CrossCheck™ GSM 1900

withIQ*Event Engine*™

Operation Manual, DRAFT

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Revision Notice

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1. Improper or inadequate maintenance by the buyer

2. Buyer-supplied software or interfacing

3. Unauthorized modification or misuse

4. Operation outside of the environmental specifications of the product

5. Improper installation, where applicable

6. Lightning or other electrical discharge

7. Fresh or salt water immersion or spray

8. Normal wear and tear on consumable parts (for example, batteries and cables)

REGULATORY APPROVALS

FCC FCC Part 24, Part 15

Industry Canada

This device complies with part 15 of the FCC Rules.

Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and

(2) This device must accept any interference received, including interference that may cause undesired operation

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Preface

Welcome to the *CrossCheck GSM Operation Manual*. This manual describes the configuration, installation, operation, maintenance, and troubleshooting of the CrossCheck GSM. The most recent version of this manual is available on the Trimble World Wide Web site.

http://www.trimble.com/products/catalog/mobile/xcheckgsm.htm

Aims and Objectives

This manual is for CrossCheck GSM mobile unit users. The objective of this manual is to explain how CrossCheck GSM operates, how users install it with Trimble or third-party products, and how users configure it for an end-to-end Event Reporting and Automatic Vehicle Location solution.

Organization

The *CrossCheck GSM Operation Manual* includes the information you need to install and operate the CrossCheck GSM. You can read which ever sections you need, in any order.

This manual includes the following chapters and appendixes:

- Chapter 1, Overview, describes the CrossCheck GSM, and includes a physical description and a functional overview of CrossCheck GSM components, options, and accessories.

- Chapter 2, Installation, gives step-by-step guidelines for physically installing the CrossCheck GSM and hardware components.

- Chapter 3, Configuration, explains how to use the Windows 95/98 HyperTerminal program to initialize the CrossCheck GSM and prepare it for operation.

- Chapter 4, Operation, includes instructions for operating and monitoring the operation of the CrossCheck GSM.

- Chapter 5, IQEvent Engine Overview, gives an overview of the IQ*Event Engine*.

- Chapter 6, Troubleshooting, gives troubleshooting guidelines for isolating and solving CrossCheck GSM problems.

- Appendix A, Specifications, includes information about CrossCheck GSM physical and performance characteristics.

- Appendix B, Voice Operation, explains how to use the handset available as part of the optional Voice Upgrade Kit.

- Appendix C, TSIP Implementation, contains the list of Trimble Standard Interface Protocol (TSIP) command and report packets supported by the CrossCheck GSM.

- Appendix D, NMEA Implementation, contains detailed information about the NMEA-0183 protocol and the subset of NMEA messages supported by the CrossCheck GSM.

- Appendix E, GSM AT-Commands, explains how the CrossCheck GSM uses the TAIP AT commands.

- The Bibliography includes recommended reading materials to supplement the information included in this manual.

- The Glossary includes definitions of commonly used words and terms.

Related Information

This manual contains system-wide, general information about the CrossCheck GSM. The following sections discuss other sources of information.

Update Notes

Application notes, firmware release notes, technical notes, manual addendums, and other useful product information are available in the Mobile Positioning and Communications area of the Trimble web site. These documents contain important information about software and hardware changes.

Files containing the latest version of this manual and other CrossCheck GSM publications are also available on the Trimble web site.

WWW Site

The Mobile Positioning and Communications web page is at the following address:

http://www.trimble.com/products/catalog/mobile/xcheckgsm.htm

Product Information

Prospective resellers (not under contract) can get general information about the CrossCheck GSM by sending email to sales_info@trimble.com or by searching the web site for information such as the CrossCheck GSM GSM data sheet.

Existing resellers can obtain additional information about the CrossCheck GSM by sending email to:

crosscheck@trimble.com

or by contacting your local sales office or sales engineer.

Reader Comment Form

A reader comment form is provided at the end of this guide. If this form is not available, comments and suggestions can be sent to: Publications, CrossCheck GSM Editor, Trimble Navigation Limited, 645 North Mary Avenue, Post Office Box 3642, Sunnyvale, CA 94088-3642. All comments and suggestions become the property of Trimble Navigation Limited.

Document Conventions

Italics are used for general emphasis.

Bold is used for strong emphasis in notes, cautions, and warnings.

Courier is used to represent the commands sent to CrossCheck GSM units and the responses returned by the unit.

Notes, Cautions, and Warnings

Notes, cautions, and warnings are used to emphasize important information.

Note – Notes give additional significant information about the subject to increase your knowledge, or guide your actions.

Caution – Cautions alert you to situations that could cause hardware damage or software error.

Warning – Warnings alert you to situations that could cause personal injury or unrecoverable data loss.

1   Overview

The CrossCheck GSM mobile unit integrates the digital GSM (Global System for Mobile Communications) cellular phone, an 8-channel GPS receiver, a controller supporting the **IQ***Event Engine*, and data-logging functions into a single package. This package is designed as a mobile communications system module for Automatic Vehicle Location (AVL) and mobile asset management applications. It operates over the GSM cellular network allowing simple, fast, and efficient transfer of information between the vehicle and base station.

1.1   The CrossCheck GSM Mobile Unit

The CrossCheck GSM Cellular mobile unit consists of a single board with integrated:

- GSM cellular transceiver module

- High-sensitivity, 8-channel GPS receiver

- Controller featuring the IQEvent Engine and data-logging functions integrated into a single package for mobile positioning and tracking applications.

This product's features and functions are similar to other products in the CrossCheck family including the CrossCheck AMPS and CrossCheck XR.

The CrossCheck GSM is housed in a single compact enclosure that simplifies the installation procedure and leads to greater reliability.

The unit contains an integrated fully featured GSM Normal Mobile Station (MS) transceiver that supports data, voice, and SMS modes of

operation. The GSM transceiver is designed to operate in dual-band at 900 MHz and1900 MHz.

The IQEvent Engine is a sophisticated event handler that allows the CrossCheck GSM to be programmed or configured to respond to a wide variety of events and signals.

Data logging is also supported, allowing the CrossCheck GSM to store 2500 to 3000 records for subsequent download.

The CrossCheck GSM will support a variety of peripherals via its standard RS232, MDT/Aux. interface. This interface supports TSIP, TAIP, NMEA and GSM (ETSI 07.07, 07.05 and V.25ter) protocols.

The ability to use voice communication over the GSM network is provided by an optional handset with an integral keypad and display. For safety and security this feature supports hands-free operation using an external loudspeaker and a separate microphone.

The CrossCheck GSM is designed to operate in a mobile environment and accommodates supply voltages between 9 – 32 volts.

GSM and GPS antennas are required for operation. You also must install a Subscriber Identity Module (SIM) that has been initialized by your GSM service provider.

The standard CrossCheck GSM configuration does not include a GPS or GSM antenna as the type of antenna required depends on the application, and these must be ordered separately.

Combo GSM/GPS Antennas

Crosscheck GSM

GSM Antenna

GPS Antenna

SIM SIM Carrier

Cigarette Lighter

12V

Ignition Sense
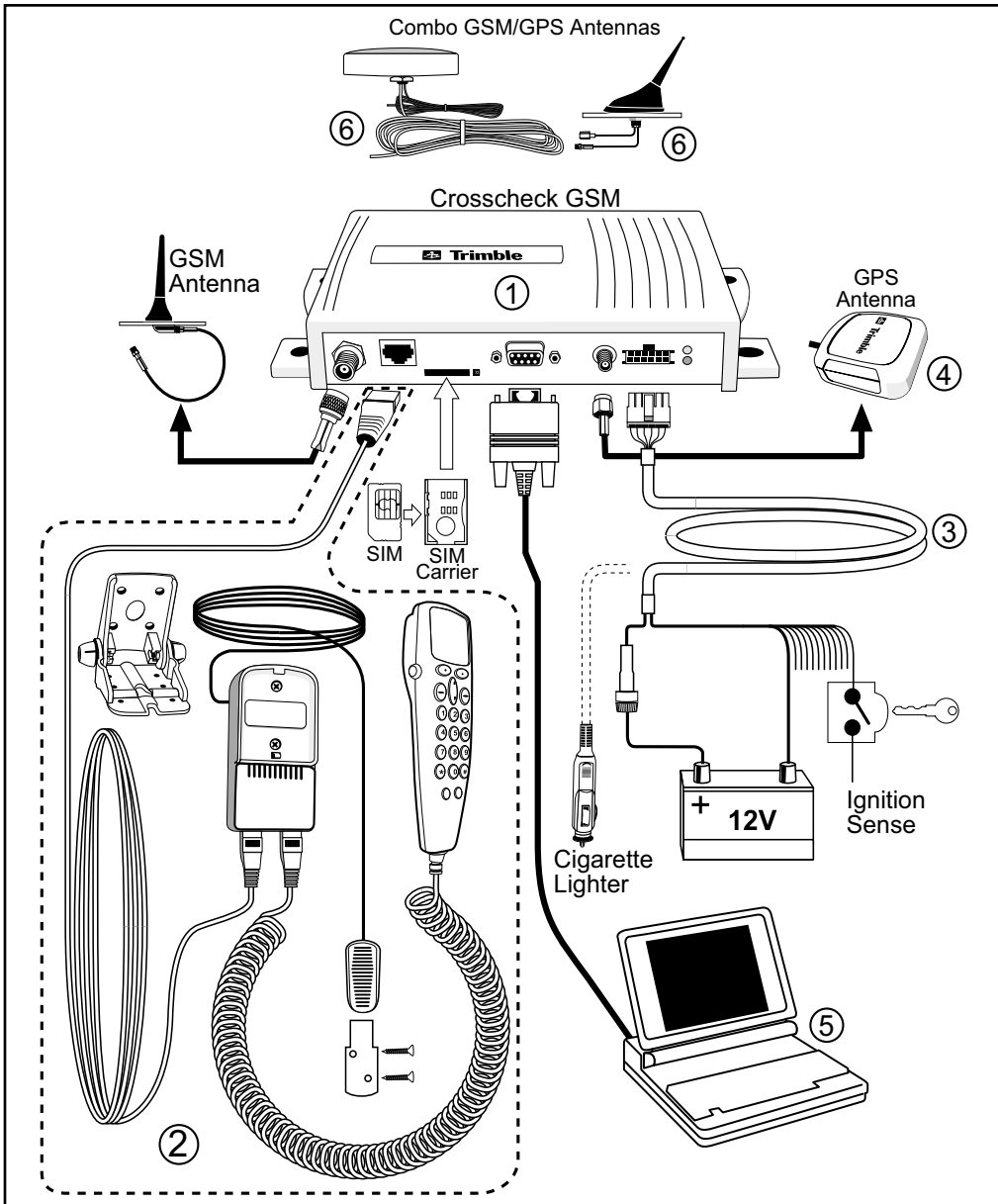
Figure 1-1   CrossCheck GSM System Accessories

The callouts in Figure 1-1 are:

1 CrossCheck GSM mobile unit

2 Voice Upgrade Kit including

    a.   Handset

    b.   Mounting bracket

    c.   Handset cradle

    d.   Hands-free microphone

    e.   Extension cable

3 Power and discrete I/O cable

4 GPS antenna

5 Laptop (not available from Trimble)

6 Combo GSM/GPS antennas

1.2 CrossCheck GSM Applications

Trimble Mobile Positioning & Communication (MPC) provides you with the core products around which you can build systems and applications for managing your transport and logistics assets.

MPC products address the need for an end-to-end solution. They provide the building blocks at both ends of the asset management system including the on-board units mounted in the vehicle and the software installed at the fixed base station.

The on-board components are centered on the CrossCheck GSM, (the GPS receiver with integrated **IQ***Event Engine* and a GSM phone). You can use the CrossCheck GSM as a standalone unit or you can interface it with external accessories and sensors to make it function as part of an on-board system.

Optional external units include a Mobile Data Terminal (MDT) to provide a driver interface to exchange messages or generate manual

event reports, and a handset for use where voice communication is required.

You can use the Trimble FleetVision software package at the base station, as a standalone fleet management system or as the communications platform for an integrated system. FleetVision features include event and alarm reporting, data handling, as well as map displays, allowing you to view the positions of mobile assets in real-time or replayed for analysis purposes. FleetVision includes an External System Interface (ESI) package. This gives system integrators and application developers the ability to customize the system by interfacing to third-party "back office systems" such as order/stock processing, route optimization systems, and the like.

1.3   CrossCheck GSM Features

The CrossCheck GSM includes these features:

- Eight channel GPS receiver

- Configurable, intelligent **IQ***Event Engine* (refer to Chapter 5)

- Slim profile for easy installation

- One serial port for RS-232 (DCE) serial communications with data throughput of 300, 600, 1200, 2400, 4800, 9600 (default), 19200, or 38400 bps

- Extensive discrete I/O (inputs and outputs) for vehicle peripheral support

- Optional Voice Upgrade Kit which supports hands-free operation

- Password-protected data communications

- NMEA-0183 Version 2.1 sentence output (see Appendix D for detailed information)

- Support for the Trimble Standard Interface Protocol (TSIP), allowing you to set GPS parameters using the serial port (see Appendix C for detailed information)

- Support for Trimble ASCII Interface Protocol (TAIP)

- User-defined parameters:

  - 10 destination addresses for outgoing reports

  - 50 simple or compound events

  - 10 time and distance sets for triggering events

  - 50 time windows for triggering events

  - 50 region windows for triggering events

  - 50 heading windows

  - 20 speed limits for triggering events

  - Combination of 10 counters, timers, and distancers

- Bulkhead and magnetic mount GPS antennas available

- Data and Event Reporting support by either Circuit Switched Data mode or Short Message Service (SMS) mode

1.4　Global Systems for Mobile Communications

Cellular mobile telephone systems have been widely available throughout the world. However, because cellular mobile telephone systems are regulated at the national level, these systems are not generally compatible with each other. To resolve this dilemma of being able to communicate from almost anywhere, but only within your own system, The European telecommunications operators (the Conference of European Postal and Telecommunications Administration, or CEPT) designed a new mobile telephone network. This network has evolved into GSM, and CEPT has turned over management of GSM to the European Technical Standards Institute (ETSI). GSM is the predominant mobile communications system throughout Europe and GSM is also widely available throughout the world.

1.4.1　GSM Cellular Phone System

The Global Standard for Mobile (GSM) protocol offers a variety of data services that allow users to send and receive data at rates of up to 9600 bps. Data may be delivered over ISDN, Packet Switched or Circuit Switched Data Networks (PSDN or CSDN) and via the Short Message Service (SMS).

SMS is a store and forward service for the bi-directional exchange of alphanumeric messages of up to 160 characters.

Architecture of the GSM network

An Automatic Vehicle Location (AVL) or Asset Management System based on GSM consists of several distinct components. The Crosscheck GSM is the mobile unit that is installed in the vehicle and contains the Subscriber Identity Module (SIM). The SIM card contains a unique International Mobile Subscriber Identity (IMSI) number. This enables the network to identify the user and therefore allow the terminal to have access to specific, subscriber services.

The GSM "cloud" is made up of two sections:

- The Base Station Subsystem that controls the radio link with the mobiles through local cells

- The Network Subsystem that controls the switching of calls between the network users, mobile to mobile, and between mobile and fixed lines

The Network Subsystem stores all administrative information including the current cell being used by the mobile unit which allows call routing and the roaming ability of GSM. An important feature of GSM is this ability to move across international and network borders, a feature that is described as "roaming." If arrangements have been made with the service provider, the SIM card will be enabled for roaming.

- Mobile Station (MS)

  - CrossCheck GSM includes a radio transmitter, receiver and voice encoder, decoder. The optional Voice Upgrade Kit includes a handset.

  - Subscriber Identify Module (SIM)—an electronic card containing a computer chip. The chip contains the subscriber information and operating system parameters. SIMs provide authentication, encryption, information storage, and subscriber account protection services (including Personal Identification Number or PIN, and Pin Unblocking Key or PUK). GSM users can move the SIM from one CrossCheck GSM to another.

- Other network components

  - Voicemail System (VMS)— delivers messages and pages to GSM users.

  - Short Message Service Center (SMSC)—delivers text messages (up to 160 characters) to GSM users.

  - Executable Short Message Platform—delivers commands to the SIM card via an over-the-air interface.

- Internetworking Function (IWF)—delivers mobile fax and data to GSM users.
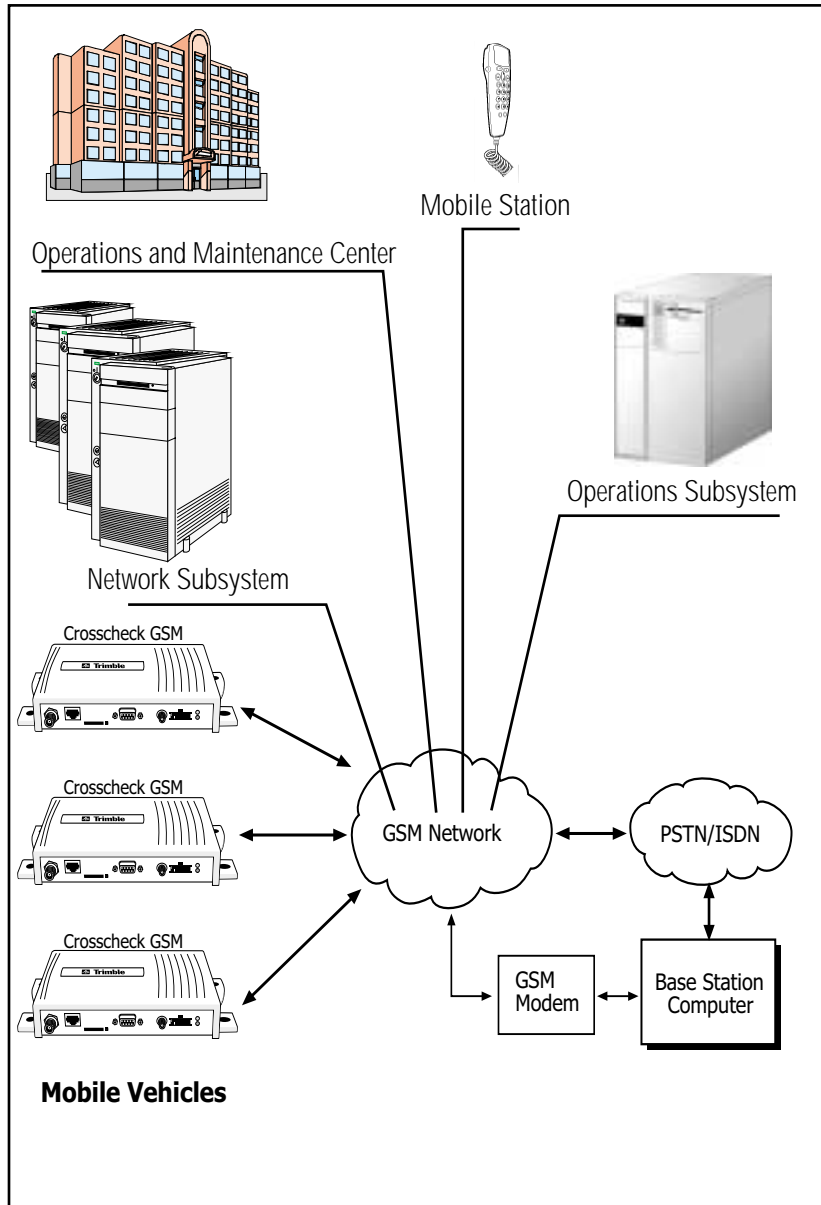
Figure 1-2   GSM Cellular Network Topology

1.5   The Global Positioning System

The Global Positioning System is a satellite-based navigation system operated and maintained by the U.S. Department of Defense. GPS consists of a constellation of 24 satellites providing world-wide, 24 hour, three dimensional (3D) coverage. Although originally conceived for military needs, GPS has a broad array of civilian applications including timing, surveying, fleet management, marine, land, aviation, and vehicle navigation.

GPS is the most accurate technology available for navigation. As a satellite based system, GPS is immune from the limitations of land based systems, which have limited coverage and whose accuracy varies with geographic location and, even under ideal conditions, cannot compare with GPS.

By computing the distance to GPS satellites orbiting the earth, a GPS receiver can calculate an accurate position. This process is called satellite ranging. GPS receivers can also provide precise time, speed, and course measurements which are important for vehicle mobile positioning and communications applications.

1.6   GPS Receiver

The CrossCheck GSM includes an advanced GPS receiver, which provides the position, course, speed and time information required for AVL and fleet management applications. A brief overview of the GPS receiver's architecture and operation is provided below.

The CrossCheck GSM's GPS receiver features an eight-channel digital signal processor (DSP) which operates at the GPS L1 frequency (1575.42 MHz) and processes the AcquisitionCoarse/ Acquisition
(C/A) code portion of the GPS signal. The RF and digital signal processing components of the GPS module are custom ASICs designed by Trimble.

1.7 GSM Operation

At power up the CrossCheck GSM automatically searches for a GSM network using a set of tables on the SIM card to determine which GSM network the phone should try to reach. These tables are the Public Land Mobile Network (PLMN) tables and each GSM network has its own unique PLMN number. This number is the Mobile Country Code (MCC) and the Mobile Network Code (MNC), which are also the first numbers of the subscriber's IMSI. (The IMSI is the MCC, plus the MNC, plus the MSIN.)

The PLMN table finds either the subscriber's home network or a network that will allow service, and registers to the network consistent with the handset. The responding network's MSC passes this request for service to the VLR. If the VLR has information about this IMSI, then it passes the request to the AUC for authentication. If the VLR cannot find any information on this IMSI, it must pass the request to the HLR and get approval before passing on the request.

Once the VLR has approval to grant the request for service, it knows the user identity, what features are authorized, and the authentication codes (from the AUC). The VLR then passes the request back to the MSC for routing to the number being called.

If the number being called is a land-based number, the MSC passes the call to the Public Switched Telephone Network (PSTN) for connection. If the number being called is another mobile number, the MSC repeats the process described above to locate the number being dialed. Depending on services supported, the call will be answered, be routed to voicemail, be intercepted by a live answering service, or simply time out with the message that the number being dialed is not available. In any case, the transmission is digital and encrypted so information cannot be intercepted easily.

2   Installation

Instructions for installing the CrossCheck GSM mobile unit in the vehicle are introduced in this chapter. This chapter covers:

- Unpacking the CrossCheck GSM

- Installer supplied parts

- Mounting the CrossCheck GSM

- Mounting the GPS and GSM cellular antennas, and routing the antenna cables

- Connecting laptop computers, Windows CE devices, and other ASCII peripherals to the MDT/Aux port

- Connecting discrete input and output leads

- Connecting power

- Mounting and connecting the Cellular Handset, hands-free cradle, and remote microphone

- Inserting the SIM

The CrossCheck GSM can be installed before or after configuring its IQ*Event Engine*. For example, you might want to configure all of the CrossCheck GSM units for a fleet of vehicles on a bench prior to installation. If you prefer to configure the CrossCheck GSM first, read Chapter 3, Configuration, before installing the CrossCheck GSM.

> **Note –** If you plan to install the CrossCheck GSM before configuring the unit, be sure to leave adequate clearance to the MDT/Aux port and other connectors. Adequate clearance must exist to connect a laptop or Mobile Data Device to the unit, and you must be able to read the LED indicators if troubleshooting is required.

