

TECHNICAL CHARACTERISTICS

"PL" TONE FREQUENCY	Selected from 67-210 Hz range
FREQUENCY DETERMINING DEVICE	"Vibrasender" Resonant Reed
STABILITY	± 0.15%
LEVEL (nominal)	350 mV rms
OUTPUT IMPEDANCE	4.7k ohms
POWER REQUIREMENTS	+9.6 V dc @ 15 mA

1. DESCRIPTION

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

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 "Vibrasender" 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 "Vibrasender" 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 feed-

back signal is coupled through C701 and R708 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. The output of Q701 is applied to feedback amplifier Q708 through C704 and R712. When the signal level exceeds a fixed amount, Q708 is biased into operation. It provides a negative feedback signal which keeps the oscillator out of limiting, thus provided a sinusoidal wave output. The "Vibrasender" resonant reed is the frequency determining device of the oscillator. It acts as a very high Q, narrow bandpass transformer, coupling only its resonant frequency and blocking all others. At its resonant frequency, the reed vibrates to couple energy from the primary to the secondary winding.

2.3 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 circuit:

--Q707 is biased "on" through R723, CR702 and Q705 to A-.

--Keyed, filter 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, filter 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.

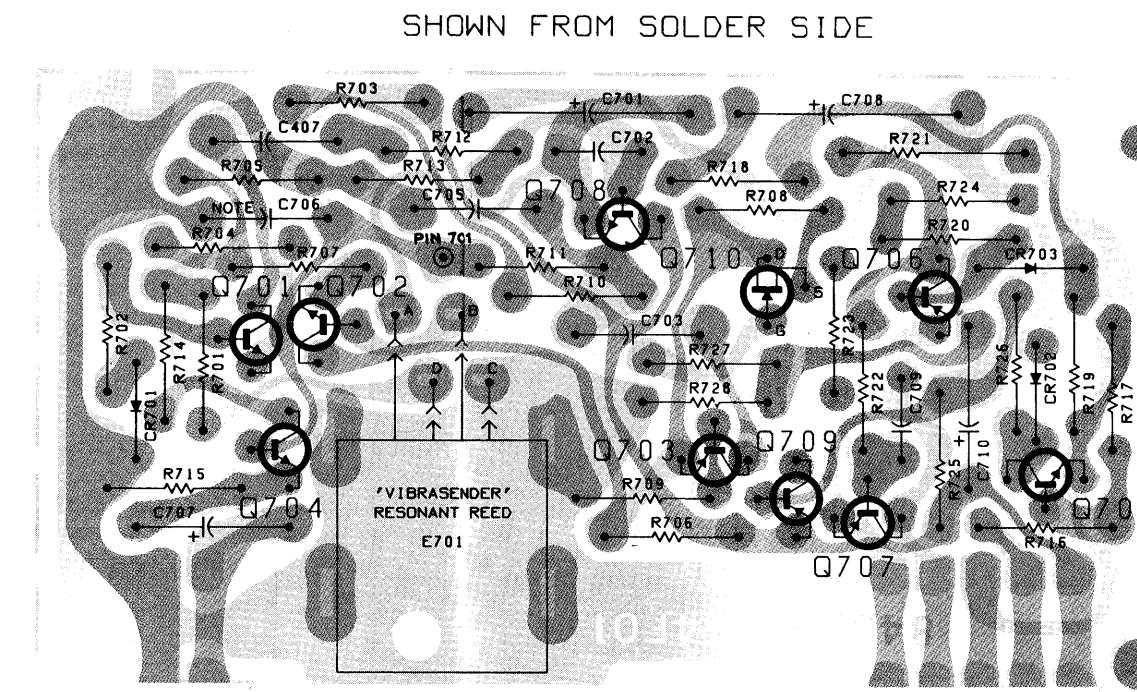
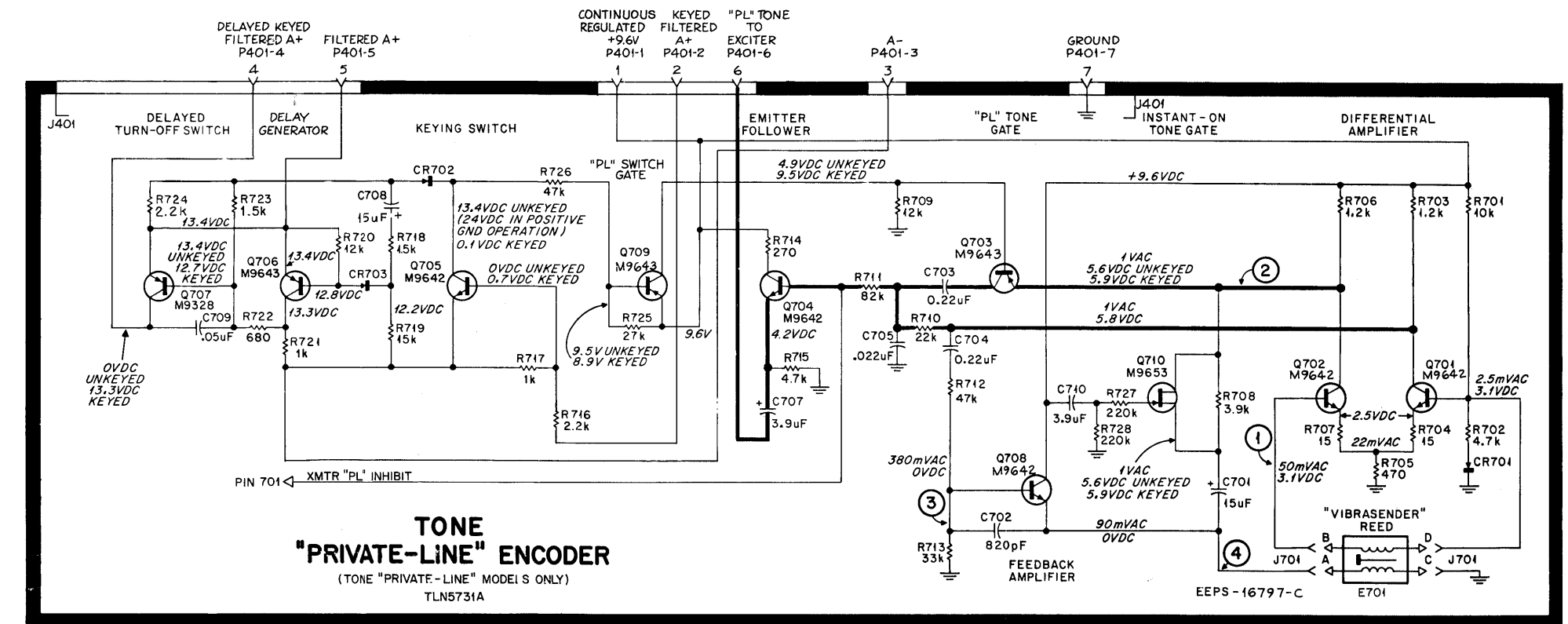
--The A+ across R721 turns off Q707 which removes the delayed keyed filter A+ from the transmitter.

