INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE TCF-10 POWER LINE CARRIER FREQUENCY-SHIFT TRANSMITTER EQUIPMENT 3 FREQUENCY—10 WATT/1-3.25 WATT/10 WATT—WITH VOICE

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

A widely used high speed relaying system used for transmission line protection consists of directional-comparison unblock relaying plus a transfer-trip channel for breaker failure protection. Normally these systems of relaying require two frequency-shift channels, wideband for unblocking and narrowband for transfer trip. A saving in channel spectrum can be affected by using a three frequency transmitter for the two relaying functions and two separate receivers, one for each function, as shown in Figures 10 and 11.

SYSTEM OPERATION

The three frequency TCF-10 carrier transmitter provides for the transmission of any of three closely controlled discrete frequencies, all within the equivalent spacing of a single wideband channel. The center frequency of the channel can vary from 30 kHz to 300 kHz in 0.5 kHz steps. The transmitter normally operates at a frequency that is 100 Hz above the channel center frequency (fc). This frequency serves as the "guard" frequency for the transfer-trip receiver and as the "block" frequency for the unblock receiver. Note that the discriminator characteristic in the unblock receiver in this case is reversed from the normal unblock receiver used with the standard two frequency transmitter. This "guard" "block" frequency is transmitted continuously when conditions are normal. It indicates at the receiving end of the line that the channel is operative and serves to prevent false operation of the receiver by line noise. The lowest frequency, which is 100 Hz less than fc is the "transfer trip" frequency and is transmitted as a signal that an operation (such as tripping a circuit breaker) should be performed at the receiving end of the line. The highest frequency, which is 300 Hz above fc, is the "unblock" frequency and is transmitted as an unblock signal for directional comparison relaying. If a subsequent transfer-trip operation is called for, the transmitter will shift to fc-100 Hz which is the "trip" frequency for the transfer trip (narrow-band receiver.)

Note that when the transmitter shifts to "unblock," the frequency is completely outside the passband of the narrow band transfer-trip receiver. Normally, this would cause a low-signal alarm output from that receiver. In order to prevent a similar alarm output in this case, the checkback output of the unblock receiver is cross-connected to the guard or block input of the transfer trip receiver (through an OR logic circuit). This logic is shown in Figure 10. The checkback output is a receiver output that indicates that a proper signal has been received without going through any time delays or other logic used for the actual relaying output.

With this cross-connected logic, both receivers will function when required, but will not give any incorrect output indications.

The transmitter normally operates at an output level of one watt at the "guard" "blocking" frequency, but increases to ten watts for either "trip" or "unblock" output. An interlock is provided in the transmitter keying circuit to give transfer-trip preference. This means that even while the transmitter is shifted to the "unblock" frequency, if the transfer-trip keying circuit is energized, the transmitter will shift to the "trip" frequency without delay.

The transmitter can also be amplitude modulated at 3.25 watts to provide a voice channel.

CONSTRUCTION

The 10 watt/1-3.25 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. See Fig. 8. All of the circuitry that is suitable for printed circuit board mounting is on four such boards, as shown in Fig. 15. The components mounted on each printed circuit board or other sub-assembly are shown enclosed by dotted lines on the internal schematic. Fig. 1. 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.

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 center frequency, a mixer and buffer amplifier, a driver stage and a power amplifier. The interstage filter is located between the driver and the power amplifier. The output 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 center frequency, or 2.03 MHz for 30 kHz center frequency. Capacitor C55 and crystal Y2 in series are connected between the positive side of the supply voltage and the base of transistor Q51 which operates in the emitter following mode. The emitter is coupled to the base through C57. With Y2 removed the base of Q51 would be held at approximately the midpoint of the supply voltage by R51 and R52. The crystal serves as a series-resonant circuit with very high inductance and low capacitance. The circuit can be made to oscillate at other than the natural frequency of the crystal by varying the series capacitor, C55. Increasing C55 will lower the frequency of oscillations and reducing C55 will raise the frequency.

Capacitor C79 (in parallel with C78) is not effective until D59 is biased in the forward direction and becomes conductive. It is biased in the reverse direction until the keying control for unblock is closed which places 45V. dc at terminal 12 of the printed circuit board. With D57 conducting, C79 and C78 are placed in parallel with C55 and C73. The adjustment of C79 will reduce the frequency of the Y2 circuit by 200 hz. Since Y2 is the lower of the two frequencies derived from Y1 and Y2, the difference frequency, which is the frequency transmitted, is now increased by 200 hz. Thus the frequency transmitted is now 200 hz above the guard frequency or 300 hz above the center 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. Capacitors C53 and C71 are not effective until D51 is biased in the forward direction and becomes conductive. It is biased in the reverse direction until the keying control is closed, which places 45 V. dc at terminal 1 of the printed circuit board. With D51 conducting, C53 and C71 are effectively in parallel with C52 and C72. The 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 keying control is closed, it increases the output power from 1 watt to 10 watts as well as changing the frequency from Guard to Transfer or Unblock Trip. This is effected by reducing the emitter resistance of buffer-amplifier transistor Q54. When the keying control is open, transistor Q55 receives no base current and is 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 control circuit, R70 is placed in parallel with R68 and the amount of emitter resistance unbypassed by C66 can be adjusted as required to obtain a 10-watt output level.

Note in the keying board logic there is that interlocking logic between the keying for "unblock" and the keying for "transfer trip". This logic permits the "transfer trip" keying to take preference over the "unblock" keying. That is, even if we have "unlock" keying and then get "transfer trip" keying, the "transfer trip" will take immediate preference over the "unblock" keying. This is accomplished by the "transfer trip" keying causing transistor Q1 to conduct which in turn shunts out the keying voltage input to transistor Q3 through diode D9. Thus while Q1 becomes conducting and consequently Q2, effecting "transfer trip" keying, this conduction of Q1 also prevents Q3 from becoming conducting and prevents "unblocking" keying.

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.

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 this signal applied to the power amplifier.

The power amplifier uses two series-connected power transistors, Q101 and Q102, operating as a class B push-pull amplifier with single-ended output. Diodes D101 and D103 provide protection for the base-emitter junctions of the power transistors. Zener diodes Z105 and Z106 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, CB and L103, CC) which are factory tuned to the second and third harmonics of the transmitter frequency. Capacitor CD 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. Autotransformer T4 matches the filter impedance to coaxial cable of 50, 60, or 70 ohms.

The series resonant circuit composed of L105, and CE is tuned to the transmitter frequency, and aids in providing resistive termination for the output stage. Jack J102 is mounted on the rear 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 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 by pass across the dc output voltage. Capacitors C1 and C2 by pass r.f. or transient voltages to ground, thus preventing damage to the transistor circuit.

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 nonconducting, R64 has been set to produce a 1 watt output, maximum modulation on the side to shut off Q55 will not result in an output level of less than 1 watt carrier at any time. Also since the output level has been set at 10 watts with Q55 completely conducting by the adjustment of R70, the maximum modulation on the side of turn on of Q55 will not result in a carrier output level of greater than 10 watts at any time. 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 priorty. 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 unblock frequency after the 52b contact has operated.

CHARACTERISTICS

Frequency Range Output	30-300 kHz, 1 watt guard—10 watts trip—(both transfer and unblock)—3.2 watts voice (into 50 to 70 ohm resistive load) at nominal rated input voltage (48 V. or 125 v.d.c.)
Frequency Stability	±10 Hz from −20° C to +55C.
Frequency Spacing	Two-way channel,—See Voice Adapter Instruction Leaflet. [41-945.6]
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, 1.15 A. trip } 48 v.d.c. 0.2 A. guard, 0.4 A. trip } 125 v.d.c.
Keying Circuit Current	4 mA.
Temperature Range	−20 to +55° C. around chassis.
Dimensions	Chassis height—5 1/4 or 3 r.u. Chassis width—19″
Weight	12 lbs.

INSTALLATION

TYPE 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

TYPE TCF-10 10W/1-3.2W/10W 3 Frequency 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 3 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 moving the adjustable core in and out a small amount from its initial position. Leave it at the point of maximum voltage across the load resistor used. Then rotate R64 farther clockwise to obtain the correct voltage for 1 watt in the load resistor, as shown in the following table.

Then change to Trip frequency by connecting together terminals 7 and 12 of the transmitter connector 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 any connection terminal to 10 of J3. 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, reconnect connection to terminal 10 of J3, remove the load resistor, and reconnect the coaxial cable circuit to the transmitter. Note on frequencies above 200 KHZ, L105 adjustment is a screw-driver adjustment. There is no knurled shaft-locking nut.

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 2.3 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, the Transfer Trip Adjustment with C53, and the unblock frequency with C79.

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. (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 (For voice)	
	48V units	125V units	48V units	125V units	48V units	125V units
TP52	20	20	20	20	20	20
TP53	5.4		5.4		5.4	
TP54	3.4		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 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 a-c 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		—
	48V	125V	48V	125V	
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	112	—
T4-2 to Gnd.	31	31	110	110	—
TP109 to Gnd.	9.8	9.8	31	31	—
J102 to Gnd.	7.8	7.8	24.5	24.5	14

CONVERSION OF TRANSMITTER FOR CHANGED CHANNEL FREQUENCY

The parts required for converting a 1W/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	274.1-287.0
50.5-53.5	95.0-100.0	180.5-191.5	287.1-300.0
54.0-57.0	100.5-106.0	192.0-200.0	
57.5-60.5	106.5-112.5	200.1-207.0	

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

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. Similarly, 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. AC Vacuum Tube Voltmeter (VTVM). Voltage range 0.003 to 30 volts, frequency range 60 hz to 330-kHz; input impedance 7.5 megohms.
  c. DC 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 330-kHz.
  c. Oscilloscope
  d. Frequency counter
  e. Ohmmeter
  f. Capacitor checker.

