INSTALLATION • OPERATION • MAINTENANCE

# INSTRUCTIONS

# TYPE TCF-10 POWER LINE CARRIER FREQUENCY-SHIFT TRANSMITTER EQUIPMENT 1 WATT/10 WATT FOR KEYED AND VOICE APPLICATIONS

**CAUTION**: It is recommended that the user of this equipment become thoroughly familiar 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 TCF-10 carrier transmitter equipment provides for the transmission of either of two closely controlled discrete frequencies, both within a narrow-band channel, over high-voltage transmission lines. The center frequency of the channel can vary from 30 to 300 KHz in 0.5 KHz steps. The two frequencies transmitted are separated by 200 Hz, one being at center frequency (fc) plus 100 Hz and the others at center frequency minus 100 Hz. The higher frequency, termed the Guard frequency, is transmitted continuously when conditions are normal. It indicates at the receiving end of the line that the channel is operative and it also serves to prevent false operation of the receiver by line noise. The lower frequency, termed the Trip frequency, is transmitted as a signal that an operation (such as tripping a circuit breaker) should be performed at the receiving end of the line.

When frequency shift carrier is used in protective relaying applications, it is recommended that the trip frequency be transmitted at a higher power level to increase reliability of the system under conditions of abnormally high channel losses or line noise. The frequency is shifted from Guard to Trip by the closing of a protective relay contact, and the same contact also shifts the transmitter from a 1-watt to a 10-watt output level.

When electro-mechanical relays are used for keying from guard to trip frequency, the contact used is connected to the high voltage input of a buffering keying board. This board buffers the input so that random noise does not key the circuits. When solid state relays are used, the 20 V D.C. voltage used for keying is connected to the low voltage input of the buffering keying board.

## CONSTRUCTION

The 1 watt/10 watt TCF-10 transmitter unit is mounted on a standard 19-inch wide chassis 5 1/4 inches (3 rack units) high with edge slots for mounting on a standard relay rack. Fuses, a pilot light, and a power switch are accessible from the front of the panel. See Fig. 6. All of the circuitry that is suitable for printed circuit board mounting is on four such boards, as shown in Fig. 13 The components mounted on each printed circuit board or other sub-assembly are shown enclosed by dotted lines on the internal schematic. Fig. 2. The location of components on the four printed circuit boards are shown on separate illustrations, Fig. 3, 4, 5, & 6.

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.

*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 module extender test card, S#1447C86G01 is available to facilitate testing.

## OPERATION

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

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 ± 100 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.10 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 frequency, or 2.03 MHz. 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, and with Y2 removed the base of Q51 would be held at appoximately 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.

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 is made to oscillate at 100 Hz above its marked frequency. Capacitor C53 is not effective until D51 is biased in the forward direction and becomes conductive. It is biased in the reverse direction until the relay control contact is closed, which places 45 V.D.C. at terminal 3 of the printed circuit board. With D51 conducting, C53 is effectively in parallel with C52, and adjustment of C53 will reduce the frequency by 200 Hz. 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 ±10 Hz over a temperature range of −20 to ± 60°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 relay control, or keying, contact is closed, it increases the output power from 1 watt to 10 watts as well as changing the frequency from Guard to Trip. This is effected by reducing the emitter resistance of buffer-amplifier transistor Q54. When the keying contact is open, transistor Q55 receives no base current and is non-conducting. 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 contact. R70 is placed in parallel with R68 and the amount of emitter resistance not bypassed by C66 can be adjusted as required to obtain a 10-watt output level.

As is shown on the Internal Schematic, Fig. 1, the voltage for the keying circuit is obtained from the 45-volt regulated supply in the transmitter, and opening the single power switch deenergizes both the transmitter and the keying circuit.

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 driver filter, FL101, consists of a series-resonant inductor and capacitor connected between the driver and power amplifier stages by appropriate transformers T1 and T2. This filter greatly improves the waveform of the signal applied to the power amplifier.

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.

The output transformer T3 couples the power transistors to the output filter FL102. The output filter includes two trap circuits (L102, $C_B$ and L103, $C_C$) which are factory tuned to the second and third harmonics of the transmitter frequency. Capacitor $C_D$ 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 cables of 50, 60, or 70 ohms.

The series resonant circuit composed of L105 and $C_E$ is tuned to the transmitter frequency, and aids in providing resistive termination for the output stage. Jack J102 is mounted on the front panel of the filter module 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.

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 transistor Q1. Depending on the load current, the dc voltage drop through transistor Q1 and resistors R1 and R2 varies to maintain a constant output voltage. Capacitor C3 provides a low carrier-frequency impedance across the dc output voltage. Capacitors C1 and C2 bypass r.f. or transient voltages to ground, thus preventing damage to the transistor circuits.

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 is 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 non-conducting, 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. Thus the modulation for voice will not result in the output carrier level dropping below 1 watt and endangering the guard frequency for relaying purposes.

The buffer keying board in addition to providing proper buffering, also contains logic for the proper keying of both frequency and output level in regards to protective relaying operation, voice adapter operation, and 52b contact operation.

It should be remembered that protective relaying operation has first priority. If the protective relay operates and puts a voltage input into any of the three input points labeled carrier auxiliary keying, the transmitter will both frequency shift to trip frequency and full 10 watts output whether voice is called for or not.

The operation of the 52b contact will remove the 10 watt keying output and permit the voice adapter to key to 3.2 Watts output for AM voice modulation. This allows voice modulation on the trip frequency after the 52b contact has operated.

## CHARACTERISTICS

| | |
|---|---|
| Frequency Range | 30-300 kHz |
| Output | 1 watt guard—10 watts trip—3.2 watts voice (into 50 to 70 ohm resistive load) |
| Frequency Stability | ±10 Hz from −20°C to +55°C. |

| | |
|---|---|
| Frequency Spacing | Two-way channel,—See Voice Adapter Instruction Leaflet. |
| Harmonics | Down 55 db (min.) from output level. |
| Input Voltage | 48 or 125 v.d.c. |
| Supply Voltage Variation | 42-56v. for nom. 48v. supply. 105-140v. for nom. 125v. supply. |
| Battery Drain | 0.5 a. guard 48 v.d.c.<br>1.15a. trip |
| | 0.25 a. guard 125 v.d.c.<br>0.5 a. trip |
| Keying Circuit Current | 4 ma. |
| Temperature Range | −20 to +55°C. around chassis. |
| Dimensions | Panel height—5 1/4″ or 3 r.u.<br>Panel width—19″ |
| Weight | 12 lbs. |

## INSTALLATION

The TCF-10 transmitter 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

The TCF-10 1W/10W transmitter is shipped with the power output controls R64, R82 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). Turn on the power switch on the panel and note the dc voltage across terminals 5 and 7 of J3. If this is in the range of 42 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 rotating 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 Trip frequency by connecting together terminals 7 and 12 of J3), 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 opening connection between terminals 12 and 7 of J3. This is done by removing handset from telephone hook switch of corresponding voice adapter.

Turn the power back on Adjust R82 for a 3.2 watt output across the load resistor (14V across 60 ohms). Open the power switch, remove the jumper, remove the load resistor, and reconnect the coaxial cable circuit to the transmitter.

| | VOLTAGE FOR | | |
|---|---|---|---|
| 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 turning the matched pair 180° and inserting a crystal in its proper socket with the other crystal unconnected. A sensitive frequency counter with a range of at least 2.2 MHz can be connected from TP51 to TP54. (Connection to TP54 rather than to TP53 provides a better signal to the counter and avoids 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 Guard and Trip frequencies should be needed, the Guard adjustment should be made with capacitor C52 and the Trip Adjustment with C53.

## MAINTENANCE

Periodic checks of the transmitter Guard and Trip power outputs will detect 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 at such times, making any necessary readjustments to return the equipment to its initial settings.

Voltage values should be recorded after adjustment 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 values are given in the following tables. Voltages should be measured with a VTVM. Readings may vary as much as ±20%.

## TABLE I
## TRANSMITTER DC MEASUREMENTS

Note: All voltages are positive with respect to Neg. 45 V. TP51). All voltages read with dc VTVM.

| Test Point | Voltage at 1 Watt Output | | Voltage at 10 Watts Output | | Voltage at 3.2 Watts Output |
|---|---|---|---|---|---|
| | 48V | 125V | 48V | 125V | (For Voice) |
| TP52 | 20 | 20 | 20 | 20 | 20 |
| TP53 | 5.4 | 5.4 | 5.4 | 5.4 | 5.4 |
| TP54 | 3.4 | 3.4 | 3.4 | 3.4 | 3.4 |
| TP55 | 21 | 21 | 18.5 | 18.5 | — |
| TP56 | 21 | 21 | 18.5 | 18.5 | — |
| TP57 | *<1.0 | 1.0 | *<1.0 | 1.0 | — |
| TP58 | 44.3 | 100 | 44.1 | 100 | — |
| TP59 | *<1.0 | 1.0 | *<1.0 | 1.0 | — |
| TERM 1 (POWER AMP MODULE) | 0 | 0 | 0 | 0 | — |
| TERM 17 (POWER AMP MODULE) | 21 ± 2 | 50V | 21 ± 2 | 50V | — |
| TERM 31 (POWER AMP MODULE) | 44.3 | 100 | 44.0 | 100 | — |

## TABLE II
## TRANSMITTER RF MEASUREMENTS

Note: Voltages taken with transmitter set to indicated output across 60 ohms. These voltages subject to variations, depending upon frequency and transistor characteristics. T51 – 3 = Terminal 3 of transformer T51. Other transformer terminals identified similarly. All read with ac VTVM.

| Test Point | Voltage at 1 watt Output | Voltage at 10 watts Output | Voltage at 3.2 Watts Output (For Voice) |
| --- | --- | --- | --- |
| TP54 to TP51 | 0.015 – 0.03 | 0.015 – 0.03 | — |
| TP57 to TP51 | 0.05 – 0.09 | 0.3 – 1.2 | — |
| TP59 to TP51 | 0.05 – 0.09 | 0.3 – 1.2 | — |
| T1-1 to TP51 | 1.65 | 5.6 | — |
| T1-3 to TP51 | 1.45 | 4.9 | — |
| T1-4 to Gnd. | .6 | 2.0 | — |
| T2-1 to Gnd. (POWER AMP MODULE) | .57 | 1.85 | — |
| TERM 1 TERM 17 (POWER AMP MODULE) | 5.2 | 17.0 | — |
| TERM 17 TERM 31 (POWER AMP MODULE) | 5.2 | 17.0 | — |
| T3-4 to Gnd. | 35 | 112 | — |
| T4-2 to Gnd. | 31 | 110 | — |
| TP109 to Gnd. | 9.8 | 31 | — |
| J102 to Gnd. | 7.8 | 24.5 | 14 |

## CONVERSION OF TRANSMITTER FOR CHANGED CHANNEL FREQUENCY

The parts required for converting a 1W/10W TCF-10 transmitter for operation on a different channel frequency consist of a pair of matched crystals for the new channel frequency, new capacitors C103 and C104 on the power amplifier circuit board if the old and new frequencies are not in the same frequency group (see table on internal schematic drawing) and, in general, new or modified filters FL101 and FL102. Inductors L101, 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 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 kHz adjustment ranges of the group 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 | 143.5-151.0 | 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 | 284.1-287.0 |
| 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.

