MOBILE RADIO

CENTURY II
MAINTENANCE MANUAL
PROGRAMMABLE CHANNEL GUARD 19C328576G1-4

Maintenance Manual LBI30893
DATAFILE FOLDER - DF5047

PROGRAMMABLE CHANNEL GUARD 19C328576G1-4

SPECIFICATIONS *

Input Voltage	8.5 Volts DC
Current Drain	40 Milliamperes Maximum
Frequency Range	67-210.7 Hz
Maximum Frequency Error	±0.2%
Encode Output Level	
67 Hz	0.7 Volts RMS Minimum
156.7 Hz	0.30 Volts RMS Minimum
210.7 Hz	0.15 Volts RMS Minimum
Encode Tone Distortion	2.0% Maximum
Programming Increments	0.25 Hz
Decode Level	35 Millivolts RMS Minimum
Decode Response Time	250 Milliseconds Maximum
PTT Delay	160 Milliseconds
STE Phase Shift	135°
Temperature Range	-30°C (-22°F) to +60°C (140°F)

*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

WARNING

Although the highest DC voltage in the unit is supplied by the vehicle battery, high current may be drawn under short circuit conditions. These currents can possibly heat metal objects such as tools, rings, watchbands, etc. enough to cause burns. Be careful when working near energized circuits.

DESCRIPTION

General Electric Channel Guard Modules 19C328576 are field programmable, synthesized single tone Channel Guard encoders/decoders for use with Century II mobile radios.

The encode function provides continuous tone-coded modulation for the transmitter. The decode function is used with the receiver to eliminate all calls that are not tone coded with the proper Channel Guard (CG) frequency.

A tone reject filter is available for use in non-Channel Guard mobiles and stations that receive tone modulated calls.

Four different Channel Guard boards are available:

- 19C328576G1 - single tone encode/decode (includes tone reject filter)
- 19C328576G2 - single tone encode only
- 19C328576G3 - single tone decode only (includes tone reject filter)
- 19C328576G4 - tone reject filter only

OPERATION

In mobile Channel Guard applications, a microphone hookswitch is supplied with the radio. The CG hookswitch is equipped with a CG disable switch.

Placing the disable hookswitch in the "up" position (towards the small speaker symbol) disables the receive Channel Guard. With the switch in the "down" position, the receive Channel Guard is disabled when the microphone is removed from the hookswitch.

In station applications, a desk microphone is available for use with Channel Guard. Pressing the MONITOR bar on the base of the desk microphone disables the CG decode function. This permits the channel to be monitored before sending a message.

CIRCUIT ANALYSIS

Channel Guard is a continuous-tone controlled squelch system that provides communications control in accordance with EIA standard RS-220-A. The basic Channel Guard system utilizes standard tone frequencies from 67 to 210.7 hertz with both the encoder and decoder operating on the same frequency. The standard Channel Guard tone frequencies are shown in the following chart.

STANDARD TONE FREQUENCIES				
67.0	88.5	107.2	131.8	167.9
71.9	91.5	110.9	136.5	173.8
74.4	94.8	114.8	141.3	179.9
77.0	97.4	118.8	146.2	186.2
79.7	100.0	123.0	151.4	192.8
82.5	103.5	127.3	156.7	203.5
85.4			162.2	210.7

The Channel Guard circuitry consists of frequency systhesizer U1003, encoder/decoder U1001, tone programming switch S1001, tone reject filter integrated circuit (IC) U1004 and associated discrete circuitry.

Frequency synthesizer U1003 includes the synthesizer IC and a 32,768 Hz reference crystal that provides the clock inputs for the encoder/decoder module (U1001). The clock inputs are required to produce the tone frequency and the digitally generated time delays for the DELAYED PTT and squelch tail elimination (STE) circuits. Tone frequency programming is accomplished by setting the 10 station switch (S1001) for the proper binary input to the synthesizer. The switch can be set to produce any CG tone from 67 Hz to 210.7 Hz in 0.25 Hz increments.

Encode/decode hybrid U1001 contains the encoder and decoder, a voice reject filter, STE circuit and the interface circuitry. The interface circuitry provides increased output drive for RX MUTE, PTT DLYD (Delayed Push-To-Talk) and other functions.

ENCODE MODE

Depressing the PTT switch applies a low (A-) to PTT lead P1005-7. This causes the PTT DLYD lead (P1005) to go low, keying the transmitter. The encoder then generates the CG tone which is applied to a low pass filter to remove any tone or clock harmonics. The filter output is then applied to CG MODULATION control R1004 and CG HI lead (P1005-4) to the transmit audio processor on the transmit/receive (TX/RX) board. Refer to the appropriate TX/RX Maintenance Manual for the CG MODULATION adjustment procedure.

When the PTT button on the microphone is released (transmitter unkeyed), the DELAYED PTT circuit in U1001 keeps the transmitter keyed for an additional 160 milliseconds. During the 160 milliseconds delay time, the encoder shifts the phase of the CG tone output 135°. This combination of 160 milliseconds delay and the 135° phase shift causes the CG decoder in other receivers

to squelch the audio before the loss of RF signal, eliminating the receiver noise burst (squelch tail elimination).

