

MASTR® II

MAINTENANCE MANUAL

STATION PROGRAMMABLE CHANNEL GUARD
(ENCODE ONLY) 19C331044G1

Maintenance Manual LB131123B

PROGRAMMABLE CHANNEL GUARD
19C331044G1

SPECIFICATIONS *

Input Voltage	10 Volts DC
Input Current	45 mA max at 10.0 VDC
Frequency Range	67-210.7 Hz
Frequency Stability	±0.2%
Encode Output Level	
67 Hz	0.75 Vrms Minimum
156 Hz	0.35 Vrms Minimum
210.7 Hz	0.2 Vrms Minimum
Encode Tone Distortion	1.5% Maximum
Programming Increments	0.25 Hz
PTT Delay	160 Milliseconds
STE Phase Shift	135°
Temperature Range	-40°C (-40°F) to +85°C (+185°F)

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

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— WARNING —

No one should be permitted to handle any portion of the equipment that is supplied with high voltage; or to connect any external apparatus to the units while the units are supplied with power. KEEP AWAY FROM LIVE CIRCUITS.

High-level RF energy in the transmitter Power Amplifier assembly can cause RF burns. KEEP AWAY FROM THESE CIRCUITS WHEN THE TRANSMITTER IS ENERGIZED!

DESCRIPTION

The General Electric Encode Only Channel Guard module 19C331044G1 is a field programmable, synthesized single tone Channel Guard encoder for use with MASTR® II stations. The encode function provides continuous tone-coded modulation of the station transmitter. The continuous tone-controlled squelch system (CTCSS) is described in EIA Standard RS-220A. The module provides encode frequencies from 67.0 to 210.75 Hz in 0.25 Hz steps. Tone frequency selection is accomplished by a ten position DIP switch. 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

CIRCUIT ANALYSIS

The Channel Guard circuitry consists of frequency synthesizer U1, encoder/filter U2, tone programming switch S1 and discrete components which allow tone level translation and the capability for disabling the encode function when required.

Frequency synthesizer U1 includes the synthesizer IC and a 32.768 Hz reference crystal that provides the clock inputs for the encoder. These clock inputs are required for producing 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 (S1) for the proper binary input to the synthesizer. The switch can be set to produce any frequency from 67 Hz to 210.7 Hz in 0.25 Hz increments. Complete instructions for setting the switch are contained in the Programming Instructions (see Table of Contents).

Encoder/Filter hybrid U2 contains the encoder, a voice reject filter and STE circuit. Depressing the PTT switch applies a low to COMBINED PTT lead J1-5. This causes the DELAYED PTT lead (J1-6) 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 coupled through J1-1 to the transmitter.

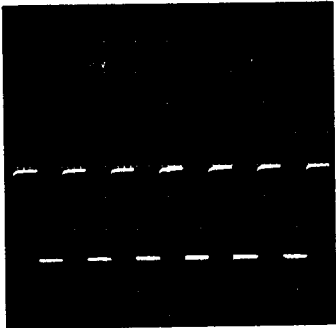
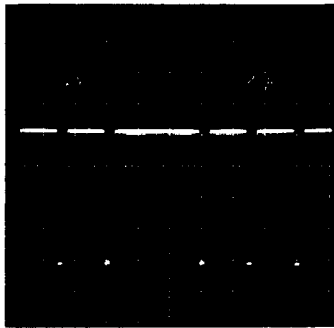
NOTE

When it is desired to have a 6 dB/octave de-emphasis for phase modulated transmitters, a jumper is connected between H6 and H7. The jumper is not used in direct FM transmitters.

When COMBINED PTT goes high (transmitter unkeyed) the DELAYED PTT circuit keeps the transmitter keyed for an additional 160 milliseconds. During the 160 millisecond delay, the encoder shifts the phase of the CG tone output 135°. This combination of 160 milliseconds delay and 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).

The encoder circuit can be disabled to allow the serviceman to make transmitter distortion and modulation checks by connecting H1, H2 or H3 to the appropriate frequency select lead.

