MOBILE RADIO

MASTR® II
MAINTENANCE MANUAL

STATION CHANNEL GUARD (ENCODE ONLY)
19C321931G8

ENCODE ONLY CHANNEL GUARD
19C321931G8

SPECIFICATIONS *

Tone Frequencies	71.9 to 250.3 Hertz
Power Requirements	10 VDC 30 Milliamperes Max.
Temperature Range	-40°C to +85°C (-40°F to 185°F)
Encode Tone Distortion	1%
Frequency Stability	±0.2%

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

GENERAL ELECTRIC

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WARNING

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

DESCRIPTION

In full duplex and repeater MASTR II stations, Channel Guard Encode Only Board 19C321931G8 is used along with the decode only board. The 19C321931G8 board is mounted on the Radio Panel Front Door adjacent to the transmitter exciter (refer to the Installation Diagram).

The 19C321931G8 board uses digital techniques to generate the EIA continuous tone-controlled squelch system (CTCSS) frequencies. A monolithic integrated circuit is used for the generation of the tone-coded signal which is fed to the station transmitter. The board consists of a PTT delay, an antenna relay driver, the Channel Guard encode integrated circuit, a resistive ladder digital-to-analog converter and a low pass filter. Frequency selection is achieved by the use of a plug-in crystal operating at 256 times the desired Channel Guard frequency.

The Channel Guard encode function is controlled by the PTT switch. The tone signal is transmitted only when the PTT switch is operated. All transmitted calls are tone coded with the Channel Guard frequency.

CIRCUIT ANALYSIS

Channel Guard is a continuous-tone controlled squelch system that provides communications control in accordance with EIA standard RS-220. The standard Channel Guard tone frequencies are listed below.

STANDARD TONE FREQUENCIES					
71.9	88.5	107.2	131.8	162.2	210.7
74.4	91.5	110.9	136.5	167.9	218.1
77.0	94.8	114.8	141.3	173.8	225.7
79.7	97.4	118.8	146.2	179.9	233.6
82.5	100.0	123.0	151.4	186.2	241.8
85.4	103.5	127.3	156.7	192.8	250.3
				203.5	

The divide by 256 counter in U1001 divides the reference clock frequency by 256 to produce a square wave at the desired Channel Guard frequency. The desired output is obtained by converting the digital pulses developed by the divider to a fair approximation of a sine wave. This is accomplished by a digital-to-analog converter. The Walsh Function Generator, summing amplifier and resistor ladder provide this conversion.

The Walsh Function coefficients of a sine wave are given in the following table. See Figure 1.

WALSH FUNCTION	SINE WAVE COEFFICIENT
1	0.637
3	-0.264
7	-0.127
5	-0.052

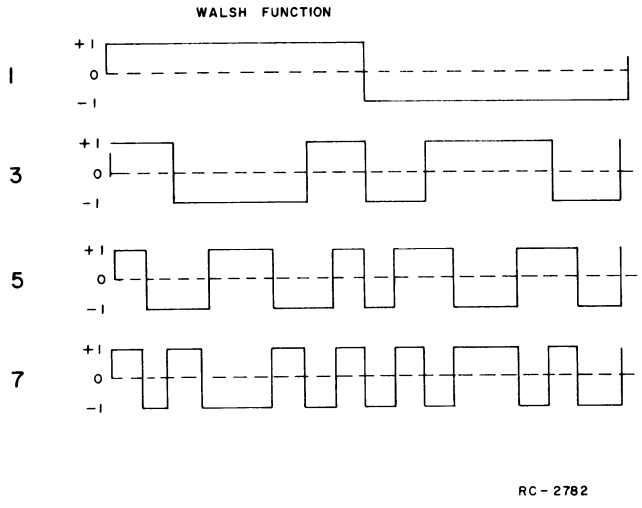


Figure 1 - Walsh Function Waveforms

The resistive weighting network (R1023, R1024, R1027, R1029) sets the level of the output current for each binary bit from the Walsh Function Generator. Capacitor C1025 AC couples the combined current to the summing amplifier (AR1002-B) which serves as a current to voltage converter. The resultant wave-shape is shown in Figure 2. This is the result of adding waveform No. 1 times 0.637 to waveform No. 3 times -0.264 to waveform No. 5 times -0.052 to waveform No. 7 times -0.127.

