, if transistors are changed, there may be considerable difference in these readings without the overall performance being affected.

Typical voltage and current values are given in Tables I through VI. Voltages should be measured with a VTVM. Readings may vary as much as ± 20%.

REPLACEMENT OF Q2 AND Q4

The two transistors Q2 and Q4 in the transmitter power-amplifier stage are a matched pair with the gain of the two units matched within 5%. If one of the transistors fails, both should be replaced with a new matched pair. This is necessary to keep the second harmonic of the transmitter output at an acceptably low value. The pair of transistors should be ordered as 1 of S#3508A21H04 matched pair transistors.

CHANGE OF OPERATING FREQUENCY

The parts required for changing the operating frequency of a type TC carrier set are as follows:

TRANSMITTER

1. Oscillator Crystal (Y101), specify frequency
2. Capacitors C1, C2, C3 and C4 (on Power Amp. board)
3. For ease of replacement, this is a complete plug-in module. However, the unit can be changed as noted below.

Inductors L102 and L103 in these filters are adjustable over a limited range, but forty-two combinations of capacitors and inductors are required to cover the frequency range of 30 kHz. to 300 kHz. The widths of the frequency groups vary from 1.5 kHz at the low end of the channel frequency range to 13 kHz at the upper end. A particular assembly can be adjusted over a somewhat wider range than the width of its assigned group since some overlap is necessary to allow for component tolerances. The nominal adjustment ranges of the groups are:

30.0-31.5	61.0-64.0	113.0-119.5	207.1-214.0
32.0-33.5	64.5-68.0	120.0-127.0	214.1-222.0
34.0-36.0	68.5-72.0	127.5-135.0	222.1-230.0
36.5-38.5	72.5-76.0	135.5-143.0	230.1-240.0
39.0-41.0	76.5-80.0	145.5-151.0	240.1-250.0
41.5-44.0	80.5-84.5	151.5-159.5	250.1-262.0
44.5-47.0	85.0-89.0	160.0-169.5	262.1-274.0
47.5-50.0	89.5-94.5	170.0-180.0	274.1-287.0
50.5-53.5	95.0-100.0	180.5-191.5	287.1-300.0
54.0-57.0	100.5-106.0	192.0-200.0	
57.5-60.5	106.5-112.5	200.1-207.0	

If the new frequency lies within the same frequency group as the original frequency, the filters can be readjusted. If the frequencies are in different groups, it is possible that changes only in the fixed capacitors may be required. In general, however, it is desirable to order complete filter assemblies adjusted at the factory for the specified frequency.

The procedure for readjustment of the 2nd and 3rd harmonic traps of filter FL102 is as follows. A signal generator and a counter should be connected to terminals 3 and 4 of transformer T105 and a 500-ohm resistor and a VTVM to the terminals of protective gap G101. The ground or shield lead of all instruments should be connected to the grounded terminal of the transformer. Set the signal generator at exactly twice the channel center frequency and at 5 to 10 volts output. Turn the core screw of the large inductor, L102, to the position that gives a definite minimum reading on the VTVM. Similarly, with the signal generator set at exactly three times the channel center frequency and 5 to 10 volts output, set the core screw of the small inductor, L103, to the position that gives a definite minimum reading on the VTVM. Then remove the instruments and the 500-ohm resistor.

If the change in frequency is enough to require a different filter, it will come factory adjusted as described in the foregoing paragraph. Since it is a plug-in module, it is a simple matter to remove the old one and replace it with the new one.

After all the tabulated changes have been made for the new frequency, the transmitter can be operated with a 50 to 70-ohm load (depending on which tap of T106 is used) connected to its output, and inductor L105 can be readjusted for maximum output at the change channel frequency by the procedure described in the ADJUSTMENT section.

If the frequency-sensitive voltmeter is available the second and third harmonic traps may be adjusted (or checked) without using an oscillator as a source of double and triple the channel frequency. Connect the frequency-sensitive voltmeter from TP109 to ground and adjust the transmitter for rated output into the selected load resistor. Set the voltmeter at twice the channel frequency and, using its tuning dial and db range switch, obtain a maximum on-scale reading of the second harmonic. Then vary the core position of L102 until a minimum voltmeter reading is obtained. Similarly, tune the voltmeter to the third harmonic and adjust L103 for minimum voltmeter reading. It should be noted that this procedure may not give the true magnitude of the harmonics because of the large value of fundamental frequency voltage present at the tuned voltmeter input terminals. This condition will overload the input circuit of some commerical instruments. However, the procedure is satisfactory for adjusting the traps for maximum harmonic rejection.

If accurate measurement of the harmonic levels is desired, the frequency-selective voltmeter is connected, through a rejection filter, to the terminals of the 60-ohm load resistor. The filter must provide high rejection of the fundamental. A twin-T filter is suitable for this purpose. The insertion losses of this filter at the second and third harmonics must be measured and taken into account.

RECEIVER

1. Receiver Oscillator Crystal (Y11), specify frequency.
2. Receiver input filter (FL201), specify frequency. Order complete input module for ease of replacement.
3. If the operating frequency is reduced, the receiver gain will probably be higher. In this case, a reduction in the setting of the i-f input control R2 will give the 40-mV sensitivity. If the new operating frequency is higher, the receiver gain may be lower. If more than 40-mV is required to obtain 180 mA output, the gain can be increased by reducing the value of one or both of the resistors R29 and R36 on OSC & mixer BD. In most cases, these resistors shall fall in the range of 68 to 47 ohms.

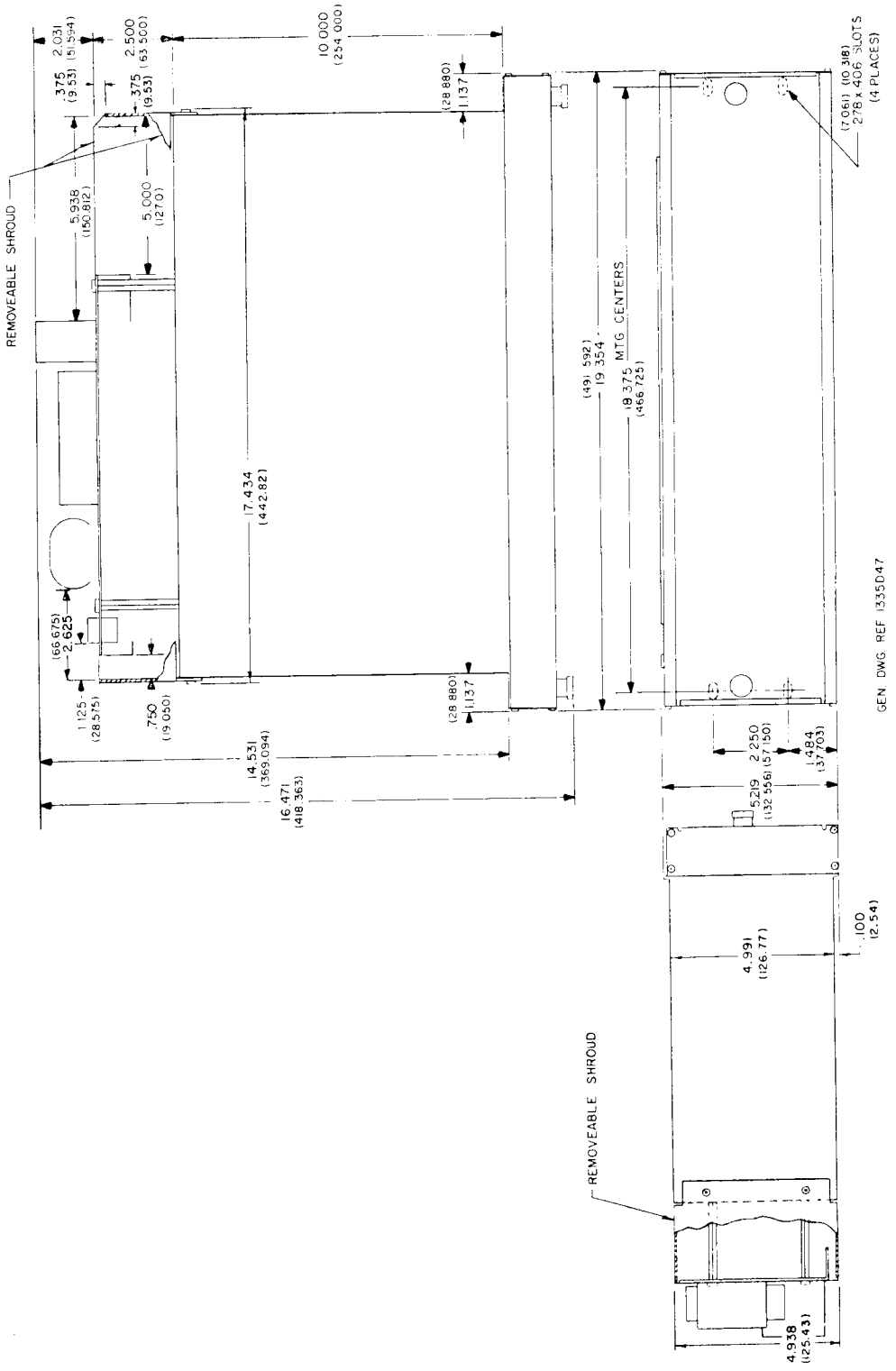


Fig. 1. Type TC-10 Carrier Assembly Outline.

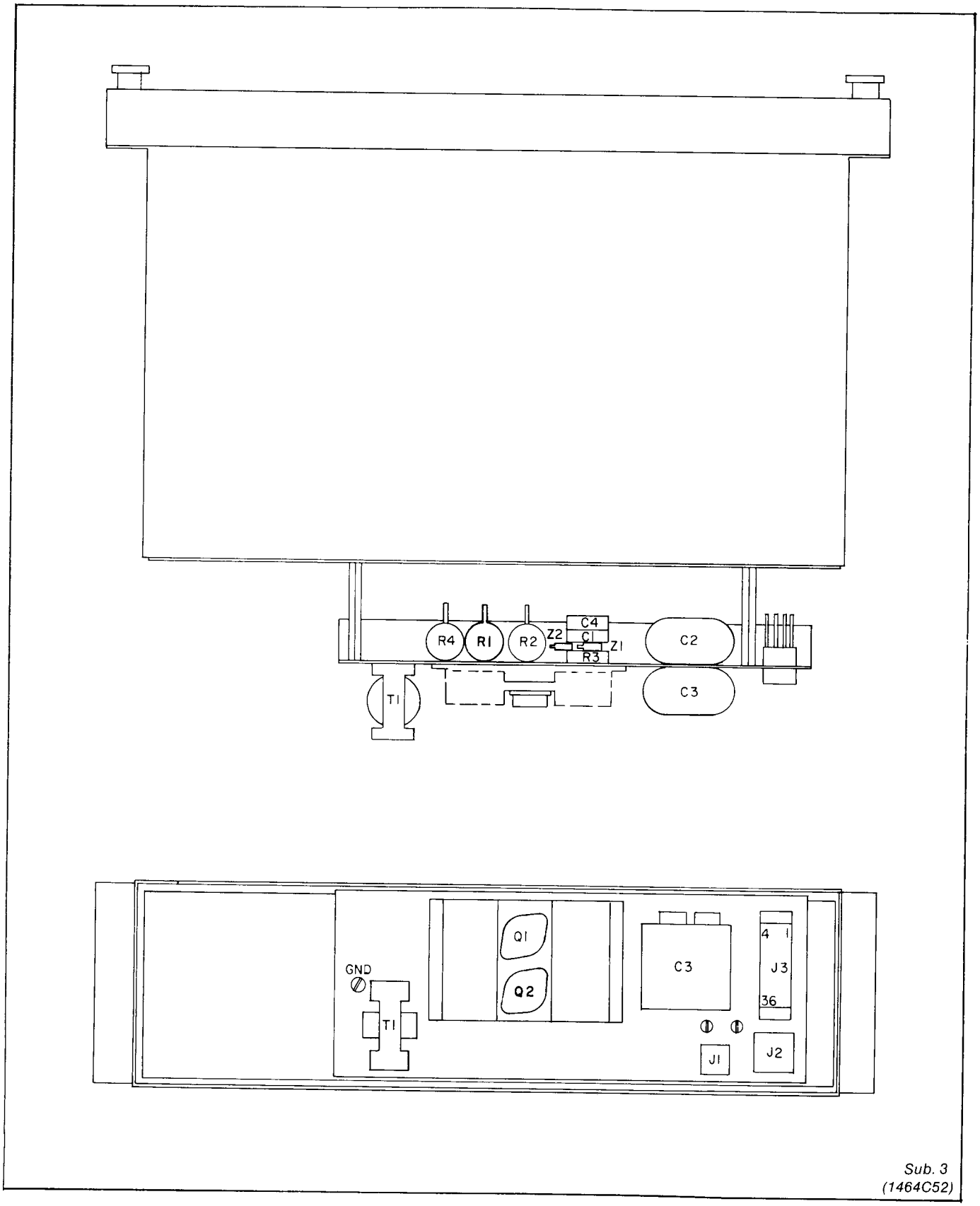
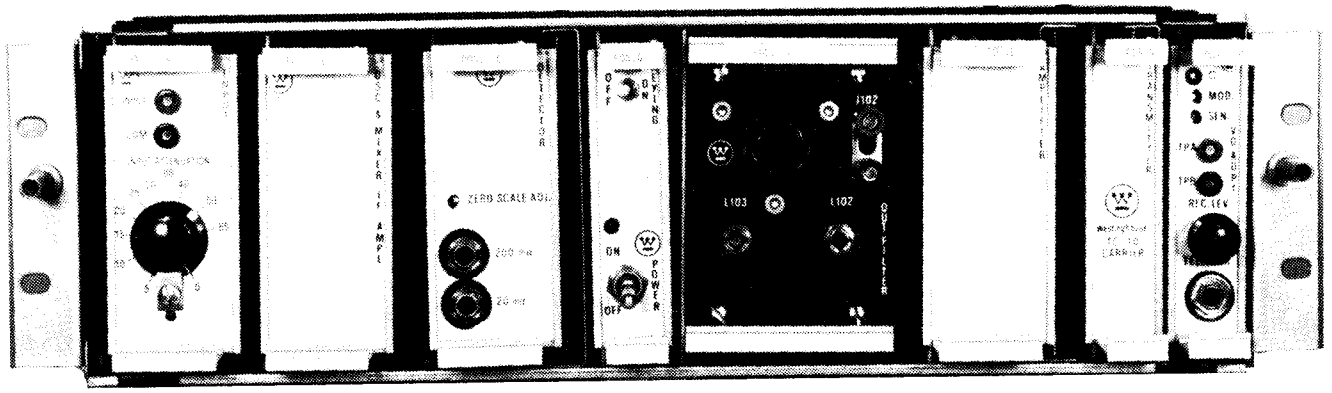
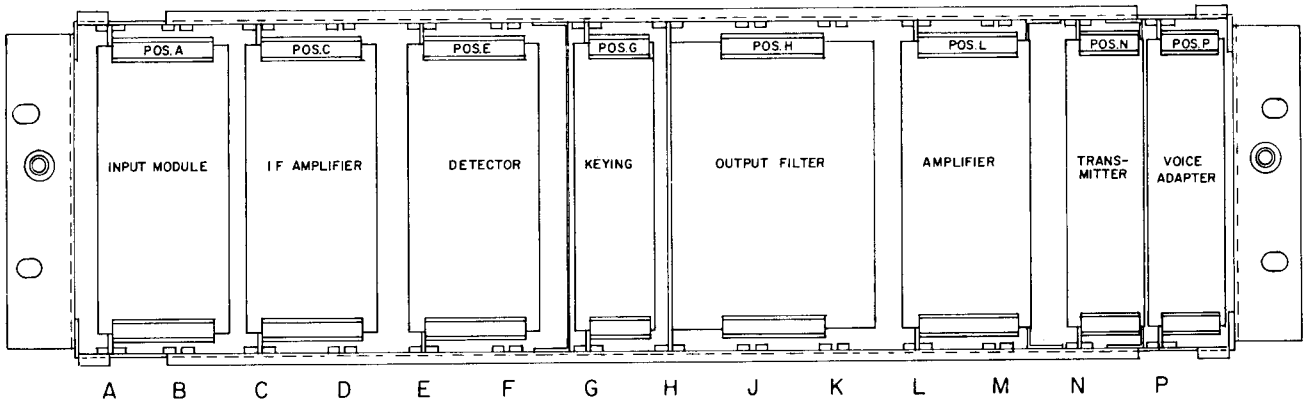


Fig. 2. Parts Location.





Sub. 3
(1464C69)

Fig. 3. Component Location - Modules.

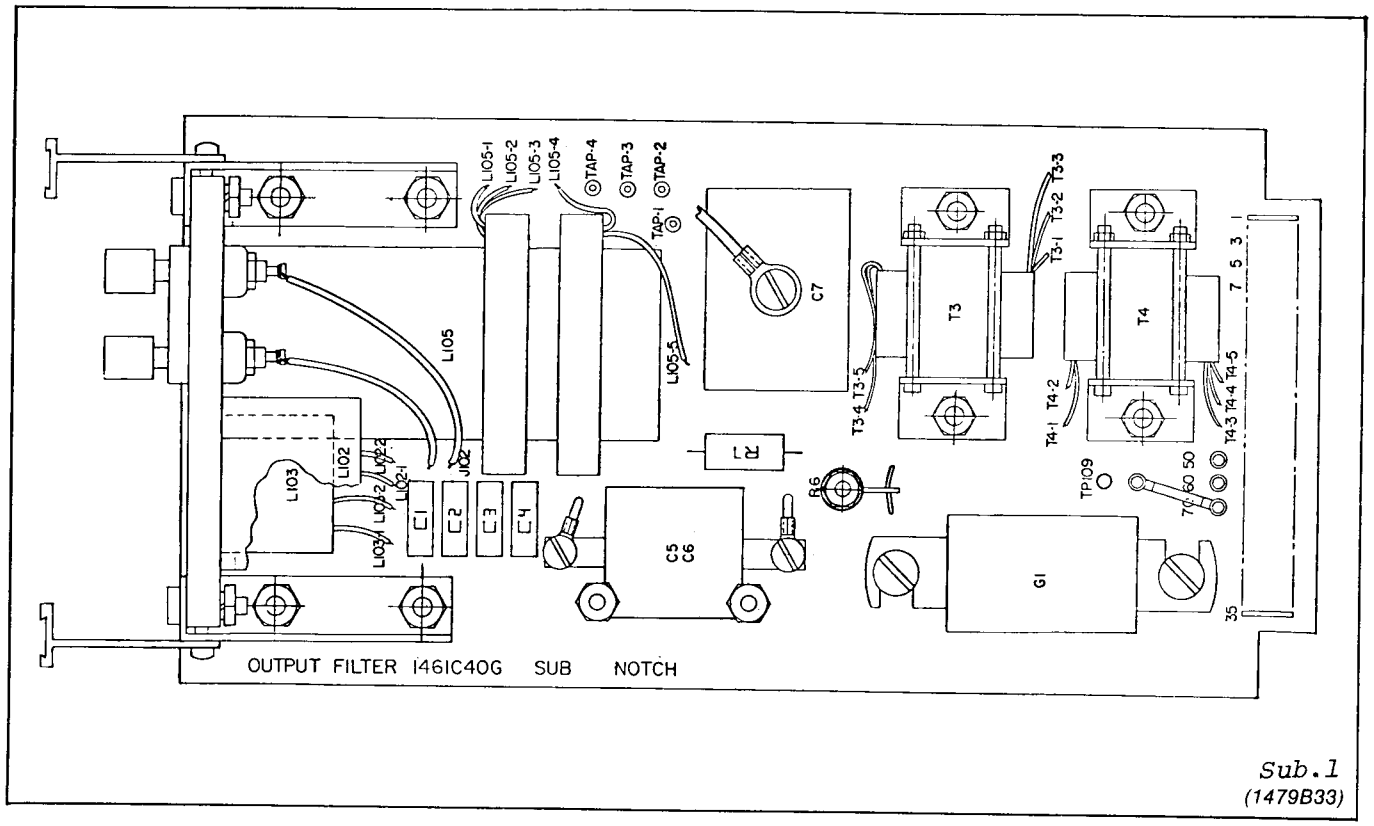


Fig. 4. Component Location - Output Filter Below 200kHz.

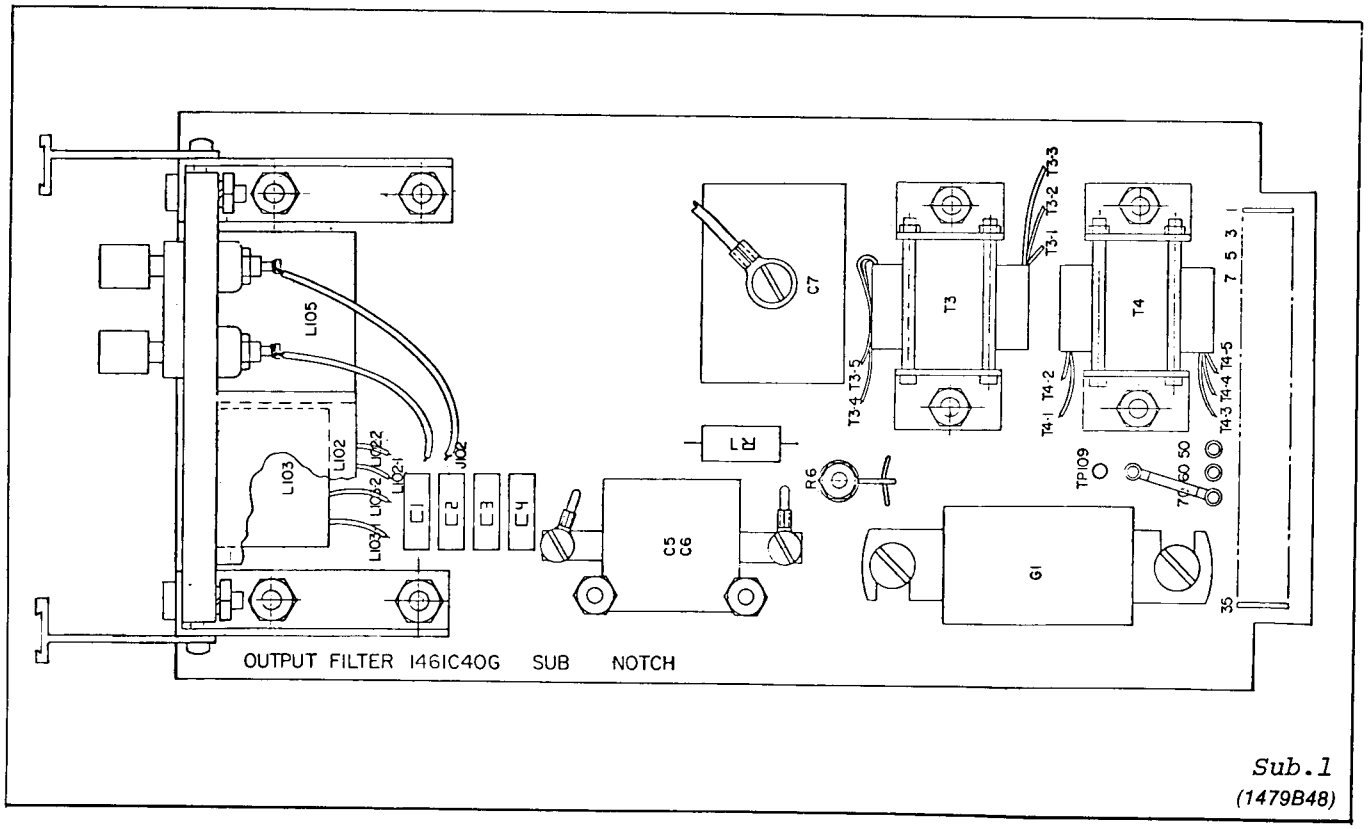


Fig. 5. Component Location - Output Filter Above 200kHz.

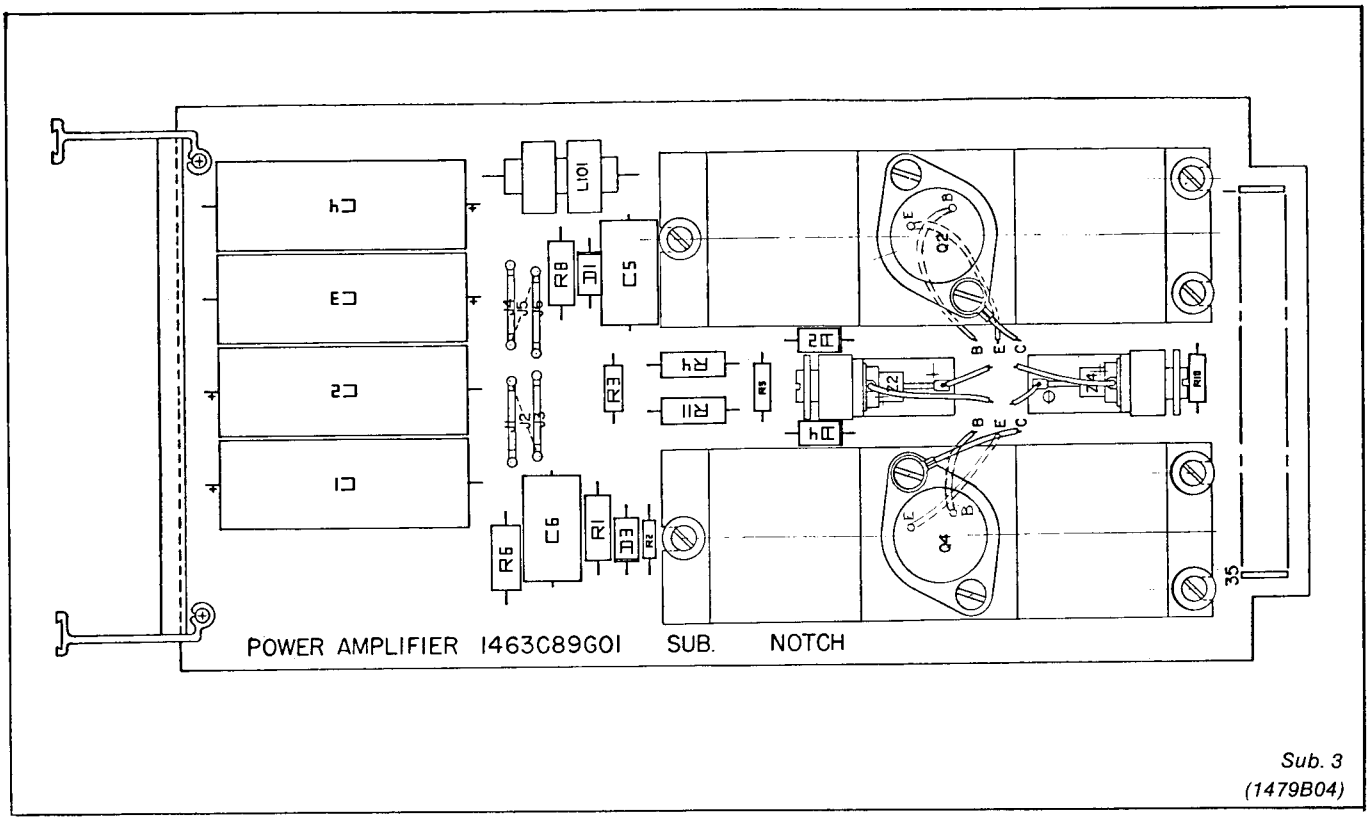


Fig. 6. Component Location - Amplifier.