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 Q703 is turned on which completes the tone path from Q702 to C703. The two tone signals 180° out of phase, combine through the phase shift capacitors to produce a signal to the emitter follower that is 240° out of phase with the original tone. Emitter follower Q704 provides impedance matching in a low impedance output and isolates the tone oscillator from the external circuit to which the tone output is applied.

TONE "PRIVATE-LINE" ENCODER

MODEL TLN5731A

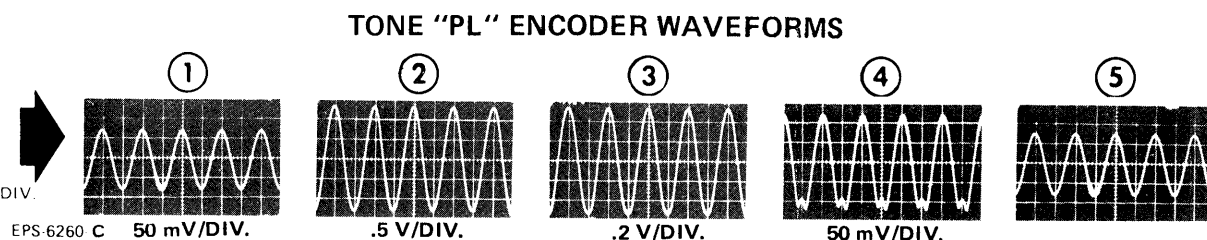


- "PL" ENCODER
- ALL AC VOLTAGE MEASUREMENTS ARE RMS VALUES. ALL AC VOLTAGES ARE SINUSOIDAL EXCEPT Q708 EMITTER. METER READING DEPENDENT UPON METER RESPONSE TO NON-SINUSOIDAL WAVE.
 - DC VOLTAGE MEASUREMENTS IN Q705, Q706 AND Q707 STAGES TAKEN WITH RESPECT TO A-. VOLTAGES FOR ALL OTHER STAGES TAKEN WITH 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.
 - UNLESS OTHERWISE STATED: CAPACITOR VALUES ARE IN PICOFARADS. RESISTOR VALUES ARE IN OHMS.
 - PIN 701 IS USED ONLY FOR CERTAIN OPTIONAL EQUIPMENT.
 - PINS J401-6 AND -7 ON THE PL ENCODER MATE WITH PINS P401-11 AND -12 ON THE EXCITER.

NEPS-7051-B

OSCILLOSCOPE WAVEFORMS MEASURED UNDER FOLLOWING CONDITIONS:

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



TONE "PL" ENCODER WAVEFORMS

EPS-17757-B

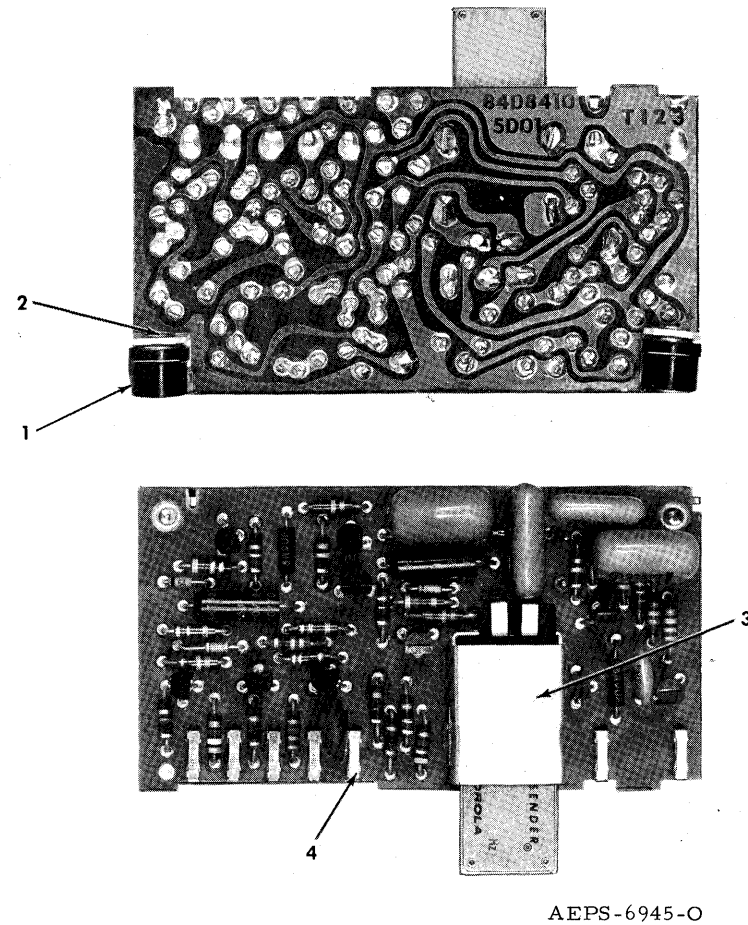
NOTE --
C706 OMITTED ON TLN5731A USED IN DC DVP APPLICATIONS AND TLN5732A.

