MOTOROLA

MICOR®
Base Station Accessories
Multiple Tone "PL" Options

THIS MANUAL HAS BEEN
DISCONTINUED

Instruction Manual
68P81106E30–B

CONTENTS

INTRODUCTION/ APPLICATIONS

1. MULTIPLE "PL" OPTION COMPLEMENT CHART

FACTORY OPTION NO.				MODULE USED	
C158BA	C261AA	C262BA	C263BA	MODEL	DESCRIPTION
4-"PL" Transmit	4-"PL" Receive	4-"PL" Repeat	4-"PL" Transmit & Receive		
X			X	TLN5746A	Matrix Control Module
X		X	X	TLN5744A	Encoder Module
X		X	X	TLN5733AV	Converter Board
	X	X	X	TLN5745A	Decoder Module

2. TECHNICAL CHARACTERISTICS

"PL" ENCODER MODULE	
MAX. NO. OF FREQUENCIES	4
"PL" TONE FREQUENCY RANGE	67-210 Hz
FREQUENCY DETERMINING DEVICE	"Vibrasender" Resonant Reed
STABILITY	±0.15%
LEVEL (NOMINAL)	1 V rms @ 67-210 Hz
OUTPUT IMPEDANCE	1.0k ohms
POWER REQUIREMENTS	13.8 Volts dc @ 20 mA

"PL" DECODER MODULE	
MAX. NO. OF FREQUENCIES	4
"PL" TONE FREQUENCY RANGE	67-210 Hz
FREQUENCY DETERMINING DEVICE	"Vibrasponder" Resonant Reed
STABILITY	±0.15%
TONE BANDWIDTH	Approx. 1 Hz
TONE SENSITIVITY	0.25 Volts ac rms reed drive
OUTPUT	13.0 Volts dc switched
POWER REQUIREMENTS	13.8 Volts dc @ 20 mA

MATRIX CONTROL MODULE		
MAX. NO. OF FREQUENCIES		4
CONTROL TONE FREQUENCIES	STD: (Hz)	1050, 1150, 1250, 1350
	CAN BE MODIFIED TO: (Hz)	1450, 1550, 1650, 1750, 1850, 1950, 2050
FREQUENCY DETERMINING DEVICE		LC Circuits
OUTPUT		4 switched ground outputs

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68P81023E67-B
2/18/76-UP

3. DESCRIPTION

3.1 PURPOSE AND APPLICATION

3.1.1 These factory installed multiple PL options are available for one- or two-frequency remotely controlled "Micor" base and repeater stations. One of the options is required whenever it is desired to transmit, receive or repeat more than one PL tone, with the capability of handling up to four PL tones. An application table at the end of this section simplifies the selection of the appropriate option for each specific type of station.

3.1.2 The multiple PL transmit options require that the station be equipped with tone remote control facilities; for dc remote control stations, tone remote control capability must also be added. Since the multiple PL options includes modules which are inserted into the remote control chassis, use of these options may exclude the use of other modules. The multiple PL transmit options prohibit the use of the "Wild Card" module or the 4-Frequency control module and the multiple PL receive and repeat options prohibit the use of the "Single Tone" decoder module.

3.1.3 Each multiple PL option consists of one or more of the following modules (refer to paragraph 1): multi PL decoder module, matrix control module, multi PL encoder module and PL converter board. Each of these items is further described in the following paragraphs.

3.2 MULTI "PL" DECODER

The multi PL decoder module contains four parallel PL decoder circuits, each of which detects a different PL tone and provides switched ground outputs when the proper PL tone is detected. The switched ground output unsquelches the receiver's audio. In repeater stations, the switched ground output also keys the transmitter. In repeater stations, an independent switched ground output from each decoder circuit selects the desired PL tone to be transmitted. This module occupies the "Single Tone" decoder position in the remote control chassis. One "Vibrasponder" resonant reed is required for each PL tone to be decoded; for less than four PL tones, reeds are omitted.

3.3 MATRIX CONTROL MODULE

The matrix control module permits remote control selection of the PL tone to be transmitted. The module detects four function tones from a remote control console and provides switched ground outputs that are applied to the multi PL encoder module, thereby selecting one of four PL tones. The matrix control module occupies the "Wild Card" module position in the remote control chassis. Although the function tones used in this module are identical to the standard function tones used in the 4-Frequency control module and "Wild Card" module, there is no conflict because both modules cannot be used in the same station.

FUNCTION TONE	"PL" TONE GENERATED
1350 Hz	#1
1250 Hz	#2
1150 Hz	#3
1050 Hz	#4

3.4 MULTI "PL" ENCODER MODULE

The multi PL encoder module generates the PL tones which are transmitted. The module contains four identical oscillator circuits and is thus capable of generating up to four PL tones. Each oscillator requires a switched ground input to become activated. The multi PL encoder module occupies the "spare" position in the remote control chassis.

3.5 "PL" CONVERTER BOARD

This board is always used in conjunction with the multi PL encoder module and provides the necessary compatibility with the transmitter. This board mounts in the transmitter in the position normally occupied by the PL encoder board in single PL transmit stations. The delayed transmitter turn-off circuits (reverse burst timing) are located on this board.

3.6 C158BA OPTION (4 "PL" TRANSMIT)

This option adapts the station for up to four PL transmit capability with remote control selection of the desired PL tones. Function tones generated at a remote control console are detected by the matrix control module, which, in turn, selects the PL tone generated by the multi PL encoder module.

3.7 C261AA OPTION (4 "PL" RECEIVE)

This option adapts the station to receive up to four different PL tones. Reception of any of the correct PL tones will unsquelch the receiver.

3.8 C262BA OPTION (4 "PL" REPEAT)

This option gives multiple PL capability to a non wire-line repeater station. Up to four different received PL signals will key the transmitter and automatically select up to four different PL tones to be transmitted. If cross coding is desired, the received PL tones need not match the transmitted PL tone.

3.9 C263BA OPTION (4 "PL" TRANSMIT & RECEIVE)

This option incorporates all of the factory installed multiple PL option modules. It adapts the transmitter for up to four PL tone transmit capability with remote control selection of the desired PL tones. In addition, this option allows the receiver to respond to up to four different received PL tones.

4. INDEPENDENT COMMAND STATION CONTROL

4.1 Independent command signifies that PL tone selection is completely independent of transmitter keying and all other control functions applied to the station. Refer to Figure 1.

4.2 When one of the four PL select switches on the console is activated, a momentary 2175 Hz high level guard tone signal is generated which allows the station to accept a forthcoming PL select function tone. The PL select function tone then sets a corresponding bistable and resets three others in the matrix control module. At this time, a PL encoder is selected and will remain selected until a new PL encoder is selected. Notice that selection of a PL tone does not, in itself, key the transmitter and that no additional function tones follow the PL select function tone.

4.3 When the transmitter is subsequently keyed by activating the console's transmit switch, a momentary 2175 Hz high level guard tone signal is again applied to the base station. Next, the transmitter key function tone is applied to the station (1950 Hz for F1; 1850 Hz for F2), which keys the transmitter and the previously selected PL tone is transmitted. Low level guard tone keeps the transmitter keyed for the duration of the message. With loss of low level guard tone, the transmitter unkeys but the previously selected PL tone remains selected.

5. TRANSMIT COMMAND STATION CONTROL

5.1 Transmit command signifies that the function tone applied to the station to select a PL tone, also simultaneously keys the transmitter. Refer to Figure 1.

5.2 When one of the four PL select switches is activated, the frequency of the function tone is determined but not generated. The function tone frequency is determined by four PL select switches on the console as with independent command selection. The difference is, however, that when one of the PL select switches is activated in the transmit command mode, function tone is not immediately applied to the station. When the transmit switch is activated, a momentary 2175 Hz high level guard tone signal is applied to the station. Next, the PL select/transmitter key function tone is applied to the station which causes the station to transmit with the chosen PL tone. As with independent command selection, function tone is followed by low level guard tone for the duration of the message. But, unlike independent command selection, loss of low level guard tone resets the previously selected PL tone as well as unkeys the transmitter. The transmit command mode of operation is necessary when multiple consoles are used with a station to give the correct PL selection status indication to all consoles. Stations are shipped from the factory jumpered for independent command station control. The matrix control module jumpers must be changed to convert to transmit command station control.

