INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE TCF-10 POWER LINE CARRIER FREQUENCY-SHIFT TRANSMITTER 10 WATT/10 WATT FOR ALL RELAYING 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 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 20Vdc voltage used for keying is connected to the low voltage input of the buffering keying board.

CONSTRUCTION

The 10-watt/10-watt TCF-10 transmitter unit is mounted on a standard 19-inch wide chassis 5¼ inches (3 rack units) high with edge slots for mounting on a standard relay rack. Fuses, a pilot light, a power switch and a jack for metering the amplifier collector current are accessible from the front of the chassis when supplied. See Fig. 15. All of the circuitry that is suitable for printed circuit board mounting is on four such boards. The components mounted on each printed board or other sub-assembly are shown enclosed by dotted lines on the internal schematic. Fig. 1 or 2. The location of components on the four printed circuit boards are shown on separate illustrations, Fig. 3, 4, 5, 6 and 7.

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.

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

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.

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 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. 1. 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 for a channel fequency of 30 KHz. 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 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.

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 Vdc 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 +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 relay control, or keying, contact is closed, it changes the frequency from Guard to Trip.

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 de-engerizes 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, C1, C2 and L103, C3, 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 turner 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 C7 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 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.

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 R1 and R2 varies to maintain a constant output voltage. The Zener diode Z2 when used serves to drop the 100v regulated supply to 45v for use with both the keying circuit and the external TCF voice adapter. It is placed in series so that it does not draw current unless called upon by the external voice adapter. Capacitor C3 provides a low carrier-frequency impedance across the dc output voltage. Capacitors C1 and C2 across the dc output voltage by pass r.f. or transient voltages to ground, thus preventing damage to the transistor circuit.

CHARACTERISTICS

Frequency Range — 30-300 kHz

Output — 10 watt guard - 10 watts trip - (into 50 to 70 ohm resistive load)

Frequency Stability — ±10 Hz from -20°C to +55°C.

Frequency Spacing —

A. When used with narrow band receiver.
   1. One-way channel, two or more signals-500 Hz min.
   2. Two-way channel, 1,000 Hz min, between transmitter and adjacent receiver frequencies.

B. When used with wide band receiver. (Except for phase comparison).
   1. One-way channel, two or more signals-1000 Hz min.
   2. Two-way channel, 2000 Hz min, between transmitter and adjacent receiver frequencies.

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 1.15a. trip	48 v.d.c.
0.2a. guard 0.4a. trip	125 v.d.c.

Keying Circuit Current — 4 ma.

Temperature Range — -20 to +55°C around chassis.

Dimensions — Panel height - 5¼" or 3 r.u. 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 10W/10W transmitter is shipped with the power output control R64 set for output of 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 power supply dc voltage. If this is in the correct range, 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 10 watts in the load resistor, as shown in the following table.

Then change to Trip frequency by connecting together terminals 9 and 5 of J3 and connecting together terminals 4 and 12 of J3, and rotate R64 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 R64 for a 10 watt output if necessary. Tighten the locking nut on L105. Open the power switch.

T106 Tap	Voltage for 10 Watts Output
50	22.4
60	24.5
70	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 moveable 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 2.3 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%.

Note that values are given for 1 watt levels as well as 10 watt levels in case it is desired to operate the set at this reduced output level which in many applications may be preferable.

TABLE I
TRANSMITTER DC MEASUREMENTS

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

Test Point	Voltage at 1 Watt Output		Voltage at 10 Watts Output	
	48V units	125V units	48V units	125V units
TP52	20	20	20	20
TP53	5.4		5.4	
TP54	3.4		3.4	
TP55	21	20	18.5	18.5
TP56	21	20	18.5	18.5
TP57	<1.0		<1.0	
TP58	44.3	100	44.1	100
TP59	<1.0		<1.0	
TP101	0	0	0	0
TP103	21±2	50	21±2	50
TP105	44.3	100	44.0	100

TABLE II
TRANSMITTER RF MEASUREMENTS

Note: Voltages taken with transmitter set of 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	
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	
	48V	125V	48V
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.	.57		1.85
TP101-TP103	5.2		17.0
TP103 to TP105	5.2		17.0
T3-4 to Gnd.	35	35	112
T4-2 to Gnd.	31	31	110
TP109 to Gnd.	9.8	9.8	31
J102 to Gnd.	7.8	7.8	24.5

CONVERSION OF TRANSMITTER FOR CHANGED CHANNEL FREQUENCY

The parts required for converting a 10W/10W TCF 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	94.0-100.0	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 with 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 terminal 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 then 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 ground 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 losses 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. A-C vacuum Tube Voltmeter (VTVM). Voltage range 0.003 to 30 volts, frequency range 60 hz to 330 kHz; impedance 7.5 megohms.

c. D-C vacuum Tube Voltmeter (VTVM).

Voltage Range: 1.5 to 300 volts.
Input Impedance 7.5 megohms.

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 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 complete nameplate data and identify the part by its designation on the Internal Schematic drawing.