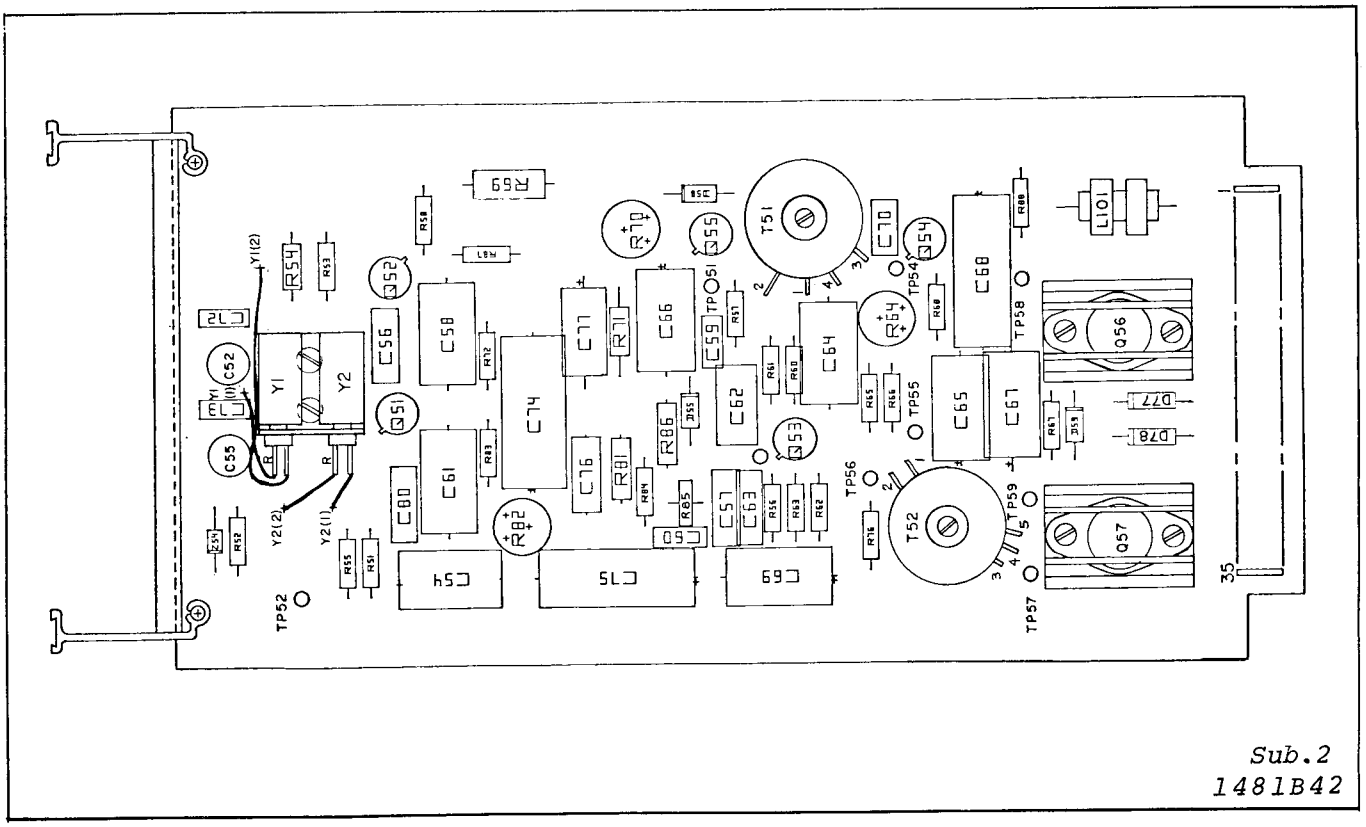


Fig. 7. Component Location - Transmitter Module.

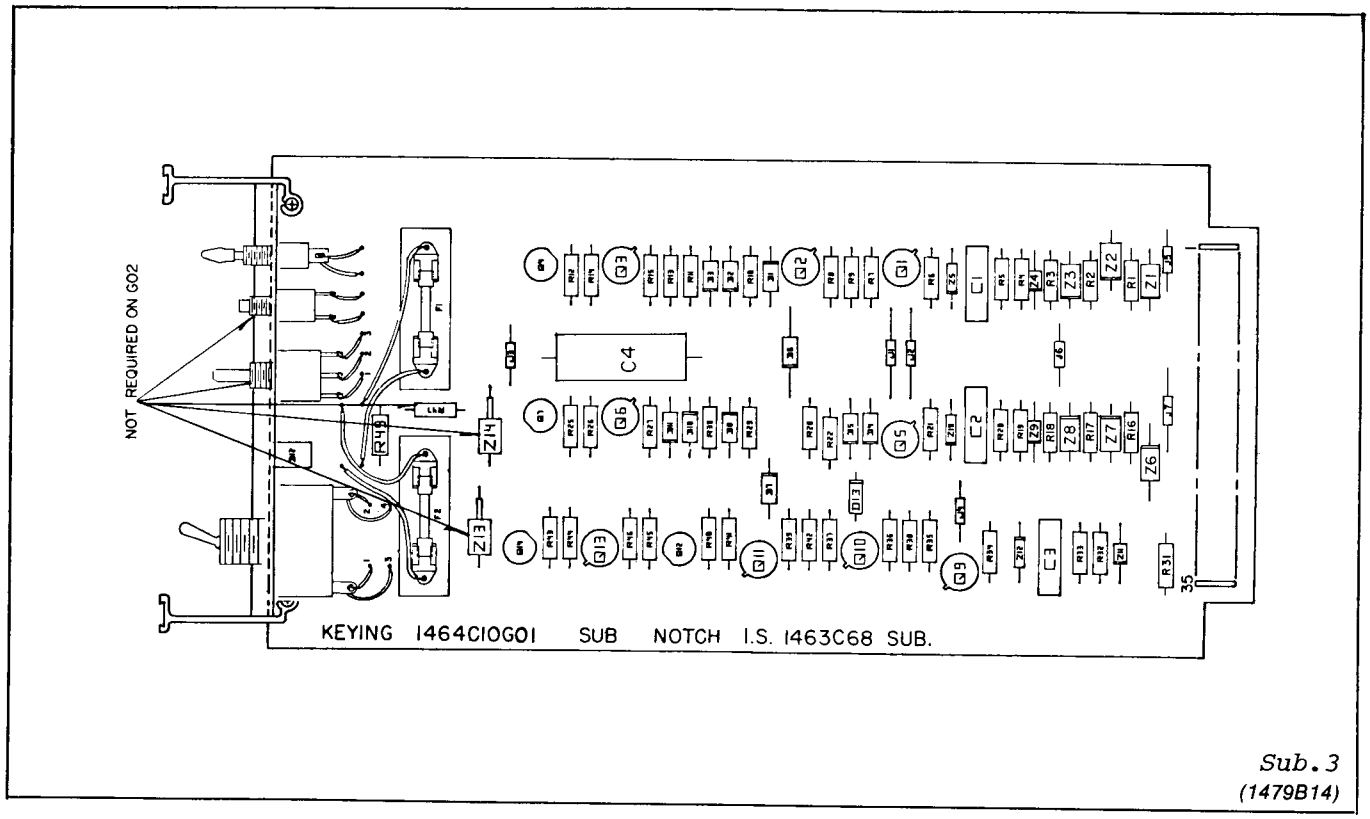


Fig. 8. Component Location - Keying Module.

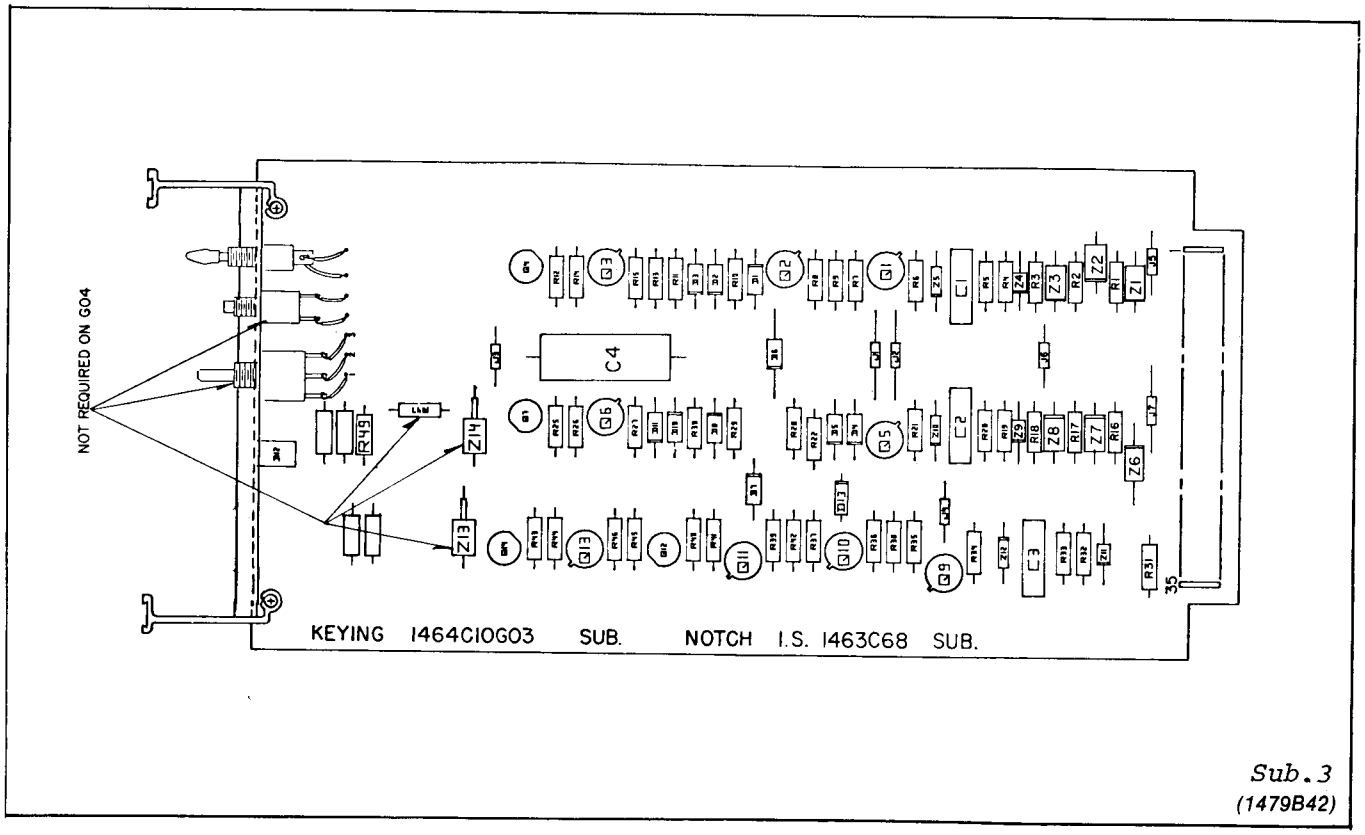


Fig. 9. Component Location - Keying Module.

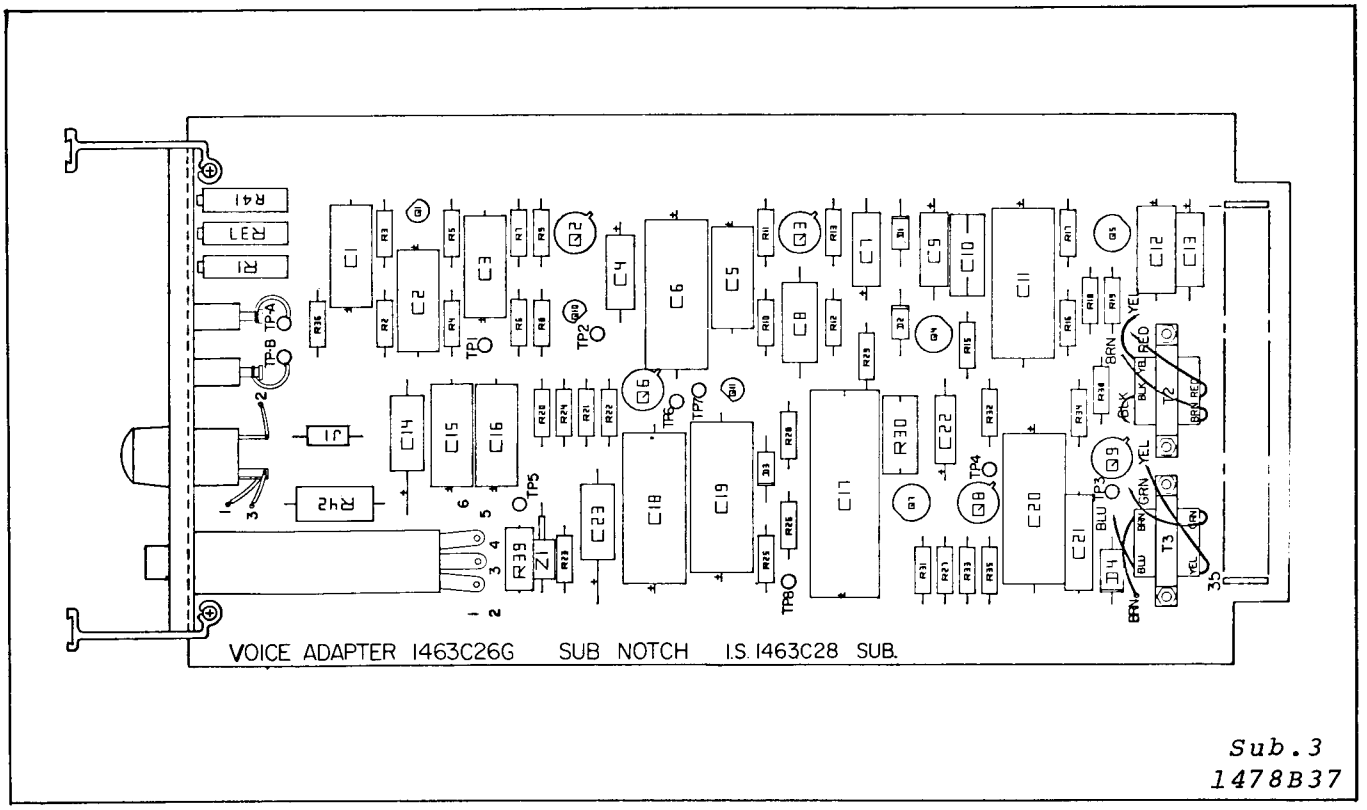


Fig. 10. Component Location - Voice Adapter Module.

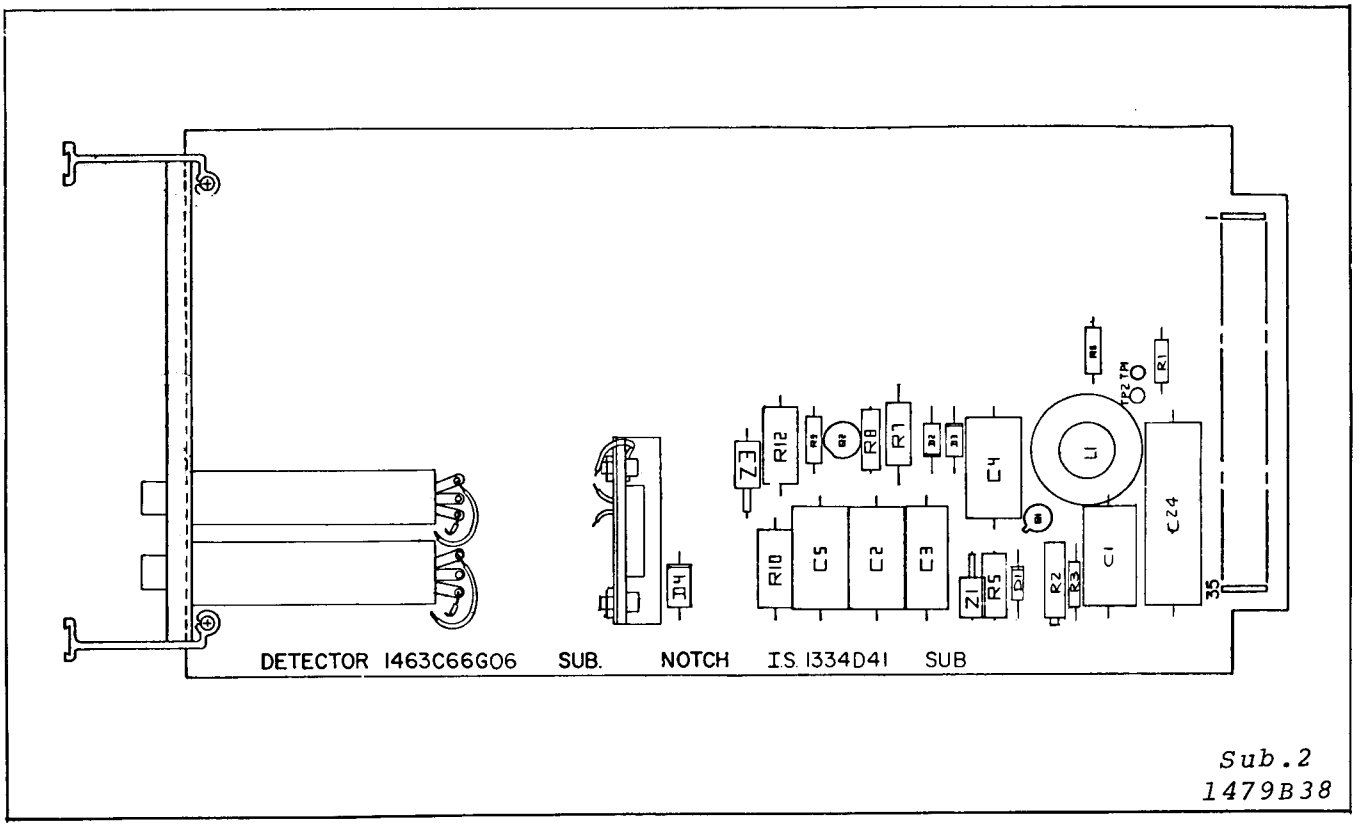


Fig. 11. Component Location - Detector Module.

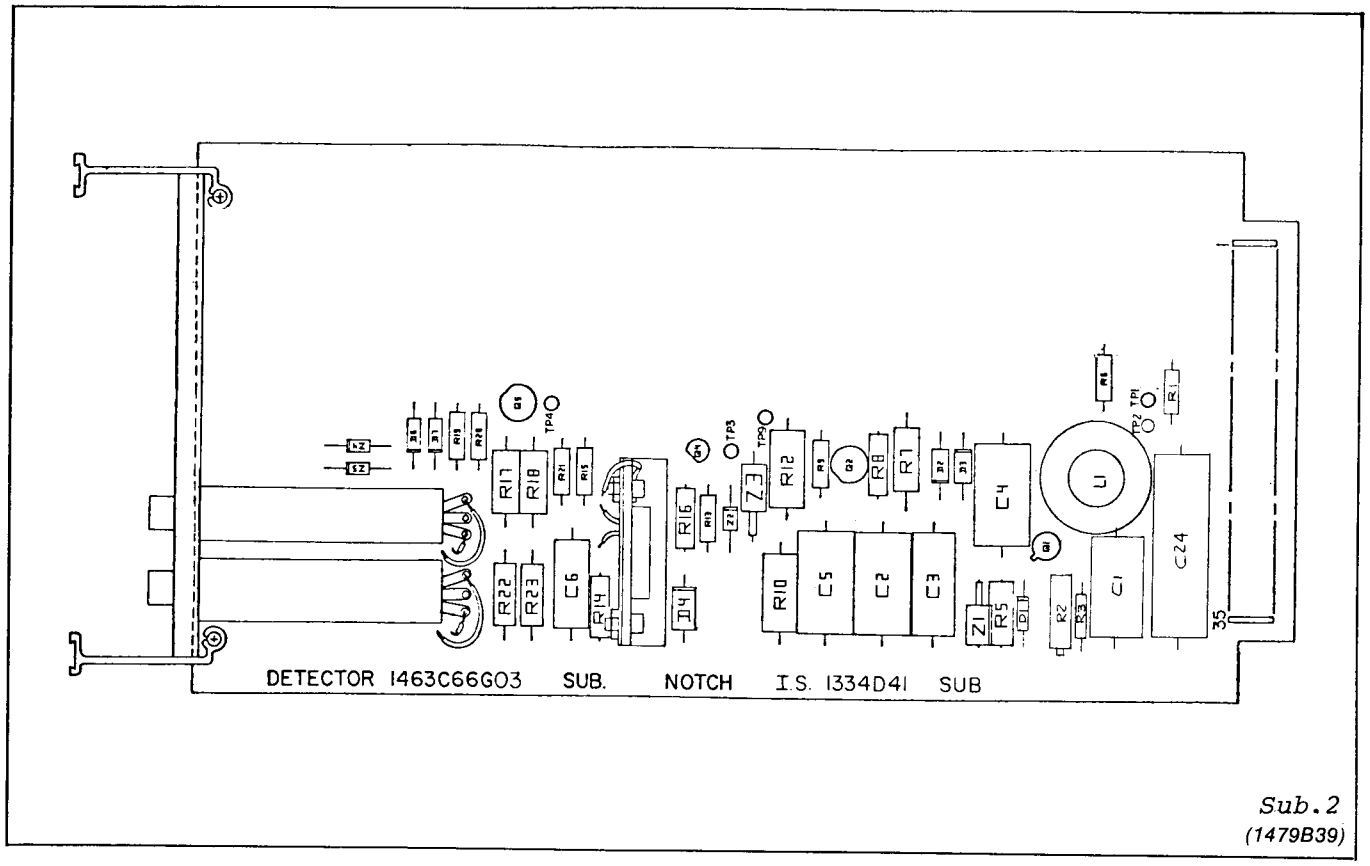


Fig. 12. Component Location - Detector Module.

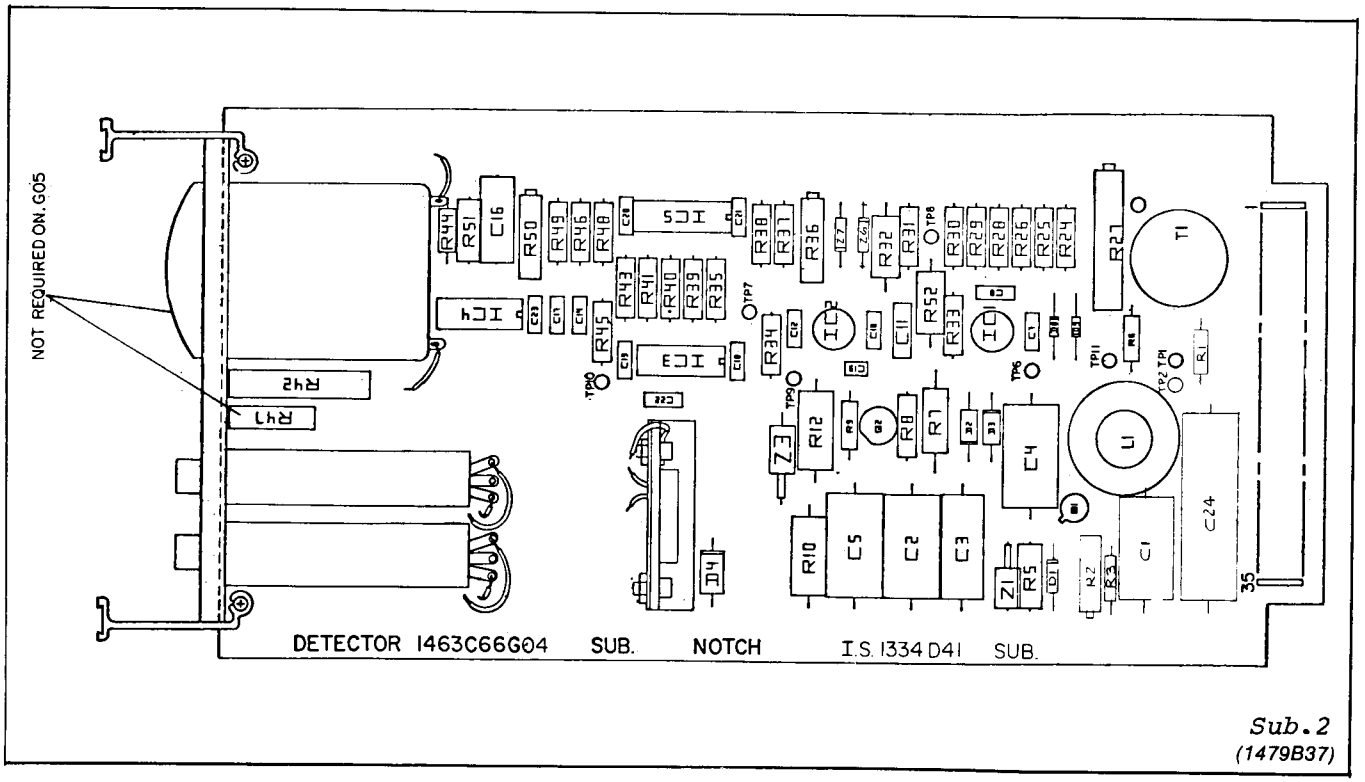


Fig. 13. Component Location - Detector Module.

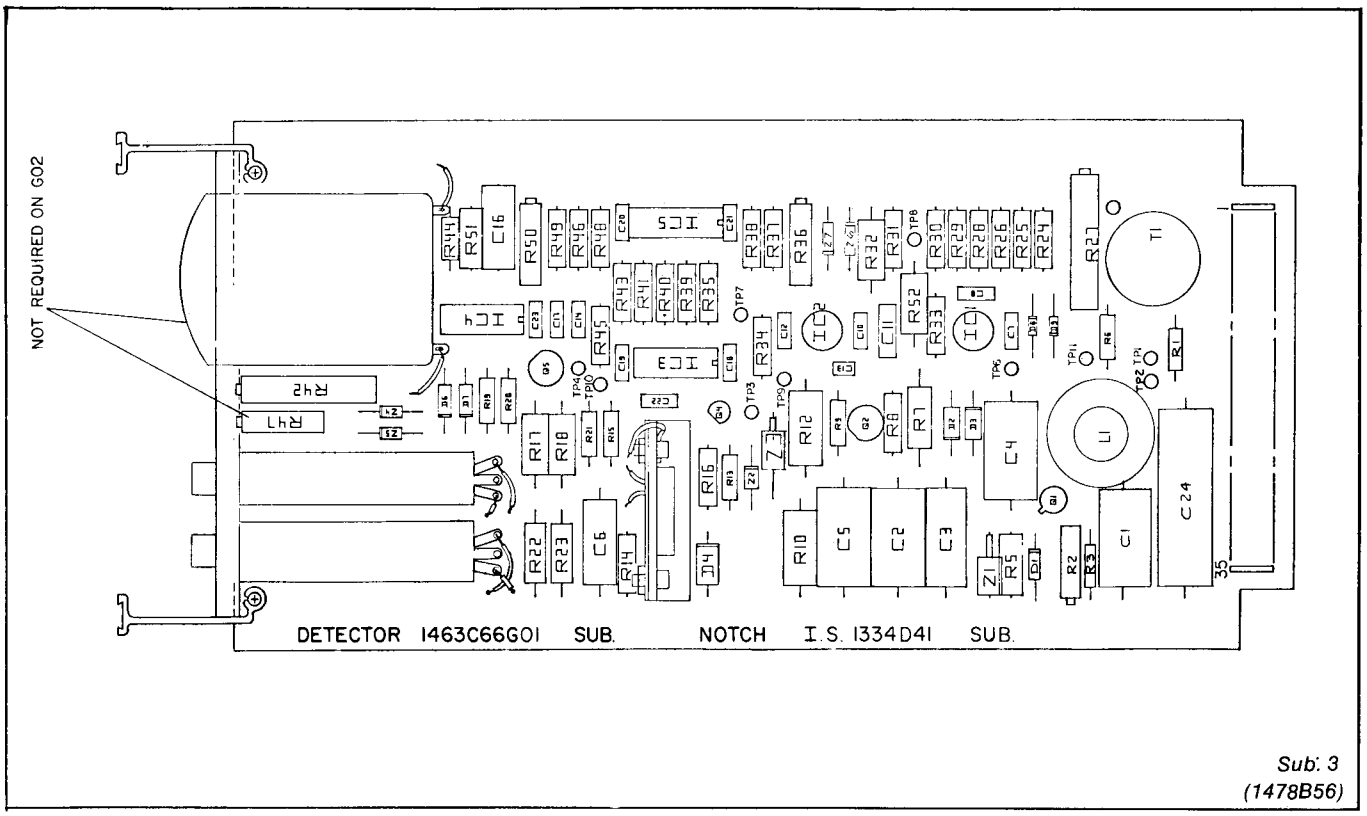


Fig. 14. Component Location - Detector Module.