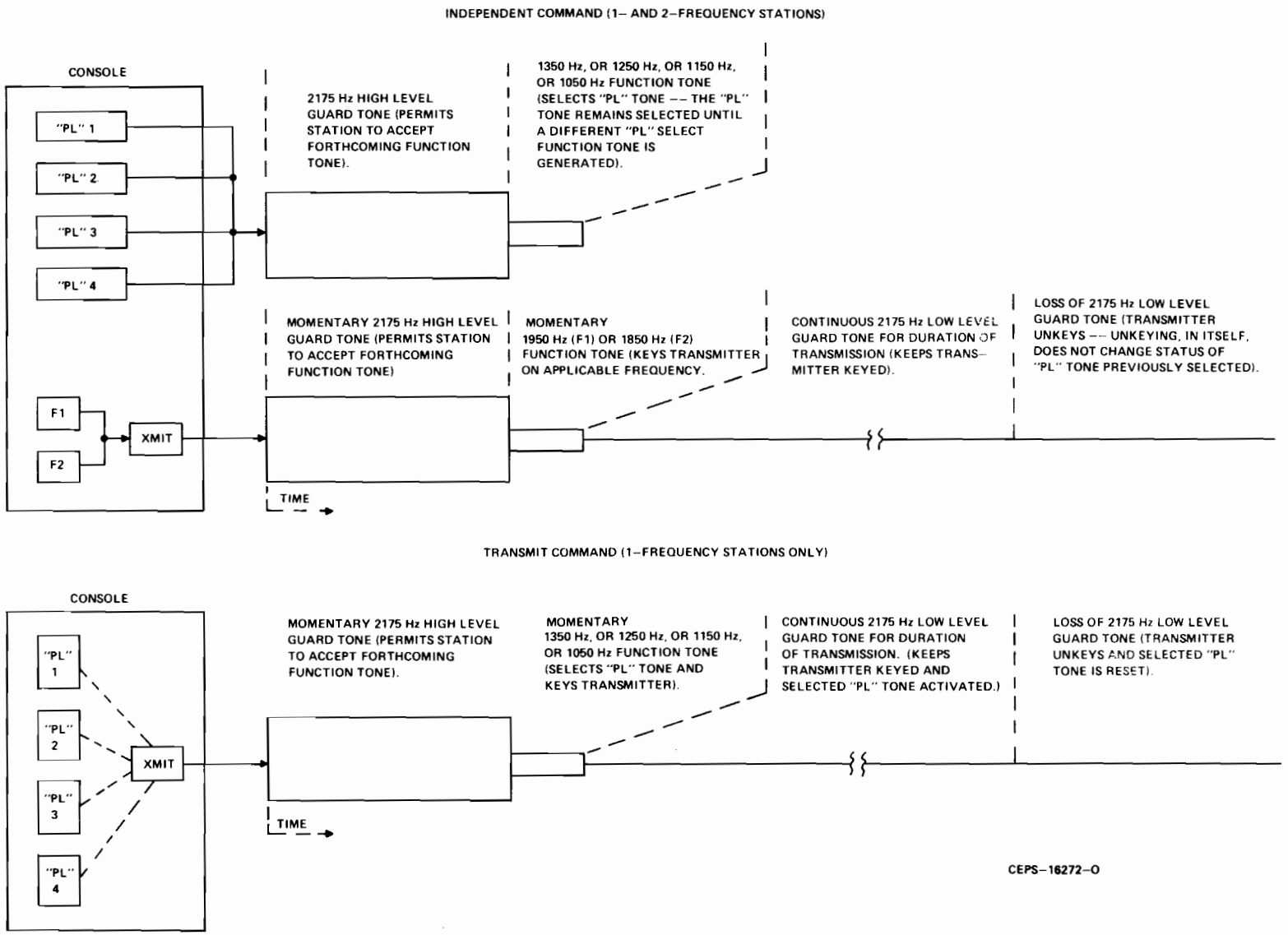
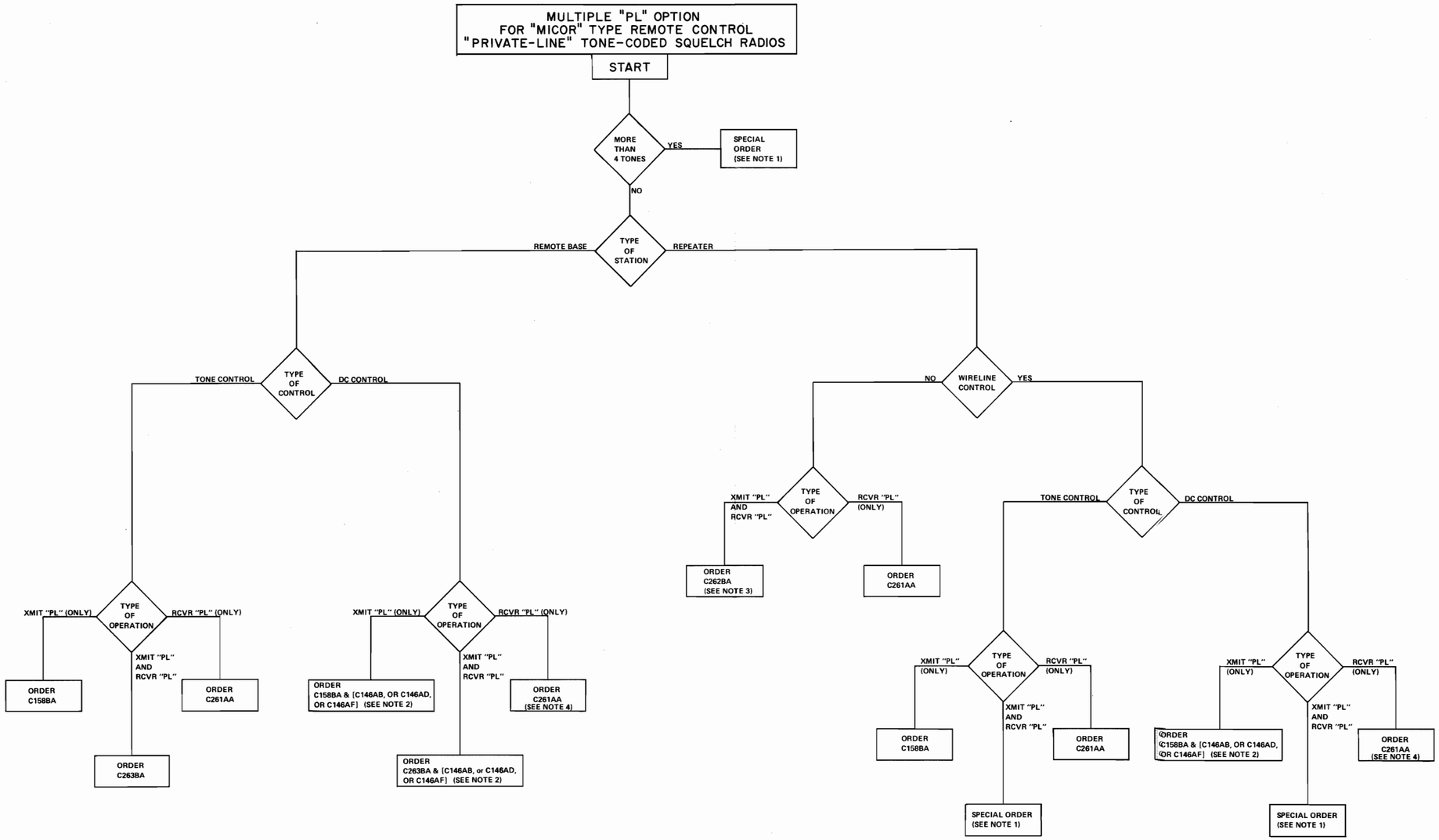


Figure 1. Independent vs. Transmit Command Timing Diagram

MULTIPLE "PL" OPTION FOR "MICOR" TYPE REMOTE CONTROL "PRIVATE-LINE" TONE-CODED SQUELCH RADIOS



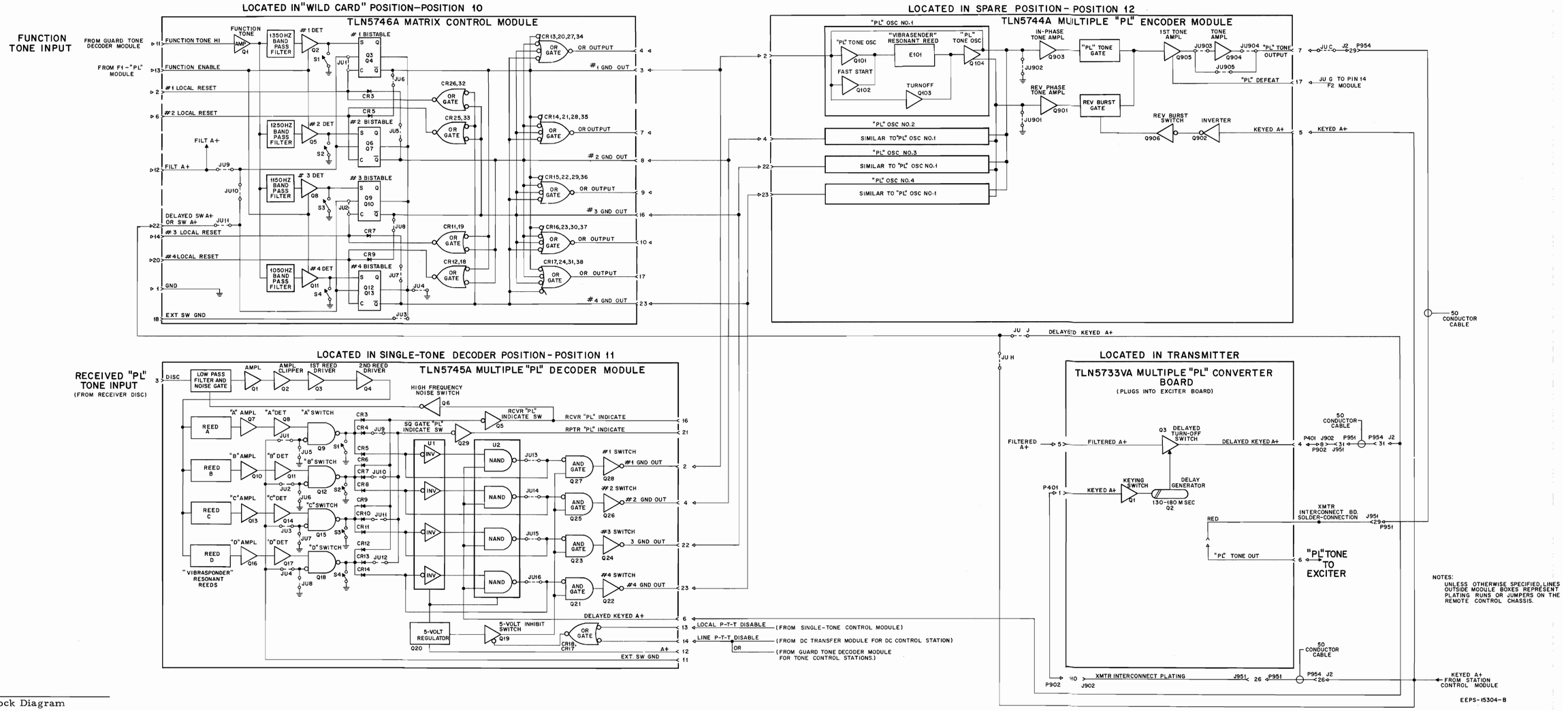
NOTES:

1. EXAMPLES OF SPECIAL ORDERS
   A. MORE THAN FOUR "PL" TONES.
   B. "PL" TONE SELECTED OTHER THAN BY INDEPENDENT SELECTION.
   C. T4-R4 STATIONS.
2. C146AB OPTION REQUIRED WITH T1-R1 STATIONS. C146AD OPTION REQUIRED WITH T2-R1 STATIONS. C146AF OPTION REQUIRED WITH T2-R2 STATIONS. (C146 OPTION ADDS TONE CONTROL TO DC CONTROLLED STATIONS.)
3. C262BA OPTION USED ONLY ON NON-WIRE LINE REPEATER STATIONS. "PL" TONE TRANSMITTED IS SELECTED BY "PL" TONE RECEIVED.
4. C261AA OPTION CAN BE USED WITH EITHER DC OR TONE REMOTE CONTROL STATIONS.

OPTION COMPLEMENT CHART

FACTORY OPTION				MODULES USED	
C158BA	C261AA	C262BA	C263BA	MODEL	DESCRIPTION
X			X	TLN5746A	MATRIX CONTROL MODULE
X		X	X	TLN5744A	ENCODER MODULE
X		X	X	TLN4733AV	"PL" CONVERTER BOARD
X	X	X	X	TLN5745A	DECODER MODULE

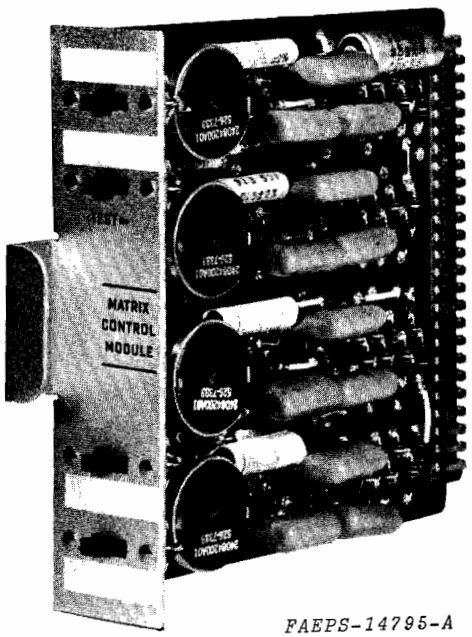
DEPS-15305-C



Functional Block Diagram
Multiple "Private-Line" Option
Motorola No. EEPS-15304-B
2/10/76-UP

MULTIPLE "PL" MATRIX CONTROL MODULE

MODEL TLN5746A



FAEPS-14795-A

1. FUNCTIONS

This matrix control module is primarily used to control the multiple PL encoder module and provides the following functions -- not all simultaneously:

- Four switched ground outputs in response to received function tones.
- Four AND function switched ground outputs in response to receive function tones when guard tone is received simultaneously.
- Five OR function outputs in response to any switched ground output generated by the module.

This matrix control module can be used in other applications also, which can be compared to the "Wild Card" module -- the difference being, that the matrix control module has diode matrix outputs rather than relay outputs as possible in the "Wild Card" module.

2. DESCRIPTION

This module is fully transistorized and occupies the "Wild Card" position in the remote control chassis. All components and circuitry are mounted on a sturdy card with connecting pins to mate with the interconnecting board of the chassis in which it is installed.

3. CIRCUIT DESCRIPTION

3.1 The matrix control module responds to specific momentary function tones as illustrated in Table 1.

TABLE 1.

Function vs. Output

Function Tone (Hz)	Bistable Operated (No.)	Ground Appears at Contact No.
1350	1	3
1250	2	8
1150	3	16
1050	4	23

NOTE

These frequencies can be changed for special applications as detailed in paragraph 9 of this section.

Each bistable, when operated, provides a switched ground output capable of handling up to 100-milliamperes of current.