DECODE MODE

In the receive mode, receiver audio from VOLUME/SQUELCH HI lead P1005-2 is applied to a voltage divider (R1002 and R1003) and then to a voice reject filter in the decode circuit. The filter removes any voice information to prevent voice blocking of clipping.

The digital decoder compares the frequency of the incoming tone to a reference clock input produced by the synthesizer. If the correct tone is detected, the decoder circuit causes the RX MUTE lead at P1005-9 to go high, unsquelching the receiver. RX MUTE lead P1005-9 is normally held in a low voltage condition when the correct CG tone is not detected.

After the CG tone is decoded, the decoder then waits for a phase shift in the tone to occur. When the phase shift occurs, the STE delay circuit in the decoder pulls the RX MUTE lead to a low voltage state. This squelches the receiver for 200 milliseconds and keeps the receiver squelched until the RF carrier applied to the receiver is removed.

Audio from VOL/SQ HI is connected to the tone reject filter through P1005-2. The filter circuit rejects all tone frequencies from 70 to 210.7 Hertz, and passes all other audio frequencies. The filtered and amplified audio is applied to the receiver audio circuits through P1005-1 (FLTRD VOL/SQ HI).

TONE REJECT FILTER

Audio and tone from the VOLUME control is applied to the tone reject filter which attenuates the tone level reaching the receiver audio circuits. The filter consists of operational amplifiers U1004 and associated circuitry.

ENCODE DISABLE

The Encode Disable circuit has been incorporated as a maintenance aid for the serviceman. This circuit can be used to disable the CG encode circuit to allow the serviceman to make transmitter distortion and modulation checks without removing the cover from the radio. The circuit consists of Q1001, C1010, R1018 and R1019.

Temporarily jumpering P910-9 (CG DISABLE) to P910-11 (A+) at the rear of the radio applies A+ to ENCODE/DECODE DISABLE lead P1005-10. The A+ is dropped across voltage dividers R1018 and R1019, applying approximately 1.7 volts to the base of Q1001. This base voltage turns on Q1001, causing the collector voltage to go low (near ground potential). The low is applied to Pin 11 of the encoder/decoder hybrid and disables the encode circuit.

CAUTION

DO NOT remove the microphone from the CG hookswitch or press the desk microphone MONITOR switch while using the encode disable jumper. To do so will short the 8.5 volt regulator on the TX/RX board to ground through the hookswitch (or desk mic), and damage to the equipment will result.

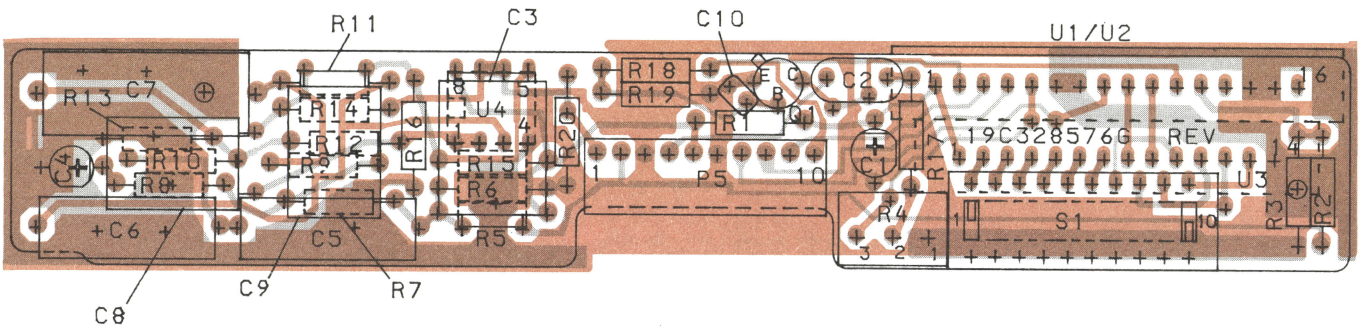
GENERAL ELECTRIC COMPANY • MOBILE COMMUNICATIONS DIVISION
WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

GENERAL ELECTRIC*
U.S.A.

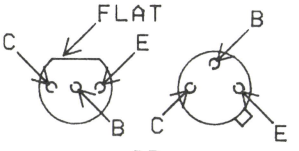
TROUBLESHOOTING PROCEDURE

Before starting the TROUBLESHOOTING PROCEDURE, check to see that 8.5 volts and A- are present at P1005.

