DESCRIPTION

The "Private-Line" (PL) encoder generates a low-frequency audio tone for continuous modulation of the transmitted rf signal in "Private-Line" operation.

NOTE

The tone signal is used only to unsquelch receivers in specific networks and is not heard.

2. FUNCTIONAL OPERATION

2.1 GENERAL

The encoder may be divided into three major sections.

Tone Oscillator - The tone oscillator generates two equal-amplitude tone signals 180° out-of-phase whenever power is applied to the radio. A feedback amplifier provides negative feedback to limit the level of oscillation. The "Vibrasender" resonant reed determines the frequency of operation.

Reverse Burst Timing Generator - The reverse burst timing generator provides a transmitter turn-off delay of approximately 150 milliseconds after the transmitter is unkeyed. During this period, a shifted phase tone (reverse burst) is developed in the tone output circuit which dampens the oscillations of the "Vibrasponder" resonant reed in listening receivers to eliminate the "squelch tail" noise burst at the end of the message.

Tone Output Circuit - The tone output circuit provides a fixed level tone output to the modulator of the transmitter and shifts the phase of the tone during the reverse burst period to rapidly dampen the "Vibrasponder" resonant reeds in listening receivers.

2.2 TONE OSCILLATOR

The tone oscillator operates continuously while the station is "on". The outputs of the differential amplifier, formed by Q701 and Q702, are identical but 180° out of phase. The amplitudes of these collector signals are independent of frequency. A positive feedback signal is coupled through C701 and R708 to sustain oscillation. In addition, Model TLN4293B has a rapid turn-on circuit. When the radio is turned on, C710 begins to charge through R728 which biases Q710 on through R727. To quickly bring the tone output up to full output, Q710 acts as a shunt around R708, which increases the positive feedback. After approximately 1.5 seconds (voltage across C710 reaches 9.0 volts) Q710 turns off and has no further effect on circuit operation. Q708 through C704 and R712. When the signal lev- from Q702 to C703. The two tone signals 180° el exceeds a fixed amount, Q708 is biased into op- out of phase, combine through the phase shift eration. It provides a negative feedback signal which keeps the oscillator out of limiting, thus pro- lower that is 240° out of phase with the original resonant reed is the frequency determining device matching in a low impedance output and isolates of the oscillator. It acts as a very high Q, narrow the tone oscillator from the external circuit to bandpass transformer, coupling only its resonant which the tone output is applied.

frequency and blocking all others. At its resonant frequency, the reed vibrates to couple energy from the primary to the secondary winding.

REVERSE BURST TIMING CIRCUIT

In the unkeyed transmitter condition, delay generator, Q706, is forward biased through CR703 and R719 to A- placing A+ across R721. This voltage is coupled to the base of the delayed turn-off switch (Q707) by R722, and Q707 is biased "off".

When the PTT button is closed, keyed filtered A+ is applied to R716 and turns on the keying switch, Q705. With Q705 acting as a short

- --Q707 is biased "on" through R723, CR702 and Q705 to A-.
- --Keyed, filtered A+ is applied through Q707 to turn on the transmitter.
- --C708 charges from the filtered A+ line through Q706 base-emitter junction, CR730 and R718. -- The PL switch gate, Q709, is turned on by bias current through R726 and Q705. This action turns off PL tone gate, Q703.

Note that Q706 has not changed states and is still turned on by bias current through R719.

When the PTT button is released, the keyed, filtered A+ bias is removed from Q705 and it turns off. The transmitter continues to receive A+ from Q707 during the following sequence of events; with Q705 turned off:

--The PL switch gate, Q709, is turned off, activating the PL tone gate, Q703, which passes the reverse burst tone signal.

--C708 discharges through R718, R719, R721, R722 and R723, back biasing CR703 and turning off Q706.

--With Q706 off, Q707 remains on by receiving base bias through R722 and R721.

