Maintenance Manual

DUAL FORMAT MDX™
806 - 870 MHz
MOBILE RADIO

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DUAL FORMAT MDX™ RADIO ASSEMBLY
ISSUE 2

SYMBOL	PART NUMBER	DESCRIPTION
		APPLICATION ASSEMBLY 19D904183
		— — — — ASSEMBLIES — — —
A1	19D902123G22	RF BOARD
A3	19D901891G2	SYSTEM BOARD
A4	19D904025G2	AUDIO AMPLIFIER BOARD
A5	19D903963G1	AUDIO/LOGIC BOARD
	19C851822G1	PA BOARD
		— — — — — KITS — — — — —
	344A4253G1	Hardware Kit (No. 1)
	344A4255G7	Hardware Kit (No. 2)
		— — — — — CABLES — — — —
	19A705301P6	Cable, Antenna
	19B801467P1	Cable, J705 to J151
	19B801467P2	Cable, J5 to J105
	19B801454P36	Cable, RX to J104
	19A705235P3	Cable, Ribbon, J901 on Audio Amplifier to J902 on System Board
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	19B802397P1	Cable, Handset
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	19C337683G2	Bracket
	19D904185G1	Cover, Bottom
	19D904186G2	Cover, Top
	19D904187G1	Panel, Front
	19B801358P18	Cable, 9 Foot, Power
	19B235310P10	Nameplate, Combination

* COMPONENTS, ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

ERICSSON

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Private Radio Systems
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Lynchburg, Virginia 24502
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NOTICE!

This manual covers Ericsson and General Electric products manufactured and sold by Ericsson Inc.

NOTICE!

Repairs to this equipment should be made only by an authorized service technician or facility designated by the supplier. Any repairs, alterations or substitution of recommended parts made by the user to this equipment not approved by the manufacturer could void the user's authority to operate the equipment in addition to the manufacturer's warranty.

NOTICE!

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SPECIFICATIONS*

GENERAL	
Regulatory Approval	
FCC (United States)	AXATR-311-A2
DOC (Canada)	TR-311
Operating Voltage	13.8 Volts ±20%
Battery Drain	
Receiver (13.8 Vdc)	
Off	0.01 Amperes (maximum)
Squelched	0.75 Amperes (maximum)
Unsquelched	2.0 Amperes (maximum at 10 Watts audio, External Speaker)
Transmitter (13.8 Vdc)	11 Amperes (maximum at 25 Watts RF)
Channel Spacing	25 kHz (12.5 kHz NPSPAC)
Frequency Stability	±1.5 PPM (±0.00015%)
Temperature Range	-30C to +60C (-22F to +140F)
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	806.0125-824.9875 MHz
Output Power	25 Watts (Intermittent duty cycle; EIA 20%)
Audio Sensitivity	125 mVrms (typical)
Spurious and Harmonics	<-16 dBm
Audio Distortion	5% maximum
Modulation Limiting	+5 kHz maximum (4 kHz max 821.000 - 824.9875 and 866.000 - 869.9875 MHz)
FM Hum and Noise	-45 dB
Audio Frequency Response Per EIA Standards	Within +1, -3 dB of a 6 dB/octave pre-emphasis curve from 300-3000 Hz
RECEIVER	
Frequency Range	851.0125-869.9875 MHz
Acceptable Frequency Displacement	±2.5 kHz minimum
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	Within +2, -8dB of a 6 dB/octave de-emphasis curve from 300 -2700 Hz
Audio Output	10 Watts (External Speaker); 4 Watts (Internal Speaker)
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 Dual Format MDX™ Mobile Radio is a synthesized, wideband radio that uses integrated circuits and microcomputer technology to provide high performance trunked operation. This radio operates in the Enhanced Digital Access Communications System (EDACS®), GE-MARC trunking environments and in conventional communications systems. The radio provides 25 Watts of RF power output in the 806.0125-824.9875 MHz and 851.0125-869.9875 MHz bands. The receiver operates in the 851.0125-869.9875 MHz band.

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

- Serial Programming Interface Module TQ3370
- Programming Cable (19B801417P10) TQ3372
- MDX Series Programming Software (EDACS) TQ3373
- MDX Series Programming Software (GE-MARC only) TQ3346

With the interface equipment and software, the computer can be used to program (or re-program) customer system frequencies, Channel Guard tones and options. Selection of options is done during radio initialization using the PC programmer.

The Dual Format MDX™ Mobile Radio assembly contains the following circuit boards and assemblies:

- Power Amplifier Board 19C851822G1
- RF Board 19D902123G22
- System Board 19D901891G2
- Audio/Logic Board 19D903963G1
- Audio Amplifier Board 19D904025G2
- Front Cap Assembly 19D904151G1

The circuit boards are all mounted on a main casting to provide easy access for servicing. Interconnect 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.

Synthesizer

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

Transmitter

The transmitter consists of a fixed-tuned exciter module, a PA module and a power control circuit. The PA module provides RF output to drive the antenna. The power control circuit controls the PA module to maintain a constant output power across the band. The RF output level is internally adjustable for rated power. Thermistors in the control circuit protect the PA from overheating by reducing the power output level.

Receiver

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.

POWER AMPLIFIER BOARD

The PA board (19C851822G1) amplifies the RF board output then connects it back to the RF board where it is coupled through a PIN diode antenna switch, the low-pass filter and the directional coupler to provide 25 watts power output at the antenna connector.

Table 1 - Standard Tone Frequencies (Hz)

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

1. Do not use 179.9 Hz or 118.8 Hz in areas served by 60 Hz power distribution systems (or 100.0 Hz or 151.4 Hz in areas supplied with 50Hz power). Hum modulation of co-channel stations may "false" Channel Guard decoders.
2. Do not use adjacent Channel Guard tone frequencies in systems employing multiple Channel Guard tones. Avoid same-areas co-channel use of adjacent Channel Guard tones whenever possible. As stated in EIA Standard RS-220, there is a possibility of decoder falsing.
3. To minimize receiver turn-on time delay, especially in system using Channel Guard repeaters or receiver voting, choose the highest usable Channel Guard tone frequency. Do not use tones below 100 Hz when it is necessary to meet the receiver response time requirements of EIA Standard RS-220.

Table 2 - Digital Channel Guard Codes

PRIMARY CODE	EQUIVALENT CODE	PRIMARY CODE	EQUIVALENT CODE	PRIMARY CODE	EQUIVALENT CODE
023	340 766	251	236 704 742	632	123 657
025		261	227 567	565	307 362
026	566	263	213 736	654	163 460 607
031	374 643	265	171 426	662	363 436 443 444
032		271	427 510 762	664	344 471 715
043	355	306	147 303 761	703	150 256
047	375 707	311	330 456 561	712	136 502
051	520 771	315	321 673	723	235 611 671
054	405 675	331	372 507	731	447 473 474 744
065	301	343	324 570	732	164 207
071	603 717 746	346	616 635 724	734	066
072	470 701	351	353 435	743	312 515 663
073	640	364	130 641	754	076 203
074	360 721	365	107	**036**	137
114	327 615	371	217 453 530	**053**	
115	534 674	411	117 756	**122**	535
116	060 737	412	127 441 711	**145**	525
125	173	413	133 620	**212**	253
131	572 702	423	234 563 621 713	**225**	536
132	605 634 714	431	262 316 730	**246**	542 653
134	273	432	276 326	**252**	661
143	333	445	222 457 575	**255**	425
152	366 415	464	237 642 772	**266**	655
155	233 660	465	056 656	**274**	652
156	517 741	466	144 666	**325**	550 626
162	416 553	503	157 322	**332**	433 552
165	354	506	224 313 574	**356**	521
172	057	516	067 720	**446**	467 511 672
174	142 270	532	161 345	**452**	524 765
205	135 610	546	317 614 751	**454**	513 545 564
223	350 475 750	606	153 630	**455**	533 551
226	104 557	612	254 314 706	**462**	472 623 725
243	267 342	624	075 501	**523**	647 726
244	176 417	627	037 560	**526**	562 645
245	370 554	631	231 504 636 745		

NOTE:
Primary codes in bold are unique Ericsson codes.

