MOTOROLA

MSR 2000™

Base and Repeater Stations

Control and Audio

Note: This manual includes the following Instruction Manual Revisions:

SMR-5233, 1/22/87
SMR-5792, 12/17/90
SMR-5804, 3/1/91
SMR-5883, 3/20/92

MUST BE USED WITH
Associated Station Manual

Instruction Manual

68P81061E40-C

MOTOROLA INC.

instruction manual revision

GENERAL

This revision outlines changes that have occurred since the printing of your instruction manual. Use this information to correct your manual.

INSTRUCTION MANUAL AFFECTED:

68P81061E40-C *MSR 2000* Base and Repeater Stations Control and Audio

REVISION DETAILS:

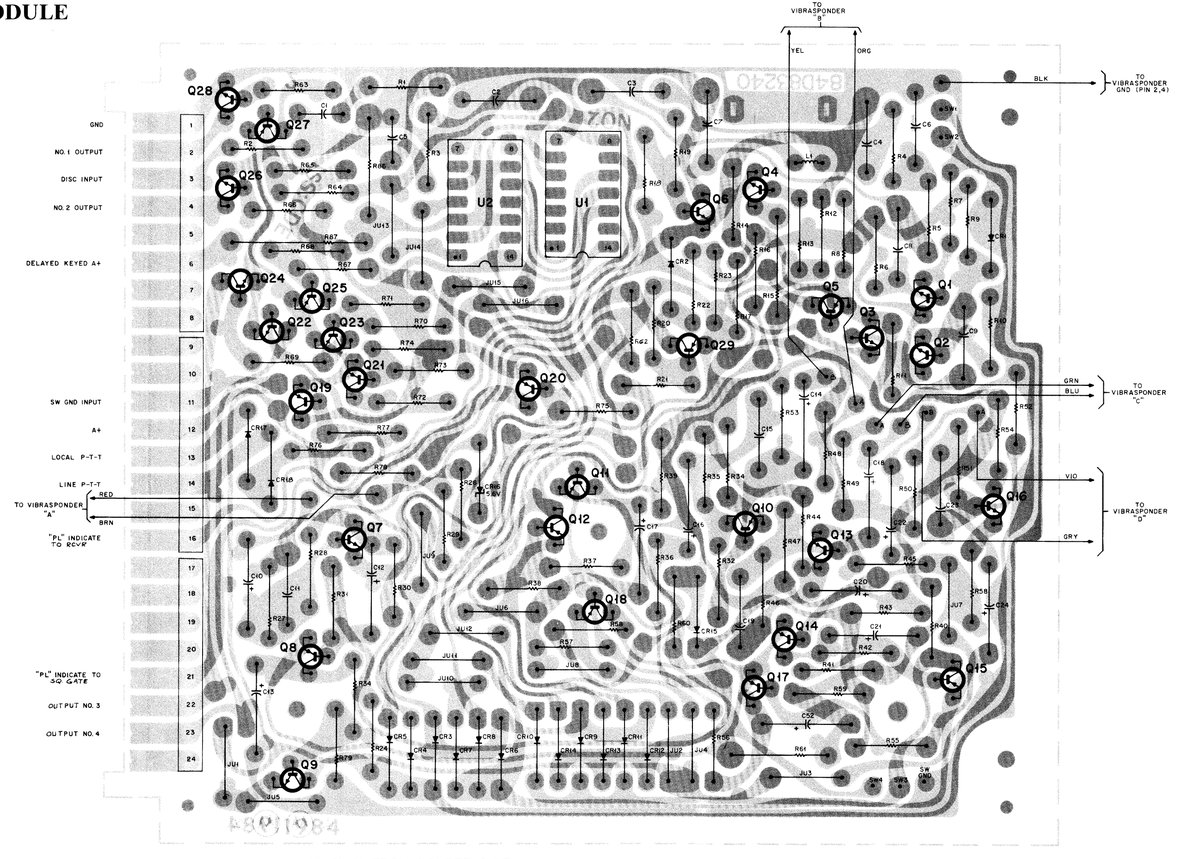
1. The TRN5392A Multiple PL Decoder Module is revised by replacing quad NAND gate U2 with a different type Quad NAND gate. Replace diagram PEPS-34703-A (behind the OPTIONAL EQUIPMENT tab) with diagram PEPS-34703-B.

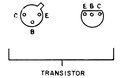
2. The TRN5331A *Spectra-TAC* Squelch Gate Module is revised by replacing screened panel (Motorola Part No. 64-83926G02) with a different screened panel (Motorola Part No. 64-83129L02). Replace instruction section 68P81062E43-C (behind the OPTIONAL EQUIPMENT tab) with instruction section 68P81062E43-D.

ATTACHMENTS:

Model TRN5329A Multiple PL Decoder Module Diagram.....PEPS-34703-B
Model TRN5331A *Spectra-TAC* Squelch Gate Module Instruction Section.....68P81062E43-D

MULTIPLE PL DECODER MODULE
MODEL TRN5329A





SOLDER SIDE * 8D-DEPS-41763-O
COMPONENT SIDE * 8D-DEPS-41764-O
OL-DEPS-41762-O

Circuit Board Detail & Parts List
*Motorola No. **PEPS-34703-B***
(Sheet 1 of 2)
1/16/87- UP

SMR-5233

parts list

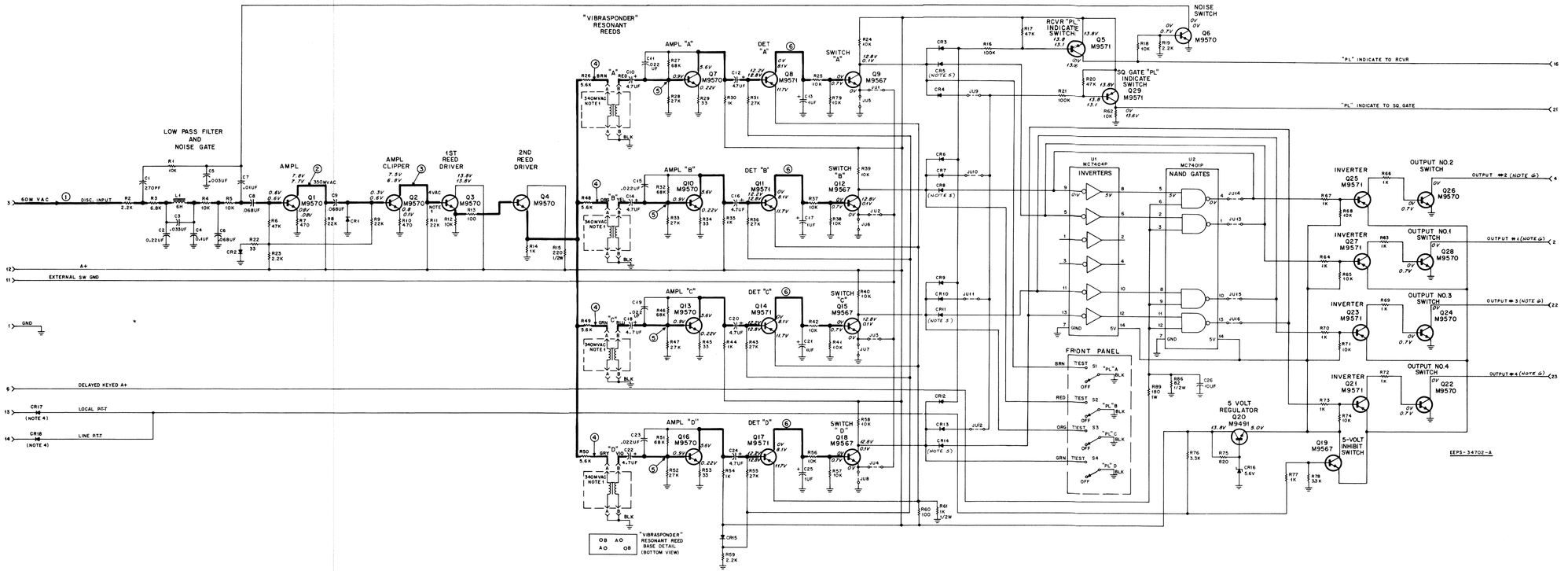
TRN5329A Multi-PL Decoder Module — PL-7968-B

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	21-821878Z6	.003; 100 V
C6	8-82905G04	.068
C7	8-82905G01	.01
C8,9	8-8242TB01	.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	48-82256C12	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	48-869491	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

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
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	51-84371K02	quad NAND gate
		non-referenced items
	9-84906E01	SOCKET; 2 used
	7-84785F01	BRACKET, reed retaining
	75-823338T8	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



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.

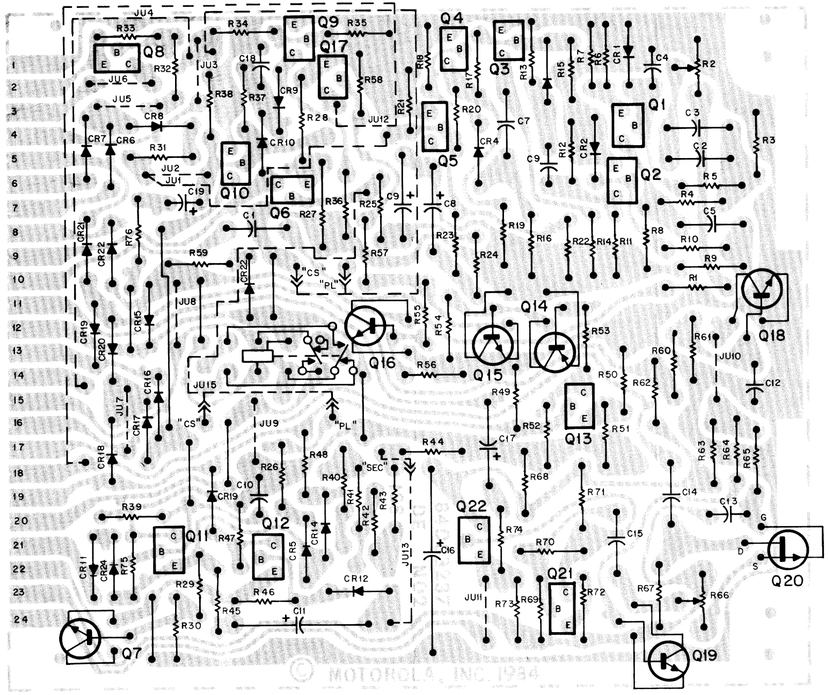
Jumper Table

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-B
(Sheet 2 of 2)
1/16/87-UP

SMR-5233

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-D**
(Sheet 1 of 2)
1/16/87-UP

SMR-5233

parts list

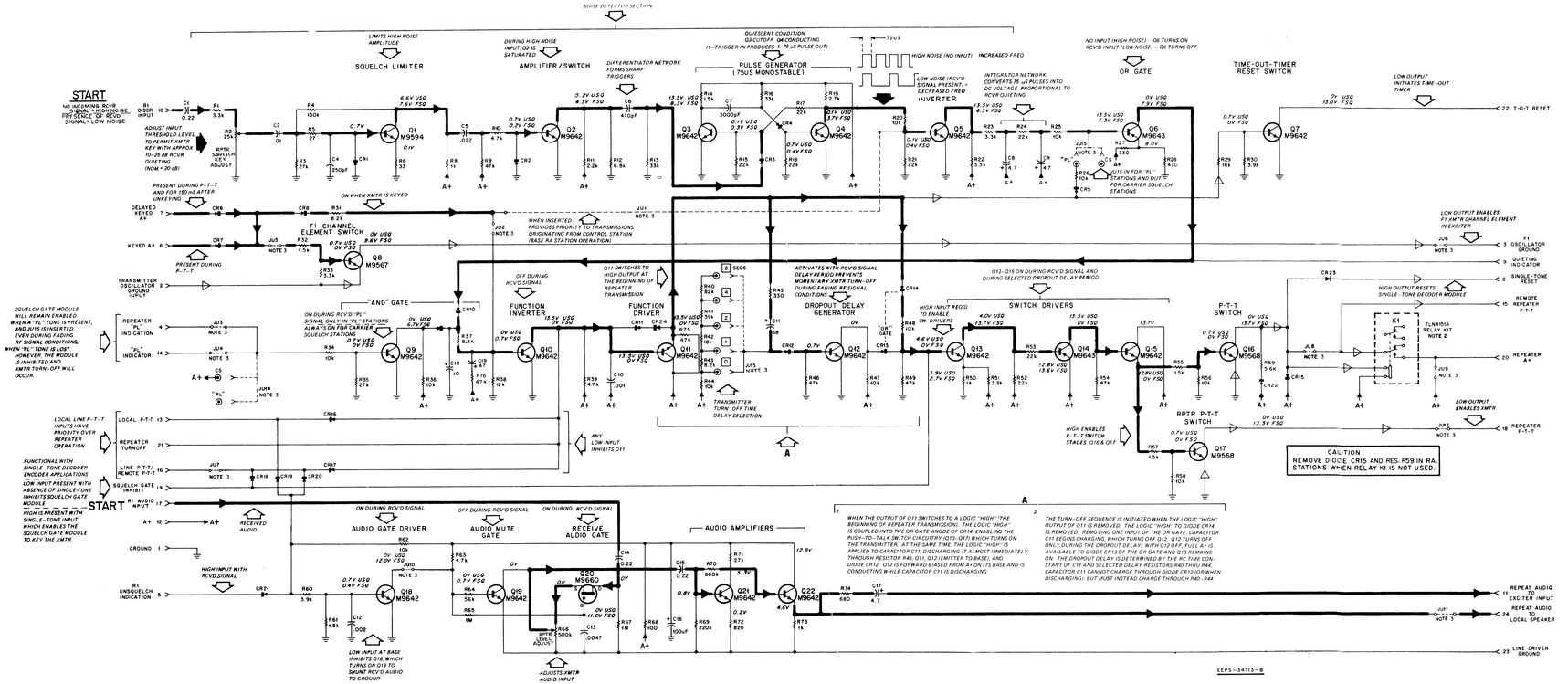
TRN5331A Squelch Gate Module — PL-7960-C

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	6-11009C61	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	6-11009C69	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
	64-83129L02	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:

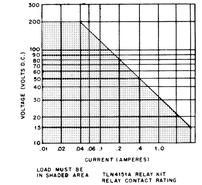
1. Unless otherwise stated: resistor values are in ohms (k = 1000). Capacitor values are in microfarads.
2. Relay kit is an optional accessory item. Refer to relay application chart for CR15, JU8 and JU9 usage with relay.
3. Refer to jumper table.
4. Voltage readings shown are for two conditions:
   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.

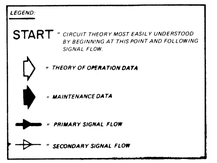
Jumper Table

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





FUNCTION

Measure received noise levels and controls transmitter keying.

Schematic Diagram
Motorola No. **68P81062E43-D**
(Sheet 2 of 2)
1/16/87-UP

Spectra-TAC SQUELCH GATE MODULE

GENERAL:

This revision outlines changes that have occurred since the printing of your instruction manual. Use this information to correct your manual.

INSTRUCTION MANUAL AFFECTED:

68P81039E45-A ..... *SPECTRA TAC*
Total Area Coverage
Voting and Satellite Receivers
Instruction Manual

68P81061E40-C *MSR2000*
Base and Repeater Stations
Control and Audio
Instruction Manual

68P81107E40-F ..... *SPECTRA TAC* ENCODER
OPTION C269
Instruction Manual

REVISION DETAILS:

This manual revision deals with changes that have been made in the following modules:

(1) TRN6552A *MICOR SPECTRA TAC* Line Driver

(2) TRN5294A *MSR2000 SPECTRA TAC* Line Driver

On the above-identified boards, inductor L2 has been replaced by a 50-kilohm potentiometer (P/N 1884944C13) and resistor R55 has been replaced by a 1-kilohm resistor (P/N 0611009C49). The GRN jumper remains on the 9 dB pin.

Changes have also been made on the following two modules:

(1) TRN6080B Satellite Receiver Audio Module

(2) TRN6956A Satellite Receiver Audio Module

On the two above-referenced board, inductor L3 has been replaced by a 50-kilohm potentiometer (P/N 1884944C13), and resistor R53 has been replaced by a 1-kilohm resistor (P/N 0611009C49). The GRN jumper remains on the 9 dB pin.

The following provides a field adjustment procedure, which should be added to the above-cited manuals.

FIELD ADJUSTMENT PROCEDURE

(1) Squelch Adjustment

The receiver squelch control should be set at 20 dB quieting. The SQMs are not designed to operate below 20 dBq. It should be noted that squelch setting of the receivers substantially affects proper system operation. If the system design provides adequate coverage, there are no reasons for setting the receiver squelch below 20 dBq.

NOTE: The following procedure requires the services of two technicians—one at the comparator site; the other at the receiver site.

(2) Path Equalization

Step 1. Any receiver collocated with the comparator or has an audio path with significant frequency response above 3500 Hz must use a QRN8498A Low-Pass Filter Module in the comparator (also available as Option C366ADSP). This module requires one SQM position in the comparator chassis.

Step 2. Turn the status tone encoder TONE LEVEL control fully counterclockwise.

Step 3. Using an audio generator, inject a 0.1 volt tone into the input point indicated below. The generator output level must remain constant from 400 Hz to 4000 Hz.

- Satellite receiver — pin 23 on the audio control module.
- Micro and MSR2000 — pin 5 on the line driver module.

Step 4. Adjust the audio generator's frequency to 1000 Hz, and set the LINE LEVEL control for a LINE output level of -10 dBm. Take note of the level produced at the corresponding comparator's SQM input.

Step 5. Adjust the audio generator's frequency to 3000 Hz. Adjust the HI FREQ EQ control (this is the 50-kilohm potentiometer that was added for modifying the board) for a level equal to the one that was recorded in Step 4 at the comparator's SQM input.

Step 6. Repeat Steps 4 and 5 until the level difference between 1 kHz and 3 kHz is less than 1 dB. The 1 kHz level reference must remain at -10 dBm.

Step 7. Set the audio generator's frequency to 400 Hz. Adjust the LO FREQ EQ jumper (ORG) or control for a level at the corresponding comparator's SQM input within 3 dB of the level recorded in Step 4. *Please note that the low frequency equalization affects the 'sound quality' of the voted audio, but does not affect the voting process itself.*

Step 8. Disconnect the audio generator.

(3) Line Level Adjustment

NOTE: This procedure must always follow the Line Adjustment procedure provided above.

Step 1. PL disable the receiver (if applicable).

Step 2. Inject a 1.0 millivolt carrier frequency signal at the receiver's antenna input.

Step 3. Modulate the carrier with a 1000 Hz tone at ±5 kHz deviation (±3.0 kHz for trunked systems).

Step 4. Set the LINE LEVEL control for the desired LINE output level. (In trunked systems, set the LINE LEVEL control for -10.0 dBm.)

Step 5. Make a note of the level the step has produced at the corresponding comparator's input. In trunked systems, this should be equal to the LINE LEVEL.

(4) Squelch Adjustment

Step 1. Disconnect any rf input to the receiver.

Step 2. Turn the SQUELCH control fully counterclockwise and PL disable the receiver (if applicable).

Step 3. Make a note of the noise voltage level at the LINE output.

Step 4. Inject a low level unmodulated carrier frequency signal at the receiver's antenna input.

Step 5. Increase the signal level until the LINE output voltage is reduced by 20 dB, i.e., one tenth of the level recorded in Step 3. This is the 20 dB quieting point.

Step 6. Turn the SQUELCH control clockwise until the receiver *just squelches*.

Step 7. PL enable the receiver (if applicable).

(5) Status Tone Adjustment

Step 1. Disconnect any rf input from the receiver.

Step 2. Adjust the TONE LEVEL control until the status tone level at the comparator's corresponding input is 13 dB below the level recorded in the Line Level Adjustment procedure, Step 5. For trunked systems, the status tone should be set to 9 dB below the level recorded in Step 5.

Step 3. Reconnect the antenna to the receiver and re-enable the transmitter (if applicable).

MOTOROLA INC.
Communications
Sector

instruction manual revision

[redacted]

GENERAL:

This revision outlines changes that have occurred since the printing of your instruction manual. Use this information to correct your manual.

INSTRUCTION MANUALS AFFECTED:

68P81061E40–C ..... *MSR 2000* Base and Repeater Stations Control and Audio

REVISION DETAILS:

1. The TRN5324A Squelch Gate Module described in instruction section 68P81062E23–C (located behind the REMOTE CONTROL Tab) and the TRN5331A *Spectra TAC* Squelch Gate Module are replaced by the TRN5331B *Spectra TAC* Squelch Gate Module described in attached instruction section 68P81062E43–E. The TRN5331B module is a direct replacement for the TRN5324A and TRN5331A modules.

2. Locate the TRN5331A *Spectra TAC* Squelch Gate Module instruction section (68P81062E43–D) behind the OPTIONAL EQUIPMENT Tab in instruction manual 68P81061E40–C and replace it with the attached TRN5331B *Spectra TAC* Squelch Gate Module instruction section 68P81062E43–E.

ATTACHMENT:

TRN5331B *Spectra TAC* Squelch Gate Module Instruction Section.....68P81062E43–E

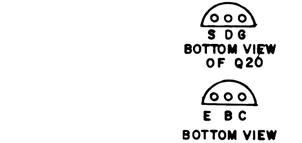
Spectra–TAC

SQUELCH GATE MODULE

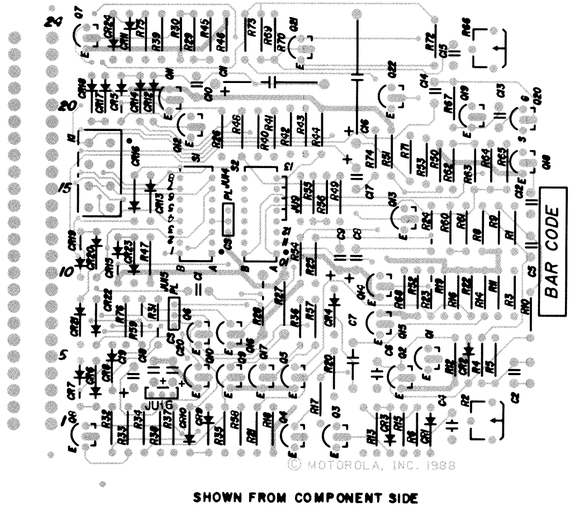
MODEL TRN5331B

CIRCUIT BOARD DETAIL and PARTS LIST

TRANSISTOR BASE DETAILS



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



SHOWN FROM COMPONENT SIDE

COMPONENT SIDE AEPS-48327-O
OVERLAY AEPS-48328-O

Motorola No. **68P81062E43-E**
(Sheet 1 of 2)
2/22/91-UP

SMR-5804

TRN5331B Squelch Gate Module — PL-11767-O

REF. SYMBOL	PART NO.	DESCRIPTION
		capacitor, fixed: uF ±5%; 63V unless otherwise stated
C1	0811051A15	0.22
C2	0811017A08	.01; 50V
C4	2100859943	250pF; 500V
C5	0811051A09	.022
C6	2100850510	470pF ±10%; 300V
C7	2100850994	3000pF; 500V
C8,9	2311054H04	4.7 ±10%; 25V
C10	2111015D13	10000pF ±10%; 100V
C11	2300865594	68 ±10%; 15V
C12	2111015B17	22000pF ±10%; 100V
C13	0811017A08	.0047; 50V
C14,15	0811051A15	0.22
C16	2382783B04	100 ±20%; 25V
C17	2311054H04	4.7 ±10%; 25V
C18	2311054H08	10 ±10%; 25V
C19	2311019A40	47 ±20%; 25V
C20	2182428B62	.01 +80-20%; 200V
CR1 thru 24	4883654H01	diode: (see note) silicon
JU9	0611009D23	jumper: resistor, 0 ohm
JU14,15,16	2880001R03	connector, plug: 3-contact
P1 thru 3	0983497F01	connector: receptacle: 8-contact
Q1	4800869594	transistor; (see note) NPN
Q2 thru 5	4800869642	NPN
Q6	4800869643	PNP
Q7	4800869642	NPN
Q8	4800869567	NPN
Q9 thru 13	4800869642	NPN
Q14	4800869643	PNP
Q15	4800869642	NPN
Q16,17	4800869568	NPN
Q18,19	4800869642	NPN
Q20	4800869660	JFET type
Q21,22	4800869642	NPN
		resistor, fixed: ±5%; 1/4W unless otherwise stated
R1	0611009C61	3300
R2	1883083G03	variable: 25K ±30%
R3	0611009C83	27K
R4	0611009D02	150K
R5	0611009C11	27
R6	0611009C13	33
R8	0611009C49	1000
R9	0611009C89	47K
R10	0611009C65	4700
R11	0611009C57	2200
R12	0611009C69	6800
R13	0611009C85	33K
R14	0611009C53	1500
R15	0611009C81	22K
R16	0611009C85	33K
R17,18	0611009C81	22K
R19	0611009C59	2700
R20	0611009C73	10K
R21	0611009C81	22K
R22,23	0611009C61	3300
R24	0611009C81	22K
R25,26	0611009C73	10K
R27	0611045A37	330; 1/2W
R28	0611045A42	510; 1/2W
R29	0611009C79	18K

TRN5331B Squelch Gate Module (cont.)

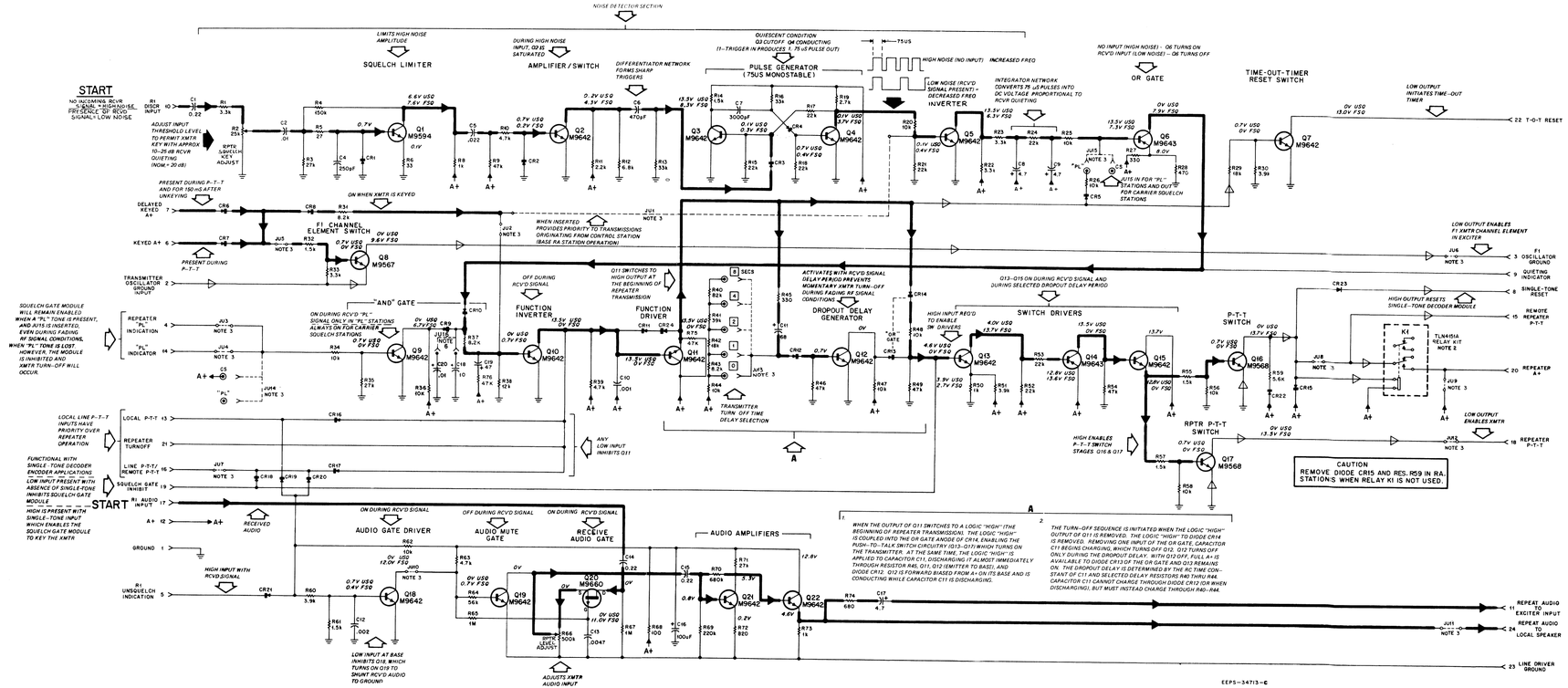
REF. SYMBOL	PART NO.	DESCRIPTION
		resistor, fixed: ±5%; 1/4W (cont.) unless otherwise stated
R30	0611009C83	3900
R31	0611009C71	8200
R32	0611009C53	1500
R33	0611009C61	3300
R34	0611009C73	10K
R35	0611009C83	27K
R36	0611009C73	10K
R37	0611009C71	8200
R38	0611009C75	12K
R39	0611009C85	4700
R40	0611009C95	82K
R41	0611009C87	39K
R42	0611009C79	18K
R43	0611009C71	8200
R44	0611009C73	10K
R45	0611009C37	330
R46	0611009C89	47K
R47,48	0611009C73	10K
R49	0611009C89	47K
R50	0611009C49	1000
R51	0611009C63	3900
R52,53	0611009C81	22K
R54	0611009C89	47K
R55	0611009C53	1500
R56	0611009C73	10K
R57	0611009C53	1500
R58	0611009C73	10K
R59	0611009C67	5600
R60	0611009C63	3900
R61	0611009C53	1500
R62	0611009C73	10K
R63	0611009C65	4700
R64	0611009C91	56K
R65	0611009D22	1meg
R66	1883083G02	variable: 500K ±30%
R67	0611009D22	1meg
R68	0611009C25	100
R69	0611009D06	220K
R70	0611009D18	680K
R71	0611009C83	27K
R72	0611009C47	820
R73	0611009C49	1000
R74	0611009C45	680
R75,76	0611009C89	47K
S1,2	4083849F02	switch, rocker: spst, 8-position
		non-referenced items:
	0384256M01	SCREW, tapping (2 used)
	4382721C01	BUSHING, snap-on (2 used)
	5483865R01	LABEL, bar code (white)
	5484246T01	LABEL, bar code
	6483129L02	PANEL
	0984728L01	SHORTING JUMPER (used with JU14,15,16)

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

TLN4151A Relay Kit — PL-11765-O

REF. SYMBOL	PART NO.	DESCRIPTION
		diode: (see note)
CR15	4882392B03	silicon
		relay:
K1	8084201A01	1A, 115VAC
		non-referenced item:
	4384920H01	SPACER, relay

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



Spectra-TAC
SQUELCH GATE MODULE
MODEL TRN5331B
SCHEMATIC DIAGRAM

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 unaffiled DC transfer module.

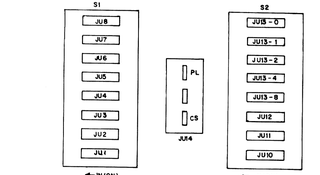
Jumper Table

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	IN	*	*	OUT	OUT	OUT	Selected Delay	IN CS	IN PL
Repeater (RA) Station	OUT	OUT	IN	IN PL	NOTE 5	OUT	*	*	OUT	OUT	OUT	Selected Delay	IN CS	IN PL

* Relay Application Chart

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

6. For SPECTRA-TAC applications, JU16 in C18 position. All other applications, JU16 in C20 position.
7. Jumper locations.



LEGEND:

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

= THEORY OF OPERATION DATA

= MAINTENANCE DATA

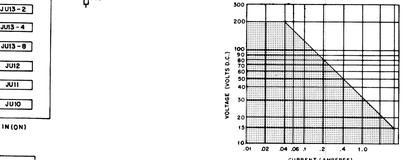
= PRIMARY SIGNAL FLOW

= SECONDARY SIGNAL FLOW

SMR-5804

FUNCTION

Measures receive noise levels and controls transmitter keying.



Motorola No. **68P81062E43-E**
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2/22/91-UP

MOTOROLA INC.

instruction manual revision

[redacted]

GENERAL:

This revision outlines changes that have occurred since the printing of your instruction manual. Use this information to correct your manual.

INSTRUCTION MANUAL AFFECTED:

68P81061E40–C	*MSR 2000* Base and Repeater Stations Control and Audio Instruction Manual

REVISION DETAILS:

1. Locate the Paging Tone Control Module instruction section 68P81062E21–A (Sheet 1 of 3) behind the Remote Control Tab of manual 68P81061E40–C and make the following change to sheet 1 of 3. In the upper right hand corner of the schematic diagram, change the Model Number from TLN5317A to TRN5317A. Add this information to your instruction manual.

MOTOROLA INC.
Communications
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MSR 2000
BASE AND REPEATER STATIONS CONTROL AND AUDIO

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5/15/86-UP

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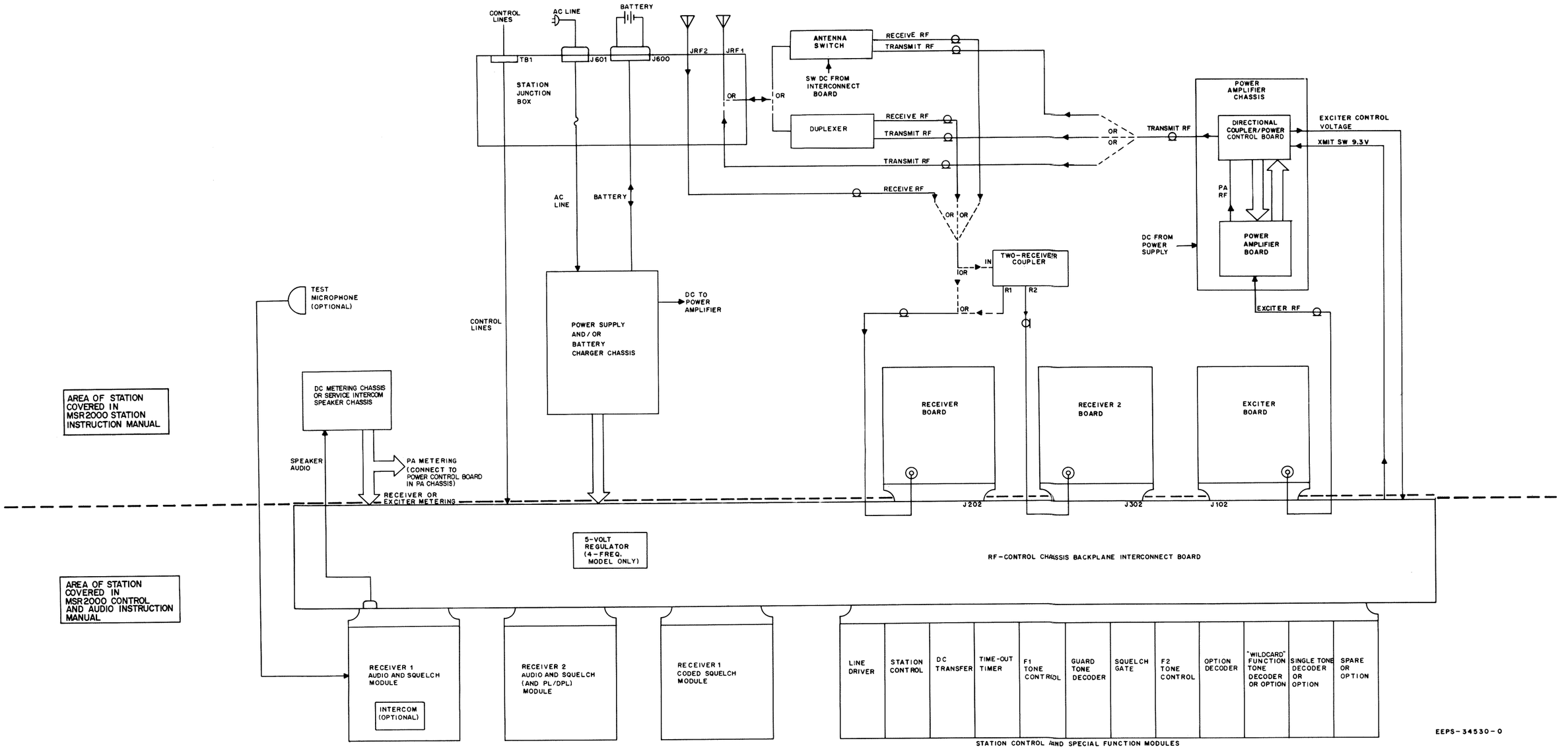

MSR 2000 Simplified Block Diagram
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1. INTRODUCTION

Motorola base and repeater station applications are described in the following paragraphs. The information is tailored to *MSR 2000* type stations.

2. APPLICATIONS

2.1 BASE STATIONS

Typically, a base station is the core of a two-way communications system. It is the fixed point from which a dispatcher sends and receives messages from the mobile and portable radios of the communications system. In many systems, the station also transmits and receives from other base stations or repeaters at fixed points within communications range.

Remotely controlled Motorola base stations may be located at the most advantageous point for rf propagation, such as the top of a tall building or a mountain peak, while the dispatcher may be located elsewhere, even several miles away. A wire line pair (such as a leased telephone line) connects between the base station and a remote control console at the dispatcher's location. Received audio from the base station is sent over the wire line to a speaker in the remote control console. Likewise, microphone audio from the remote control console is sent over the wire line to the base station to modulate the transmitter's rf carrier signal. In addition, the remote control console generates the commands necessary to operate the base station, such as transmitter keying, frequency selection (on two- or four- frequency base stations), *Private-Line* disabling of *Private-Line* receivers to allow monitoring of all on-channel communications, and receiver muting of receiver No. 2 in two-receiver stations. Circuits in the base station sense the commands generated by the remote control console and perform the necessary switching to change the mode of operation.

Two basic types of remote control commands are used for base station control; dc control and tone control. DC control uses dc current of varying magnitude and polarity to initiate the various control functions such as transmitter keying. The wire line pair must have dc continuity to be used for dc remote control operation. In some areas, telephone line pairs with dc continuity are not available. The wire line pair need not have dc continuity for tone remote control operation. Tone control uses audio tones of various frequencies to initiate the control functions. The audio tone used for transmitter keying is filtered out of the transmit audio so that the tone is not transmitted. Other commands require only a momentary application of the tone command to initiate the desired mode of operation. Additionally, more functions can be remotely controlled with tones since many different audio frequencies can be used.

A wide variety of station models are available. Models are available with various power output levels, with one-, two-, or four-frequency transmitters; one-, two-, or four-frequency receivers; with two separate receivers (for continuous monitoring of two channels); and with dc or tone remote control operation. In addition to the standard models offered, a wide variety of optional accessories are available to tailor the station to meet your communications system needs. Furthermore, the equipment was built to meet a wide flexibility of operational requirements without major equipment modification. For example, a station with two receivers can be (1) jumpered to provide receiver No. 1 priority, wherein receiver No. 2 is automatically muted whenever receiver No. 1 is receiving a signal; or (2) with a 4-wire audio line driver, receiver No. 2 audio can be carried to the dispatcher's location (or a completely separate location) on a separate wire line pair and no muting of receiver audio would occur; or (3) with an F2-R2 Mute module, the dispatcher could mute receiver No. 2 upon command from the console; or (4) with an F2-R2 Mute module, receiver No. 2 audio could be attenuated (via the line driver module) rather than fully muted upon command from the console. Jumper selection allows a preset attenuation of 10, 20 or 30 dB.

In all cases, the remote control console must be compatible with the base station. That is, it must generate the type of commands to which the base station control circuits will respond.

The *MSR 2000* rf-control chassis can accept plug-in modules for dc or tone control and a station may be equipped to operate with *both* types of control. This feature allows a station to be easily converted from one type of control to the other, if necessary.

2.2 REPEATER (RT) STATIONS

Motorola repeater (RT) stations are for use in two-way FM radio communications systems where extended range operation is required or where natural or man-made limitations to direct communications are encountered. The station is normally operated unattended and is used primarily for "mobile relay" or "one-way talk-back" repeater applications. Refer to Figure 1 for typical examples of these repeater systems.

Repeater (RT) stations have the capability of functioning both with an rf input (RT) and with wire line control (base station). When the remote supervisory facilities are not used, the station functions automatically as a repeater (RT); i.e., all control functions for the station are initiated via the received rf carrier. As a signal is received, the transmitter is automatically actuated, via the squelch gate module. The output of the receiver is fed to the transmitter modulator input circuit so that the received signal is rebroadcast at greatly increased power on the repeater transmitter frequency.

A station using supervisory remote wire line control can operate as an unattended repeater (RT) station or as a remotely controlled base station. The operator has priority over the operation of the station. The station operates as a repeater (RT) until the remote control operator initiates a transmission. In which case, the station operates as a conventional base station. The remote control operator may monitor all messages rebroadcast from the station during repeater (RT) operation.

A time-out timer module is supplied with all repeater (RT) stations. The time-out timer turns off the transmitter after a predetermined "on-the-air" time to prevent inadvertent continuous transmitter key-up. Jumper connections on the module provide a variable time period during which the transmitter may be keyed.

2.2.1 "Mobile Relay" System

In a "mobile relay" repeater system, signals received by the repeater from one mobile unit are rebroadcast to other mobiles in the system. Mobiles in this system must use a transmitter and receiver operating on different frequencies. The repeater transmitter and receiver will consequently operate on exactly the reverse frequencies of those used for the mobile transmitter and receiver.

2.2.2 "One-Way Talk Back" System

In a "one-way talk-back" repeater system, signals sent from a mobile unit in the vicinity of the repeater installations are picked up by the repeater and retransmitted to a distant base station in the system. Return signals transmitted by the base station are received directly by the mobile. The mobile transmitter and receiver normally operate on the same frequency in this type of system. The associated repeater receiver operates on the mobile transmitter frequency, while the repeater transmitter operates on the frequency of the remote base station receiver. If the base station involved is equipped with a second receiver which operates on the frequency of the mobile transmitter, a mobile unit may talk directly to the base station when operating in the immediate base station area (see dotted detail on system diagram).

2.3 REPEATER (RA) STATIONS

2.3.1 "Two-Way Radio Relay" System

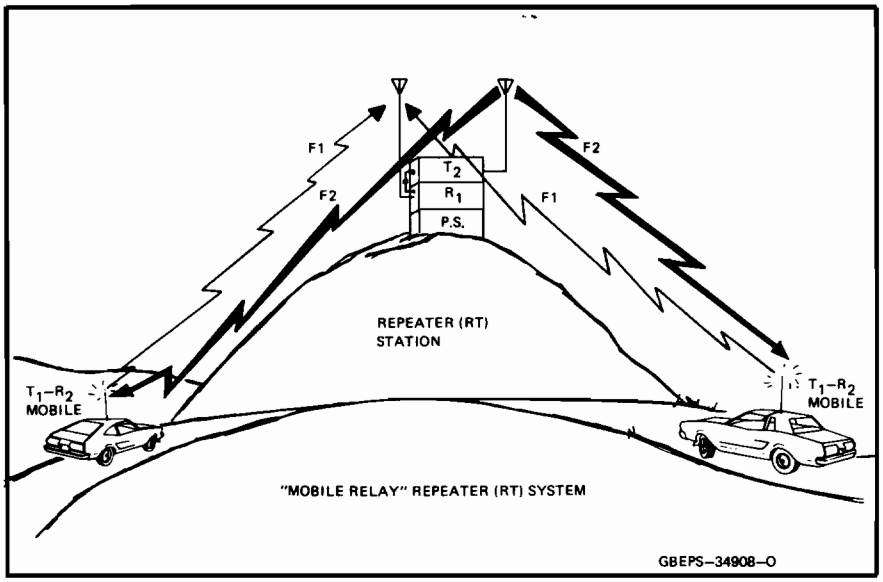
A Motorola repeater (RA) station features specific control facilities and circuitry to operate a companion base (RA) station in a "two-way radio relay" repeater system. Refer to Figure 2 for a typical example of this system.

Motorola radio controlled relay stations are used in two-way FM radio communications systems where extended range operation is required, or where natural or man-made limitations to direct communications are encountered. The radio repeater (RA) system consists of a repeater (RA) — base (RA) combination and two or more remote stations such as control and mobile stations. The repeater (RA) — base (RA) combination consists of a repeater (RA) station and a base (RA) station connected by audio and control wire lines.

A standard Motorola base station of selected operating frequencies can be used as the control station for the repeater (RA) — base (RA) combination. To control the repeater (RA) — base (RA) combination from a single control terminal, the repeater (RA) — base (RA) combination antennas should be directional. However, to control the repeater (RA) — base (RA) combination from several terminals at different locations in the system, multi-directional antennas should be used.

By proper location of the repeater (RA) station, and by proper selection of operating frequencies, transmitter rf power output and antenna characteristics, radio signals can be relayed through mountainous or other obstructive terrain, or to an operational area located at an extended range from the control station.

The repeater (RA) — base (RA) combination has two modes of operation. It can: (1) receive and re-transmit a message from a control station to a mobile station and (2) receive and re-transmit a message from a mobile station to a control station.



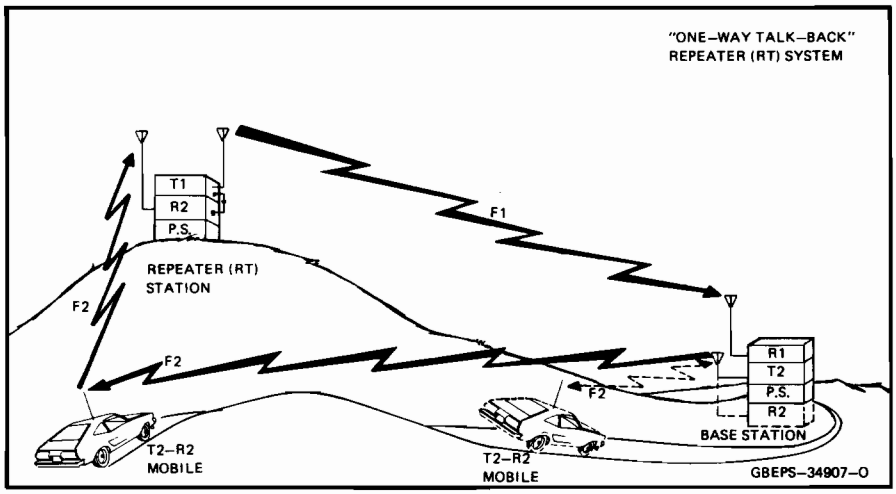


Figure 1.
Typical Repeater (RT) Systems

The mobile units and the base (RA) station operate on frequency F_1. The repeater (RA) station transmits on frequency T_2 and receives on frequency R_3. The control station transmits on frequency T_3 and receives on frequency R_2.

When the control station calls the mobile unit, the repeater (RA) turns on the base (RA) station transmitter. When receiver quieting of the repeater (RA) station reaches predetermined level, the squelch gate in the repeater (RA) station actuates. This keys the transmitter in the base (RA) station. Audio is routed from the repeater (RA) station receiver to the base (RA) station transmitter audio input. The message is sent to the mobile units on frequency T_1 by the base (RA) station transmitter.

When a mobile station calls the control station, the base (RA) station turns on the repeater (RA) transmitter. When receiver quieting of the base (RA) station reaches a predetermined level, the squelch gate in the base (RA) station actuates. This keys the transmitter in the repeater (RA) station. Audio is routed from the base (RA) station receiver to the repeater (RA) transmitter audio input. The message is sent to the control station on frequency T_2 by the repeater (RA) transmitter.

2.3.2 "Guard Tone Relay" System

A "guard tone relay" repeater system is much like the usual "two-way radio relay" repeater (RA) system — with greatly expanded control capability.

In the typical "RA" system (refer to Figure 2) a received message at the repeater (RA) station actuates the squelch gate in that station. This keys the companion base (RA) station which retransmits the message to

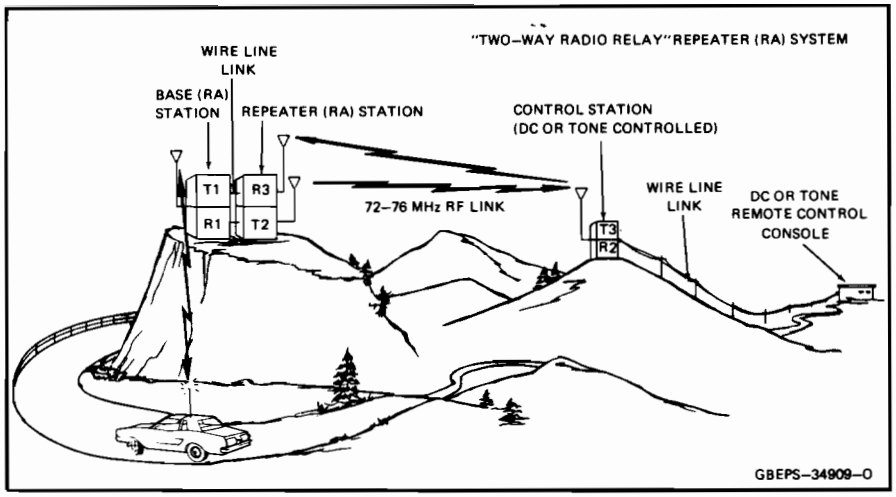


Figure 2.
Typical Two-Way Radio Relay System

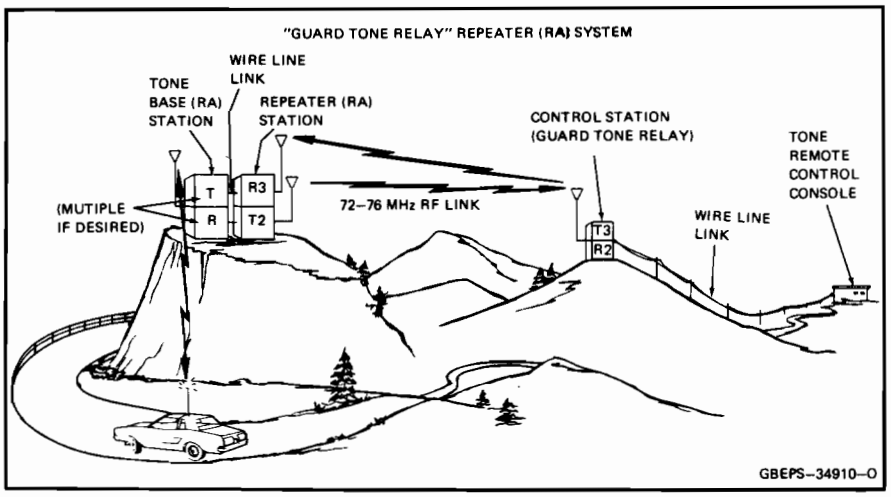


Figure 3.
Typical Guard Tone Relay System

mobile units. Only transmitter turn-on and turn-off control of the base (RA) station is possible in this system, as determined by receiver quieting-squelch gate module operation in the repeater (RA) station.

In the "guard tone relay" repeater (RA) system (refer to Figure 3) the presence of an rf signal alone at the repeater (RA) station does NOT cause the companion station to transmit. Instead, the companion station is controlled via tone signals, just as if it were connected directly to a remote control console by a wire line pair. This permits multiple frequency operation (of the companion base station), PL disable (with coded squelch models), unique function commands, etc.

For example, should the remote control console operator want to talk to a mobile unit on frequency T_4, a high level guard tone signal is sent to the control station. The control station keys IMMEDIATELY on frequency T_3 and transmits the remaining guard tone signal to the repeater (RA) station. The repeater (RA) station applies the received high level guard tone signal portion to the audio input of the companion tone controlled base (RA) station, which is then ready to accept and react to the forthcoming T_4 function tone. The flexibility and number of functions in the guard tone relay system is limited only by the sophistication of the companion tone controlled base station and the remote control console. It should be noted that a squelch gate is used in the repeater (RA) station in this guard tone application to give a transmitter channel element ground when the station is keyed. This is necessary since neither an F1-CS or F1-PL control module is used, which would otherwise supply the ground. The squelch gate is NOT used to key the companion base (RA) station.

NOTE

The high level guard tone burst sent by the remote control console should be lengthened to compensate for the delay time encountered in the keying of the guard tone relay station. Refer to the remote control console manual for details.

1. GENERAL

1.1 PURPOSE

The basic functions of remote control is to allow operation of a base station or a repeater station from a remote control point. The station can be located a considerable distance from the control point. However, a compatible remote control console must be used at the control point in order to control the station. Remote control can be done using tones or dc line currents, which are converted into commands that perform such functions as:

- Transmitter turn-on,
- Selection of transmitter and/or receiver frequencies,
- Muting and unmuting receiver audio,
- Disable receiver coded (PL or DPL) squelch.

1.2 DC CONTROL

In systems using dc control functions, a wire line pair, with dc continuity from end-to-end, must be connected between the control point and the station. Each different control function is originated by a dc currrent through the wire line pair. By varying the dc current polarity and amplitude, it is possible to remotely control several different functions:

- PL disable (receiver),
- Mute receiver #2 audio,
- Unmute receiver #2 audio,
- Turn-on transmitter and select F1 or F2 channel element,
- Turn-on transmitter without PL or DPL encoding (for paging applications).

1.3 TONE CONTROL

In systems using tone control functions, a wire line pair must be connected between the control point and the base station. However, this wire line pair need not possess dc continuity from end-to-end. Each different tone is detected in its own frequency-sensitive circuit and is then converted into a control signal (usually the output of a bistable or other switching device). By generating and detecting different tones, it is possible to remotely control several different functions:

- PL disable (receiver),
- Turn-on transmitter and select F1 or F2 channel element,
- Mute receiver #2 audio,
- Unmute receiver #2 audio,
- Two settings of squelch,
- Repeater on-off,
- PL on-off,
- Turn-on the transmitter without PL or DPL encoding (for paging applications),
- Four additional on-off functions can be utilized by using a "Wild-Card" to control either relays or solid state switches.

2. DC CONTROL APPLICATIONS

Refer to the simplified and detailed functional block diagrams at the end of this section.

2.1 TRANSMITTER TURN-ON; F1 OSCILLATOR

2.1.1 General

In this application, only one transmitter frequency can be selected. In order to turn on the transmitter and energize the channel element, a +5.5 mA control line current is applied to the line 1 terminals of the remote control chassis, and fed to pins 19 and 20 in the line driver module. This current is then applied to the dc transfer module (pins 3 and 4) and activates the positive transfer oscillator. The positive transfer oscillator output level, which is a function of the dc input level and polarity, is detected within the module and provides low level PTT (pin 10). It also generates, with delayed keyed A+ (pin 17), F1 oscillator ground (pin 14), after a 60 millisecond delay.

2.1.2 Line PTT

Line PTT is applied to the station control module (pin 14), time-out timer (pin 6), squelch gate (pin 16), and F1

tone decoder (pin 19). In the station control module, line PTT initiates three important functions:

- Keyed A+ (pin 8),
- Keyed A- (pin 7),
- Antenna switch-/audio mute (pin 2).

In the time-out timer module, line PTT starts the timing action. In the squelch gate (repeaters only), line PTT inhibits squelch gate operation to give line priority (supervision) over repeater operation. The line PTT input to the F1 tone decoder has no effect unless the station is equipped for both tone *and* dc control. In this case, line PTT resets the PL disable circuit in the F1-PL tone control module.

2.1.3 Keyed A+ and A- Outputs

The keyed A- output of the station control module applies operating voltage to the exciter of the transmitter, but the transmitter is not yet keyed because the channel element is not activated. The keyed A+ output gates the PL encoder output to the desired phase. The antenna switch-/audio mute signal causes the antenna relay to energize, transferring the antenna from the receiver to the transmitter, and mutes receiver audio by disabling the line driver amplifiers.

2.1.4 F1 Channel Element Enable

About 60 milliseconds after PTT is developed at pin 10 of the dc transfer module, F1 oscillator ground (pin 14) is applied to the channel element of the exciter. The 60 millisecond delay allows time for antenna switching before high power transmitted rf energy is applied. Although dc power was applied to the transmitter, the amplifiers are biased Class C and depend upon signal drive from the channel element before rf power output is developed. Grounding the transmitter channel element completes the last step to key the transmitter. Other means of keying the transmitter (locally, repeater, tone control) are described later.

2.2 TRANSMITTER TURN-OFF

2.2.1 General

Transmitter turn-off is a sequence of steps which allow transmission of the reverse burst PL signal (tone *Private-Line* stations) or turn-off code (*Digital Private-Line* stations), shut-down of rf power, and finally, antenna switchover to the receiver.

2.2.2 Reverse Burst PL Transmission

When positive line current is removed, the line PTT signal immediately reverts to a high. However, the delayed keyed A+ signal (at pin 17 of dc transfer module) continues for approximately 180 milliseconds. During this 180 millisecond period, F1 oscillator ground is still provided to keep the transmitter keyed.

Loss of the line PTT signal causes the keyed A+ output of the station control module (pin 8) to be removed. This causes the PL encoder-decoder to shift the phase of the PL tone for the reverse burst transmission, or the DPL encoder-decoder to transmit the turnoff code. In non-PL stations, the transmitter also continues to operate for 180 milliseconds.

2.2.3 RF Shut-Down

Keyed A- (station control pin 7) continues to be provided, as long as delayed keyed A+ is present.

Upon the loss of delayed keyed A+ and F1 oscillator ground (180 milliseconds after dc line current is removed), the transmitter shuts down because of loss of channel element ground and keyed A- power.

2.2.4 Antenna Switchover

Upon the loss of keyed A-, the antenna switch-/audio mute circuit starts a 30 millisecond turn-off delay. At the end of this 30 millisecond period, the low at pin 2 of the station control module reverts to a high. This de-energizes the antenna relay and unmutes receiver audio, placing the station in the standby condition.

If the transmitter is keyed beyond the time duration set in the time-out timer, a T-O-T key inhibit signal (pin 4 of the T-O-T) inhibits keyed A- in the station control module to start shut down of the transmitter. This allows the 30 millisecond delay before antenna switchover.

2.3 TRANSMITTER TURN-ON: F2 OSCILLATOR

In two-frequency transmitter applications, a different channel element is selected for each operating frequency. In order to turn on the transmitter and select the second (F2) channel element a +12.5 mA control line current is applied to pins 19 and 20 in the line driver module. This current is then applied to the dc transfer module (at pins 3 and 4) and activates the positive transfer oscillator. The positive transfer oscillator output level, which is a function of the dc input level and polarity, is detected within the module. The detection results in a low level line PTT (pin 10) and an F2 oscillator ground output (pinn 16). Circuit operation from this point on is the same as described for transmitter turn-on with F1 oscillator except that a ground is provided to the F2 channel element of the transmitter.

2.4 RECEIVER #2 MUTE

In this application, receiver #2 can be muted independent of any other operation. A momentary -5.5 mA control line current is applied to pin 19 and 20 in the line

driver module. This current is then applied to the dc transfer module (at pins 3 and 4) to activate the negative transfer oscillator. The negative transfer oscillator output is detected within the module and provides an R2 mute output at pin 20 to mute receiver #2 audio in the line driver module. Receiver #2 audio remains muted until the transmitter turn-on F2 oscillator function is activated at which time the R2 mute function is no longer generated.

2.5 RECEIVER *PRIVATE-LINE* DISABLING

In this application, the receiver *Private-Line* coded squelch circuit is disabled prior to the transmission for channel monitoring purposes. A -2.5 mA control line current is applied to pins 19 and 20 in the line driver module. This current is then applied to the dc transfer module (at pins 3 and 4) to activate the negative transfer oscillator. The negative transfer oscillator output is detected within the module and produces a low PL disable control output. The low is inverted to a high in the station control module (pin 23), from which it is applied to the receiver (both receivers in 2-receiver stations). The PL disable control output remains active until the transmitter is keyed by one of the dc control applications described above. Immediately after the control point furnishes the transmitter turn on command, the PL disable control output reverses and again enables the receiver PL-coded squelch circuit.

2.6 C2-R2 FREQUENCY SELECTION

Stations equipped with a two-frequency receiver and a two-frequency transmitter use a C2-R2 dc transfer module which selects a receiver channel element whenever selecting a transmitter channel element (paired switching). A +5.5 mA line current selects the F1 oscillator ground described for transmitter turn-on. It also activates an R1 bistable which provides an R1 oscillator ground (pin 21 of dc transfer module) which is routed to the R1 channel element in the receiver.

A +12.4 mA line current selects F2 oscillator ground for the transmitter as described previously. It also activates an R2 bistable which provides an R2 oscillator ground (pin 22 of dc transfer module) which is routed to the R2 channel element in the receiver.

The R1 and R2 bistables are mutually resetting so that only one can be activated at any given time. Unlike the F1 and F2 bistables, the R1 and R2 bistables do not turn off when the dc control current is removed, but remain in the selected state until changed.

2.7 PAGING (TRANSMITTING WITHOUT PL)

In this application, the transmitter can be keyed with or without PL coded modulation. To transmit with PL coded modulation, a +5.5 mA line current is applied which turns on the transmitter (F1) as described previously. To transmit without PL coded modulation, a -12.5 mA line current is applied. The dc transfer module converts this command to line PTT and F1 oscillator ground as described previously, but it also places a low on the page output (pin 20). This low signal is routed to XMIT PL INHIBIT (pin 14) of the coded squelch modules in paging stations. This permits the PL encoder output to be inhibited while a low is provided from the paging control module.

2.8 REPEATER TRANSMITTER TURN-ON

A repeater transmitter is turned on by the squelch gate module. Discriminator output from the receiver is applied to the squelch gate (pin 10). A quieted signal (reduced noise because of an incoming rf signal) actuates the squelch gate, which in turn, keys the transmitter for retransmission of the audio. In PL stations, a PL indicator (pin 14) is also required before the module is activated (correct PL tone must be decoded to produce the PL indicator signal).

The output of the squelch gate module, repeater PTT (pin 18) is applied to the station control module (pin 15). This input produces PTT control (pin 10), keyed A+ (pin 8), keyed A- (pin 7) and inhibits antenna switch-/ audio mute (pin 2). The PTT control signal is applied to the dc transfer module to activate the F1 oscillator. The remainder of transmitter turn-on and turn-off circuit operation is as described for remote control base stations.

In a non-wire line controlled repeater, jumpers JU5 and JU6 in the squelch gate module are connected, which permits keyed A+ from the station control module to enable channel element switch Q8. Q8 provides the F1 oscillator ground. In this mode, transmitter turn-off uses delayed keyed A+, from the *Private-Line* encoder, to provide delayed keyed A+ (pin 7 of squelch gate).

Receiver audio is gated through the squelch gate module (pin 17 input, pin 11 output) to the exciter. The exciter audio path through the station control module is inhibited by audio gate driver Q6 when the PTT control signal is low.

2.9 REPEATER SET-UP AND KNOCKDOWN

Repeater stations may be equipped for wire line control from the remote control point. This permits the repeater function to be disabled (knocked down) for base operation. Line operation has priority over repeater operation. Line keying produces a line PTT input (pin 14, station control module) which inhibits the PTT control signal (pin 10) as well as inhibiting the squelch gate (pin 16).

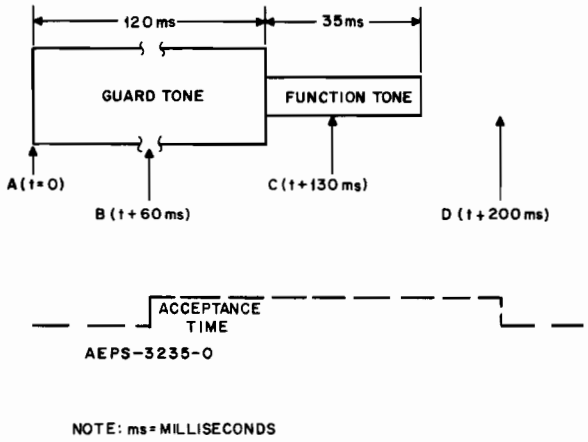


Figure 1. Tone Control Format, Non-Transmit Command

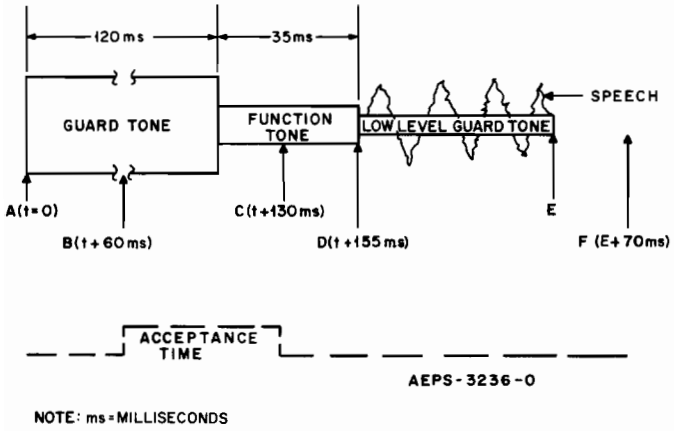


Figure 2. Tone Control Format, Transmit Command

2.9.1 Repeater Set-Up

In this application, an enabling +12.5 mA control current is generated that allows the repeater to operate. Repeater turn-on (repeater set-up) is similar to transmitter turn-on F2 oscillator except:

- A high level repeater set-up output is provided at pin 20 of the dc control module,
- Jumpers are connected so that pin 20 (of the dc control module) is connected to pin 21 of the squelch gate module,
- The squelch gate module provides a repeater PTT output at pin 8. This output is applied to the station control repeater PTT at pin 15 (instead of line PTT at pin 14) to key the transmitter.

2.9.2 Repeater Knockdown

The -5.5 mA repeater turn-off current causes operation similar to Receiver #2 Mute except the low output at pin 20 is applied to pin 21 of the squelch gate module. This low input at pin 21 inhibits the repeater PTT circuits in the squelch gate module.

3. TONE CONTROL APPLICATIONS

Refer to the simplified and detailed functional block diagrams at the end of this section.

3.1 TONE CONTROL FORMAT

In all tone control applications, tones are sent from the control point in a particular timing sequence (tone control format). All tones must be preceded by a 2175 Hz guard tone. The guard tone is used to activate circuits which detune a 2160 Hz bandpass filter in the guard tone decoder module. With the 2160 Hz bandpass detuned, all tones can pass through the guard tone decoder and then be routed to their respective decoders. The tone control format is shown in Figures 1 and 2.

As shown in Figures 1 and 2, there are two distinct types of commands; transmit commands, and non-transmit commands. A 2175 Hz guard tone always precedes the function tone(s); however, in the case of transmit commands the guard tone continues (at a 30 dB lower level) in order to keep the transmitter keyed.

3.2 TRANSMITTER TURN-ON; F1 OSCILLATOR

3.2.1 General

In this application, only one transmitter frequency can be selected. In order to turn on the channel element, the F1 transmit command format (2175 Hz guard tone followed by 1950 Hz F1 function tone) is applied to pins 19 and 20 in the line driver module. The tones are then routed out of the line driver module on pin 10 and are applied to pin 9 of the guard tone decoder.

3.2.2 Line PTT

The guard tone decoder detects the 2175 Hz guard tone and uses a portion of the detected voltage to effectively disconnect the 2160 Hz bandpass filter at the guard tone decoder input. In addition, the guard tone decoder also provides a line PTT output at pin 16 and a decoder bias output at pin 15; both resulting from the 2175 Hz tone.

The line PTT output at pin 16 is used as described for dc controlled stations, energizing the antenna relay and

muting receiver audio, and applying keyed A- to the transmitter.

The 2175 Hz guard tone signal continues to be received as long as the transmitter is being keyed; however, the level is decreased by 30 dB. Circuits within the guard tone decoder compensate for the lower guard tone level and insure that line PTT output is provided even during the lower level input.

3.2.3 F1 Channel Element Enable

With the 2160 Hz bandpass filter disconnected, the F1 function tone (1950 Hz), which follows the high level guard tone, is allowed to pass through the guard tone decoder via the function HI output at pin 11. The 1950 Hz portion of the signal is applied to the F1-PL (or F1-CS) module for detection. (Although the 1950 Hz tone is applied to other modules, it can only be detected in the F1-PL or F1-CS module.) When the 1950 Hz tone is detected in the F1-PL module, the F1 bistable produces a low F1 Osc output at pin 3 which provides a ground enable for the transmitter F1 channel element to completely key the transmitter.

3.2.4 Function Tone Enable

In order for the tone detector circuits to function, an enable signal must be provided during the control format time. This signal originates in the guard tone decoder module as the decoder bias output at pin 15 and is the result of guard tone detection. The decoder bias signal is a high-level, 350 milliseconds window that is applied to the F1-CS tone decoder (pin 15). The F1-CS module converts the signal to a low-level function enable output at pin 20. The 350 millisecond low-level function enable is applied to pin 13 of all of the tone detector circuits (in four different tone control module positions) so that tones can only be detected during the 350 millisecond window.

3.3 TRANSMITTER TURN-OFF

3.3.1 General

When low level 2175 Hz guard tone ends, transmitter turn-off begins. First, the guard tone loss is detected by activity checker Q20 in the guard tone decoder. After a 75 millisecond turn-off delay, the line PTT output (pin 16) reverts to a high.

3.3.2 Reverse Burst PL Transmission

Loss of the line PTT causes loss of keyed A+ in the station control module (pin 8). In turn, loss of keyed A+ starts the PL reverse burst transmission (turn off code in a digital system) via the *Private-Line* encoder. The PL encoder provides delayed keyed A+ for an additional 180 milliseconds while the reverse burst or turn-off code is transmitted. The delayed keyed A+ keeps the F1 bistable on (F1-PL module) to continue providing F1 channel element ground.

3.3.3 RF Shut-Down

After the 180 millisecond reverse burst period, delayed keyed A+ is removed, which turns off the F1 bistable and removes keyed A-. This turns off the channel element which removes the signal drive to the Class C rf amplifiers.

3.3.4 Antenna Switchover

30 milliseconds after keyed A- is removed, the antenna switch-/audio mute signal (station control, pin 2) allows the antenna relay to de-energize and unmutes audio in the line driver.

3.4 TRANSMITTER TURN-ON; F2 OSCILLATOR

3.4.1 F2 Control

In this application a different transmit channel element is selected for each of the two operating frequencies. In order to turn on the transmitter and select the second (F2) channel element, the transmit command format (2175 Hz guard tone followed by 1850 Hz F2 function tone) is applied to pins 19 and 20 in the line driver module. From this point the circuit operation is the same as that described for F1 selection except that the F2 channel element is selected by detection of the 1850 Hz tone in either the C2-R2, F2-R2 Mute, or F2-Control Module. The low level (ground) F2 channel element output at pin 4 is then applied to the transmitter.

3.4.2 Paging Control

When the station is equipped with an option decoder-paging control module instead of an F2-control module, the 1850 Hz command keys the transmitter on F1 and prevents transmission of the *Private-Line* code. The 1850 Hz command is detected in the paging control module by Q1, which sets paging disable bistable Q2, Q3. The Q output of the bistable provides a PL inhibit output which prevents *Private-Line* code from being generated.

- The F2 output has no effect since the transmitter is not equipped with an F2 channel element.
- The local F1 output is applied to the F1 tone control module, which activates the F1 bistable and keys the transmitter on frequency F1.

3.5 RECEIVER *PRIVATE-LINE* DISABLING

3.5.1 General

In this application a transmit channel element is not selected, therefore, the transmitter is not keyed. In order

to generate a PL disable signal, the non-transmit command format (2175 Hz guard tone followed by 2050 Hz PL disable function tone) is applied to pins 19 and 20 in the line driver module. The tones are then routed out of the line driver module on pin 10 and are applied to pin 9 of the guard tone decoder.

The guard tone decoder detects the 2175 Hz guard tone and uses a portion of the detected voltage to effectively disconnect the 2160 Hz bandpass filter at the guard tone decoder input. In addition, the guard tone decoder provides a bias output at pin 15 which is the result of the 2175 Hz tone. (A line PTT is also generated, however, it cannot key the transmitter because a channel element is not selected.)

3.5.2 PL Disable Function

With the 2160 Hz bandpass filter disconnected, the PL disable tone (2050 Hz) passes through the guard tone decoder via the function HI output at pin 11. The 2050 Hz signal is applied to the F1-PL module for detection. (Although the 2050 Hz tone is applied to other modules, it can only be detected in the F1-PL module.) When the 2050 Hz signal is detected in the F1-PL module, the PL disable bistable provides a low level PL disable control output at pin 21. The low level PL disable control is applied to the station control module at pin 20. This results in a high level PL disable output, at pin 23, to disable the *Private-Line* operation of the receiver for channel monitoring before transmission. The PL disable condition remains until a line PTT input is applied to pin 19 (which occurs when the transmitter is next keyed).

3.5.3 Function Tone Enable

In order for the tone detector to function, the guard tone decoder generates a 350 millisecond, high-level, decoder bias signal (at pin 15). The decoder bias signal originates via 2175 Hz guard tone detection and is present during the 350 millisecond time period that follows. The F1-PL module converts the decoder bias signal into a 350 millisecond, low-level, function enable signal that enables the detectors within the module during the 350 millisecond window. In addition, the function enable is also applied to other modules so that their detectors can also function during the 350 millisecond window.

3.6 R2 MUTE OR RECEIVE F1

In this application, a transmit channel element is not selected, therefore, the transmitter is not keyed. In order to generate the R2 mute signal, the non-transmit command format (2175 Hz guard tone followed by a 1750 Hz R2 mute function tone) is applied to pins 19 and 20 in the line driver module. The tones are then routed out of the line driver module on pin 10 and are applied to pin 9 of the guard tone decoder.

Circuit operation from pin 9 of the guard tone decoder is similar to that previously described for receiver *Private-Line* disabling except:

- Either the C2-R2 control module, or the F2-R2 mute control module detects the tone.
- The R2 mute output is applied to the line driver.

When the 1750 Hz R2 mute function tone is detected in the control module (C2-R2, or F2-R2 mute) the R2 mute bistable provides a low level R2 mute output at pin 7. This output is applied to the line driver module. The R2 mute signal disables the R2 audio line in the line driver.

If the C2-R2 module is used, the R2 mute bistable also initiates a low level (ground) output at pin 15 to activate the receiver F1 oscillator.

3.7 R2 UNMUTE OR RECEIVE F2

In this application, a transmit channel element is not selected, therefore, the transmitter is not keyed. In order to generate the R2 unmute signal, the non-transmit command format (2175 Hz guard tone followed by a 1650 Hz R2 unmute function tone) is applied to pins 19 and 20 in the line driver module. The tones are then routed out of the line driver module on pin 10 and are then applied to pin 9 of the guard tone decoder.

Circuit opertion from pin 9 of the guard tone decoder is similar to that previously described for receiver *Private-Line* disabling except:

- Either the C2-R2 control module, or the F2-R2 mute control module detects the tone.
- The R2 mute output is open circuited.

When the 1650 Hz R2 unmute function tone is detected in the control module (C2-R2 or F2-R2 mute), the R2 unmute bistable provides a cross-coupling to the F2 mute bistable. This causes the F2 mute bistable to open circuit the F2 mute output which, in turn, removes the F2 mute input to line driver. This allows R2 audio to pass through the line driver R2 audio line.

If the C2-R2 module is used, the R2 unmute bistable also initiates a low level (ground) output at pin 17 to activate the receiver F2 oscillator.

3.8 "WILD-CARD" ON-OFF

The optional "Wild Card" function tone decoder provides up to four solid state low-high switched outputs or optional relay contact closure outputs. Four different function tones are used to control the four circuits. Each circuit is identical, therefore, only one of the four is described, the 1050 Hz circuit. (The others are 1150 Hz, 1250 Hz, and 1350 Hz.) The 1050 Hz function tone is

applied to the line driver pins 19 and 20 in the non-transmit command format (2175 Hz guard tone followed by a 1050 Hz function tone). They are routed out of the line drive module on pin 10 and are applied to pin 9 of the guard tone decoder.

Circuit operation from pin 9 of the guard tone decoder is similar to that previously described for receiver *Private-Line* disabling except:

- The tone is detected in the "Wild Card" module.
- The output is either a relay contact or bistable output.

When the 1050 Hz function tone is detected in the "Wild Card" module, the #1 bistable provides a ground output at the Q side. This ground is normally applied through JU1 to pin 3 where it can be used as a control line. If a relay is used, JU1 is disconnected and the relay contacts are connected to the control line.

3.9 REPEATER SET-UP

In this application, the repeater keying circuits are enabled, thus allowing the repeater to be keyed by the squelch gate module. In order to generate a repeater turn-on enable signal, the non-transmit command format (2175 Hz guard tone followed by a 1450 Hz repeater-on function tone) is applied to pins 19 and 20 in the line driver module. The tones are then routed out of the line driver module on pin 10 and are applied to pin 9 of the guard tone decoder.

The guard tone decoder detects the 2175 Hz guard tone and uses a portion of the detected voltage to effectively disconnect the 2160 Hz bandpass filter at the guard tone decoder input. In addition, the guard tone decoder provides a 350 millisecond decoder bias output signal, at pin 15, which is the result of the 2175 Hz tone.