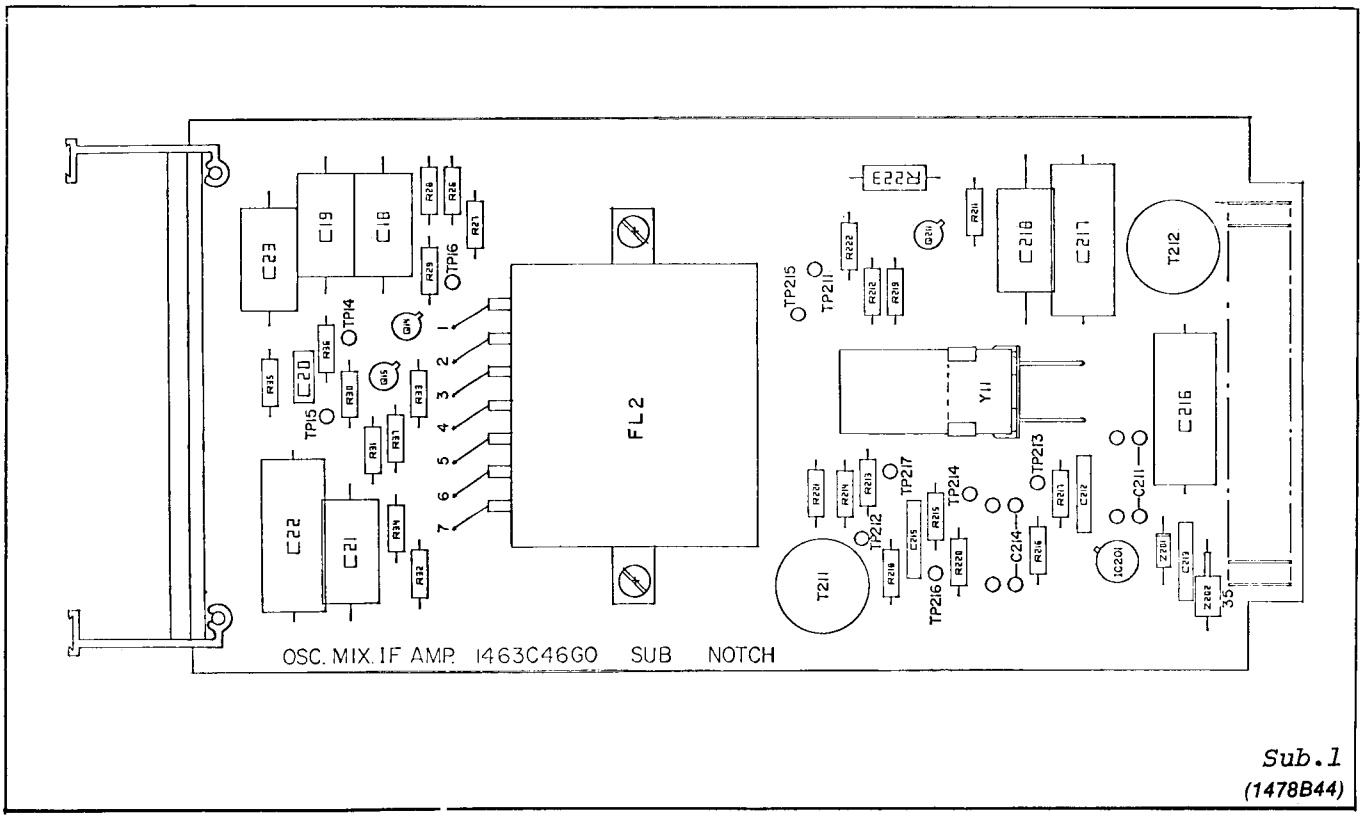


Fig. 15. Component Location - I.F. Amplifier - Oscillator.

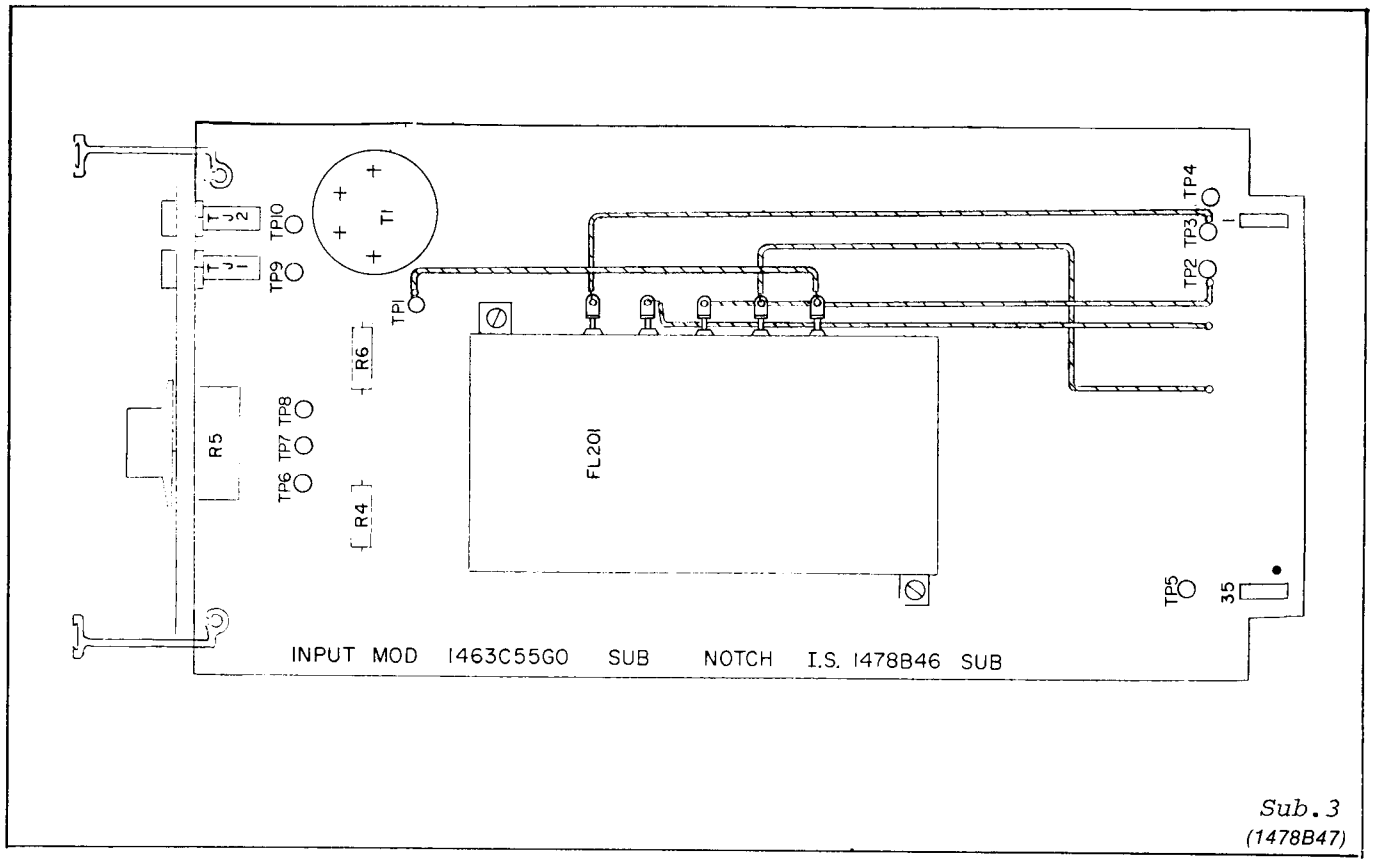


Fig. 16. Component Location - Input Module - 30 — 200 KHz.

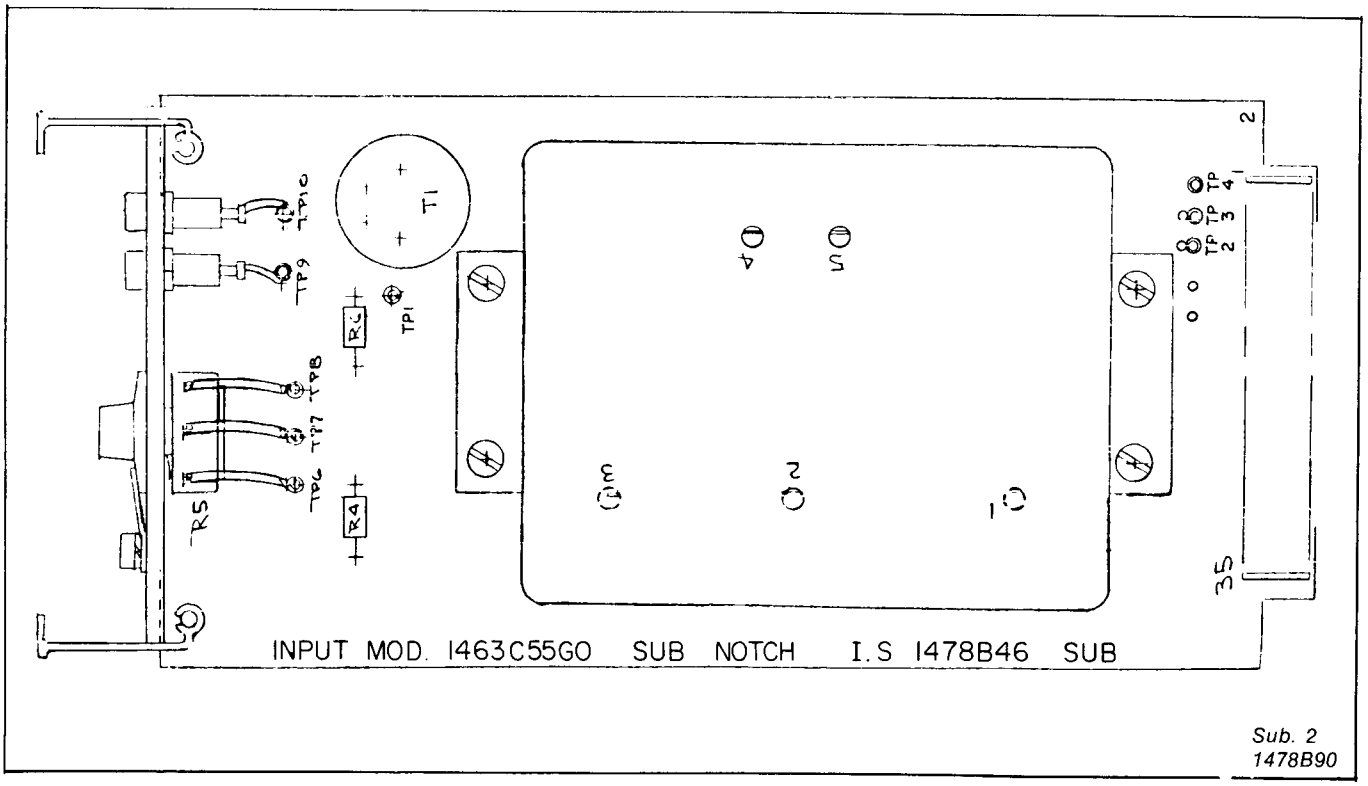


Fig. 17. Component Location - Input Module 200.1 - 300 KHz.

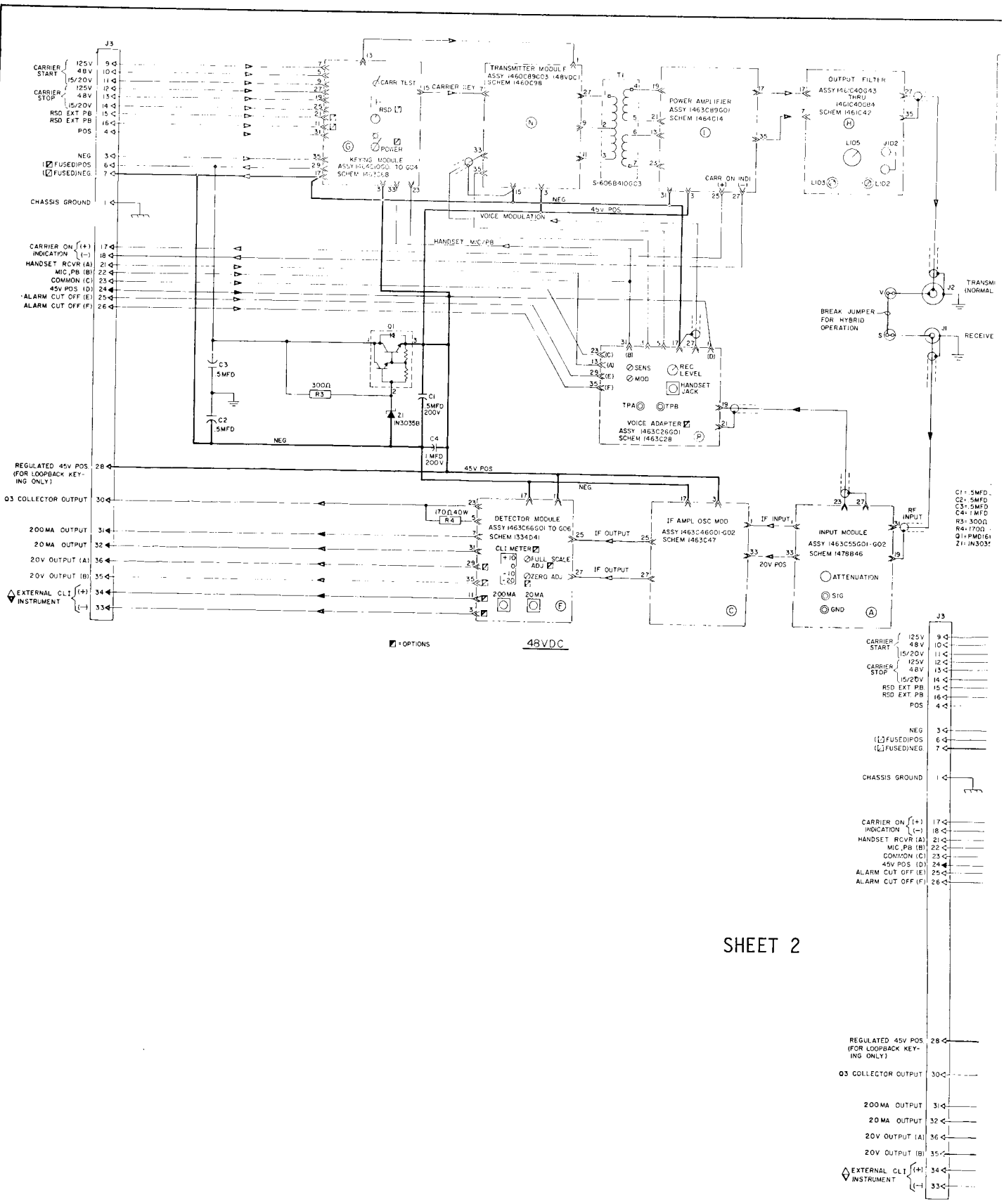
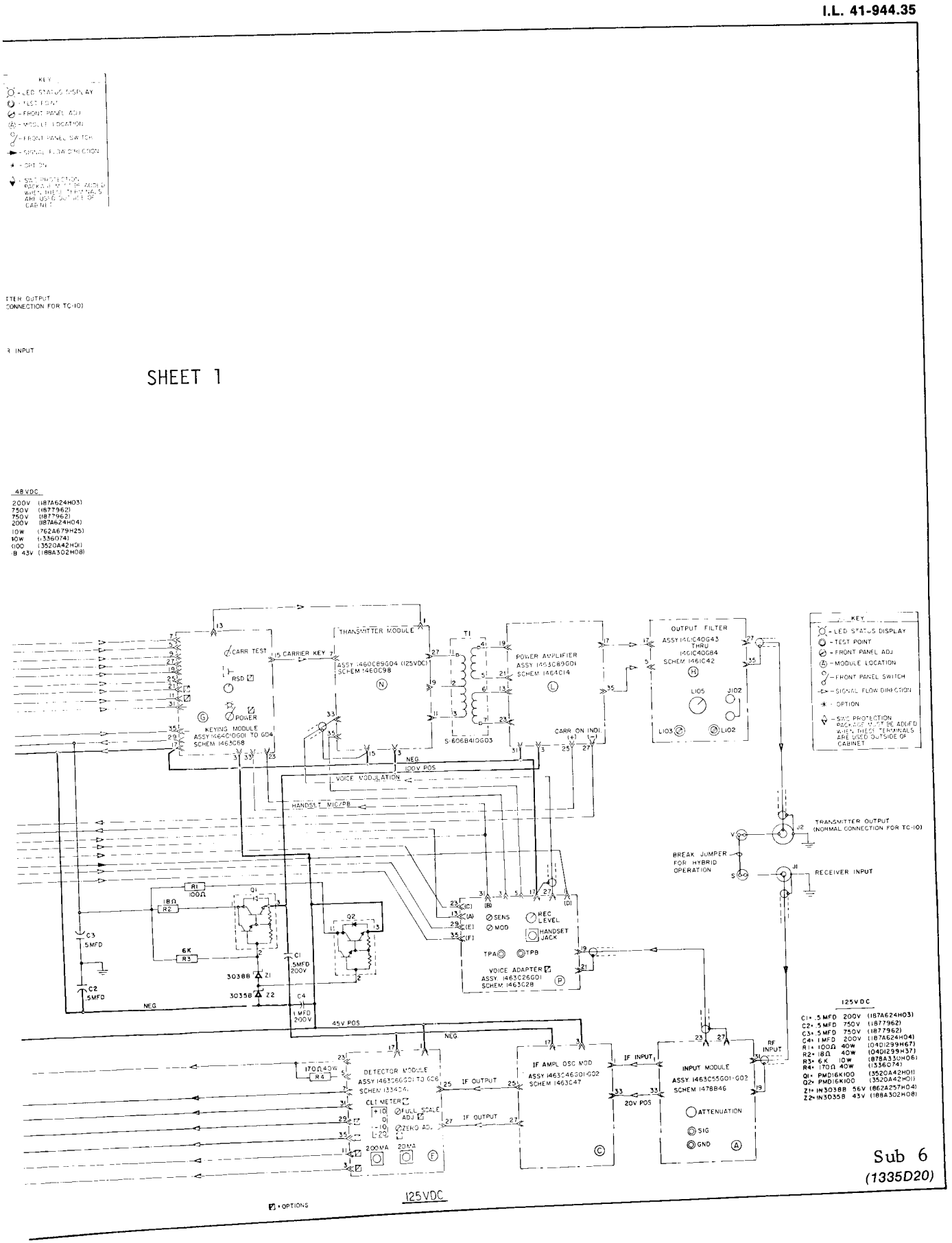


Fig. 18. Type TC-10 Over



ıll Block Schematic.

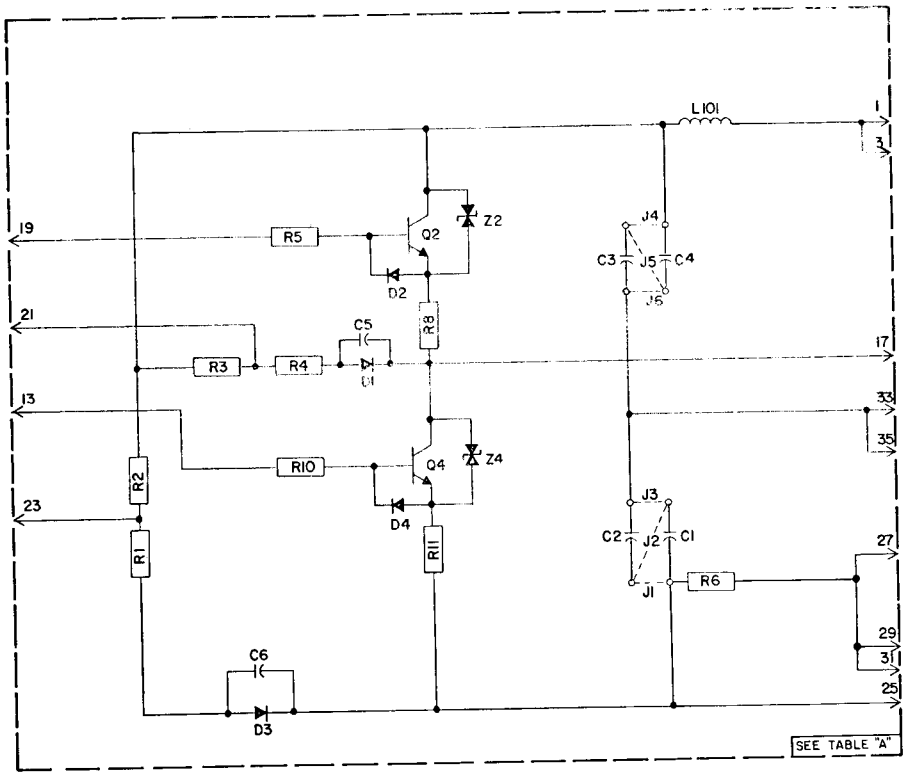


TABLE A

1463C89G01	1463C89G02	1463C89G03	COMPONENT		DESCRIPTION	STYLE NO.
-	-	-	C1	CAPACITOR	.470UF 400V	188A293H01
-	-	-	C2	CAPACITOR	.470UF 400V	188A293H01
-	-	-	C3	CAPACITOR	.470UF 400V	188A293H01
-	-	-	C4	CAPACITOR	.470UF 400V	188A293H01
-	-	-	C5	CAPACITOR	.250UF 200V	187A624H02
-	-	-	C6	CAPACITOR	.250UF 200V	187A624H02
-	-	-	C1	CAPACITOR	.220UF 400V	188A293H02
-	-	-	C3	CAPACITOR	.220UF 400V	188A293H02
1	1	1	D1	DIODE	1N4822	188A342H11
1	1	1	D2	DIODE	1N4822	188A342H11
1	1	1	D3	DIODE	1N4822	188A342H11
1	1	1	D4	DIODE	1N4822	188A342H11
1	1	1	R1	RESISTOR	2.7 1.00W 0%	629A371H24
1	1	1	R2	RESISTOR	90.9K .25W 1%	863A175H93
1	1	1	R3	RESISTOR	49.9 K .50W 1%	848A821H13
1	1	1	R4	RESISTOR	2.7 1.00W 0%	629A371H24
1	1	1	R5	RESISTOR	10.0 1.00W 5%	**629A371H01**
1	1	1	R6	RESISTOR	2.0 3.00W 5%	762A679H13
1	1	1	R8	RESISTOR	.3 1.00W10%	184A636H18
1	1	1	R10	RESISTOR	10.0 1.00W 5%	**629A371H01**
1	1	1	R11	RESISTOR	.3 1.00W10%	184A636H18
1	1	1	Q2	TRANSISTOR	2N6341	3508A21H04
1	1	1	Q4	TRANSISTOR	2N6341	3508A21H04
1	1	1	Z2	ZENER	1N2999B	629A798H04
1	1	1	Z4	ZENER	1N2999B	629A798H04
1	1	1	L101	CHOKE		3500A27H01

ENG. REF.

REARRANGE JUMPERS J1 TO J6 FOR FREQ OF OPERATION

G01	30-70 KHZ	J1, J3, J4, J6
G02	70-150 KHZ	J1, J3, J4, J6
G03	150-300 KHZ	J1, J3, J4, J6

Sub. 4
(1464C14)

Fig. 20. Internal Schematic - Power Amplifier Module.

1461C40G01,G43(30-31.5KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	2500 MMF 500V	861A846H20
C2 CAPACITOR	2700 MMF 500V	861A846H21
C3 CAPACITOR	1500 MMF 500V	762A757H03
C4 CAPACITOR	3300 MMF 500V	187A584H26
C5 CAPACITOR	4000 MMF 1200V	187A705H15
C6 CAPACITOR	4000 MMF 1200V	187A705H15
C7 CAPACITOR	7000 PF 3000V	203C872H29
L102 POT CORE		670B133G04
L103 POT CORE		670B133G06
L105 COIL		292B086G01
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
G1 LIGHTNING ARRESTER		877A116H01

1461C40G02,G44 (32-33.5KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	2500 MMF 500V	861A846H20
C2 CAPACITOR	2000 MMF 500V	187A584H01
C3 CAPACITOR	1000 MMF 500V	762A757H02
C4 CAPACITOR	3300 MMF 500V	187A584H26
C5 CAPACITOR	2500 MMF 1200V	187A705H13
C6 CAPACITOR	5000 MMF 1200V	187A705H16
C7 CAPACITOR	6000 PF 3000V	203C872H28
L102 POT CORE		670B133G04
L103 POT CORE		670B133G06
L105 COIL		292B086G01
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
G1 LIGHTNING ARRESTER		877A116H01

1461C40G03,G45(34-36 KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	2000 MMF 500V	187A584H01
C2 CAPACITOR	2000 MMF 500V	187A584H01
C3 CAPACITOR	390 MMF 500V	762A757H15
C4 CAPACITOR	3300 MMF 500V	187A584H26
C5 CAPACITOR	2500 MMF 1200V	187A705H13
C6 CAPACITOR	4000 MMF 1200V	187A705H15
C7 CAPACITOR	5500 PF 3000V	203C872H27
L102 POT CORE		670B133G04
L103 POT CORE		670B133G06
L105 COIL		292B086G01
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
G1 LIGHTNING ARRESTER		877A116H01

1461C40G04,G46 (36.5-38.5KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	1500 MMF 500V	762A757H03
C2 CAPACITOR	2000 MMF 500V	187A584H01
C4 CAPACITOR	3300 MMF 500V	187A584H26
C5 CAPACITOR	3000 MMF 1200V	187A705H14
C6 CAPACITOR	2500 MMF 1200V	187A705H13
C7 CAPACITOR	5000 PF 3000V	203C872H26
L102 POT CORE		670B133G04
L103 POT CORE		670B133G06
L105 COIL		292B086G01
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
G1 LIGHTNING ARRESTER		877A116H01

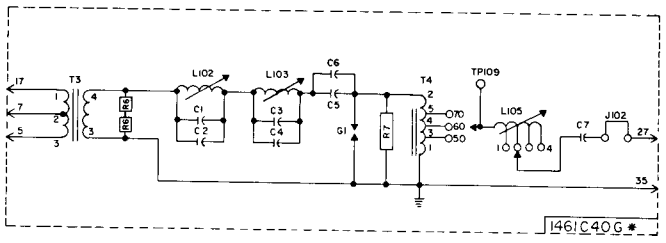


FIG.1
30 TO 200 KC

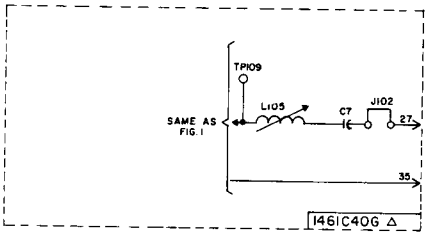


FIG.2 (OTHERWISE SAME AS FIG.1)
200.1 TO 300 KC

* -G01 THRU G32
G43 THRU G74

Δ- G33 THRU G42
G75 THRU G84

ASSEMBLY - 1461C40
COMP LOC. - 1477B28
P.C.B. - 1461C41

Sub. 6
(1461C42)

Fig. 21. Internal Schematic - Output Filter Module.

