GE Mobile Communications

MCS™

SYNTHESIZED MOBILE RADIO 136-174 MHz, 10 WATT MOBILE COMBINATION

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Maintenance Manual

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SPECIFICATIONS*

SYSTEM

Radio Type	MCS
Frequency Range:	
Transmit and Receive	136.0 to 153.0 MHz (Lo Split) 150.0 to 174.0 MHz (Hi Split)
Frequency Separation	
Transmit and Receive	17 MHz (Lo Split) 24 MHz (Hi Split)
Voltage	13.8 Vdc ±20%
Battery Drain:	
Receiver (13.8 VDC)	
Off	0.01 Amperes (maximum)
Squelched	0.40 Amperes (maximum)
Unsquelched	1.1 Amperes (maximum at 5 Watts audio)
Transmitter (13.6 VDC)	4 Amperes (maximum at 10 Watts RF)
Frequency Stability	±5ppm (±2.5 ppm optional)
Channel Spacing	30 kHz
Frequency Capacity	4 Channels
Temperature Range	-30°C (-22°F) to +60°C (+140°F)
Duty Cycle	100% Receive, 20% Transmit (EIA Duty Cycle)
Dimensions	
Radio Assembly (Less Accessories)	
Height	43.5mm (1.71 inches)
Width	160.2mm (6.31 inches)
Depth	184.2mm (7.25 inches)
Control Head	
Height	90mm (3.54 inches)
Width	145mm (5.71 inches)
Depth	60mm (2.36 inches)
Weight	
Radio Assembly (Less Accessories)	1.34 kg (47.5 ounces)
Control Head	0.88 kg (31 ounces)

COMBO

Military Specifications

STANDARD	METHODS/PROCEDURES	
	MIL-STD-810-C	MIL-STD-810-D
Low Pressure	500.1/Procedure 1	500.2/Procedure 1
High Temperature	501.1/Procedure 1,2	501.2/Procedure 1,2
Low Temperature	502.1/Procedure 1	502.2/Procedure 1,2
Temperature Shock	503.1/Procedure 1	503.2/Procedure 1
Solar Radiation	505.1/Procedure 1	505.2/Procedure 1
Humidity	507.1/Procedure 2	507.2/Procedure 2
Vibration	514.2/Procedure 8,10	514.3/Procedure 1
Shock	516.2/Procedure 1,2,3,5	516.3/Procedure 1,3,4,5,6

TRANSMITTER

Power Output	10 Watts (minimum) (40 Watts optional)
Conducted Spurious	75 dB Below Carrier (typical)
Modulation	±5.0 kHz
Audio Sensitivity	40 millivolts (typical)
Audio Frequency Characteristics (Per RS-152B)	Within +1 to -3 dB of 6 dB/octave pre-emphasis from 300 Hz to 3000 Hz per EIA standards. Post limiter filter per FCC and EIA.
FM Noise	-53 dB (typical, companion receiver method)
Power Adjust Range	5 to 10 Watts
Distortion	Less that 3% (1000 Hz) Less than 5% (300 to 3000 Hz)
Deviation Symmetry	0.3 kHz (maximum)
RF Output Impedance	50 ohms
Carrier Attack Time	50milliseconds (maximum)
Audio Attack Time	50 milliseconds (maximum)

