ERICSSON

Mobile Communications

MDX™ GE-MARC

806 - 866 MHz MOBILE RADIO

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Maintenance Manual

ERICSSON

Ericsson GE Mobile Communications Inc.
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SPECIFICATIONS*

GENERAL	
Operating Voltage	13.8 Volts ±20%
Battery Drain	
Receiver (13.8 Vdc)	
Off	0.01 Amperes (maximum)
Squelched	0.8 Amperes (maximum)
Unsquelched	3.5 Amperes (maximum at 10 Watts audio, External Speaker)
Transmitter (13.8 Vdc)	10.5 Amperes (maximum at 25 Watts RF)
Channel Spacing	25 kHz
Frequency Stability	±1.5 PPM (±0.00015%)
Temperature Range	-30°C to +60°C (-22°F to +140°F)
Dimensions (H x W x D) (Less Accessories)	
Height	5.3 cm (2.1 inches)
Width	18.2 cm (7.2 inches)
Depth	24.0 cm (9.5 inches)
Weight	3.0 kg (6.6 pounds)
Antenna Impedance	50 Ohms
TRANSMITTER	
Frequency Range	806.0125 - 820.9875 MHz and 851.0125 - 865.9875 MHz
Output Power	25 Watts (Intermittent duty cycle; EIA 20%)
Audio Sensitivity	75-105 mVrms
Spurious and Harmonics	less than -16dBm
Audio Distortion	5% Maximum
Modulation Limiting	+5 kHz maximum (4 kHz max 806.000 - 820.9875 and 851.000 - 865.9875 MHz)
FM Hum and Noise	-45 dB
Audio Frequency Response	EIA/TIA RS-603
RECEIVER	
Frequency Range	851.0125 - 865.9875 MHz
Acceptable Frequency Displacement	±2.5 kHz
Sensitivity (12 dB SINAD)	-113 dBm minimum
Spurious Response	70 dB minimum
Adjacent Channel Selectivity	68 dB minimum at ±25.0 kHz
Intermodulation Distortion	65 dB minimum
Audio Frequency Response	EIA/TIA RS-603
Audio Output	10 Watts (External Speaker); 4 Watts (Internal Speaker) 7.5 Watts (External Speaker) with Remote Mount Kit
Audio Distortion	5% maximum at 1 kHz

* These specifications are intended primarily for use by service personnel. Refer to the appropriate Specification Sheet for complete specifications.

GENERAL DESCRIPTION

The Ericsson/GE MDX™ GE-MARC mobile radio is a synthesized wideband radio that uses integrated circuits and microcomputer technology to provide high performance trunked operation. The radio provides 25 watts of RF power output in the 806 to 821 MHz and 851 to 866 MHz trunking bands without retuning. The receiver operates in the 851 to 866 MHz band without retuning.

All radio functions are stored in a programmable electrically erasable PROM (EEPROM). The radio is field programmable using an IBM compatible personal computer with the following equipment:

- Serial Programming Interface Module TQ-3310,
- GE Programming Cable TQ-3372, and
- TMX-8825/MDX GE-MARC Programming Software TQ-3344 or TQ-4344.

With the interface equipment and software, the computer can be used to program (or reprogram) customer system frequencies, Channel Guard tones and options. Programming is done through the radio.

The MDX GE-MARC radio assembly consists of the following circuit boards and assemblies:

- RF Board (19D902123)
- PA Board (19C851822)
- Audio Board (19D902188)
- Logic Board (19D902172)
- System Board (19D901891)
- Audio Amplifier Board (19D904025)
- Front Cap Assembly (19D904151)

The circuit boards are all mounted in a main casting providing easy access for servicing. Interconnecting cables and plugs are used to connect the boards to eliminate pinched wires and other wiring problems.

RF BOARD

The RF board includes the programmable frequency synthesizer, transmitter exciter, receiver front end and IF circuitry, and PIN diode Tx-Rx switch.

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 is processed on the Audio and Logic Boards, and applied to the synthesizer to modulate the VCO. The buffered VCO output drives both the transmitter exciter and the receiver mixer.

Transmitter Circuit

The transmitter circuit 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 provides RF output to drive the PA Board. The power control circuit controls the PA module by sampling the PA board 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 overheating.

Receiver Circuit

The dual conversion receiver circuit consists of a front end section, 45.3 MHz first IF, a 455 kHz second IF, and FM detector. All audio processing and squelch functions are accomplished on the Audio Board.

PA BOARD

The PA Board amplifies the RF Board PA module output to the rated output of 25 Watts. The 25 Watt output is fed back to the RF Board where the power control circuit, the antenna switch, and the low pass filter are located.

AUDIO BOARD

The Audio Board provides analog to digital and digital to analog conversion of the receive and transmit audio for digital processing by the Logic Board. The board also contains audio filtering, conventional analog tone processing, and the receiver squelch.

LOGIC BOARD

The Logic Board controls the main operation of the radio and digitally processes the receive and transmit audio. The board contains a microprocessor and associated memory circuits including an EPROM for controlling the processor and a programmable "personality" electrically erasable PROM

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(EEPROM) to store customer frequencies, tones, and options. The microprocessor provides control data to the digital signal processor (DSP), conventional tone generation and detection, frequency data to the synthesizer, and sends and receives data to another microprocessor in the Front Cap Assembly for the display and control commands.

SYSTEM BOARD

The system Board controls the main input power to the radio. The front panel POWER switch and the IGNITION SENSE input lead provide the necessary signals to the MOSFET switching circuit.

The board also interfaces all option connections from the internal boards in the radio with the optional items outside of the radio. All options that apply to the radio, interconnect to the System Board through the back of the radio using and optional cable.

AUDIO AMPLIFIER BOARD

The Audio Amplifier Board provides compression on the received audio. An audio amplifier is used to drive four watt audio power into the internal eight ohm speaker or ten watts audio power into an external four ohm speaker. With a Remote Mount Kit, the external speaker power is 7.5 watts.

FRONT CAP ASSEMBLY

The Front Cap Assembly contains the Display Board and houses the internal speaker. The Display Board contains a microprocessor that senses key closures, updates the eight character LED display and ICON displays, and communicates with the main radio microprocessor on the Logic Board.

ACCESSORIES AND OPTIONS

MICROPHONES

The standard mobile combinations use a transistorized dynamic microphone with an internal hookswitch. The microphone is housed in a sturdy case, and is supplied with a magnetic microphone hanger. The extendible coiled cord plugs into a jack on the bottom of the radio, and is secured to the radio by a cable clamp.

In trunked mode, the radio can be programmed to originate a call when the microphone is removed from the hanger, or to terminate a call when the microphone is returned to the hanger.

In conventional mode, Channel Guard (an option) is disabled when the microphone is removed from the magnetic hanger allowing the operator to monitor the channel before sending a message. Optional DTMF and desk microphones are also available for other applications.

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 continuous alert tone warns the operator to unkey and then rekey the PTT to continue the transmission. The timer can be set for 30 seconds to 7.5 minutes in 30 second increments. The timer can 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 through continuous digital coded squelch (CDCSS) Channel Guard codes. Tone frequencies range from 67.0 Hz to 210.7 Hz. There are 83 standard programmable digital codes.

The Channel Guard tone frequencies and digital codes are software programmable. Tone frequencies and digital codes can be mixed on each channel. They 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 250 ms. This mute time allows the transmission to end and mutes the squelch tail. The radio looks for STE on the received signal both when the microphone is on or off hook. STE is enabled for transmit and/or receive by PC programming the radio's personality.

PC PROGRAMMING OPTIONS

The radio is programmed using an IBM compatible personal computer equipped with an RS-232 connector. Option TQ-3310 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 but is not needed to program the radio.

Option TQ-3372 provides the radio programming cable between the PC interface unit and the radio microphone jack. TMX-8825/MDX GE-MARC PC programming software option TQ-3344 is provided on 5.25 inch diskettes and TQ-4344 is provided on 3.5 inch diskettes.

NOISE SUPPRESSION KIT OPTION

Noise Suppression Kit Option PD1A (19A148539G1) is available for installations having excessive alternator or electrical noises present on the power cable that prohibit proper radio operation. Refer to the interconnect diagram for options.

DESK MOUNTING WEDGE

Desk mounting wedge option MAIL (19C851685G2) is available for use with the AC power supply options when using the radio as a base station. The wedge mounting bracket mounts the radio with the control panel tilted up for better accessibility to the radio controls.

REMOTE MOUNT OPTION

The Remote Mount Option (MA3K) provides for controlling the main radio assembly remotely from the Front Cap Assembly. The Front Cap is removed from the main radio assembly and mounted to a rear housing containing an interface board (supplied with the option). A new front cap, without any controls or displays, containing an interface board is mounted to the main radio assembly. An 18-foot system cable is normally supplied for use between the two units.

AC POWER SUPPLIES

Two AC power supplies are available when equipping the MDX GE-MARC radio for operation as a base station.

Option PS1C (19A704647P2) is a 117 VAC, 60 Hz power supply. Option PS1D (19A704647P3) is a 120/240 VAC, 50/60 Hz power supply. Both supplies are available, depending upon the application requirements.

OPTION CABLE

Option cable CD7Z (19C851585P14) is used to bring all option connections from the System Board through the back of the radio to the outside. This cable is required with all external options.

POWER CABLE

Eighteen foot power cable Option CD9A (19B801358P17) is available for installations requiring more than the standard nine foot cable.

EXTERNAL SPEAKER OPTIONS

The military specification external speaker options provide a five inch speaker in a LEXAN housing. Option LS1F (19A149590P1) provides a dash-kit for the External Speaker. Speaker cable option CC9M (19A149590P8) is also required for operation of this option.

The radio's ten watt amplifier drives the speaker's four ohm impedance.

EXTERNAL ALARM

External Alarm Horn Relay Option SU1C (19A705499P1) requires External Alarm ON/OFF switch Option SU1F (19C851585P7). The relay option connects to pin 13 of the option cable Option CD7Z. The relay can sound the vehicle horn when a call is received. The alarm switch is used to turn the horn relay on or off.

