FUNCTIONAL DESCRIPTION

RF-CONTROL CHASSIS

REMOTE CONTROL

AUDIO & SQUELCH

OPTIONAL EQUIPMENT

Spectra-TAC ENCODER
OPTION C269

Item	Description	Alteration
TRN5293A	*Spectra-TAC* Encoder Module	Added
TRN5294A	4-Wire Line Driver Module	Replaces TRN5236A
TRN5331A	Squelch Gate Module	Replaces TRN5324A
TKN8287A	4-Wire Line Cable Kit	Replaces TKN8286A

1. APPLICATION

The *Spectra-TAC* Encoder option is available for Motorola remotely controlled *MSR 2000* base and repeater radios. The addition of this option permits the station receiver to operate as a receiver-encoder in a *Spectra-TAC* total area coverage system.

The Motorola *Spectra-TAC* Total Area Coverage System electronically compares and selects the receiver with the best signal of multiple receivers operating on the same rf frequency over a wide coverage area. The *Spectra-TAC* system consists of multiple receiver-encoder units distributed throughout a coverage area and a comparator which determines which receiver has the best signal on the same rf frequency. With the use of multiple receiver-encoders, the *Spectra-TAC* system can extend the talk-back range of personal portable and mobile radio units.

By selecting only one receiver-encoder unit, the high noise and phase distortion, which would result if several receiver audio lines were connected in parallel at the monitoring point, are eliminated.

One receiver-encoder unit is required at each given satellite site. The receiver monitors one rf frequency and amplifies the received audio for transmission to the comparator. An encoder generates a status tone for transmission to the comparator when there is no received signal.

The comparator receives the audio and tone signals from multiple receiver-encoder units, which are operating on the same rf frequency. It compares the signals and selects the receiver-encoder unit with the best audio signal (the generated tone is not used for voting). The audio of the receiver-encoder unit with the best signal is then sent to the dispatcher.

2. DESCRIPTION

The *Spectra-TAC* encoder option includes a TRN5293A *Spectra-TAC* Encoder Module, which is added in position 11; a TRN5294A 4-Wire Line Driver Module, which replaces the standard TRN5236A 2-Wire Line Driver Module; a TRN5331A Squelch Gate Module, which replaces the standard TRN5324A Squelch Gate Module in repeater systems; and a TKN8287A 4-Wire Cable Kit that replaces the standard 2-wire cable kit.

3. FUNCTION

3.1 GENERAL

3.1.1 When this option is added to a base station, the receiver becomes a voting receiver in the *Spectra-TAC* system. In this application, the receiver audio is routed to the comparator. The comparator selects (votes) the receiver with the best quality signal and routes its audio to the dispatcher console.

3.1.2 When this option is added to a repeater station, the voted audio from the comparator is applied to the station transmitter where it is retransmitted. The station automatically reverts to in-cabinet repeat (RT) operation when the comparator or the comparator wire line fails. The transmitter is normally keyed by a line PTT from the comparator. When a line PTT is not received from the comparator within approximately 200 msec after the receiver is unsquelched, the squelch gate module automatically keys the transmitter and the receiver audio is applied to the transmitter for retransmission.

3.2 TRN5293A *Spectra-TAC* ENCODER MODULE

The *Spectra-TAC* encoder module provides a status tone when the receiver is squelched. This tone is used at the comparator location to disable voting, for line checking, and for in-path loss factoring. Status tone is turned off when the receiver is unsquelched. The

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68P81112E78-O
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module also provides 400 Hz and 2500 Hz test tones for use in equalizing audio response over the telephone line (or other path). An equalizer circuit in the 4-wire line driver module can be set (via jumpers) to add gain at either or both of the test frequencies.

3.3 TRN5294A 4-WIRE LINE DRIVER MODULE

The 4-wire line driver module accepts audio from the receiver, amplifies it, and routes it via the LINE 2 terminals to the *Spectra-TAC* comparator and to the local speaker. Two transformers are used; one is used for accepting the transmit audio and control signals, and the other is used to provide audio to the comparator. The module also contains a line equalization circuit to compensate for rolloff in the frequency response of the output line.

For further details on the *Spectra-TAC* encoder and 4-wire line driver, refer to sections 68P81026E28 and 68P81029E04 attached to this section.

3.4 TRN5331A SQUELCH GATE MODULE

Keying of the transmitter by the squelch gate on *Spectra-TAC* repeaters is only desired if a wire line failure occurs. A 200 msec delay in the squelch gate allows time for the normal line transmit command before the repeater will initiate in-cabinet repeat operation.

4. INSTALLATION

The *Spectra-TAC* option is factory installed. The encoder module plugs into the remote control chassis in the single tone decoder slot. The 4-wire line driver module provides for "4-wire; 1 receiver; receiver audio on line 2" operation.

Install the station in the same manner as described for stations without this option, with the following exceptions:

- Connect the transmitter audio lines from the *Spectra-TAC* comparator output to the station's LINE 1 terminals.
- Connect the receiver audio lines from the station's LINE 2 terminals to one of the inputs of the comparator.
- After all other station levels are adjusted, as described in the station instruction manual, perform the line level, status tone level, and line equalization adjustments as described in paragraph 5.

5. ADJUSTMENTS

Three adjustments, in addition to the standard station adjustments, are required for *Spectra-TAC* operation: line level adjustment, status tone level adjustment, and line equalization adjustment. These adjustments are to be made after the standard station adjustments and must be made in the sequence given below.

5.1 LINE LEVEL ADJUSTMENT

There are two basic reasons for observing correct line level settings; (1) to avoid exceeding maximum levels allowed by the phone company, and (2) to assure correct operation of the *Spectra-TAC* equipment. The phone company will specify a maximum audio level on the phone line and the customer must specify the signal level required at the opposite end which determines the maximum line loss. In addition, for voice quality lines, the phone company may specify the maximum allowable power level. This is done to minimize crosstalk and equipment overloading. The maximum power level is determined by averaging the audio signal level over a 3-second period. Due to the pauses between speech syllables and words, the 3-second average will be in most cases, a power level 13 dB below the peak level of voice. The allowable peak level of voice is specified by the phone company as the Transmission Level Point (TLP). A 1000 Hz tone at full system deviation (±5 kHz) is recommended for setting the line level.

Step 1. Connect an ac voltmeter to the LINE 2 (+) and (−) screw terminals on the junction box. If LINE 2 terminals are not connected to the comparator, the meter must be bridged by a 600-ohm load.

Step 2. Turn the SQUELCH control fully counterclockwise and disable the PL module (if used).

Step 3. Inject an on-frequency carrier signal into the receiver antenna input.

Step 4. Modulate the receiver input with a 1000 Hz tone at ±5 kHz deviation. Determine the maximum allowable level permitted on the line and set the LINE LEVEL control on the audio control module for this level. If the specified maximum is the maximum allowable *power* (3 second average), then set the LINE LEVEL control for 13 dB above this level. Do not exceed +11 dBm.

5.2 STATUS TONE LEVEL ADJUSTMENT

5.2.1 General

5.2.1.1 Status tone level settings must be done correctly to assure correct receiver voting at the comparator. The AGC circuitry on the signal quality module provides compensation for phone line losses and permits correct receiver voting. The AGC circuitry is "set" relative to the status tone generated by the receiver encoder module. The encoder module must be installed in a TLN5935A Extender Card for TONE LEVEL adjustment access.

5.2.1.2 Two methods of status tone level adjustment are employed in the *Spectra-TAC* receivers depending upon the type of signal quality modules

utilized in the *Spectra-TAC* comparator. It is recommended that the status tone level be adjusted only after the line level has been adjusted, because both the LINE LEVEL and TONE LEVEL controls affect the level of the status tone on the line.

5.2.2 0 dB System

In a 0 dB system, the TRN6091A Signal Quality Module is required, or a TRN6091B Signal Quality Module may be jumpered to operate as a TRN6091A by installing JU4. These signal quality modules are located in the comparator chassis. The status tone level must be adjusted equal to receiver peak audio at full system deviation (±5 kHz). The status tone must not exceed maximum power and peak audio levels specified by the phone company. The following conditions must be met for proper operation of a 0 dB system:

Module	Jumper	Status
TRN5293A	JU3, JU5	IN
TRN5294A	JU1	OUT

Step 1. Connect an ac voltmeter across the LINE 2 (+) and (−) terminals which must be terminated by a 600-ohm load. Disconnect any rf input to the receiver. Turn the SQUELCH control fully clockwise until the receiver is fully squelched.

Step 2. Adjust the TONE LEVEL control on the encoder module until the line level, as measured by the ac voltmeter, is the same as the 1000 Hz test tone level set in Step 4 of paragraph 5.1.

Step 3. Remove the extender card and re-install the encoder module in the card cage.

5.2.3 −13 dB System

In a −13 dB system, the TRN6091B Signal Quality Module is utilized; JU4 is removed. The status tone level must be adjusted 13 dB below receiver peak audio at full system deviation (±5 kHz). The following conditions must be met for proper operation of a −13 dB system:

Module	Jumper	Status
TRN6293A	JU3, JU5	OUT
TRN5294A	JU1	IN

Step 1. Connect an ac voltmeter across the LINE 2 (+) and (−) terminals which must be terminated by a 600-ohm load. Disconnect any rf input to the receiver so that the receiver is squelched.

Step 2. Adjust the TONE LEVEL control on the TRN5293A Encoder Module until the line level, as measured by the ac voltmeter, is 13 dB below the 1000 Hz test tone level set by the LINE LEVEL control.

Step 3. Remove the extender card and re-install the encoder module in the card cage.

5.3 LINE EQUALIZATION ADJUSTMENT

5.3.1 General

The purpose of the line equalization procedure is to ensure sufficient audio gain to the comparator site to compensate for line losses. Two men are required to perform the line equalization procedure; one man at the receiver site and one man at the comparator site. The man at the receiver site measures the line level at the output of the receiver while the man at the comparator site measures the line level at the input to the comparator. Line equalization is performed by setting the 1 kHz test tone (used in the line level adjustment procedure) level equal to the LOW and HIGH test tone levels generated by the encoder module. The line driver must be installed in an extender card for equalization adjustment access.

5.3.2 Procedure

Step 1. Establish communications between both sites. The TMN6067A Handset may be used for transmission and monitoring purposes at the station and comparator sites. Plug the handset into J1 on the line driver module. Refer to the Maintenance section of the comparator manual (68P81026E40) for further instructions regarding operation of the handset at the comparator site.

Step 2. At the receiver site, be sure the 400 Hz, 2500 Hz, and 1 kHz test tones are at equal levels.

Step 3. Send the 1 kHz test tone, making sure the man at the comparator site measures and records the received level.

NOTE

Maximum equipment output level is +11 dBm. Be sure not to exceed this limit at any time.

Step 4. At the receiver site, send the 2500 Hz high tone by setting and holding the momentary HIGH TONE switch on the encoder module. At the comparator site, measure and compare this level with the 1 kHz level previously recorded. Inform the man at the receiver site of the difference.

Step 5. At the receiver site, install the 2500 Hz equalization jumper (on the line driver) in the position necessary to obtain the level equivalent to the 1 kHz level.

Step 6. Repeat Steps 4 and 5 using the 400 Hz low tone switch and equalization jumper.

Step 7. Repeat the entire procedure to ensure correct equalization adjustment.

Step 8. Remove the extender card and re-install the line driver in the card cage.

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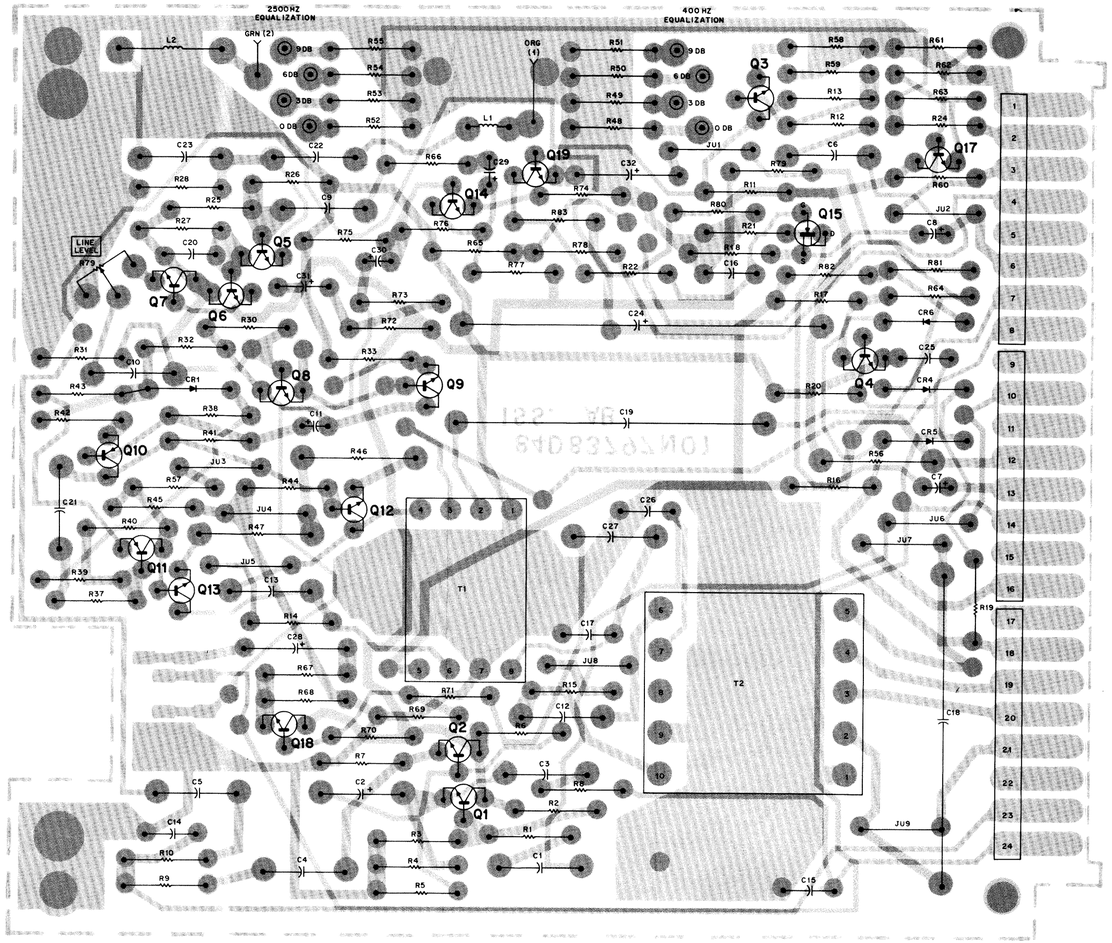
Spectra-TAC 4-WIRE LINE DRIVER MODULE

MODEL TRN5294A



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SOLDER SIDE * 8D-DEPS-34704-O
COMPONENT SIDE * 8D-DEPS-34705-O
OL-DEPS-34706-O

