![TrimTrac logo]

TrimTrac 1.5 Locator
Technical Manual

Including Enhanced Features and Vehicle Adapter or Control Module

See Exceptions for Firmware Revision: 0.80.03.0001 on Page xv

DRAFT
SUBJECT TO CHANGE WITHOUT NOTICE

Part Number 54200-XX-UG
Version 0.3b
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REVISION HISTORY

Version	Primary Author(s)	Description of Version	Date Completed
0.1	Bill Dussell	Initial draft created for internal distribution and review comments.	
0.2	Bill Dussell	Revised descriptions, defaults and some parameter name changes	4/26/2006
0.3	Bill Dussell		
0.3a	Bill Dussell	Modified SAR data section	5/22/2006
0.3b	Bill Dussell	Modified safety information	5/31/2006
0.3c	Bill Dussell	Modified safety information	6/02/2006

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Release Notice

This document is release 1.0 of the TrimTrac™ 1.5 Technical Manual, Part Number 54200-XX-UG.

THIS MANUAL IS INTENDED FOR USE BY SYSTEM INTEGRATORS, SERVICE PROVIDERS AND APPLICATION DEVELOPERS (COLLECTIVELY, "RESELLERS"). IT IS NOT INTENDED FOR END-USERS OF THE TRIMTRAC 1.5. ANY END-USER DOCUMENTATION IS TO BE PREPARED AND FURNISHED BY THE RESELLERS.

The following Product Limited Warranty gives Resellers specific legal rights. You may have others, which vary from state/jurisdiction to state/jurisdiction.

Patents

US Patents 6,801,853; 5,187,450; 5,311,149; 5,402,347; 5,564,098; 5,590,043; 5,592,173; 6,115,595; 6,898,234; and 6,990,140 apply.

Product Limited Warranty

Subject to the terms and conditions set forth herein, Trimble Navigation Limited (*"Trimble"*) makes the following warranty only to its Resellers who purchase the TrimTrac hardware product (*"Product"*) directly from Trimble: for a period of one (1) year from the date of shipment from Trimble, the Product will substantially conform to Trimble's standard published specifications for the Product and the Product hardware will be substantially free from defects in materials and workmanship. The foregoing warranty shall not apply to embedded software/firmware components.

THIS PRODUCT LIMITED WARRANTY IS PROVIDED TO RESELLERS AND TO RESELLERS ONLY. RESELLER IS SOLELY RESPONSIBLE FOR ANY AND ALL WARRANTIES MADE TO ITS CUSTOMERS, AND TRIMBLE MAKES NO WARRANTIES, EXPRESS OR IMPLIED, AND SHALL HAVE NO OBLIGATIONS OR LIABILITY TO RESELLER'S CUSTOMERS OR END-USERS OF THE PRODUCT. RESELLER SHALL NOT MAKE ANY REPRESENTATIONS OR WARRANTIES ON TRIMBLE'S BEHALF, AND SHALL FULLY INDEMNIFY, DEFEND AND HOLD TRIMBLE HARMLESS FROM ANY BREACH OF THE FOREGOING.

IF RESELLER DISTRIBUTES PRODUCT TO END-USER CUSTOMERS, RESELLER SHALL BE SOLELY RESPONSIBLE FOR PREPARING AND PROVIDING PRODUCT WARRANTIES AND PRODUCT LITERATURE TO END-USERS.

Warranty Remedies

If the Product fails during the warranty period for reasons covered by this Product Limited Warranty and Reseller notifies Trimble of such failure during the warranty period, Trimble at is option will repair OR replace the nonconforming Product, OR refund the purchase price paid by Reseller for the Product, provided that Reseller returns the Product to Trimble in accordance with Trimble's standard return material authorization procedures or as otherwise instructed by Trimble.

Warranty Exclusions and Disclaimers

The foregoing Product Limited Warranty shall only apply in the event and to the extent that (i) the Product is properly and correctly installed, configured, interfaced, maintained, stored and operated in accordance with Trimble's specifications, and (ii) the Product is not modified or misused. This Product Limited Warranty shall not apply to, and Trimble shall not be responsible for, defects or performance problems resulting from: (a) the combination or utilization of the Product with hardware or software products, information, data, systems, interfaces, services or devices not made, supplied or specified by Trimble; (b) the operation of the Product under any specifications other than, or in addition to, Trimble's standard published specifications for the Product; (c) the unauthorized installation, modification or use of the Product; (d) damage caused by: accident, lightning or other electrical discharge, water immersion or spray, or exposure to environmental conditions for which the Product is not intended; or (e) normal wear and tear on consumable parts, including by way of example and without limitation, batteries. TRIMBLE DOES NOT WARRANT OR GUARANTEE THE RESULTS OBTAINED THROUGH THE USE OF THE PRODUCT.

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WITHOUT LIMITING THE GENERALITY OF THE FOREGOING:

TRIMBLE IS NOT RESPONSIBLE FOR THE OPERATION OR FAILURE OF OPERATION OF GPS SATELLITES OR WIRELESS SERVICE OR THE AVAILABILITY OF GPS SATELLITE SIGNALS OR WIRELESS SERVICE.

THE PRODUCT MAY CONTAIN TECHNOLOGY THAT IS NOT FAULT TOLERANT AND IS NOT DESIGNED, MANUFACTURED OR INTENDED FOR USE IN ENVIRONMENTS OR APPLICATIONS IN WHICH THE FAILURE OF THE PRODUCT WOULD LEAD TO DEATH, PERSONAL INJURY OR SEVERE PHYSICAL OR ENVIRONMENTAL DAMAGE OR SEVERE FINANCIAL LOSS. ANY USE OR DISTRIBUTION BY RESELLER OR ITS CUSTOMERS IN CONNECTION WITH ANY SUCH ENVIRONMENT OR APPLICATION SHALL BE AT RESELLER'S AND ITS CUSTOMERS' SOLE RISK, AND TRIMBLE SHALL HAVE NO LIABILITY WHATSOEVER IN CONNECTION THEREWITH. RESELLER SHALL INDEMNIFY AND HOLD TRIMBLE AND ITS SUPPLIERS HARMLESS FROM ANY CLAIM BROUGH AGAINST TRIMBLE WHICH ARISES FROM RESELLER'S USE OR DISTRIBUTION OF THE PRODUCT IN CONNECTION WITH SUCH ENVIVRONMENTS OR APPLICATIONS.

SOME STATES AND JURISDICTIONS DO NOT ALLOW LIMITATIONS ON DURATION OR THE EXCLUSION OF AN IMPLIED WARRANTY, SO CERTAIN OF THE ABOVE LIMITATIONS MAY NOT APPLY TO EVERY RESELLER.

Embedded Software/Firmware

The Product and associated tools, if any, may contain embedded software/firmware, which is licensed, not sold, and is only for use within the Product as an integral part thereof. Such embedded software/firmware (which includes all updates thereto) contains valuable trade secrets and is proprietary to Trimble and its suppliers. To the greatest extent permitted by law, such embedded software/firmware may not be modified, copied, disassembled, decompiled or reverse engineered. Trimble reserves all other rights.

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TRIMBLE'S ENTIRE LIABILITY REGARDING THE PRODUCT SHALL BE LIMITED TO THE AMOUNT ACTUALLY PAID BY RESELLER FOR THE PRODUCT. TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, IN NO EVENT SHALL TRIMBLE OR ITS SUPPLIERS BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES WHATSOEVER UNDER ANY CIRCUMSTANCE OR LEGAL THEORY RELATING IN ANY WAY TO THE PRODUCTS, ACCOMPANYING DOCUMENTATION AND MATERIALS, AND ANY EMBEDDED SOFTWARE/FIRMWARE AND UPDATES THERETO (INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOSS OF BUSINESS PROFITS, BUSINESS INTERRUPTION, LOSS OF DATA OR ANY OTHER PECUNIARY LOSS), REGARDLESS OF WHETHER TRIMBLE HAS BEEN ADVISED OF THE POSSIBILITY OF ANY SUCH LOSS AND REGARDLESS OF THE COURSE OF DEALING BETWEEN TRIMBLE AND RESELLER.

BECAUSE SOME STATES AND JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF LIABILITY FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES, THE ABOVE LIMITATION MAY NOT APPLY TO EVERY RESELLER.

Notices

Class B Statement – Notice to Users. This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communication. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

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

TrimTrac

Changes and modifications not expressly approved by the manufacturer or registrant of this equipment can void your authority to operate this equipment under Federal Communications Commission rules.

Regulatory Approvals

CE
The TrimTrac 1.5 product complies with the essential requirements of the R&TTE Directive 1999/5/EC as stated by the EC Declaration of Conformity (CE0681). The TrimTrac 1.5 product complies with the European Telecommunications Standards Institute Specifications ETS300-342-1 (EMC for GSM 900MHZ and DCS 1800MHZ Radio Equipment and Systems).

EEC
The TrimTrac 1.5 product complies with Directive 72/245/EEC as amended by Directive 95/54/EC (el*72/245*95/54).

FCC The TrimTrac product complies with the FCC Part 15, FCC Part 24, and Industry Canada requirements. The TrimTrac product 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.
Error! Reference source not found.

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About this Manual

Welcome to the DRAFT *TrimTrac*^{TM} *1.5 Locator Technical Manual*. This manual is intended for use by system integrators, service providers and application developers (collectively, "Resellers"). It is not intended for end-users of the TrimTrac 1.5. Any end-user documentation is to be prepared and furnished by the Resellers.

This manual covers the TrimTrac 1.5 with 1.xx and later firmware and operating on 850 MHz, 900 MHz, 1800 MHz and 1900 MHz Global System for Mobile communication (GSM) networks. Data and Event Reporting support is by Short Message Service (SMS), General Packet Radio Service (GPRS), or both. This manual describes how to set up, configure, install, operate, and troubleshoot the product. Even if you have used other GSM or Global Positioning System (GPS) products before, Trimble recommends that you spend some time reading this manual to learn about the special features of this product. If you are not familiar with GSM or GPS, visit Trimble Component Technologies' Web site dedicated to the TrimTrac product (www.trimtrac.com) for a look at the device, GSM and GPS. Trimble assumes that you are familiar with Microsoft Windows (2000, XP), including HyperTerminal, and know how to use a mouse, select options from menus and dialogs, make selections from lists, and refer to online help.

While this manual does not apply to earlier versions of the TrimTrac locator, the TrimTrac 1.5 locator is backward compatible with applications developed for earlier versions of the TrimTrac locator.

This manual is available in portable document format (PDF) from the following Web site: http://www.trimtrac.com/support

Related Information

TrimTrac Web site at www.trimtrac.com . This site is dedicated to TrimTrac locator. Application notes, technical notes, and other useful product information are available from this site. These documents contain important information about software and hardware changes.

Release notes – the release notes describe new features of the product, information not included in the manuals, and any changes to the manuals. The release notes, if any, are available for download from the above Web address.

Authorized partners have access to a download section of the www.trimtrac.com Web site. To request a User Name and Password to access this download site, please send an email to trimtrac@trimble.com . Please include all your contact information.

TrimTrac

Technical Assistance

If you have a problem and cannot find the information you need in the product documentation, please contact your local Trimble Component Technologies sales office, sales engineer or distributor. The Trimble technical support organization can be reached by telephone at 1-800-767-4822 when dialing from within the United States, or at +1-408-481-7921 when dialing from outside the United States.

Alternately, you can contact your nearest authorized TrimTrac distributor:

Africa:
GLT, Ltd.
PO Box: 11083
Aston Manor 1630, South Africa
Tel. +27 (0)11 396 1085
Fax. +27 (0)11 396 1201
www.gpslt.com

Latin America:
Topp Data Solutions
3055 NW 84 Avenue
Doral, FL 33122 USA
Tel: +1 786-331-3303
Fax: +1 786-331-3304
www.toppdatasolutions.com

Australia, New Zealand and South Pacific Islands:
GeoSystems, Ltd.
PO Box 8160
Christchurch
Tel: +64 (0)3 963 2858
Fax: +64 (0)3 963 2857
www.geosystems.co.nz

North America:
Novotech Technologies
155 Terence Matthews Crescent
Kanata, Ontario
Canada K2M 2A8
Tel: (800) 268-8628
Fax: (800) 366-0536
www.novotechdistribution.com

Europe:
GLT, Ltd.
Henfield Business Park, Shoreham Rd
Henfield, W. Sussex, UK BN5 9SL
Tel. 44 (0)1273 491414
Fax. 44 (0)1273 491772
www.gpslt.com

Topp Data Solutions
3055 NW 84 Avenue
Doral, FL 33122 USA
Tel: +1 786-331-3303
Fax: +1 786-331-3304
www.toppdatasolutions.com

When contacting technical support, please be prepared to provide the information listed on the following page.

Information Required for Technical Assistance

1. Unit IMEI number
2. Current configurations settings and message log according to:

ATI	(See Page 101)
AT+CTKC?	(See Page 83)
AT+CTKF?	(See Page 85)
AT+CTKJ?	(See Page 87)
AT+CTKG?	(See Page 88)
AT+CTKK?	(See Page 89)
AT+CTKP?	(See Page 91)
AT+CTKX?	(See Page 93)
AT+CTKY?	(See Page 97)
AT+CTKZ?	(See Page 99)
AT+CTKO?	(See Page 91)

3. Name of SIM Card Carrier

![TrimTrac logo]

Firmware Exceptions

This manual covers the TrimTrac 1.5 with 1.00 firmware. The following features do not work as specified in firmware
Revision: 0.80.03.0001

EXCEPTIONS
`Automatic Message Log Dump` does not function correctly and should not be enabled.
Initial geofence violations are reported correctly; however, subsequent positions are reported with `TriggerType` set "1=Motion" instead of being set to "2=Alert" while any geofence violation persists. As a result, messages with geofence violation and TriggerType set to 1 will not be transmitted if Report Delay Flay is set to 1
Some geofence violation messages do not include position information. Status only messages may be sent; however, the >RTKK is provided.
When 1 Hz GPS is enabled, last known position is included in multiple messages if GPS remains unavailable.
Reponses to >QTKD messages will be delayed until the expiration of the DELAY or IDLE Timeouts if the >QTKD message was received during either of these two states even if OnDemand Polling is enabled.
If the device loses GPS time, then runtime meter threshold reporting will be in error until the device reacquires GPS time.
Geofences are 24/7 only in this version of code.
Certain default values may not coincide with the values listed in this draft manual
LPA Input Delay does not function and should not be enabled.
LPA will not disarm in Monitor-only mode.
Unit operates with external GPS antenna only. The internal GPS antenna does not function
Non-RoHS compliant

Table 1, Firmware Exceptions – TrimTrac 1.5

Safety First

Simple Guidelines

Please follow these guidelines when configuring, using or recycling the TrimTrac 1.5. Violating these guidelines may be dangerous, illegal or otherwise detrimental. Further detailed information is provided in this manual.

Do Not Operate Where Prohibited

Do not allow the TrimTrac 1.5 to operate wherever wireless phone use is prohibited or when doing so may cause interference or danger. Examples include but are not limited to operation in hospitals, aircraft, near blasting sites or wherever operation can cause interference.

Interference

Like all wireless devices, the TrimTrac 1.5 may encounter electrical interference that may affect its performance.

Avoid Body Contact with Device During Operation

Do not operate the TrimTrac 1.5 in direct contact with your body.

Qualified Service

Except for batteries and Subscriber Identification Module (SIM) card, the TrimTrac 1.5 contains no user serviceable or replaceable parts. Non-functioning units must be returned to an authorized service center for repair or replacement.

Accessories and Batteries

Use only approved accessories or batteries. Do not connect incompatible products. There is risk of explosion if an incorrect type replaces batteries. Dispose of used batteries according to the instructions provided with the batteries.

Water-Resistance

The TrimTrac 1.5 is not waterproof. Even though it is water-resistant, it is recommended that it be used where it is relatively dry and not subjected to either water streams or submersion.

Recycling

For information on how to recycle this product in the European Union, go to www.trimble.com/environment/summary.html or call +31 497 53 2430 and ask for the "WEEE Associate" or mail a request for recycling instructions to:

> Trimble Europe BV
> c/o Menlo Worldwide Logistics
> Meerheide 45
> 5521 DZ Eersel, NL.

Detailed Safety Information

Exposure to Radio Frequency Signals

The TrimTrac 1.5 is a low power radio transmitter and receiver. When it is ON, it receives and also sends out radio frequency (RF) signals.

In August 1996, the Federal Communications Commissions (FCC) adopted RF exposure guidelines with safety levels for hand-held wireless phones. Those guidelines are consistent with safety standards previously set by both U.S. and international standards bodies:

> ANSI C95.1 (1992)
>
> NCRP Report 86 (1986)
>
> ICNIRP (1996)

Those standards were based on comprehensive and periodic evaluations of the relevant scientific literature. For example, over 120 scientists, engineers, and physicians from universities, government health agencies, and industry reviewed the available body of research to develop the ANSI Standard (C95.1)

The TrimTrac 1.5 is not intended for handheld use or to be worn on the body. A minimum separation of ten (10") inches (25 cm) be maintained between the TrimTrac 1.5 and any persons' body.

Electronic Devices

Most modern electronic equipment is shielded from RF signals. However, certain electronic equipment may not be shielded against the RF signals generated by the TrimTrac 1.5.

Pacemakers

The Health Industry Manufacturers Association recommends that a minimum separation of six (6") inches be maintained between a handheld wireless phone and a pacemaker to avoid potential interference with the pacemaker. These recommendations are consistent with the independent research by and recommendations of Wireless Technology Research. The TrimTrac 1.5 is not intended for handheld use or to be worn on the body. A minimum separation of ten (10") inches (25 cm) be maintained between the TrimTrac 1.5 and any persons' body.

Persons with pacemakers:

> Should ALWAYS keep the TrimTrac 1.5 more than ten (10") inches (25 cm) from their pacemaker with the device is operational.
>
> Should not carry the TrimTrac 1.5 on their person

If there is any reason to suspect that interference is taking place, the TrimTrac 1.5 Battery Pack or Vehicle Adapter or Control Module should be removed immediately.

Other Medical Devices

If any other personal medical devices are used in the vicinity of a TrimTrac 1.5, consult the manufacturers of the medical devices to determine if they are adequately shielded from external RF energy. Physicians may be able to assist in obtaining this information.

Disable operation of the TrimTrac 1.5 by removing the Battery Pack or Vehicle Adapter or Control Module in health care facilities when any regulations posted in these areas prohibit the use of wireless phones or two-way radios. Hospitals and health care facilities may be using equipment that could be sensitive to external RF energy.

Vehicles

RF signals may affect improperly installed or inadequately shielded electronic systems in motor vehicles. Check with the manufacturer or its representative regarding the vehicle. Also consult the manufacturer of any equipment that has been added to the vehicle.

Posted Facilities

Disable operation of the TrimTrac 1.5 by removing the Battery Pack or Vehicle Adapter or Control Module in any facility where posted notices prohibit the use of wireless phones or two-way radios.

Aircraft

FCC and FAA regulations prohibit using wireless phones while in the air. Disable operation of the TrimTrac 1.5 by removing the Battery Pack or Vehicle Adapter or Control Module prior to boarding or loading in an aircraft.

Blasting Areas

To avoid interfering with blasting operations, disable operation of the TrimTrac 1.5 by removing the Battery Pack or Vehicle Adapter or Control Module when in a "blasting area" or in areas posted: "Turn off two-way radio". Obey all signs and instructions.

Potentially Explosive Atmospheres

Disable operation of the TrimTrac 1.5 by removing the Battery Pack or Vehicle Adapter or Control Module prior to entering any area with a potentially explosive atmosphere and obey all signs and instructions. Sparks in such areas could cause an explosion or fire resulting in bodily injury or even death.

Areas with a potentially explosive atmosphere are often, but not always marked clearly. Potential areas may include: fueling areas (such as gasoline stations);

below deck on boats; fuel or chemical transfer or storage facilities; vehicles using liquefied petroleum gas (such as propane or butane); areas where the air contains chemicals or particles (such as grain, dust, or metal powders); and any other area where it would normally be advisable to turn off motor vehicle engines.

For Vehicles Equipped with an Air Bag

An air bag inflates with great force. DO NOT place objects, including the TrimTrac 1.5, in the area over the air bag or in the air bag deployment area. If in-vehicle wireless equipment is improperly installed and the air bag inflates, serious injury could result.

Specific Absorption Rates (SAR)

THE TRIMTRAC 1.5 IS NOT DESIGNED TO BE WORN ON A PERSON'S BODY. AS SUCH, BODY WORN TEST POSITIONS FOR THE TRIMTRAC 1.5 ARE NOT REQUIRED BY EITHER THE EN50360/1 FOR GSM 1800 DCS BAND OR GSM900 OR FCC REQUIREMENTS FOR 850 OR 1900 PCS BAND.

The TrimTrac 1.5 is not intended for handheld use or to be worn on the body. A minimum separation of ten (10") inches (25 cm) be maintained between the TrimTrac 1.5 and any persons' body.

Additional information on Specific Absorption Rates (SAR) can be found on the Cellular Telecommunications & Internet Association (CTIA) Web site at http://www.phonefacts.net

Battery Safety Information

Adhere to the following guidelines to avoid the risk of fire or explosion:

1. Do not batteries are replaced by an incorrect type.
2. Dispose of used batteries according to the instructions provided with the batteries.
3. Do not drop, puncture, disassemble, mutilate, or incinerate batteries.
4. Touching both terminals of a battery with a metal object will short circuit the battery. Do not carry batteries loosely if the contacts may touch coins, keys, and other metal objects (such as in pockets or bags).
5. Do not heat the batteries to try to rejuvenate their charge.
6. Replace all four batteries at the same time.
7. Do not mix batteries with different charge levels.

Overview

Introduction

This manual covers the TrimTrac 1.5 operating on 850 MHz, 900 MHz, 1800 MHz and 1900 MHz GSM networks. As used in this manual, the term GSM shall include any and all of these frequencies.

Regulatory Approvals

CE
The TrimTrac product complies with the essential requirements of the R&TTE Directive 1999/5/EC as stated by the EC Declaration of Conformity (CE0681).

The TrimTrac product complies with the European Telecommunications Standards Institute Specifications ETS300-342-1 (EMC for GSM 900MHZ and DCS 1800MHZ Radio Equipment and Systems).

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The TrimTrac product 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.

TrimTrac 1.5 New Features and Capabilities

The TrimTrac 1.5 locator is a small, lightweight asset-monitoring device that requires little, if any, installation when used in its battery-powered configuration. Different hardware and setting options allow the device to be configured to meet a variety of demanding installation and operational requirements. Motion-based reporting continues to be an important tool in minimizing power consumption and recurring communication costs.

Key Features:

- Portable, AA Battery-Powered
- No External Wires or Antennas Needed
- Low or No Installation Costs
- No Custom Programming Required
- Ready-to-Use Water-Resistant Housing
- Quad-band GSM/SMS/GPRS
- Enhanced GPS

Ready-to-Use, No Custom Programming Required

Simply insert an activated SIM card and batteries and tell the device where to send the position data and the TrimTrac 1.5 is ready to start reporting. In its default configuration, reports are sent nominally at 15-minute intervals whenever there is motion; status messages are sent once every 12 hours when the device is at rest. Upon powering up, the device will self-initialize anywhere in the world and start transmitting if an authorized GSM network is available.

Alternately, the unit can be easily re-configured to address any number of more sophisticated applications or, when used with an optional plug-in module, be connected to external power, monitor multiple inputs and control other systems or devices, such as door locks, immobilizers and remote start systems.

While a basic understanding of the different TrimTrac 1.5 operational states is helpful, configuring the TrimTrac 1.5 does not require a highly skilled software programmer or technician.

Cost-effective, Universally Available Communications

The TrimTrac 1.5 takes advantage of the near universal availability of GSM SMS text messaging while also leveraging cost-effective GPRS data rate plans. Typical SMS plans offer very extensive inter-network roaming capabilities, both within a host country and internationally. SMS plans also tend to be too pricey for applications requiring more than a few reports per day.

GPRS data plans, on the other hand, typically allow for lower recurring communication costs although GPRS coverage and roaming can be restricted in some areas. The TrimTrac 1.5 takes advantage of both technologies by automatically selecting GPRS wherever such service is available, while relying upon SMS text messages as backup when outside GPRS coverage. This helps minimize recurring communication costs while allowing the greatest coverage possible.

Hardware Options

A number of different hardware options are available to enhance the suitability of the TrimTrac 1.5 to particular application requirements. These options include a miniature external GPS antenna that allows for more discrete, protected installation of the TrimTrac 1.5.

In addition, two plug-in modules are offered; both provide connection to external 9-32 VDC power to eliminate the need to change batteries and can monitor inputs of three different priority levels. The control module also provides two outputs that can be used to control other on-board devices or systems, such as door locks, immobilizers and remote start systems.

To address different mounting requirements, two mounting brackets are offered. A metal bracket is available for more permanent installations while a "quick-release" style plastic bracket is used when rapid insertion and removal of the TrimTrac 1.5 is desired. This is particularly useful when a battery- powered TrimTrac 1.5 is routinely moved from one asset to another.

Optional Plug-In Modules

The following options are available as plug-in modules that replace the standard TrimTrac 1.5 batteries:

> **Provisioning Module.** Allows configuration of the TrimTrac 1.5 via a USB 2.0 connection to a PC.

> **Vehicle Adapter Module.** Allows connection to an external 9-32 VDC power supply and provides three types of open/closed switch and wiring monitoring connections. The Vehicle Adapter Module includes a rechargeable stand-by battery that allows continued operation of the TrimTrac 1.5 for a limited period of time if external power is lost.

> **Control Module.** Same as a Vehicle Adapter Module plus two 500 mA low-side driver outputs capable of controlling one automotive grade relay each.

Enhanced Functional Capabilities

Position reporting triggered by motion continues to be an important attribute of the TrimTrac 1.5; however, a range of powerful new functional enhancements now augments this basic capability. The TrimTrac 1.5 is backwards compatible with applications developed for the first generation TrimTrac.

On-board Geofencing

The TrimTrac 1.5 can self-monitor up to two geofences. These geofences can be either rectangular or circular with reporting based upon whether the device is inside or outside the geofence area or when it has simply crossed the geofence boundary. Geofences can be established either during initial activation of the device, established on-the-fly via over-the-air commands or upon operation of a local switch connected to the TrimTrac 1.5 input module. These capabilities allow the device to be "locked down" where needed without creating nuisance reports during normal operation. (See AT+CTKK on page 89; SET_GEOFENCE_CONFIG on page 117)

Scheduled Hours of Operation

The feature is particularly useful in the monitoring of commercial assets that are used during certain hours of the day, but then are supposed to remain at rest during the after hours.

The Schedule Hours of Operation feature is used to establish how the device will operate during daily hours of normal operation. During normal hours of operation, position reports may not be needed unless, for instance, a geofence has been violated. Outside normal hours of operation, however, any motion of an asset may be considered "unauthorized" and it would be desirable for the TrimTrac 1.5 to report this motion and its current position. Monitoring of equipment at a construction site is an application example that would use this Schedule Hours of Operation feature, possibly in conjunction with a geofence. (See AT+CTKZ on page 99; SET_EXT2_APP_CONFIG on page 116)

Runtime Meters (2)

Equipment maintenance schedules are often managed based upon accumulated run-time hours. The TrimTrac 1.5 offers two resetable runtime meters: one is triggered by motion and, if a plug-in module is used, the other can be hardwired to contacts on a sensor, such as an oil pressure switch. (See AT+CTKZ on page 99; SET_EXT2_APP_CONFIG on page 116)

Start/Stop Reporting Mode

This mode causes the TrimTrac 1.5 to compute and transmit one position report upon first motion and one position report after coming to rest. There are no reports transmitted in between even though the device may be logging, but not transmitting, positions in the background. This provides a historical log that could be queried should the need arise while minimizing communication costs in the mean time. How long the device must remain at rest before transmitting the stop report is determined primarily by the DELAY Timeout, T4. (See Report Delay Flag settings in AT+CTKC on page 83; SET_APP_CONFIG on page 113)

Automatic Message Log Dump

When GSM coverage becomes available after a period of no coverage, the TrimTrac 1.5 can be configured to transmit messages that would have otherwise been transmitted had GSM coverage been uninterrupted. This feature would be used when the TrimTrac 1.5 is expected to come in and out of GSM coverage areas and it is important for the server application to know where the device has been regardless of GSM availability. (See AT+CTKZ on page 99; SET_EXT2_APP_CONFIG on page 116)

Application Feature Details

The TrimTrac 1.5 supports a number of important new application features that modify how the TrimTrac 1.5 cycles through the basic state machine described in the previous sections. Before reading this section, it would be useful to have a basic understanding of the TrimTrac 1.5 state machined as detailed in State Machine Overview section or, preferably, the State Machine Design Details section.

Even though the TrimTrac 1.5 can be used literally out-of-the-box with very little effort, if the factory default settings are used, the device is also highly configurable based on the particular requirements of any given application. When changing from factory default settings, constant vigilance must be given to communication cost and power consumption. It is possible, for instance, to configure the TrimTrac 1.5 to provide very rapid reporting, but doing so may result in unacceptably high power consumption and/or communication costs, especially if SMS is used in lieu of GPRS.

The following sections go in detail how the application features operate, how to set them up and what some of the trade offs may be in terms of power consumption and communication costs. In other sections of this technical manual, specific configuration recommendations are set fort for some typical applications scenarios.

Geofences

By establishing and using geofences, geographic areas of authorized and unauthorized use can be defined and enforced. If a geofence violation occurs, the operation of the TrimTrac 1.5 will be adjusted based upon how it is configured. For instance, should you wish to establish an area where movement of the device is "authorized" and you only wish to receive position reports when the monitored asset leaves this area, then you would use the geofence capability of the TrimTrac. The TrimTrac 1.5 can support up to two geofences. Geofence violations selectively set the Report Delay Flag while the other configuration parameters remain essentially unchanged.

Once a geofence violation is detected, the Report Delay Flag will be temporarily set "1=Transmit All Messages", the device will transmit a both a new position report noting the geofence violation and a message noting which geofence had been violated. Unless the Geofence Type had been defined as a boundary-crossing geofence, the device will continue reporting until the device is no longer violating the geofence conditions. It will report the first position that is not in violation of the geofence, but stop reporting until another geofence violation or some other appropriate TriggerType event occurs

Enforcement

You can decide whether to enforce a geofence at all times (24/7) or, if the TrimTrac 1.5 is equipped with either a Vehicle Adapter or Control Module with the LPA input connected to a switch, the geofence will be enforced only while the LPA input monitored switch is in the closed position. If the LPA input is configured as a geofence, then the LPA input cannot be used as either an alert or runtime meter input and vice versa.

Geofence Center

To establish a geofence area, whether circular or rectangular in shape, you must first select the center point of the geofence area defined in latitude and longitude. This can be done in three ways. Either you enter it into the TrimTrac 1.5 during the provisioning process, by sending a TrimTrac Application command via the GSM network, or, if the TrimTrac 1.5 is using either a Vehicle Adapter or Control Module, by configuring the LPA input to define and/or enable a geofence based upon the operation of a LPA switch.

It is acceptable to have geofences that overlap one another; however, having one geofence located entirely inside the other should be avoided.

Geofence Shape and Size

Once the centerpoint of the geofence has been determined, you must then define the overall dimensions of the geofence area. In the case of rectangular geofences, you will need to define the due East-West and North-South lengths. Alternately, you would define the diameter of the circular geofence area.

Since the geofences used by TrimTrac are orthographic projections, latitude and longitude distortions increase further away from the center point. As such, the maximum length of any given geofence dimension is limited to 1000 kilometers. For rectangular geofences, this means no side can be more than 1000 kilometers. The diameter of a circular geofence is similarly limited to 1000 kilometers.

Geofence Type

Finally, you will need to define the type of geofences that will be used. All geofences in the TrimTrac 1.5 must be of the same type, of which there are three choices: Boundary Crossing, Inclusive and Exclusive. In the case of Boundary Crossing, the TrimTrac 1.5 will send a geofence-triggered report each time the TrimTrac 1.5 detects it has crossed the boundary of an active geofence. This report will be transmitted, along with a message indicating which geofence had its boundary crossed, regardless of how the Report Delay Flag is set.

In the case of an inclusive geofence area used in conjunction with the Report Delay Flag, the device will not normally transmit position or status messages whenever it is located inside the defined geofence area. As soon as a position is computed that is outside the geofence area, the device will commence transmitting position and status reports as if the Report Delay Flag is set "0=Transmit All Messages". The device will continue transmitting in this mode until the device re-enters the inclusive geofence area.

Conversely, the device will begin transmitting position and status reports whenever the device is inside an exclusive geofence area.

The relevant parameters, settings, messages and commands used to defined and activate geofences are set forth in Table 2 on the following page and in Table 89 on page 155.

Parameter	Settings	Msg. Header (See Page)	Commands (See Page)
Geofence ID	Unique geofence identifier 1 or 2	>STKK (117) >QTKK (123) >RTKK (134)	AT+CTKK (89)
Geofence Enforcement	0=Disabled; 1=Enforced 24/7; 2=LPA Input Enforced; 3=LPA Centered and Enforced.		
Geofence Delta X	100s of meters (1 – 10000) Note: East-West length of rectangular Geofence area or, if circular, the diameter. 1=100 Meters		
Geofence Delta Y	100s of meters (0, 1 – 10000) Note: If set to "0", then circular Geofence area; else rectangular Geofence area. 1=100 Meters		
Geofence Center Latitude	WGS-84 Coordinates. Units of Degrees to 7 decimal places plus '+' sign = North and '-' = South. (-90.0000000 to +90.0000000)		
Geofence Center Longitude	WGS-84 Coordinates. Units of Degrees to 7 decimal places plus '+' sign = East and '-' = West. (-180.0000000 to +180.0000000)		
Geofence Type	0=Boundary Crossing; 1=Inclusive; 2=Exclusive	>STKZ (116) >QTKZ (123) >RTKZ (133)	AT+CTKZ (99)
Automatic Message Log Dump	0=Disabled; 1=Enabled		
Report Delay Flag	0=Transmit All Messages; 1=Transmit Alert, Query response and Scheduled messages only; 2=Transmit Motion-related AND Alert, Query response and Scheduled messages only; 3= Transmit IDLE Timeout, T1, Status Messages AND Alert, Query response and Scheduled messages only; 4=Start/Stop Reporting; 5=Log 5 messages, transmit next; 6=Log 10 messages, transmit next	>STKA (113) >QTKA (123) >RTKA (130)	AT+CTKC (83)

Table 2. Geofence Parameters, Settings, Messages and Commands

Reporting Geofence Violations

To avoid nuisance geofence violations, a 30-meter diameter circle is established with the center point being the current position of the TrimTrac 1.5. Before a geofence violation is recorded, this circle must be 100% either inside or outside the geofence area or, if the geofence is a boundary crossing type, 100% crossed over the boundary line on either side. The fixed 30-meter diameter is the typical positional error one might experience in an urban environment where reflected signals, multipath and interference may influence the position solution.

Inclusive geofence violations will be reported if the TrimTrac 1.5 is outside both geofence areas. Conversely, if the TrimTrac 1.5 is inside either of the geofence areas, then no violations will be reported.

Exclusive geofence violations will be reported if the TrimTrac 1.5 is inside either geofence area. Conversely, if the TrimTrac 1.5 is outside both geofence areas, then no violations will be reported.

Whenever a geofence violation (boundary crossing, inclusive or exclusive) has occurred, the TrimTrac 1.5 will transmit at least once to the server application assuming GSM coverage is available. In the case of inclusive and exclusive geofence violations, the device will continue transmitting reports until the device re-enters an inclusive area or exits an exclusive geofence, respectively.

Upon the initial violation of an inclusive or exclusive geofence, the TrimTrac will send a new POSITION_REP and a RESP_GEOFENCE_CONFIG message. If SMS is being used, both messages will be included in a single SMS message. The POSITION_REP will have the TriggerType set "2=Alert", the position that first triggered the violation notice and the Geofence Status field will be set "1=Violation".

The RESP_GEOFENCE_CONFIG message will denote which particular geofence was violated. Only the most recently violated geofence will be identified even if more than one geofence had been violated concurrently.

The device will continue transmitting POSITION_REP and a RESP_GEOFENCE_CONFIG message so long as motion and the geofence violation persists. Each new POSITION_REP will also have the TriggerType set "2=Alert". Similarly, if the device is unable to get a subsequent position fix or if the IDLE Timeout, T1, has expired due to no motion, the STATUS_MESSAGE with have the TriggerType set "2=Alert". In all cases, the Geofence Status flag in either the POSITION_REP or STATUS_MESSAGE will be set "1=Geofence Violation" until a new position fix that is not in violation with the geofence parameters is computed.

In the case of boundary crossing geofence, the TrimTrac will report once and only once each time a geofence boundary is crossed by sending a new POSITION_REP and a RESP_GEOFENCE_CONFIG message. If SMS is being used, both messages will be included in a single SMS message. The

POSITION_REP will have the TriggerType set "2=Alert", the position that first triggered the boundary crossing notice and the Geofence Status field will be set "1=Violation". The RESP_GEOFENCE_CONFIG message will denote which particular geofence had a boundary crossed.

Geofences and GPS Fix Rate

Depending upon how strictly geofences must be enforced, it may be advantageous to set the GPS Fix Rate to "1=GPS 1Hz". Geofences are enforced based upon the most recently computed GPS position. If the TrimTrac 1.5 only computes a new fix each time it enters the FIX State, then the latency in reporting a geofence violation is extended to the time it takes the TrimTrac 1.5 to cycle through the entire state machine.

If a more vigilant enforcement of the geofence is desired, then the GPS Fix Rate can be increased to once per second. This would afford more continuous enforcement of the geofences, albeit at the expense of power consumption, and near real time reporting of violations.

Geofences and Automatic Message Log Dump

GSM coverage may or may not be available throughout the geofence area and beyond. This means that a device may be able to slip out of and then back into a geofence area undetected by server, at least until GSM coverage became available. If a geofence violation had occurred while there was no GSM coverage, the device will maintain keep the Geofence Status flag set as a violation until reported to the server application whether not the device is inside or outside the geofence area at the time the message is transmitted.

Before the device is able to transmit a message with the geofence violation, the TrimTrac 1.5 may have traveled well beyond the geofence area while outside GSM coverage. If the Automatic Message Log Dump feature is enabled, then the device will not only transmit the message noting the geofence violation when GSM coverage becomes available, but it will also transmit all positions logged while traveling in violation of the geofence outside GSM coverage. In so doing, the server application will not only know that a geofence violation had occurred, but also where the device traveled in the mean time.

Scheduled Hours of Operation

This feature establishes daily consecutive hours during which use of the monitored asset is considered either "authorized" or "unauthorized". In so doing, you establish when no routine messages are to be transmitted. In effect, the Schedule Hours of Operation selectively sets the Report Delay Flag in accordance with a daily schedule. (Note: This feature should not be confused with Scheduled Reporting Mode or the Runtime Meters.)

Before the Schedule Hours of Operation feature can be activated, you must define a daily start time (relative to UTC) and how long each workday lasts. You must also specify

which day of the calendar week beginning Sunday UTC constitutes the first workday of the workweek and how many consecutive workdays are included in each workweek.

You cannot specify a beginning workday later than the total number of workdays per week. For instance, if you specify Monday as the first workday of week, you cannot specify seven consecutive workdays since there are only six calendar days remaining in the calendar week.