HORN ALERT OPTION

If the Horn Alert Option is present, the radio can be pre-programmed to beep the vehicle horn when a call is received (in trunked mode operation only).

To enable the Horn Alert Option, momentarily press the MENU (**MNU**) key until ALARM appears in the display. (If PHONE appears, press **MNU** again). Use the GROUP UP/DOWN (G▲, G▼) keys to toggle between Yes or No to enable or disable the alarm.

If desired, after disabling the alarm, press the CLEAR (**CLR**) key to leave the menu mode and return the display to the current area/group. The alarm remains enabled on the area/group selected in the display.

With the alarm enabled, when a call is received, the radio first sounds a pulsed alert warning tone for three (3) seconds and then begins blowing the horn five times (one second on, three seconds off, for 20 seconds). Pressing the microphone PTT during the pulsed alert tone prevents blowing the horn. The horn alert remains enabled for subsequent calls.

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Table 1 - Tone & Digital Channel Guard

TONE CG	DIGITAL CG	DIGITAL CG	DIGITAL 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 Ericsson/GE

NOTE

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

SYSTEM DESCRIPTION

The MDX GE-MARC trunked mobile radio system provides fast access to available RF channels and a degree of privacy due to selective signaling. This also eliminates annoyance of other system user's conversations while ensuring that intended calls are not missed. The trunked mobile radio system consists of a repeater for each channel and the user's mobile radio units. Tone signaling is used, with each mobile being assigned two and/or four tone, tone sequences for group designation. All mobiles in a group are assigned the same tones, so that any unit can talk to all other units in the same group.

When originating a call, the mobile identifies an idle repeater channel and interrogates it with a single burst of "busy" tone. The repeater keys its transmitter and sends a burst of "acquisition" tone back to the mobile unit. When the interrogating mobile detects the acquisition tone, it transmits its collect and group tones. These are regenerated by the repeater and "heard" by all idle mobile units in the system.

All system idle mobiles continually scan all channels to detect collect tones. Having now "heard" the collect tones they hold on the channel and wait for the group tone(s) to follow.

If the listening mobiles detect the "correct" tone sequence (the sequence of its own group), they lock on the channel, alert their operators of an incoming call and open their audio circuits. If the "correct" group tones are not detected, the mobiles remain in the idle state and continue to scan all channels for a collect tone. Once a mobile is "locked" on a channel, it remains there until the repeater times out or the operator terminates the call.

OPERATIONAL MODES

The mobile radio is always in one of three operational modes; idle, wait, or ready. The three operational modes and the conditions that cause the radio to switch from one mode to another are shown in Figure 1 (next page).

The radio enters idle mode as soon as it is turned on and begins scanning channels for incoming calls. The wait mode is entered when the user places a call. The radio remains in the wait mode if no channel is available, or until a channel is acquired. The ready or conversation mode is indicated by an alert tone and the mode indicator on the control panel.

A tone signalling Timing Diagram is shown in Figure 2.

Sequence Flow Charts for each operational mode are shown in Figures 3, 4, and 5.

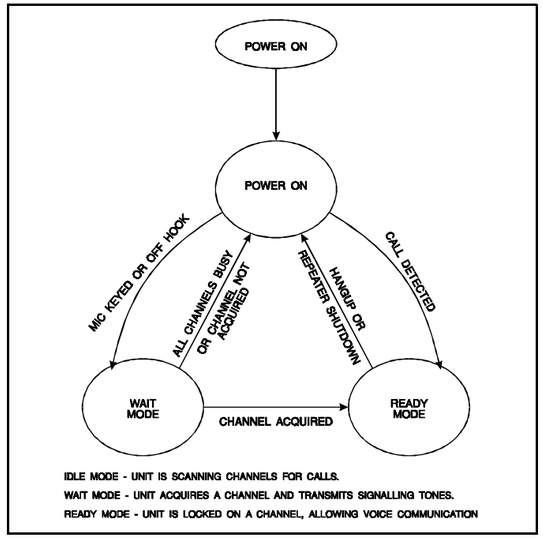

Figure 1 - Operational Modes

IDLE MODE (Figure 3)

When a mobile radio is in the Idle mode, the audio is muted and all channels programmed for call decode are sequentially scanned for an incoming call. An incoming call is identified when the mobile detects one of the collect tones programmed for the area. Upon receipt of a collect tone, the mobile waits on the channel for a short interval to receive the group or individual tone sequence sent by the calling mobile. If a group or individual tone sequence is identified as belonging to the listening mobile, the mobile then looks for busy tone for 90 milliseconds. If four tones are properly decoded, the mobile then looks for busy tone for 270 milliseconds.

If tone sequences received do not pertain to the listening mobile, the mobile remains in Idle mode and resumes scanning the channels looking for another collect tone. If the expected sequences are detected the mobile enters the Ready mode.

While in Idle mode, removing the handset from the hanger, pressing the PTT switch, or pressing the send key on the handset, causes the radio to enter the Wait mode.

WAIT MODE (Figure 4)

When the user enters Wait mode, the group tone is checked to make sure it is a valid call-originate group. If it is not valid, a high frequency steady tone is heard. If valid, the radio scans the call originate frequencies for brief intervals until it finds

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one with no busy tone. If no channel is free, the radio activates the Call Retry state if programmed for this option. This causes the radio to revert to the Idle mode and scan for a call while trying the Wait mode approximately every 20 seconds for a five minute period. If the Retry Option is not programmed, the mobile sounds a low-frequency tone, and then returns to the Idle mode.

If a channel with no busy tone is found, the mobile transmits a burst of busy tone to acquire the repeater. The repeater responds with a burst of acquisition tone. Upon receipt of the acquisition tone, the mobile proceeds to transmit the group tones (either two or four tones). If a four tone sequence is sent, the listening mobiles must detect all four and busy, before entering the Ready mode. If a two tone sequence is sent, the busy tone must be present within 90 milliseconds of the last tone in order for the listening mobile radio to enter the Ready mode. If no busy tone is present, or if the four tone sequence is not valid the listening mobile jumps to the next channel in the call originate set and checks for busy tone as described above.

READY MODE (Figure 5)

When an incoming call is detected, or an idle channel is acquired, the mobile enters the Ready mode. In this mode, the audio and push-to-talk circuits are enabled, the speaker is unmuted, and the operator is alerted by an alert tone. The radio can then be used in a conventional push-to-talk manner and the radio stays on the channel until the operator hangs up or the repeater drops the busy tone, causing the unit to revert to Idle mode.

NOTE

If a call is initiated and a sequence of five beeps is sounded, the used cannot access the radio system due to being out of the mobile receiver range or being inoperative. Any subsequent call is ignored for 20 seconds.

GLOSSARY OF SYSTEM TERMS

Idle Mode

In the "standby" condition for a mobile. Inactive but ready to call or be called. Trunked radios are Idle until they are turned off.

Wait Mode

In the "attempting origination" condition. The Wait mode is entered from Idle mode (only) as the user presses the PTT switch on the microphone, or comes "off-hook". If successful the unit becomes Ready. Otherwise, the unit is Idle or Idle/Wait after all channels are tried.

Ready Mode

In the "operating" condition. Ready is entered from Idle mode via Wait mode when calling, or directly from Idle when called. Ready mode ends (the radio reverts to Idle) when the user disconnects or with loss of received Busy Tone from the repeater. This normally occurs when the repeater shuts down after communication is completed.

Busy Tone

A "Voice-plus" tone 3051.9 Hz (standard). 2918 Hz (alternate) tone modulates mobile and repeater transmitters at low level(±1 kHz deviation) continuously. This tone is filtered from received audio and used to hold the communication channel active. It also excludes other mobiles from using the channel when a call is active.

Acquisition Tone

A tone (1962.9 Hz) sent for a duration of 50 milliseconds from the repeater. It is used as acknowledgment from the repeater of the received busy tone. It signals the mobile that sent the busy tone that (group) signalling tones can now be sent.

Collect Tone

A tone chosen from 38 standardized frequencies ranging from 508.6 Hz to 2792.4 Hz used as the first tone in the group tone sequence. The collect tone is used to gather all mobiles with the same collect tone for decoding a call. The duration of the tone varies as a function of the number of channels programmed into the mobile and/or the repeater.

In a two tone call, the mobile sends the collect tone for a programmed duration. In the four tone call, the mobile always sends a 90-millisecond collect tone that the repeater regenerates and sends for the exact 90-millisecond duration.

Group/Individual Tones

Tones chosen from the 3 standard frequencies follow the collect tone. In a two tone call, the second tone is sent for 450 milliseconds. In a four tone call, tones two through four are sent for 90 milliseconds each from the mobile, and 180 milliseconds each from the repeater.