PARTS LIST 1461C42, SHEETS 1 thru 5

1461C40G05,G47 (39-41KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	3000 MMF 500V	187A584H06
C3 CAPACITOR	820 MMF 500V	762A757H22
C4 CAPACITOR	2000 MMF 500V	187A584H01
C5 CAPACITOR	2500 MMF 1200V	187A705H13
C6 CAPACITOR	2500 MMF 1200V	187A705H13
C7 CAPACITOR	4200 PF 3000V	203C872H25
L102 POT CORE		670B133G04
L103 POT CORE		670B133G06
L105 COIL		292B086G01
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
G1 LIGHTNING ARRESTER		877A116H01

1461C40G06,G48 (41.5-44KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	2500 MMF 500V	861A846H20
C2 CAPACITOR	150 MMF 500V	861A846H25
C3 CAPACITOR	150 MMF 500V	861A846H25
C5 CAPACITOR	200 MMF 1200V	137A705H04
C6 CAPACITOR	4000 MMF 1200V	187A705H15
C7 CAPACITOR	3500 PF 3000V	203C872H23
L102 POT CORE		670B133G04
L103 POT CORE		670B133G06
L105 COIL		292B086G01
T3 TRANSFORMER		292B526GC4
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
G1 LIGHTNING ARRESTER		877A116H01

1461C40G07,G49(44.5-47KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	300 MMF 500V	187A584H09
C2 CAPACITOR	2000 MMF 500V	187A584H01
C3 CAPACITOR	180 MMF 500V	762A757H10
C4 CAPACITOR	2000 MMF 500V	187A584H01
C5 CAPACITOR	1500 MMF 1200V	187A705H11
C6 CAPACITOR	2000 MMF 1200V	187A705H12
C7 CAPACITOR	3200 PF 3000V	203C872H22
L102 POT CORE		670B133G04
L103 POT CORE		670B133G06
L105 COIL		292B086G01
T3 TRANSFORMER		292B526GC4
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
G1 LIGHTNING ARRESTER		877A116H01

1461C40G08,G50(47.5-50KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	30 MMF 500V	763A209H12
C2 CAPACITOR	2000 MMF 500V	187A584H01
C3 CAPACITOR	390 MMF 500V	762A757H15
C4 CAPACITOR	1500 MMF 500V	762A757H03
C5 CAPACITOR	3000 MMF 1200V	187A705H14
C6 CAPACITOR	200 MMF 1200V	187A705H04
C7 CAPACITOR	2800 PF 3000V	203C872H20
L102 POT CORE		670B133G04
L103 POT CORE		670B133G06
L105 COIL		292B086G01
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
G1 LIGHTNING ARRESTER		877A116H01

1461C40G09,G51 (50.5-53.5KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	300 MMF 500V	187A584H09
C2 CAPACITOR	1500 MMF 500V	762A757H03
C3 CAPACITOR	180 MMF 500V	762A757H10
C4 CAPACITOR	1500 MMF 500V	762A757H03
C5 CAPACITOR	2000 MMF 1200V	187A705H15
C7 CAPACITOR	2200 PF 3000V	203C872H17
L102 POT CORE		670B133G04
L103 POT CORE		670B133G06
L105 COIL		292B086G01
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
G1 LIGHTNING ARRESTER		877A116H01

1461C40G10,G52 (54-57KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	82 MMF 500V	763A209H23
C2 CAPACITOR	1500 MMF 500V	762A757H03
C4 CAPACITOR	1500 MMF 500V	762A757H03
C5 CAPACITOR	3000 MMF 1200V	187A705H14
C6 CAPACITOR	500 MMF 1200V	187A705H09
C7 CAPACITOR	3500 PF 3000V	203C872H23
L102 POT CORE		670B133G04
L103 POT CORE		670B133G06
L105 COIL		292B086G01
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
G1 LIGHTNING ARRESTER		877A116H01

1461C40G11,G53 (57.5-60.5KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	1000 MMF 500V	762A757H02
C2 CAPACITOR	390 MMF 500V	762A757H15
C3 CAPACITOR	1000 MMF 500V	762A757H02
C4 CAPACITOR	300 MMF 500V	187A584H09
C5 CAPACITOR	3000 MMF 1200V	187A705H14
C7 CAPACITOR	3100 PF 3000V	203C872H21
L102 POT CORE		670B133G04
L103 POT CORE		670B133G06
L105 COIL		292B086G01
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
G1 LIGHTNING ARRESTER		877A116H01

1461C40G12,G54 (61-64KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	1000 MMF 500V	762A757H02
C2 CAPACITOR	250 MMF 500V	861A846H11
C3 CAPACITOR	1000 MMF 500V	762A757H02
C4 CAPACITOR	180 MMF 500V	762A757H10
C5 CAPACITOR	300 MMF 1200V	187A705H06
C6 CAPACITOR	2500 MMF 1200V	187A705H13
C7 CAPACITOR	2800 PF 3000V	203C872H20
L102 POT CORE		670B133G04
L103 POT CORE		670B133G06
L105 COIL		292B086G01
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
G1 LIGHTNING ARRESTER		877A116H01

1461C40G13, G55 (64.5-68 KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	1000 MMF 500 V	762A757H02
C2 CAPACITOR	100 MMF 500 V	762A757H01
C3 CAPACITOR	1000 MMF 500 V	762A757H02
C4 CAPACITOR	36 MMF 500 V	763A209H14
C5 CAPACITOR	2500 MMF 1200 V	187A705H13
C7 CAPACITOR	2500 PF 3000 V	203C872H19
L102 POT CORE		670B133G04
L103 POT CORE		670B133G06
L105 COIL		292B086G01
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
GI LIGHTNING ARRESTER		877A116H01

1461C40G14, G56 (68.5-72KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	360 MMF 500 V	762A757H14
C2 CAPACITOR	620 MMF 500 V	187A584H11
C3 CAPACITOR	820 MMF 500 V	762A757H22
C4 CAPACITOR	100 MMF 500 V	762A757H01
C5 CAPACITOR	200 MMF 1200 V	187A705-104
C6 CAPACITOR	2000 MMF 1200 V	187A705H12
C7 CAPACITOR	2200 PF 3000 V	203C872H17
L102 POT CORE		670B133G04
L103 POT CORE		670B133G06
L105 COIL		292B086G01
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
GI LIGHTNING ARRESTER		877A116H01

1461C40G15, G57 (72.5-76KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	250 MMF 500 V	861A846H11
C2 CAPACITOR	620 MMF 500 V	187A584H11
C3 CAPACITOR	820 MMF 500 V	762A757H22
C5 CAPACITOR	1500 MMF 1200 V	187A705H11
C7 CAPACITOR	2000 PF 3000 V	203C872H15
L102 POT CORE		670B133G04
L103 POT CORE		670B133G06
L105 COIL		292B086G01
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
GI LIGHTNING ARRESTER		877A116H01

1461C40G16, G58 (76.5-80KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	180 MMF 500 V	762A757H10
C2 CAPACITOR	620 MMF 500 V	187A584H11
C3 CAPACITOR	130 MMF 500 V	762A757H07
C4 CAPACITOR	620 MMF 500 V	187A584H11
C5 CAPACITOR	300 MMF 1200 V	187A705H06
C6 CAPACITOR	1500 MMF 1200 V	187A705H11
C7 CAPACITOR	1800 PF 3000 V	203C872H13
L102 POT CORE		670B133G04
L103 POT CORE		670B133G06
L105 COIL		292B086G01
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
GI LIGHTNING ARRESTER		877A116H01

1461C40G17, G59 (80.5-84.5KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	1500 MMF 500 V	762A757H03
C3 CAPACITOR	270 MMF 500 V	762A757H12
C4 CAPACITOR	1500 MMF 500 V	762A757H03
C5 CAPACITOR	4000 MMF 1200 V	187A705H15
C7 CAPACITOR	2400 PF 3000 V	203C872H18
L102 POT CORE		670B133G05
L103 POT CORE		670B133G07
L105 COIL		292B086G01
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
GI LIGHTNING ARRESTER		877A116H01

1461C40G18, G60 (85-89KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	1000 MMF 500 V	762A757H02
C2 CAPACITOR	360 MMF 500 V	762A757H14
C3 CAPACITOR	82 MMF 500 V	763A209H23
C4 CAPACITOR	1500 MMF 500 V	762A757H03
C5 CAPACITOR	4000 MMF 1200 V	187A705H15
C7 CAPACITOR	2100 PF 3000 V	203C872H16
L102 POT CORE		670B133G05
L103 POT CORE		670B133G07
L105 COIL		292B086G01
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
GI LIGHTNING ARRESTER		877A116H01

1461C40G19, G61 (89.5-94.5KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	1000 MMF 500 V	762A757H02
C2 CAPACITOR	200 MMF 500 V	762A757H11
C3 CAPACITOR	1000 MMF 500 V	762A757H02
C4 CAPACITOR	390 MMF 500 V	762A757H15
C5 CAPACITOR	3000 MMF 1200 V	187A705H14
C6 CAPACITOR	500 MMF 1200 V	187A705H09
C7 CAPACITOR	1900 PF 3000 V	203C872H14
L102 POT CORE		670B133G05
L103 POT CORE		670B133G07
L105 COIL		292B086G01
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
GI LIGHTNING ARRESTER		877A116H01

1461C40G20, G62 (95-100KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	1000 MMF 500 V	762A757H02
C2 CAPACITOR	82 MMF 500 V	763A209H23
C3 CAPACITOR	1000 MMF 500 V	762A757H02
C4 CAPACITOR	250 MMF 500 V	861A846 H11
C5 CAPACITOR	3000 MMF 1200 V	187A705H14
C7 CAPACITOR	1700 PF 3000 V	203C872H12
L102 POT CORE		670B133G05
L103 POT CORE		670B133G07
L105 COIL		292B086G01
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
GI LIGHTNING ARRESTER		877A116H01

1461C40G21, G63 (100.5-106KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	360 MMF 500 V	762A757H14
C2 CAPACITOR	620 MMF 500 V	187A584H11
C3 CAPACITOR	1000 MMF 500 V	762A757H02
C4 CAPACITOR	130 MMF 500 V	762A757H07
C5 CAPACITOR	2500 MMF 1200 V	187A705H13
C7 CAPACITOR	1500 PF 3000 V	203C872H11
L102 POT CORE		670B133G05
L103 POT CORE		670B133G07
L105 COIL		292B086G01
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
GI LIGHTNING ARRESTER		877A116H01

1461C40G22, G64 (106.5-112.5KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	250 MMF 500 V	861A846H11
C2 CAPACITOR	620 MMF 500 V	187A584H11
C3 CAPACITOR	1000 MMF 500 V	762A757H02
C5 CAPACITOR	2500 MMF 1200 V	187A705H13
C7 CAPACITOR	1300 PF 3000 V	203C872H10
L102 POT CORE		670B133G05
L103 POT CORE		670B133G07
L105 COIL		292B086G01
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
GI LIGHTNING ARRESTER		877A116H01

1461C40G23, G65 (113-119.5KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	150 MMF 500 V	861A846H25
C2 CAPACITOR	620 MMF 500 V	187A584H11
C3 CAPACITOR	62 MMF 500 V	763A209H20
C4 CAPACITOR	820 MMF 500 V	762A757H22
C5 CAPACITOR	200 MMF 1200 V	187A705H04
C6 CAPACITOR	2000 MMF 1200 V	187A705 H12
C7 CAPACITOR	1100 PF 3000 V	203C872H08
L102 POT CORE		670B133G05
L103 POT CORE		670B133G07
L105 COIL		292B086G01
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
GI LIGHTNING ARRESTER		877A116H01

1461C40G24, G66 (120-127KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	56 MMF 500 V	763A209H19
C2 CAPACITOR	620 MMF 500 V	187A584H11
C3 CAPACITOR	390 MMF 500 V	762A757H15
C4 CAPACITOR	390 MMF 500 V	762A757H15
C6 CAPACITOR	2000 MMF 1200 V	187A705H12
C7 CAPACITOR	1000 PF 3000 V	203C872H07
L102 POT CORE		670B133G05
L103 POT CORE		670B133G07
L105 COIL		292B086G01
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
GI LIGHTNING ARRESTER		877A116H01

1461C40G25, G67 (127.5-135KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	300 MMF 500 V	187A584H09
C2 CAPACITOR	300 MMF 500 V	187A584H09
C3 CAPACITOR	82 MMF 500 V	763A209H23
C4 CAPACITOR	620 MMF 500 V	187A584H11
C5 CAPACITOR	200 MMF 1200 V	187A705H04
C6 CAPACITOR	1500 MMF 1200 V	187A705H11
C7 CAPACITOR	900 PF 3000 V	203C872H06
L102 POT CORE		670B133G05
L103 POT CORE		670B133G07
L105 COIL		292B086G01
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
GI LIGHTNING ARRESTER		877A116H01

1461C40G26, G68 (135.5-143KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	270 MMF 500 V	762A757H12
C2 CAPACITOR	270 MMF 500 V	762A757H12
C4 CAPACITOR	620 MMF 500 V	187A584H11
C5 CAPACITOR	1500 MMF 1200 V	187A705H11
C7 CAPACITOR	800 PF 3000 V	203C872H05
L102 POT CORE		670B133G05
L103 POT CORE		670B133G07
L105 COIL		292B086G01
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
GI LIGHTNING ARRESTER		877A116H01

1461C40G27, G69 (143.5-151KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	300 MMF 500 V	187A584H09
C2 CAPACITOR	180 MMF 500 V	762A757H10
C3 CAPACITOR	300 MMF 500 V	187A584H09
C4 CAPACITOR	250 MMF 500 V	861A846H11
C5 CAPACITOR	400 MMF 1200 V	187A705H08
C6 CAPACITOR	1500 MMF 1200 V	187A705 H11
C7 CAPACITOR	1100 PF 3000 V	203C872H08
L102 POT CORE		670B133G05
L103 POT CORE		670B133G07
L105 COIL		292B086G01
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
GI LIGHTNING ARRESTER		877A116H01

1461C40G28, G70 (151.5-159.5KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	180 MMF 500 V	762A757H10
C2 CAPACITOR	250 MMF 500 V	861A846H11
C3 CAPACITOR	250 MMF 500 V	861A846H11
C4 CAPACITOR	250 MMF 500 V	861A846H11
C5 CAPACITOR	200 MMF 1200 V	187A705H04
C6 CAPACITOR	1500 MMF 1200 V	187A705 H11
C7 CAPACITOR	1000 PF 3000 V	203C872H07
L102 POT CORE		670B133G05
L103 POT CORE		670B133G07
L105 COIL		292B086G01
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
GI LIGHTNING ARRESTER		877A116H01

1461C40G29,G71 (160-169.5KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	180 MMF 500V	762A757H10
C2 CAPACITOR	200 MMF 500V	762A757H11
C3 CAPACITOR	200 MMF 500V	762A757H11
C4 CAPACITOR	250 MMF 500V	861A846H11
C5 CAPACITOR	1500 MMF 1200V	187A705H11
C7 CAPACITOR	900 PF 3000V	203C872H06
L102 POT CORE		670B133G05
L103 POT CORE		670B133G07
L105 COIL		292B086G01
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
G1 LIGHTNING ARRESTER		877A116H01

1461C40G30,G72 (170-180KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	82 MMF 500V	763A209H23
C2 CAPACITOR	250 MMF 500V	861A846H11
C3 CAPACITOR	390 MMF 500V	762A757H15
C5 CAPACITOR	400 MMF 1200V	187A705H08
C6 CAPACITOR	1000 MMF 1200V	187A705H10
C7 CAPACITOR	750 PF 3000V	203C872H04
L102 POT CORE		670B133G05
L103 POT CORE		670B133G07
L105 COIL		292B086G01
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
G1 LIGHTNING ARRESTER		877A116H01

1461C40G31,G73 (180.5-191.5KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	300 MMF 500V	187A584H09
C3 CAPACITOR	150 MMF 500V	861A846H25
C4 CAPACITOR	200 MMF 500V	762A757H11
C5 CAPACITOR	200 MMF 1200V	187A705H04
C6 CAPACITOR	1000 MMF 1200V	187A705H10
C7 CAPACITOR	650 PF 3000V	203C872H02
L102 POT CORE		670B133G05
L103 POT CORE		670B133G07
L105 COIL		292B086G01
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
G1 LIGHTNING ARRESTER		877A116H01

1461C40G32,G74 (192-200KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	20 MMF 500V	763A209H07
C2 CAPACITOR	250 MMF 500V	861A846H11
C3 CAPACITOR	130 MMF 500V	762A757H07
C4 CAPACITOR	180 MMF 500V	762A757H10
C6 CAPACITOR	1000 MMF 1200V	187A705H10
C7 CAPACITOR	600 PF 3000V	203C872H02
L102 POT CORE		670B133G05
L103 POT CORE		670B133G07
L105 COIL		292B086G01
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
G1 LIGHTNING ARRESTER		877A116H01

1461C40G33,G75 (200.1-207 KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	56 MMF 500V	763A209H19
C2 CAPACITOR	270 MMF 500V	762A757H12
C3 CAPACITOR	200 MMF 500V	762A757H11
C4 CAPACITOR	30 MMF 500V	763A209H12
C5 CAPACITOR	200 MMF 1200V	187A705H04
C6 CAPACITOR	500 MMF 1200V	187A705H09
C7 CAPACITOR	1200 PF 3000V	203C872H09
L102 POT CORE		670B133G09
L103 POT CORE		670B133G08
L105 POT CORE		670B133G09
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
G1 LIGHTNING ARRESTER		877A116H01

1461C40G34,G76 (207.1-214 KC)

COMPONENT	DESCRIPTION	STYLE
C2 CAPACITOR	300 MMF 500V	187A584H09
C3 CAPACITOR	200 MMF 500V	762A757H11
C4 CAPACITOR	20 MMF 500V	763A209H07
C5 CAPACITOR	200 MMF 1200V	187A705H04
C6 CAPACITOR	500 MMF 1200V	187A705H09
C7 CAPACITOR	1200 PF 3000V	203C872H09
L102 POT CORE		670B133G09
L103 POT CORE		670B133G08
L105 POT CORE		670B133G09
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
G1 LIGHTNING ARRESTER		877A116H01

1461C40G35,G77 (214.1-222 KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	130 MMF 500V	861A846H25
C2 CAPACITOR	150 MMF 500V	861A846H25
C3 CAPACITOR	150 MMF 500V	861A846H25
C4 CAPACITOR	56 MMF 500V	763A209H19
C5 CAPACITOR	400 MMF 1200V	187A705H08
C6 CAPACITOR	200 MMF 1200V	187A705H04
C7 CAPACITOR	1100 PF 3000V	203C872H08
L102 POT CORE		670B133G09
L103 POT CORE		670B133G08
L105 POT CORE		670B133G09
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
G1 LIGHTNING ARRESTER		877A116H01

1461C40G36,G78 (222.1-230 KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	62 MMF 500V	763A209H20
C2 CAPACITOR	200 MMF 500V	762A757H11
C3 CAPACITOR	62 MMF 500V	763A209H20
C4 CAPACITOR	130 MMF 500V	762A757H07
C5 CAPACITOR	400 MMF 1200V	187A705H08
C6 CAPACITOR	200 MMF 1200V	187A705H04
C7 CAPACITOR	1100 PF 3000V	203C872H08
L102 POT CORE		670B133G09
L103 POT CORE		670B133G08
L105 POT CORE		670B133G09
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
G1 LIGHTNING ARRESTER		877A116H01

1461C40G37,G79 (230.1-240KC)*

COMPONENT	DESCRIPTION	STYLE
C2 CAPACITOR	250 MMF 500V	861A846H11
C3 CAPACITOR	150 MMF 500V	861A846H25
C4 CAPACITOR	20 MMF 500V	763A209H07
C6 CAPACITOR	500 MMF 1200V	187A705H09
C7 CAPACITOR	1000 PF 3000V	203C872H07
L102 POT CORE		670B133G09
L103 POT CORE		670B133G08
L105 POT CORE		670B133G09
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
G1 LIGHTNING ARRESTER		877A116H01

1461C40G38,G80 (240.1-250KC)

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	30 MMF 500V	763A209H12
C2 CAPACITOR	200 MMF 500V	762A757H11
C3 CAPACITOR	130 MMF 500V	762A757H07
C4 CAPACITOR	30 MMF 500V	763A209H12
C6 CAPACITOR	500 MMF 1200V	187A705H09
C7 CAPACITOR	900 PF 3000V	203C872H06
L102 POT CORE		670B133G09
L103 POT CORE		670B133G08
L105 POT CORE		670B133G09
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
G1 LIGHTNING ARRESTER		877A116H01

1461C40G39,G81 (250.1-262KC)*

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	56 MMF 500V	763A209H19
C2 CAPACITOR	150 MMF 500V	861A846H25
C3 CAPACITOR	62 MMF 500V	763A209H20
C4 CAPACITOR	82 MMF 500V	763A209H23
C5 CAPACITOR	400 MMF 1200V	187A705H08
C7 CAPACITOR	800 PF 3000V	203C872H05
L102 POT CORE		670B133G09
L103 POT CORE		670B133G08
L105 POT CORE		670B133G09
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
G1 LIGHTNING ARRESTER		877A116H01

1461C40G40,G82 (262.1-274KC)*

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	36 MMF 500V	763A209H14
C2 CAPACITOR	150 MMF 500V	861A846H25
C3 CAPACITOR	100 MMF 500V	762A757H01
C4 CAPACITOR	30 MMF 500V	763A209H12
C5 CAPACITOR	400 MMF 1200V	187A705H08
C7 CAPACITOR	700 PF 3000V	203C872H03
L102 POT CORE		670B133G09
L103 POT CORE		670B133G08
L105 POT CORE		670B133G09
T3 TRANSFORMER		292B526GC4
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
G1 LIGHTNING ARRESTER		877A116H01

1461C40G41,G83 (274.1-287KC)*

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	20 MMF 500V	763A209H07
C2 CAPACITOR	150 MMF 500V	861A846H25
C3 CAPACITOR	100 MMF 500V	762A757H01
C4 CAPACITOR	20 MMF 500V	763A209H07
C5 CAPACITOR	400 MMF 1200V	187A705H08
C7 CAPACITOR	650 PF 3000V	203C872H02
L102 POT CORE		670B133G09
L103 POT CORE		670B133G08
L105 POT CORE		670B133G09
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
G1 LIGHTNING ARRESTER		877A116H01

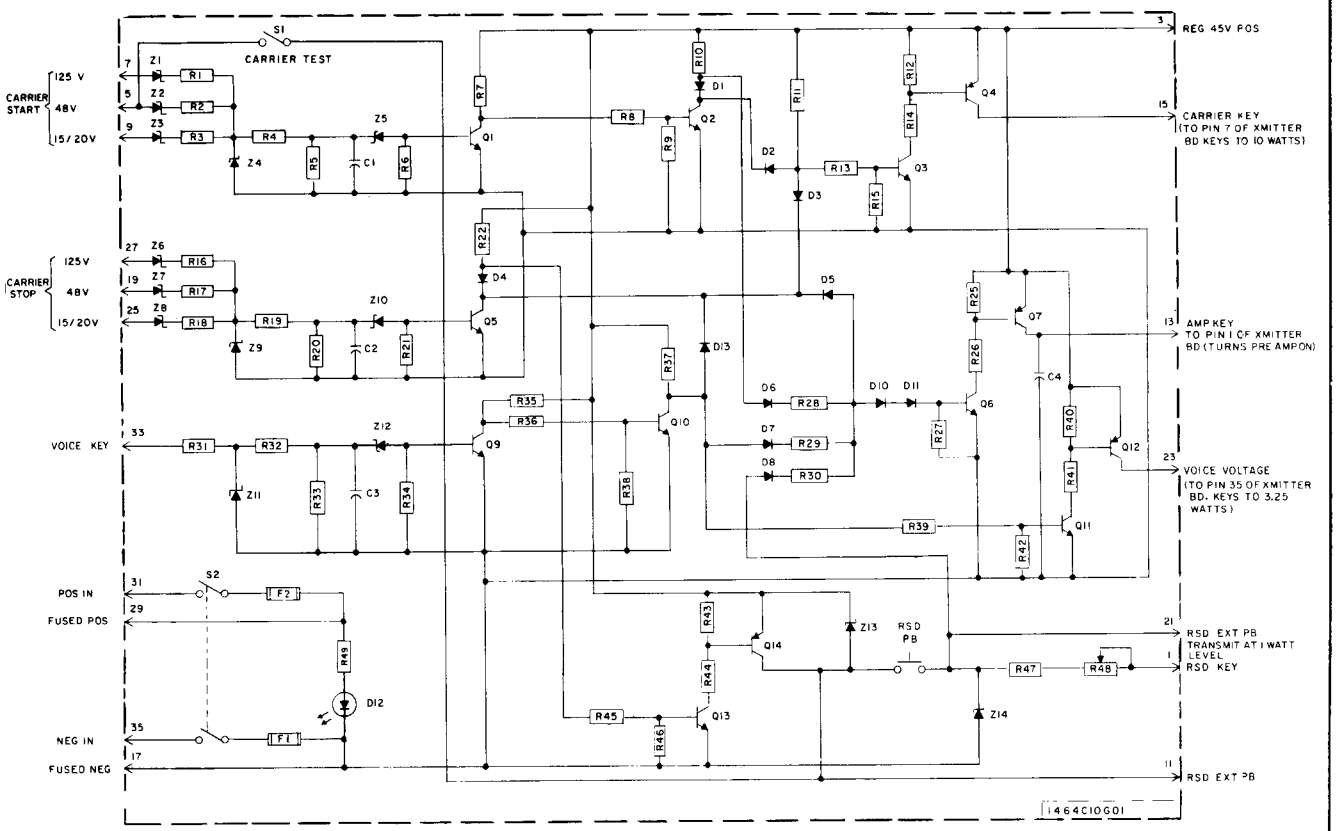
1461C40G42,G84 (287.1-300KC)*

COMPONENT	DESCRIPTION	STYLE
C2 CAPACITOR	150 MMF 500V	861A846H25
C3 CAPACITOR	82 MMF 500V	763A209H23
C4 CAPACITOR	30 MMF 500V	763A209H12
C5 CAPACITOR	400 MMF 1200V	187A705H08
C7 CAPACITOR	600 PF 3000V	203C872H01
L102 POT CORE		670B133G09
L103 POT CORE		670B133G08
L105 POT CORE		670B133G09
T3 TRANSFORMER		292B526G04
T4 TRANSFORMER		292B526G03
R6 RESISTOR	3K ± 5% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
G1 LIGHTNING ARRESTER		877A116H01