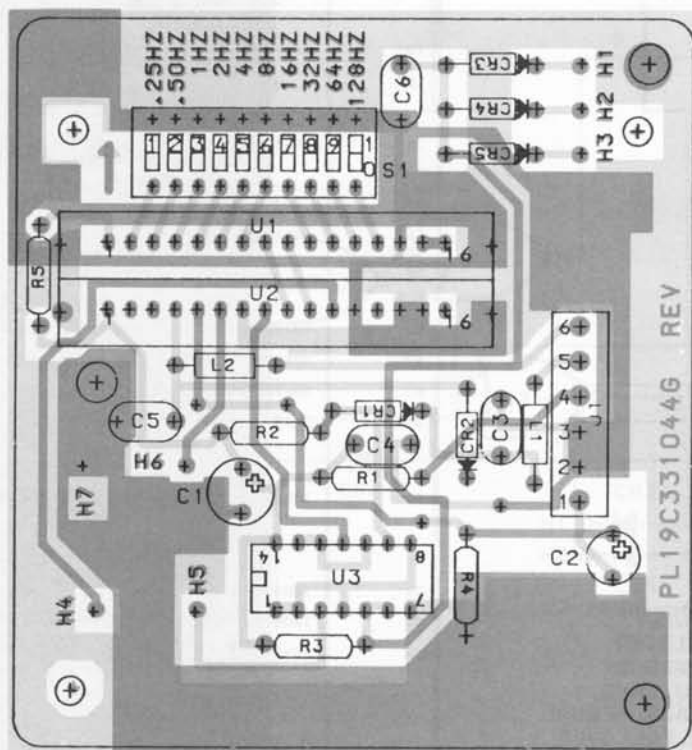
TROUBLESHOOTING PROCEDURE

SYMPTOM	PROCEDURE
No Encode Tone	<p>Check the PTT lead for a "low" (0.7 volt or less). If a low is not present on the PTT lead, check the PTT circuits of the radio. Check the DELAY CLOCK output at U1-9 for 64 Hz and the TONE CLOCK output at U1-8 for 256 times the CG frequency (EXAMPLE: If the CG frequency is 100 Hz, the TONE CLOCK output should be 25,600 Hz (see waveform below).</p> <p>If either clock output is not present, replace U1. If both clock outputs are correct, check U2-5 for tone output. If no tone is present, replace U2.</p>
Wrong Encode Tone	<p>Check to determine that S1 is programmed for the correct CG frequency (refer to the FREQUENCY PROGRAMMING INSTRUCTIONS). If S1 is set correctly, check the tone programming pins at U1-2 thru -7 and U1-10 thru -13. NOTE: Logic "1" is approximately equal to the supply voltage and logic "0" is approximately equal to A-. If logic readings correspond to S1 settings, replace U2. If the readings do not correspond to S1 settings, replace S1.</p>
Squelch Tail present (no STE)	<p>When the PTT lead is "low", J1-6 should be "low". When the PTT lead goes "high", the DELAYED PTT lead should remain low for an additional 160 milliseconds. If not, replace U2.</p>
<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>64 Hz Clock</p> </div> <div style="text-align: center;">  <p>256 X CG Tone (Tone = 100 Hz)</p> </div> </div>	

