

INSTRUCTION MANUAL

**FREQUENCY SHIFT
TONE KEYS**

MODEL TK-100

Electrocom[®] INDUSTRIES

1105 NORTH IRONWOOD DRIVE

SOUTH BEND, INDIANA



FIGURE 1 - ELECTROCOM TK-100 TONE KEYER

SECTION 1 DESCRIPTION

1.1 GENERAL

The Electrocom Model TK-100 is a self-contained, solid state audio tone oscillator that may be keyed by current input or contact closure to either of two tone frequencies. These keyed tones are suitable for feeding into audio amplifiers of AM or FM transmitters or over telephone lines for transmitting Audio Frequency Shift (AFSK) teletypewriter, data, or control signals. This tone keyer is also suitable for use with high suppression (50 db. or greater) single sideband suppressed carrier transmitters for generating Frequency Shift (FSK) signals. Provision is incorporated for CW keying of either tone, primarily for identification purposes.

A high degree of stability is achieved by the use of a semiconductor regulated power supply and a hermetically sealed, precision tuned frequency control network. This network is a plug-in assembly incorporating a quality toroidal inductor, and may easily be changed for use on different tone channels or frequency shifts. Both output level and mark/space amplitude balance controls are supplied as screwdriver adjustments. In addition, suitable switching is provided on the front panel of the TK-100 to facilitate complete station control when operating on radio-teletype.

The following paragraphs will describe the versatility and many operating features of this equipment.

1.2 SPECIFICATIONS

Audio output: .5 volt rms into 600 ohm resistive load, variable level control

Output impedance: 600 ohms nominal, unbalanced or balanced

Operating temperature range: -20 to 65° C.

Standard tone frequencies: 2125 and 2975 cps*

Calibration accuracy (25° C. ambient): ± 5 cps*

F S Input signal (normal or reverse sensing):

1. Current input: 20 to 60 ma. for mark, 0 ma. for space
2. Contact closure (1.5 ma. circulated thru contacts)
3. Voltage input: 12 to 20 v. for mark, 0 v. for space, 2000 ohm maximum source resistance

C W Input signal: Keying contacts

Maximum F S Keying speed: 200 WPM (150 bauds)

Power input: 95-135 or 190-270 volts, 50-60 cps, 10 watts max.

Case: Aluminum, grey enamel, 5-1/4 x 3-1/4 x 5 inches deep

Panel: Etched aluminum, blue-grey enamel background

Chassis: Aluminum, iridite finish

Weight: 2.5 pounds

*Other frequencies and calibration accuracies available on special order.

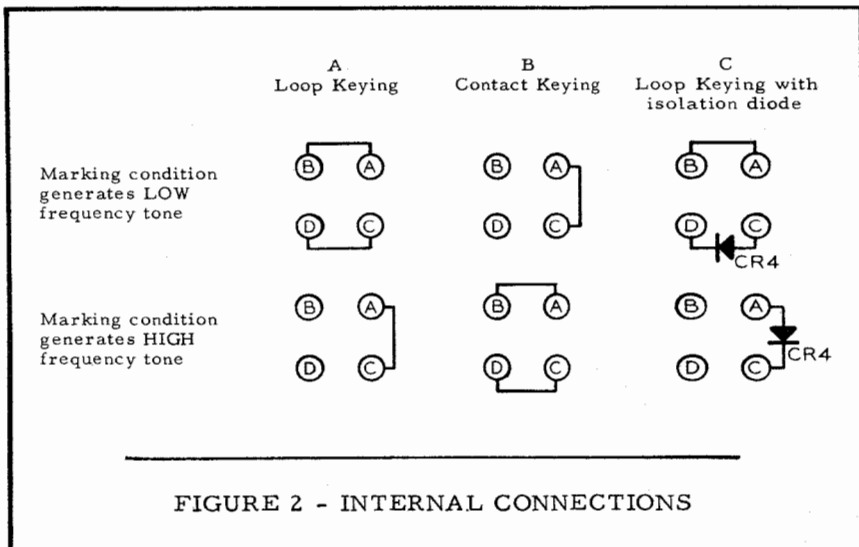
SECTION 2 INSTALLATION

2.1 UNPACKING

Carefully remove the equipment from the packing carton and examine for any possible damage which may have occurred during transit. Remove the unit from its case as described in Section 5 for a visual inspection. The packing holding the tone network firmly in place may now be removed. Check to see that the controls turn properly. Should any damage be apparent, file a claim immediately with the transportation company.

2.2 LOCATION

The TK-100 case may be placed in any position either on the operating table or on top of other equipment. Location in areas of excessive heat should be avoided. Should rack mounting be desired, a standard 3-1/2 by 19 inch wide rack panel is available. One panel can be supplied to accommodate as many as three TK-100 units.