Some 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.

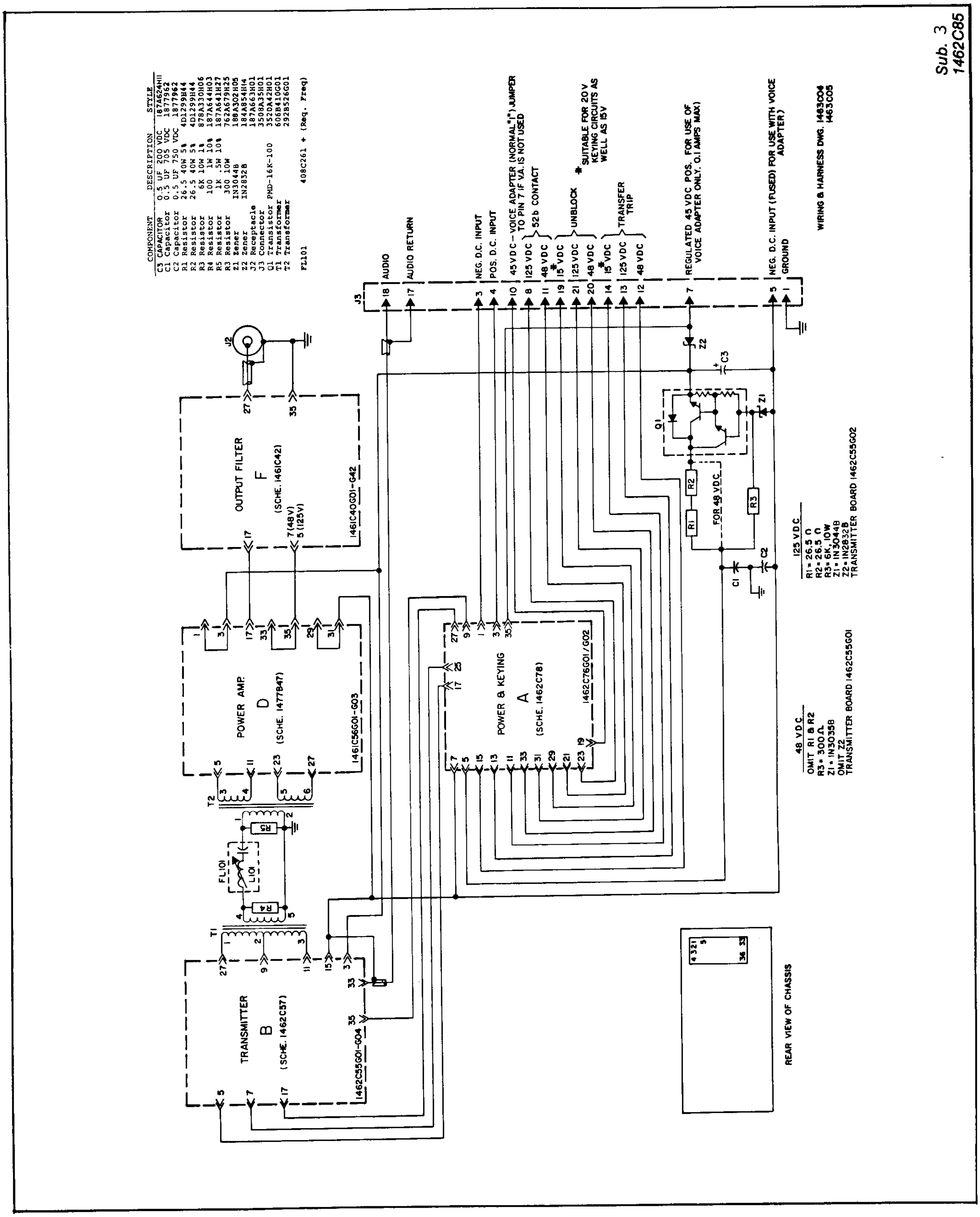


Fig. 1 Internal Schematic of Transmitter

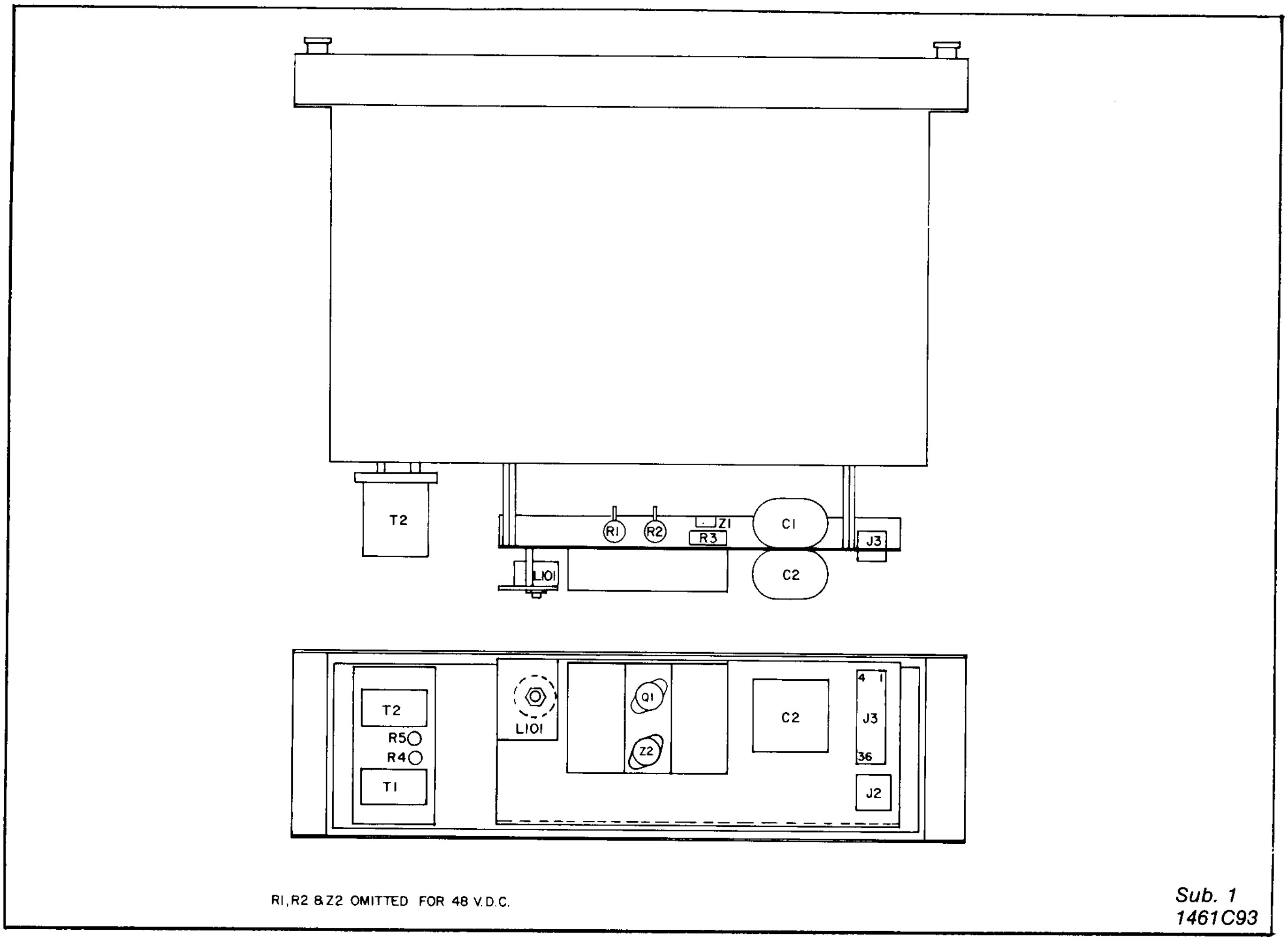


Fig. 2 Component Location Transmitter Assembly

