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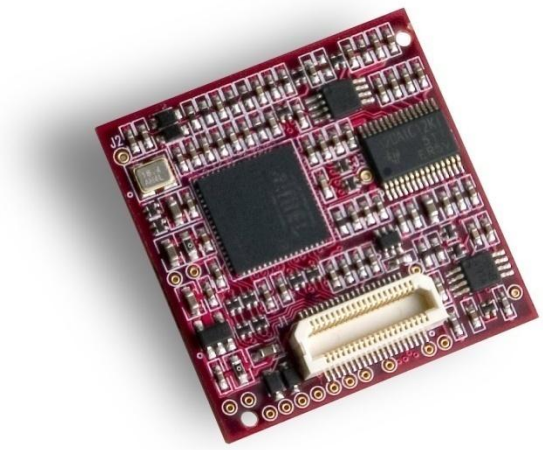
QuikSync
VQS Series Manual

VQS-500 - VQS-420 - VQS-400

Combination Voice Inversion Scrambler and GE Star®, MDC-1200®, Identification Encoder/Decoder

For

VERTEX STANDARD RADIOS



Instruction Manual

Manual Number 05 30 5000
Rev 101105

QuikSync VQS SERIES COMBINATION SOFTWARE DEFINED SECURE VOICE AND ANI ENCODER/DECODER for Vertex/Standard Radios

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Cimarron Technologies Corporation is a licensee of the Motorola MDC-1200® Protocol technology.

Manual revision 101105

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CHAPTER 1
Features

What Is the QuikSync VQS Series?

The QuikSync VQS series are devices that combine ANI encoder/decoder signaling with the Cimarron Technologies QuikSync MSK initialized voice inversion scrambling in Vertex communications radios. There are three boards in the series with incrementing levels of capabilities.

Type	Function
VQS-500	Vertex plug-in with full MDC-1200 or GE-Star signaling, including decode and display of decoded ID and maximum capability hopping secure voice
VQS-420	Vertex plug-in with full MDC-1200 or GE-Star signaling, including decode and display of decoded ID, simple inversion and the more secure “Hop on PTT” secure voice.
VQS-400	Vertex plug-in capable of simple inversion secure voice

As described in the above table, the VQS-500 is a full featured device. The VQS-420 is capable of single frequency inversion, Hop on PTT inversion and all ANI features while the VQS-400 is only capable of single frequency simple inversion with no ANI features.

The full featured VQS-500 is capable of sending PTT ANI and Emergency ANI in GE Star® or MDC-1200® signaling format. It is capable of reception of Selective Calls, Group calls and All calls and will provide audible alerts when called. It responds to radio check commands (interrogates), and to over the air open microphone monitor commands and radio disable/enable commands. In Vertex/Standard radios with displays, it also receives, decodes and displays ANI messages from other units and provides an audible alert upon receipt of emergency messages. If the host Vertex/Standard radio is equipped with a keypad, it can be used to generate, in MDC-1200® signaling format: selective calls (Alert) and radio checks (Interrogate) and is capable of functioning in a Motorola VSC enabled communications system. In GE Star® signaling format, the device can be used to generate interrogates, selective calls and cancels. In both formats, the VQS-500 and VQS-420 can send and receive eight different canned messages or statuses.

The inversion scrambling scheme is unique in that it is adaptive to the communications system in which it will be used. When initially setting up the communications system, the VQS series boards must be programmed with configuration information. QuikSync uses dynamic frequency inversion scrambling, but, unlike other schemes, the range of inversion frequencies is specified during set-up as well as minimum and maximum dwell times. In this manner, the actual inversion frequency

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can be fixed so that all units always use the same split frequency (like current low end boards on the market); or the inversion frequency can change for each press of the PTT, staying at that split frequency only for the period of that transmission; or the board can hop around a pre-defined range of frequencies in a random manner and for random dwell times. The actual decision (and level of security) can be tailored precisely to the limitations of the communications system. There are six preset levels of security to choose from when configuring the board. These preset levels can be additionally adjusted for precise system integration.

Determining Which Device you Have

All VQS devices are marked as VQS-500. The difference is in the firmware loaded into the device microprocessor. QuikWare programming software can be used to retrieve device information in order to determine which product you have. Refer to chapter 2 page 28.

Capabilities

ANI Encode

- MDC-1200® or GE Star® signaling formats.
- Identify every transmission source with the assigned ANI ID.
- Emergency message via button press.
- Man-Down alarm.
- Open Mic Monitor.
- ANI sent at Beginning, End or Both.
- In MDC-1200® signaling format can generate selective calls (Alert) and radio checks (Interrogate) and is capable of functioning in a Motorola VSC enabled communications system.
- In GE Star® signaling format, can generate interrogates, selective calls and cancels.
- The VQS-500 can send eight different canned messages or statuses.
- Programmable ANI PTT repeat timer limits data bursts during continued conversations.

ANI Decode

- Decodes and display the received ANI.
- Radio Disable and Enable.
- Selective Call, Group Call, and All Call messages.
- Status and canned messages can be programmed instead of the Emergency and Man-Down reporting.
- MDC-1200® message adaptability enhances compatibility with existing unique systems.
- Includes Short Messaging capability of eight MDC-1200 canned messages/statuses with definition aliasing of eight characters.
- Per-Channel selection of ANI signaling type, ANI ID, and Encryption parameters.

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Alias

- 1000 Alias storage capability, 500 for MDC-1200 and 500 for GE Star signaling
- Displays and recalls alpha-numeric Aliases instead of numeric ID's for both transmit and receive.

Encryption

- Voice Inversion scrambling with programmable complexity.
- Level of security can be adjusted to match the communications system.
- Software Definable Encryption Upgrades without reinvesting in new/different encryption modules.
- Over-the-Air Programmable.
- Automatic receive detection and selection of Cipher/Clear mode.
- Up to 100 Hops per second with up to 2000 Hz difference in inversion frequency per hop.
- Mean difference of 1000 Hz per hop.
- Programmable for a dynamic inversion frequency range of 2.1 kHz through 4.1 kHz.
- Programmable dynamic hop dwell time.
- Unique system protection available to ensure incompatibility with any other radio system even if key is compromised.
- Per-Channel storage of Encryption keys, Inversion frequencies, and ANI parameters.
- Stealth communications feature allows private conversations within the communications system. Can designate target audience from within those with correct key. Select one individual, a group or all.

Radio Enhancement

- Stuck microphone alert tone.
- Programmable open microphone monitor during emergency.
- "Go-ahead" beep alerts when ready for voice transmission.
- Courtesy beep transmitted when radio is unkeyed.
- Receiver ANI data mute.
- PIN feature disables radio at power-up until a PIN is entered via the radio keypad.

Set-Up and Troubleshooting

- Advanced microprocessor control permits precise pairing with communications system. This enhances encryption compatibility with repeaters, voters, varying system links and system degradations.
- Self test upon power-up.

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Specifications

Data Format	GE Star®	MDC-1200®
Modulation Type	PSK (Phase Shift Key)	FSK
Rate	400 bps on 1600hz carrier	1200/1800 Hz
ID Range	0001 to 16,383	0001-DEEE
Aliasing	1024 entries maximum	
ID Locations	ANI at Beginning, End or Both on a per-channel basis	
Transmit Messages	PTT ANI, Emergency, Man-Down, TOT. Messages can be changed to any allowable GE Star® message. Selective Call, Selective Call Cancel, Radio Check.	PTT ANI, Emergency. Man-Down sends Emergency. Short Call Alert, Long Call Alert, Voice Select Call, Radio Check. Messages can be redefined for specialized systems.
Sidetone	User definable, fully programmable	
Burst Length	280mS plus preamble	Fixed length 180mS
Attack Delay	0 mS to 2550 mS programmable in 10 mS steps.	
ANI Repeat Timer	(Time since last PTT press. If less, don't send ANI) Programmable 0 S (Send every PTT); 0 to 255 S.	
Scrambling Type	Unique Dynamic Hopping Inversion Scrambling	
Cipher/Clear Detection	Automatic receive detection and selection of cipher/clear mode	
Transmit Mode	Automatic Cipher/Clear on per channel basis with manual over-ride	
State Warning	Device warns user at keyup whether transmission will be encrypted or plain	
Rate	Up to 100 Hops per second with up to 2000 Hz difference in inversion frequency per hop. Mean difference of 1000 Hz per hop	
Signaling Method	Incorporates MDC-1200® and GE Star® signaling formats and features.	
Function Programming	All ANI and Encryption functions can be programmed via Over the air Re-Programming or via radio programming cable	
Encryption Re-Keying	Keys entered via software, keypad (if present in radio) or Over the air Re-Keying	
Key Length	64 bits (provides 18 quintillion keys)	
Inversion Freq	Programmable for a range of 2.1 kHz through 4.1 kHz	
Target Selection	Can designate target audience from within those with correct key. Select one individual, a group or all	
Radio Lock	Feature available where radio is disabled at power-up until a PIN is entered via the radio keypad	
Dwell Time	Programmable for a dynamic range between zero mS (no hop) through 1000 mS in 10 mS steps.	
Unique System Identifier	Unique system protection available to ensure incompatibility with any other radio system even if key is compromised	
Messaging	Includes Short Messaging capability of eight canned messages/statuses with definition aliasing of eight characters	
Synchronization Burst	MSK sync burst required only at beginning of transmission except for simple inversion	
Sync Burst Length	80 mS	
Multi-Agency Interoperability	Encryption keys can be stored in a per-channel basis. Changing the radio channel also changes the key to be used with the agency on that channel. Up to 254 channels can be programmed with different secure voice and ANI parameters	

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Radio System Compatibility	Advanced microprocessor control permits precise pairing with communications system. This enhances encryption compatibility with repeaters, voters, varying system links and system degradations
Programming	Programmed via Vertex radio programming cable and Cimarron Technologies QuikWare software. Also over-the-air programmable with associated hardware.
Radio Interface	Connects to mating accessory port on host radio
Supply Voltage	3.5 VDC provided by host radio
Supply Current	12 mA quiescent, 35 mA processing
Temperature	Operating: -30^{o}C to +60^{o}C.
Humidity	0% to 95% RH (non-condensing).
Dimensions	30 x 30 mm.
Upgradeability	Level of security can be increased with communications system upgrades without reinvesting in new/different encryption modules

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CHAPTER 2
Installation

The VQS series modules are fully functional in the following Vertex radios: VX-410, VX-420, VX-537, VX-820, VX-920, VX-2100, VX-2200, VX-4100, VX-4200. A module with limited functionality can be special ordered for the VX-600, VX-800 and VX-900.

This chapter uses the VX-820 in the descriptions and compatible Vertex radio programming software as an example for the installation procedure.

STEP 1

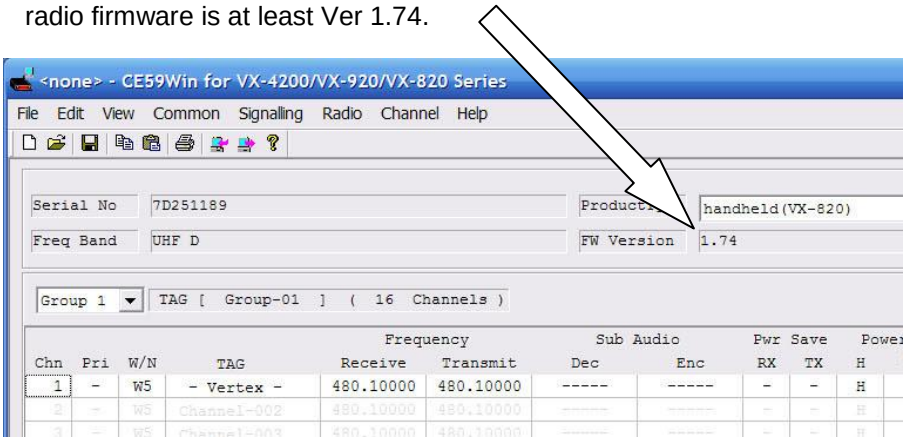
Locate the cover of the radio accessory bay, unscrew the four retaining screws, remove the cover and install the VQS Series module. Replace the cover.

STEP 2

Prepare the radio for programming with the Vertex CE-59 software. Ensure that your version of CE-59 is at least Ver 3.01.

STEP 3

Read the radio and verify that the radio firmware is at least Ver 1.74.



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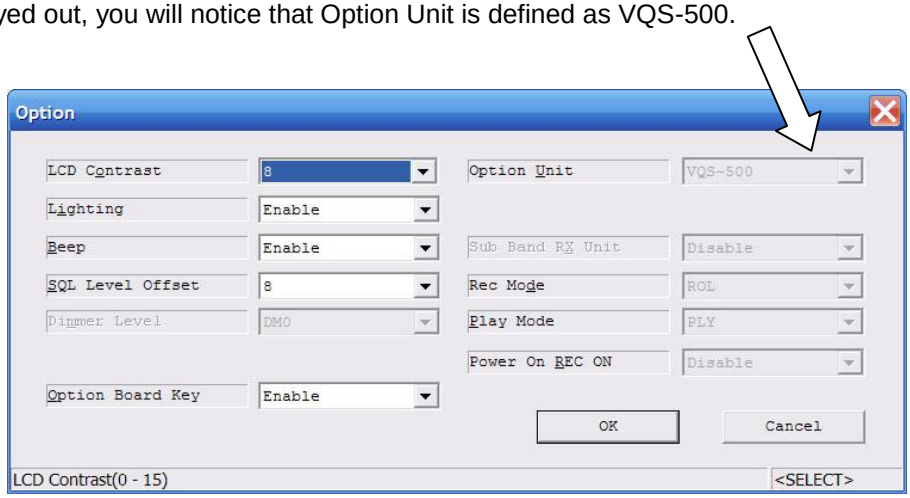
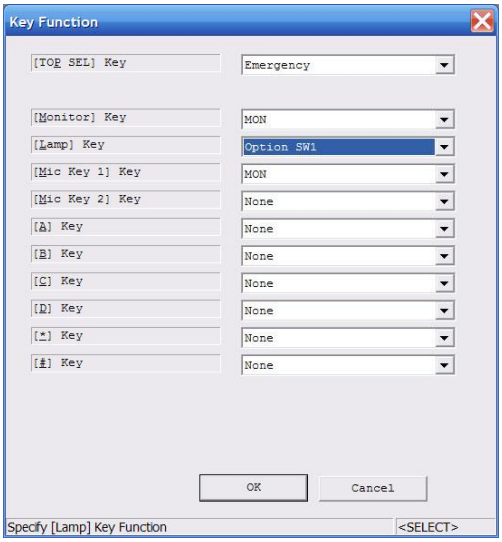
STEP 4

Then, verify that the radio has recognized the VQS board. Although grayed out, you will notice that Option Unit is defined as VQS-500.



STEP 5

Designate a button for Emergency and one to control Secure Voice. Select the function “Option SW1”



STEP 6

Make other required changes, write to the radio. Exit the CE-59 software.

STEP 7

Turn the radio off, and then hold down the PTT button and the top Orange button and turn power on and release the buttons. This puts the radio in Sub-Clone mode.

STEP 8

Start the QuikWare software. From the menu bar, select “Device” and choose VQS-500. Then select “Communications” and “Setup” and select the COM port that your programming cable is connected. If you are using the Vertex FIF-10 USB adapter, you will also need to change the setting of “*Handshake*” to “**XON/XOFF**”.

Important

The current version of firmware for the VX-410/420 does not auto detect the presence of the VQS board. If you are using this radio, perform the following additional steps in CE64:

Common>Option>VQS-500 (make the selection manually)
Turn on Signaling Type to 'Option' & Select '2'
Program a key for ACC 1 (this will turn encryption on/off)

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CHAPTER 3
Programming

Many functions and features of the QuikSync VQS-500 series boards are user programmable. In addition to signaling type, ID and radio interface parameters, the device can be optimized for the application's particular needs. The board is programmed while installed in the host radio. This is accomplished by placing the host radio into sub-clone mode and then attaching the appropriate Vertex/Standard programming cable and opening the Cimarron QuikWare software. The radio must be in sub-clone mode before attempting upload or download. Refer to the following table for radio specifics:

Radio Model	Programming Software	Firmware Version	Sub Clone Procedure
VX-537	CE-65 Ver 2.00	1.18	[PTT] + [Top Orange] + Pwr on
VX-410/420	CE-64 Ver 2.01	1.24	[PTT] + [Side 2] + Pwr on
VX-820/920	CE-59 Ver 3.01	1.74	[PTT] + [Top Orange] + Pwr on
VX-4100	CE-59 Ver 3.01	2.17	[▲] + Pwr on
VX-4200	CE-59 Ver 3.01	2.17	[P3] + Pwr on
VX-2100/2200	CE-82 Ver 2.02	1.54	[P3] + Pwr on

QuikWare Programming Software

The QuikSync VQS series of devices are programmed while installed in the host radio. This is accomplished by placing the host radio into sub-clone mode and then attaching the radio programming cable and opening the Cimarron QuikWare software.