2.3 INTERNAL CONNECTIONS

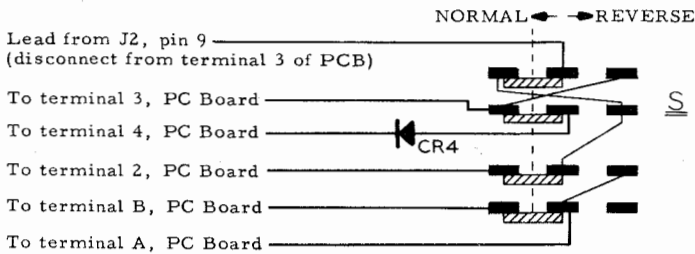
Terminals A, B, C, and D are located on the printed circuit board directly beneath the "Frequency Network." These terminals may be connected together as shown in figure 2 to allow a marking condition to produce either tone frequency. Connections shown in 2A are for loop keying, those in 2B are for contact keying. The TK-100 is factory wired for loopkeying with a mark frequency of 2125 cps.

When loopkeying is used, a small amount of current from the loop applies a voltage on the oscillator circuit maintaining a low level output signal after the TK-100 power is turned off. When operating the radio-teletype system from the TK-100 control switch, the audio output is shorted during receive periods thereby preventing this tone from coupling into other circuits. If a particular installation requires the control of power to the TK-100 from a remote point, whereby the built in control switch would not be used, this condition may be eliminated if necessary by connecting a diode as shown in figure 2C.

Figure 3 shows connections for a shift reversing switch, should this feature be desired.

2.4 EXTERNAL CONNECTIONS

All external connections are provided on the rear of the cabinet. A normally closed jack accommodates a key for C W operation. The remaining connections are to the 9 pin socket, J2, and are as follows:



NOTE: NORMAL produces low frequency tone for mark condition when using loop keying; high frequency tone when using contact keying.

REVERSE produces high frequency tone for mark condition when using loop keying; low frequency tone when using contact keying.

S- 4PDT Slide Switch, Electrocom part number SW 742

CR4- Diode, Electrocom part number 10031

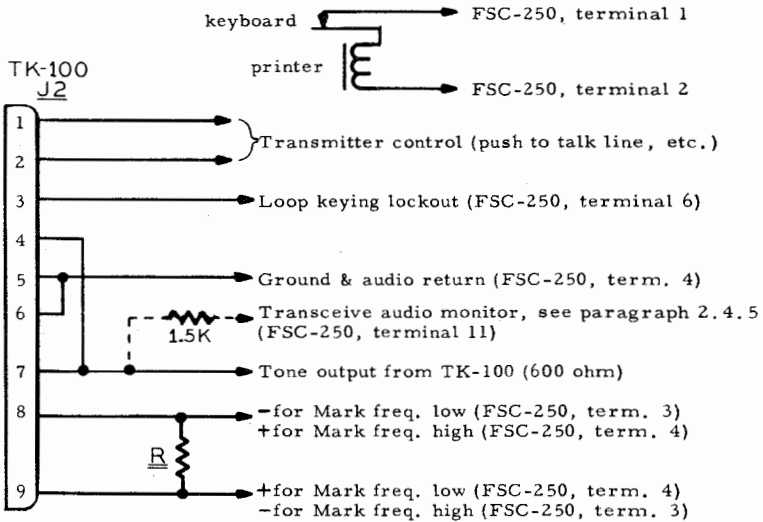
FIGURE 3 - SHIFT REVERSING SWITCH

2.4.1 Control Switching

Terminals 1 thru 5 of J2 are used for switching associated equipment when the TK-100 is used for station control. Terminals 1 and 2 are connected together when switch S1 on the front panel is placed in the "SEND" position and is normally used for transmitter-receiver changeover control. Terminal 5 connects to terminal 3 when the control switch is placed in the "TEST" or "SEND" positions, and to terminal 4 when placed in the "RECEIVE" position. When loop current keying is employed, these terminals allow "locking" the converter local loop in a marking condition during transmission, and place a ground on the audio output of the tone oscillator. If keyboard contact keying is used, these contacts connect the input of the Frequency Shift Converter to either the receiver output for rty reception, or to the output of the tone keyer for testing of the system and for local printing during transmission. Various methods for connecting these terminals are shown in figure 4. Interconnections for use with the FSC-250 are also indicated.

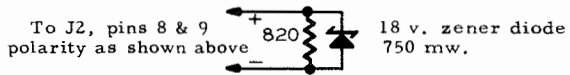
2.4.2 FS Keying Connections

Terminals 8 and 9 may be connected either to the DC loop or to keyboard contacts for sensing the frequency shift information. DC polarity must be properly observed when sensing from loop current in order for keying to take place. Proper connections for both normal and reverse loop sensing are shown in figure 4A. When loop current keying is used, the keyer senses the voltage

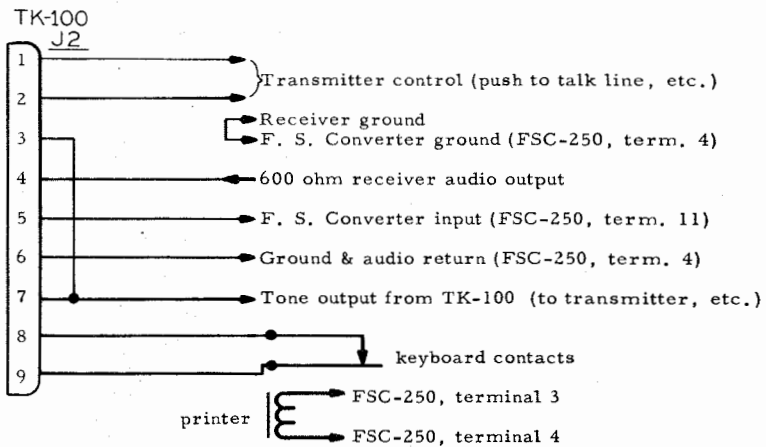


NOTE: R=270 ohm, 2 watt for 60 ma. loop
560 ohm, 1 watt for 30 ma. loop
820 ohm, 1 watt for 20 ma. loop

The following connection will allow operation on any loop current from 20 to 60 milliamperes. Polarity of zener diode must be observed.



