First InterComm™ system VCA100 user manual

BAE SYSTEMS

Table of contents

List of illustrations

List of tables

Warnings and precautions

Federal Communications Commission (FCC)

Compliance — This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Proper installation does not guarantee that interference will not occur in a particular situation. If this equipment does cause harmful interference to radio or television reception (which can be determined by turning the equipment off and on), the user is encouraged to correct the interference by one or more of the following measures:

– Reorient or relocate the receiving antenna.
– Increase the separation between the equipment and affected receiver.
– Connect equipment into an outlet on a circuit different from that to which the receiver is connected.
– Consult an experienced radio/TV technician for help.

Radio frequency (RF) exposure compliance — The First InterComm system generates and uses RF energy. Pursuant to FCC rules for the maximum permissible RF exposure, the antenna(s) specified in this manual MUST be installed so as to provide a separation distance of at least 18 inches (45 cm) from all persons. The unit may not be used to transmit for more than 50 percent of the time (average duty cycle over a 30-minute period).

Users must not change the antenna types or their location at the risk of voiding the conditions of their FCC license and/or the conditions to which the product has been certified (consult your installer in these cases). Changes or modifications to the equipment may cause harmful interference unless the modifications are expressly approved in the installation manual. The authority to operate the equipment could be lost if an unauthorized change or modification is made.

Warnings and precautions (continued)

Electromagnetic interference/compatibility

Nearly every electronic device is susceptible to electromagnetic interference (EMI) if inadequately designed, shielded, or otherwise configured for electromagnetic compatibility. It may be necessary to conduct compatibility testing to determine if any electronic equipment used in or around vehicles is sensitive to external RF energy, or if any procedures are needed to eliminate or mitigate the potential for interaction between the First InterComm system and other equipment or devices.

– **Facilities** — To avoid EMI or compatibility conflicts, turn off the First InterComm system near any facility where posted notices so instruct, such as hospitals or healthcare facilities.
– **Vehicles** — To avoid possible interaction between the First InterComm system and vehicle electronic control modules (such as antilock brakes and engine or transmission controls), the First InterComm system should be installed only by a professional installer only.
– **Pacemakers** — To avoid potential interference with pacemaker functions, maintain a minimum separation of 12 inches between First InterComm system components (the VCA100 and associated antennas).

WARNING

General precautions

– **DC power** — Ensure power into the First InterComm system does not exceed 24 Vdc.
– **Explosive environments** — Ensure the First InterComm system is turned off before entering a blasting area or in areas posted **"TURN OFF TWO-WAY RADIO."** Sparks in a potentially explosive atmosphere can cause an explosion or fire resulting in bodily injury or death.

First InterComm system quick-start procedure	
Arrive on scene	At the incident scene, position First InterComm system-equipped vehicles within a maximum of a quarter mile clear line of sight (LOS) of each other at the incident scene.
Power up	Apply power to the First InterComm system with the cab-mounted switch.
Change channel	Switch radio equipment to the tactical channel on portable radio designated for First InterComm system interoperability.
Talk	Communicate using applicable standard operating procedures (SOP).

Welcome to First InterComm™ system

The First InterComm system allows first responders from different agencies at an emergency incident to readily communicate with one another, even though their radios operate on different frequencies (i.e., VHF, UHF or 800 MHz systems, both digital and analog). The First InterComm system can accommodate many newer communication technologies such as radio systems operating in the 700-MHz band, and P25-compliant equipment.

Only one vehicle from each on-scene department is required to have a First InterComm system installed to enable linking of dissimilar radio networks. There is no requirement for special equipment, stand-alone towers, or other costly infrastructure.

Talk Group software, an optional capability included with the First InterComm system, enables the incident commander, using a standard laptop computer with wired or wireless networking capability, to monitor system status and control communications. Talk Group significantly enhances the First InterComm system, but is **not required** for voice interoperability; the latter is provided by the VCA100 and associated antennas alone.

The U.S. Department of Homeland Security has designated the First InterComm system as a Qualified Anti-Terrorism Technology under the SAFETY Act. The First InterComm system supports the National Incident Management System (NIMS) and is included in the Memorial Institute for the Prevention of Terrorism "Responders Knowledge Base" and the InterAgency Board's Standard Equipment List and Approved Equipment List.

The First InterComm system enables the responding departments to operate within their SOP. It provides day-to-day voice interoperability at an incident scene and provides improved coordination of on-site first-responder personnel.

This user manual contains a description of the First InterComm system and activation information to maximize its effectiveness.