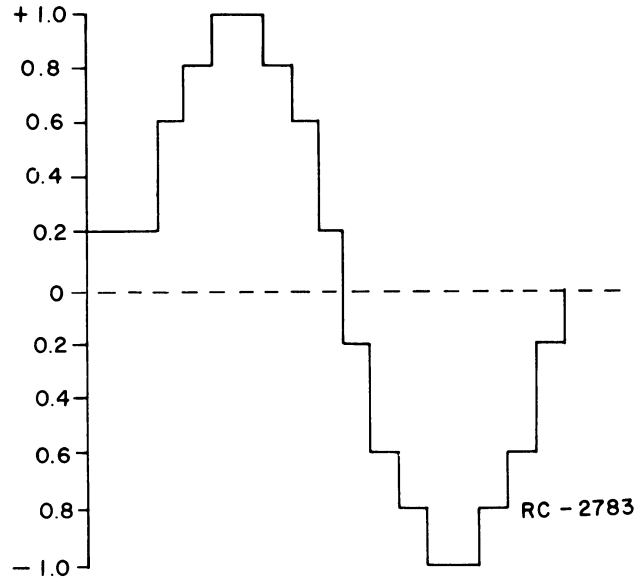


Figure 2 - Weighted Sum of Walsh Functions

De-emphasis capacitor C1027 in the feedback loop of the summing amplifier provides a 6 dB/octave rolloff. The signal is then passed through the active harmonic filter Q1008, through CG MOD ADJUST potentiometer R1060 to the transmitter exciter. Adjustment is made at the transmitter exciter. The CG MOD ADJUST control R1060 is always set at its maximum clockwise position.

SQUELCH TAIL ELIMINATION

Squelch Tail Elimination (STE) is accomplished by changing the phase of the modulating tone 135 degrees at the transmitter when the PTT switch is released and simultaneously delaying the transmitter carrier dropout for approximately 175 milliseconds. This allows sufficient time for the decoder to detect the phase reversal in the transmitted tone and mute the receiver, eliminating the squelch tail. The delay in transmit dropout is determined by the RC time constant of C1002 and R1005.

Initially, when the PTT switch is closed, Q1001 is turned on. Conduction of Q1001 operates AR1001-A. The 7.2 VDC at pin 5 of AR1001-A turns on Q1010, applying ground to J1003-2 to key the transmitter.

When PTT is released, Q1001 is turned off but AR1001-A cannot turn off until C1002 discharges to the level where the current at pin 1 is less than the current at pin 6. After approximately 175 milliseconds (determined by the RC time constant of C1002 and R1005), AR1002-A is turned off, turning off Q1010. Ground is thus removed from the DELAYED PTT lead J1003-2.

MAINTENANCE

Typical voltage readings for servicing the Channel Guard board are provided on the schematic diagram. A troubleshooting diagram containing waveform data at selected points in the circuit is provided in Figure 3.

