MOBILE RADIO

MPR Personal Series

MULTIPLE TONE CHANNEL GUARD KIT
19A138416G1-G8

Maintenance Manual LBI30821
DATAFILE FOLDER - DF4114

MULTIPLE TONE CHANNEL GUARD KIT
19A138416G1-G8

SPECIFICATIONS *

Frequency Range	67-210.7 Hz
Programming Increments	.25 Hz
Temperature and Voltage Stability (Center frequency)	±.1%
Encode Output Level	180 millivolts RMS
Encode Distortion	1.5%
Maximum Frequency Error	±0.15%
Current Drain	4 mA @ 9 VDC
Normal Input Voltage Requirements	+7.5 VDC

These specifications are intended primarily for the use of the serviceman. Refer to the appropriate Specification Sheet for the complete specifications.

GENERAL ELECTRIC

TABLE OF CONTENTS

DESCRIPTION

The General Electric Multiple Tone Channel Guard, for MPR Personel radio "B" and "C" combinations, provides up to eight encode tone frequencies and eight decode tone frequencies. The tone frequencies, in the Channel Guard frequency range of 67 to 210.7 Hz, are programmable in 0.25 Hz increments.

Application of the Multiple Tone Channel Guard can be encode only or encode/decode.

The Multiple Tone Channel Guard consists of Channel Guard Module CG and Channel Guard Controller Module CGCL. Both modules mount on controller board A3504. This limits the number of RF channels to four transmit and four receive in "B" combinations and eight transmit and eight receive in "C" combinations.

Control for the Channel Guard can be frequency select or manual select. The frequency select system has each Channel Guard tone preassigned to an RF channel. Both the Channel Guard tone and the RF channel are selected with the RF Channel Selector switch of the radio. A toggle switch is provided on the control panel to enable or disable the Channel Guard Decoder.

The manual select system uses a rotary selector switch to manually select any preprogrammed tone frequency for any RF channel. A toggle switch is also provided to enable or disable the Channel Guard Decoder.

CIRCUIT ANALYSIS

Channel Guard Module (CG)

The Channel Guard module contains a tone frequency synthesizer, encoder, decoder and Squelch Tail Eliminator circuitry (See Figure 1). The synthesizer is programmable by the CGCL module to produce Channel Guard tones from 67 to 210.7 Hz in 0.25 Hz increments. The synthesizer uses a crystal controlled 32,768 Hz reference to produce the desired clock inputs to the encoder and decoder circuits and produce digitally generated time delays for the STE circuitry.

When the transmit circuit is keyed, the $\overline{\text{CPTT}}$ lead is pulled low and the Channel Guard module responds by pulling the $\overline{\text{DPTT}}$ lead low, holding the transmit circuit in a keyed condition. The encoder circuit generates a sine wave encode tone which passes through a low pass filter to remove any clock and tone harmonics. This output tone is connected by the CG ENC lead to the transmit audio processor module (TX-AA).

When the radio is unkeyed, the $\overline{\text{CPTT}}$ lead goes high but the PTT delay circuit holds the transmit circuit in a keyed condition for an additional 160 milliseconds by holding the $\overline{\text{DPTT}}$ lead low during this time. During this 160 millisecond time, the encode circuit sends the tone with a 135° phase shift. This combination of 135° phase shift and 160 millisecond delay causes the CG decoder in other receivers to squelch the receiver audio prior to loss of RF signal. This reduces or eliminates the receiver noise burst.

During receive, the receive circuit audio on the DISCR lead is fed to the CG module where it passes through a 212 Hz low pass filter to remove voice information. This prevents voice falsing or clipping in the decoder circuit. The digital decoder compares the frequency of the incoming tone to a reference clock produced by the synthesizer. If the correct tone is detected, the module responds by releasing the CG RUS lead which is normally held in a low voltage condition when the correct tone is not detected.