First InterComm system overview

The First InterComm system consists of a Vehicle Communications Assembly (VCA100), a land mobile radio antenna, and a wireless antenna. Using standard 12-Vdc vehicle power the systems provides these features:

– No setup time required; voice interoperability is automatically available within one minute of arriving on scene.
– Responders use their existing radios; multiple radios are not required.
– Responders require minimal training.
– Scalable from routine to large incidents.

– Compliant with commercial standards for radio communications and mesh networks.
– Provides connectivity with civil and military communications systems.
– Compatible with digital technology, supporting radio system upgrades.

> **NOTE**
> – Talk Group software provides significant capability to the First InterComm system but is **not** required for voice interoperability.

The First InterComm system in action

Turning on two or more VCA100 units establishes an ad hoc wireless mesh incident area network (IAN). In Figure 1, the fire department, whose radios operate at 154.57 MHz, is talking to the police department, whose radios operate at 452.95 MHz. When a portable or mobile radio is keyed up, its voice transmission is translated into digital packets that are placed onto the IAN. Every VCA100 unit on the First InterComm network receives these digital packets, which are translated back into voice transmissions compatible with each handheld radio associated with the receiving VCA100.
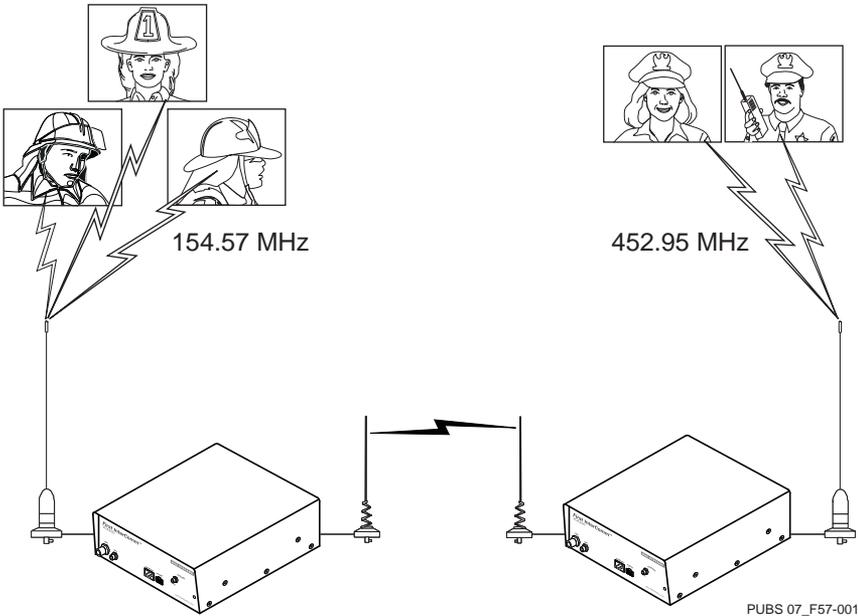

154.57 MHz   452.95 MHz

PUBS 07_F57-001

Figure 1. The First InterComm system in action

As first responders arrive on scene and activate their VCA100s, the units **automatically** connect to one another. As the first responders are joined by other agencies (e.g., public health, disaster recovery, federal agencies, National Guard), their VCA100 units connect to the IAN, thus establishing cross-jurisdictional communication. This temporary IAN (Figure 2) exists as long as VCA100-equipped vehicles are present and can expand or contract as first responders enter or leave the area.
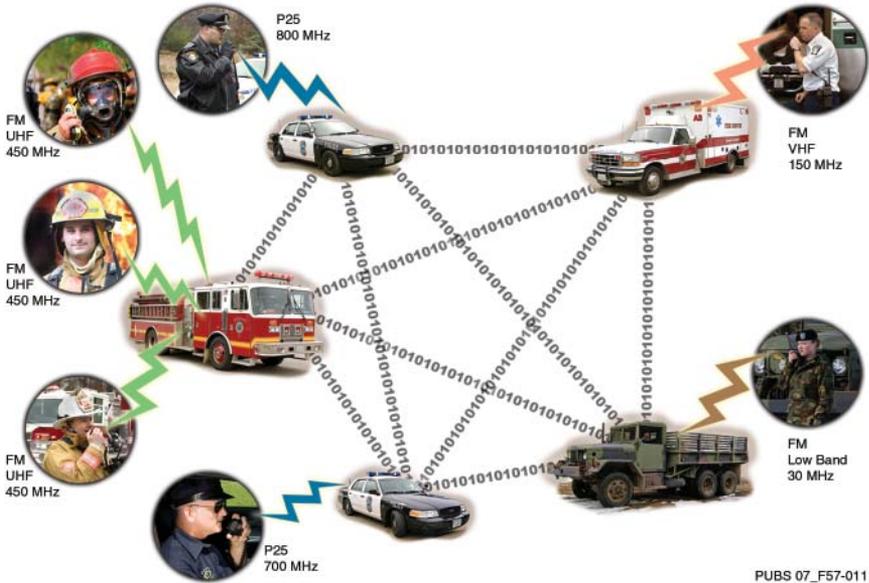