TRANSISTOR BASE DETAILS

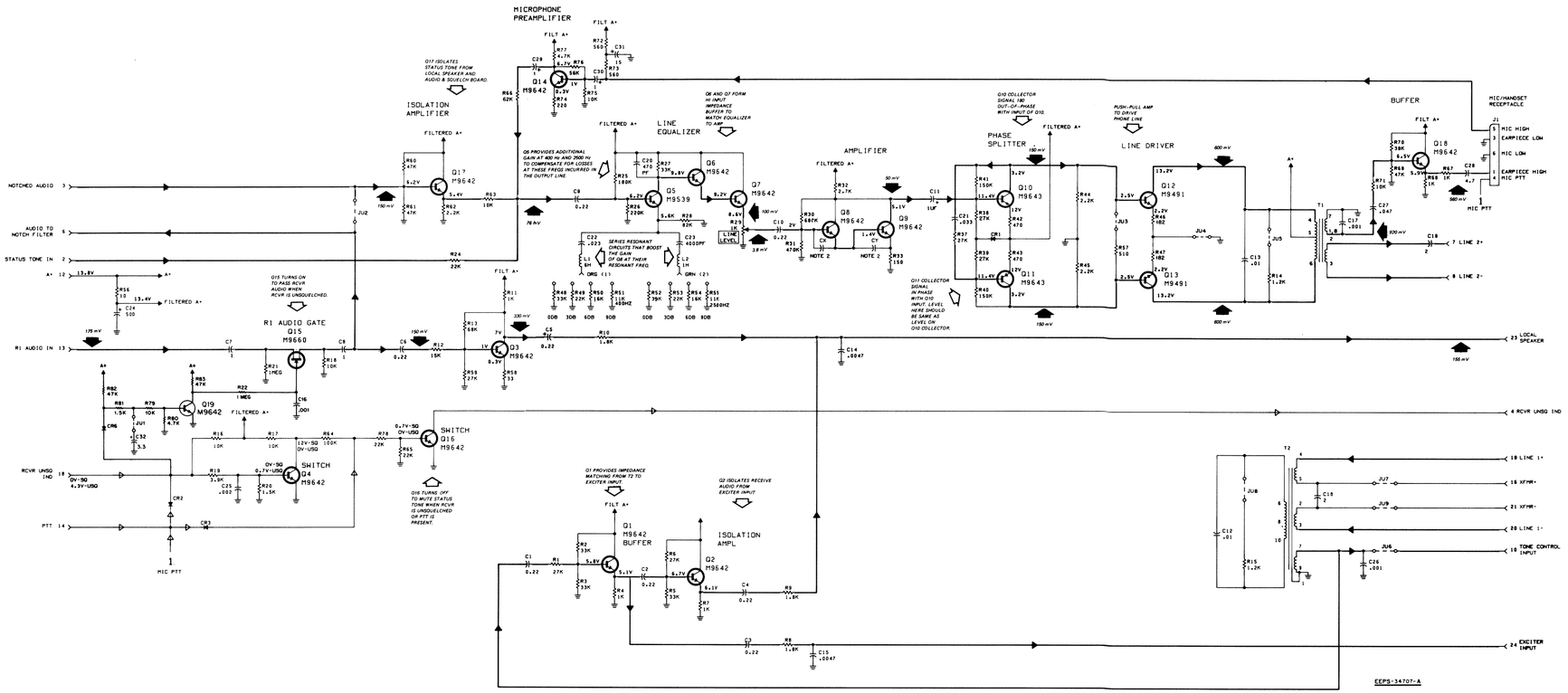
parts list

TRN5294A 4-Wire Line Driver Kit PL-7965-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed; uF ±10%: unless otherwise stated
C1 thru 6	8-82905G11	0.22; 50 V
7,8	23-84538G01	1 ±20%; 35 V
C9	8-82905G11	0.22; 50 V
C10	8-83514E02	0.10; 50 V
C12,13	8-82905G01	.01;25 V
C14,15	21-82187B27	.0047; 100 V
C16,17	21-82187B20	.001; 100 V
C18,19	8-82045F05	2; 350
C20	21-82187B07	470 pF; 500 V
C21	8-82905G16	.033; 100 V
C22	8-82905G39	.023; 50 V
C23	21-863396	4000 pF ±1%; 500 V
C24	23-83210A19	500, 20 V
C25	21-82428B25	.002 ±20%; 500 V
C26	21-82187B29	.001; 100 V
C27	8-82905G03	.047; 50 V
C28	23-84762H07	4.7 ±20%; 10 V
C29,30	23-84538G01	1 ±20%; 35 V
C31	23-84538G04	15 ±20%; 20 V
C32	23-82783B50	3.3; 15 V
		diode: (see note)
CR1,2,3,6	48-83654H01	silicon
		connector, receptacle:
J1		consists of:
	28-84269C01	male contacts; 3 req'd.
	28-84269C02	male contacts; 2 req'd.
		coil, rf:
L1	24-84003A03	choke; 6 H
L2	25-82113H02	choke; 1 H
		transistor: (see note)
Q1 thru 9	48-869642	NPN; type M9642
Q10,11	48-869643	PNP; type M9643
Q12,13	48-869491	NPN; type M9491
Q14	48-869642	NPN; type M9642
Q15	48-869660	FET, p-channel; type M9660
Q16,17,18	48-869642	NPN; type M9642
		resistor, fixed ±5%; 1/4 W: unless otherwise stated
R1	6-11009C83	27k
R2,3	6-11009C55	33k
R4	6-11009C49	1k
R5	6-11009C85	33k
R6	6-11009C83	27k
R7	6-11009C49	1k
R8,9,10	6-11009C55	1.8k
R11	6-11009C49	1k
R12	6-11009C77	15k
R13	6-11009C93	68k
R14,15	6-11009C51	1.2k
R16,17,18	6-11009C73	10k
R19	6-11009C63	3.9k
R20	6-11009C53	1.5k
R21,22	6-11009D22	1 meg
R24	6-11009C81	22k
R25	6-11009D04	180k
R26	6-11009D06	220k
R27	6-11009C85	33k
R28	6-11009C95	82k
R29	18-82515B42	variable; 1k ±20%
R30	6-11009D18	680k
R31	6-11009D14	470k
R32	6-11009C59	2.7k
R33	6-11009C29	150
R37	6-11009C83	27k
R38,39	6-11009C83	27k
R40,41	6-11009D02	150k
R42,43	6-11009C41	470
R44,45	6-11009C57	2.2k
R46,47	6-10621B23	182 ±1%
R48	6-11009C85	33k
R49	6-11009C81	22k
R50	6-11009C78	16k
R51	6-11009C74	11k
R52	6-11009C87	39k
R53	6-11009C81	22k
R54	6-11009C78	16k
R55	6-11009C74	11k
R56	6-125A01	10; 1/2 W
R57	6-124C42	510
R58	6-11009C13	33
R59	6-11009C83	27k
R60,61	6-11009C89	47k
R62	6-11009C57	2.2k
R63	6-11009C73	10k
R64	6-11009C97	100k
R65	6-11009C81	22k
R66	6-11009C92	62k
R67,68	6-11009C49	1k
R69	6-11009C89	47k
R70	6-11009C87	39k
R71	6-11009C73	10k
R72,73	6-11009C43	560
R74	6-11009C33	220
R75	6-11009C73	10k
R76	6-11009C91	56k
R77	6-11009C65	4.7k
R78	6-11009C81	22k
R79	6-11009C73	10k
R80	6-11009C65	4.7k
R81	6-11009C53	1.5k
R82,83	6-11009C89	47k
		transformer:
T1	25-84202A02	pri: 50 ohms sec: 50 ohms
T2	25-83000C01	pri: #1: 25 ohms pri #2: 25 ohms sec #1: 50 ohms sec #2: 190 ohms
		non-referenced items
	2-8364	NUT, 3/8-32 x 1/2 x 3/32"
	3-134168	SCREW, tapping; 4-40 x 1/4"; 2 used
	3-84256M01	SCREW, tapping; 2 used
	7-82613K01	BRACKET
	64-84070M02	PANEL
	5-84220B01	GROMMET; 2 used
	39-10184A24	RECEPTACLE, contact; 2 used
	9-83497F01	RECEPTACLE, 8 contact; 3 used (PCB Edge Connector)

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

Circuit Board Detail & Parts List
Motorola No. **68P81062E41-B**
(Sheet 1 of 2)
11/1/85-UP



NOTES:

1. Unless otherwise indicated, capacitor values are in microfarads.
2. Capacitors CX and CY are not installed. Pads are provided for installing CX and CY when required to correct possible RF interference, when required. Their value must be calculated for specific interference problems.
3. AC (RMS) voltages taken with a 175 mV, 1 kHz tone input at pin 13, ac voltages taken using Model S1053C AC Voltmeter (or equivalent). DC voltages taken using Model S1063B DC Multimeter (or equivalent).

Jumper Table

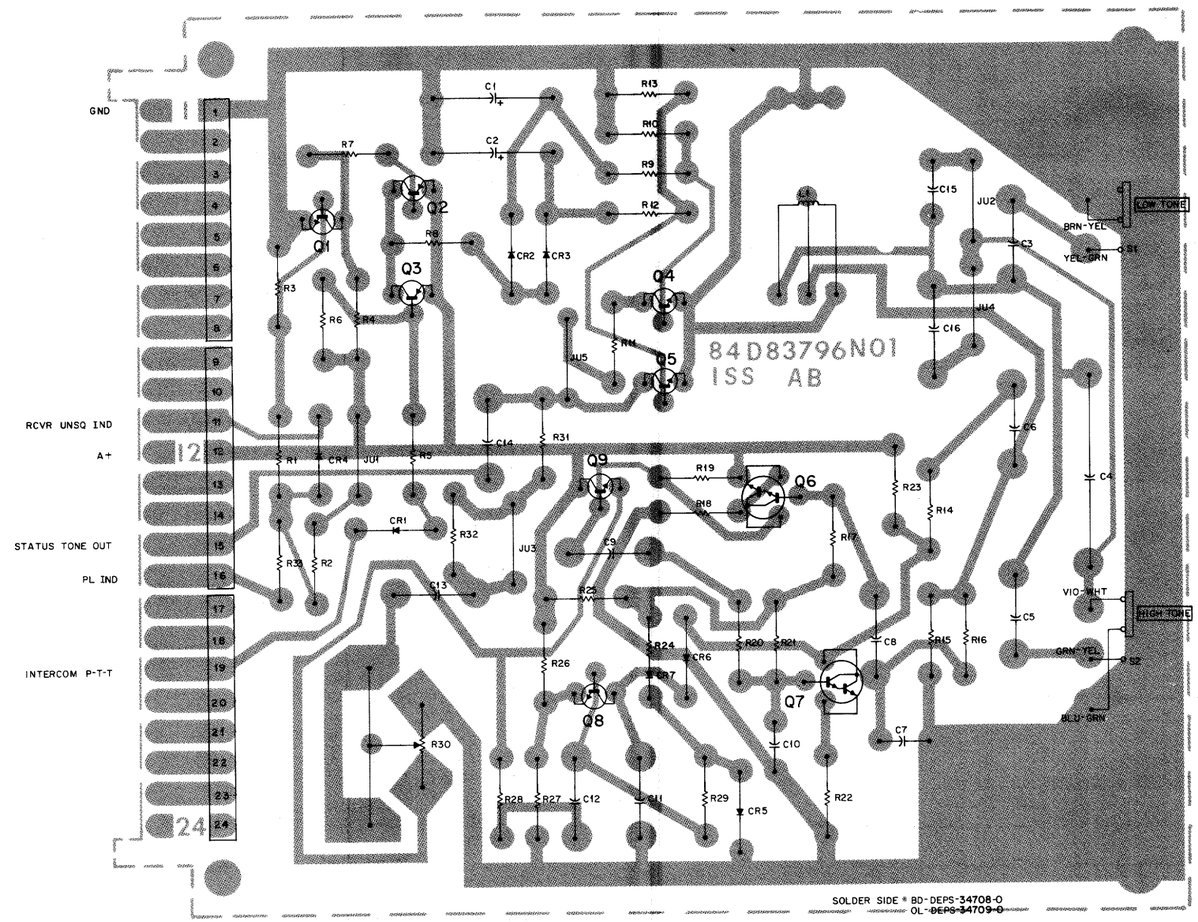
JU1	IN for —13 dB status tone operation. OUT for 0 dB status tone operation.	Normally IN
JU2	When removed, audio is routed to a 2175 Hz notch filter on the F1-PL module.	Normally IN (removed for tone control base stations)
JU3	When installed, this jumper attenuates line output 20 dB for input to microwave equipment.	Normally OUT
JU4	Provides a ground for the line driver. Removed only when an external mute is used.	Normally IN
JU5	Puts a 1.2k resistor across the primary of T1 which gives Line 2 a 600-ohm impedance. With JU5 removed, Line 2 has approximately 10k impedance.	Normally IN
JU6	Provides audio inputs to guard tone decoder in a tone controlled system.	Normally IN
JU7, 9	Provides input to dc control module.	Normally IN
JU8	Puts a 1.2k resistor across the primary of T2 which gives Line 1 a 600-ohm impedance. With JU8 removed, Line 1 has approximately 10k impedance.	Normally IN

FUNCTION

Accepts audio from receiver, amplifies it, and routes it to the *Spectra-TAC* comparator and to the local speaker. Line equalization is provided to compensate for output line rolloff. Two transformers are provided; one is used for accepting the transmit audio and control signals, and the other is used to provide audio to the comparator.