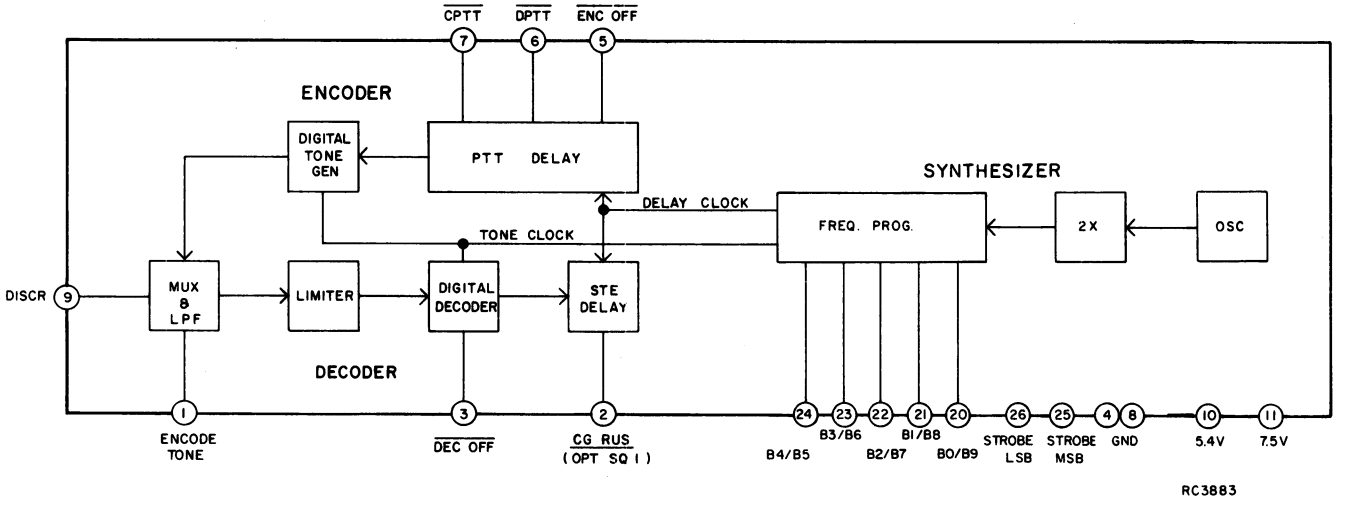


Figure 1 - Multiple Tone Channel Guard Module

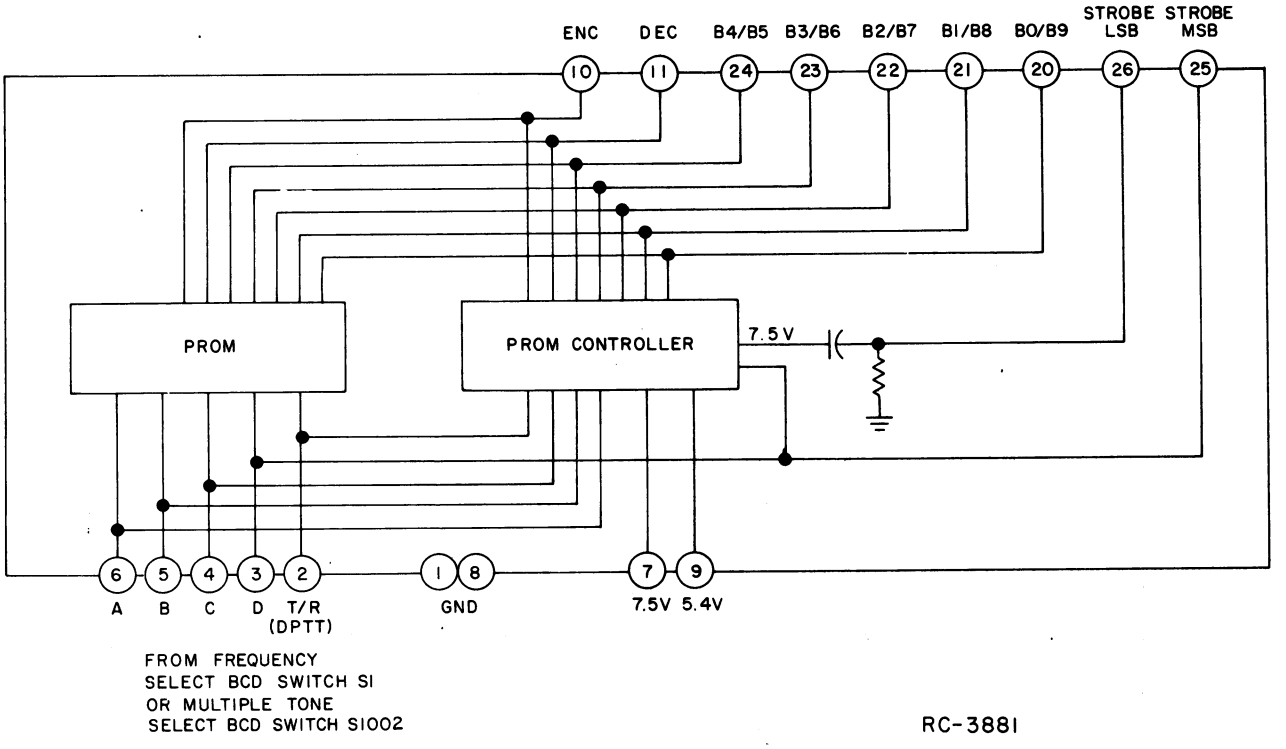


Figure 2 - Channel Guard Controller Module

After decoding the tone, the decoder then looks for a phase shift to occur. If the phase shift occurs, the decoder responds by pulling CG RUS low for 200 milliseconds using the STE delay circuit. This forces the receive circuit to squelch for 200 ms during which time the received carrier should disappear.

Channel Guard Controller Module (CGCL)

The Channel Guard Controller module contains a PROM controller and an 8 x 32 address PROM (See Figure 2).

The PROM controller monitors the BCD address inputs to the PROM. The BCD address inputs are provided by selector switch S1/S1002. When there is an address change, the PROM controller powers up the PROM allowing the PROM to produce a new output address for the CG module. The PROM controller stores the new address in latch circuits and removes power from the PROM to reduce power consumption. The PROM converts BCD programming inputs to select the correct Channel Guard tone. To program the Channel Guard ten frequency programming inputs are necessary, plus two inputs to program encode only and decode only. To reduce the number of inputs the frequency inputs are paralled to give five inputs with data being sent into the CG module twice. The first data is the most significant bits (MSB). The second data is the least significant bits (LSB).

The output data from the CGCL module is connected to the CG module through interconnect board A1001.