Parameter	Settings	Msg. Header (See Page)	Commands (See Page)
Scheduled Hours	0=Disabled; 1=Enabled	>STKZ(116) >RTKZ (133) >QTKZ(123)	AT+CTKZ (99)
Daily Start Time, T27	In Seconds (0 – 86399) after 12:00AM UTC.		
Work Day Length, T28	In Seconds (0 – 86400)		
First Work Day of Each Week	0=Sunday; 1=Monday; 2=Tuesday; 3=Wednesday; 4=Thursday; 5=Friday; 6=Saturday (All relative to UTC)		
Number of Work Days per Week	1= One Day; 2=Two Days; 3=Three Days; 4=Four Days; 5=Five Days; 6=Six Days; 7=Seven Days		

Table 3. Scheduled Hours Parameters, Settings, Messages and Commands

Runtime Meters

There are two resetable equipment runtime meters available on the TrimTrac 1.5. One is based upon motion while the other can be activated via a sensor switch connected to a Vehicle Adapter or Control Module as a LPA input (unless the LPA input is configured as a standard input or used for geofences). These meters can be individually activated or reset. The LPA-based runtime meter accumulates hours whenever the switch contacts are closed.

Each meter also has a separately programmable countdown timer. Upon expiration of the countdown timer, the TrimTrac 1.5 will transmit a message indicating which countdown timer has expired. This feature is useful in equipment maintenance applications where, of instance, a maintenance operation should occur every so many runtime hours.

To query and/or reset either or both of the runtime meters, the server application must send a QUERY_METERS message to the TrimTrac 1.5, which will respond with a RESP_METERS message containing the current runtime readings.

Parameter	Settings	Msg. Header (See Page)	Commands (See Page)
Runtime Meter Motion-based	0=Disabled; 1=Enabled	>STKZ(116) >RTKZ (133) >QTKZ(123)	AT+CTKZ (99)
Runtime Meter Motion-based Countdown, T29	In Hours (0=No Countdown, 1-990)		
Runtime Meter LPA-based	0=Disabled; 1=Enabled		
Runtime Meter LPA-based Countdown, T30	In Hours (0=No Countdown, 1-990)		
Runtime Meter LPA-based Query	0=Report Only (No Reset); 1=Report with Reset	>QTKM(125)	None
Runtime Meter Motion-based Query	0=Report Only (No Reset); 1=Report with Reset		
Runtime LPA-based Reading	Accumulated seconds since last reset, always 10 digits	>RTKM(137)	None
Runtime LPA-based Reset Confirmation	0=Report without Reset; 1=Report with Reset; 2=Disabled		
Runtime Motion-based Reading	Accumulated seconds since last reset, always 10 digits		
Runtime Motion-based Reset Confirmation	0=Report without Reset; 1=Report with Reset; 2=Disabled		

Table 4. Runtime Meter Parameters, Settings, Messages and Commands

Fix, Log and Reporting Rates

The rates at which the TrimTrac 1.5 computes, logs and transmits GPS positions need not be equal. For instance, the GPS receiver can operate in the background at the maximum rate of 1 Hz. Fixes are logged each time the TrimTrac 1.5 cycles through the state machine. Not every position that is logged, however, needs to be transmitted. Each of these rates are explained in the following sections.

Fix Rate

In its default configuration, the TrimTrac 1.5 will compute a new position fix each time the device cycles through the FIX State. Certain applications may, however, benefit from having more continuous GPS fixes available, in which case, the GPS receiver can be configured to operate at 1 Hz. Operating the GPS receiver at 1 Hz enables more real time geofence enforcement. Also, if 1 Hz GPS is enabled and the device comes to rest in an area where it can not get a final at-rest position fix, then the TrimTrac 1.5 report its last known GPS fix based on the 1 Hz rate. The GPS Fix Rate set by using either the AT+CTKZ command or by sending the TrimTrac 1.5 a SET_EXT2_APP_CONFIG message.

Log Rate

Every time the TrimTrac 1.5 cycles through the standard State Machine due to motion the TrimTrac log its current position (or position fix attempt). This logging rate is determined primarily by DELAY State Timeout, T4.

Report Rate

This refers to how many of the logged positions get transmitted. The default is every logged message gets transmitted. It may be useful, in some applications, to transmit only every other or every X logged message. This saves recurring communication costs but gives a denser historical log of previous positions should the desire to query such logged positions arise. For instance, it may be useful in historical analysis of route adherence on an exception basis.

The reporting frequency is determined by the Report Delay Flag. If set to "5", then the TrimTrac 1.5 will log five motion triggered messages, either POSITION_REP and/or STATUS_MESSAGE, and then report the next one. The five logged message remain available for subsequent download should the need arise, but on an ongoing, normal basis, they will not be transmitted. Setting the Report Delay Flag to"6" will cause the TrimTrac 1.5 to log ten messages and then transmit the next.

Parameter	Settings	Msg. Header (See Page)	Commands (See Page)
DELAY Timeout, T4	In seconds (10 – 86400)	>STKA(113) >QTKA(123) >RTKA(130)	AT+CTKC (83)
Report Delay Flag	5=Log 5 messages, transmit next; 6=Log 10 messages, transmit next		
GPS Fix Rate	0=GPS operation during FIX State only; 1=1Hz GPS operation except while stationary	>STKZ(116) >RTKZ (133) >QTKZ(123)	AT+CTKZ (99)

Table 5. Fix, Log and Reporting Rate Parameters, Settings, Messages and Commands

Input Modes

Both the Vehicle Adapter and Control Modules support three priority types of switch closure inputs: High, Medium and Low Priorities. In addition to the Automatic and Disabled Modes, two new modes of operation have been added as described below. See AT+CTKY Module-only Application Configuration on page 97 and SET_MODULE_APP_CONFIG on page 121.

Automatic Mode

When set to automatic, any activated alert can only be silenced after an acknowledgement is received from the server application. This level of acknowledgement protocol takes into account that not all packets and messages delivered by the TrimTrac 1.5 to the GSM network necessarily make it to their final destination in an uncorrupted format. The use of TCP/IP helps mitigate, but not eliminate, the risk that a message sent from the TrimTrac 1.5 might not make through. The only way to get true confirmation that the server application receive the message is for the server application to positively confirm back to the TrimTrac 1.5 that the message had indeed arrived safely. When set to "Automatic", the TrimTrac 1.5 will continuously re-transmit priority alert messages until acknowledged, or cleared, by the server application.

Network Acknowledgement

If an application requires a less stringent level of send-receive acknowledgement, then the Alert Mode can be set to "Network Acknowledgement". In this mode, it is assumed that the application server has also received any message that is confirmed to have been received by the GSM network. This provides a lower level of delivery certainly, but if used with TCP/IP in particular, may provide an acceptable level of acknowledgement.

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When set to "2=Network Acknowledgement", the TrimTrac 1.5 will accept an acknowledgment directly from the GSM protocol stack that the message had been sent to the GSM network and, presumably, received by the server application. Given the store-and-forward, non-guaranteed deliver nature of SMS and UDP, however, relying upon a GSM network acknowledgement may be risky. Use of TCP/IP over GPRS provides an added layer of delivery certainly compared to both SMS and UDP. The only way to guarantee that the server application has received the alert message, regardless of which protocol is used, remains the application level acknowledgement protocol enabled when the input mode is set "0=Automatic".

Monitor-only

When the input mode is set "3=Monitor-only", activation of the input will not in and by itself cause a new message to be transmitted to the server application. Rather, the status of the input will be indicated all subsequent position and status messages that the TrimTrac would otherwise send to the server application. No

SET_ALERT_STATE messages are required to either acknowledge or clear the alerts. Once the monitored devices or conditions have been returned to "normal", then the input status will be updated accordingly.

LPA Input Delay

In earlier versions of TrimTrac, a Low Priority Alert would become "armed" whenever the monitored switch was closed for 250 mSeconds or longer and become "activated" upon any detection of subsequent motion. This "armed-activation" sequence proved too rapid for some applications that required a delay from the time the monitored switch was closed before the Low Priority Alert became "armed". As such, TrimTrac 1.5 has a programmable input delay that postpones the arming of the LPA. This feature is expected to be useful when the LPA is used to monitor a vehicle security system. After the vehicle security system itself is armed, then the TrimTrac 1.5 itself will become armed after the LPA Input Arming Delay, T31, countdown timer expires. See AT+CTKZ Daily Hours, Runtime & Other Extended Settings on page 99 and SET_EXT2_APP_CONFIG on page 116.

Automatic Message Log Dump

In certain geographic areas, TrimTrac 1.5 will travel in and out of GSM coverage. The device will continue logging position fixes and status messages even while out of GSM coverage, but obviously it will not be able to send them when they are logged if there is no GSM coverage. The Automatic Message Log Dump feature will cause the TrimTrac 1.5 transmit all messages which would have otherwise been sent had there been GSM coverage at the time they were created and logged once a GSM network connection has been re-established. Automatic Message Log Dump can be enabled either during initial provisioning of the device or through the use of over-the-air commands.

The Automatic Message Log Dump feature must be used with a certain amount of discretion as it does not differentiate between the different message TriggerTypes. Any message that should have been transmitted had there been GSM coverage at the time will, assuming GSM coverage is re-established, get transmitted by the Automatic Message Log Dump feature. The importance of this statement becomes apparent when one or more priority input alerts get activated while outside GSM coverage.

If one or more get activated while there is no GSM coverage, then the TrimTrac 1.5 will continuously attempt to transmit those alerts until a successful transmission results. In the meantime, each of the failed transmit attempts are placed in the TrimTrac 1.5 message log with the GSM Status set "2=No Network". Once the TrimTrac 1.5 has re-entered GSM coverage, it will begin transmitting each of the previously failed transmit messages. Depending upon how long the device was outside of GSM coverage with the alerts activated, this could result in a very large number of messages being transmitted at a high rate.

Should this situation occur, then the server application should be prepared to acknowledge the incoming alerts AND to automatically reconfigure the TrimTrac to disable the Automatic Message Log Dump feature. It should be noted that re-

transmitted alert messages will have Report Sequence Numbers lower than the alert message first received by the server application.

Finally, the TrimTrac 1.5 message log could be completely filled with alert messages if the device remained outside GSM coverage for a long enough time period while one or more alerts were activated. The message log will hold up to 1,024 most recent messages. Once full, new messages will overwrite the oldest messages.

Motion Report Flag

If a TrimTrac 1.5 has been a rest for a while, it is likely in the IDLE State. Once the device starts to move, it will normally wake up, start computing a new GPS position and then report it. Depending upon the GPS signal at the time and how long it has been since the device computed its last position, the time to compute and report a new GPS fix can vary. Moreover, if there is insufficient GPS signal to compute a new fix, no new message will be sent to the server application until the FIX State Timeout, T2, has expired.

If the application requires more immediate notice that a device, which should be at-rest, has started to move, then the Motion Report Flag should be enabled. In so doing, the device will send an immediate STATUS_MESSAGE to the server application that motion has commenced. After this initial STATUS_MESSAGE is sent, then the device will go compute a new position fix and commence further reporting in accordance with its other configuration settings.

Report Delay Flag

This is an extremely important parameter used to help manage communication costs. It has little, if any, impact on power consumption, but it is instrumental in minimizing communication costs. Basically, the Report Delay Flag selectively suppresses the transmission of messages until certain events occur or messages are received from the server application.

For instance, setting the Report Delay Flag to "1" suppresses all normal position reports and status messages (except queries, scheduled reports, and priority and geofence alerts) even though the device is cycling through the state machine in background. Based on motion, it will be computing and logging, but not transmitting, new position fixes. These logged positions can be subsequently retrieved by the server application by sending the TrimTrac 1.5 the appropriate query message. The server application can change the device configuration or query it for other information and still get a response even if the Report Delay Flag is set to suppress some or all other messages. All alert, query and, if enabled, Scheduled Reporting Mode messages are transmitted regardless of how the Report Delay Flag is set.

Additionally, the Report Delay Flag can selectively suppress transmissions by time of day, when used in conjunction with the Scheduled Hours, or based upon the starting and stopping of motion. When set to "Start/Stop" reporting, the device will send a new STATUS_MESSAGE, along with its most recently logged position message, when the device first starts to move. It will continue to compute and log position fixes while in route (for later retrieval if needed), but these in route positions will not be automatically transmitted to the server applications. Once the device has come back to rest, it will compute this stopped position and transmit it to the server application.

Finally, the Report Delay Flag can alternate between logging messages and transmitting messages. For instance, it can be configured to log five or ten messages and transmit only the next one. This reduces communication costs during "normal" operation, but if the need were to arise, there is more detailed position history available for query on the device, which may be of interest if, for instance, a tracked vehicle were involved in an accident or was suspected of deviating from a desired route.

Diagnostics Mode

This feature enables or disables the LED. For covert installations, it may be useful to disable the flashing LED.

Scheduled Reporting Mode

This feature allows the transmission of status and position information at some pre-determined time regardless of how the Report Delay Flag may be set. At the designated time each week or day, depending upon how the Scheduled Reporting Mode is enabled, the TrimTrac 1.5 will transmit a new STATUS_MESSAGE containing the current state of all monitored parameters, such as battery capacity, alerts, geofence status and so on, plus the most recently logged REPORT_POSITION. If the device had been unable to compute a new position fix since the most recently REPORT_POSITION was logged, and there has been recent motion, then the new STATUS_MESSAGE will have the Position Age flag set to "1".

Enabling this Scheduled Reporting Mode has the added benefit of the server application knowing when the device will be connected to the GSM network. As such, the server application could send messages in anticipation of the TrimTrac 1.5 being connected to the GSM network at the designated time. This is particularly useful if the TrimTrac 1.5 is expected to be off the GSM network for an extended period of time due to either being out of coverage or due to lack of motion and long IDLE Timeout, T1, settings. Some GSM network operators may delay when messages or data packets get delivered to mobile devices when the mobile device has not been connected to the network for an extended period.

Polling

Polling on the TrimTrac 1.5 has been implemented somewhat differently than earlier generations of the TrimTrac locator. Polling can be implemented on the TrimTrac 1.5 either based upon motion or regardless of motion. In order to enable polling, the TrimTrac 1.5 remains connected to the GSM network in states other than just the TRANSMIT or QUERY states. Connection to the GSM network requires that the device keep the internal GSM modem powered up and operating. This, of course, increases power consumption and reduces battery life, but the ability to more continuous communication with the device may outweigh these negative side effects.

If communication with the device is required at all times, whether the device is moving or is at rest, then the Anytime Polling feature is set "2=OnDemand". The device will be able to receive and process messages sent from the server application in virtual real-time, regardless of which state the device may be in at the time, except when the device itself is already transmitting a message.

As noted above, however, leaving the GSM modem on continuous to support this Anytime Polling OnDemand capability has a negative impact on power consumption. To help mitigate this parasitic power drain, it may be useful to cycle the GSM modem on and off periodically while the device is at rest. This is the purpose of Duty-Cycled setting for Anytime Polling. When enabled, Duty-Cylced polling turns off the GSM modem for some pre-defined period while in the IDLE State (i.e. at rest with no motion) and then turns it back on momentarily to check for any messages sent by the server application. While the device is in motion, the GSM modem remains on continuously.

The In-Motion Polling feature is used when polling is to be enable ONLY while motion is sensed. If no motion is occurring and the device is in the IDLE State, then the GSM modem will be powered off except as required to process normal IDLE state messages. While in motion, however, the GSM modem will remain powered up, thereby allowing continuous connection to the GSM network.

The In-Motion Polling feature is submissive to Anytime Polling, meaning that if Anytime Polling is enabled, be it set to OnDemand or Duty-Cycled, then the GSM modem will remain powered during motion regardless of how the In-Motion Polling feature is set.

If neither Anytime Polling nor In-Motion Polling is enabled, then the device can only be query, polled, or otherwise communicated with while it is in the QUERY state only.

Query Hold Flag

The Query Hold Flag is seldom changed for its default configuration. In its default mode and assuming neither Anytime Polling nor In-Motion Polling is

enabled, if the device loses connection to the GSM network while in the QUERY state, it will not attempt to re-establish connection again until the has cycled back through the state machine and again re-enters the TRANSMIT or QUERY states.

If the Query Hold Flag is set, then the device will attempt to re-establish connection to the GSM network if connection to the GSM network was lost prior to the expiration of the QUERY State Timeout, T5. It will attempt to re-establish connection to the GSM network until the QUERY State Timeout, T5, has expired.

This may be of benefit to certain applications where no Polling is enabled and the device may be expected to rapidly come into and exit GSM coverage and there is a strong need to get messages transmitted as soon as possible. The Automatic Message Log Dump feature described elsewhere, however, should suffice in most applications.

Transmit Attempts

The number of transmit attempts is individually selectable for position reports, status messages and alert messages. Each time the device has messages to be transmitted, it has enters the TRANSMIT State and assuming a GSM network is available, it will make the specified number of transmit attempts until the TRANSMIT Timeout, T3, expires or the message is successfully transmitted, whichever is earlier.

In the case of normal position and status messages, the default number of transmit attempts is one, meaning that if the transmission attempt fails prior to expiration of the TRANSMIT Timeout, T3, either due to an error received from the GSM protocol stack or loss of GSM network connection, then the device will terminate the current TRANSMIT state and move on. It will not attempt to re-transmit the message again in either the current or subsequent TRANSMIT states unless queried to do so or if Automatic Message Log Dump is enabled.

If the number of transmit attempts is set to some other non-zero valve, then the device will make however many transmit attempts are specified until the earlier of confirmation of a successful transmission or expiration of the TRANSMIT Timeout, T3. If set to "0", then the device will continuously try to transmit the message without any transmit attempt limit until the earlier of confirmation of a successful transmission or expiration of the TRANSMIT Timeout, T3.

In the case of alert messages, the transmit attempts are all set default to 0, meaning that the device will continue to attempt to transmit alert messages until the earlier of confirmation of a successful transmission or expiration of the TRANSMIT Timeout, T3.

In almost all application, the number of transmit attempts should be set either to 0 or 1.

Motion Sensor Override

This parameter is most useful during server application development and as an override for units in the field that may have had a motion sensor failure. During "normal" operation, however, the Motion Sensor Override should always be set to default.

Setting the Motion Sensor Override to either "1=Motion Always" or "0=Motion Never" causes the TrimTrac 1.5 operate as if it is in constant motion or at rest, respectively. By forcing the device into either of these two modes, application developers can see how the device is expected to operate in the field.

Should a motion sensor malfunction in the field, then this parameter can be used to override its operation either on or off. For instance, if the motion sensor get stuck and the device will not stop reporting after coming to rest, then this command could be used to turn off the motion sensor altogether. Conversely, if the motion detector stops sensing motion even while the device is known to be moving, then the motion sensor could be over ridden into the "on" state.

Variable State Timeouts for High and Medium Priority Alerts

During normal conditions, the TrimTrac 1.5 operates in accordance with its current parameter configurations; however, when a High or Medium Priority Alert is activated, the frequency at which the TrimTrac 1.5 cycles through the state machine can be varied. For instance, the TrimTrac 1.5 may be configured to report once every 15 minutes, which may be adequate under "normal" conditions. If, however, a High or Medium Priority Alert is activated, then more frequent reporting is usually required. As such, the timeouts associated with the IDLE, DELAY and TRANSMIT states can be individually selected based upon whether a High and/or Medium Priority Alert has been activated. In the case of a High Priority Alert, the QUERY state timeout can also be varied.

Additionally and as described elsewhere, the number of Transmit Attempts can be set for High and Medium, as well as Low, Priority Alerts.

Application Scenarios

Introduction

The TrimTrac 1.5 is both elegant and powerful in its simplicity. How to best configure it for any given application, however, may not always be intuitively obvious. The intent of this section is to provide operational insight and specific configuration suggestions based on different application environments.

General Considerations

When deciding how to best configure the TrimTrac 1.5, consider the following:

1. What is the expected frequency and duration of motion?

2. How often should the unit compute a new position fix while in motion?

3. How often should the unit report while in motion? While stationary?

4. How sensitive is the end-user application to power consumption, recurring communication costs, or both?

Motion Profile

How frequently the TrimTrac 1.5 is moved and how long it remains in motion will effect unit operation. For instance, a unit that is expected to make many short trips per day will generally benefit from having a higher number of position fixes than one that moves only a couple of times per day but remains in motion longer during each trip.

Fix Density While in Motion

In general, if there are going to be multiple trips per day, setting the DELAY Timeout, T4, to 25% of the expected duration of each trip will provide a reasonable fix density. For instance, if the average time of each trip is approximately one hour, setting DELAY Timeout, T4, to 15 minutes (900 seconds) has proven to be a good balance between fix density, power consumption and, if transmitted, communication costs.

The maximum fix density one can expect to get from the TrimTrac 1.5 is one position fix every 3 to 5 minutes. While this is probably not sufficient for some dispatch, intercept and real-time fleet management application, a fix density of 3 to 5 minutes is more than acceptable for an extremely wide range of less real time critical applications.

Reporting Frequency

The rate at which the TrimTrac 1.5 computes new position fixes needs not be the same rate at which it transmits those logged positions to the server application. While the device is in motion, the DELAY Timeout, T4, setting largely determines the frequency at which the TrimTrac 1.5 will attempt to compute and log a new position fix.

How frequently those logged positions are transmitted, however, is determined mostly by the Report Delay Flag setting. For instance, if the Report Delay Flag is set to some value other than "0=Transmit All Messages", some or all of the logged positions may not be transmitted unless a QUERY_LOG or similar message is received by the TrimTrac 1.5 or if the Scheduled Reporting Mode is set to either "1=Weekly" or "2=Daily".

Battery Life and Communication Costs

If computing position fixes consumed no power and if communication costs were "free," then there would be no need to worry about such things. Alas, such is not the case. In any given application, there must be an appropriate trade off between communication costs, power consumption and battery life and the need for information. Taking into account the foregoing general considerations, the following sections look at different application scenarios and suggest possible configurations.

Polling

In its default configuration, the server application can communicate with the TrimTrac 1.5 only while the device is in the QUERY State, which may not allow frequent enough communications for some applications. As such, the TrimTrac 1.5 has several different polling options that can be activated depending upon the appropriate mixture of power consumption, communication costs and the need to communicate with the device in a timelier manner than allowed by the default settings.

Depending upon the specific application requirements, the polling capability of the TrimTrac 1.5 can be selectively turned on and off or simply left on continuously regardless of motion or current operational state.

For instance, if Anytime Polling is set to "2=Anytime OnDemand", then the GSM modem will never be turned off. The device will be able to receive and process data messages whether the device is at rest or is in motion regardless what operational state the device may be at the time.

If, on the other hand, continuous polling capabilities are required only while the device is in motion, then the In-Motion Polling feature would be set "2=OnDemand while in Motion". Once the device comes to rest, the GSM modem would be turned off to save power. It would be powered back up upon the occurrence of a TriggerType event or whenever the Polling Duty-Cycle On-Time, T20, is running.

Enabling any polling capability will have a significant impact on power consumption. Setting the Anytime Polling to "2=Anytime OnDemand" will limit the life of four AA alkaline batteries to no more than 3-5 days depending upon how frequently the GSM network pings the device for registration information. Therefore, any polling mode, except perhaps for Cycled Polling, is best reserved for those TrimTrac 1.5s using a Vehicle Adapter or Control Module.

Example Applications

Baseline (Default) Application

TrimTrac 1.5 default values are based upon two trips per day (frequency) with each trip being one hour in length (duration). Market research studies indicate that most end-user consumers believe a nominal 15-minute position reporting interval while the vehicle is moving is a good combination of timely information, reasonable SMS communication costs, and battery life.

This baseline application scenario, assuming good GPS signal strength and GSM coverage, will yield 10 position reports per day plus one or two status messages each day, depending upon how the two trips are spaced out over the course of a day. Typically, four AA alkaline batteries will last for up to 90 days before they would need to be replaced under this application scenario using factory default settings.

Command to Return Unit to Default Configuration	See Page
AT+CTKE=2	85

Table 6. Provisioning Command for Default Configuration Settings and Log Clearing

Query-to-Fix Applications

Some applications may not need regular position updates but would benefit from having regularly scheduled status updates, to confirm device health and battery lever, for instance, and to have the ability to get current position information from time-to-time when needed.

Setting	Point	Counterpoint
Report Delay Flag set to "1=Transmit Alert, Query response and Scheduled messages only".	Saves power and communication costs by not transmitting any STATUS_MESSAGE triggered by expiration of DELAY Timeout, T4	Normal reporting is halted
Scheduled Reporting Mode set to either "1=Weekly" or "2=Daily" depending upon how frequently a health and battery level check is desired	Set Scheduled Report Time, T18, to whatever time of week or day the device is to transmit a STATUS_MESSAGE with TriggerType set "4=Scheduled Report"	
Motion Sensor Override set to "2=Motion Never"	This will keep the device from computing a new	Because the device is not actively computing position

	position fix even though there may be actual motion.	fixes, the time to compute a new fix upon receipt of a QTKD message will be marginally longer. No positions will be logged between QTKD messages.
Anytime Polling set "2=Cycled"	Polling Duty-Cycle Frequency, T19, based on the desired maximum response time to a query. For instance, if a one-hour response time to a position query is acceptable, then set T19 to 3600 seconds; Polling Duty-Cycle On-Time, T20, set to 60 seconds.	With these settings, the device will turn on the GSM modem once every hour for 60 seconds. During the 60 seconds, the device is able to receive messages. If T19 is increased substantially, it may be beneficial to increase T20 to 120 or 180 seconds to allow the SMSC more time to send queued messages.
When the device is to be queried for its current position, send it a GET_POSITION message with Position Query Mode set "P=Compute New Position"	Upon receipt of the GET_POSITION message, the device will compute a new position fix regardless of how the Position Age flag is set.	The device may not receive the GET_POSITION message until the next time Polling Duty-Cycle Frequency, T19, expires (up to an one-hour in this example) or at the next Scheduled Report time, whichever is earliest.

Table 7, Minimize Communication Costs and Query-to-Fix

Query-to-Fix Configuration with Weekly status messages at Sunday 12:00AM UTC and hourly polling.	See Page
AT+CTKC=	92
AT+CTKX=	93

Table 8, Sample Non-default Commands for Query-to-Fix Configuration

Stationary Assets

Whereas a personal automobile normally moves on a daily basis, some other assets may almost never move and, when they do move, it is an extraordinary event requiring immediate action. Under normal stationary conditions, perhaps all that is required is a periodic heartbeat from the unit letting the server application know that it is still alive and functioning.

Using the Scheduled Reporting Mode, Report Delay Flag and Motion Report Flag, the unit can closely monitor and report upon initial movement while providing a regularly scheduled heart beat. Expected battery life of four AA alkaline batteries, assuming default configuration settings, except those depicted in Table 44, would be approximately 9-10 months even if the asset moved once a week for an hour or so.

Setting	Point	Counterpoint
Scheduled Reporting Mode set to either "1=Daily" or "2=Weekly".	Provides a regularly scheduled STATUS_MESSAGE letting the server application that device is operational and give a battery level indication.	Does not cause a new position fix to be computed even if there has been motion since the last logged position, but in a stationary application, this should be of little consequence.
Report Delay Flag set "2=Transmit Motion-related Messages-only"	Saves power and communication costs by not transmitting any STATUS_MESSAGE triggered by expiration of DELAY Timeout, T4.	If want only Schedule Report and Motion Report Triggered messages transmitted, set Report Delay Flag to "1=Transmit Alert, Query response and Scheduled messages only".
Motion Report Flag set "1=Report Motion in IDLE (before attempting new GPS fix)"	Sends notification to server application immediately upon sensing of initial motion. Then goes and does a position fix.	May not be worth the extra data message in some applications.

Table 9, Stationary Asset Settings

Sample Stationary Configuration Settings Expected Battery Life: 9-10 Months	See Page
AT+CTKC=	92
AT+CTKX=	93

Table 10, Sample Non-default Commands for Stationary Configuration

High-Performance Tracking and Reporting

If power consumption and communication costs are of no object and the application requires maximum fix density and constant communication, then the device can be configured to report as frequently as once every 30 seconds and could be polled at any time. The communication cost would increase substantially if the device were transmitting position fixes at the rate of one every 30 seconds. In this configuration, it is not practical to operate on four AA alkaline batteries except for very short periods measured in hours (not days). But if you and or your customer are willing to take these hits, then the TrimTrac 1.5 can be an extremely cost-effective way to monitor dynamic assets.

If GPS Fix Rate is set to "1=1Hz GPS", Anytime Polling is set "2=Anytime OnDemand", QUERY Timeout, T5 and DELAY Timeout, T4 are both set to 10 Seconds; all other parameters at default, and the unit has good GPS and GSM coverage, then the maximum reporting frequency one can expect from a TrimTrac 1.5 is one transmission every 30 seconds. This reporting rate will, however, significantly impact power consumption and communication cost, especially if SMS messaging is used.

Setting	Point	Counterpoint
Anytime Polling set "2=Anytime OnDemand".	Allows constant communication with the TrimTrac 1.5 even while actively computing a new position fix or transmitting a message.	Drastically reduces battery life to as little as 4 days even if there is no new position fixes are being computed and transmitted. Actual battery life dependent upon, amongst other things, how frequently the GSM network forces the device to re-register on the network. If longer response times are acceptable, then consider setting Anytime Polling to "1=Duty-Cycled"
DELAY Timeout, T4, set to minimum 10 seconds	Minimizes the time between message transmissions	If want only Scheduled Reporting Mode and Motion Report Flag Triggered messages transmitted, set Report Delay Flag to "1=Transmit Alert, Query response and Scheduled messages only".
QUERY Timeout, T5, set to minimum 10 seconds	Minimizes the time between message transmissions	

GPS Fix Rate set "1=1Hz GPS	Continuous computation of GPS positions while in motion. Increases resolution of Geofence enforcement and stopped position reporting	Heavy impact on power consumption and, if used, battery life.

Table 11, High Performance Settings

Sample High Performance Configuration Settings Expected Battery Life: Less than One Day	See Page
AT+CTKC=	92
AT+CTKX=	93

Table 12, Sample High Performance Settings

Note that if GPS Fix Rate is set to "1=1Hz GPS" and the TrimTrac 1.5 is unable to compute a fix when it enters the FIX State, but it was able to compute one or more fixes since the last time it was in the FIX State, then the TrimTrac 1.5 will generate a new REP_POSITION message using the most recently available fix with the Position Age set to "1=Aged" thereby denoting that there had been motion since the last position fix as shown for Message 02D7 in Table 13.

Message	Seq.No.	TriggerType	Bat.Level	GPS Week	GPS Seconds	GPS Status	GSM Status	PositionAged	Misc.	GPS Antenna	Misc.	Latitude	Longitude	Altitude	Speed	Heading
>RTKP 02D2	1	8	F	1370	344152	0	0	0	00000	1	000	+373829430	-1220126769	22	0	0
>RTKP 02D3	1	7	F	1370	344179	0	0	0	00000	1	000	+373811981	-1220120790	26	0	0
>RTKP 02D4	1	7	F	1370	344207	0	0	0	00000	1	000	+373812018	-1220120818	16	0	0
>RTKP 02D5	1	6	F	1370	344234	0	0	0	00000	1	000	+373788780	-1220128448	32	15	194
>RTKP 02D6	1	6	F	1370	344261	0	0	0	00000	1	000	+373787296	-1220129473	13	0	0
>RTKP 02D7	1	4	F	1370	344276	0	0	1	00000	1	000	+373783903	-1220130633	6	32	186
>RTKP 02D8	1	4	F	1370	344627	0	0	0	00000	1	000	+373430458	-1220143765	55	39	180
>RTKP 02D9	1	4	F	1370	344653	0	0	0	00000	1	000	+373390078	-1220143418	134	31	179
>RTKP 02DA	1	4	F	1370	344679	0	0	0	00000	1	000	+373367160	-1220143771	154	35	178

Table 13. Message Log with 1Hz GPS and PositionAged Flag.

Vehicle Adapter or Control Module without Alerts

WARNING:

Before inserting a Vehicle Adapter or Control Module into a TrimTrac base unit:

A) **Connect the red (+) and black (-) wires to a 9-32 VDC power source and install a 100k Ohm resistor across the yellow wires; OR**

B) **Set the TrimTrac MPA Mode to "1=Disabled".**

FAILURE TO DO EITHER OF THESE WILL CAUSE THE TRIMTRAC 1.5 TO IMMEDIATELY ACTIVATE A MEDIUM PRIORITY ALERT AND BEGIN TRANSMITTING NOMINALLY EVERY 2-3 MINUTES UNTIL AN ACKNOWLEDGEMENT IS RECEIVED.

Use the AT+CTKY command as shown below to disable all alerts.

Disable ALL MODULE alerts	See Page
AT+CTKY=	97

Table 14, Disable Module Alert Configuration Settings

Construction Equipment Monitoring

Many construction equipment scenarios are "exception" based reporting applications, meaning reports are not typically sent unless there is some sort of exception to the normal daily routine. Exceptions might include, for instance, equipment that has left a designated construction site, motion outside normal hours of operation, or the need to perform some sort of maintenance based upon runtime hours. Alternately, it may be beneficial for billing or taxation purposes to track how long a PTO-driven implement, such as a hole digger, is used vis-à-vis total operation of the engine. The TrimTrac 1.5 can be configured to address some or all of these scenarios.

The TrimTrac 1.5 has two resetable runtime meters. One is based on motion while the other is hardwired to either a Vehicle Adapter or Control Module as a LPA input. The motion based runtime meter can be used on either battery powered or Vehicle Adapter or Control Module equipped TrimTrac 1.5s. Use of runtime meters will help manage maintenance schedules and track equipment usage for deployment, billing and taxation purposes.

Setting	Point	Counterpoint
Runtime Meter LPA-based set "1=Enabled"	Positive start/stop of runtime meter. Can be used to monitor specific implements on the equipment, such as PTOs.	Requires a VAM or Control Module. Can not be used if LPA is configured for standard LPA input or if Geofence Enforcement is set "4=Enforced when LPA input is Closed"
Runtime Meter LPA-based Countdown, T30	Provides automatic reports based upon runtime. Good for maintenance, billing or taxation.	
Runtime Meter Motion-based	Good for monitoring when equipment is being transported or used. Can be used on battery powered or Module equipped TrimTrac 1.5s	Can not distinguish between runtime caused by transportation or operation
Scheduled Hours set "1=Enabled"	Prevents nuisance transmissions during normal working hours. Unit, however, still logs position information in the	Start time same for each workday. Consecutive daily hours and workdays only.

	background	
Scheduled Reporting Mode set to "2=Weekly"	Useful if equipment can be idle for extended periods of time	
Geofence Enforcement	Prevents nuisance transmissions so long as equipment is being used where it supposed to be used.	If geofence established and activated onsite via LPA switch, then a module is required. LPA switch can not be used for geofence if used for standard LPA input or for Runtime Meter LPA-based
GPS Fix Rate set "1=GPS 1Hz"	Provides for more continuous geofence enforcement	Substantially increased power consumption

Table 15, Construction Equipment Monitoring Settings

Sample Construction Equipment Configuration Settings Expected Battery Life: ?? Days	See Page
AT+CTKC=	92
AT+CTKX=	93

Table 16, Sample Construction Equipment Monitoring Settings

Summary End-user and Installation Instructions

Battery Powered Units

1. Configure and provision the TrimTrac 1.5 as described in the TrimTrac Technical Manual. As a minimum, the device must be provisioned with a Destination Address and, if required by the SIM card provider, a SIM PIN, even if all other factory default settings are used.

2. If SIM card is already installed, remove the TrimTrac 1.5 base cover and any installed modules to access the SIM cardholder.

3. Insert the activated SMS-enabled SIM card from your service provider or wireless carrier into the SIM cardholder and close latch making sure the SIM card is securely seated and locked into place.

4. Place the empty Battery Module in the TrimTrac 1.5 base while aligning the arrow on Battery Module with the arrow on the TrimTrac 1.5 base.

5. Press down on the Battery Module to snap it securely in place on all four corners making sure all corner clip tabs are all fully engaged.

6. Insert four fresh AA alkaline batteries into the Battery Module with polarities as shown on the Battery Module.

   > Note: The LED may or may not immediately begin flashing when the unit is shaken depending upon which operational state the device may have been in when batteries were inserted.

7. Install TrimTrac 1.5 base cover and tighten the hold down screw.

8. Place the TrimTrac 1.5 at a slight incline (TrimTrac logo facing up) with as clear of a view of the sky as possible.

9. To change batteries, remove the TrimTrac 1.5 base cover and properly dispose of old batteries, then follow steps 6 through 8 above.

Vehicle Adapter or Control Module Equipped Units

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PLEASE CONNECT ALL WIRE LEADS **PRIOR** TO INSERTING THE VEHICLE
ADAPATER MODULE INTO THE TRIMTRAC 1.5 BASE

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REQUIRED CONNECTIONS:

1. Connect RED wire to a constant, non-switched 9-32 VDC source of power (+).

2. Connect the BLACK wire to vehicle ground.

3. Connect YELLOW wires as follows:

    a. Connect YELLOW wires to High, Medium and/or Low Priority Alert devices as described in the OPTIONAL INPUTS AND ALERTS below; OR.

    b. Cut or tape off the YELLOW wires. Make sure the TrimTrac 1.5 is programmed to Disable Medium Priority Alerts.

OPTIONAL INPUTS AND ALERTS:

1. Refer to the wiring diagram provided in the Technical Manual, Figure 9, Vehicle Adapter Module Alert Wiring Diagram.

2. Mount the monitored switches or devices in the desired locations. It is best to install resistors with the values specified on the wiring diagram at the monitored switch or device (instead of at the TrimTrac 1.5). In so doing, maximum tampering protection is afforded.

3. Install a 100K-Ohm End-of-Line resistor as shown in the wiring diagram.

FINAL ASSEMBLY AND INSTALLATION:

1. Configure and provision the TrimTrac 1.5 as described in the TrimTrac Technical Manual. As a minimum, the device must be provisioned with a Destination Address and, if required by the SIM card provider, a SIM PIN, even if all other factory default settings are used.

2. Remove the TrimTrac 1.5 base cover and any previously installed module to access the SIM cardholder.

3. Insert the activated SMS-enabled SIM card from your service provider or wireless carrier into the SIM cardholder and close latch making sure the SIM card is securely seated and locked into place.

4. Remove rubber channel plug from the TrimTrac 1.5 base unit (near the cover screw insert)

5. Place the Vehicle Adapter or Control Module in the TrimTrac 1.5 base while aligning the arrow on Vehicle Adapter or Control Module with the arrow on the TrimTrac 1.5 base.

6. Press down on the Vehicle Adapter or Control Module to snap in securely in place on all four corners making sure all corner tabs are all fully engaged.

7. Route the wires and press the molded rubber piece into the channel provided.

8. Install TrimTrac 1.5 base cover and tighten the hold down screw.

9. Place the TrimTrac 1.5 at a slight incline (TrimTrac logo facing up) with as clear of a view of the sky as possible. Use the optional metal bracket for permanent installations.

STAND-BY BATTERY RECHARGE:

The internal stand-by battery should be recharged no less frequently than once every three months.

Vehicle Placement Guidelines

1. Placing the TrimTrac 1.5, or the optional external GPS antenna, where it has a clear view of the sky unobstructed by metal will maximize its ability to determine its location. Under no circumstances should the TrimTrac 1.5 be placed where it is subjected to extreme environmental conditions (temperature, vibration, water). For instance:

   a. DO NOT Leave the TrimTrac 1.5 on the dashboard exposed to direct sunlight

   b. DO NOT mount it inside the engine compartment

   c. DO NOT subject it to direct water spray from the vehicle wheels.