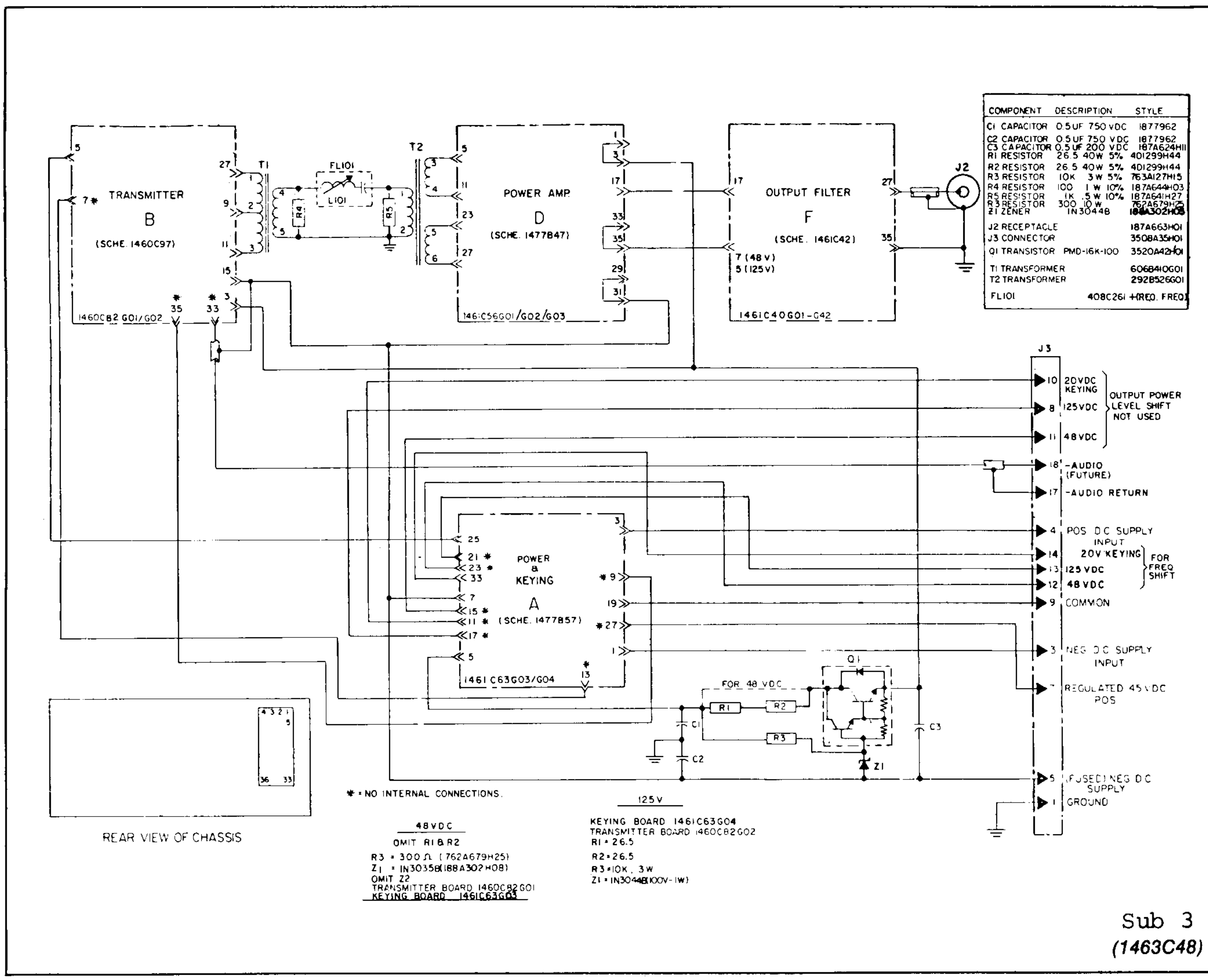
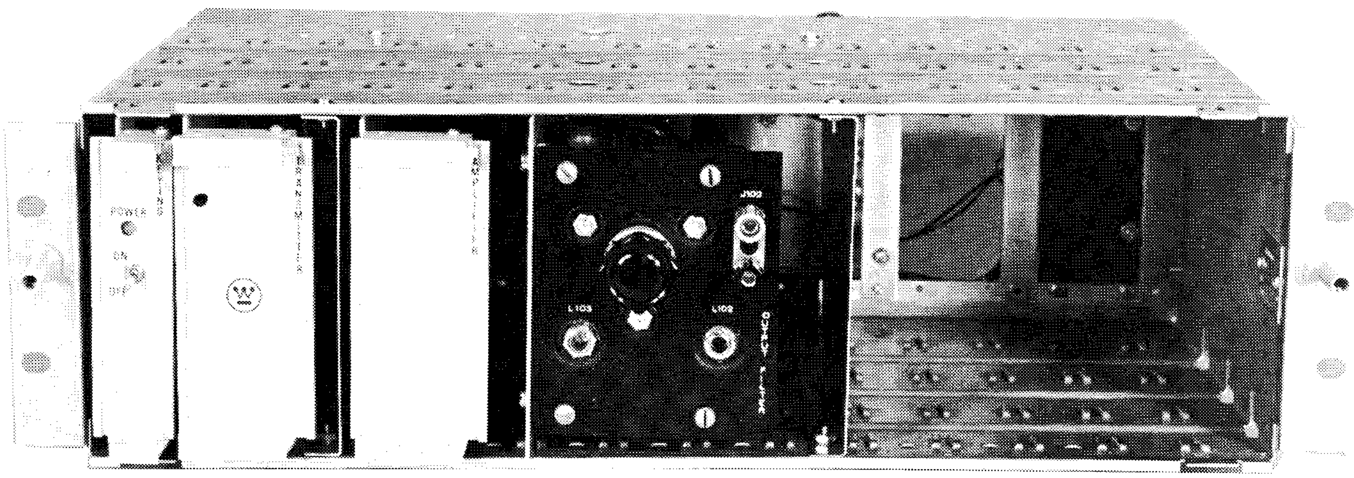
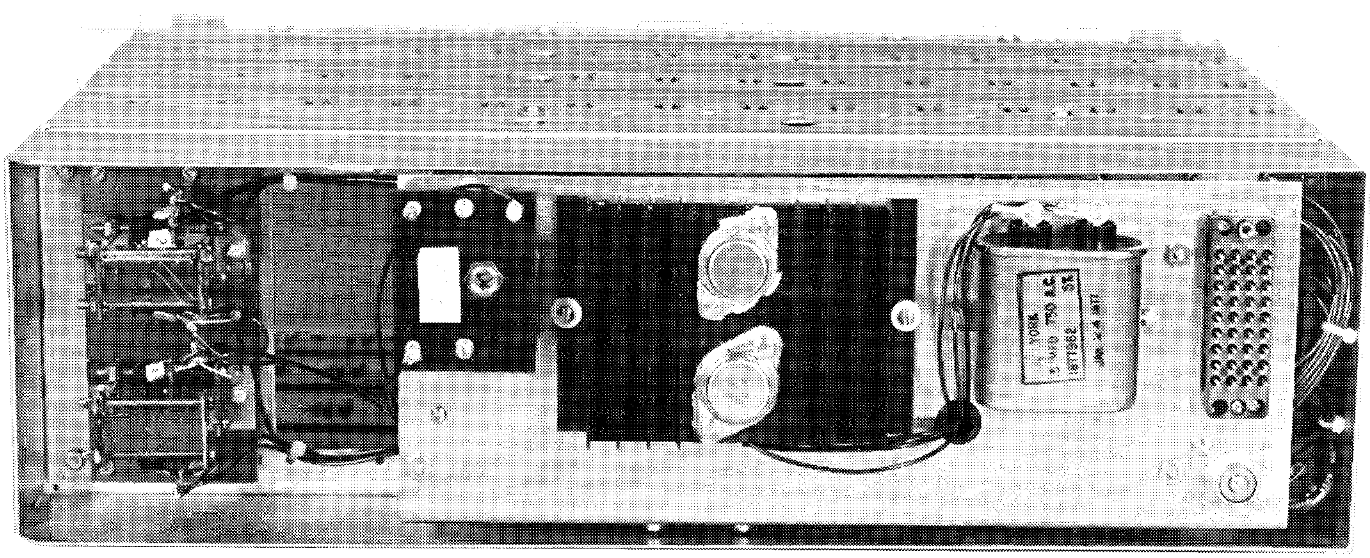


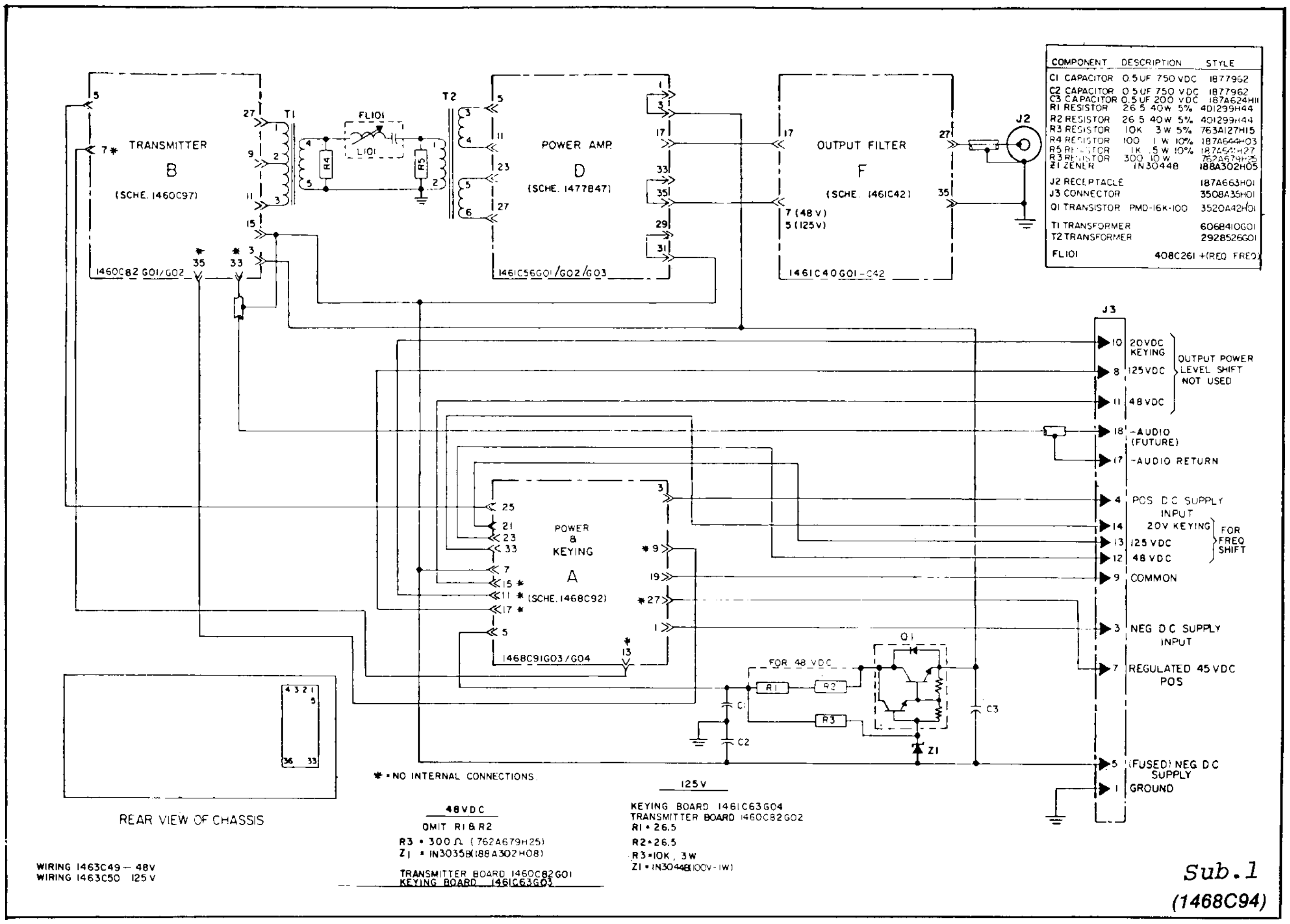
Fig. 1. Internal Schematic of Type TCF-10 Transmitter - With Switch, Pilot Light, and Fuses.