AUDIO/LOGIC BOARD

The Audio/Logic Board provides all audio and digital processing 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. The Audio/Logic Board controls the 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"** memory (an **E**lectrically **E**rasable **PROM - EEPROM**) to store customer frequencies, tones and options. The microprocessor provides control data to the **A**udio **S**ignal **P**rocessor **(ASP),** conventional tone generation and detection, frequency data for the synthesizer, and sends and receives data to another microprocessor on the Display Board for the LCD.

SYSTEM BOARD

The system board controls the main input power to the radio. IGNITION SENSE input lead provides 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 external options for the radio, interconnect to the System Board through the back of the radio using an optional cable.

FRONT CAP ASSEMBLY

The Front Cap Assembly contains the Audio Amplifier Board. The Audio Amplifier Board provides compression of the microphone audio. It also provides audio compression for the received audio in the discriminator and internal/external speaker audio paths. A 10-watt power amplifier is provided on the board to drive a 4-ohm internal/external speaker.

ACCESSORIES AND OPTIONS

PC PROGRAMMER OPTIONS

The radio is programmed using an IBM compatible personal computer equipped with a RS-232 port. Option TQ3370 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 TQ3372 provides the radio programming cable between the PC interface unit and the radio microphone jack. MDX PC programming software Option TQ3346 (GE-MARC only) or TQ3373 (EDACS) is provided in both 3.5 and 5.25 inch diskettes.

PC PROGRAMMED OPTIONS

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 warns the operator to unkey and then rekey the PTT to continue the transmission. The timer can be programmed, using the PC programmer. Any time periods between 30 seconds and 7.5 minutes can be programmed 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 **C**ontinuous **T**one **C**oded **S**quelch **S**ystem (**CTCSS**), or a **C**ontinuous **D**igital **C**oded **S**quelch **S**ystem (**CDCSS**). Tone frequencies range from 67.0 Hz to 210.7 Hz in 0.1 Hz steps. There are 83 standard PC programmable digital codes. The Channel Guard tone frequencies and codes are software programmable. Both tone frequencies and digital codes may be used. These codes and frequencies are listed in **Table 1 - Channel Guard Tone Frequencies** and **Table 2 - Digital Channel Guard Codes.**

NOTE

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

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 radio looks for STE on the received signal when the microphone is either on or off-hook. The STE is enabled for transmit and/or receive by PC programming the radio's personality.

Retry Option

If no channel is free, the radio can be programmed to activate the Call Retry state and display 'RETRYING' in the display. Retrying causes the radio to revert to Idle mode and scan for an incoming call while trying to acquire a free repeater approximately every 5 seconds for a 2 minute period.

HARDWARE AND HARDWARE OPTIONS

The location and placement of system hardware options are shown on Sheet 4 of the 800 MHz Dual Format MDX Mobile Interconnect Diagrams.

OPTION CABLE

Option Cable Option PMCD7Z 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.

NOISE SUPPRESSION KIT OPTION

Noise Suppression Kit Option PMPD1A (consisting of Filter 19A148539G1 and Installation Manual LBI-31363) is available for installations where excessive alternator or electrical noises, present on the power cable, do not permit the radio to operate properly. Refer to the interconnect diagram for the radio and options.

POWER CABLE OPTION

18-foot Power Cable Option PMCD9A, (19B801358P17), is available for installations requiring more than the standard 9-foot cable.

EXTERNAL SPEAKER OPTION

External Speaker and Cable Option PMZM1T provides the user with a five-inch waterproof speaker in a LEXAN housing. PMCC9M is an 18 inch interconnecting cable for the speaker. The radio's 10-watt amplifier drives the speaker's 4-ohm impedance. The speaker leads are connected to pins 2 and 9 of Option Cable Option PMCD7Z (19C851585P14), using External Speaker Cable Option PMCC9M (19A149590P8) (18 inches) included in the PMZM5T kit. A 16-foot cable, Option PMCD1W (19A149590P10) is also available.

EXTERNAL ALARM

External Alarm Horn Relay Option PMSU1C (19A705499P1) can sound the vehicle horn when a call is received. The option connects to pin 13 of Option Cable Option PMCD7Z (19C851585P14) and is controlled by a front panel option switch.

SYSTEM DESCRIPTION

EDACS

The Dual Format MDX mobile radio operates in either EDACS (digital) mode, or in GE-MARC (tone) mode, providing customers another dimension of flexibility in operation. Both modes provide opportunities to increase RF channel utilization through faster channel access and the privacy inherent with selective signalling.

The EDACS system uses 9600 baud, high speed, digital signalling to identify individual units, user groups, fleets, and agencies. Agencies contain multiple fleets and fleets contain multiple user groups (sub-fleets). By using this addressing scheme, large user groups can be accessed simultaneously all the way down to individual users. The programming to determine transmit encoded groups and decoded received groups is contained in the personality EEPROM of the mobile. This information is individually programmed to suit each users needs via the PC programmer for the radio.

The typical system configuration consists of at least 2 repeater stations (with a maximum number of 25) and the associated mobiles. One repeater always is a control channel dedicated to sending out continuous control data and also to receive channel request data from the mobiles. When a mobile is first turned on, it scans the available list of frequencies programmed in the personality EEPROM for a control channel. When a control channel is found, the mobile locks on to the frequency and monitors the data for a channel assignment (incoming call).

When receiving a channel assignment (incoming call), the monitoring mobile immediately switches over to the assigned voice channel and waits for a high speed data confirmation message. Upon receipt of this message, the voice paths are unmuted and the user can hear the call.

While on the voice channel, the mobile also continuously monitors the low speed, 150 baud (subaudible) data and carrier noise squelch to ensure consistent operation. Upon loss of subaudible data reception (i.e., deep fade, or out-of-range), the mobile returns to the control channel frequency.

To initiate a call, the user keys the radio (which is locked to the control channel), and a 30 millisecond high speed data slotted channel request is transmitted to the control channel receiver. The control channel processes the request from the mobile and transmits back a voice channel assignment on an unused channel.

When all available voice channels are in use, the control channel places the mobile into a queue, transmits a queue message back to the mobile, and will give a channel assignment to the requesting mobile as soon as a voice channel is free. If the system is busy and the station queue is filled to capacity, a system busy message is returned to the requesting mobile and an alert signal is given to the user.