2. Typical placement locations for the TrimTrac 1.5 include:

   a. Temporary use on the dashboard or rear window package shelf; provided, however, that it is securely fasten down and protected from direct sunlight.

   b. In the glove box.

   c. Under a passenger seat.

   Unless the optional external GPS antenna is used, it is not recommended that the TrimTrac 1.5 be placed in the trunk or boot of the vehicle.

3. Depending upon how the TrimTrac 1.5 is configured to operate, placement within the vehicle can have a significant impact on battery life and, as shown in Figure 1, the number of position reports that are generated. Actual results will vary.

Report Density v. Unit/Antenna Placement and DELAY State Timeout, T4
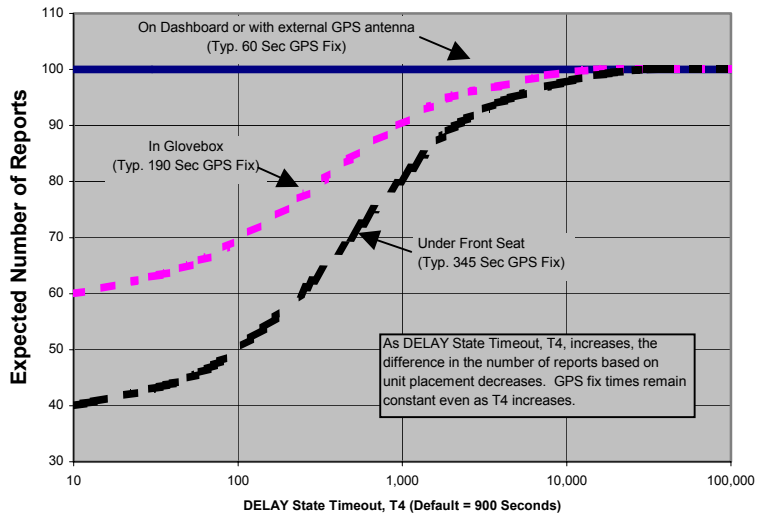
Figure 1, Vehicle Placement versus Expected Number of Reports

Technical Tips and Troubleshooting

Introduction

The TrimTrac 1.5 and accessories are designed to operate in the conditions outlined in the Specifications on page 141.

When used and maintained properly, the TrimTrac 1.5 provides years of trouble-free service. The TrimTrac 1.5 has no user-serviceable parts other than its replaceable batteries.
Should the TrimTrac 1.5 fail to operate properly, the user or service technician should troubleshoot the installation before returning any components for repair. If a component fails, return the TrimTrac 1.5 to the authorized Service and Repair Center for repair.

This chapter provides some guidelines for troubleshooting common problems associated with the TrimTrac 1.5's operation. Potential operating problems might include:

Dead Batteries

Poor contact between the Battery Pack or Vehicle Adapter or Control Module and TrimTrac 1.5 base

Poor GPS reception

Poor GSM coverage

Communication failure with base

TrimTrac 1.5 Application programming errors

If the TrimTrac 1.5 continues to operate poorly after you follow the troubleshooting guidelines described in this chapter, please contact your TrimTrac 1.5 supplier for assistance.

Battery Problems

Make sure your batteries are generating sufficient current to power your TrimTrac 1.5 and that they are installed with correct polarities. Make sure the Battery Module is securely snapped into place and the cover screw is properly tightened. Do not mix old and new batteries.

Battery Temperature Ranges

The TrimTrac 1.5 is specified to operate from −10 to +55 degrees C. This does not necessarily mean that the TrimTrac 1.5 stops working outside this range. In the case of the TrimTrac 1.5, for instance, it means that it is type approved over this range. The device may continue to operate in terms of computing position

fixes and transmitting or receiving messages both above and below this range, however, such operation is neither specified or guaranteed by Trimble or type approved.

In practice, the limiting factors in any battery-powered device in terms of temperature ranges are the batteries themselves. The capacity of alkaline batteries is, for instance, severely compromised when subjected to high temperatures. The TrimTrac 1.5 will survive when subjected to temperatures as high as +105 degrees C; however, alkaline batteries would likely be damaged and become unusable after being subjected to this elevated temperature. Conversely, low temperatures will increase the internal resistance of alkaline batteries and a voltage drop commensurate with the low temperatures will be observed.

The NiMH battery in the Vehicle Adapter or Control Module has a wider operating range than alkaline or LiION batteries, but it too will suffer from temperature extremes. In particular, the charge capacity and cycles of a NiMH battery will be decreased substantially when subjected to high temperatures. At least they will not explode or catch fire when their rated temperature specifications are exceeded like some LiION batteries.

Low temperatures do less permanent damage to batteries than high temperatures. Generally, a battery subjected to low temperature will stop working, but may recover once unit temperature is brought back to normal.

All battery life estimates assume that the batteries are at normal temperature (20 degrees C), that they have never been subjected to temperature extremes either high or low, and, in the case of the Vehicle Adapter or Control Module NiMH battery, are fully charged and have never been completely and fully discharged.

Vehicle Adapter or Control Module Battery Charging

The internal stand-by battery in the Vehicle Adapter or Control Module should never be allowed to fully discharge. Even if the Vehicle Adapter or Control Module is left uninstalled and unused, it should be connected to a 12 VDC power supply no less frequently than once every 90 days to recharge the internal stand-by battery. A good battery will reach full charge in approximately 3 hours.

GPS Reception Problems

Even though the TrimTrac 1.5 uses enhanced GPS sensitivity technology, it is still advisable to position the device or the optional external GPS antenna with as clear of a view of the sky as possible. Make sure that the TrimTrac 1.5 or antenna is reasonably positioned to receive GPS signals.

GPS Almanac Collection

When the TrimTrac 1.5 is used for the first time after being provisioned, the unit may not have a complete or current GPS almanac. If the TrimTrac 1.5 needs to collect or update the GPS almanac, it will do so by keeping the GPS receiver operating in the background. This GPS almanac collection will not interfere with the other operations of the TrimTrac 1.5.

GPS Almanac Loading

A current almanac can be collected from any operational TrimTrac 1.5 using the PC-based TrimTrac GPS Almanac Tool. This collected almanac can, in turned, be loaded into any other TrimTrac 1.5.

Converting GPS Time (UTC), GMT and Local Times

Sample source code for converting GPS (UTC), GMT, and local times is available on the www.trimtrac.com/documents partners' page.

Orientation

The TrimTrac 1.5 should be at a slight incline, preferably with a reasonably clear view of the horizon and sky. If something on the vehicle—for example, the air conditioning unit on a cab or the trailer connected to a tractor—blocks a significant portion of the horizon and the GPS signals, the GPS receiver will take longer to acquire enough satellites for a position fix. If the TrimTrac 1.5 frequently times out before completing a position fix, try moving the TrimTrac 1.5 to a new location where it, or the optional external GPS antenna, is not blocked as much.

GPS Jamming

The TrimTrac 1.5 should be installed as far away as possible from transmitting antennas, including satellite communication, radar, VHF and cellular. These transmitters may emit jamming signals that interfere with the GPS receiver's ability to track GPS satellite signals. Generally, the stronger the other transmitting device, the wider the distance required between antennas. For the TrimTrac 1.5, Trimble recommends a minimum clearance of 46 cm (approximately 18 in.) from these transmitting devices.

Land-based transmitters, including microwave and television transmitters, can also interfere with GPS reception. If the TrimTrac 1.5 is operating near an antenna farm, the TrimTrac 1.5 may temporarily lose GPS reception while in the vicinity of the transmitters. Reception should return once the TrimTrac 1.5 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 TrimTrac 1.5. If possible, turn off the equipment using other nearby antennas to see if this corrects the problem. If turning off nearby equipment un-jams your GPS signals, you need to relocate one or more of the jamming antennas.

Poor GSM Coverage

Check to make sure the SIM is not missing or incorrectly installed. Also, check to confirm that you are using the correct SIM PIN as required by your SIM card provider. Do the following:

1. Insert a SIM if none is present.

2. Remove and reinsert the existing SIM to verify proper installation.

3. Check the TrimTrac 1.5 configuration to ensure the correct PIN is programmed.

4. Make sure that the SIM card hold-down latch is securely fasten and all four corners are locked down.

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

How to Evaluate TrimTrac Placement

The number one rule in GPS is that a GPS antenna with a clear view of the sky will have better performance than one that has a blocked view. For instance, a TrimTrac 1.5 placed on the dashboard of a vehicle will almost certainly have more GPS fixes than a unit placed under the seat or in the glove box, everything else being equal. The real question is whether the TrimTrac 1.5 will provide the level of performance required to meet the needs of the application.

The answer to this question is best derived from field-testing of the specific vehicle and placement options. The test plan should call for at least one unit with an external antenna that is placed on the roof of the vehicle. This antenna placement will provide the best possible GPS performance and will establish the baselined against which all other configurations and placements will be evaluated.

Operate all devices simultaneously. Do not attempt to place a single unit in one location, do a test drive, and then relocate it to another area of interest. The only way to truly test different placements is to have one device in each location operating simultaneously with all the other units.

An example evaluation plan might be to have one device with its external antenna placed on the roof, one unit operating on the internal antenna on the dashboard with a clear view of the sky, one unit in the glove box and one under the front seat. This would require a total of four units, all identically configured.

To maximize the amount of data, we recommend using the factory default configuration, except the DELAY Timeout, T4, should be set to the minimum of 10 seconds. If an active SIM card is inserted in the TrimTrac 1.5, then this will result in a new message being logged every 2 to 3 minutes for the unit operating on the external GPS antenna placed on the roof (See Figure 2, Expected Reporting Frequencies). If no SIM card is inserted, then the TRANSMIT and QUERY states are skipped, resulting in more frequent message logging.

The vehicle should be operated as one would expect in the actual application environment. The data logged by the roof-top antenna equipped TrimTrac 1.5 will provide a performance baseline against which the other units will be compared. The analysis should compare the number of attempted position fixes versus the number of successful position fixes during the test period by unit.

In general, testing done to date indicates that a unit located in the glove box will on average get approximately 50% fewer position fixes than a unit located on the dashboard of the vehicle. Units placed under the front seat will performance about the same as units placed in the glove box unless the seat is a power seat. Power seats have considerably more metal than manually adjusted seats and the added metal attenuates the GPS signal that much more. It is not recommended that units be placed in the trunk of standard 3-box style sedans unless an optional external GPS antenna is used.

GSM Jamming

The TrimTrac 1.5, or the optional external GPS antenna, should be installed as far away as possible from other transmitting antennas including other TrimTrac 1.5s, satellite communication, radar, and VHF radio. These transmitters may emit jamming signals that 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 TrimTrac 1.5 farther away from these antennas. Generally, the stronger the other transmitting device, the wider the distance required between antennas.

No Data Communication with Base

If the TrimTrac 1.5 is not communicating with the server application as expected, do the following:

1. Confirm that a data-enabled SIM (SMS or GPRS) is inserted in the unit and that the hold down latch is pressed all the way down and securely holding the SIM card at all four corners.

2. Confirm proper provisioning, including Unit ID, SMS Destination Address, Security Password, and, if needed, SIM PIN;

3. Verify that the unit has its application parameters configured as desired. Pay particular attention to the Report Delay Flag, QUERY Timeout, T5, and TRANSMIT Timeout, T3, settings. Default settings for QUERY Timeout, T5, and TRANSMIT Timeout, T3, are recommended.

4. Set the Diagnostics Mode to "1=Enabled" and observe the LED to confirm that the unit properly enters the TRANSMIT and QUERY states.

5. Use the AT+CTKO? command with a provisioning module to review logged messages while paying particular attention to the GSM Status field.

Base Modem Configuration

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

Defective TrimTrac 1.5

To confirm that a TrimTrac 1.5 is defective, do the following:

1. Try a known-good TrimTrac 1.5.

2. Move into an area with strong GSM coverage.

3. Send the TrimTrac 1.5 a data message requesting a response.

Note – Before returning the TrimTrac 1.5, be sure to save the TrimTrac 1.5's configuration settings, and remove your SIM.

No Modem Connection with Server Application

If it appears that you have no modem connection with the Server Application, confirm that the Server Application modem is configured correctly and that the TrimTrac 1.5 is configured and operating correctly. Do the following:

1. Check to see if the Destination Address is programmed correctly.

2. Verify the Server Application software is calling the correct TrimTrac 1.5 telephone number and using the correct Unit ID, Security Password and, if required by the SIM card, the SIM PIN.

TrimTrac 1.5 Not Reporting

If it appears that the TrimTrac 1.5 is not reporting to the server application as expected, diagnose as follows:

1. **Configuration.** Always confirm whether the TrimTrac 1.5 is configured as appropriate for the particular application environment. More specifically, confirm that the provisioning parameters are correct. Correct and re-test as necessary.

2. **Lost Reports.** In this case, the TrimTrac 1.5 has successfully created a new message (Position, Status, or Alert) and it has been sent to the GSM network. If such sent messages are not received by the server application, then perhaps the messages are getting lost or delayed in the GSM network.

   Review the TrimTrac 1.5 message log and Report Sequence Numbers compared to those received by the server application. If there are missing on inconsistent Report Sequence Numbers at the server application vis-à-vis the messages logged within the TrimTrac 1.5, then a problem associated with the GSM network is the likely culprit;

3. **Unsent Reports.** If the TrimTrac 1.5 is correctly generating position and status messages as expected (as determined by reviewing the message log using the AT+CTKO? command with a provisioning module), then the reports may not be getting sent due to: no available GSM network, no SIM installed, or the Report Delay Flag is set to something other than "0=Transmit All Messages". (Note the Report Delay Flag has no effect on the sending of Alert messages);

4. **No Reports Generated.** The TrimTrac 1.5 is expected to spend a majority of its time in either the IDLE or DELAY states, during which the unit will not send any messages until motion causes a transition, the appropriate RTC-based timeouts have expired, or if an Alert condition occurs.

   Another possible cause would be the motion detector and associated latches may not be recognizing motion; in which case, the unit may dwell in IDLE until the IDLE Timeout, T1, expires even though there may have been motion in the mean time. If missed motion is suspected, the sensitivity of the motion detector can be manipulated by adjusting Static Motion Filter Timeout, T7 and the associated Static Motion Filter Counter, N3, settings and/or by adjusting the Dynamic Filter Timeout, T21, and Dynamic Motion Filter Counter, N4.

   Generally speaking, increasing the ratio between Static Motion Filter Timeout, T7 and the associated Static Motion Filter Counter, N3, will increase the motion detector sensitivity in the IDLE state; provided, however, that Static Motion Filter Timeout, T7, is not set to "0". If Static Motion Filter Timeout, T7, is set to "0", then the Static Motion Filter Counter, N3, setting is ignored and the motion detector is undamped.

   Additionally, the sensitivity of both motion detector filters can be adjusted with the Motion Counter Threshold. This parameter determines how many times during each second motion must be detected before either the Static Motion Filter Counter, N3, or Dynamic Motion Filter Counter, N4, are increased by one count.

Unit Does Not Report Stopped Position

In its default configuration, the TrimTrac 1.5 will attempt one additional position fix after the unit has come to rest. If, however, the unit is in a vehicle that has come to rest in a covered parking structure or garage, there may be insufficient GPS signal to compute a final position fix, in which case, the device will log a Status Message, but a new Position Report may not be available. In application server-based geo-fence applications, this may be problematic since the server application may not know whether the device has entered the geo-fence area.

If coming to rest in an obscured GPS signal environment is expected, then consider setting the GPS Fix Rate to "1=GPS 1Hz". In so doing, the GPS receiver will continuously compute new position fixes until the GPS signal is lost. Then, if the TrimTrac 1.5 comes to rest after losing the GPS signal due to blockage, the TrimTrac 1.5 will report the very last computed position and set the Position Age flag to "1=Aged", as opposed to sending just a new STATUS_MESSAGE. At least this way, the last reported position could be where the vehicle entered the parking structure even though it may not have been able to compute a fix in the parking structure itself.

Continued Reporting After Coming to Rest

In the event a TrimTrac 1.5 continues to report after coming to rest, it may be because the motion detector is overly sensitive for the given application environment. Fine-tuning of the motion detector settings is achieved by changing the motion timeout and second-count settings.

These configuration parameters include the Static Motion Filter Timeout, T7, and associated Static Motion Filter Counter, N3, and the Dynamic Filter Timeout, T21 and its associated Dynamic Motion Filter Counter, N4, setting can be changed as well.

In general, increasing a motion filter counter (Static Motion Filter Counter, N3 or Dynamic Motion Filter Counter, N4) as a percentage of its associated motion filter window (Static Motion Filter Timeout, T7, or Dynamic Filter Timeout, T21, respectively) will decrease the motion sensor sensitivity.

Additionally, increasing the Motion Counter Threshold will decrease the relative sensitivity of both motion detection filters.

TrimTrac Will Not Stop Reporting Every 2-3 Minutes

Chances are a Vehicle Adapter or Control Module was inserted into a TrimTrac 1.5 base when the MPA Mode was set "0=Automatic" and before the Vehicle Adapter or Control Module was:

1. Connected to an external 9-32 VDC power supply; and/or

2. An end-of-line resistor was installed across the Yellow leads (See Figure 9, Vehicle Adapter Module Alert Wiring Diagram)

The TrimTrac Vehicle Adapter or Control Module has an internal rechargeable standby battery that has a residual charge when shipped from the factory. This residual charge is typically enough to support operation of the TrimTrac 1.5 when the Vehicle Adapter or Control Module is first inserted into the TrimTrac 1.5.

Once the Medium Priority Alert is activated, the TrimTrac 1.5 will continuously transmit nominally every 2-3 minutes until the Medium Priority alert status is changed to "Acknowledged" from "Activated". This can only happen once the TrimTrac 1.5 has received the appropriately configured SET_ALERT message from the server application.

WARNING:

Before inserting a Vehicle Adapter or Control Module into a TrimTrac base unit:

A) Connect the red (+) and black (-) wires to a 9-32 VDC power source and install a 100k Ohm resistor across the yellow wires; OR

B) Set the TrimTrac MPA Status to "1=Disabled".

FAILURE TO DO EITHER OF THESE WILL CAUSE THE TRIMTRAC 1.5 TO IMMEDIATELY ACTIVATE A MEDIUM PRIORITY ALERT

AND BEGIN TRANSMITTING NOMINALLY EVERY 2-3 MINUTES UNTIL AN ACKNOWLEDGEMENT IS RECEIVED.

Verify Checksums when Analyzing Data

An easy way to analyze data received from The TrimTrac 1.5 is to log the actual messages into a text file and verify that the messages are valid by checking the checksums. Available from www.trimtrac.com is a simple checksum checker executable that can be run against a text file containing messages sent from a TrimTrac 1.5. If the checksum contained in the message is "Bad" then the program will indicate it as "BAD" and return what the correct checksum should have been. Verifying checksums helps avoid wasted time spent evaluating invalid messages.

Out of Sequence Messages

Regardless of which protocol (SMS, TCP/IP or UDP) is being used, messages received by the server application may be received out of sequence. If Automatic Message Log Dump is enabled, and the device left and re-entered GSM coverage, then the device will transmit messages logged while outside of GSM coverage after GSM has been re-established. In so doing, messages will be received by the server application out of sequence. When using UDP or SMS, there is no guarantee that messages will be received in the same order transmitted by the TrimTrac 1.5.

Updating Firmware in the Field

You can upload new firmware from a PC or laptop connected to the Provisioning Module. For more information on updating firmware in the field, please consult with your Trimble technical support representative.

LED Indicator

The LED indicator is useful for diagnosing problems. For more information, see LED States, page 103. If you detect a problem, then have the TrimTrac 1.5 inspected by qualified service personnel.

Responding to Query or Set Data Messages

The TrimTrac 1.5 processes and, except as noted below, responds immediately to any data message that it receives while in the QUERY state. It does not need to cycle back through the State Machine before a response is sent back to the server application unless the response requires a new position fix.

The TrimTrac 1.5, however, will not respond to data messages:

1. that are invalid (i.e. incorrect format, checksum, Unit ID, Security Password and, if used, SIM PIN), or

2. that are SET_ALERT_STATE messages in which a priority alert status is set "0=Clear" but the underlying condition that triggered the original alert message has not been returned to its "normal" condition.

Different network operators may also handle queued up SMS messages differently. For instance, if the TrimTrac 1.5 happens not to be in the QUERY state when the server application sends a SMS message, this SMS message will be held at the network operator's Short Message Service Center (SMSC) for future delivery. In some cases, the longer the SMS is held at the SMSC, the lower in the delivery priority the message may become. As a consequence, the SMSC may not send the queued SMS message before the QUERY Timeout, T5, has expired, especially if the TrimTrac 1.5 has not been registered on the GSM network for a long time. Therefore, if it can be reasonably expected that an application will have extended periods of time between QUERY states, then extending the QUERY Timeout, T5, should be considered.

Reporting Frequency

As shown in Figure 2, Expected Reporting Frequencies on page 50, the frequency at which the TrimTrac 1.5 will report a position, while the unit is in motion, is largely determined by:

> DELAY Timeout, T4, setting
>
> GPS Signal Strength

The time it takes for a TrimTrac 1.5 to compute a new position fix is inversely proportional to available GPS signal level. When the TrimTrac 1.5 has an unobstructed view of the sky, GPS signal strength is approximately –130 dBm. This would equate to approximately 40 seconds to compute a new position fix as shown in Figure 3, Warm Start TTFFs on page 51. For the most part, this is equivalent to the unit being placed on the dashboard or rear package shelf of a vehicle; provided, however, the window has no metalized coatings that would attenuate the GPS signal.

A unit placed in the glove box of a typical vehicle, on the other hand, may only see –136 dBm of GPS signal. In this circumstance, the unit may take upwards of 400 seconds to compute a new position fix and this assumes that objects, such as buildings and trees, outside of the vehicle, do not further obscure view of the sky.
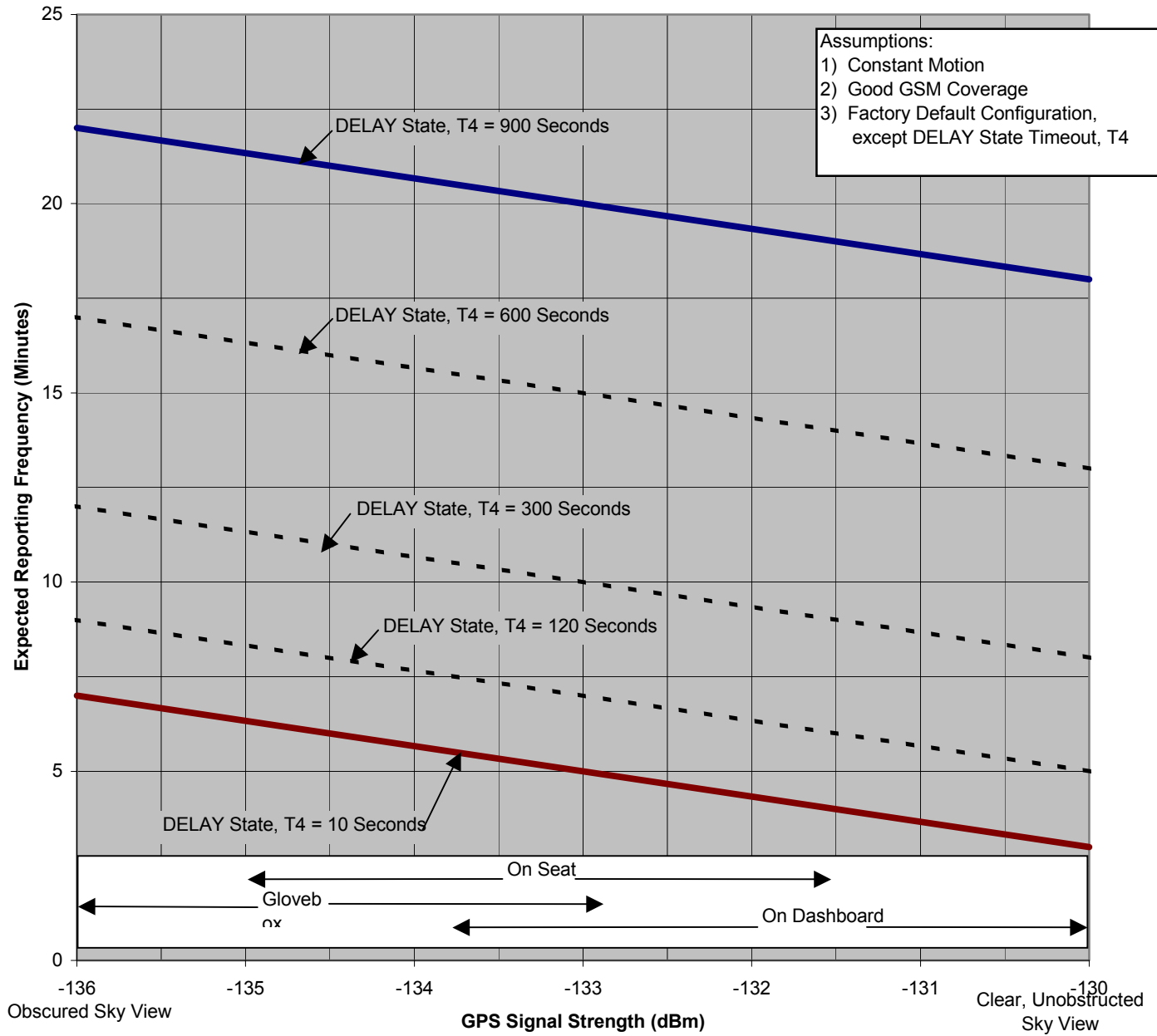
Figure 2, Expected Reporting Frequencies
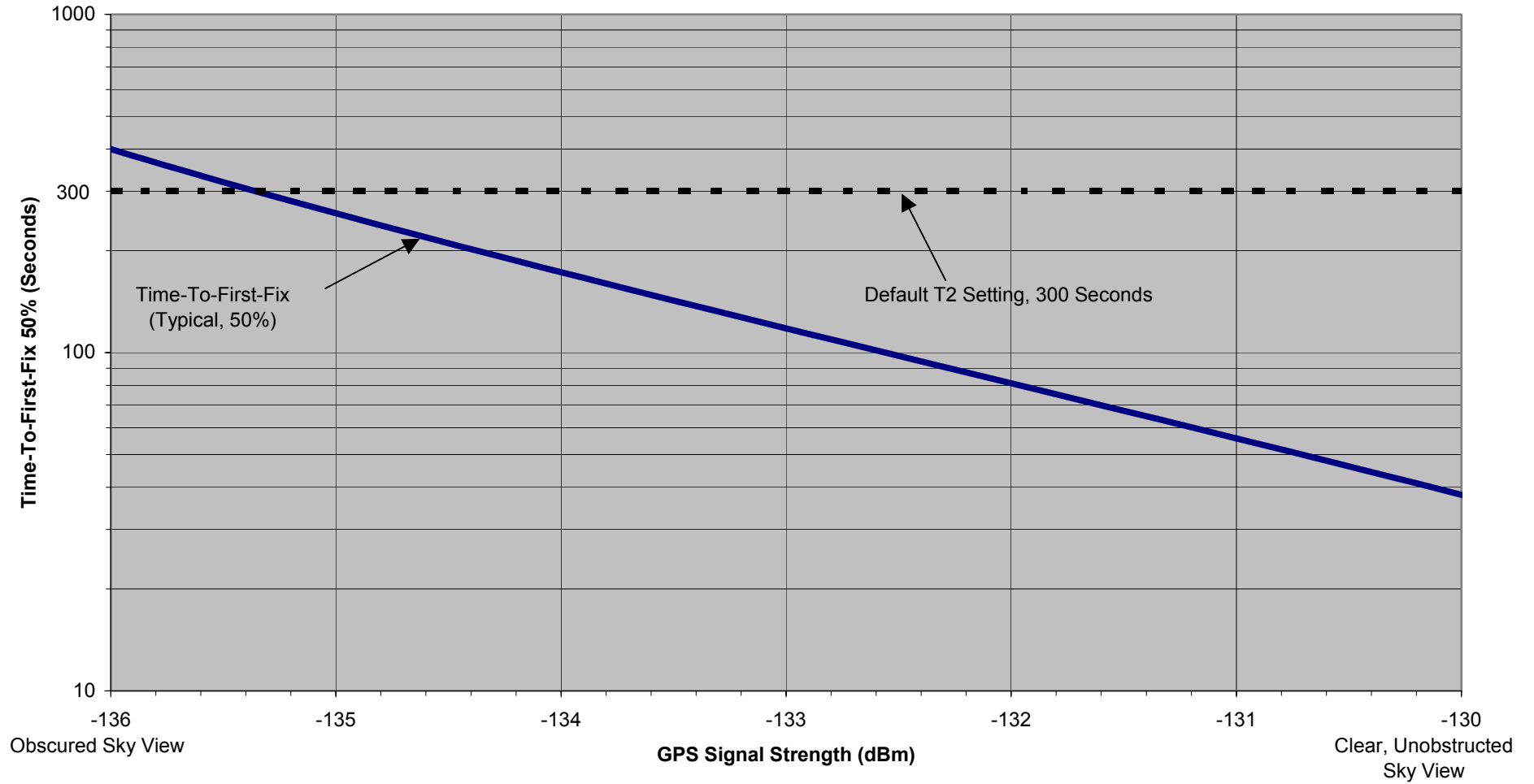
Figure 3, Warm Start TTFFs

TrimTrac State Machine

Introduction

In most applications, motion-based reporting is the fundamental operating premise of the TrimTrac 1.5 as shown in Figure 4. This generally means that the unit computes and reports new GPS position fixes only if the unit is in motion and once more after coming to rest.

To conserve power and minimize communication costs, the TrimTrac 1.5 attempts to be in a sleep mode as much as possible. Sleep modes occur both during the IDLE and DELAY states. In general, the TrimTrac 1.5 will spend a majority of its time in the IDLE state during periods of no motion. How frequently the unit computes a new position fix while in motion is determined predominantly by the setting of the DELAY Timeout, T4.
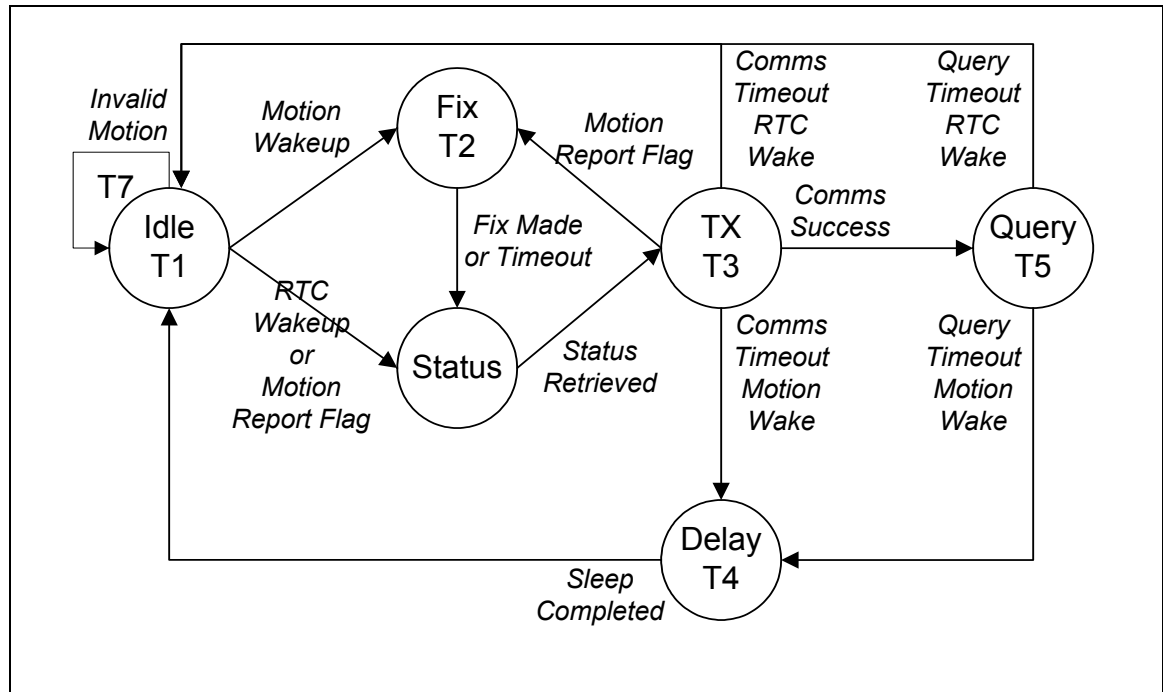
Figure 4, Summary TrimTrac Operational State Diagram

State Machine Overview

In most applications, motion-based reporting is the fundamental mode of operation. The TrimTrac state machine transitions through each state shown in Figure 4 based on motion, external inputs, timeouts, and as a result of completing defined actions (i.e. communicating to the server), as follows assuming default configuration:

IDLE: The TrimTrac 1.5 spends the majority of its time in the IDLE state. Detection of Motion results in a transition to the FIX state if the Motion Report Flag

is set "0=Disabled". If the Motion Report Flag is set "1=Enabled" then motion will cause a transition to STATUS. Expiration of IDLE Timeout, T1, causes a transition to the STATUS state. The programmable IDLE Timeout, T1, is stored as seconds and is typically on the order of 12 to 48 hours. There are also optional Anytime Polling settings that allow the device to run the communications protocol stack during the IDLE state to receive and process incoming messages.

FIX: The device attempts to fix a position until expiration of FIX Timeout, T2. If a fix is achieved, the position is read by the application, the internal real-time clock (RTC) is updated, and the TrimTrac 1.5 transitions to the STATUS state.. If no position fix is achieved prior to expiration of the FIX Timeout, T2, the TrimTrac 1.5 transitions to the STATUS state with status of "no new fix". The FIX Timeout, T2, parameter is programmable and is stored as seconds and is typically on the order of 3 to 5 minutes. If the device does not have a complete almanac, then it will keep the GPS receiver operating in the background to collect it; however, almanac collection will not delay the transition to the STATUS state once a GPS position fix is obtained.

STATUS: The TrimTrac 1.5 retrieves the latest status information, constructs the new appropriate message(s) and then transitions to the TRANSMIT state. In addition to any position and associated information, the status information includes various operational metrics such as conditional alerts, battery condition, battery change events and other such information.

TRANSMIT: The device attempts to transmit alert, position and/or status information to the server. First, the latest status information is combined with the position information in messages per the TrimTrac Application Protocol. Such messages are then sent to the GSM protocol stack to attempt transmission. If the Motion Report Flag is set "1=Enabled" and the message was a Motion Report Message then the TrimTrac 1.5 transitions back to the FIX state. If the message was not a Motion Report Message then it does not transition to the FIX state, instead if the transmission was successful, the TrimTrac 1.5 transitions to the QUERY state. If the transmission fails, the TrimTrac 1.5 transitions to the DELAY state unless the TriggerType was an IDLE timeout, in which case, it will transition back to the IDLE state. The programmable TRANSMIT Timeout, T3, is stored in seconds and is typically on the order of 1 to 5 minutes.

QUERY: The device waits to receive any requests from the server for a programmable QUERY Timeout, T5. If any requests are received, they are processed in order received and responses are sent. After expiration of the QUERY Timeout, T5, the device transitions to the DELAY state if the TriggerType was motion, or to IDLE state if the TriggerType was an IDLE timeout. The programmable QUERY Timeout, T5 is stored as seconds and is typically on the order of 1 to 2 minutes.

Normally, the TrimTrac 1.5 can only receive and process Data messages sent from the server application while in the QUERY state; however, it can receive messages during the any state if the appropriate polling capabilities are enabled. The unit can be polled for information, including new or logged position information even if the GPS receiver is actively computing new positions.

DELAY: The device disables the motion sensor wakeup and goes to sleep for a programmable DELAY Timeout, T4. When the unit wakes up it transitions to the IDLE state by enabling the motion sensor and going back to sleep. The programmable DELAY Timeout, T4, is stored as seconds and is typically on the order of 10 to 20 minutes. If In-Motion Polling is set "2=OnDemand while in Motion" or Anytime Polling is set "2=Anytime OnDemand", then the GSM modem will remain operational during DELAY and the unit will be able to receive and process data messages.

Motion Detection and Filtering

In most applications, motion-based reporting is the fundamental operating premise of the TrimTrac 1.5 as shown in Figure 4. The TrimTrac 1.5 includes a mechanical motion detector that is very sensitive to shock, vibration, tilting and motion.

There are three layers of filtering on the motion detector output. First, the device counts of the number of times motion is detected in each second. If the number of counts exceeds the threshold determined by Motion Counter Threshold, then motion is recognized as having occurred in that second.

Next, the TrimTrac keeps track of how many seconds have exceeded the Motion Counter Threshold within a configurable sampling period depending upon whether the device is stationary or is or has been in motion during the previous cycle of the state machine. Both the state and dynamic motion filters use a rolling time window during which it counts the number of seconds that motion occurred.

For instance, if the device is stationary, it will wake up and leave the IDLE state when the number of seconds during which new motion occurred, according to the Motion Counter Threshold setting, exceeds the setting of Static Motion Filter Counter, N3, during the trailing time period determined by Static Motion Filter Timeout, T7.

Conversely, if the number of seconds during which motion occurred, according to the Motion Counter Threshold setting, exceeds the setting of Dynamic Motion Filter Counter, N4, then the device transition through the IDLE State immediately upon expiration of the DELAY Timeout, T4.

State Machine Design Details

As seen in Figure 1 the state machine has six primary states that represent the basic operation of the device. This section gives a detailed description of each state, what events trigger transitions from each state, and the processing that occurs within each state and during the transition between states.

There are two status variables used along with the state of the TrimTrac 1.5:

> TriggerType; and
> ReportType

The TriggerType variable refers to what event caused the device to transition from the IDLE state. There are six TriggerTypes:

> 0=IDLE Timeout, T1
> 1=Motion Detected
> 2=Alert set "Activated" (Module-only)
> 3=Query
> 4=Scheduled Report
> 5=Stop Report

The primary ReportType variable can be either:

> STATUS_MSG or
> REPORT_POS.

The principal difference between STATUS_MSG and REPORT_POS is that REPORT_POS contains position and related information whereas STATUS_MSG does not contain such information. Please see page 127 for complete details.

Please note that the TrimTrac 1.5 transmits messages other than just STATUS_MSG and REPORT_POS messages; however, these other messages are typically responses to queries received from the server application.

A Position Age flag is set depending upon whether motion has been detected since the most recent position fix. The Position Age flag is set as follows:

> 0=Current (i.e. no motion since last position)
> 1=Aged (i.e. motion has occurred since last position)

Alert Handling – Vehicle Adapter or Control Module

When a Vehicle Adapter or Control Module is used with the TrimTrac 1.5, the device is able to monitor and report on High, Medium and Low priority inputs as shown in Figure 9, Vehicle Adapter Module Alert Wiring Diagram, on page 165. Regardless of priority, each input will be in one of the following status states at any given time:

> 0=Normal
> 1=Activated
> 2=Sent
> 3=Acknowledged
> 4=Monitor Activated

General Alert Handling

Unless the alert mode (as opposed to "alert status") is configured as "3=Monitor-only", alerts are processed in descending order of priority. High Priority Alerts, for instance, will always take precedence over Medium and Low Priority Alerts and so on. Other than having their status included in any outgoing data messages,

lesser priority alert alarms are ignored until all higher priority alerts have been either cleared to "0=Normal" or set "3=Acknowledged". The status of alerts configured in the "3=Monitor-only" mode will be included in all STATUS_MSG and REPORT_POS messages, but activation of any such monitored alerts will not in and by themselves result in new message transmissions.