CIRCUIT A - LOOP KEYING



CIRCUIT B - CONTACT KEYING

FIGURE 4 - EXTERNAL CONNECTIONS

developed across a resistance placed in series with the teleprinter loop. Since a keying potential of approximately 18 volts is optimum for this circuit, the value of resistance required varies for different values of loop current. Resistances are given for 20, 30, and 60 milliamperes loops.

When operating from contact closure, figure 4B, no polarity need be observed and terminals 8 and 9 go directly to the contacts. Occasionally high contact resistance fluctuations will cause noise on the keyed signal. If this condition occurs, connect a .1 mfd. capacitor across terminals 8 and 9.

Since the power input and audio output circuits provide D C isolation from the TK-100 F S input circuit, the keyer may be connected at any point in the D C loop. It is, however, desirable to connect this input as close to ground as possible in order to keep the potential between keyer circuitry and ground to a minimum.

2.4.3 C W Keying

A normally closed jack, J3, on the rear panel allows C W keying of the TK-100. This jack is connected to circuitry that is floating from chassis ground. It is important that neither side of the key be grounded or connected to any other circuit. Here again it is desirable that any connection of the TK-100 to the D C loop be close to ground potential, in order to minimize the voltage between the key and ground.

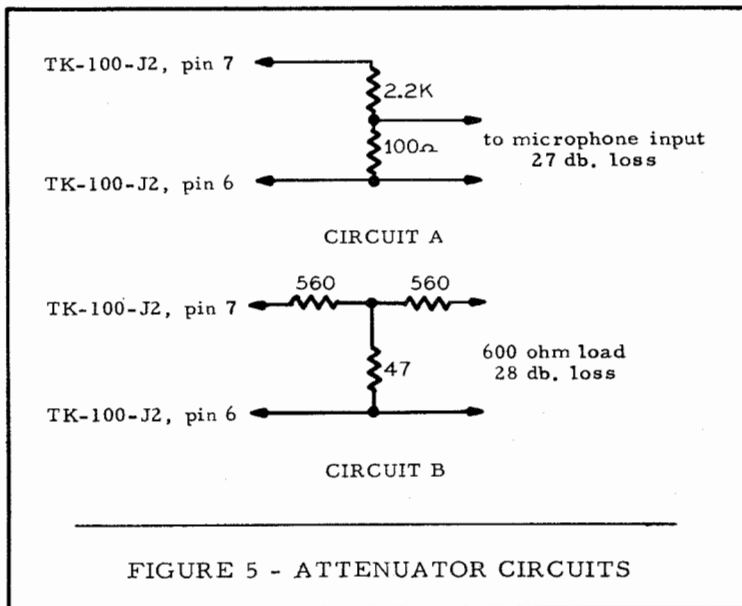
2.4.4 Audio Output

600 ohm output is available at terminals 6 and 7. As supplied from the factory, terminal 6 is connected to chassis ground, providing unbalanced 600 ohm audio output. Should balanced output be required, this ground connection may be removed.

The maximum level out of the TK-100 is in the order of .5 v rms when feeding into a 600 ohm load, or 1 volt into a high impedance load. In systems where the TK-100 is fed into a low level microphone input this voltage will have to be reduced. A fixed attenuator is recommended to prevent the possibility of overloading the microphone preamplifier of the transmitter, causing distortion and non linear operation. Fine voltage adjustment is then available by use of the output level control. Recommended attenuator circuits are shown in figure 5. Circuit A is a simple voltage divider which is satisfactory in most applications. Should the device being fed require a 600 ohm source, the constant impedance attenuator shown in Circuit B may be used.

2.4.5 Monitoring Connection

When loop current keying is used with the TK-100, the control circuitry shown in figure 4A allows monitoring of the transmitted signal on the monitor of the Frequency Shift Converter, if the receiver is left on during transmit periods. In many AFSK systems, and with most of the popular transceiver type of SSB systems, the receiver portion is muted during the transmit period. The connection shown by dashed lines in figure 4A will supply a small tone voltage from the TK-100 into the converter during the



transmit period which provides a visual monitor of the tone keyer output during transmission. This connection should not be used when visually monitoring "off the air."

2.4.6 Power

The power cord may now be plugged into a source of 115 v., 50-60 cps power. The unit is fused with a 1/8 ampere delay type fuse. 230 volt operation may be obtained by removing the yellow and brown power transformer (T2) leads from the terminal board, connecting these leads together, and insulating this connection with sleeving or tape. A 1/16 a. delay type fuse should be used for 230 volt operation.