TCF-10 TRANSMITTER (Front View)



TCF-10 TRANSMITTER (Rear View)



COMPONENT		DESCRIPTION	STYLE
C1	CAPACITOR	0.5 UF 750 VDC	1877962
C2	CAPACITOR	0.5 UF 750 VDC	1877962
C3	CAPACITOR	0.5 UF 200 VDC	187A624H11
R1	RESISTOR	26.5 40W 5%	401299H44
R2	RESISTOR	26.5 40W 5%	401299H44
R3	RESISTOR	10K 3W 5%	763A127H15
R4	RESISTOR	100 1 W 10%	187A644H03
R5	RESISTOR	1K .5 W 10%	187A541H27
R3	RESISTOR	300 10 W	762A679H25
Z1	ZENER	1N3044B	188A302H05
J2	RECEPTACLE		187A663H01
J3	CONNECTOR		3508A35H01
Q1	TRANSISTOR	PMD-16K-100	3520A42H01
T1	TRANSFORMER		606841OG01
T2	TRANSFORMER		2928526G01
FL101			408C261 + (REQ FREQ)

Fig. 2. Internal Schematic of Type TCF-10 Transmitter - Without Switch, Pilot Light and Fuses but with Mark & Space Pushbuttons.

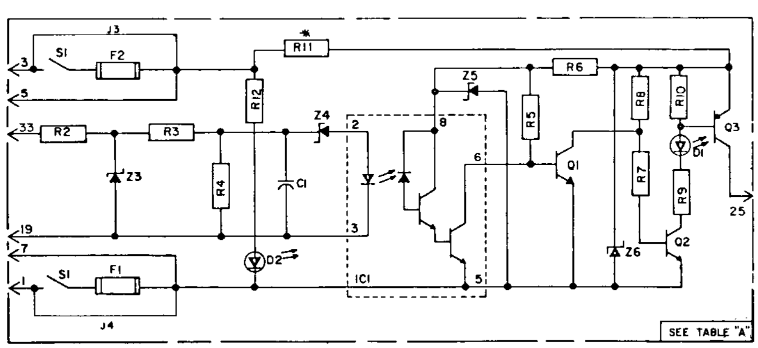


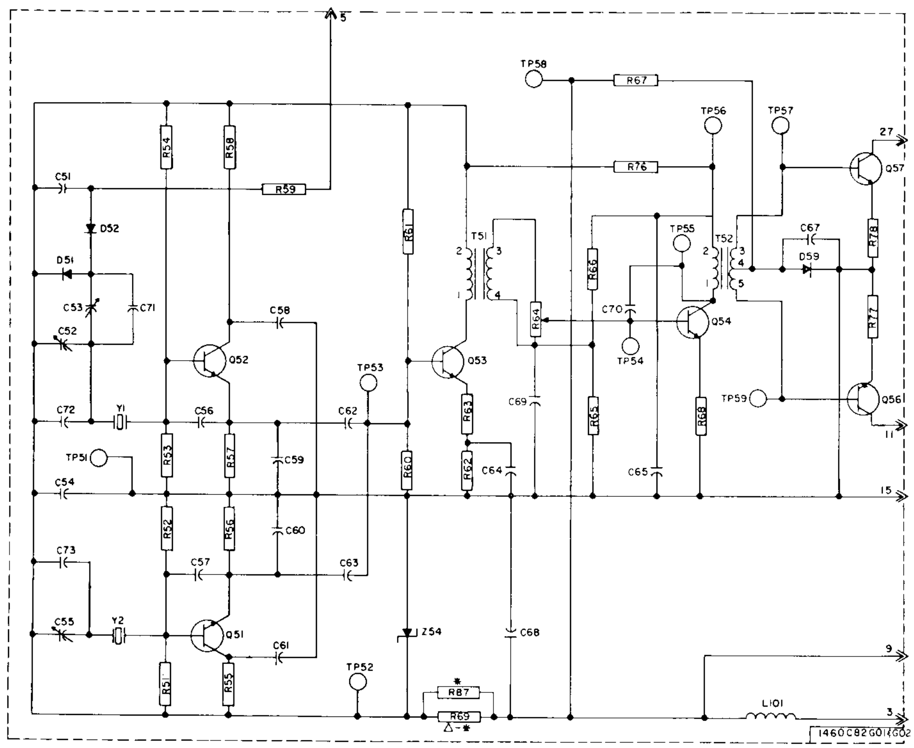
TABLE "A"
1461C63G01-G04

COMP		DESCRIPTION	STYLE NO.	WITH PL/SW & FUSE 48V G01	WITH PL/SW & FUSE 125V G02	WITHOUT PL/SW & FUSE 48V G03	WITHOUT PL/SW & FUSE 125V G04
C1	CAPACITOR	.047UF 200V	849A437H04	1	1	1	1
D1	DIODE	LED	3508A22H01	1	1	1	1
D2	DIODE	LED	3508A22H01	1	1	—	—
[illegible]	INT CKT	6N139	[illegible]	1	1	1	1
S1	SWITCH		849A249H01	1	1	—	—
R2	RESISTOR	3.0K .50W 2%	629A531H[illegible]	1	1	1	1
R3	RESISTOR	1000.0 .50W 2%	629A531H32	1	1	1	1
R4	RESISTOR	3900.0 .50W 2%	629A531H46	1	1	1	1
R5	RESISTOR	15.0K .50W 2%	629A531H60	1	1	1	1
R6	RESISTOR	120.0K .50W 2%	629A531H82	1	1	1	1
R7	RESISTOR	15.0K .50W 2%	629A531H60	1	1	1	1
R8	RESISTOR	13.0K .50W 2%	629A531H59	1	1	1	1
R9	RESISTOR	10.0K .50W 2%	629A531H56	1	1	1	1
R10	RESISTOR	6800.0 .50W 2%	629A531H52	1	1	1	1
R11	RESISTOR	6.8K 3.00W 5%	763A127H14	—	1	—	—
R11	RESISTOR	3.9 K 3.00W 5%	763A127H13	—	—	1	—
R11	RESISTOR	10.0K 3.00W 5%	763A127H15	—	—	—	1
R12	RESISTOR	10K 3.00W 5%	763A127H15	1	—	—	—
R12	RESISTOR	27.5K 3.00W 5%	763A126H60	—	1	—	—
Q1	TRANSISTOR	2N3417	848A851H02	1	1	1	1
Q2	TRANSISTOR	2N699	184A638H19	1	1	1	1
Q3	TRANSISTOR	2N3645	849A441H01	1	1	1	1
J1 *	JUMPER		862A478H01	1	—	—	—
Z6	ZENER	1N3035B 43.0 V	188A302H08	—	—	1	1
Z3	ZENER	1N759A 12.6V	837A693H01	1	1	1	1
Z4	ZENER	1N750A 4.7V	837A398H0[illegible]	1	1	1	1
Z5	ZENER	1N957B 6.8V	186A797H06	1	1	1	1
Z6	ZENER	1N3035B 43.0V	188A302H0[illegible]	—	1	—	—
F1	FUSE	1.5 AMPS	183A981H23	1	1	—	—
F2	FUSE	1.5 AMPS	183A981H23	1	1	—	—
J3	JUMPER		862A478H01	—	—	1	1
J4	JUMPER		862A478H01	—	—	1	1

* - REPLACE R11 WITH JUMPER J1 (G01 ONLY)

Sub.5
(1477B57)