When a VAM or Control Module equipped TrimTrac 1.5 detects activation of a switch or device, loss of external power or tampering with the external wiring, it will set the appropriate priority alert status to "1=Activated", unless the mode of the alert is set to "3=Monitor-only", in which case, the alert status will be set "4=Monitor Activated". The one exception to this, as more fully described below, is a Low Priority Alert for which the TrimTrac 1.5 needs to also detect motion, in addition to activation of the switch, before the Low Priority Alert status is set "1=Activated" or "4=Monitor Activated".

Resetting of the local switch or device will not reset any activated alert unless the TrimTrac 1.5 has also received a SET_ALERT_STATE message (See page 112) or if the particular alert mode has been set "3=Monitor-only".

Furthermore, activated or acknowledged alerts can only be cleared back to "0=Normal" after the fault or monitored device has been restored to normal AND the TrimTrac 1.5 has received the appropriate SET_ALERT_STATE message or if the particular alert mode has been set "3=Monitor-only". This will help guard against an unauthorized person disabling the TrimTrac 1.5 or the Vehicle Adapter or Control Module inputs. Alerts whose modes are set to "3=Monitor-only" will have their status set automatically back to 0=Normal without a SET_ALERT_STATE message being received; provided, however, that the fault or activated device has been returned to its "normal" condition.

Whenever an alert changes to "1=Activated" from "0=Normal" (and all higher priority alerts, if any, are set to either "0=Normal" or "3=Acknowledged" and the activated alert mode is not otherwise disabled or set "3=Monitor-only"), the TrimTrac 1.5 will transition from its current state as follows:

1. If HPA Status becomes set "1=Activated", then terminate the current state and go to STATUS immediately; else

2. If MPA Status becomes set "1=Activated", then, if not in TRANSMIT state, terminate the current state and go to STATUS immediately. If in TRANSMIT, then go to STATUS upon completion of current TRANSMIT state (Note: This allows the device to complete sending any current messages prior to processing the new MPA); else

3. If LPA Status becomes set "1=Activated", then, if not in FIX or TRANSMIT state, terminate the current state and go to STATUS immediately. If in FIX or TRANSMIT, then go to STATUS upon completion of current FIX or TRANSMIT state (Note: This allows the device to complete a "fresh" fix or complete sending any current messages prior to processing the new LPA).

Alerts can be changed to:

1. "2=Sent" from "1=Activated" during the TRANSMIT state if and only if the GSM protocol software has confirmed that the message has been successfully transmitted to the GSM network.

2. "3=Acknowledged" from "1=Activated" or "2=Sent" only upon the receipt of an appropriate SET_ALERT_STATE message or, if the Alert Mode is set "2=Network Acknowledgement", upon confirmation from the GSM protocol software that the message has been successfully transmitted to the GSM network.

3. "0=Normal" from "1=Activated", "2=Sent" or , "3=Acknowledged" only upon the receipt of an appropriate SET_ALERT_STATE message; provided, however, whatever condition that triggered the original alert has been cleared. If the alert mode has been configured as "3=Monitor-only", then correcting whatever condition that triggered the original alert will cause the alert status to be set back to "0=Normal".

Using a Provisioning Module to silence an alert by setting the offending priority alert mode to "1=Disable" will not clear the underlying alarm condition. Therefore, if the alert modes are later set back to "0=Automatic", either through the use of a Provisioning Module or by sending the device an SET_MODULE_APP_CONFIG message, the device will resume transmitting the associate alert messages. The underlying alert monitoring software can only be reset or cleared by sending the device the appropriate SET_ALERT_STATE message.

IDLE State

The IDLE State is the state that the device enters when it goes to sleep waiting for a TriggerType event to occur. Upon the occurrence of any TriggerType event, the unit will transition from IDLE in accordance with TriggerType and current configuration settings. While in the IDLE state, assuming default configuration, all hardware is turned off except for the Motion Sensor Wakeup Logic and the RTC; provided, however, if the Anytime Polling is set to either "1=Duty-Cycled" or "2=Anytime OnDemand", then the GSM hardware and software will operate some or all of the time and the unit is able to communicate during IDLE.

1. When the unit enters the IDLE State it checks if motion has been detected since the last position fix attempt. If yes, the TriggerType is set "1=Motion Detected" and the device immediately transitions to the FIX State bypassing all of the other IDLE state checks detailed below.

2. When the unit enters the IDLE State and no motion has been detected, it starts the IDLE Timeout, T1, and waits for a TriggerType event to occur. (LED OFF, unless Anytime Polling mode is set "2=Anytime OnDemand".)

3. Upon the occurrence of a TriggerType event, the unit will wake up and transition out of the IDLE state based upon the TriggerType event and the current configuration settings as follows:

- Upon expiration of the IDLE Timeout, T1, the TriggerType is set "0=IDLE Timeout, T1", the TrimTrac 1.5 will transition to the STATUS state (bypassing the FIX state).

- If motion is detected while in the IDLE state, the TrimTrac 1.5 will activate the Static Motion Filter Timeout, T7, and apply the Static Motion Filter Counter, N3. (Rapid LED Blinking)

  If there is sufficient continued motion, the TriggerType becomes set "1=Motion Detected" and the unit will transition to the FIX State if the Motion Report Flag is set "0=None" or to the STATUS state if the Motion Report Flag is set "1=Report IDLE Motion". If there is insufficient motion to satisfy the Static Motion Filter Counter, N3, while the Static Motion Filter Timeout, T7, is running, then the unit will return to the IDLE state sleep mode and wait for a subsequent TriggerType event to occur.

- If an alert status is in some state other than "0=Normal" or "4=Monitor Activated" or upon an initial Geofence violation, then the TriggerType shall be set "2=Alert" and the device shall transition from the IDLE State in accordance with its current configuration. See the section below for more details on input alert processing.

- If the Anytime Polling is set to "2=Anytime OnDemand", the unit keeps the GSM modem operational and the device is ready to receive messages from the sever at any time while the IDLE Timeout, T1, is running (Continuous Rapid LED Blinking). Upon receipt of any data messages, the TriggerType is set "3=Query" and the unit transitions immediately to the QUERY state to process any such received messages.

- If the Anytime Polling is set to "1=Duty-Cycled", the TrimTrac 1.5 will power duty-cycle the GSM modem on and off during the IDLE state. Each time the Polling Duty-Cycle Frequency, T19, timer expires, the GSM modem will power up and the Polling Duty-Cycle On-Time, T20, will start (Rapid LED Blinking). The GSM modem hardware will remain on until the expiration of Polling Duty-Cycle On-Time, T20, or a query message is received. Upon receipt of any query messages, the TriggerType is set "3=Query" and the unit transitions immediately to the QUERY state to process any such received messages; else it goes back into IDLE sleep until the next TriggerType event occurs or the next time the Polling Duty-Cycle Frequency, T19, timer expires.

- If the Scheduled Reporting Mode is set to either "1=Daily" or "2=Weekly" the TriggerType will be set "4=Scheduled Report" upon expiration of Scheduled Report Time, T18, timer regardless of the Report Delay Flag setting.

![TrimTrac logo]

- If either of the Runtime meters have a threshold set to some value other than "0 hours" and the accumulated runtime hours or either exceed the associated threshold, then the TriggerType will be set "5=Runtime Meter" and the device will transition to the STATUS State.

- If the Report Delay Flag is set "4=Start/Stop Report" and there has been no motion since the most recently completed FIX State, then the TriggerType will be set "6=Stop Report" and the device will transition to the STATUS State.

Alert Processing in the IDLE State:

Whenever one or more Vehicle Adapter or Control Module alerts are in some condition status other than "0=Normal" or "3=Acknowledged", and not mode set "1=Disabled" or "3=Monitor-only", alert processing during IDLE state shall be in the following order:

1. If HPA Status is set:

    a. Or becomes set to"1=Activated", then set TriggerType to "2=Alert" and go to STATUS state;

    b. "2=Sent":

        i. To FIX state if Position Age flag is set "1=Aged"; or

        ii. If Position Age flag is set "0=Current", start HPA Idle Timeout, T11. Upon expiration HPA Idle Timeout, T11, or upon detection of subsequent motion, transition to STATUS or FIX states, respectively.

2. If MPA Status is set:

    a. Or becomes set to"1=Activated", then set TriggerType to "2=Alert" and go to STATUS state;

    b. "2=Sent":

        i. To FIX state if Position Age flag is set "1=Aged"; or

        ii. If Position Age flag is set "0=Current", start MPA Idle Timeout, T12. Upon expiration MPA Idle Timeout, T12, or upon detection of subsequent motion, transition to STATUS or FIX states, respectively.

3. If LPA Status is set or becomes set to"1=Activated", then set TriggerType to "2=Alert" and go to STATUS state.

FIX State

The FIX State is the state where the GPS engine is running trying to get a fix. While in this state the GPS hardware is always turned on and the GSM radio hardware may or may not be turned off depending upon the current configuration

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settings in effect. In TrimTrac 1.5, the GPS receiver and GSM Modem can operate simultaneously (unlike earlier generations of the TrimTrac locator).

1. When the unit enters the FIX State it enables the GPS hardware and starts the FIX Timeout, T2 (Very rapid LED blink rate followed by a repeated Long ON, Long OFF LED blink rate).

2. Upon completion of a successful position fix, the relevant position related information is extracted and the internal the RTC is updated.

3. After the position fix is achieved, or upon expiration of the FIX Timeout, T2, the GPS engine can either be turned off or allowed to continue operating at 1 Hz, depending upon the current configuration. In all cases, however, the unit transitions to the STATUS state if the TrimTrac 1.5, even if the device does not have a complete valid almanac. If the unit does not have a complete, valid almanac after computing the position fix, or if Almanac Timeout, T6, has expired, the TrimTrac 1.5 will leave the GPS engine operational for up to fifteen (15) minutes more to collect almanac (LED Blink: Two Medium Blinks followed by a Long Off). Upon collection of a complete, valid almanac or expiration of the fifteen (15) minute almanac collection timer, the unit will power off the GPS engine unless GPS Fix Rate is set "1=GPS 1Hz" operation; in which case, the GPS receiver will remain powered and operational.

Alert Processing in the FIX State:

Unless their mode is set "3=Monitor-only", should either the HPA Status or MPA Status become set "1=Activated" during the current FIX state, the TrimTrac 1.5 will terminate the current fix attempt and go immediately to the STATUS state.

All other alert conditions shall have no effect on the FIX state.

STATUS State

The TrimTrac 1.5 enters the STATUS State based upon the occurrence of TriggerType events or, if entering from the FIX state, upon the computation of a new position fix or expiration of the FIX Timeout, T2.

1. When the unit enters the STATUS State it retrieves the battery, alert and operational status information and stores it in the report structure to be used during the TRANSMIT state.

2. If entering from the FIX state and the position fix attempt was successful, the Position Age flag is set "0=Current".

3. It then transitions to the TRANSMIT State.

The TrimTrac 1.5 dwells in the STATUS state only long enough to update the report structure. This process is virtually instantaneous and all alerts shall have no effect on STATUS state.

TRANSMIT State

Upon entering the TRANSMIT state from the STATUS state, the TrimTrac 1.5 will:

1. Power up the GSM hardware (if not already operational);

2. Start the TRANSMIT Timeout, T3 (LED Blink: Short ON, Long OFF);

3. Attempt find a suitable 850, 900, 1800 or 1900 MHz GSM network, establish SIM communication and register on the network; AND

4. If a suitable GSM network connection is made, transmit the latest queued messages before expiration of the TRANSMIT Timeout, T3.

The TrimTrac 1.5 will transition from the TRANSMIT state whenever any of the following occurs:

1. The GSM protocol stack confirms successful transmission of queued TrimTrac 1.5 messages; OR

2. The TrimTrac 1.5 has made Position Report Transmit Attempts, N1, or Status Message Transmit Attempts, N2, whichever the case may be, before the GSM protocol stack has confirmed successful transmission of queued TrimTrac 1.5 messages; OR

3. Expiration of TRANSMIT Timeout, T3.

Upon occurrence of any of the foregoing, the TrimTrac 1.5 will transition from the TRANSMIT state to either the IDLE, FIX, QUERY or DELAY states as follows:

1. To the IDLE state if:

   a. The TriggerType had become set "0=IDLE Timeout, T1"; "4=Scheduled Report"; "5=Runtime Meter"; or "6=Stop Report" during the most recent IDLE state; AND

   b. The TRANSMIT Timeout, T3, expires or the TrimTrac 1.5 has made Status Message Transmit Attempts, N2, before the GSM protocol stack has confirmed successful transmission of queued TrimTrac 1.5 messages.

2. To the FIX state if:

   a. The TriggerType had become set "1=Motion Detected" during the most recent IDLE state (Note: GPS Status Code will be set "7=No Fix Attempted"); AND

   b. Motion Report Flag is set "1=Report Motion in IDLE"; AND

   c. The GSM protocol stack confirms that the attempt to send the queued Motion Report succeeded; the TRANSMIT Timeout, T3, has expired OR if Status Message Transmit Attempts, N2, have been made.

3. To the QUERY state if the GSM protocol stack confirms that the attempt to send queued TrimTrac 1.5 messages, other than a Motion Report, succeeded.

4. To the DELAY state if the TriggerType is set "1=Motion Detected" and:

   a. The TrimTrac 1.5 has already cycled through the FIX state due to the Motion Report Flag being set "1=Report Motion in IDLE"; OR

   b. The TRANSMIT Timeout, T3, expires or the TrimTrac 1.5 has made Position Report Transmit Attempts, N1, or Status Message Transmit Attempts, N2, whichever the case may be, before the GSM protocol stack has confirmed successful transmission of queued TrimTrac 1.5 messages.

Alert Processing in TRANSMIT State

Should HPA Status become set "1=Activated" during the current TRANSMIT state, the TrimTrac 1.5 will terminate the current transmission attempt and go immediately to the STATUS state.

Unless alert modes are set "1=Disabled" or "3=Monitor-only", alert processing during TRANSMIT state shall be per the flowchart shown in Figure 5 through Figure 8.
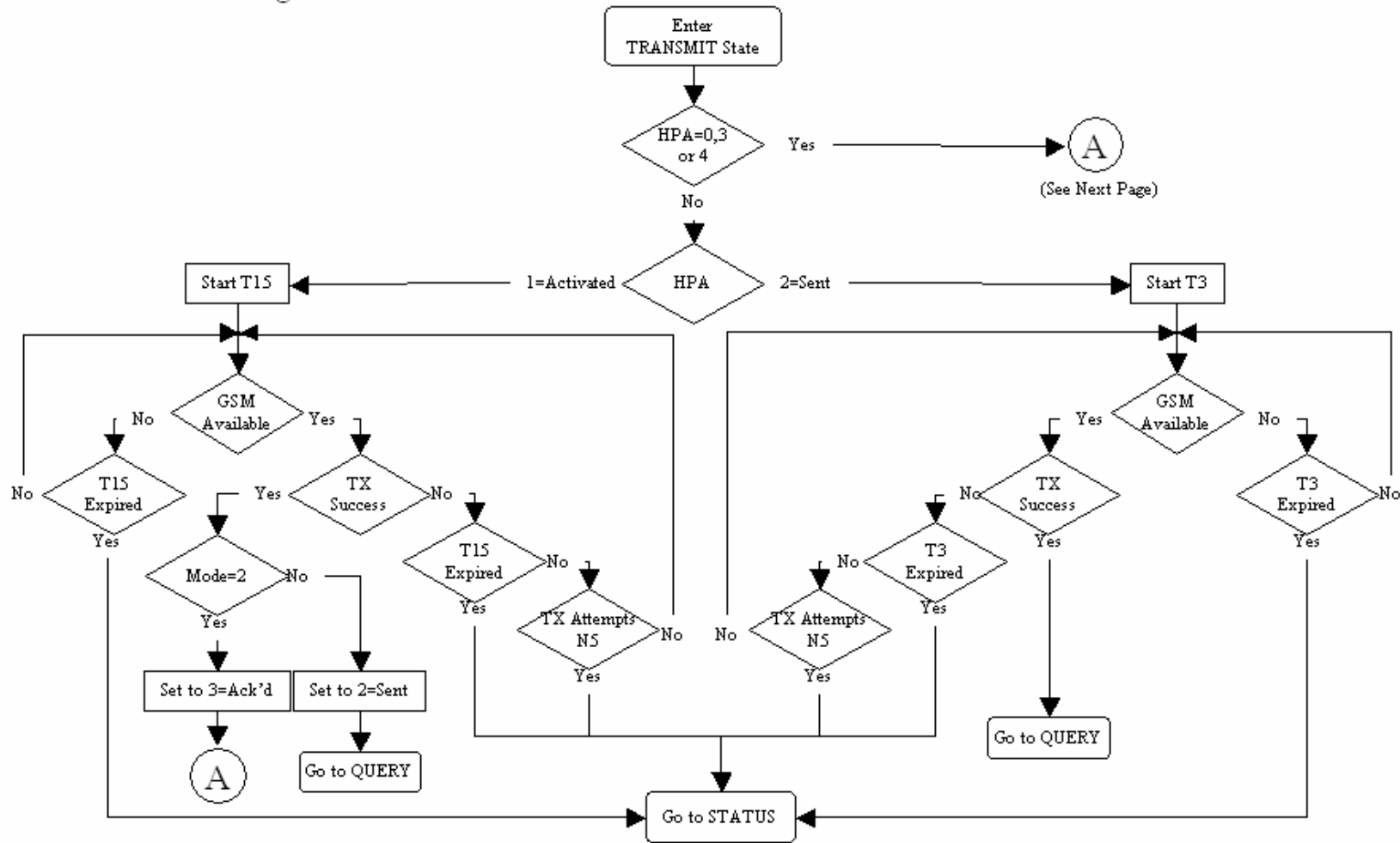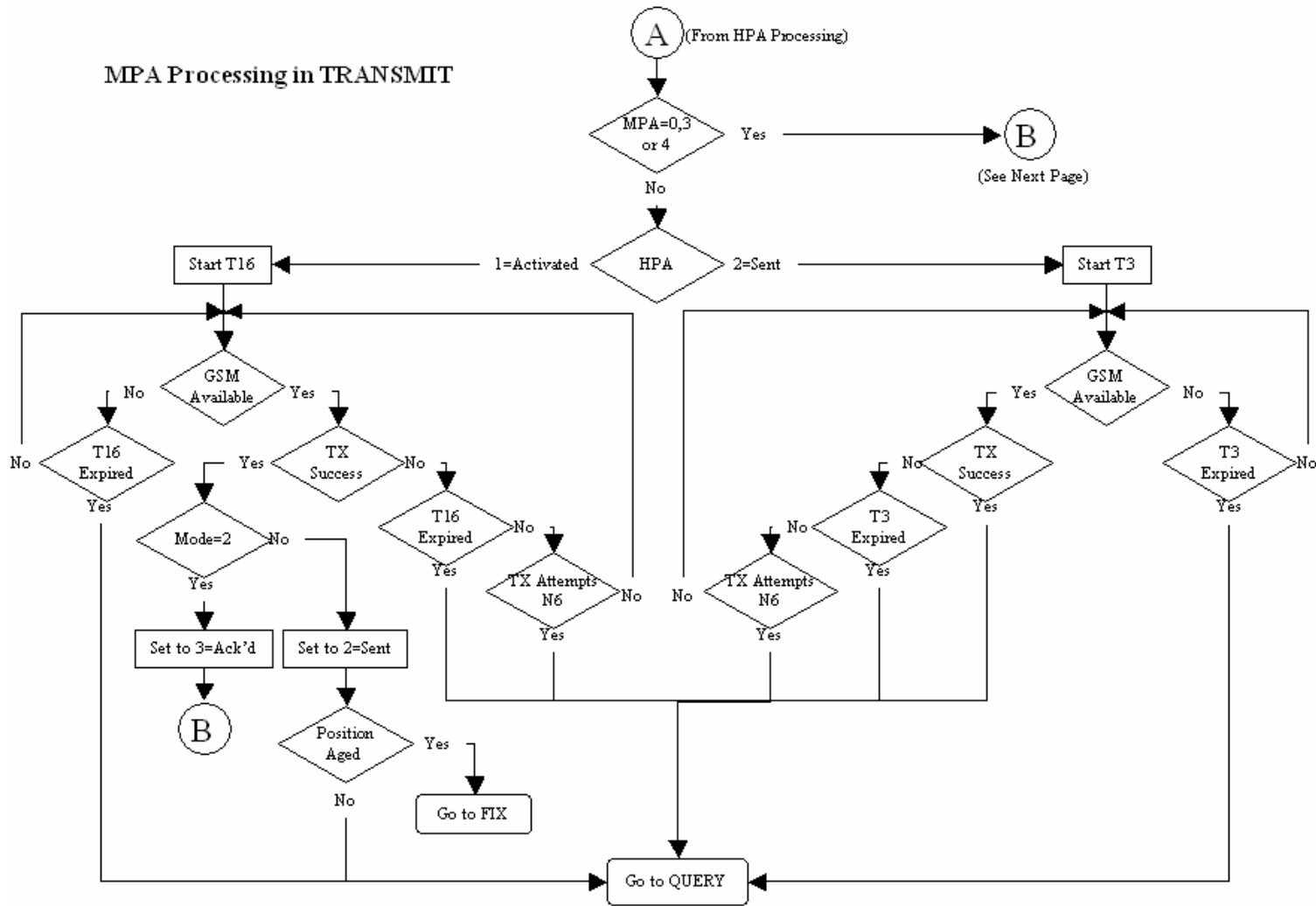
Figure 5, HPA Processing in TRANSMIT

Figure 6, MPA Processing in TRANSMIT
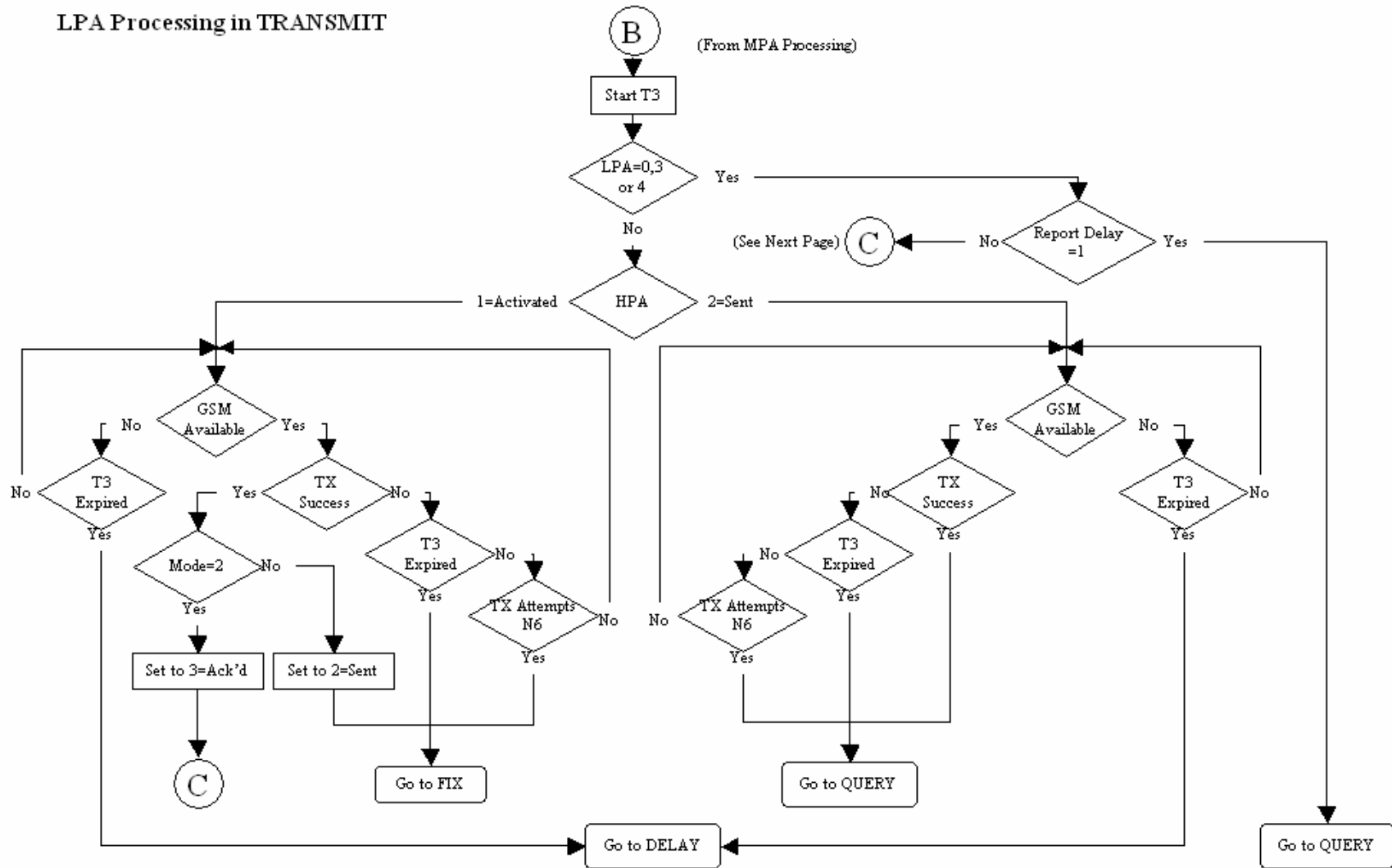
Figure 7, LPA Processing in TRANSMIT

Figure 8, Other Message Processing in TRANSMIT

QUERY State

The QUERY State is where the Application waits for incoming messages from the server. During this state the GPS hardware may be powered off but the GSM radio is powered on.

1. Upon entering the QUERY state, the TrimTrac 1.5 starts QUERY Timeout, T5 (LED Blink: Long ON, Short OFF).

2. The application then waits until the QUERY Timeout, T5, expires or a valid data message arrives, either via SMS or GPRS.

3. If a valid data message arrives it is processed and one or more messages may be generated in response to the received query. If the QUERY Timeout, T5, changes due to a received message the current QUERY state is terminated.

4. For each of the responses the TrimTrac 1.5 waits for a confirmation from the GSM protocol stack that it was sent.

5. If the QUERY Timeout, T5, expires while the application is sending responses to the received query, then the TrimTrac 1.5 will continue to send the responses and accept new queries. (Note: If a SET_ALERT message clearing activated alerts to normal is receive, but the monitored devices or conditions have not yet been return to their normal condition, then new alert messages will be initiated and the TrimTrac will not otherwise respond to the incoming SET_ALERT message)

6. When the QUERY Timeout, T5, has expired and there are no messages waiting to be sent then the TrimTrac 1.5 transitions to the DELAY State if the TriggerType was set "1=Motion Detected". If the TriggerType was set "0=IDLE Timeout, T1" then the TrimTrac 1.5 transitions to the IDLE state.

7. If Query Hold Flag is set "1=Enabled", the TrimTrac 1.5 will attempt to re-establish any GSM network connection that may have been lost prior to the expiration of QUERY Timeout, T5. It will continue attempting to re-establish the lost GSM network connection until the QUERY Timeout, T5, has expired.

8. If either the In-Motion Polling or Anytime Polling are set to "2=OnDemand while in Motion" or "2=Anytime OnDemand", respectively, the QUERY Timeout, T5, is automatically set to 10 seconds..

Alert Processing in QUERY State

Whenever one or more Vehicle Adapter or Control Module alerts are in some condition other than "0=Normal" or "3=Acknowledged", and mode not set "1=Disabled" or "3=Monitor-only", alert processing during QUERY state shall be in the following order:

1. If HPA Status is set:

    a. "1=Activated", then go to immediately to the IDLE state;

    b. "2=Sent", then ignore all data messages received prior to the receipt of SET_ALERT_STATE message and:

        i. If Position Age is set "1=Aged", then go immediately to the IDLE state; or

        ii. If Position Age is set "0=Current", then go to the IDLE state upon expiration of HPA Query Timeout, T17.

2. If MPA Status is set:

    a. "1=Activated", then go to immediately to the IDLE state;

    b. "2=Sent" then ignore all data messages received prior to the receipt of SET_ALERT_STATE message and go immediately to the IDLE state.

3. If LPA Status is set:

    a. "1=Activated", then go to immediately to the IDLE state;

    b. "2=Sent" then ignore all data messages received prior to the receipt of SET_ALERT_STATE message and go immediately to the IDLE state.

4. During the QUERY state, any alert (High, Low, Medium) status can be changed from "2=Sent" or "3=Acknowledged" to "0=Clear", "3=Acknowledged", or "X=Do not care" upon receipt of the appropriately configured SET_ALERT_STATE message.

DELAY State

The DELAY State is where the TrimTrac 1.5 normally dwells after a state machine cycle and ignores any detected motion. This effectively restricts the unit to reporting no more often than the DELAY Timeout, T4; provided, however, all Vehicle Adapter or Control Module alerts are in the "0=Normal" status condition or have their modes set "1=Disabled" or "3=Monitor-only".

1. Upon entering the DELAY State, the TrimTrac 1.5 starts DELAY Timeout, T4. (LED Blink: OFF).

2. The unit will transition from DELAY state as follows:

    a. To the IDLE state upon the earlier of:

        i. Expiration of DELAY Timeout, T4; or

        ii. Expiration of Scheduled Report Time, T18, if Scheduled Reporting Mode is set "1=Enabled".

    b. To the QUERY state upon receipt of a data message if In-Motion Polling is set "2=OnDemand while in Motion".

3. To further conserve power during the DELAY state, the software filtering of the motion sensor can be disabled by setting Reserved to "0=Disabled". While in this disabled condition, the Dynamic Filter Timeout, T21, and Dynamic Motion Filter Counter, N4, parameters are ignored.

Alert Processing in DELAY State

Whenever one or more Vehicle Adapter or Control Module alerts are in some condition other than "0=Normal", and do not have their modes set "1=Disabled" or "3=Monitor-only, alert processing during DELAY state shall be in the following order:

5. If HPA Status is set:

    a. "1=Activated", then go to immediately to the IDLE state;

    b. "2=Sent":

        i. If Position Age is set "1=Aged", then go immediately to the IDLE state; or

        ii. If Position Age is set "0=Current", then go to the IDLE state upon expiration of HPA Delay Timeout, T13.

6. If MPA Status is set:

    a. "1=Activated", then go to immediately to the IDLE state;

    b. "2=Sent":

        i. If Position Age is set "1=Aged", then go immediately to the IDLE state; or

ii. If Position Age is set "0=Current", then go to the IDLE state upon expiration of MPA Delay Timeout, T14.

c. "3=Acknowledged", then go to the IDLE state upon expiration of DELAY Timeout, T4.

7. Proceed immediately to the IDLE state whenever:

a. The LPA switch is in its "armed" closed position regardless of how the LPA Status is set.

b. LPA Status is set "1=Activated" regardless of the LPA switch position ("unarmed" open or "armed" closed).

8. All Delay Timeouts (T4, T13 and T14) are immediately terminated whenever any alert status state (HPA Status, MPA Status or LPA Status) is or becomes set to "1=Activated" and the unit immediately transitions to the IDLE state.

Alert Processing

Summary of Alert Sequence Processing.

Assuming that alert modes are NOT set "1=Disabled" or "3=Monitor-only, the following is a summary of how alerts are processed:

1. Monitored device or condition changes to "alert" condition
2. TrimTrac begins transmitting alert messages
3. Alert message received by server application
4. Server application automatically sends an ACKNOWLEDGE message to TrimTrac. This will stop the continuous re-transmission of alert messages.
5. Server application notifies service center operator or end-user that an alert condition has occurred.
6. End-user corrects or resets the device or condition in the field that triggered the alert in the first place.
7. Once field conditions have been returned to normal, end-user instructs the server application or service center operator to CLEAR the alert
8. Server application sends a CLEAR message to TrimTrac 1.5
9. TrimTrac 1.5 changes the cleared alerts back to "normal" and resumes its normal operation.

NOTE: IF A CLEAR MESSAGE IS SENT TO THE TRIMTRAC 1.5 BEFORE THE INPUT DEVICE OR CONDITION IS RESET TO ITS "NORMAL" CONDITION, A NEW ALERT MESSAGE WILL BE INITIATED AND NO RESPONSE TO THE CLEAR MESSAGE WILL BE SENT BY THE TRIMTRAC 1.5

Priority and Status-Levels

The TrimTrac 1.5 can be equipped with a Vehicle Adapter or Control Module capable of monitoring vehicle power and externally wired switches and relay contacts. Each of these devices must be assigned one of three different priority levels (High, Low, Medium). Loss of external voltage and tampering (opens, shorts, grounds) with external wiring are handled as Medium Priority Alerts.

Each alert, regardless of priority, can be in one of five status-levels at any given time:

0=Normal
1=Activated
2=Sent
3=Acknowledged
4=Monitor Activated

Operation of the TrimTrac 1.5 is altered depending upon the status of each monitored device and status of the alert. By definition, an alert is considered "normal" when in the condition as shown in Figure 9, Vehicle Adapter Module Alert Wiring Diagram on page 52 and all previous alerts have been cleared (more on clearing of alerts shortly).

An alert is said to have been "Initiated" when its status first changes from the "0=Normal" to "1=Activated" condition. Initiating an alert is a random event that can occur when the TrimTrac 1.5 is in any of its operational states (See Figure 4, Summary TrimTrac Operational State Diagram). How the TrimTrac 1.5 modifies its operational behavior is dependent upon the type of priority alert being initiated and in what state the device happens to be in at the time of initiation.

When a High or Medium Priority switch or device changes from its normal condition for 200 mSeconds or more, or upon loss of external power in the case of the Medium Priority alert, the associated alert is set to "1=Activated". The exception to this a Low Priority switch which must be held closed while motion is sensed before its status is changed to "1=Activated".

The status of an "Activated" alert will be set to "2=Sent" once the TrimTrac 1.5 has successfully transmitted the associated message to the GSM network. Depending on the priority of the alert, the TrimTrac 1.5 will operate in accordance with the associated configuration unless otherwise instructed by the server application.

Because SMS text messaging or UDP provide no guarantee of delivery, just because the TrimTrac 1.5 has successfully transmitted the alert message to the GSM network, there is no guarantee that the server application has in turn received the transmitted alert message. As such, the TrimTrac 1.5 will continue transmitting the alert messages until it receives back from the server application an appropriately configured SET_ALERT_STATE message (See 112), at which time, the alert status can be set "3=Acknowledged".

Finally, when the device that initiated the alert in the first place is returned to its "normal" condition, then the alert can be "cleared" upon receipt of an appropriately configured SET_ALERT_STATE message. If a "clear" command is sent before the monitor switch or device is returned to its "normal" condition, then a new alert will be initiated immediately and the clearing process will need to be repeated. If the alert mode was set to "3=Monitor-only", then the status of the monitored alert will be automatically reset to "0=Normal" when the device is reset; however, no separate message to this effect will be transmitted. The updated status of a monitor-only alert will simply be included in the next report to be logged.

High Priority Alert Processing

An example of a High Priority Alert could be a manually operated switch or device that requires immediate and continuous transmission of the resulting alert message until acknowledged or cleared by the server application.

Initiation of a High Priority Alert will cause the TrimTrac 1.5 to terminate immediately whatever state it happens to be in at the time and to commence continuous transmission of the alert message until a SET_ALERT_STATE message acknowledging or clearing the activated High Priority Alert is received by the TrimTrac 1.5.

Please see Table 17, High Priority Alert Processing on page 75. Also, Figure 5, HPA Processing in TRANSMIT, on page 63 has a detailed flow chart on how High Priority Alerts are processed in the TRANSMIT state.

Medium Priority Alert Processing

Activation of a Medium Priority Alert will allow the TrimTrac 1.5 to complete some of its current operations before beginning to transmit a Medium Priority Alert message. For instance, if the device happens to be in either the FIX or TRANSMIT states, it will attempt to complete those tasks, within certain time limits, before transitioning back into the TRANSMIT state to begin sending the Medium Priority Alert. Then, once sent, the device will go collect new position information while waiting for an acknowledgement from the server application. This is different than a High Priority Alert that would continuously re-transmit the alert message without computing a new position fix.

An example of a Medium Priority Alert could be a relay interconnected with an on-board security system. The relay would be activated, for instance, when the security system is in a state of "alarm" (i.e. annuciators operating).

Please see Table 18, Medium Priority Alert Processing on page 76. Also, Figure 6, MPA Processing in TRANSMIT, on page 64 has a detailed flow chart on how Medium Priority Alerts are processed in the TRANSMIT state.

Low Priority Alert Processing

Provided the Low Priority Input is not configured as either a geofence or runtime meter activation input, a Low Priority Alert is processed much the same as a Medium Priority Alert with the exception that there must also be motion before a Low Priority Alert is initiated. For instance, closing the Low Priority Alert switch shown in Figure 9, Vehicle Adapter Module Alert Wiring Diagram will not in and by itself cause the Low Priority Alert to be initiated. Opening the Low Priority Alert switch must also be accompanied by motion before becoming "activated." An application example would be interlocking a relay with the on-board security system such that when the security system is "armed", the relay is also activated. Any subsequent motion until the security system is turned-off by the owner would be "unauthorized". The TrimTrac 1.5 would sense this motion and commence transmitting an alert message until acknowledged or cleared by the server application.

Please see Table 19, Low Priority Alert Processing on page 77. Also, Figure 7, LPA Processing in TRANSMIT, on page 65 has a detailed flow chart on how Low Priority Alerts are processed in the TRANSMIT state.

Server Application-side Considerations

Upon the receipt of any alert message with a status of either "1=Activated" or "2=Sent", the server application should automatically send an immediate SET_ALERT_STATE message acknowledging (not clearing) the alert. The TrimTrac will continue transmitting the alert message until it receives this acknowledgement from the application server.

After acknowledging the alert message, the server application should set about notifying the service center operator or end-user that the TrimTrac 1.5 has reported an alert condition. If and only if it can then be subsequently confirmed that the condition that initiated the alert has been returned to normal should the server application send a SET_ALERT_STATE message clearing the alert status back to normal. If the clearing SET_ALERT_STATE message is sent before the conditions have been physically reset to normal, the TrimTrac 1.5 will initiate a new alert message immediately after the clearing message is received.

Under no circumstances should the server application automatically send a clearing SET_ALERT_STATE message immediately upon receipt of an alert message without end-user or service center operator intervention. If a SET_ALERT_STATE that clears an alert before the monitored device or condition has been returned to its normal condition, the TrimTrac 1.5 will not respond to the SET_ALERT_STATE message and new activated alert messages will be sent.