Schematic Diagram
Motorola No. **68P81062E41-B**
(Sheet 2 of 2)
11/1/85-UP

Spectra-TAC ENCODER MODULE
MODEL TRN5293A



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parts list

TRN5293A Encoder Board Kit — PL-7962-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed uF: ± 10%; 50 V: unless otherwise stated
C1	23-82783B16	2.2; 15 V
C2	23-82783B25	4.7; 25 V
C3	8-82905G05	0.15
C4	8-84326A31	.004 ± 1%
C5	8-82905G25	.0033; 100 V
C6	8-82905G11	0.22; 100 V
C7	21-82187B29	.001; 100 V
C8,9	8-82905G04	.068
C10	21-82187B29	0.22; 100 V
C11	8-82905G11	.001; 100 V
C12	8-82905G03	.047
C13,14	8-82905G11	0.22; 100 V
C15	21-840049	800 pF ± 5%; 300 V
C16	21-863293	2000 pF, 2%; 500 V
		diode: (see note)
CR1 thru 5	48-83654H01	silicon
CR6	48-855216	germanium
CR7	48-83654H01	silicon
		coil, rf:
L1	24-84200A01	choke; 1 H
		transistor: (see note)
Q1	48-869642	NPN; type M9642
Q2,3	48-869643	PNP; type M9643
Q4	48-869642	NPN; type M9642
Q5	48-869648	NPN; type M9648
Q6,7	48-869706	Darlington pair; type M9706
Q8	48-869594	NPN; type M9594
Q9	48-869642	NPN; type M9642
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R1,2	6-11009C89	47k
R3 thru 7	6-11009C73	10k
R8	6-11009C33	220
R9	6-11009C79	18k
R10	6-11009C65	4.7k
R11,12	6-11009C53	1.5k
R13	6-11009C49	1k
R14	6-11009C73	10k
R15	6-11009C57	2.2k
R16	6-11009C73	10k
R17	6-11009C89	47k
R18	6-11009C41	470
R19	6-11009C81	22k
R20,21	6-11009C89	47k
R22	6-11009C41	470
R23	6-11009C81	22k
R24	6-11009C13	33
R25	6-11009C79	18k
R26	6-84444A08	2.2k ± 1%
R27	6-84444A07	221 ± 1%
R28	6-11009C65	4.7k
R29	6-11009C73	10k
R30	18-83168C07	variable; 5k
R31	6-11009C73	10k
R32	6-11009C97	100k
R33	6-11009C89	47k
		switch, slide:
S1,2	40-83468E01	spdt; momentary
		mechanical parts
	3-84256M01	SCREW, tapping; 2 used
	5-84220B01	GROMMET; 2 used
	42-84315A01	CLIP, ground
	64-83118L02	PANEL, screened
	9-83497F01	RECEPTACLE, 8 contact; 3 used (PCB Edge Connector)

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

Circuit Board Detail & Parts List
Motorola No. **68P81062E42-A**
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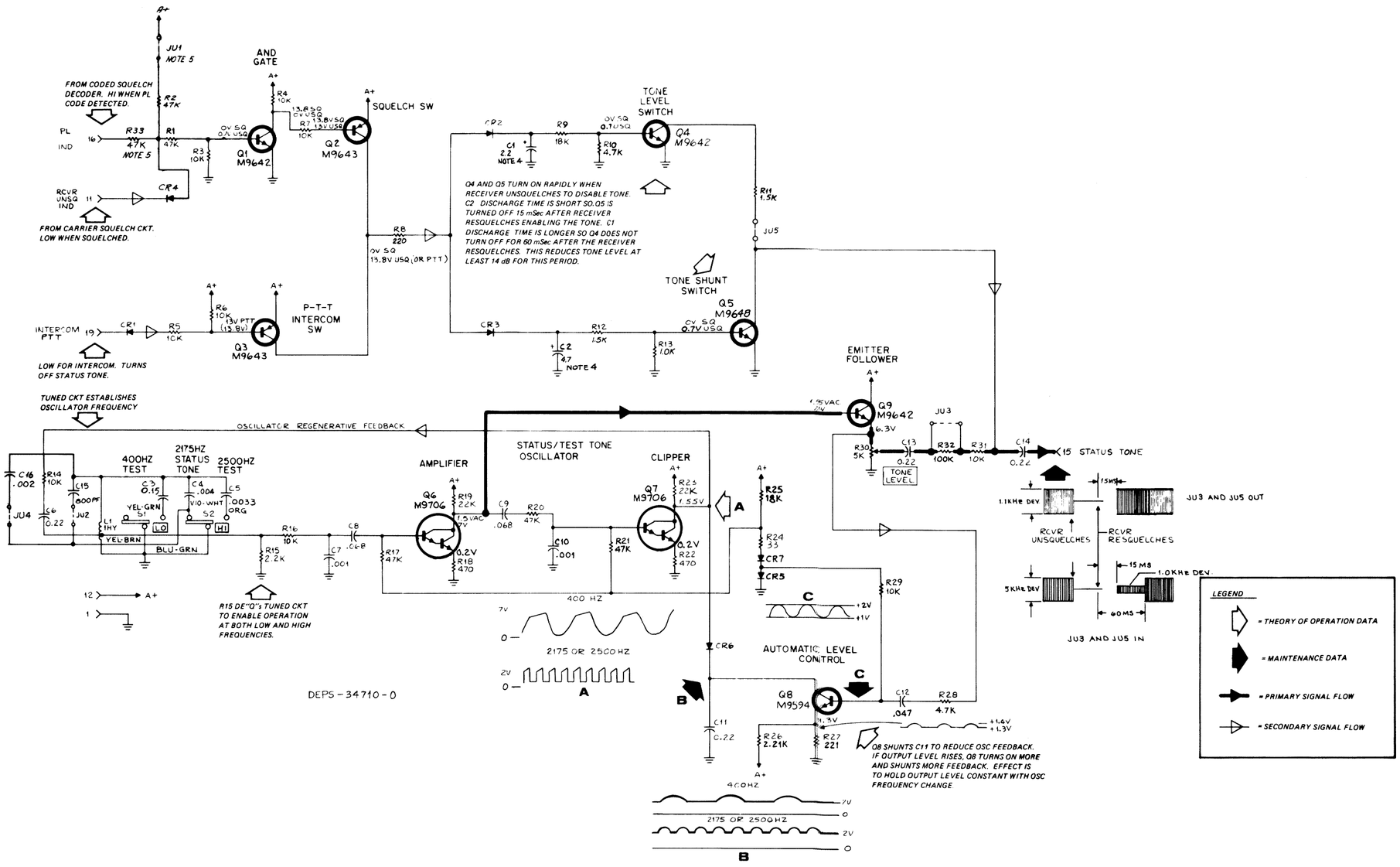

FUNCTION

Provides 2175 Hz status tone when receiver is squelched. Also provides test tones for line equalization.

NOTES:

1. Unless otherwise specified, resistors are in ohms, capacitors are in microfarads.
2. DC voltages are measured to ground with a dc voltmeter having, 11 megohm input impedance.
3. JU3 and JU5 are installed for status tone operation at full system deviation.
4. C1 and C2 are removed in IMTS applications.
5. When this module is used in a base station, (option C269) leave JU1 IN and remove R33. This applies to carrier squelch, Private-Line, Digital Private-Line models.

Jumper Usage Table

Jumper	Usage
JU1	IN for carrier squelch. OUT for PL squelch (normally IN).
JU2	OUT for status tone operation at 2375 Hz in IMTS systems, or for operation at 1950 Hz (normally IN).
JU3	Normally OUT (See Note 3).
JU4	IN for status tone operation at 1950 Hz. (normally OUT).
JU5	Normally OUT (see Note 3).

Schematic Diagram
Motorola No. **68P81062E42-A**
(Sheet 2 of 2)
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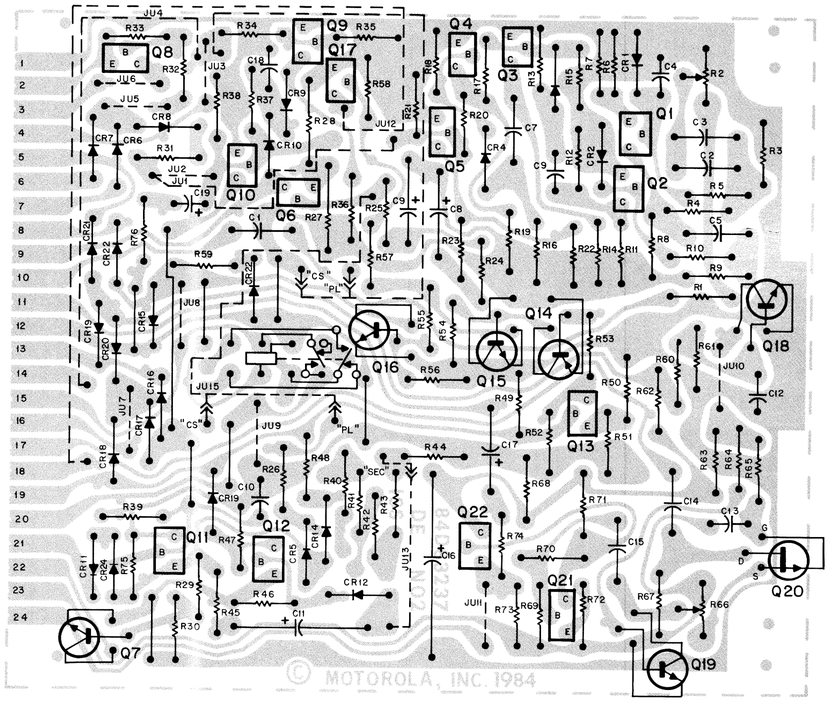
Spectra-TAC SQUELCH GATE MODULE

MODEL TRN5331A



SOLDER SIDE BD-CEPS-34576-A OL-CEPS-34577-B SHOWN FROM SOLDER SIDE

TRANSISTOR BASE DETAILS

BOTTOM VIEW ALL TRANSISTORS EXCEPT Q20

BOTTOM VIEW OF Q20

NOTE:
Q6, AND Q14 ARE PNP TYPE, ALL THE REST ARE NPN TYPE EXCEPT Q20 WHICH IS A FET

Circuit Board Detail & Parts List
Motorola No. **68P81062E43-C**
(Sheet 1 of 2)
11/1/85- UP

parts list

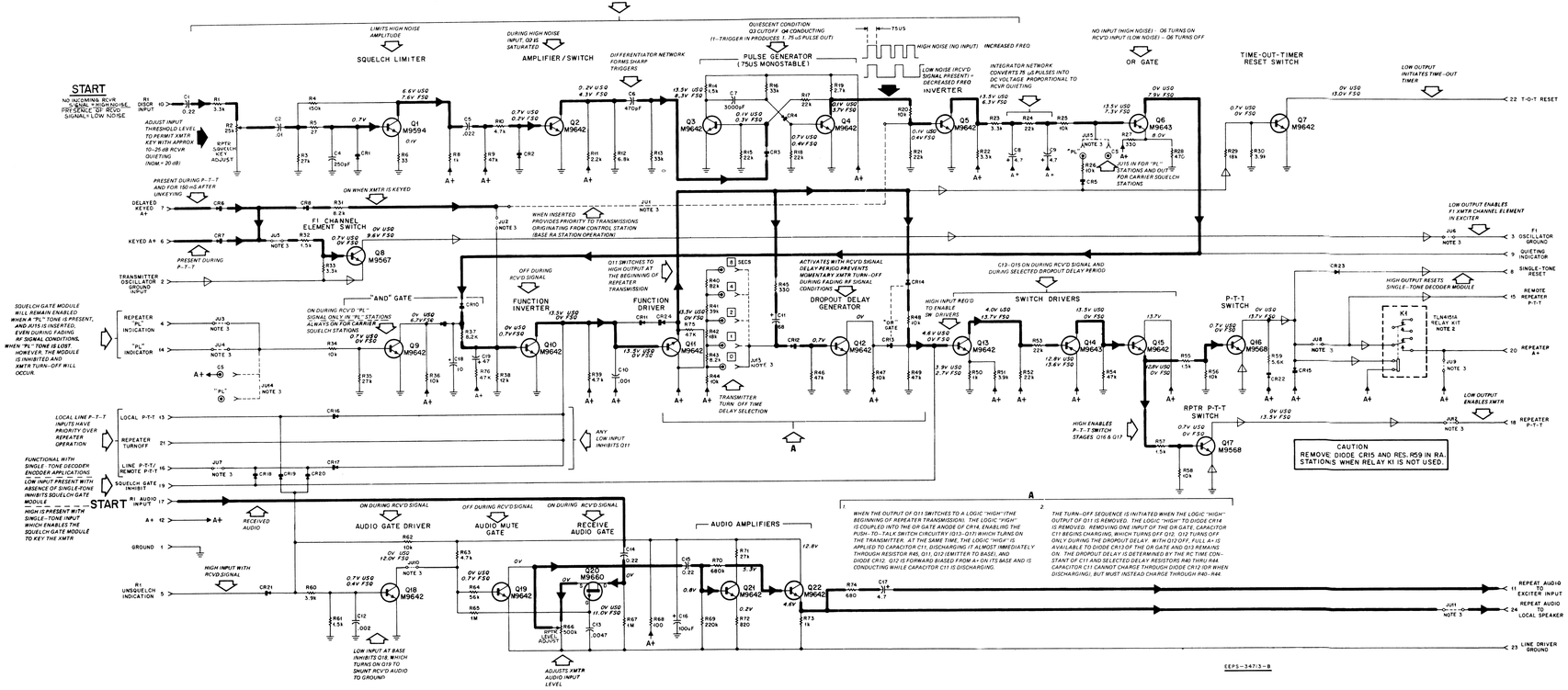
TRN5331A Squelch Gate Module PL-7960-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: pF ±10%; 50 V: unless otherwise stated
C1	8-82905G11	0.22 uF
C2	8-82905G01	.01 uF
C4	21-859943	250 ±5%; 500 V
C5	8-82905G11	0.22 uF
C6	21-850510	470; 300 V
C7	21-850994	3000 ±5%; 500 V
C8,9	23-82783B25	4.7 uF; 25 V
C10	21-82187B29	.001 uF; 100 V
C11	23-865594	68 uF; 15 V
C12	21-82428B25	.002 uF ±20%; 500 V
C13	21-83596E23	.0047 uF; 200 V
C14,15	8-82905G11	0.22 uF
C16	23-82783B04	100 uF ±20%; 25 V
C17	23-82783B25	4.7 uF; 25 V
C18	23-82783B27	10 uF; 25 V
C19	23-11019A40	47 uF
		semiconductor device, diode: (see note)
CR1 thru 24	48-83654H01	silicon
		transistor: (see note)
Q1	48-869594	NPN; type M9594
Q2 thru 5	48-869642	NPN; type M9642
Q6	48-869643	PNP; type M9643
Q7	48-869642	NPN; type M9642
Q8	48-869567	NPN; type M9567
Q9 thru 13	48-869642	NPN; type M9642
Q14	48-869643	PNP; type M9643
Q15	48-869642	NPN; type M9642
Q16,17	48-869568	NPN; type M9568
Q18,19	48-869642	NPN; type M9642
Q20	48-869660	FET, p-channel; type M9660
Q21,22	48-869642	NPN; type M9642
		resistor, fixed; 5%, 1/4 W: unless otherwise stated
R1	6-11009G61	3.3k
R2	18-83083G03	variable; 25k ±30%
R3	6-11009C83	27k
R4	6-11009D02	150k
R5	6-11009C11	27
R6	6-11009C13	33
R7	NOT USED	
R8	6-11009C49	1k
R9	6-11009C89	47k
R10	6-11009C65	4.7k
R11	6-11009C57	2.2k
R12	6-11009G89	6.8k
R13	6-11009C85	33k
R14	6-11009C53	1.5k
R15	6-11009C81	22k
R16	6-11009C85	33k
R17,18	6-11009C81	22k
R19	6-11009C59	2.7k
R20	6-11009C73	10k
R21	6-11009C81	22k
R22,23	6-11009C61	3.3k
R24	6-11009C81	22k
R25,26	6-11009C73	10k
R27	6-125A37	330;1/2 W
R28	6-125A42	510; 1/2 W
R29	6-11009C79	18k
R30	6-11009C63	3.9k
R31	6-11009C71	8.2k
R32	6-11009C53	1.5k
R33	6-11009C61	3.3k
R34	6-11009C73	10k
R35	6-11009C83	27k
R36	6-11009C73	10k
R37	6-11009C71	8.2k
R38	6-11009C75	12k
R39	6-11009C65	4.7k
R40	6-11009C95	82k
R41	6-11009C87	39k
R42	6-11009C79	18k
R43	6-11009C71	8.2k
R44	6-11009C73	10k
R45	6-11009C37	330
R46	6-11009C89	47k
R47,48	6-11009C73	10k
R49	6-11009C89	47k
R50	6-11009C49	1k
R51	6-11009C63	3.9k
R52,53	6-11009C81	22k
R54	6-11009C89	47k
R55	6-11009C53	1.5k
R56	6-11009C73	10k
R57	6-11009C53	1.5k
R58	6-11009C73	10k
R59	6-11009C67	5.6k
R60	6-11009C63	3.9k
R61	6-11009C53	1.5k
R62	6-11009C73	10k
R63	6-11009C65	4.7k
R64	6-11009C91	56k
R65	6-11009D22	1 m
R66	18-83083G02	variable; 500k ±30%
R67	6-11009D22	1 m
R68	6-11009C25	100
R69	6-11009D06	220k
R70	6-11009D18	680k
R71	6-11009C83	27k
R72	6-11009C47	820
R73	6-11009C49	1k
R74	6-11009C45	680
R75, 76	6-11009C48	47k
		mechanical parts
	3-84256M01	SCREW, tapping; 2 used
	43-82721C01	BUSHING, snap; 2 used
	64-83926G02	PANEL, screened
	5-84220B01	GROMMET; 2 used
	39-10184A10	CONTACT, plug; 9 used
	29-10184A24	CONTACT, receptacle; 3 used
	9-83497F01	RECEPTACLE, 8 contacts; 3 used (PCB Edge Connector)