After the initiating mobile receives a channel assignment from the control station, it immediately switches frequency over to the assigned voice channel and sends a burst of 9600 baud dotting. The microphone voice paths are then unmuted and the transmission begins. The transmitting mobile also continuously sends out a subaudible tone (along with voice) for system reliability. If the station loses this signalling, the voice channel is muted and all receiving mobiles are sent back to the control channel.

In normal operation, the transmitting mobile sends a high speed data burst to indicate that the user has unkeyed, causing all listening mobiles to switch back to the control channel.

CONVENTIONAL MODE

In conventional mode (not trunked) the radio can operate either with tone Channel Guard, digital Channel Guard, or carrier squelch, depending on personality programming. Tone Channel Guard range is 67.0 to 210.7 Hz. Squelch Tail Elimination (STE) is used with Channel Guard to eliminate squelch tails at the receiving radio by phase shifting the transmitted Channel Guard tone when the PTT is released.

Direct mode works identically to conventional mode except that the transmit frequency band is changed to 851 to 870 MHz to permit direct mobile-to-mobile communications.

GE-MARC

The **GE-MARC** trunked mobile radio system consists of a repeater for each channel and the users' mobile radio units. The system uses tone signalling with each mobile being assigned two and/or four tone group tone sequences. Groups of mobiles are assigned the same tones so that any unit can talk to all other units in the same group. A block diagram of the **GE-MARC MDX** is shown in Figure 1.

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 then transmits its collect and group tones which the repeater regenerates for all idle mobile units in the system.

The idle mobiles, which continually scan all channels, will stop on the active channel if any of the programmed collect tones are detected and wait for group tone(s).

If the correct tone sequence is detected, the mobiles will alert the operator of an incoming call and open their audio circuits. If the correct sequence is not detected, the idle mobiles will resume scanning the channels. Once the mobile is **"locked"** on a channel, it will remain there until the repeater times out or the operator terminates the call.

Operational Modes

The radio will always be 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 2.

The radio enters the Idle mode when power 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 until a channel is acquired, or if no channel is available. The Ready or Conversation mode is indicated by an alert tone and the mode indicator on the control panel. A signal timing diagram is shown in Figure 3.

Idle Mode

When the 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 by detecting one of the collect tones programmed in the area. Upon receipt of a collect tone, the mobile looks for a short interval for the group or individual tones providing that their collect tones are the same. When no valid tone is found, the mobile will resume scanning the channels for an incoming call.

If a group (or individual decode) tone is detected, the mobile then looks for busy tone for a 90 millisecond period. If four tones are properly decoded, the mobile will then look for busy tone for 270 milliseconds.

When no valid tones are found, the mobile will resume scanning for a call with the next channel. When a busy tone is found, the mobile will enter the Ready mode. If busy tone is not detected, the mobile remains in the Idle mode and continues scanning channels looking for an incoming call.

Removing the handset from the hanger, pressing the PTT switch or pressing the SEND key on the handset will cause the radio to enter the Wait mode.

Wait Mode

When the user enters the Wait mode, the display group is checked to make sure it is a valid call-originate group. If it is not valid, a low-frequency tone is heard for one second. If valid, the radio will scan the call-originate frequencies for brief intervals until it finds one with no busy tone on it. If no channel is free, the radio, if programmed for this option, will activate the Call Retry state and display "**RETRYING**" in the display. Retrying will cause the radio to revert to the Idle mode and scan for an incoming call while trying to acquire a free repeater approximately every 5 seconds for a 2 minute period. If the Retry option is not enabled, the mobile will sound the low-frequency tone and then return to the Idle mode and display **"BUSY".**

If a channel with no busy tone is found, the mobile transmits a burst of busy tone to acquire the repeater. The repeater then 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 mobile must detect all four tones and busy tone before entering the Ready mode. If a two-tone sequence is sent, the busy tone must be present within 90 milliseconds of the last

