



## ***GE Mobile Communications***

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# **GE-NET TMX™**

## **900 MHz MOBILE COMBINATIONS**

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GE-NET TMX™  
900 MHZ MOBILE COMBINATIONS

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SPECIFICATIONS\*

GENERAL

Operating Voltage	13.8 Volts ±20%
Battery Drain	
Transmit	6.5 Amperes
Receive	0.6 Ampere
Channel Spacing	12.5 kHz
Frequency Stability	±1.5 parts per million
Temperature Range	-30°C to +60° (-22° to +140°F)
Dimensions (H x W x D)	43.5 mm x 160.2 mm x 184.2 mm (1.7" x 6.3" x 7.25")
Weight	1.34 kg (47.5 ounces)
Antenna Impedance	50 Ohms

TRANSMITTER

Frequency Range	896-902 MHz
Output Power	15 Watts
Spurious and Harmonics	-55 dBc
Audio Distortion	5% maximum
Modulation Limiting	±2.5 kHz
Hum and Noise	40 dB
Audio Frequency Response pre-emphasis curve from	Within +1, -5dB of a 6 dB/octave 300-2500 Hz. Within +1, -10 dB of a 6dB/octave pre-emphasis curve from 2500-3000 Hz.

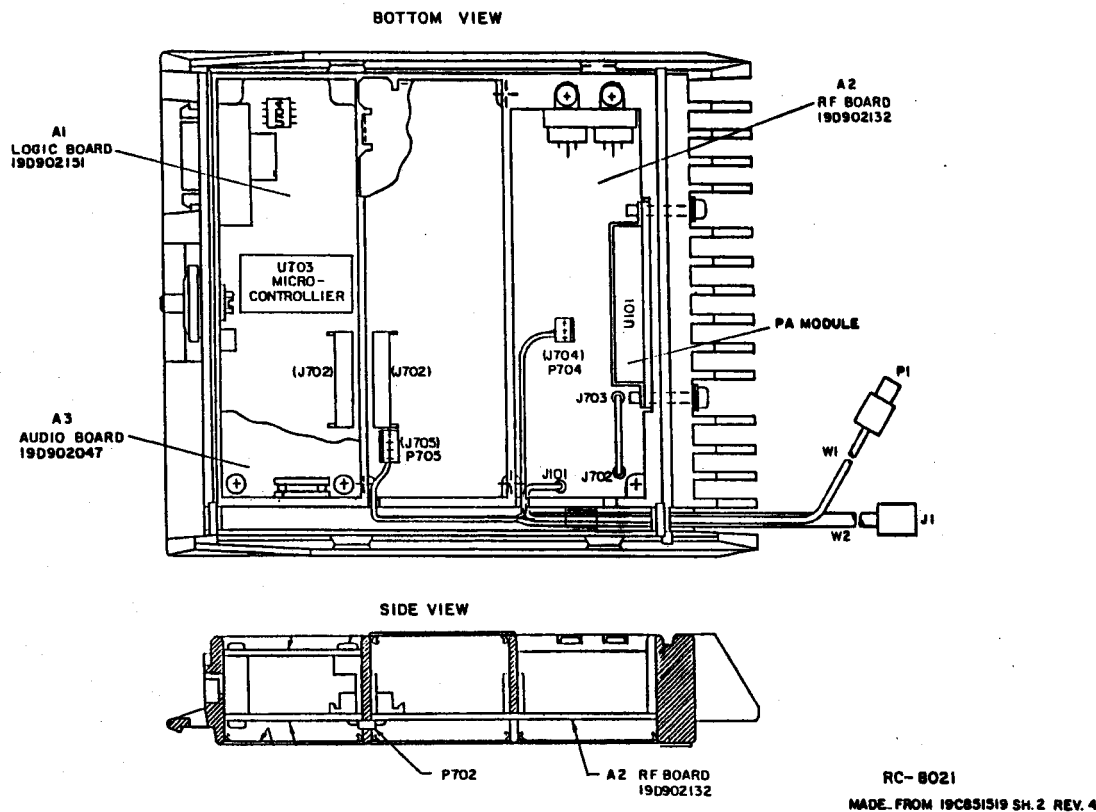
RECEIVER

Frequency Range	935-941 MHz
Modulation Acceptance	±5.5 kHz
Sensitivity (12 dB SINAD)	0.35 µV maximum, 0.25 µV typical
Spurious Response	70 dB typical (65 dB typ. 1st image)
Adjacent Channel Selectivity	65 dB typical at 12.5 kHz
Intermodulation	65 dB typical
Audio Frequency Response	Within +2, -8dB of a 6 dB/octave de-emphasis curve from 300 to 3000 Hz.
Audio Output	5Watts
Audio Distortion	5% maximum