The radio must be in sub-clone mode before attempting to upload or download

If you are using the Vertex FIF-10 USB adapter instead of the standard serial programming cable you will need to perform the following:

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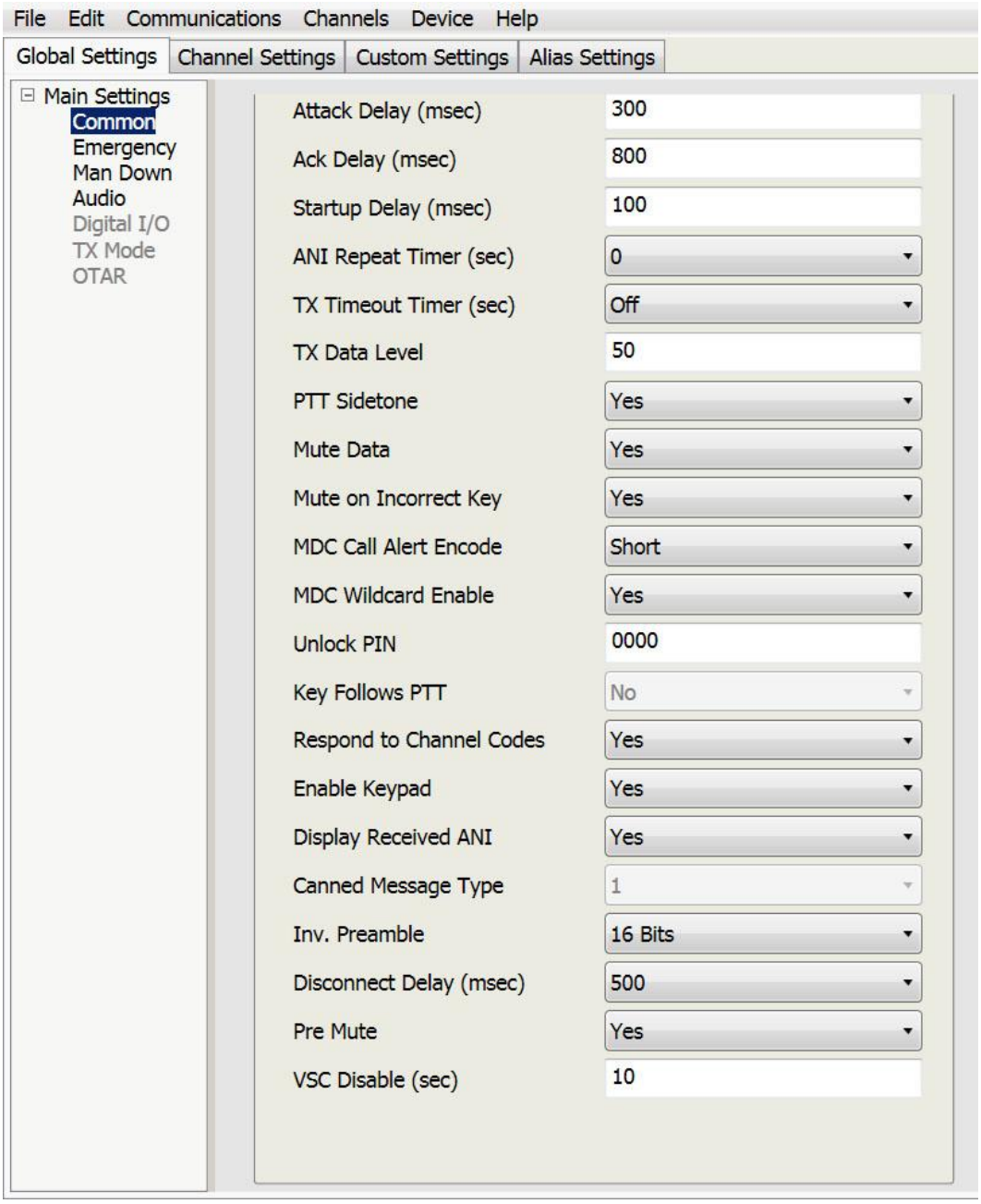
In the QuikWare software, go to “Device” and select “*VQS-500*”. Then go to “*Communications*”, select “*Setup*”. Change the setting of “*Handshake*” to “**XON/XOFF**”.

Opening Page

Upon starting, the QuikWare software program will open with the page shown below. This is the Common Settings window of the Global Settings tab. In addition to the Common Settings, you can also access settings for Emergency, Man Down, and Audio. The Menu Bar provides access to the following windows: File, Edit, Communications, Channels, Device and Help.



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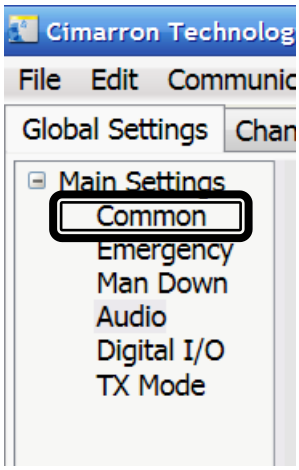
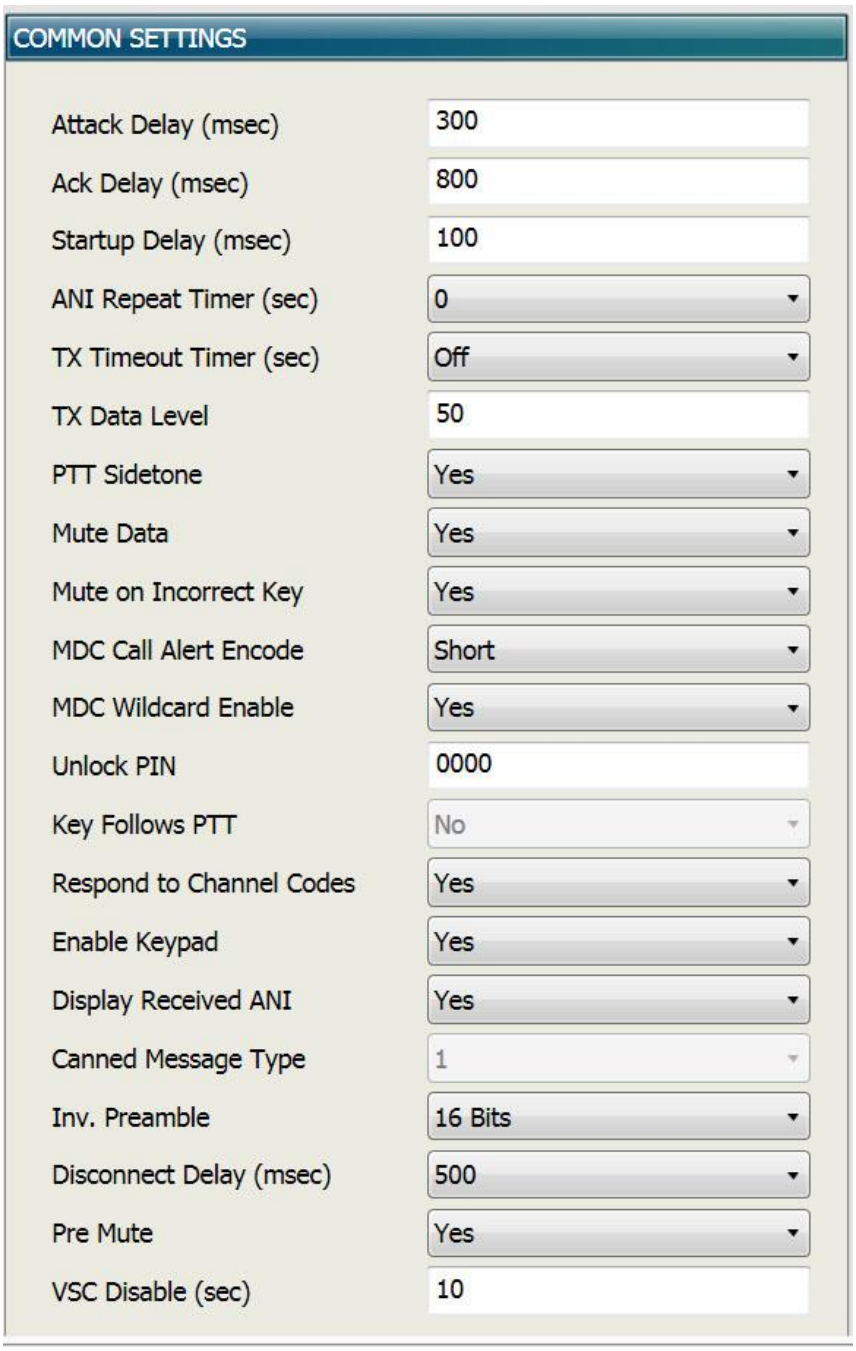
Device. In parentheses it will describe which COM port has been assigned to your USB programming cable.

Common Settings





Attack Delay

0ms to 2550ms in steps of 10ms. *[Default 300mS]*

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The period of time from when the user keys the radio and the data begins to be transmitted. This delay allows the communications system to stabilize and be ready for transmission.

Acknowledgment Delay

(0mS to 2550 mS in 10 mS steps) *[Default 800 mS]*
The period of time from when an acknowledgeable message is received and the acknowledge data packet is sent. This delay allows the receiving radio to relax from transmit mode before receiving the data.

Startup Delay

(0mS to 2550 mS in 10 mS steps)*[Default 100mS]*
This parameter holds off the startup of the device after power is applied. Used to ensure host radio stability on power up.

ANI Repeat Timer

(time since last PTT press. If less, don't send PTT ANI) (0=send every PTT; 10s, 20s, 40s, 60s, 90s, 120s) *[Default 0]*
Used to reduce the amount of data transmissions. If the selected time since the last PTT press is not exceeded, data is not transmitted with that PTT press.

TX Time Out Timer

(OFF,30s, 60s, 90s, 120s) [*Default: OFF]*
If the radio is held keyed up for greater than the selected time, the ID is transmitted and the radio is automatically unkeyed.

TX Data Level

(0 – 255) *[Default 50]*
Data deviation adjustment should not be performed until audio level adjustments have been completed. If audio adjustments are changed, data deviation must be readjusted. If the data output setting is too high for the microphone output gain level setting, data clipping will result. The VQS Series data deviation is adjusted by software selection. The value can be programmed between 1 and 255. Settings between 1 and 128 will result in output levels from 0 vpp to 250 mvpp (open output). Settings between 128 and 255 result in output levels from 250 mvpp to the maximum output of 2 VPP (open output). Modify the value of Output Level until data deviation is just below voice deviation. It is most appropriate to start at a deviation that is much lower than voice and then adjust up until the correct point is reached. Actual output voltage levels depend on the impedance of the selected interface point.

PTT Sidetone

(Y/N) *[Default Yes]*
If programmed "Yes", a tone will sound through the local speaker to advise the user to hold off talking. Prevents "Voice syllable clipping" which could occur during data transmission.

Mute Data

(Y/N) *[Default Yes]*

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Some applications may require that received ANI data not be stripped from the incoming audio. If this is set to “No” then data will be forwarded from RX Audio In to RX Audio Out. This is especially necessary if the application is in a base dispatch console that has an ANI decode feature.

Mute on Incorrect Key

(Y/N) *[Default Yes]*
The “Mute on Incorrect Key” feature forces the host radio to disable receive functions during receipt of a coded transmission where the receiving key does not match the transmitting key. Plain text transmissions continue to be received as well as transmissions encoded using similar keys.

MDC Call Alert Encode

(Long, Short) *[Default Short]*
MDC-1200® signaling defines two types of Call Alert packets. The short call alert does not contain the originator ID and does not support many extended features. This selection affects which type will be used during MDC-1200® encoding. The VQS-500 and VQS-420 will decode either type. If the device receives a short call, no originator ID will be displayed on the radio. The selection is effective for all MDC-1200® signaling channels. (Different call types cannot be selected for different channels)

MDC Wildcard Enable

(Y/N) *[Default Yes]*
If set to “No”, MDC-1200® wildcards of “F” and “E” will be handled as normal allowable ANI ID’s instead of wildcards.

Unlock PIN

(0000 – FFFF) *[Default 0000, NONE]*
This feature is available for Vertex/Standard radios that have keypads. If enabled, the radio will power-up in the “radio disabled” mode. That is, it will not be capable of transmitting nor receiving. The authorized user will enter the unlock code using the front panel keypad. Successful entry will unlock the radio until power is cycled. The code can be any sequence of digits (from the front panel) in a string of 4 hex digits in length. If set to 0000, the unlock feature is disabled.

Key Follows PTT

Not used in VQS product.

Respond to Channel Codes

(Y/N) *[Default Yes]*
If this parameter is set to No, the “channel settings” screen will have only one channel to be used regardless of the channel the radio is on.

Enable Keypad

(Y/N) *[Default Yes]*
If set to “No”, the VQS device will ignore radio front panel button presses. Keypad functionality will return to the host radio.

Display Received ANI

(Y/N) *[Default Yes]*
If set to “No”, received ANI will not be presented on the radio display.

Canned Message Type

(Message, Status) *[Default = Message]*
Canned message type can be “Message” or “Status” and determines when on an MDC-1200 signaling channel, the MDC codeword argument as message or status. For message, that would be 0127 through 0827. For status, it would be 0126 through 0826.

Inversion Preamble

(8, 16, 32, or 64) *[Default = 16]*
The encryption initialization data burst has a preamble length that is programmable for 8, 16, 32, or 64 preamble bits. Longer preambles provide for more robust data transmissions but make the secure voice setup message take longer to transmit.

Disconnect Delay

(200, 300, 400, or 500 mS) *[Default = 500]*
The disconnect delay is the time to wait after losing carrier that the board will cease following the hopping sequence. This delay will permit momentary loss of carrier (due to fading, etc) without losing synchronization with the hopping sequence. If a new MSK initialization burst is received during this delay period, the delay will be terminated and the new burst information will be followed.

Pre Mute

(Y/N) *[Default Yes]*
Pre Mute is used to eliminate the small amount of data that is heard in the local speaker before being recognized as data and being muted. Pre Mute EXPECTS all transmissions to be prefaced with data. So, the radio audio amplifier is muted when the radio is idle. When RX carrier is detected, the QS-5000 will keep the audio muted for the period of the programmed attack delay plus 100 mS. After that time elapses, the mute caused by Pre Mute is removed and is replaced by actual data mute. This function completely eliminates all received data from being presented at the local speaker.

VSC Disable

In a VSC channel, radios are always muted unless they receive a VSC command directed to them. This would make mixed fleet communications impossible between a VSC radio and a non-VSC radio. To resolve this issue, if you are using a VSC programmed device but do not target a destination for your transmission, VSC will turn off for the period of the VSC disable timer after release of PTT. This will permit reception of non-VSC radio replies. If a non-VSC reception begins before the timer expires, the entire reception will be permitted before VSC qualified reception commences again.

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Emergency Settings

Repeat Max

(1, 5, 10, 15, 20, forever) *[Default =5]*
The emergency message transmission will be repeated a programmed number of times with a programmed period between transmissions. The repeats will be transmitted regardless of radio status. If this value is set to 1 (one), the transmission will be considered a non-critical message instead of emergency.

Repeat Period

(5s, 10, 20, 30s) *[Default=10s]*
When in the emergency mode, if the number of repeat emergency transmissions is not “One”, this is the time that will be waited between emergency transmissions.

Open Microphone Monitor on Emergency TX time

(0s to 55s, 5s steps) *[Default 0s]*
If not set to zero, once an emergency is activated, the radio will key up and transmit the emergency message and then unkey for the designated Open Microphone Monitor on Emergency RX time. It will then key up again and transmit ambient noise for the period of time described in Open Microphone Monitor on emergency TX time. It will then unkey and remain unkeyed for the programmed amount of RX time and then repeat the process. It will alternate between TX and RX throughout the emergency cycle. The length of the cycle is determined by the settings of “Number of repeat emergency transmissions” and “Time between emergency repeats”. If the value is set to zero, there will be no open microphone monitor. If RX time is defined as zero, then the TX time will occur only once.

Open Microphone Monitor on Emergency RX time

(0s to 55s, 5s steps) *[Default 0s]*
If open microphone monitor on emergency TX time is not set to zero, the radio will remain unkeyed for this period of time between TX times. If the RX time is set to zero, then the TX monitor time will only occur once at the beginning of the emergency cycle.