1464C10G01

COMPONENT		DESCRIPTION	STYLE NO.
C1	CAPACITOR	.047UF 200V	849A437H04
C2	CAPACITOR	.047UF 200V	849A437H04
C3	CAPACITOR	.047UF 200V	849A437H04
C4	CAPACITOR	1.0 UF 200V	187A624H04
D1	DIODE	1N457A	184A855H07
D2	DIODE	1N457A	184A855H07
D3	DIODE	1N457A	184A855H07
D4	DIODE	1N457A	184A855H07
D5	DIODE	1N457A	184A855H07
D6	DIODE	1N457A	184A855H07
D7	DIODE	1N457A	184A855H07
D8	DIODE	1N457A	184A855H07
D10	DIODE	1N457A	184A855H07
D11	DIODE	1N457A	184A855H07
D12	DIODE	LED	350BA22H01
D13	DIODE	1N457A	184A855H07
J1	JUMPER	0 OHM RESISTOR	862A478H01
J2	JUMPER	0 OHM RESISTOR	862A478H01
J3	JUMPER	0 OHM RESISTOR	862A478H01
J4	JUMPER	0 OHM RESISTOR	862A478H01
J5	JUMPER	0 OHM RESISTOR	862A478H01
J6	JUMPER	0 OHM RESISTOR	862A478H01
J7	JUMPER	0 OHM RESISTOR	862A478H01
R1	RESISTOR	33.0K .50W 2%	629A531H68
R2	RESISTOR	13.0K .50W 2%	629A531H59
R3	RESISTOR	820.0 .50W 2%	629A531H30
R4	RESISTOR	1500.0 .50W 5%	184A763H31
R5	RESISTOR	6200.0 .50W 5%	184A763H46
R6	RESISTOR	10.0K .50W 5%	184A763H51
R7	RESISTOR	12.0K .50W 5%	184A763H53
R8	RESISTOR	27.0K .50W 5%	184A763H61
R9	RESISTOR	10.0K .50W 5%	184A763H51
R10	RESISTOR	12.0K .50W 5%	184A763H53
R11	RESISTOR	12.0K .50W 5%	184A763H53
R12	RESISTOR	4700.0 .50W 5%	184A763H43
R13	RESISTOR	10.0K .50W 5%	184A763H51
R14	RESISTOR	12.0K .50W 5%	184A763H53
R15	RESISTOR	33.0K .50W 2%	629A531H68
R16	RESISTOR	13.0K .50W 2%	629A531H59
R17	RESISTOR	13.0K .50W 2%	629A531H59
R18	RESISTOR	820.0 .50W 2%	629A531H30
R19	RESISTOR	1500.0 .50W 5%	184A763H31
R20	RESISTOR	6200.0 .50W 5%	184A763H46
R21	RESISTOR	10.0K .50W 5%	184A763H51
R22	RESISTOR	12.0K .50W 5%	184A763H53
R25	RESISTOR	4700.0 .50W 5%	184A763H43
R26	RESISTOR	12.0K .50W 5%	184A763H53
R27	RESISTOR	10.0K .50W 5%	184A763H51
R28	RESISTOR	27.0K .50W 5%	184A763H61
R29	RESISTOR	27.0K .50W 5%	184A763H61
R30	RESISTOR	27.0K .50W 5%	184A763H61
R31	RESISTOR	1800.0 .50W 5%	184A763H33
R32	RESISTOR	1500.0 .50W 5%	184A763H31
R33	RESISTOR	6200.0 .50W 5%	184A763H46

COMPONENT		DESCRIPTION	STYLE NO.
R34	RESISTOR	10.0K .50W 5%	184A763H51
R35	RESISTOR	12.0K .50W 5%	184A763H53
R36	RESISTOR	27.0K .50W 5%	184A763H61
R37	RESISTOR	12.0K .50W 5%	184A763H53
R38	RESISTOR	10.0K .50W 5%	184A763H51
R39	RESISTOR	27.0K .50W 5%	184A763H61
R40	RESISTOR	4700.0 .50W 5%	184A763H43
R41	RESISTOR	12.0K .50W 5%	184A763H53
R42	RESISTOR	10.0K .50W 5%	184A763H51
R43	RESISTOR	4700.0 .50W 5%	184A763H43
R44	RESISTOR	12.0K .50W 5%	184A763H53
R45	RESISTOR	27.0K .50W 5%	184A763H61
R46	RESISTOR	10.0K .50W 5%	184A763H51
R47	RESISTOR	8200.0 .50W 5%	184A763H49
R49	RESISTOR	18.0K .50W 2%	629A531H62
R48	RESISTOR		680A687H02
Q1	TRANSISTOR	2N699	184A638H19
Q2	TRANSISTOR	2N699	184A638H19
Q3	TRANSISTOR	2N699	184A638H19
Q4	TRANSISTOR	2N3645	849A441H01
Q5	TRANSISTOR	2N699	184A638H19
Q6	TRANSISTOR	2N699	184A638H19
Q7	TRANSISTOR	2N3645	849A441H01
Q9	TRANSISTOR	2N699	184A638H19
Q10	TRANSISTOR	2N699	184A638H19
Q11	TRANSISTOR	2N699	184A638H19
Q12	TRANSISTOR	2N3645	849A441H01
Q13	TRANSISTOR	2N699	184A638H19
Q14	TRANSISTOR	2N3645	849A441H01
Z1	ZENER	1R200 200.0V	629A369H01
Z2	ZENER	1R200 200.0V	629A369H01
Z3	ZENER	1R200 200.0V	629A369H01
Z4	ZENER	1N3686B 20.0V	185A212H06
Z5	ZENER	1N957B 6.8V	186A797H06
Z6	ZENER	1R200 200.0V	629A369H01
Z7	ZENER	1R200 200.0V	629A369H01
Z8	ZENER	1R200 200.0V	629A369H01
Z9	ZENER	1N3686B 20.0V	185A212H06
Z10	ZENER	1N957B 6.8V	186A797H06
Z11	ZENER	1N3686B 20.0V	185A212H06
Z12	ZENER	1N957B 6.8V	186A797H06
Z13	ZENER	1N3038B 56.0V	862A257H04
Z14	ZENER	1N3038B 56.0V	862A257H04
S1	SWITCH		849A299H03
S2	POWER SWITCH		880A357H01
RSD	SWITCH		350A06H01
F1	FUSE		183A981H23
F2	FUSE		183A981H23



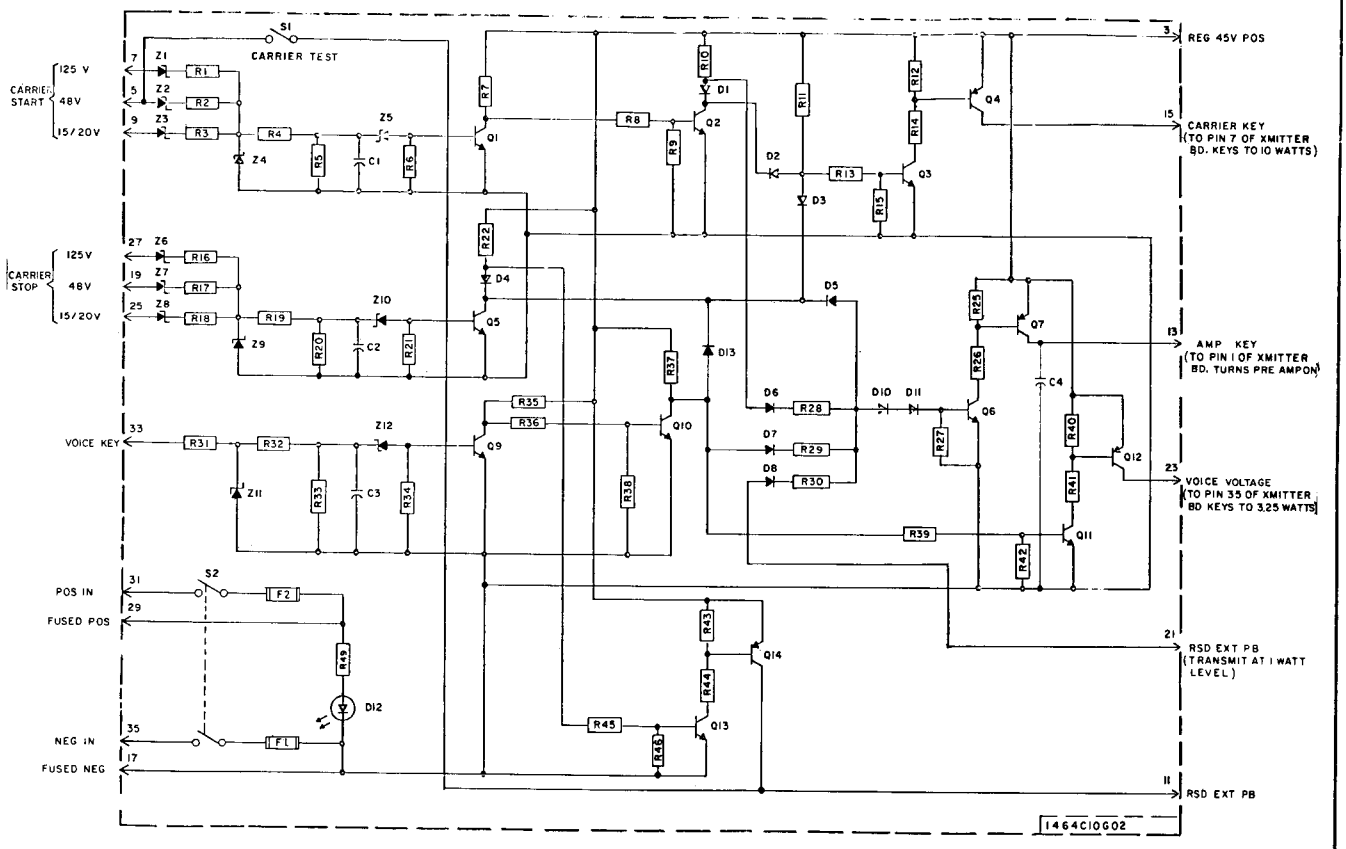
Sub. 4
SHEETS 1 & 2 (1463C68)

Fig. 22. Internal Schematic - Keying Module - with DC Power Switch and Fuses - With Reserve Signal Detector Pushbutton and Control.

1464C10G02

COMPONENT		DESCRIPTION	STYLE NO.
C1	CAPACITOR	.047UF 200V	849A437H04
C2	CAPACITOR	.047UF 200V	849A437H04
C3	CAPACITOR	.047UF 200V	849A437H04
C4	CAPACITOR	1.0 UF 200V	187A624H04
D1	DIODE	1N457A	184A855H07
D2	DIODE	1N457A	184A855H07
D3	DIODE	1N457A	184A855H07
D4	DIODE	1N457A	184A855H07
D5	DIODE	1N457A	184A855H07
D6	DIODE	1N457A	184A855H07
D7	DIODE	1N457A	184A855H07
D8	DIODE	1N457A	184A855H07
D10	DIODE	1N457A	184A855H07
D11	DIODE	1N457A	184A855H07
D12	DIODE	LED	350BA22H01
D13	DIODE	1N457A	184A855H07
J1	JUMPER	0 OHM RESISTOR	862A478H01
J2	JUMPER	0 OHM RESISTOR	862A478H01
J3	JUMPER	0 OHM RESISTOR	862A478H01
J4	JUMPER	0 OHM RESISTOR	862A478H01
J5	JUMPER	0 OHM RESISTOR	862A478H01
J6	JUMPER	0 OHM RESISTOR	862A478H01
J7	JUMPER	0 OHM RESISTOR	862A478H01
R1	RESISTOR	33.0K .50W 2%	629A531H68
R2	RESISTOR	13.0K .50W 2%	629A531H59
R3	RESISTOR	820.0 .50W 2%	629A531H30
R4	RESISTOR	1500.0 .50W 5%	184A763H31
R5	RESISTOR	6200.0 .50W 5%	184A763H46
R6	RESISTOR	10.0K .50W 5%	184A763H51
R7	RESISTOR	12.0K .50W 5%	184A763H53
R8	RESISTOR	27.0K .50W 5%	184A763H61
R9	RESISTOR	10.0K .50W 5%	184A763H51
R10	RESISTOR	12.0K .50W 5%	184A763H53
R11	RESISTOR	12.0K .50W 5%	184A763H53
R12	RESISTOR	4700.0 .50W 5%	184A763H43
R13	RESISTOR	27.0K .50W 5%	184A763H61
R14	RESISTOR	10.0K .50W 5%	184A763H51
R15	RESISTOR	33.0K .50W 2%	629A531H68
R16	RESISTOR	13.0K .50W 2%	629A531H59
R17	RESISTOR	820.0 .50W 2%	629A531H30
R18	RESISTOR	1500.0 .50W 5%	184A763H31
R19	RESISTOR	6200.0 .50W 5%	184A763H46
R20	RESISTOR	10.0K .50W 5%	184A763H51
R21	RESISTOR	12.0K .50W 5%	184A763H53
R22	RESISTOR		
R25	RESISTOR	4700.0 .50W 5%	184A763H43
R26	RESISTOR	12.0K .50W 5%	184A763H53
R27	RESISTOR	10.0K .50W 5%	184A763H51
R28	RESISTOR	27.0K .50W 5%	184A763H61
R29	RESISTOR	27.0K .50W 5%	184A763H61
R30	RESISTOR	27.0K .50W 5%	184A763H61
R31	RESISTOR	1800.0 .50W 5%	184A763H33
R32	RESISTOR	1500.0 .50W 5%	184A763H31
R33	RESISTOR	6200.0 .50W 5%	184A763H46

COMPONENT		DESCRIPTION	STYLE NO.
R34	RESISTOR	10.0K .50W 5%	184A763H51
R35	RESISTOR	12.0K .50W 5%	184A763H53
R36	RESISTOR	27.0K .50W 5%	184A763H61
R37	RESISTOR	12.0K .50W 5%	184A763H53
R38	RESISTOR	10.0K .50W 5%	184A763H51
R39	RESISTOR	27.0K .50W 5%	184A763H61
R40	RESISTOR	4700.0 .50W 5%	184A763H43
R41	RESISTOR	12.0K .50W 5%	184A763H53
R42	RESISTOR	10.0K .50W 5%	184A763H51
R43	RESISTOR	4700.0 .50W 5%	184A763H43
R44	RESISTOR	12.0K .50W 5%	184A763H53
R45	RESISTOR	27.0K .50W 5%	184A763H61
R46	RESISTOR	10.0K .50W 5%	184A763H51
R49	RESISTOR	18.0K .50W 2%	629A531H62
Q1	TRANSISTOR	2N699	184A638H19
Q2	TRANSISTOR	2N699	184A638H19
Q3	TRANSISTOR	2N699	184A638H19
Q4	TRANSISTOR	2N3645	849A441H01
Q5	TRANSISTOR	2N699	184A638H19
Q6	TRANSISTOR	2N699	184A638H19
Q7	TRANSISTOR	2N3645	849A441H01
Q9	TRANSISTOR	2N699	184A638H19
Q10	TRANSISTOR	2N699	184A638H19
Q11	TRANSISTOR	2N699	184A638H19
Q12	TRANSISTOR	2N3645	849A441H01
Q13	TRANSISTOR	2N699	184A638H19
Q14	TRANSISTOR	2N3645	849A441H01
Z1	ZENER	1R200 200.0V	629A369H01
Z2	ZENER	1R200 200.0V	629A369H01
Z3	ZENER	1R200 200.0V	629A369H01
Z4	ZENER	1N3686B 20.0V	185A212H06
Z5	ZENER	1N957B 6.8V	186A797H06
Z6	ZENER	1R200 200.0V	629A369H01
Z7	ZENER	1R200 200.0V	629A369H01
Z8	ZENER	1R200 200.0V	629A369H01
Z9	ZENER	1N3686B 20.0V	185A212H06
Z10	ZENER	1N957B 6.8V	186A797H06
Z11	ZENER	1N3686B 20.0V	185A212H06
Z12	ZENER	1N957B 6.8V	186A797H06
S1	SWITCH		849A299H03
S2	POWER SWITCH		880A357H01
F1	FUSE		183A981H23
F2	FUSE		183A981H23



Sub. 4

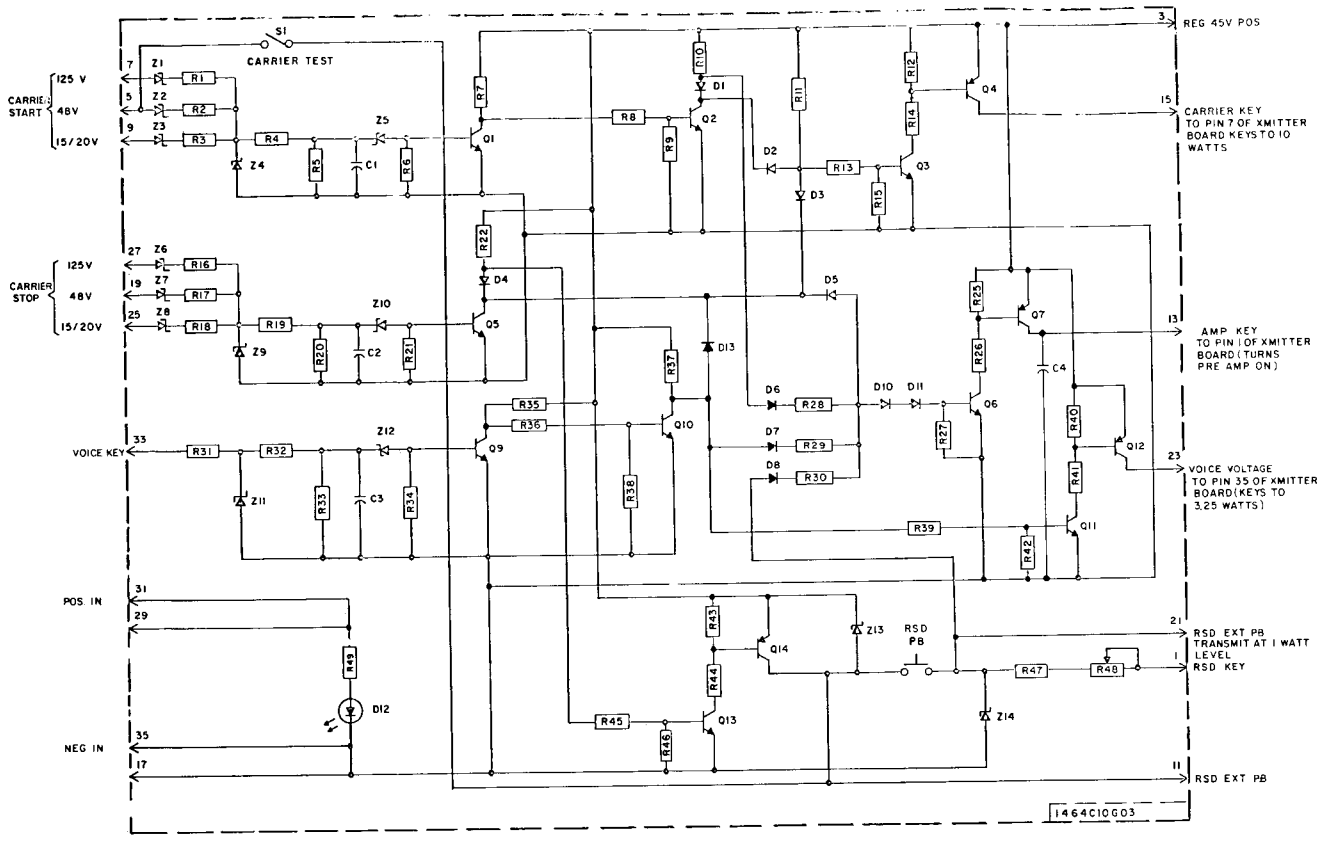
SHEETS 3&4 1463C68

Fig. 22B. Internal Schematic - Keying Module - with DC Power Switch and Fuses - without Reserve Signal Detector Components.

1464C10G03

COMPONENT		DESCRIPTION	STYLE NO.
C1	CAPACITOR	.047UF 200V	849A437H04
C2	CAPACITOR	.047UF 200V	849A437H04
C3	CAPACITOR	.047UF 200V	849A437H04
C4	CAPACITOR	1.0 UF 200V	187A624H04
D1	DIODE	1N457A	184A855H07
D2	DIODE	1N457A	184A855H07
D3	DIODE	1N457A	184A855H07
D4	DIODE	1N457A	184A855H07
D5	DIODE	1N457A	184A855H07
D6	DIODE	1N457A	184A855H07
D7	DIODE	1N457A	184A855H07
D8	DIODE	1N457A	184A855H07
D10	DIODE	1N457A	184A855H07
D11	DIODE	1N457A	184A855H07
D12	DIODE	LED	3508A22H01
D13	DIODE	1N457A	184A855H07
J1	JUMPER	0 OHM RESISTOR	862A478H01
J2	JUMPER	0 OHM RESISTOR	862A478H01
J3	JUMPER	0 OHM RESISTOR	862A478H01
J4	JUMPER	0 OHM RESISTOR	862A478H01
J5	JUMPER	0 OHM RESISTOR	862A478H01
J6	JUMPER	0 OHM RESISTOR	862A478H01
J7	JUMPER	0 OHM RESISTOR	862A478H01
R1	RESISTOR	33.0K .50W 2%	629A53IH68
R2	RESISTOR	13.0K .50W 2%	629A53IH59
R3	RESISTOR	820.0 .50W 2%	629A53IH30
R4	RESISTOR	1500.0 .50W 5%	184A763H31
R5	RESISTOR	6200.0 .50W 5%	184A763H46
R6	RESISTOR	10.0K .50W 5%	184A763H51
R7	RESISTOR	12.0K .50W 5%	184A763H53
R8	RESISTOR	27.0K .50W 5%	184A763H61
R9	RESISTOR	10.0K .50W 5%	184A763H51
R10	RESISTOR	12.0K .50W 5%	184A763H53
R11	RESISTOR	12.0K .50W 5%	184A763H53
R12	RESISTOR	4700.0 .50W 5%	184A763H43
R13	RESISTOR	27.0K .50W 5%	184A763H61
R14	RESISTOR	12.0K .50W 5%	184A763H53
R15	RESISTOR	10.0K .50W 5%	184A763H51
R16	RESISTOR	33.0K .50W 2%	629A53IH68
R17	RESISTOR	13.0K .50W 2%	629A53IH59
R18	RESISTOR	820.0 .50W 2%	629A53IH30
R19	RESISTOR	1500.0 .50W 5%	184A763H31
R20	RESISTOR	6200.0 .50W 5%	184A763H46
R21	RESISTOR	10.0K .50W 5%	184A763H51
R22	RESISTOR	12.0K .50W 5%	184A763H53
R25	RESISTOR	4700.0 .50W 5%	184A763H43
R26	RESISTOR	12.0K .50W 5%	184A763K53
R27	RESISTOR	10.0K .50W 5%	184A763H51
R28	RESISTOR	27.0K .50W 5%	184A763H61
R29	RESISTOR	27.0K .50W 5%	184A763H61
R30	RESISTOR	27.0K .50W 5%	184A763H61
R31	RESISTOR	1800.0 .50W 5%	184A763H33
R32	RESISTOR	1500.0 .50W 5%	184A763H31
R33	RESISTOR	6200.0 .50W 5%	184A763H46

COMPONENT		DESCRIPTION	STYLE NO.
R34	RESISTOR	10.0K .50W 5%	184A763H51
R35	RESISTOR	12.0K .50W 5%	184A763H53
R36	RESISTOR	27.0K .50W 5%	184A763H61
R37	RESISTOR	12.0K .50W 5%	184A763H53
R38	RESISTOR	10.0K .50W 5%	184A763H51
R39	RESISTOR	27.0K .50W 5%	184A763H61
R40	RESISTOR	4700.0 .50W 5%	184A763H43
R41	RESISTOR	12.0K .50W 5%	184A763H53
R42	RESISTOR	10.0K .50W 5%	184A763H51
R43	RESISTOR	4700.0 .50W 5%	184A763H43
R44	RESISTOR	12.0K .50W 5%	184A763H53
R45	RESISTOR	27.0K .50W 5%	184A763H61
R46	RESISTOR	10.0K .50W 5%	184A763H51
R47	RESISTOR	8200.0 .50W 5%	184A763H49
R49	RESISTOR	18.0K .50W 2%	629A53IH62
R48	RESISTOR		880A687H02
Q1	TRANSISTOR	2N699	184A638H19
Q2	TRANSISTOR	2N699	184A638H19
Q3	TRANSISTOR	2N699	184A638H19
Q4	TRANSISTOR	2N3645	849A441H01
Q5	TRANSISTOR	2N699	184A638H19
Q6	TRANSISTOR	2N699	184A638H19
Q7	TRANSISTOR	2N3645	849A441H01
Q9	TRANSISTOR	2N699	184A638H19
Q10	TRANSISTOR	2N699	184A638H19
Q11	TRANSISTOR	2N699	184A638H19
Q12	TRANSISTOR	2N3645	849A441H01
Q13	TRANSISTOR	2N699	184A638H19
Q14	TRANSISTOR	2N3645	849A441H01
Z1	ZENER	1R200 200.0V	629A369H01
Z2	ZENER	1R200 200.0V	629A369H01
Z3	ZENER	1R200 200.0V	629A369H01
Z4	ZENER	1N3684B 20.0V	185A212H06
Z5	ZENER	1N957B 6.8V	186A797H06
Z6	ZENER	1R200 200.0V	629A369H01
Z7	ZENER	1R200 200.0V	629A369H01
Z8	ZENER	1R200 200.0V	629A369H01
Z9	ZENER	1N3684B 20.0V	185A212H06
Z10	ZENER	1N957B 6.8V	186A797H06
Z11	ZENER	1N3684B 20.0V	185A212H06
Z12	ZENER	1N957B 6.8V	186A797H06
Z13	ZENER	1N3038B 56.0V	862A257H04
Z14	ZENER	1N3038B 56.0V	862A257H04
S1	SWITCH		849A299H03
RSD	SWITCH		3510A06H01



Sub. 4

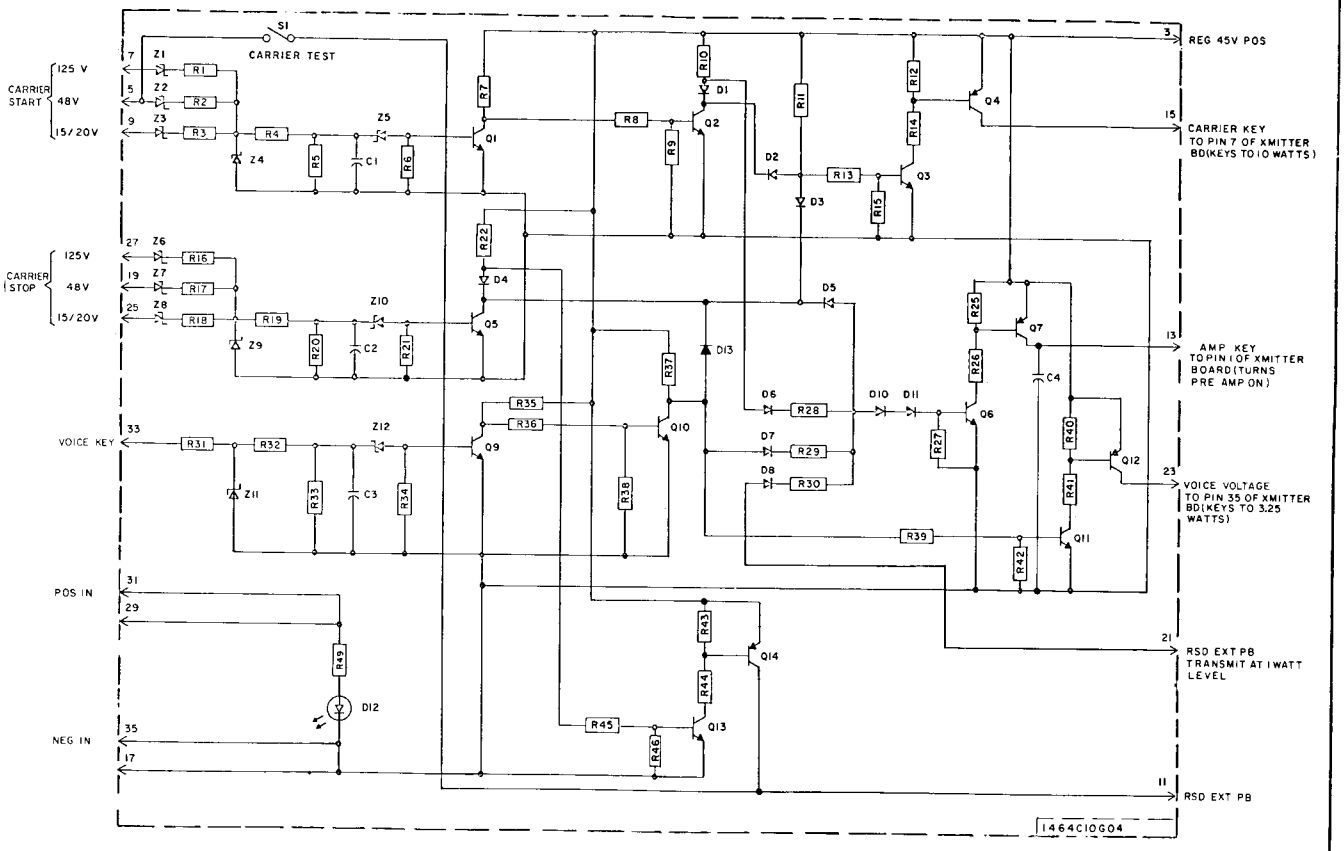
SHEETS 5&6 1463C68

Fig. 22C. Internal Schematic - Keying Module - without DC Power switch or Fuses - with Reserve Signal Detector Pushbutton and Control.