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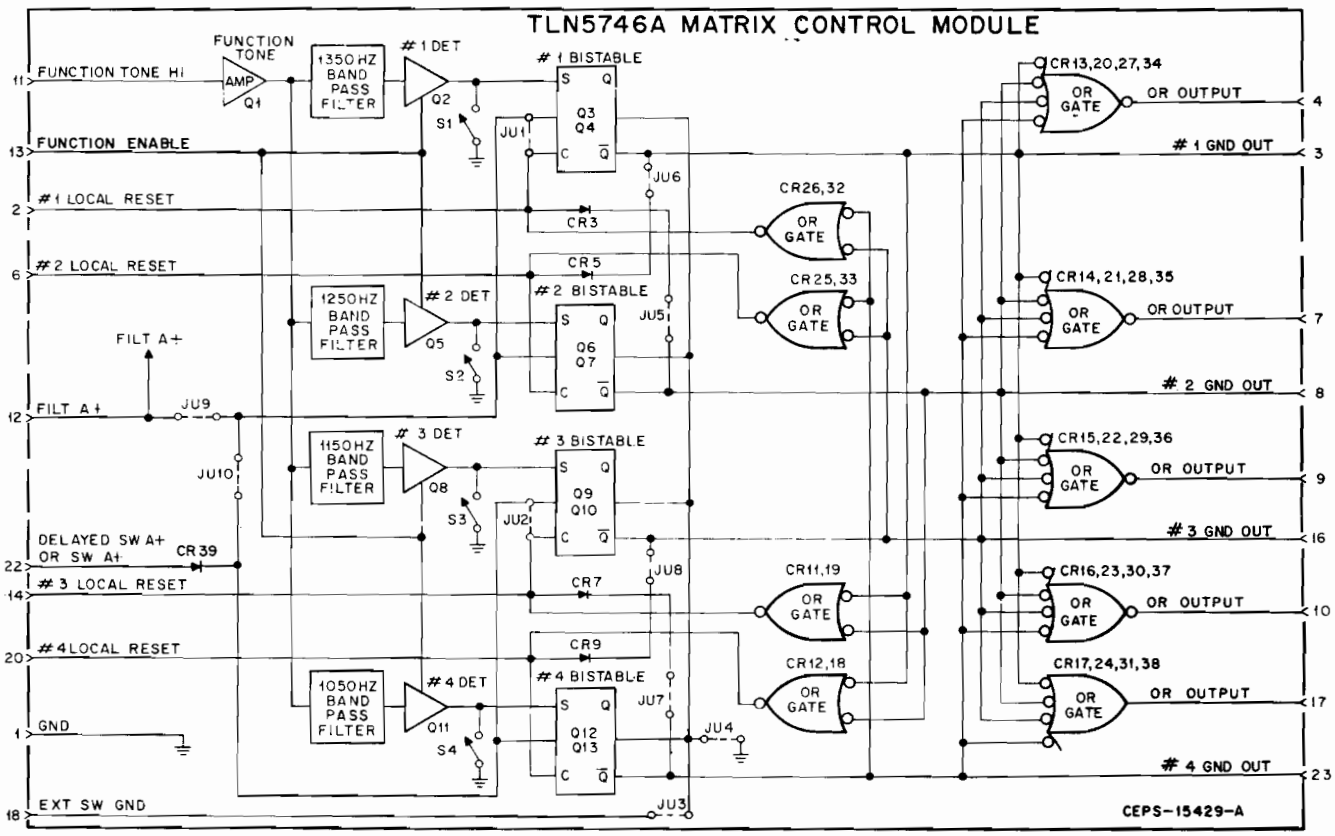


Figure 1. Functional Diagram

3.2 All function tones are applied to the matrix module at pin 11, amplified and clipped to a 16 dBm level by function tone amplifier Q1, and routed to all four bistable multivibrators simultaneously. All four detector circuits are functionally identical, except for the actual acceptance frequency.

3.3 For example, a 1350 Hz tone passes through tuned circuit L1-C4 into tone detector stage Q2. When it is detected, it causes the function No. 1 bistable multivibrator (Q3-Q4) to change state, causing the collector of Q4 to go to ground. This ground is applied to output pin 3 and the No. 1 bistable remains in the active state until reset. How each bistable is reset is determined by a diode matrix and jumper configuration in the module. As shipped from the factory, all diodes and jumpers are installed (except jumpers JU1, JU2 and JU3 which are removed). These diodes and jumpers can be rearranged to fit various applications.

3.4 Diodes involved with OR operation are CR13 thru CR17, CR20 thru CR24, CR27 thru CR31, and CR34 thru 38. When any of the four bistable multivibrators is actuated, its switched ground output is applied to output pins 4, 7, 9, 10 and 17 simultaneously. These OR output pins are useful when using two multiple PL matrix control modules. Each set of outputs is routed to the other module's local reset inputs for cross resetting all bistables. When using a second matrix control module, the options position in the remote control chassis should be modified with jumpers and plating cuts as required.

3.5 Components involved with reset operation are indicated in Table 2.

TABLE 2.

Reset Components Identification

DIODE (CR)	JUMPER (JU)
3	1
5	2
7	5
9	6
11	7
12	8
18	9
19	10
25	11
26	
32	
33	

The use of these diodes and jumpers with regard to reset operation is described in following paragraphs.

4. STANDARD RESET OPERATION

As shipped, any one bistable that is set, in turn, resets all others. The factors involved are shown in Table 3.

TABLE 3.

Standard Reset Component Configuration

Bistable Multivibrator Set	Diode Used (CR)	Jumper Used (JU)	Bistable Multivibrator Reset
1	5	6	2
	11	--	3
	12	--	4
2	3	5	1
	19	--	3
	18	--	4
3	26	--	1
	25	--	2
	9	8	4
4	32	--	1
	33	--	2
	7	7	3

5. "AND" RESET OPERATION (TRANSMIT COMMAND)

5.1 The matrix control module can be strapped to provide a switched ground output on receipt of a proper function tone and low level guard tone. Whichever bistable multivibrator is actuated will automatically be reset when the guard tone signal is removed. The receipt of guard tone is indicated at this module by the presence of switched A+ at pin 22. When this switched A+ is removed, the bistables operating with the voltage (depending on jumper configuration) are reset.

5.2 "AND" reset operation specifically requires jumper and diode changes as indicated in Table 4 (these are changes required to a previously unmodified module). Notice that the "AND" function is used with either two bistables at a time or all four at a time. This is due to switched A+ distribution allowed by jumper availability.

NOTE

Jumpers JU1 and JU2 are not factory installed and must remain out for this application. They are described in a following paragraph.

TABLE 4.

"AND" Reset Component Configuration

Function Tone Involved (Hz)	Output Pins Involved	Jumpers to be Cut (JU)	Bistable Multivibrator Involved	Diode to be Cut (CR)	Wire to be Added
1150	16	7 8 10	3 & 4 only	11 12 18 19 25 26 32 33	From pin 22 of this module to pin 24 of interconnect board at option's decoder position (provides sw. A+).
1050	23				
1350	3	5, 6 7 8 9	All 4		
1250	8				

6. MATRIX MODULE RESET OPERATION

6.1 This module can be set up such that the loss of an externally applied voltage causes all bistables to automatically reset simultaneously. In this mode of operation, each bistable is set by the applicable function tone and stays set until the loss of switched A+. The function tone amplifier Q1 is unaffected by the reset function because it operates from a steady A+.

6.2 Matrix module reset operation specifically requires jumper and diode changes as indicated in Table 5 (these are changes that are required to a previously unmodified module).

TABLE 5.

Matrix Module Reset Component Configuration

Remove Diode (CR)	Remove Jumper (JU)	Add Jumper (JU)
3	5	11
5	6	
7	7	
9	8	
11	9	
12		
18		
19		
25		
26		
32		
33		

NOTE
Delayed switched A+ or switched A+ must be applied to pin 22 of this module.

7. UNIQUE JUMPER APPLICATIONS

Table 6 identifies jumpers that are used in special applications not described previously.

8. MAINTENANCE AND TROUBLE-SHOOTING

8.1 TECHNIQUES OF ISOLATION

8.1.1 Four local test switches (S1-S4) are located on this module to facilitate identification of a malfunction. If a tone function cannot be performed from the remote point, the malfunction can be isolated to circuitry either before or after a bistable multivibrator using an applicable test switch.

8.1.2 When a test switch is activated, a switched ground output should appear at the output of the associated bistable multivibrator. If a switched ground output is produced, the malfunction is before the bistable multivibrator (1) in this module itself (possibly a malfunctioning function tone amplifier), (2) someplace else in the station (remote control chassis/intercabling), or (3) in the remote control sending unit (generator/associated circuitry - intercabling). If a switched ground output is not produced when a local test switch is actuated, the malfunction is in the bistable multivibrator itself or following circuitry.

8.2 MODULE SERVICING

8.2.1 Servicing with the Module in the Chassis

The module may be serviced while connected in the station chassis. To gain access, remove the module and insert a

TABLE 6.

Unique Jumper Applications

JUMPER (JU)	DESCRIPTION
1	Pull up jumper -- causes bistable No. 1 to actuate when A+ is applied while no reset function is applied.
2	Same as JU1 except functional with No. 3 bistable.
3	"AND" function jumper -- causes all bistables, in order to be actuated, to require applicable function tone and external (switched) ground. Jumper JU4 must be removed.

Model TLN8799A Printed Circuit Service Board. Then, insert the module in the service board. All points on the module are now accessible for voltage measurements, or other tests.

8.2.2 Servicing with the Module Out of the Chassis

The matrix control module may be serviced out of the chassis by connecting it to a signal generator and power source. The proper connections for the signal generator and power source are listed in the following table.

PIN NUMBER	CONNECTION
1, 13	Ground
11	Audio Oscillator
12	A+ (13.6 V DC)

8.3 TROUBLESHOOTING

8.3.1 Bistable Multivibrator

Step 1. Connect a dc voltmeter between pin 1 and the collector of Q4 (Q7, Q10, Q13).

Step 2. Connect an audio oscillator (high side) through a coupling capacitor to the base of Q1. The output level must not exceed 1 volt.

Step 3. Adjust the audio oscillator frequency to 1350 (1250, 1150, 1050) Hz. The voltmeter reading should fall to zero volts, indicating that the bistable multivibrator has changed state. If the change of state does not occur, check detector stage Q2 (Q5, Q8, Q11) then bistable multivibrator Q3-Q4 (Q6-Q7, Q9-Q10, Q12-Q13). If the change of state occurs, look to the function tone amplifier for a malfunction.

8.3.2 Function Tone Amplifier

Step 1. Connect an ac voltmeter from the capacitor connected to the collector of Q1 (C3) to ground.

Step 2. Connect an audio oscillator from pin 11 to ground. Adjust the oscillator output to -10 dBm at 1200 Hz.

Step 3. The measured output should be at least +10 dBm. When viewed with an oscilloscope, the waveform should be well into a clipped condition.

Step 4. If the aforementioned conditions are not attained, measure the voltages on the function tone amplifier stage.

9. SPECIAL MODIFICATIONS

To change the function tone decoder frequencies from the standard value, change those parts indicated in Figure 2 per table 7.

