



ELECTROCOM MODEL TK-100
FREQUENCY SHIFT TONE KEYER



ELECTROCOM MODEL FSC-250
FREQUENCY SHIFT CONVERTER

2125 Rank
2895 Spink

of KWM2 c/o 222509

TECHNICAL INFORMATION BULLETIN NUMBER 101

RADIO-TELETYPEWRITER OPERATION OF ELECTROCOM TK-100 AND FSC-250 WITH COLLINS SINGLE SIDEBAND EQUIPMENT

It is the purpose of this bulletin to outline the theory, requirements, equipment interconnections, and adjustments for a method which will provide quality, extremely stable radio-teleprinter performance with high suppression SSB equipment such as the Collins "S" line, KWM-2, KWS-1/75A-4, and similar units. The Electrocom Model TK-100 Frequency Shift Tone Keyer and Model FSC-250 Frequency Shift Converter are ideally suited for use in this application and may be connected without any modification to the transmitter or receiver.

THEORY

Single sideband suppressed carrier transmitters having suppression of both the carrier and unwanted sideband in excess of 50 db. will allow the generation of a r f signal when feeding a tone oscillator into the audio section of the transmitter. Since both the carrier and unwanted sideband are suppressed, only one r f output frequency appears when a sinusoidal audio tone is fed into the transmitter. The r f placement of this frequency is the difference between the suppressed carrier frequency of the transmitter and the audio frequency of the tone when operating on Lower Sideband, and the sum of these two frequencies when operating on Upper Sideband. By shifting the frequency of this audio tone the output frequency of the transmitter is shifted an equal amount. Furthermore, since the original frequency shifted signal is heterodyned to the final operating frequency, the amount of shift remains the same regardless of the output frequency. By using a highly stable, low distortion tone oscillator such as the TK-100, the overall stability approaches that of the transmitter itself and no frequency shift adjustment is required to be assured of the correct amount of shift.

Electrocom[®] INDUSTRIES

© 1962

1105 NORTH IRONWOOD DRIVE, SOUTH BEND, INDIANA

REQUIREMENTS

The system described requires (1) an audio tone keyer having low distortion and high stability with provision for "balancing" the output amplitude, (2) a high suppression SSB transmitter properly adjusted to provide maximum carrier and sideband suppression, (3) a stable SSB receiver with filter and audio response to accommodate the tone frequencies being used, and preferably with fast AVC characteristics, (4) a Frequency Shift Converter preferably utilizing the same tone frequencies as the tone keyer, complete with DC loop to operate the teleprinter and an accurate tuning indicator to allow proper frequency setting of the equipment, and (5) a teleprinter with keyboard. Because of the difficulty in maintaining proper adjustment of high speed and polar keying relays, these devices should not be used in a radio-teletype system. Instead, completely electronic keying is preferred.

In vhf systems where Audio Frequency Shift Keying is normally used the standard tone frequencies are 2125 cps for Mark and 2975 cps for Space. Since the "S" line and KWM-2 will not pass the 2975 cps tone, it is necessary to use a lower frequency space tone when operating with this equipment. Tone frequencies suggested for this application are 2125 cps for Mark and 1275 cps for Space. Tone networks and filters are available for these frequencies for both the TK-100 and FSC-250. Since these networks are plug-in units, they may be interchanged so that the TK-100 and FSC-250 may easily be adapted to either system. Should the owner of the "S" line wish to modify his equipment for using the standard 2125 and 2975 cps tones, one possible method for doing so is shown in Figure 2 (transmitter modification) and in Collins bulletin number 523-0182-00, paragraph 1.3.3, dated 15 September 1961 (receiver modification.)*

Since the output power will depend upon the overall gain of the transmitter, it is important that the transmitter have fairly uniform response to the two tones fed into it. On the 32S-1 and KWM-2 transmitters, for example, the audio passband is from approximately 300 to 2500 cps. Tone frequencies of 1275 and 2125 cps fall within this range; however, because variations in the filter response exist within the passband of the sideband filter, it is most desirable to be able to adjust the amplitude ratio of the two tones. Such adjustment will permit compensation for any filter response variation, and thereby allow the transmitter to operate at a constant power input for both mark and space frequencies. Automatic load or drive control circuits could be used to control the gain of the transmitter to the two tones; however, the existing ALC circuits in phone transmitters have time constants which are too long to accommodate the rapid, random variations produced by teletypewriter keying. Also, any transient that may be produced during keying could activate the ALC circuit. These two factors would cause power output fluctuations, and therefore, suggest that the ALC circuit be disabled during rtty operation. The power output for both tones can then be controlled by an amplitude balance adjustment on the tone keyer.