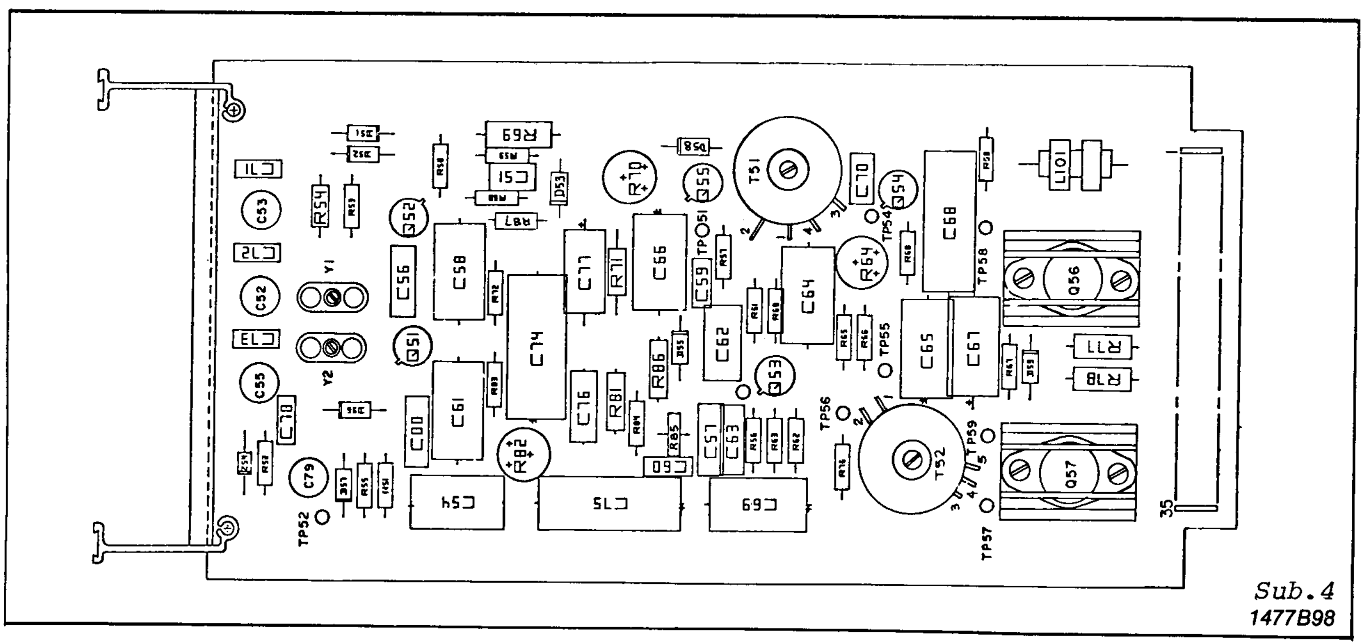


Fig. 3 Component Location Transmitter Module

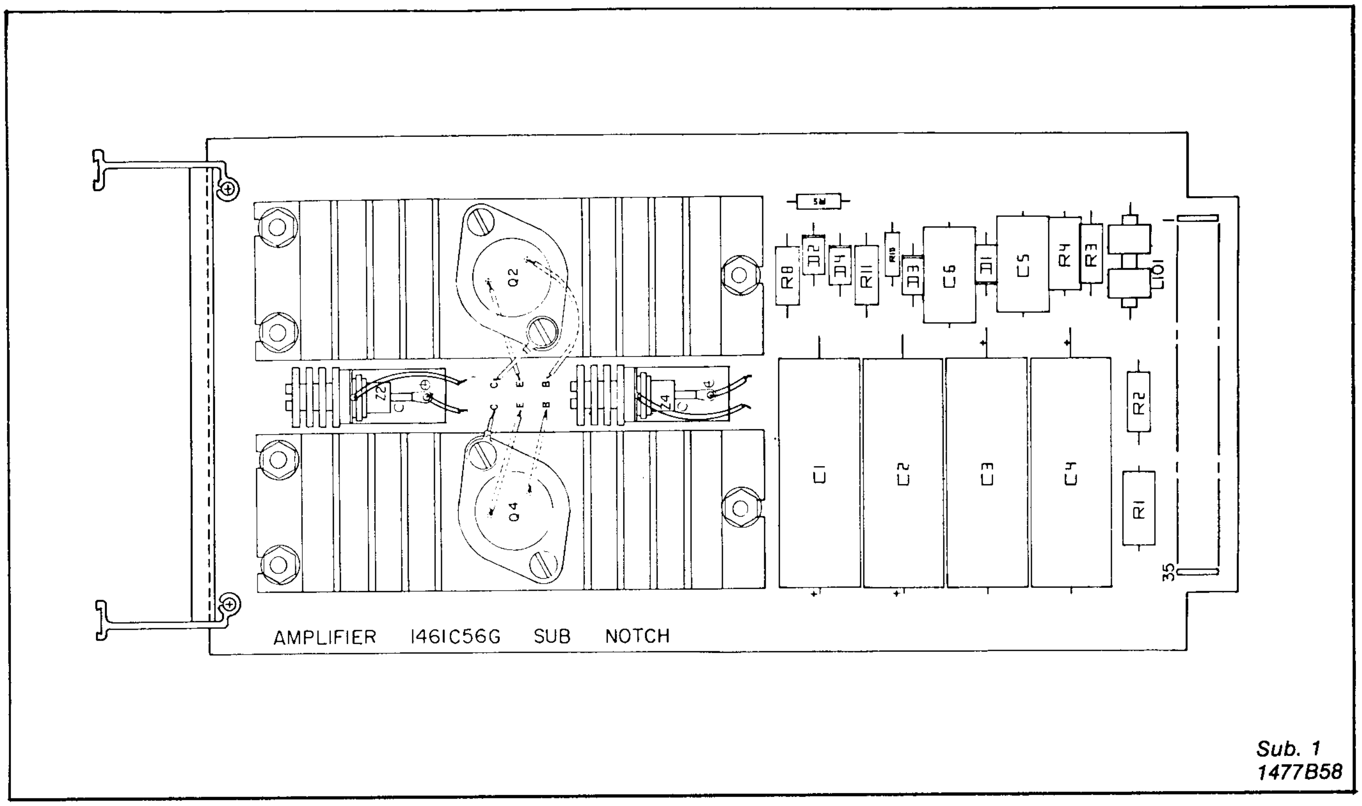


Fig. 4 Component Location Power Amplifier Module

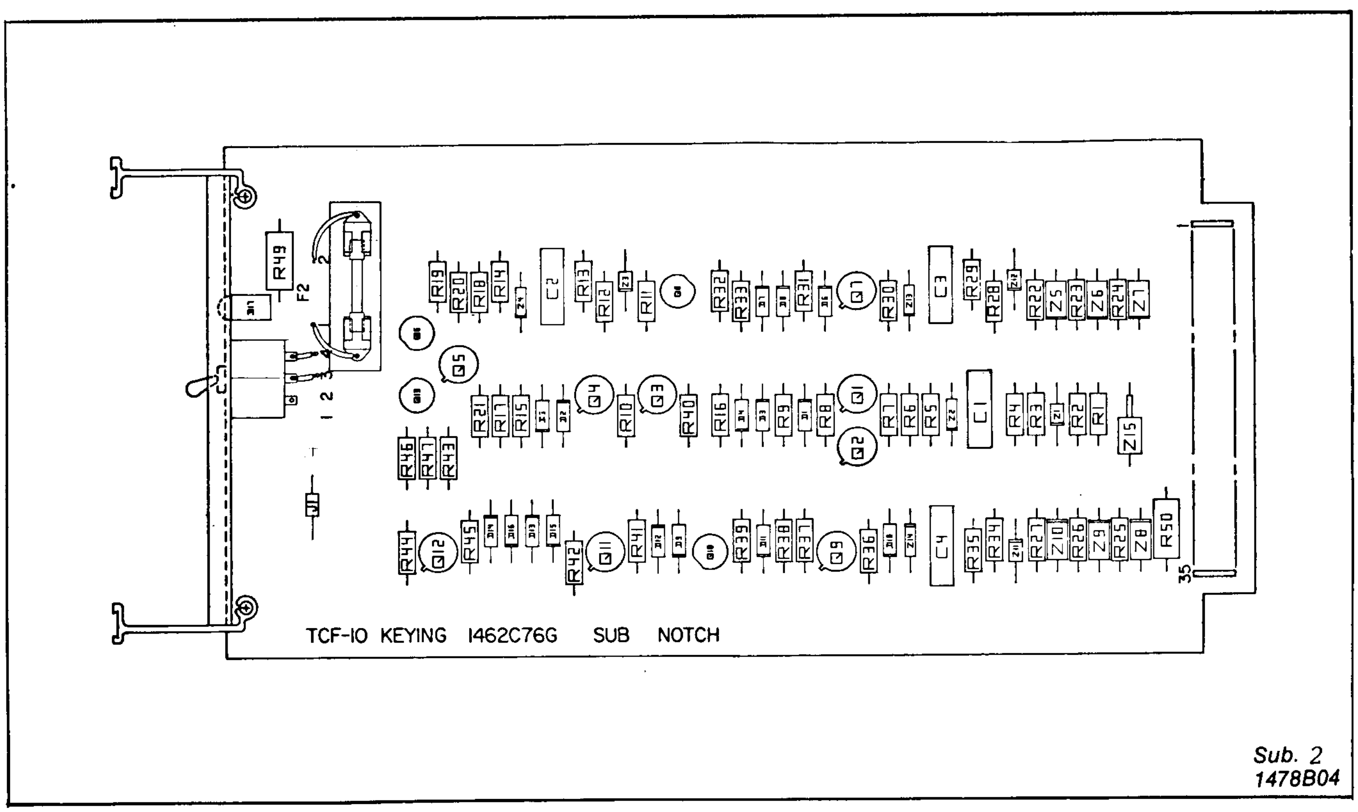
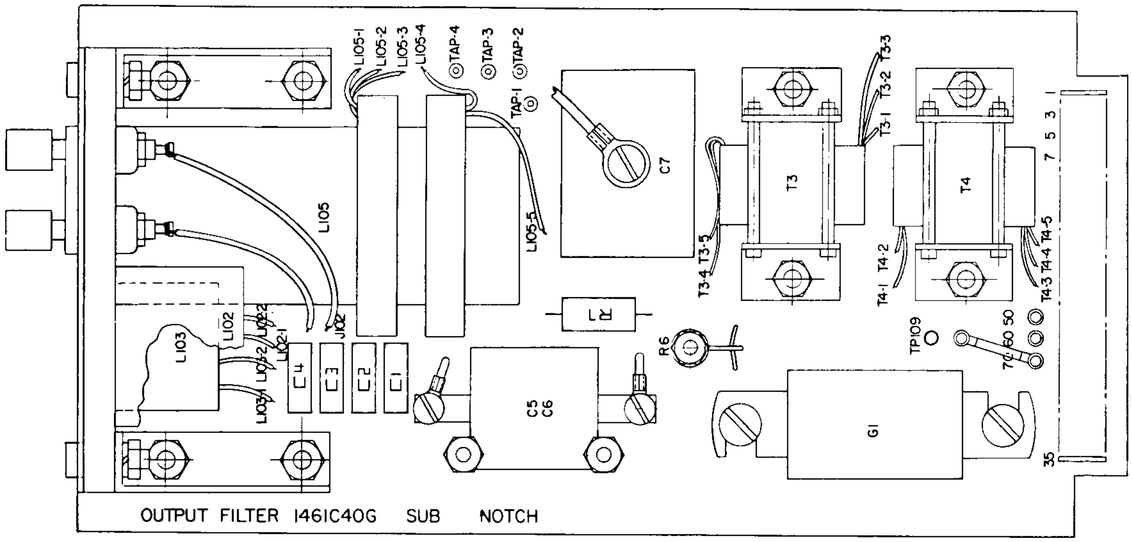