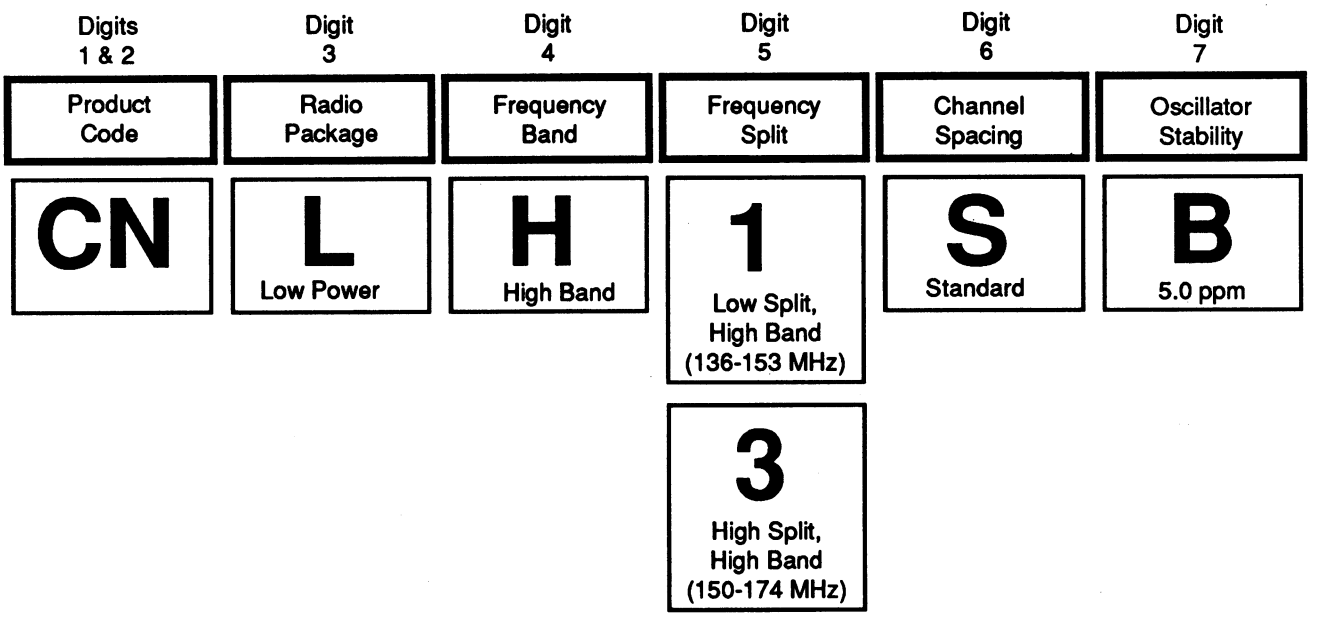
RECEIVER

Audio Ampl Output (4-ohm speaker)	5 Watts (less than 10% distortion) EIA
Sensitivity: 12 dB SINAD (EIA method)	-118 dBm (0.28 microvolts) (typical)
Selectivity (EIA two-signal method)	-80 dB ±30 kHz (typical)
Spurious Response	-70 dB (maximum)
Intermodulation	-78 dB (typical) (12dB SINAD)
Hum and Noise	
Squelched	-60 dB (maximum)
Unsquelched	-50 dB (typical)
Modulation Acceptance	±7 kHz (minimum)
Frequency Response	Within +2.0 and -8 dB of a standard 6 dB/octave de-emphasis curve from 300 to 3000 Hz EIA
RF Input Impedance	50 ohms
Receiver Attack Time	40 milliseconds, typical 100 milliseconds, maximum
Receiver Recovery Time	100 milliseconds, typical 250 milliseconds, maximum

* REFER to the appropriate Specification Sheet for the complete specifications.

COMBO

COMBINATION NOMENCLATURE



GENERAL DESCRIPTION

The General Electric MCS mobile radio is a synthesized, wideband radio, utilizing microcomputer technology to provide high reliability, high quality, and high performance in two-way, FM, mobile communications. The 150-174 MHz MCS radio provides 10 Watts RF output power with allowable channel separation of 24 MHz transmit and 24 MHz receive. The 136-153 MHz MCS provides 10 Watts with 17 MHz channel separation. An optional 40 Watt amplifier is available which mounts on the bottom of the radio.

The MCS consists of a radio assembly and a Control Head. The Control Head provides a 5 watt speaker amplifier and a 4 position channel selector switch. A POWER switch on the Control Head controls power to both the speaker amplifier and the radio. A system cable and a power cable, both 3 feet long on the Control Head, connect to the radio assembly. Optional cables are available to extend the distance between the two units.

The radio may be programmed with both tone or digital Channel Guard. A MONITOR switch on the Control Head allows disabling Channel Guard and squelch.

All channel information (frequencies, Channel Guard, and carrier control timer) is stored in a programmable electrically erasable PROM (EEPROM). The information is permanently retained even when the 12 volt battery is disconnected.

The radio is programmed using an IBM compatible personal computer equipped with a RS-232 serial interface connector. A GE supplied RS-232 interface box and cable are also required. The computer can program or reprogram the customer frequencies, Channel Guard and carrier control timer. Programming is done through the radio's system connector without opening the radio.