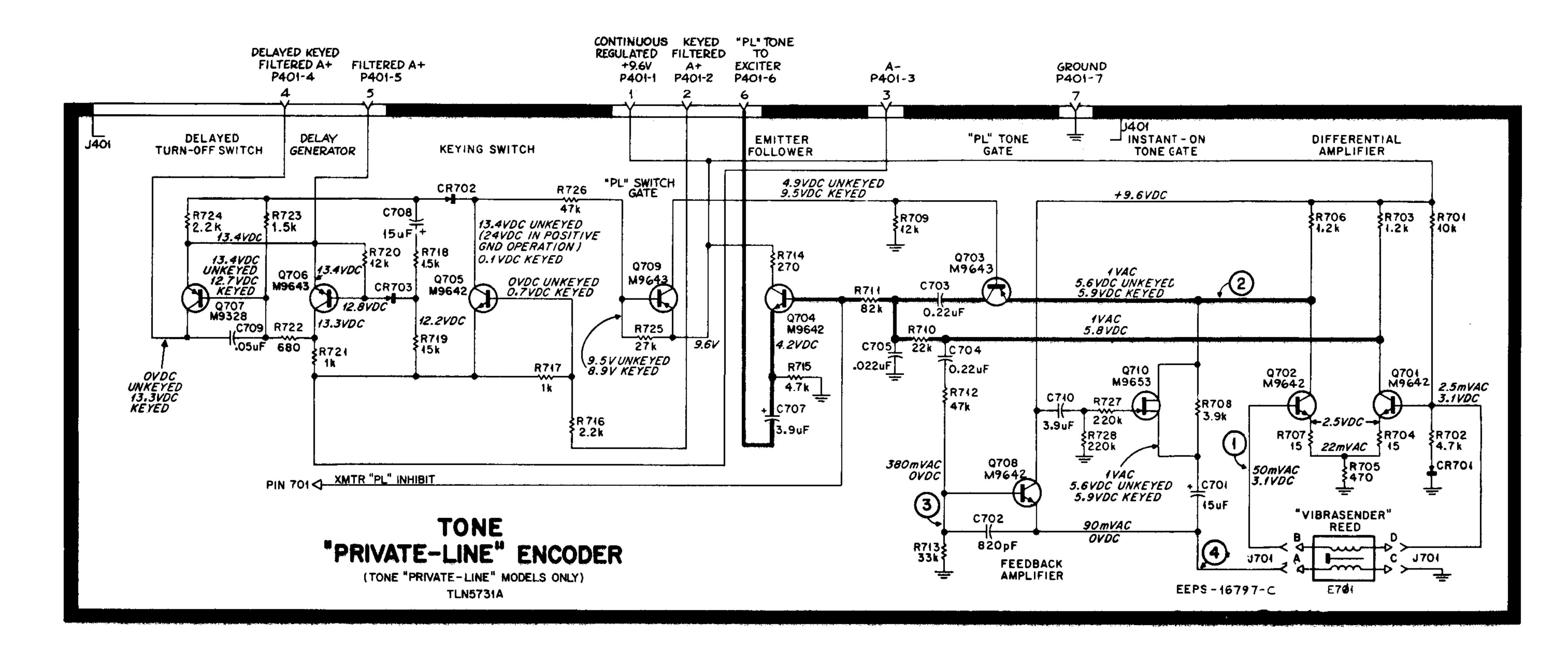
--After approximately 150 milliseconds, the voltage across C708 decreases to the point where Q706 turns on again and applies A+ across R721.

--The A+ across R721 turns off Q707 which removes the delayed keyed filtered A+ from the transmitter.