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

Spectra-TAC SQUELCH GATE MODULE

MODEL TRN5331A



NOTES:

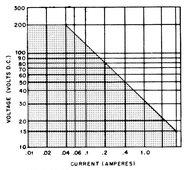
1. Unless otherwise stated: resistor values are in ohms (k = 1000). Capacitor values are in microfarads.
2. Relay kit is an optional accessory item. Refer to relay application chart for CR15, JU8 and JU9 usage with relay.
3. Refer to jumper table.
4. Voltage readings shown are for two conditions:
   USQ = Unsquelched
   FSQ = Fully squelched
5. Jumpers JU5 and JU6 are used in DC controlled PL repeater stations when such stations contain an unsuffixed DC transfer module.

Jumper Table

Application	JU1	JU2	JU3	JU4	JU5	JU6	JU7	JU8	JU9	JU10	JU11	JU12	JU13	JU14	JU15
Line Control Base	OUT	OUT	IN	OUT	OUT	OUT	IN	IN	IN	OUT	OUT	OUT	Selected Delay	IN	OUT
Repeater (RT) Station Without Wire Line Control	OUT	OUT	IN	IN PL	IN	IN	IN	IN	IN	IN	IN	IN	Selected Delay	IN CS	IN PL
Repeater (RT) Station With Wire Line Control	OUT	OUT	IN	IN PL	OT	OUT	IN	IN	IN	IN	OUT	IN	Selected Delay	IN CS	IN PL
Base (RA) Station	IN	OUT	IN	IN PL	NOTE 5	NOTE 5	IN	*	*	OUT	OUT	OUT	Selected Delay	IN CS	IN PL
Repeater (RA) Station	OUT	OUT	IN	IN PL	NOTE 5	NOTE 5	OUT	*	*	OUT	OUT	OUT	Selected Delay	IN CS	IN PL

***Relay Application Chart**

TLN4151A Relay Kit	Diode CR15	JU8	JU9	R59
Not Used	OUT	IN	IN	OUT
Used	IN	OUT	OUT	IN



LEGEND:

START - CIRCUIT THEORY MOST EASILY UNDERSTOOD BY BEGINNING AT THIS POINT AND FOLLOWING SIGNAL FLOW.

- THEORY OF OPERATION DATA
- MAINTENANCE DATA
- PRIMARY SIGNAL FLOW
- SECONDARY SIGNAL FLOW

FUNCTION

Measure received noise levels and controls transmitter keying.

Schematic Diagram
Motorola No. **68P81062E43-C**
(Sheet 2 of 2)
11/1/85- UP

MSR 2000
BASE AND REPEATER STATIONS
MULTIPLE TONE PL OPTIONS

1. MULTIPLE TONE PL OPTION COMPLEMENT CHART

Factory Option No.				Module Used	
C158AB/AE	C261AC/AH	C262AE	C263AB		
4-PL Transmit	4-PL Receive	4-PL Repeat	4-PL Transmit & Receive	Model	Description
X			X	TRN5330A	Matrix Control Module
X		X	X	TRN5292A	Encoder Module
	X	X	X	TRN5329A	Decoder Module

2. TECHNICAL CHARACTERISTICS

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

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	1k ohm
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 rms reed drive
Output	13.0 volts dc switched
Power Requirements	13.8 volts dc @ 20 mA

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68P81112E80-A
11/1/85-UP

3. DESCRIPTION

3.1 PURPOSE AND APPLICATION

These factory installed multiple PL options are available for one- or two-frequency remotely controlled fully optionable *MSR 2000* 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.

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 include modules which are inserted into the RF-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.

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

3.2 MULTI-PL DECODER

The multi-PL decoder module contains four parallel 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 RF-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 MULTI-PL MATRIX CONTROL MODULE

The multi-PL matrix control module permits remote control selection of the PL tone to be transmitted. The module detects four function tones (refer to Table 1) 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 RF-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.

Table 1. Function vs. PL Tone

Function Tone	PL Tone Selected
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 to be 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 RF-Control Chassis.

3.5 C158AB 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 multi-PL matrix control module which, in turn, selects the PL tone generated by the multi-PL encoder module.

3.6 C261AC 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.

3.7 C262AE OPTION (4-PL REPEAT)

This option gives multiple PL capability to a non wireline 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.

3.8 C263AB 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

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.

When one of the four PL select switches on the remote 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 multi-PL matrix control module. At this time, a PL encoder is selected and will remain selected until a new PL encoder isselected. 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.

When the transmitter is subsequently keyed by activating the remote 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

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.

When one of the four PL select switches on the remote console is activated, the frequency of the PL select function tone is determined, but not generated, as with independent command selection. The difference is, however, that when one of the PL select switches is activated in the transmit command mode, the PL select 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, the 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 unkeying 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 multi-PL matrix control module jumpers must be changed to convert to transmit command — station control.

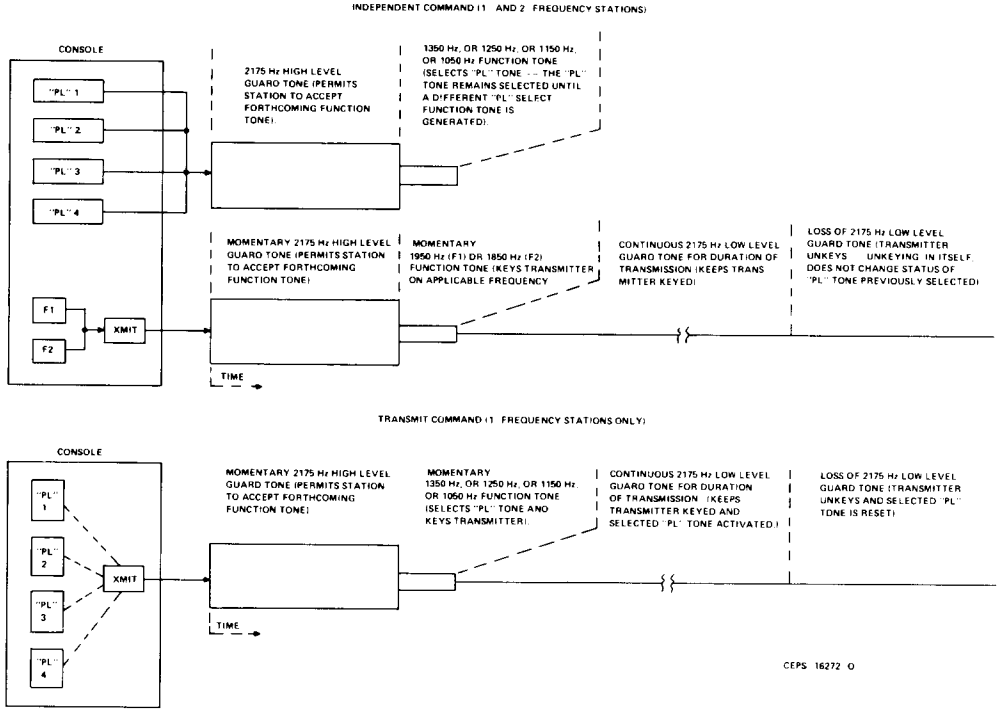

Figure 1. Independent vs. Transmit Command Timing Diagram

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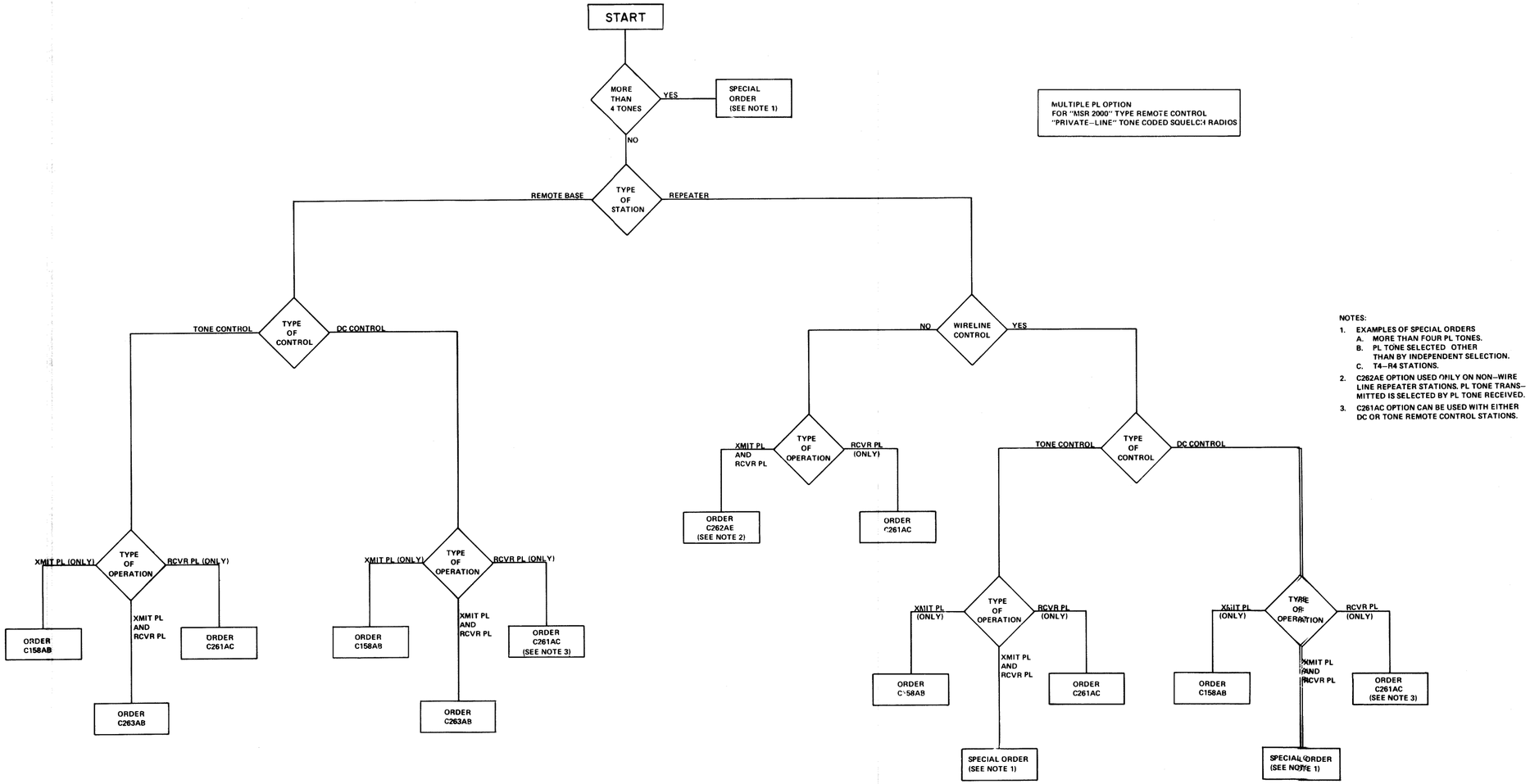


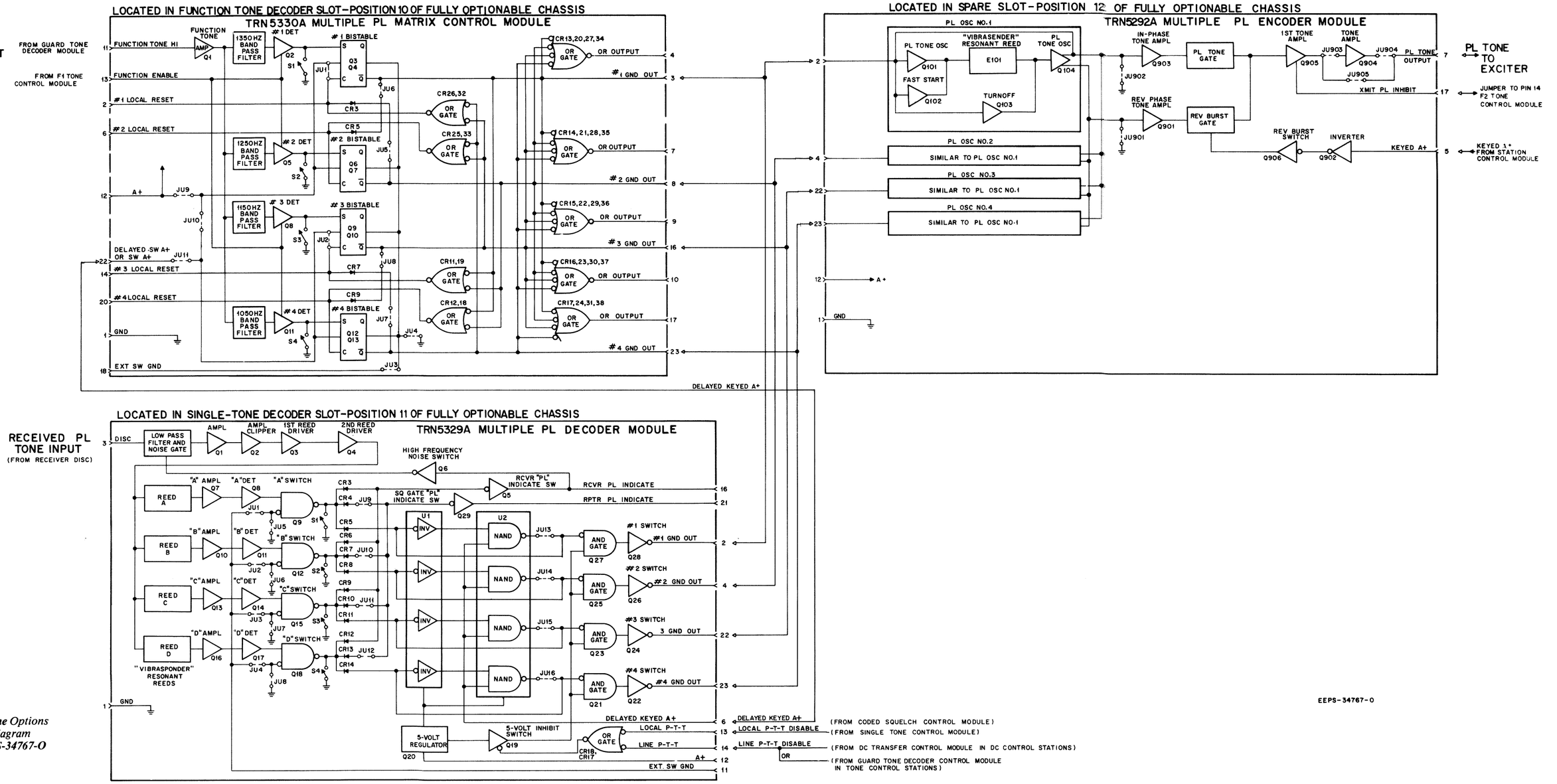
MULTIPLE PL OPTION
FOR "MSR 2000" TYPE REMOTE CONTROL
"PRIVATE-LINE" TONE CODED SQUELCH RADIOS

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. C262AE OPTION USED ONLY ON NON-WIRE LINE REPEATER STATIONS. PL TONE TRANSMITTED IS SELECTED BY PL TONE RECEIVED.
3. C261AC OPTION CAN BE USED WITH EITHER DC OR TONE REMOTE CONTROL STATIONS.