A signal generator, a frequency counter and a vacuum tube voltmeter are required for readjustment of FL101. The signal generator and the counter should be connected across terminals 4 and 5 of transformer T1 and the voltmeter across terminals 1 and 2 of transformer T2. The signal generator should be set at the channel center frequency and at 2 to 3 volts output. The core screw of the small inductor should be turned to the position that gives a true *maximum* reading on the VTVM. Turning the screw to either side of this position should definitely reduce the reading. The change in inductance with core position is less at either end of the travel than when near the center and consequently the effect of core screw rotation on the VTVM reading will be less when the resonant inductance occurs near the end of core travel.

The procedure for readjustment of the 2nd and 3rd harmonic traps of filter FL102 is somewhat similar. A signal generator and a counter should be connected to terminals 3 and 4 of transformer T3, and a 500 ohm resistor and a VTVM to the terminals of protective gap G1. 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.

After the new pair of matched crystals have been adjusted, as described under "ADJUSTMENTS", the transmitter can be operated with a 50 to 70 ohm load (depending on which tap of T4 is used) connected to its output, and inductor L105 can be readjusted for maximum output at the changed channel frequency by the procedure described in the same section.

If a frequency-sensitive voltmeter is available, the 2nd and 3rd harmonic traps may be adjusted 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 the tuning dial and db range switch, obtain a maximum on-scale reading of the 2nd harmonic. Then vary the core position of L102 until a minimum voltmeter reading is obtained. Similarily, tune the voltmeter to the third harmonic and adjust L103 for minimum voltmeter reading. Although the transmitter frequency will differ from the channel center frequency by 100 Hz, the effect of this difference on the adjustment of the harmonic traps will be negligible. It should be noted that the true magnitude of the harmonics cannot be measured in this manner because of the preponderance of the fundamental frequency at the voltmeter terminals. Accurate measurement of the harmonics requires use of a filter between TP109 and the voltmeter that provides high rejection of the fundamental. The insertion looses of this filter for the 2nd and 3rd harmonics must be measured and taken into account.

## RECOMMENDED TEST EQUIPMENT

I. Minimum Test Equipment for Installation.

a. 60-ohm 10-watt non-inductive resistor.
b. AC vacuum Tube Voltmeter (VTVM) or equivalent. Voltage range 0.003 to 30 volts, frequency range 60 hz to 330 kHz; impedance 7.5 megohms.
c. DC Vacuum Tube Voltmeter (VTVM) or equivalent.
d. Module Extender Test Card S 1447C86G01

II. Desirable Test Equipment for Apparatus Maintenance.

a. All items listed in I.
b. Signal Generator
Output Voltage: up to 8 volts.
Frequency Range: 20-kHz to 900 kHz
c. Oscilloscope
d. Frequency counter
e. Ohmmeter
f. Capacitor checker.

Some of the functions of the recommended test equipment are combined in the type TCT carrier test meter unit, which is designed to mount on a standard 19″ rack but also can be removed and used as a portable unit.

## RENEWAL PARTS

Repair work can be done most satisfactorily at the factory. However, replacement parts can be furnished, in most cases, to customers who are equipped for doing repair work. When ordering parts, always give the complete nameplate data and identify the part by its designation on the Internal Schematic drawing.