A temperature compensated oscillator module provides ±0.0005% (5 PPM) oscillator stability. An optional ±0.00025% (2.5 PPM) high stability oscillator is available.

The MCS radio consists of the following assemblies:

- RF Board
- Audio Board
- Logic Board
- Control Head

The boards are all mounted onto a main casting assembly with easy access to each for servicing. Interconnect plugs are used to interconnect the boards eliminating problems with pinched wires when replacing covers.

RF BOARD

The RF Board includes the synthesizer, the transmitter, and the receiver circuits.

Synthesizer Circuit

The synthesizer generates all transmit and receive RF frequencies. The synthesizer frequency is controlled by the microprocessor located on the Logic Board. Frequency stability is maintained by a temperature compensated reference oscillator module. Transmit audio, which is processed on the Audio Board, feeds the synthesizer to modulate the VCO. The buffered VCO output drives both the transmitter exciter and the receiver mixer.

Transmitter Circuit

The transmitter consists of a fixed-tuned exciter module, a PA module, a power control circuit, a PIN diode antenna switch, and a low pass filter.

The PA module is capable of 10 Watts output. The power control circuit controls the PA module by sampling the module output to maintain constant output power across the band.

The RF output level is internally adjustable for rated power. A thermistor in the control circuit protects the PA from over-heating.

Receiver Circuit

The dual conversion receiver circuit consists of a front end section, 45 MHz first IF, a 455 kHz second IF, and a FM detector. All audio processing and squelch functions are accomplished on the Audio Board.

AUDIO BOARD

The Audio Board provides all audio and tone processing for the receiver and transmitter, except the receiver volume control and 5 watt audio PA. The board also contains the internally adjustable receiver squelch circuit. The Audio Board obtains all control signals from the Logic Board.

LOGIC BOARD

The Logic Board contains the microprocessor and associated memory circuits which include an EPROM for controlling the processor and a programmable "personality" electrically erasable PROM (EEPROM) to store customer frequencies, tones, and options. The microprocessor provides

tone generation, tone detection, and frequency data to the synthesizer.

CONTROL UNIT

The Control Unit contains a 5 watt audio amplifier and a 3-inch speaker housed in a Lexan case. A system cable with a 9-pin plug connects to the radio. A power cable with two connectors connects to the radio's power cable and the power cable from the battery and/or ignition switch.

EQUIPMENT AND FEATURES

MICROPHONE

The standard mobile combinations use an electret microphone. The MCS microphone is housed in a sturdy case, and the extendable coiled cord plugs into a jack at the back of the Control Unit. The microphone is secured to the radio by means of a strain relief hook on the microphone cable. A microphone hanger is supplied with the microphone. An optional transistorized dynamic microphone is available.

CARRIER CONTROL TIMER (CCT)

The Carrier Control Timer turns off the transmitter after the microphone push-to-talk (PTT) switch has been keyed for a pre-programmed time period. A pulsing alert tone will warn the operator to unkey and then rekey the PTT to continue the transmission. The timer can be programmed to time out from 30 seconds to 7.5 minutes in 30 second increments. The timer can also be enabled or disabled for each channel.

CHANNEL GUARD

Channel Guard provides a means of restricting calls to specific radios through the use of a continuous tone coded squelch system (CTCSS) or a continuous digital coded squelch system (CDCSS). Tone frequencies range from 67.0 Hz to 210.7 Hz in 0.1 Hz steps. There are 83 standard programmable digital codes. The Channel Guard tone frequencies and codes are software programmable. Both tone frequencies and digital codes may be mixed on each channel. These codes and frequencies are listed in Table 1.

SQUELCH TAIL ELIMINATION (STE)

STE is used with tone and digital Channel Guard to eliminate squelch tails. The STE burst is transmitted when the microphone PTT is released. The receiving radio decodes the burst and mutes the receiver audio for 250ms. This mute time allows the transmission to end and to mute the squelch tail. The STE is enabled for transmit and/or receive by PC programming the radio's personality.