DEPS-34766-A

Applications Chart
*Motorola No. **DEPS-34766-A***
11/1/85- UP



*Multiple **Private-Line** Options*
Functional Block Diagram
Motorola No. EEPS-34767-O
6/30/82- UP

MOTOROLA INC.
Communications
Sector

MULTIPLEX PL MATRIX CONTROL MODULE
MODEL TRN5330A

1. FUNCTIONS

The multi-PL 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.

The 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

The multi-PL matrix control module is fully transistorized and occupies the "Wild Card" position in the RF-Control Chassis. All components and circuitry are mounted on a sturdy card with connecting pins to mate with the backplane interconnect board of the RF-Control Chassis.

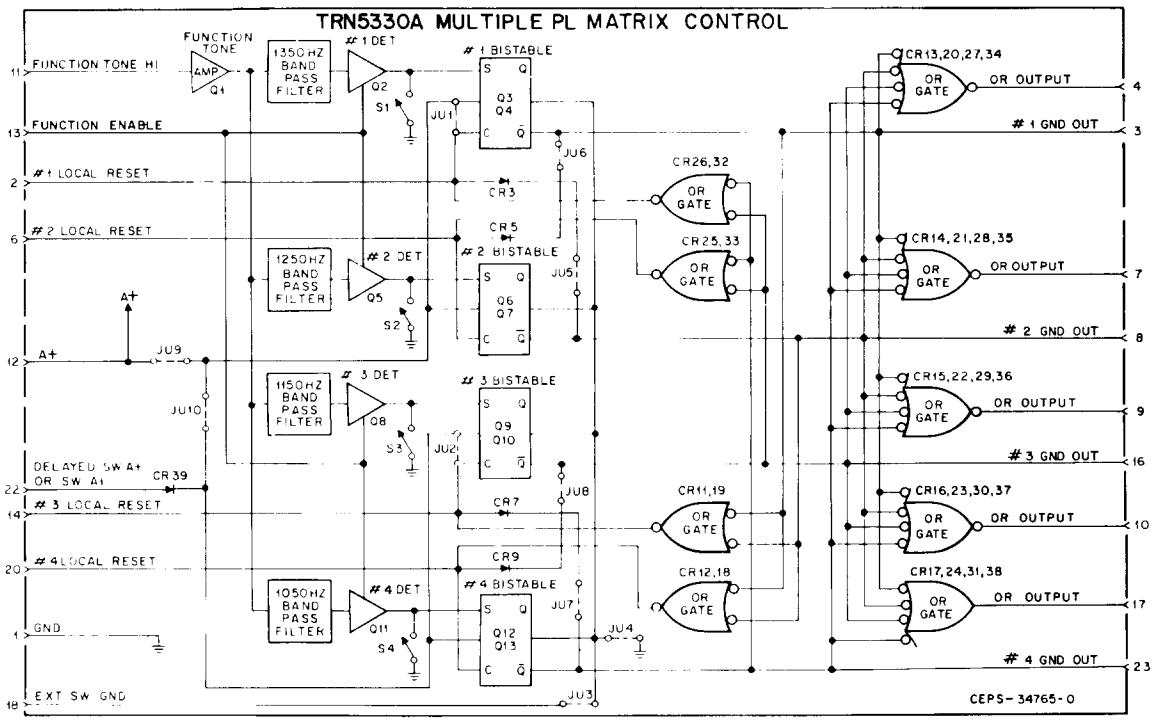


Figure 1. Functional Diagram

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3. CIRCUIT DESCRIPTION

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 Module Pin (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 mA dc.

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

For example, a 1350 Hz function tone passes through tuned circuit L1-C4 into tone detector stage Q2. When a 1350 Hz function tone is detected, Q2 causes the function #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 #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.

Diodes involved with OR operation are CR13 through CR20 through CR24, CR27 through CR31, and CR34 through CR38. When any of the four bistable multivibrators is actuated, its switched ground output is simultaneously applied to output pins 4, 7, 9, 10 and 17. 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 option's position in the RF-Control Chassis should be modified with jumpers and plating cuts as required.

Components involved with reset operation are indicated in Table 2. The use of these diodes and jumpers, with regard to reset operation, is described in the following paragraphs.

Table 2. Reset Components Identification

Diode (CR)	Jumper (JU)
3, 5, 7, 9, 11, 12, 18, 19, 25, 26, 32, 33	1, 2, 5 thru 11

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)

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 switched A+ is removed, the bistables operating with the voltage (depending on jumper configuration) are reset.

AND reset operation specifically requires jumper and diode changes as indicated in Table 4 (these are changes required to a previously unmodified *standard* 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 Involved (Hz)	Module 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 the backplane interconnect board at the option decoder position (provides sw A+).
1050	23				
1350	3	5 thru 9	All 4		
1250	8				

6. MATRIX MODULE RESET OPERATION

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 steady A+.

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 *standard module*).

Table 5.
Matrix Module Reset Component Configuration

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

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.

Table 6. Unique Jumper Applications

Jumper (JU)	Description
1	Pull up jumper — causes bistable #1 to actuate when A+ is applied while no reset function is applied.
2	Same as JU1 except functional with #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.

8. MAINTENANCE AND TROUBLESHOOTING

8.1 TECHNIQUES OF ISOLATION

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 control point, the malfunction can be isolated to circuitry either before or after a bistable multivibrator using an applicable test switch.

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 tone amplifier), (2) someplace else in the station (RF-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 In-Circuit Module Servicing

The Model TLN5935A Service Board Kit can be used to extend a control or audio module out of the front of the RF-Control Chassis. This provides access for service and maintenance without interrupting the power and signal connections.

If the service board kit is not available, the module can be plugged on to the back of the backplane interconnect board. (Tilt the RF-Control Chassis forward to obtain access to the rear of the backplane interconnect board.)

CAUTION

Care must be taken to insert the module on to the correct connector by using the legend on the backplane. Match pin 1 of the module connector with pin 1 of the proper backplane connector. An outline of the front panel's position, with respect to the backplane connector is given as part of the backplane legend to assist proper insertion.

8.2.2 Out-Of-Circuit Servicing

The matrix control module may be serviced out of the RF-Control Chassis by connecting it to a signal genera-

Table 7. Out-Of-Circuit Connections

Module Pin Number	Connection
1, 13	Ground
11	Audio Oscillator
12	A+ (13.6 V dc)

tor and power source. The proper connections for the signal generator and power source are listed in Table 7.

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.

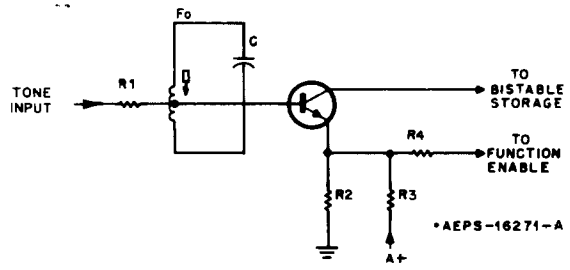


Figure 2. Typical Function Tone Detector

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 8.

Example:
Changing function decoder frequency to 1850 Hz:

Freq.	R1	R2	R3	R4	C
1850 Hz	22k ±5%	1.5k ±5%	2.7k ±5%	221 ±1%	.0069 uF ±2%

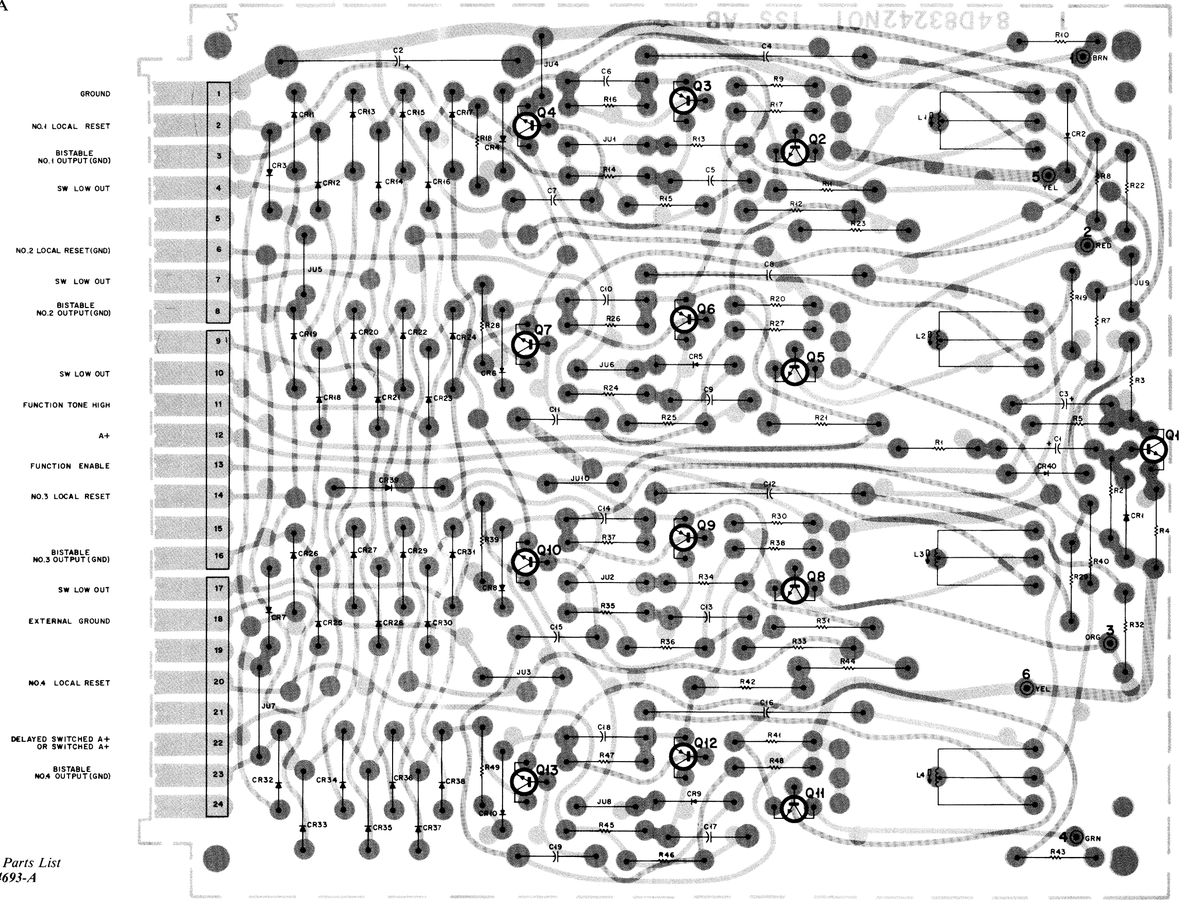
Table 8. Special Modifications

To Change Function Tone Tank Freq. To	R1 ±5% (In Ohms)	R2 ±5% (In Ohms)	R3 ±1% (In Ohms)	R4 ±1% (In Ohms)	C ±2% (In uF)	Capacitor Part No.
2050 Hz	33k	1.5k	2.7k*	221	.0056	8-84326A13
1950 Hz	27k	1k	2.2k*	221	.0062	8-84326A14
1850 Hz	22k	1.5k	2.7k*	221	.0069	8-84326A15
1750 Hz	22k	1k	2.43k	221	.0077	8-84326A16
1650 Hz	18k	1k	2.21k	221	.00865	8-84326A17
1550 Hz	15k	1k	2.21k	221	.0098	8-84326A18
1450 Hz	12k	1k	2.21k	221	.0012	8-84326A19
1350 Hz	10k	1k	2.21k	221	.0129	8-84326A20
1250 Hz	9.1k	1k	2.43k	221	.015	8-84326A21
1150 Hz	8.2k	1k	2.43k	221	.0178	8-84326A22
1050 Hz	6.8k	1k	2.43k	221	.0213	8-84326A23

* ±5% is allowable.