2.5 USE WITH SSB TRANSMITTERS HAVING AUTOMATIC LOAD OR DRIVE CONTROL

Greater output stability may be obtained by disabling the automatic load or drive control circuits on ssb transmitters so equipped when operating them on radio-teletype systems. The time constants of these circuits are normally designed for use with voice operation and are too long to properly accommodate variations produced by teletype keying. Most transmitters so equipped have an external ALC connection which may be grounded to disable the ALC feature.

SECTION 3

OPERATION

3.1 CONTROLS, FRONT PANEL

3.1.1 Control and Power Switch

The three position rotary switch on the TK-100 switches power on and off to the tone keyer and also contains contacts for controlling the complete station during radio-teletype operation. When connected as described in section 2, the "TEST" position allows local testing of the teletypewriter or will hold the printer in a steady marking condition. This position is particularly useful during periods of CW identification, to prevent random operation.

When in the "RECEIVE" position the TK-100 power is turned off, the transmitter control line is disabled, the input of the converter is connected only to the receiver audio output, and the converter keying circuit is allowed to function normally.

The "SEND" position energizes the transmitter control line, turns TK-100 power on, and connects the teleprinter loop for local monitoring. When operating transmitters having voice control (VOX) circuits with this control switch, both the VOX and anti-VOX circuits should be disabled. This will provide positive station control without having to wait for the release time constant of the VOX circuit to discharge, and assure that the transmitter is operated only when the station control selector is in the "SEND" position.

Should TK-100 station control not be desired, this switch may be used to turn the tone keyer power on when placed in either the "TEST" or "SEND" positions.

3.1.2 Balance Control

This screwdriver adjusted front panel control is provided to allow the amplitude of the mark and space tones to be adjusted to the same value. It allows the higher frequency tone to be varied approximately 1.5 db. above or below the amplitude of the lower frequency tone. This feature is somewhat unique to the TK-100 and allows compensation to the audio response of the associated transmitting equipment. When operating into conventional AM or FM transmitters the modulation percentage may be balanced with this control. It is also most useful when feeding SSB transmitters since variations in sideband filter response may be compensated by balancing the power input to the final amplifier. Procedure

for this adjustment is to transmit the low frequency tone and observe the transmitter meter reading. Next transmit the high frequency tone and adjust the "BAL." control for the same meter reading.

3.1.3 Level Control

This screwdriver adjusted front panel control varies the output voltage level of the TK-100. When the voltage requirements out of the tone keyer are low, an output attenuator should be used rather than operate the level control at a very low setting. This arrangement will improve the signal to noise ratio and prevent overloading of the input amplifier of the circuit being fed from the keyer. Suitable attenuators are described in paragraph 2.4.4.

3.2 ADJUSTMENT OF ASSOCIATED EQUIPMENT

The TK-100 may be fed over remote lines or directly into associated transmitting equipment. In either case the gain control of the transmitter should be operated at approximately its normal setting and the modulation percentage (or power input on SSB equipment) should be adjusted with the TK-100 "LEVEL" control. Be certain that all power stages of the associated equipment can withstand continuous operation at the modulation setting used. Many AM communication equipments are designed for speech operation and cannot withstand continuous single tone operation at high modulation percentage. Likewise, many SSB transmitters are designed only for speech or keyed C W operation. In either case only the maximum power allowed on these equipments for continuous single tone operation may be used without possible damage to transmitter components or tubes.

SECTION 4

THEORY OF OPERATION

The operation of the TK-100 is most easily understood by referring to the block diagram, figure 6. The following paragraphs describe the functions of these blocks.

4.1 SWITCH

Keying information from the DC loop or from contact closure provides switching current to the base of the transistor switch Q1. The emitter of this transistor is biased halfway between the maximum and minimum keyed voltage so that switching occurs over a small region in the center of the keyed waveform, thereby reducing any distortion present on the keying information. This bias also improves circuit temperature stability. When Q1 is conducting, a reactance within the frequency control network is shunted across the LC oscillator circuit, thereby shifting the oscillator frequency.

4.2 BALANCE CONTROL

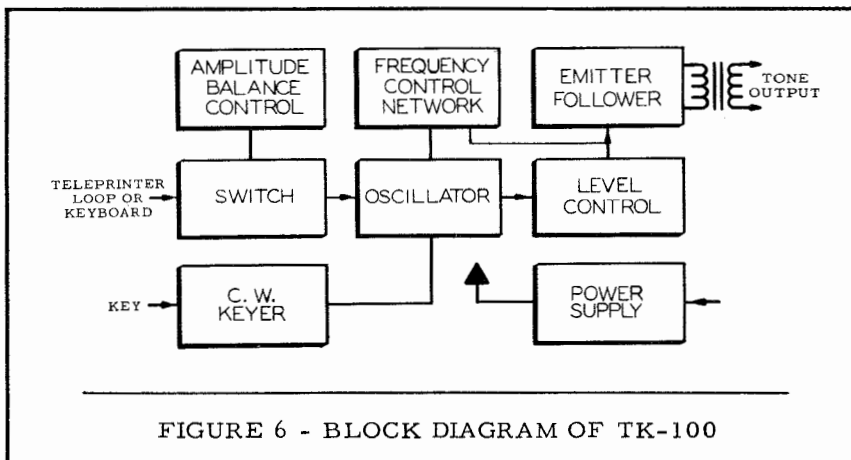
The collector load resistance of Q1 serves to load the oscillator frequency control network. The amount of loading is determined by the setting of the balance control (R5) and provides a convenient method of balancing the amplitude generated by the oscillator for the mark and space conditions. When Q1 is conducting, this high resistance is shunted by the low saturation resistance of the switch, effectively removing it from the circuit.