*Available from Collins Radio Company, Amateur Sales Dept., Cedar Rapids, Iowa

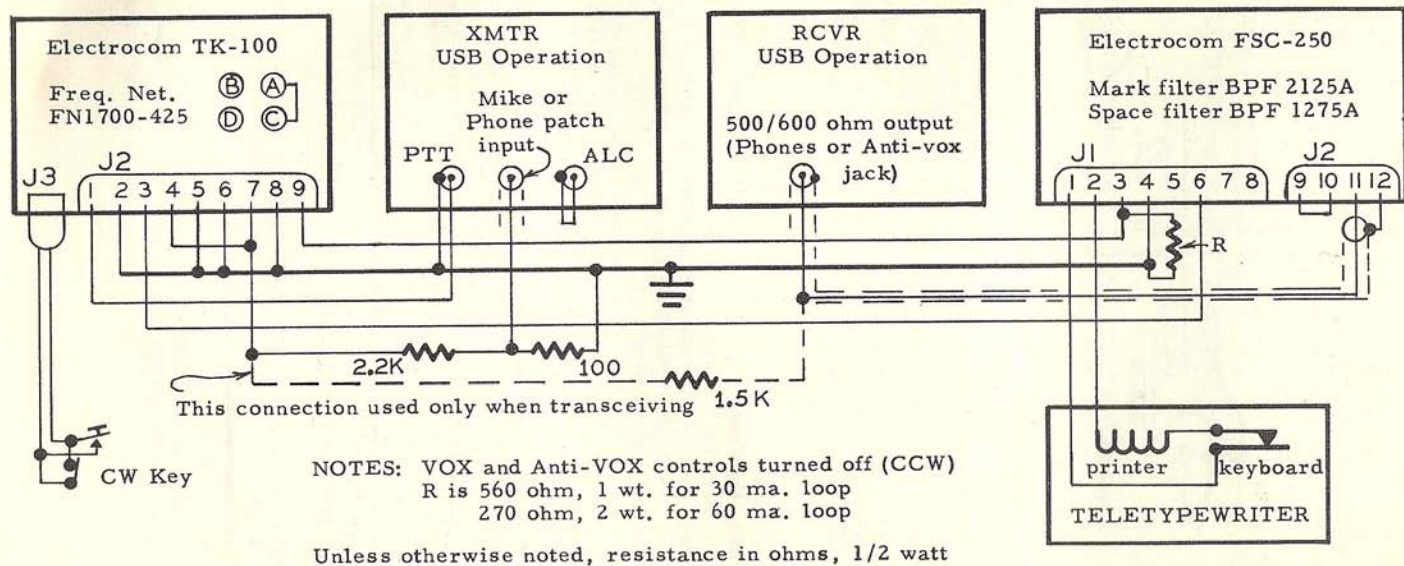


FIGURE 1 - INTERCONNECTIONS OF S-LINE OR KWM-2 WITH TK-100 AND FSC-250

The reception of the rtty signal is accomplished by tuning the receiver to produce the correct tone frequencies for the converter. These two tones correspond to the same tones used for transmitting and are then detected in the converter and changed back to D C pulses suitable for operating the teleprinter. If the same tone frequencies are used in the tone oscillator and in the converter, the system may be used to transceive when using the "S" line or KWM-2.

INTERCONNECTION OF EQUIPMENT

Figure 1 shows the connections required between the TK-100, FSC-250, Collins "S" line or KWM-2, and teletypewriter for a complete radio-teletype system. This circuit allows the 32S-1 and 75S-1 or KWM-2 to be used without modification. Note that tone frequencies of 1275 and 2125 cps are used. Either independent frequency control or transceive type of operation may be used with this system. If independent frequency control of the 32S-1 and 75S-1 is used, it is necessary to disconnect the transceive interconnecting cables normally used between these two units. This will prevent interaction between transmitter and receiver when the receiver is left turned on during the transmit period for "off the air" monitoring on the scope of the FSC-250. When used strictly as a transceiver, the dashed connection shown will allow the scope in the FSC-250 to monitor the output of the tone oscillator during transmission and assure that the tone keyer is operating properly.

The 32S-1 may also be used with receivers having a variable BFO such as the 75S-3 and 75A-4, or with the 75S-1 when modified as described earlier. With these receivers the standard 2125-2975 cps tones may be used. The lower tones (1275-2125 cps) are still required with the 32S-1; therefore, transceive operation cannot be used. When operated in this manner both the 32S-1 and the receiver should be operated in the LSB position. The following changes from the connections shown in Figure 1 are required:

- (1) Disconnect jumper between terminals A & C in TK-100, connect a jumper between terminals A & B and another jumper between terminals C & D.
- (2) Reverse leads going to J2, pins 8 and 9, on TK-100.
- (3) Change space filter in FSC-250 to BPF 2975A.

When a KWS-1 transmitter or a 32S-1 transmitter which has been modified to pass the 2975 cps tone is used, again LSB operation is selected and in addition to the above three changes from Figure 1, Frequency Network FN2550-425 is installed in the TK-100.