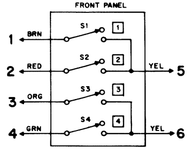
MULTIPLE PL MATRIX CONTROL MODULE

MODEL TRN5330A



SHOWN FROM SOLDER SIDE

SOLDER SIDE — BD-DEPS-34689-O
COMPONENT SIDE — BD-DEPS-34690-O
OL-DEPS-34691-O



Circuit Board Detail & Parts List
*Motorola No. **PEPS-34693-A***
(Sheet 1 of 2)
11/1/85- UP

parts list

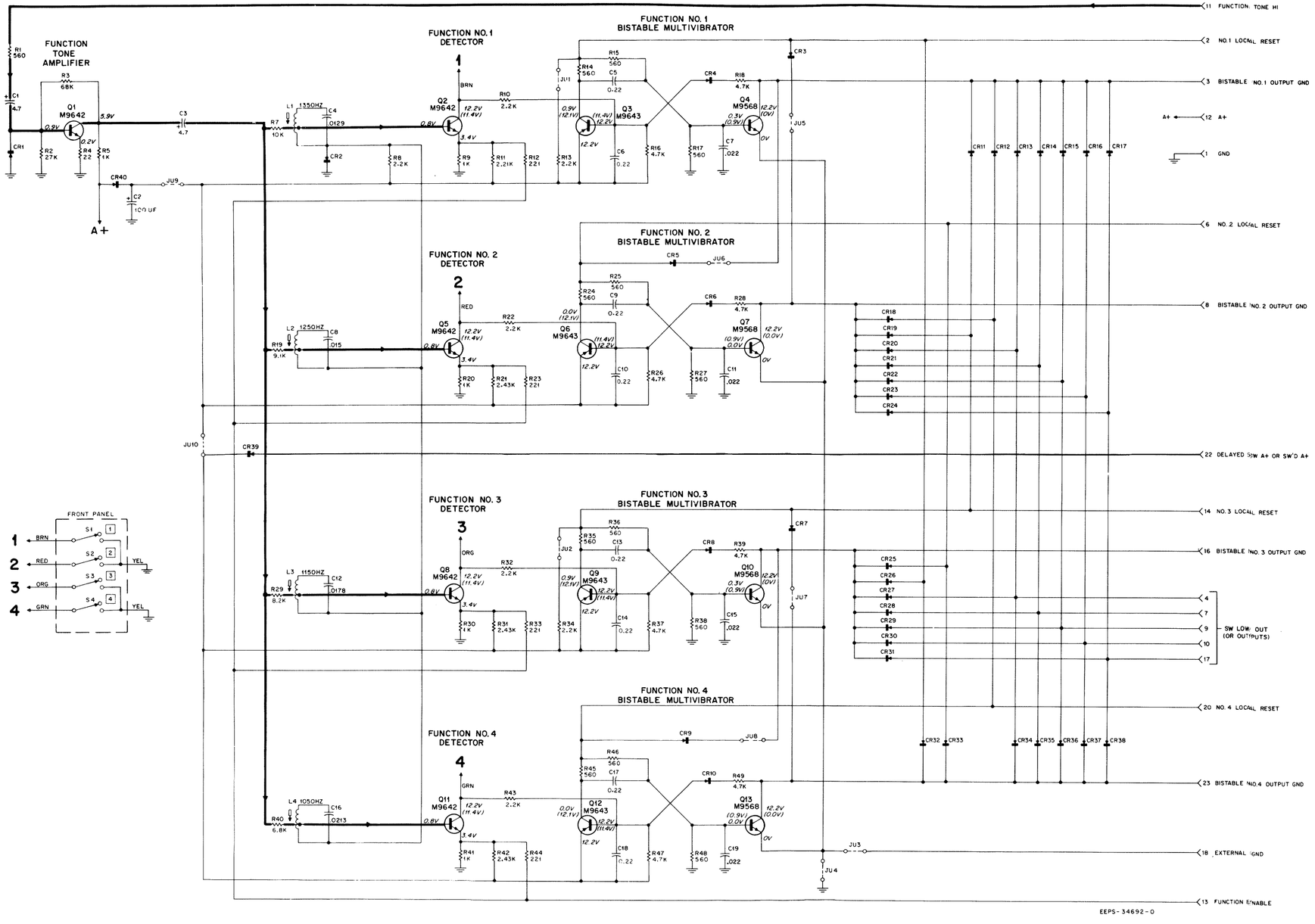
TRN5330A Matrix Control Module — PL-7958-A

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	0.22
C7	8-82905G02	.022
C8	8-84326A21	.015 ±2%
C9	8-82906G11	0.22
C10	8-82905G11	0.22
C11	8-82905G02	.022
C12	8-84326A22	.0178 ±2%
C13	8-82905G11	0.22
C14	8-82905G11	0.22
C15	8-82905G02	.022
C16	8-84326A23	.0213 ±2%
C17	8-82905G11	0.22
C18	8-82905G11	0.22
C19	8-82905G02	.022
		semiconductor 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	NPN; M9642
Q2	48-869642	NPN; M9642
Q3	48-869643	PNP; M9643
Q4	48-869568	NPN; M9568
Q5	48-869642	NPN; M9642
Q6	48-869643	PNP; M9643
Q7	48-869568	NPN; M9568
Q8	48-869642	NPN; M9642
Q9	48-869643	PNP; M9643
Q10	48-869568	NPN; M9568
Q11	48-869642	NPN; M9642
Q12	48-869643	PNP; M9643
Q13	48-869568	NPN; M9568
		resistor, fixed: ±5%; 1/4 W: unless otherwise stated
R1	6-11009C43	560
R2	6-11009C83	27k
R3	6-11009C93	68k
R4	6-11009C09	22
R5	6-11009C49	1k
R6	—	NOT USED
R7	6-11009C73	10k
R8	6-11009C57	2.2k
R9	6-11009C49	1k
R10	6-11009C57	2.2k
R11	6-84444A08	2.21k ±5%
R12	6-84444A07	221k ±1%
R13	6-11009C57	2.2k
R14	6-11009C43	560
R15	6-11009C43	560
R16	6-11009C65	4.7k
R17	6-11009C43	560
R18	6-11009C65	4.7k
R19	6-11009C72	9.1k
R20	6-11009C49	1k
R21	6-84444A09	2.43k ±1%
R22	6-11009C57	2.2k
R23	6-84444A07	221 ±1%
R24	6-11009C43	560
R25	6-11009C43	560
R26	6-11009C65	4.7k
R27	6-11009C43	560
R28	6-11009C65	4.7k
R29	6-11009C71	8.2k
R30	6-11009C48	1k
R31	6-84444A09	2.43 ±1%
R32	6-11009C57	2.2k
R33	6-6-84444A07	221 ±1%
R34	6-11009C57	2.2k
R35	6-11009C43	560
R36	6-11009C43	560
R37	6-11009C65	4.7k
R38	6-11009C43	560
R39	6-11009C65	4.7k
R40	6-11009C69	6.8k
R41	6-11009C49	1k
R42	6-84444A09	2.43k ±1%
R43	6-11009C57	2.2k
R44	6-84444A07	221 ±1%
R45	6-11009C43	560
R46	6-11009C43	560
R47	6-11009C65	4.7k
R48	6-11009C43	560
R49	6-11009C65	4.7k

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		switch, slide:
S1 thru 4	40-83468E01	spdt
		mechanical parts
	1-80757D87	PANEL ASSEMBLY: includes ref. items S1 thru S4, and;
	64-83135L02	PANEL, screened
	46-84703E01	GUIDE, circuit board
	5-84220B01	GROMMET, 2 used
	9-83497F01	RECEPTACLE, 8 contact; 3 used (PCB Edge Connector)

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

MULTIPLE PL MATRIX CONTROL MODULE
MODEL TRN5330A



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.

Schematic Diagram
*Motorola No. **PEPS-34693-A***
(Sheet 2 of 2)
11/1/85- UP

MULTIPLE PL ENCODER MODULE

MODEL TRN5292A

1. FUNCTIONS

The multi-PL encoder module generates four different PL tones which are routed to the station transmitter. This module is installed with a modified tone PL encoder-decoder module, that provides the transmitter turn-off delay of 180 milliseconds when the transmitter is unkeyed, via the removal of Delayed Keyed A+.

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 180 milliseconds before 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 modifications to the tone PL encoder-decoder module are given in Table 1.

Table 1.
Tone PL Encoder-Decoder Module Modifications

Factory Option No.	Tone PL Module	Components Removed
C158AB/AE	TRN5074A	C51 and 52
C261AC/AH	TRN5074A	R19
C262AE	TRN5073A	C51, C52, R19, Z1, and Z2
C263AB	TRN5074A	C51, C52, R19, and Z1

2. DESCRIPTION

The multi-PL encoder components and circuitry are mounted on a sturdy card with connecting pins to mate with the backplane interconnect board of the RF- Con-

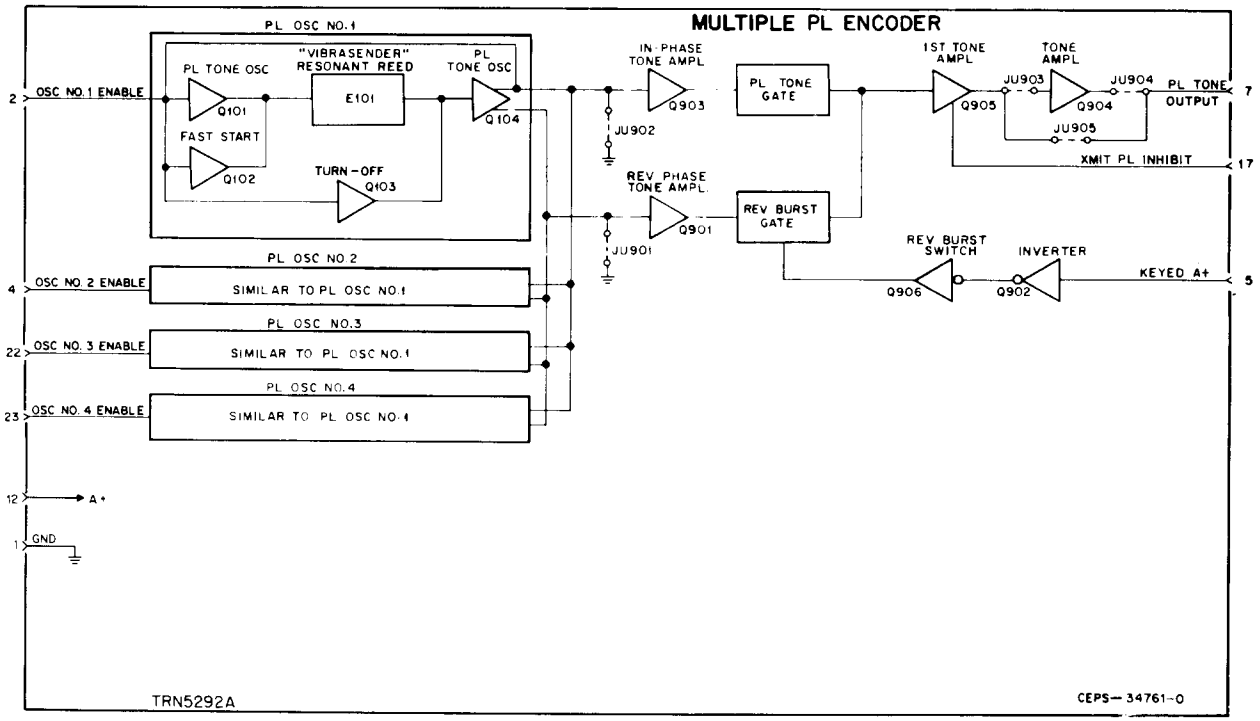


Figure 1. Functional Diagram

trol Chassis. The multiple PL encoder module occupies the SPARE position of the RF-Control Chassis.

3. CIRCUIT DESCRIPTION

3.1 MULTIPLE PL ENCODER MODULE

Operation of all four PL tone oscillators is identical. Therefore, the following theory describes only the circuit operation of PL tone oscillator #1, and is applicable to the other three.

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.

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).

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).

The purpose of the Q102 pulse circuit is to "faststart" 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. 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."

4. MAINTENANCE

4.1 RECOMMENDED TEST EQUIPMENT

- Motorola SLN6221A *Private-Line* Tone Generator — used for testing Vibrasender resonant reeds.
- Motorola solid state ac voltmeter — used for tone level measurements.
- General purpose oscilloscope — valuable for signal tracing and locating sources of distortion.
- Motorola solid state dc multimeter — used for dc voltage measuremment.
- 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.

- Check A+ input to encoder.
- Check ac signal voltage at collector of Q903.
- If signal is present, check Q904.
- 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.
- If the tone generator does not produce an output signal the reed is defective.
- 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 reverse burst is not being transmitted, check the delayed keyed A+ circuitry on the PL module.

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

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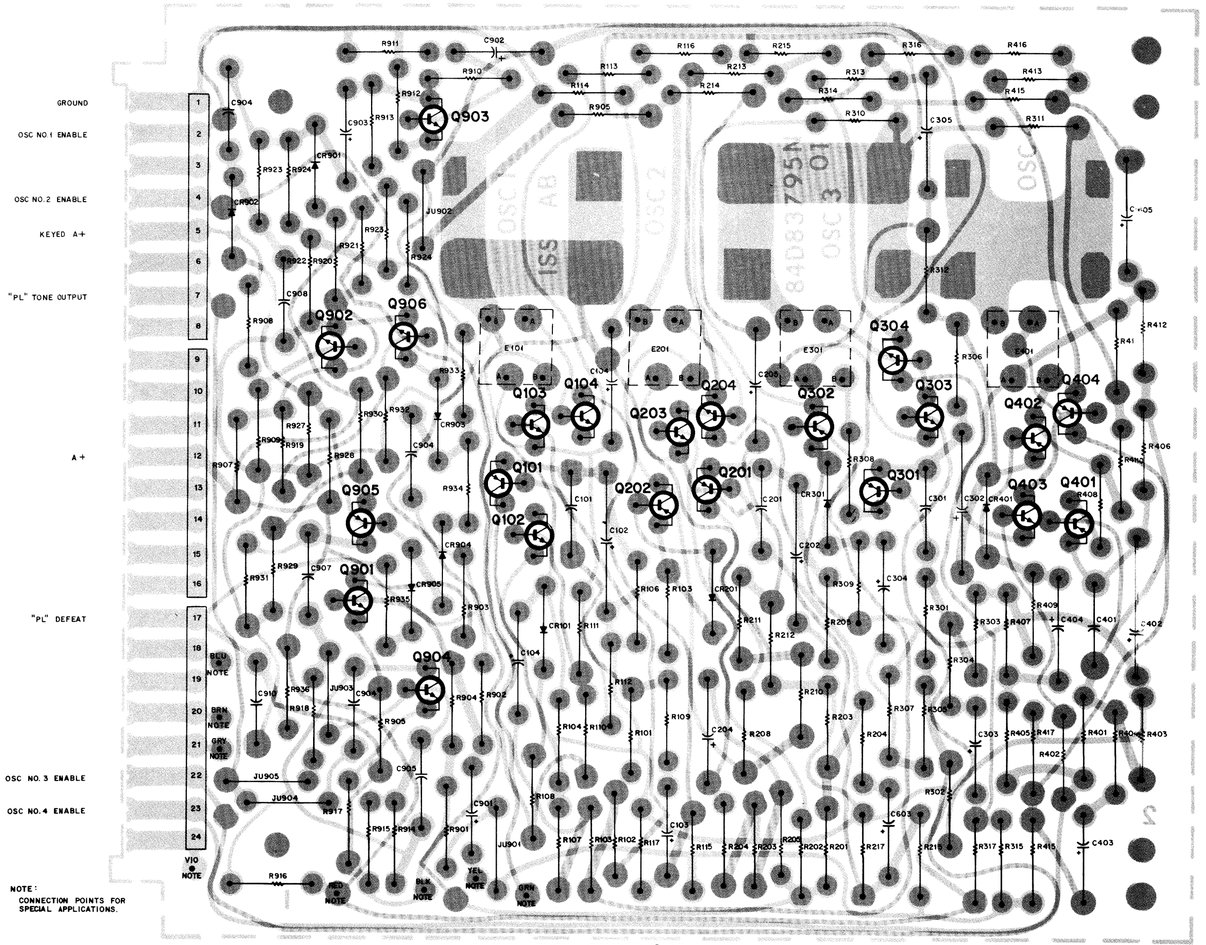
MULTIPLE PL ENCODER MODULE
MODEL TRN5292A



NOTE:
CONNECTION POINTS FOR SPECIAL APPLICATIONS.