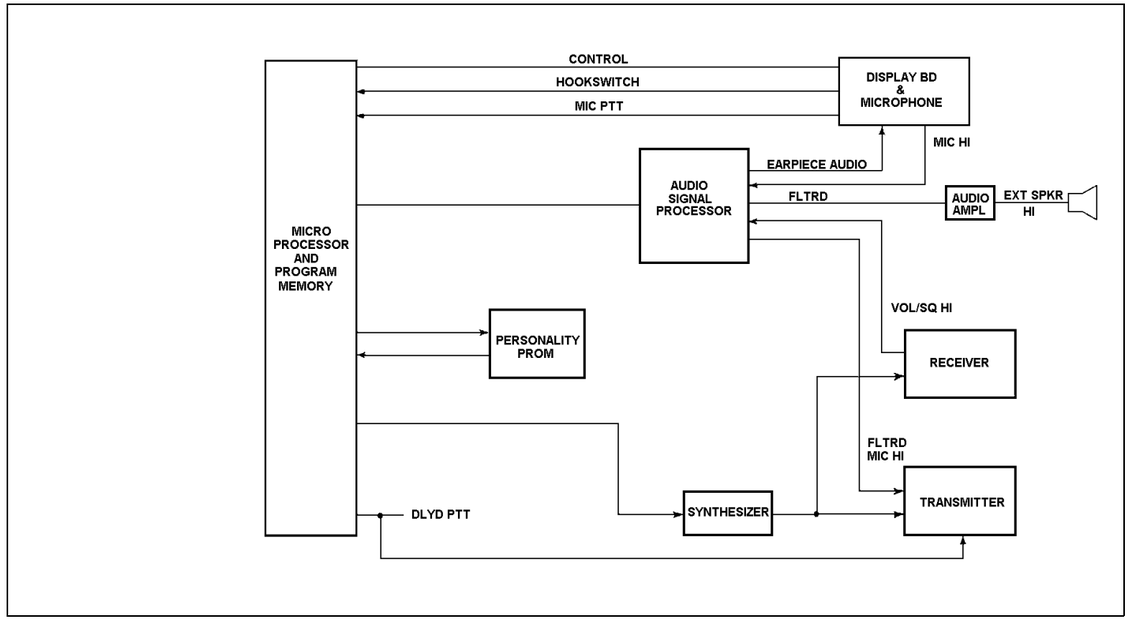


Figure 1 - GE-MARC Block Diagram

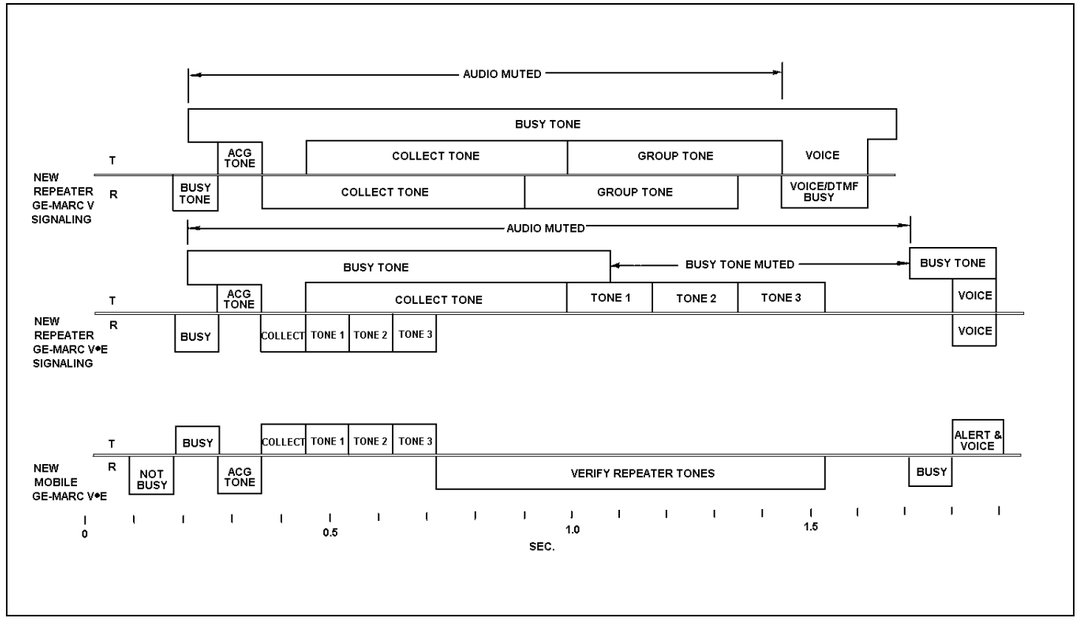


Figure 3 - Signal Timing

tone in order for the radio to enter the Ready mode. If no busy tone is present or if the four-tone sequence isn't valid, the mobile will jump to the next channel in the call originate set and check for busy tone as described above.

Ready Mode

When an incoming call has been detected or an idle channel has been 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 the conventional push-to-talk manner with the radio remaining 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 user cannot access the radio system because the mobile is out of receive range or is inoperative. Any subsequent call will be ignored for 20 seconds.

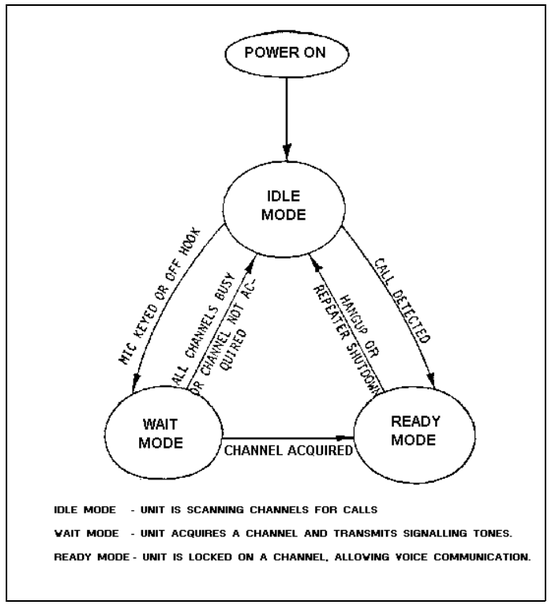


Figure 2 - GE-MARC Operational Modes

GLOSSARY OF GE-MARC TERMS

Idle Mode

In the **"standby"** condition, the mobile is inactive but prepared to call or be called. The 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 the 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 of 3051.9 Hz is the standard busy tone. The 2918 Hz is the alternate busy tone. The busy tone modulates mobile and repeater transmitters at a low level of 1 kHz deviation continuously. This tone is filtered out of the received audio and is used to hold the communication channel active. It also excludes other mobiles from using the channel when a call is active.

Acquisition Tone

A 1962.9 Hz tone sent at full deviation for 50 milliseconds from the repeater is used as acknowledgment from the repeater that a busy tone was sent and signals the mobile that signalling tones can now be sent.

Collect Tone

A tone chosen from 34 standardized frequencies, ranging from 508.6 Hz to 2792.4 Hz, is 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 which are programmed into the mobile and/or repeater.

In a two-tone call, the mobile sends the collected tone for a programmable duration. In the four-tone call, the mobile always sends a 90-millisecond collect tone which the repeater regenerates and sends for the correct duration.

Group/Individual Tones

Group/Individual Tones chosen from the 34 standard frequencies follow the collect tone. In a two-tone call, the second tone is sent for 450 milliseconds. In a four-tone call, the second, third, and fourth tones are sent for 90 milliseconds from the mobile and 180 milliseconds from the repeater.

RADIO OPERATION

A complete set of operating instructions for the Dual Format MDX are provided in LBI-38846 and are provided with each radio.

This radio is flexible in operation and can be used in any of three operating modes: Conventional radio system, Enhanced Digital Access Communications (EDACS) system, or GE-MARC (tone controlled) system. Either of the latter two systems provide trunked channel selection for increased channel utilization.

In an EDACS trunked environment, the user selects a communications system and group. In this mode, audio channel selection is transparent to the user and is controlled via digital communication with the system controller. This mode incorporates advanced programmable features and fast access to communication channels.

In a GE-MARC trunked environment, the user selects a communications area and group. In this mode, audio channel selection is also transparent to the user and is controlled via tone signalling.

In Conventional mode, the user selects a channel and communicates on that channel. In this mode, a system refers to a set of channels and a channel is a transmit/receive radio frequency pair.

The exact operation of any radio depends upon the operating mode, the programming of the radio and the particular radio system. Most features described in these operating instructions can be enabled or disabled through programming. Both of these important factors must be considered when addressing the following instructions.

USER INTERFACE

Operating controls are located on the radio front panel and microphone.

The front panel LCD provides radio status and communication control information to the operator. The keypad is used for manual number entry for individual calls access to a telephone interconnect system and activation of various EDACS, GE-MARC, and conventional features.

Turning The Radio ON/OFF

The radio is turned **ON/OFF** by pressing the PWR button in the upper left corner of the front panel. A self diagnostic test is performed when the radio is first turned on if enabled through programming. To turn the radio **OFF,** press the PWR button again.

ALERT TONES

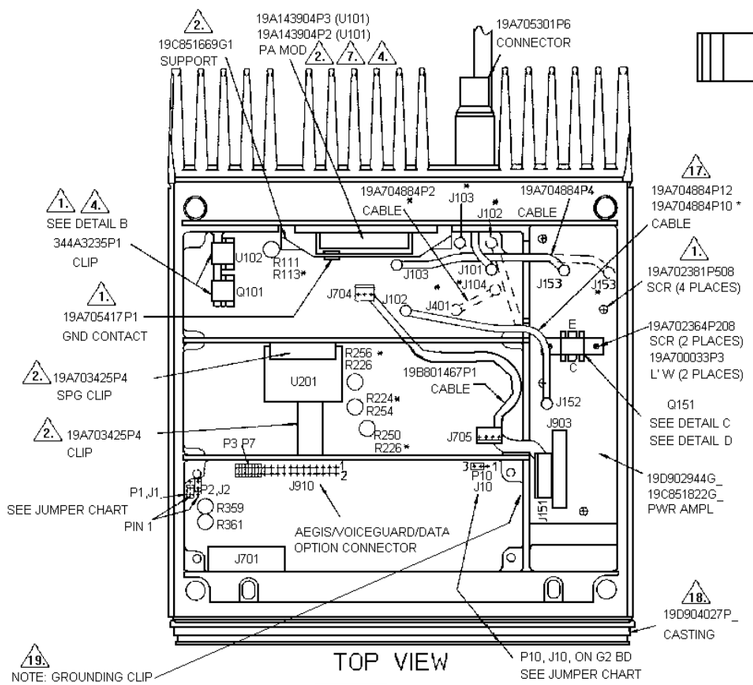
The Dual Format MDX™ radio generates a set of unique alert tones to indicate operating status. The following section identifies and describes the alert tones used in the Dual Format MDX™ radio for Conventional, GE-MARC, and EDACS applications.