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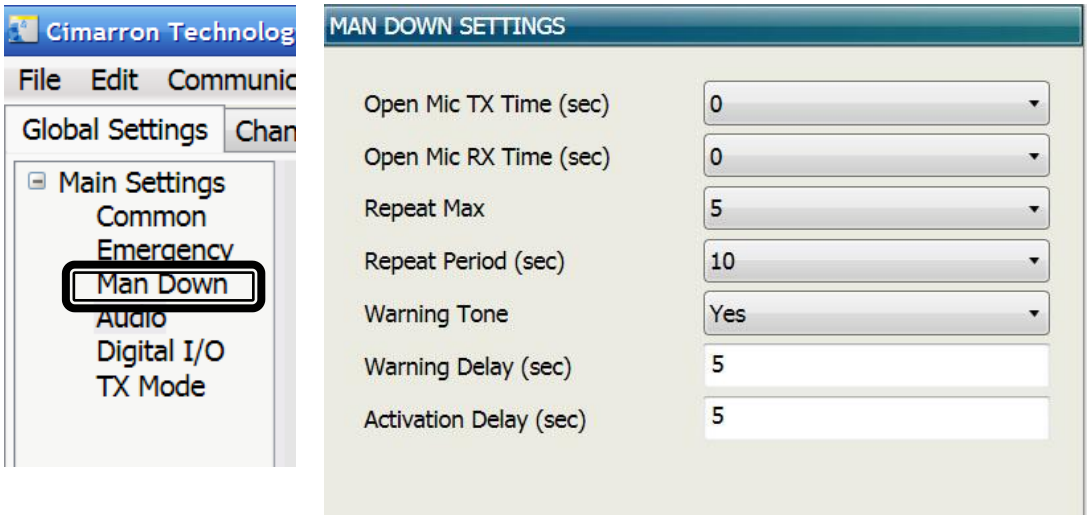
Emergency TX Warning Tone

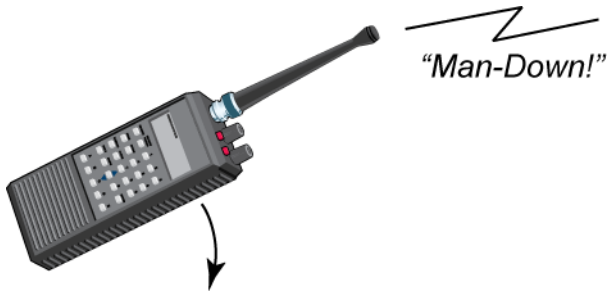
(Y/N) *[Default No]*
If programmed “Yes”, a warning tone will sound through the local speaker to advise the user that an emergency message is being transmitted.

ManDown Settings



Repeat Max

(1, 5, 10, 15, 20, forever) *[Default =5]*



The man down message transmission will be repeated a programmed number of times with a programmed period between transmissions. The repeats will be transmitted regardless of radio status. If this value is set to 1 (one), the transmission will be considered a non-critical message instead of man down.

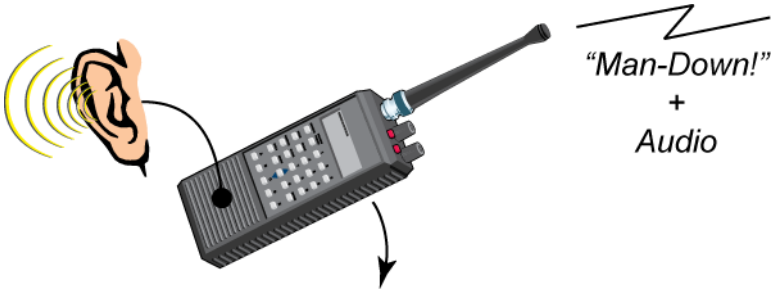
Repeat Period

(5s, 10, 20, 30s) *[Default=10s]*
Repeated Man Down transmissions will be separated by a programmed delay period between transmissions.

Note: Although the manual refers to VQS-500, you may have purchased the more economical VQS-420 which does not support hopping inversion or the VQS-400 which has neither hopping inversion nor any ANI capabilities.

Open Microphone Monitor on Man Down TX time

(0s to 55s, 5s steps) *[Default 0s]*



If not set to zero, once a man down is activated, the radio will key up and transmit the man down message and then unkey for the designated Open Microphone Monitor on Man Down RX time. It will then key up again and transmit ambient noise for the period of time described in Open Microphone Monitor on Man Down TX time. It will then unkey and remain unkeyed for the programmed amount of RX time and then repeat the process. It will alternate between TX and RX throughout the man down cycle. The length of the cycle is determined by the settings of "Number of repeat man down transmissions" and "Time between man down repeats". If the value is set to zero, there will be no open microphone monitor. If RX time is defined as zero, then the TX time will occur only once.

Open Microphone Monitor on Man Down RX time

(0s to 55s, 5s steps) *[Default 0s]*

If open microphone monitor on man down TX time is not set to zero, the radio will remain unkeyed for this period of time between TX times. If the RX time is set to zero, then the TX monitor time will only occur once at the beginning of the man down cycle.

Man Down TX Warning Tone

(Y/N) *[Default No]*

If programmed "Yes", a warning tone will sound through the local speaker at the end of the programmed warning delay to advise the user that a Man Down message will be transmitted if the radio is not up-righted within the programmed active delay time. Additionally, a warning tone will sound through the local speaker for each data transmission to advise the user that a man down message is being transmitted.

Man Down Warning Delay

(0 – 255 S) *[Default 5 S]*

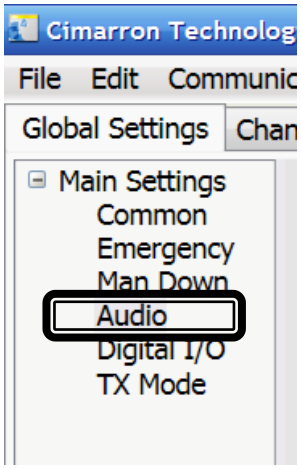
Once the VQS-500 senses a man down situation, this timer begins to run (0 – 255 S). If the radio is not up righted within this period of time, a warning tone lasting 1 second is sounded. If the radio is up righted, the warning timer resets.

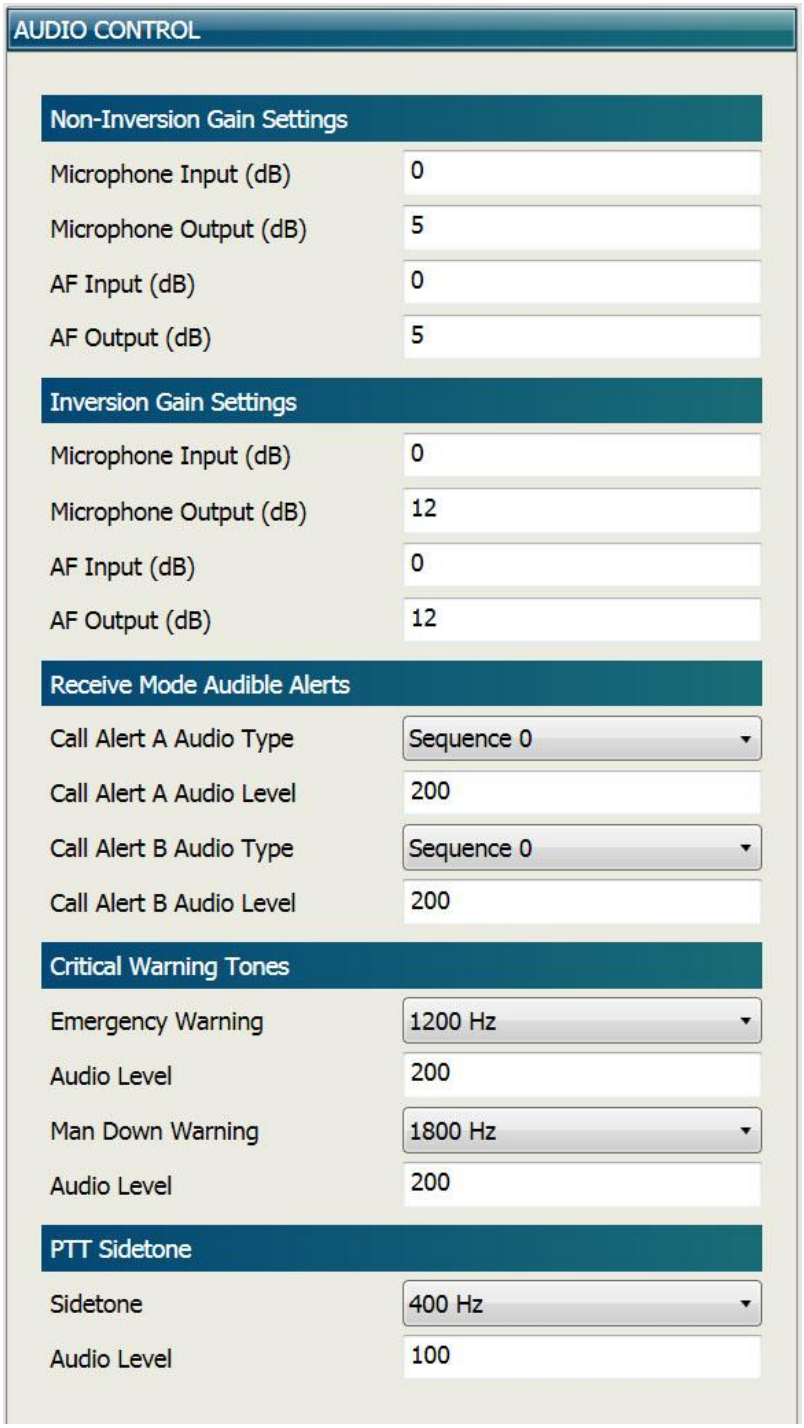
Note: Although the manual refers to VQS-500, you may have purchased the more economical VQS-420 which does not support hopping inversion or the VQS-400 which has neither hopping inversion nor any ANI capabilities.

Man Down Activation Delay

(0 – 255 S) *[Default 5 S]*
If the warning delay timer succeeds to complete its countdown and the warning tone is sounded, the activation delay timer begins to run. If the radio is not up righted within this period of time, the radio will key up and send a message to the base.

Audio Settings





Note: Although the manual refers to VQS-500, you may have purchased the more economical VQS-420 which does not support hopping inversion or the VQS-400 which has neither hopping inversion nor any ANI capabilities.

Gain Settings

Gain settings can range from -42 to +20 dB. There are a total of eight independent settings, four that affect levels with inversion taking place and four with inversion disabled.

Microphone Input gain level without inversion

This parameter adjusts the transmit (microphone) analog CODEC input audio gain level for the output of the VQS Series devices when the inversion process is disabled.

Microphone Output gain level without inversion

This parameter adjusts the transmit (microphone) analog CODEC output audio gain level for the output of the VQS Series devices when the inversion process is disabled. This setting also affects the level of Data Output. If the level is changed, be sure to recheck and readjust Data Output.

AF Input gain level without inversion

This parameter adjusts the receive (speaker) analog CODEC input audio gain level for the output of the VQS Series devices when the inversion process is disabled.

AF Output gain level without inversion

This parameter adjusts the receive (speaker) analog CODEC output audio gain level for the output of the VQS Series devices when the inversion process is disabled.

Microphone Input gain level with inversion

This parameter adjusts the transmit (microphone) analog CODEC input audio gain level for the output of the VQS Series devices when the inversion process is enabled.

Microphone Output gain level with inversion

This parameter adjusts the transmit (microphone) analog CODEC output audio gain level for the output of the VQS Series devices when the inversion process is enabled. This setting also affects the level of Data Output. If the level is changed, be sure to recheck and readjust Data Output.

AF Input gain level with inversion

This parameter adjusts the receive (speaker) analog CODEC input audio gain level for the output of the VQS Series devices when the inversion process is enabled.

AF Output gain level with inversion

This parameter adjusts the receive (speaker) analog CODEC output audio gain level for the output of the VQS Series devices when the inversion process is enabled.

Note: Although the manual refers to VQS-500, you may have purchased the more economical VQS-420 which does not support hopping inversion or the VQS-400 which has neither hopping inversion nor any ANI capabilities.

Receive Mode Audible alerts

Sixteen audio sequences are available for assignment to Call Alert A and Call Alert B. The first eight are generated by the codec and therefore audio level can also be adjusted between 0 and 255. Sequence 8 through 15 are generated via the “Beep” circuit and audio level cannot be adjusted.

Sequence	Generated by	Characteristic
0	CODEC	Ringing
1	CODEC	“Euro” siren
2	CODEC	Pager
3	CODEC	N/A
4	CODEC	N/A
5	CODEC	N/A
6	CODEC	N/A
7	CODEC	N/A
8	BEEP	Ringing
9	BEEP	“Euro” siren
10	BEEP	Pager
11	BEEP	N/A
12	BEEP	N/A
13	BEEP	N/A
14	BEEP	N/A
15	BEEP	N/A

Critical Warning Tones

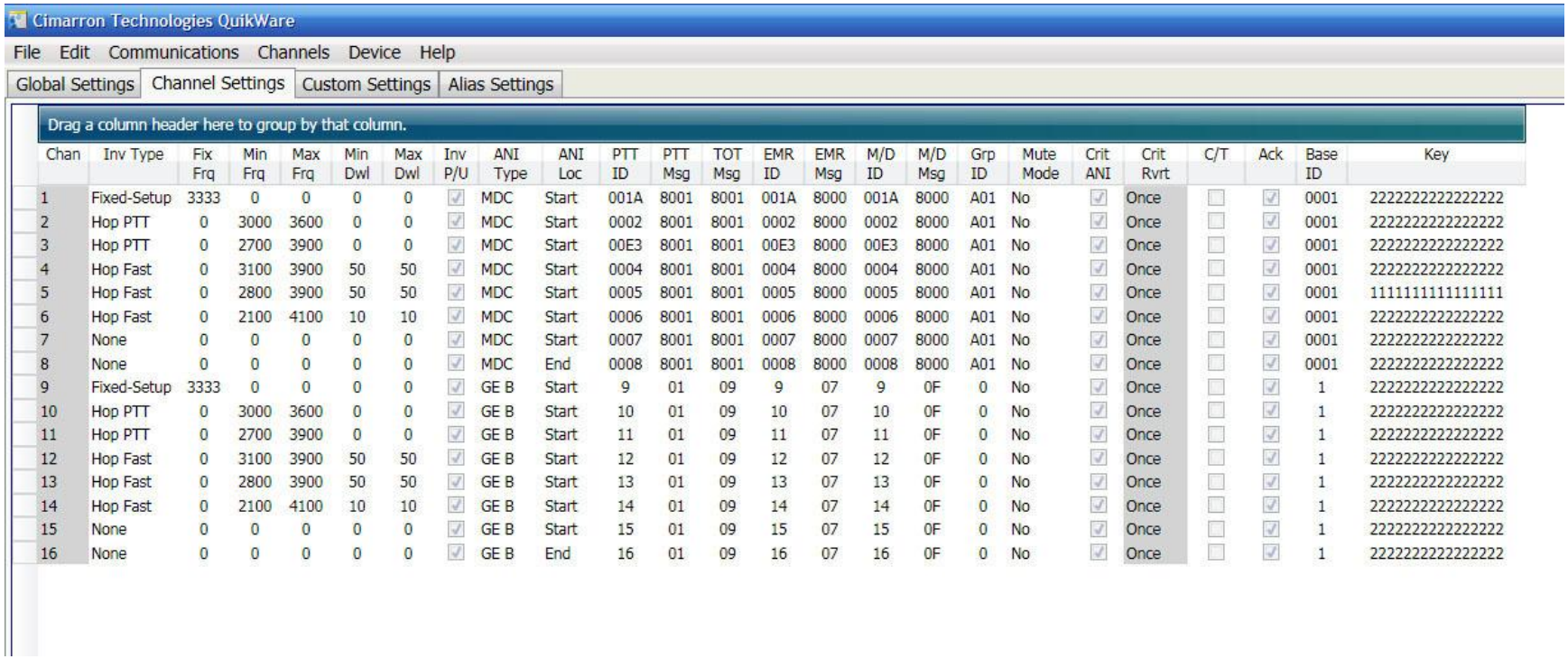
Emergency and Man Down warning tones can be programmed for the desired audio frequency and audio level can also be adjusted between 0 and 255.

PTT Sidetone

The sidetone frequency can be set to the desired frequency. The audio level of sidetone for the QS series devices cannot be adjusted. The actual output level can be padded down by attaching external resistors to the Sidetone (Orange) interface wire.

Channel Settings

The figure in the next page shows the Channel Settings window. A maximum of 254 channels can be designated. These channel numbers correspond to the first 254 programmed channels of the radio. If “Respond to Channel Codes” in the Common menu is set to “No” then only channel one will be accessible. If a Supervisor right clicks on a channel row, they will be prompted to select one of six predefined security levels, or “Manual”. Once a security level is selected, the appropriate parameters are automatically entered. After the selection, the supervisor can then modify any of the entered parameters in order to fine tune. See appendix “A” for further details of pre-defined security levels.