SYMPTOM	PROCEDURE
No Encode Tone	Check the PTT or the CG ENCODE/DECODE DISABLE leads at P1005 for a "low" (0.7 volt or less). If a "low" is not present, check the microphone and hookswitch circuits. If a "low" is present, check the DELAY CLOCK output at U1003-9 for 64 Hz and the TONE CLOCK output at U1003-8 for 256 times the Channel Guard (CG) frequency. EXAMPLE: If the CG frequency is 100 Hz, the TONE CLOCK output should be 25,600 Hz. If either clock output is not present, replace U1003. If both clock outputs are correct, check U1001-5 for a tone output. If no tone is present, replace U1001.
Encode Disable (Tone present when CG disabled)	Key the microphone and check for a tone output at P1005-4. If no tone output, make the checks listed for "No Encode Tone". If tone is present, apply a "high" (approx. 8 VDC) to the CG ENC/DEC DISABLE lead (P1005-10). Tone should not be present at CG HI lead (P1005-4). If tone is present, check for a low of approx. 0.2 VDC at the collector of Q1001. If the collector is low and tone is still present at P1005-4, replace U1001. If the collector voltage is over 1.0 VDC, check Q1001 and associated circuitry.
No Decode (Receiver won't unsquelch)	With the correct CG tone applied and the CG ENC/DEC Disable lead high, RX MUTE (P1005-9) lead should be "high" (8 VDC) or open. If not, check the clock outputs at U1003-8 (256 x CG Freq.) and U1003-9 (64 Hz). If clock outputs are incorrect, replace U1003. If clock outputs are correct, replace U1001.
Decode Disable (Receiver won't unsquelch with CG disabled)	With the correct CG tone applied to VOL/SQ HI (P1005-2), the RX MUTE lead should go "high". Next, ground the CG ENC/DEC DIS input and check to see that the RX MUTE lead goes "low" (approx. 0.2 volts). If not replace U1001.
Wrong Encode or Decode Tone	Check to determine that S1001 is programmed for the correct CG frequency (refer to the FREQUENCY PROGRAMMING INSTRUCTIONS listed in the Table of Contents). If S1001 is set correctly, check the tone programming pins at U1003-2 thru -7 and -10 thru -13. NOTE: Logic "1" is approx. supply voltage and logic "0" is approx. A-. If logic readings correspond to S1001 settings, replace U1003. If readings do not correspond to S1001 settings, replace S1001.
No Tone Reject Filter Output	With no filter output, apply a 1000 Hz 300 millivolt signal to P1005-2. If the reading at Pin 1 of U1004-A is the same as the input signal, check U1004-B and associated components. If there is no output at Pin 1, check U1004-A and associated components.
Audio output of filter contains excessive noise (motor-boating, rumble, etc.	Check CG MODULATION control R1004. The modulation should be no greater than 1 kHz deviation. Apply 100 Hz to P1005-2. Check at P1005-1 for more than 30 dB of attenuation. If output is not attenuated by at least 30 dB, check U1004 and associated circuitry. Next, apply 100 Hz and then 1000 Hz to P1005-2 and compare the RMS output reading. The 100 Hz input should be at least 30 dB attenuation (or greater) compared to the 1000 Hz input.
Squelch Tail Present (no STE)	When the PTT lead is "low", P1005-8 should be "low". When the PTT lead goes "high" (PTT released), the PPT DELAYED lead should remain "low" for an additional 160 milliseconds. If not, replace U1001.