Figure 2. The incident area network expands or contracts as needed

As numerous first responders are online, overall coordination is essential. The incident commander can assume control of the IAN via any laptop computer operating with the Windows XP® [1] operating system with Service Pack 2 and equipped with wired or wireless networking capability and First InterComm Talk Group software (Figure 3). The Talk Group allows the incident commander to:

– Establish sectors by frequency in accordance with NIMS.
– Isolate any agency equipped with First InterComm units (e.g., fire, EMS, emergency management, public works, law enforcement) into the appropriate talk groups, thereby:
  – Supporting a chain of command.
  – Improving communications efficiency.
  – Increasing emergency responder safety.

Refer to *First InterComm system Talk Group software user manual* (BAE Systems document No. A29800) for complete details on Talk Group software.
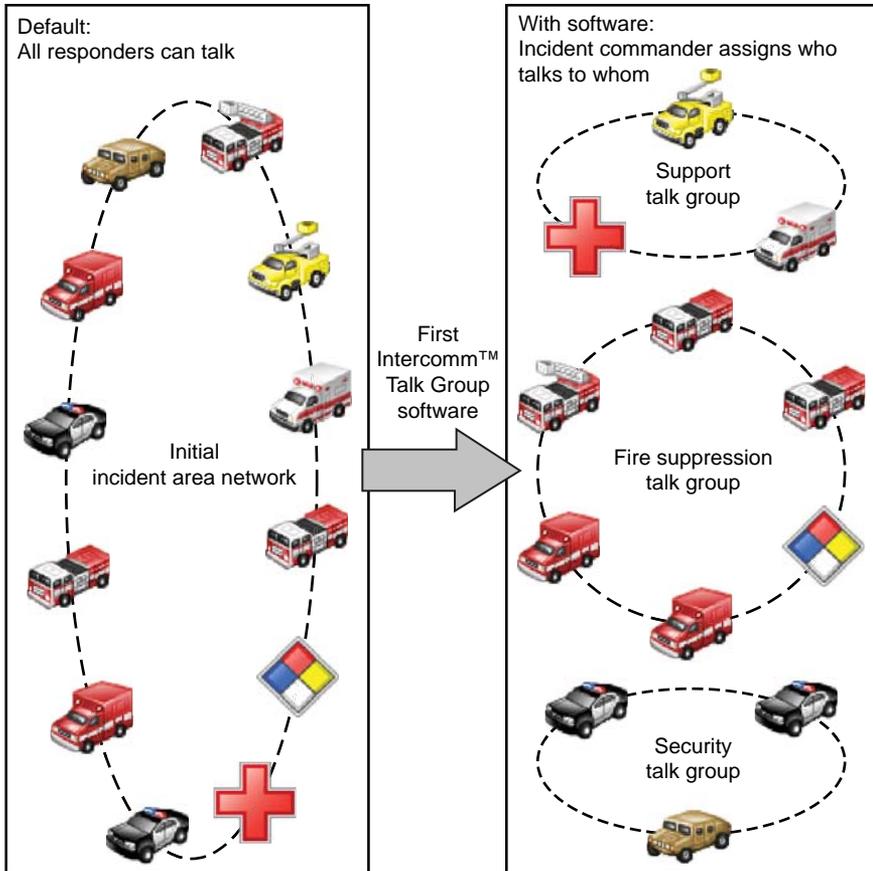
PUBS 07_F57-012

Figure 3. The First InterComm system enhanced by the optional Talk Group software

[1]Windows XP is a registered trademark of Microsoft Corporation

Operating the First InterComm system

Start-up

1. Apply power to the VCA100 with the cab-mounted switch.
2. Allow approximately one minute for the unit to initialize and connect to any other VCA100s in the area.
3. Switch radio equipment to the tactical channel on portable radio designated for First InterComm system interoperability.
4. Communicate using the applicable SOP.

> **RECOMMENDATION**
> Do not turn on the VCA100 unit until parked at the scene.

