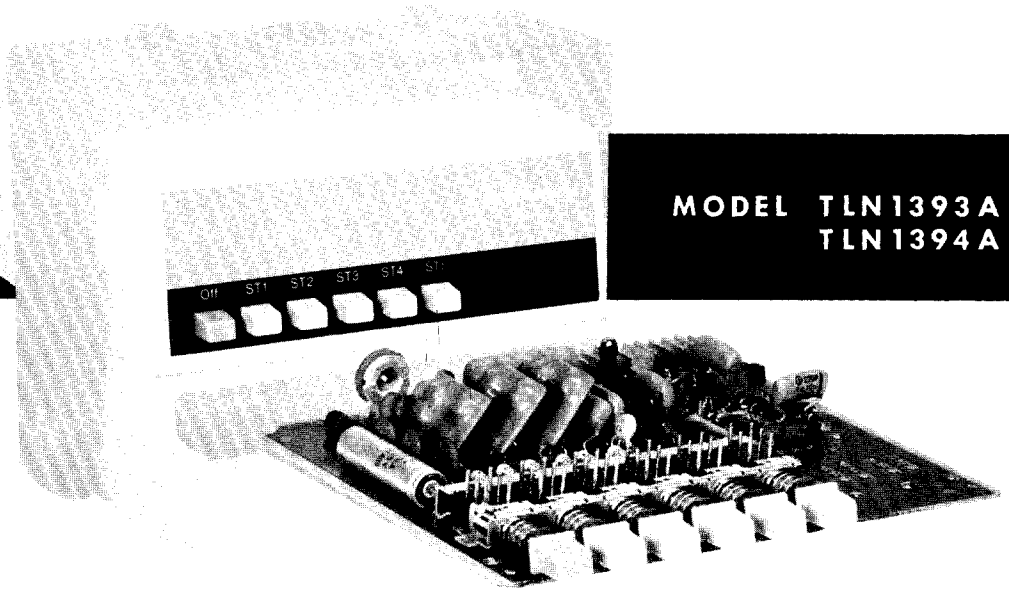
MICOR® | Systems 90

SINGLE-TONE ENCODER



MODEL TLN1393A
TLN1394A

MOTOROLA *Communications Division*

ENGINEERING PUBLICATIONS 1301 E. ALGONQUIN ROAD SCHAUMBURG, ILLINOIS 60172

THIS MANUAL HAS BEEN
DISCONTINUED

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Issue - A

1. DESCRIPTION

The "Micor" Single-Tone Encoder provides a selective tone source for mobile radio units in a single-tone controlled two-way radio system. Designed as a circuit card that slides into a "Systems 90" accessory housing, an oscillator generates a short, fixed duration audio tone when the mobile radio transmitter is keyed. This tone modulates the carrier and is transmitted to the associated receiver stations on the same rf channel. Some of the more common applications for single-tone signalling are:

- Tone-alert the receiving station to a pertinent incoming call.
- The associated receiver station may incorporate a tone decoder unit which, when activated by reception of the single tone, will complete the audio output circuit. Thus, only the receiver for whom the call was intended will receive the message.
- The receiving station may incorporate a tone decoder unit which, when activated, will open and/or close an external control circuit for repeater or external alarm system.

TECHNICAL CHARACTERISTICS

BASIC UNIT	TLN1393A one-tone output TLN1394A five-tone output
TONE FREQUENCY RANGE	1050 to 3000 Hz in 150-Hz steps.
POWER INPUT	12-volt dc operation; positive or negative ground
TONE DURATION	0.5 or 1.5 seconds. Addition of a jumper will provide a continuous tone.
OUTPUT	0.2 V maximum for a transmitter having an input impedance of approximately 220 ohms. Will provide 3.3 kHz deviation.
DIMENSIONS	Approximately 6" long, 4-1/2" deep, and 3/4" high (circuit board only)

2. INSTALLATION

a. Field Installed Option

The single-tone encoder circuit card is installed in the accessory housing, either alone or in conjunction with other radio accessories. The installation instructions provided here are for the single-tone encoder used as the only accessory. For instructions pertaining to multiple installations refer to the Installation Instructions supplied with the housing assembly.

To add the single-tone encoder in a negative ground system, refer to the schematic diagram and proceed as follows:

(1) Slide the circuit card completely into the housing assembly.

(2) Install the rear housing cover and secure with two captive screws.

(3) Disconnect the black connector (P1101) from the control head.

(4) Use the contact removal tool to remove six wires, with pins attached, from P1101 as follows:

- Yellow wire from position 1.
- Black-violet wire from position 9.
- Black-yellow wire from position 11.
- Black-orange wire from position 22.
- Orange wire from position 13.
- Violet wire from position 5.

NOTE

Steps (5) and (6) are not applicable when the wires extend at least five inches beyond the sleeving on the multiconductor cable.

(5) Remove the "S" clamp from the end of the multiconductor cable and move the strain relief back about five inches.

(6) Cut approximately five inches of sleeving off the cable. Avoid cutting the insulation of any wires.

(7) Insert the pins and wires which were removed from P1101 into the white connector (P1) as follows:

- Yellow wire into position 19.
- Black-violet wire into position 12.
- Black-yellow wire into position 20.

- Black-orange wire into position 17.
- Orange wire into position 15.
- Violet wire into position 14.

(8) Insert the pins and wires connected from P1 into P1101 as follows:

- Yellow wire into position 1.
- Black-violet wire into position 9.
- Black-yellow wire into position 11.
- Black-orange wire into position 22.
- Orange wire into position 13.

(9) Reconnect P1101 to the control head and connect P1 to the 22-pin receptacle J1 on the rear of the single-tone encoder circuit card.

(10) Remove the escutcheon backing and attach escutcheon to the housing assembly front panel.

(11) To install the monitor-tone circuit board, remove the radio set from its housing.

(12) Position the radio set with the bottom side facing up.

(13) Loosen, but do not remove, the two screws securing connector block P901 (see Figure 1).

(14) Slip the monitor-tone circuit board bracket lugs underneath the screws and tighten the screws.

(15) Connect the shorter wire (red) connector to pin 27 on P901. When viewing the connector from the front of the radio set, pin 27 is at the extreme right corner of the top row of pins.