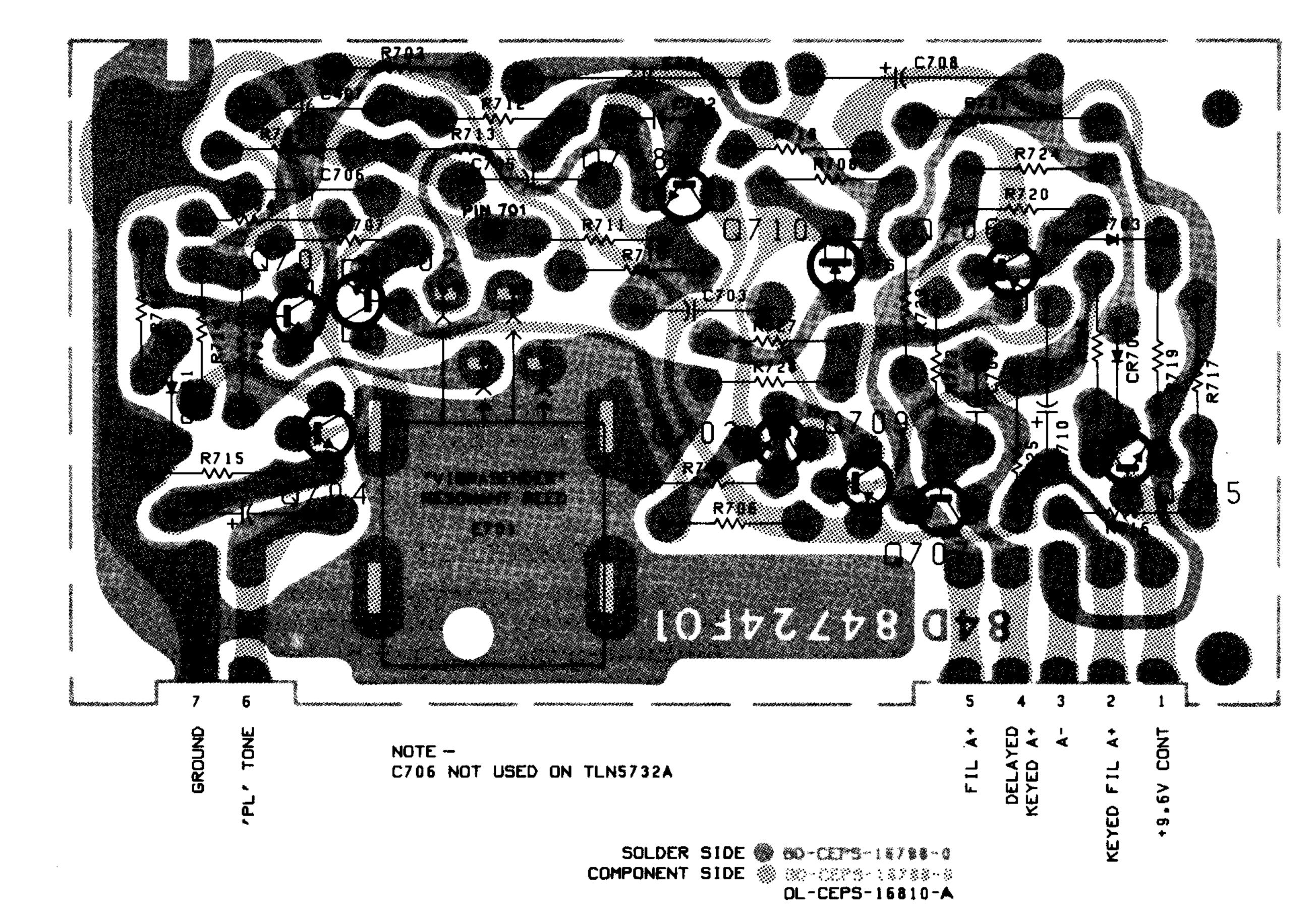
2.4 TONE OUTPUT CIRCUIT

When the transmitter is keyed, PL gate switch Q709 is turned on. Q709, in turn, gates 9.6 volts to PL tone gate Q703, turning it off. When Q703 is turned off, only the output of Q701 is coupled to emitter follower Q704. When the transmitter is unkeyed, Q709 is turned off and The output of Q701 is applied to feedback amplifier Q703 is turned on which completes the tone path capacitors to produce a signal to the emitter folviding a sinusoidal wave output. The "Vibrasender' tone. Emitter follower Q704 provides impedance

EPS-17757-A



SHOWN FROM SOLDER SIDE

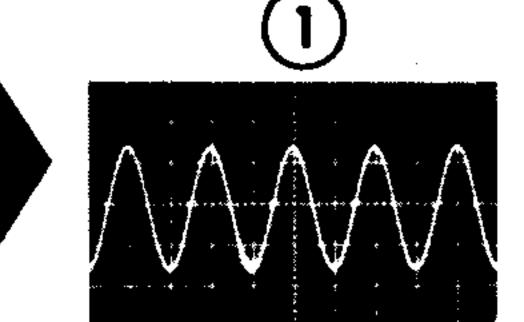


TONE "PL" ENCODER WAVEFORMS

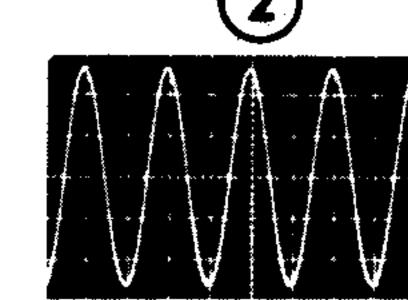
OSCILLOSCOPE WAVEFORMS MEASURED UNDER FOLLOWING CONDITIONS:

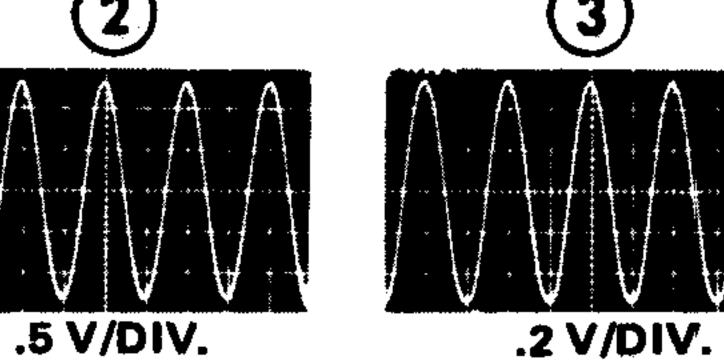
- **WAVEFORMS SHOWN USING 100-Hz** "VIBRASENDER" RESONANT REED. VERTICAL SENSITIVITY SHOWN
- HORIZONTAL DEFLECTION = 5 msec/DIV. ALL WAVEFORMS MEASURED IN RESPECT TO CHASSIS GROUND.