LEAD IDENTIFICATION
FOR Q1

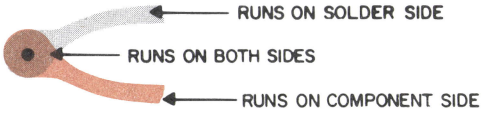


OR

IN-LINE TRIANGULAR

TOP VIEW

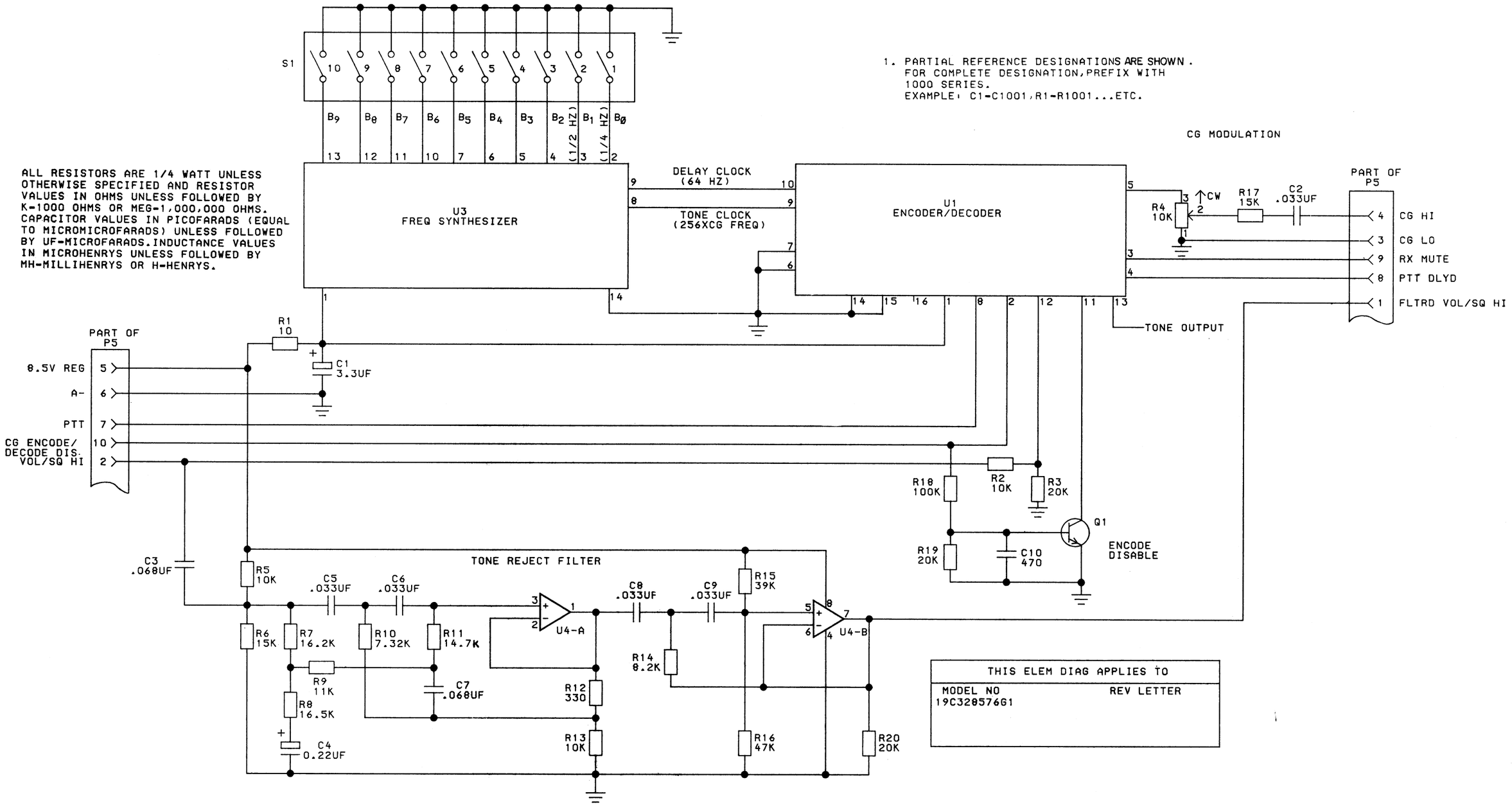
NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.



(19C330216, Rev. 1)
(19B232846, Sh. 1, Rev. 1)
(19B232846, Sh. 2, Rev. 1)

OUTLINE DIAGRAM

CHANNEL GUARD 19C328576G1-4



THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
19C328576G1	

(19D430421, Rev. 2)

SCHEMATIC DIAGRAM

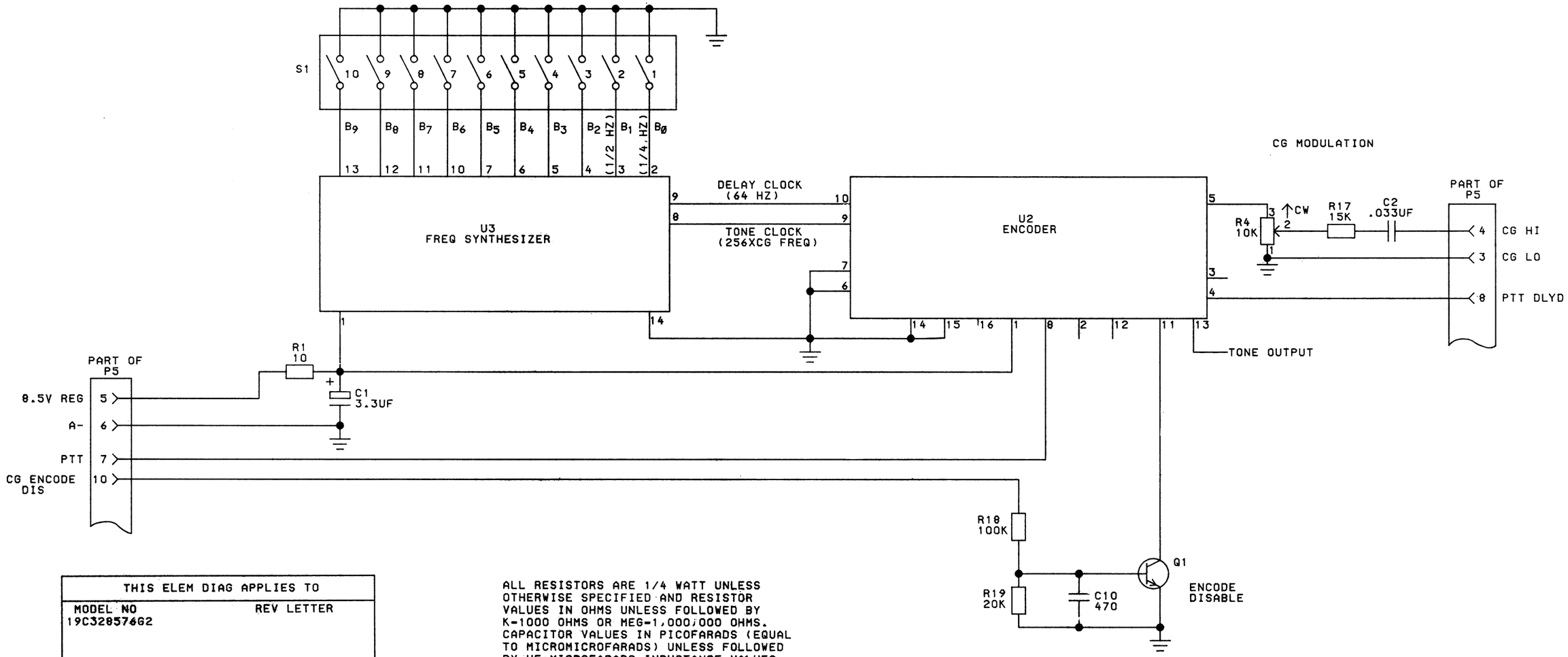
CHANNEL GUARD ENCODER/DECODER
19C328576G1