SHOWN FROM SOLDER SIDE

COMPONENT SIDE ● BD-DEPS-34495-O
SOLDER SIDE ○ BD-DEPS-34494-O
OL-DEPS-34496-O

E B C
TRANSISTOR DETAIL

Circuit Board Detail & Parts List
*Motorola No. **PEPS-34698-A***
(Sheet 1 of 2)
11/1/85- UP

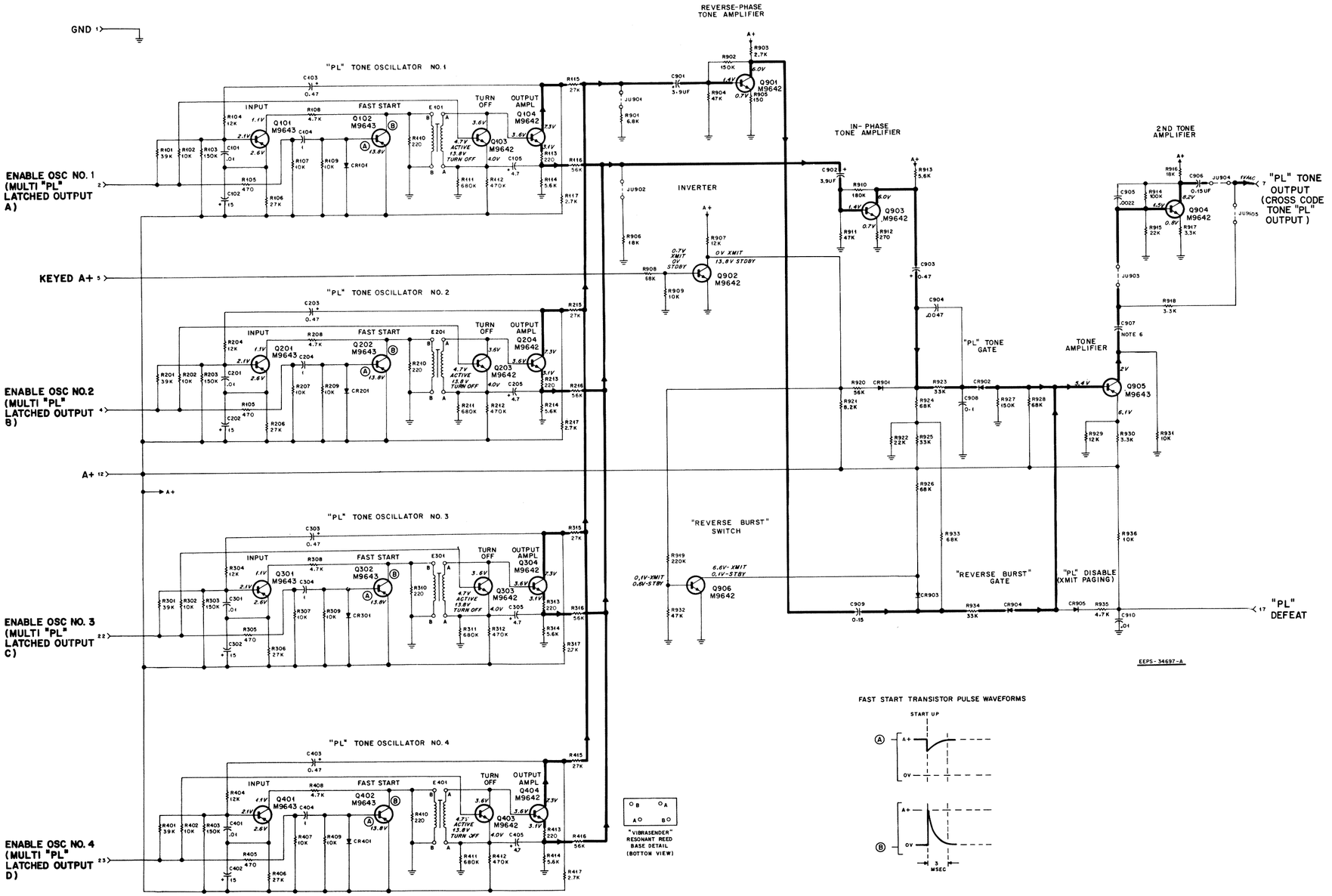
parts list

TRN5292A Multi-PL Encoder Module — PL-7966-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		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	0.47 ±20%
C904	8-82905G26	.0047; 100 V
C905	8-84496D06	.0022; 100 V
C906	8-82905G05	0.15
C907	8-82905G04	.068
C908	8-82905G07	0.1
C909	8-82905G05	0.15
C910	8-82905G01	.01
		semiconductor device, diode: (see note)
CR01, 201 301, 401, 901 thru 905	48-83654H01	silicon
		transistor:
Q101,102	48-869643	PNP; type M9643
Q103,104	48-869642	NPN; type M9642
Q201,202	48-869643	PNP; type M9643
Q203,204	48-869642	NPN; type M9642
Q301,302	48-869643	PNP; type M9643
Q303,304	48-869642	NPN; type M9642
Q401,402	48-869643	PNP; type M9643
Q403,404	48-869642	NPN; type M9642
Q901 thru 904	48-869642	NPN; type M9642
Q905	48-869643	PNP; type M9643
Q906	48-869642	NPN; type M9642
		resistor, fixed ±5%; 1/4 W: unless otherwise stated
R101	6-11009C87	39k
R102	6-11009C73	10k
R103	6-11009D02	150k
R104	6-11009C75	12k
R105	6-11009C41	470
R106	6-11009C83	27k
R107	6-11009C73	10k
R108	6-11009C65	4.7k
R109	6-11009C73	10k
R110	6-11009C33	220
R111	6-11009D18	680k
R112	6-11009D14	470k
R113	6-11009C33	220
R114	6-11009C67	5.6k
R115	6-11009C83	27k
R116	6-11009C91	56k
R117	6-11009C59	2.7k
R201	6-11009C87	39k
R202	6-11009C73	10k
R203	6-11009D02	150k
R204	6-11009C75	12k
R205	6-11009C41	470
R206	6-11009C83	27k
R207	6-11009C73	10k
R208	6-11009C65	4.7k
R209	6-11009C73	10k
R210	6-11009C33	220
R211	6-11009D18	680k
R212	6-11009D14	470k
R213	6-11009C33	220
R214	6-11009C67	5.6k
R215	6-11009C83	27k
R216	6-11009C91	56k
R217	6-11009C59	2.7k
R301	6-11009C87	39k
R302	6-11009C73	10k
R303	6-11009D02	150k
R304	6-11009C75	12k
R305	6-11009C41	470
R306	6-11009C83	27k
R307	6-11009C73	10k
R308	6-11009C65	4.7k
R309	6-11009C73	10k
R310	6-11009C33	220
R311	6-11009D18	680k
R312	6-11009D14	470k
R313	6-11009C33	220
R314	6-11009C67	5.6k
R315	6-11009C83	27k
R316	6-11009C91	56k
R317	6-11009C59	2.7k
R401	6-11009C87	39k
R402	6-11009C73	10k
R403	6-11009D02	150k
R404	6-11009C75	12k
R405	6-11009C41	470
R406	6-11009C83	27k
R407	6-11009C73	10k
R408	6-11009C65	4.7k
R409	6-11009C73	10k
R410	6-11009C33	220
R411	6-11009D18	680k
R412	6-11009D14	470k
R413	6-11009C33	220
R414	6-11009C67	5.6k
R415	6-11009C83	27k
R416	6-11009C91	56k
R417	6-11009C59	2.7k
R901	6-11009C69	6.8k
R902	6-11009D02	150k
R903	6-11009C59	2.7k
R904	6-11009C89	47k
R905	6-11009C29	150
R906	6-11009C79	18k
R907	6-11009C75	12k
R908	6-11009C93	68k
R909	6-11009C73	10k
R910	6-11009D04	180k
R911	6-11009C89	47k
R912	6-11009C35	270
R913	6-11009C67	5.6k
R914	6-11009C97	100k
R915	6-11009C81	22k
R916	6-11009C79	18k
R917	6-11009C61	3.3k
R918	6-11009C61	3.3k
R919	6-11009D06	220k
R920	6-11009C93	56k
R921	6-11009C71	8.2k
R922	6-11009C81	22k
R923	6-11009C85	33k
R924	6-11009C93	68k
R925	6-11009C85	33k
R926	6-11009C93	68k
R927	6-11009D02	150k
R928	6-11009C93	68k
R929	6-11009C75	12k
R930	6-11009C61	3.3k
R931	6-11009C73	10k
R932	6-11009C89	47k
R933	6-11009C93	68k
R934	6-11009C85	33k
R935	6-11009C65	4.7k
R936	6-11009C73	10k
		mechanical parts
	3-84256M01	SCREW, tapping; 2 used
	5-84220B01	GROMMET, 2 used
	64-83137L03	PANEL, screened
	9-83497F01	RECEPTACLE, 8 contact; 3 used (PCB Edge Connector)
	9-84910C01	SOCKET, reed; 4 used

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

MULTIPLE PL ENCODER MODULE
MODEL TRN5292A



FAST START TRANSISTOR PULSE WAVEFORMS

NOTES:

1. Unless otherwise stated, capacitor values are in microfarads. Resistor values are in ohms (k = 1000).
2. Unless othewise stated, voltages represent the active state and are taken with respect to chasis ground.
3. All AC voltage measurements are RMS value.
4. All DC voltage measurements may be taken with 20,000 ohms-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 and JU904; OUT for direct FM; IN otherwise.

Schematic Diagram
*Motorola No. **PEPS-34698-B***
(Sheet 2 of 2)
11/1/85- UP

MOTOROLA INC.
Communications Sector

MULTIPLE PL DECODER MODULE
MODEL TRN5329A

1. FUNCTIONS

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:

- (with base stations) unsquelch the receiver, or

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

This module is installed with a modified tone PL encoder-decoder module, that provides this module with Delayed Keyed A+. The modifications to the tone PL encoder-decoder module are as given in Table 1.

Table 1.
Tone PL Encoder-Decoder Module Modifications

Factory Option No.	Tone PL Module	Components Removed
C158AB/AE	TRN5074A	C51 and 52
C261AC/AH	TRN5074A	R19
C262AE	TRN5073A	C51, C52, R19, Z1, and Z2
C263AB	TRN5074A	C51, C52, R19, and Z1

2. DESCRIPTION

This module is fully transistorized and occupies the single-tone decoder module position in the RF-Control Chassis. All components and circuitry are mounted on a sturdy card with interconnecting pins to mate with the backplane interconnect board of the RF-Control Chassis.

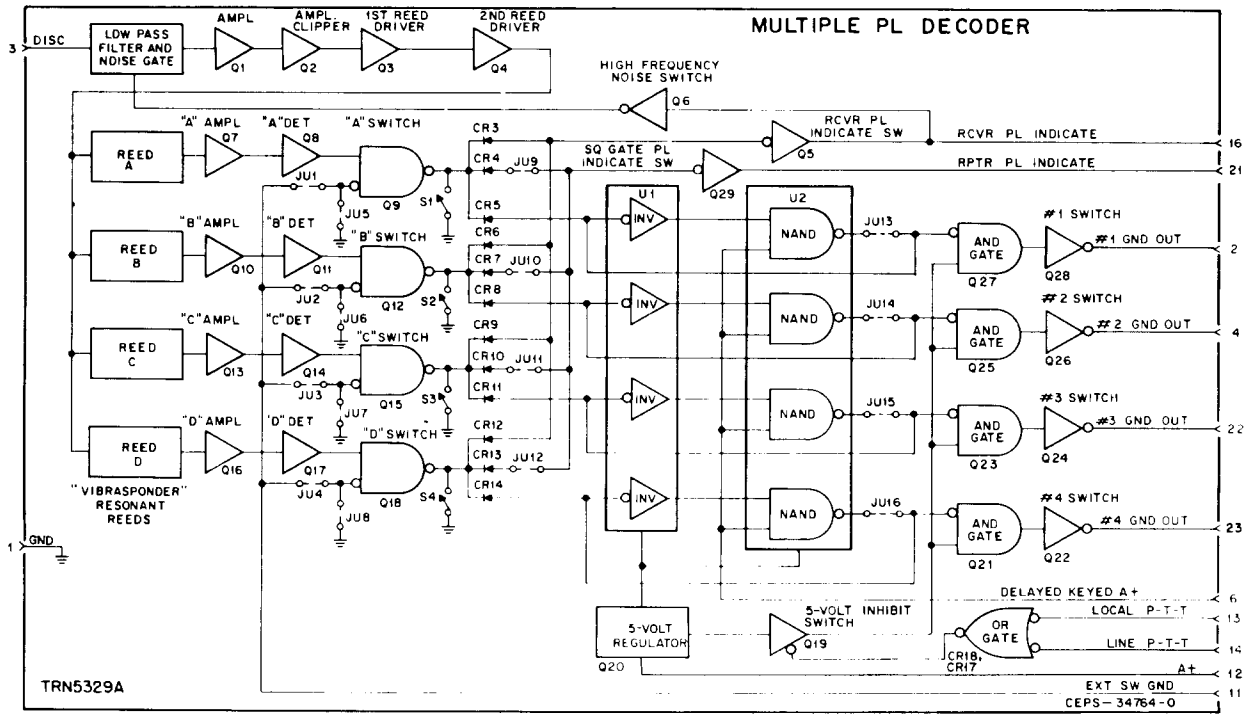


Figure 1. Functional Diagram

3. CIRCUIT DESCRIPTIONS

3.1 INTRODUCTION

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

When PL tones are present on the input signal to the decoder, the PL filter will pass the 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 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:

- 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

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

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

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. Whhen 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.

High pass filter C1, R1 and R7, provides a shunt for high frequnecy 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

The noise and PPL tones are ampified 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 resonant reeds to noise. Drivers Q3 and Q4 operate as emitter followers to provide current drive to the low impedance Vibrasponder resonant reed assembly.

3.6 VIBRASPONDER RESONANT REEDS

The Vibrasponder resonant reeds are the frequency detecting devices of the decoder. When the input tone from the Vibrasponder resonant reed 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 seconary 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 82.5 to 210 Hz range are used.

3.7 TONE DETECTORS

The following description applies to the signal flow through Vibrasponder resonant reed "A" and associated

circuits. Vibrasponder resonant reed circuits "B," "C," and "D" operate in an identical manner.

When a PL tone is detected by a Vibrasonder 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.

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

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.

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 180 milliseconds. The voltage delay 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

- Motorola S1318A, S1319A, S1320A, or S1321A RF Signal Generator. This solid-state unit provides receiver rf carrier signals.