Fig. 5 Component Location Power Amplifier Keying Module



Sub. 3
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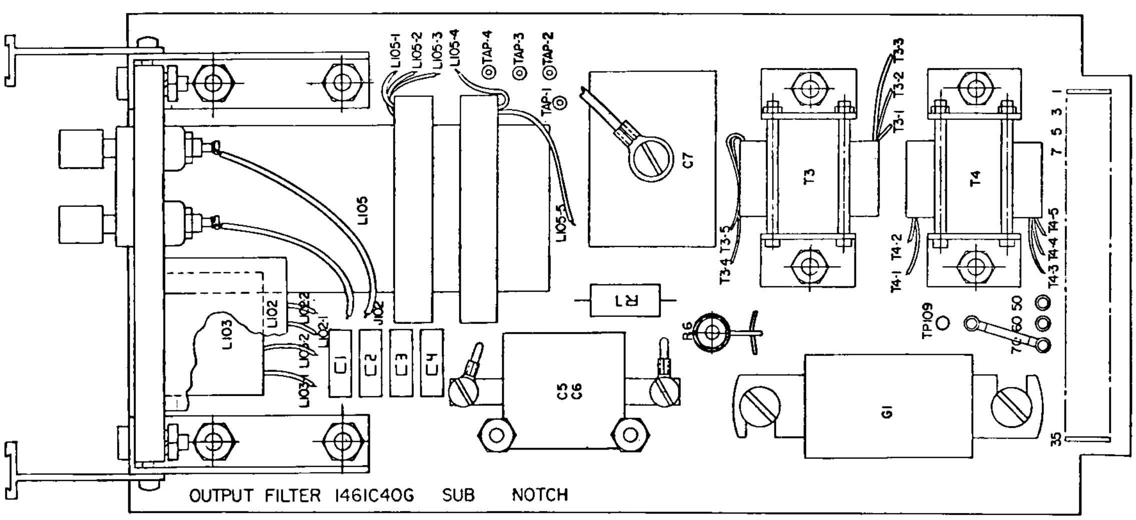

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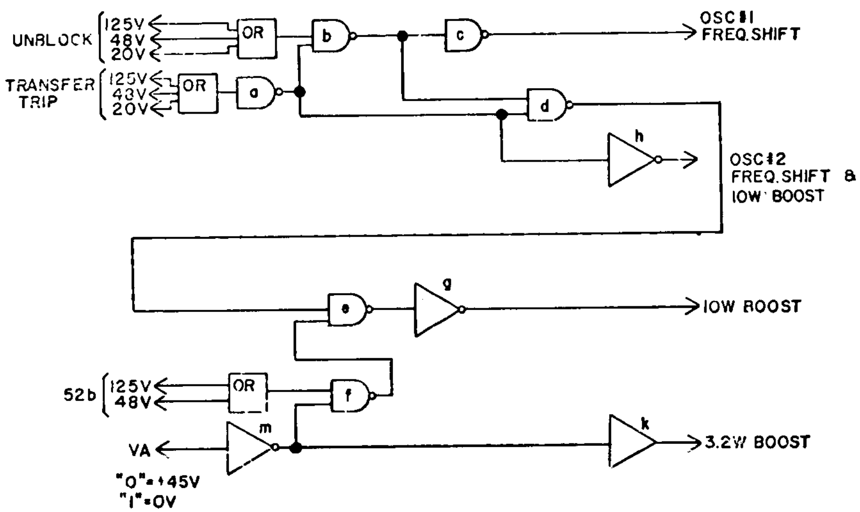
Fig. 6 Component Location Output Filter Module

LOGIC FOR 3 FREQ. WITH VOICE



TRUTH TABLE–3 FREQ. WITH VOICE

INFUT KEYING				OUTPUTS				
UN	TT	52b	VA	TT FREQ. SHIFT	UN FREQ. SHIFT	3.2W BOOST	10W BOOST	
0	0	0	0	0	0	0	0	GUARD 1W @
1	0	0	0	0	1	0	1	UNBLK. 10W @
1	1	0	0	1	0	0	1	T.T. 10W @
1	0	1	0	0	1	0	1	UNBLK. 10W @
1	0	0	1	0	1	0	1	UNBLK. 10W @
1	1	1	0	1	0	0	1	TT 10W @
1	0	1	1	0	1	1	0	UNBLK. 3.2W @
1	1	0	1	1	0	0	1	TT 10W @
1	1	1	1	1	0	1	0	TT 10W @
0	1	0	0	1	0	0	1	TT 10W @
0	1	1	0	1	0	0	1	TT 10W @
0	1	0	1	1	0	0	1	TT 10W @
0	1	1	1	1	0	1	0	TT 10W @
0	0	1 *	0	0 *	1	0	1	UNBLK 10W @
0	0	1 *	1	0 *	1	1	0	UNBLK 3.2W @
0	0	0	1	0	0	1	0	GUARD 3.2W @

* = STU RELAY AFTER 180MS OPERATION OF 52b WILL KEY TO UNBLOCK. IN THIS CASE, THE UNBLOCK KEYING IS NOT DONE BY THE LOGIC REPRESENTED BY THESE LOGIC BOARDS.