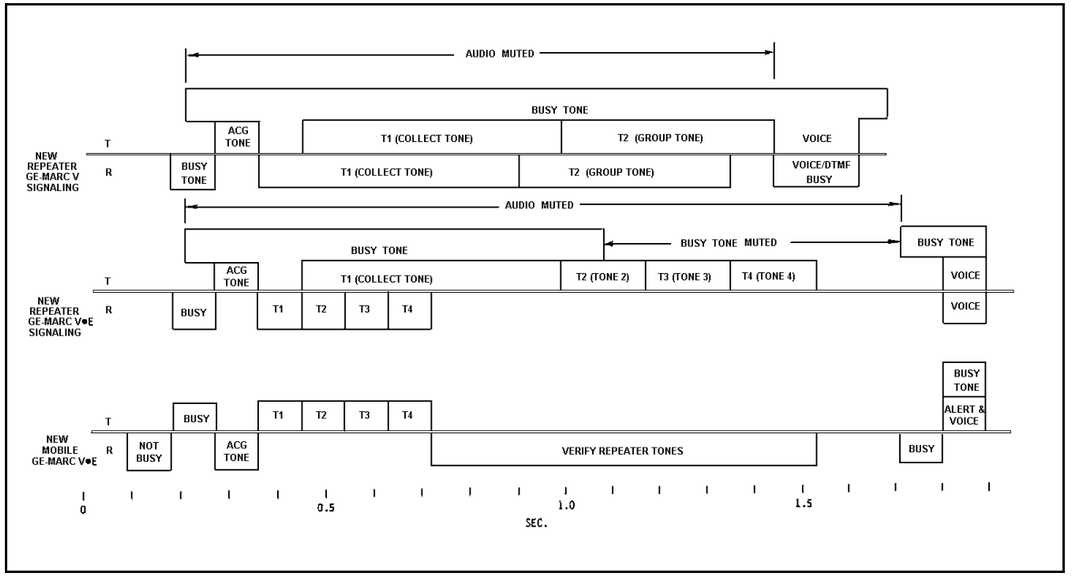

Figure 2 - Tone Signal Timing

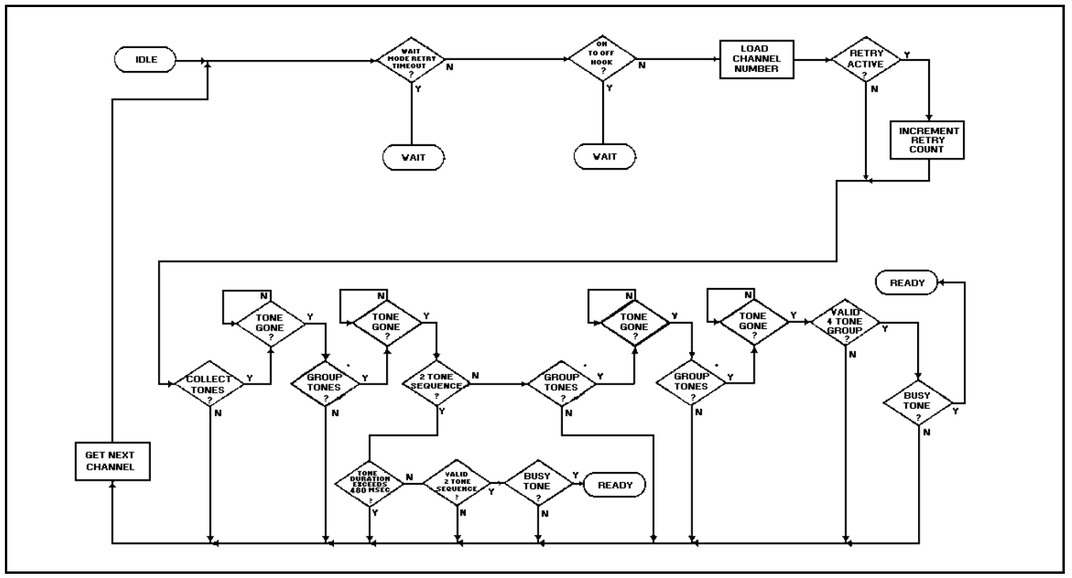

Figure 3 - Idle Mode

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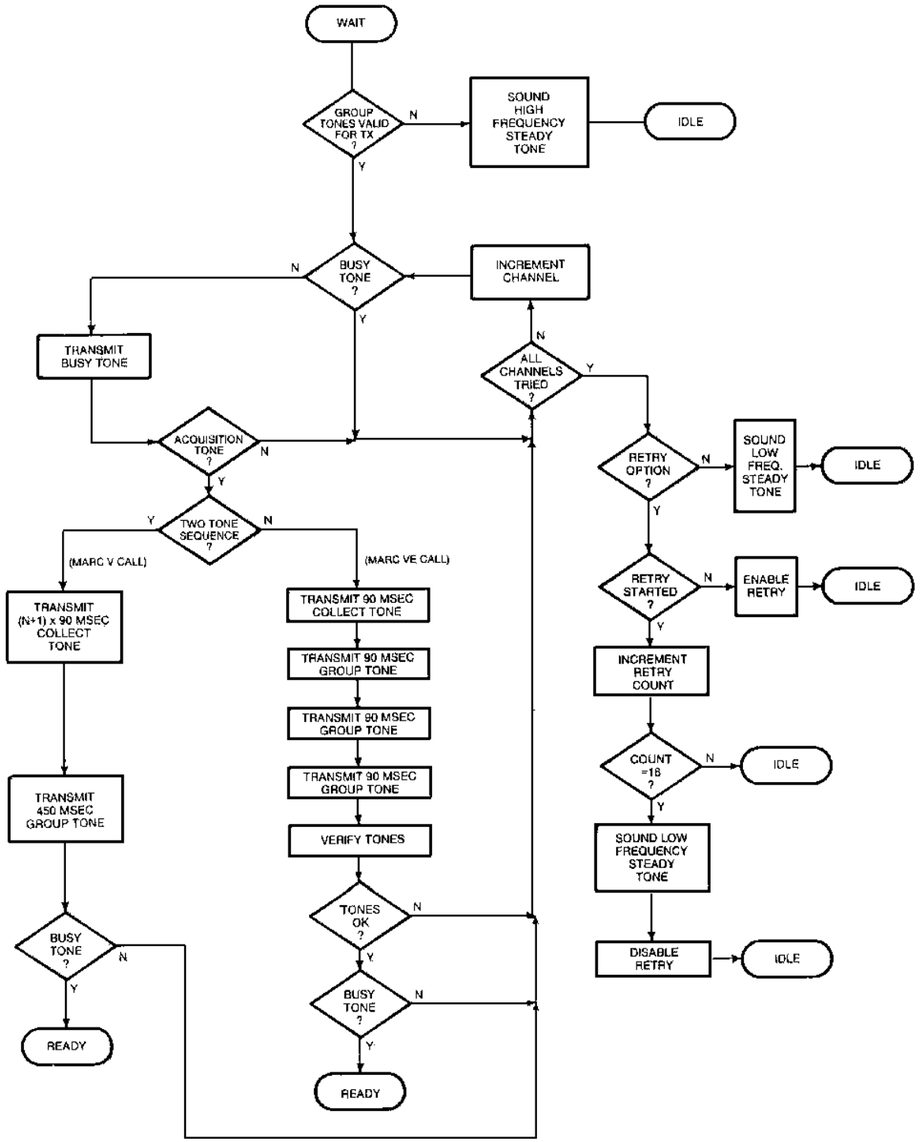

Figure 4 - Wait Mode

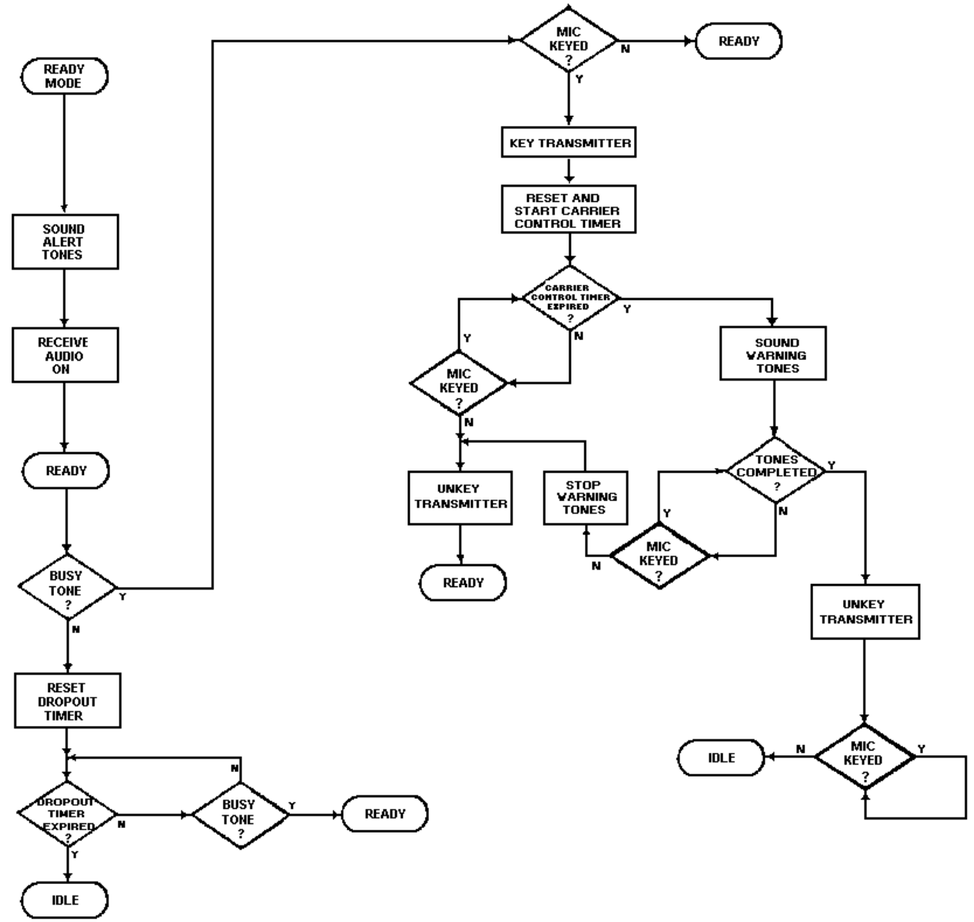

Figure 5 - Ready Mode

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CONTROL PANEL OPERATION

CONTROLS

The MDX GE-MARC trunked radio is equipped with the controls listed below (see Figure 6).

POWER (PWR)

Momentary switch. Press once to turn the radio ON. Press again to turn the radio OFF. The radio sounds three beeps and the display shows PASSED followed by the area/group last selected.

VOLUME UP/DOWN ( )

Two momentary switches. VOLUME UP and VOLUME DOWN. Beeps are heard while stepping the volume on an inactive channel. No beeps are heard if stepping a channel actively receiving.

AREA UP/DOWN (±)

Press (+) Area Up to increment to the next higher programmed area. Press (-) Area Down to decrement to the next lower area.

GROUP/SELECT UP/DOWN (G▲, G▼)

Two momentary switches. Increment or decrement groups, channels, or menu selections.

TRUNKED MODE: Increments or decrements the group. Inoperative in areas dedicated to direct mode GE-MARC channels. NOTE: THE SPECIAL CALL function is not selected when stepping through groups. Press **MNU** and then simultaneously press **G▲** to select SPECIAL CALL.

CONVENTIONAL MODE: Increments or decrements the conventional channels (up to 9 channels).