The teleprinter equipment is connected with the keyboard and printer in series in all of the above systems. This provides local copy on the machine while typing on the keyboard regardless of the frequency setting of the transmitter and receiver, and with the receiver turned on or off during transmission. In addition, only two connecting wires are required to the teleprinter. Loop keying of this type is far more versatile and assures a more reliable transition between mark and space conditions than contact keying which is often used.

RADIO-TELETYPEWRITER AND CW OPERATION OF ELECTROCOM TK-100-C OR TK-100 AND FSC-250 WITH COLLINS 32RS-1 TRANSCEIVER

It is the purpose of this bulletin to outline the equipment interconnections, adjustments, and operation of a system that will provide quality, extremely stable radio-teleprinter and CW performance with the Collins 32RS-1 transceiver and similar units.

1. INTERCONNECTIONS AND ADJUSTMENTS

1.1 Interconnect units as shown in appropriate wiring diagram, figure 1 or figure 2.

1.2 Tune 32RS-1 as for SSB operation adjusting "transmit audio" gain control for proper microphone (handset) operation. (Normally 10 o'clock setting.)

1.3 Hang up handset on the hook provided on 32RS-1.

1.4 Turn VOX gain to minimum setting. (CCW position)

1.5 Turn TK-100 control switch to SEND position. With the teleprinter circuit in a marking condition (current flowing,) adjust "level" control on TK-100 to drive 32RS-1 just below the point of Power Amplifier saturation. This point will normally be indicated by a meter reading of approximately 15 db. over S9 on the 32RS-1 when the meter selector switch is in the "PA cath ma" position. If a directional wattmeter is included in the 32RS-1 the forward power measured under this condition will be in the order of 95 watts.

Electrocom[®] INDUSTRIES

1105 NORTH IRONWOOD DRIVE, SOUTH BEND, INDIANA

1.6 Depress "break" key on teleprinter in order to place teleprinter circuit in a spacing (no current) condition. Adjust "bal" control on TK-100 for equal steady PA cathode current or wattmeter reading. This adjustment will provide equal power for both mark and space frequencies.

1.7 Increase TK-100 "level" control to the point of PA saturation as indicated by lack of further increase in PA cathode current or power output. The level should be advanced just beyond this threshold so that a slight amount of grid current will be drawn by the 6146 PA tubes. This operating point allows for minimum plate dissipation to the 6146's while delivering maximum power output on radioteletype. The transmitter should not be operated at reduced drive levels when operating with a continuous tone.

The system is now ready for radioteletype operation.

2. OPERATIONAL INFORMATION

2.1 With the switch on the TK-100 placed in the RECEIVE position the 32RS-1 is placed in the normal receiving condition for reception of SSB, RTTY, etc.

2.2 A local test feature is provided in this system for checking the operation of the RTTY equipment without placing the transmitter on the air. With the VOX and Receiver Audio gains both reduced to minimum, placement of the TK-100 switch in the TEST position will provide local monitoring of the mark and space tones on the monitor of the FSC-250. In addition, the teletypewriter may be typed upon for local testing. If the 32RS-1 speaker is turned on, a faint sidetone of these FSK tones may also be heard.

2.3 When the TK-100 control switch is placed in the SEND position the same monitoring feature exists as described in paragraph 2.2, and in addition, the transmitter is placed into operation. The motor of the teleprinter may also be started automatically if the keying selector switch of the FSC-250 is placed in the "mark" or "auto" positions and terminals 7 and 8 are wired to the motor control switch of the teleprinter as described in paragraph 2.3.4, page 4, of the FSC-250 instruction manual. Likewise, the teleprinter at the receiving end of the system will also be started upon receiving the "mark" tone. One second of continuous "space" tone will again turn the teleprinter motors off. Normal voice operation of the system will not cause automatic starting of the teleprinter.

2.4 CW operation of the 32RS-1 is obtained by plugging a key into the jack provided on the rear of the TK-100. With CW operation the equipment is tuned as described above for RTTY transmission.