Vehicle location

Wireless signals weaken as they travel away from the transmitter. The First InterComm system operates up to a quarter mile between VCA100s, assuming a clear, unobstructed LOS. Buildings, hills, vegetation and other obstructions will reduce range as shown in Figure 4. Interference from metallic objects such as large trash receptacles and vehicles can degrade performance. Whenever possible, position VCA100-equipped vehicles to minimize such factors.

PUBS 07 F57-006

Heavy signal obstruction

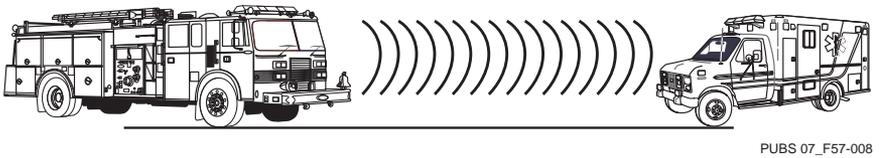PUBS 07_F57-007

Poorer reception

PUBS 07_F57-008
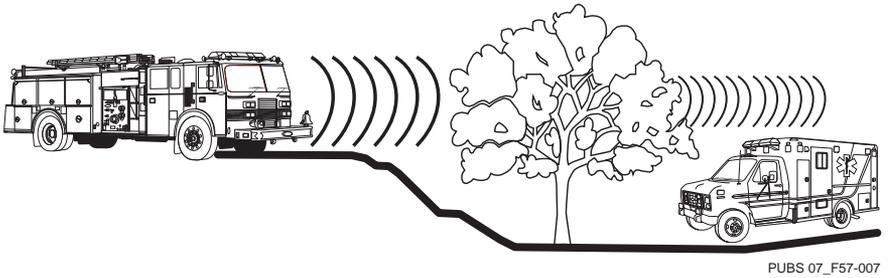
Optimal: clear line of sight

Figure 4. Area geometry or physical features can affect talk range

Signal relay (hopping)

Figure 5 shows a generalized urban incident site where there is no LOS between vehicles A and B. Figure 6 showshow positioning vehicle C enables the First InterComm system to overcome these obstacles by "hopping" voice communications (i.e., passing communications through the units that do have LOS). Thus, all units can communicate even though not all have direct LOS.
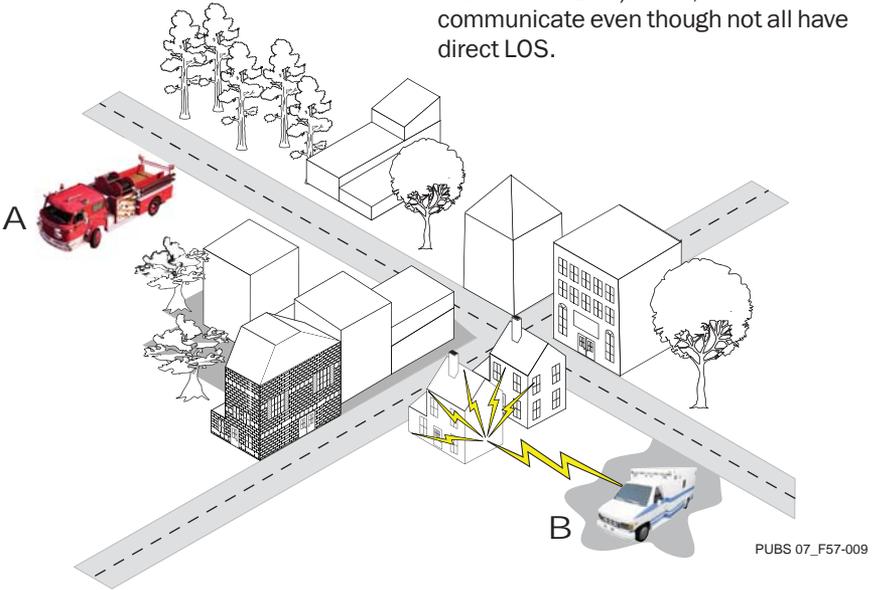