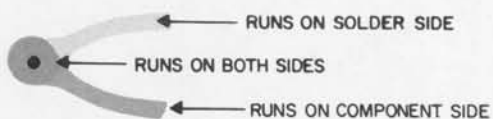
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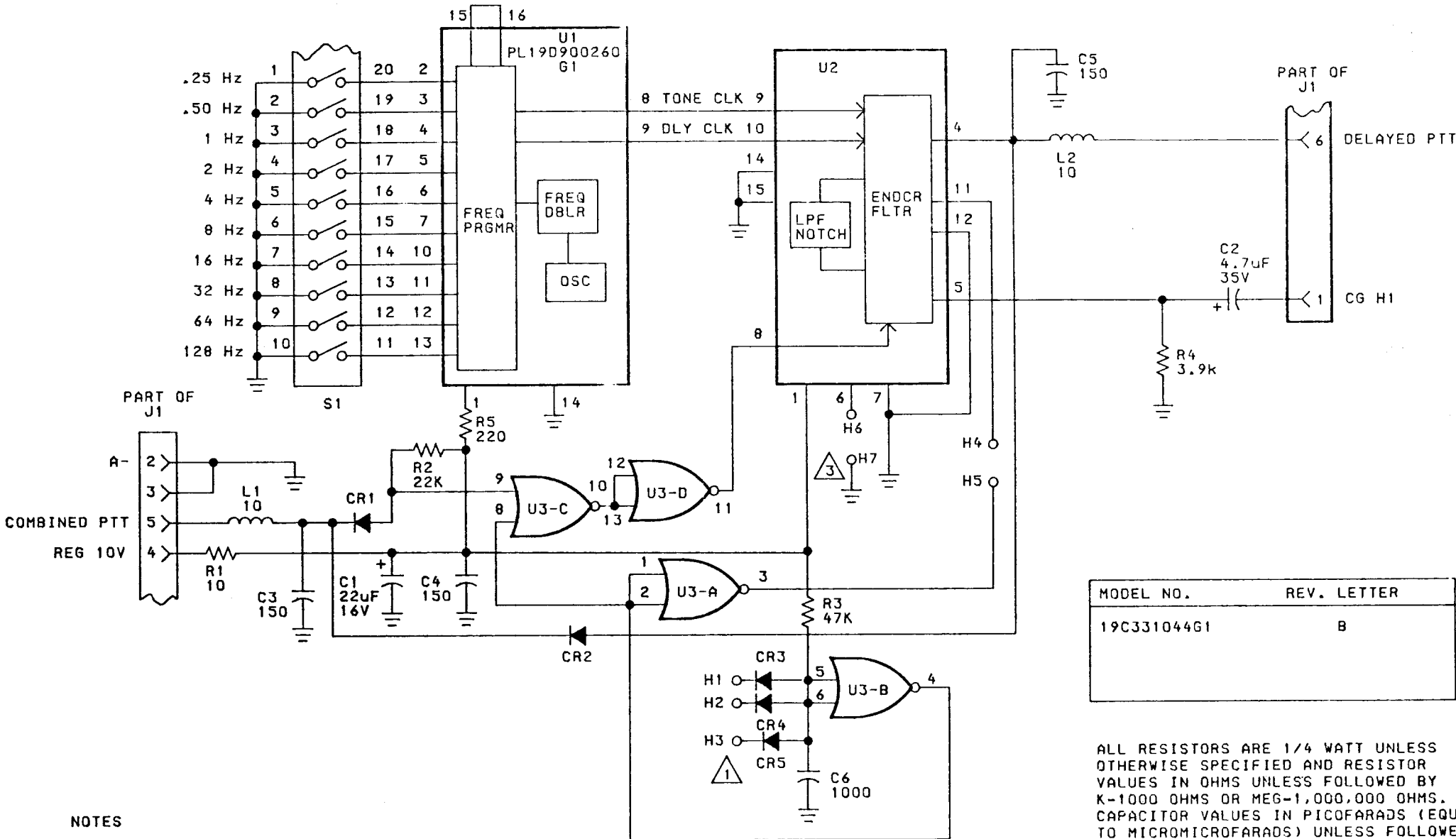


(19C331046, Rev. 2,
(19A143653, Sh. 1, Rev. 1)
(19A143653, Sh. 2, Rev. 1)



OUTLINE DIAGRAM

PROGRAMMABLE CHANNEL GUARD
19C331044G1



- NOTES
1. IN ORDER TO TRANSMIT ON F1, F2, F3 OR F4 WITHOUT SENDING CG TONE, STRAP H1, H2, OR H3 TO THE APPROPRIATE FREQUENCY SELECT LEAD.
2. GROUNDING H1, H2 OR H3 DURING TRANSMIT CAUSES AN STE REVERSE BURST TO BE SENT, TERMINATING CG ENCODE. TO DISABLE STE REVERSE BURST, FOR THIS CONDITION, A DA JUMPER IS INSTALLED BETWEEN H4 & H5.
3. FOR 6db/OCT DE-EMPHASIZED OUTPUT, A DA JUMPER IS INSTALLED BETWEEN H6 & H7.

POWER & GND CONNECTIONS		
DEVICE	V+(10V) PIN NO.	GND PIN NO.
U3	14	7
U1	1	14
U2	1	7, 12, 14, 15

MODEL NO.	REV. LETTER
19C331044G1	B

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 PICO FARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF-MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH-MILLIHENRYS OR H-HENRYS.

PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter," which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A - To provide similar tone output levels for single tone and multi-tone synthesized Channel Guard Units.
Changed R4. Value of R4 was 4.7 K ohms $\pm 5\%$, 1/4 Watt (19A700019P45).

REV. B - To improve performance of synthesizer hybrid at high temperatures.
Added R1005.

PARTS LIST

PROGRAMMABLE CHANNEL GUARD
(STATION ENCODE ONLY)
19C331044G1
REV A
ISSUE 2

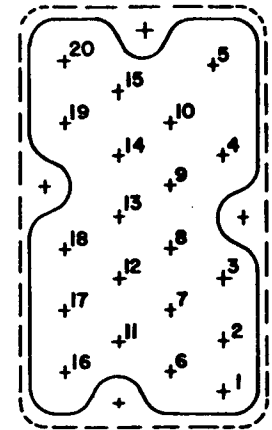
SYMBOL	GE PART NO.	DESCRIPTION
----- CAPACITORS -----		
C1	19A700003P8	Tantalum: 22 uF $\pm 20\%$, 16 VDCW.
C2	19A700003P6	Tantalum: 4.7 uF $\pm 20\%$, 16 VDCW.
C3 thru C5	19A116655P7	Ceramic disc: 150 pF $\pm 20\%$, 1000 VDCW; sim to RMC Type JF Discap.
C6	19A116655P19	Ceramic disc: 1000 pF $\pm 20\%$, 1000 VDCW; sim to RMC Type JF Discap.
----- DIODES -----		
CR1 thru CR5	19A700028P1	Silicon, fast recovery: fwd current 75 mA, 75 PIV; sim to Type 1N4148.
----- JACKS -----		
J1	19A116659P12	Connector, printed wiring: 6 contacts rated @ 5 amps; sim to Molex 09-64-1061.
----- INDUCTORS -----		
L1 and L2	19A700024P25	Coil, RF: 10.0 uH $\pm 10\%$, 3.70 ohms DC res max.
----- RESISTORS -----		
R1	19A700019P13	Deposited carbon: 10 ohms $\pm 5\%$, 1/4 w.
R2	19A700019P53	Deposited carbon: 22K ohms $\pm 5\%$, 1/4 w.
R3	19A700019P57	Deposited carbon: 47K ohms $\pm 5\%$, 1/4 w.
R4	19A700019P44	Deposited carbon: 3.9K ohms $\pm 5\%$, 1/4 w.
----- SWITCHES -----		
S1	19B800010P1	Push: 10 station, 25 milliamps at 242 DC contact rating.
----- INTEGRATED CIRCUITS -----		
U1	19D900260G1	Frequency Synthesizer.
U2	19D900496G2	Channel Guard, Encode Hybrid.
U3	19A700029P2	Digital. QUAD 2 INPUT NOR GATE.
----- MISCELLANEOUS -----		
HARNESS ASSEMBLY 19B226485G1		
P1		Connector. Includes: Shell. Contact, electrical: wire range No. 22-26 AWG; sim to Molex 08-50-0108.
----- MISCELLANEOUS -----		
	N80P13005C6	Machine screw: No. 6-32 x 5/16. (Secures board assembly).
	N404P13C6	Lockwasher, internal tooth: No. 6. (Secures board assembly).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