2.1 CrossCheck GSM Connections

This sections shows the CrossCheck GSM components connections. Figure 2-1 shows the CrossCheck GSM connections.
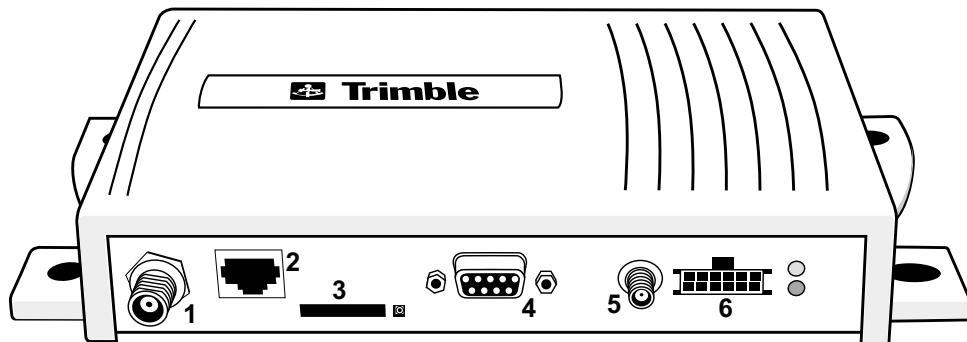
1. GSM Antenna
2. Hands-free cradle
3. SIM slot
4. MDT/Aux
5.GPS Antenna
6. Power and Discrete I/O

Figure 2-1   CrossCheck GSM Connectors

2.1.1 GSM Antenna

The GSM antenna uses a mini-UHF connector. For more information, see Appendix A, Specifications.

2.1.2 Power and Discrete I/O Pinout

Table 2-1 indicates how the power and discrete I/O cable carries signals.

Table 2-1   Power and Discrete I/O Pinout

Pin	Signal	Function
1	V_{BATT}	Input: Power 9-32V
2	GND	Ground
3	CHAS	Chassis Ground
4	GND	Ground
5	IGN	Input: Ignition Sense
6	IP3	Discrete Input 3
7	IP2	Discrete Input 2
8	XP2	Low-side Driver 2
9	IP1	Discrete Input 1
10	XP1	Low-side Driver 1
11	IP0	Discrete Input 0
12	XP0	Low-side Driver 0
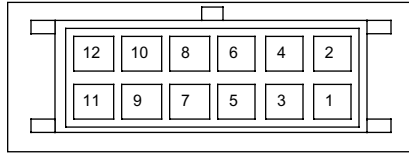
Figure 2-2   Power and Discrete I/O Pinout

2.1.3   GPS Antenna

The GPS antenna uses an SMA female connector. For more information see Appendix A, Specifications, Table A-4.

2.1.4   MDT/Aux Port

Table 2-3 illustrates the MDT port pin configuration.
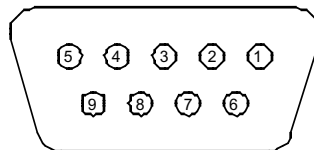
MDT/Aux

Figure 2-3   MDT/Aux Pinout

Table 2-2 shows the MDT connector pin-out.

Table 2-2   MDT Connector Pin-out

Pin #	Signal	Connection
1	DCD	Output: Carrier Detect
2	RxD	Output: Serial Data
3	TxD	Input: Serial Data
4	DTR	Input: Data Terminal Ready
5	GND	Ground
6	DSR	Output: Data Set Ready
7	RTS	Input: Request to Send
8	CTS	Output: Clear to Send
9	RI	Output: Always inactive (not supported)

2.2   Inspecting and Unpacking the Shipment

The CrossCheck GSM may arrive in one or more cartons, depending on the number of units and the options ordered with the shipment. Before opening the shipping containers, inspect the cartons for punctures or damage and immediately report any problems found to the shipping carrier. Then open the shipping cartons individually, and check their contents against the packing slip.

Table 2-3 identifies the CrossCheck GSMs and bundles, and the components included.

Table 2-3   CrossCheck GSM Units and Bundles

Part No.	Description
43455-01	CrossCheck GSM Mobile Unit (includes GPS antenna, power and I/O cable, manual, handset quick reference, and the Voice Upgrade Kit).
43455-11	CrossCheck GSM Mobile Unit 10 Unit Bundle (includes 10 CrossCheck GSMs, without GPS antennas or accessories.

Additional cartons may be included in the shipment for GPS and cellular antennas, interface cables, and Voice Upgrade Kit options. For a complete listing of CrossCheck GSM unit and component part numbers, see CrossCheck GSM Part Numbers on page A-12.

2.3   Installer Supplied Parts

The following parts must be supplied by the installer:

- Mounting fasteners for the CrossCheck GSM.

- Fasteners for mounting the GPS antenna if the antenna is the bulkhead type.

- Cable ties for securing cables to the vehicle.

- Any special connectors and adapters required to connect interface devices and power leads—the power and I/O cable is supplied with the CrossCheck GSM PN 43455-01 only.

- Subscriber Identity Module (SIM) cards.

- GSM antenna.

- GPS antenna (supplied with the CrossCheck GSM (PN 43455-01 only).

2.4   Mounting the CrossCheck GSM

The CrossCheck GSM can be installed inside any type of vehicle and in any orientation. It can be installed in an enclosed compartment or in a location with limited accessibility as long as the environmental specifications are maintained to ensure reliable operation. For example, the CrossCheck GSM can be installed on the floor under a seat or on a wall behind a seat. (The CrossCheck GSM cannot be installed inside the engine compartment, wheel well, chassis, or on any exterior surface of the vehicle.)

Choose a location for the CrossCheck GSM which allows for convenient routing and connection of the antenna and interface cables,

and which has access to a power source. When selecting a mounting location, consider the specifications listed in Appendix A, Table A-8, and avoid the following hazards:

- Direct exposure to weather

- Excessive heat (for example, exhaust manifolds)

- Excessive cold (for example, refrigeration units)

- High vibration areas (engine compartment, transmission)

- Corrosive fluids and gases (acids, petroleum products)

- Direct exposure to water (the CrossCheck GSM is not waterproof)

To mount the CrossCheck GSM:

1. Choose the mounting location.

   The CrossCheck GSM can be mounted horizontally, vertically, or in any convenient orientation protected from moisture. During normal system operation, the user does not need to see the CrossCheck GSM LED indicators. However, the ability to see the LED indicators is a definite advantage when troubleshooting the unit.

   The integral mounting flange is designed to secure the CrossCheck GSM to a flat surface. The flange has four holes for securing the unit with fasteners.

2. Use self tapping screws or machine screws to secure the unit to the mounting surface. Figure 2-4 shows the mounting dimensions.
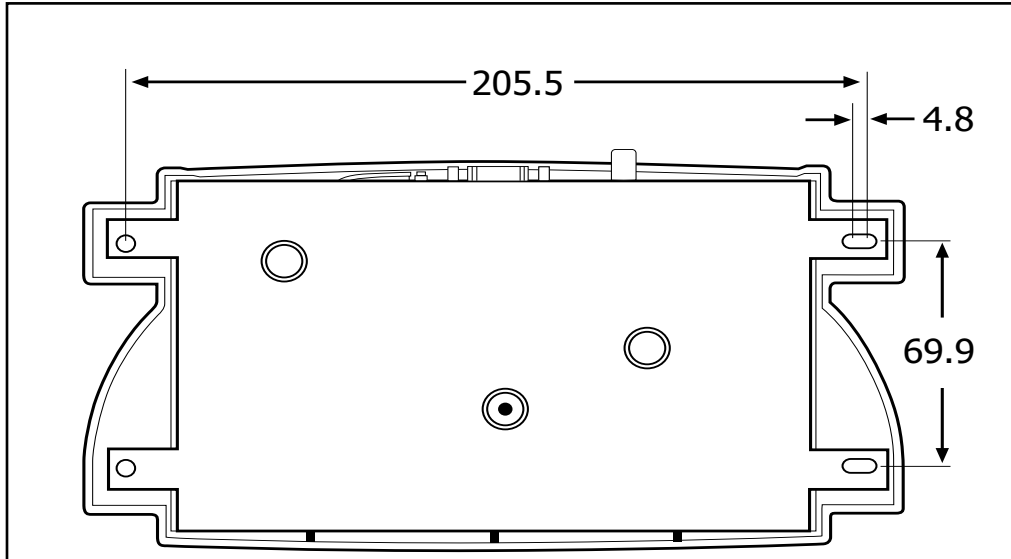
Figure 2-4   CrossCheck GSM Mounting Dimensions (in millimeters)

The installer must provide an appropriate selection of fasteners to secure the CrossCheck GSM to the mounting surface.

a.   When using self-tapping screws, select an appropriate size and length for the mounting surface. The hole size leaves some allowance for holes drilled slightly off center from the specified dimensions.

b.   When using machine screws, select a screw length which extends a safe distance beyond the mounting surface, and secure the screw with a washer and nut. Lock washers are recommended to prevent vehicle vibration from loosening the fasteners.

In general, Trimble Navigation recommends the use of number m3.5 (or number 6) pan head machine screws.

Caution – Use washers sized small enough that they do not tighten down on the plastic cover of the CrossCheck GSM when the mounting screws are secured. Otherwise, over stressing the plastic mounting surface when tightening the mounting screws can cause the plastic to crack. Tightening screws without using washers can lead to compressing, cracking, or deforming the mounting surface.

2.4.1   Connecting CrossCheck GSM to the Vehicle Chassis

For proper operation, the aluminum chassis of the CrossCheck GSM must be connected electrically (grounded) to the chassis of the vehicle on which it installed. This can be accomplished by:

*   Direct connection through metal screws (preferred), or

*   Using the chassis ground wire

Direct Connection through Mounting Screws

Mount the CrossCheck GSM mobile unit on a metal surface that is permanently attached to the vehicle chassis (for example the base of the trunk, or a mounting plate that is permanently attached to the chassis using metal screws). Fasten down the CrossCheck GSM mobile unit using metal screws driven through the metal tabs on the sides of the unit. Make sure the screws are tight, and that they make contact both with the metal on the CrossCheck GSM and with the vehicle chassis. Use star washers to ensure a reliable electrical contact to the metal tabs.

Note – If this direct connection through mounting screws method is used for chassis connection, then the chassis ground (pin 3 on the power and discrete I/O connector) on CrossCheck GSM should be left unconnected.

Connection through the Chassis Ground Wire

If the CrossCheck GSM unit cannot be mounted directly on a metal surface that is attached to the vehicle, then use the chassis ground wire (pin 3 on the power and discrete I/O connector) to make electrical contact to the vehicle chassis. Use a wire with gauge of at least 18 AWG to connect the CrossCheck GSM power connector to the vehicle chassis. Keep the wire length as short as possible by selecting a connection point in the vehicle chassis that is close to the CrossCheck GSM unit. Use a metal screw with a star washer to ensure a reliable electrical contact to the vehicle chassis.

2.5   Choosing the GPS Antenna Mounting Location

Antenna location is critical for optimum GPS performance. Choose a location for the GPS antenna with an unobstructed view of the sky, and which is safe from damage during normal vehicle operation and maintenance. GPS satellite signals do not penetrate metal or dense wood. GPS signals can penetrate plastic, glass and tinted glass (except metalized glass), fiberglass and plexiglass materials as long as the surface is relatively dry.

Caution – Never mount the GPS antenna under a metalized glass windshield, such as those used in some vehicles for window de-fogging or de-icing systems. The GPS antenna can be mounted under a tinted-glass windshield.

When selecting a location for the GPS antenna, ensure that the antenna is not shielded from satellite signals by metal objects or other impenetrable materials. For optimal GPS performance, the antenna location should have a clear view of the sky.

Disclaimer —The instructions included in this section apply to the GPS antennas sold by Trimble and may not apply to third-party products. There are many other GPS antennas available on the market which may or may not be compatible with the CrossCheck GSM, including combined GPS/GSM cellular antenna solutions which have not yet been tested and certified by Trimble.

Mount the antenna in a horizontal position (see Figure 2-5 on page 2-12), facing the sky. If the antenna must be located in the vicinity of other antennas (radio, cellular phone), locate the GPS antenna at least 46 centimeters (approximately 18 inches) away. Avoid areas of high vibration (for example, engine hoods). For permanent installations, choose a location with access both above and below the antenna mounting surface. This access is required for installing fasteners and for routing the antenna cable.

Note – The standard length of magnetic mount and bulkhead-mount GPS antenna cables supplied by Trimble is 5 meters (or approximately 16 ft.). Longer bulkhead-mount antenna cables can be prepared by the installer using the guidelines presented in Appendix A, Specifications.

Since GPS satellite signals can penetrate plastic, fiberglass and glass, the GPS antenna can also be installed on a dashboard under a sloped windshield (if the windshield is not metallized) or under a plastic fender or bumper. These alternative locations are likely to offer less satellite coverage, since the metal components of the vehicle shield the antenna from portions of the sky.

Figure 2-5 shows typical antenna mounting locations for an automobile.

Arrows show acceptable places to mount the GPS antenna

The GPS antenna can be installed inside the vehicle under the front or back windshield if the glass is not metallized.

① **Best Performance** - outside installations with an unobstructed view of the sky are the best mounting locations.

② **Reduced Performance** - interior mounting locations and bumper mounting locations are acceptable, but may not provide a clear, unobstructed view of the sky.

Figure 2-5   Antenna Mounting Locations for Automobile

Figure 2-6 shows the typical antenna mounting locations for a van.
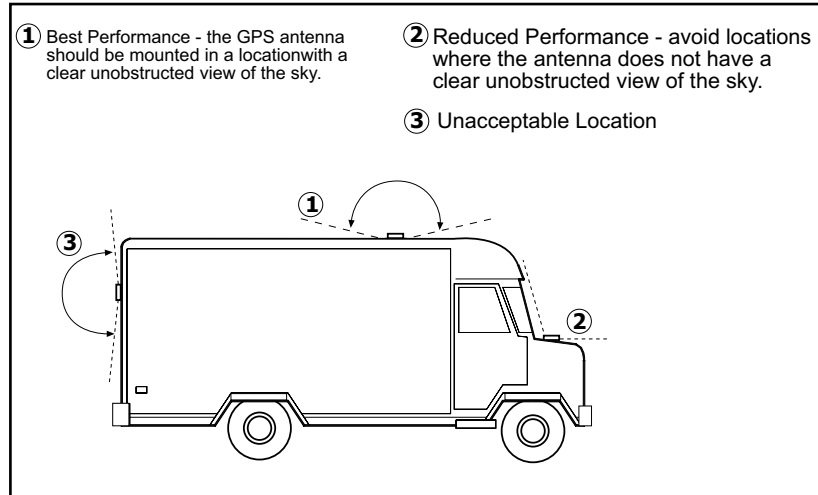
Figure 2-6   Antenna Mounting Locations

The antenna can be mounted under a fiberglass wind deflector such as those used on conventional and cabover trucks (see Figure 2-7). Make sure the wind deflector is not painted with a metallic finish.
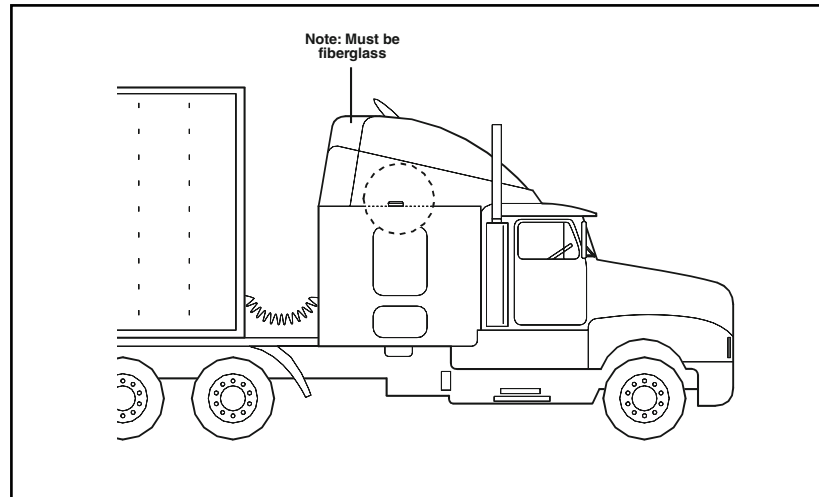
Figure 2-7   Antenna Mounted under Fiberglass Canopy

Note – The GPS antenna may be subject to performance degradation when covered by a heavy layer of snow or ice. If these are typical conditions for your application, mount the antenna in an accessible location, so snow can be easily removed.

The CrossCheck GSM can receive GPS signals from one of two types of optional Miniature BulkHead GPS antennas or a Miniature Magnetic GPS antenna, all available from Trimble. Follow the applicable procedure (below) to mount the GPS antenna.

2.5.1 Miniature BulkHead GPS Antenna with Flange (P/N 31192-00)

A straight TNC-Plug to SMA-Plug antenna cable (P/N 36107) or right-angle TNC-Plug to straight SMA-Plug antenna cable (P/N 36106) is available for the Miniature Bulkhead Antenna with Flange. For more information, see Appendix A, Specifications.

Figure 2-8 shows the Miniature Bulkhead GPS antenna mounting.
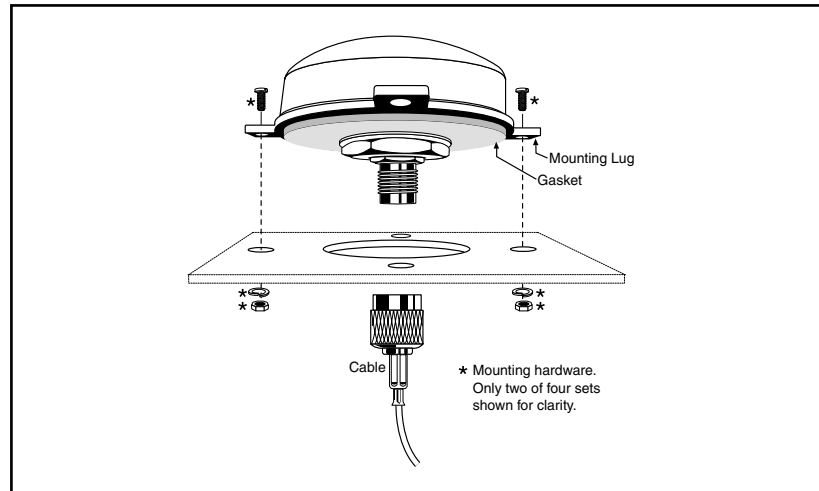
Figure 2-8   Miniature Bulkhead GPS Antenna with Flange (P/N 31192-00)

To mount the Miniature Bulkhead GPS Antenna with Flange:

1. Drill holes in the mounting surface using the antenna mounting template shown in Figure 2-9.
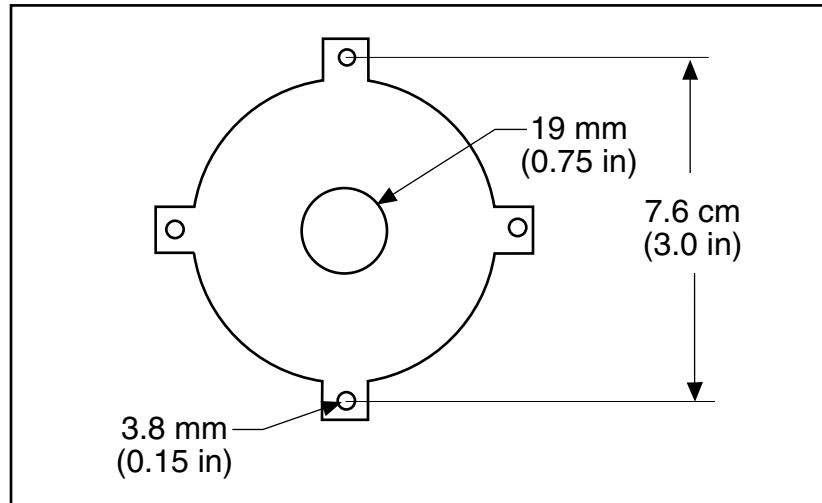
Figure 2-9   Mounting Hole Dimensions

2. Slip the antenna through the larger hole in the center of the hole pattern and rotate the antenna until the four holes in the antenna mounting flange are aligned to the hole circle.

3. Secure the antenna with the four screws, lock washers and nuts.

4. Connect the TNC connector on the antenna cable to the TNC connector on the antenna, and route the cable to the CrossCheck GSM mounting location. Use cable ties to secure the cable along the routing path. For detailed cable routing guidelines, see Routing the GPS Antenna Cable on page 2-20.

2.5.2 Miniature Bulkhead GPS Antenna without Flange (P/N 32434)

A straight TNC-Plug to SMA-Plug antenna cable (P/N 36107) or right-angle TNC-Plug to straight SMA-Plug antenna cable (P/N 36106) is available for the Miniature Bulkhead Antenna without Flange. For more information, see Appendix A, Specifications.

The metal thickness at the mounting location should be checked before drilling the mounting hole. The bulkhead mount on the antenna is designed to attach to metal surfaces with a thickness of 48 mm (0.1875) inches or less.
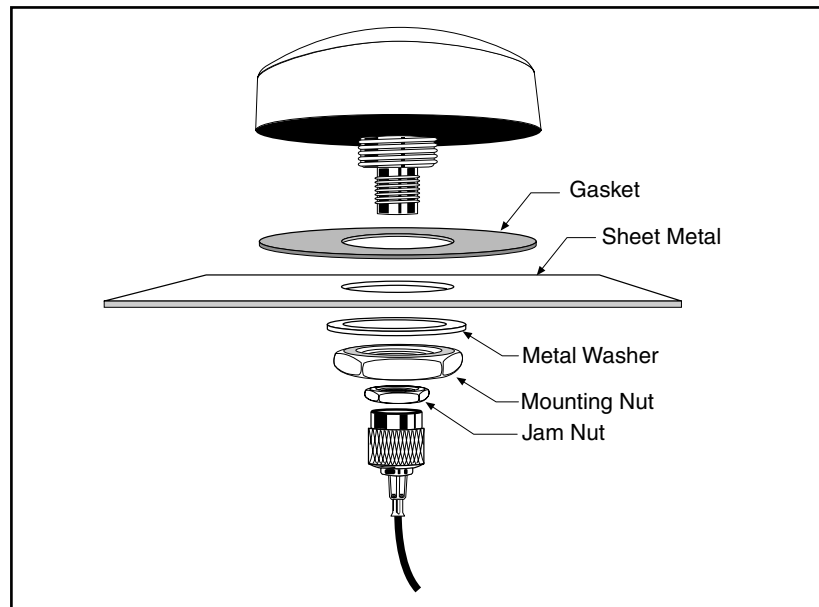
Figure 2-10   Miniature Bulkhead GPS Antenna without Flange (P/N 32434)

To mount the antenna:

1.   Choose the antenna mounting location (see Choosing the GPS Antenna Mounting Location on page 2-10).

2.   Drill a 19 mm (0.75 inch) hole at the mounting location.

3.   Remove the large nut from the bottom of the antenna.

4.   Mount the gasket as shown in Figure 2-10.

5.   Slip the antenna through the mounting hole, and secure it with the large nut.

6.   Connect the antenna cable as shown in Figure 2-10.

7.   Route the cable to the CrossCheck GSM mounting location, and connect the cable to the GPS Antenna connector. Use cable ties to secure the cable along the routing path. For detailed cable routing guidelines, see Routing the GPS Antenna Cable on page 2-20.

2.5.3   Miniature Magnetic GPS Antenna (P/N 37167)

The Miniature Magnetic Antenna features a magnetic mount for attaching the unit to ferrous metal surfaces and an integral 5 meter cable with SMA connector.
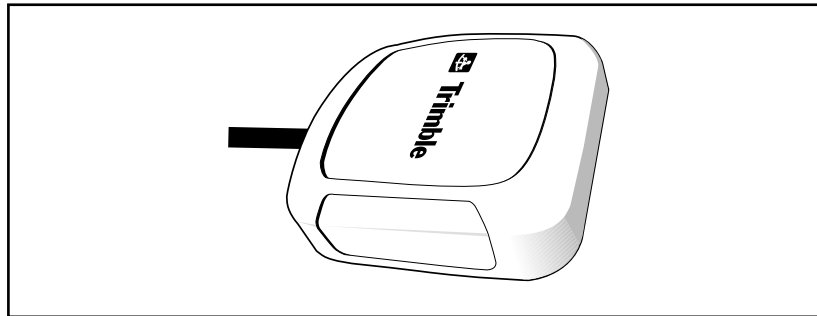
Figure 2-11   Miniature Magnetic GPS Antenna

To mount the Magnetic GPS Antenna:

1.   Choose the antenna mounting location (see Choosing the GPS Antenna Mounting Location on page 2-10).

2.   Mount the antenna to a ferrous surface. The antenna can be mounted on the exterior of the vehicle or in the vehicle's interior.