EXAMPLE: Changing function decoder frequency to 1850 Hz:

FREQ.	R (A)	R (B)	R (C)	R (D)	C
1850 Hz	22k ±5%	1.5k ±5%	2.7k ±5%	221 ±1%	.0069 uF ±2%

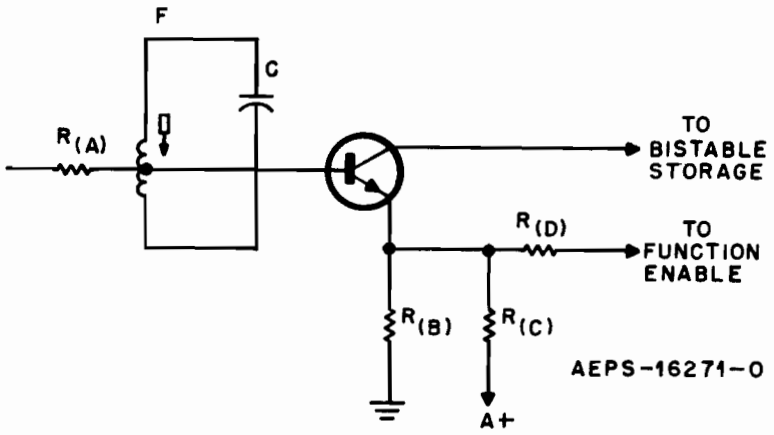
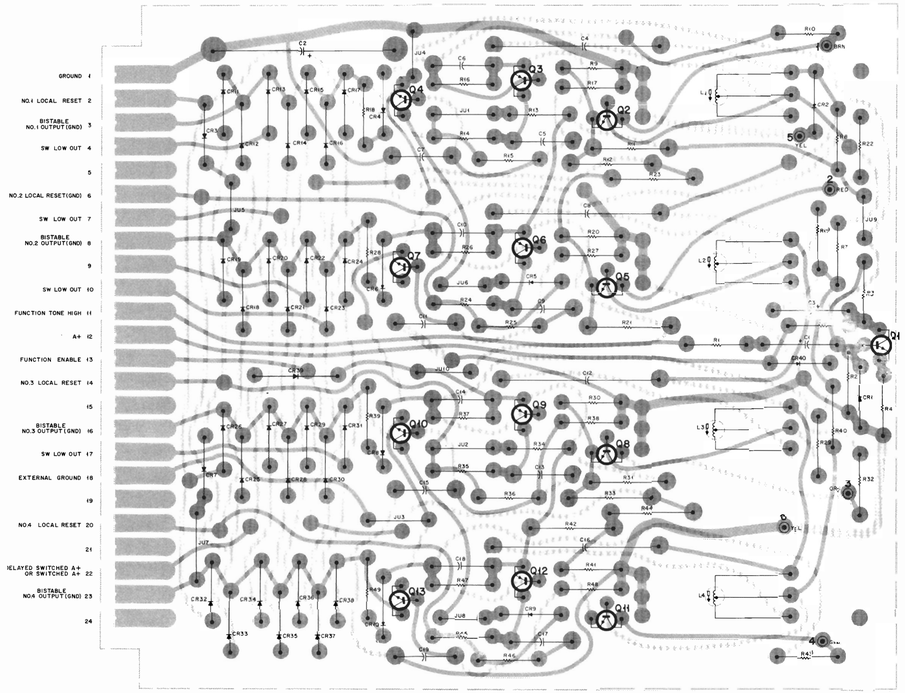


Figure 2.
Typical Function Tone Detector

Table 7.
Special Modifications

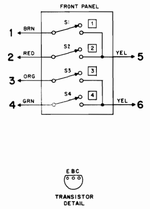
To Change Function Tone Tank Freq. To (Hz)	R (A) ±5% (In Ohms)	R (B) ±5% (In Ohms)	R (C) ±1% (In Ohms)	R (D) ±1% (In Ohms)	C ±2% (In uF)	Capacitor Part No.
2050	33k	1.5k	2.7k*	221	.0056	8D84326A13
1950	27k	1k	2.2k*	221	.0062	8D84326A14
1850	22k	1.5k	2.7k*	221	.0069	8D84326A15
1750	22k	1k	2.43k	221	.0077	8D84326A16
1650	18k	1k	2.21k	221	.00865	8D84326A17
1550	15k	1k	2.21k	221	.0098	8D84326A18
1450	12k	1k	2.21k	221	.0112	8D84326A19
1350	10k	1k	2.21k	221	.0129	8D84326A20
1250	9.1k	1k	2.43k	221	.015	8D84326A21
1150	8.2k	1k	2.43k	221	.0178	8D84326A22
1050	6.8k	1k	2.43k	221	.0213	8D84326A23

* ±5% is allowable.



SHOWN FROM SOLDER SIDE

SOLDER SIDE BS-DLPS-14796-A
COMPONENT SIDE GL-DEPS-14796-A



NOTES:

1. ALL JUMPERS ARE FACTORY INSTALLED EXCEPT JUMPERS JU1, JU2, JU3, AND JU11 WHICH ARE REMOVED.
2. VOLTAGES IN PARENTHESES INDICATE THE ACTIVE STATE.
3. ALL DC VOLTAGE MEASUREMENTS MAY BE TAKEN WITH 20,000 OHM-PER-VOLT METER.
4. UNLESS OTHERWISE STATED, CAPACITOR VALUES ARE IN MICROFARADS. RESISTOR VALUES ARE IN OHMS.
5. FOR JUMPER DESCRIPTIONS, REFER TO TEXT.

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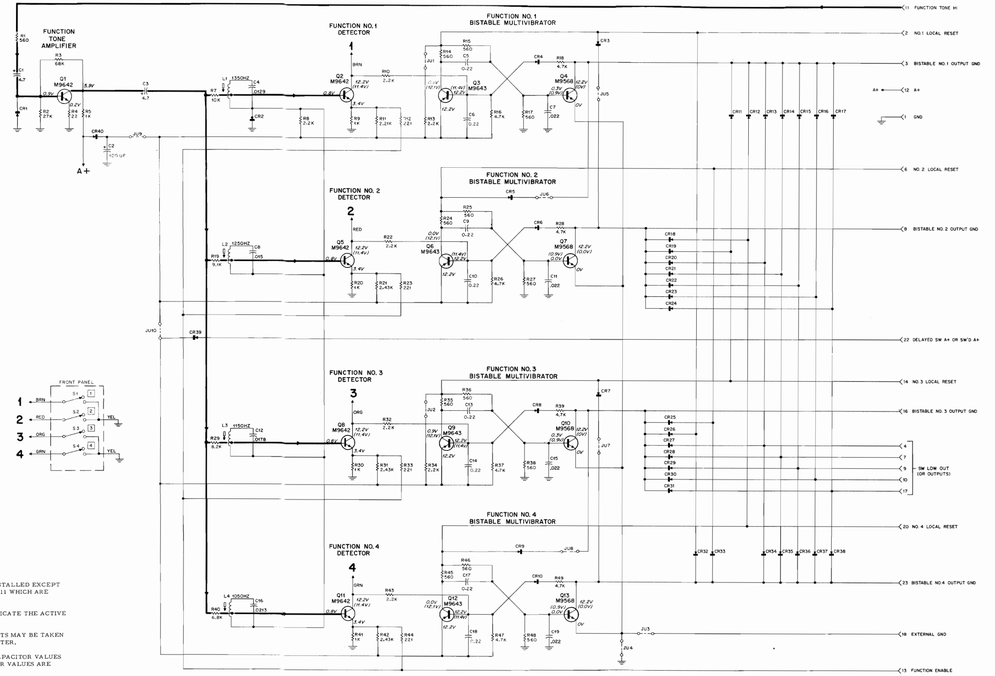


PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

TLN5746A Matrix Control Module
Schematic Diagram and Circuit Board Detail
Motorola No. PEPS-14800-A
3/12/75-UP

REVISIONS

PEPS-14800-A

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN5746A	C7, 11, C15, 19	FROM 8-82905G11, .22 uF TO 8-82905G02, .022 uF	SCHEM. & PARTS LIST
	CR39	ADDED, REPLACES JU11	
	Q1, 2, Q8, 11	FROM 48-869570, M9570 TO 48-869642, M9642	
	Q3, 6, Q9, 12	FROM 48-869571, M9571 TO 48-869643, M9643	

PARTS LIST

TLN5746A Matrix Control Module PL-2865-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF ±10%; 50 V; unless otherwise stated
C1	23-865137	4.7 ±20%; 25 V
C2	23-82601A25	100 +150-10%; 20 V
C3	23-865137	4.7 ±20%; 25 V
C4	8-84326A20	.0129 ±2%
C5	8-82905G11	0.22
C6	8-82905G11	.22
C7	8-82905G02	.022
C8	8-84326A21	.015 ±2%
C9	8-82905G11	0.22
C10	8-82905G11	.22
C11	8-82905G02	.022
C12	8-84326A22	.0178 ±2%
C13	8-82905G11	0.22
C14	8-82905G11	.22
C15	8-82905G02	.022
C16	8-84326A23	.0213 ±2%
C17	8-82905G11	0.22
C18	8-82905G11	.22
C19	8-82905G02	.022
		SEMOCONDUCTOR DEVICE, diode: (SEE NOTE)
CR1 thru 40	48-83654H01	silicon
		COIL ASSEMBLY, inductor:
L1 thru 4	1-80702B11	1 H; includes ground clip
		TRANSISTOR: (SEE NOTE)
Q1	48-869642	N-P-N; M9642
Q2	48-869642	N-P-N; M9642
Q3	48-869643	P-N-P; M9643
Q4	48-869568	N-P-N; M9568
Q5	48-869642	N-P-N; M9642
Q6	48-869643	P-N-P; M9643
Q7	48-869568	N-P-N; M9568
Q8	48-869642	N-P-N; M9642
Q9	48-869643	P-N-P; M9643
Q10	48-869568	N-P-N; M9568
Q11	48-869642	N-P-N; M9642
Q12	48-869643	P-N-P; M9643
Q13	48-869568	N-P-N; M9568
		RESISTOR, fixed: ±10%; 1/4 W; unless otherwise stated
R1	6-129620	560
R2	6-127806	27K
R3	6-129144	68K
R4	6-124A09	22 ±5%
R5	6-129805	1K ±5%
R7	6-129668	10K ±5%
R8	6-128689	2.2K
R9	6-129805	1K ±5%
R10	6-128689	2.2K
R11	6-84444A08	2.21K ±1%
R12	6-84444A07	221 ±1%
R13	6-128689	2.2K
R14	6-129620	560
R15	6-129620	560
R16	6-127804	4.7K
R17	6-129620	560
R18	6-127804	4.7K
R19	6-124A72	9.1K ±5%
R20	6-129805	1K ±5%
R21	6-84444A09	2.43K ±1%
R22	6-128689	2.2K
R23	6-84444A07	221 ±1%
R24	6-129620	560
R25	6-129620	560
R26	6-127804	4.7K
R27	6-129620	560
R28	6-127804	4.7K
R29	6-129983	8.2K ±5%
R30	6-129805	1K ±5%
R31	6-84444A09	2.43K ±1%
R32	6-128689	2.2K
R33	6-84444A07	221 ±1%
R34	6-128689	2.2K
R35	6-129620	560
R36	6-129620	560
R37	6-127804	4.7K
R38	6-129620	560
R39	6-127804	4.7K
R40	6-129237	6.8K ±5%
R41	6-129805	1K ±5%
R42	6-84444A09	2.43K ±1%
R43	6-128689	2.2K
R44	6-84444A07	221 ±1%
R45	6-129620	560
R46	6-129620	560
R47	6-127804	4.7K
R48	6-129620	560
R49	6-127804	4.7K
		SWITCH, slide:
S1 thru 4	40-83468E01	spdt
		NON-REFERENCED ITEMS
	45B83914G01	GUIDE RAIL, circuit board
	3S8022	SCREW, machine: 4-40 x 1/4"
	4S7683	LOCKWASHER: No. 4 internal
	1-80759B46	PANEL ASSEMBLY: includes: 64-84786F01 PANEL: includes legend Referenced parts S1 thru S4