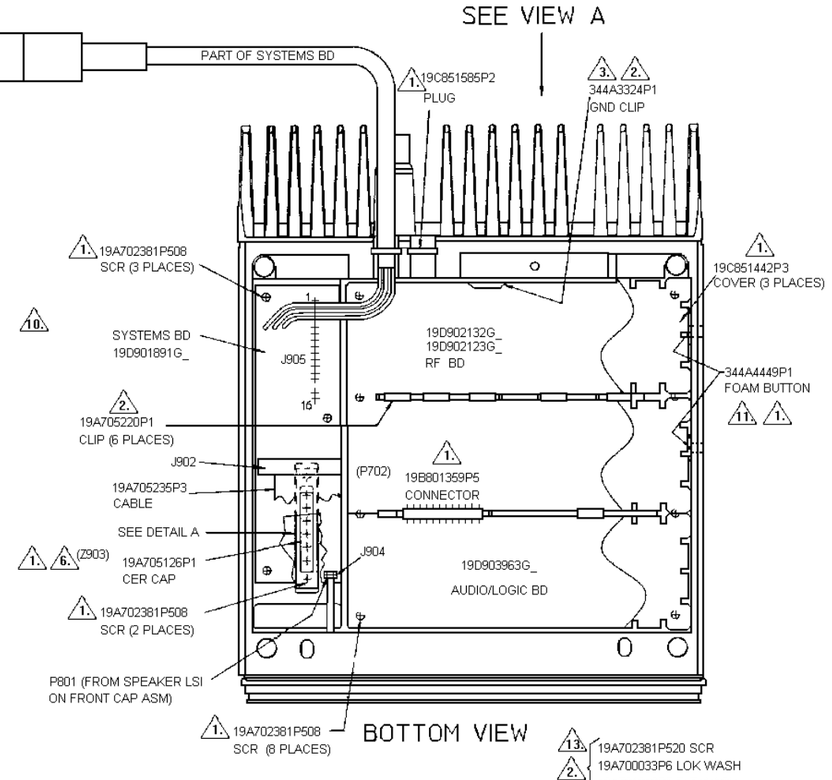
EDACS APPLICATIONS

CALL ORIGINATE ALERT	If programmed, a short tone is sounded whenever the Push-To-Talk key is pressed and the radio has acquired a channel. This tone indicates the user can begin communications.
CALL QUEUED	If one short, high-pitched tone sounds after the transmitter is keyed, this indicates that the system has placed the request in a queue. This tone sounds at both the transmitting unit and the receiving unit(s) indicating to the user on the receiving end that a call is being directed to them. If the PTT is unkeyed while in the queue, the radio autokeys (automatically keys) Push-To-Talk when a channel becomes available (see AUTOKEY).
AUTOKEY	When the PTT is keyed to place a call on the system, but the PTT is released before getting to the channel (e.g. a queued call), the radio automatically keys on the channel when it gets the assignment. The radio generates a long beep and holds the transmitter keyed for two seconds. Pressing the PTT button keeps the channel and sends the message before this two second time-out has expired.
SYSTEM BUSY	If you press the PTT key and hear three short, medium-pitched tones, this indicates that the receiving party is already on the system or the system is busy and its queue is full. You must rekey later to access the system.
CALL DENIED	A single, low-pitched beep sounds when the PTT key is pressed and the request is denied by the system. This happens if the unit is an invalid user or if the unit is requesting an unavailable service.
OUT-OF-RANGE/ SYSTEM INOPERATIVE	A single, low-pitched tone sounds immediately after the PTT key is pressed indicating the radio is out of range of the repeater. The radio tries to place the call for a short period (3 seconds) after the initial attempt. The radio generates a second low-pitched tone when it gives up trying to place the call. These tones are also heard if the system is off the air or the radio needs servicing (even when the radio is within calling range of the repeater).

GE-MARC APPLICATIONS

CALL RECEIVED ALERT	If programmed, a single alert tone sounds when a group call is received and a two-tone alert (one high followed by one low tone) sounds for an individual call.
CALL ORIGINATE ALERT	**WAIT** momentarily displays when a call is being placed. Then a three-tone alert is sounded to indicate the call origination is complete. This indicates a channel was acquired and is ready for normal conversation.
INVALID CALL ORIGINATE ALERT	A low-frequency tone is sounded for one second immediately after pressing PTT and the display does not show **WAIT.** This indicates a call was attempted within a group that is not enabled for call originate or an invalid dispatch overdial call was attempted.
SYSTEM TONES	A low-frequency tone is sounded for one second after attempting to place a trunked call and **BUSY** is displayed. This indicates that the GE-MARC system is busy. If the "Call Retry" option has been enabled through programming, the radio retries at 5 second intervals up to 15 times unless END is pressed, a channel is acquired, or an out-of-range condition occurs.
OUT-OF-RANGE ALERT	If **NO SVC** is displayed and five beeps are sounded after attempting to place a trunked call, the radio is out of range of the GE-MARC system. If the beeps sound when the radio is within known range of the system, the radio may need servicing. If the "Call Retry" is active, the radio tries the channel at twenty second intervals for five minutes.
CARRIER CONTROL TIMER	(GE-MARC and Conventional operation.) A pulsed-tone signal is sounded for a preprogrammed time after PTT is pressed. After nine seconds of pulsing the alert tone, the radio unkeys the transmitter and communications are interrupted. While the tone is pulsing, the user can release and press PTT again to reset the timer and resume the conversation. In the conventional mode, the radio unkeys and beeps until PTT is released.
SYSTEM TONES	The GE MARC radio may generate other system tones to alert the user of custom programmed events. Contact the GE-MARC system operator for details about these alert tones.

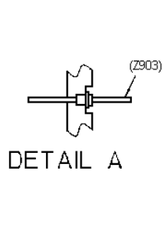


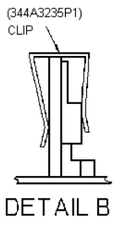


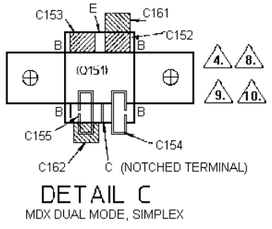
(1) MDX DUAL MODE, SIMPLEX
MDX 900 MHZ EDACS SIMPLEX

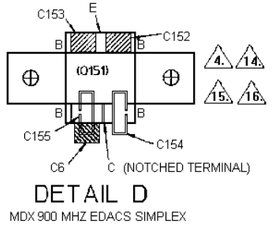
NOTES :