High Priority Alert (HPA) Flag	Position Age	
	"1=Aged"	"0=Current"
"0=Normal"	Normal Operation	
"1=Activated"	Upon initiation of a HPA, the HPA Status flag is set "1=Activated" and the device terminates its current operation immediately and transitions to STATUS state. While in the STATUS state, the devices generates a new STATUS_MESSAGE in which the TriggerType is set "2=Alert". This STATUS_MESSAGE is combined with most recent logged POSITION_REPORT, collectively "HPA Report". Then the device transitions to the TRANSMIT state and sequences as follows: a) If the GSM protocol stack confirms that the HPA Report was successfully sent to the GSM network, then the HPA Status flag is changed from "1=Activated" to "2=Sent" and the unit will transition to the QUERY state; OR b) The device will make HPA Transmit Attempts, N5, prior to the expiration of the HPA Transmit Timeout, T15. A new transmit attempt will be initiated each time the GSM protocol stack confirms the attempted transmission failed or if connection to the GSM is lost. Upon termination of the current TRANSMIT state, the device will transition to the DELAY state; OR c) If a connection to a GSM network has not been established prior to expiration of HPA Transmit Timeout, T15, then the current TRANSMIT state will be terminated and transition to the DELAY State.	
"2=Sent"	Regardless of motion, cycle continuously through FIX, STATUS, TRANSMIT(T15), QUERY(T17) and DELAY(T13) states until: a) The GSM protocol stack confirms a HPA Report containing a new position fix is successfully sent; OR b) A sequence altering message command is received during the QUERY state.	Operate in accordance with the standard State machine; provided, however, HPA Idle Timeout, T11, and HPA Delay Timeout, T13, shall apply unless otherwise instructed by the server application.
"3=Acknowledged"		

Table 17, High Priority Alert Processing

	Position Age	
Medium Priority Alert (MPA) Flag	"1=Aged"	"0=Current"
"0=Normal"	Normal Operation	
"1=Activated"	Upon initiation of a MPA, the MPA Status flag is set "1=Activated" and the device terminates its current operation immediately, unless in the TRANSMIT state, and transitions to STATUS state. If in the TRANSMIT state, then the current TRANSMIT state is completed prior to transitioning to the STATUS state. While in the STATUS state, the devices generates a new STATUS_MESSAGE in which the TriggerType is set "2=Alert". This STATUS_MESSAGE is combined with most recent logged POSITION_REPORT, collectively "MPA Report". Then the device transitions to the TRANSMIT state and sequences as follows: a) If the GSM protocol stack confirms that the MPA Report was successfully sent to the GSM network, then the MPA Status flag is changed from "1=Activated" to "2=Sent" and the unit will transition to the QUERY state; OR b) The device will make MPA Transmit Attempts, N6, prior to the expiration of the MPA Transmit Timeout, T16. A new transmit attempt will be initiated each time the GSM protocol stack confirms the attempted transmission failed or if connection to the GSM is lost. Upon termination of the current TRANSMIT state, the device will transition to the DELAY state; OR c) If a connection to a GSM network has not been established prior to expiration of MPA Transmit Timeout, T16, then the current TRANSMIT state will be terminated and transition to the DELAY State.	
"2=Sent"	Regardless of motion, cycle continuously through FIX, STATUS, TRANSMIT(T16), QUERY(T5) and DELAY(T14) states until: a) The GSM protocol stack confirms a MPA Report containing a new position fix is successfully sent; OR b) A sequence altering message command is received during the QUERY state.	Operate in accordance with the standard State machine; provided, however, MPA Idle Timeout, T12, and MPA Delay Timeout, T14, shall apply unless otherwise instructed by the server application.
"3=Acknowledged"		

Table 18, Medium Priority Alert Processing

	Position Age	
Low Priority Alert (LPA) Flag	"1=Aged"	"0=Current"
"0=Normal"	Normal Operation	
"1=Activated"	Upon motion and initiation of a LPA, the LPA Status flag is set "1=Activated" and the device terminates its current operation immediately, unless in the FIX or TRANSMIT states, and transitions to STATUS state. If in the FIX or TRANSMIT state, then those states are completed prior to transitioning to the STATUS state. While in the STATUS state, the devices generates a new STATUS_MESSAGE in which the TriggerType is set "2=Alert". This STATUS_MESSAGE is combined with most recent logged POSITION_REPORT, collectively "LPA Report". Then the device transitions to the TRANSMIT state and sequences as follows: a) If the GSM protocol stack confirms that the LPA Report was successfully sent to the GSM network, then the LPA Status flag is changed from "1=Activated" to "2=Sent" and the unit will transition to the QUERY state; OR b) The device will make LPA Transmit Attempts, N7, prior to the expiration of the TRANSMIT Timeout, T3. A new transmit attempt will be initiated each time the GSM protocol stack confirms the attempted transmission failed or if connection to the GSM is lost. Upon termination of the current TRANSMIT state, the device will transition to the DELAY state; OR c) If a connection to a GSM network has not been established prior to expiration of TRANSMIT Timeout, T3, then the current TRANSMIT state will be terminated and transition to the DELAY State.	
"2=Sent"	Regardless of motion, cycle continuously through FIX, STATUS, TRANSMIT(T3), QUERY(T5) and DELAY(T4) states until: a) The GSM protocol stack confirms a LPA Report containing a new position fix is successfully sent; OR b) A sequence altering message command is received during the QUERY state.	Operate in accordance with the standard State machine unless otherwise instructed by the server application.
"3=Acknowledged"		

Table 19, Low Priority Alert Processing

TrimTrac 1.5 Configuration

Introduction

Configuration is the process of setting the operational and communication parameters of the TrimTrac 1.5. Most, but not all, of these parameters can be set or changed over the air; however, certain non-default entries, such as the Unit ID, Security Password and SIM PIN, can only be entered or changed when the TrimTrac 1.5 is connected to a PC via a Provisioning Module.

Personnel without prior configuration or provisioning experience should familiarize themselves with the TrimTrac 1.5 operation and application characteristics as more fully described in the TrimTrac State Machine chapter beginning on page 52.

Provisioning Mode and Equipment

Before a new TrimTrac 1.5 can communicate for the first time, it must be properly configured. This entails substituting the Battery Pack or other optional modules with a Provisioning Module and then connecting it to the USB 2.0 port on a Microsoft Windows (2000, XP)-based PC. Use of USB 1.0 ports or hubs is not recommended. Some laptop computers may not have enough power available on the USB port to power Provisioning Module, especially when the laptop is operating on batteries. If a laptop is used to provision the TrimTrac 1.5, it is best to have the laptop connected to AC power. Alternately, if you must use a battery-powered laptop to configure the TrimTrac 1.5, it is best to first insert the Provisioning Module into the TrimTrac 1.5 base, connect the Provisioning Module to the USB port and THEN power up the laptop.

Microsoft's HyperTerminal is then used as the primary programming interface to send the proper AT Commands. The AT Commands are described in this section and must be used the first time the TrimTrac 1.5 is provisioned. Text fields need to be enclosed in quotation marks "_".

Provisioning Set-up

Before a TrimTrac Provisioning Module can be connected and used with an USB 2.0-equipped Microsoft Windows (2000, XP)-based PC, the appropriate USB 2.0 drivers and HyperTerminal program must be installed on the PC.

FTDI Driver Loading

The Provisioning Module uses an USB 2.0 interface chip from Future Technology Devices International Ltd. (FTDI). The easiest way for HyperTerminal to communicate with the Provisioning Module is to download and install the appropriate FTDI driver on the PC on which HyperTerminal will run.

These Windows (2000, XP, ME) drivers are available from FTDI for download and use at:

www.ftdichip.com/Drivers/VCP.htm

Select, download and install the appropriate VCP Driver for either Win'98 / ME / 2000 / XP (with enhanced BM series support) driver following the instructions provided on the Web site and with the driver.

HyperTerminal

HyperTerminal is a standard program included in all current versions of Microsoft Windows (2000, XP) and can be typically found in the Communications directory under Accessories. If HyperTerminal is not already installed on the Windows (2000, XP) PC that will be used to configure the TrimTrac 1.5, you will need to install it from your original Windows (2000, XP) CDs.

Connecting the Devices

Once the FTDI USB 2.0 device driver and HyperTerminal program are installed on the PC, connect the TrimTrac 1.5 and Provisioning Module to the PC USB 2.0 port as follows:

1. Remove the TrimTrac Battery Pack or Vehicle Adapter or Control Module from the base TrimTrac 1.5.

2. Install an active SMS-enabled SIM card in the base unit SIM cardholder.

3. Insert Provisioning Module into base TrimTrac 1.5 making sure that all four corners are securely snapped into place.

4. Connect the USB 2.0 Type-A Male end of the data cable to the Provisioning Module.

5. Connect the other USB 2.0 Type-A Male end of the cable to the PC USB 2.0 port. (Note: if the PC sound is enabled, there may be an audible sound when the cable and Provisioning Module are connected to the PC. This indicates that the USB port on the PC may not have sufficient power.)

Beginning a Provisioning Session

To commence a provisioning session, you must start HyperTerminal in the following steps:

1. Start HyperTerminal from the Windows (2000, XP), Start, All Programs, Accessories, Communications menu.

2. A "New Connection" panel will appear and enter "TrimTrac" for the New Connection Name and click "OK" button **(Note: if you have already defined "TrimTrac" connection is a previous session, then select "TrimTrac" and skip to Step 6).**

3. A "Connect Using" panel will appear and from the pull down menu select the Com port you designated as the USB 2.0 port when you installed the FTDI driver (commonly, COM4).

4. On the next panel and under "Port Settings", select the following from the pull down menus:

Bits Per Second: 115200

Data Bit   8

Parity   None

Stop Bits   1

Flow Control   None

Click "OK" when done.

5. If you wish to view what you type on the HyperTerminal Screen, click on File, Properties, Settings, ASCII Settings and checkmark the "Echo Typed Characters Locally" box. Click "OK" to close each panel.

6. To check whether you have successfully connected the TrimTrac 1.5 and Provisioning Module to HyperTerminal, type:

> AT+CTKC?

7. Assuming the factory default configuration has not been previously changed, the following response should appear:

> AT+CTKC=43200,300,120,900,60,168,20,0,0,1,0
>
> OK

8. You are now ready to begin provisioning the TrimTrac 1.5(s) by typing the AT commands described in the following sections.

WARNING:

Before inserting a Vehicle Adapter or Control Module into a TrimTrac base unit:

A) Connect the red (+) and black (-) wires to a 9-32 VDC power source and install a 100k Ohm resistor across the yellow wires; OR

B) Set the TrimTrac MPA Mode to "1=Disabled".

FAILURE TO DO EITHER OF THESE WILL CAUSE THE TRIMTRAC 1.5 TO IMMEDIATELY ACTIVATE A MEDIUM PRIORITY ALERT AND BEGIN TRANSMITTING NOMINALLY EVERY 2-3 MINUTES UNTIL AN ACKNOWLEDGEMENT IS RECEIVED.

9. When complete, reinstall the Battery Pack with four "AA" batteries or, if used, the Vehicle Adapter or Control Module.

Configuring Multiple Units

If multiple TrimTrac 1.5s need to be configured, then you can send the units text files with the desired settings rather then typing individual AT commands. To configure HyperTerminal to send text files to the TrimTrac 1.5, select Echo and set the line delay to 500 milliseconds from the HyperTerminal ASCII Setup panel under File, Properties, Settings.

To send a text file, select and open the desired text file from Transfer, Send Text File panel.

Provisioning AT Commands

AT Command Summary

The following AT commands are used to provision and configure the TrimTrac 1.5 via HyperTerminal when connected to the Provisioning Module.

Command	Description	See Page
AT+CTKC	Assigns Application parameters	83
AT+CTKC?	Queries Application parameters	
AT+CTKE	Restores Factory Defaults and/or Erases Message Log	85
AT+CTKF	Assigns GPRS Connection parameters	85
AT+CTKF?	Queries GPRS Connection parameters	
AT+CTKJ	Assigns GPRS Setup parameters	87
AT+CTKJ?	Queries GPRS Setup parameters	
AT+CTKG	Assigns GPS parameters	88
AT+CTKG?	Queries GPS parameters	
AT+CTKK	Assigns Geofence parameters	89
AT+CTKK?	Queries Geofence parameters	
AT+CTKP	Assigns SMS Communication parameters	91
AT+CTKP?	Queries SMS Communication parameters	
AT+CTKX	Assigns Extended Application parameters	93
AT+CTKX?	Queries Extended Application parameters	
AT+CTKY	Assign Vehicle Adapter and Control Module parameters	97
AT+CTKY?	Queries Vehicle Adapter and Control Module parameters	
AT+CTKZ	Assigns Extended 2 Application parameters	99
AT+CTKZ?	Queries Extended 2 Application parameters	
AT+CTKO?	Retrieves Logged Messages	91
ATI	Queries Firmware Version	101

Table 20, Summary of AT Commands

AT+CTKC Application Configuration

The AT+CTKC command is used to configure the Basic Read/Write parameters of the TrimTrac 1.5. It can query the current settings or change them to new values.

AT+CTKC=<IDLE Timeout, T1>,<FIX Timeout, T2>,<TRANSMIT Timeout, T3>,<DELAY Timeout, T4>,<QUERY Timeout, T5>,<Almanac Timeout, T6>,<Static Motion Filter Timeout, T7>,<Motion Report Flag>,<Report Delay Flag>,<Diagnostics Mode>,<Communication Mode> OK	
<IDLE Timeout, T1>	In seconds (10 – 999990). Default 43200
<FIX Timeout, T2>	In seconds (10 – 3600). Default 300
<TRANSMIT Timeout, T3>	In seconds (10 – 3600). Default 120
<DELAY Timeout, T4>	In seconds (10 – 86400). Default 900
<QUERY Timeout, T5>	In seconds (10 – 3600). Default 60
<Almanac Timeout, T6>	In hours (10 – 990). Default 168
<Static Motion Filter Timeout, T7>	In seconds (0 – 90). Note: T7 is used exclusively while in the IDLE state; however, it is superseded by the Dynamic Filter Timeout, T21, whenever Anytime Polling is: A. Set "2=Anytime OnDemand"; OR B. Set "1-Duty-Cycled" and Polling Duty-Cycle On-Time, T20, is running. Always set Static Motion Filter Timeout, T7, greater than or equal to Static Motion Filter Counter, N3. Default 20
<Motion Report Flag>	0=None; 1=Report Motion in IDLE (before attempting new GPS fix). Default 0
<Report Delay Flag>	0=Transmit All Messages; 1=Transmit Alert, Query response and Scheduled messages only; 2=Transmit Motion-related AND Alert, Query response and Scheduled messages only; 3= Transmit IDLE Timeout, T1, Status Messages AND Alert, Query response and Scheduled messages only; 4=Start/Stop Reporting; 5=Log 5 messages, transmit next; 6=Log 10 messages, transmit next. Default 0
<Diagnostics Mode>	0= None; 1= LED. Default 1
<Communication Mode>	0= SMS; 1= GPRS; 2=AutoSelect. Default 0

Table 21, AT+CTKC Assignment

Default: AT+CTKC=43200,300,120,900,60,168,20,0,0,1,0

AT+CTKC?	
+CTKC: <IDLE Timeout, T1>,<FIX Timeout, T2>,<TRANSMIT Timeout, T3>,<DELAY Timeout, T4>,<QUERY Timeout, T5>,<Almanac Timeout, T6>,<Static Motion Filter Timeout, T7>,<Motion Report Flag>,<Report Delay Flag>,<Diagnostics Mode>,<Communication Mode> OK	
<IDLE Timeout, T1>	In seconds (10 – 999990). Default 300
<FIX Timeout, T2>	In seconds (10 – 3600). Default 300
<TRANSMIT Timeout, T3>	In seconds (10 – 3600). Default 120
<DELAY Timeout, T4>	In seconds (10 – 86400). Default 900
<QUERY Timeout, T5>	In seconds (10 – 3600). Default 60
<Almanac Timeout, T6>	In hours (10 – 990). Default 168
<Static Motion Filter Timeout, T7>	In seconds (0 – 90). Note: T7 is used exclusively while in the IDLE state; however, it is superseded by the Dynamic Filter Timeout, T21, whenever Anytime Polling is: A. Set "2=Anytime OnDemand"; OR B. Set "1-Duty-Cycled" and Polling Duty-Cycle On-Time, T20, is running. Always set Static Motion Filter Timeout, T7, greater than or equal to Static Motion Filter Counter, N3. Default 20
<Motion Report Flag>	0=None; 1=Report Motion in IDLE (before attempting new GPS fix). Default 0
<Report Delay Flag>	0=Transmit All Messages; 1=Transmit Alert, Query response and Scheduled messages only; 2=Transmit Motion-related AND Alert, Query response and Scheduled messages only; 3= Transmit IDLE Timeout, T1, Status Messages AND Alert, Query response and Scheduled messages only; 4=Start/Stop Reporting; 5=Log 5 messages, transmit next; 6=Log 10 messages, transmit next. Default 0
<Diagnostics Mode>	0= None; 1= LED. Default 1
<Communication Mode>	0= SMS; 1= GPRS; 2=AutoSelect. Default 0

Table 22, AT+CTKC? Query

AT+CTKE Factory Default & Log Erase Command

The AT+CTKE command restores configuration parameters back to factory default values and erase the message log from the TrimTrac 1.5 device. After a slight pause, the RDY response will appear. Wait for RDY to appear before executing additional commands.

AT+CTKE=<Erase/Restore Mode> OK RDY	
<Erase/Restore Mode>	1= Restore Defaults; 2=Erase Message Log; 3=Erase Log & Restore Defaults

Table 23, AT+CTKE Factory Default & Log Erase Command

AT+CTKF GPRS Connection Provisioning

The AT+CTKF command configures the GPRS connection provisioning parameters. The GPRS Destination Address text field must be enclosed with quotations

AT+CTKF=<GPRS Transport Protocol>,<GPRS Session Protocol>,<GPRS Session Keep-alive Timeout, T25>,<GPRS Session Timeout, T26>,<GPRS Destination Address> OK	
<GPRS Transport Protocol>	0=UDP; 1=TCP. Default: 1
<GPRS Session Protocol>	0=None; 1=TrimTrac ICD (See Separate Document). Default: 0
<GPRS Session Keep-alive Timeout, T25>	In Seconds (0=Never; 1 –43200). Default: 300
<GPRS Session Timeout, T26>	GPRS Session Timeout, T26. Default: 0
<GPRS Destination Address>	GPRS destination address in the following format: 111.222.333.444:12345. This represents an IP Address and Port Number pair, maximum number string up to 21 characters. Must use quotation marks "_". Default: 0.0.0.0:0

Table 24, AT+CTKF Assignment

Default AT+CTKF=1,0,300, 0,"0.0.0.0:0"

AT+CTKF? CTKF:\<GPRS Transport Protocol>,\<GPRS Session Protocol>,\<GPRS Session Keep-alive Timeout, T25>,\<GPRS Session Timeout, T26>,\<GPRS Destination Address> OK	
\<GPRS Transport Protocol>	0=UDP; 1=TCP. Default: 1
\<GPRS Session Protocol>	0=None; 1=TrimTrac ICD (See Separate Document). Default: 0
\<GPRS Session Keep-alive Timeout, T25>	In Seconds (0=Never; 1 –43200). Default: 300
\<GPRS Destination Address>	GPRS destination address in the following format: 111.222.333.444:12345. This represents an IP Address and Port Number pair, maximum number string up to 21 characters. Must use quotation marks "_". Default: 0.0.0.0:0

Table 25, AT+CTKF? Query

AT+CTKJ GPRS Setup Provisioning

The AT+CTKJ command configures the GPRS setup provisioning parameters. All fields must be enclosed with quotations

AT+CTKJ=<GPRS APN>,<GPRS Username>,<GPRS Password> OK	
<GPRS APN>	Access Point Name (APN) Web Address up to 40 case sensitive alphanumeric characters. Example: "apn.trimble.com". Must use quotation marks "_". Default: <Empty>
<GPRS Username>	Up to 40 case sensitive alphanumeric characters. Must use quotation marks "_". Default: <Empty>
<GPRS Password>	Up to 20 case sensitive alphanumeric characters. Must use quotation marks "_". Default: <Empty>

Table 26, AT+CTKJ Assignment

Default: AT+CTKJ="","",""

AT+CTKJ? CTKJ: <GPRS APN>,<GPRS Username>,<GPRS Password> OK	
GPRS APN	Access Point Name (APN) Web Address up to 40 case sensitive alphanumeric characters. Example: "apn.trimble.com". Default: <Empty>
GPRS Username	Up to 40 case sensitive alphanumeric characters. Default: <Empty>
GPRS Password	Up to 20 case sensitive alphanumeric characters. Default: <Empty>

Table 27, AT+CTKJ? Query

AT+CTKG GPS Configure

The AT+CTKG command configures the GPS parameters. This command mirrors the functionality of the over-the-air GPS_CONFIG message. It can query the current settings or change them to new values.

AT+CTKG=<GPS Elevation Mask>,<GPS PDOP Mask>,<GPS PDOP Switch>,<GPS Signal Mask>,<GPS Dynamics Mode> OK	
<GPS Elevation Mask>	In degrees (0-30). Default 5
<GPS PDOP Mask>	In tenths of PDOP (60 – 200). Default 120
<GPS PDOP Switch>	In tenths of PDOP (40 – 120). Default 60
<GPS Signal Mask>	In tenths of AMUs (10 – 80). Default 10
<GPS Dynamics Mode>	(Do Not Change); Default 5

Table 28, AT+CTKG Assignment

Default: AT+CTKG=5,120,60,10,5

AT+CTKG? +CTKG: <GPS Elevation Mask>,<GPS PDOP Mask>,<GPS PDOP Switch>,<GPS Signal Mask>,<GPS Dynamics Mode> OK	
<GPS Elevation Mask>	In degrees (0-30). Default 5
<GPS PDOP Mask>	In tenths of PDOP (60 – 200). Default 120
<GPS PDOP Switch>	In tenths of PDOP (40 – 120). Default 60
<GPS Signal Mask>	In tenths of AMUs (10 – 80). Default 10
<GPS Dynamics Mode>	(Do Not Change). Default 5

Table 29, AT+CTKG? Query

AT+CTKK Geofence Configuration

The AT+CTKK command configures the Geofence parameters. All Geofences must be the same type as defined in AT+CTKZ or SET_EXT2_APP_CONFIG.

AT+CTKK=<Geofence ID>,<Geofence Enforcement>,<Reserved>,<Geofence Delta X>,<Geofence Delta Y>,<Geofence Center Latitude>,<Geofence Center Longitude> OK	
<Geofence ID>	Unique geofence identifier 1 or 2. Default: 1
<Geofence Enforcement >	0=Disabled; 1=Enforced 24/7; 2=LPA Input Enforced; 3=LPA Centered and Enforced.. Default: 0
<Reserved>	Future Use. Default: 0
<Geofence Delta X>	100s of meters (1 – 10000) Note: East-West length of rectangular Geofence area or, if circular, the diameter. 1=100 Meters. Default: 1
<Geofence Delta Y>	100s of meters (0, 1 – 10000) Note: If set to "0", then circular Geofence area; else rectangular Geofence area. 1=100 Meters Default: 1
<Geofence Center Latitude>	WGS-84 Coordinates. Units of Degrees to 7 decimal places plus '+' sign = North and '-' = South. (-90.0000000 to +90.0000000). Must be in quotation marks. Default: " +0.0000000"
<Geofence Center Longitude>	WGS-84 Coordinates. Units of Degrees to 7 decimal places plus '+' sign = East and '-' = West. (-180.0000000 to +180.0000000). Must be in quotation marks. Default: "+0.0000000"

Table 30, AT+CTKK Assignment

Default: AT+CTKK=1,0,0,1,1,"+0.0000000","+0.0000000"

AT+CTKK? CTKK: \<Geofence ID>,\<Geofence Enforcement>,\<Reserved>,\<Geofence Delta X>,\<Geofence Delta Y>,\<Geofence Center Latitude>,\<Geofence Center Longitude> OK	
\<Geofence ID>	Unique geofence identifier 1 or 2. Default: 1
\<Geofence Enforcement >	0=Disabled; 1=Enforced 24/7; 2=LPA Input Enforced; 3=LPA Centered and Enforced.. Default: 0
\<Reserved>	Future Use. Default: 0
\<Geofence Delta X>	100s of meters (1 – 10000) Note: East-West length of rectangular Geofence area or, if circular, the diameter. 1=100 Meters. Default: 1
\<Geofence Delta Y>	100s of meters (0, 1 – 10000) Note: If set to "0", then circular Geofence area; else rectangular Geofence area. 1=100 Meters Default: 1
\<Geofence Center Latitude>	WGS-84 Coordinates. Units of Degrees to 7 decimal places plus '+' sign = North and '-' = South. (-90.0000000 to +90.0000000). Default: +0.0000000
\<Geofence Center Longitude>	WGS-84 Coordinates. Units of Degrees to 7 decimal places plus '+' sign = East and '-' = West. (-180.0000000 to +180.0000000). Default: +0.0000000

Table 31, AT+CTKK? Query

AT+CTKO? Retrieve Message Log Command

The AT+CTKO? command will retrieve all messages stored in the log while in the service mode, in the order of protocol sequence number.

```
AT+CTKO?
+CTKO:
{message}
OK
```

Table 32, AT+CTK0? Query

Note: When using AT+CTKO? in HyperTerminal, use the "Capture Text" command under the "Transfer" menu to save the messages to a text file. Otherwise, some messages may be partially truncated as they are retrieved from the TrimTrac 1.5. Saving the AT+CTKO? response as a text file and sending it, along with configuration information, to Trimble is particularly helpful when requesting technical support.

AT+CTKP Provisioning

Prior to the TrimTrac 1.5 being used for the first time, the application must be provisioned using this command. The AT+CTKP command configures the SMS Communication and Security parameters. This command is the only method to change the Unit ID, SIM PIN and Security Password. It can query the current settings or change them to new values. See AT+CTKF and AT+CTKJ for GPRS related settings.

AT+CTKP=<Unit ID>,<SMS Destination Address>,<SIM PIN>,<Security Password> OK	
<Unit ID>	Always 8 alphanumeric characters, UPPER CASE ONLY. Must use quotation marks "_". Default "00000000"
<SMS Destination Address>	Maximum 24 characters including optional international dialing "+" sign and country code for SMS messages.. Must be in quotation marks. Default <Empty>
<SIM PIN>	If used, must be between 4 and 8 digits. Must use quotation marks "_" Default <Empty>
<Security Password>	Always 8 alphanumeric characters, UPPER CASE ONLY. . Must use quotation marks "_" Default "00000000"

Table 33, AT+CTKP Assignment

Default: AT+CTKP="00000000","","", "00000000"

| AT+CTKP? |
| +CTKP: <Unit ID>,<Destination Address >,<SIM PIN>,<Security Password> |
| OK |

<Unit ID>	Always 8 alphanumeric characters, UPPER CASE ONLY
<SMS Destination Address>	24 characters including optional international dialing "+" sign and country code for SMS messages..
<SIM PIN>	If used, must be between 4 and 8 digits.
<Security Password>	"********"

Table 34, AT+CTKP? Query

Note that when the SIM PIN field and the Security Password fields are queried using either AT commands or TrimTrac Application Protocol messages, they are shown masked out with the '*' character to prevent theft of the information.

AT+CTKX Extended Application Configuration

The AT+CTKX command is used to configure the enhanced Basic Read/Write parameters of the TrimTrac 1.5. It can query the current settings or change them to new values.

AT+CTKX=<Scheduled Reporting Mode>,<Scheduled Report Time, T18>,<In-Motion Polling>,<Anytime Polling>,<Polling Duty-Cycle Frequency, T19>,<Polling Duty-Cycle On-Time, T20>,<Query Hold Flag>,<Reserved>,<Position Report Transmit Attempts, N1>,<Status Message Transmit Attempts, N2>,<Static Motion Filter Counter, N3>,<Dynamic Filter Timeout, T21>,<Dynamic Motion Filter Counter, N4>,<Motion Sensor Override> OK	
<Scheduled Reporting Mode>	0=None; 1=Daily; 2=Weekly. Default 0
<Scheduled Report Time, T18>	In Seconds (0-604799). Note: This is either the seconds into the day or into the week for the device to schedule transmission of a STATUS_MESSAGE plus the most recently logged POSITION_REP, if any, when this feature is enabled. If Scheduled Reporting Mode is set "0=None", then enter 0. Default 0
<In-Motion Polling>	0=Disabled; 1=OnDemand while in Motion. Note: If set to "1=OnDemand while in Motion", the unit is able to receive and process data messages ONLY while in motion regardless of current state. Default 0
<Anytime Polling>	0=Disabled; 1=Duty-Cycled while in IDLE State; 2=Anytime OnDemand. Note: If set to "2=Anytime OnDemand", the unit is able to receive and process data messages regardless of motion, current state or how In-Motion Polling is set. If set "1=Duty-Cycled", unit is able to receive and process data messages while in QUERY or whenever while Polling Duty-Cycle On-Time, T20, is running.. Default 0
<Polling Duty-Cycle Frequency, T19>	In Seconds (10-999990). Note: Determines how frequently the Polling Duty-Cycle On-Time, T20, timer is started if and only if the Anytime Polling is set to "1=Duty-Cycled while in IDLE State" and device is NOT in motion. Default 3600
<Polling Duty-Cycle On-Time, T20>	In Seconds (0, 10-3600). Note: Determines how long after expiration of Polling Duty-Cycle Frequency, T19, timer that the unit is able to receive and process data messages. A value of zero causes the QUERY Timeout, T5, value to be used. Default 60
<Query Hold Flag>	0=Disabled; 1=Enabled. Note: Unit attempts to reconnect to the GSM network if the connection is lost during the QUERY state prior to the expiration of QUERY Timeout, T5. Default 0

<Reserved>	0=Formerly "Extended Motion Detection" in TrimTrac 1.0 Not used in TrimTrac 1.5. Default 0
<Position Report Transmit Attempts, N1>	0=Until T3 Expires; 1-255=Number of Tx Attempts. Default 1
<Status Message Transmit Attempts, N2>	0=Until T3 Expires; 1-255=Number of Tx Attempts. Default 1
<Static Motion Filter Counter, N3>	In Seconds (1-90). Note: This parameter is used only while Static Motion Filter Timeout, T7, is running in the IDLE State. It is superseded by the Dynamic Motion Filter Counter, N4 whenever: A. Anytime Polling is set "2=Anytime OnDemand"; OR B. Polling Duty-Cycle On-Time, T20, is running due to Anytime Polling being set "1=Duty-Cycled". Always set Static Motion Filter Counter, N3, equal to or less than Static Motion Filter Timeout, T7. Default 10
<Dynamic Filter Timeout, T21>	In Seconds (1-90). Note: T21 applies in TRANSMIT, QUERY and DELAY States. Also applies in IDLE if: A. Anytime Polling is set "2=Anytime OnDemand"; OR B. Polling Duty-Cycle On-Time, T20, is running due to Anytime Polling being set "1=Duty-Cycled". WARNING: Dynamic Filter Timeout, T21, must always be set equal to or greater than Dynamic Motion Filter Counter, N4; else the unit may not exit QUERY state. Default 20
<Dynamic Motion Filter Counter, N4>	In Seconds (1-90). Note: This parameter is enabled only when Dynamic Filter Timeout, T21, is active. WARNING: Dynamic Motion Filter Counter, N4, must always be set equal to or less than the setting for Dynamic Filter Timeout, T21; else the unit may not exit QUERY state.. Default 10
<Motion Sensor Override>	0=Normal; 1=Motion Always; 2=Motion Never. Note: Overrides the motion sensor if set to a value other than "0=Normal".. Default 0

Table 35, AT+CTKX Assignment

Default: AT+CTKX=0,0,0,0,3600,60,0,0,1,1,10,20,10,0

AT+CTKX?	
+CTKX: <Scheduled Reporting Mode>,<Scheduled Report Time, T18>,<In-Motion Polling>,<Anytime Polling>,<Polling Duty-Cycle Frequency, T19>,<Polling Duty-Cycle On-Time, T20>,<Query Hold Flag>,<Reserved>,<Position Report Transmit Attempts, N1>,<Status Message Transmit Attempts, N2>,<Static Motion Filter Counter, N3>,<Dynamic Filter Timeout, T21>,<Dynamic Motion Filter Counter, N4>,<Motion Sensor Override> OK	
<Scheduled Reporting Mode>	0=None; 1=Daily; 2=Weekly. Default 0
<Scheduled Report Time, T18>	In Seconds (0-604799). Note: This is either the seconds into the day or into the week for the device to schedule transmission of a STATUS_MESSAGE plus the most recently logged POSITION_REP, if any, when this feature is enabled. If Scheduled Reporting Mode is set "0=None", then enter 0. Default 0
<In-Motion Polling>	0=Disabled; 1=OnDemand while in Motion. Note: If set to "1=OnDemand while in Motion", the unit is able to receive and process data messages ONLY while in motion regardless of current state. Default 0
<Anytime Polling>	0=Disabled; 1=Duty-Cycled while in IDLE State; 2=Anytime OnDemand. Note: If set to "2=Anytime OnDemand", the unit is able to receive and process data messages regardless of motion, current state or how In-Motion Polling is set. If set "1=Duty-Cycled", unit is able to receive and process data messages while in QUERY or whenever while Polling Duty-Cycle On-Time, T20, is running.. Default 0
<Polling Duty-Cycle Frequency, T19>	In Seconds (10-999990). Note: Determines how frequently the Polling Duty-Cycle On-Time, T20, timer is started if and only if the Anytime Polling is set to "1=Duty-Cycled while in IDLE State" and device is NOT in motion. Default 3600
<Polling Duty-Cycle On-Time, T20>	In Seconds (0, 10-3600). Note: Determines how long after expiration of Polling Duty-Cycle Frequency, T19, timer that the unit is able to receive and process data messages. A value of zero causes the QUERY Timeout, T5, value to be used. Default 60
<Query Hold Flag>	0=Disabled; 1=Enabled. Note: Unit attempts to reconnect to the GSM network if the connection is lost during the QUERY state prior to the expiration of QUERY Timeout, T5. Default 0
<Reserved>	0=Formerly "Extended Motion Detection" in TrimTrac 1.0 Not used in TrimTrac 1.5. Default 0
<Position Report Transmit	0=Until T3 Expires; 1-255=Number of Tx Attempts.

Attempts, N1>	Default 1
<Status Message Transmit Attempts, N2>	0=Until T3 Expires; 1-255=Number of Tx Attempts. Default 1
<Static Motion Filter Counter, N3>	In Seconds (1-90). Note: This parameter is used only while Static Motion Filter Timeout, T7, is running in the IDLE State. It is superseded by the Dynamic Motion Filter Counter, N4 whenever: A. Anytime Polling is set "2=Anytime OnDemand"; OR B. Polling Duty-Cycle On-Time, T20, is running due to Anytime Polling being set "1=Duty-Cycled". Always set Static Motion Filter Counter, N3, equal to or less than Static Motion Filter Timeout, T7. Default 10
<Dynamic Filter Timeout, T21>	In Seconds (1-90). Note: T21 applies in TRANSMIT, QUERY and DELAY States. Also applies in IDLE if: A. Anytime Polling is set "2=Anytime OnDemand"; OR B. Polling Duty-Cycle On-Time, T20, is running due to Anytime Polling being set "1=Duty-Cycled". WARNING: Dynamic Filter Timeout, T21, must always be set equal to or greater than Dynamic Motion Filter Counter, N4; else the unit may not exit QUERY state. Default 20
<Dynamic Motion Filter Counter, N4>	In Seconds (1-90). Note: This parameter is enabled only when Dynamic Filter Timeout, T21, is active. WARNING: Dynamic Motion Filter Counter, N4, must always be set equal to or less than the setting for Dynamic Filter Timeout, T21; else the unit may not exit QUERY state.. Default 10.
<Motion Sensor Override>	0=Normal; 1=Motion Always; 2=Motion Never. Note: Overrides the motion sensor if set to a value other than "0=Normal".. Default 0

Table 36, AT+CTKX? Query

AT+CTKY Module-only Application Configuration

The AT+CTKY command configures the application parameters specific to the Vehicle Adapter or Control Module.

AT+CTKY=\<HPA Idle Timeout, T11>,\<MPA Idle Timeout, T12>,\<HPA Delay Timeout, T13>,\<MPA Delay Timeout, T14>,\<HPA Transmit Timeout, T15>,\<MPA Transmit Timeout, T16>,\<HPA Query Timeout, T17>,\<HPA Transmit Attempts, N5>,\<MPA Transmit Attempts, N6>,\<LPA Transmit Attempts, N7>,\<HPA Mode>,\<MPA Mode>,\<LPA Mode> OK	
\<HPA Idle Timeout, T11>	In Seconds (10-999990). Default 10
\<MPA Idle Timeout, T12>	In Seconds (10-999990). Default 10
\<HPA Delay Timeout, T13>	In Seconds (10-86400). Default 10
\<MPA Delay Timeout, T14>	In Seconds (10-86400). Default 10
\<HPA Transmit Timeout, T15>	0=Infinity; Else in Seconds (10-999990). Default 0
\<MPA Transmit Timeout, T16>	0=Infinity; Else in Seconds (10-999990). Default 120
\<HPA Query Timeout, T17>	In Seconds (10-3600). Default 60
\<HPA Transmit Attempts, N5>	0=Until T15 Expires; 1-255=Number of Tx Attempts before T15 expires. Default 0
\<MPA Transmit Attempts, N6>	0=Until T16 Expires; 1-255=Number of Tx Attempts before T16 expires. Default 0
\<LPA Transmit Attempts, N7>	0=Until T3 Expires; 1-255=Number of Tx Attempts before T3 expires. Default 0
\<HPA Mode>	0=Automatic; 1=Disabled; 2=Network Acknowledgement; 3= Monitor-only. Default 0
\<MPA Mode>	0=Automatic; 1=Disabled; 2=Network Acknowledgement; 3= Monitor-only. WARNING: Before inserting a Vehicle Adapter or Control Module: A) Connect the **red (+) and black (-) wires to a 9-32 VDC power source and install a 100k Ohm resistor across the yellow wires; OR** B) Return MPA Mode to its default setting "1=Disabled". Default 1.
\<LPA Mode>	0=Automatic; 1=Disabled; 2=Network Acknowledgement; 3= Monitor-only (regardless of motion). Default 0

Table 37, AT+CTKY Assignment

Default: AT+CTKY=10,10,10,10,0,120,60,0,0,0,0,1,0

AT+CTKY? CTKY: <HPA Idle Timeout, T11>,<MPA Idle Timeout, T12>,<HPA Delay Timeout, T13>,<MPA Delay Timeout, T14>,<HPA Transmit Timeout, T15>,<MPA Transmit Timeout, T16>,<HPA Query Timeout, T17>,<HPA Transmit Attempts, N5>,<MPA Transmit Attempts, N6>,<LPA Transmit Attempts, N7>,<HPA Mode>,<MPA Mode>,<LPA Mode> OK	
<HPA Idle Timeout, T11>	In Seconds (10-999990). Default 10
<MPA Idle Timeout, T12>	In Seconds (10-999990). Default 10
<HPA Delay Timeout, T13>	In Seconds (10-86400). Default 10
<MPA Delay Timeout, T14>	In Seconds (10-86400). Default 10
<HPA Transmit Timeout, T15>	0=Infinity; Else in Seconds (10-999990). Default 0
<MPA Transmit Timeout, T16>	0=Infinity; Else in Seconds (10-999990). Default 120
<HPA Query Timeout, T17>	In Seconds (10-3600). Default 60
<HPA Transmit Attempts, N5>	0=Until T15 Expires; 1-255=Number of Tx Attempts before T15 expires. Default 0
<MPA Transmit Attempts, N6>	0=Until T16 Expires; 1-255=Number of Tx Attempts before T16 expires. Default 0
<LPA Transmit Attempts, N7>	0=Until T3 Expires; 1-255=Number of Tx Attempts before T3 expires. Default 0
<HPA Mode>	0=Automatic; 1=Disabled; 2=Network Acknowledgement; 3= Monitor-only. Default 0
<MPA Mode>	0=Automatic; 1=Disabled; 2=Network Acknowledgement; 3= Monitor-only. WARNING: **Before inserting a Vehicle Adapter or Control Module:** **A) Connect the red (+) and black (-) wires to a 9-32 VDC power source and install a 100k Ohm resistor across the yellow wires; OR** **B) Return MPA Mode to its default setting "1=Disabled".**. Default 1.
<LPA Mode>	0=Automatic; 1=Disabled; 2=Network Acknowledgement; 3= Monitor-only (regardless of motion). Default 0

Table 38, AT+CTKY? Query

AT+CTKZ Daily Hours, Runtime & Other Extended Settings

The AT+CTKZ command configures the Scheduled Hours of Operation, Runtime Meter and other operation parameters as defined below.