NOTE: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

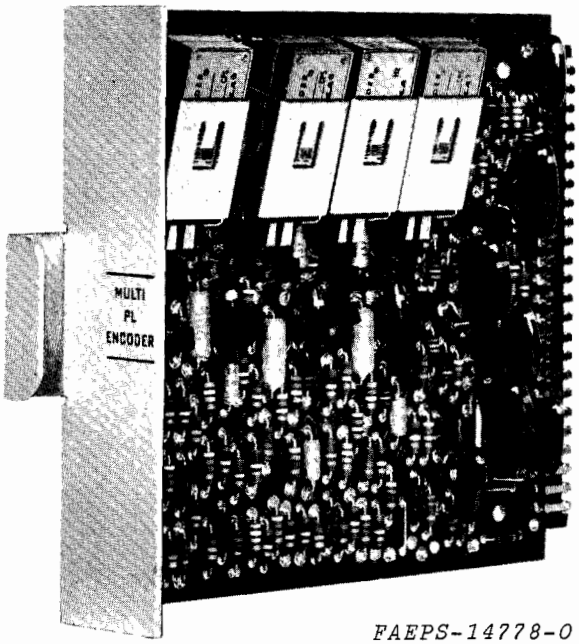
MULTI "PL" ENCODER MODULE

MODEL TLN5744A

AND

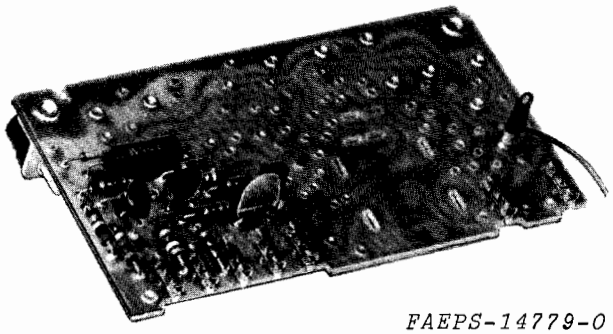
"PL" CONVERTER BOARD

MODELS TLN5747A
AND TLN5733AV



FAEPS-14778-O

Multi "PL" Encoder Module



FAEPS-14779-O

"PL" Converter Board

1. FUNCTIONS

1.1 This encoder module generates four different PL tones which are routed to the station transmitter. This module is installed with a PL converter board that provides a transmitter turn-off delay of 130-180 milliseconds when the transmitter is unkeyed.

1.2 When a switched ground signal is applied from the matrix control module, one of the PL tone oscillators is enabled. A fast start feature provides usable output from the selected oscillator within 30 milliseconds. A reverse burst feature reverses the phase of the generated PL tone for approximately 130-180 milliseconds after the transmitter is unkeyed. This dampens the "Vibrasponder" resonant reeds in listening receivers and eliminates receiver squelch tail noise bursts at the end of each message. The PL converter board generates the 130-180 millisecond turn off delay which enables the transmitter to send the reverse burst PL tone.

2. DESCRIPTION

2.1 Both the encoder and converter are mounted on sturdy cards with connecting pins to mate with the interconnecting board of the chassis in which they are installed. The multiple PL encoder module occupies the SPARE position of the remote control chassis

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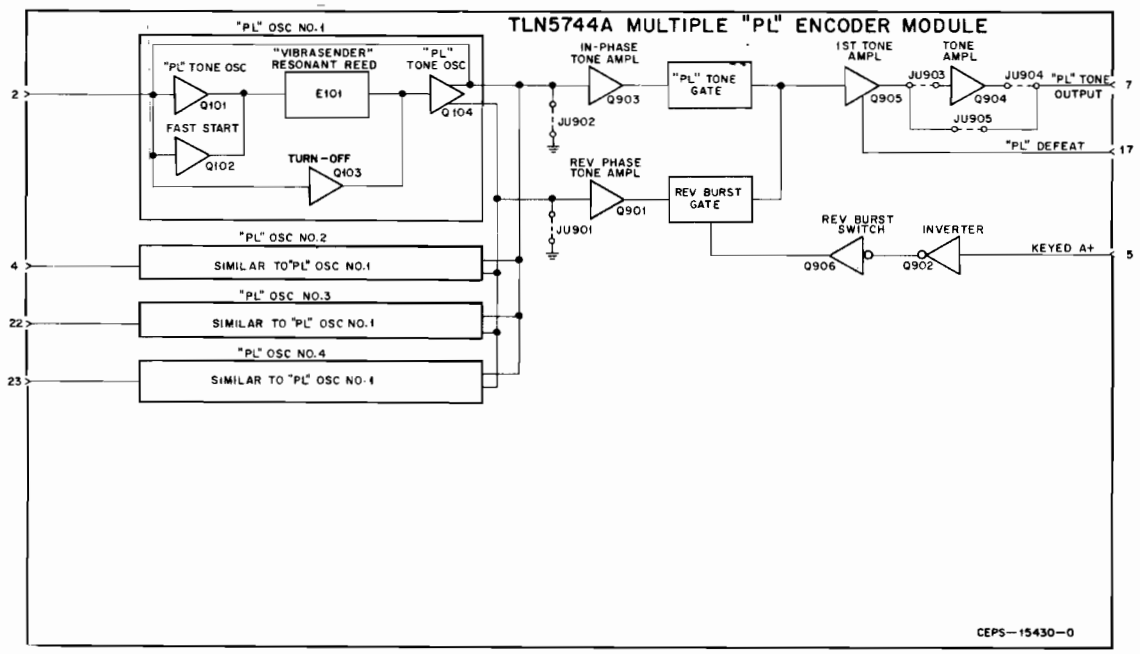

Figure 1.
Encoder Module Functional Diagram

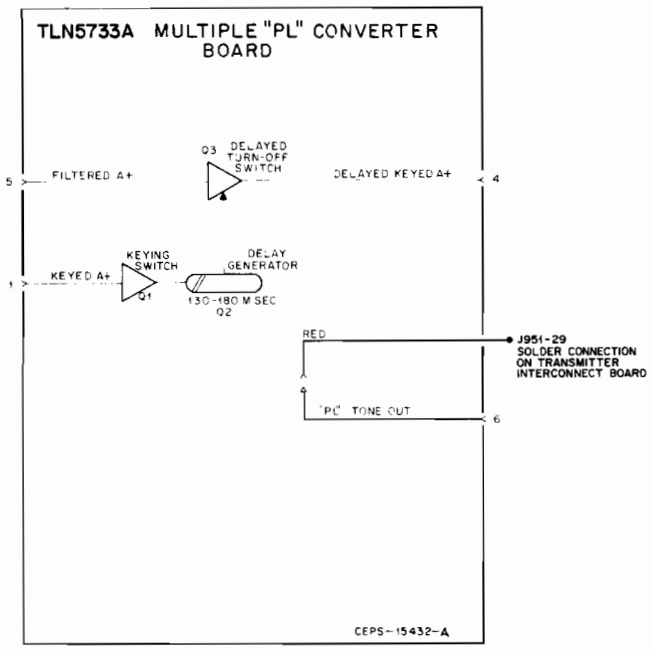

Figure 2.
Converter Board Functional Diagram

while the multiple PL converter board is located in the transmitter's exciter (in place of the single-frequency PL encoder).

3. CIRCUIT DESCRIPTION

3.1 MULTIPLE PL ENCODER MODULE

3.1.1 Operation of all four PL tone oscillators is identical. Therefore, the following theory describes only the circuit operation of PL tone oscillator No. 1, and is applicable to the other three.

3.1.2 The tone oscillator consists basically of a two-stage oscillator (Q101 and Q104), a turn-off stage (Q103), and tone amplifiers (Q904 and Q905). The frequency-determining element of the oscillator is "Vibrasender" resonant reed E101 (an electromechanical equivalent of a parallel-tuned high Q tank circuit). The output stage of the oscillator Q104 provides a tone from both its emitter and its collector. Tones from the two outputs are of opposite phase, with the Q104 emitter supplying the PL tone during a transmission and the Q104 collector supplying the out-of-phase tone (reverse burst) at the end of a transmission. These tone outputs are fed into separate amplifiers (Q901 and Q903) where they are amplified to a usable level before routing to the PL tone gate and reverse burst gate.

3.1.3 Passage of tones from one or the other outputs to the base of tone amplifiers Q904 and Q905 is controlled by the PL tone gate and the reverse burst gate. During a transmission, the PL tone gate is open, passing the tones from the emitter output of Q104, through amplifier Q903, to tone amplifiers Q904 and Q905. From the collector of Q904 the tone is fed into the transmitter modulator. (At this time, the reverse burst gate is closed.) When the operator releases his push-to-talk switch at the end of a transmission, the PL tone gate closes, terminating transmission of the in-phase "Private-Line" tone. Simultaneously the reverse burst gate opens, passing the out-of-phase tone signal from Q104 through amplifier Q901 to tone amplifiers Q904 and Q905. Q902 is an inverter stage that feeds the reverse burst switch (Q906).

3.1.4 The oscillator turn-off circuit (Q103), connected across the secondary winding of the "Vibrasender" resonant reed coil, shorts that winding so as to disable the tone output of Q101 whenever ground is removed from the oscillator turn-on point (pin 2).

3.1.5 The purpose of the Q102 pulse circuit is to "fast-start" the tone oscillator to permit faster receiver PL squelch action thereby speeding up system operation. The pulse circuit increases the PL tone oscillator rise time to a usable level in approximately 30 milliseconds instead of the usual 2-1/2 seconds. This is accomplished by pulsing the primary input of the tone oscillator "Vibrasender" resonant reed with a 3 millisecond pulse which causes the tone oscillator to "fast-start".

3.2 "PL" CONVERTER BOARD

The PL Converter Board provides a transmitter turn-off delay of approximately 130-180 milliseconds after the transmitter is unkeyed. During this period, an opposite 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 "squelch-tail" noise burst at the end of the message. When the keyed A+ is applied, keying switch Q1 and delayed turn-off switch Q3 operate immediately to key the transmitter. Delay generator Q2 is also activated. When the transmitter is unkeyed, delay generator Q3 keeps delayed turn-off switch Q3 activated for approximately 130-180 milliseconds.

4. MAINTENANCE

4.1 RECOMMENDED TEST EQUIPMENT

a. Motorola SLN6221A "Private-Line" Tone Generator -- used for testing "Vibrasender" resonant reeds.

b. Motorola solid state ac voltmeter -- used for tone level measurements.

c. General purpose oscilloscope -- valuable for signal tracing and locating sources of distortion.

d. Motorola solid state dc multimeter -- used for dc voltage measurement.

e. Motorola S1343A Series Frequency Counter or S1344A Series Frequency Counter/Deviation Meter -- used for measuring PL tone frequency.

4.2 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.

4.3 TROUBLESHOOTING

Step 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 A+ input to encoder.

b. Check ac signal voltage at ocollector of Q903.

c. If signal is present, check Q904.

d. If no signal is present any component in the oscillator loop could cause the trouble. Check the "Vibrasender" resonant reed in the "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.

Step 2. If low deviation is measured, check ac signal voltages and compare them with the schematic voltage readings to find the source of trouble.

Step 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.

Step 4. If squelch tail noise bursts are heard by all listening receivers, check dc voltages of Q902 and Q906 in keyed and unkeyed conditions.

Step 5. If the transmitter cannot be keyed, and the trouble has been isolated to the PL converter board, measure dc voltages in Q1, Q2 and Q3 stages.

Step 6. If too much tone deviation is measured, check feedback amplifier Q904.