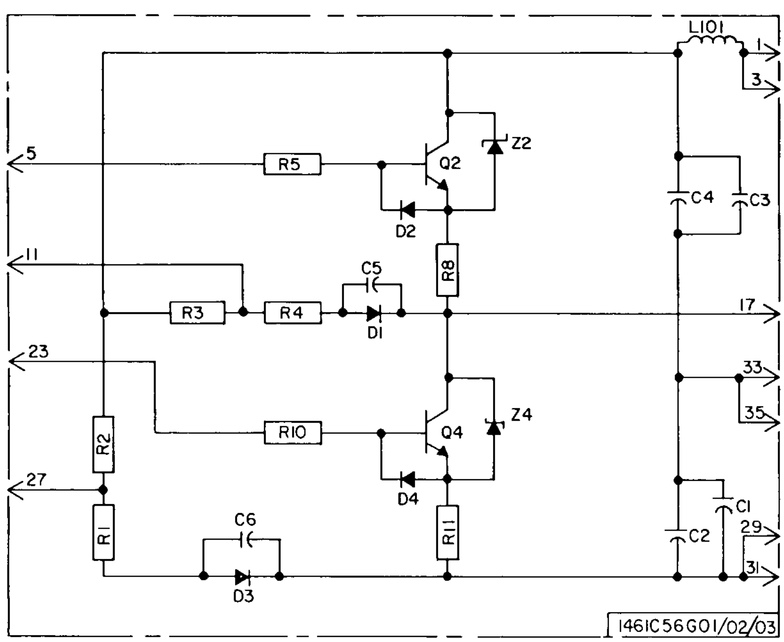
Fig. 3. Internal Schematic Keying Board.



COMPONENT		DESCRIPTION	STYLE NO.
C51	CAPACITOR	1500.000PF 500V	762A757H[illegible]
C54	CAPACITOR	[illegible] 200V	[illegible]
C56	CAPACITOR	[illegible] 500V	[illegible]
C57	CAPACITOR	[illegible] 500V	[illegible]
C58	CAPACITOR	.250UF 200V	187A624H[illegible]
C59	CAPACITOR	100.000PF 500V	762A757H[illegible]
C60	CAPACITOR	[illegible] 500V	762A757H[illegible]
C61	CAPACITOR	[illegible] 200V	187A624H[illegible]
C62	CAPACITOR	470.000PF 500V	762A757H[illegible]
C63	CAPACITOR	1000.000PF 500V	762A757H[illegible]
C64	CAPACITOR	.250UF 200V	187A624H[illegible]
C65	CAPACITOR	.250UF 200V	187A624H[illegible]
C67	CAPACITOR	.250UF 200V	187A624H[illegible]
C68	CAPACITOR	.500UF 200V	[illegible]
C69	CAPACITOR	.050UF 200V	[illegible]
C70	CAPACITOR	300.100PF 500V	[illegible]
C71	CAPACITOR	3.000PF 500V	[illegible]
C72	CAPACITOR	3.000PF 500V	[illegible]
C73	CAPACITOR	3.000PF 500V	[illegible]
C52	TRIMMER	5.5-18PF	879A834H01
C53	TRIMMER	5.5-18PF	879A834H01
C55	TRIMMER	5.5-18PF	879A834H01
D51	DIODE	1N628	[illegible]
D52	DIODE	1N628	[illegible]
D59	DIODE	1N4822	188A342H11
Y1	CRYSTAL	MATCHED PAIR	(D-SPEC)
Y2	CRYSTAL	MATCHED PAIR	(D-SPEC)
JH	JUMPER	0 OHM RESISTOR	[illegible]
R64	POT	1.0K .12 W	629A430H02
★ R69	RES	7 K 3W 1%	763A126H95
★ R87	RES	7 K 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 .12 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	[illegible] .50W 5%	[illegible]
△ R69	RESISTOR	[illegible] 3.00W 5%	[illegible]
R76	RESISTOR	[illegible] .50W 5%	[illegible]
R77	RESISTOR	2.7 1.00W 5%	[illegible]
R78	RESISTOR	2.7 1.00W 5%	[illegible]
T51	TRANSFORMER		606B537G01
T52	TRANSFORMER		606B537G03
Q51	TRANSISTOR	[illegible]	[illegible]
Q52	TRANSISTOR	[illegible]	[illegible]
Q53	TRANSISTOR	[illegible]	[illegible]
Q54	TRANSISTOR	[illegible]	[illegible]
Q56	TRANSISTOR	2N3583	849A516H05
Q57	TRANSISTOR	2N3583	849A516H05
Z54	ZENER	[illegible] 20.0V	[illegible]

Sub. 5
(1460C97)

Fig. 4. Internal Schematic Transmitter Board.



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	51 K 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. 5. Power Amplifier Board.

1461C40G01,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

1461C40G02,G44

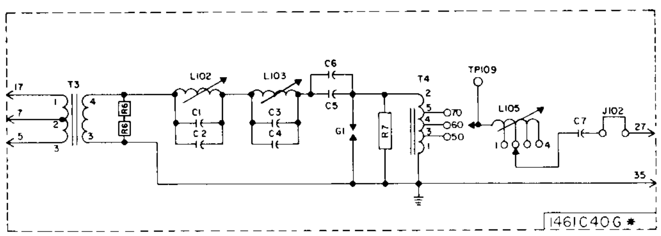
COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	2500 MMF 500V	861A846H20
C2 CAPACITOR	2000 MMF 500V	187A584H01
C3 CAPACITOR	1000 MMF 500V	762A757H02
C4 CAPACITOR	3300 MMF 500V	187A584H26
C5 CAPACITOR	2500 MMF 1200V	187A705H13
C6 CAPACITOR	5000 MMF 1200V	187A705H16
C7 CAPACITOR	6000 PF 3000V	203C872H28
L102 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

1461C40G03,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

1461C40G04,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



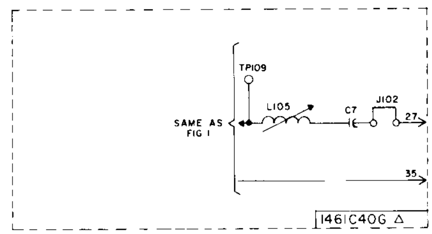


FIG.1
30 TO 200 KC

* - G01 THRU G32
G43 THRU G74

Δ - G33 THRU G42
G75 THRU G84

FIG.2 (OTHERWISE SAME AS FIG.1)
2001 TO 300 KC

ASSEMBLY - 1461C40
COMP LOC - 1477B28
PCB - 1461C41

Sub 5
(1461C42)

Fig. 6. Internal Schematic Output Filter.

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	187A642H55
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)	1E6A317H01
R7 RESISTOR	15K 10% 2W	167A642H55
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	167A642H55
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

1461C40G29, G71

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)	186A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
G1 LIGHTNING ARRESTER		877A116H01

1461C40G30, G72

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

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% UW (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
G1 LIGHTNING ARRESTER		877A116H01

1461C40G32, G74

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% 1W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
G1 LIGHTNING ARRESTER		877A116H01

1461C40G33, G75

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

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

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

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

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

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	MMF 500V	763A209H12
C2 CAPACITOR	MMF 500V	762A757H11
C3 CAPACITOR	MMF 500V	762A757H07
C4 CAPACITOR	MMF 500V	763A209H12
C6 CAPACITOR	MMF 1200V	187A705H89
C7 CAPACITOR	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

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

COMPONENT	DESCRIPTION	STYLE
C1 CAPACITOR	MMF 500V	763A209H14
C2 CAPACITOR	MMF 500V	861A846H25
C3 CAPACITOR	MMF 500V	762A757H01
C4 CAPACITOR	MMF 500V	763A209H12
C5 CAPACITOR	MMF 1200V	187A705H08
C7 CAPACITOR	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

1461C40 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 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

1461C40 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 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