With the 2160 Hz bandpass disconnected, the repeater turn-on function tone (1450 Hz) passes through the guard tone decoder via the function HI output at pin 11. The 1450 Hz function tone is applied to the repeater control option decoder module for detection. When the 1450 Hz function tone is detected, the repeater turn-on bistable is set and the low $\overline{Q}$ output is cross-coupled to the clear side of the repeater turn-off bistable. The cross-coupling produces a high level output signal at pin 9. Because this output signal is high, the function becomes repeater turn-on, instead of repeater turn-off.

The high output signal from pin 9 of the repeater control is applied to pin 21 of the squelch gate module. This high level is an enabling input, which allows the squelch gate module to produce the repeater PTT output signal, at pin 18, when the receiver quiets, due to an incoming rf signal.

3.10 REPEATER TURN-OFF

In this application, the repeater keying circuits are disabled in order to generate the repeater turn-off function. The circuit operation is similar to that described for repeater turn-on except:

- A 1550 Hz repeater turn-off function tone is used.
- When the repeater control module detects the 1550 Hz repeater turn-off function tone, it generates a low output signal, at pin 9, that disables the repeater keying function, preventing the repeater from being keyed.

3.11 MAX SQUELCH AND MIN SQUELCH

In these two applications, an attenuator is either switched in or out of the squelch control circuit. The squelch control option decoder module is used in place of the repeater control option decoder module and is the same except that only jumper JU2 is connected. Circuit operation for this application is similar to that previously described for repeater turn-on and turn-off except:

- When a 1450 Hz min squelch function tone is detected, the turn-on bistable switches the attenuator into the circuit for threshold squelch.
- When a 1550 Hz max squelch function tone is detected, the turn-off bistable cross couples to the turn-on bistable which then switches the attenuator out of the circuit for maximum squelch.
- The squelch attenuator output signal, at pin 18, reflects the condition of the attenuator squelch ratio changes.

3.12 RECEIVER PL ON - PL OFF

In these two applications the type of squelch is selected; *Private-Line* coded squelch or carrier squelch. The *Private-Line* control option decoder module is used instead of the repeater control option decoder module, and only jumpers JU3 and JU4 are connected. Circuit operation for this application is similar to that previously described above for repeater turn-on and turn-off except:

- When a 1450 Hz PL off function tone is detected, the operate carrier squelch bistable provides a low output signal on pin 20 (high on pin 5) which disables the receiver PL coded squelch circuit.
- When a 1550 Hz PL on function tone is detected, the operate PL bistable provides a low output signal on pin 5 (high on pin 20) which enables the receiver PL coded squelch circuit.

The low PL disable output signal on pin 20 (pin 5 high) is applied to the station control module pin 5. This produces a high PL disable output signal from this module, at pin 23, to disable the PL and change operation to the carrier squelch mode.

The low PL enable output signal on pin 5 is applied to the F1-PL module to produce high PL disable and function enable output signal from this module. This insures that no other function tones can be excepted and that operation remains in the PL mode.

3.13 SINGLE-TONE DECODER

The single-tone decoder module may be used in repeater systems to key a specific repeater. The single-tone decoder can detect one of 19 different audio frequencies between 600 and 3300 Hz, with a 150 Hz spacing. The input, containing the particular function tone, is applied from the receiver at pin 3 of the single-tone decoder module. The module detects the function tone and removes the ground output at pin 16 (squelch gate inhibit). This removes the inhibiting function from the squelch gate module allowing it to function normally. The single-tone decoder module is reset by the squelch gate module upon loss of received rf carrier signal. The single-tone decoder can also be used for receiving enabling. Switched A+ output is applied to the PL indicator output of the receiver, enabling the receiver squelch circuit only when the proper single-tone frequency has been received. The PL disable function may be used for monitoring the channel.

3.14 FOUR-FREQUENCY SELECTION

3.14.1 General

The 4-frequency control option decoder module converts a function tone signal from a remote source to a switched ground function for transmit and receive channel element selection. The function tone is applied to a clipper amplifier and passed to resonant tank circuits which are tuned to respond to a specific frequency: 1250 Hz, 1350 Hz, 1850 Hz, or 1950 Hz.

The function tone signal passes through the resonant tank circuit to a detector circuit where it is converted, upon application of a function enable signal from the guard tone decoder module, from a function tone to a dc voltage. This dc signal is inverted and applied to the transmit and receive latches. These latches, upon application of a clock pulse, activate the channel element drivers to provide a switched ground to the selected transmit and receive channel elements.

3.14.2 Transmit Frequency Selection

Since all frequency selection circuits are the same except for the specific frequency to which they respond, only one circuit is described, the F2 (1850 Hz) circuit. When an 1850 Hz function tone is sent from the remote control console, it is received at pin 11 of the four-frequency control option decoder module. It is then amplified and passed through the respective tank circuit. The signal is detected by the F2 detector and is converted from a 1850 Hz function tone to a logic low dc voltage. The F2 detector is enabled by the presence of the function enable signal at pin 13 from the bias switch in the F1-CS or F1-PL tone control module. This signal is developed only after the high level guard tone has been detected.

The logic low F2 detector output is inverted and applied to transmit latch flip-flop U11B and to the transmit latch clock. The clock pulse is applied to the F2 flip-flop which changes state and produces a high level Q output. This output is inverted to a logic low and is applied to the T2 transmitter channel element. As this happens, the other transmit latch flip-flops reset, cancelling any previous frequency selection.

3.14.3 Receive Frequency Selection

The logic high from the F2 transmit latch flip-flop is also applied to the receiver latch clock circuit and receiver latch flip-flop U2B. The receiver latch clock sends a pulse to receiver latch flip-flop U2B which causes the Q output to become high. The receiver latch flip-flop now remains in this state until reset. AND gate U3B applies a high to inverter Q23. The output of Q23 is a ground which selects the R2 receiver channel element.

After transmission has been completed and PTT has been released, SW 9.6 V is removed from pin 8, causing C14 to discharge. The discharge of this capacitor turns on the transmit clock causing a second pulse to be applied to the multivibrator which resets the transmit latch back to its orignial state (all Q outputs low).

The receiver latch does not reset after transmission has been completed. The receiver channel, in this explanation R2, remains activated. When transmission is changed to F1, F3, or F4, the receiver clock will pulse the receiver latch flip-flop, thus resetting R2 and turning on the appropriate receiver channel frequency for proper communications.

The power on reset circuit pulses receiver latch flip-flop U2A, resetting the multivibrator to select the R1 channel element select any time power is lost, due to removal of the card, or power outage.

4. EXCITER AUDIO

Exciter audio is defined as the audio used to modulate the transmitter. It is applied to the transmitter and can originate from several sources depending upon the modules that are used in the station.

Audio from the remote control point is applied to pins 19 and 20 of the line driver module, and is routed out of this module on pin 24. From this point, the audio is applied to pin 6 of the station control module for level control setting and gating (must be gated by PTT control). The audio leaves this module at pin 16 (as unnotched mic HI). From the station control module, it is applied to control metering connector J2, pin 7, and the F1-PL (or F1-CS) module, pin 18. The F1-PL module contains a notch filter that greatly attenuates any 2175 Hz guard tone signals present to insure that a guard tone is not transmitted "on-the-air". After filtering, the exciter audio HI output from the F1 tone control module at pin 22, is applied to the exciter, via J102-12.

5. RECEIVE AUDIO

Receiver R1 or R2 detected audio output is routed (via J202-5 or J302-5, respectively) to the line driver module at pins 13 and 22, respectively. (R1 detected audio is first routed through the R1 audio & squelch module for processing and switching. R2 detected audio is first routed through the R2 audio & squelch module for processing and switching.) In repeater operation, R1 detected audio is applied to the squelch gate module, at pin 17.

Any receive audio is routed through the line driver module; however, the output point depends upon the module used and the jumper connections.

Normally, receive audio is routed through the line 1 level set control, line amplifiers, and exists on pins 19 and 20. The wire line pair carries this audio back to the remote control point.

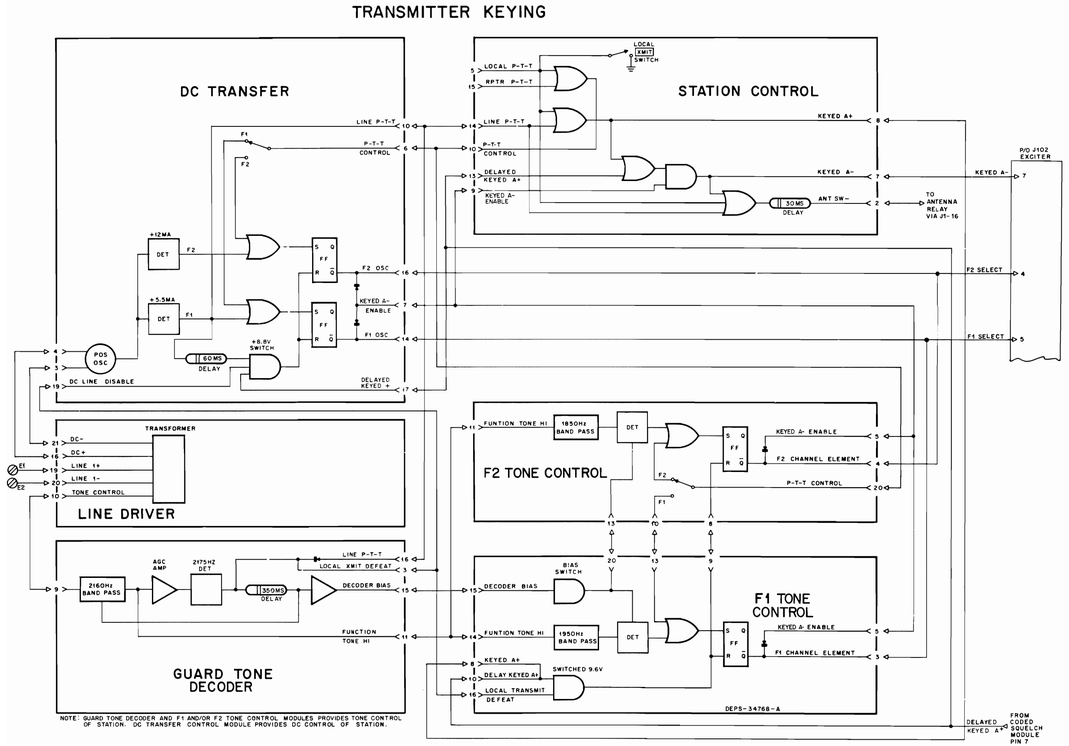
R1 detected audio may be routed to the line 1 output while R2 detected audio may be routed through the line 2 level set control, line amplifiers, and exit the module on pins 7 & 8. Both wire line pairs carry audio to a remote point.

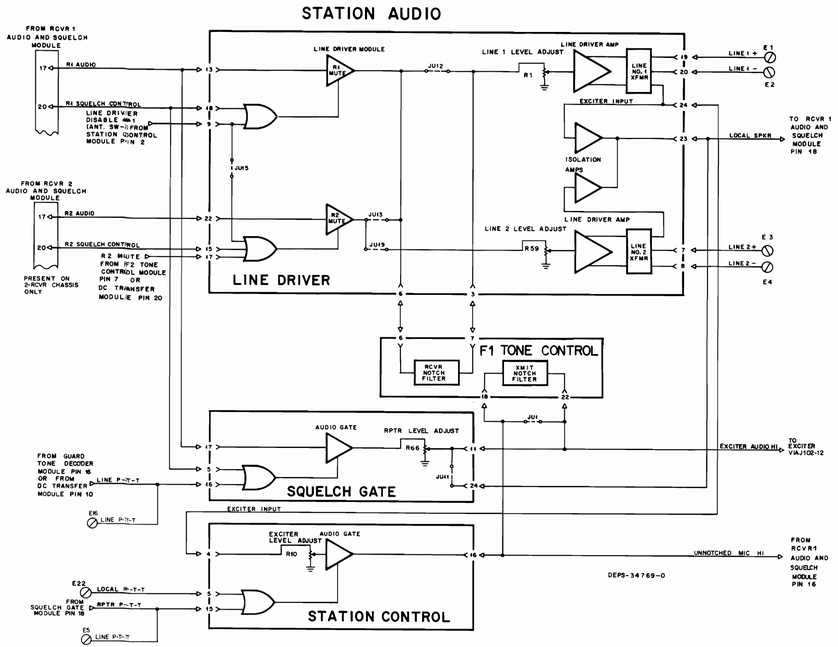
The detected audio from the receiver(s) can be routed to the line 2 output, when line 1 is to be used for transmit audio and line 2 is to be used for receive audio.

In tone controlled stations, R1 detected audio is routed from the receiver, through the F1-PL tone control module which contains a 2175 Hz receive notch filter (to remove any 2175 Hz guard tone), then to the line driver module.

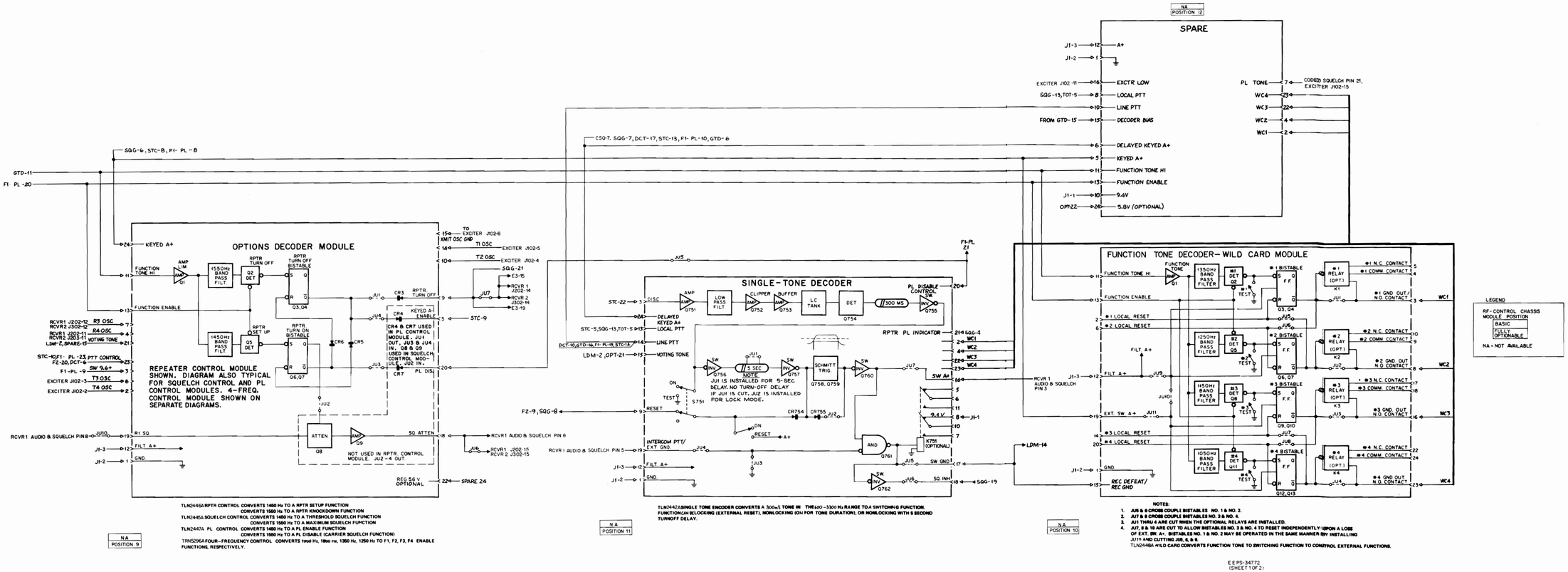
Any audio that is routed to line 1 or line 2 is sampled from the line transformer and exists the line driver module on pin 23. This audio is routed to the audio power amplifier of the R1 audio & squelch module for local speaker audio.

In repeater configurations, R1 detected audio is applied to pin 17 of the squelch gate module for gating and level setting. The audio output at pin 11 (repeat audio) is then routed to the exciter, via J102-12, for repeat transmission.

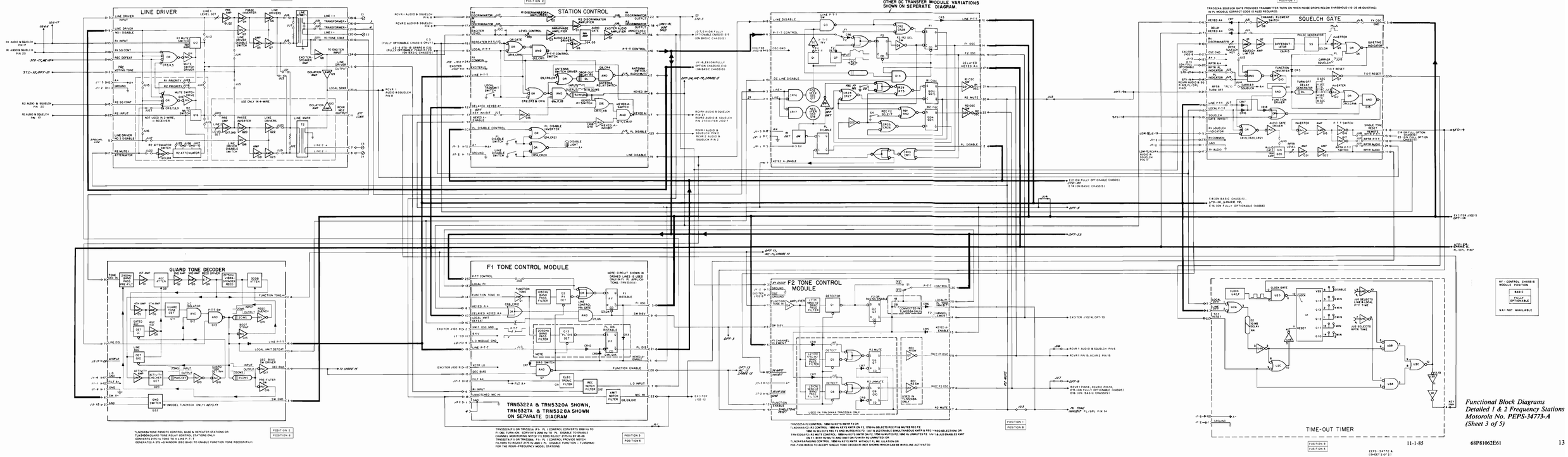




Functional Block Diagrams
Simplified 1 & 2 Frequency Stations
Motorola No. PEPS-34773-A
(Sheet 1 of 5)



Functional Block Diagrams
Detailed 1 & 2 Frequency Stations
*Motorola No. **PEPS-34773-A***
(Sheet 2 of 5)



Functional Block Diagrams Detailed 1 & 2 Frequency Stations Motorola No. PEPS-34773-A (Sheet 3 of 5)

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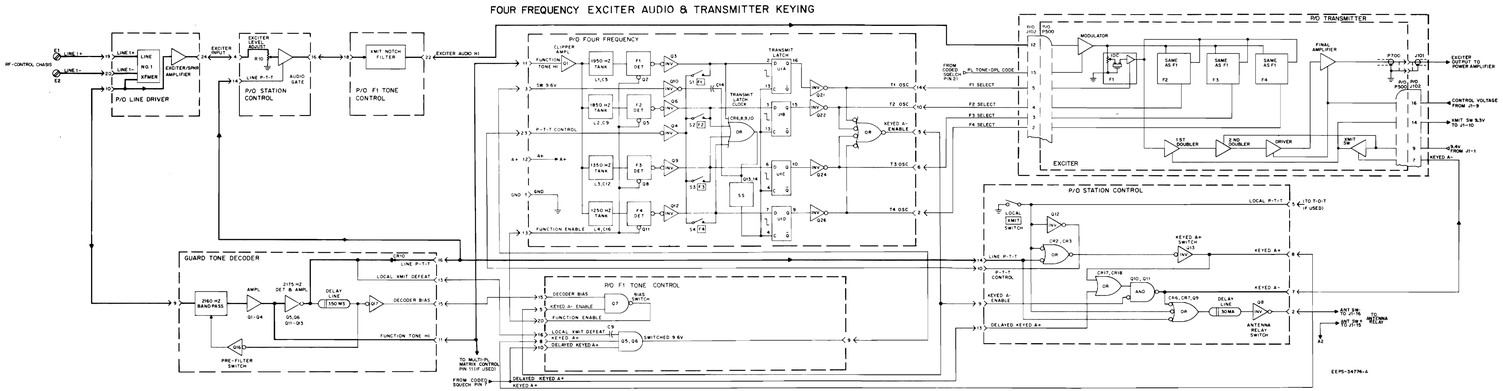
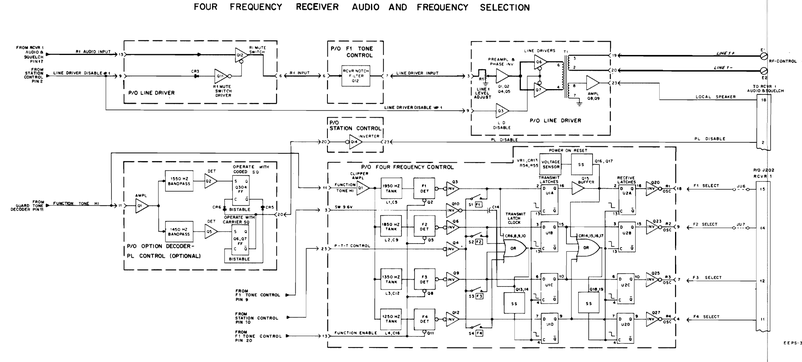
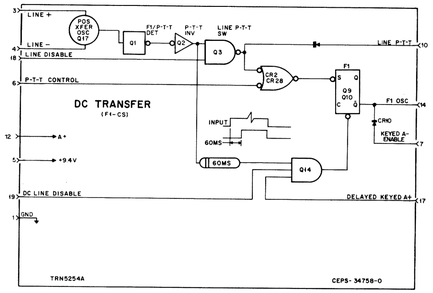
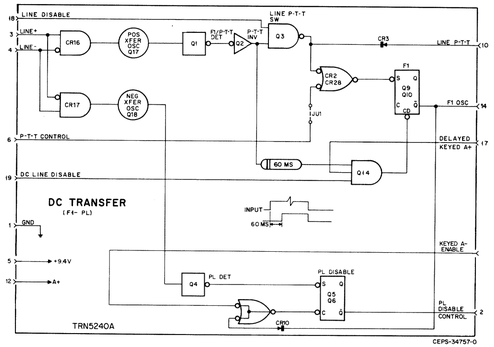
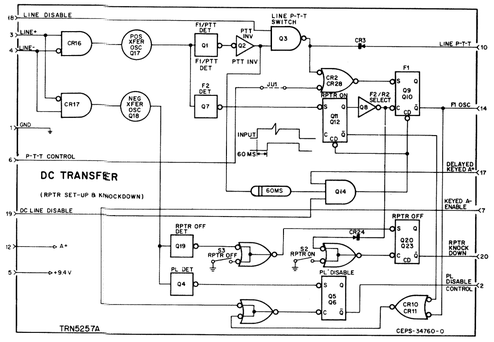


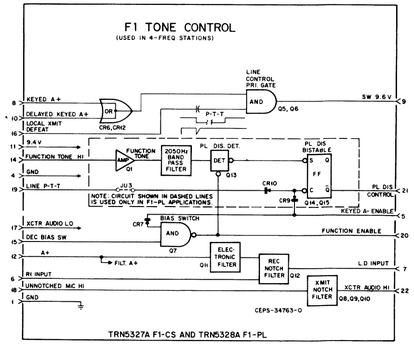


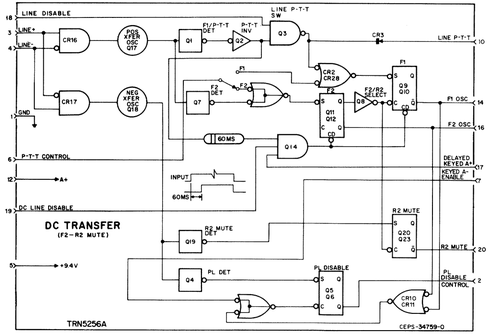
Functional Block Diagrams
Simplified 4 Frequency Stations
Motorola No. PEPS-34773-A
(Sheet 4 of 5)

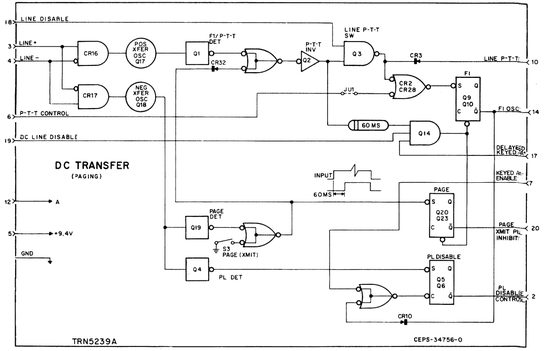


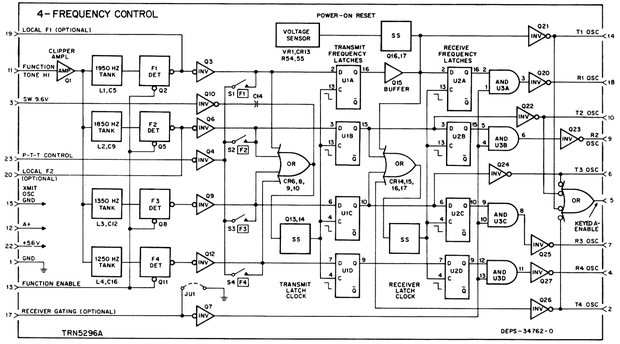












Functional Block Diagrams
Control Module Variations
*Motorola No. **PEPS-34773-A***
(Sheet 5 of 5)

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FUNCTIONAL DESCRIPTION

APPLICATIONS 68P81062E59
REMOTE CONTROL 68P81062E61

RF-CONTROL CHASSIS

RF-CONTROL CHASSIS (TLN2472B, 74B, 75B) (B VERSION) 68P81070E88

REMOTE CONTROL

REMOTE CONTROL MODULES 68P81062E63
- STATION CONTROL (TRN5321A) 68P81062E14
- LINE DRIVER (TRN5235A, 36A, 37A) 68P81062E13
- LINE DRIVER (TRN5240A, 54A, 55A, 56A) 68P81062E16
- DC TRANSFER (TRN5239A, 57A) 68P81062E17
- GUARD TONE DECODER (TLN2443A, 50A) 68P81062E18
- F1 TONE CONTROL (TRN5320A, 22A, 27A, 28A) 68P81062E19
- F2 TONE CONTROL (TLN2444A, 49A, TRN5256A, 5325A) 68P81062E21
- SQUELCH GATE (TRN5324A) 68P81062E23
- TIME-OUT TIMER (TRN2442A) 68P81062E24
- SINGLE-TONE DECODER (TLN2442A) 68P81062E26
- 4-FREQUENCY CONTROL OPTION DECODER (TRN5296A) 68P81062E22
- SQUELCH, REPEATER, AND *PRIVATE-LINE* CONTROL OPTION DECODER (TRN1249A, 50A, 51A) 68P81062E28
- "WILD CARD" CONTROL (TLN2448A) 68P81062E27

AUDIO & SQUELCH

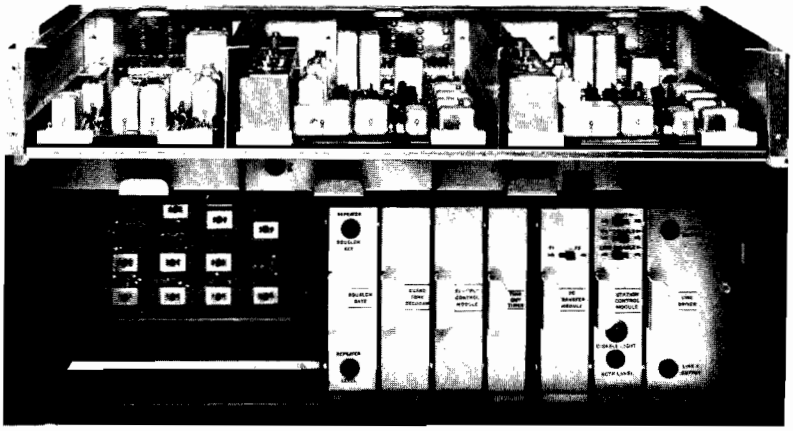
R1 AUDIO & SQUELCH MODULE (TRN9688A, 89) 68P81070E57
R1 AUDIO & SQUELCH MODULE (TRN5068A, 69A) 68P81062E57
R2 AUDIO & SQUELCH MODULE (TRN9690A, 91A, 92A) 68P81070E58
R2 AUDIO & SQUELCH MODULE (TRN5070A, 71A, 72A) 68P81062E64
TONE *PRIVATE-LINE* ENCODER-DECODER MODULE TRN5073A, 74A, 75A) 68P81062E51
DIGITAL PRIVATE-LINE ENCODER-DECODER MODULE (TRN5076A, 77A, 78A) 68P81062E52

OPTIONAL EQUIPMENT

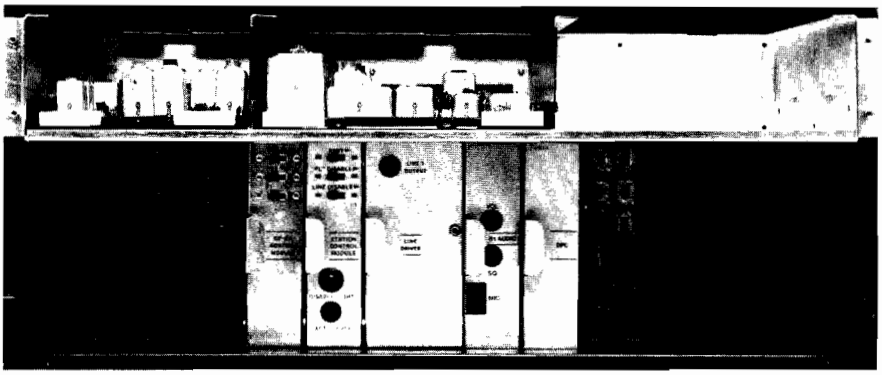
Spectra-TAC ENCODER OPTION (C269) 68P81112E78
- *Spectra-TAC* 4-WIRE LINE DRIVER MODULE (TRN5294A) 68P81062E41
- *Spectra-TAC* ENCODER MODULE (TRN5293A) 68P81062E42
- *Spectra-TAC* SQUELCH GATE MODULE (TRN5331A) 68P81062E43

MSR 2000 BASE AND REPEATER STATION MULTIPLE TONE PL OPTIONS (C158, C261, C262, C263) 68P81112E80
- MULTIPLE PL MATRIX CONTROL MODULE (TRN5330A) 68P81062E67
- MULTIPLE PL ENCODER MODULE (TRN5292A) 68P81062E68
- MULTIPLE PL ENCODER MODULE (TRN5329A) 68P81062E69

RF-CONTROL CHASSIS
B VERSION



TYPICAL FULLY OPTIONABLE RF CONTROL CHASSIS FAEPS-34814-O (F592)

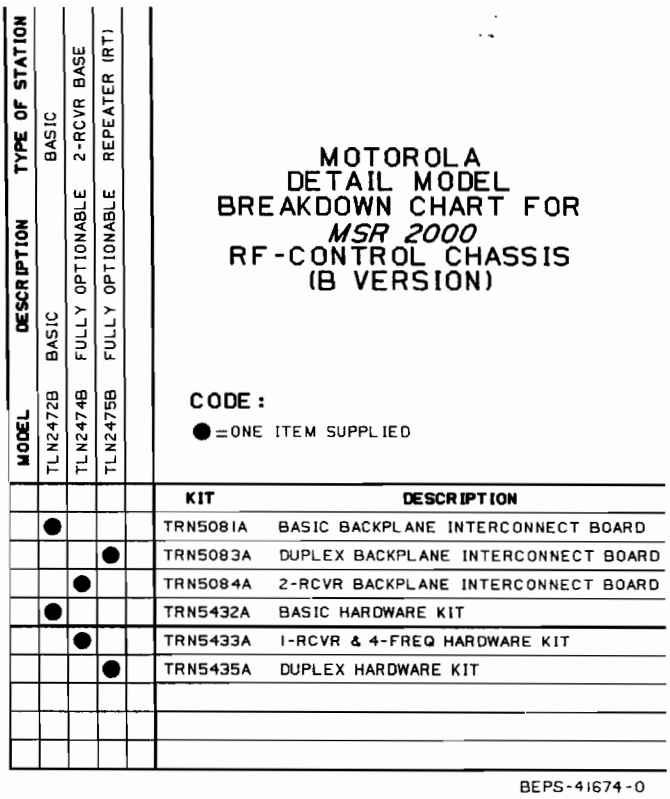


TYPICAL BASIC RF CONTROL CHASSIS FAEPS-34815-O (R592)

1. DESCRIPTION

Five RF-Control Chassis are described in this section (refer to the detail model breakdown chart). The BASIC rf control chassis uses a smaller Backplane Interconnect Board, with a maximum capacity of nine control and audio modules, one exciter, and one receiver. The FULLY OPTIONABLE RF-Control Chassis uses a larger Backplane Interconnect Board, with a maximum capacity of fifteen control and audio modules, one exciter, and two receivers.

The RF-Control Chassis mounts plug-in modules that perform control switching functions and audio processing for station operation. Nylon guide rails in the chassis align the modules with the mating connecting pins on the Backplane Interconnect Board, on the rear of the chassis.



MOTOROLA
DETAIL MODEL
BREAKDOWN CHART FOR
MSR 2000
RF-CONTROL CHASSIS
(B VERSION)

CODE:
● = ONE ITEM SUPPLIED

MODEL	DESCRIPTION	TYPE OF STATION
TLN2472B	BASIC	BASIC
TLN2474B	FULLY OPTIONABLE	2-RCVR BASE
TLN2475B	FULLY OPTIONABLE	REPEATER (RT)

TLN2472B	TLN2474B	TLN2475B	KIT	DESCRIPTION
●			TRN5081A	BASIC BACKPLANE INTERCONNECT BOARD
		●	TRN5083A	DUPLEX BACKPLANE INTERCONNECT BOARD
	●		TRN5084A	2-RCVR BACKPLANE INTERCONNECT BOARD
●			TRN5432A	BASIC HARDWARE KIT
	●		TRN5433A	1-RCVR & 4-FREQ HARDWARE KIT
		●	TRN5435A	DUPLEX HARDWARE KIT

BEPS-41674-O

2. APPLICATION

2.1 TONE OR DC REMOTE CONTROL

The RF-Control Chassis, together with the associated plug-in modules, permits a station to be operated from a remote location and performs various control or operational functions for the station. Tones or dc line currents generated at a remote location(s) are carried over wire line pairs to the station's RF-Control Chassis via the junction box, to implement the desired type of operation. The RF-Control Chassis and its modules convert the tones or dc line currents into switching functions to perform any or all of the operations listed in Tables 1, 2, and 3, depending on the modules used.

Table 1. DC Commands

DC Line Current (mA)	Operation
0	Transmitter standby, receiver operative
-2.5	PL disable (receiver)
-5.5	Mute receiver 2 audio
+5.5	Turn-on transmitter F1 oscillator; Select R1 receiver oscillator
-12.5	Turn-on transmitter F1 oscillator without PL modulation for paging (XMIT PL Inhibit)
+12.5	Turn-on transmitter F2 oscillator; Repeater turn-on; Select R2 receiver oscillator
12.5 (momentary)	Unmute receiver 2 audio

Table 2. Tone Commands

Tone Freq. (Hz)	Operation
2050	Disable receiver PL
1950	Transmit F1, or Select F1
1850	Transmit F2, or Select F2, or Transmit F1 w/o PL
1750	R2 Mute, or Receive F1*
1650	R2 Unmute or Receive F2*
1550	MAX Squelch, or Repeater OFF, or PL ON
1450	MIN Squelch, or Repeater ON, or PL OFF
1350	"Wild Card" ON #1, or Select F3
1250	"Wild Card" ON #2, or Select F4
1150	"Wild Card" ON #3
1050	"Wild Card" ON #4

*C2-R2 Receiver Frequency Selection

Table 3. Guard Tone

Tone Freq. (Hz)	Operation
2175	Function Tone Enable

2.2 PLUG-IN MODULES

All stations are equipped with plug-in exciter and receiver boards, and an R1 audio & squelch module. Coded squelch stations have an additional PL or DPL encoder-decoder module. Two receiver stations have an

additional plug-in receiver board and an R2 audio & squelch module.

All stations are also equipped with the following basic complement of control modules.

DC CONTROL
- DC Transfer Module
- Station Control Module
- Line Driver Module

TONE CONTROL
- Guard Tone Decoder Module
- F1 Tone Control
- F2, or C2-R2, Tone Control Module (2-Frequency Stations)
- Station Control Module
- Line Driver Module

Repeater stations are also equipped with a Squelch Gate Module and Time-Out Timer Module. Repeaters without wire line control may have the modules that are associated with line control operation omitted. All base and repeater stations have additional space provided for optional accessory modules.

3. SERVICE AND MAINTENANCE

3.1 LOCAL STATION OPERATION

WARNING

ALWAYS line disable this station when performing local maintenance duties. Failure to do so may result in personal injury or equipment damage. Selection of frequency by the remote control console momentarily keys this station even though the microphone push-to-talk switch has not been depressed. Upon completion of local testing, return the line disable switch to its normal position.

3.2 REMOVAL AND REPLACEMENT OF MODULES

Modules may be removed by simply pulling outward on the module, and may be replaced by pushing the module back into its position by its panel. The modules are labelled and the mounting positions are marked on the inside of the module housing and on the backplane interconnect board.

CAUTION

ALWAYS be sure of the correct module installation position before plugging a module into the RF-Control Chassis.

Technicians who service many of these stations may wish to carry spares and replace malfunctioning modules for immediate restoration of operation. The module may then be repaired at the shop and used as the next replacement spare.

NOTE

For proper operation, all jumper connections must be identical on modules that are removed and modules that are inserted before swapping can be successfully used as a troubleshooting technique.

3.3 INSTALLATION OF ADDITIONAL MODULES

When new functions (optional modules) are added, refer to the pertinent module section in this manual for proper jumpering information.

3.4 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 rear 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.

3.5 INTERCOM, OR METERING & INTERCOM

The Option C226 Series Service Intercom or Option C149 Series Metering and Intercom are optional accessories for remotely controlled *MSR 2000* base or repeater stations. Both of these accessory items facilitate testing, adjustment, and maintenance of the station. There is a specific version of these options available for any *MSR 2000* base or repeater station.

The speaker and test microphone may be used for two-way intercom between the station and the remote control console without keying the station transmitter. The speaker and microphone also may be used to locally op-

erate the station for "on-the-air" testing and maintenance. The NORMAL-INT switch (S1) selects the desired mode of operation; NORMAL for "on-the-air" testing and INT for intercom operation. The SPKR-OFF switch allows the speaker to be used during testing, or to be disabled when the station is unattended.

The intercom mode is operated by placing the NORMAL-INT switch (S1) in the INT position, the SPKR-OFF switch in the SPKR position, and depressing the microphone PTT button. Microphone audio is then routed, via the line driver, to the remote control console (over the control line). Microphone audio is also routed to the transmitter, however the INT PTT function does not key the transmitter. A message from the remote control console is applied to the speaker through the line driver and R1 audio & squelch modules.

When switch S1 is in the NORMAL position and the microphone PTT switch is activated, mic audio is again routed to the line driver. However, the line driver is inhibited under these conditions, which prevents line noise from being transmitted. Mic audio is applied to the exciter and the transmitter is keyed.

3.6 LOCAL OPERATING INSTRUCTIONS

3.6.1 Intercom

Step 1. Connect a test microphone to the microphone receptacle on the R1 audio & squelch module.

Step 2. Place the SPKR-OFF switch in the SPKR position.

Step 3. Place the NORMAL-INT switch in the INT position.

Step 4. The unit is now ready for intercom operation between the station and remote control point. Close the push-to-talk switch on the microphone and speak into the microphone to send a message. Release the button to listen; replies will be heard in the local speaker. The console operator at the remote point must also switch to an intercom mode to prevent keying the station during replies.

WARNING
Station should ALREADY be line disabled!

Step 5. Return the SPKR-OFF switch to the OFF position and return the NORMAL-INT switch to the INT position before leaving the station unattended.

3.6.2 "On-The-Air" Testing

Step 1. Connect a test microphone to the microphone receptacle on the R1 audio & squelch module.

Step 2. Place the SPKR-OFF switch in the SPKR position.

Step 3. Leave the NORMAL-INT switch in the NORMAL position.

Step 4. The unit is now ready for "on-the-air" testing. If the microphone push-to-talk switch is closed, the station's transmitter will be keyed. Speak into the microphone to transmit a message. Release the push-to-talk switch to listen. Receiver audio will be heard on the local speaker.

Step 5. Return the SPKR-OFF switch to the OFF position before leaving the station unattended.

3.6.3 Monitoring

To monitor audio quality, etc., place the SPKR-OFF switch in the SPKR position. Both receiver audio and line audio from the remote control point will be heard in the local speaker.

4. SPECIAL MODIFICATIONS

To change the Function Tone Decoder frequencies from the standard value, change those parts indicated in Figure 1 and Table 4.

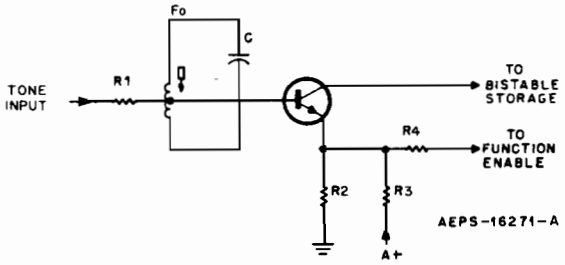


Figure 1. Typical Function Tone Detector

Table 4. Function Tone Modification Table

To Change Function Tone Tank Freq. To	R1 ±5% (Ohms)	R2 ±5% (Ohms)	R3 ±1% (Ohms)	R4 ±1% (Ohms)	C1 ±2% (uF)	Capacitor Part No.
2050 Hz	27k, 33k*	1.5k	2.7k**	221	.0056	8-84326A13
1950 Hz	22k, 27k*	1k	2.2k**	221	.0062	8-84326A14
1850 Hz	18k, 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	.0112	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

* Values for "Wild Card" only.
** ±5% is allowable.

Example: Changing "Wild Card" frequency to 1850 Hz

Freq.	R1	R2	R3	R4	C1
1850 Hz	22k ±5%	1.5k ±2%	2.7k ±5%	221 ±1%	.0069 uF ±2%

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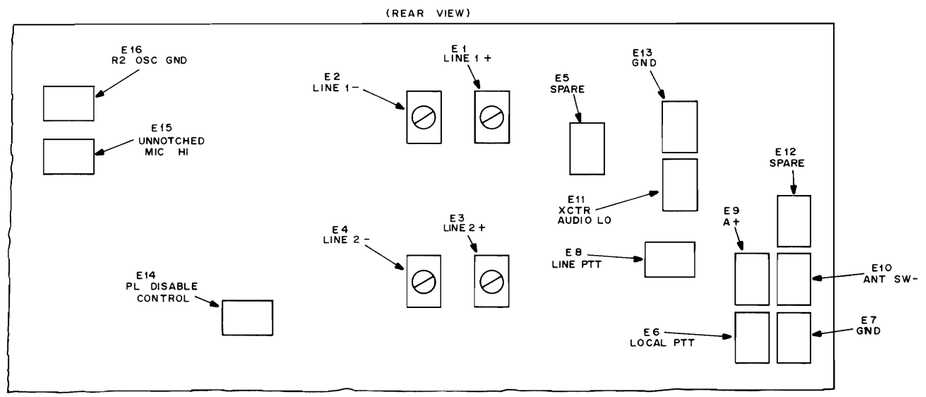
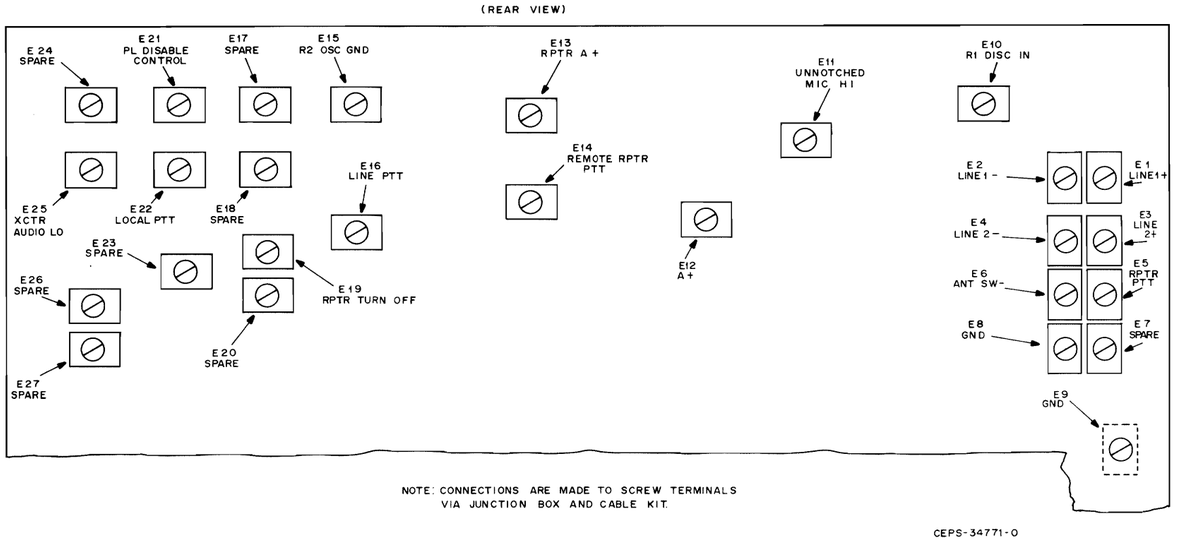
BASIC BACKPLANE INTERCONNECT BOARD
EXTERNAL CONNECTION DETAIL



NOTE: CONNECTIONS ARE MADE TO SCREW TERMINALS
VIA JUNCTION BOX AND CABLE KIT

CEPS-34770-O

FULLY OPTIONABLE BACKPLANE INTERCONNECT BOARD
EXTERNAL CONNECTION DETAIL



NOTE: CONNECTIONS ARE MADE TO SCREW TERMINALS
VIA JUNCTION BOX AND CABLE KIT.

CEPS-34771-O

parts list

reference symbol suffix	legend application
No Suffix	All Models
A	TRN5081A
C	TRN5083A
D	TRN5084A

This parts list covers 3 models of the Backplane Interconnect Board. Where differences exist, a letter code is added to the reference symbol to indicate the applicable unit.

TRN5081A Basic Backplane Interconnect Board Kit
TRN5083A Duplex Backplane Interconnect Board Kit
TRN5084A 2-Receiver Backplane Interconnect Board Kit PL-9796-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		assembly:
A901 (C)	1-80731D91	duplex filter; includes: ref. items C901 thru 916, L901 thru 916, J102
		capacitor, fixed: ± 10%; 100 V; unless otherwise stated
C1 thru 16 (A, D)	21-11015B13	.001 uF
C17 thru 29	21-11015B13	.001 uF
C30 thru 33 (C, D)	21-11015B05	220 pF
C34 thru 37 (D)	21-11015B05	220 pF
C38 thru 50 (D)	21-11015B13	.001 uF
C901 thru 916 (C)	21-82900N01	feedthru, 470 pF ± 20%; 500 V
		diode: (see note)
CR1	48-83654H01	silicon
		contact:
E1 thru 4	—	consists of:
	29-83362G01	TERMINAL, screw
	3-84482M01	SCREW, machine
E5 thru 26 (C, D)	—	consists of:
	—	consists of:
		coil, rf:
L901 thru 916 (C)	24-83961B01	choke, 3 turns
		connector, receptacle:
J1	—	consists of:
	28-84247N01	MALE; 16-contact
J2, 3, 4	9-84207B01	female; 7-contact
J5	—	consists of:
	28-83496F20	MALE; 6-contact
	28-83496F25	MALE; 8-contact
J6 (D)	9-84207B01	female; 7-contact
J102	28-83496F22	male; 10-contact; 2 used
J202	28-83496F22	male; 10-contact; 2 used
J302 (D)	28-83496F22	male; 10-contact; 2 used
		resistor, fixed:
R1	17-83122D09	22 ± 5%; 3 W
R2	6-126A23	82 ± 5%; 1 W
		voltage regulator: (see note)
VR1	48-83461E34	Zener, 5.6 V
		non-referenced items
	1-80755D01	DUPLEX FILTER BOARD (p/o ref. item A901) includes ref. items L901 thru 916 (TRN5083A)
	1-80755D02	DUPLEX FEEDTHRU ASSEMBLY (p/o ref. item A901) includes ref. item C901 thru 916 (TRN5083A)
	3-134184	SCREW, tapping: 4-40 x 5/16"; 6 used (TRN5083A)
	3-84482M01	SCREW, machine; 6-32 x 5/16";16 used (TRN5081A); 27 used (TRN5082A, 5083A, 5084A)
	28-83496F23	CONNECTOR, male; 12-contact; (PCB Edge Connectors)18 used (TRN5081A); 30 used (TRN5082A, 5083A, 5084A)
	43-84229N01	SPACER, threaded; 3 used
	26-82896N01	SHIELD, coil

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

TRN5081B Basic Backplane Interconnect Board PL-9676-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: ± 10%; 100 V: unless otherwise stated
C1 thru 29	21-11015B13	.001 uF
		diode: (see note)
CR1	48-83654H01	silicon
		contact, assembly:
E1 thru 4	1-80756D87	consists of:
	29-83362G01	TERMINAL, screw: 6-32"; 4 used
	3-84482M01	SCREW machine: 6-32 x 5/16"; 4 used
		connector, receptacle:
J1	28-84247N01	male; 16-contact
J2, 3, 4	9-84207B01	female; 7-contact
J5	—	consists of:
	28-83496F20	MALE; 6-contact
	28-83496F25	MALE; 8-contact
J102, 202	28-83828P01	male; 20-contact (PCB edge connector)
		resistor, fixed:
R2	6-126A23	82 ± 5%; 1 W
		mechanical parts
	3-134184	SCREW, tapping: 4-40 x 5/16"; 4 used
	28-83828P02	CONNECTOR, male; 24-contact (edge connector); 9 used

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

TRN5433A 1-Receiver Hardware Kit PL-9797-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	3-134185	SCREW, tapping: 6-32 x 1/4"; 4 used
	3-134186	SCREW, tapping: 6-32 x 5/16"
	3-135506	SCREW, tapping: 6-32 x 1/4"; 23 used
	27-82850N01	CHASSIS, control
	27-82876N01	CHASSIS, card cage
	39-82857N01	CONTACT, ground; 4 used
	42-82888N01	CLIP, detent; 2 used
	45-83914G01	GUIDE, card; 10 used
	46-82856N01	GUIDE, circuit board; 4 used
	46-82877N01	GUIDE, circuit board mounting; 2 used (TRN5433A, 5435A); 6 used (TRN5434A)
	54-83570K01	LABEL, chassis

TRN5432A Basic Hardware Kit PL-9798-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	3-134185	SCREW, tapping: 6-32 x 1/4"; 6 used
	3-135506	SCREW, tapping: 6-32 x 1/4"; 15 used
	27-82850N02	CHASSIS, control
	27-82885N01	CHASSIS, card cage
	39-82857N01	CONTAC, ground; 4 used
	42-82888N01	CLIP, detent; 2 used
	45-83914G01	GUIDE, card; 12 used
	46-82856N01	GUIDE, circuit board; 4 used
	54-83570K09	LABEL, chassis

External Connection Details and Parts Lists
*Motorola No. **PEPS-42062-O***
(Sheet 1 of 5)
11/1/85- UP

RF-CONTROL CHASSIS (B VERSION)

DESCRIPTION–MODULE	REEDS POSITION (PP/EPS-34542-O) / FUNCTION	GROUND, LINE DRIVER GROUND, VR1 ANODE, ALERT TONE GND, SPKR	A+, ANT. RELAY PROTECT CKT. (CR1 ANODE & R2)	ANT. SW – 1, LINE DRIVER DISABLE NO. 1	KEY INHIBIT	XCTR. SPKR LEVEL	KEYED A, RCVR UN SQ INDICATOR	KEYED A+	PTT CONTROL	LOCAL PTT	XMIT OSC GND, CHAN ELEM GND	EXCITER AUDIO LO	DELAYED KEYED A+	LINE PTT	UNNOTCHED MIC HI	LINE +, XFMR +	LINE –, XFMR –	LINE DISABLE	PL DISABLE CONTROL	PL DISABLE	R1 DISC INPUT	R1 DISC OUT, DISC	F1 OSC GND, F1 CHAN ELEM	F2 OSC GND, F2 CHAN ELEM
F2 TONE CONTROL (3–VERSIONS)	1	1, 16	12						20		2											3	6	4 *
GUARD TONE DECODER (1–VERSION)	2	1, 17	12								2	23	6	16 *				7					3	
F1 TONE CONTROL (2–VERSIONS)	3	1, 4	12					8	23		2	17	10	19	18				21 *				3 *	
DC TRANSFER (4–VERSIONS)	4	1	12						6		15		17	10 *		3	4	18	2 *				14 *	16 *
STATION CONTROL (1–VERSION)	5	1, 24	12	2 *	3	4	7 *	8 *	10 *	5 *		11	13	14	16 *			19	20	23 *	21	22 *		
LINE DRIVER (2–VERSIONS)	6	1	12	9		24 *	4 *									16 *	21 *							
R1 AUDIO & SQUELCH (2–VERSIONS)	7	1, 9, 14, 23, 24	12				21			4		19			15 *					2	8 *			
CODED SQUELCH (4–VERSIONS)	8	1, 16, 18	12				3	13				20	7 *								17			
TIME–OUT TIMER (1–VERSION)	9	1	12		4 *					5				6										
EXCITER	J102	1, 8, 10, 13	20				7				8 *	11 *											5	4
RECEIVER 1	J202	1, 4, 6, 8, 10, 13, 18	9										16											
RF–CONTROL CHASSIS CONNECTOR	J1	2, 6, 8, 12	3, 4, 5	16			14																	
CONTROL METERING CONNECTOR	J2	2, 3, 4, 6								5					7									
EXCITER METERING CONNECTOR	J3	4, 5, 6, 7																						
RECEIVER 1 METERING CONNECTOR	J4	4, 6, 7																						
FACTORY TEST CONNECTOR	J5	14	6							7		4			11				13					
EXTERNAL SCREW TERMINALS	E	7,13	9	10						6		11		8	15				14					
JUMPER WIRES (BOTH ENDS)	JU	5						2							1								4	

DESCRIPTION–MODULE	9.4 V DC	DC LINE DISABLE, LOC XMTR DEFEAT	R2 MUTE, PAGE (XMIT PL INHIBIT)	R1 OSC GND	R2 OSC GND	LINE DRIVER INPUT (NOTCHED RCVR AND/OR INTERCOM AUDIO)	R1 INPUT, LINE DRIVER OUTPUT (UNNOTCHED RCVR AND/OR INTERCOM FED)	LOCAL SPKR	TONE CONTROL IN	R1 AUDIO INPUT	R1 SQ CONT/L01 R1 SQ INDICATE	KEYED A – ENABLE	SW 9.6 V DC	LOCAL F1	FUNCTION TONE HI	DECODER BIAS SW, LINE DRIVER R2 AUDIO OUTPUT	FUNCTION ENABLE	EXCITER AUDIO HI	PL INDICATOR, SW A+	XMIT PL INHIBIT, LINE DRIVER DISABLE NO. 2	PL TONE – DPL CODE	SPKR +
F2 TONE CONTROL (3–VERSIONS)			7 *	15 *	17 *							5 *	8	10 *	11 *		13 *			14 *		
GUARD TONE DECODER (1–VERSION)		13 *						9							11 *	15 *						
F1 TONE CONTROL (2–VERSIONS)	11	16				7 *	6					5 *	9	13	14	15	20 *	22 *				
DC TRANSFER (4–VERSIONS)	5	19	20 *	21 *	22 *							7 *										
STATION CONTROL (1–VERSION)												9										
LINE DRIVER (2–VERSIONS)			17			3	6 *	23 *	10 *	13	18					11				5		
R1 AUDIO & SQUELCH (2–VERSIONS)	11						15 *	18		17 *	20								3			22 *
CODED SQUELCH (4–VERSIONS)	10																		5 *	14	21 *	
TIME–OUT TIMER (1–VERSION)																						
EXCITER	9				14													12				
RECEIVER 1	7			15																		
RF–CONTROL CHASSIS CONNECTOR	1 *																					
CONTROL METERING CONNECTOR																						
EXCITER METERING CONNECTOR																						
RECEIVER 1 METERING CONNECTOR																						
FACTORY TEST CONNECTOR																				2		15 *
EXTERNAL SCREW TERMINALS					16																	
JUMPER WIRES (BOTH ENDS)			3				6					4						1, 7		3		

DESCRIPTION–MODULE	CONTROL LINE 1–	CONTROL LINE 1+	CONTROL LINE 2–	CONTROL LINE 2	RCVR 1 DETECTED AUDIO	CONTROL VOLTAGE (POWER)	XMIT SW 9.3 V	RCVR 1 M1	RCVR1 M2	RCVR 1 M3	XMTR M1	XMTR M2	XMTR M3	LOW BAND RCVR 1, METERING	LOW BAND RCVR 1 EXTENDER ON - OFF	RCVR 1 AUDIO PL FILTER INPUT	RCVR 1 AUDIO PL FILTER OUTPUT	BATTERY ALERT TONE	ANT. SW – (CR1 CATHODE & R2)	SPARE	PLUG KEY	INTERCOM PTT
F2 TONE CONTROL (3–VERSIONS)																						
GUARD TONE DECODER (1–VERSION)																						
F1 TONE CONTROL (2–VERSIONS)																						
DC TRANSFER (4–VERSIONS)																						
STATION CONTROL (1–VERSION)																						
LINE DRIVER (2–VERSIONS)	19 *	20	8	7																		
R1 AUDIO & SQUELCH (2–VERSIONS)					7											10 *	13					5
CODED SQUELCH (4–VERSIONS)																15	19 *					
TIME–OUT TIMER (1–VERSION)																						
EXCITER						16 *	14 *				17 *	18 *	19 *									
RECEIVER 1					5 *			2 *	3 *	17 *				20 *	19							
RF–CONTROL CHASSIS CONNECTOR						9	10											7 *	15 *	[illegible]		
CONTROL METERING CONNECTOR																						
EXCITER METERING CONNECTOR											1	2	3									
RECEIVER 1 METERING CONNECTOR								1	2	3				5								
FACTORY TEST CONNECTOR	10 *	12	5	1	8															3	9	
EXTERNAL SCREW TERMINALS	1 *	2 *	3 *	4 *																5, 12		
JUMPER WIRES (BOTH ENDS)															5 *			6				

EEPS 34519 A

HOW TO READ CHART

1. This chart shows all interconnections made by the plating on both sides of the interconnect board and by wire jumpers.
2. All pin numbers in each vertical column are electrically common (interconnected by circuit board plating).
3. To trace interconnections from any starting point to all other common points proceed as follows:

Step 1. Find the module position or connector in the left hand column of the chart.

Step 2. Find the desired pin number. All pins of specific module or connector are listed in the low that extends to the right.

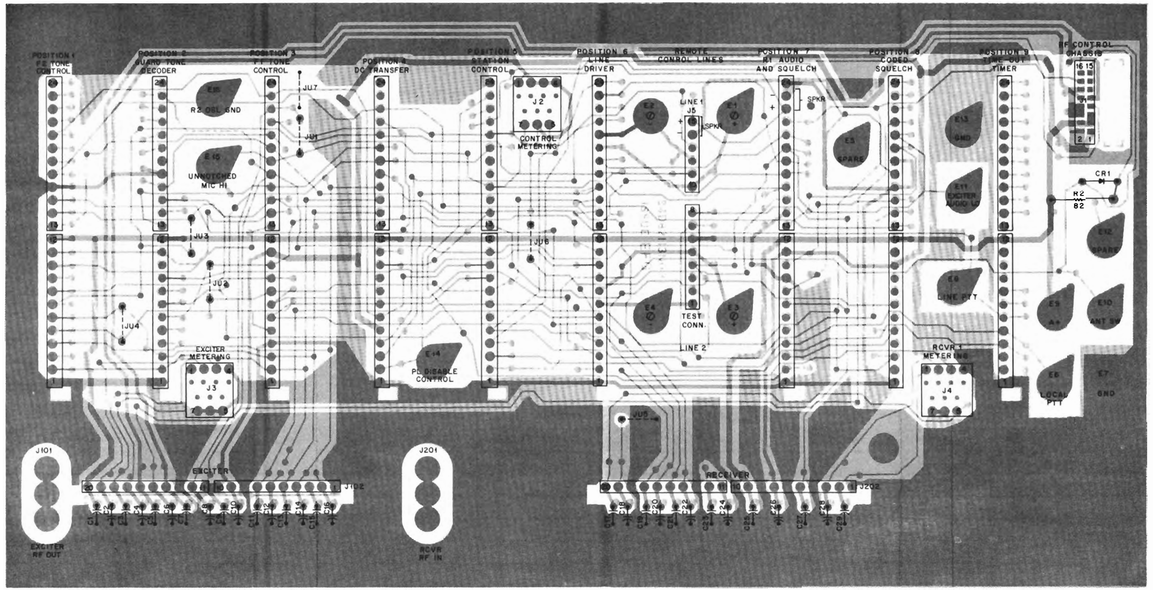
Step 3. oNote the function of the desired pin. The function is listed at the top of the column in which the pin number appears. All othr pins listed in the same column have the same function. Trace back to the left hand column to find the module or connector number. (See Example).

4. (*) indicates function source

EXAMPLE:
Station control module (module position 5), pin 10 has a function of PTT Control, which is interconnected to DC Transfer module position 4 (pin 6), F1 Tone Decoder module position 3 (pin 23), and F2 Tone Decoder module positon 1 (pin 20).

Basic Interconnect Chart
Motorola No. PEPS-42062-O
(Sheet 2 of 5)
11/1/85- UP

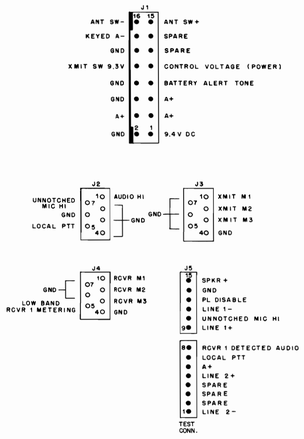
BASIC BACKPLANE INTERCONNECT BOARD



SHOWN FROM SOLDER SIDE

SOLDER SIDE = BD-DEPS-41759-O
COMPONENT SIDE = BD-DEPS-41761-O
OL-EEPS-41758-O

CONNECTOR PIN DESIGNATIONS



Jumper Table

Type of Station	Jumper						
	JU1	JU2	JU3	JU4	JU5	JU6	JU7
Remote Base-DC Controlled	IN	A	B	OUT	C	D	OUT
Remote Base-Tone Controlled	OUT	A	B	OUT	C	D	OUT

A. Out for *Private-Line* Squelch, In for Carrier Squelch
B. Normally Out, In for Paging Option
C. Normally Out, In for Low Band Receiver
D. Normally Out, In for Battery Alert Tone

Interconnect Board Position Usage Table

Position	Use	Module	Description
1	F2 Tone Control (3 Versions)	TLN2444A TLN2449A TRN5325A	C2-R2 Paging F2-Control
2	Guard Tone Decoder	TLN2443A	Standard
3	F1 Tone Control (2 Versions)	TRN5320A TRN5322A	F1-PL F1-CS
4	DC Transfer (4 Versions)	TRN5239A TRN5240A TRN5254A TRN5255A	Paging F1-PL F1-CS C2-R2
5	Station Control	TRN5321	Station Control
6	Line Driver (2 Versions)	TRN5235A TRN5236A	4-Wire 2-Wire
7	R1 Audio and Squelch (2 Versions)	TRN5068A TRN5069A	Without Intercom With Intercom
8	Coded Squelch (4 Versions)	TRN5074A TRN5075A TRN5077A TRN5078A	Simplex TA RA, PL Simplex TA RB, PL Simplex TA RA, DPL Simplex TA RB, DPL
9	Time-Out Timer	TRN5295A	Time-Out Timer

Basic Backplane Interconnect Circuit Bard Detail
Motorola No. PEPS-42062-O
(Sheet 3 of 5)
11/1/85-UP

RF-CONTROL CHASSIS (B VERSION)

HOW TO READ CHART

1. This chart shows all interconnections made by the plating on both sides of the interconnect board and by wire jumpers.
2. All pin numbers in each vertical column are electrically common (interconnected by circuit board plating).
3. To trace interconnections from any starting point to all other common points proceed as follows:

   Step 1. Find the module position or connector in the left hand column of the chart.

   Step 2. Find the desired pin number. All pins of specific module or connector are listed in the low that extends to the right.

   Step 3. oNote the function of the desired pin. The function is listed at the top of the column in which the pin number appears. All othr pins lsted in the same column have the same function. Trace back to the left hand column to find the module or connector number. (See Example).
4. (*) indicates function source.
5. NA = Not Assigned (Plating exists between points but not used.)

EXAMPLE:
Station control module (module position 2), pin 10 has a function of PTT Control, which is interconnected to DC Transfer module position 3 (pin 6), F1 Tone Decoder module position 5 (pin 23), F2 Tone Decoder module positon 8 (pin 20), and OPTION Decoder position 9 (pin 23).

DESCRIPTION–MODULE	REF. DES. POSITION (FUNCTION: PP/EPS–34542–0)	GROUND; LINE DRIVER GROUND; VR1 ANODE; 1 ALERT TONE GND; SPKR –	A+; ANT. RELAY PROTECT CKT. (CR1 ANODE & R2)	ANT. SW–; LINE DRIVER DISABLE NO. 1	TOT RESET	KEY INHIBIT	XCTR; SPKR LEVEL	KEYED A–	KEYED A+	PTT CONTROL	LOCAL PTT	XMIT OSC GND; CHAN ELEM GND	EXCITER AUDIO LO	DELAYED KEYED A+	LINE PTT	RPTR PTT	UNNOTCHED MIC HI	LINE +; XFMR +	LINE –; XMFR –	LINE DISABLE	PL DISABLE CONTROL	PL DISABLE	R1 DISC INPUT	R1 DISCR OUT; DISC	R1 SQ	R1 SQ ATTEN.
LINE DRIVER (4–VERSIONS)	1	1	12	9			24*											16*	21*							
STATION CONTROL (1–VERSION)	2	1, 24	12	2*		3	4	7*	8*	10*	5*		11	13	14	15	16*			19*	20	23*	21	22*		
DC TRANSFER (6 VERSIONS)	3	1	12							6		15		17	10*			3	4	18	2*					
TIME–OUT TIMER (1–VERSION)	4	1	12		22	4*					5				6											
F1 TONE CONTROL (4–VERSIONS)	5	1, 4	12						8	23		2	17	10	19		18				21*					
GUARD TONE DECODER (2–VERSIONS)	6	1, 17	12									2	23	6	16*					7						
SQUELCH GATE (2–VERSIONS)	7	1, 23	12		22*				6		13	2		7	16	18*								10		
F2 TONE CONTROL (4 VERSIONS)	8	1, 16	12							20		2												3		
OPTION DECODER (4–VERSIONS)	9	1	12						24	23		15													19	18*
FUNCTION TONE DECODER (2–VERSIONS)	10	1	12						19																	
SINGLE–TONE DECODER OR OPTION (3–VERSIONS)	11	1	12								13			6, 24	14						20			3		
SPARE OR OPTION (2 VERSIONS)	12	1	12						5		8		16	6	19											
R1 AUDIO & SQUELCH (2–VERSIONS)	13	1, 9, 14, 23, 24	12					21			4		19				16*					2	8*			6
R2 AUDIO & SQUELCH (3–VERSIONS)	14	1, 9, 10, 24	12					21														2				
CODED SQUELCH (6–VERSIONS)	15	1, 16, 18	12					3	13				20	7*									17			
EXCITER	J102	1, 8, 10, 13	20					7				8*	11*													
RECEIVER 1	J202	1, 4, 6, 8	9											16												
RECEIVER 2	J302	10, 13, 18	9											16												
RF–CONTROL CHASSIS CONNECTOR	J1	2, 6, 8, 12	3, 4, 5	16				14																		
CONTROL METERING CONNECTOR	J2	2, 3, 4, 6									5						7									
EXCITER METERING CONNECTOR	J3	4, 5, 6, 7																								
RECEIVER 1 METERING CONNECTOR	J4	4, 6, 7																								
FACTORY TEST CONNECTOR	J5	14	6								7		4				11				13					
RECEIVER–2 METERING CONNECTOR	J6	4, 6, 7																								
EXTERNAL SCREW TERMINALS	E	8, 9	12	6							22		26		16	5	11				21		10			
JUMPER WIRES (BOTH ENDS)	JU	11, 12	8			15			9					9			1				5		10		10	6

DESCRIPTION–MODULE	REF. DES. POSITION	F1 OSC GND; F1 CHAN ELEM	F2 OSC GND; F2 CHAN ELEM	9.4 V DC	DC LINE DISABLE; LOC XMTR DEFEAT	R2 MUTE; PAGE; RPTR ON; R2 MUTE ATTEN.	R1 OSC GND	R2 OSC GND	LINE DRIVER INPUT (NOTCHED RCVR AND/OR INTERCOM AUDIO)	R1 INPUT; LINE DRIVER OUTPUT (UNNOTCHED RCVR AND/OR INTERCOM AUDIO)	LOCAL SPKR	TONE CONTROL IN	R1 AUDIO INPUT	R2 AUDIO INPUT	R1 SQ CONTROL/R1 SQ INDICATE	KEYED A– ENABLE	SW 9.6 V DC	LOCAL F1	FUNCTION TONE HI	DECODER BIAS SW; LINE DRIVER R2 AUDIO OUTPUT	FUNCTION ENABLE	EXCITER AUDIO HI; REPEAT AUDIO	R3 OSC GND	SINGLE TONE RESET	PL INDICATOR SW A+	R2 SQ CONTROL; R2 SQ INDICATE
LINE DRIVER (4–VERSIONS)	1					17			3	6*	23*	10*	13	22	18											15
STATION CONTROL (1–VERSION)	2															9										
DC TRANSFER (6 VERSIONS)	3	14*	16*	5	19	20*	21*	22*								7*										
TIME–OUT TIMER (1–VERSION)	4																									
F1 TONE CONTROL (4–VERSIONS)	5	3*		11	16				7*	6						5*	9*	13	14	15	20*	22*				
GUARD TONE DECODER (2–VERSIONS)	6	3			13*							9							11*	15*						
SQUELCH GATE (2–VERSIONS)	7	3*									24*		17		5							11*		8*	14	
F2 TONE CONTROL (4 VERSIONS)	8	6	4*			7*	15*	17*								5*	8	10*	11		13			9		
OPTION DECODER (4–VERSIONS)	9	14*	10*													5	3		11		13		7*			
FUNCTION TONE DECODER (2–VERSIONS)	10																		11		13					
SINGLE–TONE DECODER OR OPTION (3–VERSIONS)	11			8																				9	16*	
SPARE OR OPTION (2 VERSIONS)	12			10															11	15	13					
R1 AUDIO & SQUELCH (2–VERSIONS)	13			11						15*	18		17*		20*										3	
R2 AUDIO & SQUELCH (3–VERSIONS)	14			11										17*												20*
CODED SQUELCH (6–VERSIONS)	15			10																					5*	
EXCITER	J102	5	4	9																		12				
RECEIVER 1	J202			7			15	14															12			
RECEIVER 2	J302			7			15	14															12			
RF–CONTROL CHASSIS CONNECTOR	J1			1*																						
CONTROL METERING CONNECTOR	J2																									
EXCITER METERING CONNECTOR	J3																									
RECEIVER 1 METERING CONNECTOR	J4																									
FACTORY TEST CONNECTOR	J5																									
RECEIVER–2 METERING CONNECTOR	J6																									
EXTERNAL SCREW TERMINALS	E							15																		
JUMPER WIRES (BOTH ENDS)	JU	4				2, 3	6	7		13						4						1, 14				

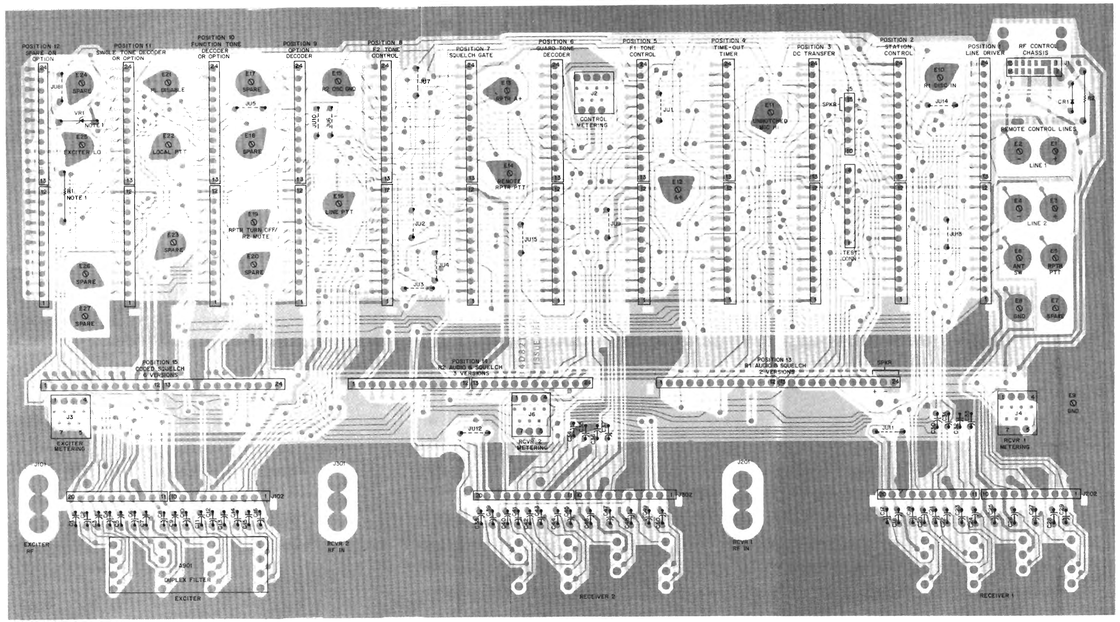
DESCRIPTION–MODULE	REF. DES. POSITION	SQ GATE INHIBIT	XMIT PL INHIBIT; LINE DRIVER DISABLE NO. 2	RPTR TURN–OFF; R2 OSC.	R2 DISC INPUT	PL TONE–DPL CODE	WC1; MTX1	WC2; MTX2	WC3; MTX3	WC4; MTX4	RCVR DEFEAT; SWITCHED GND	INTERCOM PTT (STATUS TONE INHIBIT)	STATUS TONE	R4 OSC GND	SPKR +	CONTROL LINE 1+	CONTROL LINE 1–	CONTROL LINE 2+	CONTROL LINE 2–	RPTR PL INDICATOR	RPTR A+	REMOTE RPTR PTT	PL DISABLE CONTROL	4–FREQ. REG 5.6 V DC (VR1 CATHODE & R1)	F3 OSC GND	F4 OSC GND
LINE DRIVER (4–VERSIONS)	1										14		2			19	20	8	7							
STATION CONTROL (1–VERSION)	2				17																					
DC TRANSFER (6 VERSIONS)	3																									
TIME–OUT TIMER (1–VERSION)	4																									
F1 TONE CONTROL (4–VERSIONS)	5																									
GUARD TONE DECODER (2–VERSIONS)	6																									
SQUELCH GATE (2–VERSIONS)	7	19		21																4	20*	15*				
F2 TONE CONTROL (4 VERSIONS)	8	18*	14*																							
OPTION DECODER (4–VERSIONS)	9			9*									21	4*									20*	22*	6*	2*
FUNCTION TONE DECODER (2–VERSIONS)	10						3*	8*	16*	23*	15*															
SINGLE–TONE DECODER OR OPTION (3–VERSIONS)	11	18*					2*	4*	22*	23*	17	19	15*							21*						
SPARE OR OPTION (2 VERSIONS)	12		17			7*	2	4	22	23														24*		
R1 AUDIO & SQUELCH (2–VERSIONS)	13											5*			22*											
R2 AUDIO & SQUELCH (3–VERSIONS)	14				8*																					
CODED SQUELCH (6–VERSIONS)	15		14			21*																				
EXCITER	J102					15								11											3	2
RECEIVER 1	J202													11												
RECEIVER 2	J302																									
RF–CONTROL CHASSIS CONNECTOR	J1																									
CONTROL METERING CONNECTOR	J2														1											
EXCITER METERING CONNECTOR	J3																									
RECEIVER 1 METERING CONNECTOR	J4																									
FACTORY TEST CONNECTOR	J5		2												15	10	12	5	1							
RECEIVER–2 METERING CONNECTOR	J6																									
EXTERNAL SCREW TERMINALS	E			19												1*	2*	3*	4*		13	14				
JUMPER WIRES (BOTH ENDS)	JU		3	2, 7					15														5	8		

DESCRIPTION–MODULE	REF. DES. POSITION	NA	RCVR 1 DETECTED AUDIO	RCVR 2 DETECTED AUDIO	CONTROL VOLTAGE (POWER)	XMIT SW 9.3 V	RCVR 1 M1	RCVR 1 M2	RCVR 1 M3	RCVR 2 M1	RCVR 2 M2	RCVR 2 M3	XMTR M1	XMTR M2	XMTR M3	LOW BAND RCVR 1 METERING	LOW BAND RCVR 2 METERING	LOW BAND RCVR 1 EXTENDER ON–OFF	LOW BAND RCVR 2 EXTENDER ON–OFF	RCVR 1 AUDIO PL FILTER INPUT	RCVR 1 AUDIO PL FILTER OUTPUT	BATTERY ALERT TONE	ANT. SW + (CR1 CATHODE & R2)	SPARE	PLUG KEY	RCVR UNSQUELCH INDICATOR
LINE DRIVER (4–VERSIONS)	1																									4
STATION CONTROL (1–VERSION)	2	6																								
DC TRANSFER (6 VERSIONS)	3																									
TIME–OUT TIMER (1–VERSION)	4																									
F1 TONE CONTROL (4–VERSIONS)	5																									
GUARD TONE DECODER (2–VERSIONS)	6	18																								
SQUELCH GATE (2–VERSIONS)	7																									
F2 TONE CONTROL (4 VERSIONS)	8																									
OPTION DECODER (4–VERSIONS)	9																									
FUNCTION TONE DECODER (2–VERSIONS)	10																									
SINGLE–TONE DECODER OR OPTION (3–VERSIONS)	11																									11
SPARE OR OPTION (2 VERSIONS)	12																									
R1 AUDIO & SQUELCH (2–VERSIONS)	13		7																	10*	13					
R2 AUDIO & SQUELCH (3–VERSIONS)	14			7																						
CODED SQUELCH (6–VERSIONS)	15																			15	19*					
EXCITER	J102				16*	14*							17*	18*	19*											
RECEIVER 1	J202		5*				2*	3*	17*							20*		19								
RECEIVER 2	J302			5*						2*	3*	17*					20*		19							
RF–CONTROL CHASSIS CONNECTOR	J1				9	10																7*	15*	11, 13		
CONTROL METERING CONNECTOR	J2																									
EXCITER METERING CONNECTOR	J3												1	2	3											
RECEIVER 1 METERING CONNECTOR	J4						1	2	3							5										
FACTORY TEST CONNECTOR	J5		8	3																					9	
RECEIVER–2 METERING CONNECTOR	J6									1	2	3					5									
EXTERNAL SCREW TERMINALS	E																							7, 17, 18, 20, 23, 24, 26, 27		
JUMPER WIRES (BOTH ENDS)	JU																	11*	12*			13, 14				

Fully Optionable Interconnect Chart
Motorola No. PEPS-42062-O
(Sheet 4 of 5)
11/1/85- UP

EEPS–34523–A

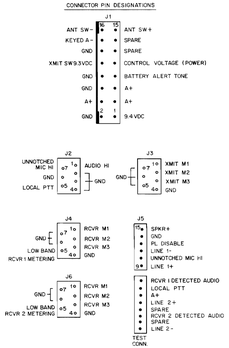
FULLY OPTIONABLE BACKPLANE INTERCONNECT BOARD



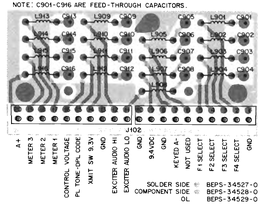
SOLDER SIDE - BD-EEPS-40483-O
COMPONENT SIDE - BD-EEPS-40484-O
OL-EEPS-40485-O

SHOWN FROM SOLDER SIDE

CONNECTOR PIN DESIGNATIONS



NOTE: C901-C916 ARE FEED-THROUGH CAPACITORS.