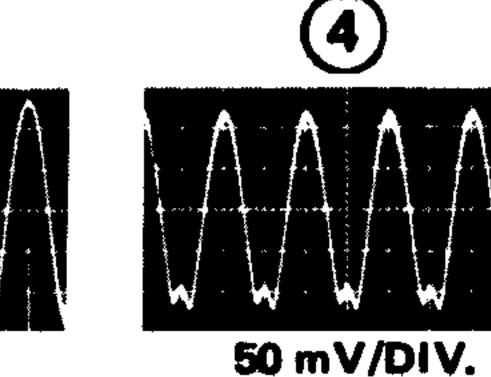
UNDER EACH WAVEFORM.

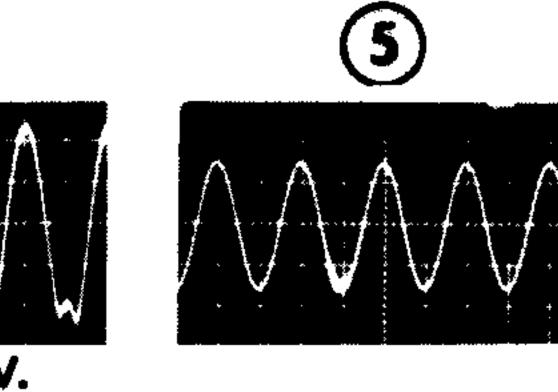


EPS-6260 C 50 mV/DIV.