4.3 OSCILLATOR AND LEVEL CONTROL

A highly stable LC transistor oscillator providing excellent waveform generates the tone frequencies. Output of this oscillator (Q2) is taken across a potentiometer connected from the emitter to common return of the tone keyer. This potentiometer serves as a level control.

4.4 FREQUENCY CONTROL NETWORK

A hermetically sealed, plug-in frequency control network connects both to the oscillator circuit and to the input of the emitter follower. This network is constructed of quality LC components, is precision tuned, and temperature compensated to provide high stability over a wide temperature range. On some networks additional filtering is provided at the input to the emitter follower in order to improve output waveform and shape circuit response.



4.5 C W KEYER

Current is supplied thru R7 and CR2 to bias the oscillator stage off. When the key contacts are closed, bias voltage is removed from the emitter of transistor Q2, and the circuit is permitted to oscillate. Capacitor C5 provides waveshaping during C W keying.

4.6 EMITTER FOLLOWER

Transistor Q3 serves as an emitter follower to provide additional isolation, power gain, and impedance matching to the output circuit. The output of this stage also contains a transformer to allow complete D C circuit isolation between the equipment being fed by the TK-100 and any keyer connection to the D C loop.

4.7 POWER SUPPLY

A transformer input, silicon diode power supply furnishes 22 volts to operate the TK-100. The circuit is regulated over a wide voltage input range by the use of a zener diode, CR1.

The transistors used in the TK-100 are of the NPN type, requiring positive collector supply voltage. In some special models when contact keying is used, the self-contained power supply may be omitted and power taken from the positive supply in the equipment with which the tone keyer is used. Current required from the associated equipment is approximately 20 ma. On these special models the common return is grounded to the associated equipment, and transformer T1 may be omitted. Capacitor C4, which is not contained in the standard model, is required when operating from either an external power supply or from battery power.

SECTION 5

MAINTENANCE

5.1 ASSEMBLY

Two subassemblies simplify maintenance on the TK-100. All transistor circuitry is contained on a printed circuit board while the power supply is mounted on an aluminum chassis. These subassemblies are fastened to the front panel by means of four sets of spacers. The entire assembly is easily removed from the case after removing the two screws adjacent to the nine pin connector, J2, on the rear. Pressure may then be placed against J2 and the fuseholder, and the unit pushed forward. Firm pressure may be required, since a compression fit exists between the assembly and the inside of the case.

5.1.1 Power Supply Subassembly

The power supply subassembly may be separated from the main assembly by removing four screws holding this chassis to the four long spacers. The power supply may then be hinged away from the rest of the assembly to gain access to all components. Component location is shown in figure 8.

5.1.2 Printed Circuit Board

After removing the power supply subassembly, the plug-in frequency network is accessible and the printed circuit board is exposed. All components are clearly identified, as shown in figure 9. Access to the rear of the circuit board is gained by unscrewing the four long spacers and pulling the board away from the front panel. Should it be necessary to remove this board completely for servicing, the wires connected to terminals 1 thru 6 will have to be unsoldered, and the strap holding this cable to the board removed.

Whenever soldering or removing components from the printed circuit board, use a small pencil type soldering iron and apply heat for as short a period as possible. Excessive heat will remove the bond between the copper and the circuit board. It is particularly important not to apply excessive or prolonged heat to any semi-conductors as permanent damage may result.

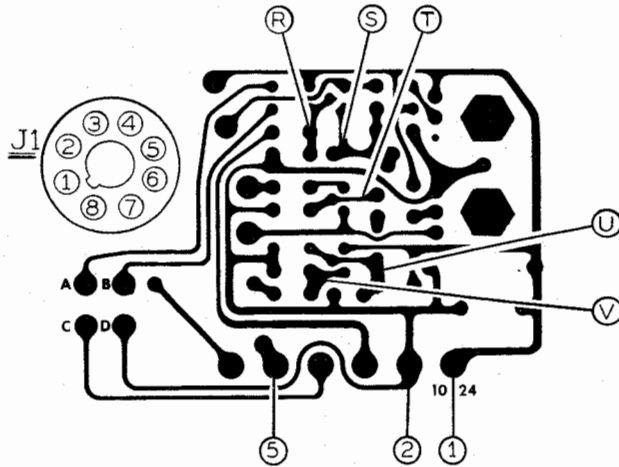
5.2 OBSERVING COMPONENT FAILURES

The balance adjustment will normally allow the higher frequency tone to be varied approximately 1.5 db. above and below the level of the lower frequency tone. Should this range of adjustment not be obtainable, transistor Q1 may be defective. Any resistance below 2000 ohms between the keying leads should produce a mark tone and any resistance over 100K ohms should produce a space tone of constant amplitude and frequency. If this condition cannot be satisfied, again Q1 may be at fault.