3.   Route the antenna cable. The antenna features a permanent antenna cable which must be routed to the location where the CrossCheck GSM is mounted. For detailed cable routing guidelines, see Routing the GPS Antenna Cable on page 2-20.

Caution – The magnetic-mount antenna cable is exposed to the environment. Since wind could cause the cable to whip around, use tie wraps to secure the cable along its route.

> **Caution –** The magnetic-mount antenna cable has no strain relief at the antenna end of the cable and is not recommended for permanent installations.

2.6   Routing the GPS Antenna Cable

The Magnetic GPS Antenna has an integral antenna cable, and the Miniature Bulkhead GPS Antennas have a separate 5 meter (or approximately 16 ft.) cable. If you are using one of the Miniature Bulkhead GPS Antenna units, attach the antenna cable to the SMA connector on the base of the antenna prior to routing the cable. When routing the cable, start at the antenna and choose the most direct path to the CrossCheck GSM while avoiding the following hazards:

- Make sure that at least two inches of clearance exists between the CrossCheck GSM's Antenna connector and the nearest obstacle.

- Make all cable bends, especially the bend at the SMA strain relief to the Antenna connector, with at least one-half inch bend radius.

- Provide an adequate service loop when routing the cable around vehicle hinges to ensure that the cable is not inadvertently pinched when a hinged door opens or closes.

- Make sure that the coax cable is not routed through areas where vehicle movement can abrade the cable surface.

- Never coil the excess antenna cable, particularly the Magnetic GPS antenna cable. A coiled cable can act as an antenna and may receive interference.

- Protect cables from exposure to corrosive fluids.

Once the cable is routed and secured, attach the cable to the CrossCheck GSM GPS (SMA) connector.

2.7   Choosing a GSM Antenna Mounting Location

Although not as critical as GPS antenna placement, cellular antenna placement is also important. Mount the cellular whip antenna in a vertical orientation in a location where it is safe from damage during normal vehicle operation and maintenance. Automated vehicle washes may damage misplaced cellular antennas.

If you are installing multiple antennas, maintain a separation of at least 46 centimeters (or approximately 18 in.) between the cellular (or other) and GPS antennas (see Figure 2-12). If you are using a combination GPS/cellular antenna, maintain a separation of at least 46 centimeters (or approximately 18 in.) between the combination antenna and any other antennas.
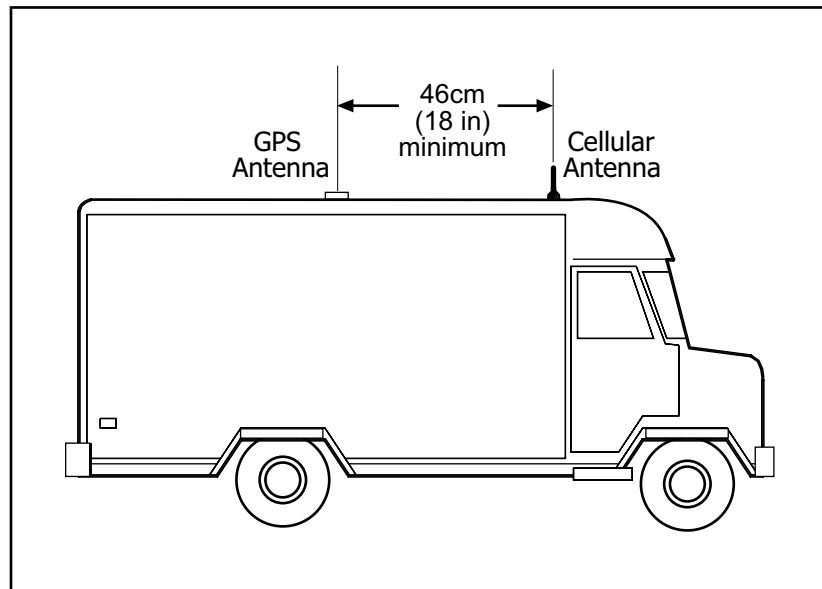
Figure 2-12   Distance Between Antenna Locations

In general, the farther the separation, the less chance of interference. For permanent antenna installations, choose a location with access

both above and below the antenna mounting surface. This access is required for installing fasteners and for routing the antenna cable.

Cellular phone dealers and installers are experts on cellular antenna placement. For some installations, the installer can substitute a glass-mount antenna as long as it conforms to the requirements listed in Appendix A, Specifications.

2.7.1   Routing the GSM Antenna Cable

The next step in the installation process is routing and connecting the antenna cable to the CrossCheck GSM. When routing the cable, start at the antenna and choose the most direct path to the CrossCheck GSM while avoiding the following hazards:

- Sharp bends or kinks in the cable.

- Excessive heat.

- Exposure to corrosive fluids.

- Never coil the excess antenna cable, particularly the cellular antenna cable. A coiled cable can act as an antenna and may receive interference.

- Provide an adequate service loop when routing the cable around vehicle hinges to ensure that the cable is not inadvertently pinched when a hinged door opens or closes.

- Make sure that the coax cable is not routed through areas where vehicle movement can abrade the cable surface.

Caution – If your cellular antenna cable is exposed to the environment, wind could cause the cable to whip around. Use tie wraps to secure the cable along its route.

Caution – A minimum separation distance of 20 cm must be maintained between the antenna and persons for this device to satisfy the RF Exposure requirements of the FCC. For fixed mount operation, the antenna co-location requirements of Section 1.1307(b)(3) of the FCC rules must be satisfied.

For fixed mount operation, the maximum gain of the antenna must not exceed 7 dBi. For mobile operation, the maximum gain of the antenna must not exceed 3 dBi.

WARNING! Use of this unit in portable operations is not permitted.

2.7.2   Connecting the Magnetic GSM Antenna Cable

After routing the GSM antenna cable, connect the cable to the mini-UHF connector. Tighten the connector firmly to prevent loosening caused by normal vehicle vibration.

2.7.3   Connecting the Permanent-Mount GSM Cable

Once the cable routing is complete and the cable is secured attach the mini-UHF connector on the antenna cable. Then attach the cable to the GSM connector on the front panel of the CrossCheck GSM.

2.8   Connecting the Power and I/O Cable

The power and I/O cable (P/N 40358) is a flexible interface for connecting power and a variety of input and output peripherals to the CrossCheck GSM (see Figure 2-13).
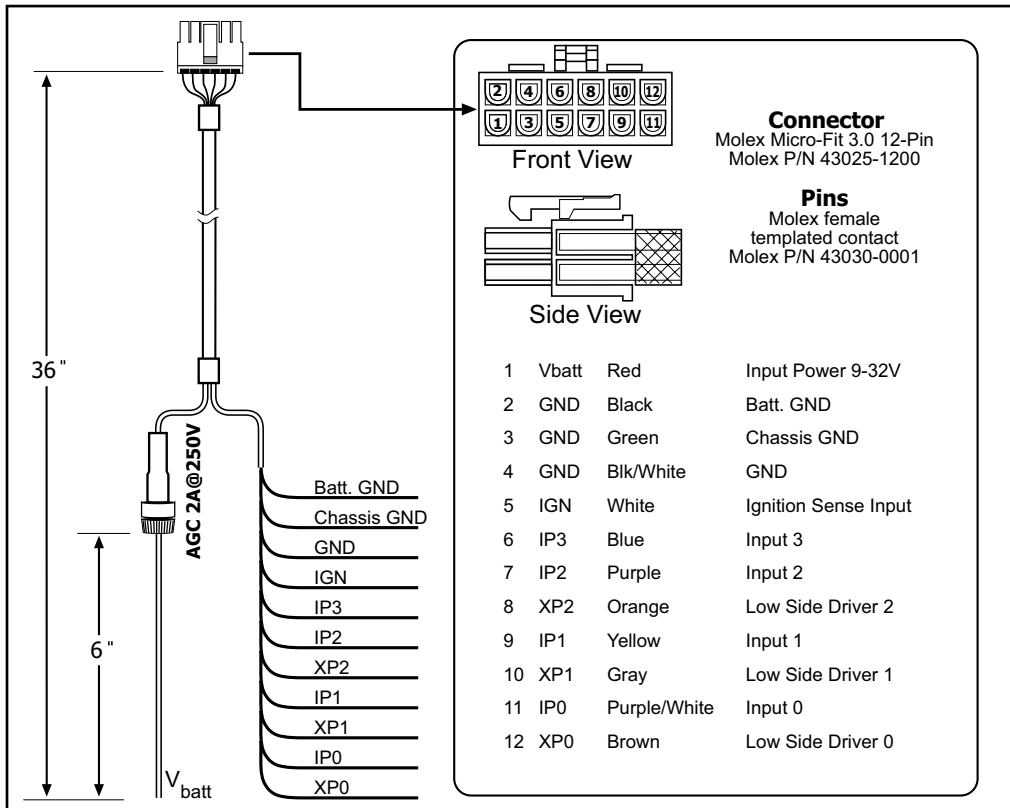
Figure 2-13   Power and I/O Cable

The power and I/O cable is 91 cm (3 ft.) long with 12 wire leads and connects to the CrossCheck GSM's I/O port. [1]

[1.] Trimble also supplies a power-only cable (not combined with I/O), for use with cigarette lighters (P/N 43505).

Table 2-4 provides pin-out information for the I/O cable. Each of the connections is briefly described in Table 2-4 and more detailed descriptions of each cable lead follow the table.

Table 2-4   Power/Interface Cable Pin-Out

Pin #	Signal	Function
1	V_{Batt}	Input: Power 9-32V
2	GND	Ground
3	CHAS	Chassis Ground
4	GND	Ground
5	IGN	Input: Ignition Sense
6	IP3	Discrete Input 3
7	IP2	Discrete Input 2
8	XP2	Low-side Driver 2
9	IP1	Discrete Input 1
10	XP1	Low-side Driver 1
11	IP0	Discrete Input 0
12	XPO	Low-side Driver 0

If you want to make your own power and I/O cable, refer to Figure 2-2 for information on the specifications for the cable connectors (Molex® P/N 43025-1200) and contacts (Molex P/N 43030-0001).

Please include a 2A fuse connected to Pin 1.

2.8.1   Inputs (IP0 to IP3)

The CrossCheck GSM unit supports four discrete inputs. The circuit diagram is shown in Figure 2-14.
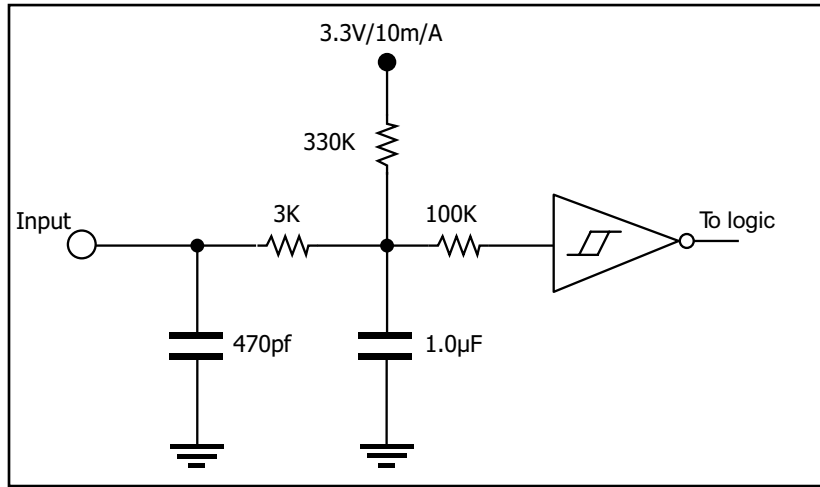
Figure 2-14   Input Circuit Diagram

Input Logic High: Open circuit or V_{in} > 2.4 VDC

Input Logic Low: V_{in} < 0.6 VDC

The inputs must remain in either state for at least 200 milliseconds before the CrossCheck GSM detects the input.

Input Current (Max) I_{in} < 3 milliamps

1 milliamp is typical at 12V.

Input Protection: Protected up to at least VBatt continuous

Each input floats to a logic high state (inactive) when left open. Grounding an input causes a logic low state (active). The CrossCheck GSM can be configured to detect either logic high or logic low states at the inputs whenever the unit is powered on.

> **Note –** The CrossCheck GSM can be configured to detect only a logic low (grounded) input when it is powered off and in power management mode.

The discrete inputs are compatible with properly connected relays and switches or with standard 3.3 volt logic levels. A properly connected relay or switch allows the input to float high in one position and grounds the input in the other position.

The input must be held in a particular logic state for at least 200 msec (configurable up to 1 second) so the CrossCheck GSM can detect it.

2.8.2   Outputs (XP0 to XP2)

The CrossCheck GSM features three discrete outputs (XP0-XP2) for driving external devices such as relays. When inactive (default state), the discrete outputs are tied to vehicle battery voltage (nominally 12 VDC) through a 15 kOhm resistor. When active, the outputs are shorted to ground through a bipolar junction transistor. In the active (low) state, the outputs can sink up to 200 milliamps. Figure 2-15 shows a diagram of a discrete output.
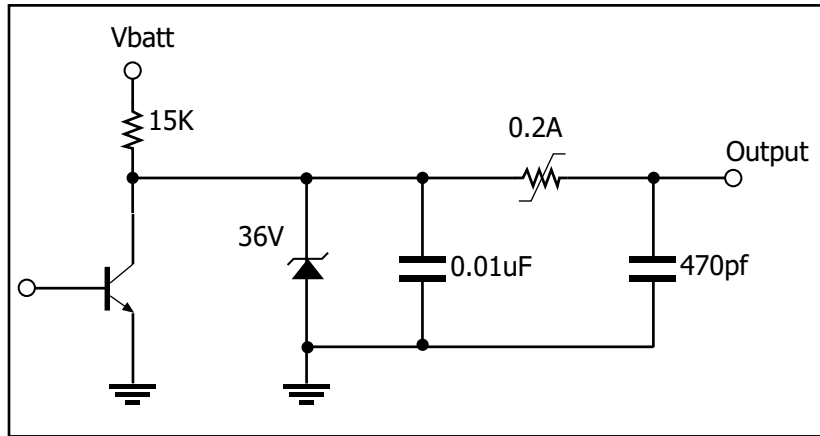
Figure 2-15   Output Circuit Diagram

Output Inactive:	15 kOhms through $V_{vehicle\text{-}battery}$,
Output Active:	Tied to ground through a saturated bipolar junction transistor, V_{out} 1.5 VDC at 200 milliamps; V_{out} < 0.5 VDC at 10 milliamps
Output Protection:	Protected against direct shorts to ground
Output Sink Current Capability	Up to 200 milliamps

For more information about discrete outputs, refer to the *TAIP/* **IQ***Event Engine Reference Manual*, section 2.5, "Digital Inputs and Outputs."

2.9   Connecting a Computer or Mobile Data Device with the Serial I/O Cable

The D-9 connector is an RS-232 (receptacle) DCE (Data Communication Equipment) serial port, making it compatible with most personal computers and Mobile Data Devices.

You can configure the MDT/Aux port with the TAIP MT command. (For more information on TAIP commands, refer to the *TAIP/***IQ***Event Engine Reference Manual.)*

The MDT port supports the following modes:

- Normal—Supports any combination of TAIP, TSIP, and NMEA protocols

- PAD—All input is converted into TAIP TX messages, all output is text stripped from TX messages

- AT—Traffic consists of AT commands and data from the MDT device to GSM, and GSM responses to the MDT device from the CrossCheck GSM

The MDT inputs (Rx) accept –3 to –15 VDC. A low input signal is less than -3VDC (typical). A high input signal is greater than+3VDC. The MDT outputs (Tx) range from –5 volts to –8 volts, depending on the load.

Note – During normal operation, the MDT/Aux service port communicates with a PC or Mobile Data Device using TAIP messages (see Chapter 5, IQEvent Engine Overview and the **IQ***Event Engine/ TAIP Reference Manual* for detailed information) at 9600 bps, 8-N-1, and no flow control. The baud rate and other communications parameters can be set to match the PC or Mobile Data Device settings.

Figure 2-16 shows the cable connections between a PC and the CrossCheck GSM.
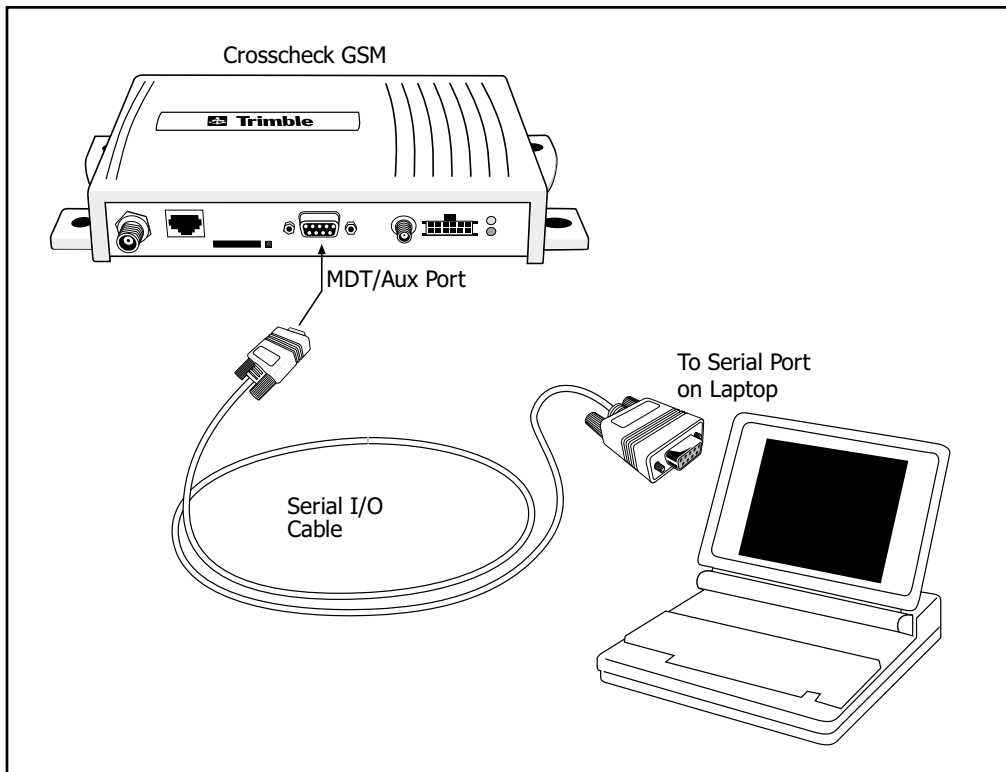
Figure 2-16   PC to CrossCheck GSM Connections

2.10 CrossCheck GSM Power

The CrossCheck GSM operates on input voltages from 9-32 VDC. The low noise amplifier integrated on the GPS antenna draws power from the CrossCheck GSM through the antenna cable. The CrossCheck GSM does not require any special power up or down sequencing.

The CrossCheck GSM's power circuitry is designed to protect the unit from random power fluctuations and conditions. Input circuits protect against transient voltage spikes found in most auto and truck environments. An external fuse protects against excessive current.

See Appendix A, Specifications, for more information on the CrossCheck GSM power requirements.

Figure 2-17 shows the power and I/O cable.
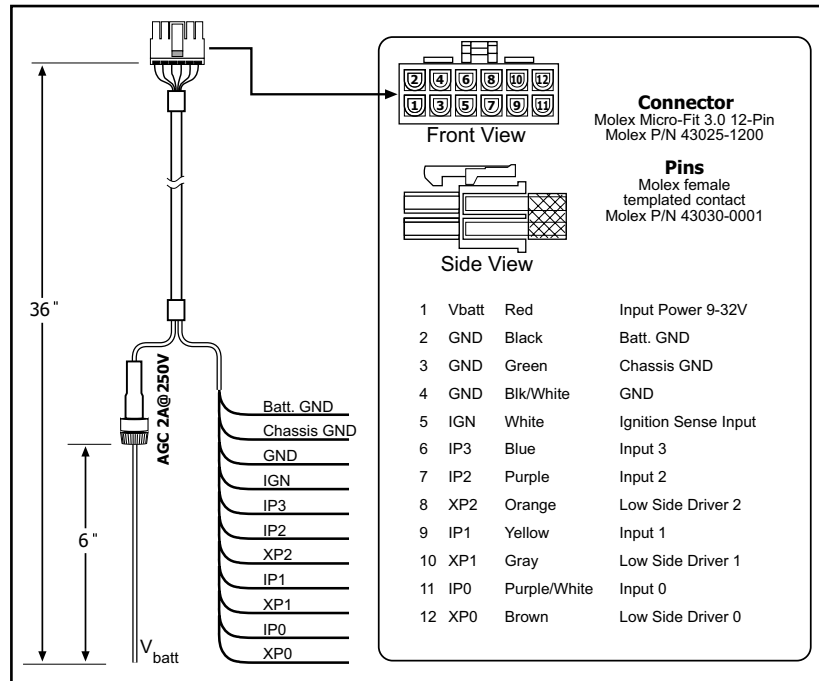
Figure 2-17   I/O Power Cable (P/N 40352)

Note – Trimble recommends installing the power and ground leads as close to the battery as possible to ensure that the CrossCheck GSM is connected to the cleanest source of power possible.

The CrossCheck GSM is protected against both input power over-voltage and reverse polarity. The primary power cable has a built-in 2-amp fuse. The DC ground line connects to the vehicle's DC ground. The Ignition Sense lead, if connected to a source of ignition switched battery voltage, senses when the vehicle's ignition is active. There are three connection options for connecting the Power, Ground, and Ignition Sense wires. These options are described in the next three sections.

Note – The CrossCheck GSM (including the cellular phone) will power down automatically when input voltage drops below 9V or exceeds 32V, see the input power specification in Appendix A. **IQ** *Event Engine* signals for under- and over-voltage are available, with default values of 9.5V and 31.5V respectively.

For configurations, refer to the TAIP PM message description in the *TAIP*/**IQ** *Event Engine Reference Manual*.

2.10.1 Connections For Power Management

For the Power Management configuration, the CrossCheck GSM operates and draws power (150 milliamps nominal) continuously only when the vehicle is running. When the ignition is off, the CrossCheck GSM responds to the change in the state of the Ignition Sense lead and goes to sleep (at programmed intervals), drawing reduced power (<10 milliamps).