ENCODE

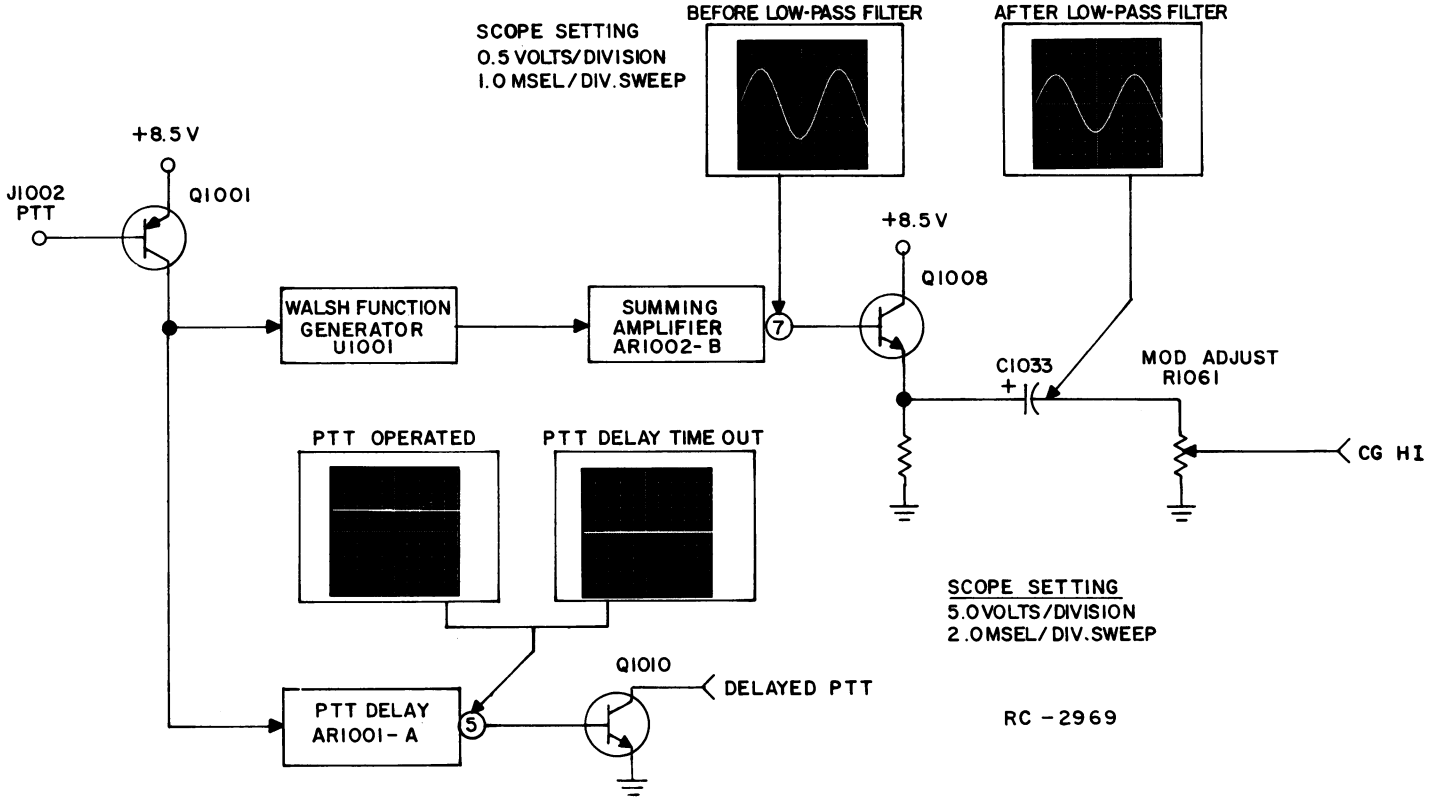
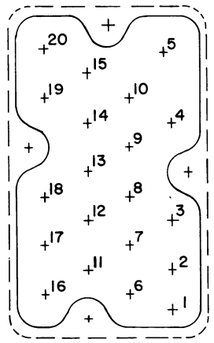
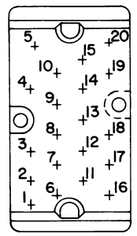


Figure 3 - Troubleshooting Diagram



VIEW AT "B"
VIEW FROM WIRING END
OF J933



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

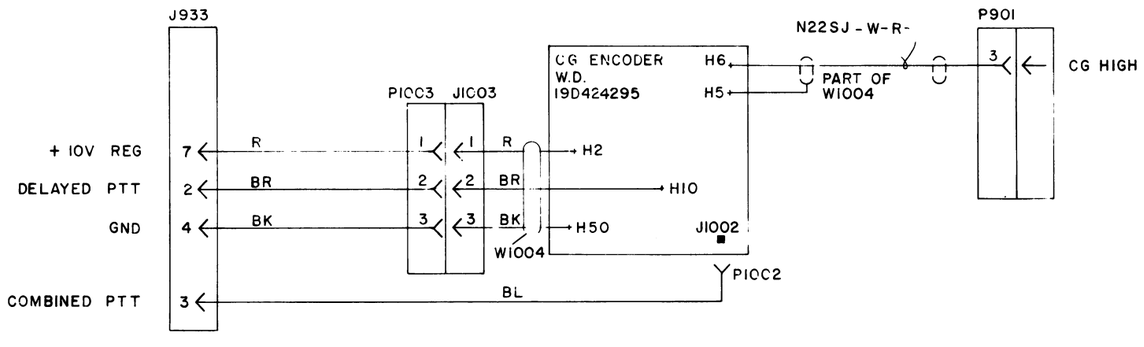


FIG 1

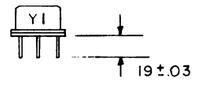


FIG 2

THESE INSTRUCTIONS COVER THE INSTALLATION OF THE CHANNEL GUARD SINGLE FREQUENCY ENCODE ONLY PL19C321931G8 BOARD INTO MASTR II STATIONS EXCEPT INTERMITTENT DUTY EXTENDED LOCAL COMBINATIONS.