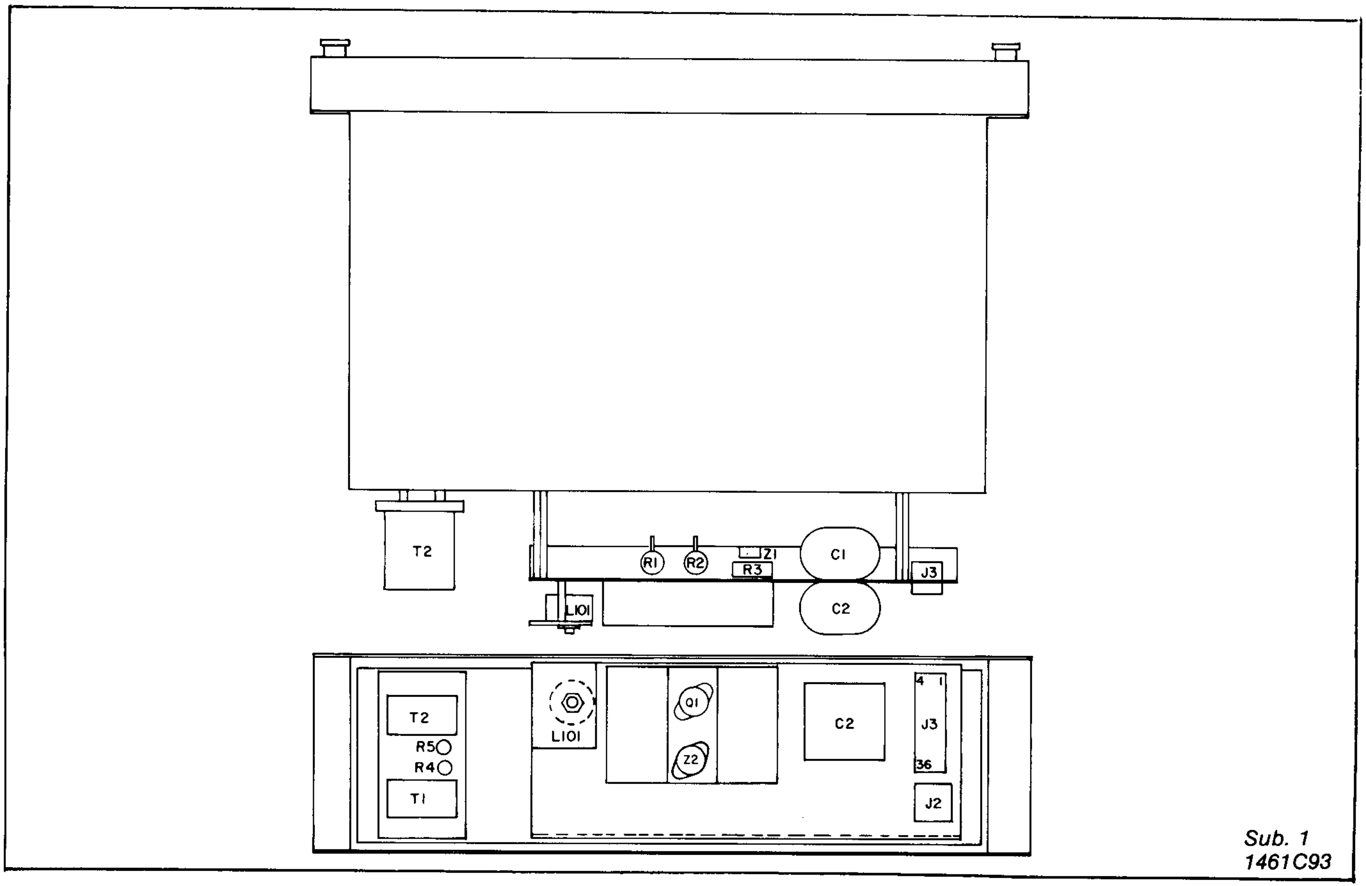



*Fig. 1. Component Location of Assembly*

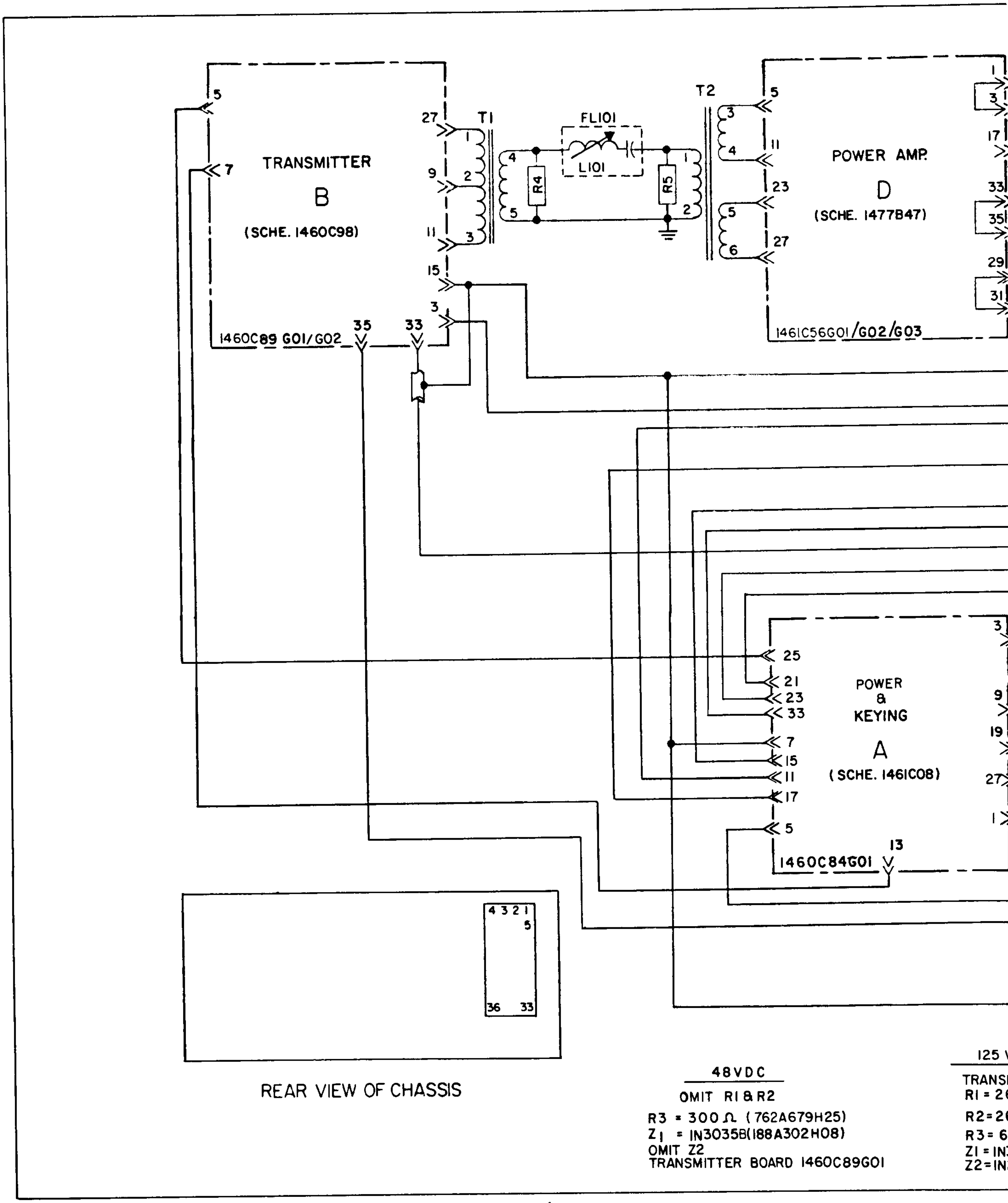
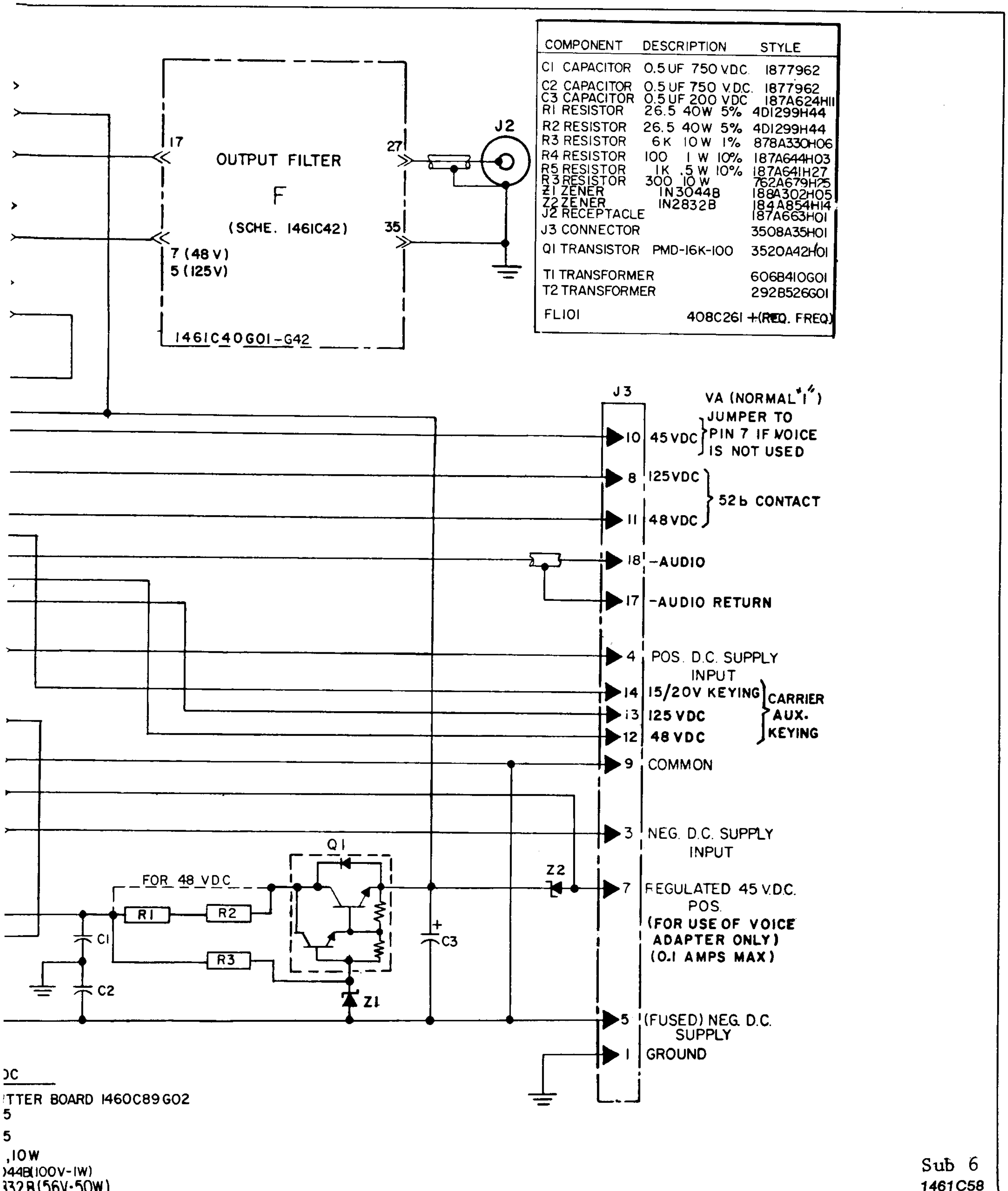
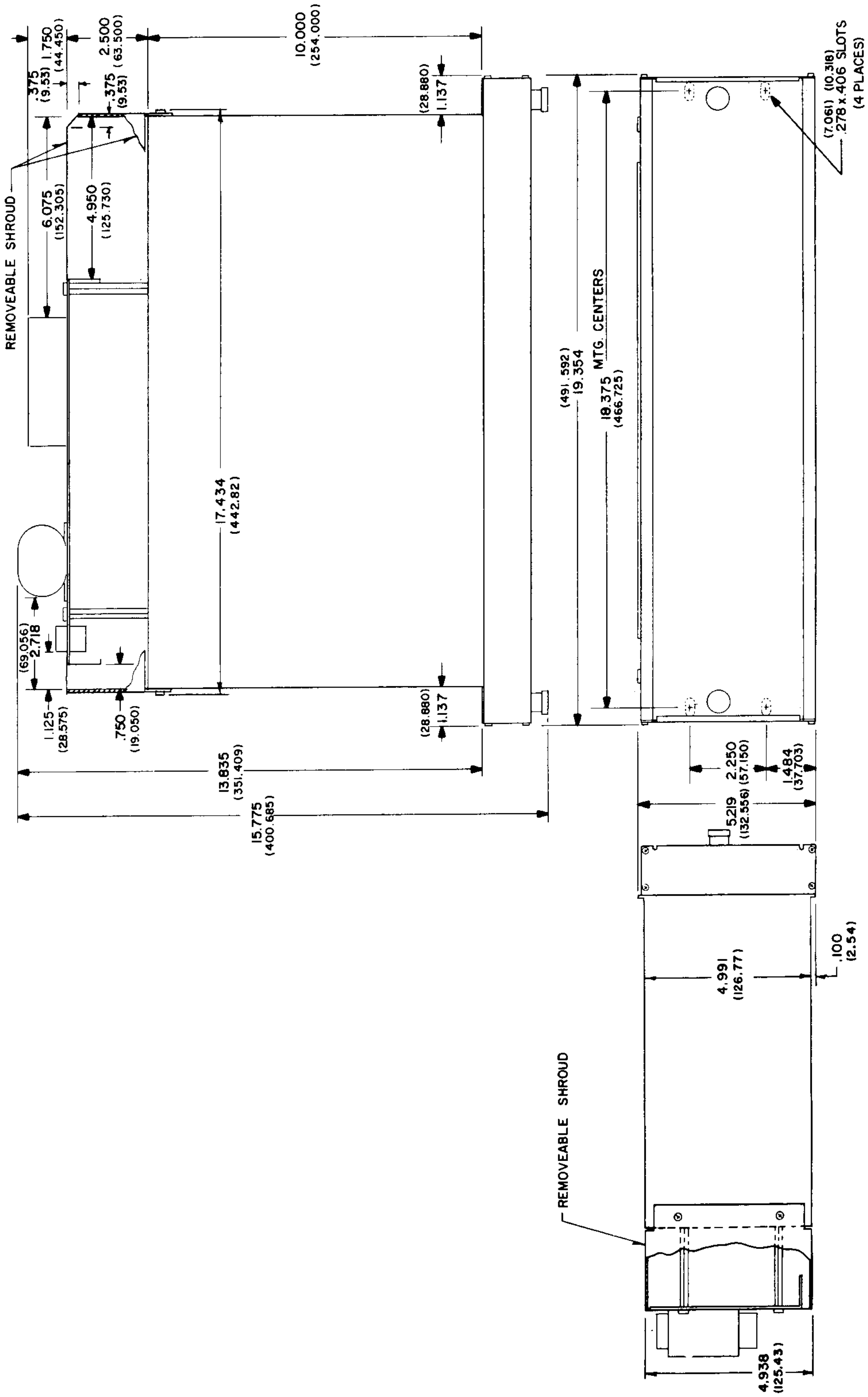



*Fig. 2. Internal Schematic of Transmitte*




| COMPONENT | DESCRIPTION | STYLE |
|---|---|---|
| C1 CAPACITOR | 0.5 UF 750 VDC. | 1877962 |
| C2 CAPACITOR | 0.5 UF 750 V.D.C. | 1877962 |
| C3 CAPACITOR | 0.5 UF 200 VDC | 187A624H11 |
| R1 RESISTOR | 26.5 40W 5% | 4D1299H44 |
| R2 RESISTOR | 26.5 40W 5% | 4D1299H44 |
| R3 RESISTOR | 6K 10W 1% | 878A330H06 |
| R4 RESISTOR | 100 1 W 10% | 187A644H03 |
| R5 RESISTOR | 1K .5 W 10% | 187A641H27 |
| R3 RESISTOR | 300 10 W | 762A679H25 |
| Z1 ZENER | 1N3044B | 188A302H05 |
| Z2 ZENER | 1N2832B | 184A854H14 |
| J2 RECEPTACLE | | 187A663H01 |
| J3 CONNECTOR | | 3508A35H01 |
| Q1 TRANSISTOR | PMD-16K-100 | 3520A42H01 |
| T1 TRANSFORMER | | 606B410G01 |
| T2 TRANSFORMER | | 292B526G01 |
| FL101 | | 408C261 +(REQ. FREQ) |