MENU OPERATION: Increments or decrements menu selections for the ALARM and PHONE menu features.

CLEAR/MONITOR (CLR)

Momentary switch.

TRUNKED MODE: Terminates the call.

DIRECT AND CONVENTIONAL MODES: Unsquelches the receiver to monitor any activity on the selected channel.

MENU OPERATION: Exits the menu when using the PHONE or ALARM options. Resets the display to the current area/group.

MENU (MNU)

Momentary switch. Accesses the menu features (PHONE and ALARM). Press **MNU** again to toggle between PHONE and ALARM. Press **CLR** to exit the menu mode and return the display to the current area/group.

PHONE: Allows selecting up to 10 preprogrammed telephone numbers. Press **G▲** or **G▼** to toggle between YES and NO.

ALARM: If the Horn Alert Option is present, press **G▲** or **G▼** to toggle between YES and NO.

SHIFT KEY FUNCTIONS

MENU/GROUP UP (MNU, G▲)

Momentary switches. Selects the special call function for the area in the display (trunked mode only). Press **MNU** and then **G▲** simultaneously. (**MNU** is acting as a "shift" key.)

MENU/VOLUME UP (MNU, [up])

Momentary switches. Immediately places receiver volume at maximum. Press MNU and then [up] simultaneously.

MENU/VOLUME DOWN (MNU, [down])

Momentary switches. Immediately places receiver volume at minimum. Press MNU and then [down] simultaneously.

A1

Ramp switch. Raises the LED intensity in seven (7) steps from the lowest to highest intensity. At power-up LED intensity is maximum (highest intensity). Press and hold A1 until the intensity is bright enough.

A2

Ramp switch. Lowers the LED intensity in seven (7) steps from the highest to lowest intensity. At power-up LED intensity is maximum (highest intensity). Press and hold A2 until the intensity is low enough.

VISUAL INDICATORS

Display Indicators

An LED display provides the operational status of the radio. The display contains transmit (TX) and busy (BSY) indicators and an alphanumeric display containing eight characters. (See Figure 6.)

TX (Transmit)

ON: Indicates Push-to-talk is pressed.

FLASHING: Indicates the radio is attempting to acquire a channel in trunked mode.

BSY (Busy)

TRUNKED MODE:

FLASHING: Indicates the radio is automatically retrying to acquire a channel while the system is busy. (Radio must be preprogrammed for the call retry option.)

ON: Indicates out-of-range of the GE-MARC system transmitters and receivers.

CONVENTIONAL MODE:

ON: Indicates the channel is busy.

Display Characters

Eight alphanumeric characters. Up to four characters are used for the area name followed by four characters for the group name.

AUDIBLE INDICATORS

Self Test Check Alert

Three beeps are sounded one second after the radio is turned on to indicate that the radio has passed the self diagnostic test. The display shows PASSED for one second.

Call Received Alert (Trunked Mode Only)

A short high frequency tone is sounded when a group call is received. A two tone alert is sounded when receiving an individual call NOTE: The radio can be preprogrammed to mute the Call Received Alert Tones.

Call Originate Alert (Trunked Mode Only)

A three tone alert is sounded after originating a trunked call. The alert indicates a channel was acquired and is ready for normal conversation.

System Busy (Trunked Mode Only)

A low frequency tone is sounded for one second after attempting to place a trunked call. The display also shows WAIT momentarily. This tone indicates the GE-MARC system is busy and you should try again later (the call retry option automatically tries again if preprogrammed).

Out Of Range Alert (Trunked Mode Only)

Five beeps are sounded after attempting to place a trunked call. These beeps indicate that the radio is out of range of the GE-MARC system, or if the beeps sound when the radio is known to be within range of the system, the radio may need servicing (even though the self-diagnostic test passed at power on).

Individual Call Originate Alert (Trunked Mode Only)

A low frequency tone is sounded for one second immediately after pressing the microphone PTT. The display does not show WAIT. A call was attempted to a group that is not enabled for call originate.

Carrier Control Timer (Trunked, Direct, And Conventional Modes)

A pulsed tone signal is sounded when the microphone PTT is pressed continuously for preprogrammed time period. After nine seconds of pulsing the alert tone, the radio unkeys the transmitter and communications is interrupted. While the tone is pulsing, the user can release and press the PTT again to reset the timer and resume the conversation.

GE-MARC System Tones

The GE-MARC system may give other alert tones to alert the user of system time-out, etc.. Contact you GE-MARC system operator for details about these alert tones.

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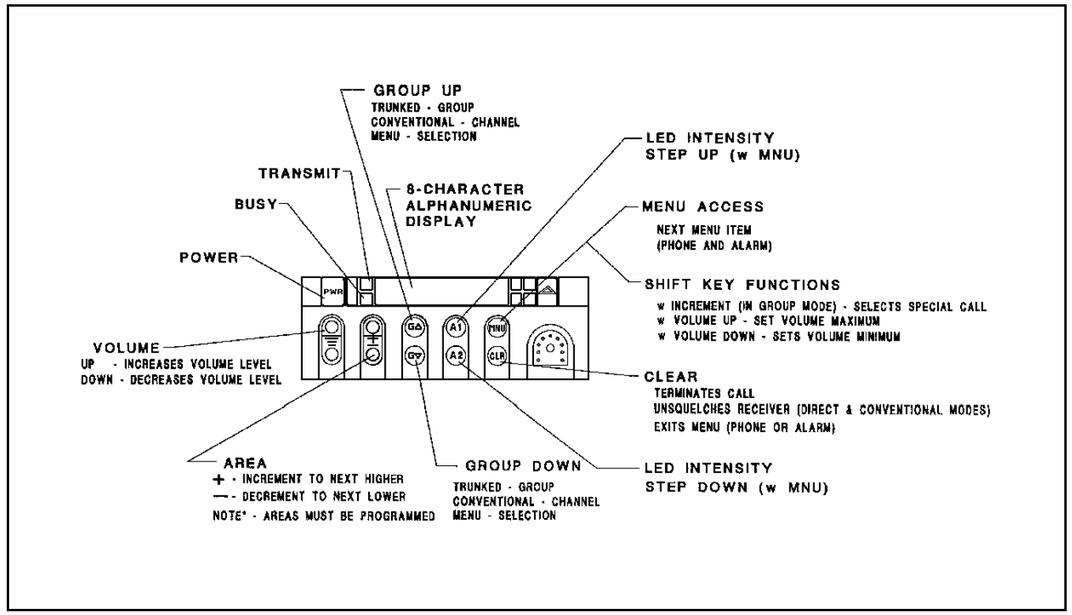

Figure 6 - MDX GE-MARC Front Panel

RADIO OPERATION

BASIC OPERATION

Press the power (PWR) switch to apply power to the radio circuitry. A self-diagnostic test is performed for one second. A three (3) beep alert signal is then heard and the display shows PASSED for one second. The display then shows the AREA and GROUP last selected.

NOTE

Should the 3-beep alert not sound, and/or the display show ERROR, contact your service representative

Set the volume level using the Volume Up/Down ( ) keys. A short beep sounds to show each volume level step. The beeps stop when maximum or minimum volume is reached or while receiving a call.

NOTE

Pressing MNU and VOLUME UP simultaneously, immediately puts the volume at maximum setting. Conversely, pressing MNU and VOLUME DOWN simultaneously, immediately puts the radio at minimum volume. The MNU key acts as a "shift" key for these operations.

Turning The Radio Off

Press the power (PWR) switch or if the radio is connected to the vehicle ignition switch, turn the vehicle ignition off. When vehicle ignition is turned back on, the radio power and all other radio settings return to the same condition last selected.

TRUNKED MODE OPERATION

NOTE

If you plan on a lengthy call (or several calls), the vehicle engine should be kept running to maintain battery charge.

Placing a Dispatch Call

1. Select the desired trunked mode AREA and GROUP using the AREA (±) and GROUP (**G▲** or **G▼**) keys. If the SPECIAL CALL (SPC) feature is desired, select the AREA followed by simultaneously pressing MENU (**MNU**) and then GROUP UP **G▲**. The display shows SPC after the area name. If the area has no programmed groups, SPC selection is automatic.

2. Momentarily press the microphone push-to-talk (PTT) switch to acquire a channel. The display shows WAIT momentarily. A three (3) tone alert signal sounds when you can begin the conversation. If the "off-hook-call-originate" option is preprogrammed, the radio automatically attempts to acquire a channel when the microphone is removed from the hanger without pressing the PTT.

   A steady one (1) second low frequency tone sounds if a call cannot be completed due to an all channels busy condition. Press the PTT again later to retry the call.

NOTE

If the call retry option has been preprogrammed in the radio, the radio automatically tries to acquire a channel every five seconds for up to fifteen times unless the area is changed or an out-of-range condition occurs.

A sequence of five (5) beeps sounds if the radio cannot access a channel due to being out of range of the GE-MARC system or an inoperative radio. Any subsequent call request is ignored for 20 seconds. However, if the area is changed, a call request can be initiated in a new area immediately.

RECEIVING A CALL (TRUNKED MODE OPERATION)

When a call is received by the radio, alert tones are sounded to inform the user of the incoming call (unless the "mute received alert tone" option has been preprogrammed).

A single tone alert indicates a group call. A two (2) tone alert indicates an individual call. The alphanumeric display flashes and contains the AREA and GROUP identifiers of the received call. Press the microphone PTT to answer the incoming call.

ENDING A CALL (TRUNKED MODE OPERATION)

Calls are ended in any of three (3) ways:

a. Pressing the clear **CLR** key.

b. Returning the microphone to the hanger (if the preprogrammed option "on-hook call terminate" is enabled), or

c. Waiting for a channel disconnect or system timeout after six (6) seconds of no channel activity (PTT).

NOTE

If a channel disconnect occurs before the conversation is ended, the call must be initiated again. To avoid confusion, a procedure should be set up designating the call originator as the one required to re-establish communications. Two or more operators originating calls simultaneously normally acquire two different channels thus making communication between the two impossible.