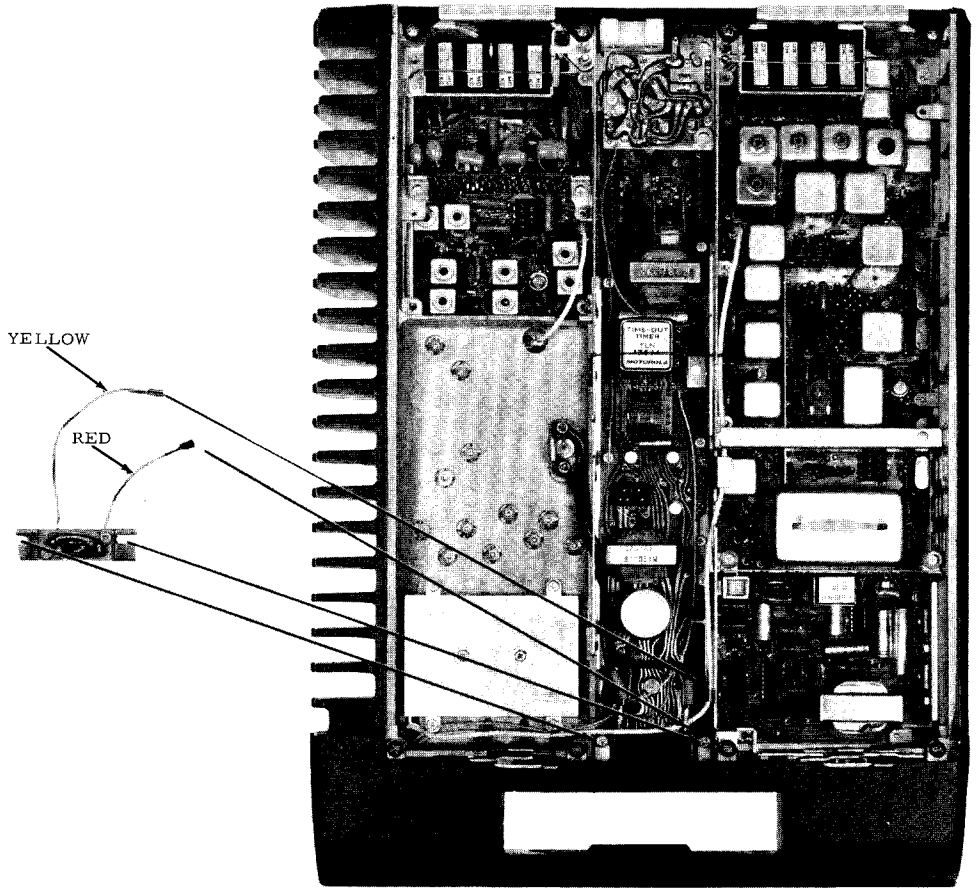

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Figure 1.
Monitor-Tone Circuit Board Installation Details

(16) Connect the longer wire (yellow) connector to pin 14 on P903 located on the control board. When viewing this connector, pin 14 is the fifth pin counting from the front of the radio set.

(17) Do not replace the radio set until the overall installation satisfies the performance requirements given in the ADJUSTMENTS section of this manual.

To install the single-tone encoder in a positive ground system, the procedure is the same as for a negative ground system with the following exceptions:

- Reverse pins 12 and 19 in the white connector (P1). (Yellow to pin 12, black-violet to pin 19.)

- Reverse pins 1 and 9 in the white connector (P1). (Yellow to pin 1, black-violet to pin 9.)

- Change the flexible wire jumper on the circuit card as shown on the single-tone encoder circuit board detail diagram.

- Reverse pins 8 and 15 in the white connector (P1). Both leads are orange colored.

b. Factory Wired Option

When the single-tone encoder option is purchased as part of a radio system, the wiring changes will have been completed. The individual system components are shipped with all interconnecting cables attached, to permit a thorough system check out before unpacking. To install the radio system proceed as follows:

(1) Install the radio and cabling as directed in the radio installation instructions.

(2) Install the trunnion bracket and housing assembly as instructed.

(3) Connect the black (and blue, if used) connectors to the control head.

(4) Connect the white connector (P1) to the single-tone encoder board jack (J1).

3. OPERATION

The operator controls on the single-tone encoder panel (see Figure 2) consist of six push button switches labelled OFF, ST1, ST2, ... ST5 (OFF and ST1 buttons only on one-tone models). The switches are mechanically interlocked so that only one can be activated at a given time. Operation of the unit is as follows:

a. Select the desired tone frequency by pushing one of the ST buttons.

b. Close the P-T-T switch on the microphone. A tone of 0.5 or 1.5 seconds (depending on the connection of JU1) duration will be heard in the loudspeaker.

c. After the tone has ended, the operator may proceed with his speech transmission.

d. Push the OFF button to turn the unit "off".

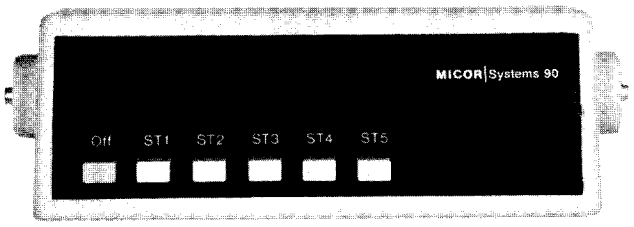

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Figure 2.
Operator's Controls

4. ADJUSTMENTS

The field installed single-tone encoder circuit board option is shipped from the factory wired for negative ground operation. Jumper JU1 (see schematic and circuit board detail) is wired to provide a 0.5 second tone. The tone level control (R15) has been factory adjusted to provide for ±3 to ±3.3 kHz deviation with a nominal radio set. Upon installation, this deviation should be checked as follows:

a. Turn on the radio set and key the transmitter. Check the deviation of the tone (on five-tone encoder units, check the deviation on the ST3 position).

b. If the deviation is not approximately ±3 to ±3.3 kHz with ST3 depressed, disconnect connector P1 and remove the rear panel of option housing. Adjust R15, the small blue control on the rear edge of the circuit card (see Figure 4) to obtain the desired deviation of the tone. Reinstall the rear panel and P1.

c. Check the maximum audio deviation of the radio set from the microphone. It is sometimes necessary to readjust the IDC control in the radio set for ±5 kHz deviation after the addition of a single-tone encoder option.

5. FUNCTIONAL OPERATION

a. Standby

In a standby condition, Q6 in the timing circuit, monostable holds switch Q1 on (see Figure 3). The output of Q1 holds the first integrator E2 off thus disabling the active filter oscillator. Therefore, there is no tone signal applied to the inputs of the output buffer and monitor tone amplifier stages. A dc control voltage from Q6 holds Q7 in saturation to prevent any internally generated noises from leaving the single-tone encoder board. The monitor-tone circuit board prevents noise picked up by the lead connected from the output of Q7 to the input of the radio set from reaching the audio stages.

b. Transmit

When the P-T-T function is activated, the P-T-T bridge activates the timing circuit monostable -- turns Q5 off and Q4 and Q6 on. Q6, in the timing circuit, turns switch Q1 off and also brings monitor tone amplifier Q7 out of saturation. The active filter oscillator is now enabled by Q1 and generates a tone in the 1050 to 3000 Hz range (depending on the value of the tone code resistors). The oscillator output passes through the output buffer amplifier and modulates the transmitter carrier. The oscillator output also passes through the monitor tone amplifier, the monitor-tone circuit, and the tone (0.5 or 1.5 seconds long) is heard in the loudspeaker. The tone ends when the timing circuit monostable "flips-back" to its standby state and causes switch Q1 to disable the oscillator. At this same time, the monitor tone amplifier is driven back into saturation.