Chan	Inv Type	Fix Frq	Min Frq	Max Frq	Min Dwl	Max Dwl	Inv P/U	ANI Type	ANI Loc	PTT ID	PTT Msg	TOT Msg	EMR ID	EMR Msg	M/D ID	M/D Msg	Grp ID	Mute Mode	Crit ANI	Crit Rvrt	C/T	Ack	Base ID	Key
1	Fixed-Setup	3333	0	0	0	0	☑	MDC	Start	001A	8001	8001	001A	8000	001A	8000	A01	No	☑	Once	☐	☑	0001	2222222222222222
2	Hop PTT	0	3000	3600	0	0	☑	MDC	Start	0002	8001	8001	0002	8000	0002	8000	A01	No	☑	Once	☐	☑	0001	2222222222222222
3	Hop PTT	0	2700	3900	0	0	☑	MDC	Start	00E3	8001	8001	00E3	8000	00E3	8000	A01	No	☑	Once	☐	☑	0001	2222222222222222
4	Hop Fast	0	3100	3900	50	50	☑	MDC	Start	0004	8001	8001	0004	8000	0004	8000	A01	No	☑	Once	☐	☑	0001	2222222222222222
5	Hop Fast	0	2800	3900	50	50	☑	MDC	Start	0005	8001	8001	0005	8000	0005	8000	A01	No	☑	Once	☐	☑	0001	1111111111111111
6	Hop Fast	0	2100	4100	10	10	☑	MDC	Start	0006	8001	8001	0006	8000	0006	8000	A01	No	☑	Once	☐	☑	0001	2222222222222222
7	None	0	0	0	0	0	☑	MDC	Start	0007	8001	8001	0007	8000	0007	8000	A01	No	☑	Once	☐	☑	0001	2222222222222222
8	None	0	0	0	0	0	☑	MDC	End	0008	8001	8001	0008	8000	0008	8000	A01	No	☑	Once	☐	☑	0001	2222222222222222
9	Fixed-Setup	3333	0	0	0	0	☑	GE B	Start	9	01	09	9	07	9	0F	0	No	☑	Once	☐	☑	1	2222222222222222
10	Hop PTT	0	3000	3600	0	0	☑	GE B	Start	10	01	09	10	07	10	0F	0	No	☑	Once	☐	☑	1	2222222222222222
11	Hop PTT	0	2700	3900	0	0	☑	GE B	Start	11	01	09	11	07	11	0F	0	No	☑	Once	☐	☑	1	2222222222222222
12	Hop Fast	0	3100	3900	50	50	☑	GE B	Start	12	01	09	12	07	12	0F	0	No	☑	Once	☐	☑	1	2222222222222222
13	Hop Fast	0	2800	3900	50	50	☑	GE B	Start	13	01	09	13	07	13	0F	0	No	☑	Once	☐	☑	1	2222222222222222
14	Hop Fast	0	2100	4100	10	10	☑	GE B	Start	14	01	09	14	07	14	0F	0	No	☑	Once	☐	☑	1	2222222222222222
15	None	0	0	0	0	0	☑	GE B	Start	15	01	09	15	07	15	0F	0	No	☑	Once	☐	☑	1	2222222222222222
16	None	0	0	0	0	0	☑	GE B	End	16	01	09	16	07	16	0F	0	No	☑	Once	☐	☑	1	2222222222222222

Note: Although the manual refers to VQS-500, you may have purchased the more economical VQS-420 which does not support hopping inversion or the VQS-400 which has neither hopping inversion nor any ANI capabilities.

Inv Type

Inversion type can be None, Fixed, Fixed with Setup, Hop PTT and Hop Fast. None grays out all inversion related cells. Fixed grays out min/max freq cells and Hop grays out the Fix freq cell. If “None” is selected, then inversion will not be available on that channel.

Type	Function
None	Inversion is disabled
Fixed	Standard voice inversion always using the same inversion frequency
Hop PTT	Inversion frequency is changed for each press of the PTT (not available with VQS-400)
Hop Fast	True frequency hopping inversion randomly using frequencies in defined range (min frq and max frq) for a random period using dwells in defined range (min dwl and max dwl) (only available with VQS-500)
Fixed-Setup	Standard voice inversion always using the same inversion frequency but each transmission is prefaced with a setup message describing the transmission as secure. (not available with VQS-400)

Fix Frq

This inversion frequency is used if the inversion type selected is “Fixed”.

Min Frq

This parameter determines the lowest frequency to be used when performing hopping inversion. The field is available if inversion type selected is “Hop PTT” or “HOP Fast”, otherwise it is grayed out. Valid entries are from 2100 to 4100 Hz.

Max Frq

This parameter determines the highest frequency to be used when performing hopping inversion. The field is available if inversion type selected is “Hop PTT” or “HOP Fast”, otherwise it is grayed out. Valid entries are from 2100 to 4100 Hz.

Min Dwl

This parameter determines the smallest amount of time to rest at a particular inversion frequency before moving to the next inversion frequency. The field is available if inversion type selected is “Hop PTT” or “HOP Fast”, otherwise it is grayed out. Valid entries are from 0 to 1000 mS in 10 mS steps.

Max Dwl

This parameter determines the largest amount of time to rest at a particular inversion frequency before moving to the next inversion frequency. The field is available if inversion type selected is “Hop PTT”

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or “HOP Fast”, otherwise it is grayed out. Valid entries are from 0 to 1000 mS in 10 mS steps.

P/U INV

The power up mode parameter determines the condition of voice inversion scrambling when the radio is powered up. If On, the radio will scramble all transmissions unless it is manually changed to plain mode. If the mode is set to plain, the radio will not scramble transmissions unless it is manually changed to scramble mode.

ANI Type

“MDC” or “GE x” where x designates the GE Star® format. GE Star® formats are selectable from A through P. See page 55 for more details.

ANI Loc

None, Start, End, Both *[Default = Start]*
If programmed “Start”, the ID will be transmitted when the user keys the radio. If programmed “End”, the ID will be transmitted when the user unkeys the radio. “Both” will provide ID transmissions at both the Start and the End.

PTT ID – EM ID – M/D ID

Generally, the PTT ID Emergency ID and the Man Down ID are the same; however, they could be programmed different if desired. In MDC-1200®, the valid ID range is from 0001 through DEEE. A radio ID cannot contain the character F nor can it begin with the character E as these are defined as wildcards. However, a radio can encode to a target ID containing these characters. In GE Star®, the actual maximum value depends on the GE Star® format type selected (1 – 16383). A radio cannot be programmed for an ID of 0 (zero) but a radio can encode to a target ID of 0.

PTT MSG

In MDC-1200®, the default PTT message is 8001. In GE Star®, the default is “01”. Although these values are adjustable to permit worldwide system flexibility, they should never be changed except to accommodate documented system variances.

TOT MSG

In MDC-1200®, the default TOT message is 8001. In GE Star®, the default is “09”. Although these values are adjustable to permit worldwide system flexibility, they should never be changed except to accommodate documented system variances.

EM MSG

In MDC-1200®, the default emergency message is 8000. In GE Star®, the default is “07”. Although these values are adjustable to permit worldwide system flexibility, they should never be changed except to accommodate documented system variances.

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M/D MSG

In MDC-1200®, the default man down message is 8000. In GE Star®, the default is “0F”. Although these values are adjustable to permit worldwide system flexibility, they should never be changed except to accommodate documented system variances.

Group ID

In GE Star® format, the actual maximum value depends on the GE Star® format type selected (0 – 16383). A GE Star® “ALL CALL” is a selective call to ID 0 (zero) and is not re-definable. A group call can be any valid number but must not be used as a PTT or Emergency ID on any radio in the system. The default is 0 (zero) which effectively means that there is no group call (only the all call). In MDC-1200®, units can be assigned group ID’s that consist of three HEX digits excluding the digit “F”.

Mute Mode

If set to “VSC”, in GE Star®, the radio will remain muted unless a GE Star® Selective Call command is received. A Call Cancel will again mute the receiver. In MDC-1200®, VSC will be enabled. In a system that uses Voice Select Call (VSC), all radios remain muted until a VSC command to their ID is received. Then the radio unmutes until loss of receive carrier. If this feature is enabled, the radio will remain muted unless a VSC command is received. If set to STEALTH, receipt of a selective call or a VSC command targeting an ID other than the devices will cause the receive audio to be muted for the duration of the call. Once the channel busy line signals that the radio is no longer receiving, then the radio will again be able to receive audio. If set to NONE, these special mute features are disabled.

Crit ANI

If enabled, any PTT press during a critical cycle (e.g. emergency or man down) that would generate a PTT ANI will generate the critical message instead.

CRIT RVRT

Not used in the VQS product.

C T

Unkey Courtesy Tone. If programmed “Yes”, a tone will be transmitted when the user unkeys to inform listeners that they may now transmit.

ACK

(Y/N) [Default Yes]
If this feature is enabled, an acknowledgment will be transmitted whenever required.

Base ID

[Default=0001]
Additional security can be realized by defining the ID of the base authorized to make over the air key changes and reprogramming. If this

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parameter is set to 0000, then Base ID will be ignored and the VQS-500 and VQS-420 will react to commands from any base ID.

Encryption Key

A supervisor can enter a key in three different ways:

1. Click on the appropriate Key field, highlight the entry and enter the new 16 character key.

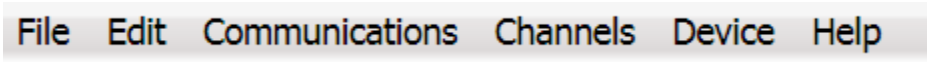
OR

Click on the appropriate Key field, then click on the appearing button . 

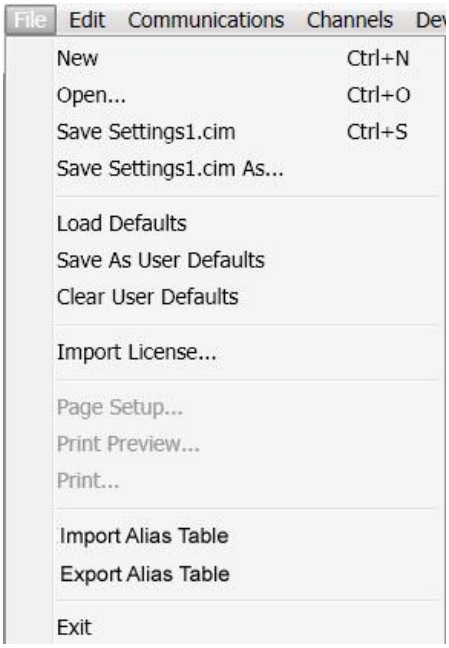
This will open a new box:

2. Enter a “Pass Phrase” and then click on “Generate Key” and the phrase is converted to a key. The same phrase always generates the same key
3. Click on “Random” and then click on “Generate Key”.

The MenuBar



File



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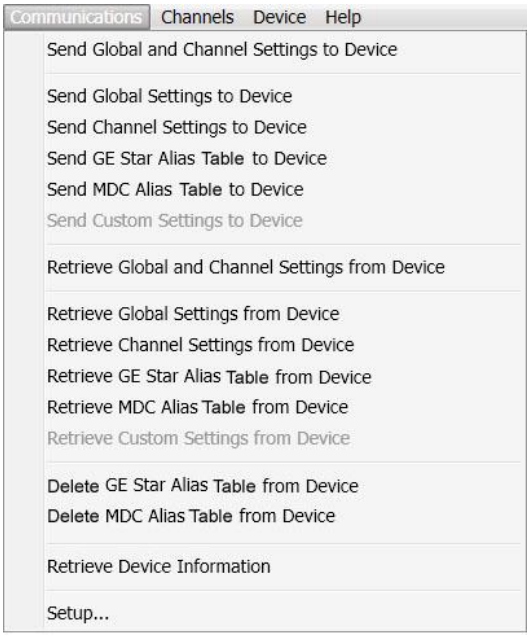
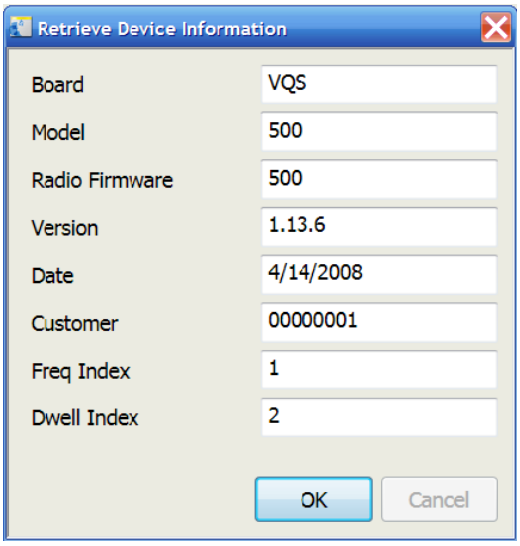
Communications



Selections are available to send and retrieve settings and alias tables from the device. You can select “All”, “Global” or “Channel” settings to be transferred as well as handling individual Alias tables. This feature makes reprogramming faster if changes have been made only in one section of the device. This window also permits deleting of specified alias tables.

You can also select “Retrieve Device Information” which provides you with information relating to the firmware installed in the device.



Channels

Selecting “Channels” will allow you to set the number of rows available in the channel settings tab. When installed in a fully compatible Vertex radio, up to 254 channels can be independently provisioned.

Note: Although the manual refers to VQS-500, you may have purchased the more economical VQS-420 which does not support hopping inversion or the VQS-400 which has neither hopping inversion nor any ANI capabilities.

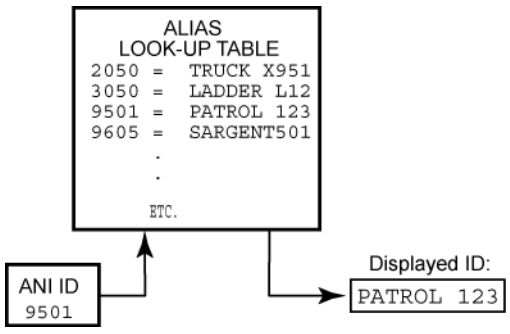
Device

Available selections are VQS-400, VQS-420, VQS-500, QS-4000, QS-4200, QS-5000, and KL-500.

Type	Function
VQS-400	Vertex plug-in capable of simple inversion secure voice
VQS-420	Vertex plug-in with full MDC-1200 or GE-Star signaling, including decode and display of decoded ID, simple inversion and Hop on PTT secure voice
VQS-500	Vertex plug-in with full MDC-1200 or GE-Star signaling, including decode and display of decoded ID and maximum capability hopping secure voice
QS-4000	Universal wire in capable of simple inversion secure voice
QS-4200	Universal wire-in with MDC or GE-Star signaling, simple inversion and Hop on PTT secure voice
QS-5000	Universal wire-in with MDC or GE-Star signaling and maximum capability hopping secure voice
CIM-2200	Universal wire-in Dual Format ANI encoder/decoder
CIM-1200	Universal wire-in Dual Format ANI encoder
KL-500	Vertex plug-in Over-the-air reprogrammer/rekeyer.

Alias

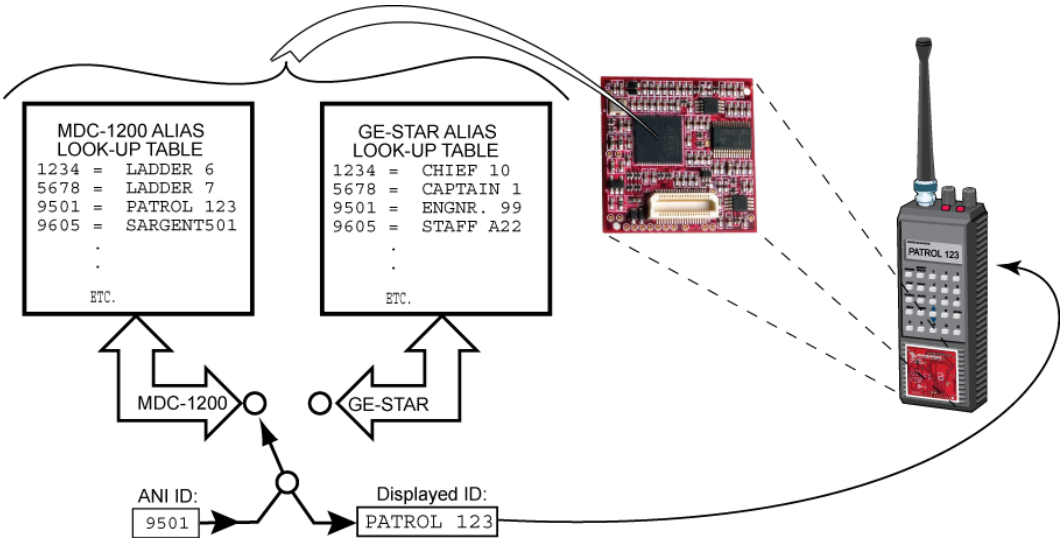
Aliasing is a method where alpha-numeric names can be related to actual unit ID numbers. In this manner, users see (and select) pre-determined names instead of ID numbers. For example, if unit 9501 is PATROL 123, an alias can be set up so that every time unit 9501 ANI is received, the radio displays PATROL 123 instead. Aliasing also affects transmit capabilities so that if a user wants to send a selective call to PATROL 123, they will select PATROL 123 and not ”9501”.



The alias function relates a numeric ID to an alphanumeric “alias”. If the function is enabled, the associated alias will be presented instead of the actual ID. The alias will be used for all encode and decode functions. If an ID is received that does not have an associated alias, then the ID will be used. There are two independent Alias tables in the VQS-500. One for MDC-1200® ID’s, and one for GE Star® ID’s. If the radio is on an MDC-1200® signaling channel, the MDC Alias table will be used. If it is on a GE Star® signaling channel, the GE Star® Alias table will be used.

Note: Although the manual refers to VQS-500, you may have purchased the more economical VQS-420 which does not support hopping inversion or the VQS-400 which has neither hopping inversion nor any ANI capabilities.

Each table has a maximum capacity of 512 entries. Each entry can be up to 10 characters in length.



Creating and Manipulating the Alias Tables

The Alias table is created using a text editor like Notepad. The table must be constructed as described below:

```
NNNNN,AAAAAAAAAA,1,2
```

Where:

N	Up to five digit ID. For GE Star® Format, this number will be between 1 and 16383. In MDC, the entry will be a 4 character ID which can include all HEX characters (e.g. A12E). Leading zeros will be removed by QuikWare.
A	Up to ten character Alias. Can contain only upper case alpha and numbers as well as the characters “/”, “*”, “:” and “-“ (slash, asterisk, colon, dash). lowercase characters will be converted to upper case by QuikWare.
1	Two digit number 00 through 99 for future use. QuikWare currently changes this value to zero zero.
2	One digit number 0 through 9 for future use. QuikWare currently changes this value to zero.