TONE "PRIVATE-LINE" ENCODER

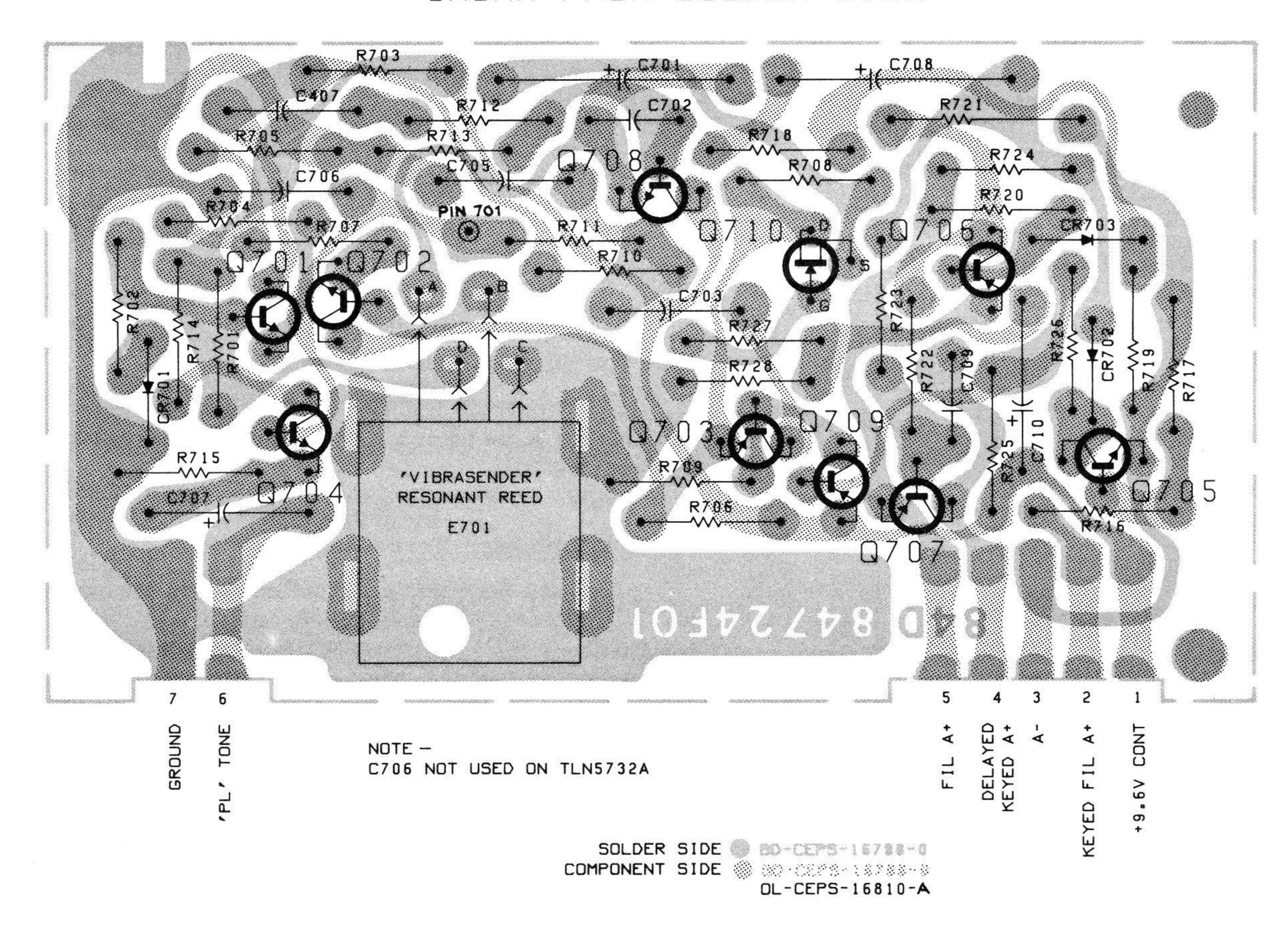
MODEL TLN5731A

"PL" ENCODER

- 701. ALL AC VOLTAGE MEASUREMENTS ARE RMS VALUES. ALL AC VOLTAGES ARE SINUSOIDAL EXCEPT Q708 EMITTER. METER READING DEPENDENT UPON METER RESPONSE TO NON-SINUSOIDAL WAVE.
- 702. DC VOLTAGE MEASUREMENTS IN Q705, Q706 AND Q707 STAGES TAKEN WITH RESPECT TO A-. VOLTAGES FOR ALL OTHER STAGES TAKEN WITH RESPECT TO CHASSIS GROUND. ALL DC VOLTAGES MAY BE MEASURED WITH 20,000 OHM-PER-VOLTMETER OR HIGH IMPEDANCE DC **VOLTMETER (11 MEGOHM) EXCEPT BASE OF Q704 WHICH** CAN ONLY BE MEASURED WITH A HIGH IMPEDANCE METER.
- 703. UNLESS OTHERWISE STATED: CAPACITOR VALUES ARE IN PICOFARADS. RESISTOR VALUES ARE IN OHMS.
- 704. PIN 701 IS USED ONLY FOR CERTAIN OPTIONAL EQUIP-MENT