SHOWN FROM SOLDER SIDE

Jumper Table

Type of Station	J1	JU2	JU3	JU4	JU5	JU6	JU7	JU8	JU9	JU10	JU11	JU12	JU13	JU14	JU15
Base-DC Control	IN	OUT	IN	OUT	IN	OUT	OUT	OUT	D	E	F	G	H	H	OUT
Base-Tone Control	OUT	OUT	OUT	OUT	C	C	C	OUT	D	E	F	G	H	H	OUT
RT RPTR-Non Wireline	IN	OUT	OUT	IN	IN	OUT	OUT	OUT	D	E	F	G	H	H	OUT
RT RPTR-DC Control	IN	A	B	OUT	IN	OUT	OUT	OUT	D	E	F	G	H	H	OUT
RT RPTR-Tone Control	OUT	OUT	OUT												
RA RPTR	IN	OUT	OUT	IN	IN	OUT	OUT	OUT	D	E	F	G	H	H	OUT
RA Base-DC Control	IN	OUT	OUT	IN	IN	OUT	OUT	OUT	D	E	F	G	H	H	OUT
RA Base-Tone Control	OUT	OUT	OUT	OUT	IN	OUT	OUT	OUT	D	E	F	G	H	H	OUT

A. JU2 Normally OUT, IN when TLN5257A RPTR Control Module Used.
B. JU3 Normally IN, OUT when Option C143 (Remote RPTR Control) Used.
C. Normally, JU5 IN and JU6 and 7 OUT, JU5 OUT and JU6 and JU7 IN for 4-Freq. Receive and Transmit Operation.
D. JU9 IN for Carrier Squelch and DPL, OUT for PL.
E. JU10 Normally OUT; IN when Option C13 (Remote Squelch Control) Used.
F. JU11 Normally OUT; IN for Low Band RCVR 1.
G. JU12 Normally OUT; IN for Low Band RCVR 2.
H. JU13 and JU14 Normally OUT, except as follows:
   1. If a normal base station with battery alert tone is used, JU13 is IN and JU14 is OUT.
   2. If a RPTR station with battery alert tone is used, JU14 is IN and JU13 is OUT.

NOTES:

1. Diode VR1 and resistor R1 are part of TRN5084A fully optionable Backplane Interconnect Board, used only with 4-freq. stations.
2. Unique control modules employed for either *Spectra* TAC, Multi-PL, or RA Base Options Functional Operation.

Interconnect Board Position Usage Table

Position	Use	Module	Description
1	Line Driver (4-Versions) Note 2	TRN5235A TRN5236A TRN5237A TRN5294A	4 Wire-2 RCVR 2 Wire-1 RCVR 2 Wire-2 RCVR 4 Wire-*Spectra*-TAC
2	Station Control	TRN5321A	Station Control
3	DC Transfer (6-Versions)	TRN5239A TRN5240A TRN5254A TRN5255A TRN5256A TRN5257A	Paging F1-PL F1-CS C2-R2 F2-R2 Mute RPTR Set Up
4	Time-Out Timer	TRN5295A	Time-Out Timer
5	F1 Tone Control (4-Versions)	TRN5320A TRN5322A TRN5327A TRN5328A	F1-PL F1-CS F1-CS, 4-Freq. F1-PL, 4-Freq.
6	Guard Tone Decoder (2-Versions) Note 2	TLN2443A TLN2450A	
7	Squelch Gate (2-Versions) Note 2	TRN5324A TRN5331A	Standard *Spectra*-TAC
8	F2 Tone Control (4-Versions)	TLN2444A TLN2449A TRN5325A TRN5326A	C2-R2 Paging F2-Control F2-R2 Mute
9	Option Decoder (4-Versions)	TLN2445A TLN2446A TLN2447A TRN5296A	Squelch Control RPTR Control PL Control 4-Freq. Control
10	Function Tone Decoder (2-Versions) Note 2	TLN2448A TRN5330A	"Wild Card" Control Multi-PL Matrix Control
11	Single Tone Decoder or Option (3-Versions) Note 2	TLN2442A TLN5293A TRN5329A	Single Tone Decoder *Spectra*-TAC Encoder Multi-PL Decoder
12	Spare or Option (2-Versions) Note 2	Spare TRN5292A	Spare Multi-PL Encoder
13	RCVR 1 Audio & Squelch (2-Versions)	TRN5068A TRN5069A	Without Intercom With Intercom
14	RCVR 2 Audio & Squelch (3-Versions)	TRN5070A TRN5071A TRN5072A	R2-PL R2-CS R2-DPL
15	Coded Squelch (6-Versions)	TRN5073A TRN5074A TRN5075A TRN5076A TRN5077A TRN5078A	Duplex TARB, PL Simplex TARA, PL Simplex TARB, PL Duplex TARB, DPL Simplex TARA, DPL Simplex TARB, DPL

Fully Optional Backplane Interconnect and Duplex Filter Circuit Board Detail
Motorola No. PEPS-42062-O
(Sheet 5 of 5)
11/1/85- UP

FUNCTIONAL DESCRIPTION

APPLICATIONS 68P81062E59
REMOTE CONTROL 68P81062E61

RF-CONTROL CHASSIS

RF-CONTROL CHASSIS (TLN2472B, 74B, 75B) (B VERSION) 68P81070E88

REMOTE CONTROL

REMOTE CONTROL MODULES 68P81062E63
- STATION CONTROL (TRN5321A) 68P81062E14
- LINE DRIVER (TRN5235A, 36A, 37A) 68P81062E13
- LINE DRIVER (TRN5240A, 54A, 55A, 56A) 68P81062E16
- DC TRANSFER (TRN5239A, 57A) 68P81062E17
- GUARD TONE DECODER (TLN2443A, 50A) 68P81062E18
- F1 TONE CONTROL (TRN5320A, 22A, 27A, 28A) 68P81062E19
- F2 TONE CONTROL (TLN2444A, 49A, TRN5256A, 5325A) 68P81062E21
- SQUELCH GATE (TRN5324A) 68P81062E23
- TIME-OUT TIMER (TRN2442A) 68P81062E24
- SINGLE-TONE DECODER (TLN2442A) 68P81062E26
- 4-FREQUENCY CONTROL OPTION DECODER (TRN5296A) 68P81062E22
- SQUELCH, REPEATER, AND *PRIVATE-LINE* CONTROL OPTION DECODER (TRN1249A, 50A, 51A) 68P81062E28
- "WILD CARD" CONTROL (TLN2448A) 68P81062E27

AUDIO & SQUELCH

R1 AUDIO & SQUELCH MODULE (TRN9688A, 89) 68P81070E57
R1 AUDIO & SQUELCH MODULE (TRN5068A, 69A) 68P81062E57
R2 AUDIO & SQUELCH MODULE (TRN9690A, 91A, 92A) 68P81070E58
R2 AUDIO & SQUELCH MODULE (TRN5070A, 71A, 72A) 68P81062E64
TONE *PRIVATE-LINE* ENCODER-DECODER MODULE TRN5073A, 74A, 75A) 68P81062E51
DIGITAL PRIVATE-LINE ENCODER-DECODER MODULE (TRN5076A, 77A, 78A) 68P81062E52

OPTIONAL EQUIPMENT

Spectra-TAC ENCODER OPTION (C269) 68P81112E78
- *Spectra-TAC* 4-WIRE LINE DRIVER MODULE (TRN5294A) 68P81062E41
- *Spectra-TAC* ENCODER MODULE (TRN5293A) 68P81062E42
- *Spectra-TAC* SQUELCH GATE MODULE (TRN5331A) 68P81062E43

MSR 2000 BASE AND REPEATER STATION MULTIPLE TONE PL OPTIONS (C158, C261, C262, C263) 68P81112E80
- MULTIPLE PL MATRIX CONTROL MODULE (TRN5330A) 68P81062E67
- MULTIPLE PL ENCODER MODULE (TRN5292A) 68P81062E68
- MULTIPLE PL ENCODER MODULE (TRN5329A) 68P81062E69

REMOTE CONTROL MODULES

1. INTRODUCTION

The remote control modules permit remote wire line control of base station and repeater (RT) stations. The following modules are provided with the station dependent upon the type of station control and operation.

2. STANDARD MODULE DESCRIPTION

2.1 STATION CONTROL MODULE (DC and Tone Controlled Station)

This module provides the necessary integration of control functions from other modules in the remote chassis to key the station transmitter. Exciter audio amplification is also provided with amplitude adjustment by means of a potentiometer which is accessible through the front panel. Amplifiers are also provided to amplify the receiver discriminator output which is used externally.

2.2 LINE DRIVER MODULE (DC and Tone Controlled Stations)

The line driver module amplifies the receiver audio which is routed to the remote control point over wire line, and amplifies audio from the remote control point which is to be transmitted. Thus, it also provides monitoring of all repeater messages. For a repeater (RT) station that is *not* to be wire line controlled, this module can be omitted.

The line driver module is available in three models: 1-receiver, 2-wire (standard); 2-receiver, 2-wire (standard with 2-receiver base stations); and 4-wire (optional). The 4-wire line driver permits the transmit and receive audio to be carried on separate wire lines, or permits receive No. 2 audio to be carried on a separate wire line.

2.3 DC TRANSFER MODULE (DC Controlled Stations)

The dc transfer module converts dc line currents to control functions for use by a remote control console operator via wire lines. Six dc transfer module versions are available and perform the functions shown in Table 1.

2.4 GUARD TONE DECODER (Tone Controlled Stations)

The guard tone decoder converts a 2175 Hz guard tone signal received from a remote control source to a line push-to-talk voltage. The decoder also amplifies and distributes received function tones to other function decoders.

2.5 F1-CS AND F1-PL CONTROL MODULES (Tone Controlled Stations)

Both modules convert a 1950 Hz tone signal from a remote control source to a switched ground to turn on the transmitter channel element. The F1-PL module also converts a 2050 Hz tone signal to a switched ground to disable the PL operation of the receiver for channel monitoring before transmitting. In carrier squelch stations, the PL disable function is not required and is therefore not used.

Table 1. DC Transfer Module Application

Module Version	Line Current (mA)	Function
F1-CS	+ 5.5	Keys transmitter on F1.
F1-PL	+ 5.5	Keys transmitter on F1.
	− 2.5	PL disables receiver.
C2-R2	+ 5.5	Keys transmitter on F1 and selects R1.
	+12.5	Keys transmitter on F2 and selects R2.
	− 2.5	PL disables receiver.
F2-R2 Mute	+ 5.5	Keys transmitter on F1.
	+12.5	Keys transmitter on F2 and unmutes R2.
	− 2.5	PL disables receiver.
	− 5.5	Mute R2.
Paging (Optional)	+ 5.5	Keys transmitter on F1 with PL tone.
	−12.5	Keys transmitter on F1 without PL tone.
	− 2.5	PL disables receiver.
Repeater Control (Optional For Repeaters Only)	+ 5.5	Keys transmitter on F1.
	+12.5	Repeater turn-on.
	− 2.5	PL disables receiver.
	− 5.5	Repeater turn-off.

2.6 F2 TONE DECODER MODULES (Tone Controlled Stations)

The F2 tone decoder module is available in four versions which perform the functions shown in Table 2.

Table 2. F2 Tone Decoder Application

Module Version	Function Tone (Hz)	Function
F2 Control	1850	Keys transmitter on F2.
C2-R2	1850	Keys transmitter on F2.
	1750	Selects R1, inhibits R2.
	1650	Selects R2, inhibits R1.
F2-R2 Mute (Optional)	1850	Keys transmitter on F2.
	1750	Mutes R2.
	1650	Unmutes R2.
Paging (Optional)	1850	Keys transmitter on F1 without PL modulation.

2.7 SQUELCH GATE MODULE (Repeater Stations)

The squelch gate module is used in all repeater (RT) stations, dc or tone controlled, or non-wire line controlled. The squelch gate module produces an output to activate the transmitter when a carrier signal is received that has sufficiently high signal-to-noise ratio. *Private-Line* stations also require decoding of the proper PL code in addition to receiving a strong carrier signal.

2.8 TIME-OUT TIMER MODULE (Repeater Stations)

The time-out timer (T-O-T) module is standard in all repeater (RT) models and is an optional accessory for base station models. It limits the period of time the transmitter can be keyed. It can be set to limit the continuous transmission time from line controlled operation, and to limit the transmission time of individual users of the repeater. The time-out start of each is independent of the other. The unit can be preset for 1/2, 1, 2, 4 or 8 minutes by connecting jumpers to the corresponding time multiplier output.

3. OPTIONAL MODULE DESCRIPTION

3.1 SINGLE-TONE DECODER MODULE (DC and Tone Controlled Stations)

The single-tone decoder module provides a transistor switched output (logic low or high) or an optional relay closure upon receipt of the proper tone. The module responds only to a specific audio tone of at least 300 milliseconds duration. Nineteen different frequencies from 600 to 3300 Hz at 150 Hz intervals are available. The module can be jumpered so the output is latched on (must be reset by an external command), momentary on, or 5 seconds on. The single-tone decoder module can be used to control other functions as described in the following examples.

In repeater (RT) stations, the module may be used to inhibit repeater operation until the correct audio tone is received by the receiver. In this application, it is operated in the latched mode and is reset by the squelch gate upon loss of received carrier signal.

In base or repeater stations, the output of the module can be wired to inhibit (mute) receiver audio until the proper tone is received.

3.2 OPTION DECODERS

A tone controlled station may use *one* of the following decoders.

3.2.1 Four-Frequency Control Module (Tone Controlled Stations)

The four-frequency control module converts the proper function tones into frequency selection commands for selection of the station operating frequency. Refer to Table 3 for a listing of the necessary function tones. This control module also includes front chassis mounted switches which permit local frequency selection, when desired. The four-frequency control module operates with a F1-CS or F1-PL control module compatible with four-frequency operation. These F1 control modules provide biasing voltage for the four-frequency module and include the 2175 Hz notch filters.

Table 3. Four-Frequency Selection Tones

Function Tone	Frequency Selected
1950 Hz	F1: Transmitter keys on frequency T1. Receiver operates in standby mode on frequency R1.
1850 Hz	F2: Transmitter keys on frequency T2. Receiver operates in standby mode on frequency R2.
1350 Hz	F3: Transmitter keys on frequency T3. Receiver operates in standby mode on frequency R3.
1250 Hz	F4: Transmitter keys on frequency T4. Receiver operates in standby mode on frequency R4.

3.2.2 Squelch Control Module

This module converts the 1450 Hz and 1550 Hz function tone burst to two levels of squelch sensitivity in the carrier squelch mode of receiver operation.

3.2.3 *Private-Line* Control Module

This module converts the 1450 Hz and 1550 Hz function tone bursts to PL or carrier squelch mode of operation. It differs from the PL disable function of the F1-PL module in that the receiver does not revert to PL operations when the transmitter is keyed. When this module is operated in the PL mode, the PL disable function of the F1-PL module is unaffected to allow monitoring before transmitting.

3.2.4 Repeater Control Module

This module may be used in a repeater (RT) station only. It converts a 1450 Hz function tone to a repeater enable command (repeater "set-up") and a 1550 Hz function tone to repeater disable (repeater "knock-down"). In the repeater "knock-down" mode the station operates as a conventional base station only.

3.3 "WILD CARD" CONTROL MODULE

This module may be added to any model station. It provides four tone-activated transistor switched outputs which may be used to control the operation of four relays in response to function tone commands of 1350, 1250, 1150 and 1050 Hz. The circuits may be cross-connected to two on-off outputs if desired. The outputs may be used for any desired remotely controlled switching at the base station site such as on-off control of antenna tower lights, emergency power generating equipment, etc.

3.4 TLN4151A RELAY KITS

The Model TLN4151A Relay Kits are for use in the "Wild Card" module, single-tone decoder module, or squelch gate module. They provide a form "C" output circuit which is isolated from the module board circuitry, with higher voltage and current switching capability than provided by the normal transistor output.

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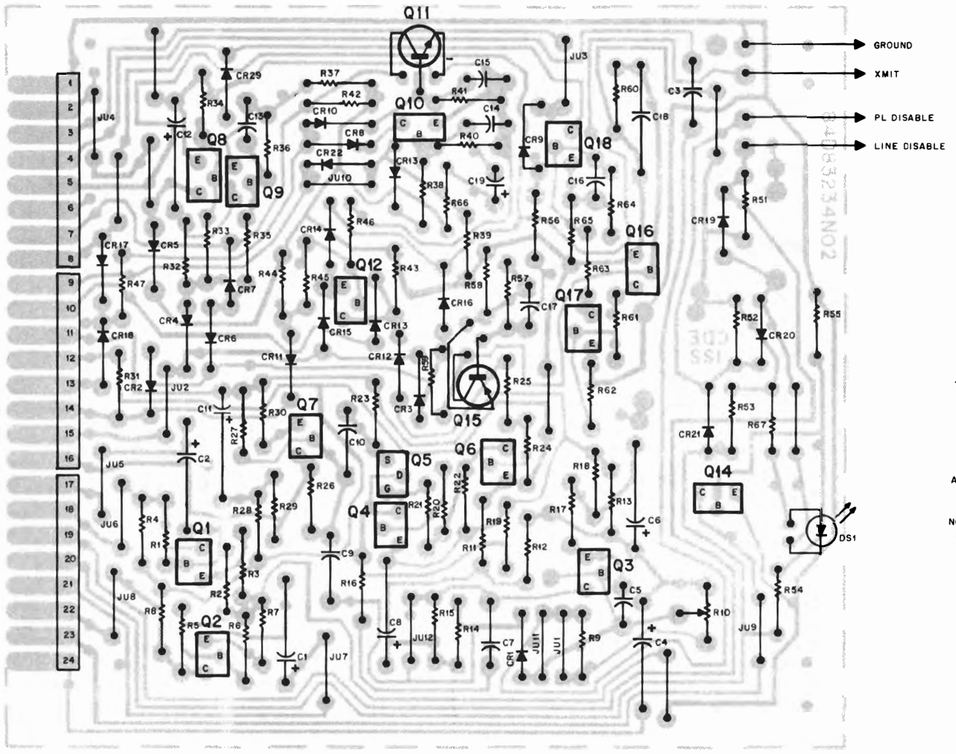
MODEL TRN5321A STATION CONTROL MODULE



SOLDER SIDE ◎ BD-CEPS-34548-A
OL-CEPS-34549-A SHOWN FROM SOLDER SIDE

TRANSISTOR BASE DETAILS

BOTTOM VIEW
ALL TRANSISTORS EXCEPT Q5

Q5 BASE DETAIL (BOTTOM VIEW)

NOTE:
Q6,Q9,Q15,Q16,Q18 ARE PNP TYPE, ALL THE REST ARE NPN TYPE.

Circuit Board Detail & Parts List
Motorola No. **68P81062E14-B**
(Sheet 1 of 2)
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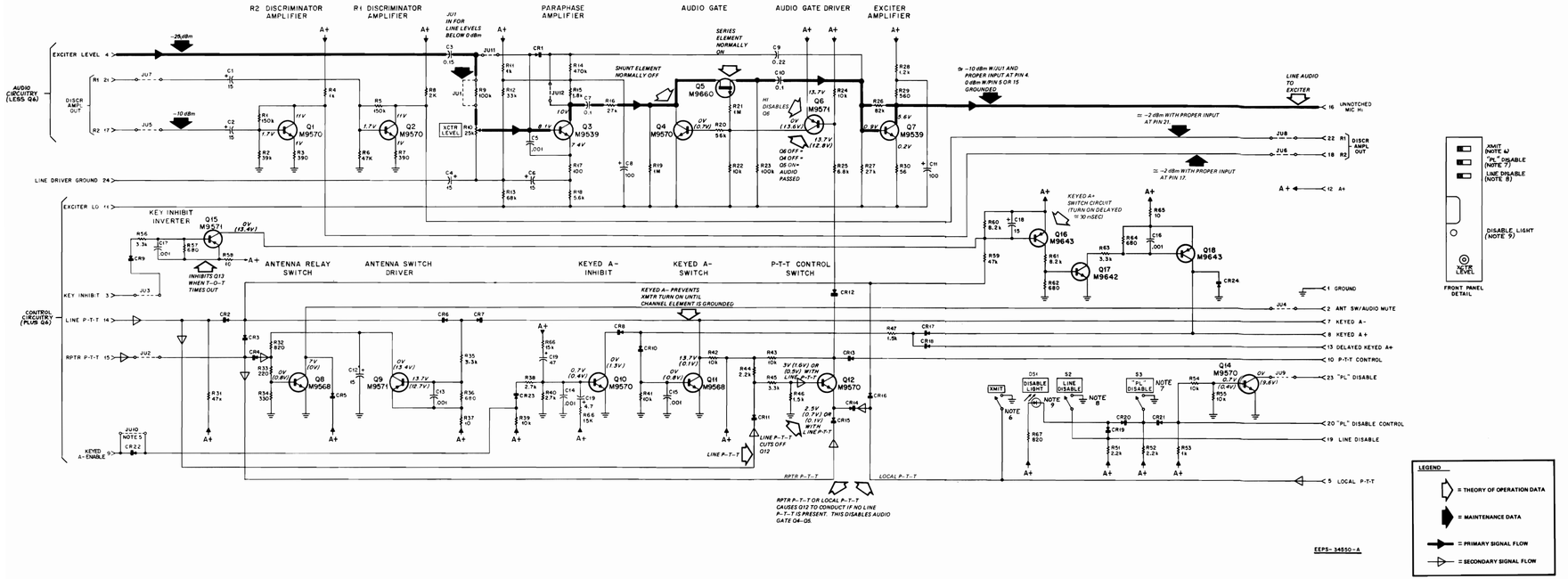
parts list

TRN5321A Station Control Module — PL-7957-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ± 10%; 50 V:unless otherwise stated
C1,2	23-865136	15 ±20%; 25 V
C3	8-82905G05	0.15
C4	23-865136	15 ±20%; 25 V
C5	21-82187B29	.001; 100 V
C6	23-865136	15 ±20%; 25 V
C7	8-82905G07	0.10
C8	23-84665F03	100
C9	8-82905G11	0.22
C10	8-82905G07	0.10
C11	23-84665F03	100
C12	23-865136	15
C13 thru 17	21-82187B29	.001; 100 V
C18	23-82783B24	15 ±10%; 25 V
C19	23-11019A40	47
		semidonductor device diode: (see note)
CR1,2,3,4	48-83654H01	silicon
CR5	48-82466H13	silicon
CR6 thru 24	48-83654H01	silicon
		lamp, incandescent:
DS1	48-88245C28	LED
		transistor: (see note)
Q1,2	48-869642	NPN; type M9642
Q3	48-869539	NPN; type M9539
Q4	48-869642	NPN; type M9642
Q5	48-869660	FET, p-channel; type M9660
Q6	48-869643	PNP; type M9643
Q7	48-869539	NPN; type M9539
Q8	48-869568	NPN; type M9568
Q9	48-869643	PNP; type M9643
Q10	48-869642	NPN; type M9642
Q11	48-869568	NPN; type M9568
Q12	48-869642	NPN; type M9642
Q13		NOT USED
Q14	48-869642	NPN; type M9642
Q15, 16	48-869643	PNP; type M9643
Q17	48-869642	NPN; type M9642
Q18	48-869643	PNP; type M9643
		resistor, fixed: ± 10%; 1/4 W: unless otherwise stated
R1	6-11009D02	150k
R2	6-11009C87	39k
R3	6-11009C39	390
R4	6-11009C49	1k
R5	6-11009D02	150k
R6	6-11009C89	47k
R7	6-11009C39	390
R8	6-11009C56	2k
R9	6-11009C97	100k
R10	18-83083G03	var: 25k
R11	6-11009C49	1k
R12	6-11009C85	33k
R13	6-11009C93	68k
R14	6-11009D14	470k
R15	6-11009C55	1.8k
R16	6-11009C83	27k
R17	6-11009C25	100
R18	6-11009C67	5.6k
R19	6-11009D22	1 meg
R20	6-11009C91	56k
R21	6-11009D22	1 meg
R22	6-11009C73	10k
R23	6-11009C97	100k
R24	6-11009C73	10k
R25	6-11009C69	6.8k
R26	6-11009C95	82k
R27	6-11009C83	27k
R28	6-11009C51	1.2k
R29	6-11009C43	560
R30	6-11009C19	56
R31	6-11009C89	47k
R32	6-11009C47	820
R33	6-11009C33	220
R34	6-11009C37	330
R35	6-11009C61	3.3k
R36	6-11009C45	680
R37	6-11009C01	10
R38	6-11009C59	2.7k
R39	6-11009C73	10k
R40	6-11009C59	2.7k
R41	6-11009C73	10k
R42	6-11009C73	10k
R43	6-11009C73	10k
R44	6-11009C57	2.2k
R45	6-11009C61	3.3k
R46	6-11009C53	1.5k
R47	6-11009C53	1.5k
R48,49,50		NOT USED
R51,52	6-11009C57	2.2k
R53	6-11009C49	1k
R54,55	6-11009C73	10k
R56	6-11009C61	3.3k
R57	6-11009C45	680
R58	6-11009C01	10
R59	6-11009C89	47k
R60, 61	6-11009C71	8.2k
R62	6-11009C45	680
R63	6-11009C61	3.3k
R64	6-11009C45	680
R65	6-11009C01	10
R66	6-11009C77	15k
R67	6-11009C47	820 ohms
		switch:
S1	40-83468E01	slide; xmtr.
S2,3	40-83204B01	slide; PL & line disable
		mechanical parts
	3-84256M01	SCREW, tapping; 2 used
	43-82721C01	BUSHING, snap
	5-84220B01	GROMMET; 2 used
	9-83497F01	RECEPTACLE, 8 contact; 3 used (PCB Edge Connector)
	39-10184A10	CONTACT, plug; 4 used
	64-83112L11	PANEL, screened

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



Maintenance & Troubleshooting

This module may be serviced either while connected to the unified chassis interconnect board or while connected to separate external test equipment. Refer to the unified chassis interconnect board servicing information in this manual for "setup" details.

Step 1. Check jumpers as applicable for the mode of operation of this module.

Step 2. Connect power and signal sources to the module as indicated in the following chart.

Pin No.	Connect
1, 11, 34	Ground
4	Audio Oscillator
12	+ 12 Volts dc
16	AC Voltmeter to Ground
2	10 Kilohms to 12 Volts dc
10	10 Kilohms to 12 Volts dc
23	10 Kilohms to 12 Volts dc

Note: Level adjust control should be full clockwise.

Step 3. Adjust audio oscillator output for -25 dBm at pin 4. Pin 16 should measure approximately -10 dBm with JU1 connected. If this level cannot be achieved, check stages Q3 and Q7. If the level is correct, ground pin 5 or pin 15 and note that the reading drops to 0. If this does not occur check stages Q4 and Q5 and their associated driver stages.

Step 4. Ground pins 14 and 9. Measure the dc voltage at pins 10 and 8. Eachshould read + 12 volts. Pins 7 and 2 should read zero. If a voltage or ground does not appear at the prescribed location, check each stage associated with that location.

Step 5. Ground pin 15. Measure the dc voltage at pins 7 and 2. Each should read + 12 volts. Pin 10 should read zero volts.

Step 6. With pin 15 still grounded, apply a ground to pin 14. Check for + 12 volts dc at pin 10.

Step 7. Ground pin 20 and check the dc voltage at pin 23. The meter indication should be + 12 volts. Remove the ground from pin 20 and the voltage should drop to zero.

Step 8. Apply a -10 dBm signal from the audio oscillator to pin 17 and measure the ac voltage at pin 18. The voltmeter should indicate approximately -2 dBm.

Step 9. Apply a -10 dBm signal from the audio oscillator to pin 21 and check the ac voltage on pin 22. The indication should be approximately -2 dBm.

Control Theory

When a PTT signal is applied to pin 5, 14, or 15 the following functions occur:

— A low is applied to the base of Q16. After a 30 millisecond delay. This provides a high output to pin 8 and to Q11 from Q17 and Q18.

— The drive to Q11 will be inhibited by Q10 until a low is applied to pin 9, indicating an oscillator channel element ground. This prevents A- from energizing the transmitter circuits until after the channel element has been grounded. Q11 can also be inhibited by a low entering on pin 3 from the time-out-timer module at the end of a pre-set time limit.

— The low is also applied to the base of Q9 where it is inverted and applied as a high to the base of Q8. If a low is applied as repeater PTT on pin 15, Q8 will be inhibited. However, if the low is applied to either pin 5 or 14, Q8 will saturate and provide a low to operate the antenna switch. Switch Q8 does not turn off the instant PTT low is removed. Instead it is kept on for the time required for C12 to discharge through R32 and R33. This allows the high level rf energy to decay before the antenna switch reverts to the receive condition.

— If the PTT low is applied to the module on pin 5 or 15, a conduction path is provided for Q12. When Q12 conducts, a low is applied to pin 10. This control can be overridden by a line PTT signal applied to pin 14. This signal reaches the base of Q12 causing it to cut off and remove the low from pin 10.

When Xmit switch S1 is actuated, a ground is supplied to the emitter of Q12 with the same result as a low applied to pin 5 or 15. Actuating line disable switch S2 applies a ground output to pin 19. S2 also provides a ground to the disable light DS1, which causes it to illuminate. When PL disable switch S3 is actuated, DS1 also illuminates and a low is applied to the base of PL disable inverter Q14. This low causes Q14 (which is normally conducting) to cut off and removes the PL disable switched ground from pin 23. The station should not be left in the line or PL disable mode under normal operating conditions.

In Private-Line applications, keyed A- release is delayed at the end of a transmission by an input to pin 13 from the external Private-Line reverse burst circuitry. This input maintains transmitter keying for the duration of the reverse burst tone.

FUNCTION

- Integrates control functions from other modules to key the station transmitter.
- Adjusts exciter audio level.
- Amplifies receiver discriminator signals which are used externally.

NOTES:

1. JU1 is in for line levels below 0 dBm and removed for line levels above 0 dBm.
2. JU2 thru JU8 is in for all wire line control base stations and (RT) repeaters.
3. JU9 is in for PL operation and removed for carrier squelch operation.
4. Voltages shown in parentheses are normally measured when function is activated. Voltages not in parentheses are normally measured when function is deactivated.
5. JU10 out for non-wire line repeaters.
6. To key the transmitter, slide the Xmit switch to the right (closed) and hold in this position. To unkey the transmitter, release the switch.
7. When the PL disable switch is in the (normal) position (to the left) the Private-Line function of the station is operational. In the actuated position (to the right), the receiver Private-Line tone-coded squelch circuit is disabled so that all on-frequency signals may be monitored.
8. When the line disable switch is in the normal position (to the left, open), station operation can be initiated by remote control in the actuated position (to the right, closed), remote controls are disabled and the station can only be operated via local controls.
9. The disable light is illuminated when either the PL or line disable switches are actuated.

Schematic Diagram
Motorola No. **68P81062E14-B**
(Sheet 2 of 2)
11/1/85- UP

MODELS TRN5235A, 36A, 37A LINE DRIVER MODULES

1. LINE DRIVER MAINTENANCE & TROUBLESHOOTING

This module may be serviced while connected to the control chassis via an extender card or by plugging it onto the rear of the backplane interconnect board. Refer to control chassis servicing information in this manual for additional "set-up" details.

1.1 TRN5235A LINE DRIVER/4-WIRE AUDIO MODULE SERVICING

1.1.1 General

When servicing in the chassis use the service extension or plug onto the rear of the backplane interconnect board.

1.1.2 Receive Audio (Line Amplifier No. 1)

Step 1. Inject a 1000 Hz tone at pin 3 and adjust the oscillator output for 150 mV.

Step 2. Adjust the LINE 1 LEVEL control for +11 dBm across the 600-ohm load at pins 19 and 20. If this level cannot be obtained, check preamplifier stages Q1 and Q2. Next check phase inverter Q4, amplifier Q5, line drivers Q6 and Q7, line 1 transformer T1, and line driver disable switch Q3. Check that the proper jumpers are installed.

Step 3. Connect the ac voltmeter between pin 23 and ground. The voltage should be approximately 0.7 V. If the level in Step 2 is satisfactory and this level is not correct, check exciter††speaker amplifier Q8, isolation amplifier Q9, and transformer T1.

Step 4. Apply a ground to pin 9. The outputs measured in Steps 2 and 3 should drop to zero. If they do not drop to zero, check diode CR1 and line driver disable switch Q3.

1.1.3 Receive Audio (Line Amplifier No. 2)

Step 1. Inject a 1000 Hz tone at pin 22 and adjust the oscillator output for 150 mV.

Step 2. Adjust the line 2 level control for +11 dBm across the 600-ohm load at pins 7 and 8. If +11 dBm cannot be obtained, check preamplifier stages Q17 and Q19. Next, check phase inverter Q20, amplifier Q21, line drivers Q22 and Q23, line 2 transformer T2, and line driver disable switch Q18. Check that the proper jumpers are connected.

NOTE

If the output is extremely low (70 dB below the +11 dBm level) check if jumper JU24 (first receiver priority) is in. If JU24 is in, apply ground to pin 18 to defeat the R1 priority.

Step 3. Connect an ac voltmeter between pin 23 and ground. The voltage should be approximately 0.7 V. If the level in Step 2 is satisfactory and this level is not correct, check isolation amplifier Q10 and transformer T2.

Step 4. Apply a ground to pin 5. The outputs measured in Steps 2 and 3 should drop to zero. If they do not drop to zero, check diode CR10 and line driver disable switch Q18.

1.1.4 Transmit Audio

Step 1. Inject a 1000 Hz tone between pins 19 and 20 and adjust the oscillator output to zero dBm.

Step 2. The voltage measured between pin 10 and ground should be at least 0.77 V ac. If this reading is incorrect, check transformer T1.

Step 3. The voltage between pin 24 and ground should be approximately 0.36 V ac. If the reading in Step 2 is correct and this reading is incorrect, check exciter/speaker amplifier Q8.

Step 4. The voltage measured between pin 23 and ground should be approximately 0.18 V ac. If the reading in Step 3 is correct and this reading is incorrect, check isolation amplifier Q9.

1.1.5 Receive Audio Mute Switches

Step 1. Inject a 1000 Hz tone between pin 13 and ground and adjust the oscillator output for 150 mV.

Step 2. The voltage measured between pin 6 and ground should be approximately 145 mV. However, if jumper JU18 is in (second receiver priority) the voltage reading should be zero. If jumper JU18 is in, apply a ground to pin 15. The voltage measured between pin 6 and ground should go to 145 mV. If the voltage between pin 6 and ground is considerably below 145 mV, check R1 mute switch Q12 and R1 mute switch driver Q11. The output between pin 6 and ground should also go to zero if a ground is applied to pins 9, 14, or 18. If the voltage does not go to zero, check OR gate diodes CR3 and CR5, R1 switch driver Q11, and R1 mute switch Q12.

Step 3. Inject a 1000 Hz tone between pin 22 and ground and adjust for 150 mV output.

Step 4. The voltage measured between pins 7 and 8 should be approximately +11 dBm. However, if this voltage is extremely low (such as -59 dBm) the R2 mute switch might be turned off due to receiver priority jumpering. If JU24 (first receiver priority) is in, connect pin 18 to ground and check that pins 15 and 17 are not grounded. If the priority jumpering and/or grounding connections are made to pass R2 audio and the output at pins 7 and 8 is still low, check R2 mute switch Q16, R2 mute switch driver Q15, and the R2 attenuator switch stage Q13 and Q14.

Step 5. Connect pin 15 to ground and check that the signal level at pins 7 and 8 decreases by approximately 70 dB.

1.2 TRN5236A LINE DRIVER/2-WIRE 1-RECEIVER AUDIO MODULE SERVICING

1.2.1 General

When servicing in the chassis, use the service extension or plug onto the rear of the backplane interconnect board.

1.2.2 Receive Audio (Line Amplifier No. 1)

Perform the Line Amplifier No. 1 procedure for the 4-wire audio module (paragraph 1.1.2), except that the level at pin 23 should be approximately 1.4 V.

1.2.3 Transmit Audio

Perform the Transmit Audio procedure described for the 4-wire audio module (paragraph 1.1.4).

1.2.4 Receive Audio Mute Switch

Step 1. Inject a 1000 Hz tone between pin 13 and ground and adjust the oscillator output for 150 mV.

Step 2. The voltage measured between pin 6 and ground should be approximately 145 mV. If the voltage is considerably below 145 mV, check R1 mute switch Q12 and R1 mute switch driver Q11. The output voltage between pin 6 and ground should drop to zero if a ground is applied to pins 9, 14, or 18. If it does not drop to zero, check OR gate diodes CR3 and CR5, R1 mute switch Q12, and R1 mute switch driver Q11.

1.3 TRN5237A LINE DRIVER/2-WIRE 2-RECEIVER AUDIO MODULE

1.3.1 General

When servicing in the chassis, use the service extension or plug onto the rear of the backplane interconnect board.

1.3.2 Receive Audio (Line Amplifier No. 1)

Perform the Line Amplifier No. 1 procedure described for the 4-wire audio module (paragraph 1.1.2), except that the level at pin 23 should be approximately 1.4 V.

1.3.3 Transmit Audio

Perform the Transmit Audio procedure described for the 4-wire audio module (paragraph 1.1.4).

1.3.4 Receiver Audio Mute Switches

Step 1. Inject a 1000 Hz tone between pin 13 and ground and adjust the oscillator output for 150 mV.

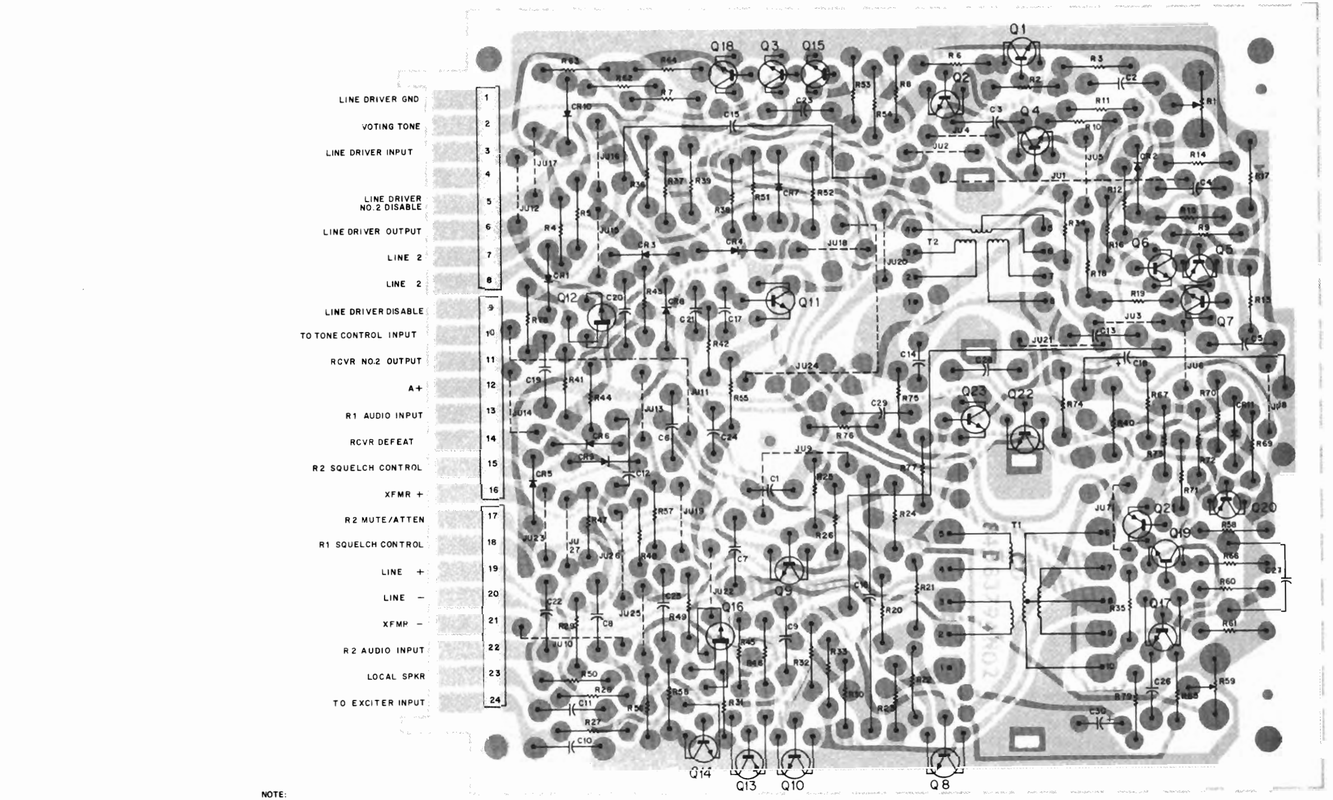
Step 2. The voltage measured between pin 6 and ground should be approximately 145 mV. However, if jumper JU18 is in (second receiver priority) the voltage reading should be zero. if jumper JU18 is in, apply a ground to pin 15. The voltage measured between pin 6 and ground should go to 145 mV. If the voltage between pin 6 and ground is considerably below 145 mV, check R1 mute switch Q12 and R1 mute switch driver Q11. The output between pin 6 and ground should also decrease by approximately 70 dB if a ground is applied to pins 9, 14, or 18. If the voltage does decrease by this amount, check OR gate diodes CR3 and CR5, R1 mute switch driver Q11, and R1 mute switch Q12.

Step 3. Inject a 1000 Hz tone between pin 22 and ground and adjust the oscillator for 150 mV output.

Step 4. The voltage measured between pin 6 and ground should be approximately 140 mV. However, if jumper JU24 (first receiver priority) is in, the voltage reading should be approximately 70 dB below this level. If jumper JU24 is in, apply a ground to pin 18. The voltage measured between pin 6 and ground should go to 140 mV. If the voltage between pin 6 and ground is considerably below 140 mV, check R2 mute switch Q16 and R2 mute switch driver Q12. With jumper JU15 in, the output pin 6 should also decrease by approximately 70 dB when a ground is applied to pins 5, 9, 14, or 15. With jumper JU23 in, the output at pin 6 should decrease by approximately 70 dB when a ground is applied to pin 17. If the output at pin 6 does not decrease by the 70 dB, check OR gate diodes CR6, CR7, CR8, and CR9, mute switch driver Q15 and mute switch Q16.

If a ground is present at pin 17 and jumper JU22 is in, the voltage at pin 6 will be attenuated. The amount of attenuation is determined by selection of jumpers JU25, JU26, and JU27. If the voltage is not attenuated check mute/attenuator switch Q13 and Q14.

MODELS TRN5235A, 36A, 37A LINE DRIVER MODULES



SHOWN FROM SOLDER SIDE

NOTE:
THIS BOARD DETAIL IS APPLICABLE TO ALL THREE LINE DRIVER MODELS. PLATING RUNS ARE IDENTICAL TO ALL THREE. PART LOCATIONS ARE ALSO IDENTICAL EXCEPT FOR APPLICABLE DELETIONS AS INDICATED ON THE SCHEMATIC DIAGRAM (e.g., R20 IS LOCATED IN THE SAME PLACE FOR ALL MODELS).

SOLDER SIDE BD-DEPS-36692-O
COMPONENT SIDE BD-DEPS-36693-O
OL-DEPS-36694-O

Circuit Board Detail & Parts List
Motorola No. **68P81062E13-C**
(Sheet 2 of 3)
11/1/85-UP

parts list

legend

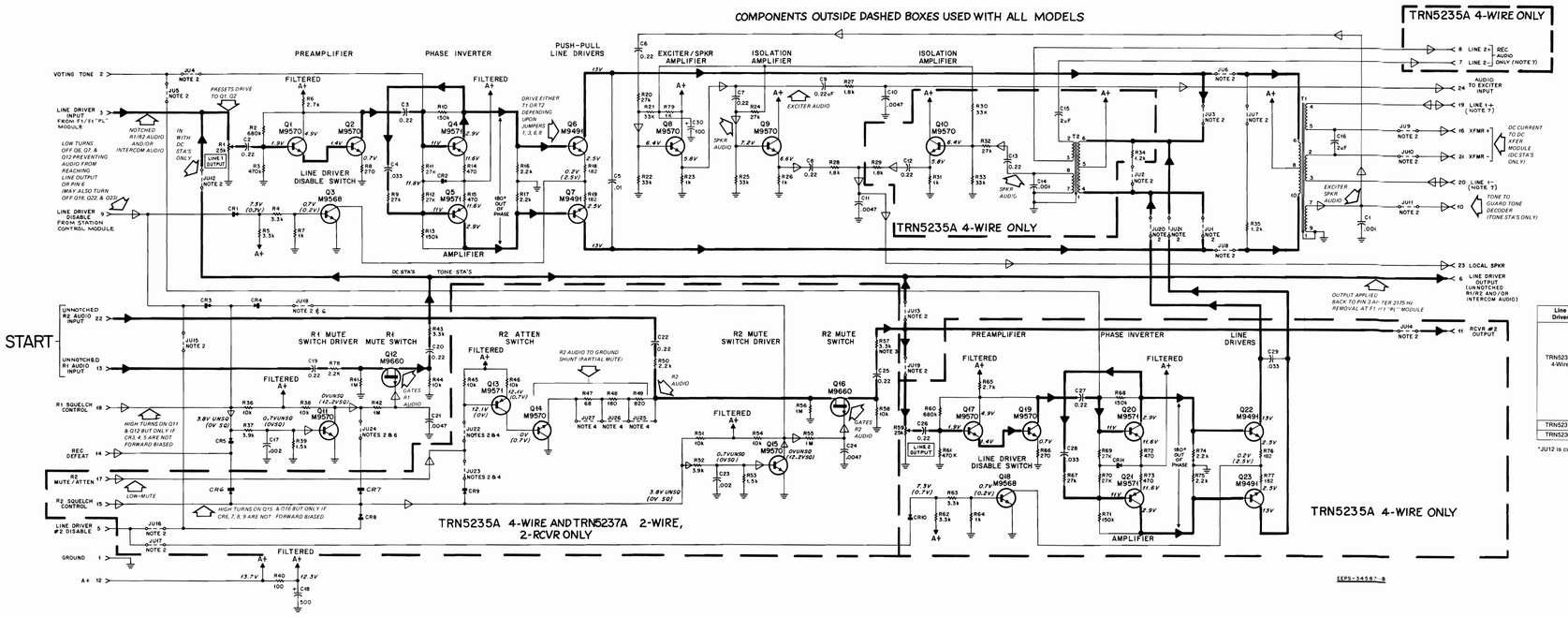
reference symbol suffix	application
No Suffix	All Models
A	TRN5236A
B	TRN5237A

This parts list covers 3 models of the line driver module. When differences exist, a letter code is added to the reference symbol to indicate the applicable unit.

TRN5235A Line Driver Module (4-Wire)
TRN5236A Line Driver Module (2-Wire, 1-RCVR)
TRN5237A Line Driver Module (2-Wire, 2-RCVR) PL-7963-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ±10%; 50 V: unless otherwise stated
C1 (A,B)	21-82187B29	.001; 100 V
C2,3 (A,B)	8-82905G11	0.22
C4 (A,B)	8-82905G08	.033
C5 (A,B)	8-82905G01	.01
C6 thru 9 (A,B)	8-82905G11	0.22
C10,11 (A,B)	8-82905G26	.0047; 100 V
C12,13	8-82905G11	0.22
C14	21-82187B29	.001; 100 V
C15,16 (A,B)	8-82045E05	2; 350 V
C17 (A,B)	21-82428B25	.002 ±20%; 500 V
C18 (A,B)	23-84669A23	500 V; 25 V
C19,20 (A,B)	8-82905G11	0.22
C21 (A,B)	21-82428B27	.0047; 100 V
C22 (B)	8-82905G11	0.22
C23 (B)	21-82428B47	.002 ±20%; 500 V
C24 (B)	21-82428B27	.0047; 100 V
C25,26,27 (B)	8-82905G11	0.22
C28,29	8-82905G08	.033
C30	23-11019A46	100 ±20%; 25 V
		semiconductor device, diode: (see note)
CR1 thru 11	48-82392B03	silicon
		transistor: (see note)
Q1,2 (A,B)	48-869570	NPN; type M9570
Q3 (A,B)	48-869568	NPN; type M9568
Q4,5 (A,B)	48-869571	PNP; type M9571
Q6,7 (A,B)	48-869491	NPN; type M9491
Q8 thru 11 (A,B)	48-869570	NPN; type M9570
Q12 (A,B)	48-869660	FET, p-channel; type M9660
Q13 (B)	48-869571	PNP; type M9571
Q14,15 (B)	48-869570	NPN; type M9570
Q16 (B)	48-869660	FET, p-channel; type M9660
Q17	48-869570	NPN; type M9570
Q18	48-869568	NPN; type M9568
Q19	48-869570	NPN; type M9570
Q20,21	48-869571	PNP; type M9571
Q22,23	48-869491	NPN; type M9491
		resistor, fixed: ±5%; 1/4 W: unless otherwise stated
R1 (A,B)	18-83083G03	var; 25k
R2 (A,B)	6-11009D18	680k
R3 (A,B)	6-11009D14	470k
R4,5 (A,B)	6-11009C61	3.3k
R6 (A,B)	6-11009C59	2.7k
R7 (A,B)	6-11009C49	1k
R8 (A,B)	6-11009C35	270
R9 (A,B)	6-11009C83	27k
R10 (A,B)	6-11009D02	150k
R11,12 (A,B)	6-11009C83	27k
R13 (A,B)	6-11009D02	150k
R14,15 (A,B)	6-11009C41	470
R16,17 (A,B)	6-11009C57	2.2k
R18,19 (A,B)	6-10621B23	182 ±1%
R20 (A,B)	6-11009C83	27k
R21,22 (A,B)	6-11009C85	33k
R23 (A,B)	6-11009C49	1k
R24 (A,B)	6-11009C83	27k
R25 (A,B)	6-11009C85	33k
R26 (A,B)	6-11009C49	1k
R27,28,29 (A,B)	6-11009C55	1.8k
R30	6-11009C85	33k
R31	6-11009C49	1k
R32	6-11009C83	27k
R33	6-11009C85	33k
R34, 35	6-11009C51	1.2k
R36 (A,B)	6-11009C73	10k
R37 (A,B)	6-11009C63	3.9k
R38 (A,B)	6-11009C73	10k
R39 (A,B)	6-11009C53	1.5k
R40 (A,B)	6-11009C25	100
R41,42 (A,B)	6-11009D22	1 meg
R43 (A,B)	6-11009C61	3.3k
R44,45,46 (B)	6-11009C73	10k
R47 (B)	6-11009C21	68
R48 (B)	6-11009C31	180
R49 (B)	6-11009C47	820
R50 (B)	6-11009C57	2.2k
R51 (B)	6-11009C73	10k
R52 (B)	6-11009C63	3.9k
R53 (B)	6-11009C53	1.5k
R54 (B)	6-11009C73	10k
R55,56 (B)	6-11009D22	1 meg
R57 (B)	6-11009C61	3.3k
R58 (B)	6-11009C73	10k
R59 (B)	18-83083G03	var; 25k
R60	6-11009D18	680k
R61	6-11009D14	470k
R62,63	6-11009C61	3.3k
R64	6-11009C49	1k
R65	6-11009C59	2.7k
R66	6-11009C35	270
R67	6-11009C83	27k
R68	6-11009D09	150k ±5%
R69,70	6-11009C83	27k
R71	6-11009D02	150k ±5%
R72,73	6-11009C41	470
R74,755	6-11009C57	2.2k ±5%
R76,77	6-10621B23	182 ±1%
R78 (A,B)	6-11009C57	2.2k
R79	6-11019C49	1k
		transformer:
T1	25-83000H01	pri #1: pin 2 & 3 res 25 ohms pri #2: pin 4 & 5 res 150 ohms sec #1: pin 6 & 10 res 50 ohms sec #2: pin 7 & 9 res 160 ohms
T2	25-84202A02	pri: pin 2 & 3 res 50 ohms sec #1: pin 4 & 6 res 50 ohms sec #2: pin 7 & 8 res 150 ohms
		mechanical parts
	3-134168	SCREW, tapping: 4-40 x 1/4"; 2 used
	3-84256M01	SCREW, tapping; 2 used
	5-84220B01	GROMMET; 2 used
	7-82613K01	BRACKET
	43-82721C01	BUSHING, snap; 2 used
	64-83110L04	PANEL, screened (TRN5235A)
	64-83110L06	PANEL, screened (TRN5236A, 5237A)
	9-83497F01	CONNECTOR, receptacle: 8 contact; 3 used(PCB Edge Connector)

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



NOTES:

1. Unless otherwise stated: resistor values are in ohms (K = 1000) capacitor values are in microfarads.
2. Exact audio routing and disabling in the line driver module is dependent on the jumper placements. Refer to jumper table.
3. At points showing two voltages, the voltage in parentheses is a result of a logic low at the control function input.
4. Partial or complete R2 audio muting is accomplished as follows:

R2 Audio Attenuator	Jumper Configuration (JU)
10 dB	JU22 IN; JU23, 25, 26, 27 OUT
20 dB	JU22, 25 IN; JU23, 26, 27 OUT
30 dB	JU22, 25, 26 IN; JU23, 27 OUT
Complete	JU22 OUT, JU23 IN

5. R57 is removed in the 4-wire, 1 rec application.
6. Receiver priority is accomplished as follows:

Priority	Jumper Configuration
Rcvr No. 1	JU18 OUT; JU24 IN
Rcvr No. 2	JU18 IN; JU24 OUT
First Come, First Served	JU18 & JU24 IN

7. Control current control tones and exciter (Xmit) audio functions are always carried on Line 1. Line 2, when used, only carries rec audio.

IMPORTANT

Refer to Function Table Maintenance Troubleshooting Information shown on facing page.

Line Driver		JU1	JU2	JU3	JU4	JU5	JU6	JU7	JU8	JU9	JU10	JU11	JU12	JU13	JU14	JU15	JU16	JU17	JU18	JU19	JU20	JU21	JU22	JU23	JU24
TRN5235A 4-Wire	4 Wire; 1 Rec Rec Audio on Line 2 (Note 5)	Out	In	Out	Out	Out	Out	In	Out	In	In	In	Out	In	Out	In	In	In	Out	In	In	In	Out	Out	Out
	4-Wire; 2 Rec R1 Priority Rec Audio on Line 2	Out	In	Out	Out	Out	Out	In	Out	In	In	In	Out	In	Out	In	In	In	Out	In	In	In	Out	In	In
	4-Wire; 2 Rec R1 Audio Line 1 R2 Audio Line 2	Out	In	Out	Out	Out	In	In	In	In	In	In	*In	Out	Out	In	In	In	Out	In	In	In	Out	In	Out
TRN5237A	2-Wire; 2 Rcvr	Out	Out	Out	Out	Out	In	In	In	In	In	In	*In	Out	In	Out	Out	Out	Out	Out	Out	Out	Out	In	In
TRN5236A	2-Wire, 1 Rcvr	Out	Out	Out	Out	Out	In	In	In	In	In	In	*In	Out	Out	Out	Out	Out	Out	Out	Out	Out	Out	Out	Out

*JU12 is cut in tone remote control applications.

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

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

FUNCTION

- TRN5235A 4-Wire Audio Module

  Accepts audio from up to two different receivers. Amplifies the audio and routes it out to either of two line outputs, or the local speaker; two transformers are provided. One is used for accepting the transmit audio and control signals, and the other is used to provide line audio to a remote point; gating circuits allow external control of R1 mute, R2 mute, and line driver disable functions.

- TRN5236A 2-Wire 1-Receiver Audio Module

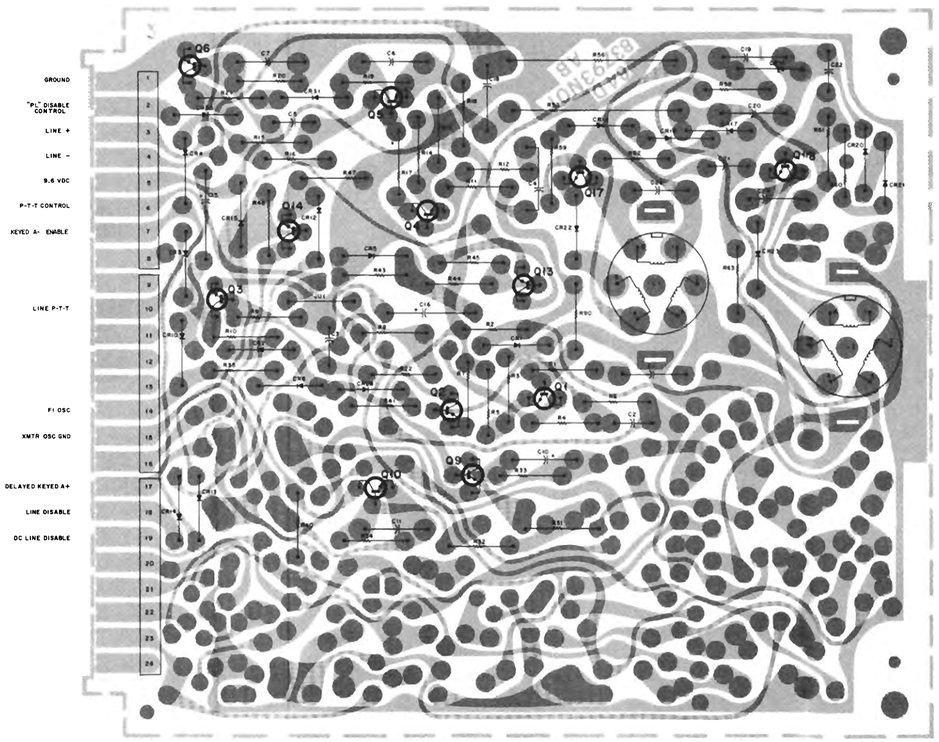
  Accepts audio from one receiver, amplifies the audio and routes it either through an amplifier section or as a direct output; a single transformer is used to accept the transmit audio and control signals and also provide line audio to a remote point; gating circuits allow external control of R1 mute and line driver disable functions.

- TRN5237A 2-Wire 2-Receiver Audio Module

  Accepts audio from up to two different receivers, and routes it either through an amplifier section or as a direct output. A single transformer is used to accept the transmit audio and control signals and also provide line audio to a remote point; gating circuits allow external control of R1 mute, R2 mute, and line driver disable functions.

Schematic Diagram
Motorola No. **68P81062E13-C**
(Sheet 3 of 3)
11/1/85- UP

TRN5240A F1-PL DISABLE



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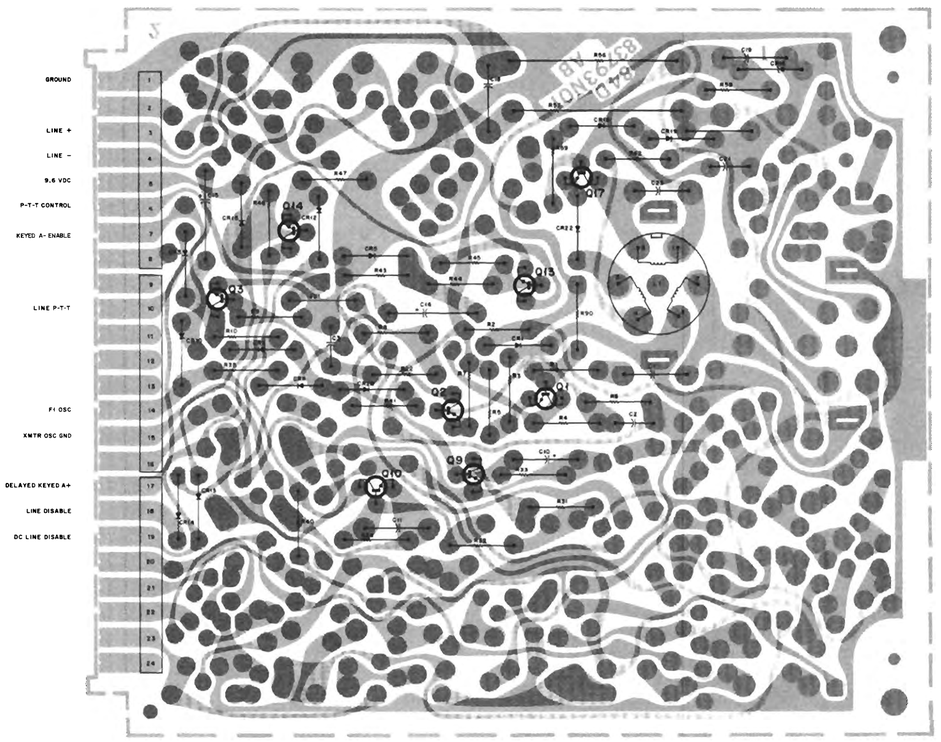
SOLDER SIDE: BD-DEPS-34554-O
COMPONENT SIDE: BD-DEPS-34555-O
OL-DEPS-34556-O

TRN5254A F1 CONTROL



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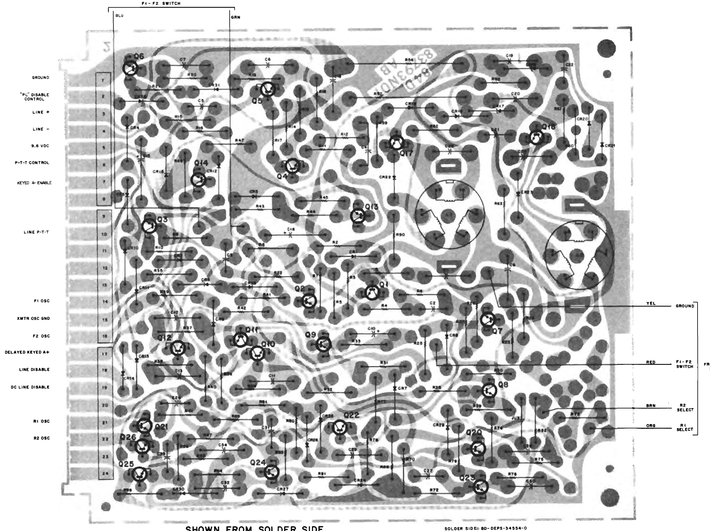
SOLDER SIDE: BD-DEPS-34554-O
COMPONENT SIDE: BD-DEPS-34553-O
OL-DEPS-34557-O

Circuit Board Details
Motorola No. **68P81062E16-A**
(Sheet 1 of 3)
11/1/85-UP

DC TRANSFER MODULES

MODELS TRN5240A, 54A, 55A, 56A

TRN5255A C2-R2 CONTROL



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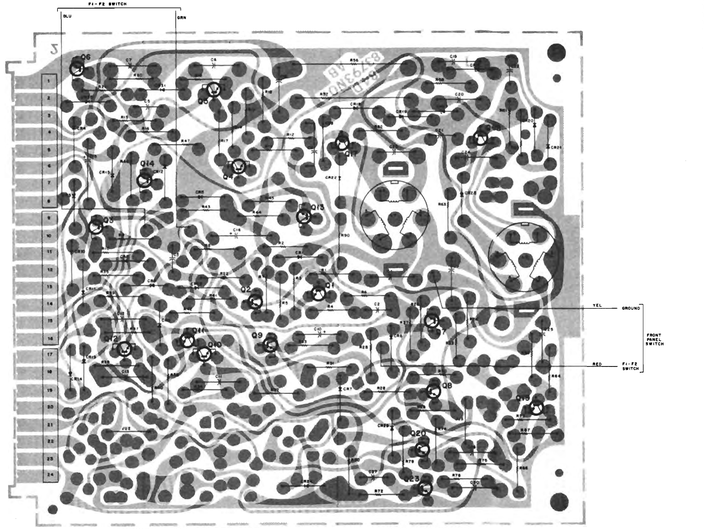
SOLDER SIDE: 80-26P3-94584-0
COMPONENT SIDE, 80-26P3-94583-0
01-5255-94583-0

TRN5256A F2-R2 MUTE



SHOWN FROM SOLDER SIDE

SOLDER SIDE-80-26P6-94584-0
COMPONENT SIDE 80-26P6-94583-0
01-5256-94583-2

Circuit Board Details & Parts List
Motorola No. **68P81062E16-A**
(Sheet 2 of 3)
11/1/85-UP

parts list

legend

reference symbol suffix	application
No Suffix	All models
A	TRN5240A
B	TRN5256A
C	TRN5254A
D	TRN5255A

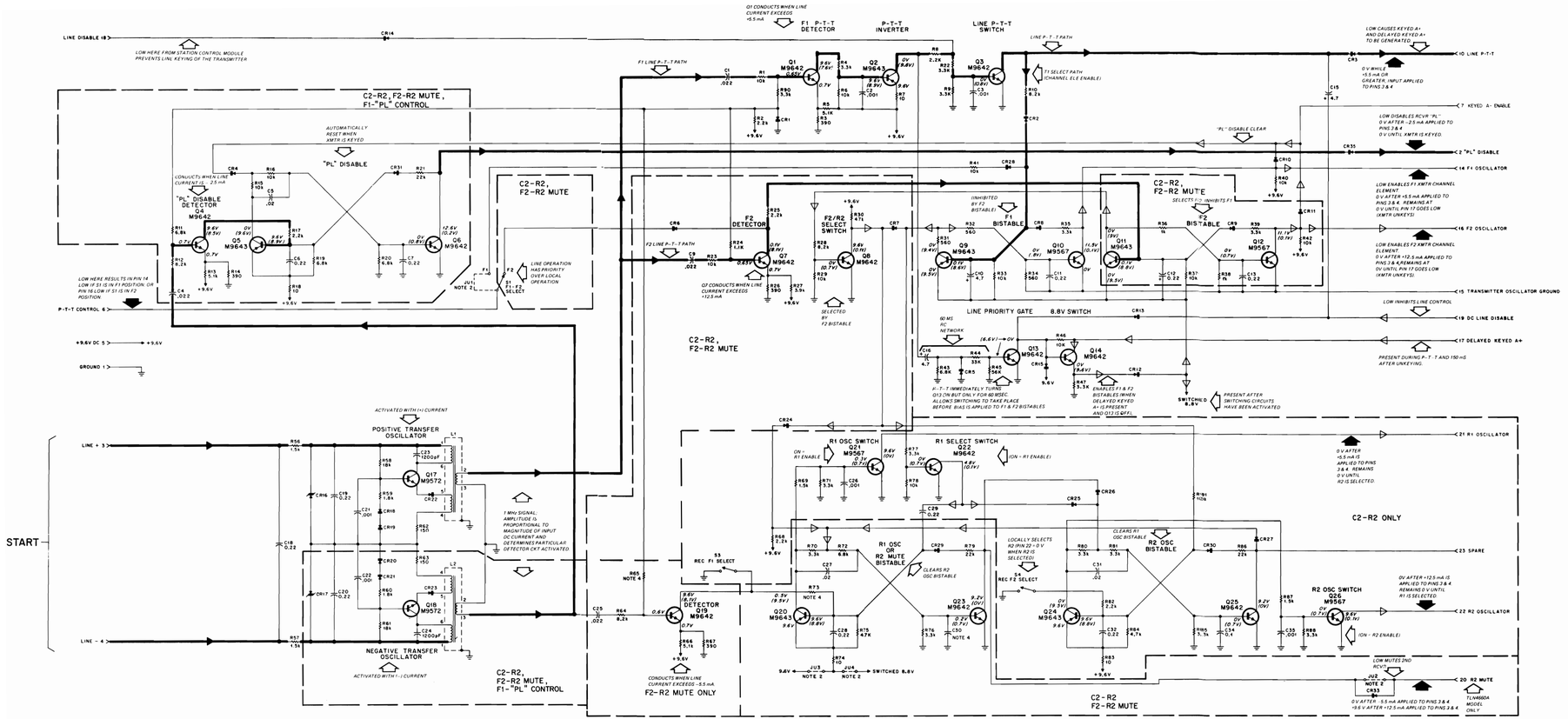
This parts list covers 4 models of the DC Transfer module. Where differences exist, a letter code is added to the reference symbol to indicate the applicable unit.

TRN5240A F1-PL Control DC Transfer Module
TRN5256A F2-R2 Mute DC Transfer Module
TRN5254A F1 Control DC Transfer Module
TRN5255A C2-R2 DC Transfer Module PL-7955-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ± 10%; 50 V: unless otherwise stated
C1	8-82905G02	.022
C2,3	21-82187B29	.001; 100 V
C4 (A,B,D)	8-82905G02	.022
C5 (A,B,D)	21-82428B26	.02 + 80-20%; 200 V
C6,7 (A,B,D)	8-82905G02	0.22
C9 (B,D)	8-82905G02	.022
C10	23-865137	4.7 ±20%; 25 V
C11	8-82905G11	0.22
C12 (B,D)	8-82905G11	0.22
C13 (B,D)	8-82905G11	0.22
C15,16	23-865137	4.7 ±20%; 25 V
C18 (A,C,D)	8-82905G11	0.22
C19 (A,C,D)	8-82905G11	0.22
C20 (A,C,D)	8-82905G11	0.22
C21,22	21-82187B29	.001; 100 V
C23,24	21-874352	1200 pF ±5%; 300 V
C25	8-82905G11	.022
C26 (D)	21-82187B29	.001; 100 V
C27 (B,D)	21-82428B26	.02 + 80-20%; 200 V
C28 (B,D)	8-82905G11	0.22
C29 (D)	8-82905G11	0.22
C30 (B,D)	8-83813H09	.033; 100 V
C31 (D)	21-82428B26	.02 + 80-20% 200 V
C32 (D)	8-82905G11	0.22
C34 (D)	8-83813H09	.033; 100 V
C35 (D)	21-82187B29	.001; 100 V
		semiconductor device, diode: (see note)
CR1, 2, 3	48-83654H01	silicon
CR4 (A,B,D)	48-83654H01	silicon
CR5	48-83654H01	silicon
CR6 (B,D)	48-83654H01	silicon
CR7 (B,D)	48-83654H01	silicon
CR8	48-83654H01	silicon
CR9 (B,D)	48-83654H01	silicon
CR10	48-83654H01	silicon
CR11 (B,D)	48-83654H01	silicon
CR12 thru 15	48-83654H01	silicon
CR18 thru 24	48-83654H01	silicon
CR25 (D)	48-83654H01	silicon
CR26 (D)	48-83654H01	silicon
CR27 (D)	48-83654H01	silicon
CR28, 29	48-83654H01	silicon
CR30 (D)	48-83654H01	silicon
CR31 (A,B,D)	48-83654H01	silicon
CR33	48-83654H01	silicon
		coil; rf:
L1,2	24-83008H01	oscillator
		transistor: (see note)
Q1	48-869642	NPN; type M9642
Q2	48-869643	PNP; type M9643
Q3	48-869642	NPN; type M9642
Q4 (A,B,D)	48-869642	NPN; type M9642
Q5 (A,B,D)	48-869643	PNP; type M9643
Q6 (A,B,D)	48-869642	NPN; type M9642
Q7 (B,D)	48-869642	NPN; type M9642
Q8 (B,D)	48-869642	NPN; type M9642
Q9	48-869643	PNP; type M9643
Q10	48-869567	NPN; type M9567
Q11 (B,D)	48-869643	PNP; type M9643
Q12 (B,D)	48-869567	NPN; type M9567
Q13, 14	48-869642	NPN; type M9642
Q17	48-869572	NPN; type M9572
Q18 (A,D)	48-869572	NPN; type M9572
Q19 (B)	48-869642	NPN; type M9642
Q20 (B,D)	48-869643	PNP; type M9643
Q21 (D)	48-869567	NPN; type M9567
Q22 (D)	48-869642	NPN; type M9642
Q23 (B,D)	48-869642	NPN; type M9642
Q24 (D)	48-869643	PNP; type M9643
Q25 (D)	48-869642	NPN; type M9642
Q26 (D)	48-869567	NPN; type M9567
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R1	6-11009C73	10k
R2	6-11009C57	2.2k
R3	6-11009C39	390
R4	6-11009C61	3.3k
R5	6-11009C86	5.1k
R6	6-11009C73	10k
R7	6-11009C01	10
R8	6-11009C57	2.2k
R9	6-11009C61	3.3k
R10	6-11009C71	8.2k
R11 (A,B,D)	6-11009C69	6.8k
R12 (A,B,D)	6-11009C71	8.2k
R13 (A,B,D)	6-11009C66	5.1k
R14 (A,B,D)	6-11009C39	390
R15 (A,B,D)	6-11009C73	10k
R16 (A,B,D)	6-11009C73	10k
R17 (A,B,D)	6-11009C57	2.2k
R18 (A,B,D)	6-11009C01	10
R19 (A,B,D)	6-11009C69	6.8k
R20 (A,B,D)	6-11009C69	6.8k
R21 (A,B,D)	6-11009C81	22k
R22	6-11009C61	3.3k
R23 (B,D)	6-11009C73	10k
R24 (B,D)	6-11009C50	1.1k
R25 (B,D)	6-11009C57	2.2k
R26 (B,D)	6-11009C39	390
R27 (B,D)	6-11009C66	5.1k
R28 (B,D)	6-11009C71	8.2k
R29 (B,D)	6-11009C73	10k
R30 (B,D)	6-11009C89	47k
R31, 32	6-11009C43	560
R33	6-11009C73	10k
R34	6-11009C43	560
R35	6-11009C61	3.3k
R36 (B,D)	6-11009C49	1k
R37 (B,D)	6-11009C73	10k
R38 (B,D)	6-11009C49	1k
R39 (B,D)	6-11009C61	3.3k
R40, 41	6-11009C73	10k
R42 (B,D)	6-11009C73	10k
R43	6-11009C69	6.8k
R44	6-11009C85	33k
R45	6-11009C91	56k
R46	6-11009C73	10k
R47	6-11009C61	3.3k
R56, 57	17-83027H03	1.5k; 3 W
R58	6-11009C79	18k
R59, 60	6-11009C55	1.8k
R61	6-11009C79	18k
R62, 63	6-11009C29	150
R64	6-11009C71	8.2k
R65	6-11009C57	2.2k
R66	6-11009C66	5.1k
R67	6-11009C39	390
R68 (D)	6-11009C57	2.2k
R69 (D)	6-11009C53	1.5k
R70	6-11009C61	3.3k
R71 (D)	6-11009C61	3.3k
R72	6-11009C69	6.8k
R73	6-11009C57	2.2k
R74	6-11009C01	10
R75	6-11009C65	4.7k
R76	6-11009C61	3.3k
R77 (D)	6-11009C61	3.3k
R78 (D)	6-11009C73	10k
R79	6-11009C81	22k
R80 (D)	6-11009C61	3.3k
R81 (D)	6-11009C61	3.3k
R82 (D)	6-11009C57	2.2k
R83 (D)	6-11009C01	10
R84 (D)	6-11009C65	4.7k
R85 (D)	6-11009C61	3.3k
R86 (D)	6-11009C81	22k
R87 (D)	6-11009C53	1.5k
R88 (D)	6-11009C61	3.3k
R89	6-11009C71	8.2k
R90	6-11009C61	3.3k
R91 (D)	6-11009C73	10k
		switch:
S1	40-83204B01	slide
S3,4	40-83468E01	slide
		voltage regulator: (see note)
VR1	48-83461E12	Zener; 27 V
VR2 (A,B,D)	48-83461E12	Zener; 27 V
		non-referenced items
	9-83497F01	RECEPTACLE, female: 8-contact; 3 used (PCB Edge Connector)
	14-84436N01	CAN, insulated coil
	64-83120L02	PANEL, screened (TRN5240A, TRN5254A)
	64-83121L02	PANEL, screened (TRN5255A)
	64-83122L02	PANEL, screened (TRN5256A)
	26-82072C03	SHIELD, coil; 2 req'd.
	76-83960B07	CORE, 6 req'd.