1464C10G04

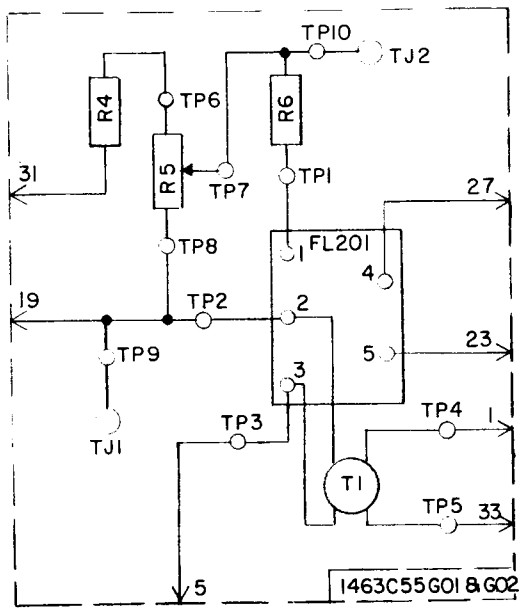
COMPONENT		DESCRIPTION	STYLE NO.
C1	CAPACITOR	.047UF 200V	849A437H04
C2	CAPACITOR	.047UF 200V	849A437H04
C3	CAPACITOR	.047UF 200V	849A437H04
C4	CAPACITOR	1.0 UF 200V	187A624H04
D1	DIODE	1N457A	184A855H07
D2	DIODE	1N457A	184A855H07
D3	DIODE	1N457A	184A855H07
D4	DIODE	1N457A	184A855H07
D5	DIODE	1N457A	184A855H07
D6	DIODE	1N457A	184A855H07
D7	DIODE	1N457A	184A855H07
D8	DIODE	1N457A	184A855H07
D10	DIODE	1N457A	184A855H07
D11	DIODE	1N457A	184A855H07
D12	DIODE	LED	3508A22H01
D13	DIODE	1N457A	184A855H07
J1	JUMPER	0 OHM RESISTOR	862A478H01
J2	JUMPER	0 OHM RESISTOR	862A478H01
J3	JUMPER	0 OHM RESISTOR	862A478H01
J4	JUMPER	0 OHM RESISTOR	862A478H01
J5	JUMPER	0 OHM RESISTOR	862A478H01
J6	JUMPER	0 OHM RESISTOR	862A478H01
J7	JUMPER	0 OHM RESISTOR	862A478H01
R1	RESISTOR	33.0K .50W 2%	629A531H68
R2	RESISTOR	13.0K .50W 2%	629A531H59
R3	RESISTOR	820.0 .50W 2%	629A531H30
R4	RESISTOR	1500.0 .50W 5%	184A763H31
R5	RESISTOR	6200.0 .50W 5%	184A763H46
R6	RESISTOR	10.0K .50W 5%	184A763H51
R7	RESISTOR	12.0K .50W 5%	184A763H53
R8	RESISTOR	27.0K .50W 5%	184A763H61
R9	RESISTOR	10.0K .50W 5%	184A763H51
R10	RESISTOR	12.0K .50W 5%	184A763H53
R11	RESISTOR	12.0K .50W 5%	184A763H53
R12	RESISTOR	4700.0 .50W 5%	184A763H43
R13	RESISTOR	27.0K .50W 5%	184A763H61
R14	RESISTOR	12.0K .50W 5%	184A763H53
R15	RESISTOR	10.0K .50W 5%	184A763H51
R16	RESISTOR	33.0K .50W 2%	629A531H68
R17	RESISTOR	13.0K .50W 2%	629A531H59
R18	RESISTOR	820.0 .50W 2%	629A531H30
R19	RESISTOR	1500.0 .50W 5%	184A763H31
R20	RESISTOR	6200.0 .50W 5%	184A763H46
R21	RESISTOR	10.0K .50W 5%	184A763H51
R22	RESISTOR	12.0K .50W 5%	184A763H53
R25	RESISTOR	4700.0 .50W 5%	184A763H43
R26	RESISTOR	12.0K .50W 5%	184A763H53
R27	RESISTOR	10.0K .50W 5%	184A763H51
R28	RESISTOR	27.0K .50W 5%	184A763H61
R29	RESISTOR	27.0K .50W 5%	184A763H61
R30	RESISTOR	27.0K .50W 5%	184A763H61
R31	RESISTOR	1800.0 .50W 5%	184A763H33
R32	RESISTOR	1500.0 .50W 5%	184A763H31
R33	RESISTOR	6200.0 .50W 5%	184A763H46

COMPONENT		DESCRIPTION	STYLE NO.
R34	RESISTOR	10.0K .50W 5%	184A763H51
R35	RESISTOR	12.0K .50W 5%	184A763H53
R36	RESISTOR	27.0K .50W 5%	184A763H61
R37	RESISTOR	12.0K .50W 5%	184A763H53
R38	RESISTOR	10.0K .50W 5%	184A763H51
R39	RESISTOR	27.0K .50W 5%	184A763H61
R40	RESISTOR	4700.0 .50W 5%	184A763H43
R41	RESISTOR	12.0K .50W 5%	184A763H53
R42	RESISTOR	10.0K .50W 5%	184A763H51
R43	RESISTOR	4700.0 .50W 5%	184A763H43
R44	RESISTOR	12.0K .50W 5%	184A763H53
R45	RESISTOR	27.0K .50W 5%	184A763H61
R46	RESISTOR	10.0K .50W 5%	184A763H51
R49	RESISTOR	18.0K .50W 2%	629A531H62
Q1	TRANSISTOR	2N699	184A638H19
Q2	TRANSISTOR	2N699	184A638H19
Q3	TRANSISTOR	2N699	184A638H19
Q4	TRANSISTOR	2N3645	849A441H01
Q5	TRANSISTOR	2N699	184A638H19
Q6	TRANSISTOR	2N699	184A638H19
Q7	TRANSISTOR	2N3645	849A441H01
Q9	TRANSISTOR	2N699	184A638H19
Q10	TRANSISTOR	2N699	184A638H19
Q11	TRANSISTOR	2N699	184A638H19
Q12	TRANSISTOR	2N3645	849A441H01
Q13	TRANSISTOR	2N699	184A638H19
Q14	TRANSISTOR	2N3645	849A441H01
Z1	ZENER	1R200 200.0V	629A369H01
Z2	ZENER	1R200 200.0V	629A369H01
Z3	ZENER	1R200 200.0V	629A369H01
Z4	ZENER	1N3686B 20.0V	185A212H06
Z5	ZENER	1N957B 6.8V	186A797H06
Z6	ZENER	1R200 200.0V	629A369H01
Z7	ZENER	1R200 200.0V	629A369H01
Z8	ZENER	1R200 200.0V	629A369H01
Z9	ZENER	1N3686B 20.0V	185A212H06
Z10	ZENER	1N957B 6.8V	186A797H06
Z11	ZENER	1N3686B 20.0V	185A212H06
Z12	ZENER	1N957B 6.8V	186A797H06



Sub. 4
SHEETS 7&8 1463C68

Fig. 22D. Internal Schematic - Keying Module - without DC Power Switch or Fuses - without Reserve Signal Detector Components.

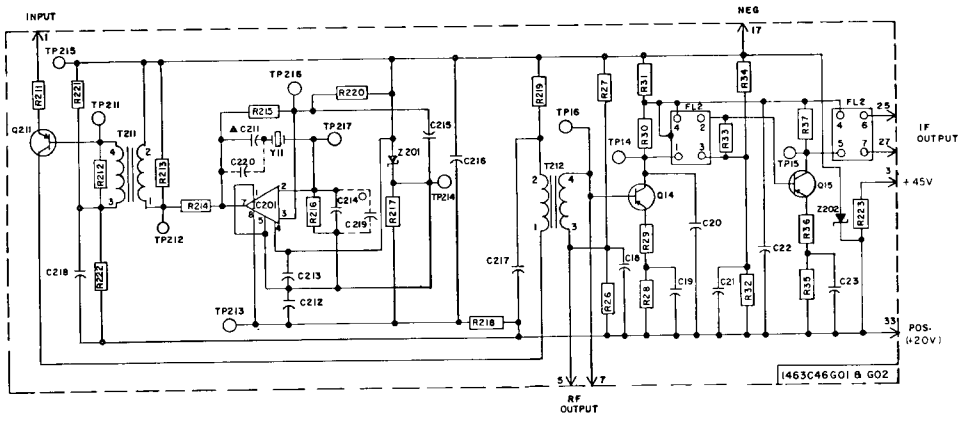


COMPONENT	DESCRIPTION	STYLE NO.
R4 RESISTOR	10 K .50 W 5%	184A763H51
R6 RESISTOR	10 K 50 W 5%	184A763H51
R5 POTENTIOMETER	10 K 2 W	185A086H10
FL201 FILTER		□
TJ1 TIP JACK	BLACK	187A332H02
TJ2 TIP JACK	RED	187A332H01
T1 10K 10K TRANSF.		714B677G01

□ = TO BE DETERMINED

Sub 2
(1478B46)

Fig. 23. Internal Schematic - Input Module.



COMPONENT		DESCRIPTION	STYLE NO.
C18	CAPACITOR	.250UF 200V	187A624H02
C19	CAPACITOR	.250UF 200V	187A624H02
C20	CAPACITOR	100-000PF 500V	762A757H01
C21	CAPACITOR	.250UF 200V	187A624H02
C22	CAPACITOR	1.000UF 200V	187A624H04
C23	CAPACITOR	.250UF 200V	187A624H02
▲ C211	CAPACITOR	SEE NOTE ▲	
C213	CAPACITOR	.100UF 50V	184A663H04
C215	CAPACITOR	.100UF 50V	184A663H04
C216	CAPACITOR	1.000UF 200V	187A624H04
C217	CAPACITOR	1.000UF 200V	187A624H04
C218	CAPACITOR	.250UF 200V	187A624H02
○ C214	CAPACITOR	SEE NOTE ○	
1C201	INT CKT	MA710	201C826H03
J1	JUMPER	0 OHM RESISTOR	862A478A01
R26	RESISTOR	3300.0 .50W 5%	184A763H39
R27	RESISTOR	22.0K .50W 5%	184A763H59
R28	RESISTOR	680.0 .50W 5%	184A763H23
R29	RESISTOR	68.0 .50W 5%	187A290H21
R30	RESISTOR	10.0K .50W 5%	184A763H51
R31	RESISTOR	330.0 .50W 5%	184A763H15
R32	RESISTOR	3300.0 .50W 5%	184A763H39
* R33	RESISTOR	1000.0 .50W 5%	184A763H27
R34	RESISTOR	22.0K .50W 5%	184A763H59
R35	RESISTOR	680.0 .50W 5%	184A763H23
R36	RESISTOR	68.0 .50W 5%	187A290H21
R37	RESISTOR	10.0K .50W 5%	184A763H51
R211	RESISTOR	10.0K .50W 5%	184A763H51
R212	RESISTOR	1000.0 .50W 5%	184A763H27
R213	RESISTOR	10.0K .50W 5%	184A763H51
R214	RESISTOR	2700.0 .50W 5%	184A763H37
R215	RESISTOR	10.0K .50W 5%	184A763H51
R216	RESISTOR	8200.0 .50W 5%	184A763H48
R217	RESISTOR	2000.0 .50W 5%	184A763H34
R218	RESISTOR	150.0 .50W 5%	184A763H07
R219	RESISTOR	330.0 .50W 5%	184A763H15
R220	RESISTOR	47.0K .50W 5%	184A763H67
R221	RESISTOR	220.0K .50W 5%	184A763H83
R222	RESISTOR	4700.0 .50W 5%	184A763H43
R223	RESISTOR	1000.0 1W 5%	184A643H27
@ R33	RESISTOR	300.0 50W 5%	184A763H14
Q14	TRANSISTOR	2N4249	849A441H03
Q15	TRANSISTOR	2N4249	849A441H03
Q211	TRANSISTOR	2N4249	849A441H03
* FL2	FILTER		762A613G01
@ FL202	FILTER		187A590G03
CR201	ZENER	1N753A 6.2V	862A926H13
CR202	ZENER	1N3027B 43.0V	188A302H07
Y11	CRYSTAL	SEE NOTE □	
T211	TRANSF		714B677G01
T212	TRANSF		205C043G03

▲ C211 RANGES FROM 100PF TO 1000 PF

○ C214 MAY VARY UP TO 100PF 187A695H01 THROUGH H23

□ Y11 FREQ. EQUALS RCVR (CHANNEL) FREQUENCY PLUS 20KHZ

* FOR G01 FOR NARROW BAND TC-10

@ FOR G02 FOR WIDE BAND TC-10

Sub 3
(1463C47)

Fig. 24. Internal Schematic - I.F. Amplifier Oscillator Module.

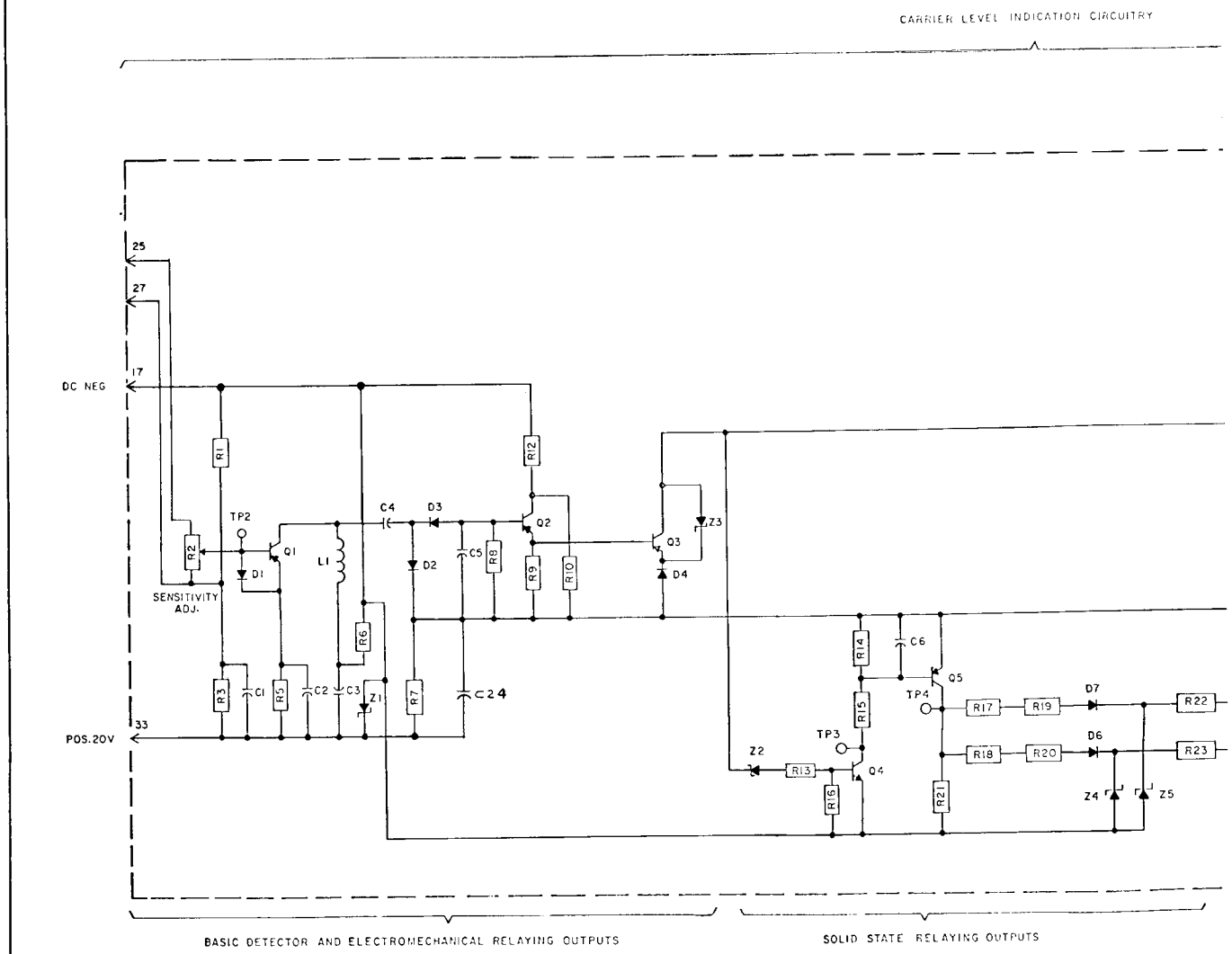
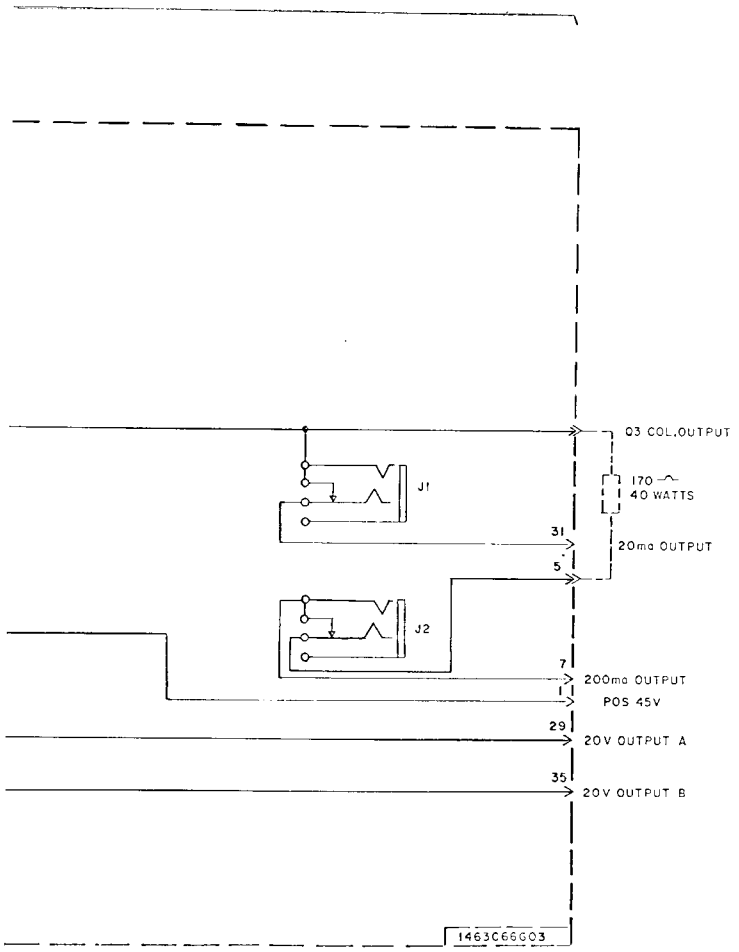


Fig. 25B. Internal Schematic - Detect
20 Volt Outputs.

COMPONENT		DESCRIPTION	STYLE NO.
C1	CAPACITOR	.250UF 200V	187A624H02
C2	CAPACITOR	.250UF 200V	187A624H02
C3	CAPACITOR	.100UF 200V	187A624H01
C4	CAPACITOR	.250UF 200V	187A624H02
C5	CAPACITOR	.250UF 200V	187A624H02
C6	CAPACITOR	.270UF 200V	188A669H05
C7	CAPACITOR	.010UF 50V	184A663H01
C24	**CAPACITOR**	**2.0UF 200V**	**187A624H05**



D1	DIODE	1N4148	836A928H06
D2	DIODE	1N457A	184A855H07
D3	DIODE	1N457A	184A855H07
D4	DIODE	1N4818	188A342H06
D6	DIODE	1N645A	837A692H03
D7	DIODE	1N645A	837A692H03

R1	RESISTOR	27.0K .50W 5%	184A763H61
R3	RESISTOR	4700.0 .50W 2%	629A531H48
R5	RESISTOR	470.0 1.00W 5%	187A643H19
R6	RESISTOR	2000.0 .50W 5%	184A763H34
R7	RESISTOR	560.0 1.00W 5%	187A643H21
R8	RESISTOR	10.0K .50W 1%	848A820H45
R9	RESISTOR	1500.0 .50W 5%	184A763H31

COMPONENT		DESCRIPTION	STYLE NO.
R10	RESISTOR	4.7K2.00W10%	187A642H43
R12	RESISTOR	4.7K2.00W10%	187A642H43
R13	RESISTOR	27.0K .50W 5%	184A763H61
R14	RESISTOR	10.0K .50W 1%	848A820H45
R15	RESISTOR	6800.0 .50W 5%	184A763H47
R16	RESISTOR	10.0K .50W 1%	848A820H45
R17	RESISTOR	700.0 3.00W 5%	763A127H25
R18	RESISTOR	700.0 3.00W 5%	763A127H23
R19	RESISTOR	120.0 .50W 5%	184A763H05
R20	RESISTOR	120.0 .50W 5%	184A763H05
R21	RESISTOR	82.0K .50W 5%	184A763H73
R22	RESISTOR	150.0 3.00W 5%	762A679H01
R23	RESISTOR	150.0 3.00W 5%	762A679H01
L1	**CHOKE**		**187A599H01**

COMP LOC 1478B00

Q1	TRANSISTOR	2N4249		849A441H03
Q2	TRANSISTOR	2N3645		849A441H01
Q4	TRANSISTOR	2N3417		848A851H02
Q5	TRANSISTOR	2N4356		849A441H02
Q3	**TRANSISTOR**	**2N4903**		**187A673H13**
Z1	ZENER	1N3027B	20.0V	162A302H07
Z2	ZENER	1N3686B	20.0V	185A212H06
Z3	ZENER	**1N3038B**	**56.0V**	**862A257H04**
Z4	ZENER	1N4747A	20.0V	849A437H01
Z5	ZENER	1N4747A	20.0V	849A437H01
Z6	ZENER	**1N4460**	**6.2V**	**837A693H08**
Z7	ZENER	**1N4460**	**6.2V**	**837A693H08**