Sub. 1
1480B82

Fig. 7 Logic for 3 Frequency With Voice

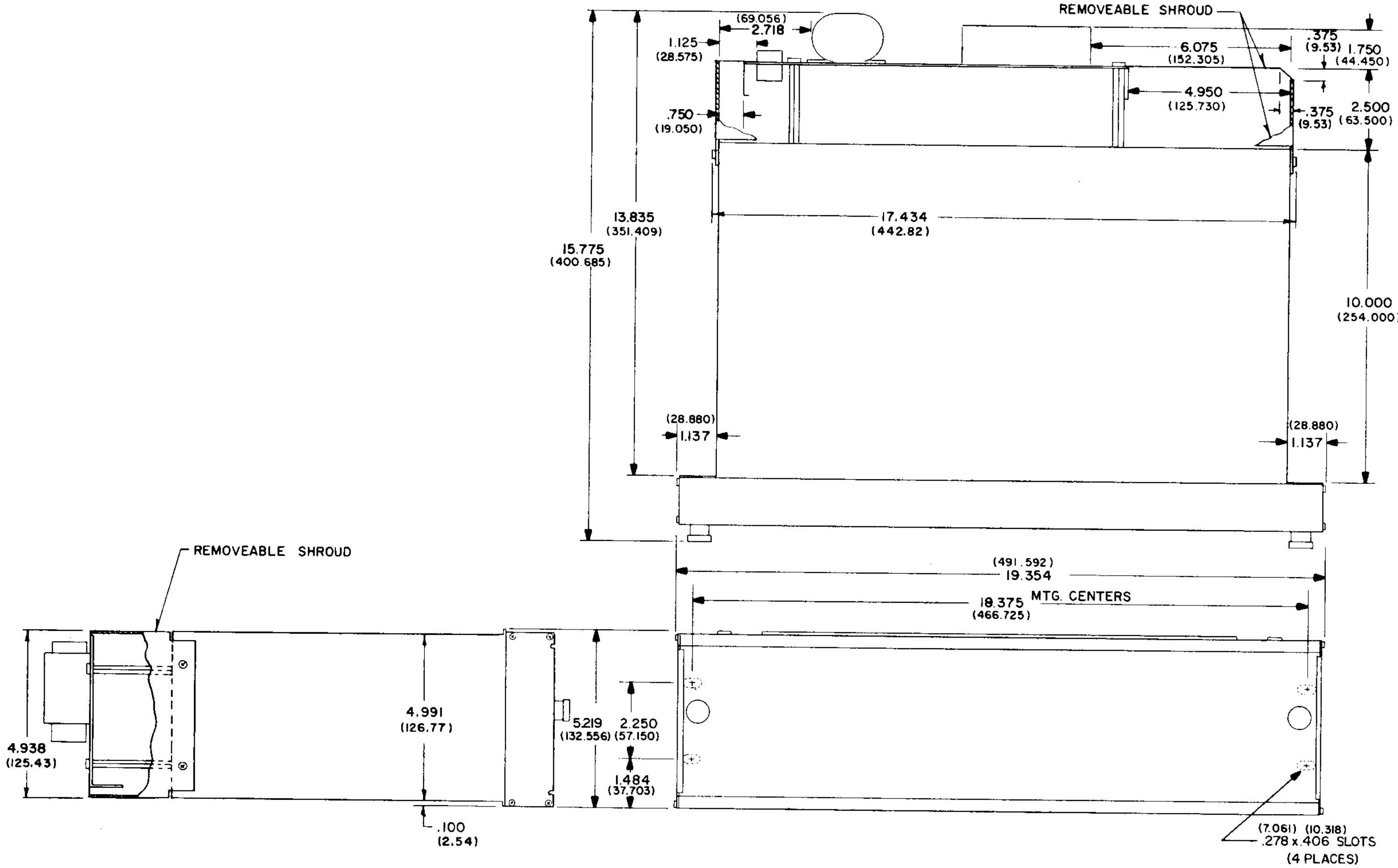


Fig. 8 Outline & Drilling for Transmitter Assembly

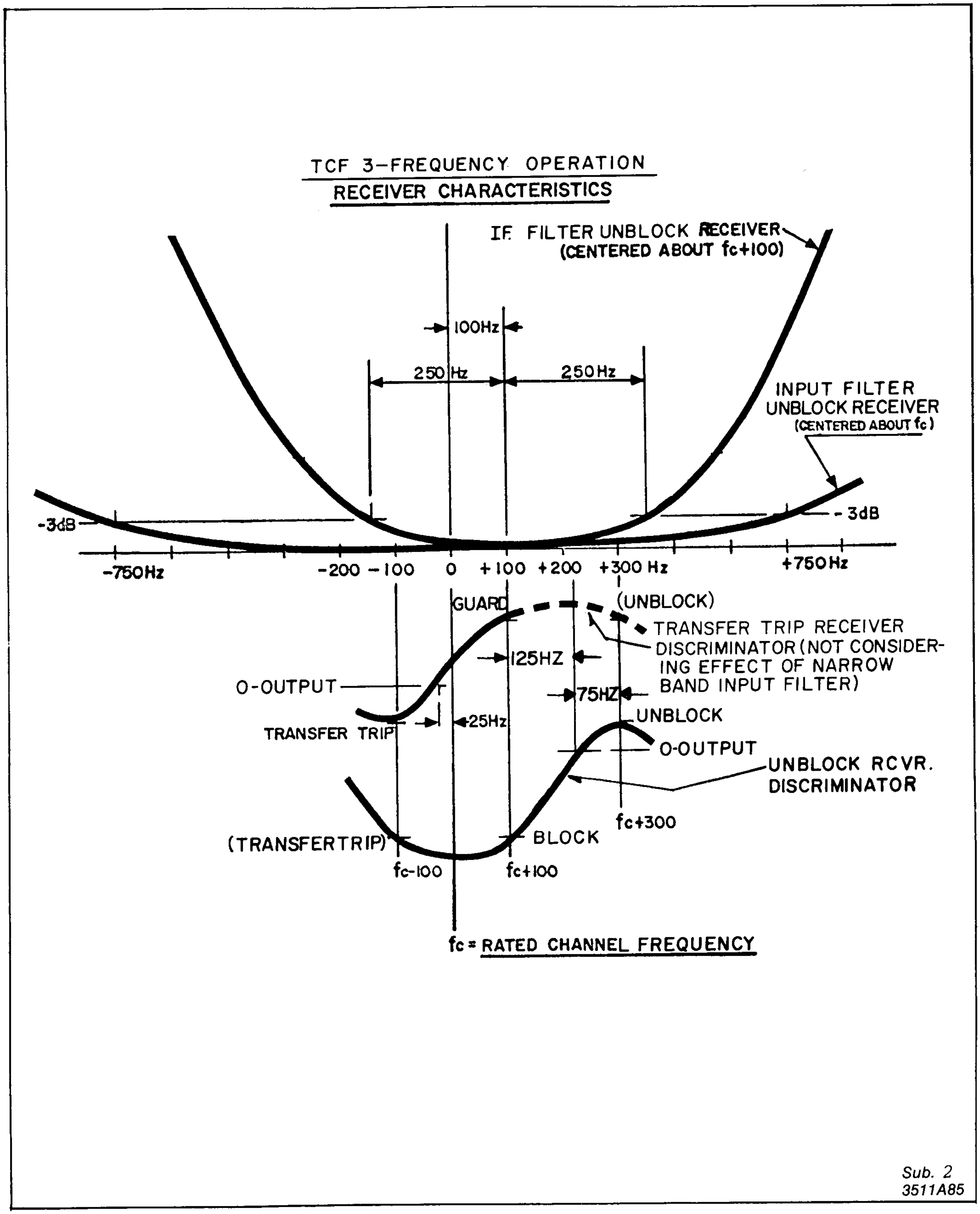


Fig. 9 Three Frequency Operation—Receiver Characteristics

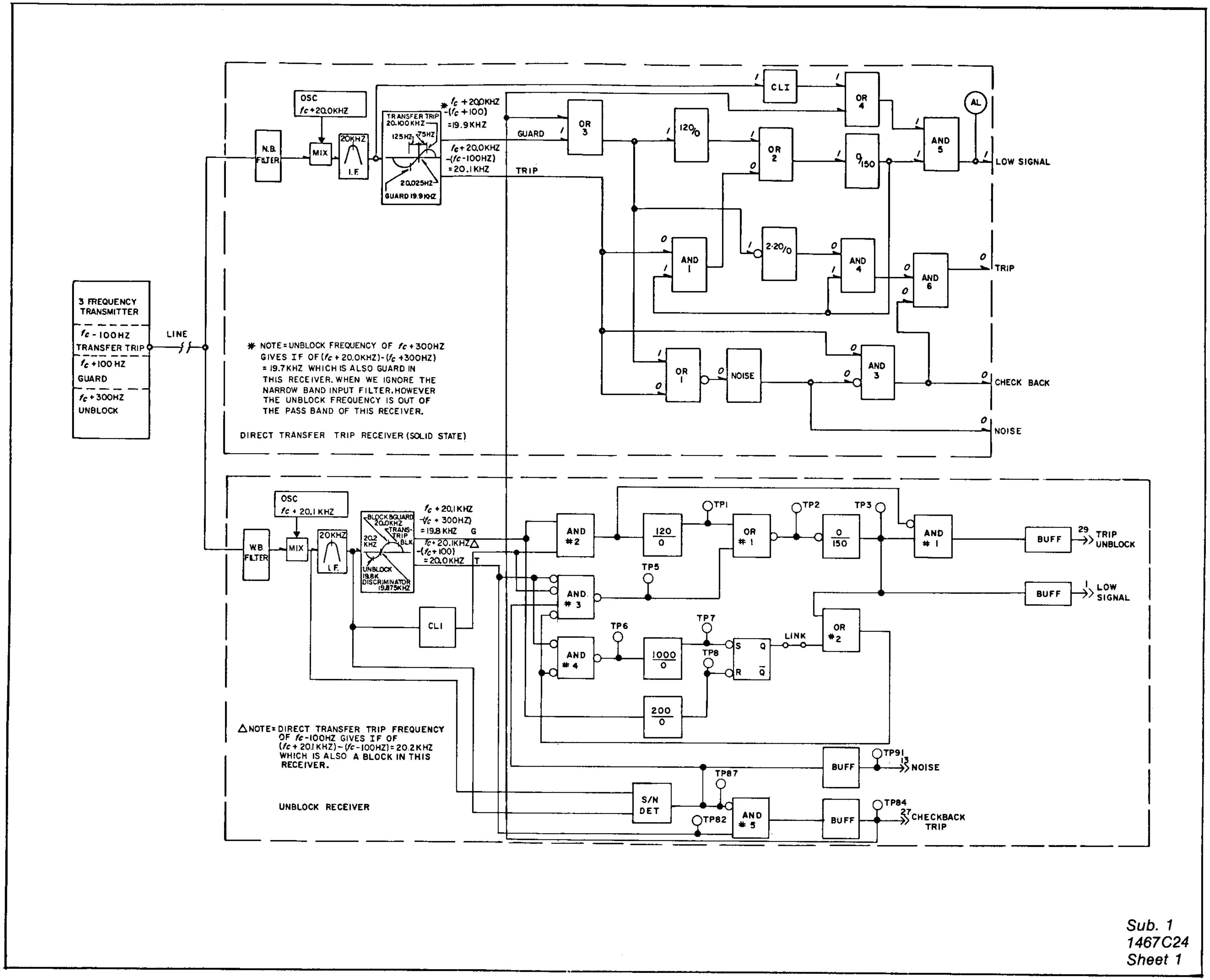