- 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.

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

- 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 resonant 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 deviation.

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 340 millivolts rms of PL tone at 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. Approximatley 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,

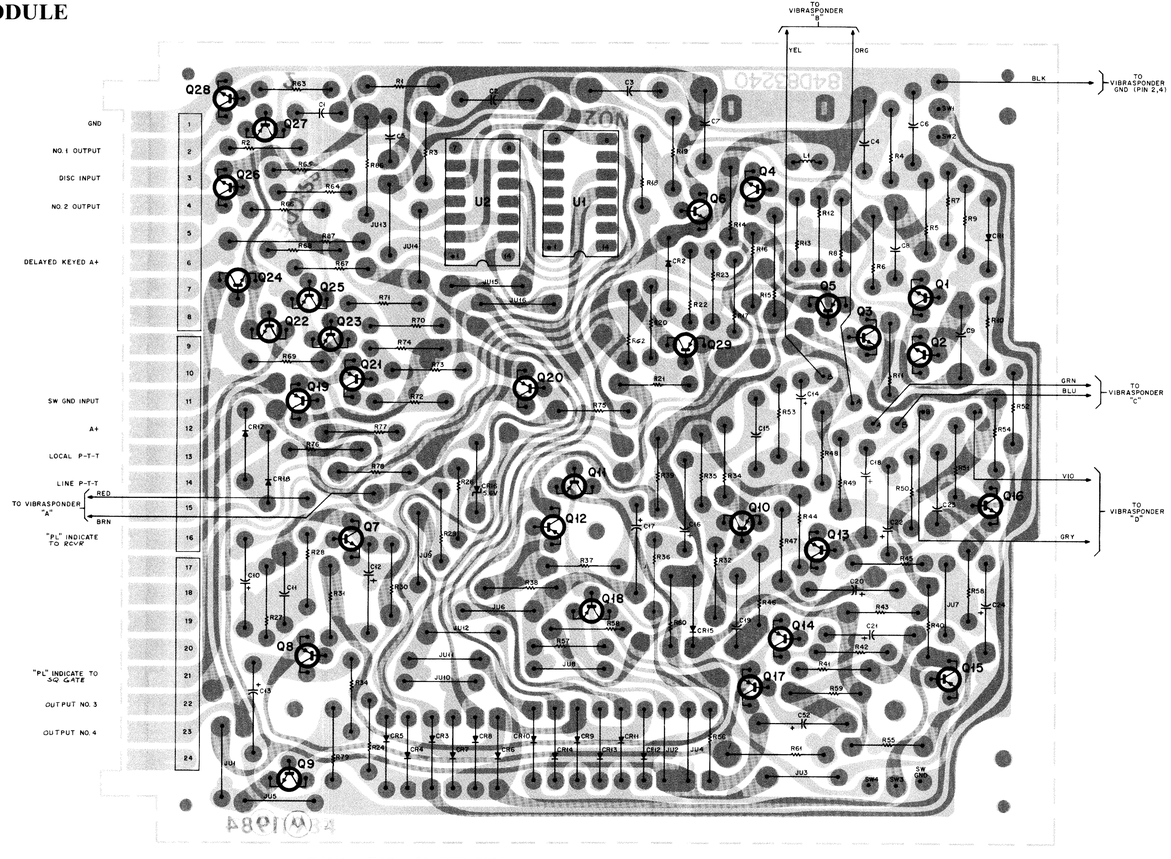
noise and PL tone will both be present and will produce erroneous readings.

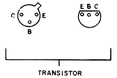
Step 2. With 60 millivolts PL tone input, measure signal and dc voltages at various points in the decoder to isolate the trouble. Typical values for a normally operating decoder are given on the schematic diagram. Some waveforms are not sinusoidal and should be measured with an oscilloscope. Most ac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

MULTIPLE PL DECODER MODULE

MODEL TRN5329A





SOLDER SIDE BD-DEPS-41763-O
COMPONENT SIDE BD-DEPS-41764-O
OL-DEPS-41762-O

Circuit Board Detail & Parts List
Motorola No. PEPS-34703-A
(Sheet 1 of 2)
11/1/85-UP

parts list

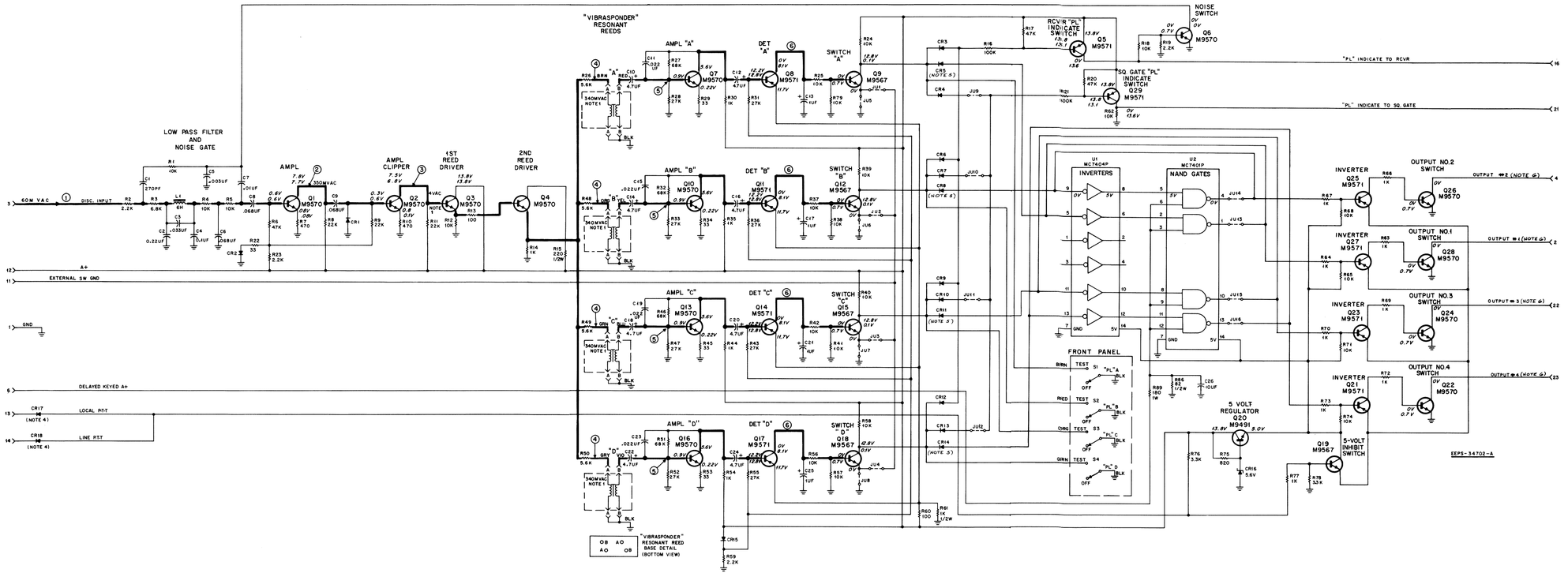
TRN5329A Multi-PL Decoder Module PL-7968-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ± 10%; 50 V: unless otherwise stated
C1	21-859178	270 pF ± 5%; 300 V
C2	8-82905G32	0.22
C3	8-82905G08	.033
C4	8-82905G30	0.1
C5	21-82187B26	.003; 100 V
C6	8-82905G04	.068
C7	8-82905G01	.01
C8,9	8-82427B01	.068
C10	23-865137	4.7 ± 20%; 25 V
C11	8-82905G02	.022
C12	23-865137	2.7 ± 20%; 25 V
C13	23-82783B08	1 ± 20%; 35 V
C14	23-865137	4.7 ± 20%; 25 V
C15	8-82905G02	.022
C16	23-865137	4.7 ± 20%; 25 V
C17	23-82783B08	1 ± 20%; 35 V
C18	23-865137	4.7 ± 20%; 25 V
C19	8-82905G02	.022
C20	23-865137	4.7 ± 20%; 25 V
C21	23-82783B08	1 ± 20%; 35 V
C22	23-865137	4.7 ± 20%; 25 V
C23	8-82905G02	.022
C24	23-865137	4.7 ± 20; 25 V
C25	23-82783B08	1 ± 20%; 35 V
C26	23-11019A20	10 ± 20%; 50 V
		semiconductor device, diode: (see note)
CR1 thru 4	48-82392B03	silicon
CR5	48-82178A04	germanium
CR6,7	48-82392B03	silicon
CR8	48-82178A04	germanium
CR9,10	48-82392B03	silicon
CR11	48-82178A04	germanium
CR12,13	48-82392B03	silicon
CR14	48-82178A04	germanium
CR15	48-822392B03	silicon
CR16	48-82556C12	Zener; 5.6 V
CR17,18	48-82392B03	silicon
		reactor; a-f choke:
L1	24-84003A03	6 H
		transistor: (see note)
Q1 thru 4	48-869570	NPN; type M9570
Q5	48-869571	PNP; type M9571
Q6,7	48-869570	NPN; type M9570
Q8	48-869571	PNP; type M9571
Q9	48-869567	NPN; type M9567
Q10	48-869570	NPN; type M9570
Q11	48-869571	PNP; type M9571
Q12	48-869567	NPN; type M9567
Q13	48-869570	NPN; type M9570
Q14	48-869571	PNP; type M9571
Q15	48-869567	NPN; type M9567
Q16	48-869570	NPN; type M9570
Q17	48-869571	PNP; type M9571
Q18,19	48-869567	NPN; type M9567
Q20	48-86491	NPN; type M9491
Q21	48-869571	PNP; type M9571
Q22	48-869570	NPN; type M9570
Q23	48-869571	PNP; type M9571
Q24	48-869570	NPN; type M9570
Q25	48-869571	PNP; type M9571
Q26	48-869570	NPN; type M9570
Q27	48-869571	PNP; type M9571
Q28	48-869570	NPN; type M9570
Q29	48-869571	PNP; type M9571
		resistor, fixed ± 5%; 1/4 W: unless otherwise stated
R1	6-11009C73	10k
R2	6-11009C57	2.2k
R3	6-11009C69	6.8k
R4,5	6-11009C73	10k
R6	6-11009C89	47k
R7	6-11009C41	470
R8,9	6-11009C81	22k
R10	6-11009C41	470
R11	6-11009C81	22k
R12	6-11009C73	10k
R13	6-11009C25	100
R14	6-11009C49	1k
R15	6-125C33	220; 1/2 W
R16	6-11009C97	100k
R17	6-11009C89	47k
R18	6-11009C73	10k
R19	6-11009C57	2.2k
R20	6-11009C89	47k
R21	6-11009C97	100k
R22	6-11009C13	33
R23	6-11009C57	2.2k
R24,25	6-11009C73	10k
R26	6-11009C67	5.6k
R27	6-11009C93	68k
R28	6-11009C83	27k
R29	6-11009C13	33
R30	6-11009C49	1k
R31	6-11009C83	27k
R32	6-11009C93	68k
R33	6-11009C83	27k
R34	6-11009C13	33
R35	6-11009C49	1k
R36	6-11009C83	27k
R37 thru 42	6-11009C73	10k
R43	6-11009C83	27k
R44	6-11009C49	1k
R45	6-11009C13	33
R46	6-11009C93	68k
R47	6-11009C83	27k
R48,49,50	6-11009C67	5.6k
R51	6-11009C93	68k
R52	6-11009C83	27k
R53	6-11009C13	33
R54	6-11009C49	1k
R55	6-11009C83	27k
R56,57,58	6-11009C73	10k
R59	6-11009C57	2.2k
R60	6-11009C25	100
R61	6-125C49	1k; 1/2 W
R62	6-11009C73	10k
R63,64	6-11009C49	1k
R65	6-11009C73	10k
R66,67	6-11009C49	1k
R68	6-11009C73	10k
R69,70	6-11009C49	1k
R71	6-11009C73	10k
R72,73	6-11009C49	1k
R74	6-11009C73	10k
R75	6-11009C47	820
R76	6-11009C61	3.3k
R77	6-11009C49	1k
R78	6-11009C61	3.3k
R79	6-11009C73	10k
R80	6-126C31	180 ± 10%; 1 W
R81	6-125A73	82; 1/2 W
		switch, slide:
S1 thru S4	40-83204B01	dpdt
		integrated circuit: (see note)
U1	51-84805E02	hex inverter
U2	51-84805E20	quad NAND gate
		non-referenced items
	9-84906E01	SOCKET; 2 used
	7-84785F01	BRACKET, reed retaining
	75-82333B18	PAD
	1-80757D86	PANEL ASSEMBLY; includes; ref. items S1 thru S4, and:
	64-83137L04	PANEL; screened
	1-80759B43	BRACKET & SOCKET ASSEMBLY, includes:
	7-84784F01	BRACKET, reed socket, mounting
	64-84782F02	PANEL, screened
	9-83035A02	SOCKET; reed; 4 used
	43-84783F01	BUSHING, spacer (threaded) 3 used
	3-135084	SCREW, tapping; 4-40 x 5/16"; 3 used
	3-84256M01	SCREW, tapping; 2 used
	4-51143	WASHER, insulator; 3/8"; 3 used
	5-84220B01	GROMMET, 2 used
	9-83497F01	RECEPTACLE, 8 contact; 3 used (PCB Edge Connector)

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

MULTIPLE PL DECODER MODULE

MODEL TRN5329A



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NOTES:

1. Due to square wave characteristic some meters respond differently. Voltage should be measured with an oscilloscope.
2. AC voltage readings are RMS values with 60 millivolts PL tone input. Use high impedance (10 megohm) ac voltmeter. Measurement made with respect to chassis ground.
3. DC voltage readings taken with high impedance (11 megohm) dc voltmeter. Top value is measured without PL tone. Bottom value is measured with 60 millivolts PL tone input. Measurement made with respect to chassis ground.
4. Diodes CR17 and CR18 provide local PTT and Line PTT priority over repeat operation. removal of both diodes inhibits local and line PTT priority.
5. Diodes CR5, 8, 11 and 14 are always connected except for when the diodes are removed, the decoder does not influence PL encoder output.
6. Collector valtage to Q22, 24,2 6 and 28 must not exceed +30 volts.

Jumper Table

Jumper (JU)	Function
1 2 3 4	Permits external switched ground to enable detector switches. Normally OUT.
5 6 7 8	Provides internal ground to enable detector switches. Normally IN.
9 10 11 12	Routes PL indicate (Xmit key) to sq. gate for non wireline applications. Normally all IN. Example, to cause messages accompanied by codes A and B to be repeated but not messages accompanied by codes C and D. Jumpers 9 and 10 must be IN and jumpers 11 and 12 must be OUT.
13 14 15 16	Causes circuit to latch until delayed keyed A + is lost so that there is time to transmit a reverse burst PL tone before the transmitter unkeys. Normally IN for repeaters.

Schematic Diagram
Motorola No. PEPS-34703-A
(Sheet 2 of 2)
11/1/85- UP