6. THEORY OF OPERATION

a. Standby

In a standby condition, Q5 in the monostable timing circuit is conducting while Q4 is cut off (see Figure 3 and the schematic diagram). The conduction of Q5 places the base of inverter Q6 at approximately ground potential and holds it cut off. The resulting high collector voltage of Q6 is coupled to the base of switch Q1 and also through CR6 to the base of the monitor tone amplifier Q7. The high voltage on the base of Q1 keeps this stage conducting heavily and effectively grounds pin 3 of the first integrator E2. This ground disables the active filter oscillator and no tone signal is generated. At the same time, the high voltage coupled through CR6 causes Q7 to operate in its saturation region which effectively grounds the monitor tone output. Extraneous noise generated within the encoder is shunted through Q7 and cannot leave the encoder board. Noise picked up by the lead connecting the output of Q7 to the radio set is kept from reaching the audio stages by the monitor-tone circuit. The noise is reduced by the divider-attenuator network consisting of R101 and R102. The residual noise does not have sufficient amplitude to forward bias the limiter network (CR101, CR102). This effective open circuit keeps noise from entering the radio set.

b. Transmit

When the P-T-T switch on the microphone is activated, a ground is placed at the junction of CR8 and CR10. This ground creates a current path through CR10, R48, R49, and CR9 to A+ (in a negative ground system). The voltage developed across R48 biases Q8 into conduction and its low collector voltage is coupled through CR7 to the junction of R33 and C17. This voltage change is coupled by C17 and reverse biases CR5. Q5 is now zero-biased and cuts-off to activate the timing circuit monostable. The high collector voltage of Q5 biases both Q4 and Q6 into conduction. As Q6 conducts, its low collector voltage drives switch Q1 to near cut-off and at the same time causes Q7 to shift its operating point from saturation to an active region on its amplification characteristic curve.

The high impedance of switch Q1 allows the active filter oscillator to generate a tone whose frequency is determined by the tone code resistors (R17 and R18 only in one-tone models). Positive feedback voltage for the oscillator circuitry is provided by a path through C5, R6, R3, C2 and a limiter (CR1, CR2) from the output of E2 to the input of E1. Because of the extremely high Q's of the active filters, a negative stabilization feedback voltage is coupled from the output of E2 (through R2) to pin 3 of E1. The tone-frequency output of the oscillator circuitry will range from 1050 to 3000 Hz (in 150 Hz steps) depending on the values of the tone code resistors.

The tone output from the active filter oscillator is coupled from pin 5 of E2 to the bases of both the output buffer amplifier and the monitor tone

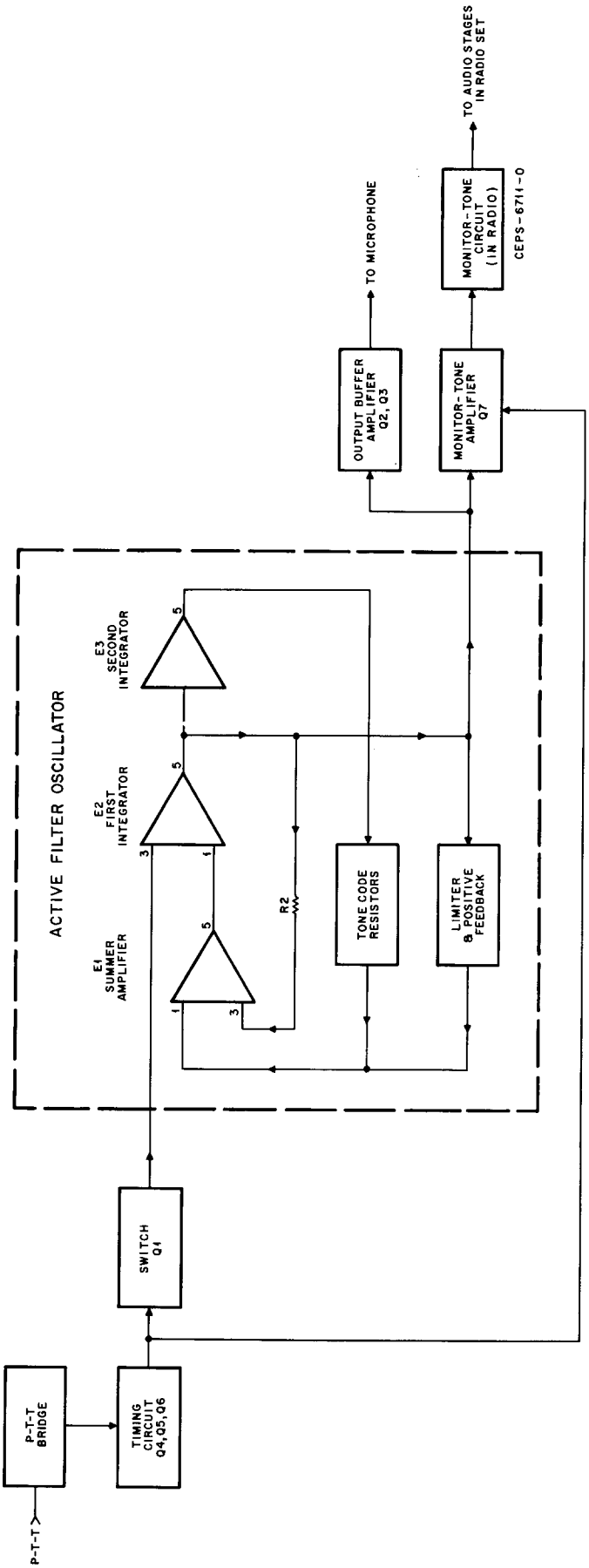


Figure 3.
Functional Operation Diagram

amplifier. The output buffer amplifier isolates the high impedance output of the active filter oscillator circuit from the low impedance of the microphone. The amplified tone signal is coupled through R14, R15, and C15 to the microphone and FM modulates the transmitter carrier. R15 controls the tone amplitude output and consequently the amount of carrier deviation. The tone signal applied to the base of Q7 is amplified (since Q7 is no longer in saturation) and applied to the monitor-tone circuit. The tone signal has sufficient amplitude (approximately 10 V p-p), so that even after passing through the divider-attenuator network, it forward biases the limiter network (CR101, CR102). This allows the tone signal to pass through to the audio stages in the radio set and be heard in the loudspeaker. The operator, upon hearing the end of the 0.5 or 1.5 second tone, may then proceed with his voice transmission.