r for Keyed and Voice Applications

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1445C80

*Fig. 7. Outline & Drilling for Transmitter Assembly*

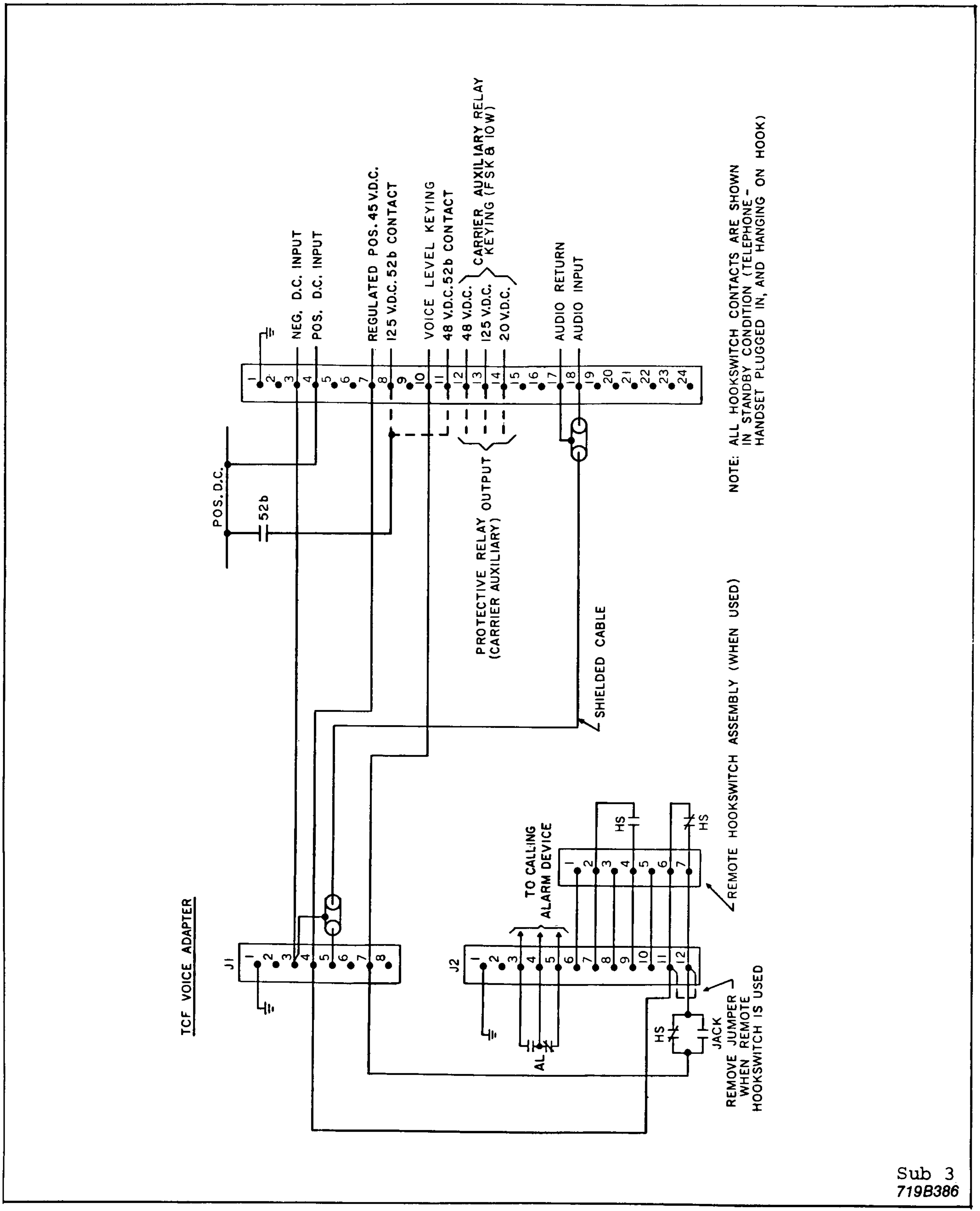
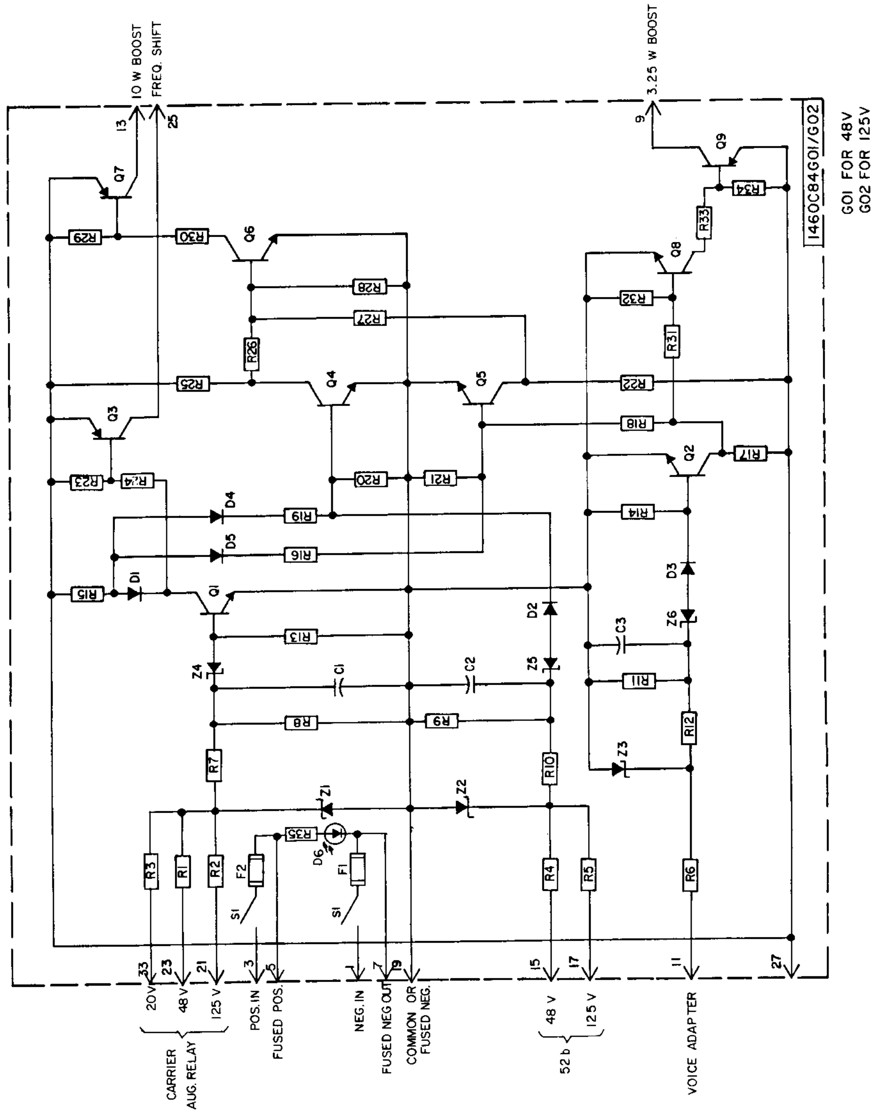


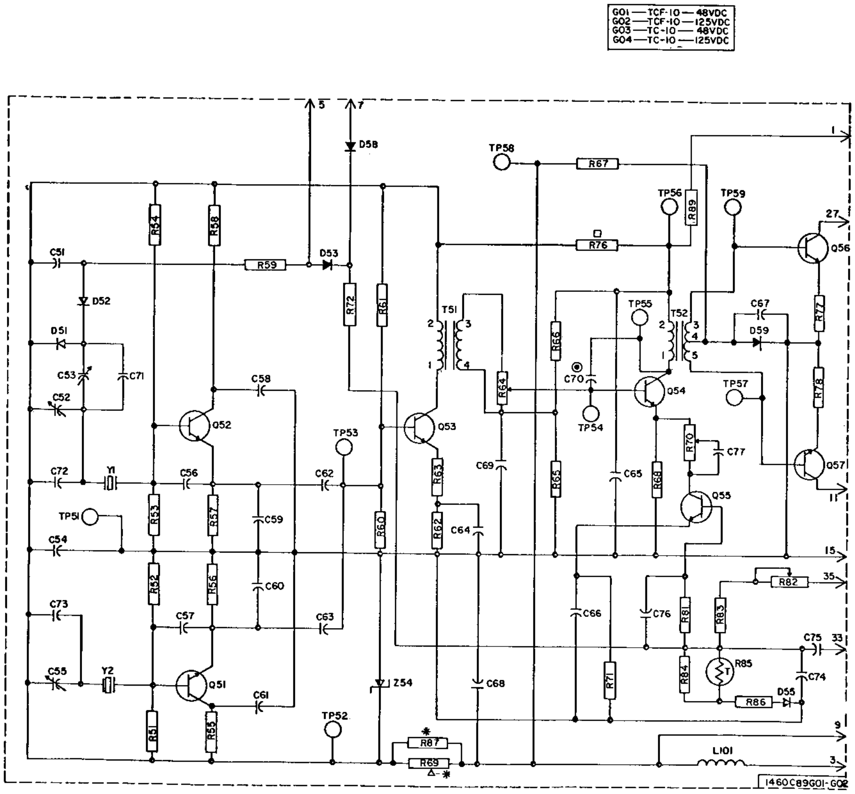

*Fig. 8. Voice Adapter, Relaying & Transmitter Interconnections*




| COMPONENT | | DESCRIPTION | STYLE NO. |
|---|---|---|---|
| C1 | CAPACITOR | .047UF 200V | 849A437H04 |
| C2 | CAPACITOR | .047UF 200V | 849A437H04 |
| C3 | CAPACITOR | .047UF 200V | 849A437H04 |
| D1 | DIODE | 1N457A | 184A855H07 |
| D2 | DIODE | 1N645A | 837A692H03 |
| D3 | DIODE | 1N645A | 837A692H03 |
| D4 | DIODE | 1N457A | 184A855H07 |
| D5 | DIODE | 1N457A | 184A855H07 |
| D6 | DIODE | LED | 3508A22H01 |
| J1 | JUMPER | 0 OHM RESISTOR | 862A478H01 |
| J2 | JUMPER | 0 OHM RESISTOR | 862A478H01 |
| R1 | RESISTOR | 18.0K .50W 2% | 629A531H62 |
| R2 | RESISTOR | 51.0K .50W 2% | 629A531H73 |
| R3 | RESISTOR | 1800.0 .50W 2% | 629A531H38 |
| R4 | RESISTOR | 18.0K .50W 2% | 629A531H62 |
| R5 | RESISTOR | 51.0K .50W 2% | 629A531H73 |
| R6 | RESISTOR | 18.0K .50W 2% | 629A531H62 |
| R7 | RESISTOR | 1500.0 .50W 2% | 629A531H36 |
| R8 | RESISTOR | 6200.0 .50W 2% | 629A531H51 |
| R9 | RESISTOR | 6200.0 .50W 2% | 629A531H51 |
| R10 | RESISTOR | 1500.0 .50W 2% | 629A531H36 |
| R11 | RESISTOR | 6200.0 .50W 2% | 629A531H51 |
| R12 | RESISTOR | 1500.0 .50W 2% | 629A531H36 |
| R13 | RESISTOR | 10.0K .50W 2% | 629A531H56 |
| R14 | RESISTOR | 10.0K .50W 2% | 629A531H56 |
| R15 | RESISTOR | 12.0K .50W 2% | 629A531H58 |
| R16 | RESISTOR | 27.0K .50W 2% | 629A531H66 |
| R17 | RESISTOR | 12.0K .50W 2% | 629A531H58 |
| R18 | RESISTOR | 27.0K .50W 2% | 629A531H66 |
| R19 | RESISTOR | 27.0K .50W 2% | 629A531H66 |
| R20 | RESISTOR | 10.0K .50W 2% | 629A531H56 |
| R21 | RESISTOR | 10.0K .50W 2% | 629A531H56 |
| R22 | RESISTOR | 12.0K .50W 2% | 629A531H58 |
| R23 | RESISTOR | 4.7K .50W 2% | 629A531H48 |
| R24 | RESISTOR | 12.0K .50W 2% | 629A531H58 |
| R25 | RESISTOR | 12.0K .50W 2% | 629A531H58 |
| R26 | RESISTOR | 27.0K .50W 2% | 629A531H66 |
| R27 | RESISTOR | 27.0K .50W 2% | 629A531H66 |
| R28 | RESISTOR | 10.0K .50W 2% | 629A531H56 |
| R29 | RESISTOR | 4.7K .50W 2% | 629A531H48 |
| R30 | RESISTOR | 12.0K .50W 2% | 629A531H58 |
| R31 | RESISTOR | 12.0K .50W 2% | 629A531H58 |
| R32 | RESISTOR | 10.0K .50W 2% | 629A531H56 |
| R33 | RESISTOR | 12.0K .50W 2% | 629A531H58 |
| R34 | RESISTOR | 4.7K .50W 2% | 629A531H48 |
| Δ R35 | RESISTOR | 10.0K 3.00W 5% | 763A127H15 |
| Ø R35 | RESISTOR | 27.5K 3.00W 5% | 763A126H60 |
| Q1 | TRANSISTOR | 2N699 | 184A638H19 |
| Q2 | TRANSISTOR | 2N699 | 184A638H19 |
| Q3 | TRANSISTOR | 2N3645 | 849A441H01 |
| Q4 | TRANSISTOR | 2N699 | 184A638H19 |
| Q5 | TRANSISTOR | 2N699 | 184A638H19 |
| Q6 | TRANSISTOR | 2N699 | 184A638H19 |
| Q7 | TRANSISTOR | 2N3645 | 849A441H01 |
| Q8 | TRANSISTOR | 2N699 | 184A638H19 |
| Q9 | TRANSISTOR | 2N3645 | 849A441H01 |
| Z1 | ZENER | 1N3686B 20.0V | 185A212H06 |
| Z2 | ZENER | 1N3686B 20.0V | 185A212H06 |
| Z3 | ZENER | 1N3686B 20.0V | 185A212H06 |
| Z4 | ZENER | 1N957B 6.8V | 186A797H06 |
| Z5 | ZENER | 1N957B 6.8V | 186A797H06 |
| Z6 | ZENER | 1N957B 6.8V | 186A797H06 |
| F1 | FUSE | 1.5 AMP | 183A981H23 |
| F2 | FUSE | 1.5 AMP | 183A981H23 |
| S1 | SWITCH | | 849A249H01 |