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

DC TRANSFER MODULES
MODELS TRN5240A, 54A, 55A, 56A



Module Description	Line Current	Function
F1-PL	+ 5.5 mA	Key Transmitter on F1.
	-2.5 mA	PL Disable Receiver
F2-R2 Mute	+ 5.5 mA	Key Transmitter on F1
	+ 12.5 mA	Key Transmitter on F2, Unmute R2
	-2.5 mA	PL Disable Receiver
	-5.5 mA	Mute R2
F1-CS	+ 5.5 mA	Transmit on F1
C2-R2	+ 5.5 mA	Transmit on F1, Select R1
	+ 12.5 mA	Transmit on F2, Select R2
	-2.5 mA	PL Disable Receiver

BENCH TESTING SET-UP

Pin No.	Connect
1, 15	Ground
10, 2	10k ohms to 9.6 volts dc
3	Through 0 to 15 dc milliameter to 70 to 100 volts dc current source
4	To negative (-) of current source
5	9.6 volts
17	12 volts dc

NOTES:

1. Unless otherwise stated: resistor values are in ohms (k = 1000); capacitor values are in microfarads.
2. Jumper chart.

	Model	JU1	JU2	JU3	JU4
F1-PL	TRN5240A	IN	OUT	OUT	OUT
F2-R2 Mute	TRN5256A	OUT	IN	IN	OUT
F1 CONT	TRN5254A	IN	OUT	OUT	OUT
C2-R2	TRN5255A	OUT	OUT	IN	OUT

3. Voltages shown in parentheses are normally measured when function is activated. Voltages not in parentheses are normally measured when function is deactivated.
4. See parts list for component values.
5. All bistables are complementary. Therefore, both bistable transistors are on or off simultaneously.
6. NA.
7. While either pins 18 or 19 are grounded, line currents will not activate the module.

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

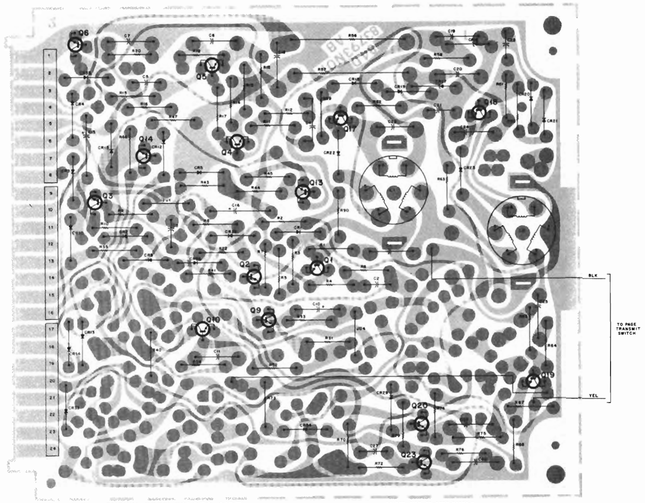
Converts dc line currents to station control functions.

Schematic Diagram
Motorola No. **68P81062E16-A**
(Sheet 3 of 3)
11/1/85-UP

DC TRANSFER (OPTION) MODULE

MODELS TRN5239A, 57A

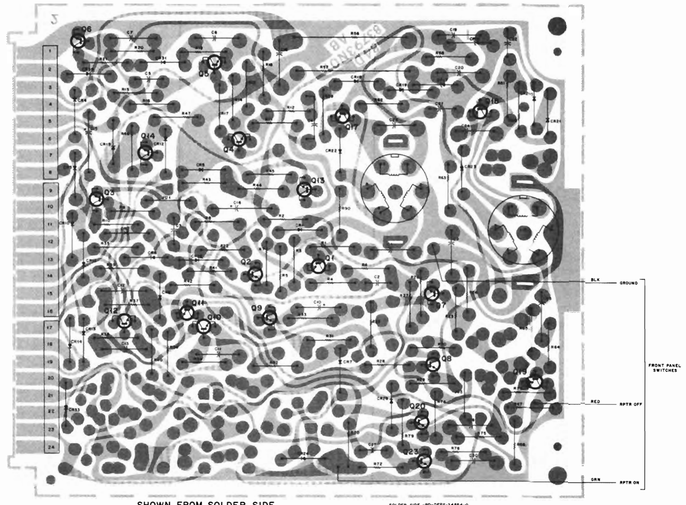
TRN5239A PAGING CONTROL



SHOWN FROM SOLDER SIDE

SOLDER SIDE (80-DEP0-34594-O
COMPONENT SIDE 80-DEP0-34593-O
OL-DEP0-34583-O

TRN5257A REPEATER CONTROL



SHOWN FROM SOLDER SIDE

SOLDER SIDE (80-DEP0-34594-O
COMPONENT SIDE 80-DEP0-34593-O
OL-DEP0-34583-O

Circuit Board Details & Parts List
Motorola No. **68P81062E17-B**
(Sheet 1 of 2)
11/1/85-UP

parts list

legend

reference symbol suffix	application
No Suffix	All models
A	TRN5239A
B	TRN5257A

This parts list covers 2 models of the DC Transfer module. Where differences exist, a letter code is added to the reference symbol to indicate the applicable unit.

TRN5239A Paging Control DC Transfer Module
TRN5257A Repeater Control DC Transfer Module PL-7954-A

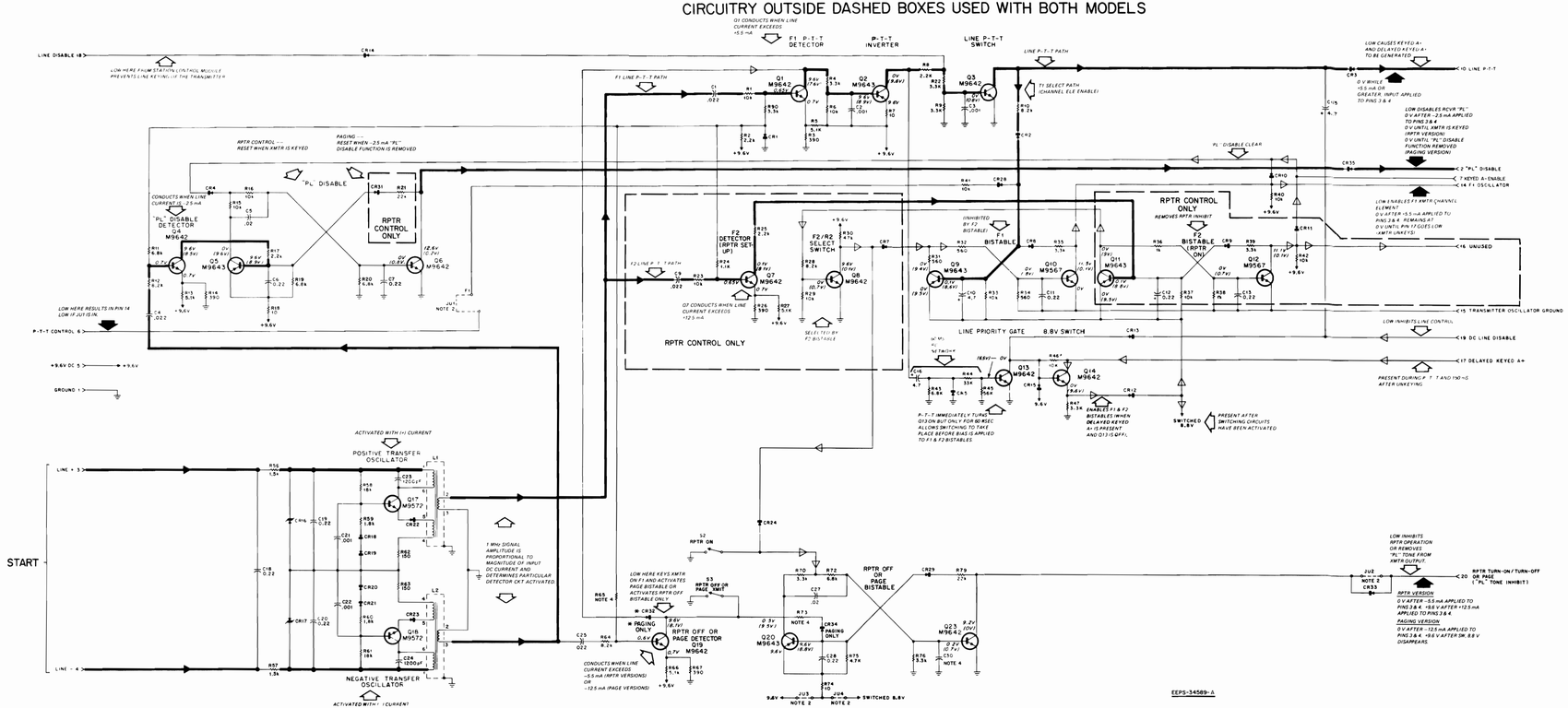
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ± 10%; 50 V: unless otherwise stated
C1	8-82905G02	.022
C2,3	21-82187B29	.001; 100 V
C4	8-82905G02	.022
C5	21-82428B26	.02 + 80-20%; 200 V
C6,7	8-82905G02	0.22
C9 (B)	8-82905G02	.022
C10	23-865137	4.7 ± 20%; 25 V
C11	8-82905G11	0.22
C12 (B)	8-82905G11	0.22
C13 (B)	8-82905G11	0.22
C15,16	23-865137	4.7 ± 20%; 25 V
C18,19,20	8-82905G11	0.22
C21,22	21-82187B29	.001; 100 V
C23,24	21-874352	1200 pF ± 5%; 300 V
C25	8-82905G11	.022
C26		NOT USED
C27	21-82428B26	.02 + 80-20%; 200 V
C28	8-82905G11	0.22
C29		NOT USED
C30	8-83813H09	.033; 100 V
		diode: (see note)
CR1 thru 6	48-83654H01	silicon
CR7 (B)	48-83654H01	silicon
CR8	48-83654H01	silicon
CR9 (B)	48-83654H01	silicon
CR10	48-83654H01	silicon
CR11 (B)	48-83654H01	silicon
CR12 thru 15	48-83654H01	silicon
CR18 thru 24	48-83654H01	silicon
CR26, 29	48-83654H01	silicon
CR31 (B)	48-83654H01	silicon
CR32 (A)	48-83654H01	silicon
CR33 (A)	48-84616A01	silicon, hot carrier
CR33 (B)	48-83654H01	silicon
CR34 (A)	48-83654H01	silicon
		coil; rf:
L1,2	24-83008H01	oscillator
		transistor: (see note)
Q1	48-869642	NPN; type M9642
Q2	48-869643	PNP; type M9643
Q3	48-869642	NPN; type M9642
Q4	48-869642	NPN; type M9642
Q5	48-869643	PNP; type M9643
Q6	48-869642	NPN; type M9642
Q7 (B)	48-869642	NPN; type M9642
Q8 (B)	48-869642	NPN; type M9642
Q9	48-869643	PNP; type M9643
Q10	48-869567	NPN; type M9567
Q11	48-869643	PNP; type M9643
Q12	48-869567	NPN; type M9567
Q13, 14	48-869642	NPN; type M9642
Q17, 18	48-869572	NPN; type M9572
Q19	48-869642	NPN; type M9642
Q20	48-869643	PNP; type M9643
Q23	48-869642	NPN; type M9642
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R1	6-11009C73	10k
R2	6-11009C57	2.2k
R3	6-11009C39	390
R4	6-11009C61	3.3k
R5	6-11009C66	5.1k
R6	6-11009C73	10k
R7	6-11009C01	10
R8	6-11009C57	2.2k
R9	6-11009C61	3.3k
R10	6-11009C71	8.2k
R11	6-11009C69	6.8k
R12	6-11009C71	8.2k
R13	6-11009C66	5.1k
R14	6-11009C39	390
R15	6-11009C73	10k
R16	6-11009C73	10k
R17	6-11009C57	2.2k
R18	6-11009C01	10
R19	6-11009C69	6.8k
R20	6-11009C69	6.8k
R21(B)	6-11009C81	22k
R22	6-11009C61	3.3k
R23 (B)	6-11009C73	10k
R24 (B)	6-11009C50	1.1k
R25 (B)	6-11009C57	2.2k
R26 (B)	6-11009C39	390
R27 (B)	6-11009C66	5.1k
R28 (B)	6-11009C71	8.2k
R29 (B)	6-11009C73	10k
R30 (B)	6-11009C89	47k
R31	6-11009C43	560
R32	6-11009C43	560
R33	6-11009C73	10k
R34	6-11009C43	560
R35	6-11009C61	3.3k
R36 (B)	6-11009C49	1k
R37 (B)	6-11009C73	10k
R38 (B)	6-11009C49	1k
R39 (B)	6-11009C61	3.3k
R40	6-11009C73	10k
R41	6-11009C73	10k
R42 (B)	6-11009C73	10k
R43	6-11009C69	6.8k
R44	6-11009C85	33k
R45	6-11009C91	56k
R46	6-11009C73	10k
R47	6-11009C61	3.3k
R56	17-83027H03	1.5k; 3 W
R57	17-83027H03	1.5k; 3 W
R58	6-11009C79	18k
R59	6-11009C55	1.8k
R60	6-11009C55	1.8k
R61	6-11009C79	18k
R62	6-11009C29	150
R63	6-11009C29	150
R64	6-11009C71	8.2k
R65 (A)	6-11009C53	1.5k
R65 (B)	6-11009C57	2.2k
R66	6-11009C66	5.1k
R67	6-11009C39	390
R70	6-11009C61	3.3k
R72	6-11009C69	6.8k
R73 (A)	6-11009C57	2.2k
R73 (B)	6-11009C49	1k
R74	6-11009C01	10
R75	6-11009C65	4.7k
R76	6-11009C61	3.3k
R79	6-11009C57	22k
R90	6-11009C61	3.3k
		switch:
S1	40-83204B01	slide
S2 (B)	40-83468E01	slide
S3,4	40-83468E01	slide
		voltage regulator: (see note)
VR1,2	48-83461E12	Zener; 27 V
		non-referenced items
	9-83497F01	RECEPTACLE, female: 8-contact; 3 used (PCB Edge Connector)
	64-83123L02	PANEL, screened (TRN5239A)
	64-83124L03	PANEL, screened (TRN5257A)
	26-858660	SHIELD, coil; 2 req'd.
	76-839608I07	CORE, 6 req'd.

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

DC TRANSFER (OPTION) MODULE

MODELS TRN5239A, 57A

CIRCUITRY OUTSIDE DASHED BOXES USED WITH BOTH MODELS



Module Description	Line Current	Function
Paging (Optional)	+ 5.5mA	Key transmitter on F1 with PL modulation.
	-2.5mA	PL disable receiver
	-12.5mA	Key transmitter on F1 without PL modulation.
RPTR Control (optional for repeater)	+ 5.5 mA + 12.5 mA	Transmit on F1 Repeater turn-on
	-2.5 mA	PL disable receiver
	-5.5 mA	Repeater turn-off

Bench Testing Set Up

Pin No.	Connect
1, 15	Ground
10, 2, 20	10K ohms to 96 volts dc
3	Through 0 to 15 dc milliameter to 70 to 100 volts dc current source
4	To negative (—) of current source
5	9.6 volts
17	12 volts dc

NOTES:

1. Unless otherwise stated; resistor values are in ohms (k = 1000) and capacitor values are in microfarads.
2. Jumper Chart.

	Model	JU1	JU2	JU3	JU4
Paging	TRN5239A	IN	OUT	OUT	IN
RPTR Cont.	TRN5257A	IN	OUT	IN	OUT

3. Voltages shown in parenthesis are normally measured when function is activated. Voltages not in parentheses are normally measured when function is deactivated.
4. See parts list for component values.
5. All bistables are complementary. Therefore both bistable transistors are on or off simultaneously.
6. N/A.
7. While either pins 18 or 19 are grounded, line currents will not activate the module.

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

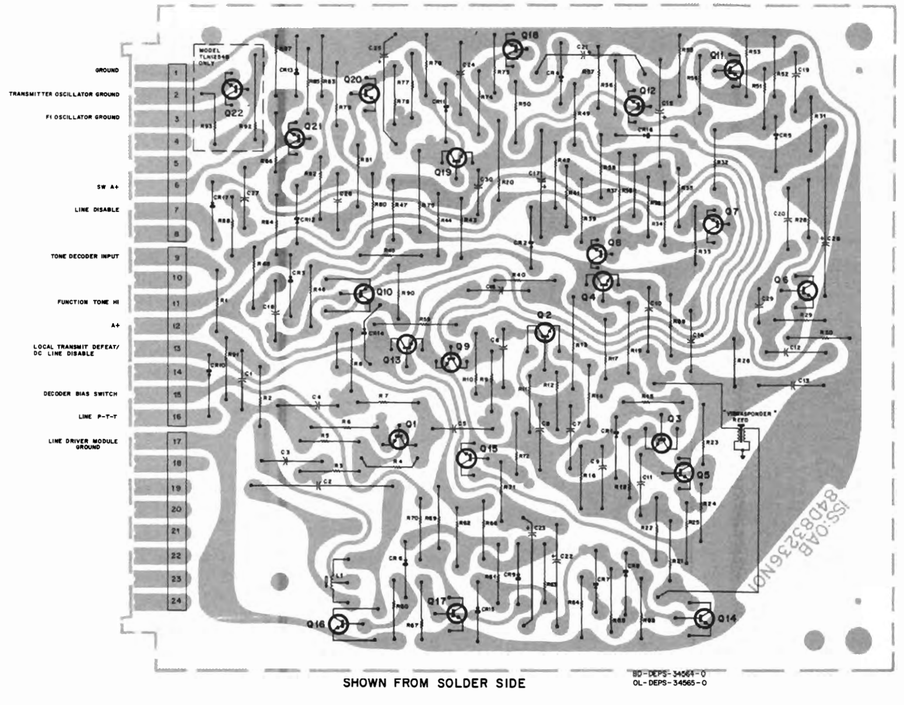
FUNCTION

Converts dc line currents to station control functions.

Schematic Diagram
Motorola No. **68P81062E17-B**
(Sheet 2 of 2)
11/1/85- UP

GUARD TONE DECODER MODULES

MODELS TLN2443A, 50A



SHOWN FROM SOLDER SIDE

Circuit Board Detail & Parts List
Motorola No. **68P81062E18-A**
(Sheet 1 of 2)
11/1/85- UP

parts list

legend

reference symbol suffix	application
No Suffix	All Models
A	TRN5307A Decoder without GND switch circuit
B	TRN5319A Decoder with GND switch circuit

This parts list covers 2 models of the GLuard Tone Decoder Module. Where differences exist, a letter code is added to the reference symbol to indicate the applicable model.

TRN5307A Guard Tone Decoder Board
TRN5319A Guard Tone Decoder Board PL-7959-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ±5%; 50 V: unless otherwise stated
C1	8-82905G26	.0047
C2	8-84326A29	.005 ±2%
C3	8-82905G07	0.1
C4	8-82905G11	0.22
C5, 6, 7	8-82905G02	.022
C8	8-82905G25	.0033
C9	8-82905G01	.01
C10	8-82905G11	0.22
C11 thru 14	8-82905G04	.068
C15	23-865136	15 ±20%; 25 V
C16	8-82905G03	.047
C17	23-865136	15 ±20%; 25 V
C18, 19, 20	8-82905G04	.068
C21	23-865137	4.7 ±20%; 25 V
C22	23-82783B08	1.0 ±20%; 35 V
C23	23-865136	15 ±20%; 25 V
C24	8-82905G11	0.22
C25	23-865136	15 ±20%; 25 V
C26	8-82905G07	0.1
C27	8-82905G11	0.22
C28	23-82601A25	100 +150-10%; 20 V
C29. 30	21-82187B14	.001; 100 V
		semiconductor device, diode: (see note)
CR1 thru 17	48-83654H01	silicon
		coil assembly, inductor:
L1	1-80702B11	1 H; incl. ground clip
		transistor: (see note)
Q1	48-869539	NPN; type M9539
Q2	48-869594	NPN; type M9594
Q3,4	48-869570	NPN; type M9570
Q5	48-869594	NPN; type M9594
Q6	48-869570	NPN; type M9570
Q7	48-869571	PNP; type M9571
Q8	48-869570	NPN; type M9570
Q9	48-869594	NPN; type M9594
Q10,11	48-869571	PNP; type M9571
Q12 thru 14	48-869570	NPN; type M9570
Q15	48-869648	NPN; type M9648
Q16 thru 19	48-869570	NPN; type M9570
Q20	48-869571	PNP; type M9571
Q21	48-869570	NPN; type M9570
Q22 (B)	48-869567	NPN; type M9567
		resistor, fixed: ±10%; 1/4 W: unless otherwise stated
R1	6-11009C73	10k
R2	6-11009C69	6.8k
R3	6-11009C81	22k
R4	6-11009D06	220k
R5	6-11009C97	100k
R6	6-11009C49	1k
R7	6-11009C73	10k
R8	6-11009C81	22k
R9	6-11009C77	15k
R10	6-11009C61	3.3k
R11	6-11009D02	150k
R12	6-11009D18	680k
R13	6-125A73	10k; 1/2 W
R14	6-11009C45	680
R15	6-11009D18	680k
R16	6-11009D08	270k
R17	6-11009C73	10k
R18	6-11009C41	470
R19	6-11009C45	680
R20	6-125C37	330; 1/2 W
R21	6-11009C53	1.5k
R22	6-11009C13	33
R23	6-11009C93	68k
R24	6-11009C83	27k
R25	6-11009C01	10
R26	6-11009C49	1k
R28	6-11009C93	68k
R29	6-11009C83	27k
R30	6-11009C11	27

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R31	6-11009C49	1k
R32	6-11009C75	12k
R33	6-11009C33	220
R34	6-11009C89	47k
R35	6-11009C57	2.2k
R36	6-11009C99	120k
R37	6-125C97	100k
R38	6-11009C81	22k
R39	6-11009C93	68k
R40	6-11009C73	10k
R41	6-11009C89	47k
R42	6-11009C95	82k
R43, 44	6-11009C57	2.2k
R45	6-11009C37	330
R46	6-11009C75	12k
R47	6-11009C61	3.3k
R48	6-11009C51	1.2k
R49, 50	6-11009C13	33
R51	6-11009C75	12k
R52	6-11009C61	3.3k
R53	6-11009C57	2.2k
R54	6-11009C35	270
R55	6-11009C89	47k
R56	6-11009C65	4.7k
R57	6-11009C57	2.2k
R58	6-11009C25	100
R59	6-125C49	1k; 1/2 W
R60	6-11009C89	47k
R61	6-11009C81	22k
R62	6-11009C93	68k
R63	6-11009C81	22k
R64	6-11009C75	12k
R65	6-11009C61	3.3k
R66	6-11009C93	68k
R67, 68	6-11009C89	47k
R69, 70	6-11009C57	2.2k
R71	6-11009C73	10k
R72	6-11009C89	47k
R73	6-11009C49	1k
R74	6-11009C61	3.3k
R75	6-125C49	1k; 1/2 W
R76	6-11009C49	1k
R77	6-11009C63	3.9k
R78	6-11009C49	1k
R79	6-11009C57	2.2k
R80	6-11009C25	100
R81	6-11009C57	2.2k
R82	6-11009C73	10k
R83	6-11009C57	2.2k
R84	6-11009C49	1k
R85	6-11009C09	22
R86	6-11009C93	68k
R87	6-11009C81	27k
R88	6-11009C37	330
R89	6-11009C01	10
R90	6-11009C49	1k
R91	6-11009C57	2.2k
R92	6-11009C49	1k
R93	6-11009C61	3.3k
		mechanical parts
	3-84256M01	SCREW, tapping; 2 used
	64-83128L02	PANEL, screened
	5-84220B01	GROMMET; 2 used
	9-83497F01	RECEPTACLE, 8 contact; 3 used (PCB Edge Connector)
	1-80702B13	ASSEMBLY SOCKET and BRACKET
	9-83697M01	RECEPTACLE, female; 13 used

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

GUARD TONE DECODER MODULES

MAINTENANCE & TROUBLESHOOTING

1. CONNECTIONS

This module may be serviced either while connected to the control chassis or while connected to separate external test equipment. Refer to control chassis servicing information in the manual for additional set-up details.

Make the following connections to the module.

Pin Number	Connection
1, 17	Ground
9	Audio oscillator through 0.1 uF
11	AC Voltmeter
12	A+ (13.9 V dc)

2. NORMAL CONDITIONS

Excessive deviations from these values indicate abnormal conditions.

Function	Typical Value
Pull-In Line Level @ 2175 Hz	-31 dBm
Drop-Out Line Level @ 2175 Hz	-51 dBm
PTT Turn-On Time	Less than 100 Milliseconds
PTT Turn-Off Time	Less than 100 Milliseconds
Prefilter Switch Time	375 Milliseconds
Gated AGC Threshold	-45 dBm
Line AGC Threshold	-18 dBm
Prefilter Frequency	2160 Hz
Vibrasponder Frequency	2175 Hz

3. MODULE MALFUNCTION LOCATION TECHNIQUES

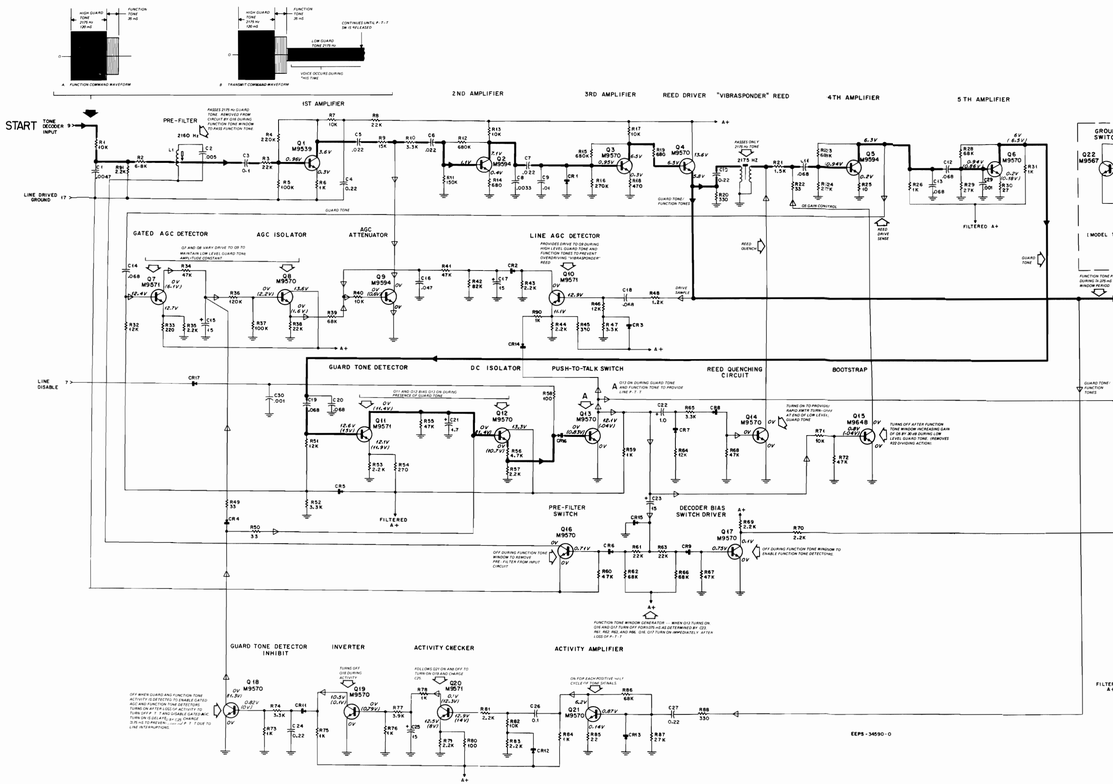
Step 1. Inject a 15 millivolt, 2175 Hz audio tone into pin 9.

Step 2. Measure the dc voltage from pin 13 to ground as the tone input voltage reaches 15 millivolts, pin 13 should go to ground if the ground does not occur. Check voltages on transistors Q1 through Q6, Q11, Q12 and Q13.

Step 3. Connect an ac voltmeter across pin 11 and ground, and a dc voltmeter to pin 13 and ground. With an accurate 2175 Hz tone injected at pin 9, pin 13 should go to ground and remain. When pin 13 is at ground the output level at pin 11 should remain constant at 180 millivolts ±3 dB when the input level is slowly varied from 3 millivolts to 80 millivolts. If this does not occur, check Q1 through Q5, Q7, Q8, and Q9.

Step 4. Ground the base of the Q16 prefilter switch. With the ac voltmeter connected to pin 11, inject a 2000 Hz tone into pin 9. As the input level is raised to 40 millivolts ±3 dB. The level measured at pin 11 should reach approximately 3 volts ac and then level off with proper operation, increasing the signal amplitude at pin 9 to 4 volts ac should cause only a 3 dB increase in the level at pin 11 from that with 40 millivolt input. If Step 3 was ok and Step 4 did not operate, check Q10.

Step 5. Repeat Steps 1 and 2 with an accurate 2175 Hz tone. To check the drop-out level, slowly reduce the signal amplitude at pin 9 until the voltage at pin 13 goes to the A+ level. Measure the ac voltage at pin 9. Extra attenuation may be required between the audio oscillator and pin 9, since the dropout level is typically less than −60 dBm (1 mV).



Model Complement

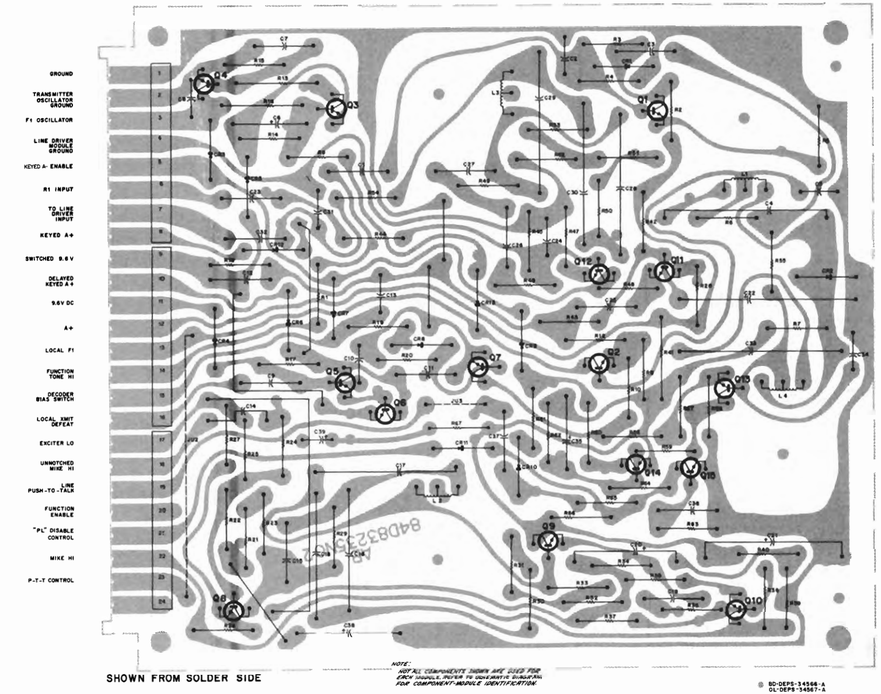
Model	Module	Reed (2175 Hz)	Application
TLN2443A	TRN5307A	TLN6709BH	Remote control base and repeater stations
TLN2450A	TRN5319A	TLN6709BH	Guard tone relay control stations.

FUNCTION

- Converts 2175 Hz guard tone signal to line PTT signal.
- Amplifies and distributes received function tones to other function decoders.
- Provides security against remote control chassis falsing from function tone signals outside predetermined time frame.
- Turns transmitter off at end of PTT.
- Transmitter channel element ground provided with TLN2450A Module. (A guard tone relay control station does not include this circuitry on any other module.)

Maintenance & Schematic Diagram
Motorola No. **68P81062E18-A**
(Sheet 2 of 2)
11/1/85- UP

F1-CS & F1-PL TONE CONTROL MODULES



Circuit Board Diagram and Parts List
Motorola No. **68P81062E19-B**
(Sheet 1 of 2)
11/1/85- UP

parts list

legend

reference symbol suffix	application
No Suffix	All Models
A	TRN5322A
B	TRN5327A
C	TRN5327A

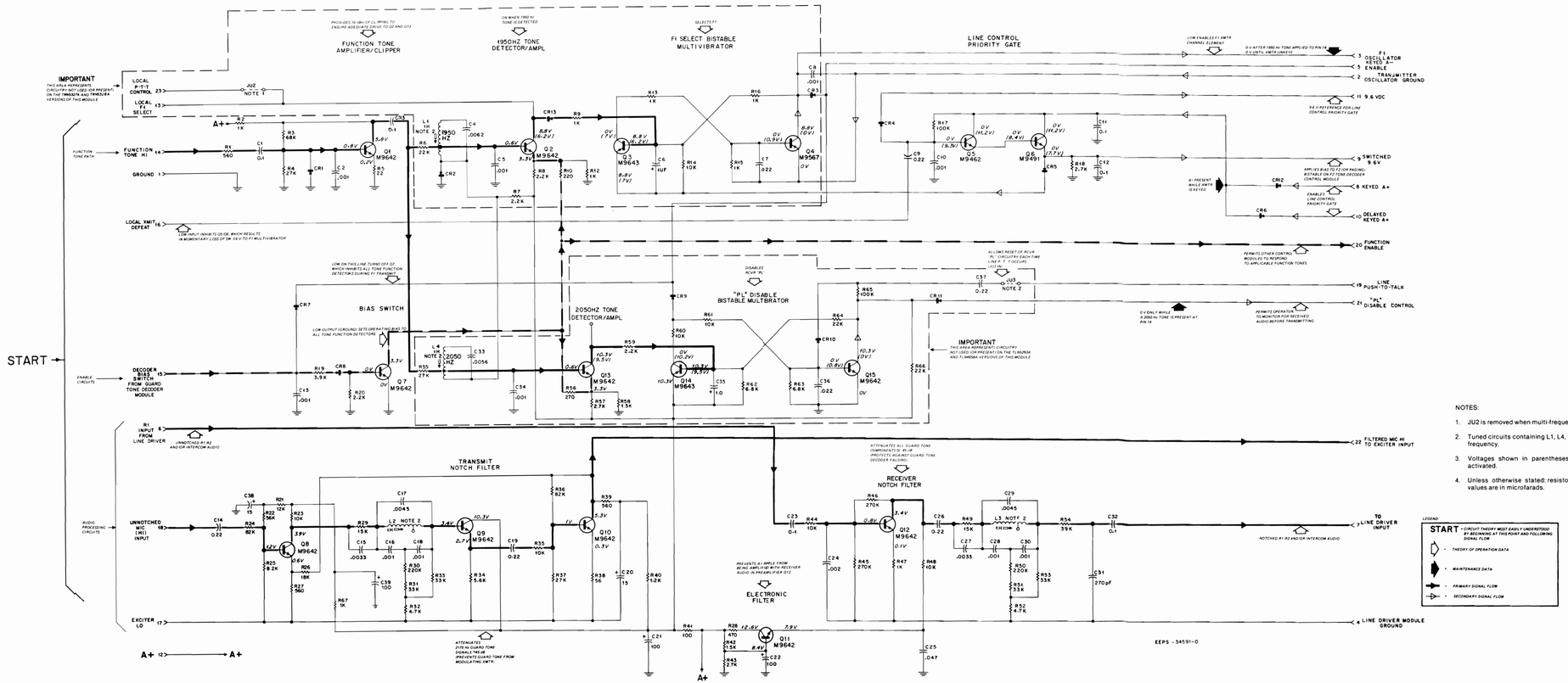
This parts list covers 4 models of the F1 Tone Decoder Modules. Where differences exist, a letter code is added to the reference symbol to indicate the applicable unit.

TRN5320A F1-PL Control, F1 Tone Control Module
TRN5322A F1-CS Control, F1 Tone Control Module
TRN5327A 4-Frequency F1-CS Control, F1 Tone Control Module
TRN5328A 4-Frequency F1-PL Control, F1 Tone Control Module PL-8001-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ±10%; 50 V: unless otherwise stated
C1 (A)	8-82905G07	0.1
C2 (A)	21-82187B29	.001; 100 V
C3 (A)	8-82905G07	0.1
C4 (A)	8-84326A14	.0062 ±2%
C5 (A)	21-82187B29	.001; 100 V
C6 (A)	23-82783B08	1 ±20%; 35 V
C7 (A)	8-82905G02	.022
C8 (A)	21-82187B29	.001; 100 V
C9 (A, B, C)	8-82905G11	0.22
C10 (A, B, C)	21-82187B29	.001; 100 V
C11, 12 (A, B, C)	8-82905G07	0.1
C13 (A, B, C)	21-82187B29	.001; 100 V
C14 (A, B, C)	8-82905G11	0.22
C15 (A, B, C)	8-82905G25	.0033
C16 (A, B, C)	882284C01	.001
C17 (A, B, C)	8-84326A30	.0045 ±1%
C18 (A, B, C)	8-82284C01	.001
C19 (A, B, C)	8-82905G11	0.22
C20 (A, B, C)	23-865136	15 ±20%; 25 V
C21 (A, B, C)	23-84669A19	100 +150-10%; 20 V
C22 (A, B, C)	23-82601A25	100 +150-10%; 20 V
C23 (A, B, C)	8-82905G07	0.1
C24 (A, B, C)	21-82187B27	.002; 100 V
C25 (A, B, C)	8-82905G03	.047
C26 (A, B, C)	882905G11	0.22
C27 (A, B, C)	8-82905G25	.0033
C28 (A, B, C)	8-82284C01	.001
C29 (A, B, C)	8-84326A30	.0045 ±1%
C30 (A, B, C)	8-82284C01	.001
C31 (A, B, C)	21-82187B22	270 pF; 200 V
C32 (A, B, C)	8-82905G07	0.1
C33 (B)	8-84326A13	.0056 ±2%
C34 (B)	21-82187B29	.001; 100 V
C35 (B)	23-82783B08	1 ±20%; 35 V
C36 (B)	8-82905G02	.022
C37 (B)	8-82905G11	0.22
C38 (B, C)	23-865136	15 ±20%; 25 V
C39	23-11019A46	100 ±20%; 25 V
		diode: (see note)
CR1 (A, B)	48-83654H01	silicon
CR2 (A, B)	48-83654H01	silicon
CR3 (A, B)	48-83654H01	silicon
CR4 thru 8	48-83654H01	silicon
CR9 (A, C)	48-83654H01	silicon
CR10 (A, C)	48-83654H01	silicon
CR11 (A, C)	48-83654H01	silicon
CR12	48-83654H01	silicon
CR13 (A, B, C)	48-83654H01	silicon
		coil, af:
L1 (A, B, C)	1-80702B11	1 H; includes ground clip
L2, 3	1-80702B11	1 H; includes ground clip
L4 (A)	1-80702B11	1 H; includes ground clip
		transistor: (see note)
Q1, 2 (A)	48-869642	NPN; type M9642
Q3 (A)	48-869643	PNP; type M9643
Q4 (A)	48-869567	NPN; type M9567
Q5 (A, B, C)	48-869642	NPN; type M9642
Q6 (A, B, C)	48-869491	NPN; type M9491
Q7 thru 12 (A, B, C)	48-869642	NPN; type M9642
Q13 (B)	48-869642	NPN; type M9642
Q14 (B)	48-869643	PNP; type M9643
Q15 (B)	48-869642	NPN; type M9642
		resistor, fixed: ±5%; 1/4 W: unless otherwise stated
R1 (A)	6-11009C43	560
R2 (A)	6-11009C49	1k
R3 (A)	6-11009C93	68k
R4 (A)	6-11009C83	27k
R5 (A)	6-11009C09	22k
R6 (A)	6-11009C81	22
R7, 8 (A)	6-11009C57	2.2k
R9 (A)	6-11009C49	1k
R10 (A)	6-11009C33	220
R11		NOT USED
R12 (A)	6-11009C49	1k
R13 (A)	6-125C49	1k; 1/2 W
R14 (A)	6-11009C73	10k
R15 (A)	6-11009C49	1k
R16 (A, B, C)	6-125C49	1k; 1/2 W
R17 (A, B, C)	6-11009C97	100k
R18 (A, B, C)	6-11009C59	2.7k
R19 (A, B, C)	6-11009C63	3.9k
R20 (A, B, C)	6-11009C57	2.2k
R21 (A, B, C)	6-11009C79	18k
R22 (A, B, C)	6-11009C91	56k
R23 (A, B, C)	6-11009C73	10k
R24 (A, B, C)	6-11009C95	82k
R25 (A, B, C)	6-11009C71	8.2k
R26 (A, B, C)	6-11009C79	18k
R27 (A, B, C)	6-11009C43	560
R28 (A, B, C)	6-11009C41	470
R29 (A, B, C)	6-11009C77	15k
R30 (A, B, C)	6-11009D06	220k
R31 (A, B, C)	6-11009C88	33k
R32 (A, B, C)	6-11009C65	4.7k
R33 (A, B, C)	6-11009C85	33k
R34 (A, B, C)	6-11009C67	5.6k
R35 (A, B, C)	6-11009C73	10k
R36 (A, B, C)	6-11009C95	82k
R37 (A, B, C)	6-11009C83	27k
R38 (A, B, C)	6-11009C19	56
R39 (A, B, C)	6-11009C43	560
R40 (A, B, C)	6-11009C51	1.2k
R41 (A, B, C)	6-125A25	100; 1/2 W
R42 (A, B, C)	6-11009C53	1.5k
R43 (A, B, C)	6-11009C59	2.7k
R44 (A, B, C)	6-11009C73	10k
R45, 46 (A, B, C)	6-11009D08	270k
R47 (A, B, C)	6-11009C49	1k
R48	6-11009C73	10k
R49 (A, B, C)	6-11009C77	15k
R50 (A, B, C)	6-11009D06	220k
R51 (A, B, C)	6-11009C85	33k
R52 (A, B, C)	6-11009C65	4.7k
R53 (A, B, C)	6-11009C85	33k
R54 (A, B, C)	6-11009C87	39k
R55	6-11009C83	27k
R56	6-11009C35	270
R57	6-11009C59	2.7k
R58	6-11009C53	1.5k
R59	6-11009C57	2.2k
R60, 61	6-11009C73	10k
R62, 63	6-11009C69	6.8k
R64	6-11009C81	22k
R65	6-11009C97	100k
R66	6-11009C81	22k
R67	6-11009C49	1k
		mechanical parts
	3-84256M01	SCREW, tapping; 2 used
	5-84220B01	GROMMET; 2 used
	64-83127L02	PANEL, screened (TRN5320A)
	64-83126L02	PANEL, screened (TRN5322A)
	64-84317A02	PANEL, screened (TRN5328A)
	64-84394A02	PANEL, screened (TRN5327A)
	9-83497F01	RECEPTACLE, connector; 8-contact; 3 used (PCB Edge)

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

F1-CS & F1-PL TONE CONTROL MODULES



FUNCTION

TRN5322A F1-CS Control	Keys XMTR on F1.
TRN5320A F1-PL Control	Keys XMTR on F1 and PL disables RCVR.
TRN5327A F1-CS Control (4-Freq. Carrier Squelch Station)	Provides receive and transmit notch filters. Frequency selected on separate TRN5296A 4-Frequency Control Module.
TRN5328A F1-PL Control (4-Freq. PL Squelch Station)	Provides receive and transmit notch filters and PL disables RCVR. Frequency selected on separate TRN5296A 4-Frequency Control Module.

NOTES:

1. JU2 is removed when multi-frequency and paging transmitters are used.
2. Tuned circuits containing L1, L4, L2 and L3 are factory adjusted to the required frequency.
3. Voltages shown in parentheses are normally measured when function is activated.
4. Unless otherwise stated: resistor values are in ohms (k = 1000), capacitor values are in microfarads.

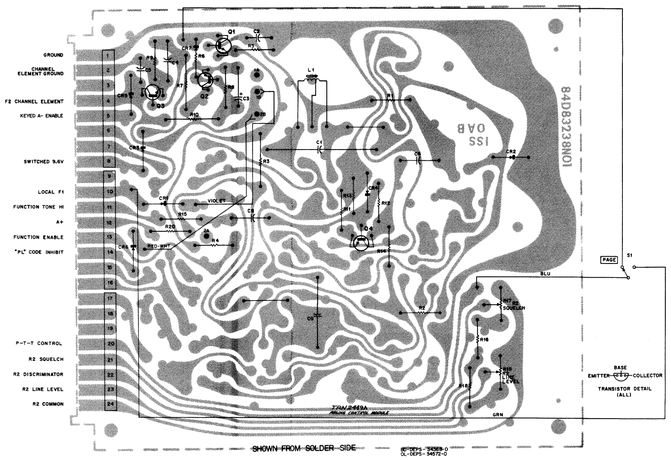
LEGEND
START = CIRCUIT THEORY MOST EASILY UNDERSTOOD BY BEGINNING AT THIS POINT AND FOLLOWING SIGNAL FLOW
= THEORY OF OPERATION DATA
= MAINTENANCE DATA
= PRIMARY SIGNAL FLOW
= SECONDARY SIGNAL FLOW

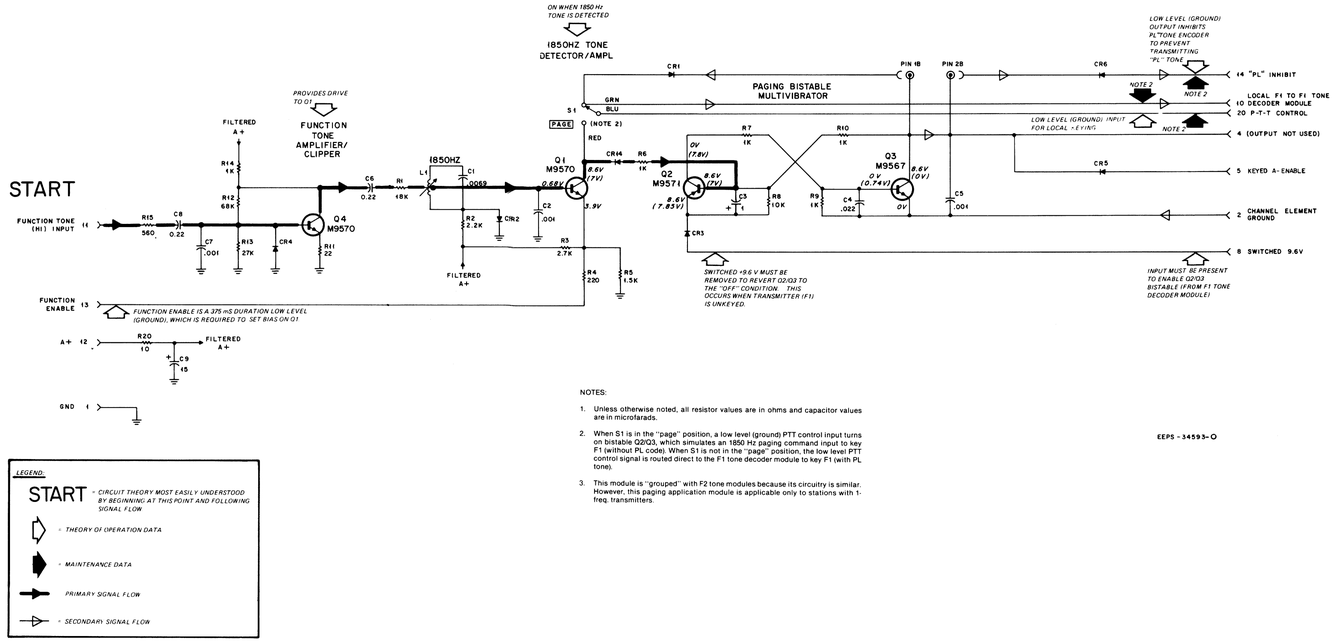
Schematic Diagram
Motorola No. **68P81062E19-B**
(Sheet 2 of 2)
11/1/85- UP

PAGING TONE CONTROL MODULE

XMODEXXTRN5317AXX
MODEL TRN5317A
(PER SMR-5883)

TRN5317A PAGING TONE CONTROL





NOTES:

1. Unless otherwise noted, all resistor values are in ohms and capacitor values are in microfarads.
2. When S1 is in the "page" position, a low level (ground) PTT control input turns on bistable Q2/Q3, which simulates an 1850 Hz paging command input to key F1 (without PL code). When S1 is not in the "page" position, the low level PTT control signal is routed direct to the F1 tone decoder module to key F1 (with PL tone).
3. This module is "grouped" with F2 tone modules because its circuitry is similar. However, this paging application module is applicable only to stations with 1-freq. transmitters.

EEPS - 34593-O

FUNCTION

Received 1850 Hz function tone keys transmitter on F1 and disables PL encoder (allows transmitter to transmit without a PL code).

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

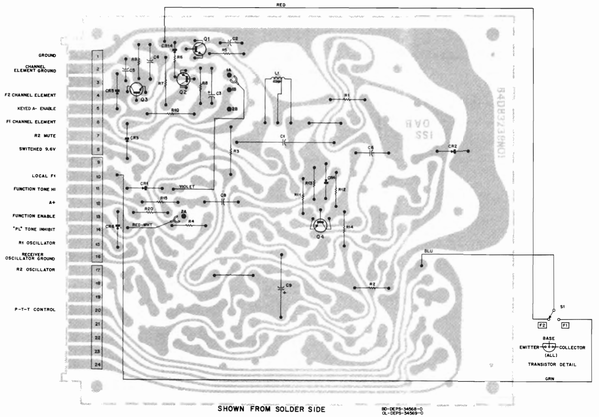
Circuit Board Detail & Schematic Diagram
Motorola No. **68P81062E21-A**
(Sheet 1 of 3)
11/1/85- UP

F2 TONE CONTROL MODULE
MODEL TRN5325A

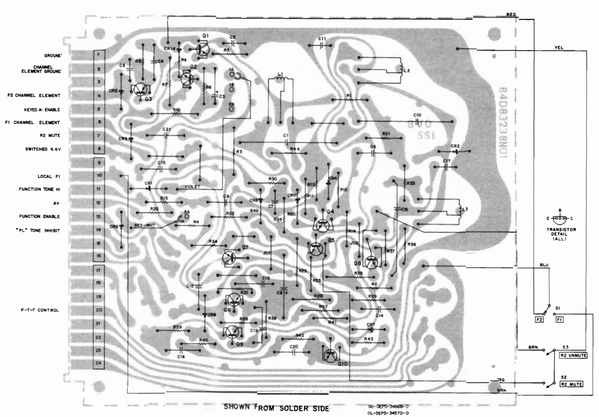
F2-R2 MUTE TONE CONTROL MODULE
MODEL TRN5326A

C2-R2 TONE CONTROL MODULE
MODEL TLN5308A

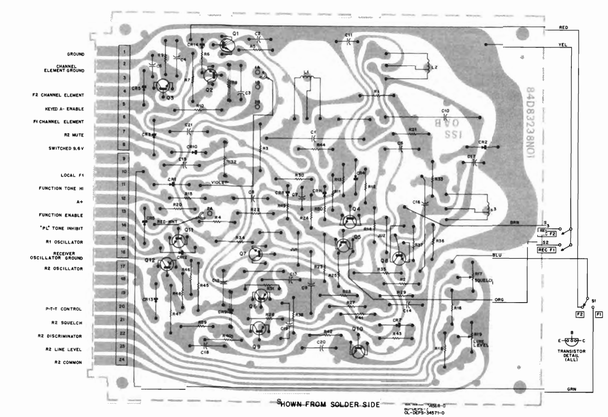
TRN5325A F2 TONE CONTROL



TRN5326A F2-R2 MUTE TONE CONTROL



TLN5308A C2-R2 TONE CONTROL



Circuit Board Details & Parts Lists
Motorola No. **68P81062E21-A**
(Sheet 2 of 3)
11/1/85- UP

parts list

legend

reference symbol suffix	application
No Suffix	All Models
A	TRN5325A
B	TRN5326A
C	TRN5317A

This parts list covers 4 models of the Mode Mute & Decoder Bd. modes. Where differences exist a code is added to the reference symbol to indicate the applicable unit.

TRN5325A Tone Decoder Module, F2 Control
TRN5326A Tone Decoder Module, F2 R2 Mute Control
TRN5317A Tone Decoder Board, Paging Control
TRN5308A Tone Decoder Board, C2-R2 Control PL-7981-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ± 10%; 50 V: unless otherwise stated
C1 (A, B, C)	8-84326A15	.0069 ± 2%
C2 (A, B, C)	21-82187B29	.001; 100 V
C3 (A, B, C)	23-82763B08	1 ± 20%, 35 V
C4 (A, B, C)	8-82905G02	.022
C5 (A, B, C)	21-82187B29	.001; 100 V
C6 (A, B, C)	8-82905G11	0.22
C7 (A, B, C)	21-82187B29	.001; 100 V
C8 (A, B, C)	8-82905G11	0.22
C9 (A, B, C)	23-865136	15 ± 20%; 25 V
C10 (B)	8-84326A16	.0077 ± 2%
C11 (B)	21-82187B29	.001; 100 V
C12 thru 15 (B)	8-82905G11	0.22
C16 (B)	8-84326A17	.00865 ± 2%
C17 (B)	21-82187B29	.001; 100 V
C18 thru 21 (B)	8-82905G11	0.22
		diode: (see note)
CR1 thru 5 (A, B, C)	48-83654H01	silicon
CR6 thru 9 (B)	4-883654H01	silicon
CR10 thru 13	48-83654H01	silicon
CR14 (B)	48-83654H01	silicon
CR15 (A, B)	48-83654H01 or 48-84616A01	silicon hot carrier
		coil, at:
L1 (A, B, C)	1-80702B11	1 H; includes ground clip
L2, 3 (B)	1-80702B11	1 H; includes ground clip
		transistor: (see note)
Q1 (A, B, C)	48-86970	NPN; type M9570
Q2 (A, B, C)	48-86971	PNP; type M9571
Q3 (A, B, C)	48-86956T	NPN; type M9567
Q4 (A, B, C)	48-86970	NPN; type M9570
Q5 (B)	48-86970	NPN; type M9570
Q6 (B)	48-86971	PNP; type M9571
Q7, 8 (B)	48-86970	NPN; type M9570
Q9 (B)	48-86971	PNP; type M9571
Q10 (B)	48-86970	NPN; type M9570
Q11, 12	48-86956T	NPN; type M9567
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R1 (A, B, C)	6-11009C79	18k
R2 (A, B, C)	6-11009C57	2.2k
R3 (A, B, C)	5-125A59	2.7k; 1/2 W
R4 (A, B, C)	6-11009C33	220
R5 (A, B, C)	6-11009C53	1.5k
R6 (A, B, C)	6-11009C49	1k
R7 (A, B, C)	5-125C49	1k; 1/2 W
R8 (A, B, C)	6-11009C73	10k
R9 (A, B, C)	6-11009G49	1k
R10 (A, B, C)	5-125C49	1k; 1/2 W
R11 (A, B, C)	6-11009C09	22
R12 (A, B, C)	6-11009C93	68k
R13 (A, B, C)	6-11009C83	27k
R14 (A, B, C)	6-11009G49	1k
R15 (A, B, C)	6-11009C43	560
R16 (C)	6-11009C61	3.3k
R17 (C)	18-83083G03	variable; 25k
R18 (C)	6-11009C61	3.3k
R19 (C)	18-83083G03	variable; 25k
R20 (A, B, C)	6-11009C01	10
R21 (B)	6-11009C81	22k
R22 (B)	6-84444A07	221 ± 1%
R23 (B)	6-84444A09	2.43 ± 1%
R24 (B)	6-11009C49	1k
R25 (B)	6-11009C57	2.2k
R26, 27 (B)	6-11009C43	560
R28 (B)	6-11009C65	4.7k
R29 (B)	6-11009C43	560
R30 (B)	6-11009D10	330k
R31 (B)	6-11009C65	4.7k
R32 (C)	6-11009C61	3.3k
R33 (B)	6-11009C79	18k
R34 (B)	6-84444A07	221 ± 1%
R35 (B)	6-84444A08	2.21k ± 1%
R36 (B)	6-11009C49	1k
R37, 38 (B)	6-11009C57	2.2k
R39, 40	6-11009C43	560
R41 (B)	6-11009C65	4.7k
R42 (B)	6-11009C43	560
R43 (B)	6-11009C65	4.7k
R44 (B)	6-11009D10	330k
R45 (C)	6-125C53	1.5k; 1/2 W
R46 (C)	6-11009C61	3.3k
R47 (C)	6-125C53	1.5k; 1/2 W
R48 (C)	6-11009C61	3.3k
R49, 50 (B)	6-11009C55	1.8k
		switch:
S1 (A, B)	40-83204B01	slide; dpdt
S2, 3 (B)	40-83468E01	slide; spdt
		mechanical parts
	1-80702B15	ASSEMBLY, wire and terminal; includes:
	39-10184A24	CONTACT, receptacle
	37-82603D01	SLEEVING coded #1
	1-80702B16	ASSEMBLY, wire and terminal; includes:
	39-10184A24	CONTACT, receptacle
	37-82603D02	SLEEVING, coded #2
	1-80754D50	ASSEMBLY, circuit board; includes:
	39-10184A30	CONTACT, plug
	1-80757D84	ASSEMBLY PANEL; includes: (TRN5325A) refer part S1
	64-83130L02	PANEL, screened
	1-80757D85	ASSEMBLY PANEL; includes: (TRN5326A) refer parts S1, S2, S3
	64-83131L02	PANEL, screened
	9-83497F01	RECEPTACLE, female: 8-contact; 3 used (PCB Edge)
	5-84220B01	GROMMET; 2 used (TRN5325A, 5326A)
	3-84256M01	SCREW, tapping; 2 used (TRN5325A, 5326A)
	42-10217A02	STRAP, tie; .019 x 3.62" WHT

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

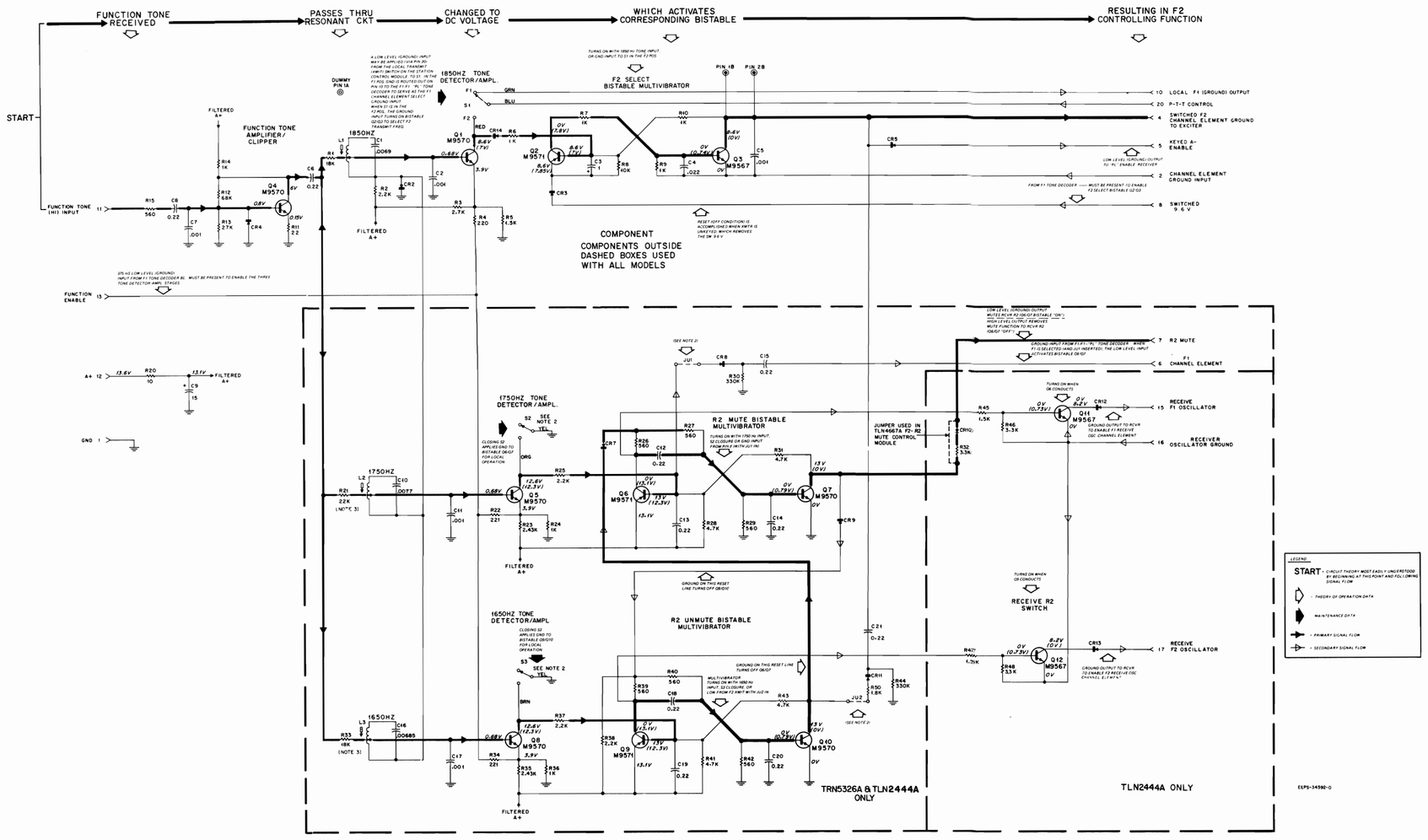
legend

reference symbol suffix	application
No Suffix	All Models
A	TRN5309A

This parts list covers 2 models of the Panel Decoder modes. Where differences exist a code is added to the reference symbol to indicate the applicable unit.

TRN5309A C2-R2 Control Module Panel
TRN5318A Paging Control Module Panel PL-7982-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		switch, slide:
S1	40-83204B01	dpdt
S2 (A)	40-83468E01	spdt
S3	40-83468E01	spdt
		mechanical parts
	3-84256M01	SCREW, tapping; 2 used
	64-83121L02	PANEL, screened (TRN5309A)
	64-83132L02	PANEL, screened (TRN5318A)



F2 TONE CONTROL MODULE
MODEL TRN5325A

F2-R2 MUTE TONE CONTROL MODULE
MODEL TRN5326A

C2-R2 TONE CONTROL MODULE
MODEL TLN2444A

FUNCTION

TRN5325A F2 Tone Control	1850 Hz tone keys XMTR on F2.
TRN5326A F2-R2 Mute Tone Control	1. 1850 Hz tone keys XMTR on F2. 2. 1750 Hz tone mutes RCVR R2. 3. 1650 Hz tone unmutes RCVR R2.
TLN2444A C2-R2 Tone Control	1. 1850 Hz tone keys XMTR on F2. 2. 1750 Hz tone selects F1 receive osc. 3. 1650 Hz tone selects F2 receive osc.

NOTES:

1. Unless otherwise noted, all resistor values are in ohms (k = 1000) and capacitor values are in microfarads.
2. Refer to switch/jumper table for in and out functional description.

Model Complement

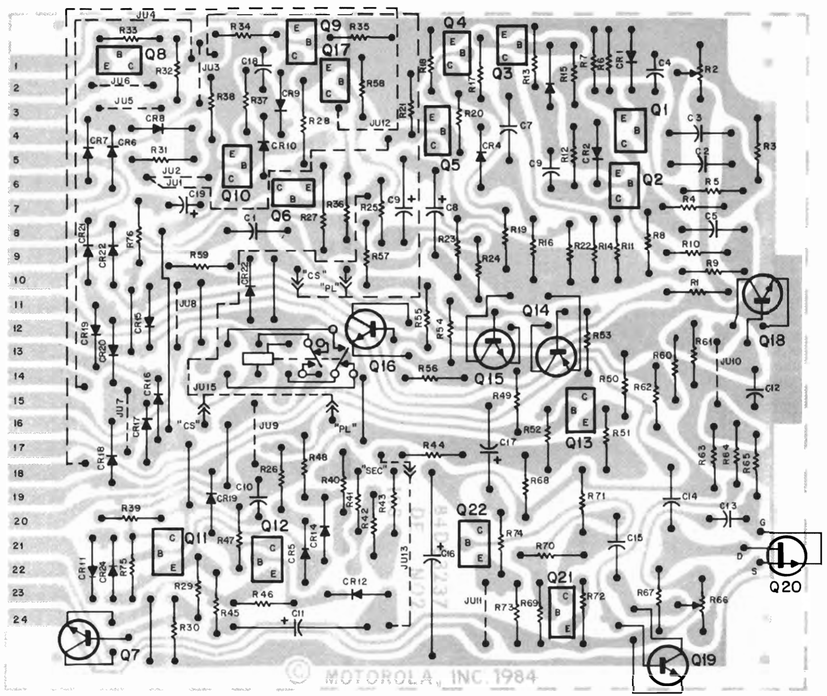
Model	Board	Panel
TLN2444A	TRN5308A	TRN5309A
TLN2449A	TRN5317A	TRN5318A
TRN5325A	—	—
TRN5326A	—	—

Switch/Jumper Table

Switch/ Jumper	F2 Control	F2-R2 Mute Control	C2-R2 Control
S1	F1/F2	F1/F2	F1/F2
S2	(Not Used)	R2 Mute	Rec F1
S3	(Not Used)	R2 Unmute	Rec F2
JU1	(Not Used)	IN Permits an F1 Xmit comand to mute Rcvr R2. When JU1 is out, the 1750 Hz tone command must be generated to mute Rcvr. R2.	IN Permits an F1 Xmit command to enable the F1 receive osc. and disable F2 receive osc. Simultaneously, When JU1 is out, the 1750 Hz tone command must be generated to enable the F1 receive osc.
JU2	(Not Used)	IN Permits an F2 Xmit command to unmute Rcvr R2. When JU2 is out, the 1650 Hz tone command must be generated to unmute Rcvr R2.	IN Permits an F2 Xmit command to enable the F2 receive osc. and disable the F1 receive osc. Simultaneously, when JU2 is out, the 1650 Hz tone command must be generated to enable the F2 receive osc.

Schematic Diagram
Motorola No. **68P81062E21-A**
(Sheet 3 of 3)
11/1/85- UP

SQUELCH GATE MODULE
MODEL TRN5324A



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 and Parts Lists
Motorola No. **68P81062E23-C**
(Sheet 1 of 2)
11/1/85- UP

parts list

TRN5324A Squelch Gate Module — PL-7961-C

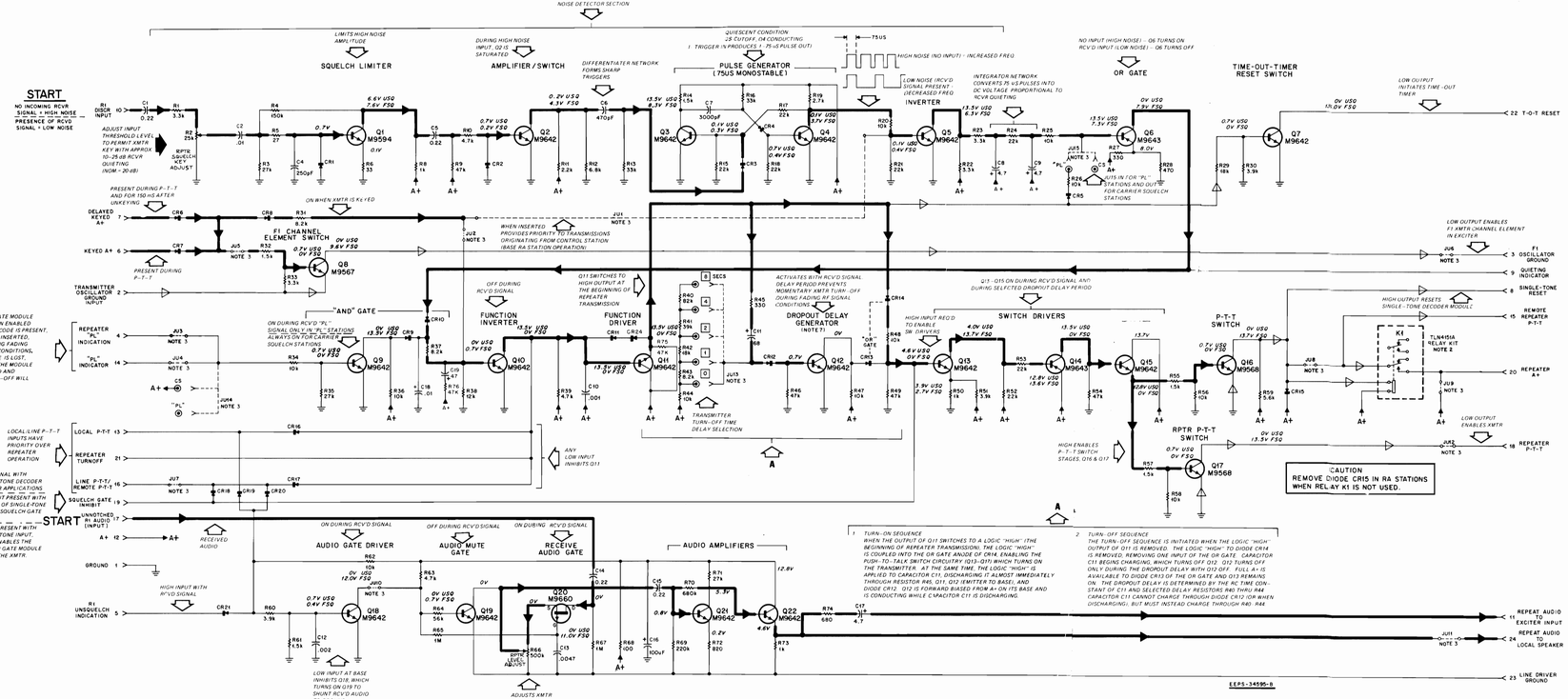
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: pF ±10%; 50 V: unless otherwise stated
C1	8-82905G11	0.22 uF
C2	8-82905G01	.01 uF
C3		NOT USED
C4	21-859943	250 ±5%; 500 V
C5	8-82905G02	.022 uF
C6	21-850510	470; 300 V
C7	21-850994	3000 ±5%; 500 V
C8,9	23-82783B25	4.7 uF; 25 V
C10	21-82187B29	.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	21-82428B62	.01 uF
C19	23-11019A40	47 uF
		semiconductor device, diode: (see note)
CR1 thru 23	48-83654H01	silicon
CR24	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: ±10%; 1/4 W: unless otherwise stated
R1	6-11009C61	3.3k
R2	18-83083G03	variable; 25k ±30%
R3	6-11009C83	27k
R4	6-11009D06	150k
R5	6-11009C11	27
R6	6-11009C13	33 ±5%
R7	NOT USED	
R8	6-11009C49	1k ±5%
R9	6-11009C89	47k
R10	6-11009C65	4.7k
R11	6-11009C57	2.2k
R12	6-11009C69	6.8k
R13	6-11009C85	33k
R14	6-11009C53	1.5k
R15	6-11009C81	22k
R16	6-11009C85	33k ±5%
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 ±5%; 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	6-11009C89	47k
		mechanical parts
	3-84256M01	SCREW, tapping; 2 used
	43-82721C01	BUSHING, snap; 2 used
	64-83129L02	PANEL, screened
	5-84220B01	GROMMET; 2 used
	9-83497F01	RECEPTACLE, 8 contact; 3 used (PCB Edge Connector)
	39-10184A24	RECEPTACLE, contact; 3 used
	39-10184A10	CONTACT, plug; 9 used

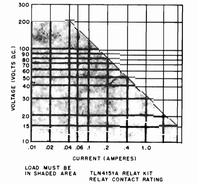
note: Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

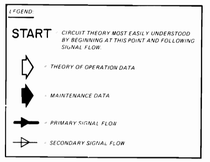
TLN4151A Relay Kit — PL-455-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
See Schematic	48-82392B03	silicon (reverse voltage protection)
		relay, armature:
K1	80-84201A01	2 form "C" coil res. 200 ohms
		non-referenced items
	43-84920H01	SPACER, relay

SQUELCH GATE MODULE
MODEL TRN5324A







FUNCTION

Measures receive noise levels and controls transmitter keying.

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 OUT for tone controlled stations and IN for dc controlled stations.

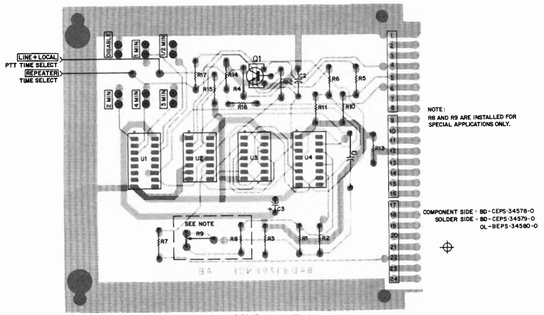
Jumper Table

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	
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	OUT	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	NOTE	NOTE	OUT	*	*	OUT	OUT	OUT	Selected Delay	IN CS	IN PL
Community Repeater (RT) Station	OUT	OUT	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	Selected Delay	OUT	IN

***Relay Application Chart**

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

Schematic Diagram
Motorola No. **68P81062E23-C**
(Sheet 2 of 2)
11/1/85- UP



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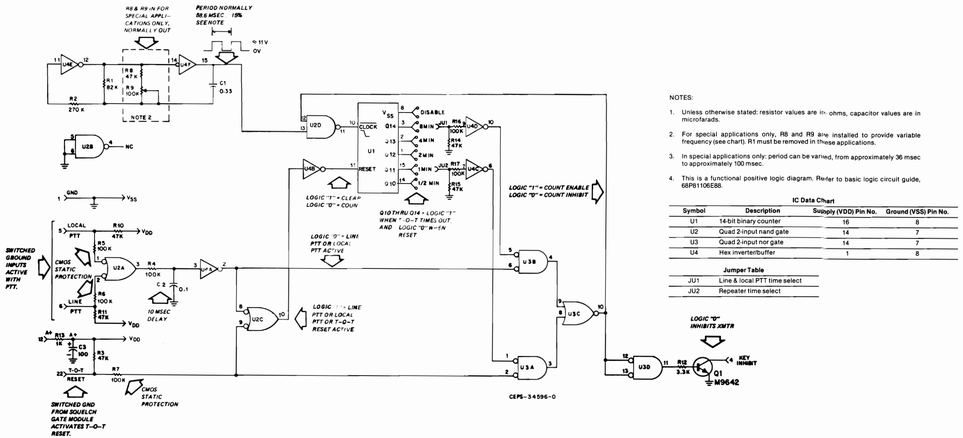


NOTES:

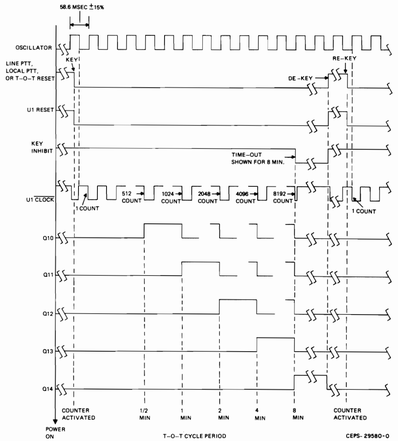
1. Unless otherwise stated: resistor values are in ohms, capacitor values are in microfarads.
2. For special applications only, R8 and R9 are installed to provide variable frequency (see chart). R1 must be removed in these applications.
3. In special applications only: period can be varied, from approximately 36 msec to approximately 100 msec.
4. This is a functional positive logic diagram. Refer to basic logic circuit guide, 68P81105E88.