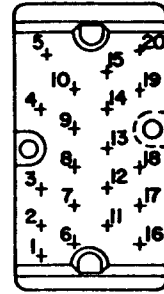
SCHEMATIC DIAGRAM

PROGRAMMABLE CHANNEL GUARD
19C331044G1

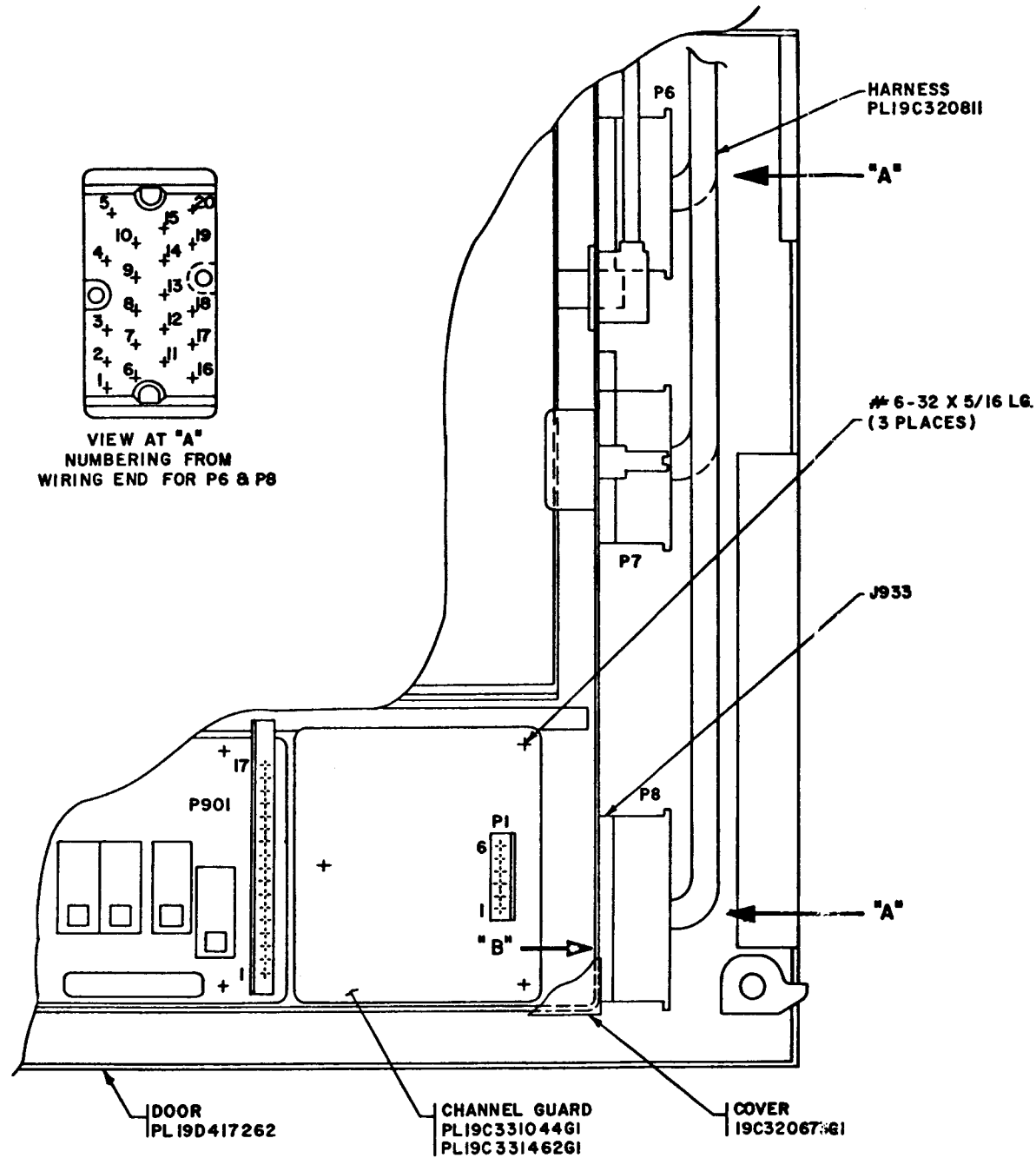
(19C331062, Rev. 4)



VIEW AT "B"
VIEW FROM WIRING END
OF J933



VIEW AT "A"
NUMBERING FROM
WIRING END FOR P6 & P8



THESE INSTRUCTIONS COVER THE INSTALLATION OF THE CHANNEL
GUARD SINGLE FREQUENCY ENCODE ONLY PL19C331044G1 OR
PL19C331462G1 BOARD INTO MASTR II STATIONS
EXCEPT INTERMITTENT DUTY EXTENDED LOCAL COMBINATIONS.

INSTRUCTIONS.