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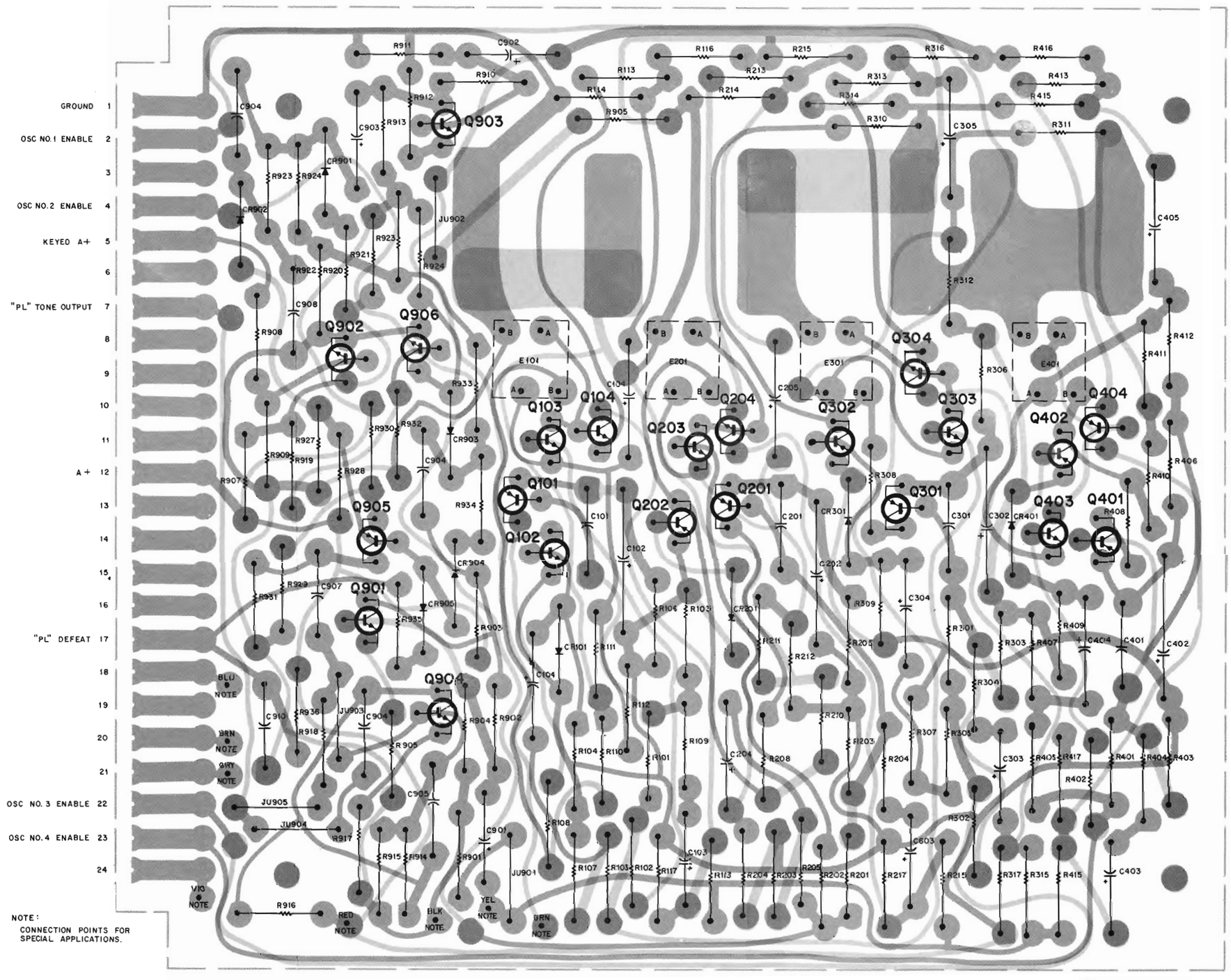


TLN5744A Multi PL Encoder Module
Schematic Diagram and Circuit Board Detail
Motorola No. PEPS-14784-B
(Sheet 1 of 2)
3/12/75-UP

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

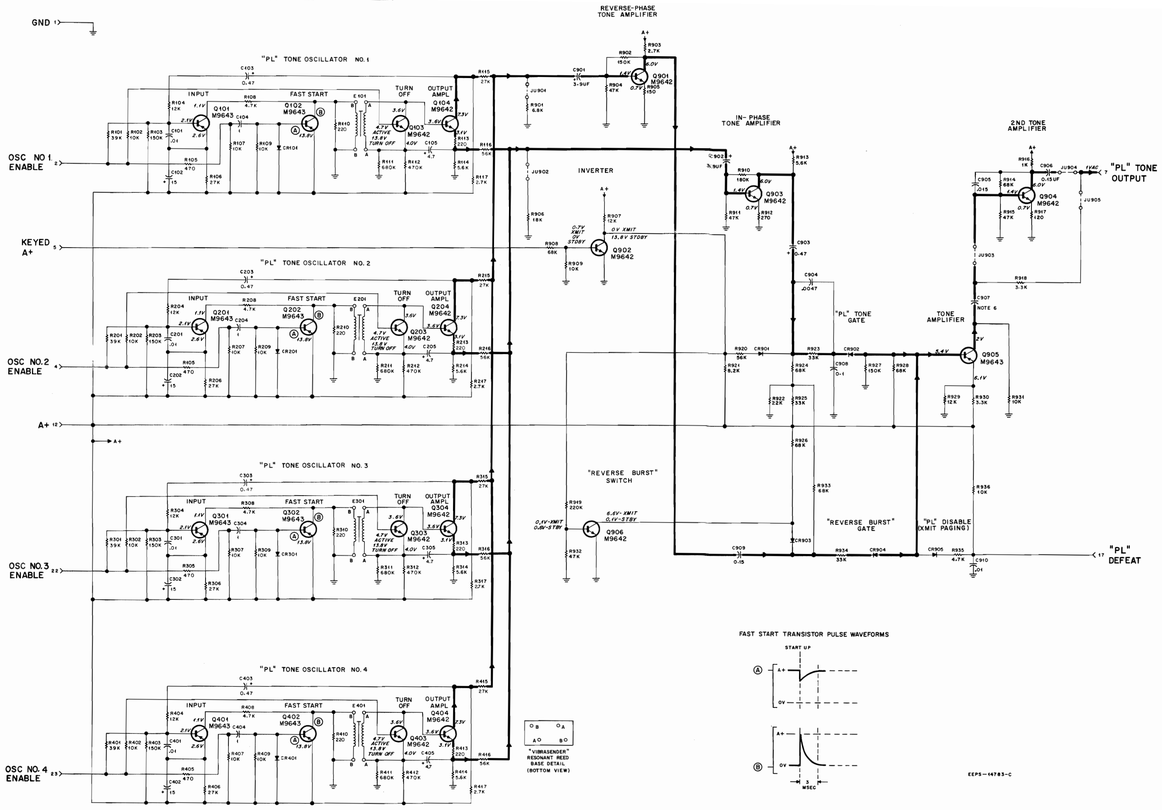
TLN5744A Multi PL Encoder Module PL-2863-A

		CAPACITOR, fixed: uF ±10%; 50 V; unless otherwise stated
C101	8-82905G01	.01
C102	23-865136	15 ±20%; 25 V
C103	23-84762H14	0.47 ±20%
C104	23-82783B08	1.0 ±20%; 35 V
C105	23-865137	4.7; 25 V
C201	8-82905G01	.01
C202	23-865136	15 ±20%; 25 V
C203	23-84762H14	0.47 ±20%
C204	23-82783B08	1.0 ±20%; 35 V
C205	23-865137	4.7; 25 V
C301	8-82905G01	.01
C302	23-865136	15 ±20%; 25 V
C303	23-84762H14	0.47 ±20%
C304	23-82783B08	1.0 ±20%; 35 V
C305	23-865137	4.7; 25 V
C401	8-82905G01	.01
C402	23-865136	15 ±20%; 25 V
C403	23-84762H14	0.47 ±20%
C404	23-82783B08	1.0 ±20%; 35 V
C405	23-865137	4.7; 25 V
C901, 902	23-84762H08	3.9 ±20%; 15 V
C903	23-84762H14	0.57 ±20%
C904	8-82905G26	.0047; 100 V
C905	8-82905G10	.015; 100 V
C906	8-82905G05	0.15
C907	--	NOTE 6
C908	8-82905G07	0.1
C909	8-82905G05	0.15
C910	8-82905G01	.01
		SEMICONDUCTOR DEVICE, diodes (SEE NOTE)
CR101, 201, 301, 401, 901 thru 905	48-836541H01	silicon
		TRANSISTOR, NPN; unless otherwise stated (SEE NOTE)
Q101, 102	48-869643	PNP; type M9643
Q103, 104	48-869642	type M9642
Q201, 202	48-869643	PNP; type M9643
Q203, 204	48-869642	type M9642
Q301, 302	48-869643	PNP; type M9643
Q303, 304	48-869642	type M9642
Q401, 402	48-869643	PNP; type M8643
Q403, 404	48-869642	type M9642
Q901 thru 904	48-869642	type M9642
Q905	48-869643	PNP; type M9643
Q906	48-869642	type M9642
		RESISTOR, fixed: ±5%, 1/4 W; unless otherwise stated
R101	6-129777	39k
R102	6-129668	10k
R103	6-128683	150k
R104	6-129887	12k
R105	6-127801	470 ±10%
R106	6-127806	27k ±10%
R107	6-129225	10k ±10%
R108	6-129669	4.7k
R109	6-129225	10k ±10%
R110	6-131275	220
R111	6-131857	680k
R112	6-129149	470k
R113	6-131275	220
R114	6-129982	5.6k
R115	6-127806	27k ±10%
R116	6-129242	56k ±10%
R117	6-129707	2.7k
R201	6-129777	39k
R202	6-129668	10k
R203	6-128683	150k
R204	6-129887	12k
R205	6-127801	470 ±10%
R206	6-127806	27k ±10%
R207	6-129225	10k ±10%
R208	6-129669	4.7k
R209	6-129225	10k ±10%
R210	6-131275	220
R211	6-131857	680k

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R212	6-129149	470k
R213	6-131275	220
R214	6-129982	5.6k
R215	6-127806	27k ±10%
R216	6-129242	56k ±10%
R217	6-129707	2.7k
R301	6-129777	39k
R302	6-129668	10k
R303	6-128683	150k
R304	6-129887	12k
R305	6-127801	470 ±10%
R306	6-127806	27k ±10%
R307	6-129225	10k ±10%
R308	6-129669	4.7k
R309	6-129225	10k ±10%
R310	6-131275	220
R311	6-131857	680k
R312	6-129149	470k
R313	6-131275	220
R314	6-129982	5.6k
R315	6-127806	27k ±10%
R316	6-129242	56k ±10%
R317	6-129707	2.7k
R401	6-129777	39k
R402	6-129668	10k
R403	6-128683	150k
R404	6-129887	12k
R405	6-127801	470 ±10%
R406	6-127806	27k ±10%
R407	6-129225	10k ±10%
R408	6-129669	4.7k
R409	6-129225	10k ±10%
R410	6-131275	220
R411	6-131857	680k
R412	6-129149	470k
R413	6-131275	220
R414	6-129982	5.6k
R415	6-127806	27k ±10%
R416	6-129242	56k ±10%
R417	6-129707	2.7k
R901	6-128687	6.8k ±10%
R902	6-128683	150k
R903	6-129707	2.7k
R904	6-131527	47k
R905	6-131276	150
R906	6-128904	18k ±10%
R907	6-129887	12k
R908	6-129299	68k
R909	6-129668	10k
R910	6-129229	180k ±10%
R911	6-128902	47k
R912	6-131525	270
R913	6-129882	5.6k
R914	6-129299	68k
R915	6-128902	47k
R916	6-129905	1k
R917	6-10401A27	120
R918	6-124A61	3.3k
R919	6-129147	220k ±10%
R920	6-129242	56k
R921	6-128686	8.2k ±10%
R922	6-129667	22k
R923	6-129526	33k
R924	6-129299	68k
R925	6-129526	33k
R926	6-129299	68k
R927	6-128683	150k
R928	6-129299	68k
R929	6-129887	12k
R930	6-129981	3.3k
R931	6-129668	10k
R932	6-128902	47k ±10%
R933	6-129299	68k
R934	6-129526	33k
R935	6-129669	4.7k
R936	6-129668	10k

		NON-REFERENCED ITEMS
	9-84910C01	SOCKET, "Vibrasponder" resonant reed
	45-8391 4G01	GUIDE RAIL, circuit board
	3-8022	SCREW, machine 4-40 x 1/4"
	4-7683	LOCKWASHER: No. 4

NOTE: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.