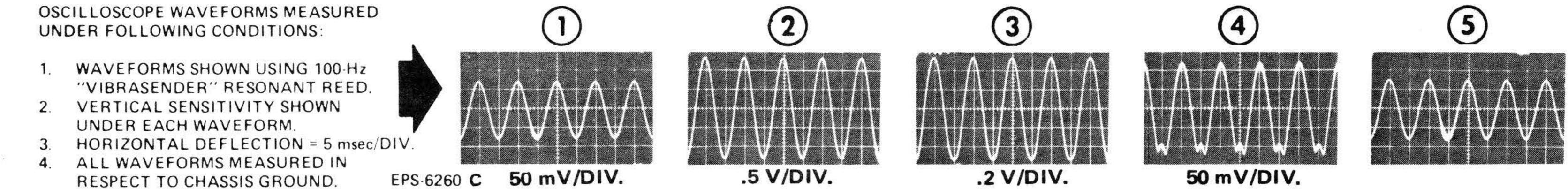
EPS-7051-A

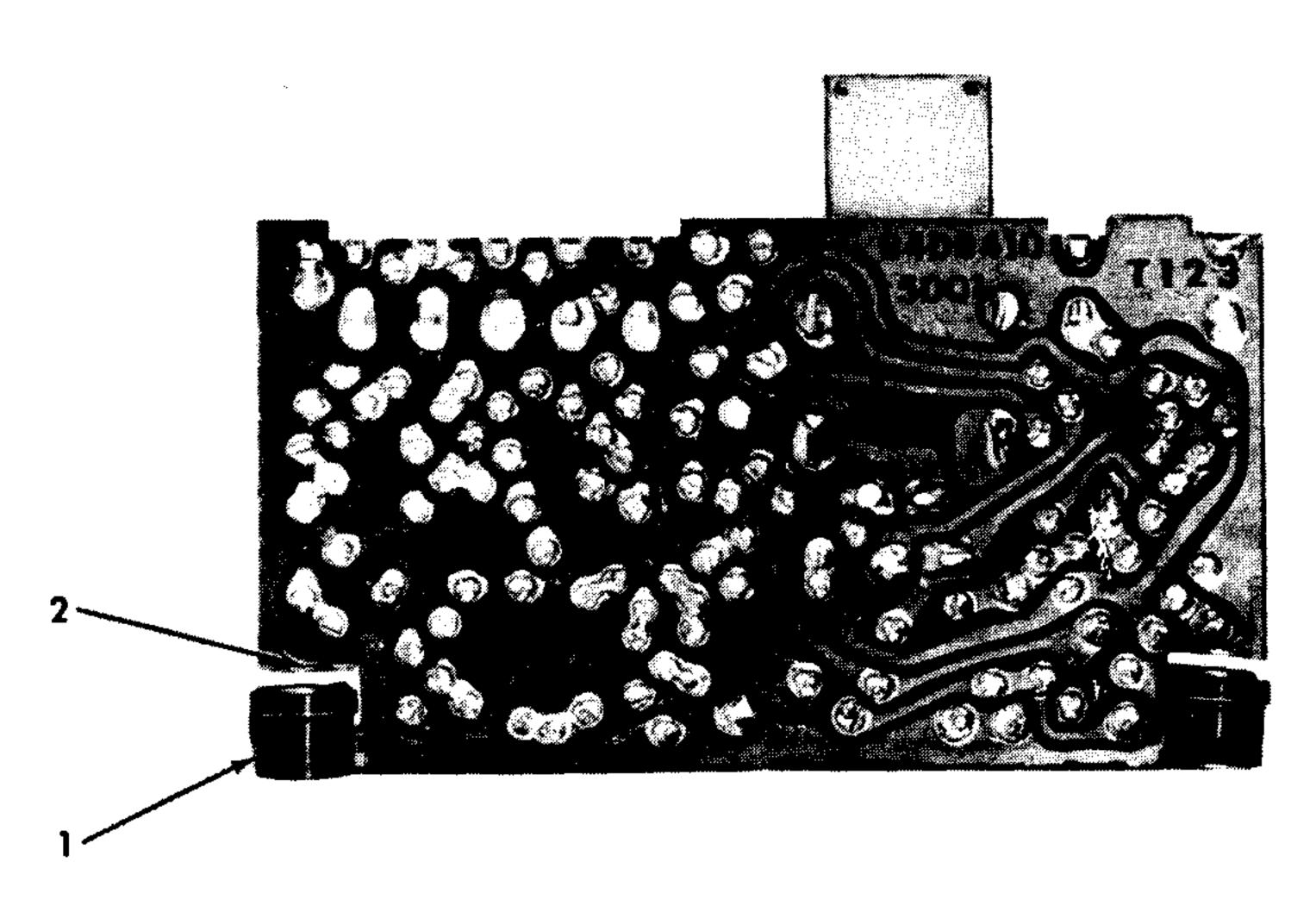
SHOWN FROM SOLDER SIDE

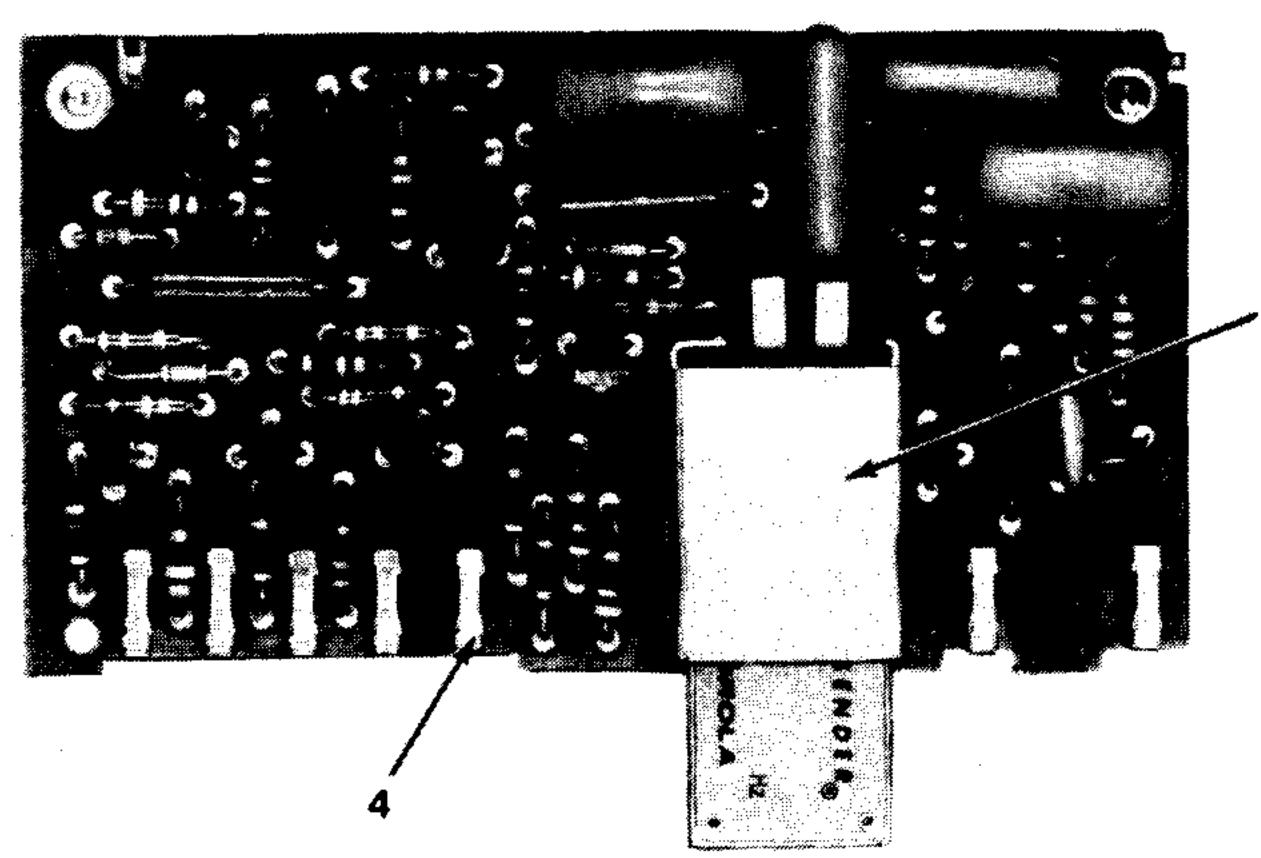


RESPECT TO CHASSIS GROUND.