Existing Alias tables used in the Cimarron C Plus are acceptable and will be modified by QuikWare for compatibility in the following manner:

1. Assignment field will be replaced with “00”
2. Beep field will be replaced with “0”
3. The end of file marker “$” will be deleted
4. The 8 character alias field will be extended by adding 2 spaces to the left.

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Many Vertex/Standard radios are capable of displaying 10 characters, but some only support 8. If your alias table is loaded into an 8 character radio, the two left most characters will be lost.

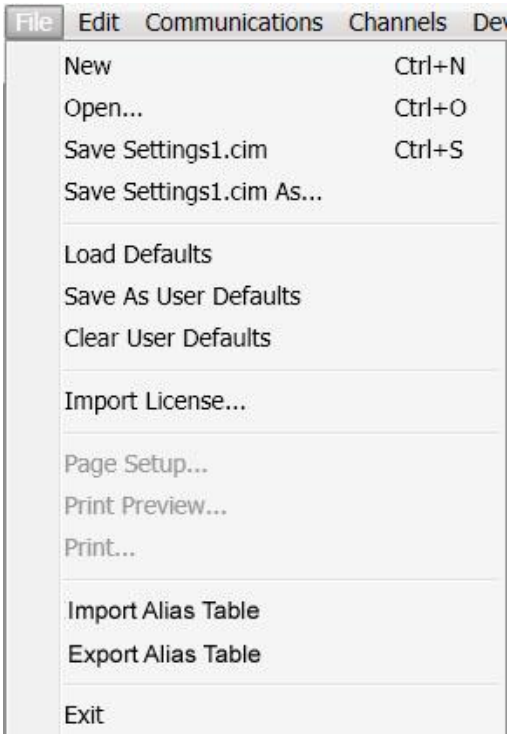
A table can be mixed with obvious GE Star ID's (containing five digits) and MDC ID's (with hex characters A through E) and still loaded into either VQS Alias slot. If the table has been loaded into the GE Star slot, the ID's containing hex characters will be effectively ignored as will five digit GE Star ID's when loaded in the MDC slot. This flexibility permits the user to create only one combined table and load it into both VQS alias slots. The completed alias table should look like this:

```
1234,  LADDER 6,00,0
5678,  LADDER 7,00,0
9501,PATROL 123,00,0
A56E,   CAPTAIN,00,0
9605,SARGENT501,00,0
```

Unlike the Alias table used in the C Plus, entries do not need to be in any order. Once built, the table should be saved as a .txt file for importing into QuikWare and subsequent loading into a VQS device.

Importing an Alias Table

To import an alias table into QuikWare, select "File" in the menu bar and then select "Import Alias Table"



Once imported, you will be able to view it by selecting the "Alias Table" tab in QuikWare. The table will be presented in table format as well as describe where the table was retrieved [DOWNLOADED FROM DEVICE] or [IMPORTED FROM FILE]:

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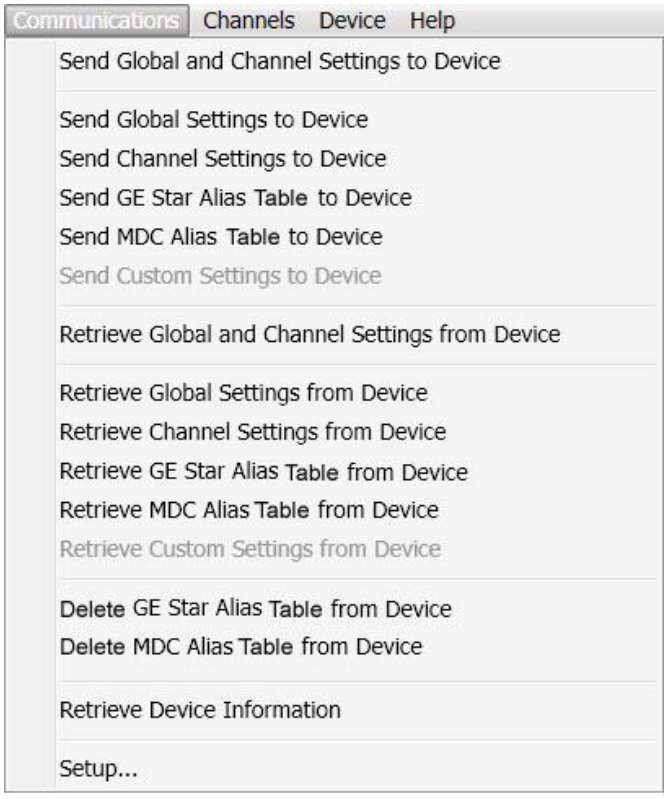
TABLE IMPORTED FROM FILE

ID	ALIAS	OPT1	OPT2
1234	LADDER 6	00	0
5678	LADDER 7	00	0
9501	PATROL 123	00	0
A56E	CAPTAIN	00	0
9605	SARGENT501	00	0

Sending an Alias Table to a VQS

After importing an alias table and viewing it, the table can be loaded into a VQS device. The VQS has two slots that can contain alias tables. These are MDC Alias and GE Star Alias. If you have one consolidated alias table that contains all of your ID's and all ID's are different, then you can load the same alias table into both VQS alias slots. If, however, you have a mixed fleet of both GE Star and MDC where the same ID exists in both formats but have different aliases, then you would need to load two different alias tables. An example of this would be: Channel 1 uses GE Star signaling and the Fire Chief has ID -1-. Channel 2 uses MDC and the Police captain uses ID -1-. You would load two different alias tables where the GE Star entry for id -1- is `1,FIRE CHIEF,00,0` and the MDC entry for id -1- is `1, CAPTAIN,00,0` .

To send an alias table, under communications, select which alias slot you desire to load the table into. The table that is seen in the Alias Tab will be sent to the slot you selected.



Note: Although the manual refers to VQS-500, you may have purchased the more economical VQS-420 which does not support hopping inversion or the VQS-400 which has neither hopping inversion nor any ANI capabilities.

Retrieving an Alias Table from a VQS

To retrieve an alias table, under communications, select which alias table you desire to retrieve. The table will be retrieved and can be viewed using the Alias Tab of QuikWare. After retrieval, the table can be loaded into another VQS or it can be saved using the Export Alias Table function under “File” in the menu bar.

Deleting an Alias Table from a VQS

To delete an alias table from a device, under communications, select which alias table you desire to delete from the device.

Radio Programming Software

The VQS Series board must be installed into the radio and radio power cycled before attempting to use the associated radio programming software. This is so that the software detects the presence of the VQS-500 and makes available additional options that are specific to the VQS-500.

Note: Although the manual refers to VQS-500, you may have purchased the more economical VQS-420 which does not support hopping inversion or the VQS-400 which has neither hopping inversion nor any ANI capabilities.

CHAPTER 4
Operation

VQS-500 Basic Operation

The VQS-500 combines ANI encoder/decoder signaling with the Cimarron Technologies QuikSync voice inversion scrambling function in Vertex communications radios. The board is capable of sending PTT ANI and Emergency ANI in GE Star® or MDC-1200® signaling format. It is capable of reception of Selective Calls, Group calls and All calls and will provide audible alerts when called. It responds to radio check commands (interrogates), and to over the air open microphone monitor commands and radio disable/enable commands. In Vertex/Standard radios with displays, it also receives, decodes and displays ANI messages from other units and provides an audible alert upon receipt of emergency messages. If the host Vertex/Standard radio is equipped with a keypad, it can be used to generate, in MDC-1200® signaling format: selective calls (Alert) and radio checks (Interrogate) and is capable of functioning in a Motorola VSC enabled communications system. In GE Star® signaling format, the device can be used to generate interrogates, selective calls and cancels.

VQS-420 Basic Operation

The VQS-420 has all of the features of the VQS-500 but the secure voice function is limited to single frequency simple inversion and Hop on PTT scrambling. You still have all of the ANI capabilities on a per-channel basis as well as being able to select different inversion frequencies for each channel.

VQS-400 Basic Operation

The VQS-400 is not capable of any ANI functions and the secure voice function is limited to single frequency simple inversion scrambling. Because there is no ANI capability, the device cannot be reprogrammed with OTAR functions. Inversion frequencies can be assigned on a per-channel basis.

The host radio can be programmed on a per-channel basis to activate the inversion scrambling process. Additionally, a button can be programmed to turn the process off or on or the administrative function can be used to enable/disable inversion scrambling. The VQS-500 will accept the per channel radio information, but it also can be programmed to power up in the cipher mode or the plain mode. This means that, during radio programming, you can determine which channels will have secure voice available, and during VQS device programming, you can determine if, when on the programmed channels, the board defaults to being on or off. The VQS series devices will not operate in inversion scrambling mode on a channel that is not programmed for inversion scrambling. It may, however, be programmed to require manual activation on a channel programmed for inversion scrambling.

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Viewing the Programmed ID

To review the programmed ID on the channel selected, press the # (pound) key. The ID will be displayed for 5 seconds and then the display will return to the channel information presentation.

PTT ANI Operation

On specified radio channels, with the press of the PTT button, the VQS-500 and VQS-420 disables the radio microphone and then transmits the ANI ID and, if scrambling is also enabled a brief setup message. While the radio is transmitting the data, a tone sounds in the local speaker to advise the user to hold off talking. This prevents "syllable clipping". If the VQS device is in Cipher Mode and PTT Sidetone is enabled, the beep will sound like "boo-beep" to advise the user that his transmission will be scrambled. If the board is in Clear Mode, the beep will sound like "Bee-boop" to remind the user that his voice is being transmitted in the clear.

After the data is transmitted, the PTT sidetone stops and the microphone is activated. The digital ANI burst can be programmed to occur when the PTT is first pressed, or when the PTT is released, or at both times. If the burst is programmed for transmission when the PTT is released or the radio is on a non signaling channel, a short "go ahead" beep will be heard and there will be no sidetone with data transmission. Regardless of ANI location (beginning or end), the encryption setup message occurs at the beginning of transmission. When the PTT is released and transmission is over, a courtesy beep is transmitted to inform the listener that they can now transmit.

The PTT sidetone and courtesy beep can be individually deactivated in personality programming.

To reduce the amount of data transmissions, data can be programmed to not occur during continuing conversations. A value can be selected for the time since the last PTT press. If the selected time is not exceeded in subsequent key-ups, data is not sent. Programmable times are 0, 10s, 20s, 40s, 60s, and 120s. *[Default = 0].* If the time selected is 0 (zero), ANI will be sent with every PTT press.

Stealth Call

There are occasions when it is necessary to have a private conversation between two individuals or with a select group of users while not

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permitting others to listen in. The Stealth call feature permits these private conversations.

In an MDC-1200® VSC system, all conversations are directed to specific users. But in a standard communications system this function is not available. With a VQS-500 or 420 that is not VSC activated (see page 41 for VSC system information) press the <FCN> (A) button until STEALTH appears in the display then press the <ID> (B) button to select the target radio. If an alias table is present, the radio enters the alias mode of ID selection. If there is no alias table, any valid ID can be entered. If you desire to enter an ID instead of the alias, press and hold the <ID> (B) button for longer than 2 seconds. Refer to page 47 for more information. If an error is made in the ID entry, continue to fill out the four character ID and then press <CLR> (C) and reenter the ID. After the ID is entered, press the PTT and talk. Stealth data will be transmitted to inhibit the receive of all radios except the target radio and private communications may proceed. This stealth mode remains in effect to permit continued conversations until the <CLR> (C) button is pressed. While in stealth mode, the display will alternately show the target ID (or Alias) and —STEALTH—. ID's that contain E or F can be entered by pressing * for E and # for F.

When the radio receives a stealth command with a matching ID, the radio responds by emitting a series of tones. All non-targeted radios will respond by inhibiting the receive function for that transmission. The display will show alternating between the calling ID (or Alias) and —STEALTH—. The targeted user may press the PTT and talk without any special button presses. Appropriate stealth data will be transmitted to open the target radio and communications may proceed. This stealth mode remains in effect to permit continued conversations until the <CLR> button is pressed. Once radios are in the stealth mode described above, continued conversations are not prefaced with the receive alert series tones. Receipt of a stealth call is not acknowledged.

Emergency Message

An Emergency message is transmitted whenever the designated emergency button is held down for greater than the time programmed in the personality of the radio.

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The emergency message ID can be programmed to be different than the radio PTT ANI. If the ID's are different and an emergency message is sent, the VQS-500 or VQS-420 will expect an acknowledgment to the emergency ID not the PTT ID.

The emergency message transmission will be repeated a programmed number of times with a programmed period between transmissions. The repeats will be transmitted regardless of radio status. Available times are as follows:

Number of repeat emergency transmissions. (1, 5, 10, 15, 20, forever) *[Default = 5].* Time between emergency repeats. (5s, 10, 20, 30s) *[Default=10s].*

If desired, a warning tone can be sounded in the local speaker to advise the user that an emergency message has been sent.

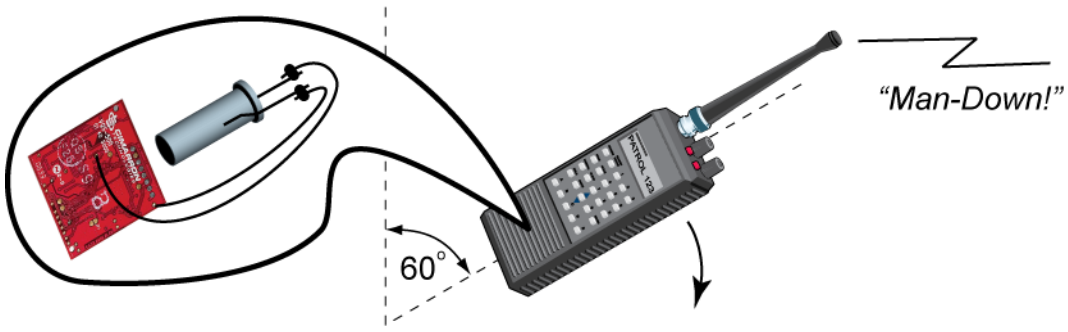
In conjunction with a properly configured radio personality, the radio will change channels prior to sending the emergency message.

The emergency cycle is terminated at the conclusion of the repeats; upon receipt of an acknowledgment or by pressing <FCN> (A) <D>. Cycling power also will terminate the cycle.

If the number of repeat transmissions is set to 1 (one), the transmission will be considered non-critical. The radio display will present "Msg Sent" instead of "Emrgency". The message type can be changed to a unique value.

Man Down Setup

The VQS-500 board contains wire feed-throughs for attaching wires to permit the connection of a man down sensing switch. The man down input terminals are feed-throughs J2 and J3 where J2 is ground and J3 is the high side. J3 must not be attached to any point that exceeds 3.6 VDC or microprocessor damage will result. It should only be attached to the tilt switch. The VQS-400 does not have the man down feature.



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The Man-Down message transmission is generally initiated by closure of a tilt switch located within a hand-held radio when the radio is continuously tipped greater than 60 degrees from vertical. There are two programmable timers associated with the man down feature.

Man Down Warning Delay

The man down warning delay is programmable 0 to 255 seconds. Once the board senses a man down situation, this timer begins to run. If the radio is not up righted within this period of time, and “Warning Tone” is enabled, a warning tone lasting 1 second is sounded. If the radio is up righted, the warning timer resets.

Man Down Activation Delay

If the warning delay timer succeeds to complete its countdown and the warning tone is sounded, the activation delay timer begins to run. The activation delay timer is programmable 0 to 255 seconds. If the radio is not up righted within this period of time, the radio will key up and send a message to the base. If “Warning Tone” is enabled, the radio speaker will sound an alert tone for each transmitted data message.

In GE Star® the man down message ID can be programmed to be different than the radio PTT ANI. If the ID’s are different and a man down message is sent, the VQS-500 or VQS-420 will expect an acknowledgment to the man down ID not the PTT ID.

In GE Star®, this message can be unique and distinguishable from a general emergency message. In MDC-1200®, an emergency message will be sent.

The man down message transmission will be repeated a programmed number of times with a programmed period between transmissions. The repeats will be transmitted regardless of radio status. Available times are as follows:

Number of repeat man down transmissions. (1, 5, 10, 15, 20, forever) *[Default = 5].* Time between man down repeats. (5s, 10, 20, 30s) *[Default=10s].*

In conjunction with a properly configured radio personality, the radio will change channels prior to sending the man down message.

Due to the nature of the Man Down critical message, it takes precedence over an Emergency message. This means that if a radio is in the emergency cycle when a Man Down occurs, the emergency is terminated and replaced with the Man Down cycle.

The Man Down cycle is terminated at the conclusion of the repeats; upon receipt of an acknowledgment or by pressing <FCN> (A) <D>. Cycling power also will terminate the cycle.

If the number of repeat transmissions is set to 1 (one), the transmission will be considered non-critical. The radio display will present “Msg Sent”

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instead of “Man-Down”. The message type can be changed to a unique value.