The active filter oscillator continues to generate a tone until the monostable timing circuit returns to its original stable state. Enabling the P-T-T function originally turned Q5 off and Q4 on. Capacitor C16 will start charging through the resistive network of R30 and R29 (if jumper JU1 is out). The RC time constant of this network determines the reverse bias time of CR5. After 1.5 seconds (0.5 seconds with JU1 in) the charge on C16 reaches a potential which is high enough to forward bias CR5. The conduction of CR5 biases Q5 into conduction. The resulting low collector voltage of Q5 biases both Q4 and Q6 to cut-off. The high collector voltage of Q6 turns on switch Q1 which shuts off the active filter oscillator and the tone ends.

For testing or adjustment purposes, a continuous tone can be generated by connecting a jumper from pin 22 to pin 3 or 13 on J1. This connection holds switch Q1 off and the active filter oscillator will generate a continuous tone.

Diode CR12 prevents the encoder unit from receiving a false keying signal when the ignition switch is turned on or off.

7. MAINTENANCE

Single-tone encoder maintenance can be broken down into two categories; testing and troubleshooting. Testing is actually an extension of troubleshooting and is limited to comparing voltage measurements to those indicated on the schematic diagram.

CAUTION

It is recommended that units installed in a positive ground system be serviced in a negative ground bench test set-up. In a positive ground installation, the ground is "floating" and the encoder board ground should never be connected or shorted to the vehicle ground.

a. In-System Testing

Making circuit voltage checks necessitates removing the circuit card from the housing assembly and is accomplished as follows:

(1) Disconnect the white connector attached to the circuit card.

(2) Loosen the two captive screws securing the rear housing cover and remove the cover.

(3) Slide the circuit card out of the housing assembly and place the card atop the housing with the solder side up.

(4) Reconnect the white connector (removed previously) to the proper location on the circuit card.

CAUTION

Do not allow the circuit card to come into contact with any metallic object which may cause damage from an accidental short circuit.

(5) Apply power to the system and proceed to take the necessary voltage measurements.

b. Bench Testing

A check out of single-tone encoder can also be performed on a test bench. The following equipment is required for a thorough circuit check-out.

- DC Power Supply
- Oscilloscope
- Service bench VTVM
- Frequency counter

To perform a bench check proceed as follows:

(1) Remove white connector from rear of the circuit card.

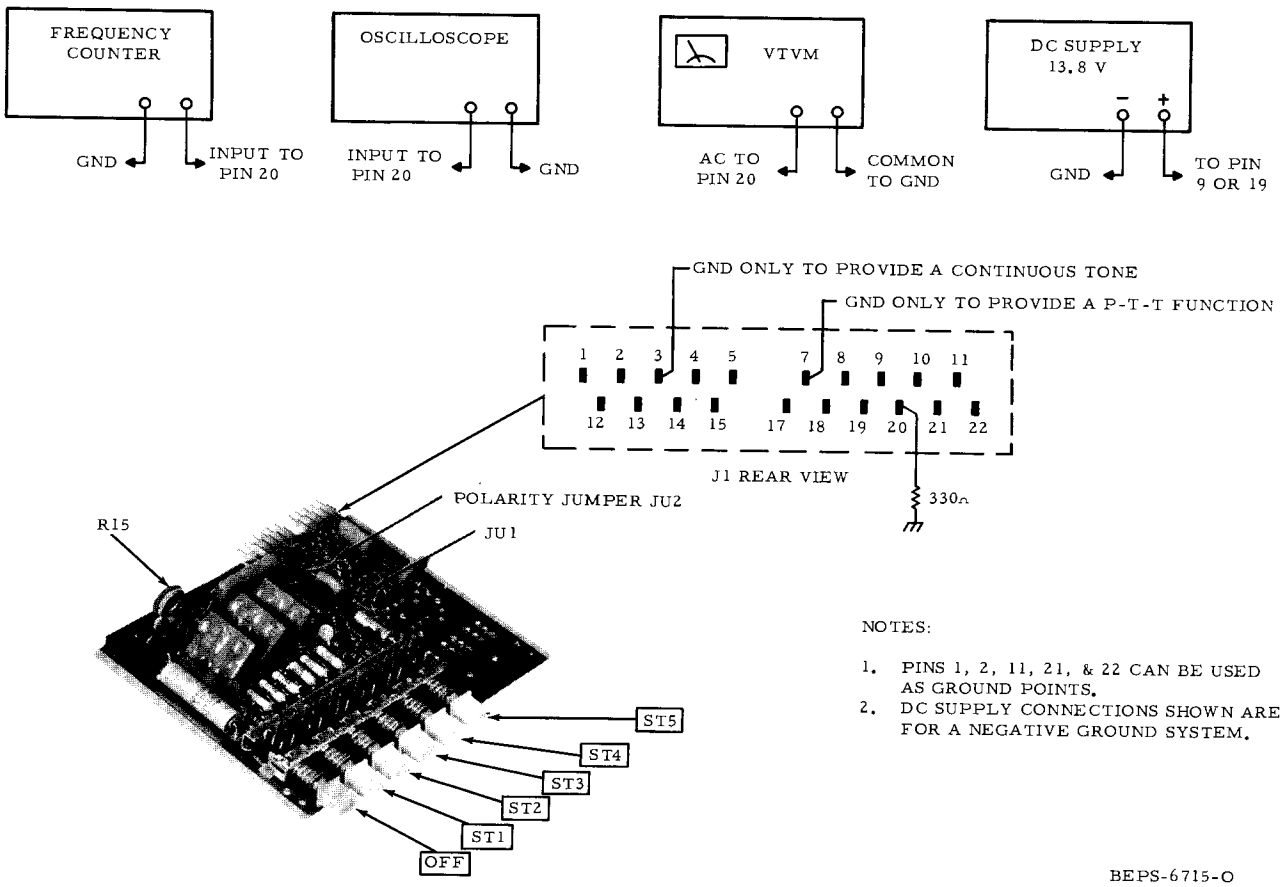


Figure 4.
Bench Test Equipment Set-Up

(2) Loosen two captive screws securing the rear housing cover and remove the rear cover.

(3) Remove the circuit card from the housing.

(4) Set up the single-tone encoder circuit card as shown in Figure 4.

(5) Depress one of the ST buttons.

● Continuous-key the single-tone encoder board by grounding pin 3 or 13 on J1. The signal output amplitude (at pin 20 on J1) should read approximately 150 mV on the VTVM. (R15 should be adjusted to provide ±3 kHz deviation when installed in a radio set.)