1. PART OF MDX/MDR MARRIAGE HARDWARE KIT 344A4253G1.
2. PART OF RF BD HARDWARE KIT 344A4255G6 (800MHZ).
   PART OF RF BD HARDWARE KIT 344A4255G8 (900MHZ).
3. INSTALL BETWEEN PWB AND CASTING. SOLDER TO PWB.
4. APPLY SILICONE GREASE (19A701337P1) TO PA MOD, Q101 AND U102 ON RF BD AND Q151 ON PA BD ALSO U801 AND U727 ON AUDIO AMPLIFIER BD.
5. DIP ENDS OF SCREWS THAT GO INTO CASTING IN GREASE (19A115204P1) BEFORE INSTALLING INTO CASTING. TORQUE TO 15 INCH-POUNDS.
6. LUBRICATE Z903 PINS WITH GREASE (19A704532P1).
7. INSTALL U101 FLUSH TO PWB AND FASTEN WITH SUPPORT TO CASTING BEFORE SOLDERING LEADS TO PWB. TOP OF U101 SHALL NOT EXTEND MORE THAN 0.25 ABOVE ADJACENT CASTING.
8. PRE-TIN AREA AROUND Q151 WHERE TRANSISTOR LEADS AND C152 - C155, C161 AND C162 ARE TO BE SOLDERED.
9. SOLDER Q151 LEADS WITH A MINIMUM OF SOLDER TO BD BEFORE INSTALLING CAPACITORS. SOLDER C152 - C155 AGAINST BODY OF Q151 ON TOP OF TRANSISTOR LEADS AS SHOWN BEFORE INSTALLING C161 AND C162 AGAINST C152 AND C155 AS SHOWN.
10. PART OF PA BD KIT 344A4256G10 (800MHZ).
    PART OF PA BD KIT 344A4256G12 (900MHZ).
11. APPLY OVER TWO HOLES ON INSIDE OF CASTING.
12. P1001 PART OF REMOTE MOUNT.
13. WEATHERPROOF HOLES AROUND SCREWS USING RTV162 (19A701648P2).
14. PRE-TIN AREA AROUND Q151 WHERE TRANSISTOR LEADS AND C152-C155 & C6 ARE TO BE SOLDERED.
15. SOLDER Q151 LEADS WITH A MINIMUM OF SOLDER TO BD BEFORE INSTALLING CAPACITORS. SOLDER C152 - C155 AGAINST BODY OF Q151 ON TOP OF TRANSISTOR LEADS AS SHOWN BEFORE INSTALLING C6 AGAINST C155 AS SHOWN.
16. PART OF PA BD KIT 344A4256G12.
17. ROUTE THE TWO PA CABLES AS SHOWN: J103-J153 CABLE THROUGH THE LARGE NOTCH NEAREST HEATSINK. J102-J152 CABLE THROUGH SMALL NOTCH.
18. SECURE GASKET TO CASTING USING RTV3140.
19. 19A803825P1 CLIP, GND. 6 PLACES. THESE CLIPS TYP DENOTED BY CROSS-HATCH CLIPS CAN BE BROKEN TO MAKE HALF CLIPS AS NEEDED.







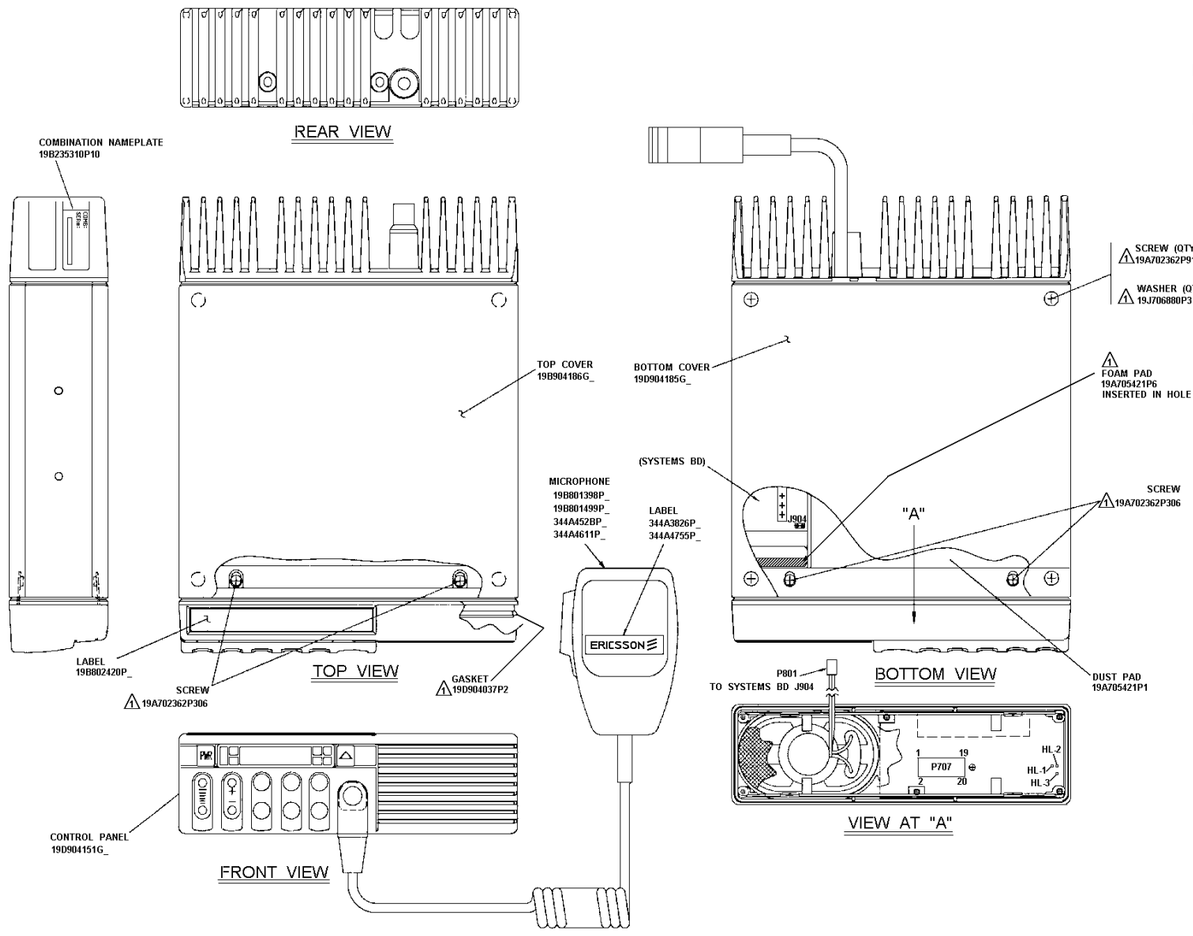


AUDIO/LOGIC BD JUMPER CHART		
JUMPER	INSTALLATION	NOTES
P1	J1-1&2	BASE BOOST DISABLED
P2	J2-2&3	TX SIDETONE NEG. POLARITY
P3	J910-23 & 24	NO OPTION INSTALLED
P4	J910-25 & 26	NO OPTION INSTALLED
P5	J910-27 & 28	NO OPTION INSTALLED
P6	J910-29 & 30	NO OPTION INSTALLED
P7	J910-31 & 32	NO OPTION INSTALLED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

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

* 900 MHZ ONLY

(19D904183, Sh. 1, Rev. 18)