When **IQ***Event Engine* is configured for power management, the CrossCheck GSM can be scheduled to wake up periodically, typically long enough to refresh its GPS position) or could wake up when triggered by an external signal or GSM Ring, and then go back to standby mode. Therefore, even though the CrossCheck GSM is drawing power while awake, its duty cycle is a fraction of what it would be under continuous power, and battery life is extended. For additional information, refer to PM Message in the *TAIP/***IQ***Event Engine Reference Manual*.
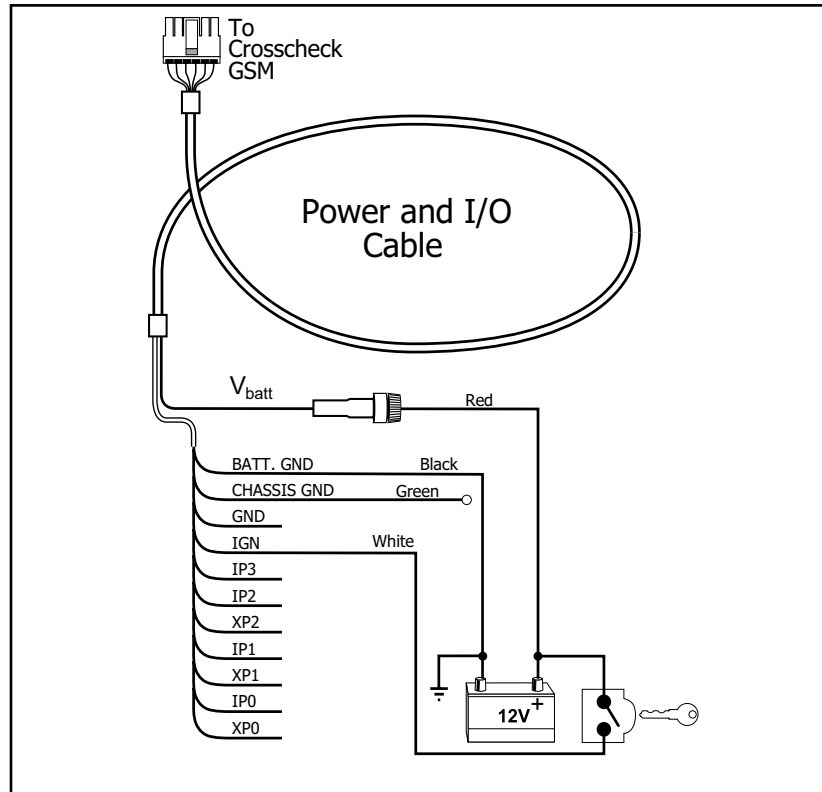
Figure 2-18   Power Management Power Connections

To install the power cable for use with the Power Management feature:

1.   Connect the primary power line to a non-switched/continuous source of DC power, such as the vehicle's battery.

2.   Connect the Ignition Sense line to ignition switched battery power, so that this line is active when the ignition is on.

> **Note –** For the Power Management mode, make sure that the Command parameter is set to 'A' using the PM message (refer to PM Message in the TAIP/**IQ** *Event Engine Reference Manua*l). Power Management is disabled (Command parameter is set to 'D') by default which is equivalent to the Continuous Power mode (see below).

2.10.2 Continuous Power Connection (No Power Management)

For the Continuous Power configuration (see Figure 2-19), the CrossCheck GSM operates and draws power continuously, (150 milliamps is typical without the Voice Upgrade Kit, 325 milliamps is typical with the Voice Upgrade Kit) even when the vehicle is not running.
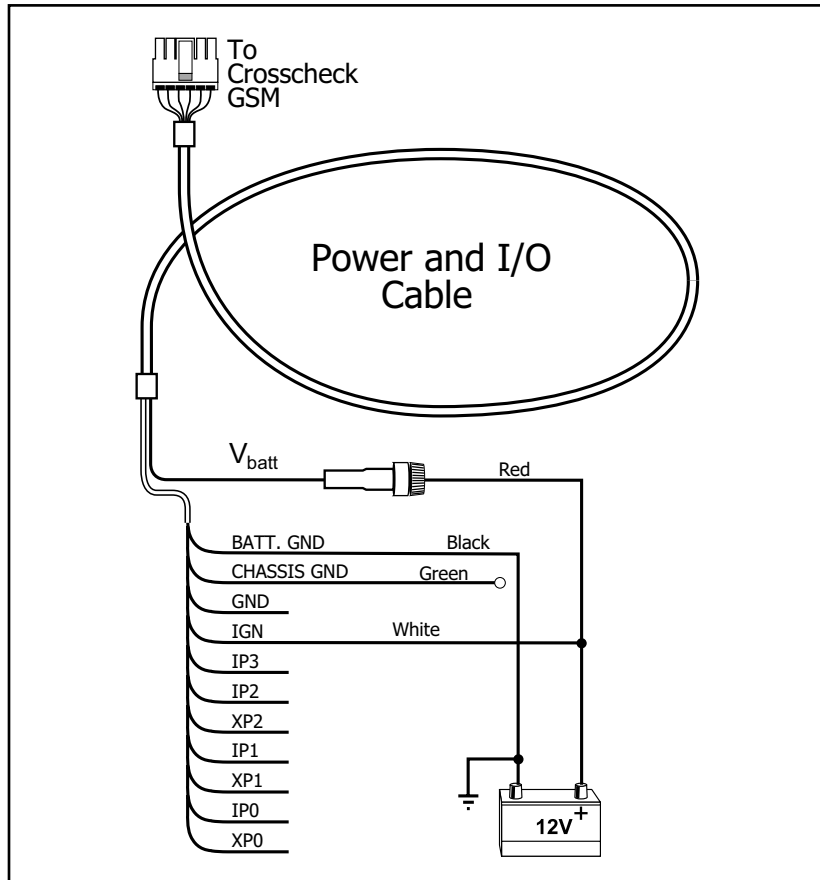
Figure 2-19   Continuous Power Connections

To connect the power cable to continuous power:

First connect the primary power line, then connect the ignition sense line to a non-switched/continuous source of DC power, such as the vehicle's battery.

> **Note –** With the Continuous Power Configuration, the CrossCheck GSM may drain the car battery in 1 to 3 weeks, depending on battery quality and remaining life span, and if the vehicle is not operating during the entire time. Observe extreme care when using this connection option. The CrossCheck GSM will automatically power off when the voltage drops below 9 VDC.

2.11 Installing the CrossCheck GSM Voice Upgrade Kit

The Voice Upgrade Kit (P/N 43456) includes the items shown in Figure 2-20.
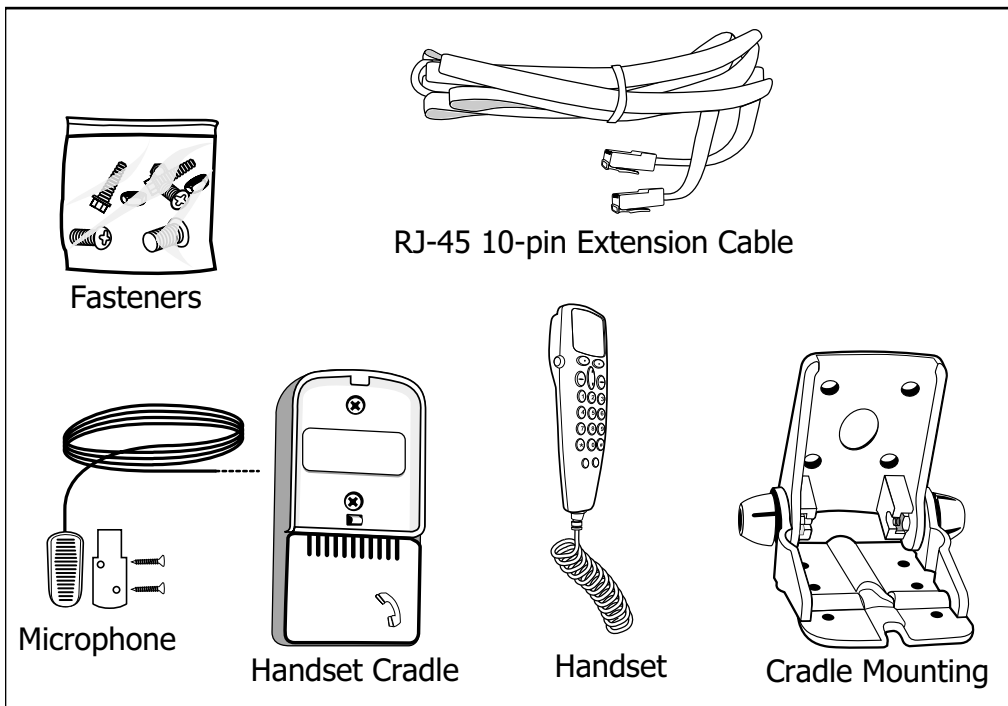
Figure 2-20 Voice Upgrade Kit Components

Use the RJ-45 Extension Cable to connect CrossCheck GSM the cradle.

To perform the installation, the following components from the Voice Upgrade Kit are used:

- Handset

- Cradle Mounting Bracket

- 5 meter (or approximately 16 ft.) RJ-45 Extension Cable for connecting to the CrossCheck GSM

- Microphone

- Handset Cradle

- Mounting Fasteners

As an example, Figure 2-21 shows the typical cable interconnection scheme between a CrossCheck GSM mounted in a car trunk with the RJ-45 Extension Cable.
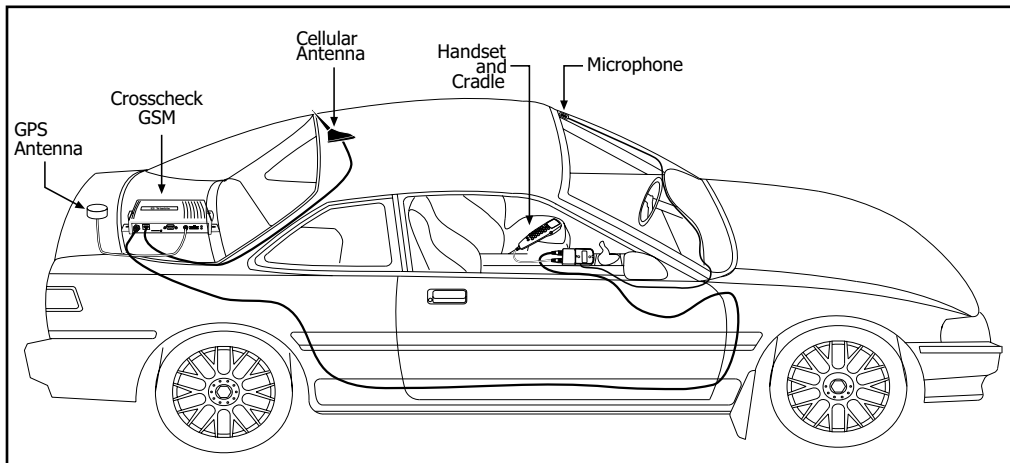
Figure 2-21   Typical Voice Upgrade Kit Installation for Car with the CrossCheck GSM Mounted in Trunk

Installer-Supplied Components

The parts listed in Table 2-5 must be supplied by the installer.

Table 2-5   Items Supplied by Installer

Qty	Item Supplied by Installer
1	Mounting Stand (if necessary)
varies	Appropriate Screws for installing the Mounting Stand

2.11.1 Mounting the Cradle Mounting Bracket

The Handset Cradle, Cradle Mounting Bracket, and fasteners are included with the Voice Upgrade Kit. Figure 2-22 shows the assembly of the Handset Cradle and the Cradle Mounting Bracket.
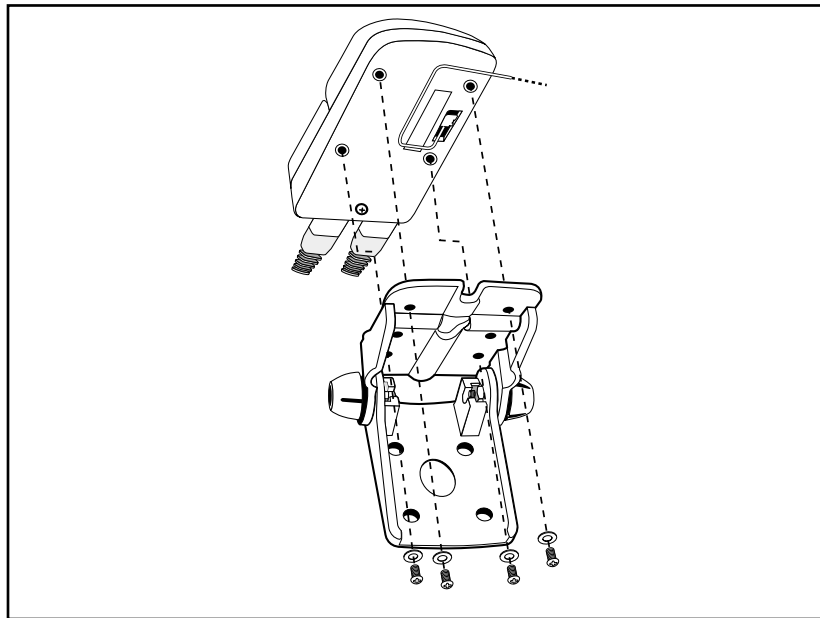
Figure 2-22   Cradle Mounting Bracket Assembly

The Cradle Mounting Bracket can be mounted on the vehicle dashboard or at another location within easy reach of the driver.

To install the Cradle Mounting Bracket:

1. Choose an appropriate location to install the Cradle Mounting Bracket, ensuring that the location meets these conditions:

    • Material is firm enough to provide a stable mount

    • No hazards exist when driving in the self-tapping screws (wiring, fuel tank)

    • Cradle Mounting Bracket does not interfere with seat travel or gear shift movement

    • Handset is positioned for comfortable viewing

    • Easy access to the handset from the driver's seat

Note – If a suitable mounting location cannot be found for the Cradle Mounting Bracket, a 2, 4, or 6 inch pedestal mount, or a right-angle swivel bracket and bracket adapter latch can be used.

2. Orient the base of the Cradle Mounting Bracket in the most accessible direction for grasping the handset, and use the holes in the Cradle Mounting Bracket as a hole drilling template for marking holes at the mounting location.

3. Secure the Cradle Mounting Bracket to the dash or other vehicle mounting location using the appropriate fasteners.

4. Insert the handset into the Handset Cradle, and press down until the handset snaps into the Cradle.

2.11.2 Installing the Extension Cable

To install the extension cable:

Note – The 10-pin, RJ-45 Extension Cable is a 10-conductor cable, not an 8-conductor RJ-11 phone cable or a regular 8-pin RJ-45 LAN cable. Do not substitute an RJ-11, or regular RJ-45, extension cable for the 10-pin, RJ-45 Extension Cable.

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1. Route the RJ-45 extension cable, through the vehicle chassis to the CrossCheck GSM.

2. Connect one end of the RJ-45 extension cable (if used) to the RJ-45 jack on the, and the other end to the RJ-45 jack on the handset cradle.

2.12 Choosing a Location for the Microphone

Figure 2-23 illustrates the recommended locations for placement of the microphone.
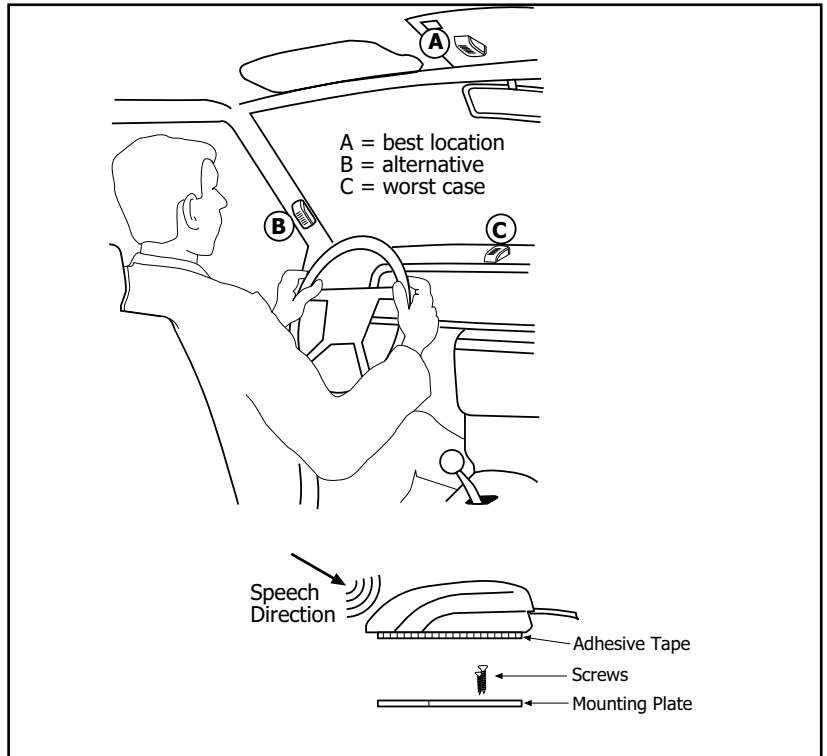
Figure 2-23   CrossCheck GSM Microphone

2.13 The Subscriber Identity Module

Figure 2-24 shows how to insert the SIM, in SIM carrier, into the CrossCheck GSM. To move your GSM account to another CrossCheck GSM or GSM handset, simply insert your SIM into that device.
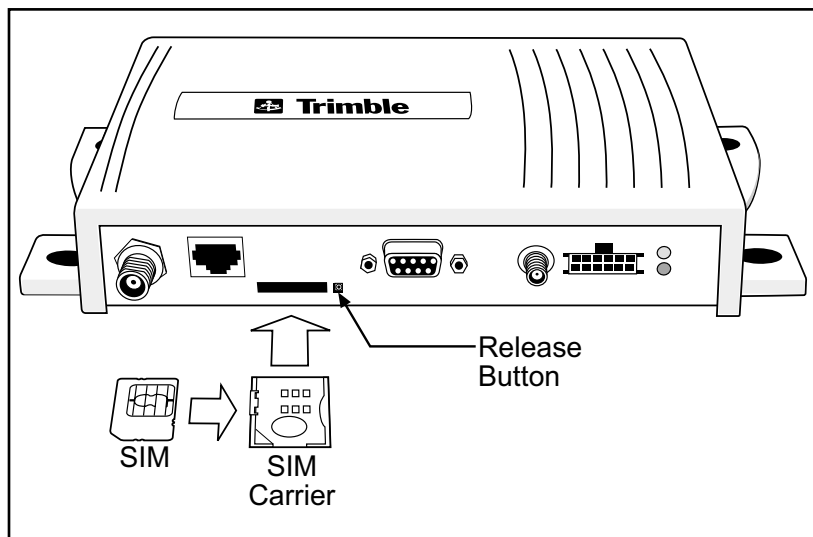
Figure 2-24   SIM Module and SIM Carrier

Note – To eject the SIM, press the release button with the point of a ball point pen.

Caution – Before powering up and testing the installation, you must complete the configuration procedures described in Chapter 3, Configuration. Failure to complete the configuration procedures may cause permanent blocking of the SIM.

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3   Configuration

The information provided in this chapter shows you how to use TAIP messages and the Microsoft Windows 95/98/NT/2000 HyperTerminal program to configure the CrossCheck GSM's **IQ***Event Engine*.

3.1   Communications Session Language

TAIP (Trimble ASCII Interface Protocol) serves as the communications session language for initializing, configuring, and monitoring the CrossCheck GSM. For detailed information about IQEE and the TAIP format, refer to the *TAIP/***IQ***Event Engine Reference Manual* (P/N 38341-00).

Note – For a more elegant approach to configuring the CrossCheck GSM, the **IQ***Event Engine* Configuration software can be used. See the Trimble Web site (http://www.trimble.com/products/catalog/mobile/xcheckgsm.htm) for more information.

3.2 Installing the HyperTerminal Initialization File

To install the HyperTerminal initialization file for Windows 95/98/ NT, first download the file (CrossCheck GSM.ht) from the following web site:

http://www.trimble.com/products/catalog/mobile/xcheckgsm.htm

Place the CrossCheck GSM.ht file in the HyperTerminal directory. If Windows is installed on drive C, the HyperTerminal program should be installed in the following location:

C:\Program Files\Accessories\HyperTerminal

Create a *Startup* menu shortcut using the following command line:

"hypertrm.exe" CrossCheck GSM.ht

Detailed instructions for creating shortcuts are included in the Microsoft Windows documentation and help system.

3.3 Preparing to Configure the CrossCheck GSM Unit

The instructions in the remainder of this chapter show you how to configure the CrossCheck GSM using the HyperTerminal program CrossCheck GSM.ht file. However, you can use any communications program capable of handling the direct exchange of ASCII data across an RS-232 serial connection, including communication programs for other operating systems.

3.3.1 Connecting the PC to the CrossCheck GSM Unit

Before beginning, connect a PC serial port to the MDT/Aux port on the CrossCheck GSM. For instructions, see Connecting the Power and I/O Cable on page 2-24.

3.3.2 Starting the HyperTerminal Program

To start the HyperTerminal program, select the *Startup* menu shortcut to display the following window:
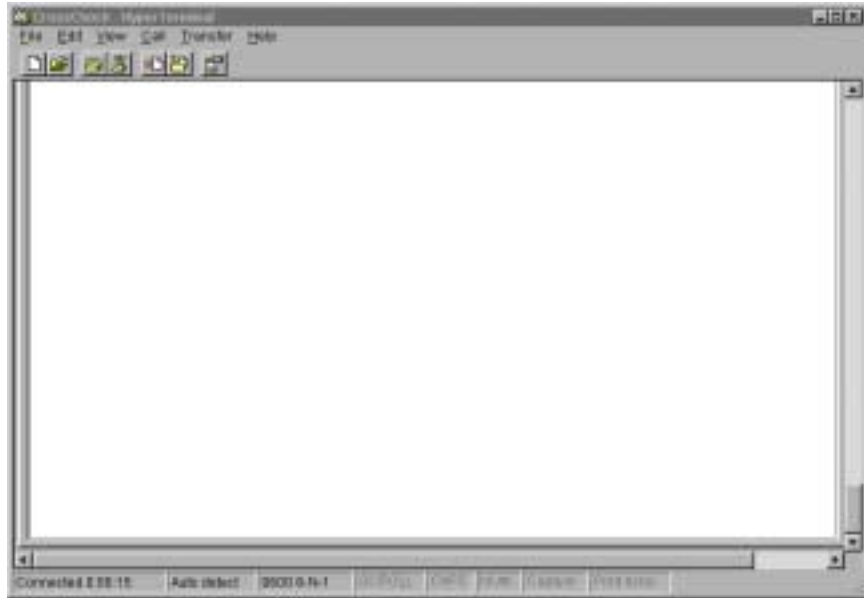
Figure 3-1   HyperTerminal Window

The HyperTerminal window's titlebar should begin with the 'CrossCheck GSM' configuration file name as shown above.

By default, the CrossCheck GSM.ht file configures the HyperTerminal program to look for the CrossCheck GSM on COM1. If the CrossCheck GSM is connected to another port (COM2, for example), select Properties from the File menu and configure the HyperTerminal program to use the correct serial port.

On-line help is provided in the Properties dialog for setting the parameters correctly.

3.3.3 Testing the Serial Link with the CrossCheck GSM Unit

To test the CrossCheck GSM for proper operation:

1. Apply power to the CrossCheck GSM.

2. Send a simple query message. For example, you can type the following message in the HyperTerminal window to send the following message to query the CrossCheck GSM for the product name and software version:

    ```
    >QVR<
    ```

    If the CrossCheck GSM is operating properly, it should acknowledge the query by sending a response such as:

    ```
    >RVRCrossCheck (TM) GSM;VERSION 1.00
    (date); PROD=06.00;TAIP=01.10;ID:0000;
    <checksum><
    ```

Note – Version numbers may vary.

3.4 Initializing the CrossCheck GSM Unit

This section discusses how you configure your Subscriber Identity Module (SIM), program your GSM PIN and calling options, and set the TAIP ID.

3.4.1 SIM Configuration and Activation

To operate CrossCheck GSM, you need a SIM card. A SIM is a "smart" card containing a microprocessor and associated logic. It is about the size of a postage stamp. SIMs can be obtained from a network provider, a service provider, or from a mobile phone shop. When you obtain a SIM, make sure that it is configured for data and voice operation, as well as SMS services that normally come with GSM cellular service.

You need a data number if the circuit switched connection is to be made from a land line connection (PSTN/ISDN). However, a voice number is sufficient if the circuit switched connection is between two GSM units (CrossCheck and GSM phone at the base). In this case, the voice number supports voice, SMS, and circuit switched modes.

You can use SMS for simple reporting, either querying from the base or exception reporting from the mobile unit. It should not be used for lengthy sessions, such as log download.