Failure of Q2 will normally cause oscillation to cease, or produce poor waveform. Failure of Q3 may cause output voltage to be low or the waveform distorted.

Although testing of transistors is difficult without removing them from the circuit, figure 7 contains voltage measurements that may assist in locating circuit difficulties without removing any components. The unit may be returned to the factory for service at a nominal charge, should difficulty arise.

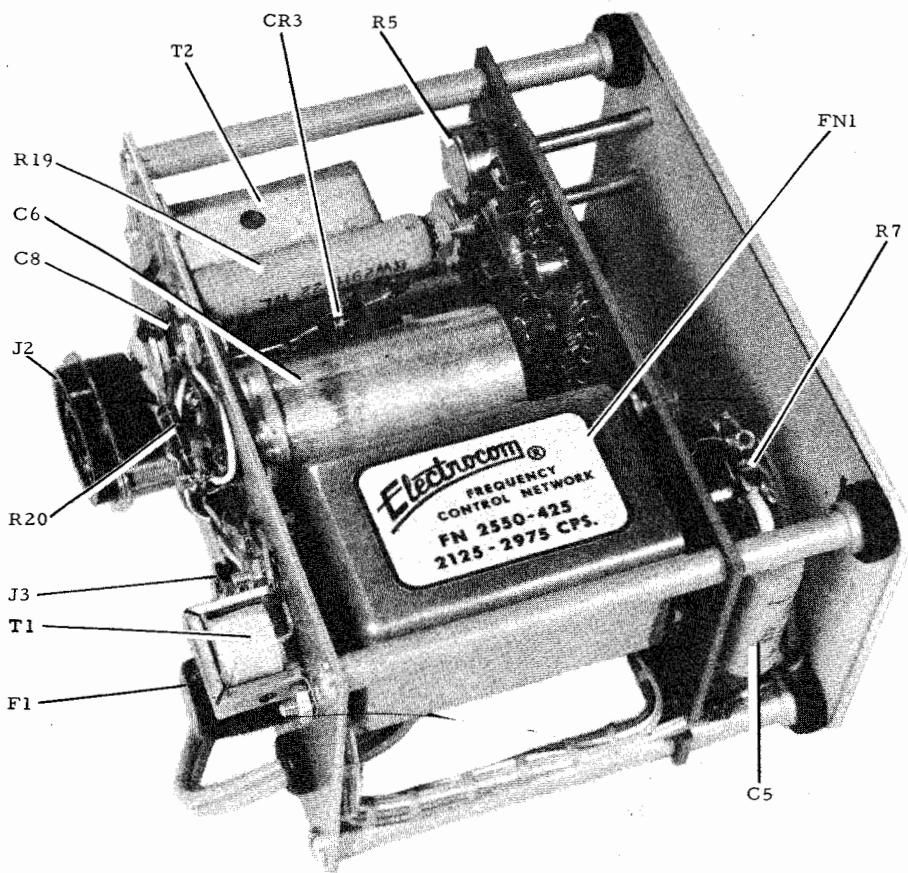
FIGURE 7 - VOLTAGE MEASUREMENTS



METER TEST POINT		VOLTS DC	NOTES			
+	-		*1	*2	*3	*4
R	S	→	-10	.3	.3	-6.5
R	2		.1	14	13	3
S	2		10	14	13	10
J1-6	2		22	13	12	22
T	2	4				
J1-8	T	.4; 2	*5			
J1-8	2	4.5; 7	*5			
U	2	18.5				
U	V	.2				
V	2	18.3				
1	2	22				
5	2	0; 7.5	*5			
C6A (+) (power supply)	C6 case	35				

NOTES:

- *1 A & C jumpered, J2-8 & 9 not connected
- *2 A & C jumpered, J2-8 & 9 connected together
- *3 A & B jumpered, C & D jumpered; J2-8 & 9 not connected
- *4 A & B jumpered, C & D jumpered; J2-8 & 9 connected
- *5 Voltages given for J3 closed and opened respectively