PARTS LIST & SCHEMATIC - SHEETS 1 THRU 5 - DRAWING 1461C42

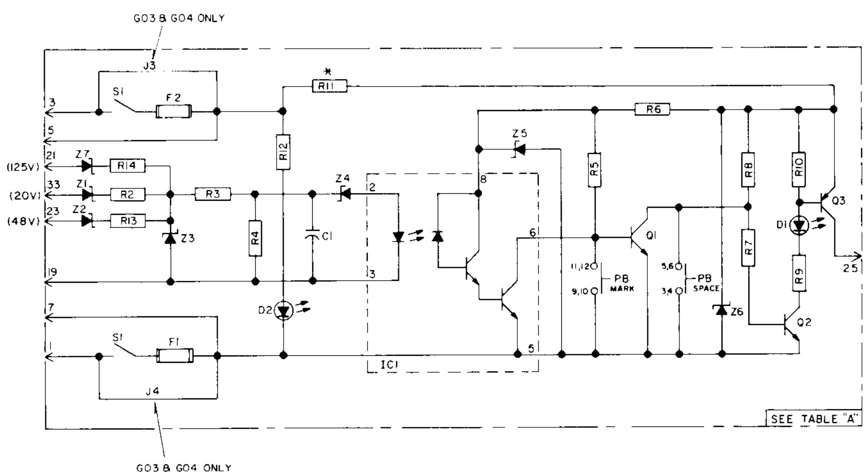


TABLE "A"
1468C91G01-G04

COMP.	DESCRIPTION	STYLE NO.	WITH PL/SW & FUSE 48V G01	WITH PL/SW & FUSE 125V G02	WITHOUT PL/SW & FUSE 48V G03	WITHOUT PL/SW & FUSE 125V G04
C1 CAPACITOR	.047UF 200V	849A437H04	1	1	1	1
D1 DIODE	LED	3508A22H01	1	1	1	1
D2 DIODE	LED	3508A22H01	1	1	—	—
IC1 INT.CKT	6N139	775B621H01	1	1	1	1
R2 RESISTOR	3.0K .50W 2%	629A531H43	1	1	1	1
R3 RESISTOR	1000.0 .50W 2%	629A531H32	1	1	1	1
R4 RESISTOR	3900.0 .50W 2%	629A531H46	1	1	1	1
R5 RESISTOR	15.0K .50W 2%	629A531H60	1	1	1	1
R6 RESISTOR	120.0K .50W 2%	629A531H82	1	1	1	1
R7 RESISTOR	15.0K .50W 2%	629A531H60	1	1	1	1
R8 RESISTOR	13.0K .50W 2%	629A531H59	1	1	1	1
R9 RESISTOR	10.0K .50W 2%	629A531H56	1	1	1	1
R10 RESISTOR	6800.0 .50W 2%	629A531H52	1	1	1	1
R11 RESISTOR	6.8K 3.0W 5%	763A127H14	—	1	—	—
R11 RESISTOR	3.9K 3.0W 5%	763A127H13	—	—	1	—
R11 RESISTOR	10.0K 3.0W 5%	763A127H15	—	—	—	1
R12 RESISTOR	10.0K 3.0W 5%	763A127H15	1	—	—	—
R12 RESISTOR	27.5K 3.0W 5%	763A127H60	—	1	—	—
R13 RESISTOR	18.0K .50W 2%	629A531H62	1	1	1	1
R14 RESISTOR	51.0K 2.0W 5%	185A207H68	1	1	1	1
Q1 TRANSISTOR	2N3417	848A851H02	1	1	1	1
Q2 TRANSISTOR	2N699	184A638H19	1	1	1	1
Q3 TRANSISTOR	2N3645	849A441H01	1	1	1	1
Z1 ZENER	1R200	629A369H01	1	1	1	1
Z2 ZENER	1R200	629A369H01	1	1	1	1
Z3 ZENER	1N759 12.6V	837A693H01	1	1	1	1
Z4 ZENER	1N750A 4.7V	837A398H03	1	1	1	1
Z5 ZENER	1N957B 6.8V	186A797H06	1	1	1	1
Z6 ZENER	1N3035B 43.0V	188A302H08	—	1	1	1
Z7 ZENER	1R200	629A369H01	1	1	1	1
J1 JUMPER	0 OHM	862A478H01	1	1	1	1
J2 JUMPER	0 OHM	862A478H01	1	1	1	1
J3 JUMPER	0 OHM	862A478H01	—	—	1	1
J4 JUMPER	0 OHM	862A478H01	—	—	1	1
J5* JUMPER	0 OHM	862A478H01	1	—	—	—
F1 FUSE	1.5 AMPS	183A981H23	1	1	—	—
F2 FUSE	1.5 AMPS	183A981H23	1	1	—	—
S1 SWITCH		849A249H01	1	1	—	—
PB SWITCH	PUSHBUTTON	1444C83H04	1	1	1	1

*=REPLACE R11 WITH JUMPER J5 (G01 ONLY)

Sub 1
(1468C92)

Fig. 7. Internal Schematic Keying Board with Pushbutton.

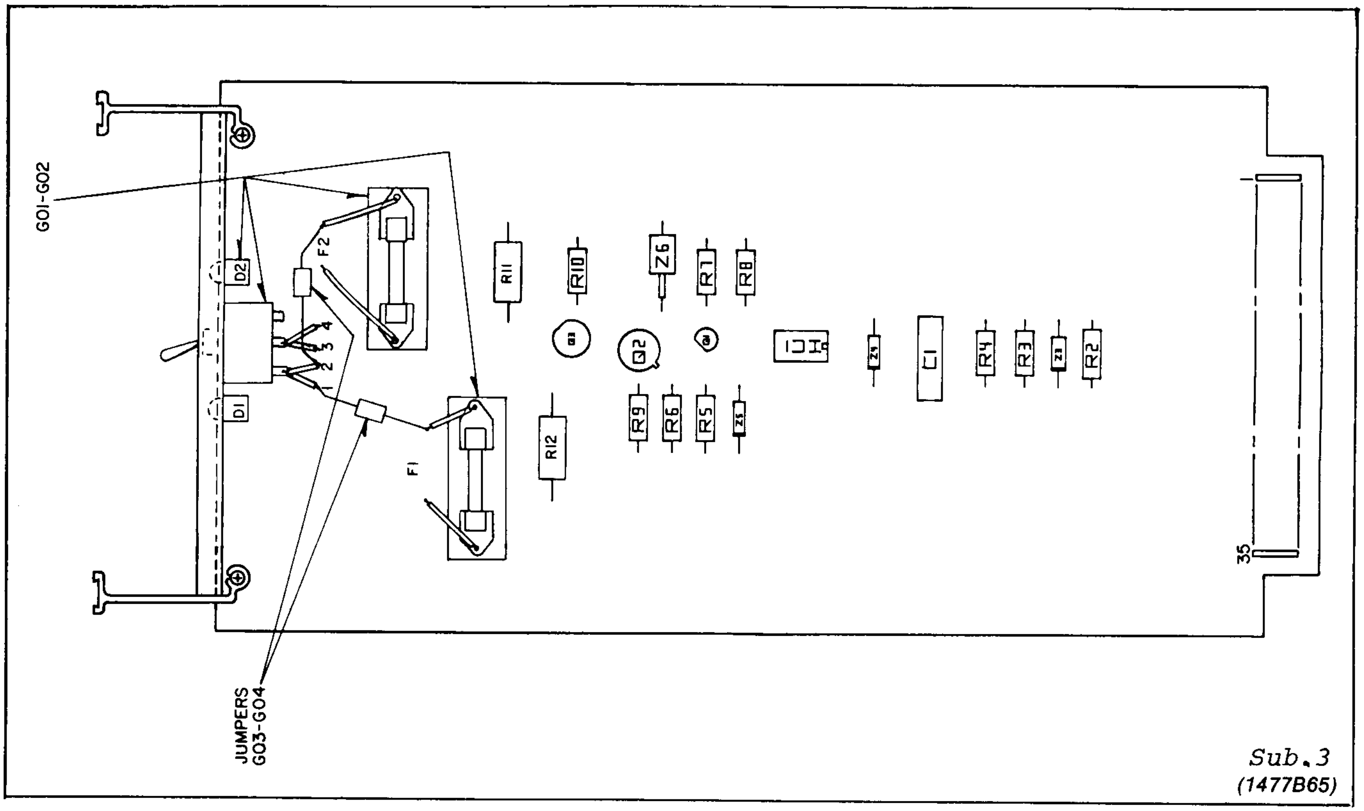


Fig. 8. Component Location Keying Board.