PROM PROGRAMMING

Inputs

TONE	CHANNEL	PROM OUTPUT DATA	PROM PROG. POS. TX	RX
1		MSB	8	24
		LSB	0	16
2		MSB	9	25
		LSB	1	17
3		MSB	10	26
		LSB	2	18
4		MSB	11	27
		LSB	3	19
5		MSB	12	28
		LSB	4	20
6		MSB	13	29
		LSB	5	21
7		MSB	14	30
		LSB	6	22
8		MSB	15	31
		LSB	7	23

Outputs

B_0 - Has a LSB value of .25 Hz or a MSB value of 128 Hz

B_1 - LSB = .5 Hz MSB = 64 Hz

B_2 - LSB = 1 Hz MSB = 32 Hz

B_3 - LSB = 2 Hz MSB = 16 Hz

B_4 - LSB = 4 Hz MSB = 8 Hz

B_5 - Decode ON/OFF 0 = Off

B_6 - Encode ON/OFF 0 = Off

B_7 - Not Used

NOTE: If a tone channel does not require a encode or decode freq. the respective encode or decode should be programmed off and the freq. programmed as zero.

Example

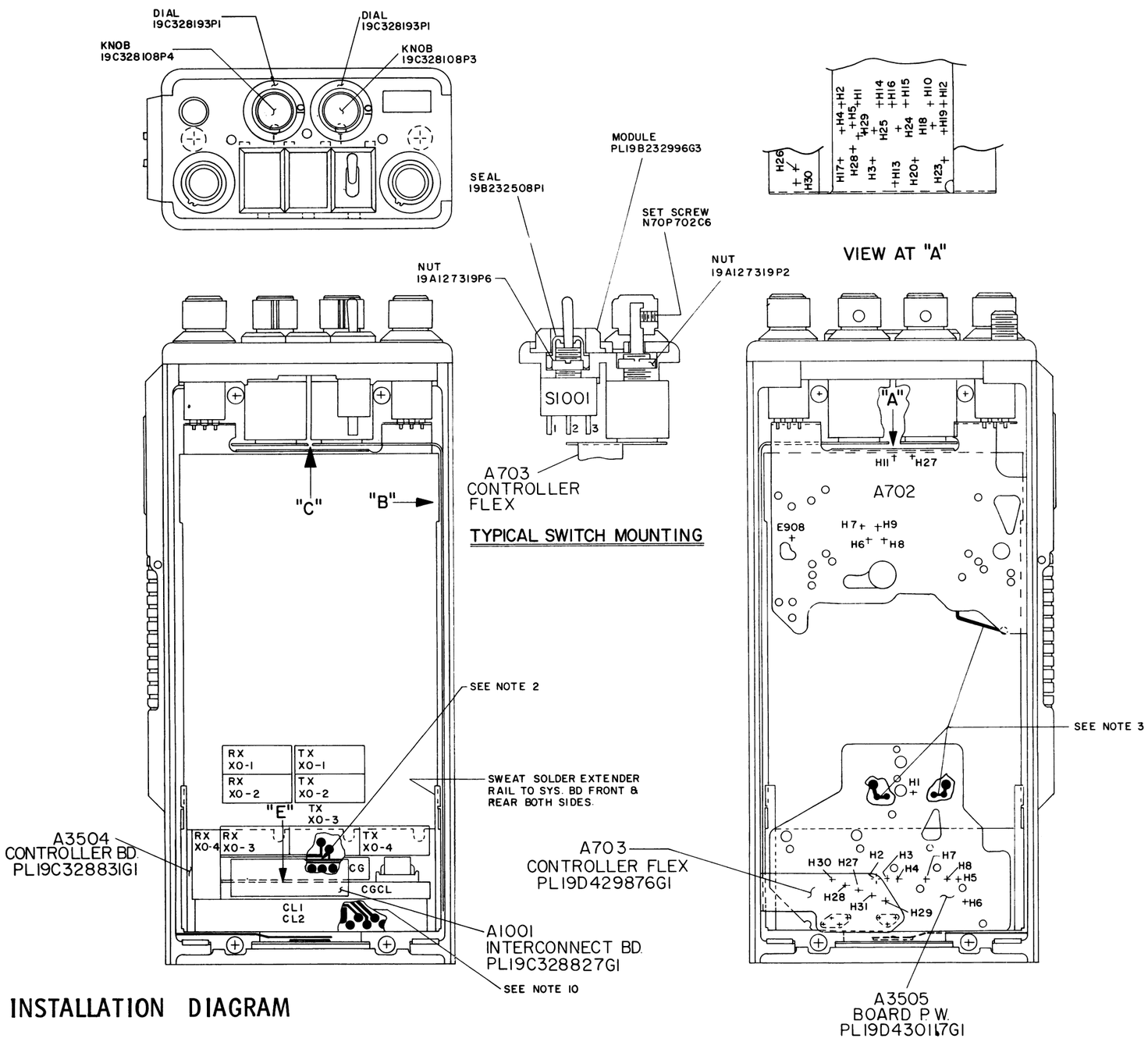
Channel 6 has a Tx tone freq. of 103.5 Hz and a Rx freq. 71.9 Hz.

PROM Prog. Pos	Output								Freq	
	B_0	B_1	B_2	B_3	B_4	B_5	B_6	B_7		
13	0	1	1	0	0	1	1	0		96 Hz
5	0	1	1	1	1	1	1	0		7.5 Hz
									TOTAL	103.5 Hz
29	0	1	0	0	1	1	1	0		72 Hz
21	0	0	0	0	0	1	1	0		0 Hz
									TOTAL	72 Hz

NOTE: Since 71.9 Hz is not a multiple of .25 Hz it should be rounded off to the nearest multiple of .25 Hz or 71.9 Hz = 72 Hz.