TABLE 1
TONE & DIGITAL CHANNEL GUARD

TONE CG	DIG. CG	DIG. CG	DIG. CG
No. CG	023	261	654
67.0	025	263	662
71.9	026	265	664
74.4	031	271	703
77.0	032	306	712
79.7	043	311	723
82.5	047	315	731
85.4	051	331	732
88.5	054	343	734
91.5	065	346	743
94.8	071	351	754
97.4	072	364	036*
100.0	073	365	053*
103.5	074	371	122*
107.2	114	411	145*
110.9	115	412	
114.8	116	413	212*
118.8	125	423	225*
123.0	131	431	246*
127.3	132	432	252*
131.8	134	445	255*
136.5	143	464	266*
141.3	152	465	274*
146.2	155	466	325*
151.4	156	503	332*
156.7	162	506	356*
162.2	165	516	446*
167.9	172	532	452*
173.8	174	546	454*
179.9	205	565	455*
186.2	223	606	462*
192.8	226	612	523*
203.5	243	624	526*
210.7	244	627	
	245	631	
	251	632	

*Codes Unique to General Electric

NOTE

To reverse the polarity of the digital Channel Guard codes, type I ("inverted") before the code number, i.e. I023.

AVAILABLE OPTIONS

PC PROGRAMMING OPTIONS

The radio is programmed using an IBM compatible personal computer equipped with a RS-232 connector. Option TQ3310 provides the RS-232 serial interface unit and the cable between the PC and the unit. (An auxiliary power supply for the unit is also included which is not needed to program the MCS.) Option TQ3314 provides the MCS programming cable between the PC interface unit and the MCS system connector. Option TQ3317 provides the MCS programming software to run on the PC.

RF POWER AMPLIFIER

RF Power Amplifier Option RA01 amplifies a 10 watt MCS radio to 40 watts output. The amplifier covers both band splits (136-174 MHz) without any tuning adjustments. Installation requires replacing the radio's bottom cover with the amplifier assembly and plugging in coaxial jumpers. A new bottom cover mounting plate is included for mounting the modified radio.

NOISE SUPPRESSION KIT OPTION

Noise Suppression Kit Option PD01 (19A148539G1) is available for installations where excessive alternator or electrical noises present on the power cable do not permit the radio to operate properly.

POWER CABLE OPTION

20 foot power cable Option CC01 (19B801358P6) is available for installations requiring more than the standard 9 foot cable.

SYSTEM CABLE OPTIONS

Two system cable lengths are available to extend the distance between the radio and the control head. Option CC03 (19B801348P2) provides an additional 6 feet and Option CC04 (19B801348P1) provides 18 feet. The power cable must also be extended between the two units by cutting a power cable to length (Option CC01) and using the Molex connectors supplied with the Control Head.

SERVICE OPTIONS

Test Point Adapter box Option TQ2356 allows receive audio monitoring and transmit audio injection without opening the radio. The adapter connects between the Control Head and the radio and provides test points on each of the 9 lines of the system cable.

Service cable 19A704875P1 provides an extension between the Audio Board and the Logic Board. Both sides of the Audio Board are available for servicing using the cable.

OPERATION

The operation of the MCS radio is described briefly below, for a more detailed description refer to the Operator's Manual (LBI-31969).

TO RECEIVE A MESSAGE:

1. Slide the ON-OFF switch to the right.
2. Select the proper channel by rotating the channel select switch.
3. Press the monitor switch to disable squelch circuit and Channel Guard decoder. Adjust VOLUME control for comfortable listening level and then release MONITOR switch for normal operation.

TO SEND A MESSAGE:

1. Turn the radio on as described above.
2. Select the proper channel.
3. Press the MONITOR switch to determine that channel is not in use and set the desired listening level.
4. Press the PTT button on the microphone and begin your message. The XMIT indicator should be lit. Release the PTT button to end transmission.

NOTE

Always speak in a normal tone of voice. Hold the microphone cupped in your hand and touching your cheek lightly. Speak across the face of the microphone, not directly into it. Shouting will degrade your transmissions, do not speak any louder than normal.