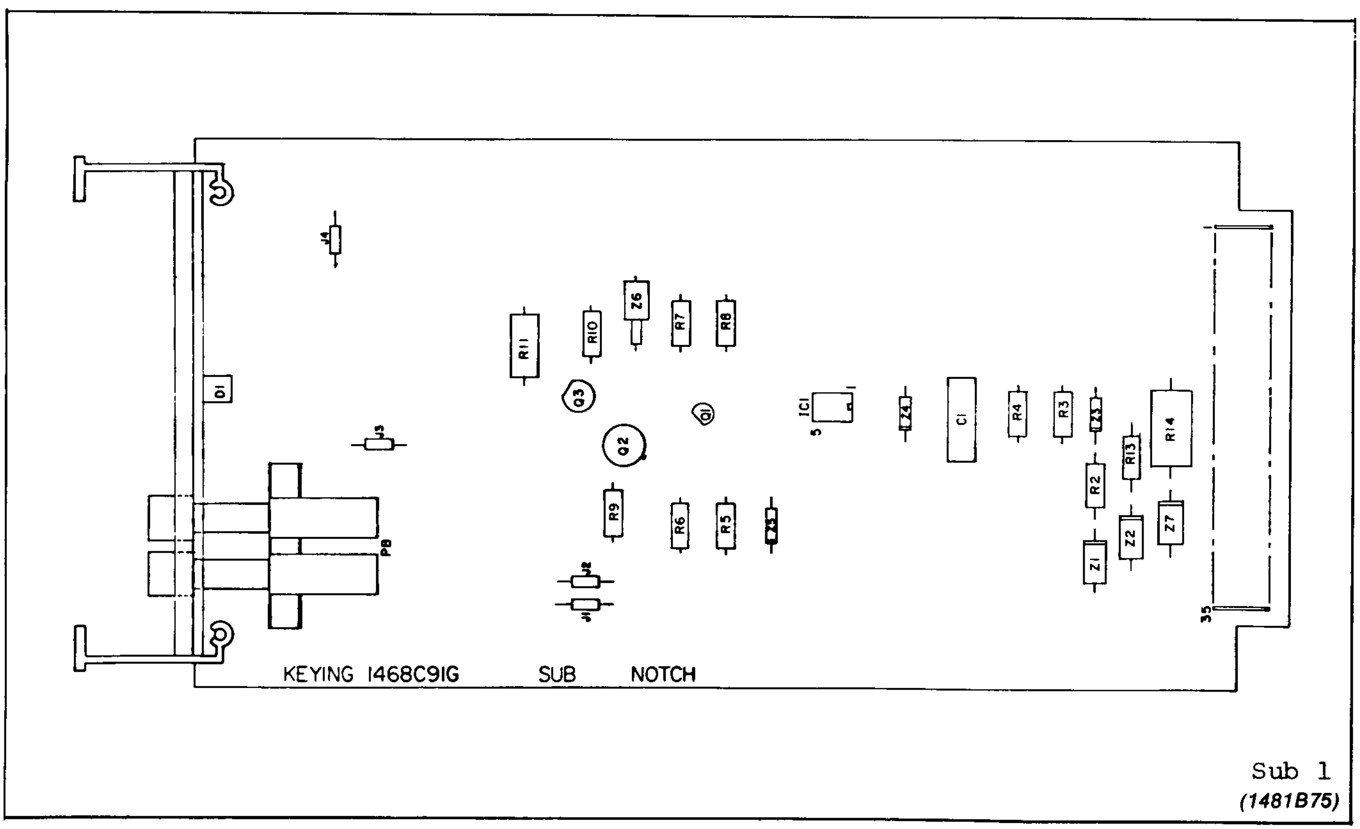


Fig. 9. Component Location Keying Board with Pushbuttons.

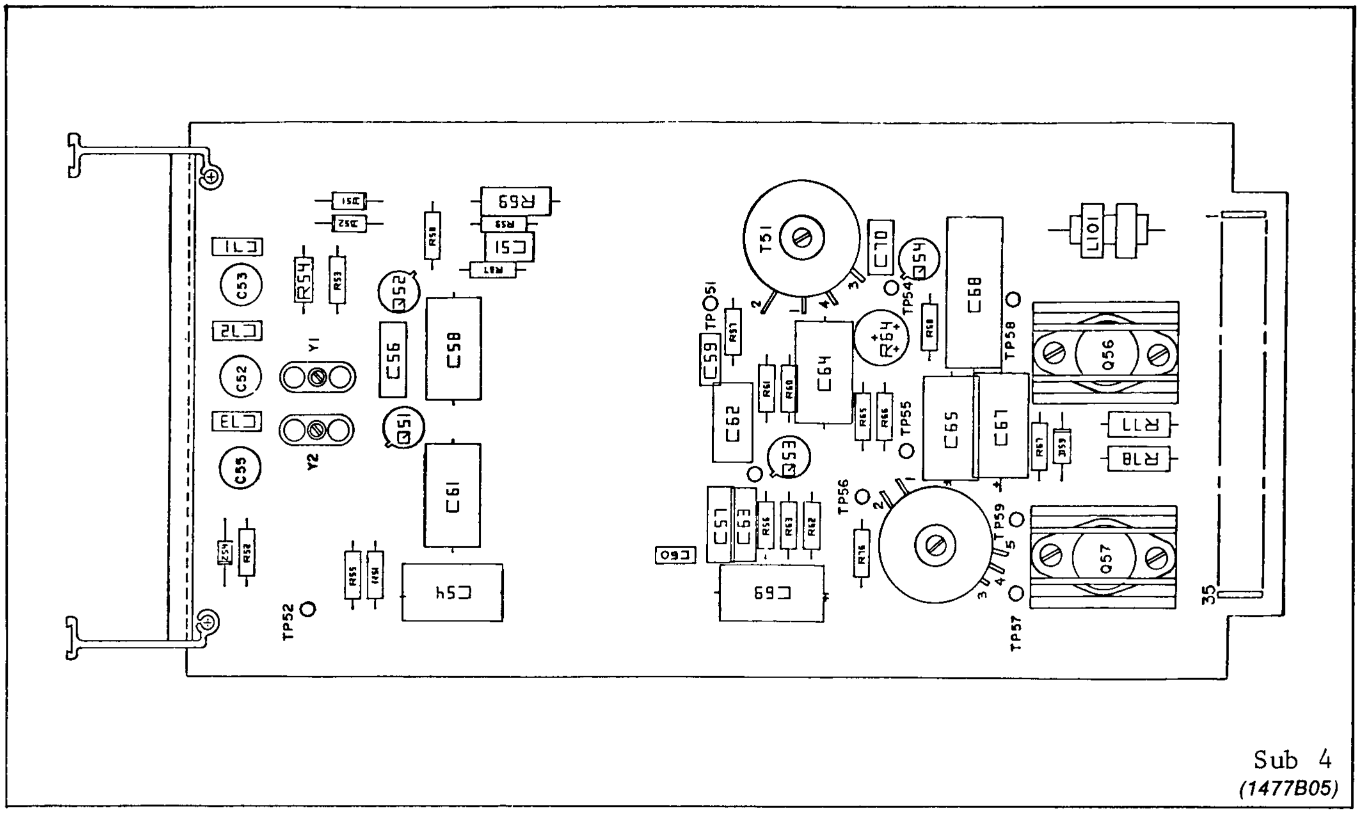


Fig. 10. Component Location Transmitter Board.