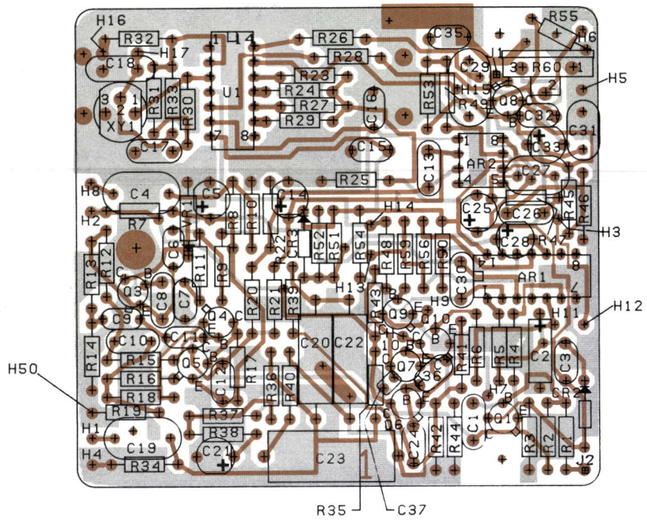
INSTRUCTIONS.

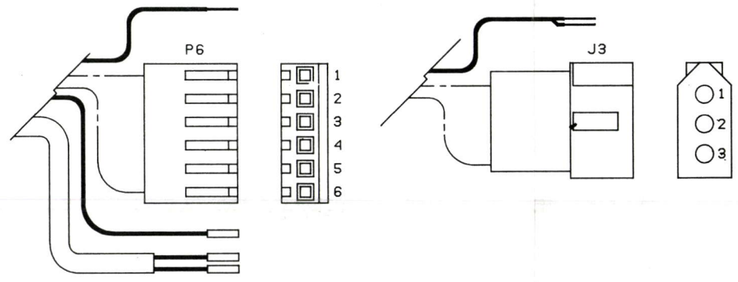
1. REMOVE COVER PL19C320673G1.
2. MOUNT CHANNEL GUARD PL19C321931G8 BOARD ASM. AS SHOWN USING HARDWARE SUPPLIED.
3. AT P8 (PART OF STATION HARNESS 19C320811) REMOVE WIRES FROM P8-2 AND P8-3 AND INDIVIDUALLY TAPE ENDS.
4. INSTALL (SOLDER) ORANGE WIRES SUPPLIED, BETWEEN P6-7 AND P8-3 AND BETWEEN P6-8 AND P8-2.
5. REMOVE WIRES FROM J933-2 AND J933-3 AND CUT ENDS AS SHORT AS POSSIBLE.
6. INSTALL (SOLDER) PL19B227621G1 HARNESS TO J933 AS FOLLOWS: (SEE VIEW AT "B" & FIG.1)
   SF22-R TO J933-7
   SF22-BK TO J933-4
   SF22-BR TO J933-2
   SF22-BL TO J933-3
7. AT P901 PART OF EXCITER HARNESS PL19D417262G3 REMOVE CONTACT FROM P901-3, AND CUT WIRE AS SHORT AS POSSIBLE. (USE TOOL 19B219951P1 TO REMOVE CONTACT). INSTALL N22-SJ-W-R WIRE FROM CHANNEL GUARD BD IN P901-3.
8. INSTALL P1002 OF HARNESS PL19B227621G1 ON J1002 ON CHANNEL GUARD BOARD.
9. CONNECT P1003 TO J1003.
10. TRIM LEADS OF Y1 PER FIG. 2 AND INSTALL.
11. INSTALL COVER PL19C320673.