GENERAL ELECTRIC COMPANY • MOBILE COMMUNICATIONS DIVISION
WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

GENERAL ELECTRIC*
U.S.A.



INSTALLATION DIAGRAM

MULTIPLE TONE CHANNEL GUARD
KITS 19A138416G1,3,5 & 7
(Sheet 1)

(19D429873, Sh. 1, Rev. 1)

THESE INSTRUCTIONS COVER THE INSTALLATION OF HARDWARE KIT PL 19A138416G1, G3, G5, G7 FOR THE APPLICATION OF MULTI FREQUENCY AND MULTI TONE IN HIGH BAND "B" CASE MPR.

(1) • 1. REMOVE KNOBS, TOP COVER AND FRONT AND BACK COVERS, IF PRESENT.

2. CUT EXTENSION BOARD A3505 ALONG DOTTED LINE AND CUT OFF EXTENDER RAILS AS SHOWN; ALSO CUT RUN ON A3504 CONTROLLER BOARD (1 PLACE).

(3) ● 3. CUT RUN ON SYSTEM BOARD IN THREE PLACES IF REQUIRED.

4. ASSEMBLE CONTROLLER BOARD A3504 TO SYSTEM BOARD AND EXTENSION BOARD A3505 TO CONTROLLER AND SYSTEM BOARD AS SHOWN. AFTER SOLDERING, TRIM PINS FLUSH TO RAISED .030. REMOVE JUMPER WIRE (DM) BETWEEN A702-H27 AND A702-H11.

(5) 5. SET STOPS ON MULTI FREQ SWITCH AND MULTI TONE SWITCH IF REQUIRED, TO ORDER PER CHART SHOWN. (SEE SH. 3)

6. PUNCH OUT HOLES IN TOP PLATE AND TOP COVER TO MOUNT SWITCHES AS SHOWN.

(7) ■ 7. INSTALL SWITCH OF CONTROLLER FLEX A703 AND RUN THE FLEX CIRCUIT DOWN THE SIDE OF THE CASE CONNECTING TO CONTROLLER BOARD A3504, AFTER SOLDERING, TRIM PINS FLUSH TO RAISED .030.

8. INSTALL S1001 FOR ENCODE/DECODE UNITS AND A1002 FOR MANUAL TONE SELECT, IN POSITION SHOWN. MAKE CONNECTION FROM CHART.

FROM	TO	WIRE	REMARK
A703-H17	A702-H12	T28-BK	ALL GROUPS
A703-H28	A3505-H6	T28-W-V	ALL GROUPS
A703-H25	E908	T28-W-V	ALL GROUPS
A703-H27	A3505-H5	T28-O	GROUP 5,7
A703-H24	A702-H30	T28-O	GROUP 5,7
A702-H2	S1001-2	T28-BK	GROUP 5,7
A703-H30	A3505-H8	T28-V	GROUP 5
A703-H26	S1001-3	T28-V	GROUP 5
A3505-H8	A3505-H9	T28-V	GROUP 7
A702-H1	S1001-3	T28-V	GROUP 7
A703-H29	A3505-H2	T28-W	GROUP 3,7
A703-H31	A3505-H3	T28-W-BL	GROUP 3,7
A703-H30	A3505-H4	T28-W-BR	GROUP 3,7
A703-H22	S1002-H3	T28-W	GROUP 3,7
A703-H23	S1002-H5	T28-W-BL	GROUP 3,7
A703-H26	S1002-H2	T28-W-BR	GROUP 3,7
A702-H2	S1002-H1	T28-BK	GROUP 3,7

9. ASSEMBLE SEAL OVER S1001 AND REPLACE BLANK MODULE WITH THE CG MODULE.

10. IF CG TONES ARE TO BE MANUAL SELECT, CUT RUNS ON COMPONENT SIDE OF CONTROLLER BOARD (A3504) IN THREE (3) PLACES.

11. SOLDER ALL ELECTRICAL CONNECTIONS.

12. INSTALL THE REQUIRED CONTROLLER CL1 OR CL2, THE OSCILLATORS, CG, CGCL, CGCL PROM, AND (A1001) INTERCONNECT BD AS SHOWN. THE CGCL PROM IS PROGRAMMED TO ORDER PER INSTRUCTIONS 19A138336.