TONE "PL" ENCODER WAVEFORMS







AEPS-6945-O

MECHANICAL PARTS LIST

TLN5731A and TLN4293B

"Private-Line" Encoder PL-1308-D

CODE	MOTOROLA PART NO.	DESCRIPTION
1 2	42-84284B01 3-138162	RETAINER, screw: 2 req'd LOCKSCREW, tapping: No 4 x 3/8" Phillips hex head; 2 req'd
3	42-84116B02	SOCKET & BRACKET ASSEM- BLY: for "Vibrasender"
4	9-83011H01	Resonant Reed TERMINAL, pin: female 7 req'd

REFERENCE	MOTOROLA PART NO.	DESCRIPTION
2 t INI BOLL	PART NO.	

ELECTRICAL PARTS LIST

PL-3260-C TLN5731A Tone "Private-Line" Encoder CAPACITOR, fixed: uF; ±10%; 50 V; unless otherwise stated C701 23-84762H09 15 ±20%; 20 V 21-82187B23 820 pF; 500 V 8-82905G32 C703, 704 8-83813H08 NOT USED 23-84762H08 3.9 uF ±20%; 15 V 23-83214C26 15; 25 V 21-82372C04 .05; +80-20%; 25 V 23-84762H08 3.9 uF $\pm 20\%$; 15 V DIODE: (SEE NOTE I) CR701, 702, 48-83654H01 silicon CONNECTOR, receptacle: J401 consists of 7 female contact terminals (Part No. 9-83011H01) mounted on edge of circuit board "VIBRASENDER" RESONANT REED: (SEE NOTE II) E701 TLN6824A "plug-in" unit TRANSISTOR: (SEE NOTE I) Q701, 702 48-869570 NPN; type M9570 or 48-869642 NPN; type M9642 Q703 48-869571 PNP; type M9571 or 48-869643 PNP; type M9643 Q704, 705 48-869570 NPN; type M9570 or 48-869642 NPN; type M9642 Q706 48-869571 PNP; type M9571 or 48-869643 PNP; type M9643 48-869328 Q707 PNP; type M9328 Q708 48-869570 NPN; type M9570 or 48-869642 NPN; type M9642 Q709 48-869571 PNP; type M9571 or 48-869643 | PNP; type M9643 FET; type M9653 Q710 48-869653 RESISTOR, fixed: ±5%; 1/4 W; unless otherwise stated R701 6-124A73 6-124A65 R703, 706 6-124A51 6-124A05 6-124A41 6-124A05 6-124A63 $12k \pm 10\%$ 6-124C75 6-124A81 6-124A95 6-124A89 6-124A85 270 ±10% 6-124C35 6-124A65 6-124C57 $2.2k \pm 10\%$ 6-124C49 1k ±10% 6-124A53 6-124A77 6-124A75

NOTES:

R727, 728

R726

I. For optimum performance, replacement diodes and transistors must be ordered by Motorola part number.

 $2.2k \pm 10\%$

27k ±10%

47k ±10%

220k ±10%

6-125A49

6-124A45

6-124A53

6-124C57

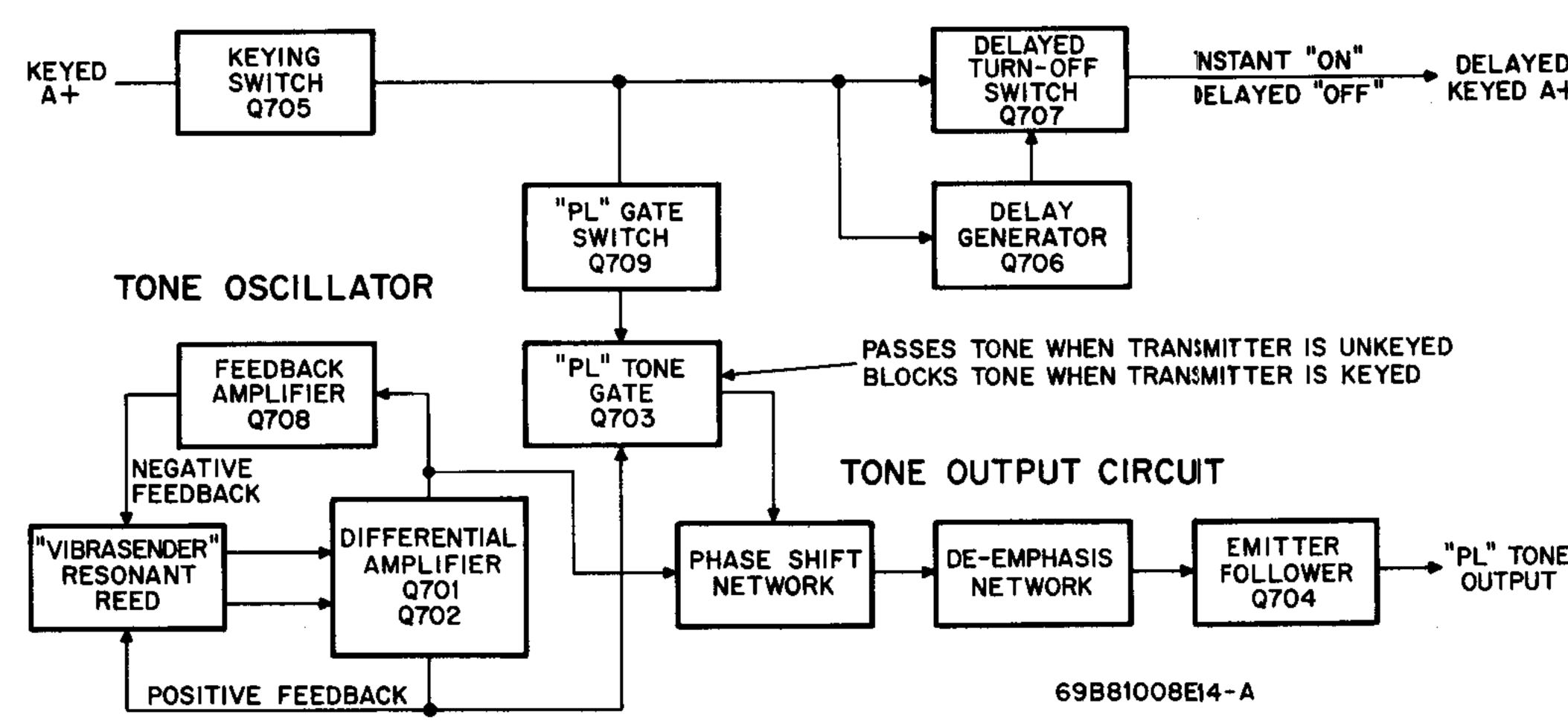
6-124C83

6-124C89

6-124D06

II. The "Vibrasender" Resonant Reed (Model KLN6210A) is not a part of the encoder board. When ordering a complete board, the reed must be ordered separately.

REVERSE BURST TIMING CIRCUIT



Tone "Private-Line" Encoder Block Diagram

MAINTENANCE

a. Recommended Test Equipment

- (1) Motorola SLN6221A "Private-Line" Tone Generator -- used for testing "Vibrasender" resonant reeds.
- (2) Motorola Solid-State AC Voltmeter -- used for tone level measurement.
- (3) General purpose oscilloscope -- valuable for signal tracing and locating sources of distortion.
- (4) Motorola Solid-State DC Multimeter -- used for dc voltage measurement.
- (5) Motorola S1343 Series Frequency Counter or S1344 Series Frequency Counter/ Deviation Meter -- used for measuring PL tone frequency.

b. Performance Test

Measure frequency deviation of the transmitter in which the PL encoder is installed. With the transmitter keyed and PL tone modulation (only), deviation should read ± 0.5 to ± 1.0 kHz.

c. Troubleshooting

- (1) If no deviation is measured the trouble may lie in the tone oscillator or tone output circuit. The trouble may be isolated by the following steps.
 - (a) Check 9.6-volt input to encoder.
- (b) Check ac signal voltage at collector of Q701.
 - (c) If signal is present, check Q704.

- (d) If no signal is present any component in the oscillator loop could cause the trouble. Check the "Vibrasender" resonant reed in the SLN6221A "Private-Line" Tone Generator.
- (e) If the tone generator does not produce an output signal the reed is defective.
- (f) If the reed is good, replace it in the encoder and make dc voltage measurements in the tone oscillator circuit to locate the defective component.
- (2) If low deviation is measured, check ac signal voltages and compare them with the chart readings to find the source of trouble.
- (3) If deviation is normal, but calls are not being received, check the frequency of the PL encoder tone. If off-frequency, replace the "Vibrasender" resonant reed.
- (4) If squelch tail noise bursts are heard by all listening receivers, check dc voltages of Q703 and Q706 in keyed and unkeyed conditions.
- (5) If the transmitter cannot be keyed, and the trouble has been isolated to the PL encoder board, measure dc voltages in Q705 and Q707 stages.
- (6) If too much tone deviation is measured, check feedback amplifier Q708.