PARTS LIST

CHANNEL GUARD
19C328576G1 ENCODE/DECODE
19C328576G2 ENCODE ONLY
19C328576G3 DECODE ONLY
19C328576G4 TONE REJECT FILTER

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - CAPACITORS - - - - - - - -
C1001	19A134202P5	Tantalum: 3.3 µf ±20%, 15 VDCW.
C1002	19A700005P10	Polyester: 0.033 µf ±10%, 50 VDCW.
C1003	19A116080P6	Polyester: 0.068 µf ±10%, 50 VDCW.
C1004	19A134202P10	Tantalum: 0.22 µf ±20%, 35 VDCW.
C1005 and C1006	19C300075P33001G	Polyester: 0.033 µf ±2%, 100 VDCW; sim to GE Type 61F.
C1007	19C300075P68001G	Polyester: 0.068 µf ±2%, 100 VDCW; sim to GE Type 61F.
C1008 and C1009	19A700005P10	Polyester: 0.033 µf ±10%, 50 VDCW.
C1010	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M.
		- - - - - - - - - - - PLUGS - - - - - - - - - - -
P1005	19A134152P35	Connector, printed wiring: sim to Molex 22-152101.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q1001	19A115910P1	Silicon, NPN; sim to Type 2N3904.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1001	19A700106P15	Composition: 10 ohms ±5%, 1/4 w.
R1002	19A700106P87	Composition: 10K ohms ±5%, 1/4 w.
R1003	3R152P203J	Composition: 20K ohms ±5%, 1/4 w.
R1004	19A116559P206	Variable, cermet: 10K ohms ±20%, 0.5 w; sim to CTS Series 360.
R1005	19A700106P87	Composition: 10K ohms ±5%, 1/4 w.
R1006	19A700106P91	Composition: 15K ohms ±5%, 1/4 w.
R1007	19C314256P21622	Metal film: 16.2K ohms ±1%, 1/4 w.
R1008	19C314256P21652	Metal film: 16.5K ohms ±1%, 1/4 w.
R1009	19C314256P21102	Metal film: 11K ohms ±1%, 1/4 w.
R1010	19C314256P27321	Metal film: 7.3K ohms ±1%, 1/4 w.
R1011	19C314256P21472	Metal film: 147K ohms ±1%, 1/4 w.
R1012	19A700106P51	Composition: 330 ohms ±5%, 1/4 w.
R1013	19A700106P87	Composition: 10K ohms ±5%, 1/4 w.
R1014	19A700106P85	Composition: 8.2K ohms ±5%, 1/4 w.
R1015	19A700106P101	Composition: 39K ohms ±5%, 1/4 w.
R1016	19A700106P103	Composition: 47K ohms ±5%, 1/4 w.
R1017	19A700106P91	Composition: 15K ohms ±5%, 1/4 w.
R1018	19A700106P111	Composition: 100K ohms ±5%, 1/4 w.
R1019 and R1020	3R152P203J	Composition: 20K ohms ±5%, 1/4 w.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S1001	19B209629P1	Push: 10 stations; sim to CTS 206-10.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - -
U1001	19D430412G1	Encode/Decode Hybrid-CG.
U1002	19D430412G2	Encode Only Hybrid-CG.
U1003	19D430393G1	Freq. Synthesizer.
U1004	19A134511P2	Linear, Dual OP AMP; sim to LM258N, 8 Pin Minidip Package.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES



THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
19C328576G2	

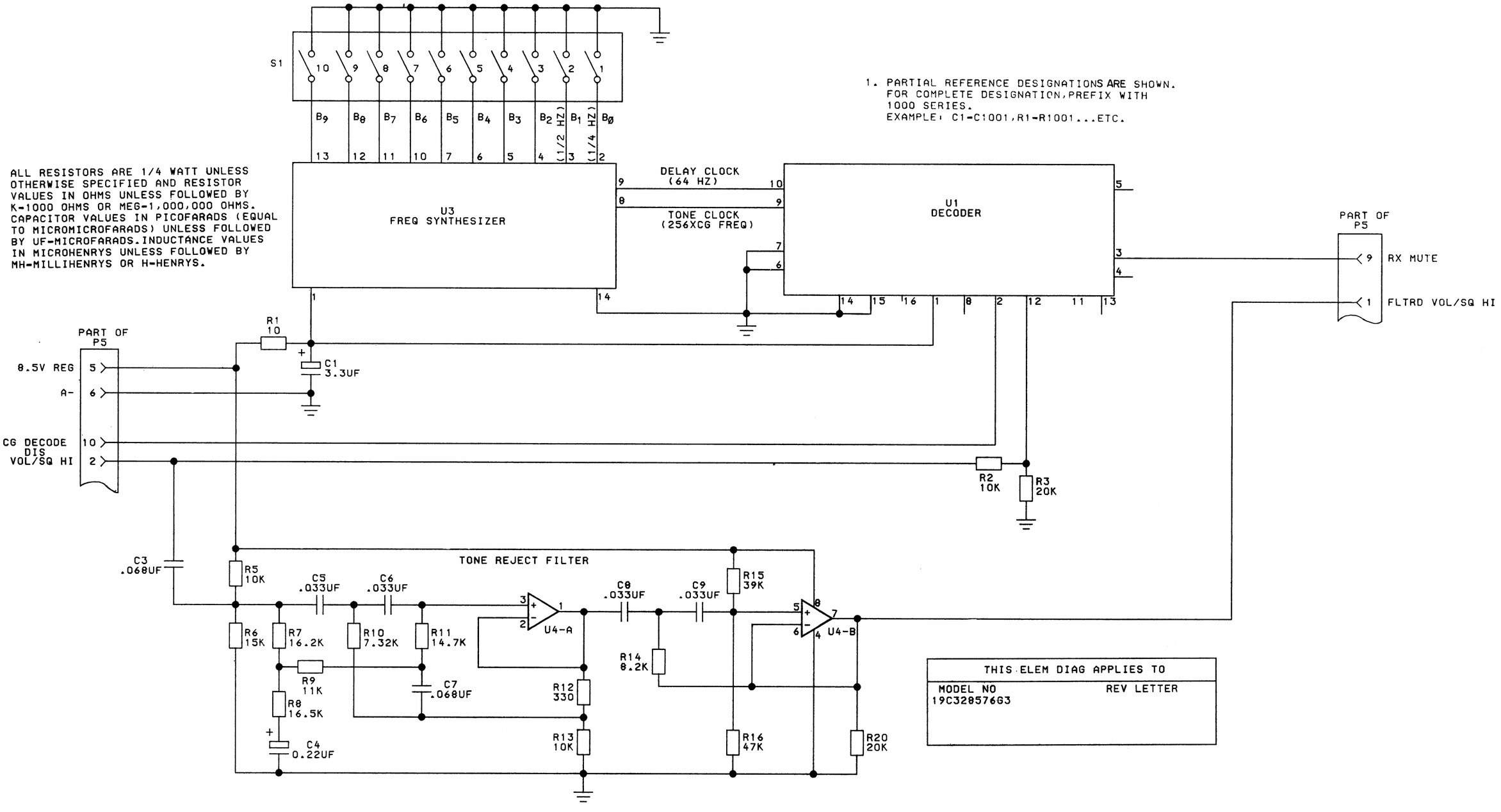
ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K-1000 OHMS OR MEG-1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF-MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH-MILLIHENRYS OR H-HENRYS.

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION, PREFIX WITH 1000 SERIES.
   EXAMPLE: C1-C1001, R1-R1001...ETC.

(19D430426, Rev. 2)

SCHEMATIC DIAGRAM

CHANNEL GUARD ENCODER
19C328576G2



1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION, PREFIX WITH 1000 SERIES. EXAMPLE: C1=C1001, R1=R1001...ETC.