GE Mobile Communications

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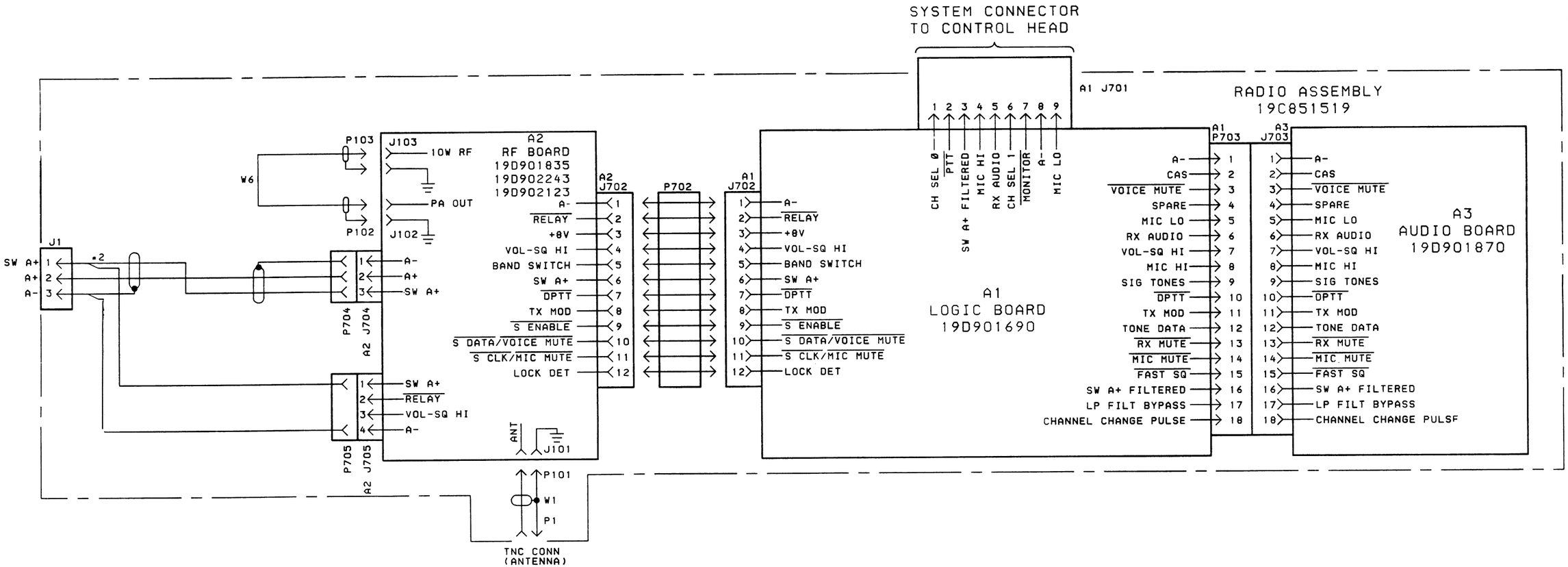
COMBO