EQUIPMENT INTERCONNECTIONS

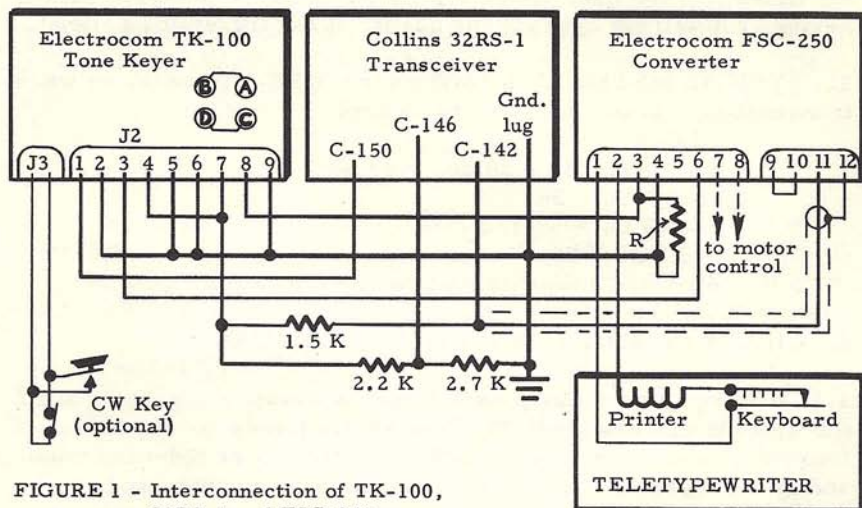


FIGURE 1 - Interconnection of TK-100,
32RS-1 and FSC-250

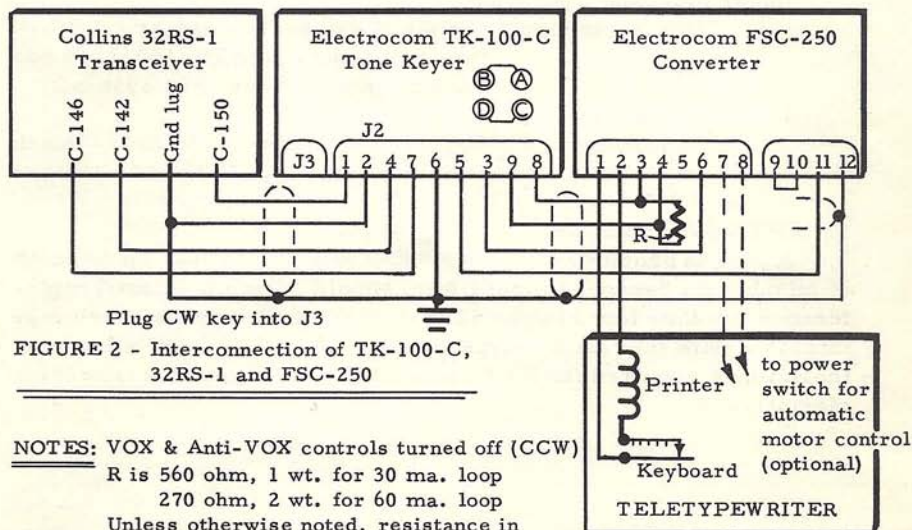


FIGURE 2 - Interconnection of TK-100-C,
32RS-1 and FSC-250

NOTES: VOX & Anti-VOX controls turned off (CCW)

R is 560 ohm, 1 wt. for 30 ma. loop

270 ohm, 2 wt. for 60 ma. loop

Unless otherwise noted, resistance in

ohms, 1/2 watt

2.5 If the 32RS-1 is to be used for RTTY and CW operation only, greater output power stability during keying will be achieved if the ALC is disabled. This may easily be accomplished by removing the ALC rectifier tube in the 32RS-1, V18. When voice operation will also be used with the system the ALC may be left operative at all times. This may produce a slight meter fluctuation during keying, but will not degrade the quality of the transmitted signal.

3. TYPICAL METER READINGS on the 32RS-1 transceiver when transmitting a steady tone are as follows:

ALC-S = 0

PA CATH MA = 20 db. over S9

+275 VDC = S9

+800 VDC = S8-1/2

-75 VDC = S9

Forward power on wattmeter = 110 watts

4. CHOICE OF 32RS-1 CRYSTAL FREQUENCIES

4.1 With equipment interconnections as shown in figures 1 and 2 the system will transmit the "mark" frequency as the lower r f frequency when operating the 32RS-1 in the Upper Sideband mode, and as the higher r f frequency when using Lower Sideband.

4.2 The actual r f frequency of the transmitted mark signal is determined as follows:

Upper Sideband Operation

Mark frequency = Crystal frequency - 455 kc. + Mark
tone frequency from TK-100 (2125 cps
for standard 850 cps shift system.)

Lower Sideband Operation

Mark frequency = Crystal frequency + 455 kc. - Mark
tone frequency from TK-100

5. OPTIONAL FILTERS

A plug is provided within the FSC-250 converter for installation of an optional bandpass input filter, should adjacent channel interference produce tones in the 32RS-1 receiver bandpass which may interfere with the radioteletype signals. This filter will allow only those tones required for RTTY operation to feed into the converter circuitry.

ADDITIONAL INSTRUCTIONS FOR ELECTROCOM® INDUSTRIES MODEL TK-100-C F. S. TONE KEYER

DESCRIPTION

The Electrocom® Model TK-100-C is a modified version of the Model TK-100 frequency shift tone keyer designed to mount in the accessory panel of the Collins 32RS-1 transceiver. The panel of this unit is black with white lettering and matches in appearance other accessory units normally supplied by Collins for use with the 32RS-1. The TK-100-C also contains built in attenuating and mixing resistors to allow direct interconnection into the 32RS-1 and the Electrocom Model FSC-250 frequency shift converter.