(19D424296, Rev. 1)

INSTALLATION INSTRUCTIONS

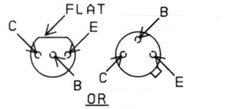
CHANNEL GUARD 19C321931G8





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

LEAD IDENTIFICATION
FOR Q1-Q10

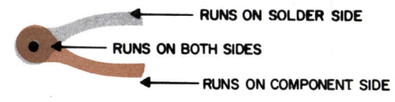


TOP VIEW

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

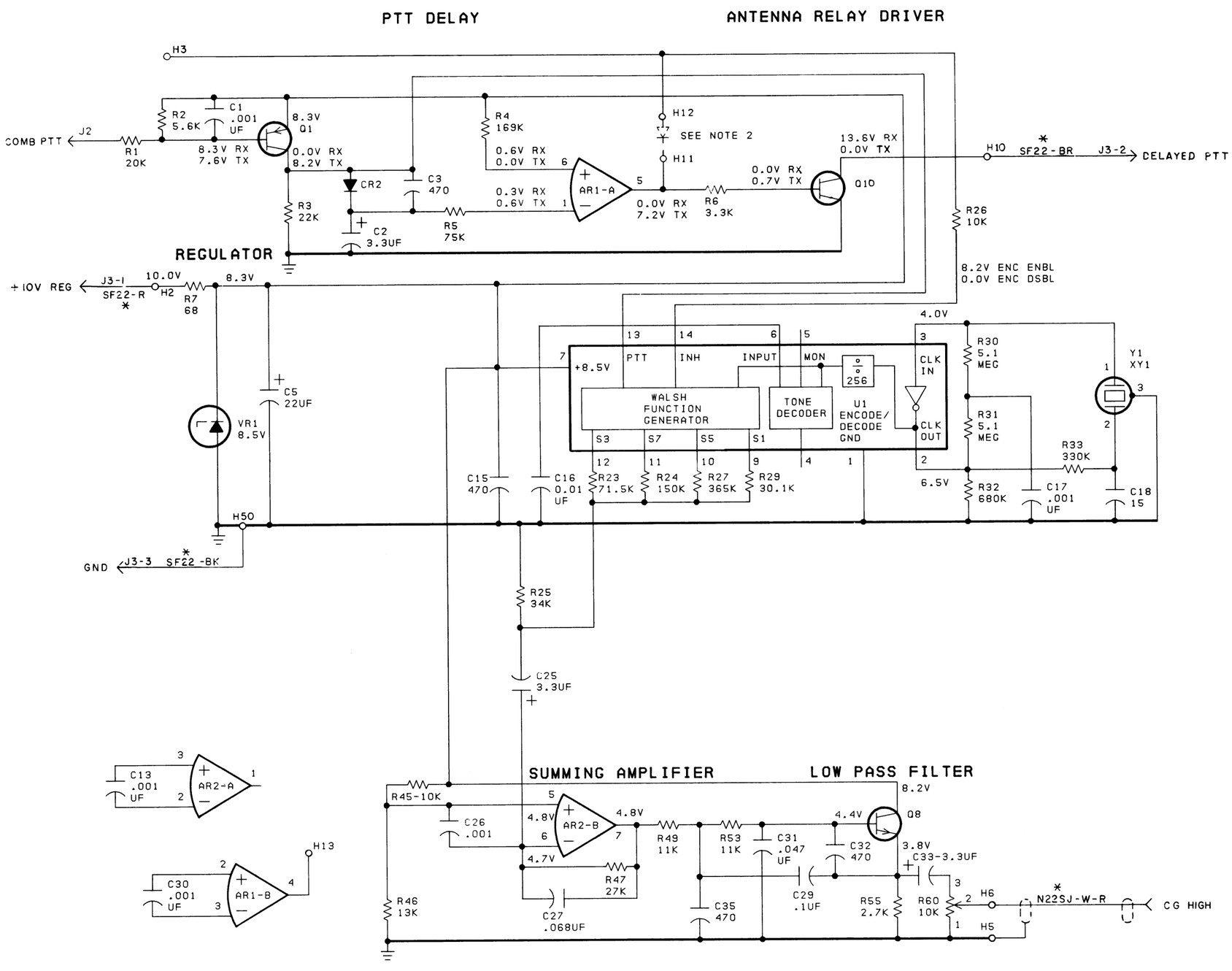
CONNECTION CHART							
FROM	TO	WIRE	TERMINATION	GR.1	GR.2	GR.3	GR.8
H2	P6-6	SF24-R		1	1	1	
H1	P6-3	N22SJ-WG		1		1	
H4	P6-1	SHIELD		1		1	
H8	P6-4	N22SJ-WBK		1		1	
	P6-1	SHIELD		1		1	
H7	P6-2	SF24-W		1		1	
H9	P6-5	SF24-Y		1		1	
H15	LET HANG	SF24-G		1			
H10	LET HANG	SF24-BR	P11	1	1		
H6	LET HANG	N22SJ-WR		1	1		
H5		SHIELD		1	1		
H2	J3-1	SF22-R					1
H50	J3-3	SF22-BK					1
H5		SHLD W-R					1
H6	LET HANG	N22SJ-WR					1
H10	J3-2	SF22-BR					1