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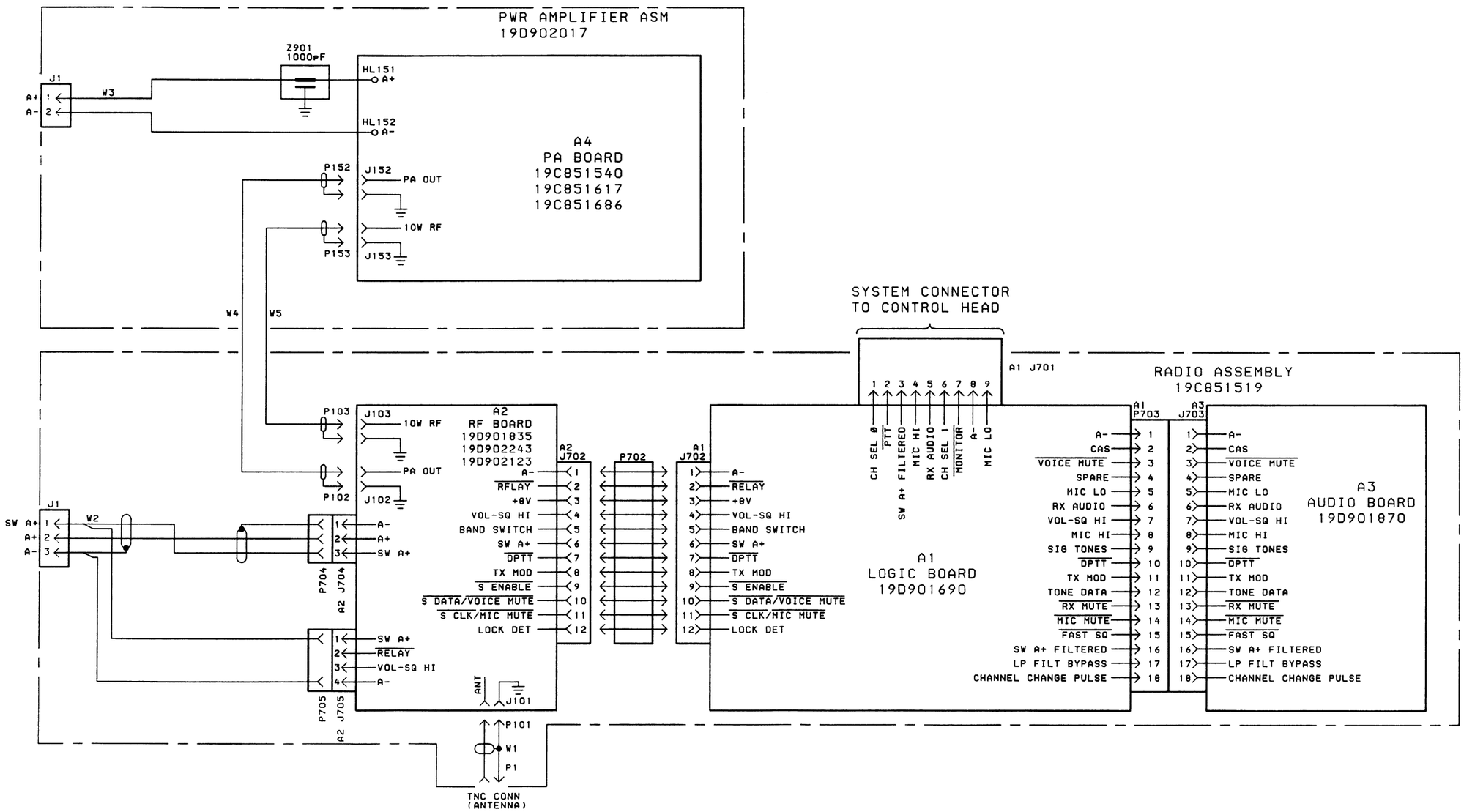

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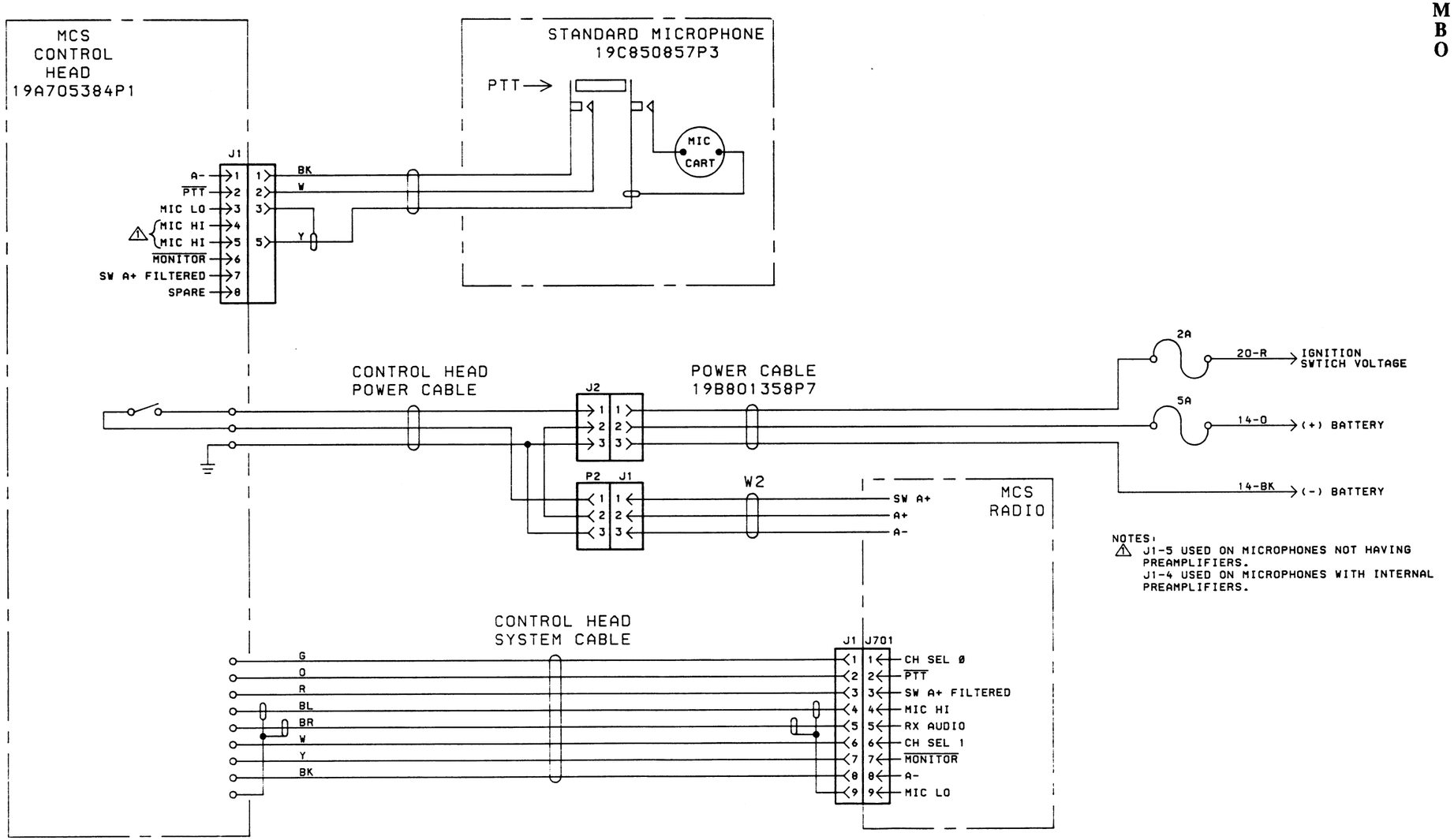