PUBS 07_F57-009

Figure 5. LOS obstructions prevent communications
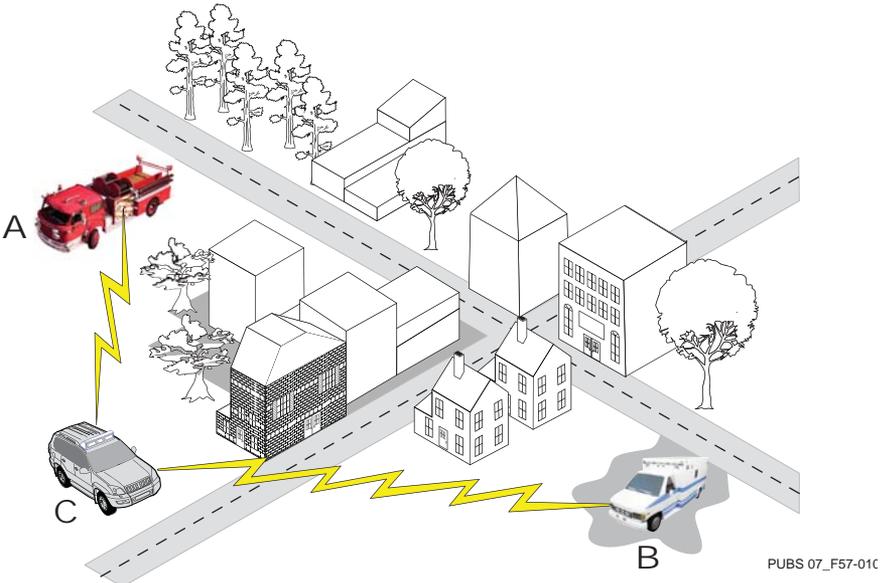

PUBS 07_F57-010

Figure 6. First InterComm range is extended by "hopping"

Troubleshooting

> **IMPORTANT**
> – If the First InterComm system appears to interfere with incident site
>   operations, immediately turn off every VCA100 unit and Talk Group software in
>   use and return to normal operating procedures.
> – If Talk Group software or laptop computer problems occur, the VCA100 units
>   will remain in their assigned talk groups. If the laptop or Talk Group software
>   is not functional and communication is needed among all responders, cycle
>   power to all VCA100s. This entails turning off the power to the VCA100 and
>   then repowering.

Table 1. VCA100 troubleshooting procedures

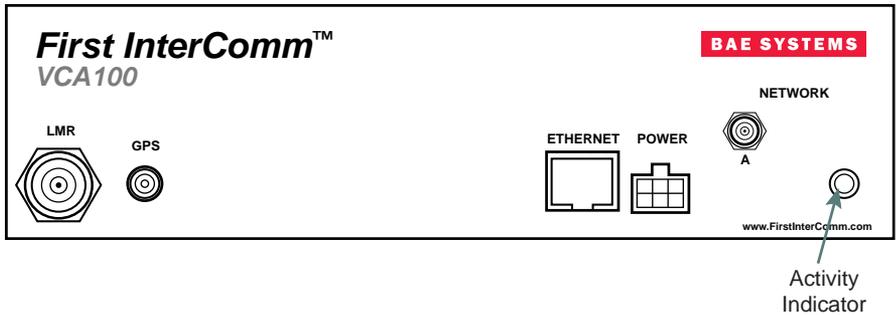| Problem	Action	Comments
No communications via First InterComm systems	1. Verify indicator on power switch is lit. If not, verify that fuse is good. 2. Verify the activity indicator on VCA100 front panel is lit. 3. Verify all communication devices are using the designated interoperability channel. 4. Verify at least two VCA100s are in the incident area and power has been applied to the units for at least 60 seconds. 5. Verify each VCA100 wireless antenna has clear LOS to other wireless antennas. 6. Verify distance between VCA100 wireless antennas is a quarter mile or less.	1. If the activity indicator is not easily viewed, a secondary power indication is an amber LED in the lower right corner of the Ethernet connector (Figure 7). 2. If the fuse is good, but there is no power indication, contact maintenance personnel.

First InterComm system component descriptions

The First InterComm system consists of:
– VCA100 unit matched to user's existing radio network frequencies.
– Vehicle-mounted wireless antenna.
– Land mobile radio antenna matched to user's existing radio network frequencies.
– Remote on/off switch.
– Talk Group software (optional capability).

The VCA100 unit

The VCA100 unit (Figure 7) is vehicle-mounted and has no operator controls other than a remote power-on switch. Once the VCA100 is initialized, operations are transparent to the operator, responders need only set their radio equipment to the pre-designated interoperability channel to monitor or speak to members of other radio networks at the site. The specific VCA100 model is based on the radio frequencies used by the participating department (see Appendix A).