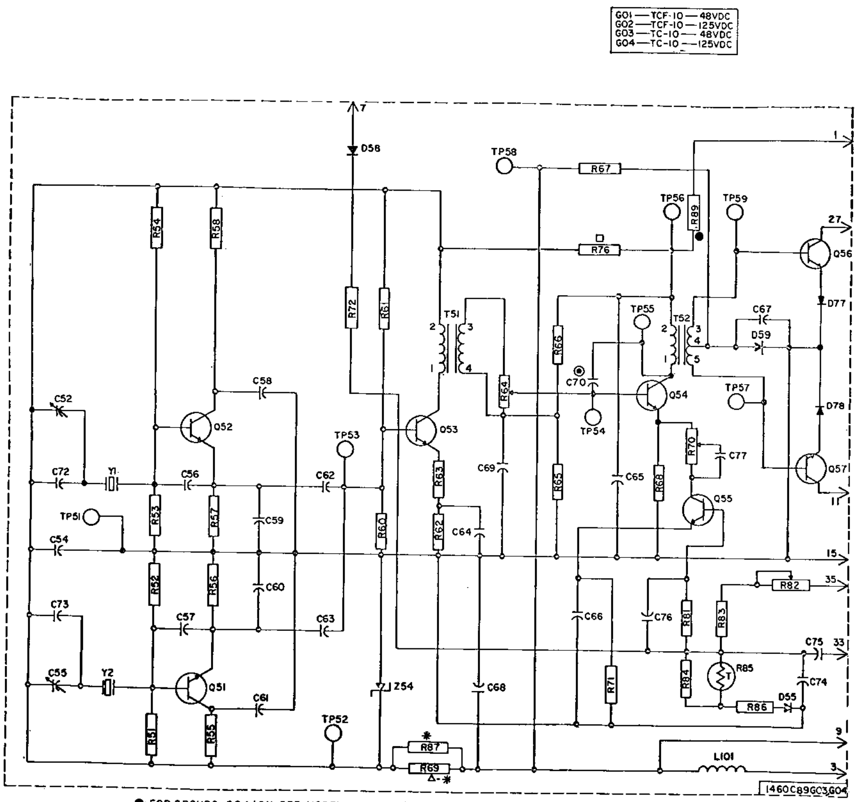
Sub 2
1461C08

*Fig. 9. Internal Schematic Power & Keying Module*




□-FOR GROUPS 1&2  *-FOR G02 125VDC △-FOR G01 48VDC  ⊙-OMIT FOR VOICE ABOVE 60KHZ

| COMPONENT | | DESCRIPTION | STYLE NO. |
|---|---|---|---|
| C51 | CAPACITOR | 1500.000PF 500V | 762A757H03 |
| C54 | CAPACITOR | .100UF 200V | 187A624H01 |
| C56 | CAPACITOR | 2000.000PF 500V | 187A584H01 |
| C57 | CAPACITOR | 2000.000PF 500V | 187A584H01 |
| C58 | CAPACITOR | .250UF 200V | 187A624H02 |
| C59 | CAPACITOR | 100.000PF 500V | 762A757H01 |
| C60 | CAPACITOR | 100.000PF 500V | 762A757H01 |
| C61 | CAPACITOR | .250UF 200V | 187A624H02 |
| C62 | CAPACITOR | 4700.000PF 500V | 762A757H04 |
| C63 | CAPACITOR | 1000.000PF 500V | 762A757H02 |
| C64 | CAPACITOR | .250UF 200V | 187A624H02 |
| C65 | CAPACITOR | .250UF 200V | 187A624H02 |
| C66 | CAPACITOR | .250UF 200V | 187A624H02 |
| C67 | CAPACITOR | .250UF 200V | 187A624H02 |
| C68 | CAPACITOR | .500UF 200V | 187A624H11 |
| C69 | CAPACITOR | .250UF 200V | 187A624H02 |
| C70 | CAPACITOR | 300.000PF 500V | 187A584H09 |
| C71 | CAPACITOR | 3.000PF 500V | 861A846H03 |
| C72 | CAPACITOR | 3.000PF 500V | 861A846H03 |
| C73 | CAPACITOR | 3.000PF 500V | 861A846H03 |
| C74 | CAPACITOR | 1.000UF 200V | 187A624H04 |
| C75 | CAPACITOR | .500UF 200V | 187A624H11 |
| C76 | CAPACITOR | .010UF 600V | 764A278H10 |
| C77 | CAPACITOR | .470UF 200V | 188A669H01 |
| C52 | TRIMMER | 5.5-18PF | 879A834H01 |
| C53 | TRIMMER | 5.5-18PF | 879A834H01 |
| C55 | TRIMMER | 5.5-18PF | 879A834H01 |
| D51 | DIODE | 1N628 | 184A855H12 |
| D52 | DIODE | 1N628 | 184A855H12 |
| D53 | DIODE | 1N628 | 184A855H12 |
| D55 | DIODE | 1N457A | 184A855H07 |
| D58 | DIODE | 1N628 | 184A855H12 |
| D59 | DIODE | 1N4822 | 188A342H11 |
| Y1 | CRYSTAL | MATCHED PAIR | (D-SPEC) |
| Y2 | CRYSTAL | MATCHED PAIR | (D-SPEC) |
| L101 | CHOKE | 50-7 5% | 3500A27H01 |
| -R89 | RESISTOR | 2000.0 .50W 5% | 184A763H34 |
| R64 | POT | 1.0K .12W | 629A430H02 |
| R70 | POT | 1.0K .12W | 629A430H02 |
| R82 | POT | 25.0K | 629A430H09 |
| * R69 | RES | 7K 3W 1% | 763A126H95 |
| * R87 | RES | 7K 3W 1% | 763A126H95 |
| R51 | RESISTOR | 10.0K .50W 5% | 184A763H51 |
| R52 | RESISTOR | 10.0K .50W 5% | 184A763H51 |
| R53 | RESISTOR | 10.0K .50W 5% | 184A763H51 |
| R54 | RESISTOR | 10.0K .50W 5% | 184A763H51 |
| R55 | RESISTOR | 100.0 .50W 5% | 184A763H03 |
| R56 | RESISTOR | 3600.0 .50W 5% | 184A763H40 |
| R57 | RESISTOR | 3600.0 .50W 5% | 184A763H40 |
| R58 | RESISTOR | 100.0 .50W 5% | 184A763H03 |
| R59 | RESISTOR | 10.0K .50W 5% | 184A763H51 |
| R60 | RESISTOR | 5600.0 .50W 5% | 184A763H45 |
| R61 | RESISTOR | 15.0K .50W 5% | 184A763H55 |
| R62 | RESISTOR | 10.0K .50W 5% | 184A763H51 |
| R63 | SENSISTOR | 1.2K .12W 10% | 187A685H03 |
| R65 | RESISTOR | 5600.0 .50W 5% | 184A763H45 |
| R66 | RESISTOR | 15.0K .50W 5% | 184A763H55 |
| □-R67 | RESISTOR | 200 K .50W 2% | 629A531H87 |
| R68 | RESISTOR | 330.0 .50W 5% | 184A763H15 |
| △-R69 | RESISTOR | 800.0 3.00W 5% | 184A359H06 |
| R71 | RESISTOR | 6.5K .50W 1% | 848A820H27 |
| R72 | RESISTOR | 5600.0 .50W 5% | 184A763H45 |
| R76 | RESISTOR | 2000.0 .50W 5% | 184A763H34 |
| R77 | RESISTOR | 2.7 1.00W 0% | 629A371H24 |
| R78 | RESISTOR | 2.7 1.00W 0% | 629A371H24 |
| R81 | RESISTOR | 1000.0 .50W 1% | 848A819H48 |
| R83 | RESISTOR | 10.0K .50W 1% | 848A820H45 |
| R84 | RESISTOR | 27.0 .50W 5% | 187A290H11 |
| R85 | RESISTOR | 10.0 .00W10% | 185A211H03 |
| R86 | RESISTOR | 750.0 .50W 1% | 848A819H36 |
| □ T51 | TRANSFORMER | | 606B537G01 |
| □ T52 | TRANSFORMER | | 606B537G03 |
| Q51 | TRANSISTOR | 2N697 | 184A638H18 |
| Q52 | TRANSISTOR | 2N697 | 184A638H18 |
| Q53 | TRANSISTOR | 2N697 | 184A638H18 |
| Q54 | TRANSISTOR | 2N699 | 184A638H19 |
| Q55 | TRANSISTOR | 2N697 | 184A638H18 |
| Q56 | TRANSISTOR | 2N3583 | 849A516H05 |
| Q57 | TRANSISTOR | 2N3583 | 849A516H05 |
| Z54 | ZENER | 1N3686B 20.0V | 185A212H06 |
| T51 | TRANSFORMER | | 606B537G04 |
| T52 | TRANSFORMER | | 606B537G05 |