DIRECT MODE OPERATION

The direct mode provides short range, line of sight communications. In the direct mode, the radio is not operational on the GE-MARC System.

1. Press the AREA UP/DOWN (±) keys to select the direct mode area.

2. Press the GROUP UP/DOWN (**G▲** or **G▼**) keys to select the channel (up to nine [9] channels may be available in any conventional area).

3. Before making a call, determine if the channel is in use. Press CLEAR (**CLR**) to momentarily disable the squelch for a more complete monitoring of the channel. Also, removing the microphone from the hanger allows you to monitor the channel without disabling the squelch (Busy Tone is disabled). The Busy indicator in the display now shows if the channel is in use.

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CONVENTIONAL MODE OPERATION

1. Press the AREA UP/DOWN (±) keys to select the conventional mode area. If more than one channel is available in the conventional area, press the GROUP UP/DOWN (**G▲** or **G▼**) keys to select the channel (up to nine [9] channels may be available in the conventional area).

2. Before making a call, determine if the channel is busy. Press CLEAR (**CLR**) to momentarily disable the squelch for a more complete monitoring of the channel. Also, removing the microphone from the hanger allows you to monitor the channel without disabling the squelch (Busy Tone is disabled). The Busy Indicator in the display now shows if the channel is in use.

TELEPHONE INTERCONNECT CALLS

The radio can be preprogrammed with up to ten (10) telephone numbers. Each dialer number can contain up to fifteen (15) digits. Place a Telephone Interconnect call as follows:

1. Select the AREA and GROUP that are valid for interconnect calls. If the SPECIAL CALL (SPC) feature is desired in trunked mode, select the area, then simultaneously press MENU (**MNU**) and GROUP UP **G▲**. The display shows SPC following the area name. If the area has no programmed groups, SPC selection is automatic.

2. Momentarily press the MENU (**MNU**) key. If ALARM appears in the display, press **MNU** a second time until phone appears. PHONE remains in the display for one second and then the telephone number last selected is displayed. Use the GROUP UP/DOWN (**G▲** or **G▼**) keys to step to the desired telephone number. If you want to cancel the PHONE mode, press CLEAR (**CLR**) at any time to reset the current area/group.

NOTE

If a number contains more than seven (7) digits, the radio displays the first digits of the number for one second, and then displays the last seven (7) digits.

3. With the desired phone number in the display, momentarily press microphone PTT. The radio acquires a channel and dials the number. When in trunked mode the radio gives the same alert tones to show the channel was not available as described under section PLACING A DISPATCH CALL (TRUNKED MODE OPERATION).

NOTE

After dialing the first number, if another number must be sent (for credit card calls, etc.), first press MENU (**MNU**), select the other number using GROUP UP/DOWN (**G▲** or **G▼**), and then momentarily press the microphone PTT.

4. To end a call, momentarily press CLEAR (**CLR**) once to disconnect the telephone interconnect only. If desired, another interconnect call can now be placed before the system times out, in six (6) seconds, by pressing **MNU** and selecting the number. Press CLEAR (**CLR**) a second time to disconnect from the system immediately.

NOTE

When the radio is first turned on, momentarily pressing MENU always selects ALARM first. Pressing MENU a second time selects the PHONE mode with the first of ten (10) dialer numbers. While operating the radio, the radio remembers the MENU mode and the dialer number last selected. However, after the radio is turned off, the MENU mode again selects ALARM first, and the dialer number is the first number in the list.

MAINTENANCE

This section contains information required to service the radio. Included are preventive maintenance checks, procedures for replacing transistors, Integrated Circuits (ICs) and chip components. Refer to the Service Section (LBI-38973) for transmitter and receiver alignment procedures, and service checks for the transmitter and receiver.

INITIAL ADJUSTMENT

After the radio is installed (as described in the Installation Manual), the following adjustments should be made by a certified electronics technician.

TRANSMITTER ADJUSTMENT

Adjustment for the transmitter includes measuring the forward and reflected power, and setting the transmitter to rated power output. Then measure the frequency and modulation and record these measurements for future reference. For the complete transmitter adjustment, refer to the Alignment Procedure in the Service Section (LBI38973).

RECEIVER ADJUSTMENT

No adjustment for the input circuit is required. For complete receiver adjustment, refer to the receiver Alignment Procedure in the Service Section.

SERVICE OPTIONS

To facilitate troubleshooting of problems on the printed circuit board assemblies, the following service accessories are available:

TMX Handset Option 19B801596P1 provides a method for accessing the radio test mode function for radio alignment and testing. This test setup requires Test Point Adapter Option TQ2356 and Adapter Cable Option 19B801417P12.

Test Point Adapter Option TQ2356 provides a way to connect a TMX handset to the radio to access the test mode functions. Using the adapter the technician can monitor receive audio, inject transmit audio, and access test points for all nine (9) pins of the microphone connector.

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

Service Cable 19B801348P4 provides a two (2) foot extension between the nine (9) pin "D" connectors (J701 and P701) on the Logic Board and the Audio Amplifier Board.

Service Cable 19A705235P2 is a ribbon cable extension (two feet) that fits between the System Board and the Audio Amplifier Board connectors to provide easier servicing of the Front Cap Assembly.

PREVENTIVE MAINTENANCE

To assure high operating efficiency and to prevent mechanical and electrical failures from interrupting system operations, routine checks should be made of all mechanical and electrical parts at regular intervals. This preventive maintenance should include the checks listed in Table 1 - Maintenance Checks.

REMOVING IC's

Removing IC's (and most other soldered-in components) can be easily accomplished by using a vacuum desoldering tool. To remove an IC, heat each lead separately on the solder side and remove the old solder with the desoldering tool.

CHIP COMPONENTS

Replacement of chip components should always be done with a temperature-controlled soldering iron at 700°F (371°C). However, do not touch the black metal film of the resistors or the ceramic body of capacitors with the soldering iron.

CAUTION

The CMOS Integrated Circuit Devices used in this equipment can be destroyed by static discharges. Before handling one of these devices, the service person should discharge themselves by touching the case of a bench instrument that has a three (3) pronged power plug connected to an output with a known good earth ground. When soldering or desoldering a CMOS device, the soldering iron should also have a power cord with a three pronged plug connected to an output with a known good earth ground. A battery operated soldering iron may be used in place of the regular soldering iron.

Removing Chip Components

1. Using two soldering irons, heat both ends of the chip at the same time until the solder flows, and then remove and discard the chip.

2. Remove excess solder with a vacuum solder extractor.

3. Carefully remove the epoxy adhesive and excess flux to prevent damage to the printed wire board.

NOTE

The metallized end terminations of the parts may be touched with the soldering iron without causing damage.

Replacing Chip Components

1. Using as little solder as possible, "tin" one of the ends of the component and one of the pads on the printed wiring board.

2. Place the "tinned" end of the component on the "tinned" pad on the board and simultaneously touch the component and the pad with a well "tinned" soldering iron while pressing the component down on the board.

3. Place the "tinned" soldering iron on the other end of the component and the pad simultaneously. Apply solder to the top end of the component until the solder starts to flow. Use as little solder as possible while getting a good joint.

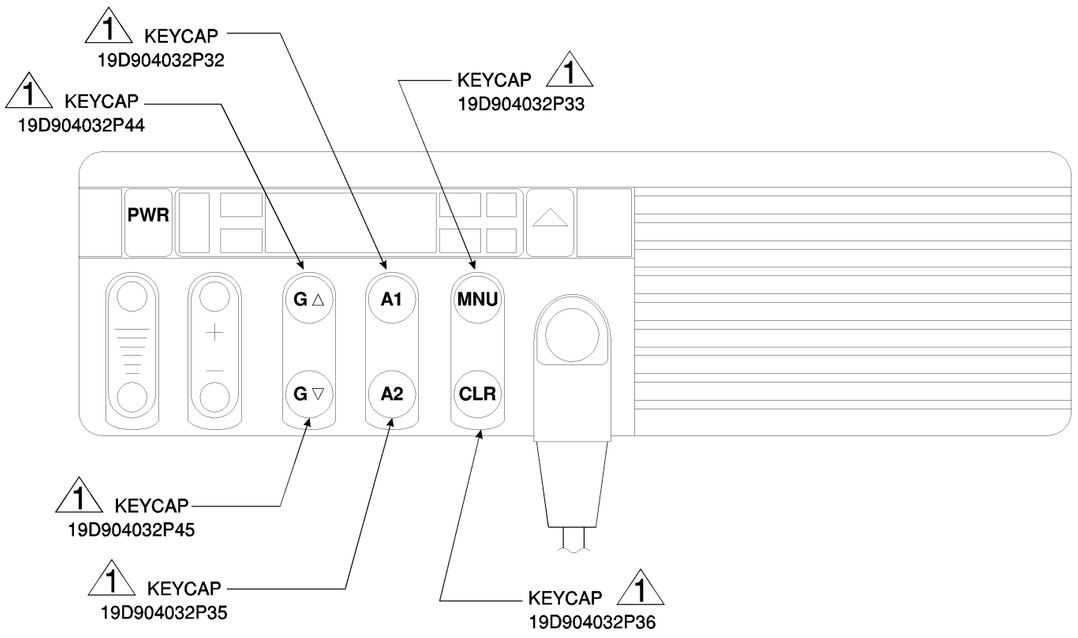
4. After the component has cooled, remove all flux from the component and printed wiring board area with alcohol.