● Timing can be measured by connecting an oscilloscope to the output (pin 20 on J1) while grounding pin 7 or 17 (P-T-T function) on J1. The tone duration should be 0.5 seconds with JU1 connected or 1.5 seconds with JU1 disconnected. Be sure to remove the ground from pin 3 or 13.

● The tone frequency can be measured by connecting the frequency counter to the output (pin 20 on J1). Ground pin 3 or 13 on J1 to obtain a continuous tone output.

c. Troubleshooting

A troubleshooting chart is provided as an aid in isolating the cause of any malfunction attributed to the single-tone encoder circuits. This chart presents a logical sequence of steps which result in isolating a faulty component or circuit. Refer to this chart when attacking any problem caused by this unit. Refer to the schematic diagram for typical voltage readings.

d. Repair

Any component on the circuit card can be replaced by following accepted repair procedures.

If any of the precision parts (R1, R4, R7, C7, C9, E1, E2, or E3) in the active filter oscillator require replacement, retuning may

become necessary. Careful factory selection of R5 (between 0 and 6k ohms) assures that the active filter oscillator is operating within specifications.

After replacement of any one of the above precision parts, check the tone frequencies generated by the activation of each push button. If the tone frequencies are within 0.5% of the nominal value, the unit is within specifications. If the tone frequencies are more than 0.5% off, it may be desirable to bring them closer to the nominal frequency.

Increasing the value of R5 will lower the tone frequency, while a decrease in the resistance of R5 will raise the tone frequency. The value of R5 affects each of the tone frequencies or the one tone frequency (one-tone models). The nominal value of R5 is approximately 2.5 to 3k ohms. A ±3k ohm change in the value of R5 will shift the frequency range of the active filter oscillator by approximately ±1%. Therefore, if retuning of the active filter oscillator is necessary, change the value of R5 in small increments using precision resistors.

NOTE

The solder side of the single-tone encoder board is coated with "Krylon" plastic spray. To make electrical contact with points on the board it is necessary to "scratch-thru" the protective coating by using a sharp probe. When repair work is complete, it is highly recommended that the board be recoated lightly with "Krylon" spray or equivalent.

Refer to the "Micor" radio instruction manual for information pertaining to ordering replacement parts. Upon completion of repairs, the circuit card is reinstalled as follows:

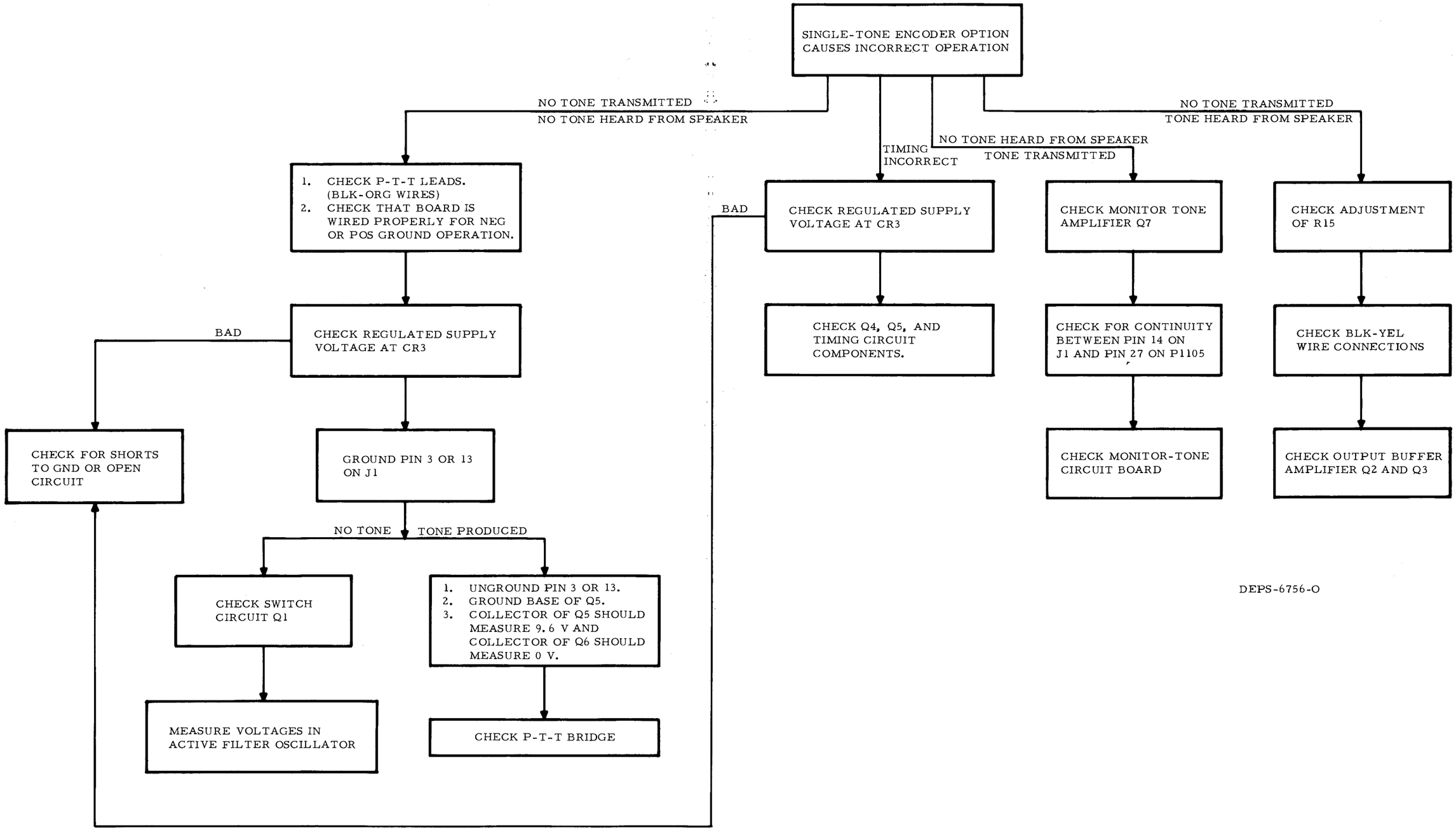
(1) Disconnect the white connector from the circuit card.

(2) Slide the card completely into the housing.

(3) Install the rear housing cover and secure with two captive screws.

(4) Reconnect the white connector to the proper locations.