All information contained in the TK-100 manual also applies to the TK-100-C with the exception of the connections to J2. The audio mixer/attenuator provided within this keyer presents an output impedance of approximately 1300 ohms and is designed to feed into the high impedance microphone input of the 32RS-1.

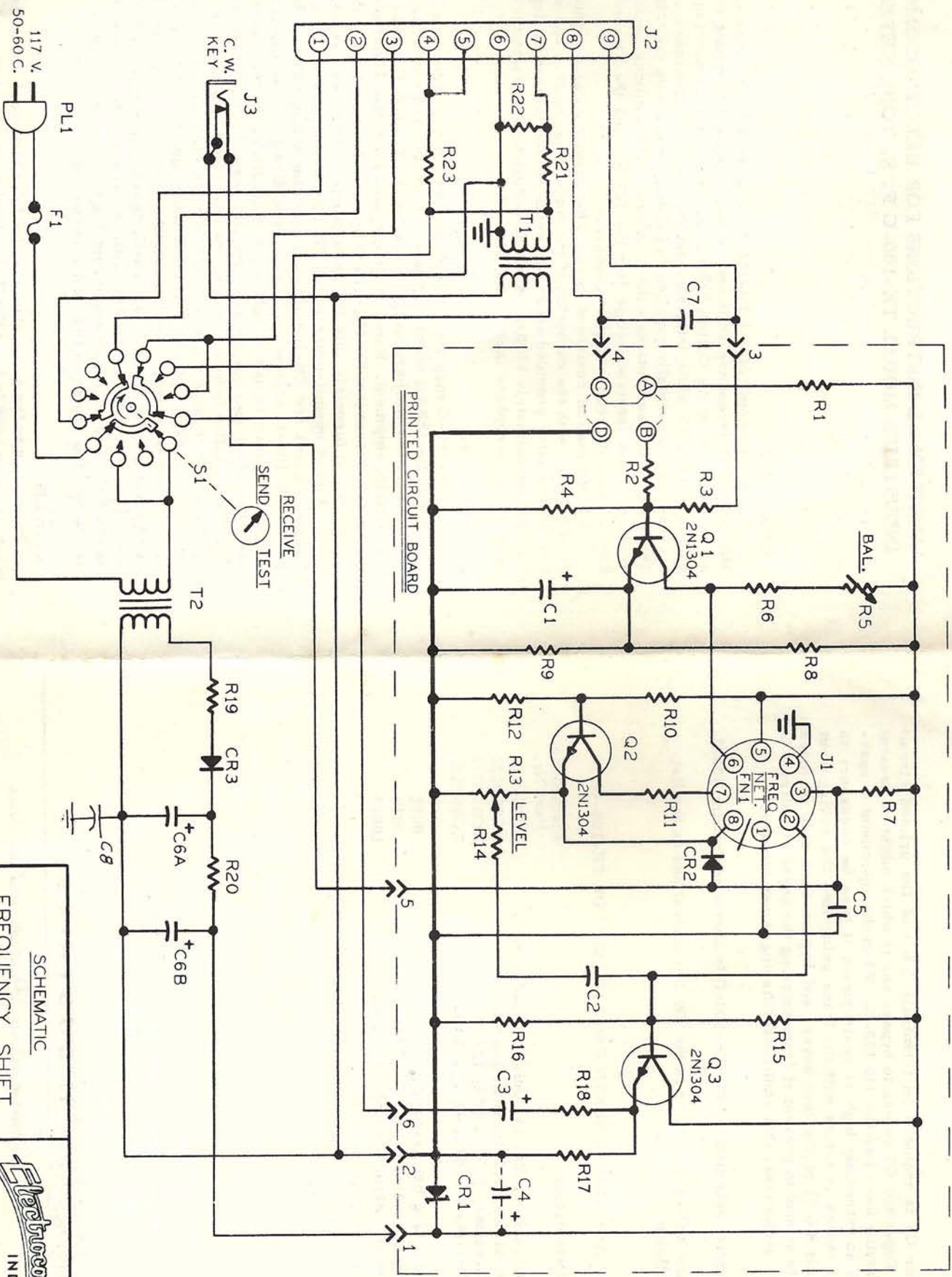
INSTALLATION

The TK-100-C may be mounted into any of the three positions provided in the 32RS-1 accessory panel. Remove and discard the four screws and fiber washers used for holding the TK-100-C panel to its frame during shipment. Remove a blank panel from the 32RS-1 accessory panel, insert the TK-100-C into this space, and secure with the screws which formerly held the blank panel. These screws thread into the tapped mounting bar of the TK-100-C after passing thru the accessory panel and TK-100-C panel mounting holes. When mounting the TK-100-C adjacent to the Collins directional wattmeter, it will be necessary to use a right angle coax fitting on the wattmeter connector which extends towards the tone keyer. This coax fitting should be installed before mounting the tone keyer into position.