Table 2 - Maintenance Checks

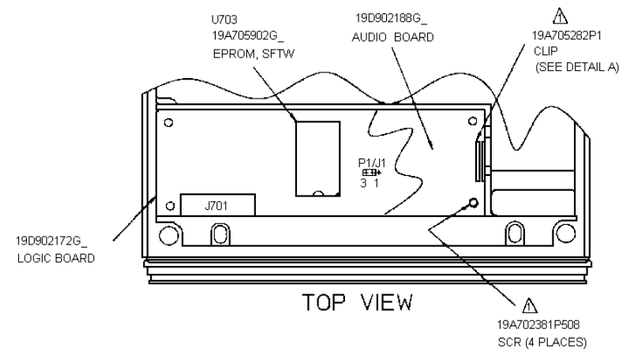
MAINTENANCE CHECKS	INTERVAL	
	6 Months	**As Required**
CONNECTIONS - Ground Connections and connections to the voltage source should be periodically checked for tightness. Loose or poor connections to the power source cause excessive voltage drops and faulty operation. When ground connections are not made directly to the battery, the connection from the battery to the vehicle chassis must be checked for low impedance. A high impedance causes excessive voltage drops and alternator noise problems.	X	
ELECTRICAL SYSTEM - Check the voltage regulator and alternator or generator periodically to keep the electrical system within safe and economical operating limits. Overvoltage is indicated when the battery loses water rapidly. Usage of 1 or 2 ounces of water per cell per week is acceptable for batteries in continuous operation. A weak battery often causes excessive noise or faulty operation.		X
MECHANICAL INSPECTION - Since mobile units are subject to constant shock and vibration, check for loose plugs, nuts, screws, and other parts, to make sure that nothing is working loose. Be sure that all screws are properly torqued.	X	
ANTENNA - The antenna, antenna base, and all contacts should be kept clean and free from dirt or corrosion. If the antenna or its base should become coated or poorly grounded, loss of radiation and a weak signal will result.	X	
ALIGNMENT - The transmitter and receiver meter readings should be checked periodically, and the alignment "touched up" when necessary. Refer to the applicable Alignment Procedure and Troubleshooting sheet for typical voltage readings.		X

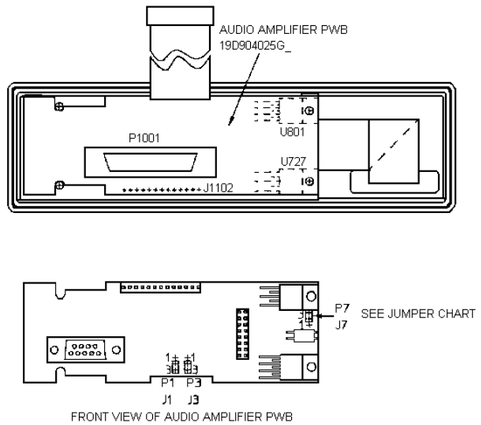
MDX GE-MARC RADIO

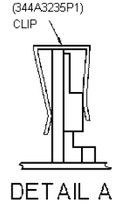
19D902123G22	RF Board Assembly
344A4255G6	RF Board Kit
19C851822G1	PA Board Assembly
344A4256G10	TX/PA Board Kit
19D902188G3	Audio Board
19D902172G1	Logic Board
19A705553P1	Digital Integrated Circuit
19D901891G3	System Component Board
19D904025G2	Audio Amplifier Board
19D904151G1	Front Cap Assembly
344A4254G1	Key Cap Kit
19D904027P1	Frame Assembly
19D904186G1	Cover, Radio Top
19D904185G1	Cover, Radio Bottom
344A4253G1	Marriage Hardware Kit
19B802420P1	Nameplate, LOGO, EGE
19A138051G11	Mounting Hardware Kit
19B801398P14	Microphone
19B801398P5	Microphone Hanger, Magnetic
19B801358P18	Power Cable Assembly (9 foot)
19A705301P6	Antenna Cable Assembly
19B801253P5	Ribbon Cable Assembly
19A702235P3	Ribbon Cable Assembly
19A704884P11	RF Cable Assembly
19A704884P4	RF Cable Assembly
19B801467P11	Cable Assembly



MDX GE-MARC (SIMPLEX)







4 MDX GE-MARC
SAME AS PART 1 (MDX DUAL MODE. SIMPLEX)
EXCEPT AS SHOWN.

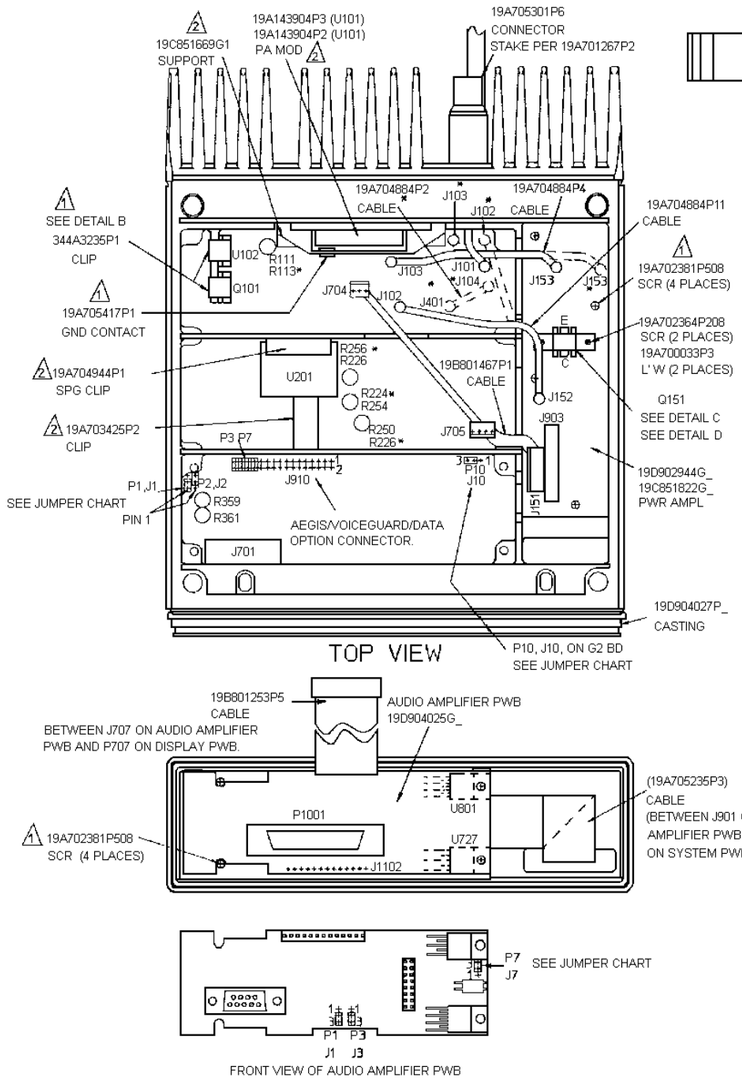
AUDIO AMPLIFIER BD JUMPER CHART		
JUMPER	INSTALLATION	NOTES
P1	J1-2&3	12V SW PW. ON
P3	J3-2&3	MODE SELECT LOW
P7	J7-2&3	SWITCHED SPKR HI AUDIO

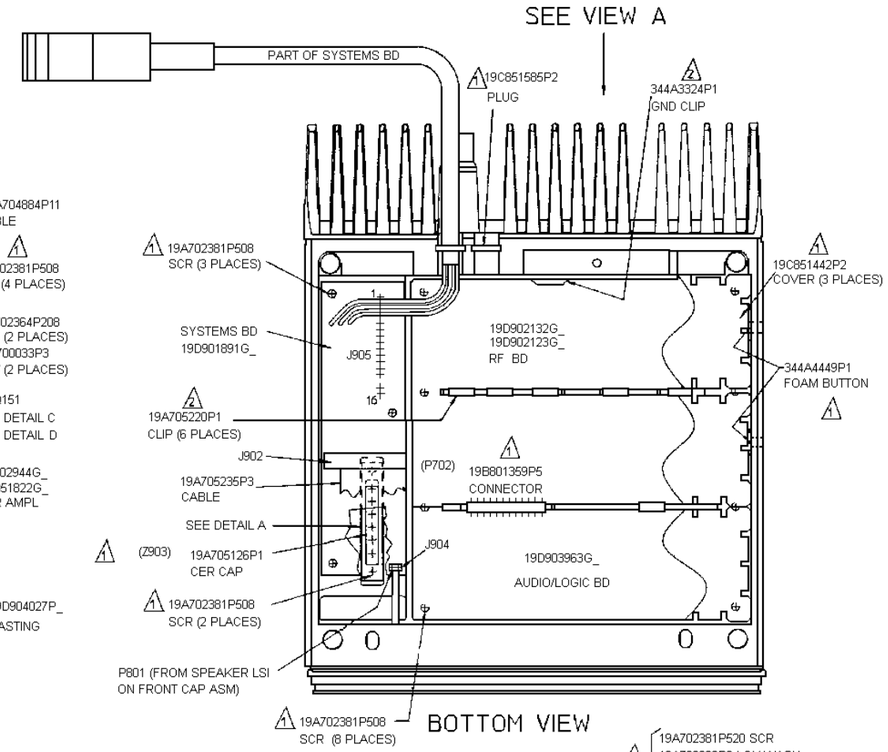
LOGIC BD JUMPER CHART		
JUMPER	INSTALLATION	NOTES
P1	J1-2&3	SELECT 45.3 MHZ RADIO IF OFFSET (VS 45.0125)

MDX™ GE-MARC RADIO

(19D904183, Sheet 5, Rev. 3)

(19D904183, Sheet 6, Rev. 4)





(1) MDX DUAL MODE, SIMPLEX
MDX 900 MHZ EDACS SIMPLEX

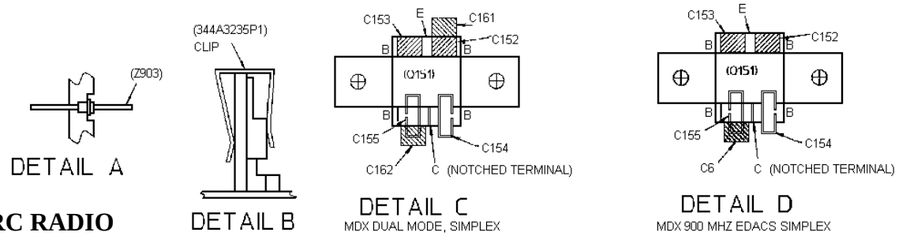
NOTES :

1. PART OF MDX MARRIAGE HARDWARE KIT 344A4253G1.
2. PART OF RF BD HARDWARE KIT 344A4255G6 (800MHZ).
   PART OF RF BD HARDWARE KIT 344A4255G8 (900MHZ).