Fig. 10-1 Receiver Logic Diagram - Solid State Output

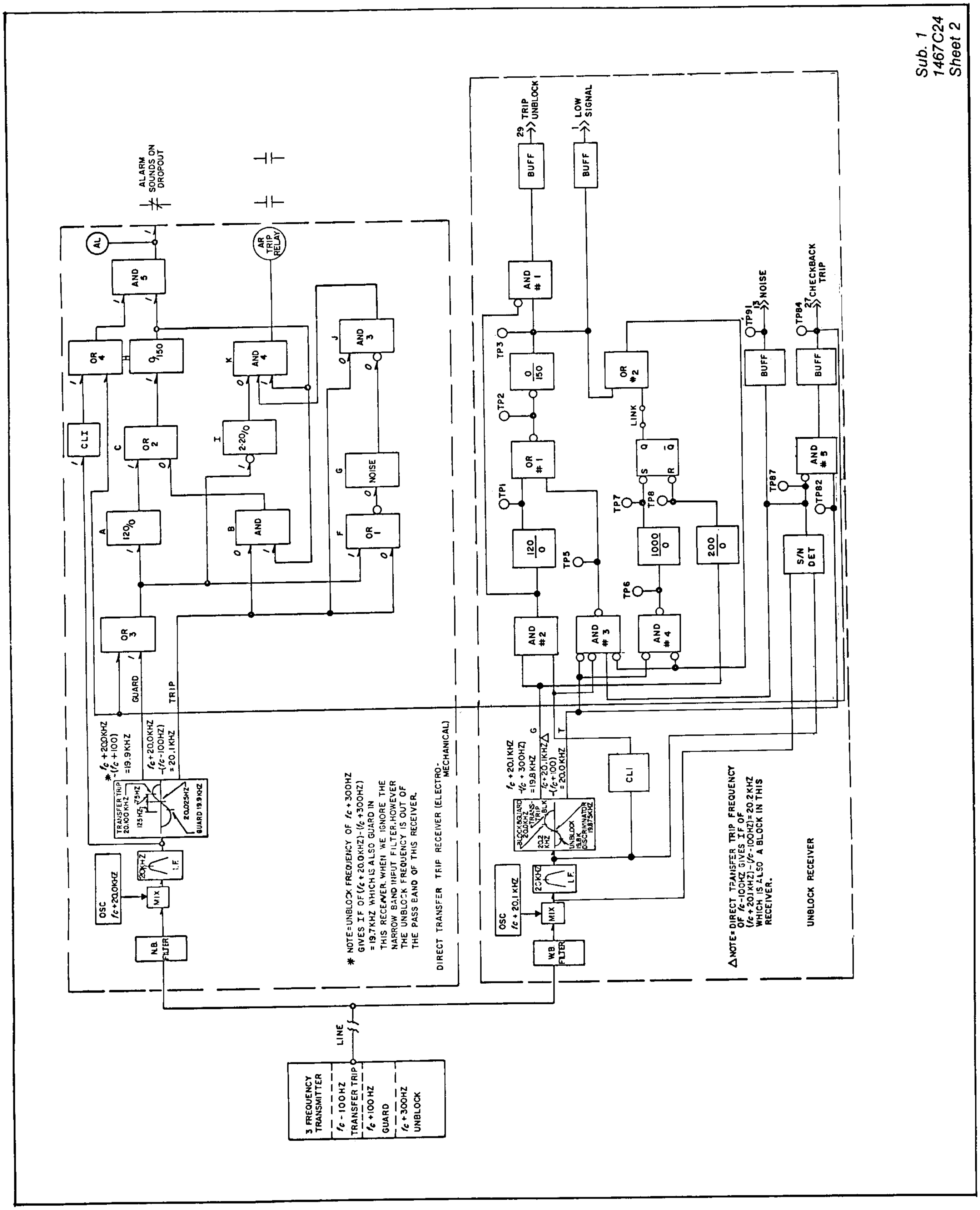
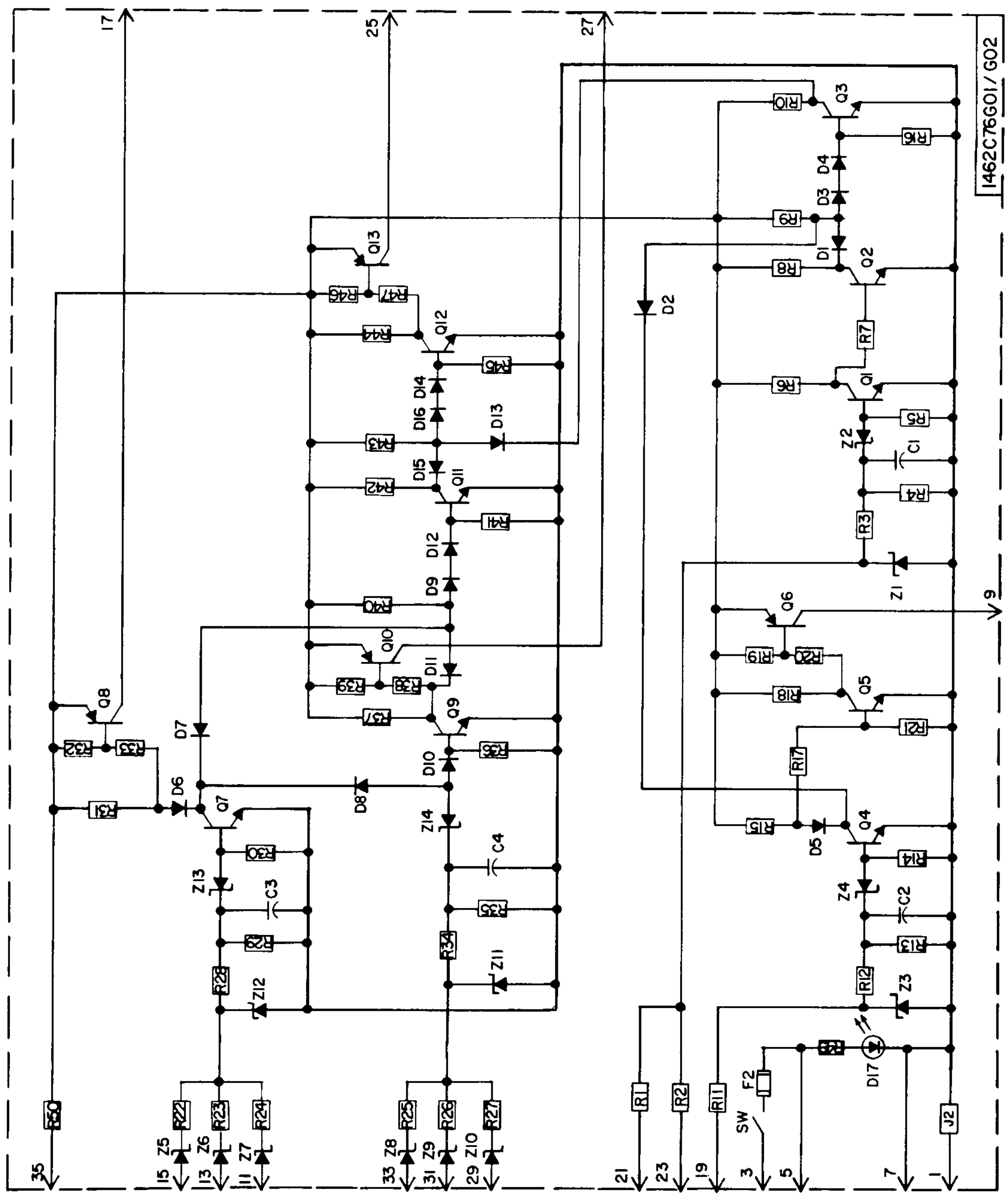


Fig. 10-2 Receiver Logic Diagram - AR Relay Output



Sub. 3
1462C78

Fig. 11 Internal Schematic Power & Keying Module

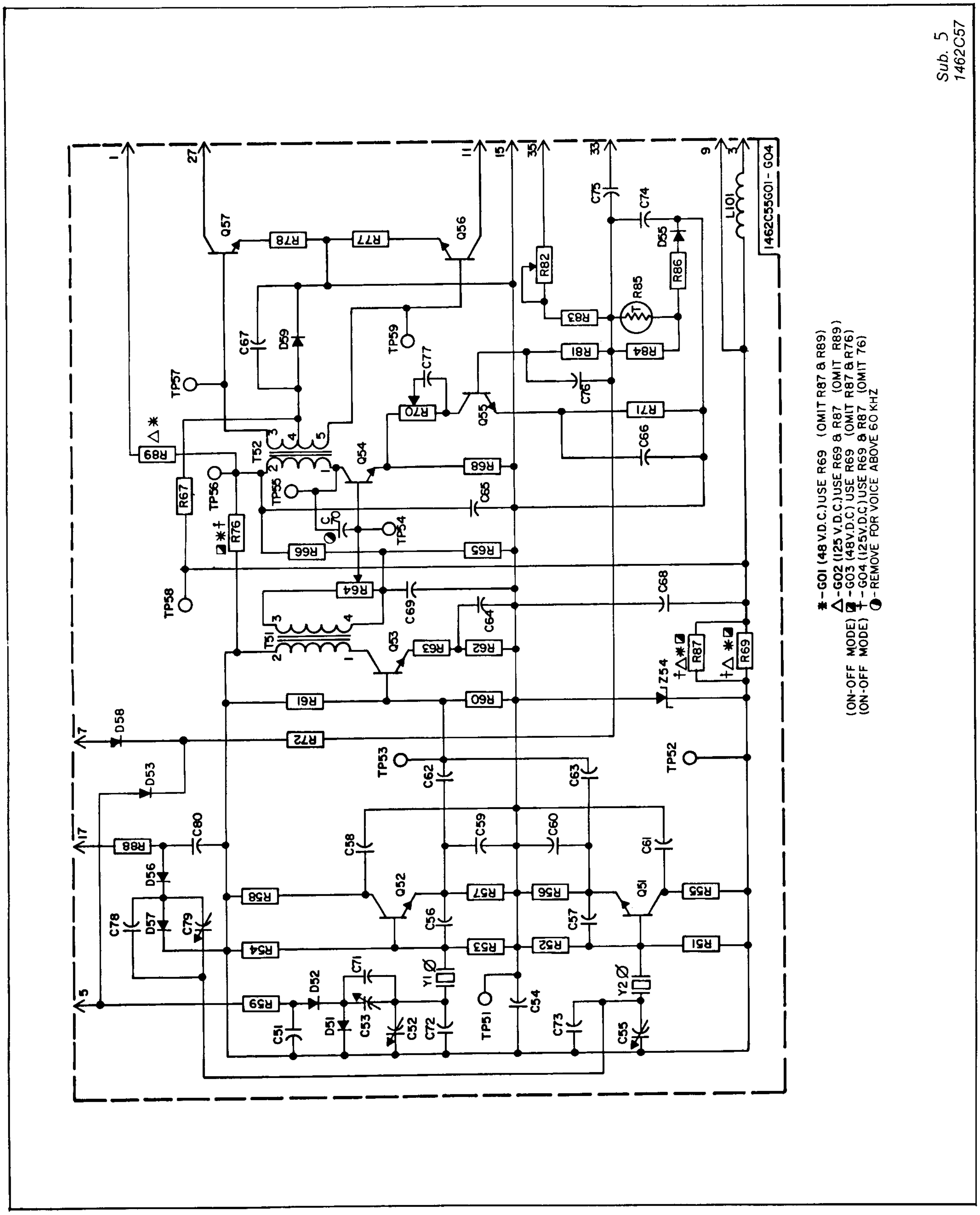
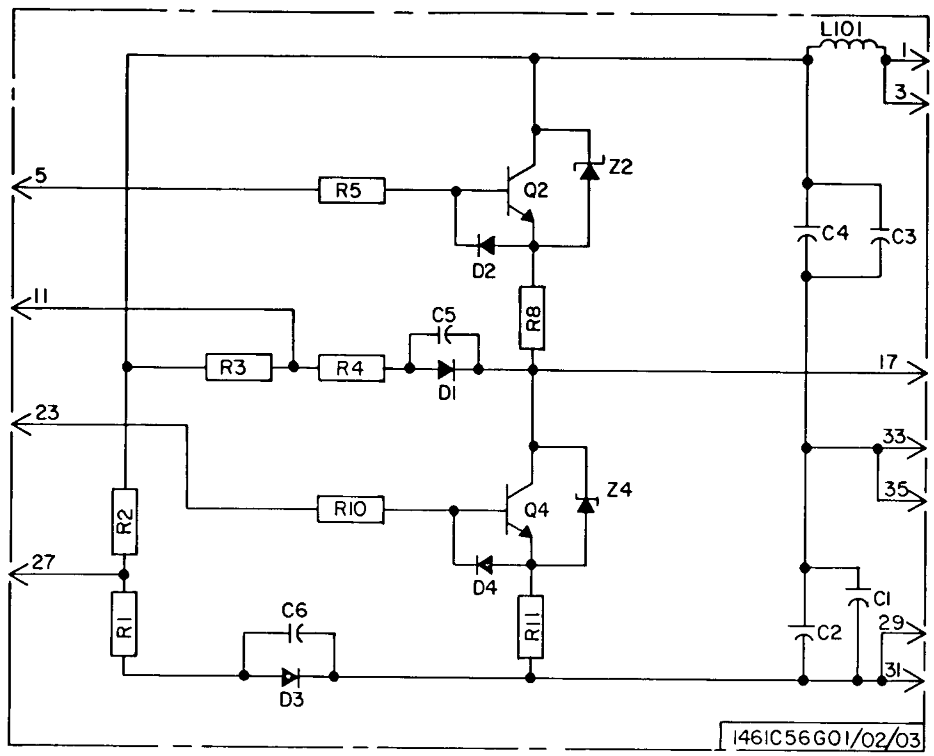