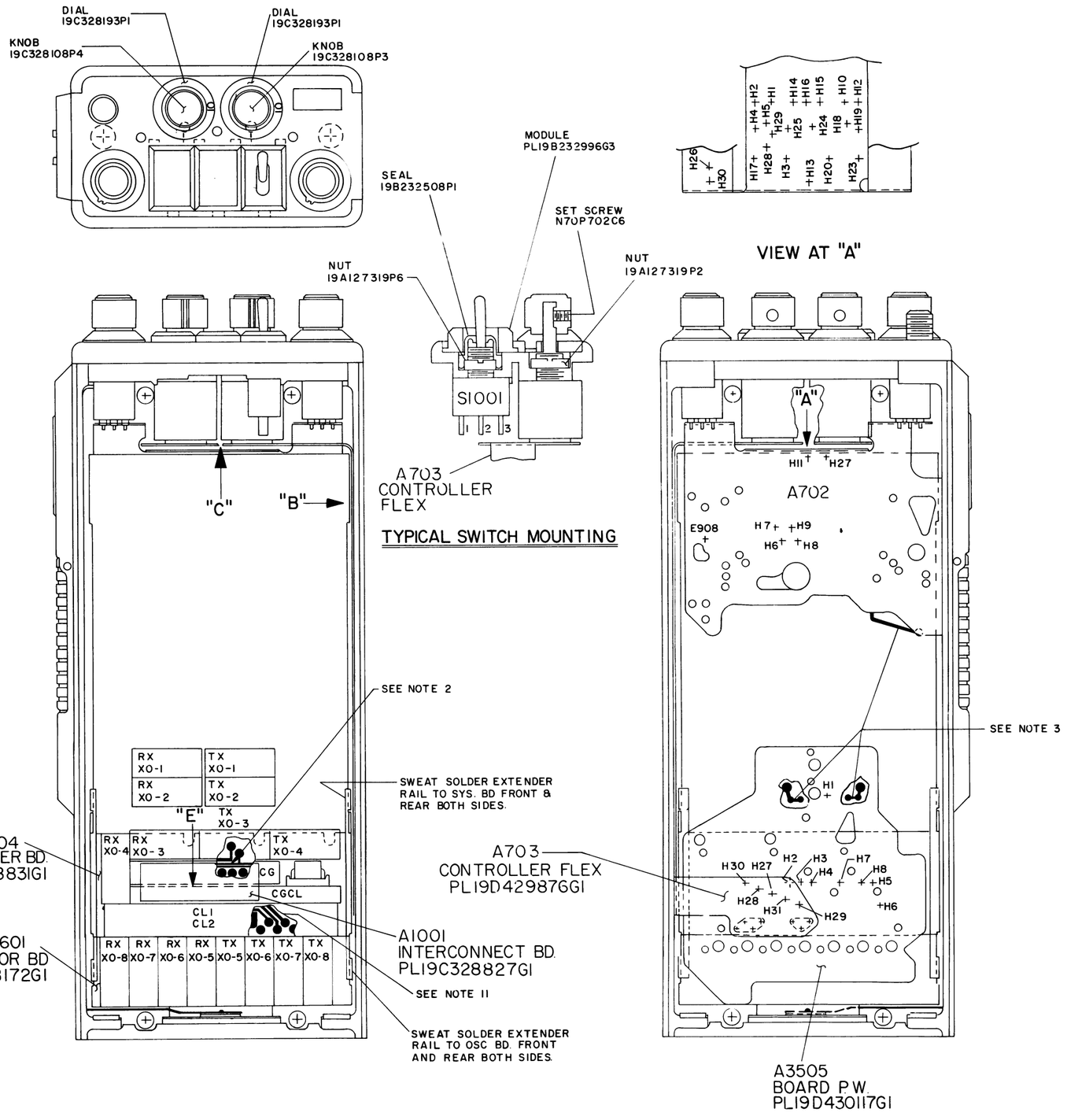
*13. IF ALL OTHER OPTIONS THAT REQUIRE REMOVAL OF THE TOP COVER HAVE BEEN INSTALLED. SNAP ON TOP COVER AND INSTALL KNOBS AND FRONT AND BACK COVERS.

14. INSTALL FREQUENCY AND TONE DIAL AND KNOB AS SHOWN.

* REQUIRED IN FIELD INSTALLATION.

● THIS STEP REQUIRED ONLY IF SP (PSLM) OR SL (SLM) OPTION INSTALLED.

■ BEFORE INSTALLING SWITCH ASSEMBLY A703 CHECK OPTION IF THERE IS A PSLM (SP) OR A SLM (SL) OPTION IN THIS UNIT IT WOULD BE ADVISABLE TO DO THE WORK REQUIRED BY EITHER OF THESE OPTIONS BEFORE INSTALLING SWITCH.



(19D429873, Sh. 2, Rev. 1)

THESE INSTRUCTIONS COVER THE INSTALLATION OF HARDWARE KIT PL19A138416G2, G4, G6, G8 FOR THE APPLICATION OF MULTI FREQUENCY AND MULTI TONE IN HIGH BAND "C" CASE MPR.

(2)

* 1. REMOVE KNOBS, TOP COVER AND FRONT AND BACK COVERS, IF PRESENT.

2. CUT RUN ON A3504 CONTROLLER BOARD (1 PLACE) AS SHOWN.

(4)

● 3. CUT RUN ON SYSTEM BOARD IN THREE PLACES IF REQUIRED.

4. ASSEMBLE CONTROLLER BOARD A3504 TO SYSTEM BOARD AND OSCILLATOR BOARD A3601 TO CONTROLLER BOARD. ASSEMBLE EXTENSION BOARD A3505 TO SYSTEM BOARD, CONTROLLER BOARD AND OSCILLATOR BOARD AS SHOWN. AFTER SOLDERING TRIM PINS FLUSH TO RAISED .030.

(6)

5. REMOVE JUMPER WIRE (DM) BETWEEN A702-H27 & A702-H11.

6. SET STOPS ON MULTI FREQ SWITCH AND MULTI TONE SWITCH IF REQUIRED TO ORDER PER CHART SHOWN. (SEE SH. 3)

(8)

7. PUNCH OUT HOLES IN TOP PLATE AND TOP COVER TO MOUNT SWITCHES AS SHOWN.

■ 8. INSTALL SWITCH OF CONTROLLER FLEX A703 AND RUN FLEX CIRCUIT DOWN THE SIDE OF THE CASE CONNECTING TO CONTROLLER BOARD A3504. AFTER SOLDERING, TRIM PINS FLUSH TO RAISED .030.