AT+CTKZ=<Motion Counter Threshold>,<Scheduled Hours>,<Daily Start Time, T27>,<Work Day Length, T28>,<First Work Day of Each Week>,<Number of Work Days per Week>,<Runtime Meter Motion-based>,<Runtime Meter LPA-based>,<Runtime Meter Motion-based Countdown, T29>,<Runtime Meter LPA-based Countdown, T30>,<Automatic Message Log Dump>,<GPS Fix Rate>,<LPA Input Arming Delay, T31>,<Geofence Type> OK	
<Motion Counter Threshold>	Counter (1-2000). Default: 10
<Scheduled Hours>	0=Disabled; 1=Enabled. Default: 0
<Daily Start Time, T27>	In Seconds (0 – 86399) after 12:00AM UTC.. Default: 0
<Work Day Length, T28>	In Seconds (0 – 86400). Default: 43200
<First Work Day of Each Week >	0=Sunday; 1=Monday; 2=Tuesday; 3=Wednesday; 4=Thursday; 5=Friday; 6=Saturday (All relative to UTC). Default: 1
<Number of Work Days per Week>	1= One Day; 2=Two Days; 3=Three Days; 4=Four Days; 5=Five Days; 6=Six Days; 7=Seven Days. Default: 5
<Runtime Meter Motion-based >	0=Disabled; 1=Enabled. Default: 0
<Runtime Meter LPA-based>	0=Disabled; 1=Enabled. Default: 0
<Runtime Meter Motion-based Countdown, T29>	In Hours (0=No Countdown, 1-990). Default: 0
<Runtime Meter LPA-based Countdown, T30>	In Hours (0=No Countdown, 1-990). Default: 0
<Automatic Message Log Dump>	0=Disabled; 1=Enabled. Default: 0
<GPS Fix Rate>	0=GPS operation during FIX State only; 1=1Hz GPS operation except while stationary. Default: 0
<LPA Input Arming Delay, T31	In Seconds (0-990). Default: 0
<Geofence Type>	0=Boundary Crossing; 1=Inclusive; 2=Exclusive. Default 1

Table 39, AT+CTKZ Assignment

Default: AT+CTKZ=10,0,0,43200,1,5,0,0,0,0,0,0,0,1

AT+CTKZ?	
CTKZ: <Motion Counter Threshold>,<Scheduled Hours>,<Daily Start Time, T27>,<Work Day Length, T28>,<First Work Day of Each Week>,<Number of Work Days per Week>,<Runtime Meter Motion-based>,<Runtime Meter LPA-based>,<Runtime Meter Motion-based Countdown, T29>,<Runtime Meter LPA-based Countdown, T30>,<Automatic Message Log Dump>,<GPS Fix Rate>,<LPA Input Arming Delay, T31>,<Geofence Type>	
OK	
<Motion Counter Threshold>	Counter (1-2000).
<Scheduled Hours>	0=Disabled; 1=Enabled.
<Daily Start Time, T27>	In Seconds (0 – 86399) after 12:00AM UTC..
<Work Day Length, T28>	In Seconds (0 – 86400).
<First Work Day of Each Week >	0=Sunday; 1=Monday; 2=Tuesday; 3=Wednesday; 4=Thursday; 5=Friday; 6=Saturday (All relative to UTC).
<Number of Work Days per Week>	1= One Day; 2=Two Days; 3=Three Days; 4=Four Days; 5=Five Days; 6=Six Days; 7=Seven Days.
<Runtime Meter Motion-based >	0=Disabled; 1=Enabled.
<Runtime Meter LPA-based>	0=Disabled; 1=Enabled.
<Runtime Meter Motion-based Countdown, T29>	In Hours (0=No Countdown, 1-990).
<Runtime Meter LPA-based Countdown, T30>	In Hours (0=No Countdown, 1-990).
<Automatic Message Log Dump>	0=Disabled; 1=Enabled.
<GPS Fix Rate>	0=GPS operation during FIX State only; 1=1Hz GPS operation except while stationary.
<LPA Input Arming Delay, T31	In Seconds (0-990).
<Geofence Type>	0=Boundary Crossing; 1=Inclusive; 2=Exclusive. Default 1

Table 40, AT+CTKZ? Query

ATI Retrieve Firmware Version Command

The ATI command will retrieve the firmware version. Note that no "?" mark is used in this query

```
ati

Trimble Navigation Ltd

TrimTrac (tm)

Revision: {message}

OK
```

Table 41, ATI Query

TrimTrac 1.5 Defaults

Introduction

Factory default settings of the TrimTrac 1.5 are listed in Table 82 through Table 86, beginning on page 147. All such default settings can be easily changed to suit the particular application requirements. The challenge for most is figuring out the true applications requirements.

While most of the settings can be configured or changed by sending the appropriate commands over the GSM network, non-default entries for certain fields such as the Unit Identification number (Unit ID), Security Password and SIM PIN can only be entered or changed while the device is connected to a PC using the Provisioning Module. Please refer to the TrimTrac State Machine chapter beginning on page 52 for detailed descriptions of each TrimTrac state.

The TrimTrac 1.5 comes from the factory with no time set and with no GPS almanac or location stored in memory. The time and location is set once the device has achieved its first position fix. A GPS Almanac can be loaded in either of two ways:

1. Use the Windows PC-based TrimTrac GPS Almanac Tool to retrieve a current almanac from an operational TrimTrac 1.5 and send that almanac to other TrimTrac 1.5s; or

2. The TrimTrac 1.5 will download a complete current almanac from the GPS satellites after it has computed its first fix. Collection of the almanac will occur in the background and will not delay or otherwise interfere with other operations, such as transmitting or receiving over-the-air messages.

If an almanac is collected from the GPS satellites, it is important that when the TrimTrac 1.5 is first activated that it be given a clear view of the sky with sufficient time to calculate its first position fix and to collect a full almanac.

Security Considerations

Communication Security

To maintain the security of the TrimTrac 1.5 it will only accept an incoming TrimTrac Application message if the Unit ID and Security Password in the message match those contained in the TrimTrac 1.5. The message must also include a correct Checksum value. This will ensure that only the authorized server application is able to change the device configuration. If any of these fields in the TrimTrac 1.5 do not match the incoming message, then those messages are ignored with no response forthcoming from the TrimTrac 1.5.

The SIM PIN is a feature of GSM SIMs that allows the owner of the SIM to put a lock on the SIM. In order to use the account associated with the SIM, the user of the GSM device must provide the SIM PIN after SIM insertion or device power

up. The SIM PIN setting is stored in the firmware and is used if the SIM requests it. If so requested, the SIM PIN is used to attempt to unlock the SIM. If the unlock fails, the SIM PIN is marked as having caused a failure and not retried until the user physically connects the TrimTrac 1.5 to a Provisioning Module and uses the AT+CKTP command to change the SIM PIN. This is to prevent the SIM from becoming unusable after 10 SIM PIN failures. The SIM PIN cannot be read back once set. It can only be overwritten.

Configuration Security

The configurable parameters are divided into two groups, the provisioning group and the read/write group.

The provisioning group includes parameters that can only be read, but not changed. They are set at time of manufacturing or, in some cases, at time of provisioning. The values such as the IMEI Number and Firmware Version are written at time of manufacturing. The SMS Destination Address is written at time of provisioning or can be changed over the air using the SET_PROV_CONFIG message.

The read/write group depicted in Table 91, Read-only Parameters on page 159 includes operational parameters that are changed as a part of the normal operation of the TrimTrac 1.5. Sending a TrimTrac Application message to the TrimTrac 1.5 via the GSM network can change all these values. Using these messages the server application can change the functionality of the TrimTrac 1.5. The communication security methods will protect these values from being changed by an unauthorized user.

Diagnostics

When the Diagnostics Mode is enabled and set to 1 (LED) the LED on the TrimTrac 1.5 will blink at different rates depending on the TrimTrac 1.5's operational state. If the TrimTrac 1.5 is powered off the LED is off. Once the battery charge drops to 10% or below, the LED remains on in all states except the DELAY State when the LED is turned off. Please see Table 42 for a full description of LED blink rates.

TrimTrac State	Blink Rate	In Plain Words…
IDLE while sensing motion or if Anytime Polling is active	250ms ON / 250 ms OFF	Rapid blinking
Starting FIX State	100ms ON / 300ms OFF.	Very short, rapid blinking
FIX	2 Sec ON / 2 Sec OFF	Long Blink, Long Off
TRANSMIT	200ms ON / 1800ms OFF	Short Blink, Long Off
QUERY	1800ms ON / 200ms OFF	Long Blink, very short off time
DELAY	Always OFF if powered off, otherwise 250ms ON / 10,000ms OFF	If the LED blinks once every 10 seconds, then the device has the GPS, GSM or both powered up.
DELAY to IDLE	One 2 Second ON	One blink as unit transitions from DELAY to IDLE state
IDLE while waiting for motion (IDLE "sleep")	OFF unless Anytime Polling is active, then 250ms ON / 250 ms OFF	Unless the Anytime Polling is active, the LED will be off during IDLE State while there is no motion; otherwise, LED will blink rapidly.
Collecting Almanac	400ms ON / 200ms OFF / 400ms ON / 2200ms OFF	Two Medium Blinks followed by a Long Off
All except DELAY State	Always ON	Low Battery (either AA alkaline batteries or Vehicle Adapter or Control Module standby battery).

Table 42, Diagnostic LED Blink Rates

TrimTrac Application Protocol

Introduction

The TrimTrac Application Protocol is used to communicate with and control TrimTrac 1.5s that have already been provisioned and deployed to the field.

The TrimTrac 1.5 communicates with the server application by sending and receiving data messages based on an ASCII-like protocol (in lieu of the AT commands used during initial provisioning). This TrimTrac Application Protocol uses the same message structure as the Trimble ASCII Interface Protocol (TAIP) even though no TAIP messages defined for Trimble products other than the TrimTrac 1.5 are used. It is used to communicate with and control TrimTrac 1.5s that have already been provisioned and deployed to the field.

For security reasons, the Unit ID, Security Password, and SIM PIN cannot be changed over-the-air using TrimTrac Application Protocol messages.

To minimize the number of data messages sent to the TrimTrac 1.5, more than one TrimTrac Application Protocol message may be combined into a single SMS text message, up to the maximum number of 160 characters per SMS. The QUERY_POSITION message, however, cannot be combined with other commands in a single SMS message. In some cases, the TrimTrac 1.5 may similarly include more than one response in a single SMS. See QUERY_POSITION on page 125 and Aggregate Log Reporting Flag in QUERY_LOG on page 124 for more details.

Message Format

Basic Message

All TrimTrac Application Protocol messages use printable ASCII characters. Upper case and lower case alpha characters are generally interchangeable, i.e., lower case characters are converted to upper case alpha in the TrimTrac 1.5 before parsing.

Each message has the following general format with the contents of the data string being message dependant. Valid messages are limited to 128 characters.

>ABB{C}[;PW=PPPPPPPP];ID=YYYYYYYY;*ZZ<

Element	Meaning
>	Start of new message
<	End of message
A	Message Qualifier (Q, R, or S)
BB	2-character Message Identifier (Must be TK)

Element	Meaning
C	Data string.
PPPPPPPP	Security Password. Always 8 alphanumeric characters, UPPER CASE ONLY. Default 00000000
YYYYYYYY	Unit ID. Always 8 alphanumeric characters, UPPER CASE ONLY. Default 00000000
ZZ	2-character checksum.
{x}	Signifies that x can occur zero or more times
[x]	Signifies that x may optionally occur once

Table 43, Basic Message Format

Message Framing

Each TrimTrac Application Protocol message is framed by the start, end ASCII characters '>', '<', respectively. These characters are not allowed other than as start-of-message and end-of-message indicators. Multiple TrimTrac Application Protocol messages may be combined into a single SMS text message up to the maximum number of 160 characters per SMS.

Message Qualifiers

A one-character Message Qualifier is used to describe the action to be taken on the message. The following table lists the valid qualifiers:

Qualifier	Action
Q	Query for data or parameters (sent to TrimTrac 1.5)
S	Set or configure parameters (sent to TrimTrac 1.5)
R	Response to a query or a scheduled or autonomous report (from the TrimTrac 1.5)

Table 44, Message Qualifiers

Data String

The Message Qualifier and the Message Identifier dictate the format and length of the data string. The Data String can consist of any printable ASCII characters with the exception of the > and < characters. Most messages are length sensitive and many use the ';' character as field separator. Data fields are fixed length regardless of the values entered.

Security Password

A Security Password (denoted as "PW" in messages) must be used in all communications with the TrimTrac 1.5. The default Security Password is set to "00000000"; however, the TrimTrac 1.5 may be assigned any UPPERCASE

alphanumeric password of up to eight characters while the TrimTrac 1.5 is connected to a Provisioning Module.

The TrimTrac 1.5 checks all incoming messages for a Security Password and all incoming message must include a Security Password. If the Security Password included in a message sent to TrimTrac 1.5 does not match the Security Password configured in the TrimTrac 1.5, then the message is ignored.

Unit ID

The Unit ID must be used in all communications with the TrimTrac 1.5. The TrimTrac 1.5 may be assigned an UPPERCASE alphanumeric Unit ID of eight characters only while the TrimTrac 1.5 is connected to a Provisioning Module (available separately). The default Unit ID is set to 00000000.

The TrimTrac 1.5 checks all incoming messages for a Unit ID and all incoming message must include a Unit ID. If the Unit ID included in a message sent to TrimTrac 1.5 does not match the Unit ID configured in the TrimTrac 1.5, then the message is ignored.

Checksum

The checksum field is always required and provides for a two-digit hexadecimal checksum value, which is computed by XOR'ing all characters from the beginning of the message up to and including the * character. See Table 45, Sample XOR Checksum Source Code. The checksum is always the last element of the message before the end-of-message delimiter.

```
/****************************************************************************
 * Function:      AppProtocolCalcTAIPChecksum
 * Parameters:    pszTAIPMsg, checksum
 * Returns:       Pointer to Checksum Header ;* if found, NULL otherwise.
 * Description:   This function checks for the presense of the TAIP checksum
 *                header.  If it exists it calculates the checksum and
 *                places it in the checksum parameter and returns a pointer
 *                to the checksum header.
 *                Otherwise it returns NULL without changing checksum.
 ****************************************************************************/
char* AppProtocolCalcTAIPChecksum(char *pszTAIPMsg, unsigned char *checksum)
{
    char *pcEnd;
    char *pc;
    unsigned char cs;

    if((pcEnd = strstr(pszTAIPMsg, ";*")) != NULL) {

        pc = pszTAIPMsg;          // Start of the checsumed chars.
        pcEnd += 2;               // Move to the first non-checksumed char.
        cs = 0;

        while(pc < pcEnd) {

            cs ^= *pc;
            pc++;

        }

        *checksum = cs;

        return pcEnd-2;
    } else {
        return NULL;
    }
}
```

Table 45, Sample XOR Checksum Source Code

TrimTrac Application Protocol Message Summary (Sorted by Name)

Header	Message Name	Description	See Page
>QTK{x}	**QUERY_CONFIG**	Requests current configuration settings where x=A,F,G,J,K,V,X,Y or Z	123
>QTKR	QUERY_LOG	Requests logged messages (REPORT_POS and STATUS_MSG)	123
>QTKM	QUERY_METERS	Requests/Clears current state of Runtime Meters	125
>QTKD	QUERY_POSITION	Requests current or logged position information	125
>QTKU	QUERY_CONTROL_OUTPUTS	Requests current status of Control Module outputs	126
>RTKP	REPORT_POS	Basic position message	127
>RTKL	RESP_ALERT_STATE	Reports acknowledgment or, if conditions all normal, clearing of alerts	129
>RTKA	RESP_APP_CONFIG	Reports current Basic Application parameters	130
>RTKX	RESP_EXT_APP_CONFIG	Reports current Extended Application parameters	131
>RTKZ	RESP_EXT2_APP_CONFIG	Reports Scheduled Hours of Operation, Runtime Meters and other parameters	133
>RTKK	RESP_GEOFENCE_CONFIG	Reports Geofence parameters	134
>RTKF	RESP_GPRS_CONNECT_CONFIG	Reports GPRS Configuration	135
>RTKJ	RESP_GPRS_SETUP_CONFIG	Reports GPRS Setup	136
>RTKG	RESP_GPS_CONFIG	Reports GPS parameters	134
>RTKM	RESP_METERS	Reports Runtime meter readings	137
>RTKV	RESP_PROV_CONFIG	Reports current SMS Communication parameters	137
>RTK{1-4}	RESP_QUERY_AGGR	Reports summary of two logged messages	138
>RTKR	RESP_QUERY_LOG	Reports requested logged messages	138
>RTKY	RESP_MODULE_APP_CONFIG	Reports current Module application parameters	139
>RTKU	RESP_MODULE_OUTPUT	Reports current Module Output condition	140
>STKL	SET_ALERT_STATE	Acknowledges or clears Module alerts	112
>STKA	SET_APP_CONFIG	Changes Basic Application parameters	113
>STKX	SET_EXT_APP_CONFIG	Changes Extended Application parameters	114
>STKZ	SET_EXT2_APP_CONFIG	Changes Scheduled Hours of Operation, Runtime Meters and other parameters	116
>STKK	SET_GEOFENCE_CONFIG	Changes Geofence parameters	117
>STKF	SET_GPRS_CONNECT_CONFIG	Changes GPRS Configuration	118
>STKJ	SET_GPRS_SETUP_CONFIG	Changes GPRS Setup	119
>STKG	SET_GPS_CONFIG	Changes GPS parameters	119
>STKV	SET_PROV_CONFIG	Changes SMS Communication parameters	120
>STKY	SET_MODULE_APP_CONFIG	Changes module application parameters	121
>STKU	SET_CONTROL_OUTPUT	Controls Control Module Outputs	122
>RTKS	STATUS_MSG	Same as REPORT_POS except no location/altitude/velocity data	127

Table 46, TrimTrac Application Protocol Messages (Sorted by Name)

TrimTrac Application Protocol Message Summary (Sorted by Header)

Header	Message Name	Description	See Page
>QTK{x}	**QUERY_CONFIG**	Requests current configuration settings where x=A,F,G,J,K,V,X,Y or Z	123
>QTKD	QUERY_POSITION	Requests current or logged position information	125
>QTKM	QUERY_METERS	Requests/Clears current state of Runtime Meters	125
>QTKR	QUERY_LOG	Requests logged messages (REPORT_POS and STATUS_MSG)	123
>QTKU	QUERY_CONTROL_OUTPUTS	Requests current status of Control Module outputs	126
>RTK{1-4}	RESP_QUERY_AGGR	Reports summary of two logged messages	138
>RTKA	RESP_APP_CONFIG	Reports current Basic Application parameters	130
>RTKF	RESP_GPRS_CONNECT_CONFIG	Reports GPRS Configuration	135
>RTKG	RESP_GPS_CONFIG	Reports GPS parameters	134
>RTKJ	RESP_GPRS_SETUP_CONFIG	Reports GPRS Setup	136
>RTKK	RESP_GEOFENCE_CONFIG	Reports Geofence parameters	134
>RTKL	RESP_ALERT_STATE	Reports acknowledgment or, if conditions all normal, clearing of alerts	129
>RTKM	RESP_METERS	Reports Runtime meter readings	137
>RTKP	REPORT_POS	Basic position message	127
>RTKR	RESP_QUERY_LOG	Reports requested logged messages	138
>RTKS	STATUS_MSG	Same as REPORT_POS except no location/altitude/velocity data	127
>RTKU	RESP_MODULE_OUTPUT	Reports current module Output condition	140
>RTKV	RESP_PROV_CONFIG	Reports current SMS Communication parameters	137
>RTKX	RESP_EXT_APP_CONFIG	Reports current Extended Application parameters	131
>RTKY	RESP_MODULE_APP_CONFIG	Reports current module application parameters	139
>RTKZ	RESP_EXT2_APP_CONFIG	Reports Scheduled Hours of Operation, Runtime Meters and other parameters	133
>STKA	SET_APP_CONFIG	Changes Basic Application parameters	113
>STKF	SET_GPRS_CONNECT_CONFIG	Changes GPRS Configuration	118
>STKG	SET_GPS_CONFIG	Changes GPS parameters	119
>STKJ	SET_GPRS_SETUP_CONFIG	Changes GPRS Setup	119
>STKK	SET_GEOFENCE_CONFIG	Changes Geofence parameters	117
>STKL	SET_ALERT_STATE	Acknowledges or clears module alerts	112
>STKU	SET_CONTROL_OUTPUT	Controls Control Module Outputs	122
>STKV	SET_PROV_CONFIG	Changes SMS Communication parameters	120
>STKX	SET_EXT_APP_CONFIG	Changes Extended Application parameters	114
>STKY	SET_MODULE_APP_CONFIG	Changes module application parameters	121
>STKZ	SET_EXT2_APP_CONFIG	Changes Scheduled Hours of Operation, Runtime Meters and other parameters	116

Table 47, TrimTrac Application Protocol Messages (Sorted by Header)

TrimTrac Command and Response Summary

COMMANDS SENT TO TRIMTRAC			RESPONSES SENT FROM TRIMTRAC		
See Page	Command Message Name	Command Header	Response Header	Response Message Name	See Page
123	QUERY_LOG	>QTKR	>RTKR or >RTK{1-4}	RESP_QUERY_LOG or RESP_QUERY_AGGR	138
125	QUERY_METERS	>QTKM	>RTKM	RESP_METERS	137
125	QUERY_POSITION	>QTKD	>RTKS +/or >RTKP	STATUS_MSG +/or REPORT_POS	127
123	QUERY_CONFIG	>QTKA	>RTKA	RESP_APP_CONFIG	130
123	QUERY_CONFIG	>QTKX	>RTKX	RESP_EXT_APP_CONFIG	131
123	QUERY_CONFIG	>QTKZ	>RTKZ	RESP_EXT2_APP_CONFIG	133
123	QUERY_CONFIG	>QTKK	>RTKK	RESP_GEOFENCE_CONFIG	134
123	QUERY_CONFIG	>QTKF	>RTKF	RESP_GPRS_CONNECT_CONFIG	135
123	QUERY_CONFIG	>QTKJ	>RTKJ	RESP_GPRS_SETUP_CONFIG	136
123	QUERY_CONFIG	>QTKG	>RTKG	RESP_GPS_CONFIG	134
123	QUERY_CONFIG	>QTKV	>RTKV	RESP_PROV_CONFIG	137
123	QUERY_CONFIG	>QTKX	>RTKX	RESP_EXT_APP_CONFIG	131
123	QUERY_CONFIG	>QTKY	>RTKY	RESP_MODULE_APP_CONFIG	139
112	SET_ALERT_STATE	>STKL	>RTKL	RESP_ALERT_STATE	129
113	SET_APP_CONFIG	>STKA	>RTKA	RESP_APP_CONFIG	130
114	SET_EXT_APP_CONFIG	>STKX	>RTKX	RESP_EXT_APP_CONFIG	131
116	SET_EXT2_APP_CONFIG	>STKZ	>RTKZ	RESP_EXT2_APP_CONFIG	133
117	SET_GEOFENCE_CONFIG	>STKK	>RTKK	RESP_GEOFENCE_CONFIG	134
118	SET_GPRS_CONNECT_CONFIG	>STKF	>RTKF	RESP_GPRS_CONNECT_CONFIG	135
119	SET_GPRS_SETUP_CONFIG	>STKJ	>RTKJ	RESP_GPRS_SETUP_CONFIG	136
119	SET_GPS_CONFIG	>STKG	>RTKG	RESP_GPS_CONFIG	134
120	SET_PROV_CONFIG	>STKV	>RTKV	RESP_PROV_CONFIG	137
121	SET_MODULE_APP_CONFIG	>STKY	>RTKY	RESP_MODULE_APP_CONFIG	139
122	SET_CONTROL_OUTPUT	>STKU	>RTKU	RESP_CONTROL_OUTPUT	140
			>RTKP	REPORT_POS	127
			>RTKS	STATUS_MSG	127

Table 48, TrimTrac Command and Response Summary

Configuration Messages

The following messages are sent to the TrimTrac 1.5 to configure application, GPS and GSM parameters and to set Vehicle Adapter or Control Module alert and application parameters.

SET_ALERT_STATE

This message is sent to the TrimTrac 1.5 to acknowledge or clear alert states; provided, however, that the TrimTrac 1.5 is connected to a Vehicle Adapter or Control Module. When received the TrimTrac 1.5 will send a RESP_ALERT_STATE message in response, UNLESS:

1. the SET_ALERT_STATE messages attempts to Clear an alert before all activated inputs have been returned to their normal non-alert conditions, in which case, no RESP_ALERT_STATE message will be sent. Instead, a new alert message will be generated.

2. If battery powered, sending the device a SET_ALERT_STATE message will have no effect and not cause a RESP_ALERT_STATE message to be returned.

>STKABCD;PW=PPPPPPPP;ID=YYYYYYYY;*ZZ<	
A	**Always 'L':** Indicates alert state setting
B	**HPA Status:** 'X' = Do not care, '3' = Ack, '0' = Clear
C	**MPA Status:** 'X' = Do not care, '3' = Ack, '0' = Clear
D	**LPA Status:** 'X' = Do not care, '3' = Ack, '0' = Clear
PPPPPPPP	**Security Password.** Always 8 alphanumeric characters, UPPER CASE ONLY. . Default 00000000
YYYYYYYY	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	**Checksum.**

Table 49, SET_ALERT_STATE Message

Sample SET_ALERT_STATE Message to ACKNOWLEDGE alerts:
>STKL333;PW=00000000;ID=00000000;*16<

Sample SET_ALERT_STATE Message to CLEAR all alerts:
>STKL000;PW=00000000;ID=00000000;*15<

NOTE: Sending a Clear command before returning all conditions to their normal, non-alert states will re-initiate the alert message sequence. If you wish to silence an activated alert before the monitored device or condition have been restored to their normal non-alert state, then send an acknowledgement SET_ALERT_STATE message. This will not clear the alert, but it will stop re-transmissions until the condition is cleared.

SET_APP_CONFIG

The SET_APP_CONFIG message is used by the server application to set the primary state machine parameters in the TrimTrac 1.5. When received the TrimTrac 1.5 will send a RESP_APP_CONFIG message in response.

`>STKABBBBBBCCCCCCDDDDDDEEEEEEFFFFFFGGGTTHIJK;PW=PPPPPPP P;ID=YYYYYYYY;*ZZ<`	
`A`	**TrimTrac Configuration Set:** 'A' = Application Parameters
`BBBBBB`	**IDLE Timeout, T1**. In seconds (10 – 999990). Default 43200
`CCCCCC`	**FIX Timeout, T2**. In seconds (10 – 3600). Default 300
`DDDDDD`	**TRANSMIT Timeout, T3**. In seconds (10 – 3600). Default 120
`EEEEEE`	**DELAY Timeout, T4**. In seconds (10 – 86400). Default 900
`FFFFFF`	**QUERY Timeout, T5**. In seconds (10 – 3600). Default 60
`GGG`	**Almanac Timeout, T6**. In hours (10 – 990). Default 168
`TT`	**Static Motion Filter Timeout, T7**. In seconds (0 – 90). Note: T7 is used exclusively while in the IDLE state; however, it is superseded by the Dynamic Filter Timeout, T21, whenever Anytime Polling is: A. Set "2=Anytime OnDemand"; OR B. Set "1-Duty-Cycled" and Polling Duty-Cycle On-Time, T20, is running. Always set Static Motion Filter Timeout, T7, greater than or equal to Static Motion Filter Counter, N3. Default 20
`H`	**Motion Report Flag**. 0=None; 1=Report Motion in IDLE (before attempting new GPS fix). Default 0
`I`	**Report Delay Flag**. 0=Transmit All Messages; 1=Transmit Alert, Query response and Scheduled messages only; 2=Transmit Motion-related AND Alert, Query response and Scheduled messages only; 3= Transmit IDLE Timeout, T1, Status Messages AND Alert, Query response and Scheduled messages only; 4=Start/Stop Reporting; 5=Log 5 messages, transmit next; 6=Log 10 messages, transmit next. Default 0
`J`	**Diagnostics Mode**. 0= None; 1= LED. Default 1
`K`	**Communication Mode**. 0= SMS; 1= GPRS; 2=AutoSelect. Default 0
`PPPPPPPP`	**Security Password**. Always 8 alphanumeric characters, UPPER CASE ONLY. Default 00000000
`YYYYYYYY`	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
`ZZ`	**Checksum.**

Table 50, SET_APP_CONFIG Message

SET_EXT_APP_CONFIG

This message is used to set the Extended Application parameters in the TrimTrac 1.5. When received the TrimTrac 1.5 will send a RESP_EXT_APP_CONFIG message in response.

>STKABCCCCCCDEFFFFFFGGGGGGHIJJJKKKLLMMNNO;PW=PPPPPPPP;ID=YYYYYYYY;*ZZ<	
A	**TrimTrac Configuration Set**: 'X' = Extended Application Parameters
B	**Scheduled Reporting** Mode. 0=None; 1=Daily; 2=Weekly. Default 0
CCCCCC	**Scheduled Report Time, T18**. In Seconds (0-604799). Note: This is either the seconds into the day or into the week for the device to schedule transmission of a STATUS_MESSAGE plus the most recently logged POSITION_REP, if any, when this feature is enabled. If Scheduled Reporting Mode is set "0=None", then enter 0. Default 0.
D	**In-Motion Polling.** 0=Disabled; 1=OnDemand while in Motion. Note: If set to "1=OnDemand while in Motion", the unit is able to receive and process data messages ONLY while in motion regardless of current state. Default 0
E	**Anytime Polling.** 0=Disabled; 1=Duty-Cycled while in IDLE State; 2=Anytime OnDemand. Note: If set to "2=Anytime OnDemand", the unit is able to receive and process data messages regardless of motion, current state or how In-Motion Polling is set. If set "1=Duty-Cycled", unit is able to receive and process data messages while in QUERY or whenever while Polling Duty-Cycle On-Time, T20, is running.. Default 0. Note: In-Motion Polling is treated as always "1=Enabled" when Anytime Polling is set to "2=Anytime OnDemand".
FFFFFF	**Polling Duty-Cycle Frequency, T19.** In Seconds (10-999990). Note: Determines how frequently the Polling Duty-Cycle On-Time, T20, timer is started if and only if the Anytime Polling is set to "1=Duty-Cycled while in IDLE State" and device is NOT in motion. Default 3600.
GGGGGG	**Polling Duty-Cycle On-Time, T20.** In Seconds (0, 10-3600). Note: Determines how long after expiration of Polling Duty-Cycle Frequency, T19, timer that the unit is able to receive and process data messages. A value of zero causes the QUERY Timeout, T5, value to be used. Default 60.
H	**Query Hold Flag.** 0=Disabled; 1=Enabled. Note: Unit attempts to reconnect to the GSM network if the connection is lost during the QUERY state prior to the expiration of QUERY Timeout, T5. Default 0.
I	**Reserved.** 0=Formerly "Extended Motion Detection" in TrimTrac 1.0 Not used in TrimTrac 1.5. Default 0.
JJJ	**Position Report Transmit Attempts,** N1. 0=Until T3 Expires; 1-

	255=Number of Tx Attempts. Default 1.
KKK	**Status Message Transmit Attempts,** N2. 0=Until T3 Expires; 1-255=Number of Tx Attempts. Default 1.
LL	**Static Motion Filter** Counter, N3. In Seconds (1-90). Note: This parameter is used only while Static Motion Filter Timeout, T7, is running in the IDLE State. It is superseded by the Dynamic Motion Filter Counter, N4 whenever: A. Anytime Polling is set "2=Anytime OnDemand"; OR B. Polling Duty-Cycle On-Time, T20, is running due to Anytime Polling being set "1=Duty-Cycled". Always set Static Motion Filter Counter, N3, equal to or less than Static Motion Filter Timeout, T7. Default 10.
MM	**Dynamic Filter Timeout, T21.** In Seconds (1-90). Note: T21 applies in TRANSMIT, QUERY and DELAY States. Also applies in IDLE if: A. Anytime Polling is set "2=Anytime OnDemand"; OR B. Polling Duty-Cycle On-Time, T20, is running due to Anytime Polling being set "1=Duty-Cycled". WARNING: Dynamic Filter Timeout, T21, must always be set equal to or greater than Dynamic Motion Filter Counter, N4; else the unit may not exit QUERY state. Default 20.
NN	**Dynamic Motion Filter Counter,** N4. In Seconds (1-90). Note: This parameter is enabled only when Dynamic Filter Timeout, T21, is active. WARNING: Dynamic Motion Filter Counter, N4, must always be set equal to or less than the setting for Dynamic Filter Timeout, T21; else the unit may not exit QUERY state.. Default 10.
O	**Motion Sensor** Override. 0=Normal; 1=Motion Always; 2=Motion Never. Note: Overrides the motion sensor if set to a value other than "0=Normal".. Default 0.
PPPPPPPP	**Security Password.** Always 8 alphanumeric characters, UPPER CASE ONLY. . Default 00000000
YYYYYYYY	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	**Checksum.**

Table 51, SET_EXT_APP_CONFIG Message

SET_EXT2_APP_CONFIG

This message is used to set the Extended 2 Application parameters in the TrimTrac 1.5. When received the TrimTrac 1.5 will send a RESP_EXT2_APP_CONFIG message in response.

>STKABBBBCDDDDDEEEEEFGHIJJJKKKLMNNNO;PW=PPPPPPPP;ID=YYYYYYYY;*ZZ<	
A	**TrimTrac-1.5 Configuration Set**: 'Z' = Extended 2 Application Parameters
BBBB	**Motion Counter Threshold**: Counter (1-2000). Default 10
C	**Scheduled Hours**: 0=Disabled; 1=Enabled. Default 0
DDDDD	**Daily Start Time,** T27: In Seconds (0 – 86399) after 12:00AM UTC.. Default 0
EEEEE	**Work Day Length,** T28: In Seconds (0 – 86400). Default 43200
F	**First Work Day of Each Week**: 0=Sunday; 1=Monday; 2=Tuesday; 3=Wednesday; 4=Thursday; 5=Friday; 6=Saturday (All relative to UTC). Default1
G	**Number of Work Days per Week**: 1= One Day; 2=Two Days; 3=Three Days; 4=Four Days; 5=Five Days; 6=Six Days; 7=Seven Days. Default 5
H	**Runtime Meter Motion-based**: 0=Disabled; 1=Enabled. Default 0.
I	**Runtime Meter LPA-based**: 0=Disabled; 1=Enabled. Default 0
JJJ	**Runtime Meter Motion-based Countdown, T29:** In Hours (0=No Countdown, 1-990). Default 0
KKK	**Runtime Meter LPA-based Countdown, T30:** In Hours (0=No Countdown, 1-990). Default 0
L	**Automatic Message Log Dump**: 0=Disabled; 1=Enabled. Default 0
M	**GPS Fix Rate**: 0=GPS operation during FIX State only; 1=1Hz GPS operation except while stationary. Default 0
NNN	**LPA Input Arming Delay,** T31**:** In Seconds (0-990). Default 0
O	**Geofence Type:** 0=Boundary Crossing; 1=Inclusive; 2=Exclusive
PPPPPPPP	**Security Password**. Always 8 alphanumeric characters, UPPER CASE ONLY. . Default 00000000
YYYYYYYY	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	**Checksum.**

Table 52, SET_EXT2_APP_CONFIG Message

SET_GEOFENCE_CONFIG

This message is used to set up a Geofence in the TrimTrac-1.5 device. When received the TrimTrac-1.5 device will send a RESP_GEOFENCE_CONFIG message in response. Please note that all geofences must be the same type (Boundary Crossing, Exclusive, Inclusive) as determined by either SET_EXT2_APP_CONFIG or AT+CTKZ.

`>STKABBCDEEEEEFFFFFGGGHHHHHHHIIIIJJJJJJJ;PW=PPPPPPPP;ID=YYYYYYYY;*ZZ<`	
`A`	**TrimTrac-1.5 Configuration Set**: 'K' = Geofence Parameters
`BB`	**Geofence ID**: Unique geofence identifier 1 or 2. Default 1
`C`	**Geofence Enforcement**: 0=Disabled; 1=Enforced 24/7; 2=LPA Input Enforced; 3=LPA Centered and Enforced.. Default 0
`D`	**Reserved.** Default: 0
`EEEEE`	**Geofence Delta X**: 100s of meters (1 – 10000) Note: East-West length of rectangular Geofence area or, if circular, the diameter. 1=100 Meters. Default 1.
`FFFFF`	**Geofence Delta Y**: 100s of meters (0, 1 – 10000) Note: If set to "0", then circular Geofence area; else rectangular Geofence area. 1=100 Meters
`GGG.HHHHHHH`	**Geofence Center Latitude**: WGS-84 Coordinates. Units of Degrees to 7 decimal places plus '+' sign = North and '-' = South. (-90.0000000 to +90.0000000). Default +0.0000000
`IIII.JJJJJJJ`	**Geofence Center Longitude**: WGS-84 Coordinates. Units of Degrees to 7 decimal places plus '+' sign = East and '-' = West. (-180.0000000 to +180.0000000). Default +0.0000000
`PPPPPPPP`	**Security Password**. Always 8 alphanumeric characters, UPPER CASE ONLY. . Default 00000000
`YYYYYYYY`	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
`ZZ`	**Checksum.**

Table 53, SET_ GEOFENCE_CONFIG Message

SET_GPRS_CONNECT_CONFIG

This message is used to set the GPRS Connection Configuration Values in the TrimTrac-1.5 device. When received the TrimTrac-1.5 device will send a RESP_GPRS_CONNECT_CONFIG message in response.

>STKABCDDDDDEEEEEFFFFFFFFFFFFFFFFFFFFF";PW=PPPPPPPP;ID =YYYYYYYY;*ZZ<	
A	**TrimTrac-1.5 Configuration Set:** 'F' = GPRS Communication Configuration Parameters.
B	**GPRS Transport** Protocol: 0=UDP; 1=TCP. Default 1
C	**GPRS Session Protocol**: 0=None; 1=TrimTrac ICD (See Separate Document). Default 0
DDDDD	**GPRS Session Keep-alive Timeout, T25**: In Seconds (0=Never; 1 –43200). Default: 300
EEEEE	**GPRS Session Timeout, T26**: In Seconds (0=Never; 1 –43200). Default 0
FFFFFFFF FFFFFFFF FFFFF(21 chars)	**GPRS Destination Address**: GPRS destination address in the following format: 111.222.333.444:12345. This represents an IP Address and Port Number pair, maximum number string up to 21 characters. Note: The quote (") symbol must be used to terminate this text field. It may also be used to terminate this field early. Default 0.0.0.0:0
PPPPPPPP	**Security Password**. Always 8 alphanumeric characters, UPPER CASE ONLY. . Default 00000000
YYYYYYYY	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	**Checksum.**

Table 54, SET_GPRS_CONNECT_CONFIG Message

SET_GPRS_SETUP_CONFIG

This message is used to set the GPRS Setup Configuration Values in the TrimTrac-1.5 device. When received the TrimTrac-1.5 device will send a RESP_GPRS_SETUP_CONFIG message in response.