Emergency and Man Down Open Microphone Monitor

If this feature is enabled, when an emergency or Man Down is activated, the radio will key up and transmit the message and then unkey for the designated RX time. It will then key up again and transmit ambient sound for the programmed TX time. It will then unkey and remain unkeyed for the RX time and then repeat the process. It will alternate between TX and RX throughout the cycle. The length of the cycle is determined by the settings of “Number of repeat emergency (or man down) transmissions” and “Time between emergency (or man down) repeats”. If the TX time is defined as zero, there will be no open microphone monitor. If RX time is defined as zero, then the TX time will occur only once.

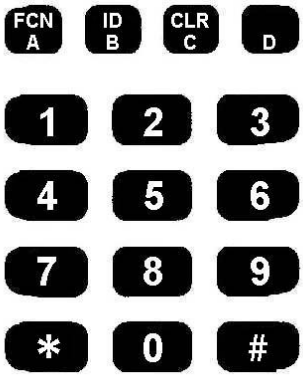
Time-Out-Timer and Stuck-Microphone

The Time-Out-Timer feature terminates a transmission that is longer than the programmed time. Available times are Off, 30s, 60s, 90s, and 120s. *[Default = Off].* The radio will automatically unkey and a low frequency (500 Hz) tone will be heard in the local speaker for four seconds or until the radio is unkeyed. The value of the time-out-timer is programmable in the radio personality programming.

To permit identification of the offending radio, prior to un-keying the transmitter, the VQS-500 or VQS-420 will send the radio ID.

MDC-1200® Operations

Radio Check



To send a radio check, press the <FCN> (A) button until “CHECK” appears in the display then press the <ID> (B) button to select the target radio. If an alias table is present, the radio enters the alias mode of ID selection. If there is no alias table, any valid ID can be entered. If you desire to enter an ID instead of the alias, press and hold the <ID> (B) button for longer than 2 seconds. Refer to page 47 for more information. If an error is made in the ID entry, continue to fill out the four character ID and then press <CLR> (C) and reenter the ID. After the ID is entered, momentarily press the radio PTT to send the message. Data is sent and then the radio unkeys. If an acknowledgment is received from the target radio, the display changes to —ACK—. If no acknowledgment is received in five seconds, the display changes to alternating between the target ID (or Alias) and —NAC— for five seconds. If the target ID that was entered contains “wildcards” signifying that it is a group or all-call, the acknowledge bit in the signaling packet will be cleared and no ACK will be expected. ID’s that contain E or F can be entered by pressing * for E and # for F.

If the radio receives a radio check command with a matching ID, the radio shows no indication of being checked except that the TX led may illuminate. The radio will send the appropriate acknowledgment to the requesting radio.

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Call Alert

The VQS-500 and VQS-420 are capable of both “Long call alert” and “Short call alert”. The personality programming of the Cimarron board permits the selection of which call alert will be used for transmit. In receive, the VQS-500 or VQS-420 will react to either type, but a received short call alert will not have sender ID information.

To Send a call alert, press the <FCN> (A) button until “ALERT” appears in the display then press the <ID> (B) button to select the target radio. If an alias table is present, the radio enters the alias mode of ID selection. If there is no alias table, any valid ID can be entered. If you desire to enter an ID instead of the alias, press and hold the <ID> (B) button for longer than 2 seconds. Refer to page 47 for more information. If an error is made in the ID entry, continue to fill out the four character ID and then press <CLR> (C) and reenter the ID. After the ID is entered, momentarily press the radio PTT to send the message. Data is sent and then the radio unkeys. If an acknowledgment is received from the target radio, the display changes to —ACK—. If no acknowledgment is received in five seconds, the display changes to alternating between the target ID (or Alias) and —NAC—for five seconds. If the target ID that was entered contains “wildcards” signifying that it is a group or all-call, the acknowledge bit in the signaling packet will be cleared and no ACK will be expected. ID’s that contain E or F can be entered by pressing * for E and # for F.

If the radio receives a call alert command with a matching ID, the radio responds by emitting a series of tones. If the received alert was a “long call alert”, the display will alternate between the sending ID (or Alias) and —CALL—. If the received alert was a “short call alert”, the display will only show —CALL—. The call alert tone is repeated every 10 seconds. Pressing the <CLR> button or keying the radio silences the alert tones and reverts the display to channel information. The radio will send the appropriate acknowledgment to the requesting radio.

Voice Select Call (VSC)

This selection only appears if VSC has been enabled in VQS programming. If VSC has not been enabled, then “STEALTH” function appears in the place of VSC. See page 36 for further information.

In a system that uses Voice select call, all radios remain muted until their ID is received. Then the radio unmutes until loss of receive carrier.

To converse with another user in a voice select call system, press the <FCN> (A) button until VSC appears in the display then press the <ID> (B) button to select the target radio. If an alias table is present, the radio enters the alias mode of ID selection. If there is no alias table, any valid ID can be entered. If you desire to enter an ID instead of the alias, press and hold the <ID> (B) button for longer than 2 seconds. Refer to page 47 for more information. If an error is made in the ID entry, continue to fill out the four character ID and then press <CLR> (C) and reenter the ID. After the ID is entered, press the PTT and talk. VSC data will be transmitted to open the target radio and communications may proceed. This VSC mode remains in effect to permit continued conversations until the <CLR> (C) button is pressed. While in VSC mode, the display will

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show alternating between the target ID (or Alias) and —VSC—. ID's that contain E or F can be entered by pressing * for E and # for F.

When the radio receives a Voice select call command with a matching ID, the radio responds by emitting a series tones and allows the receive audio to pass to the speaker. The display will show alternating between the calling ID (or Alias) and —VSC—. The speaker remains unmuted until loss of carrier. The user may press the PTT and talk without any special button presses. VSC data will be transmitted to open the target radio and communications may proceed. This VSC mode remains in effect to permit continued conversations until the <CLR> (C) button is pressed. Once radios are in the VSC mode described above, continued conversations are not prefaced with the receive alert series tones. Receipt of a Voice Select Call is not acknowledged.

If an emergency message is received during VSC operations, all VSC connections will be cancelled.

Open Microphone Monitor

Open Microphone Monitor is a receive only function. If the radio receives an open mic monitor command, the radio will key up, send an acknowledgment and then activate the microphone to transmit ambient sound for a period of 15 seconds. After which, the radio unkeys.

Radio Disable/Enable

Radio disable and enable are receive only functions. Only base dispatch systems with appropriate equipment are capable of transmitting these commands.

Upon receipt of a Radio Disable command, the radio receive functions will remain muted and transmit functions will be disabled. The VQS-500 or VQS-420 continues to monitor receive audio for subsequent commands and acts upon them. Receipt of a Radio enable command returns the radio to normal operation. The radio will send the appropriate acknowledgment to the transmitting station.

Group and Fleet ID's

MDC-1200 signaling permits targeting groups and fleets of field units for actions like Alert, Radio Disable and Radio Enable. Because these messages are targeting multiple units, receiving units will not acknowledge receipt of the message. There are different ways to implement groups and fleets in the ID scheme of the field units.

Wild Card Addressing

This method does not use separately defined group ID's in the sense that the customer needs to organize unit PTT ID's in a system that would recognize membership in specific fleets and/or groups. Here's an example:

A municipality shares a communications system between Fire, Police and Ambulance. When setting up the ID system, it was decided the following numbering scheme would be used. The first digit (MSD) describes the organization, the next digit describes the group within the

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organization and the last two digits (LSD's) describe the specific radio within the group.
ID's in the 1000 range would be Fire
ID's in the 2000 range would be Police
ID's in the 3000 range would be Ambulance
In this manner, If it were necessary to alert the entire fire department, the Alert message would be sent to ID 1FFF. Likewise, all police would be alerted with 2FFF and all ambulances with 3FFF. Now, within the organizations, there can be 15 groups (0 through E). To contact group 0, the Alert would target ID 10FF, group 1 would be 11FF etc. There can be 238 individual units in any one group (00 through EE). If you wanted to alert fireman number 25 in group 6, you would target ID 1625.

Group Addressing

Individual ID's are not allowed to have ID's that begin with "E" (range is from 0001 to DEEE with "F" not allowed in any position). This is because an ID that begins with E signifies that the following number is a "Group ID" instead of a PTT ID. Group ID's are programmed into devices in addition to their individual PTT ID. For the purpose of customer perspective and programming, group ID's contain three digits (as the MSD is always "E"). For field units, the programmed group ID is only used to qualify incoming messages. The group ID is never transmitted by the field unit. The manner in which group ID's are assigned determines whether the groupings are fleet based or non-fleet based.

Fleet Based

In a manner similar to Wild Card addressing, fleet based group addressing requires a prepared scheme when assigning group ID's. Group ID's do not consider individual radios, so that a group ID would be defined as "E" + fleet number + group number. To alert all radio's of fleet 1, the alert message would be sent to E1FF.

Non-Fleet (Group) Based

In Non-Fleet based group addressing, there are no defined fleets. Group ID's are assigned from 001 through EEE. To alert group 12, the alert message would be sent to E012.

GE Star® Operations

Interrogate

To Send an interrogate command, press the <FCN> (A) button until "CHECK" appears in the display then press the <ID> (B) button to select the target radio. If an alias table is present, the radio enters the alias mode of ID selection. If there is no alias table, any valid ID can be entered. If you desire to enter an ID instead of the alias, press and hold the <ID> (B) button for longer than 2 seconds. Refer to page 47 for more information. If an error is made in the ID entry, continue to fill out the five-character ID and then press <CLR> (C) and reenter the ID. After the ID is entered, momentarily press the radio PTT to send the message. Data is sent and then the radio unkeys. If an acknowledgment is received from the target radio, the display changes to —ACK—. If no acknowledgment is received in five seconds, the display changes to

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alternating between the target ID (or Alias) and —NAC—for five seconds.

If the radio receives an interrogate command with a matching ID, the radio shows no indication of being checked except that the TX led may illuminate. The radio will send the appropriate acknowledgment to the requesting radio. If the radio receives an interrogate command with an ID that matches the programmed GE Star® group ID (or 00000 for “all-call”), the VQS-500 or VQS-420 will not send an acknowledgment or take any action.

Selective Call

To send a selective call, press the <FCN> (A) button until “CALL” appears in the display then press the <ID> (B) button to select the target radio. If an alias table is present, the radio enters the alias mode of ID selection. If there is no alias table, any valid ID can be entered. If you desire to enter an ID instead of the alias, press and hold the <ID> (B) button for longer than 2 seconds. Refer to page 47 for more information. If an error is made in the ID entry, continue to fill out the five-character ID and then press <CLR> (C) and reenter the ID. After the ID is entered, momentarily press the radio PTT to send the message. Data is sent and then the radio unkeys. If an acknowledgment is received from the target radio, the display changes to —ACK—. If no acknowledgment is received in five seconds, the display changes to alternating between the target ID (or Alias) and —NAC—for five seconds.

If the radio receives a selective call with a matching ID, the radio responds by emitting a series of tones from the speaker and the display will show —CALL—. The call alert tone is repeated every 10 seconds. The radio will send the appropriate acknowledgment to the requesting radio. If the radio receives a selective call command with an ID that matches the programmed GE Star® group ID (or 00000 for “all-call”), the VQS-500 will not send an acknowledgment. Pressing the <CLR> (C) button or pressing the radio PTT button silences the alert tones and reverts the display to channel information.

If GE Star® “Selective call to unmute” has been enabled, the radio receive audio remains muted until receipt of a selective call. It will then remain unmuted until receipt of a Call Cancel.

Call Cancel

To cancel a previously sent GE Star® Selective Call, press the <FCN> (A) button until “CALLCNCL” appears in the display then press the <ID> (B) button to select the target radio. If an alias table is present, the radio enters the alias mode of ID selection. If there is no alias table, any valid ID can be entered. If you desire to enter an ID instead of the alias, press and hold the <ID> (B) button for longer than 2 seconds. Refer to page 47 for more information. If an error is made in the ID entry, continue to fill out the five-character ID and then press <CLR> (C) and reenter the ID. After the ID is entered, momentarily press the radio PTT to send the message. Data is sent and then the radio unkeys. If an acknowledgment is received from the target radio, the display changes to —ACK— . If no acknowledgment is received in five seconds, the display

changes to alternating between the target ID (or Alias) and —NAC—for five seconds.

If the radio receives a selective call cancel with a matching ID, the radio responds by reverting the display (if it still shows —CALL—) and silences the repeating alert tone. The radio will send the appropriate acknowledgment to the requesting radio. If the radio operator had already cleared the display and repeating alert tone, the receiving radio takes no action.

If GE Star® “Selective call to unmute” has been enabled, the radio receive audio will become muted until receipt of a subsequent selective call.

Open Microphone Monitor

Open Microphone Monitor is a receive only function. If the radio receives an open mic monitor command, the radio will key up, send an acknowledgment and then activate the microphone to transmit ambient sound for a period of 15 seconds. After which, the radio unkeys.

Radio Disable/Enable

Radio disable and enable are receive only functions. Only base dispatch systems with appropriate equipment are capable of transmitting these commands.

Upon receipt of a Radio Disable command, the radio receive functions will remain muted and transmit functions will be disabled. The VQS-500 or VQS-420 continues to monitor receive audio for subsequent commands and acts upon them. Receipt of a Radio enable command returns the radio to normal operation. The radio will send the appropriate acknowledgment to the transmitting station.

Group Call and All Call ID’s in a GE Star system

GE Star signaling permits assignment of a group ID to devices that have the capability of decoding and acting upon Selective Call messages. Because these messages are targeting multiple units, receiving units will not acknowledge receipt of the message.

In two-way GE Star capable field units, in addition to assigning a unique PTT ID, there is a group ID. Units of a particular group are all assigned the same group ID. If a number is being used as a group ID, it cannot be used as a unit ID within that communications system.

GE Star reserves the ID “0000” as an “All Call”. All field units receiving a call for unit 0000 will react to the message.

Decode ID Display Operations

The VQS-500 decodes and displays received ANI during idle periods when the radio display is showing channel information. If an alias table entry exists for the received ID, the alpha-numeric alias will be substituted for the numerical ID. The display alternates between the message type and the ID. For received PTT ANI, only the ID is

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displayed. The display shows the ID and type for the entire period the radio is in receive mode from the identified radio. After the transmitting radio unkeys, the display reverts to channel information. The ID will be displayed for a minimum of 5 seconds unless overwritten by another message or the receiver becomes inactive and then active again. The last received information can be recalled by pressing the <ID> (B) button. The display will revert to channel information again after 5 seconds. Decode ID display operations do not occur while the operator is actively entering information via the keypad, or when the unit is in an emergency or man-down cycle. If a message is received while in this mode, the operator may view the last message by exiting the entry routine and then pressing the <ID> (B) button. While waiting for an ACK message, the display will show “SENDING”. In this mode, received ID’s will not be displayed and receipt of an ACK will overwrite the recall information that would be displayed by pressing the <ID> (B) button. ID’s and the message types are handled as follows:

GE Star®

On a GE Star® signaling channel, message types will be displayed as described in the following table. Highlighted message types are not displayed. The display will alternate between the message type and the ID. PTT ANI displays only the ID. Undefined message types are displayed, alternating with the received GE Star® message code.

STAR CODE	Message code	Radio Display	REMARKS
000-0000	00	STATUS 0	Status
001–0000	10	STATUS 1	Status
010-0000	20	STATUS 2	Status
011-0000	30	STATUS 3	Status
100-0000	40	STATUS 4	Status
101-0000	50	STATUS 5	Status
110-0000	60	STATUS 6	Status
111-0000	70	STATUS 7	Status
000-0001	01	(none)	ANI ID and Sel Call / Ack
000-0010	02	INTG ACK	Interrogate / Ack
000-0011	03	REQ TALK	Request to talk
000-0100	04	MSSAGE C	Canned Message
000-0101	05	MSSAGE D	Canned Message
000-0110	06	TAXI BID	Taxi Bid
000-0111	07	EMRGENCY	Emergency
000-1000	08	CNCL ACK	Call Cancel / Ack
000-1001	09	STUCKMIC	Stuck Microphone
000-1010	0A	MNTR ACK	Open Mic Monitor / Ack
000-1011	0B	MSSAGE F	Canned Message
000-1100	0C	MSSAGE G	Canned Message
000-1101	0D	MSSAGE H	Canned Message
000-1110	0E	MSSAGE J	Canned Message
000-1111	0F	MAN DOWN	Man Down
100-1010	4A	DSBL ACK	Radio Disable / Ack
101-1010	5A	ENBL ACK	Radio Enable / Ack
(not listed)	(not listed)	0x HH*	Undefined

* where HH is the received GE Star® message code.

Note: Although the manual refers to VQS-500, you may have purchased the more economical VQS-420 which does not support hopping inversion or the VQS-400 which has neither hopping inversion nor any ANI capabilities.

MDC-1200®

The only ANI displayed are PTT ANI and Emergency ANI (types 0x8000 and 0x8001). PTT ANI displays only the ID.

Aliasing Capabilities

Alias entries consist of a 10 character field for an alpha/numeric alias and the associated signaling ID. When programming the alias table, the user must decide whether to use an 8 or 10 character alias depending on which length is appropriate for the display of the radios in use.