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

## COMBINATION NOMENCLATURE

DIGITS 1 & 2	DIGITS 3 & 4	DIGIT 5	DIGIT 6	DIGITS 7 & 8	DIGIT 9
Product Code	Radio Type	Frequency	Function	Power Output	Version
<b>DT</b>	<b>MX</b> Wide Bandspread Mobile	<b>9</b> 900 MHz	<b>3</b> Dispatch Only	<b>15</b> 10-15 Watts	<b>B</b> Basic



### Figure 1 - Radio Layout Diagram

## GENERAL DESCRIPTION

The General Electric GE-NET TMX<sup>TM</sup> mobile is a synthesized, wideband radio that uses integrated circuits and microcomputer technology to provide high performance trunked operation. The radio operates in the 896 to 902 MHz (transmit) and 935 to 941 MHz (receive) trunking bands, and provides a power output of 15 watts. The trunking signaling format is based on 4800 baud high speed digital coding which provides a typical system access time of 1/3 of a second.

The GE-NET TMX radio consists of the radio assembly and a control unit. The control unit is an externally mounted unit which consists of a five watt speaker/amplifier, an on-off switch, a microphone connector, a four position area/group switch, and a monitor button. Up to four areas and/or group combinations can be field programmed into the radio and accessed by the user from the four position switch on the controller. The mobile can access up to 20 channel frequencies in any system (area).

The GE-NET TMX15 watt transmitter RF output is set by an internal power control. A power detection circuit located just before the antenna connector keeps the power output constant over changing voltage and temperature conditions.

Contiguous 12.5 kHz spaced channels with 39 MHz transmit-receive offset are used in the 900 MHz trunking system. In addition, the frequency determining element (TCXO) has a stability of 1.5 PPM (0.00015%) over the operating temperature range to insure operation in the specified channel bandwidth.

The radio is field programmable using an IBM compatible personal computer with the following equipment:

- Serial Programming Interface Module TQ3310,  
GE Programming Cable TQ3314, and  
GE-NET TMX Programming Software TQ3325.

With the interface equipment and software, the computer can be used to program (or reprogram) customer individual ID codes, group codes, system frequencies and options. Programming is done through the radio's system connector without opening the radio.

## RADIO ASSEMBLY

The GE-NET TMX radio assembly consists of the following circuit boards:

- **Logic Board A1 (19D902151G1)**

- RF Board A2 (19D902132G1)
- Audio Board A3 (19D902047G1)

The three 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.

## LOGIC BOARD

The logic board contains the microprocessor and associated support circuitry, EEPROM field programmable memory, EPROM software, a custom high speed data modem IC, DAC, and electronic audio potentiometer. This board provides all the signaling functions (4800 baud high speed and subaudible low speed data generation and detection) as well as alert tones, data loading for the transceiver synthesizer, control of transmit and receive, and maximum audio level set from the radio. The individual radio personality is field programmable through the electrically erasable PROM (EEPROM).

## RF BOARD

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

## Receiver

The receiver is a dual conversion superheterodyne with a first intermediate frequency of 39 MHz and a second intermediate frequency of 455 kHz. A quadrature detector is used to recover the audio from the carrier. The receiver is designed with fixed RF filters to operate over the entire 935 to 941 MHz range without retuning.

## Transmitter

The transmitter circuit consists of a broadband exciter fed by the frequency synthesizer and a broadband power amplifier module. The output of the power amplifier is fed through a PIN switching circuit and a low-pass filter to the antenna cable. The transmitter is designed to operate over the 896 to 902 range without retuning. A power control circuit senses the output at the antenna port and varies the exciter bias to keep the RF power constant over varying operating conditions.