NOTES:
⚠ J1-5 USED ON MICROPHONES NOT HAVING PREAMPLIFIERS.
J1-4 USED ON MICROPHONES WITH INTERNAL PREAMPLIFIERS.

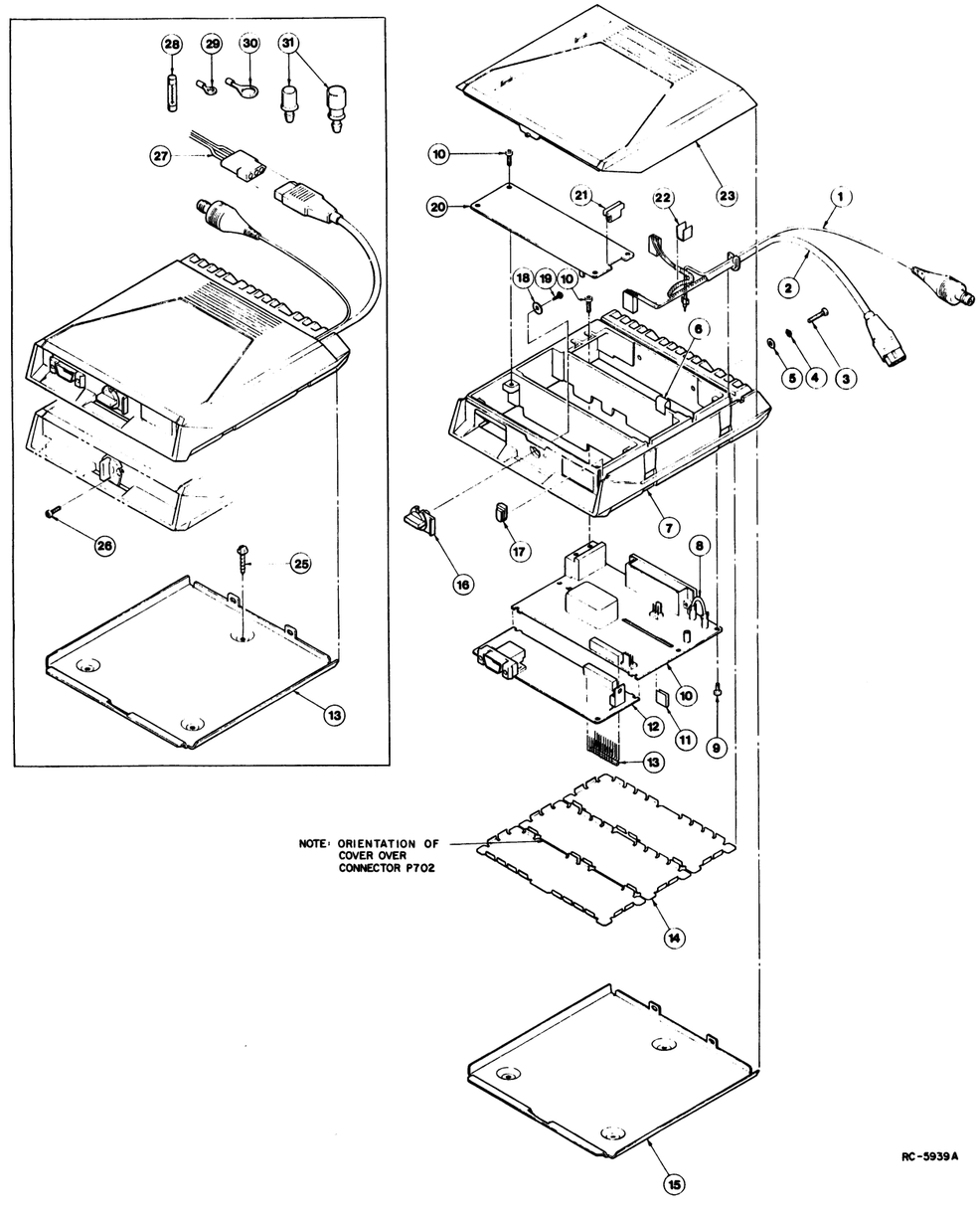
(19D902024, Sh. 3, Rev. 0)