`>STKABBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBB"CCCCCCCC CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC"DDDDDDDDDDDDDDDDDDDD" ;PW=PPPPPPPP;ID=YYYYYYYY;*ZZ<`	
`A`	**TrimTrac-1.5 Configuration Set:** 'J' = GPRS Communication Configuration Parameters
`BBB`…`BBB` `(40 chars)`	**GPRS APN**: Access Point Name (APN) Web Address up to 40 case sensitive alphanumeric characters. Example: "apn.trimble.com". Note: The quote (") symbol must be used to terminate this text field. It may also be used to terminate this field early. Default <Empty>
`CCC`…`CCC` `(40 chars)`	**GPRS Username**: Up to 40 case sensitive alphanumeric characters. Note: The quote (") symbol must be used to terminate this text field. It may also be used to terminate this field early. Default <Empty>
`DDD`…`DDD` `(20 chars)`	**GPRS Password**: Up to 20 case sensitive alphanumeric characters. Note: The quote (") symbol must be used to terminate this text field. It may also be used to terminate this field early. Default <Empty>
`PPPPPPPP`	**Security Password**. Always 8 alphanumeric characters, UPPER CASE ONLY. . Default 00000000
`YYYYYYYY`	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
`ZZ`	**Checksum.**

Table 55, SET_ GPRS_SETUP _CONFIG Message

SET_GPS_CONFIG

The SET_GPS_CONFIG message is used by the server application to set the TrimTrac GPS parameter values in the TrimTrac 1.5. When received the TrimTrac 1.5 will send a RESP_GPS_CONFIG message in response. Please note that these GPS configuration parameters will seldom need to be changed from default values. It is NOT recommended that they be changed without first consulting with your Trimble representative.

>STKABBCCCDDDEEEF;PW=PPPPPPPP;ID=YYYYYYYY;*ZZ<	
A	**TrimTrac Configuration Set**: 'G' = GPS Parameters
BB	**GPS Elevation Mask**. In degrees (0-30). Default 5
CCC	**GPS PDOP Mask**. In tenths of PDOP (60 – 200). Default 120
DDD	**GPS PDOP Switch**. In tenths of PDOP (40 – 120). Default 60
EEE	**GPS Signal Mask**. In tenths of AMUs (10 – 80). Default 10
F	**GPS Dynamics Mode**. (Do Not Change). Default 5
PPPPPPPP	**Security Password**. Always 8 alphanumeric characters, UPPER CASE ONLY. . Default 00000000
YYYYYYYY	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	**Checksum.**

Table 56, SET_GPS_CONFIG Message

SET_PROV_CONFIG

The SET_PROV_CONFIG message is used by the server application to set the SMS Communication values in the TrimTrac 1.5. When received by the TrimTrac 1.5, the unit will send a RESP_PROV_CONFIG message in response.

>STKABBBBBBBBBBBBBBBBBBBBBBBBBBBBB;PW=PPPPPPPP;ID=YYYYYYYY;*ZZ<	
A	**TrimTrac Configuration Set:** 'V' = Provisioning Parameters
BBBBBB BBBBBB BBBBBB BBBBBB	**SMS Destination** Address**.** 24 characters including optional international dialing "+" sign and country code for SMS messages.. Field padding in **SPACES** (not 0's) before the international dialing "+" sign. Default <Empty>.
PPPPPPPP	**Security Password.** Always 8 alphanumeric characters, UPPER CASE ONLY. Default 00000000
YYYYYYYY	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	**Checksum.**

Table 57, SET_PROV_CONFIG Message

SET_MODULE_APP_CONFIG

This message is used by the server to set the Application Parameter Values associated with the Vehicle Adapter and Control Modules. When received the TrimTrac 1.5 will send a RESP_MODULE_APP_CONFIG message in response. TrimTrac 1.5s not equipped with a MODULE ignore the message.

>STKABBBBBBCCCCCCDDDDDDEEEEEEFFFFFFGGGGGGHHHHHHIIIJJJK KKLMN;PW=PPPPPPPP;ID=YYYYYYYY;*ZZ<	
A	**MODULE-only Configuration Set:** 'Y' = MODULE-only Parameters
BBBBBB	**HPA Idle Timeout, T11.** In Seconds (10-999990) Default 10
CCCCCC	**MPA Idle Timeout, T12.** In Seconds (10-999990). Default 10
DDDDDD	**HPA Delay Timeout, T13.** In Seconds (10-86400). Default 10
EEEEEE	**MPA Delay Timeout, T14.** In Seconds (10-86400). Default 10
FFFFFF	**HPA Transmit Timeout, T15.** 0=Infinity; Else in Seconds (10-999990). Default 0
GGGGGG	**MPA Transmit Timeout, T16.** 0=Infinity; Else in Seconds (10-999990). Default 120
HHHHHH	**HPA Query Timeout, T17.** In Seconds (10-3600). Default 60
III	**HPA Transmit Attempts, N5.** 0=Until T15 Expires; 1-255=Number of Tx Attempts before T15 expires. Default 0.
JJJ	**MPA Transmit Attempts, N6.** 0=Until T16 Expires; 1-255=Number of Tx Attempts before T16 expires. Default 0
KKK	**LPA Transmit Attempts, N7.** 0=Until T3 Expires; 1-255=Number of Tx Attempts before T3 expires. Default 0
L	**HPA Mode.** 0=Automatic; 1=Disabled; 2=Network Acknowledgement; 3= Monitor-only. Default 0
M	0=Automatic; 1=Disabled; 2=Network Acknowledgement; 3= Monitor-only. WARNING: **Before inserting a Vehicle Adapter or Control Module:** **A) Connect the red (+) and black (-) wires to a 9-32 VDC power source and install a 100k Ohm resistor across the yellow wires; OR** **B) Return MPA Mode to its default setting "1=Disabled".** Default 1.
N	**LPA Mode.** 0=Automatic; 1=Disabled; 2=Network Acknowledgement; 3= Monitor-only (regardless of motion). Default 0
PPPPPPPP	**Security Password.** Always 8 alphanumeric characters, UPPER CASE ONLY. . Default 00000000
YYYYYYYY	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	**Checksum.**

Table 58, SET_MODULE_APP_CONFIG Message

SET_CONTROL_OUTPUT

This message is sent by the server to set the Control Module Output pins to the desired state. When received the device will send a RESP_CONTROL_OUTPUT message.

`>STKABCDDDDDDDDDDDDDDDD;PW=PPPPPPPP;ID=YYYYYYYY;*ZZ<`	
`A`	Always 'U': Indicates a set Control Module output message.
`B`	**Output 1:** 0=Output Low; 1=Output High; 2=No Change.
`C`	**Output 2:** 0=Output Low; 1=Output High; 2=No Change.
`DDDD` `DDDD` `DDDD` `DDDD`	**Reserved for future use.** 16 digits. Must be sent as '0000000000000000'.
`PPPPPPPP`	**Security Password.** Always 8 alphanumeric characters, UPPER CASE ONLY. . Default 00000000
`YYYYYYYY`	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
`ZZ`	**Checksum.**

Table 59, SET_CONTROL_OUTPUT Message

Query Messages

QUERY_CONFIG

This QUERY_CONFIG message is used by the server application to request the TrimTrac 1.5 send its TrimTrac Application, GPS or Communication parameters in the appropriate RESP_APP_CONFIG, RESP_PROV_CONFIG or RESP_GPS_CONFIG message.

`>QTKA;PW=PPPPPPPP;ID=YYYYYYYY;*ZZ<`	
`A`	**TrimTrac Configuration Set**: 'A' = Application Parameters 'F' = GPRS Connection Parameters 'G' = GPS Parameters 'J' = GPRS Setup Parameters 'K' = Geofence Parameters 'V' = Provisioning Parameters 'X' = Extended Application Para. 'Y' = MODULE-only Application Para. 'Z' = Extended 2 Application Para.
`PPPPPPPP`	**Security Password.** Always 8 alphanumeric characters, UPPER CASE ONLY. Default 00000000
`YYYYYYYY`	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
`ZZ`	**Checksum.**

Table 60, QUERY_CONFIG Message

QUERY_GEOFENCE_CONFIG

This QUERY_GEOFENCE_CONFIG message is used by the server application to request the TrimTrac 1.5 send its geofence parameters in the appropriate RESP_GEOFENCE_CONFIG message.

`>QTKABB;PW=PPPPPPPP;ID=YYYYYYYY;*ZZ<`	
`A`	**TrimTrac Configuration Set**: 'K' = Geofence Parameters
`BB`	**Geofence ID:** Unique geofence identifier 1 or 2**.** Use lead 0.
`PPPPPPPP`	**Security Password.** Always 8 alphanumeric characters, UPPER CASE ONLY. Default 00000000
`YYYYYYYY`	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
`ZZ`	**Checksum.**

Table 61, QUERY_GEOFENCE_CONFIG Message

QUERY_LOG

This message is used by the server application to request logged REPORT_POS or STATUS_MSG messages that may not have been received at the server application. The TrimTrac 1.5 will send the corresponding messages to the server application in response to this message at the rate of one REPORT_POS or STATUS_MSG per message. At the end of the messages a RESP_QUERY_LOG or RESP_QUERY_AGGR is sent. The TrimTrac 1.5 log contains 1,024 of the most recent messages. Care should be taken when structuring the QUERY_LOG message. Querying the entire log, for instance, will result in the transmission of all 1,024 logged messages.

>QTKABBBBCCCC[DE[FGHIJJJK[LLLLMMMMMM[NNNNOOOOOO]]]];PW=PPPPPPPP;ID=YYYYYYYY;*ZZ<	
A	**Always 'R':** Indicates a query for old REPORT messages
BBBB	**Beginning Protocol Sequence Number**. 16-bit Hex (0000-FFFF) incrementing by 1 for each logged report.
CCCC	**Ending Protocol Sequence Number.** 16-bit Hex (0000-FFFF) incrementing by 1 for each logged report
PPPPPPPP	**Security Password.** Always 8 alphanumeric characters, UPPER CASE ONLY. . Default 00000000
YYYYYYYY	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	**Checksum.**
Optional	
D	**Aggregate Log Reporting Flag**: 'T' = enabled, 'F' = disabled. When enabled, aggregate reports may be returned.
E	**Stop RESP_QUERY_LOG** message from being sent: 'T' = do not send, 'F' = send. Used to stop the unit from fulfilling previous QUERY_LOG requests.
F	**Filter 1:** 'Z' = All, 'U' = Unsent only.
G	**Filter 2:** 'Z' = All, 'P' = Position only, 'S' = Status only.
H	**Filter 3:** 'Z' = All, 'A' = Alert only
I	Time range: 'Z' = Unused, 'N' = Newest, 'O' = Oldest
JJJ	Maximum Number of Messages to be sent in response to the current QUERY_LOG message. If non-zero then this limits the total number of message that can be sent from the log. If zero then the number of messages sent from the log limit is 1,024 messages. Applicable if Time range is not 'Z'.
K	**Last Message:** '1' = automatically include the last message in the log regardless of the filter settings, '0' = don't automatically include the last message in the log.
LLLL	**GPS week number of starting date**
MMMMMM	**GPS seconds into week of starting date**.
NNNN	**GPS week number of ending date.** 'Most recent' if not present.
OOOOOO	**GPS seconds into week of ending date.** 'Most recent' if not present.

Table 62, QUERY_LOG Message

QUERY_METERS

This message is sent by the server to request the current state of the runtime meters (See SET_EXT2_APP_CONFIG for runtime meter setup instructions). The meters can also be individually cleared via this message.

>QTKABC;PW=PPPPPPPP;ID=YYYYYYYY;*ZZ<	
A	**Always 'M':** Indicates a query runtime meters message.
B	**Runtime Meter Motion-based Query**: 0=Report Only (No Reset); 1=Report with Reset
C	**Runtime Meter LPA-based Query**: 0=Report Only (No Reset); 1=Report with Reset
PPPPPPPP	**Security Password.** Always 8 alphanumeric characters, UPPER CASE ONLY. . Default 00000000
YYYYYYYY	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	**Checksum.**

Table 63, QUERY_METERS Message

QUERY_POSITION

This message is used to command the TrimTrac 1.5 to report either its current or its most recently logged position.

The unit will compute and report new position fix if the QUERY_POSITION Operation Mode is set "P=Compute New Position Fix" OR, if there has been motion since the last position fix and the QUERY_POSITION Operation Mode is set "S=Compute if Position Aged". The unit will respond by computing a new position fix and then sending a new REPORT_POS message (with TriggerType set to "3=Query"); provided, however, that the TrimTrac 1.5 was able to compute a new position fix prior to expiration of the GPS Fix Timeout specified in the QUERY_POSITION message.

The unit will send a new STATUS_MSG and the most recently logged REPORT_POS (in a single SMS message if Communication Mode is set "0=SMS") if:

1. QUERY_POSITION has the Operation Mode set "L=Logged"; OR

2. QUERY_POSITION has the Operation Mode set "S= Compute if Position Aged", but there has been no motion since the last logged position (i.e. Position Aged is set "0=Current"); OR

3. No GPS fix was achieved prior to expiration of the GPS Fix Timeout specified in the QUERY_POSITION message and:

   a. QUERY_POSITION has the Operation Mode set "S= Compute if Position Aged" and there has been motion since the last logged position (i.e. Position Aged is set "1=Aged"); OR

b. QUERY_POSITION Operation Mode is set "P=Compute New Position Fix".

The new STATUS_MSG will have the TriggerType set to "3=Query" and the Position Aged flag will be set '1'=Aged if there has been motion since the last logged position; else the Position Aged flag will be set "1=Current".

>QTKABCCCC;PW=PPPPPPPP;ID=YYYYYYYY;*ZZ<	
A	**Always 'D':** Indicates a query Position message.
B	**Position Query Mode.** S=Compute if Position Aged; P=Compute New Position Fix; L=Status Report with Last logged position
CCCC	**Position Query Fix Timeout.** In Seconds (10-3600). Note: Temporarily overrides current FIX Timeout, T2, if Position Query Mode set to "S=Compute" and report current position. Settings longer than 600 minutes are generally not recommended. No default value.
PPPPPPPP	**Security Password.** Always 8 alphanumeric characters, UPPER CASE ONLY. . Default 00000000
YYYYYYYY	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	**Checksum.**

Table 64, QUERY_POSITION Message

QUERY_CONTROL_OUTPUT

This message is sent by the server to request the current state of the Control Module Outputs. TrimTrac responds by sending RESP_CONTROL_OUTPUT message.

>RTKA;ID=YYYYYYYY;*ZZ<	
A	**Always 'U':** Indicates a query Control Module output message.
PPPPPPPP	**Security Password.** Always 8 alphanumeric characters, UPPER CASE ONLY. . Default 00000000
YYYYYYYY	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	**Checksum.**

Table 65, QUERY_CONTROL_OUTPUT Message

Position, Status and Response Messages

REPORT_POS and STATUS_MSG

These two messages are the most common. The difference between the REPORT_POS and STATUS_MSG is that the REPORT_POS message contains position information. STATUS_MSG does not contain any position.

>RTKABBBBCDDDEFFFFGGGGGGSTVOPQRWXUUU[HHHIIIIIIIJJJJKKK KKKKLLLLLLMMMNNN];ID=YYYYYYYY;*ZZ<	
A	**TrimTrac Report Type:** 'P' = Position Report 'S' = Status Report
BBBB	**Protocol Sequence Number.** 16-bit Hex (0000-FFFF) incrementing by 1 for each logged report.
C	**TriggerType** 0=IDLE Timeout 1=Motion Detected 2=Alert set "Activated" (Modules-Only) 3=Query 4=Scheduled Report 5=Runtime Meter Report 6=Stop Motion Report
DDD	**Battery Level.** 0-100%.
E	**Battery Changed Flag.** T=True; F=False
FFFF	**GPS Week Number.** Always 4 Digits
GGGGGG	**GPS Seconds into Week.** Always 6 Digits.
S	**GPS Status Code.** 0=3D GPS Fix 1=2D GPS Fix 2=Fix Timeout, 0 SVs 3=Fix Timeout, 1 SV 4=Fix Timeout, 2 SVs 5=Fix Timeout, 3 SVs 6=GPS Error 7=No Fix attempted
T	**GSM Status Code** 0=Network Available 1=Message Logged (i.e. Report Delay Flag set=1) 2=Network Timeout 3=SIM Error / No SIM 4=SIM PIN Error 5=Pre-TX log (Low battery)
V	**Position Age:** 0=Current (i.e. no motion since last position) 1=Aged (i.e. motion has occurred since last position)
O	**HPA Status:** 0=Normal; 1=Activated; 2=Sent; 3=Acknowledged; 4=Monitor Activated
P	**MPA Status:** 0=Normal; 1=Activated; 2=Sent;

	3=Acknowledged; 4=Monitor Activated
Q	**LPA Status:** 0=Normal; 1=Activated; 2=Sent; 3=Acknowledged; 4=Monitor Activated
R	**External Power:** 0=Bad (Below 5 VDC); 1=Good (5 VDC or higher)
W	**Geofence Status:** 0=Normal; 1=Violation; 5= New LPA-based Geofence
X	**Extended GPS Status code:** 0=Internal Antenna, Almanac Complete 1=External Antenna, Almanac Complete 2=Int. Antenna, Almanac Incomplete 3=Ext.Antenna, Almanac Incomplete Note: Always 0 if GPS Status Code set to 7
UUU	Reserved for future use
YYYYYYYY	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	**Checksum.**
	Optional (Provided only if Position Report)
HHH.IIIIIII	**Latitude.** WGS-84 Coordinates. Units of Degrees to 7 decimal places plus '+' sign = North and '-' = South. (-90.0000000 to +90.0000000)
JJJJ.KKKKKKK	**Longitude.** WGS-84 Coordinates. Units of Degrees to 7 decimal places plus '+' sign = East and '-' = West. (-180.0000000 to +180.0000000)
LLLLLL	**Altitude.** WGS-84 Altitude reference to MSL. In Feet, always 5 Digits plus sign (-99999 to +99999)
MMM	**Horizontal Speed.** Miles Per Hour. Always 3 Digits.
NNN	**Heading.** Relative to True North, increasing Easterly. Units of Degrees. Always 3 Digits. (000-359).

Table 66, REPORT_POS and STATUS_MSG Messages

Each new outbound REPORT_POS and STATUS_MSG message is given a Report Sequence number. The sequence number is 16 bits and increments by one with each message created and rolls over to 0000 once the maximum 16-bit value of FFFF is reached. The TrimTrac Application saves the message in non-volatile memory each time one is created; this is called the Message Log. The Message Log is a FIFO log of the last 1,024 REPORT_POS or STATUS_MSG messages (whether transmitted or only logged) such that when it is full the oldest one is deleted. The Message Log can be queried with the QUERY_LOG message from the server application.

RESP_ALERT_STATE

The TrimTrac 1.5 sends this message after a SET_ALERT_STATE request is received and processed; provided, however, that the TrimTrac 1.5 is connected to a Vehicle Adapter or Control Module. If battery powered, then this message will not be sent upon receipt of a SET_ALERT_STATE request.

`>RTKABCD;ID=YYYYYYYY;*ZZ<`	
A	**Always 'L':** Indicates operation mode setting
B	**HPA Status.** 0=Normal; 1=Activated; 2=Sent; 3=Acknowledged; 4=Monitor Activated
C	**MPA Status.** 0=Normal; 1=Activated; 2=Sent; 3=Acknowledged; 4=Monitor Activated
D	**LPA Status.** 0=Normal; 1=Activated; 2=Sent; 3=Acknowledged; 4=Monitor Activated
YYYYYYYY	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	**Checksum.**

Table 67, RESP_ALERT_STATE Message

RESP_APP_CONFIG

This is the response message to the SET_APP_CONFIG and QUERY_CONFIG messages containing the Application Parameter values.

`>RTKABBBBBBCCCCCCDDDDDDEEEEEEFFFFFFGGGTTHIJKLLLLMMMMMMNPP;ID=YYYYYYYY;*ZZ<`	
`A`	**TrimTrac Configuration Set:** 'A' = Application Parameters
`BBBBBB`	**IDLE Timeout, T1.** In seconds (10 – 999990)
`CCCCCC`	**FIX Timeout, T2.** In seconds (10 – 3600)
`DDDDDD`	**TRANSMIT Timeout, T3.** In seconds (10 – 3600)
`EEEEEE`	**DELAY Timeout, T4.** In seconds (10 – 86400)
`FFFFFF`	**QUERY Timeout, T5.** In seconds (10 – 3600)
`GGG`	**Almanac Timeout, T6.** In hours (10 – 990)
`TT`	**Static Motion Filter Timeout, T7.** In seconds (0 – 90). Note: T7 is used exclusively while in the IDLE state; however, it is superseded by the Dynamic Filter Timeout, T21, whenever Anytime Polling is: A. Set "2=Anytime OnDemand"; OR B. Set "1-Duty-Cycled" and Polling Duty-Cycle On-Time, T20, is running. Always set Static Motion Filter Timeout, T7, greater than or equal to Static Motion Filter Counter, N3.
`H`	**Motion Report Flag.** 0=None; 1=Report Motion in IDLE (before attempting new GPS fix)
`I`	**Report Delay Flag.** 0=Transmit All Messages; 1=Transmit Alert, Query response and Scheduled messages only; 2=Transmit Motion-related AND Alert, Query response and Scheduled messages only; 3= Transmit IDLE Timeout, T1, Status Messages AND Alert, Query response and Scheduled messages only; 4=Start/Stop Reporting; 5=Log 5 messages, transmit next; 6=Log 10 messages, transmit next
`J`	**Diagnostics Mode.** 0= None; 1= LED
`K`	**Communication Mode.** 0= SMS; 1= GPRS; 2=AutoSelect
`LLLL`	Battery Change Week: GPS Week Number, always 4 digits
`MMMMMM`	Battery Change Time: Seconds into GPS Week, always 6 digits
`N.PP`	Firmware Version: Numeric String
`YYYYYYYY`	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
`ZZ`	**Checksum.**

Table 68, RESP_APP_CONFIG Message

RESP_EXT_APP_CONFIG

This is the response message to the SET_EXT_APP_CONFIG and QUERY_CONFIG message containing the Extended Application Parameter values.

`>RTKABCCCCCCDEFFFFFFGGGGGGHIJJJKKKLLMMNNO;ID=YYYYYYYY;` `*ZZ<`	
A	**TrimTrac Configuration Set**: 'X' = Extended Application Parameters
B	**Scheduled Reporting** Mode. 0=None; 1=Daily; 2=Weekly
CCCCCC	**Scheduled Report Time, T18**. In Seconds (0-604799). Note: This is either the seconds into the day or into the week for the device to schedule transmission of a STATUS_MESSAGE plus the most recently logged POSITION_REP, if any, when this feature is enabled. If Scheduled Reporting Mode is set "0=None", then enter 0.
D	**In-Motion Polling.** 0=Disabled; 1=OnDemand while in Motion. Note: If set to "1=OnDemand while in Motion", the unit is able to receive and process data messages ONLY while in motion regardless of current state.
E	**Anytime Polling.** 0=Disabled; 1=Duty-Cycled while in IDLE State; 2=Anytime OnDemand. Note: If set to "2=Anytime OnDemand", the unit is able to receive and process data messages regardless of motion, current state or how In-Motion Polling is set. If set "1=Duty-Cycled", unit is able to receive and process data messages while in QUERY or whenever while Polling Duty-Cycle On-Time, T20, is running.. Default 0. Note: In-Motion Polling is treated as always "1=Enabled" when Anytime Polling is set to "2=Anytime OnDemand".
FFFFFF	**Polling Duty-Cycle Frequency, T19.** In Seconds (10-999990). Note: Determines how frequently the Polling Duty-Cycle On-Time, T20, timer is started if and only if the Anytime Polling is set to "1=Duty-Cycled while in IDLE State" and device is NOT in motion. Default 3600. Note: Determines the frequency at which the QUERY state is enabled while in the IDLE state if and only if the Anytime Polling is set to "1=Duty-Cycled".
GGGGGG	**Polling Duty-Cycle On-Time, T20.** In Seconds (0, 10-3600). Note: Determines how long after expiration of Polling Duty-Cycle Frequency, T19, timer that the unit is able to receive and process data messages. A value of zero causes the QUERY Timeout, T5, value to be used. Default 60.
H	**Query Hold Flag.** 0=Disabled; 1=Enabled. Note: Unit attempts to reconnect to the GSM network if the connection is lost during the QUERY state prior to the expiration of QUERY Timeout, T5.
I	**Reserved.** 0=Formerly "Extended Motion Detection" in TrimTrac 1.0 Not used in TrimTrac 1.5.
JJJ	**Position Report Transmit Attempts,** N1. 0=Until T3 Expires; 1-255=Number of Tx Attempts.

KKK	**Status Message Transmit Attempts,** N2. 0=Until T3 Expires; 1-255=Number of Tx Attempts.
LL	**Static Motion Filter** Counter, N3. In Seconds (1-90). Note: This parameter is used only while Static Motion Filter Timeout, T7, is running in the IDLE State. It is superseded by the Dynamic Motion Filter Counter, N4 whenever: A. Anytime Polling is set "2=Anytime OnDemand"; OR B. Polling Duty-Cycle On-Time, T20, is running due to Anytime Polling being set "1=Duty-Cycled". Always set Static Motion Filter Counter, N3, equal to or less than Static Motion Filter Timeout, T7. Default 10.
MM	**Dynamic Filter Timeout, T21.** In Seconds (1-90). Note: T21 applies in TRANSMIT, QUERY and DELAY States. Also applies in IDLE if: A. Anytime Polling is set "2=Anytime OnDemand"; OR B. Polling Duty-Cycle On-Time, T20, is running due to Anytime Polling being set "1=Duty-Cycled". WARNING: Dynamic Filter Timeout, T21, must always be set equal to or greater than Dynamic Motion Filter Counter, N4; else the unit may not exit QUERY state. Default 20.
NN	**Dynamic Motion Filter** Counter, N4. In Seconds (1-90). Note: This parameter is enabled only when Dynamic Filter Timeout, T21, is active. WARNING: Dynamic Motion Filter Counter, N4, must always be set equal to or less than the setting for Dynamic Filter Timeout, T21; else the unit may not exit QUERY state.. Default 10.
O	**Motion Sensor** Override. 0=Normal; 1=Motion Always; 2=Motion Never. Note: Overrides the motion sensor if set to a value other than "0=Normal".. Default 0.
YYYYYYYY	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	**Checksum.**

Table 69, RESP_EXT_APP_CONFIG Message

RESP_EXT2_APP_CONFIG

This is the response message to the SET_EXT2_APP_CONFIG and QUERY_CONFIG message containing the Extended 2 Application Parameter values.

`>RTKABBBBCDDDDDEEEEEFGHIJJJKKKLMNNNO;ID=YYYYYYYY;*ZZ<`	
`A`	**TrimTrac-1.5 Configuration Set**: 'Z' = Extended 2 Application Parameters
`BBBB`	**Motion Counter Threshold**: Counter (1-2000). Default 10
`C`	**Scheduled Hours**: 0=Disabled; 1=Enabled. Default 0
`DDDDD`	**Daily Start Time,** T27: In Seconds (0 – 86399) after 12:00AM UTC.. Default 0
`EEEEE`	**Work Day Length,** T28: In Seconds (0 – 86400). Default 43200
`F`	**First Work Day of Each Week**: 0=Sunday; 1=Monday; 2=Tuesday; 3=Wednesday; 4=Thursday; 5=Friday; 6=Saturday (All relative to UTC). Default1
`G`	**Number of Work Days per Week**: 1= One Day; 2=Two Days; 3=Three Days; 4=Four Days; 5=Five Days; 6=Six Days; 7=Seven Days. Default 5
`H`	**Runtime Meter Motion-based**: 0=Disabled; 1=Enabled. Default 0.
`I`	**Runtime Meter LPA-based**: 0=Disabled; 1=Enabled. Default 0
`JJJ`	**Runtime Meter Motion-based Countdown, T29:** In Hours (0=No Countdown, 1-990). Default 0
`KKK`	**Runtime Meter LPA-based Countdown, T30:** In Hours (0=No Countdown, 1-990). Default 0
`L`	**Automatic Message Log Dump**: 0=Disabled; 1=Enabled. Default 0
`M`	**GPS Fix Rate**: 0=GPS operation during FIX State only; 1=1Hz GPS operation except while stationary. Default 0
`NNN`	**LPA Input Arming Delay,** T31**:** In Seconds (0-990). Default 0
`O`	**Geofence Type:** 0=Boundary Crossing; 1=Inclusive; 2=Exclusive
`YYYYYYYY`	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
`ZZ`	**Checksum.**

Table 70, RESP_EXT2_APP_CONFIG Message

RESP_GEOFENCE_CONFIG

This is the response message to the SET_ GEOFENCE _CONFIG and QUERY_GEOFENCE_CONFIG message containing the Geofence Parameter values.

>RTKABBCDEEEEEFFFFFGGGHHHHHHHIIIIJJJJJJJ;ID=YYYYYYYY;* ZZ<	
`A`	**TrimTrac-1.5 Configuration Set**: 'K' = Geofence Parameters
`BB`	**Geofence ID**: Unique geofence identifier 1 or 2. Default 1
`C`	**Geofence Enforcement**: 0=Disabled; 1=Enforced 24/7; 2=LPA Input Enforced; 3=LPA Centered and Enforced.. Default 0
`D`	**Reserved.** Default: 0
`EEEEE`	**Geofence Delta X**: 100s of meters (1 – 10000) Note: East-West length of rectangular Geofence area or, if circular, the diameter. 1=100 Meters. Default 1.
`FFFFF`	**Geofence Delta Y**: 100s of meters (0, 1 – 10000) Note: If set to "0", then circular Geofence area; else rectangular Geofence area. 1=100 Meters
`GGG.HHHH HHH`	**Geofence Center Latitude**: WGS-84 Coordinates. Units of Degrees to 7 decimal places plus '+' sign = North and '-' = South. (-90.0000000 to +90.0000000). Default +0.0000000.
`IIII.JJJ JJJJ`	**Geofence Center Longitude**: WGS-84 Coordinates. Units of Degrees to 7 decimal places plus '+' sign = East and '-' = West. (-180.0000000 to +180.0000000). Default +0.0000000
`YYYYYYYY`	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
`ZZ`	**Checksum.**

Table 71, RESP_ GEOFENCE_CONFIG Message

RESP_GPRS_CONNECT_CONFIG

This is the response message to the SET_ GPRS_CONNECT _CONFIG and QUERY_CONFIG message containing the GPRS Connection Parameter values.

`>RTKABCDDDDDEEEEEFFFFFFFFFFFFFFFFFFFFF";ID=YYYYYYYY;*ZZ<`	
`A`	**TrimTrac-1.5 Configuration Set:** 'F' = GPRS Communication Configuration Parameters.
`B`	**GPRS Transport** Protocol: 0=UDP; 1=TCP. Default 1
`C`	**GPRS Session Protocol**: 0=None; 1=TrimTrac ICD (See Separate Document). Default 0
`DDDDD`	**GPRS Session Keep-alive Timeout, T25**: In Seconds (0=Never; 1 –43200). Default: 300
`EEEEE`	**GPRS Session Timeout, T26**: In Seconds (0=Never; 1 –43200). Default 0
`FFFFFFFF FFFFFFFFF FFFFF(21 chars)`	**GPRS Destination Address**: GPRS destination address in the following format: 111.222.333.444:12345. This represents an IP Address and Port Number pair, maximum number string up to 21 characters. Note: The quote (") symbol must be used to terminate this text field. It may also be used to terminate this field early. Default 0.0.0.0:0
`YYYYYYYY`	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
`ZZ`	**Checksum.**

Table 72, RESP_GPRS_CONNECT_CONFIG Message

RESP_GPRS_SETUP_CONFIG

This is the response message to the SET_ GPRS_SETUP _CONFIG and QUERY_CONFIG message containing the GPRS Setup Parameter values.

`>RTKABBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBB"CCCCCCCC`
`CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC"DDDDDDDDDDDDDDDDDDDD"`
`;PW=PPPPPPPP;ID=YYYYYYYY;*ZZ<`	

`A`	**TrimTrac-1.5 Configuration Set:** 'J' = GPRS Communication Configuration Parameters
`BBB…BBB` `(40 chars)`	**GPRS APN**: Access Point Name (APN) Web Address up to 40 case sensitive alphanumeric characters. Example: "apn.trimble.com". Note: The quote (") symbol must be used to terminate this text field. It may also be used to terminate this field early. Default <Empty>
`CCC…CCC` `(40 chars)`	**GPRS Username**: Up to 40 case sensitive alphanumeric characters. Note: The quote (") symbol must be used to terminate this text field. It may also be used to terminate this field early. Default <Empty>
`DDD…DDD` `(20 chars)`	**GPRS Password**: Up to 20 case sensitive alphanumeric characters. Note: The quote (") symbol must be used to terminate this text field. It may also be used to terminate this field early. Default <Empty>
`YYYYYYYY`	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
`ZZ`	**Checksum.**

Table 73, RESP_ GPRS_SETUP _CONFIG Message

RESP_GPS_CONFIG

This is the response message to the SET_GPS_CONFIG and QUERY_CONFIG message containing the GPS Configuration.

`>RTKABBCCCDDDEEEF;ID=YYYYYYYY;*ZZ<`	
`A`	**TrimTrac Configuration Set:** 'G' = GPS Parameters
`BB`	**GPS Elevation Mask.** In degrees (0-30)
`CCC`	**GPS PDOP Mask.** In tenths of PDOP (60 – 200)
`DDD`	**GPS PDOP Switch.** In tenths of PDOP (40 – 120)
`EEE`	**GPS Signal Mask.** In tenths of AMUs (10 – 80)
`F`	**GPS Dynamics Mode.** (Do Not Change)
`YYYYYYYY`	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
`ZZ`	**Checksum.**

Table 74, RESP_GPS_CONFIG Message

RESP_METERS

This is the response message to the QUERY_METERS message. This message is also sent whenever either Runtime meter reaches it automatic report threshold, if so enabled. (See SET_EXT2_APP_CONFIG for runtime meter setup instructions).

>RTKABCDDDDDDDDDDEEEEEEEEEE;ID=YYYYYYYY;*ZZ<	
A	**Always 'M':** Indicates a query runtime meters message.
B	**Runtime Meter Motion-based Query:**
C	**Runtime Meter LPA-based Query:**
DDDDD **DDDDD**	**Runtime Motion-based Reading:** Accumulated seconds since last reset, always 10 digits
EEEEE **EEEEE**	**Runtime LPA-based Reading:** Accumulated seconds since last reset, always 10 digits
YYYYYYYY	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	**Checksum.**

Table 75, RESP_METERS Message

RESP_PROV_CONFIG

This is the response message to the SET_PROV_CONFIG and QUERY_CONFIG message containing the provisioning information.

>RTKABBBBBBBBBBBBBBBBBBBBBBBB;ID=YYYYYYYY;*ZZ<	
A	**TrimTrac Configuration Set:**　　　'V' = Provisioning Parameters
BBBBBBBB **BBBBBBBB** **BBBBBBBB**	**SMS Destination Address.** 24 characters including optional international dialing "+" sign and country code for SMS messages.. Field padding in **SPACES** (not 0's) before the international dialing "+" sign
YYYYYYYY	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	**Checksum.**

Table 76, RESP_PROV_CONFIG Message

RESP_QUERY_AGGR

The TrimTrac 1.5 sends this message after a QUERY_LOG request is received and processed, and if Aggregate Log Reporting Flag is 'enabled'. It will contain messages in aggregated format as shown below. The entire message can be no more than 160-byte SMS message.

`>RTKA{B};ID=YYYYYYYY;*ZZ<`	
`A`	'1' to '4': Indicates number of REPORT_POS messages contained in this RESP_QUERY_AGGR message.
`B`	Message fields from Report Type to the first semi-colon (excluded).
`YYYYYYYY`	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
`ZZ`	**Checksum.**

Table 77, RESP_Query_AGGR Message

RESP_QUERY_LOG

This message is sent after a QUERY_LOG request is received and processed. It will contain the number of messages actually retrieved from the Message Log and sent to the server application.

`>RTKABBBB;ID=YYYYYYYY;*ZZ<`	
`A`	Always 'R': Indicates a response to a QUERY_LOG
`BBBB`	Number of messages sent from the log up to a maximum of 1,024 messages.
`YYYYYYYY`	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
`ZZ`	**Checksum.**

Table 78, RESP_QUERY_LOG Message

RESP_MODULE_APP

This is the by the TrimTrac 1.5 in response to the SET_MODULE_APP_CONFIG and QUERY_CONFIG message.

>RTKABBBBBBCCCCCCDDDDDDEEEEEEFFFFFFGGGGGGHHHHHHIIIJJJKKKLMN;ID=YYYYYYYY;*ZZ<
A	**MODULE-only Configuration Set:** 'Y' = MODULE-only Parameters
BBBBBB	**HPA Idle Timeout, T11.** In Seconds (10-999990)
CCCCCC	**MPA Idle Timeout, T12.** In Seconds (10-999990)
DDDDDD	**HPA Delay Timeout, T13.** In Seconds (10-86400)
EEEEEE	**MPA Delay Timeout, T14.** In Seconds (10-86400)
FFFFFF	**HPA Transmit Timeout, T15.** 0=Infinity; Else in Seconds (10-999990)
GGGGGG	**MPA Transmit Timeout, T16.** 0=Infinity; Else in Seconds (10-999990)
HHHHHH	**HPA Query Timeout, T17.** In Seconds (10-3600)
III	**HPA Transmit Attempts,** N5. 0=Until T15 Expires; 1-255=Number of Tx Attempts before T15 expires
JJJ	**MPA Transmit Attempts,** N6. 0=Until T16 Expires; 1-255=Number of Tx Attempts before T16 expires
KKK	**LPA Transmit Attempts,** N7. 0=Until T3 Expires; 1-255=Number of Tx Attempts before T3 expires
L	**HPA Mode.** 0=Automatic; 1=Disabled; 2=Network Acknowledgement; 3= Monitor-only
M	**MPA Mode.** 0=Automatic; 1=Disabled; 2=Network Acknowledgement; 3= Monitor-only. WARNING: **Before inserting a Vehicle Adapter or Control Module:** **A) Connect the red (+) and black (-) wires to a 9-32 VDC power source and install a 100k Ohm resistor across the yellow wires; OR** **B) Return MPA Mode to its default setting "1=Disabled".**
N	**LPA Mode.** 0=Automatic; 1=Disabled; 2=Network Acknowledgement; 3= Monitor-only (regardless of motion)
YYYYYYYY	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	**Checksum.**

Table 79, RESP_MODULE_APP Message

RESP_CONTROL_OUTPUT

This is the by the TrimTrac 1.5 in response to the SET_CONTROL_OUTPUT or QUERY_CONTROL_OUTPUT messages.