First InterComm™
VCA100

BAE SYSTEMS

NETWORK

LMR
GPS
ETHERNET   POWER
A

www.FirstInterComm.com

Activity
Indicator

Figure 7. VCA100 front panel connectors

LMR	Two-way radio antenna connection, TNC
GPS	Reserved for future implementation
Ethernet	Factory use only
Power	Nominal 13.6 Vdc and 1.75A max On/off control is via cab-mounted switch toggle switch
Network	Wireless antenna port A, reverse polarity SMA connector
Activity indicator	Power on built-in-test indicator light

Power-on built-in test (PBIT)

The activity indicator displays the progress of the built-in tests that run during boot up of the VCA100. Once power is applied, the indicator will light for approximately 30 seconds, turn off for approximately 10 seconds, turn on again and remain on, indicating all tests passed. If the indicator does not illuminate the second time, PBIT has identified an out-of-tolerance condition (e.g., temperature or voltage extremes). If the VCA100 had been exposed to temperatures below -20° C or above 60° C when the symptom appeared, allow the unit to reach an operating temperature within this range, cycle power, and monitor for correct indications. If the symptoms persist, a fault is present and maintenance personnel should be contacted.

Mobile radio antennas

This vehicle-mounted antenna matches the frequency range of its associated VCA100 unit and must be compatible with the user's existing radio network.

Wireless antenna

This vehicle-mounted antenna covers the 2.4-GHz to 2.5-GHz frequency range and is compatible with the VCA100.

Appendix A
VCA100 specifications
General

Dimensions	2.5" × 8.5" × 8.5" (H x W x D)
Weight	4 pounds
Input voltage	9 to 17 Vdc (13.6 Vdc nominal)
Input current	1.75A maximum (at 13.6V)
Input power connector	6-pin Molex
Frequency	Varies with model
Transmit power	5 to 6 watts in LMR band (typical)
Connectors	
Network	RP-SMA (SMA with male pin)
LMR	TNC with receptacle contact
GPS	SMA with receptacle contact (future option)
Ethernet	RJ-45 (factory use only)
Environmental	
Cooling	Ambient air, no fan
Temperature	-20°C to +60°C (operating)
Humidity	Up to 90%
Vibration	MIL-STD-810F, Method 514.5, procedure I
Shock	MIL-STD-810F, Method 516.5, procedure I

VCA100 configurations

Model	Protocol	Encryption	Band	Frequency range
VCA100-L1FCGX	FM	None	VHF, Low-band	29.7 – 37 MHz
VCA100-L2FCGX	FM	None	VHF, Low-band	35 – 50 MHz
VCA100-V1FCGX	FM	None	VHF, High-band	136 – 174 MHz
VCA100-V1PCGX	FM/P25	None	VHF, High-band	136 – 174 MHz
VCA100-V1PAGX	FM/P25	DES/AES	VHF, High-band	136 – 174 MHz
VCA100-V1PDGX	FM/P25	DES	VHF, High-band	136 – 174 MHz
VCA100-U1FCGX	FM	None	UHF	450 – 520 MHz
VCA100-71PCGX	FM/P25	None	700	764 – 806 MHz
VCA100-81FCGX	FM	None	800	806 – 870 MHz
VCA100-81PCGX	FM/P25	None	800	806 – 870 MHz
VCA100-81PDGX	FM/P25	DES	800	806 – 870 MHz
VCA100-91FCGX	FM	None	900	896 – 941 MHz

Appendix B
Acronyms and abbreviations

AEL	Authorized equipment list
AES	Advanced encryption standard adopted as standard by U.S. government
DC	Direct current
DES	Data Encryption Standard
DHS	Department of Homeland Security
EMI	Electromagnetic interference
FCC	Federal Communications Commission
FM	Frequency modulation
GPS	Global Positioning System
IAN	Incident area network
LED	Light-emitting diode
LOS	Line of sight
MIL-STD	Military standard
NIMS	National Incident Management System
P25	Project 25 (encryption protocol for digital communications)
RF	Radio frequency
SEL	Standardized equipment list
SMA	Subminiature version A (RF connector)
SOP	Standard operating procedures
TNC	Threaded Neill-Concelman (RF connector)
UHF	Ultra high frequency
VCA	Vehicle communications assembly
VHF	Very high frequency
VoIP	Voice-over-Internet protocol

BAE Systems contact information

Telephone support 603-459-5643

E-mail firstintercomm.eis@baesystems.com

www.firstintercomm.com

Companion documentation

First InterComm™ system Talk Group software user manual, document No. A29800, July 2008

Cleared for open publication 07/08

We Protect Those Who Protect Us®

PUBS-07-F57-VCA100usermanual