(19C327068, Rev. 6)
(19B227193, Sh. 2, Rev. 1)
(19B227193, Sh. 3, Rev. 1)



OUTLINE DIAGRAM

CHANNEL GUARD ENCODE ONLY
19C321931G8



(19D424295, Rev. 4)

NOTES:
1. +8.5V CONNECTED TO AR1001-PIN 14 AND TO AR1002-PIN 8. GND CONNECTED TO AR1001-PIN 7 AND TO AP1002-PIN 4.
2. IF ENCODE TONE IS DESIRED ONLY WHEN PTT IS LOW, A 19A115250P1 DIODE IS INSERTED BETWEEN H11 & H12.
3. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION PREFIX WITH 1000 SERIES. EXAMPLE: C1=C1001; R1=R1001.

* PART OF W1004

VOLTAGE READING

VOLTAGE READINGS ARE TYPICAL READINGS MEASURED TO SYSTEM NEGATIVE (H5) WITH A 20,000 OHM-PER-VOLT METER.

MODEL NO	REV LETTER
PL19C321931G8	B

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

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

CHANNEL GUARD ENCODE ONLY 19C321931G8

PARTS LIST

LBI30268A

MASTR II STATION ENCODE ONLY
CHANNEL GUARD
19C321931G8

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - INTEGRATED CIRCUITS - - - - - -
AR1001	19A134122P1	Linear: Quad Operational Amplifier; sim to RCA CA 3401.
AR1002	19A116754P1	Linear: Dual In-Line 8- Pin Minidip package; sim to T1, SN72558 NSC.
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1001	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C1002	5496267P409	Tantalum: 3.3 µf ±5%, 15 VDCW; sim to Sprague Type 150D.
C1003	5494481P107	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C1005	19A134202P6	Tantalum: 22 µf ±20%, 15 VDCW.
C1013	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C1015	5494481P107	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C1016	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C1017	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C1018	5490008P8	Silver mica: 15 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C1025	19A134202P5	Tantalum: 3.3 µf ±20%, 15 VDCW.
C1026	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C1027	19A116080P106	Polyester: 0.068 µf ±10%, 50 VDCW.
C1029	19A116080P207	Polyester: 0.1 µf ±5%, 50 VDCW.
C1030	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C1031	19A116080P205	Polyester: 0.047 µf ±5%, 50 VDCW.
C1032	5494481P107	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C1033	19A134202P5	Tantalum: 3.3 µf ±20%, 15 VDCW.
C1035	5494481P107	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1002	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
CR1004*	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV. Added by REV A. Deleted by REV B.
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J1002	19A116779P5	Contact, electrical: sim to Molex 08-50-0414.
J1003		Connector. Includes:
	19B209288P10	Shell.
	5496809P18	Contact, electric: sim to Molex Products 1380-T. (Quantity 3).
		- - - - - - - - - - TRANSISTORS - - - - - - - -
Q1001	19A115852P1	Silicon, PNP; sim to Type 2N3906.
Q1008	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q1010	19A115910P1	Silicon, NPN; sim to Type 2N3904.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1001	3R152P203J	Composition: 20K ohms ±5%, 1/4 w.