SINGLE-TONE ENCODER TROUBLESHOOTING CHART



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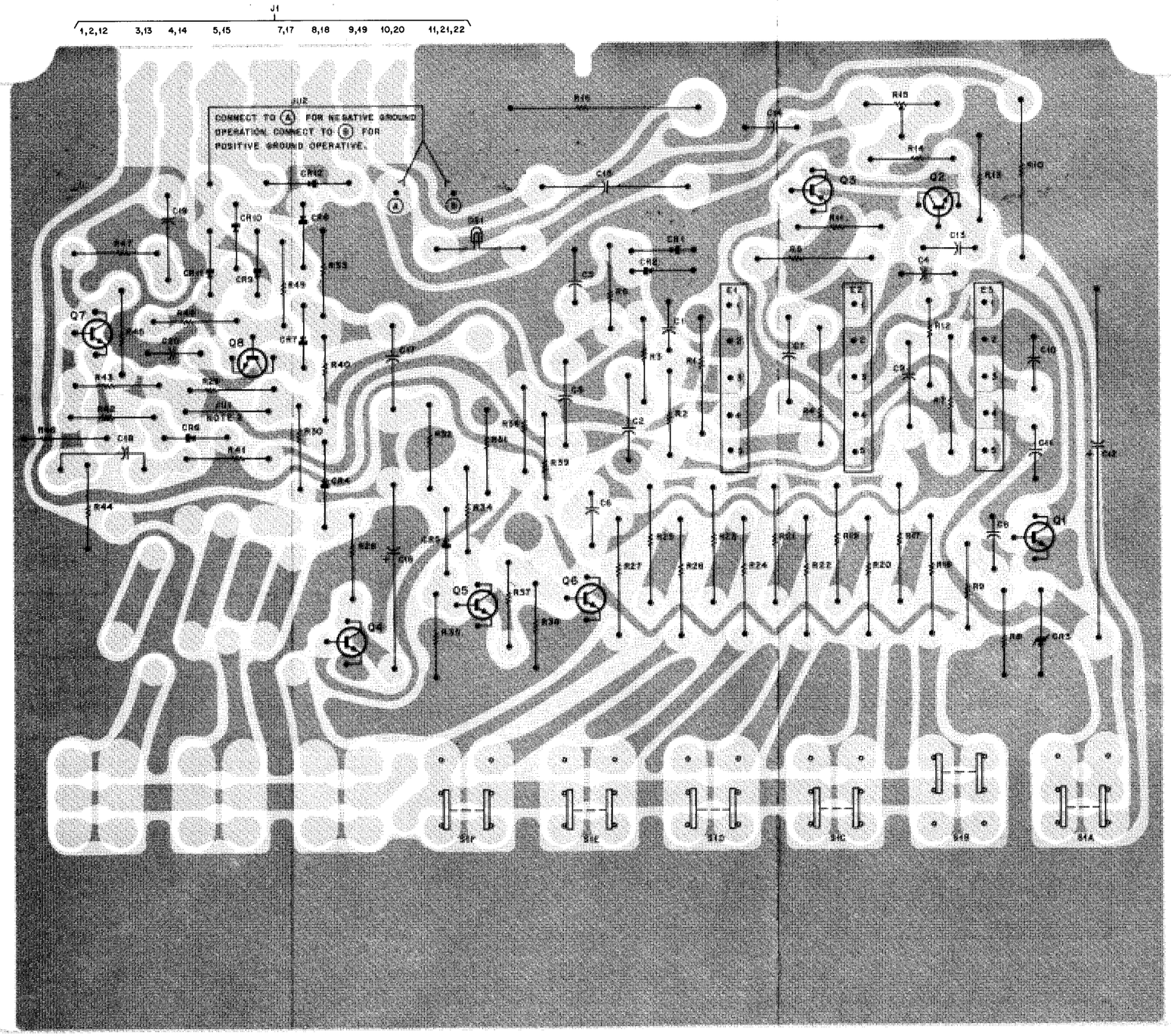

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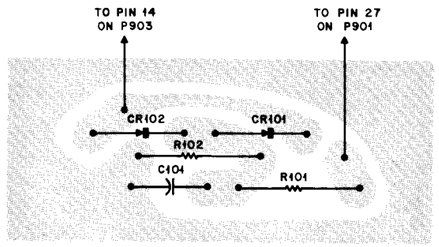
TRANSISTOR DETAIL



OL-BEPS-6734-O

SOLDER SIDE

COMPONENT SIDE

OL-DEPS-6751-O

NOTES SHOWN ON SCHEMATIC AND INTERCABLING DIAGRAM

Single-Tone Encoder
Circuit Board Details
Motorola No. PEPS-6736-O
3/12/71-NPC

TONE FREQUENCY IN Hz	PAIRED RESISTORS REQUIRED	
	"X" SET RESISTORS (R17, 19, 21, 23, OR 25)	"Y" SET RESISTORS (R18, 20, 22, 24, OR 26)
1050	100	383k
1200	2.2k	280k
1350	3.9k	210k
1500	100	165k
1650	2.2k	127k
1800	2.2k	100k
1950	2.2k	78.7k
2100	2.2k	61.9k
2250	1.8k	48.7k
2400	2.2k	37.4k
2550	1.5k	28.7k
2700	1.5k	21.0k
2850	1.5k	14.3k
3000	1.5k	8.87k
2000	37.4k	37.4k
2200	5.62k	48.7k

REFER TO THE PARTS LIST FOR THE MOTOROLA PART NUMBERS OF THE ABOVE RESISTORS.