9. INSTALL S1001 FOR ENCODE/DECODE UNITS AND S1002 FOR MANUAL TONE SELECT, IN POSITION SHOWN. MAKE CONNECTIONS FROM CHART.

FROM	TO	WIRE	REMARKS
A703-H17	A702-H12	T28-BK	ALL GROUPS
A703-H28	A3505-H6	T28-W-V	ALL GROUPS
A703-H25	E908	T28-W-V	ALL GROUPS
A703-H27	A3505-H5	T28-O	GROUP 6, 8
A703-H24	A702-H30	T28-O	GROUP 6, 8
A702-H2	S1001-2	T28-BK	GROUP 6, 8
A703-H30	A3505-H8	T28-V	GROUP 6
A703-H26	S1001-3	T28-V	GROUP 6
A3505-H8	A3505-H9	T28-V	GROUP 8
A702-H1	S1001-3	T28-V	GROUP 8
A703-H29	A3505-H2	T28-W	GROUP 4, 8
A703-H31	A3505-H3	T28-W-BL	GROUP 4, 8
A703-H30	A3505-H4	T28-W-BR	GROUP 4, 8
A703-H22	S1002-H3	T28-2	GROUP 4, 8
A703-H23	S1002-H5	T28-W-BL	GROUP 4, 8
A703-H26	S1002-H2	T28-W-BR	GROUP 4, 8
A702-H2	S1002-H1	T28-BK	GROUP 4, 8

10. ASSEMBLE SEAL OVER S1001 AND REPLACE BLANK MODULE WITH THE CG MODULE.

11. IF CG TONES ARE TO BE MANUAL SELECT, CUT RUNS ON COMPONENT SIDE OF CONTROLLER BOARD (A3504) IN THREE (3) PLACES.

12. SOLDER ALL ELECTRICAL CONNECTIONS.

13. INSTALL THE REQUIRED CONTROLLER CL1 OR CL2, THE OSCILLATORS, CG, CGCL, CGCL PROM AND (A1001) INTERCONNECT BD AS SHOWN. THE CGCL PROM IS PROGRAMMED TO ORDER PER INSTRUCTION 19A138336.

* 14. IF ALL OTHER OPTIONS THAT REQUIRE REMOVAL OF THE TOP COVER HAVE BEEN INSTALLED, SNAP ON TOP COVER AND INSTALL KNOBS AND FRONT AND BACK COVERS.

15. INSTALL FREQUENCY AND TONE DIAL AND KNOB AS SHOWN.

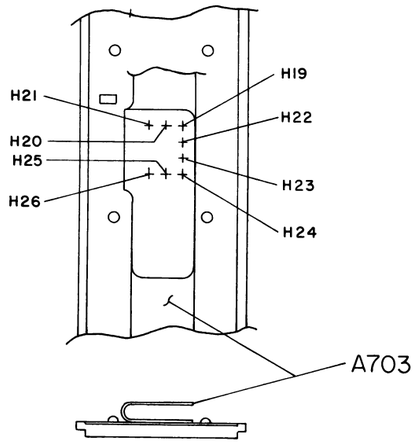
* REQUIRED IN FIELD INSTALLATION.

● THIS STEP REQUIRED ONLY IF SP (PSLM) OR SL (SLM) OPTION INSTALLED.

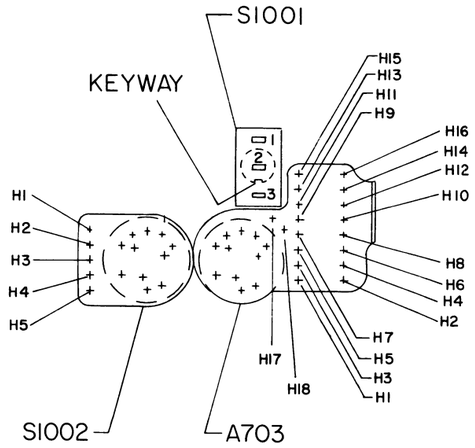
■ BEFORE INSTALLING SWITCH ASSEMBLY A703, CHECK OPTION. IF THERE IS A PSLM (SP) OR A SLM (SM) OPTION IN THIS UNIT, IT WOULD BE ADVISABLE TO DO THE WORK REQUIRED BY EITHER OF THESE OPTIONS BEFORE INSTALLING SWITCH.

INSTALLATION DIAGRAM

MULTIPLE TONE CHANNEL GUARD KITS 19A138416G2,4,6 & 8 (Sheet 2)



VIEW AT "B"



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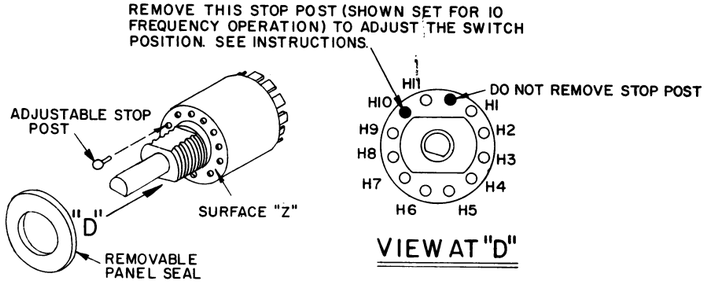