SOLDER SIDE COMPONENT SIDE
80-CEPS-16788-8
QL-CEPS-16810-B

68P81026E71-H
(Sheet 1 of 2)
5/10/79-UP

TONE "PRIVATE-LINE" ENCODER

MODEL TLN5731A



MECHANICAL PARTS LIST

TLN5731A and TLN4293B
"Private-Line" Encoder

PL-1308-D

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

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
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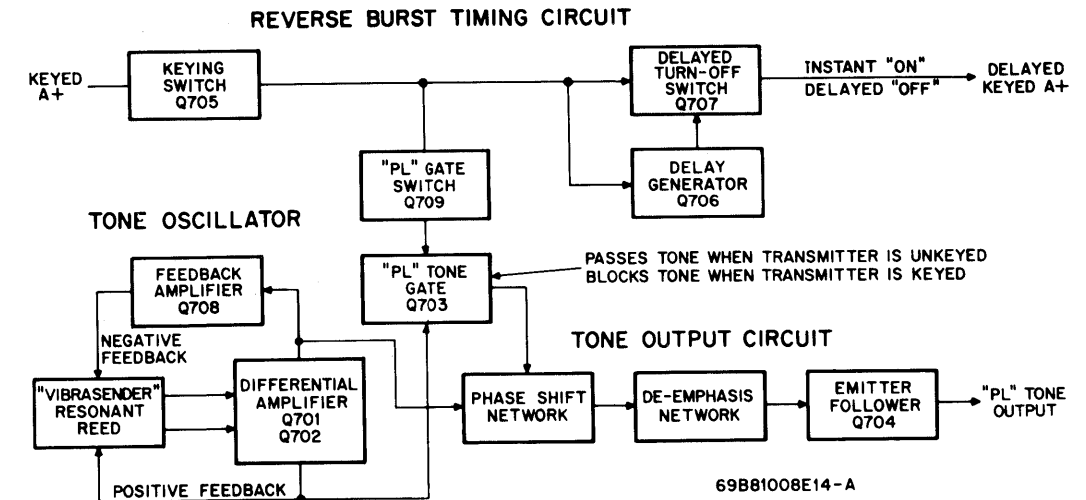
ELECTRICAL PARTS LIST

TLN5731A Tone "Private-Line" Encoder PL-3260-D

C701	23-84762H09	CAPACITOR, fixed: μF ; $\pm 10\%$; 50 V; unless otherwise stated
C702	21-82187B23	15 $\pm 20\%$; 20 V
C703, 704	8-82905G32	820 pF; 500 V
C705	8-83813H08	0.22
C706		NOT USED
C707	23-84762H08	3.9 μF $\pm 20\%$; 15 V
C708	23-83214C26	15; 25 V
C709	21-82372C04	.05; $+80-20\%$; 25 V
C710	23-84762H08	3.9 μF $\pm 20\%$; 15 V
CR701, 702, 703	48-83654H01	DIODE: (SEE NOTE I) silicon
J401		CONNECTOR, receptacle: consists of 7 female contact terminals (Part No. 9-83011H01) mounted on edge of circuit board
E701	KLN6210A	"VIBRASENDER" RESONANT REED: (SEE NOTE II) "plug-in" unit
Q701, 702	48-869570	TRANSISTOR: (SEE NOTE I) NPN; type M9570
Q703	48-869571	NPN; type M9642
Q704, 705	48-869570	PNP; type M9571
Q706	48-869571	PNP; type M9643
Q707	48-869328	NPN; type M9570
Q708	48-869570	NPN; type M9642
Q709	48-869571	PNP; type M9571
Q710	48-869571	PNP; type M9643
		FET; type M9653
R701	6-124A73	RESISTOR, fixed: $\pm 5\%$; 1/4 W; unless otherwise stated
R702	6-124A65	10k
R703, 706	6-124A51	4.7k
R704	6-124A05	1.2k
R705	6-124A41	15
R707	6-124A05	470
R708	6-124A63	15
R709	6-124C75	3.9k
R710	6-124A81	12k $\pm 10\%$
R711	6-124A95	22k
R712	6-124A89	82k
R713	6-124A85	47k
R714	6-124C35	33k
R715	6-124A65	270 $\pm 10\%$
R716	6-124C57	4.7k
R717	6-124C49	2.2k $\pm 10\%$
R718	6-124A53	1k $\pm 10\%$
R719	6-124A77	1.5k
R720	6-124A75	15k
R721	6-125A49	12k
R722	6-124A45	1k; 1/2 W
R723	6-124A53	680
R724	6-124C57	1.5k
R725	6-124C83	2.2k $\pm 10\%$
R726	6-124C89	27k $\pm 10\%$
R727, 728	6-124D06	47k $\pm 10\%$
		220k $\pm 10\%$

NOTES:

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



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 measurement in the tone oscillator circuit to locate the defective components.

(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 is 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.