INTERNAL VIEW, TK-100
FIGURE 8

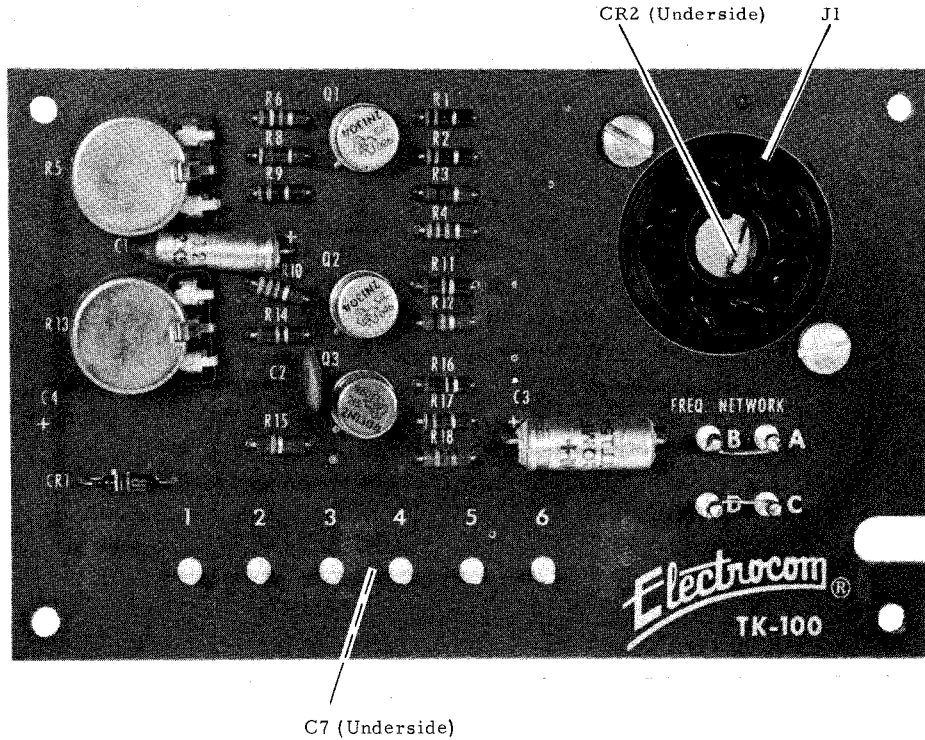
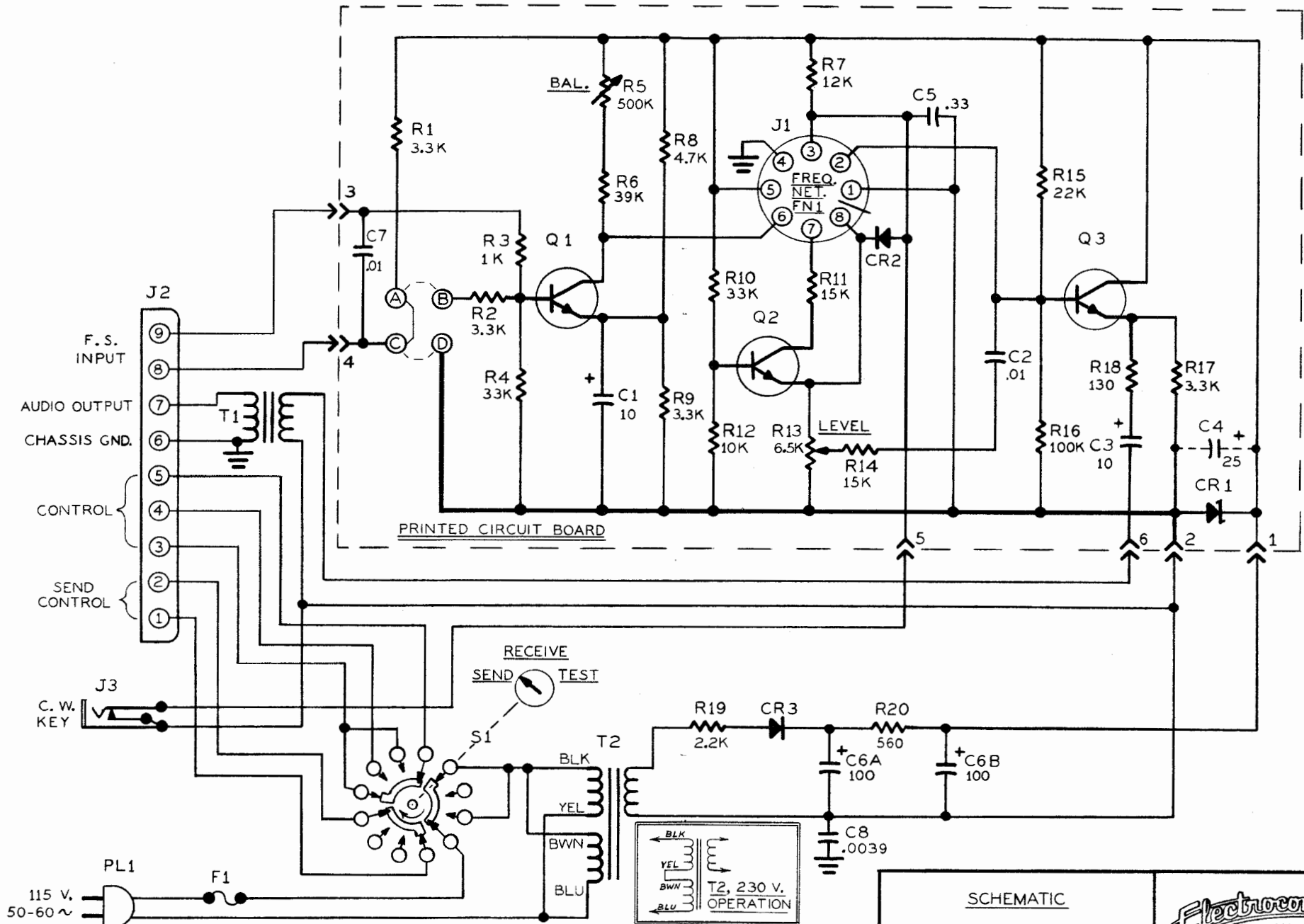