IC Data Chart

Symbol	Description	Snipply (VDD) Pin No.	Ground (VSS) Pin No.
U1	14-bit binary counter	16	8
U2	Quad 2-input nand gate	14	7
U3	Quad 2-input nor gate	14	7
U4	Hex inverter/buffer	1	8

Jumper Table

JU1	Line & local PTT time select
JU2	Repeater time select



TIME-OUT TIMER MOUDLE

MODEL TRN5295A

FUNCTION

Limits the period of time the transmitter may be keyed.

parts list

TRN5295A Time-Out Timer PL-7964-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C1	8-83813H29	0.33 uF ±10%, 50 V
C2	21-82372C01	0.1 uF +80-20%, 25 V
C3	23-84665F03	100 uF +100-10%, 25 V
		transistor: (see note)
Q1	48-869642	NPN; silicon
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R1	6-11009C95	82k
R2	6-11009D08	270k
R3	6-11009C89	47k
R4-7	6-11009C97	100k
R8	6-11009C89	47k (used for special applications only)
R9	18-84944C97	var. 100k ± 20%, 0.1 W (used for special applications only)
R10,11	6-11009C89	47k
R12	6-11009C61	3.3k
R13	6-11009C49	1k
R14,15	6-11009C89	47k
R16,17	6-11009C97	100k
		integrated circuit: (see note)
U1	51-82884L42	14-bit binary counter
U2	51-82884L05	Quad, 2-input NAND gate
U3	51-82884L04	Quad, 2-input NOR gate
U4	51-82884L02	HEX inverter/buffer
		non-referenced items
	29-83167C01	TERMINAL, strain relief; 2 used
	39-10184A24	CONTACT, receptacle; 2 used
	9-83011H01	RECEPTACLE, board mounting; 9 used
	39-10184A10	CONTACT, plug; 12 used
	43-865080	BUSHING, threaded; 2 used
	3-84256M01	SCREW, tapping; 2 used
	5-84220B01	GROMMET; 2 used
	9-83497F01	RECEPTACLE, 9 contact; 3 used (PCB Edge Connector)
	64-83125L02	PANEL, screened

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

Schematic Diagram, Circuit Board Detail, Maintenance, and Parts List
Motorola No. **68P81062E24-A**
11/1/85- UP

GENERAL

The time-out timer (T-O-T) module is standard in all repeater (RT) models and is an optional accessory for base station models. It limits the period of time the transmitter can be keyed. It can be set to limit transmission time from line controlled operation, and to limit the transmission time of individual repeater users. The timing period of each is independent of the other. The unit can be preset for 1/2, 1, 2, 4, or 8 minutes or unlimited continuous keying by jumper selection.

CIRCUIT DESCRIPTION

The initial condition of the time-out-timer module is: local PTT, line PTT and T-O-T reset at a high (logic "1") level, with A + applied to the module.

The high local and line PTT inputs to U2A cause its output to be low. This low is inverted by U4A producing a high input to U2C-8. This high input, plus the high T-O-T reset input to U2C-9, forces the output at U2C-10 low. This low is inverted by U4B, producing a high at counter U1 reset input. The high reset input clears the counter by forcing and holding all of the outputs low.

Jumpers JU1 and JU2 connect two low outputs of U1 to the inputs of U4D and U4C, respectively. A local or line PTT input (base station) executes the T-O-T timing function via JU1. A T-O-T reset input (repeater PTT) executes the T-O-T timing function via JU2.

The low outputs of U1 are inverted by U4D and U4C, producing high inputs at U3B-5 and U3A-1, respectively. These high inputs, plus the highs from the T-O-T reset input and U4A-2, cause the outputs of U3B and U3A to be low. These low inputs are applied to U3C and cause its output to be high. This high is applied to U2D, enabling it, and to U3D, resulting in a high at the key inhibit output of the module. This high output allows the station transmitter to operate if keyed.

The timing function is started by a low line PTT, a low local PTT, or a low T-O-T reset signal from the squelch gate module. A low on the local PTT or the line PTT input causes the output of U2A to be high. This high is delayed by R4, C2 and is inverted by U4A, producing a low input to U2C-8. This low input, or a low T-O-T reset input to U2C-9, causes the output of U2C to be high which is inverted by U4B. The resulting low enables counter U1. The oscillator output passes through U2D to the CLOCK input of U1. For every negative-going transition at the CLOCK input of counter U1, the counter is advanced by one count.

Due to the period of the oscillator: 512 counts corresponds to 30 seconds (Q10 output); 1024 counts corresponds to 1 minute (Q11 output); 2048 counts corresponds to 2 minutes (Q12 output); 4096 counts corresponds to 4 minutes (Q13 output); and 8192 counts corresponds to 8 minutes (Q14 output). (See timing diagram.)

Assume that both time select jumpers are connected to the Q10 outputs of U1. The Q10 output goes high at the end of the 30 second timing period. This high is inverted by U4D and U4C, producing low inputs at U3B-5 and U3A-1, respectively. These low inputs, plus either the low from the T-O-T reset input or the low output of U4A-2, cause the output of U3A or U3B, respectively, to go high. The high output of either U3A or U3B causes the output of U3C to go low. This low is applied to U2D, which disables it and prevents any further transitions from reaching the CLOCK input of U1.

The low U3C output is also applied to U3D, which functions as an inverter and causes Q1 to turn on. This results in a low at the key inhibit output of the module which inhibits the station transmitter.

The transmitter will remain inhibited until the switched ground start signal is removed from the module input. At that time, the module returns to its initial condition, which results in the counter being held in reset (all outputs low) and the station transmitter being uninhibited. When a start signal is again applied, another timing cycle begins.

If line and local PTT time select jumper JU1 is connected to the 30 second output, and repeater time select jumper JU2 is connected to the 2 minute output; then a start signal (switched ground) on either the line PTT or the local PTT input will inhibit the transmitter after 30 seconds, or a start signal on the T-O-T reset input will inhibit the transmitter after 2 minutes.

If either or both of the time select jumpers are connected to the DISABLE (ground) output of U1, the corresponding start signal input(s) will not inhibit the transmitter and unlimited continuous transmission is possible.

In special applications, it may be desirable to obtain a T-O-T cycle period other than those normally available. To vary the oscillator period, remove R1 and insert R8 and R9. Connect a +13.8 V dc power supply between pin 12 and ground, pin 1. Monitor the oscillator output at U4F-15, with respect to ground.

Then, using the variable timing chart, choose an appropriate output and connect both time select jumpers to that output. Adjust R9 for the desired (calculated) period. An audio frequency counter or an oscilloscope may be used to monitor the oscillator output.

MAINTENANCE & TROUBLESHOOTING

This module may be serviced either while connected to the station or while connected to external test equipment as described in the RF-Control Chassis section of this manual. The following check-out procedure is intended for out-of-station servicing but is functionally applicable to in-station servicing also.

CAUTION

This module uses CMOS integrated circuits which can be damaged by excessive static charges. Handle module by edges only.

Step 1. Remove the module from the chassis.

Step 2. Connect a 13.5 V dc power supply to the module so ground (−) is connected to pin 1 and the positive (+) terminal is connected to pin 12. Turn the power supply on.

Step 3. Connect a 5k ohm resistor between module pins 4 and 12.

Step 4. Connect time selection jumpers JU1 & JU2 to the "DISABLE" output (ground).

Step 5. Check the oscillator frequency with a counter connected between pin 15 of U4 and ground. The frequency should be 17.1 Hz ±2.5 Hz. An oscilloscope may be used in place of the audio frequency counter. The oscillator period should be 58.6 msec, ±9 msec.

Step 6. Connect a temporary jumper between module pins 5 and 1.

Step 7. Refer to the schematic and timing diagram and note the desired timing cycle for different outputs of the module. Use a stop-watch to compare the desired timing of highs and lows on a VTVM. Timing should be accurate to within ±15%.

Step 8. Move the temporary jumper to pins 6 and 1 and repeat Step 7.

Step 9. Move the temporary jumper to pins 22 and 1 and repeat Step 7.

Step 10. Connect both time selection jumpers to "1/2 MIN" output. Module pin 4 should go low after 1/2 minute (±4.5 sec.).

Step 11. If a defective output is not located, check connections and continuity of plating for opens and shorts.

VARIABLE TIMING CHART (SPECIAL APPLICATIONS ONLY)

FACTORY FIXED (±15%)		58.6 MSEC OR 17.1 HZ	Q10 1/2 MIN.	Q11 1 MIN.	Q12 2 MIN.	Q13 4 MIN.	Q14 8 MIN.	DISABLE INFINITY
VARIABLE	MAXIMUM	99.6 MSEC OR 10.0 HZ	51 SEC OR 0.85 MIN	102 SEC OR 1.7 MIN	204 SEC OR 3.4 MIN	408 SEC OR 6.8 MIN	816 SEC OR 13.6 MIN	INFINITY
	MINIMUM	36.2 MSEC OR 28.4 HZ	18 SEC OR 0.3 MIN	36 SEC OR 0.6 MIN	72 SEC OR 1.2 MIN	144 SEC OR 2.4 MIN	288 SEC OR 4.8 MIN	INFINITY

GENERAL FORMULA: $F = (1/1/2^{(N-1)})$; WHERE I IS THE DESIRED TIME-OUT TIME IN SECONDS, N IS THE CHOSEN Q OUTPUT NUMBER, AND F IS THE REQUIRED OSCILLATOR FREQUENCY IN HERTZ.

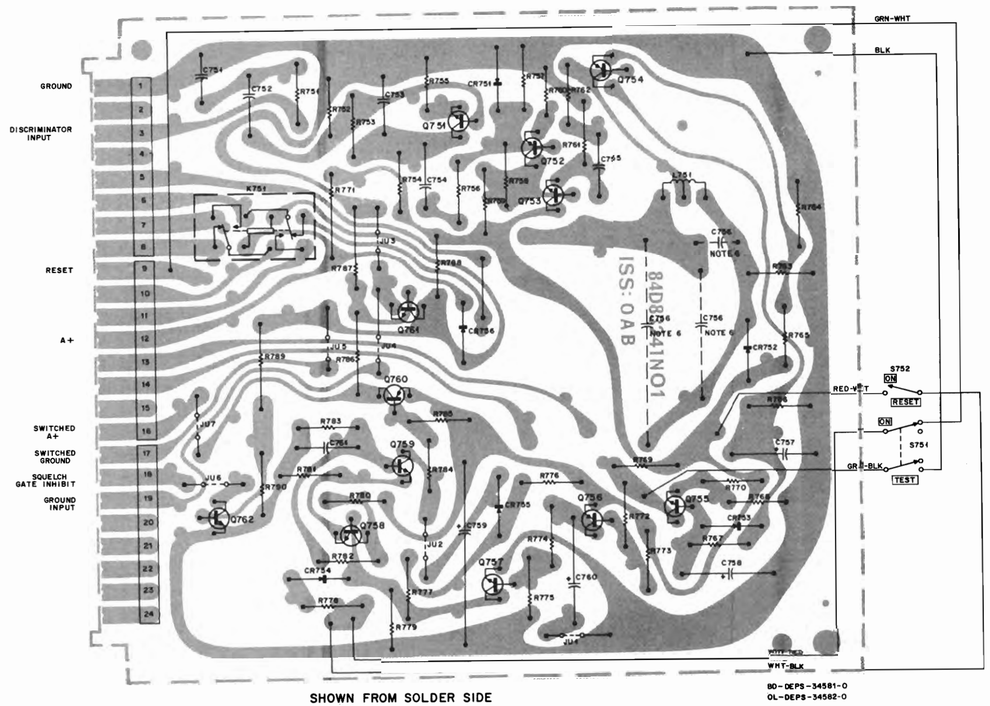
FOR EXAMPLE, TO CALCULATE THE OSCILLATOR FREQUENCY NEEDED TO PRODUCE A 3 MINUTE T-O-T PERIOD, FIRST DETERMINE FROM THE ABOVE CHART WHICH OUTPUT MUST BE USED – Q12. SECOND, INSERT THE KNOWNS INTO THE GENERAL FORMULA, AND CALCULATE THE REQUIRED FREQUENCY:

$F = (1/1) \times (2^{(N-1)} = [1/(3 \times 60)] \times (2^{(12-1)} = (1/180) \times (2048) = 11.4$ HZ

FOR A 5 MINUTE T.O.T. PERIOD, $F = (1/1) \times (2^{(N-1)} = (1/(5 \times 60)) \times (2^{(13-1)} = 13.7$ HZ

BEPS-27258-A

SINGLE-TONE DECODER MODULE
MODEL TLN2442A



SHOWN FROM SOLDER SIDE

80-DEPS-34581-O
OL-DEPS-34582-O

Circuit Board Detail and Parts Lists
Motorola No. **68P81062E26-A**
(Sheet 1 of 2)
11/1/85- UP

parts list

TRN5305A Tone Decoder Board — PL-7979-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ± 10%; 50 V: unless otherwise stated
C751	21-82187B29	.001; 100 V
C752	8-82905G11	0.22
C753	8-82905G01	.01
C754	8-82905G02	.022
C755	8-82905G07	0.1
C756		(see: FREQUENCY DETERMINING COMPONENTS)
C757	23-82783B08	1 ± 20%; 35 V
C758	23-83214C02	15 ± 20%; 25 V
C759	23-82601A25	100 + 150-10%; 20 V
C760	23-83214C02	15 ± 20%; 25 V
C761	8-82905G07	0.1
		diode: (see note)
CR751 thru 756	48-83654H01	silicon
		coil, af:
L751	1-80702B11	assembly, inductor and ground clip (1 H)
		transistor: (see note)
Q751, 752, 753	48-869570	NPN; type M9570
Q754	48-869571	PNP; type M9571
Q755	48-869570	NPN; type M9570
Q756	48-869571	PNP; type M9571
Q757, 758, 759	48-869570	NPN; type M9570
Q760	48-869571	PNP; type M9571
Q761	48-869568	NPN; type M9568
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R751	6-11009D06	100k
R752	6-11009D08	270k
R753	6-11009D14	470k
R754	6-11009C73	10k
R755	6-11009C37	330
R756	6-11009C81	22k
R757	6-11009D08	270k
R758	6-11009D10	330k
R759	6-11009C73	10k
R760	6-11009C37	330
R761	6-11009C57	2.2k
R762		(see: FREQUENCY DETERMINING COMPONENTS)
R763	6-11009C55	1.8k
R764	6-11009C57	2.2k
R765	6-11009C27	120
R766	6-11009C65	4.7k
R767	6-11009C89	47k
R768	6-11009C51	1.2k
R769	6-11009C89	47k
R770	6-11009C63	3.9k
R771	6-125C01	10; 1/2 W
R772	6-11009C89	47k
R773	6-11009C73	10k
R774	6-11009D06	220k
R775	6-11009C89	47k
R776	6-11009C73	10k
R777	6-11009C81	22k
R778	6-11009C77	15k
R779	6-11009C65	4.7k
R780	6-11009C57	2.2k
R781	6-11009C27	120
R782	6-11009C81	22k
R783, 784	6-11009C69	6.8k
R785	6-11009C57	2.2k
R786	6-125C49	1k; 1/2 W
R787	6-125C37	330; 1/2 W
R788	6-11009C57	2.2k
R789	6-125C81	22k; 1/2 W
R790	6-11009C73	10k

frequency determining components

The frequency-determining components of this decoder are C756 and R762. In some cases, C756 consists of two capacitors connected in parallel. Refer to the following table.

		600 Hz:
C756	8-84326A27	.0057 uF + 20%; 50 V
	& 8-84326A06	.0095 uF ± 3%; 50 V
R762	6-124C57	1.5k ± 10%; 1/4 W
		750 Hz:
C756	8-84326A26	.0420 uF ± 2%; 50 V
R762	6-124C57	1.5k ± 10%; 1/4 W
		900 Hz:
C756	8-84326A24	.0261 uF ± 2%; 50 V
	& 8-84326A02	.0030 uF ± 3%; 50 V
R762	6-124C57	2.2k
		1050 Hz:
C756	8-84326A23	.0213 uF ± 2%; 50 V
R762	6-124C61	3.3k
		1200 Hz:
C756	8-84326A08	.0158 uF ± 3%; 50 V
	& 21-859947	510 pF ± 5%; 500 V
R762	6-124C61	3.3k
		1350 Hz:
C756	8-84326A20	.0129 uF ± 2%; 50 V
R762	6-124C65	4.7k
		1500 Hz:
C756	8-84326A18	.0098 uF ± 2%; 50 V
	& 21-848236	650 pF ± 5%; 300 V
R762	6-124C69	6.8k
		1650 Hz:
C756	8-84326A17	.00865 uF ± 2%; 50 V
R762	6-124C69	6.8k
		1800 Hz:
C756	8-84326A05	.0073 uF ± 3%; 50 V
R762	6-124C73	10k
		1950 Hz:
C756	8-84326A14	.0062 uF ± 2%; 50 V
R762	6-124C73	10k
		2100 Hz:
C756	8-84326A30	.0045 uF ± 1%; 50 V
	& 21-873269	820 pF ± 2%; 300 V
R762	6-124C77	15k
		2250 Hz:
C756	8-84326A30	.0045 uF ± 1%; 50 V
	& 21-840047	150 pF ± 5%; 500 V
R762	6-124C77	15k
		2400 Hz:
C756	8-84326A03	.0042 uF ± 3%; 50 V
R762	6-124C79	18k
		2550 Hz:
C756	8-84326A02	.0030 uF ± 3%; 50 V
	& 21-848236	650 pF ± 5%; 300 V
R762	6-124C81	22k
		2700 Hz:
C756	8-84326A02	.0030 uF ± 3%; 50 V
	& 21-859942	220 pF ± 5%; 500 V
R762	6-124C81	22k
		2850 Hz:
C756	8-84326A02	.0030 uF ± 3%; 50 V
R762	6-124C81	22k
		3000 Hz:
C756	8-84326A01	.0021 uF ± 5%; 500 V
	& 21-859947	510 pF ± 5%; 500 V
R762	6-124C83	27k
		3150 Hz:
C756	8-84326A01	.0021 uF ± 5%; 50 V
	& 21-859178	270 pF ± 5%; 300 V
R762	6-124C85	33k
		3300 Hz:
C756	8-84326A01	.0021 uF ± 5%; 500 V
R762	6-124C85	33k
		mechanical parts
	42-10217A02	STRAP, tie; 2 used
	5-84220B01	GROMMET; 2 used
	9-83497F01	RECEPTACLE, female; 8-contact; 3 used (PCB Edge)

TRN5306A Single-Tone Decoder Module Panel — PL-7980-A

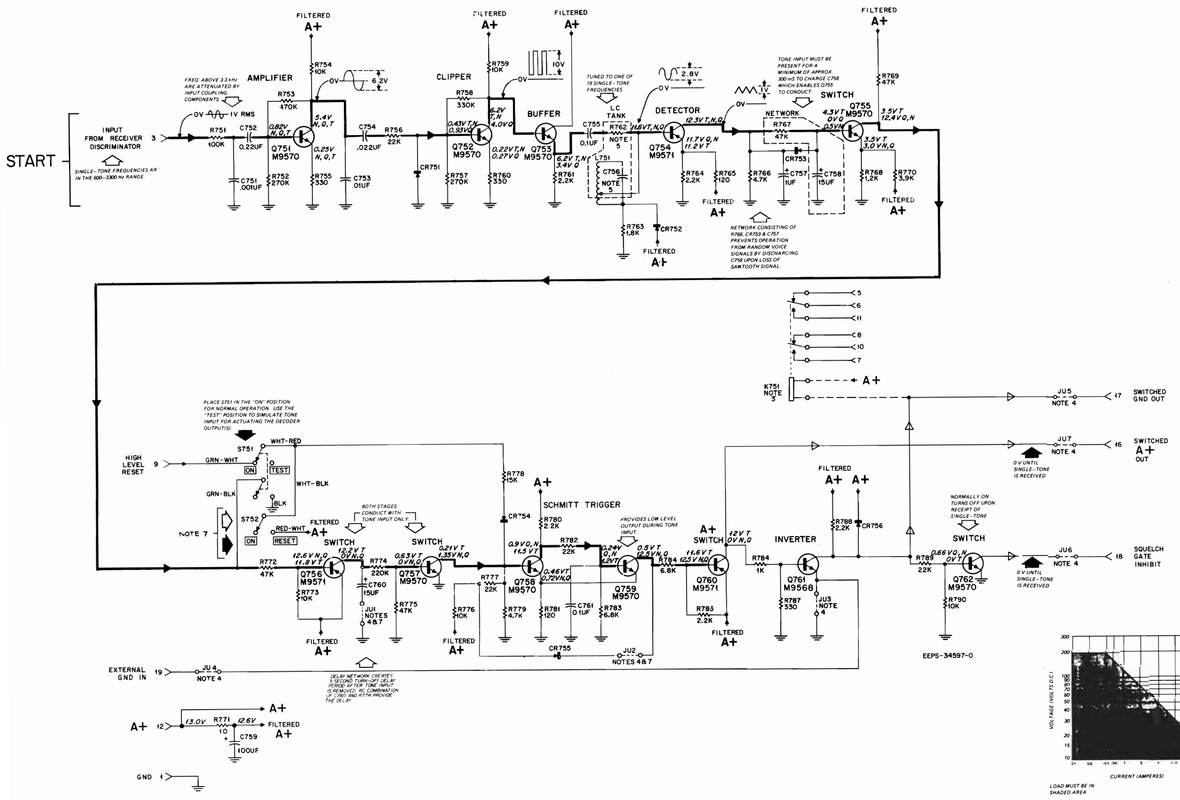
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		switch, slide:
S751	40-83204B01	dpdt
S752	40-83468E01	spdt
		mechanical parts
	3-84256M01	SCREW, tapping; 2 used
	1-80757D80	ASSEMBLY, panel includes ref. items S751, 752, and:
	64-83136L02	PANEL, screened

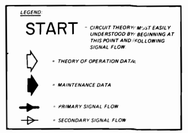
TLN4151A Relay Kit — PL-455-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		diode:
See Schematic	48-82392B03	silicon (reverse voltage protection)
		relay, armature:
K1	80-84201A01	2 form "C," coil res. 200 ohms
		non-referenced item
	43-84920H01	SPACER, relay

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

SINGLE-TONE DECODER MODULE
MODEL TLN2442A





NOTES:

1. Unless otherwise stated, resistor values are in ohms (k = 1000). Capacitor values are in microfarads.
2. Voltage indicated exists for following condition or combination of conditions:
   N = Noise
   Q = Quieting
   T = Tone
3. TLN4151A relay is optional accessory. Refer to accompanying graph for relay contact ratings.
4. Jumper connections table for repeater operation.

Jumper	Repeater (RT)		Community Repeater (RT)	
JU1 (Note 7)	IN for Non-Lock	OUT for Lock	IN for Non-Lock	OUT for Lock
JU2 (Note 7)	OUT for Non-Lock	IN for Lock	OUT for Non-Lock	IN for Lock
JU3	IN		IN	
JU4	OUT		OUT	
JU5	OUT		IN	
JU6	IN		OUT	
JU7	OUT		OUT	

5. Frequency-determining component. See parts list for value.
6. Voltage readings and waveforms are ± 20%.
7. This module can be strapped for non-locked or locked operation via jumpers JU1 and 2. Non-locked signifies that decoder outputs automatically revert back to the "before received single-tone code" state (after the 5-second interval). Locked signifies that the decoder outputs do not automatically revert upon loss of single-tone. Rather, the outputs remain "set" until reset either by a high applied to pin 9 or switch S752 momentarily placed in the reset position. Switch S752 is functional only when the decoder is strapped for the locked mode.

Model Complement

Model	Board	Panel
TLN2442A	TRN5305A	TRN5306A
TLN4151A Relay (optional)	—	—

MAINTENANCE AND TROUBLESHOOTING

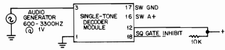
This module can be serviced either while in the control chassis or while out. The following procedure is for out-of-chassis servicing but it is functionally applicable to in-chassis servicing as well.

Step 1. Remove the single-tone decoder module and check the jumpers at this time for correctness in this module's mode of operation. Note any errors and continue with the test procedure.

Step 2. Connect jumpers in test scheme as follows:

OUT — JU1, JU2, JU4
IN — JU3, JU5, JU6, JU7

Step 3. Set up test equipment as follows:



Step 4. Perform an overall module operation check by injecting the proper single-tone frequency on pin 3. Pin 18 should be at A+ and remain there after approximately 300 milliseconds.

Removal of the single-tone frequency should immediately cause pin 18 to go to ground potential.

If the output is abnormal, proceed to Step 5.

Step 5. Place the on-test switch in the test position. Pins 16 and 18 should read A+ and pin 17 should read ground potential.

Return the switch to the ON position. Pins 16 and 18 should drop to near 0 volts and pin 17 should go to A+.

If all voltages are abnormal, check the dc voltages in switches Q756 and Q757, Schmitt trigger Q758 and Q759, and switch Q760. If pin 16 is normal but pins 17 and 18 are abnormal, check Q761. If only pin 18 is abnormal, check Q762. Correct the trouble and recheck Step 4.

If all voltages are normal, stages Q756 through Q762 are operating satisfactorily. Proceed to Step 6.

Step 6. Inject the proper single-tone frequency at pin 3. Measure waveforms and voltages as shown on the schematic diagram for stages Q751 through Q755. Correct any trouble and recheck Step 4.

Step 7. Rearrange jumpers that were changed in Step 2 (if any).

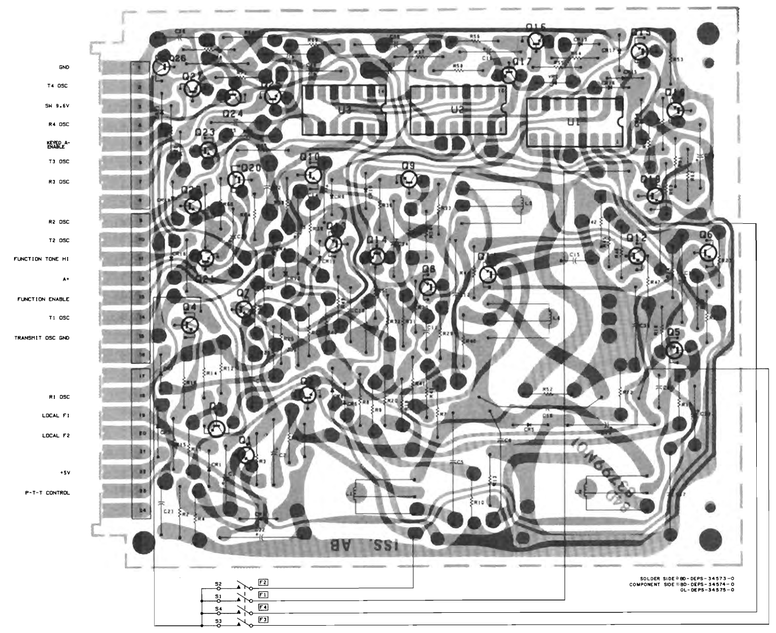
FUNCTION

Decodes audio freq. tone to control external circuitry with switched ground and/or voltage levels.

Schematic Diagram and Maintenance
Motorola No. **68P81062E26-A**
(Sheet 2 of 2)
11/1/85- UP

4-FREQUENCY CONTROL OPTION DECODER MODULE

MODEL TRN5296A



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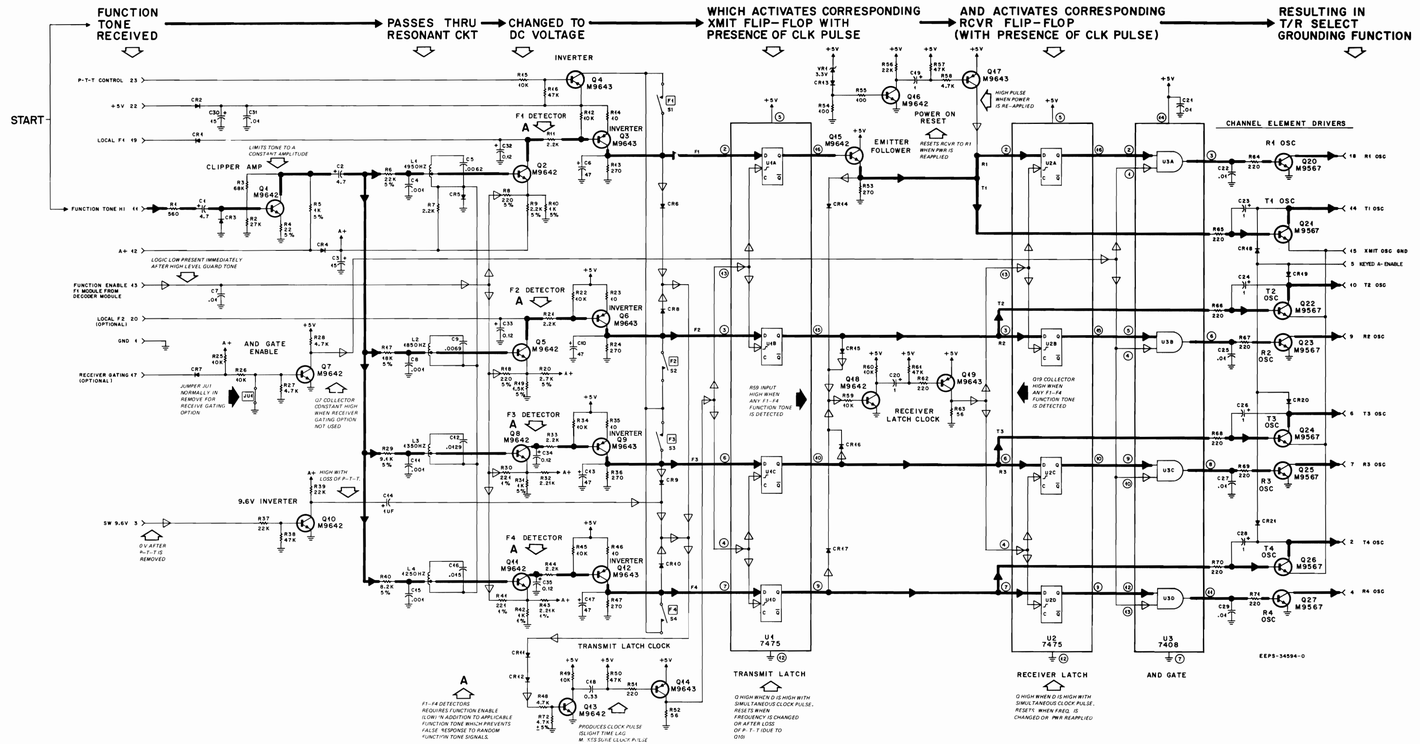
Circuit Board Detail and Parts List
Motorola No. **68P81062E22-A**
(Sheet 1 of 2)
11/1/85-UP

parts list

TRN5296A 4-Frequency Control Module PL-7967-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ±20%; 50 V: unless otherwise stated
C1,2	23-865137	4.7; 25 V
C3	23-865136	15; 25 V
C4	21-82187B29	.001 ±10%; 100 V
C5	8-84326A14	.0062 ±2%
C6	23-868446	47; 6 V
C7	8-82905G01	.01 ±10%; 50 V
C8	21-82187B29	.001; 100 V
C9	8-84326A15	.0069 ±2%; 50 V
C10	23-868446	47; 6 V
C11	21-82187B29	.001 ±10%; 100 V
C12	8-84326A20	.0129 ±2%
C13	23-868446	47; 6 V
C14	23-82783B08	1; 35 V
C15	21-82187B29	.001 ±10%; 100 V
C16	8-84326A21	.015 ±2%
C17	23-868446	47; 6 V
C18	8-82905G42	0.33 ±10%
C19,20	23-82783B08	1; 35 V
C21,22	8-82905G01	.01 ±10%
C23,24	23-82783B08	1; 35 V
C25	8-82905G01	.01 ±10%
C26	23-82783B08	1; 35 V
C27	8-82905G01	.01 ±10%
C28	23-82783B08	1; 35 V
C29	8-82905G01	.01 ±10%
C30	23-865136	15; 25 V
C31	8-82905G01	.01 ±10%
C32 thru 35	23-83214C23	.12; 20 V
		semiconductor device, diode: (see note)
CR1	48-83654H01	silicon
CR2	48-82466H13	silicon
CR3 thru 21	48-83654H01	silicon
		coil, audio freq.:
L1 thru 4	1-80702B11	assembly inductor and grommet clip
		transistor: (see note)
Q1,2	48-869642	NPN; type M9642
Q3,4	48-869643	PNP; type M9643
Q5	48-869642	NPN; type M9642
Q6	48-869643	PNP; type M9643
Q7,8	48-869642	NPN; type M9642
Q9	48-869643	PNP; type M9643
Q10,11	48-869642	NPN; type M9642
Q12	48-869643	PNP; type M9643
Q13	48-869642	NPN; type M9642
Q14	48-869643	PNP; type M9643
Q15,16	48-869642	NPN; type M9642
Q17	48-869643	PNP; type M9643
Q18	48-869642	NPN; type M9642
Q19	48-869643	PNP; type M9643
Q20 thru 27	48-869567	NPN; type M9567
		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	6-11009C81	22k
R7	6-11009C57	2.2k
R8	6-11009C33	220
R9	6-11009C57	2.2k
R10	6-11009C49	1k
R11	6-11009C57	2.2k
R12	6-11009C73	10k
R13	6-11009C35	270
R14	6-11009C01	10
R15	6-11009C73	10k
R16	6-11009C89	47k
R17	6-11009C79	18k
R18	6-11009C33	220
R19	6-11009C53	1.5
R20	6-11009C59	2.7k
R21	6-11009C57	2.2k
R22	6-11009C73	10k
R23	6-11009C01	10
R24	6-11009C35	270
R25,26	6-11009C73	10k
R27,28	6-11009C65	4.7k
R29	6-11009C72	9.1k
R30	6-84444A07	221 ±1%
R31	6-11009C49	1k
R32	6-84444A08	2.21k ±1%
R33	6-11009C57	2.2k
R34	6-11009C73	10k
R35	6-11009C01	10
R36	6-11009C35	270
R37	6-11009C81	22k
R38	6-11009C89	47k
R39	6-11009C81	22k
R40	6-11009C71	8.2k
R41	6-84444A07	221 ±1%
R42	6-11009C49	1k
R43	6-84444A08	2.21k ±1%
R44	6-11009C57	2.2k
R45	6-11009C73	10k
R46	6-11009C01	10
R47	6-11009C35	270
R48	6-11009C65,	4.7k
R49	6-11009C73	10k
R50	6-11009C89	47k
R51	6-11009C33	220
R52	6-11009C19	56
R53	6-11009C35	270
R54,55	6-11009C25	100
R56	6-11009C81	22k
R57	6-11009C89	47k
R58	6-11009C65	4.7k
R59,60	6-11009C73	10k
R61	6-11009C89	47k
R62	6-11009C33	220
R63	6-11009C19	56
R64 thru 71	6-11009C33	220
R72	6-11009C65	4.7
		switch, slide:
S1 thru 4	40-83468E01	spdt
		integrated circuit: (see note)
U1,2	51-84371K25	quad bistable latch
U3	51-84371K09	quad AND gate
		semiconductor device, diode: (see note)
VR1	48-82256C26	Zener
		non-referenced items
	3-84256M01	SCREW, tapping: 2 used
	5-84220B01	GROMMET; 2 used
	9-83497F01	RECEPTACLE, 8 contact; 3 used (PCB Edge Connector)
	64-83133L02	PANEL, screened

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



NOTES:

1. Receipt of a new function tone resets any selection previously made.
2. Receiver remains latched onto respective frequency until reset by a new frequency selection. Transmitter frequency is reset with loss of switched 9.6 V.
3. Transmitter keys only momentarily when the frequency is selected.
4. Transmitter remains keyed during a voice transmission until the push-to-talk command is interrupted.

LOCAL OPERATION

WARNING

Always line disable this station before performing maintenance to prevent unexpected keying of the station by remote control. Actuation of the frequency select switch momentarily keys the station even without operating the microphone push-to-talk switch.

When local keying of the station is desired the following steps are necessary.

Step 1. Line disable the station.

Step 2. Hold the Xmit switch, on the station control module, to the right.

Step 3. Select the desired frequency F1, 2, F3 or F4 on the module and actuate switch momentarily.

Step 4. After testing, always return line disable switch to normal position.

NOTE

The station transmitter is not "on-the-air" until Step 3 is completed. The frequency select switch must be released before unkeying.

Function Table

Function Tone	Frequency Selected
1950 Hz	F1: Transmitter keys on frequency T1. Receiver operates in standby mode on frequency R1.
1850 Hz	F2: Transmitter keys on frequency T2. Receiver operates in standby mode on frequency R2.
1350 Hz	F3: Transmitter keys on frequency T3. Receiver operates in standby mode on frequency R3.
1250 Hz	F4: Transmitter keys on frequency T4. Receiver operates in standby mode on frequency R4.

4-FREQUENCY CONTROL OPTION DECODER MODULE

MODEL TRN5296A

DESCRIPTION

The *MSR 2000* 4-Frequency Tone Remote Control Base Stations are similar to the 1-frequency tone remote control models described in the station instruction manual, except that they have the capability of operating on four channels. This capability is provided, primarily, by the addition of a 4-frequency control module. These stations use paired switching; that is, both the transmitter and receiver frequencies are switched upon command from the console. The 4-frequency control module contains the circuits for selecting both the transmitter and receiver channel in response to tone commands from the console.

WARNING

Always LINE DISABLE the station before performing *any* transmitter maintenance. The transmitter is keyed for a short period whenever a transmitter or receiver channel is commanded, even without operating the push-to-talk switch at the console. For this reason, it is very important to LINE DISABLE to prevent any unexpected keying.

The function table on the schematic diagram lists the tone frequencies used as commands for selecting the transmitter and receiver channel.

Other differences between the 4-frequency and 1-frequency models include a different F1-CS (or F1-PL) tone control module (TRN5327A or TRN5328A). They differ from the 1-frequency F1 tone control modules described in this manual in that the 1950 Hz F1 detector circuit is removed, since it is relocated to the 4-frequency control module. The 4-frequency control module plugs into the function tone decoder slot (position 10) and the F1 Tone Control Module plugs into position 5. The "Wild Card" Function Tone Decoder Module is no longer applicable as an optional accessory. Also, the multiple tone PL transmit option is also excluded. The RF-Control Chassis includes a 5-volt regulator circuit, since regulated 5 volts is required by the 4-frequency control module.

FUNCTION

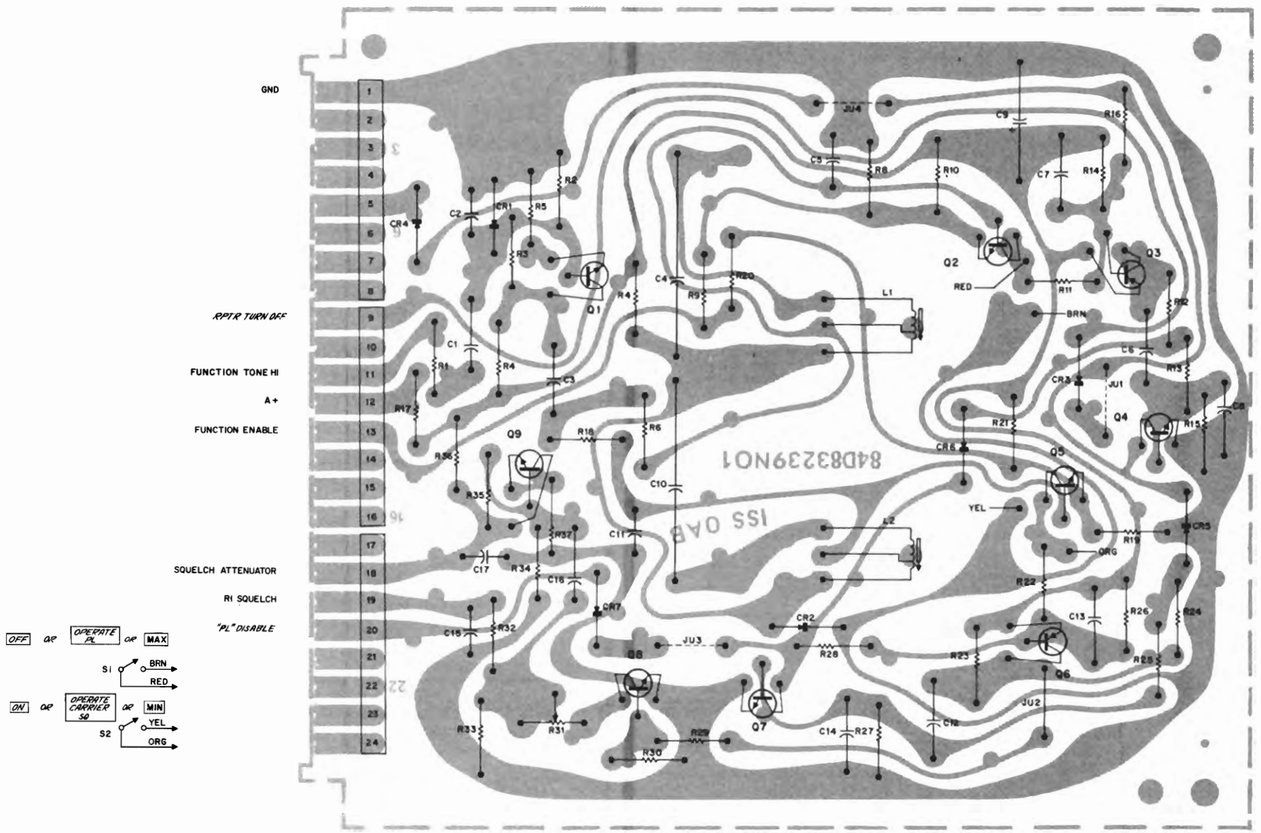
Converts function tones from remote source to grounding functions for transmit and receive channel element selection.

Schematic Diagram
Motorola No. **68P81062E22-A**
(Sheet 2 of 2)
11/1/85-UP

SQUELCH CONTROL OPTION DECODER MODULE
MODEL TLN2445A

REPEATER CONTROL OPTION DECODER MODULE
MODEL TLN2446A

PRIVATE-LINE CONTROL OPTION DECODER MODUE
MODEL TLN2447A



NOTE:

Wire colors shown on switches S1 & S2 are for TLN2445A and TLN2447A. Wire colors for TLN2446A are the same except on S1 the BRN wire is YEL and on S2 the YEL wire is BRN.

Circuit Board Detail and Parts Lists
Motorola No. **68P81062E28-B**
(Sheet 1 of 2)
11/1/85- UP

parts list

TRN5311A Squelch Control Module Panel
TRN5312A Repeater Control Module Panel
TRN5313A *Private-Line* Control Module Panel — PL-7998-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		switch, slide:
S1, 2	40-83468E01	spdt; spring return
		mechanical parts
	1-80757D81	ASSEMBLY, panel (TRN5311A); includes ref. items S1, S2, and
	64-83124L05	PANEL, screened
	1-80757D73	ASSEMBLY, panel (TRN5312A); includes ref. items S1, S2, and
	64-83124L04	PANEL, screened
	1-80757D82	ASSEMBLY, panel (TRN5313A); includes ref. items S1, S2, and
	64-83124L06	PANEL, screened
	3-84256M01	SCREW, tapping; 2 used

TRN5310A Tone Decoder Board
TRN5464A Tone Decoder Board
TRN5465A Tone Decoder Board — PL-7997-O

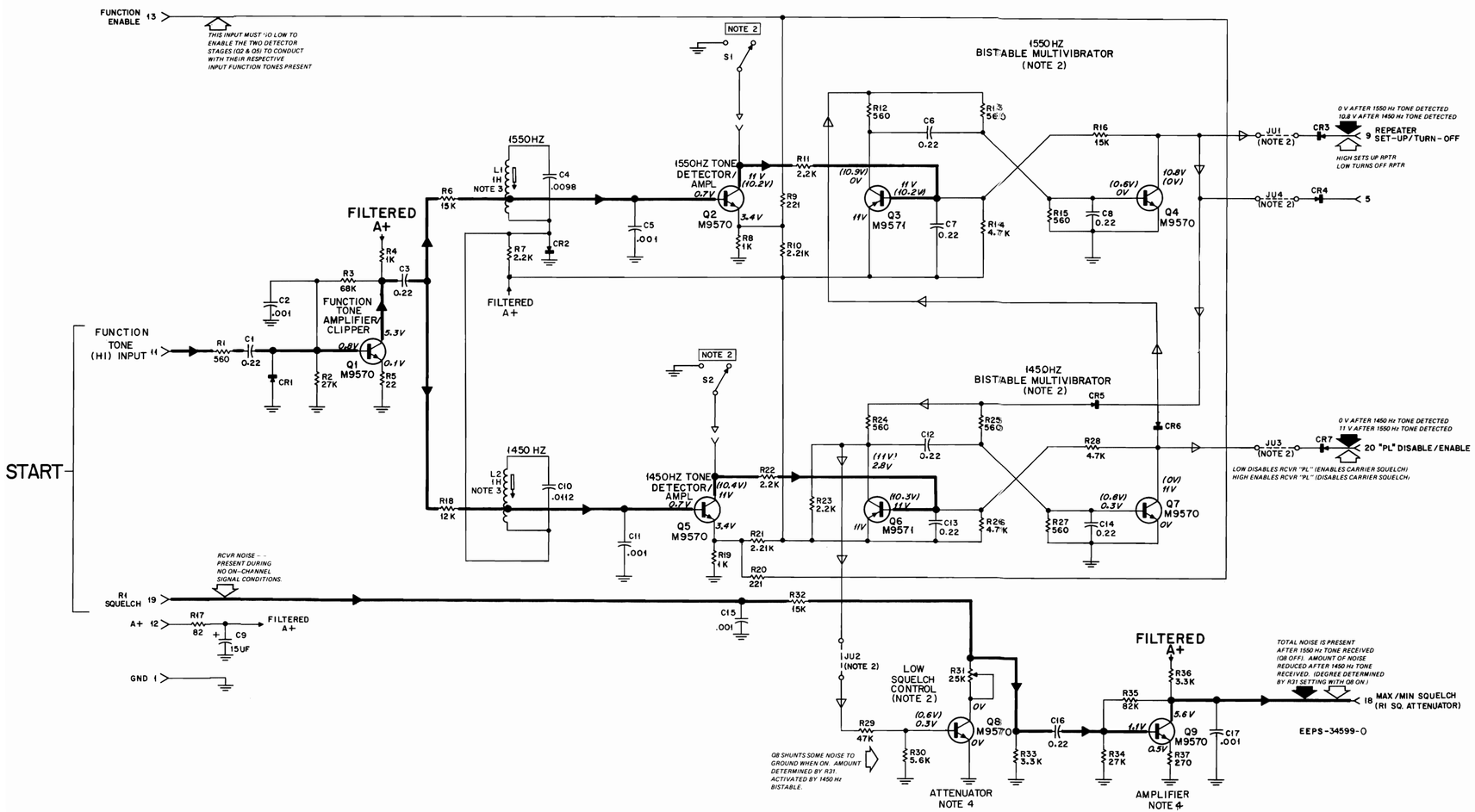
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ± 10%; 50 V: unless otherwise stated
C1	8-82905G11	0.22
C2	21-82187B29	.001; 100 V
C3	8-82905G11	0.22
C4	8-84326A18	.0098 ± 2%
C5	21-82187B29	.001; 100 V
C6, 7, 8	8-82905G11	0.22
C9	23-865136	15 ± 20%; 25 V
C10	8-84326A19	.0112 ± 2%
C11	21-82187B29	.001; 100 V
C12, 13, 14	8-82905G11	0.22
C15	21-82187B29	.001; 100 V
C16	8-82905G11	0.22
C17	21-82187B29	.001; 100 V
		diode: (see note)
CR1 thru 7	48-83654H01	silicon
		coil, af:
L1, 2	1-80702B11	assembly, inductor and ground clip (1 H)
		transistor: (see note)
Q1, 2	48-869570	NPN; type M9570
Q3	48-869571	PNP; type M9571
Q4, 5	48-869570	NPN; type M9570
Q6	48-869571	PNP; type M9571
Q7, 8, 9	48-869570	NPN; type M9570
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R1	6-11009C43	560
R2	6-11009C83	27k
R3	6-11009C93	68k
R4	6-11009C49	1k
R5	6-11009C09	22
R6	6-11009C77	15k
R7	6-11009C57	2.2k
R8	6-11009C49	1k
R9	6-84444A07	221 ± 1%
R10	6-84444A08	2.21k ± 1%
R11	6-11009C57	2.2k
R12, 13	6-11009C43	560
R14	6-11009C65	4.7k
R15	6-11009C43	560
R16	6-11009C77	15k
R17	6-11009C23	82
R18	6-11009C75	12k
R19	6-11009C49	1k
R20	6-84444A07	221 ± 1%
R21	6-84444A08	2.21k ± 1%
R22, 23	6-11009C57	2.2k
R24, 25	6-11009C43	560
R26	6-11009C65	4.7k
R27	6-11009C43	560
R28	6-11009C65	4.7k
R29	6-11009C89	47k
R30	6-11009C67	5.6k
R31	18-83083G03	variable; 25k ± 30%
R32	6-11009C77	15k
R33	6-11009C61	3.3k
R34	6-11009C83	27k
R35	6-11009C95	82k
R36	6-11009C61	3.3k
R37	6-11009C35	270
		mechanical parts
	5-84220B01	GROMMET; 2 used
	9-83497F01	RECEPTACLE, 8-contact; 3 used (PCB Edge)

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

SQUELCH CONTROL OPTION DECODER MODULE
MODEL TLN2445A

REPEATER CONTROL OPTION DECODER MODULE
MODEL TLN2446A

PRIVATE-LINE CONTROL OPTION DECODER MODULE
MODEL TLN2447A



FUNCTION

Selects one of two modes of operation in response to 1450 Hz and 1550 Hz function tones.

Model/Function Table

Function Tone Frequency	TLN2445A Squelch Control	TLN2446A Repeater Control	TLN2447A Private-Line Control
1500 Hz	Maximum Squelch Operation	Repeater Turn Off Operation	Private-Line Tone-Coded Squelch Operation
1450 Hz	Threshold Squelch Operation	Repeater Setup Operation	Carrier Squelch Operation

Function — Selects desired mode of operation by decoding remote generated 1450 and 1550 Hz function tones.

Application Table

	Squelch Control Module	Private-Line Control Module	Repeater Control Module
S1	Max. Sq.	Operate PL	RPTR Knockdown
S2	Min. Sq.	Operate Carrier Squelch	RPTR Setup
Q3/Q4	Operate Maximum Squelch	Operate PL	Repeater Turn Off
Q6/Q7	Operate Threshold Squelch	Operate Carrier Squelch	Repeater Set Up
R31	Low Squelch Control	(Not Used)	(Not Used)
JU1	OUT	OUT	IN
JU2	IN	OUT	OUT
JU3	OUT	IN	OUT
JU4	OUT	OUT	OUT

NOTES:

1. Voltages in parentheses are for active state.
2. Refer to table for application and/or description.
3. Factors adjusted to required frequency.
4. Used in squelch control models only.

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

Schematic Diagram
Motorola No. **68P81062E28-B**
(Sheet 2 of 2)
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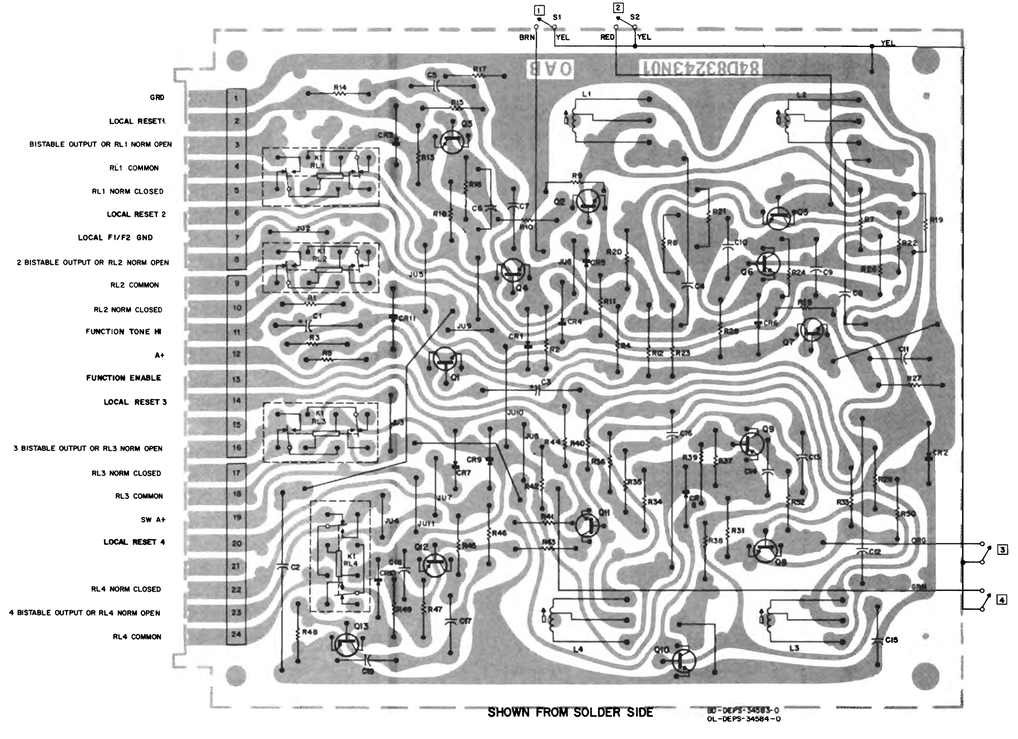
"WILD CARD" CONTROL MODULE
MODEL TLN2448A



Circuit Board Detail and Parts Lists
Motorola No. **68P81062E27-A**
(Sheet 1 of 2)
11/1/85- UP

parts list

TRN5315A "Wild Card" Control Module Board — PL-8000-O

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, 6	8-82905G11	0.22
C7	8-82905G02	.022
C8	8-84326A21	.015 ± 2%
C9, 10	8-82905G11	0.22
C11	8-82905G02	.022
C12	8-84326A22	.0178 ± 2%
C13, 14	8-82905G11	0.22
C15	8-82905G02	.022
C16	8-84326A23	.0213 ± 2%
C17, 18	8-81905G11	0.22
C19	8-82905G02	.022
		semiconductor device, diode: (see note)
CR1 thru 11	48-83654H01	silicon
		coil assembly, inductor:
L1 thru 4	1-80702B11	1 H; incl. ground clip 42-84315A01
		transistor: (see note)
Q1, 2	48-869642	NPN; type M9642
Q3	48-869643	PNP; type M9643
Q4	48-869568	NPN; type M9568
Q5	48-869642	NPN; type M9642
Q6	48-869643	PNP; type M9643
Q7	48-869568	NPN; type M9568
Q8	48-869642	NPN; type M9642
Q9	48-869643	PNP; type M9643
Q10	48-869568	NPN; type M9568
Q11	48-869642	NPN; type M9642
Q12	48-869643	PNP; type M9643
Q13	48-869568	NPN; type M9568
		resistor, fixed: ± 10%; 1/4 W: unless otherwise stated
R1	6-11009C43	560
R2	6-11009C83	27k
R3	6-11009C93	68k
R4	6-11009C09	22 ± 5%
R5	6-11009C49	1k ± 5%
R7	6-11009C73	10k ± 5%
R8	6-11009C57	2.2k
R9	6-11009C49	1k ± 5%
R10	6-11009C57	2.2k
R11	6-84444A08	2.21k ± 1%
R12	6-84444A07	221 ± 1%
R13	6-11009C57	2.2k
R14, 15	6-11009C43	560
R16	6-11009C65	4.7k
R17	6-11009C43	560
R18	6-11009C65	4.7k
R19	6-11009C72	9.1k ± 5%
R20	6-11009C49	1k ± 5%
R21	6-84444A09	2.43k ± 1%
R22	6-11009C57	2.2k
R23	6-84444A07	221 ± 1%
R24, 25	6-11009C43	560
R26	6-11009C65	4.7k
R27	6-11009C43	560
R28	6-11009C65	4.7k
R29	6-11009C71	8.2k ± 5%
R30	6-11009C49	1k ± 5%
R31	6-84444A09	2.43k ± 1%
R32	6-11009C57	2.2k
R33	6-84444A07	221 ± 1%
R34	6-11009C57	2.2k
R35, 36	6-11009C43	560
R37	6-11009C65	4.7k
R38	6-11009C43	560
R39	6-11009C85	4.7k
R40	6-11009C69	6.8k ± 5%
R41	6-11009C49	1k ± 5%
R42	6-84444A09	2.43k ± 1%
R43	6-11009C57	2.2k
R44	6-84444A07	221 ± 1%
R45, 46	6-11009C43	560
R47	6-11009C65	4.7k
R58	6-11009C43	560
R49	6-11009C05	4.7k
		mechanical parts
	5-84220B01	GROMMET; 2 used
	9-83497F01	RECEPTACLE, female: 8-contact; 3 used (PCB Edge Connector)

TRN5316A "Wildcard" Control Module Panel — PL-7999-A

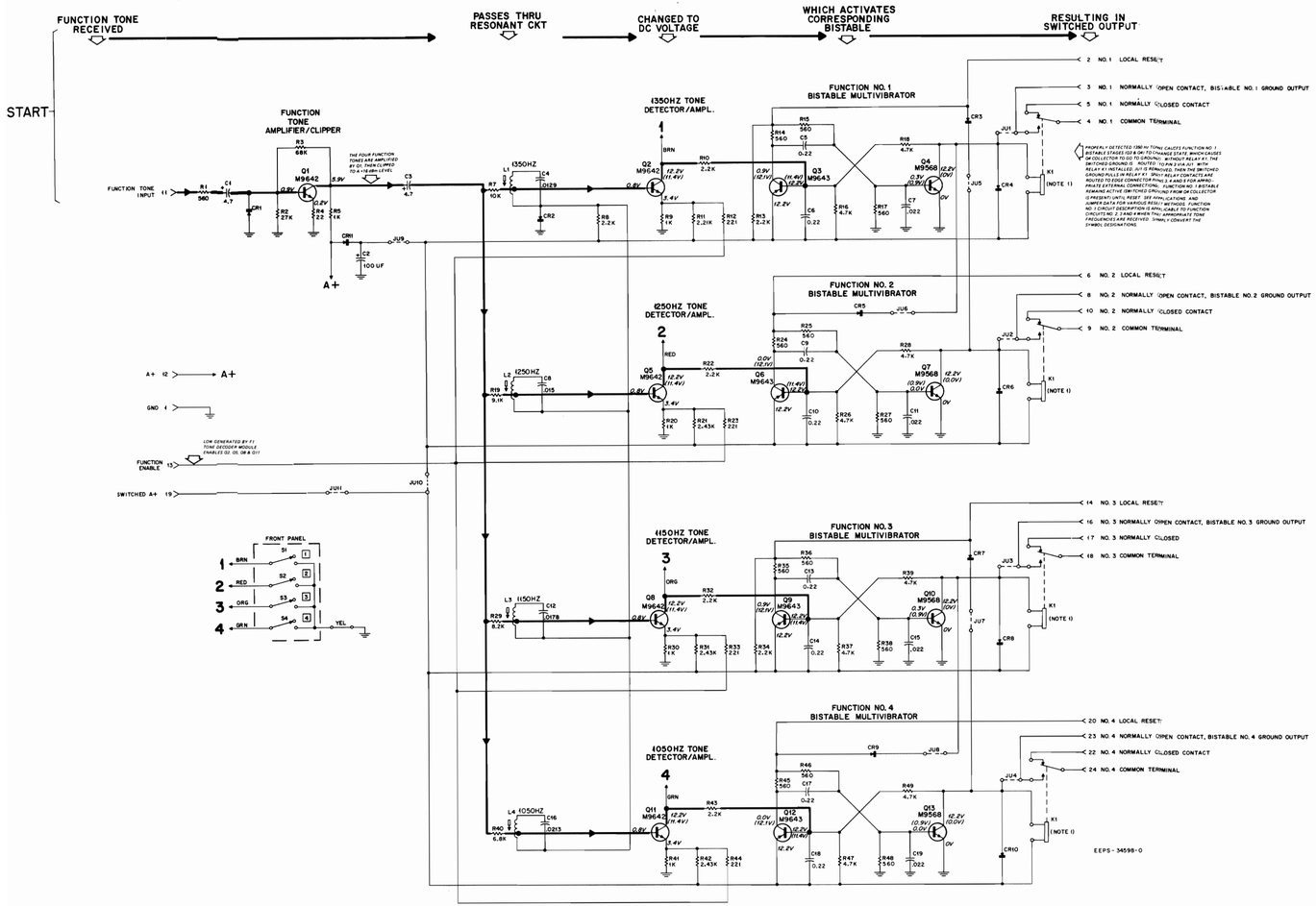
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		switch, slide:
S1 thru 4	40-83468E01	spdt
		non-referenced items
	1-80757D83	PANEL ASSEMBLY, include:
	64-83134L02	PANEL SWITCHES S1 thru S4
	3-84256M01	SCREW, tapping; 2 used

TLN4151A Relay Kit — PL-455-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		diode:
See Schematic	48-82392B03	silicon (reverse voltage protection)
		relay, armature:
K1	80-84201A01	2 form "C," coil res. 200 ohms
		non-referenced item
	43-84920H01	SPACER, relay

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

"WILD CARD" CONTROL MODULE
MODEL TLN2448A



FUNCTION

Converts function tones of 1050 Hz, 1150 Hz, 1250 Hz and 1350 Hz into transistor closures; relay closures optional. Allows remote control point to operate up to four universal on-off switches at the station site.

NOTES:

1. TLN4151A relay is an optional accessory. Refer to graph for relay contact rating.
2. Unless otherwise noted, all resistor values are in ohms and capacitor values are in microfarads.

Applications & jumper data

A. Operation without relays (jumpers JU1-JU4 must be connected)

Function Tone (Hz)	Bistable Operated	Output Pin
1350	No. 1	3
1250	No. 2	8
1150	No. 3	16
1050	No. 4	23

B. Operation with relays

Function Tone (Hz)	Bistable & Relay Operated	Output Pins N.O.	C	N.C.	Remove Jumper
1350	No. 1	3	4	5	JU1
1250	No. 2	8	9	10	JU2
1150	No. 3	16	18	17	JU3
1050	No. 4	23	24	22	JU4

C. Mixture of relay and non-relay operation is permissible.

D. Paired reset operation.

With this type of operation, 1350 Hz function tone latches bistable No. 1 on and resets bistable No. 2. A 1250 Hz function tone latches bistable No. 2 and resets bistable No. 1.

To Operate Bistables as Pairs	Connect Jumpers	Remove Jumpers
No. 1 & No. 2	JU5, JU6, JU9	JU11
No. 3 & No. 4	JU7, JU8, JU9, JU10	JU11

E. Independent bistable operation.

With this type of operation, each bistable can be activated independently by its function tone. Bistables can be reset only as a group by interruption or switched A + at pin 19 (reset when transmitter unkeys). For independent bistable operation, connect jumpers JU10 and JU11, and remove jumpers JU5 thru JU9.

F. Mixture of paired reset operation for bistable No. 1 & 2, and independent bistable operation for bistable No. 3 & 4 is permissible. Connect jumpers JU5, JU6, JU9 and JU11. Remove jumpers JU7, JU8 and JU10.

G. Local reset operation

Independent, external reset of each bistable is available by applying a switched ground to the associated local reset pin. This operation may be the only method of bistable resetting, or may be in addition to paired reset or independent bistable operation. If it is to be the only method of bistable resetting, connect jumper JU9 and JU10 and remove jumpers JU5-JU8 and JU11.

Model Complement

Model	Board	Panel
TLN2448A	TRN5315A	TRN5316A
TLN4151A Relay (Optional)	—	—

Schematic Diagram
Motorola No. **68P81062E27-A**
(Sheet 2 of 2)
11/1/85- UP

FUNCTIONAL DESCRIPTION

APPLICATIONS 68P81062E59
REMOTE CONTROL 68P81062E61

RF-CONTROL CHASSIS

RF-CONTROL CHASSIS (TLN2472B, 74B, 75B) (B VERSION) 68P81070E88

REMOTE CONTROL

REMOTE CONTROL MODULES 68P81062E63
- STATION CONTROL (TRN5321A) 68P81062E14
- LINE DRIVER (TRN5235A, 36A, 37A) 68P81062E13
- LINE DRIVER (TRN5240A, 54A, 55A, 56A) 68P81062E16
- DC TRANSFER (TRN5239A, 57A) 68P81062E17
- GUARD TONE DECODER (TLN2443A, 50A) 68P81062E18
- F1 TONE CONTROL (TRN5320A, 22A, 27A, 28A) 68P81062E19
- F2 TONE CONTROL (TLN2444A, 49A, TRN5256A, 5325A) 68P81062E21
- SQUELCH GATE (TRN5324A) 68P81062E23
- TIME-OUT TIMER (TRN2442A) 68P81062E24
- SINGLE-TONE DECODER (TLN2442A) 68P81062E26
- 4-FREQUENCY CONTROL OPTION DECODER (TRN5296A) 68P81062E22
- SQUELCH, REPEATER, AND *PRIVATE-LINE* CONTROL OPTION DECODER (TRN1249A, 50A, 51A) 68P81062E28
- "WILD CARD" CONTROL (TLN2448A) 68P81062E27

AUDIO & SQUELCH

R1 AUDIO & SQUELCH MODULE (TRN9688A, 89) 68P81070E57
R1 AUDIO & SQUELCH MODULE (TRN5068A, 69A) 68P81062E57
R2 AUDIO & SQUELCH MODULE (TRN9690A, 91A, 92A) 68P81070E58
R2 AUDIO & SQUELCH MODULE (TRN5070A, 71A, 72A) 68P81062E64
TONE *PRIVATE-LINE* ENCODER-DECODER MODULE TRN5073A, 74A, 75A) 68P81062E51
DIGITAL PRIVATE-LINE ENCODER-DECODER MODULE (TRN5076A, 77A, 78A) 68P81062E52

OPTIONAL EQUIPMENT

Spectra-TAC ENCODER OPTION (C269) 68P81112E78
- *Spectra-TAC* 4-WIRE LINE DRIVER MODULE (TRN5294A) 68P81062E41
- *Spectra-TAC* ENCODER MODULE (TRN5293A) 68P81062E42
- *Spectra-TAC* SQUELCH GATE MODULE (TRN5331A) 68P81062E43

MSR 2000 BASE AND REPEATER STATION MULTIPLE TONE PL OPTIONS (C158, C261, C262, C263) 68P81112E80
- MULTIPLE PL MATRIX CONTROL MODULE (TRN5330A) 68P81062E67
- MULTIPLE PL ENCODER MODULE (TRN5292A) 68P81062E68
- MULTIPLE PL ENCODER MODULE (TRN5329A) 68P81062E69

R1 AUDIO & SQUELCH MODULES

Model Table

Model	Description
TRN9688A	Standard
TRN9689A	Standard with Intercom

1. GENERAL

1.1 PHYSICAL DESCRIPTION

The TRN9688A, 89A R1 Audio & Squelch Modules are plug-in modules designed for use with Motorola base and repeater stations. All components and circuitry are mounted on a sturdy circuit card with connecting terminals that mate with the backplane interconnect board of the station's rf control chassis.

1.2 FUNCTIONAL DESCRIPTION

Either the Model TRN9688A R1 Audio & Squelch Module or Module TRN9689A with intercom circuitry (option) functions as an audio amplifier between the receiver detector output and line driver module. Either module also accepts microphone audio and PTT signals for local operation of the transmitter.

The receiver detector circuit feeds an audio signal to the R1 Audio & Squelch Module for amplification (U1A) and input to the carrier squelch circuitry and line driver module (pin 17). The line driver module returns audio to the R1 audio and squelch module (pin 18) for amplification and output to a local speaker (pin 22). The squelch circuitry operates from rf carrier, coded squelch, or a combination of carrier and coded squelch. For local operation of the station, the operator uses a handset or microphone for audio (J1-5) and MIC PTT (J1-6) inputs to the R1 Audio & Squelch Module. The audio is amplified (U1B) for modulation of the exciter (pin 16). The MIC PTT signal mutes the local speaker (U4B), enables intercom audio (optional) output (U4D), and produces a local PTT signal output (pin 4) for keying the transmitter. During intercom operation (optional), the NORMAL-INTERCOM switch S1 must be placed in the INTercom position to insure that the MIC PTT signal does not key the transmitter, via the local PTT output (pin 5). Intercom audio is routed, via the line driver module, to the remote control console. Remote control console intercom audio is routed from the line driver module to R1 Audio & Squelch Module (pin 18), as described previously.

2. DETAILED THEORY OF OPERATION

(Refer to the functional block and schematic diagrams at the end of this instruction section.)

2.1 VARIABLE GAIN AMPLIFIER CIRCUIT

The gain of U1A is adjustable by means of gain adjust R4. The gain is adjusted to provide a nominal voltage (380 mV rms) to the squelch circuit input (U101A-1). U1A also supplies receiver audio to the tone PL module and level adjust R7. The output of R7 drives the audio mute gate U4A. If the station is equipped with tone PL, JU1 is cut. When JU1 is cut, the R1 DET audio signal is routed through a PL filter, which is located on the tone PL module, and then applied to U4A.

2.2 AUDIO MUTE GATE CIRCUIT

U4A is a CMOS transmission gate. With a logic high control voltage, the gate is placed in the ON state. When in the ON state, audio mute gate U4A will supply audio to de-emphasis amplifier U3A. When the control voltage is switched to a logic low control voltage the gate is placed in the off (high impedance) state. In this condition, the audio signal is muted.

2.3 DE-EMPHASIS AMPLIFIER CIRCUIT

De-emphasis amplifier U3A amplifies the low level signal to provide the drive necessary for proper line driver operation. Feedback elements C7 and R13 also provide 6 dB per octave de-emphasis. Additional frequency response shaping is provided by the combination of C6, R12 & C9, R15.

2.4 AUDIO AMPLIFIER CIRCUIT

Amplifier U3B provides the necessary drive to the audio power amplifier. Frequency response shaping is provided by C12 and R20. Limit adjust R18 is adjusted to limit maximum audio power output to 1 watt. Drive to the power amplifier is first routed through audio mute gate U4B and volume control R25. U4B mutes the speaker audio during a MIC PTT signal.

2.5 AUDIO POWER AMPLIFIER CIRCUIT

Volume control R25 output is coupled to the audio power amplifier U2 by C17. U2 provides 1 watt of audio power into an 8-ohm speaker, at less than 5% distortion.

2.6 MIC AUDIO AMPLIFIER CIRCUIT

During local operation, mic audio is supplied to pin 5 of mic connector J1. For local transmission, this audio is amplified by U1B to provide the necessary drive to the exciter for proper operation.

2.7 INTERCOM OPTION CIRCUITRY

When the intercom option is present (TRN9689A only), mic audio is coupled through intercom mute gate U4D to the line driver. U4C inverts mic PTT to control intercom mute gate U4D. Intercom audio is muted by U4D when there is no mic PTT signal (GND) at U4C-6.

2.8 NOISE ACTIVATED SQUELCH CIRCUIT

2.8.1 Remote Controlled Squelch Circuit

With the remote controlled squelch option, JU101 is removed and JU102 and JU103 are installed. Then the R1 disc input signal, for the squelch circuit, is first routed through a remote controlled squelch module (option). This module provides the capability of remotely adjusting the squelch opening sensitivity. The remotely adjusted squelch signal is returned to the R1 Audio & Squelch Module as the R1 SQ ATTENUATOR signal, at pin 6.

2.8.2 Squelch Input Circuitry

The input to first amplifier/limiter U101A is a pre-emphasis network. This circuit boosts the noise content of the input signals above 5 kHz, for squelch processing the first amplifier/limiter is driven into limit to prevent audio signals from squelching the receiver. The amplified and limited noise signal is sent through a frequency shaping network to squelch control R25.

The squelch control wiper provides signal to second amplifier/limiter U101B. U101B amplifies the noise signal and relimits audio signals to provide further protection against audio signals squelching the receiver. The output signal of U101B is frequency shaped and sent to noise detector U101C.

2.8.3 Noise Detector and Switching Circuits

Noise detector U101C is a half wave rectifier-amplifier which produces negative going spikes at its output, U101C-12. The average dc value of these spikes is a function of received signal strength. The lowest average dc output voltage corresponds to a no signal input (maximum noise) condition. As the received signal strength increases, the noise level decreases, and the average dc output voltage increases.

The squelch switching circuitry operates in two modes. With a receive signal just above the opening sensitivity, squelch closing is slow (approximately 150 ms), which produces the squelch tail heard at the end of a received message. The 150 ms delay is present to prevent the received message from being chopped during a weak fluttering signal. With a strong signal (approximately 10 dB above opening sensitivity), squelch closing occurs immediately after the end of a received signal. This prevents the squelch tail from being heard.

Active integrator U101D provides squelch opening and slow squelch closing. U101D compares the detector's average dc output voltage with a reference voltage to determine squelch opening and closing.

Fast squelch closing is provided by Q102. A strong signal charges C116 through R120, turning Q102 on. With Q102 on, the collector voltage lowers to approximately 3.9 V dc. At the end of a strong signal, noise spikes from the detector are captured by CR103. This immediately discharges C116, turning off Q102. When Q102 turns off, its collector voltage goes to 9.4 volts, and C118 forces Q103 to close the squelch.

2.9 SQUELCH LOGIC CIRCUITRY

The squelch logic circuitry performs the necessary switching functions to provide proper squelch operation. This circuitry can operate in one of three different modes by selecting proper jumper cuts. Refer to the jumper table on the schematic diagram. For noise activated squelch operation only, JU105 is cut. In this mode, Q107 is always turned on. Squelching is controlled by the squelch noise circuit, through Q104. For coded (PL or DPL) squelch activation, both JU104 and JU105 remain in. In this mode, squelch turn-on is controlled by a proper coded squelch detection only. A proper coded squelch detection pulls the PL indicate line high, turning on Q105 and Q107. When PL DISABLED in this configuration, Q107 is turned on. This allows either a proper coded squelch detection or a noise activated squelch detection to open the squelch. This provides the OR squelch function.

In the third mode of operation, JU104 is cut and JU105 remains in. This produces the AND squelch function. AND squelch means that both a proper coded squelch

detection and a noise activated squelch detection are required to open squelch. A proper coded squelch detection turns on Q107 and a noise activated squelch detection turns on Q104. Both are required to open squelch. When PL DISABLED in this configuration, both Q106 and Q107 are turned on. Again, this provides the OR squelch function, where either a proper coded squelch detection or a noise activated squelch detection will open squelch. With Q107 on, and either Q104 or Q105 on, Q108 and Q109 are turned off. This enables audio mute gate U4A, creating an open squelch condition.

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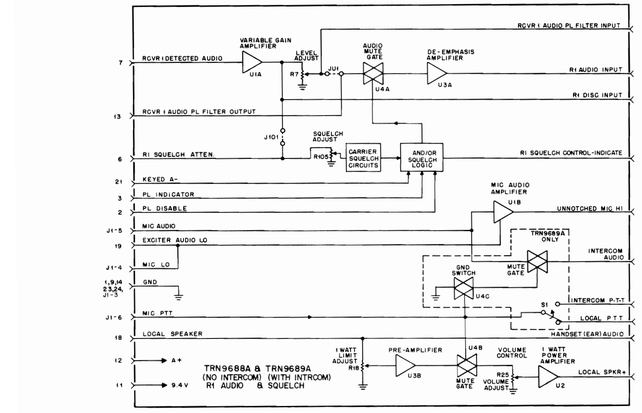
R1 AUDIO AND SQUELCH MODULES

MODELS TRN9688A, 89A



TRN9688A, 89A R1 Audio & Squelch Modules With and Without Intercom Functional Block Diagram, Circuit Board Detail and Parts List
Motorola No. ***PEPS-41742-A***
(Sheet 1 of 2)
5/15/86-UP

SHOWN FROM SOLDER SIDE

SOLDER SIDE BD-DEPS-3 4469-O
COMPONENT SIDE BD-DEPS-3 4470-O
OL-DEPS-3 4471-O

parts list

legend

reference symbol suffix	application
no suffix	all models
A	TRN9688A
B	TRN9689A

This parts list covers 2 models of the R1 Audio and Squelch Modules. Where differences exist, a letter code is added to the reference symbol to indicate the applicable unit.