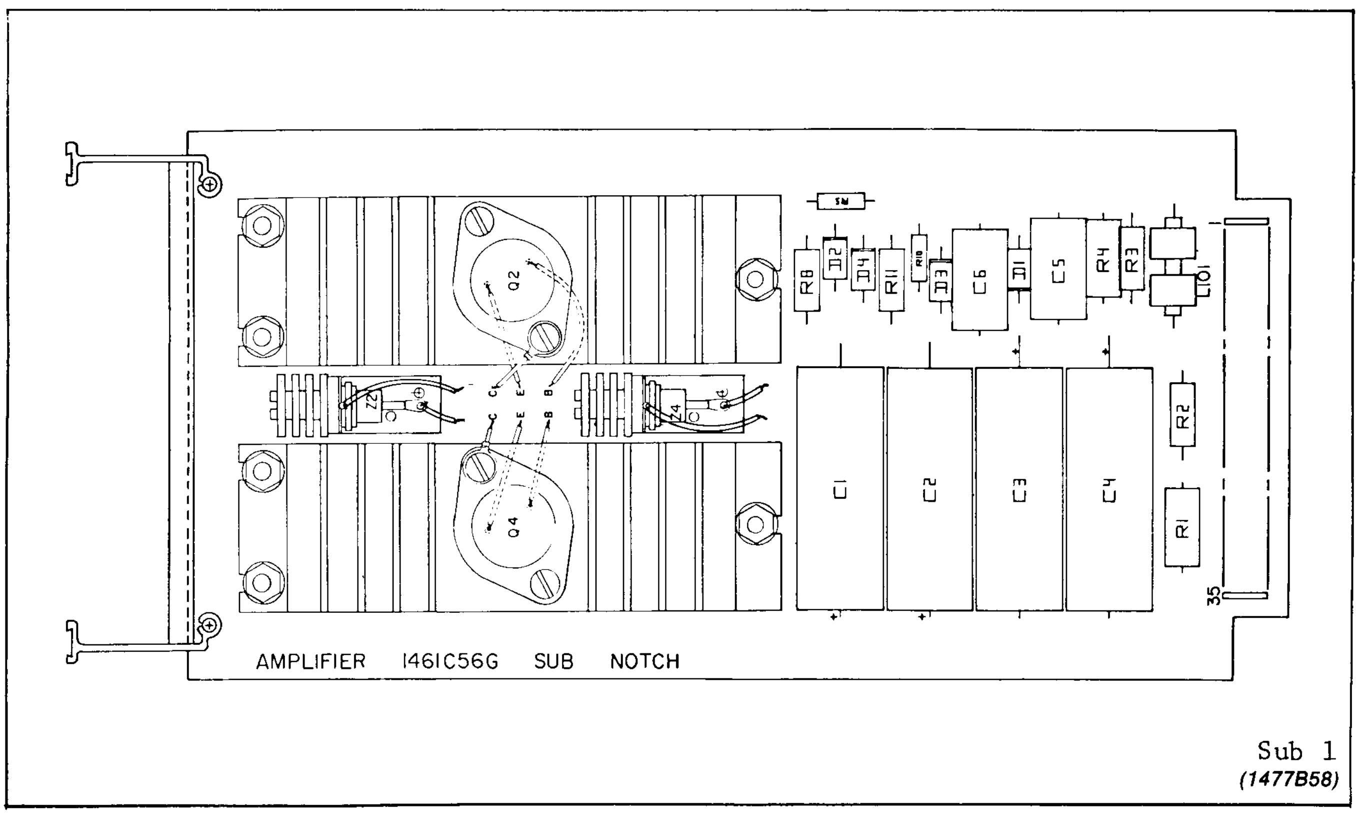


Fig. 11. Component Location Amplifier Board.

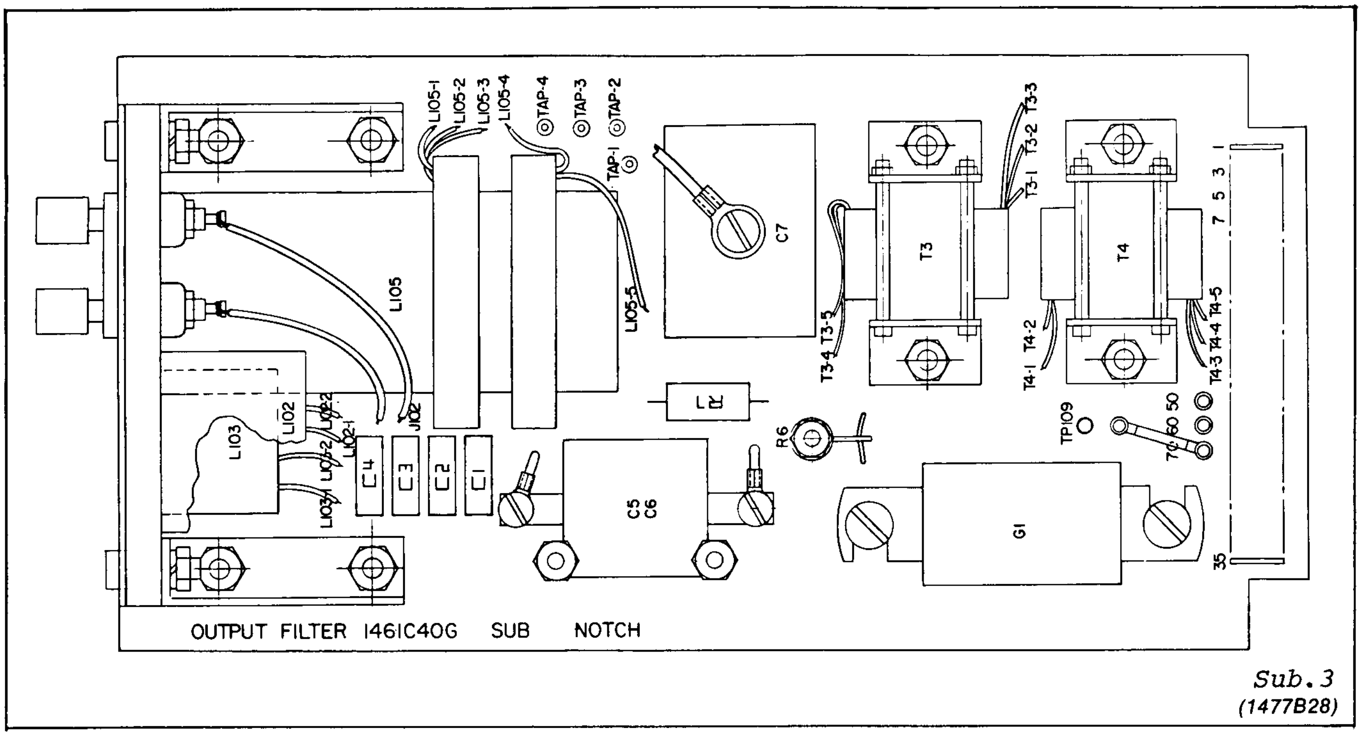


Fig. 12. Component Location Output Filter Board.

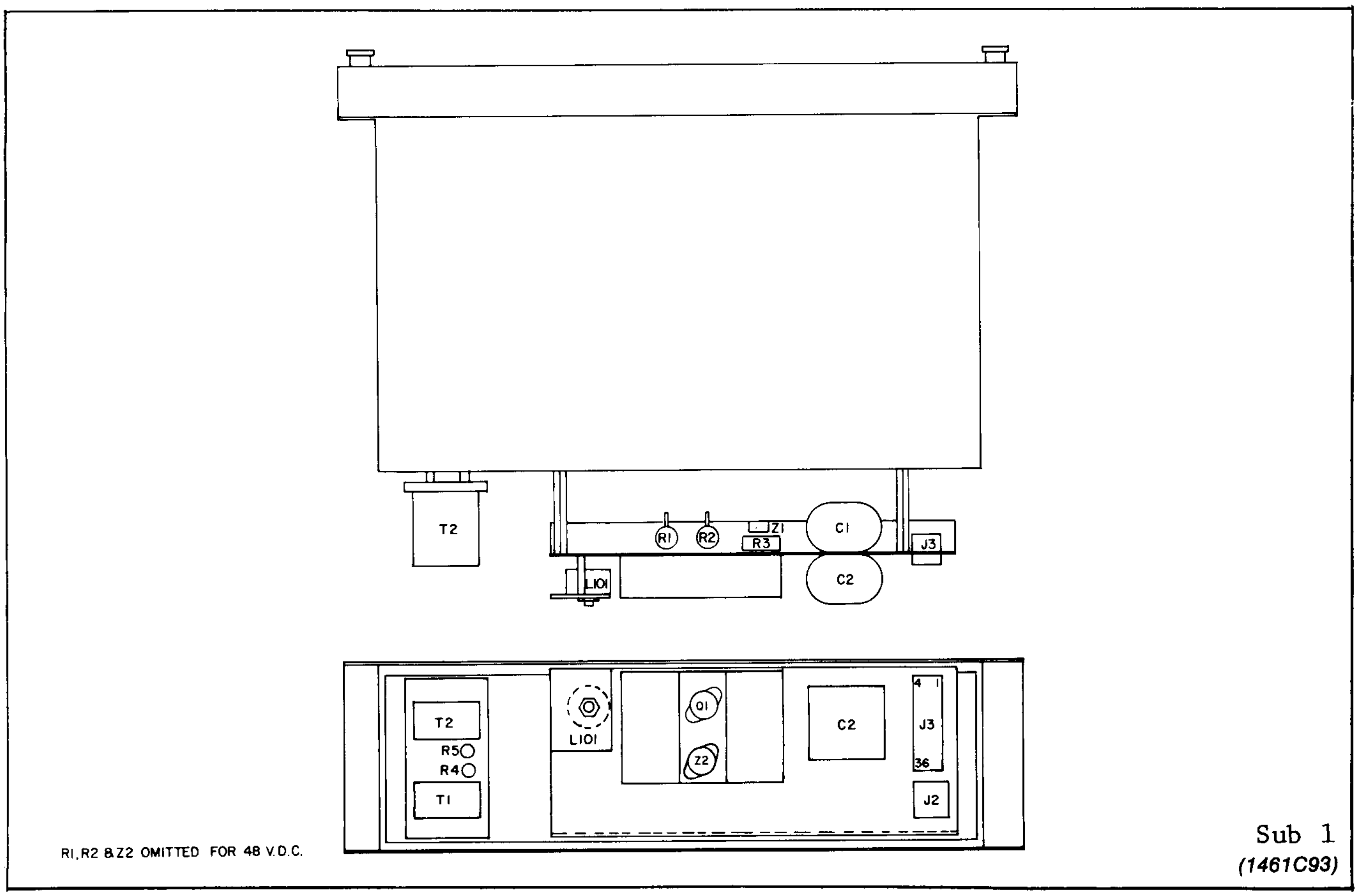


Fig. 13. Component Location Transmitter Assembly.