REVISIONS PEPS-14784-B			
CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN5744A	Q101, 102 Q201, 202 Q301, 302 Q401, 402 Q905	FROM 48-869571, M9571 TO 48-869643, M9643	SCHEM. & PARTS LIST
	Q103, 104 Q203, 204 Q303, 304 Q403, 404 Q901-904 Q906	FROM 48-869570, M9570 TO 48-869642, M9642	
	R918	FROM 6-129226, 100k TO 6-124A61, 3.3k	2ND TONE AMPL.

NOTES:

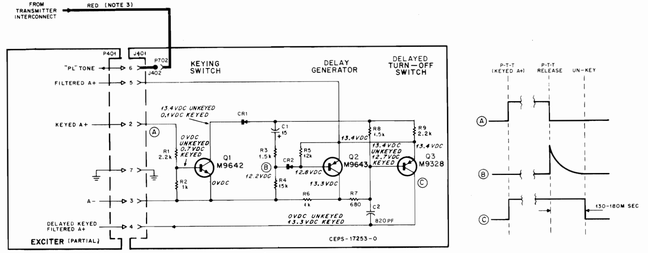
1. UNLESS OTHERWISE STATED: CAPACITOR VALUES ARE IN MICROFARADS, RESISTOR VALUES ARE IN OHMS.
2. UNLESS OTHERWISE STATED: VOLTAGES REPRESENT THE ACTIVE STATE AND ARE TAKEN WITH RESPECT TO CHASSIS GROUND.
3. ALL AC VOLTAGE MEASUREMENTS ARE RMS VALUE.
4. ALL DC VOLTAGE MEASUREMENTS MAY BE TAKEN WITH 20,000 OHM-PER-VOLT METER.
5. JUMPER TABLE

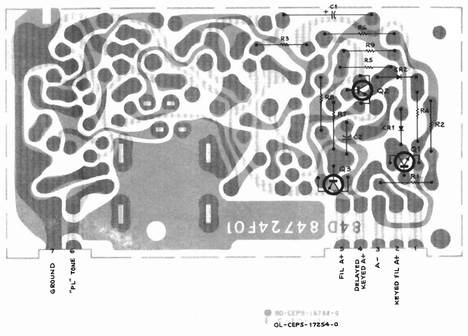
JUMPER	STATUS
JU901, 902	IN FOR 4-FREQUENCY APPLICATIONS; OUT FOR 8-FREQUENCY APPLICATIONS
JU903, 904	IN WHEN TRANSMITTER-EXCITER UTILIZES DIRECT FREQUENCY MODULATION; OUT WHEN DIRECT FM IS NOT USED (SERRASOID MODULATOR IS INCORPORATED).
JU905	OPPOSITE OF JU903 & JU904 -- OUT FOR DIRECT FM; IN OTHERWISE.

6. CAPACITOR C907 IS PART OF TLN5747A "PL" CONVERTER BOARD KIT. REFER TO APPLICABLE PARTS LIST FOR COMPONENT VALUE.

NEPS-15370-A

TLN5744A Multi PL Encoder Module
Schematic Diagram and Circuit Board Detail
Motorola No. PEPS-14784-B
(Sheet 2 of 2)
3/12/75-UP





TLN5733AV and TLN5747A PL Converter Board
Schematic Diagram and Circuit Board Detail
Motorola No. PEPS-14788-C
2/10/76-UP

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
PARTS LIST		
TLN5733AV "PL" Converter		PL-4227-O
C1	23-84762H09	CAPACITOR, fixed: 15 uF ±20%; 20 V
C2	21-82187D23	820 pF ±10%; 500 V
C907	8-82905C04	.068 (132-174 MHz Stations) (SEE NOTE II)
	or 8-82905G11	.22 (25-50 MHz Stations) (SEE NOTE II)
CR1, 2	48-83654H01	SEMICONDUCTOR DEVICE, diode: (SEE NOTE I) silicon
Q1	48-869642	TRANSISTOR: (SEE NOTE I) NPN; type M9642
Q2	48-869643	PNP; type M9643
Q3	48-869328	PNP; type M9328
R1, 9	6-124C57	RESISTOR, fixed: ±5%; 1/4 W unless otherwise stated 2.2k ±10%
R2	6-124C49	1k ±10%
R3, 8	6-124A53	1.5k
R4	6-124A77	15k
R5	6-124A75	12k
R6	6-124A49	1k
R7	6-124A45	680

NOTES:

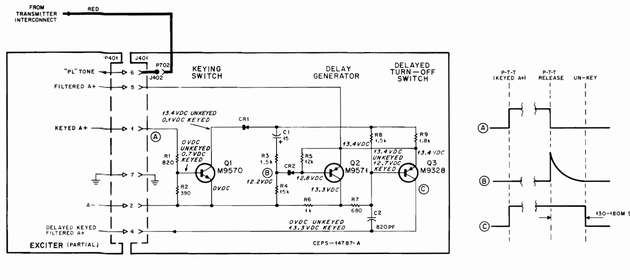
I. For optimum performance, diodes, transistors and integrated circuits must be ordered by Motorola part numbers.

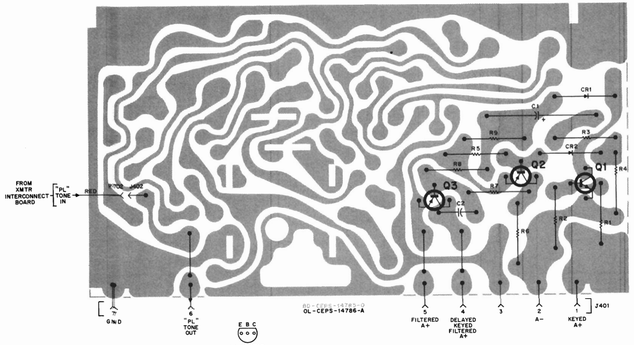
II. Capacitor C907 is located on the TLN5744A multiple "PL" encoder module but is part of this converter board kit.

NOTES:

1. UNLESS OTHERWISE STATED, RESISTOR VALUES ARE IN OHMS.
2. DC VOLTAGE MEASUREMENTS IN Q1, Q2, AND Q3 STAGE TAKEN IN RESPECT TO A—. ALL DC VOLTAGES MAY BE MEASURED WITH 20,000 OHM-PER-VOLT METER.
3. WHEN USED IN BASE STATIONS THE RED WIRE TO P702 IS DELETED.

NEPS-17256-O





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REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
PARTS LIST		
TLN5747A "PL" Converter		PL-2866-A
C1	23-83214C26	CAPACITOR, fixed: 15 uF ±20%; 25 V
C2	21-82187D23	820 pF ±10%; 500 V
C907	8-82905C04	.068 (132-174 MHz Stations) (SEE NOTE II)
	or 8-82905G11	.22(25-50 MHz Stations) (SEE NOTE II)
CR1, 2	48-83654H01	SEMICONDUCTOR DEVICE, diode: (SEE NOTE I) silicon
Q1	48-869570	TRANSISTOR: (SEE NOTE I) NPN: type M9570
Q2	48-869571	PNP: type M9571
Q3	48-869328	PNP: type M9328
R1	6-129132	RESISTOR, fixed: ±10%; 1/4 W unless otherwise stated 820
R2	6-129863	390
R3	6-129862	150
R4	6-129236	15k ±5%
R5	6-129887	12k ±5%
R6	6-129805	1k ±5%
R7	6-129984	680 ±5%
R8	6-129681	1.5k ±5%
R9	6-129269	1.8k

NOTES:

I. For optimum performance, diodes, transistors and integrated circuits must be ordered by Motorola part numbers.

II. Capacitor C907 is located on the TLN5744A multiple "PL" encoder module but is part of this converter board kit.

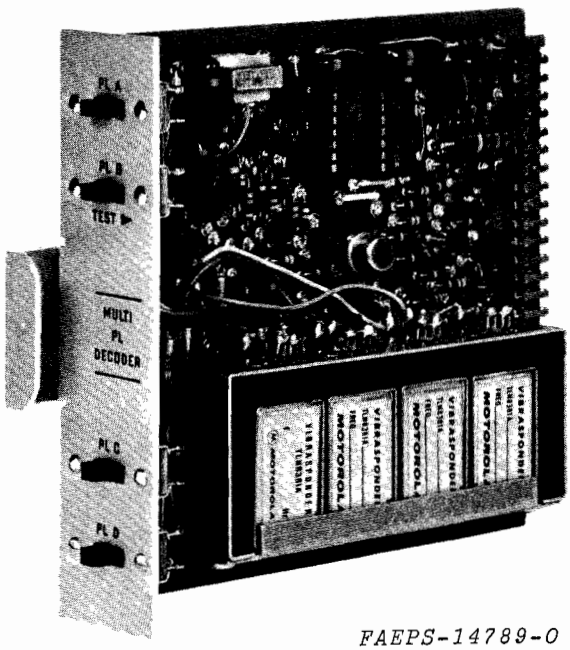
NOTES:

1. UNLESS OTHERWISE STATED, RESISTOR VALUES ARE IN OHMS.
2. DC VOLTAGE MEASUREMENTS IN Q1, Q2, AND Q3 STAGE TAKEN IN RESPECT TO A-. ALL DC VOLTAGES MAY BE MEASURED WITH 20,000 OHM-PER-VOLT METER.

NEPS-15371-O

MULTI "PL" DECODER MODULE

MODEL TLN5745A



FAEPS-14789-O

1. FUNCTIONS

1.1 This multi PL decoder module is used with base and repeater stations to provide multiple PL receive operation. It is also used with non-wire line repeater stations to select the PL tone transmitted with repeated messages. Depending on the PL tone received, a switched ground signal will appear at one of the outputs of this module which is used to:

(1) (with base stations) unsquelch the receiver or

(2) (with non-wire line repeater stations) unsquelch the receiver and enable an associated PL oscillator in the multi PL encoder module.

2. DESCRIPTION

2.1 This module is fully transistorized and occupies the "Single-Tone" Decoder position in the remote control chassis. All components and circuitry are mounted on a sturdy card with interconnecting pins to mate with the interconnecting board of the chassis in which it is installed.

3. CIRCUIT DESCRIPTIONS

3.1 INTRODUCTION

3.1.1 This module responds only to specific continuous low-frequency tones from a transmitter in the same "Private-Line" system. Four "Vibrasponder" resonant reeds are used as tone detectors by the decoder. These reeds detect tones within an accuracy of less than one Hertz (0.15%). A switched ground from an open collector output stage is provided for each of the four detected tone inputs by the decoder.