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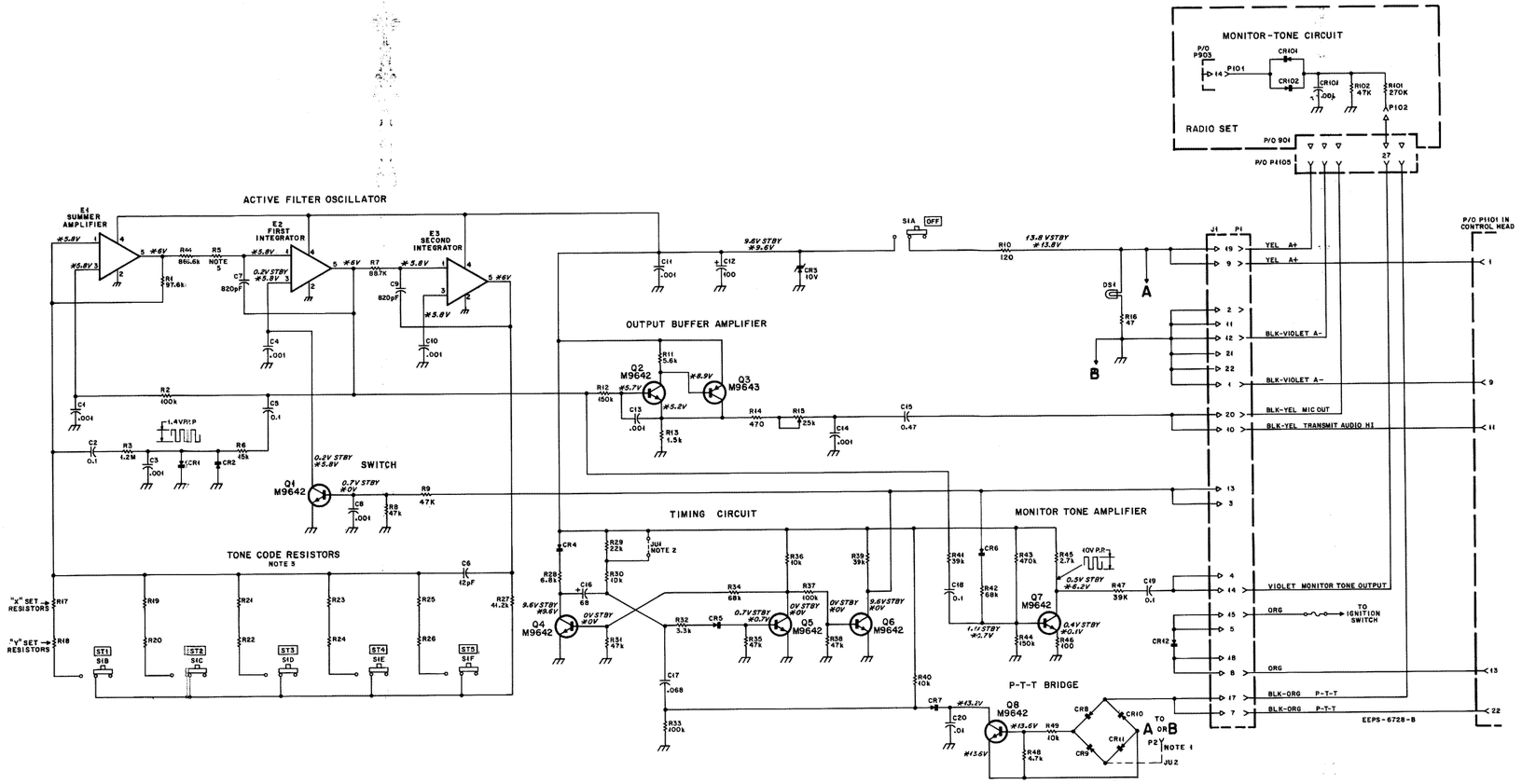

TYPICAL AC VOLTAGES			
	E1	E2	E3
PIN 5 @1200 Hz	0.5	0.9	1.5
PIN 5 @2000 Hz	0.7	1	0.9
PIN 5 @3000 Hz	0.7	0.6	0.3

EPS-6729-O

MODEL AND SUFFIX TABLE

ITEM	SUFFIX	DESCRIPTION	MODEL TLN1393A	MODEL TLN1394A
			SUFFIX	SUFFIX
			DESCRIPTION	DESCRIPTION
				SINGLE-TONE ENCODER (1-TONE)
				SINGLE-TONE ENCODER (5-TONE)
TLN4525A	2	ENCODER BOARD (1-TONE)	X	
TLN4526A	2	ENCODER BOARD (5-TONE)		X
TLN4535A		SINGLE-TONE TUNING KIT	X	X
7KN6506A		CABLE ASSEMBLY	X	X
TLN4512A		HDW & ESCUTCHEON (1-TONE)	X	
TLN4513A		HDW & ESCUTCHEON (5-TONE)		X
TLN4586A		MONITOR-TONE BOARD	X	X

EPS-6757-A

NOTES:

1. JU2 IS CONNECTED TO POINT A FOR NEGATIVE GROUND OPERATION. CONNECT JU2 TO POINT B FOR POSITIVE GROUND OPERATION.
2. JU1 IN TO PROVIDE A 0.5 SECOND TONE. REMOVE JU1 TO OBTAIN A 1.5 SECOND TONE. JUMPER PIN 22 TO PIN 13 ON J1 TO OBTAIN A CONTINUOUS TONE.
3. S1C THROUGH S1F NOT USED ON ONE-TONE MODELS.
4. UNLESS OTHERWISE STATED: CAPACITOR VALUES ARE IN MICROFARADS, RESISTOR VALUES ARE IN OHMS.
5. R5 IS FACTORY SELECTED. VALUE VARIES FROM 0 TO 6k.
6. ALL VOLTAGES SHOWN ON SCHEMATIC ARE DC AND MEASURED WITH A 20k-OHM-PER-VOLT MULTIMETER.
   - A. *VOLTAGES MEASURED DURING CONTINUOUS KEYING CONDITION, I.E., WITH PIN 22 JUMPERED TO PIN 13 ON J1.
   - B. ALL * PIN 5 VOLTAGES IN ACTIVE FILTER OSCILLATOR VARY WITH FREQUENCY. THOSE SHOWN WERE MEASURED AT 2 kHz.
   - C. VOLTAGES SHOWN IN TABLE ARE AC AND MEASURED WITH A VTVM.
   - D. ALL VOLTAGES ARE REFERENCED TO ENCODER BOARD GROUND.
   - E. ⏚ DENOTES ENCODER BOARD GROUND.
   - F. ⏚ DENOTES BATTERY GROUND.
   - G. ALL AC AND DC VOLTAGES SHOWN ARE TYPICAL VALUES.

EPS-6712-O

PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Single-Tone Encoder
Schematic and Intercabling Diagram
Motorola No. 63P81102E32-A
7/24/73-NPC

REVISIONS

63P81102E32-A

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION	REFER TO CIRCUIT BOARD
TLN1393A TLN1394A	R9	FROM 6S124A95, 82k TO 6S131527, 47k	Q1 BASE	NONE
	R10	FROM 6S6389, 220 ±1%, 10 W TO 6S488021, 120 ±10%, 1 W	J1-19	
	R14	FROM 6S129818, 820 TO 6S129709, 470	Q3 COLLECTOR	
	R101	FROM 6S129777, 39k TO 6S124B08, 270k	MONITOR-TONE CIRCUIT	
	R102	FROM 6S129981, 3.3k TO 6S131527, 47k		
	P101	FROM 29S10134A53 TO 29S10134A48		
	R47	FROM 6S124B08, 270k TO 6S129777, 39k		
TLN1393A (TLN4525A-1) TLN1394A (TLN4526A-1)	CR8 THRU CR11	FROM 48C83654H01 TO 48D82420C01	PARTS LIST	
TLN1393A (TLN4525A-2) TLN1394A (TLN4526A-2)	R7	FROM 6D84640C02, 86.6k TO 6D84640C36, 86.7k	E2-5	

PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

TLN1393A Single-Tone Encoder (1-Tone)
TLN1394A Single-Tone Encoder (5-Tone) PL-1244-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF; ±10%; 100 V; unl. stated
C1	21D82187B20	.001
C2	8D82905G07	0.1; 50 V
C3, 4	21D82187B20	.001
C5	8D82905G07	0.1; 50 V
C6	21D82133G47	12 pF ±5%; 500 V; N330
C7	21K87326G9	820 pF ±2%; 300 V
C8	21D82187B20	.001
C9	21K87326G9	820 pF ±2%; 300 V
C10, 11	21D82187B20	.001
C12	23D82601A09	100 +150-10%; 25 V
C13, 14	21D82187B20	.001
C15	8D82905G33	0.47 ±20%; 50 V
C16	23K86559A4	68; 15 V
C17	8D82905G04	.068; 50 V
C18, 19	8D82905G07	0.1; 50 V
C20	21D82428B59	.01 +80-20%; 200 V
C101	21D82187B20	.001
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1, 2	48C83654H01	silicon
CR3	48D82256C11	silicon; Zener type; 10 V ±5%
CR4 thru 7	48C83654H01	silicon
CR8 thru 11	48D82420C01	silicon
CR12	48C82466H13	silicon
CR101, 102	48C83654H01	silicon
		LAMP, incandescent:
DS1	65B83554G01	min. wedge base; 12 V; 0.19 A; type no. 161
		CIRCUIT MODULE:
E1 thru 3	1V80716B182	film-type hybrid assembly
		CONNECTOR, receptacle:
J1		c/o contact terminals mounted on edge of circuit board; as follows: 28C84269C01 TERMINAL, contact: narrow mtg tab (lower row), 28C84269C02 TERMINAL, contact: wide mtg tab (upper row)
		JUMPER:
JU1		(for reference only)
JU2	1V80718B144	incl. reference part P2
		CONNECTOR, plug:
P1		incl. 14C84556B07 BODY: (white): terminal positions numbered 1 through 22 (6 and 16 blanked), 9C84151B01 TERMINAL, contact: female
P2	39S10184A07	(wire terminal plug); female; single-contact
P101	29S10134A48	(wire terminal plug); female; single-contact
P102	29S10134A53	(wire terminal plug); female; single contact
P901		(for reference only)
P903		(for reference only)
P1101		(for reference only)
P1105		(for reference only)
		TRANSISTOR: (SEE NOTE)
Q1, 2	48R86964A2	NPN; type M9642
Q3	48R86964A3	PNP; type M9643
Q4 thru 8	48R86964A2	NPN; type M9642
		RESISTOR, fixed: ±5%; 1/4 W; unl. stated
R1	6D84640C103	97.6k ±0.5%
R2	6S124A97	100k
R3	6S124B24	1.2 meg
R4	6D84640C102	86.6k ±0.5%
R5		(NOTE: Factory-selected. Refer to instruction manual concerning determination of replacement value. See listing below for correlation of part number with resistance value.)
	6D84640C20	511 ±0.5%
	6D84640C21	750 ±0.5%
	6D84640C22	1.02k ±0.5%
	6D84640C23	1.37k ±0.5%
	6D84640C24	1.74k ±0.5%
	6D84640C25	2.10k ±0.5%
	6D84640C26	2.49k ±0.5%
	6D84640C27	2.87k ±0.5%
	6D84640C28	3.24k ±0.5%
	6D84640C29	3.57k ±0.5%
	6D84640C30	3.92k ±0.5%
	6D84640C31	4.22k ±0.5%
	6D84640C32	4.53k ±0.5%
	6D84640C33	4.87k ±0.5%
	6D84640C39	5.32k ±0.5%
	6D84640C35	5.62k ±0.5%
	6D84640C40	6.04k ±0.5%
R6	6S129236	15k
R7	6D84640C36	86.7k ±5%
R8	6S131527	47k
R9	6S131527	47k
R10	6S488021	120 ±10%; 1 W
R11	6S129982	5.6k
R12	6S128683	150k
R13	6S129681	1.5k
R14	6S129709	470
R15	18C83083G03	var: 25k ±30%
R16	6S488035	47 ±10%; 2 W
R17 thru 26		(NOTE: Values used correspond with frequency required; see table on schematic diagram. Refer to listing below for correlation of part number with resistance value.)
	6S131524	100
	6S129681	1.5k
	6S129820	1.8k
	6S129804	2.2k
	6S129707	2.7k
	6S129819	3.9k
	6D84640C35	5.67k ±0.5%
	6D84640C05	8.87k ±0.5%
	6D84640C06	14.3k ±0.5%
	6D84640C07	21.0k ±0.5%
	6D84640C08	28.7k ±0.5%
	6D84640C09	37.4k ±0.5%
	6D84640C10	48.7k ±0.5%
	6D84640C11	61.9k ±0.5%
	6D84640C12	78.7k ±0.5%
	6D84640C13	100k ±0.5%
	6D84640C14	127k ±0.5%
	6D84640C15	165k ±0.5%
	6D84640C16	210k ±0.5%
	6D84640C17	280k ±0.5%
	6D84640C18	383k ±0.5%
R27	6D84640C37	41.2k ±0.5%
R28	6S129237	6.8k
R29	6S129667	22k
R30	6S129668	10k
R31	6S131527	47k
R32	6S129981	3.3k
R33	6S124A97	100k
R34	6S129299	68k
R35	6S131527	47k
R36	6S129668	10k
R37	6S124A97	100k
R38	6S131527	47k
R39	6S129777	39k
R40	6S129668	10k
R41	6S129777	39k
R42	6S129299	68k
R43	6S129149	470k
R44	6S128683	150k
R45	6S129707	2.7k
R46	6S131524	100
R47	6S129777	39k ±10%
R48	6S131527	47k
R49	6S129668	10k
R101	6S124B08	270k ±10%
R102	6S131527	47k
		SWITCH ASSEMBLY, push: interlocking, with lockout; non-shorting:
S1	40D84324C03	(1-tone); 2 section; c/o:
S1A		2 form "C"
S1B		2 form "C"
		NOTE: Switch does not include 14C84360C01 INSULATOR: 2 req'd
S1	40D84324C11	(5-tone); 6-section; c/o:
S1A		2 form "C"
S1B		2 form "C"
S1C		2 form "C"
S1D		2 form "C"
S1E		2 form "C"
S1F		2 form "C"
		NOTE: Switch does not include 14C84360C01 INSULATOR: 6 req'd
		LAMPHOLDER:
XDS1	9C84285C01	2-contact; for "wedge"-type lamp
		NON-REFERENCED ITEMS
	13D84319C19	ESCUTCHEON (1-tone)
	13D84319C05	ESCUTCHEON (5-tone)
	38C84321C01	PUSHBUTTON (shadow pearl)
	38C84321C02	PUSHBUTTON (orange)
	38B84617C01	SPACER, pushbutton lockout: 3 req'd (5-tone only)
	66C84699B01	CONTACT REMOVAL TOOL

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.