The SIM card is the true identity of any GSM phone (including a CrossCheck GSM) as far as the mobile network is concerned. Once you have obtained a SIM card, the network you have chosen may require that you set a PIN (Personal Identification Number), which is a four to eight digit number that can be used to protect the SIM from unauthorized use. You can set the PIN on the SIM by putting the SIM into a standard mobile phone and using that phone's PIN setting ability.

You will also need to supply the PIN to the CrossCheck GSM unit as it will be initializing the SIM on your behalf. Trimble recommends setting the PIN in the CrossCheck GSM unit before inserting the SIM, as this avoids having old PINs rejected by the SIM (see below). The

PIN is set using the PC message (`>SPCGE;PIN=x...x<`) as described in Programming the GSM PIN and Calling Options on page 3-8.

Having set the PIN, Trimble recommends that you:

1. Verify that the PIN is correct, (`>QPC<`).

2. Remove power from the CrossCheck.

3. Insert the SIM.

4. Apply power to the unit.

The supplier of your SIM will probably provide additional information. If you intend to send SMS (Short Message Service) messages, make sure you are provided with an SCA (Service Center Address). This is the telephone number of an SMSC (Short Message Service Center) and is required by the CrossCheck GSM in order for it to send SMS messages. (Set it using the `>SPCGE;SCA=nnnnn...<` command where `nnnnn` is the SCA). Typically, each network provider has one or more SMSCs. Please be aware that there are some reports of SMS interoperability issues between some networks or subnetworks, but these are few and there should not be a problem if you are operating within a single network.

Warning – Incorrect entry of the PIN could cause the SIM to be blocked. For more information on blocked SIMs, see SIMs and the Network.

3.4.2   SIMs and the Network

The SIM controls network access by verifying that the PIN it contains matches the PIN supplied by the CrossCheck GSM firmware. If the numbers do not match, or if the SIM is not inserted in the CrossCheck GSM, the amber GSM LED fast blinks and one of the following messages is output to the MDT port:

```
>SPCGE;SIM=PIN ERR<   - PIN in PC message does not match SIM
>SPCGE;SIM=BLANKPIN< - PIN field in PC message is empty
```

```
>SPCGE;SIM=ABSENT<    - SIM card is not present
```

Access to the GSM network is then prevented. Once a PIN mismatch occurs, the CrossCheck GSM firmware will not attempt to initialize the SIM with its PIN (even after a power cycle) until another set pin command (>SPC...<) has been entered. This is done to prevent the SIM being "blocked" (see below). After a PIN mismatch, subsequent CrossCheck GSM resets causes the GSM LED to fast blink, and the following message is displayed at the MDT port:

```
>SPCGE;SIM=PIN ERR<
```

Once a new set PIN command has been entered, the CrossCheck GSM firmware attempts once more to initialize the SIM with the PIN. This occurs even if an identical PIN is entered in the set PIN command to allow for the condition where the PIN is correct but an incorrect SIM was inserted.

Warning – After three consecutive PIN errors, the SIM will be "blocked." If this is the case, the Comms LED on the CrossCheck GSM fast blinks, and the following message is output to the MDT port:

```
>SPCGE;SIM=PUK REQ<
```

 You will now have to supply a PUK (Personal Unlocking Key). You will need to obtain this eight digit number from the network operator. To enter this number, you will need to place the SIM in a standard mobile phone and use its PUK capabilities.

After ten consecutive wrong entries of a PUK, the SIM will be permanently blocked from GSM operation. A permanently blocked SIM will cause the CrossCheck GSM unit amber LED to fast blink, and the following message is displayed at the MDT port:

```
>SPCGE;SIM=FAILED<
```

You can check the status of the SIM at anytime by using the query:

```
>QPC;SIM=<
```

3.4.3 Further Information

There are a variety of sources of further information (for example, the use of PIN2, number lockouts, and PC utilities for configuring SIMs), particularly on the web. Trimble recommends that you do a web search for this information as it is continuously changing. ETSI is a good source of definitive material (http://www.etsi.org at the time of writing), as is the GSM association (http://www.gsmworld.com at the time of writing).

3.4.4 Programming the GSM PIN and Calling Options

Enter the cellular PIN using the TAIP PC message:

>SPCGE;PIN=x...x<

where $x...x$ is the PIN currently defined for the SIM that is inserted in the CrossCheck GSM's SIM slot. If no PIN is defined for the SIM card, you do not need to enter a PIN. Once a PIN is entered, it is maintained in non-volatile (battery-backed) memory, and is used on each CrossCheck GSM power up to initialize the GSM module. Whenever the SIM card is changed, the PIN must be re-entered.

Note – Due to factory default settings, messages received from the CrossCheck GSM always include the unit's Vehicle ID and an appended checksum. For brevity, these two parameter settings are ignored in the examples below.

Factory Defaults

To query the CrossCheck GSM for the current configuration, send the following message:

>QPC<

A new CrossCheck GSM (out of the carton) responds with a message containing the factory default parameter settings for the protocol configuration:

```
>RPCGE;RADIO=26;RX=ALL;TX=CSW,PSTN,DTRDCD,
0,500,1500;SCA=; PIN=; TRACE=0;
BRN=0060,04;BRA=0060,04;ALH=1;ROUTE=0<
```

The Protocol Type is always set to **G** (GSM) and the Protocol Enable Flag is always set to **E** (Enabled).

For Circuit Switched calls, the BRN and BRA parameters allow adjustment of the CrossCheck GSM's built-in scheme for retry attempts when a circuit-switched (CSW) call to the base station cannot be connected. The BRN parameters adjust the retry scheme for Normal connections (when no alarm messages are queued), and the BRA parameters adjust the retry scheme for Alarm connections (when at least one alarm message is queued).

Note – When CrossCheck GSM is in Circuit Switched Data mode, it can support either PSTN or ISDN connections. Contact your network operator for information on which connection is supported.

Parameters consist of a back-off time (in seconds) and a maximum number of retries. The back-off time specifies only the time until the first retry attempt; subsequent retry times are determined by the back-off / retry algorithm. For detailed information, refer to Back-off/Retry Algorithm in the *TAIP/IQEvent Engine Reference Manual*.

Note – For detailed information about message queue operation, see Destination Addresses and Message Queuing in the *TAIP/IQEvent Engine Reference Manual*.

For CSW calls, ALH is one of three Alarm mode parameter settings. These modes determine how Alarm messages are processed when an active CSW call is in progress. For detailed information about selecting an Alarm mode (ALH), see Alarm Handling in the *TAIP/IQEvent Engine Reference Manual*.

For detailed information about each message parameter, refer to PC Message in the *TAIP/IQEvent Engine Reference Manual*.

3.4.5 Setting the TAIP ID

To set the TAIP ID, you need to send the ID message with the **S** qualifier. Each CrossCheck GSM should be assigned a unique alphanumeric ID to give the vehicle a unique identity. To set the ID to **CA20,** enter the following message:

```
>SIDCA20<
```

The CrossCheck GSM should reply with the following response:

```
>RIDCA20<
```

Note – The CrossCheck GSM will accept a TAIP ID of between four and eight digits. However, FleetVision will accept only four digits. If you are using FleetVision, the TAIP ID must be four digits.

3.4.6   Circuit-Switched versus Short Message Service Mode

Circuit-Switched (CSW) calls rely on connection-oriented communications for sending data between parties. A typical CSW call occurs in a data transfer between two computers. The calling computer sends its call request through a modem, which sets up the call to the modem connected to the receiving computer. Once the connection is established, the data is transferred between the modems.

Short Message Service calls do not require a connection to the party being called. Instead of setting up a connection between two parties, SMS messages go to a SMS center (SMSC). This central processing facility then buffers the message until the recipient phone becomes active.

While CSW data is a modulated and demodulated signal, SMS is a alphanumeric message containing up to 160 characters - much like a pager message.

CSW mode is efficient for large volumes of data, while SMS is best for short messages.

CrossCheck GSM can be configured to use SMS to provide cost-effective data transfer capabilities.

3.5 Testing the Handset Installation

The CrossCheck GSM should be tested in both handset and hands-free voice mode before finishing the installation. For detailed instructions, see Programming the GSM PIN and Calling Options on page 3-8.

3.5.1 Service Provider Configuration

You need to select a GSM service provider, purchase a SIM, and have the service provider initialize your SIM. The SIM should be initialized for voice (Circuit Switched Communications), and for SMS (Data Services) if desired.

3.5.2 Voice Mode Test

To test the Voice mode:

1. Place a call to a test number.

2. Test the handset and hands-free modes to assure proper operation during the call.

3. End the call and have someone call your cellular phone number.

4. End the call.

4   Operation

Once the installation and configuration are completed, the CrossCheck GSM is ready for operation. When power is applied, the CrossCheck GSM can then operate automatically without user intervention, based on its **IQ***Event Engine* configuration.

This chapter provides a basic overview of the CrossCheck GSM's operation, including:

- LED Indicators
- GPS Receiver
- GSM Phone

The **IQ***Event Engine* controls the CrossCheck GSM's operation and interfaces with both the GPS receiver and GSM phone. For detailed information, see the *TAIP/***IQ***Event Engine Reference Manual*.

4.1 LED Indicators

The CrossCheck GSM includes two LED indicators: GPS and GSM. The **IQ***Event Engine* continuously monitors GPS receiver and GSM phone operation and controls the two LED indicators (see Figure 4-1).

GSM LED (Amber)

GPS LED (Green)
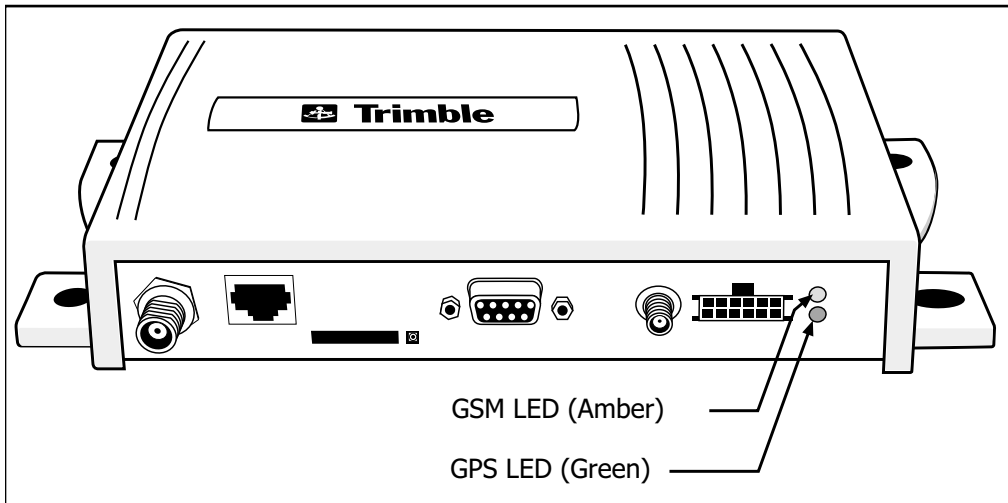
Figure 4-1   Crosscheck GSM LED Indicators

4.1.1 LED States

The GPS and GSM LED each have three states: On, Off, and Blink.

The CrossCheck GSM's power is off when both LED indicators are off, and power is on when one or more LED indicators are on or blinking.

4.1.2   GPS and GSM LED States

Table 4-1 identifies the GPS LED states.

Table 4-1   GPS LED States (Green LED)

GPS LED State	Meaning
On	Computing GPS position fixes.
Blink	Not computing GPS position fixes.
Off	No power is available, or CrossCheck GSM is in Sleep mode, or Standby mode.

Table 4-1 identifies the GSM LED states.

Table 4-2   GSM LED States (Amber LED)

GSM LED State	Meaning
On	Data or voice call in process.
Blink	GSM is not registered with network.
Off	GSM is registered with network or in Standby mode.

4.1.3 LED Power-on Sequence

When the CrossCheck GSM's ignition input and power inputs are activated, both LEDs blink once, turn off for approximately five seconds, then are on for approximately two seconds.

The GPS LED is on for approximately two seconds, then blinks until the first position fix is computed. During this period, the GSM LED blinks until the unit is established in a GSM area, at which point, the GSM LED turns off. When a call is active, the GSM LED stays on for the duration of the call.

When the first position fix is computed, the GPS LED turns on continuously. Afterwards, the GPS LED remains on when computing position fixes or blinks when no position fixes are computed. The GSM LED turns on when a GSM connection is in progress, turns off when no call is in progress, and blinks if no GSM coverage is available or call has not been established.

4.2 GPS Receiver Operation

At power-up, the GPS receiver is initialized with the last known position. Using this information, the GPS receiver acquires satellite signals. During the satellite acquisition process, which normally requires less than two minutes, the green GPS LED blinks. Once three or more satellites are acquired, the GPS receiver computes positions, course, speed and time fixes, and the GPS LED remains on.

A blinking GPS LED indicates that the GPS receiver is not tracking enough satellites to calculate a current position. This occurs occasionally when the vehicle is obscured from satellite signals by terrain, buildings, trees, tunnels or other structures. During this period, called satellite reacquisition, the GPS receiver continuously searches for the obscured satellites and expands its search to other satellites to continue position computations. For brief blockages, the GPS receiver normally reacquires a lost satellite signal and resumes position fixes in less than two seconds.

4.3   GSM Operation

When the GSM LED (amber LED) is off, it means that the unit is registered with the network or in Standby mode. If the CrossCheck GSM is not registered with the network, the LED will blink, and when a data or voice call is in progress, the LED stays on.

The LED indicators are also a useful diagnostic tool. See LED Diagnostic Errors, page 6-9 for more information.

5   **IQ***Event Engine* Overview

The**IQ***Event Engine* (IQEE) manages the operation of the CrossCheck GSM and allows intelligent, autonomous reporting to a base station, to an internal log for later retrieval, or to the MDT/Aux port. By selectively transmitting its position and status only when user-defined events occur the CrossCheck GSM can provide much more specific data for fleet and mobile asset management, while significantly reducing communications costs.

The**IQ***Event Engine* is highly configurable and can be tailored to a wide variety of AVL applications. Its event-based reporting engine can trigger events and event actions based on user-configurable specifications. Thus CrossCheck GSM operation can be automatically changed to react to real-time conditions in the vehicle.

The**IQ***Event Engine* utilizes the following elements to manage CrossCheck GSM operation.

- **Event Engine**—monitor configured event triggers, generate events, initiate event actions

- **Wireless Communications**—queue messages to selected destinations, establish communications, and handle retries when wireless communications are busy or unavailable

- **Data Log**—store and retrieve event, status, and configuration data in internal Data Log

- **MDT Interface**—Integrate a mobile data terminal or other data device to pass data to/from custom software at the base station

- **Discrete I/O**—monitor external device inputs as event triggers and allow control of external devices based on IQEE events

- **Power Management**—provide configurable power-saving strategies

- **Password Protection**—allow secure access to CrossCheck GSM configuration and status data

The following paragraphs contain a brief description of these elements and the associated TAIP message(s) used for configuration and status.   For a detailed description of **IQ***Event Engine* and the TAIP protocol (IQEE's native protocol), please refer to the TAIP/ **IQ***Event Engine Reference Manual*.

5.1   Event Engine

The Event Engine is a simple yet powerful tool to intelligently react to real-time conditions in the vehicle and control CrossCheck GSM reporting and internal operation. It monitors a set of trigger signals, evaluates user-configured events, generates event reports, and initiates other user-specified event actions. Its power comes from its configurability (event triggers and actions are completely user-specified) and its self-modifying capability (event actions can enable or modify the current configuration).

5.1.1   Event Triggers

An event definition contains a set of conditions or triggers that cause an event to occur. The elemental triggers are listed below, but events are typically triggered by a Boolean combination of triggers. For example, an event could be defined to occur when the vehicle enters or leaves a specified region while cellular coverage is available and a discrete input is active. The following elemental triggers are available:

- Position inside/outside a region

- Time elapsed and/or distance traveled

- Time of day, date

- Speed

- Heading

- Ignition on/off (depending on power wiring)

- Discrete Input/Output signals active/inactive

- Counter reaches a specified number

- Data received on MDT port

- Data log over/under 80% full

- GPS status (position fix, antenna connected)

- Communications status (available, roaming, open data connection)

- Power management status (active, about to sleep, reason for wakeup)

- User Flags true/false

- Battery voltage low/high/OK

5.1.2 Event Reports and Event Actions

An event definition specifies an event report and/or other action to occur when the event is triggered. Event reports can be routed to a base station via wireless communications, to the CrossCheck GSM's MDT serial interface, or to the Data Log.

In addition to event reports, other event actions can be specified. These actions can modify the behavior of the CrossCheck GSM and also modify the configuration of events and event triggers. For example, an event that occurs at 8 AM each day can set the Power Management configuration for a 15 minute cycle, and a complementary event that occurs at 5 PM each day can set the Power Management configuration for a 2 hour cycle, thus adjusting CrossCheck GSM power consumption according to expected use. Another example can accumulate the length of time a vehicle spends

in a particular area. An event that occurs when entering a region can start/resume a timer, and a complementary event that occurs when exiting a region can stop/suspend the timer.

The following are examples of typical event actions:

- Report event with position & time to base, MDT, or Data Log

- Turn an output device on/off

- Start/stop/suspend/resume a timer

- Start a distancer

- Start/increment a counter

- Set a user flag to true or false

- Alter an event definition

- Alter a trigger configuration

- Alter power management configuration

Events are configured via the TAIP ED message.

5.2   Wireless Communications

The CrossCheck GSM's wireless communications channel is used to exchange data with one or more base station locations. It can be used in polled mode, where query/response sequences are initiated by a base station, and in autonomous mode, where IQEE-generated event reports are delivered to up to 10 destinations.

The CrossCheck GSM allows configuration for Circuit-Switched or packet-switched (SMS) communications.

In polled mode, responses to queries are returned to the caller via open circuit-switched connection, or via SMS message to the originator of the SMS query.

In autonomous mode, up to 10 destinations can be configured, each with an associated Destination Address (phone number) and out-bound message queue. The message queues draw from a single

memory pool, so an accumulation of messages in one DA queue reduces the number of messages available for other DA queues.

When an IQEE event is generated, the event report is placed in the DA queue configured for that event. The configured event priority determines the priority of the DA queue, and the DA queue priority determines whether an immediate call is made to deliver the messages in the queue. The configurable priority levels are

- **Alarm**—A DA queue is marked as an Alarm queue when at least one Alarm message is contained in the queue. When a DA queue becomes an Alarm queue, a call is initiated to deliver the messages in the queue. Alarm queues take precedence over Normal queues. Additionally, an Alarm Handling Mode can be configured to re-route an alarm message to an open connection or to preempt an in-bound connection.

- **Normal**—A DA queue is marked as a Normal queue when at least one Normal message and no Alarm message is contained in the queue. When a DA queue becomes a Normal queue, a call is initiated to deliver the messages in the queue.

- **Low**—A DA queue is marked as a Low priority queue when only Low priority messages are contained in the queue. A Low priority queue accumulates messages without initiating a call.

The CrossCheck GSM provides built-in schemes for retry attempts when a circuit-switched call to a Destination Address cannot be connected. Separate retry schemes are provided for Normal connections (when no alarm messages are queued) and for Alarm connections (when at least one alarm message is queued). Configuration parameters allow adjustment of back-off times and maximum number of retries. When the retry limit is reached, no more attempts are made until a new message enters the queue or until the CrossCheck GSM unit is reset (power cycle or Power Management shutdown/wakeup).

The Wireless Communications channel is configured via the TAIP PC message.

5.3 Data Log

The **IQ***Event Engine* maintains a Data Log in non-volatile, battery-backed memory.

The Data Log is a circular log, where new entries overwrite the oldest log entries.

The following types of data can be directed to the Data Log:

- **IQEE Event Reports** containing an event number and the GPS location and time associated with the event.

- **TAIP TX message**s routed from MDT input

- **IQEE configuration and status data** generated by Event Actions (TAIP queries) for example, counter values, timer values, discrete I/O states, configuration parameters.

Data Log entries can be retrieved and erased via a wireless comms connection or via the MDT serial interface. A facility is available to allow recovery from interruptions in lengthy retrieval sessions.

Data Log control and retrieval is accomplished via the TAIP DL message.

5.4 MDT Interface

The CrossCheck GSM MDT interface allows connection to an external serial device, such as a PC/laptop or message terminal. The MDT interface can be configured in the following modes:

- **Normal mod**e—In Normal mode, the MDT interface is used for CrossCheck GSM configuration and status. The default protocol is TAIP, which is the **IQ***Event Engine* native protocol. IQEE can be configured, events can be reported, and Data Logs can be retrieved via TAIP messages. Other selectable protocols are TSIP and NMEA.

- **PAD mode**—In PAD (Packet Assemble/Disassemble) mode, message text can be input to the CrossCheck GSM and output

from the CrossCheck GSM. All text input is partitioned into packets (according to PAD mode selections) and inserted into TAIP TX messages for routing to a base station or to the Data Log. TX messages received from a base station (or generated by IQEE and routed to the MDT) are stripped of their TAIP "wrapper." and the remaining text data is output to the MDT.

- **AT command mode**—In this mode, the MDT interface becomes an interface to the CrossCheck GSM's internal GSM Comms module. The Comms module can then be used as a data modem. An AT command/response dialog can be used to set up data connections and transfer data via the GSM network.

Configuration of the MDT interface is controlled by the TAIP MT message.

5.5 Discrete I/O

The **IQ**_Event Engine_ provides discrete I/O support to trigger events and send control signals to external devices.

Discrete inputs are de-bounced and transitions are registered once per second to provide Event Engine triggers.

Digital outputs can be set active or inactive or pulsed with selectable pulse width and can be controlled on user demand or from a configured event occurrence.

Discrete I/O control and status is accomplished with the TAIP SS message.

5.6 Power Management

The CrossCheck GSM can be configured in power-save mode to prolong vehicle battery life. The power management strategy is configurable and is in effect only when the vehicle ignition line is not active, that is, when ignition is on, the CrossCheck GSM is also on.

Power management can be configured for timed shutdown/wakeup cycles (for example, wake up every hour at 50 minutes past the hour, and stay awake for 10 minutes) and/or for wakeup from an external signal (for example, when discrete input 1 becomes active). Configurable shutdown delays allow orderly shutdown (for example, the Comms Activity Timeout specifies the time to wait for completion of an active call before shutdown).

Power Management controlled shutdown normally turns off all CrossCheck GSM components. However, a Comms Standby mode can be selected to allow the unit to shut down while keeping the GSM module powered on. The GSM module can then maintain network status and wake up the CrossCheck GSM on an incoming Ring. When Comms Standby is selected, the GSM module will remain On for the selected standby time following each controlled shutdown.

Power Management is configured via the TAIP PM message.

5.7   Password Protection

Access to IQEE configuration and status data can be password-protected. Each CrossCheck GSM can have its own password, or a common fleet password can be assigned. When the password is set and password protection is enabled, the password must be sent each time a dialog is initiated via Communications Channel or MDT connection. Autonomous reports generated by the **IQ***Event Engine* are not affected by password protection.

Passwords are configured and sent via the TAIP PW message.

6   Troubleshooting

The CrossCheck GSM is designed to operate in the conditions found in vehicle applications. When installed and maintained properly, the CrossCheck GSM mobile unit provides years of trouble-free service.

Invalid inputs at any input port (MDT, GSM, over-the-air) do not cause permanent loss of function of the CrossCheck GSM. When presented with inputs that exceed the scope of the appropriate specification, the CrossCheck GSM will ignore the input or implement predictable and reasonable behaviors.

The CrossCheck GSM utilizes watchdog timers on applicable tasks to reduce the possibility of processor "hangs." When a fatal error is detected (or a watchdog timer expires) the controller will restart and attempt to resume normal operation.

All fatal errors and unexpected restarts are logged, and can be inspected via the MDT port or over the air. (For more information, see the Extended Diagnostic Message 5 (X5) in the *TAIP/**IQ***Event Engine Reference Manual*.