>RTKABCDDDDDDDDDDDDDDD;ID=YYYYYYYY;*ZZ<	
A	Always 'U': Indicates a set Control Module output message.
B	Output 1: 0=Output Low; 1=Output High; 2=No Module Attached0=Output Low; 1=Output High; 2=No Change; 3=No Module Attached
C	Output 2:
DDDDDDDDD DDDDDDD	Reserved for future use. Must be sent as '0000000000000000'.
YYYYYYYY	**Unit ID.** Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	**Checksum.**

Table 80, RESP_MODULE_OUTPUT Message

Specifications

GSM Specifications

GSM 850/900/1800/1900 MHz

Normal MS – SMS Data Only
Class 4 (2W) @ 900 MHz
(EGSM) and 850 MHz (GSM)
Class 1 (1W) @ 1800 MHz
(GSM 1800 DCS) and 1900
MHz (GSM 1900 PCS)

Subscriber Identity Module

1.8/3.0 Volt

Type Approvals

FCC Part 15, FCC Part 24
Industry Canada
CE MARK
EC R&TTE Type Examination

GPS Specifications

General

L1 (1575.42 MHz) frequency,
C/A code

Sensitivity

Minimum –136.0 dBm with
GSM coverage.

Accuracy

Horizontal: < 6 meters (50%)
Altitude: <11 meters (50%)

Acquisition

Signal Power   -130.0 dB -136.0 dB
Hot Start (50%)   <24 sec
Warm Start (50%)<38 sec <400 sec
Cold Start (50%) <90 sec

Dynamics

Acceleration: 4g (39.2 m/sec2)
Motional jerk: 20 m/sec3

Environmental Specifications

Temperature

Operating: -10°C to + 55°C

Humidity

5% to 95% RH non-
condensing @ +40oC

Vibration*

0.008 g2/Hz   5 Hz to   20 Hz
0.05g2/Hz   20 Hz to 100 Hz
-3 dB/octave 100 Hz to 900 Hz

Shock*

Operational: 40g for 11mSec
Non-operational:
            75g for 6 mSec

* = Requires Vehicle Adapter or
Control Module

Physical Specifications

Assembly

Injection molded plastic with
integrated battery pack

Size

143 mm x 76 mm x38 mm
5.78" x 2.99" x1.44"

Weight

205 grams (7.2 oz) not
including batteries

TrimTrac Part Numbers

The following are Trimble part numbers for the TrimTrac 1.5 and accessories:

Part Number	Description
	TrimTrac 1.5 with Cover and Battery Module
	TrimTrac 1.5 with Cover and Vehicle Adapter Module
	TrimTrac 1.5 with Cover and Vehicle Adapter and Battery Modules
	TrimTrac 1.5 with Cover and Control Module
	TrimTrac 1.5 with Cover and Control and Battery Modules
	TrimTrac Provisioning Module Kit
	TrimTrac 1.5 Starter Kit
Accessories and Parts	
	TrimTrac 1.5 Base
	TrimTrac 1.5 Cover
	TrimTrac 1.5 Battery Module
	TrimTrac Vehicle Adapter Module
	TrimTrac 1.5 Control Module
	TrimTrac Provisioning Module
	TrimTrac Metal Bracket
	TrimTrac Plastic Bracket
	TrimTrac 1.5 CD-ROM Technical Manual
	USB A-to-A Cable

Table 81, TrimTrac and TrimTrac 1.5 Part Numbers

Bibliography

European Telecommunications Standards Institute (ETSI). ETSI is the standards body for GSM worldwide operations. Specifications on various aspects of GSM phone operations (AT commands, installation requirements, and terminology) are available for download from ETSI at: www.etsi.org

GPS, A Guide to the Next Utility, Trimble P/N 18239 (1992). A short, non-technical introduction to GPS. Explains what GPS does, how it works, and its capabilities and limitations. www.trimble.com

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

GSM World. The GSM World site has information on the technical and business aspects of GSM. Contact information is available for GSM carriers as well as GSM hardware manufacturers. www.gsmworld.com

ICD-GPS-200. *NAVSTAR GPS Space Segment: Navigation User Interfaces*, drawing number ICD-GPS-200 (3 July 1991). The official definition of the data formats used in NAVSTAR GPS satellite signals. www.navcen.uscg.gov/gps

> Commanding Officer
> USCG NAVCEN
> 7323 Telegraph Road
> Alexandria, VA 22315
> 703-313-5900

Proceedings of the Institute of Navigation, Washington DC. A series of three volumes of papers describing GPS Theory published between 1980 and 1986 by the Institute of Navigation. Essential source material for system designers. www.ion.org

SAE J1455 Joint SAE/TMC Recommended Environmental Practices for Electronic Equipment Design (Heavy Duty Trucks). www.sae.org

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.
Altitude	Height above mean sea level (MSL).
ASCII	American Standard Code for Information Interchange.
C/A	Coarse Acquisition code used to receive GPS signals with receivers designed operate using SPS (Standard Positioning Service).
Checksum	The message checksum field provides for a 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. The checksum is always the last element of the sentence before the message < delimiter. The use of checksums can help in instances where the communication channel is noisy.
ETSI	European Telecommunications Standards Institute.
GMT	Greenwich Mean Time.
GPRS	General Packet Radio Service.
GPS	Global Positioning System.
GSM	Global System for Mobile communications.
HPA	High Priority Alert
IMEI	International Mobile Equipment Identity.
IMSI	International Mobile Subscriber Identity.
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.
LPA	Low Priority Alert
MPA	Medium Priority Alert
PC	Windows (2000, XP)-compatible Personal Computer.
PCS	Personal Communications Service.
PIN	Personal Identity Number.
RF	Radio Frequency.
SIM	Subscriber Identity Module.
SMPP	Short Message Peer to Peer.
SMS	Short Message Service.
SPS	Standard Positioning Service.
TAIP	Trimble ASCII Interface Protocol.
UTC	Coordinated Universal Time
VAM	Vehicle Adapter Module

Quick Reference Tables

Basic Unit, SMS and Security Parameters, Messages and Command

Parameter	Unit/Notes	Default	Messages	Commands
Unit ID	Unique unit identifier. Always 8 alphanumeric characters, UPPER CASE ONLY, and can only be changed using Provisioning Module.	00000000	ALL	AT+CTKP
SMS Destination Address	Destination address to which all SMS messages will be sent (See GPRS Destination Address for IP addresses). Must be entered prior to initial deployment, but can be subsequently changed using either a Provisioning Module or over-the-air command. 24 characters including optional international dialing "+" sign and country code for SMS messages..	<Empty>	>STKV >QTKV >RTKV	AT+CTKP
SIM PIN	Entered only if required by SIM card and can be entered or changed using Provisioning Module. If used, must be between 4 and 8 digits.	<Empty>	>STKV	AT+CTKP
Security Password	Always 8 alphanumeric characters, UPPER CASE ONLY. Non-default entries can only be made using Provisioning Module.	00000000	>STK(all) >QTK(all)	AT+CTKP

Table 82, Basic Unit, SMS and Security Parameters, Messages and Command

GPS Parameters, Messages and Commands

Parameter	Unit/Notes	Default	Messages	Commands
GPS Elevation Mask	In degrees (0-30)	5		
GPS Signal Mask	In tenths of AMUs (10 – 80)	10	>STKG	
GPS PDOP Mask	In tenths of PDOP (60 – 200)	120	>QTKG	AT+CTKG
GPS PDOP Switch	In tenths of PDOP (40 – 120)	60	>RTKG	
GPS Dynamics Mode	(Do Not Change)	5		

Table 83, GPS Parameters, Messages and Command

Basic State Machine Parameters, Messages and Commands

Parameter	Unit/Notes	Default	Messages	Commands
IDLE Timeout, T1	In seconds (10 – 999990)	43200	>STKA >QTKA >RTKA	AT+CTKC
FIX Timeout, T2	In seconds (10 – 3600)	300		
TRANSMIT Timeout, T3	In seconds (10 – 3600)	120		
DELAY Timeout, T4	In seconds (10 – 86400)	900		
QUERY Timeout, T5	In seconds (10 – 3600)	60		
Almanac Timeout, T6	In hours (10 – 990)	168		
Static Motion Filter Timeout, T7	In seconds (0 – 90). Note: T7 is used exclusively while in the IDLE state; however, it is superseded by the Dynamic Filter Timeout, T21, whenever Anytime Polling is: A. Set "2=Anytime OnDemand"; OR B. Set "1-Duty-Cycled" and Polling Duty-Cycle On-Time, T20, is running. Always set Static Motion Filter Timeout, T7, greater than or equal to Static Motion Filter Counter, N3.	20		
Motion Report Flag	0=None; 1=Report Motion in IDLE (before attempting new GPS fix)	0		
Report Delay Flag	0=Transmit All Messages; 1=Transmit Alert, Query response and Scheduled messages only; 2=Transmit Motion-related AND Alert, Query response and Scheduled messages only; 3= Transmit IDLE Timeout, T1, Status Messages AND Alert, Query response and Scheduled messages only; 4=Start/Stop Reporting; 5=Log 5 messages, transmit next; 6=Log 10 messages, transmit next	0		
Diagnostics Mode	0= None; 1= LED	1		
Communication Mode	0= SMS; 1= GPRS; 2=AutoSelect	0		

Table 84, Basic State Machine Parameters, Messages and Command

Enhanced Feature Parameter Ranges and Default Settings

Parameter	Unit/Notes	Default	Messages	Commands
Scheduled Reporting Mode	0=None; 1=Daily; 2=Weekly	0	>STKX >QTKX >RTKX	AT+CTKX
Scheduled Report Time, T18	In Seconds (0-604799). Note: This is either the seconds into the day or into the week for the device to schedule transmission of a STATUS_MESSAGE plus the most recently logged POSITION_REP, if any, when this feature is enabled. If Scheduled Reporting Mode is set "0=None", then enter 0.	0		
In-Motion Polling	0=Disabled; 1=OnDemand while in Motion. Note: If set to "1=OnDemand while in Motion", the unit is able to receive and process data messages ONLY while in motion regardless of current state.	0		
Anytime Polling	0=Disabled; 1=Duty-Cycled while in IDLE State; 2=Anytime OnDemand. Note: If set to "2=Anytime OnDemand", the unit is able to receive and process data messages regardless of motion, current state or how In-Motion Polling is set. If set "1=Duty-Cycled", unit is able to receive and process data messages while in QUERY or whenever while Polling Duty-Cycle On-Time, T20, is running.	0		
Polling Duty-Cycle Frequency, T19	In Seconds (10-999990). Note: Determines how frequently the Polling Duty-Cycle On-Time, T20, timer is started if and only if the Anytime Polling is set to "1=Duty-Cycled while in IDLE State" and device is NOT in motion.	3600		
Polling Duty-Cycle On-Time, T20	In Seconds (0, 10-3600). Note: Determines how long after expiration of Polling Duty-Cycle Frequency, T19, timer that the unit is able to receive and process data messages. A value of zero causes the QUERY Timeout, T5, value to be used.	60		

Parameter	Unit/Notes	Default	Messages	Commands
Query Hold Flag	0=Disabled; 1=Enabled. Note: Unit attempts to reconnect to the GSM network if the connection is lost during the QUERY state prior to the expiration of QUERY Timeout, T5.	0		
Reserved	0=Formerly "Extended Motion Detection" in TrimTrac 1.0 Not used in TrimTrac 1.5.	0		
Position Report Transmit Attempts, N1	0=Until T3 Expires; 1-255=Number of Tx Attempts	1	>STKX >QTKX >RTKX	AT+CKTX
Status Message Transmit Attempts, N2	0=Until T3 Expires; 1-255=Number of Tx Attempts	1		
Static Motion Filter Counter, N3	In Seconds (1-90). Note: This parameter is used only while Static Motion Filter Timeout, T7, is running in the IDLE State. It is superseded by the Dynamic Motion Filter Counter, N4 whenever: A. Anytime Polling is set "2=Anytime OnDemand"; OR B. Polling Duty-Cycle On-Time, T20, is running due to Anytime Polling being set "1=Duty-Cycled". Always set Static Motion Filter Counter, N3, equal to or less than Static Motion Filter Timeout, T7.	10		
Dynamic Filter Timeout, T21	In Seconds (1-90). Note: T21 applies in TRANSMIT, QUERY and DELAY States. Also applies in IDLE if: A. Anytime Polling is set "2=Anytime OnDemand"; OR B. Polling Duty-Cycle On-Time, T20, is running due to Anytime Polling being set "1=Duty-Cycled". **WARNING:** Dynamic Filter Timeout, T21, must always be set equal to or greater than Dynamic Motion Filter Counter, N4; else the unit may not exit QUERY state.	20		

Parameter	Unit/Notes	Default	Messages	Commands
Dynamic Motion Filter Counter, N4	In Seconds (1-90). Note: This parameter is enabled only when Dynamic Filter Timeout, T21, is active. **WARNING:** Dynamic Motion Filter Counter, N4, must always be set equal to or less than the setting for Dynamic Filter Timeout, T21; else the unit may not exit QUERY state..	10	>STKX >QTKX >RTKX	AT+CTKX
Motion Sensor Override	0=Normal; 1=Motion Always; 2=Motion Never. Note: Overrides the motion sensor if set to a value other than "0=Normal"..	0		

Table 85, Enhanced Feature Parameters and Defaults.

Vehicle Adapter or Control Module Parameter Ranges and Default Settings

Parameter	Unit/Notes	Default	Messages	Commands
HPA Idle Timeout, T11	In Seconds (10-999990)	10		
MPA Idle Timeout, T12	In Seconds (10-999990)	10		
HPA Delay Timeout, T13	In Seconds (10-86400)	10		
MPA Delay Timeout, T14	In Seconds (10-86400)	10		
HPA Transmit Timeout, T15	0=Infinity; Else in Seconds (10-999990)	0		
MPA Transmit Timeout, T16	0=Infinity; Else in Seconds (10-999990)	120		
HPA Query Timeout, T17	In Seconds (10-3600)	60		
HPA Transmit Attempts, N5	0=Until T15 Expires; 1-255=Number of Tx Attempts before T15 expires	0		
MPA Transmit Attempts, N6	0=Until T16 Expires; 1-255=Number of Tx Attempts before T16 expires	0		
LPA Transmit Attempts, N7	0=Until T3 Expires; 1-255=Number of Tx Attempts before T3 expires	0	>STKY >QKTY >RTKY	AT+CTKY
HPA Mode	0=Automatic; 1=Disabled; 2=Network Acknowledgement; 3= Monitor-only	0		
MPA Mode	0=Automatic; 1=Disabled; 2=Network Acknowledgement; 3= Monitor-only. **WARNING: Before inserting a Vehicle Adapter or Control Module:** **A) Connect the red (+) and black (-) wires to a 9-32 VDC power source and install a 100k Ohm resistor across the yellow wires; OR** **B) Return MPA Mode to its default setting "1=Disabled".**	1		
LPA Mode	0=Automatic; 1=Disabled; 2=Network Acknowledgement; 3= Monitor-only (regardless of motion)	0		

Table 86, Vehicle Adapter or Control Module Parameters and Defaults.

GPRS Communication Provisioning Read/Write Parameters :

Parameter	Unit/Notes	Default	Messages	Command
GPRS APN	Access Point Name (APN) Web Address up to 40 case sensitive alphanumeric characters. Example: "apn.trimble.com".	\<Empty\>	>STKJ >QTKJ >RTKJ	AT+CTKJ
GPRS Username	Up to 40 case sensitive alphanumeric characters	\<Empty\>		
GPRS Password	Up to 20 case sensitive alphanumeric characters	\<Empty\>		
GPRS Session Keep-alive Timeout, T25	In Seconds (0=Never; 1 –43200) Note: Idle time before sending "Keep-alive" packet	300	>STKF >QTKF >RTKF	AT+CTKF
GPRS Session Protocol	0=None; 1=TrimTrac ICD (See Separate Document)	0		
GPRS Transport Protocol	0=UDP; 1=TCP	1		
GPRS Session Timeout, T26	In Seconds (0=Never; 1 –43200) Note: Idle time before closing current GPRS session and opening a new GPRS session.	0		
GPRS Destination Address	GPRS destination address in the following format: 111.222.333.444:12345. This represents an IP Address and Port Number pair, maximum number string up to 21 characters Note: IP_Address and Port to which all GPRS packets will be sent (See "SMS Destination Address" for SMS messages).	0.0.0.0:0		

Table 87, GPRS Communication Provisioning Read/Write Parameters.

Extended1.5 Read/ Write Parameters :

Parameter	Unit/Notes	Default	Messages	Commands
Motion Counter Threshold	Counter (1-2000). Note: Number of motion counts per second required before motion counter is set.	10	>STKZ >QTKZ >RTKZ	AT+CTKZ
Scheduled Hours	0=Disabled; 1=Enabled	0		
Daily Start Time, T27	In Seconds (0 – 86399) after 12:00AM UTC.	0		
Work Day Length, T28	In Seconds (0 – 86400) Note: Number of seconds worked each workday.	43200		
First Work Day of Each Week	0=Sunday; 1=Monday; 2=Tuesday; 3=Wednesday; 4=Thursday; 5=Friday; 6=Saturday (All relative to UTC)	1		
Number of Work Days per Week	1= One Day; 2=Two Days; 3=Three Days; 4=Four Days; 5=Five Days; 6=Six Days; 7=Seven Days. Note: Number of consecutive workdays each week.	5		
Runtime Meter Motion-based	0=Disabled; 1=Enabled	0		
Runtime Meter LPA-based	0=Disabled; 1=Enabled	0		
Runtime Meter Motion-based Countdown, T29	In Hours (0=No Countdown, 1-990)	0		
Runtime Meter LPA-based Countdown, T30	In Hours (0=No Countdown, 1-990)	0		
Automatic Message Log Dump	0=Disabled; 1=Enabled. Note: Causes previously unsent messages to be transmitted upon re-entering GSM network coverage.	0		
GPS Fix Rate	0=GPS operation during FIX State only; 1=1Hz GPS operation except while stationary. Note: 1 Hz used for Geofence monitoring and last known position reporting.	0		
LPA Input Arming Delay, T31	In Seconds (0-990). Number of seconds after initial contact closure before LPA becomes "Armed".	0		

Table 88, Extended1.5 Read/Write Parameters.

Geofence Settings:

Parameter	Unit/Notes	Default	Messages	Commands
Geofence ID	Unique geofence identifier 1 or 2	1	>STKK >QTKK >RTKK	AT+CTKK
Geofence Enforcement	0=Disabled; 1=Enforced 24/7; 2=LPA Input Enforced; 3=LPA Centered and Enforced.	0		
Reserved	Future Use	0		
Geofence Delta X	100s of meters (1 – 10000) Note: East-West length of rectangular Geofence area or, if circular, the diameter. 1=100 Meters	1		
Geofence Delta Y	100s of meters (0, 1 – 10000) Note: If set to "0", then circular Geofence area; else rectangular Geofence area. 1=100 Meters	1		
Geofence Center Latitude	WGS-84 Coordinates. Units of Degrees to 7 decimal places plus '+' sign = North and '-' = South. (-90.0000000 to +90.0000000)	+0.0000000		
Geofence Center Longitude	WGS-84 Coordinates. Units of Degrees to 7 decimal places plus '+' sign = East and '-' = West. (-180.0000000 to +180.0000000)	+0.0000000		
Geofence Type	0=Boundary Crossing; 1=Inclusive; 2=Exclusive	1	>STKZ	AT+CTKZ

Table 89, Geofence Settings.

Stateless Operations

Parameter	Unit/Notes	Message or Command
Output 1	0=Output Low; 1=Output High; 2=No Change	>STKU
Output 2	0=Output Low; 1=Output High; 2=No Change	
Runtime Meter Motion-based Query	0=Report Only (No Reset); 1=Report with Reset	>QTKM >RTKM
Runtime Meter LPA-based Query	0=Report Only (No Reset); 1=Report with Reset	
Position Query Mode	S=Compute if Position Aged; P=Compute New Position Fix; L=Status Report with Last logged position.	>QTKD >RTKD
Position Query Fix Timeout	In Seconds (10-3600). Note: Temporarily overrides current FIX Timeout, T2, if Position Query Mode set to "S=Compute" and report current position. Settings longer than 600 minutes are generally not recommended.	
Erase/Restore Mode	1= Restore Defaults; 2=Erase Message Log; 3=Erase Log & Restore Defaults	AT+CTKE

Table 90, Stateless Operations

Read-Only Parameters, Formats and Ranges

Parameter	Value	Messages
Protocol Sequence Number	16-bit Hex (0000-FFFF) incrementing by 1 for each logged report	
TriggerType	0=IDLE Timeout 1=Motion Detected 2=Alert set "Activated" (Modules-Only) 3=Query 4=Scheduled Report 5=Runtime Meter Report 6=Stop Motion Report	
Battery Level	0-100%	
Battery Changed Flag	T=True; F=False	
GPS Week Number	Always 4 Digits	
GPS Seconds into Week	Always 6 Digits	
GPS Status Code	0=3D GPS Fix 1=2D GPS Fix 2=Fix Timeout, 0 SVs 3=Fix Timeout, 1 SV 4=Fix Timeout, 2 SVs 5=Fix Timeout, 3 SVs 6=GPS Error 7=No Fix attempted	>RTKP >RTKS
Extended GPS Status code	0=Internal Antenna, Almanac Complete 1=External Antenna, Almanac Complete 2=Int. Antenna, Almanac Incomplete 3=Ext.Antenna, Almanac Incomplete Note: Always 0 if GPS Status Code set to 7	

Parameter	Value	Messages
GSM Status Code	0=Network Available 1=Message Logged (i.e. Report Delay Flag set=1) 2=Network Timeout 3=SIM Error / No SIM 4=SIM PIN Error 5=Pre-TX log (Low battery).	>RTKP >RTKS
Position Age	0=Current (i.e. no motion since last position) 1=Aged (i.e. motion has occurred since last position)	
HPA Status	0=Normal; 1=Activated; 2=Sent; 3=Acknowledged; 4=Monitor Activated	
MPA Status	0=Normal; 1=Activated; 2=Sent; 3=Acknowledged; 4=Monitor Activated	
LPA Status	0=Normal; 1=Activated; 2=Sent; 3=Acknowledged; 4=Monitor Activated	
Geofence Status	0=Normal; 1=Violation; 5= New LPA-based Geofence	
External Power	0=Bad (Below 5 VDC); 1=Good (5 VDC or higher)	
Latitude	WGS-84 Coordinates. Units of Degrees to 7 decimal places plus '+' sign = North and '-' = South. (-90.0000000 to +90.0000000)	>RTKP
Longitude	WGS-84 Coordinates. Units of Degrees to 7 decimal places plus '+' sign = East and '-' = West. (-180.0000000 to +180.0000000)	
Altitude	WGS-84 Altitude reference to MSL. In Feet, always 5 Digits plus sign (-99999 to +99999)	
Horizontal Speed	Miles Per Hour. Always 3 Digits	
Heading	Relative to True North, increasing Easterly. Units of Degrees. Always 3 Digits. (000-359)	
Runtime Motion-based Reading	Accumulated seconds since last reset, always 10 digits	
Runtime LPA-based Reading	Accumulated seconds since last reset, always 10 digits	
Runtime Motion-based Reset Confirmation	0=Report without Reset; 1=Report with Reset; 2=Disabled	>RTKM

Parameter	Value	Messages
Runtime LPA-based Reset Confirmation	0=Report without Reset; 1=Report with Reset; 2=Disabled	
Battery Change Week	GPS Week Number, always 4 digits	>RTKA
Battery Change Time	Seconds into GPS Week, always 6 digits	
Firmware Version	Numeric String	
Output 1	0=Output Low; 1=Output High; 2=No Change; 3=No Module Attached	>RTKU
Output 2	0=Output Low; 1=Output High; 2=No Change; 3=No Module Attached	

Table 91, Read-only Parameters

AT Command and Default Summary

Command	Description	Default Settings	See Page
AT+CTKC	Assigns Application parameters	AT+CTKC=43200,300,120,900,60,168,20,0,0,1,0	83
AT+CTKC?	Queries Application parameters		
AT+CTKF	Assigns GPRS Connection parameters	AT+CTKF=1,0,300, 0,”0.0.0.0:0”	85
AT+CTKF?	Queries GPRS Connection parameters		
AT+CTKJ	Assigns GPRS Setup parameters	AT+CTKJ=””,””,””	87
AT+CTKJ?	Queries GPRS Setup parameters		
AT+CTKG	Assigns GPS parameters	AT+CTKG=5,120,60,10,5	88
AT+CTKG?	Queries GPS parameters		
AT+CTKK	Assigns Geofence parameters	AT+CTKK=1,0,0,1,1,”+0.0000000”,”+0.0000000”	89
AT+CTKK?	Queries Geofence parameters	AT+CTKK=2,0,0,1,1,”+0.0000000”,”+0.0000000”	
AT+CTKP	Assigns SMS Communication parameters	AT+CTKP=“00000000”,””,””, “00000000”	91
AT+CTKP?	Queries SMS Communication parameters		
AT+CTKX	Assigns Extended Application parameters	AT+CTKX=0,0,0,0,3600,60,0,0,1,1,10,20,10,0	93
AT+CTKX?	Queries Extended Application parameters		
AT+CTKY	Assign Vehicle Adapter and Control Module parameters		97

`AT+CTKY?`	Queries Vehicle Adapter and Control Module parameters	AT+CTKY=10,10,10,10,0,120,60,0,0,0,0,1,0	
`AT+CTKZ`	Assigns Extended 2 Application parameters		99
`AT+CTKZ?`	Queries Extended 2 Application parameters	AT+CTKZ=10,0,0,43200,1,5,0,0,0,0,0,0,0,1	
`AT+CTKE`	Restores Defaults and/or Erases Log	Not Applicable	85
`AT+CTKO?`	Retrieves Logged Messages	Not Applicable	99
`ATI`	Queries Firmware Version	Not Applicable	101

Table 92, Summary of AT Commands and Defaults

TrimTrac Application Protocol Message Summary (Sorted by Name)

Header	Message Name	Description	See Page
>QTK{x}	QUERY_CONFIG	Requests current configuration settings where x=A,F,G,J,K,V,X,Y or Z	123
>QTKR	QUERY_LOG	Requests logged messages (REPORT_POS and STATUS_MSG)	123
>QTKM	QUERY_METERS	Requests/Clears current state of Runtime Meters	125
>QTKD	QUERY_POSITION	Requests current or logged position information	125
>QTKU	QUERY_CONTROL_OUTPUTS	Requests current status of Control Module outputs	126
>RTKP	REPORT_POS	Basic position message	127
>RTKL	RESP_ALERT_STATE	Reports acknowledgment or, if conditions all normal, clearing of alerts	129
>RTKA	RESP_APP_CONFIG	Reports current Basic Application parameters	130
>RTKX	RESP_EXT_APP_CONFIG	Reports current Extended Application parameters	131
>RTKZ	RESP_EXT2_APP_CONFIG	Reports Scheduled Hours of Operation, Runtime Meters and other parameters	133
>RTKK	RESP_GEOFENCE_CONFIG	Reports Geofence parameters	134
>RTKF	RESP_GPRS_CONNECT_CONFIG	Reports GPRS Configuration	135
>RTKJ	RESP_GPRS_SETUP_CONFIG	Reports GPRS Setup	136
>RTKG	RESP_GPS_CONFIG	Reports GPS parameters	134
>RTKM	RESP_METERS	Reports Runtime meter readings	137
>RTKV	RESP_PROV_CONFIG	Reports current SMS Communication parameters	137
>RTK{1-4}	RESP_QUERY_AGGR	Reports summary of two logged messages	138
>RTKR	RESP_QUERY_LOG	Reports requested logged messages	138
>RTKY	RESP_MODULE_APP_CONFIG	Reports current module application parameters	139
>RTKU	RESP_CONTROL_OUTPUT	Reports current Control Module Output condition	140
>STKL	SET_ALERT_STATE	Acknowledges or clears Module alerts	112
>STKA	SET_APP_CONFIG	Changes Basic Application parameters	113
>STKX	SET_EXT_APP_CONFIG	Changes Extended Application parameters	114
>STKZ	SET_EXT2_APP_CONFIG	Changes Scheduled Hours of Operation, Runtime Meters and other parameters	116
>STKK	SET_GEOFENCE_CONFIG	Changes Geofence parameters	117
>STKF	SET_GPRS_CONNECT_CONFIG	Changes GPRS Configuration	118
>STKJ	SET_GPRS_SETUP_CONFIG	Changes GPRS Setup	119
>STKG	SET_GPS_CONFIG	Changes GPS parameters	119
>STKV	SET_PROV_CONFIG	Changes SMS Communication parameters	120
>STKY	SET_MODULE_APP_CONFIG	Changes Module application parameters	121
>STKU	SET_CONTROL_OUTPUT	Controls Control Module Outputs	122
>RTKS	STATUS_MSG	Same as REPORT_POS except no location/altitude/velocity data	127

Table 93, TrimTrac Application Protocol Messages (Sorted by Name)

TrimTrac Application Protocol Message Summary (Sorted by Header)

Header	Message Name	Description	See Page
>QTK{x}	QUERY_CONFIG	Requests current configuration settings where x=A,F,G,J,K,V,X,Y or Z	123
>QTKD	QUERY_POSITION	Requests current or logged position information	125
>QTKM	QUERY_METERS	Requests/Clears current state of Runtime Meters	125
>QTKR	QUERY_LOG	Requests logged messages (REPORT_POS and STATUS_MSG)	123
>QTKU	QUERY_CONTROL_OUTPUTS	Requests current status of Control Module outputs	126
>RTK{1-4}	RESP_QUERY_AGGR	Reports summary of two logged messages	138
>RTKA	RESP_APP_CONFIG	Reports current Basic Application parameters	130
>RTKF	RESP_GPRS_CONNECT_CONFIG	Reports GPRS Configuration	135
>RTKG	RESP_GPS_CONFIG	Reports GPS parameters	134
>RTKJ	RESP_GPRS_SETUP_CONFIG	Reports GPRS Setup	136
>RTKK	RESP_GEOFENCE_CONFIG	Reports Geofence parameters	134
>RTKL	RESP_ALERT_STATE	Reports acknowledgment or, if conditions all normal, clearing of alerts	129
>RTKM	RESP_METERS	Reports Runtime meter readings	137
>RTKP	REPORT_POS	Basic position message	127
>RTKR	RESP_QUERY_LOG	Reports requested logged messages	138
>RTKS	STATUS_MSG	Same as REPORT_POS except no location/altitude/velocity data	127
>RTKU	RESP_CONTROL_OUTPUT	Reports current Control Module Output condition	140
>RTKV	RESP_PROV_CONFIG	Reports current SMS Communication parameters	137
>RTKX	RESP_EXT_APP_CONFIG	Reports current Extended Application parameters	131
>RTKY	RESP_MODULE_APP_CONFIG	Reports current Module application parameters	139
>RTKZ	RESP_EXT2_APP_CONFIG	Reports Scheduled Hours of Operation, Runtime Meters and other parameters	133
>STKA	SET_APP_CONFIG	Changes Basic Application parameters	113
>STKF	SET_GPRS_CONNECT_CONFIG	Changes GPRS Configuration	118
>STKG	SET_GPS_CONFIG	Changes GPS parameters	119
>STKJ	SET_GPRS_SETUP_CONFIG	Changes GPRS Setup	119
>STKK	SET_GEOFENCE_CONFIG	Changes Geofence parameters	117
>STKL	SET_ALERT_STATE	Acknowledges or clears Module alerts	112
>STKU	SET_CONTROL_OUTPUT	Controls Control Module Outputs	122
>STKV	SET_PROV_CONFIG	Changes SMS Communication parameters	120
>STKX	SET_EXT_APP_CONFIG	Changes Extended Application parameters	114
>STKY	SET_MODULE_APP_CONFIG	Changes module application parameters	121
>STKZ	SET_EXT2_APP_CONFIG	Changes Scheduled Hours of Operation, Runtime Meters and other parameters	116

Table 94, TrimTrac Application Protocol Messages (Sorted by Header)

TrimTrac Command and Response Summary

| COMMANDS SENT TO TRIMTRAC			RESPONSES SENT FROM TRIMTRAC		
See Page	Command Message Name	Command Header	Response Header	Response Message Name	See Page
123	QUERY_LOG	>QTKR	>RTKR or >RTK{1-4}	RESP_QUERY_LOG or RESP_QUERY_AGGR	138
125	QUERY_METERS	>QTKM	>RTKM	RESP_METERS	137
125	QUERY_POSITION	>QTKD	>RTKS +/or >RTKP	STATUS_MSG +/or REPORT_POS	127
123	QUERY_CONFIG	>QTKA	>RTKA	RESP_APP_CONFIG	130
123	QUERY_CONFIG	>QTKX	>RTKX	RESP_EXT_APP_CONFIG	131
123	QUERY_CONFIG	>QTKZ	>RTKZ	RESP_EXT2_APP_CONFIG	133
123	QUERY_GEOFENCE_CONFIG	>QTKK	>RTKK	RESP_GEOFENCE_CONFIG	134
123	QUERY_CONFIG	>QTKF	>RTKF	RESP_GPRS_CONNECT_CONFIG	135
123	QUERY_CONFIG	>QTKJ	>RTKJ	RESP_GPRS_SETUP_CONFIG	136
123	QUERY_CONFIG	>QTKG	>RTKG	RESP_GPS_CONFIG	134
123	QUERY_CONFIG	>QTKV	>RTKV	RESP_PROV_CONFIG	137
123	QUERY_CONFIG	>QTKX	>RTKX	RESP_EXT_APP_CONFIG	131
123	QUERY_CONFIG	>QTKY	>RTKY	RESP_MODULE_APP_CONFIG	139
112	SET_ALERT_STATE	>STKL	>RTKL	RESP_ALERT_STATE	129
113	SET_APP_CONFIG	>STKA	>RTKA	RESP_APP_CONFIG	130
114	SET_EXT_APP_CONFIG	>STKX	>RTKX	RESP_EXT_APP_CONFIG	131
116	SET_EXT2_APP_CONFIG	>STKZ	>RTKZ	RESP_EXT2_APP_CONFIG	133
117	SET_GEOFENCE_CONFIG	>STKK	>RTKK	RESP_GEOFENCE_CONFIG	134
118	SET_GPRS_CONNECT_CONFIG	>STKF	>RTKF	RESP_GPRS_CONNECT_CONFIG	135
119	SET_GPRS_SETUP_CONFIG	>STKJ	>RTKJ	RESP_GPRS_SETUP_CONFIG	136
119	SET_GPS_CONFIG	>STKG	>RTKG	RESP_GPS_CONFIG	134
120	SET_PROV_CONFIG	>STKV	>RTKV	RESP_PROV_CONFIG	137
121	SET_MODULE_APP_CONFIG	>STKY	>RTKY	RESP_MODULE_APP_CONFIG	139
122	SET_CONTROL_OUTPUT	>STKU	>RTKU	RESP_CONTROL_OUTPUT	140
			>RTKP	REPORT_POS	127
			>RTKS	STATUS_MSG	127

Table 95, TrimTrac Command and Response Summary

Parameter Cross Reference TrimTrac 1.5 Versus Earlier TrimTrac Versions

TrimTrac 1.5	Previous TrimTrac Versions	Reason
In-Motion Polling	DELAY State Polling Mode	Concurrent GPS & GSM enabled
SMS Destination Address	Destination Address	Avoid confusion with GPRS address
Reserved	Dynamic Motion Filter	Motion detector is always filtered
Polling Duty-Cycle On-Time, T20	IDLE State Cycled Polling Duration, T20	More Descriptive
Polling Duty-Cycle Frequency, T19	IDLE State Cycled Polling Interval, T19	More Descriptive
Anytime Polling	IDLE State Polling Mode	Concurrent GPS & GSM enabled
All other existing parameter names unchanged		

Table 96.   Parameter Name Field Cross-Reference
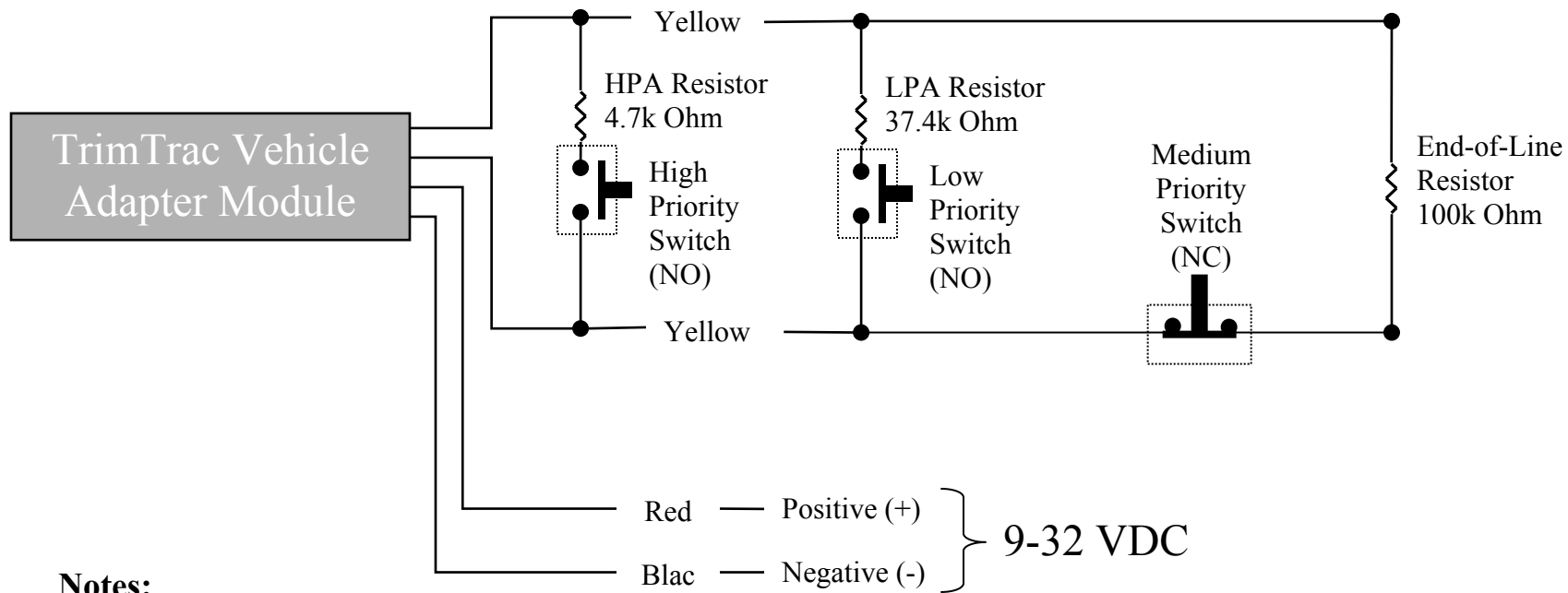
Notes:

- High and Low Priority switches must be Normally Open; Medium Priority switch must be Normally Closed
- HPA and MPA Switches can be either Momentary or Latching, LPA switch must latching-type
- High, Low and Medium Switches are optional and can be used in any combination
- Multiple switches can be used in parallel in each branch circuit; provided, however that branch resistance values are maintained as shown.
- End-of-Line Resistor is required unless MPA Mode is set "1=Disabled"
- If Alert Switches are not used, then set HPA, MPA and LPA Modes all to "1=Disabled"
- Set MPA Mode to "1=Disabled" if you do not want a MPA message if no external VDC is available.
- All resistors (+/- 5%, .250 Watt min.) and switches provided by installer.
- Opens, shorts and ground faults on main circuit and loss of external VDC handled as "Medium Priority Alerts"
- New High and Low Priority alerts may not be recognized if a Medium Priority alert caused by an open, short or ground fault is in already in effect.

Figure 9, Vehicle Adapter Module Alert Wiring Diagram

Figure 10, Control Module Wiring Diagram (TBD)