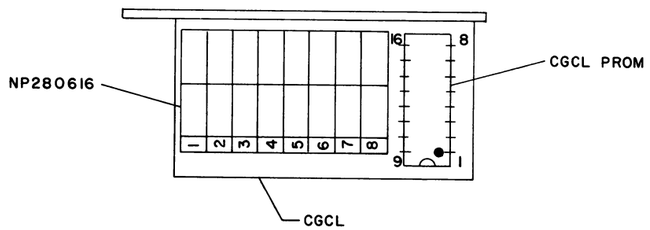
VIEW AT "D"

INSTRUCTIONS FOR STOP INSTALLATION ON MULTI-FREQUENCY SWITCH OR TONE SWITCH:

1. SHAFT MUST BE FULL COUNTER CLOCKWISE AS VIEWED FROM KNOB END.
2. REMOVE PANEL SEAL FOR ADJUSTMENT OF STOPS. SEE VIEW "D".
3. INSTALL ADJUSTABLE STOPS PER CHART BELOW:

NO. OF FREQ OR TONE	MOVE ADJUSTABLE STOP	
	FROM	TO
2	H10	H2
3	H10	H3
4	H10	H4
5	H10	H5
6	H10	H6
7	H10	H7
8	H10	H8

4. REASSEMBLE PANEL SEAL WITH SIDE MARKED "BOTTOM" AGAINST SURFACE "Z".



VIEW AT "E"

INSTALLATION DIAGRAM

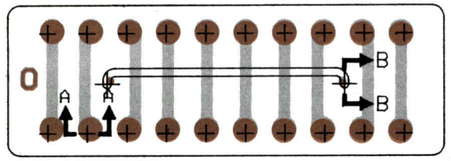
MULTIPLE TONE CHANNEL GUARD KITS
(Sheet 3)

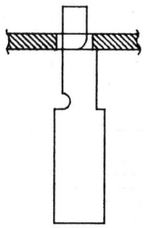
(19D429873, Sh. 3, Rev. 1)

Before beginning the following procedure, refer to the MPR Troubleshooting Tree listed in the Table of Contents of Maintenance Manual LBI30771.

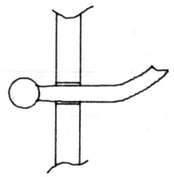
STEP	PROCEDURE
	CONTROLLER MODULE (CGCL)
1	Check all CG tones for correct operation. If all tones are wrong, check the Controller. If only one is wrong replace the PROM.
2	To check the Controller, remove the interconnect board (A1001) and turn the unit on. With a high impedance voltmeter, the programming leads can be checked for LSB of the decoder channel. Press the PTT bar and the LSB of the encoder can be checked.
3	Ground Pin 25 of the controller module. Press the PTT bar and the MSB of the encoder can be checked as in step 2. Release the PTT and check the MSB of the decoder. NOTE: The MSB of the decoder must be checked after the PTT is released or the channel/tone selector is changed. This initiates a new sequence from the controller and with Pin 25 ground this holds the PROM output to the MSB.
4	If the module fails step 2 or 3 with a known good PROM, replace the controller.
	MULTIPLE TONE CHANNEL GUARD MODULE (CG)
5	Remove controller module.
6	Calculate tone code. Refer to Table of Contents for PROM PROGRAMMING.
7	With unit on, connect desired program (MSB) pins to ground. Then connect Pin 25 to ground. Next change program connections to (LSB) pins to ground. DO NOT REMOVE GROUND CONNECTION FROM PIN 25. Connect Pin 26 to ground. At this point the programming connections may be removed except for Pins 25 and 26.
8	Press the PTT bar and the radio will encode the programmed tone. If not, replace the CG module.
9	Apply the correct RF frequency, modulated with the desired CG tone to the input of the receive circuit. This will open the CG decoder. If not replace the CG module.
10	If the CG module passes the above test and the CG system problems still exist, check the controller.

INTERCONNECTION BOARD
A1001



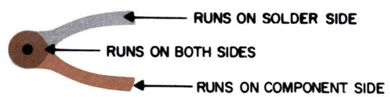


SECTION A-A
ENLARGED
TYP. 20 PLACES

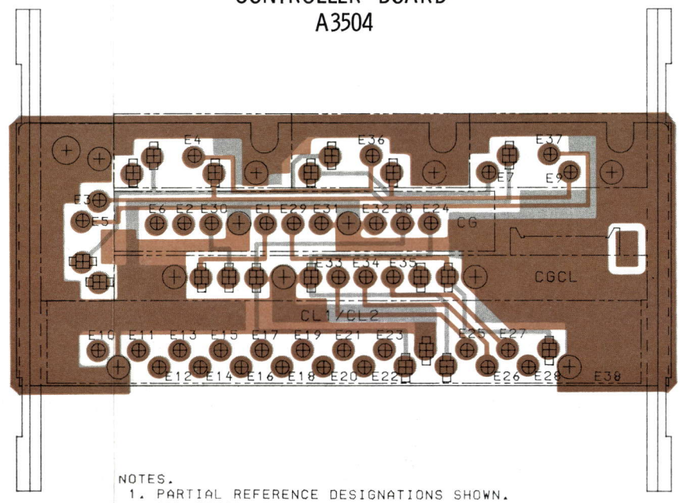


SECTION 'B-B'
ENLARGED

(19B233513, Rev. 0)
(19A138080, Sh. 1, Rev. 0)
(19A138080, Sh. 2, Rev. 0)



CONTROLLER BOARD
A3504



NOTES.
1. PARTIAL REFERENCE DESIGNATIONS SHOWN. ALL DESIGNATIONS ARE 3500 SERIES; EXAMPLE: E1= E3501.