AUDIO/LOGIC BD JUMPER CHART		
JUMPER	INSTALLATION	NOTES
P1	J1-1&2	BASE BOOST DISABLED
P2	J2-2&3	TX SIDETONE NEG. POLARITY
P3	J910-23 & 24	NO OPTION INSTALLED
P4	J910-25 & 26	NO OPTION INSTALLED
P5	J910-27 & 28	NO OPTION INSTALLED
P6	J910-29 & 30	NO OPTION INSTALLED
P7	J910-31 & 32	NO OPTION INSTALLED
P10	J10-2 & 3	MDX,EXCEPT 900 MHZ
P10	NOT INSTALLED	MDX, 900 MHZ

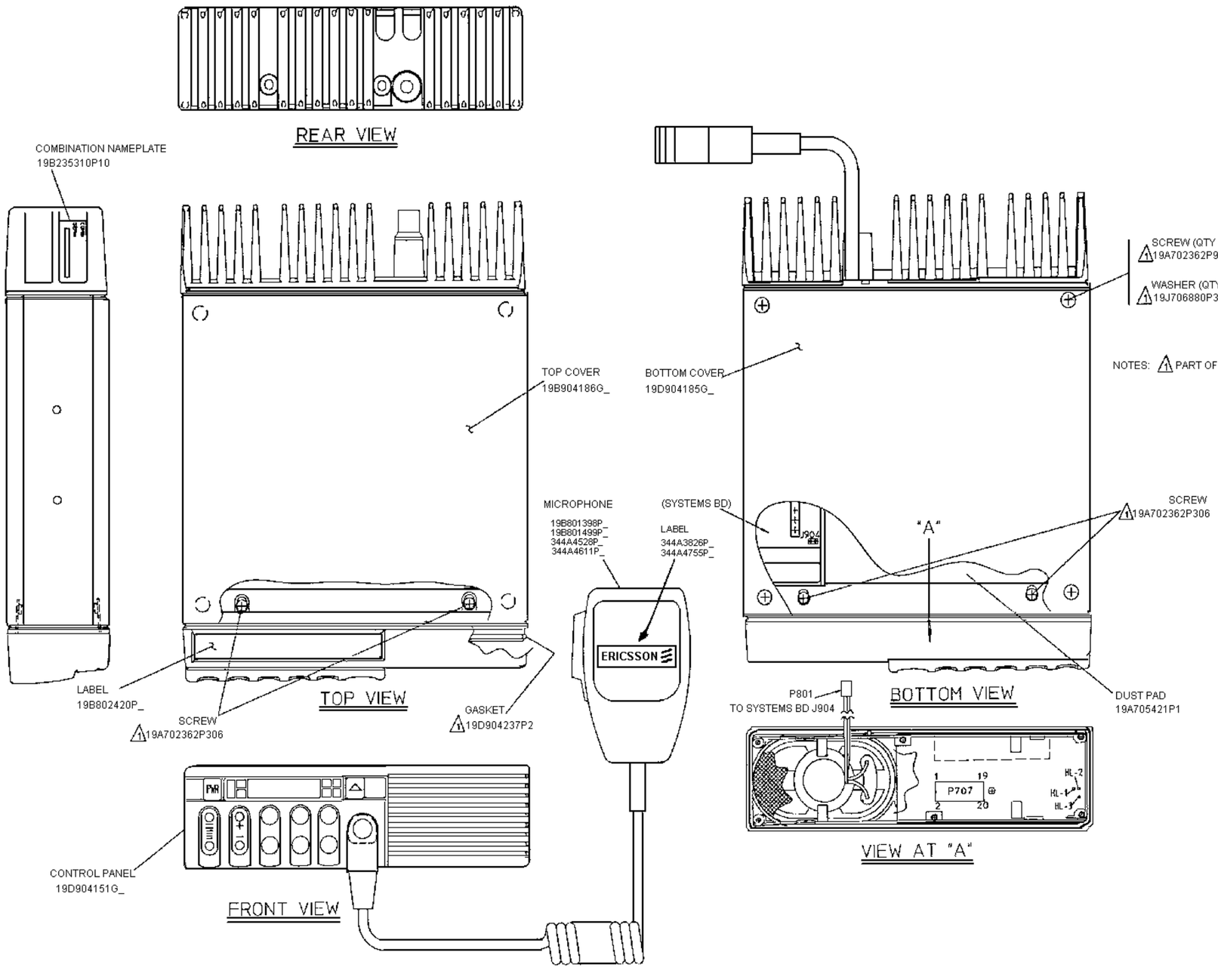
* 900 MHZ ONLY

AUDIO AMPLIFIER BD JUMPER CHART		
JUMPER	INSTALLATION	NOTES
P1	J1-1&2	12V SW PW CONTROLLED
P3	J3-1&2	MODE SELECT LOW
P7	J7-2&3	SWITCHED SPKR HI AUDIO



MDX™ GE-MARC RADIO

(19D904183, Sheet 1, Rev. 1)



PART 1 CONTINUED

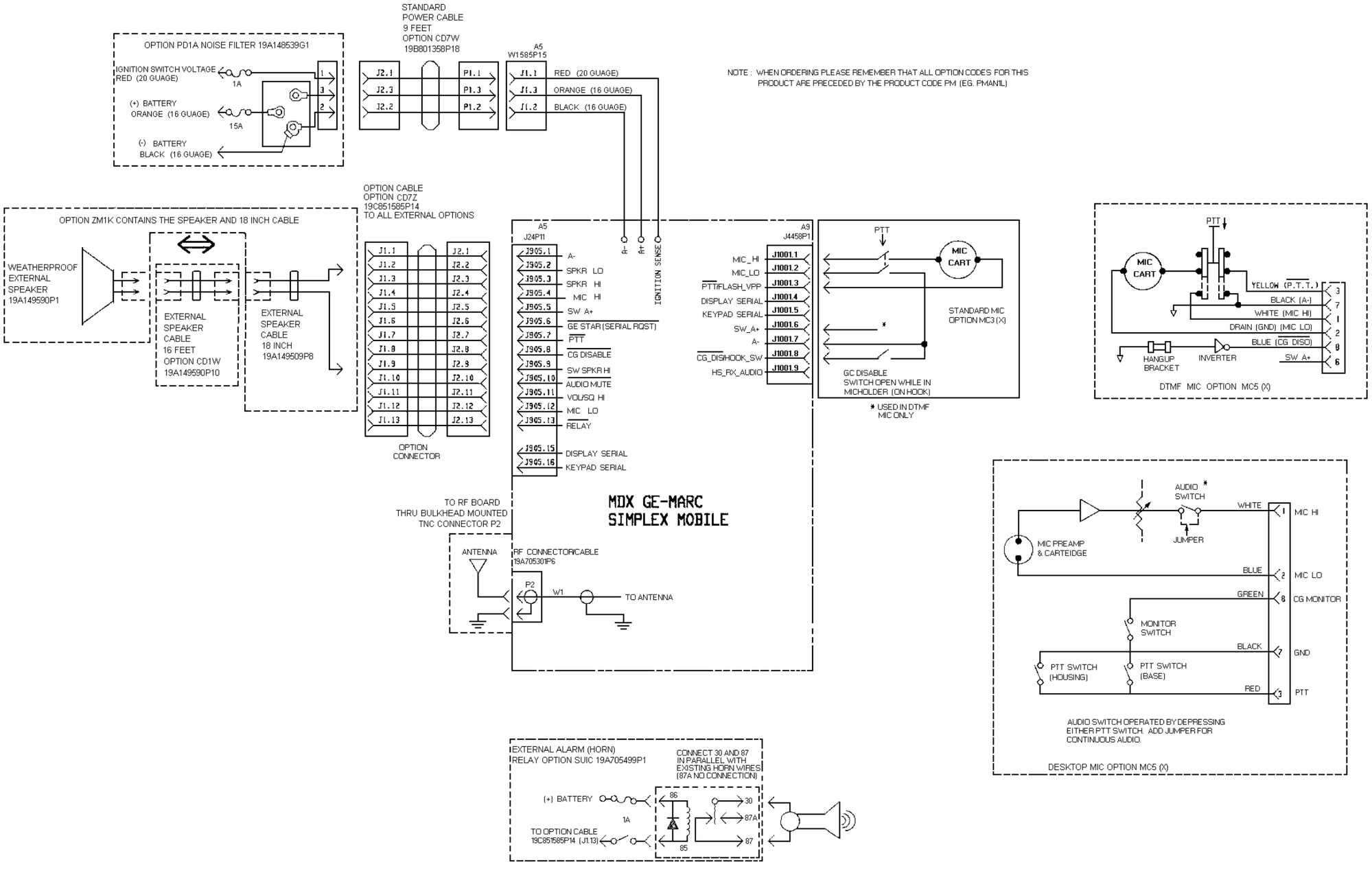
MDX DUAL MODE (SIMPLEX)

(10) INSTALL LABEL ON MICROPHONE.

NOTES: 1 PART OF HDW KIT 344A4253G1.