TRN9688A R1 Audio and Squelch Module
TRN9689A R1 Audio and Squelch with Intercom Module PL-9669-A

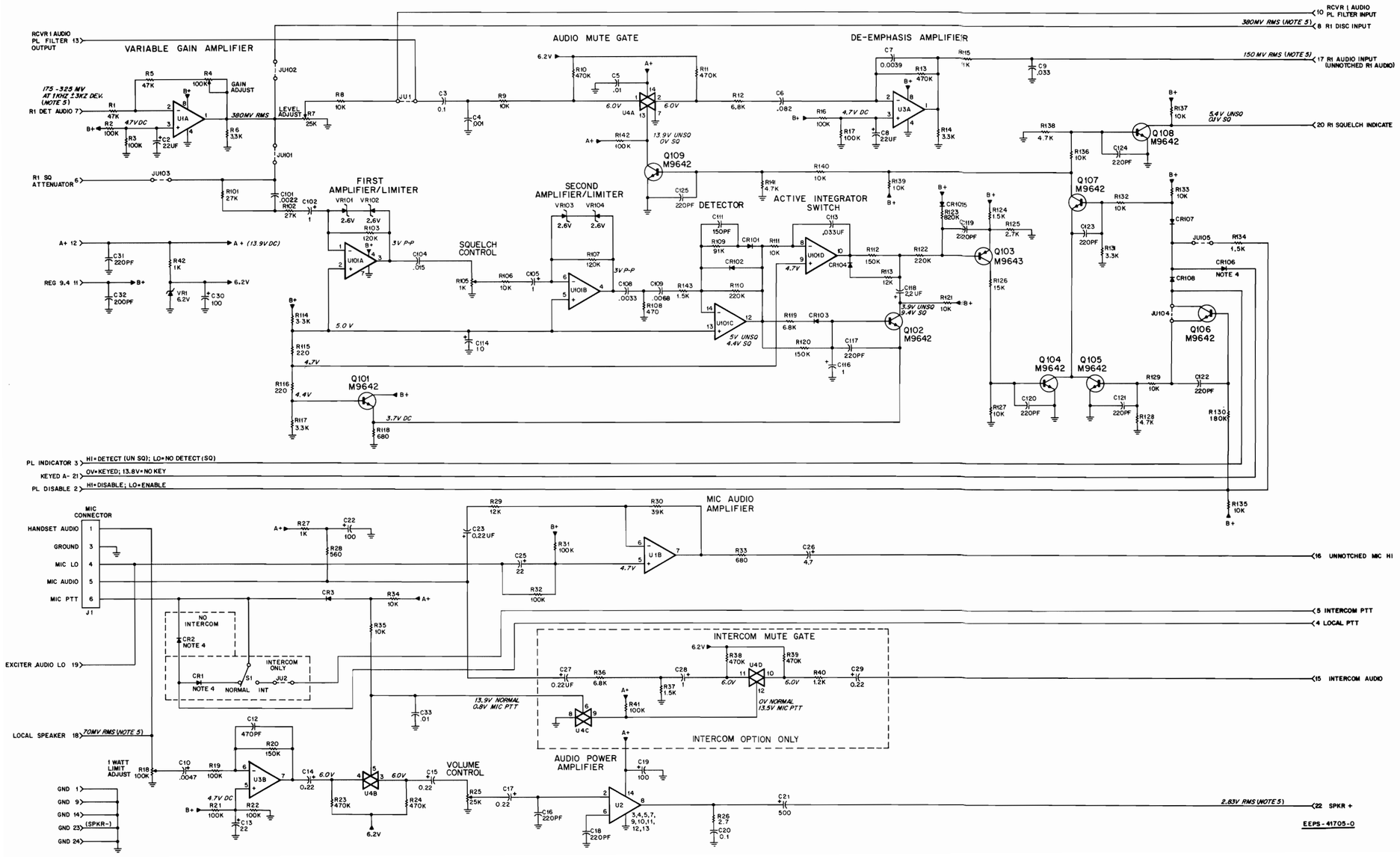
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ±20%; 50 V; unless otherwise stated
C1	—	NOT USED
C2	23-11019A27	22; 25 V
C3	8-11017A17	0.1 ±5%
C4	8-11017A01	.001 ±5%
C5	8-11017B08	.01 ±5%
C6	8-84637L13	.082 ±10%
C7	8-11017A18	.0039 ±5%
C8	23-11019A27	22; 25 V
C9	8-11017A13	.033 ±10%
C10	8-11017B06	.0047 ±10%
C11	—	NOT USED
C12	21-11022F58	470 pF ±5%
C13	23-11019A27	22; 25 V
C14, 15	23-11019A03	0.22
C16	21-11015B05	220 pF ±10%; 100 V
C17	23-11019A03	0.22
C18	21-11015B05	220 pF ±10%; 100 V
C19	23-11019A46	100; 25 V
C20	8-11017A17	0.1 ±5%
C21	23-83210A19	500
C22	23-11019A46	100; 25 V
C23	23-11019A03	0.22
C24	—	NOT USED
C25	23-11019A27	22; 25 V
C26	23-11019A16	4.7; 35 V
C27 (B)	23-11019A03	0.22
C28 (B)	23-11019A09	1
C29 (B)	23-11019A03	0.22
C30	23-11019A46	100; 25 V
C31, 32	21-11015B05	220 pF ±10%; 100 V
C33	8-11017B08	.01 ±10%
C34 thru 100	—	NOT USED
C101	8-11017A03	.0022
C102	23-11019A09	1
C103	—	NOT USED
C104	8-11017A09	.015
C105	23-11019A09	1
C106	—	NOT USED
C108	8-11017A05	.0033
C109	8-11017A07	.0068
C110	—	NOT USED
C111	21-11022G59	150 pF
C112	—	NOT USED
C113	8-11017B13	.033 ±10%
C114	23-11019A20	10; 25 V
C115	—	NOT USED
C116	23-11019A09	1
C117	21-11015B05	220 pF ±10%; 100 V
C118	23-11019A11	2.2
C119 thru 125	21-11015B05	220 pF ±10%; 100 V
		diode: (see note)
CR1 (B)	48-83654H01	silicon
CR2 (A)	48-83654H01	silicon
CR3	48-83654H01	silicon
CR4 thru 100	—	NOT USED
CR101 thru 108	48-83654H01	silicon
		connector, receptacle:
J1	28-82326N01	male; 5-contact (mic)
		jumper:
JU1	6-11009B23	0 ohms
JU2 (B)	6-11009B23	0 ohms
JU3 thru 100	—	NOT USED
JU101 thru 105	6-11009B23	0 ohms
		transistor: (see note)
Q101, 102	48-869642	NPN; type M9642
Q103	48-869643	PNP; type M9643
Q104 thru 109	48-869642	NPN; type M9642
		resistor, fixed: ±5%; 1/4 W: unless otherwise stated
R1	6-11009E69	47k
R2, 3	6-11009E97	100k
R4	18-82374N02	variable; 100k ohms
R5	6-11009A89	47k
R6	6-11009E61	3.3k
R7	18-82374N01	variable; 25k

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R8, 9	6-11009E73	10k
R10, 11	6-11009F14	470k
R12	6-11009E69	6.8k
R13	6-11009F14	470k
R14	6-11009E61	3.3k
R15	6-11009E49	1k
R16, 17	6-11009E97	100k
R18	18-83083G01	variable; 100k
R19	6-11009E97	100k
R20	6-11009F02	150k
R21, 22	6-11009E97	100k
R23, 24	6-11009F14	470k
R25	18-83083G16	variable; 25k
R26	6-124055	2.7
R27	6-11009A49	1k
R28	6-11009A43	560
R29	6-11009E75	12k
R30	6-11009E87	39k
R31, 32	6-11009E97	100k
R33	6-11009E45	680
R34, 35	6-11009A73	10k
R36 (B)	6-11009E69	6.8k
R37 (B)	6-11009A53	1.5k
R38, 39 (B)	6-11009B14	470k
R40 (B)	6-11009A51	1.2k
R41 (B)	6-11009A97	100k
R42	6-11009A49	1k
R43 thru 100	—	NOT USED
R101	6-11009E83	27k
R102	6-11009A83	27k
R103	6-11009E99	120k
R105	18-83083G28	variable; 1k
R106	6-11009E73	10k
R107	6-11009E99	120k
R108	6-11009E41	470
R109	6-11009E96	91k
R110	6-11009B06	220k
R111	6-11009E73	10k
R112	6-11009B02	150k
R113	6-11009A75	12k
R114	6-11009A61	3.3k
R115, 116	6-11009A33	220
R117	6-11009E61	3.3k
R118	6-11009E45	680
R119	6-11009A69	6.8k
R120	6-11009B02	150k
R121	6-11009A73	10k
R122	6-11009B06	220k
R123	6-11009B20	820k
R124	6-11009A53	1.5k
R125	6-11009A59	2.7k
R126	6-11009A77	15k
R127	6-11009A73	10k
R128	6-11009A65	4.7k
R129	6-11009A73	10k
R130	6-11009B04	180k
R131	6-11009A61	3.3k
R132, 133	6-11009A73	10k
R134	6-11009A53	1.5k
R135, 136, 137	6-11009A73	10k
R138	6-11009A65	4.7k
R139, 140	6-11009A73	10k
R141	6-11009A65	4.7k
R142	6-11009A97	100k
R143	6-11009E53	1.5k
		switch, pushbutton:
S1 (B)	40-84979B15	2-pole; push-push
		integrated circuit: (see note)
U1	51-80067C03	dual op-amplifier
U2	51-83629M22	1 watt audio
U3	51-80067C03	dual op-amplifier
U4	51-82884L14	antenna switch
U5 thru 100	—	NOT USED
U101	51-83629M06	op-amplifier
		voltage regulator: (see note)
VR1	48-83696E07	Zener type; 6.2 V
VR2 thru 100	—	NOT USED
VR101 thru 104	48-82256C33	Zener type; 2.6 V
		mechanical parts
	3-84256M01	SCREW, tapping; 4-10 × 5/16"; 2 used
	5-84220B01	GROMMET
	9-83497F01	RECEPTACLE, female; 8-contact; 3 used (circuit board edge connector)
	14-84360C01	INSULATOR, switch (TRN5069A)
	38-84962D01	PUSHBUTTON (TRN5069A)
	43-82721C01	BUSHING, snap; 2 used
	64-82865N01	PANEL, front (TRN5069A)
	64-82865N02	PANEL, front (TRN5068A)

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

R1 AUDIO AND SQUELCH MODULES

MODELS TRN9688A, 89A



NOTES:

1. Unless otherwise indicated, resistors in ohms, and capacitors in microfarads.
2. Local speaker connected to pins 22 (SPKR ±) and 23 (SPKR —).
3. C27, 28, 29, CR1, JU2, R36 thru 41, and 51 present on TRN9689A only.
4. Refer to jumper table for usage.
5. System Adjustment Procedure:
   A. Apply 1 mV rms of received frequency, modulated with a 1 kHz tone ±3 kHz deviation, to the receiver 1 RF input.
   B. Install JU102. Set R4 for 380 mV rms at pin 8-R1 disc input. Remove JU102.
   C. Set R7 for 150 mV rms at pin 17-R1 audio input.
   D. Set R25 max clockwise, adjust R18 for 2.83 V rms.

Jumper Table

Jumper	IN	OUT
JU1	No PL Filter Used	PL Filter Used
JU2	For *Spectra-TAC* Option	Normally
JU101	Normally	For Remote Squelch Option
JU102	For PL, DPL, Repeater, Single Tone Decoder, and Remote Squelch Option	Normally
JU103	For Remote Squelch Option	Normally
JU104	For PL "OR" Squelch	For PL "AND" Squelch'
JU105	For PL Squelch	For Carrier Squelch

Diode	IN	OUT
CR1	For Intercom Option	Normally
CR2	Normally	For Intercom Option
CR106	Normally	For Repeater

TRN9688A, 89A R1 Audio & Squelch Modules
With and Without Intercom
Schematic Diagram
Motorola No. ***PEPS-41742-A***
(Sheet 2 of 2)
5/15/86-UP

R1 AUDIO & SQUELCH MODELS

MODELS TRN5068A, 69A

Model Table

Model	Description
TRN5068A	Standard
TRN5069A	Standard with Intercom

1. GENERAL

1.1 PHYSICAL DESCRIPTION

The TRN5068A, 69A R1 Audio & Squelch Modules are plug-in modules designed for use with Motorola base and repeater stations. All components and circuitry are mounted on a sturdy circuit card with connecting terminals that mate with the backplane interconnect board of the station's rf control chassis.

1.2 FUNCTIONAL DESCRIPTION

Either the Model TRN5068A R1 Audio & Squelch Module or Module TRN5069A with intercom circuitry (option) functions as an audio amplifier between the receiver detector output and line driver module. Either module also accepts microphone audio and PTT signals for local operation of the transmitter.

The receiver detector circuit feeds an audio signal to the R1 Audio & Squelch Module for amplification (U1A) and input to the carrier squelch circuitry and line driver module (pin 17). The line driver module returns audio to the R1 audio and squelch module (pin 18) for amplification and output to a local speaker (pin 22). The squelch circuitry operates from rf carrier, coded squelch, or a combination of carrier and coded squelch. For local operation of the station, the operator uses a handset or microphone for audio (J1-5) and MIC PTT (J1-6) inputs to the R1 Audio & Squelch Module. The audio is amplified (U1B) for modulation of the exciter (pin 16). The MIC PTT signal mutes the local speaker (U4B), enables intercom audio (optional) output (U4D), and produces a local PTT signal output (pin 4) for keying the transmitter. During intercom operation (optional), the NORMAL-INTERCOM switch S1 must be placed in the INTercom position to insure that the MIC PTT signal does not key the transmitter, via the local PTT output (pin 5). Intercom audio is routed, via the line driver module, to the remote control console. Remote control console intercom audio is routed from the line driver module to R1 Audio & Squelch Module (pin 18), as described previously.

2. DETAILED THEORY OF OPERATION

(Refer to the functional block and schematic diagrams attached to this instruction section.)

2.1 VARIABLE GAIN AMPLIFIER CIRCUIT

The gain of U1A is adjustable by means of gain adjust R4. The gain is adjusted to provide a nominal voltage (380 mV rms) to the squelch circuit input (U101A-1). U1A also supplies receiver audio to the tone PL module and level adjust R7. The output of R7 drives the audio mute gate U4A. If the station is equipped with tone PL, JU1 is cut. When JU1 is cut, the R1 DET audio signal is routed through a PL filter, which is located on the tone PL module, and then applied to U4A.

2.2 AUDIO MUTE GATE CIRCUIT

U4A is a CMOS transmission gate. With a logic high control voltage, the gate is placed in the ON state. When in the ON state, audio mute gate U4A will supply audio to de-emphasis amplifier U3A. When the control voltage is switched to a logic low control voltage the gate is placed in the off (high impedance) state. In this condition, the audio signal is muted.

2.3 DE-EMPHASIS AMPLIFIER CIRCUIT

De-emphasis amplifier U3A amplifies the low level signal to provide the drive necessary for proper line driver operation. Feedback elements C7 and R13 also provide 6 dB per octave de-emphasis. Additional frequency response shaping is provided by the combination of C6, R12 & C9, R15.

2.4 AUDIO AMPLIFIER CIRCUIT

Amplifier U3B provides the necessary drive to the audio power amplifier. Frequency response shaping is provided by C12 and R20. Limit adjust R18 is adjusted to limit maximum audio power output to 1 watt. Drive to the power amplifier is first routed through audio mute gate U4B and volume control R25. U4B mutes the speaker audio during a MIC PTT signal.

2.5 AUDIO POWER AMPLIFIER CIRCUIT

Volume control R25 output is coupled to the audio power amplifier U2 by C17. U2 provides 1 watt of audio power into an 8-ohm speaker, at less than 5% distortion.

2.6 MIC AUDIO AMPLIFIER CIRCUIT

During local operation, mic audio is supplied to pin 5 of mic connector J1. For local transmission, this audio is amplified by U1B to provide the necessary drive to the exciter for proper operation.

2.7 INTERCOM OPTION CIRCUITRY

When the intercom option is present (TRN5069A only), mic audio is coupled through intercom mute gate U4D to the line driver. U4C inverts mic PTT to control intercom mute gate U4D. Intercom audio is muted by U4D when there is no mic PTT signal (GND) at U4C-6.

2.8 NOISE ACTIVATED SQUELCH CIRCUIT

2.8.1 Remote Controlled Squelch Circuit

With the remote controlled squelch option, JU101 is removed and JU102 and JU103 are installed. Then the R1 disc input signal, for the squelch circuit, is first routed through a remote controlled squelch module (option). This module provides the capability of remotely adjusting the squelch opening sensitivity. The remotely adjusted squelch signal is returned to the R1 Audio & Squelch Module as the R1 SQ ATTENUATOR signal, at pin 6.

2.8.2 Squelch Input Circuitry

The input to first amplifier/limiter U101A is a pre-emphasis network. This circuit boosts the noise content of the input signals above 5 kHz, for squelch processing the first amplifier/limiter is driven into limit to prevent audio signals from squelching the receiver. The amplified and limited noise signal is sent through a frequency shaping network to squelch control R25.

The squelch control wiper provides signal to second amplifier/limiter U101B. U101B amplifies the noise signal and relimits audio signals to provide further protection against audio signals squelching the receiver. The output signal of U101B is frequency shaped and sent to noise detector U101C.

2.8.3 Noise Detector and Switching Circuits

Noise detector U101C is a half wave rectifier-amplifier which produces negative going spikes at its output, U101C-12. The average dc value of these spikes is a function of received signal strength. The lowest average dc output voltage corresponds to a no signal input (maximum noise) condition. As the received signal strength increases, the noise level decreases, and the average dc output voltage increases.

The squelch switching circuitry operates in two modes. With a receive signal just above the opening sensitivity, squelch closing is slow (approximately 150 ms), which produces the squelch tail heard at the end of a received message. The 150 ms delay is present to prevent the received message from being chopped during a weak fluttering signal. With a strong signal (approximately 10 dB above opening sensitivity), squelch closing occurs immediately after the end of a received signal. This prevents the squelch tail from being heard.

Active integrator U101D provides squelch opening and slow squelch closing. U101D compares the detector's average dc output voltage with a reference voltage to determine squelch opening and closing.

Fast squelch closing is provided by Q102. A strong signal charges C116 through R120, turning Q102 on. With Q102 on, the collector voltage lowers to approximately 3.9 V dc. At the end of a strong signal, noise spikes from the detector are captured by CR103. This immediately discharges C116, turning off Q102. When Q102 turns off, its collector voltage goes to 9.4 volts, and C118 forces Q103 to close the squelch.

2.9 SQUELCH LOGIC CIRCUITRY

The squelch logic circuitry performs the necessary switching functions to provide proper squelch operation. This circuitry can operate in one of three different modes by selecting proper jumper cuts. Refer to the jumper table on the schematic diagram. For noise activated squelch operation only, JU105 is cut. In this mode, Q107 is always turned on. Squelching is controlled by the squelch noise circuit, through Q104. For coded (PL or DPL) squelch activation, both JU104 and JU105 remain in. In this mode, squelch turn-on is controlled by a proper coded squelch detection only. A proper coded squelch detection pulls the PL indicate line high, turning on Q105 and Q107. When PL DISABLED in this configuration, Q107 is turned on. This allows either a proper coded squelch detection or a noise activated squelch detection to open the squelch. This provides the OR squelch function.

In the third mode of operation, JU104 is cut and JU105 remains in. This produces the AND squelch function. AND squelch means that both a proper coded squelch

detection and a noise activated squelch detection are required to open squelch. A proper coded squelch detection turns on Q107 and a noise activated squelch detection turns on Q104. Both are required to open squelch. When PL DISABLED in this configuration, both Q106 and Q107 are turned on. Again, this provides the OR squelch function, where either a proper coded squelch detection or a noise activated squelch detection will open squelch. With Q107 on, and either Q104 or Q105 on, Q108 and Q109 are turned off. This enables audio mute gate U4A, creating an open squelch condition.

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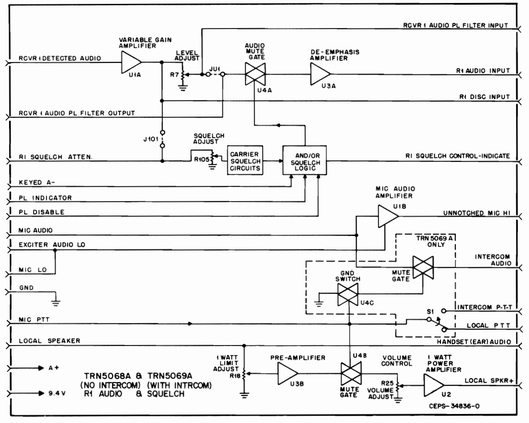
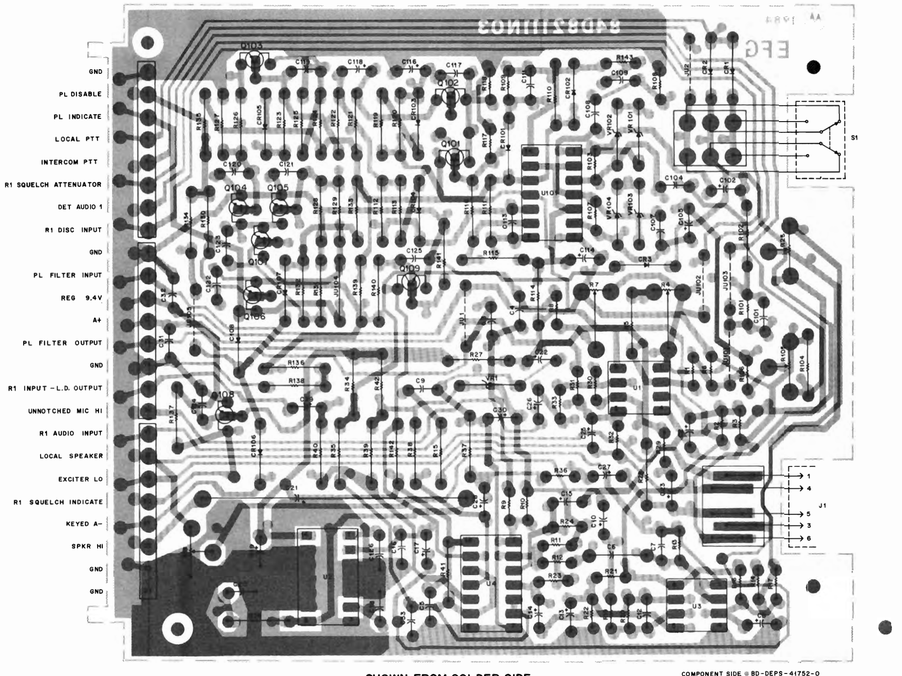
R1 AUDIO & SQUELCH MODULES

MODEL TRN5068A, 69A



With and Without Intercom
Functional Block Diagram, Circuit Board Detail and Parts List
Motorola No. PEPS-34906-B
(Sheet 1 of 2)
11/1/85-UP



SHOWN FROM SOLDER SIDE

COMPONENT SIDE = BD-DEPS-41752-O
SOLDER SIDE = BD-DEPS-41753-O
OL-DEPS-41751-O

parts list

legend

reference symbol suffix	application
no suffix	all models
A	TRN5068A
B	TRN5069A

This parts list covers 2 models of the R1 Audio and Squelch Modules. Where differences exist, a letter code is added to the reference symbol to indicate the applicable unit.

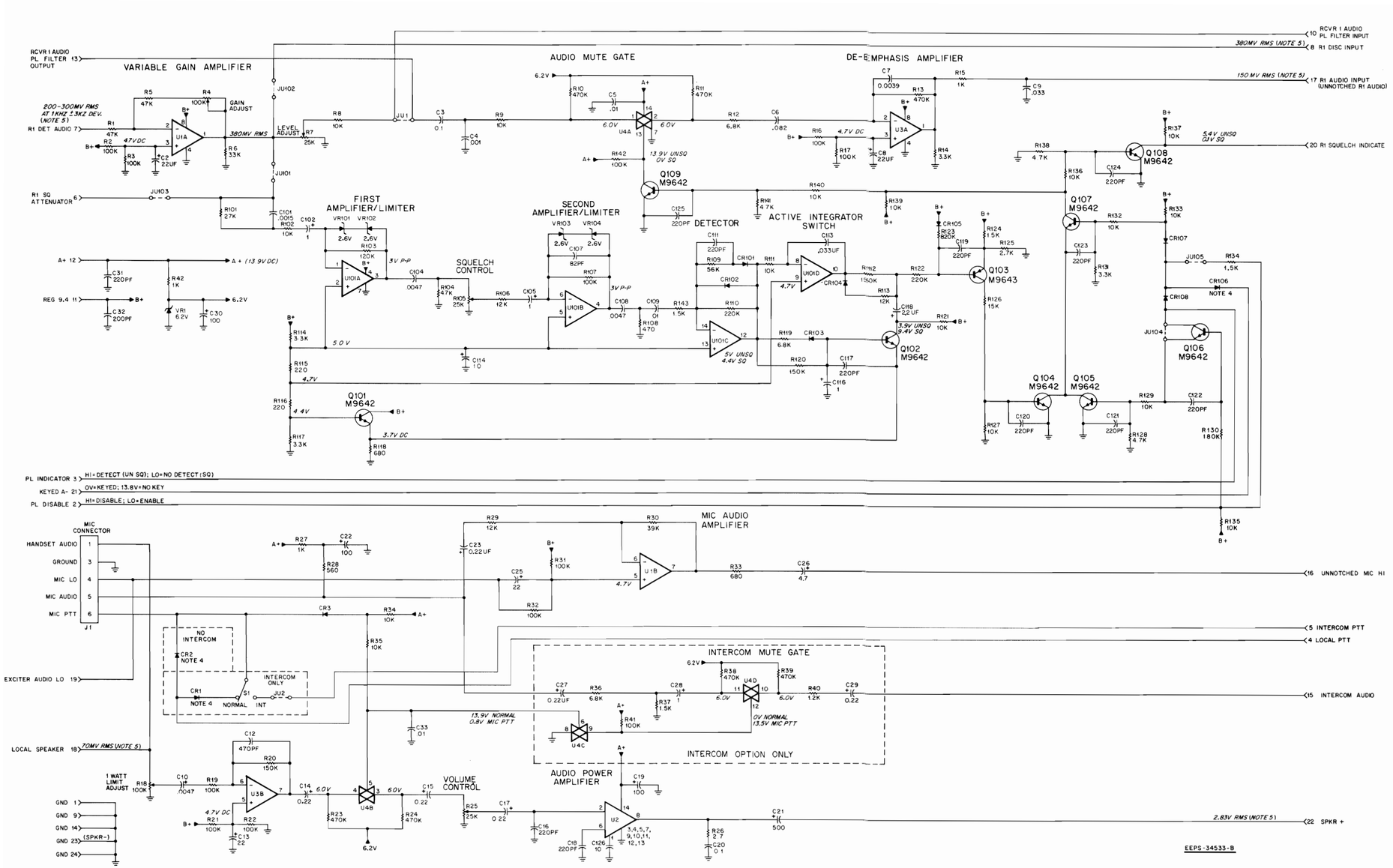
TRN5068A R1 Audio and Squelch Module
TRN5069A R1 Audio and Squelch with Intercom Module PL-7941-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ±20%; 50 V; unless otherwise stated
C1	—	NOT USED
C2	23-11019A27	22; 25 V
C3	8-11017A17	0.1 ±5%
C4	8-11017A01	.001 ±5%
C5	8-11017B08	.01 ±5%
C6	8-84637L13	.082 ±10%
C7	8-11017A18	.0039 ±5%
C8	23-11019A27	22; 25 V
C9	8-11017A13	.033 ±10%
C10	8-11017B06	.0047 ±10%
C11	—	NOT USED
C12	21-11022F58	470 pF ±5%
C13	23-11019A27	22; 25 V
C14, 15	23-11019A03	0.22
C16	21-11015B05	220 pF ±10%; 100 V
C17	23-11019A03	0.22
C18	21-11015B05	220 pF ±10%; 100 V
C19	23-11019A46	100; 25 V
C20	8-11017A17	0.1 ±5%
C21	23-83210A19	500
C22	23-11019A46	100; 25 V
C23	23-11019A03	0.22
C24	—	NOT USED
C25	23-11019A27	22; 25 V
C26	23-11019A16	4.7; 35 V
C27 (B)	23-11019A03	0.22
C28 (B)	23-11019A09	1
C29 (B)	23-11019A03	0.22
C30	23-11019A46	100; 25 V
C31, 32	21-11015B05	220 pF ±10%; 100 V
C33	8-11017B08	.01 ±10%
C34 thru 100	—	NOT USED
C101	8-11017B02	.0015 ±10%
C102	23-11019A09	1
C103	—	NOT USED
C104	8-11017B06	.0047 ±10%
C105	23-11019A09	1
C106	—	NOT USED
C107	21-11014B47	82 pF ±5%; 100 V
C108	8-11017B06	.0047 ±10%
C109	8-11017B08	.01 ±10%
C110	—	NOT USED
C111	21-11015B05	220 pF ±10%; 100 V
C112	—	NOT USED
C113	8-11017B13	.033 ±10%
C114, 126	23-11019A20	10; 25 V
C115	—	NOT USED
C116	23-11019A09	1
C117	21-11015B05	220 pF ±10%; 100 V
C118	23-11019A11	2.2
C119 thru 125	21-11015B05	220 pF ±10%; 100 V
		diode: (see note)
CR1 (B)	48-11034A01	silicon
CR2 (A)	48-11034A01	silicon
CR3	48-11034A01	silicon
CR4 thru 100	—	NOT USED
CR101 thru 108	48-11034A01	silicon
		connector, receptacle:
J1	28-82326N01	male; 5-contact (mic)
		jumper:
JU1	42-11060A01	0 ohms
JU2 (B)	42-11060A01	0 ohms
JU3 thru 100	—	NOT USED
JU101 thru 105	6-11009B23	0 ohms
		transistor: (see note)
Q101, 102	48-869642	NPN; type M9642
Q103	48-869643	PNP; type M9643
Q104 thru 109	48-869642	NPN; type M9642
		resistor, fixed: ±5%; 1/4 W: unless otherwise stated
R1	6-11009E89	47k
R2, 3	6-11009E97	100k
R4	18-82374N02	variable; 100k ohms
R5	6-11009A89	47k
R6	6-11009E61	3.3k
R7	18-82374N01	variable; 25k
R8, 9	6-11009E73	10k
R10, 11	6-11009F14	470k
R12	6-11009E69	6.8k
R13	6-11009F14	470k
R14	6-11009E61	3.3k
R15	6-11009E49	1k
R16, 17	6-11009E97	100k
R18	18-83083G01	variable; 100k
R19	6-11009E97	100k
R20	6-11009F02	150k
R21, 22	6-11009E97	100k
R23, 24	6-11009F14	470k
R25	18-83083G16	variable; 25k
R26	6-124D55	2.7
R27	6-11009A49	1k
R28	6-11009A43	560
R29	6-11009E75	12k
R30	6-11009E87	39k
R31, 32	6-11009E97	100k
R33	6-11009E45	680
R34, 35	6-11009A73	10k
R36 (B)	6-11009E69	6.8k
R37 (B)	6-11009A53	1.5k
R38, 39 (B)	6-11009B14	470k
R40 (B)	6-11009A51	1.2k
R41 (B)	6-11009A97	100k
R42	6-11009A49	1k
R43 thru 100	—	NOT USED
R101	6-11009E83	27k
R102	6-11009A73	10k
R103	6-11009E99	120k
R104	6-11009A65	4.7k
R105	18-83083G16	variable; 25k
R106	6-11009E75	12k
R107	6-11009E97	100k
R108	6-11009E41	470
R109	6-11009E91	56k
R110	6-11009B06	220k
R111	6-11009E73	10k
R112	6-11009B02	150k
R113	6-11009A75	12k
R114	6-11009A61	3.3k
R115, 116	6-11009A33	220
R117	6-11009E61	3.3k
R118	6-11009E45	680
R119	6-11009A69	6.8k
R120	6-11009B02	150k
R121	6-11009A73	10k
R122	6-11009B06	220k
R123	6-11009B20	820k
R124	6-11009A53	1.5k
R125	6-11009A59	2.7k
R126	6-11009A77	15k
R127	6-11009A73	10k
R128	6-11009A65	4.7k
R129	6-11009A73	10k
R130	6-11009B04	180k
R131	6-11009A61	3.3k
R132, 133	6-11009A73	10k
R134	6-11009A53	1.5k
R135, 136, 137	6-11009A73	10k
R138	6-11009A65	4.7k
R139, 140	6-11009A73	10k
R141	6-11009A65	4.7k
R142	6-11009A97	100k
R143	6-11009E53	1.5k
		switch, pushbutton:
S1 (B)	40-84979B15	2-pole; push-push
		integrated circuit: (see note)
U1	51-80067C03	dual op-amplifier
U2	51-83629M22	1 watt audio
U3	51-80067C03	dual op-amplifier
U4	51-82884L14	antenna switch
U5 thru 100	—	NOT USED
U101	51-83629M06	op-amplifier
		voltage regulator: (see note)
VR1	48-11034A13	Zener type; 6.2 V
VR2 thru 100	—	NOT USED
VR101 thru 104	48-82256C33	Zener type; 2.6 V
		mechanical parts
	3-84256M01	SCREW, tapping; 4-10 × 5/16"; 2 used
	5-84220B01	GROMMET
	9-83497F01	RECEPTACLE, female; 8-contact; 3 used (circuit board edge connector)
	14-84360C01	INSULATOR, switch (TRN5069A)
	38-84962D01	PUSHBUTTON (TRN5069A)
	43-82721C01	BUSHING, snap; 2 used
	64-82865N01	PANEL, front (TRN5069A)
	64-82865N02	PANEL, front (TRN5068A)

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

R1 AUDIO & SQUELCH MODULES

MODELS TRN5068A, 69A



NOTES:

1. Unless otherwise indicated, resistors in ohms, andcapacitors in microfarads.
2. Local speaker connected to pins 22 (SPKR ±) and 23 (SPKR —).
3. C27, 28, 29, CR1, JU2, R36 thru 41, and 51 present on TRN5069A only.
4. Refer to jumper table for usage.
5. System Adjustment Procedure:
   - A. Apply 1 mV rms of received frequency, modulated with a 1 kHz tone ± 3 kHz deviation, to the receiver 1 RF input.
   - B. Install JU102. Set R4 for 380 mV rms at pin 8-R1 disc input. Remove JU102.
   - C. Set R7 for 150 mV rms at pin 17-R1 audio input.
   - D. Set R25 max clockwise, adjust R18 for 2.83 V rms.

Jumper Table

Jumper	IN	OUT
JU1	No PL Filter Used	PL Filter Used
JU2	For *Spectra-TAC* Option	Normally
JU101	Normally	For Remote Squelch Option
JU102	For PL, DPL, Repeater, Single Tone Decoder, and Remote Squelch Option	Normally
JU103	For Remote Squelch Option	Normally
JU104	For PL "OR" Squelch	For PL "AND" Squelch'
JU105	For PL Squelch	For Carrier Squelch

Diode	IN	OUT
CR1	For Intercom Option	Normally
CR2	Normally	For Intercom Option
CR106	Normally	For Repeater

With and Without Intercom
Schematic Diagram
Motorola No. ***PEPS-34906-B***
(Sheet 2 of 2)
11/1/85- UP

R2 AUDIO & SQUELCH MODELS

MODELS TRN9690A, 91A, 92A

Model Table

Model	Description
TRN9690A	With Carrier Squelch
TRN9691A	With Carrier & PL Squelch
TRN9692A	With Carrier & DPL Squelch

1. GENERAL

1.1 PHYSICAL DESCRIPTION

The TRN9690A, 91A, and 92A R2 Audio & Squelch Modules are plug-in modules designed for use with Motorola base and repeater stations. All components and circuitry are mounted on a sturdy circuit card with connecting terminals that mate with the backplane interconnect board of the station's RF Control Chassis. These modules are used only with two receiver stations.

1.2 FUNCTIONAL DESCRIPTION

Each of these modules function as an audio amplifier between the second receiver's detector output and the line driver module. They also can perform a carrier squelch function for the second receiver. Additionally, Model TRN9691A can perform a PL squelch function, and Model TRN9692A can perform a DPL squelch function.

The second receiver detector circuit feeds an audio signal to the R2 Audio & Squelch Module for amplification (U1), input to the carrier squelch circuitry, and output to the line driver module (pin 17). The line driver module returns audio to the R1 audio & squelch module (pin 18) for amplification and output to a local speaker (pin 22). The on-board squelch circuitry operates from rf carrier, coded squelch, or a combination of carrier and coded squelch.

2. DETAILED THEORY OF OPERATION

(Refer to the functional block and schematic diagrams at the end of this instruction section.)

2.1 VARIABLE GAIN AMPLIFIER CIRCUIT

The gain of U1 is adjustable by means of gain adjust R3. The gain is adjusted to provide a nominal voltage (380 mV rms) to the squelch circuit input (U101A-1). U1 also supplies receiver audio to possible on-board PL or DPL circuitry, and level adjust R7. The output of R7 drives audio mute gate Q1. If the station is equipped with tone PL, JU1 is cut. When JU1 is cut, the R2 DET AUDIO signal is routed through an on-board PL filter, and then applied to Q1.

2.2 AUDIO MUTE GATE CIRCUIT

Q1 is a P-Channel Field Effect Transistor (FET). With a logic low control voltage, the FET is placed in the ON state. When in the ON state, audio mute gate Q1 will supply audio to de-emphasis amplifier U2. When the control voltage is switched to a logic high, the gate is placed in the OFF (high impedance) state. In this condition, the audio signal is muted.

2.3 DE-EMPHASIS AMPLIFIER CIRCUIT

De-emphasis amplifier U2 amplifies the low level signal to provide the drive necessary for proper line driver operation. Feedback elements C9 and R12 also provide 6 dB per octave de-emphasis. Additional frequency response shaping is provided by the combination of C8 and R11, and R14 (on TRN9690A, 91A), or C8 and R11, and C10 and R14 (on TRN9692A).

2.4 NOISE ACTIVATED (CARRIER) SQUELCH CIRCUIT

2.4.1 Squelch Input Circuitry

The input to first amplifier/limiter U101A is a pre-emphasis network. This circuit boosts the noise content of the input signals above 5 kHz, for squelch processing the first amplifier/limiter is driven into limit to prevent audio signals from squelching the receiver. The amplified and limited noise signal is sent through a frequency shaping network to SQUELCH control R105.

The squelch control wiper provides signal to second amplifier/limiter U101B. U101B amplifies the noise signal and relimits audio signals to provide further protection against audio signals squelching the receiver. The

output signal of U101B is frequency shaped and sent to noise detector U101C.

2.4.2 Noise Detector and Switching Circuits

Noise detector U101C is a half wave rectifieramplifier which produces negative going spikes at its output, U101C-10. The average dc value of these spikes is a function of received signal strength. The lowest average dc output voltage corresponds to a no signal input (maximum noise) condition. As the received signal strength increases, the noise level decreases, and the average dc output voltage increases.

The squelch switching circuitry operates in two modes. With a receive signal just above the opening sensitivity, squelch closing is slow (approximately 150 ms), which produces the squelch tail heard at the end of a received message. The 150 ms delay is present to prevent the received message from being chopped during a weak fluttering signal. With a strong signal (approximately 10 dB above opening sensitivity), squelch closing occurs immediately after the end of a received signal. This prevents the squelch tail from being heard.

Active integrator U101D provides squelch opening and slow squelch closing. U101D compares the detector's average dc output voltage with a reference voltage to determine squelch opening and closing.

Fast squelch closing is provided by Q102. A strong signal charges C112 through R120, turning Q102 on. With Q102 on, the collector voltage lowers to approximately 3.9 V dc. At the end of a strong signal, noise spikes from the detector are captured by CR104. This immediately discharges C112, turning off Q102. When Q102 turns off, its collector voltage goes to 9.4 volts, and C114 forces Q103 to close the squelch.

2.5 *PRIVATE-LINE* TONE CODED SQUELCH CIRCUIT

2.5.1 General

Essentially, the on-board PL decoder circuit of Model TRN9691A R2 Audio & Squelch Module detects a received PL tone and unsquelches the receiver when the proper PL tone is received. In addition, PL tone filtering is provided so that the PL tone is not heard in normal received audio.

Received R2 audio enters the PL circuit as R2 DISC INPUT (from U1-6), and is routed through an active low pass filter (Q201 and 202) before being applied to the input of the tone decoder IC U201-8. When the proper PL tone is decoded, U201 produces a square wave at the decode output (U201-13), unloaded. The square wave is detected by detector switch circuitry (Q204 and 205), which then enables PL INDICATOR output switch (Q206).

PL filter circuitry is utilized (JU1 out) to remove (attenuate) PL tones from the received audio. The received audio is filtered, first by a high pass filter, and then by a notch filter. A gyrator circuit is used for the notch filter to provide high "Q" inductance, without employing inductors.

2.5.2 PL Decoder Circuit Description

NOTE

The decoder IC U201 generates a high PL INDICATOR output (on the collector of Q206) when a proper PL tone is detected.

2.5.2.1 LOW PASS FILTER

The 5-pole low pass filter (Q201 and 202) attenuates high frequency noise above 192.8 Hz from the received R2 DISC INPUT audio. This provides the balance of the decoder circuitry additional falsing and blocking immunity.

2.5.2.2 DECODER AND REED

The filtered PL tone is applied to the decoder tone input (U201-8), where it is amplified and limited. The PL tone is then fed to the decoding reed Z201, pins 2 and 3. If the PL tone is of the proper frequency, it will cause the reed to resonate. The reed secondary (pins 1 and 4) reacts to the sympathetic vibration and returns the PL tone to the decoder reed secondary input U201-11. The decoder then amplifies and limits the PL tone once again, and provides an output at U201-13, Decode Output.

NOTE

If no proper PL tone is detected, the output of U1-13 stays high.

2.5.2.3 DETECTOR SWITCH

When an output is present (indicating a proper PL tone detection) at the decode output of U201 (pin 13), it is waveshaped by capacitor C212 into a sawtooth waveform at a level of approximately 0.8 V p-p. If a high (no detect) is present at U201-13, the level of this same waveform is constant, approximately 2.2 V. The balance of the detector switch circuitry inverts, filters, and amplifies the sawtooth waveform to produce a true logic level (logic high) at the collector of Q206 (PL INDICATOR).

2.5.2.4 NOISE GATE

Noise Gate Q203 allows a small amount of high frequency noise (with 1-pole of low pass filtering) to be fed to the decoder input, U201-8 when the PL INDICATOR output at the collector of Q206 is low. This tends to minimize noise falsing of the decoder. When the PL INDICATOR output is high, the high frequency noise sam-

ple is shunted to ground. This allows the onboard PL circuit to be more sensitive, once it receives a signal, and helps to prevent decoder dropout during brief signal fades.

2.5.2.5 8.4 V REGULATOR

The Q207 regulator circuit provides a constant 8.4 V dc (E+) to the PL decoder IC, U201.

2.6 *DIGITAL PRIVATE-LINE* CODED SQUELCH CIRCUIT

2.6.1 General

Essentially, the on-board DPL decoder circuit of Model TRN9692A R2 Audio & Squelch Module detects a received DPL code, and unmutes the receiver when the proper code is received. Received R2 audio enters the DPL circuit as R2 DISC INPUT (from U1-6), and is routed through an active low pass filter (Q301 and 302), where frequencies above the DPL code range are attenuated. The output of the low pass filter is applied to phase-lock-loop (PLL) data conditioner U302, which squares the shape of the incoming code word. The output of the data conditioner is routed, via level shifter Q303, to the input of the decoder IC U301-11.

The decoder circuit consists of IC U301, a 50 kHz clock (Y301 and Q304), and the information stored in the code plug (J301). When the proper code has been detected, the decoder provides a logic high at U301-7. That high provides a logic low, via audio enable Q305, to enable the PL INDICATOR output switch (Q306).

The logic high at U301-7 is also applied to sensitivity switch U304C, to disable the constant current source of U304D-U304E. With the constant current source disabled, the voltage at U302-8 is lowered, causing the sensitivity of U302 to increase. This provides additional immunity to audio interference and improved squaring of the incoming code word.

When the incoming (received) signal ceases, the sending transmitter produces a turn-off code. When the turn-off code is detected by the decoder, the detected output at U301-7 switches low. This decreases the sensitivity of the data conditioner and causes receiver audio to be muted.

2.6.2 DPL Decoder Circuit Description

NOTE

The decoder IC U301 generates a high (PL INDICATOR) output on the collector of Q206 when a proper DPL code is detected.

2.6.2.1 LOW PASS FILTER

The low pass filter circuit is similar to the one previously described for the PL decoder circuit in this section. However, the filter's output is fed through a PLL data conditioner (U302) for waveshaping, and a level shifter (Q303) to properly process the incoming code word, before presenting it to the decoder (U301) circuitry.

2.6.2.2 DECODER AND CODE PLUG

The processed code word is applied to the decoder's data input (U301-11), where it is compared to the data stored in'the code plug (J301), at a 50 kHz rate. If the incoming code word is correct, U301 will provide a logic high at the decoder's detected output U301-7.

NOTE

If no proper code word is detected, the output of U301-7 stays low.

2.6.2.3 AUDIO ENABLE

When a high output is present at U301-7 (indicating a proper DPL code detection), it is inverted by Q305 to enable Q306. Output switch Q306 then produces a true logic level (logic high) at its collector (PL INDICATOR).

2.6.2.4 REGULATOR CIRCUIT

Regulator Q307 provides three regulated dc voltages from station A+ (13.9 V). These voltages, in addition to A+, power all circuitry in the DPL decoder section of the module. The regulated voltages are:

10.5 V (C+), 6.2 V (D+), and 11.1 V (E+).

2.7 AND-OR SQUELCH LOGIC CIRCUITRY

The squelch logic circuitry performs the necessary switching functions to provide proper squelch operation. This circuitry can operate in one of three different modes by selecting proper jumper cuts. Refer to the jumper table on the schematic diagram. First, for noise activated squelch operation only, JU102 is cut. In this mode, Q107 is always turned on. Squelching is controlled by the squelch noise circuit, through Q104. For coded (PL or DPL) squelch activation, both JU101 and JU102 remain in. In this mode, squelch turn-on is controlled by a proper coded squelch detection only. A proper coded squelch detection pulls the PL INDICATOR line high, turning on Q105 and Q107. Second, when PL DISABLED in this configuration, Q107 is turned on. This allows either a proper coded squelch detection *or* a noise activated squlech detection to open the squelch. This provides the OR squelch function.

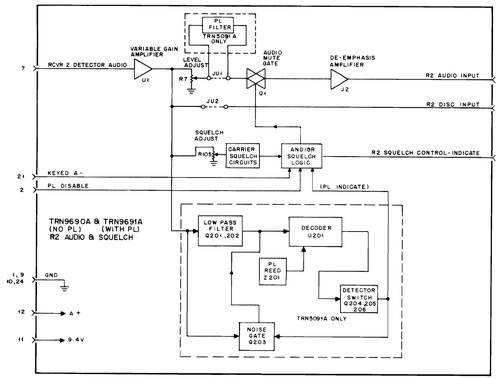
In the third mode of operation, JU101 is cut and JU102 remains in. This produces the AND squelch function.

AND squelch means that both a proper coded squelch detection and a noise activated squelch detection are required to open squelch. A proper coded squelch detection turns on Q107 and a noise activated squelch detection turns on Q104. Both are required to open squelch. When PL DISABLED in this configuration both Q106 and Q107 are turned on. Again, this provides the OR squelch function, where either a proper coded squelch detection *or* a noise activated squelch detection will open squelch.

With Q107 on, and either Q104 or Q105 on, Q108 and Q109 are turned off. This enables audio mute gate Q1, creating an open squelch condition.

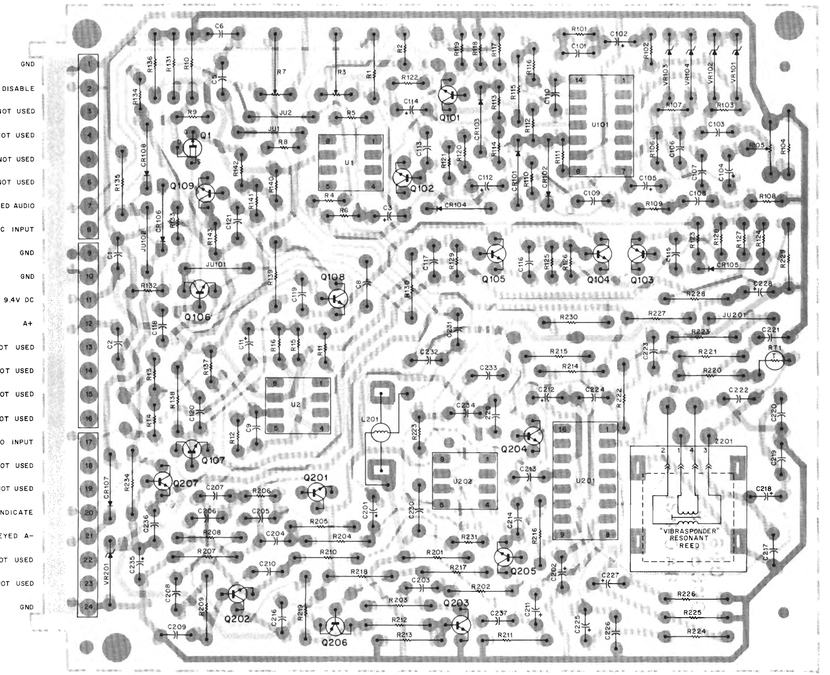
R2 AUDIO AND SQUELCH MODULES

MODELS TRN9690A, 91A



CEPS-41708-O

TRN9690A (Carrier Only), 91A (with PL), R2 Audio & Squelch Module: Functional Block Diagram, Circuit Board Detail, and Parts List
Motorola No. PEPS-41743-A
(Sheet 1 of 2)
5/15/86-LP



SHOWN FROM SOLDER SIDE

SOLDER SIDE BD-DEPS-34534-C
COMPONET SIDE BD-DEPS-34535-C
OL-DEPS-34536-A

parts list

legend

reference symbol suffix	application
no suffix	all models
A	TRN9690A
B	TRN9691A

This parts list covers 2 models of the R2 Audio and Squelch Modules. Where differences exist, a letter code is added to the reference symbol to indicate the applicable unit.

TRN9690A R2 Audio and Squelch
TRN9691A R2 Audio and Squelch with PL Module PL9670-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ±5%; 50 V: unless otherwise stated
C1, 2	21-11015B05	220 pF ±20%; 100 V
C3	23-11019A27	22 ±20%; 25 V
C4	—	NOT USED
C5	8-11017A17	0.1
C6	—	NOTE 2
C7	—	NOT USED
C8	8-84637L36	.082; 100 V
C9	8-11017A18	.0039
C10	—	NOTE 1
C11	23-11019A27	22 ±20%; 25 V
C12 thru 100	—	NOT USED
C101	8-11017A23	.0022 ±10%
C102	23-11019A09	1 ±20%
C103	8-11017A09	.015
C104	23-11019A09	1 ±20%
C105	23-11019A20	10 ±20%; 25 V
C107	8-11017A05	.0033
C108	8-11017A07	.0068
C109	21-11025G59	150 pF
C110	8-11017A13	.033
C112	23-11019A09	1 ±20%
C113	21-11015B05	220 pF ±10%; 100 V
C114	23-11019A11	2.2 ±20%
C115 thru 121	21-11015B06	220 pF ±10%; 100 V
C122 thru 200	—	NOT USED
C201, 202 (B)	23-11019A20	10 ±20%; 25 V
C203 (B)	8-11017B01	.001 ±10%
C204, 205 (B)	8-11017B08	.01
C206 (B)	8-11017B02	.0015 ±10%
C207 (B)	21-11015B05	220 pF ±10%; 100 V
C208 (B)	8-11017B16	.068
C209 (B)	8-11017B09	.015
C210 (B)	21-11015B05	220 pF ±10%; 100 V
C211 (B)	23-11019A20	10 ±20%; 25 V
C212 (B)	23-11019A09	1 ±20%
C213, 214 (B)	21-11015B05	220 pF ±10%; 100 V
C215 (B)	8-11017B01	.001 ±10%
C216 (B)	21-11015B05	220 pF ±10%; 100 V
C217 (B)	8-11017A17	0.1
C218 (B)	23-11019A20	10 ±20%; 25 V
C219 (B)	21-11015B05	220 pF ±10%; 100 V
C220, 221 (B)	8-11017B06	.0047 ±10%
C222, 223, 224 (B)	21-11015B05	220 pF ±10%; 100 V
C225 (B)	23-11019A09	1 ±20%
C226	8-11017B06	.0047 ±10%
C227, 228 (B)	23-11019A20	10 ±20%; 25 V
C229 (B)	8-11017B01	.001 ±10%
C230 (B)	8-84637L36	.082 ±10%; 250 V
C231 (B)	8-11017A14	.047
C232 (B)	8-11017A11	.022
C233 (B)	8-11017A17	0.1
C234 (B)	21-11015B05	220 pF ±10%; 100 V
C235 (B)	23-11019A20	10 ±20%; 25 V
C236 (B)	21-11015B05	220 pF ±10%; 100 V
C237 (B)	8-11017B08	.01
CR101 thru 108	48-83654H01	**diode: (see note 3)** silicon
		jumper:
JU1 (A)	6-11009B23	0 ohms
JU2	6-11009B23	0 ohms
JU3 thru 100	—	NOT USED
JU101, 102	6-11009B23	0 ohms
JU103 thru 200	—	NOT USED
JU201 (B)	6-11009B23	0 ohms
L201 (B)	24-84003A01	**coil, rf:** choke; 6 H
		transistor: (see note 3)
Q1	48-869660	FET, p-channel; type M9660
Q2 thru 100	—	NOT USED
Q101, 102	48-869642	NPN; type M9642
Q103	48-869643	PNP; type M9643
Q104 thru 108	48-869642	NPN; type M9642
Q109	48-8689646	NPN; type M9646
Q110 thru 200	—	NOT USED

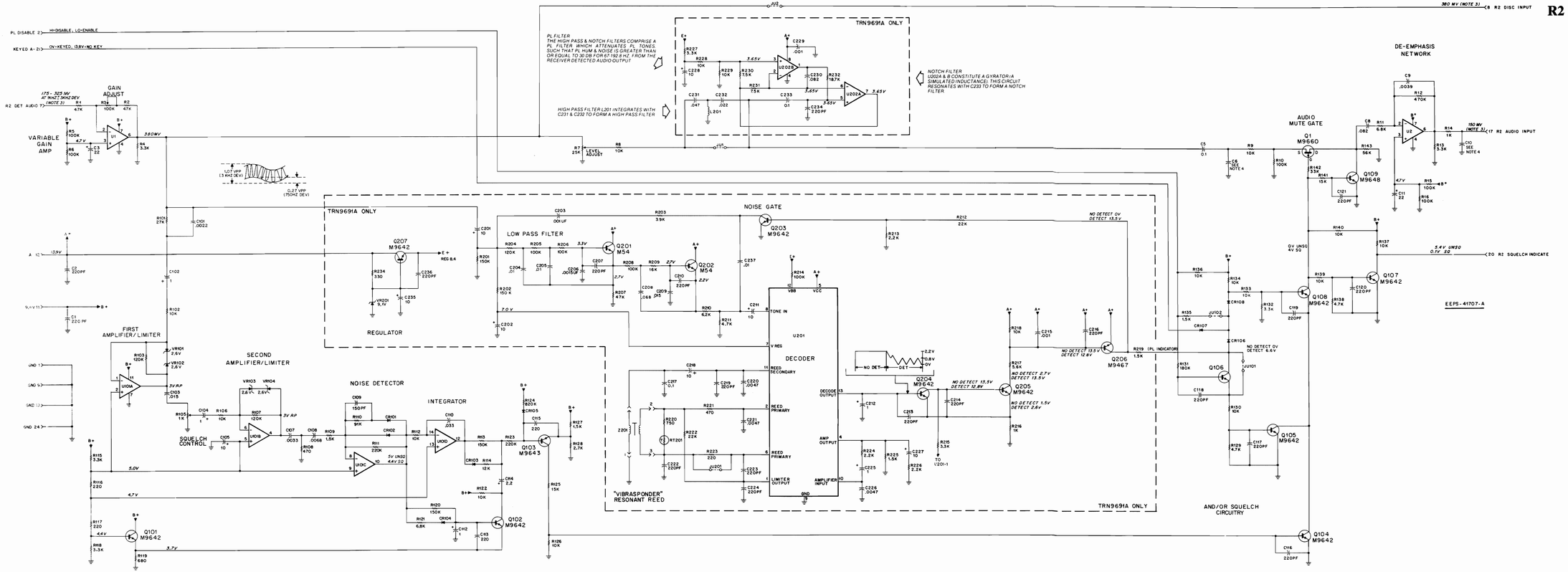
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
Q201, 202 (B)	48-134674	NPN; type M54
Q203, 204, 205 (B)	48-869642	NPN; type M9642
Q206 (B)	48-869467	PNP; type M9467
Q207 (B)	48-869642	NPN; type M9642
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R1	6-11009A89	47k
R2	6-11009E69	47k
R3	18-8237N02	variable; 100k
R4	6-11003E61	3.3k
R5, 6	6-11009E97	100k
R7	18-8237N01	variable; 25k
R8, 9	6-11009E73	10k
R10	6-11009A97	100k
R11	6-11009E69	6.8k
R12	6-11009F14	470k
R13	6-11009E61	3.3k
R14	6-11009E49	1k
R15, 16	6-11009E97	100k
R17 thru 100	—	NOT USED
R101	6-11009A83	27k
R102	6-11009A73	27k
R103	6-11009E99	120k
R105	18-83083G28	variable; 1k
R106	6-11009E73	10k
R107	6-11009E99	120k
R108	6-11009E41	470
R109	6-11009E53	1.5k
R110	6-11009E96	91k
R111	6-11009F06	220k
R112	6-11009E73	10k
R113	6-11009F02	150k
R114	6-11009E75	12k
R115	6-11009A61	3.3k
R116, 117	6-11009E33	220
R118	6-11009E61	3.3k
R119	6-11009E45	680
R120	6-11009F02	150k
R121	6-11009E69	6.8k
R122	6-11009E73	10k
R123	6-11009F06	220k
R124	6-11009F20	820k
R125	6-11009E77	15k
R126	6-11009E73	10k
R127	6-11009E53	1.5k
R128	6-11009E59	2.7k
R129	6-11009E65	4.7k
R130	6-11009A73	10k
R131	6-11009B04	180k
R132	6-11009E61	3.3k
R133, 134	6-11009E73	10k
R135	6-11009A53	1.5k
R136	6-11009A73	10k
R137	6-11009E73	10k
R138	6-11009A65	4.7k
R139	6-11009A73	10k
R140	6-11009E73	10k
R141	6-11009E77	15k
R142	6-11009E61	33k
R143	6-11009E91	56k
R144 thru 200	—	NOT USED
R201, 202 (B)	6-11009B02	150k
R203 (B)	6-11009A63	3.9k
R204 (B)	6-11009A99	120k
R205 (B)	6-11009A97	100k
R206 (B)	6-11009E97	100k
R207 (B)	6-11009A89	47k
R208 (B)	6-11009A97	100k
R209 (B)	6-11009A78	16k
R210 (B)	6-11009A68	6.2k
R211 (B)	6-11009A65	4.7k
R212 (B)	6-11009A51	22k
R123 (B)	6-11009A57	2.2k
R214 (B)	6-11009A97	100k
R215 (B)	6-11009A61	3.3k
R216 (B)	6-11009A49	1k
R217 (B)	6-11009A67	5.6k
R218 (B)	6-11009A73	10k
R219 (B)	6-11009A53	1.5k
R220 (B)	6-11009A46	750
R221 (B)	6-11009A41	470
R222 (B)	6-11009A81	22k
R223 (B)	6-11009A33	220
R224 (B)	6-11009A57	2.2k
R225 (B)	6-11009A53	1.5k
R226 (B)	6-11009A57	2.2k
R227 (B)	6-11009A61	3.3k
R228, 229 (B)	6-10621C91	10k ±1%; 1/8 W
R230, 231 (B)	6-10621C79	7.5k ±1%; 1/8 W
R232 (B)	6-10621D18	18.7k ±1%; 1/8 W
R233	—	NOT USED
R234 (B)	6-11009A37	330
		thermistor:
RT201 (B)	6-865641	300 @ 25°C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note 3)
U1, 2	51-80067C02	single op-amplifier
U3 thru 100	—	NOT USED
U101	51-83629M06	op-amplifier
U102 thru 200	—	NOT USED
U201 (B)	51-80074C02	tone, decoder/oscillator
U202 (B)	51-82609M33	dual op-amplifier
		voltage regulator: (see note 3)
VR101 thru 104	48-82256C33	Zener type, 2.6 V
VR105 thru 200	—	NOT USED
VR201 (B)	48-82256C38	Zener type, 9.1 V
		***Vibrasponder*Resonant Reed**
Z201	KLN6209A	resonant frequency as required
		mechanical parts
	3-84256M01	SCREW, tapping; 4-10 x 5/16"; 2 used
	5-84220B01	GROMMET, 2 used
	9-83497F01	RECEPTACLE, female; 8-contact; 3 used (circuit board edge connector)
	9-84910C01	SOCKET, reed (TRN5071A)
	64-83858N02	PANEL, screened

notes:
1. Use 8-11017A13 .033 uF ±5%; 50 V for R2 audio & squelch only.
2. Use 8-11017B01 .001 uF ±10%; 50 V for R2 audio & squelch and use 8-11017A18 .0039 uF ±5%; 50 V for R2 "PL".
3. For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

R2 AUDIO AND SQUELCH MODULES

MODELS TRN9690A, 91A



NOTES:

1. Unless otherwise indicated, resistors in ohms, capacitors in microfarads.
2. Refer to jumper table for usage.
3. System adjustment procedure:
   A. Apply 1 mV rms of received frequency, modulated with a 1 kHz tone ± 3 kHz deviation, to the receiver 2 RF input.
   B. Install JU2. Set R3 for 380 mV rms at pin 8-R2 disc input. Remove JU2.
   C. Set R7 for 150 mV rms at pin 17-R2 audio input.

Jumper Table

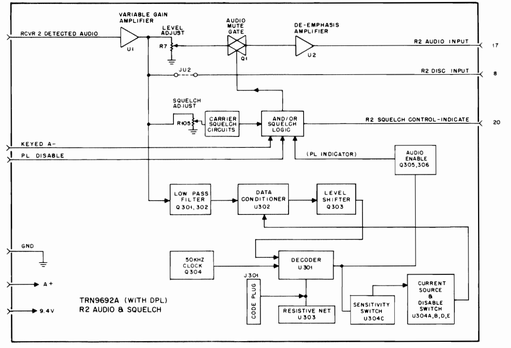
Jumper	IN	OUT
JU1	For Carrier Squelch	For PL Squelch
JU2	For Factory Test	Normally
JU101	Normally	For PL "AND" Squelch
JU102	Normally	For Carrier Squelch
JU201	Normally	When using 67 Hz Reed

TRN9690A (Carrier Only), 91A (With PL), R2 Audio & Squelch Modules Schematic Diagram Motorola No. PEPS-41743-A (Sheet 2 of 2) 5/15/86-UP

R2 AUDIO & SQUELCH MODULES

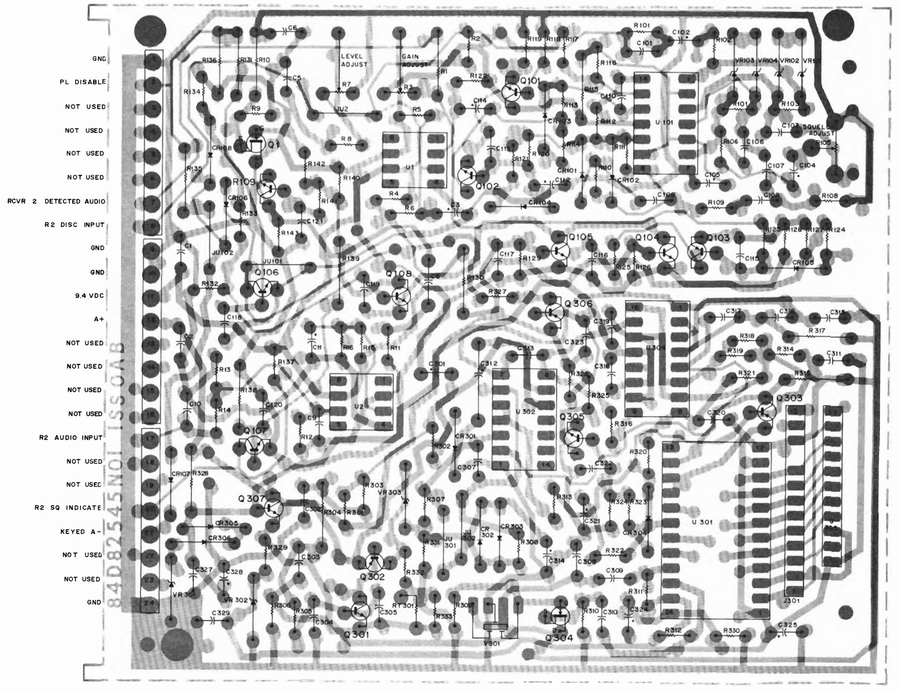
R2 AUDIO AND SQUELCH MODULE

MODEL TRN9692A



GEPS-41771-O

TRN9692A (with DPL)
R2 Audio & Squelch Module
Block Diagram, Circuit Board Detail, and Parts List
Motorola No. ***PEPS-41744-B***
(Sheet 1 of 2)
5/1/86-UP



SHOWN FROM SOLDER SIDE

COMPONENT SIDE = BD-DEPS-34539-O
SOLDER SIDE = BD-DEPS-34538-O
OL-DEPS-34540-B

parts list

TRN9692A R2 Audio and Squelch with DPL Module — PL-9671-B

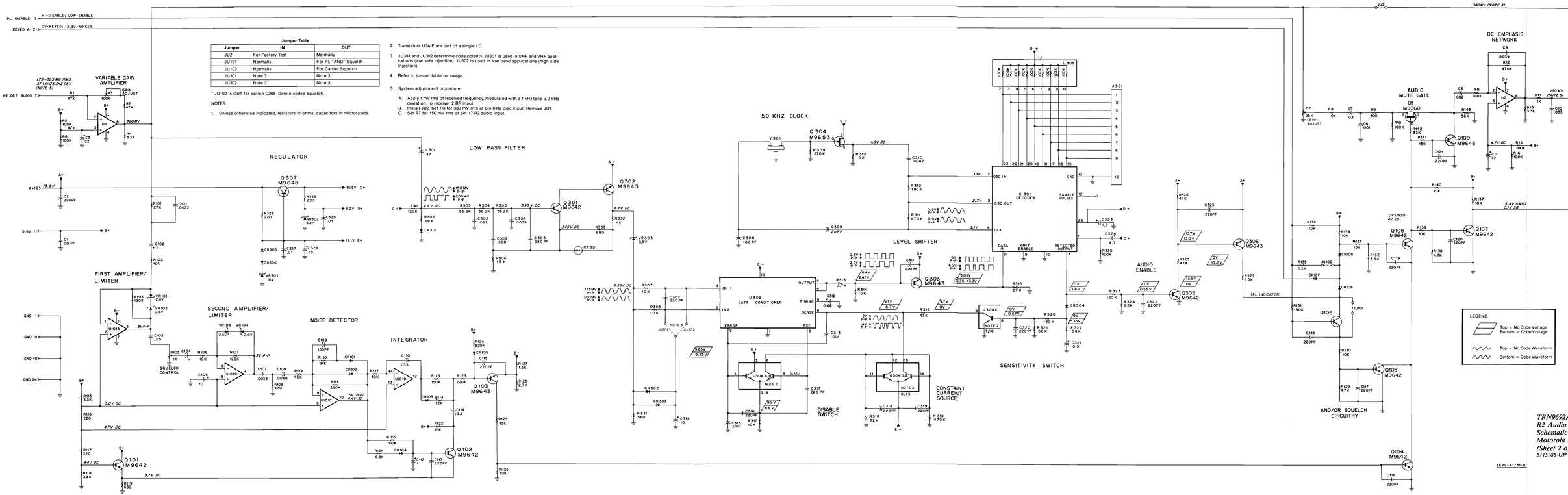
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ±5%; 50 V: unless otherwise stated
C1, 2	21-11015B05	220 pF ±20%; 100 V
C3	23-11019A27	22 ±20%; 25 V
C4	—	NOT USED
C5	8-11017A17	0.1
C6	8-11017B01	.001
C7	—	NOT USED
C8	8-84631L36	.082; 100 V
C9	8-11017A18	.0039
C10	8-11017A13	.033
C11	23-11019A27	22 ±20%; 25 V
C12 thru 100	—	NOT USED
C101	8-11017A03	.0022
C102	23-11019A09	1 ±20%
C103	8-11017A09	.015
C104	23-11019A09	1 ±20%
C105	23-11019A20	10 ±20%; 25 V
C106	—	NOT USED
C107	8-11017A05	.0033
C108	8-11017A07	.0068
C109	21-11022G59	150 pF
C110	8-11017A13	.033
C112	23-11019A09	1 ±20%
C113	21-11015B05	220 pF ±10%; 100 V
C114	23-11019A11	2.2 ±20%
C115 thru 121	21-11015B05	220 pF ±10%; 100 V
C122 thru 300	—	NOT USED
C301	23-84612M20	47 ±10%; 25 V
C302	8-11017A11	.022
C303	8-11017A16	.068
C304	8-11017A18	.0039
C305	21-11015B05	220 pF ±10%; 100 V
C306	—	NOT USED
C307	21-11015B05	220 pF ±10%; 100 V
C308	21-11022A55	100 pF
C309	21-11022A37	20 pF
C310	21-11021A21	.0047 ±10%
C311	21-11015B05	220 pF ±10%; 100 V
C312	23-82783B46	0.68; 35 V
C313	21-11015B13	.001 ±10%; 100 V
C314	23-84612M18	10 ±10%; 25 V
C315	21-11015B13	.001 ±10%; 100 V
C316 thru 320	21-11015B05	220 pF ±10%; 100 V
C321	23-84612M17	6.8 ±10%; 25 V
C322, 323	21-11015B05	220 pF ±10%; 100 V
C324, 325	23-11019A16	4.7 ±20%; 35 V
C326	—	NOT USED
C327	21-11021F04	.01 ±20%
C328	23-84612M19	15 ±10%; 25 V
C329	21-11021F04	.01 ±20%
CR101 thru 108	48-83654H01	**diode: (see note)** silicon
CR109 thru 300	—	NOT USED
CR301	48-83654H02	silicon
CR302, 303	48-84616A01	hot carrier
CR304, 305, 306	48-83654H01	silicon
J301	9-82071K01	**connector, receptacle:** female; 12-contact (DPL plug)
JU2	42-11060A01	**jumper:** 0 ohms
JU3 thru 100	—	NOT USED
JU101, 102	42-11060A01	0 ohms
JU103 thru 300	—	NOT USED
JU301, 302	42-11060A01	0 ohms
Q1	48-869660	**transistor: (see note)** FET, p-channel; type M9660
Q2 thru 100	—	NOT USED
Q101, 102	48-869642	NPN; type M9642
Q103	48-869643	PNP; type M9643
Q104 thru 108	48-869642	NPN; type M9642
Q109	48-88696648	NPN; type M9648
Q110 thru 300	—	NOT USED
Q301	48-869642	NPN; type M9642
Q302, 303	48-869643	PNP; type M9643
Q304	48-869653	FET, N-channel; type M9653
Q305	48-869642	NPN; type M9642
Q306	48-869643	PNP; type M9643
Q307	48-869648	NPN; type M9648
R1	6-11009A89	**resistor, fixed: ±5%; 1/4 W:** unless otherwise stated 47k
R2	6-11009E89	47k
R3	18-82374N02	variable; 100k
R4	6-11009E61	3.3k
R5, 6	6-11009E97	100k
R7	18-82374N01	variable; 25k
R8, 9	6-11009E73	10k
R10	6-11009A97	100k
R11	6-11009E69	6.8k
R12	6-11009F14	470k
R13	6-11009E61	3.3k

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R14	6-11009E49	1k
R15, 16	6-11009E97	100k
R17 thru 100	—	NOT USED
R101	6-11009E83	27k
R102	6-11009E73	10k
R103	6-11009E99	120k
R104	—	NOT USED
R105	18-83083G28	variable; 1k
R106	6-11009E73	10k
R107	6-11009E99	120k
R108	6-11009E41	470
R109	6-11009E53	1.5k
R110	6-11009E96	91k
R111	6-11009F06	220k
R112	6-11009E73	10k
R113	6-11009F02	150k
R114	6-11009E75	12k
R115	6-11009A61	3.3k
R116, 117	6-11009E33	220
R118	6-11009E61	3.3k
R119	6-11009E45	680
R120	6-11009F02	150k
R121	6-11009E69	6.8k
R122	6-11009E73	10k
R123	6-11009F06	220k
R124	6-11009F20	820k
R125	6-11009E77	15k
R126	6-11009E73	10k
R127	6-11009E53	1.5k
R128	6-11009E59	2.7k
R129	6-11009E65	4.7k
R130	6-11009A73	10k
R131	6-11009B04	180k
R132	6-11009E61	3.3k
R133, 134	6-11009E73	10k
R135	6-11009A53	1.5k
R136	6-11009A73	10k
R137	6-11009E73	10k
R138	6-11009A65	4.7k
R139	6-11009A73	10k
R140	6-11009E73	10k
R141	6-11009E77	15k
R142	6-11009E85	33k
R143	6-11009E91	56k
R144 thru 300	—	NOT USED
R301	6-11009E99	120k
R302	6-11009E63	68k
R303, 304, 305	6-10621D64	56.2k ±1%; 1/8 W
R306	6-11009E53	1.5k
R307, 308	6-11009E73	10k
R309	6-11009F08	270k
R310	6-11009E77	15k
R311	6-11009F14	470k
R312	6-11009F04	180k
R313	6-11009E59	2.7k
R314	6-11009E73	10k
R315	6-11009A83	27k
R316	6-11009E89	47k
R317	6-11009A73	10k
R318	6-11009E95	82k
R319	6-11009F14	470k
R320	6-11009E99	120k
R321, 322	6-11009E91	56k
R323	6-11009E99	120k
R324	6-11009E95	82k
R325, 326	6-11009E89	47k
R327	6-11009E53	1.5k
R328	6-11009A33	220
R329	6-11009E33	220
R330	6-11009E97	100k
R331	6-11009E43	560
R332	6-11009E49	1k
R333	6-11009E45	680
RT301	6-83241P01	**thermistor:** 305 @ 25°C
U1, 2	51-80067C02	**integrated circuit: (see note)** single op-amplifier
U3 thru 100	—	NOT USED
U101	51-83629M06	op-amplifier
U102 thru 300	—	NOT USED
U301	51-80074C01	encoder/decoder
U302	51-83629M01	phase lock loop
U303	51-82142K02	resistor network
U304	51-83629M10	transistor array
VR101 thru 104	48-82256C33	**voltage regulator:** Zener type; 2.6 V
VR105 thru 300	—	NOT USED
VR301	48-82256C11	Zener type; 10 V
VR302	48-83696E07	Zener type; 6.2 V
VR303	48-82256C26	Zener type; 3.3 V

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		crystal: (see note)
Y301	48-82003K01	50 kHz
		mechanical parts
	3-84256M01	SCREW, tapping; 4-10 × 5/16"; 2 used
	5-84220801	GROMMET; 2 used
	9-82071K01	PLUG, socket
	9-83497F01	RECEPTACLE, female; 8-contact; 3 used
		(circuit board edge connector)
	64-83858N03	PANEL, screened

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

R2 AUDIO AND SQUELCH MODULE
MODEL TRN9692A



Jumper Table		
Jumper	IN	OUT
JU2	For Factory Test	Normally
JU101	Normally	For PL "AND" Squelch
JU102*	Normally	For Carrier Squelch
JU301	Note 3	Note 3
JU302	Note 3	Note 3

* JU102 is OUT for option C268. Delete coded squelch.

NOTES

1. Unless otherwise indicated, resistors in ohms, capacitors in microfarads.
2. Transistors U3A-E are part of a single I.C.
3. JU301 and JU302 determine code polarity. JU301 is used in UHF and VHF applications (low side injection). JU302 is used in low band applications (high side injection).
4. Refer to jumper table for usage.
5. System adjustment procedure:
   A. Apply 1 mV rms of received frequency, modulated with a 1 kHz tone ± 3 kHz deviation, to receiver 2 RF input.
   B. Install JU2. Set R3 for 380 mV rms at pin 8-R2 disc input. Remove JU2.
   C. Set R7 for 150 mV rms at pin 17-R2 audio input.