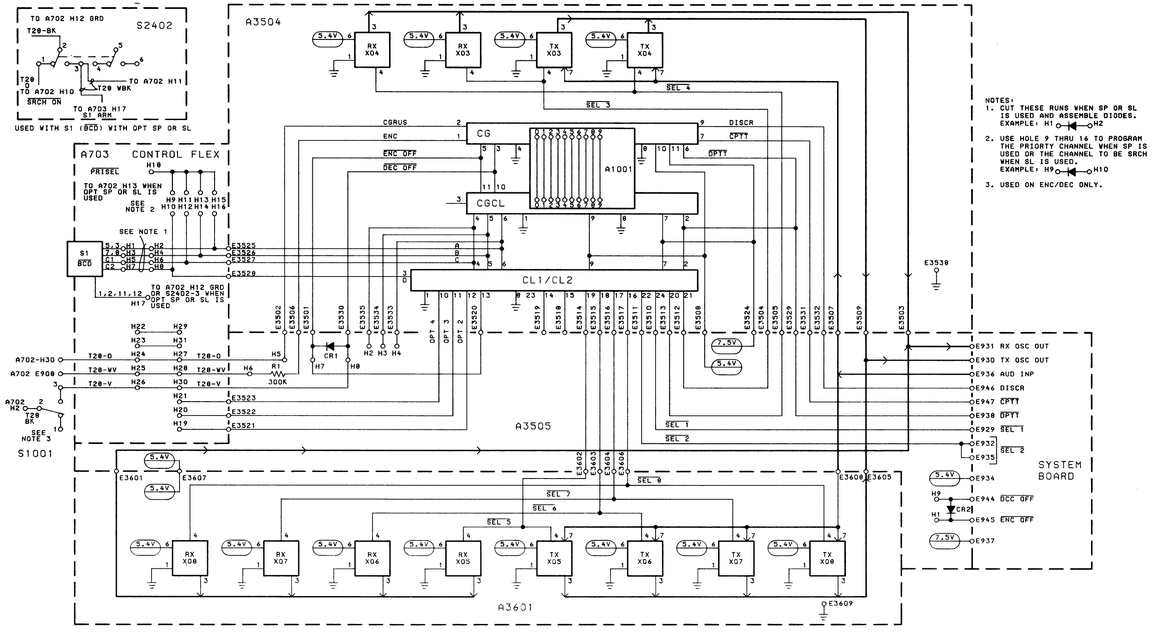
(19C328832, Rev. 1)
(19A138088, Sh. 1, Rev. 0)
(19A138088, Sh. 2, Rev. 0)

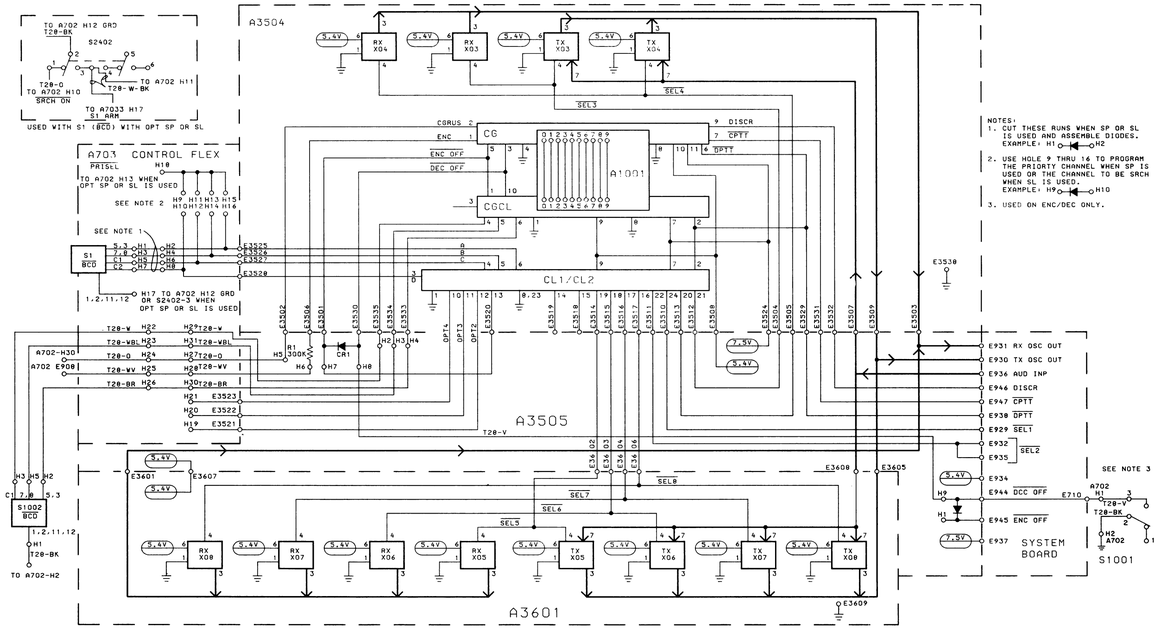
EXTENDER BOARD
A3505

(19C330566, Rev. 0)
(19A138098, Sh. 1, Rev. 0)
(19A138098, Sh. 2, Rev. 0)

OUTLINE DIAGRAM

MULTIPLE TONE CHANNEL GUARD
KITS 19A138416G1-G8





SCHEMATIC DIAGRAM

MULTIPLE FREQUENCY AND MULTIPLE TONE FREQUENCY SELECT