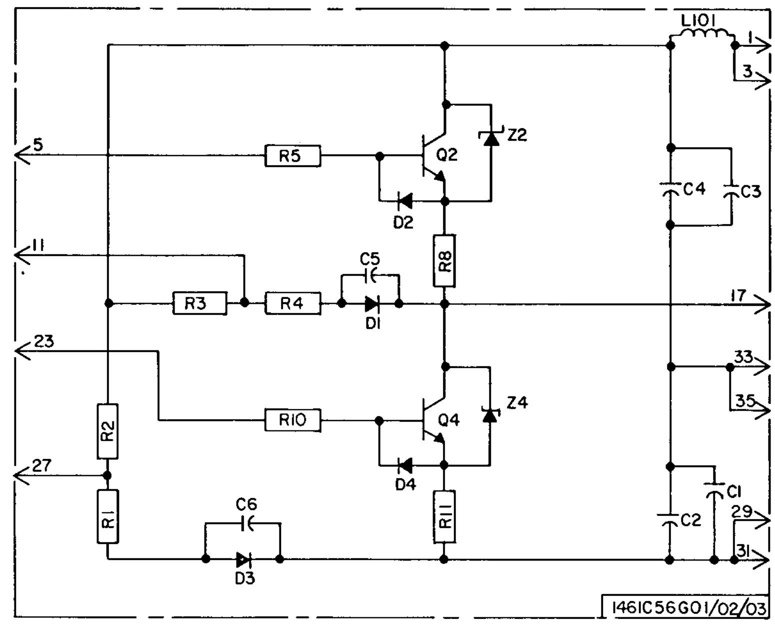



●-FOR GROUPS 3&4 (ON-OFF MODE)  *-FOR G04 (125 V.D.C.) △-FOR G03 (48 V.D.C.)  ⊙-OMIT FOR VOICE ABOVE 60KHZ

| COMPONENT | | DESCRIPTION | STYLE NO. |
|---|---|---|---|
| C54 | CAPACITOR | .100UF 200V | 187A624H01 |
| C56 | CAPACITOR | 2000.000PF 500V | 187A584H01 |
| C57 | CAPACITOR | 2000.000PF 500V | 187A584H01 |
| C58 | CAPACITOR | .250UF 200V | 187A624H02 |
| C59 | CAPACITOR | 100.000PF 500V | 762A757H01 |
| C60 | CAPACITOR | 100.000PF 500V | 762A757H01 |
| C61 | CAPACITOR | .250UF 200V | 187A624H02 |
| C62 | CAPACITOR | 4700.000PF 500V | 762A757H04 |
| C63 | CAPACITOR | 1000.000PF 500V | 762A757H02 |
| C64 | CAPACITOR | .250UF 200V | 187A624H02 |
| C65 | CAPACITOR | .250UF 200V | 187A624H02 |
| C66 | CAPACITOR | .250UF 200V | 187A624H02 |
| C67 | CAPACITOR | .250UF 200V | 187A624H02 |
| C68 | CAPACITOR | .500UF 200V | 187A624H11 |
| C69 | CAPACITOR | .250UF 200V | 187A624H02 |
| C70 | CAPACITOR | 300.000PF 500V | 187A584H09 |
| C72 | CAPACITOR | 3.000PF 500V | 861A846H03 |
| C73 | CAPACITOR | 3.000PF 500V | 861A846H03 |
| C74 | CAPACITOR | 1.000UF 200V | 187A624H04 |
| C75 | CAPACITOR | .500UF 200V | 187A624H11 |
| C76 | CAPACITOR | .010UF 600V | 764A278H10 |
| C77 | CAPACITOR | .470UF 200V | 188A669H01 |
| C52 | TRIMMER | 5.5-18PF | 879A834H01 |
| C55 | TRIMMER | 5.5-18PF | 879A834H01 |
| D55 | DIODE | 1N457A | 184A855H07 |
| D58 | DIODE | 1N628 | 184A855H12 |
| D59 | DIODE | 1N4822 | 188A342H11 |
| Y1 | CRYSTAL | MATCHED PAIR | (D-SPEC) |
| Y2 | CRYSTAL | MATCHED PAIR | (D-SPEC) |
| D77 | DIODE | 1N4822 | 188A342H11 |
| D78 | DIODE | 1N4822 | 188A342H11 |
| L101 | CHOKE | 50-7 5% | 3500A27H01 |
| ●-R89 | RESISTOR | 2000.0 .50W 5% | 184A763H34 |
| R64 | POT | 1.0K .12W | 629A430H02 |
| R70 | POT | 1.0K .12W | 629A430H02 |
| R82 | POT | 25.0K | 629A430H09 |
| * R69 | RES | 7K 3W 1% | 763A126H95 |
| * R87 | RES | 7K 3W 1% | 763A126H95 |
| R51 | RESISTOR | 10.0K .50W 5% | 184A763H51 |
| R52 | RESISTOR | 10.0K .50W 5% | 184A763H51 |
| R53 | RESISTOR | 10.0K .50W 5% | 184A763H51 |
| R54 | RESISTOR | 10.0K .50W 5% | 184A763H51 |
| R55 | RESISTOR | 100.0 .50W 5% | 184A763H03 |
| R56 | RESISTOR | 3600.0 .50W 5% | 184A763H40 |
| R57 | RESISTOR | 3600.0 .50W 5% | 184A763H40 |
| R58 | RESISTOR | 100.0 .50W 5% | 184A763H03 |
| R60 | RESISTOR | 5600.0 .50W 5% | 184A763H45 |
| R61 | RESISTOR | 15.0K .50W 5% | 184A763H55 |
| R62 | RESISTOR | 10.0K .50W 5% | 184A763H51 |
| R63 | SENSISTOR | 1.2K .12W 10% | 187A685H03 |
| R65 | RESISTOR | 1.8K .50W 5% | 184A763H33 |
| R66 | RESISTOR | 8.2K .50W 5% | 184A763H49 |
| R67 | RESISTOR | 200 K .50W 2% | 629A531H87 |
| R68 | RESISTOR | 330.0 .50W 5% | 184A763H15 |
| △-R69 | RESISTOR | 800.0 3.00W 5% | 184A359H06 |
| R71 | RESISTOR | 6.5K .50W 1% | 845A820H27 |
| R72 | RESISTOR | 5600.0 .50W 5% | 184A763H45 |
| R76 | RESISTOR | 2000.0 .50W 5% | 184A763H34 |
| R81 | RESISTOR | 1000.0 .50W 1% | 843A819H48 |
| R83 | RESISTOR | 5K .50W 1% | 848A320H17 |
| R84 | RESISTOR | 27.0 .50W 5% | 187A290H11 |
| R85 | RESISTOR | 10.0 .00W10% | 185A211H03 |
| R86 | RESISTOR | 750.0 .50W 1% | 848A819H36 |
| T51 | TRANSFORMER | | 606B537G01 |
| T52 | TRANSFORMER | | 606B537G03 |
| Q51 | TRANSISTOR | 2N697 | 184A638H18 |
| Q52 | TRANSISTOR | 2N697 | 184A638H18 |
| Q53 | TRANSISTOR | 2N697 | 184A638H18 |
| Q54 | TRANSISTOR | 2N699 | 184A638H19 |
| Q55 | TRANSISTOR | 2N697 | 184A638H18 |
| Q56 | TRANSISTOR | 2N3583 | 849A516H05 |
| Q57 | TRANSISTOR | 2N3583 | 849A516H05 |
| Z54 | ZENER | 1N3686B 20.0V | 185A212H06 |
| ● T51 | TRANSFORMER | | 606B537G04 |
| ● T52 | TRANSFORMER | | 606B537G05 |

Sub 8
*Sheet 1* *Sheet 2* *1460C98*

*Fig. 10. Internal Schematic Transmitter Module*




| 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 |
| C2 | CAPACITOR | .220UF 400V | 188A293H02 |
| C4 | CAPACITOR | .220UF 400V | 188A293H02 |
| D1 | DIODE | 1N4822 | 188A342H11 |
| D2 | DIODE | 1N4822 | 188A342H11 |
| D3 | DIODE | 1N4822 | 188A342H11 |
| D4 | DIODE | 1N4822 | 188A342H11 |
| Z2 | ZENER | IN2009C | 184A617H14 |
| Z4 | ZENER | IN2009C | 184A617H14 |
| R1 | RESISTOR | 2.7 1W 0% | 629A371H24 |
| R2 | RESISTOR | 100K 1.00W 5% | 187A644H75 |
| R3 | RESISTOR | 51K 1.00W 5% | 187A643H68 |
| R4 | RESISTOR | 2.7 1W .0% | 629A371H24 |
| R5 | RESISTOR | 10.0 .50W 5% | 187A290H01 |
| R8 | RESISTOR | .27 1.00W 10% | 184A636H13 |
| R10 | RESISTOR | 10.0 .50W 5% | 187A290H01 |
| R11 | RESISTOR | .27 1.00W 10% | 184A636H13 |
| Q2, Q4 | TRANSISTOR | 2N6341 (MATCHED) PAIR | 3508A21H04 |

G01 - FOR 30-70 KHZ USE C1, C2, C3, C4 = .47 UF.
G02 - FOR 70-150 KHZ USE C2, C4 = .47 UF OMIT C1 & C3.
G03 - FOR 150 TO 300 KHZ USE C2, C4 = .22 UF OMIT C1 & C3.

Sub 6
*1477B47*

*Fig. 11. Internal Schematic Power Amplifier Module*

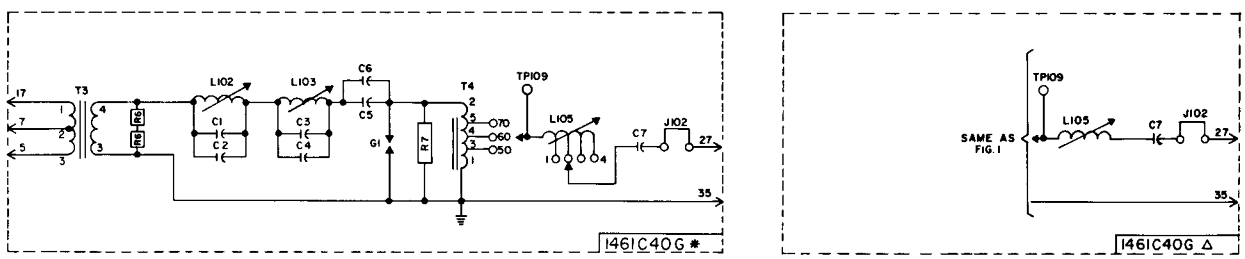



FIG.1
30 TO 200 KC

* - G01 THRU G32
G43 THRU G74

Δ - G33 THRU G42
G75 THRU G84

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

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

Sub 5
*1461C42*

*Fig. 12. Internal Schematic Output Filter Module*

# PARTS LIST

**1461C40 G01, G43**

| 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 |

**1461C40 G02, G44**

| 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 |

**1461C40 G03, G45**

| 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 |

**1461C40 G04, G46**

| 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 |

#### 1461C40G05,G47

| 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

| 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 | 187A705H04 |
| 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 | | 292B526G04 |
| T4 TRANSFORMER | | 292B526G03 |
| R6 RESISTOR | 3K ± 5% 8W (2 REQ) | 188A317H01 |
| R7 RESISTOR | 15K 10% 2W | 187A642H55 |
| G1 LIGHTNING ARRESTER | | 877A116H01 |

#### 1461C40G07,G49

| 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 | | 292B526G04 |
| T4 TRANSFORMER | | 292B526G03 |
| R6 RESISTOR | 3K ± 5% 8W (2 REQ) | 188A317H01 |
| R7 RESISTOR | 15K 10% 2W | 187A642H55 |
| G1 LIGHTNING ARRESTER | | 877A116H01 |

#### 1461C40G08,G50

| 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

| 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

| 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

| 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

| 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

| COMPONENT | DESCRIPTION | STYLE |
|---|---|---|
| C1 CAPACITOR | 1000 MMF 500V | 762A757H02 |
| C2 CAPACITOR | 100 MMF 500V | 762A757H01 |
| C3 CAPACITOR | 1000 MMF 500V | 762A757H02 |
| C4 CAPACITOR | 36 MMF 500V | 763A209H14 |
| C5 CAPACITOR | 2500 MMF 1200V | 187A705H13 |
| C7 CAPACITOR | 2500 PF 3000V | 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 |
| G1 LIGHTNING ARRESTER | | 877A116H01 |