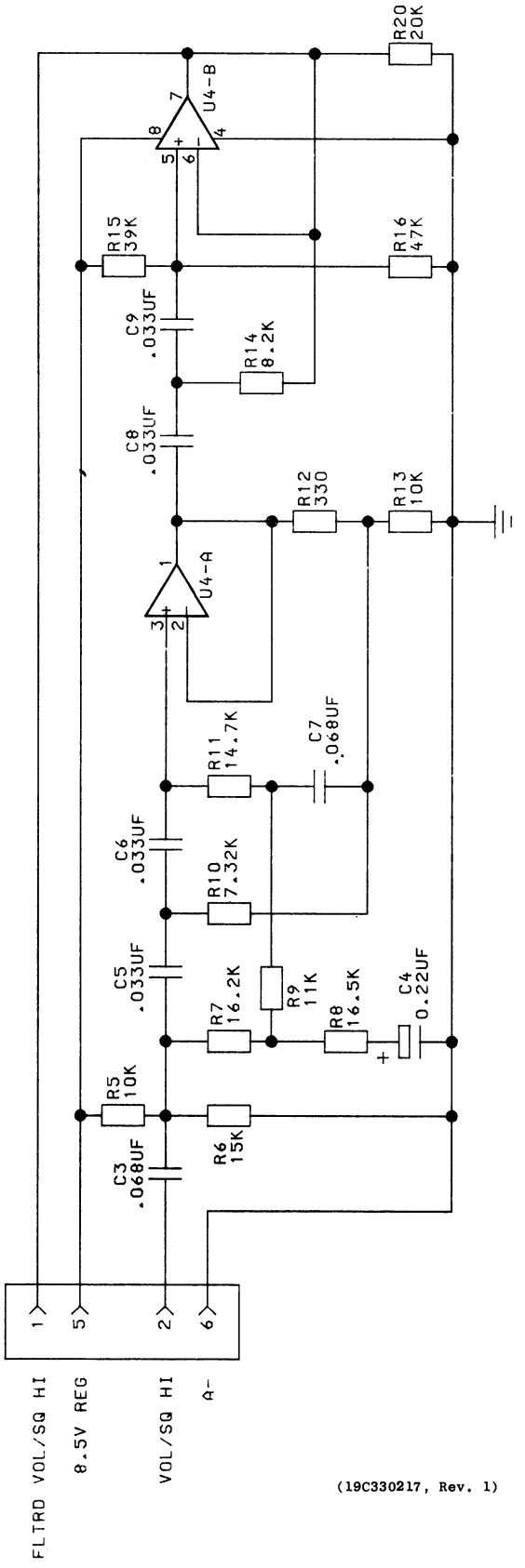
ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
19C328576G3	

SCHEMATIC DIAGRAM

(19D430422, Rev. 2)

CHANNEL GUARD DECODER
19C328576G3



(19C330217, Rev. 1)

1. PARTIAL REFERENCE DESIGNATION ARE SHOWN. FOR COMPLETE DESIGNATION, PREFIX WITH 1000 SERIES. EXAMPLE: C1-C1001, R1-R1001...ETC.

THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
19C328576G4	

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K-1000 OHMS OR MEG-1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF-MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH-MILLIHENRYS OR H-HENRYS.

SCHEMATIC DIAGRAM

TONE REJECT FILTER 19C328576G4

Issue 1

1. TO PROGRAM A STANDARD CHANNEL GUARD FREQUENCY FROM THE CHART, OPEN EACH SWITCH STATION INDICATED BY AN "X", CLOSE EACH SWITCH STATION INDICATED BY A BLANK. SEE VIEW "A".

2. TO PROGRAM A NEW STANDARD FREQUENCY, USE THE ÷ 2 BINARY FORMULA; PLUS THE FRACTIONAL BITS. STATIONS 1-10 REPRESENT BINARY DIGITS FROM 0.25 TO 128, I.E. 0.25, 0.5, 1,2,4,...128. FOR EACH "ONE" CALCULATED BY THE ÷ 2 FORMULA, OPEN THE CORRESPONDING SWITCH STATIONS.

   FOR EXAMPLE, TO DETERMINE SWITCH SETTING FOR 134.7 Hz.
   SET STATIONS 1, 2 FROM THE FRACTIONAL PART CHART SET STATIONS 3-10 BY THE ÷ 2 FORMULA

	REMAINDER	STATION
134 ÷ 2 = 67	0	3
67 ÷ 2 = 33	1	4
33 ÷ 2 = 16	1	5
16 ÷ 2 = 8	0	6
8 ÷ 2 = 4	0	7
4 ÷ 2 = 2	0	8
2 ÷ 2 = 1	0	9
1 ÷ 2 + 0	1	10

   FIRST DIVISION ALWAYS CORRESPONDS TO SWITCH STATIONS 3

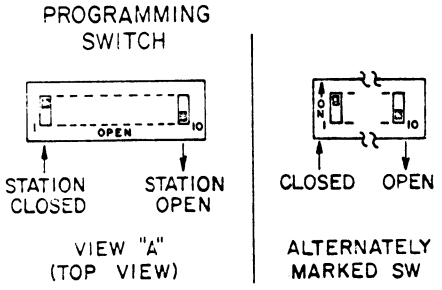
   THUS THE SWITCH SETTING FOR 134.7 Hz IS

10	9	8	7	6	5	4	3	2	1
X					X	X		X	X

   WHERE "X" INDICATES AN OPEN STATION.