TRN9692A (with DPL)
R2 Audio & Squelch Module
Schematic Diagram
Motorola No. PEPS-41744-B
(Sheet 2 of 2)
5/15/86-UP

EEPS-41731-B

R2 AUDIO & SQUELCH MODELS

MODELS TRN5070A, 71A, 72A

Model Table

Model	Description
TRN5070A	With Carrier Squelch
TRN5071A	With Carrier & PL Squelch
TRN5072A	With Carrier & DPL Squelch

1. GENERAL

1.1 PHYSICAL DESCRIPTION

The TRN5070A, 71A, and 72A R2 Audio & Squelch Modules are plug-in modules designed for use with Motorola base and repeater stations. All components and circuitry are mounted on a sturdy circuit card with connecting terminals that mate with the backplane interconnect board of the station's RF Control Chassis. These modules are used only with two receiver stations.

1.2 FUNCTIONAL DESCRIPTION

Each of these modules function as an audio amplifier between the second receiver's detector output and the line driver module. They also can perform a carrier squelch function for the second receiver. Additionally, Model TRN5071A can perform a PL squelch function, and Model TRN5072A can perform a DPL squelch function.

The second receiver detector circuit feeds an audio signal to the R2 Audio & Squelch Module for amplification (U1), input to the carrier squelch circuitry, and output to the line driver module (pin 17). The line driver module returns audio to the R1 audio & squelch module (pin 18) for amplification and output to a local speaker (pin 22). The on-board squelch circuitry operates from rf carrier, coded squelch, or a combination of carrier and coded squelch.

2. DETAILED THEORY OF OPERATION

(Refer to the functional block and schematic diagrams attached to this instruction section.)

2.1 VARIABLE GAIN AMPLIFIER CIRCUIT

The gain of U1 is adjustable by means of gain adjust R3. The gain is adjusted to provide a nominal voltage (380 mV rms) to the squelch circuit input (U101A-1). U1 also supplies receiver audio to possible on-board PL or DPL circuitry, and level adjust R7. The output of R7 drives audio mute gate Q1. If the station is equipped with tone PL, JU1 is cut. When JU1 is cut, the R2 DET AUDIO signal is routed through an on-board PL filter, and then applied to Q1.

2.2 AUDIO MUTE GATE CIRCUIT

Q1 is a P-Channel Field Effect Transistor (FET). With a logic low control voltage, the FET is placed in the ON state. When in the ON state, audio mute gate Q1 will supply audio to de-emphasis amplifier U2. When the control voltage is switched to a logic high, the gate is placed in the OFF (high impedance) state. In this condition, the audio signal is muted.

2.3 DE-EMPHASIS AMPLIFIER CIRCUIT

De-emphasis amplifier U2 amplifies the low level signal to provide the drive necessary for proper line driver operation. Feedback elements C9 and R12 also provide 6 dB per octave de-emphasis. Additional frequency response shaping is provided by the combination of C8 & R11, and R14 (on TRN5070A, 71A), or C8 & R11, and C10 & R14 (on TRN5072A).

2.4 NOISE ACTIVATED (CARRIER) SQUELCH CIRCUIT

2.4.1 Squelch Input Circuitry

The input to first amplifier/limiter U101A is a pre-emphasis network. This circuit boosts the noise content of the input signals above 5 kHz, for squelch processing the first amplifier/limiter is driven into limit to prevent audio signals from squelching the receiver. The amplified and limited noise signal is sent through a frequency shaping network to SQUELCH control R105.

The squelch control wiper provides signal to second amplifier/limiter U101B. U101B amplifies the noise signal and relimits audio signals to provide further protection against audio signals squelching the receiver. The

output signal of U101B is frequency shaped and sent to noise detector U101C.

2.4.2 Noise Detector and Switching Circuits

Noise detector U101C is a half wave rectifier-amplifier which produces negative going spikes at its output, U101C-10. The average dc value of these spikes is a function of received signal strength. The lowest average dc output voltage corresponds to a no signal input (maximum noise) condition. As the received signal strength increases, the noise level decreases, and the average dc output voltage increases.

The squelch switching circuitry operates in two modes. With a receive signal just above the opening sensitivity, squelch closing is slow (approximately 150 ms), which produces the squelch tail heard at the end of a received message. The 150 ms delay is present to prevent the received message from being chopped during a weak fluttering signal. With a strong signal (approximately 10 dB above opening sensitivity), squelch closing occurs immediately after the end of a received signal. This prevents the squelch tail from being heard.

Active integrator U101D provides squelch opening and slow squelch closing. U101D compares the detector's average dc output voltage with a reference voltage to determine squelch opening and closing.

Fast squelch closing is provided by Q102. A strong signal charges C112 through R120, turning Q102 on. With Q102 on, the collector voltage lowers to approximately 3.9 V dc. At the end of a strong signal, noise spikes from the detector are captured by CR104. This immediately discharges C112, turning off Q102. When Q102 turns off, its collector voltage goes to 9.4 volts, and C114 forces Q103 to close the squelch.

2.5 *PRIVATE-LINE* TONE CODED SQUELCH CIRCUIT

2.5.1 General

Essentially, the on-board PL decoder circuit of Model TRN5071A R2 Audio & Squelch Module detects a received PL tone and unsquelches the receiver when the proper PL tone is received. In addition, PL tone filtering is provided so that the PL tone is not heard in normal received audio.

Received R2 audio enters the PL circuit as R2 DISC INPUT (from U1-6), and is routed through an active low pass filter (Q201 & 202) before being applied to the input of the tone decoder IC U201-8. When the proper PL tone is decoded, U201 produces a square wave at the decode output (U201-13), unloaded. The square wave is detected by detector switch circuitry (Q204 & 205), which then enables PL INDICATOR output switch (Q206).

PL filter circuitry is utilized (JU1 out) to remove (attenuate) PL tones from the received audio. The received audio is filtered, first by a high pass filter, and then by a notch filter. A gyrator circuit is used for the notch filter to provide high "Q" inductance, without employing inductors.

2.5.2 PL Decoder Circuit Description

NOTE

The decoder IC U201 generates a high PL INDICATOR output (on the collector of Q206) when a proper PL tone is detected.

2.5.2.1 LOW PASS FILTER

The 5-pole low pass filter (Q201 & 202) attenuates high frequency noise above 192.8 Hz from the received R2 DISC INPUT audio. This provides the balance of the decoder circuitry additional falsing and blocking immunity.

2.5.2.2 DECODER AND REED

The filtered PL tone is applied to the decoder tone input (U201-8), where it is amplified and limited. The PL tone is then fed to the decoding reed Z201, pins 2 and 3. If the PL tone is of the proper frequency, it will cause the reed to resonate. The reed secondary (pins 1 and 4) reacts to the sympathetic vibration and returns the PL tone to the decoder reed secondary input U201-11. The decoder then amplifies and limits the PL tone once again, and provides an output at U201-13, Decode Output.

NOTE

If no proper PL tone is detected, the output of U1-13 stays high.

2.5.2.3 DETECTOR SWITCH

When an output is present (indicating a proper PL tone detection) at the decode output of U201 (pin 13), it is waveshaped by capacitor C212 into a sawtooth waveform at a level of approximately 0.8 V p-p. If a high (no detect) is present at U201-13, the level of this same waveform is constant, approximately 2.2 V. The balance of the detector switch circuitry inverts, filters, and amplifies the sawtooth waveform to produce a true logic level (logic high) at the collector of Q206 (PL INDICATOR).

2.5.2.4 NOISE GATE

Noise Gate Q203 allows a small amount of high frequency noise (with 1-pole of low pass filtering) to be fed to the decoder input, U201-8 when the PL INDICATOR output at the collector of Q206 is low. This tends to minimize noise falsing of the decoder. When the PL INDICATOR output is high, the high frequency noise sam-

ple is shunted to ground. This allows the onboard PL circuit to be more sensitive, once it receives a signal, and helps to prevent decoder dropout during brief signal fades.

2.5.2.5 8.4 V REGULATOR

The Q207 regulator circuit provides a constant 8.4 V dc (E+) to the PL decoder IC, U201.

2.6 *DIGITAL PRIVATE-LINE* CODED SQUELCH CIRCUIT

2.6.1 General

Essentially, the on-board DPL decoder circuit of Model TRN5072A R2 Audio & Squelch Module detects a received DPL code, and unmutes the receiver when the proper code is received. Received R2 audio enters the DPL circuit as R2 DISC INPUT (from U1-6), and is routed through an active low pass filter (Q301 & 302), where frequencies above the DPL code range are attenuated. The output of the low pass filter is applied to phase-lock-loop (PLL) data conditioner U302, which squares the shape of the incoming code word. The output of the data conditioner is routed, via level shifter Q303, to the input of the decoder IC U301-11.

The decoder circuit consists of IC U301, a 50 kHz clock (Y301 & Q304), and the information stored in the code plug (J301). When the proper code has been detected, the decoder provides a logic high at U301-7. That high provides a logic low, via audio enable Q305, to enable the PL INDICATOR output switch (Q306).

The logic high at U301-7 is also applied to sensitivity switch U304C, to disable the constant current source of U304D-U304E. With the constant current source disabled, the voltage at U302-8 is lowered, causing the sensitivity of U302 to increase. This provides additional immunity to audio interference and improved squaring of the incoming code word.

When the incoming (received) signal ceases, the sending transmitter produces a turn-off code. When the turn-off code is detected by the decoder, the detected output at U301-7 switches low. This decreases the sensitivity of the data conditioner and causes receiver audio to be muted.

2.6.2 DPL Decoder Circuit Description

NOTE

The decoder IC U301 generates a high (PL INDICATOR) output on the collector of Q206 when a proper DPL code is detected.

2.6.2.1 LOW PASS FILTER

The low pass filter circuit is similar to the one previously described for the PL decoder circuit in this section. However, the filter's output is fed through a PLL data conditioner (U302) for waveshaping, and a level shifter (Q303) to properly process the incoming code word, before presenting it to the decoder (U301) circuitry.

2.6.2.2 DECODER AND CODE PLUG

The processed code word is applied to the decoder's data input (U301-11), where it is compared to the data stored in the code plug (J301), at a 50 kHz rate. If the incoming code word is correct, U301 will provide a logic high at the decoder's detected output U301-7.

NOTE

If no proper code word is detected, the output of U301-7 stays low.

2.6.2.3 AUDIO ENABLE

When a high output is present at U301-7 (indicating a proper DPL code detection), it is inverted by Q305 to enable Q306. Output switch Q306 then produces a true logic level (logic high) at its collector (PL INDICATOR).

2.6.2.4 REGULATOR CIRCUIT

Regulator Q307 provides three regulated dc voltages from station A+ (13.9 V). These voltages, in addition to A+, power all circuitry in the DPL decoder section of the module. The regulated voltages are:

10.5 V (C+), 6.2 V (D+), and 11.1 V (E+).

2.7 AND-OR SQUELCH LOGIC CIRCUITRY

The squelch logic circuitry performs the necessary switching functions to provide proper squelch operation. This circuitry can operate in one of three different modes by selecting proper jumper cuts. Refer to the jumper table on the schematic diagram. First, for noise activated squelch operation only, JU102 is cut. In this mode, Q107 is always turned on. Squelching is controlled by the squelch noise circuit, through Q104. For coded (PL or DPL) squelch activation, both JU101 and JU102 remain in. In this mode, squelch turn-on is controlled by a proper coded squelch detection only. A proper coded squelch detection pulls the PL INDICATOR line high, turning on Q105 and Q107. Second, when PL DISABLED in this configuration, Q107 is turned on. This allows either a proper coded squelch detection *or* a noise activated squlech detection to open the squelch. This provides the OR squelch function.

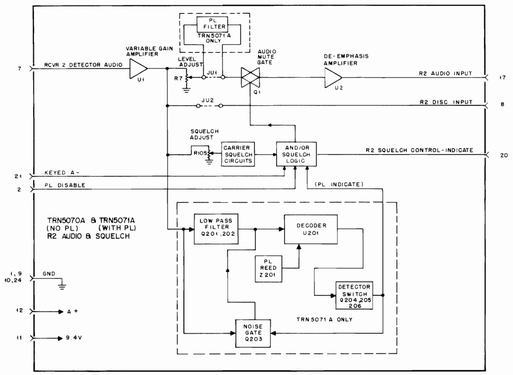
In the third mode of operation, JU101 is cut and JU102 remains in. This produces the AND squelch function.

AND squelch means that both a proper coded squelch detection and a noise activated squelch detection are required to open squelch. A proper coded squelch detection turns on Q107 and a noise activated squelch detection turns on Q104. Both are required to open squelch. When PL DISABLED in this configuration both Q106 and Q107 are turned on. Again, this provides the OR squelch function, where either a proper coded squelch detection *or* a noise activated squelch detection will open squelch.

With Q107 on, and either Q104 or Q105 on, Q108 and Q109 are turned off. This enables audio mute gate Q1, creating an open squelch condition.

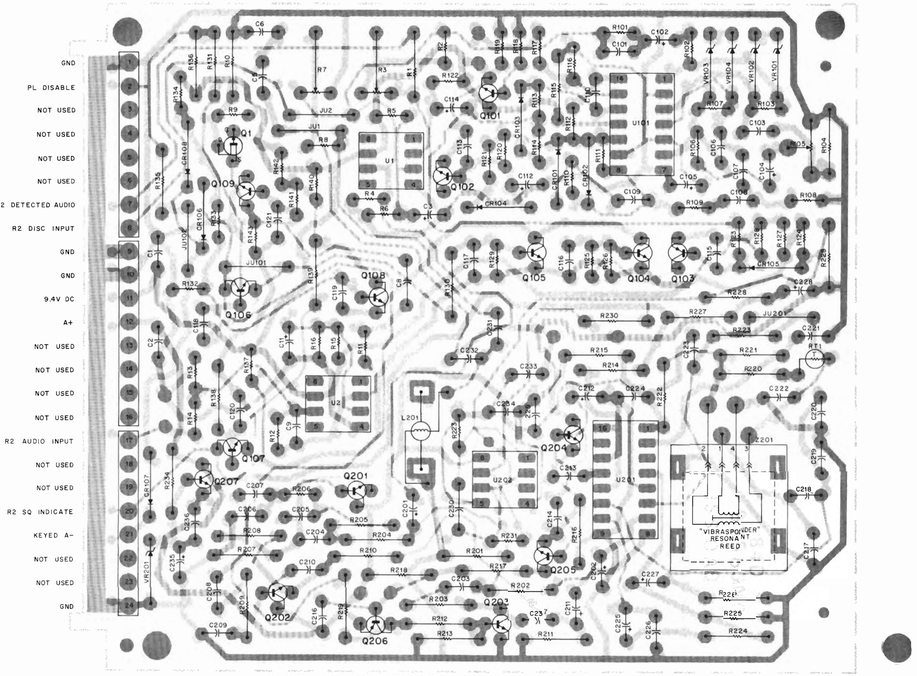
R2 AUDIO & SQUELCH MODULES

MODELS TRN5070A (CARRIER ONLY),
71A (WITH PL)



CEPS-34837-O

Functional Block Diagram, Circuit Board Detail, and Parts List
Motorola No. PEPS-34957-C
(Sheet 1 of 2)
11/1/85-UP



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SOLDER SIDE BD-DEPS-34534-O
COMPONET SIDE BD-DEPS-34535-O
OL-DEPS-34536-A

parts list

legend

reference symbol suffix	application
no suffix	all models
A	TRN5070A
B	TRN5071A

This parts list covers 2 models of the R2 Audio and Squelch Modules. Where differences exist, a letter code is added to the reference symbol to indicate the applicable unit.

TRN5070A R2 Audio and Squelch
TRN5071A R2 Audio and Squelch with PL Module PL-7952-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ± 5%; 50 V; unless otherwise stated
C1, 2	21-11015B05	220 pF ±20%; 100 V
C3	23-11019A27	22 ±20%; 25 V
C4	—	NOT USED
C5	8-11017A17	0.1
C6	—	NOTE 2
C7	—	NOT USED
C8	8-84631L36	.082; 100 V
C9	8-11017A18	.0039
C10	—	NOTE 1
C11	23-11019A27	22 ±20%; 25 V
C12 thru 100	—	NOT USED
C101	8-11017B02	.0015 ±10%
C102	23-11019A09	1 ±20%
C103	8-11017B06	.0047
C104	23-11019A09	1 ±20%
C105	23-11019A20	10 ±20%; 25 V
C106	21-11014B47	82 pF; 100 V
C107	8-11017B06	.0047 ±10%
C108	8-11017B08	.01 ±10%
C109	21-11015B05	220 pF ±10%; 100 V
C110	8-11017A13	.033
C112	23-11019A09	1 ±20%
C113	21-11015B05	220 pF ±10%; 100 V
C114	23-11019A11	2.2 ±20%
C115 thru 121	21-11015B05	220 pF ±10%; 100 V
C122 thru 200	—	NOT USED
C201, 202 (B)	23-11019A20	10 ±20%; 25 V
C203 (B)	8-11017B01	.001 ±10%
C204, 205 (B)	8-11017B08	.01
C206 (B)	8-11017B02	.0015 ±10%
C207 (B)	21-11015B05	220 pF ±10%; 100 V
C208 (B)	8-11017B16	.068
C209 (B)	8-11017B09	.015
C210 (B)	21-11015B05	220 pF ±10%; 100 V
C211 (B)	23-11019A20	10 ±20%; 25 V
C212 (B)	23-11019A09	1 ±20%
C213, 214 (B)	21-11015B05	220 pF ±10%; 100 V
C215 (B)	8-11017B01	.001 ±10%
C216 (B)	21-11015B05	220 pF ±10%; 100 V
C217 (B)	8-11017A17	0.1
C218 (B)	23-11019A20	10 ±20%; 25 V
C219 (B)	21-11015B05	220 pF ±10%; 100 V
C220, 221 (B)	8-11017B06	.0047 ±10%
C222, 223, 224 (B)	21-11015B05	220 pF ±10%; 100 V
C225 (B)	23-11019A09	1 ±20%
C226	8-11017B06	.0047 ±10%
C227	23-11019A20	10 ±20%; 25 V
C228 (B)	23-11019A46	100 ±20%; 25 V
C229 (B)	8-11017B01	.001 ±10%
C230 (B)	8-84631L36	.082 ± 10%; 250 V
C231 (B)	8-11017A14	.047
C232 (B)	8-11017A11	.022
C233 (B)	8-11017A17	0.1
C234 (B)	21-11015B05	220 pF ±10%; 100 V
C235 (B)	23-11019A20	10 ±20%; 25 V
C236 (B)	21-11015B05	220 pF ±10%; 100 V
C237 (B)	8-11017B08	.01
		diode: (see note 3)
CR101 thru 108	48-83654H01	silicon
		jumper:
JU1 (A)	42-11060A01	0 ohms
JU2	42-11060A01	0 ohms
JU3 thru 100	—	NOT USED
JU101, 102	42-11060A01	0 ohms
JU103 thru 200	—	NOT USED
JU201 (B)	42-11060A01	0 ohms
		coil, rf, choke: 6 H
L201 (B)	24-84003A03	
		transistor: (see note 3)
Q1	48-869660	FET, p-channel; type M9660
Q2 thru 100	—	NOT USED
Q101, 102	48-869642	NPN; type M9642
Q103	48-869643	PNP; type M9643
Q104 thru 108	48-869642	NPN; type M9642
Q109	48-869648	NPN; type M9648
Q110 thru 200	—	NOT USED
Q201, 202 (B)	48-134674	NPN; type M54
Q203, 204, 205 (B)	48-869642	NPN; type M9642
Q206 (B)	48-869467	PNP; type M9467
Q207 (B)	48-869642	NPN; type M9642
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R1	6-11009A89	47k
R2	6-11009E89	47k
R3	18-82374N02	variable; 100k
R4	6-11009E61	3.3k
R5, 6	6-11009E97	100k
R7	18-82374N01	variable; 25k
R8, 9	6-11009E73	10k
R10	6-11009A97	100k
R11	6-11009E69	6.8k
R12	6-11009F14	470k
R13	6-11009E61	3.3k
R14	6-11009E49	1k
R15, 16	6-11009E97	100k
R17 thru 100	—	NOT USED
R101	6-11009E83	27k
R102	6-11009E73	10k
R103	6-11009E99	120k
R104	6-11009A65	4.7k
R105	18-83083G16	variable; 25k
R106	6-11009E75	12k
R107	6-11009E97	100k
R108	6-11009E41	470
R109	6-11009E53	1.5k
R110	6-11009E91	56k
R111	6-11009F06	220k
R112	6-11009E73	10k
R113	6-11009F02	150k
R114	6-11009E75	12k
R115	6-11009A61	3.3k
R116, 117	6-11009E53	220
R118	6-11009E61	3.3k
R119	6-11009E45	680
R120	6-11009F02	150k
R121	6-11009E69	6.8k
R122	6-11009E73	10k
R123	6-11009F06	220k
R124	6-11009F20	820k
R125	6-11009E77	15k
R126	6-11009E73	10k
R127	6-11009E53	1.5k
R128	6-11009E59	2.7k
R129	6-11009E65	4.7k
R130	6-11009A73	10k
R131	6-11009B04	180k
R132	6-11009E61	3.3k
R133, 134	6-11009E73	10k
R135	6-11009A53	1.5k
R136	6-11009A73	10k
R137	6-11009E73	10k
R138	6-11009A65	4.7k
R139	6-11009A73	10k
R140	6-11009E73	10k
R141	6-11009E77	15k
R142	6-11009E85	33k
R143	6-11009E91	56k
R144 thru 200	—	NOT USED
R201, 202 (B)	6-11009B02	150k
R203 (B)	6-11009A93	3.9k
R204 (B)	6-11009A99	120k
R205 (B)	6-11009A97	100k
R206 (B)	6-11009E97	100k
R207 (B)	6-11009A89	47k
R208 (B)	6-11009A97	100k
R209 (B)	6-11009A78	16k
R210 (B)	6-11009A68	6.2k
R211 (B)	6-11009A65	4.7k
R212 (B)	6-11009A81	22k
R123 (B)	6-11009A57	2.2k
R214 (B)	6-11009A97	100k
R215 (B)	6-11009A61	3.3k
R216 (B)	6-11009A49	1k
R217 (B)	6-11009A67	5.6k
R218 (B)	6-11009A73	10k
R219 (B)	6-11009A53	1.5k
R220 (B)	6-11009A46	750
R221 (B)	6-11009A41	470
R222 (B)	6-11009A81	22k
R223 (B)	6-11009A33	220
R224 (B)	6-11009A57	2.2k
R225 (B)	6-11009A53	1.5k
R226 (B)	6-11009A57	2.2k
R227 (B)	6-11009A69	6.8k
R228, 229 (B)	6-10621C91	10k ± 1%; 1/8 W
R230, 231 (B)	6-10621C79	7.5k ± 1%; 1/8 W
R232 (B)	6-10621D18	18.7k ± 1%; 1/8 W
R233	—	NOT USED
R234 (B)	6-11009A37	330
		thermistor:
RT201 (B)	6-83241P01	300 @ 25°C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note 3)
U1, 2	51-80067C02	single op-amplifier
U3 thru 100	—	NOT USED
U101	51-83629M06	op-amplifier
U102 thru 200	—	NOT USED
U201 (B)	51-80074C02	tone, decoder/oscillator
U202 (B)	51-82609M33	dual op-amplifier
		voltage regulator: (see note 3)
VR101 thru 104	48-82256C33	Zener type; 2.6 V
VR105 thru 200	—	NOT USED
VR201 (B)	48-82256C38	Zener type; 9.1 V
		***Vibraponder*/Resonant Reed**
Z201	KLN6209A	resonant frequency as required
		mechanical parts
	3-84256M01	SCREW, tapping; 4-10 x 5/16", 2 used
	5-84220B01	GROMMET, 2 used
	9-83497F01	RECEPTACLE, female; 8-contact; 3 used (circuit board edge connector)
	9-84910C01	SOCKET, reed (TRN5071A)
	64-83858N02	PANEL, screened

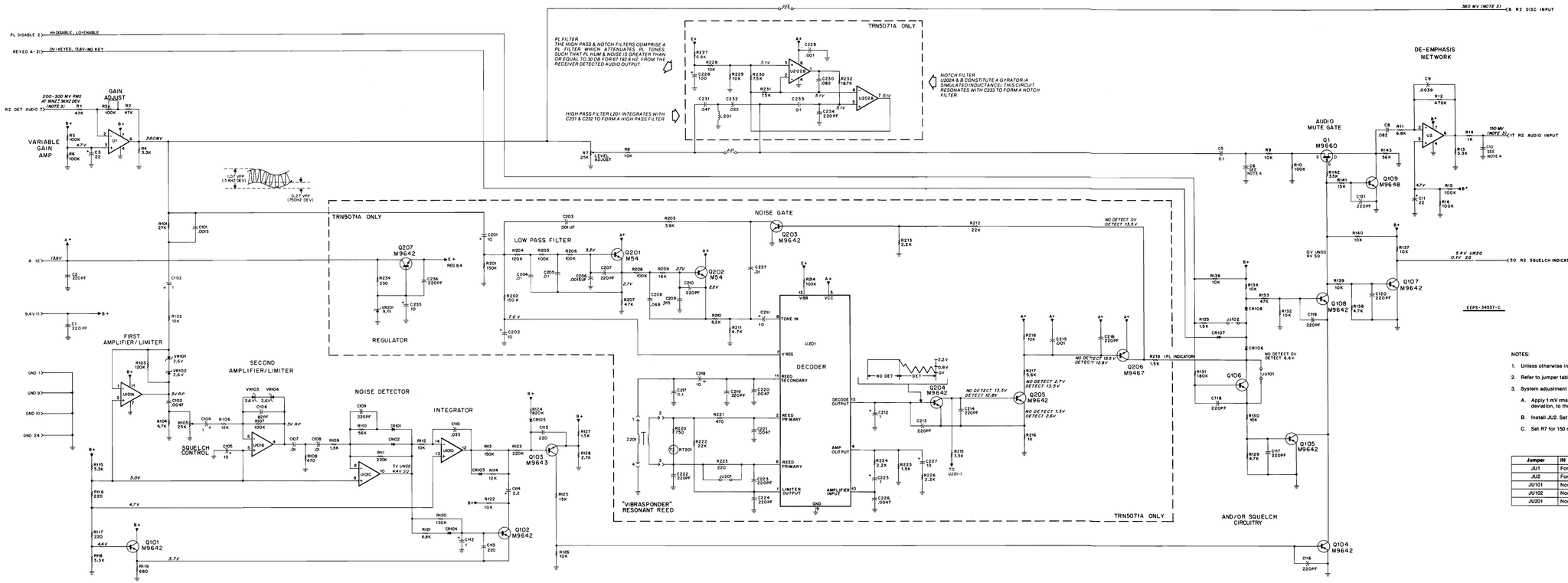
notes:
1. Use 8-11017A13 .033 µF ± 5%; 50 V for R2 audio & squelch. 2. Use 8-11017B01 .001 µF ± 10%; 50 V for R2 audio & squelch and use 8-11017A18 .0039 µF ± 5%; 50 V for R2 "PL".
3. For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

revisions

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
	C111	OMITTED 21-11015B05 200 pF	

R2 AUDIO & SQUELCH MODULES

MODELS TRN5070A (CARRIER ONLY), 71A (WITH PL)



NOTES:

1. Unless otherwise indicated, resistors in ohms, capacitors in microfarads.
2. Refer to jumper table for usage.
3. System adjustment procedure:
   - A. Apply 1 mV rms of received frequency, modulated with a 1 kHz tone ± 3 kHz deviation, to the receiver 2 RF input.
   - B. Install JU2. Set R4 for 380 mV rms at pin 8-R2 disc input. Remove JU2.
   - C. Set R7 for 150 mV rms at pin 17-R2 audio input.

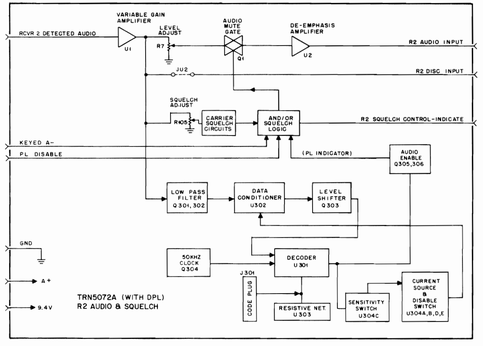
Jumper Table

Jumper	IN	OUT
JU1	For Carrier Squelch	For PL Squelch
JU2	For Factory Test	Normally
JU1101	Normally	For PL "AND" Squelch
JU102	Normally	For Carrier Squelch
JU201	Normally	When using 67 Hz Reed

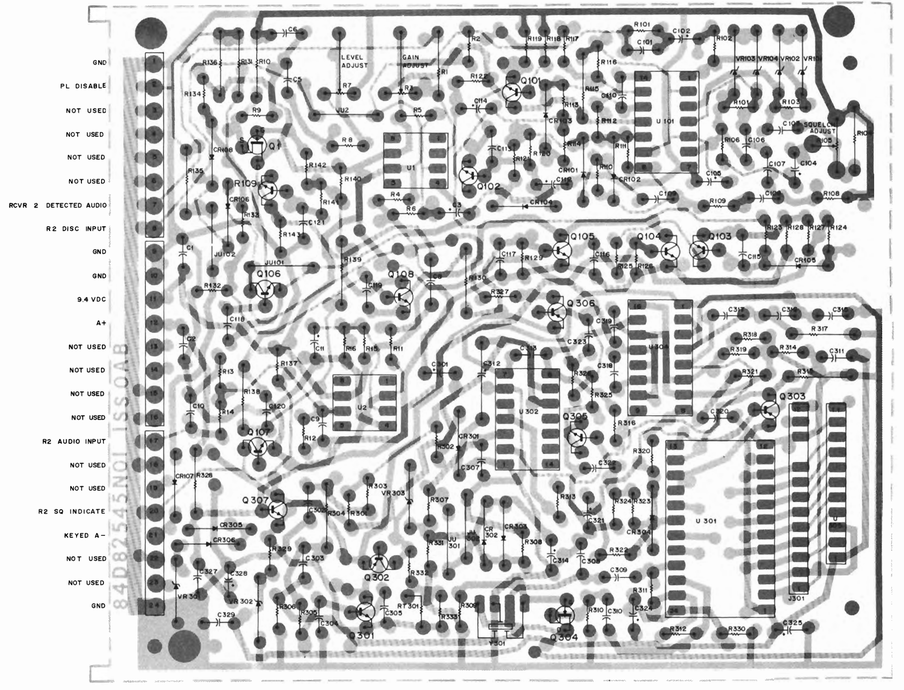
Schematic Diagram
Motorola No. PEPS-34957-C
(Sheet 2 of 2)
11/1/85- UP

R2 AUDIO & SQUELCH MODULE

MODEL TRN5072A (WITH DPL)



CEPS-34838-O



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COMPONENT SIDE © 8D-DEPS-34539-O
SOLDER SIDE © 8D-DEPS-34538-O
OL-DEPS-34540-A

Block Diagram, Circuit Board Detail, and Parts List
Motorola No. PEPS-34958-C
(Sheet 1 of 2)
11/1/85-UP

parts list

TRN5072A R2 Audio and Squelch with DPL Module PL-7953-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ±5%; 50 V: unless otherwise stated
C1, 2	21-11015B05	220 pF ±20%, 100 V
C3	23-11019A27	22 ±20%; 25 V
C4	—	NOT USED
C5	8-11017A17	0.1
C6	8-11017B01	.001
C7	—	NOT USED
C8	8-84637L36	.082; 100 V
C9	8-11017A18	.0039
C10	8-11017A13	.033
C11	23-11019A27	22 ±20%; 25 V
C12 thru 100	—	NOT USED
C101	8-11017B02	.0015 ±10%
C102	23-11019A09	1 ±20%
C103	8-11017B06	.0047
C104	23-11019A09	1 ±20%
C105	23-11019A20	10 ±20%; 25 V
C106	21-11014B47	82 pF; 100 V
C107	8-11017B06	.0047 ±10%
C108	8-11017B08	.01 ±10%
C109	21-11015B05	220 pF ±10%; 100 V
C110	8-11017A13	.033
C112	23-11019A09	1 ±20%
C113	21-11015B05	220 pF ±10%; 100 V
C114	23-11019A11	2.2 ±20%
C115 thru 121	21-11015B05	220 pF ±10%; 100 V
C122 thru 300	—	NOT USED
C301	23-84612M20	47 ±10%; 25 V
C302	8-11017A11	.022
C303	8-11017A16	.068
C304	8-11017A18	.0039
C305	21-11015B05	220 pF ±10%; 100 V
C306	—	NOT USED
C307	21-11015B05	220 pF ±10%; 100 V
C308	21-11022A55	100 pF
C309	21-11022A37	20 pF
C310	21-11021A21	.0047 ±10%
C311	21-11015B05	220 pF ±10%; 100 V
C312	23-82783B48	0.68; 35 V
C313	21-11015B13	.001 ±10%; 100 V
C314	23-84612M18	10 ±10%; 25 V
C315	21-11015B13	.001 ±10%; 100 V
C316 thru 320	21-11015B05	220 pF ±10%; 100 V
C321, 322	23-84612M17	6.8 ±10%; 25 V
C323	21-11015B05	220 pF ±10%; 100 V
C324, 325	23-11019A16	4.7 ±20%; 35 V
C326	—	NOT USED
C327	21-11021F04	.01 ±20%
C328	23-84612M19	15 ±10%; 25 V
C329	21-11021F04	.01 ±20%
		diode: (see note)
CR101 thru 108	48-83654H01	silicon
CR109 thru 300	—	NOT USED
CR301	48-83654H02	silicon
CR302, 303	48-84616A01	hot carrier
CR304, 305, 306	48-83654H01	silicon
		connector, receptacle:
J301	9-82071K01	female; 12-contact (DPL plug)
		jumper:
JU2	42-11060A01	0 ohms
JU3 thru 100	—	NOT USED
JU101, 102	42-11060A01	0 ohms
JU103 thru 300	—	NOT USED
JU301, 302	42-11060A01	0 ohms
		transistor: (see note)
Q1	48-869660	FET, p-channel; type M9660
Q2 thru 100	—	NOT USED
Q101, 102	48-869642	NPN; type M9642
Q103	48-869643	PNP; type M9643
Q104 thru 108	48-869642	NPN; type M9642
Q109	48-8869648	NPN; type M9648
Q110 thru 300	—	NOT USED
Q301	48-869642	NPN; type M9642
Q302, 303	48-869643	PNP; type M9643
Q304	48-869653	FET, N-channel; type M9653
Q305	48-869642	NPN; type M9642
Q306	48-869643	PNP; type M9643
Q307	48-869648	NPN; type M9648
		resistor, fixed: ±5%; 1/4 W: unless otherwise stated
R1, 2	6-11009E89	47k
R3	18-82374N02	variable; 100k
R4	6-11009E61	3.3k
R5, 6	6-11009E97	100k
R7	18-82374N01	variable; 25k
R8, 9	6-11009E73	10k
R10	6-11009A97	100k
R11	6-11009E69	6.8k
R12	6-11009F14	470k
R13	6-11009E61	3.3k
R14	6-11009E49	1k
R15, 16	6-11009E97	100k
R17 thru 100	—	NOT USED
R101	6-11009E83	27k
R102	6-11009E73	10k
R103	6-11009E99	120k
R104	6-11009A65	4.7k
R105	18-83083G16	variable; 25k
R106	6-11009E75	12k
R107	6-11009E97	100k
R108	6-11009E41	470
R109	6-11009E53	1.5k
R110	6-11009E91	56k
R111	6-11009F06	220k
R112	6-11009E73	10k
R113	6-11009F02	150k
R114	6-11009E75	12k
R115	6-11009A61	3.3k
R116, 117	6-11009E33	220
R118	6-11009E61	3.3k
R119	6-11009E45	680
R120	6-11009F02	150k
R121	6-11009E69	6.8k
R122	6-11009E73	10k
R123	6-11009F06	220k
R124	6-11009F20	820k
R125	6-11009E77	15k
R126	6-11009E73	10k
R127	6-11009E53	1.5k
R128	6-11009E59	2.7k
R129	6-11009E65	4.7k
R130	6-11009A73	10k
R131	6-11009B04	180k
R132	6-11009E61	3.3k
R133, 134	6-11009E73	10k
R135	6-11009A53	1.5k
R136	6-11009A73	10k
R137	6-11009E73	10k
R138	6-11009A65	4.7k
R139	6-11009A73	10k
R140	6-11009E73	10k
R141	6-11009E77	15k
R142	6-11009E85	33k
R143	6-11009E91	56k
R144 thru 300	—	NOT USED
R301	6-11009E99	120k
R302	6-11009E83	68k
R303, 304, 305	6-10621D64	56.2k ±1%; 1/8 W
R306	6-11009E53	1.5k
R307, 308	6-11009E73	10k
R309	6-11009F08	270k
R310	6-11009E77	15k
R311	6-11009F14	470k
R312	6-11009F04	180k
R313	6-11009E59	2.7k
R314	6-11009E73	10k
R315	6-11009A83	27k
R316	6-11009E89	47k
R317	6-11009A73	10k
R318	6-11009E95	82k
R319	6-11009F14	470k
R320	6-11009E99	120k
R321, 322	6-11009E91	56k
R323	6-11009E99	120k
R324	6-11009E95	82k
R325, 326	6-11009E89	47k
R327	6-11009E53	1.5k
R328	6-11009A33	220
R329	6-11009E33	220
R330	6-11009E97	100k
R331	6-11009E43	560
R332	6-11009E49	1k
R333	6-11009E45	680
		thermistor:
RT301	6-83241P01	300 @25°C
		integrated circuit: (see note)
U1, 2	51-80067C02	single op-amp/filter
U3 thru 100	—	NOT USED
U101	51-83629M06	op-amp/filter
U102 thru 300	—	NOT USED
U301	51-80074C01	encoder/decoder
U302	51-83629M01	phase lock loop
U303	51-82142N02	resistor network
U304	51-83629M10	transistor array
		voltage regulator:
VR101 thru 104	48-82256C33	Zener type; 2.6 V
VR105 thru 300	—	NOT USED
VR301	48-82256C11	Zener type; 10 V
VR302	48-83696E07	Zener type; 6.2 V
VR303	48-82256C03	Zener type; 4.7 V
		crystal: (see note)
Y301	48-82003K01	50 kHz
		mechanical parts
	3-84256M01	SCREW, tapping; 4-10 × 5/16"; 2 used
	5-84220B01	GROMMET, 2 used

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	9-82071K01	PLUG, socket
	9-83497P01	RECEPTACLE, female; 8-contact; 3 used (circuit board edge connector)
	64-83858N03	PANEL, screened

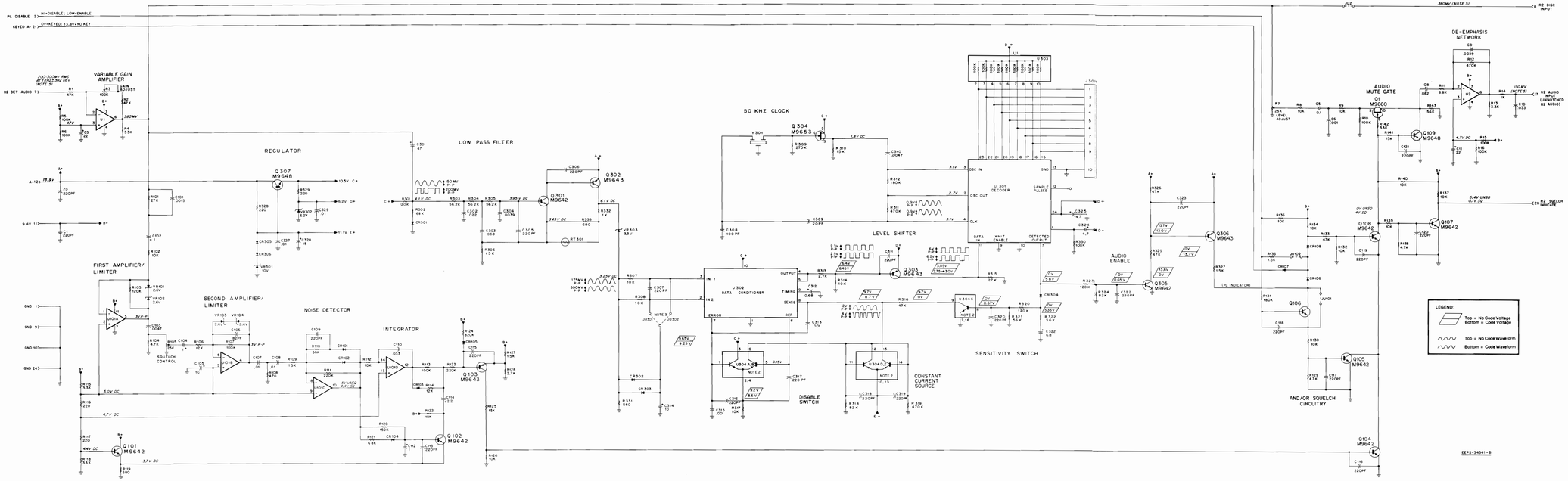
note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

revisions

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
	C111	OMITTED 21-11015B05; 200 pF ±10%; 100 V	

R2 AUDIO & SQUELCH MODULE

MODEL TRN5072A (WITH DPL)



Jumper Table

Jumper	IN	OUT
JU2	For Factory Test	Normally
JU101	Normally	For PL "AND" Squelch
JU102	Normally	For Carrier Squelch
JU301	Note 3	Note 3
JU302	Note 3	Note 3

NOTES

1. Unless otherwise indicated, resistors in ohms, capacitors in microfarads.
2. Transistors U3A-E are part of a single I.C.
3. JU301 and JU302 determine code polarity. JU301 is used in UHF and VHF applications (low side injection). JU302 is used in low band applications (high side injection).
4. Refer to jumper table for usage.
5. System adjustment procedure:
   A. Apply 1 mV rms of received frequency, modulated with a 1 kHz tone ± 3 kHz deviation, to receiver 2 RF input.
   B. Install JU2. Set R4 for 380 mV rms at pin 8-R2 disc input. Remove JU2.
   C. Set R7 for 150 mV rms at pin 17-R2 audio input.

Schematic Diagram
Motorola No. PEPS-34958-C
(Sheet 2 of 2)
11/1/85- UP

MOTOROLA INC.
Communications
Sector

TONE *PRIVATE-LINE* ENCODER-DECODER MODULE

MODELS TRN5073A, 74A, 75A

Model Table

Model	Description
TRN5073A	Duplex (TARB)
TRN5074A	Simplex (TARA)
TRN5075A	Simplex (TARB)

1. DESCRIPTION

The TRN5073A/74A/75A Tone *Private-Line* (PL) Encoder-Decoder Modules are plug-in modules designed for use with Motorola base and repeater stations. All components and circuitry are mounted on a sturdy circuit card with connecting terminals that mate with the backplane interconnect board of the station's rf control chassis. These modules are used with the following types of stations: Simplex TARA and TARB and Duplex TARB.

NOTE

TARA means that the PL encoder-decoder module employs the same PL code (one reed used) for transmit and receive. TARB means that the PL encoder-decoder module employs a different PL code for transmit and receive (two reeds used).

2. FUNCTIONS

Each of these modules encodes and decodes *Private-Line* tones. The encoder modulates the transmitter and delays transmitter turn-off 180 ms to allow transmission of a turn-off reverse tone burst. The decoder detects a received PL tone and unsquelches the receiver when the proper PL tone is received. In addition, PL tone filtering is provided so that the PL tone is not heard in normal received audio.

3. FUNCTIONAL OPERATION

Refer to the functional block and schematic diagrams attached to this instruction section.

3.1 SIMPLEX TARA AND TARB PL MODULES

The TARA PL module incorporates one integrated circuit (U1) and one resonant reed (Z1) for both encoding and decoding purposes. Similarly, the TARB PL module also incorporates one integrated circuit (U1), but uses two resonant reeds (Z1 and Z2) which allows the user to receive on one PL code and transmit on a different PL code. Other than these differences both modules function identically.

In the decode (receive) mode, received audio enters the PL module at the R1 DISC INPUT (pin 17), and is routed through an active low pass filter (Q1 and Q2) before being applied to the input of the tone decoder-encoder IC U1-8. When the proper PL tone is decoded, U1 produces a square wave at the decode output (pin 13) of U1, unloaded. The square wave is detected by detector switch circuitry (Q4 and Q5), which then enables PL INDICATOR output switch (Q6).

In the encode (transmit) mode, U1 (or U101) drives the PL reed primary. The code output at U1-3, which is sinusodial is sampled by AGC circuitry which controls the amount of drive to the primary of the PL reed. By controlling the drive amount to the PL reed, a constant output voltage is present at PL CODE OUT, pin 21.

At the end of a transmission, the loss of KEYED A+ triggers delayed keyed A+ timing circuit U2. U2 now provides delayed keyed A+ for 180 ms, and enables the phase shifter network so that a reverse burst (a phase shifted version of the PL tone) can be transmitted. Reverse burst causes the on-channel PL receivers to squelch rapidly.

PL filter circuitry is utilized to remove (attenuate) PL tones from the received audio. The received audio is filtered, first by a high pass filter, and then by a notch filter. Gyrator circuits are used to provide high "Q" inductance, without employing inductors.

3.2 DUPLEX T_AR_B PL MODULE

This module is essentially the same as the simplex versions, except that it permits the user to decode (receive) and encode (transmit) simultaneously. In addition, the encode and decode codes may be different. This is accomplished by using two PL reeds, and two integrated circuits U1 and U101. In this configuration, one reed and one IC are dedicated for decoding purposes, while the other reed and IC are dedicated for encoding purposes.

4. DECODER CIRCUIT DESCRIPTION

NOTE
The decoder portion of IC U1 generates a high at the PL INDICATOR output (pin 5) when a proper PL tone is detected.

4.1 LOW PASS FILTER

The 5-pole low pass filter attenuates high frequency noise above 192.8 Hz from the audio spectrum. This provides the balance of the decoder circuitry additional falsing and blocking immunity.

4.2 DECODER AND REED

The filtered PL tone is applied to the decoder tone input (U1-8) where it is amplified and limited. The PL tone is then fed to the decoding reed (Z1 for T_AR_A and Z2 for T_AR_B on Duplex applications), pins 2 and 3. If the PL tone is of the proper frequency, it will cause the reed to resonate. The reed secondary (pins 1 and 4) reacts to the sympathetic vibration and returns the PL tone to the decoder reed secondary input U1-11. The decoder now amplifies and limits the PL tone again, and provides an output at U1-13, Decode Output.

NOTE
If no PL tone is detected, the output of U1-13 is high.

4.3 DETECTOR SWITCH

When an output is present (indicating a proper PL tone detection) at the decode output of U1 (pin 13), it is waveshaped by capacitor C14 into a sawtooth waveform at a level of approximately 0.8 V p-p. If a high (no detect) is present at U1-13, the level of this same waveform is constant, approximately 2.2 V. The balance of the detector switch circuitry inverts, filters, and amplifies the sawtooth waveform (or high) to produce a true logic level at the PL INDICATOR output at pin 5 of the PL module.

4.4 NOISE GATE

Noise Gate Q3, allows a small amount of high frequency noise (with 1-pole of low pass filtering) to be fed to the decoder input, U1-8 when the PL INDICATOR output at pin 5 of the PL module is low. This tends to minimize noise falsing of the decoder. When the PL INDICATOR output is high, the high frequency noise sample is shunted to ground. This allows the PL module to be more sensitive once it receives a signal, and helps to prevent decoder dropout during brief signal fades.

5. ENCODER CIRCUIT DESCRIPTION

NOTE
The encoder portion of U1 (for T_AR_A or T_AR_B applications) or U101 (for Duplex applications), generates a PL tone of the same frequency as that of the resonant PL reed, and produces a PL CODE output at pin 21 of the PL module.

5.1 PL ENCODE SWITCH

The PL Encode Switch (Q8) is normally on unless one of the following conditions exist:

- Keyed A+ (pin 13) or Delayed Keyed A+ (pin 7) is low,
- PL Tone Inhibit (pin 14) is low.

When Q8 is on, the collector of Q9 is high (8.4 V).

5.2 ENCODER AND REED

When the PL Encode Switch is on, U1-16 (Encode Enable) and U1-14 goes high enabling the encoder, which in turn drives encode reed Z1. Encode reed Z1 now vibrates at its own resonant frequency, and U1 then produces a sine wave of the proper frequency at its output (Code Out), U1-3. The code output is fed back to Z1, via Q7 (which controls the drive to Z1) providing an automatic gain control which keeps the encoder output constant.

5.3 DELAYED KEYED A+ TIMING CIRCUIT

When keyed A+ (module pin 13) goes low after being high, U2-3 goes high for 180 ms. The high output of U2-3 causes pin 7 of the PL module to be high for the same time period, producing delayed keyed A+. When keyed A+ goes low, U2-6, 7 (which were low) go high at a rate determined by the RC time constant of R31 and C33.

When the voltage at U2-6, 7 is at the same level as the voltage at U2-5, delayed keyed A + ceases.

5.4 AMPLIFIER AND REVERSE BURST PHASE SHIFTER

When keyed A + is high, Q11 and Q12 are off. The Q13 amplifier circuitry amplifies the PL code output from U1-3 (or U101-3) of the encoder. When keyed A + goes low, delayed keyed A + goes high and turns on Q11 and Q12 which then change the phase of the PL code output (at pin 21 of the module) approximately 240° resulting in an amplified PL reverse burst.

5.5 8.4 V REGULATOR

This circuit provides a constant 8.4 V dc to various points in the PL encode switch circuitry.

5.6 PL FILTER

The PL filter provides PL tone filtering of receiver detected audio. The filter consists of a 3-pole high pass filter and a 1-pole notch filter. The PL filter incorporates capacitors and gyrator (an active, high "Q" inductance) circuits to provide attenuation of PL frequencies from 67 to 192.8 Hz.

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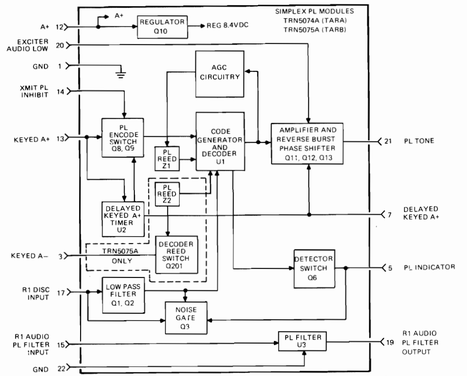
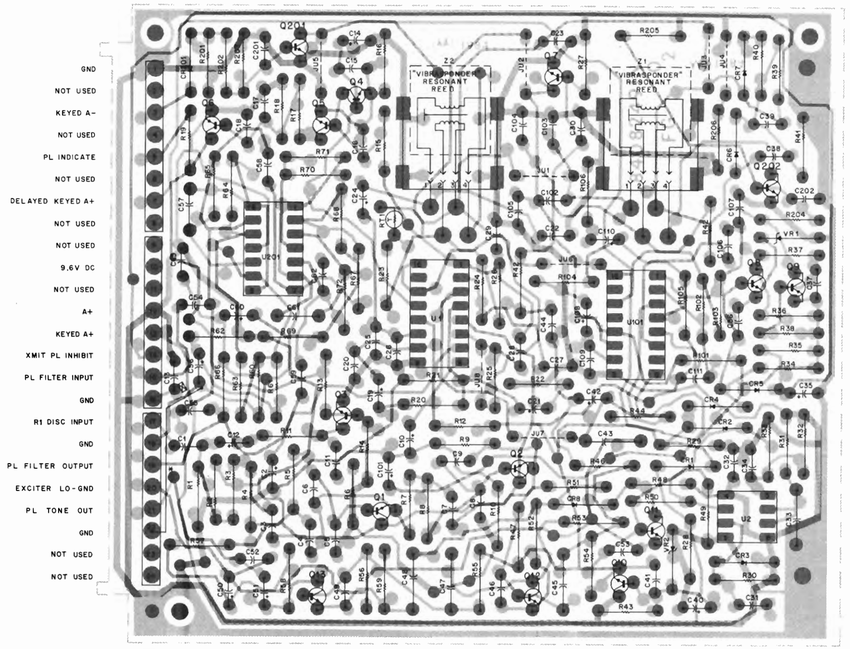
TONE *PRIVATE-LINE* ENCODER-DECODER MODULES

MODELS TRN5073A, 74A, 75A



Functional Block Diagrams, Circuit Board Detail and Parts List
Motorola No. ***PEPS-34857-B***
(Sheet 1 of 2)
11/1/85- UP



SHOWN FROM SOLDER SIDE

parts list

legend

reference symbol suffix	application
no suffix	all models
A	TRN5073A
B	TRN5074A
C	TRN5075A

This parts list covers 3 models of the PL Encoder-Decoder Modules. Where differences exist, a letter code is added to the reference symbol to indicate the applicable unit.

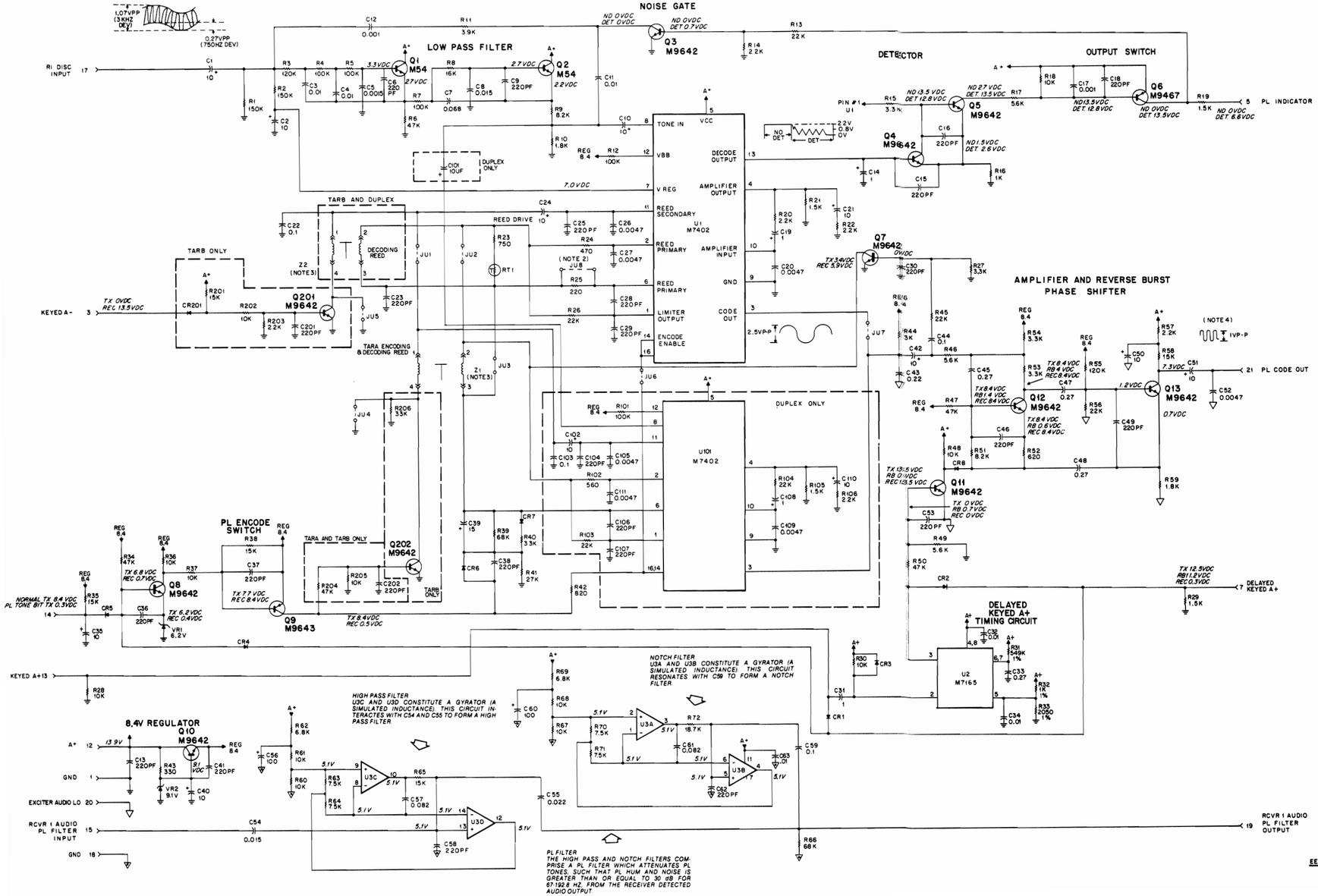
TRN5073A PL Encoder-Decoder (Duplex TARB) Module
TRN5074A PL Encoder-Decoder (Simplex TARA) Module
TRN5075A PL Encoder-Decoder (Simplex TARB) Module PL-7974-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ±10%; 50 V: unless otherwise stated
C1, 2	23-11019A20	10 ±20%; 25 V
C3, 4	8-11017B08	.01
C5	8-11017B02	.0015
C6	21-11015B05	220 pF; 100 V
C7	8-11017B16	.068
C8	8-11017B09	.015
C9	21-11015B05	220 pF; 100 V
C10	23-11019A20	10 ±20%; 25 V
C11	8-11017B08	.01
C12	8-11017B01	.001
C13	21-11015B05	220 pF; 100 V
C14	23-84612M09	1
C15, 16	21-11015B05	220 pF; 100 V
C17	8-11017B01	.001
C18	21-11015B05	220 pF; 100 V
C19	23-11019A09	1
C20	8-11017B06	.0047
C21	23-11019A20	10 ±20%; 25 V
C22	8-11017B17	0.1
C23	21-11015B05	220 pF; 100 V
C24	23-11019A20	10 ±20%; 25 V
C25	21-11015B05	220 pF; 100 V
C26, 27	8-11017B06	.0047
C28, 29, 30	21-11015B05	220 pF; 100 V
C31	23-11019A09	1
C32	8-11017B08	.01
C33	8-84637L15	0.27 ±5%; 100 V
C34	8-11017B08	.01
C35	23-11019A20	10 ±20%; 25 V
C36, 37, 38	21-11015B05	220 pF; 100 V
C39	23-84612M19	15; 25 V
C40	23-11019A20	10 ±20%; 25 V
C41	21-11015B05	220 pF; 100 V
C42	23-11019A20	10 ±20%; 25 V
C43	8-84637L22	0.22; 100 V
C44	8-11017B17	0.1
C45	8-84637L15	0.27 ±5%; 100 V
C46	21-11015B05	220 pF; 100 V
C47, 48	8-84637L15	0.27 ±5%; 100 V
C49	21-11015B05	220 pF; 100 V
C50, 51	23-11019A20	10 ±20%; 25 V
C52	8-11017B06	.0047
C53	21-11015B05	220 pF
C54	8-11017A09	.015 ±5%
C55	8-11017A11	.022 ±5%
C56	23-11019A46	100 ±20%; 25 V
C57	8-84637L36	.082 ±5%; 100 V
C58	21-11015B05	220 pF; 100 V
C59	8-11017A17	0.1
C60	23-11019A46	100 ±20%; 25 V
C61	8-84637L36	.082 ±5%; 100 V
C62	21-11015B05	220 pF; 100 V
C63	8-11017B08	.01 uF
C64 thru 100	—	NOT USED
C101, 102 (A)	23-11019A20	10 ±20%; 25 V
C103 (A)	8-11017B17	0.1
C104 (A)	21-11015B05	220 pF; 100 V
C105 (A)	8-11017B06	.0047
C106, 107 (A)	21-11015B05	220 pF; 100 V
C108 (A)	23-11019A09	1
C109 (A)	8-11017B06	.0047
C110 (A)	23-11019A20	10 ±20%; 25 V
C111 (A)	8-11017B06	.0047
C112 thru 200	—	NOT USED
C201 (C)	21-11015B05	220 pF; 100 V
C202 (B, C)	21-11015B05	220 pF; 100 V
		diode: (see note)
CR1 thru 8	48-83654H01	silicon
CR9 thru 200	—	NOT USED
CR201 (C)	48-83654H01	silicon
		jumper:
JU1, 2 (B, C)	42-11060A01	0 ohms
JU3 (B)	42-11060A01	0 ohms
JU4 (A, B)	42-11060A01	0 ohms
JU5 (A)	42-11060A01	0 ohms
JU6, 7 (B, C)	42-11060A01	0 ohms
JU8	42-11060A01	0 ohms
		transistor: (see note)
Q1, 2	48-134674	NPN; type M54
Q3, 4, 5	48-869642	NPN; type M9642
Q6	48-869467	PNP; type M9467
Q7, 8	48-869642	NPN; type M9642
Q9	48-869643	PNP; type M9643
Q10 thru 13	48-869642	NPN; type M9642
Q14 thru 200	—	NOT USED
Q201, 202 (C)	48-869642	NPN; type M9642
		resistor, fixed: ±5%; 1/4 W: unless otherwise stated
R1, 2	6-11009B02	150k
R3	6-11009A99	120k
R4, 5	6-11009A97	100k
R6	6-11009A89	47k
R7	6-11009A97	100k
R8	6-11009A78	16k
R9	6-11009A71	8.2k
R10	6-11009A55	1.8k
R11	6-11009A63	3.9k
R12	6-11009A97	100k
R13	6-11009A81	22k
R14	6-11009A57	2.2k
R15	6-11009A61	3.3k
R16	6-11009A49	1k
R17	6-11009A67	5.6k
R18	6-11009A73	10k
R19	6-11009A53	1.5k
R20	6-11009A57	2.2k
R21	6-11009A53	1.5k
R22	6-11009A57	2.2k
R23	6-11009A46	750
R24	6-11009A41	470
R25	6-11009A33	220
R26	6-11009A81	22k
R27	6-11009A85	33k
R28	6-11009A73	10k
R29	6-11009A53	1.5k
R30	6-11009A73	10k
R31	6-10621E60	549k ±1%; 1/8 W
R32	6-10621B94	1k ±1%; 1/8 W
R33	6-10621C25	2050 ±1%; 1/8 W
R34	6-11009A89	47k
R35	6-11009A77	15k
R36, 37	6-11009A73	10k
R38	6-11009A77	15k
R39	6-11009A93	68k
R40	6-11009A61	3.3k
R41	6-11009A81	27k
R42	6-11009A47	820
R43	6-11009A37	330
R44	6-11009A60	3k
R45	6-11009A81	22k
R46	6-11009A67	5.6k
R47	6-11009A89	47k
R48	6-11009A73	10k
R49	6-11009A67	5.6k
R50	6-11009A89	47k
R51	6-11009A71	8.2k
R52	6-11009A44	620
R53, 54	6-11009A61	3.3k
R55	6-11009A99	120k
R56	6-11009A81	22k
R57	6-11009A57	2.2k
R58	6-11009A77	15k
R59	6-11009A55	1.8k
R60, 61	6-10621C91	10k ±1%; 1/8 W
R62	6-11009A69	6.8k
R63, 64	6-10621C79	7.5k ±1%; 1/8 W
R65	6-10621D09	15k ±1%; 1/8 W
R66	6-11009A93	68k
R67, 68	6-10621C91	10k ±1%; 1/8 W
R69	6-11009A69	6.8k
R70, 71	6-10621C79	7.5k ±1%; 1/8 W
R72	6-10621D18	18.7k ±1%; 1/8 W
R73 thru 100	—	NOT USED
R101 (A)	6-11009A97	100k
R102 (A)	6-11009A43	560
R103 (A)	6-11009A81	22k
R104 (A)	6-11009A57	2.2k
R105 (A)	6-11009A53	1.5k
R106 (A)	6-11009A57	2.2k
R107 thru 200	—	NOT USED
R201 (C)	6-11009A77	15k
R202 (C)	6-11009A73	10k
R203 (C)	6-11009A57	2.2k
R204 (B, C)	6-11009A89	47k
R205 (B, C)	6-11009A73	10k
R206 (C)	6-11009A85	33k
		thermistor:
RT1	6-83241P01	300 @ 25°C
		integrated circuit: (see note)
U1	51-80074C02	PL driver & level detector
U2	51-84371K65	monolithic timer
U3	51-83629M06	op-amplifier
U4 thru 100	—	NOT USED
U101 (A)	51-80074C02	PL driver & level detector

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		voltage regulator: (see note)
VR1	48-83696E07	Zener type; 6.2 V
VR2	48-82256C38	Zener type; 9.1 V
Z1	KLN6209A	Vibrasponder Resonant Reed
Z2(A, C)	KLN6209A	Vibrasponder Resonant Reed
		mechanical parts
	3-84256M01	SCREW, tapping; 4-10 x 5/16"; 2 used
	5-84220B01	GROMMET; 2 used
	9-83497F01	RECEPTACLE, female; 8-contact; 3 used (circuit board edge connector)
	9-84910C01	SOCKET, reed; 2 used (TRN5073A, 75A)
	64-82865N01	PANEL, front

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

TONE *PRIVATE-LINE* ENCODER-DECODER MODULES
MODELS TRN5073A, 74A, 75A



NOTES:

1. Unless otherwise indicated, resistors are in ohms, and capacitors are in microfarads.
2. Jumper wire JU8 normally in. Out when using 67 Hz reed.
3. For simplex TARA systems, Z1 encodes and decodes. For simplex TARB and duplex systems, Z1 encodes and Z2 decodes.
4. Amplitude is 1 V p-p when PL module is connected to exciter.

Jumper Table

	Simplex Duplex		
	TARA	TARB	TARB
JU1	IN	IN	OUT
JU2	IN	IN	OUT
JU3	IN	OUT	OUT
JU4	IN	OUT	IN
JU5	OUT	OUT	IN
JU6	IN	IN	OUT
JU7	IN	IN	OUT
JU8	NOTE 2		

EEPS-34532-B

Schematic Diagram
Motorola No. PEPS-34857-B
(Sheet 2 of 2)
11/1/85- UP

DIGITAL-PRIVATE LINE ENCODER-DECODER MODULES

Model Table

Model	Description
TRN5076A	Duplex TARB
TRN5077A	Simplex TARA
TRN5078A	Simplex TARB

1. GENERAL

1.1 PHYSICAL DESCRIPTION

The TRN5076A, 77A, 78A *Digital Private-Line* (DPL) Encoder-Decoder Modules are plug-in modules designed for use with Motorola base and repeater stations. All components and cirucitry are mounted on a sturdy circuit card with connecting terminals that mate with the backplane interconnect board of the station rf-control chassis.

1.2 FUNCTIONAL DESCRIPTION

Each of these modules can encode and decode subaudible *Digital Private-Line* codes. The encoder modulates the transmitter, and when the PTT signal is removed, the circuitry delays transmitter turn-off by approximately 180 ms to allow transmission of a receiver turn-off code. The decoder detects a received DPL code, and unmutes the receiver when the proper code is received.

2. DESCRIPTION OF OPERATION

Refer to the functional block and schematic diagrams attached to this instruction section.

2.1 SIMPLEX TARA AND TARB DPL MODULES

2.1.1 General

The TRN5077A Simplex TARA Module incorporates one integrated circuit (U1) and one code plug (connected to J1) for both encoding and decoding. The TRN5078A Simple TARB Module also incorporates U1, but uses two code plugs (J250 and J251). The code plug designated J250 is used for the transmit code, and the code plug designated J251 is used for the receive code.

2.1.2 Decode Mode

In the decode (receive) mode, receiver audio is applied to the DPL module at pin 17, R1 DISC INPUT, and is routed through active low pass filter Q2-Q3, where frequencies above the DPL code range are attenuated. The output of the low pass filter is applied to phase-lock-loop data conditioner U2, which squares the shape of the incoming code word. The output of the data conditioner is routed, via level shifter Q4, to the input of the decoder circuitry.

The decoder circuit consists of encoder-decoder U1, a 50 kHz clock (Y1, Q5), and the information stored in the code plug. When the proper code has been detected, the decoder provides a logic high at U1-7. This provides a logic high, via audio enable circuit Q15 & Q16, to pin 5, PL INDICATOR. This signal controls the audio mute gate on the station R1 audio and squelch module.

The logic high at U1-7 is also applied to sensitivity switch U3C, to disable the constant current source of U3D-U3E. With the constant current source disabled, the voltage at U2-8 is lowered, causing the sensitivity of U2 to increase. This provides additional immunity to audio interference and improved squaring of the incoming code word.

When the incoming (received) signal ceases, the sending transmitter produces a turn-off code. When the turn-off code is detected by the decoder, the detected output at U1-7 switches low. This decreases the sensitivity of the data conditioner and mutes receiver audio.

2.1.3 Encode Mode

When the station PTT signal is present, KEYED A+ is generated within the station. With KEYED A+ high, a high is generated at the collector of Q6, and is applied to encoder-decoder U1-9 (XMIT ENABLE). This causes U1 to switch to the encode mode. Encoder U1 then generates the transmit DPL code according to information stored in the code plug. The transmit DPL code signal is routed through the encoder low pass filter circuit (Q12 & Q13) to remove audio-frequency harmonics. The output

of the low pass filter is applied to the exciter via pin 21, DPL CODE OUT. During transmission, C22 is used in the circuit to shift the corner frequency of the filter. During the time when only turn-off code is transmitted, C22 is out of the circuit in order to unshift the corner frequency of the filter. When the PTT signal ceases, the loss of KEYED A+ triggers the delayed keyed A+ circuit (Q8, Q9, & Q10). This circuit provides DELAYED KEYED A+ to the station, via pin 7, for a period of approximately 180 ms, during which time the encoder sends the turn-off code to the exciter for transmission.

The transmit DPL code signal is inhibited during transmission (required for proper paging operation) by applying a low to pin 14, TRANSMIT PL INHIBIT. The low turns Q14 on, which shunts the junction of R17, R18, R20, and C20 to ac ground.

2.2 DUPLEX T_AR_B DPL MODULE

The TRN5076A Duplex T_AR_B Module is the same as the simplex versions, except that the module allows the station to decode (receive) and encode (transmit) simultaneously. This is accomplished by using separate, dedicated encoder and decoder integrated circuits and code plugs. In duplex operation, U1 is a decoder only, and U100 is an encoder only.

3. CIRCUIT DESCRIPTIONS

3.1 DELAYED KEYED A+ TIMING CIRCUIT

The delayed keyed A+ timing circuit is used to maintain transmitter turn-on long enough for the DPL encoder to send the turn-off code. This period is approximately 180 ms.

When pin 13, KEYED A+, goes low at the end of a transmission (loss of PTT), the negative side of C27 approaches A+. It should be noted that since the voltage on C27 cannot change instantaneously, the voltage at the junction of R53, R54 & CR5 is increased. When this voltage is larger than the anode voltage of CR5, the diode does not conduct. Thus, the collector of Q9 swings low (approaches ground), the base of Q10 approaches A+, and the collector of Q10 swings low, which turns off Q10. Therefore, the delayed keyed A+ line switches low, which causes station transmission to cease.

3.2 TWO-CODE SWITCH CIRCUIT

The two-code switch circuit (Q250 & Q251) on simplex T_AR_B models is used to select and enable the proper code plug for transmit and receive modes. Code plug J250 is active in the transmit mode, and code plug J251 is active in the receive mode.

During the receive mode, the collector of keyed A+ switch Q6 is low. This low is inverted by Q250, and is applied as a high to code plug J250, to disable the transmit code. The high from Q250 is inverted by Q251, and applied as a low to code plug J251, to enable the receive code.

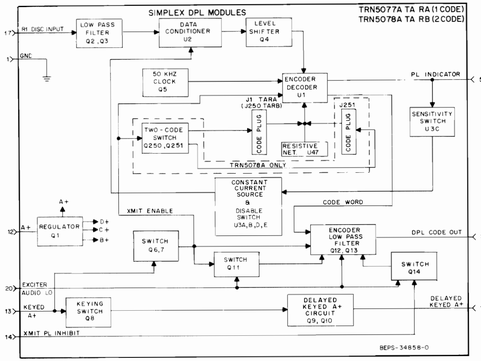
During the transmit mode, the collector of keyed A+ switch Q6 is high, which causes the transmit code from J250 to be enabled (inverted low by Q250), and the receive code from J251 to be disabled (inverted high by Q251).

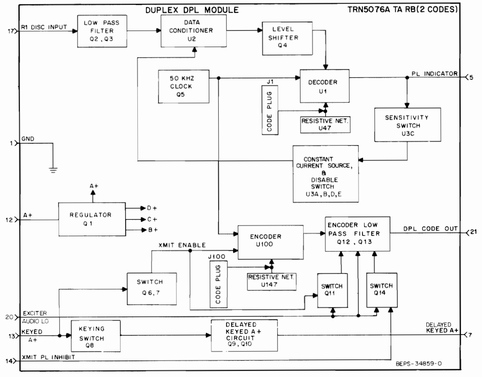
3.3 REGULATOR CIRCUIT

Regulator Q1 provides three regulated dc voltages from station A+ (13.9 V). These voltages, in addition to A+, power all circuitry on the DPL board. The regulated voltages are 11.1 V (B+), 10.5 V (C+), and 6.2 V (D+).

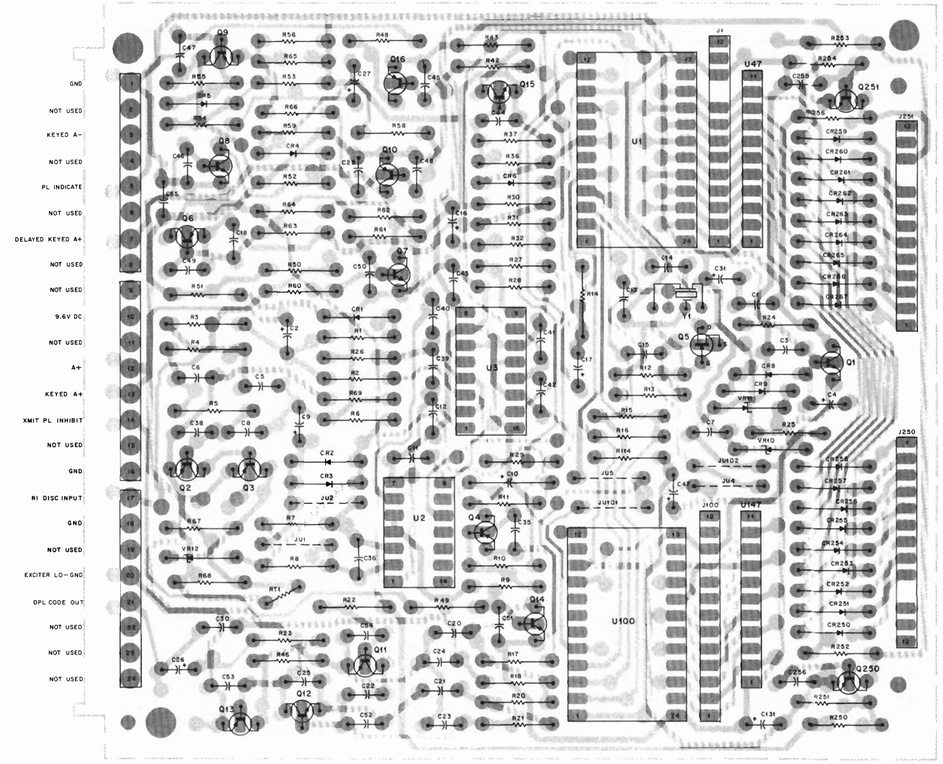
DIGITAL PRIVATE-LINE ENCODER-DECODER MODULES

MODELS TRN5076A, 77A, 78A





Functional Block Diagrams, Circuit Board Detail, and Parts List
Motorola No. PEPS-34860-B
(Sheet 1 of 2)
11/1/85-UP



SHOWN FROM SOLDER SIDE

SOLDER SIDE BD-DEPS-34437-O
COMPONENT SIDE BD-DEPS-34438-O
OL-DEPS-34439-O

parts list

legend

reference symbol suffix	application
No Suffi	All models
A	TRN5076A
B	TRN5077A
C	TRN5078A

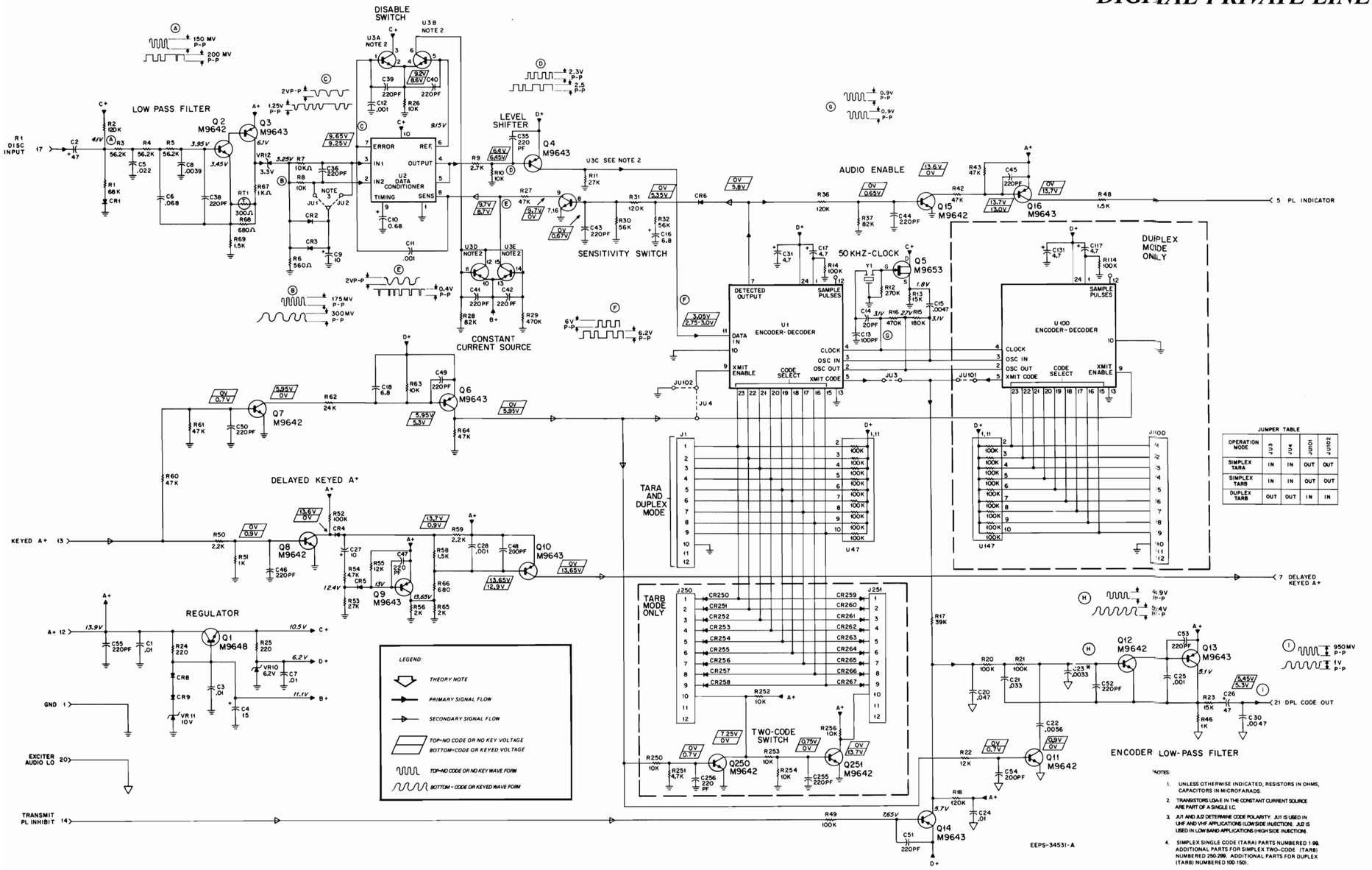
This parts list covers 3 models of the DPL Encoder-Decoder Modules. Where differences exist, a letter code is added to the reference symbol to indicate the applicable unit.