The CrossCheck GSM mobile unit has no user-serviceable parts. If a component fails, the CrossCheck GSM must be returned for repair to the authorized Service and Repair Center.

Should the CrossCheck GSM fail to operate properly, the installer or service technician should troubleshoot the installation before returning any components for repair. This chapter provides some guidelines for troubleshooting common problems associated with the CrossCheck GSM's operation. Potential operating problems might include:

- No power

- Poor GPS reception

- Poor GSM coverage

- Communication failure with base

- LED error indicators

- **IQ***Event Engine* programming error

If the CrossCheck GSM mobile unit continues to operate poorly after following the troubleshooting guidelines described in this chapter, contact the CrossCheck GSM supplier for assistance.

This chapter also describes the self tests available with your CrossCheck GSM.

6.1 No Power

The GPS and GSM LEDs on the front of the CrossCheck GSM should be illuminated if there is power to the unit. If both of these LEDs are off, it is likely that you do not have power to the unit. To correct this condition, check the conditions described in following sections.

6.1.1 Cabling Problems

Make sure the all cables are securely plugged into the proper unit connectors. Check for shorts and opens. Verify that you have proper pin and lug crimps.

6.1.2 Connection Problems

Make sure that all connectors are secure and that the power source is providing the correct voltage. Verify that crimps are done correctly.

6.1.3 Fuse Problems

Verify the integrity of the CrossCheck GSM 2-amp fuse (part of the power cable—P/N 40358). If you do not use the Trimble power cable, you are responsible for proper fusing of the CrossCheck GSM.

6.1.4 Battery Problems

Make sure your battery power source is generating sufficient current to power your CrossCheck GSM (1.5A max at 12VDC without the Voice Upgrade Kit, 2.0A max at 12VDC with the Voice Upgrade Kit). Check BTU settings for possible problems. Check the under voltage/ over voltage programmed range.

6.2 GPS Reception Problems

The green GPS LED normally remains on when the GPS receiver is computing position fixes and blinks once, every second, when not computing position fixes.

If the LED is always off, check the power connections.

If the LED fails to turn on when the vehicle is not obscured from receiving satellite signals, check the conditions described in following sections.

6.2.1 GPS Antenna Location

The GPS antenna must be installed in a horizontal plane with a clear view of the horizon and sky. If a significant portion of the horizon is blocked by something on the vehicle, try another location on the vehicle if the current location is suspect. For example, if the GPS signals are blocked by the air conditioning unit on a vehicle's cab or the trailer connected to a tractor, the GPS receiver may have difficulty acquiring enough satellites for a position fix. Move the antenna to a new location where it is not blocked.

6.2.2 Jamming

The GPS antenna should be installed as far away as possible from transmitting antennas, including satellite communication, radar, VHF and cellular. These transmitters may emit jamming signals which interfere with the GPS receiver's ability to track GPS satellite signals, which are very weak. Generally, the stronger the other transmitting device, the wider the distance required between antennas. For the CrossCheck GSM, Trimble recommends a minimum clearance of 46 centimeters (or approximately 18 in.) between the GPS and GSM antennas.

Land-based transmitters, including microwave and television transmitters, can also interfere with GPS reception. If the vehicle is operating near an antenna farm, the CrossCheck GSM may temporarily lose GPS reception while the vehicle is in the vicinity of the transmitters. Reception should return once the vehicle moves away from the transmitters.

If your GPS signals are being jammed, and moving does not correct the situation, the source of the jamming signal may be another antenna mounted too close to your GPS antenna. If possible, turn off the equipment using other nearby antennas to see if this corrects the problem. If turning off nearby equipment unjams your GPS signals, you need to relocate one or more antennas.

6.2.3 Antenna Cable and Connectors

A common problem is damage to the GPS antenna cable during installation. Inspect the GPS antenna cable along its entire length. Look for cuts or pinches in the cable or other signs of deterioration. Check the connectors for signs of stress and broken or bent center pins. If the cable is suspect, try a known good replacement cable.

If you are using a cable from a source other than Trimble, ensure that its performance specifications meet those specified in Appendix A. Cables that do not meet those specifications inhibit the GPS receiver's ability to track weak satellite signals.

6.2.4 Defective GPS Antenna

Infrequently, the GPS antenna may be defective. If the installed GPS antenna is suspect, disconnect the suspect antenna from the CrossCheck GSM and temporarily connect a known good antenna.

If the reception significantly improves, replace the defective unit and return it to Trimble for evaluation and repair.

If you are using an antenna from a source other than Trimble, assure that its performance specifications meet those specified in Appendix A. Antennas that do not conform to those specifications, will inhibit the GPS receiver's ability to track weak satellite signals.

6.3 Poor GSM Coverage

If the amber GSM LED blinks once every second, even when the vehicle is in an area with strong GSM coverage, check the conditions described in following sections. Also, try a known good antenna.

6.3.1 GSM Antenna Location

The GSM whip antenna should be installed in a vertical orientation with a relatively unobstructed clearance around the antenna. Try another location on the vehicle if the current location is suspect. Try another known good antenna.

Even in areas with strong GSM service, there may be pockets where GSM service is poor or non-existent due to how the carrier builds their networks. Contact your local service provider for information on GSM coverage.

6.3.2 GSM Jamming

The GSM antenna should be installed as far away as possible from other transmitting antennas including satellite communication, radar, and VHF radio. These transmitters may emit jamming signals which interfere with the GSM phone's ability to track the GSM signal.

If there are other transmitting antennas located on the vehicle, try moving the GSM antenna farther away from these antennas. Generally, the stronger the other transmitting device, the wider the distance required between antennas.

6.3.3 Antenna Cable and Connectors

A common problem is damage to the GSM antenna cable during installation. Inspect the antenna cable along its entire length. Look for cuts or pinches in the cable or other signs of deterioration. Check the connectors for signs of stress or corrosion and broken or bent center pins. If the cable is suspect, try a known good replacement cable.

6.3.4 Defective GSM Antenna

Infrequently, a new GSM antenna could be defective or could become defective because it is prone to vandalism and other sources of mechanical damage. Inspect the antenna.

If there are signs of damage, disconnect the antenna and temporarily connect a known good antenna.

If the GSM service significantly improves, replace the defective antenna.

If you are using an antenna from a source other than Trimble, assure that its performance specifications meet those specified in Appendix A. Antennas that do not conform to those specifications, will inhibit the transceiver's ability to receive and transmit.

6.4 No Data Communication with Base

Check the conditions described in following sections if the CrossCheck GSM cannot communicate with the base, you can see that it is calling in data mode, and you have verified that it is calling the correct number.

6.4.1 Base Modem Configuration

Consult the modem manual for configuration instructions. Each modem manufacturer has its own settings and control commands. Verify that your configuration, PIN numbers, etc. are correct.

6.4.2 Defective CrossCheck GSM Unit

In this case, the only remedy is to replace the CrossCheck GSM and return the defective unit to Trimble, or a local service center, for repair. Before returning the CrossCheck GSM, be sure to save the CrossCheck GSM's configuration settings, and remove your SIM.

If you believe that the CrossCheck GSM is defective, first move into an area with strong GSM coverage. Call the CrossCheck GSM from a regular phone. Be sure to use the data number for the SIM, not a voice number. Try a known good GSM antenna.

If you hear tone when the CrossCheck GSM answers, then the CrossCheck GSM is operating normally. If you do not receive a signal tone, the CrossCheck GSM may be defective.

6.4.3   No Modem Connection with Base Station

Confirm that the base station modem is configured correctly, and CrossCheck GSM unit is configured and operating correctly. Check to see if the proper base station phone number is programmed correctly.

Confirm the following:

- Verify the base station software is calling the correct CrossCheck GSM telephone number. Often SIMs have both voice and data numbers. Confirm that the base is calling a data number.

- If you are using SMS, make sure the correct SCA is set.

6.4.4   Base Station Software

FleetVision

If you are using FleetVision:

- Check channel setup for proper settings.

- Verify that the CrossCheck GSM unit is programmed correctly.

- Check system for proper modem setup.

Other Tracking Software

If the base station is not using FleetVision software, the base station software may not be correctly integrated with the CrossCheck GSM. Contact your software vendor for assistance.

6.5   Updating Firmware in the Field

You can upload new firmware from a PC or laptop connected to the MDT port.

For more information on updating firmware in the field, refer to the Trimble website (http://www.trimble.com/products/catalog/mobile/xcheckgsm.htm) and follow the re-flash instructions.

6.6   LED Diagnostic Errors

The LED indicators are useful for diagnosing problems. The CrossCheck GSM mobile unit should be inspected by qualified service personnel if any of the situations described in Table 6-1 occurs.

Table 6-1   LED Diagnostic Indicators

LED Error Condition	Meaning
GSM LED Blinks for extended period of time while in a known good coverage area	• GSM antenna cable may not be connected or damaged. Check the cable and the connectors. Try a known good GSM antenna. • You may be in an area of poor coverage. Try moving to a known area of good coverage. • Check the power source.
GPS LED Blinks for extended period of time	• The GPS antenna may have failed, try a known good antenna. The antenna cable may not be connected to the unit. Check for a damaged GPS antenna cable. • Turn the unit off and then back on again. • Replace the unit.
Both LEDs are off	• Check power source. • Check in-line power fuse. • Check for low voltage. • Try a known good unit.
Both LEDs blink rapidly immediately after power up	Built-in Self Test Failure: Cycle power. If condition persists, return to factory.

6.7   Understanding Power-up Tests

A series of basic hardware tests are run on power-up to detect fatal hardware errors. Flaws detected at this level, in most cases, will prevent the CrossCheck GSM from functioning normally.

6.7.1   Power-up Self-Test

Power-up self-test is initiated automatically on power-up following the startup initialization code. The controller outputs a prompt to the

MDT port. If an ESC is detected at the MDT port within a few seconds after displaying the prompt, the controller will then issue status messages via the MDT port, which can be displayed or printed by a diagnostic terminal (for example, a PC).

The status message will indicate if the unit is working or not. If your CrossCheck GSM does not pass the power-up Self Test, gather the status message information and contact your service representative for help.

If the CrossCheck GSM suffers a fatal error during start up (for example, memory failure) both LEDs blink at a faster than normal rate. These errors are occasionally caused by noise or power-supply transients that exceed specified ratings. If the CrossCheck GSM fails the power-up Self Test when installed but not on (for example) a test bench, examine the power supplied to the unit in the vehicle for excessive noise or fluctuations.

If you still have problems with your CrossCheck GSM, please send E-mail to Trimble (at Trimble_Support@Trimble.com) with a description of the problem. Please include all the details you can, such as the name of the product, serial number, part numbers, firmware version, LED states, and the like.

A   Specifications

This appendix lists CrossCheck GSM and antenna specifications, including:

- Standard components

- General specifications

- **IQ***Event Engine* specifications

- GPS specifications

- Physical specifications

- Environmental specifications

- Accessories (Ordered Separately)

- I/O characteristics

- CrossCheck GSM part numbers

A.1   Standard Components

- In-vehicle Mobile Unit (with integrated mounting bracket)

- I/O Power Cable

Table A-1   General Specifications

Power Requirements	**During a call** - no Voice Upgrade Kit: 1.5A peak @12V; 600 milliamps average @ 12V; 7.2W
	During a call - with Voice Upgrade Kit: 2.0A peak @12V; 1.1A average @ 12V; 13.2W
	Quiescent (not transmitting) - no Voice Upgrade Kit: 150 milliamps max @ 12V
	Quiescent (not transmitting) - with Voice Upgrade Kit: 325 milliamps max @ 12V
	Standby (GSM receiver on, rest of unit off): 45 milliamps typical @ 12V
	Sleepmode (all functions off, IGN sense and inputs active): 10 milliamps max @ 12V 20 milliamps max @ 24V.
Memory (Data Storage)	2500 to 3,000 records
Serial Port	MDT/Aux: (1) RS-232 DCE
Serial Port Speed (bps)	300, 600, 1200, 2400, 4800, 9600 (default), 19200, 38400
Data Rate over the Air	9,600 bps maximum (GSM "non-transparent" mode)
Message Formats	TAIP, TSIP, NMEA-0183 Version 2.1
Digital I/O Ports	Inputs: (4) switch closures; ignition Outputs: (3) 200 milliamp low-side drivers
Status LEDs	GPS (green) and Cellular (amber)

Table A-2   IQ*Event Engine* Specifications

Event Triggers	Inputs (4); Outputs (3); Power; Power management; Data log; Ignition; First GPS fix; GPS fix; Cellular; Roaming; GPS antenna; Battery over or under voltage; Regions; Speeds; Heading; Distance/Counter/ Timer; Time elapsed or Time of day; User defined; or any combination
Event Actions	Report to base (up to 10 destinations); Log report; Report to serial port; Modify another event; Change output driver status; Set or Increment a counter/timer/ /distance; Modify time/distance reporting; or Change power management
Messaging	Accommodates a variety of mobile data terminals, laptops, palmtops and PDAs
Output Data	Latitude, longitude, altitude, speed, heading, time and events
Ignition Sense	Off: VI < 0.8 V; On: VI > 2.4 V

Table A-3   GPS Specifications

Receiver	L1 frequency, C/A code (SPS), 8-channel continuous tracking receiver using the Trimble FirstGPS™ and Colossus™ technology
Update Rate	Once per second maximum
Accuracy[a]	Position: better than10 meters (50% CEP) Velocity: < 0.5 meter/second Time: <0.5 meters/second
Time to First Fix	Cold start: < 180 seconds 90% of cases Warm start: < 45 seconds 90% of cases Hot back-up: < 20 seconds 90% of cases Reacquisition after 15 sec blockage: < 2 seconds 90% of cases
Datum	WGS-84

a.   All GPS receivers are subject to degradation of position and velocity accuracies under Department of Defense imposed Selective Availability (S/A). Position may be degraded up to 100 meters 2D RMS.

Table A-4   GPS Antenna Requirements

Antenna Impedance	50 Ohms
Antenna RF Gain	23 dB minimum gain, measured at the input connector to the CrossCheck GSM
VSWR	2:1 Max over range
Power	4.5 +/- 0.5 VDC @ 30 milliamps maximum on center conductor

Table A-5   GSM Antenna Requirement

Antenna Type	Passive, 900/1900MHz nominal, omnidirectional
Antenna Impedance	50 ohms (nominal)
VSWR	2:1 Max over entire frequency range
Minimum Gain	Min 0 dBi, Max for mobile installations: 3dBi, for fixed 7dBi
Frequency	Tx: 880-915 MHz GSM900; 1850-1910 MHz GSM1900 Rx: 925-960 MHz GSM900; 1930-1990 MHz GSM1900

Table A-6   GSM Specications

Cellular	GSM 11.10-1 : Class 4 (2W) 2 GSM900, Class 1 (1W) @ GSM1900
Frequencies	Dual band 900/1900 MHz
SIM	External access, 3V
Operations	Communications via Circuit Switch or Short Message Service (SMS) (GSM 07.05) Three voice calling modes: emergency calls only, call authorized numbers only, or unlimited calling. Event reporting: data-only
Regulatory Approvals	FCC Part 24, Part 15, Industry Canada

Table A-7   Crosscheck GSM Unit Physical Specifications

Assembly	Bottom: Aluminum Top: Injection-molded plastic with integrated shield
Size	9.6"W x 4.75"D x 1.9"H 228 mmW x 121 mmDx 48 mmH
Weight	1 lb. (460 g)
Connectors	MDT/Aux: DB9 (receptacle) Handset: RJ-45 10-pin Power/Ignition + Digital I/O: Molex Micro-Fit 3.0 12-pin 2-row locking (receptacle) SIM: SIM carrier P/N 39816 GPS Antenna: SMA (receptacle) 50 Ω Cellular Antenna: mini-UHF (receptacle) 50 Ω

A.2   Environmental Specifications

Table A-8   CrossCheck GSM Unit (P/N 39772-01)

Operating Temperature	– 20°C to +55°C for GSM 900 mode – 10°C to +55°C for GSM 1900 mode
Storage Temperature	– 25°C to +70°C
Humidity	5% to 95% RH, non-condensing at +40°C
Altitude	-1000 to +18,000 meters
Velocity	515 meters/second (999 miles/hour)
Vibration	$0.008g^2$/Hz 5Hz +3dB/Octave 5Hz to 20 Hz $0.05g^2$/Hz 20Hz to 100Hz -3dB/Octave 100Hz to 800Hz $0.001g^2$/Hz 800Hz to 1000Hz
Shock	Operational: 40 g for 11 milliseconds Non operational: 75 g for 6 milliseconds
Auto Transient Noise	ETS 300 342-1, Section 9-5
MTBF	100,000 hours

Table A-9   Miniature Bulkhead GPS Antenna with Flange (P/N 31192-00)

Size	62.6 mm D x 19.0 mm H (3.5" D x 0.75" H)
Weight	0.13 kg (4.59 ounces)
Mounting Hole Circle	762 mm (3.0 in.), 4 holes, 0.6mm (0.15 in)
Center Mounting Hole	63 mm (0.75 in.)
Threaded Nut	63mm TNC (0.75 in)
Operating Temperature	-40°C to +85°C
Storage Temperature	-55˚C to +85˚C
Humidity	5% to 95% RH, non-condensing at +40°C
Casing	Dustproof, waterproof, shock-resistant polycarbonate

Table A-10   Miniature Bulkhead GPS Antenna without Flange (P/N 32434)

Size	62.6 mm D x 19.0 mm H (3.5" D x 0.75" H)
Weight	0.13 kg (4.59 ounces)
Mounting Hole	63 mm (0.75 in.)
Threaded Nut	63mm TNC (0.75 in)
Operating Temperature	-40°C to +85°C
Storage Temperature	-55˚C to +85˚C
Humidity	5% to 95% RH, non-condensing at +40°C
Casing	Dustproof, waterproof, shock-resistant polycarbonate

Table A-11   Miniature Magnetic GPS Antenna (P/N 37167)

Size	40.0 mm W x 47.0 mm D x 13.3 mm H (1.515" W x 1.85" D x 0.524" H)
Weight	Antenna and cable: 0.13 kg (4.59 ounces) Antenna only: 0.045 kg (1.59 ounces)
Operating Temperature	-40°C to +85°C

Table A-11   Miniature Magnetic GPS Antenna (P/N 37167)

Storage Temperature	-55˚C to +85˚C
Humidity	5% to 95% RH, non-condensing at +40°C
Casing	Dustproof, waterproof, shock-resistant polycarbonate with magnetic mount

A.3   Accessories (ordered separately)

- GPS antennas: Permanent or magnetic mount

- Combination power and digital I/O cable (10-packs)

- Optional Voice Upgrade Kit including:

  - Handset

  - Hands-free cradle and detached microphone

  - 5 meter extension cable

  - Cradle mounting bracket

- FleetVision

- FleetVision External Systems Interface SDK

A.4 I/O Characteristics

Table A-12 MDT/Aux Port

Input Protocols	TAIP, TSIP
Output Protocols	TAIP, TSIP, NMEA-0183 Version 2.1
Physical	TXD, RXD, RTS, CTS, GND, DTR, DCD, DTS
Baud Rates	38400, 19200, 9600 (default), 4800, 2400, 1200, 600, 300
IQ*Event Engine* **and TAIP Messages**	Refer to the **IQ***Event Engine/TAIP Reference Manual*.
NMEA Messages	GGA, GLL, GSA, RMC, CTG, ZDA
TSIP Packets[a]	Command Packets: 0x1D, 0x1E, 0x1F, 0x20, 0x21, 0x22, 0x23, 0x24, 0x25, 0x26, 0x27, 0x28, 0x29, 0x2A, 0x2B, 0x2C, 0x2D, 0x2E, 0x2F, 0x31, 0x32, 0x34, 0x35, 0x37, 0x38, 0x39, 0x3A, 0x3B, 0x3C, 0x3D, 0x3F, 0x60, 0x61, 0x62, 0x65, 0x6A, 0x6E, 0x75, 0x77, 0x8E, 0x8E 0x60, 0x8E 0x62, 0x8E 0x64, 0x8E 0x6B, 0x8E 0x6D, 0x8F 0x6F, 0xBB, and 0xBC

Report Packets: 0x40, 0x41, 0x42, 0x43, 0x44, 0x45, 0x46, 0x47, 0x48, 0x49, 0x4A, 0x4B, 0x4C, 0x4D, 0x4F, 0x54, 0x55, 0x56, 0x57, 0x58, 0x59, 0x5A, 0x5B, 0x5C, 0x5F, 0x6D, 0x6F, 0x76, 0x78, 0x82, 0x83, 0x84, 0x85, 0x8F, 0x8F 0x60, 0x8F 0x62, 0x8F 0x64, 0x8F 0x6B, 0x8F 0x6D, 0x8F 0x8F, 0xBB, and 0xBC

For additional information, see Appendix C, TSIP Implementation. |

a. Preliminary

Table A-13   Digital Inputs: IP0 to IP3

Input Logic High	Open circuit or V_{in} > 2.4 VDC
Input Logic Low	V_{in} < 0.6 VDC
	The inputs must remain in either state for at least 200 milliseconds before the CrossCheck GSM detects the input.
Input Current	I_{in} ± 3 milliamps
Input Protection	Protected up to at least V_{Batt} continuous

Table A-14   Digital Outputs: XP0 to XP2

Output Inactive	15 KOhms tied to $V_{vehicle-battery}$, V_{out}, depending on load
Output Active	Tied to ground through a saturated bipolar junction transistor, V_{out} <1.5 VDC @ 200 milliamps; V_{out} < 0.5 VDC @ 10 milliamps
Output Sink Current Capability	Up to 200 milliamps
Output Protection	Protected against direct shorts to ground

A.5   CrossCheck GSM Part Numbers

Part number for the CrossCheck GSM, options, and accessories are listed in Table A-15.

Table A-15   Component Part Numbers

Description	Part No.
CrossCheck GSM Cellular Mobile Unit	39772-01
Upgrade Kits	
Voice Upgrade Kit	43456
GPS Antenna & Cable Bundles	
GPS Antenna bundle (flange, straight cable), Includes: 31192-00 Mini Bulkhead antenna, TNC-p, gasket, 5-hole flange 36107 Cable, straight, TNC-r to straight SMA-p, 5 meter	36697-00
GPS Antenna bundle (flange, right angle cable), Includes: 31192-00 Mini Bulkhead antenna, TNC-p, gasket, 5-hole flange 36106 Cable, right angle, TNC-r to right angle SMA-p, 5 meter	36698-00
GPS Antenna bundle (no flange, straight cable), Includes: 32434 Mini Bulkhead antenna, TNC-p, gasket, 5-hole flange 36107 Cable, straight, TNC-r to straight SMA-p, 5 meter	36699-00
GPS Antenna bundle (no flange, right angle cable), Includes: 32434 Mini Bulkhead antenna, TNC-p, gasket, 5-hole flange 36106 Cable, right angle, TNC-r to right angle SMA-p, 5 meter	36700-00

Table A-15   Component Part Numbers (Continued)

Description	Part No.
GPS Antenna & Cables Separates	
Mini Bulkhead antenna, TNC-p, gasket, and 5-hole flange	31192-00
Mini Bulkhead antenna, TNC-p, gasket, no flange	32434
Cable, straight TNC-r to straight SMA-p, 5 meter	36107
Cable, right angle TNC-r to straight SMA-p, 5 meter	36106
Right angle adapter, SMA-p to SMA-r	36200
Mini Magnetic antenna with 5 meter cable, SMA-p	37167
Cables and Accessories	
Serial I/O cable, DB9 straight p-to-r, 6 ft.	36084
Serial I/O cable, DB9 straight p-to-r, 15 ft.	35319
Replacement Items	
Power and I/O cable, 2A fuse (10 pack)	40358-10
Voice Upgrade Kit	43456
Documentation (free download of latest revision from web site)	
Installation and Operation Manual, latest revision	43458-00
TSIP Reference Manual, latest revision	34462-00
TAIP/IQ Event Engine Reference Manual	38341-00

B   Voice Operation

This appendix is applicable to the CrossCheck GSM unit. It describes the Handset operation and gives instructions for navigating through the menus in order to change options.