STANDARD CG
FREQUENCY CHART

	SWITCH STATIONS									
FREQ.	10	9	8	7	6	5	4	3	2	1
67		X					X	X		
71.9		X			X					
77		X			X	X		X		
82.5		X		X			X		X	
88.5		X		X	X				X	
94.8		X		X	X	X	X		X	X
100		X	X			X				
103.5		X	X			X	X	X	X	
107.2		X	X		X		X	X		X
110.9		X	X		X	X	X	X		
114.8		X	X	X			X		X	X
118.8		X	X	X		X	X		X	X
123.0		X	X	X	X		X	X		
129.3		X	X	X	X	X	X	X		X
131.8	X						X	X	X	X
136.5	X				X				X	
141.3	X				X	X		X		X
146.2	X			X			X			X
151.4	X			X		X	X	X	X	
156.7	X			X	X	X			X	X
162.2	X		X				X			X
167.9	X		X		X					
173.8	X		X		X	X		X	X	X
179.9	X		X	X		X				
186.2	X		X	X	X		X			X
192.8	X	X							X	X
203.5	X	X			X		X	X	X	
210.7	X	X		X			X		X	X



FRACTIONAL PART CHART

FROM TO	STA. 1	2
0.00-0.12		
0.13-0.37	X	
0.38-0.62		X
0.63-0.87	X	X

BY INSPECTION, 0.7 IS BETWEEN 0.63 AND 0.87, OPEN STATIONS 1, 2.

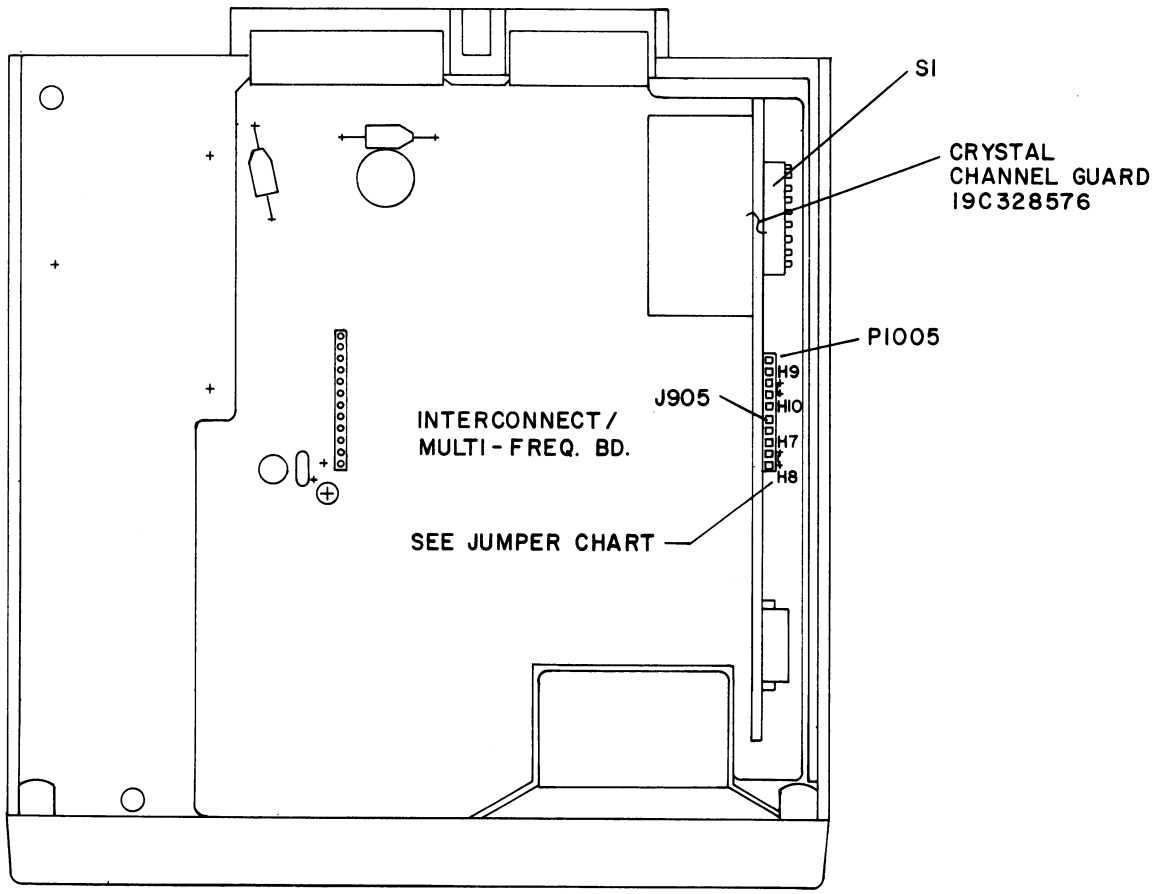
(19C330836, Rev. 1)

PROGRAMMING INSTRUCTIONS

CHANNEL GUARD TONE FREQUENCIES
19C328576G1-4

CRYSTAL CHANNEL GUARD 19C328576

JUMPER CHART				
DA WIRE JUMPER	(18) ENCODER/DECODER (STD.)	(19) OPTION 2643 ENCODE ONLY	(20) OPTION 2644 DECODER ONLY	(21) OPTION 2645 TONE REJECT FILTER ONLY
H7 TO H8	DELETE	———	DELETE	DELETE
H9 TO H10	DELETE	DELETE	———	———



TOP VIEW — COVER REMOVED

(19D430281, Sh. 8, Rev. 4)