PART 1 CONTINUED

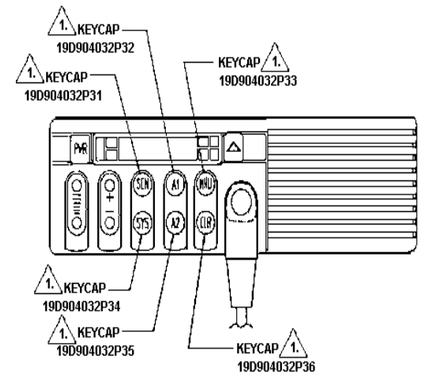
MDX DUAL MODE (SIMPLEX)

PART 5 CONTINUED

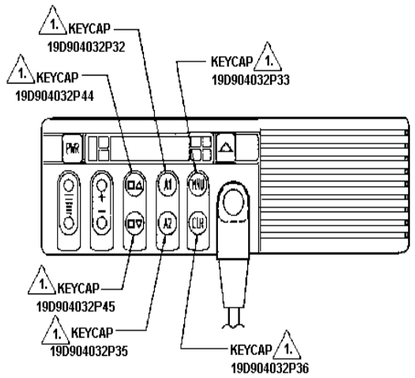
MDX CONVENTIONAL, UHF & VHF

(10) INSTALL LABEL ON MICROPHONE

NOTES: 1. PART OF HDW KIT 344A4253G1



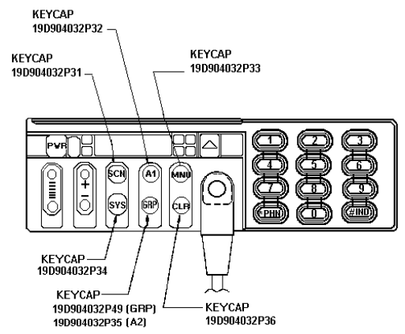
MDX CONVENTIONAL (SIMPLEX)
MDX DUAL FORMAT TRUNKING MODE (SIMPLEX)



MDX GE-MARC

NOTES:

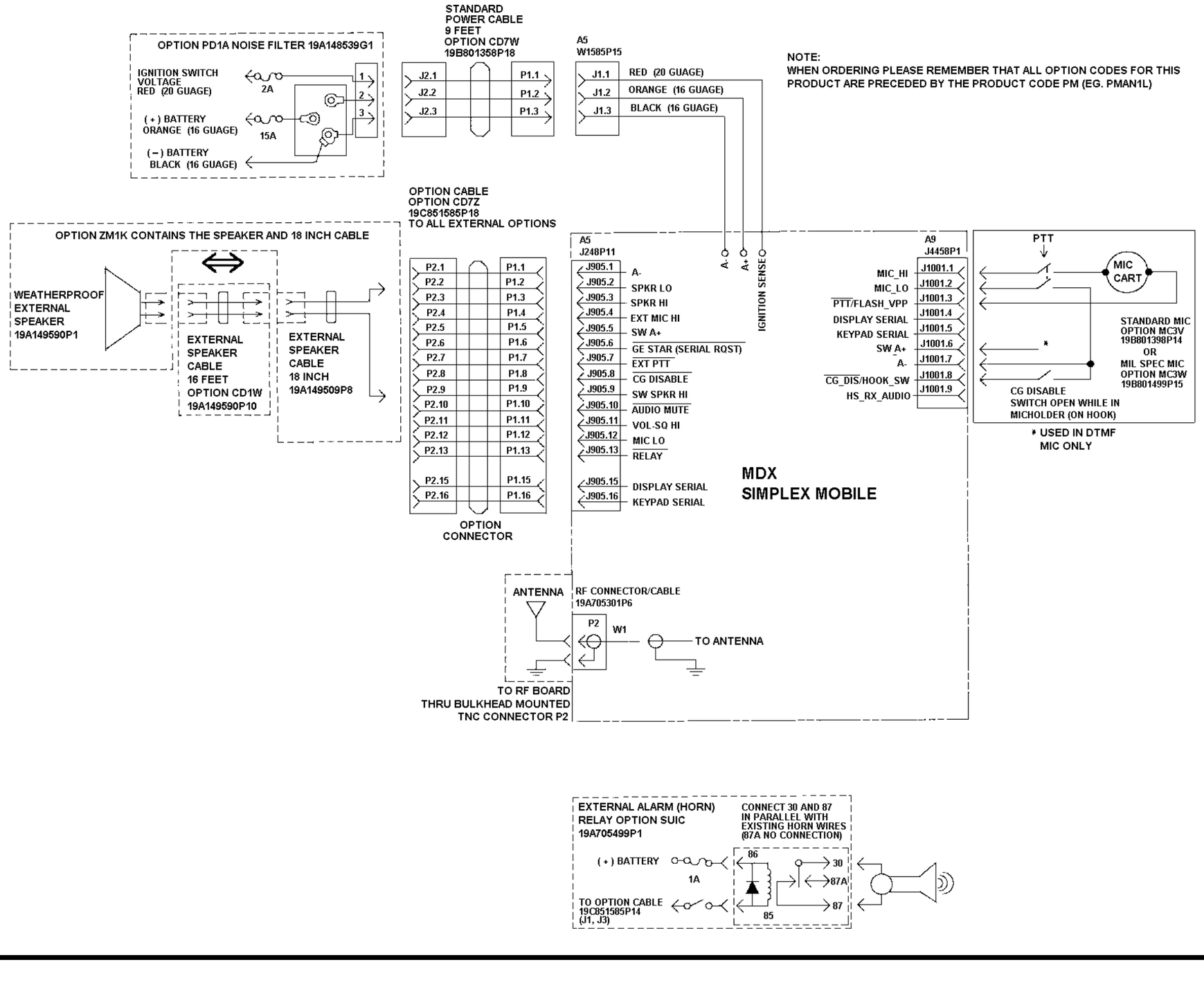
1. PART OF KEYCAP KIT 344A4254G1.