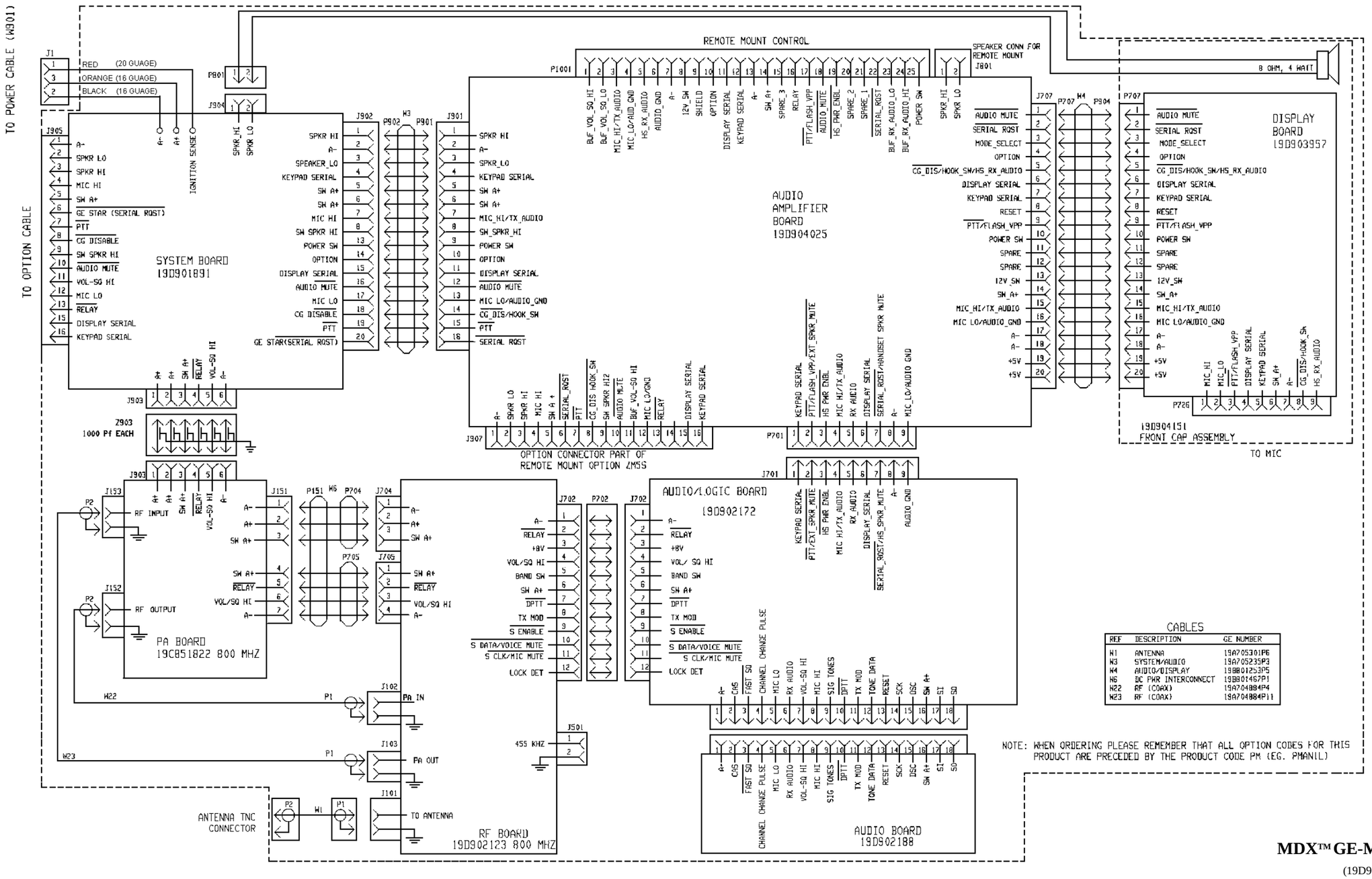
MDX™ GE-MARC RADIO

(19D904183, Sheet 2, Rev. 2)



MDX™ GE-MARC RADIO

(19D904832, Sheet 1, Rev. 0)



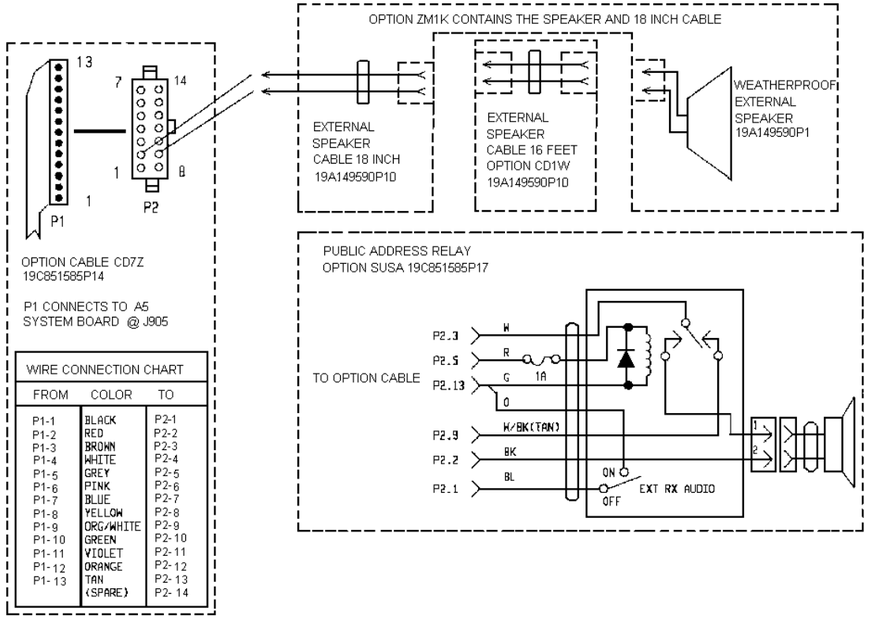
MDX™ GE-MARC RADIO

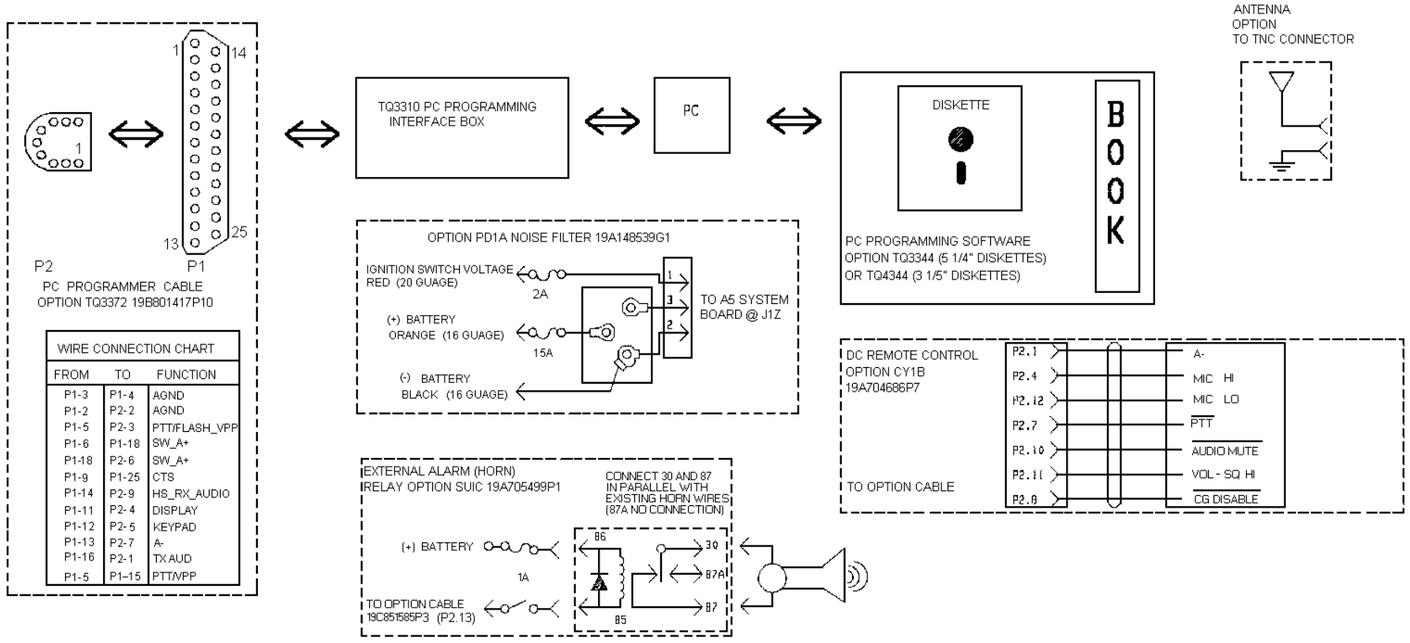
(19D904832, Sheet 2, Rev. 0)

OPTION NUMBER	OPTIONS AVAILABLE	EGE NUMBER
ANIL	ANTENNA, 800 MHZ, ROOFTOP, INC	19B209568P5
*	POWER CABLE, 9 FEET	19B801358P18
CD9A	POWER CABLE, 18 FEET	19B801358P17
*	STANDARD MICROPHONE	19B801398P14
MC3W	MIL SPEC MICROPHONE	19D801499P15
*	MIC HANGER	---
AN1M	ANTENNA, 900 MHZ, ROOFTOP, INC	19B801182P3
LS1F	WATER-PROOF SPEAKER 5" X 5"	19A149590P1
CC9M	EXTERNAL SPEAKER CABLE, 18 INCHES	19A149509P8
CD1W	EXTERNAL SPEAKER CABLE,16 FEET (REQUIRES CC9M)	19A149590P10
ZM1K	SPEAKER KIT (LS1F, CC9M)	---
CD7Z	OPTION CABLE	19C851585P14
PD1A	NOISE SUPPRESSION KIT	19A148539G1
SUIC	HORN ALARM RELAY KIT	19A705499P1
TQ3372	PC PROGRAMMER CABLE	19B801417P9
TQ3310	PC PROGRAMMING INTERFACE BOX	19D438367G1
TQ3364	PC PROGRAMMING SOFTWARE (EDACS & GEMARC)	---
TQ3346	PC PROGRAMMING SOFTWARE (GEMARC ONLY)	--
*	MOUNTING BRACKET KIT	19A138051G11
ZM5S	18 FEET REMOTE MOUNT KIT (MA3K,CD9C,MA3J)	---
SU5A	PUBLIC ADDRESS RELAY/EXT SPEAKER RELAY KIT	19C851585P17
CY1B	DC REMOTE CONTROL	19A704686P7
TQ3370	PC PROGRAMMING/FLASH INTERFACE BOX	19D438367G2

* OPTIONS ARE STANDARD

NOTE : WHEN ORDERING PLEASE REMEMBER THAT ALL OPTION CODES FOR THIS PRODUCT ARE PRECEDED BY THE PRODUCT CODE PM (EG. PMAN1L). FOR A COMPLETE LISTING OF OPTIONS SEE YOUR AUTHORIZED EGE DEALER.





MDX™ GE-MARC RADIO

(19D904832, Sheet 3, Rev. 0)

LBI-38960

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