## Synthesizer

First mixer injection and transmitter exciter drive is derived from the synthesizer circuit. The synthesizer consists

of the VCO, prescaler IC, PLL IC, and reference oscillator (TCXO). The logic board serially loads channel frequency information into the PLL Integrated Circuit (IC).

Diode Switch

As the same antenna port is used for the receiver input and transmitter power output, a PIN diode switch is used to connect these stages together. High RF isolation is provided to the receiver input when the transmitter is powered to prevent receiver damage. The transmitter is isolated during receive to minimize signal losses to the receiver.

AUDIO BOARD

All of the voice signals to and from the transceiver and control unit, and the digital filtering to and from the transceiver are processed by the audio board. Functions provided by the audio board circuitry include the receiver noise squelch, received audio (voice) filtering and amplification, transmit audio (voice) filtering and amplification, transmit deviation limiting, received subaudible data filtering and limiting, received high speed (4800 baud) data filtering and limiting, and transmit data waveshaping. The audio board also performs the necessary preemphasis and deemphasis on the audio voice signals.

CONTROL UNIT

The control unit for the GE-NET TMX radio houses a five watt audio amplifier, a three-inch speaker, switch controls, and red transmit indicator. The POWER switch controls power to the audio amplifier and the radio. A two-or four position channel selector permits selection of one to four channels. The MONITOR button selects an auxiliary function or serves as an out-of-range indicator when activated.

The control unit connects to the radio through a system cable with a nine pin connector. The power cable has two connectors; one connects to the power cable from the vehicle battery or ignition switch, and the other connects to the radio. An eight-pin microphone jack is located on the back of the control unit.

SYSTEM DESCRIPTION

The General Electric 900 MHz digital 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 system uses 4800 baud high speed digital signaling 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 simultaneously all the way down to individual users can be accessed. This programming to determine transmit encoded groups and decoded received groups is contained in the personality EEPROM contained in the mobile. This information is individually programmed to each users needs via the PC programmer for the radio.

Typical system configuration consists of at least 2 repeater stations (with a maximum number of 20), and the associated mobiles. One repeater always is a control channel which is 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 onto 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 a loss of subaudible data reception (i.e. deep fade, out of range), the mobile will return to the control channel frequency. At the end of a normal voice message (initiating mobile unkeys), the subaudible data from the voice channel switches to a 200 Hz tone which signals the receiving mobile to close voice paths and return to the control channel for future calls.

To initiate a call, the user keys the radio (which is locked to the control channel), and a 60 milliseconds 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 will place the mobile into a queue, transmit back to the mobile a queue message, 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 will be sent back to the requesting mobile and an alert will be 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 4800 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 signaling, the voice channel is muted and all receiving mobiles are sent back to the control channel.

In normal operation, the transmitting mobile also sends a phase shift on this subaudible tone to indicate that the user has unkeyed, and to switch listening mobiles back to the control channel.

OPERATION

TUNING THE RADIO ON

1. Slide the POWER OFF/ON switch to the ON position. If the radio is wired through the vehicle ignition switch, make sure that the ignition switch is turned on.
2. The radio performs a self diagnostic test each time you turn it on. You will hear a three-beep alert signal indicating that your radio has passed the test and is ready for operation. (NOTE: If you do not hear the three-beep alert, contact your service representative.)
3. Set the VOLUME control for the desired listening level. You may press the MONITOR push-button and use the service range indicator beeps to adjust the volume level.
4. Select the proper channel using the CHANNEL select switch. You will hear a short beep each time you change channels.

You are now ready to place a call!

PLACING A DISPATCH CALL

If you plan on making a lengthy call, or several calls, make sure that the vehicle engine is running to maintain your battery charge.

1. Make sure that the radio is turned ON, and the proper channel is selected.
2. Press and hold down the PTT switch on the microphone. The XMIT indicator on the control unit will light.
3. You will hear a short beep (if the radio is not programmed to mute the beeps) indicating that you have access to the

system. When you hear the beep, you can begin your message. (NOTE: If you hear two or more tones, or a continuous tone, the system may be busy, your request has been placed in queue, or your call request has been denied for some reason. Refer to the ALERT TONE AND FUNCTIONS section for more details.)