#### 1461C40G14,G56

| COMPONENT | DESCRIPTION | STYLE |
|---|---|---|
| C1 CAPACITOR | 360 MMF 500V | 762A757H14 |
| C2 CAPACITOR | 620 MMF 500V | 187A584H11 |
| C3 CAPACITOR | 820 MMF 500V | 762A757H22 |
| C4 CAPACITOR | 100 MMF 500V | 762A757H01 |
| C5 CAPACITOR | 200 MMF 1200V | 187A705H04 |
| C6 CAPACITOR | 2000 MMF 1200V | 187A705H12 |
| 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 |

#### 1461C40G15,G57

| COMPONENT | DESCRIPTION | STYLE |
|---|---|---|
| C1 CAPACITOR | 250 MMF 500V | 861A846H11 |
| C2 CAPACITOR | 620 MMF 500V | 187A584H11 |
| C3 CAPACITOR | 820 MMF 500V | 762A757H22 |
| C5 CAPACITOR | 1500 MMF 1200V | 187A705H11 |
| C7 CAPACITOR | 2000 PF 3000V | 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 |
| G1 LIGHTNING ARRESTER | | 877A116H01 |

#### 1461C40G16,G58

| COMPONENT | DESCRIPTION | STYLE |
|---|---|---|
| C1 CAPACITOR | 180 MMF 500V | 762A757H10 |
| C2 CAPACITOR | 620 MMF 500V | 187A584H11 |
| C3 CAPACITOR | 130 MMF 500V | 762A757H07 |
| C4 CAPACITOR | 620 MMF 500V | 187A584H11 |
| C5 CAPACITOR | 300 MMF 1200V | 187A705H06 |
| C6 CAPACITOR | 1500 MMF 1200V | 187A705H11 |
| C7 CAPACITOR | 1800 PF 3000V | 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 | 197A642H55 |
| G1 LIGHTNING ARRESTER | | 877A116H01 |

#### 1461C40G17,G59

| COMPONENT | DESCRIPTION | STYLE |
|---|---|---|
| C1 CAPACITOR | 1500 MMF 500V | 762A757H03 |
| C3 CAPACITOR | 270 MMF 500V | 762A757H12 |
| C4 CAPACITOR | 1500 MMF 500V | 762A757H03 |
| C5 CAPACITOR | 4000 MMF 1200V | 187A705H15 |
| C7 CAPACITOR | 2400 PF 3000V | 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 |
| G1 LIGHTNING ARRESTER | | 877A116H01 |

#### 1461C40G18,G60

| COMPONENT | DESCRIPTION | STYLE |
|---|---|---|
| C1 CAPACITOR | 1000 MMF 500V | 762A757H02 |
| C2 CAPACITOR | 360 MMF 500V | 762A757H14 |
| C3 CAPACITOR | 82 MMF 500V | 763A209H23 |
| C4 CAPACITOR | 1500 MMF 500V | 762A757H03 |
| C5 CAPACITOR | 4000 MMF 1200V | 187A705H15 |
| C7 CAPACITOR | 2100 PF 3000V | 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) | 1E8A317H01 |
| R7 RESISTOR | 15K 10% 2W | 187A642H55 |
| G1 LIGHTNING ARRESTER | | 877A116H01 |

#### 1461C40G19,G61

| COMPONENT | DESCRIPTION | STYLE |
|---|---|---|
| C1 CAPACITOR | 1000 MMF 500V | 762A757H02 |
| C2 CAPACITOR | 200 MMF 500V | 762A757H11 |
| C3 CAPACITOR | 1000 MMF 500V | 762A757H02 |
| C4 CAPACITOR | 390 MMF 500V | 762A757H15 |
| C5 CAPACITOR | 3000 MMF 1200V | 187A705H14 |
| C6 CAPACITOR | 500 MMF 1200V | 187A705H09 |
| C7 CAPACITOR | 1900 PF 3000V | 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 |
| G1 LIGHTNING ARRESTER | | 877A116H01 |

#### 1461C40G20,G62

| COMPONENT | DESCRIPTION | STYLE |
|---|---|---|
| C1 CAPACITOR | 1000 MMF 500V | 762A757H02 |
| C2 CAPACITOR | 82 MMF 500V | 763A209H23 |
| C3 CAPACITOR | 1000 MMF 500V | 762A757H02 |
| C4 CAPACITOR | 250 MMF 500V | 861A846H11 |
| C5 CAPACITOR | 3000 MMF 1200V | 187A705H14 |
| C7 CAPACITOR | 1700 PF 3000V | 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 |
| G1 LIGHTNING ARRESTER | | 877A116H01 |

#### 1461C40G21,G63

| COMPONENT | DESCRIPTION | STYLE |
|---|---|---|
| C1 CAPACITOR | 360 MMF 500V | 762A757H14 |
| C2 CAPACITOR | 620 MMF 500V | 187A584H11 |
| C3 CAPACITOR | 1000 MMF 500V | 762A757H02 |
| C4 CAPACITOR | 130 MMF 500V | 762A757H07 |
| C5 CAPACITOR | 2500 MMF 1200V | 187A705H13 |
| C7 CAPACITOR | 1500 PF 3000V | 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 |
| G1 LIGHTNING ARRESTER | | 877A116H01 |

#### 1461C40G22,G64

| COMPONENT | DESCRIPTION | STYLE |
|---|---|---|
| C1 CAPACITOR | 250 MMF 500V | 861A846H11 |
| C2 CAPACITOR | 620 MMF 500V | 187A584H11 |
| C3 CAPACITOR | 1000 MMF 500V | 762A757H02 |
| C5 CAPACITOR | 2500 MMF 1200V | 187A705H13 |
| C7 CAPACITOR | 1300 PF 3000V | 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 |
| G1 LIGHTNING ARRESTER | | 877A116H01 |

#### 1461C40G23,G65

| COMPONENT | DESCRIPTION | STYLE |
|---|---|---|
| C1 CAPACITOR | 150 MMF 500V | 861A846H25 |
| C2 CAPACITOR | 620 MMF 500V | 187A584H11 |
| C3 CAPACITOR | 62 MMF 500V | 763A209H20 |
| C4 CAPACITOR | 820 MMF 500V | 762A757H22 |
| C5 CAPACITOR | 200 MMF 1200V | 187A705H04 |
| C6 CAPACITOR | 2000 MMF 1200V | 187A705H12 |
| C7 CAPACITOR | 1100 PF 3000V | 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 |
| G1 LIGHTNING ARRESTER | | 877A116H01 |

#### 1461C40G24,G66

| COMPONENT | DESCRIPTION | STYLE |
|---|---|---|
| C1 CAPACITOR | 56 MMF 500V | 763A209H19 |
| C2 CAPACITOR | 620 MMF 500V | 187A584H11 |
| C3 CAPACITOR | 390 MMF 500V | 762A757H15 |
| C4 CAPACITOR | 390 MMF 500V | 762A757H15 |
| C6 CAPACITOR | 2000 MMF 1200V | 187A705H12 |
| C7 CAPACITOR | 1000 PF 3000V | 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 |
| G1 LIGHTNING ARRESTER | | 877A116H01 |

#### 1461C40G25,G67

| COMPONENT | DESCRIPTION | STYLE |
|---|---|---|
| C1 CAPACITOR | 300 MMF 500V | 187A584H09 |
| C2 CAPACITOR | 300 MMF 500V | 187A584H09 |
| C3 CAPACITOR | 82 MMF 500V | 763A209H23 |
| C4 CAPACITOR | 620 MMF 500V | 187A584H11 |
| C5 CAPACITOR | 200 MMF 1200V | 187A705H04 |
| C6 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 |

#### 1461C40G26,G68

| COMPONENT | DESCRIPTION | STYLE |
|---|---|---|
| C1 CAPACITOR | 270 MMF 500V | 762A757H12 |
| C2 CAPACITOR | 270 MMF 500V | 762A757H12 |
| C4 CAPACITOR | 620 MMF 500V | 187A584H11 |
| C5 CAPACITOR | 1500 MMF 1200V | 187A705H11 |
| C7 CAPACITOR | 800 PF 3000V | 203C872H05 |
| L102 POT CORE | | 670B133G05 |
| L103 POT CORE | | 670B133G07 |
| L105 COIL | | 292B086G01 |
| T3 TRANSFORMER | | 292B526G04 |
| T4 TRANSFORMER | | 292B526G03 |
| R6 RESISTOR | 3K ± 5% 1W (2 REQ) | 188A317H01 |
| R7 RESISTOR | 15K 10% 2W | 187A642H55 |
| G1 LIGHTNING ARRESTER | | 877A116H01 |

#### 1461C40G27,G69

| COMPONENT | DESCRIPTION | STYLE |
|---|---|---|
| C1 CAPACITOR | 300 MMF 500V | 187A584H09 |
| C2 CAPACITOR | 180 MMF 500V | 762A757H10 |
| C3 CAPACITOR | 300 MMF 500V | 187A584H09 |
| C4 CAPACITOR | 250 MMF 500V | 861A846H11 |
| C5 CAPACITOR | 400 MMF 1200V | 187A705H08 |
| C6 CAPACITOR | 1500 MMF 1200V | 187A705H11 |
| C7 CAPACITOR | 1100 PF 3000V | 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 |
| G1 LIGHTNING ARRESTER | | 877A116H01 |

#### 1461C40G28,G70

| COMPONENT | DESCRIPTION | STYLE |
|---|---|---|
| C1 CAPACITOR | 180 MMF 500V | 762A757H10 |
| C2 CAPACITOR | 250 MMF 500V | 861A846H11 |
| C3 CAPACITOR | 250 MMF 500V | 861A846H11 |
| C4 CAPACITOR | 250 MMF 500V | 861A846H11 |
| C5 CAPACITOR | 200 MMF 1200V | 187A705H04 |
| C6 CAPACITOR | 1500 MMF 1200V | 187A705H11 |
| C7 CAPACITOR | 1000 PF 3000V | 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) | 1E6A317H01 |
| R7 RESISTOR | 15K 10% 2W | 187A642H55 |
| G1 LIGHTNING ARRESTER | | 877A116H01 |

**146IC40 G29,G71**

| COMPONENT | DESCRIPTION | STYLE |
|---|---|---|
| C1 CAPACITOR | 180 MMF 500 V | 762A757H10 |
| C2 CAPACITOR | 200 MMF 500 V | 762A757H11 |
| C3 CAPACITOR | 200 MMF 500 V | 762A757H11 |
| C4 CAPACITOR | 250 MMF 500 V | 861A846H11 |
| C5 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) | 186A317H01 |
| R7 RESISTOR | 15K 10% 2W | 167A642H55 |
| G1 LIGHTNING ARRESTER | | 877A116H01 |