Fig. 12 Internal Schematic Transmitter Module



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	51 K 1.00W 5%	187A643H68
R4	RESISTOR	2.7 1W 0%	629A371H24
R5	RESISTOR	10.0 .50W 5%	187A290H01
R3	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. 13 Internal Schematic Power Amplifier Module

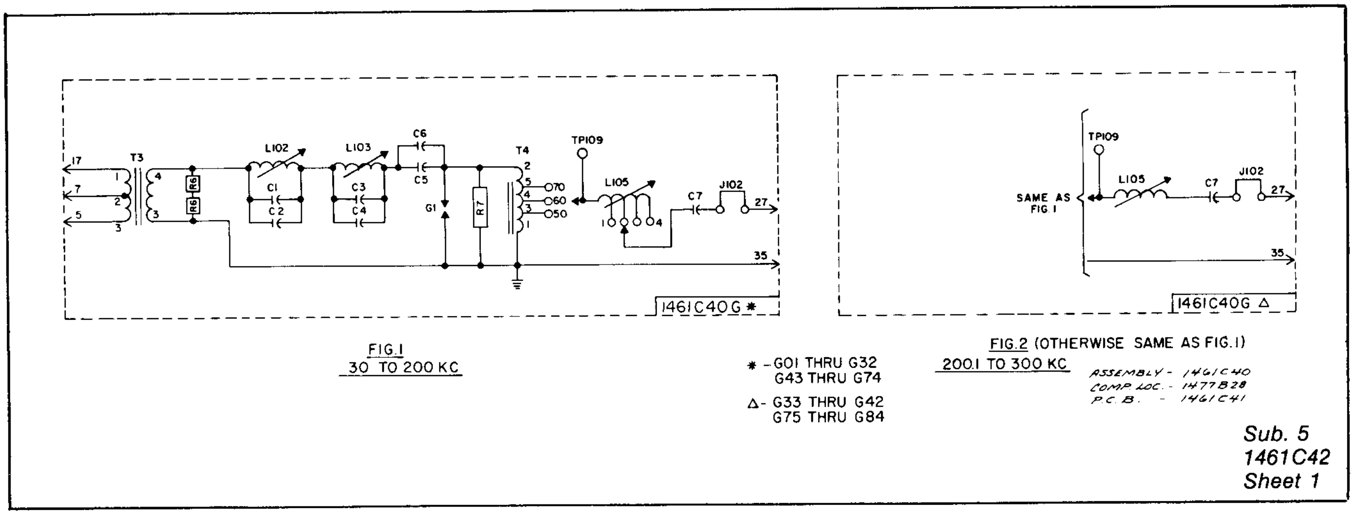


Fig. 14 Internal Schematic Output Filter

PARTS LIST

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

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)	188A317H01
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	400 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% 8W (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)	188A317H01
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)	188A317H01
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% 8W (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% 8W (2 REQ)	188A317H01
R7 RESISTOR	15K 10% 2W	187A642H55
G1 LIGHTNING ARRESTER		877A116H01

1461C40G33,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

1461C40G34,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

1461C40G35,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

1461C40G36,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

1461C40G37,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

1461C40G38,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

1461C40G39,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

1461C40G40,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

1461C40G41,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

1461C40G42,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

Sub. 1
1461C89

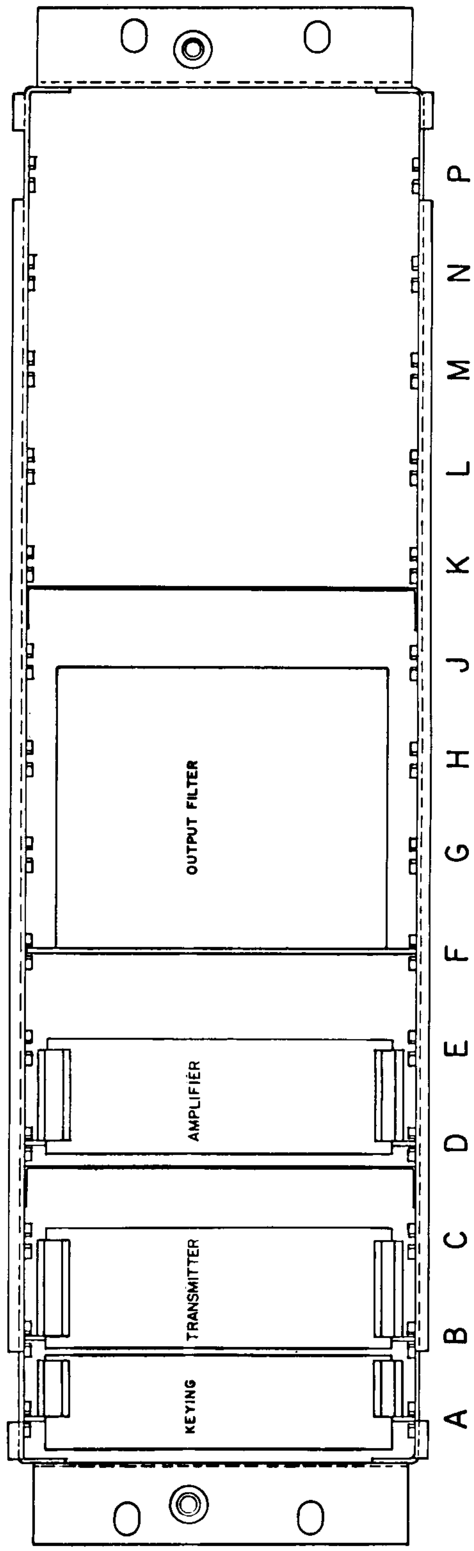


Fig. 15 Module Location

INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE TCF-10 POWER LINE CARRIER FREQUENCY-SHIFT TRANSMITTER EQUIPMENT 3 FREQUENCY—10 WATT/1-3.25 WATT/10 WATT—WITH VOICE

THIS SHEET NOTES CHANGES WHICH SHOULD BE MADE IN INSTRUCTION LEAFLET I. L. 41-945.74 DATED MARCH 1979.