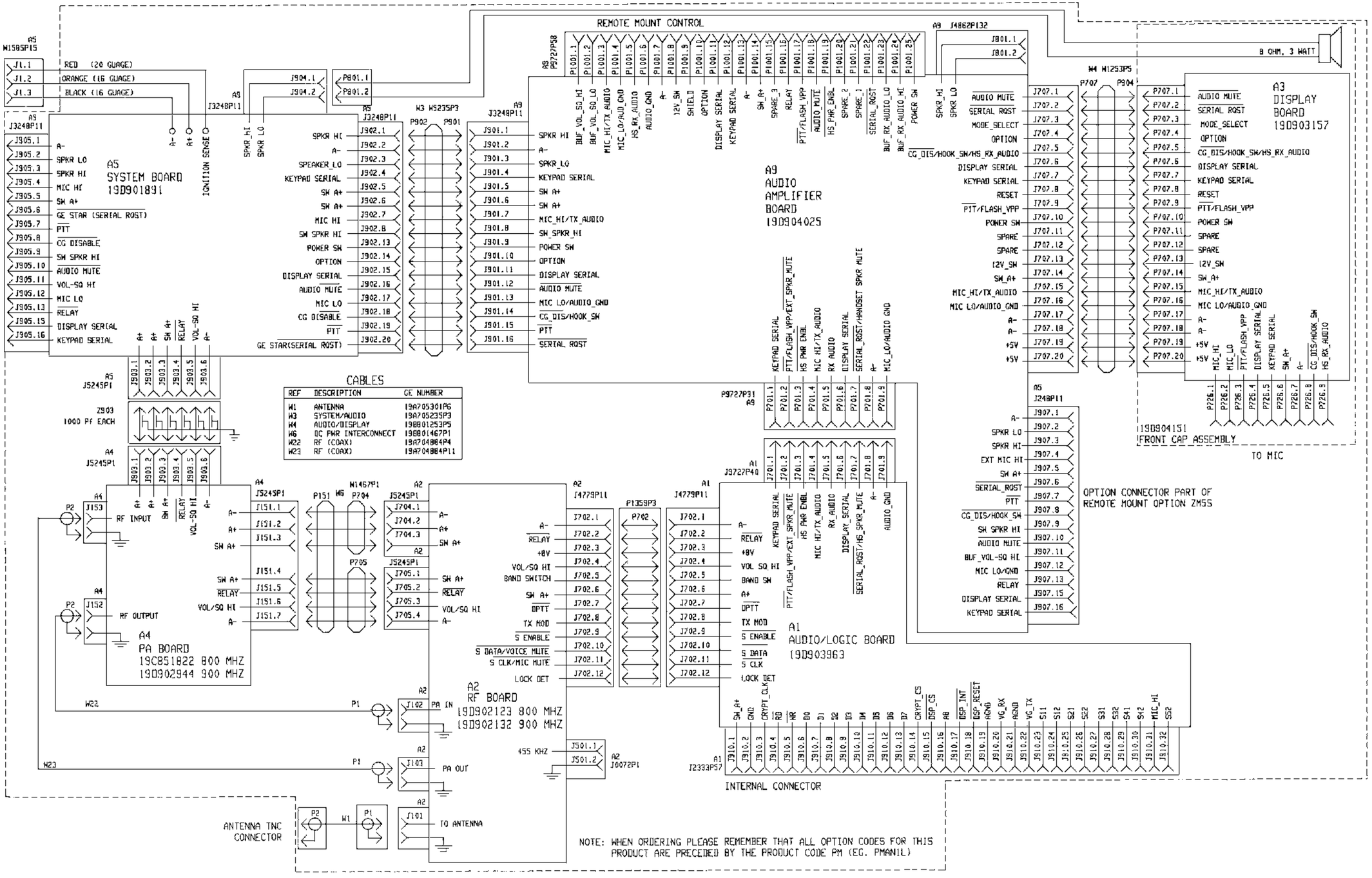
MDX SYSTEM CONTROL UNIT

(19D904183, Sh. 2, Rev. 18)

(19D904183, Sh. 5, Rev. 18)



(19D904133, Sh. 1, Rev. 4)

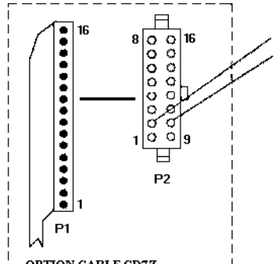


(19D904133, Sh. 2, Rev. 4)

OPTION NUMBER	OPTIONS AVAILABLE	PART NUMBER
AN1L	ANTENNA, 800 MHz, ROOFTOP, INC	19B209568P5
¥	POWER CABLE, 9 FEET	19B801356P18
CD9A	POWER CABLE, 18 FEET	19B801358P17
¥	STANDARD MICROPHONE	19B801358P14
MC3H	MIL SPEC MICROPHONE	19B801499P15
¥	MIC HANGER	- - - - - - - - -
AN1M	ANTENNA, 900 MHz, ROOFTOP, TNC	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	19C851585P18
PD1A	NOISE SUPPRESSION KIT	19A148539G1
SUIC	HORN ALARM RELAY	19A705499P1
TQ3372	PC PROGRAMMER CABLE	19B801417P10
TQ3364	PC PROGRAMMING SOFTWARE (EDACS & GEMARC)	- - - - - - - - -
TQ3346	PC PROGRAMMING SOFTWARE (GEMARC & CONV 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

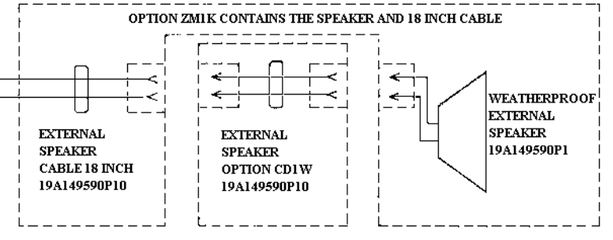
NOTE:
WHEN ORDERING PLEASE REMEMBER THAT ALL OPTION CODES FOR THIS PRODUCT ARE PRECEDED BY THE PRODUCT CODE PM (EG. PMAN1L).
FOR A COMPLETE LISTING OF OPTIONS SEE YOUR AUTHORIZED DEALER.

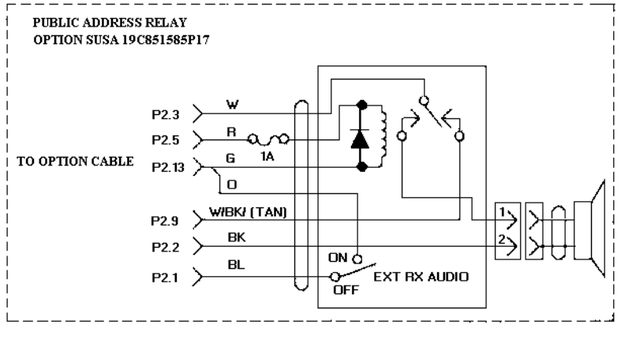


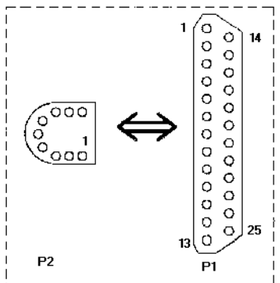
OPTION CABLE CD7Z
19C851585P18

P1 CONNECTS TO A5
SYSTEM BOARD @ J905

WIRE CONNECTION CHART		
FROM	COLOR	TO
P1-1	BLACK	P2-1
P1-2	WHITE	P2-2
P1-3	RED	P2-3
P1-4	GREEN	P2-4
P1-5	ORANGE	P2-5
P1-6	BLUE	P2-6
P1-7	W / BK	P2-7
P1-8	R / BK	P2-8
P1-9	G / BK	P2-9
P1-10	OR / BK	P2-10
P1-11	BL / BK	P2-11
P1-12	BK / W	P2-12
P1-13	R / W	P2-13
P1-15	G / W	P2-15
P1-16	BL / W	P2-16







PC PROGRAMMER CABLE
OPTION TQ3372 19B801417P10

WIRE CONNECTION CHART		
FROM	TO	FUNCTION
P1 - 3	P1 - 4	AGND
P1 - 2	P2 - 2	AGND
P1 - 5	P2 - 3	PTT/FLASH_VPP
P1 - 6	P1 - 18	SW_A+
P1 - 18	P2 - 6	SW A+
P1 - 9	P1 - 25	CTS
P1 - 14	P2 - 9	HS_RX_AUDIO
P1 - 11	P2 - 4	DISPLAY
P1 - 12	P2 - 5	KEYPAD
P1 - 13	P2 - 7	A-
P1 - 16	P2 - 1	TX AUD
P1 - 5	P1 - 15	PTT/VPP