**146IC40 G30,G72**

| COMPONENT | DESCRIPTION | STYLE |
|---|---|---|
| C1 CAPACITOR | 82 MMF 500 V | 763A209H23 |
| C2 CAPACITOR | 250 MMF 500 V | 861A846H11 |
| C3 CAPACITOR | 390 MMF 500 V | 762A757H15 |
| C5 CAPACITOR | 400 MMF 1200 V | 137A705H08 |
| C6 CAPACITOR | 1000 MMF 1200 V | 137A705H10 |
| C7 CAPACITOR | 750 PF 3000 V | 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 |

**146IC40 G31,G73**

| COMPONENT | DESCRIPTION | STYLE |
|---|---|---|
| C1 CAPACITOR | 300 MMF 500 V | 187A584H09 |
| C3 CAPACITOR | 150 MMF 500 V | 861A846H25 |
| C4 CAPACITOR | 200 MMF 500 V | 762A757H11 |
| C5 CAPACITOR | 200 MMF 1200 V | 187A705H04 |
| C6 CAPACITOR | 1000 MMF 1200 V | 187A705H10 |
| C7 CAPACITOR | 650 PF 3000 V | 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) | 186A317H01 |
| R7 RESISTOR | 15K 10% 2W | 187A642H55 |
| G1 LIGHTNING ARRESTER | | 877A116H01 |

**146IC40 G32,G74**

| COMPONENT | DESCRIPTION | STYLE |
|---|---|---|
| C1 CAPACITOR | 20 MMF 500 V | 763A209H07 |
| C2 CAPACITOR | 250 MMF 500 V | 861A846H11 |
| C3 CAPACITOR | 130 MMF 500 V | 762A757H07 |
| C4 CAPACITOR | 180 MMF 500 V | 762A757H10 |
| C6 CAPACITOR | 1000 MMF 1200 V | 187A705H10 |
| C7 CAPACITOR | 600 PF 3000 V | 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 |

**146IC40 G33,G75**

| COMPONENT | DESCRIPTION | STYLE |
|---|---|---|
| C1 CAPACITOR | MMF 500 V | 763A209H19 |
| C2 CAPACITOR | MMF 500 V | 762A757H12 |
| C3 CAPACITOR | MMF 500 V | 762A757H11 |
| C4 CAPACITOR | MMF 500 V | 763A209H12 |
| C5 CAPACITOR | MMF 1200 V | 187A705H04 |
| C6 CAPACITOR | MMF 1200 V | 187A705H09 |
| C7 CAPACITOR | PF 3000 V | 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 |

**146IC40 G34,G76**

| COMPONENT | DESCRIPTION | STYLE |
|---|---|---|
| C2 CAPACITOR | MMF 500 V | 187A584H09 |
| C3 CAPACITOR | MMF 500 V | 762A757H11 |
| C4 CAPACITOR | MMF 500 V | 763A209H07 |
| C5 CAPACITOR | MMF 1200 V | 187A705H04 |
| C6 CAPACITOR | MMF 1200 V | 187A705H09 |
| C7 CAPACITOR | PF 3000 V | 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 |

**146IC40 G35,G77**

| COMPONENT | DESCRIPTION | STYLE |
|---|---|---|
| C1 CAPACITOR | MMF 500 V | 861A846H25 |
| C2 CAPACITOR | MMF 500 V | 861A846H25 |
| C3 CAPACITOR | MMF 500 V | 861A846H25 |
| C4 CAPACITOR | MMF 500 V | 763A209H19 |
| C5 CAPACITOR | MMF 1200 V | 187A705H08 |
| C6 CAPACITOR | MMF 1200 V | 187A705H04 |
| C7 CAPACITOR | PF 3000 V | 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 |

**146IC40 G36,G78**

| COMPONENT | DESCRIPTION | STYLE |
|---|---|---|
| C1 CAPACITOR | MMF 500 V | 763A209H20 |
| C2 CAPACITOR | MMF 500 V | 762A757H11 |
| C3 CAPACITOR | MMF 500 V | 763A209H20 |
| C4 CAPACITOR | MMF 500 V | 762A757H07 |
| C5 CAPACITOR | MMF 1200 V | 187A705H08 |
| C6 CAPACITOR | MMF 1200 V | 187A705H04 |
| C7 CAPACITOR | PF 3000 V | 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 |

**146IC40 G37,G79**

| COMPONENT | DESCRIPTION | STYLE |
|---|---|---|
| C2 CAPACITOR | MMF 500 V | 861A846H11 |
| C3 CAPACITOR | MMF 500 V | 861A846H25 |
| C4 CAPACITOR | MMF 500 V | 763A209H07 |
| C6 CAPACITOR | MMF 1200 V | 187A705H09 |
| C7 CAPACITOR | PF 3000 V | 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 |

**146IC40 G38,G80**

| COMPONENT | DESCRIPTION | STYLE |
|---|---|---|
| C1 CAPACITOR | MMF 500 V | 763A209H12 |
| C2 CAPACITOR | MMF 500 V | 762A757H11 |
| C3 CAPACITOR | MMF 500 V | 762A757H07 |
| C4 CAPACITOR | MMF 500 V | 763A209H12 |
| C6 CAPACITOR | MMF 1200 V | 187A705H09 |
| C7 CAPACITOR | PF 3000 V | 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 |

**146IC40 G39,G81**

| COMPONENT | DESCRIPTION | STYLE |
|---|---|---|
| C1 CAPACITOR | MMF 500 V | 763A209H19 |
| C2 CAPACITOR | MMF 500 V | 861A846H25 |
| C3 CAPACITOR | MMF 500 V | 763A209H20 |
| C4 CAPACITOR | MMF 500 V | 763A209H23 |
| C5 CAPACITOR | MMF 1200 V | 187A705H08 |
| C7 CAPACITOR | PF 3000 V | 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 |

**146IC40 G40,G82**

| COMPONENT | DESCRIPTION | STYLE |
|---|---|---|
| C1 CAPACITOR | MMF 500 V | 763A209H14 |
| C2 CAPACITOR | MMF 500 V | 861A846H25 |
| C3 CAPACITOR | MMF 500 V | 762A757H01 |
| C4 CAPACITOR | MMF 500 V | 763A209H12 |
| C5 CAPACITOR | MMF 1200 V | 187A705H08 |
| C7 CAPACITOR | PF 3000 V | 203C872H03 |
| 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 |

**146IC40 G41,G83**

| COMPONENT | DESCRIPTION | STYLE |
|---|---|---|
| C1 CAPACITOR | MMF 500 V | 763A209H07 |
| C2 CAPACITOR | MMF 500 V | 861A846H25 |
| C3 CAPACITOR | MMF 500 V | 762A757H01 |
| C4 CAPACITOR | MMF 500 V | 763A209H07 |
| C5 CAPACITOR | MMF 1200 V | 187A705H08 |
| C7 CAPACITOR | PF 3000 V | 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 |

**146IC40 G42,G84**

| COMPONENT | DESCRIPTION | STYLE |
|---|---|---|
| C2 CAPACITOR | MMF 500 V | 861A846H25 |
| C3 CAPACITOR | MMF 500 V | 763A209H23 |
| C4 CAPACITOR | MMF 500 V | 763A209H12 |
| C5 CAPACITOR | MMF 1200 V | 187A705H08 |
| C7 CAPACITOR | PF 3000 V | 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 |

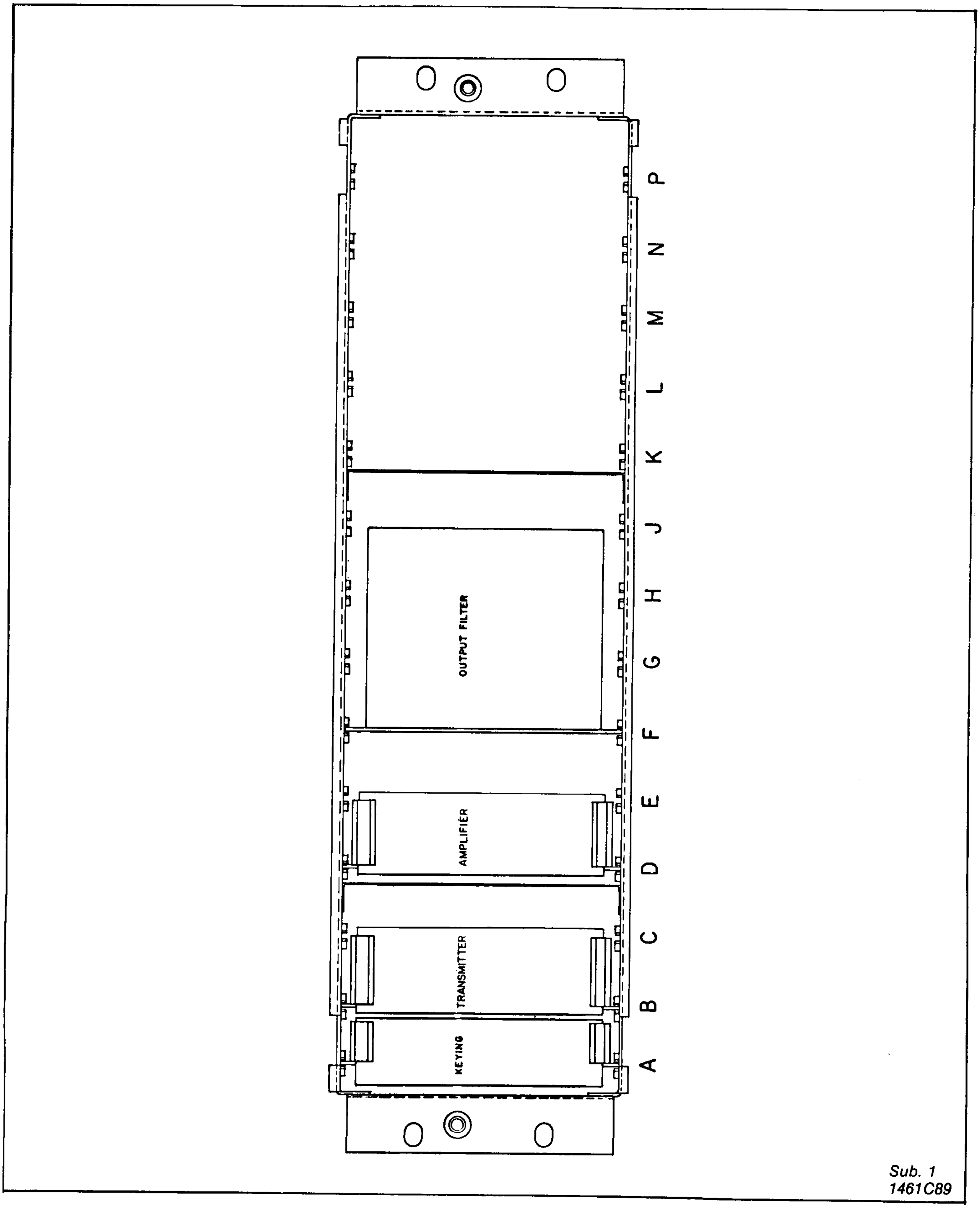



*Fig. 13. Module Location*

**WESTINGHOUSE ELECTRIC CORPORATION**

**RELAY-INSTRUMENT DIVISION** **CORAL SPRINGS, FL.**

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