The Cimarron QuikWare programming software is used to create the alias tables and load and retrieve the tables from the radio. If tables are retrieved from the radio, their entries can be edited using QuikWare and then reloaded into the radio. Upon receipt of an ANI data burst, the VQS-500 or VQS-420 searches the appropriate alias table to see if the ID is present. If it is, the alias is displayed on the radio instead of the ID. If there is no entry in the table, the ID is displayed.

For the transmit capabilities, after you press the <FCN> (A) button to select the desired outbound message type, if an alias table exists, a short press of the <ID> (B) button allows you to access the alias table. In this mode, aliases can be selected from the previously loaded alias table. Additional presses of the <ID> (B) button move through the last 10 targeted aliases. After the top ten, the entire alias table is available in alphabetical order. Press the <FCN> (A) button to scroll up through the list and press the <D> button to scroll down through the list. To skip to the bottom of the table, press the <#> key. To skip to the top of the table, press the <0> key. Pressing number keys 1 through 9 allows you to rapidly skip through the table. Press the <*> key to skip to the top of the top ten list. This skipping motion is described below, where the number in the table is the entry number to which you are brought when the associated button is pressed:

	Number of Aliases in Table			
Button Pressed	**50**	**100**	**150**	**200**
1	5	10	15	20
2	10	20	30	40
3	15	30	45	60
4	20	40	60	80
5	25	50	75	100
6	30	60	90	120
7	35	70	105	140
8	40	80	120	160
9	45	90	135	180

Note: Although the manual refers to VQS-500, you may have purchased the more economical VQS-420 which does not support hopping inversion or the VQS-400 which has neither hopping inversion nor any ANI capabilities.

After pressing the skip button(s), the <FCN> (A) button scrolls up from that spot and the <D> scrolls down. At any time, the <*> brings you to the top of the top ten list and the <#> brings you to the bottom of the table.

Press the <CLR> (C) button to exit the alias mode.

When the desired target Alias is displayed in the radio display, pressing the PTT button completes the call to the targeted radio.

If an alias table exists but you desire to enter the actual ID, press and hold the <ID> (B) button for more than 2 seconds to place the radio in ID mode for ID selection.

Canned Messages to Replace Emergency and Man-Down

In GE Star® signaling mode, the message type can be changed to a unique value and emergency activation can be programmed for an available radio button and man down input can be attached to an external switch to send canned messages. To send canned messages, the message repeat counter should be set to 1 and the message will be considered non-critical. The radio display will present “Msg Sent” instead of “Emrgency” or “Man-Down”. The man down input terminals on the board are feed-throughs J2 and J3 where J2 is ground and J3 is the high side. J3 must not be attached to any point that exceeds 3.6 VDC or microprocessor damage will result. It should only be attached to the tilt switch.

Non-critical messages as described above are transmitted on the current radio channel and do not expect an acknowledgment. However, if an acknowledgment is received the radio display will show –ACK– .

Canned Messages

In MDC-1200® signaling mode, pressing the A scrolls the user through the available message types to be transmitted. They are “ALERT”, “VSC”, “CHECK” and “MESSAGE”. In GE Star® signaling mode, the available message types are “CALL”, “CALLCNCL”, “CHECK” and “MESSAGE”.

After selecting “MESSAGE”, you are prompted to enter a number between 1 and 8 that corresponds to the canned message to be sent. Canned messages are predetermined and loaded using the Cimarron QuikWare software. Upon pressing the desired number button (1 through 8), the radio display will present the associated text for the selected message so that, if you were to press “1”, the display would present “At Base” instead of “1”. Note that most Vertex radio displays are limited to 8 characters. The default message table is as follows:

1	At Base
2	Loading
3	Enroute
4	At Scene
5	On Break

Note: Although the manual refers to VQS-500, you may have purchased the more economical VQS-420 which does not support hopping inversion or the VQS-400 which has neither hopping inversion nor any ANI capabilities.

6	Req Help
7	In Svc
8	Out Svc

Once the display is presenting the desired message, press the PTT button to send the selected message.

The message is received, decoded and displayed by all radios properly equipped and C Plus base equipment. The receiving unit's display will alternate between ID (or alias) of sending unit and the programmed canned message. VQS-500's do not acknowledge the receipt of the message. If the "ack" bit is set, a receiving C Plus will acknowledge the message.

If you desire to target a particular ID or group of ID's as recipient(s) of the message, after selecting "MESSAGE" and then entering the number of the message to be sent, press the <ID> (B) button and enter the target ID (or Alias) then press the PTT button to send the message. In this mode, the VQS-500 will actually send a dual-packet (long) MDC burst where the first word contains the destination ID and message or status with the argument being the number of the message/stat. For message, that would be 0127 through 0827. For status, it would be 0126 through 0826. The second word would be 0080 for no ack and 0082 for ack and contain the source ID. Single packet MDC burst definitions are 0147 through 0847 for message and 0146 through 0846 for status. When programming this feature, you will designate which MDC type to send, whether it is a status or a message.

Radio Lock Feature

The VQS series boards have a lock feature, where, if enabled, the radio powers-up in the locked mode. This inhibits the radio from transmitting and receiving. To unlock the radio, the user enters a code via the radio keypad. Successful entry of the code unlocks the radio. The lock feature can be overridden by over-the-air commands from the base unit if necessary.

Mute on Incorrect Crypto Key

The "Mute on Incorrect Key" feature forces the host radio to disable receive functions during receipt of a coded transmission where the receiving key does not match the transmitting key. Plain text transmissions continue to be received as well as transmissions encoded using similar keys.

Crypto Keys

The VQS-500 series receives channel information from the host radio microprocessor. Because of this, crypto keys or inversion frequencies can be assigned on a per-channel basis as well as ANI parameters like format type and ID. Memory permits the channelization for the first 254 radio channels. In radios with full keypads, field updating of individual crypto keys is available. After entering "Key Entry" mode using the "#", "A" buttons, you will be prompted via the radio display to designate which channel key position to store the new key.

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Although QuikSync changes the inversion frequency or even the hop sequences each time the PTT button is pressed, to maintain security, users are encouraged to change the crypto key often.

Crypto key changes can be made in three different manners: 1) over-the-air; 2) via programming cable and computer; 3) in Vertex/Standard radios with full keypad, using the front panel keypad.

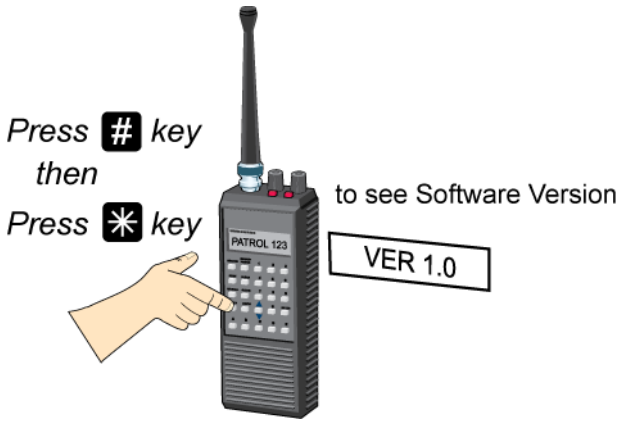
Over-the-air key flush is a feature where a command is sent from the base unit directing the targeted board to flush all of its stored keys and disable the voice inversion scrambling functions. Unlike the radio disable command, the radio continues to function normally, only without inversion scrambling and with all key material zeroized.

VQS-500 Series Administration Mode

Administration mode is entered by pressing the # button. The current ANI ID is shown in the radio display.

Before the 5 second time-out occurs, pressing the following buttons accesses the functions listed:

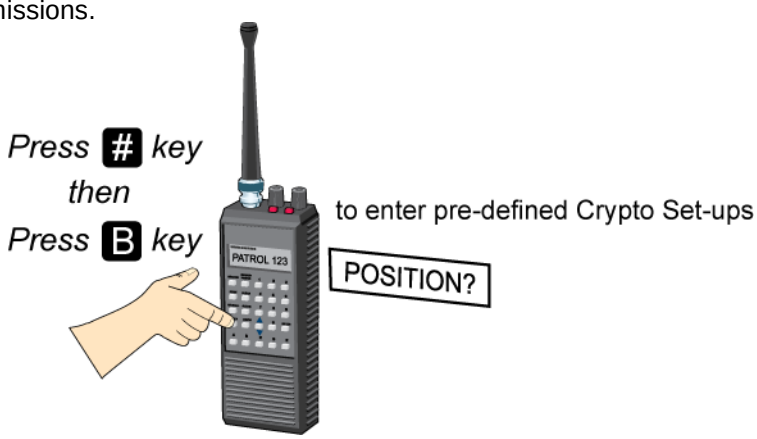
✳ Displays Software Version



Note: Although the manual refers to VQS-500, you may have purchased the more economical VQS-420 which does not support hopping inversion or the VQS-400 which has neither hopping inversion nor any ANI capabilities.

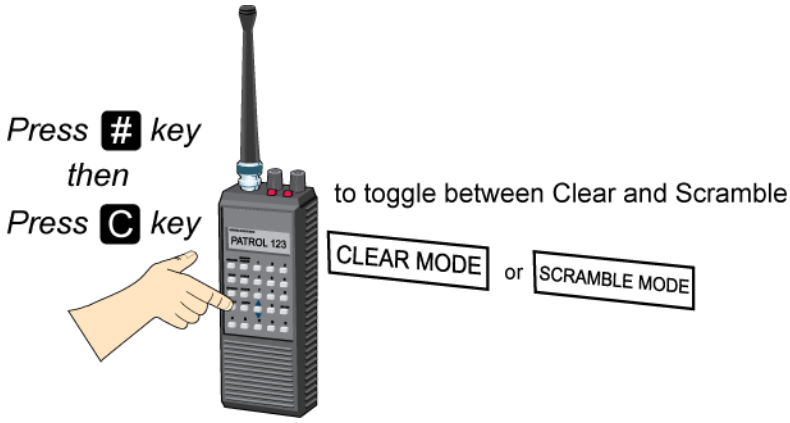
A Accesses the crypto key entry mode. The display will show "CHAN?" Enter three digits for the channel key you wish to change (leading zeros are required). The display will show "KEY?" Enter the 16 character key using * for "E" and # for "F". Successful key replacement will result in the display showing "STORED" and the local speaker emitting "boo-beep". If an error is made in the key entry, continue to fill out the 16 character Key and then press <CLR> (C) and reenter the Key.

B For radios that do not support per-channel functionality, this button allows the selection of one of the pre-defined personalities which corresponds to the channel rows of the QuikSync channel screen. Once you press the "B" button, the display will show "CHAN". Respond by entering the three digit channel position to use with subsequent transmissions.



C Toggles the radio between scramble mode and clear mode. If the VQS-500 series board is not enabled in radio personality software, then you will not be permitted to change to scramble mode. If Speech Enunciation is enabled, the radio speaker will say "clear mode" or "scramble mode" when being changed. If speech enunciation is not enabled, scramble mode will be reported with "boo-beep" and clear mode will be reported with "bee-boop". With the cycling of power, the startup mode is determined by the personality configuration parameter "Power up mode".

Note: Although the manual refers to VQS-500, you may have purchased the more economical VQS-420 which does not support hopping inversion or the VQS-400 which has neither hopping inversion nor any ANI capabilities.

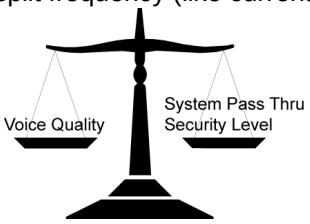


Note: Although the manual refers to VQS-500, you may have purchased the more economical VQS-420 which does not support hopping inversion or the VQS-400 which has neither hopping inversion nor any ANI capabilities.

CHAPTER 5
Technical Information

Inversion Scrambling

The Cimarron inversion scrambling scheme is unique in that it is adaptive to the communications system in which it will be used. When initially setting up the communications system, the VQS-500 series boards must be programmed with configuration information. QuikSync uses dynamic frequency inversion scrambling, but, unlike other schemes, the range of inversion frequencies is specified during set-up as well as minimum and maximum dwell times. In this manner, the actual inversion frequency can be fixed so that all units always use the same split frequency (like current low end boards on the market); or the inversion frequency can change for each press of the PTT, staying at that split frequency only for the period of that transmission; or the board can hop around a pre-defined range of frequencies in a random manner and for random dwell times. The actual decision (and level of security) can be tailored precisely to the limitations of the communications system.



There are six preset levels of security to choose from when configuring the VQS-500 board (The VQS-420 and VQS-400 are only capable of Level 1 security). These preset levels can be additionally adjusted as necessary for precise system integration.

	Description	Pro	Con
Level 1	Single inversion frequency	Best audio quality, Best system pass thru	Not very secure
Level 2	Frequency changes every PTT	Better security, easy system pass thru	Marginal security
Level 3	Wider frequency changes on every PTT	Improved security	Reduced voice quality System pass thru could suffer
Level 4	Frequencies changing randomly with fixed dwell times every PTT	Much better security	Voice quality and system pass thru may suffer
Level 5	Frequencies and dwell time changing randomly every PTT	Very good security	Voice quality lower, may not pass thru systems
Level 6	Frequencies and dwell time changing randomly at wide variations	Excellent security	Lowest voice quality, may not pass thru systems.

Each transmission that does not use simple single frequency inversion is prefaced with a very short MSK “setup” data burst. This digitally encrypted data burst initializes the receiving radios and presents the “game plan” for the inversion scrambling process which is valid only for that transmission. Because the MSK data burst is encrypted, only those QuikSync units with the correct crypto key will successfully decrypt the game plan and be able to extract clear audio from the voice inversion scrambling hash. Additionally, special codes are available for assignment to demanding clients which will make their VQS-500’s totally incompatible with any other VQS-500 even if the crypto key is compromised.

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If the security level selected is not simple single frequency inversion, the receiving VQS-500 will automatically select the correct mode (plain or scrambled) in which to operate. So even though a radio has the VQS-500 installed and activated to transmit scrambled speech, if an unscrambled transmission is received, the board will not attempt to unscramble it, allowing it to pass directly to the receive audio circuits. However, the user will need to turn off his voice inversion scrambling in order to reply to the individual transmitting in plain mode.

The VQS-500 can be placed in a mode which uses predefined inversion frequencies instead of using the digital encryption setup mode. The operation is then similar to legacy voice inversion modules where only one inversion frequency is used or a list of inversion frequencies can be selected from. In this mode, there is no setup burst transmitted at the beginning of scrambled transmissions and all received transmissions are assumed to have been scrambled.

GE Star® Message Types

The GE Star bits designated S2, S3, S4 and M1 through M4 are used to code various messages. The VQS-500 and VQS-420 can be programmed so that different message types are transmitted for PTT ANI, Emergency ANI, Man Down and TOT ANI. The desired star code is selected via the Cimarron QuikWare programming software. The table below describes the Star codes, the value to enter in QuikWare and the corresponding decoder displayed message:

STAR CODE	Message code	Decode display	REMARKS
000-0000	00	STATUS 0	Status
001–0000	10	STATUS 1	Status
010-0000	20	STATUS 2	Status
011-0000	30	STATUS 3	Status
100-0000	40	STATUS 4	Status
101-0000	50	STATUS 5	Status
110-0000	60	STATUS 6	Status
111-0000	70	STATUS 7	Status
000-0001	01	(none)	ANI ID and Sel Call / Ack
000-0010	02	INTG ACK	Interrogate / Ack
000-0011	03	REQ TALK	Request to talk
000-0100	04	MSSAGE C	Canned Message
000-0101	05	MSSAGE D	Canned Message
000-0110	06	TAXI BID	Taxi Bid
000-0111	07	EMRGENCY	Emergency
000-1000	08	CNCL ACK	Call Cancel / Ack
000-1001	09	STUCKMIC	Stuck Microphone
000-1010	0A	MNTR ACK	Open Mic Monitor / Ack
000-1011	0B	MSSAGE F	Canned Message
000-1100	0C	MSSAGE G	Canned Message
000-1101	0D	MSSAGE H	Canned Message
000-1110	0E	MSSAGE J	Canned Message
000-1111	0F	MAN DOWN	Man Down
100-1010	4A	DSBL ACK	Radio Disable / Ack
101-1010	5A	ENBL ACK	Radio Enable / Ack
(not listed)	(not listed)	UNDEFINE	Undefined

Note: Although the manual refers to VQS-500, you may have purchased the more economical VQS-420 which does not support hopping inversion or the VQS-400 which has neither hopping inversion nor any ANI capabilities.

GE Star® Format Types

Radio systems using GE Star® can define the T1, T2 and S1 bits to have different values or various meanings. Industry-wide, there are sixteen accepted variants with Format “B” being the industry defacto standard. The VQS-500 and VQS-420 are programmable for any of the sixteen variants.

Format Definitions

The following table defines the sixteen GE Star® formats.