Wiring interconnections for the TK-100-C, 32RS-1, and FSC-250 are shown in Figure 2 of "Technical Information Bulletin Number 102." Wiring is easily accomplished with two four-conductor shielded cables feeding from J2 on the TK-100-C: one cable going to the 32RS-1 connections, the other to the FSC-250. A cable kit (Electrocom part number 10092) is available which contains the necessary cable, loop current sensing resistors (R), and accessories.

PARTS LIST

In addition to the parts shown in the TK-100 manual, those listed below are also used in the TK-100-C. Resistors R21, R22, and R23 are mounted on a terminal board directly above connector J2, while



C4 USED ONLY ON BATTERY AND EXTERNALLY POWERED MODELS

SCHEMATIC
FREQUENCY SHIFT
tone keyer
 MODEL TK-100-C

Electronics
INDUSTRIES
 1115 N. IRONWOOD DRIVE
 SOUTH BEND, INDIANA

10002
 REV A
 DATE 2-16-62

capacitor C7 is mounted on terminals 3 & 4 of the printed circuit board. Capacitor C7 serves to bypass any rf which might be present on the keying lines into the TK-100-C. When the equipment is operating in an extremely high rf environment it may be necessary to place rf chokes in series with the leads going into the keying input (terminals 8 & 9) of the tone keyer, and bypass each side of these chokes to ground to prevent rf from entering the keyer circuitry. In normal installations, this additional filtering is not required.

The complete schematic of the TK-100-C is shown on drawing 10002.

Component values are shown in the TK-100 manual and on the list which follows:

ADDITIONAL SERVICE PARTS LIST FOR TK-100-C

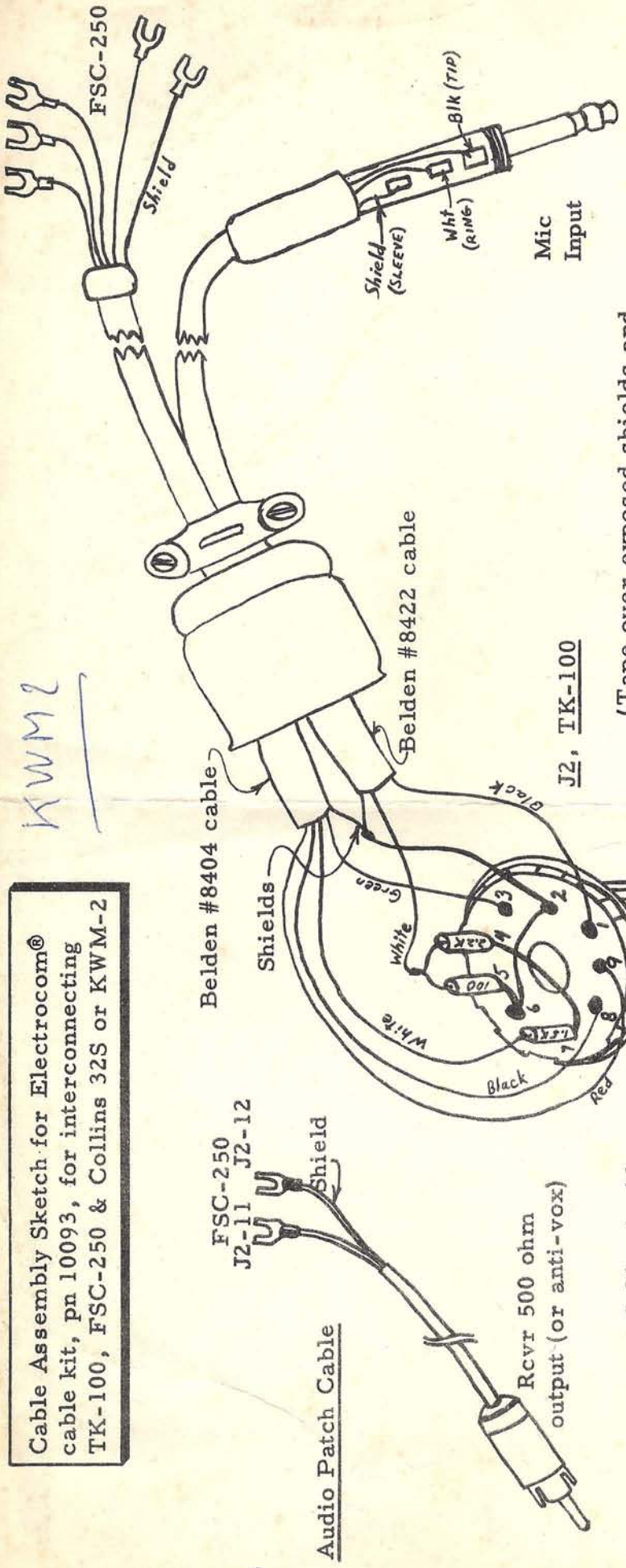
Item	Description	Electrocom Part Nr.
C7	Capacitor, disc ceramic, .01 μ fd., 50 v.	21TG-S10
R21	Resistor, 2.2K Ω , 10%, 1/2 wt.	RC05B222
R22	Resistor, 2.7K Ω , 10%, 1/2 wt.	RC05B272
R23	Resistor, 1.5K Ω , 10%, 1/2 wt.	RC05B152
	Mounting bar assembly	10018
	Spacer, Aluminum, .782" long	10019
	Panel, Aluminum, black enamel	10013