R1002	3R152P562K	Composition: 5.6K ohms ±10%, 1/4 w.
R1003	3R152P223K	Composition: 22K ohms ±10%, 1/4 w.
R1004	19C314256P21693	Metal film: 169K ohms ±1%, 1/4 w.
R1005	19C314256P27502	Metal film: 75K ohms ±1%, 1/4 w.
R1006	3R152P332K	Composition: 3.3K ohms ±10%, 1/4 w.
R1007	3R152P680J	Composition: 68 ohms ±5%, 1/4 w.
R1023	19C314256P27152	Metal film: 71.5K ohms ±1%, 1/4 w.
R1024	19C314256P21503	Metal film: 150K ohms ±1%, 1/4 w.
R1025	19C314256P23402	Metal film: 34K ohms ±1%, 1/4 w.
R1026	3R152P103K	Composition: 10K ohms ±10%, 1/4 w.
R1027	19C314256P23653	Metal film: 36.5K ohms ±1%, 1/4 w.
R1029	19C314256P23012	Metal film: 30.1 ohms ±1%, 1/4 w.
R1030 and R1031	3R152P515J	Composition: 5.1 megohms ±5%, 1/4 w.
R1032	3R152P684J	Composition: 680K ohms ±5%, 1/4 w.
R1033	3R152P334J	Composition: 330K ohms ±5%, 1/4 w.
R1045	3R152P103J	Composition: 10K ohms ±5%, 1/4 w.
R1046	3R152P133J	Composition: 13K ohms ±5%, 1/4 w.
R1047	3R152P273J	Composition: 27K ohms ±5%, 1/4 w.
R1049	19C314256P21102	Metal film: 11K ohms ±1%, 1/4 w.
R1053	19C314256P21102	Metal film: 11K ohms ±1%, 1/4 w.
R1055	3R152P272J	Composition: 2.7K ohms ±5%, 1/4 w.
R1060	19B209358P106	Variable, carbon film: approx 300 to 10K ohms ±10%, 0.25 w; sim to CTS Type X-201.
R1061*	3R152P912J	Composition: 9.1K ohms ±5%, 1/4 w. Added by REV A. Deleted by REV B.
R1062*	3R152P333J	Composition: 33K ohms ±5%, 1/4 w. Added by REV A. Deleted by REV B.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - -
U1001	19D406009P1	Integrated circuit: digital.
		- - - - - - - - VOLTAGE REGULATORS - - - - - - -
VR1001	4036887P9	Zener: 500 mW, 8.5 v. nom.
		- - - - - - - - - - CABLES - - - - - - - - - -
W1004		HARNESS ASSEMBLY 19C321931G7 (Includes J1003)
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XY1001	5490277P1	Transistor, phen: 4 contacts; sim to Elco 3303.
		- - - - - - - - - - CRYSTALS - - - - - - - - - -
		NOTE: When reordering give GE Part Number and specify exact frequency needed.
Y1001	19A134279	Crystal Unit, quartz.
	19A134279P1	71.9 Hz
	19A134279P3	74.4 Hz
	19A134279P5	77.0 Hz
	19A134279P7	79.7 Hz
	19A134279P9	82.5 Hz
	19A134279P11	85.4 Hz
	19A134279P13	88.5 Hz
	19A134279P15	91.5 Hz
	19A134279P17	94.8 Hz
	19A134279P19	97.4 Hz
	19A134279P21	100.0 Hz
	19A134279P23	103.5 Hz
	19A134279P25	107.2 Hz
	19A134279P27	110.9 Hz
	19A134279P29	114.8 Hz
	19A134279P31	118.8 Hz
	19A134279P33	123.0 Hz
	19A134279P35	127.3 Hz
	19A134279P37	131.8 Hz
	19A134279P39	136.5 Hz
	19A134279P41	141.3 Hz
	19A134279P43	146.2 Hz
	19A134279P45	151.4 Hz
	19A134279P47	156.7 Hz
	19A134279P49	162.2 Hz
	19A134279P51	167.9 Hz
	19A134279P53	173.8 Hz
	19A134279P55	179.9 Hz
	19A134279P57	186.2 Hz
	19A134279P59	192.8 Hz
	19A134279P61	203.5 Hz

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

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 add a oscillator limiter circuit. Added CR1004, R1061 and R1062.

REV. B - To remove the oscillator limiter circuit. Removed CR1004, R1061 and R1062.