NOTE

In rare instances, several low pitched, fast "chirps" will be heard before the call originate tone is sounded. This is caused by your radio automatically retrying to gain access to the system after the first attempt failed (Auto-Retry). This will normally occur in fringe coverage areas, and in heavily used systems. The Auto-Retry is one of the features of the radio system to provide reliable communications under adverse conditions.

4. After you have finished your call, releasing the microphone PTT switch ends the call automatically.

RECEIVING A DISPATCH CALL

1. You will hear a beep each time you have an incoming call. A single tone beep indicates that you are receiving a group call. A two tone, high low alert indicates that you are receiving an individual call. You will then hear the voice message. After you have received the incoming call, you can send an answer by pressing the PTT switch and talking across the face of the microphone.

NOTE

In some modes of operation such as multigroup decode, agency call, fleet or individual call, you must answer the caller within five seconds. If not, two short beeps will sound, the call will be terminated, and normal system operations will resume. (See your head of operations for system details).

2. You can receive individual calls from anyone in the system regardless of the position of your channel selector switch.
3. When you hear two fast, high pitched beeps, someone in your system has tried to call you but the call was queued because the system is busy. These beeps let you know that you will receive a call shortly.

GLOSSARY

CALL RECEIVED ALERT TONES:

An alert tone will be sounded when a group call is received. A 2 tone high/low alert is sounded for individual calls. (NOTE: The radio can be preprogrammed to mute the Call Received Alert Tones).

CALL ORIGINATE ALERT TONE:

A short alert tone is sounded after the microphone is keyed to indicate the radio has acquired a voice channel and the user may begin talking. (NOTE: The radio can be preprogrammed to mute the Call Originate Alert Tone).

SYSTEM BUSY:

Four short, low pitched alert tones are sounded to indicate a busy system and the call queue buffer is full. The tones will repeat if the microphone button is held down.

CALL QUEUED:

Two short high pitched beeps are sounded to indicate a queued message has been received from the system. The tones are sounded at the initiating mobile and the receiving mobiles. If the initiating user continues to hold down the microphone button, the mobile will repeat the alerts.

CALLED DENIED:

Five long, low pitched tones are sounded after the microphone PTT switch is activated. This indicates the individual radio is not valid on the current system.

UNIT DISABLED:

A continuous low pitched alert tone is sounded when the microphone PTT switch is pushed to indicate that the radio has been disabled by the system. The mobile is incapable of transmitting or receiving calls in this mode until the system re-enables the unit.

OUT-OF-RANGE/SYSTEM INOPERATIVE:

Short, low pitched tones are sounded immediately after the microphone PTT switch is pushed to indicate a mobile out-of-range condition. The same tones are sounded if the monitor switch is pushed on the control unit and the radio is out-of-range. If the beeps are sounded when the mobile is within known range of the station, this indicates the system is off the air or that the mobile is in need of service. The tones are repeated as long as the microphone PTT is activated or the monitor switch held.

SELF-CHECK TEST ALERT TONE:

Three beeps are sounded shortly after the radio is turned on. This indicates that the radio has passed the self diagnostic test and is ready for system operation.

CARRIER CONTROL TIMER:

The Carrier Control Timer alert is a long, low pitched tone that is sounded after the microphone PTT switch has been activated continuously for a preprogrammed time. The transmitter will unkey after the alert is sounded and communication is interrupted.

AREA OR SYSTEM:

The terms area and system are used interchangeably to refer to the particular group of station repeaters currently providing service to the mobile. Mobiles can be preprogrammed to work in different areas by changing the selector switch position (i.e. different systems in different cities).

GROUP (OR SUBFLEET):

A group of users share the same preprogrammed group identification number in their mobiles. All mobiles in the same group will receive a dispatch call placed by any one mobile in the group.

GROUP SETS AND MULTI-GROUP DECODING:

The radio can be preprogrammed to monitor up to 5 group numbers simultaneously. This permits the user to monitor several user groups and to receive calls from these groups. Upon receiving a call from any one of the groups, the mobile will lock out from receiving or transmitting to other groups for a period of 5 seconds. After 5 seconds of no activity on the group, the radio will sound two short, low pitched beeps to indicate the end of the lockout period and that the radio is again ready to receive a call from any of the preprogrammed groups.