FIGURE 9 - PRINTED CIRCUIT BOARD, TK-100

SERVICE PARTS LIST

ITEM	DESCRIPTION	ELECTROCOM PART NUMBER
C1	Capacitor, tantalum, 10 μ fd., 20 v.	10041
C2	Capacitor, disc ceramic, .01 μ fd., 50 v.	21TG-S10
C3	Capacitor, min. electrolytic, 10 μ fd., 25 v.	10042
C4	Capacitor, min. electrolytic, 25 μ fd., 25 v. (Not used on standard TK-100. Used only on battery or externally powered models.)	10043
C5	Capacitor, mylar tubular, .33 μ fd., 100 v.	22TM-1033
C6	Capacitor, electrolytic, 100-100 μ fd., 50 v.	11B0085
C7	Same as C2	21TG-S10
C8	Capacitor, disc ceramic, .0039 μ fd., 1 kv.	215GA-D39
CR1	Diode, zener, 22 v., 10%, 1 wt.	10033
CR2, CR4	Diode, silicon, 10 μ a. max. @-10 v., 50 piv	10031
CR3	Diode, silicon, 50 ma., 200 piv	10032 (1N2069)
F1	Fuse, 1/8 ampere slow blow (115 v. operation) 1/16 a. slow blow (230 v. operation), 3AG	313.125 313.062
FN1	Frequency Control Network, 2125-2975 cps	FN2550-425
J1	Receptacle, octal socket, molded	167-7MIP8
J2	Receptacle, 9 pin socket, molded, with spacers	10018
J3	Jack, closed circuit type	23-12A
PL1	Plug, cord set, 6 feet, plastic	1917-106
Q1, Q2, Q3	Transistor, type 2N3569 (silicon) or type 2N1304 (germanium)	2N3569 2N1304
R1, R2	Resistor, fixed comp., 3,300 ohm, 10%, 1/4 wt.	RC02B332
R3	Resistor, fixed comp., 1,000 ohm, 10%, 1/4 wt.	RC02B102
R4	Resistor, fixed comp., 33K ohm, 10%, 1/4 wt.	RC02B333
R5	Resistor, variable comp., slotted shaft 500K ohm, 20%, 1/4 wt., log A taper	KX 1290
R6	Resistor, fixed comp., 39K ohm, 10%, 1/4 wt.	RC02B393

R7	Resistor, fixed comp., 12K ohm, 10%, 1/2 wt.	RC05B123
R8	Resistor, fixed comp., 4,700 ohm, 10%, 1/4 wt.	RC02B472
R9	Resistor, fixed comp., 3,300 ohm, 10%, 1/4 wt.	RC02B332
R10	Resistor, fixed comp., 33K ohm, 10%, 1/4 wt.	RC02B333
R11	Resistor, fixed comp., 15K ohm, 10%, 1/4 wt.	RC02B153
R12	Resistor, fixed comp., 10K ohm, 10%, 1/4 wt.	RC02B103
R13	Resistor, variable comp., slotted shaft 6,500 ohm, 10%, 1/4 wt., linear taper	KX 1292A
R14	Resistor, fixed comp., 15K ohm, 10%, 1/4 wt.	RC02B153
R15	Resistor, fixed comp., 22K ohm, 10%, 1/4 wt.	RC02B223
R16	Resistor, fixed comp., 100K ohm, 10%, 1/4 wt.	RC02B104
R17	Resistor, fixed comp., 3,300 ohm, 10%, 1/4 wt.	RC02B332
R18	Resistor, fixed comp., 130 ohm nominal, 1/4 wt. (Actual value is selected during final test and may vary between 100 and 150 ohms.)	RC02A131
R19	Resistor, fixed w.w., 2,200 ohm, 10%, 10 wt.	RW100B222
R20	Resistor, fixed comp., 560 ohm, 10%, 1/2 wt.	RC05B561
S1	Switch, rotary, phenolic wafer, 3 P 3 Position	18757-1
T1	Transformer, output, Primary - 150 ohm Secondary - 500 ohm	10163
T2	Transformer, power, Primary - 115 or 230 v., 50-60 cps.; Secondary - 135 v., 30 ma.	T-173A
XF1	Receptacle, fuse holder, 3AG	13-HKP
<u>CHASSIS AND ASSEMBLY PARTS</u>		
	Case, Deep drawn, grey enamel	10012
	Panel, Etched, blue-grey background	10010
	Power Supply Mtg. Plate, aluminum, iridite	10011
	Printed Circuit Board, drilled	10024
	Spacer, Aluminum, 1.125" long	10015
	Spacer, Aluminum, 2.718" long	10016
	Knob, black pointer	657-3L



NOTES: 1. S1 VIEWED FROM REAR
 2. RESISTANCE IN OHMS
 3. CAPACITANCE IN MFD.

4. C4 USED ONLY ON BATTERY AND EXTERNALLY POWERED MODELS

SCHMATIC
 FREQUENCY SHIFT
 TONE KEYER
 MODEL TK-100

Electrocom
 INDUSTRIES
 1105 N. IRONWOOD DRIVE
 SOUTH BEND, INDIANA

10001-V REV. B
 DATE 2-14-67