SHEET 2 (Sub. 5) 1334D41

r Module - with 200mA and 20mA outputs, and Two

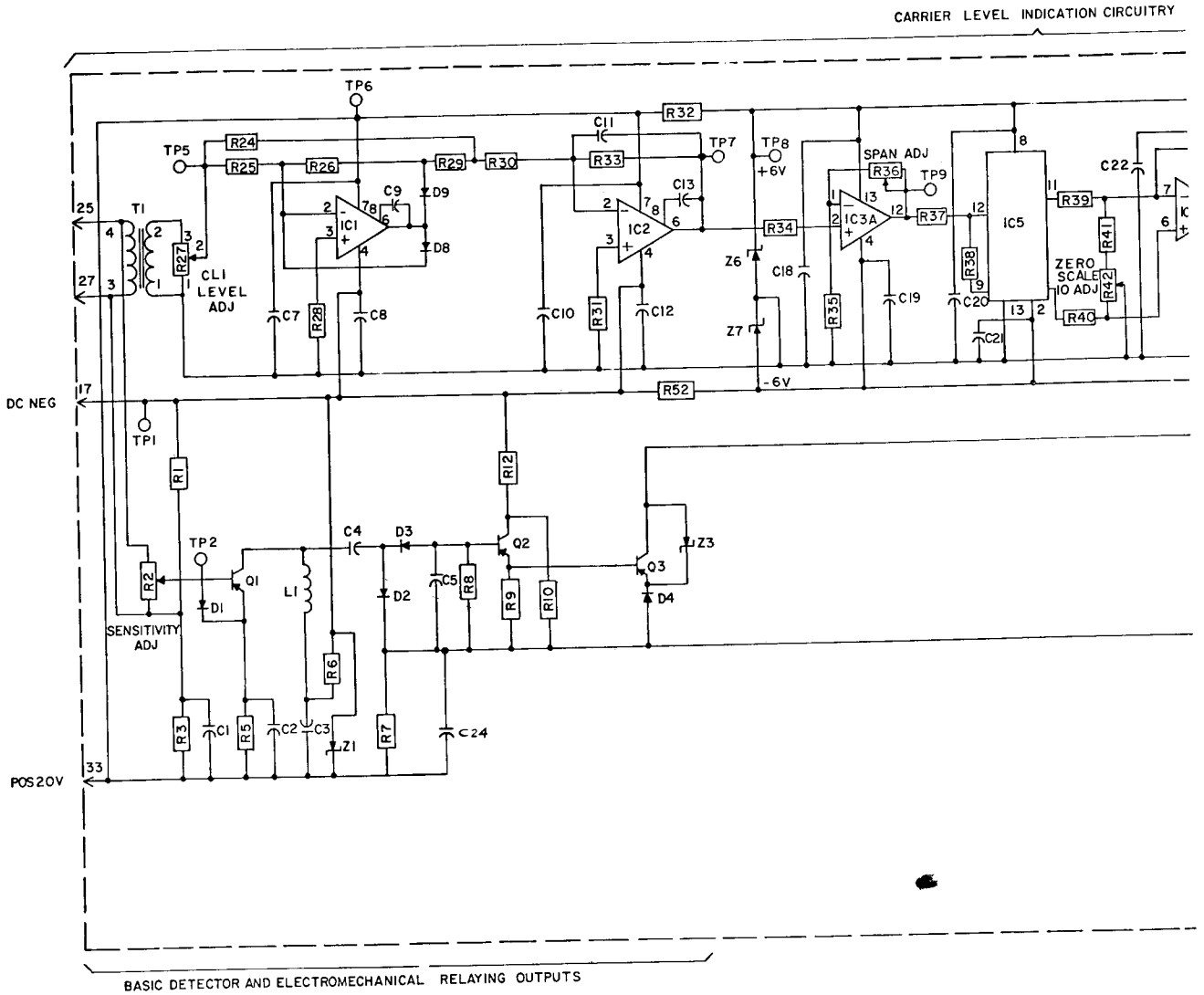
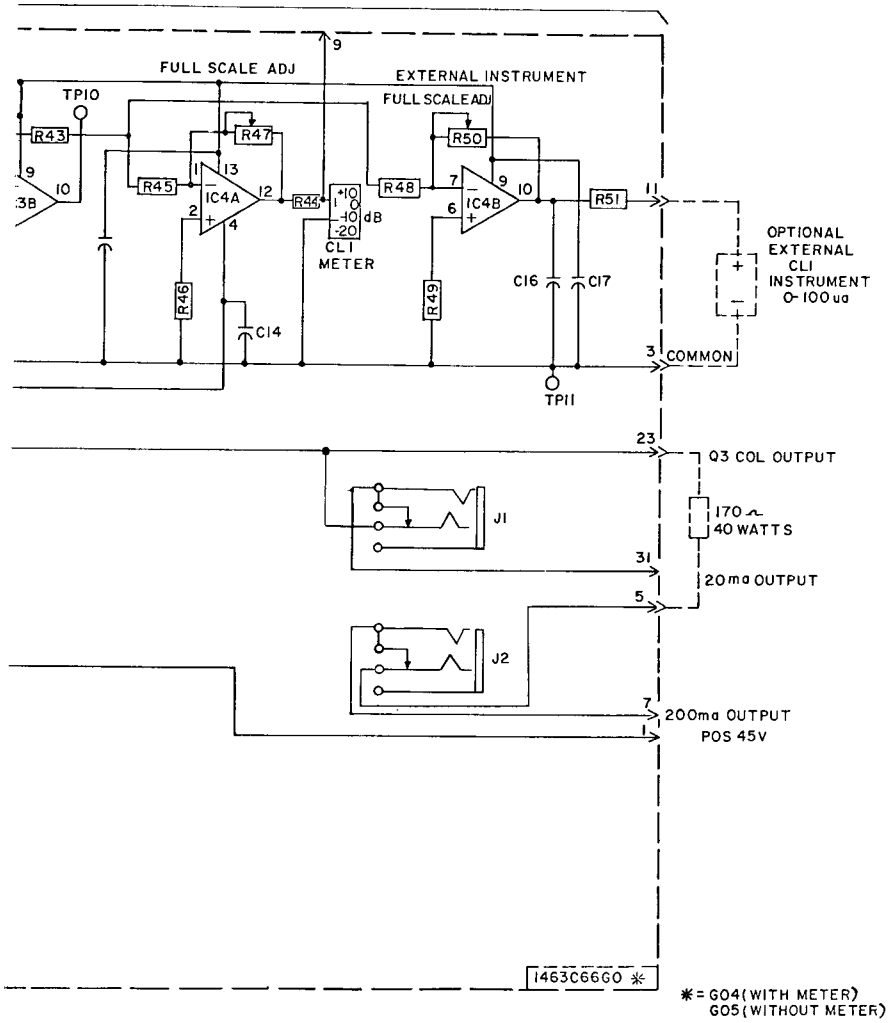


Fig. 25D. Internal Schem



COMPONENT		DESCRIPTION			STYLE NO.
C1	CAPACITOR	.250UF	200V		187A624H02
C2	CAPACITOR	.250UF	200V		187A624H02
C3	CAPACITOR	.100UF	200V		187A624H01
C4	CAPACITOR	.250UF	200V		187A624H02
C5	CAPACITOR	.250UF	200V		187A624H02
C7	CAPACITOR	.010UF	50V		184A663H01
C8	CAPACITOR	.010UF	50V		184A663H01
C9	CAPACITOR	33.000PF	200V		879A989H07
C10	CAPACITOR	.010UF	50V		184A663H01
C11	CAPACITOR	.470UF	50V		762A680H04
C12	CAPACITOR	.010UF	50V		184A663H01
C13	CAPACITOR	33.000PF	200V		879A989H07
C14	CAPACITOR	.010UF	50V		184A663H01
C16	CAPACITOR	.270UF	200V		188A669H05
C17	CAPACITOR	.010UF	50V		184A663H01
C18	CAPACITOR	.010UF	50V		184A663H01
C19	CAPACITOR	.010UF	50V		184A663H01
C20	CAPACITOR	.010UF	50V		184A663H01
C21	CAPACITOR	.010UF	50V		184A663H01
C22	CAPACITOR	.010UF	50V		184A663H01
C23	CAPACITOR	.010UF	50V		184A663H01
C24	CAPACITOR	2.0UF	200V		187A624H05
D1	DIODE	1N4148			836A928H06
D2	DIODE	1N457A			184A855H07
D3	DIODE	1N457A			184A855H07
D4	DIODE	1N4818			188A342H06
D8	DIODE	1N4148			836A928H06
D9	DIODE	1N4148			836A928H06
IC1	INT CKT	SE531T			3512A10H01
IC2	INT CKT	SE531T			3512A10H01
IC3	INT CKT	747DM			1443C52H01
IC4	INT CKT	747DM			1443C52H01
IC5	INT CKT	SN56502			3512A09H01
R2	POT	10.0K	.75W		880A826H05
R27	POT	50.0K	.50W		629A645H06
R36	POT	250.0K	.75W		880A826H10
R42	POT	2.5K	.25W		629A645H07
* R47	POT	5.0K	.75W		880A826H09
R50	POT	5.0K	.75W		880A826H09
R1	RESISTOR	27.0K	.50W	5%	184A763K61
R3	RESISTOR	4700.0	.50W	2%	629A531H48
R5	RESISTOR	470.0	1.00W	5%	187A643H19
R6	RESISTOR	2000.0	.50W	5%	184A763H34
R7	RESISTOR	150.0	3W	5%	762A679H01
R8	RESISTOR	10.0K	.50W	1%	848A820H45
R9	RESISTOR	1500.0	.50W	5%	184A763H31
R10	RESISTOR	4.7K	2.00W	10%	187A642H43
R12	RESISTOR	4.7K	2.00W	10%	187A642H43
R24	RESISTOR	4750.0	.50W	1%	848A820H14
R25	RESISTOR	4750.0	.50W	1%	848A820H14
R26	RESISTOR	15.0K	.50W	1%	848A820H62
R28	RESISTOR	4990.0	.50W	1%	848A820H16
R29	RESISTOR	4990.0	.50W	1%	848A820H16
R30	RESISTOR	4990.0	.50W	1%	848A820H16
R31	RESISTOR	4990.0	.50W	1%	848A820H16
R32	RESISTOR	68.0	3.00W	5%	763A127H13
R33	RESISTOR	10.0K	.50W	1%	848A820H45
R34	RESISTOR	2.0K	.50W	1%	848A819H77
R35	RESISTOR	4990.0	.50W	1%	848A820H16
R37	RESISTOR	1000.0	.50W	1%	848A819H48
R38	RESISTOR	15.0K	.50W	1%	848A820H62
R39	RESISTOR	2.0K	.50W	1%	848A819H77
R40	RESISTOR	2.0K	.50W	1%	848A819H77
R41	RESISTOR	17.8K	.50W	1%	848A820H69
R43	RESISTOR	1000.0	.50W	1%	848A819H48
R44	RESISTOR	100.0	.50W	2%	629A531H08
R45	RESISTOR	560.0	.50W	2%	629A531H26
R46	RESISTOR	1000.0	.50W	1%	848A819H48
R48	RESISTOR	560.0	.50W	2%	629A531H26
R49	RESISTOR	1000.0	.50W	1%	848A819H48
R51	RESISTOR	100.0	1.00W	5%	187A643H03
R52	RESISTOR	68.0	3.00W	5%	763A127H18
L1	CHOKE				187A599H01
*	METER				879A875H01
T1	TRANSFORMER	10K/10K			7148677G01
Q1	TRANSISTOR	2N4249			849A441H03
Q2	TRANSISTOR	2N3645			849A441H01
Q3	TRANSISTOR	2N4903			187A673H13
Z1	ZENER	1N3027B	20.0V		188A302H07
Z3	ZENER	1N3038B	56.0V		862A257H04
Z6	ZENER	1N4460	6.2V		837A693H08
Z7	ZENER	1N4460	6.2V		837A693H08

SHEET 4 (Sub. 5) 1334D41

atic with CLI - with 200mA and 20mA outputs.

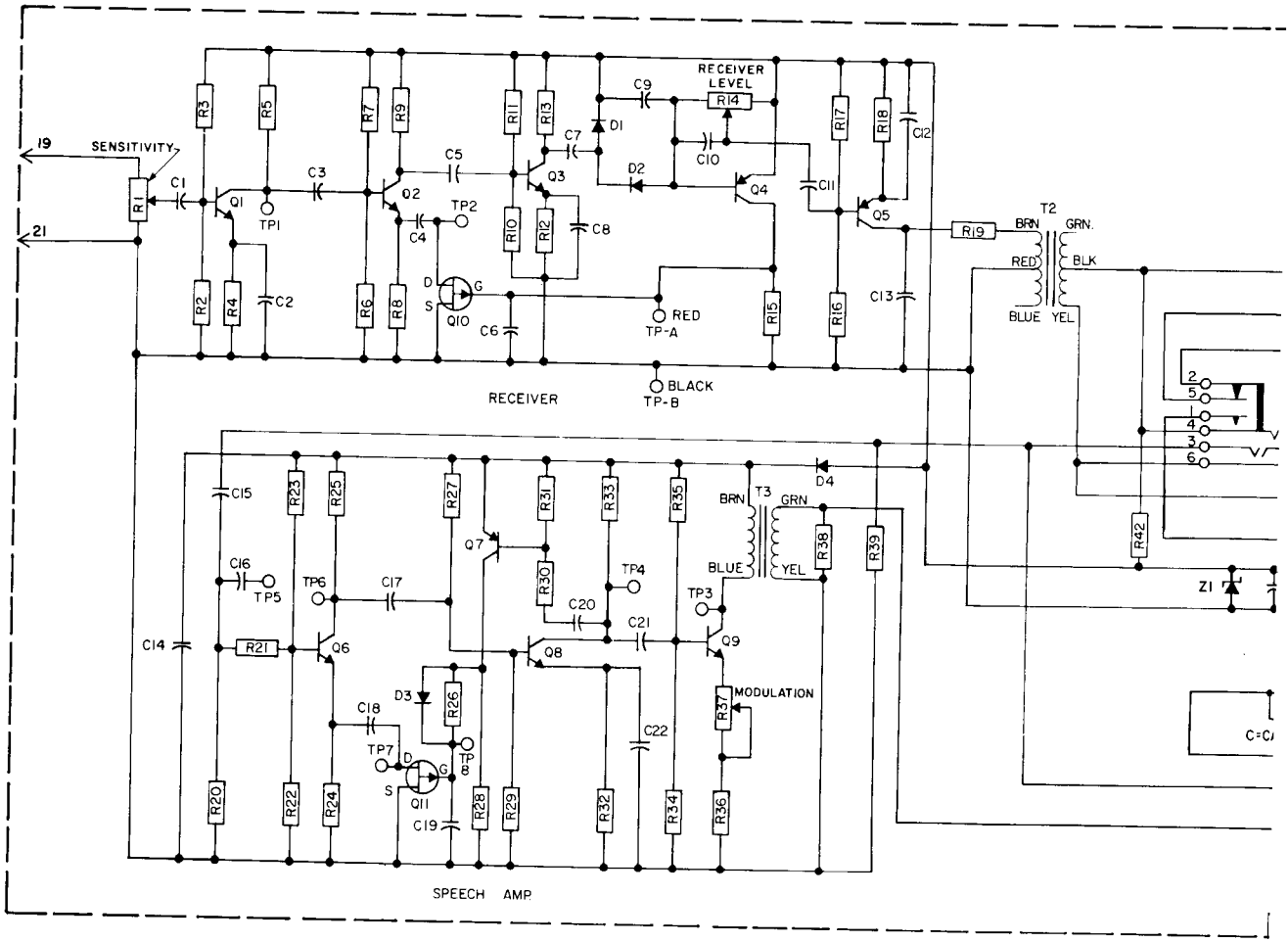
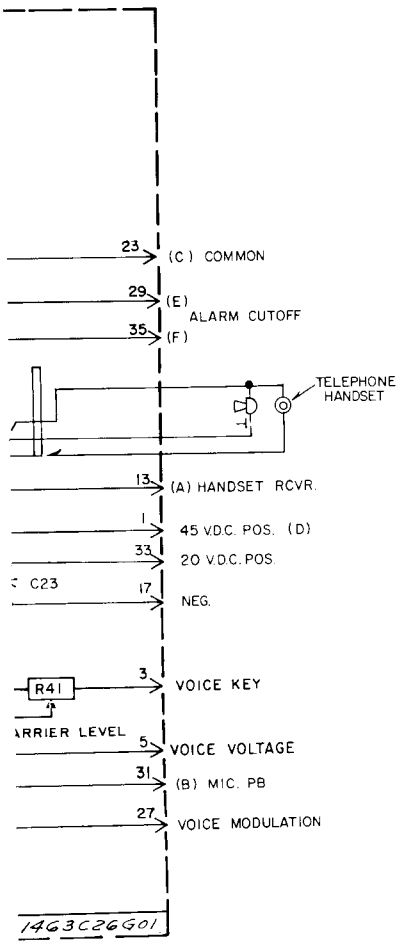


Fig. 26. Internal Sc



COMPONENT		DESCRIPTION			STYLE NO.
C1	CAPACITOR	.100UF	200V		187A624H01
C2	CAPACITOR	.100UF	200V		187A624H01
C3	CAPACITOR	.100UF	200V		187A624H01
C4	CAPACITOR	.010UF	600V		764A278H10
C5	CAPACITOR	.100UF	200V		187A624H01
C6	CAPACITOR	1.000UF	200V		187A624H04
C7	CAPACITOR	.010UF	600V		764A278H10
C8	CAPACITOR	.050UF	200V		187A624H08
C9	CAPACITOR	.010UF	600V		764A278H10
C10	CAPACITOR	.220UF	50V		848A648H09
C11	CAPACITOR	1.000UF	200V		187A624H04
C12	CAPACITOR	47.000UF	25V		187A508H12
C13	CAPACITOR	.010UF	600V		764A278H10
C14	CAPACITOR	47.000UF	50V		862A177H06
C15	CAPACITOR	.100UF	200V		187A624H01
C16	CAPACITOR	.100UF	200V		187A624H01
C17	CAPACITOR	2.000UF	200V		187A624H05
C18	CAPACITOR	1.000UF	200V		187A624H04
C19	CAPACITOR	1.000UF	200V		187A624H04
C20	CAPACITOR	1.000UF	200V		187A624H04
C21	CAPACITOR	.020MF	200V		187A624H09
C22	CAPACITOR	6.800UF	25V		184A661H25
C23	CAPACITOR	47.000UF	50V		862A177H06
D1	DIODE	1N457A			184A855H07
D2	DIODE	1N457A			184A855H07
D3	DIODE	1N457A			184A855H07
D4	DIODE	1N4818			188A342H06
R1	POT	500.0	.75W		880A826H08
R37	POT	10.0K	.75W		880A826H05
R41	POT	20.0K	.75W		880A826H01
R2	RESISTOR	5600.0	.50W	5%	184A763H45
R3	RESISTOR	27.0K	.50W	5%	184A763H61
R4	RESISTOR	2000.0	.50W	5%	184A763H34
R5	RESISTOR	10.0K	.50W	5%	184A763H51
R6	RESISTOR	10.0K	.50W	5%	184A763H51
R7	RESISTOR	10.0K	.50W	5%	184A763H51
R8	RESISTOR	47.0K	.50W	5%	184A763H67
R9	RESISTOR	10.0K	.50W	5%	184A763H51
R10	RESISTOR	3300.0	.50W	5%	184A763H39
R11	RESISTOR	82.0K	.50W	5%	184A763H59
R12	RESISTOR	2000.0	.50W	5%	184A763H34
R13	RESISTOR	10.0K	.50W	5%	184A763H51
R15	RESISTOR	820.0K	.50W	5%	184A763H83
R16	RESISTOR	56.0K	.50W	5%	184A763H69
R17	RESISTOR	4700.0	.50W	5%	184A763H43
R18	RESISTOR	1.0K	.50W	5%	184A763H27
R19	RESISTOR	6800.0	.50W	5%	184A763H47
R20	RESISTOR	220.0	.50W	5%	184A763H11
R21	RESISTOR	2700.0	.50W	5%	184A763H37
R22	RESISTOR	1000.0	.50W	5%	184A763H27
R23	RESISTOR	15[illegible]	.5[illegible]	5%	184A763H31
R24	RESISTOR	82.0K	.50W	5%	184A763H59

COMPONENT		DESCRIPTION			STYLE NO.
R25	RESISTOR	10.0K	.50W	5%	184A763H51
R26	RESISTOR	2.2M	.50W	5%	187A690H35
R27	RESISTOR	39.0K	.50W	5%	184A763H55
R28	RESISTOR	220.0K	.50W	5%	184A763H[illegible]
R29	RESISTOR	6800.0	.50W	5%	184A763H47
R30	RESISTOR	100.0K	2.00W	5%	185A207H75
R31	RESISTOR	100.0K	.50W	5%	184A763H75
R32	RESISTOR	2000.0	.50W	5%	184A763H34
R33	RESISTOR	10.0K	.50W	5%	184A763H51
R34	RESISTOR	3600.0	.50W	5%	184A763H[illegible]
R35	RESISTOR	47.0K	.50W	5%	184A763H[illegible]
R36	RESISTOR	560.0	.50W	5%	184A763H21
R38	RESISTOR	560.0	.50W	5%	184A763H21
R39	RESISTOR	1.0K	3.00W	5%	763A127H[illegible]
R42	RESISTOR	1.2K	2.00W	5%	185A207H29
Q1	TRANSISTOR	2N3417			848A851H[illegible]
Q2	TRANSISTOR	2N699			184A638H19
Q3	TRANSISTOR	2N699			184A638H19
Q4	TRANSISTOR	2N4356			849A441H[illegible]
Q5	TRANSISTOR	2N4356			849A441H[illegible]
Q6	TRANSISTOR	2N699			184A638H19
Q7	TRANSISTOR	2N4356			849A441H[illegible]
Q8	TRANSISTOR	2N657			184A638H[illegible]
Q9	TRANSISTOR	2N699			184A638H19
Q10	TRANSISTOR	2N5465			879A876H[illegible]
Q11	TRANSISTOR	2N5465			879A876H01
Z1	ZENER	1N[illegible]7B		5%	188A[illegible]H[illegible]
J1	TEL-JACK				879A935H01
	POT				880A687H01
T2	TRANSFORMER				879A875H01
T3	TRANSFORMER				879A875H01

Sub 3
SHEET 1&2 (1463C28)

hematic - Voice Adapter.

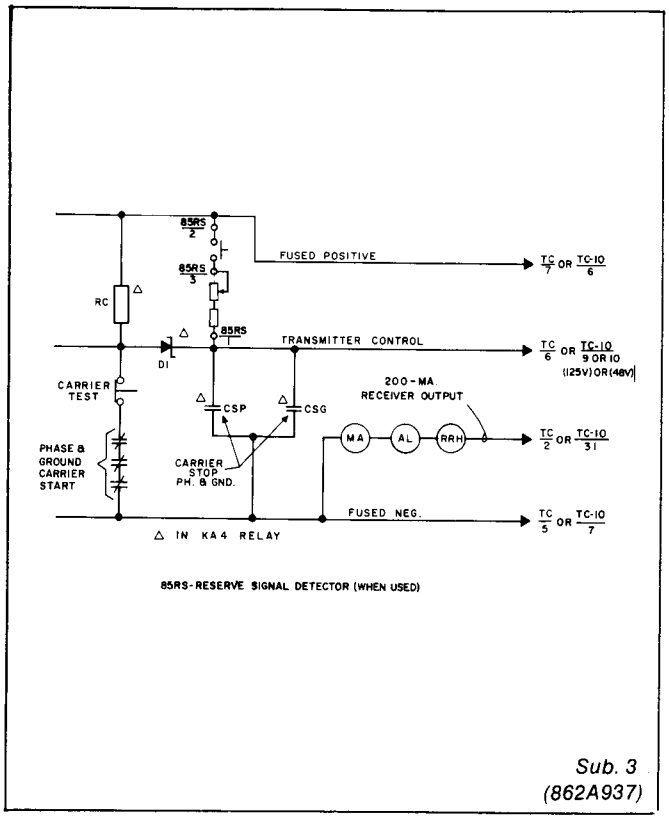


Fig. 28. Elementary K-Dar Carrier Control Circuits.

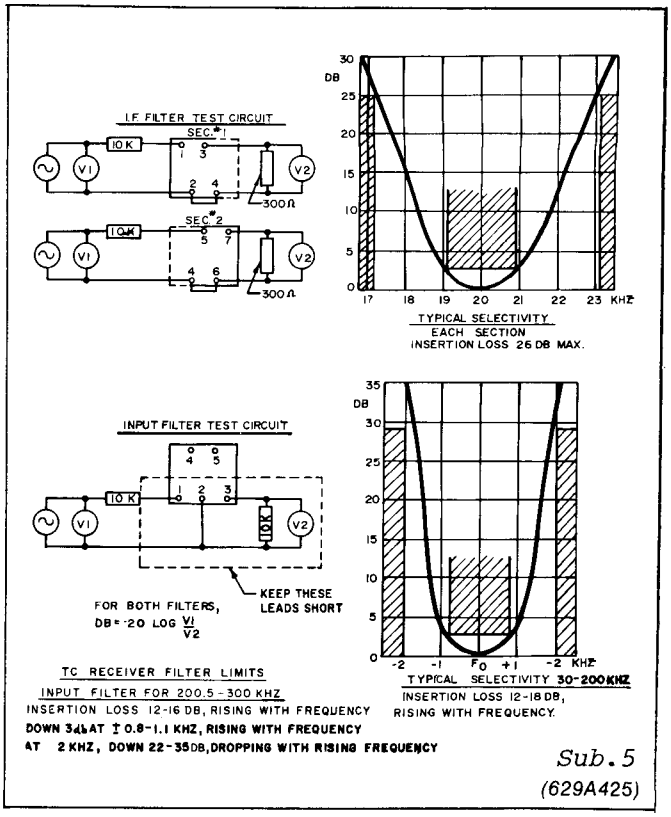


Fig. 29. Type TC-10 Receiver Filter Characteristics.

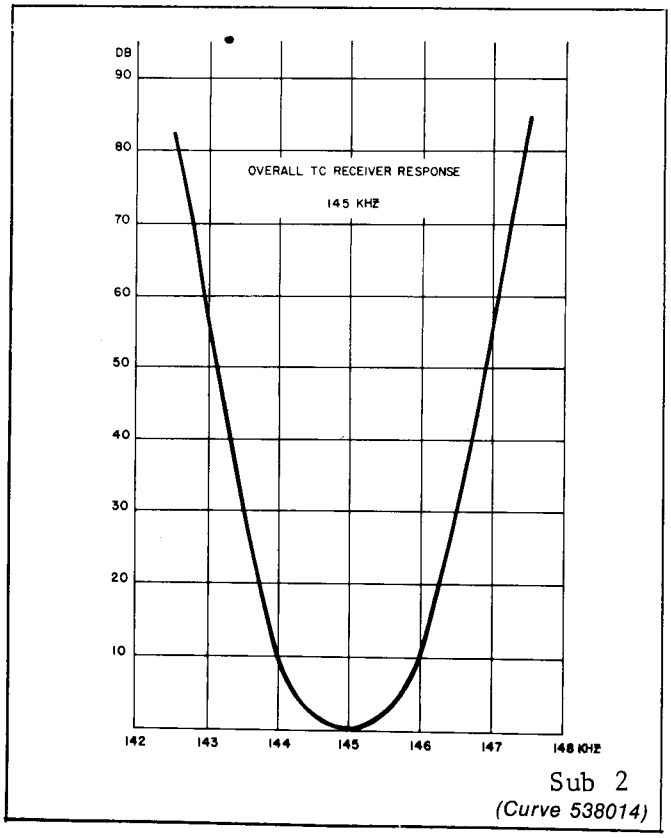


Fig. 30. Type TC-10 Overall Selectivity Curve.

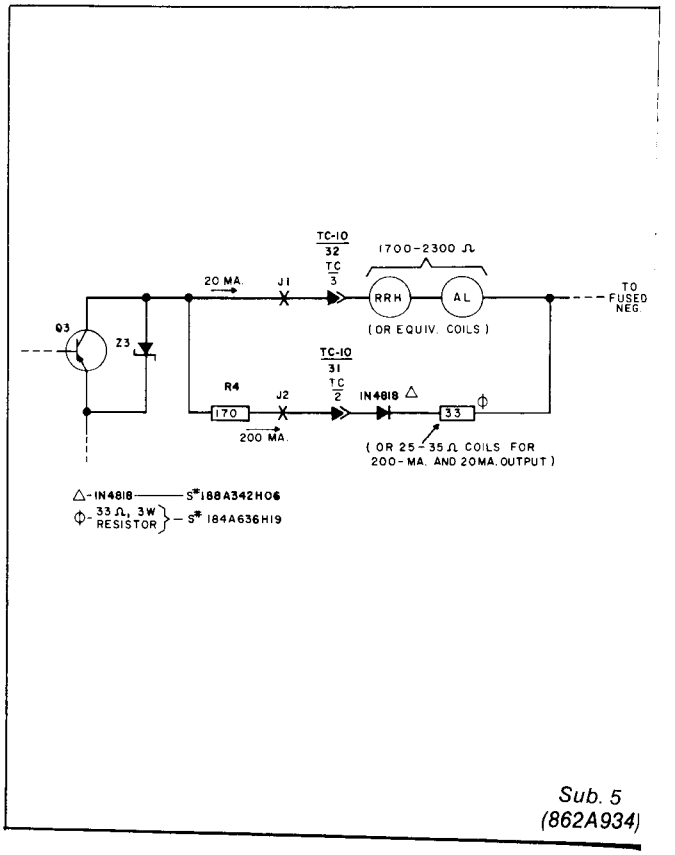


Fig. 31. Type TC-10 Receiver Output For 20 ma Operation.