1. REMOVE COVER PL19C320673G1.
2. MOUNT CHANNEL GUARD PL19C331044G1 OR 19C331462G1 BOARD ASM.
AS SHOWN USING HARDWARE SUPPLIED.
3. AT P8 (PART OF STATION HARNESS 19C320811) REMOVE WIRES FROM
P8-2 AND P8-3 AND INDIVIDUALLY TAPE ENDS.
4. INSTALL (SOLDER) ORANGE WIRES SUPPLIED, BETWEEN P6-7 AND P8-3
AND BETWEEN P6-8 AND P8-2.
5. REMOVE WIRES FROM J933-2 AND J933-3 AND CUT ENDS AS SHORT AS
POSSIBLE.
6. INSTALL (SOLDER) PL198226485G1 HARNESS TO J933 AS FOLLOWS:
(SEE VIEW AT "B" & FIG.1)
SF22-BK TO J933-4
SF22-BL TO J933-3
SF22-R TO J933-7
SF22-BR TO J933-2
7. AT P901 PART OF EXCITER HARNESS PL19D417262G3 REMOVE CONTACT
FROM P901-3, AND REMOVE WIRE FROM HARNESS. (USE TOOL
198219951P1 TO REMOVE CONTACT). INSTALL W22-G WIRE FROM
PL198226485G1 HARNESS IN P901-3.
8. INSTALL P1 OF HARNESS PL198226485G1 ON J1 ON CHANNEL GUARD
BOARD PL19C331044G1 OR 19C331462G1 AS SHOWN.
9. INSTALL COVER PL19C320673G1.
10. A DIGITAL CHANNEL GUARD EXCITER IS REQUIRED WITH DIGITAL CHANNEL
GUARD 19C331462G1.

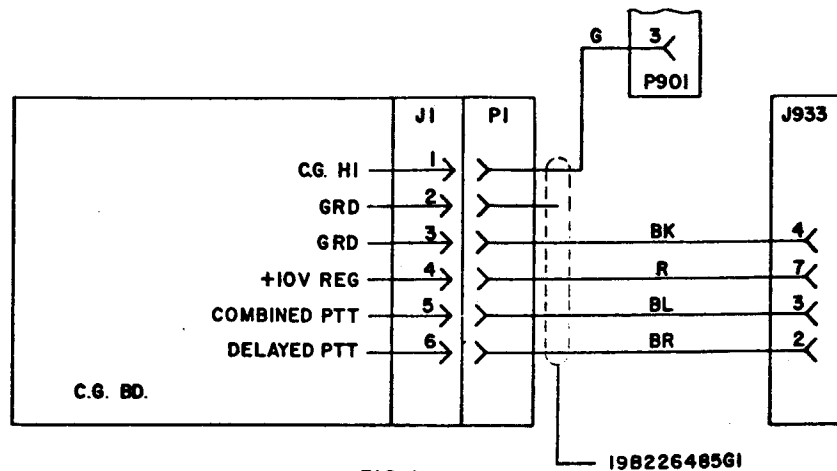
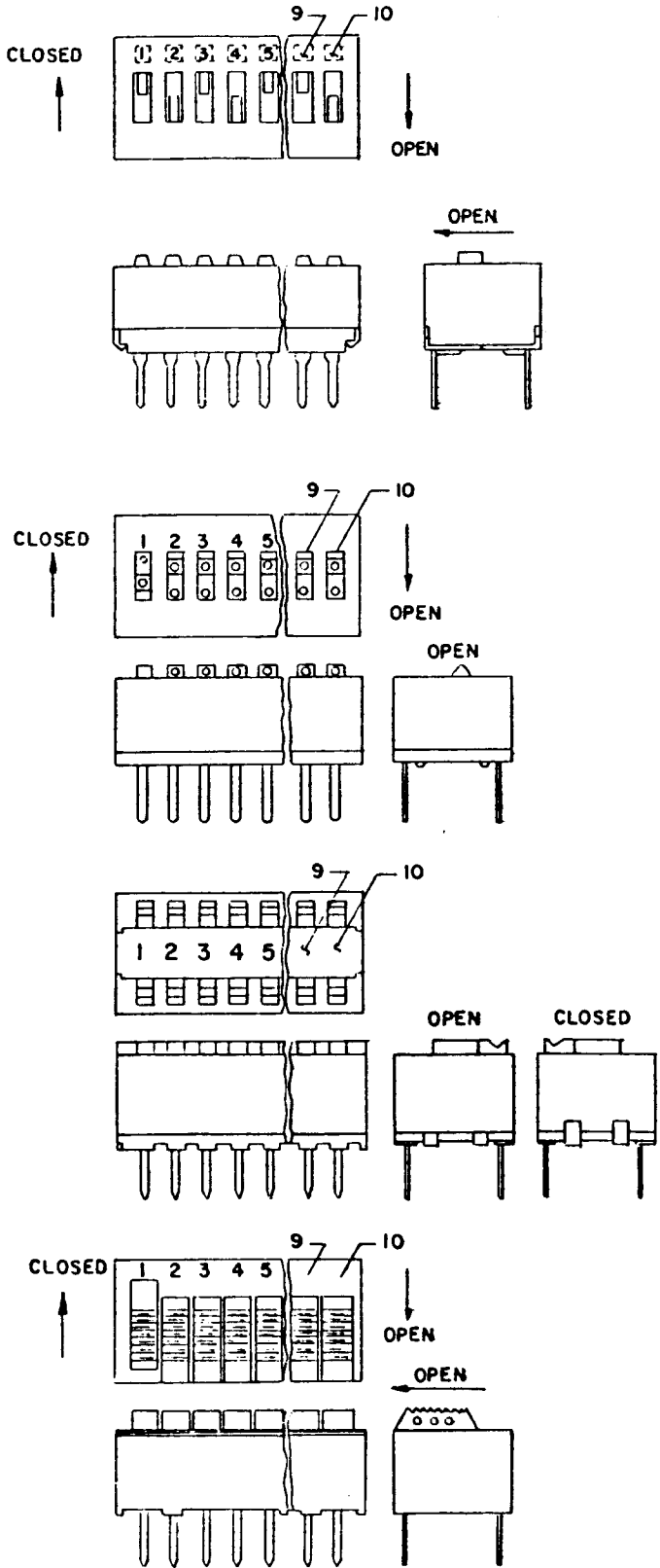