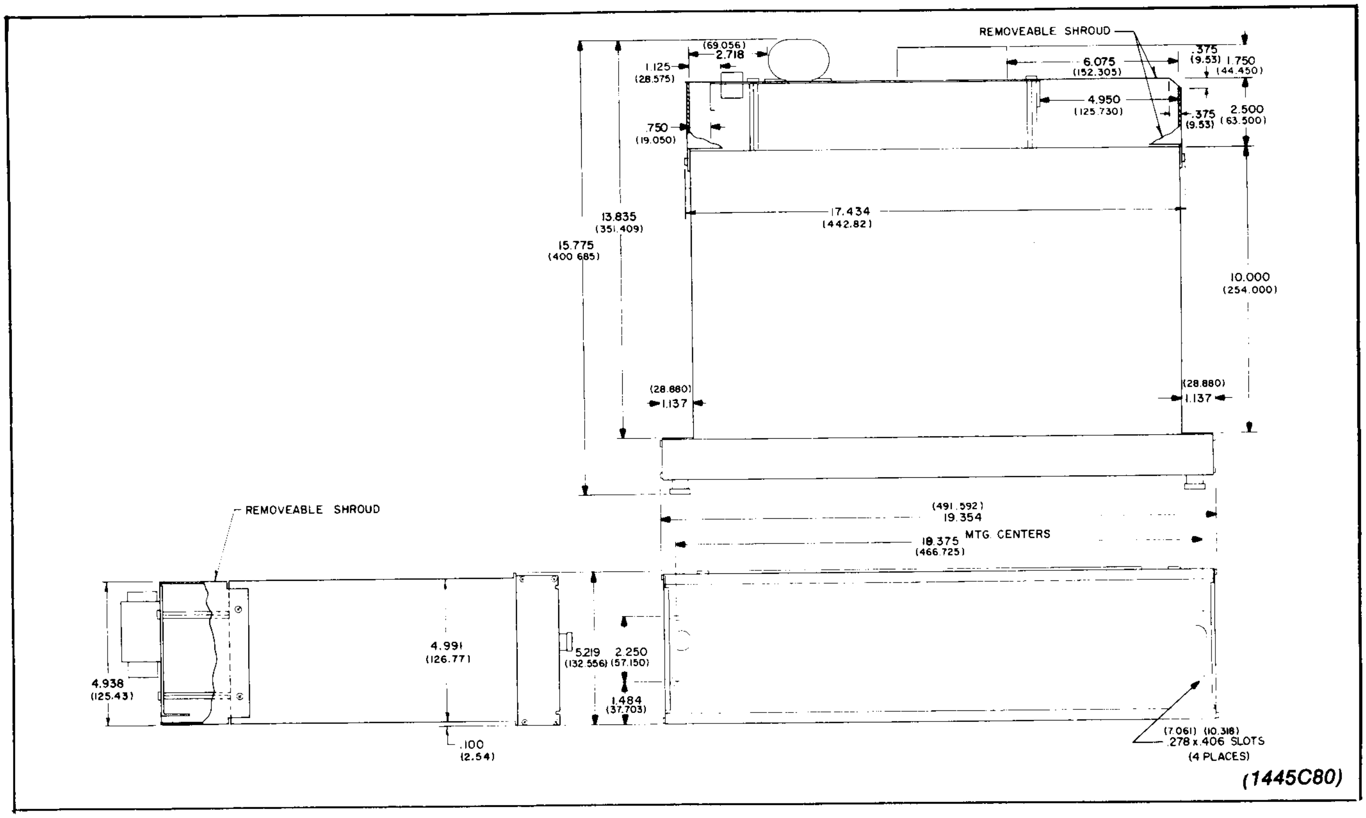


Fig. 14. Outline & Drilling for Transmitter Assembly.

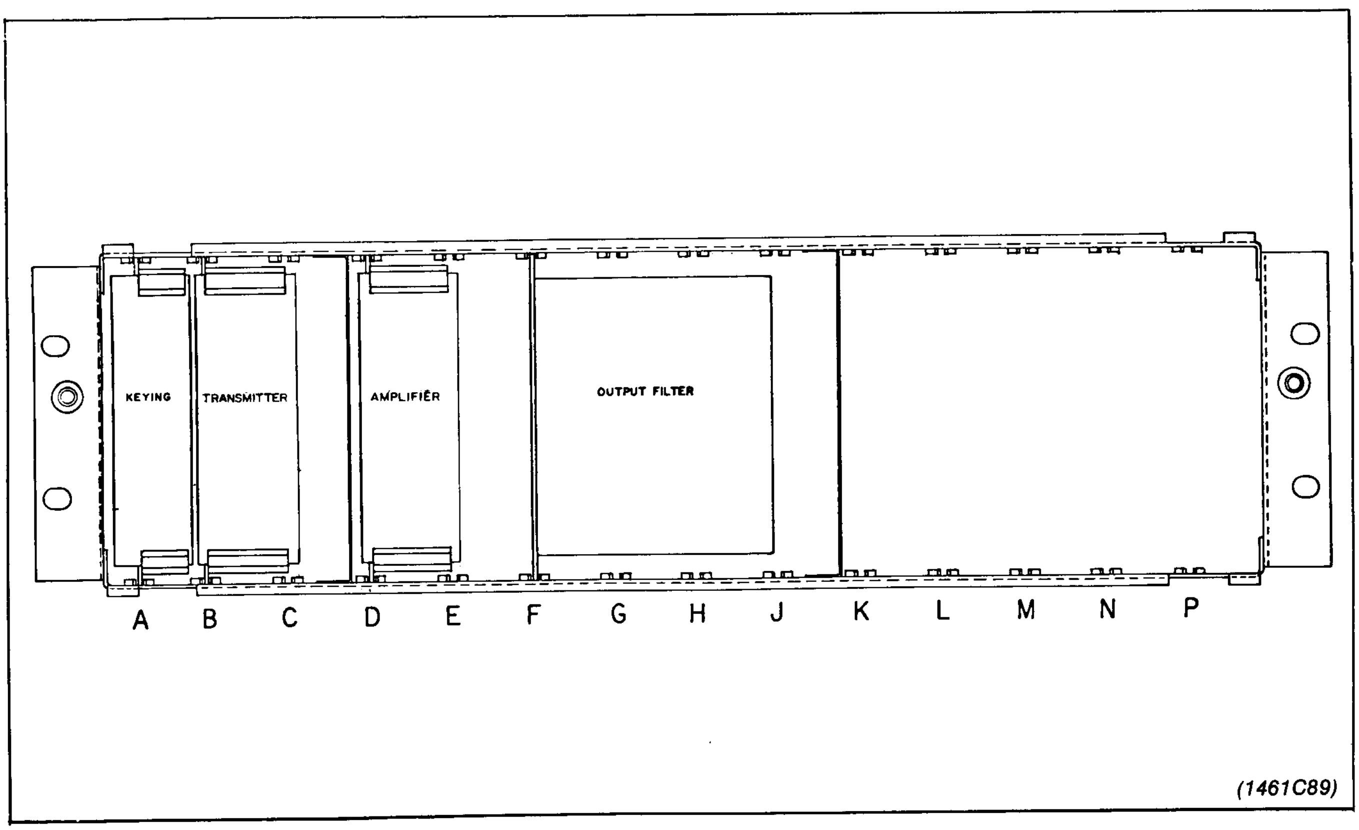


Fig. 15. Module Location.

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