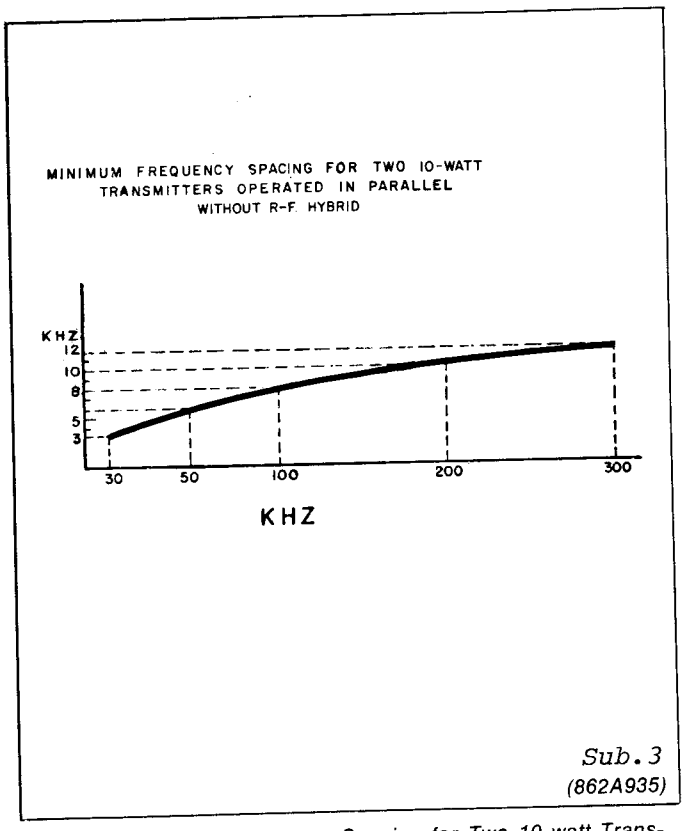


Fig. 32. Minimum Frequency Spacing for Two 10 watt Transmitters Operated in Parallel.

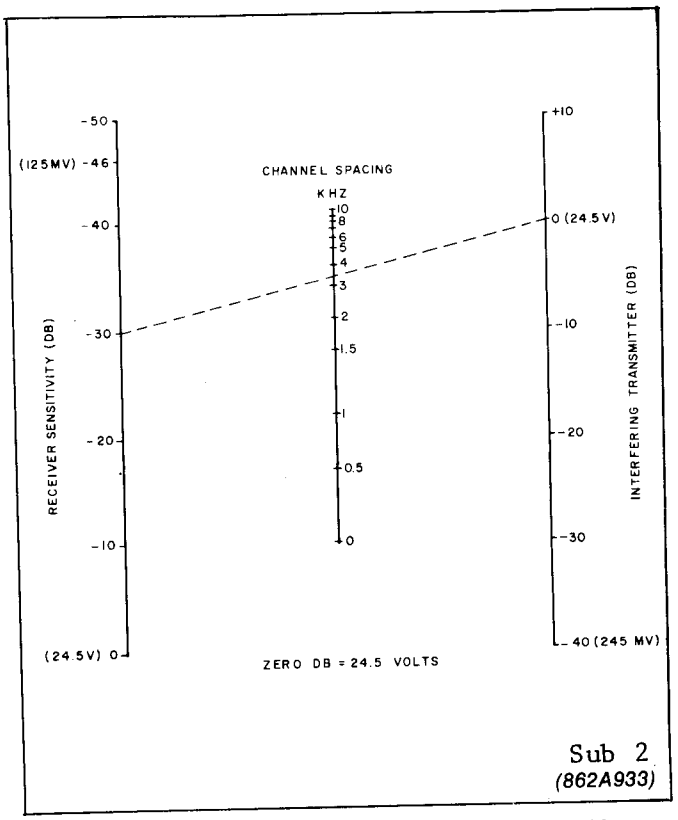


Fig. 33. Minimum Channel Spacing for Keyed Carrier 60 pps.

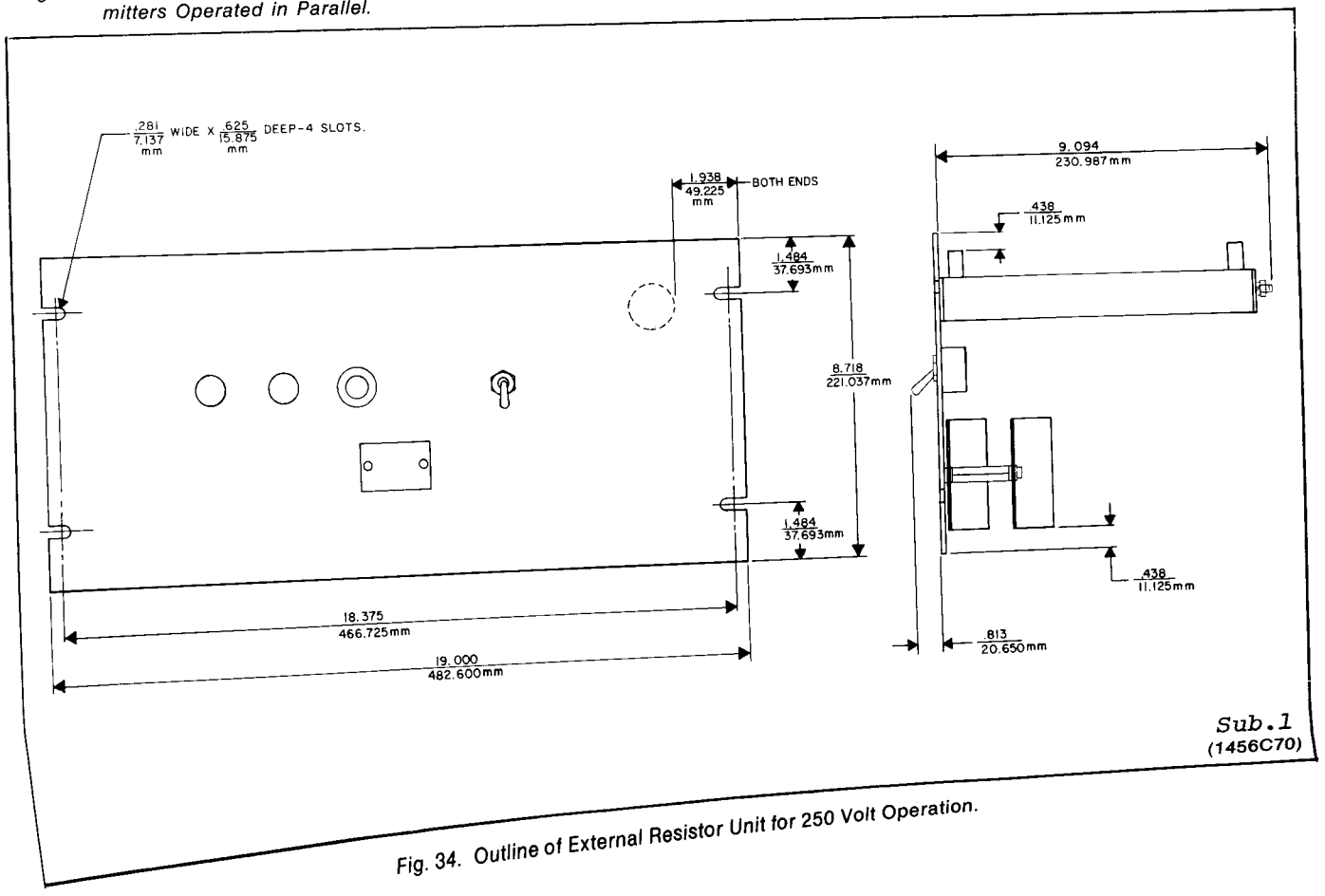
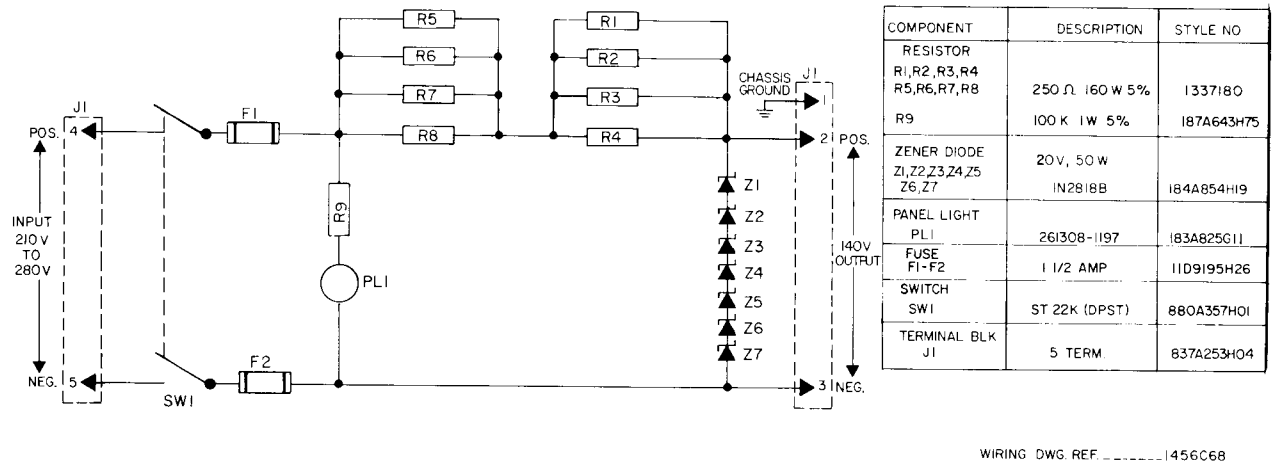


Fig. 34. Outline of External Resistor Unit for 250 Volt Operation.

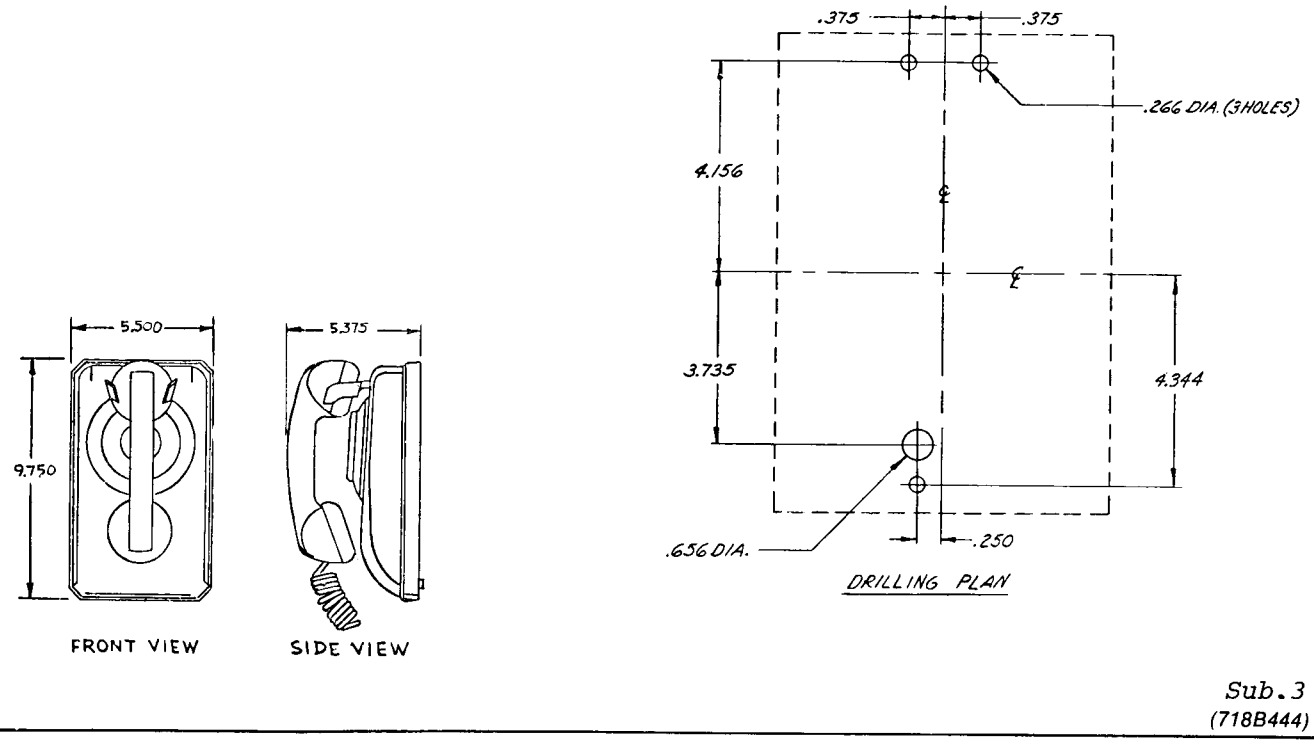


COMPONENT	DESCRIPTION	STYLE NO
RESISTOR R1,R2,R3,R4 R5,R6,R7,R8	250 Ω 160 W 5%	133718O
R9	100 K 1W 5%	187A643H75
ZENER DIODE Z1,Z2,Z3,Z4,Z5 Z6,Z7	20V, 50 W IN2818B	184A854H19
PANEL LIGHT PL1	261308-1197	183A825G11
FUSE F1-F2	1 1/2 AMP	11D9195H26
SWITCH SW1	ST 22K (DPST)	880A357H01
TERMINAL BLK J1	5 TERM.	837A253H04

WIRING DWG. REF. 1456C68

Sub.1
(775B835)

Fig. 35. Schematic of External Resistor Unit for 250 VDC Operation.



Sub.3
(718B444)

Fig. 36. Remote Hookswitch Assembly for Surface Mounting.

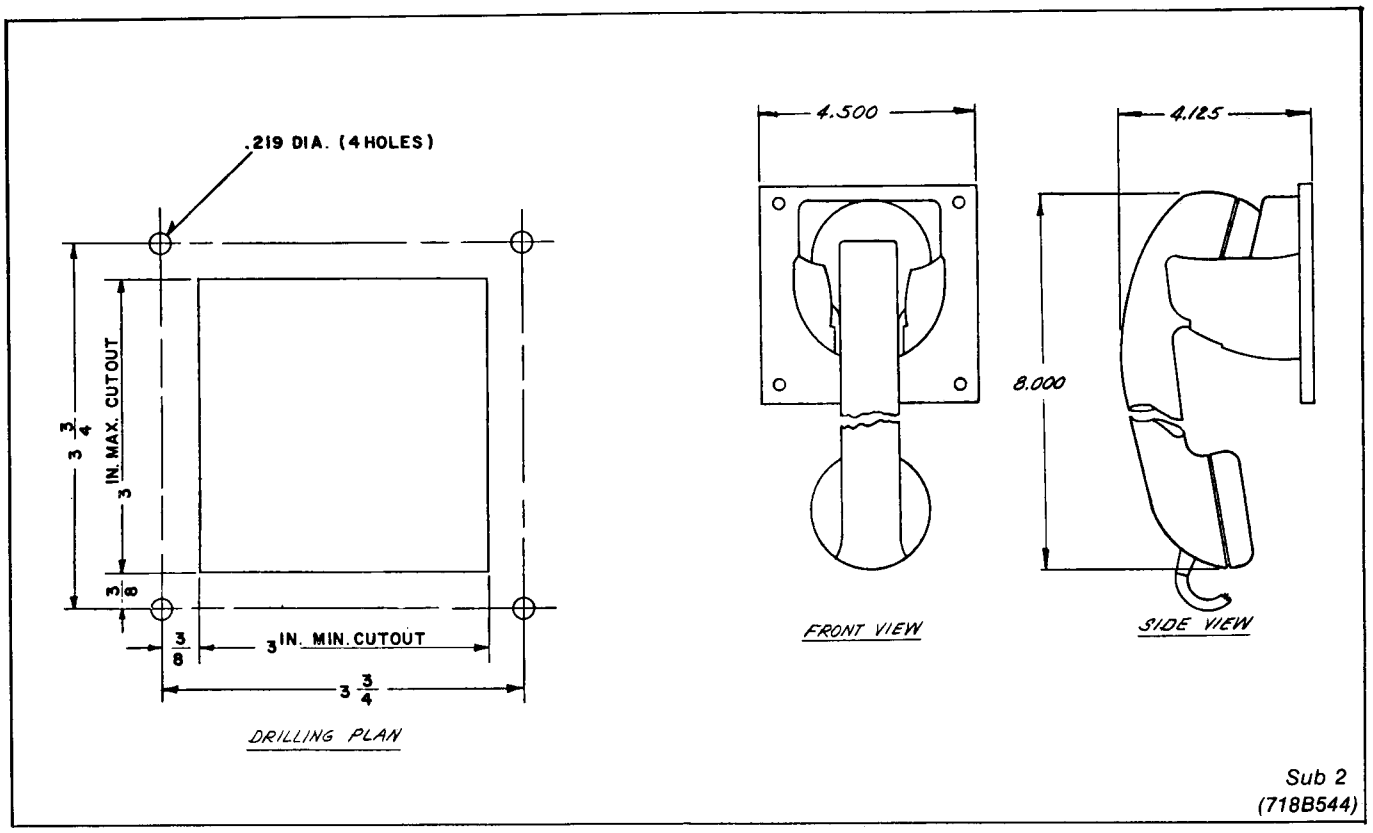


Fig. 37. Remote Hookswitch Assembly for Panel Mounting.

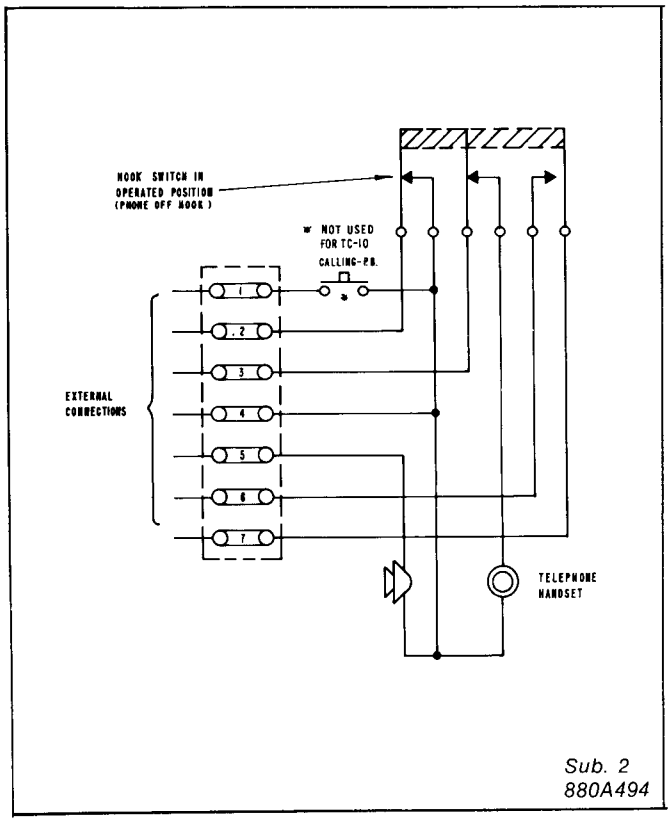


Fig. 38. Remote Hookswitch Assembly Internal Schematic

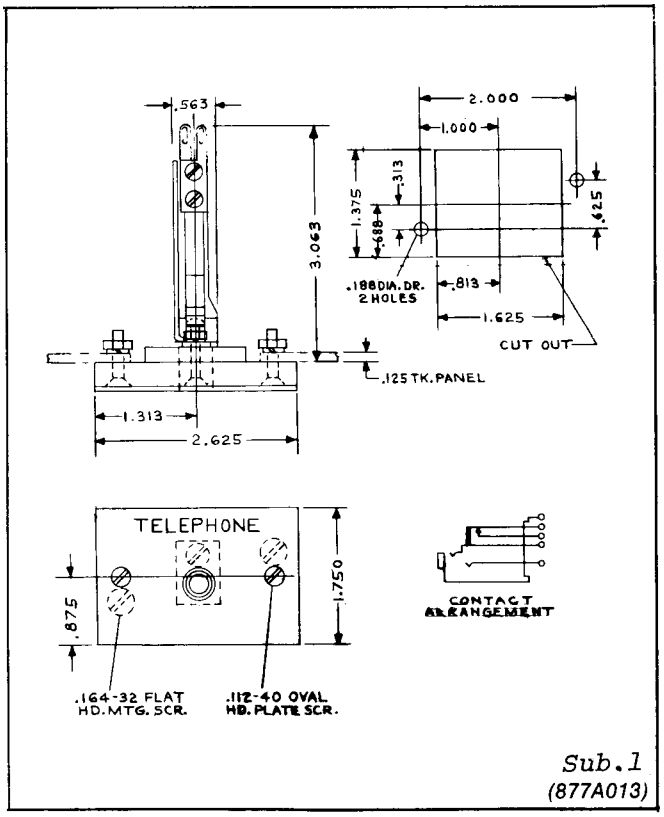


Fig. 39. Remote Telephone Jack Assembly.

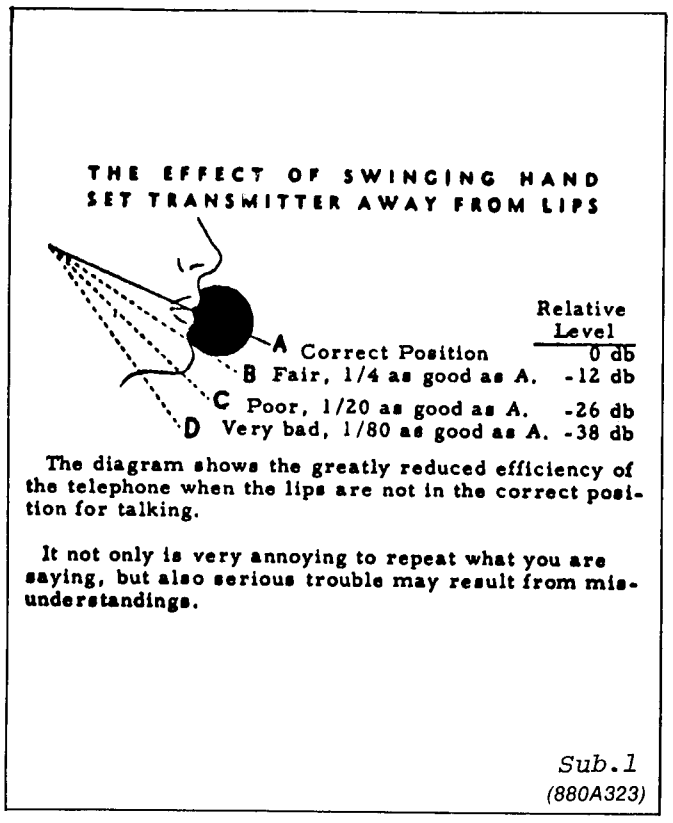


Fig. 40. Proper Usage of the Noise Cancelling Handset.

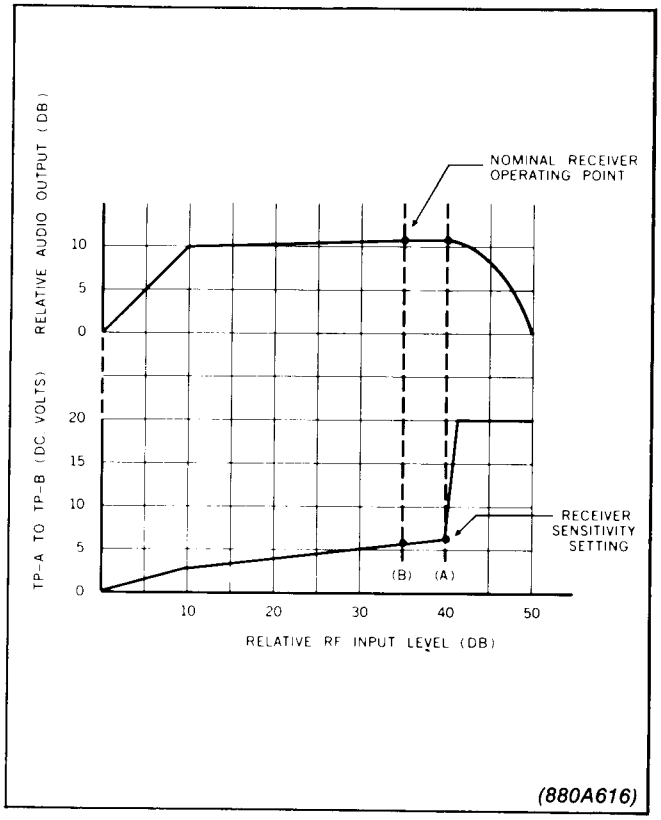


Fig. 41. Voice Receiver Automatic Volume Control Response.

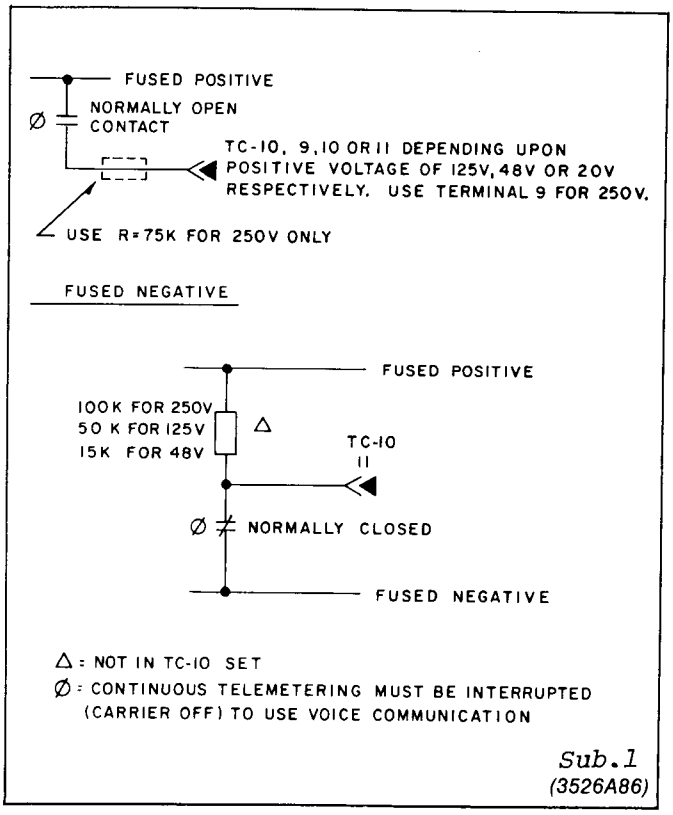
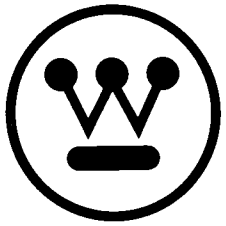


Fig. 42. External Circuitry for On-Off Keying of Type TC-10 Transmitter for Telemetering or Supervisory Control (Without Protective Relaying) from either Normally Close or Normally-Open Contact).



WESTINGHOUSE ELECTRIC CORPORATION

RELAY-INSTRUMENT DIVISION

CORAL SPRINGS, FL.

Printed in U.S.A.