FIG. 1

(19D432643, Rev. 1)

INSTALLATION INSTRUCTIONS

PROGRAMMING SWITCH



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 FIG 1.
2. TO PROGRAM A NEW STANDARD FREQUENCY, USE THE $\div 2$ 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 $\div 2$ 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 $\div 2$ FORMULA

	REMAINDER	STATION
$134 \div 2 = 67$	0	3
$67 \div 2 = 33$	1	4
$33 \div 2 = 16$	1	5
$16 \div 2 = 8$	0	6
$8 \div 2 = 4$	0	7
$4 \div 2 = 2$	0	8
$2 \div 2 = 1$	0	9
$1 \div 2 = 0$	1	10

FIRST DIVISION ALWAYS CORRESPONDS TO SWITCH STATION 3

THUS THE SWITCH SETTING FOR 134.7 Hz IS

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

WHERE "X" INDICATES AN OPEN STATION.

FRACTIONAL PART CHART		STA.	
FROM	TO	1	2
0.00	0.12		
0.13	0.37	X	
0.38	0.62		X
0.63	0.87	X	X
0.88	0.99		

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

IF FRACTIONAL PART IS BETWEEN 0.88 AND 0.99, SET STATIONS 1 AND 2 AS ABOVE AND ROUND FREQUENCY UP TO THE NEXT HIGHER INTEGER. (I.E. FOR 179.9 Hz, PROGRAM AS IF FREQUENCY WAS 180 Hz)

FREQ.	SWITCH STATIONS									
	1	2	3	4	5	6	7	8	9	10
67			X	X					X	
71.3					X				X	
74.4	X			X	X				X	
77		X	X		X	X			X	
79.7	X	X	X	X	X	X			X	
82.5		X		X			X		X	
85.4	X	X			X		X		X	
88.5		X				X	X		X	
91.5		X	X	X		X	X		X	
94.3	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	
114.4	X	X		X			X	X	X	
118.8	X	X		X	X		X	X	X	
123.0			X	X		X	X	X	X	
127.3	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	X
179.9				X		X	X	X	X	X
186.2	X			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

PROGRAMMING INSTRUCTIONS