B.1   Handset Menus

Table B-1   Quick Guide to Functions

Accessing your Phone Book	Press **Up/Down** key. Or, from Start screen, press **Names** to access Phone Book.
Answering a call	Press **Call** key (Green), or pick up the handset.
Clearing a digit from the display	Press **Clear**.
Clearing entire number from the display	Press and hold **Clear** for several seconds.
Ending a call	Press **Call End** key (Red), or hang up the handset.
Last number redial	From Start screen, press **Down** key. The screen displays the last number called. Press **OK** to redial.
Making a call	Enter phone number, then press **Call** key (Green).
Keybeep on/off	From Start screen, press **Menu**. Press **Up/Down** to select **Settings**. Press **OK**. Press **Change** to turn on or off Keybeep.

Set language to another language	From Start screen, press **Menu**, press **OK** to select **Languages**. Press **Up/Down** key to select desired language from the list, for example, 1/6 English then press **OK**.
Radio volume adjust	During a call, press **Up**/ **Down** key to increase or decrease the radio volume.
Set Hands—Free mode	Press Set Hands-Free mode button. Hang up within 3 seconds

Table B-2   Quick Guide To the Menu

Entering the menu	From Start screen, press **Menu**.
Exiting the menu	Press **Back** repeatedly.
Backing up one level	Press **Back**.
Scrolling the menu	Press **Menu**, then **Up/Down** key.

Table B-3   Quick Guide To Phone Book (Future)

Entering the Phone Book	From Start screen, press **Names**.
Backing up one level	Press **Back**.
Exiting the Phone Book	Press **Back** repeatedly.
Scrolling the Phone Book	Press **Names**, then **Up/Down** key.
Editing a phone number	Press **Clear** to erase last character. Hold **Clear** to erase phone number.

Table B-4   Handset Menu Map

Start Screen					
Menu				**Names**	
Languages	**Messages**	**Settings**		**Phone Book**	
English Deutsch Italiano Francais Español Turkish	No dialog	Keybeep	Ring tones		

B.2   The CrossCheck GSM Handset

Use CrossCheck GSM unit for voice calls with the Handset Option. The handset is connected to the CrossCheck unit through the RJ-45 connector.

B.2.1   Supported Features

The Handset menus allow you to perform the following operations:

• Program and dial 20 authorized numbers

• Set Screen Language to another Language

• Adjust the Handset/Hands-Free volume

• Set the Handset keybeep on/off

• View Cellular Phone status

• Set hands-free mode

B.3   Handset Controls and Indicators

Figure B-1 shows the cellular handset keys and LCD.

Soft Key

Soft Key

Green Call Key

Red Call End Key

Navigation Key
(Up/Down Key)

Key Reserved for
Future Options

Hands Free
Mode Key

Figure B-1   Cellular Handset

B.3.1   LCD

The back-lighted LCD (Liquid Crystal Display) displays cellular status messages, Handset Menu, Names screens, and error messages. For descriptions of the screen elements appearing on the LCD, see Figure B-2.

B.3.2   Call Control Keys

The two Soft keys are operational. Use the four Navigation keys (**Call** (Green), **Call End** key (Red), **Up** key, and **Down** key) to navigate through the menu system, enable or disable (toggle) menu options, dial telephone numbers, save changes, and abandon changes.

B.3.3 Keypad

Use the keypad to dial telephone numbers manually and enter data when the menu system is displayed.

B.3.4 Hands-Free Key

The hands-free key enables hands-free mode. The handset must be in the cradle to operate in the hands-free mode.

B.4 Screen Elements

The following sections describe the screen elements you may see displayed on the LCD. The LCD has a number of variable and pre-defined symbols as shown in Figure B-2.

Initialize Screen   Start Screen   Call in Progress Screen
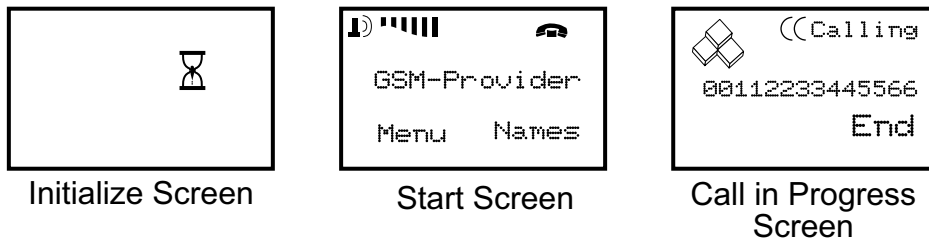
Figure B-2   LCD Screen Elements

The *Waves and Cells* icon displays when a voice call is in progress. The *Cellular Signal* indicator shows the strength of the cellular signal. The CrossCheck GSM handset displays the net provider and the field strength as a bar diagram. The more Signal Strength Power Bars that are displayed means a better signal and clearer sounding call. The telephone icon in the upper right corner indicates on-hook/off-hook handset status.

B.4.1 B.2.2 Start Screen

The *Start* screen displays when you turn on the handset. The *Start* screen typically shows the RF Signal, your service provider, and gives you two choices with the Soft Functions keys. By pressing one of the Soft Function keys, you can switch to a submenu, such as setup menu or names/Phone Book menu. Figure B-3 shows the *Start* screen.

On Hook   Off Hook   No SIM Installed

Figure B-3   Start Screen Elements

The *Start* screen indicates that the handset is powered on and ready for operation. The screen elements appearing on the *Start* screen are displayed automatically, depending on the current state of the handset and the action currently being performed.

B.4.1.1   GSM Status Elements

The *GSM Start* screen also displays information about the GSM network currently being used.

B.4.1.2   Error Messages Elements

CrossCheck GSM supports a number of error messages that appear on the handset display. These messages only appear on the handset when the CrossCheck GSM unit is powered on. See Error Message Elements on page B-7 for a list of typical error messages.

If an error occurs, the error message is repeated approximately every half second.

B.4.1.3   Error Message Elements

- **SIM card missing?**—A SIM card with animated figures and a question mark (?) displays.

- **No Service**—The cellular phone does not have service.

B.4.1.4   Number Entry Screen

As soon as you begin to dial a telephone number, the *Number Entry* screen displays automatically from the *Start* screen. The screen is shown in Figure B-4.

Start Screen

Type the first digit of the telephone number from the Start Screen.

```
 )"IIII          ☎
   GSM-Provider

 Menu    Names
```

The Number Entry screen displays as soon as you press the first digit of the telephone number.
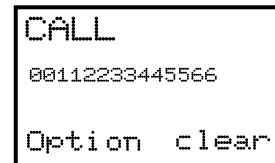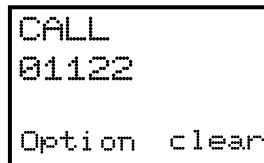
The cursor marks the location where the next digit will appear.

```
CALL
01122


Option   clear
```

```
CALL
00112233445566


Option   clear
```

Telephone number digits appear in left-to-right order when typed. The display shows 11 characters on large form and automatically changes to smaller form when the number of digits exceeds 11 (maximum of 16 digits).

```
 ◇◇       ((Calling
   00112233445566
               End
```
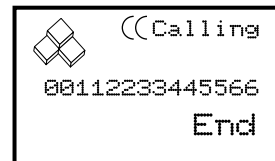
Figure B-4   Number Entry Screen

B.4.1.5 Dialing Telephone Numbers

To dial a telephone number:

1. From the *Start* screen, press any number key to place the handset in the *Number Entry* screen, then continue entering the number.

2. From the *Number Entry* screen, the **Soft Functions Clear** key erases a single number if you hold it down briefly. If you hold the **Soft Functions Clear** key down for more than 2 or 3 seconds, it erases the entire number and returns you to the *Start* screen.

3. The **Call** key (Green), dials the number displayed on the LCD. Terminate a call by pressing the **Call End** key (Red).

B.5 Handset Menu

The Handset Menus allow the user to perform these operations:

- Languages: Select a handset display language

- Settings: Set Keybeep on/off

- Settings: Adjust radio volume

B.5.1 Accessing the Handset Menus

Access the Handset Menus by pressing the left Soft Function key from the *Start* screen, (labeled **Menu** on the LCD). Use the arrow keys to navigate through the menus. Table B-5 shows the Handset menu and the keys you must press to access the menu.

To select a menu option, press the left Soft Function key when the menu displays on the left corner of the *Start* screen. Use the **Up/Down** keys to select menu options.

Press the **Down** key from the *Start* screen to jump directly to the *Last Called Number Dialed* screen. A telephone number is selected from the last dial list.

Table B-5 Handset Menu Map

Menu			
Languages	**Messages**	**Settings**	
English Deutsch Italiano Francais Español Turkish	No dialog	Keybeep	Ring tones

B.5.2 Navigating Through the Handset Menus

The Soft Function keys and Navigation keys are used to display the Handset menus, Phone Books and select options from screens.

Use these keys to navigate from the highest level in the Handset menu to the lowest level. The following sections explain the operation of the two Soft Function keys and the four Navigation keys.

B.5.2.1 Soft Function Keys

When the *Start* screen displays, press the left Soft Function key to access the Menu Screen, or press the right Soft Function key to access the Names Screen. Use the **Up/Down** keys and left or right Soft Function key to display additional sub-menus options.

The left Soft Function key, the **OK** key and **Change** key, go through the menu system. The right Soft Function key, the **Back** key and **Clear** key, move backward through the menu system. Hold down the **Back** key for several seconds to return to the *Start* screen. Holding down the **Clear** key for several seconds deletes the entire number.

B.5.2.2 Up/Down Keys

The **Up/Down** keys can be used to increase or decrease handset and hands-free volume when in call.

When menus display, use the **Up/Down** keys to navigate through the menus or to toggle the settings on some screens.

Press the **Up/Down** keys from the *Start* screen and select an entry from the Last Dial List.

B.5.2.3   Call End Key (Red)

The **Call End** key (Red) performs several functions depending on the menu or screen currently displayed on the LCD.

- When a call is in progress, the **Call End** key (Red) terminates the telephone call.

- From most screens, you can press the **Call End** key (Red) to navigate backwards through the menu system. Each time you press the **Call End** key (Red), the previous screen displays.

    Continue to press the **Call End** key (Red) until the *Start* screen displays.

- From most menus and screens, you can hold down the **Call End** key (Red) for several seconds to return to the *Start* screen.

Note – The incoming call is rejected when you press the **Call End** key (Red).

B.5.2.4   Call Key (Green)

- The **Call** key (Green) places the handset in the Dialing state and dials the telephone number currently displayed on the LCD. The **Call** key (Green) can be used to begin a call attempt after manually entering a number from the *Start* screen or from the Phone Book menu.

- Pressing the **Call** key (Green) from the *Start* screen, changes to the phone number entry menu and automatically inserts the last dialed number.

> **Note –** The incoming call is accepted when you press the **Call** key (Green).

B.5.3 Set Languages to Another Language

To set LCD display to another language:

1. Press the left Soft Function key from the *Start* screen to access the **Menu Languages** screen.

2. Press the **Up/Down** keys to select the language from the list, which includes:

- English

- Deutsch

- Italiano

- Francais

- Español

- Turkish

3. Press **OK** to select the desired language.

4. Press **Back** return to the *Start* screen.

```
 ┌──────────────────┐
 │   Languages      │
 │                  │
 │ OK         back  │
 └──────────────────┘
```

```
┌────────────┐  ┌────────────┐  ┌────────────┐  ┌────────────┐  ┌────────────┐
│ Language:  │  │ Language:  │  │ Language:  │  │ Language:  │  │ Language:  │
│ English    │  │ Deutsch    │  │ Italiano   │  │ Francais   │  │ Espanol    │
│            │  │            │  │            │  │            │  │            │
│ OK    back │  │ OK    back │  │ OK    back │  │ OK    back │  │ OK    back │
└────────────┘  └────────────┘  └────────────┘  └────────────┘  └────────────┘
```

```
┌────────────┐
│ Language:  │
│ Turkish    │
│            │
│ OK    back │
└────────────┘
```
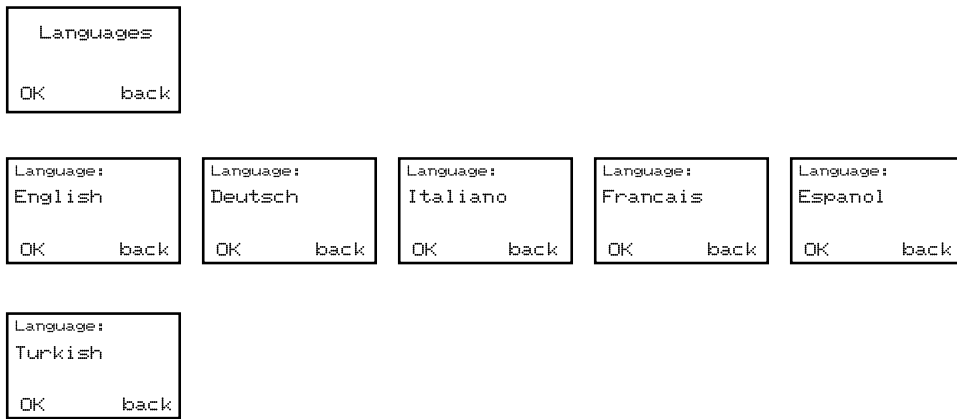
Figure B-5   Set LCD Display Languages to Another Language

B.5.4   Set Keybeep

The keybeep can be set to On or Off at the handset.

To change the keybeep:

1. Press the left Soft Function key from the *Start* screen to access the Menu.

2. Press the **Up/Down** keys until the Settings menu displays.

3. Press **OK** to display the Keybeep screen (the default beep is click on).

4. Press **Change** to set the Keybeep sounds on or press **Change** again to set the Keybeep sounds off.

5. Press **Back** return to the *Start* Screen.

```
┌─────────────────────┐
│                     │
│     Settings        │
│                     │
│                     │
│ OK           back   │
│                     │
└─────────────────────┘
```

```
┌─────────────────────┐   ┌─────────────────────┐
│ Keybeep:            │   │ Keybeep:            │
│                     │   │                     │
│       □             │   │       ☑             │
│                     │   │                     │
│ Change      back    │   │ Change      back    │
└─────────────────────┘   └─────────────────────┘
```
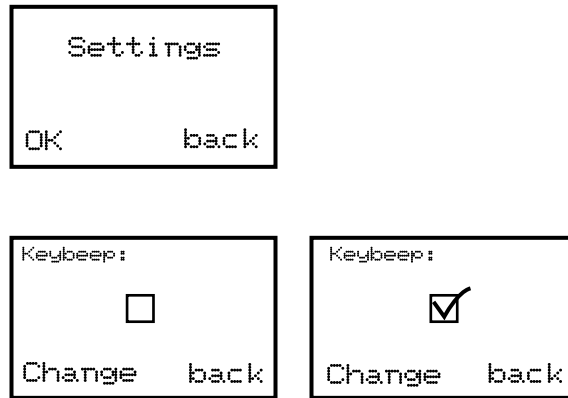
Figure B-6   Set Keybeep On/Off

B.5.5   Adjust Handset and Hands-Free Volume

During a call, you can adjust the radio volume with the **Up/Down** keys.

To adjust the radio volume:

1. During a call, press the **Up/Down** keys to adjust the radio volume.

2. Radio volume displays as a bar.

B.6   Phone Book (Future Enhancement)

The *Names* Screen lets you add up to 20 voice-only telephone numbers to the Authorized Number List, or dial any of the authorized numbers on the list. You can only program authorized numbers for voice-only communications from this menu.

B.6.1 Dialing a Number from Phone book

You can dial authorized telephone numbers for voice-only calls from the Phone Book menu.

The Authorized Number List can store 20 voice-only numbers, and you can use the Phone Book screen to dial these telephone numbers.

To dial an authorized number from Phone Book:

1. Press the right Soft Function key, **Names** from the *Start* screen to display the Phone Book screen.

2. Press the **Up/Down** keys to navigate through the Phone Book Number List to select the desired *Authorized Telephone Number*.

3. Press the left Soft Functions key **OK** to dial the number. The handset displays the *Calling* message as it dials the number and attempts to make a voice connection.

```
 ))'''''||||         (phone icon)

    GSM-Provider

   Menu    Names
```

```
Phonebook:
0011223344 5566

 John Wayne

Option   Back
```

```
Last Dial
0011223344 5566

 John Wayne

Option   Back
```

```
   (((Calling

 00112233445566
            End
```
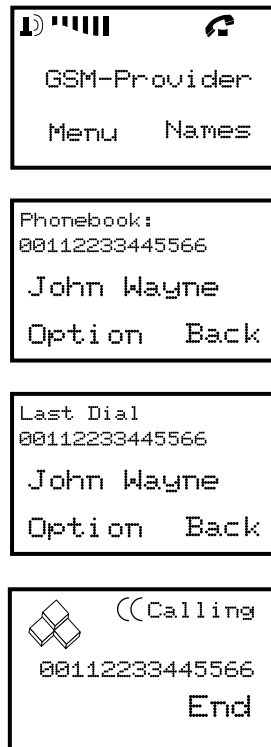
Figure B-7   Dialing a Number from Phone Book

B.7   Change to Hands-Free Mode

The *Hands-Free* button enables the use of Hands-Free mode. When enabled, the handset operates as a hands-free speaker phone when mounted in its base.

During a call, you can place the handset in the hands-free cradle to change to hands-free operation.

When you press the bottom right key (right loudspeaker symbol), you have three seconds to place the handset in the cradle to enable hands-free operation. Otherwise the call will be terminated.

To enable Hands-Free mode:

1. Press the Hands-Free key on the handset to activate hands-free operation.

2. Place the handset in cradle within 3 seconds.

The *Telephone* icon in the upper right corner shows on-hook /off-hook handset status.

```
 ))"'III          ☏
    GSM-Provider
Menu        Names
```

```
 ))"'III          ☎
    GSM-Provider
Menu        Names
```
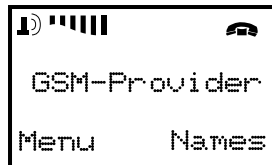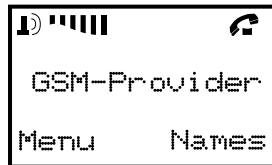
Figure B-8   Change to Hands-Free Mode

C   TSIP Implementation

The CrossCheck GSM supports the Trimble Standard Interface Protocol (TSIP) through the MDT/Aux port. Detailed information about TSIP and TSIP command and report packets is provided in the *TSIP Reference*, Trimble P/N 34462-00.

TSIP is only supported through the CrossCheck GSM's MDT/Aux serial port and should be used by advanced users only. As a binary protocol, TSIP is designed for computer-to-computer interaction.

Note – The CrossCheck GSM supports a battery-backed configuration block. All user-defined GPS operating parameter settings and flag settings are stored in the configuration block. Soft resets (Command Packet 0x25) and powering the unit Off and On do not effect the settings stored in the configuration block. The contents of the configuration block can be requested by sending Command Packet 0x8E 0x6F, and the CrossCheck GSM responds by sending the configuration block in Report Packet 0x8F 0x6F. For more information, refer to the *TSIP Reference*.

C.1 Supported TSIP Packets

Table C-1 contains a numerical listing of the TSIP command and report packets supported by the CrossCheck GSM.

Table C-1   TSIP Packets

ID	Type	Name
0x1D	CMD	Oscillator Offset
0x1E	CMD	Clear non-volatile memory
0x1F	CMD	Firmware information request
0x20	CMD	Almanac Request
0x21	CMD	Current time request
0x22	CMD	Position Fix Mode
0x23	CMD	Initial Position (ECEF)
0x24	CMD	Position Fix Mode Request
0x25	CMD	Soft reset/self-test
0x26	CMD	Health Request
0x27	CMD	Signal Levels Request
0x28	CMD	GPS System Message Request
0x29	CMD	Almanac Health Page Request
0x2A	CMD	2D Mode Altitude
0x2B	CMD	Initial Position (LLA)
0x2C	CMD	Operating Parameters
0x2D	CMD	Oscillator Offset Request
0x2E	CMD	GPS Time
0x2F	CMD	UTC Parameters Request
0x31	CMD	Accurate Initial Position (ECEF)
0x32	CMD	Accurate Initial Position (LLA)
0x34	CMD	1SV Mode
0x35	CMD	I/O Option Flags
0x37	CMD	Last Position/Velocity Request
0x38	CMD	Download/Upload SV System Data

Table C-1   TSIP Packets (Continued)

ID	Type	Name
0x39	CMD	SV Attribute Database
0x3A	CMD	Last Raw Measurement Request
0x3B	CMD	SV Ephemeris Status Request
0x3C	CMD	SV Tracking Status Request
0x60	CMD	DGPS PR Corrections
0x61	CMD	DGPS Delta-PR Corrections
0x62	CMD	DGPS Position Fix Mode
0x65	CMD	Differential Correction Status Request
0x6E	CMD	Synchronized Measurement Parameters
0x6E 0x01	CMD	Synchronized Measurement Parameters
0x70	CMD	Position/Velocity Filter
0x71	CMD	
0x73	CMD	
0x75	CMD	Overdetermined Mode
0x77	CMD	Maximum PRC Age
0x80	CMD	
0x81	CMD	Set st_diagnostic_level
0x82	CMD	
0x8E	CMD	Application Commands
0x8E 0x64	CMD	Firmware Name Request
0x8E 0x6F	CMD	Firmware Version Name and Cfg Block Request
0xBB	CMD	Receiver Cfg Parameters
0xBB 0x00	CMD	Primary Receiver Cfg Parameters Request
ID	Type	Name
0x13	RPT	TSIP Parsing Error Notification
0x40	RPT	Single SV Almanac
0x41	RPT	GPS Time
0x42	RPT	Single-precision ECEF fix
0x43	RPT	Velocity Fix (ECEF)

Table C-1   TSIP Packets (Continued)

0x45	RPT	Firmware Information
0x46	RPT	Receiver Health
0x47	RPT	Signal Levels, All SVs
0x48	RPT	GPS System Message
0x49	RPT	Almanac Health Page
0x4A	RPT	Single-precision LLA fix, or Manual 2D Reference Altitude Parameters
0x4B	RPT	Machine/ID, Additional Status
0x4C	RPT	Operating Parameters
0x4D	RPT	Oscillator offset
0x4E	RPT	GPS Time Cmd Verification
0x4F	RPT	UTC Parameters
0x54	RPT	1SV Osc Bias and Rate
0x55	RPT	I/O Options
0x56	RPT	Velocity (ENU)
0x57	RPT	Last Computed Fix
0x58	RPT	SV Systems Data
0x59	RPT	SV Attribute Database Status
0x5A	RPT	Raw Measurement
0x5B	RPT	SV Ephemeris
0x5C	RPT	SV Tracking Status
0x6D	RPT	All-In-View Satellite Selection Report
0x6E	RPT	Synchronized Measurement Parameters
0x6E 0x01	RPT	Synchronized Measurement Output Parameters
0x6F 0x01	RPT	Synchronized Measurements
0x70	RPT	Position/Velocity Filter Operation
0x72	RPT	
0x74	RPT	

Table C-1   TSIP Packets (Continued)

0x76	RPT	Overdetermined Mode
0x78	RPT	Maximum PRC Age
0x82	RPT	Differential Position Fix Mode
0x83	RPT	Double-Precision XYZ Position Fix & Clock Bias
0x84	RPT	Double-Precision LLA Position Fix & Clock Bias
0x85	RPT	Differential Correction Status
0x8F	RPT	Application Reports
0x8F **0x64**	RPT	Firmware Version Name
0x8F **0x6F**	RPT	Firmware Version and Cfg
0xBB	RPT	Receiver Cfg Parameters
0xBB **0x00**	RPT	Primary Receiver Cfg Parameters

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D   NMEA Implementation

The CrossCheck GSM mobile unit can output a selection of NMEA-0183 Version 2.1 sentences. NMEA-0183 sentences can be generated and output to the MDT/Aux serial port only, allowing the CrossCheck GSM to interface with external instruments.