PARTS LIST

MCS MECHANICAL PARTS
ISSUE 2

SYMBOL	GE PART NO.	DESCRIPTION
1	19A705301P1	RF Cable (W1).
2	19C851497P3	Power Cable (W2).
3	19A702381P520	Screw: M3.5 - 0.6 X 20. (Quantity 2).
4	19A701312P5	Flatwasher: M3.5. (Quantity 2).
5	19A700033P6	Lockwasher: M3.5. (Quantity 2).
6	19A705244P1	Clip.
7	19D901728G1	Casting.
8	19A704884P2	RF Cable (W6).
9	19A702381P508	Screw: M3.5 - 0.6 x 8. (Quantity 13).
10		RF Board (A2).
11	19A705220P1	Clip. (Quantity 2).
12		Logic Board (A1).
13	19B801359P3	Connector. (P702).
14	19C851442P1	Cover. (Quantity 3).
15	19C851504G1	Bottom Cover.
16	19C851505P1	Latch.
17	19C851497P2	Hole Plug.
18	N402P37B6	Flatwasher: No. 6.
19	N130P1206B6	Screw: No. 6-20 x 3/8.
20		Audio Board (A3).
21	19A705282P1	Clip.
22	19A704943P1	Clip, spring tension.
23	19B801397G3	MCS Top Cover.
		NOTE: THE FOLLOWING PARTS ARE PART OF HARDWARE KIT 19A704685G1.
25	N743P1716B	Screw, self drilling: #10 - 16 x 1. (Quantity 3).
26	19A703668P510	Screw, tamper resistant: M3.5 - 0.6 x 10.
		NOTE: A #15 TORX R TAMPER RESISTANT DRIVER (STO618) IS REQUIRED TO INSTALL/REMOVE THIS SCREW. RADIO IS SHIPPED WITH 19A703668P510 SCREW IN THIS POSITION.
27	19B801358P7	Battery cable, 9 feet.
		NOTE: THE FOLLOWING PARTS ARE SUPPLIED WITH THE BATTERY CABLE.
28	1R16P5	Fuse: 2 amp, sim to Bussman AGC2. (Quantity 1).
	7102673P5	Fuse: 5 amp, sim to Bussman AGC5. (Quantity 1).
29		Terminal: sim to Amp 34112. (Quantity 2).
30		Terminal: sim to Amp 34126. (Quantity 2).
31	19A149451P2	Fuse holder: sim to Bussman HHB. (Quantity 2).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.



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