Electrocom[®] INDUSTRIES

Communications Products and Systems

1105 NORTH IRONWOOD DRIVE, SOUTH BEND, INDIANA

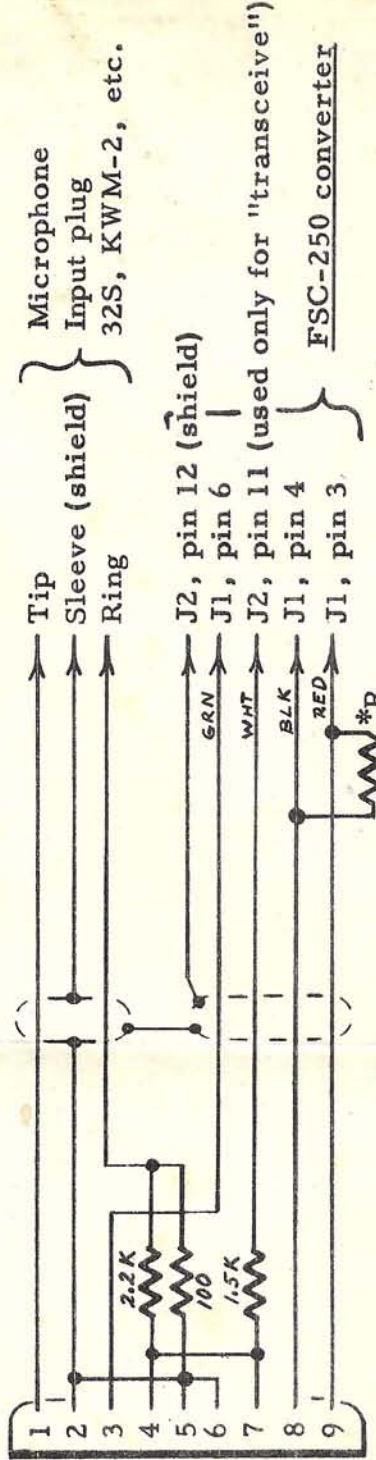
Cable Assembly Sketch for Electrocom® cable kit, pn 10093, for interconnecting TK-100, FSC-250 & Collins 32S or KWM-2



KWM2

(Tape over exposed shields and end of cable with plastic tape)

ALC Shorting Plug (fabricate from one end of audio patch cable)



J2 TK-100 tone keyer

Microphone Input plug 32S, KWM-2, etc.