Note – The CrossCheck GSM cannot transmit NMEA-0183 sentences over-the-air.

D.1 NMEA-0183 Sentence Structure

NMEA-0183 sentences are strings of comma-delimited text. Figure D-1 shows the structure of an NMEA-0183 sentence.
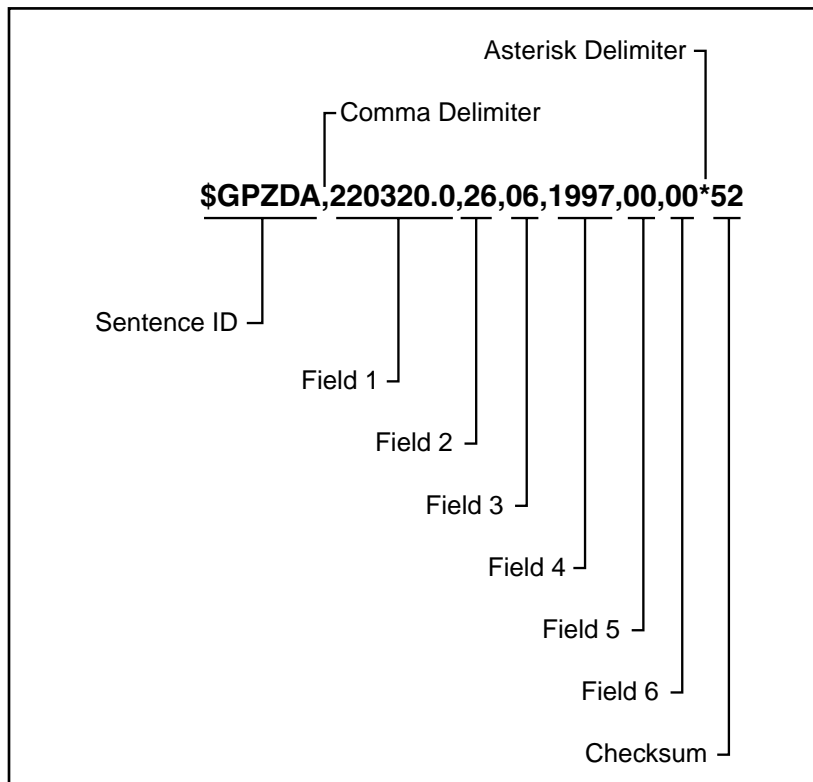
Figure D-1   Sample ZDA Sentence Structure

Each NMEA sentence includes a sentence ID to distinguish the sentence from other NMEA sentences in the data stream. The actual data included in NMEA-0183 sentences is placed in fields. An NMEA sentence contains several fields, and each field is preceded by a comma character. The sample sentence in Figure D-1 contains six fields. NMEA sentences can include an optional checksum value which is useful for checking the integrity of the data included in the sentence.

The sentence structure of the sample ZDA sentence, shown below and the sentence fields are described in Table D-1:

```
$GPZDA,152145,21,05,1996,-7,00*50
```

Table D-1   Sample ZDA Sentence Structure

Field	Description
1	Time, in UTC. (152145 in the sample sentence)
2	Day, 01 to 31. (21 in the sample sentence)
3	Month, 01 to 12. (05 in the sample sentence)
4	Year. (1996 in the sample sentence)
5	Local time zone offset from GMT, 00 to ±13 hours. (–7 in the sample sentence)
6	Local time zone offset from, minutes. Fields 5 and 6, together, yield the total offset. For example, if field 5 is '–5' and field 6 is '15', local time is 5 hours and 15 minutes earlier than GMT. (00 in the sample sentence)
Checksum	The CrossCheck GSM conforms to NMEA-0183 Version 2.1 which states that checksums are mandatory for all sentences. Checksum values are always included in output sentences, but are optional for input sentences.

The NMEA-0183 sentence examples in this chapter are presented in the format shown in Table D-1. The structure of each sample sentence is shown in the paragraphs preceding the sentence structure table.

The numbers in the Field column represent the sentence fields in left-to-right order. Field 1 is the first field following the first comma delimiter. In the sample sentence, field 1 contains the UTC Time value (152145).

D.1.1 Symbols and Delimiters

Symbols and delimiters are used to identify or separate the various kinds of data included in the sentence.

NMEA-0183 sentences always begin with a dollar sign character ($) character which is immediately followed by a sentence ID code. For the sample ZDA sentence, GPZDA is the sentence ID. The dollar sign character marks the beginning of a sentence.

The string of comma delimited text immediately following the sentence ID code is composed of fields containing data. Each field follows a comma character (,). For the sample sentence, the data fields are shown below:

```
,152145,21,05,1993,-7,00
```

NMEA-0183 sentences are always terminated with a carriage return and line feed. The carriage return and line feed pair mark the end of the sentence.

D.1.2 Checksum Values

The CrossCheck GSM conforms to NMEA-0183 Version 2.1 which states that checksums are mandatory for all sentences. Checksum values are always included in output sentences, but are optional for input sentences.

The sample sentence, shown in Table D-1, includes a checksum value. An asterisk character (*) is used to delimit the last data field from the checksum value (50 in the sample sentence).

The checksum is the 8-bit exclusive OR of all characters in the sentence, including the commas, between but not including the '$' and '*' delimiters. The hexadecimal result is converted to two ASCII characters (0-9, A-F). The most significant character appears first.

D.1.3 Field Formats

The data values included in fields meet the format specifications established for the NMEA-0183 Version 2.1.

Null Fields

Null fields are included in some NMEA sentences when no data is available for a particular field. Null fields are empty and are usually reserved for transmitting data on a periodic or irregular basis. The comma delimiter for the Null field is immediately followed by the comma delimiter for the next field in the sentence string.

The inclusion of Null fields in a sentence is important because many NMEA sentences contain a fixed number of fields. NMEA sentence interpreters (software for processing NMEA sentences) expect to find a fixed number of fields in these sentences, and specific kinds of data in each field. The sentence processing software assumes that no data is available for a particular field when a Null field is encountered while interpreting a sentence.

Latitude and Longitude Values

Latitude and longitude values are included in sentences in *ddmm.mmmm* format. Longitude is always represented as *dddmm.mmmm* in a single field. Within the field, degree values are in *dd* or *ddd* format, and minutes and decimal fractions of minutes are in *mm.mmmm* format.

Latitude and longitude direction values (north, south, east, or west) are placed in a separate field. Direction is a single character: 'N', 'S', 'E', or 'W' for *North, South, East,* or *West.*

The datum for latitude and longitude is WGS-84 or NAD-83, depending on the reference station coordinates. In the U.S.A., the latitude and longitude coordinates are presented using the NAD-83 datum.

Time Values

Time values are in UTC (Universal Time Coordinated), and are inserted in sentence strings in *hhmmss* format, where *hh* is hours (from 00–23), *mm* is minutes, and *ss* is seconds.

Other Values

The format of data included in each data field is controlled by the NMEA-0183 Version 2.1 requirements for each type of NMEA sentence. The NMEA-0183 Version 2.1 standard should be considered to be the definitive resource for the format and content of the data fields included in sentences, therefore you should refer to the standard whenever a question arises about the structure of any NMEA sentence.

D.2 NMEA Sentence Summary

Table D-2 describes the NMEA-0183 sentence set supported by the CrossCheck GSM and identifies the page number where you can find detailed information about each sentence.

Table D-2   NMEA-0183 Sentences

Sentence	Sentence Contents	Output Frequency	Page
GGA	Time, position, and fix related data	Each GPS Fix	D-8
GLL	Position fix, time of position fix, and status	Each GPS Fix	D-9
GSA	GPS position fix mode, SVs used for navigation and DOP values	Each GPS Fix	D-10
RMC	UTC time, status, latitude, longitude, speed over ground (SOG), date, and magnetic variation of the position fix	Every other GPS Fix	D-11
VTG	Actual track made good and speed over ground	Each GPS Fix	D-11
ZDA	UTC day, month, and year, and local time zone offset	Once per second	D-13

When you enable the NMEA protocol, sentences are output automatically at the frequencies specified in Table D-2. When the receiver is not producing GPS fixes, only the ZDA message is sent.

D.3   GGA

The GGA sentence contains the time, position, and fix related data. The sentence structure is shown below:

```
$GPGGA,151924,3723.4544,N,12202.2697,W,
2,09,1.9,-17.49,M,-25.67,M,1,0000*57
```

Table D-3 identifies the GGA sentence fields.

Table D-3   GGA Sentence Fields

Field	Description
1	UTC of position fix
2	Latitude in DD MM,MMMM format (0–7 decimal places)
3	Direction of latitude (N or S)
4	Longitude in DDD MM,MMMM format (0–7 decimal places)
5	Direction of longitude (E or W)
6	GPS Quality indicator: 0 = fix not valid, 1 = GPS fix. 2 = DGPS fix
7	Number of SVs in use, 00–12
8	HDOP
9	Antenna height, MSL reference
10	'M' indicates that the altitude is in meters.
11	Geoidal separation
12	'M' indicates that the geoidal separation is in meters
13	Age of differential GPS data record, Type 1. Null when DGPS not used
14	Base station ID, 0000–1023

D.4   GLL

The GLL sentence specifies the position fix, time of position fix, and status. The sentence structure is shown below:

```
$GPGLL,3723.4543,N,12202.2696,W,151933,
A*3E
```

Table D-4 identifies the GLL sentence fields.

Table D-4   GLL Sentence Fields

Field	Description
1	Latitude in DD MM,MMMM format (0–7 decimal places)
2	Direction of latitude ('N' or 'S')
3	Longitude in DDD MM,MMMM format (0–7 decimal places)
4	Direction of longitude, ('E' or 'W')
5	UTC of position
6	Fixed text 'A' shows that data is valid

D.5   GSA

The GPS sentence identifies the GPS position fix mode, the SVs used for navigation, and the DOP values. The sentence structure is shown below:

```
$GPGSA,A,3,19,28,14,18,27,22,31,29,,,,,
1.7,1.0,1.3*35
```

Table D-5 identifies the GSA sentence fields.

Table D-5   GSA Sentence Fields

Field	Description
1	Mode: M = Manual, forced to operate in 2D or 3D, A = Automatic, 3D/2D
2	Mode: 1 = Fix not available, 2 = 2D, 3 = 3D
3–14	ID's of SVs used in position fix (null for unused fields)
15	PDOP
16	HDOP
17	VDOP

D.6   RMC

The RMC sentence identifies the UTC time, status, latitude, longitude, speed over ground (SOG), date, and magnetic variation of the position fix.

```
$GPRMC,184804.00,A,3723.476543,N,12202.
239745,W,000.0,0.0,051196,15.6,E*7C
```

Table D-6   RMC Sentence Fields

Field	Description
1	Time: UTC time of the position fix in hhmmss.ss format.
2	Status: A = Valid, V = Navigation Receiver Warning (V is output whenever the GPS receiver suspects something is wrong)
3	Latitude coordinate (the number of decimal places, 0–7, is programmable and determined by the numeric precision selected in TSIP Talker for a RMC sentence).
4	Latitude direction: N = North, S = South
5	Longitude coordinate (the number of decimal places, 0–7, is programmable and determined by the numeric precision selected in TSIP Talker for a RMC sentence)
6	Longitude direction: W = West, E = East
7	Speed Over Ground (SOG) in knots
8	Track Made Good, True, in degrees
9	Date in dd/mm/yy format
10	Magnetic Variation in degrees
11	Direction of magnetic variation: E = Easterly variation from True course (subtracts from True course), W = Westerly variation from True course (adds to True course)

D.7   VTG

The VTG sentence identifies the actual track made good and speed over ground. The sentence structure is shown below:

```
$GPVTG,0,T,,,0.00,N,0.00,K*33
```

Table D-7 identifies the VTG sentence fields.

Table D-7   VTG Sentence Fields

Field	Description
1	Track made good
2	Fixed text 'T' shows that track made good is relative to true north
3	Not used
4	Not used
5	Speed over ground in knots
6	Fixed text 'N' shows that speed over ground is in knots
7	Speed over ground in kilometers/hour
8	Fixed text 'K' shows that speed over ground is in kilometers/hour

D.8 ZDA

The ZDA sentence identifies the UTC day, month, and year, and local time zone offset. The sentence structure is shown below:

```
$GPZDA,152145,21,05,1993,-7,00*50
```

Table D-8 identifies the ZDA sentence fields.

Table D-8   ZDA Sentence Fields

Field	Description
1	Time, in UTC
2	Day, 01 to 31
3	Month, 01 to 12
4	Year
5	Local time zone offset from GMT, 00 to ±13 hours
6	Local time zone offset from, minutes. Fields 5 and 6, together, yield the total offset. For example, if field 5 is '–5' and field 6 is '15', local time is 5 hours and 15 minutes earlier than GMT

CrossCheck GSM Operation Manual

E GSM AT-Commands

CrossCheck GSM supports ETSI 07.07 and 07.05 GSM services by providing direct access to the internal GSM module. The GSM interface is enabled by the TAIP MT command (>SMTA<), which reconfigures the MDT port into AT command mode. Once in AT command mode, an MDT application has access to most internal GSM module's functions and features.

To exit AT command mode, the MDT must issue a AT+TAIP command, which returns the MDT port to TAIP mode. Refer to the **IQ**_Event Engine/TAIP Reference Manual_ for details of the transition to and from GSM-AT mode.

The following is a summary of the AT commands supported by the CrossCheck GSM, which is a subset of the ETSI 07.07/07.05 command set. Since there is no audio interface at the MDT port, there is no support for voice calls.

E.1   General Commands

Table E-1   General Commands Supported

+CCID	Card Identification
+CFUN	Set phone functionality
+CGMI	Manufacturer identification
+CGMM	Request model identification
+CGMR	Request revision identification
+CGSN	Product Serial Number
+CIMI	Request IMSI
+CMEE	Report Mobile Equipment errors
+CPAS	Phone activity status
+CSCS	Select TE character set
+GCAP	Capabilities list
A/	Repeat last command

E.2   Call Control Commands

Table E-2   Call Control Commands Supported

+CEER	Extended error report
+CICB	Incoming Call Bearer
A	Answer a call
D	Dial command
DL	Redial last number
H	Hang-Up command
S0	Automatic answer

E.3   Network Service Commands

Table E-3   Network Service Commands Supported

+COPS	Operator selection
+CPOL	Preferred operator list
+CREG	Network registration
+CSQ	Signal Quality
+WOPN	Read operator name

E.4   Security Commands

Table E-4   Security Commands Supported

+CLCK	Facility lock
+CPIN	Enter PIN
+CPIN2	Enter PIN2
+CPINC	PIN remaining attempt number
+CPWD	Change password

E.5 Short Messages Commands (PDU Mode)

Table E-5 SMS Commands Supported

+CMGD	Delete message
+CMGF	Preferred Message Format
+CMGL	List message
+CMGR	Read message
+CMGS	Send message
+CMGW	Write Message to Memory
+CMSS	Send Message From Storage
+CNMI	New message indication
+CPMS	Preferred Message Storage
+CRES	Restore settings
+CSAS	Save Settings
+CSCA	Service center address
+CSCB	Select Cell Broadcast Message Types
+CSDH	Show text mode parameters
+CSMP	Set Text Mode Parameters
+CSMS	Select message service
+WCBM	Cell Broadcast Message Identifiers
+WMGO	Message overwriting
+WMSC	Message status modification

E.6 Supplementary Services Commands

Table E-6   Supplementary Services Commands Supported

+CACM	Accumulated call meter
+CAMM	Accumulated call meter maximum
+CAOC	Advice of charge
+CCFC	Call forwarding
+CCWA	Call waiting
+CHLD	Call related supplementary services
+CLCC	List current calls
+CLCK	Call barring
+CLIP	Calling line identification presentation
+CLIR	Calling line identification restriction
+COLP	Connected line identification presentation
+CPUC	Price per unit and currency table
+CPWD	Modify SS password
+CSSN	Supplementary service notifications
+CUSD	Unstructured supplementary service data

E.7 Data Commands

Table E-7   Data Commands Supported

+CBST	Bearer type selection
+CR	Service reporting control
+CRC	Cellular result codes
+CRLP	Radio link protocol parameters

E.8 V.24-V.25 Commands

Table E-8 V24-V25 Commands Supported

&C	Set DCD signal
&D	Set DTR signal
&F	Restore factory settings
&S	Set DSR signal
&T	Auto-tests
&V	Display configuration
&W	Save configuration
+ICF	DTE-DCE character framing
+IFC	DTE-DCE local flow control
+IPR	Fixed DTE rate
E	Echo
O	Back to online mode
Q	Result code suppression
V	DCE response format
Z	Default configuration

E.9 Specific AT Commands

Table E-9   AT Commands Supported

+CCED	Cell environment description
+CCED	Automatic RxLev indication
+CMER	Mobile Equipment event reporting
+WIND	General Indications
+WLPR	Read Language Preference
+WLPW	Write Language Preference

E.10 GSM Class 1 FAX Commands

The core commands defined by ITU T.31 are supported:

+FRH=3, +FRH=?,

+FTH=3, +FTH=?,

+FRM=24,48,72,96, +FRM= ?,

+FTM=24,48,72,96, +FTM= ?,

+FRS= <any duration>,

+FTS= <any duration>.

Commands like +FAR, +FCC,... are not supported.

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ICD-GPS-200, see: NAVSTAR GPS Space Segment/Navigation User Interfaces

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GSM Made Simple, George Lamb published by Cordero Consulting and Regal Printing, Atlanta GA, 1997 (ISBN 0-966-57520-2)

Glossary

The Glossary defines technical terms and abbreviations used in this manual. It includes terms from the fields of wireless communications and GPS technology.

0D　　　　Time only in GPS terminology.

2D　　　　Two dimensions and time in GPS terminology.

3D　　　　Three dimensions and time in GPS terminology.

2D GPS　　Two-dimensional GPS position fix and time.

3D GPS　　Three-dimensional GPS position fix and time.

2D DGPS　Two-dimensional differential GPS position fix and time.

3D DGPS　Three-dimensional differential GPS position fix and time.

Altitude　Height of the vehicle above mean sea level (MSL).

ASCII　　American Standard Code for Information Interchange.

AVL　　　Automatic Vehicle Location.

C/A　　　Coarse Acquisition code used to receive GPS signals with receivers designed operate using SPS (Standard Positioning Service).

Call duration　Duration of a cellular connection, in 1/10 second increments.

CDMA	Code Division Multiple Access. A way to allow many conversations to occur on the same frequency at the same time. Each packet on frequency is tagged with a special code so it can be distinguished from all the other packets. See TDMA.
CEPT	Conference on European Postal and Telecommunication Administration.
checksum	1) The TAIP message checksum field provides for an optional two-digit hexadecimal checksum value, which is computed by *XOR'ing* all characters from the beginning of the sentence up to and including the '*' character. If included, the checksum is always the last element of the sentence before the message '<' delimiter. The default mode of operation is to include checksum in sentences. The use of checksums can help in instances where the communication channel is noisy.
	2) The CrossCheck GSM conforms to NMEA-0183 Version 2.1 which states that checksums are mandatory for all NMEA sentences. Checksum values are always included in output sentences, but are optional for input sentences.
	3) A number of TSIP subpackets use an integer checksum value to verify the integrity of the data included in a subpacket.
CSW	Circuit Switched mode.
DCE	Data Communication Equipment
DGPS	Differential Global Positioning System.
Digital I/O	Port used to accept up to four input signals from external alarms and for sending up to three output signals to external devices. The Digital I/O port also provides GPS Status, Vehicle Ignition Status, Power, and GSM Cellular Status information.
DSP	Digital Signal Processor.
DTR	Data Terminal Ready.

DUART	Dual Universal Asynchronous Receiver/Transmitter.
ETSI	European Telecommunications Standards Institute
FEC	Forward Error Correction.
GPS	Global Positioning System.
GSM	Global System for Mobile communications.
heading	Direction vehicle is travelling, in degrees from True North, increasing easterly.
IMEI	International Mobile Equipment Identity.
IMSI	International Mobile Subscriber Identity.
I/O	Input/Output.
IQ*Event Engine*	Firmware for managing the configuration and operation of the CrossCheck GSM, answering incoming voice or data calls, initiating outgoing voice or data calls, establishing a communication link with the base station, responding to polls and commands from the base station, transmitting position and event reports, monitoring the CrossCheck GSM's discrete input signals, triggering the CrossCheck GSM's output driver signals, serving as the MDT/Aux port interface, controlling the LED indicators.
latitude	Latitude coordinate of position fix with positive value indicating North.
LED	Light-Emitting Diode
longitude	Longitude coordinate of position fix with positive value indicating East.
MDT	Mobile Data Terminal.

MDT/Aux	RS-232 serial port for interfacing to a PC or Mobile Data Device.
MPC	Trimble Mobile Positioning & Communication line of products.
MOSMS	Mobile Oriented Short Message Service. See SMS.
MS	Mobile Station.
MSC	Mobile Switching Center.
MSISDN	Mobile Subscriber ISDN (Integrated Services, Digital Network).
MSL	Mean Sea Level.
MTS	Mobile Telephone Service.
NMC	Network Maintenance Center.
NMEA	National Maritime Electronics Association.
Null Field	NMEA-0183 null fields are included in some NMEA messages when no data is available for a particular field. Null fields are empty and are usually reserved for transmitting data on a periodic or irregular basis. The comma delimiter for the Null field is immediately followed by the comma delimiter for the next field in the message string.
OMC-R	Operations and Maintenance Center for GSM network.
OMC-S	Operations and Maintenance Center for GSM MSC.

PAD mode   Packet Assemble and Disassemble mode is available for two-way messaging between a base station and a device connected to the CrossCheck GSM's MDT/Aux port. In PAD mode, data received from the MDT/Aux port is assembled into Text (TX) messages that are then transmitted over the Communications Channel or saved to the Data Log. Data received in TX messages over the Communications Channel are extracted from the TX messages and sent to the device connected to the MDT/Aux port. The configuration of PAD mode is controlled by the MDT Mode (MT) message, which allows specification of packet assembly parameters, including maximum packet length, end-of-packet delimiters, and packet assembly timeout parameters.

PC   Windows-compatible Personal Computer.

PCN   Personal Communications Networks.

PCS   Personal Communications Service.

PIN   Personal Identification Number.

POTS   Plain Old Telephone System.

PSTN   Public Switched Telephone Network.

RAM   Random Access Memory.

RF   Radio Frequency.

Rx   Receive.

Shutdown mode   Power management mode in effect when the **IQ**_Event Engine_ makes the transition to a power off sleep state.

SIM   Subscriber Identify Module.

SMS   Short Message Service.

SPS   Standard Positioning Service.

TAIP	Trimble ASCII Interface Protocol. Refer to the *TAIP/IQEvent Engine Reference Manual* for more information.
TDMA	Time Division Multiple Access. A method for allowing multiple users to access the same frequency by taking turns packet by packet.
TIMSI	An alias for IMSI.
TSIP	Trimble Standard Interface Protocol.
Tx	Transmit.
UART	Universal Asynchronous Receiver/Transmitter.
VDC	Volts of Direct Current.
Vehicle ID	A Vehicle Identification (ID) may optionally be used in all the communications with the CrossCheck GSM. The CrossCheck GSM may be assigned a four to eight-character alphanumeric ID and can be configured to output the specified ID in all TAIP messages.

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