INDIVIDUAL CALL:

Every mobile radio has a preprogrammed, unique individual identification code assigned to it. A mobile can be preprogrammed to individually call one particular mobile by using this function.

FLEET:

A fleet of users is made up of multiple groups (subfleets). Mobiles can be preprogrammed to make fleet calls to access multiple user groups simultaneously.

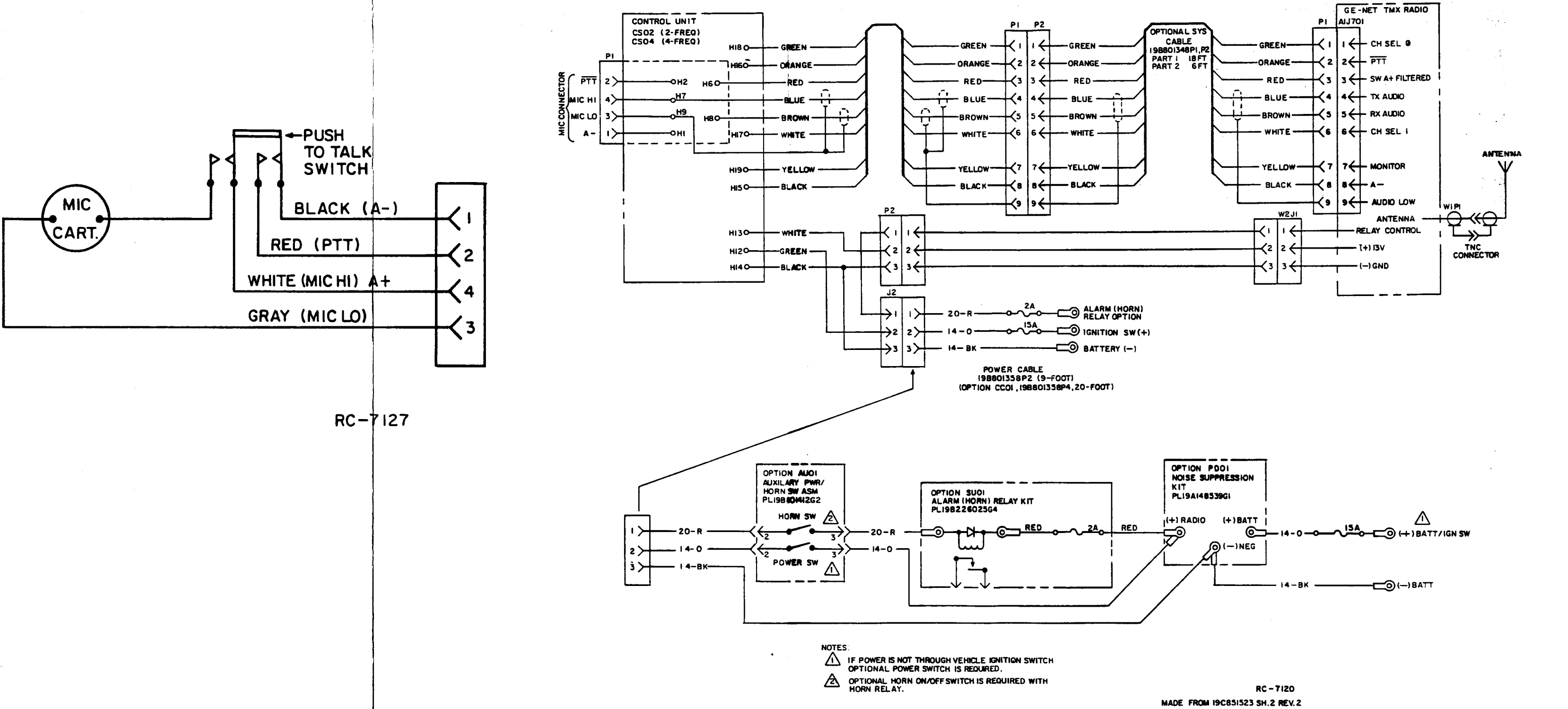
AGENCY:

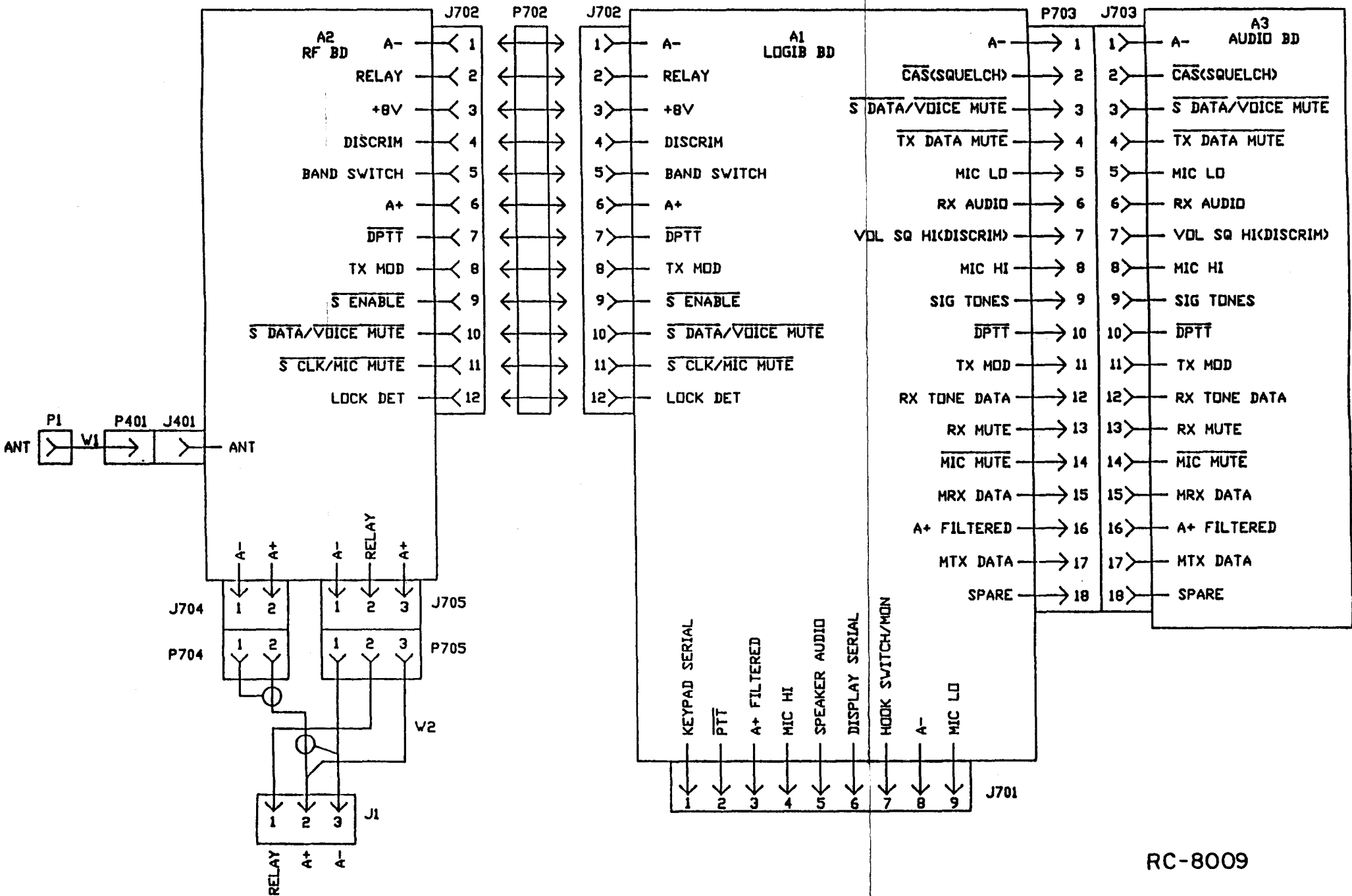
An agency is composed of multiple fleets. Mobiles can be preprogrammed to initiate agency calls to access multiple fleets.



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GE-NET TMX  
Radio Interconnection