TRN5076A DPL Encoder-Decoder (Duplex TARB) Module
TRN5077A DPL Encoder-Decoder (Simplex TARA) Module
TRN5078A DPL Encoder-Decoder (Simplex TARB) Module PL-7943-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ±5%; 50 V; unless otherwise stated
C1	21-11021F04	.01 ±20%
C2	23-84612M20	47 ±10%, 25 V
C3	21-11021F04	.01 ±20%
C4	23-84612M19	15 ±10%; 25 V
C5	8-11017A11	.022
C6	8-11017A16	.068
C7	21-11021F04	.01 ±20%
C8	8-11017A18	.0039
C9	23-84612M18	10 ±10%; 25 V
C10	23-82783848	0.68, 35 V
C11, 12	21-11015B13	.001 ±10%; 100 V
C13	21-11022A55	100 pF
C14	21-11022A37	20 pF
C15	21-11021A21	.0047 ±10%
C16	23-84612M17	6.8 ±10%; 25 V
C17	23-11019A16	4.7 ±20%; 35 V
C18	23-84612M17	6.8 ±10%; 25 V
C19	—	NOT USED
C20	8-11017A14	.047
C21	8-11017A13	.033
C22	8-11017A19	.0056
C23	8-11017A05	.0033
C24	21-11021F04	.01 ±20%
C25	21-11015B13	.001 ±10%; 100 V
C26	23-84612M20	47 ±10%; 25 V
C27	23-84612M18	10 ±10%; 25 V
C28	21-11015B13	.001 ±10%; 100 V
C29	—	NOT USED
C30	8-11017B06	.0047
C31	23-11019A16	4.7 ±20%; 35 V
C32, 33, 34	—	NOT USED
C35, 36	21-11015B05	220 pF ±10%; 100 V
C37	—	NOT USED
C38 thru 54	21-11015B05	220 pF ±10%; 100 V
C55 thru 116	—	NOT USED
C117 (A)	23-11019A16	4.7 ±20%; 35 V
C118 thru 130	—	NOT USED
C131 (A)	23-11019A16	4.7 ±20%; 35 V
C132 thru 254	—	NOT USED
C255, 256 (C)	21-11015B05	220 pF ±10%; 100 V
		diode: (see note)
CR1	48-83654H02	silicon
CR2, 3	48-84616A01	hot carrier
CR4, 5, 6	48-83654H01	silicon
CR7	—	NOT USED
CR8, 9	48-83654H01	silicon
CR10 thru 249	—	NOT USED
CR250 thru 267 (C)	48-83654H01	silicon
		connector, receptacle:
J1	9-82071K01	female; 12-contact (DPL plug)
J2 thru 99	—	NOT USED
J100 (A)	9-82071K01	female; 12-contact (DPL plug)
J101 thru 249	—	NOT USED
J250, 251 (C)	9-82071K01	female; 12-contact (DPL plug)
		jumper:
JU1 thru 4	42-11060A01	0 ohms
JU5 thru 100	—	NOT USED
JU101, 102 (A)	42-11060A01	0 ohms
		transistor: (see note)
Q1	48-869648	NPN; type M9648
Q2	48-869642	NPN; type M9642
Q3, 4	48-869643	PNP; type M9643
Q5	48-869653	field-effect; M9653
Q6	48-869643	PNP; type M9643
Q7, 8	48-869642	NPN; type M9642
Q9, 10	48-869643	PNP; type M9643
Q11, 12	48-869642	NPN; type M9642
Q13, 14	48-869643	PNP; type M9643
Q15	48-869642	NPN; type M9642
Q16	48-869643	PNP; type M9643
Q17 thru 249	—	NOT USED
Q250, 251 (C)	48-869642	NPN; type M9642
		resistor, fixed: ± 5%; 1/4 W; unless otherwise stated
R1	6-11009A93	68k
R2	6-11009A99	120k
R3, 4, 5	6-10621D64	56.2k ± 1%
R6	6-11009A43	560

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R7, 8	6-11009A73	10k
R9	6-11009A59	2.7k
R10	6-11009A73	10k
R11	6-11009A83	27k
R12	6-11009B08	270k
R13	6-11009A77	15k
R14	6-11009A97	100k
R15	6-11009B04	180k
R16	6-11009B14	470k
R17	6-11009A87	39k
R18	6-11009A99	120k
R19	—	NOT USED
R20, 21	6-11009A97	100k
R22	6-11009A75	12k
R23	6-11009A77	15k
R24, 25	6-11009A33	220
R26	6-11009A73	10k
R27	6-11009A89	47k
R28	6-11009A95	82k
R29	6-11009B14	470k
R30	6-11009A91	56k
R31	6-11009A99	120k
R32	6-11009A91	56k
R33, 34, 35	—	NOT USED
R36	6-11009A99	120k
R37	6-11009A95	82k
R38 thru 41	—	NOT USED
R42, 43	6-11009A89	47k
R44, 45	—	NOT USED
R46	6-11009A49	1k
R47	—	NOT USED
R48	6-11009A53	1.5k
R49	6-11009A97	100k
R50	6-11009A57	2.2k
R51	6-11009A49	1k
R52	6-11009A97	100k
R53	6-11009A83	27k
R54	6-11009A65	4.7k
R55	6-11009A75	12k
R56	6-11009A56	2k
R57	—	NOT USED
R58	6-11009A53	1.5k
R59	6-11009A57	2.2k
R60, 61	6-11009A89	47k
R62	6-11009A62	24k
R63	6-11009A73	10k
R64	6-11009A89	47k
R65	6-11009A56	2k
R66	6-11009A45	680
R67	6-11009A49	1k
R68	6-11009A45	680
R69	6-11009A53	1.5k
R70 thru 113	—	NOT USED
R114 (A)	6-11009A97	100k
R115 thru 249	—	NOT USED
R250 (C)	6-11009A73	10k
R251 (C)	6-11009A65	4.7k
R252, 253 (C)	6-11009A73	10k
R254 (C)	6-11009A65	4.7k
R255	—	NOT USED
R256 (C)	6-11009A73	10k
		thermistor:
RT1	6-83241P01	300 @ 25°C
		integrated circuit: (see note)
U1	51-80074C01	encoder/decoder
U2	51-83629M01	phase loop lock
U3	51-83629M10	transistor array
U4 thru 46	—	NOT USED
U47	51-82142K02	resistor network
U48 thru 99	—	NOT USED
U100 (A)	51-80074C01	encoder/decoder
U101 thru 146	—	NOT USED
U147 (A)	51-82142K02	resistor network
		voltage regulator: (see note)
VR10	48-83696E07	Zener type; 6.2 V
VR11	48-82256C11	Zener type; 10 V
VR12	48-82256C26	Zener type; 3.3 V
		crystal: (see note)
Y1	48-82003K01	50k
		mechanical parts
	3-84256M01	SCREW, tapping; 4-10 x 5/16"; 2 used
	5-84220B01	GROMMET
	9-83497F01	RECEPTACLE, female; 8-contact; 3 used (circuit board edge connector)
	14-861196	INSULATOR, XTAL
	64-83837N01	PANEL, front

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



JUMPER TABLE				
OPERATION MODE	JU3	JU4	JU101	JU102
SIMPLEX TARA	IN	IN	OUT	OUT
SIMPLEX TARB	IN	IN	OUT	OUT
DUPLEX TARB	OUT	OUT	IN	IN

NOTES:

1. UNLESS OTHERWISE INDICATED, RESISTORS IN OHMS, CAPACITORS IN MICROFARADS.
2. TRANSISTORS Q3-A-E IN THE CONSTANT CURRENT SOURCE ARE PART OF A SINGLE I.C.
3. JU1 AND JU2 DETERMINE CODE POLARITY. JU1 IS USED IN UHF AND VHF APPLICATIONS (LOW SIDE INJECTION). JU2 IS USED IN LOW BAND APPLICATIONS (HIGH SIDE INJECTION).
4. SIMPLEX SINGLE CODE (TARA) PARTS NUMBERED 1-99. ADDITIONAL PARTS FOR SIMPLEX TWO-CODE (TARB) NUMBERED 250-299. ADDITIONAL PARTS FOR DUPLEX (TARB) NUMBERED 100-150.

Schematic Diagram
Motorola No. ***PEPS-34860-B***
(Sheet 2 of 2)
11/1/85- UP

FUNCTIONAL DESCRIPTION

APPLICATIONS 68P81062E59
REMOTE CONTROL 68P81062E61

RF-CONTROL CHASSIS

RF-CONTROL CHASSIS (TLN2472B, 74B, 75B) (B VERSION) 68P81070E88

REMOTE CONTROL

REMOTE CONTROL MODULES 68P81062E63
- STATION CONTROL (TRN5321A) 68P81062E14
- LINE DRIVER (TRN5235A, 36A, 37A) 68P81062E13
- LINE DRIVER (TRN5240A, 54A, 55A, 56A) 68P81062E16
- DC TRANSFER (TRN5239A, 57A) 68P81062E17
- GUARD TONE DECODER (TLN2443A, 50A) 68P81062E18
- F1 TONE CONTROL (TRN5320A, 22A, 27A, 28A) 68P81062E19
- F2 TONE CONTROL (TLN2444A, 49A, TRN5256A, 5325A) 68P81062E21
- SQUELCH GATE (TRN5324A) 68P81062E23
- TIME-OUT TIMER (TRN2442A) 68P81062E24
- SINGLE-TONE DECODER (TLN2442A) 68P81062E26
- 4-FREQUENCY CONTROL OPTION DECODER (TRN5296A) 68P81062E22
- SQUELCH, REPEATER, AND *PRIVATE-LINE* CONTROL OPTION DECODER (TRN1249A, 50A, 51A) 68P81062E28
- "WILD CARD" CONTROL (TLN2448A) 68P81062E27

AUDIO & SQUELCH

R1 AUDIO & SQUELCH MODULE (TRN9688A, 89) 68P81070E57
R1 AUDIO & SQUELCH MODULE (TRN5068A, 69A) 68P81062E57
R2 AUDIO & SQUELCH MODULE (TRN9690A, 91A, 92A) 68P81070E58
R2 AUDIO & SQUELCH MODULE (TRN5070A, 71A, 72A) 68P81062E64
TONE *PRIVATE-LINE* ENCODER-DECODER MODULE TRN5073A, 74A, 75A) 68P81062E51
DIGITAL PRIVATE-LINE ENCODER-DECODER MODULE (TRN5076A, 77A, 78A) 68P81062E52

OPTIONAL EQUIPMENT

Spectra-TAC ENCODER OPTION (C269) 68P81112E78
- *Spectra-TAC* 4-WIRE LINE DRIVER MODULE (TRN5294A) 68P81062E41
- *Spectra-TAC* ENCODER MODULE (TRN5293A) 68P81062E42
- *Spectra-TAC* SQUELCH GATE MODULE (TRN5331A) 68P81062E43

MSR 2000 BASE AND REPEATER STATION MULTIPLE TONE PL OPTIONS (C158, C261, C262, C263) 68P81112E80
- MULTIPLE PL MATRIX CONTROL MODULE (TRN5330A) 68P81062E67
- MULTIPLE PL ENCODER MODULE (TRN5292A) 68P81062E68
- MULTIPLE PL ENCODER MODULE (TRN5329A) 68P81062E69

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
6/30/82- UP

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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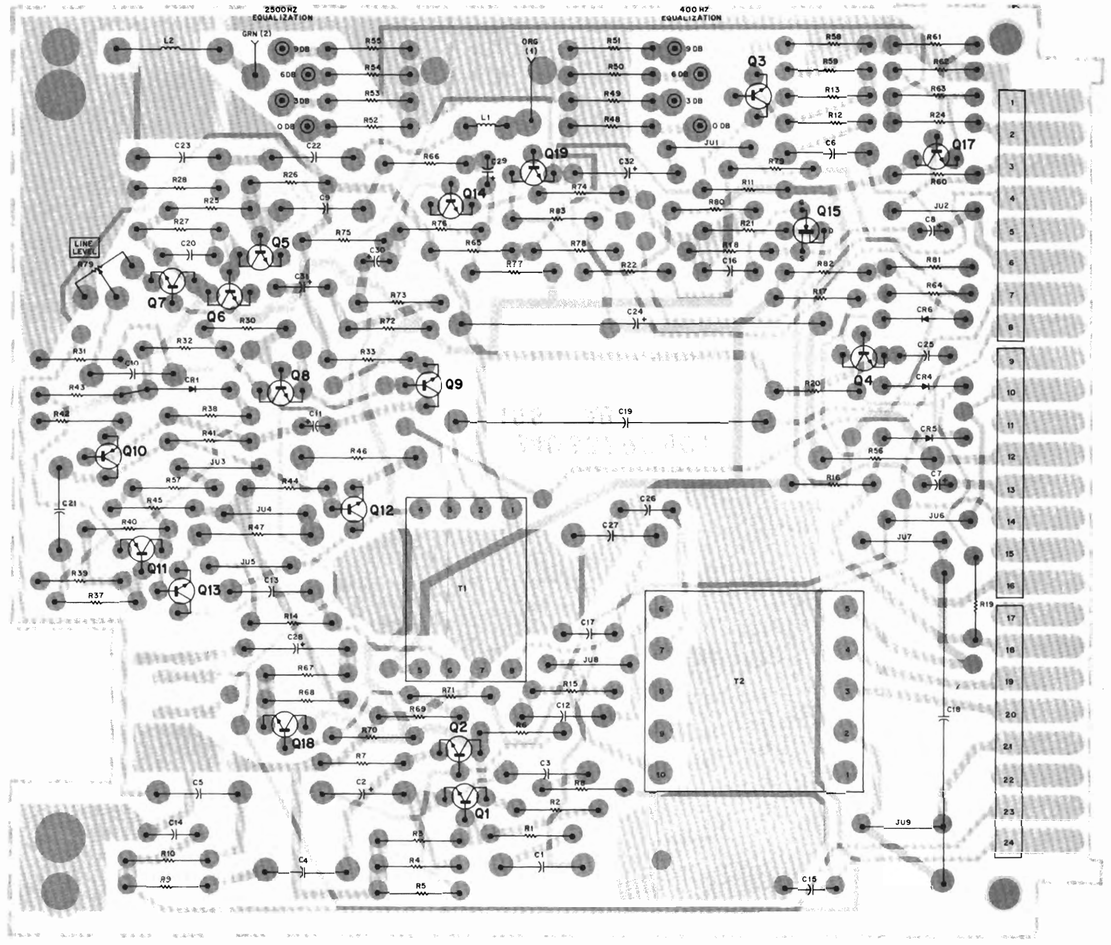
Spectra-TAC 4-WIRE LINE DRIVER MODULE

MODEL TRN5294A



SHOWN FROM COMPONENT SIDE

TRANSISTOR BASE DETAILS

SOLDER SIDE	BD-DEPS-34704-O
COMPONENT SIDE	BD-DEPS-34705-O
	OL-DEPS-34706-O

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

parts list

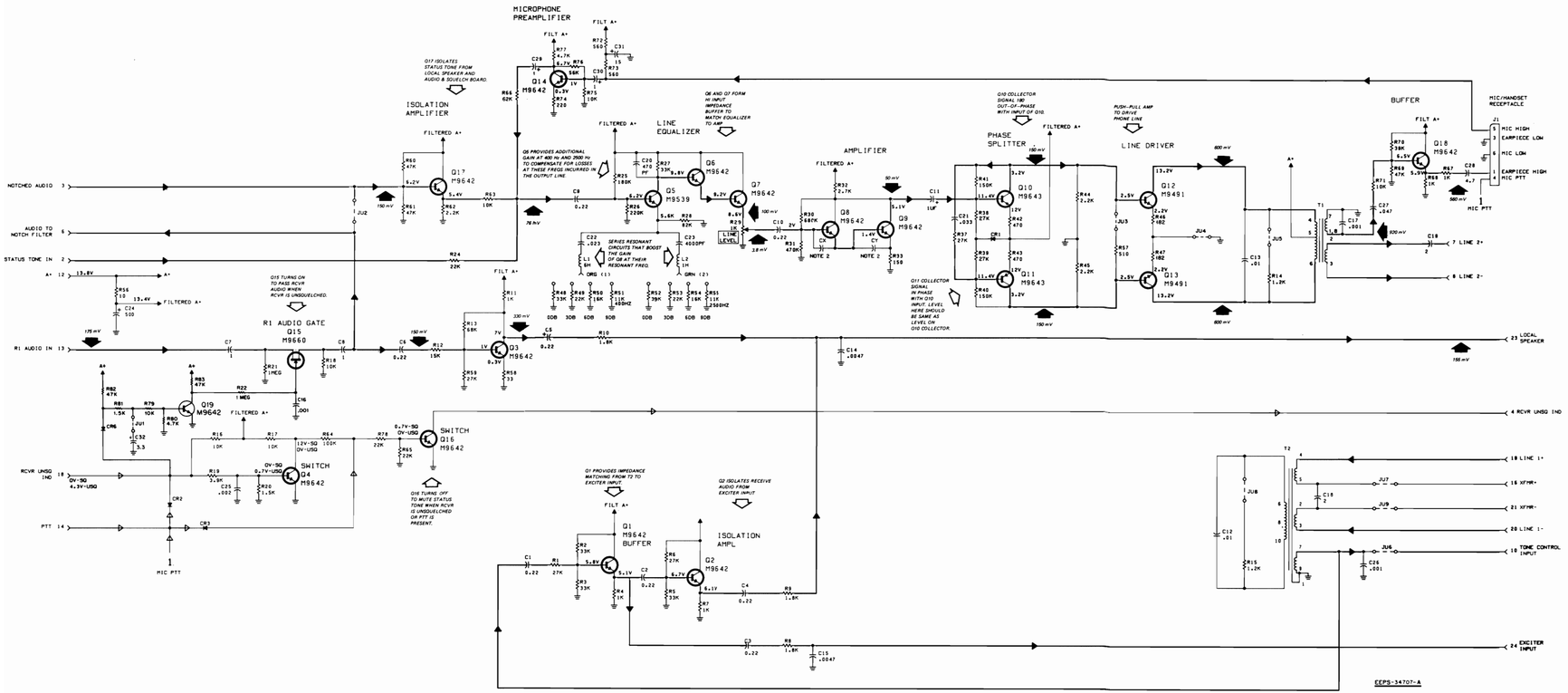
TRN5294A 4-Wire Line Driver Kit — PL-7965-B

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	6-10821B23	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.

Spectra-TAC 4-WIRE LINE DRIVER MODULE

MODEL TRN5294A



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

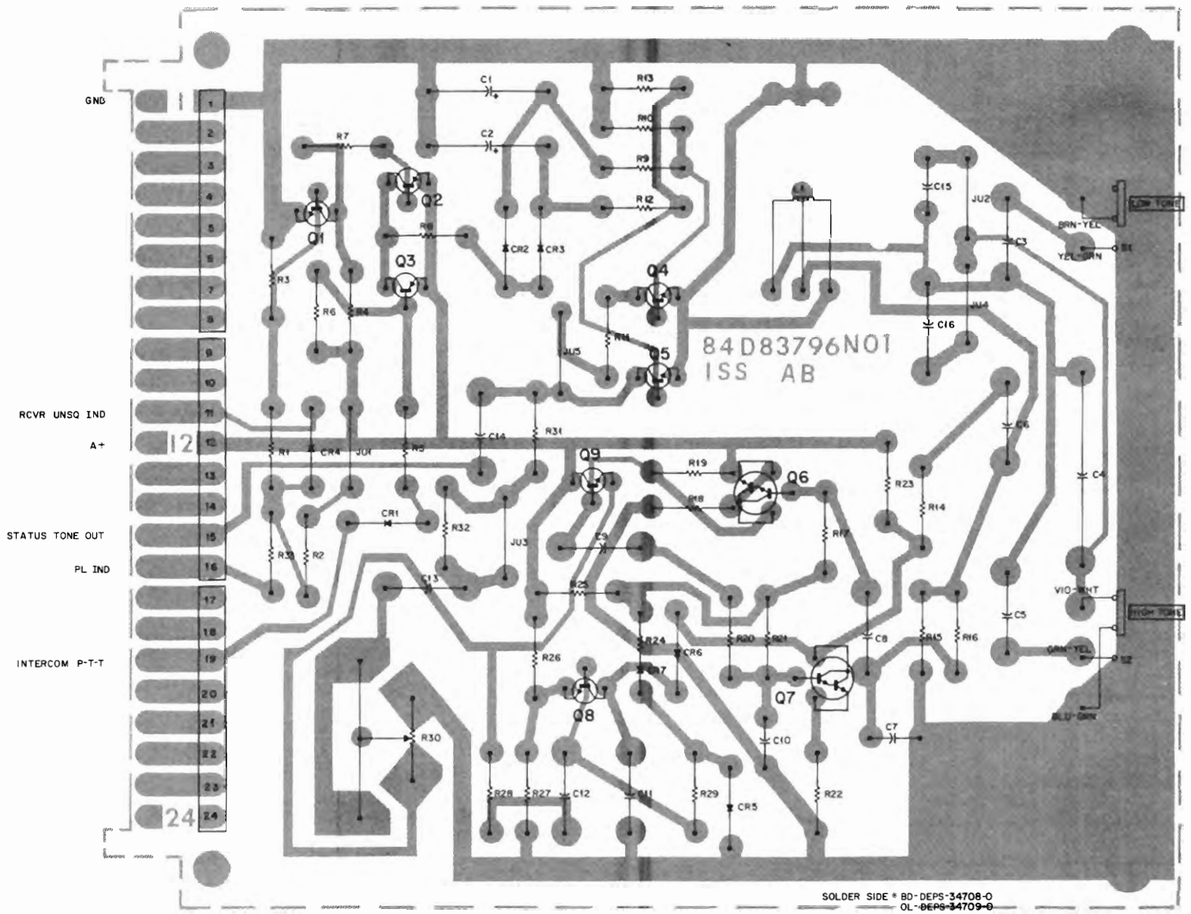
JU1	IN for —13 dB status tone operation. OUT for 0 dB status tone operation.	Normally IN
JU2	When removed, audio is routed to a 2175 Hz notch filter on the F1-PL module.	Normally IN (removed for tone control base stations)
JU3	When installed, this jumper attenuates line output 20 dB for input to microwave 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



SHOWN FROM SOLDER SIDE

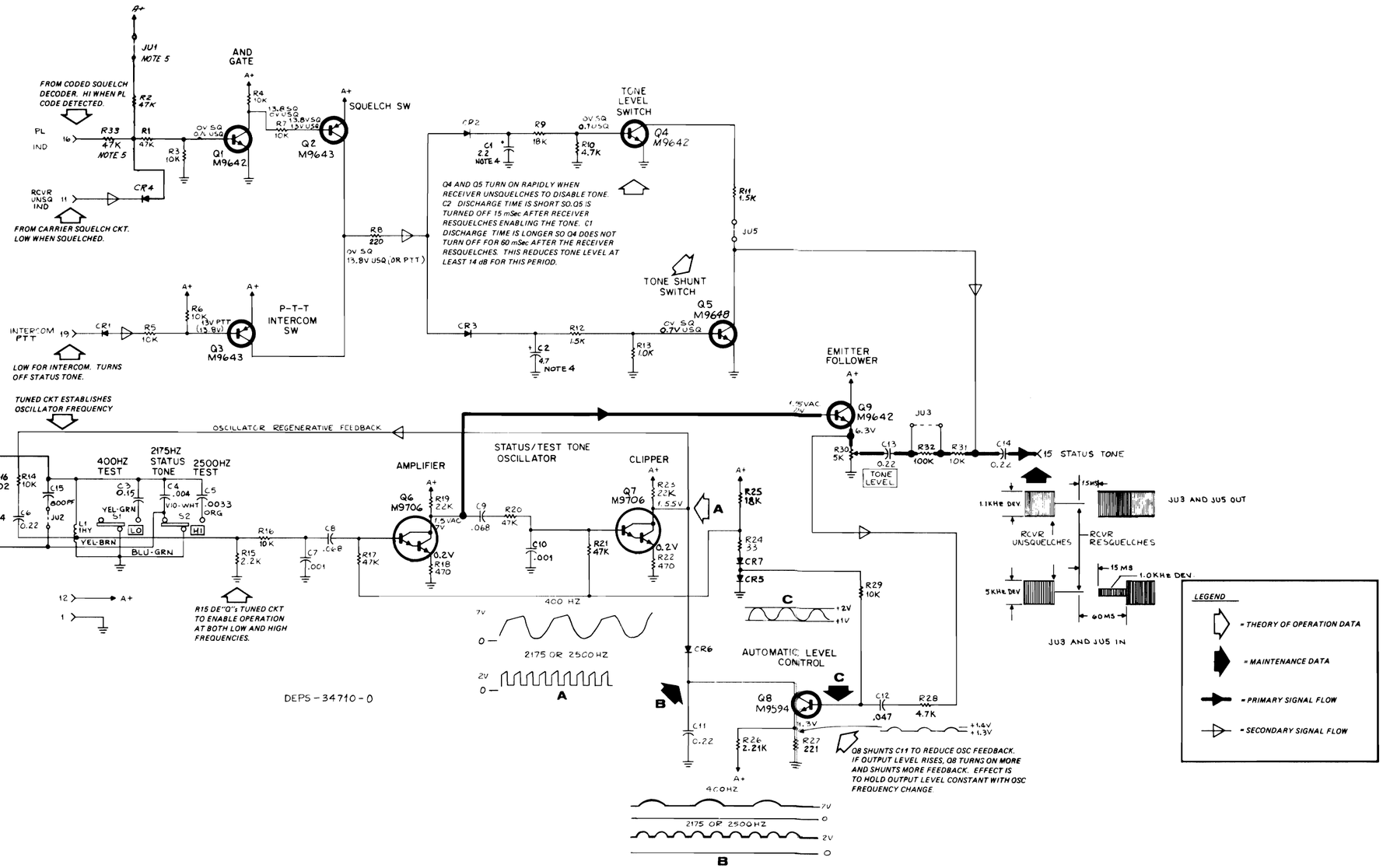
parts list

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**
(Sheet 1 of 2)
11/1/85-UP



FUNCTION

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

NOTES:

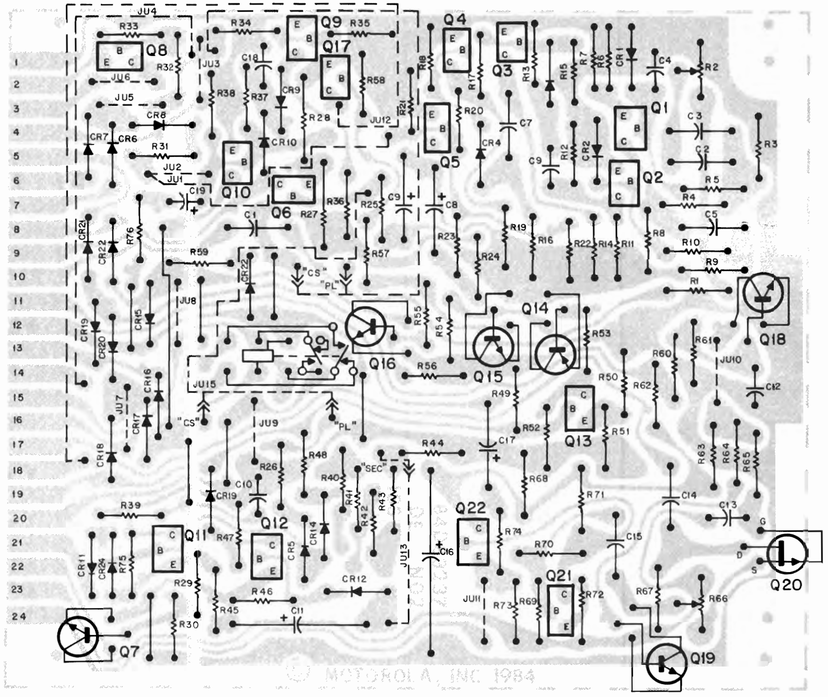
1. Unless otherwise specified, resistors are in ohms, capacitors are in microfarads.
2. DC voltages are measured to ground with a dc voltmeter having, 11 megohm input impedance.
3. JU3 and JU5 are installed for status tone operation at full system deviation.
4. C1 and C2 are removed in IMTS applications.
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)
11/1/85- UP

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

parts list

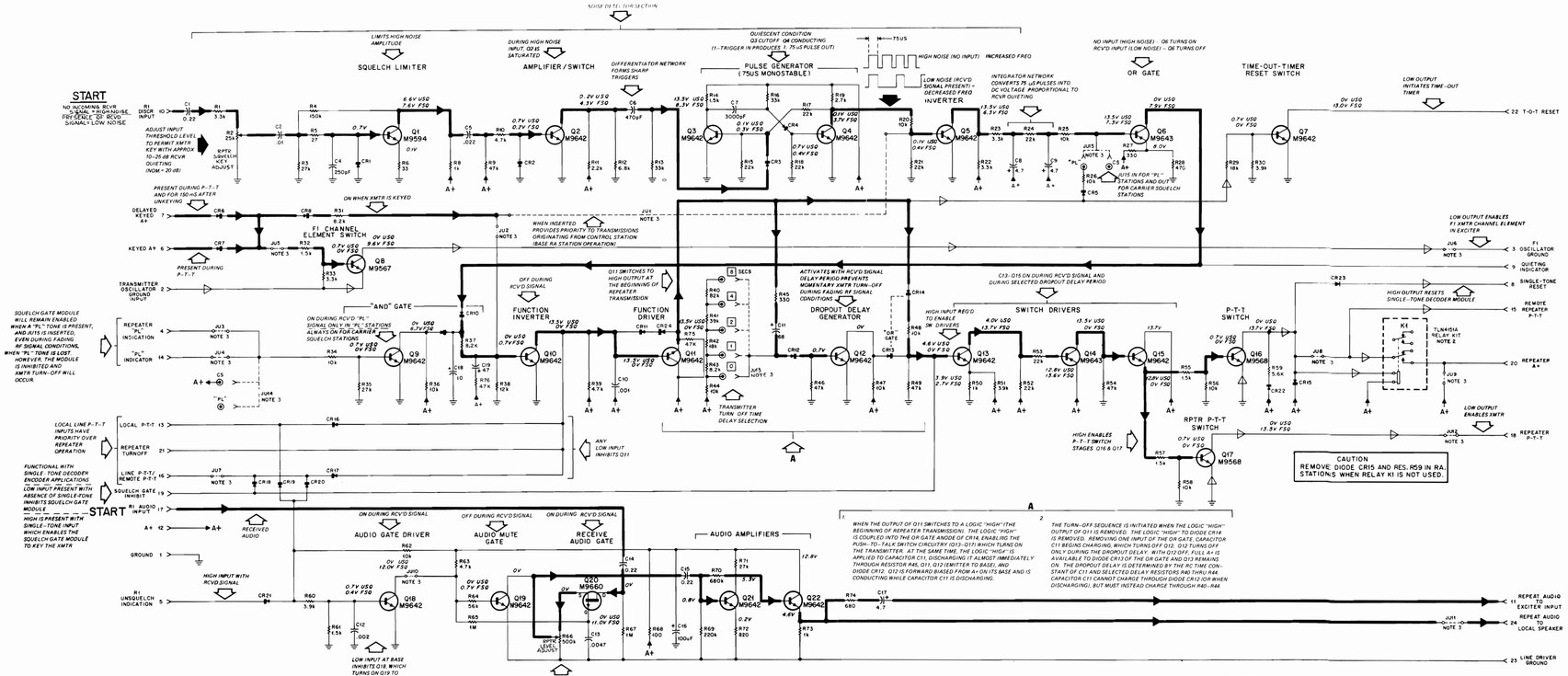
TRN5331A Squelch Gate Module PL-7960-B

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	6-11009C61	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	6-11009C69	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.

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

Spectra-TAC SQUELCH GATE MODULE
MODEL TRN5331A



NOTES:

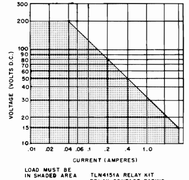
1. Unless otherwise stated: resistor values are in ohms (k = 1000). Capacitor values are in microfarads.
2. Relay kit is an optional accessory item. Refer to relay application chart for CR15, JU8 and JU9 usage with relay.
3. Refer to jumper table.
4. Voltage readings shown are for two conditions:
   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.

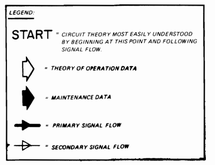
Jumper Table

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





FUNCTION

Measure received noise levels and controls transmitter keying.

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

"Spectra-TAC" SQUELCH GATE MODULE

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

technical writing services
1301 E. Algonquin Road, Schaumburg, IL 60196

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.

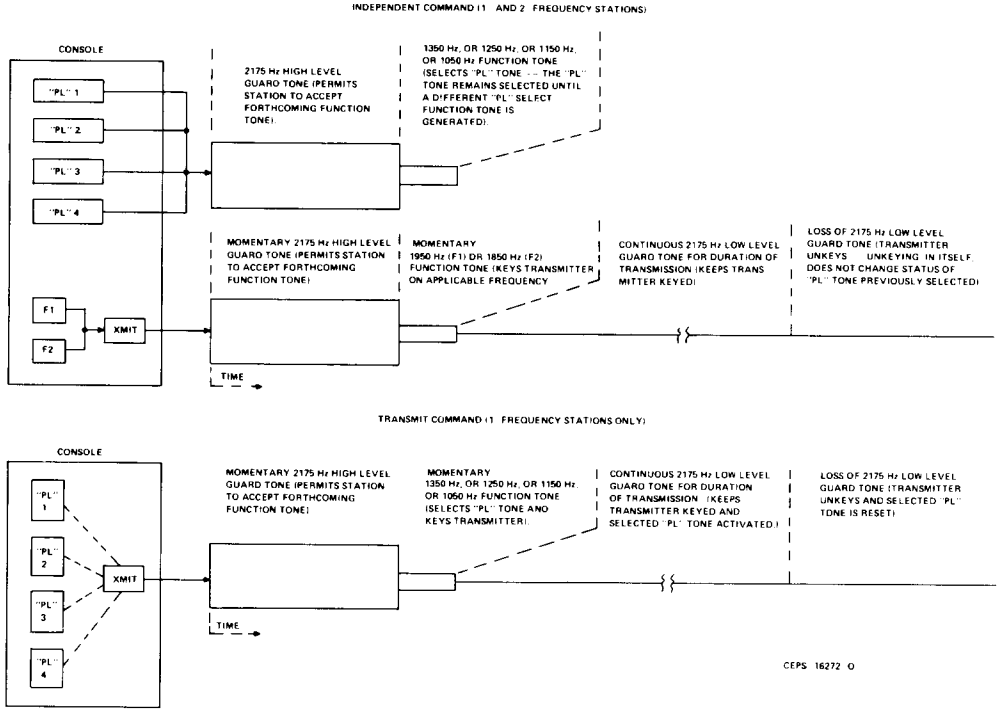


Figure 1. Independent vs. Transmit Command Timing Diagram

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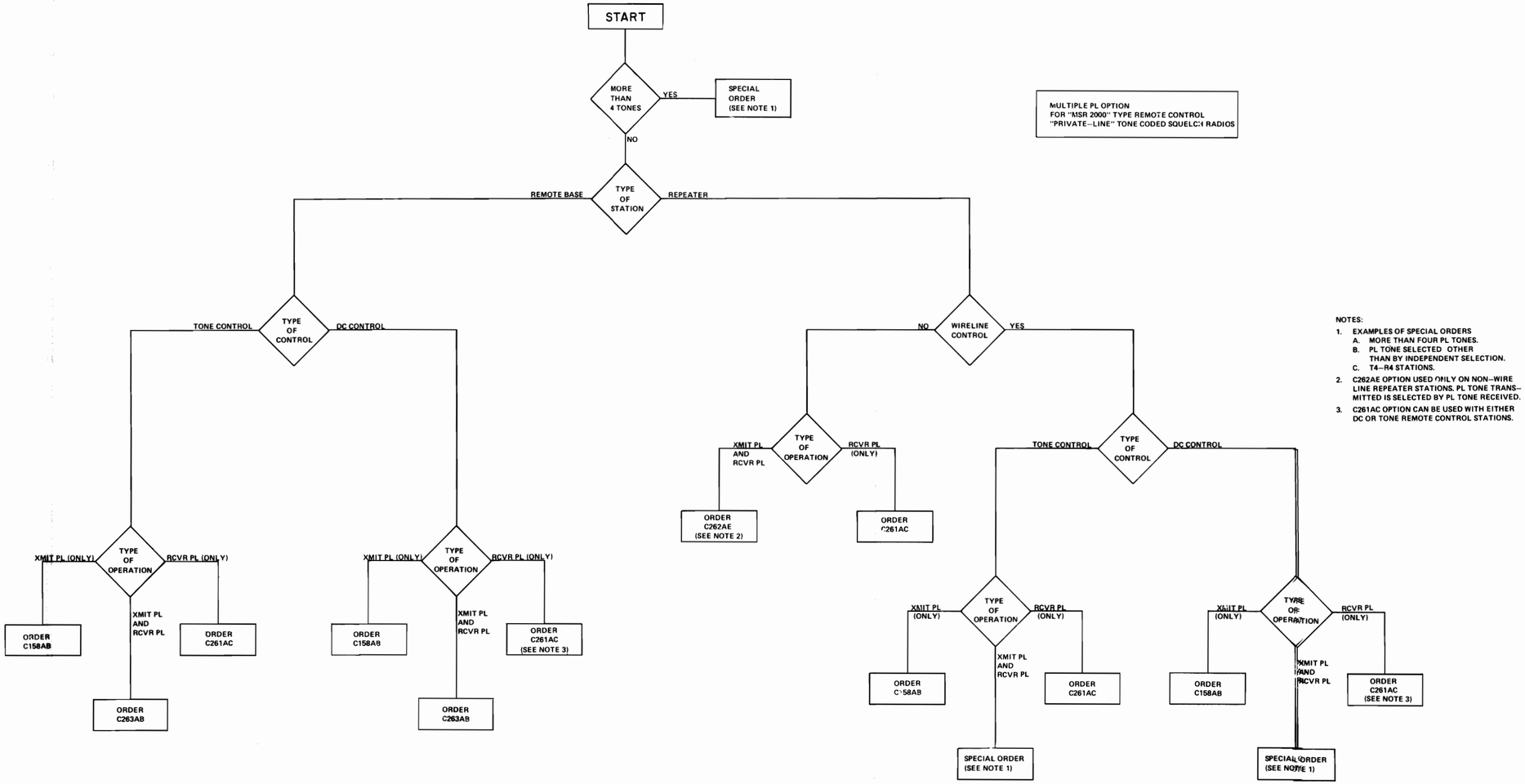


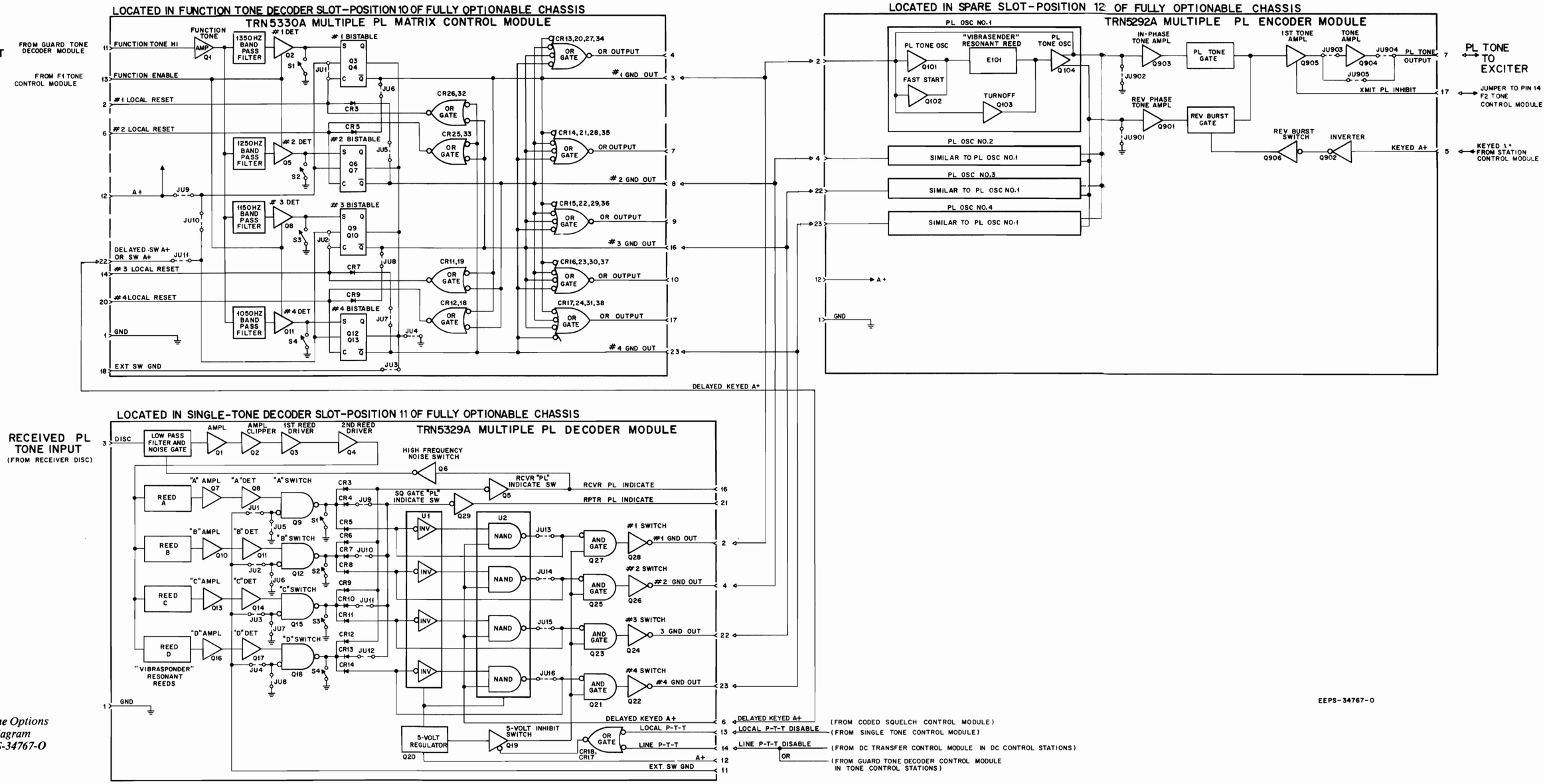
MULTIPLE PL OPTION
FOR "MSR 2000" TYPE REMOTE CONTROL
"PRIVATE-LINE" TONE CODED SQUELCH RADIOS

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.

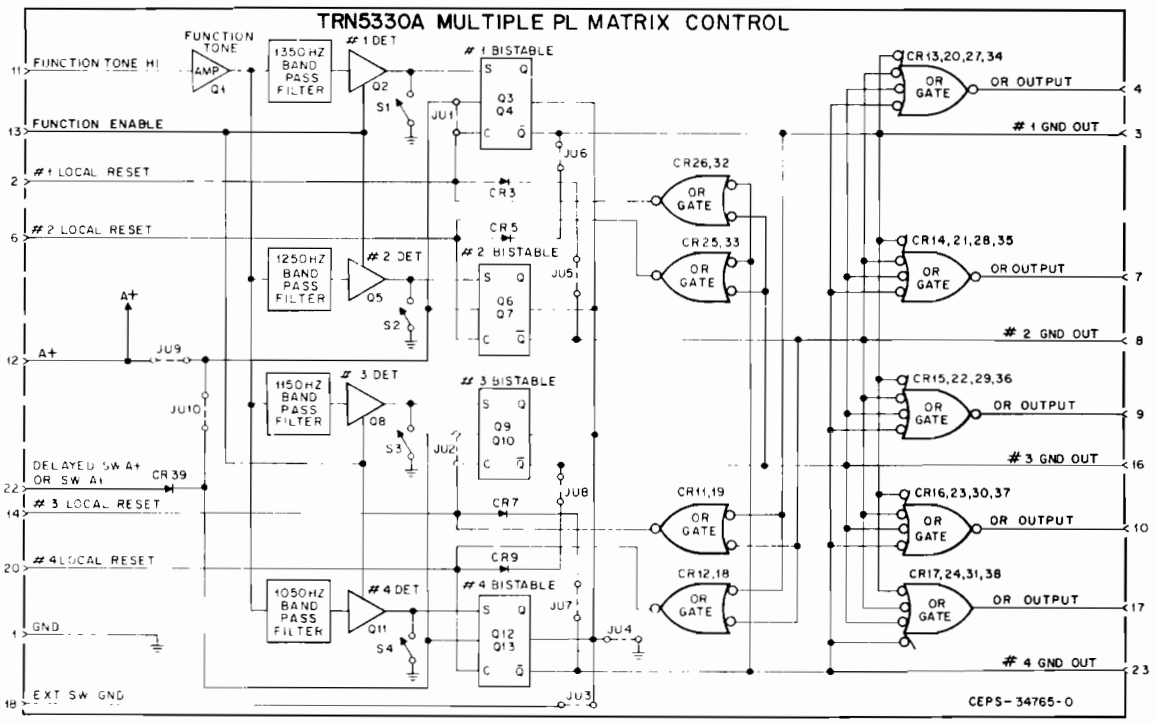


Figure 1. Functional Diagram

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.

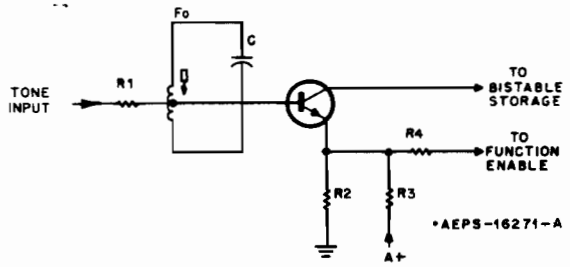


Figure 2. Typical Function Tone Detector

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%

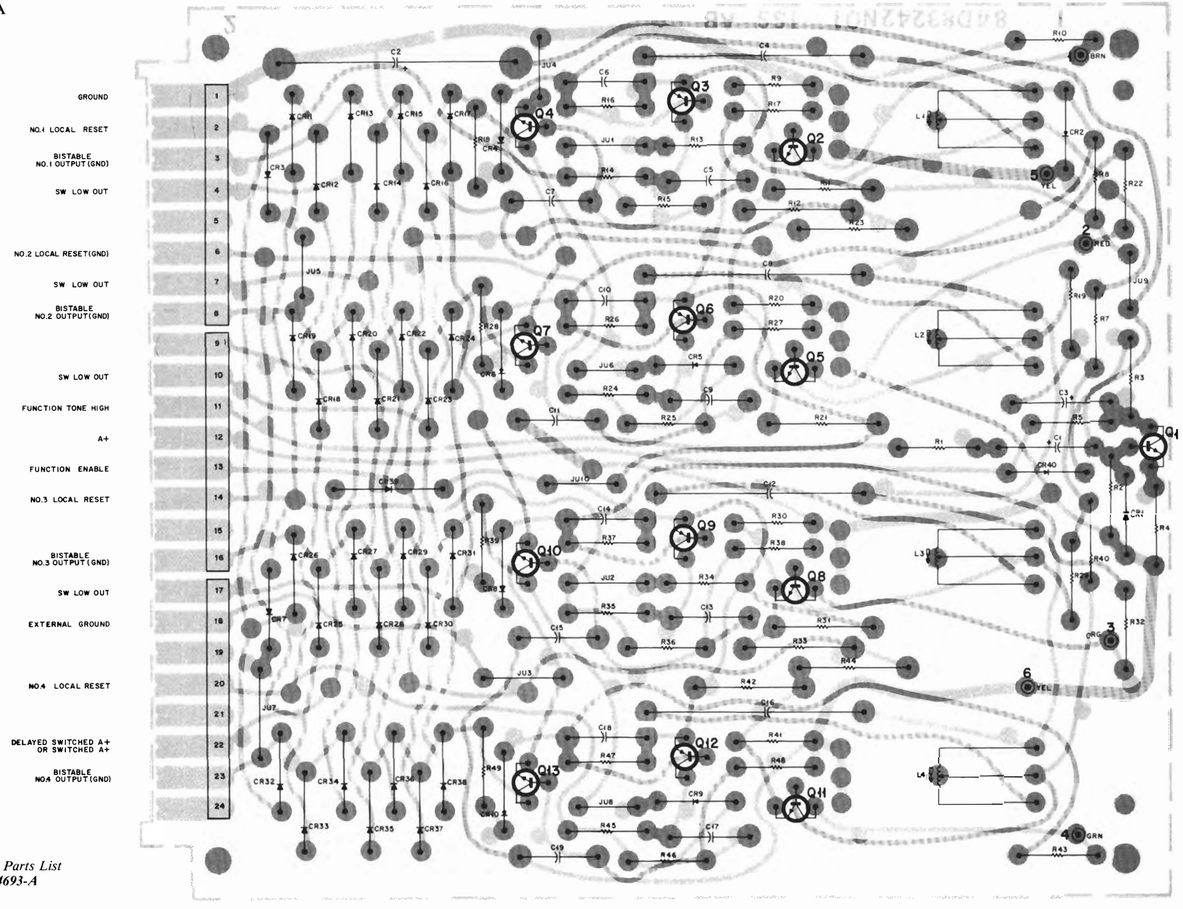
Table 8. Special Modifications

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.

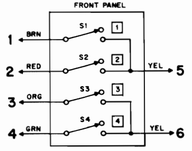
MULTIPLE PL MATRIX CONTROL MODULE

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

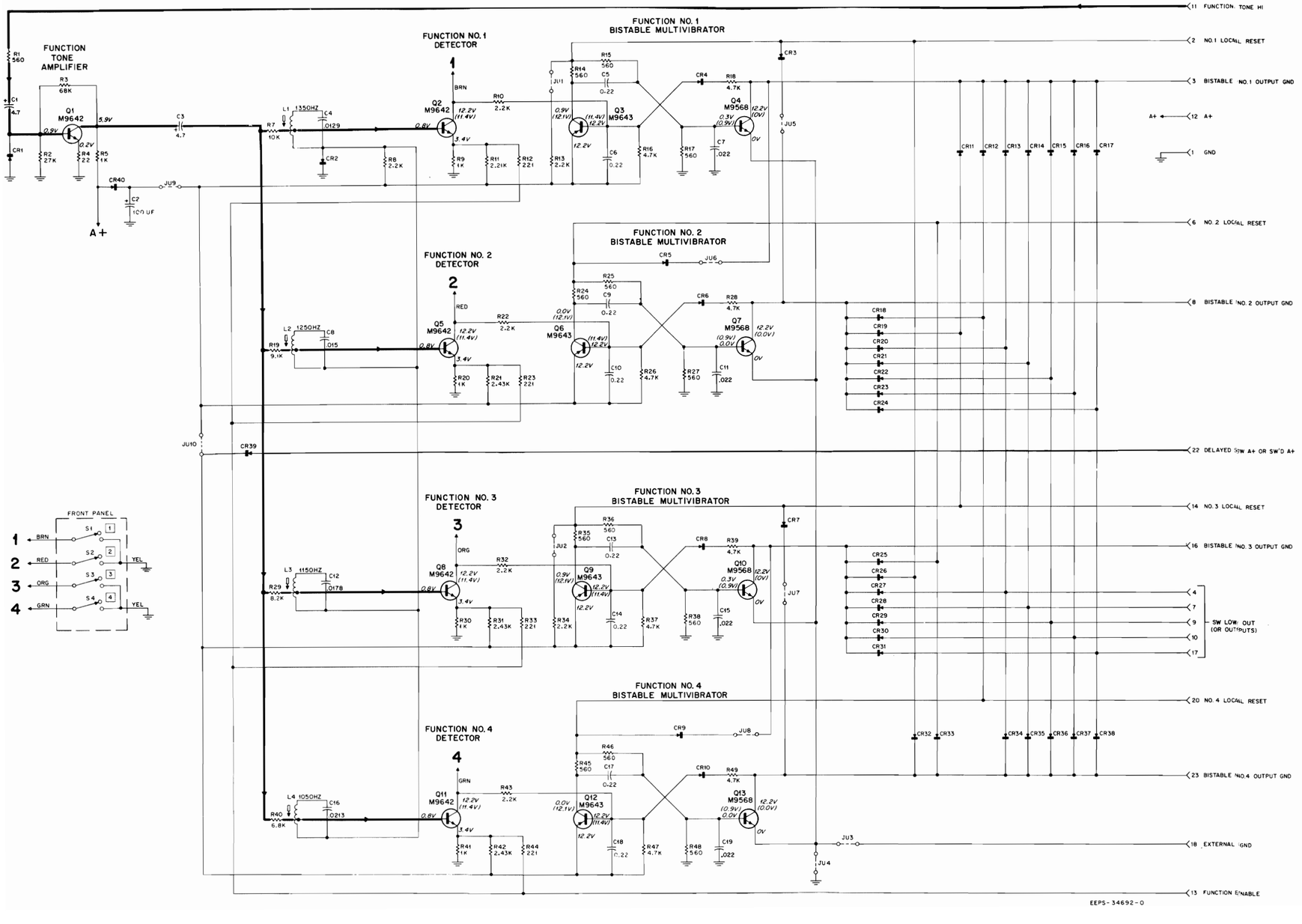
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ± 10%; 50 V: unless otherwise stated
C1	23-865137	4.7 ±20%; 25 V
C2	23-82601A25	100 +150-10%; 20 V
C3	23-865137	4.7 ±20%; 25 V
C4	8-84326A20	.0129 ±2%
C5	8-82905G11	0.22
C6	8-82905G11	0.22
C7	8-82905G02	.022
C8	8-84326A21	.015 ±2%
C9	8-82905G11	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
CR1 thru 40	48-83654H01	**semiconductor device, diode: (see note)** silicon
L1 thru 4	1-80702B11	**coil assembly, inductor:** 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-

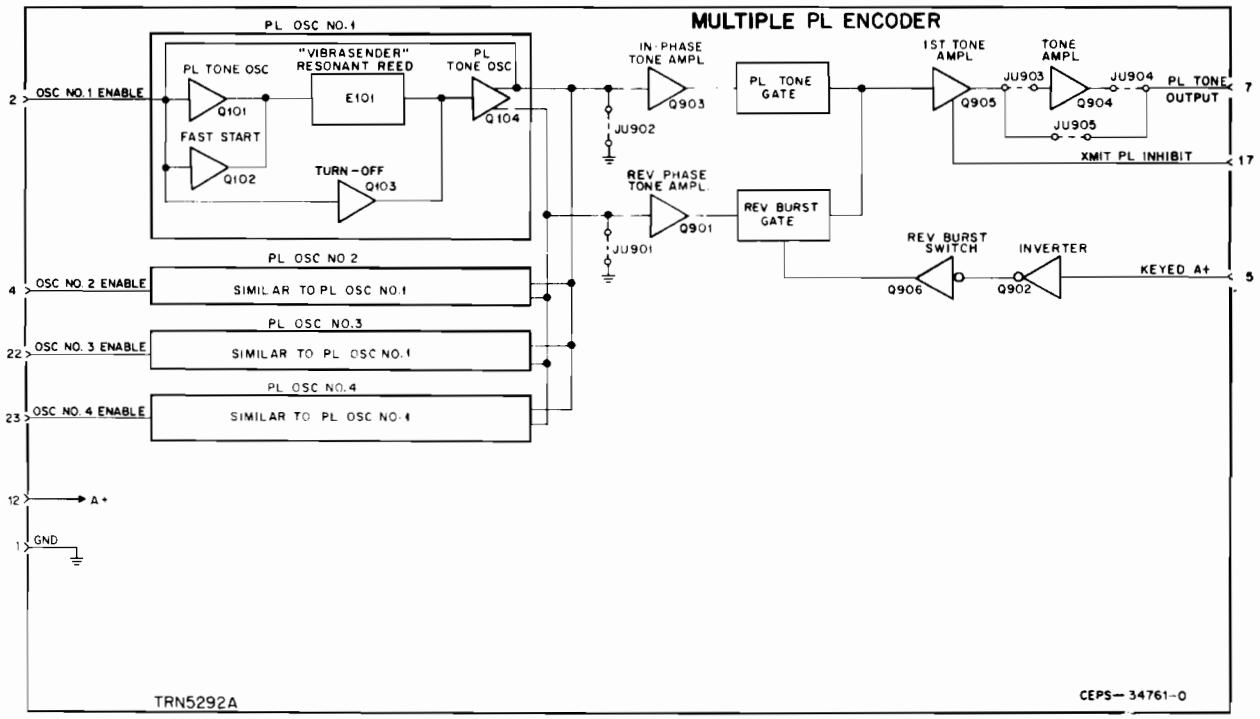


Figure 1. Functional Diagram

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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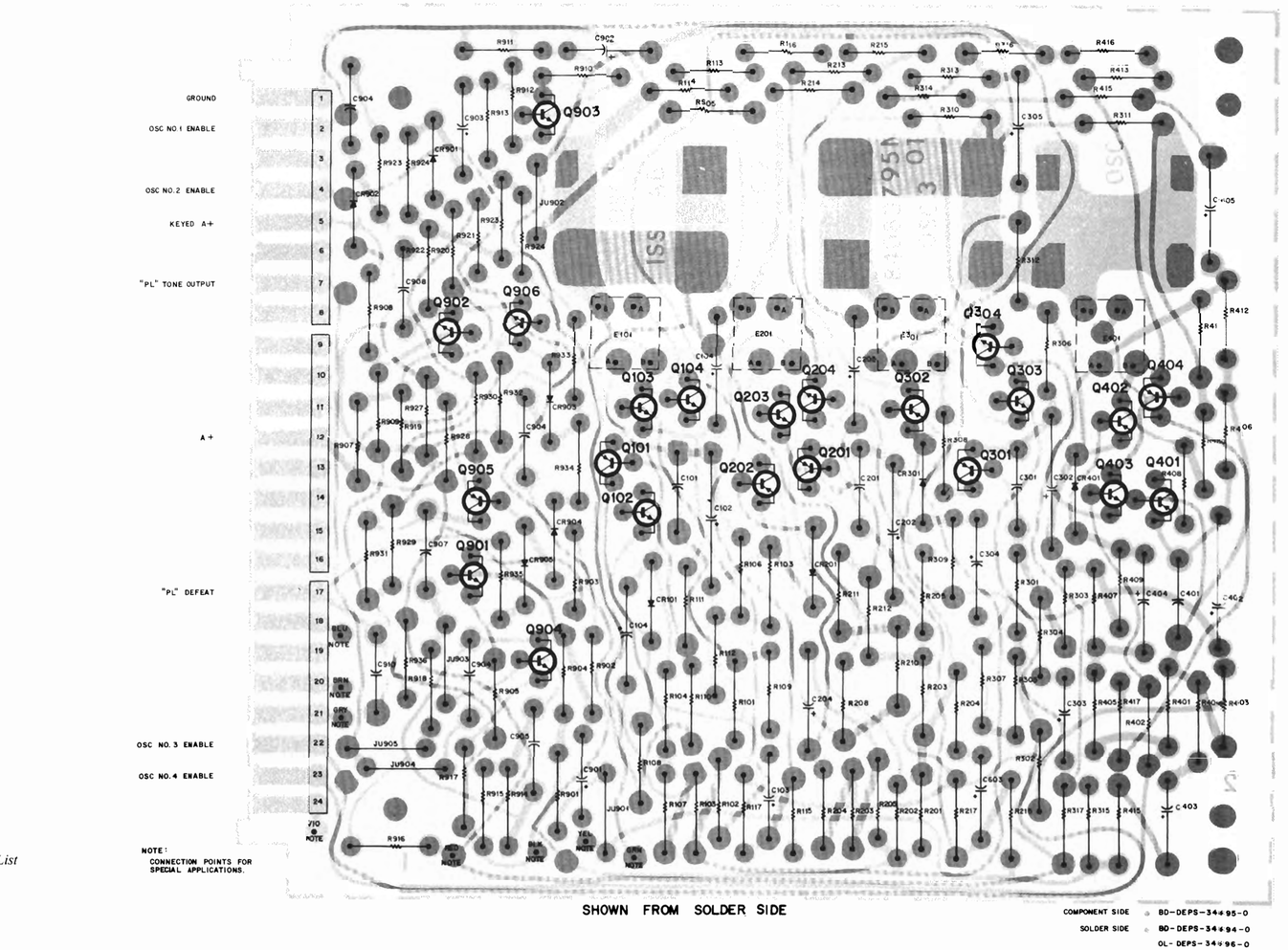
MULTIPLE PL ENCODER MODULE

MODEL TRN5292A



SHOWN FROM SOLDER SIDE

COMPONENT SIDE ○ BD-DEPS-3449 5-O

SOLDER SIDE ○ BD-DEPS-3449 4-O

OL-DEPS-3449 6-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

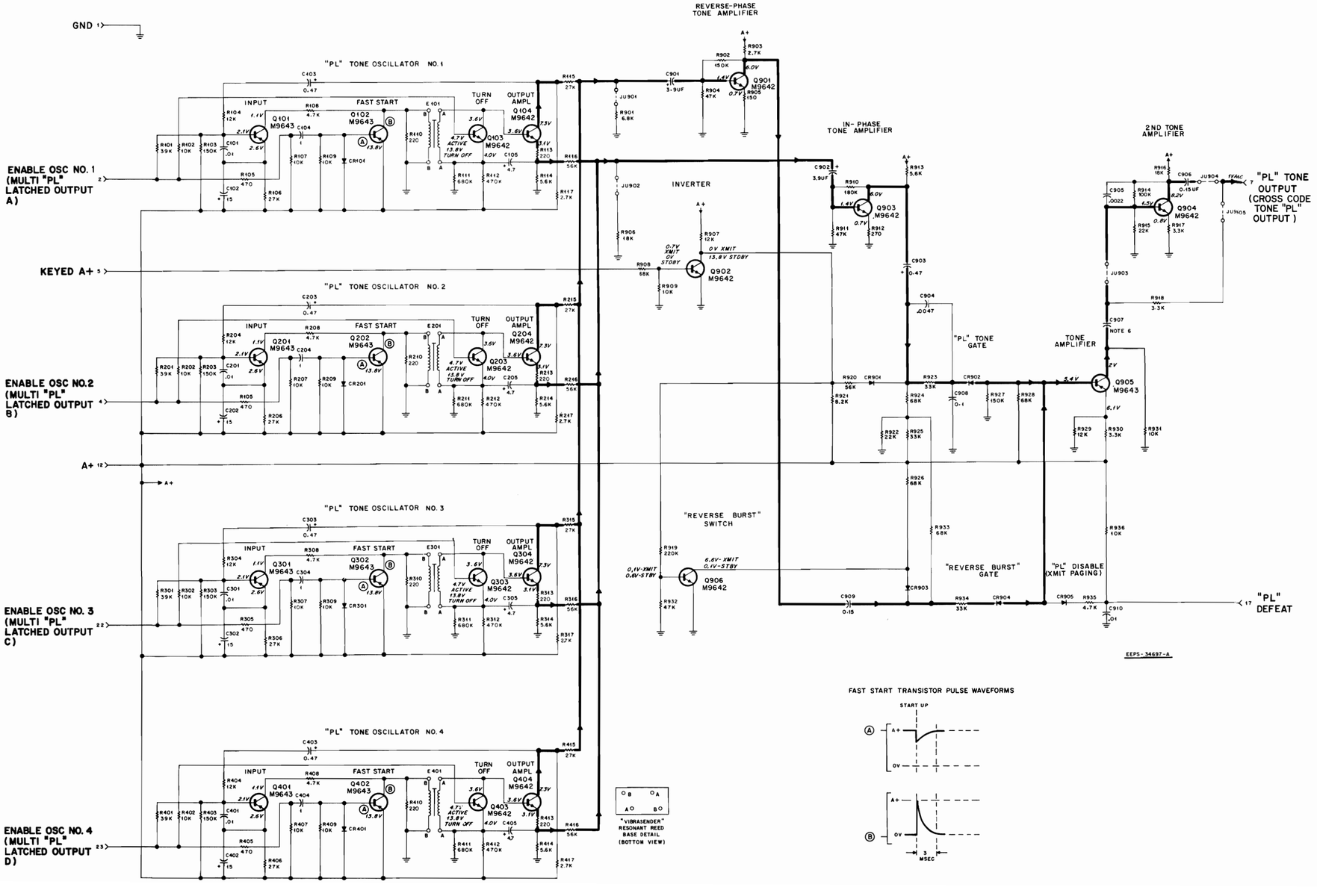
TRN5292A Multi-PL Encoder Module PL-7966-A

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

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
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	6-11009D89	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	6-11009D89	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	6-11009D89	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.

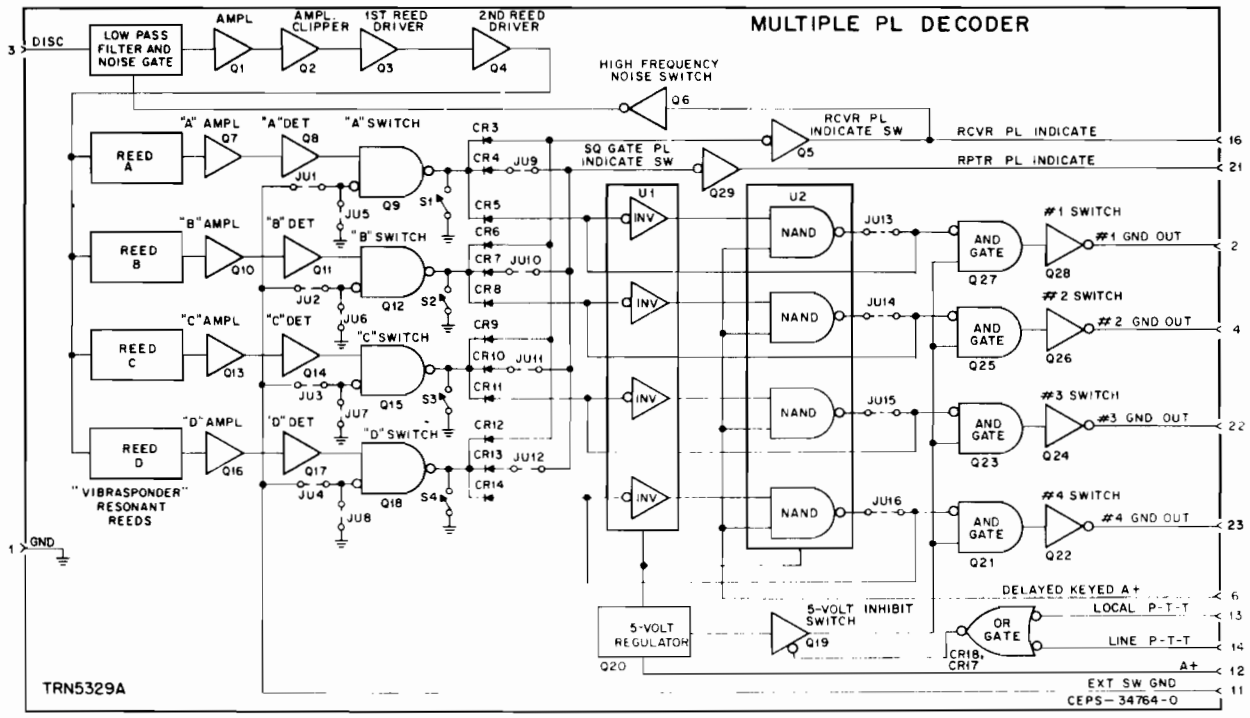


Figure 1. Functional Diagram

technical writing services
1301 E. Algonquin Road, Schaumburg, IL 60196

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,

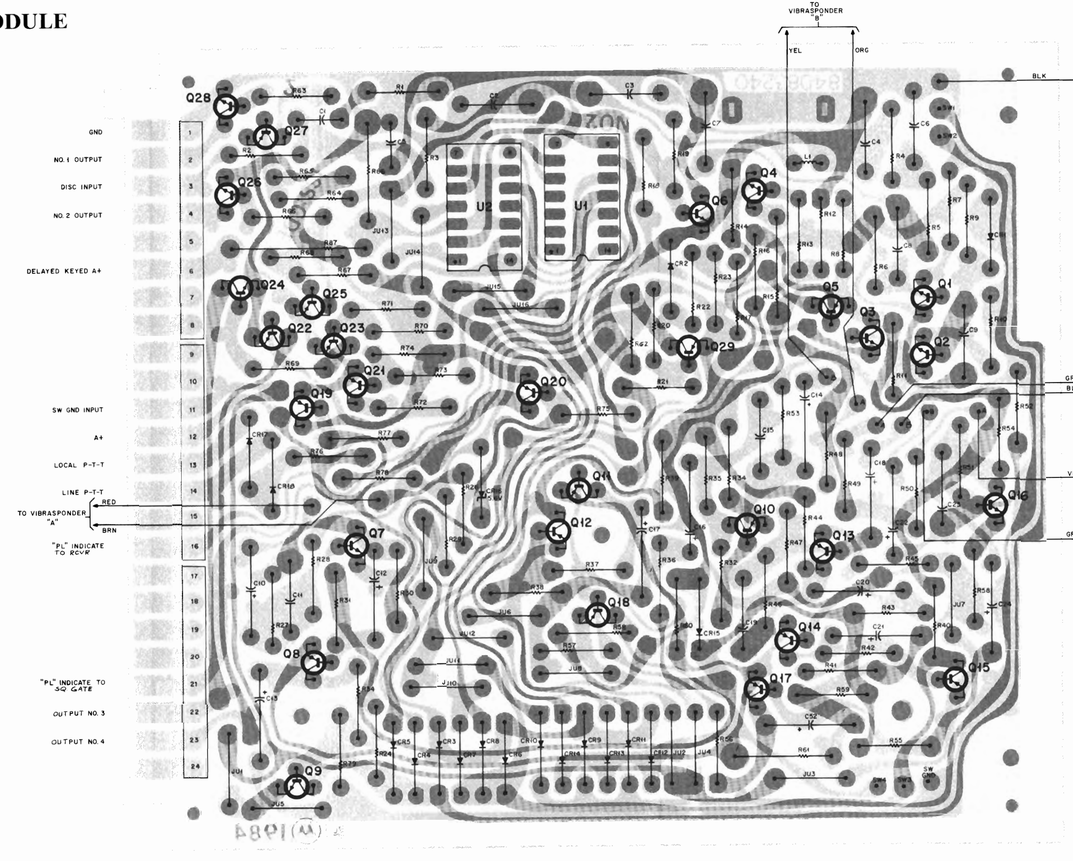
noise and PL tone will both be present and will produce erroneous readings.

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.

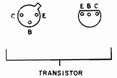
Step 3. If under normal operating conditions, the PL tones are heard with the speaker audio, the high pass filter on the decoder board should be checked.

MULTIPLE PL DECODER MODULE

MODEL TRN5329A



SHOWN FROM SOLDER SIDE



TRANSISTOR DETAILS

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

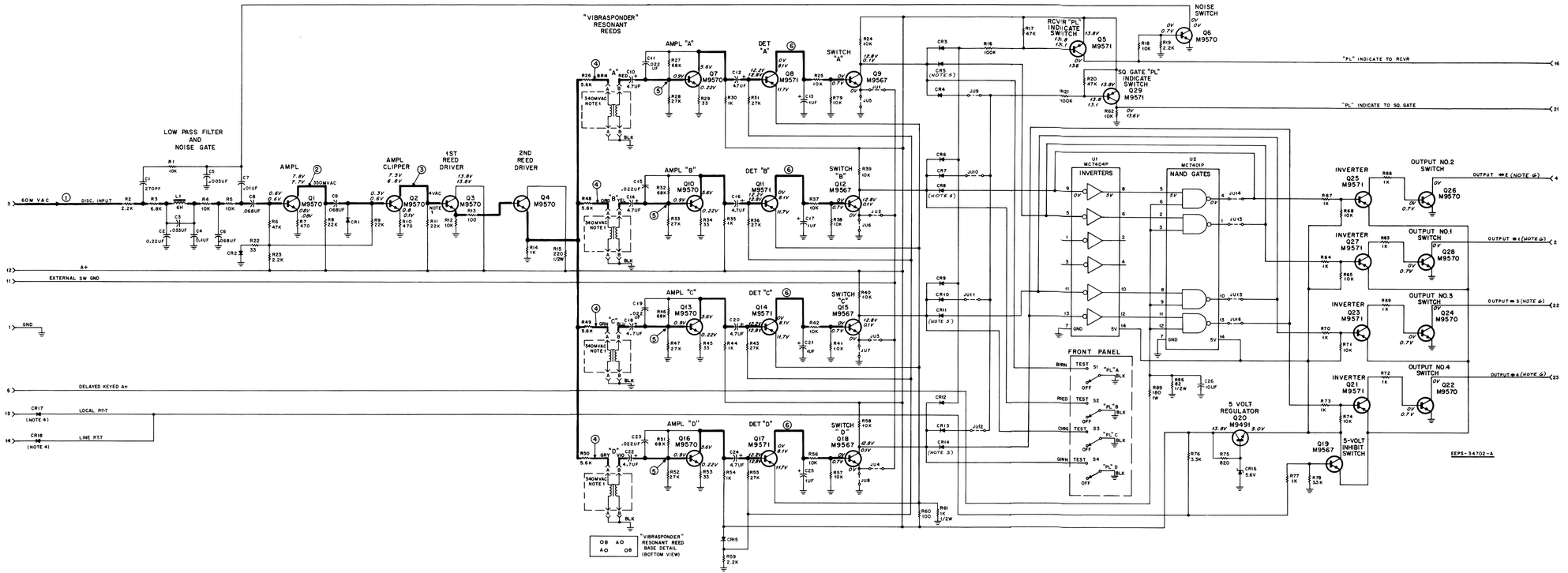
TRN5329A Multi-PL Decoder Module — PL-7968-A

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	4.7 ±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	48-82256C12	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	48-869491	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	51-84905E02	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
	64-84762F02	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



END OF DOCUMENT

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