FSC-250 converter

Ref: Technical Information Bulletin #101

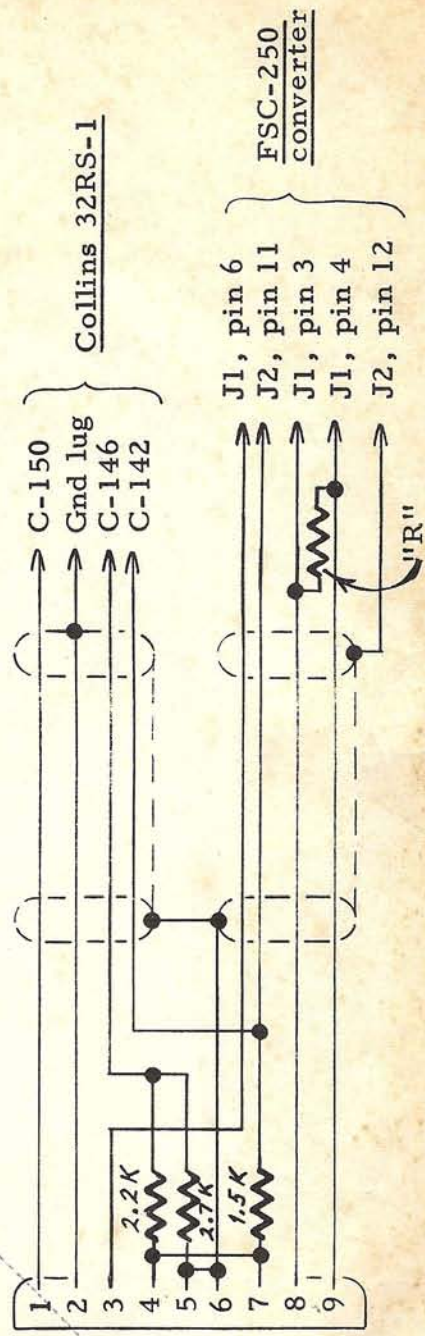
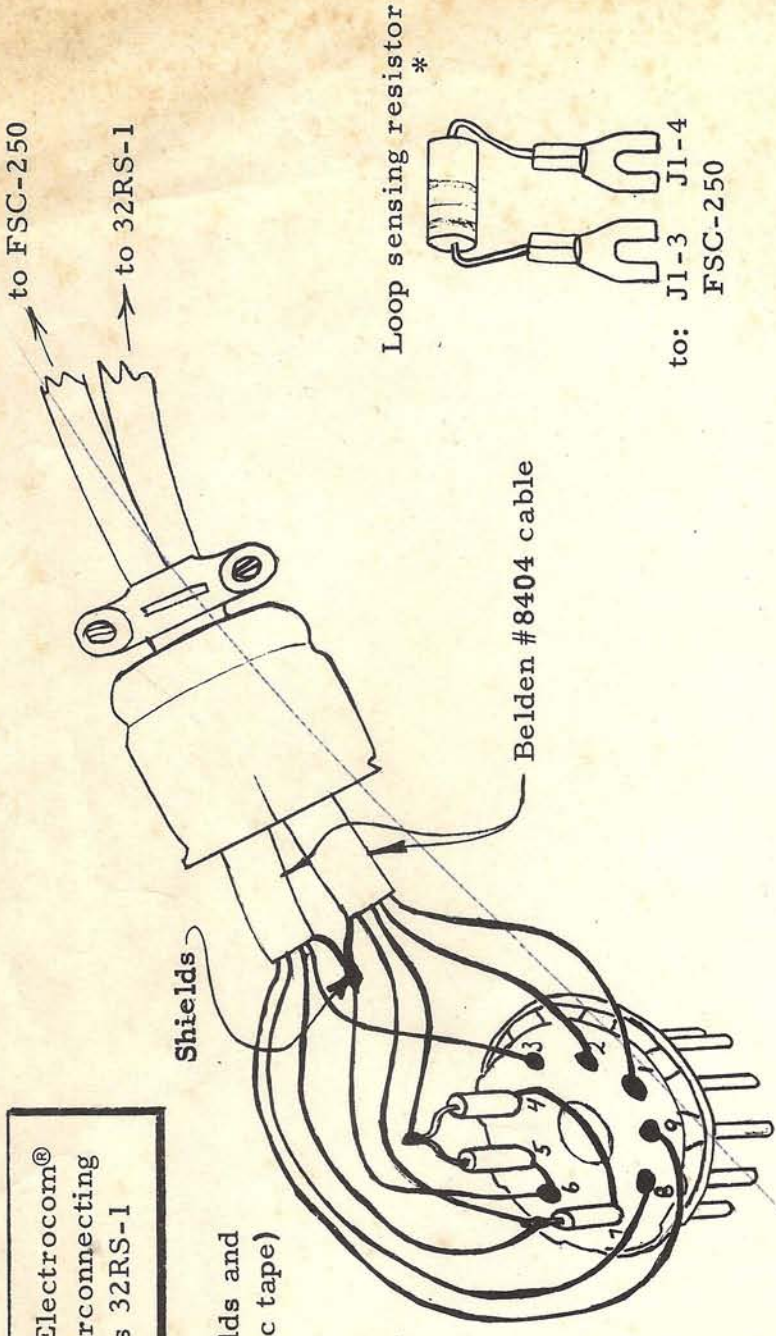
*NOTE: Mount loop sensing resistor (R) between J1 pin 3 and J1 pin 4 on rear of FSC-250. Use resistor value as follows: 560 ohm, 1 wt. for 30 ma. loop; 470 ohm, 2 wt. for 40 ma. loop; 270 ohm, 2 wt. for 60 ma. loop



* Loop Sensing Resistor

Cable Assembly Sketch for Electrocom® cable kit, pn 10091, for interconnecting TK-100, FSC-250, & Collins 32RS-1

(tape over exposed shields and end of cable with plastic tape)



J2
TK-100
tone keyer

* NOTE: Mount loop sensing resistor (R) between J1 pin 3 and J1, pin 4 on rear of FSC-250. Use resistor value as follows: 560 ohm, 1 wt. for 30 ma. loop; 470 ohm, 2 wt. for 40 ma. loop; 270 ohm, 2 wt. for 60 ma. loop