CØMPØNENT		DESCRIPTIØN	STYLE NØ.
C1	CAPACITØR	.047UF 200V	849A437H04
C2	CAPACITØR	.047UF 200V	849A437H04
C3	CAPACITØR	.047UF 200V	849A437H04
C4	CAPACITØR	.047UF 200V	849A437H04
D1	DIØDE	1N645A	837A692H03
D2	DIØDE	1N645A	837A692H03
D3	DIØDE	1N645A	837A692H03
D4	DIØDE	1N645A	837A692H03
D5	DIØDE	1N645A	837A692H03
D6	DIØDE	1N645A	837A692H03
D7	DIØDE	1N645A	837A692H03
D8	DIØDE	1N645A	837A692H03
D9	DIØDE	1N645A	837A692H03
D10	DIØDE	1N645A	837A692H03
D11	DIØDE	1N645A	837A692H03
D12	DIØDE	1N645A	837A692H03
D13	DIØDE	1N645A	837A692H03
D14	DIØDE	1N645A	837A692H03
D15	DIØDE	1N645A	837A692H03
D16	DIØDE	1N645A	837A692H03
D17	DIØDE	LED	3508A22H01
R1	RESISTØR	18.0K .50W 2%	629A531H62
R2	RESISTØR	51.0K .50W 2%	629A531H73
R3	RESISTØR	1500.0 .50W 2%	629A531H36
R4	RESISTØR	6200.0 .50W 2%	629A531H51
R5	RESISTØR	10.0K .50W 2%	629A531H56
R6	RESISTØR	12.0K .50W 2%	629A531H58
R7	RESISTØR	27.0K .50W 2%	629A531H66
R8	RESISTØR	12.0K .50W 2%	629A531H58
R9	RESISTØR	27.0K .50W 2%	629A531H66
R10	RESISTØR	12.0K .50W 2%	629A531H58
R11	RESISTØR	18.0K .50W 2%	629A531H62
R12	RESISTØR	1500.0 .50W 2%	629A531H36
R13	RESISTØR	6200.0 .50W 2%	629A531H51
R14	RESISTØR	10.0K .50W 2%	629A531H56
R15	RESISTØR	12.0K .50W 2%	629A531H58
R16	RESISTØR	10.0K .50W 2%	629A531H56
R17	RESISTØR	27.0K .50W 2%	629A531H66
R18	RESISTØR	12.0K .50W 2%	629A531H58
R19	RESISTØR	4.7K .50W 2%	629A531H48
R20	RESISTØR	12.0K .50W 2%	629A531H58
R21	RESISTØR	10.0K .50W 2%	629A531H56
R22	RESISTØR	18.0K .50W 2%	629A531H62
R23	RESISTØR	51.0K .50W 2%	629A531H73
R24	RESISTØR	1800.0 .50W 2%	629A531H38
R25	RESISTØR	18.0K .50W 2%	629A531H62
R26	RESISTØR	51.0K .50W 2%	629A531H73
R27	RESISTØR	1800.0 .50W 2%	629A531H38
R28	RESISTØR	1500.0 .50W 2%	629A531H36
R29	RESISTØR	6200.0 .50W 2%	629A531H51
R30	RESISTØR	10.0K .50W 2%	629A531H56
R31	RESISTØR	12.0K .50W 2%	629A531H58
R32	RESISTØR	4.7K .50W 2%	629A531H48
R33	RESISTØR	12.0K .50W 2%	629A531H58
R34	RESISTØR	1500.0 .50W 2%	629A531H36
R35	RESISTØR	6200.0 .50W 2%	629A531H51
R36	RESISTØR	10.0K .50W 2%	629A531H56
R37	RESISTØR	12.0K .50W 2%	629A531H58
R38	RESISTØR	12.0K .50W 2%	629A531H58
R39	RESISTØR	4.7K .50W 2%	629A531H48
R40	RESISTØR	27.0K .50W 2%	629A531H66
R41	RESISTØR	10.0K .50W 2%	629A531H56
R42	RESISTØR	12.0K .50W 2%	629A531H58
R43	RESISTØR	27.0K .50W 2%	629A531H66
R44	RESISTØR	12.0K .50W 2%	629A531H58
R45	RESISTØR	10.0K .50W 2%	629A531H56
R46	RESISTØR	4.7K .50W 2%	629A531H48
R47	RESISTØR	12.0K .50W 2%	629A531H58
* R49	RESISTØR	10.0K3.00W 5%	763A127H15
△ R49	RESISTOR	27.5K 3.00W	763A126H60
R50	JUMPER	0 OHMS	862A478H01
J2	JUMPER	0 OHMS	862A478H01
Q1	TRANSISTØR	2N699	184A638H19
Q2	TRANSISTØR	2N699	184A638H19
Q3	TRANSISTØR	2N699	184A638H19
Q4	TRANSISTØR	2N699	184A638H19
Q5	TRANSISTØR	2N699	184A638H19
Q6	TRANSISTØR	2N4356	849A441H02
Q7	TRANSISTØR	2N699	184A638H19
Q8	TRANSISTØR	2N4356	849A441H02
Q9	TRANSISTØR	2N699	184A638H19
Q10	TRANSISTØR	2N4356	849A441H02
Q11	TRANSISTØR	2N699	184A638H19
Q12	TRANSISTØR	2N699	184A638H19
Q13	TRANSISTØR	2N4356	849A441H02
Z1	ZENER	1N3686B 20.0V	185A212H06
Z2	ZENER	1N957B 6.8V	186A797H06
Z3	ZENER	1N3686B 20.0V	185A212H06
Z4	ZENER	1N957B 6.8V	186A797H06
Z5	ZENER	1R200 200.0V	629A369H01
Z6	ZENER	1R200 200.0V	629A369H01
Z7	ZENER	1R200 200.0V	629A369H01
Z8	ZENER	1R200 200.0V	629A369H01
Z9	ZENER	1R200 200.0V	629A369H01
Z10	ZENER	1R200 200.0V	629A369H01
Z11	ZENER	1N3686B 20.0V	185A212H06
Z12	ZENER	1N3686B 20.0V	185A212H06
Z13	ZENER	1N957B 6.8V	186A797H06
Z14	ZENER	1N957B 6.8V	186A797H06

* - FOR 48V G02
△ - FOR 125V G01

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Fig. 11[a]. Electrical Parts List for Power & Keying Module.

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.

(OVER)

CØMPØNENT		DESCRIPTIØN	STYLE NØ.
C51	CAPACITØR	1500.000PF 500V	762A757H03
C54	CAPACITØR	.10UF 200V	187A624H01
C56	CAPACITØR	2000.000PF 500V	187A584H01
C57	CAPACITØR	2000.000PF 500V	187A584H01
C58	CAPACITØR	.250UF 200V	187A624H02
C59	CAPACITØR	100.000PF 500V	762A757H01
C60	CAPACITØR	100.000PF 500V	762A757H01
C61	CAPACITØR	.250UF 200V	187A624H02
C62	CAPACITØR	4700.000PF 500V	762A757H04
C63	CAPACITØR	1000.000PF 500V	762A757H02
C64	CAPACITØR	.250UF 200V	187A624H02
C65	CAPACITØR	.250UF 200V	187A624H02
C66	CAPACITØR	.250UF 200V	187A624H02
C67	CAPACITØR	.250UF 200V	187A624H02
C68	CAPACITØR	.500UF 200V	187A624H11
C69	CAPACITØR	.250UF 200V	187A624H02
C70	CAPACITØR	300.000PF 500V	187A584H09
C71	CAPACITØR	3.000PF 500V	861A846H03
C72	CAPACITØR	3.000PF 500V	861A846H03
C73	CAPACITØR	3.000PF 500V	861A846H03
C74	CAPACITØR	1.000UF 200V	187A624H04
C75	CAPACITØR	.500UF 200V	187A624H11
C76	CAPACITØR	.010UF 600V	764A278H10
C77	CAPACITØR	.470UF 200V	188A669H01
C78	CAPACITØR	3.000PF 500V	861A846H03
C80	CAPACITØR	1500.000PF 500V	762A757H03
D51	DIØDE	1N628	184A855H12
D52	DIØDE	1N628	184A855H12
D55	DIØDE	1N457A	184A855H07
D56	DIØDE	1N628	184A855H12
D57	DIØDE	1N628	184A855H12
D59	DIØDE	1N4822	188A342H11
D53	DIODE	1N628	184A855H12
D58	DIODE	1N628	184A855H12
R64	PØT	1.0K .12W	629A430H02
R70	PØT	1.0K .12W	629A430H02
R82	PØT	25.0K .12W	629A430H09
R51	RESISTØR	10.0K .50W 5%	184A763H51
R52	RESISTØR	10.0K .50W 5%	184A763H51
R53	RESISTØR	10.0K .50W 5%	184A763H51
R54	RESISTØR	10.0K .50W 2%	184A763H51
R55	RESISTØR	100.0 .50W 5%	184A763H03
R56	RESISTØR	3600.0 .50W 5%	184A763H40
R57	RESISTØR	3600.0 .50W 5%	184A763H40
R58	RESISTØR	100.0 .50W 5%	184A763H03
R59	RESISTØR	10.0K .50W 5%	184A763H51
R60	RESISTØR	5600.0 .50W 5%	184A763H45
R61	RESISTØR	15.0K .50W 5%	184A763H55
R62	RESISTØR	10.0K .50W 5%	184A763H51
R63	SENSISTOR	1.2K .12W 10%	187A685H03
R65	RESISTØR	5600.0 .50W 5%	184A763H45
R66	RESISTØR	15 K .50W 5%	184A763H55
R67	RESISTØR	200 K .50W 2%	629A531H87
R68	RESISTØR	330.0 .50W 5%	184A763H15
△-R69	RESISTØR	7 K 3.00W 1%	763A126H95
R71	RESISTØR	6.5K .50W 1%	848A820H27
R72	RESISTØR	5600.0 .50W 5%	184A763H45
R76	RESISTØR	2000.0 .50W 5%	184A763H34
R77	RESISTØR	2.7 1.00W 0%	629A371H24
R78	RESISTØR	2.7 1.00W 0%	629A371H24
R81	RESISTØR	1000.0 .50W 1%	848A819H48
R83	RESISTØR	10.0K .50W 5%	184A763H51
R84	RESISTØR	27.0 .50W 5%	187A290H11
R85	RESISTØR	10.0 .00W10%	185A211H03
R86	RESISTØR	750.0 .50W 1%	848A819H36
R87	RESISTØR	7K 3.00W 1%	763A126H95
R88	RESISTØR	10.0K .50W 5%	184A763H51
R89	RESISTØR	2000.0 .50W 5%	184A763H34
✱-R69	RESISTOR	800.0 3.00W 5%	184A859H06
Q51	TRANSISTØR	2N697	184A638H18
Q52	TRANSISTØR	2N697	184A638H18
Q53	TRANSISTØR	2N697	184A638H18
Q54	TRANSISTØR	2N699	184A638H19
Q55	TRANSISTØR	2N697	184A638H18
Z54	ZENER	1N3686B 20.0V	185A212H06
T51	TRANSFORMER		606B537G01
T52	TRANSFORMER		606B537G03
Y1	CRYSTAL	MATCHED PAIR	D-SPEC
Y2	CRYSTAL	MATCHED PAIR	D-SPEC
C52	TRIMMER	5.5-18PF	879A834H01
C53	TRIMMER	5.5-18PF	879A834H01
C55	TRIMMER	5.5-18PF	879A834H01
C79	TRIMMER	5.5-18PF	879A834H01

✱ = 48V (G01-G03)

△ = 125V (G02-G04)

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Fig. 12 [a]. Electrical Parts List for Transmitter Module.