3.2 "PL" TONE PRESENT

3.2.1 With PL tones present with the input signal to the decoder, the PL filter passes low frequency PL tones and attenuates voice and noise frequencies above 300 Hz. The noise switch shorts out high frequency noise frequencies. The tone from the PL filter is amplified by the PL amplifier and is limited to a fixed level by the amplifier/clipper. The tone is applied to the "Vibrasponder" resonant reed which vibrates when the tone is the same frequency as the reed's resonant frequency. When the reed is vibrating, the device acts as a transformer and couples the tone from primary to secondary. The tone is amplified in

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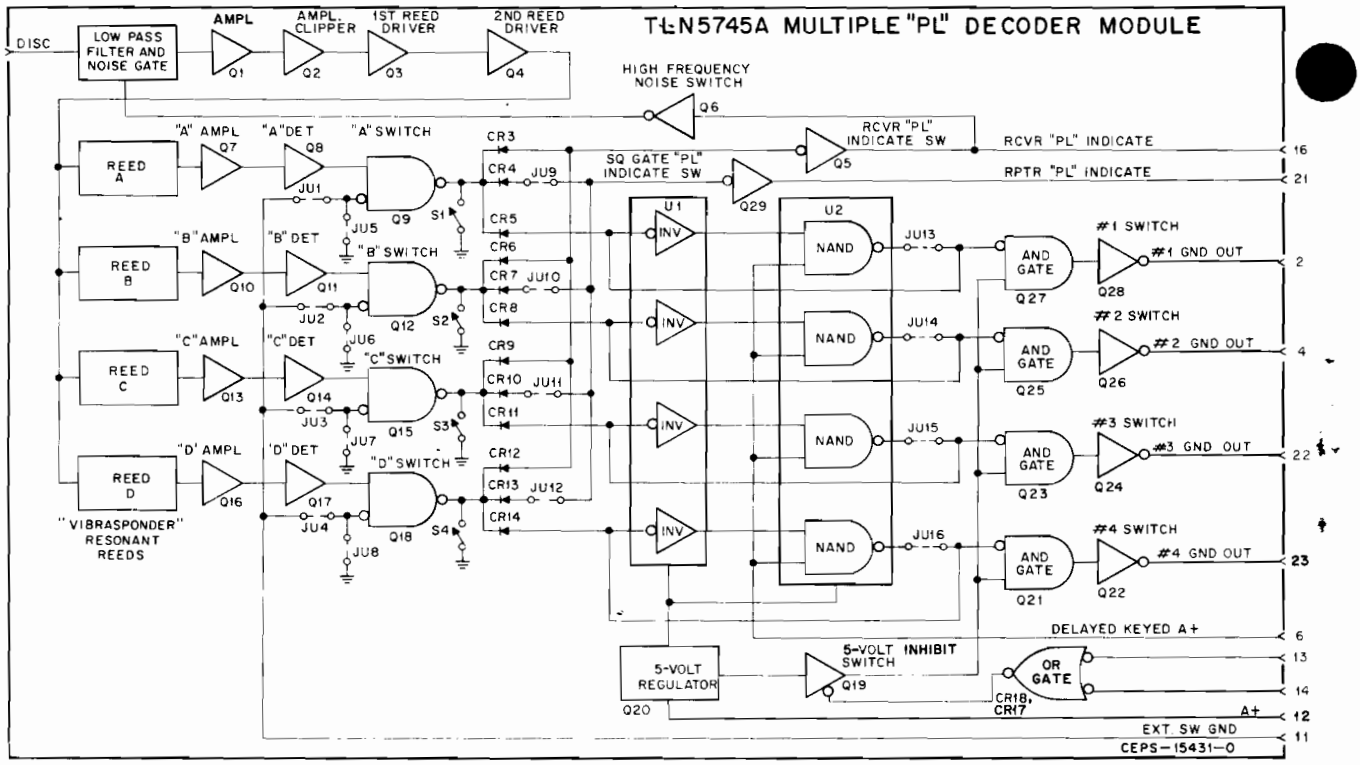

Figure 1. Functional Diagram

the next stage and applied to a detector. When a tone is present, the detector develops a dc output which activates the detector output switch. When the detector output switch is activated, its ground output is applied to three circuits -- the

- Receive PL indicate switch which, in turn, drives the high frequency noise switch (shorts input high frequency noise and voice signals to ground) and provides an output "high" on the PL indicate line to the station's receiver (unsquelches the receiver).

- Squelch gate PL indicate switch which, in turn, provides an output "high" on the PL indicate line to a repeater station's squelch gate module (keys the station's transmitter).

- Through inverter and latch circuits to an applicable output switch which, in turn, is activated (provides an associated ground level output in response to the particular PL tone detected).

3.3 PL TONE NOT PRESENT

3.3.1 When no PL tone is present, or when a PL tone of an incorrect frequency is present, the "Vibrasponder" does not operate. Therefore, the output of all detector switches is high which inhibits the squelch gate through pin 21.

3.3.2 When no PL tone is detected, switch Q6 is off. This allows high frequency noise to bypass the PL filter which prevents random low frequency noise from activating the "Vibrasponder" resonant reeds.

3.4 INPUT CIRCUITS

3.4.1 The receiver discriminator output signal is applied to the multi PL decoder input at pin 3. When no carrier is received this signal consists of noise only. When voice or voice/PL tone frequencies are received, the noise is reduced and the voice/PL tone frequencies are routed through the low pass PL filter and noise gate circuits. The low pass PL filter, which consists of L2, C2, C3, and C4, sharply attenuates all signals above 300 Hz. Therefore, voice and noise frequencies above 300 Hz are effectively blocked while PL tones are passed.

3.4.2 High pass filter, C1, R1 and R7, provides a shunt for high frequency noise around the PL filter when no tones are detected. The high frequency noise desensitizes

the amplifier/clipper and prevents low frequency noise from triggering the decoder. When a PL tone is detected, noise switch Q6 shorts all high frequency signals to ground.

3.5 AMPLIFIER/CLIPPER

3.5.1 The noise and PL tones are amplified and coupled to amplifier/clipper Q2 by Q1. Diode CR1 and Q2 (base emitter junction) limit both the positive and negative signal swing to a maximum amplitude. The output of Q2 provides a constant drive to compensate for the tone amplitude deviation between transmitters. Q2 also reduces the sensitivity of the "Vibrasponder" reeds to noise. Drivers Q3 and Q4 operate as emitter followers to provide current drive to the low impedance "Vibrasponder" reed assembly.

3.6 "VIBRASPONDER" RESONANT REEDS

3.6.1 The "Vibrasponder" resonant reeds are the frequency detecting devices of the decoder. When the input tone from the "Vibrasponder" driver is the same frequency as a reed's resonant frequency, the reed vibrates. At resonance, the reed acts as a high Q transformer coupling energy from the primary to the secondary winding. At all other frequencies, the reed will not vibrate and no energy is coupled to the secondary winding. The reed is a precision built device consisting of a tuned cantilever reed of special steel mounted on a rugged base with a coil and permanent magnets. The entire assembly is spring-mounted and hermetically sealed in a metal housing to insure long life at peak performance under all types of conditions. Its design eliminates the need for servicing throughout its useful life. The plug-in unit is easily removed and replaced. The reed is sensitive to within 1 Hz of its resonant frequency. Specific tones in the 67 to 210 Hz range are used.

3.7 TONE DETECTORS

3.7.1 The following description applies to the signal flow through "Vibrasponder" resonant reed "A" and associated circuits. "Vibrasponder" circuits "B", "C", and "D" operate in an identical manner.

3.7.2 When a PL tone is detected by a "Vibrasponder" resonant reed, a resonant sinusoidal waveform appears at its output. This signal is amplified by Q7. (Negative feedback through C11 maintains the sinusoidal voltage.) The output of Q7 is detected by Q8.

3.7.3 Detector Q8 is normally turned off by +13.4 volts on the base and +12.3 volts on the emitter. Therefore, when a tone is detected, Q8 turns on each time the tone signal waveform goes negative more than 1.3 volts (the amount of Q8 reverse bias). Each time Q8 turns on, C13 is charged by the +12.3 volts on the emitter. When Q8 turns off, C13 discharges through R25 and the base of Q9 turning on Q9. When Q9 turns on, it applies a ground to the base of Q5 and Q29, turning them on. When Q5 and Q29 are turned on, they apply a positive level to the receiver and squelch gate respectively. The positive level from Q5 also turns on Q6 which shunts high frequency noise from the PL filter to ground.

3.8 DECODER OUTPUT

3.8.1 When a tone is detected, the low output of Q9 is applied to inverter U1-5. This low is inverted and applied to NAND gate U2-2. When delayed keyed A+ is applied to U2-3, a low level is generated and fed back to U1-5, causing a latch condition and applying a continuous low to the base of Q27. This low turns on Q27 and Q28 producing a low (ground level) output #1 signal at pin 2.

3.8.2 When transmission has been completed, and the PL tone has dropped, the collector of detector output switch Q9 goes high. This high reverse biases all three isolation diodes, causing the three associated circuits to reverse their operation as previously described. Delayed keyed A+ remains on for approximately 130-180 milliseconds. This delay voltage keeps the NAND gate on, feeding back the output to the input of inverter U1, thereby keeping a high applied to pin 1 of U2. This state continues until delayed keyed A+ drops, causing the NAND gate to return to its normal state.

4. MAINTENANCE

4.1 RECOMMENDED TEST EQUIPMENT

a. Motorola S1318A, S1319A, S1320A, or S1321A RF Signal Generator. This solid-state unit provides receiver rf carrier signals.
b. Motorola SLN6221A "PL" Tone Generator and "Vibrasender" resonant reeds on the same frequency as the "Vibrasponder" resonant reeds of the decoder. An audio signal generator may be used if it is accurately set to the decoder frequency. However, to

obtain the accuracy necessary, the frequency should be adjusted while the signal is measured on a frequency counter.

c. Tektronix/Telequipment Model D61 Oscilloscope for tone signal measurement. Some measurements may be taken with a high impedance ac voltmeter.

d. Motorola solid state multimeter for dc voltage measurements.

4.2 PERFORMANCE TESTS

A 0.25 microvolt rf carrier signal modulated ±0.5 kHz with PL tone should unsquelch the receiver. This can be checked as follows:

Step 1. Connect the rf signal generator to the receiver rf input receptacle. Set the signal generator output to the receiver carrier frequency, then set the output to minimum.

Step 2. Modulate the signal generator output ±0.5 kHz with a PL tone of the frequency stamped on one of the "Vibrasponder" resonant reeds. The tone can be generated with a Motorola SLN6221A "PL" Tone Generator and a "Vibrasponder" resonant Reed. A "Vibrasender" reed from the PL encoder may be used if it is the proper frequency.

Step 3. Also modulate the signal generator with an audio tone in the 300 to 3000 Hz range at ±3.3 kHz.

Step 4. Increase the output of the signal generator until the receiver unsquelches and the audio tone is heard on the speaker. No more than 0.25 microvolt should be required to unsquelch the receiver.

4.3 TROUBLESHOOTING

If the PL decoder does not operate, or operates improperly, the following hints may be helpful in locating the malfunction.

4.3.1 Testing the "Vibrasponder" Resonant Reeds

One of the first tests should be a check of the "Vibrasponder" resonant reeds. Inject a 340 millivolt rms PL tone of the proper frequency directly to the primary of each reed. Use an oscilloscope or ac voltmeter to check the output across the secondary of the reeds. Approximately 75 millivolts rms should be measured. If the reeds are good, continue with other decoder tests.

4.3.2 Decoder Testing

Step 1. To test the decoder, inject a 1000 microvolt carrier signal into the receiver. Adjust PL modulation for 60 millivolts rms tone signal at the input to the decoder. If the PL tone is injected directly onto the decoder for testing, an rf carrier signal should be injected into the receiver to quiet the receiver noise. Otherwise, noise and PL tone will both be present and will produce erroneous readings.

Step 2. With 60 millivolts PL tone input, measure signal and dc voltages at various points in the decoder to isolate the trouble. Typical values for a normally operating decoder are given on the schematic diagram. Some waveforms are not sinusoidal and should be measured with an oscilloscope. Most ac voltmeters are calibrated to read accurately only for sinusoidal signals.

Step 3. If under normal operating conditions, the PL tones are heard with the speaker audio, the high pass filter on the decoder board should be checked.

PAGE 5

AND ALL

SUBSEQUENT

PAGES ARE

MISSING FROM THE

ORIGINAL DOCUMENT.

THEY WILL BE ADDED WHEN AVAILABLE.