Format	Description	T1	T2	S1	Comments
A	IDs to 2047 (1st 11 bits).	X	X	X	T1, T2, and S1 ignored
B	IDs to 16383 (14 bit ID)	8192	4096	2048	Expanded-ID STAR #1.
C	IDs to 16383 (14 bit ID)	4096	8192	2048	GE-STAR #3.
D	IDs to 16383 (14 bit ID)	4096	2048	8192	Compatible with GE-STAR #4
E	IDs to 4095 (12 bit ID, T2 = "0")	2048	M0	X	GE-STAR #1. T2 = "0" for Mobile.
F	IDs to 4095 (12 bit ID, T2 = "1")	2048	P1	X	GE-STAR #1. T2 = "1" for Portable.
G	IDs to 8191 (13 bit ID, T2 = "0")	4096	M0	2048	GE-STAR #2. T2 = "0" for Mobile.
H	IDs to 8191 (13 bit ID, T2 = "1")	4096	P1	2048	GE-STAR #2. T2 = "1" for Portable.
I	IDs to 4095 (12 bit ID), Tags="00"	0	0	2048	System "0"
J	IDs to 4095 (12 bit ID), Tags="01"	0	1	2048	System "1".
K	IDs to 4095 (12 bit ID), Tags="10"	1	0	2048	System "2".
L	IDs to 4095 (12 bit ID), Tags="11"	1	1	2048	System "3".
M - P	IDs to 2047 (11 bit ID)			X	Identical to I - L with capability only to program IDs to max of 2047.

Value Assignment	Description
8192	If bit is set, add 8192 to ID
4096	If bit is set, add 4096 to ID
2048	If bit is set, add 2048 to ID
M0	If the bit is not set, originator is a Mobile
P1	If the bit is set, originator is a Portable
X	This bit is ignored

For system types E through H, the board will look for the T2 bit to designate if the received message is from a mobile or portable. The radio display will describe the source. Typically, a radio system that uses these descriptors will use formats E and F or G and H. If the VQS-500 is programmed for format E and it receives a PTT ANI from a mobile radio programmed for format E, the radio display will show the unit ID and an “M” because the originator was a mobile radio. If it receives a PTT ANI from a portable radio programmed for format F, the radio display will show only the unit ID.

If Aliases are used, the right most character in the display will be used to show the descriptor (M or P). If the radio has an 8 character display and

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the programmed alias has 8 characters, the right most character of the alias will be blanked and the descriptor will be shown in its place.
For system types I through P, the board looks for a match in the T1 and T2 bits. If the bits match then the board will react to the received message. If not, the message is ignored. This is for communications systems that have multiple unrelated users so that different users do not see ID's from other users.

MDC-1200® Message Type

To increase flexibility of the VQS-500 and VQS-420 and enhance compatibility with existing communications systems, the format of encoded MDC-1200® messages can be modified. The default message type for a PTT ANI is represented by 0x8001 and the default message type for an Emergency ANI is 0x8000. These parameters should not be changed without a thorough understanding of the signaling system and existing signaling codes.

Creating and using the 64 bit key

The VQS-500 can store a table of 254 per channel crypto keys which, on capable Vertex radios, will be used depending on the radio channel selected. The 64 bit key is comprised of 16 hex characters. The key can be loaded using the programming cable or via the radio keypad (if present). Additionally, the key can be updated over the air.
Any 16 character hex number can be used for the crypto key. For additional security, Cimarron recommends our key generating software. The software permits the following two methods of key generation:

Pass Phrase Entry

The pass phrase entry method prompts the user to enter a word or a phrase. The entry is then converted into the 16 character hex key code. Entering the same phrase at any time results in the generation of the same 64 bit key code.

Random Generation

If random generation method is selected, the software will create a 16 character hex key code.

Over-The-Air Rekeying

Cimarron QuikSync products are capable of being rekeyed over the air using the key loader KL-500. Over the air rekeying can target individual units, or a pre-defined group or all units. Positive feedback is realized when individual units are targeted. This is because the field units will acknowledge successful receipt and rekeying. But if all units need to be rekeyed, this could take a lot of air time. Group or "All" rekeying is very fast (it only requires one transmission of the KL-500) but there is no feedback from field units and therefore, no guarantee that all units have been successfully rekeyed.

Rekeying over the air is digitally encrypted using the existing key. This is important to keep in mind. If the key has already been compromised, over the air rekeying will not protect future transmissions. But if an organization is attempting to break an existing key in use, rekeying

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before they succeed will force them to start their efforts over from the beginning. Over the air rekeying can also be implemented using a “flea-power” transmitter in a morning briefing room. Compromised radios would not be exposed to the new key.

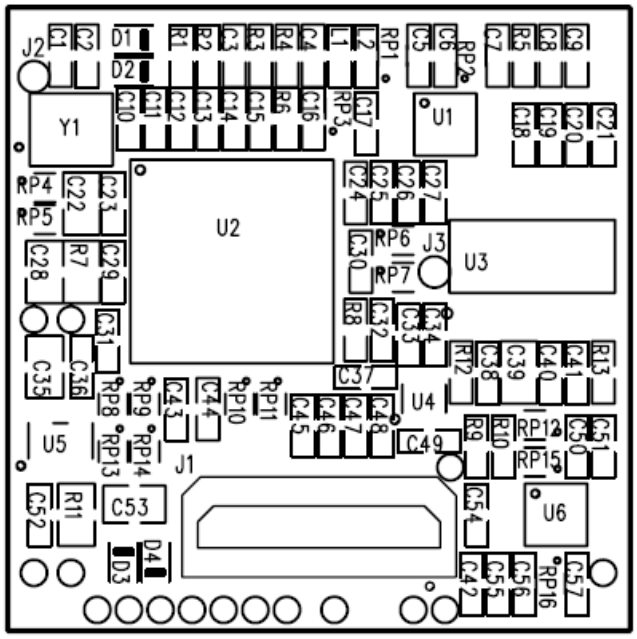
The VQS-400 is not capable of over the air rekeying.

Over-The-Air Reprogramming

In addition to over-the-air rekeying of the crypto key, the VQS-500 can also be completely reprogrammed over the air. This includes all parameters in the flash memory structure. Refer to the Cimarron KL-500 manual for operational specifics.

The VQS-400 is not capable of over the air reprogramming.

Component Location



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CHAPTER 6
Product Support

If you have any questions or comments about Cimarron products, please make use of our technical support hotline at (760) 738-3283.

Cimarron Technologies Corporation
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Escondido, CA 92029
Technical Support Hot-Line (760) 738-3283
service@cimtechcorp.com
www.cimtechcorp.com

WARRANTY

Cimarron Technologies Corporation warrants this product to be free from defects in material and workmanship for a period of three years from date of shipment. If a malfunction occurs due to defective material or workmanship, the product will be repaired or replaced (Cimarron's discretion) without charge if returned to the factory

This warranty does not apply to any failure or damage caused by accident, neglect, unreasonable use, improper installation, or to alterations or modifications to the unit. Nor does the warranty extend to damage incurred by force majeure (natural causes) such as lightning, fire, floods, or other such catastrophes, nor to damage caused by environmental extremes, power surges and/or transients

Cimarron Technologies Corporation makes no other warranty, either expressed or implied, with respect to this product. Cimarron Technologies Corporation specifically disclaims the implied warranties of merchantability and fitness for a particular purpose. Some states or provinces do not allow limitations on how long an implied warranty lasts, so the above limitation or exclusion may not apply to you.

The remedies provided herein are customer's sole and exclusive remedies. In no event shall Cimarron Technologies Corporation be liable for any lost profits, direct, indirect, special, incidental, or consequential damages, whether based on contract, tort, or any other legal theory.

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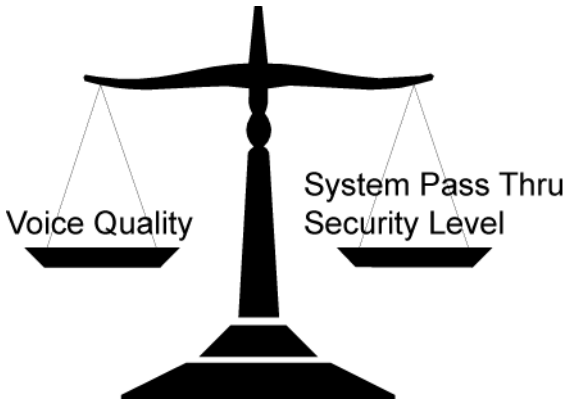
Appendix A
Secure Voice Considerations

The VQS-500 is designed to permit adjustment of its inversion parameters to meet the security requirements of the user while remaining within the constraints of the communications system and the desired audio quality of the communications.

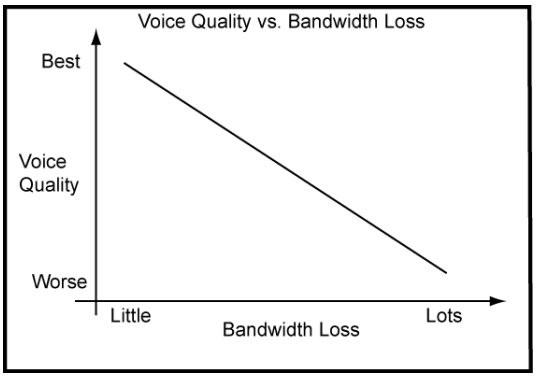


These adjustments allow the implementing facility (radio shop) to get the best audio quality that their communications system and security requirements will allow.

This appendix addresses the interactions between inversion settings, system requirements, security level and voice quality.

Voice Quality

Voice quality is a function of the permitted voice spectrum and the quality of the procedure (and components) that performs the inversion process. The radio transmitted voice spectrum is limited by the actual radio equipment to a band from 300 Hz to 3000 Hz. So normal audio that has not been processed by an inversion scrambler is limited to that spectrum.



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Voice inversion scrambling takes the frequency component and creates a mirror image around an inversion frequency. This process results in spectrum loss. To illustrate this loss, consider the following examples.

Example 1:

Inversion frequency is 2200 Hz and results in 300 becoming 1900 and 3000 becoming (!) -800 Hz. Radio processing then allows only the resultant spectrum of 300 through 1900 Hz to be transmitted. At the recovery, 300 becomes 1900 and 1900 becomes 300 resulting in a recovered spectrum of 300 - 1900. A loss of the 1900 Hz through 3000 Hz audio.

Example 2:

Inversion frequency is 4000 Hz and results in 300 becoming 3700 and 3000 becoming 1000 Hz. Radio processing then allows only the resultant spectrum of 1000 through 3000 Hz to be transmitted. At the recovery, 1000 becomes 3000 and 3000 becomes 1000 resulting in a recovered spectrum of 1000 - 3000. A loss of the 300 through 1000 Hz audio.

After complete processing and radio filtering, low inversion frequencies kill high freq response and makes audio at speaker "bassy" while high inversion frequencies kill low freq response and makes the audio at speaker "tinny".

Now, consider example 3:

Inversion frequency is 3300 Hz results in 300 becoming 3000 and 3000 becoming 300 Hz. Radio processing then allows the entire resultant spectrum of 300 through 3000 Hz to be transmitted. At the recovery, 300 once again becomes 3000 and 3000 becomes 300. There is no spectrum loss at an inversion frequency near or on 3300 Hz.

So, the best audio quality can be obtained by making an inversion scrambler work at around 3300 Hz. The farther the inversion process moves from 3300 Hz, the more the voice quality suffers.

But, a scrambler that inverts at 3300 Hz all of the time only provides minimal security from eavesdroppers while providing the best audio quality.

Security Level

So, there's minimal tactical security to a scrambler that always uses the same frequency for inversion. In many cases, this level of security is sufficient, and it affords the best audio quality. But, resourceful adversaries require resourceful countermeasures.

You could periodically change your inversion frequency, always staying around 3300 Hz and maybe avoiding those inversion frequencies used by the most available and common scramblers.

The more frequently you change your inversion frequency, the higher level of security you achieve. Additionally, the greater the change in your

inversion frequency without any incremental steps, the more difficult it will be for eavesdroppers to continue monitoring your communications.

The actual security level achieved by voice scramblers is inversely proportional to their audio quality. Additionally, existing descramblers and their availability to the general public significantly reduces your chances of maintaining tactical security.

Scramblers that periodically change inversion frequency are called “Hoppers” if they go from one discreet frequency to another without traveling through the “in-between” frequencies. Otherwise, they could be “Rolling” code scramblers that make a lot of incremental stops while going from one frequency to another.

The greater the frequency difference from one stop to another, the higher the level of security. Additionally, the more frequent the change, the higher the security. Now, together, permit random changing of the direction of the frequency shift, random selection of inversion frequency and random period of time before changing, and your tactical security level has been drastically improved.

The VQS-500 allows for programming lower and upper inversion frequency limits as well as minimum and maximum “dwell” times. A dwell time is the time that the scrambler board will use one inversion frequency before changing to the next. All changes are randomly executed as is the subsequent direction of travel.

The VQS-500 is capable of being programmed to use inversion frequencies from 2100 Hz to 4100 Hz and dwell times from 10 mS to 1 Second. You can vary these as required for your tactical security environment. Remember that best audio is achieved at 3300 Hz and slower (or no) dwell times. Best security is achieved with large inversion frequency swings and rapid dwell times. The VQS-500 is also uniquely able to change inversion frequency on a per PTT basis so that each transmission uses a different frequency.

These unique capabilities give the implementing radio shop previously unheard of flexibility. The inversion process can be precisely tailored to match the requirements of the end-user. But there is still one additional consideration before deciding on values to use.

System Considerations

Existing voice security equipment provides a particular fixed level of security. The manufacturer has designed multiple model number scramblers with varying levels of security and voice quality. Typically, a system manager would decide which model number to use by analyzing customer requirements balanced with system capabilities. Then they would implement the model that matched those requirements. The higher level of security, the more the manufacturer charges for the board. If the requirements change, or the communications system is upgraded, they are either stuck with the level of security they already have, or they need to replace all security components with ones that match the new requirements. The VQS-500 has been designed so that the security level is software defined. This means that as requirements change, the

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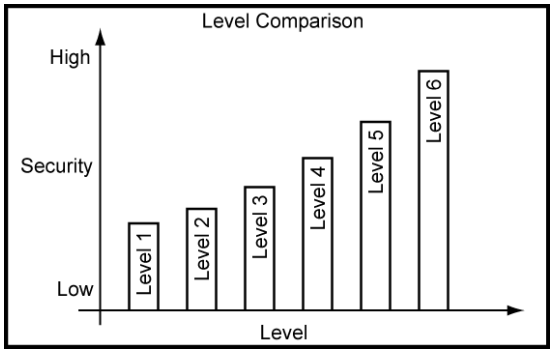
boards can be simply reprogrammed to once again match the requirements. The same board will do simple, non-changing inversion scrambling as well as high speed random true hopping and everything in between.

We have discussed how as voice security goes up, voice quality goes down. But those are not your only considerations when deciding on inversion process parameters. The overall communications system must be capable of transporting your scrambled signals and, in the case of hopping schemes, the data message that synchronizes the process.

Complex communications systems may be made up of a wide mix of microwave links, voters, repeaters, landlines and other equipment. These devices result in "processing" the audio and as such, influence your maximum attainable security level. If the communications system already limits the available frequency spectrum, you will have less spectrum for the inversion process. If you use a too advanced scrambler board (or software defined scheme in the case of the Cimarron board) on a degraded communications system, the resulting voice quality will be unacceptable or the inversion process will not be able to recover the original audio from the scrambled audio. In hopping schemes, if the setup data message is not successfully being delivered through the communications links, then descrambling will not take place.

Making it Simple

The VQS-500 offers software definable voice security. To make initial scheme implementation easier, the VQS-500 allows the selection of pre-programmed levels of inversion scrambling when configuring the board. These preset levels can be additionally adjusted if necessary for precise system integration. The lowest level uses only one inversion frequency which is never changed. The remaining levels progressively increase the inversion frequency range and rapidity of changing the inversion frequency. These preset levels will provide the system manager with a starting point and a development tool for experimentation if desired. Once a level is selected that meets user requirements, the parameters can then be further adjusted to "fine tune" them to attain the security level, voice quality and system limitations desired.



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Level One

Level one is the simplest scrambling method and consists of one non-varying inversion frequency. The inversion frequency selected provides for the widest bandwidth inversion resultant. This provides the most basic level of security. The presence of a setup databurst instructs the VQS-500 to descramble the incoming audio.

Level Two

Level two provides basic security using dynamic inversion scrambling where the inversion frequency is changed for every transmission. The inversion frequency range used is centered around “sweet” frequencies that afford the largest resultant bandwidth and most easily pass through complex communications systems. A different inversion frequency is selected each time the radio PTT is depressed.

Level Three

Level three security uses a wide range of inversion frequencies that is changed for each transmission.

Level Four

This level provides stronger security by varying inversion frequency at a fixed dwell time. This is dynamic inversion scrambling that hops from frequency to frequency. Inversion frequency range is limited. A typical one minute transmission will be scrambled by different inversion frequencies approximately 250 times.

Level Five

Level Five security uses a wide range of inversion frequencies that are randomly selected and used for random periods of time before they are changed. This results in audio that is scrambled with varying frequencies for varying periods. It would not be possible for a listener without the similar equipment and the precise crypto key to synchronize on the scrambled signal. Inversion frequency and dwell time ranges are conservative, affording high security with good audio quality.

Level Six

Level six affords the most secure of the six preset levels. Inversion frequencies between 2100 Hz and 4100 Hz are randomly selected to scramble the transmitted audio. The selected audio is used for a random period of time, changing up to 100 times a second. Even the period of time that the inversion frequency is used is randomly changed. One frequency might be used for 10 milliseconds while the next frequency might be used for 100 milliseconds.

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